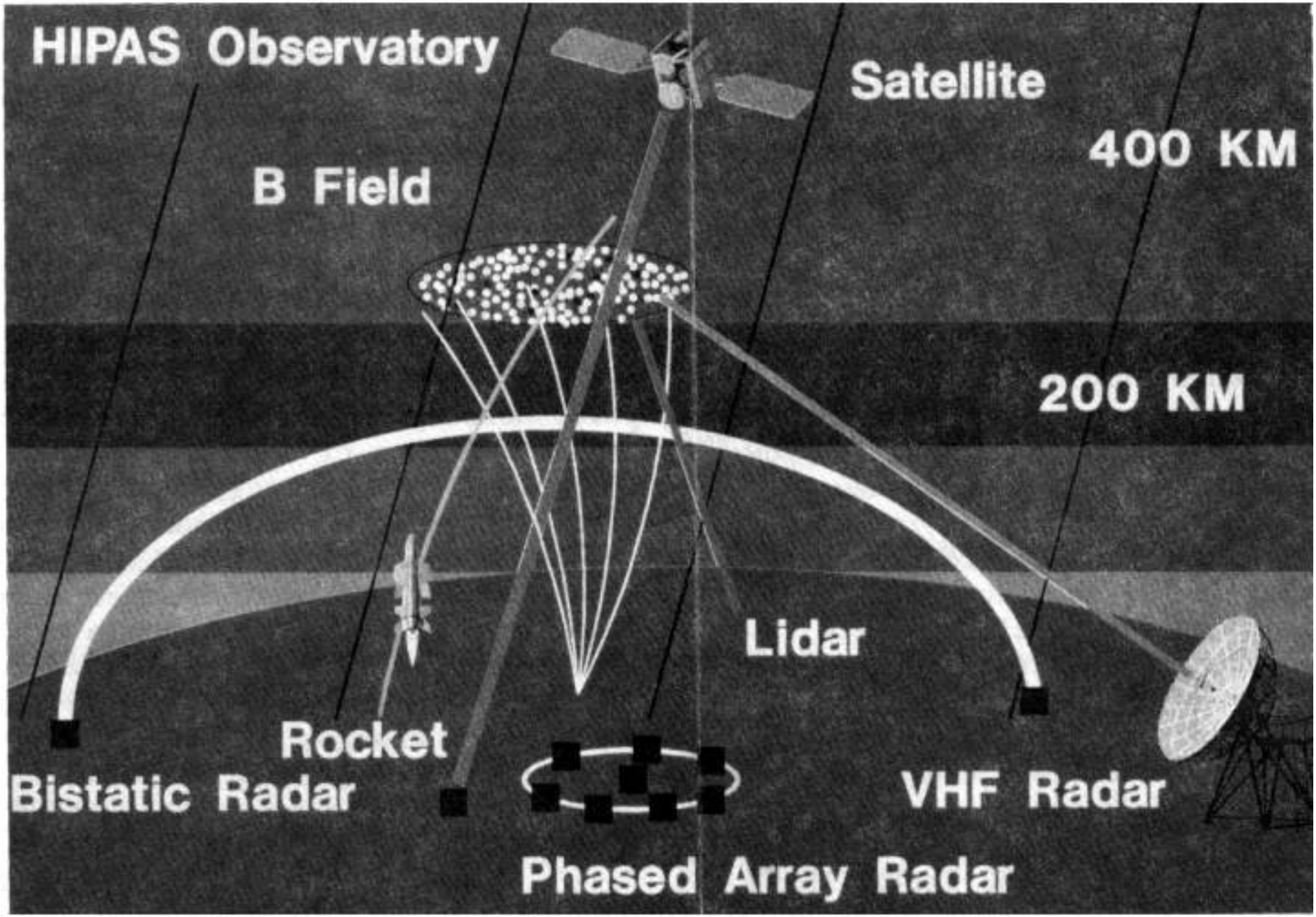
Exciting Opportunities for Alaska: Using HIPAS Observatory for Communications, Environment and Basic Science

Director: Alfred Y. Wong

Aug 27, 2001


HIPAS Observatory
Satellite
400 KM
B Field
200 KM
Lidar
Rocket
Bistatic Radar
VHF Radar
Phased Array Radar

HIPAS Observatory

- HIPAS Observatory, located at Fairbanks in central Alaska, is a unique place. It is one of the best locations for the observation of the Auroral Borealis.
- The nearly vertical magnetic field lines connect the location to both the magnetosphere and the open field lines.
- Over the last twenty years the HIPAS Observatory has built up a spectrum of communication frequencies from very low to very high frequencies – ELF (Extremely Low Frequencies) to laser frequencies.

