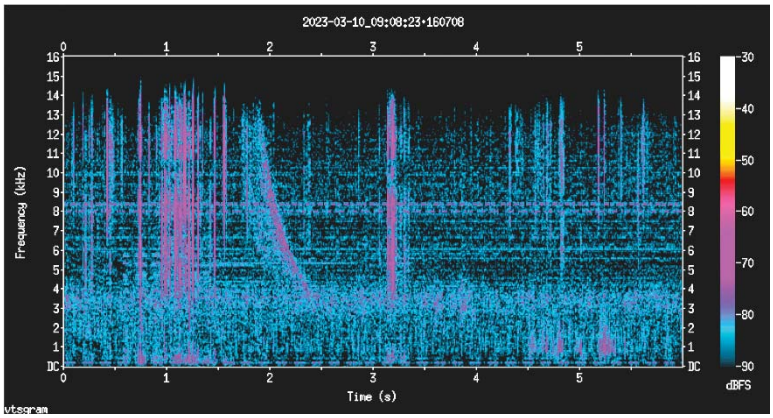
HamSCI Workshop 2023: A Radio Science Collaboration

This year's event focused on forging amateur-professional bonds.

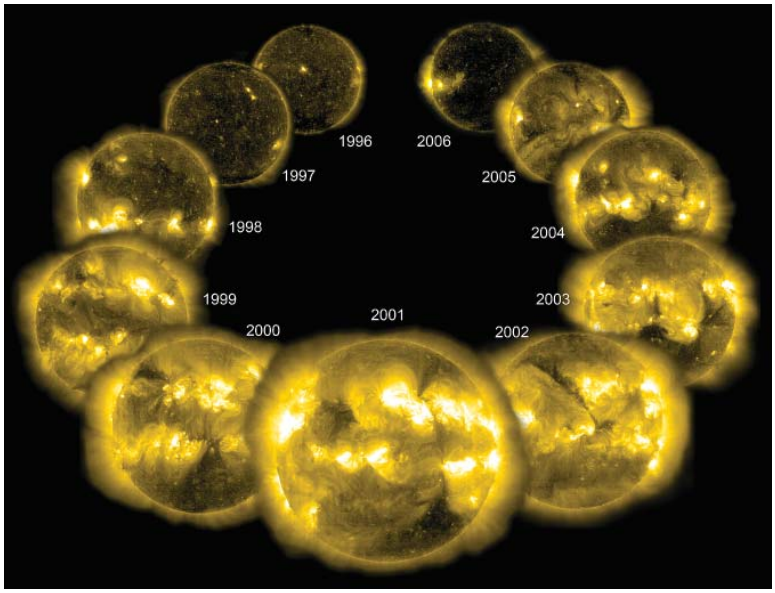
Gary Mikitin, AF8A

More than 150 space physics researchers, educators, engineers, college students, licensed amateurs, and members of the Ham Radio Science Citizen Investigation (HamSCI) community came together at the sixth annual HamSCI Workshop on March 17 – 18, 2023, where they listened, learned, and contributed to scientific investigations involving the Earth's ionosphere and magnetosphere. This year's workshop was presented by The University of Scranton, and it emphasized cooperation between HamSCI's professional science community and its volunteer citizen scientists, many of whom are active amateur radio operators.

HamSCI's (**www.hamsci.org**) fundamental objectives include fostering collaboration among those interested in radio science. Collaboration begins with scientists raising questions and offering theories. HamSCI's citizen scientists review the theories (sometimes offering their own) and contribute valuable data and expertise on relevant amateur radio activities, from designing software-defined radios to offering practical insight on radio wave propagation. Scientists use the data to test their theories and publish the results. Annual HamSCI workshops bring everyone together and promote understanding through in-person discussions. For more information on other HamSCI and citizen science projects, see the sidebars "Getting Involved with HamSCI" and "NASA and Citizen Science."



Very low-frequency enthusiasts were represented at the workshop by Jonathan Rizzo, KC3EEY. He showed a spectrogram of a recently received whistler (visible here as the signal frequency that changes from 13 to 3 kHz from 2 to 2.5 seconds). He explained that whistlers begin as radio emissions from lightning, propagating long distances through ducts in the Earth's magnetosphere. [Photo courtesy of Jonathan Rizzo, KC3EEY]



NASA Program Scientist Dr. Esayas Shume promoted the Heliophysics Big Year, during which we will experience two solar eclipses in North America, followed by a solar maximum (currently predicted for early 2025). He offered this electrical impedance tomography image in the 284 Angstrom wavelength of extreme ultraviolet light of past solar cycles as evidence of what we can expect during Solar Cycle 25. [Photo courtesy of the NASA Solar and Heliospheric Observatory]

