Théo Lebeau

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Keywords: study of gas dynamics in galaxy clusters and filaments using cosmological simulations

Research Experiences

- **Postdoctoral fellow** *Oct 2025 -*
  Kapteyn Astronomical Institute, University of Groningen Groningen, Netherlands
  – Supervisors: Saleem Zaroubi
  – Scholarship funded by the Open University of Israel

- **PhD** *Oct 2022 - Oct 2025*
  Institut d'Astrophysique Spatiale (IAS) Orsay, France
  – Title: "The impact of physical processes in and around galaxy clusters on the estimation of their boundaries and mass: case study of the Virgo cluster numerical replica"
  – Supervisors: Nabila Aghanim & Jenny Sorce
  – Defence date: 2nd of October, 2025

- **2nd year Master Degree research internship** *Mar 2022 - Jun 2022*
  Institut d'Astrophysique Spatiale (IAS) Orsay, France
  – Project: Study of a constrained zoom-in simulation of the Virgo cluster
  – Supervisors: Nabila Aghanim & Jenny Sorce

- **1st year Master Degree research internship** *May 2021 - Jul 2021*
  Institut d'Astrophysique Spatiale (IAS) Orsay, France
  – Project: Study of galaxy clusters pressure profiles in the IllustrisTNG simulation
  – Supervisors: Nabila Aghanim & Hideki Tanimura

- **Bachelor research internship** *Jan 2020*
  Laboratoire de Physique SUBAtomique et TECHnologies associées (SUBATECH) Nantes, France
  – Project: Calibration of the XENON1T detector using ^{83m}Kr and light yield determination
  – Supervisors: Sara Diglio & Julien Masbou

Education

- **PhD in Astronomy and Astrophysics** *2025*
  Université Paris-Saclay Orsay, France

- **Magister degree in Fundamental Physics, specialisation in Astrophysics (M2)** *2022*
  Université Paris-Saclay Orsay, France

- **Bachelor degrees in Physics and Mathematics** *2020*
  Université de Nantes Nantes, France

Publications

Refereed (rank A) as first author

1. *Gas motion in the ICM of the Virgo cluster replica*
   Lebeau, Ettori, Aghanim, Sorce & Paste, Submitted to A&A, under revision, ArXiv ID: 2506.14441

2. *Velocity fields and turbulence from cosmic filaments to galaxy clusters*
   Lebeau, Zaroubi, Aghanim, Sorce & Langer, accepted in A&A, ArXiv ID: 2501.09573

3. *Can the splashback radius be an observable boundary of galaxy clusters?*
   Lebeau, Ettori, Aghanim & Sorce, A&A 689, A19 (2024)

4. *Mass bias in clusters of galaxies: Projection effects on the case study of Virgo replica*
   Lebeau, Sorce, Aghanim, Hernández-Martínez & Dolag, A&A 682, A157 (2024)

Refereed (rank A) as co-author

1. *Simulating the LOcal Web (SLOW) – V: Thermodynamic Properties and Evolution of Local Galaxy Clusters*
   Hernández-Martínez, Dolag, Steinwandel, Sorce, **Lebeau**, Aghanim & Seidel,
   Submitted to A&A, under revision, ArXiv ID: 2507.15858

2. *Simulating the LOcal Web (SLOW) – II: Properties of local galaxy clusters*
   Hernández-Martínez, Dolag, Seidel, Sorce, Aghanim, Pilipenko, Gottlöber, **Lebeau** & Valentini, A&A 687, A253 (2024)

Proceedings

1. *Projection effects on pressure profiles: a case study of the Virgo replica*
   Lebeau, Sorce & Aghanim, mm Universe Proceedings, EPJ Web of conferences, 2024

2. *CLONES: digital twins of the local Universe*
   Sorce, Aghanim, **Lebeau** et al., High Performance Computing in Science and Engineering – Garching/Munich, 2024

Talks

Invited talks and seminars

1. **Can the splashback radius be an observable boundary of galaxy clusters?** *Mar 2025*
   Seminars of the CMB-S4 clusters analysis working group online (Univ. of Illinois, USA)

2. **Physics processes of the cosmic gas in galaxy clusters environment** *Oct 2024*
   Day of the astrophysics axis of the Univ. Paris-Saclay Graduate School Orsay, France

3. **Physics processes biasing galaxy clusters mass estimation: case study of the Virgo cluster simulated replica** *Sep 2024*
   INAF-OAS Seminar Bologna, Italy

Contributed talks

1. **Gas motion in the ICM of the Virgo cluster replica** *Jun 2025*
   EAS annual meeting Cork, Ireland

2. **Can the splashback radius be an observable boundary of galaxy clusters?** *May 2025*
   Expanding the boundaries of dark matter halos workshop online (Shangai, China)

3. **Turbulence from cosmic filaments to galaxy clusters** *Nov 2024*
   SNO Ramses days Paris, France

4. **Physics processes biasing galaxy clusters mass estimation: case study of the Virgo cluster simulated replica** *Oct 2024*
   Ultimate cluster cosmology workshop Orsay, France

5. **Turbulence in the ICM of the Virgo cluster simulated replica** *Jul 2024*
   EAS annual meeting Padova, Italy

