Carlos Argüelles

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Education

2012–2015 **University of Wisconsin at Madison**,
PhD. in Physics.

2009–2012 **Pontificia Universidad Católica del Perú**,
M. Sc. in Physics.

2004–2008 **Pontificia Universidad Católica del Perú**,
Ba. Sc. in Physics.

Professional Experience

Jul. 2020 – Ongoing **Assistant Professor**, Harvard University.
Department of Physics, Faculty of Arts and Sciences

Oct. 2015 – Jul. 2020 **Postdoctoral Research Associate**, Massachusetts Institute of Technology.
Researcher in Janet Conrad's group.

Jul. 2012 – Aug. 2015 **Research Assistant**, University of Wisconsin - Madison.
Research assistant under the supervision of Francis Halzen.

Mar. 2010 – Jul. 2012 **Research Assistant**, Pontificia Universidad Católica del Perú.
Research assistant under the supervision of Alberto Gago.

Mar. 2010 – Dec. 2010 **Teacher**, Colegio Santa Margarita.
High school physics teacher.

Mar. 2007 – Dec. 2011 **Teaching Assistant**, Pontificia Universidad Católica del Perú.
Teaching assistant in undergraduate courses.

Awards and Fellowships

2021 International Union of Pure and Applied Physics Young Scientist Prize in Astroparticle Physics.

2021 Sloan Research Fellow (awarded 75,000 US$).

2020 IceCube Collaboration Impact Award for "for key contributions in the development of a suite software tools used broadly in IceCube analyses, and his leading efforts in the advancement of diversity, equity and inclusion within the collaboration."

2017 American Physical Society Division of Astroparticle Physics thesis award finalist.

2015-2020 Wisconsin IceCube Particle Astrophysics Center (WIPAC) Honorary Fellow.

2011 Fermilab Theory Group Latin American Fellow.

2007-2008 Scholarships to spend a summer semesters at *Instituto de Matemática Pura e Aplicada* (IMPA).

2006 Scholarships for outstanding performance in physics to continue his undergraduate and graduate studies in physics at *Pontificia Universidad Católica del Perú*.

Collaboration Leadership, Community Involvement, and Outreach

2020 **Judge**, *ENVISION: Female STEM competition*.
ENVISION is a semester-long research competition that encourages female high school students interested in STEM to apply their scientific knowledge in an area of their interest. Competitors must work in groups of four or less to write a research proposal.

Oct. 2018 – ongoing **Beyond the Standard Model Working Group Technical Leader**, IceCube Collaboration.

May 2017 – ongoing **IceCube Diversity Taskforce Member**, IceCube Collaboration.

2016 **El Universo es Tuyo**, IceCube Collaboration Spanish Master Class.
Outreach activity for Spanish speakers.

Journal Referee.
Referee for Journal of Cosmology and Astroparticle Physics, Journal of High Energy Physics, European Physical Journal C, International Journal of Modern Physics A, Modern Physics Letters A, Physics Letters B, and Physical Review Letters

Grant Review.
Referee for National Science Foundation and FWF Austrian Science Fund

Workshop and conference organizations.
co-organizer of IceDUNE Workshop, 2021

Teaching Experience

International Schools and Workshops

Aug. 2019 **ICTP-SFAIR School on High-Energy Astrophysics**, São Paulo, Brazil.
Invited lecturer on high-energy neutrino physics. Developed course syllabus and practical exercises.

Undergraduate Level Teaching

Jan. 2021 – May. 2021 **Harvard University**, Cambridge, MA, USA.
Main lecturer of Electricity and Magnetism (15b).

Mar. 2007 – Dec. 2011 **Pontificia Universidad Católica del Perú**, Lima, Peru.
Teaching assistant in the General Science Studies, General Humanity Studies, and Science and Engineering departments. In these departments I was a teaching assistant of the following classes:
- In General Science Studies: Calculus 2, Calculus 4, General Physics 2, and Introduction to University Physics;
- In Science and Engineering: Probability, Probability and statistics, Computational techniques in physics, and Elementary particles;
- In General Humanity Studies: Cosmology and Introduction to experimental sciences.

