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# Mauricio Gamonal

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## Education

**Ph.D., Physics** Pennsylvania State University, University Park, PA, USA **Exp. 2026**

Advisor: Prof. Eugenio Bianchi.

**M.Sc., Physics,** Pontificia Universidad Católica de Chile, Santiago, Chile **June 2021**

Thesis Title: Cosmic inflation in modified models of gravity and an analysis on GWs.

Advisor: Prof. Jorge Alfaro.

Degree conferred with *summa cum laude*.

**B.Sc., Physics,** Pontificia Universidad Católica de Chile, Santiago, Chile **July 2018**

Degree conferred with *summa cum laude*.

## Research Interests

At the interface of quantum gravity and cosmology, my research focuses on how classical spacetime emerges from quantum geometry and how this process can leave observable imprints in the primordial Universe. I am particularly interested in pursuing three distinct but complementary directions:

- **Characterizing quantum gravity:** Which structural and dynamical features distinguish quantum gravity from other quantum field theories, and how do quantum-gravitational processes manifest in settings such as very early Universe or black holes?
- **Emergence and effective dynamics:** How can we derive controlled effective descriptions from microscopic theories, such as loop quantum gravity and spinfoams, and relate them to effective frameworks, including LQC, modified gravity, and effective field theory?
- **Links to testable predictions:** To what extent can these effective descriptions be confronted with data, for example via CMB anisotropies and non-Gaussianities, primordial black holes, and primordial GWs, and what would constitute a genuine signature of quantum gravity?

## In preparation

10. E. Bianchi, **M. Gamonal**, *Preinflationary dynamics from higher curvature gravity* (in preparation, March 2026).
9. E. Bianchi, C. Chen, **M. Gamonal**, *Toller functions and Feynman $i\varepsilon$ in spinfoams* (to appear, December 2025).
8. E. Bianchi, C. Chen, **M. Gamonal**, *Causal spinfoam vertex for Lorentzian quantum gravity* (to appear, December 2025).

## Refereed Publications

7. E. Bianchi, **M. Gamonal**, *Starobinsky inflation with self-consistent Weyl-squared corrections*, Phys. Rev. D **112**, 124006 (2025), [arXiv:2506.10081].
6. E. Bianchi, **M. Gamonal**, *Squeezed vacua and primordial features in effective theories of inflation at N2LO*, Phys. Rev. D **111**, 124024 (2025), [arXiv:2410.11812].
5. E. Bianchi, **M. Gamonal**, *Primordial power spectrum at N3LO in effective theories of inflation*, Phys. Rev. D **110**, 104032 (2024), [arXiv:2405.03157].
4. **M. Gamonal**, *Slow-roll inflation in $f(R,T)$ gravity and a modified Starobinsky-like inflationary model*, Phys. Dark Univ. **31**, 100768 (2021) [arXiv:2010.03861].
3. J. Alfaro and **M. Gamonal**, *A nontrivial footprint of standard cosmology in the future observations of low-frequency gravitational waves*, Gen. Rel. Grav. **52**, no.12, 118 (2020) [arXiv:1902.04550].

## Unrefereed Publications

2. **M. Gamonal**, *The effective theory of quantum gravity: Spacetime emergence and primordial echoes*, Ph.D. dissertation, Pennsylvania State University (exp. 2026).
1. **M. Gamonal**, *Cosmic inflation in modified models of gravity and an analysis on gravitational waves*, Master's thesis, Pontificia Universidad Católica de Chile (2021).

## Research Experience

**Pennsylvania State University**

Projects with Eugenio Bianchi: Aspects of Quantum Gravity. **Summer 2022 – Present**

- Developed a program to determine the cosmological dynamics and primordial power spectra derived from the effective theory of quantum gravity. Computed analytical predictions for primordial observables and confronted with observational constraints.
- Characterized the mathematical structure of Toller functions from the representation theory of SL(2,$\mathbb{C}$), and used them to define the causal spinfoam vertex amplitude for Lorentzian quantum gravity in four dimensions, including its asymptotics.

Projects with Abhay Ashtekar: Coulombic modes of gravity **Summer 2023 – Present**

- Reviewed the Newman-Penrose formalism to distinguish radiative from Coulombic modes in the Maxwell theory. Participated in discussions regarding dynamical horizons in black hole physics, including its thermodynamics properties.
- Discussed the role of the gauge invariant Bardeen potential as the Coulombic mode of gravity in cosmological perturbations, including its direct quantization and equivalence with purely gravitational frameworks, such as $f(R)$ gravity and Starobinsky inflation.

**Pontificia Universidad Católica de Chile**

Projects with Jorge Alfaro: Gravity and cosmology **August 2018 – June 2021**

- Developed a theoretical framework in linearized gravity to study corrections to gravitational wave propagation in the ΛCDM model, with potential applications in PTA experiments.

## Invited Talks

8. International Loop Quantum Gravity Seminar, Online — February 3, 2026
7. Primordial Universe and Gravitation Seminar, IGC, Penn State — December 6, 2024
6. International Loop Quantum Gravity Seminar, Online. — September 10, 2024
5. GravUC Seminar, Pontificia Universidad Católica de Chile — December 15, 2023
4. Primordial Universe and Gravitation Seminar, IGC, Penn State — October 27, 2023
3. Primordial Universe and Gravitation Seminar, IGC, Penn State — November 11, 2022
2. La Parte y el Todo VIII, Afunalhue, Chile (online talk) — January 4, 2021
1. PizzaSeminar 2020 (online talk, in Spanish) — June 17, 2020

