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Dr Calum Hawcroft

Employment & Education

2022–present **Postdoctoral Researcher**, STScI. *Coordinator of Massive Stars research group. Member of GREENS group. Supervisor: Dr. Claus Leitherer.*

2018–2022 **PhD Astrophysics**, *Empirical mass-loss rates and clumping properties of O stars in the Milky Way and Magellanic Clouds (thesis link)*, KU Leuven, Supervisors: Prof. Dr. H. Sana, Prof. Dr. J. Sundqvist & Dr. L. Mahy.

2014–2018 **MPhys Physics with Astrophysics**, University of Leeds, UK, 1^{st} Class with Honours.

Research Interests & Highlights

Expert in UV+optical+IR spectroscopic studies of massive stars and star-forming galaxies, quantifying stellar winds, evolution and feedback throughout the Universe with the aim of understanding metallicity-dependent processes that regulate galaxy evolution.

Stellar winds: Determining the most accurate mass-loss rates of O-type stars including wind structure effects with UV+optical spectroscopy. (Hawcroft et al. 2021,2024b)

Establishing the first empirical relation between stellar wind speed and metallicity with HST-ULLYSES. (Hawcroft et al. 2024a)

Unlocking a new hot-wind regime in the infrared with JWST. (Law et al. 2024, Hawcroft et al. PID 8683)

Starburst Galaxies: Developer of pyStarburst99 population synthesis code to predict observational diagnostics and integrated properties of star-forming galaxies. (Hawcroft et al. accepted, Hawcroft et al. PID 17867)

Future Observatories: Driving future UV telescope capabilities as co-lead author of massive stars at low metallicity science case for the Habitable Worlds Observatory (HWO - science case document) and core member of UVEX science team.

Community Consortia: Active member of stellar and galactic community collaborations based on large ground and space-based observing programmes including XShootU, BLOeM, VFTS and Cosmic Spring.

Publications

2020-Present **4 Lead Author Papers**, *+2 2^{nd} Author, +3 3^{rd} Author*, Total of 22 Co-Author Papers, h-index=14. ADS Link

Observing & Computing Summary

- **PI of >40 hours of science programs** with JWST/MIRI and ESO/CRIRES spectroscopy. Co-I of >100 orbits & >100 hours of HST and ESO spectroscopic surveys.
- **Awarded $280,000 as PI** of HST and JWST programmes.
- **Awarded a combined ~50,000 CPU hours as PI** on NASA and Belgian high-performance computing facilities.

Select Community Engagement & Initiatives

April 2025 **Panelist for NASA proposal review**, *virtual discussion panel.*

2023-2025 **Panel Support Scientist for HST & JWST**, *HST cycles 31, 32, 33 and JWST cycle 3.*

2023-present **Postdoc representative to both the science mission office and research computing forum**, *STScI.*

2020-present **Panelist at multiple astronomy careers events and summer school speaker**, *outreach events.*

2019-present **Presenter at Science Conferences/Workshops**, *20 to-date.*

Supervisor & Teaching Roles

2019-2022 **Project Supervisor**, *Thomas Konings & Roel Lefever (MSc projects on Wolf-Rayet stars), Jens Jochems (BSc project on massive protostars)*, IvS, KU Leuven, Belgium.

2015-2018 **Teaching Assistant**, *MSc course 'Star and Planet Formation', BSc course 'Astronomy Methods, Tools and Techniques'*, IvS, KU Leuven, Belgium.

Grants

2025 **JWST Cycle 4 Grant**, *$230,000 awarded as PI.*

2024 **HST Cycle 32 Grant**, *$50,000 awarded as PI.*

Select Talks & Seminars

Sept 2025 **The next generation of pyStarburst99 models**, *Contributed Talk*, IAU Symposium 402, Ensenada.

April 2025 **(Very) Massive stars at low metallicity**, *Invited Stellar Seminar*, Department of Astronomy, University of Geneva.

Sept 2023 **The impact of metallicity on the feedback of stellar populations**, *Invited Departmental Seminar*, Astrophysics Department, University of Sheffield.

August 2022 **Stellar wind properties of O-type stars**, *Contributed Talk*, IAU GA XXXI, Busan.

