

Welcome to the HamSCI newsletter! It is amazing to see how this initiative has grown since starting it in 2015; I am thrilled we now have such a vibrant community with enthusiastic volunteer participants launching this regular publication. At its core, HamSCI is focused on the "continuation and extension of the amateur's proven ability to contribute to the advancement of the radio art," a primary purpose of amateur radio as defined by Part 97 of the United States FCC rules. Building on more than a century of scientific and engineering contributions by hams, the spark of experimentation and pursuit of new knowledge continues to be alive and well in the amateur radio community today. While I am now proud to lead the HamSCI initiative as an associate professor of Physics and Engineering at the University of Scranton, it is the skill and passion of the amateur radio community that really drives the progress and direction of HamSCI today. I would like to extend a huge thank you to all the current and past HamSCI participants and warmly welcome all who join us now and in the future!

— VY 73 de Nathaniel W2NAF

[hamsci.org](http://hamsci.org)

## TEACHING, RESEARCH, AND COMMUNITY AT THE NEW W3USR HAM RADIO STATION *By Stan Zygmunt*

Vibrant views of Jesuit education already occurring at The University of Scranton's state-of-the-art amateur radio station were celebrated at the formal dedication of the facility located on the fifth floor of the Loyola Science Center.

University of Scranton President, Rev. Joseph Marina, S.J., referenced the teaching, research and engagement with students and the greater community already taking place at the station in his remarks at the ceremony.

"Dr. Frissell and his colleagues in the Physics and Engineering Department have sparked the curiosity of students – starting a student amateur radio club (W3USR), leveraging the station's capacities in courses, and involving students in research projects," said Father Marina, who also blessed the station at the ceremony. "True to a Jesuit education, the station's resources have turned outward in service to others – whether inviting Cub Scouts in to encourage interest in science or leveraging the station's capabilities for the emergency

communication needs of area agencies."

Father Marina also mentioned the numerous research projects led by Nathaniel Frissell, Ph.D., associate professor of physics and engineering at the University, and his colleagues in the Physics and Engineering Department.

"The research has supported projects with NASA with students sharing their discoveries in presentations at national conferences. Research has involved partnerships with other colleges, such as Case Western, the New Jersey Institute of Technology and the University of Alabama," said Father Marina.

At the dedication, Dr. Frissell (W2NAF) provided an overview of the station's state-of-the-art antennas and communication equipment, as well as some of the research projects that have leveraged the station's capacities, including the Ham Radio Science Citizen Investigation (HamSCI) network he developed through projects supported by National Science Foundation



## TEACHING, RESEARCH, AND COMMUNITY AT THE NEW W3USR HAM RADIO STATION *continued*

grants, including the University's participation in NASA's Citizen Science Investigations that studied the effects of the recent total solar eclipse on the earth's ionosphere. Dr. Frissell also acknowledged the generous grant the station received from the Amateur Radio Digital Communications (ARDC) foundation, with additional support from Mary Lou West, Ph.D., (KC2NMC), Edward Hayes (N6XEM), Jeffrey DePolo (WN3A), DXEngineering, and the NSF.

Speaking at the dedication were University of Scranton student Alexandros Papadopoulos, (KC3WUD) Scotrun, a computer engineering major at Scranton, and Steve Cerwin, (WA5FRF) a community volunteer and retired scientist at Southwest Research Institute, who discussed research projects they have conducted using data gathered from these projects.



The dedication included a presentation by Bob Inderbitzen, (NQ1R) director of marketing and innovation for the National Association for Amateur Radio (ARRL), who granted W3USR Student Amateur Club ARRL Affiliated Club status. Since its inception in 1918, the Affiliated Club Program has united amateur radio clubs to enhance the Amateur Radio Service, recognizing their crucial role in developing active radio operators and serving local communities. The formal presentation of a certificate of membership was made to University

student and W3USR Student Amateur Radio Club president Gerard Piccini, (KD2ZHK) Monroe Township, New Jersey, who is majoring in electrical engineering at Scranton.



"You are now part of a thriving network of college ham radio stations across the country, each contributing to a larger tapestry of knowledge, innovation, and fun," said Inderbitzen, who also serves as staff advisor the ARRL Collegiate Amateur Radio Program.

Also speaking at the ceremony were Rosy Schechter, KJ7RYV, executive director of ARDC and Shikha Raizada, Ph.D., (WP4PYE) NSF aeronomy program director; and Tracy Stewart, Ph.D., interim provost and senior vice president for academic affairs at The University of Scranton.



Immediately following the ceremony, students presented posters of their research projects and tours of the radio station were conducted.



