Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

PEM30-01 Room:105 Time:May 20 09:00-09:15

Correlation between Substorm Onset Ground and Space Observations: Implication for Kinetic Ballooning Instability

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The observations of substorm onset phenomena in the magnetosphere and ionosphere are examined to study their correlation and understand the substorm onset mechanism. In particular, we examine the Pi2 wave structure, propagation, frequency and growth rate in the magnetosphere observed by the THEMIS satellites and the structure and dynamics of the substorm auroral onset arcs. We show the correlation between the substorm onset arcs and the Pi2 pulsations in terms of wave structure, propagation, and the exponential growth of arc intensity and Pi2 wave amplitude. The correlation between the ground and space phenomena strongly supports the kinetic ballooning instability (KBI) as the cause of substorms. We demonstrate that KBI is most unstable in the strong cross-tail current region magnetic field lines and the KBI parallel electric field accelerates electrons along the magnetic field lines into the ionosphere to produce the substorm onset arc.

Keywords: substorm, kinetic ballooning instability, magnetospheric dynamics, magnetospheric structure

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PEM30-02 Room:105 Time:May 20 09:15-09:30

Investigation of the Triggering Mechanism of Magnetospheric Substorm by means of 2-1/2D Full-Particle Simulation

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The triggering mechanism of substorm in the Earth's Magnetotail is thought to be closely related to the magnetic reconnection and the tearing mode instability. Recently we proposed a new scheme of the substorm onset called "Catapult Current Sheet Relaxation Model (CCSR Model)" to physically understand the results from statistical analyses of GEOTAIL and THIMIS data. In the results, it can be seen that the local maximum region of the northward magnetic field around X ˜ -17Re are created a few minutes before substorm onset, and the magnetic reconnection occurs at the tailward edge of the enhancement at the time of substorm onset. We investigate a stability of the current sheet by means of particle simulation in order to physically verify the results of the statistical analyses.

We have given a magnetic field structure which is akin to the Earth's dipole magnetic field together with a stretched magnetic field by thin current sheet as a basic initial condition of our simulation. We have started the simulation with such initial condition. In an early stage, the fluctuation of magnetic field which seems to be produced by tearing mode instability has been found at the location tailward of the boundary between dipole-field and current sheet with a distance about one wave length of the tearing mode with a maximum growth rate. Further, we have investigated variations in the development of the instability by adding the local enhancement of the northward magnetic field to the initial current sheet. It was found that such local enhancement of the northward magnetic field enhances the instability in the current sheet. By shifting initial location of the local enhancement, we found that the most rapid development of tearing mode occurred when the tailward edge of the local enhancement and the location of the original tearing mode overlap with each other.

The obtained results suggest that the results of the statistical analyses of the satellite data reflect the tearing mode instability occurring in the thin current sheet with the effect of the convective electric field at the time of substorm onset.

Keywords: Substorm, Tearing instability, Magnetic reconnection

PEM30-03 Room:105 Time:May 20 09:30-09:45

Investigation of the characteristics of the dipolarization region with THEMIS data (II)

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Taking an advantage of THEMIS/All-Sky Imager (ASI) observations with high time resolution (typically 3 sec), we performed the superposed epoch analysis on the evolution of the Earth's magnetotail with THEMIS probe data. In this study, we focus on the progress of the dipolarization and low frequency electromagnetic turbulence closely associated with the current disruption. Practically, the standard deviations of the magnetic field data with the time window of 1 min were obtained.

By investigating the location and timing of the enhancements of standard deviations for three components of the magnetic field, we found that the first variation occurs at X ˜ -10 Re. Interestingly, the enhancement starts near the lobe-side boundary of the near-Earth plasma sheet, and it rapidly propagates earthward. It was also found that the earthward flows start simultaneously with the enhancement of the magnetic field variations about 20 sec before the substorm onset that was determined by auroral breakup with ASI data. The tailward flows whose velocities are less that those of the earthward flows start at the same time. The region of flow enhancement expands in an earthward direction synchronized with the enhancement of magnetic field variations.

Prior to these variations, convective earthward flows reach the very thin plasma sheet at X ˜ -12 Re, and further proceeds earthward. The convective flows originally accompany large magnetic field variations, but they seem to trigger the occurrence of considerable enhancement of the magnetic field fluctuations associated with the current disruption. Those statistical features support the outside-in model for substorm triggering.

