GUILLAUME DRÉAU

@ guillaume.dreau@obspm.com +33 6 48 71 63 82 0000-0002-0135-8720 NASA/ADS: publication list

RESEARCH INTERESTS

Asteroseismology | Stellar evolution | Stellar structure | Red giants | Acoustic glitches | AGB bump | Stellar modeling | Oscillation spectrum analysis

EDUCATION

1. Ph.D. — Astrophysics

Laboratoire d'Etudes Spatiales et d'Instrumentation en Astrophysique — Observatoire de Paris

September 2019 – Present Meudon — France

"Seismic analysis of red giants on the asymptotic giant branch"

Benoît Mosser and Yveline Lebreton

Characterise the oscillation spectrum of evolved giants, including red-giant and asymptotic-giant stars. Use the second helium ionisation zone signature in p-mode frequencies to find the physical basis of the classification method between red giants and asymptotic giants. Then, use the seismic quantities to constrain stellar interiors thanks to stellar models. Calibrate mixing processes during helium burning phases with the luminosity bump on the asymptotic giant branch.

Oscillation spectrum: analysis | Signal processing: detection | Data processing: data fitting | MCMC: emcee | Stellar evolution code: MESA | Stellar oscillation code: ADIPLS | Python | Fortran95 | Bash | InversionKit

2. Magister degree — Selective course, including

Master's degree (2nd year) — Astronomy and Astrophysics	With highest honours	**Rank: 4/36**
Master's degree (1st year) — Fundamental physics	With highest honours	**Rank: 2/95**
Bachelor's degree — Fundamental physics	With honours	**Rank: top 10%**

Université Paris-Saclay

September 2016 – July 2019 Orsay — France

3. Two-year intensive program — Math and Physics pathway

Preparatory class for the national competitive exam for entry to engineering schools — Lycée Pothier

September 2014 – June 2016 Orléans — France

RESEARCH EXPERIENCE

Projects

1. Master (2nd year) research internship

Laboratoire d'Etudes Spatiales et d'Instrumentation en Astrophysique — Observatoire de Paris

March 2019 – June 2019 Meudon — France

"Seismic analysis of red giants on the asymptotic giant branch"

Benoît Mosser and Charlotte Gehan

Study the p-mode pattern of evolved giants and extract the second helium ionisation zone signature in order to understand the classification method of red-giant and asymptotic-giant stars.

Oscillation spectrum: analysis | Signal processing: detection | Data processing: data fitting | Python

2. Master (1st year) research internship

Centro de Astrofísica da Universidade do Porto

May 2018 – July 2018 Porto — Portugal

"On the determination of helium abundance of red giants"

Margarida Cunha, Mathieu Vrard and Pedro Avelino

Characterisation of the second helium ionisation zone using pressure modes in order to improve the determination of helium abundance in red giants. Test our ability to infer the pure p-modes frequencies using the mixed-mode pattern in the early and intermediate phases of the red giant branch.

The results of this work have been published in MNRAS.

Data processing: data fitting | MCMC: emcee | Python | Bash

3. National physics competition

French Physicists Tournament – **Université Paris-Saclay** **Rank: 3/12**

October 2017 – February 2018 Orsay – France

Frédéric Bouquet and Frédéric Moisy

In a team of 11 students, build a scientific process to work on 11 open problems of interdisciplinary Physics. Then, comparison of our results to those from different teams. While a team was presenting their results, an opposing team had to highlight the weaknesses and the strong point of the reporter's work.

Wind tunnel experiments | Data processing: data fitting | Teamwork | Scientific debates

4. Bachelor research internship

Laboratoire d'Etudes Spatiales et d'Instrumentation en Astrophysique – **Observatoire de Paris**

June 2017 – July 2017 Meudon – France

"Gaseous and dusty marks of outbursts on the comet 67P with the MIRO instrument of Rosetta"

Nicolas Biver

Analysis of molecular spectra in the line of sight of outbursts on the comet 67P in order to track the evolution of surface element abundances and infer the most abundant ones.

Molecular spectrum: analysis | Data processing: data fitting | Fortran95 | GILDAS

5. International competition

International Sustainable World Engineering Energy Environment Project (I-SWEEEP) – **Harmony school**

October 2013 – May 2014 Houston – Texas

Christiane Sellier

Radio-detection of meteors entering the atmosphere by frequency analysis of waves emitted by GRAVES, which is an emitter situated in Dijon, in France.

