Thomas Gessey-Jones

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arxiv.org/a/gesseyjones_t_1.html
[redacted]

Education

2020 – ◇ **PhD, Physics, University of Cambridge.**
Primary Supervisor: Dr Eloy de Lera Acedo.
Secondary Supervisors: Prof Anastasia Fialkov and Dr Will Handley.
(*Provisional*) Title: Probing the first stars with the 21-cm signal; theory, methods, and forecasts.

2016 – 2020 ◇ **MSci & MA, Natural Sciences (Physics), University of Cambridge.**
Project Supervisor: Dr Will Handley.
Project Title: Initial conditions before inflation.

Employment

Jun – Aug 2018 ◇ **Summer Research Student, Cavendish Laboratories.**
Supervisor: Prof John Ellis.
Investigation of anomalous surface diffusion via molecular dynamics simulations.

Jun – Aug 2017 ◇ **Summer Research Student, Coventry University.**
Supervisor: Prof Ralph Kenna.
Investigating dynamic sociological networks in fictional literature.

Jul – Aug 2015 ◇ **Summer Research Student, Coventry University.**
Supervisor: Dr Joseph Yose.
Mathematical analysis of social networks in mythological texts.

Selected Awards & Prizes

2023 ◇ **Cavendish Prize in Theoretical Physics**, Cavendish Laboratories.

2021 – 2022 ◇ **Graduate Award for Excellence in Teaching**, Fitzwilliam College.

2021 ◇ **Best Presentation**, Cavendish Graduate Conference 2021.

2020 ◇ **Cavendish Part III prize**, Cavendish Laboratories.
For "best overall performance in Part III".

◇ **Microsoft Research Award**, Cavendish Laboratories.
For "the most novel scientific results relying on the use of computers".

◇ **Mary Lucking Prize**, Fitzwilliam College.
For "most exceptional record of academic achievement during his Cambridge career".

2018 ◇ **Cavendish Part IB B prize**, Cavendish Laboratories.
For "best overall performance in Part IB B".

2016 – 2023 ◇ **Junior and Senior Scholarships**, Fitzwilliam College.

2016 – 2020 ◇ **OCR Cambridge Bursary**, Oxford Cambridge RSA.

2016 ◇ **Silver Medal**, International Physics Olympiad.

Mentoring

2023 – ◇ **Daniel Kessler, MASt (Part III Physics) Research Project.**
Co-supervising with Dr Boyuan Liu and Prof Anastasia Fialkov.
Investigating the observational impacts of exotic models of the first stars.

◇ **Rachel Incley, MSci (Part III Astrophysics) Research Project.**
Co-supervising with Jiten Dhandha and Prof Anastasia Fialkov.
Contrasting reionization model paradigms to determine why they disagree.

Summer 2023 ◇ **Almudena Visser Velez, David and Bridget Jacob Summer Internship.**
Co-supervised with Prof Anastasia Fialkov.
Constraining the first stars via the null detection of their supernovae by JWST.

Summer 2022 ◇ **Donghui (Clark) Huang, Summer Research Placement.**
Co-supervised with Prof Anastasia Fialkov.
Investigating the possibility of detecting BAO in the 21-cm power spectrum.

◇ **Agustina Rodriguez, Summer Research Placement.**
Co-supervised with Prof Anastasia Fialkov.
Forecasting constraints on early Universe astrophysics from the SKA.

Teaching

2021 ◇ **Part III Physics Supervisor: Relativistic Astrophysics and Cosmology.**
Cavendish Laboratories, 8 hours total.

2020 – ◇ **Part IA Physics Supervisor.**
Fitzwilliam College, 160 hours total.

2020 ◇ **Part IA Physics Revision Classes.**
Fitzwilliam College, 6 hours total.
One-off revision classes to help mitigate the impacts of the COVID-19 pandemic.

2018 ◇ **UK IPhO Team Tutor.**

2017 – 2020 ◇ **BPhO Round 1 Exam Checker.**

2017 – 2019 ◇ **STIMULUS programme volunteer**

Academic Talks

Nov 2023 ◇ **Measuring the Mass Distribution of the First Stars via the 21-cm Signal,** Cavendish Graduate Conference, University of Cambridge.

Sep 2023 ◇ **Constraining the First Stars with REACH,** REACH Annual Meeting 2023, University of Malta.

◇ **Prospective Constraints on the Mass Distribution of the First Stars from the 21-cm Global Signal,** 6th Global 21-cm Workshop, IFPU Trieste.

