

# Arthur Le Saux, Ph.D.

CEA, AIM ◊ CNRS ◊ Université Paris-Saclay ◊ Université Paris Cité

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Fluid dynamics ◊ Stellar Physics ◊ Atmospheric sciences ◊ Numerical simulations

## POSITION

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**Postdoctoral Research Fellow** (4 years contract) *Octobre 2024 - Present*

**AIM, CEA, Université Paris-Saclay**

Funded by the **4D-STAR** ERC Synergy grant (PIs: Profs. Drs. C. Aerts, S. Mathis, M. Rieutord and A. Dotter)

Impact of rotation and magnetism on asteroseismic properties of stars

## PUBLICATIONS & PRESENTATIONS (LIST P. 3)

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**10 Papers in peer-reviewed scientific journals:** 2 first author, 5 major contributions and 3 co-author contributions (Citations = 94, h-index = 5, i10 index = 3).

Google Scholar profile: <https://scholar.google.com/citations?hl=fr&user=wjPdt4AAAAJ>

**10 Conference proceedings**

**8 Press releases on artistic collaboration**

**27 Oral Presentations:** 11 in international conferences and 6 invited

**9 Posters:** 7 in international conferences

## EDUCATION

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**Ph.D. in Physics & Astronomy, University of Exeter** *June 2023*

Thesis: Understanding mixing processes in stars using hydrodynamic simulations

**Master of Science (MSc), Observatoire de Paris** *August 2019*

Astronomy, Astrophysics & Space Engineering

Specialisation: Stellar physics, Asteroseismology, Numerical Methods, Data Science

**Master of Engineering (MEng), Ecole Centrale de Lyon** *August 2018*

Specialisation: Hydrodynamics, Nanotechnologies and Biotechnology

**Bachelor of Science, Sorbonne Université** *June 2015*

Mechanical Engineering

Specialisation: Fluid dynamics, Acoustics, Thermal Physics

**French Baccalaureate, Lycée Alphonse Daudet** *June 2011*

Scientific, with Highest Honours

Specialisation: Life Science and Mathematics

## RESEARCH EXPERIENCE

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**Postdoctoral Research Fellow** (2 years contract) *June 2023 - Octobre 2024*

**Laboratoire de Météorologie Dynamique, Sorbonne Université**

Funded by the **ANR SOUND** grant (PI: Dr. S. Guerlet)

Modelling the atmospheric dynamics of Neptune and Uranus using a Global Climate Model

**Postgraduate Research Student** *Sept. 2019 - June 2023*

**Physics & Astronomy, University of Exeter**

Co-direction: CRAL, Ecole Normale Supérieure, Lyon, Université de Lyon

Supervisors: Prof. Isabelle Baraffe & Dr. Thomas Guillet

Study of waves and convective penetration in stellar interiors using the fully compressible time implicit hydrodynamical code MUSIC

*Master's thesis* (5 months) *March 2019 - August 2019*

**AIM, CEA, Université Paris-Saclay**

Supervisors: Dr. Rafael A. García & Dr. Lisa Bugnet

Identification and classification of pulsating stars by combining classical asteroseismology and machine learning methods

*Observation Trainee* (1 week) *March 2019*

**Instituto de Radioastronomía Milimétrica, Granada**

Supervisors: Dr. Pierre Guillard

Turbulence and proto-stellar outflows mapping in L1251-A

*Master's thesis* (6 months) *March 2018 - August 2018*

**Laboratoire de Météorologie Dynamique, Sorbonne Université**

Supervisors: Dr. Sébastien Lebonnois

Study of large-scale gravity waves in the deep atmosphere of Venus

*Research Intern* (3 months) *April 2017 - July 2017*

**Physics & Astronomy, University of Exeter**

Supervisors: Prof. Isabelle Baraffe

Theoretical and numerical approach of hydrodynamic processes in stellar interiors

*Research Project* *Sept. 2017 - June 2018*

**Institut des Nanotechnologies de Lyon**

Supervisors: Dr. Bertrand Vilquin & Dr. Pedro Rojo Romeo

Theoretical and practical study on hyperbolic metamaterials

## GRANTS & AWARDS

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CNES Postdoctoral Fellowship (Declined because of position at CEA-Saclay) *Spring 2024*

