

# Dwaipayan Debnath

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<https://ddebathkul.github.io/>

## Research Interests

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Massive-star atmospheres and winds · Computational astrophysics · Stellar evolution and feedback · Binary interaction and evolution

## Research Positions

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### PhD in Astrophysics

KU Leuven, Belgium — Nov 2022 – present

- Thesis: *Multi-dimensional Modelling of Massive-Star Atmospheres*

### Observing Astronomer

Mercator Telescope, La Palma — 29 May – 10 Jun 2024

### Summer Intern (Visiting Students Program)

Raman Research Institute, Bangalore — May – Jul 2017

- Study of dispersion measure of pulsar PSR B0834+06

## Academic Background

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### MSc in Astronomy & Astrophysics

KU Leuven, Belgium

- Thesis: *Updating Atomic Database for Astrophysical Applications; First Effects on the Wind Dynamics of Wolf-Rayet Stars*

### B.Tech. in Electronics & Communication Engineering

NIT Agartala, India

- Thesis: *Return Loss, Bandwidth and Gain Improvement of Microstrip Antenna using Modified Inset Feeding*

## (Co-)authored Papers

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- **Debnath, D.**, Sundqvist, J. O., Moens, N., Van der Sijpt, C., Verhamme, O., & Poniowski, L. G. (2024). *2D unified atmosphere and wind simulations of O-type stars*. *Astronomy & Astrophysics*, 684, A177. DOI: [10.1051/0004-6361/202348206](https://doi.org/10.1051/0004-6361/202348206)
- Ud-Doula, A., Sundqvist, J. O., Narechania, N., **Debnath, D.**, Moens, N., & Keppens, R. (2025). *Suppression of photospheric turbulence in strongly magnetic O-stars in radiation-MHD simulations*. *Astronomy & Astrophysics*. DOI: [10.1051/0004-6361/202452375](https://doi.org/10.1051/0004-6361/202452375)
- González-Torà, G., Sander, A. A. C., Sundqvist, J. O., **Debnath, D.**, Delbroek, L., Josiek, J., Lefever, R. R., Moens, N., Van der Sijpt, C., & Verhamme, O. (2025). *Improving 1D stellar atmosphere models with insights from multi-D simulations I: O-stars*. *Astronomy & Astrophysics*. DOI: [10.1051/0004-6361/202452241](https://doi.org/10.1051/0004-6361/202452241)
- Van der Sijpt, C., Sundqvist, J. O., **Debnath, D.**, Driessen, F. A., & Moens, N. (2025). *Structure formation in O-type stars and Wolf-Rayet stars*.

Astronomy & Astrophysics.

DOI: [10.1051/0004-6361/202452385](https://doi.org/10.1051/0004-6361/202452385)

- González-Torà, G., Sander, A. A. C., Moens, N., Sundqvist, J. O., **Debnath, D.**, Delbroek, L., Josiek, J., Lefever, R. R., Van der Sijpt, C., Verhamme, O., & Bernini-Peron, M. (2025). *Improving 1D stellar atmosphere models with insights from multi-D simulations II: 1D versus 3D model comparison for Wolf-Rayet stars.* Astronomy & Astrophysics. DOI: [10.1051/0004-6361/202554125](https://doi.org/10.1051/0004-6361/202554125)
- Sundqvist, J. O., **Debnath, D.**, Backs, F., Verhamme, O., Moens, N., Delbroek, L., Dickson, D., Schillemans, P., Van der Sijpt, C., & Dirickx, M. (2025). *An on-the-fly line-driven-wind iterative mass-loss estimator (LIME) for hot, massive stars of arbitrary chemical compositions.* Astronomy & Astrophysics. DOI: [10.48550/arXiv.2504.00936](https://doi.org/10.48550/arXiv.2504.00936)
- Moens, N., **Debnath, D.**, Verhamme, O., Backs, F., Van der Sijpt, C., Sundqvist, J. O. & Sander, A. A. C. (2025). *2D unified atmosphere and wind simulations for a grid of O-type stars.* Astronomy & Astrophysics. DOI: [10.1051/0004-6361/202556825](https://doi.org/10.1051/0004-6361/202556825)
- Delbroek, L., Sundqvist, J. O., **Debnath, D.**, Backs, F., Moens, N., Van der Sijpt, C., Verhamme, O., & Schillemans, P. (2025). *Spectral synthesis of 3D unified model atmospheres with winds for O-stars.* Astronomy & Astrophysics. DOI: [10.1051/0004-6361/202556421](https://doi.org/10.1051/0004-6361/202556421)

## Conference Contributions

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- **The Wolf-Rayet Phenomenon**, Morelia, Mexico  
First effects from 3D models on observations of Wolf-Rayet stars
- **EAS Meeting**, Kraków, Poland  
2D unified atmosphere and wind models of O-stars
- **XshootU Workshop**, Prague  
2D unified atmosphere and wind models of O-stars
- **POEMS**, Rio de Janeiro  
Multi-D unified atmosphere and wind simulations of O-stars
- **Fundamentals of Stellar Outflows**, Leuven  
Contributed talk: From multi-D stellar-wind models to spectral synthesis
- **XshootU Workshop**, Vienna  
Contributed talk: Line-driven-wind iterative mass-loss calculator (LIME)

## Seminars

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- **IVS Seminar Series**, Leuven  
Multi-D unified atmosphere and wind simulations of O-stars
- **Massive Star Seminar Series**  
Wind accretion, tidal interaction, Roche-lobe overflow, and mass transfer in massive binary systems

## Teaching and Outreach

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- Teaching Assistant - Galaxies & Cosmology; Computational Astrophysics, Masters, A&A, KU Leuven
- Supervisor - Theoretical Research Project (Luis Antonio Bala), Masters A&A, KU Leuven
- Supervisor - Research Project (Anya Schmit, Luka Vranckx, Sara Heyvaert), Masters A&A, KU Leuven
- Co-supervisor - Research Project (Agung Prawira Negara, Lotte Van Marcke), Masters A&A, KU Leuven
- Co-supervisor - Master thesis (Cécile de Wassige):  
*Mass loss in evolution of massive stars in the early Universe: effects of chemical surface enrichment*, KU Leuven
- Developed [LIME](#), an online tool to compute line-driven mass-loss rates for tunable stellar parameters and abundances

## Technical Skills

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**Programming:** Python, Fortran 90, C++, Matlab, Bash, L<sup>A</sup>T<sub>E</sub>X

**Tools:** NumPy/SciPy, Astropy, Matplotlib, f2py, Git, Jupyter, Docker

**Codes:** MPI-AMRVAC, MFORCE, FASTWIND, MESA

**HPC:** VSC (Vlaams Supercomputer Centrum), KU Leuven clusters

## References

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Prof. Jon Sundqvist — Institute of Astronomy, KU Leuven

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Dr. Nicolas Moens — Institute of Plasma Astrophysics, KU Leuven

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