Callum T. Donnan

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Research Interests

Galaxy formation & evolution, first stars & galaxies, cosmic reionization, stellar populations, large-scale structure, galaxy-halo connection

Education

PhD Astrophysics, University of Edinburgh, Edinburgh, UK 2021 - 2025

- Thesis: "*Exploring the formation of the first galaxies with VISTA and JWST*"
- **Supervisors: James Dunlop, Ross McLure, Derek McLeod**

MPhys Astrophysics, University of St Andrews, St Andrews, UK 2016 - 2021

- Thesis: "*The gas content of galaxies in the cosmic web*"
- **Supervisor: Rita Tojeiro**

Research Positions

Post Doctoral Research Associate, NOIRLab, Tucson, AZ, USA 2025 - Present

Summer Research Student, University of St Andrews, St Andrews, UK 2021

Institute of Astronomy Summer Research Programme, University of Cambridge, Cambridge, UK 2020

Summer Research Student, University of St Andrews, St Andrews, UK 2019

Awards & Grants

JWST Cycle 4 PI GO 6954, $\sim \$95k$ 2025

MPhys Thesis Prize for best MPhys astrophysics thesis 2021

Dean's List (awarded for averaging a first class across the academic year.) 2016 - 2021

Cormack Vacation Scholarship from the Royal Society of Edinburgh 2019

School of Physics & Astronomy Student Staff Council Vacation Award 2019

Medal (Astronomy and Astrophysics First & Second Level) 2016 - 2018

Margaret Stewart Prize (Awarded to the best First Year student in Astronomy and Astrophysics) 2016 - 2017

Telescope Programs

Co-I, Is the quest for Cosmic Dawn beyond all H0pe?, GO 11171, 13 hours, PI: D. McLeod	JWST Cycle 5
PI, Spectroscopic confirmation of the most robust z=15 galaxy candidate, GO 6954, 6 hours	JWST Cycle 4
Co-I, The CANDELS-Area Prism Epoch of Reionization Survey (CAPERS), GO 6368, 194 hours, PI: M. Dickinson	JWST Cycle 3
Co-I, Dead or alive? Unveiling the nature of massive galaxies in the early Universe, GO 5545, 10 hours, PI: L. Barrufet	JWST Cycle 3
Co-I, EXCELS: The Early eXtragalactic Continuum and Emission Line Survey, GO 3543, 72 hours, PI: A. Carnall & F. Cullen	JWST Cycle 2
Co-I, Characterizing true $z > 12$ galaxies and $z \sim 4-7$ interlopers in preparation for JWST Cycle 2, DD 2750, 8 hours, PI: P. Arrabal Haro	JWST DDT
Co-I, The AURORA Survey: First Direct Metallicity Calibrations at High Redshift, GO 1914, 63 hours, PI: A. Shapley & R. Sanders	JWST Cycle 1
Co-I, PRIMER: Public IMaging for Extragalactic Research, GO 1837, 196 hours, PI: J. Dunlop	JWST Cycle 1

Supervision, Teaching & Outreach

Public talk, Space drafts	2026
Supervisor, undergraduate summer research project	2024
Teaching Assistant, Physics 1A, Discovering Astronomy, Observational Astronomy	2021-2024
Royal Observatory open day, JWST presentation to members of the public	2023
High School Outreach, presentations to high school students on astronomy	2018-2023

Invited Talks

Miracles of the Early Universe II, Geneva, Switzerland	2026
The Growth of Galaxies in the Early Universe – XI, Sesto, Italy	2026
Seminar, Space Telescope Science Institute (StSci)	2025
Colloquium, Steward Observatory, University of Arizona	2025
The Growth of Galaxies in the Early Universe – X, Sesto, Italy	2025
Colloquium, University of St Andrews	2024
The Growth of Galaxies in the Early Universe – IX, Sesto, Italy	2024

The Growth of Galaxies in the Early Universe – VIII, Sesto, Italy 2023

The Growth of Galaxies in the Early Universe – VII, Sesto, Italy 2022

Seminar, CfA Galaxy Cluster Group, Harvard University 2022

Contributed Talks

Continuing the JWST Revolution: Understanding Early Galaxy Formation, MIAPbP, Garching, Germany 2026

