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Section 7. Magnetospheric Radio Emissions

The routine observations of VLF/ELF emissions have been continued at Moshiri by means of minimum level reading circuits at four frequencies of 8.0,5.0,2.5 and 0.8kHz. Very sensitive VLF receiving equipments by making use of correlative method will be installed at Moshiri and Kagoshima for the further study of medium-latitude VLF emissions and also for the study of wave-particle interactions in the electron slot region and in the inner radiation belt.

We have successfully completed the simultaneous direction finding experiments for medium-latitude VLF emissions at Brorfelde(Denmark) and Chambon-la-Foret(France). The data on VLF emissions for these three years are being analysed,and interesting informations have emerged on the generation mechanism of hiss and discrete emissions(chorus,periodic emissions). During the last year's campaign we have made the coordinated measurement on the ground(our two stations and Poitiers) and on the ISIS satellites. A collaborative work with University of Poitiers on whistlers and VLF emissions based on those coordinated measurements has been sponsored by the Japan Society for Promotion of Sciences. The main emphasis of our collaboration will be the distribution of whistler ducts,non-ducted propagation in the lower exosphere after exiting from the duct,duct properties and magnetospheric plasma convection.

The VLF/ELF emissions based on the data from Ariel 4 satellite is being analysed for a specific magnetic storm on 16-19 December,1971. Those data will be supplemented by other VLF data from other satellites and by the particle data from other satellites,which will enable us to know the temporal evolution of emission generation over the whole region of the magnetosphere.

A new direction finding based on the measurement of time differences at spaced stations has been carried out for auroral VLF hiss at Syowa Station,Antarctica, in order to obtain further understanding of auroral hiss. A comparison of the results of arrival direction of auroral hiss with the all-sky photographs of aurora has shown that the auroral hiss has not emerged from the whole region of bright aurora,but from some localised region in it where we find rapid changes in luminosity and in motion. This experiment will be completed shortly. An additional rocket experiment was carried out to determine the wave normal direction of VLF emissions in the polar ionosphere.

The equatorial VLF emissions have been investigated based on the Ariel 3 and 4 satellite data. It is found that the origin of equatorial VLF emissions is probable to be thunderstorms,but some of intense ones may be amplified by some mechanism.

Very unusual VLF noise event has been recorded at Sakushima during a moderately severe magnetic storm. It showed discrete traces with harmonic relations and the required energy of resonant electrons is estimated to be in a range of several tens of MeV on the assumption of cyclotron resonance interaction.

Following theoretical analyses have been made in order to answer the questions raised by the experiments. The mechanism of triggering VLF emissions by a natural whistler has been studied by using the variation of unperturbed phase angle for negligible wave intensity,which is determined by the spatial inhomogeneity and wave frequency variation. The interaction time defined by the unperturbed phase angle is found to be of use in the study of phase bunching of electrons by a variable frequency wave with a reference to its comparison with the bunching time. This is quantitatively confirmed by calculating the trajectories of electrons in phase space in the presence of a whistler with different amplitude.

In order to study the generation region of storm-time VLF emissions and the energetic electrons responsible for them,we have calculated the trajectories of energetic electrons injected from the plasma sheet region in the presence of the corotation and convection electric fields and gradient-B effect. Also we predict the plasmapause by tracing the trajectories of thermal plasma. The calculations were carried out for a time-dependent model of the convection electric field simulating some magnetic storms. The results will be applied,as an example,to the case of the above-mentioned storm on 16-19 December,1971. Our calculations for electrons will be extended to protons in future.

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Publications

Hayakawa,M.,Y.Tanaka,M.Kashiwagi,J.Ohtsu and A.Iwai : Preliminary results on the direction finding for medium-latitude VLF emissions in Europe, Proc.Int'l Workshop on Selected Topics of Magnetosphric Physics, Tokyo,p.380, March,1979.

Hayakawa,M.,M.Kashiwagi,Y.Tanaka,A.Iwai,J.Ohtsu and T.Okada : Multistationed observations of medium-latitude VLF/ELF emissions, to be presented at Symp. on Observations of Magnetospheric and Ionospheric Phenomena in Polar Region, Nat'l Inst.Polar Res. Tokyo, March,1980.

Nishino,M.,A.Iwai,Y.Tanaka and T.Yamaguchi : Direction finding for auroral VLF hiss based on the measurement of time differences among three spaced stations, Trans.Inst.Elect.Comm.Engrs.Japan, in press, 80(in Japanese).

Ohtsu,J. and M.Kashiwagi : An unusual VLF noise event observed at Sakushima on Sep.29,1978, Proc.Res.Inst.Atmos. Nagoya Univ., 26,133, 1979.

Tanaka,Y.,M.Hayakawa and M.Nishino : An observing plan of wave normal direction of auroral VLF emissions on board a rocket at Syowa Station, Proc.2nd Symp. Rocket Experiments in Antarctica, Nat'l Inst. Polar Res. p.76, Oct. 1978.

Tanaka,Y.,M.Hayakawa,A.Iwai,T.Okada,M.Satoh and J.Ohtsu : Preliminary report of the simultaneous observation of VLF emissions at Brorfelde(Denmark),Chambon-la-Foret(France) and Moshiri, Proc.Res.Inst. Atmos. Nagoya Univ. 25,7,1978.

Yoshida,T.,J.Ohtsu and M.Hayakawa : On the conditions of triggering VLF emissions by a natural whistler, in this issue,1980.