

ELIJAH MATHEWS

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EDUCATION

The Pennsylvania State University

Ph.D. in Astronomy & Astrophysics

Advisor: Dr. Joel Leja

Summer 2025 (*expected*)

University Park, PA

The Pennsylvania State University

M.S. in Astronomy & Astrophysics

Advisor: Dr. Joel Leja

Overall GPA: 3.230/4.0

December 2020

University Park, PA

University of North Dakota

B.S. in Physics & Mathematics (double major)

Summa cum laude

Advisors: Dr. Wayne Barkhouse, Dr. Timothy Young

Overall GPA: 3.977/4.0

Majors GPA: 4.000/4.0

May 2018

Grand Forks, ND

EXPERIENCE

Department of Astronomy & Astrophysics, The Pennsylvania State University

Graduate Research Assistant

January 2021 - present

University Park, PA

- Developing a resolved-SED fitting algorithm using the No-U-Turn and Microcanonical Langevin Monte Carlo samplers, which allows entire 2D galaxy images in multiple filters to be fit quickly on a GPU, while also taking into account inherent degeneracies due to smearing from the instrumental point spread function
- Emulating stellar population synthesis (SPS) using machine learning techniques in Julia and Python, greatly reducing the computational cost of predicting high-precision stellar population spectral energy distributions
- Incorporating aforementioned SPS emulator into Prospector, a modern and complex Bayesian stellar population inference code, allowing for the code's use on much larger datasets without the need for vast computing resources
- Contributing to the Pirate resolved-SED fitting research collaboration by contributing code, attending teleconferences, and presenting updates on my progress
- Mentoring a graduate student working on similar research through weekly meetings to discuss progress, resolve issues, and outline next steps
- Presenting progress updates and discussing recent scientific literature at weekly meetings

Department of Astronomy & Astrophysics, The Pennsylvania State University

Graduate Teaching Assistant

August 2018 - December 2020

University Park, PA

- Gave twice-weekly planetarium and telescope demonstrations for non-major students enrolled in introductory courses
- Assisted astronomy major students using the rooftop observatories
- Taught lab sections for the observational astronomy course (e.g. Fourier optics, CCD photography, spectroscopy, photometry)
- Provided several fill-in lectures for the non-major introductory cosmology course, on topics ranging from dark matter to string theory
- Participated in public outreach events, including the department's annual AstroFest and open houses, by operating telescopes, showing members of the public the Moon, planets, and deep-sky objects, and describing some of the scientific knowledge of the objects being shown

- Graded assignments for various courses, both major and non-major
- Held weekly office hours for non-major students taking introductory courses

Department of Physics & Astrophysics, University of North Dakota
Undergraduate Research Assistant

May 2017 - May 2018
 Grand Forks, ND

- Contributed to research on galaxies in the red-sequence, using data from WISE, 2MASS, Spitzer, and Herschel
- Assisted in an observing run with the Blanco 4m telescope at Cerro Tololo Inter-American Observatory, Chile
- Assisted in an observing run with the WIYN 0.9m telescope at Kitt Peak National Observatory

Department of Physics & Astrophysics, University of North Dakota
Undergraduate Research Assistant

May 2016 - May 2017
 Grand Forks, ND

- Worked to improve the UND Physics & Astrophysics Marten-Kraus telescope located near Inkster, ND
- Improved the telescope's pointing model, giving the telescope persistent pointing accuracy of ~ 8 arcsec
- Configured the telescope's autoguider, permitting long exposures with integration times greater than 20 minutes
- Established a detailed set of procedures for the telescope to improve the reliability of telescope operations
- Helped prepare the observatory for future autonomous observation campaigns
- Performed astrometry on various asteroids, comets, and supernovae

LEADERSHIP

Northern Sky Astronomical Society
President

August 2015 - August 2018
 Grand Forks, ND

- Led the largest and most active amateur astronomy organization in North Dakota
- Hosted numerous public "star parties" around the Greater Grand Forks area
- Gave public educational talks on astronomical science and events
- Started and maintained a club newsletter and aurora borealis notification list
- Organized a club trip to Oregon for the 2017 total solar eclipse
- Worked with media to promote upcoming eclipses and other events
- Purchased and sought funding for various astronomical equipment (e.g. telescopes, filters, cameras)
- Managed club social media account, advertising club events and astronomical phenomena

Northern Sky Astronomical Society
Vice President

August 2014 - August 2015
 Grand Forks, ND

- Attended monthly meetings and helped lead discussion on recent events in astronomy
- Participated in public events and showed members of the public various objects in the night sky

ACADEMIC HONORS

Jay & Marie Bjerkaas Physics Scholarship

Spring 2017, Spring 2016

ND Space Grant Consortium Undergraduate Fellowship

Spring 2017

ND EPSCoR Advanced Undergraduate Research Award

Spring 2016

Daniel P. Michelsen Memorial Scholarship

Fall 2015

UND Presidential Scholarship

Spring 2014

UND President's Honor Roll

All Semesters Eligible

UND Dean's List

All Semesters

TECHNICAL STRENGTHS

Computer Languages	Julia, Python, Bash, Wolfram (Mathematica), R, C
Software Packages	Flux.jl, AdvancedHMC.jl, JAX, BlackJAX, PyMC, scikit-learn, Plots.jl, Matplotlib
Theoretical Skills	Astrophysics, High-Performance Computing, Cosmology, Optics, Image Processing
Tools	Linux (RHEL), Vim, Slurm, L ^A T _E X

