Jaime Ernesto FORERO ROMERO, PhD

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Summary

As a researcher, my objective is to use astronomical observations, fundamental physics theories, and artificial intelligence to enhance our comprehension of the universe. In particular, I use large data sets from simulations and observations to better understand the nature of dark energy and dark matter.

Work Experience

Associate Professor (with tenure) August 2015 - present

Physics Department, Universidad de los Andes, Bogotá, Colombia

Assistant Professor August 2012 - July 2015

Physics Department, Universidad de los Andes, Bogotá, Colombia

Gruber Fellow September 2011 - July 2012

Astronomy Department, UC Berkeley, Berkeley, CA, USA

Postdoctoral Fellow September 2007 - August 2011

Leibniz Institute for Astrophysics Potsdam (AIP), Potsdam, Germany

Education

2005-2007	PhD in Physics at the École Normale Supérieure de Lyon, France
2003-2005	MSc in Physics (Magistère Interuniversitaire) at the École Normale Supérieure, Paris, France
2001-2003	Undergratuate Physics Studies (second and fourth year) at Instituto Balseiro, Bariloche, Argentina
1999-2001	Undergratuate Physics Studies (first and second year) at Universidad Nacional de Colombia, Bogotá, Colombia)

Teaching and Mentoring

Teaching since 2012:	I have taught several courses to undergraduate engineering majors, physics majors, and science majors at Universidad de los Andes. Specifically, I have taught ≈2000 undergraduate engineering majors courses on basic mechanics and electromagnetism, ≈500 undergraduate physics majors courses on basic computational methods, ≈200 undergraduate science majors courses on basic astronomy, and ≈100 physics graduate students advanced courses on computational physics, machine learning and artificial intelligence.
Mentoring since 2012:	Advised 18 undergraduate senior thesis, 3 Masters thesis, 1 PhD thesis, 3 postdoctoral researchers.

Scientific Collaborations

2014-present Member (Builder) of the Dark Energy Spectroscopic Instrument (DESI), a next-generation sky survey that is creating the largest 3D map of the universe. DESI is an international science collaboration managed by Lawrence Berkeley National Laboratory (Berkeley Lab) with primary funding for construction and operations from the U.S. Department of Energy (DOE) Office of Science.

2017-2022 Colombian Coordinator for the Latinamerican Chinese European Galaxy Formation Network (LACEGAL), an European Union's Horizon 2020 Research and Innovation program that aimed at addressing key questions in galaxy formation and the large-scale structure of the Universe with the goal of producing the multi-wavelength theoretical models needed to meet the challenge posed by observations.

Scientific Milestones

2020-present **Automation of Quality Assurance (QA) tasks**. Developed automation of QA tasks (geared towards DESI's spectroscopic reduction pipeline) through unsupervised machine learning. We used the Uniform Manifold Approximation and Projection (UMAP) to project DESI nightly data into a 2-dimensional space. In this space we are able to find a small number of outliers that correspond to instrument fluctuations that trigger visual inspection procedures of the raw data, allowing the development of an appropriate solution through data reprocessing. https://zenodo.org/record/6554524

2019-present **Deep Learning Applications.** Developed deep learning techniques for applications in cosmology, large scale structure studies and transient detection. https://doi.org/10.1007/s11433-020-1586-3,https://doi.org/10.3847/1538-4357/abf3bb,https://doi.org/10.1093/mnras/staa2973.

2014-present **Dark Energy Spectroscopic Instrument (DESI)**. Contributed to the design and operations of DESI by developing software tools in Python for fiber assignment, target selection, and quality assurance tasks. My builder status in the collaboration recognizes these contributions. Our software stack can be found at https://github.com/desihub

2012-present **Research Group Leader**. As a tenured professor at Los Andes University (Colombia), I lead a computational cosmology group that utilizes machine learning and deep learning techniques to analyze large galaxy surveys and simulations to extract and interpret cosmological information. Some of our projects can be found at https://github.com/astroandes.

2009-present **Cosmic Web Classification**. Introduced a popular classification method for the cosmic web, categorizing each spatial point as one of four possible web types: voids, sheets, filaments, and knots. This categorization relies on evaluating the Hessian of the gravitational potential. The method is widely used in simulations and observations. https://doi.org/10.1111/j.1365-2966.2009.14885.x.

Leadership

2015-2020	Founder and coordinator of the Andean Regional Office of Astronomy for Development, sponsored by the International Astronomical Union (IAU).
2016	Co-organizer of the XV Latin American IAU Regional Assembly, making it the first international meeting of that kind in Colombia.
2013 / 2015	Main organizer of the First and Second Workshop *Astronomía en los Andes*, which were held to convene astronomers in the Andean region.

Bibliometrics

According to the SAO/NASA Astrophysics Data System (ADS), I have co-authored 62 refereed publications since my first publication in 2007. These papers gather 1791 citations in total, with an H-index of 21. My most cited first author publication (*A dynamical classification of the cosmic web*) has 223 citations. According to Google Scholar the papers I have co-authored gather 2865 citations in total, with an H-index of 24.

