

Alex Soto

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Education

- 2016 – 2020 📖 **Ph.D. in Physics**, Pontificia Universidad Católica de Chile.
Thesis title: *Exploring the landscape of Very Special Relativity*.
- 2013 – 2015 📖 **M.Sc. in Physics**, Universidad de Chile.
Thesis title: *Predictions of the effective field theory in cosmic inflation*.
- 2008 – 2012 📖 **B.Sc. in Physics**, Universidad de Chile.

Postdoctoral positions and visits

- 2025 – Present 📖 **Marie Skłodowska-Curie Actions (MSCA) Postdoctoral Fellow**, IFPAN, Poland.
- 2021 – 2024 📖 **Postdoctoral position**, Newcastle University, UK.
- 2020 📖 **Research Visitor**, King's College London, UK.

Teaching

Teaching in Universities

- Mar – Jul 2025 📖 **Mechanics**, Universidad de las Américas (Level: Undergraduate).
- 📖 **Experimental Physics**, Universidad de las Américas (Level: Undergraduate).
- 📖 **Fundamentals of Physics and Mathematics**, Universidad de las Américas (Level: Undergraduate).
- Mar – Aug 2021 📖 **Laboratory of Newtonian Physics**, Universidad del Bio-Bio (Level: Undergraduate).

Teaching assistant

- Mar – Jul 2021 📖 **Introduction to Gauge Theories**, Institute of Physics, Pontificia Universidad Católica de Chile (Level: Graduate).
- Aug – Dec 2020 📖 **Quantum Field Theory I**, Institute of Physics, Pontificia Universidad Católica de Chile (Level: Graduate).
- 📖 **Methods of Mathematical Physics I**, Institute of Physics, Pontificia Universidad Católica de Chile (Level: Undergraduate).
- Aug – Dec 2019 📖 **Electricity and Magnetism**, Institute of Physics, Pontificia Universidad Católica de Chile (Level: Undergraduate).
- Aug – Dec 2018 📖 **Electromagnetic theory**, Institute of Physics, Pontificia Universidad Católica de Chile (Level: Undergraduate).
- 📖 **Methods of Mathematical Physics I**, Institute of Physics, Pontificia Universidad Católica de Chile (Level: Undergraduate).
- Mar – Jul 2018 📖 **Classical Mechanics**, Institute of Physics, Pontificia Universidad Católica de Chile (Level: Graduate).
- Mar – Jul 2015 📖 **Quantum Field Theory**, Department of Physics, Faculty of Physical Sciences and Mathematics, Universidad de Chile (Level: Graduate).

Teaching (continued)

Mar – Jul 2013

■ **Experimental Methods II**, Department of Physics, Faculty of Science, Universidad de Chile (Level: Undergraduate).

Teaching in schools

Aug 2015 – Feb 2016

■ **Physics teacher**, Colegio Adventista Buenaventura.

Feb 2013 – Feb 2016

■ **Physics teacher**, Colegio Polivalente Adventista Santiago Sur.

Publications

- 1 M. Ghasemkhani, G. Soleimani, **A. Soto**, and R. Bufalo. “On the photon mass generation in Rarita–Schwinger QED”. In: *Eur. Phys. J. C* 84.12 (2024), p. 1281.  DOI: 10.1140/epjc/s10052-024-13640-6. arXiv: 2412.08168 [hep-th].
- 2 Nick P. Proukakis, Gerasimos Rigopoulos, and **Alex Soto**. “Self-Consistent Stochastic Finite-Temperature Modelling: Ultracold Bose Gases with Local (s-wave) and Long-Range (Dipolar) Interactions”. In: (2024). arXiv: 2407.20178 [cond-mat.quant-gas].
- 3 Carlos M. Reyes, César Riquelme, Marco Schreck, and **Alex Soto**. “Reduced geometry and its role in explicit spacetime symmetry violation”. In: *Phys. Rev. D* 111.12 (2025), p. 124011.  DOI: 10.1103/PhysRevD.111.124011. arXiv: 2407.19264 [gr-qc].
- 4 Carlos M. Reyes, César Riquelme, and **Alex Soto**. “Cosmology with explicit and spontaneous background fields”. In: *JCAP* 05 (2025), p. 014.  DOI: 10.1088/1475-7516/2025/05/014. arXiv: 2407.13041 [gr-qc].
- 5 Nick P. Proukakis, Gerasimos Rigopoulos, and **Alex Soto**. “Unified description of corpuscular and fuzzy bosonic dark matter. II. Dissipation and stochastic forces”. In: *Phys. Rev. D* 111.2 (2025), p. 023505.  DOI: 10.1103/PhysRevD.111.023505. arXiv: 2407.08860 [astro-ph.CO].
- 6 Nick P. Proukakis, Gerasimos Rigopoulos, and **Alex Soto**. “Hybrid model of condensate and particle dark matter: Linear perturbations in the hydrodynamic limit”. In: *Phys. Rev. D* 110.2 (2024), p. 023504.  DOI: 10.1103/PhysRevD.110.023504. arXiv: 2311.05280 [astro-ph.CO].
- 7 Alessandro Santoni, Jorge Alfaro, and **Alex Soto**. “Graviton mass bounds in very special relativity from binary pulsar’s gravitational waves”. In: *Phys. Rev. D* 108 (4 2023), p. 044072.  DOI: 10.1103/PhysRevD.108.044072. arXiv: 2306.02464 [gr-qc].
- 8 Nick P. Proukakis, Gerasimos Rigopoulos, and **Alex Soto**. “Unified description of corpuscular and fuzzy bosonic dark matter”. In: *Phys. Rev. D* 108 (8 2023), p. 083513.  DOI: 10.1103/PhysRevD.108.083513. arXiv: 2303.02049 [astro-ph.CO].
- 9 M. Ghasemkhani, V. Rahmanpour, R. Bufalo, M. N. Mnatsakanova, and **A. Soto**. “Induced CP-violation in the Euler–Heisenberg Lagrangian”. In: *Eur. Phys. J. C* 83.1 (2023), p. 39.  DOI: 10.1140/epjc/s10052-022-11145-8. arXiv: 2109.11411 [hep-th].
- 10 N. E. Mavromatos, Sarben Sarkar, and **A. Soto**. “Schwinger–Dyson equations and mass generation for an axion theory with a PT symmetric Yukawa fermion interaction”. In: *Nucl. Phys. B* 986 (2023), p. 116048.  DOI: 10.1016/j.nuclphysb.2022.116048. arXiv: 2208.12436 [hep-ph].
- 11 Z. Haghgouyan, M. Ghasemkhani, R. Bufalo, and **A. Soto**. “Induced non-Abelian Chern–Simons effective action in very special relativity”. In: *Eur. Phys. J. Plus* 137.6 (2022), p. 732.  DOI: 10.1140/epjp/s13360-022-02941-y. arXiv: 2207.00639 [hep-th].

