Joel Leja

Assistant Professor, Astronomy and Astrophysics
Penn State University
515 Davey Laboratory
251 Pollock Road
University Park, PA, 16802

1-530-410-3077
joel.leja@psu.edu
https://jrleja.github.io/

RESEARCH INTERESTS

galaxy formation and evolution, stellar populations, statistics and machine learning

EDUCATION

Yale University — New Haven, CT
- Ph.D in Astronomy — 2016
  - Thesis: *Tracing Galaxies Through Cosmic Time*
  - Advisor: Prof. Pieter van Dokkum
- MS in Astronomy — 2012

University of California, Berkeley
- BA in Physics and Astrophysics (honors) — 2010

PROFESSIONAL POSITIONS

Lee M. Hammarstrom - Dr. Keiko Miwa Ross Early Career Professor — 2024–present
Penn State

Assistant Professor of Astronomy & Astrophysics — 2020–present
Penn State; co-hired through the Institute for Computational & Data Sciences

NSF Astronomy & Astrophysics Postdoctoral Fellow — 2017–2020
CfA | Harvard & Smithsonian

Postdoctoral Fellow — 2016-2017
CfA | Harvard & Smithsonian
Mentor: Professor Charlie Conroy

Graduate Student Researcher — 2010-2016
Yale University
Advisor: Professor Pieter van Dokkum

FUNDED GRANTS

Summary: $1.6M total, $568k as PI. Click grant name for official URL & CoI list.

HST GO Cycle 32 (72 orbits/budget not yet submitted) (**CoPI**) — 2026–2029
Fulfilling the UV Legacy of the Hubble and Webb Deep Public Frontier Field

JWST GO Cycle 3 ($47k budget under review) (**CoI**) — 2025–2028
Clumpy Relics: The First Spectroscopic Confirmation of Globular Clusters at z 3

JWST GO Cycle 3 ($174k budget under review) (**CoI/Admin PI**) — 2025–2028
A Census of Optical Diagnostics of Ionizing Sources Across Cosmic Time

JWST GO Cycle 2 ($102k) (**CoI**) — 2024–2027
Medium Bands, Mega Science: Resolved Photometry of Abell 2744

JWST GO Cycle 2 ($279k) (**CoI**) — 2023–2026
RUBIES: A complete census of the rare, extreme and red

Penn State Institute for Computational & Data Sciences Seed Grant ($29k) (**PI**) — 2022–2023

A Computational Moonshot for Modern Galaxy Surveys

JWST GO Cycle 1 ($221k) (**CoI**) 2022–2025

UNCOVER: Ultra-deep NIRCam and NIRSpec Observations Before the Epoch of Reionization

JWST GO Cycle 1 ($95k) (**CoI**) 2022–2025

The Stellar and Gas Content of Galaxies at Cosmic Noon

JWST Archival ($239k) (**PI**) 2022–2025

Preventing the Slit-Loss Catastrophe Using Flexible, Spatially Resolved Galaxy Models

HST Archival ($133k) (**CoI**) 2020–2023

Pirate: Walking the Plank to Spatially Resolved Stellar Populations in CANDELS

NSF Astronomy & Astrophysics Fellowship ($300k) (**PI**) 2017–2020

Bringing Galaxy Evolution into Focus by Pushing SED Models to the Limit

HONORS AND AWARDS

Lee M. Hammarstrom - Dr. Keiko Miwa Ross Endowed Chair 2024

Inaugural holder, $2M endowment.

Clarivate Highly Cited Researcher 2023 2023

top 1% of cited papers in astrophysics over past 10 years, 1 out of 36 awarded in US

Brouwer Prize, Yale University 2019

awarded to a student for a contribution of unusual merit to astronomy during their PhD thesis.

