

MATT SAMPSON

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Experience

Princeton University 2022 – Present
Graduate Researcher (Machine Learning) NJ, USA

- Designed, implemented, tested score-based diffusion model to assist in galaxy source separation. To be used in upcoming large telescope surveys **Python (JAX, equinox)**, **HPC/GPU computing**, **remote/cluster computing**
- Implemented method for computing efficient 2^{nd} order methods quantifying hallucinations in neural networks (**JAX**)
- Developed novel regularization methods for generative latent ODE models **JAX–Python**

Australian National University Jan 2021 – Nov 2021
Honours Researcher (Computational Astrophysics/Software) Australia

- Assisted in the development of a novel cosmic ray propagation code **CRIPTIC (C++, Python, bash)**
- Troubleshoot, fixed bugs and implemented features such as continuous time integration, external file reading into the source code (**GDB: The GNU Project Debugger**)

Queensland University of Technology 2019 – 2021
Research Assistant (Computational Statistician) Remote – Brisbane, QLD, Australia

- Assisted in development of statistical tools improving on standard MCMC routines, increase runtime performance by **90%** with no drop model quality **MATLAB, bash**
- Designed and developed statistical analysis tools for very large datasets in biology **Python, R, MATLAB, bash**, work resulting in publications for the biology team.

Technical Skills

Languages: Python (JAX, PyTorch, diffrax, equinox), C++, FORTRAN, R, MATLAB

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

Education

Princeton University, NJ, USA 2022 - 2026 expected
Ph.D. in Computational Astrophysics (machine learning)

Princeton University, NJ, USA 2023
Masters in Computational Astrophysics (machine learning)

Australian National University, Canberra, Australia 2021
Honours (similar to US masters) in Computational Astrophysics First class honours, GPA 6.9/7

Queensland University of Technology, Brisbane, QLD, Australia 2020
Bachelor of Mathematics (Applied and Computational) Awarded with distinction GPA 7/7

Queensland University of Technology, Brisbane, QLD, Australia 2020
Bachelor of Science (Physics) Awarded with distinction GPA 6.9/7

Selected Publications

- **Sampson, M. L.**, Melchior, P., (2024). “Path-minimised latent ODEs as inference models” *arXiv:2410.08923*
 - **Sampson, M. L.**, Melchior, P., Ward, C., & Birmingham, S. (2024). “Score-matching neural networks for improved multi-band source separation” *Astronomy and Computing, arXiv preprint arXiv:2401.07313* **Citations: 2**
 - **Sampson, M. L.**, Beattie, J. R., Krumholz, M. R., Crocker, R. M., Federrath, C., Seta, A. (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: 16**
 - **Sampson, M. L.**, Melchior, P. (2023) “Spotting Hallucinations in Inverse Problems with Data-Driven Priors” *ICML ML4 Astro Spotlight talk* **Citations: 1**
 - 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: 9**
 - 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: 14**
 - 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: 167**
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