Exhibit 1

The research requiring the FCC license pertains to radar studies of the Earth's ionosphere. Below is the abstract of the proposal submitted to the National Science Foundation (NSF) of the United States outlining the research. This project has been approved and carries the NSF number ATM-9713027.

Note - the FCC has already granted a license for the HF radar described below (callsign WA2XVQ, file 5947-EX-PL-1997). We believe we will be able to perform additional, complementary science helpful to this NSF project by installing and operating an ionosonde at our research site. The ionosonde is a low-power transceiver that constructs a vertical profile of the ionosphere by sweeping frequencies briefly in the lower HF band. The ionosonde would only operate for a few minutes each hour and for a few days each month. It has a low-power pulsed transmitter with a small duty cycle and feeds an inefficient, resistor-loaded, broadband antenna. Numerous ionosondes are deployed by other research groups throughout North America.

We expect to renew the NSF project mentioned above and expect our research to continue for several more years. License renewals will be sought as time elapses.

Summary

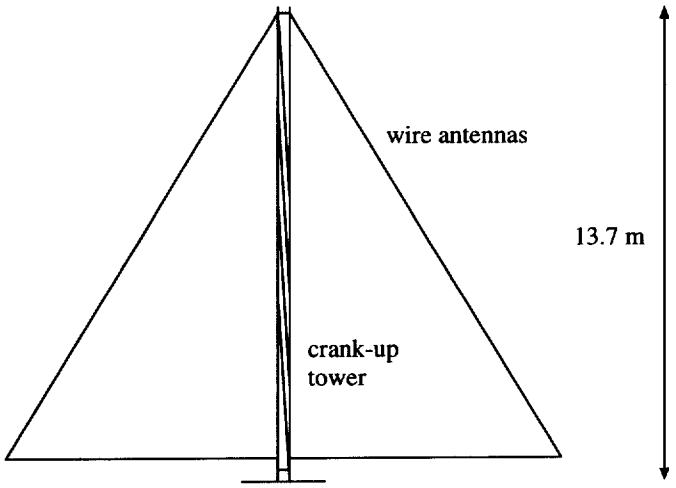
This is a proposal for the study of plasma waves that arise in sporadic ionization layers in the ionospheric E region at midlatitudes (midlatitude sporadic E). Our study, which will have experimental and theoretical components, is intended to shed light on a number of recent discoveries about these plasma waves. We will mainly investigate four questions: 1) what is the significance of the quasiperiodic structures observed by ground-based radar [*Yamamoto et al.*, 1991], 2) how well does the standard model of E region plasma waves developed to explain electrojet radar echoes account for midlatitude HF observations, 3) what is the source of streaming instabilities at midlatitudes, and what do they reveal about fundamental E region plasma physics, and 4) what is the storm-time behavior of plasma waves in the midlatitude E region?

The experimental component of the proposed research will be facilitated by our construction of a medium-power pulsed HF Doppler radar interferometer to be deployed at Clemson University. The radar will have capabilities similar to portable HF and VHF radars now in operation but will be constructed at low cost from commercially-available components. The modest peak power (~10 kW) of the radar will be compensated for with extensive use of long binary phase coded pulses. Unlike other radar systems used for studying ionospheric plasma waves, which are usually deployed remotely for a few weeks at at time in campaign mode, ours will be constantly accessible to investigators and students at Clemson University. We will be able to use the radar to study the climatology (seasonal and solar cycle variability) of sporadic E layers over the continental U.S. and the plasma waves within. We will also be able to activate the radar on short notice to observe the response of the ionosphere to storm-time drivers such as penetrating electric fields and disturbance dynamos, gravity waves propagating from the auroral zone, and micropulsations.

The HF radar will be part of the Clemson Atmospheric Research Laboratory (CARL) and serve as an outdoor classroom, complementing departmental classes on space plasma physics. It will provide a laboratory for graduate students in the physics department and engineering college, help us to introduce them to issues outside the curriculum such as signal processing and radar techniques, and prepare them for experimental careers and experiments at other radar observatories worldwide.

References

Yamamoto, M., S. Fukao, R. F. Woodman, T. Ogawa, T. Tsuda, and K. Kato, Mid-latitude E-region field-aligned irregularities observed with the MU radar, *J. Geophys. Res.*, *96*, 15,943, 1991.


wire antennas
13.7 m
crank-up
tower