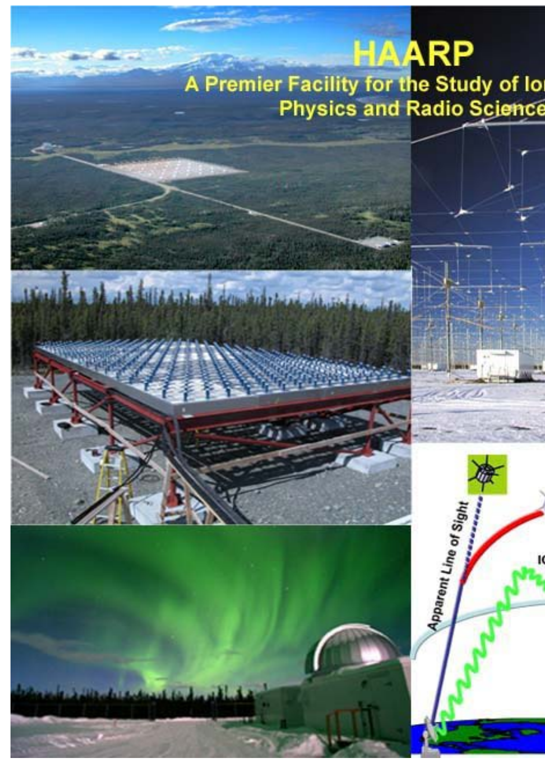
SUMMARY:

The **High Frequency Active Auroral Research Program (HAARP)** is an investigation project jointly funded by the US Air Force, the US Navy, the University of Alaska, and the Defense Advanced Research Projects Agency (DARPA).[1] Its purpose is to investigate the ionosphere and establish whether some of its properties can be used for communication or surveillance purposes.[2] Started in 1993, the project is proposed to last for a period of twenty years. The system was designed and built by Advanced Power Technologies[*citation needed*] (APTI) and since 2003, by BAE Advanced Technologies.[1]

The facility currently operates a VHF and UHF radar, a fluxgate magnetometer, a digisonde, and an induction magnetometer alongside the transmitter facilities.



The HAARP site

The project site (62°23′30″N 145°09′03″W) is north of Gakona, Alaska just west of Wrangell-Saint Elias National Park. An environmental impact statement led to permission for an array of up to 180 antennas to be erected.[3] The HAARP has been constructed at the previous site of an over-the-horizon radar (OTH) installation. A large structure, built to house the OTH now houses the HAARP control room, kitchen, and offices. Several other small structures house various instruments.

The HAARP site has been constructed in three distinct phases: [4]

1. The **Developmental Prototype** (DP) had 18 antenna elements, organized in three columns by six rows. It was fed with a total of 360 kilowatts (kW) combined transmitter output power. The DP transmitted just enough power for the most basic of ionospheric testing.
2. The **Filled Developmental Prototype** (FDP) had 48 antenna units arrayed in six columns by eight rows, with 960 kW of transmitter power. It was fairly comparable to other ionospheric heating facilities. This was used for a number of successful scientific experiments and ionospheric exploration campaigns over the years.
3. The **Final IRI** (FIRI) will be the final build of the IRI. It has 180 antenna units, organized in 15 columns by 12 rows, yielding a theoretical maximum gain of 31 dB. A total of 3.6 MW of transmitter power will feed it, equvilant to the power of just under 8 performance cars[5]. The total ERP (effective radiated power) will be 3,9811 MW (961 dBW). As of March 2007, all the antennas were in place, but the final quota of transmitters had not yet been installed, the final phase was completed and the antenna array was undergoing testing aimed at fine-tuning its performance to comply with safety requirements required by regulatory agencies.

Instrumentation and operation

The **I**onospheric **R**esearch **I**nstrument (IRI) is the primary instrument at HAARP, which is a high-frequency (HF) transmitter system used to temporarily energize a portion of the ionosphere. Study of this modified volume yields important information for understanding natural ionospheric processes.