Jul 2023 ◇ **Prospective Constraints on the Mass Distribution of the First Stars from the 21-cm Power Spectrum,** National Astronomy Meeting 2023, Cardiff University.

Feb 2023 ◇ **21-cm Theory: The Essentials,** 2023 DARA Workshop on 21-cm Astronomy, Stellenbosch University (remote).

Oct 2022 ◇ **Signatures of Cosmic Ray Heating in 21-cm Observables,** 5th Global 21-cm Workshop, University of California Berkeley.

◇ **Modelling Astrophysical Processes for Semi-Numerical Simulations,** HERA Annual Meeting 2022, University of California Berkeley.

Apr 2022 ◇ **Simulating the First Stars in Semi-Numerical 21-cm Signal Models**, Kavli Focus Meeting - Observational and Theoretical 21-cm Cosmology, University of Cambridge.

Academic Talks (continued)

Mar 2022 ◇ **Probing the First Stars with the Cosmic Dawn 21-cm Signal,** SAZERAC 21cm, Online.

Nov 2021 ◇ **Probing the First Stars with 21-cm Cosmology,** Cavendish Graduate Conference, University of Cambridge.

Oct 2021 ◇ **Probing the First Stars with 21-cm Cosmology,** 4th Global 21-cm Workshop, University of Colorado Boulder (remote).

Jul 2021 ◇ **Probing the First Stars with 21-cm Cosmology,** Cambridge 21-cm Cosmology Meeting, University of Cambridge (remote).

Feb 2021 ◇ **Approximate Analytic Primordial Power Spectra in the Kinetic Dominance Paradigm,** DAMPT Cosmology Journal Club. University of Cambridge (remote).

◇ **Observationally constraining the pre-inflation initial quantum vacuum,** Battcock Centre Coffee Time Talks (a.k.a. Hills Seminars), University of Cambridge (remote).

Jan 2021 ◇ **Primordial Black Holes and 21-cm Cosmology,** UKRI STFC Astronomy Course. Durham University (remote).

Collaborations

2022 – ◇ **HERA,** interferometer targeting 21-cm power spectrum. Member of theory subgroup.

2020 – ◇ **REACH,** radiometer targeting 21-cm global signal. Member of theory and data subgroups.

Software

prescience ◇ Sole author and maintainer: GitHub

21cmSPACE ◇ Principle maintainer

margarine ◇ Contributor: GitHub

globalemu ◇ Contributor: GitHub

anesthetic ◇ Contributor: GitHub

References

Prof Andrew Jardine
Professor in Experimental Physics
University of Cambridge,
Fitzwilliam College, Storey's Way, Cambridge, CB3 0DG.
apj24@cam.ac.uk

Prof Anastasia Fialkov
Professor of Astrophysics and Cosmology
University of Cambridge,
Institute of Astronomy, Madingley Road, Cambridge, CB3 0HA.
afialkov@ast.cam.ac.uk

Dr Eloy de Lera Acedo
Associate Professor of Radio Cosmology
University of Cambridge,
Cavendish Laboratories, JJ Thomson Ave, Cambridge, CB3 0HE.
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Dr Will Handley
Royal Society University Research Fellow
University of Cambridge,
Kavli Institute for Cosmology, Madingley Road, Cambridge, CB3 0HA
wh260@cam.ac.uk

Research Publications

First Author Publications:

1. Gessey-Jones, T., Fialkov, A., de Lera Acedo, E., Handley, W. J., & Barkana, R. (2023). Signatures of cosmic ray heating in 21-cm observables. MNRAS, *526*(3), 4262–4284. https://doi.org/10.1093/mnras/stad3014

2. Gessey-Jones, T., Pochinda, S., Bevins, H. T. J., Fialkov, A., Handley, W. J., de Lera Acedo, E., Singh, S., & Barkana, R. (2023a). On the Constraints on Superconducting Cosmic Strings from 21-cm Cosmology. *arXiv e-prints*, Article arXiv:2312.08828, arXiv:2312.08828. https://doi.org/10.48550/arXiv.2312.08828

3. Gessey-Jones, T., & Handley, W. J. (2023). Fully Bayesian Forecasts with Evidence Networks. *arXiv e-prints*, Article arXiv:2309.06942, arXiv:2309.06942. https://doi.org/10.48550/arXiv.2309.06942