Charting Cosmic Dawn in Copenhagen , Copenhagen, Denmark 2026

The Inaugural Cosmic Frontier Center Conference, UT Austin, Austin, TX, USA 2025

Beyond the Edge of the Universe, Sintra, Portugal 2024

Observing and Simulating Galaxy Evolution in the Era of JWST, Ascona, Switzerland 2024

Cosmic Dawn at High Latitudes, Stockholm, Sweden 2024

First Stars VII, New York, USA 2024

National Astronomy Meeting, Cardiff, UK 2023

First Light, MIT, Cambridge, MA, USA 2023

A new era in extragalactic astronomy: early results from the James Webb Space Telescope, University of Cambridge, Cambridge, UK 2023

National Astronomy Meeting, Warwick, UK 2022

Press

Scientific American, Astronomers puzzle over early origins of mysterious 'red monster' galaxy, link 2026

Physics magazine, JWST Sees More Galaxies than Expected, link 2024

Physicsworld, JWST spectrometer refines redshifts of distant galaxies, link 2023

Le Parisein, Distant galaxies: the James Webb Telescope defies all odds, link 2023

Nature News, Four revelations from the Webb telescope about distant galaxies, link 2022

BBC News, Scottish astronomers push James Webb deeper back in time, link 2022

VICE, A Cosmic Web Connecting the Universe Shapes Dark 2022

Matter in Galaxies, Study Finds, link

Teams & Memberships

Observing Collaborations

SPAM, Team member — 2026 - present

Spectroscopic confirmation of the most robust $z = 15$ galaxy candidate, PI — 2025 - present

CAPERS, Core-team member and survey organizer — 2024 - present

CEERS, Team member — 2024 - present

PRIMER, Core-team member — 2021 - present

AURORA, Target selection — 2021 - present

Journal clubs/seminars

EURECA galaxy seminar series organizer, Steward Observatory/NOIRLab — 2025 - present

XGAL journal club organizer, University of Edinburgh — 2023 - 2024

Professional Memberships

AAS Full member, American Astronomical Society — 2025 - present

Computing

Languages

Python (numpy, scipy, astropy, matplotlib) — Expert

Fortran 77/95 — Proficient

C++ — Experienced

Software

JWST Pipeline (NIRSpec reduction pipeline for MSA and fixed slit) — Expert

Image reduction/processing (SWarp, SCAMP, PENCIL, PSF convolution) — Expert

Photometry (SExtractor, astropy, TPHOT) — Expert

SED fitting (EAZY, BAGPIPES) — Expert

Observation Planning

Survey design of *JWST*/NIRSpec programs (PID: 1914, 2750, 5343, 6368, 6954)

Target Selection (by constructing catalogues from *JWST*/NIRCam)

Planning (MSA planning tool, exposure time calculator)

Publications (43, 6 as first author, h-index: 31, citations: 4,476)

First Author:

1. **Donnan, C.T.**, McLeod, D. J., McLure, R. J., et al., *ApJ, 933, 224*, Spectroscopic Confirmation of a Large and Luminous Galaxy with Weak Emission Lines at $z = 13.53$ — 2026

1. **Donnan, C.T.**, Dickinson, M., Taylor, A. J., et al., *ApJ, 933, 224*, Very bright, very blue, and very red: JWST CAPERS analysis of highly luminous galaxies with extreme UV slopes at $\mathbf{z = 10}$ — 2025

2. **Donnan, C.T.**, Dunlop, J. S., McLure, R. J., et al., *MNRAS, 539, 2409*, No evidence (yet) for increased star-formation efficiency at $\mathbf{z = 6 - 13}$ — 2025

3. **Donnan, C.T.**, McLure, R. J., Dunlop, J. S., et al., *MNRAS, 533, 3222*, JWST PRIMER: A new multi-field determination of the evolving galaxy UV luminosity function at redshifts $\mathbf{z \simeq 9 - 15}$ — 2024

