Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

PEM28-01 Room:302 Time:May 28 12:00-12:15

Outflow structure of 3D magnetic reconnection

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Magnetic reconnection is believed to be a key process in magnetospheric dynamics of the Earth, in particular, in magnetospheric substorms. Fast earthward flows are frequently observed in the near-Earth region of the magnetotail in association with substorms and are attributed to magnetic reconnection. The fast earthward flows are usually termed the bursty bulk flows (BBFs) and have a typical spatial scale in the y (GSM) direction with 2-3 Re (Re: Earth radii). The BBFs are considered to be the main transporter of the plasma momentum and energy in the magnetotail, and be responsible for the plasma heating at the depolarization fronts and aurora breakup in the polar ionosphere. However, the relation between the BBFs and magnetic reconnection is poorly understood yet. Main issue arises in the 3D characteristics. It is clear from the observations that the BBFs have a 3D structure, while the 3D dynamics of reconnection has not been revealed clearly, mainly because of the limitation of computer resources.

Since the BBFs have an MHD scale (much larger than the ion inertia length) in the y direction, the 3D MHD simulations have been carried out to investigate the generation mechanism in the course of magnetic reconnection. However, it has been suggested that the scale of the BBFs depends sensitively on the resistivity which is provided artificially at the x-line. Furthermore, for the case without the artificial resistivity, no BBFs arise in the system. These results from the MHD simulations imply that the BBF is an MHD-scale dynamics originated from kinetic physics, therefore the kinetic simulations are needed.

The 3D kinetic simulations of magnetic reconnection so far have focused on the dissipation mechanism at the x-line. Our previous particle-in-cell (PIC) simulations have found that the anomalous resistivity is generated due to a current sheet shear mode at the x-line and is enhanced significantly in association with plasmoid ejections. However, the system size in the y direction was only 10 ion inertia length in the previous simulations, so that the outflow structure was almost uniform along the y axis. The present study has challenged larger-scale PIC simulations in 3D with the help of the adaptive mesh refinement (AMR). The simulations are performed on the K, the state-of-the-art supercomputer of Japan. The system size is 40 ion inertia length in the y direction which is larger than the typical BBF scale. It is found that a larger-scale kink mode evolves around the x-line, in addition to the current sheet shear mode, and is enhanced due to plasmoid (flux lope) ejections. As a result, the thin current layer becomes more turbulent in the present simulations. The plasmoid ejections are three dimensional and have a scale of 10-20 ion inertia length in y, corresponding to the wavelength of the large-scale kink mode. This scale is roughly consistent with the BBFs scale. The ion outflow jets are also three dimensional and are regulated by the kink mode. The present results from large-scale 3D PIC simulation suggest that the outflow structure of 3D reconnection is determined by the large-scale kink mode arising along the x-line, which wavelength is comparable with the BBFs observed frequently in the near-Earth magnetotail.

Keywords: magnetic reconnection, particle-in-cell simulation, 3D dynamics, turbulence, outflow jet

PEM28-02 Room:302 Time:May 28 12:15-12:30

The Magnetic Reconnection Outflow in the Near-Earth Plasma Sheet

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In the near-Earth plasma sheet, earthward fast plasma flows over several hundred km/s are observed by in-situ satellites. These plasma flows are suddenly decelerated by the dominant dipolar magnetic field at around 10 Re. The following tailward rebound flows are also observed by them. In this paper, we studied the three dimensional evolution of these earthward and tailward flows using MHD simulation and analyses of GEOTAIL observation data during from 1995 to 2005.

Keywords: Near Earth Plasma Sheet, Magnetic Reconnection, Plasma Flow, Bursty Bulk Flow, Bounce Flow

PEM28-03 Room:302 Time:May 28 12:30-12:45

Energy budget of the plasma sheet during auroral substorms

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Where is the magnetic energy for the expansion phase of auroral substorms accumulated? This question was raised by Akasofu (2013), and it was concluded that the magnetic energy must be accumulated in the plasma sheet within a distance of 10 Re to meet the large total energy consumption by the ionosphere. Many different features of substorms are reasonably reproduced by the new global MHD simulation (Tanaka et al., 2010), where high-pressure regions such as cusps and inner plasma sheet are essentially important to maintain the enhanced Region1 and Region2 field-aligned current systems. Both magnetic energy and thermal energy are therefore important to understand the energy budget during the substorm, and that is the motivation of the present study. The purpose of this paper is to evaluate the energy budget of the plasma sheet in a simulated substorm. Magnetic energy and thermal energy of the plasma sheet, as well as the energy consumption by the ionosphere are evaluated. Possible important role of dipolarization in the energy conversion is also discussed.

Using the global MHD simulation, it is found that magnetic energy release rate and thermal energy accumulation rate are balanced in the plasma sheet during the early expansion phase of the simulated substorm. Around the peak of the expansion phase, energy release rate in the plasma sheet does not meet the energy consumption rate in the ionosphere. External energy source from outside of the plasma sheet is needed to maintain the high auroral activity. The JxB force of the dipolarization does the work to increase the thermal energy inside. This is how the accumulated magnetic energy within a distance of 10 Re is converted into the thermal energy during the early expansion. The increase of the thermal energy is the source of enhanced Region-2 field-aligned current system. Region1 field-aligned current must be supplied from outside of the plasma sheet to maintain the high auroral activity in the ionosphere. The dynamo of Region1 is slow-mode expansion in the cusp-mantle region. The enhanced conductivity plays the essential role to introduce the large Region 1 field aligned current because the dynamo has the nature of voltage-generator.

Keywords: Substorm, plasma sheet, aurora, Magnetohydrodynamics

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PEM28-04 Room:302 Time:May 28 14:15-14:30

Intensity distribution of AE and Dst and its relation to solar wind parameters

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Storm-substorm relationship and related solar wind-magnetosphere coupling process are studied on the basis of statistical analyses of AE, Dst, epsilon parameter and Em using OMNI data base from 1995 to 2013 and Wp index data from 2005. The statistical relationship between AE and Dst is examined to clarify the difference between CME storm and CIR storm. The intensity distribution of AE and Dst for a year is compared with that of epsilon and Em parameters in the solar wind.

The obtained major results are,

1). Relationship between AE at substorm and Dst is rather linear.

2). AE vs Dst relationship at CIR storm is different from that at CME storm.

3). Intensity distribution of AE and Dst for a year shows the exponential distribution.

4). Intensity distribution of epsilon parameter for a year shows the power low distribution.

5). Intensity distribution of Em for a year shows the exponential distribution.

6). The results 3) to 5) suggest that magnetospheric disturbances are mainly controlled by the solar wind electric field rather than by solar wind Poynting flux.

