

# Flavio Pineda

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*Theoretical physicist specialized in early-universe cosmology and high-energy physics. My research explores quantum field theory in curved spacetime, gravitational particle production, inflationary dynamics, primordial black holes, and gravitational-wave signatures. I am particularly interested in connecting fundamental fields with cosmological observables. Passionate about teaching and developing computational tools for theoretical physics.*

## Education

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**Universidad Autónoma Metropolitana-Iztapalapa**

**Mexico City**  
March. 2026

*PhD*

- **Thesis: Aspects of multi-field Higgs- $R^2$  inflation and the early universe**
- **Advisor: Dr. Luis Octavio Pimentel Rico**

## Publications

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### Peer-Reviewed Journal Articles

- Pimentel, L.O., Pineda, F. Particle creation in some LRS Bianchi I models. *Gen Relativ Gravit* 53, 62 (2021). <https://doi.org/10.1007/s10714-021-02828-w>
- Pineda, F., Pimentel, L.O. Non-perturbative approach for scalar particle production in Higgs- $R^2$  inflation. *Eur. Phys. J. C* 85, 731 (2025). <https://doi.org/10.1140/epjc/s10052-025-14426-0>
- Pineda, F., Pimentel, L.O. Isocurvature-induced features in Higgs- $R^2$  inflation. <https://arxiv.org/abs/2512.14455> (under review in *Physical Review D*)

### Manuscripts in preparation

- Pineda F, Pimentel LO. “Primordial non-Gaussianities from transient turns in multi-field Higgs- $R^2$  inflation”—Expected submission Spring 2026.
- Pineda, F. PrimordialPy: a Python library for computing primordial power spectrum and primordial black holes abundance from single-field inflation.

## Academic experience

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**Department of Physics, UAM-I**  
*Assistant Professor*

**Mexico City**  
*May 2017-2020*

- Designed and delivered lectures for 10+ undergraduate physics courses (e.g., Classical Mechanics, Electromagnetism, Quantum Mechanics), improving student pass rates through active learning techniques.
- Assisted in the development of academic activities related to specific tasks of support in teaching in the area of physics.

## Online Physics teacher

Mexico City  
Dec. 2023-2024

- Delivered tailored lessons in General Relativity, Cosmology, and QFT to an undergraduate student at the Complutense University of Madrid.
- Designed personalized syllabi focused on deep conceptual understanding and problem-solving skills.
- Used advanced tools and visual aids to explain spacetime curvature, cosmic evolution, and quantum interactions

## Department of Physics, UAM-I Assistant Researcher

Mexico City  
Feb 2025

- Software development: *PrimordialPy*, a Python library to calculate primordial spectra and PBH abundance for single-field inflationary models. <https://github.com/fpineda94/primordialpy.git>
- Derived analytical expressions for non-Gaussianity parameters in multi-field inflation.
- Led a research project on gravitational particle production in the early universe.

## Presentations and participation in events

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### Invited Talks / Seminars

- Particle creation in some LRS Bianchi-I models  
XXIX Annual Meeting of the Division of Gravitation and Mathematical Physics of the Mexican Physics Society, Mexico City (Online) - April 2021
- Particle production in the early universe  
Cosmology and Relativistic Astrophysics Seminar. CINVESTAV, Mexico City - September 2024

### Conferences presentations

- The gauge principle and electromagnetic interaction  
LVIII National Physics Congress. Mérida, Yucatán, Mexico - October 2015
- Scalar and spinorial fields in Bianchi type I universe  
XIII Workshop of the Division of Gravitation and Mathematical Physics. León, Guanajuato, Mexico-November 2019
- Particle production by induced couplings in Higgs inflation  
XXXII Annual Meeting of the Division of Gravitation and Mathematical Physics of the Mexican Physical Society. Mexico City, Mexico - April 2024
- Non-perturbative particle production in Higgs-inflation.  
LXVII National Physics Congress. Chihuahua, Chihuahua, Mexico - October 2024
- Generating primordial features in mul-field Higgs- $R^2$  inflation  
LXVIII National Physics Congress. Toluca, EDOMEX, Mexico-October 2025
- Non-perturbative approach for scalar particle production in Higgs- $R^2$  inflation.  
X ComHEP: Colombian Meeting on High Energy Physics, Universidad de Antioquia, Colombia-December 2025

## Skills

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### Computational tools

- Python
- Mathematica
- LaTeX
- FORTRAN (basic knowledge)
- Software: PrimordialPy (developer), PyTransport, CLASS.

## Languages

- English (Fluent)
- Spanish (Native)
- German (A2)

## Awards

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- **Academic Merit Medal**, M.Sc. in Physics, UAM-Iztapalapa (2022)
- National PhD Fellowship (SECIHTI-Mexico)