Jacob Nibauer

jnibauer@princeton.edu | jnibauer.github.io
ORCID: 0000-0001-8042-5794 | Publications: NASA ADS

Education

Princeton University — Princeton, NJ
M.A., Ph.D. Astrophysics (intended) — *Sep. 2021 onwards*

University of Pennsylvania — Philadelphia, PA
B.A. Physics & Astronomy with Honors | *Summa cum laude* — *Aug. 2017 - May 2021*

- ⋆ Senior Honors Thesis: *Mixture Models and Astrophysical Data: From Planetary Systems to Stellar Populations*

Honors & Awards

NSF Graduate Research Fellowship Program	2023
Best Student Paper in Astrostatistics (Joint Statistical Meeting)	2023
Phi Beta Kappa, University of Pennsylvania	2022
Chambliss Astronomy Achievement Award, AAS	2021
Rose Research Award, UPenn	2021
Martin Schwarzschild Graduate Fellowship, Princeton University	2021
University of Pennsylvania CURF Grant Recipient	2020
LSST Corporation Grant Recipient	2019
Math Department Good Teaching Award, UPenn	2018, 2019, 2020
Dean's List, UPenn	All years offered (covid)
UPenn Undergraduate Research Fellowship Recipient	2018

Publications

Lead Author

9. **Nibauer, J.**; Pearson, S.*: Testing Dark Matter with Generative Models for Extragalactic Stellar Streams*, 2025, Submitted, arxiv:2508.02666

8. **Nibauer, J.**; Bonaca, A.*: Galactic Accelerations from the GD-1 Stream Suggest a Tilted Dark Matter Halo*, 2025, ApJL, 985, L22, doi:10.3847/2041-8213/add0a9

7. **Nibauer, J.**; Bonaca, A.; Spergel, D.; Price-Whelan, A.; Greene, A.; Starkman, N; Johnston, K. `streamsculptor`*: Hamiltonian Perturbation Theory for Stellar Streams in Flexible Potentials with Differentiable Simulations*, 2025, ApJ, 983, 68, doi:10.3847/1538-4357/adb8e8

6. **Nibauer, J.**; Bonaca, A.; Lisanti, L.; Erkal, D.; Hastings, Z. *Slant, Fan, and Narrow: the Response of Stellar Streams to a Tilting Galactic Disk*, 2024, ApJ, 969, 55, doi:10.3847/1538-4357/ad4299

5. Starkman*, N.; **Nibauer*, J.** (*co-first authors); Bovy, J.; Webb, J.; Tavangar, K.; Price-Whelan, A. *Stream Members Only: Data-Driven Characterization of Stellar Streams with Mixture Density Networks*, 2023, ApJ, 980, 253 doi:10.3847/1538-4357/ad94f2

4. **Nibauer, J.**; Bonaca, A.; Johnston, K. *Constraining the Gravitational Potential From the Projected Morphology of Extragalactic Tidal Streams*, 2023, ApJ, 954, 195, doi:10.3847/1538-4357/ace9bc

3. **Nibauer, J.**; Belokurov, V.; Cranmer, M.; Goodman, J.; Ho, S. *Charting Galactic Accelerations with Stellar Streams and Machine Learning*, 2022, ApJ, 940, 22, doi:10.3847/1538-4357/ac93ee

2. **Nibauer, J.**; Baxter, E.; Jain, B.; van Saders, J.; Beaton, R.; Teske, J. *Statistics of the*

Chemical Composition of Solar Analog Stars and Links to Planet Formation, 2021, ApJ, 907, 116, doi:10.3847/1538-4357/abd0f1

1. **Nibauer, J.**; Baxter, E.; Jain, B. *The Statistics of Extended Debris Disks Measured with Gaia and Planck*, 2020, AJ, **159**, 210, doi:10.3847/1538-3881/ab8192

Contributing Author

3. Sola, E. et al.; *STRRINGS: STReams in Residual Images of Nearby GalaxieS*, 2025, Submitted, arxiv:2508.02154

2. Bell, E. et al.; *The low-mass and structured stellar halo of M83*, 2025, Submitted to ApJ

1. Hensley, B. et al.; The Simons Observatory Galactic Science Working Group, *The Simons Observatory: Galactic Science Goals and Forecasts*, 2022, ApJ, **929**, 166, doi:10.3847/1538-4357/ac5e36

