CAROLINA CUESTA-LAZARO

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RESEARCH EXPERIENCE

New York University *2026 - Present*
Assistant Professor

Flatiron Institute *2025 - Present*
Associate Research Scientist

Institute for Advanced Studies *2025 - 2026*
Postdoctoral Member

MIT/Harvard University *2022 - 2025*
IAIFI Postdoctoral Fellow

Amazon *2020 - 2021*
Machine Learning Research

Ibex *2018*
Data Science Intern

EDUCATION

Durham University *2017 - 2022*
Ph.D., Astronomy & Astrophysics
Dissertation: *Mining for cosmological information: Simulation-based methods for galaxy clustering and redshift space distortions*
Advisors: Prof. Baojiu Li, Prof. Carlton Baugh

Heidelberg University *2015 - 2017*
M.Sc., Physics
Dissertation: *Second-order effects on gravitational lensing*
Advisors: Prof. Bjoern Malte Schaefer

Universidad Autonoma de Madrid *2011 - 2015*
B.Sc., Physics

AWARDS AND HONORS

Hubble fellowship *declined* *2025*

IAS long term membership (5 years) *2025*

Flatiron Research Fellow *2025*

Rising Stars in Physics *2024*

Spotlight talk at NeurIPS ML4PS *2024*

Winner team Ariel ML data challenge (exoplanet atmosphere retrieval) *2023*

Spotlight talk at ICML ML for Astro *2023*

Botton foundation fellowship *2023, 2024*

IAIFI Fellowship *2022*
NSF AI Institute for Artificial Intelligence and Fundamental Interactions

Oxford University Beecroft fellowship *declined* *2022*

CITA posdoctoral fellowship *declined* *2022*

Royal Society RAMP Early Career Investigator Awards *2021*
Recognizes early career researchers who have made exceptional contributions to the Rapid Assistance in Modelling the Pandemic (RAMP) initiative.

STEM for Britain finalist *2021*
Selected for the 2021's competition held in Parliament to showcase innovative scientific research to MPs

Durham Physics Department Awards for Excellence *2020*

Best Student Paper at SPIE *2019*
Medical Imaging: Biomedical Applications in Molecular, Structural, and Functional Imaging

TEACHING

Lecturer

NASA STIG Lecture Series *2026*
Introduction to Reinforcement Learning

Smith College *2026*
Machine Learning for Cosmology

Tonale Winter School *2025*
Machine Learning for Cosmology

MIT/Harvard Center for Astrophysics Summer Talks *2025*
Lecture and tutorials on Generative Modelling

Heidelberg Summer School *2025*
Lecture and tutorials on Generative Modelling for Science

A3Net Summer School *2025*
Lecture and tutorials on Generative Modelling for Science

University of Arizona *2025*
Lecture and tutorials on Generative Modelling for Science

Collaborative Graduate Education (CGE) course *2024*
Lecture on Machine learning and Simulation-based inference

IAIFI Summer School *2024*
Lecture on Simulation-based inference

Latam summer school *2023*
Lecture and tutorials on Generative Models

Latino Initiate Program (LPI), Center for Astrophysics *2023*
Lecture and tutorials on Machine learning with python

IAIFI Summer School *2023*
Tutorials on Generative Models

Tech Ethics undergraduate course, Princeton University *2023*
Lecture on pandemic modelling and ethics of care at Steven Kelt's Ethics undergraduate course

Instituto de Astrofisica de Canarias *2021*
Workshop on Graph Neural Networks

Physics Christmas Lecture at Durham University *2020*

Ibex *2018*
Developed 4 day workshop lectures and tutorials on machine learning

Teaching assistant

Planets and Cosmology 3rd year course *2019 - 2022*

Theoretical Physics 3rd year course *2018*

GRANTS AND FUNDING

Hartree centre *2020*
Granted 2 M Cpu/h proposal within the JUNE collaboration

Intel Research Award *2018*
Financial and computational support relating to the publication of papers in medical imaging

UKRI-STFC *2017*
Ph.D Studentship Full funding for doctoral program

Deutschland Stipendium (Funded by SAP) *2016*
The Deutschlandstipendium supports highly talented students in Germany.

