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PARTICLE INJECTION EVENTS DURING AURORAL BREAK-UP'S AS OBSERVED BY OFF-MIDNIGHT SATELLITE (EXTENDED ABSTRACT)

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Injection of energetic particles observed near the geosynchronous orbit is one of the characteristic features of the substorm expansion phase (*e.g.*, BAKER, 1984; NAKAMURA *et al.*, 1991). Changes in the particle flux obtained near the local midnight show a transient and dispersionless signature, while the particles obtained by off-midnight satellites are dispersed in energy. Energy dispersion signature has been considered to be caused by energy-dependent drifts of the particles from the source region.

We carried out the drift trajectory analysis of the substorm event that occurred at 2210 UT ($Kp=2$) on April 18, 1986 to infer the substorm injection region and the injection time. Using this method, we studied the correlation of particle injection events with a concurrent auroral break-up's measured by a ground-based optical observation.

Figure 1 shows all the data used in this study. The top panel is energetic particle flux (30–300 keV electrons) monitored by the Charged Particle Analyzer (CPA) on board geosynchronous satellite S/C 1984-037, which was located at morning sector (0300 LT sector). The middle panel shows the Position-Time (P-T) displays of aurora along the geomagnetic east-west lines of 67.5°S, 67.0°S and 66.5°S latitudes in the field of view of Syowa Station (2210 LT meridian). The bottom panel presents the Pi2 oscillations (band-pass filtered H component) observed by the fluxgate magnetometer at Huancayo, Peru (1710 LT meridian). Of seven Pi2 onsets in the figure, first five Pi2 onsets that occurred at 2209, 2223, 2231, 2247 and 2259 UT are accompanied by the concurrent auroral break-up's. During this interval, CPA on board S/C 1984-037 observed three prominent flux increases with energy dispersions. In below, we discuss how those three electron flux enhancements marked as 'A', 'B' and 'C' in the top panel correlate to the onset of Pi2 and auroral break-up's marked as 'a', 'b' and 'c'.

To estimate the drift paths of electrons, we assumed the dipole magnetic field configuration and Volland-Stern type convection E-field for $Kp=2$. Furthermore, pitch angle of 90° was used for the calculation. The results of the trajectory trace are illustrated in Fig. 2. Firstly, the time (UT) when the peak of each energy

