Chengxin Liu

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EDUCATION

Wuhan University (WHU), School of Physics and Technology 09/2022-06/2026
- **Bachelor of Science in Physics** (Expected), **Yan Jici Elite Class in Physics**, jointly established by the Institute of Physics, Chinese Academy of Sciences and Wuhan University
- GPA: **3.70/4.0**, Average Score: **88.6/100**
- Core Courses: *Thermodynamics and Statistical Physics* (92), *Electrodynamics* (93), *Probability Theory and Mathematical Statistics B* (90), *Linear Algebra A* (96), *Theoretical Mechanics* (89), *Mathematical Methods for Physics* (88), *Computational Physics* (83)

RESEARCH INTERESTS

Condensed Matter Physics, Optics, Computational Physics, Statistical Physics, Quantum Information

RESEARCH EXPERIENCE

Research Assistant, **Dr. Fanglin Bao's Group, Westlake University**
Infrared Imaging Algorithm Optimization and System Integration Based on Heat Radar
07/2025-08/2025
- Designed and integrated an infrared optical experimental system, and built a unified LabVIEW control framework to automate multi-device acquisition and accelerate data analysis across infrared cameras, spectrometers, and microscopes
- Developed a constrained least-squares signal recovery framework derived from the thermal radiation model, and implemented coordinate descent and alternating optimization in MATLAB to estimate key parameters, including temperature, view factor, and spectral emissivity
- Utilized TeX (Temperature, Emissivity, Texture) decomposition to suppress ghosting artifacts in thermal imaging and integrated machine-learning-driven optimization to enhance reconstruction of textures, granularity, and fine details
- Applied quasi-Newton methods combined with regularized nonparametric estimation (smoothing splines, kernel regression) to accurately reconstruct the emissivity function $E(\nu)$, demonstrating the model's robustness on 86-band hyperspectral data (7-14 μm)
- Validated algorithm performance in diverse scenarios (portraits, forests, urban streets, and infrared low-shielding materials), confirming generalization and stability under complex environments, and planned further parameter optimization for deployment on integrated chip architectures

Research Assistant, **Associate Professor Duanduan Wan's Group, Wuhan University**
Monte Carlo Validation of a Universal Statistical Relation for Concave Particles 02/2025-06/2025
- Constructed concave hard particle systems with various geometries, including H-shape and pentagram, using HOOMD-blue
- Extended the Monte Carlo simulation framework to test the universality of a statistical relation for more diverse and complex concave particle shapes
- Optimized Python code and enhanced data processing strategies to accommodate larger-scale and higher-precision computational tasks
- Focused on three representative concave particle types for detailed simulation analysis, with current results aligning with theoretical predictions

Monte Carlo Validation of a Universal Statistical Relation for Convex Particles 10/2024-01/2025
- Employed HOOMD-blue to model convex hard particle systems with various geometries, including 1D line segments, 2D disks, and 3D spheres
- Performed Monte Carlo simulations, including random walk and random insertion, to compute both sides of the proposed universal relation and verify its validity
- Developed modular Python scripts for environment built-up, Monte Carlo execution, and post-processing analysis
- Deployed simulations on a multi-core high-performance computing system and utilized MPI-based parallelization to optimize resource usage, addressing high parallelism in large-scale runs
- Improved result reliability by tuning simulation parameters, refining boundary conditions, and extending model configurations to address numerical instability and sampling error

- Incorporated the fundamental thermodynamic relation that connects entropy, pressure, and chemical potential, revealing the intricate interplay of geometry and thermodynamics in hard particle systems

SELECTED PROJECTS

Object Detection Based on YOLO Model   12/2024-02/2025
- Built a stable training environment based on PyTorch, supporting object detection on images, videos, and other data types
- Collected and processed multiple datasets, converting them into YOLO-compatible formats for training various detection tasks
- Trained YOLOv5-based CNN models and optimized parameters through iterative testing to maximize performance within existing computational constraints
- Monitored key metrics such as accuracy and confidence continuously to ensure model convergence and prevent overfitting
- Adjusted datasets dynamically according to model weaknesses, achieving accurate drone-bird differentiation and effective mask-wearing detection

Symbolic Computation of General Relativity Based on Mathematica   07/2024-08/2024
- Utilized the xACT package in Mathematica to perform tensor calculations, testing and deriving known metrics
- Applied Einstein's field equations to analyze celestial properties

Visualization of Mercury Precession Process Based on MATLAB   05/2024
- Used normalized parameters to reduce computational scale and applied approximations to the field equations to optimize computational efficiency
- Represented Mercury as a point mass and adjusted the step size to ensure the required precision for the simulation
- Visualized Mercury-like orbits successfully, clearly demonstrating the precession process

EXTRACURRICULAR ACTIVITIES

Forward Player, Basketball Team, School of Physics and Technology, WHU   08/2023-Present
Athlete, Sports Team, School of Physics and Technology, WHU   11/2023
Sports Representative, Class 3, School of Physics and Technology, WHU   09/2022-03/2023

AWARDS & HONORS

Outstanding Student, WHU   12/2024
Outstanding Student Third-Class Scholarship (Ratio: Top15%), WHU   11/2024
5th Place, 2024 "Tengfei Cup" Basketball Tournament, WHU Sports Committee   05/2024
Outstanding Student, WHU   12/2023
Outstanding Student Second-Class Scholarship (Ratio: Top 10%), WHU   12/2023
1st Prize (Ratio: Top 13.7%), 15th National College Student Mathematics Competition, Chinese Mathematical Society   12/2023
5th Place, Men's 200m, 2023 Student-Faculty Athletics Meet, WHU Sports Committee   11/2023
2nd Prize (Ratio: Top 27%), 38th National High School Student Physics Competition, Chinese Physical Society   11/2021
3rd Prize (Ratio: Top 42%), 37th National High School Student Physics Competition, Chinese Physical Society   11/2020

TECHNICAL SKILLS

C, Python (SciPy, NumPy, Pandas, Matplotlib, HOOMD-blue), MATLAB, LabVIEW, Mathematica (xAct), YOLO, Linux, Latex