Physics & Astrophysics Commencement Speaker, UC Berkeley 2010

Departmental Citation in Astrophysics, UC Berkeley 2010

outstanding scholarship by a graduating senior in Astrophysics

Regents and Chancellors Scholar, UC Berkeley 2006

most prestigious UC Berkeley scholarship awarded to undergraduates

Robert C. Byrd Scholar 2006

federally funded merit-based scholarship for exceptional high-school seniors

MENTORING & OUTREACH

Lecture to Chester County Astronomical Society (upcoming) Dec 2024

Ashketar Frontiers of Science Public Lecture, $\sim$ 200 participants, PSU Feb 2024

'Stars & Scientists' Outreach Talk, $\sim$ 120 participants, PSU Oct 2023

NASA / Webb Community Subject Matter Expert 2021–

Presentations and Q&A sessions at STEM community events in central PA about JWST.

Coordinator of the Flipped Science Fair 2018–2020

Coordinated, directed, and planned events wherein professional astronomers present their research to panels of middle school judges, reaching ∼150 students per session

Guest Scientist at URJ 6 Points Sci-Tech Academy 2017

Shared my research with middle-schoolers through presentations and in-classroom, interactive Q&A sessions

I have served as the research advisor for the following grads & postdocs:

Nikko Cleri, Penn State postdoctoral researcher 2024–

Emilie Burnham Faith, Penn State graduate student 2023–

Kanishk Pandey, Penn State graduate student 2023–

Bingjie Wang, Penn State postdoctoral researcher 2022–

Gautam Nagaraj, Penn State graduate student 2021–2023

Will Bowman, Penn State graduate student (now postdoc at Yale) 2021–2022

Elijah Mathews, Penn State graduate student 2020–

Yijia Li, Penn State graduate student 2020–
Imad Pasha, Yale University graduate student 2019–2020
Jonathan Cohn, graduate student at Texas A&M 2017–2018

and the following undergraduate students:

Nathan Cristello, Penn State undergraduate 2023–
Junyu Zhang, Penn State undergraduate, published in ApJ 2021–
Liam Schwartz, Penn State undergraduate 2021
Leah Zuckerman, Brown undergraduate, published in ApJ 2020–2021
Yuxin Dong, Brown undergraduate, published in ApJ 2019–2021
Evan Haze Nunez, Smithsonian Astrophysical Observatory REU, poster at the AAS 2018
Michael Bueno, Banneker Institute undergraduate research, poster at the AAS 2017
Christopher Bradshaw, Yale undergraduate thesis 2014–2015

HIGH PERFORMANCE COMPUTING EXPERIENCE

Extensive experience in high-performance computing ($>$ 20 million CPU hours) in a variety of cluster environments: The Roar Supercomputer (PSU), the Odyssey Cluster (CfA), and LSU/SuperMIC + TACC Stampede (XSEDE).

Harvard Supercomputing Grant (1.5M CPU Hours) (**PI**) 2017
Observational Galaxy Evolution with Odyssey

OBSERVING EXPERIENCE

Palomar/TripleSpec (5m): 6 nights 2018
Keck/MOSFIRE (10m): 5 nights 2013
WIYN/HYDRA (4m): 2 nights 2011
Nickel/Photometry (1m): $\sim$20 nights 2009–2010

SELECTED SCIENCE TALKS

Astrophysics Colloquium – University of Illinois at Urbana-Champaign (invited, upcoming) 2025
HEP-Astro Seminar – University of Michigan (invited, upcoming) 2025
Physics Colloquium – UT Knoxville (invited, upcoming) 2025
Astrophysics Seminar – Northwestern/CIERA (invited, upcoming) 2024
Lurking Lions: Hidden Challenges to Solving Galaxy Formation – South Africa (contributed) 2024
IAUS#391 The First Chapters of Our Cosmic History with JWST– South Africa (invited review) 2024
American Physical Society, Future of JWST – Sacramento (invited review) 2024
New Evolution of MultiMessenger Astrophysics, Galaxies Panel – Penn State (invited) 2023
Astronomers Speak Statistics, Joint Statistical Meeting – Toronto (invited) 2023
Galaxy Transformation Across Time & Space – Australian National University (invited review) 2023
Astronomy Colloquium – UC Davis 2023
Astronomy Colloquium – University of Washington 2023
Astronomy & Astrophysics Colloquium – UC Berkeley 2023
Astronomy Colloquium – Yale University 2023
Astronomy Colloquium – Penn State University 2022
Review talk on Galaxy Star Formation Histories – JWST Pan-SED fitting forum (invited) 2022
The LEGA-C Spectroscopic Galaxy Survey Meeting – University of Ghent 2022
Astronomy Colloquium – University of Pittsburgh 2022
Astronomy Colloquium – Tufts University 2022
Astronomy Colloquium – UMass Amherst 2022

