

Joey S.G. Mombarg

Born: 09-12-1993, Arnhem, The Netherlands

✉ jmombarg@irap.omp.eu

🏠 <https://jmombarg.github.io/PersonalWebsite/>



Employment

Postdoctoral researcher

Toulouse, France

Institut de Recherche en Astrophysique et Planétologie, Université Paul Sabatier III. Funded by the French National Research Agency (ANR) programme (MASSIF, PI Meilland).

Sep 2022 - Present

- Two-dimensional modelling of angular momentum transport and mass loss in fast rotating massive stars in the group of Prof. Dr. Michel Rieutord.

Postdoctoral researcher

Leuven, Belgium

Institute of Astronomy, KU Leuven, Celestijnenlaan 200D, 3001 Leuven, Belgium. Funded by the European Union's Horizon 2020 research and innovation programme (grant agreement No 670519: PARADISE, PI Aerts).

Mar 2022 - Aug 2022

- Modelling gravity mode pulsations in A/F-type pulsators in the group of Prof. Dr. Conny Aerts.

Education

PhD Astronomy and Astrophysics

Leuven, Belgium

Institute of Astronomy, KU Leuven.

Mar 2018 - Feb 2022

- Thesis title: “*Asteroseismic Modelling of Intermediate-mass Stars*”.
- Supervisors: Prof. Dr. C. Aerts and Dr. Timothy Van Reeth.
- Research stay at Université Toulouse III Paul Sabatier, Toulouse, France from April 12 2021 - Nov 1 2021 under the supervision of Prof. Dr. Michel Rieutord. Awarded FWO (Flanders Research Foundation) long-stay travel grant.
- Topic: My PhD focused on modelling gravity mode pulsations in A/F-type pulsators to derive masses, ages, and mixing efficiencies with the goal of improving our understanding of the mechanism(s) behind the transport of angular momentum and chemical elements. My PhD thesis can be found [here](#).

MSc Physics and Astronomy

Nijmegen, The Netherlands

Radboud University. Specialization in Particle and Astrophysics.

Aug 2015 - Feb 2018

- Graduated Bene Meritum.
- Thesis title: “*Detection and characterization of Jovian S-bursts*” (see awards).
- Supervisors: Dr. M. Klein-Wolt and C. Brinkerink.
- Attended a planetary science collaboration meeting organized by L’Observatoire de Paris - LESIA, Paris.
- Summer project (6 ECTS) with the asteroseismology group of KU Leuven.

BSc Physics and Astronomy

Nijmegen, The Netherlands

Radboud University. Minor Astrophysics.

Sep 2012 - Jul 2015

- Graduated Bene Meritum.
- Thesis title: “*Simulating the variable sky for BlackGEM*”.
- Supervisor: Dr. E Körding.

Conference and Workshop Participation

TA MESA summer school 2022

UCSB, California, USA

5-day workshop on the stellar evolution code Modules for Experiments in Stellar Astrophysics (MESA).

8-12 Aug 2022

TASC6/KASC13 conference

Leuven, Belgium

- 90-min tutorial (invited): *‘Forward seismic modelling of gravity modes’*
- Poster contribution: *‘Improved stellar evolution models with radiative levitation and rotational mixing’* Online version can be found [here](#).

11-15 Jul 2022

Workshop stellar physics group Institut de Recherche en Astrophysique et Planétologie

Villalier, France

Oral contribution: *‘Improving the theory of chemical mixing inside intermediate-mass stars with asteroseismology’*

18-19 Oct 2021

European Astronomical Society (EAS) 2020

Online

Poster contribution: *‘Predicting stellar gravity-mode pulsations and evolution tracks with neural networks’*

29 Jun -3 Jul 2020

Stars and their Variability: Observed from Space

Vienna, Austria

Oral contribution: *‘Improving stellar evolution models with atomic diffusion from asteroseismology of intermediate-mass stars’*

19-23 Aug 2019

Tess Sci Con I

Cambridge, USA

Poster contribution: *‘High-precision mass and age estimates of F-type stars from asteroseismology’*

29 July - 2 Aug 2019

TASC5/KASC12

Cambridge, USA

Oral contribution: *‘Improving stellar evolution models with atomic diffusion from asteroseismology of intermediate-mass stars’*