Keywords: magnetosphere, aurora, substorm, current disruption, THEMIS

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PEM30-04 Room:105 Time:May 20 09:45-10:00

Poleward expansion of high-altitude acceleration region at substorm

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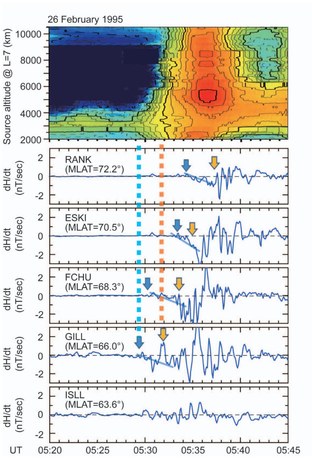
It is well established, since the first phenomenological study of auroral substorm by Akasofu [1964], that auroral bulge expands poleward after breakup. Fujii et al. [1994] showed that the poleward edge of the auroral bulge is characterized by dense upward FAC and intense electron precipitation. On the other hand, the behavior of field-aligned acceleration during the bulge development has not been well understood. In this paper we examine the evolution of field-aligned acceleration during the substorm expansion phase invoking spatial development of high latitude Pi pulsations.

Figure shows that the start time of the negative excursion of DC-ULF at GILL (blue arrow) corresponds to that of the low-altitude AKR enhancement (vertical blue line), and the commencement of large amplitude Pi 2 (yellow arrow) corresponds to that of the high-altitude AKR breakout (vertical yellow line). This means that GILL station was almost the foot print of the magnetospheric substorm onset. Wave forms of Pi 2 at higher latitudes indicated the poleward motion of bulge front, and high-altitude AKR (manifestation of high- altitude acceleration) was active during the poleward motion of the bulge front. This indicates an important consequence that the bulge front accompanied the high-altitude acceleration throughout the poleward expansion, resulting in the continuous emanation of active high- altitude AKR.

Keywords: field-aligned acceleration, high-altitude acceleration region, poleward expansion, substorm



PEM30-05 Room:105 Time:May 20 10:00-10:15

Contribution of wave activity observed around the X-line to the reconnection energy dissipation

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In JpGU 2012, we have reported plasma wave activity observed in one of the best event on May 15, 2003 of the near Earth magnetotail reconnection. Our conclusion was that the Geotail observation is consistent with the collisionless reconnection model as shown in recent kinetic simulation results. Recently, Zenitani et al. (2012) successfully estimated the energy dissipation rate of the same reconnection event. Their result is also consistent with our interpretation that the observed wave activity cannot be a major player of the reconnection dissipation. To confirm our present conclusion more, we have examined plasma wave activity observed in some more reconnection events where Geotail possibly encountered with the electron diffusion. As a result, we commonly found that the wave intensity right in the center of the electron current layer, that is a possible X-line, is much weaker than that in its surrounding region. These Geotail observations suggest that the magnetic diffusion region of the near Earth magnetotail reconnection site is mainly controlled by the physics of the collisionless reconnection process, rather than the anomalous resistivity due to turbulence.

Keywords: magnetic reconnection, energy dissipation

PEM30-06 Room:105 Time:May 20 10:15-10:30

Particle and field near the equatorial region in the magnetosphere at the onset of pulsating aurora

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Fundamental characteristics of pulsating auroras, such as modulation region, modulation mechanism, and their shapes are still open question. Simultaneous observation onboard satellite and on the ground are important method to examine such fundamental characteristics of pulsating aurora. In this study we examined some selected pulsating auroral events, which obtained onboard Cluster spacecraft and ground-based all-sky camera at Syowa-Iceland conjugate-pair and also onboard THEMIS satellites and the THEMIS ground-based all-sky camera network. Both of Cluster and THEMIS satellites were located near the equatorial plane in the magnetosphere. The particle and field signatures in the magnetosphere during pulsating aurora are; 1) All pulsating aurora associate with high-energy (>10 keV) electron flux enhancement, 2) Not all pulsating aurora associate with ELF/VLF wave enhancement, 3) It is difficult to identify a quasi-periodic modulation of high-energy electron flux, which may be corresponding to pulsating aurora patch. We will discuss modulation region and possible mechanism of pulsating aurora.

Keywords: aurora, pulsating aurora, high energy electron, plasma wave, magnetosphere, ionosphere

PEM30-07 Room:105 Time:May 20 10:30-10:45

THEMIS observations of electromagnetic ion cyclotron emissions in the innere magnetosphere

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Electromagnetic ion cyclotron (EMIC) triggered emissions were first reported by Pickett et al. [2010]. These were observed by the Cluster spacecraft close to the plasmapause in the equatorial region of the magnetosphere, which have rising tone spectra similar to those of whistler-mode chorus emissions. These phenomena have received much attention because of the possibility of their strong interaction with particles in the inner magnetosphere pointed out by Shoji et al. [2011] and Omura and Zhao [2012], regardless of their few observations.