Located on the fifth floor (penthouse suite) of the Loyola Science Center, the main station has floor to ceiling glass walls with sweeping views of the city of Scranton. Last academic year, a 40-foot tower with a Skyhawk High Frequency antenna for 14, 21, and 28 MHz, as well as VHF/UHF satellite and microwave antennas, some with rotating mounts were installed, in addition to heavy-duty controllers, all-mode transceivers, speakers, desktop microphones and other components.

A dinner reception concluded the dedication events.

WVIA news reporter Sarah Hofius Hall spoke to Dr. Frissell about the amateur radio station at a recent community session. The station is open to members of the general public Thursday evenings from 7 p.m. to 9 p.m. during the spring and fall semesters.





The HamSCI group has been very active during 2024, both doing projects and writing about them. One important type of communication is presenting our results to the professional scientific community, especially the American Geophysical Union. Their annual meeting in December each year attracts upwards of 30, 000 participants. This year it will be held in Washington, DC from December 9 to 13. HamSCI will have 18 presentations, including two large group reports, seven more focused reports by our professional scientists, and nine smaller reports by our college students from the University of Scranton and NJIT. It is exciting to read the titles, and heartening to read the author lists. There are 91 individual people listed! We should all be very proud to be included in such a vibrant community.

## HAMSCI AT THE BIG AGU24 CONFERENCE IN WASHINGTON, DC

By Dr. Mary Lou West, KC2NMC

### BY PROFESSIONALS:

1. *Results from the 2023/2024 HamSCI Festivals of Eclipse Ionospheric Science and What Comes Next*, Nathaniel A Frissell, Devin M Diehl, Rachel Frissell, Robert McGwier, Majid Mokhtari, Cuong D. Nguyen, Alexandros Papadopoulos, Gerard Piccini, Jonathan Rizzo, Simal Sami, Robert Spalletta, Rachel K Boedicker, John Gibbons, Adam Goodman, David Kazdan, Laura Schwartz, Shashank Sastry, Maris Usis, Christian Zorman, Travis Atkison, William Engelke, Hyomin Kim, Gareth William Perry, Kuldeep Pandey, Dr. Kristina Collins, Philip Erickson, David McGaw, Joseph D Huba, Mary Lou West, Philip Gladstone, John R Ackermann, William Blackwell, Steve Cerwin, Cameron Cushing, McKenzie Denton, Edward Efcak, Paul Elliott, Gwyn Griffiths, Nick Hall-Patch, Phil Karn, George Kavanagh, David Larsen, William Liles, Jesse McMahan, Thomas McDermott, Gary Mikitin, Peter Nordberg, Adarsh Pashikanti, Gregory Popelas, Stanley Pozerski, Robert Reif, Rob S. Robinett, Jay Schwartz, H. Ward Silver, Franco Venturi, Ronald Wilcox, David M Witten, Gamal Zayed  
<https://agu.confex.com/agu/agu24/meetingapp.cgi/Paper/1686823>
2. *HamSCI Festivals of Eclipse Ionospheric Science: Creating an International Community of Volunteers to Study the Ionospheric Impacts of the 2023/2024 North American Solar Eclipses and Beyond*, Nathaniel A Frissell, Devin M Diehl, Rachel Frissell, Robert McGwier, Majid Mokhtari, Cuong D. Nguyen, Gerard Piccini, Alexandros Papadopoulos, Jonathan Rizzo, Simal Sami, Robert Spalletta, Rachel K Boedicker, John Gibbons, Adam Goodman, David Kazdan, Laura Schwartz, Shashank Sastry, Maris Usis, Christian Zorman, Travis Atkison, William Engelke, Hyomin Kim, Gareth William Perry, Kristina Collins, Kuldeep Pandey, Philip Erickson, David McGaw, Joseph D Huba, Mary Lou West, Philip Gladstone, John R Ackermann, Steve Cerwin, William Blackwell, Cameron Cushing, McKenzie Denton, Edward Efcak, Paul Elliott, Gwyn Griffiths, Nick Hall-Patch, Phil Karn, George Kavanagh, David Larsen, William Liles, Jesse McMahan, Thomas McDermott, Gary Mikitin, Peter Nordberg, Adarsh Pashikanti, Gregory Popelas, Stanley Pozerski, Robert Reif, Rob S. Robinett, H. Ward Silver, Jay Schwartz, Franco Venturi, David M Witten, Ronald Wilcox, Gamal Zayed  
<https://agu.confex.com/agu/agu24/meetingapp.cgi/Paper/163429>
3. *Solar Eclipse QSO Party (SEQP) Ionospheric Results*, Kuldeep Pandey, Gareth William Perry, Nathaniel A Frissell, Travis Atkison, William D Engelke, Joseph D Huba, Mary Lou West, Philip J S Gladstone, Cameron M Cushing, McKenzie Denton, Edward Efcak, Gary Mikitin, H. Ward Silver, and the HamSCI Community  
<https://agu.confex.com/agu/agu24/meetingapp.cgi/Paper/1706039>

