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We discuss observations from the IMAGE Low Energy Neutral Atom (LENA) imager on March 31, 2001 when the solar wind flux, as measured by ACE/SWEPAM, was over a factor of ten higher than typical solar wind conditions. Observations from LANL-94 on this day indicate that over the time period of interest, about 0330-0600 UT, the magnetopause was inside of geosynchronous orbit. The flux of neutrals resulting from solar wind charge exchange with the Earth's geocorona scales with the product of: (1) solar wind flux, (2) geocoronal density, (3) line of sight integration length, and (4) the reciprocal of the square of the source distance. Because all of these factors increase dramatically with high solar wind flux, LENA observes significant brightening between the direction of the Sun and the Earth on this day. These emissions are a continuous non-linear function of solar wind flux, varying as the solar wind flux to about the 3.7 power. They cannot be explained by a LENA response to energetic charged particles. The LENA data have been compared to results of global MHD simulations performed at the Community Coordinated Modeling Center (CCMC) using the BATSRUS global MHD code developed at the University of Michigan for this day. The comparison shows that solar wind charge exchange with the Earth's geocorona will produce the signal observed by LENA. Furthermore, structure in the LENA observations can be mapped to features appearing in the CCMC simulations, suggesting that plasma structure in the magnetosheath may be imaged using low energy neutral atom line-of-sight profiles.

URL: http://goewin.gsfc.nasa.gov/LENA/

### SM41C-06 1110h INVITED

### IMAGE/HENA: Examples of Ring Current Configuration During Extreme Solar Wind Conditions

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We will give an overview over different examples of ring current configurations during extreme values of interplanetary magnetic field (IMF) $B_y$ and $B_z$. The 15 July 2000 storm displayed IMF $B_z$ down to -60 nT and a subsequent formation of a ring current close to the Earth. The 12 August 2000 displayed IMF $B_y$=30 nT and $B_z$=-30 nT with an entry point of the flow during the mainphase highly skewed towards dawn which may be an effect of plasma entry along the dawnside flanks of the magnetopause due to the highly positive IMF $B_y$. We will present the ion distributions inverted from the ENA image sequences through a method by *R. Demajistre et al.* at this conference and give lower limits on the current density.

### SM41C-07 1130h

### Composition measurements of energetic neutral atoms using the IMAGE/HENA sensor

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The High Energy Neutral Atom instrument (HENA; see Mitchell et al., 2000) on the IMAGE spacecraft has, for more than a year, returned energetic neutral atom images of the Earths ring current during magnetic storms. Recent analysis of the pulse-height data has indicated that hydrogen ENA may be separated from oxygen ENA on the basis of their microchannel plate pulse-height, combined with the measured particle velocity. Taking advantage of this analysis, the HENA team generated a new version of the HENA flight software, which now enables the instrument to form ENA images separately for hydrogen and for oxygen. We will show first results from HENA demonstrating this new capability, which should permit us to follow the global dynamics of hydrogen and oxygen independently throughout a storm.

URL: http://sd-www.jhuapl.edu/IMAGE/

### SM41C-08 1145h

### Tail Current Contribution to Dst during Major Storms

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A question exists concerning the relative contributions of the ring current and the tail current to Dst during magnetic storms. In global MHD simulation, at least, as this talk shows, the tail current contribution can be significant. Global MHD simulations generate ring currents that are abnormally weak but tail currents that, judged by the size of the tail and by the strength of the tail field, are normally strong. If, therefore, global MHD simulation produces a sizable Dst, it is generated mostly by the tail current-an assumption that can be directly checked. The ISM MHD code is well suited for Dst studies since it computes the magnetic field everywhere in the solution domain from the base of the ionosphere to the outer, solar-wind boundaries of the code. A good determination of Dst can be obtained from the z-component of the magnetic field above the ionosphere at the poles. We report an analysis of the output of the ISM code for a run made to simulate conditions of the Bastille Day storm. We compare the ISM-determined polar cap potential and Dst against observed values. The polar cap potential agrees with DMSP measurements, and, surprisingly, ISM's Dst accounts for most of the observed maximum value.

