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Group 2.1 Ionosphere Physics

The research group for ionosphere physics have been involved mainly in two categories of research fields; one concerns research on the ionospheric plasma and waves by spacecraft techniques and the other research on the polar ionosphere and atmosphere by ground-based remote sensing techniques especially by IS radar. The research by spacecraft techniques has been much progressed owing to successful launch of the scientific satellite AKEBONO by ISAS on February 1989. The research by IS radar has been forwarded within the frame of planning stage.

1. Experiments with AKEBONO Satellite and Rockets

Japanese scientific satellite, AKEBONO(EXOS–D), was successfully launched from Kagoshima Space Center, Institute of Space and Astronautical Science (ISAS) on February 21, 1989 into an eccentric polar orbit with the perigee of about 300 km and the apogee of about 10,000 km. The tri-axial loop antenna for radio wave experiment was deployed successfully and the long wire-antenna of 60m tip-to-tip for radio wave and electric field measurements was extended satisfactorily. The following observations with AKEBONO were carried out.

(a) Global Observations of VLF Waves

Measurements of VLF waves were carried out in the various regions along the orbit of the satellite with the wide-band radio sensor on board AKEBONO. Emissions of VLF waves triggered by Omega signals were detected at AKEBONO, and their wave-vector, pointing vector, absolute intensity and frequency spectrum were measured precisely. Ionic plasma waves near the equatorial plane, whistlers, and VLF emissions in the auroral regions, such as Hiss and Chorus, were observed, and characteristics of their generation and propagation were investigated together with the particle data obtained from simultaneous measurements.

(b) AKEBONO-HIPAS Cooperative Experiment

Okada joined the AKEBONO-HIPAS Experiment, in which VLF emissions arising from ionospheric heating by high power radio beam of HF waves under VLF modulation transmitted from HIPAS at Fairbanks, Alaska were detected at AKEBONO.

(c) AKEBONO-Rocket Cooperative Experiment

Okada joined the AKEBONO-Rocket Cooperative Experiment, in which simultaneous observations of auroral radio emissions were carried out both at AKEBONO and S–520–12 ISAS sounding rocket launched from Andoya, Norway on February 26, 1990.

(d) Electric Field Measurements with AKEBONO

Large amplitude DC electric fields of which vectors directed to poleward were observed with the double-probe on board AKEBONO at the region outside of the late evening plasmapause during the period of the magnetic storm occurred in the middle of March 1989. The accuracy of the electric field measurements by the double-probe method under the influences of the particles and photoelectrons colliding the probe were investigated.

(e) Rocket Observation of VLF and MF Signals

Field intensities of VLF signals from Omega station and NDT station and of MF signals from Kumamoto Broadcasting Station were measured with the radio wave sensor developed in collaboration with the group of Kanazawa University and installed on ISAS sounding rocket S-310-18 launched from Kagoshima Space Center, ISAS. the electron density and electron temperature of the daytime ionospheric D and E regions so to fit the observed field intensities were analyzed.

(2) Polar Ionosphere and IS Radar Plan

(a) Magnetosphere-Ionosphere-Thermosphere Coupling

Behaviors of particles, electric fields and energetics in the magnetosphere-ionosphere-thermosphere system were reviewed and discussed with respect to the following items; (1) magnetospheric particles from ionospheric origin, (2) precipitating particles from the magnetosphere, (3) convection electric fields in the polar ionosphere, (4) electric fields and thermospheric winds in the polar region, (5) energy of the precipitating particles, (6) Joule dissipation energy, and (7) kinetic energy of the thermospheric motions.

(b) Ionosphere-Middle Atmosphere Coupling in the Polar Region

Dynamical and chemical couplings between the ionosphere and middle atmosphere in the polar region were reviewed and discussed in focus on the winter absorption anomaly and polar mesopause summer phenomena.

(c) Plan of Polar Cusp IS Radar

Understanding of the solar wind energy, momentum and mass transfer mechanisms across the magnetospheric boundaries is still important research theme for the solar-terrestrial system. The dayside polar cusp region at the upper atmosphere levels where all of the geomagnetic field lines threading through the magnetopause converge carrying with information on the solar wind-magnetosphere interaction is of benefit place to make investigation by ground-based techniques. At Ny-Alesund, Spitsbergen, Svalbard, the most adequate place to investigate the dayside polar cusp phenomena, observations of aurora, geomagnetic variations and ionospheric absorption have been carried out under cooperation between the Research Institute of Atmospherics, Nagoya University and the Polar Research Institute, Norway. In order to achieve more understanding of the solar wind-magnetosphere-ionosphere-thermosphere system, a plan for establishment of IS radar at Spitsbergen under national and international cooperation has been studied and discussed. Basic research with respect to the plan of Spitsbergen IS radar has been commenced.

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- Nobuo Matuura -
- Toshimi Okada -

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