

An NJIT researcher throws a global ham radio 'party' to study the eclipse

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Members of NJIT's ham radio club preparing for the eclipse. From left to right - Nathaniel Frissell, Peter Teklinski, director of Core Systems and Telecommunications for NJIT and club adviser, Spencer Gunning (standing) Joshua Vega (sitting) and Joshua Katz (standing). Credit: New Jersey Institute of Technology

When a solar eclipse plunges the country into darkness Aug. 21, Nathaniel Frissell will be stationed directly along the shadow's path, leading one of the largest ionospheric experiments in the history of space science from the back porch of a cabin in Gilbertsville, Kentucky.

With a 102 ft. wire antenna, he will contact a network of [ham radio](#) operators he's assembled around the world to test the strength and reach of their high frequency signals as one measure of the [eclipse](#)'s impact on Earth's atmosphere. More than a week in advance, nearly 200 operators - from New Jersey, to Tennessee, to Wyoming in the U.S. and at far-flung locales such as Chile, Greece and India - are already signed on to be "citizen-scientists" that day by recording their contacts with one another. Their number grows daily.

"Among other phenomena, we're hoping to use our [radio](#) transmissions to identify how much of the ionosphere is impacted by the eclipse and how long the effects last," explains Frissell, an assistant research professor of physics at NJIT's Center for Solar Terrestrial Research and a sophisticated practitioner of ham radio who is intent on elevating the technology's role in space science research. He will share data and analysis from the day at the American Geophysical Union annual meeting in December.

Frissell has been preparing for this rare event for more than two years. While a Ph.D. student at Virginia Tech, he founded the Ham Radio Science Citizen Investigation (HamSCI), an organization that connects professional researchers such as space physicists and astronomers with the amateur radio community. By merging their data, the different groups will be able to construct a comprehensive picture of atmospheric effects caused by [space weather](#) events ranging from the [solar eclipse](#) later this month to more common phenomena, such as solar flares. In 2014, he first demonstrated the use of ham radio data by showing the effects of an X-class solar flare on high frequency communications.

On NJIT's campus, members of Frissell's team of undergraduate ham radio operators, including Spencer Gunning, Joshua Vega and Joshua Katz, have been constructing a website and developing data analysis tools that will allow them to gather and interpret the observations generated during the eclipse. Hundreds of hams around the world are planning on participating in this event, and they will be generating a large and diverse set of measurements.

Katz, along with Shaheda Shaik, a physics major and student researcher at NJIT's Center for Solar-Terrestrial Research, will give a talk on the eclipse at the United Astronomy Clubs of New Jersey (UACNJ) observatory at Jenny Jump State Forest Saturday, Aug. 19. Katz will return to the observatory Aug. 21 with other members of the NJIT K2MFF Amateur Radio Club to participate in the HamSCI Eclipse Ham Radio experiments. They plan on operating outside so they can view the eclipse while using their radios.

"We'll be participating in an international data-collection effort, learning more about the space weather effects of the eclipse, exposing the general public to amateur radio and watching a beautiful once-in-a-lifetime solar event all on the same day," Katz says. "That's more excitement than programmers and data analysts like me are usually allowed to have in a single sitting!"

New Jersey will experience a partial eclipse - about 75 percent shadow cover that day - beginning shortly after 1 p.m. Visitors can participate that day in UACNJ's Eclipse Observation event. (See <http://www.uacnj.org> for details.)

Frissell calls the eclipse "a spectacular event that has gripped the public's imagination."

"What's exciting from a researcher's perspective is that people have

access to tools such as digital radios and computers that are connected in ways they weren't in the past, allowing us to make observations and then collect and share them," he notes. "For us, this is an unusual opportunity to learn things we don't know about the ionosphere, the electrified region of Earth's upper atmosphere formed when ultraviolet light from the Sun dislodges electrons from neutral particles such as oxygen, nitrogen and helium. This is one of the very few times we're able to conduct a controlled experiment around a space weather event. Normally, we have no advanced knowledge over when, where and how they happen."

Ham radio operators are acutely interested in the ionosphere, in part because it allows them to communicate with each other across thousands of miles and despite the Earth's curvature, which disrupts normal line-of-sight communications. Their high-frequency radio waves bounce off the upper atmosphere and are refracted back down on the other side of the globe. The composition of the ionosphere at different levels affects their ability to transmit.

"A station in Texas may not normally be able to talk to one in North Dakota on a particular frequency at a certain time of day. However, the eclipse will change the ionospheric state and possibly create communication paths that do not normally exist. We will be looking for those changes, among other impacts," he notes. "If you suddenly alter the ionosphere as happens during an eclipse, by reducing the number of ions or changing the temperature, for example, does it create waves or instabilities? How far can these effects be detected?"

A major source of HamSCI data comes from the [Reverse Beacon Network](#) (RBN). The Reverse Beacon Network is an automated radio (1.8 - 144 MHz) receiving network created and maintained voluntarily by ham radio operators. The [American Radio Relay League](#) (ARRL) is working with HamSCI to organize and promote a [Solar Eclipse QSO Party](#) (hamsci.org/seqp), a contest-like operating event designed to get

hams on the air during the eclipse.

Provided by New Jersey Institute of Technology

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