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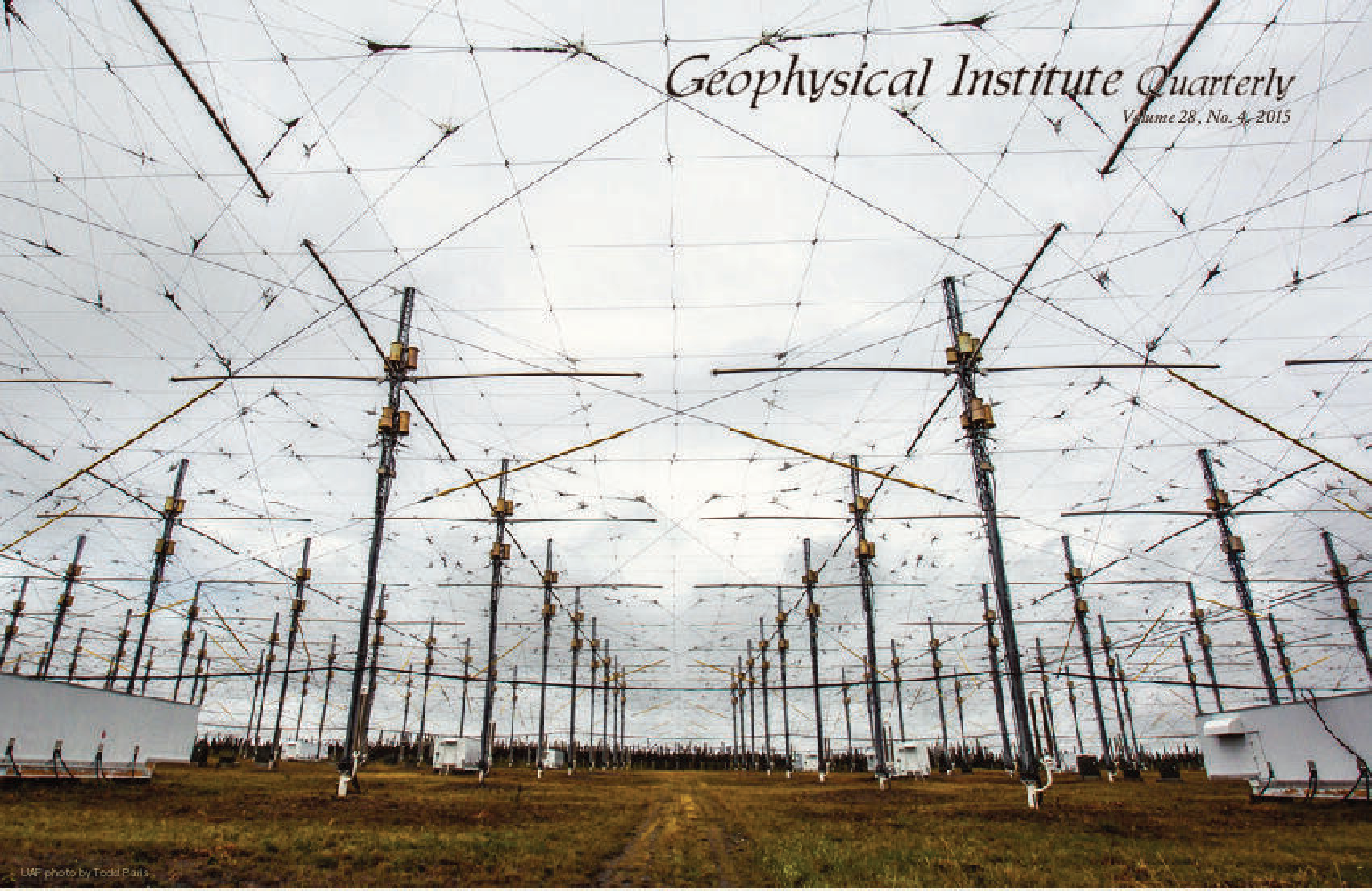


UAF photo by Todd Paris

HAARP is Now a UAF Research Facility

The facilities at the High Frequency Active Auroral Research Program are the best in the world to study the upper atmosphere using active experiments.

The facility is so valuable that Geophysical Institute Director Bob McCoy and others campaigned to have the Gakona, Alaska, research station saved from permanent closure and become a facility managed by the University of Alaska Fairbanks.

