

finish. The event occurred on November 24, 2001 during a very disturbed storm interval. The giant undulations began to develop at around 13UT and persisted for approximately 2 hours. The sunward propagation speed was on the order of 0.6 km/s. In addition to the IMAGE/FUV observations (WIC, SI-12, and SI-13 passbands), numerous other datasets will be presented including ground magnetometer data which show that the undulations were associated with Pc5 type magnetic pulsations. Geosynchronous particle data and other IMAGE datasets will also be presented. Possible generation mechanisms for the giant undulations will be discussed.

SM62A MCC: Hall D Saturday 1330h

Discontinuous Cusp and Magnetospheric Boundary Layers I Posters

Presiding: M J Engebretson, Augsburg College; Q Zong, Boston University

SM62A-0482 1330h POSTER

Solar Wind Control of the Cusp Aurora for Northward IMF

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The Imager for Magnetopause-to-Aurora Global Explorations (IMAGE) Far Ultraviolet Instrument (FUV) images the auroral oval in doppler-shifted Lyman-alpha. On the dayside, a bright spot poleward of the auroral oval can be seen occasionally. This ionospheric spot can be interpreted as the location of the cusp created by intense proton precipitation through reconnection of magnetospheric lobe field lines for northward interplanetary magnetic field (IMF) conditions. In order to deduce the orientation of the IMF with regards to the Earth's magnetic field during such a reconnection process, event conditions were selected between the end of May 2000 to mid-December 2001 during which the IMF was northward, steady, and had an higher than average density and velocity. Of these 344 events, 56 showed a bright spot. The occurrence frequency of a spot appears to be higher for small values of Bx/Bz. For the 56 cases with a bright spot, the spot location was compared with the predicted location of anti-parallel regions using the 1996 Tsyanenko model. The majority of the anti-parallel reconnection sites tailward of the cusp when mapped to the ionosphere coincide with the observed spot. For many of the cases, the solar wind parameters were outside of the Tsyanenko model. This may account for some of the discrepancy between the model and observations. The agreement between the model and observations for the majority of the cases is consistent with the hypothesis that reconnection occurs at anti-parallel regions for northward IMF.

SM62A-0483 1330h POSTER

Evidence for closed structures at the magnetopause: the case for multiple reconnections.

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We analyze two LBL crossings made by Interball Tail satellite under southward magnetosheath magnetic field. Observed ion velocity distributions within LBL include: (a) D-shaped distributions, (b) ion velocity distributions consisting of two counter-streaming components of magnetosheath-type, and (c) distributions with three components one of which has nearly zero parallel velocity and two counter-streaming components. We interpret these distributions as a natural consequence of the formation of spiral magnetic flux tubes consisting of a mixture of alternating segments originating from the magnetosheath and from magnetospheric plasma. The shapes of ion and electron velocity distributions and their evolution with decreasing number density in LBL indicate that a significant part of LBL is located on magnetic field lines of long spiral flux tube islands at the magnetopause, as has been proposed and found to occur in magnetopause simulations. Anomalous magnetosheath-like plasma flow with Bz component opposite to magnetosheath one was observed while IMF Bz remained negative. We consider these observations as evidence for multiple reconnections between magnetosheath and magnetospheric flux tubes.

SM62A-0484 1330h POSTER

Properties, Structure and Dynamics of the Exterior Cusp Under Northward IMF, Cluster Multi Event Analysis

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We have studied in detail multi-spacecraft observations of four Cluster exterior cusp passes during the years 2001 and 2002. All of them occurred during northward Interplanetary Magnetic Field (IMF) intervals. A well-bounded region where the magnetic field exhibits very low diamagnetic values and the ions display high levels of isotropisation is sampled. We refer to this region as the Stagnant Exterior Cusp (SEC). We show that the overall picture of the region is compatible with a reconnection site poleward of the cusp for all four events. The global topology of the exterior cusp and SEC can be inferred and reveals that the solar-wind plasma at least partly gets access to the magnetosphere through a sharp boundary delimiting the SEC from the unperturbed magnetosheath. Multi spacecraft data analysis further permits to highlight that the whole region is highly dynamic. The SEC-magnetosheath boundary presents abrupt changes in the magnetic field and plasma parameters and is shown to be rotational in nature. We will put particular emphasis on the exact characteristics and possible nature of this key boundary of the magnetosphere.

