



Nathaniel Starkman
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 Brinson Prize Fellow
 @ MIT Kavli

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📄 Publications 🔗 arXiv 📄 Zenodo 📞 0000-0003-3954-3291



🏛️ EDUCATION

- 2018 – 2024 **PhD in Astronomy & Astrophysics**, University of Toronto 🔗 Toronto, ON, Canada
NSERC CGS-D Fellow 2020–2023. **NSERC CGS-M Fellow** 2019–2020.
 Thesis: Charting Stellar Streams of the Milky Way
 Supervisors: Jo Bovy, Jeremy Webb
- 2014 – 2018 **B.S. in Mathematical Physics and Astronomy**, Case Western Reserve University 🔗 Cleveland, OH, USA
 Summa Cum Laude.
 Supervisors: Stacy McGaugh

📋 SELECT PROFESSIONAL APPOINTMENTS

- 2024 – 2027 **Postdoctoral Associate**, MIT Kavli Institute for Astrophysics and Space Research 🔗 Cambridge, MA, USA
 Brinson Prize Fellowship (2024–2027).
- 2021 – **Coordinator & Core Developer**, Astropy 🔗
 Role: Member, Core Developer Team; lead maintainer for Cosmology, co-maintainer of Units.
 2025–2028: Coordination Committee (executive committee).
 2025–2026: Strategic Planning and Organizing Committee.
 Funding: Astropy Cycle III — Cosmology and Quantity 2.0.
 Team awards: 2025 AAS Lancelot M. Berkeley–New York Community Trust Prize, the 2023 IOP Publishing Top Cited Paper Award and the 2022 ADASS Prize for an Outstanding Contribution to Astronomical Software.

📄 SELECT PUBLICATIONS

Students I supervised or advised: [undergraduate[†]](#), [graduate[†]](#).

1. **N. Starkman**, J. Nibauer, S. Pearson, **S. Wu[†]**, L. Necib. *When Streams Curve Away: a Test of Dark Matter from Extragalactic Stellar Stream Populations*. [SUBMITTED](#) 🔗 [arXiv:2609.40057](#)
2. Euclid Collaboration, **N. Starkman**, J. Nibauer, S. Pearson, **S. Wu[†]**, M. Walmsley, L. Necib, et al. *Euclid Quick Data Release (Q1): The geometry of dark matter halos from extragalactic streams*. *Astronomy & Astrophysics* [SUBMITTED](#) 🔗 [ADS](#) 🔗 [arXiv:2606.21774](#)
3. **C. Myers[†]**, **N. Starkman**, L. Necib. *Reconstructing Galactic Gravitational Potentials from Stellar Kinematics with Physics-Informed Neural Networks*. *Monthly Notices of the Royal Astronomical Society* [SUBMITTED](#) 🔗 [ADS](#) 🔗 [arXiv:2606.18386](#) 🔗
4. L. Necib, D. Folsom, E. Y. Davies, **N. Starkman**, A. Thoyas. *Galactic Amnesia: The Information Washout of the Milky Way Merger History*. [SUBMITTED](#) 🔗 [ADS](#) 🔗 [arXiv:2605.04138](#)
5. **N. Starkman**, J. Nibauer. *phasecurvefit: A High-Performance JAX Framework for Phase-Space Walks with Pluggable Metrics and Strategies*. *Journal of Open Source Software* [SUBMITTED](#) 📄 [pyOpenSci review](#) 🔗
6. **S. Wu[†]**, **N. Starkman**, S. Pearson, J. Nibauer, J. Miro-Carretero, D. Martinez-Delgado. *Potamides: Mapping Dark Matter Halo Shapes from Stellar Stream Tracks in the Local Universe*. *The Astrophysical Journal* [ACCEPTED](#) 🔗 [ADS](#) 🔗 [arXiv:2605.07809](#)
7. **S. Wu[†]**, **N. Starkman**, J. Nibauer, S. Pearson. *Potamides: JAX tools for curvature-based inference from stellar streams*. *Journal of Open Source Software* 11, 10712 📄 [10.21105/joss.10712](#) 🔗
8. **C. Myers[†]**, **N. Starkman**, L. Necib. *Physics-Informed Neural Networks for Modeling Galactic Gravitational Potentials*. *Advances in Neural Information Processing Systems (NeurIPS 2025)* 📄 [OpenReview](#) 🔗
9. J. Nibauer, A. Bonaca, D. N. Spergel, A. M. Price-Whelan, J. E. Greene, **N. Starkman**, et al. *Stream-Sculptor: Hamiltonian Perturbation Theory for Stellar Streams in Flexible Potentials with Differentiable Simulations*. *The Astrophysical Journal* 983, 68 📄 [10.3847/1538-4357/adb8e8](#) 🔗 [ADS](#) 🔗 [arXiv:2410.21174](#)

