



Nathaniel Starkman
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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

🏢 PROFESSIONAL APPOINTMENTS

- 2024 – 2027 **Postdoctoral Associate**, MIT Kavli Institute for Astrophysics and Space Research 🔗 Cambridge, MA, USA
Brinson Prize Fellowship (2024–2027).
- 2021 – **Coordinator (2025 – 2028), Strategic Planner (2025 – 2026) & Core Developer**, Astropy 🔗 Remote
Coordination Committee (executive committee), 2025–2028.
Strategic Planning and Organizing Committee, 2025–2026.
Member, Core Developer Team; lead maintainer for Cosmology, co-maintainer of Units.
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.

🏆 GRANTS & FELLOWSHIPS

- Oct 2026 **Pacific Postdoc Program at the University of Washington**, Pacific Postdoc Program Fellow, University of Washington 🔗
A one-month fellowship at the Dark Universe Science Center at the University of Washington in Seattle, funded by the Dark Universe Science Center and the Simons Institute.
- Feb 2024 **Brinson Prize Fellowship**, Prize Fellow, Brinson Foundation 🔗 USD 360,000
“to support early-career astrophysicists and cosmologists who are committed to chasing bold ideas with creative, nimble, and innovative research.”
- 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”
- Jul 2022 **Astropy Cycle III Funding Grants** 🔗 USD 8,000
USD 8,000 NASA ROSES and Moore Foundation funding to Astropy Lead: “Quantity 2.0: unitful calculations beyond NumPy”
- 2019 – 2024 **Massey Junior Fellow**, Junior Fellow, Massey College
University of Toronto's graduate college for those showing exceptional promise and engagement within academia and the world beyond it.
- 2018 – 2024 **University of Toronto Graduate Fellowship**, University of Toronto CAD 23,000–32,000 p.a.

🏆 AWARDS

- Jan 2025 **AAS Lancelot M. Berkeley–New York Community Trust Prize**, American Astronomical Society 🔗, to the *Astropy Collaboration*
Team award, as a core developer and Coordination Committee member of Astropy.

- Nov 2023 **IOP Publishing Top Cited Paper Award, North America**, IOP Publishing 
to the *Astropy Collaboration*
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 
to the *Astropy Project*
Team award, as a core developer of Astropy.

PUBLICATIONS

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

18. **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](#)
17. 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](#)
16. [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](#) 
15. 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](#)
14. **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](#) 
13. [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](#)
12. [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](#) 
11. [C. Myers[†]](#), **N. Starkman**, L. Necib. *Physics-Informed Neural Networks for Modeling Galactic Gravitational Potentials*. *Advances in Neural Information Processing Systems (NeurIPS 2025)*  [OpenReview](#) 
10. 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](#)
9. **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](#)  
8. **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](#)  [ADS](#)  [arXiv:2311.16960](#)  
7. **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](#)  [arXiv:2310.01578](#)  
6. **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](#)  [arXiv:2212.00949](#)    
5. 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](#)    

4. **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)   
3. **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) 
2. 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)
1. **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](https://ui.adsabs.org/abs/2018MNRAS.480.2292S)  [arXiv:1802.09967](https://arxiv.org/abs/1802.09967)

SOFTWARE DEVELOPMENT

phasecurvefit  2026

Paths through phase space

plum 

Multiple dispatch in Python

quax 

Multiple dispatch in JAX

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

INVITED TALKS

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

PRESENTATIONS

Aug 2026	New Frontiers in Cosmology (Talk) Energy Structures of Extragalactic Stellar Streams Reveal Dark Matter Halos	A Coruña, Spain
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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	

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 S ₅ ”
2019 – 2022	Massey Tutoring Program
	Volunteer math and physics tutor to prospective first-generation college students
	2019, 2020 and 2022.

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

PROFESSIONAL SERVICE

2022 – 2023	Massey House Committee
	Junior Fellow governance committee at Massey college.
2019 – 2024	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

OUTREACH

- Aug 2026 **Public Talk in Jesi, Italy**, Astrophysics and Space Science in Marche III [🔗](#)
- Oct 2021 **Origins Science Scholars Lecture Series**, Origins Science Scholars program, Case Western Reserve University Online
Science of Origins: Dark Matter and the Milky Way
- 2019 – 2021 **AstroTours Telescope Organizer**, Dunlap Institute for Astronomy & Astrophysics, University of Toronto [🔗](#)
Organizer for all telescope outreach in Dunlap's public event
- 2019 – 2022 **Massey Telescopes Outreach Coordinator**, Massey College
Organizing committee member for astronomy outreach and appreciation at Massey College
- 2019 **Planet Party Toronto Volunteer**, Department of Astronomy and Astrophysics, University of Toronto
- 2018 – 2020 **Astronomy on Tap Toronto Volunteer**, Department of Astronomy and Astrophysics, University of Toronto
- 2018 – 2019 **AstroTours Planetarium Presenter**, Dunlap Institute for Astronomy & Astrophysics, University of Toronto
Regular planetarium show designer and presenter for Dunlap's AstroTours public outreach
- 2018 – 2021 **AstroTours Toronto Outreach Volunteer**, Dunlap Institute for Astronomy & Astrophysics, University of Toronto

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