Apply Letter

of Zhongqi Xiu

Driven by my passion for optics, I joined the Quantum Information Lab on the advice of a senior alumnus to explore Fiber Cavity QED. In my first project, I tackled the complex task of cooling and controlling atoms within a fiber cavity. This required our new team to build several optical systems from the ground up, including designing the paths for cooling, detecting, and repumping light, as well as sourcing and assembling an advanced vacuum system. With the persistent support of my mentor and dedicated fellow students, I spent six months meticulously selecting a vacuum pump and designing the cavity using specialized software. Managing such a significant project for the first time not only honed my technical skills but also deepened my appreciation for the meticulous process of scientific research. Achieving a vacuum level of $10^{-}11$ Torr was a triumphant milestone, paving the way for our cold atom injection and trapping experiments.

Despite initial setbacks in coupling light and aligning fibers, and grappling with an unstable vacuum system that hindered atom cooling, two weeks of relentless fine-tuning finally paid off. Detecting strong fluorescence signals and capturing clear CCD images of single atoms inside the cavity was a moment of pure exhilaration, affirming that I had found my true calling. This breakthrough solidified my passion for optics and reinforced my determination to contribute to the advancement of quantum optics. Driven by the excitement of exploring new frontiers and the satisfaction of overcoming experimental challenges, I am more committed than ever to dedicating my professional career to unraveling the mysteries of light and its quantum properties.

Seeking to deepen my interdisciplinary expertise in optics, I joined Rice University's SCOPE Lab as a visiting scholar in the summer of 2024. Under Prof. Shengxi Huang and Wenjing Wu, I explored single-photon emission in transition metal dichalcogenides. Leveraging my fiber cavity lab experience, I quickly adapted to optical characterization techniques like photoluminescence and Raman spectroscopy. Despite initial unfamiliarity with two-dimensional materials and nanofabrication, extensive literature review and theoretical study enabled me to contribute innovative ideas and procedural adjustments. Additionally, I developed user-friendly data processing applications that streamlined figure generation for our team. This experience solidified my foundation in optics and reinforced my commitment to advancing optical engineering through interdisciplinary research.

Hence, I would be honored to apply to the Duke graduate program and join your research lab as a PhD student. I envision leveraging Duke's robust funding and collaborative environment to push the boundaries of optical engineering, blending my technical prowess with creative problem-solving. My diverse experiences and unwavering dedication fuel my ambition to contribute meaningfully to the scientific world while staying true to my unique blend of interests and skills.

ZHONGQI XIU

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EDUCATION

University of Science and Technology of China *(2021 - Present)*
Major in Optic and Optical Engineering
GPA: 3.68/4.3 (87/100)

HONORS

Chung-Yao Chao Talent Program Scholarship *2023*
Outstanding Student Scholarship, Silver Prize (Top 10%) *2022,2023*
Endeavor Scholarship (Top 5%) *2022*
First Prize in the electromagnetism course essay competition (IYPT 2022) *2022*
Outstanding Freshman Scholarship, Third prize *2021*

RESEARCH EXPERIENCE

Single photon emitter creation in few layer 2D materials *2024 - Present*
Supervisors: Wenjing Wu and Prof. Shengxi Huang SCOPE Lab

- Exfoliated WSe_2 and WS_2 thin layers and fabricated heterostructures with hBN and graphene. Transferred heterostructures onto pre-fabricated substrates with strain engineering features (nano pillars, nano discs).
- Performed remote nitrogen plasma treatment on exfoliated WS_2 flakes to create substitution defects.
- Carried out optical spectroscopy measurements, including photoluminescence (PL), Raman, and time-correlated single photon counting (TCSPC) spectroscopy, to comprehensively study the property of single photon emitters.
- Examined the single photon emission quality by conducting photon statistic measurements, obtain second-order correlation function $g^{(2)}(\tau)$ using Hanbury Brown and Twiss (HBT) interferometry.
- Improved the purity of SPE by polarization selection, electrostatic gating, and charge transfer between molecules and graphene.