10. **N. Starkman**, A. M. Price-Whelan, J. Nibauer. *unxt: A Python package for unit-aware computing with JAX*. Journal of Open Source Software 10, 7771  [10.21105/joss.07771](https://doi.org/10.21105/joss.07771)  
11. **N. Starkman**, J. Nibauer, J. Bovy, J. Webb, K. Tavangar, A. Price-Whelan, et al. *Stream Members Only: Data-Driven Characterization of Stellar Streams with Mixture Density Networks*. The Astrophysical Journal 980, 253  [10.3847/1538-4357/ad94f2](https://doi.org/10.3847/1538-4357/ad94f2)  ADS  [arXiv:2311.16960](https://arxiv.org/abs/2311.16960)  
12. **N. Starkman**, G. Starkman, A. Kosowsky. *Angular Correlations of Cosmic Microwave Background Spectrum Distortions from Photon Diffusion*. Monthly Notices of the Royal Astronomical Society 529, 2274  [10.1093/mnras/stae665](https://doi.org/10.1093/mnras/stae665)  [arXiv:2310.01578](https://arxiv.org/abs/2310.01578)  
13. **N. Starkman**, J. Bovy, J. Webb, D. Calvetti, E. Somersalo. *On the fast track: Rapid construction of stellar stream paths*. Monthly Notices of the Royal Astronomical Society 522, 5022  [10.1093/mnras/stad1166](https://doi.org/10.1093/mnras/stad1166)  [arXiv:2212.00949](https://arxiv.org/abs/2212.00949)   
14. The Astropy Collaboration, A. M. Price-Whelan, P. L. Lim, N. Earl, **N. Starkman**, L. Bradley, D. L. Shupe, et al. *The Astropy Project: Sustaining and Growing a Community-oriented Open-source Project and the Latest Major Release (v5.0) of the Core Package*. The Astrophysical Journal 935, 167  ADS  [arXiv:2206.14220](https://arxiv.org/abs/2206.14220)   
15. **N. Starkman**, J. S. Sidhu, H. Winch, G. Starkman. *Straight Lightning as a Signature of Macroscopic Dark Matter*. Physical Review D 103, 063024  [10.1103/PhysRevD.103.063024](https://doi.org/10.1103/PhysRevD.103.063024)  [arXiv:2006.16272](https://arxiv.org/abs/2006.16272)  
16. **N. Starkman**, J. Bovy, J. Webb. *An extended Pal 5 stream in Gaia DR2*. Monthly Notices of the Royal Astronomical Society  [10.1093/mnras/staa534](https://doi.org/10.1093/mnras/staa534)  [arXiv:1909.03048](https://arxiv.org/abs/1909.03048) 
17. P. Li, F. Lelli, S. S. McGaugh, **N. Starkman**, J. M. Schombert. *A constant characteristic volume density of dark matter haloes from SPARC rotation curve fits*. Monthly Notices of the Royal Astronomical Society  [10.1093/mnras/sty2968](https://doi.org/10.1093/mnras/sty2968)  [arXiv:1811.00553](https://arxiv.org/abs/1811.00553)
18. **N. Starkman**, F. Lelli, S. S. McGaugh, J. Schombert. *A new algorithm to quantify maximum discs in galaxies*. Monthly Notices of the Royal Astronomical Society 480, 2292  [10.1093/mnras/sty2011](https://doi.org/10.1093/mnras/sty2011)  ADS  [arXiv:1802.09967](https://arxiv.org/abs/1802.09967)