PRESENTATIONS

Poster Presentation, 245th AAS Meeting, National Harbor, MD <i>Introducing Pirate: Using Neural Nets and the No-U-Turn Sampler to Sail SED-Fitting into the Spatially-Resolved Seas</i>	January 2025
Poster Presentation, Space Telescope Science Institute Workshop, Virtual <i>Building a More Efficient and Capable SED-Fitting Suite in the Age of JWST</i>	March 2022
Lunch Talk, The Pennsylvania State University, University Park, PA <i>Emulating Stellar Population Synthesis with Neural Networks</i>	December 2020
Astronomy Public Talk, University of North Dakota, Grand Forks, ND <i>From Sea to Shining Sea: The Great American Eclipse</i>	September 2017
Poster Presentation, 2017 ND EPSCoR Conference, Fargo, ND <i>Marten Observatory: UND's Newest and Largest Telescope</i>	April 2017
Astronomy Public Talk, University of North Dakota, Grand Forks, ND <i>Amateur Astronomy: Science for Everyone</i>	March 2017

PUBLICATIONS

As of January 2025, I am an author on **7 papers** that have a total of **352 citations** (*h*-index 5, *i*-10 index 4).

First Author:

- **Mathews, E. P.**; Leja, J.; Speagle, J. S.; Johnson, B. D.; Gibson, J.; Nelson, E. J.; Suess, K. A.; Tacchella, S.; Whitaker, K. E.; Wang, B., “As Simple as Possible but No Simpler: Optimizing the Performance of Neural Net Emulators for Galaxy SED Fitting,” 2023, *The Astrophysical Journal*, Vol. 954, Iss. 2, id. 132. [doi:10.3847/1538-4357/ace720](https://doi.org/10.3847/1538-4357/ace720) (9 citations)

Contributing Author:

- Park, M.; Belli, S.; Conroy, C.; Johnson, B. D.; Davies, R. L.; Leja, J.; Tacchella, S.; Mendel, J. T.; Benton, C.; Bugiani, L.; Emami, R.; Khoram, A. H.; Li, Y.; Maheson, G.; **Mathews, E. P.**; Naidu, R. P.; Nelson, E. J.; Terrazas, B. A.; Weinberger, R., “Widespread Rapid Quenching at Cosmic Noon Revealed by JWST Deep Spectroscopy,” 2024, *The Astrophysical Journal*, Vol. 976, Iss. 1, id. 72. [doi:10.3847/1538-4357/ad7e15](https://doi.org/10.3847/1538-4357/ad7e15) (2 citations)
- Bugiani, L.; Belli, S.; Park, M.; Davies, R. L.; Mendel, J. T.; Johnson, B. D.; Khoram, A. H.; Benton, C.; Cimatti, A.; Conroy, C.; Emami, R.; Leja, J.; Li, Y.; Maheson, G.; **Mathews, E. P.**; Naidu, R. P.; Nelson, E. J.; Tacchella, S.; Terrazas, B. A.; Weinberger, R., “AGN Feedback in Quiescent Galaxies at Cosmic Noon Traced by Ionized Gas Emission,” 2024, submitted to *The Astrophysical Journal*. [arXiv:2406.08547](https://arxiv.org/abs/2406.08547)
- Belli, S.; Park, M.; Davies, R. L.; Mendel, J. T.; Johnson, B. D.; Conroy, C.; Benton, C.; Bugiani, L.; Emami, R.; Leja, J.; Li, Y.; Maheson, G.; **Mathews, E. P.**; Naidu, R. P.; Tacchella, S.; Terrazas, B. A.; Weinberger, R., “Star formation shut down by multiphase gas outflow in a galaxy at a redshift of 2.45,” 2024, *Nature*, Vol. 630, id. 54-58. [doi:10.1038/s41586-024-07412-1](https://doi.org/10.1038/s41586-024-07412-1) (13 citations, 107 Altmetric)

- Davies, R. L.; Belli, S.; Park, M.; Mendel, J. T.; Johnson, B. D.; Conroy, C.; Benton, C.; Bugiani, L.; Emami, R.; Leja, J.; Li, Y.; Maheson, G.; **Mathews, E. P.**; Naidu, R. P.; Nelson, E. J.; Tacchella, S.; Terrazas, B. A.; Weinberger, R., “*JWST* reveals widespread AGN-driven neutral gas outflows in massive $z \sim 2$ galaxies,” 2024, *Monthly Notices of the Royal Astronomical Society*, Vol. 528, Iss. 3, id. 4976-4992. doi:10.1093/mnras/stae327 (23 citations, 42 Altmetric)
- Nelson, E. J.; Suess, K. A.; Bezanson, R.; Price, S. H.; van Dokkum, P.; Leja, J.; Wang, B.; Whitaker, K. E.; Labbé, I.; Barrufet, L.; Brammer, G.; Eisenstein, D. J.; Gibson, J.; Hartley, A. I.; Johnson, B. D.; Heintz, K. E.; **Mathews, E.**; Miller, T. B.; Oesch, P. A.; Sandles, L.; Setton, D. J.; Speagle, J. S.; Tacchella, S.; Tadaki, K.-I.; Übler, H.; Weaver, J. R., “JWST Reveals a Population of Ultrared, Flattened Galaxies at $2 \lesssim z \lesssim 6$ Previously Missed by HST,” 2023, *The Astrophysical Journal Letters*, Vol. 948, Iss. 2, id. L18. doi:10.3847/2041-8213/acc1e1 (61 citations)
- Labbé, I.; van Dokkum, P.; Nelson, E.; Bezanson, R.; Suess, K. A.; Leja, J.; Brammer, G.; Whitaker, K.; **Mathews, E.**; Stefanon, M.; Wang, B., “A population of red candidate massive galaxies ~ 600 Myr after the Big Bang,” 2023, *Nature*, Vol. 616, id. 266-269. doi:10.1038/s41586-023-05786-2 (244 citations, 4538 Altmetric)