John P. Ferrier Jr, PhD

Somerville, MA

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NSF Graduate Research Fellow and PhD-level scientist with 15+ years of cumulative experience spanning technical leadership, AI/ML research, and full-stack engineering. A US Air Force (SSgt) veteran with a previous security clearance, proven in leading diverse teams, managing fleet-wide technology programs, and overseeing $3M+ in operational assets. Combines a deep scientific background in physics and AI with hands-on software and hardware engineering to lead complex R&D projects from concept to completion.

Technical Skills

- **Leadership & Management (15+ years)**: Program Management, Team Leadership & Training, Operations Management ($3M+ Assets), Safety & Compliance (EHS), Project Lifecycle Management, Stakeholder Relations, Mentorship
- **Machine Learning (5+ years)**: PyTorch, TensorFlow, HuggingFace, Scikit-Learn, JAX, Bayesian Optimization, Gaussian Processes, Deep Neural Networks (DNNs), Physics-Informed Neural Networks (PINNs), Language Models
- **Software & Data (10+ years)**: Python, C++, Swift, NumPy, Pandas, SciPy, Slurm (HPC), FastAPI, SQL, Linux, MacOS, Windows, Git/GitHub/GitLab
- **Web Development (5+ years)**: ReactJS, NodeJS, HTML, CSS, JavaScript, Tailwind CSS, PHP, MySQL
- **Engineering & Hardware (10+ years)**: SolidWorks, FreeCAD, AutoDesk, EagleCAD, CNC, 3D Printing, Laser Cutting, Soldering (SMT & Through-hole), Microfluidics, Microcontroller Development
- **Physics & Research (10+ years)**: Density Functional Theory (DFT), ASE/GPAW, Chemical Vapor Deposition (CVD), Atomic Force Microscopy (AFM), Raman Spectroscopy, SEM, TEM

Professional Experience

Mercor Intelligence | Boston, MA **Sept 2025-Present**
Writer/Reviewer

- Serve as a writer/reviewer of LLM reasoning model datasets on PhD-level physics problems—ensuring fellow writers maintain coherent structures while confirming cogent solutions.

Northeastern University – 2D Quantum Materials Laboratory | Boston, MA **Jan 2019-Sept 2024**
Doctoral Researcher

Machine Learning & Computational Physics

- Developed **neural network** methods that achieved more precise convergence with **2D quantum material synthesis** experimental results after *~10 samples* and with increased speed after *~150 samples*, surpassing **Gaussian Processes**.
- Reduced computational predictions for **2D quantum material** (**graphene**, **h-BN**, **MoS_2**, **$MoSe_2$**, **WS_2**, **WSe_2**) synthesis by developing a new thermodynamic model using **Python, NumPy, GPAW, ASE, and SciPy**.
- Developed **Computational Fluid Dynamics** software using the **Lattice Boltzmann method** to predict CVD gas flow, cutting experimental discovery time by *90%*.
- Constructed comprehensive automated **DFT** software for material categorization and **DFT** value convergence, saving pre-calculated values to shorten future *computation times by up to 99%.*
- Created a **Blender3D** plugin for visualizing **DFT**-derived electron cloud density changes over time.

Software & Hardware Engineering

- Designed and constructed a self-calibrating Raman Spectroscope with a **Qt-based GUI** software and faster motor control, resulting in *~$500k savings* for the lab by averting the need to replace a broken Raman unit.
- Fabricated **custom circuit boards** for full digital control over **CVD** gas flow controllers, enhancing experimental precision, minimizing human error, and enabling remote monitoring.
- Designed a **robotic system in SolidWorks** for the **automated stacking of 2D materials**.
- Created automated Raman curve fitting and analysis software (using **Tkinter**, **Python**, and **LMFit**), reducing data collection time by up to *90%* per sample compared to commercial software.

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- Established a **shell script** for installing **GPAW** on **ARM-based** Apple products before **GPAW's** availability on **conda-forge** or **Homebrew**.

Research & Scientific Discovery

- Discovered a novel method for graphene synthesis that lowered the temperature by *20%* and enabled atmospheric pressure, leading to a *54% energy reduction* and a *43% decrease in synthesis time*.
- Conducted *theoretical and experimental* investigations to identify the synthesis parameters of **K_2CoS_2**, leading to the successful synthesis of a 2D trigonal potassium-centric crystal.
- Collaborated with **NASA engineers** to create a method for synthesizing **graphene** on the **ISS**, examining the impact of convection on synthesis.