High School Level Teaching

Mar. 2010 – Dec. 2010 **Colegio Santa Margarita**, Lima, Peru.
Was responsible of general physics for two senior high school classes of thirty students each. Designed syllabus of lectures, evaluations, and laboratory classes.

Invited Seminars and Talks

2021 Colloquia Harvard-Smithsonian Center for Astrophysics, Cambridge, Massachusetts, USA.

2021 Seminars Ohio State University, Columbus, Ohio, USA; Virginia Tech, Blacksburg, Virginia, USA; King's College London, London, UK; Kavli IPMU, Kashiwa, Japan.

2020 Colloquia Case Western Reserve University, Cleveland, Ohio, USA; Pabna University of Science and Technology, Pabna, Bangladesh.

2020 Seminars Michigan State University, East Lansing, Michigan, USA.

2019 Colloquia Sungkyunkwan University, Seoul, Korea; Universidade Estadual Paulista and ICTP-SAIFR, Sao Paulo, Brazil.

2019 Seminars Université Libre de Bruxelles, Brussels, Belgium; Los Alamos National Laboratory, Los Alamos, NM, USA; FermiLab LPC Physics Forum, Batavia, IL, USA; Durham University, Durham, UK; Harvard, Cambridge, MA, USA; Massachusetts Institute of Technology, Cambridge, MA,USA; Rutgers University, New Brunswick, NJ, USA; Pontificia Universidad Católica del Perú, Lima, Peru.

2019 Webinars Invisible Network, Europe.

2018 Seminars Niels Bohr Institute, Copenhagen, Denmark.

2017 Seminars Massachusetts Institute of Technology, Cambridge, MA, USA; Wayne State University, Detroit, MI, USA; FermiLab Theory Group, Batavia, IL,USA; DESY-Zeuthen, Berlin, Germany.

2016 Seminars — University of Washington, Seattle, WA, USA; Brookhaven National Laboratory, Upton, NY, USA; Instituto de Física Corpuscular, Valencia, Spain; Yale Wright Laboratory, New Haven, CT, USA; California Institute of Technology, Pasadena, CA, USA; Columbia University, New York City, NY, USA; University of Michigan at Ann Arbor, Ann Arbor, MI, USA; SLAC National Accelerator Laboratory, Menlo Park, CA, USA; Northwestern University, Evanston, IL, USA; Ohio State University, Columbus, OH, USA.

2016 Webinars — Latin American Webinars on Physics, America.

2015 Seminars — Harvard, Cambridge, MA, USA; Massachusetts Institute of Technology, Cambridge, MA, USA; Pennsylvania State University, College Park, PA, USA.

Conferences and Workshops

Invited Plenary Talks

Aug. 2018 **TeVPa2018**, Berlin, Germany.

Plenary Talks

May 2019 **Eight Meeting on CPT and Lorentz Symmetry**, Bloomington, IN, USA.

Aug. 2018 **nuFACT**, Blacksburg, VA, USA.

Jun. 2017 **Rencontre du Vietnam**, Quy Nhon, Vietnam.

Jun. 2016 **Seventh Meeting on CPT and Lorentz Symmetry**, Bloomington, IN, USA.

Invited Parallels

Jul. 2021 **Sterile Neutrino Search at Underground Detectors**, Institute for Basic Science, Korea.

Apr. 2021 **American Physical Society April Meeting**, Online format, USA.

Mar. 2021 **Workshop on Interplay of Neutrino and Dark matter Experiments and Exotic Searches**, Nagoya, Japan.

Oct. 2019 **Neutrino Platform Week**, CERN, Geneva, Switzerland.

Sep. 2019 **NEPLES**, KIAS, Seoul, Korea.

Jun. 2019 **Rencontres de Blois**, Blois, France.

Jun. 2019 **Workshop on Non-standard Interactions in Neutrino Experiments**, St. Louis, MO, USA.