SM62A-0485 1330h POSTER

An Event Comparison of Global MHD Simulation and SuperDARN HF Radar in the North Polar Cusp

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On June 5, 1998 a number of the Northern Hemisphere SuperDARN HF radars recorded good backscatter in the cusp region from ~14:00 to 16:00 UT, from which maps of ionospheric convection and backscatter widths have been derived. For comparison the time-varying Lyon-Fedder Global MHD model of this event has been simulated using IMP-8 and WIND spacecraft measurements of solar wind input. The time interval of interest is characterized by negative IMF Bz and negative IMF By following a positive IMF Bz interval. Good correspondence is found between the MHD model and the SuperDARN ionospheric convection patterns confirming that this is an excellent event for a detailed comparison of model and observation. The parameters to be compared include: ionospheric footprints of the MHD cusp plasma versus the location of large SuperDARN backscatter widths; MHD dayside open-closed field line boundaries versus SuperDARN determined open-closed boundaries and the convection flows relative to these boundaries; footprints of MHD merging regions versus features in the SuperDARN convection and backscatter widths. The overall purpose of these comparisons is to understand the SuperDARN observations in the context of the 3D magnetosphere and to investigate how SuperDARN can be used to identify cusp and magnetic merging regions.

SM62A-0486 1330h POSTER

Multi-Spacecraft Observations of the Mid-Altitude Cusp

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Many aspects of the magnetospheric cusps, from how it should be defined to how various altitude measurements relate to each other, remain to be resolved. The Cluster mission, with its unique multi-spacecraft capabilities offer exciting new insights into the nature and structure of the mid-altitude cusps. Previous studies have shown the low-altitude cusps to be consistent with the Crooker antiparallel merging model. At high altitudes, observations reported by Savin using Interball and Prognos data indicate large amplitude, low-frequency waves in the Turbulent Boundary Layer just

at and outside the magnetopause. Recent Cluster observations made at mid-altitudes ($\sim 5 R_E$) will be presented which are consistent with the narrow, wedge-shaped cusp of Crooker and contain persistent wave signatures that are compatible with the previously reported high-altitude measurements. Thus, the cusp signatures observed at a wide range of altitudes begin to present a coherent picture of the cusp as the focus of open field lines from the entire magnetopause current layer.

URL: <http://cluster.space.swri.edu/~waynek/agu.html>

SM62A-0487 1330h POSTER

Polar cap Bifurcation During Steady-State Northward Interplanetary Magnetic Field With $|B_Y| \sim B_Z$

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We propose a polar cap configuration model that occurs for steady-state northward interplanetary magnetic field (IMF) with $|B_Y| \sim B_Z$. When the IMF reconnects with the closed geomagnetic field, two types of open geomagnetic field lines are created. For the first type, the neutral point and the foot point are in the same hemisphere; for the second type the neutral point and the foot point are in opposite hemispheres. The latter type of field lines are draped against the magnetopause and subsequently slip through the magnetopause while undergoing antisunward motion. This field line motion results in intrusion of open magnetic flux into the flanks plasma sheet, and its ionospheric signature is the bifurcation of the polar cap. For $B_Y > 0$ the intrusion occurs on the duskside (dawnside) in the northern (southern) ionosphere, and conversely for $B_Y < 0$. The field lines which have slipped through the magnetopause into the plasma sheet then reconnect with closed geomagnetic field lines to complete a steady-state magnetic flux circulation.

SM62A-0488 1330h POSTER

A multi-scale spatio-temporal examination of the cusp and boundary layers.

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Discontinuous cusp ion signatures have traditionally been explained in terms of time varying magnetic reconnection at the magnetopause and associated convection velocity field. Recently a number of studies have suggested that under steady solar wind conditions the discontinuous cusp can be explained as a spatial rather than temporal structure. Since the driver of the system, the turbulent solar wind, is itself scale free with both spatial and temporal structure, it seems more likely that the cusp is generally both spatially and temporally structured. To this end, we examine the system in the context of spatio-temporal structures on a variety of scales. In this paper we present evidence that ionospheric flows and currents associated with the cusp and boundary layers exist over a wide range of scales. Time series analysis of data from SuperDARN radar and ground based magnetometers show no preferred temporal scale, while the relationship between the radar and magnetometer data is indicative of a multi-scale spatial character. There is evidence that the multi-scale character of these flows and currents varies with location. We investigate this variation further and discuss our findings in the context of a multi-scale reconnection driver.

