

Joey S.G. Mombarg



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

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

Employment

Postdoctoral researcher

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

Toulouse, France

Sep 2022 - Present

Postdoctoral researcher

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).

Leuven, Belgium

Mar 2022 - Aug 2022

Education

PhD Astronomy and Astrophysics

Institute of Astronomy, KU Leuven.

- Thesis title: “*Asteroseismic Modelling of Intermediate-mass Stars*”.
- Supervisors: Prof. Dr. C. Aerts and Dr. Timothy Van Reeth.
- 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](#).

Leuven, Belgium

Mar 2018 - Feb 2022

MSc Physics and Astronomy

Radboud University. Specialization in Particle and Astrophysics.

Nijmegen, The Netherlands

Aug 2015 - Feb 2018

BSc Physics and Astronomy

Radboud University. Minor Astrophysics.

Nijmegen, The Netherlands

Sep 2012 - Jul 2015

Conference and Workshop Participation

TA MESA summer school 2023

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

Budapest, Hungary

28 Aug - 1 Sep 2023

TASC7/KASC14

Oral contribution: ‘*Testing angular momentum transport on the main sequence*’

Honolulu, Hawaii, USA

17-21 Jul 2023

TA MESA summer school 2022

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

UCSB, California, USA

8-12 Aug 2022

<p>TASC6/KASC13 conference</p> <ul style="list-style-type: none"> • 90-min tutorial (invited): <i>‘Forward seismic modelling of gravity modes’</i> • Poster contribution: <i>‘Improved stellar evolution models with radiative levitation and rotational mixing’</i> Online version can be found here. 	<p>Leuven, Belgium</p> <p>11-15 Jul 2022</p>
<p>Workshop stellar physics group Institut de Recherche en Astrophysique et Planétologie</p> <p>Oral contribution: <i>‘Improving the theory of chemical mixing inside intermediate-mass stars with asteroseismology’</i></p>	<p>Villalier, France</p> <p>18-19 Oct 2021</p>
<p>European Astronomical Society (EAS) 2020</p> <p>Poster contribution: <i>‘Predicting stellar gravity-mode pulsations and evolution tracks with neural networks’</i></p>	<p>Online</p> <p>29 Jun -3 Jul 2020</p>
<p>Stars and their Variability: Observed from Space</p> <p>Oral contribution: <i>‘Improving stellar evolution models with atomic diffusion from asteroseismology of intermediate-mass stars’</i></p>	<p>Vienna, Austria</p> <p>19-23 Aug 2019</p>
<p>Tess Sci Con I</p> <p>Poster contribution: <i>‘High-precision mass and age estimates of F-type stars from asteroseismology’</i></p>	<p>Cambridge, USA</p> <p>29 July - 2 Aug 2019</p>
<p>TASC5/KASC12</p> <p>Oral contribution: <i>‘Improving stellar evolution models with atomic diffusion from asteroseismology of intermediate-mass stars’</i></p>	<p>Cambridge, USA</p> <p>22-26 July 2019</p>
<p>Nederlandse Astronomen Conferentie 2019</p> <p>Oral contribution: <i>‘Masses, Ages, and Core Properties of Intermediate-mass Stars from Asteroseismology and Spectroscopy’</i></p>	<p>Groningen, The Netherlands</p> <p>27-29 May 2019</p>
<p>Lorentz workshop: ‘Weighting stars from birth to death’</p> <p>Oral contribution: <i>‘Probing the fundamental parameters and core properties of γ Dor stars’</i></p>	<p>Leiden, The Netherlands</p> <p>19-23 Nov 2018</p>
<p>PHOST 2018</p> <p>Oral contribution: <i>‘The effect of atomic diffusion on gravity modes of young stars with a convective core’</i></p>	<p>Banyuls-sur-mer, France</p> <p>2-7 Sep 2018</p>
<p>MESA Summer School 2018</p> <p>5-day workshop on the stellar evolution code MESA.</p>	<p>UCSB, California, USA</p> <p>13-17 Aug 2018</p>
<p>Nederlandse Astronomen Conferentie 2018</p> <p>Poster contribution: <i>‘Atomic diffusion in young stars with a convective core’</i></p>	<p>Groningen, Netherlands</p> <p>16-18 May 2018</p>

Seminars

Good vibrations seminar

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

Link to video [here](#).

Online

July 2021

Institut de Recherche en Astrophysique et Planétologie

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

Journal club / seminar hybrid

Toulouse, France

May 2021

Institute of Astronomy

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

KU Leuven, Belgium

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

KU Leuven

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

Leuven, Belgium

May - July 2022

MSc thesis co-supervisor

KU Leuven

- 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’

Leuven, Belgium

Sep 2019 - July 2020

Teaching Assistant

KU Leuven

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

Leuven, Belgium

Mar 2018 - ongoing

Teaching Assistant

Radboud University

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

Nijmegen, Netherlands

Sep 2015 - Jan 2016

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

6 first-author, 10 co-author, 450+ citations, h-index 10

[Link to ADS Library](#)

Mombarg, J. S. G.; Rieutord M.; Espinosa Lara F.; “The first two-dimensional stellar structure and evolution models of rotating stars. Calibration to β Cephei pulsator HD 192575”, *Astronomy & Astrophysics*, Volume 677, L5

Mombarg, J. S. G.; “Calibrating angular momentum transport in intermediate-mass stars from gravity-mode asteroseismology”, *Astronomy & Astrophysics, Volume 677, A63*

Moyano, F. D.; Eggenberger, P.; Salmon, S. J. A. J.; ; **Mombarg, J. S. G.**; Ekström, S. “Angular momentum transport by magnetic fields in main sequence stars with Gamma Doradus pulsators”, *Astronomy & Astrophysics, Volume 677, A6*

Burssens, S.; Bowman, D. M.; Michielsen, M.; Simón-Díaz, S.; Aerts, C.; Vanlaer, V.; Banyard, G.; Nardetto, N.; Townsend, R. H. D.; Handler, G.; **Mombarg, J. S. G.**; Vanderspek, R.; Ricker, G. “A calibration point for stellar evolution from massive star asteroseismology”, *Nature Astronomy*

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 Differentiation, and Infrastructure”, 2023, *The Astrophysical Journal Supplement Series, 265, 15*

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; Feuillet, 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., Buyschaert 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

Software development

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

Python, Tensorflow

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)

Fortran

Developer. 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)

C++

2D stellar structure and evolution. See Mombarg et al. (2023) in publication list.

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