spacecraft and new techniques to determine the prime longitude (the system III direction in which the current sheet has its highest elevation), elevation angle and thickness of the current sheet. We show that the prime longitude of the current sheet varies both as a function of radial distance and local time. As previously discovered, the current sheet is delayed (i.e. its RH system III longitude is reduced) proportionally to the radial distance but we now show that the delay is systematically larger in the dawn sector compared to its value in the dusk sector. We relate the delay of the current sheet to the structure of Jupiter's magnetospheric field and to the Alfven wave travel time. Next, we determine the elevation angle of the current sheet and show that the current sheet becomes parallel to the solar wind flow at large distance. Finally we determine the thickness of Jovian current sheet by modeling the magnetic field and show that the current sheet is much thicker on the dusk side compared to its value in other local time sectors. We speculate on physical mechanisms that cause local time variations in the thickness of Jupiter's current sheet.

SM51B-06 0830h POSTER

Langmuir Wave Observations by the Cassini Spacecraft

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The voyage of Cassini from its launch in 1997 to its arrival at Saturn in July 2004 has allowed observation by the same instruments of a variety of plasma and radio wave emissions at different planets, and in the solar wind at different distances from the sun. Langmuir waves (also known as electron plasma oscillations) are one of these plasma wave emissions that has been detected by Cassini at a variety of locations, including upstream of Venus, Earth, Jupiter, and in the solar wind. Langmuir waves produced at the Saturnian bowshock are also expected to be detected as Cassini approaches Saturn. The characteristics of the Langmuir waves detected by Cassini will be examined and compared to previous observations by other spacecraft. The electric field amplitude and the amplitude probability distribution of the Langmuir waves will also be determined and compared to the various theories of Langmuir wave production and propagation, including strong turbulence and stochastic growth theory.

SM51C CC: 516 B Friday 0830h

Reconnection? Dayside *(joint with SH)*

Presiding: **M M Kuznetsova,** NASA Goddard Space Flight Center**; J D Scudder,** University of Iowa

SM51C-01 0830h

Resolved Two Dimensional Maps of the Magnetic Separator at the Earth's Magnetopause

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Analysis of the motion and extent of the electron diffusion region at a site of magnetic reconnection on May 29, 1996 resolved by the Polar spacecraft will be presented. A narrow region of electron skin depth scales is resolved and portrayed with a variety of two dimensional maps. In this innermost region the thermal electrons are directly determined to have gyroradii larger than the scale sizes of this region. Such conditions are highly conducive to demagnetizing the electron fluid and are identified as the source of "non-idealness" that permits magnetic reconnection to proceed. The motion of the magnetic separator has been removed in making this two dimensional picture. The velocities of this pattern along the reconnection normal and transverse to it have radically different speeds. Those transverse to the normal are rather precisely bounded by the Alfven speed using the electron mass; those along the normal are bounded by speed limits involving the ion mass. The time sequences of the measurements have also been interpreted to show that the vicinity of the actual magnetic separator has an "X" topology rather than an chain of "X" and "O"s.

SM51C-02 0845h

Electron signatures from active merging sites

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We interpret field aligned electrons with energies between 0.5 and several keV observed at the dayside magnetopause current layer as signatures of active merging somewhere on that field line. Electron gyrotropy breaks down near the merging separator. Trapped plasma sheet fluxes and magnetosheath fluxes entering the separator region loose their source-identity relative to magnetic field lines at active merging sites on the dayside magnetopause. As they exit between the separatrices, electrons re-attach to magnetic field lines with random pitch angles, creating significant fluxes parallel to the magnetic field at all energies. At locations remote from the separator, the higher energy fluxes are seen closest to the separatrices. Electrons with energies between 0.5 and several keV follow the inner separatrix into the ionosphere near the edge of the cusp, where they can excite 557.7 nm emissions. The presence of significant parallel fluxes at these energies is a signature of active merging. Electron fluxes are observed in both parallel directions at the inner separatrix as they are quickly mirrored back from the ionosphere. Near the outer separatrix the fluxes will be away from the separator only. We present Polar data illustrating the above properties when B_Z is nearly southward. When IMF B_Y is present the standard 2-dimensional geometry of the separator region becomes more complicated. MHD simulations and Polar data suggest that active merging signatures in the electrons and ions on the magnetosphere and magnetosheath sides of the local magnetopause current layer may be tied to very different source regions. The presence of accelerated ions at magnetopauses with moderate to high magnetic shear is not a sufficient condition for local component magnetic merging. Merging may be occurring at remote locations, with magnetic field lines on both sides of the current layer exhibiting different signatures from different sources. The signatures are varying with time.

