Frederik De Ceuster

✉ frederik.deceuster@gmail.com
☎ +32(0) 498 71 16 82
@FredDeCeuster
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EMPLOYMENT

- Postdoctoral research fellow — 2022 - 2025
  Research Foundation - Flanders (FWO),
  working at the **Institute of Astronomy**, **KU Leuven** (Belgium)
- Postdoctoral researcher — 2021 - 2022
  Institute of Astronomy, **KU Leuven** (Belgium)
- Web, Social media, and Training manager (part time: 20%) — 2017 - 2021
  DiRAC: Distributed Research utilising Advanced Computing,
  (United Kingdom)
- Research assistant — Aug. - Oct., 2016
  Laboratory for Solid State Physics of Prof. Dr. J.-P. Locquet,
  KU Leuven (Belgium)

EDUCATION

- Doctor of Philosophy (**PhD**; Computational Astrophysics) — 2017 - 2021
  University College London, United Kingdom
  Thesis: Simulating 3D Radiation Transport,
  a modern approach to discretisation
  and an exploration of probabilistic methods
  Supervisors: Dr. Jeremy Yates, Prof. Dr. Leen Decin,
  Prof. Dr. Peter Boyle, and Prof. Dr. James Hetherington
- Master of Science (**MSc**; Theoretical Physics) — 2014 - 2016
  KU Leuven, Belgium (Magna Cum Laude)
  Thesis: Holographic explorations of spacetime singularities
  Supervisors: Dr. Adam Bzowski, and Prof. Dr. Thomas Hertog
- Bachelor of Science (**BSc**; Major Physics, Minor Mathematics) — 2011 - 2014
  KU Leuven, Belgium (Magna Cum Laude)

SELECTED PUBLICATIONS

(A complete publication list can be found below and online here.)

- F. De Ceuster, et al., *3D Line Radiative Transfer & Synthetic Observations with Magritte*, Journal of Open Source Software, Vol. 7, Num. 71, pp. 3905, 2022.
- F. De Ceuster, et al., *Magritte, a modern software library for 3D radiative transfer: II adaptive ray-tracing mesh construction and reduction*, Monthly Notices of the Royal Astronomical Society, Vol. 499, Issue 4, pp. 5194-5204, 2020, arXiv:2011.14998.
- L. Decin, et al., *(Sub)stellar companions shape the winds of evolved stars*, Science, Vol. 369, Issue 6510, pp. 1497-1500, 2020, arXiv:2009.11694.
- F. De Ceuster, et al., *Magritte, a modern software library for 3D radiative transfer: I Non-LTE atomic and molecular line modelling*, Monthly Notices of the Royal Astronomical Society, Vol. 492, Issue 2, pp. 1812-1826, 2020, arXiv:1912.08445.

TEACHING

- **Lecturer** for *Physics I: Mechanics*, BSc Physics & Mathematics at KU Leuven, Fall term 2021, substituting for Prof. Dr. Leen Decin.
- **Teaching assistant** for *Physics I: Mechanics*, BSc Physics & Mathematics at KU Leuven, Fall term 2016, 2018, 2019, 2020.
- **Teaching assistant** for *Physics II: Electromagnetism*, BSc Physics & Mathematics at KU Leuven, Spring term 2015, 2016.

SOFTWARE PROJECTS

(All my projects can be found on github.com/FredDeCeuster)

- **Magritte**: an open-source software library for simulating 3D radiation transport & synthetic observations, github.com/Magritte-code/Magritte, see also magritte.readthedocs.io.
- **Paracabs**: parallelisation and acceleration abstractions for performance scaling and portability, github.com/Magritte-code/Paracabs.

INTERNSHIPS

- February 2018, 6-month internship with **Intel** at the University of Edinburgh, *Parallelisation and scaling analysis of the transport solver Magritte*, supervisor: Prof. Dr. Peter Boyle.
- October 2019, 6-month internship with **Intel** (remotely), *Implementation and analysis of hardware acceleration in the transport solver Magritte*, supervisor: Prof. Dr. Peter Boyle.

GRANTS

- Research Foundation - Flanders (FWO), 3-year **Postdoctoral Research Fellowship** (FWO: 1253223N; 2022-2025).
- KU Leuven, Belgium, 1-year **Postdoctoral Mandate** (PDMT2/21/066; 2021-2022).
- Engineering & Physical Sciences Research Council (EPSRC, UK) industrial Cooperative Awards in Science & Technology (iCASE), a 4-year **PhD project** at University College London, Project Reference: 1878976.

