Alek Hunter **Kemeny**

Harvard Quantum Initiative · Duke University '23 · Quantum Technologies

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Education

Harvard University, Ph.D. in Quantum Physics | GPA: 4.0 | Advisor: Kang-Kuen Ni — *Cambridge, MA*

Massachusetts Institute of Technology, Visiting Student | 2023 — *Cambridge, MA*

Duke University, A.B. in Physics | Class of 2023 | Major GPA: 3.98/4.00 — *Durham, NC*

Awards & Fellowships

2024 **National Science Foundation Graduate Research Fellowship**. Awarded to **2,037 out of 12,000+** applicants. Provides full funding for 3 years of graduate study. *National Science Foundation*

2024 **Massachusetts Institute of Technology Presidential Fellowship**. Awarded to **120 out of 34,000+** applicants across all departments at the Institute. Fully funds the first year of graduate studies (declined). *Massachusetts Institute of Technology*

2023 **IBM Qiskit Advocate**. Requires IBM Qiskit Certification, organizing community events, and open-source Qiskit contributions. *IBM Quantum*

2023 **Harvard John A. Paulson School of Engineering and Applied Sciences REU NSF Fellowship†**. Awarded to **55 out of 1000+** applicants. Supports undergraduates conducting research across various scientific and engineering fields . *Harvard University*

2023 **NSF-ERC Center for Quantum Networks REU Fellowship†**. Awarded to **8 out of 40+** applicants. Supports undergraduates conducting research in Quantum Information Science and Engineering. *University of Arizona*

2023 **Goldwater Scholarship† Finalist**. One of four finalists nominated by Duke for "the most prestigious undergraduate scholarship in the natural sciences, mathematics, and engineering in America." *Barry Goldwater Scholarship & Excellence in Education Foundation*

2022 **Quantum Undergraduate Research at IBM and Princeton (QURIP)† Fellowship**. Awarded to **10 out of 300+** applicants. Summer undergraduate research fellowship combining academic research in quantum science with industry research. *Princeton University & IBM*

2022 **Yale Summer Undergraduate Research Fellowship†; The Leadership Alliance (SR-EIP)†**. Awarded to "**15 out of hundreds** of applicants" (declined). The Leadership Alliance supports underrepresented scholars pursuing professional research careers. *Yale University*

2021 **HackDuke† Winning Hackathon Project**. The largest 24-hour student-run hackathon for social good. **7 winners, 80 projects**. We trained a generative adversarial network to find extant stable novel molecules using a database of FDA-approved pharmaceutical molecules. *HackDuke*

Publications & Presentations

Publications

1. A. Kotwal, **H. Kemeny**, J. Yang, J. Fan. **A low-latency graph computer to identify metastable particles at the Large Hadron Collider for real-time analysis of potential dark matter signatures**. *Nature Scientific Reports,* **14**, 10181 (2024). https://doi.org/10.1038/s41598-024-60319-9†

Presentations

1. R. Cimmino, Y. Wang, K. Wang, **H. Kemeny**, KK. Ni. **A Dual-Species Optical Tweezer Array of Na and Cs Rydberg Atoms.** ITAMP Winter School Session, 2025 February 24; Tucson, AZ

2. **H. Kemeny**, H. Choi, D. Englund. **Object Tracking using Entangled Quantum Sensor Networks.** NSF-ERC Center for Quantum Networks REU Poster and Presentation Session, 2023 August 14; Tucson, AZ

3. **H. Kemeny**, H. Choi, D. Englund. **Optimal Sensor Placement for Quantum Sensor Networks.** Harvard John A. Paulson School of Applied Sciences and Engineering REU Poster and Presentation Session, 2023 August 4; Cambridge, MA

4. **H. Kemeny**, K. Krsulich. **Spin-locking Benchmarks for Driven Evolution of IBM Superconducting Qubits.** Quantum Undergraduate Research at IBM and Princeton Poster Session 2, 2022 August 26; Yorktown Heights, NY.