This study reports the presence of various EMIC triggered emissions found in the flux gate magnetometer (FGM) data onboard the THEMIS probes during the interval from 2007 to 2011. They are Pc1-2 emissions with narrow-band frequency and sporadic frequency variation with the timescale of tens of second. We can find them over a broad area between the magnetopause and the plasmapause, mainly in the dayside of 6-10Re. We recognize various type of emissions which have typical rising-tone spectra, have falling-tone spectra analogous to whistler-mode faling-tone discrete emissions, and are exited simuletaneously in the different frequency bands bounded by the cyclotron frequencies of ions.

Omura et al. [2010] have developed the nonlinear wave growth theory which explains the generation of the EMIC triggered emissions. We compared some events observed with their theory, and found that the obtained relation between the magnetic amplitudes of the emissions and variations in frequencies are well explained by the theory. In addition, there are rising-tone emissions with right-hand polarization and the lower limits in frequency corresponding to the equatorial crossover frequency. We consider that they are the L-mode emissions generated by nonlinear growth and suffered the mode change through the propagation process. According to the nonlinear growth theory, a rising-tone emission is initially generated with a continuous frequency waves in the generation region, normally equatorial plane. This belongs to two different branchs in dispersion relation of EMIC wave with a boundary at the crossover frequency around half of the gyrofrequency at the source region. These two branchs propagate from the source region through different processes, and it is expected that the branch with upper frequencies can propagate over a relatively high latitude than the lower branch. This result is important as these emissions generated in the equator as L-mode waves.

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PEM30-08 Room:105 Time:May 20 11:00-11:15

Comparison study of particle acceleration in the Earth's magnetotail and solar corona

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One of the most famous rapid energy conversion mechanisms in space is a magnetic reconnection. The general concept of a magnetic reconnection is that the rapid energy conversion from magnetic field energy to thermal energy, kinetic energy or non-thermal particle energy. The understanding of rapid energy conversion rates from magnetic field energy to other energy is the fundamental and essential problem in the space physics. One of the important goals for studying magnetic reconnection is to answer what plasma condition/parameter controls the energy conversion rates. Earth's magnetotail has been paid much attention to discuss a magnetic reconnection, because we can discuss magnetic reconnection characteristics in detail with direct in-situ observation. Recently, solar atmosphere has been focused as a space laboratory for magnetic reconnection because of its variety in plasma condition. So far considerable effort has been devoted toward understanding the energy conversion rates of magnetic reconnection, and various typical features associated with magnetic reconnection have been observed in the Earth's magnetotail and the solar corona.

In this talk, we first introduce the variety of plasma condition/parameter in solar corona and Earth's magnetotail. Later, we discuss what plasma condition/parameter controls the energy conversion from magnetic field to especially non-thermal particle. To compare non-thermal electron and ion acceleration in magnetic reconnection, we used Hard X-ray (electron) /Neutron monitor (ion) for solar corona and Geotail in-situ measurement (electron and ion) for magnetoatil. We found both of electron and ion accelerations are roughly controlled by reconnection electric field (reconnection rate). However, some detail point is different in ion and electron acceleration. Further, we will discuss what is the major difference between solar corona and Earth's magnetotail for particle acceleration.

Keywords: flare, substorm, particle acceleration, comparison study

PEM30-09 Room:105 Time:May 20 11:15-11:30

Coupling between the ULF waves and the ring current in the inner magnetosphere based on the GEMSIS-RC model

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Understanding of acceleration mechanisms of electrons to cause drastic variation of the Earth's outer radiation belt is one of outstanding issues of the geospace researches. While the radial diffusion of the electrons driven by ULF waves has been considered as one of the candidate mechanisms, efficiency of the mechanism under realistic ULF characteristics and distribution is far from understood. GEMSIS (Geospace Environment Modeling System for Integrated Studies) of STEL, Nagoya University, is the observation-based modeling project for understanding energy and mass transportation from the Sun to the Earth in the geospace environment. Aiming at understanding the dynamics of the inner magnetosphere during the geospace storms, the GEMSIS-Magnetosphere working team has developed a new physics-based model for the global dynamics of the ring current (GEMSIS-RC model). The GEMSIS-RC model is a self-consistent and kinetic numerical simulation code solving the five-dimensional collisionless drift-kinetic equation for the ring-current ions in the inner-magnetosphere coupled with Maxwell equations.

