PEM37-P01 Room:Poster Time:April 30 18:15-19:30

Auroral vortex, auroral surge, and vortical current in the ionosphere associated with the Pi2 pulsations

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The auroral breakup event occurred at 0500UT 27 January 1986 in central Canada is studied using all-sky video image from two optical stations (GWR and SHM) and magnetometer data from three ground stations including the optical stations.

The spatiotemporal motion of the ionospheric vortical current explained the ground magnetometer data in the auroral zone. During the activation of the current vortex, auroras composed of the shear layers rotating clockwise and the auroral surge propagating westward were observed.

It is found that the auroral surge first appeared at the onset latitudes propagated poleward passing through the auroral vortex and became the poleward boundary aurora-surge (PBAS)(1).

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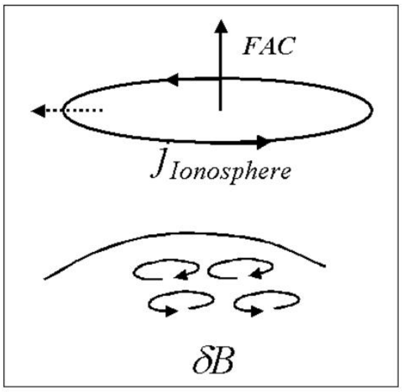
Keywords: Aurora dynamics, Pi2 pulsation, Ionospheric current vortex



PEM37-P02 Room:Poster Time:April 30 18:15-19:30

Generation mechanism of steady-state field-aligned currents: A general theory in terms of plasma convection

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It is well known that field-aligned currents (FACs) play an important role in that they transfer electromagnetic energy and momentum from the magnetosphere to the ionosphere. Recent global magnetohydrodynamic (MHD) simulations indicate that in almost all cases the pressure gradient force is the major driver of FACs [Tanaka, 2003, 2007]. The inertia force becomes appreciable only in very special cases such as the preliminary impulse (PI) in sudden commencements (SCs) [Fujita et al., 2003]. Thus the pressure gradient mechanism is working universally and represents the essence of the dynamical nature of the magnetosphere. What is less or not at all understood, however, is the role of plasma convection in FAC generation. One misconception is that plasma convection is irrelevant to pressure gradient-driven FACs. In fact, convection plays a vital role in energy conversion. This paper describes a general theory of steady-state FACs, with an emphasis on the importance of plasma convection. FACs are created and maintained through the following two processes that occur spatially contiguously with each other. (1) A "dynamo" process in which plasma thermal energy is converted to electromagnetic energy. A magnetospheric dynamo is necessary in order to sustain a steady-state FAC system. This dynamo is generated by expanding plasma flow (div($\mathbf{v}$) $>$0) that is characterized by the slow mode in MHD waves. The wave normal is directed to the $-$ grad(B) direction, and the flow speed in the wave normal direction (the "normal" component) becomes the phase speed of the slow mode wave. Slow mode disturbances do not associate FACs. (2) A process in which field-perpendicular currents transform into field-aligned currents. This process occurs by a mode conversion of the waves from slow to Alfvenic. If the pressure gradient has a component perpendicular to both the wave normal and the magnetic field (the "tangential" component), it produces a magnetic tension and consequently excites Alfven mode disturbances. The flow speed in the wave normal direction becomes the phase speed of the Alfven mode wave. The Alfven mode is associated with tangential plasma flow, and consequently the plasma motion becomes rotational.

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Keywords: field-aligned current, dynamo, convection

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PEM37-P03 Room:Poster Time:April 30 18:15-19:30

Multi-spacecraft analysis of tailward plasma flows in the near-Earth plasma sheet : THEMIS observations

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In the near-Earth's plasma sheet, the magnetic field is abruptly dipolarized, associated with an aurora activity. In this region, most of plasma flows are earthward, while some are tailward. Although the candidate mechanism for such tailward flow is considered as rebound flows and/or a part of vortex flows, the quantitative occurrence rate is not fully understood. In this work, we selected events that THEMIS spacecraft observed tailward flows near the magnetic dipolarization region, and then categorized in flow patterns before the tailward flows. Based on the results, we statistically analyzed the categolized events, and estimated the space structure of tailward flows by multi-spacecraft analysis. Consequently, we show the occurrence rate of such rebound flows and the vortex flows.