Keywords: substorm, magnetic storm, solar wind interaction

PEM28-05 Room:302 Time:May 28 14:30-14:45

Possible Formation Scenario of Transpolar Aurora

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There might be two types of transpolar auroras, they say. 1) One type of the transpolar aurora appears in the pole ward edge of electron precipitations, which expanded from dawn side aurora oval or dusk side aurora oval depending on the IMF by polarity, as mentioned by Makita ea. al. (1991). The evidences were inferred from the satellite particle data together with aurora images taken by the low altitude polar satellites. This type of transpolar aurora, which is associated with relatively intense electron precipitations near the pole ward boundary, tends to become much more luminous, forming so-called theta aurora. 2) Another type of transpolar aurora is theta aurora, which appears under the conditions of strong northward IMF. This type of theta aurora is cause by a sign change of IMF By . (Tanaka et al, 2004) This transition includes a lobe field line replacement from old IMF originating fields to new IMF originating fields, rotation of plasma sheet to the opposite inclination, and reformation of ionospheric convection cell. In the midst of the reconfiguration, old and new convection systems must coexist in the magnetosphere-ionosphere system and the polar cap and tail lobes are continuously encroached by the new open field lines connected to the new IMF. Whereas magnetic field lines accumulated in new lobes tend to rotate the outer plasma sheet in the opposite direction, the old merging-cell convection still continues to generate closed field lines that must return to dayside against the new lobe formation. The growth of new lobes results in the blocking of the return path toward the dayside of closed field lines generated in the old merging cell to form the kink structure in the plasma sheet. Losing their return path, these closed field lines generated from old lobes accumulate on the nightside. The theta, then, appears at the foot points of these accumulated closed field lines. We have joined NASA IMAGE project, receiving real time telemetry data over Japan from 2000 to 2005. By investigating IMAGE data, we confirmed that two different processes actually exist. In the talk, we like to report our examination and discuss on the relationship between above mentioned two types of transpolar auroras.

Keywords: Theta Aurora, IMAGE satellite, MHD simulation

PEM28-06 Room:302 Time:May 28 14:45-15:00

Coexistence of a polar cap arc and a polar cap patch

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A polar cap arc aligned with the trailing edge of a polar cap patch was observed at 2350 UT on 23 December 2014 by an all-sky imager (ASI) installed at Longyearbyen, Svalbard. It is known that polar cap patches are manifestation of southward interplanetary magnetic field (IMF) while polar cap arcs are manifestation of northward IMF. It is also known that both polar cap patches and polar cap arcs may appear simultaneously when the direction of IMF reverses from southward ($Bz<0$) to northward ($Bz>0$). Known cases of such events showed that a patch and an arc were not far from each other, i.e. they were within the field of view of the instrument, but they were separated. In our observation, on the other hand, a patch and an arc were very close to each other. All-sky images of 630.0 nm emission showed that the brightness of the trailing edge of a patch suddenly increased just before entering the auroral oval. These images indicated that there was a narrow strip of auroral emission along the edge of the patch. The variation of the F-layer peak electron density (NmF2), deduced from F-layer critical frequency (foF2) data observed by Svalbard Dynasonde, was in good agreement with the variation of 630.0 nm brightness at the zenith, indicating that the patchy object in the ASI image was actually the plasma patch. At the same time, the ASI-measured 557.7 nm brightness data suggest that the bright arc along the patch edge had an auroral nature. Almost exactly an hour before this event, the direction of IMF measured by ACE satellite reversed from southward to northward. Furthermore, Svalbard Dynasonde data showed a reversal of the east-west component of F-layer drift velocity at almost the same time as the arc appeared, suggesting that there was a horizontal velocity shear in the F region above Svalbard. This also suggests that the observed bright arc was indeed an auroral arc. One peculiarity of this event is that the observed arc was extended from east to west, unlike the well-known north-south polar-cap arcs. With these observational facts we will discuss the possible origin of the arc.

Keywords: polar cap patch, polar cap arc, polar ionosphere, magnetosphere, arc origin

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PEM28-07 Room:302 Time:May 28 15:00-15:15

Substorm Pi2 pulsations: Polarization patterns caused by azimuthal propagation of ionospheric loop currents

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The map of polarizations of high latitude Pi2 in Samson and Harrold (1983) presented patterns of the ellipticity and major axis orientations in the horizontal plane, covering from auroral zone to mid-latitude over the nighttime sector spanning 5.3 MLT. The substorm processes caused complexities in the polarization map of Pi2 pulsations.

We show that the polarization map of Samson and Harrold (1983) at first seem impossible will explain the Pi2 pulsations in simple way. These ground polarization patterns convey much information on the energy source of Pi2 pulsations and mode of oscillations in the magnetosphere.

References:
Samson, J.C., and B. G. Harrold (1983), Maps of the polarizations of high latitude Pi2s, J.Geophys.Res., 88, 5736-5744.

Keywords: Pi2 pulsation, Loop currents in auroral zone

PEM28-08 Room:302 Time:May 28 15:15-15:30

Comparisons of Pi pulsations and substorm developments observed on the ground and in the near-earth magnetotail

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We present unique results of recent work for comparisons of Pi pulsations and their relation to substorm developments observed on the ground and in the night-side magnetotail. The observations of Pi pulsations and aurora on the ground and of the magnetic field oscillations at the geosynchronous orbit and in the near-earth magnetotail are examined in detail. The expansion onset of a substorm examined was registered at 0512 UT on 4th April 2009. Pi pulsations appeared to oscillate from 0502 UT about 10 minutes earlier than the expansion onset. The Pi pulsations initiated with a small amplitude oscillation in association with faint appearance of auroral luminousity oscillations concurrently to the Pi 2 oscillations. The auroral luminousity oscillations became clear from 0506 UT in association with the clear appearance of the Pi 2 oscillations, particularly in the magnetic field D component oscillations. The large amplitude Pi 2 oscillations began to appear suddenly from 0509 UT accompanied with a slight poleward movement of the auroral activity, and then the aurora began to move suddenly poleward from 0512 UT with the auroral luminosity enhancement, which is the expansion onset. For about 3 minutes after the expansion onset the aurora continued to activate at the poleward site. Then the aurora became weak and moved gradually to the lower latitude side from 0515 UT, but the Pi 2 oscillations still continued to oscillate. During this substorm activity Pi 2 oscillations were clearly observed simultaneously at the geosynchronous orbit by GOES 11 and GOES 12 in the pre and post midnight sector, respectively, which provided very interesting oscillation signatures, i.e., the antiphase oscillations in the horizontal components of the magnetic field, implying that the polarization of the magnetic field horizontal components was opposite each other, suggesting the opposite flow direction of the field-aligned currents (FACs), that is upward and downward in the pre and postmidnight sector. Thus these observations at the synchronous orbit represent clear evidence of Pi 2 oscillations as substorm current wedge FAC oscillations. While, the observations by the THEMIS satellites located in the near-earth magnetotail at the radial distance from – 10 Re to – 13 Re provided a very important indication concerning to the growth of Pi oscillations and substorm processes in the near-earth magnetotail. For the most earthward satellite, THEMIS A (THA) observed small amplitude magnetic field perturbations from 0505 UT almost simultaneous to the clear appearance of the Pi 2 oscillations on the ground and at the geosynchronous orbit, and then the magnetic field perturbations became to oscillate gradually in the amplitude, which continued until 0513UT, when the dipolarization signature appeared at this site. While, the THEMIS E (THE) satellite located a little tailward nearest to the THA observed the gradual increase of the magnetic field intensity from 0504 UT and then observed the field decrease from 0507 UT associated with the plasma pressure increase. The dipolarization and associated plasma depression appeared at 0512UT. Thus, the dipolarizations observed at the THEMIS satellites was almost coincident to the expansion onset on the ground. These are summaries in this work, which indicate the close relation between Pi oscillations observed on the ground and substorm processes in the ionosphere, at the synchronous orbit and in the near-earth magnetotail.