- 12 Carlos M. Reyes, Marco Schreck, and **Alex Soto**. “Cosmology in the presence of diffeomorphism-violating, nondynamical background fields”. In: *Phys. Rev. D* 106.2 (2022), p. 023524.  DOI: 10.1103/PhysRevD.106.023524. arXiv: 2205.06329 [gr-qc].
- 13 M. Ghasemkhani, V. Rahmanpour, R. Bufalo, and **A. Soto**. “Impossibility of obtaining a CP-violating Euler–Heisenberg effective theory from a viable modification of QED”. In: *Eur. Phys. J. C* 82.4 (2022), p. 376.  DOI: 10.1140/epjc/s10052-022-10351-8. arXiv: 2204.02126 [hep-ph].
- 14 N. E. Mavromatos, Sarben Sarkar, and **A. Soto**. “PT symmetric fermionic field theories with axions: Renormalization and dynamical mass generation”. In: *Phys. Rev. D* 106.1 (2022), p. 015009.  DOI: 10.1103/PhysRevD.106.015009. arXiv: 2111.05131 [hep-th].
- 15 Nick E. Mavromatos and **Alex Soto**. “Dynamical Majorana neutrino masses and axions II: Inclusion of anomaly terms and axial background”. In: *Nucl. Phys. B* 962 (2021), p. 115275.  DOI: 10.1016/j.nuclphysb.2020.115275. arXiv: 2006.13616 [hep-ph].
- 16 Jean Alexandre, Nick E. Mavromatos, and **Alex Soto**. “Dynamical Majorana neutrino masses and axions I”. In: *Nucl. Phys. B* 961 (2020), p. 115212.  DOI: 10.1016/j.nuclphysb.2020.115212. arXiv: 2004.04611 [hep-ph].
- 17 R. Bufalo, M. Ghasemkhani, Z. Haghgouyan, and **A. Soto**. “Induced Maxwell–Chern–Simons effective action in very special relativity”. In: *Eur. Phys. J. C* 80.12 (2020), p. 1129.  DOI: 10.1140/epjc/s10052-020-08660-x. arXiv: 2004.02176 [hep-th].
- 18 Jorge Alfaro and **Alex Soto**. “Schwinger model à la Very Special Relativity”. In: *Phys. Lett. B* 797 (2019), p. 134923.  DOI: 10.1016/j.physletb.2019.134923. arXiv: 1907.06273 [hep-th].
- 19 Jorge Alfaro and **Alex Soto**. “Photon mass in very special relativity”. In: *Phys. Rev. D* 100.5 (2019), p. 055029.  DOI: 10.1103/PhysRevD.100.055029. arXiv: 1901.08011 [hep-th].
- 20 Sander Mooij, Gonzalo A. Palma, Grigoris Panotopoulos, and **Alex Soto**. “Consistency relations for sharp inflationary non-Gaussian features”. In: *JCAP* 09 (2016), p. 004.  DOI: 10.1088/1475-7516/2016/09/004. arXiv: 1604.03533 [astro-ph.CO].
- 21 Sander Mooij, Gonzalo A. Palma, Grigoris Panotopoulos, and **Alex Soto**. “Consistency relations for sharp features in the primordial spectra”. In: *JCAP* 10 (2015). [Erratum: *JCAP* 02, E01 (2016)], p. 062.  DOI: 10.1088/1475-7516/2015/10/062. arXiv: 1507.08481 [astro-ph.CO].
- 22 Gonzalo A. Palma and **Alex Soto**. “B-modes and the sound speed of primordial fluctuations”. In: *Phys. Rev. D* 91 (2015), p. 063525.  DOI: 10.1103/PhysRevD.91.063525. arXiv: 1412.0033 [hep-th].