5. **H. Kemeny**, C. S. Chiu, B. Smitham, A. Houck. **Time-evolution of Qubit Coupled to Photonic Lattice at Stationary Inflection Point.** Quantum Undergraduate Research at IBM and Princeton Poster Session 1, 2022 July 16; Princeton, NJ.

Research

Dual-Species Rydberg Atom Array for Quantum Computing and Simulation

Harvard University Physics

Ph.D. Student; Advisor: Professor Kang-Kuen Ni — *September 2024 - PRESENT*

Building a neutral atom quantum computer with cesium and sodium atoms. I completed the design and construction of a new ultra-high-vacuum chamber. This upgrade positions the experiment to reach higher Rabi frequencies on sodium and suppress stray-field-induced dephasing, key parameters for the high-fidelity quantum operations we plan to demonstrate in the coming year. In parallel, I wrote FPGA-based control code that automatically locks our excitation lasers, eliminating daily manual tuning; I also installed a new optical breadboard for the improved imaging fidelity of sodium. Ultimately, I aim to use AI and automation techniques to build a self-driving lab.

IBM Quantum Compilers and Benchmarks

MIT-IBM Watson AI Laboratory

Full-Time Research Engineer — *September 2023 - September 2024*

Built a novel benchmarking tool for quantum compilers. As a Qiskit Developer, I also fixed bugs, added features, and managed Qiskit releases. As an intern in summer 2022, I created a software package, spinlocker†, that serves as an extension for Qiskit experiments. This package contains Nuclear Magnetic Resonance-inspired pulse gate experiments ($T_{1\rho}$) that I programmed for benchmarking the coherence times of single and entangled qubits on IBM superconducting quantum hardware (Python, Qiskit, IBMQ).

Entangled Quantum Sensor Networks for Vehicle Navigation Without GPS

MIT RLE

Researcher; PI: Professor Dirk Englund — *June 2023 - May 2024*

Developed a procedure to support the navigation of vehicles in GPS-denied locations. I developed a general representation for dynamic, distributed magnetic fields and derived a Quantum Cramér-Rao bound for magnetic field estimation. I created an algorithm for optimal sensor placement of entangled quantum sensor networks. I supervised an undergrad who is implementing an algorithm to use my optimal measurements for precisely determining the location of our vehicle anywhere on the planet using a map of Earth's magnetic field.

Pulse Optimization for Trapped-Ion Quantum Computers

Duke & Sandia National Labs

Researcher; PI: Professor Kenneth Brown — *June 2021 - August 2023*

Built the first general AMFM pulse optimizer for trapped-ion platforms. I implemented a gradient-based optimization method (Pytorch) to find robust AMFM pulse sequences for *user-defined* gates. This project initiated a collaboration with Sandia National Laboratories, where I led an effort to integrate our software with Sandia's trapped-ion hardware. I also implemented an optimization method achieving state-of-the-art fidelity (99.92%) for the Molmer-Sorenson gate by solving the master equation at every step in optimization to incorporate a complete picture of system noise.

Laser-Locking for Improved and Consistent Gate Times in a Trapped-Ion Quantum Computer

Duke Quantum Center

Researcher; PI: Professor Kenneth Brown — *December 2022 - May 2023*

Built hardware to achieve consistent gate times in a trapped-ion quantum computer. More specifically, I constructed a circuit that performs a PID loop for locking the amplitude of our pulse laser. I aligned the laser beam by manually tuning mirrors, soldered connectors for voltage controllers, and break-point tested using a spectrum analyzer. Ultimately, I was successful in locking the laser, confirmed by calculating the Allan deviation.

