

## Jordan C. Hanson, PhD

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*Member of the IceCube Gen2 Collaboration*

*Summer Faculty Research Fellow for the Office of Naval Research*

*Recipient of the CCAPP Post-doctoral fellowship at The Ohio State University*

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<b>Position</b>	<b>Assistant Professor of Physics, Department of Physics and Astronomy, Whittier College, 2017-Present</b>	
<b>Skills</b>	<i>Extensive experience in high-energy physics research, engineering research, physics education, mentorship, and committee service at Whittier College.</i> <ul style="list-style-type: none"><li>• <b>Physics instruction at high-school, college, and graduate levels: introductory and advanced level</b></li><li>• <b>Computer science teaching: digital signal processing, digital circuit design at college level</b></li><li>• <b>Mathematics teaching: elementary statistics at college level, developed the first summer online statistics program in Whittier College history</b></li><li>• Computational Electromagnetism (CEM) research in RF antenna and phased array design for IceCube Gen2 and the Office of Naval Research (Whittier College)</li><li>• Workforce development and reliability analysis for the Office of Naval Research (Whittier College)</li><li>• Terabyte-scale data analysis and high-performance computing (Ohio State Univ. and UC Irvine)</li><li>• Building simulations and mathematical physics models (Ohio State Univ. and Whittier College)</li><li>• Organizing and leading expeditions to Antarctica to deploy physics hardware (UC Irvine)</li><li>• Performing radio-frequency field measurements and anechoic chamber measurements in support of physics objectives (UC Irvine, Univ. of Kansas)</li><li>• RF circuit design and testing/validation (UC Irvine, Univ. of Kansas)</li><li>• Created the RF design lab at Whittier College; extensive experience in RF test bench equipment, e.g. oscilloscopes, vector network analyzers/spectrum analyzers, power meters, and signal generators (UC Irvine, Univ. of Kansas, OSU, Whittier College)</li><li>• Software skill: C++, Python, MATLAB, Octave, Jupyter, MEEP, WaveDROM, LaTeX</li><li>• Organizing workshops and conferences, public speaking, outreach coordination</li><li>• Organizing and operating STEM recruitment and research programs for young women from local high school students interested in studying STEM at Whittier College</li><li>• Recipient of DEI grant for application development to foster inclusion in introductory STEM courses</li><li>• Studying DEI in introductory STEM through Cottrell Scholars Network</li></ul>	
<b>Education</b>	<ul style="list-style-type: none"><li>• Doctor of Philosophy (PhD), Physics, University of California, Irvine (March 2013)</li><li>• Master of Science (M.S), Physics, University of California, Irvine (August 2008)</li><li>• Bachelor of Science (B.S), Intensive Track, in Physics, Yale University (June 2007)</li></ul>	
<b>Research Experience</b>	<u>Whittier College</u>	Fall 2017 – Present
	<ul style="list-style-type: none"><li>• <b>Initiated a radio-frequency (RF) testing and design laboratory</b></li><li>• <b>Awarded three Summer Faculty Research Fellowships through the Office of Naval Research</b></li><li>• <b>Mentoring students in firmware and software design, electrical engineering</b></li><li>• <b>Mentoring students in mathematical physics research, publication on Askaryan radiation</b></li><li>• Helped a student create a firmware/software solution in order to upgrade ARIANNA detector boards</li><li>• Helped a student build a from-scratch drone, with designs for solar recharge and polar deployment</li><li>• Published research regarding RF propagation in polar ice and firn, interactions with ice/ocean floor</li><li>• Published mathematical physics model of Askaryan radiation with undergraduate researcher</li><li>• Developed a python-based FDTD model of broadband RF phased arrays for Navy radar testing with two undergraduate researchers</li><li>• Participated in workshop series entitled “Inclusivity in Introductory STEM Courses” through the Cottrell Scholars Network, research focusing on methodology for boosting inclusion and belonging in Introductory STEM courses for marginalized students</li><li>• Received Whittier College DEI grant for application development to boost inclusion in introductory STEM courses</li></ul>	

- Created a fully analytic model of the Askaryan effect adopted by the physics community
- Leading the data analysis to discover the world-record highest energy neutrinos
- Organized a workshop at Ohio State pertaining to improved analysis efficiency and machine learning
- Investigating ways to use smartphones as cosmic ray detection arrays

