Daniel Muthukrishna

Physicist, engineer and AI researcher · Research Scientist, MIT Kavli Institute · AstroAI Fellow, Harvard & Smithsonian Center for Astrophysics
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Profile

AI researcher with a decade of experience developing foundational methods to model, predict, and make optimal decisions about complex physical systems, deployed in production on NASA space missions and international sky surveys, and a background in electrical and aerospace engineering and RF hardware. Publications span NeurIPS, ICML, ICLR, and the leading astrophysics journals (3,000+ citations, h-index 21). Proven record of leading multidisciplinary teams of engineers and scientists, securing competitive research funding, and mentoring researchers from high school to PhD level.

Research and Work Experience

Harvard University & Smithsonian Astrophysical Observatory — *Cambridge, MA, USA*

AstroAI Fellow, Center for Astrophysics — *Sep. 2025 – Present*

- Lead development of causal foundation models that disentangle underlying physics from instrument effects in scientific time series and imaging, enabling models to generalise across observatories, sensors, and scientific domains (ICML 2025, ICLR 2026, NeurIPS 2026).
- Coordinate a multi-modal AI group of eleven researchers and organise the AstroAI seminar series across Harvard and the Smithsonian.

Massachusetts Institute of Technology — *Cambridge, MA, USA*

Research Scientist, Kavli Institute for Astrophysics and Space Research — *Sep. 2025 – Present*

Postdoctoral Researcher — *Sep. 2021 – Aug. 2025*

- Pioneered geometry-conditioned diffusion models (BEAM) that model and remove scattered-light systematics in TESS images without paired data (NASA-funded; NeurIPS 2026). NASA used its blind forecast of the scattered light to position the spacecraft for the January 2026 observations of interstellar comet 3I/ATLAS.
- Lead the Astronet group for NASA's TESS mission, directing twelve software engineers (including volunteers from Google and Meta), research scientists, faculty, and PhD students to deliver the production deep learning pipeline for vetting exoplanet candidates.
- Developed deep learning and Bayesian frameworks for time-series analysis across TESS, ZTF, and LSST; created RAPID and DASH, real-time transient classifiers adopted by major surveys worldwide, and deployed a classifier and anomaly detector live on the Lasair alert broker.

University of California, Santa Cruz — *Santa Cruz, CA, USA*

Kavli Summer Fellow, Machine Learning in the Era of Large Astronomical Surveys — *Jul. 2019 – Aug. 2019*

Australian National University — *Canberra, Australia*

Research Assistant, Mount Stromlo Observatory — *Mar. 2017 – Aug. 2017*

Gemini South Observatory — *La Serena, Chile*

Research Internship — *Dec. 2016 – Feb. 2017*

Micreo Limited — *Brisbane, Australia*

Radio Frequency Engineer — *Dec. 2014 – Sep. 2016*

- Designed, simulated, manufactured, and bench-tested microwave-frequency systems for electronic-warfare applications on defence contracts.
- Worked alongside the RF design on FPGA-based signal processing and embedded edge-computing hardware.

Education

University of Cambridge — *Cambridge, UK*

PhD in Astrophysics, Institute of Astronomy — *Oct. 2017 – Jun. 2021*

- Thesis: Data-Driven Discovery of Transients in the New Era of Time-Domain Astronomy. Advisors: Prof. Kaisey Mandel, Prof. Gautham Narayan.

University of Queensland — *Brisbane, Australia*

Bachelor of Science, Physics (First Class Honours) — *Mar. 2012 – Dec. 2016*

Bachelor of Engineering, Electrical & Aerospace (First Class Honours) — *Mar. 2012 – Dec. 2016*

- Coursework and project work in digital systems, embedded computing, and FPGA design; thesis awarded the IEEE Student Thesis Prize.