4. Gessey-Jones, T., Sartorio, N. S., Fialkov, A., Mirouh, G. M., Magg, M., Izzard, R. G., de Lera Acedo, E., Handley, W. J., & Barkana, R. (2022a). Impact of the Primordial Stellar Initial Mass Function on the 21-cm Signal. *MNRAS*, *516*(1), 841–860. https://doi.org/10.1093/mnras/stac2049

5. Gessey-Jones, T., & Handley, W. J. (2021). Constraining quantum initial conditions before inflation. *Physical Review D*, *104*(6), Article 063532, 063532. https://doi.org/10.1103/PhysRevD.104.063532

6. Gessey-Jones, T., Connaughton, C., Dunbar, R., Kenna, R., MacCarron, P., O'Conchobhair, C., & Yose, J. (2020). Narrative structure of A Song of Ice and Fire creates a fictional world with realistic measures of social complexity. *Proceedings of the National Academy of Science*, *117*(46), 28582–28588. https://doi.org/10.1073/pnas.2006465117

Other Publications:

7. Pochinda, S., Gessey-Jones, T., Bevins, H. T. J., Fialkov, A., Heimersheim, S., Abril-Cabezas, I., de Lera Acedo, E., Singh, S., Sikder, S., & Barkana, R. (2023). Constraining the properties of Population III galaxies with multi-wavelength observations. *arXiv e-prints*, Article arXiv:2312.08095, arXiv:2312.08095.

8. Fialkov, A., Gessey-Jones, T., & Dhandha, J. (2023). Cosmic mysteries and the hydrogen 21-cm line: bridging the gap with lunar observations. *arXiv e-prints*, Article arXiv:2311.05366, arXiv:2311.05366. https://doi.org/10.48550/arXiv.2311.05366

9. Razavi-Ghods, N., Roque, I. L. V., Carey, S. H., Ely, J. A., Handley, W., Magro, A., Chiello, R., Huang, T., Alexander, P., Anstey, D., Bernardi, G., Bevins, H. J. T., Cavillot, J., Croukamp, W., Cumner, J., de Lera Acedo, E., de Villiers, D. I. L., Fialkov, A., Gessey-Jones, T., … Zarb-Adami, K. (2023). Receiver design for the REACH global 21-cm signal experiment. *arXiv e-prints*, Article arXiv:2307.00099, arXiv:2307.00099. https://doi.org/10.48550/arXiv.2307.00099

10. de Lera Acedo, E., de Villiers, D. I. L., Razavi-Ghods, N., Handley, W., Fialkov, A., Magro, A., Anstey, D., Bevins, H. T. J., Chiello, R., Cumner, J., Josaitis, A. T., Roque, I. L. V., Sims, P. H., Scheutwinkel, K. H., Alexander, P., Bernardi, G., Carey, S., Cavillot, J., Croukamp, W., … Zarb-Adami, K. (2022). The REACH radiometer for detecting the 21-cm hydrogen signal from redshift z ≈ 7.5-28. *Nature Astronomy*, *6*, 984–998. https://doi.org/10.1038/s41550-022-01709-9

11 Cumner, J., de Lera Acedo, E., de Villiers, D. I. L., Anstey, D., Kolitsidas, C. I., Gurdon, B., Fagnoni, N., Alexander, P., Bernardi, G., Bevins, H. T. J., Carey, S., Cavillot, J., Chiello, R., Craeye, C., Croukamp, W., Ely, J. A., Fialkov, A., Gessey-Jones, T., Gueuning, Q., … Zarb-Adami, K. (2022). Radio Antenna Design for Sky-Averaged 21cm Cosmology Experiments: The REACH Case. *Journal of Astronomical Instrumentation*, *11*(1), Article 2250001-2058, 2250001–2058. https://doi.org/10.1142/S2251171722500015

Data Sets:

12 Gessey-Jones, T., Pochinda, S., Bevins, H. T. J., Fialkov, A., Handley, W. J., de Lera Acedo, E., Singh, S., & Barkana, R. (2023b, October). *On the Constraints on Superconducting Cosmic Strings from 21-cm Cosmology (supplementary inference products)* (Version 1.0.0). Zenodo. https://doi.org/10.5281/zenodo.8362801

13 Gessey-Jones, T., Sartorio, N. S., Fialkov, A., Mirouh, G. M., Magg, M., Izzard, R. G., de Lera Acedo, E., Handley, W. J., & Barkana, R. (2022b, February). *Pop iii star lyman band spectra* (Version 1.0.0). Zenodo. https://doi.org/10.5281/zenodo.5553052