Select Publications

- **Hawcroft C.**, Leitherer. C, et al., 2025, "pySTARBURST99: The Next Generation of STARBURST99", accepted for publication at ApJS.
- **Hawcroft C.**, Mahy L., Sana H., et al., 2024b, "Empirical mass-loss rates and clumping properties of O-type stars in the LMC", Astronomy and Astrophysics, 690, id. A126 (IF: 5.636, 6 citations, peer reviewed)
- Law D., **Hawcroft C.**, et al. 2024 "JWST/MIRI detection of [Ne V], [Ne VI], and [O IV] wind emission in the O9V star 10 Lacertae", ApJ Letters, 976L, id. 25L (IF:8.8, 3 citations, peer reviewed)
- **Hawcroft C.**, Sana H., Mahy L. et al., 2024a, "X-Shooting ULLYSES: Massive stars at low metallicity. III. Terminal wind speeds of ULLYSES massive stars", Astronomy and Astrophysics, 688, id. A105 (IF: 5.636, 35 citations, peer reviewed)
- **Hawcroft C.**, Sana H., Mahy L. et al., 2021, "Empirical mass-loss rates and clumping properties of Galactic early-type O supergiants", Astronomy and Astrophysics, 655, id. A67 (IF: 5.636, 42 citations, peer reviewed)

Select Proposals

- **JWST Cycle 4 - 34.4 hours & $230,000 awarded as PI on MIRI** (Title: MIRI spectroscopy of high ionisation stellar wind emission lines: Solving the weak wind problem in late O-type stars)
- **HST Cycle 32 - $50,000 awarded as PI** (Archival proposal - Title: A new theoretical spectral library across the upper-HRD)
- **ESO Telescopes P113 - 6.5h awarded as PI on VLT with CRIRES instrument** (Title: Massive Star Outflows: Weak Wind Phenomena in the Infrared)
- HST Cycle 31 - **110 orbits awarded as CoI on COS** (Title: A Legacy Far-Ultraviolet Spectral Atlas of Extremely Metal-Poor O Stars aka TEMPOS)
- ESO Telescopes P112 - **117h awarded as CoI on FLAMES instrument** (Title: Towards an understanding of massive stars in the Early Universe)
- NASA HEC computing time - **40,460 SBUs (equivalent to $11,700) awarded as PI** (Title: TEMPOS)

Large Collaborations

HWO NASA's next flagship mission will include UV spectroscopic capacity. As co-lead of the massive stars science case I am helping define the impact of, and requirements to, fully characterise massive stars and winds at very low metallicity (sub-SMC).

UVEX UVEX will survey ∼1000s of massive stars in the LMC & SMC, I am primarily helping define the spectral resolution requirements to accurately measure wind parameters, as well as building the list of targets.

XShootU	Community collaboration based on large spectroscopic HST-UV and ESO-Optical survey of 100s of OB stars in the LMC & SMC. I produced the first science results on wind speeds, built frameworks for stellar atmosphere modelling and am producing population synthesis predictions with the XShootU library.
BLOeM	Large ESO optical binary monitoring survey in the SMC including spectroscopic characterisation of OB stars to inform binary statistics at low metallicity.
VFTS	Similar to BLOeM but based in the LMC, expanding metallicity coverage.
Cosmic Spring	Large collaboration based on multiple JWST programmes focused on high-redshift, low-metallicity stellar populations with gravitational lenses, to which I apply the newly developed population synthesis predictions with massive stars.

Press & Media Coverage

2022 **Discovery and characterisation of dormant black-hole & massive star binary systems**, *e.g. ESO, Harvard, BBC, Space.com, CNN*.

2023 **First results from the XShootU collaboration**, *Armagh Coverage*.

Additional Proposals & Observing Experience

- VSC Tier-1 (Belgian HEC) Computing Time - **7,315 node days awarded as PI over two proposals** (Title: Massive Stars Outflows - A multiwavelength genetic fitting algorithm)
- Keck Telescopes 2024 - **2.5 nights awarded as CoI on DEIMOS instrument** (Title: Completing a Legacy Spectral Atlas of Extremely Metal-Poor Stars)
- ESO Telescopes P109 - **11.3h awarded as CoI on CRIRES instrument** (Title: Effects of the episodic mass loss on the fates of massive stars)
- Mercator Telescope (private 1.2m telescope at La Palma, Spain) - **31h awarded as PI on HERMES Spectrograph** (Title: Massive star outflows - a multiwavelength approach to constrain the clumping)
- Mercator Telescope, HERMES Spectrograph - **25 nights experience operating facility as local observer**
- Keck Telescope, DEIMOS Instrument - **4 nights experience operating facility as observing team**

Extended Community Engagement & Initiatives

2024-present **Committee member of massive stars online seminar course**, *IAU G2 initiative*.

