



Léo Vacher

PHD Student in cosmology



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12 rue Déodora,
31400 Toulouse, France



+33 642851972



GitHub: LeoVacher



leo.vacher@irap.omp.eu

About me

After a master's degree in particle physics and cosmology at the University Grenoble-Alpes, I am currently a PHD student at the Institut de recherche en astrophysique et planétologie (IRAP) in Toulouse since 2020.

My research interests are centered on observational cosmology, gravitation theory and galactic astrophysics. In this framework, I am an active member of the *LiteBIRD* and the *Euclid* collaborations.

Coding languages

C

Python

(relative uses)

Research interests

Cosmology, astrophysics, cosmic microwave background, foregrounds, *LiteBIRD*, interstellar medium, observational probes of inflation, fundamental constants stability, tests of the Einstein's equivalence principle and foundations of general relativity and gauge theories.

Education

since 2020	Ph.D. candidate in Cosmology and Astrophysics	Toulouse
	<i>Ongoing</i>	
since 2021	M.Sc. Logic, Philosophy and History of sciences	Université de Lorraine
	<i>Ongoing</i>	
2018-2020	M.Sc. Subatomic Physics and Cosmology	Université Grenoble-Alpes
	<i>With high honors, second</i>	
2018-2020	Magisterium of fundamental physics	Université Grenoble-Alpes
	<i>With high honors, valedictorian</i>	
2015-2018	B.Sc. Fundamental Physics	Université Clermont-Auvergne
	<i>With high honors, valedictorian</i>	

Publications with major contributions

2022	Generative Models of Multi-channel Data from a Single Example – Application to Dust Emission Bruno Régaldo-Saint Blancard, Erwan Allys, Constant Auclair, François Boulanger, Michael Eickenberg, François Levrier, <u>Léo Vacher</u> , Sixin Zhang arXiv:2208.03538
2022	Constraints on extended Bekenstein models from cosmological, astrophysical, and local data <u>Léo Vacher</u> , João F. Dias, Nils Schöneberg, C. J. A. P. Martins, Samy Vinz, Savvas Nesseris, Guadalupe Cañas-Herrera, Matteo Martinelli arXiv:2207.03258
2022	Dust polarization spectral dependence from Planck HFI data. Turning point on CMB polarization foregrounds modelling Alessia Ritacco, François Boulanger, Vincent Guillet, Jean-Marc Delouis, Jean-Loup Puget, Jonathan Aumont, <u>Léo Vacher</u> arXiv:2206.07671
2022	High precision modeling of polarized signals: moment expansion method generalized to spin-2 fields <u>L. Vacher</u> , J. Chluba, J. Aumont, A. Rotti, L. Montier. arXiv:2205.01049
2022	Probing Cosmic Inflation with the <i>LiteBIRD</i> Cosmic Microwave Background Polarization Survey <i>LiteBIRD</i> collaboration. arXiv:2202.02773
2022	Moment expansion of polarized dust SED: a new path towards capturing the CMB <i>B</i> -modes with <i>LiteBIRD</i> <u>L. Vacher</u> , J. Aumont, L. Montier, S. Azzoni, F. Boulanger, M. Remazeilles (for the <i>LiteBIRD</i> collaboration) arXiv:2111.07742 A&A 10.1051/0004-6361/202142664
2019	Astrophysical and local constraints on string theory: runaway dilaton models C.J.A.P. Martins, <u>L. Vacher</u> arXiv:1911.10821 Phys.Rev. D 100, 123514 -2019

Languages

German

Portuguese

English

French

Referees

- J. Aumont (IRAP)
- L. Montier (IRAP)
- F. Boulanger (LPENS)
- C.J.A.P. Martins (CAUP)

Toolbox

- Redacting: LaTeX, Office
- Data analysis: emcee, MontePython, getdist, scipy, mpfit, lmfit
- Cosmological analysis: CLASS, Py-master, X-Pol, CAMB
- Instrumental/foreground analysis: healpy, toast, litebird-sim, fgbuster, Pysm2 and Pysm3
- Symbolic calculations: mathematica, sympy

Teaching

2020-2023 PHD Teaching assistant

Université Paul Sabatier

- Tutorials and problem solving:
 - Thermodynamics (L2): 45 hours
 - Astrophysics (L3): 12 hours
 - Newtonian point mechanics (L1): 15 hours
- Labs:
 - Mechanics (L1): 21 hours
 - Electrodynamics (L1): 18 hours
- Student projects:
 - Interviews for professional project module (L2)
 - Light and colors (L1): 18 hours (Supervision and evaluation of interdisciplinary student projects)

2020-2023 Internship supervisions

Université Paul Sabatier

- N. Gentil (L2 - 7 months) - Far Side Lobes asymmetries.
- S. Vizyl (L2 - 7 months) - Extended Bekenstein model

since 2022 Author for the website Yonomy
Teaching and outreach in physics

2021 Marker for the PLANCKS-2021 event, cosmology session Porto
International competition for bachelor and masters students

2017-2018 Employee of the «Insignis» association Clermont-Ferrand
Weekly or holiday lessons of mathematics with classes of six students
secondary to high school

2016-2021 Yearly interventions in high-school Clermont-Ferrand
Discussion in class of philosophy about research in modern physics

Outreach and associative activities

2021 Writing article for the web-journal «explorer»:
«*LiteBIRD* en quête des premières fractions de secondes de
l'Univers.»
Scientific journalism

2021 Writing short article for the web-journal «pulsar #41»:
«A General Relativity Workbook by Thomas A. Moore»
Academic book review

2021 Writing article for the web-journal «explorer»:
«*LiteBIRD* en quête des premières fractions de secondes de
l'Univers.»
Scientific journalism

2021-2023 Animator for the association «UPS in space» Toulouse
active member: Astronomical observations and public talks

2021-2023 Animator for the association «UniverSciel» Toulouse
animations related to astronomy in schools and astronomical obser-
vations events

2021-2022 Animator for the association «les étoiles brillent pour tous» Toulouse
Science outreach in public places having difficult access to education
(hospitals, penitentiary structures ...).

2019 Interventions in primary school: "questions and answers about the
Universe" Lyon
Ecole primaire Jules Verne Caluire et Cuire

2018 Animator for the astronomy association «campus des étoiles»
Clermont-Ferrand
Leading of public astronomical observations, science outreach.

Awards and grants

2022	Award for best talk at IRAP's PHD Day 2022	Toulouse, France
2021	Award for best oral communication at IJUP-2021,	Porto, Portugal
2021	Award for second talk at IRAP's PHD Day 2021	Toulouse, France
2020	PHD National grant.	Toulouse, France

Graduate classes, conferences and summer schools

2022	Rencontres de Moriond, cosmology session Proceedings available at arxiv:2203.07246 .	La Thuile, Italy
2021-2023	Euclid Summer school: La science des futurs grands relevés cosmologiques 3 years doctoral school on cosmology	France
2021-2023	Fundamental cosmology from the ELT and space 4th Azores School on Observational Cosmology. Doctoral school on observational cosmology	Angra do Heroísmo, Açores, Portugal
2021	Fundamental cosmology from the ELT and space 4th Azores School on Observational Cosmology. Doctoral school on observational cosmology	Angra do Heroísmo, Açores, Portugal
2021	Theory of Gravitation and Variation in Cosmology Doctoral school on theoretical cosmology	CIRM, Marseille, France
2021	ED-127: Bayesian statistics Doctoral program on Bayesian statistics.	Sorbonne University, Paris, France