Keywords: Pi oscillations, substorm, magnetosphere

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PEM28-09 Room:302 Time:May 28 15:30-15:45

Lower-thermospheric wind variations in auroral patches at the substorm recovery phase

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Measurements of the lower-thermospheric wind with a Fabry-Perot interferometer (FPI; 557.7 nm) at Tromsϕ, Norway found the largest wind variations in a night during appearance of the auroral patches at the substorm recovery phase. Taking into account magnetospheric processes of plasma energy accumulation and release in the substorm evolution (i.e., principal part of the energy accumulated in the plasmasheet at the growth phase is released for a short time of the expansion phase), it is an attractive result of the largest amplitude in the measured winds at the latter part of the substorm or the recovery phase. We think that this phenomenon is essentially important for understanding the energy transfer and dissipation processes in the magnetosphere and the upper atmosphere at high latitudes.

Our researching activity is the first detailed investigation regarding the magnetosphere-ionosphere-thermosphere coupled system at the substorm recovery phase using comprehensive data sets of solar wind, geomagnetic field, auroral pattern, and FPI-derived wind. This study selected five events between November 2010 and January 2012, particularly focusing on the wind-variation signatures in the auroral morphology, and detected three clear evidences in all of the events: (1) wind fluctuations were isolated at the edge and/or in the darker area of the auroral patch, and the largest vertical amplitude and the longest oscillation period were about 20 m/s and about 10 minutes, respectively, (2) the convection electric field was smaller than 15 mV/m, and (3) wind fluctuations accompanied the pulsating aurora. These characteristics suggest that the energy dissipation to produce the wind fluctuations is localized in the auroral pattern. Joule heating and Lorentz force are not the principal mechanism because of small electric field. That is a notable characteristics different from the mechanism at the substorm growth and expansion phases. Particle heating must be a minor component in the energy dissipation because of the isolated wind fluctuation in the darker area. Some other mechanisms should play a principal role at the substorm recovery phase; but unknown yet.

Keywords: aurora, substorm, Fabry-Perot interferometer, ionosphere, thermosphere, polar region

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PEM28-10 Room:302 Time:May 28 15:45-16:00

Quasi-periodic spatial modulation of pulsating aurora

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A quasi-periodic intensity modulation of pulsating auroras has been considered to be formed by pitch-angle scattered electrons with whistler-mode chorus waves, because the intensity modulation is consistent with the time scale of chorus elements. A 2-D simulation study showed the latitudinal displacement of chorus elements from the magnetic field line, and the Cluster satellites observed oblique propagations of chorus waves close to the equator. These oblique chorus waves may be seen as the quasi-periodic spatial modulations of the pulsating aurora in the ionosphere. The purpose of this study is to examine the oblique propagation of chorus elements as a possible mechanism of the spatial modulations of the pulsating aurora. We used data obtained by a highly sensitive sCMOS camera installed at Poker Flat Research Range (PFRR) in Alaska from February to April 2014. The imaging sensor of 2048 x 2048 pixels and the narrow field of view of 15 x 15 degrees enable us to identify the smallest auroral structure ever observed. The field of view approximately corresponds to 27 km x 27 km at 100 km altitude, and the spatial resolution is ~52 m when 4 by 4 binning is used. From the initial analysis of a magnetic storm event on February 19, 2014, we found several events of spatial variations of small-scale (5 km across on average) elongated patches during the ON-phase of the main pulsating patch. The typical propagation speed of the small elongated patches is an order of 50 km/s at the 100 km altitude, which corresponds to an order of 1000 km/s in the magnetosphere. In the presentation we add some more storm events to show statistical results of the propagation directions and the speed, the scale-size, and the periodicity of small-scale pulsating auroral patches to compare with the simulated results of chorus wave-electron interactions which may form the spatial variations of pulsating patches in the ionosphere.

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PEM28-11 Room:302 Time:May 28 16:15-16:30

Characteristics of polarization in auroral emissions based on wide-field polarization spectroscopic observation

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Recently the linear polarization (up to 17 %) of auroral 630 nm emission has been reported from ground-based measurements (Bommier et al., 2011). However, characteristics of auroral polarization, such as substorm dependence, are not understood well. This study we focus on the polarization in auroral 557.7nm emission as well as 630 nm emission, and developed the wide-field (130 deg) north-south meridian imaging polarization spectrograph. In addition, we also developed the polarization telescope with Wollaston prisms to calibrate polarization effect additionally caused by air particle in the line-of-light direction.

The wide-field imaging spectrograph consists of a fish-eye lens, wire-grid linear polarizer, VPH grating and EMCCD camera, covering 450 ? 710 nm range with 2.0 nm resolution. To obtain the auroral polarization with accuracy better than 1%, we developed the calibration LED lamp with a rotating linear polarizer and carried out the precise calibration of instrumental (artificial) polarization for the whole 130 deg FOV with interval of 3 deg.

We have performed continuous measurement of auroral polarization since November 2014 at Poker Flat, Alaska. For geomagnetically disturbed event on Nov. 20, 2014, the polarization in auroral 630 nm emission was maximized up to 8% at low-elevation angle (~10 deg), and decreased toward the magnetic zenith, where the polarization was ~1%. On the other hand, there was strong polarization in 557.7 nm emission (greater than 10%), which should not polarized from the theory of magnetic quadra-pole emission process.

We estimated the relative energy of precipitating electrons from the ration of 630nm and 557.7nm emissions, and found that the polarization of auroral 630nm emission increased as the energy of precipitating electron decreased. I this talk we will give the recent results and discuss issues for further study on auroral polarization.

Keywords: aurora, polarization, development

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PEM28-12 Room:302 Time:May 28 16:30-16:45

Antarctic large area network observation of auroral phenomena using unmanned system

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Space and upper atmospheric sciences group in the National Institute of Polar Research (NIPR) is now planning to carry out a ground-based network observation project of auroral phenomena using unmanned observation system during the next term of the Japanese Antarctic Research Expedition (JARE) programme.

At present, 8 unmanned magnetometers have been deployed within the area of 66 to 72 degree magnetic latitude and 60 to 85 degree magnetic longitude around Syowa Station. Along the inland route to Dome Fuji Station, 3 BAS (British Antarctic Survey) type unmanned magnetometers are deployed, while along the coast area, 5 NIPR type ones are deployed. At these 8 points, 1 sec resolution magnetic observations are carried out continuously through the year with a 3-axis fluxgate magnetometer.

Within this JARE programme term (the 8th term), a new unmanned auroral observation system, which is equipped with 3-axis fluxgate magnetometer, all-sky auroral imager, and GNSS/TEC receiver, has been developed by NIPR, and one set of the system will be deployed around Molodezhnaya Station located about 300 km east from Syowa Station. In the next 9th term, another set will be deployed around the SerRondane area located about 800 km west from Syowa. In addition to the observations at these unmanned sites, we will promote a collaboration with the observations at Indian Station Maitri and South African Station Sanae, which are located further westward from SerRondane area at sub-auroral latitudes, to construct a large area auroral observation network within the area of 62 to 72 degree magnetic latitude and 45 to 85 degree magnetic longitude.