We applied the GEMSIS-RC model for simulation of global distribution of ULF waves to test its capability of describing fast time scale phenomena like SCs and ULF waves. Comparison between runs with/without ring current ions show that the existence of hot ring current ions can deform and amplify the original sinusoidal waveforms. The deformation causes the energy cascade to higher frequency range (Pc4 and Pc3 ranges). The cascade is more pronounced in the high beta case. It is also shown that the existence of plasmapause strengthens ULFs outside the plasmapause and widens the MLT region where the E_r (toroidal) component is excited from initially-given E_{phi} (poloidal) component. We report how the amplification and reflection of the ULF waves depend on the ring current parameters such as its density and temperature.

Keywords: inner magnetosphere, ring current, radiation belt, ULF wave, Pc5, drift resonance

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PEM30-10 Room:105 Time:May 20 11:30-11:45

Study on current generation mechanism in Earth's magnetosphere

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A study on perpendicular and parallel current generation mechanism in the magnetosphere is important problems in interaction between the solar wind and earth's magnetosphere-ionosphere. As the solar wind and IMF becomes abnormal conditions, plasma turbulence are strongly excited near boundary layers in the magnetosphere. In the plasma sheet magnetic reconnection occurs in patchy and intermittent manner to produce streamer-like structure. At the magnetopause, more regular vortex train is formed for northward IMF.

Dayside reconnection occurs in patchy and intermittent manner to give seeds of plasma turbulence. As the results, complicated and strong vortex turbulence appears in flank magnetopause. We will demonstrate those phenomena from 3-dimensional visualization method of simulation results to iscuss relationship between the currents and vortices in boundary layers. In particularly we will stress relationship among parallel and perpendicular components of vorticity and current, and also compressibility in order to understand the fundamental picture of magnetospheric physics.

Keywords: MHD Simulation, current generation mechanism, Vorticity and compressibility, Magnetic Reconnection, Magnetospheric Dynamics, Boundary Layer Instabilities

PEM30-11 Room:105 Time:May 20 11:45-12:00

THEMIS observations of plasma transport induced by eddy turbulence

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We provide an event study of THEMIS observations of the low-latitude boundary layer in the noon-dawn sector of the magnetosphere on 2008-12-05. Simultaneous multipoint observations show that the magnetosheath-like plasma is transferred earthward from the magnetopause. This earthward transport is accompanied by decrease in the density and fluctuating bulk flow, indicating that the transport is not due to convection. We calculate the eddy diffusion coefficients from the observed velocity data and found that the numbers are in good quantitative agreement with the spatial and time scales of the observed earthward transport signatures. Our study suggests that the observed transport is due to diffusive transport via turbulent eddy motions as is the case of an ordinary (Navier-Stokes) fluid.

Keywords: plasma transport, diffusion, turbulence, THEMIS

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PEM30-12 Room:105 Time:May 20 12:00-12:15

Statistical Study on Jovian Magnetospheric Response to Solar Wind Dynamic Pressure

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Structures and dynamics of planetary magnetospheres depend on magnitude of their planetary magnetic field, inner plasma source, and plasma wind from stars, and hence magnetospheres show a wide variety. Past observations have revealed the typical structures/dynamics of the Jovian magnetosphere, which represents distinctive plasma environments compared to the Earth's magnetosphere. However, the magnetospheric response to the variable solar wind is still unclear, due to the absence of the solar wind monitor at the Jovian orbit. I approach this issue by using the calculated solar wind parameters via MHD equations whose input parameters are based on the observation at the Earth's orbit.Referring the propagated solar wind parameters, I investigate the variability of the Jovian magnetotail. Through statistical analyses using data obtained from Jovian orbiter Galileo, I find the tendency that the structure of nightside current sheet changes, magnetic field north-south component is disturbed, and the energetic particle fluxes enhance, responding to the increase of the solar wind dynamic pressure. On the other hand, energetic particle beams were often observed even when solar wind dynamic pressure is low. Furthermore, when energetic particle beams are absent, north-south magnetic field disturbances and energetic particle enhancements were not significant. Assuming that such beams are generated by transient magnetic reconnection in Jovian magnetotail, I argue that (1) Jovian tail reconnection can occur without solar wind dynamic pressure increase, whereas (2) tail reconnection is not a sufficient but a necessary condition for large north-south magnetic field disturbance and energetic particle enhancement at the location of Galileo.