During active ionospheric research, the signal generated by the transmitter system is delivered to the antenna array, transmitted in an upward direction, and is partially absorbed, at an altitude between 70 km (43 mi) to 350 km (217 mi) (depending on operating frequency), a few tens of kilometers in diameter over the site. The intensity of the HF signal in the ionosphere is less than 3 µW/cm², tens of thousands of times less than the Sun's natural electromagnetic radiation reaching the earth and hundreds of times less than even the normal random variations in intensity of the Sun's natural ultraviolet (UV) energy which creates the ionosphere. The small effects that are produced, however, can be observed with the sensitive scientific instruments installed at the HAARP facility and these observations can provide new information about the dynamics of plasmas and new insight into the processes of solar-terrestrial interactions.[6]

Each antenna element consists of a crossed dipole that can be polarized for linear, ordinary mode (O-mode), or extraordinary mode (X-mode) transmission and reception.[7][8] Each part of the two section crossed dipoles are individually fed from a custom built transmitter, that has been specially designed with very low distortion. The ERP of the IRI is limited by more than a factor of 10 at its lower operating frequencies. Much of this is due to higher antenna losses and a less efficient antenna pattern.

HAARP can transmit between 2.7 and 10 MHz. This frequency range lies above the AM radio broadcast band and well below Citizens' Band frequency allocations. The HAARP is licensed to transmit only in certain segments of this frequency range, however. When the IRI is transmitting, the bandwidth of the transmitted signal is 100 kHz or less. The IRI can transmit continuously (CW) or pulses as short as 10 microseconds (µs). CW transmission is generally used for ionospheric modification, while short pulses are frequently repeated, and the IRI is used as a radar system. Researchers can run experiments that use both modes of transmission, modifying the ionosphere for a predetermined amount of time, then measuring the decay of modification effects with pulsed transmissions.

Current facilities

In the United States, there are three ionospheric heating facilities: the HAARP, the HIPAS, near Fairbanks, Alaska, and (currently offline for reconstruction) one at the Arecibo Observatory[citation needed] in Puerto Rico. The European Incoherent Scatter Scientific Association (EISCAT) operates an ionospheric heating facility, capable of transmitting over 1 GW effective radiated power (ERP), near Tromsø, Norway.[9] Russia has the Sura Ionospheric Heating Facility, in Vasilsursk near Nizhniy Novgorod, capable of transmitting 190 MW ERP.

A fluxgate magnetometer built by the University of Alaska Fairbanks Geophysical Institute is available to chart variations in the Earth's magnetic field. Rapid and sharp changes may indicate a geomagnetic storm. A digisonde provides ionospheric profiles, allowing scientists to choose appropriate frequencies for IRI operation. The HAARP makes current and historic digisonde information available online. An induction magnetometer, provided by the University of Tokyo, measures the changing geomagnetic field in the Ultra Low Frequency (ULF) range of 0–5 Hz.

Research at the HAARP

HAARP's main goal is basic science research of the uppermost portion of the atmosphere, known as the ionosphere. Essentially a transition between the atmosphere and the magnetosphere, the ionosphere is where the atmosphere is thin enough that the sun's x-rays and UV rays can reach it, but thick enough that there are still enough molecules present to absorb those rays. Consequently, the ionosphere consists of a rapid increase in density of free electrons, beginning at ~70 km, reaching a peak at ~300 km, and then falling off again as the atmosphere disappears entirely by ~1000 km. Various aspects of HAARP can study all of the main layers of the ionosphere.

The profile of the ionosphere, however, is highly variable, showing minute-to-minute changes, diurnal changes, seasonal changes, and year-to-year changes. This becomes particularly complicated near the Earth's poles, where a host of physical processes (like auroral lights) are unlocked by the fact that the alignment of the Earth's magnetic field is nearly vertical.

On the other hand, the ionosphere is traditionally very difficult to measure. Balloons cannot reach it because the air is too thin, but satellites cannot orbit there because the air is still too thick. Hence, most experiments on the ionosphere give only small pieces of information. HAARP approaches the study of the ionosphere by following in the footsteps of an ionospheric heater called EISCAT near Tromsø, Norway. There, scientists pioneered exploration of the ionosphere by perturbing it with radio waves in the 2-10 MHz range, and studying how the ionosphere reacts. HAARP performs the same functions but with more power, and a more flexible and agile HF beam.