## HamSCI AT THE BIG AGU24 CONFERENCE IN WASHINGTON, DC *continued*

4. *First Observations Linking Large-Scale Traveling Ionospheric Disturbances to Polar Vortex Strength*, Nathaniel A Frissell, V Lynn Harvey, Erich Becker, Sophie Phillips, Katrina Bossert, Sevag Derghazarian, Larisa P Goncharenko, Philip Erickson, Mary Lou West, Gareth William Perry, Diego Sanchez, William Engelke, Nicholas Callahan, Travis Atkison, Robert Gerzoff, Devin M Diehl, Richard L Collins, Sharon Vadas, J. Michael Ruohoniemi and Joseph B. H. Baker  
<https://agu.confex.com/agu/agu24/meetingapp.cgi/Paper/1637229>
5. *Amateur Radio Communications Showed the Tonga Blast, a Driver from Below*, Mary Lou West, Diego Sanchez, Nathaniel A Frissell, William D Engelke, Rob S Robinett, and Sevag Derghazarian  
<https://agu.confex.com/agu/agu24/meetingapp.cgi/Paper/1739625>
6. *HamSCI HF Multipath Propagation Mode Analysis Using Amateur Radios and Audio Waveforms Sensitive to Time Difference of Arrival (TDOA)*, Steve Cerwin WA5FRF, Jesse T. McMahan K1FR, Alexandros Papadopoulos KC3WUD, Gerard Piccini KD2ZHK, Paul Bilberry N5DUP, Sam Blackshear AB5YO, Kristina V. Collins KD8OXT, Nathaniel A. Frissell W2NAF  
<https://agu.confex.com/agu/agu24/meetingapp.cgi/Paper/1596220>
7. *Making Amateur Radio Data Available for Ionospheric Research*, William D Engelke, Nathaniel A Frissell, Travis Atkison, Philip John Erickson, William E Rideout, and Katherine Cariglia  
<https://agu.confex.com/agu/agu24/meetingapp.cgi/Paper/1643048>
8. *HamSCI as a Novel Dataset to Validate Ionospheric Models*, Kornyanat Hozumi, Nathaniel A Frissell, Gwyn Griffiths, and Min-Yang Chou  
<https://agu.confex.com/agu/agu24/meetingapp.cgi/Paper/1635272>
9. *Observations of the Solar Eclipse Impact on Ionospheric Density*, Kuldeep Pandey, Gareth William Perry, Daniel Emmons, Bharat Kunduri, Joseph D Huba, Alex Chartier and David Themens  
<https://agu.confex.com/agu/agu24/meetingapp.cgi/Paper/1755187>

State-of-the-art ham radio equipment and antennas were installed on the fifth floor and roof of the Loyola Science Center for the W3USR Amateur Radio Station funded by an Amateur Radio Digital Communications (ARDC) grant awarded to Nathaniel Frissell, Ph.D., W2NAF



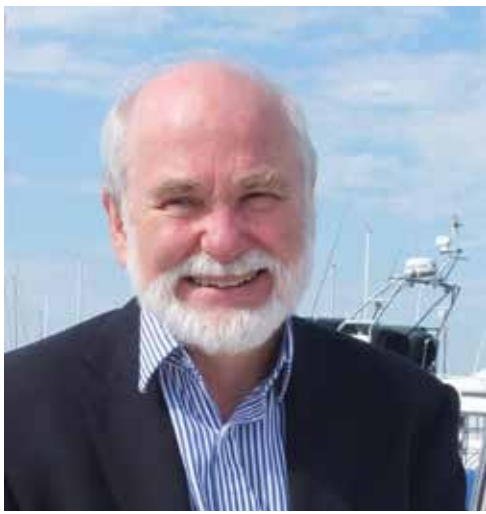
Students stand outside the W3USR Amateur Radio Station at the University of Scranton Loyola Science Center with Dr. Frissell.



