Louise **Welsh**

Astronomer

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Summary

In my research, I study chemical evolution across cosmic time as well as the first stars and galaxies. Primarily, I use the largest optical telescopes in the world to study some of the least chemically evolved gas 2 billion years after the Big Bang. The gas clouds are encoded with information about their star formation history and can, in combination with a chemical enrichment model that I have developed, reveal the mass distribution of ancient stellar populations. This information is invaluable because the properties of the first stellar populations are still shrouded in mystery. This work is possible through a process known as quasar absorption line spectroscopy – where gas between a bright background galaxy and our telescope can be seen, and subsequently studied, in absorption. This field will soon be revolutionised thanks to upcoming spectroscopic surveys that will produce datasets of unprecedented quality and scope. Furthermore, in the next decade, we will see the advent of the next generation of ground-based telescopes with apertures 3 times greater than the current state-of-the-art. My current research is focused on maximally utilising these technological advances to reveal the properties of the first stars. This research is essential to understand the first instances of chemical enrichment and galaxy formation in the early Universe.

Employment

INAF Astronomical Observatory of Trieste — *Trieste, Italy*

Postdoctoral Researcher — *Sep. 2023 - PRESENT*

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

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

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 (7 invited, 33 total)

Most recent:

Aug. 2024	**Isotopes as a Probe of the Growth of Galaxies**, The carbon isotopes of the first stars (invited)	*Sexten*
May 2024	**First Stars VII**, [O/Fe] enhancement in the most metal-poor DLAs	*New York*
Dec. 2023	**WEAVE QSO 2023**, LIFU programme to study the environments of metal-poor DLAs	*France*
Nov. 2023	**ESO Metals 2023**, [O/Fe] enhancement in the most metal-poor DLAs	*Chile*
Sep. 2023	**Spectral Fidelity**, The metal-poor Universe (invited)	*Italy*
July. 2023	**Habitable Worlds**, Near pristine DLAs: A window to the first stars	*STScI*
May. 2023	**IFPU First Stars** , The most metal-poor DLAs as a window to the first stars (invited)	*Italy*
April 2023	**Wine & Cheese seminar**, Oxygen-enhanced extremely metal-poor DLAs	*Johns Hopkins*

Proposal History as Principle Investigator

2024	**VLT/XSHOOTER**, 8 hours, P113.	*ESO*
2023	**VLT/ESPRESSO 4-UT**, 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**, 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

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

Teaching

2023	**Advisor**, Student bachelor thesis in physics	*Milano-Bicocca U.*
2022 - 2023	**Demonstrator**, Laboratory of Data Acquisition (postgraduate course)	*Milano-Bicocca U.*
2021	**Advisor**, Nuffield Research Placement	*Durham University*
2019 - 2021	**Demonstrator**, Level 2: Stars and Galaxies	*Durham University*
2018 - 2020	**Demonstrator**, Level 1: Further Mathematics for Geoscientists	*Durham University*
2018 - 2019	**Demonstrator**, Level 1: Maths toolkit for Scientists	*Durham University*

Memberships and activities

2023 -	**Peer reviewer**, A&A
2023 -	**WEAVE**, IFU Working Group Member for WEAVE QSO survey.
2022	**WMAG 2022**, Organising committee member for the 'What Matters around Galaxies - 2022' conference.
2022 -	**Peer reviewer**, MNRAS.
2021 -	**WEAVE**, Member of the WEAVE-QSO survey.
2021 -	**Peer reviewer**, Astrophysical Journal.
2021 - 2023	**Astrocoffee**, Organiser of weekly astrocoffee seminars at Milano-Bicocca.
2021 - 2023	**INAF**, Associate member of INAF - Osservatorio Astronomico di Brera.
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

Planetarium *North East, UK*

Show provider *Oct. 2018 - Sep. 2020*

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

Computing Skills

Programming Python, git, high-performance computing, batch systems, RStudio.

Publications

- **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
- A. Longobardi et al. (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. Cooke et al. (2022) "Primordial helium-3 redux: The helium isotope ratio of the Orion nebula", ApJ, 932, 60
- **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
- R. Cooke, **L. Welsh**, M. Fumagalli, & M. Pettini (2020) "A limit on Planck-scale froth with ESPRESSO", MNRAS, 494, 4884
- **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

My ADS publication library can be found here: https://tinyurl.com/louiseadslibrary.