SM62A-0489 1330h POSTER

Effect of B_y in three-dimensional reconnection at the dayside magnetopause

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Asymmetric magnetic reconnection with a nonzero B_y component is studied using a three-dimensional MHD simulation and the results are interpreted in terms of the dayside reconnection at the magnetopause. The B_y component is implemented by rotating the magnetosheath field. It is seen that a magnetic bulge is formed in the magnetosheath region but displaced in the y -direction due to the tilted magnetic field line geometry of reconnection. The bulge moves away from the reconnection region along the magnetopause with a speed significantly slower than that of the symmetric case. In fact, the reconnection rate is seen much slower than the symmetric case. It is also seen that the reconnection rate decreases as the angle of rotation increases. The discontinuity associated with magnetic reconnection geometry is identified as a slow shock with Alfvén waves attached to it on the magnetospheric side, while on the magnetosheath side an intermediate shock is seen, which evolves into a slow shock and a rotational discontinuity near the center of the bulge and near the y -directional edges of the current disruption region. A large B_y component is generated on the open field lines, exceeding the initial sheath B_y near the center of the bulge. The inflow mass flux into the reconnection region from the magnetosheath is seven times larger than that from the magnetosphere in the present study, while the outflow mass flux into the magnetosphere is five times larger than that into the magnetosheath, implying that a significant mass transfer occurs from the magnetosheath into the magnetosphere. The outflow plasmas move mostly along the magnetic field lines in the downstream and transported toward the polar region.

SM62A-0490 1330h POSTER

Global MHD Simulation of Dayside Proton Aurora: Comparisons with IMAGE Observations

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The IMAGE mission provides a unique opportunity to test the accuracy of current global models of the solar wind interaction with the Earth's magnetosphere. We report the results of comparisons between the output of three-dimensional magnetohydrodynamic (MHD) simulations and images from the Far Ultraviolet Instrument (FUV) SI-12 instrument on board IMAGE showing the occurrence of proton auroras during several periods of relatively high solar wind dynamic pressure. We find a very good agreement between intensifications in the auroral emissions measured by FUV SI-12 and the enhancement of plasma flows into the dayside ionosphere predicted by the global simulations. Examining the IMAGE observations in the context of the dayside magnetosphere's topological changes inferred from the simulations, we find that the global dynamics of the auroral proton precipitation patterns observed by IMAGE are consistent with magnetic field reconnection occurring as a continuous process while the IMF changes direction and the solar wind dynamic pressure varies. However, the global simulations also indicate that some of the transient patterns observed by IMAGE are consistent with some additional sporadic reconnection processes. Global merging patterns found in the simulations agree with the antiparallel merging model, though

component merging might locally broaden the merging region, especially in the region where shocked solar wind discontinuities first reach the magnetopause.

SM62A-0491 1330h POSTER

Multi-point electric field observations in the high- and mid-altitude cusp

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The Cluster quartet crosses the cusp region at high altitudes ($8-12 R_E$) in January-April and at mid altitudes (near $5-6 R_E$) in August-October. At high altitudes the satellites quite frequently enter/exit the cusp through the exterior cusp whose characteristics are much less known than those of the proper cusp. The cusp is detected as a region of enhanced low-frequency wave activity, and the wave activity extends beyond the magnetopause, into the exterior cusp region. The amplitude of the waves tends to increase with decreasing altitude. The cusp also appears as a region of increased plasma density. A typical density is several tens of electrons in cm^{-3} , but it can also often exceed 100 cm^{-3} . Interestingly, the high-latitude boundary layers adjacent to the cusp differ from the cusp region: the density is significantly lower and the electric fields are usually not turbulent although they are temporally variable.

In this study we will concentrate on multi-point electric field observations by the Cluster electric field instrument (EFW) which lets us study both plasma drift patterns and electron density variations (from the spacecraft potential data) within the cusp region. We also utilize simultaneous ion (CIS), electron (PEACE), and magnetic field (FGM) measurements that provide us with valuable additional information about the conditions of the cusp (ion injections, field-aligned currents etc). We investigate both dynamical and structural aspects as well as the level of turbulence within the cusp region. We will put a particular emphasis on the level of coherence/non-coherence in dc electric field variation between the four points for different satellite separations between 100 and 1000 km.

SM62A-0492 1330h POSTER

Bifurcation, symmetry-breaking, and dissipative structures of magnetosphere with southward IMF in a 3D particle simulation

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The energy transfer from the solar wind to the Earth magnetosphere, and the cause of magnetic storm have been mysteries for decades. Axford proposed that the reconnection of magnetic field at the dayside magnetopause is one of the candidate to explain the huge energy transfer from the solar wind to the Earth magnetic field. However, the mechanism of reconnection has not been understood well in magnetospheric physics.

