Nathan Fredman

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PROFESSIONAL SUMMARY

PhD physicist with 12 years of hands-on experience building, operating, and troubleshooting cold-atom and quantum-optics experiments. Experience spans lasers, optics, RF systems, timing electronics, control platforms, and data analysis, including migration of legacy controls to a Python-based system and development of calibration and analysis workflows for precision optical-lattice measurements. Seeking roles in quantum hardware, instrumentation, controls, or R&D.

TECHNICAL SKILLS

Programming & Control: Python, MATLAB, Mathematica, LabVIEW

Quantum / AMO Experimental: Laser optics, optical alignment, optical lattices, dipole traps, RF modulation, timing and synchronization, vacuum hardware, instrumentation

Laser Systems: Diode, ECDL, Ti:sapphire, fiber, and tapered-amplifier laser systems; cavity stabilization, injection locking, TA-seeded diode systems, and optical power and frequency calibration

Components: AOMs, EOMs, DDSs, cameras, shutters, coils, photodiodes, RF hardware, power meters

Analysis & Calibration: Quantitative modeling, nonlinear parameter estimation, uncertainty analysis, data visualization, signal processing, calibration workflows, and experimental data reduction

Hardware & Tools: Origin, AutoCAD, electronics assembly, soldering, RF sources, power supplies, basic machine shop tools, Microsoft Office

PROFESSIONAL EXPERIENCE

DeMarco Lab, University of Illinois Urbana-Champaign **June 2018 – Present**

Graduate Research Assistant

- Operated and troubleshot complex ultracold-atom experiments integrating lasers, optics, RF systems, timing electronics, control software, and data acquisition, supporting reliable experimental operation and precision measurement campaigns.
- Served as the sole graduate student on the potassium-40 apparatus, helping guide the experiment through a controlled sunset phase that preserved technical knowledge and reusable infrastructure for the lab.
- Helped revitalize the rubidium-87 apparatus and restore data-taking capability after more than six years of inactivity by rebuilding optics, revalidating controls, and reestablishing experimental workflows.
- Migrated experimental controls from a homebuilt system to a Python-based platform by rewriting sequences, remapping channels, integrating hardware, and validating timing behavior, enabling continued operation on a modern control stack.
- Characterized timing jitter, synchronization, drift, and repeatability to verify reliable control-system performance and support confidence in experimental measurements.
- Built, aligned, locked, and maintained laser, lattice, dipole, and imaging beam paths across dozens of optical paths, supporting stable operation and optical power and frequency calibration.
- Performed mobility measurements in thermal and disordered optical lattice gases and developed calibration routines for trap frequencies, lattice depths, beam waists, imaging response, magnetic fields, and background systematics, enabling reproducible extraction of physics.
- Developed reusable analysis tools in Python, MATLAB, and Origin for automated fitting, uncertainty analysis, and reanalysis of experimental data, improving consistency and reproducibility of extracted results.
- Diagnosed failures across optics, electronics, timing, software, and calibration, recovered experiments after downtime, and trained newer students on experimental and analysis workflows to support continuity within the lab.
- Created simulations in Mathematica, MATLAB, and Python to model complex atomic systems and validate experimental observables against theoretical predictions, including mean-field and atomic-limit models.

Rubidium Rydberg Lab, University of Maryland **November 2014 – June 2018**

Undergraduate Research Assistant

- Contributed to Rydberg-atom experiments relevant to quantum information research, supporting lab publications on nonlinear optical and multi-particle interaction effects.
- Developed Python and C++ tools for laboratory control, including support for beat-note locks and cavity-control systems.
- Built Arduino-based interfaces for apparatus control, including a temperature-control box using a thermistor, PID loop, and Peltier device.
- Built and tested a microcontroller-based scanning transfer cavity lock, including chip population and electronics integration, to support laser frequency stabilization.
- Designed vacuum-system and experimental hardware components in AutoCAD.

University of Illinois Urbana-Champaign **August 2024 – May 2026**

Teaching Assistant, Advanced Undergraduate Physics Laboratory

- Guided students through laboratory experiments, uncertainty analysis, and technical report preparation across upper-level physics courses.
- Troubleshot equipment and supported students in data analysis and interpretation of experimental results.

EDUCATION

University of Illinois Urbana-Champaign
PhD, Physics — Expected Aug 2026

University of Maryland, College Park
BS, Physics

HONORS

University of Illinois Fellowship for Excellence in Physics
University of Maryland Physics Departmental Honors
Sigma Pi Sigma Physics Honor Society

SELECTED PUBLICATIONS

Entangleware Sequencer — Co-author, arXiv preprint

Compressibility Measurement of the Thermal MI–BG Transition — Contributor / co-author, arXiv preprint

Transport in Disordered Optical Lattice Gases — Co-author on manuscript in preparation

Mobility in Weakly Interacting Thermal Gases — Co-author on manuscript in preparation