Gautham N. Sabhahit

POSTDOCTORAL RESEARCH ASSISTANT · MASSIVE STARS & STELLAR ASTROPHYSICS

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Web: gautham-sabhahit.github.io · Publications: ADS author library · Code: github.com/Apophis-1/

RESEARCH INTERESTS

My main research interests lie in massive stars, their mass loss and wind-driving physics, and the impact of these wind outflows on the internal structure and evolution of massive stars across all phases. I have expertise in hydrodynamical modelling of the wind structure of massive stars using the PoWR atmosphere code, with recent work focused on the winds of the most massive stars, such as those in the Tarantula Nebula. Complementary to these investigations in the local Universe, I study how mass loss governs the lives and deaths of massive stars in the early Universe using the MESA structure and evolution code. This question has gained new urgency with the advent of high-redshift spectroscopy: JWST is now detecting UV wind-line features that may originate from massive stars, alongside the detection of heavy black-hole mergers such as GW190521.

CURRENT POSITION

Postdoctoral Research Assistant Nov 2023 – Present

Armagh Observatory & Planetarium (AOP), Armagh, United Kingdom

PhD THESIS

Title: *"Theoretical studies of massive stars near the Eddington limit"*

Institution: Armagh Observatory & Planetarium (AOP), Armagh, United Kingdom

Supervisor: Prof. Jorick S. Vink

Timeline: Nov 2019 – Oct 2023

EDUCATION

PhD, Astrophysics Nov 2019 – Oct 2023

Armagh Observatory & Planetarium (AOP), Armagh, United Kingdom

MSc, Physics (Taught Postgraduate) Sep 2018 – Oct 2019

University of Leeds, Leeds, United Kingdom

BEng, Mechanical Engineering Aug 2014 – Jul 2018

National Institute of Technology Karnataka (NITK), Surathkal, India · GPA 9.2

CODES & PROGRAMMING

- **MESA (stellar evolution):** extensive experience with stellar-evolution calculations; developed and implemented a custom mass-loss framework tailored for very massive stars within the MESA codebase (in Fortran), enabling detailed studies of their evolution and endpoints. Implementation available at github.com/Apophis-1/VMS_Paper2.
- **PoWR (non-LTE stellar atmospheres):** hydrodynamical wind–atmosphere calculations yielding theoretical mass-loss prescriptions for massive stars.
- **Programming:** Python (proficient), Fortran (proficient).

RESEARCH SUPERVISION

- Guided a Queen's University Belfast Bachelor's student. 2025 & 2026
- Guided a Trinity College Dublin Bachelor's student. 2023

COLLABORATIONS & MEMBERSHIPS

- XShooter + ULLYSES collaboration, Working Groups 4 and 5. 2021 –
- International Astronomical Union (IAU) Junior member. 2024 –

SERVICE

- Peer reviewer for *Astronomy & Astrophysics* (A&A) and *The Astrophysical Journal* (ApJ), since 2023.
- LOC member, IAU Symposium 361, Ballyconnell, Ireland (2021–2022).
- Seminar organiser at Armagh Observatory & Planetarium (2024–2025).
- Journal Club organiser at Armagh Observatory & Planetarium (2021–2022).

CONTRIBUTED TALKS

- *Hydrodynamically consistent mass-loss rates for very massive stars: wind physics, stellar evolution, and cosmic implications* — MIAPbP workshop on Bridging Gaps in High-Mass Star Research, Munich, Germany. Sep 2026
- *Winds and ionising fluxes from very massive stars in the early Universe* — Hera 2025 Workshop, Pisa, Italy. Sep 2025
- XShooting Ullyses meeting, Vienna, Austria. May 2025
- *Mass-loss predictions for very massive stars* — Munichfest 2025: celebrating 40 years of research on hot luminous stars, La Palma, Spain. Apr 2025
- *Winds from very massive stars* — TOSCA-2024 (Topical Overview on Star Cluster Astrophysics), Siena, Italy. Oct 2024
- *Mass-loss implementation of very massive stars; kink implementation across high and low metallicity* — VFTS, ESAC, Villafranca del Castillo, Madrid, Spain. Sep 2024
- *Mass-loss implementation of very massive stars* — The Wolf–Rayet Phenomenon in the Universe, Morelia, Mexico. Jun 2023
- *Mass-loss implementation and temperature evolution of massive stars* — STARS 2020, Cambridge, United Kingdom. Aug 2022
- *Mixing and mass loss beyond the main sequence* — Massive Stars Near and Far (IAU Symposium 361), Ireland. May 2022
- *Super-adiabaticity and the $\mathcal{Z}$-independence of the Humphreys–Davidson limit* — Massive Stars and Black Holes, Maynooth University, Ireland. Nov 2021

REFERENCES

Prof. Dr. Jorick S. Vink
Armagh Observatory & Planetarium, Armagh, United Kingdom (PhD supervisor)
jorick.vink@armagh.ac.uk

Prof. Dr. Andreas A. C. Sander
Zentrum für Astronomie der Universität Heidelberg (ZAH), Heidelberg, Germany
andreas.sander@uni-heidelberg.de