PEM30-P01 Room:Convention Hall Time:May 20 18:15-19:30

Low-frequency waves in the near-Earth magnetotail before substorm dipolarization onsets

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Dipolarization which occurs in the near-Earth magnetotail is an important process for understanding the substorm triggering mechanism. In the present study we have investigated low-frequency waves that were observed at X~-10 Re before substorm dipolarization onsets. First, we analyzed Geotail data for 43 substorm events. We find that there are small-amplitude Alfven and slow-mode magnetosonic waves with a period of 1-2 min from at least 10 min before dipolarization onset. These waves substantially grow after onset. The amplitude of the waves before onset is relatively large in the off-equator plasma sheet and the plasma sheet boundary layer, while it is smaller at the equator and in the lobe. We also analyzed multi-point observations from THEMIS. Based on these results, we discuss the relationship between the low-frequency waves, dipolarization, and substorm expansion onset.

Keywords: substorm, magnetotail, dipolarization, low-frequency waves

PEM30-P02 Room:Convention Hall Time:May 20 18:15-19:30

Statistical properties of Pc5 waves in the mid-latitude ionosphere observed by the SuperDARN Hokkaido HF radar

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The Pc5 wave, which is one of ULF waves, is defined as the continuous pulsation in the frequency range between 1/600 and 1/150 Hz. It has been considered that the magnetospheric Pc5 waves are globally and directly generated either by solar wind dynamic pressure variations on the dayside or by Kelvin-Helmholtz surface waves on the dawn/dusk flank, and partially and indirectly on the nightside by wave-particle interactions. Pc5 waves can play an important role in the mass and energy transport in the inner magnetosphere. The radiation belt electrons in the inner magnetosphere can be significantly accelerated by the Pc5 waves, as suggested by previous studies. One of outstanding problems in Pc5 studies is to clarify its global distribution, generation mechanisms, and especially their dependence on the solar wind parameters.

We conducted a statistical analysis of data from the SuperDARN Hokkaido HF radar in mid-latitude ionosphere. The beams 5 and 14 data of the HF radar and the OMNI solar wind data for the period from January, 2007 to December, 2012 are used. We identified Pc5 wave events through an automatic Pc5 selection with criteria to extract coherent variation over a certain range of the magnetic latitude and by the visual inspection after the automatic selection. Out of the 60 events identified, and we examined 55 events during which the OMNI data are available. As a result, the Pc5 waves in the mid-latitude ionosphere are roughly categorized into two types, i.e., events under low-speed solar wind and high-speed solar wind conditions. The amplitude of the high-speed solar wind Pc5 events tends to increase with increasing solar wind velocity. This result is consistent with the idea that they are driven by the Kelvin-Helmholtz instability at the magnetopause. On the other hand, the amplitude of the low-speed solar wind Pc5 events has a positive correlation with the variances of the solar wind dynamic pressure. It is thus implied that the Pc5 events under the low-speed condition in the low-latitude are directly driven by the solar wind dynamic pressure variations.

Keywords: inner magnetosphere, ULF wave, SuperDARN Hokkaido HF radar, Pc5 wave

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PEM30-P03 Room:Convention Hall Time:May 20 18:15-19:30

Calibration of the KAGUYA/WFC data for AKR polarization analysis

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[1]Kanazawa University

The KAGUYA spacecraft frequently observed auroral kilometric radiations (AKR) which were originated from the Earth's auroral region. It is well-known that the AKR is dominated by right-handed (R-X) mode wave with small contribution of left-handed (L-O) one. Observation probability for magnetic local time and latitude, intensity, frequency range depend on the polarizations. The KAGUYA mission gave a good opportunity to make a stochastic analysis of such dependences from lunar orbits.

The WFC was a plasma wave receiver onboard the KAGUYA spacecraft. The frequency sweep receiver WFC-H, which was a subsystem of the WFC, continuously observed power spectrum and polarizations of waves in a frequency range from 1 kHz to 1 MHz during the whole mission period. However, there is a serious problem in the obtained polarization data. Because of differences of onboard-processing timings between two orthogonal antennas X and Y, the polarization data cannot be used at all. In the present study, we develop a calibration method on these data to derive exact AKR polarizations.

The processing time lag between X-Ych was caused by asynchronous operation of two onboard ICs called PDCs (programmable down converters) which were assigned to X-Ych signals, respectively. The role of the PDCs is to divide the frequency range from 1 kHz to 1 MHz into 26 narrow bands.

