Jaime Ruiz-Zapatero

Research Software Engineer | 🐍 julia | 🇬🇧 🇪🇸

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Summary

I am a research software engineer at the Advanced Research Computing (ARC) centre of University College London (UCL) developing infrastructure for the LSST and Euclid cosmological surveys to enable new science. I also have a deep interest in accelerating Bayesian inference with gradient methods and Gaussian processes as tools for model-agnostic science.

Expertise

🧠 **Classical machine learning**: developed tests of fundamental assumptions of Cosmology using Gaussian processes as tools for agnostic modelling.

🗄 **Big data reduction**: co-author of the largest repository of consistently combined summary statistics in Cosmology from pixel maps.

🏔 **High-dimensional statistical inference**: developed gradient based inference algorithms to constrain thousands of parameters.

`</>` **Auto-differentiable programming**: developed the first library of auto-differentiable methods for cosmology in `Julia`.

Fellowships and Grants

2024 Schmidt AI in Science Fellowships (declined)

Education   Honours

2020 - 2024	PhD Astrophysics at **University of Oxford**	STFC studentship
	Supervisors: David Alonso and Pedro Ferreira	St Cross College studentship
2023 Jan-May	Long term attachment at BCCP, **UC Berkeley**	
	Supervisors: Uroš Seljak	
2016 - 2020	Msci Theoretical Physics at **UCL**	MAPS faculty Dean's list
	Supervisor: Benjamin Joachimi	Additional seasonal prize for merit
		First class honours
2014 - 2016	Bachillerato cientifico-tecnologico	Matricula de honor
	at **La Salle Buen Pastor**	Premio extraordinario de Bachillerato

Work Experience

Research Software Engineer for LSST and Euclid at UCL, London (UK)   April 2024 - Current
Euclid: building summary statistics from pixel maps.
LSST: speeding photometric uncertainty marginalisation.

Probabilistic programming engineer at the CBL Lab, Cambridge (UK)   June-Dec 2023
Refactored the `Turing.jl` library for Bayesian inference from a monolithic into a microservice design by writing a new interface between `Turing.jl`'s probabilistic programming language and external inference algorithms.

Natural language processing internship at Satalia (UK)   Aug-Sept 2019
Developed a natural language processor to classify employees reports into the company's projects as well as a scheduler to asses and minimize project delays based on Monte Carlo simulations.

Students

2024 - 2025	Shreya Banerjee (Bsc literature review): The State of Neutrino Mass Constraints in Particle Physics and Cosmology

Teaching and other responsibilities

2024 - 2025	Bsc Literature review supervisor at UCL (London).	2022	Special Relativity and Symmetries tutor at St Peter's College (Oxford).
2021	Leveling up physics mentor (Oxford).	Current	Cosmology seminar organizer at UCL and Oxford
On demand	Referee for OJA, EPJ-C, JCAP and APJ		

Selected Projects

nz_prior.py (2024-2025)   Link to repository
LSST collaboration code to convert realizations of the distribution of a sample of galaxies into redshift uncertainty priors for inferece.

heracles.py (2024-2025)   Link to repository
Euclid collaboration code to measure angular power spectra from galaxy clustering and weak lensing catalogues.

MicroCanonicalHMC.jl (2023)   Link to repository
Gradient based inference algorithm inspired by the dynamics of the microcanonical ensemble.

LimberJack.jl (2021-2023)   Link to repository
Fully differentiable `Julia` code to compute predictions of summary statistics of cosmological observables.

Cosmoteka (2020-2023)   Link to repository
Biggest repository of summary statistics combined in an statistically consistent way in Cosmology.

Selected Talks and Seminars

- <u>Kavli Institute of Cosmology</u> - Cambridge, November 2023   1 hour talk
- <u>Royal Observatory of Edinburgh</u> - Edinburgh, November 2023   30 mins talk
- <u>IAP</u> - Paris, November 2023   1 hour talk
- <u>EAS 2023</u> - Krakow, July 2023   15 mins talk
- <u>KIPAC cosmology seminar</u> - Stanford University, March 2023   1 hour talk
- <u>CNRS cosmology seminar</u> - CNRS, December 2022   1 hour joint talk
- <u>Portsmouth cosmology seminar</u> - University of Portsmouth (remote), May 2022   1 hour talk

Publications

1. García-García, C. *et al.* The growth of density perturbations in the last 10 billion years from tomographic large-scale structure data. **2021,** 030. arXiv: 2105.12108 [astro-ph.CO] (Oct. 2021).

2. Ruiz-Zapatero, J. *et al.* Geometry versus growth. Internal consistency of the flat ΛCDM model with KiDS-1000. **655,** A11. arXiv: 2105.09545 [astro-ph.CO] (Nov. 2021).

3. Ruiz-Zapatero, J. *et al.* Impact of the Universe's expansion rate on constraints on modified growth of structure. **106,** 083523. arXiv: 2207.09896 [astro-ph.CO] (Oct. 2022).

4. Ruiz-Zapatero, J. *et al.* Model-independent constraints on Ω_m and H(z) from the link between geometry and growth. **512,** 1967–1984. arXiv: 2201.07025 [astro-ph.CO] (May 2022).

5. Bonici, M., Bianchini, F. & Ruiz-Zapatero, J. Capse.jl: efficient and auto-differentiable CMB power spectra emulation. *arXiv e-prints,* arXiv:2307.14339. arXiv: 2307.14339 [astro-ph.CO] (July 2023).

6. Hadzhiyska, B. *et al.* Cosmology with 6 parameters in the Stage-IV era: efficient marginalisation over nuisance parameters. *The Open Journal of Astrophysics* **6,** 23. arXiv: 2301.11895 [astro-ph.CO] (July 2023).

7. Jego, B. *et al.* Constraining the physics of star formation from CIB-cosmic shear cross-correlations. **520,** 583–598. arXiv: 2209.05472 [astro-ph.CO] (Mar. 2023).

8. Jego, B. *et al.* The star-formation history in the last 10 billion years from CIB cross-correlations. **520,** 1895–1912. arXiv: 2206.15394 [astro-ph.GA] (Apr. 2023).

9. Ruiz-Zapatero, J. *et al.* LimberJack.jl: auto-differentiable methods for angular power spectra analyses. *arXiv e-prints,* arXiv:2310.08306. arXiv: 2310.08306 [astro-ph.CO] (Oct. 2023).

10. Ruiz-Zapatero, J. *et al.* Analytical marginalization over photometric redshift uncertainties in cosmic shear analyses. **522,** 5037–5048. arXiv: 2301.11978 [astro-ph.CO] (July 2023).

11. Mootoovaloo, A. *et al.* Assessment of gradient-based samplers in standard cosmological likelihoods. **534,** 1668–1681. arXiv: 2406.04725 [astro-ph.IM] (Nov. 2024).

12. Mootoovaloo, A. *et al.* EMUFLOW: normalizing flows for joint cosmological analysis. **536,** 190–202. arXiv: 2409.01407 [astro-ph.CO] (Jan. 2025).