Kavli Summer Program in-person workshop, Göttingen, Germany (1000\$) *Fall 2022*

Kavli Summer Program Fellowship (Awarded to 8 fellows/ year) (2000\$) *Spring 2021*

1st Prize Postgraduate Conference Presentations, Exeter, UK (60\$) *Winter 2021*

Artistic residency, Le Port des Créateurs, Toulon, France (7000\$) *Winter 2019*

College funded PhD Studentship (3.5 years), University of Exeter, UK (20000\$ /yr) *Spring 2019*

Observation time (36h), IRAM 30m telescope, Granada, Spain *Spring 2019*

## STUDENT SUPERVISION

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**Kanah Smith**, 4 month (40% supervision), in the context of the *Summer 2022*  
[Simons-NSBP Scholars Program](#), hosted by the CCA, Flatiron Institute, New-York, USA,

Co-supervisor: Dr. Lisa Bugnet

**Armand Leclerc**, 6 month (60% supervision), University of Exeter, UK, *Summer 2021*

Co-supervisor: Prof. Isabelle Baraffe

**Benoit Gay**, 6 month (40% supervision), University of Exeter, UK, *Summer 2020*

Co-supervisor: Prof. Isabelle Baraffe

## TEACHING

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Teaching Assistant at the [MESA summer school 2023](#) *August 2023*

Demonstrator for 2nd year Physics problem class in Quantum Mechanics, *2020 - 2023*

Electromagnetism, Thermal Physics and Condensed Matter (96 hr/yr)

Private lessons to high school students (2h/ week) *2010-2015*

## LANGUAGES

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**Human**      French (native), English (B1, fluent),  
                 Spanish (conversational), Italian (beginner)

<b>Programming (Good expertise)</b>	Python, Bash, Fortran 77/95/08, HTML, Excel
<b>Programming (Notions)</b>	MATLAB, R
<b>Python Packages</b>	Pandas, Matplotlib, Numpy, Scipy, h5py, xarray

## OUTREACH

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<i>Astronomy on Tap</i> , Elephant & Castle, Lyon, France	June 2024
<i>The music of stars</i> , public talk at The Cabin, Praha, Czech Republic	May 2023
Scientific mediation action for high school students, organised by Le Cercle FESR and Declics, Lycée Du Parc and Lycée Saint-Just (Lyon), and Lycée Henri Bergson (Paris)	2022 - 2023
Invited conference on the relationship between art and science, MUREX festival	July 2021
<i>Street confs</i> , Presentation of scientific research and stellar physics to the public in the streets of Marseille	June 2019

## ARTISTIC COLLABORATION

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Active collaboration with [Léo Fourdrinier](#), plastic artist working in Toulon (France). Through regular discussion, Léo reinterprets my research on stars and planets for his plastic work.

<i>Poems hides theorems</i> , Leo Fourdrinier solo exhibition, reinterpretation of works from artistic collaboration, <a href="#">Galerie les Filles du Calvaire</a> (Paris)	2024
<i>Art Genève</i> , Contemporary and modern art international fair, one piece from artistic collaboration, Palexpo (Geneva)	2024
<i>La lune dans un oeil et le soleil dans l'autre</i> , Solo art exhibition of Léo Fourdrinier, with several pieces from artistic collaboration, <a href="#">CACN</a> , Nîmes, France.	2022
<i>PULSE</i> , Art Exhibition on the theme of asteroseismology, L'Axolotl Gallery (Toulon)	2020
Collaboration initiated during the <a href="#">Booster #4</a> artistic residency hosted at Le Port des Créateurs (Toulon)	2019

## CONFERENCE ORGANISING

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Organiser for a Parallel Session at the <a href="#">National Astronomy Meeting 2023</a>	3rd-7th July 2023
Organiser for the EMPS PGR conference 2022 (University of Exeter) and designer of the conference website	4th-5th April 2022

## PUBLICATIONS LIST

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### ◦ Publications in peer-reviewed scientific journals (10)

First author publications (2)

1. **Le Saux, A.**, Baraffe, I., Guillet, T., et al., *Two dimensional simulations of internal gravity waves in a 5 solar mass star zero-age-main-sequence model* (2023), MNRAS 552, 2
2. **Le Saux, A.**, Guillet, T., Baraffe, I., et al., *Two-dimensional simulations of solar like models with artificially boosted luminosity. II. Impact on internal gravity waves* (2022), A&A 660, A51