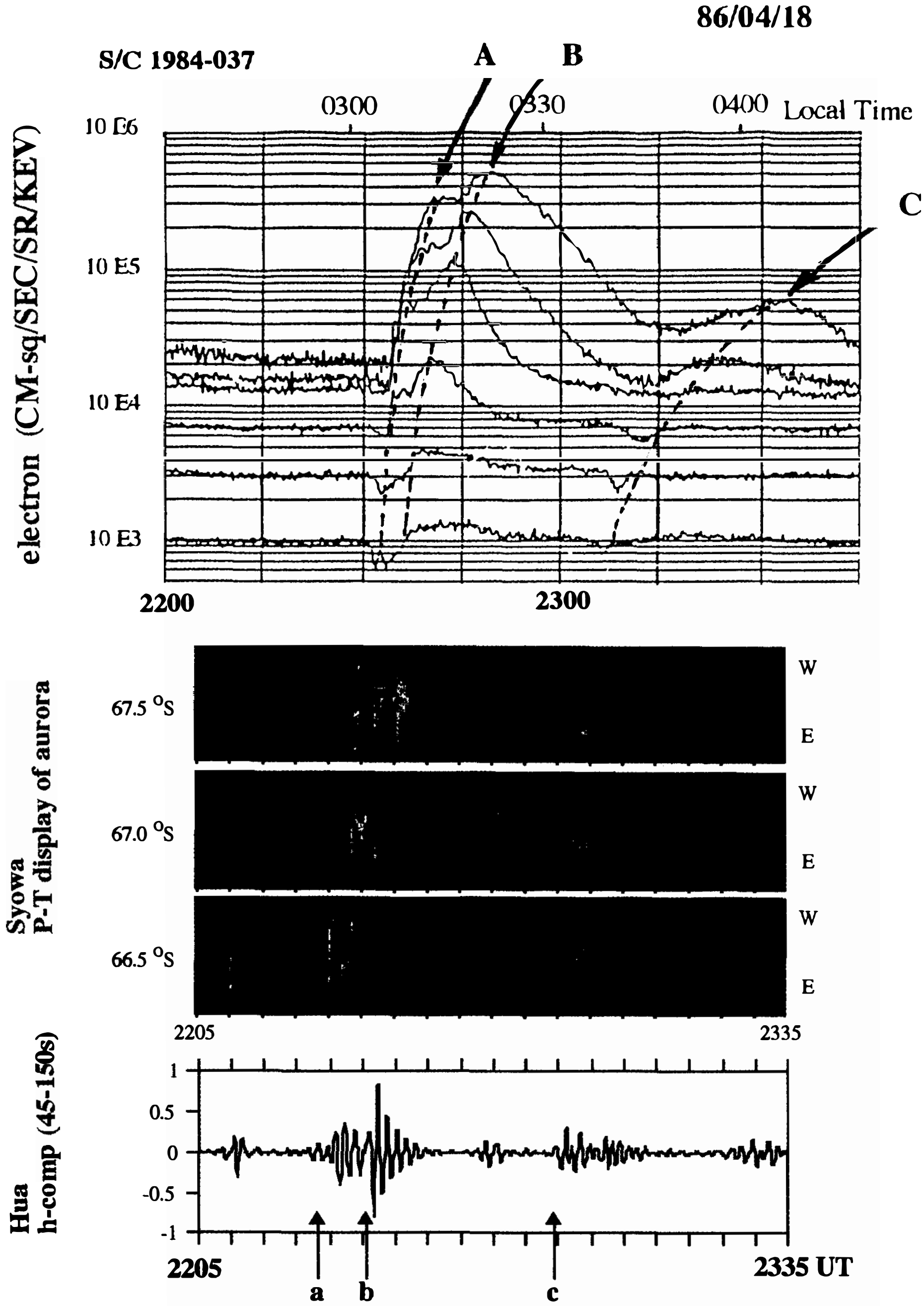

Fig. 1. (Top panel): Energetic electron flux (30–45, 45–65, 65–95, 95–140, 140–200, 200–300 keV) monitored by the Charged Particle Analyzer on board geosynchronous satellite S/C 1984-037 at morning sector. The peaks of the electron flux for each energy channels are traced by the dotted lines 'A', 'B' and 'C'.

(Middle panel): Position-Time display of aurora along the geomagnetic east-west lines of 67.5°S, 67.0°S and 66.5°S latitudes in the Syowa field of view.

(Bottom panel): Pi2 oscillations (band-pass filtered H component) observed by the fluxgate magnetometer at Huancayo, Peru.

channel was detected at S/C is plotted as a function of the location (LT) of the satellite by a circle for 'A' event, and a ×-mark for 'B' event. Then, the electron