Some of the main scientific findings from HAARP include:

1. Generation of very low frequency radio waves by modulated heating of the auroral electrojet, useful because generating VLF waves ordinarily requires gigantic antennas
2. Production of weak luminous glow (below what you can see with your eye, but measurable) from absorption of HAARP's signal
3. Production of ultra low frequency waves in the 0.1 Hz range, which are next to impossible to produce any other way
4. Generation of whistler-mode VLF signals which enter the magnetosphere, and propagate to the other hemisphere, interacting with Van Allen radiation belt particles along the way
5. VLF remote sensing of the heated ionosphere

Research at the HAARP includes:

1. Ionospheric heating
2. Plasma line observations
3. Stimulated electron emission observations
4. Gyro-frequency heating research
5. Spread F observations
6. Airglow observations
7. Heating induced scintillation observations
8. VLF and ELF generation observations (http://www-star.stanford.edu/~vlf/publications/2008-03.pdf)
9. Radio observations of meteors
10. Polar mesospheric summer echoes: Polar mesospheric summer echoes (PMSE) have been studied using the IRI as a powerful radar, as well as with the 28 MHz radar, and the two VHF radars at 49 MHz and 139 MHz. The presence of multiple radars spanning both HF and VHF bands allows scientists to make comparative measurements that may someday lead to an understanding of the processes that form these elusive phenomena.
11. Research on extraterrestrial HF radar echos: the Lunar Echo experiment (2008).[10][11]
12. Testing of SS-Spread Spectrum Transmitters 2009
13. Meteor shower impacts on the ionosphere
14. Response and recovery of the ionosphere from solar flares and geomagnetic storms
15. The effect of ionospheric disturbances on GPS satellite signal quality

Objectives

The HAARP project aims to direct a 3.6 MW signal, in the 2.8-10 MHz region of the HF band, into the ionosphere. The signal may be pulsed or continuous. Then, effects of the transmission and any recovery period will be examined using associated instrumentation, including VHF and UHF radars, HF receivers, and optical cameras. According to the HAARP team, this will advance the study of basic natural processes that occur in the ionosphere under the natural but much stronger influence of solar interaction, as well as how the natural ionosphere affects radio signals. This will enable scientists to develop techniques to mitigate these effects in order to improve the reliability and/or performance of communication and navigation systems, which would have a wide range of applications in both the civilian and military sectors.

The project is funded by the Office of Naval Research and jointly managed by the ONR and Air Force Research Laboratory, with the principal involvement of the University of Alaska. Many other universities and educational institutions have been involved in the development of the project and its instruments, namely the University of Alaska (Fairbanks), Stanford University, Penn State University (ARL), Boston College, UCLA, Clemson University, Dartmouth College, Cornell University, Johns Hopkins University, University of Maryland, College Park, University of Massachusetts, MIT, Polytechnic Institute of New York University, and the University of Tulsa. The project's specifications were developed by the universities, which are continuing to play a major role in the design of future research efforts. There is both military and commercial interest in its outcome, as many communications and navigation systems depend on signals being reflected from the ionosphere or passing through the ionosphere to satellites. Thanks to the more penetrating properties of VLF and ELF, advancements in underwater and underground research and applications are now possible. This may lead to improved methods for submarine communication and the ability to remotely sense the mineral content of the terrestrial subsurface, among other things. In addition, an improved understanding the ionosphere's impact on satellite signals transmitted to Earth may increase the accuracy of GPS navigation, since those satellite signals are affected in an unknown way as they pass through the ionosphere.

The HAARP project offers annual open days to permit the general public to visit the facility, and makes a public virtue of openness; according to the team, "there are no classified documents pertaining to the HAARP." Each summer, the HAARP holds a summer-school for visiting students, including foreign nationals, giving them an opportunity to do research with one of the world's foremost research instruments.

HAARP controversy

Power emitted

The critics' views have been rejected by HAARP's defenders, who have pointed out that the amount of energy at the project's disposal is minuscule compared to the colossal energies dumped into the atmosphere by solar radiation and thunderstorms. A University of Alaska Fairbanks Geophysical Institute scientist has compared the HAARP to an "immersion heater in the Yukon River."

