Jose M. **Munoz Arias**

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Education

2023 – Present **Ph.D. Physics, Massachusetts Institute of Technology**
Laboratory of Exotic Molecules and Atoms (EMA). Advisor: Ronald F. Garcia Ruiz.
Research: Connecting nuclear theory and experiment through physics-driven emulation *and precision laser spectroscopy of radioactive species at FRIB.*

2019 – 2023 **B.S. Physics with Honors**, EIA University, Colombia GPA: 4.9/5.0

Research Experience

Graduate Research, MIT — Lab. of Exotic Molecules and Atoms 2023 – Present

- Developed BANNANE / FRAME, a multi-fidelity Bayesian emulator for ab initio nuclear structure (VS-IMSRG), enabling global predictions of energies, R_{ch}, μ, and Q moments across isotopic chains with full UQ. [*Phys. Rev. Lett.* **136**, 082501 (2026)]
- Bayesian calibration and Shapley sensitivity analysis of chiral EFT LECs across multiple chains, quantifying the impact of individual couplings on nuclear observables.
- Developed Bayesian optimization tools for guiding experimental search and measurement campaigns.
- Development of alternative many-body methods using tensorial network approaches.
- Applied symbolic ML to discover interpretable nuclear models from data. [*Commun. Phys.* **8**, 101 (2025)]
- First laser-spectroscopy measurements of charge radii of Al and Si, probing nuclear structure at the proton drip line. [arXiv:2504.08265, submitted]
- Large-scale VS-IMSRG and shell-model calculations on HPC clusters (SubMIT, ORNL). DAQ design for laser spectroscopy; experimental work on radioactive molecules (with Harvard & Caltech).

Prior & interdisciplinary research:

- Constrained diffusion models for tabular data generation in finance [*ACM ICAIF*; poster at *NeurIPS 2025*].
- CMS Experiment, CERN (2022–23): ML for b-tagging and anomaly detection in luminosity data.
- Neutrino oscillation physics at DUNE; BSM scalar dark-matter models (EIA / U. de Medellín).
- Equivariant NNs for jet physics [NeurIPS 2023]; ML for nuclear β-decay [*Phys. Rev. C*, 2023].

Selected Talks

- **Invited**, INT Workshop "Nuclear Hamiltonians for Advancing Nuclear Physics and Beyond" (2026).
- MIT Physics Department Colloquium (2025)
- University of Vienna (2025)
- U. of Florida (2024).
- PAINT 2025 (UBC)
- TRIUMF Ab Initio Nuclear Theory (2024)
- DNP 2024 (APS)
- ACAT 2025 (Hamburg)
- IAIFI Seminar (MIT, 2024)
- AI4Physics (U. Tokyo, 2024).

Fellowships & Awards

2024–26 Henry Kendall Fellowship, MIT
2023 Lauren Fellowship, MIT | Academic Excellence Award (top of class), EIA University
2022 CERN Summer Student Programme | Mitacs Scholarship (UBC) | Erasmus+ Fellowship
2017–18 First Place, Colombian Physics Olympiad; Honourable Mention, IOAA (Beijing)

Technical Skills

Nuclear theory: VS-IMSRG, coupled cluster, shell-model diagonalization, chiral EFT / LEC calibration
ML & computation: PyTorch, JAX, Bayesian neural networks, multi-fidelity emulation, symbolic regression, diffusion & generative models, equivariant networks, Bayesian optimization, UQ; C++, Python, HPC
Experiment: Laser spectroscopy, DAQ design, radioactive beam techniques at FRIB
Languages: English (fluent), Spanish (native)