University of Kansas

Spring 2013 – Fall 2015

- Simulated radar-echoes of cosmic ray extensive air showers for the TARA collaboration
- Deployed radar detectors as part of the TARA remote station program
- Performed anechoic chamber measurements to calibrate the ARIANNA and TARA detectors
- Gained teaching and mentoring experience through the QuarkNet program
- Created and taught a summer physics course

University of California, Irvine

Summer 2007 - Spring 2013

- Designed, constructed, tested, and deployed the first ARIANNA neutrino detector in Antarctica
- Led the analysis of the first data collected by ARIANNA stations, constraining the ultra-high energy cosmogenic neutrino flux
- Independently organized and led expeditions to Antarctica to perform glaciological measurements in support of physics objectives
- Ran high-performance computing (HPC) codes, using machine learning, to train software to distinguish low-SNR impulses from RF thermal noise

Yale University

Summer 2006

- Performed Monte Carlo calculations of the interaction length of relativistic electrons in super-fluid helium in support of the XENON dark-matter detector innovation
- Designed a laser-scanning system to reveal helium molecules in superfluid helium

Los Alamos National Laboratory

Summer 2005

- Measured the muon Cherenkov tank event-rates over an altitude range of 0-14,000 ft. from the base to the summit of Mt. Evans, in Colorado, as part of the Milagro collaboration (now High Altitude Water Cherenkov detector)
- Compared results to cosmic-ray theory and presented at Milagro collaboration meeting

**References**

- Amy Connolly, PhD ... Prof. of Physics, The Ohio State University
- Steven Barwick, PhD ... Prof. of Physics, University of California, Irvine
- Dave Besson, PhD ... Prof. of Physics, University of Kansas
- Albrecht Karle, PhD ... Prof. of Physics, University of Wisconsin
- Gary Yeakley ... Retired Engineer at the Naval Surface Warfare Center, Corona, CA
- Jeffery Benson... Engineer at the Naval Surface Warfare Center, Corona, CA
- Allan Halgren, PhD ... Professor of Physics at Uppsala University, Uppsala, Sweden
- Stephanie Wissel, PhD ... Professor of Physics at Pennsylvania State University, State College, PA

**Published Papers**

- \*J.C. Hanson and R. Hartig “Complex Analysis of Askaryan Radiation: A Fully Analytic Model in the Time-Domain” *Physical Review D*, **105** 123019 (2022).
- The RNO-G Collaboration “In situ, broadband measurement of the radio frequency attenuation length at Summit Station, Greenland” arXiv:2201.07846 (2022). *Accepted for publication in the Journal of Glaciology*.
- \*J.C. Hanson “Broadband RF Phased Array Design with MEEP: Comparisons to Array Theory in Two and Three Dimensions” *Electronics Journal (MDPI)* **10** 4 (2021). *Acknowledged by editor as one of the top 10 papers in Electronics Journal for Dec. 2020 to May. 2021*.
- \*J.C. Hanson “Broadband RF Phased Array Design for UHE neutrino detection.” Proceedings of 37<sup>th</sup> International Cosmic Ray Conference, Berlin, Germany (2021).
- The RNO-G Collaboration “Design and sensitivity of the Radio Neutrino Observatory in Greenland (RNO-G)” *Journal of Instrumentation* **16** P03025 (2021).
- The ARIANNA Collaboration. “Probing the Angular and Polarization Reconstruction of the ARI-