Major contributions (5)

1. Buldgen, G., Canocchi, G., **Le Saux, A.** et al., *The Future of Solar modelling: requirements for a new generation of Solar models.*, (Submitted)
2. Morton, J., Guillet, T., Baraffe, I., Morison, A., **Le Saux, A.** et al., *Limitations of Tracer Particle Methods for Characterising Mixing by Internal Gravity Waves in Massive Main-Sequence Stars*, (In review)
3. Morison, A., **Le Saux, A.**, Baraffe, I., et al. *Effect of stratification atop the convective core of 5 solar mass main-sequence star* (2024), MNRAS 532, 2

4. Baraffe, I., Constantino, T., Clark, J., **Le Saux, A.** et al., *Local heating due to convective overshooting and the solar modelling problem* (2022), A&A 659, A53
5. Vlaykov, D. G., Baraffe, I., Constantino, T., Goffrey, T., Guillet, T., **Le Saux, A.** et al., *Impact of radial truncation on global 2D hydrodynamical simulations for a Sun-like model* (2022), MNRAS 514, 1

Co-author contributions (3)

1. Dethero, M-G., Pratt, J., [...], **Le Saux, A.** et al., *The shape of convection in 2D and 3D global simulations of stellar interiors*, (Accepted for publication in A&A)
2. Baraffe, I., Clarke, J., [...], **Le Saux, A.** et al., *A study of convective core overshooting as function of stellar mass based on twodimensional hydrodynamical simulations* (2023), MNRAS, 519, 4
3. Baraffe I., Pratt J., [...], **Le Saux A.** et al., *Two-dimensional simulations of solar like models with artificially boosted luminosity. I. Impact on convective penetration* (2021), A&A 654, A126

o **Conference Proceedings (10)**

1. **Le Saux, A.** et al., *Exploring the atmospheric dynamics of the Ice Giants: A General Circulation Model Approach with a Parametrization of Convection* (2024), Europlanet Science Congress 2024
2. Carrión-González, O., [...], **Le Saux, A.** et al., *Measuring Neptune's temperature maps and CO abundance with ALMA* (2024), Europlanet Science Congress 2024
3. **Le Saux, A.** et al., *Investigating Atmospheric Dynamics of Uranus and Neptune: A General Circulation Model Approach with a Parametrization of Convection* (2024), EGU General Assembly 2024
4. N. Clément, [...], **Le Saux, A.** et al., *Convective storms and methane clouds on Uranus & Neptune: sporadicity and latitudinal variations revealed by a 3D cloud-resolving model* (2024), EGU General Assembly 2024
5. **Le Saux, A.**, *Exploring waves properties with multi-dimensional fully compressible hydrodynamical simulations: from solar type stars to intermediate-mass stars* (2023), American Astronomical Society Meeting 241
6. Smith, K., **Le Saux, A.**, Bugnet, L., *Asteroseismology: Unveiling Stellar Nature Through Oscillation Pattern Recognition* (2023), American Astronomical Society Meeting 241
7. **Le Saux, A.** et al., *Modelling waves in solar-like interiors with the MUSIC code* (2022), The 21st Cambridge Workshop on Cool Stars, Stellar Systems, and the Sun
8. **Le Saux, A.**, Bugnet, L., Mathur, S., et al. *Automatic classification of K2 pulsating stars using Machine Learning* (2019), SF2A 2019 Proceeding
9. Breton, S., [...], Le Saux, A. et al. (2019), *Determining surface rotation periods of solar-like stars observed by the Kepler mission using machine learning techniques* SF2A 2019 Proceeding
10. Lebonnois, S., Garate-Lopez, I., **Le Saux, A.** & Plougonven, R., *Wave activity below the clouds of Venus with the IPSL Venus GCM* (2019), 21st EGU General Assembly

o **Press releases on artistic collaboration (8)**

1. [La sérendipité post-antique de Léo Fourdrinier](#), The Steidz, Oct. 12th, 2024
2. [Léo Fourdrinier at the Centre d'Art Contemporain de Nîmes](#), Artmirror, Feb. 9th, 2022
3. [Nîmes : l'antiquité et les étoiles dans les rêveries de Léo Fourdrinier au nouveau Centre d'Art contemporain](#) (French), Midi Libre, Oct. 19th, 2021