Scientific purposes of this large area network observation are as follows:

1. To observe phenomena which appear around the time of substorm onset.
2. To observe temporal variation of conjugacy of auroral phenomena.
3. To observe phenomena associated with various wave-particle interactions during the storm and substorm times in the inner magnetosphere region.

Keywords: unmanned observation, large area network, auroral phenomena, conjugacy

PEM28-13 Room:302 Time:May 28 16:45-17:00

Properties of energetic ion PSD during magnetic storms observed by Van Allen Probes

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It is observationally known that the contribution of O+ ions to the ring current increases with increasing size of magnetic storms, while H+ is the main component of the ring current ions during small storms. Ion injection from the magnetotail caused by substorms is considered as one of the principal mechanisms that supply energetic ions to the ring current region. However, the dependence of the ion injection properties on ion species (such as the depth of ion injection into the inner magnetosphere) is far from well understood as is the role of injection itself. To characterize the ion supply to the ring current during magnetic storms, we investigate in this study the properties of energetic H+ and O+ phase space densities (PSDs) during geomagnetic substorms observed by the Van Allen Probes mission. We examine substorms that occurred during the periods of April 23, 2013 to April 28, 2013, April 29, 2013 to May 5, 2013, and March 15, 2013 to March 20, 2013. Using energetic ion (greater than 50 keV) and magnetic field data obtained by the RBSPICE and EMFISIS instruments onboard Van Allen Probes, we study the temporal variations of H+ and O+ PSD spatial distributions and compare their properties during each of the substorm events.

We calculated the first adiabatic invariant, mu, and PSD for ions within a pitch angle range from 70 to 110 degrees. PSDs for specific mu values (mu = 0.3, 0.5 and 1.0 keV/nT) were obtained as a function of L for each ion species for each orbit of Van Allen Probes during each substorm. We identified a sudden increase in each PSD spatial distribution as an injection boundary. The results for the period of April 23-28, 2013 show that both H+ and O+ ions penetrated directly down to $L<5$ during the main phase of the magnetic storm (minimum Dst greater than -65 nT). The penetration boundary of H+ ions was located at smaller L at dusk than at dawn. We also find that H+ ions with smaller mu values (mu = 0.3 and 0.5 keV/nT) penetrated earlier than those with larger mu values (mu = 1.0 keV/nT). In contrast, the timing of O+ penetrations is almost the same for all O+ ions regardless of the mu values. The results also show that O+ ions penetrated more deeply in L and earlier in time than do the H+ ions. These results taken together suggest that the source of the injected O+ ions is located closer to Earth than that of the protons (the inner edge of the plasma sheet) and therefore suggest the importance of the contribution of subauroral O+ ions to the storm-time ring current.

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PEM28-14 Room:302 Time:May 28 17:00-17:15

Statistical analysis of magnetosonic waves from the Van Allen Probes data

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Magnetosonic waves (MSWs) are X mode electromagnetic emissions seen at between the proton cyclotron frequency and the lower hybrid resonant frequency. Their magnetic field fluctuations have a linear polarization. It has been suggested that MSWs can contribute to the acceleration of relativistic electrons in the radiation belts. In this study, we statistically investigate plasmaspheric MSWs using data from the EMFISIS instrument onboard the Van Allen Probes. The MSWs occur at all local times but in this study we observe them mainly on the dayside and during both magnetically quiet and active periods. We also investigate the polarization of MSWs using the spectral matrix. At $L<1.5$, the polarization of at the lower frequency component of MSWs changes from R-mode to X-mode. At the same location, there are some L-mode waves that may be converted from the R-mode waves below the cross-over frequency. These L-mode waves may contribute to the plasmaspheric EMIC waves deep in the plasmasphere.

Keywords: MSW, inner magnetosphere, Van Allen Probes, EMIC

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PEM28-15 Room:302 Time:May 28 17:15-17:30

Loss processes of outer radiation belt electron: Contribution of magnetopause shadowing

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The Earth's radiation belts consist of the inner and outer radiation belts, and these regions are composed of highly energetic electrons. Especially in the outer radiation belt, the energetic electron fluxes are highly variable during magnetic storms. Energetic electrons in the radiation belts sometimes cause satellite charging, resulting in gradual degradation of instruments and devices onboard satellites. Therefore, it is important to understand basic physics of the energetic electron variation in the outer radiation belt from the point of view of space weather. It has been considered that the drastic change of the outer radiation belt is controlled by the delicate balance between transport, acceleration and loss processes. However, each process has complex physical mechanisms and there remain still much outstanding questions.

In this study, we particularly focused on the loss processes. As a possible loss process, (i) precipitation to the atmosphere, (ii) Dst-effect and (iii) direct loss from the magnetopause (magnetopause shadowing) have been considered. The correlation between the magnetopause location and the outer boundary of the outer radiation belt was reported by Matsumura et al. [2011]. Turner et al. [2012] suggested that a rapid depression of outer belt electrons is caused by the sudden inward shift of the magnetopause and subsequent enhancement of outward radial diffusion. However, the regions where electrons escape and how the magnetopause shadowing effect reaches smaller L-value are still open questions.

In order to understand the effect of magnetopause shadowing, we used the concept of the drift shell splitting. Due to the asymmetric configuration of Earth's magnetosphere, charged particles which have different pitch angles drift along the different drift shells. On the dayside, particles whose pitch angles are closer to 90 degrees have drift shells closer to the magnetopause. It is expected that, as a result of magnetopause shadowing, the pitch angle distribution will be the butterfly distribution. To investigate this hypothesis, we used Solid State Telescope (SST) onboard the THEMIS satellite and analyzed pitch angle distributions of energetic electrons.

Our result shows inward shift of dominant region of butterfly distribution when the magnetopause is compressed. We consider that this change is caused by the effect of inward shift of the magnetopause. However, the correlation coefficient between the magnetopause standoff distance and the shadowing region (the region where the effect of magnetopause shadowing is observed in the pitch angle distributions) is relatively low. It is because the effect of drift shell expansion due to the enhancement of the ring current. Then we calculate the largest $L*$ which has last closed drift shell, $L*max$ [Koller and Zaharia, 2011] and compared $L*max$ with shadowing regions. The result shows good correlation and it supports the scenario that the electron loss is caused by the magnetopause shadowing.

However, our result also shows a little difference between loss and shadowing region. It means that the other loss processes are necessary to explain the total loss of outer belt electrons. We investigate this difference of the two by calculating 1-D Fokker Planck radial diffusion model. The simulation result supports the Turner's scenario, magnetopause shadowing and subsequent enhancement of outward radial diffusion. However, strong radial diffusion coefficients are required to explain observation.

We also consider the precipitation loss to the atmosphere by using POES. POES can detect strong precipitation events. However, these precipitation events are not detected for all the events, there are some events which we can rarely detect strong precipitations. Thus, it is suggested that precipitation loss is not the main cause of loss but just the subsequent loss. However, we need to investigate further about precipitation loss.

Keywords: radiation belt, magnetopause shadowing, drift shell splitting, loss process

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

PEM28-16 Room:302 Time:May 28 17:30-17:45

Topside sounding of upper ionosphere by EXOS-D/PWS in 2015

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We present initial results of sounder experiments by the Akebono (EXOS-D) satellite conducted in March-April 2015.