Using a 3D full electromagnetic full particle simulation code, we have investigated the structural stability of the Earth magnetosphere at the dayside magnetopause with a time-varying southward IMF. The distance between the magnetopause and the Earth, R_{mp}

was measured with varying southward IMF step by step slowly. Suppose that the Earth magnetic field motion evolves according to the time-dependent equation in the general form $B_z = G(B, \lambda)$. Solutions of $G(B, \lambda) = 0$ represent steady magnetic fields we have been considering. When the parameter λ (IMF B_z) is varied, one mean magnetic field may persist, but become unstable to small perturbations as λ crosses a critical value. At such a transition point, a new magnetic field may bifurcate with breaking symmetry, which shows dissipative structures. The hysteresis in the $IMFB_z - R_{mp}$ plot indicates that the energy transfer system from the solar wind to the magnetosphere is dissipative, which is caused by the subcritical bifurcation. The differences of local and global steady reconnections are discussed with 3D magnetic field structures.

SM62A-0493 1330h POSTER

Decelerated magnetosheath plasma flow at high latitudes behind the cusp region: Interball Tail observations

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On May 25, 1996 the Interball Tail spacecraft was moving through the northern hemisphere of the high-latitude magnetosphere on its outbound trajectory. It successively crossed lobe field lines followed by the high latitude magnetopause, then entering the magnetosheath proper near the cusp region covering magnetic local time from 8h20m to 9h30m at magnetic latitudes of about 77°. IMF observed by WIND was northward during the time interval of interest and favorable for reconnection at high latitude magnetopause. The well-defined De Hoffmann Teller frame and stress balance indicate that the magnetopause was a rotational discontinuity with ongoing reconnection. After the magnetopause crossing, the spacecraft observed decelerated magnetosheath flow in the sub-Alfvénic regime. A gradually increasing of the flow velocity is observed and the plasma flow regime changed from sub-Alfvénic through Alfvénic to super-Alfvénic one. We explain these results by direct passing of the Interball Tail through the secondary stagnation point, which has been predicted by theoretical and semiempirical models of the high latitude magnetopause.

SM62A-0494 1330h POSTER

Ground and satellite observations of Pc 1-2 waves on open field lines poleward of the dayside cusp.

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Pc 1-2 waves were first identified poleward of the cusp in high-latitude ground magnetometer data by Dyrud et al. [JGR 102, 27011, 1997]. We report here on simultaneous field and particle observations from the Polar satellite and from ground magnetometer data that confirm the presence of these mantle waves and characterize the ion distributions associated with them. These mantle waves were found to occur during 45% of the available passes of Polar across the cusp and mantle during the interval March-May 2000, during which time the orbit of Polar was near local noon as it crossed these latitudes. Pointing vector calculations using Polar electric and magnetic field data show a mixture

of upward and downward energy flux in the cusp but consistently downward flux when mantle waves are observed. This is consistent with earlier observations that ground-based magnetometers can detect such mantle waves but not the more intense wave activity observed by spacecraft in the mid- and low-altitude cusp. In-situ particle observations from the Hydra instrument appear to confirm the generation mechanism suggested by Dyrud et al., that cusp particles mirroring at low altitudes and then traveling outward in the plasma mantle poleward of the cusp are the source of the free energy for these waves.

SM62A-0495 1330h POSTER

A study of Pc 3-4 pulsations observed by the Cluster satellites and multiple ground-based observatories

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Although the dominant source of Pc 3 magnetic pulsations in Earth's magnetosphere is now understood to be in the ion foreshock region upstream of Earth's bow shock, the paths by which these waves travel toward Earth are still not well understood. In this study we present observations of several Pc 3 events observed in late 2001 both by the Cluster satellites and by arrays of ground observatories. During the majority of the events studied Cluster observed Pc 3 activity while passing latitudinally through the dayside outer magnetosphere, but in two cases Cluster observed waves at high altitudes deep in the polar cap. IMF data were used to confirm that conditions were favorable for the generation of upstream waves during most of these events; the IMF was nearly radial (low cone angle), and the IMF magnitude was consistent with the frequency of the waves observed both at the satellites and on the ground, based on the empirical relation f (in mHz) $\sim 6 |B|$ (in nT). Signals at the four Cluster satellites and at various ground stations will be compared in order to test competing transport models, including direct subsolar propagation via fast mode waves and indirect high latitude propagation via the cusp/cleft regions.

