



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, Strategic Planner & Core Developer**, Astropy 🔗 Remote
Member, Coordination Committee (executive committee).
Member, Strategic Planning and Organizing Committee.
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**, Dark Universe Science Center, University of Washington; Simons Institute 🔗
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** 🔗 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”
- 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](#)  [arXiv: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)	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)	

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) Energy Structures of Extragalactic Stellar Streams Reveal Dark Matter Halos	Copenhagen, Denmark
Jan 2026	York Seminar (Talk) Euclid: The Geometry of Dark Matter Halos from Extragalactic Streams	Toronto, ON, Canada
Nov 2025	TeVPA (Talk) 🔗 Euclid: The Geometry of Dark Matter Halos from Extragalactic Streams	Valencia, Spain
Oct 2025	IAUS 403 (Talk) 🔗 Euclid: The Geometry of Dark Matter Halos from Extragalactic Streams	Córdoba, Spain
Sep 2025	Cosmology 2025 (Talk) 🔗 Euclid: The Geometry of Dark Matter Halos from Extragalactic Streams	Portoferraio, Italy
Sep 2025	MKI Journal Club (Talk) Euclid: The Geometry of Dark Matter Halos from Extragalactic Streams	Cambridge, MA, USA
May 2025	DDA #56 🔗 Extra-Galactic Gravity using Streams (EGGS) from Euclid's Zoo(niverse)	Atlanta, GA, USA
May 2025	Euclid LU-SWG (Talk) Extra-Galactic Gravity using Streams (EGGS) from Euclid's Zoo(niverse)	Lausanne, Switzerland
Aug 2024	ASA: Astrostatistics Interest Group Paper Competition 🔗 Stream Members Only: Data-Driven Characterization of Stellar Streams	not attended
Aug 2024	Streams 24: The theory edition (Talk) 🔗 From JAX to Galax, a new generation of stellar stream tools Using ML to select stellar stream members	Durham, UK
May 2024	Division on Dynamical Astronomy #55 (Talk) 🔗 Stream Members Only: Data-Driven Characterization of Stellar Streams	Toronto, ON, Canada
May 2024	Globular Clusters and Their Tidal Tails (Talk) 🔗 Stream Members Only: Data-Driven Characterization of Stellar Streams	Toronto, ON, Canada
Oct 2023	DESC sprint week	Pittsburgh, PA, USA
May 2023	Astropy Conference (Talk) An Interoperable Future with Astropy	Cambridge, MA, USA
Mar 2023	IAUS379: Dynamical Masses of Local Group Galaxies (Poster) 🔗 🔗 Stellar Stream Track Reconstruction, with Errors	Potsdam, Germany
Jan 2023	AAS 2023 (Talk) Astropy Tutorials on Units & Constants	Seattle, WA, USA
Oct 2022	CATS-2022 🔗 Streams22: A workshop for assembling a Community Atlas of Tidal Streams	Pasadena, CA, USA

CONFERENCES

Sep 2026	Astropy 2026 Conference Role: Coordination Committee and Strategic Planning Committee; moderated online discussion and helped moderate the AI sessions.	Online
Aug 2026	Astrophysics and Space Science in Marche III: Big Bang, Big Stars, Big Computers Role: SOC	Jesi, Italy
Jan 2026	Gaia Hackathon 🔗 Role: LOC	Cambridge, MA, USA
Jun 2025	Astropy Coordination Meeting 🔗 Role: SOC	Santa Cruz, CA, USA
May 2025	Division of Dynamical Astronomy #56 🔗 🔗 Role: SOC	Atlanta, GA, USA
Jan 2025	Gaia Hackathon 🔗 Role: LOC	Cambridge, MA, USA
Oct 2024	JAXtronomy Workshop 🔗 Role: SOC	New York, NY, USA

Jun 2024	Astropy Core Developer Conference	Santa Cruz, CA, USA
May 2024	From JAX to Galax  Workshop at Globular Clusters and Their Tidal Tails	Toronto, ON, Canada
Feb 2023	The Future of Astrophysical Data Infrastructure 	Online
Mar 2022	Astropy Core Developer Conference (Talk) The future of interoperability with Python's Protocols Role: Core developer, maintainer for Astropy Cosmology and Units	Boston, MA, USA

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 –	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

OUTREACH

- 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