Plasma wave sounder experiments have been conducted by Stimulated Plasma Wave experiment (SPW) subsystem of Plasma Wave and Sounder experiments (PWS) on board the Akebono satellite in the topside ionosphere and plasmasphere [Oya et al., JGG 1990]. The sounder experiments have two main purposes: One is the remote sensing of the topside ionosphere including polar region and inner plasmasphere, and another is active experiments by the stimulation of plasma waves in space. Both of them have been successfully conducted by the SPW subsystem of Akebono/PWS.

During March-April 2015, we carry out sounder experiments by the Akebono satellite in both polar region and equatorial region of ionosphere/plasmasphere. In this paper we study echoes obtained by the experiments and derived altitude profile of the plasma density of the topside ionosphere. We also investigate plasma resonances appeared in ionograms and discuss their generation mechanism based on the weak turbulence theory of the sequence of diffuse plasma resonances [e.g., Oya, 1970].

Keywords: topside sounding, upper ionosphere

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PEM28-17 Room:302 Time:May 28 17:45-18:00

Seasonal dependence of the plasmaspheric density along the 210MM: Continuous observations by ground magnetometers

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In this paper we have applied the cross-phase method and the amplitude-ratio method to the MAGDAS/CPMN ground magnetometers MGD (Magadan) and PTK (Paratunka, Kamchatka), located in the Russian Far East along the 210MM (Magnetic Meridian), and identified FLR (field-line resonance) events. MGD is located at (53.6, 219.1) magnetic latitude and longitude [deg], and PTK is located at (46.2, 226.2). Their L values are 2.9 and 2.1. We have identified the FLR events by using both visual inspection and an automatic-identification computer code.

Although the two magnetometers are separated by about seven degrees in magnetic latitudes, which is larger than the typical separation (about 1-2 degrees) for which the cross-phase and amplitude-ratio methods are efficient, but we could identify more than a hundred FLR events a year from the MGD/PTK-pair data, and the FLR events had a fairly continuous coverage from January to December.

In this paper we estimate the plasmaspheric density from thus obtained FLR frequencies, and examine their seasonal dependence. The result suggests a weak, but marginally significant seasonal dependence with maxima in winter and minima in summer. More details will be discussed at the presentation.

PEM28-P01 Room:Convention Hall Time:May 27 18:15-19:30

The estimation of the altitude of auroral emission from grand-based multiple optical observation

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It is known that precipitation of relatively high energy (greater than 10 keV) electrons produce pulsating aurora. However, precise characteristics of precipitating electrons producing pulsating aurora, such as the local time dependence of their energy, and small-scale distribution within a patch (~100 km horizontal scale) are not understood well. Ground-based optical triangulation is useful to estimate the auroral height, which is responsible to the energy of precipitating electrons.

In this study, we analyzed the data of N2+428nm auroral emission that obtained with ground-based all-sky EMCCD cameras at three stations in north Scandinavia (Kilpisjarvi, Abisko and Tromso), for the pulsating auroral event during 26th February, 2014 to estimate the pulsating auroral height using the triangulation method.

We chose an auroral patch which is seen correspondence each other visually and positioned near the center the field of the view of the EMCCD camera. We used data in range where is in the latitude of 68-69 degrees north and the longitude of 20-24 degrees east in this analysis to analysis data in area surrounded auroral patch. Then, we gained relatively auroral intensity distribution to divide intensity at each point by average of intensity in that data selected.

To obtain the distribution between two point, we did subtraction of relatively intensity at two points . And same steps were conducted for other patterns. We calculated the distribution by changing the altitude at intervals of 2km. When the distribution was the minimum value, it was the auroral height.

We estimated that auroral height is 98~104km in this case. This height was in range of the tick electron density zone (about 90-120km) observed EISCAT simulataneously. Compared with past studies, this result is said that it is consistency value and the precipitation electron may have ~10keV.

In this presentation, we report these result of estimation and discuss them.

Keywords: pulsating aurora, altitude of auroral emission, grand-based multiple observation

PEM28-P02 Room:Convention Hall Time:May 27 18:15-19:30

Postnoon aurora spot and poleward-drifting multiple arcs

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To understand when and how the postnoon aurora spot is created, we examined data from the all-sky imager installed in Longyearbyen, Svalbard. From the detailed examination of the data obtained during two winter seasons (2013-2014, and 2014-2015), we have found that the postnoon aurora spot consists of poleward-drifting multiple arcs, which happened at intervals of about 2 min. In some events, each poleward-drifting arc distorts into a folding structure at the final stage of the poleward drift, and becomes even brighter. We report the characteristics of the occurrence and motion of the poleward-drifting arcs, and discuss what is important for the creation of the postnoon aurora spot.

Keywords: High-latitude ionosphere, postnoon aurora spot, auroral arc, all-sky imager

PEM28-P03 Room:Convention Hall Time:May 27 18:15-19:30

Variability in the open magnetic flux during superstorms

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We report temporal variation of open magnetic flux of the polar cap during the superstorm on 11/20/2003 by using in-situ measurements made by DMSP spacecraft and remote-sensing measurements made by TIMED spacecraft. We examined how the shape of the poleward boundary of the auroral oval changed. Our result shows that the poleward boundary is extremely distorted in the morning sector during the main phase of the superstorm. In the expanding/contracting polar cap paradigm, this sector is not regarded as an important element. We discuss some significant points that are not included in that conventional paradigm.

Keywords: Polar cap, magnetic flux, superstorm

Japan Geoscience Union Meeting 2015
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PEM28-P04 Room:Convention Hall Time:May 27 18:15-19:30

Estimation of Plasma Condition Before 1970 Using Digitized Data Created by Tracing Analog Magnetograms

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It is important to know the plasma mass density in the magnetosphere, since it controls the Alfven velocity, which is one of fundamental parameters for the magnetospheric phenomena. We can estimate indirectly the plasma mass density from geomagnetic pulsations, e.g., Pc3 or Pc4. But no digital data of the geomagnetic field with a time resolution of 1.0 second exists before the middle of 1980s. There is also no available satellite data of magnetospheric ion mass density before 1970. The ion composition in the magnetosphere before 1970, therefore, remains unclear.

Mashiko et al. [2013] has developed a program to convert analog magnetograms to digital values with a time resolution of 7.5-seconds, and it makes possible to study various geomagnetic pulsations. According to statistical analysis by Nose [2010], Pi2 periods are represented by the following empirical equation:

$$T = 17.65\ [\pm 0.80] \times M(\mathrm{amu}) - 1.34\ [\pm 0.05] \times \sum \mathrm{Kp} + 108.68\ [\pm 0.94]$$

where T and M represent the Pi2 period and the average plasma ion mass, respectively. From this equation, we can estimate the average plasma ion mass (M) in the nightside plasmasphere when we obtain T and $\sum$ Kp.

From 7.5-seconds digital data created from analog magnetograms for 1964-1975, we estimate the average plasma ion mass in the nightside plasmasphere during solar cycle 20. We perform statistical analysis and compare the estimated average plasma ion mass with F10.7 on long-term basis so that we investigate how solar activities affect on the plasmasphere.

