Jui-Teng (Roy) Hsu

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Research Statement

My research interests are developing and the application of computational tools in the field of astrophysics, particularly those governing fundamental physical processes. My practical experience includes developing numerical simulation models and enhancing computational tools for sophisticated data analysis, specifically for use on high-performance computing (HPC) systems.

Education

University of Massachusetts Amherst, Amherst, Massachusetts — Sep. 2025 - Present
Doctor of Philosophy in Astronomy, in progress

Muhlenberg College, Allentown, Pennsylvania — May 2024
Bachelor of Science in Physics and Computer Science
GPA: 3.85/4.00 — Physics Major GPA: 4.00/4.00

Awards and Honors

Dr. Robert A. Boyer Prize in Physics — 2024

Presidential Scholarship ($30,000/year) — 2022-2024

Dean's List (All semesters) — 2022-2024

Supercomputing Awards

PI on "Probing Cluster Plasma Physics with Simulations of Jellyfish Tails"
NSF ACCESS. Proposal ID: PHY240275. Award: 400,000 ACCESS credits (equiv. $1400)
Start Date: 2024-10-09. End Date: 2026-04-09.

Research Experiences

Probing Cluster Plasma Physics with Simulations of Jellyfish Tails — Aug. 2025 - Present
University of Massachusetts Amherst - Initial Research Project
Advisor: Dr. Yuan Li

- Investigated the interaction between jellyfish galaxy tails and the intracluster medium through high-resolution simulations of Kelvin-Helmholtz Instability (KHI)
- Simulated key physical processes, including viscosity, conduction, magnetic fields, and radiative cooling, using the Athena++ code
- Implemented a series of 2D and 3D simulations to study the development of KHI in jellyfish tails

Zeeman Spectral Modeling Code Repository — June 2023 - August 2023
National Radio Astronomy Observatory Summer Research Assistantship
Advisor: Dr. Preshanth Jagannathan (NRAO)

- Assessed the efficacy of Zeeman spectral line modeling with frequentist and Bayesian approaches
- Created a Python package and implemented Markov Chain Monte Carlo (MCMC) sampling methods for automated, unsupervised Zeeman spectral modeling
- Optimized the software deployment on HPC clusters through parallelization
- Validated software reliability by outperforming published results in VLA Zeeman data tests

Atmospheric Muon Rates Code Repository & Detector Report — June 2022 - May 2023
Muhlenberg College Physics Capstone Project
Mentored by Dr. Brett Fadem (Muhlenberg)

- Developed, from scratch in C++, numerical simulation models of atmospheric cosmic ray muons, incorporating relevant physical processes (e.g., relativity, decay, and energy loss)
- Built a functioning muon telescope using scintillators and SiPMs to detect muons, integrating circuit design and signal processing techniques
- Utilized Arduino and Python (numpy, scipy, matplotlib) for data collection, analysis, and fitting observed muon rates to theoretical distributions (Poisson and $\cos^2\theta$ distributions)

Publications & Conference Presentations

"Zeeman Spectral Line Modeling"
243rd Meeting of the American Astronomical Society — January 2024
Published in *Research Notes of the AAS*, DOI: 10.3847/2515-5172/ad9c6c — December 2024

"Computational Simulation of Atmospheric Muon Rates"
Fall Meeting of the Division of Nuclear Physics, American Physical Society (APS) — October 2022

Skills

- Programming languages: Python, C/C++, Bash, Java
- OS & Software: Linux, LaTeX, Git/Github, Athena++, Mathematica

Relevant Coursework

Physics: Analytical Mechanics, Electromagnetism (Graduate), Quantum Mechanics, Thermal & Statistical Physics (Graduate)

Computer Science & Mathematics: C Programming, Data Structures & Algorithms, Computer Architecture, Operating Systems, Real Analysis

Teaching Experience

Teaching Assistant, University of North Texas — Sep. 2024 - Present

- Prepare and conduct lectures on introductory astronomy labs for undergraduate students enrolled in PHYS 1052 - The Solar System and PHYS 1062 - Stars and the Universe

Workshop Tutor, Muhlenberg College — Sep. 2022 - May. 2024

- Organize the general computer science workshops for students enrolled in CS courses ranging from introductory to advanced levels including CS 2, Data Structures & Algorithms, and AI.

References

- Dr. Yuan Li — Email: yuanli@umass.edu
  Assistant Professor, Department of Astronomy, University of Massachusetts Amherst
- Dr. Preshanth Jagannathan — Email: pjaganna@nrao.edu
  Associate Scientist, National Radio Astronomy Observatory
- Dr. Brett Fadem — Email: brettfadem@muhlenberg.edu
  Professor, Department of Physics, Muhlenberg College
- Dr. Jorge Silveyra — Email: silveyrj@lafayette.edu
  Assistant Professor, Department of Computer Science, Lafayette College