Jun. 2018 **PANE**, ICTP, Trieste, Italy.

Mar. 2017 **PINS**, SLAC, Menlo Park, CA, USA.

Jan. 2017 **American Physical Society April Meeting**, District of Columbia, USA.

Sep. 2016 **TeVPa**, CERN, Geneva, Switzerland.

Apr. 2016 **American Physical Society April Meeting**, Salt Lake City, Utah, USA.

Parallel Talks

May. 2020 **Phenomenology 2020 Symposium**, Pittsburgh, PA, USA.

Oct. 2019 **PPNT**, Uppsala, Sweden.

Aug. 2017 **TeVPa**, Columbus, Ohio, USA.

Jul. 2017 **VietNus**, Quy Nhon, Vietnam.

May 2017 **IPA**, Madison, WI, USA.

Jan. 2017 **American Physical Society April. Meeting**, District of Columbia, USA.

Dec. 2016 **Astroparticle Physics at Ecuador**, Quito, Ecuador.

Sep. 2016 **TeVPa**, Geneva, Switzerland.

Aug. 2016 **International Conference of High-Energy Physics**, Chicago, IL, USA.

Sep. 2015 **Very Large Volumne Neutrino Telescope**, Rome, Italy.

Jun. 2015 **Weak Interactions and Neutrinos**, Heidelberg, Germany.

Mar. 2012 **PASI: Exploring the Terascale and Beyond**, Buenos Aires, Argentina.

Poster Presentations

Jun. 2020 **Neutrino**, Chicago, IL, USA.

Jul. 2019 **36th International Cosmic-Ray Conference**, Madison, WI, USA.

Jul. 2018 **Neutrino**, Heidelberg, Germany.

Jul. 2016 **Neutrino**, London, UK.

Jun. 2015 **Invisibles**, Madrid, Spain.

Dec. 2010 **VII Simposio Latinoamericano de Física de Altas Energías**, Valparaiso, Chile.

Peer-reviewed Publications

My ORCID is https://orcid.org/0000-0003-4186-4182. For a full publication list go to: http://inspirehep.net/search?p=exactauthor%3AC.A.Arguelles.1&sf=earliestdat

Selected Publications in Particle Physics

Closing the Neutrino BSM Gap: Physics Potential of Atmospheric Through-going Muons at DUNE, Preprint arXiv:2106.01508, Austin Schneider, Barbara Skrzypek, Carlos A. Argüelles, Janet M. Conrad, Submitted to the *Physical Review D*.

Contribution: Guided graduate students and wrote paper.

Explaining the MiniBooNE Excess Through a Mixed Model of Oscillation and Decay, Preprint arXiv:2105.06470, Stefano Vergani, Nicholas W. Kamp, Alejandro Diaz, Carlos A. Argüelles, Janet M. Conrad, Mike H. Shaevitz, Melissa A. Uchida, Submitted to the *Physical Review Letters*.

Contribution: Designed model, guided graduate students, and wrote paper.

Millicharged Particles from the Heavens: Single- and Multiple-Scattering Signatures, Preprint arXiv:2104.13924, Carlos A. Argüelles, Kevin J. Kelly, Victor M. Muñoz, Submitted to the Journal of High Energy Physics.

Contribution: Wrote millicharged particle Monte Carlo, implemented Super-Kamiokande analysis, guided graduate students, and wrote paper.

An eV-scale sterile neutrino search using eight years of atmospheric muon neutrino data from the IceCube Neutrino Observatory, Phys. Rev. Letters 125, 141801 (2020), IceCube Collaboration, Preprint arXiv:2005.12942.

Contribution: One of the leading authors. Guided graduate students, wrote analysis framework, wrote paper, and developed Bayesian analysis.

Searching for eV-scale sterile neutrinos with eight years of atmospheric neutrinos at the IceCube neutrino telescope, Phys. Rev. D 102, 052009 (2020), IceCube Collaboration, Preprint arXiv:2005.12943.

Contribution: One of the leading authors. Guided graduate students, wrote analysis framework, wrote paper, and developed Bayesian analysis.