A Superconducting Circuit for Quantum Memory

Princeton University

QURIP Intern; PI: Professor Andrew Houck — *June 2022 - July 2022*

Analytically and computationally investigated superconducting circuits that produce slow light phenomena, called "non-Markovian" physics. I developed a rigorous mathematical argument constructing the minimum area circuit that can generate slow light behavior (Mathematica). I implemented a time-evolution simulation of this circuit coupled to a qubit and found predictable qubit excitation revivals with simulated disorders (Python). This indicates that an experimental implementation of this device could support quantum memories.

Unsupervised learning for State-of-the-Art Particle Tracking @ Large Hadron Collider

CERN

Researcher; PI: Professor Ashutosh Kotwal — *June 2021 - June 2023*

Implemented novel AI algorithm for real-time particle tracking and identification. I optimized our algorithm for FPGA integrated circuit architecture (C++, Xilinx Vivado) to achieve a throughput of <250 ns, allowing for fragment path reconstruction at 40 MHz. This constitutes a two order of magnitude increase in speed from current CPU architecture and beats state-of-the-art performance for image recognition tasks. The ultimate goal of this project is to upgrade computer systems at the LHC to search for metastable supersymmetric particles that may correspond to dark matter.

Leadership

Inkwell, Inc. The First AI-Native Classroom

Cambridge, MA

CEO and Co-Founder — *June 2023 – PRESENT*

I co-founded Inkwell with the aim of providing ultra-personalized education for students and supercharging teachers with AI grading & analytics. I first co-led a team of 10 open-source† developers building generative AI chatbots† that served as companions for courses, such as MIT 6.2410 Laboratory in Quantum Systems Engineering and BYU's Photonics Bootcamp. I realized that bolting chatbots onto existing EdTech software left powerful capabilities on the table and have since pivoted to building Inkwell, a learning management system built from the ground up around AI. We currently have $300k revenue and are working with our clients at the NSF and Center for Semiconductor Manufacturing to deploy Inkwell in classrooms this fall. I was invited to present this work at MIT Generative AI Week† as well as the AI Fairness Workshop† at the University of Toronto.

Duke Quantum Information Society

Duke University

Co-President — *June 2021 - May 2023*

Led an organization of over 25 members where we teach undergraduates about quantum science and get people involved in quantum research. Under my leadership, we:

- hosted HackDuke-Quantum collaboration with IBM and led workshop on Qiskit to help dozens of students create quantum computing projects.
- organized multiple quantum computing seminars hosting industry and academic experts, attracting over 40 participants on average.
- created Quantum Project Groups, teaching students quantum computing by building projects and open-source contributions to Qiskit.

I personally mentored over 20 students in learning quantum information and securing research internships. I also pioneered a STEM mentorship program pairing senior undergrads with underclassmen.

Duke Physics Undergraduate Quantum Computing Course

Duke University

Course Instructor — *January 2022 - May 2023*

Taught student-run Intro Applied Quantum Computing course in the Duke Physics department. Our curriculum covers intro quantum mechanics, quantum circuits, quantum computing hardware, quantum algorithms, and quantum chemistry. I planned and taught weekly sessions to 18 students, prepared Qiskit lessons and powerpoint slides, and graded final presentations. Faculty Sponsor: Professor Kenneth Brown.

Skills

Programming Languages	Python, Rust, C/C++, SQL, Shell, Java, JavaScript, Swift
Libraries	QuTip, PyTorch, Pandas, NumPy, SciPy, Matplotlib/Seaborn, Firebase, Express
Technologies	Cursor, ChatGPT, Qiskit, LEAN, FPGA HDKs, Mathematica, AWS/GCP, Vercel, Jupyter, LaTeX, Git, Linux, Xcode, React
Developer Skills	Vibe Coding, AI Tools, Open-Source Development, Multiprocessing, Full-Stack Web & Mobile Development
Experimental Skills	Vacuum Chambers, Machine Shop Certified, Clean Room Certified, Optics, CAD, 3D Printing, Red Pitaya
Interests	Human Longevity, Meditation, Philosophy, Anki, Polymarket, Building PCs, Rubik's Cubes, Guitar