Use the largest astronomical mirror and LIDAR in Alaska

- To monitor the ozone profile
- To conduct optical communications experiments

Use the largest laser in Alaska

- To generate an ionized medium for communication purposes
- To excite ion cyclotron waves to accelerate CO_2^- molecules out of the atmosphere, thus helping to solve the CO_2 green house warming problems

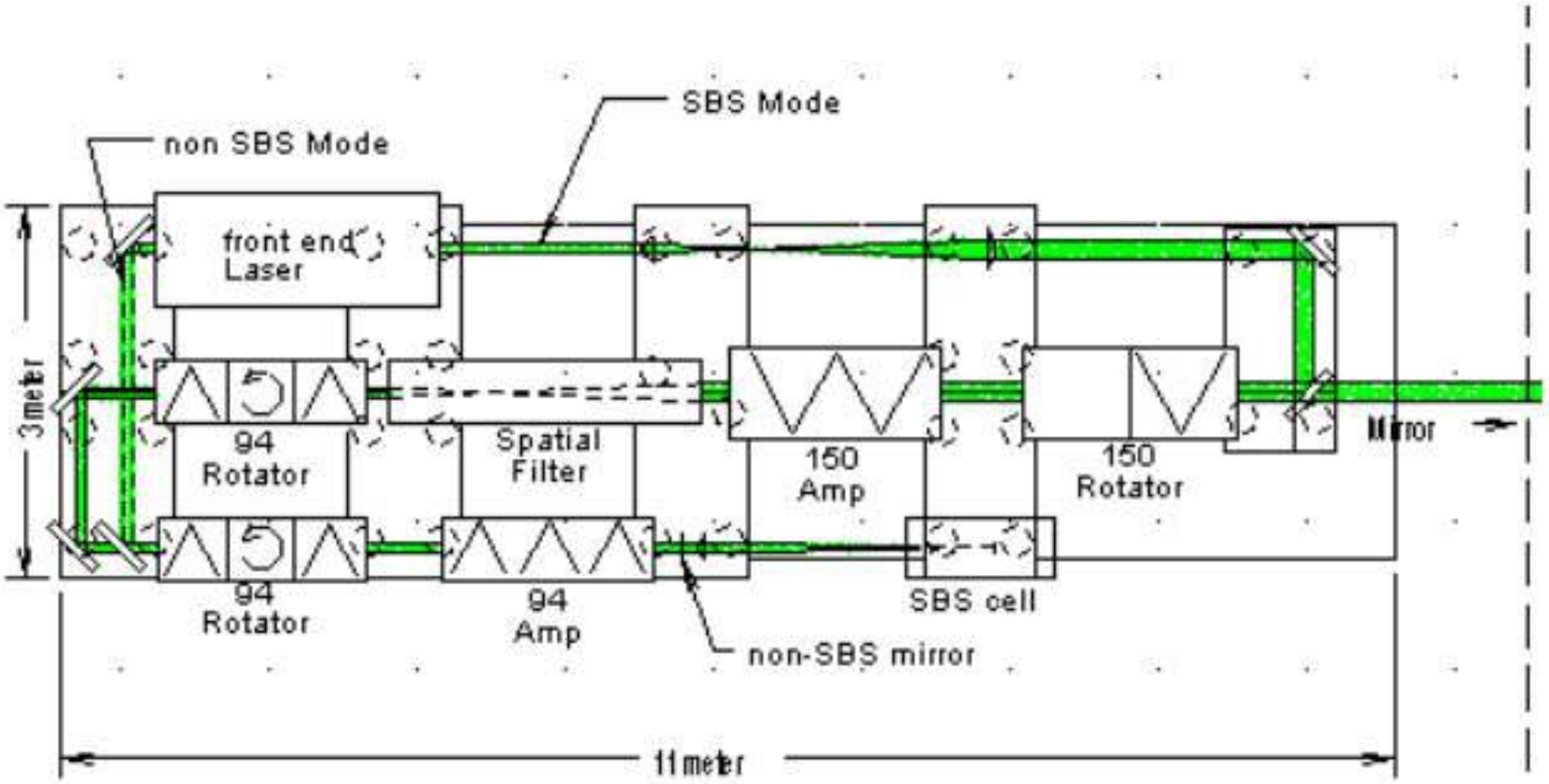
Mirror

- 2.7 m diameter rotating mercury mirror at HIPAS.
- Project Leader: Dr. Ralph Wuerker

