

HUGO ALBERTO AYALA SOLARES

PhD ASTROPHYSICS

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WORK EXPERIENCE

Assistant Research Professor

Pennsylvania State University

January 2022 – Ongoing

State College, PA, United States

- Updating and maintaining the Astrophysical Multimessenger Observatory Network (AMON) at Pennsylvania State University.
- Search of sources of gamma-ray and neutrino emission by using a multimessenger approach.
- Member of the High Altitude Water Cherenkov (HAWC) Observatory.
- Member of the Southern Wide-field Gamma-ray Observatory (SWG0).
- Science and Multimessenger/Multiwavelength coordinator in HAWC.
- Associate Member of the IceCube Neutrino Observatory.

Postdoctoral Scholar

Pennsylvania State University

May 2017 – December 2021

State College, PA, United States

- Building the Astrophysical Multimessenger Observatory Network (AMON) at Pennsylvania State University.
- Study gamma-ray emission from large-scale structures with HAWC data.
- Develop realtime coincidence analyses between different datasets to find interesting candidate multimessenger sources.

PhD Researcher

Michigan Technological University

August 2011 – May 2017

Houghton, MI, United States

- Created and maintained laser calibration system of the HAWC detector.
- Developed algorithms to reconstruct astrophysical events.
- Developed an algorithm to search for weak signal in high-level background

Research Intern

Photonics and Mathematical Optics Group, ITESM

Spring 2011

Monterrey, N.L., México

- Studied equations for spiral profiles of light after passing through birefringent objects.

TEACHING EXPERIENCE

Classes and Laboratories

- Spring 2016
 - Spring 2016-Instructor for Waves and Thermodynamics Lab MTU
 - Fall 2013-Instructor for Astronomy Lab MTU
 - Spring 2013-Instructor for Astronomy Lab MTU
 - Fall 2012-Instructor for Electromagnetism Lab MTU
 - Spring 2012-Instructor for Classical Mechanics Lab MTU
 - Fall 2011-Instructor for Classical Mechanics Lab MTU
 - Fall 2010-Teaching Assistant for Electromagnetic Theory Class ITESM
 - Spring 2009-Instructor for Classical Mechanics Lab ITESM
 - Fall 2008-Physics and Mathematics Adivser ITESM
 - Fall 2007-Physics and Mathematics Adivser ITESM
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Mentoring

- Mentoring 9 undergraduates and 4 graduate students at Pennsylvania State University (Fall 2020-Fall 2022). Projects involve the use of HAWC data to identify unidentified gamma-ray sources as well as search for extragalactic sources.

LANGUAGES

Spanish (Native Language)

English (Fluent)

German (Intermediate)

EDUCATION

Ph.D. in Physics

Michigan Technological University

📅 August 2011 - May 2017

📍 Houghton, MI, United States

Thesis title: "[Search for High-Energy Gamma Rays in the Northern Fermi Bubble Region with the HAWC Observatory](#)"

Advisor: Dr. Petra Hütemeyer (University of Hamburg/DESY)

B.Sc. in Engineering Physics

Instituto Tecnológico y de Estudios Superiores de Monterrey

📅 August 2006 - December 2010

📍 Monterrey, N.L., México

Advisor: Dr. Alfonso Serrano Heredia

International Exchange Program

Michigan Technological University

📅 August 2009 - June 2010

📍 Houghton, MI, United States

RESEARCH GRANTS

- Swift Guest Investigator Program NASA Cycle 15 (\$38.5K)
- Swift Guest Investigator Program NASA Cycle 16 (\$38.5K)

PRESENTATIONS

- Congreso Nacional de Física, Zacatecas, México, 10/2022, **Invited**
- CRIS2022, Naples, Italy 09/2022
- Shanghai Jiao Tong University 05/2022, **Seminar**
- Pennsylvania State University 04/2022, **Seminar**
- APS meeting, New York 04/2022
- University of Alabama at Huntsville (UAH), Huntsville AL, 04/2022, **Seminar**
- HEAD meeting, Pittsburgh 03/2022
- Nazarbayev University, 02/2022, **Seminar**
- Low-latency alerts & Data analysis for Multimessenger Astrophysics Workshop 01/2022 **Invited**
- SciMMA [Public Online talk](#) 01/2022 **Invited**
- ICRC 2021 Online event 07/2021
- APS 2021 Online event 04/2021
- ICRC 2019 Madison, Wisconsin 07/2019
- IGC@25 State College, Pennsylvania State University 06/2019
- AMON Workshop Chiba, Japan 05/2019 **Invited**
- APS Denver, Colorado 04/2019
- Asterics Groningen, The Netherlands 03/2019 **Invited**
- Non-thermal Universe Cochem, Germany 09/2018 **Invited**
- VHEUP Quy Nhon, Vietnam 08/2018 **Invited**
- APS Columbus, Ohio 04/2018
- APS Washington, D.C. 01/2017
- Gamma16 Heidelberg, Germany 07/2016

