Aarya Patil

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Research Interests

My research is in the interdisciplinary fields of astrostatistics and astroinformatics. I develop and apply novel statistical and computational tools to understand how galaxies like the Milky Way form and evolve.

Professional Appointments

2023 - 2026 **LSST Discovery Alliance Catalyst Fellow**, MPIA — USD 72,100/year
Independent fellowship with USD 15k research budget/year

2017 **Developer**, Google Summer of Code (GSoC) Participant with OpenAstronomy/Astropy
Mentors: T. Aldcroft (Harvard-Smithsonian), M. van Kerkwijk (UToronto) & H. M. Günther (MIT)

Education

2023 **University of Toronto**, Direct-Entry PhD in Astronomy & Astrophysics — Canada
Thesis title: Order in Chaos - Decoding the age-metallicity structure of the Milky Way disk
Supervisors: Jo Bovy & Gwendolyn Eadie

2018 **S. P. Pune University**, BEng in Computer Engineering (CGPA: 9.45/10) — India

Selected Awards & Honors

2025 **Lancelot M. Berkeley–N.Y. Community Trust Prize for The Astropy Project**
Prize for meritorious work in astronomy by the American Astronomical Society (AAS)
One of 5 coordination committee and 4 finance committee members (top leadership role in the project)

2024, 2022 **Astrostatistics Student Paper Competition Finalist** (top 5) — USD 100/year
American Statistical Association/Astrostatistics Interest Group (ASA/AIG)

2026 - 2027 **MPIA Postdoctoral Fellowship** (Catalyst Fellowship extension)

2023 - 2025 **Schmidt AI in Science Postdoctoral Fellowship** (declined)

2022 - 2023 **Data Sciences Institute Doctoral Student Fellowship** — CAD 25,000/year
Data Sciences Institute, University of Toronto, up to 3 years of funding

2021 - 2022 **International Graduate Student Doctoral Fellowship** — CAD 3,000
Astronomy & Astrophysics, University of Toronto, academic excellence award

2018 - 2023 **University of Toronto Graduate Fellowships** — CAD 23,250 + tuition/year

2018 - 2021 **Massey College Junior Fellowship at the University of Toronto** — CAD 11,000

2017 **ABU ROBOCON 2017 - All India Rank 10** out of 125 teams
Programming Head, Pune Institute of Computer Technology Robotics Team

Major Grants

International Astronomical Union Hands-On Workshops (conditional) — Euro 29,200
2025 Co-Investigator (Co-I): "Learning Data Science for Exploring Astronomical Archives" workshop in Kenya

Astropy Cycle III/IV Funding Grants USD 20,860

2024 Lead: Pan-African School for Emerging Astronomers (PASEA) 2024 in Tunisia ($640)
2023 Co-I: Python/Astropy Training School in Bulgaria ($8,670)
2022 Lead: PASEA 2022 in Zambia ($11,550)

Dunlap Institute (UofT) Seed Funding Grants CAD 35,968

2022 Co-I: PASEA 2022 in Zambia ($29,100)
2022 Co-I: Intertwining Dunlap/UofT & Sustainable Open-Source Software via Astropy ($6,868)

Supervision/Mentorship

2024 - Present **Nikki Yat Ning Wang** (BASc graduate, UCL)
MPIA summer internship: Time-series analysis to probe the interior of massive stars

2024 - Present **Rohith Pudari** (PhD, Computer Eng., UofT) with Shurui Zhou (UofT)
Large Language Model (LLM) to generate tutorials for scientific software

2024 - Present **Jenny Su** (PhD, Astronomy & Astrophysics, UofT) with Gwendolyn Eadie (UofT)
Estimating the periodicities of RR Lyrae stars using the multitaper F-test

2022 - 2024 **Jiayi Sun** (PhD, Computer Eng., UofT) with Shurui Zhou (UofT) and Jin Guo (McGill)
Improving collaboration efficiency of open-source scientific software teams

Summer 2021 **Suyog Garg** (BTech, IIITDM → MSc Physics, UTokyo) with Hans Moritz Guenther (MIT)
GSoC project: "Implementing the MRT/CDS table standards in Astropy"

2019 - 2020 **Stephanie Joachim** (High school, Harbord Collegiate Institute, Toronto)
Massey College Tutoring and Mentorship Program for students in need of academic support

Teaching

Instructor (materials available on GitHub)

