

Southward propagating auroral structure with spatial sub-structures in the early recovery phase of the substorm

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We have carried out ground-based observations with a narrow field of view (fov) camera, all-sky camera, and photometer at Poker Flat Research Range between Nov. 2011 and Mar. 2012 to study aurora dynamics associated with plasma physical process in the inner edge of plasma sheet and outer radiation belt. An Electron Multiplying Charge Coupled Device (EMCCD) camera, a main instrument of us, is optimized to investigations of both temporal and spatial characteristics of pulsating auroras (PAs) in micro-meso scale. It has a narrow fov (49 deg. x 49 deg.), corresponding to 110 km x 110 km at altitude of 110 km, and high sampling rate up to 100 frames per second. Using data from all-sky camera, we can compare auroral structures in micro-meso to global scale. A photometer is designed to measure photon count rate with two wavelengths (N₂ 670.0 and O 844.6 nm) simultaneously.

In this presentation, we will report an event related to substorm on 1st Dec., 2011. Solar wind velocity continued 450 km/s during the day. An isolated substorm occurred around 1200 UT, and AE index reached 300 nT on the same time. South propagating aurora, with patchy structure and temporal scale of about 100 km, appeared in our fov 20 minutes after this break up. Key findings in this event can be summarized as follows.

[1] A large-scale auroral structure (~100 km) with 4 - 6 s pulsation and propagation southward appeared at 1220 UT, 20 min. after breakup.

[2] The similar event was reported in *Nakajima et al.* [2012], so this auroral structure may be driven by Fermi-type accelerations associated with earthward flow.

[3] This aurora consisted of a few sub-structures with 5-30 km width and strong 2.4-2.5 Hz modulations, and they had independent back and forth motions in the large-scale structure.

[4] The scale of the large structure corresponds to MHD scale in the magnetic equator, but the spatial scale of sub-structures is very close to proton gyro radius. Therefore, the spatial and temporal characteristics of the sub-structures are expected to manifest violation of MHD approximation [e.g., *Ebihara et al.*, 2010].

[5] Estimated flow velocities to the perpendicular directions inside the patch are almost corresponding to Alfvén speed, which suggests standing fast mode waves are related to generations of precipitation.