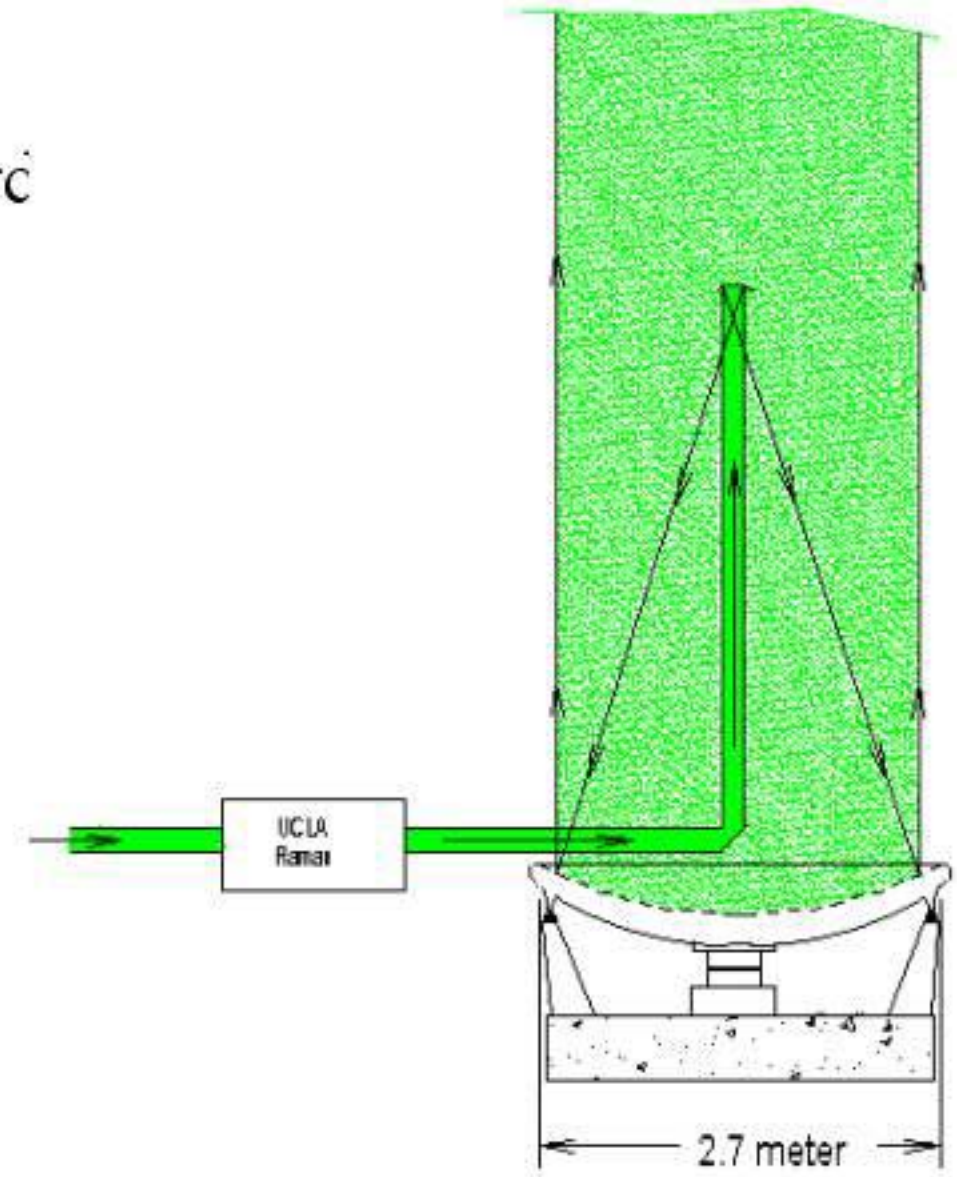
HIPAS Lidar

- Photograph of the HIPAS lidar building taken 11/21/2000 with a camera looking to the north (ASA 200 film, f/2.8, 5 minute exposure).

Layout for Nova Laser in New Addition to Lidar Bldg.