4. **Donnan, C.T.**, McLeod, D. J., McLure R. J., et al., *MNRAS, 520, 4554*, The abundance of $z \geq 10$ galaxy candidates in the HUDF using deep JWST NIRCam medium-band imaging. — 2023

5. **Donnan, C.T.**, McLeod, D. J., Dunlop J. S., et al., *MNRAS, 518, 6011*, The evolution of the galaxy UV luminosity function at redshifts $z \simeq 8 - 15$ from deep JWST and ground-based near-infrared imaging. — 2023

6. **Donnan, C.T.**, Tojeiro, R., Kraljic, K., *Nature Astronomy, 6, 599*, The role of the cosmic web in the scatter of the galaxy stellar mass - gas metallicity relation. — 2022

Second Author:

7. McLeod, D. J., **Donnan, C.T.**, McLure R. J, et al., *MNRAS, 527, 5004*, The galaxy UV luminosity function at $z \simeq 11$ from a suite of public JWST ERS, ERO, and Cycle-1 programs — 2024

Co-Author:

8. Liu, F.-Y. F., McLeod D. J., Sutlieff B. J., et al. *arXiv:2608.07461*, A clear detection of proper motion confirms that the claimed $z \simeq 32$ galaxy candidate, "Capotauro", is a Y-type brown dwarf — 2026

8. Taylor E., Carnall A. C., Matlby, D., et al. *MNRAS, 549, 918*, The JWST EXCELS survey: outflows in $1.5 < z < 5$ quiescent and recently quenched galaxies are likely relics from episodic AGN activity — 2026

12. Sanders, R. L., Shapley, A. E., et al. *ApJ, 2003, 228*, The AURORA Survey: High-Redshift Empirical Metallicity Calibrations from Electron Temperature Measurements at $z = 2 - 10$ — 2026

12. Leung, H-H, Carnall A. C, Taylor, E., et al. *MNRAS, 549, 827*, The JWST EXCELS survey: the ages and abundances of $3 < z < 5$ massive quiescent galaxies show that downsizing was already in place by $z \simeq 4$ 2026

13. Barrufet, L., Dunlop, J. S., Begley, R., et al. *MNRAS, 548, 770*, Strength in Numbers: Red Galaxies Bolster the Cosmic Star Formation Rate Density at $z > 3$ 2026

13. Galois, P., Benoist, C., Castignani, G, et al. *arXiv:2606.13359*, Galaxy clusters in the VIDEO fields: detection and characterisation in the context of MOONRISE 2026

13. Chworowsky, K., Finkelstein, S. L., Taylor, A. J., et al. *arXiv:2605.13966*, Massive Galaxies Form Early and Gray: Stellar Assembly and Dust Attenuation at $z > 3.5$ from CAPERS 2026

13. Barro, G., Pérez-González, P. G., et al. *ApJ, 1003, 96*, From "The Cliff" to "Virgil": Mapping the Spectral Diversity of Little Red Dots with JWST/NIRSpec 2026

11. Napolitano, L., Pentericci, L., Dickinson, M., et al. *A&A, 708, 102*, Lyα visibility from $z = 4.5$ to 11 in the UDS field: evidence for a high neutral hydrogen fraction and small ionized bubbles at z $\sim$ 7 2026

11. Stanton, T. M., Cullen, F., Carnall, A. C., et al. *MNRAS, 547, 449*, The JWST EXCELS Survey: gas-phase metallicity evolution at $2 < z < 8$ 2026

11. McLeod, D. J., Dunlop, J. S., McLure, R. J., et al. *arXiv:2604.16666*, A search for the first galaxies across $0.6\,\mathrm{deg}^2$ of JWST imaging: new evidence for a rapid decline in star-formation activity at $z > 12$ 2026

11. Pérez-González, P. G., Barro, G., Carniani, S., et al. *arXiv:2602.20247*, Little Red Dots: One Photometric Tag Concealing Diverse Spectroscopic Flavors of Massive Star Formation and Black Hole Activity 2026