Keywords: Dipolarization, Tailward flow

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PEM37-P04 Room:Poster Time:April 30 18:15-19:30

Simultaneous observation of a field-aligned current by the JAXA QZS satellite and a MAGDAS ground observatory

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In this paper we conduct a QZS-MAGDAS conjunction study of a field-aligned current (FAC). QZS (Quasi-Zenith Satellite) is operated by JAXA, and MAGDAS is the ground magnetometer network mainly operated by ICSWSE (International Center for Space Weather Science and Education), Kyushu Univ.

There have been only limited number of papers on satellite-ground conjunction studies of FACs, because satellites usually passes overhead at a ground observatory in a short time.
On the other hand, the footpoint of QZS stays near one ground point in Siberia, Russia, because the orbit of QZS is close to that of geosynchronous satellites on the Japanese meridian. Moreover, a few Siberian MAGDAS observatories exist near the QZS footpoint.

Another advantage of QZS is that, unlike geosynchronous satellites, QZS has 41deg inclination and 0.1deg eccentricity which enable QZS to stay for a long time at northern high latitudes in the magnetosphere; this high-latitude feature increases the detectability of FACs, because the FAC magnitude is in general smaller near the equator, i.e., the FAC source region in the magnetosphere. Thus, the pair of QZS and Siberian MAGDAS is expected to have more chances of simultaneously observing the same FAC than past satellite-ground pairs.

We have been searching for events in which, when QZS and a Siberian MAGDAS observatory were located near the same field line (calculated by the Tsyganenko 96 model), QZS and MAGDAS simultaneously observed transient magnetic field perturbations.

In this paper we present such an event observed by QZS and a Siberian MAGDAS observatory CHD (Chokurdakh). We have found that the transient magnetic perturbations of this event can be interpreted to have been generated by the motion of a local current circuit consisting of line FACs and an ionospheric current. More details will be presented at the meeting.

PEM37-P05 Room:Poster Time:April 30 18:15-19:30

Comparison between particle environment around GEO from global MHD simulation and that from LANL satellite

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Substorm injection is one of the important element of magnetospheric substorm, like auroral break up. Studying substorm injection is important to understand the physics of substorms. Also, substorm injection temporaly changes the particle environment around satellites at GEO. And dynamical variations of particle environment around GEO is one of the causes of satellite anomaly due to surface charging. We try to evaluate our magnetospheric global MHD simulation code by comparing output from global MHD code and LANL satellite particle data. Previous work has be done by Nakamura [2009]. We will examine the possibility of substorm injection prediction using global MHD simulation. Detailed comparison between simulation and observation will be shown in our presentation.

Keywords: Space Weather Forecast, Magnetosphere, Substorm, Modeling, Global MHD simulation, Geosynchronous orbit

PEM37-P06 Room:Poster Time:April 30 18:15-19:30

Energy dispersion and trajectory of particles injected from the magnetotail in magnetospheric quiet conditions

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Particle injection is sudden enhancement in flux of energetic charged particles, commonly observed at geosynchronous orbit (6.6R$_E$), and associated with magnetospheric substorms. Since 2007, dispersive particle injections have been observed in the further dawnside of the magnetosphere (>10R$_E$) than geosynchronous orbit in quiet conditions with the spacecraft Geotail and THEMIS. Although only electron injections are observed in most cases, both electron and ion injections are observed in some cases. The injected population displays energy dispersion in which more energetic particles arrive at a given location earlier than less energetic particles. This dispersion occurs because of energy dependence of particle drift in the magnetospheric magnetic field. In order to investigate the time delay, we have calculated electron trajectories in the inner magnetosphere. We assume that the magnetospheric magnetic field is a simple dipole and the magnetospheric electric field is sum of a convection electric field and a corotation electric field, and obtain the particle trajectories in the equatorial plane using particle drift velocity. We find that the time delay is related to the intensity of the convection electric field. The simulations and observations show that electrons drift from the nightside through the dawnside to the dayside while ions drift from the nightside through the duskside to dayside. However, in the range given by the dipole field, it is not possible to explain the energy dispersion as observed. The shape of the magnetic field is different from the magnetic dipole in the magnetic tail region because the magnetosphere is stretched by the solar wind. In order to provide a more realistic magnetic field model in the magnetosphere, we use the Tsyganenko model that is an empirical magnetic field model of the magnetosphere. In this study, multi-satellite observations and test particle simulations are carried out to explore mechanisms in energization and transport of electrons in the quiet magnetosphere.