Laser Beam directed
by large mirror upward
to the ionosphere

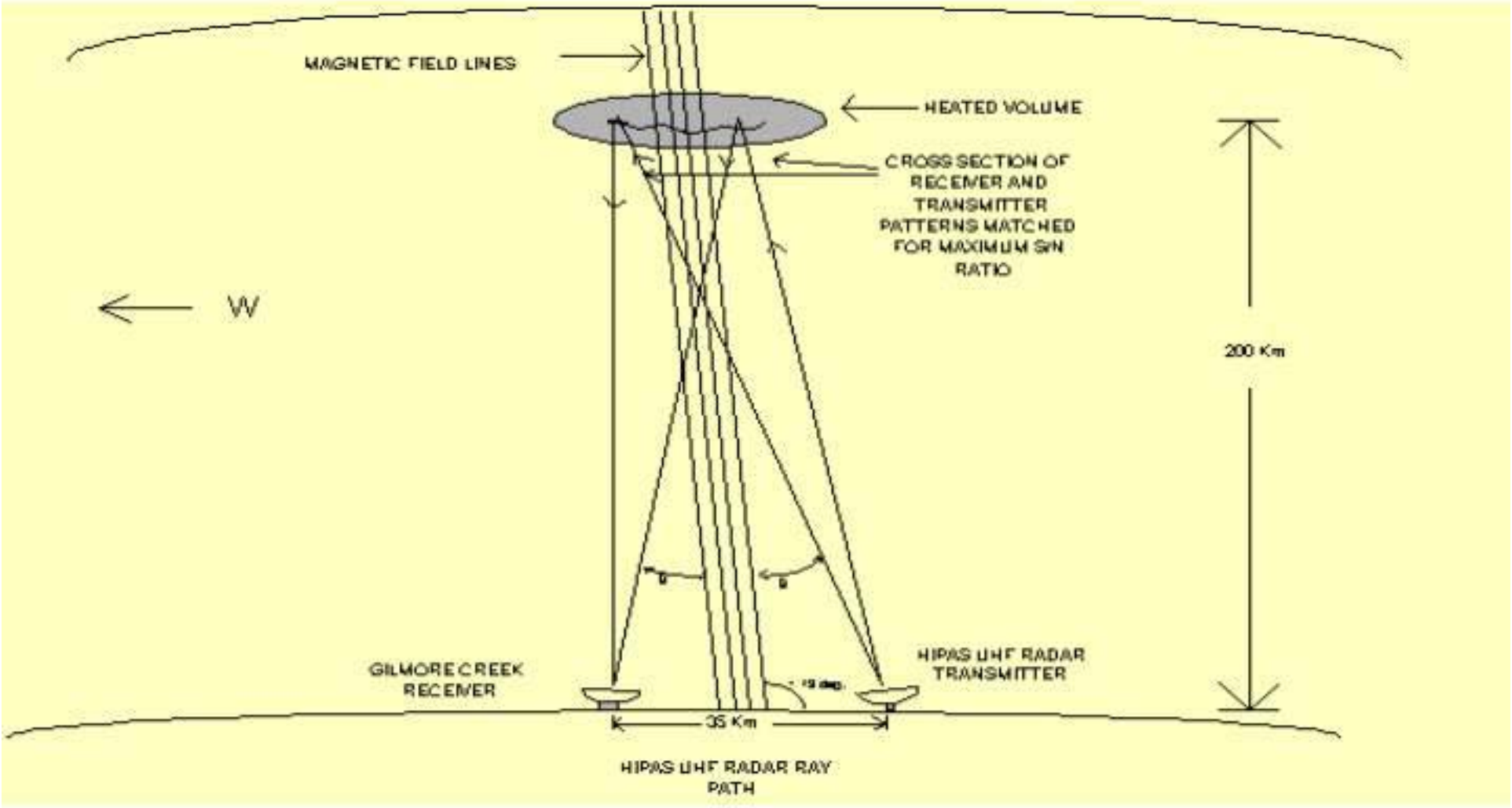


Additional Opportunities

- Transport and reassemble Clear Air Station surplus radar equipment at HIPAS to build the largest radar for Basic Science in Alaska.
- Provide training and job opportunities for technologists in Alaska in the areas of telecommunication and energy.
- Cooperate with GCI to have an All Alaskan Network of monitoring stations in Alaska consisting of a maximum of 75 stations.

HIPAS UHF Bistatic Auroral Radar (HUBAR)

General HUBAR ray path



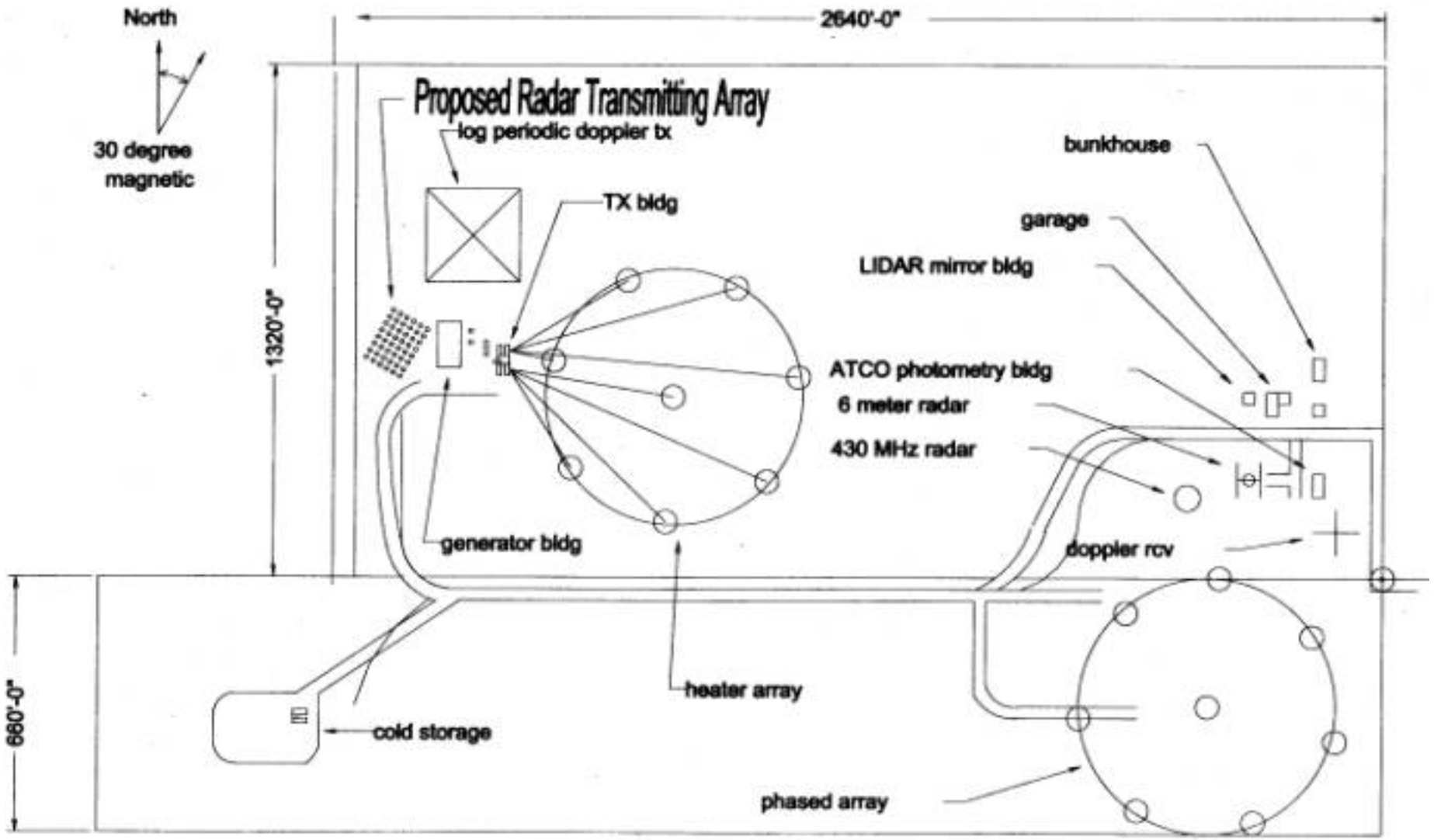
Bistatic UHF Radar from Clear Air Station