SELECTED INVITED TALKS

[1] **SBI for galaxy formation, Cambridge** *2026*

[2] **Advancing Field Level Inference and SBI for Cosmology, Perimeter** *2026*

[3] **Max Planck-IAS-NTU Center Kick-off** *2026*

[4] **ESI Workshop Vienna: Theory Meets Numerics** *2025*

[5] **Sexten Center for Astrophysics** *2025*

[6] **TAP Lectureship, University of Arizona** *2025*

[7] **Northeastern, Physics Colloquium** *2025*

[8] **NYU, Seminar** *2025*

[9] **UW Madison, Seminar** *2025*

[10] **UT Austin, Seminar** *2025*

[11] **UT San Antonio, Seminar** *2025*

[12] **Biomedical and Astronomical Signal Processing (BASP) Frontiers** *2025*

[13] **NeurIPS Machine Learning for the physical sciences (spotlight talk)** *2024*

[14] **Cosmology Seminar, Princeton** *2024*

[15] **TriState, Center for Computational Astrophysics (Flatiron Institute)** *2024*

[16] **APEC seminar, University of Tokyo** *2024*

[17] **CD3 seminar, IPMU Tokyo** *2024*

[18] **Cosmology and astrophysics with simulations and ML, Flatirion Institute** *2024*

[19] **Deep Learning x Solar Physics, Oslo** *2024*

[20] **AI goes MAD at IFT, Universidad Autonoma de Madrid** *2024*

[21] **Rutgers HETC Seminar Series, Rutgers** *2024*

[22] **Stanford Cosmology seminar, Stanford** *2024*

[23] **Lawrence Berkeley National Laboratory Cosmology seminar, Berkeley** *2024*

[24] **CCAP Seminar, The Ohion State University** *2024*

[25] **AstroAI workshop, Harvard University** *2024*

[26] **DIPC seminar, San Sebastian** *2024*

[27] **Center for Theoretical Physics seminar, MIT** *2024*

[28] **Physics Colloquium, Boston University** *2024*

[29] **Data Science x Astronomy-Astrophyics Seminar, Yale** *2023*

[30] **ICML Astrophyiscs Workshop (spotlight talk)** *2023*

[31] **European Astronomy Society meeting, Krakow** *2023*

[32] **LMU Astrophysics Seminar, Ludwig Maximilian University of Munich** *2023*

[33] **Tri State seminar at CCA, Flatiron Institute** *2023*

[34] **Astro Seminar series, Waterloo** *2023*

[35] **Astrophysics and cosmology seminar, University of Pennsylvania** *2023*

[36] **ITC Seminar, Harvard University** *2022*

[37] **Astrophysics Seminar, UCL** *2022*

[38] **Cosmology Seminar, cosKASI** *2022*

[39] **Astro Seminar series, Waterloo** *2022*

[40] **Tea talk at KIPAC, Stanford** *2021*

[41] **United Nations Global Pulse workshop** *2021*

[42] **Cosmology Seminar, Edinburgh University** *2020*

[43] **IPMU Seminar, University of Tokyo** *2019*

[44] **Seninar, The Rutherford Appleton Laboratory** *2019*

SELECTED OUTREACH ACTIVITIES

SXSW (South by South West) *2024*
Revolutionizing Astrophysics with AI

HerWILL *2024*
Generative AI workshop for women in data science

Cambridge Science Festival *2023*
Lunch & Learn: Ethics in AI and Art

Cambridge Science Festival *2022*

Space Camp school events at local primary schools in Durham *2019, 2022*
Co-developed and lead several space camp day events

How to build an epidemics simulation *2021*
Series at talks at local schools on mathematical modelling

AstroCuenca *2019*
Invited talk at an association of amateur astronomers

Space & Languages Challenge at local high schools in Durham *2019*
Participated in outreach events relating astronomy and languages

Changing cosmic perceptions Art project at Durham University *2019*
Led a workshop aimed at primary school children

STEMettes hack days at Durham University *2019*
Participated in a series of hack days to promote science amongst young girls

Mentor for NUSTEM at Northumbria University *2018*
Participated in networking activities to encourage young female students to study physics

SERVICE

SOC member for the ML4Astro workshop co-located with ICML *2025*

SOC member for the CAMELS workshop *2024*

Lead topical group at the Dark Energy Spectroscopic Instrument *2023 - Present*
Alternative Clustering Methods

Organizer of the Freedom Trail of Code *2023*
3 day hackathon on AI x Astro in the Boston area