2023 **The Astropy training school** Sofia, Bulgaria
Co-designed/taught (team of 4) a week-long (40 hrs) Astropy course for Eastern European students/scientists

2022 **Pan-African School for Emerging Astronomers (PASEA)** Livingstone, Zambia
Co-designed/taught (team of 3) a week-long (40 hrs) data science course for postgraduate students in Africa

2022 **PASEA Alumni Research Program** (virtual)
Co-designed/taught (team of 3) a week-long (40 hrs) astronomical data analysis course for PASEA alumni

Guest lecturer

2024 **International Max-Planck Research School Student Symposium**, 15 Nov. MPA, Garching
Deliver a 'Milky Way and smaller scales' lecture for PhD students; provide feedback on their presentations

Teaching Assistant (TA)

Winter 2021, 22 **Head TA**, AST 201: The Sun and its Neighbours, UofT
Led 30+ TAs for a 1000+ student course for non-science/engineering majors

Fall 2020, 21 **TA**, AST 221: Stars and Planets, UofT
Designed and ran weekly tutorials, held office hours, graded exams for astrophysics majors

2018 - 2020 **TA**, AST 201 and AST 101: Stars and Galaxies, UofT
Ran tutorials (40 students of 1000), planetarium shows, observing nights; designed test questions

Workshops

2024 **2024 Astropy SURF Tutorial & Hackathon** Utrecht, Netherlands
Co-organised a hack day and ran Python/Astropy tutorial sessions for university students across Netherlands

2024 **Introduction to Statistics 101** MPIA, Germany
Designed and taught a hands-on statistics workshop over 6 hours

Training & Certification

2021 - 2022 Teaching Fundamentals Certificate, Teaching Assistants' Training Program, UofT
2020 Advanced Training in Academic Writing and Speaking, GCAC, UofT

Publications

Refereed

Published:

2025 Sun, J.[*]; **Patil, A. A.**; Li, Y.; Guo, J. & Zhou, S. "Advancing Sustainable Communities in Scientific OSS: A Replication Study with Astropy". Accepted to the International Conference on Cooperative and Human Aspects of Software Engineering (CHASE)[1]. [arXiv/2402.15081] [*]led by student

2024 **Patil, A. A.**; Eadie, G.; Speagle, J. & Thomson, D. "Improving Power Spectrum Estimation Using Multitapering: Efficient Asteroseismic Analyses for Understanding Stars, the Milky Way, and Beyond". The Astronomical Journal, Volume 168, Issue 5, article id. 193, 21pp. [arXiv/2209.15027][3 citations]

2023 **Patil, A. A.**; Bovy, J.; Jaimungal, S.; Frankel, N. & Leung, H. W. "Decoding the age-chemical structure of the Milky Way disc: an application of copulas and elicitable maps". Monthly Notices of the Royal Astronomical Society, Volume 526, Issue 2, pp.1997-2016 [arXiv/2306.09319] [6 citations]

2022 **Patil, A. A.**; Bovy, J.; Eadie, G. & Jaimungal, S. "Functional Data Analysis for Extracting the Intrinsic Dimensionality of Spectra: Application to Chemical Homogeneity in the Open Cluster M67". The Astrophysical Journal, Volume 926, Issue 1, article id. 51, 24pp. [arXiv/2109.10891] [7 citations]

2022 The Astropy Collaboration, Price-Whelan, A. M.; Lim, P. L.; Earl, N.; Starkman, N.; Bradley, L.; Shupe, D. L.; **Patil, A. A.** 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, Volume 935, Issue 2, article id 167, 20pp. [arXiv/2206.14220] [2396 citations]

2018 The Astropy Collaboration et al. incl. **Patil, A. A.**. "The Astropy Project: Building an Open-science Project and Status of the v2.0 Core Package". The Astronomical Journal, Volume 156, Issue 3, article id. 123, 19pp. [arXiv/1801.02634] [7706 citations]

Submitted:

Patil, A. A.; Eadie, G.; Speagle, J. & Thomson, D. "Improving Harmonic Analysis using Multitapering: Precise frequency estimation of stellar oscillations using the harmonic F-test". Under Review at the Astronomical Journal. [arXiv/2405.18509]

"Collaboration Challenges and Opportunities in Developing Scientific Open-Source Software Ecosystems: A Case Study on Astropy". Conditional acceptance to the ACM SIGCHI Conference on Computer-Supported Cooperative Work & Social Computing (CSCW) led by student

In preparation:

Patil, A. A.; Aerts, C.; Wang, NYN.[*] & Van Beeck, J. "Beyond prewhitening: A new, efficient method to detect gravity modes in massive stars". To be submitted to A&A by May 2025. [*]student

[1]In computer engineering, peer-reviewed conferences are premier venues, often rivaling journals in quality and impact.