**BY STUDENTS:**

10. *A Multi-Year Climatology of 14 MHz Amateur Radio Large-Scale Traveling Ionosphere Disturbances Made Using a Novel Automated Detection Technique*, Diego Sanchez, Nathaniel A. Frissell, Mary Lou West, V. Lynn Harvey, Sharon Vadas, Erich Becker, Gareth W. Perry, William D. Engelke, Nicholas Callahan, Travis Atkinson, Philip J. Erickson, and Robert Gerzoff  
<https://agu.confex.com/agu/agu24/meetingapp.cgi/Paper/1721141>
11. *Characterizing Ionospheric Variability Through HF Doppler Measurements: A Combined Statistical and Ray-Tracing Analysis*, Sabastian Fernandes, Gareth W. Perry, Tiago Trigo, Nathaniel A. Frissell, John Gibbons, and Ham Radio Science Citizen Investigation  
<https://agu.confex.com/agu/agu24/meetingapp.cgi/Paper/1718101>
12. *A Solar Cycle of Medium Scale Traveling Ionospheric Disturbances Observed Using SuperDARN Radars in the Northern and Southern Hemispheres*, James P. Fox, Nicholas Guerra, Thomas J. Pisano, Michael Molzen, Nathaniel A. Frissell, V. Lynn Harvey, Joseph Klobusicky, Mark Fenner, Joseph B. H. Baker, J. Michael Ruohoniemi  
<https://agu.confex.com/agu/agu24/meetingapp.cgi/Paper/1637186>
13. *Integration & Validation of a Standardized Library & File Format for PyDARNMUSIC & DARNtids: Migrating From Legacy Pickle Files to HDF5 & Implementing a Comprehensive Testing Suite*, Nicholas J. Guerra, James P. Fox, Thomas J. Pisano, Michael Molzen, Nathaniel A. Frissell, Paul M. Jackowitz, Joseph B. H. Baker, and J. Michael Ruohoniemi  
<https://agu.confex.com/agu/agu24/meetingapp.cgi/Paper/1713616>
14. *Investigating North American SuperDARN Observations of Medium-Scale Traveling Ionospheric Disturbances During January 2016*, Michael J. Molzen, Thomas J. Pisano, Nicholas Guerra, James P. Fox, Nathaniel A. Frissell, Sharon Vadas, V. Lynn Harvey, Joseph B. H. Baker, and J. Michael Ruohoniemi  
<https://agu.confex.com/agu/agu24/meetingapp.cgi/Paper/1716280>
15. *High Frequency Radio Receivers for Ionospheric Observations in the HamSCI Personal Space Weather Station Network*, Cuong Nguyen, Nathaniel A. Frissell, John Gibbons, Rachel Boedicker, Christian Zorman, Kristina V. Collins, William D. Engelke, Travis Atkinson, William Blackwell, Robert Robinett, Gwyn Griffiths, Paul Elliott, Phil Karn and the HamSCI Community  
<https://agu.confex.com/agu/agu24/meetingapp.cgi/Paper/1722293>
16. *Analysis of the HamSCI Solar Eclipse High Frequency Time Difference of Arrival Experiment Observations Using Automated Techniques*, Alexandros Papadopoulos, Gerard Piccini, Steve Cerwin, Paul Bilberry, Samuel Blackshear, Jesse McMahan, Nathaniel A. Frissell, Robert A. Spalletta, Aidan Montare, and Kristina V. Collins  
<https://agu.confex.com/agu/agu24/meetingapp.cgi/Paper/1735739>
17. *A Low-Cost Low-Power Chirp Ionosonde for Studying Eclipse Ionospheric Impacts*, Gerard N. Piccini, Robert W. McGwier, Robert A. Spalletta, Nathaniel A. Frissell, Majid Mokhtari, Philip J. Erickson  
<https://agu.confex.com/agu/agu24/meetingapp.cgi/Paper/1641156>
18. *Forward Modeling of SuperDARN Medium Scale Traveling Ionospheric Disturbance Measurements Using High Frequency Raytracing and the PyDARN-MUSIC Toolkit*, Thomas J. Pisano, Michael J. Molzen, Nicholas J. Guerra, James P. Fox, Nathaniel A. Frissell, V. Lynn Harvey, Joseph B. H. Baker, and J. Michael Ruohoniemi  
<https://agu.confex.com/agu/agu24/meetingapp.cgi/Paper/1630538>





## HAMSCI PROFILE: GWYN GRIFFITHS, G3ZIL

WSPR enthusiast and inquisitive propagation data analyst

By Dr. Mary Lou West, KC2NMC

quite often on research ships.

Gwyn has been a ham for fifty years, but like many people he set it aside for years. He learned about HamSCI from his friend Rob Robinett. The skills Gwyn brings to our collaboration include computer programming as well as creativity, physical insight, visualization skills, technical writing, nurturing teams of people, and communicating fluently and persuasively with a wide range of audiences. On the technical page of the WSPRDaemon website (<http://wsprdaemon.org/technical.html>) there are many short articles he has written to explain focused topics.