Since the ionosphere is inherently a chaotically turbulent region, HAARP's defenders state any artificially induced changes would be "swept clean" within seconds or minutes at the most. Ionospheric heating experiments performed at the Arecibo Observatory's ionospheric heater and incoherent scatter radar have shown that after periods of modification (up to an hour), the ionosphere returns to normal within about the same period of time it had been heated.

Additionally, the ULF and ELF radio signals indirectly generated by HAARP ionospheric heating are millions of times weaker than naturally generated signals, such as radio atmospherics from lightning, and magnetospheric chorus waves, so they have no real impact on the radio wave environment on Earth.

Open activities

Furthermore, supporters of HAARP argue that its activities have been, since its establishment, extremely open. All activities are logged and publicly available. Scientists without security clearances, even foreign nationals, are routinely allowed on site. The HAARP facility regularly (once a year on most years according to the HAARP home page) hosts open houses, during which time any civilian may tour the entire facility.

In addition, scientific results obtained with HAARP are routinely published in major research journals (such as *Geophysical Research Letters*, or *Journal of Geophysical Research*), written both by university scientists (American and foreign) or by US Department of Defense research lab scientists.

Weapon

The objectives of the HAARP project became the subject of controversy in the mid-1990s, following claims that the antennas could be used as a weapon. A small group of American physicists aired complaints in the non-peer-reviewed letters *Physics and Society*,[12] charging that the HAARP could be seeking ways to destroy or disable enemy spacecraft[*citation needed*] or disrupt communications over large portions of the planet. The physicist critics of the HAARP have had little complaint about the project's current stage, but have expressed fears that it could in the future be expanded into an experimental weapon, especially given that its funding comes from the Office of Naval Research and the Air Force Research Laboratory.[*citation needed*]

These concerns were amplified by Bernard Eastlund, a physicist who developed some of the concepts behind the HAARP in the 1980s and proposed using high-frequency radio waves to energize the ionosphere in order to disable incoming missiles, thus "knocking out" out enemy satellite communications. The US military became interested in the idea as an alternative to the laser-based Strategic Defense Initiative[*dubious* – *discuss*]. However, Eastlund's ideas were eventually dropped as SDI itself mutated into the more limited National Missile Defense of today. The contractors selected to build HAARP have denied that any of Eastlund's patents were used in the development of the project.

After the physicists raised early concerns, the controversy was stoked by local activism. In September 1995, a book entitled *Angels Don't Play This HAARP: Advances in Tesla Technology* by Nick Begich Jr., son of Congressman Nick Begich and brother of Senator Mark Begich, claimed that the project *in its present stage* could be used for "geophysical warfare".[*citation needed*] Other conspiracy theorists extended the power of HAARP: "HAARP... can change weather patterns over whole continents, jam global communications systems, disrupt mental processes, manipulate the earth's upper atmosphere."[13]

In August 2002, a critical mention of HAARP technology came from the State Duma (parliament) of Russia. The Duma issued a press release on the HAARP written by the international affairs and defense committees, signed by 90 deputies and presented to then President Vladimir Putin. The statement claimed:

> The U.S. is creating new integral geophysical weapons that may influence the near-Earth medium with high-frequency radio waves ... The significance of this qualitative leap could be compared to the transition from cold steel to firearms, or from conventional weapons to nuclear weapons. This new type of weapons differs from previous types in that the near-Earth medium becomes at once an object of direct influence and its component.[14]

However, given the timing of the Russian intervention, it is possible that it was related to a controversy at the time concerning the US withdrawal in June 2002 from the Russian-American Anti-Ballistic Missile Treaty.[*citation needed*] This high level concern is paralleled in the April 1997 statement by the U.S. Secretary of Defense over the power of such electromagnetic weaponry. Russia owns and operates an ionospheric heater system as powerful as the HAARP, called 'Sura,' which is located roughly 150 km (93 mi) from the city of Nizhny Novgorod.[15]

NOTE: Also check out the following link to 'hear' what HAARP sounds like: http://www.brojon.org/frontpage/bj1203.html