We find that the correlation coefficient (C.C.) between monthly average plasma ion mass and monthly F10.7 is 0.500, while that between monthly average plasma ion mass and monthly $\sum$ Kp is 0.154. In order to consider long-term variations and increase statistical significance, we also calculate correlation coefficients between moving average of these parameters with a time window of 1 year. We find that C.C. = 0.838 between the mass and F10.7, and C.C. = 0.372 between the mass and $\sum$ Kp. This shows that long-term variations of the average plasma ion mass, in particularly, in the time scale longer than 1 year, have stronger correlations with F10.7 than $\sum$ Kp. It is noteworthy that during solar cycle 20, which has smaller maximum of F10.7 than other vicinity cycles, the estimated average plasma ion mass has smaller maximum value than other cycles.

One of the causes of variations in the magnetospheric plasma ion composition is upflowing ionospheric ions. The ionospheric ion upflow is enhanced by solar radiation such as ultraviolet radiation (UV) or extra ultraviolet radiation (EUV), and geomagnetic activities such as precipitation of energetic particles or aurora electrojet. Here we study the dependence of average plasma ion mass on F10.7 and $\sum$ Kp, and find the strong correlation with F10.7. This result suggests that in long-term variations, solar radiation is dominant mechanism to produce or heat oxygen ions.

Keywords: Pi2 pulsations, analog magnetogram, average plasma ion mass, plasmasphere, solar activity, upflowing ionospheric ions

PEM28-P05 Room:Convention Hall Time:May 27 18:15-19:30

Ionospheric currents induced by Dst field and their effects on the geomagnetic field variation

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Ionospheric currents induced by Dst field were simulated, and their effects on the geomagnetic field variation was estimate. It was found that a vortex current system is induced in the dayside ionosphere for the variation of less than 10 minutes because of the lower nighttime conductivity, and causes geomagnetic field variation in the Y-component.

Keywords: Dst field, induced ionospheric currents, geomagnetic field variation

Japan Geoscience Union Meeting 2015
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PEM28-P06 Room:Convention Hall Time:May 27 18:15-19:30

CubeSat Project for the observation of Sq current at extreme low altitude

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It is well known that Sq (Solar quiet) current in the dayside ionosphere has been considered as a significant subsequence of Mesosphere-Ionosphere-Magnetosphere coupling. The intensity and the pattern of the Sq current often vary due to the magnetospheric disturbances such as magnetic storms and substorms while the fundamental pattern of the current is determined by the global distribution of the tidal wind flowing in the mesosphere. The study of the Sq current has been conducted by many investigators from various view points of the M-I-M coupling. In particular, the north-south asymmetry of the potential has been focused in terms of the energy balance between each hemisphere through the field line. In order to explain this potential asymmetry, an InterHemispheric Field Aligned Current (IHFAC) was theoretically predicted by *Maeda* [1974] and Fukushima [1979, 1991]. After that the ground magnetic observations supported such idea [*Takeda* 1990; *Stening* 1989; *Fukushima* 1994]. However the detailed morphology of the IHFAC is not well understood yet, despite that the direct detection of the IHFAC at Low Earth Orbit (LEO) was reported in the observation by the Ørsted satellite [*Yamashita* and *Iyemori*, 2002] and the CHAMP satellite [*Park et al*., 2011].

We think that the in-situ satellite observation in the lower altitude and the smaller inclination compared to the Ørsted (Altitude=760km, Inc.=97deg.) and the CHAMP (Altitude=454km, Inc.=87deg.) can be an efficient approach to reveal the morphology of the Sq current. In order to investigate the electromagnetic M-I-M coupling of the Sq current system including the IHFAC, the in-situ observation by a CubeSat (2U or 3U size satellite emitted from ISS) just above the coupling region closed to the foot print of IHFAC with the altitude of less than 400km (F region in the ionosphere) is planned in collaboration with 8 national colleges which belong to National Institute of Technology (KOSEN). The fluxgate magnetometer and the impedance probe are considered to be installed in the satellite to observe the small perturbation of the magnetic field and the electron density.After the ejection from the ISS, the CubeSat will gradually glide down to the upper atmosphere due to the strong atmospheric drag and finally burn up in it. The duration of the possible observation is estimated for more than 50 days. Such an extremely low cost satellite enables to conduct the observation in the lowest altitude where the conventional satellite cannot be operated because of a low cost-effectiveness.

Keywords: Sq current, Inter-hemispheric FAC, CubeSat

Japan Geoscience Union Meeting 2015
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PEM28-P07 Room:Convention Hall Time:May 27 18:15-19:30

Verification of proto-flight models of Medium Energy Particle analysers (MEPs) for ERG

KASAHARA, Satoshi[1*] ; YOKOTA, Shoichiro[1] ; MITANI, Takefumi[1] ; ASAMURA, Kazushi[1] ;
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ERG (Exploration of energization and Radiation in Geospace) is geospace exploration spacecraft, which is planned to be launched in FY2016. The mission goal is to understand the radiation belt dynamics especially during space storms. The key of this mission is the observations of electrons and ions in medium-energy range (10-200 keV), since these particles excite various electromagnetic waves (e.g., EMIC waves, magnetosonic waves, and whistler waves), which are believed to play significant roles in the relativistic electron acceleration and loss. Proto-flight models (PFMs) of the medium-energy electron analyser and ion mass spectrometer have been fabricated and their performance tests are started. We report these initial results.

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PEM28-P08 Room:Convention Hall Time:May 27 18:15-19:30

Development of stacked silicon strip detectors for MeV electron on board the Geospace exploration satellite "ERG"

MITANI, Takefumi[1*] ; KASAHARA, Satoshi[1] ; TAKASHIMA, Takeshi[1] ; HIRAHARA, Masafumi[2] ; MIYAKE, Wataru[3] ; HASEBE, Nobuyuki[4]

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The Energization and Radiation in Geospace (ERG) project will explore how relativistic electrons in the radiation belts are generated during space storms. "High energy particle (electron)" instrument (HEP-e) on board ERG satellite will measures 3-D distribution of high energy electron between 70 keV and 2 MeV. In high resolution mode, HEP-e measures the energy and incident direction of each electron with time resolution of 2 μsec.

The detection parts of HEP-e are six pinhole cameras which consist of mechanical collimators, silicon semiconductor detectors and readout ASICs. Three camera measure electrons with energy of 70 keV - 1 MeV and other three with energy of 700 keV - 2 MeV.

The flight model of HEP-e is under manufacture and the verification tests before integration are ongoing. In this presentation we introduce HEP-e instrument and report results of the step-by-step verification tests of each component before final assembly.

Keywords: ERG, silicon semiconductor detector, electron acceleration

Japan Geoscience Union Meeting 2015
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PEM28-P09 Room:Convention Hall Time:May 27 18:15-19:30

Performance evaluation of the fluxgate magnetometer installed on the ERG satellite

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We conducted the performance evaluation tests on 5-8 November 2014, on the fluxgate magnetometer (MGF) being installed on the ERG satellite. The MGF is required to have the accuracy of 5nT (0.03%) with a 8000nT range when it measures the magnetic field in the Earth's inner magnetosphere. In order to evaluate its measurement accuracy, we investigated the in/output linearity of ADC by comparing the digital outputs to the continuous input voltage (~0-±3V). We also investigated the ADC noise dependence on the analog input voltage for 30s digital outputs every 0.15V inputs from ~0 to ±3V.