Member of the Early Career and Equity committee at IAIFI *2023 - Present*

Member of the Industry Partnership committee at IAIFI *2023 - Present*

NSF GFRP reviewer *2022*

Workshop reviewer at ICML and NeurIPS *2022 - Present*

Co-organizer of the Postdoc application day at Durham University *2022*

Referee for JCAP, MNRAS and New Astronomy *2021 - Present*

Student Journal Club organizer at Durham University *2020-2021*

SOC member at the STFC Data Intensive Science Summer School *2021*

Machine Learning Journal Club organizer at Durham University *2017-2019*

PUBLICATIONS

First Author or Advisee-led Peer-reviewed Articles

[1] Wiemann, M., Smith, L., Melchior, P., Mishra-Sharma, S., Gordon Wilson, A., Izmailov, P., Cuesta-Lazaro, C. "DiscoverPhysics: Benchmarking LLMs for Out-of-the-Box Scientific Thinking" Submitted (2026) [arXiv:2605.26087]

[2] Mercader-Perez, P., Cuesta-Lazaro, C., Muthukrishna, D., Audenaert, J., Villar, V.A., Hogg, D.W., Huertas-Company, M., Freeman, W.T. "Learning What's Real: Disentangling Signal and Measurement Artifacts in Multi-Sensor Data, with Applications to Astrophysics" ICLR Workshop on Foundation Models for Science (2026) [arXiv:2604.09787]

[3] Vidal, E.P., Gagliano, A.T., Cuesta-Lazaro, C. "Hierarchical Simulation-Based Inference of Supernova Power Sources and their Physical Properties" Submitted (2025) [arXiv:2510.14202]

[4] Liu, M.-S., Cuesta-Lazaro, C. "Continuous Representations of Baryonic Feedback for Robust Inference from Multiple Simulation Suites" NeurIPS Machine Learning and the Physical Sciences Workshop (2025).

[5] Mudur, N., Cuesta-Lazaro, C., Toomey, M., Finkbeiner, D., "An LLM-driven framework for cosmological model-building and exploration" COLM LM4Sci (2025).

[6] Akhmetzhanova, A., Cuesta-Lazaro, C., Mishra-Sharma, S., "Detecting Model Misspecification in Cosmology with Scale-Dependent Normalizing Flows" Machine Learning: Science and Technology 6(4) and ML4Astro Workshop (spotlight talk) (2025) [arXiv:2508.05744].

[7] Kannan, S., Qiu, T., Cuesta-Lazaro, C., Jeong, H., "CosmoFlow: Scale-Aware Representation Learning for Cosmology with Flow Matching" ML4Astro Workshop (2025) [arXiv:2507.11842].

[8] Cuesta-Lazaro, C. et al. "Joint cosmological parameter inference and initial condition reconstruction with Stochastic Interpolants" NeurIPS ML for the Physical Sciences (2024).

[9] Park, C.F, Mudur, N., Cuesta-Lazaro, C., et al. "3D Reconstruction of Dark Matter Fields with Diffusion Models: Towards Application to Galaxy Surveys" ICML AI4Science (2024).

[10] Balla, J., Mishra-Sharma, S., Cuesta-Lazaro, C., Jaakkola, T., Smidt, T., "A Cosmological Benchmark for Symmetry-Preserving Data Processing" NeurReps (2024). [arXiv:2410.20516]

[11] Cuesta-Lazaro, C., Mishra-Sharma, S., "Point cloud approach to generative modeling for galaxy surveys at the field level" ICML ML4Astro (Spotlight talk) and Physical Review D 109 (12) (2024). [arXiv:2311.17141]

[12] Cuesta-Lazaro, C., et al. "SUNBIRD: A simulation-based model for full-shape density-split clustering" Monthly Notices of the Royal Astronomical Society 531 (3), 3336-3356 (2024). [arXiv:2309.16539]

[13] Mudur, N., Cuesta-Lazaro, C., Finkbeiner, D. "Diffusion-HMC: Parameter Inference with Diffusion Model driven Hamiltonian Monte Carlo" NeurIPS Machine learning in the physical sciences (2024) [arXiv:2405.05255]

[14] Ono, V. et al (including Cuesta-Lazaro, C.). "Debiasing with Diffusion: Probabilistic reconstruction of Dark Matter fields from galaxies with CAMELS" The Astrophysical Journal, Volume 970, Number 2 (2024) [arXiv:2403.10648]

[15] Park, C.F. et al (including Cuesta-Lazaro, C.). "Probabilistic reconstruction of Dark Matter fields from biased tracers using diffusion models" NeurIPS Machine learning in the physical sciences (2023). [arXiv:2311.08558]

[16] Aubin, M., Cuesta-Lazaro, C. et al. "Simulation-based Inference for Exoplanet Atmospheric Retrieval: Insights from winning the Ariel Data Challenge 2023 using Normalizing Flows" ECML PKDD (2023). [arXiv:2309.09337]