He is proud of his involvement with the autonomous submarine robots used in the open ocean as well as under Antarctic ice shelves. In this risky business he learned how to be open with failures as well as successes, to apply risk analysis ideas, and to nurture good people. After retirement he continues as a consultant on underwater systems. He was awarded the IEEE Oceanic

Engineering Society Distinguished Technical Achievement Award and the Oceanology International Lifetime Achievement Award.

He is an active member of the RSGB Propagation Studies Committee. He appreciates the precision Doppler capabilities developed by HamSCI and continues to extract pertinent information about the ionosphere from WSPR and FST4W observations. Comparing SNR and frequency spread on eclipse days can shed light on propagation modes such as one-hop, two-hop, and two-hop sidescatter. The goal is to learn more about the physics of the upper atmosphere. He hopes that the HamSCI collaboration will soon help him even more by providing the physics-based SAMI3 model of the ionosphere during the recent eclipses to be used with the PyLap raytracing program.

For all of us, Gwyn encourages life-long learning and often says his favorite cautionary thought, "Are you sure about that?"

Gwyn Griffiths has always loved the sea. He grew up on a small island off an island off an island (Holy Island, Isle of Anglesey, North Wales, and Britain). Welsh is his mother tongue. In high school he was fascinated by 'conduction current signaling, (electromagnetics in seawater) to communicate from the surface to a diver. That group almost won the BBC contest for Young Scientists of the Year.

He grew up to be an engineer who designed, built, and used many types of equipment to investigate the ocean from Antarctica to Greenland. Most of his career was with the Institute of Oceanographic Sciences and Southampton University, UK, and

## HAMSCI PROFILE: ROB ROBINETT, AI6VN

A latent amateur contributes much to the understanding of the ionosphere.

By Ed Efchak, WX2R



**Q:** How did you learn about HamSCI and how did you get involved? How have you been involved in the past? What is your current involvement?

**A:** In 2018 I volunteered to install a KiwiSDR system at the historic radio station KPH receive site (<http://www.kphsdr.com:8073/>) located in the Point Reyes National Seashore (<https://www.nps.gov/pore/index.htm>) and operated for the National

Park Service by the Maritime Radio Historical Society (<https://www.radiomarine.org/>). The KPH site was established the Guglielmo Marconi and Dr. Harold Beverage in the 1910s and is the premier shortwave listening site on the West Coast. In 2018 Dr. Frissell contacted MRHS to see if KPH could contribute to the HamSCI efforts, and his request was forwarded to me.

*Continued on next page*

# HamSCI IN THE NEWS

Thanks to IEEE Spectrum for featuring our work in its September issue.



Student Member, **Gerard N. Piccini, KD2ZHK**, is operating one of the radios at the University of Scranton's amateur radio station.

Find the feature online at:  
<https://spectrum.ieee.org/ham-radio-inspired-scranton-student>



HamSCI Member, **Dr. Jim Breakall WA3FET**, Receives Major Award from the Radio Club of America

Find the feature online at:  
[https://www.radioclubofamerica.org/2024Awards\\_Fellows](https://www.radioclubofamerica.org/2024Awards_Fellows)

## HAMSCI PROFILE: ROB ROBINETT, AI6VN *continued*

In my professional activities I was most interested in creating monitoring systems. When I resumed my ham radio activities in 2017 after a 40-year hiatus, I soon learned of the WSPR beacon system and its potential to provide propagation data. However, the single band at a time implementation of WSPR in the WSJT-x application limited its usefulness for propagation studies. Seeing the opportunity to apply my software skills to the WSPR monitoring task, I began developing the open source WSPR system WsprDaemon (WD) (<http://wsprdaemon.org/>) now used by most of the leading reporting WSPR stations in the world.

The eight receive channel KiwiSDR was the primary receiver used by WD sites, so it was not well suited to making recordings for HamSCI's GRAPE project due to its lack of sophistication. But in 2023 I discovered the RX888 SDR (<https://www.amazon.com/Receiver-Luminum-Industrial-Beautiful-1kHz-64Mhz/dp/B09FZW89L8>). This, when used with Phil Karn's open source KA9Q-radio software (<https://github.com/ka9q/ka9q-radio>), allowed WD to add GRAPE support. This WD-GRAPE hardware and software system simultaneously records all 10 of the WWV and CHU transmissions along with all of the WSPR and FT4/8 bands and uploads those recordings to the appropriate databases by HamSCI's PSWS servers, ([wsprnet.org](http://wsprnet.org)) and (<https://pskreporter.info/>).

In the coming year I plan to help assemble, deploy and support WD-GRAPE systems as part of the DASI2 grant project.