Selected Awards and Funding

2025 **NASA TESS Guest Investigator Program**, PI, awarded $90,000 for modelling TESS systematics with generative AI (15% success rate)
2025 **MIT Generative AI Impact Consortium**, co-PI, awarded $150,000 to develop an astrophysics foundation model
2025 **AstroAI Fellowship, Smithsonian Astrophysical Observatory**, fellowship funding independent AI research ($86,000 per year)
2024 **DAAD AInet Fellow**, selected as an outstanding international early-career AI researcher
2021 **Paul Murdin Prize**, best published journal paper by an astronomy PhD student at Cambridge
2019 **JSM Astrostatistics Student Paper Competition**, finalist for the best astrostatistics paper, American Statistical Association
2017 **Cambridge Australia Poynton Scholarship**, awarded to top Australian applicants for PhD study at Cambridge
2017 **Imperial College President's PhD Scholarship**, awarded to the top applicants across Imperial College (declined in favour of Cambridge)
2017 **Bok Prize High Commendation**, awarded to the top three astronomy Honours or Master's theses in Australia
2016 **IEEE Student Thesis Prize**, best engineering thesis in Queensland
2016 **GBST Best Software Project**, best software-related thesis at the University of Queensland

Selected Publications

Over 40 publications with 3,000+ citations (h-index 21) across AI venues and the leading astrophysics journals; full list on ADS. Daggers (†) mark students under my direct supervision.

- †Tufto, D., **Muthukrishna, D.** *Reversing the Roles of Signal and Noise: Modeling Noise in Astronomical Images without Paired Data.* Accepted to NeurIPS 2026, main track.
- †Mercader-Perez, P., Cuesta-Lazaro, C., **Muthukrishna, D.**, et al. *Learning What's Real: Disentangling Signal and Measurement Artifacts in Multi-Sensor Data, with Applications to Astrophysics.* ICLR Workshop on Foundation Models for Science (2026); accepted to NeurIPS 2026, main track.
- Klein, S., **Muthukrishna, D.** [equal first-author]. *Representation Learning in Physics.* Invited review for the VERaIPHY initiative; submitted to SciPost Physics (2026).
- †Mercader-Perez, P., †Dimond, D., **Muthukrishna, D.**, et al. *Identifying Exoplanets with Deep Learning. VII. Automating Exoplanet Discovery in TESS Data with AstroNet-Vetting-v2.* Accepted to AJ (2026).
- PhyTS collaboration, Armstrong, B., et al. [incl. **Muthukrishna, D.**]. *PhyTS: A Benchmark for Scientific Time Series.* Accepted to NeurIPS 2026, Evaluations and Datasets Track.
- †Waehner, N., Cuesta-Lazaro, C., **Muthukrishna, D.**, Glidden, A., Garraffo, C. *Towards Robust Biosignature Gas Detection in Exoplanet Atmospheres.* Accepted to the NeurIPS 2026 Machine Learning and the Physical Sciences Workshop.
- Gregory, P., Audenaert, J., et al. (incl. **Muthukrishna, D.**). *ASTRAFier: A Novel and Scalable Transformer-based Stellar Variability Classifier.* Submitted to AAS Journals (2026, in review).
- Audenaert, J., **Muthukrishna, D.** [equal first-author], et al. *Causal Foundation Models: Disentangling Physics from Instrument Properties.* ICML Workshop on Foundation Models for Structured Data (2025).
- †Gupta, R., **Muthukrishna, D.**, et al. *Transfer Learning for Transient Classification: From Simulations to Real Data and ZTF to LSST.* MNRAS Letters, 542, L132 (2025).
- †Gupta, R., **Muthukrishna, D.** *Simulation-Based Pretraining and Domain Adaptation for Astronomical Time Series Tasks with Minimal Labeled Data.* ICML Workshop on Foundation Models for Structured Data (2025); submitted to MNRAS.
- †Gupta, R., **Muthukrishna, D.**, Lochner, M. *A Classifier-Based Approach to Multi-Class Anomaly Detection for Astronomical Transients.* RAS Techniques and Instruments, 4, rzae054 (2024).
- †Huang, H., **Muthukrishna, D.**, et al. *Predicting the Age of Astronomical Transients from Real-Time Multivariate Time Series.* NeurIPS Machine Learning and the Physical Sciences Workshop (2023).
- **Muthukrishna, D.**, Mandel, K., et al. *Real-time Detection of Anomalies in Large-scale Transient Surveys.* MNRAS, 517, 393 (2022). Paul Murdin Prize.
- **Muthukrishna, D.**, Narayan, G., et al. *RAPID: Early Classification of Explosive Transients using Recurrent Neural Networks.* PASP, 131, 118002 (2019). 250+ citations.
- **Muthukrishna, D.**, Parkinson, D., Tucker, B. *DASH: Deep Learning for the Automated Spectral Classification of Supernovae and their Hosts.* ApJ, 885, 85 (2019).