Dark Matter Annihilation to Neutrinos: An Updated, Consistent & Compelling Compendium of Constraints, Preprint arXiv:1912.09486, C.A. Argüelles, A. Diaz, A. Kheirandish, A. Olivares-Del-Campo, I. Safa, and A. C. Vincent, Submitted to *Review of Modern Physics*.

Contribution: Reviewed constraints and experiments. Guided graduate students.

Searches for Atmospheric Long-Lived Particles, Journal of High Energy Physics volume 2020, Article number: 190 (2020), C.A. Argüelles, P. Coloma, P. Hernández, and V. Muñoz, Preprint arXiv:1910.12839.

Contribution: Wrote code to compute cosmic-ray air shower meson distributions and provided input on IceCube limitations and capabilities.

Combining Sterile Neutrino Fits to Short Baseline Data with IceCube Data, Phys. Rev. D 101, 055020 (2020), M.H. Moulai, C.A. Argüelles, G. Collin, J.M. Conrad, A. Diaz, and M. Shaevitz, Preprint arXiv:1910.13456.

Contribution: Guided graduate students and wrote the paper.

Where Are We With Light Sterile Neutrinos?, Phys.Rept. 884 (2020), A. Diaz, C.A. Argüelles, G. Collin, J.M. Conrad, and M. Shaevitz, Preprint arXiv:1906.00045.

Contribution: Made general edits and paper writing. Mainly contributed in the sections related to: new statistical treatments, sterile neutrinos in non-accelerator sources, astrophysical neutrinos, and cosmology.

Testing New Physics Explanations of MiniBooNE Anomaly at Neutrino Scattering Experiments, Phys. Rev. Lett. 123, 261801, C.A. Argüelles, M. Hostert, and Y.-D. Tsai, Preprint arXiv:1812.08768.

Contribution: Developed phenomenology, guided graduate students, and performed part of the analysis.

Exploring a Nonminimal Sterile Neutrino Model Involving Decay at IceCube, Phys. Rev. D 97, 055017, Z. Moss, M. H. Moulai, C. A. Argüelles, and J. Conrad, Preprint arXiv:1711.05921.

Contribution: Developed phenomenology, guided graduate student and undergrad on analysis.

Neutrino Interferometry for High-Precision Tests of Lorentz Symmetry with IceCube, Nature Physics (2018), IceCube Collaboration, Preprint arXiv:1709.03434.

Contribution: Developed phenomenology, did analysis, and guiding graduate student on the analysis.

First Constraints on the Complete Neutrino Mixing Matrix with a Sterile Neutrino, Phys. Rev. Letters 117 221801 (2016), G.H. Collin, C.A. Argüelles, J.M. Conrad, and M.H. Shaevitz, Preprint arXiv:1607.00011.

Contribution: Integrated IceCube into the global fit. Determined the allowed range of extended PMNS matrix element parameters.

Searches for Sterile Neutrinos with the IceCube Detector, Phys. Rev. Letters 117 071801, IceCube Collaboration, Preprint arXiv:1605.01990.

Contribution: Paper associated with my thesis analysis; see thesis for detailed contributions.

Dark Gauge Bosons: LHC Signatures of Non-Abelian Kinetic Mixing, Phys. Let. B 2017.04.037, C.A. Argüelles, X.-G. He ,G. Ovanesyan, T. Peng, and M. Ramsey-Musolf, Preprint arXiv:1604.00044.

Contribution: Implemented the model in MadGraph.

Sterile Neutrino Fits to Short Baseline Data, Nucl. Phys. B908 (2016) 354-365, G.H. Collin, C.A. Argüelles, J.M. Conrad, and M.H. Shaevitz, Preprint arXiv:1607.00011.

Contribution: Guided graduate student.

The High-Energy Behavior of Photon, Neutrino and Proton Cross Sections, Phys. Rev. D92 (2015) no.7, 074040, C.A. Argüelles, F. Halzen, L. Wille, M. Kroll, and M. H. Reno, Preprint arXiv:1504.06639.