22-26 July 2019

Nederlandse Astronomen Conferentie 2019

Groningen, The Netherlands

Oral contribution: *‘Masses, Ages, and Core Properties of Intermediate-mass Stars from Asteroseismology and Spectroscopy’*

27-29 May 2019

Lorentz workshop: ‘Weighting stars from birth to death’

Leiden, The Netherlands

Oral contribution: *‘Probing the fundamental parameters and core properties of γ Dor stars’*

19-23 Nov 2018

PHOST 2018

Banyuls-sur-mer, France

Oral contribution: *‘The effect of atomic diffusion on gravity modes of young stars with a convective core’*

2-7 Sep 2018

MESA Summer School 2018

UCSB, California, USA

5-day workshop on the stellar evolution code MESA.

13-17 Aug 2018

Nederlandse Astronomen Conferentie 2018

Groningen, Netherlands

Poster contribution: *‘Atomic diffusion in young stars with a convective core’*

16-18 May 2018

Seminars

Good vibrations seminar

Online

“Asteroseismic modelling of gravito-inertial modes in γ Doradus pulsators”

July 2021

Link to video [here](#).

Institut de Recherche en Astrophysique et Planétologie

Toulouse, France

“Constraining stellar evolution theory with asteroseismology of γ Doradus stars using deep learning”

May 2021

Journal club / seminar hybrid

Institute of Astronomy

KU Leuven, Belgium

“Pulse fiction: Gravito-inertial asteroseismology of intermediate-mass stars”

Dec 2019

Scientific Awards and Grants

- | | | |
|------|---|-------------------------------|
| 2021 | IRAP PhD day Best poster award
Title: “Asteroseismic modelling of A- and F-type pulsators”.
Authors: J.S.G Mombarg | Toulouse,
France |
| 2020 | Long-stay travel grant Research Foundation - Flanders (FWO)
9-month travel grant (14850EUR) for research stay at Institut de Recherche en Astrophysique et Planétologie (IRAP), Toulouse, France. (Shortened to 6.5 month due to COVID pandemic.) | Leuven,
Belgium |
| 2018 | Netherlands Astronomy Conference 2018 Best poster award
Title: “Atomic diffusion and pulsations in young stars with a convective core”.
Authors: J.S.G Mombarg, M. Michielsen, M.G. Pedersen and C. Aerts. | Groningen, The
Netherlands |
| 2018 | De Zeeuw-Van Dishoeck 2018 award
Award (3000EUR) for best astronomy Master thesis in The Netherlands awarded by the “Koninklijke Hollandse Maatschappij der Wetenschappen”. | Haarlem, The
Netherlands |

Teaching

Student project co-supervisor

Leuven, Belgium

KU Leuven

May - July 2022

- Co-supervisor of BSc student Rebecca Rehm.
Project title: ‘The impact of radiative levitation on mode excitation of B-type pulsators’

MSc thesis co-supervisor

Leuven, Belgium

KU Leuven

Sep 2019 - July 2020

- Mentor of MSc student Jan Henneco (Supervisor: Dr. T. Van Reeth).
Thesis title: ‘The effect of the centrifugal deformation of stars on g-mode pulsations’

Teaching Assistant

Leuven, Belgium

KU Leuven

Mar 2018 - ongoing

- TA for the BSc introductory courses to astronomy, and mechanics.
- TA for MSc course ‘Asteroseismology’.

Teaching Assistant

Nijmegen, Netherlands

Radboud University

Sep 2015 - Jan 2016

- TA of the BSc biology and physics courses ‘Mathematics for Biologists’, ‘Biophysics’ and ‘Mechanics’ (3h/week).

Scientific community work

Gaia DR3 PR event

Brussels, Belgium

ESA

Jun 2022

- In the context of pulsating stars observed with Gaia DR3, I made an animation demonstrating asteroseismology. Link to the article can be found [here](#).

STEM University

Leuven, Belgium

KU Leuven

Feb 2022

- Workshop on stars and (exo)planets for primary and high school children, ~15 participants, 1.5-hour workshop.