11. Berg, D. A., Sanders, R. L., Shapley, A. E., et al. *ApJ, 996, 68*, The AURORA Survey: Robust Helium Abundances at High Redshift Reveal a Subpopulation of Helium-enhanced Galaxies in the Early Universe 2026

8. Pahl, A. J., Shapley, A., Reddy, N. A., et al. *ApJ, 996, 37*, The JWST EXCELS Survey: A spectroscopic investigation of the ionizing properties of star-forming galaxies at $1 < z < 8$ 2025

9. Begley, R., McLure, R. J., Cullen, F., et al. *MNRAS, 545, 1995*, The JWST EXCELS Survey: A spectroscopic investigation of the ionizing properties of star-forming galaxies at $1 < z < 8$ 2025

10. Stevenson, S. D., Carnall, A. C., Leung, H., et al. *MNRAS, 545, 2087*, PRIMER & JADES reveal an abundance of massive quiescent galaxies at $2 < z < 5$ 2025

25. Liu, F.-Y., Dunlop, J. S., McLure, R. J., et al., *MNRAS, 545, 1961*, JWST PRIMER: A deep JWST study of all ALMA-detected galaxies in PRIMER COSMOS – dust-obscured star-formation history back to $z \simeq 7$ 2025

25. Nakane, M., Kokorev, V., Fujimoto, S., et al., *arXiv:2511.14483*, VENUS: A Strongly Lensed Clumpy Galaxy at $z \sim 11 - 12$ behind the Galaxy Cluster MACS J0257.1-2325 2025

30. Leung, G. C. K., Finkelstein, S. L., Pérez-González, P. G., et al., *ApJ, 992, 26*, Exploring the Nature of Little Red Dots: Constraints on AGN and Stellar Contributions from PRIMER MIRI Imaging 2024

15. Sanders, R. L., Shapley, A. E., Topping, M. W., et al. *ApJ, 989, 209*, The AURORA Survey: The Nebular Attenuation Curve of a Galaxy at $z = 4.41$ from Ultraviolet to Near-infrared Wavelengths 2025

14. Taylor, A. J., Kokorev, V., Kocevski, D. D., et al. *ApJL, 989,L7*, CAPERS-LRD-z9: A Gas-enshrouded Little Red Dot Hosting a Broad-line Active Galactic Nucleus at $z = 9.288$ 2025

20. Kokorev, V., Chávez Ortiz, Óscar A., et al. *ApJL, 988, L10*, CAPERS Observations of Two UV-bright Galaxies at $z > 10$. More Evidence for Bursting Star Formation in the Early Universe 2025

18. Arellano-Córdova, K. Z., Cullen, F., Carnall, A. C., et al. *MNRAS, 540, 2991*, The JWST EXCELS survey: direct estimates of C, N, and O abundances in two relatively metal-rich galaxies at $z \simeq 5$ 2025

17. Hamadouche, M. L., McLure, R. J., Carnall, A. C., et al. *MNRAS, 541, 463*, JWST PRIMER: strong evidence for the environmental quenching of low-mass galaxies out to $z \simeq 2$ 2025

19. Cullen, F., Carnall, A. C., Scholte, D., et al. *MNRAS, 540, 2176*, The JWST EXCELS survey: an extremely metal-poor galaxy at $z = 8.271$ hosting an unusual population of massive stars 2025

22. Taylor, A. J., Finkelstein, S. L., Kocevski, D. D., et al. *ApJ, 986, 165*, Broad-Line AGN at $3.5 < z < 6$: The Black Hole Mass Function and a Connection with Little Red Dots 2025

21. Scholte, D, Cullen, F., Carnall, A. C., et al. *MNRAS, 540, 1800*, The JWST EXCELS survey: probing strong-line diagnostics and the chemical evolution of galaxies over cosmic time using T_e-metallicities 2025

23. Kocevski, D. D., Finkelstein, A. L., Barro G., et al., *ApJ, 986, 126*, The Rise of Faint, Red AGN at $z > 4$: A Sample of Little Red Dots in the JWST Extragalactic Legacy Fields 2025