Seminars and conferences

Conference talks

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| Jan 2018 |  | “One loop electron Self energy in VSR QED with a VSR photon mass”, La Parte y el todo, Afunalhue, Chile. |
| Nov 2018 |  | “Aspects on QED in Very Special Relativity”, SOCHIFI, Antofagasta, Chile |
| |  | “QED Process in Very Special Relativity”, XII Latin American Symposium on High Energy Physics, Lima, Peru |
| Jan 2019 |  | “QED Process in Very Special Relativity”, La Parte y el todo, Afunalhue, Chile |
| Jun 2019 |  | “Two dimensional chiral anomaly in Very Special Relativity”, Workshop Cosmology and Particles, Chillan, Chile |
| Jan 2021 |  | “Dynamical Majorana Neutrino Masses and Axions”, Virtual Talk, La Parte y el todo, Chile |
| Aug 2022 |  | “Unified description of corpuscular and fuzzy scalar dark matter”, COSMO 22, Rio de Janeiro, Brazil |

Seminars and conferences (continued)

- Jan 2023  “Unified description of corpuscular and fuzzy scalar dark matter”, UK QFT XI, Cambridge, UK
- Apr 2023  “Unified description of corpuscular and fuzzy bosonic dark matter”, IberiCos 2023, Ponte de Lima, Portugal
- Sep 2023  “Unified model for particles and condensate Dark Matter: The importance of the self-interaction”, COSMO 23, Madrid, Spain
- Jul 2024  “Unified model for particles and condensate Dark Matter: The role of self-interaction”, 15th International Workshop on the Identification of Dark Matter, L'Aquila, Italy
- Sep 2024  “Bosonic Dark Matter: How to mix Particle Physics, Cosmology and Cold Atom Physics”, Applications of Field Theory to Hermitian and Non-Hermitian Systems, Invited talk, London, UK

Seminars

- Apr 2020  “Looking QED through the glasses of Very Special Relativity”, University of Sussex, UK
- May 2020  “Looking QED through the glasses of Very Special Relativity”, University of Edinburgh, UK
- Jun 2020  “Looking QED through the glasses of Very Special Relativity”, Pontificia Universidad Católica de Chile, Chile
-  “Looking QED through the glasses of Very Special Relativity”, Cavendish Laboratory, University of Cambridge, UK
- Oct 2020  “An introduction of Very Special Relativity”, University of Plymouth, UK
- Nov 2023  “Bose-Einstein condensates as Dark Matter: A talk between particle physics, cosmology and cold atom physics”, Newcastle University, UK
- Oct 2024  “Bosonic Dark Matter: combining cosmology and cold atom physics”, U. del Bio-Bio, Chile
- Nov 2025  “A common language in cosmology and cold atoms: Quantum field theory tools”, IFPAN, Poland

Posters presented

- Sep 2014  “Corrections to the sound speed limit in cosmic inflation”, SOCHIFI, Concepcion, Chile
- Nov 2022  “Unified description of corpuscular and fuzzy scalar dark matter”, Virtual edition, 4th Kashiwa Dark Matter Symposium, Japan
- Jun 2026  “A Self-Consistent Quantum Kinetic Theory for Ultracold Bose Gases with Long-Range Interactions”, Workshop and School on Frontiers in ultracold quantum gases, Mahon, Spain

Fellowships and grants

- 2013 - 2015  Conicyt National Master's Grant: CONICYT-PCHA/MagisterNacional/2013-221320624
- 2016 - 2020  Conicyt National Doctoral Grant: CONICYT-PFCHA/Doctorado Nacional/2017-21171194
- 2020  ANID Grant for Research Internship Abroad N°21171194
- 2025-2027  Marie Skłodowska-Curie Actions (MSCA) Postdoctoral Fellowship Project 101209941 - BosLong

Other Activities

Peer Review	 Physics Letters B
	 JCAP
	 Nuclear Physics B
Web maintenance	 Aug 2011 - Jan 2012 - Maintenance of the website of the Physics Department, Faculty of Science, Universidad de Chile
Outreach	 Nov 2019 - Judge at a school science fair in Colegio Adventista Buenaventura, Chile
	 Apr 2024 - Virtual Talk “Discovering the light in the universe” for rural school “El Tayán”, Monte Patria, Chile

Other Skills

Other Courses	 Machine Learning by Stanford University in Coursera
Coding	 Python, C, C++, Perl, Mathematica, PHP, $\text{\LaTeX}$
Databases	 MySQL
Web Dev	 HTML, CSS
Languages	 Spanish (native) and English (fluent)