Galread – Princeton University 2021
Astrophysics Seminar — Purdue University 2019
ITC Luncheon — Harvard-Smithsonian CfA 2019
GOGREEN Spectral Survey Workshop — York University (invited) 2019
Uncovering galaxy evolution in the ALMA and JWST era – IAU Symposium 352 (contributed) 2019
Lunch Talk — Leiden University 2019
LEGA-C Spectral Survey Workshop — Ghent University (invited) 2019
Challenges in Panchromatic Galaxy Modeling – IAU Symposium 314 (contributed) 2018
The Art of Measuring Physical Parameters in Galaxies – CANDELS Collaboration (invited) 2018
NSF AAPF Symposium — 231st AAS Meeting 2018
Astronomy Seminar — University of Connecticut 2017
Plumbing Star Formation Rates in the Age of JWST — Texas A&M (invited) 2017
Advances in Galaxy Evolution — Ringberg Castle (invited) 2017
Astronomy Seminar — Tufts University 2017
Lunch Talk — Carnegie Observatories 2016
Astronomy Tea Talk — Caltech 2016
Astrophysics Brown Bag Lunch — MIT Kavli Institute 2016
Galaxies and Cosmology seminar — Harvard-Smithsonian CfA 2016
Linking Observations & Theory with New-Generation Spectral Models — IAP Paris (contributed) 2016
3D-HST Physics, Evolution, Census Conference — Yale (invited) 2015
A Fitting Conference — Harvard (invited) 2015

TEACHING EXPERIENCE

Assistant Professor, Penn State University 2020–
ASTR 120: The Big Bang Universe
ASTR 502: Radiative Processes in Astrophysics
ASTR 504: Extragalactic Astronomy
ASTR 589: Seminar in Current Astronomical Research
Astroinformatics Summer School: Bayesian Hierarchical Modeling

Teaching Fellow, Yale University 2010–2016
ASTR 110: Planets and Stars
ASTR 160: Frontiers and Controversies in Astrophysics
ASTR 210: Stars and Their Evolution

Residential College Mathematics & Science Tutor, Yale University 2011
Drop-in physics tutoring for Yale undergraduates (∼5 hours / week)

Graduate Student Instructor, UC Berkeley 2010
ASTRO W12: The Planets

Physics Tutor and Student Lecturer (UC Berkeley) 2008–2010
Weekly lectures on topics in introductory physics, drop-in tutoring (∼6 hours/week)
Course coordinator; trained other physics tutors

PROFESSIONAL EXPERIENCE

Referee for *The Astrophysical Journal, The Astrophysical Journal Letters, Monthly Notices of the Royal Astronomical Society, Monthly Notices of the Royal Astronomical Society Letters, Astronomy & Astrophysics, Astronomy & Computing*

Committees: Graduate Program Committee (2x), Qualifying Exam Committee (5x), Admissions Committee (1x), Eberly Prize Postdoctoral Committee (1x member, 1x chair), Institute for Computational & Data Sciences Coordinating Committee (1x), IGC fellowship selection

committee (1x), Recruitment Committee (1x), Faculty Hiring Committee (1x)