[17] Cuesta-Lazaro, C. et al. "Galaxy clustering from the bottom up: a streaming model emulator I" Monthly Notices of the Royal Astronomical Society 523 (3), 3219-3238 (2023) [arXiv:2208.05218]

[18] Paillas, E. Cuesta-Lazaro, C., et al. "Constraining $\nu\Lambda$CDM with density-split clustering" Monthly Notices of the Royal Astronomical Society (2023) [arXiv:2209.04310]

[19] Cuesta-Lazaro et al. "What does the sea say to the shore? A BERT based DST style approach for speaker to dialogue attribution in novels" Association for Computational Linguistics (ACL) (2022)

[20] Aylett-Bullock, J., Cuesta-Lazaro, C. (co-first author) et al. "June: open-source individual-based epidemiology simulation" Royal Society open science (2021) 8/7

[21] Cuesta-Lazaro, C., et al. "Towards a non-Gaussian model of redshift space distortions" Monthly Notices of the Royal Astronomical Society, 498/1 (2020) [arXiv:2002.02683]

[22] Bullock, J., Cuesta-Lazaro, C. (co-first author) et al. "XNet: A convolutional neural network (CNN) implementation for medical X-ray image segmentation suitable for small datasets" SPIE, Medical Imaging: Biomedical Applications in Molecular, Structural, and Functional Imaging (2019)

[23] Cuesta-Lazaro, C. et al. "Gravitational corrections to light propagation in a perturbed FLRW universe and corresponding weak-lensing spectra" Monthly Notices of the Royal Astronomical Society 477/1 (2018) [arXiv:1801.03325]

Significant contribution

[1] Ting, Y.-S., Wadekar, D., et al (including Cuesta-Lazaro, C.) "Deep Learning for Astrophysics: An Open Textbook from the NASA Cosmic Origins AI/ML Science and Technology Interest Group" (2026) [arXiv:2606.30855]

[2] Pinciroli Vago, N.O., Di Tella, R., Cuesta-Lazaro, C., Smith, M.J., Garraffo, C., Martinez-Galarza, R. "Augmenting representations with scientific papers" Submitted (2026) [arXiv:2603.04516]

[3] Horowitz, B., Cuesta-Lazaro, C., Yehia, O. "BaryonBridge: Stochastic Interpolant Model for Fast Hydrodynamical Simulations" ML4Astro 2025 Workshop at ICML (2025) [arXiv:2510.19224]

[4] Sullivan, J., Cuesta-Lazaro, C., et al "High-redshift Millennium and Astrid galaxies in effective field theory at the field level" Submitted to MNRAS (2025) [arXiv:2505.03626]

[5] Martinez-Galarza, R. et al (including Cuesta-Lazaro, C.) "Augmenting X-Ray Astronomical Representations with Scientific Knowledge through Contrastive Learning" ICLR Re-Align Workshop (2025)

[6] Pinon, M. et al (including Cuesta-Lazaro, C.) "A theoretical approach to density-split clustering" JCAP (2025) [arXiv:2501.14638]

[7] Liu, W., Paillas, E., Cuesta-Lazaro, C. et al."Cosmological constraints from the Minkowski functionals of the BOSS CMASS galaxy sample" Submitted to JCAP (2025) [arXiv:2501.01698]

[8] Ivanov, M., Cuesta-Lazaro, C. et al."The Millennium and Astrid galaxies in effective field theory: comparison with galaxy-halo connection models at the field level" Submitted to ApJ (2024) [arXiv:2412.01888]

[9] Ivanov, M., Obuljen, A., Cuesta-Lazaro, C., Toomey, M., "Full-shape analysis with simulation-based priors: cosmological parameters and the structure growth anomaly" Submitted to ApJ (2024) [arXiv:2409.10609]

[10] Nguyen, T., Villaescusa-Navarro, F., Mishra-Sharma, S., Cuesta-Lazaro, C., et al "How DREAMS are made: Emulating Satellite Galaxy and Subhalo Populations with Diffusion Models and Point Clouds" Submitted to ApJ (2024) [arXiv:2409.02980]

[11] Craigie, M., Taylor, P. L., Ting, Y. S., Cuesta-Lazaro, C., et al. "Unsupervised Searches for Cosmological Parity Violation: Improving Detection Power with the Neural Field Scattering Transform" Submitted to ApJ (2024) [arXiv:2405.13083]