The MGF measures the magnetic field by returning feedback currents into the sensor. It required to evaluate the time delay of responses to the magnetic field variation and the maximum magnetic field variation which the MGF can response. We derived the time delay with the correlation analysis between the input voltage (10Hz sin waves with ~±4000nT amplitudes) and the digital outputs. We also investigated the maximum frequency of the magnetic field variation by adding large amplitude (1-4V) sine waves (9-36Hz).

In our presentation, we report those performance evaluation results.

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PEM28-P10 Room:Convention Hall Time:May 27 18:15-19:30

Statistical study of the magnetic storm phase dependence of the inner boundary of the plasma sheet electrons

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The locations of inner boundary of the plasma sheet electrons during magnetic storm have been analyzed statistically by using THEMIS data. Plasma sheet electrons are carried to the earth due to magnetospheric convection, and then drift toward the morning sector in the vicinity of the earth. Thus, the inner boundary of the plasma sheet electrons is formed around 3 - 7 R_E. In addition, plasma sheet electrons can precipitate along a magnetic field line, and produce aurora in the earth's ionosphere.

Previous studies investigated the dependence of the location of the inner boundary of the plasma sheet electrons on geomagnetic indices such as Kp and AE index [Korth et al., 1999; Jiang et al., 2011]. Jiang et al. [2011] reported the local time distribution of the inner boundary of the plasma sheet electrons in both quiet and disturbed conditions by referring AE index. In this study, we focus not only on dependences on Dst index but also on dependences on phase of magnetic storms. The data which we used are obtained by ESA (Electrostatic Analyzer) onboard the THEMIS satellite. ESA measures the energy flux, density and temperature of particles over the energy range from a few eV to 30 keV for electrons and to 25 keV for ions. In the present study, we use ESA data of 1 to 10 keV electrons. We perform analyses of events during two magnetic storms on July 6, 2013 and June 17, 2012. We also perform a statistical analysis of the positions of inner boundary of the plasma sheet electrons.

Event analyses indicates that the inner boundaries were located around 3 - 4 R_E and 4 - 10 R_E in the main phase and the recovery phase of the magnetic storm, respectively. We find that the boundaries are closer to the earth in the main phase than those identified during the recovery phase of the same magnetic storm. In addition, we find in the main phase of the magnetic storm that the identified inner boundaries of the plasma sheet electrons with energy from 0.7 to 9 keV are located around the similar radial distance. On the other hand, in the recovery phase of the magnetic storm, we find that the inner edge of the low energy electron (˜1keV) is closer to the earth than that of the high energy electron (˜9eV). In the magnetic storm of June 17, 2012, the recovery phase continued for two days. The inner boundary of the plasma sheet electrons was at 3.9 R_E in the first day and 6.1 RE in the second day. The difference between L of 1 keV electrons and that of 9 keV is 1.4 in the first day and 3.7 in the second day, so the energy dependence of the location of the inner boundary of the plasma sheet electrons becomes more evident in the second day than in the first day.

The result of our statistical study shows the similar energy dependences in the recovery phase of small magnetic storms but different tendency in the main phase of the magnetic storm. We also reveal that the typical radial distance of the inner boundary during the storm main phase is 3.9 R_E. Disappearance of the energy dependence of the location of the plasma sheet electrons (the difference between L of 1 keV electrons and that of 9 keV is less than 0.6) suggests the presence of the strong electric field in the vicinity of the earth. Finally, we compared the locations of the inner edge of the plasma sheet electrons obtained by ESA onboard THEMIS satellite with those estimated based on the steady state drift boundary model proposed by Jiang et al. [2011] and Volland-Stern electric field model . As a result, the model cannot fully explain the observed independence of the positions of the inner edges of the plasma sheet electrons on the kinetic energy of the electrons during magnetic storm, especially in the recovery phase of the magnetic storm. The results suggest that there are some additional electric fields in the inner magnetosphere and further investigations on them will be needed in future.

Keywords: plasma sheet inner edge, plasma sheet, convection electric field, magnetic storm, aurora, substorm

PEM28-P11 Room:Convention Hall Time:May 27 18:15-19:30

Observation of heavy ions from the earth's ionosphere in the plasma sheet

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There are two plasma sources of the plasma sheet in the Earth's magnetotail, i.e., the solar wind and ionospheric outflows. Previous observations have shown that the ionospheric plasma contribution to the plasma sheet depends largely on geomagnetic activities. However, supply mechanism of the ionospheric plasma to the plasma sheet is far from well understood. In order to investigate the fate of ionospheric outflows in the plasma sheet, we have found cold O^+ and He^+ beams in the plasma sheet at the distance about 20 Re(Earth radii) in the Geotail LEP data from January 1997 to December 2005. The Energy-time spectrograms of the LEP ion data obtained in the plasma sheet show the signatures of cold heavy ion beams outflowing from the ionosphere. Because the mass analysis data of ion with energies less than 10 keV are not available, we identify ion species by velocity distribution function. The plasmas in the plasma sheet are dominated by the $E\times B$ drift, therefore the plasma bulk velocities perpendicular to the local magnetic field should be equal in spite of the ion species. We survey the differences of the geomagnetic activities for these ion beams in the plasma sheet. The results show that the intense ion beams are frequently observed when the geomagnetic storms occurred. The energy of these cold heavy ion beams is generally less than 10 keV. In this presentation we discuss these statistical tendencies of the cold heavy ion beams in the plasma sheet.

Keywords: magnetosphere, ion outflow, plasma sheet

PEM28-P12 Room:Convention Hall Time:May 27 18:15-19:30

Geotail observations of dayside magnetopause reconnection I

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On 06 July 2013, Geotail observed the dayside magnetopause reconnection for a long time period. In the period 0000-0800 UT on 06 July 2013, the solar wind has an almost constant speed of 350 km/s and the Interplanetary Magnetic Field (IMF) is almost southward, having a value of (0.0, +4.5, -12.0 nT). Geotail traveled from the magnetosheath to the magnetosphere. The Geotail position is (Xgsm, Ygsm, Zgsm) = (9.72, -2.23, -0.49 Re) at 0400 UT and (8.91, 0.87, -1.73) at 0600 UT, respectively. Geotail stays in the vicinity of the magnetopause, almost in the front magnetosphere. Reconnection jets with a speed of 200 km/s are observed near the reversal of the magnetic field. The reconnection jets flow northward, indicating that the reconnection site is located south of the Geotail position. There are two cases in the magnetic field variations. In most cases, the Bz magnetic field component is dominant and the field reverses from southward to northward in the crossing into the magnetosphere, and the reconnection jets are almost field-aligned. However, the magnetic field becomes almost perpendicular to the north-south direction, and the positive By magnetic field component is dominant. The reconnection jets are convection flows. In this study, the magnetic field topology and its relationship to the jets are investigated.