Leadership, Management, & Mentorship

- Oversaw laboratory **safety training, purchasing, chemical inventories, and safety compliance** for the 2D Quantum Materials Laboratory, managing over $400k in equipment and supplies.
- Supported Professor Swastik Kar in establishing the Experiential Quantum Advancement Laboratories (EQUAL), interviewing 30+ potential professors and aiding in equipment consulting and procurement.
- Mentored undergraduate and graduate students on condensed matter physics experimental protocols and SOPs, guiding 5+ students on experiments and safety procedures.
- Served as the Teaching Assistant for two Physics 1 classes and one Physics 2 class, instructing, mentoring, and grading 40+ undergraduate students.
- Collaborated with the NEU Physics department to develop an interactive Muon detector project for science outreach, enhancing the **MIT CosmicWatch** with updated interactive features.

The Wyss Institute – Disease Biophysics Group | Boston, MA **June 2015-Aug 2018**

Research Assistant – Engineer III

Software Engineering & Data Science

- Served as the **in-house engineer** for all software projects, developing *10+* robotic and software systems for data collection and analysis.
- Developed high-speed real-time video processing software for muscular cell tracking, decreasing *computational time by 99.7%* and resulting in a publication.
- Utilized **Python** to create high-density patterning software for **photolithography mask development** for fat-cell culture islands, leading to a publication.
- Assisted in developing **mathematical models** for muscular thin film structure efficacy.

Robotics, Hardware, & Mechanical Design

- Served as the **in-house engineer for all mechanical and electrical engineering** projects.
- Designed a **microfluidic** connecting robot for high-throughput **Organ-On-a-Chip** testing, using **SolidWorks and Blender**.
- Engineered an automated nanofiber collection system for **3D printed heart ventricles**, conserving manual labor.
- Developed a compact and low-powered **electrospinning** technology using less than *15-watts*, achieving comparable nanofiber development to traditional high-voltage techniques (verified by SEM).
- Engineered stainless steel quick connect systems for **Organ-On-a-Chip** replacements, reducing preparation time by *~15x*.
- Developed a **signal filtering circuit** for tracking insulin in a microfluidic **Organ-On-a-Chip**, reducing signal noise and decreasing data post-processing.
- Designed a proposed high-speed light stimulator for photo-induced muscular cell stimulation using **SolidWorks and Blender3D**.
- Rendered *20+* 3D models and images for publications and grant applications using **SolidWorks** and **Blender3D**.

Biomedical Research & Impact

- Contributed to the development of **heart, brain, and pancreas on a chip technology**, culminating in a Nature publication and a patent.
- Conducted *20+* **cell-culture and transplantation** procedures for brain and heart cells in **Organ-On-a-Chip** experiments, resulting in a Nature publication.

Web Development & Administration

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- Engineered **web-based administrative software** (utilizing Harvard ID login) for handling purchase requests and **tracking grant purchases**, streamlining laboratory requests for *40+* graduate students and post-docs.
- Redesigned the laboratory WordPress website through a custom front-end theme and a modified back end (**PHP, MySQL, JavaScript, CSS**), creating an easier to navigate platform for contact and information.

Harvard University – Disease Biophysics Group | Cambridge, MA **June 2015-Aug 2018**
Laboratory Manager

Leadership & People Management

- Supervised a biophysics research group of *40+ graduate students and post-docs*, **ensuring adherence to safety protocols**.
- **Trained** and assisted *30+ researchers* on the proper usage and maintenance of lab equipment.
- Supported *40+ laboratory graduate students and post-docs* as an intermediary for lab culture and **conflict resolution**.

Operations & Logistics Management

- **Managed** lab supply restocking, overseeing **NIH, DARPA, and NSF grants** consumable purchasing.
- Conducted annual inventories of *500+ chemicals/$3M+ in lab equipment*, and managed routine lab clean-up for inspections and laboratory startups.
- Organized *40+* presentations and managed end-of-year laboratory meetings.
- Managed and facilitated laboratory preparations for *20+* tours for distinguished guests and **government officials**.

Laboratory Safety & Compliance

- Served as the **Laboratory Safety lead**, collaborating with **EH&S** on inspections and compliance.
- Led the lab to be recognized as **the most compliant and safe on the Harvard SEAS campus**.