Member of the SOC for the EAS 2022 conference

Valencia, Spain

Special session on Machine Learning in astronomy.

2022

Lecture at high school

Online

Berthoutsinstituut, Mechelen

May 2021

- Online lectures for high school students on stellar evolution, black holes, exoplanets, and space travel. ~50 participants, 2 times 45-min lecture.

Scientific reviewer

Monthly Notices of the Royal Astronomical Society

2020

High School visit

Leuven, Belgium

KU Leuven

March 2019

- Departmental visit high school students, ~20 participants, 1-hour workshop.

Ladies@Science

Leuven, Belgium

KU Leuven

April 2019, April 2018

- Exoplanet workshop for high school girls, ~20 participants, 1-hour workshop.

Kids University

Leuven, Belgium

KU Leuven

Oct 2018

- Solar system workshop for primary school children, ~30 participants, 1-hour workshop.

Observing Experience

Observer at the Mercator Telescope

La Palma, Spain

4 × 10 nights on site, 1 × 5 nights remote

Sep 2019, Apr 2022

- Service mode.

Co-observer at the Hale telescope

Palomar, USA

3 nights

Jan 2017

- As part of the MSc course “Telescope Observing”.

Publications

4 first-author, 8 co-author, 270+ citations, h-index 8

[Link to ADS Library](#)

Jermyn, A. S.; Bauer, E. B.; Schwab, J.; Farmer, R.; Ball, W. H.; Bellinger, E. P.; Dotter, A.; Joyce, M.; Marchant, P.; **Mombarg, J. S. G.**; Wolf, W. M.; Wong, T. L. S.; Cinquegrana, G. C.; Farrell, E.; Smolec, R.; Thoul, A.; Cantiello, M.; Herwig, F.; Toloza, O.; Bildsten, L.; Townsend, R. H. D.; Timmes, F. X. “Modules for Experiments in Stellar Astrophysics (MESA): Time-Dependent Convection, Energy Conservation, Automatic Differentia-

tion, and Infrastructure”, 2022 (under review), [arXiv:2208.03651](#)

Mombarg, J. S. G.; Dotter, A.; Rieutord, M.; Michielsen, M.; Van Reeth, T.; Aerts, C., “Predictions for gravity-mode periods and surface abundances in intermediate-mass dwarfs from shear mixing and radiative levitation”, 2022, [The Astrophysical Journal, Volume 925, Issue 1, id.154](#)

Pavlovski, K.; Hummel, C. A.; Tkachenko, A.; Dervisoglu, A.; Kayhan, C.; Zavala, R. T.; Hutter, D. J.; Tycner, C.; Sahin, T.; Audenaert, J.; Baeyens, R.; Bodensteiner, J.; Bowman, D. M.; Gebruers, S.; Janssen, N. E.; **Mombarg, J. S. G.**, “Dynamical parallax, physical parameters and evolutionary status of the components of the bright eclipsing binary α Draconis”, 2022, [Astronomy & Astrophysics, Volume 658, id.A92](#)

Aerts C.; Augustson K.; Mathis S.; Pedersen M. G.; **Mombarg J. S. G.**; Vanlaer V.; Van Beeck J.; Van Reeth T., “Rossby numbers and stiffness values inferred from gravity-mode asteroseismology of rotating F- and B-type dwarfs”, 2021, [Astronomy & Astrophysics, Volume 656, id.A121](#)

Serenelli, Aldo; Weiss, Achim; Aerts, Conny; Angelou, George C.; Baroch, David; Bastian, Nate; Bergemann, Maria; Bestenlehner, Joachim M.; Czekala, Ian; Elias-Rosa, Nancy; Escorza, Ana; Van Eylen, Vincent; Feillet, Diane K.; Gandolfi, Davide; Gieles, Mark; Girardi, Leo; Lodieu, Nicolas; Martig, Marie; Miller Bertolami, Marcelo M.; **Mombarg, Joey S. G.**; Morales, Juan Carlos; Moya, Andres; Nsamba, Benard; Pavlovski, Kresimir; Pedersen, May G.; Ribas, Ignasi; Schneider, Fabian R. N.; Silva Aguirre, Victor; Stassun, Keivan; Tolstoy, Eline; Tremblay, Pier-Emmanuel; Zwintz, Konstanze, “Weighing stars from birth to death: mass determination methods across the HRD”, 2021, [The Astronomy and Astrophysics Review, Volume 29](#)

