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IDENTIFICATION OF POLAR CAP BOUNDARY IN THE NIGHTSIDE SECTOR (EXTENDED ABSTRACT)

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During the northward IMF condition, it was reported based on optical measurements that lots of arcs appear inside the auroral oval and they coincide with regions of electron precipitation (*e.g.*, LASSEN and DANIELSEN, 1989). Sometimes it is seen that spiky (structured) precipitations of electrons with energies less than 500 eV fill the entire polar cap region (LASSEN and DANIELSEN, 1989). In such a case, it is very difficult to identify the poleward boundary of the oval region connecting to the plasma sheet merely by looking at the electron precipitation data alone. Even if identified, question is where is the source of the precipitating electrons seen in the high latitude region.

Data from the low-energy charged particle detector (LEP) on board the EXOS-D (AKEBONO) satellite were used to identify the plasma sheet bouhdary during the northward IMF condition. Over 30 dawn to dusk passes from November 1989 to February 1990 in the nightside polar region were examined, when the magnetic activity index (K_p index) was less than 1. The particle precipitation region, which is characterized by continuous and hard electrons with their average energy higher than 500 eV, is commonly seen in the low-latitude part. On the other hand, spiky precipitations of electrons with energies less than 500 eV are common in the poleward part.

An example is shown in Fig. 1. Top two panels show *E-t* diagrams for precipitating electrons and ions. We can see hard electron precipitations in the periods from 5:57 to 6:01, and from 6:42 to 6:54, while spiky precipitations of electrons can be seen in the high latitude region. Sometimes spiky precipitations of electrons fill entire polar region (see example shown in Fig. 2). It seems difficult to identify the poleward boundary of the plasma sheet merely through the change of electron precipitation. On the contrary we can see a well defined boundary in the precipitation of energetic ions. In the example of Fig. 1, ions disappear on the poleward side of the boundaries seen at 6:03 and 6:26. In the case of Fig. 2, the ion boundaries are identified at 5:50 and 6:04. Though the intensity of the precipitating ions differs in each portion, the mean energy of ions is in a range from 5 keV to 10 keV which coincide with that in the plasma sheet.

Temperature of electrons with peak spectra was evaluated by fitting the accelerated Maxwellian to the observed data. By using this method, we can also evaluate an acceleration energy (peak energy). These two values are shown in the bottom

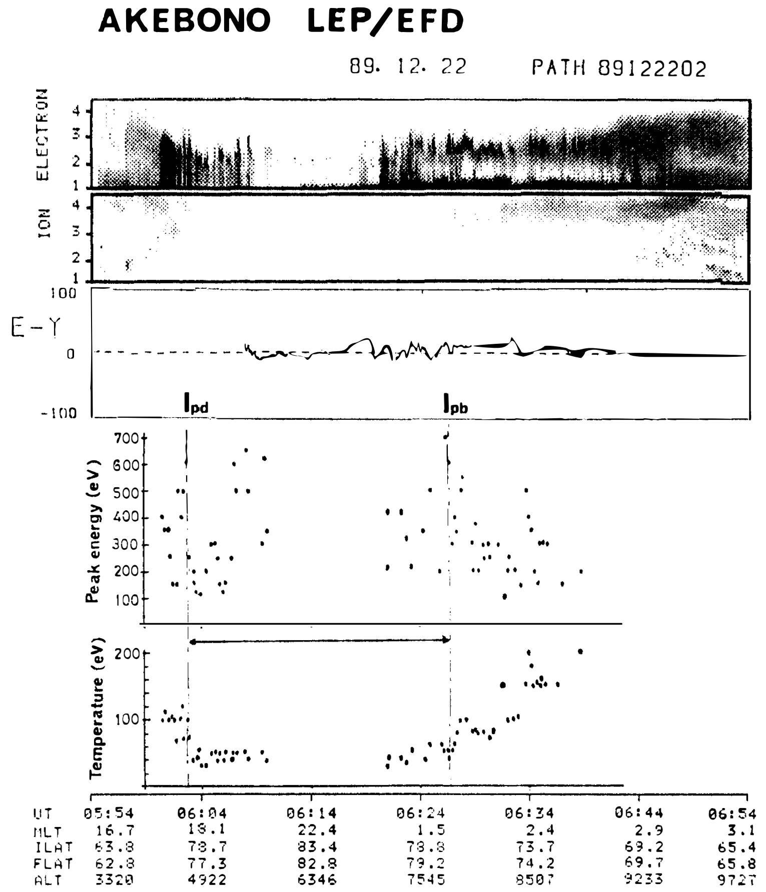

Fig. 1. Particle and electric field data observed by AKEBONO on Dec. 22, 1989.

two diagrams in Figs. 1 and 2. Although the peak energy scatters, the electron temperature shows a systematic dependence on latitude; it takes low values poleward of the ion boundary, while it takes high values on the low latitude side of the boundary. From these results, we propose that the position of the plasma sheet boundary is defined by the termination of the ion precipitation, and the region with energetic ions will correspond to the polar cap region.