Su, J.*; **Patil, A. A.** & Eadie, G. "Estimating precise properties of RR Lyrae stars using the multitaper F-test". To be submitted to AAS journals by June 2025. *led by student

Non-refereed

2022 **Patil. A.** "aaryapatil/tapify: v0.1.0". Zenodo. doi.org/10.5281/zenodo.7312220

2022 Cruz, K.; Günther, H. M.; **Patil, A.**; Swinbank, J.; & Tollerud, E. "Astropy Proposal for Enhancement 19: Distributing Astropy Project Funding (APE19)". Technical Report, Zenodo. doi.org/10.5281/zenodo.6312048

2021 Robitaille, T. et al. incl. **Patil, A.** "astropy/astropy: v4.2.1", Zenodo. doi.org/10.5281/zenodo.4670729

2020 **Patil, A.**; Bovy, J.; & Eadie G. "Likelihood-free Inference of Chemical Homogeneity in Open Clusters". Joint Statistical Meetings Proceedings, ASA, pp 1838-1844.

Selected Professional Activities & Services

2025 - Present **Coordination Committee Member** (one of 5), The Astropy Project
Overall coordination and management of the project

2024 - 2025 **Program Chair**, ASA/Astrostatistics Interest Group
Coordinate & organize astrostatistics invited/contributed sessions at the Joint Statistical Meetings
Help run the group's annual Student Paper Competition

2024 - Present **Manuscript Referee**, RAS Techniques and Instruments

2024 - Present **Software Referee**, pyOpenSci/Journal of Open Source Software (JOSS)

2021 - Present **Finance Committee Member** (one of 4), The Astropy Project
Acquire/manage grants for the project, e.g., ∼1.6 million USD in Moore Foundation/NASA grants
Helped acquire a NASA foundation award in 2024 (cooperative agreement for up to five years)

2021 - Present **International Member**, WoAA, India
Supporting women, gender minorities, LGBTQI+ people in aeronautics, astronautics, STEM

Workshops & Schools

2025 (future) **Python in Astronomy Conference**, Scientific Organizing Committee (SOC)

2025 (future) **Data Science in Astronomy School**, Lead Organizer India
Proposal to organize a school at the Inter-University Centre for Astronomy and Astrophysics

2025 (future) **Data Science for Exploring Astronomical Archives**, Co-organizer Kenya
Funds acquired from the IAU I-HOW inititative, TU-Kenya, Max Planck Society

2022, 2024 **PASEA**, Co-organizer Zambia, Tunisia
Refer to the PASEA paper: Strubbe et al. (2021), Nature Astronomy, Volume 5, p. 217-220
Two PASEA co-directors won the 2024 IAU Astronomy Education Prize

2022 **Gaia Hike Workshop**, SOC Canada
Co-developed the talk/tutorial schedule and led the unconference session programming

Service at Home Institution

Max Planck Institute for Astronomy

2023 - Present **Fundamental Skills Workshop Co-organizer**, Data Science Group
Organize and run monthly workshops on data science skills as part of the group

2024 **MPIA Summer Internship Committee Member**
Propose internship projects, review applications, conduct interviews, and coordinate the internship

University of Toronto

2022 - 2023 **SMILE Journal Club Co-organizer**, Astronomy & Astrophysics
Inviting local/external speakers in astrostatistics and astroinformatics; organizing talks

2021 - 2023 **Learn Astropy Project Local Representative**, Dunlap Institute
Improving the computing skills of the Institute and developing educational resources for Astropy

2021 - 2022 **Anti-Racism Meetings Co-organizer**, Astronomy & Astrophysics
Running weekly meetings to learn and to take action against racism in the workplace

2020 - 2023 **Governing Board Risk Committee Member**, Massey College
First Elected Student on the Governing Board; helped develop the COVID-19 risk plan

2019 - 2022 **MasseyScope Astronomy Outreach Co-founder**, Massey College

2018 - 2020 **Anti-Racism and Diversity Committee Co-chair**, Massey College

2018 - 2021 **Mental Health, Health & Safety, Course Committee Member**, Grad. Astronomy