In order to estimate the time (phase) differences between X-Ych signals in these bands, we used overlapped-frequency range data in the adjacent two bands. We statistically calculated differences of the "XY phase difference" in the adjacent two bands. As a result, the differences had linear property for frequency, which means that the time lags between X-Ych are constant in all the 26 narrow bands. The delay time of Ych signal to Xch one is 1.1 microseconds. We also estimated time delays of three low pass filters in the PDC in each narrow band. According to these results, all the WFC-H polarization data can be calibrated.

Before calibration, the polarization depends on only the frequency. This result seems strange because the AKR polarization is stable for frequency in principle. After calibration, on the other hand, the polarization depends only on time and exhibits a 2-hour periodicity. This result is reasonable because the arrival direction of the AKR varies depending on the satellite attitude. Using the calibrated data, we obtained the AKR polarizations for ambient magnetic field. It is possible to study the AKR polarizations propagating from the northern and southern hemispheres independently using the occultation of the Moon.

Keywords: KAGUYA, AKR, calibration

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PEM30-P04 Room:Convention Hall Time:May 20 18:15-19:30

Poloidal component of Pi2 in the meridian planes

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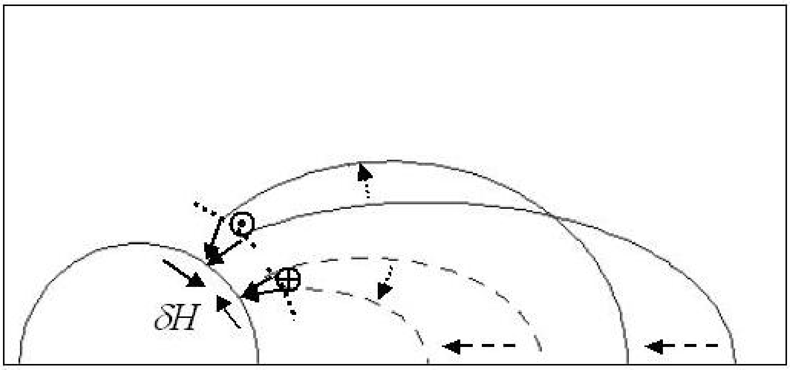
It is well known that Pi2s demonstrate the reversal of the H amplitudes and polarization in H-D plane in auroral zone. Recently, it is shown that these characteristic Pi2 properties are attributed to the poloidal component (*). We emphasize:

(1) The poloidal component related to the H amplitude reversal on the ground was excited by the diamagnetic currents in the magnetosphere flowing eastward.
(2) The onset latitudes of the poleward expansion inferred from auroral observations and diamagnetic currents in the magnetosphere are correlated.

References
* Saka, Hayashi, Koga, (JGR, 2012).

Keywords: Pi2 pulsation, aurora breakup, substorm, poloidal component



Deformation of field lines in the meridian planes

Japan Geoscience Union Meeting 2013
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PEM30-P05 Room:Convention Hall Time:May 20 18:15-19:30

Multi-scale temporal variations of pulsating auroras: on-off pulsation and a few-Hz modulation

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Pulsating aurora (PA) is characterized by the periodically changing emission amplitudes with on-off pulsations of less than 1 s to a few tens of seconds. PA is also well-known as its patchy structure with the horizontal size of 10-200 km. The energy of precipitating electrons ranges from one to a few tens of keV, which is thought to result from pitch angle scattering due to wave-particle interactions near the magnetic equator. Recently, Nishimura et al. [2010] found a one-to-one correspondence between the intensities of PA and amplitudes of whistler mode chorus near the equator. Similarly, electron cyclotron harmonics (ECH) were observed with on-phase of PA. ULF wave is expected to control the excitation of both the whistler mode chorus and ECH by the modulation of the local plasma density. However, an important problem, identifying which mechanism is the most dominant, remains unsolved. In addition, since PA has the distinctive properties in a variety of spatial and temporal scales, we should investigate such multi-scale properties statistically to further understandings of the generation mechanism of PA. The purpose in this study is to reveal the precise spatial-temporal properties and to establish a generation mechanism of PA using ground-based instruments. We developed an EMCCD camera with a wide field-of-view (FOV) and 100-Hz sampling, which is optimized to spatio-temporal properties such as the small-scale structures ($<$ 10-30 km) and rapid temporal variations (3-Hz modulations) in a 2-D plane.