PUBLICATIONS

First-author refereed publications

1. *Hydrodynamical mass-loss rates for very massive stars. II. New theoretical mass-loss predictions at solar metallicity ($Z = 0.02$)*, 2026, A&A — G. N. Sabhahit, J. S. Vink, A. A. C. Sander. arXiv:2607.28012
2. *Hydrodynamical mass-loss rates for very massive stars. I. Investigating the wind kink*, 2026, A&A — G. N. Sabhahit, J. S. Vink, A. A. C. Sander. doi:10.1051/0004-6361/202557298
3. *Minimum and maximum mass–luminosity relations for stripped stars*, 2025, A&A — G. N. Sabhahit, J. S. Vink, A. A. C. Sander, V. Ramachandran. doi:10.1051/0004-6361/202554852
4. *A new mass estimate method with hydrodynamical atmospheres for very massive WNh stars*, 2025, A&A — G. N. Sabhahit, J. S. Vink, A. A. C. Sander, M. Bernini-Peron, P. A. Crowther, R. R. Lefever, T. Shenar. doi:10.1051/0004-6361/202453447
5. *Stellar expansion or inflation?*, 2025, A&A — G. N. Sabhahit, J. S. Vink. doi:10.1051/0004-6361/202451976
6. *Very massive stars and pair-instability supernovae: mass-loss framework for low metallicity*, 2023, MNRAS — G. N. Sabhahit, J. S. Vink, A. A. C. Sander, E. R. Higgins. doi:10.1093/mnras/stad1888
7. *Mass-loss implementation and temperature evolution of very massive stars*, 2022, MNRAS — G. N. Sabhahit, J. S. Vink, E. R. Higgins, A. A. C. Sander. doi:10.1093/mnras/stac1410
8. *Superadiabaticity and the metallicity independence of the Humphreys–Davidson limit*, 2021, MNRAS — G. N. Sabhahit, J. S. Vink, E. R. Higgins, A. A. C. Sander. doi:10.1093/mnras/stab1948

Co-authored refereed publications

1. *The robustness of bi-stability jump predictions*, 2026, A&A — J. S. Vink, G. N. Sabhahit, A. A. C. Sander. doi:10.1051/0004-6361/202659949
2. *The winds of OBA hypergiants and luminous blue variables: dynamically consistent atmosphere models reveal multiple wind regimes*, 2026, A&A — M. Bernini-Peron, A. A. C. Sander, G. N. Sabhahit, F. Najarro, V. Ramachandran, J. S. Vink. doi:10.1051/0004-6361/202558762
3. *Metal-poor single Wolf–Rayet stars: the interplay of optically thick winds and rotation*, 2025, A&A — L. Boco et al. doi:10.1051/0004-6361/202556187
4. *Near-Eddington mass loss of hydrogen-rich Wolf–Rayet stars: consequences of continuum acceleration, metallicity, and temperature*, 2025, A&A — R. R. Lefever et al. doi:10.1051/0004-6361/202554505
5. *The impact of wind mass loss on nucleosynthesis and yields of very massive stars at low metallicity*, 2025, A&A — E. R. Higgins, J. S. Vink, R. Hirschi, A. M. Laird, G. N. Sabhahit. doi:10.1051/0004-6361/202453472
6. *The black hole–pair instability boundary for high stellar rotation*, 2025, MNRAS — E. R. J. Winch, G. N. Sabhahit, J. S. Vink, E. R. Higgins. doi:10.1093/mnras/staf676
7. *Coupling hydrodynamics with comoving frame radiative transfer. III. The wind regime of early-type B hypergiants*, 2025, A&A — M. Bernini-Peron et al. doi:10.1051/0004-6361/202554127
8. *The maximum black hole mass at solar metallicity*, 2024, A&A — J. S. Vink, G. N. Sabhahit, E. R. Higgins. doi:10.1051/0004-6361/202450655
9. *Modelling time-dependent convective penetration in 1D stellar evolution*, 2024, ApJ — C. Johnston et al. doi:10.3847/1538-4357/ad2343
10. *Stellar wind yields of very massive stars*, 2023, MNRAS — E. R. Higgins, J. S. Vink, R. Hirschi, A. Laird, G. N. Sabhahit. doi:10.1093/mnras/stad2537

11. *Exploring the red supergiant wind kink: a universal mass-loss concept for massive stars*, 2023, A&A — J. S. Vink, G. N. Sabhahit. doi:10.1051/0004-6361/202347801

12. *X-Shooting ULLYSES: massive stars at low metallicity. I. Project description*, 2023, A&A — J. S. Vink et al. doi:10.1051/0004-6361/202245650

13. *The temperature dependency of Wolf–Rayet-type mass loss: an exploratory study for winds launched by the hot iron bump*, 2023, A&A — A. A. C. Sander et al. doi:10.1051/0004-6361/202245110

14. *The hydrogen clock to infer the upper stellar mass*, 2022, MNRAS — E. R. Higgins, J. S. Vink, G. N. Sabhahit, A. A. C. Sander. doi:10.1093/mnras/stac2485

15. *Maximum black hole mass across cosmic time*, 2021, MNRAS — J. S. Vink, E. R. Higgins, A. A. C. Sander, G. N. Sabhahit. doi:10.1093/mnras/stab842

Totals: 9 first-author papers (8 published) and 16 co-authored papers (15 published), plus 3 conference proceedings.[1]

[1] Full, up-to-date list available on the linked ADS author library.