

# Léo Vacher

PH.D STUDENT IN ASTROPHYSICS AND COSMOLOGY

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

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## Education

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### Université Paul Sabatier

*Toulouse, France*

DOCTOR OF PHILOSOPHY (PH.D), ASTROPHYSICS AND COSMOLOGY

*09/2020 - 09/2023*

- 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: Investigating the ontology of Gauge theories and the gauge interpretations of gravity

### Université Grenoble-Alpes

*Grenoble, France*

MAGISTER AND MASTER'S DEGREE, SUBATOMIC PHYSICS AND COSMOLOGY

*2018 - 2020*

- With high honors

### Université Clermont Auvergne

*Clermont-Fd, France*

BACHELOR DEGREE, FUNDAMENTAL PHYSICS

*2015 - 2018*

- With high honors

## Publications

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1. 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](https://arxiv.org/abs/2302.05228).
2. **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](https://arxiv.org/abs/2301.13500).
3. The LiteBIRD collaboration (including **L. Vacher**). Sensitivity Modeling for LiteBIRD. 2022. Journal of Low Temperature Physics.
4. **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](https://arxiv.org/abs/2210.14768).
5. **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](https://arxiv.org/abs/2207.03258).
6. The LiteBIRD collaboration (including **L. Vacher**). 2022. Optical Characterization of OMT-Coupled TES Bolometers for LiteBIRD. Journal of Low Temperature Physics.
7. B. Régalo-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](https://arxiv.org/abs/2208.03538).
8. 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](https://arxiv.org/abs/2206.07671).
9. **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](https://arxiv.org/abs/2205.01049).

10. 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](https://arxiv.org/abs/2202.02773).
11. **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](https://arxiv.org/abs/2111.07742).
12. 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](https://arxiv.org/abs/2202.01324).
13. 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](https://arxiv.org/abs/2111.09140).
14. 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](https://arxiv.org/abs/1911.10821).

## Presentations, conferences and graduate schools

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

## Academic teaching

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- 2023 **Fluid mechanics (L3)**, Teaching Assistant (14 h). Université Paul Sabatier.
- 2023 **Geometrical optics (L1)**, Teaching Assistant (18 h). Université Paul Sabatier.
- 2022 **Astrophysics (L3)**, Teaching Assistant (12 h). Université Paul Sabatier.
- 2021, 2022 **Thermodynamics (L2)**, Teaching Assistant (45h). Université Paul Sabatier.
- 2021 **Point Mechanics (L1)**, Teaching Assistant (15h). Université Paul Sabatier.
- 2021 **Light & colors (L1)**, Teaching Assistant (18h). Université Paul Sabatier.
- 2021, 2022 **Mechanics & Electrokinetics (L1)**, Lab Assistant (40h). Université Paul Sabatier.

## Student advising

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- 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

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**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

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- 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

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### 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**, Discussion in class of philosophy about modern physics. *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 ».