## Contributed Talks (selected)

11. Quantum Gravity 2025, Penn State, State College, PA, USA. — July 24, 2025
10. 7th Neighborhood Workshop, Penn State, State College, PA, USA. — April 3, 2025
9. APS Global Physics Summit, American Physical Society, Anaheim, CA, USA. — March 18, 2025
8. Loops' 24, Florida Atlantic University, Fort Lauderdale, FL, USA. — May 7, 2024
7. 6th Neighborhood Workshop, Penn State, State College, PA, USA. — April 29, 2024
6. Cosmology from Home 2023 (online, pre-recorded talk). — July 4, 2023
5. APS April Meeting, American Physical Society, Minneapolis, MN, USA. — April 15, 2023
4. APS MAS, American Physical Society, University Park, PA, USA. — December 3, 2022
3. XXII Chilean Symposium of Physics, UTEM, Santiago, Chile. — November 25, 2020
2. Cosmosur V, UV & PUCV, Valparaíso, Chile. — October 2019
1. XII Latin American Symposium on High Energy Physics, Lima, Perú. — November 2018

## Attendance at summer schools & workshops

6. Loops' 24 Summer School, Fort Lauderdale, FL, USA. — May 2024
5. Basics of Quantum Gravity, ISQG (online). — May–November 2022
4. Loops' 22 Summer School, Aix-Marseille & ENS Lyon, France. — July 2022
3. Loop Quantum Gravity Summer School (online). — June 2021
2. Vienna summer school on gravitational quantum physics (online). — September 2020
1. CosmoAndes 2018, Pontificia Universidad Católica de Chile. — January 2018

## Fellowships and Awards

**Excellence in Physics Prize,** Distinguished Student Program, American Physical Society **2025**
**W. Donald Miller Fellowship,** Eberly College of Science, Penn State. **2025**
**David Duncan Graduate Fellowship,** Eberly College of Science, Penn State. **2025**
**LQG Summer School 2024 Grant,** Loops'24 LOC/Blaumann Foundation. **2024**
**DGRAV Travel Award,** American Physical Society. **2023**
**Homer F. Braddock Fellowship,** Eberly College of Science, Penn State. **2022**
**David H. Rank Physics Award,** Eberly College of Science, Penn State. **2022**
**Blaumann Research Grant (Call #1),** Blaumann Foundation. **2022**
**Fulbright Fellowship,** Foreign Student Program, Ph.D. sponsorship. **2021–2025**
**Beca Igualdad de Oportunidades,** ANID (Chilean government), Ph.D. funding **2021–2025**
**Beca Bicentenario,** MINEDUC (Chilean government), full B.Sc. funding. **2014–2018**

## Professional Activities, Outreach, and Service

### Memberships

American Physical Society: DGRAV, FIP, FECS, MAS.

WithOut SpaceTime (WOST consortium)

Institute for Gravitation and the Cosmos – Focus Initiative: Open Quantum Universe

Cosmology in Chile (also part of the organizing committee)

### Honor societies

Inducted into the Tri-Alpha Honor Society, Eta Psi Chapter.

### Journal referee

Annals of Physics, Physics of the Dark Universe

### Conference organizer

Quantum Gravity 2025, University Park, PA, USA **July 2025**
Member of LOC: Week-long international conference.

1st PizzaSeminar poster session, PUC, Chile **March 2020**
Main organizer: Two-day online poster session, 20 participants.

School of Gravity and General Relativity, CECs, Valdivia, Chile **February 2020**
Main organizer: Week-long national summer school, 50 participants.

### Seminar organizer

Primordial Universe and Gravitation (PUG) seminar, Penn State. **Fall 2024 – Present**

PizzaSeminar, PUC, Chile. **Spring 2020 – Spring 2021**

### Conference chair

APS Mid-Atlantic Section, University Park, PA, USA. **December 2022**

La parte y el todo VIII, Afunalhue, Chile. **January 2021**

### Outreach

Gravi-tea podcast **Since November 2024**
2 episodes recorded with Penn State faculty. To be published.

TA in Physics LATAM. **June–September 2023**
Online lectures on General Relativity for Latin students.

Physics and Astronomy for Women+ **May 2022**
Outreach activities performed in an elementary school.

Desde la Ciencia Marathon **June 2020**
Outreach online talk on gravitational waves (in Spanish).

Science communication student organization: Fisica Itinerante **2015–2018**
Positions: Coordinator, Community Manager and Executive Director (2016).

## Teaching Experience (selected)

**Teaching Assistant**, Pennsylvania State University

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| PHYS 561, Quantum Mechanics I (Graduate level). | **Summer 2025** |
| PHYS 214, Wave Motion and Quantum Physics. | **Summer 2022, 2025** |
| PHYS 213, Fluids and Thermal Physics. | **Summer 2022** |
| PHYS 250, Introductory Physics I (Lab). | **Fall/Spring 2022, Spring 2023** |

**Teaching Assistant**, Pontificia Universidad Católica de Chile

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| FIZ0211, Thermodynamics. | **Spring 2020** |
| FIZ0311, Modern Physics. | **Falls 2018-2019** |
| FIZ3150, General Relativity (Graduate level). | **Fall 2018** |
| FIZ0312, Thermodynamics (Lab). | **Spring 2017, Spring 2019 & Fall 2017** |
| FIZ0312, Waves and Optics (Lab). | **Spring 2017** |

## Computational skills

**Languages**—Experience with Mathematica, Python, Markdown, Fortran, and LaTeX.

**Other software**—Python libraries: Numpy, Scipy, Matplotlib, etc. Cosmology libraries: CAMB, CLASS. Symbolic software: Cadabra, xAct, Maple, wxMaxima.

**Oral skills**—Fluent in English; native Spanish speaker.

## References

**Eugenio Bianchi,** Associate Professor of Physics, Pennsylvania State University
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**Jorge Alfaro,** Professor of Physics, Pontificia Universidad Católica de Chile
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