Refereed Publications

[1] Andrew P. Cooper et al. "Overview of the DESI Milky Way Survey". In: 947.1, 37 (Apr. 2023), p. 37. DOI: 10.3847/1538-4357/acb3c0. arXiv: 2208.08514 [astro-ph.GA].

[2] Elise Darragh-Ford et al. "Target Selection and Sample Characterization for the DESI LOW-Z Secondary Target Program". In: 954.2, 149 (Sept. 2023), p. 149. DOI: 10.3847/1538-4357/ace902. arXiv: 2212.07433 [astro-ph.GA].

[3] V. A. Fawcett et al. "A striking relationship between dust extinction and radio detection in DESI QSOs: evidence for a dusty blow-out phase in red QSOs". In: 525.4 (Nov. 2023), pp. 5575–5596. DOI: 10.1093/mnras/stad2603. arXiv: 2308.14790 [astro-ph.GA].

[4] Hongyu Gao et al. "The DESI One-Percent Survey: Constructing Galaxy-Halo Connections for ELGs and LRGs Using Auto and Cross Correlations". In: 954.2, 207 (Sept. 2023), p. 207. DOI: 10.3847/1538-4357/ace90a. arXiv: 2306.06317 [astro-ph.GA].

[5] Luz Ángela Garcıa et al. "Analysis of the impact of broad absorption lines on quasar redshift measurements with synthetic observations". In: (Oct. 2023). DOI: 10.1093/mnras/stad2993. arXiv: 2304.05855 [astro-ph.CO].

[6] J. Guy et al. "The Spectroscopic Data Processing Pipeline for the Dark Energy Spectroscopic Instrument". In: 165.4, 144 (Apr. 2023), p. 144. DOI: 10.3847/1538-3881/acb212. arXiv: 2209.14482 [astro-ph.IM].

[7] Boryana Hadzhiyska et al. "Planting a Lyman alpha forest on ABACUSSUMMIT". In: 524.1 (Sept. 2023), pp. 1008–1024. DOI: 10.1093/mnras/stad1920. arXiv: 2305.08899 [astro-ph.CO].

[8] Boryana Hadzhiyska et al. "Synthetic light-cone catalogues of modern redshift and weak lensing surveys waith ABACUSSUMMIT". In: 525.3 (Nov. 2023), pp. 4367–4387. DOI: 10.1093/mnras/stad2563. arXiv: 2305.11935 [astro-ph.CO].

[9] ChangHoon Hahn et al. "The DESI Bright Galaxy Survey: Final Target Selection, Design, and Validation". In: 165.6, 253 (June 2023), p. 253. DOI: 10.3847/1538-3881/accff8. arXiv: 2208.08512 [astro-ph.CO].

[10] S. Kent et al. "Astrometric Calibration and Performance of the Dark Energy Spectroscopic Instrument Focal Plane". In: 166.4, 177 (Oct. 2023), p. 177. DOI: 10.3847/1538-3881/acf7c3. arXiv: 2307.06238 [astro-ph.IM].

[11] Jeongin Moon et al. "First detection of the BAO signal from early DESI data". In: 525.4 (Nov. 2023), pp. 5406–5422. DOI: 10.1093/mnras/stad2618. arXiv: 2304.08427 [astro-ph.CO].

[12] Adam D. Myers et al. "The Target-selection Pipeline for the Dark Energy Spectroscopic Instrument". In: 165.2, 50 (Feb. 2023), p. 50. DOI: 10.3847/1538-3881/aca5f9. arXiv: 2208.08518 [astro-ph.IM].

[13] Michael Rashkovetskyi et al. "Validation of semi-analytical, semi-empirical covariance matrices for two-point correlation function for early DESI data". In: 524.3 (Sept. 2023), pp. 3894–3911. DOI: 10.1093/mnras/stad2078. arXiv: 2306.06320 [astro-ph.CO].

[14] Corentin Ravoux et al. "The Dark Energy Spectroscopic Instrument: One-dimensional power spectrum from first Lyman-α forest samples with Fast Fourier Transform". In: (Oct. 2023). DOI: 10.1093/mnras/stad3008. arXiv: 2306.06311 [astro-ph.CO].

[15] Antoine Rocher et al. "The DESI One-Percent survey: exploring the Halo Occupation Distribution of Emission Line Galaxies with ABACUSSUMMIT simulations". In: 2023.10, 016 (Oct. 2023), p. 016. DOI: 10.1088/1475-7516/2023/10/016. arXiv: 2306.06319 [astro-ph.CO].

[16] Christoph Saulder et al. "Target selection for the DESI Peculiar Velocity Survey". In: 525.1 (Oct. 2023), pp. 1106–1125. DOI: 10.1093/mnras/stad2200. arXiv: 2302.13760 [astro-ph.CO].

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[26] ShuYang Pan et al. "Cosmological parameter estimation from large-scale structure deep learning". In: *Science China Physics, Mechanics, and Astronomy* 63.11, 110412 (Sept. 2020), p. 110412. DOI: 10.1007/s11433-020-1586-3. arXiv: 1908.10590 [astro-ph.CO].

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