Steven D. Cunnington

Personal details

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Research overview

I am a cosmologist focusing on how surveys of large-scale cosmic structure can test our understanding of the Universe. My primary research is developing a technique that maps emission intensity from neutral hydrogen at radio wavelengths. I have leading roles in the collaborations that are at the forefront of this technique, known as HI intensity mapping. I am also involved in optical/near-infrared collaborations and am interested in the benefits gained from cross-correlation between surveys at multiple wavelengths.

Research positions

Apr 2025 - Present	Stephen Hawking Research Fellow Institute of Cosmology & Gravitation, UNIVERSITY OF PORTSMOUTH
Apr 2022 - Apr 2025	Post-Doctoral Research Associate THE UNIVERSITY OF MANCHESTER
Dec 2021 - Apr 2022	Post-Doctoral Research Assistant THE UNIVERSITY OF EDINBURGH
Oct 2019 - Dec 2021	Post-Doctoral Research Assistant QUEEN MARY UNIVERSITY OF LONDON

Education

Oct 2016 - Sep 2019	PhD Cosmology - *Cert. (Feb 2020) Examiners: Prof David Alonso and Prof Robert Crittenden* Institute of Cosmology & Gravitation, UNIVERSITY OF PORTSMOUTH *Thesis*: Synergies Between 21cm & Optical Surveys for Probing Large Scale Cosmic Structure First Supervisor: Prof David Bacon - Co-Supervisor: Dr Alkistis Pourtsidou
Oct 2012 - Jun 2016	BSc (Hons) Physics - *First Class Honours* UNIVERSITY OF SOUTHAMPTON
Summer 2015	Summer Research Placement Institute of Cosmology & Gravitation, UNIVERSITY OF PORTSMOUTH Placement Supervisor: Prof Thomas Collett

Grants & awards

Royal Astronomical Society Early Career Award (£1,000) - Career which has shown the most promising development within five years of PhD completion	Jan 2025
UKRI Stephen Hawking Fellowship (£420,248) - Funding for project *Establishing the era for large-scale radio cosmology*	Sep 2024
Royal Society International Exchange grant (£6,000) - Funding research exchange visits with Canada promoting collaboration between MeerKLASS and CHIME	Jun 2024
SKAO sponsorship for annual SWG meeting (€2,000)	Jan 2023
SEPNet Student Conference fund for student-led conference (£4,500)	Apr 2019
ICG Portsmouth funded studentship and maintenance grant for PhD (∼£43,000 + fees)	Oct 2016
SEPNet Summer Research Placement Grant (£2,000)	Jun 2015

Collaboration membership & roles

- Member of the MeerKAT Large Area Synoptic Survey (**MeerKLASS**) — **2019 - Present**
  - Full member — Oct 2019 - Present
  - MeerKLASS Power Spectrum and Foreground Cleaning **Working Group lead** — Jun 2022 - Nov 2024
  - MeerKLASS Power Spectrum **Working Group lead** — Nov 2024 - Present
  - A leading co-author on the successful MeerKLASS 2,500 hour multi-year proposal — May 2023
  - A leading co-author on the successful extra-large observing proposal (XLP) renewal — Feb 2025
- Member of Square Kilometre Array (**SKA**) Cosmology Science Working Group (SWG) — **2018 - Present**
  - SKA Cosmology SWG Simulations **Working Group lead** — Mar 2021 - Present
  - Founding member of SKAO intensity mapping foreground cleaning challenge — Jan 2020 - Present
- Member of Euclid Consortium — **2018 - Present**
  - Regular contributor to Additional Probes Galaxy Clustering Working Package — Jul 2018 - Nov 2021
  - Lead for the 21cm-Euclid synergies project - (plans to revisit) — Dec 2020 - Nov 2021

Selected talks

2025

Invited colloquia/conferences (1):
- Astronomy Seminar, *University of Sussex, Brighton, UK*
- Royal Astronomical Society Highlights Meeting, *Burlington House, London, UK*
- Cosmology Seminar, Institute of Cosmology and Gravitation, *University of Portsmouth, UK*

Contributed talks (2):
- National Astronomy Meeting *Durham University, UK*
- SKAO General Science Meeting *Goerlitz, Germany*