The statistical study on the cross-scale properties was presented based on 53 events observed at Poker Flat Research Range during the period from December 1st, 2011 to March 1st, 2012. The observed modulation frequency ranged from 1.5 to 3.3 Hz. Any strong modulations were not seen in frequency range higher than about 3 Hz in our study, which may suggest that the TOF of electron makes the time-smoothing effect on the rapid variations higher than 3 Hz. Furthermore, the frequency of modulation showed relatively strong correlation to auroral intensity with the correlation coefficient of 0.52, and it can be explained with non linear wave growth theory suggesting that higher modulation frequency with larger wave amplitude of whistler mode chorus. In contrast, the on-off pulsations showed no significant correlations with any of other properties of PA. This result implies that the on-off periods may be determined by the balance of a variety of factor, such as a spatial size on the flux tube, a drift velocity of an energetic electron. Alternatively, long-term variations of the cold plasma density would control the condition for wave-particle interactions in the temporal scale of the on-off pulsation periods.

Keywords: Aurora, Inner magnetosphere, Wave-particle interactions, Ground-based observations, ULF waves

Japan Geoscience Union Meeting 2013
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PEM30-P06 Room:Convention Hall Time:May 20 18:15-19:30

Simulation on the IMF Bz control of the chorus wave excitation during the high-speed coronal hole streams

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Electron flux of the outer belt tends to increase when the high-speed solar wind interacts with the magnetosphere. The flux enhancement depends not only on the solar wind speed but also on the offset in the north-south component of the interplanetary magnetic field, i.e. the southward offset causes larger flux enhancement than the northward offset, although large-amplitude Alfvenic fluctuations always exist in the high-speed solar wind. If the acceleration process of the outer-belt electrons via the whistler-wave particle interaction is dominant, the populations of hot electrons, plasmasphere, and whistler waves enhance all together during the SBz stream, while they weakens all together during the NBz stream. We have observationally shown the north-south IMF dependence. In this study, we use the relativistic-RAM electron model to confirm the north-south IMF dependences of the key parameters. The data measured by LANL/MPA is used as a boundary condition at L=6.6. As a result, in the SBz stream, there are enhancements of hot electrons of ~30 keV and lower-band whistler mode waves around L=4 at dawn-side, while they are at $L>5$ in the NBz stream. It is found that, in our simulations, these differences are primarily originated from the magnetospheric convection. We further discuss an assessment of non-linear whistler wave growth based on the threshold of the non-linear growth and the optimum wave amplitude [Omura and Nunn, 2011]. The regions for the non-linear growth are different from that for the intense linear growth. The assessment of non-linear whistler wave growth is useful to identify when and where we can observe chorus waves.

Keywords: inner magnetosphere, whistler chorus, simulation, solar wind - magnetosphere coupling

PEM30-P07 Room:Convention Hall Time:May 20 18:15-19:30

Use of magnetic field measurements as an indicator of spacecraft locations

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It is known that the configuration of the magnetosphere is more complicated than that of the intrinsic magnetic field only due to highly dynamical and time-dependent magnetospheric currents. There are empirical magnetospheric models derived from statistical analysis of large data sets. However, the models give us average states, which often results in deviation from instantaneous magnetospheric configurations. It is important to construct a technique to show where spacecraft is located in the magnetosphere, especially, how far from the magnetic equator spacecraft is when we interpret the observational results since the distance from the equator is a significant controlling factor for evolution of plasma temperature anisotropy and plasma wave intensities. In this study, using the data obtained by the THEMIS spacecraft, we show a simple method to estimate spacecraft location relative to the magnetic equator using local magnetic field measurements. The method uses the ratio of Br to |B|, where Br and |B| is the radial component of the magnetic field vector and total magnetic field intensity, respectively. When we choose a simple dipole magnetic field as a reference, we can analytically estimate the magnetic latitude from the measured ratio Br/|B|. Since rising tone chorus emissions are generated in the region close to the magnetic equator and propagate higher latitudes in both the Northern and Southern hemispheres, the method was tested by deriving the latitudinal distribution of propagation direction of rising tone chorus emissions measured by THEMIS. We analyzed 246 rising tone chorus events and statistically derived the latitudinal distribution referring to both the dipole magnetic latitude and the magnetic latitude estimated by Br/|B|. The latitudinal distributions based on the dipole magnetic latitude and estimated magnetic latitude show that 77 % (190 events) and 98 % (241 events) of the events are observed to propagate from the equator to higher latitudes, respectively. It indicates that the magnetic latitude based on the magnetic field measurements is more reliable than the dipole magnetic latitude to show the spacecraft location relative to the magnetic equator. We will test and discuss the performance of our method by comparing the latitudinal distribution of propagation direction of chorus emissions based on the estimated magnetic latitude with that based on the empirical magnetospheric models. We will also discuss capabilities of the method and applications to magnetospheric studies, especially plasma wave phenomena.