SELECT FELLOWSHIPS & AWARDS

Oct 2026	Pacific Postdoc Program 
	A one-month fellowship at the University of Washington in Seattle
Jan 2025	AAS Lancelot M. Berkeley–New York Community Trust Prize , American Astronomical Society 
	<i>to the Astropy Collaboration</i> Team award, as a core developer and Coordination Committee member of Astropy.
Feb 2024	Brinson Prize Fellowship 
	"to support early-career astrophysicists and cosmologists who are committed to chasing bold ideas with creative, nimble, and innovative research."
Nov 2023	IOP Publishing Top Cited Paper Award, North America , IOP Publishing 
	<i>to the Astropy Collaboration</i> Team award, as an author of the v5.0 paper: top 1% most-cited in Astronomy and Astrophysics.
May 2022	OSOTF HUDD Award at Massey , Massey College 
	Ontario Student Opportunity Trust Fund
2022	ADASS Prize for an Outstanding Contribution to Astronomical Software , Astronomical Data Analysis Software and Systems 
	<i>to the Astropy Project</i> Team award, as a core developer of Astropy.
2018 – 2024	University of Toronto Graduate Fellowship , University of Toronto

MAJOR GRANTS

Jul 2022	Astropy Cycle III Funding Grant 	USD 12,000
	USD 12,000 NASA ROSES and Moore Foundation funding to Astropy Lead: "Cosmology in Astropy"	

USD 8,000 NASA ROSES and Moore Foundation funding to Astropy Lead: "Quantity 2.0: unitful calculations beyond NumPy"

SELECT SOFTWARE

potamides 2026

Constrain gravitational potentials from stellar stream curvature

coordinax

Coordinates in JAX

Astropy 2022

Astronomy in Python

galax

Galactic dynamics in JAX

unxt 2025

Units in JAX

plum

Multiple dispatch in Python

quax

Multiple dispatch in JAX

SELECT INVITED TALKS

Aug 2026	Marche III: Big Bang, Big Stars, Big Computers (Jesi)	Jesi, Italy
	Energy Structures of Extragalactic Stellar Streams Reveal Dark Matter Halos	
Jun 2026	EAS 26-S10 (Lausanne) 	Lausanne, Switzerland
	The Geometry of Dark Matter Halos from Extragalactic Streams	
Feb 2026	CWRU Seminar (Cleveland)	Cleveland, OH, USA
	Computationally Unscrambling EGGS (Extra-Galactic Gravity from Streams)	
Nov 2025	TevPA (Valencia)	Valencia, Spain
	The Geometry of Dark Matter Halos from Extragalactic Streams	
Oct 2025	DARK seminar (Copenhagen)	Copenhagen, Denmark
	The Geometry of Dark Matter Halos from Extragalactic Streams	
Oct 2025	Texas A&M Seminar (Texas)	College Station, TX, USA
	The Geometry of Dark Matter Halos from Extragalactic Streams	
Sep 2025	CCA Software seminar (NYC)	New York, NY, USA
	unxt, coordinax, and software development in JAX	
Sep 2025	Princeton Thunch Seminar (Princeton) 	Princeton, NJ, USA
	Euclid: The Geometry of Dark Matter Halos from Extragalactic Streams	
Mar 2025	DARK seminar (Copenhagen)	Copenhagen, Denmark
	Bayesian models for detecting streams in LSST data	
Oct 2024	CWRU Seminar 	Cleveland, OH, USA
	Stream Members Only: Data-Driven Characterization of Stellar Streams for Inference on the Galactic Potential	
Jan 2023	CITA Seminar	Toronto, ON, Canada
	Astropy Cosmology: the Present and the Expanding Future	
Mar 2022	Oxford Physics Colloquium	Online
	Straight Lightning as a Signature of Macroscopic Dark Matter (Invited Colloquium Talk)	

