Léo Vacher

PH.D IN ASTROPHYSICS AND COSMOLOGY

Institut de recherche en astrophysique et planétologie (IRAP). Toulouse, France

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Postdoctoral appointments

International School for Advanced Studies (SISSA) *Trieste, Italy*

RESEARCH FELLOW *Since 2023*

- Data analysis for Cosmic Microwave Background studies

Education

Université Paul Sabatier *Toulouse, France*

DOCTOR OF PHILOSOPHY (PH.D), ASTROPHYSICS AND COSMOLOGY *2020-2023*

- Mention
- Thesis: Understanding the Galactic polarized signal in the quest for new fundamental physics in the Cosmic Microwave Background
- Supervisors: Dr. J. Aumont and Dr. L. Montier

Université de Lorraine *Nancy, France*

MASTER'S DEGREE, LOGIC, PHILOSOPHY AND HISTORY OF SCIENCES *2021 - present*

- Thesis project: Investigating the ontology of classical and quantum gauge theories.

Université Grenoble-Alpes *Grenoble, France*

MAGISTER AND MASTER'S DEGREE, SUBATOMIC PHYSICS AND COSMOLOGY *2018 - 2020*

- With high honors (très bien)
- master thesis: Modeling the spectral complexity of CMB Galactic foregrounds in the quest of primordial B-modes (IRAP, Toulouse)
- magister internship: Characterizing the turbulent CO emission of Molecular clouds (IPAG, Grenoble)
- master 1 internship: Astrophysical and local tests of Einstein's equivalence principle and string theory (CAUP, Porto)

Université Clermont Auvergne *Clermont-Fd, France*

BACHELOR DEGREE, FUNDAMENTAL PHYSICS *2015 - 2018*

- With high honors (très bien)
- Internship: spin chains and quantum algebra: Introduction to coordinate and algebraic Bethe Ansatz, to solve the Heisenberg XXX and XXZ Hamiltonians (LAPTh, Annecy)

Publications

1. N. Schöneberg, **L. Vacher**, J. D. F. Dias, M. M. C. D. Carvalho, C. J. A. P. Martins. 2023. News from the Swampland – Constraining string theory with astrophysics and cosmology. Submitted to JCAP. Preprint available at arXiv:2307.15060.

2. U. Fuskeland et al. (including **L. Vacher**). 2023. Tensor-to-scalar ratio forecasts for extended LiteBIRD frequency configurations. Submitted to A&A. Preprint available at arXiv:2302.05228.

3. **L. Vacher**, N. Schöneberg, J. F. Dias, C. J. A. P. Martins, F. Pimenta. 2023. Runaway dilaton models: improved constraints from the full cosmological evolution. Submitted to Phys.Rev. D. Preprint available at arXiv:2301.13500.

4. The LiteBIRD collaboration (including **L. Vacher**). Sensitivity Modeling for LiteBIRD. 2022. Journal of Low Temperature Physics.

5. **L. Vacher**, J. Aumont, F. Boulanger, L. Montier, V. Guillet, A. Ritacco, J. Chluba. 2022. Frequency dependence of the thermal dust E/B ratio and EB correlation: insights from the spin-moment expansion. Submitted to A&A. Preprint available at arXiv:2210.14768.

6. **L. Vacher**, J. F. Dias, N. Schöneberg, C. J. A. P. Martins, S. Vinzl, S. Nesseris, G. Cañas-Herrera, M. Martinelli. 2022. Constraints on extended Bekenstein models from cosmological, astrophysical, and local data. Phys.Rev. D 106,083522. Preprint available at arXiv:2207.03258.

7. The LiteBIRD collaboration (including **L. Vacher**). 2022. Optical Characterization of OMT-Coupled TES Bolometers for LiteBIRD. Journal of Low Temperature Physics.

8. B. Régaldo-Saint Blancard, E. Allys, C. Auclair, F. Boulanger, M. Eickenberg, F. Levrier, **L. Vacher**, S. Zhang. 2022. Generative Models of Multi-channel Data from a Single Example – Application to Dust Emission. ApJ:10.3847/1538-4357/aca538. Preprint available at arXiv:2208.03538.

9. A. Ritacco, F. Boulanger, V. Guillet, J.M. Delouis, J.L. Puget, J. Aumont, **L. Vacher**. 2022. Dust polarization spectral dependence from Planck HFI data. Turning point on CMB polarization foregrounds modelling. A&A:10.1051/0004-6361/202244269. Preprint available at arXiv:2206.07671.

10. **L. Vacher**, J. Chluba, J. Aumont, A. Rotti, L. Montier. 2022. High precision modeling of polarized signals: Moment expansion method generalized to spin-2 fields. A&A: 10.1051/0004-6361/202243913. Preprint available at arXiv:2205.01049.

11. The LiteBIRD collaboration (including **L. Vacher**). 2022. Probing Cosmic Inflation with the LiteBIRD Cosmic Microwave Background Polarization Survey. Submitted to PTEP. Preprint available at arXiv:2202.02773.

12. **L. Vacher**, J. Aumont, L. Montier, S. Azzoni, F. Boulanger, M. Remazeilles (for the LiteBIRD collaboration). 2022. Moment expansion of polarized dust SED: a new path towards capturing the CMB B-modes with LiteBIRD. A&A: 10.1051/0004-6361/202142664. Preprint available at arXiv:2111.07742.