- Diagnostics are crucial to the understanding of the ionosphere.
- The radar available from Clear Air Station will provide essential information on the ionosphere.
- The objective of this task is to measure the effect of electron plasma waves (EPW) on the scattering of HF radiation from the ionosphere.
- The task includes several design and fabrication elements, as well as the measurement program.

- Some of the required hardware exists on-site.
- Our implementation procedure is based on experience with existing prototype equipment, which includes:
- 1) at HIPAS: HF transmitter and UHF transmitter;
- 2) at the Gilmore Creek (NOAA) station: two large dishes (of which one currently has a UHF receiver).

UCLA-HIPAS FACILITY
STATION SITE PLAN

August 1995



Project Goals

- Construction of High Resolution Polar Region Coherent Radar.
- Integration with existing HIPAS diagnostics.
- Understanding Basic Science.

Description

- The Hipas UHF Bistatic Auroral Radar (HUBAR) will be a high powered, versatile ionospheric scatter radar operating in the 430 MHz range.
- The transmitter and receiver facilities will be separated by approximately 30 km, affording several operational and performance advantages over previous ionospheric radar facilities in the region.
- Receiver site will use an existing steerable 90 ft. parabolic antenna, located at the Gilmore Creek/NOAA site.

All Alaska Monitoring Project

Create Multi-Station Receiving Capability in Alaska for HF holographic study based on:

S.C. Sung and A.Y. Wong, HF Holography, UCLA PPG report.

