# Louise Amber **Welsh**

Astronomer

*Centre for Extragalactic Astronomy, Durham University, South Road, Durham, UK, DH1 3LE*

louise.a.welsh@durham.ac.uk | lawelsh.github.io | Louise Welsh | 0000-0003-3174-7054


## Research Interests

The first stars and galaxies — early chemical enrichment — galaxy evolution — quasar absorption line spectroscopy — the baryon cycle — the interplay between gas and galaxies — high fidelity spectroscopy.

## Employment

**Centre for Extragalactic Astronomy** — *Durham, UK*

CEA Postdoctoral Fellow — *Jan. 2025 - PRESENT*

**INAF Astronomical Observatory of Trieste** — *Trieste, Italy*

Postdoctoral Researcher — *Sep. 2023 - Dec. 2024*

**University of Milano Bicocca** — *Milan, Italy*

Postdoctoral Researcher — *Sep. 2021 - Sep. 2023*

## Education

**Centre for Extragalactic Astronomy, Durham University** — *Durham, UK*

PhD in Astrophysics — *Oct. 2017 - Sep. 2021*

- Thesis: 'A window to the first stars: An investigation of chemically near-pristine environments'
- Advisor: Prof. Ryan Cooke & Prof. Michele Fumagalli

**Lancaster University** — *Lancaster, UK*

Master of Physics (MPhys): 1st Class (Hons) — *Oct. 2012 - Jul. 2016*

- Thesis: 'Investigating cold dark matter candidates'
- Advisor: Dr. John McDonald

## Awards and Fellowships

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| 2025 | **CEA Fellowship**, Awarded to pursue observationally based independent research for three years. | *Durham University* |
| 2021 | **Keith Nicholas Prize**, Awarded for outstanding overall performance by a postgraduate student. | *Durham University* |
| 2019 | **Associate Fellow of the Higher Education Academy**, through the Durham Excellence in Learning and Teaching Awards scheme. | |
| 2019 | **Martin and Beate Block Award**, Awarded to a promising researcher at the Aspen winter meeting 'Into the Starlight'. | *Aspen Centre for Physics* |
| 2016 | **Azzedine Hammiche Prize**, Awarded for exceptional fourth year project work. | *Lancaster University* |

## Talks (17 invited, 54 total)

Most recent:

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| June 2026 | **Groningen seminar**, The enrichment and environment of extremely metal-poor DLAs (invited) | *Netherlands* |
| May. 2026 | **Galactic metal cycles**, The enrichment and environment of extremely metal-poor DLAs (invited) | *Ireland* |
| Mar. 2026 | **40 years of DLAs**, The curious case of metal-poor DLAs at cosmic noon | *Japan* |
| Mar. 2026 | **CAR seminar**, The curious case of metal-poor DLAs at cosmic noon (invited) | *UK* |
| Dec. 2025 | **Baryon cycle from reionization**, The curious case of metal-poor DLAs at cosmic noon (invited) | *Chile* |
| July 2025 | **BRIDGCE2025**, The curious case of metal-poor DLAs at cosmic noon | *UK* |
| May. 2025 | **INAF Arcetri**, The curious case of metal-poor DLAs at cosmic noon (invited) | *Italy* |
| May. 2025 | **IGM-galaxy connection in the 1st Gyr**, The clustering of metals at the end of reionization (invited) | *Italy* |
| May. 2025 | **EQUALs**, The carbon isotope ratio of metal-poor DLAs | *Italy* |
| Jan. 2025 | **The enigma of first stars in the era of JWST**, Near-pristine DLAs and their chemistry (invited) | *Italy* |

## Proposal History as Principal Investigator

154 hours awarded using the 8.2 m VLT instruments, 2.5 nights ($\sim 25$ hours) awarded using the 10 m Keck telescope instruments through NOIRLab, and 7 nights ($\sim 70$ hours) awarded using the 4.2 m WHT instruments.

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| 2025 | **Keck II/KCWI**, 1/2 night, 2025A. | *NOIRLab* |
| 2024 | **VLT/XSHOOTER**, 8 hours, P113. | *ESO* |
| 2023 | **VLT/ESPRESSO 4-UT**, $4 \times 1.2$ nights, P112. | *ESO* |
| 2023 | **VLT/UVES**, 10 hours, P111. | *ESO* |
| 2023 | **Keck I/HIRES**, 1 night, 2023A. | *NOIRLab* |
| 2022 | **VLT/UVES**, 10 hours, P110. | *ESO* |
| 2022 | **VLT/ESPRESSO 1-UT**, 7 hours, P109. | *ESO* |
| 2022 | **VLT/ESPRESSO 3-UT**, $3 \times 8$ hours, P109. | *ESO* |
| 2021 | **VLT/UVES**, 18 hours, P108. | *ESO* |
| 2021 | **Keck I/HIRES**, 1 night, 2021B. | *NOIRLab* |
| 2020 | **VLT/ESPRESSO 1-UT**, 9 hours, P105. | *ESO* |
| 2020 | **VLT/UVES**, 20 hours, P105. | *ESO* |
| 2019 | **WHT/ISIS**, 7 nights, 2019B. | *ING* |

