Iván Mauricio **Burbano Aldana**

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Education

University of California, Berkeley
Berkeley, CA, USA

Ph.D. in Physics

January 2021 - December 2026

(expected)

Perimeter Institute for Theoretical Physics, University of Waterloo
Waterloo, ON, Canada

M.Sc. in Theoretical Physics

August 2019 - December 2020

- Perimeter Scholars International Program completed on June 2020.

Instituto de Física Teórica, Universidade Estadual Paulista "Júlio de Mesquita Filho"
São Paulo, SP, Brazil

Master's in Theoretical Physics

February 2019 - August 2020

- Thesis: Cohomological Field Theory in the BV Formalism

Universidad de los Andes
Bogotá D.C., Colombia

Master's in Physics (not completed)

January 2018 - December 2018

- Interrupted to pursue the SAIFR-Perimeter Fellowship.

Universidad de los Andes
Bogotá D.C., Colombia

Undergraduate Degree in Physics

July 2014 - March 2018

- Thesis: KMS States and Tomita-Takesaki Theory, supervised by: Dr. Andrés Fernando Reyes Lega.
- Graduated with Cum Laude honors.
- Minor: Mathematics

Research Experience

University of California, Berkeley
Berkeley, CA, USA

Graduate Student Researcher

June 2023 - Present

- Developing theoretical tools necessary to study the theory of strong interactions using quantum computers.
- Scattering analysis of the $O(3)$ non-linear sigma model using Monte Carlo methods on traditional computers.

Perimeter Institute for Theoretical Physics
Waterloo, ON, Canada

Master's Thesis

August 2019 - June 2020

- Using the Batalin-Vilkoviski formalism to explore the relationship between the descriptions of gauge theories using factorization algebras and nets of observables. Supervised by Dr. Kevin Costello and co-supervised by Dr. Kasia Rejzner.

Universidad de los Andes
Bogotá D.C., Colombia

Research Master's Graduate Assistant

June 2018 - July 2018

- Carried out research that led to "Emergent Gauge Symmetries and Quantum Operations". Identified and proved the existence of an emerging gauge group in purification schemes through the GNS representation.

California Institute of Technology
Pasadena, CA, USA

Summer Undergraduate Research Fellowship

June 2017 - August 2017

- Aided the investigation, characterization, and correction of image centroid motions at the Precision Projector Laboratory in the Jet Propulsion Laboratory (NASA).
- Built Distortionator, a Python program that aids the analysis of distortions in a two dimensional lattice by calculating the convergence, shears, rotations, and translations between different instances of the lattice.
- The detectors investigated will be used for the study of weak gravitational lenses and dark matter in missions such as WFIRST and Euclid.
- Supervised by Dr. Roger Smith and Dr. Andrés Plazas.

Publications

- I. M. Burbano, M. A. Carrillo, R. Urek, A. N. Ciavarella and R. A. Briceño, "Real-time Estimators for Scattering Observables: A full account of finite volume errors for quantum simulation," [arXiv:2506.06511 [hep-lat]].

- A. N. Ciavarella, I. M. Burbano and C. W. Bauer, "Efficient Truncations of SU(N_c) Lattice Gauge Theory for Quantum Simulation," [arXiv:2503.11888 [hep-lat]].

- I. M. Burbano and C. W. Bauer, "Gauge Loop-String-Hadron Formulation on General Graphs and Applications to Fully Gauge Fixed Hamiltonian Lattice Gauge Theory," [arXiv:2409.13812 [hep-lat]].

- I. M. Burbano and F. Calderón, "Self-Normalizing Path Integrals," Found. Phys. **54**, no.5, 60 (2024) doi:10.1007/s10701-024-00779-1 [arXiv:2109.00517 [hep-th]].

- I. M. Burbano, J. Kulp and J. Neuser, "Duality defects in E_8," JHEP **10**, 186 (2022) doi:10.1007/JHEP10(2022)187 [arXiv:2112.14323 [hep-th]].

- I. M. Burbano, T. R. Perche and B. de S.L. Torres, "A path integral formulation for particle detectors: the Unruh-DeWitt model as a line defect," JHEP **03**, 076 (2021) doi:10.1007/JHEP03(2021)076 [arXiv:2012.14912 [hep-th]].