SM62A-0496 1330h POSTER

Nonlinear Particle Transport at the Magnetopause and LBL

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We consider particle scattering and transport through thin boundary layers modeling the magnetopause and the LBL. Previous results using a thin current sheet model indicated pitch angle scattering while a modified tangential discontinuity field produced pitch angle filtering. Neither of these simple models showed chaotic or stochastic transport. Subsequent results with a Kelvin-Helmholtz field model showed inhibition of transport by nonlinear trapping. In this study we first show that Geotail magnetic field observations, even when rapid fluctuations are averaged out, rarely show fields consistent with a thin current sheet or a modified tangential discontinuity, but can in many cases resemble a hybrid of the two. We use this

fact to build a simple analytic field model of the boundary layer and study the dynamics of charged particles in this model. Results show that chaotic behavior does occur and increases as the strength of the guide field parallel to the discontinuity decreases to a level consistent with observations, allowing nonlinear transport across the layer as well as pitch angle scattering and filtering and a source-asymmetry effect. Simulations of the boundary layer effect on particle velocity distributions show that models of this type have the potential to explain complex, multisource distributions.

SM62A-0497 1330h POSTER

Relationship between Geogenic Plasma and Magnetic Shear at the Subsolar Magnetopause

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The rate of reconnection is determined by the magnetic shear as well as the inward plasma and magnetic fluxes from magnetosheath and magnetospheric sides of a reconnection site. While there are ample observations to characterize the relatively hot magnetosheath or boundary layer plasma, observations of cold geogenic plasma that may contribute in an important way are somewhat lacking. We analyze measurements from POLAR and Wind to study the characteristics of cold ionospheric ions at the energy range of few hundred eVs or less and their relationship with magnetic shear at the subsolar magnetopause. Our preliminary results show that sunward flow bursts of such ions at the magnetospheric side of the magnetopause are often observed when the magnetic shear at the subsolar magnetopause is larger. Event studies as well as statistical studies will be presented.

SM62A-0498 1330h POSTER

Cluster Observations of the Magnetopause: Magnetosheath Transition, Dynamics and Current Structures

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The dynamics, shape and structure of the magnetopause can be unambiguously determined using the four spacecraft data from Cluster. Multi-spacecraft techniques can be applied which measure, for example: the extent of the current layer; boundary orientation, thickness and motion, and local deviation from planarity. We investigate a number of magnetopause crossings observed by Cluster in these terms and also explore issues of identification, such as boundary crossing times. The analysis shows that, although often planar on presently covered Cluster spatial scales (100-3000 km), strong acceleration of the boundary is usually present and can affect the determination of boundary thickness at each spacecraft. The detailed nature of the magnetopause current layer, and of transient magnetic signatures such as FTEs, is also often directly calculated. The local direction of the magnetopause current, for example, consistently compares well to observed plasma density and flows. Good knowledge of boundary orientation and motion can accurately scale the plasma and field signatures across the boundary layer. We use this scaling of the transition through the magnetopause to the magnetosheath to compare with a transition parameter, designed to identify each plasma environment.

SM62A-0499 1330h POSTER

Penetration of ions into the Magnetosphere Driven by Magnetic Fluctuations in the Turbulent Magnetopause

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We performed test particle simulation of ion motion in the turbulent magnetopause, modeling it as a sheared magnetic field configuration with additional stochastic static magnetic field fluctuations. Varying the level of the fluctuations $\delta B/B_0$, and the magnetic field shear parameter b_y , we calculated the number of particles penetrating from the magnetosheath to the magnetosphere side of the magnetopause (N_p). We found that N_p grows rapidly with the growth of fluctuation level in the linear regime, $\delta B/B_0 < 1$, while for highly nonlinear fluctuations $\delta B/B_0 > 1$ the growth of N_p slows down or even sometimes N_p is reduced. N_p is larger for smaller b_y , but this dependence is not so strong. Maximum number of penetrated particles is about 15% of the total number of particles injected from the magnetosheath.

SM62A-0500 1330h POSTER

Sources of Cusp Energetic Ions

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Cusp Energetic particles (CEPs) observed by the Polar spacecraft provide new insight into the particle acceleration and transport processes within the geospace. Three sources have been proposed: bow shock diffuse ions, shocked solar wind ions locally accelerated in the cusp, and energetic particles injected from the magnetotail. The bow shock model suggests that solar wind ions undergo first order Fermi acceleration at the quasi-parallel bow shock and are subsequently transported into the cusp. Therefore, it is expected to see CEPs controlled by upstream parameters. The tail injection model predicts CEPs are closely associated with the substorm activity. We perform a statistical study of CEP events identified in the Polar data for a number of parameters (IMF components, shock geometry, solar wind velocity, Mach number, AE index) to determine the relative contributions from the bow shock and magnetotail. Because the mechanism for the local acceleration remains unknown, features unique to this model but not the other two models are difficult to identify. Thus those CEP events that cannot be explained by the bow shock and magnetotail injection models provide the upper limit for CEP events of local acceleration. Preliminary results of the statistical study will be presented. Other possible sources for CEPs will also be discussed.

