Miguel A. Sabogal García

Contact Information

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My research explores new physics beyond the ΛCDM model, investigating its potential to address current cosmological and astrophysical tensions, particularly those related to the H0 and S8 parameters. I focus on understanding how alternative models of Dark Energy (DE) and other cosmological phenomena may influence cosmic structure formation. This research is complemented by the development of advanced computational models and the application of cutting-edge techniques, such as Monte Python (Monte Carlo Markov Chain code in Python), CLASS (the Cosmic Linear Anisotropy Solving System), and Gaussian processes (Machine Learning), to probe the underlying physics of the cosmos.

Research Experience, Publications, and Projects

Submitted Publications

- Giarè, W., **Sabogal, M. A.**, Nunes, R. C., & Di Valentino, E. (2024b). *Interacting Dark Energy after DESI Baryon Acoustic Oscillation measurements*. arXiv:2404.15232. Accepted for publication in: *Physical Review Letters*.

- **Sabogal, M. A**., Silva, E., Nunes, R. C., Kumar, S., Di Valentino, E., & Giarè, W. (2024c). *Quantifying S8 tension and evidence for interacting dark energy from redshift-space distortion measurements*. arXiv:2408.12403. Accepted for publication in: *Physical Review D*.

Peer-Reviewed Publications

- **Sabogal, M. A**., Akarsu, Ö., Bonilla, A., Di Valentino, E., & Nunes, R. C. (2024a). *Exploring new physics in the late Universe's expansion through non-parametric inference*. **The European Physical Journal C**, 84(7), 703. DOI: 10.1140/epjc/s10052-024-13081-1 arXiv:2407.04223.

- Cardona, W., & **Sabogal, M. A.** *Holographic energy density, dark energy sound speed, and tensions in cosmological parameters: H0 and S8*. **Journal of Cosmology and Astroparticle Physics**, 2023(02), 045. DOI 10.1088/1475-7516/2023/02/045 arXiv:2210.13335.

- Oliveros, A., **Sabogal, M. A.,** & Acero, M. A. *Barrow holographic dark energy with Granda–Oliveros cutoff*. **The European Physical Journal Plus** 137, 783 (2022). DOI: 10.1140/epjp/s13360-022-02994-z.

Science outreach publications

- **Sabogal, M. A.** *Estimación de la constante de Hubble a partir de señales de las oscilaciones acústicas bariónicas con datos simulados del LSST* (2023). **Astrobitos en español** (Spanish version of Astrobites.org). Link to the article.

Education

Expected 2025 | **Master's in Physics (Astrophysics Focus)**, Universidade Federal do Rio Grande do Sul (UFRGS), Brazil.

- Thesis: *Probing new physics beyond the ΛCDM in light of current some cosmological and astrophysical tensions*. **Advisor**: Rafael C. Nunes.

Summer 2023 | **Perimeter-SAIFR-IFT Journeys into Theoretical Physics**, IFT/ICTP-SAIFR , São Paulo, Brazil.

- Participated in the most competitive summer school in Latin America on theoretical physics.

Winter 2022 | **Bachelor's Degree in Physics**, Universidad del Atlántico, Barranquilla, Colombia.

- Thesis: *Cosmological analysis of the Barrow Holographic Dark Energy using the Infrared Granda-Oliveros cutoff.* **Advisors**: Alexander Oliveros & Mario A. Acero.

Professional experience

Summer 2022 | **Research intern**, *Red de Estudiantes de Astronomía de Colombia & LSST Observatory.*

- *Designed and developed specialized software in Python for cosmological data analysis.*
- *Conducted statistical analyses using MCMC and machine learning techniques to interpret and model cosmological datasets.*

Advisor: Javier González Sánchez.

Media & Interviews

Interview in **The New Scientist** – *"Invisible 'dark radiation' may explain a big problem with dark energy"*

- Interviewed by **Leah Crane** about the article "*Interacting Dark Energy after DESI Baryon Acoustic Oscillation measurements*" (submitted to *Physical Review Letters*), *The New Scientist*, May 9, 2024.

Official article link: The New Scientist - Interview

Personal repository: My Repository - Interview

Honors and Awards

- *Funding award* ***"****Virtual Internship in Rubin/LSST Science to Provide Research Experience to Undergraduate Students in Colombian Institutions****"****,* 1 of 5 students granted by the *Legacy Survey of Space and Time observatory.*
- ***Undergraduate Honors Thesis***, Universidad del Atlántico, awarded for outstanding research in Physics.

Computational skills

Specialized software ***Monte Python*** *(Monte Carlo Markov Chain code in Python),* ***Cosmic Linear Anisotropy Solving System (CLASS),*** and ***Gaussian processes (GaPP):*** *Advanced*

Programming Languages: Python (Advanced), C/C++ (Intermediate), Fortran 90 (Intermediate), MATLAB/Mathematica/Excel (Advanced), HTML (Basic)

Techniques: Machine Learning, Process Automation, Statistical analysis (MCMC), Object-oriented programming.

Additional languages

English (TOEFL Certified) – Advanced Proficiency (**C1**: Reading, Listening; **B2**: Speaking, Writing) | November 2022

Portuguese – Elementary Proficiency (**A2**: All Skills)

Spanish (Native)

Courses and certifications

PYTHON IN ASTRONOMY Astropy Course(2022)

Conferences and Talks

Event: *XIV Latin American Symposium on High Energy Physics*

Type of event: *International Congress*

Type of participation: *Speaker*

Conference title: *Decoding Holographic Dark Energy in the structure formation*.

Place: *QUITO, ECUADOR - Universidad San Francisco de Quito, 14/11/2022 – 18/11/2022.*

Event: *CoCo 2021: Cosmology in Colombia*

Type of event: *National Congress*

Type of participation: *Speaker*

Conference title: *Cosmological analysis of Barrow holographic dark energy model considering the Granda-Oliveros infrared cutoff*.

Place: *Online, 08/09/2021 – 11/09/2021.*