Gebruers, Sarah; Straumit, Ilya; Tkachenko, Andrew; **Mombarg, Joey S. G.**; Pedersen, May G.; Van Reeth, Timothy; Li, Gang; Lampens, Patricia; Escorza, Ana; Bowman, Dominic M.; De Cat, Peter; Vermeylen, Lore; Bodensteiner, Julia; Rix, Hans-Walter; Aerts, Conny, “A homogeneous spectroscopic analysis of a Kepler legacy sample of dwarfs for gravity-mode asteroseismology”, 2021, [Astronomy & Astrophysics, Volume 650, id.A58, 23 pp](#), Impact factor: 5.802

Mombarg J. S. G., Van Reeth T., and Aerts C., “Constraining stellar evolution theory with asteroseismology of γ Doradus stars using deep learning”, 2021, [Astronomy & Astrophysics, Volume 650, id.A58, 23 pp](#)

Henneco, Jan; Van Reeth, Timothy; Prat, Vincent; Mathis, Stéphane; **Mombarg, Joey S. G.**; Aerts, Conny, “The effect of the centrifugal acceleration on period spacings of gravito-inertial modes in intermediate-mass stars”, 2021, [Astronomy & Astrophysics, Volume 648, id.A97](#)

Mombarg J. S. G., Dotter A., Van Reeth T., Tkachenko A., Gebruers S. and Aerts C., “Asteroseismic modeling of gravity modes in slowly rotating A/F stars with radiative levitation”, 2020, [The Astrophysical Journal, Volume 895, Issue 1, id.51](#)

Mombarg J. S. G., Van Reeth T., Pedersen M. G., Molenberghs G., Bowman D. M., Johnston C., Tkachenko A. and Aerts C., “Asteroseismic masses, ages and core properties of gamma Doradus stars using gravity-inertial dipole modes and spectroscopy”, 2019, [Monthly Notices of the Royal Astronomical Society, Volume 485, Issue 3, Pages 3248-3263](#)

Aerts C. Molenberghs G., Michielsen M., Pedersen M. G., Björklund R., Johnston C., **Mombarg J. S. G.**, Bowman D. M., Buysschaert B., Pápics P. I., Sekaran S., Sundqvist J. O., Tkachenko A., Truyaert K., Van Reeth T. and Vermeyen E., 2018, “Forward Asteroseismic Modeling of Stars with a Convective Core from Gravity-mode Oscillations: Parameter Estimation and Stellar Model Selection”, [The Astrophysical Journal Supplement Series, 237, id15](#)

Van Reeth T., **Mombarg J. S. G.**, Mathis S., Tkachenko A., Fuller J., Bowman D. M., Buysschaert B., Johnston C., García Hernández A., Goldstein, J. Townsend, R. H. D. and Aerts, C., 2018, “On the sensitivity of gravito-inertial modes to differential rotation in intermediate-mass main-sequence stars”, [Astronomy & Astrophysics, 618:A24](#)

Programming

Advanced **Python**, **LaTeX**, **Fortran**

Basic **C++**, **Matlab**

SSE and pulsation codes **MESA**, **GYRE**, **ESTER**, **TOP**

Software development

Computing Pulsation Periods and Photospheric Observables (C-3PO)

Designed neural network to for modelling of gravity-mode pulsators. See Mombarg et al. (2021) in publication list.

Github repo: <https://github.com/JMombarg/c3po>

Modules for Experiments in Stellar Astrophysics (MESA)

Community contributor. Method for computing radiative accelerations and consistent Rosseland mean opacities from monochromatic opacity tables.

See Mombarg et al. (2022) and Jermyn et al. (2022) in publication list.

Github repo: <https://github.com/MESAHub/mesa>

Evolution STEllaire en Rotation (ESTER)

Implementing methods to compute opacities and mass-loss.

Github repo: <https://github.com/ester-project/ester>

Languages

Native	Dutch
Fluent	English
Proficient	French level B2.
Basic	German, Russian German: level A2. Russian: level A1.