SM62A-0501 1330h POSTER

Energetic Electrons as a Field Line Topology Tracer in the Cusp Region: Cluster Rapid Observations

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Energetic electron observations should be able to clearly delineate regions of open and closed magnetic field lines in the high latitude and thus contributed crucially to understanding and resolving an internal debate going on between groups measuring only the lower energy (<30 keV) plasma. Energetic electrons are unique to fully assess magnetic-field-line topology and thus distinguish between competing high latitude boundary / cusp dynamic models.

The energetic electrons in the high latitude region (including cusp) has been examined in detail by using Cluster/RAPID data set for four consecutive high latitude/ cusp crossings with energies of about 20-400 keV between 16 March to 19 March 2001.

The stable flux of energetic electrons are observed mainly in the time interval when the IMF has a pre-dominant positive Bz component and were associated with lower plasma density and without an obvious tailward plasma flow (< 30 keV). No electrons or only spike-like electron events has been observed during IMF negative Bz whereas the plasma density is high and associated with a clear tailward flow. No stable energetic electron flux has been observed during IMF southward indicates that the cusp has a general open field line geometry.

High flux energetic particle have been observed in the region very frequently, although a number of possible sources have been proposed, the origin of these energetic particles is still on debate. No matter where those particles come from, a mechanism is needed to maintain them in the cusp. The energetic electron observation provide new clues to understand the dynamic cusp process.

SM62A-0502 1330h POSTER

Cusp Region as Viewed by Energetic Electrons and Ions: A Statistical Study Using Cluster Rapid Data

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In this paper, we present statistical results from the energetic electron and ion data set obtained by RAPID/Cluster. The energy range for ions extends from 30 to 1500 keV and for electrons between 20 to 400 keV. Data set obtained by Cluster from January 1 to June 30, 2001 are used to study the extension of the cusp in magnetic local time, invariant latitude, and its dependence on geomagnetic activity, e.g. Dst, Kp indices and the solar wind and Interplanetary Magnetic Field (IMF) conditions. Furthermore, the relation between the energetic particles and local plasma and magnetic field is explored in detail. Frequently the energetic particles provide the clearest/cleanest indication of the boundaries of the cusp region. Energetic ions are essentially present on each pass through this region but the energetic electron behavior in the cusp region was significantly more structured and variable than the ions. The asymmetry between south and north cusp was also studied and will be discussed.

SM62A-0503 1330h POSTER

Energetic Particles Observed in the Cusp Region during a Strom Recovery Phase

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The strongest storm in the past 50 years has been recorded on 31 March 2001. The Dst index reached to 360 nT at around 0900UT. This storm was triggered by a coronal mass ejection (CME), a lot of fine features of this giant magnetic storm have been observed by the Cluster mission. In this paper, we only focus on its early recovery phase between 11:00-15:00UT, 31, March, 2001, when Cluster spacecraft were traveling in the high latitude region - crossing tail lobe, plasma mantle, the cusp region and the boundary layer, possible entry layer. Very high flux of energetic ions has been observed in those regions, including a large amount of oxygen and helium ions. The origin of these energetic particles is still an open question. Although a number of possible sources have been proposed, they are most likely magnetospheric origin and leak out to the cusp region because of very high flux ratio of helium and heavy ions to protons recorded by Cluster. No matter where they come from, a mechanism is needed to maintain them in the cusp. Observation also shows that enhanced energetic electrons are confined in a very narrow region while protons occupied a large region, and heavy ions can be seen in a much wider region. This implies that the cusp current sheet plays a crucial role to maintain energetic particles in the cusp region.

SM62A-0504 1330h POSTER

Ion Acceleration on Closed Field Lines as a Result of Cusp Reconnection

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Certain 0-10 keV dayside multi-energy dispersive ion distributions, measured at low altitudes on closed field lines, have previously been interpreted as the result of sudden magnetic field compression acceleration (Boehm et al., JGR, 104, 2943, 1999). The multiple energies approximate those expected for ions accelerated in a single event, observed after differing numbers of bounces between hemispheres. The original fits to the dispersion assumed acceleration near the equator, as the result of a solar wind pressure pulse. However, no corresponding pressure pulses were found.

We now reinterpret the ion acceleration as resulting from compression of closed dayside cusp field lines in the region of their maximum curvature. The dispersion fits are insensitive to this change in location of the acceleration, given the large total ion travel distances. The compression is assumed to be the result of northward IMF reconnection tailward of the cusp, producing both an increased magnetic tension over the dayside cusp and an added dynamic pressure due to sunward-accelerated plasma. We show that the correct order of magnitude of ion acceleration on closed field lines results from this compression, that the dayside multi-energy events are associated with northward IMF cusp reconnection, and that the location of the multi-energy ion events is immediately adjacent to open cusp field lines.