13. P. Vielva et al. (including **L. Vacher**). 2022. Polarization angle requirements for CMB B-mode experiments. Application to the LiteBIRD satellite. JCAP 2022(04):029. Preprint available at arXiv:2202.01324.

14. N. Krachmalnicoff et al. (including **L. Vacher**). 2022. In-flight polarization angle calibration for LiteBIRD: blind challenge and cosmological implications. JCAP 2022(01):039. Preprint available at arXiv:2111.09140.

15. C.J.A.P. Martins and **L. Vacher**. 2019. Astrophysical and local constraints on string theory: runaway dilaton models. Phys.Rev. D 100, 123514. Preprint available at arXiv:1911.10821.

Presentations, conferences and summer schools

1. Talk. 2023. From the Galaxy to the Big-Bang. Banyuls, France.
2. Talk and Organization Comitee (LOC). 2023. Ibericos. Ponte de Lima, Portugal.
3. Talk. 2022. Galactic science and CMB foregrounds Workshop. Tenerife, Spain.
4. Talk and Organization comitee (LOC). 2022. LiteBIRD F2F meeting. Okayama University, Japan.
5. Talk. 2022. CMB france #4. IAP, France.
6. Talk. 2022. Pan-Experiment Galactic Science Group. Online.
7. Talk. 2022. Cosmology session of the 56th Rencontres de Moriond. La Thuile, Italy. Proceedings: arXiv:2203.07246.
8. Talk. 2022. PHD Day. IRAP, France. First prize for best oral presentation.
9. Talk. 2022. CMB France #3. IAP, France.
10. Talk. 2021. IJUP, Universidade do Porto, Portugal. Best oral communication in "Maths, Physics & Astronomy".
11. Summer School. 2021 and 2022. Euclid Summer School , France.
12. Summer School. 2021. "Fundamental cosmology from the ELT and space". Angra do Heroísmo, Açores, Portugal.
13. Talk. 2021. CMB france #2. IAP, France.
14. Talk. 2021. Ibericos. Universidade de Coimbra, Portugal.
15. Talk. 2021. Theory of Gravitation and Variation in Cosmology. CIRM, Marseille, France.
16. Talk. Cosmo21. University of Illinois, USA.
17. Talk. 2021. PHD Day. IRAP, France. Second prize for best oral presentation.
18. Poster. 2021. Fall LiteBIRD S2S meeting. Online.
19. Talk. 2020. CMB france #1. IAP, France.
20. Organization comitee (LOC). 2019. IAU Symposium #352. IAU Symposium. Viana do Castelo, Portugal.

Academic teaching

2023	**Jury member for the DU: "parcours spéciaux"**, Jury (4 h). Université Paul Sabatier.
2023	**Fluid mechanics (L2/L3)**, Tutorials (14 h). Université Paul Sabatier.
2023	**Geometrical optics (L1)**, Tutorials (18 h). Université Paul Sabatier.
2022	**Astrophysics (L3)**, Tutorials (12 h). Université Paul Sabatier.
2021, 2022	**Thermodynamics (L2)**, Tutorials (45h). Université Paul Sabatier.
2021	**Point Mechanics (L1)**, Tutorials (15h). Université Paul Sabatier.
2021	**Light** & **colors (L1)**, Tutorials (18h). Université Paul Sabatier.
2021, 2022	**Mechanics** & **Electrokinetics (L1)**, Lab (40h). Université Paul Sabatier.

Student advising

2022-2023	**J. Delhomelle**, undergraduate (L2), Université Paul Sabatier. 6 months.
2020-2021	**S. Vinzl**, undergraduate (L2), Université Paul Sabatier. 7 months.
2021-2022	**N. Gentil**, undergraduate (L2), Université Paul Sabatier. 7 months.

Collaborations

LiteBIRD collaboration. Active member of systematics and foregrounds joint study groups and Galactic project study group.

Euclid consortium. Active member of work package #10 of the theoretical cosmology working group.

Grants and project fundings

2022	**H2020-RISE Grant. P.I.: G. Patanchon.**, Funding for a 1 month travel grant to Okayama University, Japan
2021	**FCT-Grant: #2022.04048.PTDC. "Phi from the Sky". PI: C.J.A.P. Martins.**, Universidade do Porto, Portugal
2020-2023	**National PHD Grant - SDU2E**, Université Paul Sabatier

Outreach and services

Non Academic teaching activities

2021	**PLANCKS21**, Marker for the international competition, cosmology session.	*Porto*
2016-2018	**Insignis**, Weekly group lessons of mathematics from secondary to high school.	*Clermont-Fd*
2016-2021	**High-school interventions**, Introducing the challenges of modern physics in classes of philosophy.	*Clermont-Fd*
2016-2021	**Primary school interventions.**, Introduction to astronomy.	*Lyon*

Associative activities

2020-2022	**Les étoiles brillent pour tous**, Public science outreach (hospitals, prisons ...).	*Toulouse*
2020-2023	**UniverSciel**, Animations related to astronomy in schools.	*Toulouse*
2020-2023	**UPS in space**, Astronomical observations and public talks.	*Toulouse*
2018	**Le campus des étoiles**, Public astronomical observations, science outreach.	*Clermont-Fd*

Writings

2021-today	**Yolonomy**, Co-Founder of the website. Teaching and outreach in physics.
2021	**Exploreur**, Web article: LiteBIRD en quête des premières fractions de secondes de l'Univers.
2021	**Pulsar #41**, Book review. « A General Relativity Workbook by Thomas A. Moore».