**Q: What HamSCI projects interest you the most?**

**A:** I am interested in WD-GRAPE antenna selection and/or design.

**Q: What skills do you have that are best suited to HamSCI? How might other amateurs obtain similar skills?**

**A:** My Linux system software development skills are uncommon in the ham community. I learned them from mentors in my professional life and offer tutoring to hams interested in the subject. I host a weekly online meeting for WD users where all are welcome to bring their radio and software skills, interests, and problems.

**Q: Why type(s) of equipment do you have in your shack? Antennas?**

**A:** I have no equipment at my home and do no transmitting. But I install and support public SDR installations at KPH and at KFS (<http://kfs.wsprdaemon.org:8073/>), a second premier West Coast shortwave reception site located thirty miles south of San Francisco. In 'retirement' ham radio has become my primary activity, so I spend most of my time working in WD and now on developing and deploying the receive systems it supports. I was first licensed in 1963 as a novice with callsign WN6JAY. I let that license expire in the 1970's and obtained my Extra Class license AI6VN when I resumed my interest in 2017.

**Q: Finally, tell us a little about yourself and your contribution to HamSCI as well as to scientific research.**

**A:** I am a 1974 Stanford graduate and have spent most of my professional life working at and then founding several venture funded startups which developed real-time broadcast quality TV compressional hardware. Gwyn G3ZIL continues to be my close partner on the WsprDaemon project.

# HamSCI IN THE NEWS

HamSCI's **McKenzie Denton**, KO4GLN, is featured in the September 2024 issue of *ARRL On The Air* and her participation in Field Day with her club. She is also featured in the ARRL September/October issue of *On The Air* and is the cover story.



**Dr. Nathaniel Frissell**, W2NAF, and **Gary Mikitin**, AF8A, have an article in the November 2024 issue of *QST* on "What Solar Eclipses Have to Tell Us" with an overview of the early findings of our earlier Solar Eclipse QSO Party efforts.



## UPDATE ON HamSCI ACTIVITIES AT NJIT

By *Dr. Gareth Perry, KD2SAK*

*Assistant Professor of Solar-Terrestrial Research*

The New Jersey Institute of Technology (NJIT), located in Newark, New Jersey, has been a key part of the HamSCI collective since its infancy. Dr. Nathaniel Frissell started HamSCI at Virginia Tech before he moved to NJIT and then the University of Scranton. Since Frissell's departure, Prof. Hyomin and I have led the HamSCI efforts at NJIT. Over the years HamSCI activities at NJIT have grown steadily and can be split into three categories. They are the development of the magnetometer component of the Personal Space Weather Station (PSWS), which is led by Prof. Kim; HamSCI Grape 1 low IF receiver (hereafter referred to as "Grape") observations and analysis; and finally, HamSCI Festival of Eclipse and Ionospheric Science (FoEIS) observations and analysis. In this short communication I will focus on the latter two initiatives given that they make up a sizable portion of my research portfolio at NJIT.

NJIT's Grape has been monitoring WWV at 10 MHz nearly continuously since March 2021. Several NJIT undergraduate students have analyzed various aspects of this data set, including the variability of WWV's Doppler residuals (the residual is computed by subtracting WWV's transmitting frequency, 10 MHz, from the frequency of WWV's signal measured at NJIT). Analysis by NJIT graduate Sabastian Fernandes (BSc Engineering Physics/Applied Physics, NJIT, 2024) has identified disparate Doppler residual characteristics between daytime/nighttime conditions. His conclusion is that Doppler residual variability is determined by a superposition (or lack thereof) of multi-hop propagation modes between WWV and NJIT. This is a key result which

can help us better understand how the Doppler residuals measured by HamSCI Grape receivers can be used to study space weather and geophysical phenomena. Fernandes will present his results at the upcoming American Geophysical Union (AGU) Annual Meeting happening in Washington, D.C. this December.

Additional Grape 1 receivers were deployed by NJIT students in support of April 2024 eclipse efforts, under the guidance of Kim, and future deployment are planned in support of NJIT undergraduate scholastic activities. The HamSCI PSWS project has been integrated into the senior-level physics course (PHYS 450: Advanced Physics Lab) at NJIT, to provide undergraduate students with hands-on experience in a citizen science initiative. Additionally, a group of Space Force Reserve Officers' Training Corps (ROTC) cadets participated in the HamSCI PSWS project as part of their training program, enhancing their practical skills and understanding of scientific research in the field of space physics and space weather.