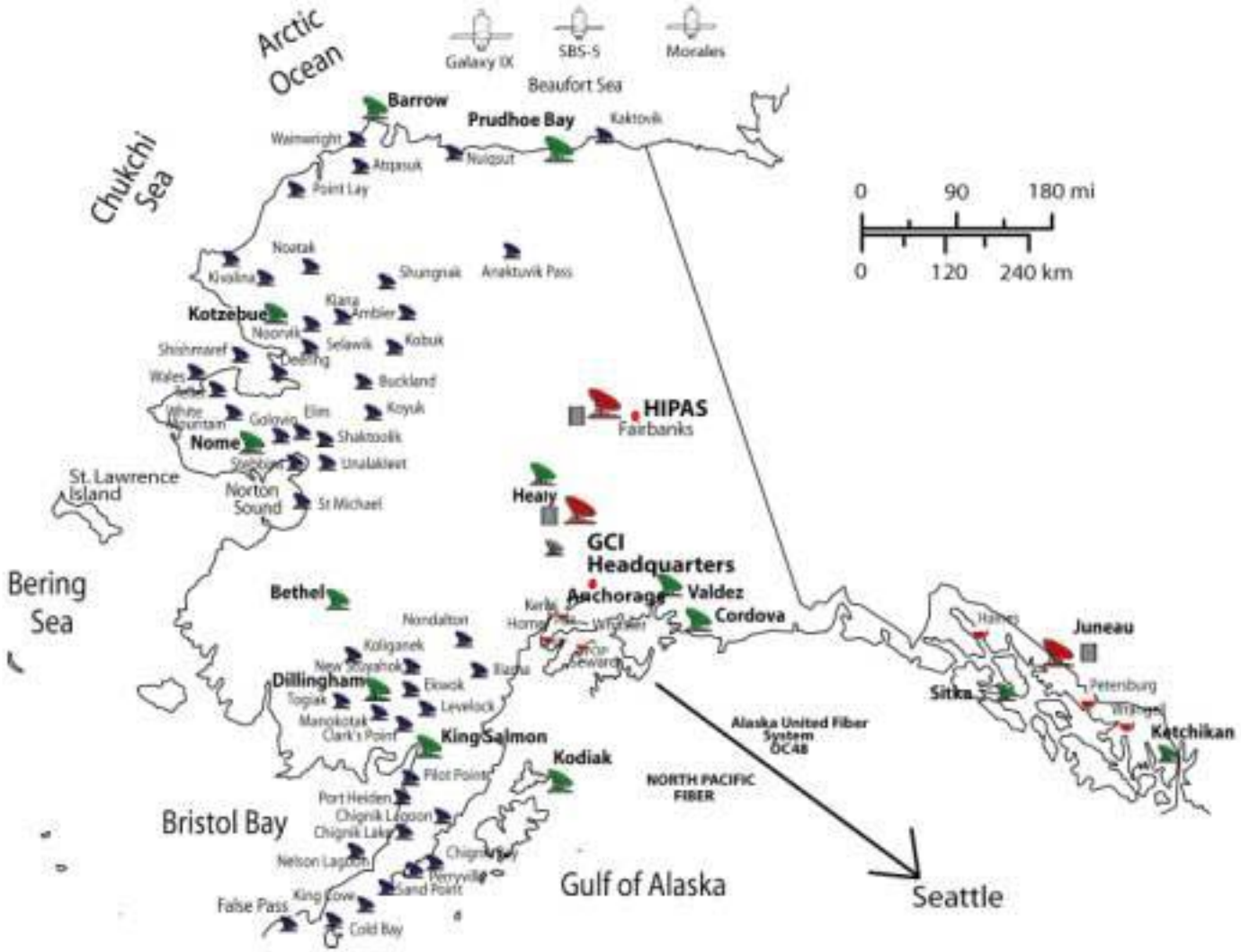
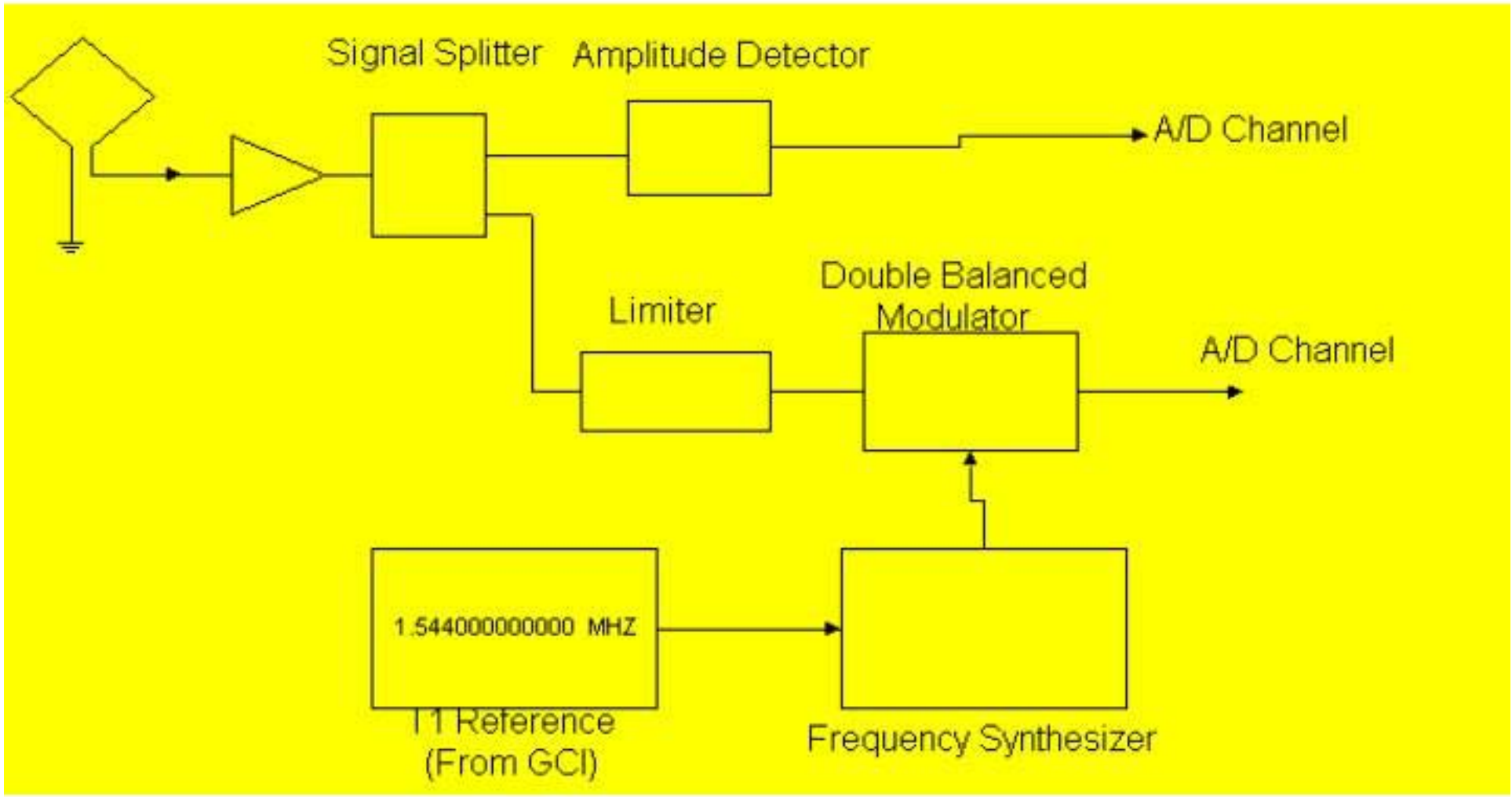