"It's an exquisite facility," McCoy said.

The Department of Defense handed over the facility to UAF in a ceremony on August 11, 2015. Now McCoy and GI's Space Physics faculty have three years to find scientists who will pay to do atmospheric research at the facility.

HAARP uses powerful customizable radio waves to excite the ionosphere, the upper layer of the atmosphere 40 to 600 miles above Earth.

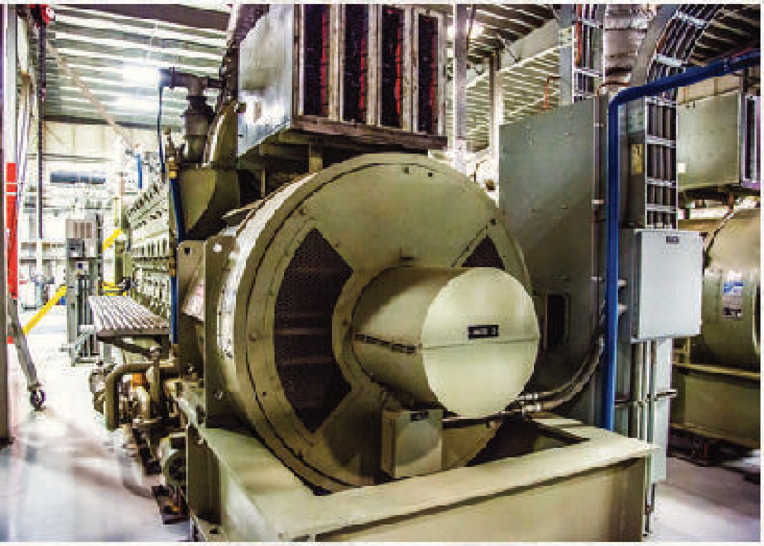
Solar winds interact with the Earth's magnetic field, causing auroras and generating ionospheric effects that can disrupt communications signals from GPS and other satellites in orbit above the ionosphere. With HAARP scientists can conduct research on the ionosphere so we can better understand how these disruptive effects occur.

Construction began in 1993 and was completed in 2007 at a cost of $290 million. DOD's objectives were to explore ionospheric processes and phenomena, particularly how they relate to communications. It is the most powerful and flexible of four such facilities in the world.

DOD finished using the facility and planned to destroy it in the summer of 2014, but Alaska Sen. Lisa Murkowski stepped in. The stoppage gave McCoy and others time to work out a deal for the ownership transfer.

McCoy says the HAARP business model will be like other UAF facilities, such as Poker Flat Research Range or Toolik Field Station: scientists will apply for grants to do basic research there.

The GI plans to hold open houses and tours of HAARP beginning in spring 2016.



What is HAARP good for?

Not many people understand the uses of the field of antennae that make up HAARP. Even for space physicists, speaking of the equipment without using words like "scintillation" and "magnetotellurics" is difficult. The difficulty of the subject matter has led to assertions of weather control and the capability of the equipment to set off earthquakes.

But the reality is a device that Geophysical Institute Director Bob McCoy calls the best in the world at what it does.

HAARP has a transmitter array of 180 crossed dipoles on about 30 acres off the Tok Cutoff Road. The dipoles are arranged in a grid and can produce up to 3,600 kW of radiated power in frequencies from 2.8 to 10 MHz.

The main HAARP transmitter, powered by five diesel generators, is only one part of the scientific observatory. Radio receivers and tranceivers, radars, telescopes, photometers and all-sky imagers are also located at the facility.

What does it do?

All these tools enable the study of radio wave interactions with the upper atmosphere. They also allow researchers to heat a minuscule portion of the ionosphere and see what happens.

"(With HAARP), it is now possible to conduct controlled experiments, versus simply watching and waiting for the sun to perturb space and attempting to learn from studying the response," Herbert Carlson of Utah State University said at a workshop on future uses of HAARP. The purpose of the workshop, held in 2013, was to learn if researchers would become customers if the facility reopened.

What's to be gained from perturbing space? The ionosphere carries and reflects radio signals from GPS and many other satellites. These signals are often disturbed during natural solar storms.