Single atom trapping based on movable optical lattices *2022 - 2024*
Supervisors: Dr. Jian Wang and Prof. Chuanfeng Li CAS Key Lab of Quantum Information

- Contributed to the optical path building in a magneto-optical trap for ^{87}Rb. Independently built the double pass configuration to adjust the frequency of cooling light with Bragg diffraction.
- Built and tested the second ultrahigh optical accessible vacuum system in the lab, in which an Rb atom dispenser was mounted for the MOT and optical dipole traps for ensembles and single atoms. Reached ultra-high vacuum in the system: 3×10^{-11} Torr.
- Independently pre-treated the optical fibers for vacuum systems and tested the mode field diameter of treated single-mode fiber to optimize the mode matching between the modes of cavity and fiber.
- Carried out control circuits design and installed control electronics, including the microwave amplifier, radio frequency switch, and radio frequency generator, into multiple integrated chassis to facilitate the connection of electrical devices in the optical path.
- Achieved the control time of atoms to 3s (Unpublished)

PUBLICATION

Wenjing Wu, **Zhongqi Xiu**, Hangzheng Shen, Song Liu, James C. Hone, Junichiro Kono, Shengxi Huang.(Unpublished)
Approaching the intrinsic purity of single photon emitter in atomically thin semiconductor

TEACHING ASSISTANT

Optics B(Fall 2023) *2023*

- Instructor: Prof. Zheng Xi
- Credit 3; Class: 58 juniors; Course Website: icourse.club/course/22022

KEY COURSES TAKEN

Mathematical Analysis (90)	Function of Complex Variable (94)	Computer Programming (95)
Quantum Mechanics (95)	Advanced Photon Physics* (93)	Optics (90)
Engineering Optics* (94)	Equations of Mathematical Physics (90)	Solid State Physics (90)

(* means graduate course)

OPERATION PROFICIENCY

Optical path construction

- Coupling and design of optical paths
- Fiber and free space beam and instrument aligning
- Mode-locking and testing of lasers

Characterization

- Optical spectroscopy (photoluminescence, time-correlated spectroscopy, Raman spectroscopy, reflectance, polarization resolved spectroscopy, HBT interferometry)

Nanofabrication

- Thin film deposition, lithography, dry and wet etching, 2D heterostructure stacking and transferring.

SKILLS

Programming Languages	Python, C/C++, HTML/CSS
Frameworks and Softwares	Anaconda, MATLAB, Solidworks, LabVIEW, Keil, COMSOL
English	TOEFL: 99 (R: 26; L: 27; S: 22; W: 24;)

CURRICULAR PROJECTS

Discover physical concepts with machine learning and neural networks *2021 - 2022*

- Independently built neural networks with three neurons using MATLAB.
- Derived the Planck radiation law formula from original spectrum data using the model.

Simulation and review of light field modes in Fabry–Pérot cavity *2022*

- Simulated the optical characteristics (transmission rate, resonance mode...) of Fabry–Pérot resonators using COMSOL and compared the results with analytical solutions.

RoboGame 2023 *2023*

- Designed the main control board (STM32) using Cubemx and Keil
- Drew the power distribution boards PCB, ensured consistency across all robot components.
- Wrote and fine-tuned the PID algorithm for wheel movement.