Software

1. Starkman, N.; Price-Whelan, A.; **Nibauer, J.**; `unxt`: *A Python Package for Unit-Aware Computing with JAX*, 2025, JOSS, **10**, 107, doi:10.21105/joss.07771

Presentations & Talks

Carnegie Mellon Univ., Gravity in the Local Group — June 2025

- *Talk.* The Galactic Acceleration Field from the GD-1 Stream

Univ. of Copenhagen, Cosmic Dawn Center — March 2025

- *Invited Seminar.* Mapping Dark Matter around Galaxies with Stellar Streams

Caltech TAPIR Seminar — Feb 2025

- *Invited Seminar.* Mapping Dark Matter around Galaxies with Stellar Streams

Milky Way Methods, Ringberg Castle, Bavaria — July 2024

- *Talk.* Perturbation theory for Stellar Streams with Differentiable Programming

Milky Way Assembly Tale — May 2024

- *Talk.* Forward Mode Differentiation of Hamilton's Equations for Perturbation Theory and Tidal Streams

Division of Dynamical Astronomy — May 2024

- *Talk.* Forward Mode Differentiation of Hamilton's Equations for Perturbation Theory and Tidal Streams

SDSS MWAG Meeting — March 2024

- *Talk.* Probing the Dark Matter Halos of External Galaxies with Tidal Features

Dynamics Blackboard Meeting, Institute for Advanced Study — March 2024

- *Talk.* Forward Mode Differentiation of Hamilton's Equations for Perturbation Theory and Tidal Streams

Galaxy Lunch, Yale University — March 2024

- *Invited Talk.* Painting on the Perturbations: Differentiable Models for Stellar Streams and Dark Matter Subhalos

Milky Way as a Galaxy, SDSS-IV WG — March 2024

- *Talk.* Stream Curvature as a Dark Matter Probe: Constraining Halo Shapes with Extragalactic Streams

Milky Clouds over Manhattan, Flatiron Institute — Feb 2024

- *Talk.* Painting on the Perturbations: Differentiable Simulations for Stellar Streams

Univ. of Surrey Astrophysics Seminar — Feb 2024

- *Invited Seminar.* Stellar Streams as Multi-Scale Probes: from Disk Tilting to Dark Matter

Joint Statistical Meeting — August 2023

- *Talk.* Stellar Streams and Machine Learning: Towards a data-driven map of the Milky Way. Winner of best paper award for Nibauer et al. 2023

IAS Summer Streams Meeting — July 2023

- *Talk.* Mapping the Dark Matter: from the Milky Way, to Beyond

CMB-S4 Spring Meeting — March 2023

- *Talk.* Galactic Science with CMB Surveys

AAS 241: General Meeting — Jan 2023

- *Talk.* The Gravitational Potential from Extragalactic Tidal Streams

Institute for Advanced Study, Dynamics Group — Nov 2022

- *Chalk Talk.* From Morphology Alone: Mapping the Dark Matter Distribution with Extragalactic Tidal Debris

Center for Computational Astrophysics, Dynamics Group — Oct 2022

- *Talk.* From Morphology Alone: Mapping the Dark Matter Distribution with Extragalactic Tidal Debris

Carnegie Observatories Tea Talk — July 2022

- *Talk.* Constructing Flexible Models for the Milky Way Potential

Towards Real-Time Galactic Dynamics — July 2022

- *Panelist.* Estimating Galactic Accelerations with Stellar Streams: the Milky Way and Beyond

CMB-S4 Astrophysics Workshop — July 2022

- *Invited Talk.* Galactic Science With CMB Surveys: Constraining Planetary Systems through Thermal Emission

Univ. of Cambridge Galactic Dynamics Group — May 2022

- *Talk.* Charting Galactic Accelerations with Stellar Streams

AAS 53$^{\text{rd}}$ Division of Dynamical Astronomy — April 2022

- *Talk.* Charting Galactic Accelerations with Stellar Streams

Center for Computational Astrophysics, Cosmology×Data-Science — April 2022

- *Talk.* Model Independent Potential Reconstruction with Stellar Streams

Center for Computational Astrophysics, Lunch Talk — April 2022

- *Talk.* Model Independent Potential Reconstruction with Stellar Streams

University of Montreal: Parsec Institute — March 2022

- *Invited Talk.* Charting Galactic Accelerations with Stellar Streams

Brown University Machine Learning Seminar — Feb 2022

- *Invited Talk.* ML for Galactic Dynamics: Constructing Flexible Models for the Milky Way Potential