\*Primary or  
Corresponding  
author

- ANNA Detector at the South Pole.” Journal of Instrumentation (JINST) **15** (2020) p. 09039
- C. Glaser *et al* “NuRadioMC: simulating the radio emission of neutrinos from interaction to detector.” European Physical Journal C (**80**) n. 77 (2020).
  - The ARIANNA Collaboration. “White Paper: ARIANNA-200 high energy neutrino telescope.” arXiv:2004.09841
  - The ARIANNA Collaboration. “Neutrino Vertex Reconstruction with In-Ice Radio Detectors using Surface Reflections and Implications for the Neutrino Energy Resolution.” Journal of Cosmology and Astroparticle Physics (JCAP) **11** (2019) p. 030
  - The ARIANNA Collaboration. “A Search for Cosmogenic Neutrinos with the ARIANNA Test-Bed using 4.5 Years of Data.” Journal of Cosmology and Astroparticle Physics (JCAP) **03** (2020) p. 053
  - \*J.C. Hanson et al. “Observation of classically ‘forbidden’ electromagnetic wave propagation and implications for neutrino detection.” Journal of Cosmology and Astroparticle Physics. (**2018**) (2018)
  - P. Allison et al. “Measurement of the real dielectric permittivity  $\epsilon_r$  of glacial ice.” Astroparticle Physics Journal **108** (2019) pp. 63-73
  - \*J.C. Hanson and A. Connolly. “Complex Analysis of Askaryan Radiation: A Fully Analytic Treatment including the LPM effect and Cascade Form Factor.” Astroparticle Physics. (**91**) pp. 75-89 (2017).
  - The ARIANNA Collaboration. “Radio detection of air showers with the ARIANNA experiment on the Ross Ice Shelf”, Astroparticle Physics (**90**) pp. 50-68 (2017).
  - The TARA Collaboration. “First Upper Limits on the Radar Cross Section of Cosmic-Ray Induced Extensive Air Showers”, Astroparticle Physics (**87**) pp. 1-17 (2017).
  - The ARIANNA Collaboration. “Live-time and sensitivity of the ARIANNA Hexagonal Radio Array.” Proceedings of the International Cosmic-Ray Conference 2015, The Hague, The Netherlands (2015).
  - The ARIANNA Collaboration. “Performance of the ARIANNA Hexagonal Radio Array.” Proceedings of the International Cosmic-Ray Conference 2015, The Hague, The Netherlands (2015).
  - The ARIANNA Collaboration. “A First Search for Cosmogenic Neutrinos with the ARIANNA Hexagonal Radio Array.” Astroparticle Physics Journal (70) pp. 12-36 (2015)
  - \*J.C. Hanson et al. “Time-Domain Response of the ARIANNA Detector.” Astroparticle Physics Journal (62) pp. 139-151 (2015).
  - \*J.C. Hanson et al. “Radar absorption, basal reflection, thickness and polarization measurements from the Ross Ice Shelf, Antarctica.” Journal of Glaciology (**61**) 227, pp. 438-446(9) (2015)
  - The ARIANNA Collaboration. “Design and Performance of the ARIANNA HRA-3 Neutrino Detector Systems.” IEEE Transactions on Nuclear Science (**62**) 5 pp. 2202-2215 (2015).
  - The TARA Collaboration. “Telescope Array Radar (TARA) observatory for Ultra-High Energy Cosmic Rays.” Nuclear Instrumentation and Methods in Physics Research, A (**767**) 322-338 (2014).
  - S. Kleinfelder et al. “Design and Performance of the Autonomous Data Acquisition System for the ARIANNA High Energy Neutrino Detector.” IEEE Transactions on Nuclear Science (**60**) 2, 612-618 (2013).
  - \*J.C. Hanson, for the ARIANNA Collaboration. “Ross Ice Shelf Thickness, Radio-Frequency Attenuation and Reflectivity: Implications for the ARIANNA UHE Neutrino Detector”. Proceedings of the 32<sup>nd</sup> International Cosmic Ray Conference, Beijing, China (2011).
  - L. Gerhardt, S.R. Klein, T. Stezelberger, S.W. Barwick, K. Dookayka, J.C. Hanson, R. Nichol. “A prototype station for ARIANNA: A detector for cosmic neutrinos.” Nuclear Instrumentation and Methods in Physics Research, A (**634**) 85-91, (2010).
  - W.G. Rellergert, S.B. Cahn, A. Garvan, J.C. Hanson, W.H. Lippincott, J.A. Nikkel, and D.N. McKinsey. “Detection and Imaging of He<sub>2</sub> Molecules in Superfluid Helium.” Physical Review Letters (**100**) 025301 (2008).

## Invited Lectures

- Invited to teach source entitled “Introduction to GPS Signals for Onboarding of Navy Personnel” (2022). *In service of the Office of Naval Research.*
- Invited to teach source entitled “RF Field Engineering: A practical introduction” (2021). *In service of the Office of Naval Research.*
- “IceCube-Gen2 Radio Array Surface Calibration: Opportunities from Unique Transmitter and Receiver Systems” (2021). *IceCube Generation 2 Calibration Workshop.*
- “Finite Difference Time-Domain Methods for Askaryan Propagation Modeling in IceCube-Gen2” (2021). *IceCube Generation 2 Calibration Workshop.*
- “Classically Forbidden Askaryan Radiation: A decade of exploration in Antarctica in the search for

