Jiachen He

Mobile : +1-859-300-4816
GitHub: https://github.com/jhe274
Email : jiachen.he@outlook.com
Linkedin: https://www.linkedin.com/in/jiachen-he-370558267/
Portfolio: https://jhe274.github.io/portfolio-bruce.github.io//

Skills Summary

- **Laser & Optical Systems**: Laser optics, fiber optics, solid-state lasers, polarization modulation ellipsometry, polarimetry, interferometry
- **Instrumentation & Electronics**: Cryogenic systems, lock-in amplifiers, electro-optic modulators, RF signal generators, spectrum analyzers, oscilloscopes, photodetectors
- **Software & Programming**: Python (scientific computing, hardware automation), C++, MATLAB, Zemax, COMSOL, Autodesk Inventor, LabVIEW, Mathematica
- **Simulation & Modeling**: Magnetic field design (Merritt coils, finite element analysis), optical metrology, quantum light-matter interaction
- **Platforms & Systems**: Unix/Linux, Windows, Python based synchronous data acquisition system

Professional Experience

- **Graduate Research Assistant** — University of Kentucky
  Experimental Realization of a High-Sensitivity Optical Magnetometer Using the Resonant Faraday Effect — *August 2019 - Present*
  - **Optical Metrology**: Expert in polarization modulation ellipsometry, specializing in precise optical alignment, system calibration, and optimization. Developed a system for detecting minute magnetic field variations associated with spin-polarized Helium-3 targets using magneto-optic effects, achieving a sensitivity of 850 nrad per mG.
  - **Laser Frequency Stabilization**: Extensive experience in spectroscopic laser locking using PDH and DSAS techniques with optical cavities and alkali metals (Rb, K), reducing laser frequency drift to $\sim 200\,\mathrm{kHz/h}$ – over 110 times more stable than unlocked systems. Implemented sideband locking over 40 GHz using a 6 GHz bandwidth EOM for precise frequency control.
  - **Software Development**: Published two Python packages on GitHub using object-orientated programming to interface with scientific instruments like wavelength meter and Gaussmeter, eliminating reliance on low-level SCPI commands while optimizing buffer management and communication protocols.
  - **Lab Automation**: Proficient in developing modular Python-based synchronous data acquisition systems for communication with scientific instruments such as wavelength meter, laser controller, lock-in amplifiers, and Gaussmeter. The system efficiently initializes, configures, and synchronizes instruments, sending TTL-level pulse trigger signals and recording data in their buffers with sub-millisecond time differences.
  - **Merritt Coil Development and Implementation**: Developed a compact Merritt coil system using advanced parametric mechanical modeling in Autodesk Inventor, achieving a 6x reduction in size compared to traditional Helmholtz coils. The design doubled the longitudinal field gradient and expanded the uniform field range by 33%. Collaborated with machine shop teams to ensure manufacturability and successful implementation, supported by Python for simulation and optimization.
  - **Compact Magnetic Field Deisgn**: Independently designed and developed a magnet box prototype using COMSOL and MATLAB Simulink, this early career project achieving a 7 G magnetic field with a 20 mG/cm gradient over a 10 cm range. Enhanced expertise in finite element analysis by leveraging concepts such as magnetic scalar potential and image fields.
  - **Cryogenic and Vacuum Systems**: Contributed to system calibration and maintenance of a cryogenic system, gaining hands-on experience with vacuum technologies over five years.
  - **Ongoing Projects**: Implementing machine learning algorithms for real-time magnetic field cancellation.
- **Summer Research** — University of Kentucky
  Research on Etch Track-Directed Growth of Carbon Nanotubes on Graphite — *May 2018 - August 2018*
- **Graduation Project** — Shenzhen University
  Research on the Control System of Intelligent Fish Tank Based on Single Chip Microcomputer — *September 2015 - May 2016*
- **Open Laboratory Fund Project** — Shenzhen University
  Research on the Design of Temperature-controlled Automatic Watering Device — *September 2012 - October 2013*

Education

- **University of Kentucky** — United States
  Ph.D. in Physics — *(Expected May 2025) August 2019 - Present*
  ***Foci**: Magnetic field modeling, quantum light-matter interaction, magneto-optic effects, optical metrology, spin-exchange optical pumping, optical homodyne detection, and laser frequency stabilization.*
- **University of Kentucky** — United States
  M.S. in Physics — *August 2017 - May 2019*
- **Shenzhen University** — China
  B.E. in Measurement Control Technology and Instruments — *September 2010 - July 2017*
  ***Thesis**: Research on the Control System of Intelligent Fish Tank Based on Single Chip Microcomputer.*

Publications

- **Korsch, W., Broering, M., Timsina, A., Leung, K.K., Abney, J., Budker, D., Filippone, B.W., He, J., Kandu, S., McCrea, M. and Roy, M., 2024. Electric charging effects on insulating surfaces in cryogenic liquids.** Review of Scientific Instruments, 95(4).
- **Jiachen He, Wolfgang Korsch, "Experimental Realization of a High-Sensitivity Optical Magnetometer Using the Resonant Faraday Effect"**: "In preparation"

Presentations

In Person

- **J. He, W. Korsch, "Using the resonant Faraday effect to probe external magnetic fields"**: American Physical Society Global Physics Summit, Anaheim, March 2025
- **J. He, W. Korsch, "Resonant Faraday rotation measurements in a potassium vapor cell."**: American Physical Society April meeting, Sacramento, April 2024

Poster Presentations

- **J. He, W. Korsch,"Resonant Faraday rotation measurements in a potassium vapor cell."**: Department of Physics & Astronomy, University of Kentucky, August 2024
  Awarded Second Overall Best Poster
- **J. He, W. Korsch, "A compact magnet design to create low-gradient magnetic field in the presence of magnetic shielding."**: National Nuclear Physics Summer School, Massachusetts Institute of Technology, Cambridge, July 2022
- **J. He, W. Korsch,"A compact magnet design to create low-gradient magnetic field in the presence of magnetic shielding."**: Department of Physics & Astronomy, University of Kentucky, August 2021

Honors & Awards

- Graduate Student Congress (GSC) Conference Award *April 2024*
- Huffaker Travel Scholarship, Department of Physics & Astronomy, University of Kentucky *2022, 2024, 2025*
- Departmental fellowship for graduate students with an outstanding curriculum *August 2017 - May 2019*
- Max Steckler Fellowship, Graduate School Fellowship, University of Kentucky *August 2018*

Leadership & Collaborations

- **Alumni Liaison** *February 2025 - Present*
- **Department Representative at Graduate Student Congress (GSC)** *August 2023 - August 2024*
- **High School Mentorship** *September 2023 - May 2024*
  Guided a high school student in a scientific project exploring light polarization and measuring the speed of light using Herriott style cavity mirrors and custom built rotating mirror.
- **Undergraduate Mentorship** *2021 - 2024*
  Supervised multiple undergraduate students in research, including a Research Experiences for Undergraduates (REU) participant from MIT, providing theoretical guidance on the resonant Faraday effect in a two-level system. The project culminated in a presentation at the 2024 Division of Nuclear Physics (DNP) Meeting.
- **Collaboration with Engineers** *2019 - Present*
  Partnered with machine shop engineers with a strong track record of designing custom-built electronic devices and developing a Merritt coil winding system.

Professional Affiliations

- American Physical Society (APS) *2021 - Present*
- Society of Photo-Optical Instrumentation Engineers (SPIE) *2024 - Present*