6. **Can the splashback radius be an observable boundary of galaxy clusters ?** *May 2024*
   GdR Cophy Episode 2 Lyon, France

7. **Can the splashback radius be an observable boundary of galaxy clusters ?** *May 2024*
   Tuorla-Tartu meeting Turku, Finland

8. **Gas dynamics in the ICM of galaxy clusters: case study of a Virgo replica** *Mar 2024*
   Elbereth Conference Paris, France

9. **Mass bias in clusters of galaxies: case study of Virgo CLONE replica** *Dec 2023*
   RAMSES SNO kick-off meeting Lyon, France

10. **Biases in the estimation of the hydrostatic mass of the Virgo simulated CLONE** *Jun 2023*
    mm Universe conference Grenoble, France

11. **Biases in the estimation of the hydrostatic mass of the Virgo simulated CLONE** *Jun 2023*
    CLUES meeting Munich, Germany

12. **Towards bias-free mass calibration of galaxy clusters using constrained cosmological simulations** *Mar 2023*
    Elbereth Conference Paris, France

Posters

1. **Gas motion in the ICM of the Virgo cluster replica** *Jul 2025*
   Tracing Cosmic Evolution with Galaxy Clusters V Conference Sesto, Italy

2. **Studying physics processes in and around galaxy clusters with cosmological simulations** *May 2025*
   IAS young researchers and engineers day Orsay, France

3. **Turbulence in galaxy clusters and cosmic filaments** *Jun 2024*
   IAS young researchers and engineers day Orsay, France

4. **Towards bias-free mass calibration of galaxy clusters using constrained cosmological simulations** *Dec 2023*
   Colloque Alain Bouyssy Orsay, France

5. **Towards bias-free mass calibration of galaxy clusters using constrained cosmological simulations** *Oct 2023*
   Journée de l'axe Astro de la Graduate School de Physique de l'Université Paris-Saclay Orsay, France

6. **Towards bias-free mass calibration of galaxy clusters using constrained cosmological simulations** *Jun 2023*
   IAS young researchers and engineers day Orsay, France

7. **Towards bias-free mass calibration of galaxy clusters using constrained cosmological simulations** *Apr 2023*
   "Future Cosmology" summer school Cargèse, France

Supervision and teaching

- **Co-Supervision of Léa Gagneux (2nd year Bachelor Degree trainee)** *Jan-Apr 2025*
  3.5 months research internship
- **Co-Supervision of Jade Paste (1st year Master Degree trainee)** *May-Jun 2024*
  2 months research internship
- **Astronomy pratical works (15h/year)** *2022-2024*
  1st year Master Degree
- **Electromagnetism courses (21h/year)** *2023-2024*
  2nd year Bachelor Degree
- **Co-supervision of astronomy projects (one week)** *2023*
  1 week project with four students of 3rd year Bachelor Degree

Main Skills

Programming Languages: Analysis of cosmological simulations with Fortran (own RAMSES-related data preparation and map creation codes) and Python (use of scientific (numpy,scipy,astropy,...), visualisation (matplotlib,pyvista,...) and optimisation (numba,jax,...) libraries)
Languages: English (fluent), French (mother tongue)

Contributions to the community

International

- **Referee for "The Open Journal of Astrophysics"** *2024*

Local

- **Member of the LOC for the Ultimate Cluster Cosmology workshop @ IAS** *2024*
- **Co-organisation of bimonthly Cosmology team seminars** *2024 - 2025*
- **Co-organisation of the IAS young researchers and engineers day** *2024 & 2025*
- **Elected as doctoral student representative at the laboratory board** *2024 - 2025*
- **Elected as doctoral student representative at the Paris-Saclay University Physics Graduate School board** *2023 - 2025*
- **Management of the Cosmology team's conference webpage** *2022 - 2024*

Collaborations

- **Member of the LOCALIZATION project** *2022-2025*
  P.I.s: Nabila Aghanim (IAS,Paris-Saclay University) & Klaus Dolag (LMU, Munich)

Grants

- **Financial support from doctoral school to participate to "Future Cosmology" summer school (∼500€)** *Apr 2023*
- **3-years PhD half-grant from doctoral school "Astronomie & Astrophysique d'Ile-de-France" (∼50k€)** *2022 - 2025*

Proposals

- **Co.I of project Proposal for Tier 0/Tier 1 HPC Access at the Gauss Center for supercomputing** *2023*
  45Mcpu hours obtained on the LRZ supercomputer to run the LOCALIZATION simulation

Outreach

- **"Introduction to Astrophysics", meeting with 7th grade students** *Apr 2025*
- **"The story of my PhD", ALCOR Astronomy association event** *Oct 2024*
- **Conference "Introduction to cosmology" for secondary school students** *Dec 2023*
- **Participation to the "Science Festival 2022" at IAS** *Oct 2022*

Personal Interests

- **Basketball in competition**
- **Guitar in amateur band**

References

- **Nabila Aghanim**: nabila.aghanim@universite-paris-saclay.fr
- **Jenny Sorce**: jenny.sorce@univ-lille.fr
- **Stefano Ettori**: stefano.ettori@inaf.it
- **Saleem Zaroubi**: saleem@astro.rug.nl