2024

Invited colloquia/conferences (3):
- Instituto de Astrofísica Seminar, *CAUP Porto, Portugal*
- 21 cm Cosmology, Tianlai Collaboration Meeting *Hangzhou Dianzi University, China*
- MeerKLASS Workshop *STIAS: Stellenbosch Institute for Advanced Study, South Africa*

Contributed talks (4):
- Frontiers in Cosmology and Gravitational Physics *University of Portsmouth, UK*
- Cosmology in the Alps *Eurotel Victoria, Les Diablerets, Switzerland*
- SKAO Cosmology SWG Meeting *Observatoire de la Cote d'Azur, Nice, France*
- Cosmology from Home 2024 *Virtual Conference*
- SKAO Cosmology SWG Meeting *Centro de Astrofísica da Universidade do Porto, Portugal*

2023

Invited colloquia/conferences (2):
- IX Meeting on Fundamental Cosmology *La Laguna, Canary Islands, Spain*
- Cosmology Seminar *DAMTP University of Cambridge, UK*

Contributed talks (2):
- Present and Future of Line-Intensity Mapping *Max Planck Institute for Astrophysics, Munich, Germany*
- Tianlai 21cm Cosmology Workshop *Northeastern University, Shenyang, China [Online Talk]*

2022

Invited colloquia/conferences (4):
- Cosmology & Particle Physics *University of Geneva, Switzerland*
- LSS Seminar *IFPU, Trieste, Italy*
- Physics Seminar *Tata Institute of Fundamental Research, Mumbai, India* [*Online Talk*]
- 21cm Cosmology Workshop *University of Wisconsin, USA* [*Online Talk*]

Contributed talks (5):
- A Cosmic Window to Fundamental Physics *IFT, Madrid, Spain*
- SKAO HI IM Workshop *University of Edinburgh, UK*
- Cosmology from Home 2022 *Virtual Conference*
- EAS Annual Meeting 2022 *Valencia, Spain*
- SAZERAC 21cm 2022 *Virtual Conference*

Conference & workshop organisation

MeerKLASS Workshop - [Co-organiser] - *Wallenberg Conference Centre, Stellenbosch, SA* — Mar 2025

MeerKLASS Busy week - [LOC lead] - *University of Manchester* — Sep 2024

MeerKLASS Workshop - [Co-organiser] - *Wallenberg Conference Centre, Stellenbosch, SA* — Feb 2024

The National Astronomy Meeting (21cm Session) - [SOC member] - *Cardiff University* — Jul 2023

SKAO Cosmology SWG Annual Meeting - [LOC lead] - *University of Manchester* — Jan 2023

SEPnet Student-led Conference - [Lead organiser] - *University of Southampton* — Apr 2019

Teaching & supervision

Student supervision:

● PhD:	Daniel Tassie - *PhD Student, University of Portsmouth* Named co-supervisor	Oct 2025 - Present
	Tobias Russell - *PhD Student, University of Manchester* Devised initial project and assisted the supervision of PhD	Sep 2024 - Present
	Zhaoting Chen - *PhD Student, University of Manchester* Mentor and involved in some PhD projects	Apr 2022 - Sep 2023
	Paula S. Soares - *PhD Student, Queen Mary University of London* Mentored and assisted the supervision of PhD projects	Oct 2019 - Sep 2022
● Masters:	Victoria Nakafingo - *MPhys Student, University of the Western Cape* Devised and co-supervised the Masters project	Sep 2024 - Present
	Georgia Kiddier - *MPhys Student, University of Manchester* Devised and co-supervised the Masters project	Sep 2022 - May 2023
	Dounia Nanadoumgarlacroze - *MPhys Student, University of Manchester* Devised and co-supervised the Masters project	Sep 2022 - May 2023
	Isabelle Ye - *MSc Student, Queen Mary University of London* Devised and co-supervised the Masters project	Feb 2021 - Aug 2021
	Andrew Scullane - *MSc Student, Queen Mary University of London* Devised and co-supervised the Masters project	Oct 2020 - Jan 2021
● Undergrad.	Samuel Novak - *Summer Research Intern, University of Manchester* Sole supervisor for 6 week full-time research placement	Jun 2024 - Aug 2024
	Tobias Russell - *Summer Research Intern, University of Manchester* Sole supervisor for 6 week full-time research placement	Jul 2023 - Aug 2023
● College	Oliver Thomason - *Y12 Placement Student, University of Manchester* Devised and supervised the three-week Nuffield placement programme	Aug 2022

