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Group 2.1 Ionospheric Physics

The region extending from about 60 km to some thousands kilometers above the ground is called the ionosphere, where the charged particles (free electrons and ions) are abundant. The ionosphere is a transient region from fully ionized magnetosphere to the neutral atmosphere. The ionosphere has been investigated by in-situ measurements using spacecrafts and by remote sensing using ground-based facilities such as radars.

(1) Ionospheric Plasma by Spacecraft Radio Wave Experiment

Radio waves transmitted from the ground are absorbed and reflected during the course of their propagation through the ionosphere, yielding the wave intensity variation with height. Wave intensity measurement enables us to deduce the profiles of the electron density and the collision frequency. Radio wave receivers including antenna systems to be installed onboard spacecrafts have been developed in collaboration with Kanazawa University and other several institutes. The radio experiment onboard the S-310-18 rocket launched by the Institute of Space and Astronautical Science (ISAS) was successfully carried out in January 1988.

Natural VLF radio emissions in the polar ionosphere will be investigated by the EXOS-D satellite launched February 1989 by ISAS. Our contribution is development of the tri-axial loop antenna system to be installed onboard EXOS-D, which enables us to receive HF (High Frequency) waves arising from natural phenomena such as Auroral kilometric radiation (AKR) as well as to receive VLF waves. Measurements of these radio emissions in the wide frequency band reveal the characteristics of the ionosphere.

(2) Ionosphere Dynamics by Spacecraft Electric Field Measurement

The DC electric field is one of the fundamental physical quantity of the ionosphere. The plasma convection in the polar ionosphere is a characteristic phenomenon in relation to the dynamics of the ionosphere and to the ionosphere-magnetosphere coupling process. The plasma motion in the magnetized ionosphere is driven by the ionospheric electric field. We will survey the electric field in the polar ionosphere with the wire-type doubleprobe onboard the EXOS-D satellite by collaboration with ISAS.

We will also contribute to the measurements of the electric field by the GEO-

TAIL satellite mission in 1990's. In addition to the wire-type double probe system, the spherical double probe will be installed on it to measure the electric field in the distant tail region, where the plasma is warm and dilute.

(3) Dynamics of the Polar Ionosphere by IS Radar

A feasibility study on the remote sensing technique, the IS (Incoherent Scattering) radar, which will be developed to study the dynamics of the polar ionosphere, has been started.

When VHF (Very High Frequency) and UHF (Ultra High Frequency) radio waves are transmitted to the ionosphere, a small part of their wave energy is reflected through the incoherent scattering process by the electrons and ions of the ionospheric plasma. From detection of the doppler shift and the spectral broadening of the scattered wave, the plasma characteristics, such as the drift velocity, electron and ion temperature, can be measured.

Because the scattering coefficient is very small, a high power transmitter and an efficient receiving system with a wide effective receiving area are needed. Some basic studies to promote the polar region IS radar project are carried out and also the collaborative studies with the international STP community are planned.

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