Selected Presentations (2020 - Present)

Invited Conference Talks

2024 **LSST Discovery Alliance Catalyst Symposium**, Oct. 21 — Chicago, USA
Plenary talk: Bridging Astrophysics & Data Science

2024 **243rd meeting of the AAS**, Jan. 8 — New Orleans, USA
Expert panelist: Building on 25 Years of Community Organization in Astro Software Development

2023 **LSST Discovery Alliance Catalyst Symposium**, Oct. 23 — Tucson, USA
Building a unified model of the Milky Way galaxy using Rubin/LSST

2022 **Astronomical Software Development Workshop**, May 20 — New York, USA
Project Governance & Management Session Lead (format modified due to COVID-19)

2021 **Statistical Challenges in Modern Astronomy VII Conference**, June 10
Bayesian Breakout: Likelihood-free Inference of Chemical Homogeneity in Open Clusters (virtual)

2020 **Joint Conf. for Sch. & Uni. students on Natural & Math. Sciences, Ukraine**, Dec. 3
How did the Milky Way Galaxy Form and Evolve? (virtual)

Invited Colloquia & Seminars

2025 **Institute of Astronomy (IvS) Seminar**, March 6 — Leuven, Belgium
Improved time-series analysis in the golden era of asteroseismology

2024 **Tartu Observatory Weekly Astronomical Seminar**, Oct 1 — Tartu, Estonia
Asteroseismology to understand stars and the Milky Way

2024 **KIPAC Tea Talk**, Aug 9 — Stanford, USA
Improving Time-Series Analysis to understand stars, the Milky Way, and beyond

2024 **LSST Discovery Alliance Institutional Members Meeting**, March 13
Community Impact: Data Science with LSST workshops (virtual)

2024 **Florida State University Astrophysics Group Seminar**, Feb. 21
Building a unified model of the Milky Way galaxy using astrostatistics (virtual)

2024 **Königstuhl Colloquium**, Feb. 16 — Heidelberg, Germany
Understanding the formation history of the Milky Way galaxy using astrostatistics

2023 **Toronto AstrophysicS Talks, Y'all (TASTY)**, Nov. 2023 — Toronto, Canada
Order in Chaos: Decoding the Age-Metallicity Structure of the Milky Way disk

2023 **NRC Herzberg Astronomy and Astrophysics Seminar**, March 1 — Victoria, Canada
Building a unified model of the Milky Way galaxy

2022 **Good Vibrations Seminar**, Oct. 26
Multitaper Spectral Analysis: Precise asteroseismic modeling of stars, exoplanets, and beyond (virtual)

2021 **Statistics & MachIne LEarning (SMILE) Journal Club, UofT**, Nov. 19
"Multitaper Spectral Estimation for Asteroseismology" (virtual)

2021 **Women of Aeronautics and Astronautics (WoAA), India**, Dec. 4
Around the World Speaker Series: From Computer Engineering to Astrophysics (virtual)

2020 **International CHASC AstroStatistics Centre, Harvard University**, Nov. 17
Likelihood-free Inference of Chemical Homogeneity in Open Clusters (virtual)

2020 **SMILE, UofT**, October 16
Introduction to Neural Networks (virtual)

Contributed Conferences Talks

2024	LSST@Europe6	La Palma, Spain
2020 - 2024	Joint Statistical Meetings (JSM) Conference	USA/Canada
2024	Astropy coordination meeting	Utrecht, Netherlands
2024	243rd meeting of the AAS	New Orleans, USA
2023	Astrostatistics in Canada and Beyond	Banff, Canada
2022, 2023	TASC/KASC Workshop	USA/Belgium
2023	Canadian Astronomical Society (CASCA) Meeting	Penticton, Canada
2023	Wide-Field Spectroscopy vs Galaxy Formation Theory	Tucson, USA
2022	Multitaper Spectral Analysis Workshop	virtual
2021	HRMOS Science Workshop	virtual
2020, 2021	Sloan Digital Sky Survey Meeting	virtual
2021	GALactic Archaeology with HERMES Science Meeting	virtual
2021	Stellar Stats Workshop, UofT	virtual

Outreach

2018 - 2022	AstroTours Toronto Outreach Volunteer
2018 - 2020	Astronomy on Tap Toronto Volunteer
2020	National Society of Black Physicists Booth Volunteer
2019	Planet Party Toronto and Science Rendezvous Toronto Volunteer