Contribution: Performed the calculations described in the text in parallel with L. Wille and M. Kroll.

Searching for cavities of various densities in the Earth's crust with a low-energy electron-antineutrino beta-beam, Mod. Phys. Lett. A30 (2015) no. 29, 1550148, C.A. Argüelles, M. Bustamante, and A.M. Gago, Preprint arXiv:1201.6080.

Contribution: Implemented oscillations in the presence of cavities, performed the analysis, wrote paper text and made figures.

Selected Publications in Astrophysics and Astroparticle Physics

The Future of High-Energy Astrophysical Neutrino Flavor Measurements, Preprint arXiv:2012.12893, Ningqiang Song, Shirley Weishi Li, Carlos A. Argüelles, Mauricio Bustamante, and Aaron C. Vincent, Submitted to *Physical Review D*.

Contribution: Started the work, analysis discussion, and wrote text.

The IceCube high-energy starting event sample: Description and flux characterization with 7.5 years of data, Preprint arXiv:2011.03545, IceCube Collaboration, Submitted to *Physical Review D*.

Contribution: One of the leading authors. Guided graduate students, wrote analysis framework, design astrophysical model test, wrote paper, and developed Bayesian analysis.

Measurement of Astrophysical Tau Neutrinos in IceCube's High-Energy Starting Events, Preprint arXiv:2011.03561, IceCube Collaboration, Submitted to *Physical Review Letters*.

Contribution: One of the leading authors. Guided graduate students, wrote analysis framework, and developed statistical analysis.

χaroν: a tool for neutrino flux generation from WIMPs, Journal of Cosmology and AstroParticle Physics 10.1088/1475-7516/2020/10/043, Q. Liu, J. Lazar, C.A. Argüelles, A. Kheirandish, Preprint arXiv:2007.15010.

Contribution: Wrote dark matter capture calculation, improved treatment of `nuSQUIDS` solar neutrino propagation, guided graduate students, and edited paper.

Probe of Sterile Neutrinos Using Astrophysical Neutrino Flavor, Journal of Cosmology and Astroparticle Physics 10.1088/1475-7516/2020/02/015, C.A. Argüelles, K. Farrag, T. Katori, R. Khandelwal, S. Mandalia, J. Salvado, Preprint arXiv:1909.05341.
Contribution: Conceived idea, guided graduate students, and edited the paper.

Observing EeV neutrinos through the Earth: GZK and the anomalous ANITA events, Journal of Cosmology and Astroparticle Physics 2001 (2020) no.01, 012, I. Safa, A. Pizzuto, C. Argüelles, F. Halzen, R. Hussain, A. Kheirandish, J. Vandenbroucke, Preprint arXiv:1909.10487.
Contribution: Developed structure of neutrino propagation algorithm and guided graduate students.

Solar Atmospheric Neutrinos and the Sensitivity Floor for Solar Dark Matter Annihilation Searches, Journal of Cosmology and Astroparticle Physics 07(2017)024, C.A. Argüelles, G. de Wasseige, A. Fedynitch, and B.J.P. Jones, Preprint arXiv:1703.07798.
Contribution: Wrote code that propagated neutrino fluxes through the Sun and wrote the discussion of oscillation physics and neutrino transport on the paper.

Imaging Galactic Dark Matter with High-Energy Cosmic Neutrinos, Phys. Rev. Letters 119 201801 (2017), C.A. Argüelles, A. Kheirandish, and A. C. Vincent, Preprint arXiv:1703.00451.
Contribution: Initiated the idea, developed the phenomenology in collaboration with a theorist, and developed likelihood framework for the analysis.

Production of keV Sterile Neutrinos in Supernovae: New Constraints and Gamma Ray Observables, Phys. Rev. D 99, 04301, C.A. Argüelles, V. Brdar, and J. Kopp, Preprint arXiv:1605.00654.
Contribution: Performed calculations detailed in the paper in parallel with V. Brdar.