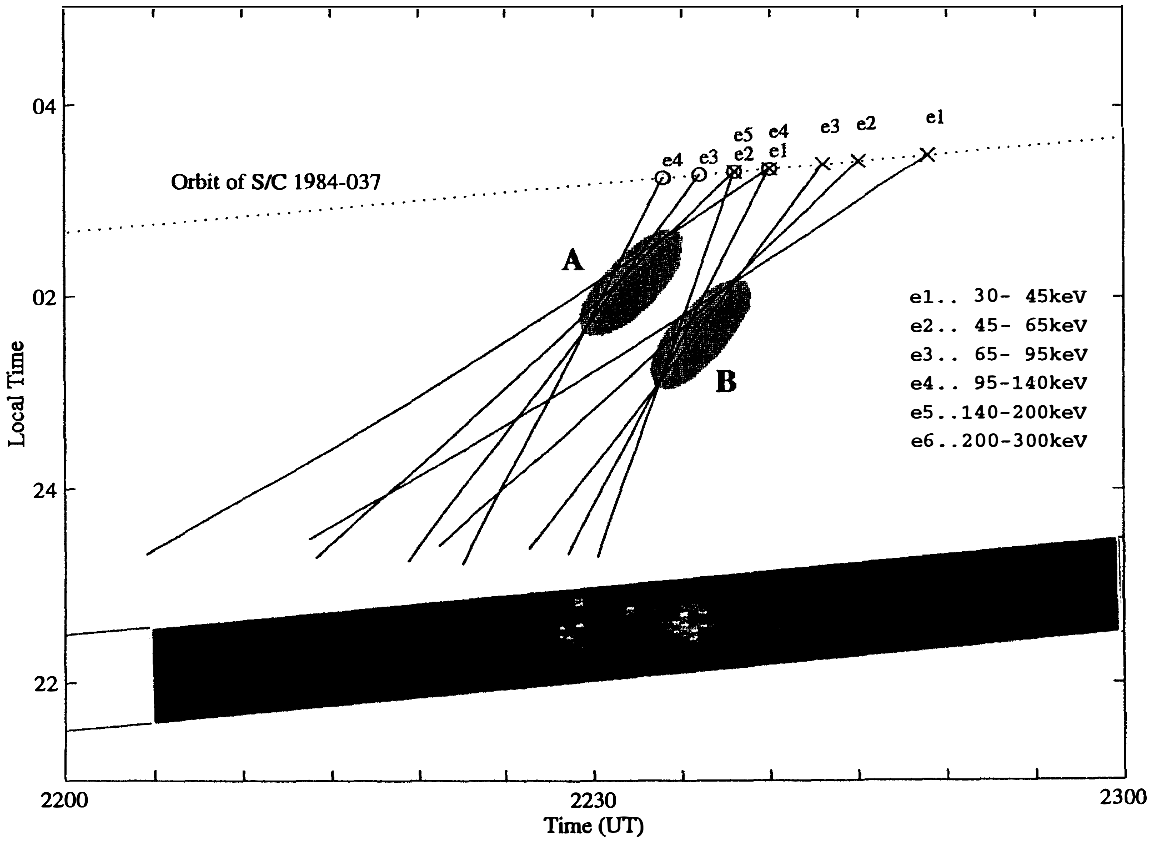

Fig. 2. The electron trajectories for 'A' and 'B' injection events shown in Fig. 1 are illustrated by solid lines (see text). In the bottom panel, the LT profile of the Syowa aurora (integrated with respect to the latitudes) is displayed as a function of UT.

trajectory for respective energy channel was traced back using the angular drift velocities estimated by the lower energy values for the channel (*i.e.*, 30 keV for 30–45 keV range). The trajectories thus obtained are drawn by solid lines in Fig. 2. The solid lines should meet at a point if injection occurred at a specific UT and LT (REEVES *et al.*, 1990), while for the present events the intersection is scattered and UT and LT for the events 'A' and 'B' tend to be focused on the shaded area 'A' and 'B' as shown in Fig. 2. In addition, we presented the integrated P-T display (with respect to latitudes) of the aurora together with the electron trajectories. This P-T display represents the UT change of auroral LT profiles. As a result of this comparison, it was shown that the particles were injected at intervals when the intensification of the aurora was taking place. Furthermore, the above intervals were overlapped the concurrent Pi2 activities at the dip-equator (see Fig. 1). A similar result was obtained for event 'C', but we did not plot it in Fig. 2, because only lower two energy channels were available for the trajectory trace.

In order to estimate how the particle trajectories depend on the different field model, we checked the trajectories by the Tsyganenko 89 magnetospheric model (not shown), and found that the simultaneity between the particle injection and the intensification of optical aurora does not change.

Finally, we suggest that the injection for event 'A' occurred at a local time sector of 02 LT, which was more eastward of the eastern edge of Syowa aurora (23 LT). When the trajectory calculation was carried out by the Tsyganenko 89 model, the injection occurred at a local time sector of 01 LT but did not overlap the Syowa aurora.

Acknowledgments

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