Tianrui Wu

Quantitative researcher, Physics student
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Education

University of Arizona **Jan. 2026 – Dec. 2026**
Major in Physics, minor in Mathematics | GPA N/A, Physics GPA N/A *Tucson, Arizona*

Duke University **Aug. 2021 – Dec. 2024**
Major in Physics, Mathematics, minor in CS | GPA 3.92, Physics GPA 4.0 *Durham, North Carolina*

Hangzhou Foreign Languages School **Sep. 2018 – Jun. 2021**
High School Diploma | Special-class scholarship (1%) *Hangzhou, China*

Research Experiences

Predicting Power Spectrum Window Function with Neural Network **June 2024 – August 2024**
Summer Research Fellow, Mentor: Dr. Olivier Doré *SPHEREx Team, Caltech*

- Generated lognormal mock catalogs with real SPHEREx survey masks. Developed convolutional neural network model using the ResUNet architecture to predict window function effects on galaxy power spectrum measurements.
- Achieved percentage error for power spectrum predictions, enhanced accuracy of local primordial non-Gaussianity $f_{\rm NL}^{\rm loc}$ parameter inference for SPHEREx, improving understanding of early inflation dynamics.
- Drafted and delivered the project proposal, two interim reports, a final presentation, and a final report to the faculty committee.

Weak Lensing Cosmology with Survey Synergies **May 2022 – December 2024**
Research Assistant, Mentor: Prof. Michael A. Troxel *Cosmology Group, Duke University*

- Developed a Python-based pipeline for joint analysis of Roman Space Telescope and Rubin Observatory simulations, constructing two-point correlation functions and applying MCMC inference to constrain cosmological parameters with photometric redshift improvements.
- Evaluated mode-based strategies and ground-space survey synergies of galaxy photometric redshift, found tighter constraints on cosmic homogeneity with 20% increase in Figure of Merit with new methods.

Calibration of Distance Ladders with Synthetic Stellar Populations **September 2023 – August 2024**
Research Assistant, Mentor: Prof. Daniel Scolnic *Cosmology Group, Duke University*

- Developed python pipeline to create synthetic catalogs and systematically extracted features from H-R diagrams. Integrated novel distance calibration methods into a unified pipeline for calibration and comparisons.
- Compared JWST distance measurements results from recent literature of different teams. Quantified galaxy–dust correlations using latest SDSS data with SQL queries and Python scripts.

Quantifying Wetland Carbon Emissions in Southeastern US **May 2023 – August 2023**
Team Lead, Mentor: Prof. Wenhong Li *Data-plus Program , Duke University*

- Employed climatology to an adaptive missing value imputation method to clean up data, programmed a layered Shiny web app as the final deliverable, wrote and optimized a random forest model through grid-search, helped teammates troubleshoot SVM and MLP Models. Host weekly meetings, delivered poster and presentation video.

Skills

Selected Coursework: Intro to Cosmology*, Stellar Astrophysics*, General Relativity§, Abstract Algebra§, Electrodynamics, Quantum Mechanics, Probabilities, Differential Geometry, Statistical Inference, Machine Learning*, Data Structures and Algorithms, Computer Architecture.
Languages: Python, Rust, Java, C/C++, SQL, MATLAB, LaTeX | *English, Mandarin.*
Tools and Skills: Git, Jupyter Suite, VS Code; astropy, NumPy, pandas, polars, Matplotlib, PyTorch, qlib | Data Analysis, MLOps, Data Engineering, Factor Research, Market Microstructure Modeling.