[12] Krause, E. et al (including Cuesta-Lazaro, C.). "A Parameter-Masked Mock Data Challenge for Beyond-Two-Point Galaxy Clustering Statistics" The Astrophysics Journal (2024) [arXiv:2405.02252]

[13] Ivanov, M., Cuesta-Lazaro, C. et al. "Full-shape analysis with simulation-based priors: constraints on single field inflation from BOSS" Phys.Rev.D 110 (2024) [arXiv:2402.13310]

[14] Ho, M. et al (including Cuesta-Lazaro, C.). "LtU-ILI: An All-in-One Framework for Implicit Inference in Astrophysics and Cosmology" Open Journal of Astrophysics (2024) [arXiv:2402.05137]

[15] Paillas, E., Cuesta-Lazaro, C. et al. "Cosmological constraints from density-split clustering in the BOSS CMASS galaxy sample" Monthly Notices of the Royal Astronomical Society (2023) [arXiv:2309.16541]

[16] Payot, N. et al (including Cuesta-Lazaro, C.). "Learning an Effective Evolution Equation for Particle-Mesh Simulations Across Cosmologies" NeurIPS Machine learning in the physical sciences (2023) [arXiv:2311.18017]

[17] Ruan, C., Cuesta-Lazaro, C. et al. "An emulator-based halo model in modified gravity–I. The halo concentration-mass relation and density profile" Monthly Notices of the Royal Astronomical Society (2023) [arXiv:2301.02970]

[18] Harnois-Deraps et al (including Cuesta-Lazaro, C.). "MGLENS: Modified gravity weak lensing simulations for emulation-based cosmological inference" Monthly Notices of the Royal Astronomical Society (2023) 525/4 [arXiv:2211.05779]

[19] Hou, J., et al (including Cuesta-Lazaro, C.). "Cosmological Probes of Structure Growth and Tests of Gravity" Universe 9/7 (2023) [arXiv:2306.13726]

[20] Ruan, C., Cuesta-Lazaro, C. et al. "Towards an accurate model of small-scale redshift-space distortions in modified gravity" Monthly Notices of the Royal Astronomical Society 514/1 (2022) [arXiv:2110.10033]

[21] Bullock, J. et al (including Cuesta-Lazaro, C.). "Epidemiological modelling in refugee and displaced populations settlements: challenges and ways forward" BMJ Global Health (2022) 7/e007822

[22] Vernon, I. et al (including Cuesta-Lazaro, C.). "Bayesian emulation and history matching of JUNE" Philosophical transactions of the Royal Society (2022)

[23] Bullock, J., Cuesta-Lazaro, C. et al. "Operational response simulation tool for epidemics within refugee and IDP settlements" PLoS Comput Biology (2021)

Other Peer-reviewed Articles

[1] Gondhalekar, Y., Bose, S., Li, B., Cuesta-Lazaro, C. "Emulation of $f(R)$ modified gravity from ΛCDM using conditional GANs" Monthly Notices of the Royal Astronomical Society 536 (2), 1408-1427 (2025) [arXiv:2407.15934]

[2] Quera-Bofarull, A., et al (including Cuesta-Lazaro, C.). "Don't Simulate Twice: One-Shot Sensitivity Analyses via Automatic Differentiation" Proceedings of the 2023 International Conference on Autonomous Agents and Multiagent Systems 1867/1876 (2023)

[3] Shadab, A. et al (including Cuesta-Lazaro, C.). "Towards testing the theory of gravity with DESI: summary statistics, model predictions and future simulation requirements" Journal of Cosmology and Astroparticle Physics (2021) 2021/11

Non-refereed

Cuesta-Lazaro, C., et al. "Vaccinations or non-pharmaceutical interventions: Safe reopening of schools in england" medRxiv 2021.09.07.21263223 (2021)

Cuesta-Lazaro, C. "Mining for cosmological information: Simulation-based methods for Redshift Space Distortions and Galaxy Clustering." PhD Thesis. Durham University (2022)

SOFTWARE

Cuesta-Lazaro, C., Paillas, E. florpi/SUNBIRD *2023*

Quera-Bofarull, A., Cuesta-Lazaro, C. et al. IDAS-Durham/JUNE: JUNE 1.1.1. Zenodo *2021*

Bullock, J., Cuesta-Lazaro, C. et al. UNGlobalPulse/UNGP-settlement-modelling *2021*

Bullock, J., Cuesta-Lazaro, C. et al. X-Net *2019*