- A. P. Balachandran, I. M. Burbano, A. F. Reyes-Lega and S. Tabban, "Emergent Gauge Symmetries and Quantum Operations," J. Phys. A **53**, no.6, 06LT01 (2020) doi:10.1088/1751-8121/ab6143 [arXiv:1906.05464 [quant-ph]].

Honors, Awards & Grants

2024	**HUGS Third Place Seminar Price**, Jefferson Lab	*Newport News, USA*
2022	**Outstanding Graduate Student Instructor Award**, UC Berkeley	*Berkeley, CA, USA*
2018	**SAIFR-Perimeter Fellowship**, Journeys into Theoretical Physics	*São Paulo, Brazil*

- The fellowship included $\sim$ USD $34,000$ for my studies in Canada (including tuition) and $\sim$ USD $6,000$ for my studies in Brazil (not including tuition). Out of the 688 applicants, I was one of the 26 accepted to the Perimeter Scholars International program.

2018	**Quantum Entropy Ambiguities and Modular Theory**, INV-2018-34-1295, Universidad de los Andes	*Bogotá, Colombia*

- Received a grant for $\sim$ USD $1,300$ destined towards publishing "Emergent Gauge Symmetries and Quantum Operations" and presenting it in an international scientific event.

2018	**Cum Laude Undergraduate Degree**, Universidad de los Andes	*Bogotá, Colombia*

- Graduated with a global GPA in the top 3% over the past 5 years in the faculty of sciences.

2015/2017	**Semiannual Excellence**, Universidad de los Andes	*Bogotá, Colombia*

- Obtained the highest GPA of the semester in the physics department.

2016	**Ramón de Zubiría**, Universidad de los Andes	*Bogotá, Colombia*

- Obtained the highest overall GPA in the physics department.

2014	**Honorable Mention**, 45th International Physics Olympiad	*Astana, Kazakhstan*
2013	**Third Place**, XXIX Olimpiada Colombiana de Física	*Bogotá, Colombia*

Teaching Experience

University of California, Berkeley — *Berkeley, CA, USA*

GRADUATE STUDENT INSTRUCTOR — *January 2021 - May 2023*

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  - Quantum Mechanics II (gradschool), discussion, Spring 2023
  - Introduction to Statistical and Thermal Physics, discussion, Fall 2022
  - Analytic Mechanics, discussion, Summer 2022
  - Introduction to Mathematical Physics, discussion, Spring 2022.
  - Introductory Mechanics and Relativity, discussion, Fall 2021.
  - Physics for Scientists and Engineers, discussion and lab, Spring 2021 (2 sections).
- Led discussion sections and designed/graded quizzes, homework and work sheets.

University of California, Berkeley — *Berkeley, CA, USA*

SERVICE WORK — *January 2021 - Present*

- Mentored 7 Physics Directed Reading Programs
- Taught in Python4STEM and codirected the Monte Carlo for Statistical Field Theories programs in REYES. Currently working on an in-person edition of Python4Physics for historically underserved communities in the Bay Area.

Perimeter Institute for Theoretical Physics — *Waterloo, ON, Canada*

TEACHING ASSISTANT — *May 2020 - June 2020*

- Aided the Symmetries course of the Undergraduate Theoretical Physics Summer Program

Universidad de los Andes — *Bogotá D.C., Colombia*

TEACHING MASTER'S GRADUATE ASSISTANT — *January 2018 - December 2018*

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  - Physics 2, discussion, Fall 2018.
  - Experimental Physics 1, Fall 2018 (2 sections).
  - Physics 1, discussion Spring 2018.
  - Basic Physics 1, discussion Spring 2018 (2 sections).
- Led discussion sections and designed/graded quizzes, homework and work sheets.
- Conducted experiments using Logger Pro and other Vernier educational devices.

Universidad de los Andes — *Bogotá D.C., Colombia*

TEACHING ASSISTANT — *January 2016 - December 2016*

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  - Linear Algebra 2 with Dr. Cesar Neyit Galindo Martinez in Fall 2016.
  - Linear Algebra (Honors) with Dr. Sergio Miguel Adarve Delgado in Spring 2016.
- Graded homework and held office hours to help students with their questions.
- Clinic for Problem-Solving in Fall 2016: helped students of first and second-year physics courses with their homeworks and related inquiries.

