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Section 7. Magnetospheric Radio Emissions

Routine observations of VLF emissions and related phenomena have been continued at our observatories,Moshiri,Sakushima and Kagoshima. Temporal measurements have been made on the direction finding and polarization for magnetospheric VLF waves.

The data from European VLF campaign made several years ago are being analyzed. Characteristics of mid-latitude VLF hiss emissions which take place in the dawn sector,being associated with substorms and exhibit interesting frequency drifts have been interpreted in terms of the quasi-linear electron Cyclotron instability. The direction finding data for auroral VLF emissions aboard a rocket at Syowa,Antarctica, are being analyzed.

We emphasize the following two directions of research; (1) Direction finding for magnetospheric plasma waves on board spacecrafts in order to elucidate their generation and propagation mechanism, and (2) Study of wave-particle interactions by means of an active experiment. As for the first subject, we have carried out the measurement of wave normal directions for various types of emissions. We have found that the chorus in the lower band ($f < f_{He}/2$) are generated by electromagnetic electron loss-cone instability by substorm electrons. The upper band chorus ($f > f_{He}/2$) is identified as being a quasi-electrostatic whistler mode, and its generation mechanism is being studied by solving the full dispersion relation for realistic particle distribution functions. Wave normals of plasmaspheric ELF hiss observed on GEOS have been determined,which has yielded that the waves are generated by large θ angles on majority of cases. The generation of waves with large θ angles is very consistent with the ground-based polarization measurement at Moshiri. Furthermore,the ELF hiss in a detached plasma region of the magnetosphere has been analyzed. The collaborative work on Arcad project is being continued and we show an example of interesting discoveries; the Doppler broadening of the VLF transmission signal and the associated side-band structures seeming to be resulted from the nonlinear wave-wave interaction in the ionosphere. We are now engaged in the development of signal analysis system and direction finding measurement to be installed on the forthcoming satellites,EXOS-D and OPEN.

As for the second subject, we carried out the conjugate measurement on the reception of whistler-mode signal from the DECCA signal transmitted from Hokkaido, at its conjugate point, Birdsville,Qld,Australia in June-September, 1984. We have succeeded in detecting the whistler-mode signals especially during sunset and sunrise and furthermore an enhancement of signal intensity by more than 20-30 dB is noticed during geomagnetic disturbances,being indicative of an amplification phenomenon. An additional interesting fact is the amplitude modulation with the periods of the order of a few seconds and a few minutes. Moreover, we made the reception of whistler signal and the associated triggered signals from a high-power VLF transmitter at Komsomolskmur,USSR, at its conjugate point,Ceduna. Data are being analyzed. In order to incorporate with these experimental studies, theoretical studies have been made on the electron Cylotron resonance interaction between LF waves and electrons with quasi-relativistic energy in the inner radiation belt. The test particle study has shown that quasi-relativistic electons with very large pitch angles provide much more energy to the wave than non-relativistic electrons do. The theoretical consideration is being continued.

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