

Study on dynamics of black aurora based on simultaneous optical and particle observations by Reimei satellite

Yasuyuki Obuchi[1]; Takeshi Sakanoi[2]; Shoichi Okano[3]; Atsushi Yamazaki[4]; Kazushi Asamura[4]; Yasumasa Kasaba[5]; Masafumi Hirahara[6]; Yusuke Ebihara[7]; Kanako Seki[8]

[1] Planet. Plasma Atmos. Res. Cent., Tohoku Univ.; [2] PPARC, Grad. School of Sci., Tohoku Univ.; [3] PPARC, Tohoku Univ.; [4] ISAS/JAXA; [5] Tohoku Univ.; [6] Dept. Earth & Planet. Sci, Univ. Tokyo; [7] Nagoua Univ., IAR; [8] STEL, Nagoya Univ.

In 1970's, fine scale dark structures were found in diffuse aurora by ground-based optical observation, and named as black aurora [Royrvik, 1976; Davis, 1978]. Since then, various types of black aurora, such as black arc, black patch, and black vortex, have been reported [e.g. *Kimball and Hallinan*, 1998; *Trondsen and Cogger*, 1997]. However, their generation mechanism is still unknown in present days. In order to investigate fine scale structures of aurora, a scientific satellite Reimei, which was launched into a ~640km altitude 0050-1250 LT polar orbit from Baikonur Space Center in Kazakhstan in August 2005, has been carrying out aurora observations with optical imaging and particle measurement. Optical observations of black arc and black patch were successfully made with Multi-spectral Auroral Camera, which is on board Reimei, for 23 events in a period from November 1st, 2005 through October 30th, 2006. Among them, simultaneous optical imaging and precipitation particle observations were made for 13 events, of which nine events are black arc events, and other four events are black patch events. Nineteen events out of all 23 events were observed in the northern hemisphere, and the others were observed in the southern hemisphere. Based on the analysis of these black aurora events, it was found that precipitating electron flux with energies greater than 2 - 7 keV for black arc and black patch is deficient compared to that for surrounding diffuse aurora. On the other hand, the electron flux with energies less than that for black patch is almost same to that for surrounding diffuse aurora. This fact suggests that the deficiency of electron flux with energies greater than 2 - 7 keV is not caused by any electric field such as the divergent electric field. Based on our observation results, it is strongly suggested that the pitch angle diffusion by upper band whistler mode waves is suppressed in a source region of black aurora while diffuse aurora surrounding the black aurora is produced by precipitating electrons that was caused by pitch angle diffusion due to upper band whistler mode waves and/or electrostatic Electron Cyclotron Harmonic waves in the plasma sheet. Accordingly, our results of Reimei observations for black aurora suggest that hot electron (few keV) density is sufficiently low in the source region of black aurora. Furthermore, drifting speed for two events of drifting black patches were derived using 2D correlation analysis. The drift speed of a black patch on January 27, 2006 was about 5.7 km/sec, and that on October 1, 2006 was about 3.3 km/sec. Because of existence of concurrent inverted-V structure, ExB force is expected for drifting electrons in a source region where these black patches were produced. Electric fields, which cause such ExB drift, were estimated from drift speeds derived by using 2D correlation analysis of image data. Estimated electric fields are in close agreement with an electric field calculated from inverted-V structure for the both event.