Leadership, Open-Source Systems and Service

Team leadership and mentoring. Lead the twelve-person Astronet team for NASA's TESS mission and coordinate the eleven-person multi-modal AI group at the Center for Astrophysics. Supervised fourteen students from high school to PhD, including three current PhD and Master's students (Pablo Mercader-Perez and Drew Tufto at MIT, Anna Tartaglia at Harvard); students have published at NeurIPS, ICML, MNRAS, and RASTI, and have gone on to Stanford, Caltech, UT Austin, Tesla, Waymo, Verizon, Capital One, and OpenAI.

Open-source AI systems in operational use. RAPID (real-time transient classification; 250+ citations; integrated into the Fink and Lasair alert brokers), DASH and AstroDASH 2.0 (supernova spectral classification, with a web platform and REST API), BEAM (generative correction of space-telescope systematics), MCIF and the simulation-pretrained classifier (running live on Lasair on the LSST and ZTF alert streams), and open COVID-19 dashboards used worldwide.

Review panels and refereeing. Invited review panellist for the National Science Foundation (survey proposals of up to $2 million; 2024, 2026), NASA's TESS Guest Investigator Program (2024, 2026), and Schmidt Sciences' LINCC Frameworks mid-project review ($3 million per year; 2025); Master's thesis examiner, University of Canterbury (2025); CfA Predoctoral Research Review Committee (2026); referee for ApJ, Nature Astronomy, A&A, MNRAS, AJ, IEEE journals, and the NeurIPS and ICML machine learning for physical sciences workshops.

Invited talks. CERN (2026, Gravitational Waves in the Era of AI); NASA AI/ML Science and Technology Lecture (2026); NASA Goddard, TESS Partners' Meeting (2026); Johns Hopkins University, Institute for Data-Intensive Engineering and Science (2025); University of Oxford, Breakthrough Discuss (2024); NASA Jet Propulsion Laboratory, Machine Learning and Instrument Autonomy group (2023); Korea Astronomy and Space Science Institute (2022); Stanford University, SLAC AI Seminar Series (2020); industry seminar at Telstra (2021).

Collaborations and community. Long-term member of the LSST Dark Energy Science Collaboration (co-developed the PLAsTiCC classification challenge, 1,000+ teams on Kaggle), the Young Supernova Experiment, the Dark Energy Survey (OzDES), and the Habitable Worlds Observatory AI/ML Working Group; co-organiser of the Boston Astrophysics x Machine Learning Hackathon (2024) and the Accelerating Physics with ML workshop at MIT (2023); local organising committee, TESS Science Conference III.

Teaching. Designed and lecture the thirteen-week undergraduate course Data-driven Astronomy: Machine Learning and Statistics for Modern Astronomy (Cambridge Centre for International Research, 2023 – present); organised and lectured Cambridge's intensive summer computing course (2018, 2019).

Skills

Machine learning	Diffusion and flow-matching models, transformers, recurrent and convolutional networks, causal representation learning, simulation-based pretraining and domain adaptation, Bayesian inference, anomaly detection.
Systems and software	Production ML pipelines for a NASA mission, real-time inference on live alert streams, distributed GPU training, web apps and REST APIs; Python (PyTorch, TensorFlow, JAX, scikit-learn), C, C++, SQL, MATLAB, Fortran, Java.
Hardware	Electrical and aerospace engineering training; RF and microwave design, simulation and manufacture; PCB assembly and bench test (VNA, spectrum analyser, oscilloscope); firmware and hardware for microcontrollers, FPGAs, and embedded edge-computing systems.