Radio astronomy: detection | Spectrum analysis: Doppler shift

Conference and workshop participations

1. ELBERETH conference

Online

February 2021

Conference both addressed and organised by Ph.D. students from all astronomy and astrophysics laboratories of Île-de-France.

Talk: "Disentangling red giants and asymptotic giants".

2. Ph.D. day

Laboratoire d'Etudes Spatiales et d'Instrumentation en Astrophysique – **Observatoire de Paris**

June 2020 Meudon – France

Talk: "Disentangling red giants and asymptotic giants".

3. Red-giant seismology workshop (RGWS 2020)

University of Graz

February 2020 Graz – Austria

Talk: "Seismic analysis of red-giant and asymptotic-giant stars".

Publications

1. Seismic constraints on the internal structure of evolved stars: From high-luminosity RGB to AGB stars

G. Dréau, B. Mosser, Y. Lebreton, C. Gehan, T. Kallinger

Astronomy & Astrophysics, 650, A115, 19 pp., 2021

2. On using dipolar modes to constrain the helium glitch in red giant stars

G. Dréau, M. S. Cunha, M. Vrard, P. P. Avelino

Monthly Notices of the Royal Astronomical Society, 497, 1008-1014, 2020

Collaborative work

1. PLATO WP 127: hare & hound exercise 1

Coordinated by A. Miglio, B. Mosser, J. Montalbán, P. Ventura

Justify the use of red-giant stars as valuable constraints on main-sequence stars. Quantify how the precision and accuracy of stellar parameters (such as helium-to-metal enrichment ratio and main-sequence near-core mixing) depend on the number of evolved stars to be observed by PLATO and on seismic constraints.

Generate grid of stellar models up to the end of the clump phase with different masses, metallicities and helium abundances.

Present and past collaborations

1. Using the AGB bump as a calibrator for mixing processes in the core-helium burning phase

Diego Bossini — Instituto de Astrofísica e Ciências do Espaco, Porto

Model overshooting, penetrative convection and semiconvection with the stellar evolution code MESA during the core-helium burning phase to reproduce the luminosity bump on the asymptotic giant branch.

2. Comparison of the classification methods between red-giant and asymptotic-giant stars

Thomas Kallinger — Institut für Astrophysik, Vienna — Mathieu Vrard — The Ohio State University, Ohio

Study the agreements and disagreements between classification methods of red giants and asymptotic giants and their efficiencies as a function of stellar evolution.

OBSERVING EXPERIENCE

1. Observatoire de Paris

0.6m and 1.0m telescopes, 5 nights

January 2020 – Present — Meudon – France

In the context of the 1st year master course “Observational techniques and Data analysis”

Optical wavelength imaging of the Orion nebula and verification of the Bouguer law.

2. Observatoire de Haute-Provence (OHP)

0.8m and 1.2m telescopes, 5 nights

March 2019 — Saint-Michel-l’Observatoire – France

Optical wavelength imaging of galaxies and classification of stars with high-resolution spectrometry.

TEACHING EXPERIENCE

1. Mentor for early graduate students

Université Paris Sciences & Lettres – Observatoire de Paris

October 2020 – Present — Paris – France

2 mentees. Estimated time commitment: 6 hours per mentee.

Support in schooling, including in writing CV and cover letters, in the choice of internships and integration modules.

2. Teaching fellow

Université Paris Sciences & Lettres — Observatoire de Paris

October 2019 – Present | Paris – France

- 1st year master courses: Hydrodynamics (12 hours, tutorials), Statistical physics (10 hours, tutorials), Instrumentation: physics and instruments (10 hours, tutorials), Observational techniques and Data analysis (40 hours, tutorials and observation sessions).

3. Tutor for online materials

DU Lumières sur l'Univers — Observatoire de Paris

October 2019 – June 2021 | Paris – France

- 10 students. Estimated time commitment: 6 hours per student.
- Support in online materials and exercises (Bachelor and Master level).

OUTREACH EXPERIENCE

1. LOC Member

ELBERETH conference

November 2020 – February 2021 | Online

SKILLS

Programming

Python, Fortran95, LaTeX	●●●●○
C++, Bash	●●●○○
IDL, GDL	●●○○○

Specific software & tools

MESA, ADIPLS	●●●●○
InversionKit	●●○○○

Languages

French	●●●●●
English	●●●●○
Spanish	●●●○○