Reviewer for NSF Astronomy & Astrophysics	2024
JWST Cycle 3 Expert Reviewer	2023
Reviewer for NASA Astrophysical Data Analysis grants	2023
HST Large/Treasury TAC	2023
PSU Center for Astrostatistics Lunch Talk Organizer	2023
STFC Astronomy Grants Panel reviewer (UK)	2022
PFS Survey: Working Group Lead, Low-Redshift Continuum Galaxy Evolution Science	2022–
Science Organizing Committee for 'Statistical Challenges in Modern Astronomy VIII	2021–2023
Member of the Institute for Gravitation & the Cosmos at PSU	2020–
Reviewer for Polish National Science Centre	2020
FINESST (Future Investigators in NASA Earth and Space Science and Technology) reviewer	2019-2020
Referee for HST Mid-Cycle Proposals	2018–2019
Webmaster for the NSF AAPF	2018–2020
Galaxy Lunch Board at Yale	2015–2016
Panel Member for Yale Telescope Time Allocation Committee	2014

PRESS

PSU/ApJ Release, "Tiny bright objects discovered at dawn of universe baffle scientists"	2024
PSU/Nature Release, "'Cosmic lighthouses' that cleared primordial fog identified with JWST"	2024
PSU/ApJL Release, "JWST discovery of the second- and fourth-most distant galaxies"	2023
Featured in NHK's 'Cosmic Front' July 2023 Documentary on JWST	2023
ICDS Feature Story, "Machine learning takes starring role in exploring the universe"	2023
NASA/Nature/PSU Release, "Massive early galaxies defy prior understanding of the universe"	2023
NPR, the Guardian, the Atlantic, CNN, BBC Radio, New Zealand Radio, multiple TV interviews	
NASA/STScI/PSU Release, "JWST uncovers new details in Pandora's Cluster"	2023
NASA/STScI/PSU Release, "Bright light from early universe 'opens new chapter in astronomy"	2022
Keck/Northwestern/PSU Press Release, "Tracing the origins of rare, cosmic explosions"	2022
STScI/ALMA/PSU Press Release, "Early, massive galaxies running on empty"	2021
Yale GSAS Profile, "Tracing the History of the Universe"	2014
STScI Press Release, "Hubble Reveals First Scrapbook Pictures of Milky Way's Formative Years"	2013
Yale Press Release, "Watching the Milky Way Grow Up"	2013

PUBLICATIONS

I am an author of 148 publications in total including 17 still undergoing review and 1 recently accepted, of which 10 are first author works and another 32 are second/third author. As of Jul 2024, these works have 11,838 citations with an h-index of 54, including 1,375 citations to first author works.

A complete of authored papers is available HERE; the subset of published papers is HERE, and the subset of submitted/accepted papers is HERE. Below I highlight first-, second-, and third-author works; my name is **bolded** and authors under my direct supervision are <u>underlined</u>.

First Author

1. *A New Census of the* $0.2 < z < 3.0$ *Universe, Part II: The Star-Forming Sequence*
   Leja, Joel et al., 2022, ApJ, 936, 165L

2. *A New Census of the* $0.2 < z < 3.0$ *Universe, Part I: The Stellar Mass Function*
   Leja, Joel et al., 2020, ApJ, 893, 111L

3. *Beyond UVJ: More Efficient Selection of Quiescent Galaxies with Ultraviolet/Mid-infrared Fluxes*
Leja, Joel et al., 2019, ApJ, 880L, 9L

4. *An Older, More Quiescent Universe from Panchromatic SED Fitting of the 3D-HST Survey*
Leja, Joel et al., 2019, ApJ, 877, 140L

5. *How to measure galaxy star formation histories II: Nonparametric models*
Leja, Joel et al., 2019, ApJ, 876, 3L

6. *Hot dust in Panchromatic SED Fitting: Identification of AGN and improved galaxy properties*
Leja, Joel et al., 2018, ApJ, 854, 62L

7. *Deriving Physical Properties from Broadband Photometry with Prospector: Description of the Model and a Demonstration of its Accuracy Using 129 Galaxies in the Local Universe*
Leja, Joel et al., 2017, ApJ, 837, 170L

