

Iván Mauricio Burbano Aldana

366 Physics North, Berkeley, CA, USA, 94720

✉ ivan_burbano@berkeley.edu | [ivanbur](#) | [ivanbur](#) | [I. M. Burbano](#) | [Personal website](#)

Education

University of California, Berkeley

PH.D. IN PHYSICS

Berkeley, CA, USA

January 2021 - December 2026

(expected)

Perimeter Institute for Theoretical Physics, University of Waterloo

M.SC. IN THEORETICAL PHYSICS

Waterloo, ON, Canada

August 2019 - December 2020

- Perimeter Scholars International Program completed on June 2020.

Instituto de Física Teórica, Universidade Estadual Paulista “Júlio de Mesquita Filho”

MASTER'S IN THEORETICAL PHYSICS

São Paulo, SP, Brazil

February 2019 - August 2020

- Thesis: [Cohomological Field Theory in the BV Formalism](#)

Universidad de los Andes

MASTER'S IN PHYSICS (NOT COMPLETED)

Bogotá D.C., Colombia

January 2018 - December 2018

- Interrupted to pursue the [SAIFR-Perimeter Fellowship](#).

Universidad de los Andes

UNDERGRADUATE DEGREE IN PHYSICS

Bogotá D.C., Colombia

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

GRADUATE STUDENT RESEARCHER

Berkeley, CA, USA

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

MASTER'S THESIS

Waterloo, ON, Canada

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

RESEARCH MASTER'S GRADUATE ASSISTANT

Bogotá D.C., Colombia

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

SUMMER UNDERGRADUATE RESEARCH FELLOWSHIP

Pasadena, CA, USA

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

- Ciavarella, A.N., Burbano, I.M. & Bauer, C.W., Efficient Truncations of $SU(N_c)$ Lattice Gauge Theory for Quantum Simulation (2024). <https://arxiv.org/abs/2503.11888>
- Burbano, I.M. & Bauer, C.W., Gauge Loop-String-Hadron Formulation on General Graphs and Applications to Fully Gauge Fixed Hamiltonian Lattice Gauge Theory (2024). <https://arxiv.org/abs/2409.13812>
- Burbano, I.M. & Calderón, F., Self-Normalizing Path Integrals, Found Phys 54, 60 (2024). <https://doi.org/10.1007/s10701-024-00779-1>
- Burbano, I.M., Kulp, J. & Neuser, J. Duality Defects in E_g . (2021) [https://doi.org/10.1007/JHEP10\(2022\)187](https://doi.org/10.1007/JHEP10(2022)187)
- Burbano, I.M., Perche, T.R. & de S. L. Torres, B. A path integral formulation for particle detectors: the Unruh-DeWitt model as a line defect. *J. High Energ. Phys.* **2021**, 76 (2021). [https://doi.org/10.1007/JHEP03\(2021\)076](https://doi.org/10.1007/JHEP03(2021)076)

- Balachandran A.P., Burbano, I.M., Reyes-Lega A.F. & Tabban S., et al. Emergent Gauge Symmetries and Quantum Operations. *J. Phys. A: Math. Theor.* **53** 06LT01 (2020) <https://doi.org/10.1088/1751-8121/ab6143>.

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 ~ USD 34, 000 for my studies in Canada (including tuition) and ~ 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 ~ 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

- - 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

- - 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

- - 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

TOWARDS $\gamma^* \gamma^* \rightarrow \pi\pi$ ON THE LATTICE

Newport News, VA, USA

June 2024

Theory Seminar @ Jefferson Lab

LOOP-STRING-HADRON ON A MAXIMAL TREE: A TALE OF GAUGE INVARIANCE AND FLOWERS

Newport News, VA, USA

February 2024

ICTP Physics Without Frontiers: Advanced Lectures on Theoretical Physics

MATEMÁTICA-FÍSICA: NUDOS, GEOMETRÍA Y SUPERSIMETRÍA

Zoom

February 2023

International Seminar: Differential Geometry and Mathematical Physics

TEOREMA DE NOETHER: ASPECTOS VARIACIONALES, SIMPLÉCTICOS Y COHOMOLÓGICOS

Bogotá D.C., Colombia

May 2022

The Compass Lectures

PATH INTEGRALS: SUMMING OVER A WHOLE NEW INFINITY

Berkeley, CA, USA

October 2021

Seminario Estudiantil Iberoamericano de Física Teórica

INTEGRALES DE CAMINO: SUMANDO SOBRE TODA UNA NUEVA INFINIDAD

Online

October 2021

Seminario Estudiantil Iberoamericano de Física Teórica

INTRODUCCIÓN AL FORMALISMO BV

Online

May 2020

Emmy Noether Workshop: The Structure of Quantum Space Time @ Perimeter Institute

EMERGING GAUGE SYMMETRIES AND QUANTUM OPERATIONS

Waterloo, ON, Canada

November 2019

4th Joint Dutch-Brazil School on Theoretical Physics @ Instituto de Física Teórica

EMERGING GAUGE SYMMETRIES AND QUANTUM OPERATIONS

São Paulo, SP, Brazil

February 2019

Quantum Field Theory and Mathematical Physics Seminar @ Universidad de los Andes

THE DEFINITION OF A VON NEUMANN ALGEBRA

Bogotá D.C., Colombia

October 2018

Noncommutative Geometry and Poisson Geometry Around Groupoids

APPLICATIONS OF TOMITA-TAKESAKI THEORY I

Villa de Leyva, Boyacá, Colombia

July 2018

Quantum Optics Seminar @ Universidad de los Andes

QUANTUM LOGIC AND THE ORTHOCOMPLEMENTED LATTICE OF PROPOSITIONS

Bogotá D.C., Colombia

June 2018

Topological Order and Beyond @ Universidad de los Andes

KMS STATES AND TOMITA-TAKESAKI THEORY

Bogotá D.C., Colombia

May 2018

Quantum Field Theory and Mathematical Physics Seminar @ Universidad de los Andes

ALGEBRAIC FORMULATION OF QUANTUM PHYSICS

Bogotá D.C., Colombia

February 2018

La Cicuta Magazine 7th Edition Release @ Universidad de los Andes

ON THE COMMUNICATION AND CENSORSHIP OF SCIENCE

Bogotá D.C., Colombia

September 2017

Quantum Field Theory and Mathematical Physics Seminar @ Universidad de los Andes

ORTHOCOMPLEMENTED QUANTUM LATTICES OF PROPOSITIONS

Bogotá D.C., Colombia

April 2017

Schools and Conferences Attended

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).