Jiachen He

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Skills Summary

- **Instrumentation & Electronics**: Laser Optics, Fiber Optics, Solid-State Lasers, Polarimeter, PIDs, cryogenic system, vacuum chamber, Fluxgate/Hall Effect Magnetometer, Lock-in Amplifier, Photoelastic Modulator, Electro-optic Modulator (EOM), RF Signal Generator, RF Amplifier, Spectrum Analyzer, Oscilloscope, Photo Detectors, Optical Chopper, DVMs.
- **Optical Metrology**: Polarization Modulation Ellipsometry, optical alignment, precision optical measurements, interferometry.
- **Languages**: English, Chinese(Mandarin), Python, C++, LaTeX
- **Software**: Zemax, COMSOL Multiphysics, MATLAB, Mathematica, Autodesk Inventor, LabVIEW, Microsoft Office
- **Platforms**: Unix-based OS (Linux, Mac OS), Microsoft Windows
- **Soft Skills**: Leadership, Effective Time Management, Event Coordination, Technical Writing, Public Speaking & Presentations, Data Analysis, Module Development, Strong Communication & Collaboration, Analytical Reasoning, Problem Solving, Project Management.

Professional Experience

- **Graduate Research Assistant** — University of Kentucky
  Research on sensitive 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 2.5 μrad per 10 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**: Strong background in scientific programming, developed comprehensive Python packages for the wavelength meter and Gaussmeter, facilitating efficient communication and buffer usage without relying on low-level SCPI commands.
  - **Data Analysis**: Created and implemented multiple Python scripts for comprehensive polarization modulation ellipsometry data analysis. All scripts and packages are available on GitHub to promote transparency and collaboration in scientific research.
  - **Synchronous Data Acquisition (SDAQ)**: Proficient in developing modular Python-based SDAQ 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**: Designed and simulated a compact Merritt coil system to replace Helmholtz coils, reducing the size by 6x while doubling the longitudinal field gradient and increasing the uniform field range by 33%. Utilized Python and Autodesk Inventor, collaborating closely with machine shop teams to ensure successful implementation.
  - **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**: 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*

Teaching Experience

- **University of Kentucky** — Lexington, US
  Graduate Teaching Assistant — *August 2017 - May 2019*
  - Instructed undergraduate students in Newtonian mechanics, electromagnetism, and physical optics through hands-on lab sessions and interactive recitations, fostering a deeper understanding of core physics concepts.
- **Beijing Dasheng Online Science and Technology Co., Ltd.** — Shenzhen, China
  Oral English Teacher (Online) — *February 2016 - July 2016*
  - As an online English instructor, I taught fundamental communication skills to adult learners, enhancing their oral proficiency.

Education

- **University of Kentucky** United States
  Ph.D. in Physics *(Expected Graduation Date: May 2025) August 2019 - Present*
  ***Courses**: Advanced Mechanics, Quantum Mechanics, Electromagnetic Theory, Statistical Mechanics, Methods of Theoretical Physics, Solid State Physics, Fundamental Particle Physics, Computational Physics.*

  ***Focus**: Magnetic field design and modeling, quantum light-matter interaction, magneto-optic effect, spin-exchange optical pumping, laser & fiber optics, optical metrology, polarization modulation ellipsometry, optical homodyne detection, atomic spectroscopy, balanced polarimetry, 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 investigation of a high-sensitivity optical magnetometer based on 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*
  Foster connections between alumni and current students, facilitating networking and engagement opportunities

- **Graduate Student Congress (GSC) Representative** *August 2023 - August 2024*
  Represented the Physics Department in GSC, advocating for graduate student interests and promoting interdisciplinary collaboration.

- **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, 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-made 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*

Volunteering

- **Raleigh International** Gorkha, Nepal
  Venturer *July 2016 - August 2016*
  - Created a simple webpage using online tools and successfully raised £2000 within two days to support a charity program aiding the earthquake-affected village of Chuwatar, Nepal.
  - Contributed to the construction of sanitary installations, water purification systems, and the laying of water pipelines, including excavating the foundation for a water reservoir to improve local living conditions and ensure a reliable clean water supply.

- **Beijing Youngs Group Public Relation Planning Co., Ltd.** Shenzhen, China
  Volunteer Docent, Intel Developer Forum 2015 *August 15, 2015 - August 21, 2015*
  - Selected as one of the top 10 out of 500 volunteers and recognized as an "Exceptional Volunteer".