- Fermi-VERITAS-HAWC Workshop Salt Lake City, Utah 04/2016
- APS Salt Lake City, Utah 04/2016
- Fermi Symposium Washington, D.C. 11/2015
- ICRC 2015 The Hague, Netherlands 08/2015
- APS Baltimore, MD 04/2015
- Graduate Research Colloquium at MTU Houghton, MI 02/2015 **Award best talk**
- Fermi-VERITAS-HAWC Workshop Madison, WI 10/14
- Fermi-VERITAS-HAWC Workshop Maryland, MD 02/14
- ICRC 2013 Rio de Janeiro, Brazil 07/13 **Poster**
- Fermi Summer School Delaware 05/13

SERVICE AND OUTREACH

- Part of the committee to organize the Postdoctoral Symposium at Penn State
- Jury member of PhD Thesis "TeV Spectra of Mrk 421 and Mrk 501 seen by HAWC" by Sara Coutiño de León
- Reviewer of manuscript submitted to Science
- Participated in AstroFest 2019 at Pennsylvania State University
- Astronomy nights at Michigan Tech 2016
- Physics outreach activities for elementary schools in Houghton, MI 2015

TECHNICAL SKILLS

- **Statistics** - Regression, Confidence intervals, Likelihood methods, Bayesian methods
- **Machine Learning** - Classification, Regression, Feature engineering, Bayesian optimization
- **Python** - NumPy, SciPy, pandas, scikit-learn, astropy, amonpy
- **C++**
- **Visualization** - matplotlib

AWARDS

- 2017 Henes Fellowship Assistant Award by Department of Physics at MTU
- 2016 Doctoral Finishing Fellowship Award by Graduate School at MTU
- 2016 Graduate Research Assistantship by Department of Physics at MTU
- 2012 Outstanding Teaching Assistant
- 2011-2015 Graduate Teaching Assistantship by Department of Physics at MTU
- 2010 Honorable Mention of Excellence by ITESM
- 2010 Dean's List 4.0 at MTU
- 2006-2010 Academic Excellence Scholarship by ITESM

PUBLICATIONS

Selected Articles

- Ayala Solares, H. A., Coutu, S., Cowen, D., Fox, D. B., Grégoire, T., McBride, F., ... Zhou, H. (2022). Search for Gamma-Ray and Neutrino Coincidences Using HAWC and ANTARES Data. *Submitted to ApJ*, arXiv:2209.13462. arXiv: 2209.13462 [astro-ph.HE]
- Albert, A., Alfaro, R., Alvarez, C., et al. (2021b). Evidence that ultra-high-energy gamma rays are a universal feature near powerful pulsars. *The Astrophysical Journal Letters*. doi:10.3847/2041-8213/abf4dc
- Albert, A., Alfaro, R., Alvarez, C., et al. (2021d). Probing the sea of cosmic rays by measuring gamma-ray emission from passive giant molecular clouds with HAWC. *The Astrophysical Journal*. doi:10.3847/1538-4357/abfc47
- Albert, A., Alvarez, C., Camacho, J. R. A., et al. (2021). A survey of Active Galaxies at TeV photon energies with the HAWC gamma-ray observatory. *The Astrophysical Journal*. doi:10.3847/1538-4357/abca9a
- Solares, H. A. A., Coutu, S., DeLaunay, J. J., et al. (2021). Multimessenger gamma-ray and neutrino coincidence alerts using HAWC and IceCube subthreshold data. *The Astrophysical Journal*. doi:10.3847/1538-4357/abcaa4
- Albert, A., Alfaro, R., Alvarez, C., et al. (2020a). 3hwc: The Third HAWC catalog of very-high-energy gamma-ray sources. *The Astrophysical Journal*. doi:10.3847/1538-4357/abc2d8
- Ayala Solares, H. A. [H. A.], Coutu, S., Cowen, D., et al. (2020). The Astrophysical Multimessenger Observatory Network (AMON): Performance and science program. *Astroparticle Physics*.

