Miguel A. Sabogal García

Contact Information

Email: miguel.sabogal@ufrgs.br | **Phone:** + 55 51982044107 | **Website:** msabogal.github.io | **Updated to:** October 16, 2025

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

Overview & Metrics: 10 works, h-index = 8 (INSPIRE). Full list of citations on INSPIRE. Published in Physical Review Letters(1), Physical Review D (4), JCAP (2), EPJC (1), EPJ Plus (1), Physics of the Dark Universe (1).

Peer-Reviewed Publications

- **Sabogal, M. A**., & Nunes, R. C. *Robust Evidence for Dynamical Dark Energy from DESI Galaxy-CMB Lensing Cross-Correlation and Geometric Probes*. **JCAP,** 09 084 (2025) DOI: 10.1088/1475-7516/2025/09/084 arXiv:2505.24465.

- Souza, M. S., **Sabogal, M. A**., Nunes, R. C. & De Felice, A. *Challenging ΛCDM: 5σ Evidence for a Dynamical Dark Energy Late-Time Transition*. **Phys. Rev. D** 112, 043513 (2025) DOI: 10.1103/n86r-sjgm arXiv:2503.23225.

- Di Valentino, E., Said, J. L., Riess, A., et al. including **Sabogal, M. A**. *The CosmoVerse White Paper: Addressing observational tensions in cosmology with systematics and fundamental physics*. **Physics of the Dark Universe**, 101965 (2025) DOI:10.1016/j.dark.2025.101965 arXiv:2504.01669.

- Silva, E., **Sabogal, M. A**., Souza, M. S., Nunes, R. C., Di Valentino, E. & Kumar, S. *New Constraints on Interacting Dark Energy from DESI DR2 BAO Observations*. **Phys. Rev. D** 111, 123511 (2025) https://link.aps.org/doi/10.1103/qqc6-76z4 arXiv:2503.23225.

- **Sabogal, M. A**., Silva, E., Nunes, R. C., Kumar, S. & Di Valentino, E. *Sign switching in dark sector coupling interactions as a candidate for resolving cosmological tensions*. **Phys. Rev. D** 111, 043531 (2025) DOI: 10.1103/PhysRevD.111.043531 arXiv:2501.10323.

- Giarè, W., **Sabogal, M. A.**, Nunes, R. C., & Di Valentino, E. *Interacting Dark Energy after DESI Baryon Acoustic Oscillation measurements*. **Phys. Rev. Lett.** 133, 251003 (2024) DOI: 10.1103/PhysRevLett.133.251003 arXiv:2404.15232.

- **Sabogal, M. A**., Silva, E., Nunes, R. C., Kumar, S., Di Valentino, E., & Giarè, W. *Quantifying S8 tension and evidence for interacting dark energy from redshift-space distortion measurements*. **Phys. Rev. D** 110, 123508 (2024) DOI: 10.1103/PhysRevD.110.123508 arXiv:2408.12403.

- **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 2028 | **Ph.D. in Physics**, Università degli Studi di Trento, Italy.

- Thesis *To be determined*.
  Advisor: Sunny Vagnozzi.

Fall 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 2025 | **"Exploring the Universe with JWST" Vatican Observatory Summer School 2025,** Vatican City.

- Selected as one of only 25 students worldwide for this prestigious program, which offers advanced training in astrophysics and hands-on research with the James Webb Space Telescope.

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 and Academic service

Fall 2025 | **Visiting Researcher**, Observatorio Nacional (ON), Rio de Janeiro, Brazil.

- Conducted research in collaboration with Armando Bernui, focusing on 2D BAO analyses and cosmological data interpretation.

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.

2025 - present | **Referee** for scientific Journals (but not limited to): MNRAS, Physics of the Dark Universe.

Media & Interviews

Overview: 3 interviews, 2 research coverage, 1 academic spotlight. Full list on personal website.

Interview in *Astronomy* – *"Why some astronomers are starting to doubt cosmology's standard model"* by Daniela Mata about the article "*Sign switching in dark sector coupling interactions as a candidate for resolving cosmological tensions*", May 12.

- Official article link: Astronomy - Interview

Research Coverage handled by the Sheffield University – *"Dark matter and dark energy: A cosmic handshake?",* February 19, 2025.

- Official article link: Sheffiled - Press Release

Interview in *Sociedade Brasileira de Física* – *"Interação no setor escuro pode resolver enigma na taxa de expansão do universo"* by Roger Marzochi featuring arXiv:2404.15232, January 30, 2025.

- Official article link: SBF - Interview

Interview in *The New Scientist* – *"Invisible 'dark radiation' may explain a big problem with dark energy"* by Leah Crane about the article "*Interacting Dark Energy after DESI Baryon Acoustic Oscillation measurements*", May 9, 2024.

- Official article link: The New Scientist - Interview
- Personal repository: My Repository - Interview

Research Coverage in *Astrobites* – *"So, how's it going with the Hubble tension?" by Katherine Lee* featured article on "Interacting Dark Energy after DESI Baryon Acoustic Oscillation Measurements", January 18, 2025.

- Official article link: Astrobite - Article

Academic Spotlight in Universidad del Atlántico's official news portal — about "Nuevamente estudiante de Física de Uniatlántico pasante de Investigación en programa internacional?", July 14, 2022.

- Official article link: Institutional Recognition

Honors and Awards

- **UniTrento Scholarship, Italy**. Fully funded postgraduate scholarship awarded for academic excellence and potential in research.
- **CAPES Scholarship, Brazil**. Fully funded postgraduate scholarship awarded for academic excellence and potential in research.
- ***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 *LSST (Legacy Survey of Space and Time observatory).*
- ***Undergraduate Honors Thesis***, Universidad del Atlántico, awarded for outstanding research in Physics.

Computational skills

Specialized software ***MontePython*** *(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) – C1
TOEFL iBT: 96/120 (equivalent to IELTS score of 7.0) | March 2025

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.*