"With heat, we can create a disturbance and watch how quickly it dissipates," said Bill Bristow, a space physicist and the Geophysical Institute's chief scientist for HAARP. "We can generate irregularities to test the effects on satellite-to-ground radio systems. We don't have to wait for Mother Nature to generate conditions."

UAF photos by Todd Paris

NEW LEADERSHIP—At left, a ceremonial key to the facility was presented to (left to right) GI Director Bob McCoy and UAF Chancellor Brian Rogers by Maj. Gen. Thomas Masiello, joined by Col. David Goldstein, Dr. Craig Selcher of the Air Force Research Laboratory, and Associate Deputy Assistant Secretary of the Air Force for Science, Technology and Engineering Jeff Stanley. At right, UAF Interim Vice Chancellor for Research Larry Hinzman stands with Bob McCoy under the transmitter array.

What kind of science does it support?

Since it opened in 2003 with funding the late Ted Stevens helped secure, HAARP has hosted many scientists doing applied research for the military. One such study used the antenna array to heat a part of the ionosphere that in turn acted as a low-frequency antenna that could send an ocean-penetrating signal to a submarine. That ping could tell a submarine captain to surface in order to receive conventional radio communications.

Researchers with the Naval Research Laboratory once bounced HAARP signals off the moon. Almost one-half million miles later, they received the radio waves in New Mexico. Analysis of the echoes provided information about the subsurface of the moon.

"The military had specific objectives, but now we can do more basic science," Bristow said. "It will help us with general ionospheric/thermospheric modeling."

Much of the military research performed at HAARP was published in academic journals such as Nature, showing the results were of interest to the wider scientific community. And not all the work done was related to military research. Students in the annual Polar Aeronomy and Radio Science summer school designed and conducted their own experiments at the facility after attending lectures at UAF and visiting Poker Flat Research Range.

More uses of HAARP: With the HAARP transmitter, scientists can induce their own airglow, a sort of artificial aurora. How does that happen? That's a question scientists are trying to answer, and an example of basic research perhaps leading to better understanding of radio waves' interaction with the ionosphere.

Using the transmitter, researchers can test how heating a key area affects GPS signals. In the same way, they can observe what disturbances do to synthetic aperture radar signals.

Researchers can also use the transmitters to induce irregularities in the geomagnetic field-aligned plasma. That allows them to alter the ionosphere's properties that affect the distance that high-frequency radio signals skip. Under the right conditions, they can also disrupt high-frequency radio communications in a small area.

Seismologists and volcanologists are interested to see if HAARP might help them map magma chambers within volcanoes. Researchers are able to use HAARP to generate very low frequency signals in the ionosphere. By the reaction of those signals as received on the ground, scientists might be able to tell molten rock from hard rock. The ability to generate extreme low-frequency signals also allows researchers to image other underground phenomena, like the presence of tunnels or large chambers.

HAARP—Opposite page, from top: the HAARP antenna array with the operations building in the background; one of the five generators used to power the antenna array when it is operating; science pad 3 optical observatory and instrumentation shelters; power generation switchgear and protective relay lineup.

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Managing HAARP

The High Frequency Active Auroral Program is now part of the Geophysical Institute. Chief scientist and UAF space physics professor William Bristow and manager Jessica Matthews will work together with long-time HAARP employees Marty Karjala and Tracey Coon to transition the foremost active ionospheric facility in the world into a viable and thriving research facility.

Bristow will seek financial support from sponsors and organize scientific campaigns. He plans to establish HAARP as a subauroral research facility in addition to continued ionospheric research, resulting in a greater variety of instruments deployed.

"After working hard to keep it alive, I look forward to getting it back in operation," Bristow said. "I want to make sure it is used to its fullest potential."

Matthews, a recently retired Air Force commander, plans to use her conversion from military to civilian life as a guide when managing HAARP.

"It's an interesting transition from a military to civilian program," Matthews said. "HAARP is extraordinarily complex and highly visible, so combining a scientific and day-to-day manager is a smart and efficient relationship that will help to build a more sustainable program."

Bristow and Matthews are based at the GI in Fairbanks and will work closely with Karjala, research supervisor, and Coon, electrical engineer, who are located in Gakona.

photo courtesy Karsten Scheuren, Galileo

TRAINING—Long-time HAARP employee Marty Karjala is working with new management to smooth the transition.