Figure 3 shows scatter plots of the ion boundaries over 30 passes. It is interesting that the boundary does not exceed 82 deg. of the invariant latitude. This result is consistent with the previous work done by TROSHICHEV and NISHIDA in which they determined the plasma sheet boundary by using the DMSP F6 and F7 particle data. Even in the quiet period, the plasma sheet boundary does not move drastically toward the pole region.

The spike type electrons, observed in the polar cap region, are thought to be of magnetosheath origin, because the temperature (a few tens of eV) is nearly the same as that of magnetosheath electrons. The precipitation mechanism is not clear at this writing, but there is a clue to it. Electric field data (dawn to dusk component) shown in the middle panels of Figs. 1 and 2 indicate a very irregular structure in the portion where spiky electron precipitations were observed. Electron

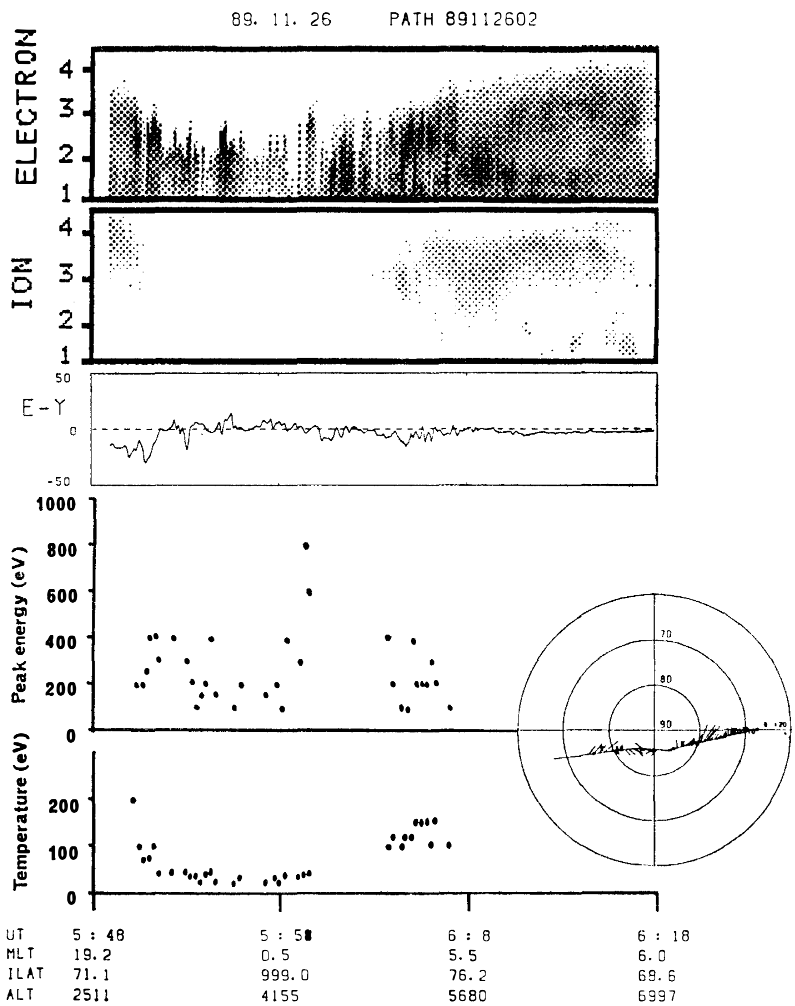

Fig. 2. Same as Fig. 1, but on Nov. 26, 1989.

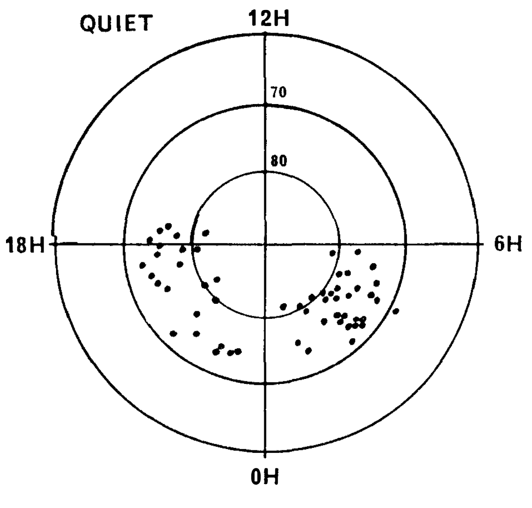

Fig. 3. Scatter plots of the observed ion boundaries on the polar map.

precipitation spikes may be caused by a highly fluctuating electric field. Fluctuation of the electric field in the polar cap region may be due to a random reconnection on the magnetopause during the northward IMF condition proposed by NISHIDA (1989).

Spike like structure of electrons embedded in the plasma sheet region (6:01 to 6:03, 6:26 to 6:42 in Fig. 1 and 6:04 to 6:11 in Fig. 2) may partly correspond to the classical BPS region, but seems to be an overlap region between the structured and unstructured regions of electron precipitation. It still remains for future studies.

References

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