- Ayala Solares, H. A. [H. A.], Cowen, D. F., DeLaunay, J. J., et al. (2019). A search for cosmic neutrino and gamma-ray emitting transients in 7.3 yr of ANTARES and Fermi-LAT data. *The Astrophysical Journal*, 886(2), 98.
- Abeysekara, A., Albert, A., Alfaro, R., et al. (2018a). A search for dark matter in the galactic halo with HAWC. *Journal of Cosmology and Astroparticle Physics*, 2018(02), 049–049.
- Abeysekara, A., Albert, A., Alfaro, R., et al. (2018b). Very-high-energy particle acceleration powered by the jets of the microquasar SS 433. *Nature*, 82–85.
- Abeysekara, A. U., Albert, A., Alfaro, R., et al. (2017c). Search for very high-energy gamma rays from the northern fermi bubble region with HAWC. *The Astrophysical Journal*, 842(2), 85.

Journal Articles

- Albert, A., Alfaro, R., Alvarez, C., Álvarez, J. D., Camacho, J. R. A., Arteaga-Velázquez, J. C., ... HAWC Collaboration. (2022). HAWC Study of the Ultra-high-energy Spectrum of MGRO J1908+06. *The Astrophysical Journal*, 928(2), 116. doi:10.3847/1538-4357/ac56e5. arXiv: 2112.00674 [astro-ph.HE]
- Albert, A., Alfaro, R., Alvarez, C., Angeles Camacho, J. R., Arteaga-Velázquez, J. C., Arunbabu, K. P., ... Zepeda, A. (2022). Cosmic ray spectrum of protons plus helium nuclei between 6 and 158 TeV from HAWC data. *PRD*, 105(6), 063021. doi:10.1103/PhysRevD.105.063021. arXiv: 2204.06662 [astro-ph.HE]
- Albert, A., Alfaro, R., Alvarez, C., Camacho, J. R. A., Arteaga-Velázquez, J. C., Arunbabu, K. P., ... The Hawc Collaboration. (2022). Long-term Spectra of the Blazars Mrk 421 and Mrk 501 at TeV Energies Seen by HAWC. *The Astrophysical Journal*, 929(2), 125. doi:10.3847/1538-4357/ac58f6. arXiv: 2106.03946 [astro-ph.HE]
- Abeysekara, A. U., Albert, A., Alfaro, R., et al. (2021). HAWC observations of the acceleration of very-high-energy cosmic rays in the cygnus cocoon. *Nature Astronomy*. doi:10.1038/s41550-021-01318-y
- Albert, A., Alfaro, R., Alvarez, C., et al. (2021a). Evidence of 200 tev photons from HAWC J1825-134. *The Astrophysical Journal*. doi:10.3847/2041-8213/abd77b
- Albert, A., Alfaro, R., Alvarez, C., et al. (2021c). HAWC search for high-mass microquasars. *The Astrophysical Journal Letters*, 912(1), L4. doi:10.3847/2041-8213/abf35a
- Albert, A., Alfaro, R., Alvarez, C., et al. (2021e). Spectrum and morphology of the very-high-energy source HAWC J2019+368. *The Astrophysical Journal*. doi:10.3847/1538-4357/abecda
- Abeysekara, A. U., Albert, A., Alfaro, R., et al. (2020). Multiple galactic sources with emission above 56 TeV detected by HAWC. *Phys. Rev. Lett.*, 124, 021102.
- Akiyama, S., Alfaro, R., Alvarez, C., et al. (2020). Interplanetary magnetic flux rope observed at ground level by HAWC. *The Astrophysical Journal*, 905(1), 73. doi:10.3847/1538-4357/abc344
- Albert, A., Alfaro, R., Alvarez, C., et al. (2020b). Constraining the local burst rate density of primordial black holes with HAWC. *Journal of Cosmology and Astroparticle Physics*, 2020(04), 026–026.
- Albert, A., Alfaro, R., Alvarez, C., et al. (2020c). Constraints on lorentz invariance violation from HAWC observations of gamma rays above 100 TeV. *Phys. Rev. Lett.*, 124, 131101.
- Albert, A., Alfaro, R., Alvarez, C., et al. (2020d). Constraints on the Emission of Gamma-Rays from M31 with HAWC. *The Astrophysical Journal*, 893(1), 16.
- Albert, A., Alfaro, R., Alvarez, C., et al. (2020e). HAWC J2227+610 and its association with G106.3+2.7, a new potential galactic PeVatron. *The Astrophysical Journal*. doi:10.3847/2041-8213/ab96cc
- Albert, A., Alfaro, R., Alvarez, C., et al. (2020f). Search for gamma-ray spectral lines from dark matter annihilation in dwarf galaxies with the High-Altitude Water Cherenkov observatory. *Phys. Rev. D*, 101, 103001.
- Albert, A., Alfaro, R., Ashkar, H., et al. (2019). Science Case for a Wide Field-of-View Very-High-Energy Gamma-Ray Observatory in the Southern Hemisphere. *arXiv e-prints*, arXiv:1902.08429. arXiv: 1902.08429 [astro-ph.HE]
- Ayala Solares, H. A. [H. A.]. (2019). AMON Multimessenger Alerts: Past and Future. *Galaxies*, 7(1).
- Aartsen, M., Ackermann, M., Adams, J., et al. (2018). Multimessenger observations of a flaring blazar coincident with high-energy neutrino IceCube-170922a. *Science*, 361(6398).
- Albert, A., Alfaro, R., Alvarez, C., et al. (2018a). Dark matter limits from dwarf spheroidal galaxies with the HAWC gamma-ray observatory. *The Astrophysical Journal*, 853(2), 154.
- Albert, A., Alfaro, R., Alvarez, C., et al. (2018b). First hawc observations of the sun constrain steady TeV gamma-ray emission. *Phys. Rev. D*, 98, 123011.
- Turley, C. F., Fox, D. B., Keivani, A., et al. (2018). A coincidence search for cosmic neutrino and gamma-ray emitting sources using IceCube and Fermi-LAT public data. *The Astrophysical Journal*, 863(1), 64.
- Abbott, B. P., Abbott, R., Abbott, T. D., et al. (2017). Multi-messenger observations of a binary neutron star merger. *The Astrophysical Journal*, 848(2), L12.
- Abeysekara, A. U., Albert, A., Alfaro, R., et al. (2017a). Daily monitoring of TeV gamma-ray emission from Mrk 421, Mrk 501, and the crab nebula with HAWC. *The Astrophysical Journal*, 841(2), 100. doi:10.3847/1538-4357/aa729e