## Proposal History as Primary Scientific Investigator

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| 2023 | **WEAVE/LIFU**, 21 hours, 2023B. | *UK PATT* |
| 2020 | **Palomar/Hale**, 7 night, 2020A. | *Caltech* |

## Teaching

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| 2023 - | **Co-supervisor**, Four student projects in physics (3 MPhys, 1 BSc). |
| 2023 - | **Laboratory demonstrator**, Astronomy research laboratories (undergraduate and postgraduate). |
| 2018 - | **Demonstrator**, Various first and second year courses including: Maths toolkit for scientists, Further maths for geoscientists, Stars and galaxies, and weekly tutorials. |

## International Collaborations

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| 2025 - | **GHOSTLy**, Project coordinator of Gemini/GHOST large programme of $z \sim 5$ quasars. |
| 2025 - | **JAGGER**, Member of the combined JWST ALMA survey of gas and galaxies at the end of reionization. |
| 2023 - | **EQUALS**, Member of the first ESO/ESPRESSO large programme focused on $z \sim 3 - 4$ quasars. |
| 2023 - | **XQR-30**, Member of VLT/X-SHOOTER large programme focused on $z > 5.7$ quasars. |
| 2023 - 2025 | **WEAVE**, IFU Working Group Member for WEAVE QSO survey. |
| 2021 - | **WEAVE**, Member of the WEAVE-QSO survey. |

## Professional memberships and activities

Organising committee member of four conferences, peer-reviewer for three journals, postdoctoral representative at my current institute, and various additional professional activities.

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| 2025 - | **CEA**, Postdoctoral representative for the centre for extragalactic astronomy group Durham |
| 2025 | **NAM2025**, Lead organiser of NAM session with three parallel blocks |
| 2023 - | **INAF**, Associate member of INAF - Osservatorio Astronomico di Trieste |
| 2022 | **WMAG 2022**, Organising committee member for the 'What Matters around Galaxies - 2022' conference |
| 2021 - | **Peer reviewer**, Astrophysical Journal, Astronomy & Astrophyics, and MNRAS |
| 2021 - 2023 | **Astrocoffee**, Organiser of weekly astrocoffee seminars at Milano-Bicocca |
| 2020 - 2021 | **OCW social**, Member of committee responsible for organising department social events |
| 2020 | **DEX XVI**, LOC member for the '2020 Vision: progress and tensions in astronomy' workshop |
| 2019 | **Small Galaxies, Cosmic Questions**, LOC member for the 'Small Galaxies, Cosmic Questions' conference |
| 2018 - 2019 | **Journal Club**, Convener of a weekly meeting of postgraduate students at Durham University |

## Outreach

**Universe Makers** *North East, UK*

VOLUNTEER *2025 -*

Involved in the delivery of the exhibit on computational astrophysics at the Royal Society Summer Exhibition 2026.

**Moon Palace** *North East, UK*

VOLUNTEER *2025 -*

Volunteer on mobile school bus that has been converted to hold a functional telescope and engage visitors with astronomy and the cosmos.

**Pre-school astronomy** *Milan, Italy*

VOLUNTEER *2022 - 2023*

Visited local preschools to develop and play astronomy related games with students.

**Planetarium** *North East, UK*

SHOW PROVIDER *2018 - 2020*

Delivered shows on the constellations and planets at events (including multiple science festivals) and local schools using an inflatable planetarium.

## Accepted Publications

Seven first author publications and twelve n$^{\text{th}}$ order publications with a h-index of eight based on my ADS publication library. This can be found here: https://tinyurl.com/louiseadslibrary.

First author:

- **L. Welsh**, V. D'Odorico, F. Fontanot, R. Davies, S. E. I. Bosman, G. Cupani, G. Becker, L. Keating, E. Ryan-Weber, M. Bischetti, M. Haehnelt, H. Chen, Y. Zhu, S. Lai, M. Hirschmann, L. Xie, and Y. Qin (2025) "The clustering of C IV and Si IV at the end of reionisation: A perspective from the E-XQR-30 survey", A&A 703, 274
- **L. Welsh**, R. Cooke, M. Fumagalli, M. Pettini, and G. C. Rudie (2024) "A survey of extremely metal-poor gas at cosmic noon: Evidence of elevated [O/Fe]", A&A, 691, A285
- **L. Welsh**, R. Cooke, M. Fumagalli, & M. Pettini (2023) "Towards ultra metal-poor DLAs: linking the chemistry of the most metal-poor DLA to the first stars", MNRAS, 525, 527
- **L. Welsh**, R. Cooke, M. Fumagalli, & M. Pettini (2022) "Oxygen-enhanced EMP DLAs: A signpost of the first stars?", ApJ, 929, 158
- **L. Welsh**, R. Cooke, & M. Fumagalli (2021) "The stochastic enrichment of Population II stars", MNRAS, 500, 5214
- **L. Welsh**, R. Cooke, M. Fumagalli, & M. Pettini (2020) "A bound on the $^{12}$C/$^{13}$C ratio in near-pristine gas with ESPRESSO", MNRAS, 494, 1411
- **L. Welsh**, R. Cooke, & M. Fumagalli (2019) "Modelling the chemical enrichment of Population III supernovae: the origin of the metals in near-pristine gas clouds", MNRAS, 487, 3363