中国科学技术大学
University of Science and Technology of China

Scholastic Record

Reg.NO: PB21020666	Name: Xiu Zhongqi	Gender: Male	Date of Birth: 2004-04-10
Enrl Date: 2021-09-01	Dep Date:	E.S: 4	
School: School of Physical Sciences			
Major: Photoelectric Information Science and Engineering	All Curriculum GPA: 3.68	All Curriculum Weighted Average Score: 87.29	

Term	Course Title	Gr.	Hrs.	Cr.	Term	Course Title	Gr	Hrs	Cr.
2021FA	Military Skills	Pass	70	2	2022SP	English Communication Intermediate II	86	40	2
2021FA	English Reading & Writing Upper Intermediate I	88	20	1	2022SP	Practice on Chinese Important Thoughts	Pass	80	2
2021FA	Mechanics A	75	80	4	2022SP	English Reading & Writing Upper Intermediate II	83	20	1
2021FA	English Communication Intermediate I	83	40	2	2022SP	Mathematical Analysis B2	90	120	6
2021FA	Moral and Legal Education	83	60	3	2022SP	College Physics – Base Experimentation A	92	60	1.5
2021FA	Military Theory	Pass	40	2	2022SP	Advanced English Writing	88	20	1
2021FA	Computer Programming A	95	100	4	2022SP	Thermotics A	85	60	3
2021FA	Linear Algebra B1	87	80	4	2022SP	Safety in the Chemical Laboratory	Pass	20	1
2021FA	Basic Sports	B	40	1	2022SP	Crime and Civilization	A-	18	1
2022SP	Electromagnetism A	87	80	4	2022SP	An Outline of Modern and Contemporary Chinese History	94	60	3
2022SP	Freshman Seminar	A	20	1	2022SP	Tennis I	B	40	1
2022FA	An introduction to Metaverse	A+	40	2	2023SP	Atomic Physics A	78	80	4
2022FA	Fundamentals of Marxism	81	60	3	2023SP	Computational Method	87	60	3
2022FA	Optics A	90	80	4	2023SP	Electrodynamics	83	80	4
2022FA	Probability Theory and Mathematical Statistics	88	60	3	2023SP	Equations of Mathematical Physics A	90	60	3
2022FA	Theoretical Mechanics A	85	80	4	2023SP	Introduction to Chinese Important Thoughts	90	60	3
2022FA	Table Tennis II	A	40	1	2023SP	Field Operations	B+	40	1
2022FA	English Communication Intermediate III	90	20	1	2023SP	Contemporary Sci-Tech ART	A+	40	2
2022FA	Function of Complex Variable A	94	60	3	2023SP	College Physics Experiment III	85	60	1.5
2022FA	Fundamental of Electronics	83	60	3	2023SU	Design and Practice of Robot	A	60	2
2022FA	College Physics - Comprehensive Experimentation A	87	60	1.5					
2023FA	New Youth's Study of CPC History	Pass	20	1	2023FA	Computational Physics B	80	60	3
2023FA	Quantum Mechanics B	95	80	4	2024SP	Engineering Optics	94	80	4
2023FA	Situation and Policy	Pass	40	2	2024SP	Physics Specialized Base Experiments	87	80	2
2023FA	Technique of Quantum Information	79	60	3	2024SP	Solid State Physics B	90	60	3
2023FA	Mathematical Analysis B1	85	120	6	2024SP	Fundamentals of Modern Optics	86	60	3
2023FA	Creative Design and Application of VR/AR/MR Technology	A+	50	2	2024SP	Advanced Photon Physics	93	60	3
2023FA	Laser Principle and Technology	85	60	3	2024SP	Thermodynamics and Statistical Physics A	83	80	4
2023FA	New Media Visual Art: From Digital Image to AI Painting	B+	40	2					

Special Campaign(*)			A-	4	2023FA

Note:(H) represents the curriculum of Honors;FA:Fall SP:Spring SU:Summer
Grades on the pass/fail system do not count toward GPA and weighted average score

GPA Calculation:

Centesimal Grade:	100~95	94~90	89~85	84~82	81~78	77~75	74~72	71~68	67~65	64	63~61	60
Letter Grade:	A+	A	A-	B+	B	B-	C+	C	C-	D+	D	D-
Point Value:	4.3	4	3.7	3.3	3	2.7	2.3	2	1.7	1.5	1.3	1

$$GPA = \frac{\text{(Course Credit * Course GP)}}{\text{Course Credit}}$$

Office of Academic Affairs

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