Presentations

HUGS Seminar @ Jefferson Lab   *Newport News, VA, USA*
Towards $\gamma^*\gamma^* \rightarrow \pi\pi$ on the Lattice   *June 2024*

Theory Seminar @ Jefferson Lab   *Newport News, VA, USA*
Loop-String-Hadron on a Maximal Tree: A tale of gauge invariance and flowers   *February 2024*

ICTP Physics Without Frontiers: Advanced Lectures on Theoretical Physics   *Zoom*
Matemática-Física: Nudos, Geometría y Supersimetría   *February 2023*

International Seminar: Differential Geometry and Mathematical Physics   *Bogotá D.C., Colombia*
Teorema de Noether: Aspectos Variacionales, Simplécticos y Cohomológicos   *May 2022*

The Compass Lectures   *Berkeley, CA, USA*
Path Integrals: summing over a whole new infinity   *October 2021*

Seminario Estudiantil Iberoamericano de Física Teórica   *Online*
Integrales de Camino: sumando sobre toda una nueva infinidad   *October 2021*

Seminario Estudiantil Iberoamericano de Física Teórica   *Online*
Introducción al Formalismo BV   *May 2020*

Emmy Noether Workshop: The Structure of Quantum Space Time @ Perimeter Institute   *Waterloo, ON, Canada*
Emerging Gauge Symmetries and Quantum Operations   *November 2019*

4th Joint Dutch-Brazil School on Theoretical Physics @ Instituto de Física Teórica   *São Paulo, SP, Brazil*
Emerging Gauge Symmetries and Quantum Operations   *February 2019*

Quantum Field Theory and Mathematical Physics Seminar @ Universidad de los Andes   *Bogotá D.C., Colombia*
The Definition of a von Neumann Algebra   *October 2018*

Noncommutative Geometry and Poisson Geometry Around Groupoids   *Villa de Leyva, Boyacá, Colombia*
Applications of Tomita-Takesaki Theory I   *July 2018*

Quantum Optics Seminar @ Universidad de los Andes   *Bogotá D.C., Colombia*
Quantum Logic and the Orthocomplemented Lattice of Propositions   *June 2018*

Topological Order and Beyond @ Universidad de los Andes   *Bogotá D.C., Colombia*
KMS States and Tomita-Takesaki Theory   *May 2018*

Quantum Field Theory and Mathematical Physics Seminar @ Universidad de los Andes   *Bogotá D.C., Colombia*
Algebraic Formulation of Quantum Physics   *February 2018*

La Cicuta Magazine 7th Edition Release @ Universidad de los Andes   *Bogotá D.C., Colombia*
On the Communication and Censorship of Science   *September 2017*

Quantum Field Theory and Mathematical Physics Seminar @ Universidad de los Andes   *Bogotá D.C., Colombia*
Orthocomplemented Quantum Lattices of Propositions   *April 2017*

Schools and Conferences Attended

Year	Title	Country
2024	**Unraveling the Particle World and the Cosmos at Berkeley**, UC Berkeley	*United States*
2024	**Hampton University Graduate Studies Program**, Jefferson Lab	*United States*
2023	**U.S. Quantum Information Science Summer School**, Fermilab	*United States*
2022	**Field Theories and Vertex Algebras**, University of California, Los Angeles	*United States*
2022	**Physical Mathematics of Quantum Field Theory**, University of Massachusetts, Amherst	*United States*
2021	**Blackwell Tapia Conference 2021**, Mathematical Sciences Research Institute	*United States*
2021	**Chern-Simons and Other Topological Field Theories**, Mathematical Sciences Research Institute	*United States*
2019	**Minicourse on Quantum Gravity from the QFT Perspective**, Instituto de Física Teórica	*Brazil*
2019	**4th Joint Dutch-Brazil School on Theoretical Physics**, Instituto de Física Teórica	*Brazil*
2018	**Random Physical Systems**, Mathematical Physics Month	*Chile*
2018	**Journeys Into Theoretical Physics**, Instituto de Física Teórica	*Brazil*
2018	**Noncommutative Geometry and Poisson Geometry Around Groupoids**, Pontificia Universidad Javeriana	*Colombia*
2018	**Topological Order and Beyond**, Universidad de los Andes	*Colombia*
2017	**Dynamics of Quantum Systems Outside of Equilibrium**, Universidad de los Andes	*Colombia*

Additional Skills

Programming	Unix/Linux, Python, Mathematica, LaTeX, Git
Languages	Spanish (native), English (TOEFL 120/120), Portuguese (proficiency exam of the Instituto de Física Teórica).