Second author:

- T. A. M. Berg, **L. A. Welsh**, R. J. Cooke, L. Christensen, V. D'Odorico, S. L. Ellison, and S. López (2025) "Unmixed metals: variations in the enrichment of z $\sim$ 4 sub-damped Lyman $\alpha$ systems", MNRAS, 541, 2405
- R. Cooke and **L. Welsh** (2025) "A determination of the cosmic microwave background temperature using Galactic molecules", MNRAS, 536, 1980
- R. Cooke, **L. Welsh**, M. Fumagalli, & M. Pettini (2020) "A limit on Planck-scale froth with ESPRESSO", MNRAS, 494, 4884

Co-author:

- R. J. Cooke, J. W. Johnson, P. Noterdaeme, M. Pettini, **L. Welsh**, A. Wong, and C. Peroux (2026) "Towards a measurement of the primordial helium isotope ratio", ApJ, 1003, 225
- P. Noterdaeme, S. Balashev, T. Berg, S. Cristiani, R. Cuellar, G. Cupani, S. Di Stefano, V. D'Odorico, C. Fian, B. Godard, S. López, D. Milaković, A. Trost, and **L. Welsh** (2026) "One H2 molecule per ten million H-atoms reveals sub-pc scale cold overdensities at z~4", A&A, 707, 66
- S. Rowlands, R. Davies, E. Ryan-Weber, L. Keating, A. Sebastian, G. Becker, M. Bischetti, H. Chen, F. Davies, V. D'Odorico, P. Gaikwad, S. Gallerani, M. Haehnelt, G. Kulkarni, R. Meyer, **L. Welsh**, and Y. Zhu (2026) "E-XQR-30: Evidence for an Increase in the Ionization State of Metal Absorbers from $z \sim 6$ to $z \sim 2$", MNRAS, 546, 1, 2254

- T. A. M. Berg, V. D'Odorico, E. Boera, G. Calderone, R. Cuellar, G. Cupani, S. Cristiani, S. Di Stefano, A. Grazian, F. Guarneri, V. Iršič, S. Lopez, D. Milakovic, P. Noterdaeme, L. Pasquini, M. Viel, and **L. Welsh** (2025) "From the intergalactic to the interstellar scales – EQUALS: a high-resolution legacy survey of gas in the distant Universe using ESPRESSO", Messenger 195, 23
- D. Ďurovčíková, A.-C. Eilers, R. A. Simcoe, **L. Welsh**, R. A. Meyer, J. Matthee, E. V. Ryan-Weber, M. Yue, H. Katz, S. Satyavolu, G. Becker, F. B. Davies, and E. P. Farina (2025) "An Extremely Metal-poor Ly$\alpha$ Emitter Candidate at z = 6 Revealed through Absorption Spectroscopy", ApJL, 987, L33
- D. Milaković, J. K. Webb, P. Molaro, C.-C. Lee, P. Jethwa, G. Cupani, M. T. Murphy, **L. Welsh**, V. D'Odorico, S. Cristiani, R. Génova Santos, C. J. A. P. Martins, N. J. Nunes, T. M. Schmidt, F. A. Pepe, M. R. Zapatero Osorio, Y. Alibert, J. I. González Hernández, P. Di Marcantonio, E. Palle, R. Rebolo, N. C. Santos, S. G. Sousa, and A. Suárez Mascareño (2024) "Isotopic abundance of carbon in the DLA towards QSO B1331+170", MNRAS, 534, 12
- E. H. Nuñez, C. C. Steidel, E. N. Kirby, G. C. Rudie, N. Z. Prusinski, Y. Chen, Z. Zhuang, A. L. Strom, D. K. Erb, M. Pettini, **L. Welsh**, D. S. N. Rupke, and R. J. Cooke (2024) "KBSS-InCLOSE. I. Design and First Results from the Inner Circumgalactic Medium of QSO Line-of-sight Emitting Galaxies at z $\sim$ 2–3", ApJ, 976, 41
- A. Longobardi, M. Fossati, M. Fumagalli, B. Agarwal, E. Lofthouse, M. Galbiati, R. Dutta, T. A. M. Berg, and **L. A. Welsh** (2023) "Towards an automatic approach to modelling the circumgalactic medium: new tools for mock making and fitting of metal profiles in large surveys", RASTI, 2, 470
- R. J. Cooke, P. Noterdaeme, J. W. Johnson, M. Pettini, **L. Welsh**, C. Peroux, M. T. Murphy, and D. H. Weinberg (2022) "Primordial Helium-3 Redux: The Helium Isotope Ratio of the Orion Nebula", ApJ, 932, 60