

KUNAL SINHA

Experimental quantum engineering for neutral-atom processors

@ ksinha24@wisc.edu

+1 (608)4401125

Madison, USA

EDUCATION

University of Wisconsin, Madison, USA

M.S. Physics - Quantum Computing

3.65/4.00

Advanced Quantum Computing, Applied Optics, Light Interactions with Quantum Materials,
Quantum Mechanics, Qubit Tune-up and Programming

August, 2024 - December 2025

University of Pune, India

Bachelor of Engineering in Electronics and Telecommunication Engineering

Digital Signal Processing, VLSI, Machine Learning, Information Theory & Computer Networks

July, 2017 - July, 2021

PUBLICATIONS, PREPRINTS & PATENT

Papers

- C. N. Mude, L. Phuttitarn, S. Maurya, **K. Sinha**, M. Saffman, and S. Tannu, "Enabling Fast and Accurate Neutral-Atom Readout through Image Denoising," arXiv:2510.25982
- **K. Sinha** and J.T. Choy, "QITCAT: An End-to-End Quantum Interferometry Toolkit for Cold Atom Technologies," in preparation.
- L. Phuttitarn, **K. Sinha**, C. Poole, and M. Saffman, "Measuring Atomic Qubits with a SPAD Array," in preparation.
- **K. Sinha**, R. Dalvi, M. G. Chandra and S. Chatterjee, "MetQuan - A Comprehensive Toolkit for Variational Quantum Sensing and Metrology," COMSNETS 2024.Link

Patent

- T. M. Graham, **K. Sinha**, and M. Saffman, "Scalable and Fast Optical Addressing of Atomic Qubit Arrays," in preparation.

Poster

- DAMOP 2025: Towards fast error syndrome measurements in dual species atomic qubit arrays

RESEARCH EXPERIENCE

Saffman Lab (PI - Prof. Mark Saffman), University of Wisconsin-Madison

Graduate Researcher

September 2024 - Present

Control stack & FPGA integration

- Building the control system for a dual-species (Rb-Cs) neutral atom quantum computer by defining modular ARTIQ+QICK (FPGA based control hardware) flows for state preparation, qubit tune-up, continuous loading, and quantum error correction oriented operation.
- Programmed QICK and RF front-end; implemented Verilog extensions for neutral atom support, multi-tone generation for rearrangement, and currently implementing on-FPGA camera-feed processing (matched-filter) to reduce latency.

Qubit Readout & imaging

- Benchmarked SPAD (Pi-Imaging) vs Hamamatsu qCMOS for neutral atom readout; optimized optical alignment and machine calibration to maximize collected photons and minimize readout time.
- Performed noise-aware simulations of SPAD/CMOS/EMCCD imaging chains to study fidelity vs. integration time and guide detector choice.
- Developed a Generative-Adversarial-Network-based routine to denoise qubit array readout (arXiv:2510.25982)

AOD based multitone parallelized addressing of atomic qubit arrays

- Co-invented a fast, scalable optical addressing scheme for large atomic arrays; patent in preparation.
- Built physics-informed neural network (PINN) tooling for intermodulation suppression and arbitrary amplitude multitone acousto-optic deflector (AOD) drives within the same addressing scheme.

Experiment operations & simulations

- Deployed quality of life fixes, telemetry, and runtime monitoring for the cesium qubit array experiment and operated the system for calibration / experiment runs.
- Investigating microwave assisted optical pumping strategies for improved state preparation in the dual-species array.

(continued on next page)

Choy Lab (PI - Prof. Jennifer Choy), University of Wisconsin-Madison

Graduate Researcher

August, 2024 - Present

- Developed QitCat, an open-source, end-to-end cold-atom interferometry simulator (states, light pulses, gravity evolution, realistic noise) with GPU-accelerated ensemble sweeps for quantum sensor design.
- Extending the framework with ML based denoising / reconstruction for low SNR signals in atom interferometry experiments. (work being carried out in collaboration with Prof. Swamit Tannu (CSE))
- Contributed to ARTIQ setup and operation for atom interferometry experiment automation and hardware bring-up.

Tata Consultancy Services - Research and Innovation Labs, Bengaluru

Research Scholar

February, 2023 - July 2024

- Developed MetQuan, a quantum sensing and metrology simulation toolkit with cross-compatibility across Qiskit, QuTiP, Cirq, and PennyLane, featuring variational ansatz design, and noise-aware probe state evolution for precision measurement optimization.
- Simulated multi-parameter phase estimation using variational quantum circuits. Benchmarked against Ramsey spectroscopy, achieving enhanced sensitivity in phase detection.

PROFESSIONAL WORK EXPERIENCE

Avoma, Inc

Senior Software Engineer

November, 2022 - June, 2024

- Designed and maintained large-scale audio/video machine learning pipelines; introduced machine learning operations practices that improved model scalability and cut infra costs by 45%.
- Collaborated in a production engineering team, reinforcing software engineering discipline now applied to lab control stacks.

FinSoftAI Solutions Private Limited

Founding Engineer

February, 2020 - November, 2022

- Developed a proof-of-concept for AI-driven trading platform, progressed it to a minimum viable product by architecting workflows for equity research, utilizing blockchain technology to ensure secure data handling.
- Led a team of engineers and conducted demos for prospective clients and investors, effectively communicating the platform's capabilities and business value, fostering successful engagements and stakeholder relationships.

DextromindAI LLP

Co-Founder

February, 2020 - January 2021

- Spearheaded the development of a progressive web application, designed to empower the visually impaired with navigation tools in unfamiliar environments using cost efficient monocular camera based devices.

Omdena

Lead Machine Learning Engineer (Volunteer)

December, 2019 - May, 2020

- Performed causal analysis to understand policy effects on the economically marginalized during pandemics.
- Worked on understanding and analysing the impact of sex education in Polish Society.

SKILLS

Neutral-atom QC calibration and control Control hardware and pulse programming (ARTIQ, QICK, OPX)
Optical setup and alignment FPGA / Verilog (camera path, multitone AOD) Quantum software (QuTiP, Qiskit, Cirq)
Python, C/C++, Docker, Kubernetes Machine Learning

PROJECTS

Dynamical Decoupling for Transmon Qubits (Physics 763: Qubit Tune-Up, course project)

September 2025 - Present

- Implementing OPX+/QUA-based DD primitives (baseline, XY-4/8, UDD) to study dephasing mitigation under 4 ns timing constraints and finite-length DRAG pulses.
- Running randomized benchmarking with DD inserted in Clifford idle periods to quantify error-per-gate improvements and overhead across noise-biased transmon.

Quantum Reinforcement Learning for Zero-Sum Games

August, 2020 - May, 2021

- Undertook Bachelor's thesis project to devise a Quantum Deep Reinforcement Learning model, incorporating quantum feedforward layers using parameterised ansatz within traditional DRL structures.
- Employed the Deep Q-learning algorithm to demonstrate superior performance over classical Deep Q-Network models, particularly for zero-sum games like Tic-Tac-Toe.