Keywords: magnetosphere, magnetic reconnection

PEM28-P13 Room:Convention Hall Time:May 27 18:15-19:30

Geotail observations of dayside magnetopause reconnection II

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Plasma velocity distributions perpendicular to the magnetic field are generally isotropic by Larmor motion of ions and electrons. In actuality, isotropic velocity distributions are observed by Geotail. However, anisotropic ion velocity distributions were observed in the magnetosheath nearby the magnetopause when Geotail crossed the dayside magnetopause and observed ion flow jets by magnetic reconnection. The Geotail data of ion Energy-Time spectrogram on July 6, 2013 indicate anisotropic velocity distributions of ions energies higher than 20 keV at 0330 UT. The Geotail orbit is from magnetosheath through the magnetopause to the magnetosphere. The spacecraft GSM coordinates at the time of anisotropic ion velocity distribution observation are (9.8, 3.0, -0.2)R_E. This Geotail position is in the magnetosheath nearby the magnetopause. Ion energies are about 1 keV in the distant magnetosheath from the magnetopause. There are no ions with energies higher than 10 keV in the magnetosheath. There are ions with energies higher than 20 keV in magnetosphere. Thus, these ions are considered to go out toward the magnetosheath from the magnetosphere. We explain anisotropic ion velocity distributions by reconnecting magnetic field geometry.

Keywords: magnetosphere, magnetic reconnection

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PEM28-P14 Room:Convention Hall Time:May 27 18:15-19:30

Characteristic of the dayside and nightside reconnection region in the Earth's magnetosphere

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We have investigated the magnetic reconnection at the dayside of the magnetosphere (X=0˜20 Re) and at the nightside (X=-30˜-10 Re) by using Geotail observations. Especially, we concentrate on the dayside magnetic reconnection event that has not been intensively studied compared to the nightside reconnection. In the case of nightside reconnection, the lobe plasma conditions in the northern and southern lobes are generally the same. Therefore, it is expected that the symmetric reconnection will occur. On the other hand, in the case of dayside reconnection, the reconnection mixes different plasmas (magnetosphere and solar wind plasmas). Thus, the asymmetric reconnection will occur in the dayside of the magnetosphere. We chose the reconnection events investigating the occurrence of simultaneous flow and magnetic field reversals by using the Geotail data. Then, we studied the energy exchange between plasma and electric field. The quadrupole structure produced by the Hall effect near the magnetic neutral line by using the magnetic field data is also studied. We analyzed 36 nightside reconnection events. In 13 events, we found that the velocity distribution function of ions shows two-component signature (cold inflow and hot outflow), which is the typical feature observed in the magnetic reconnection region. In addition, we identified 12 ion heating events near the neutral line. In the same way, we analyzed 26 dayside reconnection events. We could not find two-component and heating signatures of ions near the neutral line. The quadrupole magnetic field structure (By, GSM) due to the Hall effect also shows different characteristics between the dayside and nightside reconnection. In the case of dayside reconnection event, only 10 events out of 26 events show the quadrupole signature, and the others had different characteristics from quadrupole. Based on these results, we will discuss the difference between symmetric reconnection and asymmetric reconnection.

Keywords: magnetic reconnection, Hall effect, asymmetry, Geotail spacecraft

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The separation of temporal and spatial fluctuation of magnetic field data obtained by SWARM satellites.

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It is difficult to separate temporal and spatial fluctuation from data obtained by satellites.

Sugiura et al. (1984) suggested that the small-scale magnetic fluctuations over the high-latitude ionosphere are mainly caused by small-scale field aligned currents.We revealed the fact observationally by using the high-time resolution magnetic data from SWARM satellites.

We took correlation coefficients between satellite-A and satellite-B by shifting time (i.e., correlation function) and picked up the peak of them for each time interval used for the calculation. Then we found, sometimes, the value of correlation coefficient without time shifting is larger than that with time shifting. In short, temporal fluctuations are sometimes more dominant than special fluctuations.

To compare with the results obtained by Ishii et al, (1992), we analyzed this tendency in more detail by changing filtering window, latitudes and MLT.

In addition, we show the relationship with AE index to estimate the effort of external factors (e.g. substorms).

Keywords: SWARM satellites, high-latitude ionosphere, field-aligned current, magnetic fluctuations, separation of temporal and spacial fluctuations

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Spatial characteristic of mid- and low-latitude Pi2 pulsations observed by the Swarm satellite in the upper ionosphere

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At substorm onsets, low-latitude Pi2 pulsations are observed on ground. While low-latitude Pi2 pulsations on the night side have high coherence with magnetic field perturbations in the compressional and radial components observed by satellites in the plasmasphere, some studies show that there is no magnetic signals in the plasmasphere on the dayside which correspond to low latitude Pi2 pulsations (Takahashi et al., 2005; Teramoto et al., 2008; 2011). Using magnetic field data obtained by the low-altitude Oersted satellite, Han et al. (2004) found that compressional Pi2 pulsations observed on the dayside in the topside ionosphere show out-of-phase oscillation with those at low-latitude ground stations. They suggested that the dayside Pi2 pulsations are generated by the dayside ionospheric current system rather than the cavity mode resonance mode. In contrast, Sutcliffe and Luher (2010) found that no Pi2-related magnetic signals can be detected in the topside ionosphere, using the CHAMP satellite. To reveal generation mechanism of Pi2 pulsations at low latitude, more studies at topside ionosphere are needed.

In this study, we compare Pi2 pulsations observed in the upper ionosphere and on low-latitude ground, using the magnetic field data obtained by the Swarm satellite and at Kakioka (KAK, 27.19 degrees geomagnetic latitude, 208.79 degrees geomagnetic longitude) and San Juan (SJG, 28.20 degrees geomagnetic latitude, 6.10 degrees geomagnetic longitude). The Swarm satellite was launched on November 2013 and consists of the three identical satellites (Swarm-A, -B, and -C) in polar orbits. We statistically investigate Pi2 pulsations observed by the Swarm satellites. On the nightside, Pi2 pulsations in the compressional and radial components have high coherence with those at the low-latitude ground stations. On the other hand, Pi2 pulsations observed by Swarm on the dayside do not show high coherence with those on the low-latitude ground stations. We will show typical Pi2 events observed by the Swarm satellites at different local times and discuss possible mechanisms of low-latitude Pi2 pulsations.

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The study of ULF pulsation driven by the KH instability using a next generation M-I coupling simulation model

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ULF pulsation plays an important role in electron acceleration of outer radiation belt. One of the ULF generation mechanisms is an excitation due to KH instability at the magnetopause. Claudepierre et al. [2008] reported the ULF pulsation following the KH instability using a global MHD simulation model. Our next generation magnetosphere-ionosphere coupling global MHD simulation model reproduced the ULF pulsation at the magnetosphere and the ground following the KH instability because the resolution is improved. In this study, we have done the spectral analysis to ULF pulsation at the magnetosphere and ground. We drove the simulation changing the solar wind velocity of 800 km/s, 600 km/s, and 400 km/s. we made the spatial distribution of the integrated ULF wave power at the equatorial plane. In the results, we found that the integrated ULF wave power and the peak frequency depend on the solar wind velocity. The integrated ULF wave power is distributed lying on 2-3 layers at the magnetopause. These features are consistent with the results of Claudepierre et al. [2008]. We also found that there is the region of the strong ULF power, which seems to propagate form KH instability, at L= 8 Re in the night side in the case of northward IMF and the solar wind velocity of 800 km/s. In this lecture we will report the results of the detail analysis.

Keywords: ULF pulsation, KH instability, global MHD simulation