239$^{\text{th}}$ AAS General Meeting, Utah (Cancelled due to Covid) — Jan 2022

- *iPoster and Talk.* Deep Learning the Gravtiational Potential from a Snapshot of 5D Kinematic Phase Space

Pan-Experiment Galactic Science Group — Nov 2021

- *Invited Talk.* Forecasting Thermal Emission from Exo-Oort Clouds with the Simons Observatory

238th AAS General Meeting, Virtual — June 2021

- *iPoster and Talk.* Signatures of Planet Formation in the Chemical Composition of Solar Analogs? A New Statistical Approach
- *Panelist.* Exoplanet and Brown Dwarf Press Conference

Emerging Researchers in Exoplanet Science (ERES), Virtual — May 2021

- *Talk.* Signatures of Planet Formation in the Chemical Composition of Solar Analogs? A New Statistical Approach

Penn Fall Virtual Research Expo — Sep 2020

- *Poster.* Presented research characterizing refractory element depletion patterns across large samples of stars using data from APOGEE.

Exoplanets III, Virtual. — July 2020

- *Poster.* Presented preliminary results characterizing refractory element depletion patterns across large samples of stars using data from APOGEE.

LSST Project & Community Workshop, Tuscon, AZ. — Aug 2019

- *Poster & Talk.* Statistics of extended debris disks measured with *Gaia* and *Planck*. Main results presented among other selected undergraduates in plenary session.

University of Pennsylvania Data Science Seminar — Aug 2019

- *Talk.* Taught a tutorial session on applications of neural networks to image processing in the context of unsupervised machine learning and scientific data analysis.

CURF Research Expo, University of Pennsylvania — Sep 2018

- *Poster.* The search for Fast Evolving Luminous Transients (FELTs) in the Dark Energy Survey.

Selected Press Coverage

New Planetarium — April 2025

- The Tilted Halo Mystery: What the GD-1 Stellar Stream Tells Us About the Shape of Our Galaxy's Dark Matter

Penn Today — June 2021

- "Connecting a star's chemical composition and planet formation"

Universe Today — June 2021

- "What's the Connection Between the Chemistry of a Star and the Formation of its Planets?"

Teaching Experience

AST 205, Planets in the Universe (TA) — Fall 2022

- Office hours, review sessions, grading of problem sets.

Physics 359, Statistics & Machine Learning (TA) — Spring 2021

- Office hour sessions & grading of weekly problem sets. Course is intended to provide students pursuing research in physics with a strong background in statistical data analysis and machine learning applications.

Math 114E, Multivariable Calculus for Engineers (TA) Fall 2018 - Spring 2020

- Taught weekly recitations for up to three sections, $\sim$ 100 students. Graded problem sets, exams, and held office hours.

Multivariable Calculus Teaching Resources Fall 2018 - Spring 2020

- Created a set of lecture notes and recitation problems currently available at https://www.math.upenn.edu/~ghrist/BLUE.html. Resources used by students, TAs, and lecturers.

Service & Outreach

Princeton University Prison Teaching Initiative Fall 2023-Spring 2024

- Instructor for Phys130, introductory astronomy at South Woods State Prison
- Tutor in introductory college Algebra at South Woods State Prison

Princeton University Public Observing Fall 2022

- Helped run public observing night at Princeton University, open to the community.

Riverside Elementary Science Day Spring 2022

- Outreach day at local elementary school in New Jersey. Helped create demos on the spectrum of light and connections to space telescopes.

Moelis Access Science Physics Curriculum Chair Sep 2018 - Sep 2019

- Crafted hands on lessons for high school physics students in the West Philadelphia region. Roles also included curriculum development, teaching, and other administrative duties.

Moelis Access Science Head TA Sep 2018 - Sep 2019

- Assisted West Philadelphia high school physics teachers in carrying out lesson plans, labs, and demonstrations.

UnEarthed Magazine, Writer Fall 2018

- Wrote for a student run organization at Penn, focused on providing digestible scientific articles to middle school and high school students in the West Philadelphia community.