Publications

Riess, A.G., Scolnic, D., et al. (Wu, T. included), JWST Validates HST Distance Measurements: Selection of Supernova Subsample Explains Differences in JWST Estimates of Local H0, arxiv.org/abs/2408.11770. *ApJ published.*

*graduate level

Honors and Awards

Global Wildcat Scholarship, University of Arizona
Jocelyn Bell Burnell Outstanding Leadership Scholarship, Society of Physics Students
Membership, Sigma Pi Sigma, National Physics Honor Society
Department Nominee, Faculty Scholars 2024, Duke University
Dean's List with Distinction, Fall 2021, Spring 2023, Fall 2023, Fall 2024, Duke University
Top Student Presenter, American Physical Society March Meeting 2022
Physics and Astronomy 3rd Grand Award, 2021 Regeneron International Science and Engineering Fair
Top Gold Medalist, British Physics Olympiad 2021

Work Experiences

Quantitative Researcher, Remote | *Qrigin Co. Ltd.* **August 2025 – Current**

- **Execution Algorithms**: Designed algorithms based on alpha signals and microstructure (TWAP, VWAP, IS) for major CEXs (Okx, Coinbase, Binance), reducing slippage costs by $\sim$ 2bps.
- **Alpha Strategy**: Leveraged deep learning to predict short-term price dynamics. Achieved a post-fee Sharpe ratio ¿ 10 on Coinbase with stable operation for 2+ months.
- **Factor Mining**: Systematically integrated 200+ medium-to-high frequency factors (k-line, order book, derivatives), significantly improving win rates in live models.

Quantitative Researcher | *InsightCheck Capital Investment Co. Ltd.* **February 2025 – August 2025**

- Designed and deployed quantitative models for equity and cryptocurrency markets by researching market microstructure, order book dynamics, and high-frequency factors. Successfully implemented strategies in live trading, including a market-making model that achieved average net returns of $\sim$ 2 bps after fees.
- Engineered and optimized a high-performance order book reconstruction engine using market-by-order data, achieving $\sim$ 1 second processing for the full A-share universe with validated accuracy. Proficient in Python data analysis libraries (Pandas, NumPy, Polars) and learned Rust for performance-critical systems.

Teaching Assistant, SAGE Facilitator | *Math Department, Duke University* **August 2022 – April 2024**

- Assisted over 40 students weekly with Multivariable Calculus, Linear Algebra, and Advanced Probability during two 3-hour Math Help Room shifts. Prepared and led two 1-hour discussion sessions weekly for Multivariable Calculus as a SAGE Facilitator.
- Rated "Excellent" with a score of 30/30 by supervisor and peers in the annual TA review of 2023 and 2024.

Leadership

Stargazing Devils Astronomy Club **September 2021 – December 2024**
Founder, President *Duke University*

- Founded and leading **first Astronomy Club** at Duke. Organize weekly astronomy open house at Duke Teaching Observatory with 100+ audiences. Hosted three comet events, four meteor shower events, and three eclipse events. Served as NASA Partner Eclipse Ambassador. Secured funding and organized trips to 2023 and 2024 solar eclipses for 14 students. Organized solar eclipse watch party with 300+ participants.
- Hosted 20+ astrophotography events with the Skynet platform and telescopes; lead Observation Team for stargazing activities with a thriving astrophotography team. Led physics outreach efforts after pandemic, hosted demos and field-trips for 5 local schools.

Society of Physics Students **June 2022 – December 2024**
President 2024, Co-President 2023, Member 2022 *Duke University*

- Revived chapter from pandemic, organized four research panels, created and hosted six student-faculty seminars, hosted three tours of research labs. Launched MATLAB and LaTeXworkshops, grad school info panels, and Women's mentorship program. Organized 2023 SPS Zone 5 meeting with 100+ participants, won 2023 Outstanding Chapter Award.
- Volunteered 35+ hours in departmental physics outreach effort to 7 local schools and science fairs.

American Physical Society **June 2022 – May 2024**
APS Student Ambassador *Remote*

- Recruit APS members, organize physics study sessions, manuscript workshops, APS publication party. Hosted Physics Undergraduates Learning and Sharing Experiences (PULSE) Webinar Series as Technology Chair.
- Invited to 2023, 2024 APS Leadership Meetings, advocate on policy priorities for the physics community on US Congressional Visits Day.

Duke Vertices Science Journal **September 2021 – August 2024**
Peer Reviewer, Senior Editor *Duke University*

- Review 2 manuscripts per month on STEM topics; provide revision strategies for student researchers; implemented a synopsis system for general audience resulting a 210% increase in website visits; invited by editor-in-chief to join exec team.