

# Sebastián Urrutia-Quiroga

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*Physics & Teaching*

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## Education

- 2017–to date **Ph.D. (c)**, *University of Massachusetts, Amherst.*  
Particle physics.
- 2013–2015 **M.Sc.**, *Pontificia Universidad Católica de Chile (PUC), Santiago*, Conferred with Maximum Distinction.  
Particle physics.
- 2013–2015 **Professional degree**, *Pontificia Universidad Católica de Chile, Santiago*, Conferred with Maximum Distinction.  
Electrical Engineering.
- 2009–2013 **B.Eng.Sc.**, *Pontificia Universidad Católica de Chile, Santiago*, Conferred with Distinction.

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## Ph.D. thesis (in progress)

- title *TeV-scale lepton number violation: neutrinoless double beta decay, the origin of matter and energy frontier probes.*
- supervisor Prof. Michael Ramsey-Musolf.
- description Lepton number violation (LNV) provides feasible theoretical explanations to several open questions in particle physics and a rich phenomenology at different energy scales. These two aspects make LNV research very attractive for theoretical and experimental physicists. A deep understanding of the underlying connections between nuclear physics, collider physics, and cosmology is the primary goal of this work.

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## Master thesis

- title *Higgs Bosons in extensions of the Standard Model: the Inert Doublet Model case.*
- supervisors Prof. Marco Aurelio Díaz (Physics Institute) and Prof. Ángel Abusleme (School of Engineering).
- description We study the Inert Higgs Doublet Model and its inert scalar Higgs  $H$  as the only source for dark matter. It is found that three mass regions of the inert scalar Higgs can give the correct dark matter relic density. Collider experiments are advised to search for  $D^\pm \rightarrow HW^\pm$  decay in the two jets plus missing energy channel.

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Chilean

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## Research experience

2018–2020 **Research assistant**, *University of Massachusetts*, Amherst.

Lepton number violation (LNV) at the TeV-scale:

- Dimension  $d = 9$  LNV effective operators to generate neutrino masses and neutrinoless double beta decay.
- Collider phenomenology at the Large Hadron Collider (LHC) and future 100 TeV colliders.
- TeV-scale effects in the standard leptogenesis scenario.

2014–2017 **Research assistant**, *Pontificia Universidad Católica de Chile*, Santiago.

- Group theory and its implications in particle physics.
- Phenomenological studies for Beyond Standard Model physics, focused on Run 2 and Run 3 of the LHC and linear colliders.

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## Teaching experience

Spring 2020 **Instructor**, *University of Massachusetts*, Amherst.

Physics 131, the first semester in a two-semester, algebra-based course on introductory physics. The format of this course is Team-Based-Learning (TBL).

2017–to date **Teaching assistant**, *University of Massachusetts*, Amherst.

Introductory physics for life sciences majors and graduate-level courses (classical mechanics, electrodynamics, and mathematical methods for physics).

2017–2018, **Instructor of record**, *Pontificia Universidad Católica de Chile*, Santiago.

2020 Academic pre-training program in physics for Engineering first-year students.

2010–2017 **Teaching assistant**, *Pontificia Universidad Católica de Chile*, Santiago.

Undergraduate-level courses for science-related majors:

- Statics and dynamics, thermodynamics, electricity and magnetism, and mathematical methods for physics.
- Single and multivariable calculus, and ordinary differential equations.
- Electronics, electric materials, and electric circuits.

2010–2017 **Academic mentor**, *Pontificia Universidad Católica de Chile*, Santiago.

Tutoring math and physics sessions for science-related majors at the Support Center for Academic Performance and Vocational Exploration (CARA UC).

2009–2014 **Instructor and Teaching assistant**, *Pontificia Universidad Católica de Chile*, Santiago.

Classical mechanics, fluid physics, and special relativity courses for high school students at the Educational Program for Academically Talented Children (Penta UC).

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## Languages

Spanish Native proficiency.

English Full professional proficiency.

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## Computer skills

Programming languages	Python, C++	Document preparation	L <sup>A</sup> T <sub>E</sub> X, Microsoft Word
Technical computing	Mathematica, Matlab	Operating system	Microsoft Windows, MacOS, Linux

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## Research interests

High energy physics, particle physics, beyond standard model phenomenology, electroweak interactions, Higgs mechanism, quantum field theory in general.

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## Schools, seminars, and conferences

- 2020 Virtual Colloquium, Los Alamos National Laboratory, New Mexico.
- 2020 Phenomenology 2020 Symposium, University of Pittsburgh, Pennsylvania.
- 2020 Mini-workshop: Particle theory of neutrinoless double-beta decay, Snowmass Topical Group on Neutrino Properties.
- 2019 National Nuclear Physics Summer School, University of Tennessee, Knoxville.
- 2016 4th Chilean School of High Energy Physics, Universidad Técnica Federico Santa María, Valparaíso.

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## Scholarships and Awards

- 2020 Arthur Quinton T.A. award, Physics Department, UMass, Amherst.  
*Awarded to an outstanding Teaching Assistant.*
- 2018 Most inspiring T.A. award, School of Engineering, PUC, Chile.  
*Award conferred by the Engineering Student Association.*
- 2018 Becas Chile grantee, CONICYT, Chile.  
*Scholarship to support Ph.D. students out of the country.*
- 2016 Fulbright grantee, Fulbright student program, USA.
- 2016 “Marcos Orrego Puelma” award, Instituto de Ingenieros de Chile, Chile.
- 2015 Best student of the 2015 class, School of Engineering, PUC, Chile.
- 2014 Beca Nacional de Magister grantee, CONICYT, Chile.  
*Scholarship to support M.Sc. students in Chile.*
- 2011, 2014, A-class teaching assistant, Math Department, PUC, Chile.
- 2015 *Highest T.A. category in the Department.*
- 2009 “Padre Hurtado” award, PUC, Chile.  
*Full funding to carry out undergraduate studies.*

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## Volunteer activities

- Elaboration of problem set volumes for math or physics courses, 2010–to date. Available free of charge in my personal website.
- International Masterclass-Chile, Physics Institute, PUC, Chile. Organizing committee member, 2015–2016.
- High Energy Festival, Physics Institute, PUC, Chile. Organizing committee member, 2015–2016.
- Talent + Inclusion program, School of Engineering, PUC, Chile. Mentor, 2014–2015.
- Student Association, School of Engineering, PUC, Chile. Electrical engineering representative, 2014.

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## Publications

- [1] Marco Aurelio Díaz, Benjamin Koch, and Sebastián Urrutia-Quiroga. Constraints to Dark Matter from Inert Higgs Doublet Model. *Adv. High Energy Phys.*, 2016:8278375, 2016.
- [2] Marco Aurelio Díaz, Nicolás Rojas, Sebastián Urrutia-Quiroga, and José W. F. Valle. Heavy Higgs Boson Production at Colliders in the Singlet-Triplet Scotogenic Dark Matter Model. *JHEP*, 08:017, 2017.
- [3] Ivania Maturana-Ávila, Marco Aurelio Díaz, Nicolás Rojas, and Sebastián Urrutia-Quiroga. Towards a way to distinguish between IHDM and the Scotogenic at CLIC. In *Prospects in Neutrino Physics (NuPhys2018) London, United Kingdom, December 19-21, 2018*, 2019.

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