Undergraduate teaching:

Invited speaker for AstroSoc Research Talk (*University of Manchester*)	Oct 2024
Invited speaker for PhySoc Research Poster Workshop (*University of Manchester*)	Oct 2022
Introduction to Mathematical Physics Teaching assistant (*University of Portsmouth*)	Oct 2018 - Dec 2018
Computational Physics Lab - Teaching assistant (*University of Portsmouth*)	Oct 2017 - Dec 2017

Departmental responsibilities

JBCA Weekly Colloquium (*University of Manchester*) - co-organiser	Jun 2022 - Present
LSS Weekly Journal Club (*Queen Mary University of London*) - co-organiser	Apr 2021 - Nov 2021

Assessment & refereeing

Expert reviewer for UKRI Future Leaders Fellowship applications — Sep 2024 - Present

Journals:

- Referee for Nature Astronomy	Dec 2023 - Present
- Referee for Physical Review D	Jul 2023 - Present
- Referee for The Astrophysical Journal	Jun 2023 - Present
- Referee for Journal of Cosmology & Astroparticle Physics	Aug 2022 - Present
- Referee for Astronomy & Astrophysics	May 2022 - Present
- Referee for Monthly Notices of the Royal Astronomical Society	Feb 2020 - Present

Public code

Cartesian regridding of line intensity maps (*Python*) - Core Developer
→ github.com/stevecunnington/gridimp - pipeline for transforming pixelised line intensity maps in (R.A., Dec., ν) coordinates onto a Cartesian comoving grid on which a Fast Fourier Transform can be performed. Package also includes codes for simulated mock generation, power spectra estimation and modelling.

HI intensity mapping multipole expansion (*Python*) - Core Developer
→ github.com/IntensityTools/MultipoleExpansion - pipeline for measuring and modelling the HI intensity mapping power spectrum and its multipole decomposition. Provides example simulated data and investigates the impact from 21cm foreground removal and beam effects.

Gaussian Process Regression (GPR) for foreground removal (*Python*) - Contributing Developer
→ github.com/paulassoares/gpr4im - demonstrative toolkit of how GPR techniques can be used for foreground removal in HI intensity maps.

Public outreach, volunteering & media

- "Meet the Astronomer" Jodrell Bank Centre for Engagement (Aug 2025)
- "Meet the Expert" SKAO Outreach event at Jodrell Bank Discovery Centre (Apr 2024)
- Founder of STEMField (an outreach scheme under launch encouraging youth footballers into STEM). Interest in supporting the initiative has been expressed by Manchester United and Manchester City.
- Quoted in article on MeerKAT cosmological detection (scitechdaily.com and others)
- Astronomy on Tap Organiser (Feb 2018)
- Stargazing Live Portsmouth Volunteer (2017-2019)
- Student representative for Athena Swan Committee (2017-2019)
- Organiser for a series of University of Portsmouth Physics Staff v Students charity football matches (2017-2019)

Outreach Talks Presented:

High Legh Community Observatory - *High Legh, UK*	Sep 2025
Knutsford SciBar - *Knutsford, UK*	Jul 2025
Didsbury SciBar - *Didsbury, UK*	Apr 2025
TLG Meeting - *Online Talk*	Sep 2023
The Local Group Astronomy Club - *Online Talk*	Mar 2022
East Sussex Astronomical Soc. - *Egerton Park, East Sussex, UK*	Jul 2019
Chichester U3A Science Group - *Fishbourne Centre, West Sussex, UK*	Jun 2019
The Local Group Astronomy Club - *Cooden Beach Hotel, East Sussex, UK*	Feb 2019
Eastbourne Astronomical Soc. - *Willingdon Memorial Hall, East Sussex, UK*	Oct 2018
Winchester Cafe Sci - *Winchester Discovery Centre, Hampshire, UK*	Sep 2018
The Local Group Astronomy Club - *Cooden Beach Hotel, East Sussex, UK*	May 2018

Journal articles [link to NASA ADS full publication list]

Summary:	Total publications: 29	Total citations: 1124	Highest cited paper: 357
(as of 29/09/2025)	First/Corresponding author: 11	Solo author: 1	Highest cited first author: 92

Five publications representing particularly key contributions to my research portfolio are identified in **blue bold** text.

