Bayu Wilson

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EDUCATION

Ph.D in Physics, University of California, Riverside (UCR) September 2024
Dissertation title: "*Modeling Lyman-alpha Emissions by Ionization-Fronts for the Direct. Imaging of Reionization*"
Committee: Anson D'Aloisio (chair), George Becker, and Simeon Bird

M.S. in Physics, University of California, Riverside (UCR) March 2021

B.S. Astronomy & Physics, University of Washington, Seattle (UW) June 2019
Minor: Mathematics

RESEARCH EXPERIENCE

Artificial Intelligence Assisted Cosmological Simulations, UCR February 2024 - September 2024

- Led a deep learning (DL) based project to super-resolve 3-dimensional cosmological simulations by a factor of 8
- Constructed and curated training datasets tailored to address astrophysics research questions connecting 6 orders of magnitude in spatial scale coupled with time evolution over a billion years of cosmic history
- Trained a generative-adversarial DL model on GPU nodes of the Frontera supercomputer

Modeling Emissions from Ionization Fronts (I-fronts), UCR September 2023 - September 2024

- Reduced dimensionality of I-front emissions to only 3 parameters that are easy to extract from simulations
- Produced a publicly available, rigorously tested model that can reduce the computational cost of modeling I-front emissions by 4 orders of magnitude
- Applied model to cosmological radiative transfer simulations which enabled the first theoretical study of I-front emission during the end of reionization; a pivotal moment in cosmic history that has never been directly detected
- Created mock images of cosmological I-front emission as well as image processing methodologies which indicate that detecting I-fronts during reionization is likely possible given favorable conditions

Fourier Statistics to Probe Intergalactic Gas , UW August 2018 - June 2021

- Developed pipeline from scratch using Python to process spectral quasar data from the Very Large Telescope in Chile for the study of thermal properties of intergalactic gas
- Utilized cross-correlations in fourier statistics to break parameter degeneracies in thermal models and check the effect of uncorrelated noise and systematics that contaminate previous parameter predictions
- Performed Bayesian analysis to sample the model parameter space and found that the constraints on the relevant parameter was tightened by a factor of ~2

Processing Galaxy Images of the Early Universe, Leiden University, NL June 2017 - August 2017

- Programmed an image reduction pipeline in Python for observations with Canada-France-Hawaii Telescope's MegaCam instrument

Statistical Analysis of Quasar Spectra, UW September 2015 - May 2017

- Forward-modeled quasar continuum using principal component analysis (PCA)
- Calculated transformation matrix to statistically remove the effects of spectral contaminants

PERSONAL PROJECTS

Medical image data augmentation using generative AI — September 2024
Bayesian marketing analysis using MCMC — August 2024
Quasar spectral reconstruction with PCA — July 2024
Tracking dancer spins with pre-trained pose detection model — June 2024

TECHNICAL SKILLS

Languages: Python, C/C++, Bash, SQL
Libraries & API's: TensorFlow, pytorch, keras, pandas, NumPy, matplotlib, Scikit-Learn
Statistics: fourier analysis, dimensionality reduction, regression modeling, Bayesian inference, principal component analysis
Tools & Version Control: Git, Github, Jupyter, Google Colab

PUBLICATIONS & PRESENTATIONS

B. Wilson, A. D'Aloisio, G. D. Becker, C. Cain, & E. Visbal (2024). Imaging reionization's last phases with I-front Lyman-α emissions. *arXiv preprint arXiv:2406.14625*. https://arxiv.org/abs/2406.14625

B. Wilson, A. D'Aloisio, C. Cain, E. Visbal, & G. D. Becker (2024). Quantifying Lyman-α emissions from reionization fronts. *arXiv preprint arXiv:2406.14622*. https://arxiv.org/abs/2406.14622v1

J. T. Roth, A. D'Aloisio, C. Cain, **B. Wilson**, Y. Zhu, & G.D. Becker (2024). The effect of reionization on direct measurements of the mean free path. *Monthly Notices of the Royal Astronomical Society, 530(4), 5209-5219.* https://academic.oup.com/mnras/article/530/4/5209/7667927

B. Wilson, V. Iršič, & M. McQuinn (2022). A measurement of the Lyman-β forest power spectrum and its cross with the Lyman-α forest in X-Shooter XQ-100. *Monthly Notices of the Royal Astronomical Society, 509(2), 2423-2442.* https://academic.oup.com/mnras/article/509/2/2423/6406512

B. Wilson, V. Iršič, & M. McQuinn (2019). The Lyman-beta Forest Power Spectrum from the XQ-100 Legacy Survey. Poster presented at: American Astronomical Society (AAS) Meeting #233, January 6–10, 2019 at the Washington State Convention Center

TEACHING & OUTREACH

Salsa Dance Instructor, UCR — January 2022 - September 2024

- Provided salsa dance instruction with a focus on consent, expression, and cultural context for over 300 community members (cumulatively)

Virtual Astronomy Outreach, UCR — January 2021 - June 2021

- Collaborated with local organizations to provide virtual science activities for elementary school-aged youth to introduce them to astronomy and other sciences
- Designed an interactive "create-a-constellation" virtual activity to explore geographical, cultural, and personal perspectives of the night sky

Teaching Assistant, UCR March 2020 - September 2024

- Instructed various *Introductory Physics* labs and discussion sections to undergraduate students
- Created pedagogical worksheets tailored to the needs of the class

Founder/Mobile Planetarium Committee, UW September 2018 - June 2019

- Established this committee to increase diversity in astronomy via engaging planetarium presentations for middle school students in the Seattle Public School District
- Recruited fellow students at UW to join the committee in order to perform community outreach

CLUE Physics Tutor, UW September 2016 - June 2019

- Tutored hundreds of undergraduate students on a drop-in basis
- Reflected on implicit biases to promote equity and inclusion in the learning space
- Led review sessions in preparation for exams

CERTIFICATIONS

DeepLearning.AI on Coursera July 2024
IBM Data Science by IBM on Coursera August 2021

AWARDS

Gluck Fellowship for the Arts October 2022 - September 2024
Chancellor's Distinguished Fellowship September 2019
Behr Outreach Award March 2017
Mary Gates Research Scholarship January 2017
Annual Dean's List 2016-2019