United States Air Force - SSgt | LRAFB, AR **Mar 2006-Mar 2012**
Electronic Warfare Technician

Leadership & Program Management

- **Led and mentored** a team of specialized technicians as a Staff Sergeant (SSgt), managing all aspects of **technical training, performance management, and career development**.
- **Managed** a fleet-wide technology upgrade program, coordinating the transition of *20+* aircraft to new **laser defense systems**; served as the primary program liaison between the USAF and defense contractor Northrop Grumman for LAIRCM systems.
- Directed maintenance operations in a high-pressure deployed environment (**Afghanistan**), leading rapid-response shift repairs for mission-critical **Electronic Warfare** systems on a C-130J fleet.

Critical Problem Solving & Technical Operations

- Performed root cause analysis on a systemic avionics failure affecting the entire C-12 fleet; engineered and deployed a solution that *restored 100% of critical communication missions* in **Iraq** and **Afghanistan**.
- Maintained and repaired complex **Electronic Warfare** and avionics systems on a C-130 fleet during deployment in **Iraq**, ensuring high operational availability for all assigned aircraft.

Software & Process Improvement

- Engineered and deployed a web application (**PHP, MySQL**) to automate the merger of two separate inventory management (CTK) databases, reducing manual data consolidation time by *over 80%.*
- Designed and implemented a new "waterfall" workflow for optimizing operational readiness, **establishing a new efficiency record for the Air Mobility Command** by significantly expediting deployment response times.

Early Research & Engineering Experience **Mar 2012-Aug 2018**

Intern/Visiting Scholar

Software & Automation Development

- Developed high-speed video processing software (**C++, OpenCV**) to analyze heart cell force exertion, increasing analysis speed by *over 200x* compared to previous methods. (**Harvard REU**)

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- Engineered **Python-based** software (via FreeCAD) for the dynamic design of Venturi resonators, automating the generation of STL files for high-throughput 3D printing and testing. (**U. Central Arkansas**)
- Created GUI software with the **Qt framework** to streamline software accessibility and adoption for researchers in the lab. (**Harvard REU**)

Hardware Engineering & Prototyping

- Modified existing FDM 3D printers into gel-based 3D bioprinters, saving the laboratory *$5k+* in new equipment costs. (**Sogang University**)
- Constructed circuits to dynamically control the chemical states of a novel material, leading to the creation of ink-printed color-changing circuits. (**Sogang University**)
- 3D printed and tested dynamically designed Venturi resonator systems with a closed-testing system controlled by a Raspberry Pi, successfully isolating *15+ frequencies*. (**U. Central Arkansas**)
- Assisted in engineering a bioreactor system for closed-environment, microfluidic biological testing using **SolidWorks**. (**Sogang University**)
- Assisted in engineering a Rotary Jet Spinning machine to produce Extra-Cellular Matrix (ECM) nanofibers, contributing to a publication. (**Harvard REU**)

Research Funding & Project Initiation

- Acquired *$10k in funding* from the Arkansas Space Grant Consortium for a **NASA**-focused research project on 3D printed acoustic resonating systems for potential use on the ISS. (**U. Central Arkansas**)

Education & Certifications

Northeastern University | Boston, MA

PhD: Condensed Matter Physics

Dissertation: *Harnessing Machine learning and Computational Modeling for Optimizing the Experimental Synthesis of 2D Quantum Materials*

Master of Science: Condensed Matter Physics

Harvard Extension School | Cambridge, MA

Graduate Certificate: Nanophysics

University of Central Arkansas | Conway, AR

Bachelor of Science: Mathematical Physics

Department of Defense | Little Rock Air Force Base

Certifications & Training: Air Force Trainer Course, Airman Leadership School, Defensive Systems, Soldering, Electronic Warfare Systems, Electronics

Awards, Patents, & Publications

Patents: Microfluidic trapping chip and uses thereof for culture and assay of cell clusters and objects (US20210197196A1)

Invited Talk: "Leveraging Linear Algebra Methods for High-Speed Video Processing." **USMA West Point** Mathematics Colloquium (2017)

Awards: NSF GRFP, NSF REU Grant, NNIN Grant, Arkansas Space Grant, SPS Awards as chapter president: Blake Lilly Prize, Marsh W. White Award, Outstanding Chapter Award.

Publications: Co-author of *8+* peer-reviewed publications in Nature, Biomedical Engineering, ACS Nano. Full list available on Google Scholar.

Presentations: 5+ presentations at NNIN, MRS, and APS. Full list available on Google Scholar.