29. Square Kilometre Array Science Data Challenge 3a: foreground removal for an EoR experiment
Bonaldi, A., Hartley, P., Braun, R., ..., **Cunnington, S.**, et al. (2025)
MNRAS staf1466, Sep 2025, [arXiv:2503.11740]

28. CRAFTS for HI cosmology: I. data analysis and preliminary results
Yang, W., Wolz, L., Li, Y., ..., **Cunnington, S.**, et al. (2024)
ApJ 279, 32, Jul 2025, [arXiv:2412.08173]

27. Emission-line Stacking of 21 cm Intensity Maps with MeerKLASS: Inference Pipeline and Application to the L-band Deep-field Data
Chen, Z., **Cunnington, S.**, et al. (2025)
ApJ 279, 19, Jun 2025, [arXiv:2504.03908]

26. Hydrogen intensity mapping with MeerKAT: Preserving cosmological signal by optimising contaminant separation
Carucci, I. P., Bernal, J. L., **Cunnington, S.**, et al. (2024)
Submitted to A&A, Dec 2024 (accepted), [arXiv:2412.06750]

25. **MeerKLASS L-band deep-field intensity maps: entering the HI dominated regime**
MeerKLASS Collaboration, ..., **Cunnington, S.** [*corresponding author*], et al. (2024)
MNRAS 537, Issue 4, 3632–3661, Mar 2025, [arXiv:2407.21626]

24. Radio Frequency Interference from Radio Navigation Satellite Systems: simulations and comparison to MeerKAT single-dish data
Engelbrecht, B. N., Santos, M. G., Fonseca, J., ..., **Cunnington, S.**, et al. (2024)
MNRAS 536, Issue 1, 1035–1055, Jan 2025, [arXiv:2404.17908]

23. Modeling the Nonlinear Power Spectrum in Low-redshift HI Intensity Mapping
Li, Z., Wolz, L., Guo, H., **Cunnington, S.**, et al. (2024)
MNRAS 534, Issue 3, 1801–1815, Nov 2024, [arXiv:2407.02131]

22. Cosmology with ESO–SKAO Synergies
Santos, M., Camera, S., Chen, Z., **Cunnington, S.**, Fonseca, J. (2024)
The Messenger 193, 20–23, Sep 2024, [arXiv:2503.03915]

21. **Accurate Fourier-space statistics for line intensity mapping: Cartesian grid sampling without aliased power**
Cunnington, S. and Wolz, L. (2024)
MNRAS 528, Issue 4, 5586–5600, Mar 2024, [arXiv:2312.07289]

20. MeerKLASS simulations: Mitigating 1/f noise for auto-correlation intensity mapping measurements
Irfan, M. O., Li, Y., Santos, M. G., ..., **Cunnington, S.**, et al. (2023)
MNRAS 527, Issue 3, 4717–4729, Jan 2024, [arXiv:2312.07289]

19. **The foreground transfer function for HI intensity mapping signal reconstruction: MeerKLASS and precision cosmology applications**
Cunnington, S., Wolz, L., Bull, P., Carucci, I. P., et al. (2023)
MNRAS 523, Issue 2, 2453–2477, May 2023, [arXiv:2302.07034]

18. Baryon acoustic oscillations from HI intensity mapping: the importance of cross-correlations in the monopole and quadrupole
Rubiola, A., **Cunnington, S.**, Camera, S., (2021)
MNRAS 516, Issue 4, 5454–5470, Nov 2022, [arXiv:2111.11347]

17. **HI intensity mapping with MeerKAT: power spectrum detection in cross-correlation with WiggleZ galaxies**
Cunnington, S., Li, Y., Santos, M., Wang, J., et al. (2022)
MNRAS 518, Issue 4, 6262–6272, Oct 2022, [arXiv:2206.01579]

16. Detecting the power spectrum turnover with HI intensity mapping
Cunnington, S., (2022)
MNRAS 512, Issue 2, 2408–2425, May 2022, [arXiv:2202.13828]