Discussions and Presentations

This year, many presentations concerned ionospheric dynamics, a subject important to radio amateurs because of the iono-

NASA and Citizen Science

HamSCI is one of 36 projects under the NASA Science Mission Directorate (**https://science.nasa.gov/citizen science**). Many of these citizen science projects are related to our sun, which is receiving a lot of attention during 2023 – 2025 — NASA's Heliophysics Big Year (**https://youtu.be/DVYWwASlOXc**). Solar Cycle 25 and the upcoming North American solar eclipses are the premier Big Year events.

sphere's significant role in the propagation of HF (3 – 30 MHz) radio waves.

HamSCI's goals — advancing scientific research and understanding through amateur radio activities, encouraging the development of new technologies to support this research, and providing educational opportunities for the amateur community and the general public — were evident throughout the conference sessions, mealtime conversations, and after-hours camaraderie.

More than 50 authors shared their experiences and knowledge through 20-minute presentations and poster sessions, which involved 3 × 4-foot informational placards displayed in a common area where attendees could mingle with the posters' authors. Live demonstrations showcased Weak Signal Propagation Reporter (WSPR) and FST4W beacon technology, coherent CW, and more. Representatives and speakers from ARRL, Amateur Radio Digital Communications (ARDC), and Youth on the Air added to the discussions and to attendees' enjoyment.

HamSCI, along with Case Western Reserve University, developed the Grape Doppler shift receiving and measurement system. Chief Designer John Gibbons, N8OBJ, introduced version 1.12 at this year's workshop. For more details, watch "Grape Version 1.12 at HamSCI 2023" on ARRL's YouTube channel (**www.youtube.com/watch?v=y7w0dLhCfZI**).

Gwyn Griffiths, G3ZIL, presented virtually from his home in the UK. He made the case for using FST4W-120 (available in the *WSJT-X* software suite) to identify unusual propagation paths, such as above-the-maximum usable frequency two-hop side scatter.

Dr. Michael Hartinger of the Space Science Institute explained how ultra low-frequency (ULF) waves form resonances in Earth's magnetosphere, similar to sound waves resonating in musical instruments. His team is mapping ULF waves to the audible spectrum, allowing citizen scientists to identify electromagnetic activity in the ULF region through listening studies. Visit **https://angeo.copernicus.org/articles/40/121/2022** for more information.

Veronica Romanek, KD2UHN, of The University of Scranton explained traveling ionospheric disturbances, which are moving, wave-like irregularities in the ionosphere. She used data collected with a HamSCI Personal Space Weather Station (the Grape 1 receiver) in her analysis.

More workshop presentations, posters, videos, and a photo album are available at **https://hamsci.org/hamsci2023**.

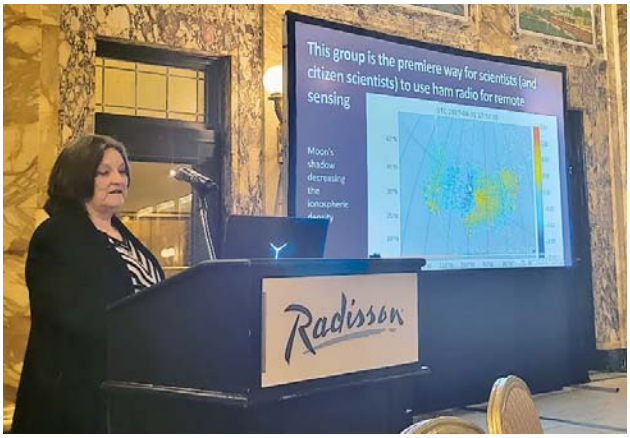
Showcasing and Supporting Amateur Radio

The University of Scranton Amateur Radio Club, W3USR, installed and operated a low-band station in the university's Loyola Science Center. A few steps away, the Amateur Radio Through the Ages historical display featured radios, accessories, QSLs, and *QST* issues from the past 100 years. The display was created through the efforts of the Murgas Amateur Radio Club, K3YTL; members of W3USR; Director of the university's Hope Horn Gallery Dr. Darlene Miller-Lanning, and many volunteers. Photos of the display are available at **https://bit.ly/42bmNfE**.