SM51C-03 0900h

CLUSTER Observation of Signatures of Continuous Reconnection and Characteristics of Dayside Magnetopause Around Cusp

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In this paper, we will present a case study of continuous reconnection at the dayside magnetopause observed by the Cluster spacecraft. On 1 April 2003, the four Cluster spacecraft experienced multiple encounters with Earth's dayside magnetopause under a fairly stable southwest-ward interplanetary magnetic field (IMF). Accelerated plasma flows whose magnitude and direction are consistent with the predictions of the reconnection theory (Walén relation) were observed at and around the magnetopause current layer for a prolonged interval of 3 hours. Reversals in the Y component of ion bulk flow between the magnetosheath and magnetopause current layer and acceleration of magnetosheath electrons were also observed. This event provides strong in-situ evidence that magnetic reconnection at the dayside magnetopause can be continuous for many hours. However, the reconnection process appeared to be very dynamic rather than steady despite the steady nature of the IMF. Detailed analysis using multi-spacecraft magnetic field and plasma measurements shows that the dynamics and structure of the magnetopause current layer/boundary can be very complex. For example, highly variable magnetic and electric fields were observed in the magnetopause current layer. Minimum variance analysis shows that the magnetopause normal deviates from the model normal. Surface waves resulted from the reconnection may be involved in the oscillation of the magnetopause.

SM51C-04 0915h

The Spherical Tearing Mode

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While our understanding of resistive tearing modes in two-dimensional magnetic configurations is quite complete, relatively little is known is known about the geometry and dynamics of tearing modes in truly three-dimensional magnetic configurations like the Earth's magnetosphere. We present new results on the spherical tearing mode, which is the three dimensional generalization of the classical tearing mode first discovered by Furth, Killeen, and Rosenbluth (FKR). In this model, loops of field lines connecting magnetic nulls play the role of X-lines lines in two-dimensional slab geometry. In the initial equilibrium, a closed spherical surface composed of null-null lines separates an inner region of closed field lines from an outer region of open field lines. A new fast tearing instability of this three-dimensional equilibrium, which contains a closed spherical separatrix composed of null-null lines, is identified. The instability growth rate scales as S-1/4, where S is the Lundquist number, and is thus significantly faster than the FKR tearing mode. The spherical tearing surface breaks up, enabling the closed field lines to break and reconnect with open field lines. The new geometry thus realized is relevant to the type of 3D magnetic geometries realized in global 3D MHD codes in which reconnection is usually forced by the solar wind. Implications for 3D reconnection in the Earth's magnetosphere will be discussed.

SM51C-05 0930h

The Structure of the Electron Demagnetization Layer in Guide-Field Reconnection

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We present an analysis based on particle-in-cell simulations and kinetic theory of the electron dissipation region in component merging. Specifically, we will derive scaling laws of the electron demagnetization scale based on electron nongyrotropy effects, which continue to play the dominant role even in the presence of a guide field. We will compare our results to those of other recent and on-going investigations, and derive a general expression of the reconnection electric field for guide-field magnetic reconnection.

SM51C-06 0945h

Anti-Parallel Merging vs. Component Dayside Reconnection: Role in Magnetospheric Dynamics

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Magnetic reconnection is a key process in magnetospheric dynamics. In the presence of a nonzero IMF B_y component and of southward IMF B_z, magnetic neutral points are formed near the flanks of the magnetosphere. The relative role of almost anti-parallel merging near neutral points vs. component reconnection at the subsolar stagnation point is a matter of ongoing discussions. To address this problem we employ global MHD model BATSRUS with adaptive mesh refinement, which resides at CCMC. We perform simulations of magnetosphere dynamics after IMF turning from an initial northward orientation to IMF clock angles $90^\circ < \theta < 180^\circ$. We will pay special attention to the formation of multiple reconnection sites (almost anti-parallel and component). Prior to reconnection onset in the magnetotail, the rate of dayside reconnection can be estimated as the rate of the polar cap growth. We compare the contributions from all reconnection sites to the total newly reconnected magnetic flux. In addition to the role of local guide magnetic field the effects of local current sheet thickness and local flow pattern on the reconnection rate are investigated. We will pay special attention to the effects of spatial resolution and resistivity.

SM51D CC: 519 A Friday 0830h

Inner Magnetosphere

Presiding: **D M Ober,** Mission Research Corporation**; J L Roeder,** Aerospace Corporation

SM51D-01 0830h

A Tale of Two Indices

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We have examined the ratio of the two indices SymH* and AsymH as a function of storm phase and solar wind VBz for about 160 storms. VBz was determined with solar wind data from the Wind and Ace spacecraft. Our initial results indicated that the ground disturbance is more symmetric during the main phase than it is in the recovery phase. Furthermore, these results showed that the ground disturbance grows more asymmetric starting about 5 hours into the recovery phase. These results disagree with previous reports [e.g. Sugiura and Chapman, 1960] and to theory which posits that the ring current is most asymmetric in the main phase and becomes increasingly symmetric during the recovery phase. These results held for weak storms, strong storms, and storms with a sudden commencement. In this report we show that the cause of this aberrant behavior is bias in both indices. We are able to reproduce the Sugiura and Chapman results by subtracting fixed offsets in both the AsymH and SymH* indices. The offset in SymH* is caused by the manner in which the baseline of quiet days is defined. The offset in AsymH is a consequence of its definition as the peak-to-peak amplitude of the local time profile of the disturbance variation in H. Our results raise serious questions above the value of these indices as measures of the partial and symmetric ring current.