24. Lines, N. E. P., Bowler, R. A. A., Adams, N. J., et al., *MNRAS, 539, 2685*, JWST PRIMER: a lack of outshining in four normal $z = 4$-6 galaxies from the ALMA-CRISTAL Survey 2025

26. Begley, R., McLure, R. J., Cullen, F., et al. *MNRAS, 537, 3245*, The evolution of [OIII]+Hβ equivalent width from $\mathbf{z \simeq 3-8}$: implications for the production and escape of ionizing photons during reionization 2025

27. Shapley, A. E., Sanders, R. L., Topping, M. W., et al. *ApJ, 981, 167*, The AURORA Survey: An Extraordinarily Mature, Star-forming Galaxy at $z \sim 7$ 2025

29. Shapley, A. E., Sanders, R. L., Topping, M. W., et al., *ApJ, 980, 242*, The AURORA Survey: A New Era of Emission-line Diagrams with JWST/NIRSpec 2025

28. Stanton, T. M., Cullen, F., Carnall, A. C., et al. *MNRAS, 537, 1735*, The JWST EXCELS survey: tracing the chemical enrichment pathways of high-redshift star-forming galaxies with O, Ar, and Ne abundances 2025

31. Merlin, E., Santini, P., Paris, D, et al., *arXiv:2409.00169*, ASTRODEEP-JWST: NIRCam-HST multiband photometry and redshifts for half a million sources in six extragalactic deep fields 2024

32. Carnall, A. C., Cullen, F., McLure, R. J., et al., *MNRAS, 534, 325*, The JWST EXCELS survey: Too much, too young, too fast? Ultra-massive quiescent galaxies at $3 < z < 5$ 2024

33. Stanton, T. M., Cullen, F., McLure, R. J., et al., *MNRAS, 532, 3102*, The NIRVANDELS Survey: the stellar and gas-phase mass-metallicity relations of star-forming galaxies at $z = 3.5$ 2024

34. Varadaraj, R. G., Bowler, R. A. A., Jarvis, M. J., et al., *MNRAS, 533, 3724*, The sizes of bright Lyman-break galaxies at $z \simeq 3-5$ with JWST PRIMER 2024

35. Weibel, A., Oesch, P. A., Barrufet, L., et al., *MNRAS, 533, 1808*, Galaxy Build-up in the first 1.5 Gyr of Cosmic History: Insights from the Stellar Mass Function at $z \sim 4-9$ from JWST NIRCam Observations 2024

36. Begley, R., Cullen, F., McLure, R.J., *MNRAS, 527, 4040*, Connecting the escape fraction of Lyman-alpha and Lyman-continuum photons in star-forming galaxies at $z \simeq 4-5$ 2024

37. Cullen, F., McLeod, D. J., McLure, R.J., *MNRAS, 531, 997*, Evidence for the emergence of dust-free stellar populations at $z > 10$ 2024

38. Arrabal Haro, P., Dickinson, M., Finkelstein, S. L., *Nature, 622, 707*, Confirmation and refutation of very luminous galaxies in the early Universe 2023

39. Carnall, A. C., McLure, R. J., Dunlop, J. S., *Nature, 619, 716*, A massive quiescent galaxy at redshift 4.658 2023

40. Hamadouche, M. L., Carnall, A. C., McLure, R. J., *MNRAS, 521, 5400*, The connection between stellar mass, age, and quenching time-scale in massive quiescent galaxies at $z \simeq 1$ 2023

41. Carnall, A. C., McLeod, D. J., McLure, R. J., *MNRAS, 520, 3974*, A surprising abundance of massive quiescent galaxies at $3 < z < 5$ in the first data from JWST CEERS 2023

42. Cullen, F., McLure, R. J., McLeod, D. J., *MNRAS, 520, 14*, The ultraviolet continuum slopes (β) of galaxies at $z \simeq 8 - 16$ from JWST and ground-based near-infrared imaging 2023

43. Carnall, A. C., Begley, R., McLeod, D. J., *MNRAS, 518, 45*, A first look at the SMACS0723 JWST ERO: spectroscopic redshifts, stellar masses, and star-formation histories 2023