SUPERVISION

- Shiqi Su (**PhD**, **Astronomy & Astrophysics**), topic: *Artificial neural networks for emulating radiative transfer simulations*, academic years 2021-2025, at University of Leicester.
- Thomas Ceulemans (**PhD**, **Astronomy & Astrophysics**; **FWO fellow**), topic: *Computational aspects of radiative transfer*, academic years 2021-2025, at KU Leuven.
- Annika Lauwerys (**High school final project**), topic: *Astronomical image deprojection using the Doppler shifts of spectral lines*, academic year 2021-2022, ZAVO Zaventem.
- Arnout Coenegrachts (**MSc thesis**, **Astronomy & Astrophysics**) topic: *Modelling the 3D distribution of NaCl around the AGB star IK Tauri*, academic year 2021-2022, at KU Leuven.
- Mats Esseldeurs (**MSc thesis**, **Astronomy & Astrophysics**) topic: *Implementing a ray-tracing 3D radiative transfer solver in the smoothed-particle hydrodynamics code PHANTOM*, academic year 2021-2022, at KU Leuven. (Won the Paul Smeyers Prize for best thesis in the Master of Astronomy & Astrophysics 2022.)
- Astha (**Research project**, **Physics**) topic: *Probabilistic numerics for solving linear partial differential equations*, spring semester 2022, at KU Leuven.
- Anirudh Sharma (**Research project**, **Physics**) topic: *Operator-adapted wavelets for optimal function approximation*, spring semester 2022, at KU Leuven.

- Atulit Srivastava (**MSc thesis**, **Astronomy & Astrophysics**) topic: *Machine Learning solutions to accelerate Radiative Transfer computations*, academic year 2020-2021, at KU Leuven.
- Thomas Ceulemans (**MSc thesis**, **Mathematics**), topic: *Multigrid solutions for Radiative Transfer*, academic year 2020-2021, at KU Leuven.
- Shiqi Su (**MSc thesis**, **Mathematics**), topic: *Artificial neural networks for uncertainty quantification*, academic year 2020-2021, at University College London.

TALKS

- **Seminar** at the Department of Physics and Astronomy, Ghent University (March 24, 2022): *Approximate Radiative Transfer*;
- IAU Symposium 366: The Origin of Outflows in Evolved Stars (November 1, 2021; online); **invited training session**: *3D Radiative Transfer & Synthetic Observations with Magritte*;
- DELVE: The death-throes of evolved stars, a virtual encounter (April 12, 2021; online); **contributed talk**: Beyond the Treachery of Images: 3D Radiative Transfer with Magritte;
- **Seminar** at the Institute of Astronomy, KU Leuven (February 26, 2021; online), together with Silke Maes and Jolien Malfait: Hydro/radiative modelling of AGB wind-companion interactions;
- **Seminar** at the Institute of Astronomy, KU Leuven (October 10, 2019): Magritte, a modern software library for 3D radiative transfer.

OTHER

- **Organiser/Chair** of the **ENSOR** meetings: monthly meetings during the 2019-2020 Covid pandemic bringing together physicists, chemists, engineers, and mathematicians from University College London (UCL), KU Leuven, University of Oxford, and several other institutes, to present and discuss transferable methods, and foster new collaborations. This led, for instance, to the PhD project of Silke Maes, that sprung from several ENSOR talks on the emulation of chemical models, resulting in a collaboration between KU Leuven, UCL, University of Leeds, and Leiden University.
- **co-I** of the **DiRAC HPC project** - RAC 12 call: **dp147**: *Simulations and Models of the ALMA ATOMIUM Project Data*, 25.76 million cpu hours + 318 TB storage (Data Intensive Cambridge), 10.56 million cpu hours + 751 TB storage (Data Intensive Leicester). Allocation doubled in the RAC 13.5 call; hence total of 72.64 million cpu hours, 2138 TB storage, awarded after peer-review;
- **co-I** of the **ALMA Large Program** (ID 2018.1.00659.L), **ATOMIUM**: *ALMA Tracing the Origins of Molecules in dUst-forming oxygen-rich M-type stars*, 113.2 hr, awarded after peer-review;