FIGURE 1. **Location of commercial communications receiver sites in Alaska.**

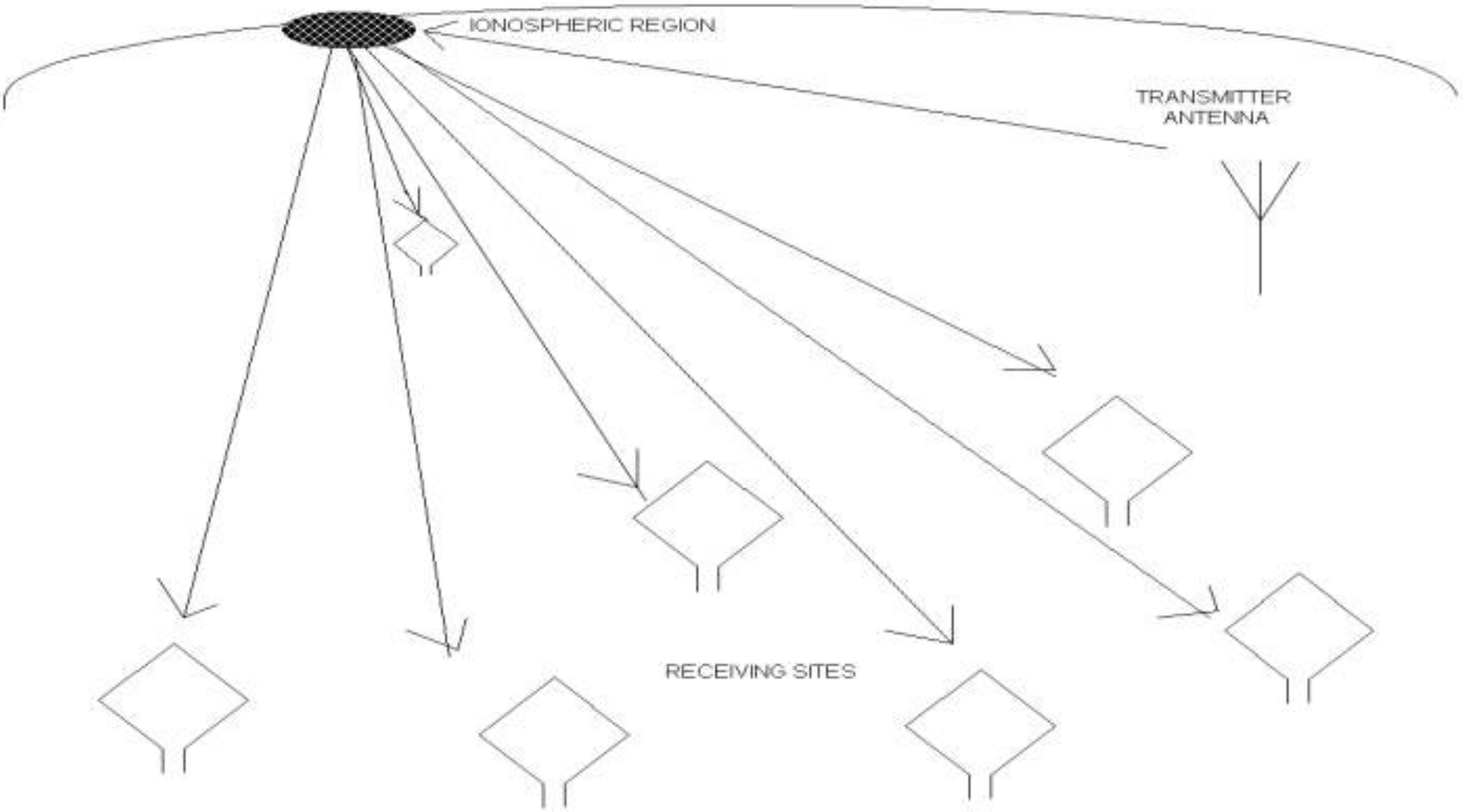
Collaboration with General Communications, Inc.