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PEM30-P08 Room:Convention Hall Time:May 20 18:15-19:30

Long-Term variations of Saturn's Auroral Radio Emissions by the Solar Ultraviolet Flux and Solar Wind

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The long-term variations of Saturn's auroral current system have been suggested to be controlled by the seasonal variations of the polar ionospheric conductivities and atmospheric conditions associated with the solar ultraviolet (UV) flux. However, that long-term variations are not investigated in terms of the other controlling factors such as the solar wind variations in the timescale of the solar cycle. This study investigated the long-term variations of Saturnian Kilometric Radiations (SKR) as a proxy of the auroral current, which were observed by Cassini's radio and plasma wave experiment mostly during the southern summer (DOY 001, 2004 to DOY 193, 2010). We deduced the height distribution of the SKR source region in the northern (winter) and southern (summer) hemispheres from the remote sensing of SKR spectra. It was found that on average the southern (summer) SKR was 7 dB grater than the north (winter) in the spectral density, and the altitude of the southern flux peak (0.7 Rs) was lower than the north (0.9 Rs). The southern and northern spectral densities became comparable with each other around the equinox in August, 2009. These results suggest the stronger field aligned acceleration during the summer than the winter by the seasonal UV effect as opposed to the terrestrial one. The long-term correlation analysis was performed for the SKR and solar wind parameters extrapolated from Earth's orbit by the MHD simulation focusing on variations at timescales beyond several weeks. We found the clear positive correlations between the solar wind parameters and peak flux density in both of the southern and northern hemispheres during the declining phase of the solar activities. It is concluded that the solar wind variations in the timescale of the solar cycle controls the SKR source region in addition to the seasonal solar UV effect. The variation of SKR activity over both seasonal and solar cycles are discussed comparatively to the terrestrial case.

Keywords: Saturn, aurora, radio, magnetosphere, solar activity

Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

PEM30-P09 Room:Convention Hall Time:May 20 18:15-19:30

Importance of correctly removing the underground-conductivity effect in the gradient methods

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There are methods called the hodograph method and the amplitude-phase gradient method (APGM below) that are used to obtain the latitude dependence of the field-line-resonance (FLR) frequency by using data from two ground magnetometers latitudinally separated by ~100km. They both apply FFT to the two magnetometers' data, and calculate the amplitude ratio and the cross phase between the two stations' data as functions of the frequency. From there the two methods use different ways to estimate the latitude dependence of the FLR frequency; the hodograph method fits a circle to the obtained ratio (as a complex number including both the amplitude ratio and the cross phase) to separate out the non-FLR signal in the data, while APGM assume that the obtained amplitude ratio and phase difference include no non-FLR signal and obtains the FLR frequency (as a function of latitude) in an algebraic manner. In this paper we discuss the differences between the two methods by using example events, and show that the both methods need precise enough removal of the effects of the underground conductivity, superposed on the signal from space, in the magnetic field data before applying the method. More details will be presented at the meeting.

PEM30-P10 Room:Convention Hall Time:May 20 18:15-19:30

Characteristics of energy conversion and electron acceleration around the fast plasma flows in near-Earth magnetotail

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Fast earthward flows accompanied by large B_Z enhancement, are sometimes observed in the near-Earth magnetotail. Such B_Z enhancements are called "dipolarization front". In some cases, earthward flows are instantly followed by the tailward flows. We call such events as "flow reversal", where the earthward flow seems to reverse to the tailward flow. However, the energy conversion and electron acceleration mechanisms during the flow are not fully understood. In this study, the two types of events were analyzed using THEMIS spacecraft data from Dec., 2008 through Mar., 2009. The number of events is 25 for dipolarization front events [1] and 16 for flow reversal events. Based on the results of j dot E and electron distribution function, we discuss energy conversion and electron acceleration mechanisms during the dipolarization front events or flow reversal events.

[1] A.Runov, V.Angelopoulos, X.-Z.Zhou, X.J.Zhang, S.Li, F.Plaschke and J.Bonnell, A THEMIS multiscale study of dipolarization fronts in the magnetotail plasma sheet, J. Geophys. Res., 116, A05216, 2011.

Keywords: energy conversion, fast plasma flow, electron distribution function