Dr. Kuldeep Pandey, an NJIT Postdoctoral Fellow, has been busy analyzing radio communication data collected during the October 2023 and April 2024 eclipses—this includes observations during the HamSCI QSO parties, organized as part of the FoEIS. So far Pandey's focus has been on the PSKReporter, WSPR, and RBN data sets. He has been sifting through these extensive data sets to study how the eclipses affected the terrestrial ionosphere, and the response of each eclipse differs from one another. Pandey will also be presenting his research at AGU in December.



## UPDATE ON HamSCI ACTIVITIES AT NJIT *continued*

HamSCI and the research performed at NJIT could not have been possible without the tireless efforts of HamSCI participants as well as the financial support of the American Taxpayer. At NJIT, we have been fortunate enough to have received consistent funding from the National Science Foundation (NSF) and the National Aeronautics and Space Administration (NASA). This includes a recent award from NASA under the Heliophysics Citizen

Science Investigation (HCSI) program. One of the goals of this project is to develop HamSCI's ability to investigate transient heliophysical and geophysical events, such as the recent May 2024 Gannon Storm, broadening HamSCI activities beyond those focused on eclipse science. HamSCI has made significant contributions to eclipse science, generating data sets that will be studied for years to come. Unfortunately, there will not be an

eclipse in the United States until 2031; the next total solar eclipse will not occur until 2045! Therefore, the goal is to develop HamSCI into a collective that can leverage the coverage, expertise, and toil of its participants to focus on various aspects of space weather and ionospheric science, such as geomagnetic storms, all the while advancing the art and science of radio.

## NOTES FROM ALL OVER ▶▶▶▶▶▶

### USING FST4W

FST4w is a digital communication mode, originally developed by the WSJT-X team (Joe Taylor, K1JT et al.) for the LF and MF bands. It has been found to be useful for propagation studies also on the HF bands, just as WSPR has been used since 2010.

FST4w has several advantages over WSPR: One, it has a lower decode threshold, about 1.4 dB lower than WSPR, meaning it can be decoded as signals travel over greater distances, and/or under poorer band conditions, than WSPR.

Two (of particular interest to ionospheric researchers) is the ability to measure spectral spread (variation in received frequency) when FST4w signals are decoded. This may lead to new research findings on the causes of ionospheric variation.



### GOING TO HamCATION? STOP & VISIT HamSCI!

HamSCI will be at HamCation in Orlando, FL from February 7-9, 2025, at the Orlando Fairgrounds and we will be talking science. Stop by our booth to learn more about our work and please check out the program for more information on our presenters.

It is a great opportunity to learn more about HamSCI, citizen-science, and take in a bit of the Florida sun. Hope to see you there! For more information, check out the HamCation website: <https://www.hamcation.com/>



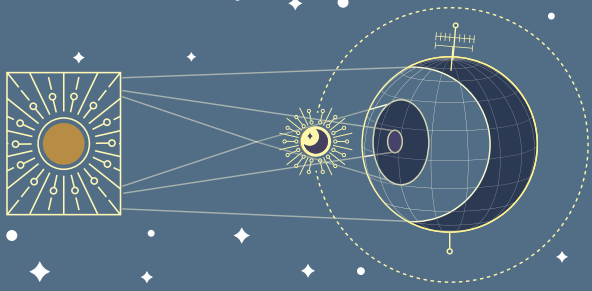
## SAVE THE DATE FOR THE HamSCI WORKSHOP **HamSCI WORKSHOP 2025**

The HamSCI 2025 workshop will be March 14 - 15, 2025 at NJIT.

Look for emails, reflector notifications and, of course, the HamSCI website....[www.hamsci.org](http://www.hamsci.org).

## HamSCI IARU ANNIVERSARY OPERATING EVENT

HamSCI is looking to conduct further ionospheric research in 2025 during the centenary of the International Amateur Radio Union with an operating event. As with the 2024 solar eclipse experiments, amateur radio operators will be essential in collecting data in the true spirit of citizen science. Stay tuned!



**ARE YOU A EUROPEAN AMATEUR RADIO OPERATOR?**

HamSCI is looking for hams who might be interested in participating in experiments regarding solar eclipses occurring over Europe in 2025 and 2026. Interested?

Drop a note to [hamsci@hamsci.org](mailto:hamsci@hamsci.org) and let us know.

## WHAT IS HamSCI?

HamSCI, the Ham Radio Science Citizen Investigation, is a platform for the publicity and promotion of projects that are consistent with the following objectives:

- Advance scientific research and understanding through amateur radio activities.
- Encourage the development of new technologies to support this research.
- Provide educational opportunities for the amateur community and the public.

HamSCI serves as a means for fostering collaborations between professional researchers and amateur radio operators. It assists in developing and maintaining standards and agreements between all people and organizations involved.