- Abeysekara, A. U., Albert, A., Alfaro, R., et al. (2017b). Observation of the crab nebula with the HAWC gamma-ray observatory. *The Astrophysical Journal*, 843(1), 39.
 - Abeysekara, A. U., Albert, A., Alfaro, R., et al. (2017d). The 2HWC HAWC observatory gamma-ray catalog. *The Astrophysical Journal*, 843(1), 40.
 - Abeysekara, A. U., Alfaro, R., Alvarez, C., et al. (2017). The HAWC real-time flare monitor for rapid detection of transient events. *The Astrophysical Journal*, 843(2), 116.
 - Abeysekara, A. U., Alfaro, R., Alvarez, C., et al. (2016). Search for TeV gamma-ray emission from point-like sources in the inner galactic plane with a partial configuration of the HAWC observatory. *The Astrophysical Journal*, 817(1), 3.
 - Abeysekara, A. U., Alfaro, R., Alvarez, C., et al. (2014a). Observation of small-scale anisotropy in the arrival direction distribution of TeV cosmic rays with HAWC. *The Astrophysical Journal*, 796(2), 108.
 - Abeysekara, A. U., Alfaro, R., Alvarez, C., et al. (2014b). Sensitivity of HAWC to high-mass dark matter annihilation. *Phys. Rev. D*, 90, 122002.
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Conference Proceedings

- Ayala Solares, H. A. [Hugo Alberto]. (2019). Studying Cosmic-ray Interactions in Giant Molecular Clouds with the HAWC Gamma-ray Observatory. (arXiv:1908.06073). arXiv: 1908.06073 [astro-ph.HE]
- Keivani, A., Ayala Solares, H. A., DeLaunay, J., & AMON Core Team. (2017). Astrophysical Multimessenger Observatory Network (AMON): Science, Infrastructure, and Status. In *35th international cosmic ray conference (icrc2017)* (Vol. 301, p. 629). arXiv: 1708.04724 [astro-ph.IM]