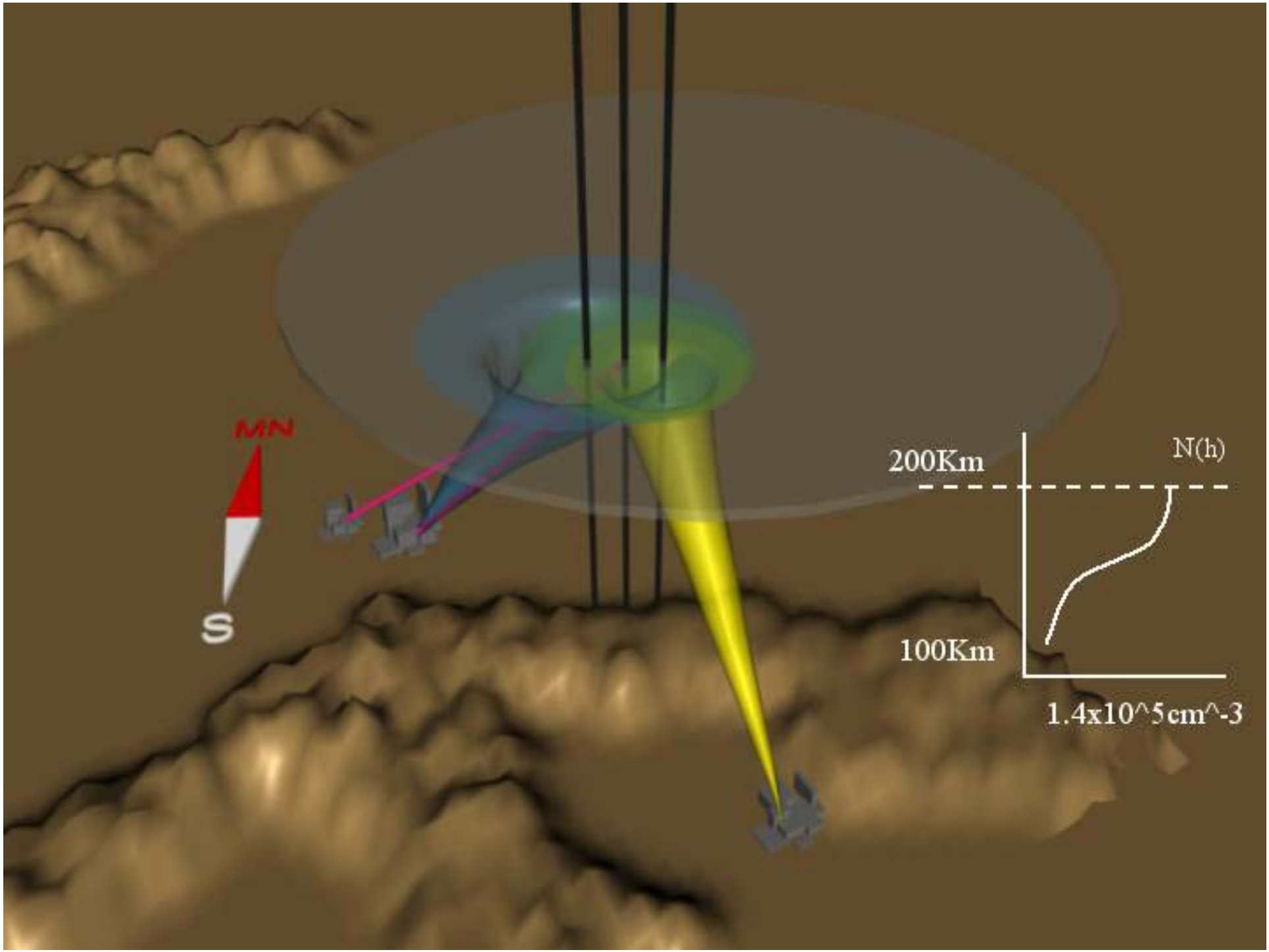
- Because of the universal availability of T1 reference signals throughout the GCI network, an extremely simple synchronous (homodyne) receiver can be used to measure the phase and amplitude of an HF signal transmitted from a central location (HIPAS).
- This will allow, for the first time, the construction of an economical very-large-baseline HF interferometer.

Receiver Block Diagram



System Layout




MN
S
200Km
N(h)
100Km
1.4x10^5cm^-3

HIPAS Observatory has maintained a tradition of innovations in Alaska.

- HIPAS was the first to demonstrate communications with a submarine submerged in the Gulf of Alaska using the energy associated with the auroral electrojet.
- HIPAS was used to demonstrate coupling between high frequency waves and low frequency waves.
- HIPAS was the first to demonstrate that the ionosphere has memory of previous perturbations.

Training

- HIPAS has trained students and professionals in areas of science and technologies.
- Graduates are now working in aerospace firms and technical firms in Alaska.

- HIPAS is easily accessible and is an ideal place to train Alaska citizens in the advanced technology of communications.
- All Alaska communication network gives Alaskan natives access to technologies.
- HIPAS has hosted national and international conferences.

- HIPAS Observatory is surrounded by a host of excellent facilities belonging to the University of Alaska, Fairbanks, and local firms.
- HIPAS Observatory has served the State in research and education in the area of communications and environmental monitoring.
- Our new initiatives will involve an even larger number of communication practitioners and students.
- With the growth of telecommunication industries there is a dire need of trained personnel in all areas of communications such as digital coding, control, antennas and receivers.

Budget: $ 1.5 million.

1. Continuing installation of largest Lidar and tests: $ 0.75 million
2. Complete All Alaska Monitoring: $ 0.25 million
3. Transport and install Clear Air Station radar: $ 0.50 million