8. *Reconciling the Observed Star-forming Sequence with the Observed Stellar Mass Function*
Leja, Joel et al., 2015, ApJL, 798, 115L

9. *Exploring the Chemical Link between Local Ellipticals and Their High-redshift Progenitors*
Leja, Joel et al., 2013, ApJL, 778L, 24L

10. *Tracing Galaxies Through Cosmic Time with Number Density Selection*
Leja, Joel et al., 2013, ApJ, 766, 33L

Second/Third Author

11. *Cue: A Fast and Flexible Photoionization Emulator for Modeling Nebular Emission Powered By Almost Any Ionizing Source*
Li, Yijia; **Leja, Joel** et al., 2024, ApJ submitted, arXiv:2405.04598

12. *RUBIES: Evolved Stellar Populations with Extended Formation Histories at $z \sim 7-8$ in Candidate Massive Galaxies Identified with JWST/NIRSpec*
Wang, Bingjie; **Leja, Joel** et al., 2024, ApJL, 969L, 13W

13. *No top-heavy stellar initial mass function needed: the ionizing radiation of GS9422 can be powered by a mixture of AGN and stars*
Li, Yijia; **Leja, Joel** et al., 2024,ApJL, 969L, 5L

14. *Quantifying the Effects of Known Unknowns on Inferred High-redshift Galaxy Properties: Burstiness, the IMF, and Nebular Physics*
Wang, Bingjie; **Leja, Joel** et al., 2024, ApJ, 963, 74W

15. *The UNCOVER Survey: A First-look HST+JWST Catalog of Galaxy Redshifts and Stellar Population Properties Spanning $0.2 \leq z \leq 15$*
Wang, Bingjie; **Leja, Joel** et al., 2024, ApJS, 270, 12W

16. *SBI++: Flexible, Ultra-fast Likelihood-free Inference Customized for Astronomical Applications*
Wang, Bingjie; **Leja, Joel** et al., 2023, ApJ, 952L, 10W

17. *As Simple as Possible but No Simpler: Optimizing the Performance of Neural Net Emulators for Galaxy SED Fitting*
Mathews, Elijah; **Leja, Joel** et al., 2023, ApJ, 954, 132M

18. *Inferring More from Less: Prospector as a Photometric Redshift Engine in the Era of JWST*
Wang, Bingjie; **Leja, Joel** et al., 2023, ApJ, 944L, 58W

19. *REQUIEM-2D: A diversity of formation pathways in a sample of spatially-resolved massive quiescent galaxies at $z\sim2$*
Akhshik, Mohammad; Whitaker, Katherine E.; **Leja, Joel** et al., 2023, ApJ, 943, 179A

20. *Beyond UVJ: Color Selection of Galaxies in the JWST Era*
Antwi-Danso, Jacqueline; Papovich, Casey; **Leja, Joel**, 2023ApJ, 943, 166A

21. *A simple spectroscopic technique to identify rejuvenating galaxies*
Zhang, Junyu; Li, Yijia; **Leja, Joel** et al., 2022, accepted to ApJ, in press

22. *Monte Carlo Techniques for Addressing Large Errors and Missing Data in Simulation-based Inference*
Wang, Bingjie; **Leja, Joel** et al., 2022, NeurIPS, arXiv:2211.03747

23. *Flexible Models for Galaxy Star Formation Histories Both Shift and Scramble the Optical Color-M/L Relationship*
Li, Yijia; **Leja, Joel**, 2022, ApJ, 940, 88L

24. *A Bayesian Population Model for the Observed Dust Attenuation in Galaxies*
Nagaraj, Gautam; Forbes, John C.; **Leja, Joel** et al., 2022, ApJ, 932, 54N

25. *How Well Can We Measure Galaxy Dust Attenuation Curves? The Impact of the Assumed Star-dust Geometry Model in Spectral Energy Distribution Fitting*
Lower, Sidney; Narayanan, Desika; **Leja, Joel** et al., 2022, ApJ, 931, 14L

