Matt L. Sampson

Homepage | matt.sampson@princeton.edu | linkedin | SampsonML | Scholar

Research interests

I studying ways to advance science through the use of machine learning with a particular focus on modeling dynamical systems, deep learning, and generative modelling.

Education

- **Princeton University** *2022-Present*
  Doctor of Philosophy Princeton, USA
  - **Specialization:** Machine learning, computational astrophysics
- **Princeton University** *2022-2023*
  Masters of Science Princeton, USA
- **Australian National University** *2021*
  Honours (First class) Canberra, Australia
  - **Thesis:** "*Simulating large scale cosmic ray propagation through compressible magnetohydrodynamic turbulence*
- **Queensland University of Technology** *2017-2020*
  Bachelor of Science Brisbane, Australia
  - **Major:** Physics
- **Queensland University of Technology** *2017-2020*
  Bachelor of Science Brisbane, Australia
  - **Major:** Applied and Computational Mathematics

Publications

C=Conference/workshop, J=Journal, R=In review

[R] **Sampson, M. L.**, Melchior, P., (2025). "Path-minimised latent ODEs as inference models" *arXiv:2410.08923*

[J] Ward, C., Melchior, P., **Sampson, M.L.**, et al., (2025). "Disentangling transients and their host galaxies with scarlet2: A framework to forward model multi-epoch imaging." *Astronomy and Computing, 100930*

[J] **Sampson, M. L.**, Melchior, P., Ward, C., & Birmingham, S. (2024). "Score-matching neural networks for improved multi-band source separation" *Astronomy and Computing, 49, 100875*
Citations: 2

[J] **Sampson, M. L.**, Beattie, J. R., Krumholz, M. R., et al. (2023) "The turbulent diffusion of streaming cosmic rays through compressible, partially ionised plasma." *Monthly Notices of the Royal Astronomical Society 519 (1), 1503-1525*
Citations: 21

[C] **Sampson, M. L.**, Melchior, P. (2023) "Spotting Hallucinations in Inverse Problems with Data-Driven Priors" *ICML ML4 Astro Spotlight talk*
Citations: 2

[J] Krumholz, M. R., Crocker, R. M., **Sampson, M. L.,** (2022) "Cosmic Ray Interstellar Propagation Tool using Itô Calculus (CRIPTIC): software for simultaneous calculation of cosmic ray transport and observational signatures." *Monthly Notices of the Royal Astronomical Society 517 (1), 1355-1380*
Citations: 12

[J] Beattie, J. R., Krumholz, M. R., Federrath, C., **Sampson, M. L.,** Crocker, R. M. (2022). "Ion Alfvén velocity fluctuations and implications for the diffusion of streaming cosmic rays" *Frontiers in Astronomy and Space Sciences*
Citations: 15

[J] Stevenson, S., **Sampson, M. L.**, Powell, J., et al. (2019). The impact of pair-instability mass loss on the binary black hole mass distribution. *The Astrophysical Journal, 882(2), 121.*
Citations: 176

Research Internships/other Positions

- **Research Assistant QUT (Computational Statistics)** 2020–2021
  Worked as a research assistant at the Queensland University of Technology with Professor Kevin Burrage and Dr Brodie Lawson in the area of computational statistics involving techniques from the fields of MCMC and information geometry.
- **ICRAR Summer Scholar (Computational Astrophysics)** 2019–2020
  Worked under the supervision of Professors Chris Power and Peter Quinn investigating the structure of dark matter haloes through the use of observational data and SPH simulations.
- **Research Assistant QUT (Computational Statistics/Data Analysis)** 2019–2020
  Employed as a research assistant at the Queensland University of Technology under the supervision of Associate Professor Jennifer Firn. Tasks involved using local HPC infrastructure to run statistical models using R on ecological data.
- **CAS Summer Scholar (Computational Astrophysics)** 2018–2019
  Worked under the supervision of Dr Simon Stevenson and Dr Jade Powell to study the effect of Pulsational Pair Instability supernova on the binary black hole merger rate. This was done using the HPC facility OzStar and the population synthesis code COMPAS https://compas.science/.
- **Research Assistant QUT (Medical Physics)** 2018
  Employed as a research assistant at the Queensland University of Technology under the supervision of Professor Soniya Yambem. Involved in the production and testing of organic biosensors used to detect trace amounts of glucose from external sources such as saliva.

Technical Skills

Languages: Python (JAX, PyTorch, diffrax, equinox), C++, FORTRAN, R, MATLAB (*ordered by proficiency*)
Mathematical: advanced calculus and linear algebra, ODEs/PDEs, statistics and probability, Bayesian inference, computational statistics
Dev/Databases/Other: Git, bash, remote/cluster computing, high-performance computing, SQL

Teaching Experience

Experience teaching the following units at QUT and Princeton where my role ranged from the delivery of content, marking of assignments in an equitable manner, and engaging students with new content such as programming languages and higher level statistics for the first time.

- AST205 Planets and the Universe (1 Semester)
- SEB104 Grand Challenges in Science (3 Semesters)
- SEB113 Quantatative Analysis (3 Semesters)
- SEB115 Experimental Science (2 Semesters)
- PVB101 Physics of the Very Large (2 Semesters)
- BVB204 Ecology - Statistics Component (2 Semesters)

Honors and Awards

- 2022 Princeton Gradute Program First Year Fellowship in Natural Sciences
- 2021 Bok Honours Scholarship in Astrophysics at the RSAA
- 2020 Deans List of Commendation for academic excellence
- 2020 Equal first place prize for best science talk at ANU RSAA student conference
- 2020 Best presentation PVB302 Quantum Physics poster conference
- 2019 Accepted into the Deans Scholars Program QUT for high achieving students
- 2019 ICRAR-Pawsey Centre Vacation Scholar
- 2019 Deans List of Commendation for academic excellence
- 2018 Swinburne Centre for Astrophysics and Supercomputing Summer Vacation Scholarship
- 2018 Deans List of Commendation for academic excellence
- 2017 Accepted into QUT's College of Excellence for high acheiving students
- 2017 Deans List of Commendation for academic excellence

References

Provided per request