New Physics in Astrophysical Neutrino Flavor, Phys. Rev. Letters 115 161303, C.A. Argüelles, T. Katori, and J. Salvado, Preprint arXiv:1506.02043.
Contribution: Equal contributions from the three authors on this work.

Sterile Neutrinos and Indirect Dark Matter Searches in IceCube, Journal of Cosmology and Astroparticle Physics 07:016,201, C.A. Argüelles and J. Kopp, Preprint arXiv:1202.3431.
Contribution: Performed the calculations and analysis described in the paper.

The Brightening of Saturns's F Ring, Icarus, 2012,219, 181-193, doi:10.1016/j.icarus.2012.02.020, Preprint arXiv:1408.2536.
Contribution: Processed Cassini's raw data.

IceCube Expectations for Two High-Energy Neutrino Production Models at Active Galactic Nuclei, Journal of Cosmology and Astroparticle Physics 1012:005,2010, C.A. Argüelles, M. Bustamante, and A.M. Gago, Preprint arXiv:1008.1396.
Contribution: Performed the statistical analysis, made model comparison plots, and collaborated on article writing.

Selected Publications in Statistics, Computing, and Experimental Methods

LeptonInjector and LeptonWeighter: A neutrino event generator and weighter for neutrino observatories, Preprint arXiv:2012.10449, IceCube Collaboration, Submitted to Comput.Phys.Commun..
Contribution: Worked in code design, wrote first implemetation of LeptonWeighter, guided graduate students to improve and integrate the project in IceCube software, and maintains the code.

A Simple Quantum Integro-Differential Solver (SQuIDS), Comput.Phys.Commun. 255 (2020) 107405, C.A. Argüelles, J. Salvado, and Christopher N. Weaver.
Contribution: Updated version of the SQuIDS software. Worked on code and documentation.

Pulse Shape Particle Identification by a Single Large Hemispherical Photo-Multiplier Tube, JINST 15 (2020) 05, T05002, S. Samani, S. Mandalia, C. Argüelles, S. Axani, Y. Li, M.H. Moulai, B. Ty, Z. Xie, J. Conrad, T. Katori, P. Sandstrom, Preprint arXiv:1912.03901.
Contribution: Run the experiment and guided graduate students.

Efficient propagation of systematic uncertainties from calibration to analysis with the SnowStorm method in IceCube, Journal of Cosmology and Astroparticle Physics 1910 (2019) no.10, 048, IceCube Collaboration, Preprint arXiv:1909.01530.
Contribution: Development of method and guided graduate students.

Neutrino oscillations in a quantum processor, Phys. Rev. Research. 1 (2019) 033176, C.A. Argüelles and B.J.P. Jones, Preprint arXiv:1904.10559.
Contribution: Equal contribution of all authors.

A binned likelihood for stochastic models, Journal of High Energy Physics 06 (2019) 030., C.A. Argüelles, A. Schneider, and T. Yuan, Preprint arXiv:1901.04645.

Contribution: Participated in the likelihood construction, guided graduate student, and wrote sections of the paper.

Unified atmospheric neutrino passing fractions for large-scale neutrino telescopes, Journal of Cosmology and Astroparticle Physics 1807 (2018) no. 07, 047, C.A. Argüelles, S. Palomares-Ruiz, A. Schneider, L. Wille, and T. Yuan, Preprint arXiv:1805.11003.

Contribution: Developed the phenomenology and performed parts of the calculation.

High-energy neutrino attenuation in the Earth and its associated uncertainties, Journal of Cosmology and Astroparticle Physics 11(2017)012, A. C. Vincent, C.A. Argüelles, and A. Kheirandish, Preprint arXiv:1706.09895.

Contribution: Estimated neutrino cross section uncertainties and collaborated in development of the nuFATE code.

A Simple Quantum Integro-Differential Solver (SQuIDS), Computer Physics Communications 196 (2015) 569-591, C.A. Argüelles, J. Salvado, and Christopher N. Weaver, Preprint arXiv:1412.3832.

Contribution: Developed algorithm and wrote package code.