REFEREES

- **Prof. Dr. Leen Decin** (Postdoc supervisor)
  Institute for Astronomy,
  KU Leuven
  Email: leen.decin@kuleuven.be
- **Revd. Dr. Jeremy Yates** (PhD supervisor)
  Department of Computer Science & UCL Centre for Space Exo-chemistry Data,
  University College London
  Email: j.a.yates@ucl.ac.uk

- **Dr. Clare Jenner** (supervisor at DiRAC)
  Deputy director at DiRAC, Project Scientist at University College London
  DiRAC, University College London
  Email: c.jener@ucl.ac.uk

PUBLICATIONS

- C. A. Gottlieb, L. Decin, A. M. S. Richards, F. De Ceuster, et al., *ATOMIUM: ALMA tracing the origins of molecules in dust forming oxygen-rich M-typestars. Motivations, sample, calibration, and initial results*, Astronomy & Astrophysics, Vol. 660, nr. A94, 2022, arXiv:2112.04399.

- F. De Ceuster, et al., *3D Line Radiative Transfer & Synthetic Observations with Magritte*, Journal of Open Source Software, Vol. 7, Num. 71, pp. 3905, 2022.

- S. Maes, W. Homan, J. Malfait, L. Siess, J. Bolte, F. De Ceuster, L. Decin, *SPH modelling of companion-perturbed AGB outflows including a new morphology classifications scheme*, Astronomy & Astrophysics, Vol. 653, nr. A25, 2021, arXiv:210.00505.

- J. Malfait, W. Homan, S. Maes, J. Bolte, L. Siess, F. De Ceuster, L. Decin, *SPH modelling of wind-companion interactions in eccentric AGB binary systems*, Astronomy & Astrophysics, Vol. 652, nr. A51, 2021, arXiv:210.01074.

- W. Homan, et al., *ATOMIUM: The astounding complexity of the near circumstellar environment of the M-type AGB star R Hydrae. I. Morpho-kinematical interpretation of CO and SiO emission*, Astronomy & Astrophysics, Vol. 651, nr. A82, 2021, arXiv:2104.0729.

- F. De Ceuster, J. Bolte, W. Homan, S. Maes, J. Malfait, L. Decin, J. Yates, P. Boyle, J. Hetherington, *Magritte: 3D radiative transfer library*, Astrophysics Source Code Library, ascl:2012.025, 2020.

- F. De Ceuster, et al., *Magritte, a modern software library for 3D radiative transfer: II adaptive ray-tracing mesh construction and reduction*, Monthly Notices of the Royal Astronomical Society, Vol. 499, Issue 4, pp. 5194-5204, 2020, arXiv:2011.14998.

- W. Homan et al., *ATOMIUM: A high-resolution view on the highly asymmetric wind of the AGB star π^1Gruis. I. First detection of a new companion and its effect on the inner wind*, Astronomy & Astrophysics, Vol 644, nr. A61, 2020, arXiv:2010.05509.

- L. Decin, et al., *(Sub)stellar companions shape the winds of evolved stars*, Science, Vol. 369, Issue 6510, pp. 1497-1500, 2020, arXiv:2009.11694.

- F. De Ceuster, et al., *Magritte, a modern software library for 3D radiative transfer: I Non-LTE atomic and molecular line modelling*, Monthly Notices of the Royal Astronomical Society, Vol. 492, Issue 2, pp. 1812-1826, 2020, arXiv:1912.08445.

- F. De Ceuster, J. Yates, P. Boyle, L. Decin, J. Hetherington, MAGRITTE: a new multidimensional accelerated general-purpose radiative transfer code, Why Galaxies Care About AGB Stars: A Continuing Challenge through Cosmic Time, Proceedings of the International Astronomical Union, Vol. 343, pp. 381-382.

- T. Danilovich, A. M. S. Richards, A. I. Karakas, M. Van de Sande, L. Decin, F. De Ceuster, *An ALMA view on CS and SiS around oxygen-rich AGB stars*, Monthly Notices of the Royal Astronomical Society, Vol. 484 Issue 1, pp. 494-509, 2019, arXiv:1901.00070.

- M. Van de Sande, J. O. Sundqvist, T. J. Millar, D. Keller, W. Homan, A. de Koter, L. Decin, F. De Ceuster, *Determining the effects of clumping and porosity on the chemistry in a non-uniform AGB outflow,* Astronomy & Astrophysics, Vol. 616, nr. A106, 2018, arXiv:1803.0176.