Sufficient ion acceleration can only occur if the compression occurs quickly. This requires that the initiation of reconnection, to a degree sufficient to produce the compression, take place in less than ~1 minute.

SM62A-0505 1330h POSTER

Correlative Motion of two IMAGE/LENA Hydrogen Rate Peaks Observed in the Low- and Mid-Latitude Dayside Magnetosheath Direction

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Recent studies using IMAGE/LENA observations have shown that significant brightening between the direction of the Sun and the Earth under certain conditions is the result of solar wind ions charge-exchanging with geocoronal neutral hydrogen atoms in the flow in the magnetosheath, and that the brightening tends to increase when the subsolar standoff distance is reduced. The inward motion of the magnetopause is caused by the increase of the solar wind dynamic pressure and that of a southward component of IMF, and the latter also causes the cusp entry region to move equatorward. We test if LENA can monitor the magnetopause inward/outward motion and the cusp equatorward/poleward motion simultaneously to identify dynamical features of these two types of motion. First, from the intervals of IMAGE noon-midnight orbits, we surveyed for events when the magnetopause was inside of geosynchronous orbit and at the same time either GOES 8 or GOES 10 observed magnetosheath magnetic field near the subsolar point. We also required that LENA hydrogen counts from the sun direction during a selected interval are not correlated with the variations of the ACE/EPAM flux data for ions with energies between 47 and 65 keV/e so as to exclude a possibility that the count enhancements are due to suprathermal ions penetrating collimator. LENA observations taken at Z=4 Re in the dayside magnetosphere on April 11, 2001 show the continuous and correlated motion of two hydrogen peaks coming from the mid- and low-latitude sheath direction. When a sphere with a radius of geosynchronous orbit (=6.6 Re) is assumed around the Earth, the line of sight of these mid- and low-latitude enhancements intersects the sphere at 5-6 Re and a few Re away from the equatorial plane, respectively. We show how these motions can be related to the dynamics of the magnetopause, and their characteristics are discussed in terms of solar wind data measured by ACE and sheath magnetic field data from GOES 8/10.

SM62A-0506 1330h POSTER

The Diamagnetic Cavity in the Exterior Cusp and "Stagnation Region" as it is Seen From Interball-Tail.

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Interball-Tail orbits were traced in the special coordinate system based on the Tsyganenko-96 geomagnetic field model which moves relative to GSM depending on the season and interplanetary conditions. Plasma parameters and magnetic field magnitude in this system indicate an existence of spatially confined region where magnetic field is significantly less than the Tsyganenko-96 model prediction, and plasma number density is close to the magnetosheath plasma density. The ion temperature in this region is unexpectedly high and convection velocity is small. This is generally inconsistent with the model which considers the cusp as a region of reconnected field lines convection. This region was statistically investigated to clarify the problems as follows: 1) the mechanism of plasma heating in the "diamagnetic cavity", 2) the nature of the magnetopause in this region, 3) the reason of plasma stagnation.

SM62A-0507 1330h POSTER

A Vlasov Simulation Study of Electrostatic Shocks in Collisionless Plasmas

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We have developed a low-noise non-periodic electrostatic Vlasov simulation code to simulate electrons' motion across a shock ramp of an ion acoustic shock. Our results indicate that the electric field at the shock ramp, due to electron thermal pressure gradient across the shock ramp, can decelerate incoming upstream ions and accelerate incoming electrons. A cold electron beam is formed downstream from the shock ramp. A perturbation that the electron beam received at the shock ramp, was amplified by two-stream instability due to interaction between cold electron beam and hot downstream plasmas. A phase mixing region can be found at the leading edge of the accelerated electron beam. The phase mixing region forms an electron hole which propagates toward downstream side at a speed slightly greater than the electron thermal speed. The size of the electron hole, or the size of phase mixing region, increases with increasing downstream electron temperature. The propagation speed of the electrostatic solitary wave increases with increasing the size of phase mixing region. Relationship between solitary waves observed in our simulation and the fast upward going electrostatic solitary waves in the downward field-aligned current region of the auroral zone will be discussed.