Getting Involved with HamSCI

HamSCI welcomes participation from anyone interested in radio science. Their home page has links to current and past projects, along with a calendar of teleconferences. Current projects include:

- North American Solar Eclipse QSO Parties (**https://hamsci.org/contest-info**) — These contests will be held during the October 2023 and April 2024 North American solar eclipse events. Activity will be on the 6- to 160-meter bands, using CW, SSB, and digital modes, including WSPR and FST4W. Hams are expected to generate millions of research-worthy data points.
- Grape 1 Personal Space Weather Station Doppler Shift Study (**https://hamsci.org/grape1**) — Build a Grape receiver as part of assembling a high-stability receiving setup. The setups will be used to monitor standard frequency stations WWV/H and CHU, in order to research the behavior of the ionosphere's bottom side.
- Tangerine Software-Defined Radio (**https://tangerinesdr.com**) — Contribute to the hardware and software design of a research-grade platform that's capable of wideband radio reception and data collection, VLF to HF, and potentially beyond.



During the workshop's keynote address, Dr. Patricia Reiff, W5TAR, of Rice University explained that amateurs interested in fields such as astronomy, botany, and ornithology have long contributed to science. She encouraged ham radio operators to continue that tradition through activities like ballooning, CubeSat deployment, and HamSCI. [Photo courtesy of Ann Marie Rogalcheck-Frissell, KC2KRQ]

While holding an amateur license is not a prerequisite for HamSCI participation, all members are encouraged to earn a license and call sign. To make licensing convenient, the Scranton Pocono Amateur Radio Klub, K3CSG, proctored a Volunteer Examiner session, and three attendees earned their first ham license during the workshop.

Many Thanks

HamSCI is grateful to the National Science Foundation, ARDC, DX Engineering, and ARRL for supporting the conference by way of grants, door prizes, and providing speakers for the workshop.

The 2024 HamSCI Workshop will be held at Case Western Reserve University in Cleveland, Ohio. Follow HamSCI's Facebook page (**www.facebook.com/HamSCI**) or visit their website for future announcements.

Gary Mikitin, AF8A, has been licensed since 1977. A retired electrical engineer, he enjoys portable operating, DXing, and contesting on HF CW. He currently volunteers as the Amateur Radio Community Coordinator for HamSCI. When not in his shack, Gary enjoys being outdoors and traveling by bicycle with his wife, Christine. He can be reached at **af8a@arrl.net**.

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The National Traffic System — A History and ARRL's Path Forward

Everything hams need to know about the past, present, and future of the NTS.

Fred Kemmerer, AB1OC, and Marcia Forde, KW1U

The National Traffic System (NTS) is an important resource for amateur radio public service and emergency communications. A major focus is to ensure that we can deliver traffic quickly and efficiently during emergency situations. It also serves as an enjoyable activity and training ground for amateur radio operators.

History

Amateur radio is many things, including a voluntary noncommercial communication service offered to the public. It was for this communication service that ARRL was created. Following the trunk lines of the early 1900s and a hiatus during World War II, the NTS was formed in 1949. Throughout its existence, the NTS has always been ready to assist in natural and manmade disasters.

Messages were relayed using radiograms patterned after the telegrams of the 1800s and early 1900s. Messages are now generally relayed through a network of traffic nets, both CW and voice. By the 1990s, a digital traffic network was formed using HF PACTOR and VHF packet and later, the sound card mode VARA HF. This network, with regional hubs across the country and operating 24/7, was designed with interoperability in mind, so messages can easily move between the various modes, and be delivered within hours rather than days.

The Current State of the NTS

Today, rapid and inexpensive means of communication are available throughout the world, leading some to question the future of the NTS. Modern communication methods have led to a dependence on the internet, which is subject to disablement due to cyberattacks and extreme weather events. For this reason, emergency communication via other means has become a major focus of many, including the amateur radio community and ARRL. A revitalization to better support emergency responders is a primary reason for modernizing the NTS. There is also a need to recruit new traffic handlers, standardize methods and training, and improve message delivery speed and reliability.

Ethan Hansen, KC1OIP, relays radiogram messages from his station via the NTS. [Photo courtesy of Ethan Hansen, KC1OIP]

Plans for Improvement

In April 2022, the ARRL Emergency Communications and Field Services Committee chartered a project called NTS 2.0 to develop ways to improve ARRL's support for NTS and help it evolve and grow. The NTS 2.0 Steering Committee led the working group by surveying the current state of the NTS and developing goals for ARRL's support going forward. The Steering Committee's efforts include a comprehensive set of issues that must be addressed to realize the NTS 2.0 goals. Some important issues include:

- Improving ease and reliability of delivered messages
- Handling Incident Command System ICS-213 traffic in a consistent manner, including interworking standards to better enable transit via digital, voice, and CW modes
- Creating nationwide standards and tools for reporting traffic
- Developing measurement methods to assess and improve reliability, speed, and other performance issues
- Providing resources that enable the public and other emergency communications services to easily access the NTS to send and receive messages