URSI

Gathered at the 1969 meeting of the International Union of Radio Science

RADIO SCIENCE

Amplification of low frequency signals

Measurements of whistler-like, very low frequency radio signals generated by ground stations have been made aboard the OGO-4 satellite. For VLF stations located at mid and high latitudes, the magnetic field strength at the satellite "presents several striking features," Dr. J. J. Angerami of Stanford University said.

Reporting joint research with Drs. R. R. Scarabucci and R. A. Helliwell, he said the signal usually disappeared near the magnetic equator. In the hemisphere of the transmitter, the whistler-like signals are strong near the station, decreasing slowly with distance.

In the opposite hemisphere, however, the low frequency radio waves are much stronger. The scientists attribute this enhancement to magnetospheric focusing. The 17.8 kilohertz radiation also shows a high latitude cutoff in the opposite hemisphere that may be related to the position of the plasmapause.

They have computed that the VLF radio waves take from 100 to 500 milliseconds to travel from one hemisphere to another, depending upon the latitude at which the signals are injected. Their computations were made for a wide range of frequencies at different latitudes.

The amplitude measurements from the satellite included both the man-made signals and those from naturally occurring whistlers, generated by lightning in thunderstorms.

METEOROLOGY

Radar for the troposphere

A pair of new continuous wave radars just going into operation at the U.S. Naval Electronics Laboratory Center in San Diego promises to reveal new information about the lower part of the atmosphere. Observations with the tropospheric sounding facility are so recent that scientists are still in the process of determining exactly what the radar records mean.

Dr. Juergen H. Richter termed some of the data "weird—unexpected and unexplained," citing as an example one invisible layer of air that suddenly dropped within one minute from 335 meters to 305 meters. Another example was a 10 to 20 second oscillation in another invisible layer at about 210 meters.

The two radars, ten-foot parabolic dishes, are aimed vertically and were specifically designed to probe the lower troposphere, recording previously unavailable information starting as low as 60 meters.

The sounding facility is located in a climatological area in which strong gradients of refractive index, the invisible layers detected by the radars, often prevail.

The continuous wave radars are modulated by FM. This kind does not have the problem of a minimum distance for ranging as does pulse radar, so atmospheric features closer to the ground can be observed. The radars also offer the extremely high range of resolution of one meter, with a very low noise rating resulting in excellent sensitivity. Their beams cross at 50 meters.

PULSARS

X-rays from Crab nebula

The Crab nebula, already known as the source of pulsating radio and light waves from pulsar NP-0532, has now been found by a team of Naval Research Laboratory scientists to pulsate about 30 times a second in X-rays.

The X-ray pulsar in the Crab was detected from analysis of data taken on a rocket flight from White Sands Missile Range on March 13. Dr. Herbert Friedman of NRL reported to the Smithsonian Astrophysical Observatory in Cambridge, Mass., that the pulsar has a double structure in X-rays, as it does also in radio- and light-waves.

The pulsed component of the X-ray flux amounts to about five percent of the total X-ray flux from the Crab. The rocket launch had as its main objective looking for the X-ray spectrum of the Crab, and for X-rays in the plane and poles of the Milky Way galaxy. That data are still under analysis by Gilbert Fritz, Dr. Richard Henry and John Meekins.

Discovery of the pulsations in X-rays was cited at the URSI meeting by Dr. Thomas Gold of Cornell University as additional evidence for the theory that pulsars are rotating neutron stars. X-rays had previously been suggested as supporting the neutron star theory (SN: 3/1, p. 207).

Drs. F. C. Michel and W. H. Tucker of Rice University in Houston disagree with the neutron star theory. They believe the pulsed radiation can result from the interaction between two basic types of plasma discontinuities in relative motion—the tangential and shock discontinuities.

PLASMA PHYSICS

Flow in the polar ionosphere

The polar regions lying within the auroral zone have magnetic field lines that stream into the tail of the magnetosphere. The hydrogen and helium ions in this region accelerate outward to supersonic speeds, escaping from the earth.

The hydrogen ions are produced at altitudes above 600 to 750 kilometers by charge exchange with ionized oxygen, Drs. P. M. Banks and T. E. Holzer of the University of California in San Diego have calculated. The helium ions, in contrast, are produced through direct photo-ionization at higher altitudes.

The calculations were made because satellite observations had shown that these two ions were virtually missing from the polar regions.

They found that while the magnitude of the hydrogen ion flux can vary significantly when different model conditions are used, the flux of helium ions is "remarkably constant for large ranges" in oxygen ion density and the neutral atmospheric composition.

Changes in the photo-ionization rate for helium produce almost directly proportional changes in the helium ion flux. The calculations show that far from the earth, the ion densities vary with the magnetic field strength.