4. *PULSE, con obra de Léo Fourdrinier* (Spanish), [Anti]Materia, April 2nd, 2020
5. *PULSE, Léo Fourdrinier At L'axolotl*, Toulon, France (English), O Fluxo, March 2020
6. *Exposition PULSE de Léo Fourdrinier* (French), Revue Point Contemporain, March 2020
7. *Léo Fourdrinier - La tête dans les étoiles* (French), Cité des Arts, Feb. 3rd, 2020
8. *Voyage dans le vide sidéral au Port des créateurs* (French), Var Matin, Jan. 25th, 2020

## ORAL PRESENTATIONS & POSTERS

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### o Oral presentations (27)

#### Invited presentations (4)

1. Turbulence Day at ENS de Lyon, June 2024, *Lyon, France*
2. Beyond Boussinesq workshop, October 2023, *Lyon, France*
3. Future of solar modelling workshop, September 2023, *Sierre, Switzerland*
4. Fluid Dynamics of the Sun and stars workshop, November 2022, *Göttingen, Germany*

#### Invited seminars (3)

1. Institute of Science & Technology, February 2024, *Klosterneuberg, Austria*
2. LESIA, Observatoire de Paris, Université PSL, May 2023, *Meudon, France*
3. Observatoire de Genève, December 2022, *Versoix, Switzerland*

#### Contributed talks (20)

1. EPSC Assembly, Septembre 2024, *Berlin, Germany*
2. Meeting SF2A 2024, June 2024, *Marseille, France*
3. EGU General Assembly 2024, April 2024, *Vienna, Austria*
4. Perspectives colloquium, French National Program in Stellar Physics, January 2024, *Marseille, France*
5. Generic PCM days, LMD, October 2023, *Paris, France*
6. MUSIC Team Talk, October 2023, *Online*
7. Institut de Recherche en Astrophysique et Planétologie, March 2023, *Toulouse, France*
8. Astrophysics group (Seminar with L. Fourdrinier), February 2023, *University of Exeter, UK*
9. AAS #241 meeting (remote **Dissertation talk**), January 2023, *Seattle, USA*
10. Fluid Dynamics of the Sun and stars workshop, November 2022, *Göttingen, Germany*
11. MUSIC Team Talk, November 2022, *University of Exeter, UK*
12. Angular momentum in stellar systems workshop, September 2022, *CEA, Paris, France*
13. Cool Stars 21 (**Plenary session**), July 2022, *Toulouse, France*
14. French National Program in Stellar Physics workshop: Codes for stellar physics, June 2022, *Observatoire de Paris, Meudon, France*
15. European Astronomical Society meeting 2022, Session 21, June 2022, *Valencia, Spain*
16. Good Vibrations seminar series, April 2022, *Online*
17. Astrophysics group, December 2021, *University of Exeter, UK*

18. MUSIC Team Talk, November 2021, *Online*
19. Kavli Summer Program in Astrophysics, June 2021, *Online*
20. EMPS PGR Conference 2021 (**Best Presentation Award**), March 2021, Exeter, UK

◦ **Posters (9)**

1. *Topological Lamb-like waves could help to probe the innermost regions of the Sun*, Journées SF2A 2024, Marseille, France
2. *Modelling stellar interiors with the MUSIC code*, Journées SF2A 2023, Strasbourg, France
3. *Unveiling stellar nature through oscillations pattern recognition*, EAS General Assembly, 27 June – 1 July 2022, Valencia, Spain
4. *Modelling waves in stellar interiors with the MUSIC code*, TASC6/KASC13 Workshop, 11-15 July 2022, Leuven, Belgium
5. *Two-dimensional simulations of solar like models with artificially enhanced luminosity*, Kavli Summer Program in Astrophysics 2021, June 2021, *Online*
6. *Two-dimensional simulations of solar like models with artificially enhanced luminosity*, Cool Stars 20.5, March 2020, *Online*
7. *Internal gravity waves in two-dimensional compressible simulations of solar like models*, PGR conference 2021, 10-11 March 2021, Exeter, UK
8. *Internal Gravity Waves in Stars: Impact of artificially boosted models*, Atelier ExoSystèmes I : Evolution, 28-30 Janvier 2020, Paris, France
9. *Automatic classification of K2 pulsating stars using Machine Learning*, Journées SF2A 2019, Nice, France