SM62B MCC: 123 Saturday 1330h

Coupling of the Subauroral Ionosphere, Plasmasphere, and Magnetosphere I (joint with SA)

Presiding: F J Rich, Air Force

Research Laboratory; A J Ridley, University of Michigan

SM62B-01 1335h INVITED

The Subauroral Polarization Stream and Observations of Disturbance Electric Fields at Mid Latitudes

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Electric fields often appear in regions of low ionospheric conductivity equatorward of auroral electron precipitation during disturbed geomagnetic conditions. Strong, poleward-directed electric fields driving sunward plasma convection at sub-auroral latitudes in the evening local time sector were termed polarization jets by Galperin et al. [Ann. Geophys., 1974]. Similar intense, latitudinally narrow structures are usually referred to as sub-auroral ion drifts (SAID) [Spiro et al., J. Geophys. Res., 1979] in the US literature. Yeh et al. [J. Geophys. Res., 1991] described broader regions of sunward plasma drift, equatorward of and separated from the evening auroral convection cell. The term Subauroral Polarization Stream (SAPS) has been proposed by Foster and Burke [EOS, 2002] as an inclusive term for both these types of subauroral electric field disturbance phenomena. The observational characteristics of SAID and SAPS will be reviewed.

Observations of subauroral plasma convection with DMSP and other satellites, and with the Millstone Hill incoherent scatter radar, are used to characterize SAPS phenomenology and to address its causes and effects in the coupled inner-magnetosphere / ionosphere system. A database of ~10,000 radar scans has been examined to determine the average characteristics of the disturbance convection electric field in the midlatitude ionosphere. SAPS is seen as a persistent secondary westward convection peak which lies equatorward of the auroral two-cell convection and spans the nightside from dusk to the early morning sector for all Kp greater than 4. Pre-midnight, the SAPS westward convection lies equatorward 60°A, spans 3° - 5° of latitude, and has an average peak amplitude of >900 m/s. In the pre-dawn sector, SAPS is seen as a region of antisunward convection equatorward ~ 55°A, spanning ~ 3° of latitude, with an average peak amplitude of 400 m/s.

The radar observations find that SAPS occurrence probability is greater than 50% between 20 MLT and 02 MLT for Kp >~5. For Kp ~5+, the SAPS probability exceeds 80% between 20 MLT and 00 MLT and is greatest near dusk (16-18 MLT). An occurrence probability >40% extends to near dawn (06 MLT) for Kp ~5.

SM62B-02 1355h INVITED

Low Latitude Ionospheric Storm Time Electric Fields

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Ionospheric electric fields and currents exhibit strong perturbations with a large range of time scales during periods of enhanced high latitude currents and energy deposition. At low and equatorial latitudes, the strongest ionospheric and thermospheric storm effects are driven by zonal prompt penetration and disturbance dynamo electric fields, which can significantly alter the altitudinal/latitudinal distributions of ionization over a large area of the globe, and control the occurrence of ionospheric scintillations and equatorial spread-F. Over the last decade major progress has been made in quantifying the climatological storm time dependent responses of low latitude electric fields and currents to changes in magnetospheric convection, and in the validation of global models. However, there are still fundamental unanswered questions dealing with the large variability of the perturbation electric fields, particularly during strongly active times. Important sources of disturbance electric field variability may include changes in the high latitude potential and conductivity distributions, magnetospheric reconfiguration, and season and solar cycle dependent characteristics. In this talk, we will present the major characteristics of the low latitude disturbance electric fields and we will discuss some recent experimental and modeling efforts aimed at improving their understanding.

SM62B-03 1415h

A Modeling Study of the Ionospheric Response to SAPS

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The Sub-Auroral Polarization Stream (SAPS) has been identified as a region of enhanced westward plasma flow in the night-time mid-latitude ionosphere during geomagnetically disturbed conditions. A description of the SAPS electric field, based on observations from the Millstone Hill incoherent scatter radar, is used here as a driver for the Utah State University Time Dependent Ionospheric Model (TDIM) in order to assess the effect of the SAPS on the mid-latitude night-time F-region. Tests are conducted for various effective durations of the SAPS, up to seven hours, as well as for different background convection patterns. A longitudinal, or UT, dependence of the ionospheric response is examined. It is found that within the SAPS region, a large amount of density structuring occurs, including regions of enhancements and depletions; in some cases the difference in $N_m F_2$ is as large as a factor of 20.

SM62B-04 1430h

The relation of sub-auroral electron and proton precipitation to plasmaspheric and magnetospheric conditions

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During the first two years of the NASA IMAGE mission, global-scale images of auroral precipitation have revealed electron and proton precipitation away from the main auroral oval. The most common manifestations include detached proton arcs in the dusk sector, and impulsive precipitation of electrons and protons on the dayside. A third type of auroral form was observed