SELECT PRESENTATIONS

Aug 2026	New Frontiers in Cosmology (Talk)	A Coruña, Spain
	Energy Structures of Extragalactic Stellar Streams Reveal Dark Matter Halos	
Jul 2026	Near Field Cosmology in the Era of Big Data (Talk) 	Toronto, ON, Canada
	Energy Structures of Extragalactic Stellar Streams Reveal Dark Matter Halos	
Jun 2026	DARK Seminar (Talk)	Copenhagen, Denmark
	Energy Structures of Extragalactic Stellar Streams Reveal Dark Matter Halos	
Jan 2026	York Seminar (Talk)	Toronto, ON, Canada
	Euclid: The Geometry of Dark Matter Halos from Extragalactic Streams	
Nov 2025	TeVPA (Talk) 	Valencia, Spain
	Euclid: The Geometry of Dark Matter Halos from Extragalactic Streams	
Oct 2025	IAUS 403 (Talk) 	Córdoba, Spain
	Euclid: The Geometry of Dark Matter Halos from Extragalactic Streams	

Sep 2025	Cosmology 2025 (Talk) 	Portoferraio, Italy
	Euclid: The Geometry of Dark Matter Halos from Extragalactic Streams	
Sep 2025	MKI Journal Club (Talk)	Cambridge, MA, USA
	Euclid: The Geometry of Dark Matter Halos from Extragalactic Streams	
May 2025	DDA #56 	Atlanta, GA, USA
	Extra-Galactic Gravity using Streams (EGGS) from Euclid's Zoo(niverse)	
May 2025	Euclid LU-SWG (Talk)	Lausanne, Switzerland
	Extra-Galactic Gravity using Streams (EGGS) from Euclid's Zoo(niverse)	
Aug 2024	ASA: Astrostatistics Interest Group Paper Competition 	not attended
	Stream Members Only: Data-Driven Characterization of Stellar Streams	
Aug 2024	Streams 24: The theory edition (Talk) 	Durham, UK
	From JAX to Galax, a new generation of stellar stream tools Using ML to select stellar stream members	
May 2024	Division on Dynamical Astronomy #55 (Talk) 	Toronto, ON, Canada
	Stream Members Only: Data-Driven Characterization of Stellar Streams	
May 2024	Globular Clusters and Their Tidal Tails (Talk) 	Toronto, ON, Canada
	Stream Members Only: Data-Driven Characterization of Stellar Streams	
Oct 2023	DESC sprint week	Pittsburgh, PA, USA
May 2023	Astropy Conference (Talk)	Cambridge, MA, USA
	An Interoperable Future with Astropy	
Mar 2023	IAUS379: Dynamical Masses of Local Group Galaxies (Poster)  	Potsdam, Germany
	Stellar Stream Track Reconstruction, with Errors	
Jan 2023	AAS 2023 (Talk)	Seattle, WA, USA
	Astropy Tutorials on Units & Constants	
Oct 2022	CATS-2022 	Pasadena, CA, USA
	Streams22: A workshop for assembling a Community Atlas of Tidal Streams	

SELECT CONFERENCES

Sep 2026	Astropy 2026 Conference	Online
	Role: Coordination Committee and Strategic Planning Committee; moderated online discussion and helped moderate the AI sessions.	
Aug 2026	Astrophysics and Space Science in Marche III: Big Bang, Big Stars, Big Computers	Jesi, Italy
	Role: SOC	
Jan 2026	Gaia Hackathon 	Cambridge, MA, USA
	Role: LOC	
Jun 2025	Astropy Coordination Meeting 	Santa Cruz, CA, USA
	Role: SOC	
May 2025	Division of Dynamical Astronomy #56  	Atlanta, GA, USA
	Role: SOC	
Jan 2025	Gaia Hackathon 	Cambridge, MA, USA
	Role: LOC	
Oct 2024	JAXtronomy Workshop 	New York, NY, USA
	Role: SOC	
Jun 2024	Astropy Core Developer Conference	Santa Cruz, CA, USA
May 2024	From JAX to Galax 	Toronto, ON, Canada
	Workshop at Globular Clusters and Their Tidal Tails	
Feb 2023	The Future of Astrophysical Data Infrastructure 	Online
Mar 2022	Astropy Core Developer Conference (Talk)	Boston, MA, USA
	The future of interoperability with Python's Protocols Role: Core developer, maintainer for Astropy Cosmology and Units	

