Jordan C. Hanson, PhD
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Position

Assistant Professor of Physics, Department of Physics and Astronomy, Whittier College, 2017-Present

Skills

I have extensive experience in high-energy physics research, engineering research, physics education at introductory and advanced levels, mentoring students, and service to my institution and community.

- **Physics teaching at high-school, college, and graduate levels**
- **Computer science teaching: digital signal processing, digital circuit design at college level**
- **Mathematics teaching: elementary statistics at college level**
- **Organized 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, Ohio State Univ., Whittier College)**
- Mathematical physics research of Askaryan radiation and propagation in polar ice (Whittier College)
- Radar phased array engineering research (Whittier College, and the Office of Naval Research)
- Terabyte-scale data analysis and high-performance computing (Ohio State Univ. and UC Irvine)
- Building simulations and mathematical physics models (Ohio State Univ. and Whittier College)
- Organizing and leading expeditions to Antarctica to deploy physics hardware (UC Irvine)
- Performing radio-frequency field measurements and anechoic chamber measurements in support of physics objectives (UC Irvine, Univ. of Kansas)
- RF circuit design and testing/validation (UC Irvine, Univ. of Kansas, Ohio State Univ.)
- Software skill: **C++, Python, MATLAB, Octave, Jupyter, MEEP, WaveDROM, LaTeX**
- Organizing workshops and conferences, public speaking, outreach coordination
- Led outreach programs for young women from local high school students interested in studying STEM at Whittier College

Education

- Doctor of Philosophy (PhD), Physics, University of California, Irvine (March 2013)
- Master of Science (M.S), Physics, University of California, Irvine (August 2008)
- Bachelor of Science (B.S), Intensive Track, in Physics, Yale University (June 2007)

Research Experience

Whittier College — Fall 2017 – Present

- **Forming an Educational Partnership Agreement (EPA) with a US Naval research laboratory to foster a new generation of engineering research for Whittier College students**
- **Initiated a radio-frequency (RF) testing and design laboratory**
- **Awarded three Summer Faculty Research Fellowships through the Office of Naval Research**
- **Mentoring students in firmware and software design, electrical engineering**
- **Mentoring students in mathematical physics research, publication on Askaryan radiation**
- Helped a student create a firmware/software solution in order to upgrade ARIANNA detector boards
- Helped a student build a from-scratch drone, with designs for solar recharge and polar deployment
- Published research regarding RF propagation in polar ice and firn, interactions with ice/ocean floor
- Published research regarding mathematical physics of Askaryan radiation
- Developed a python-based FDTD model of broadband RF phased arrays for naval testing applications

The Ohio State University — Fall 2015 – 2017

- Created a fully analytic model of the Askaryan effect adopted by the neutrino physics community
- Leading the data analysis to discover the world-record highest energy neutrinos with the ARA and ARIANNA collaborations
- 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
- Taught and mentored gifted high school students in physics research through the QuarkNet program
- Created and taught a summer physics course from scratch

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 - HAWC)
- 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
- Christopher Clark, PhD … Chemical Engineer at the Naval Surface Warfare Center, Corona, CA
- Jeffery Benson … Telecommunications 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

*Primary or Corresponding author

- *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).
- J. A. Aguilar *et al*. "*In situ*, broadband measurement of the radio frequency attenuation length at Summit Station, Greenland." Journal of Glaciology (2022) pp. 1-9, Cambridge University Press.
- *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 37th International Cosmic Ray Conference, Berlin, Germany (2021).
- The ARIANNA Collaboration. "Probing the Angular and Polarization Reconstruction of the ARIANNA 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 ε_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 Treat-

ment 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 32nd 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_2 Molecules in Superfluid Helium." Physical Review Letters (**100)** 025301 (2008).

Invited Lectures

- "Broadband RF Phased Array Design with MEEP" (2022). *Invited to speak at the inaugural CEM conference MeepCon, MIT, Summer 2022.*
- Invited to teach course entitled "Introduction to GPS M-Code Signals for Onboarding of Navy Personnel" (2022). *In service of the Office of Naval Research.*
- Invited to teach course 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.*
- "U*ltra-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 Hawa'i, Honolulu, Hawa'i.*
- *"*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 14th 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), 2021-2022.**
  - **Whittier Scholars Program Advisory Board (WSP Council), present**
- **Service to the Navy:**
  - **Created two online courses for engineers and sailors in the Navy tasked with maintaining radar and RF infrastructure (2021-2022)**
- **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*