Research Interests

of Zhongqi Xiu (Yang's Lab applicant for 2025 Fall)

Four years ago, my passion for computer science—fueled by great interests of software programming and hardware engineering—seemed destined to shape my future. Also, upon entering the University of Science and Technology of China, I found myself struggling in physics courses, overshadowed by classmates who had long embraced the subject. However, just as I was beginning to doubt my path, a chance encounter with the book Let There Be Light transformed everything. Its engaging narrative about the journey of light and the essence of quantum physics ignited a newfound fascination within me. Immersed in theoretical and experimental optics, I discovered the exhilarating challenge of exploring new physical phenomena and mastering optical instruments. This revelation shifted my focus from computer science, revealing my true passion for physics and optics. Now, driven by a deep-seated enthusiasm and a desire to contribute to the field of quantum optics, I am wholeheartedly committed to pursuing my Ph.D. at Harvard in the fall 2025, eager to dedicate my professional career to exploring the mysteries of light and its quantum properties.

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.

Passionate about precision in quantum optics, I made some simulation of combination of the cavity cooling and feed back cooling to reach new cooling temperature limit. I calculated the combination of 2 cooling methods and certified that the new method's lowest temperature has the correct positive correlation with a low cavity decay rate. Also, with simulating the new model using the Quantum Monte Carlo to find the lowest temperature the new method can reach, I compared with the separated cooling method and the new method could reach a lower temperature, which means the laser cooling method can also be enhanced with this new method.

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.

Balancing my deep-rooted passion for optics with a love for computer science, I lived a journey that seamlessly intertwines both fields. From exploring physical concepts with neural networks and simulating intricate light field modes to pioneering quantum cooling techniques, my projects have been a playground for innovation and curiosity. My stint at RoboGame 2023 was a thrilling departure, where leading a team to build a robot from scratch taught me invaluable lessons in leadership and system integration. The summer of 2024 at Rice University's SCOPE Lab was transformative, immersing me in cutting-edge single-photon emission research and allowing me to contribute meaningful advancements despite venturing into new territories of two-dimensional materials and nanofabrication. Developing user-friendly data processing applications underscored my commitment to making complex science accessible and collaborative.

The supportive community at Harvard ignited my desire to join the graduate program. Here, I envision leveraging Harvard's robust funding and collaborative environment to push the boundaries of optical imaging, blending my technical prowess with creative problem-solving. Ultimately, I aspire to inspire the next generation of scientists as a faculty member, fostering a vibrant research community where quantum optics and innovative teaching converge. 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.