March 2024 **SOC member and session chair of science workshop**, *ULLYSES: Continuing the Voyage of Discovery*.

April 2024 **LOC member of science conference**, *Recipes to Regulate Star Formation at All Scales*.

2024-present **Contributed manuscript reviews to MNRAS**.

2025-present **Member of American Astronomical Society (AAS)**.

Extended Publication List

- Fabry M., **Hawcroft C.**, Frost A. J. et al. 2021, "Resolving the dynamical mass tension of the massive binary 9 Sagittarii", Astronomy and Astrophysics, 651, id. A119, (IF: 5.636, 15 citations, peer reviewed)
- Abdul-Masih M., Sana H., **Hawcroft C**. et al., 2021, "Constraining the overcontact phase in massive binary evolution. I. Mixing in V382 Cyg, VFTS 352, and OGLE SMC-SC10 108086", Astronomy and Astrophysics, 651, id. A96, (IF: 5.636, 41 citations, peer reviewed)
- Bestenlehner, J. M., Crowther, P. A., **Hawcroft, C**. et al. 2025, "X-Shooting ULLYSES: Massive Stars at Low Metallicity: XI. Pipeline-determined Physical Properties of Magellanic Cloud OB Stars", Astronomy and Astrophysics, 695, id. A198, (IF: 5.636, 2 citations, peer reviewed)
- Lundqvist E., Zackrisson E., **Hawcroft C**. et al. 2024, "Spectroscopic characterisation of gravitationally lensed stars at high redshifts", Astronomy and Astrophysics, 690, id. A291, (IF: 5.636, 4 citations, peer reviewed)
- Abdul-Masih, M. et al. 2020, "On the signature of a 70-solar-mass black hole in LB-1", Nature, Volume 580, Issue 7805, p.E11-E15 (IF 2019: 42.778, 75 citations, peer reviewed)
- Shenar, T. et al, 2020, "The 'hidden' companion in LB-1 unveiled by spectral disentangling", Astronomy and Astrophysics, 639, id. L6, (IF: 5.636, 122 citations, peer reviewed)

- Shenar, T. et al, 2022, "An X-ray-quiet black hole born with a negligible kick in a massive binary within the Large Magellanic Cloud", Nature Astronomy, Volume 6, p. 1085-1092 (IF: 15.65, 79 citations, peer reviewed)
- Bodensteiner, J. et al, 2020, "is HR 6819 a triple system containing a black hole? An alternative explanation", Astronomy and Astrophysics, 641, id. A43, (IF: 5.636, 98 citations, peer reviewed)
- Frost, A. et al, 2022, "HR 6819 is a binary system with no black hole. Revisiting the source with infrared interferometry and optical integral field spectroscopy", Astronomy and Astrophysics, 659, id. L3, (IF: 5.636, 30 citations, peer reviewed)
- Mahy, L. et al, 2022, "Identifying quiescent compact objects in massive Galactic single-lined spectroscopic binaries", Astronomy and Astrophysics, 664, id. A159, (IF: 5.636, 60 citations, peer reviewed)
- Brands, S. A. et al. 2025, "X-Shooting ULLYSES: massive stars at low metallicity: XII. The clumped winds of O-type (super)giants in the Large Magellanic Cloud", Astronomy and Astrophysics, 000, id. A00 (IF: 5.636, 2 citations, peer reviewed)
- Brands, S. A. et al. 2022, "The R136 star cluster dissected with Hubble Space Telescope/STIS. III. The most massive stars and their clumped winds", Astronomy and Astrophysics, 663, id. A36 (IF: 5.636, 97 citations, peer reviewed)
- Backs, F. et al. 2024, "X-Shooting ULLYSES: Massive stars at low metallicity: VI. Atmosphere and mass-loss properties of O-type giants in the Small Magellanic Cloud", Astronomy and Astrophysics, 692, id. A88 (IF: 5.636, 7 citations, peer reviewed)
- Vink, J. S. et al., 2023, "X-Shooting ULLYSES: Massive stars at low metallicity. I. Project Description", Astronomy and Astrophysics, 675, id. A154 (IF: 5.636, 47 citations, peer reviewed)
- Sana, H. et al., 2024, "X-Shooting ULLYSES: Massive stars at low metallicity. II. DR1: Advanced optical data products for the Magellanic Clouds", Astronomy and Astrophysics, 688, id. A104 (IF: 5.636, 13 citations, peer reviewed)
- Bernini-Peron, M. et al., 2024, "X-Shooting ULLYSES: Massive stars at low metallicity. VII. Stellar and wind properties of B supergiants in the SMC", Astronomy and Astrophysics, 692, id. A89 (IF: 5.636, 11 citations, peer reviewed)
- Shenar, T. et al., 2024, "Binarity at LOw Metallicity (BLOeM): I. a spectroscopic VLT monitoring survey of massive stars in the SMC", Astronomy and Astrophysics, 690, id. A289 (IF: 5.636, 18 citations, peer reviewed)
- Johnson, C. et al, 2021, "Characterization of the variability in the O+B eclipsing binary HD 165246", Monthly Notices of the Royal Astronomical Society, 503, 1124-1137, (IF: 5.356, 14 citations, peer reviewed)