- cosmic neutrinos” (2018) *Departmental Colloquium for Whittier College*
- “Ultra-high Energy Neutrinos, Antarctica, Greenland, and the Askaryan Effect: A Summary.” (2016) *Invited speaker for the particle physics seminars at Weizmann Institute, Rehovot, Israel, and at Technion University, Haifa, Israel.*
- “Ultra-high Energy Neutrinos, Antarctica, Greenland, and the Askaryan Effect: A Summary.” (2016) *Invited speaker to the TeV Particle Astrophysics (TeVPA) conference at CERN, Geneva, Switzerland.*
- “A Review of UHE neutrino detection using the Askaryan effect.” (2016) *Invited speaker to the Very High Energy particle Astrophysics (VHEPA) conference at the University of Hawaii, Honolulu, Hawaii.*
- “A Review of UHE neutrino detection using the Askaryan effect.” (2016) *Invited speaker to the KICP Workshop, UHEAP 2016, University of Chicago, Chicago, IL.*
- “A Review of UHE neutrino detection using the Askaryan effect.” (2015) *Invited speaker to the KICP Workshop on the Giant Radio Array for Neutrino Detection, University of Chicago, Chicago, IL.*
- “Future Prospects of UHE neutrino detection with Electromagnetic Fields.” (2014) *Invited speaker to the Very High Energy particle Astrophysics (VHEPA) conference at the University of Tokyo (Kashiwa), Kashiwa, Japan.*
- “Searching for Cosmic Rays with the Telescope Array Radar Experiment.” (2014) *Department colloquium at the University of Kansas.*
- “Ultra-high Energy Neutrino Detection in Antarctica with ARIANNA and ARA.” (2013) *Invited seminar in High Energy Physics at the University of Wichita.*
- “Under-water and Under-Ice Neutrino Astronomy.” (2013) *Invited speaker to the 14<sup>th</sup> ICATPP Conference on Astroparticle, Particle, Space Physics and Detectors for Physics Applications, Villa Olmo, Como, Italy.*
- “Developing the Next Generation of UHE Neutrino Detectors in Antarctica.” (2012) *Seminar in High Energy Physics at the University of Kansas.*

## Service

- **Whittier College Committees:**
  - **Enrollment and Student Affairs Committee (ESAC), 2018-2020**
  - **Educational Resources and Digital Liberal Arts Committee (ERC/DLAC), 2020-2021.**
  - **Educational Policy Committee (EPC), 2021-present**
  - **Appointed to Whittier Scholars Program Advisory Board, present**
  - **Artemis Program: STEM recruitment and training for young women in local area high schools**
- **Service to the Navy:**
  - **Creating online course for engineers in the Navy tasked with maintaining radar and RF infrastructure (2021-present)**
- **Whittier College Awards:**
  - **Student Life Award for Outstanding Organization Adviser, CRU (Campus Crusade Christian Fellowship), 2018**
- **Public Panels and Lectures:**
  - The Artemis Program: Introducing high-school aged women to physics research at Whittier College 2019-2020 and 2020-2021.
  - “Hunting for Wild Antarctic Astroparticles.” Los Nietos Middle School, Los Nietos, CA (2018)
  - “Our Home.” (2016) *Upper Arlington Library Summer Astronomy Series.*
  - “Experimental Particle Astrophysics in Antarctica.” (2016) *New Vistas in Astronomy Public Lecture Series, Columbus Astronomical Society. Columbus, OH.*
  - “The Martian.” *Participated in a public question/answer panel following screening of The Martian at The Gateway Independent Theater.*
- **Current Volunteer Work**
  - Volunteer as a Knight of Columbus, Our Lady of the Miraculous Medal Parish, Montebello, CA (2017-present)
    - Repairing parish buildings and fundraising for parish
  - Volunteer at the Knights of Columbus, St. Matthew the Apostle Parish, Gahanna, OH (2016-2017):
    - *Serving food for the homeless at YWCA Women and Family Center*
    - *Volunteer at Columbus Catholic Diocese Soccer Tournament*
    - *Volunteer Cook/Dishwasher, St. Matthew’s Parish Annual Fish Fry*
  - Volunteer, Ohio State Department of Astronomy Observatory (2015-present) (public observing)

- *Providing and operating a 114-mm Newtonian reflector for public observing*
- Instructor for Young Scholars Program (YSP), Ohio State Department of Physics
- Volunteer at the Knights of Columbus, St. John the Evangelist Parish, Lawrence, Kansas (2013-2015)
  - *Volunteer Cook/Dishwasher, St. John's Parish Annual Fish Fry*
  - *Volunteer Groundskeeper, St. John's Parish*