26. *Empirical Dust Attenuation Model Leads to More Realistic UVJ Diagram for TNG100 Galaxies*
Nagaraj, Gautam; Forbes, John C.; **Leja, Joel** et al., 2022, ApJ, 939, 29N

27. *Physical Properties of the Host Galaxies of Ca-rich Transients*
Dong, Yuxin; Milisavljevic, Dan; **Leja, Joel** et al., 2022, ApJ, 927, 199D

28. *Recovering the star formation histories of recently-quenched galaxies: the impact of model and prior choices*
Suess, Katherine A.; **Leja, Joel** et al., 2022, ApJ, 935, 146S

29. *Reproducing the UVJ Color Distribution of Star-forming Galaxies at $0.5 < z < 2.5$ with a Geometric Model of Dust Attenuation*
Zuckerman, Leah; Belli, Sirio; **Leja, Joel**; Tacchella, Sandro, 2021, ApJ, 923, 18M

30. *Stellar Population Inference with Prospector*
Johnson, Benjamin D.; **Leja, Joel** et al., 2021, ApJS, 254, 22J

31. *Chronicling the Host Galaxy Properties of the Remarkable Repeating FRB 20201124A*
Fong, Wen-fai; Dong, Yuxin; **Leja, Joel**, et al., 2021, ApJ, 919L, 23F

32. *Recent Star Formation in a Massive Slowly Quenched Lensed Quiescent Galaxy at z = 1.88*
Akhshik, Mohammad; Whitaker, Katherine E.; **Leja, Joel** et al., 2021, ApJL, 907L, 8A

33. *The GOGREEN survey: post-infall environmental quenching fails to predict the observed age difference between quiescent field and cluster galaxies at $z > 1$*
Webb, Kristi; Balogh, Michael L.; **Leja, Joel** et al., 2020, MNRAS, 498, 5317W

34. *How Well Can We Measure the Stellar Mass of a Galaxy: The Impact of the Assumed Star Formation History Model in SED Fitting*
Lower, Sidney; Narayanan, Desika; **Leja, Joel** et al., 2020, ApJ, 904, 33L

35. *Brackett-γ as a Gold-standard Test of Star Formation Rates Derived from SED Fitting*
Pasha, Imad; **Leja, Joel** et al., 2020, ApJ, 898, 165P

36. *SPECULATOR: Emulating Stellar Population Synthesis for Fast and Accurate Galaxy Spectra and Photometry*
Alsing, Justin; Peiris, Hiranya; **Leja, Joel** et al., 2020, ApJS, 249, 5A

37. *Predicting fully self-consistent satellite richness, galaxy growth and star formation rates from the STastical sEmi-Empirical modeL STEEL*
Grylls, Philip J.; Shankar, F.; **Leja, J.** et al., MNRAS, 491, 634G

38. *How to measure galaxy star-formation histories I: Parametric models*
Carnall, A. C.; **Leja, J**. et al., 2019, ApJ, 873, 44C

39. *Measuring the Delay Time Distribution of Binary Neutron Stars. III. Using the Individual Star Formation Histories of Gravitational-wave Event Host Galaxies in the Local Universe*
Safarzadeh, Mohammadtaher; Berger, Edo; **Leja, Joel** et al, 2019, ApJ, 878L, 14S

40. *ZFOURGE: Extreme 5007 Emission May Be a Common Early-lifetime Phase for Star-forming Galaxies at $z > 2.5$*
Cohn, Jonathan H.; **Leja, Joel** et al., 2018, ApJ, 869, 141C

41. *Constraining the Low-mass Slope of the Star Formation Sequence at $0.5 < z < 2.5$*
Whitaker, Katherine E.; Franx, Marijn; **Leja, Joel**, et al., 2014, ApJ, 795, 104W

42. *The Assembly of Milky Way-like Galaxies Since $z\sim2.5$*
van Dokkum, Pieter G.; **Leja, Joel** et al., 2013, ApJ, 771L, 35V