Keywords: magnetosphere, perticle injection, energy dispersive, Tsyganenko, quiet condition, trajectory

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PEM37-P07 Room:Poster Time:April 30 18:15-19:30

Time development of the Dipolarization Front and its interactions with the dipole-field region obtained by 2-1/2 dimensi

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Bursty bulk flows with increasing B_z (northward component of the magnetic field), which are caused by magnetic reconnections in the magnetotail, are called Dipolarization Front (DF). Under the picture of the Near Earth Neutral Line model, which is one of the models explaining the triggering of substorms, the compression of the dipole region by DF and the pileup of DF itself around the near-Earth plasma sheet boundary cause a wide increase of B_z in the night magnetosphere. Although there are many observational studies of DFs by spacecraft, there are no full-particle simulations that examine the case in which the DF approaches to the dipole region.

In this context, we have performed two-dimensional full-particle simulations for the initial magnetic configuration which is akin to Earth's dipole magnetic field together with a stretched magnetic field by the thin current sheet. We have generated the magnetic reconnection and earthward plasma flows accompanied by B_z, and examined the time development of the flows and the interactions with Earth's dipole-field.

In our simulations, a minimal region of the northward magnetic field where B_z does not increase have been formed between the dipole region and flux pileup region, different from the common picture of Dipolarization. The reason of this can be considered as follows; (1) the earthward flows transport and accumulate the plasmas of the current sheet around the near-Earth plasma sheet boundary, (2) the pressure of the accumulated plasmas decelerate the flow, (3) B_z piles up in the tailward of the boundary. This result is different from the common effect of the DF that it broadly increases B_z in the night side of the magnetosphere. Because of the two-dimensionality in our simulations, the accumulated plasmas cannot leave in the Y-direction (eastward), producing such characteristic region. We also discuss on the structure of the particle flow velocity and particle density distributions near the DF by comparing with observational results.

Keywords: Substorm, Dipolarization Front, Dipolarization

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3D Full kinetic simulations of plasma flow interaction with meso- and micro-scale magnetic dipoles

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Plasma flow response to a magnetic dipole and the resulting formation of a magnetosphere depends on the intensity of the magnetic moment of the dipole. In this study, we examined plasma flow interactions with a magnetic dipole which is much smaller than the Earth's intrinsic magnetic dipole by performing three-dimensional full Particle-In-Cell simulations. The size of a magnetic dipole immersed in a plasma flow is characterized by distance L from its center at which the equilibrium is satisfied between the pressure of the magnetic field of the dipole and that of the plasma flow. In the Earth's magnetosphere, L implies the magnetopause location. We particularly focused on meso- and micro-scale magnetic dipoles in which L is comparable to and smaller than the gyroradius of ions in the flow. In the meso-scale case, ions kinetics should be dominantly considered while electrons whose gyroradius is sufficiently small can be treated as fluid. In the micro-scale, however, electrons as well as ions should be treated particles because L becomes small and the electron kinetics cannot be ignored either. Our interest is in the formation of current layer at the magnetosphere boundary in the both scales. Corresponding to the formation of a magnetosphere, the boundary current also depends on the size of the magnetosphere.

In the meso-scale case, the boundary current is dominated by the electron diamagnetic current at the large density gradient found at the distance of L. This signature is similar to the case of the Earth's magnetosphere. In the micro-scale case, however, the trajectories of ions and electrons gyration play an important role to determine the boundary current. Since the ion's gyroradius is larger than L, charge separation between ions and electrons occurs in the upstream region. As particles approach to the inner dipole, the electron gyroradius becomes small and electron drift motion becomes dominant. It is also confirmed that static electric field caused by the charge separation affect the plasma dynamics and the resulting current flow.

Keywords: Magnetic dipole, Meso-scale, Plasma response, Boundary current layer, Plasma particle simulation

PEM37-P09 Room:Poster Time:April 30 18:15-19:30

Estimation of the plasma sheet thickness in the Mercury's magnetosphere from the MESSENGER observations: IMF dependence

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Only two of spacecraft arrived at the Mercury until now: NASA's MESSENGER which went into orbit around Mercury in 2011 and Mariner 10 which investigated Mercury for two years from 1974. Although the Mercury's magnetosphere was first found by the Mariner 10, the magnetosphere has not been quantitatively understood. With the observations of magnetic field, we deduced the thickness of the plasma sheet and examined its dependence on the IMF (Interplanetary Magnetic Field) As a result, the plasma sheet thickness is estimated as 0.12-0.19 R_M during the northward IMF, and 0.02-0.08 R_M during the southward IMF. Bi-polar magnetic field signatures, which can be associated with the plasma flow in the plasma sheet, are observed both during northward and southward IMF. We then discuss the substorm-related phenomena in the Mercury's plasma sheet.

Keywords: MESSENGER, Mercury's Magnetsphere, plasma sheet, plasma flow, substorm