URL: http://www.igpp.ucla.edu/jweygand

SM51D-02 0845h

Inner Magnetosphere Magnetic Field Evolution From a Simulated Storm-Time Plasma Distribution

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We model the magnetic field evolution in the near-Earth magnetosphere (2 to 6.6 RE) during the major magnetic storm of October 2001. The evolution is portrayed as a time series of still "snapshots" (one hour apart) in each of which the magnetic (Lorentz) force is equilibrated by plasma pressure gradient forces. Each "snapshot" is computed by employing our iterative 3-D equilibrium code, which is fed anisotropic pressure data in the equatorial plane that is an output from a kinetic ring current model [Jordanova et al., 1997]. In the equilibrium code the parallel and perpendicular pressures are at each iteration extended along the magnetic field lines through considerations of energy and magnetic moment conservation. As computational boundary conditions for the 3-D equilibrium model we use inner and outer magnetic flux surfaces obtained from Tsyganenko's empirical model T01, parameterized with appropriate solar wind and DST values characterizing this particular storm event. We analyze the changes in the magnetic field configuration, plasma pressure and electric currents at each stage of the magnetic storm, focusing on how much the self-consistent magnetic field structure departs from both the dipolar and the T01 configurations during such a disturbed event. We find deep depressions in the magnetic field (compared to dipole) even very close to Earth at the peak of the storm, showing that during such disturbed times the dipole model is not appropriate even very close to Earth.

SM51D-03 0900h

Quasi-Periodic Energetic Particle Injections on the Duskside during a Steady Magnetospheric Convection Event: A New Type of Onset

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Quasi-periodic energetic particle injections have been observed at geosynchronous orbit on the duskside during a steady magnetospheric convection event. We examine high resolution auroral imager data and ground magnetometer data associated with these injections and conclude that they were not associated with classical substorm signatures. Based on an analysis of the data, it is proposed that these injections are caused by the explosive non-linear growth of a shear-flow-ballooning instability in the region where sub-auroral polarization streams (SAPs) also occur. It is suggested that interchange will occur preferentially in the low-conductivity SAPs region since the magnetic Richardson number is lowest there and the 'line-tying' effect will also be least stabilizing there. We propose that the observed particle injection signatures and auroral morphology constitute a new type of explosive 'onset' that can occur during intervals of strong convection.

SM51D-04 0915h

The Magnetospheric Lobe at Geosynchronous Orbit: Where, When, and How?

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Typically geosynchronous orbit lies within the plasmasphere, plasma trough, and plasma sheet regions of the inner magnetosphere. During extreme solar wind conditions, however, the magnetosphere adjusts itself such that the magnetopause, bow shock, or even the open field lines of the magnetospheric lobes can extend into geosynchronous orbit. Polar-rain-type particles and the complete absence of all magnetospheric charged particle populations characterize these lobe events. Using an extensive set of observations from the Los Alamos MPA instruments along with the corresponding solar wind conditions observed by ACE we have identified the typical locations where the open field lines of the lobe are encountered at geosynchronous orbit and the unique set of solar wind driving conditions that lead to such encounters. Using this set of solar wind conditions the global configuration of the magnetosphere is modeled with the Integrated Space Weather Model (ISM), placing these data into context. The observations and simulation results are in good agreement. Events when multiple geosynchronous MPA observations are available further strengthen this agreement. Using this combined data analysis and modeling approach we explain how the magnetosphere becomes so distorted that the open field lines of the lobe are able to extend into geosynchronous orbit.

SM51D-05 0930h

The frequencies of the harmonics of standing Alfven waves and their implication to plasma mass distribution along geomagnetic field lines: Statistical analysis of CRRES data

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The relationship among the frequencies of the harmonics of standing Alfven waves depends on the variation of plasma mass density along the geomagnetic field line. This in turn means that observed standing wave frequencies may be used to infer the mass density variation, which is difficult to measure with particle instruments on spacecraft. Determination of the density variation is important in understanding mass transport processes in the ionosphere-magnetosphere system and also in improving magnetospheric diagnostic techniques using ULF waves. We investigate the frequencies of multi-harmonic toroidal standing Alfven waves detected in the electric and magnetic fields measured by the Combined Release and Radiation Effects Satellite (CRRES). The data cover the entire CRRES mission period from July 1990 to October 1991. Using a semi-automated procedure we identify over 4000 samples of the fundamental toroidal frequency (f1), which are often accompanied by the second (f2) and third (f3) harmonics. Most ($\sim$3000) fundamental frequency samples are taken at dipole L shells from 4 to 8 and at magnetic local time (MLT) from 1200 to 1800, and we perform statistical analyses of the frequencies in this L-MLT domain. The most frequently observed ratios are f2/f1 $\sim$ 2.5 and f3/f1 $\sim$ 4.0 for 4 < L < 6 and f2/f1 $\sim$ 2.8 and

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