Extended Conference List

- **STScI HotSci 2025 seminar series speaker** (Title: Solving the weak wind problem in O-type stars with JWST/MIRI)
- **Aspen workshop attendee 2025** (Cosmic Change Agents: Massive stars in the early universe)
- **Contributed talk - AAS 246 Anchorage, Alaska** (Title: (Very) Massive stars at low metallicity - The next generation of pyStarburst99 models
- **Flash talk & poster - Cosmic Frontiers Conference Austin, TX 2025** (Title: pyStarburst99: The next generation of Starburst99 at low metallicity)
- **Flash talk & poster - HWO: Towards the Habitable Worlds Observatory Washington, DC 2025** (Title: Massive stars at low metallicity - The latest results from Local Group surveys and the link to HWO
- **Flash talk & poster - Inter+Stellar STScI Spring Symposium 2025** (Title: pyStarburst99: The next generation of Starburst99 at low metallicity)
- **Discussion panelist & posters at Munichfest 2025 La Palma** (Panel: Future prospects for the field. Poster 1: MIR wind emission in 10 Lac (O9V star). Towards a solution to the weak-wind problem. Poster 2: Population Synthesis at low metallicity. New predictions for integrated stellar populations with (very) massive stars)

- **Science working group member - HWO meeting Rochester 2024**
- **STScI HotSci 2024 seminar series speaker** (Title: Massive stars at low metallicity)
- **Flash talk & poster - Stanfest 2024 Leuven** (Title: The impact of metallicity on massive stars in stellar populations)
- **Discussion leader - XShootU Wide Workshop Leuven 2024**
- **Science working group member - HWO meeting Baltimore 2024**
- **Discussion leader - XShootU Wide Workshop Prague 2023**
- **Contributed talk - The Wolf-Rayet Phenomenon in the Universe Morelia 2023** (Title: Stellar wind properties of O-type stars)
- **Session moderator - Science with the Habitable Worlds Observatory and Beyond 2023** (STScI, USA)
- **Contributed talk - IAU361 Massive Stars 2021 Ireland** (Online) (Title: New empirical mass-loss rates and clumping properties of massive stars)
- **Contributed talk - VFTS Heidelberg 2022** (Title: Stellar wind properties of O-type stars)
- **Contributed talks - IAUGA XXXI Busan 2022** (Titles: 1. Terminal wind speeds with ULLYSES, 2. Stellar wind properties of O-type stars)
- **Research seminar at IvS (KU Leuven, 2021)**
- **Research seminar at API (University of Amsterdam, 2020)**
- **Poster showcased at international conference EWASS 2019 Lyon and 2021 Virtual** (Title: Impact of porosity on mass-loss rates from massive stars - A key ingredient in their evolution)
- Attendee - VFTS Edinburgh 2019, VFTS Munich 2023