SAMUEL PATRONE

Phenomenological Physicist

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WHO I AM

I work at the crucial interface between abstract mathematical models and experimental observations in cosmology and particle physics. My research transforms theoretical predictions into testable signatures that can be probed in laboratories and telescopes. From improving dark matter detection sensitivity by over 10x to extracting fundamental physics from gravitational waves, I specialize in making the *invisible universe* experimentally accessible.

EDUCATION

Ph.D. in Physics *2020–2026*

California Institute of Technology | GPA: 4.3/4.0

James A. Cullen Memorial Fellow (2021) & Danny Koh Graduate Fellow (2020)
Advisor: Prof. Mark B. Wise · Thesis: *"Tracing New Physics: From Symmetry to Observation"*

M.Sc. & B.Sc. in Physics *2015–2020*

Sapienza University of Rome | 110/110 summa cum laude

Class Rank: #1 BSc (30.68/30), Top 5% MSc (30.32/30) · Sapienza School for Advanced Studies
Cumulative fellowships: €15,000+ including Enrico Persico Scholarship & INFN-NSF/LIGO Fellowship

RESEARCH IMPACT

Graduate Research in Theoretical Physics *2020–Present*

Walter Burke Institute for Theoretical Physics (Caltech)

Cosmology & Large-Scale Structure:

- **Inflation:** Computing non-Gaussianities in warm inflation.
- **Leptogenesis:** Developed and numerically studied leptogenesis in automatic Nelson-Barr models linking CP violation to the baryon matter-antimatter asymmetry (JHEP 2025).
- **Galaxy Bias:** Analytical and numerical calculations of the Galaxy bispectrum. Resolved regularization ambiguities in bias expansion (JCAP 2023).

Particle Physics Phenomenology:

- **Dark Matter detection:** Refined ALPs searches using adaptive Monte Carlo techniques for electromagnetic showers in beam dump experiments, improving bounds >10x (PRD, 2026).
- **BSM Physics:** Calculated 2-loop corrections to Higgs mass and naturalness bounds in quark-lepton unification theories (PRD 2024).

Gravitational Waves Phenomenology *2019–2020*

LIGO Lab (Caltech) & VIRGO (Sapienza Università di Roma)

Pioneered Bayesian framework to extract polarization content from gravitational waves, enabling new tests of General Relativity (LIGO DCC 2020). Master's thesis awarded Con.Scienze 2020 national prize.

INDUSTRY EXPERIENCE

Human Frontier Collective Specialist - Gen AI *May 2025-Present*

ScaleAI | $100/hour (part-time)

Designed and validated complex physics problems – from graduate level to frontier – for training LLMs. Ensured scientific rigor of AI responses in physics, bridging my expertise with practical AI applications.

PUBLICATIONS & TALKS

Publications:

- K. Berghaus and S. Patrone, "Non-Gaussianities in Warm Inflation," *In preparation*
- S. Patrone et al., "Long-lived axionlike ... electromagnetic cascades," *Phys. Rev. D* (2026)
- C. Murgui and S. Patrone, "Leptogenesis in automatic Nelson-Barr models," *JHEP* (2025)
- P. Fileviez Pérez et al., "Finite naturalness and ... unification," *Phys. Rev. D* (2024)
- S. Patrone et al., "Regularization scheme dependence ... galaxy bias," *JCAP* (2023)
- S. Patrone et A. J. Weinstein, "Gravitational wave polarizations ...relativity test," *LIGO DCC* (2020)

Invited Talks:

[2026]: UC Santa Cruz – [2025]: University of Zurich, Texas A&M, Northwestern
[2024]: CERN, Case Western Reserve University

RECOGNITION

James A. Cullen Fellow 2021
Caltech academic excellence

Con.Scienze Prize 2020
Italy's best physics thesis

Danny Koh Fellow 2020
$18,000 graduate support

Enrico Persico Scholar 2020
€6,000 from Lincei Academy

INFN/LIGO-NSF Fellow 2019
International collaboration

TECHNICAL SKILLS

Theory: QFT, General Relativity, Cosmological Perturbations

Phenomenology: Cross Sections, Event Generation, Signal Analysis

Computing: Python, C, C++, Mathematica, ROOT

Methods: Adaptive Monte Carlo, Bayesian Inference, Boltzmann Equations, Loop Calculations

LANGUAGES

English (Fluent), Italian (Native), Spanish (Intermediate), Mathematics (Universal)

TEACHING & LEADERSHIP

Physics TA Fellow (2024-25)
Managed 100+ TAs, $1.8K budget, curriculum development (Caltech)

Teaching Excellence
100+ students, Certificate of Practice in University Teaching (Caltech)

Science Communicator (2018-20)
3 years bilingual museum tours (Sapienza)

Civic Leader (2015-18)
Youth Council President for 30K residents

BEYOND PHYSICS

Pianist · *Tiramisseur*