15. Gaussian Process Regression for foreground removal in HI intensity mapping experiments
Soares, P., Watkinson, C., **Cunnington, S.**, Pourtsidou, A., (2022)
MNRAS 510, Issue 4, 5872–5890, March 2022, [arXiv:2105.12665]

14. HI constraints from the cross-correlation of eBOSS galaxies and Green Bank Telescope intensity maps
Wolz, L., Pourtsidou, A., Masui, K., Chang, T.-C., ..., **Cunnington, S.** et al. (2022)
MNRAS 510, Issue 3, 3495–3511, March 2022, [arXiv:2102.04946]

13. Measurements of the diffuse Galactic synchrotron spectral index and curvature from MeerKLASS pilot data
Irfan, M. O., Bull, P., Santos, M. G., ..., **Cunnington, S.** et al.., (2022)
MNRAS 509, Issue 4, 4923–4939, February 2022, [arXiv:2111.08517]

12. HI intensity mapping correlation function from UNIT simulations: BAO and observationally induced anisotropy
Avila, S., Vos-Ginés, B., **Cunnington, S.** et al, (2022)
MNRAS 510, Issue 1, 292-308, February 2022, [arXiv:2105.10454]

11. SKAO HI Intensity Mapping: Blind Foreground Subtraction Challenge
Spinelli, M., Carucci, I., **Cunnington, S.** et al.., (2022)
MNRAS 509, Issue 2, 2048–2074, January 2022, [arXiv:2107.10814]

10. The HI intensity mapping bispectrum including observational effects
Cunnington, S., Watkinson, C., Pourtsidou, A., (2021)
MNRAS 507, Issue 2, 1623–1639, October 2021, [arXiv:2102.11153]

9. **21cm foregrounds and polarization leakage: a user's guide on cleaning and mitigation strategies**
Cunnington, S., Irfan, M., Carucci, I., Pourtsidou, A., Bobin, J., (2021)
MNRAS 504, Issue 1, 208–227, June 2021, [arXiv:2010.02907]

8. HI intensity mapping with MeerKAT: Calibration pipeline for multi-dish autocorrelation observations
Wang, J., Santos, M., Bull, P., Grainge, K., **Cunnington, S.** et al. (2021)
MNRAS 505, Issue 3, 3698-3721, May 2021, [arXiv:2011.13789]

7. Multipole expansion for HI intensity mapping experiments: unbiased parameter estimation
Soares, P., **Cunnington, S.**, Pourtsidou, A., Blake, C., (2021)
MNRAS 502, Issue 2, 2549–2564, January 2021, [arXiv:2008.12102]

6. The degeneracy between primordial non-Gaussianity and foregrounds in 21cm intensity mapping experiments
Cunnington, S., Camera, S., Pourtsidou, A., (2020)
MNRAS 499, Issue 3, 4054–4067, December 2020, [arXiv:2007.12126]

5. Multipole expansion for HI intensity mapping experiments: simulations and modelling
Cunnington, S., Pourtsidou, A., Soares, P., Blake, C., Bacon, D., (2020)
MNRAS 496, Issue 1, 415–433, July 2020, [arXiv:2002.05626]

4. Cosmology with Phase 1 of the Square Kilometre Array: Red Book 2018: Technical specifications and performance forecasts
Square Kilometre Array Cosmology Science Working Group: Bacon, D., ..., **Cunnington, S.** et al. (2020)
Publ. Astron. Soc. Austral. 37, e007, March 2020, [arXiv:1811.02743]

3. Impacts of Foregrounds on HI Intensity Mapping Cross-Correlations
Cunnington, S., Wolz, L., Pourtsidou, A., Bacon, D., (2019)
MNRAS 488, Issue 4, 5452–5472, October 2019, [arXiv:1904.01479]

2. HI Intensity Mapping for Clustering-Based Redshift Estimation
Cunnington, S., Harrison, I., Pourtsidou, A., Bacon, D., (2019)
MNRAS 482, Issue 3, 3341–3355, January 2019, [arXiv:1805.04498]

1. Observational Selection Biases in Time-Delay Strong Lensing and their Impact on Cosmography
Collett, T., **Cunnington, S.**, (2016)
MNRAS 462, Issue 3, 3255–3264, November 2016, [arXiv:1605.08341]