HamSCI was started by ham-scientists who study upper atmospheric and space physics. These scientists recognized that projects such as the Reverse Beacon Network, WSPRNet, PSKReporter, DX Cluster, ClubLog, and others are generating big data sets that could provide useful observations of the Earth's ionosphere and related systems. Because of this, HamSCI's initial focus is on these fields of research. In the future, other researchers may join HamSCI and broaden its scope.

For scientists, working with the amateur radio community is a way to access individually managed stations, available by the hundreds in dozens of countries, with receive and transmit capabilities across the electromagnetic spectrum, easily identified in areas of interest and deployed to remote locations, for free.

## ABOUT CITIZEN SCIENCE

Citizen science is scientific work undertaken by members of the public, often in collaboration with or under the direction of professional scientists and scientific institutions.

HamSCI engages amateur radio operators to help with the collection and analysis of data to help better understand the changing conditions of "space weather" within the ionosphere. As a HamSCI citizen scientist, you help collect valuable scientific data that can make a meaningful impact on scientific research.



## A SLICE OF SCIENCE HISTORY

By Ron Wilcox, KF7ZN

In the sixth century B.C. a conflict began between the Medes and the Lydians. There were issues of contested land, and a king's son being murdered. There followed five years of warfare with neither side gaining complete victory. Our interest lies in the sixth year of warfare, according to the historian Herodotus around 585 B.C. In the Battle of the Eclipse (also called the Battle of Halys) things were at a draw when the day grew dark, and the sun disappeared. With the battle at a stalemate, it was felt that darkness was an omen, and a treaty was agreed to, thus ending the six years of war.

While other eclipses in ancient times did not have this dramatic and positive of an effect, they were celestial events that were the topics of mystique and of lore. For almost every group of people in these times far past, they were omens and portents of something bad or at the least ominous. Which makes sense if you are convinced that something is eating, damaging, or destroying the sun. Being outside and seeing this,

one would think "nothing good can come of this." With saving the sun in mind, let us look at a few of the many reactions.

Across the world as the sun disappeared many civilizations felt there must be something eating it. For the Chinese, among others, this was a dragon eating the sun, and the beating of pans and drums would drive the dragon away, revealing the sun once again. Here is a commemorative stamp from Indonesia in 2016 showing a dragon eating the sun.

Wolves were another common cause as they chased the sun across the sky and then caught it, slowly devouring the sun.

The Chippewa's believed the sun's fire was going out and shot flaming arrows up into the sky, at the sun, to help it reignite.

Ancient Greeks believed that the Gods were angry, and the sun would leave and abandon the Earth. In fact, eclipse is Greek for abandonment.

My favorite is the Navaho traditions, marking a sacred occasion, where people will sit inside in reflection and reverence for the cosmos.

Then we move to today, where last April 8th, millions of people watched and enjoyed the eclipse, many making it a family time of education and memories, combined with scientists, both lay and professional studying the ecliptic effects. There were tours, sold out motels, long lines, newscasts, massive publicity, and social events planned months ahead.

So, whether it is ancient carvings and petroglyphs suggesting an eclipse, someone or something devouring the sun or our present-day scientific study of an eclipse, they are truly a memorable and spectacular celestial event leaving us in awe of nature and space.

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# JOIN HamSCI

We welcome you to join the HamSCI community! We are a group of amateur radio operators and scientists working together to study the ionosphere and further amateur radio. HamSCI consists of many different types of projects accessible to a variety of skill levels with various focuses on science to engineering to pure amateur radio.

The easiest way to participate in the HamSCI Community is by joining the HamSCI Google Group. The HamSCI Google Group is an e-mail discussion forum to facilitate communication between hams, the professional space and atmospheric science communities, and anyone else interested. When requesting to join, please include some information about who you are and why you would like to join.  
**WELCOME!!**

## HamSCI WEEKLY MEETINGS

There are numerous ways to learn about and participate in HamSCI activities. We meet three times a week on various aspects of our work:

**TAPR/HamSCI Technical Session:** This weekly telecon is hosted on Mondays at 9 PM Eastern by TAPR and The University of Scranton to support collaborative HamSCI-TAPR projects.

**GRAPE-Low Cost PSWS Session:** This weekly telecon is on Thursdays at 10 AM Eastern hosted by Case Western Reserve University to support the Grape Low-Cost Personal Space Weather Station Project.

**The HamScience Telecon:** Weekly telecon on Thursdays at 4 PM Eastern to discuss data collection, analysis and conclusions related to HamSCI's scientific research efforts. All backgrounds, including researchers, data analysts and citizen scientists, are welcome and encouraged to attend.

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