MENTORING

- May 2026 **Reem Hamraz Google Summer of Code for Astropy** 
Hardening Astropy's core stability
- 2025 – 2026 **Amir Abdul (Howard)**
Baryon Modeling in External Galaxies with Stellar Streams
Leadership Alliance National Symposium, July 23–25, 2025
2025 NSBP-NSHP Joint Annual Conference, November 19–23, 2025
2026 APS Global Physics Summit, March 14–20, 2026
- 2025 – 2026 **Taisiia Karasova (MIT) with Prof. Lina Necib (MIT)**
Machine Learning Galaxy intrinsic sizes
- 2024 – 2026 **Charlotte Myers (MIT) with Prof. Lina Necib (MIT)**
Physics-Informed Neural Networks for Modeling Galactic Gravitational Potentials
NeurIPS Paper
- 2023 – 2025 **Connor McKeigan (Astronomy, UofT) with Prof. Ting Li (UofT)**
Undergraduate thesis project: “Characterizing the stellar streams of S5”
- 2019 – 2022 **Massey Tutoring Program**
Volunteer math and physics tutor to prospective first-generation college students
2019, 2020 and 2022.

SELECT TEACHING

- 2019 – 2020 **Lead Observer: AST101-325**, University of Toronto
Role: Trained and liaised with TAs and students in all courses using the campus telescope facilities.
- 2019 – 2024 **TA, AST 201: Stars and Galaxies**, University of Toronto
Role: Designed and ran weekly course tutorial sections, created exam questions, proctored exams, and graded course projects.
2019, 2021–2024.
- 2018 – 2023 **TA, AST 101: The Sun and its Neighbours**, University of Toronto
Role: Designed and ran weekly course tutorial sections, planetarium shows, & observing nights; created exam questions, proctored exams, and graded course projects.
2018, 2021–2023.

PEER REVIEW

- Journals — Astronomy & Astrophysics · The Astrophysical Journal · European Physical Journal C · Monthly Notices of the Royal Astronomical Society · Journal of Open Source Software ([commensurability: a Python package for classifying astronomical orbits based on their toroid volume](#))
- Panels — National Science Foundation project funding panel

SELECT PROFESSIONAL SERVICE

- 2022 – 2023 **Massey House Committee**
Junior Fellow governance committee at Massey college.
- 2019 – **Massey Junior Fellow**, Massey College
University of Toronto's graduate college for those showing exceptional promise and engagement within academia and the world beyond it.
- 2019 – **MasseyScope Committee Member**, Massey College
Organizing astronomy outreach with a focus on underprivileged communities
- 2019 – 2020 **Sigma Nu Alumni Advisory Board**
Role: Member of the Sustainability and Chapter Operations committees
- 2018 – **Canadian Astronomical Society (CASCA)**, Canadian Astronomical Society

OUTREACH

- 2019 – 2021 **AstroTours Telescope Organizer** 
Organizer for all telescope outreach in Dunlap's public event
- 2019 – 2022 **Massey Telescopes Outreach Coordinator**
Organizing committee member for astronomy outreach and appreciation at Massey College

- 2019 **Planet Party Toronto Volunteer**
- 2018 – 2020 **Astronomy on Tap Toronto Volunteer**
- 2018 – 2019 **AstroTours Planetarium Presenter**
Regular planetarium show designer and presenter for Dunlap's AstroTours public outreach
- 2018 – 2021 **AstroTours Toronto Outreach Volunteer**

SELECT MEDIA

- Feb 2023 **The New Scientist**, [The New Scientist](#) 
Featured in article on various strategies to detect dark matter, including the method from my paper
- May 2021 **Smithsonian Feature Article**, [Smithsonian Feature Article](#) 
Interviewed for feature article about my paper