## SM42A MC: Hall D Thursday 1330h

### Paradigms of Ring Current Decay I

*(joint with SA, SH, AE)*

***Presiding:*** **I Y Daglis,** National Observatory of Athens**; R M Thorne,** UCLA

### SM42A-0825 1330h POSTER

### Polar/Cammice Investigation of Storm Time Ring Current Asymmetry

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Recent results from CRRES and ring current models indicate that the ring current is asymmetric during the main phase of magnetic storms and becomes symmetric during the recovery phase. It is expected that the asymmetry of the ring current is energy dependent and related to the strength of the electric field. The current Polar/CAMMICE data is taken by an instrument nearly identical to that used for the CRRES study. However, Polar has been monitoring magnetic storms since spring 1996 to the present and provides a larger number of events for study. Polar is in an eighteen hour orbit, covers all local times every six months and has observed numerous ring current enhancements. For example, a moderate magnetic storm on October 10, 1997 produced a strong (orders of magnitude) noon-midnight asymmetry in the in the 3 and 5 MeV/G $H^+$ ion fluxes at L values of 3 to 4 with the lower flux observed near noon. Several hours into the recovery the noon-midnight asymmetry was less than a factor of two. A similar result was observed during the January 10, 1997 event when Polar was traversing the dawn-dusk plane and the peak $H^+$ fluxes at constant $\mu$ (3 and 5 MeV/G) were observed on the dusk side for L values of 3 to 4. At higher L values and larger $\mu$ values the fluxes were fairly symmetric. This is in qualitative agreement with recent ring current modeling results. These and other storm time ring current asymmetry observations by Polar/CAMMICE will be discussed and summarized.

### SM42A-0826 1330h POSTER

### Effects of Interchange Instability on the Dynamics of the Ring Current During September 25, 1998 Magnetic Storm

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The established picture of ring current decay during magnetic storms is a combination of losses due to drift through the dayside magnetopause in the main or early recovery phase followed by a slower decay due to charge exchange of ring current particles with the geocorona. We present numerical simulations of the inner magnetosphere for the September 25, 1998 magnetic storm suggesting the possibility of an additional loss process resulting from interchange instability in the inner magnetosphere following a decrease in the plasma sheet pressure. We use the Rice Convection Model with the outer boundary set at geosynchronous orbit. Measurements of low-energy (less than 50 keV) particles by Los Alamos geosynchronous satellites are used to estimate the plasma distribution on the outer boundary of the model. The simulation shows that when the plasma pressure on the boundary drops a factor of 5 in the main phase of the storm, the plasma sheet becomes interchange unstable. We present results showing rapid loss of the storm-time ring current caused by strong ripple-like electric fields associated with the instability. The ring-current particles are adiabatically de-energized as they move out, so the result of the interchange is a decrease of total particle energy in the inner magnetosphere. This process may play an important role in the rapid recovery of Dst during this storm.

### SM42A-0827 1330h POSTER

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From the precise magnetic field measurements by the Oersted satellite at low-altitudes over various local time, a distinct spatial variation at mid- and low- latitudes was detected in the eastward component residuals ($\Delta B_\phi$) after the subtraction of a geomagnetic main field model. The average $\Delta B_\phi$ decreases on the dayside as latitude increases and it increases on the nightside; that is, the latitudinal structure of the $\Delta B_\phi$ has a negative trend in the northward direction on the dayside, and a positive trend on the nightside. The slope of latitudinal profile of $\Delta B_\phi$ is steep on both dayside and nightside under geomagnetically disturbed condition, and has a high correlation with geomagnetic activity index such as the ap. These results strongly suggest the existence of a day-night net Birkeland current system that flows into the polar ionosphere on the dayside, and flows out on the nightside. These net currents seem to distribute in wide local time range, and the current intensity is strong around 1000LT and 1400LT on the dayside, and around 2200LT on the nightside. This local time distribution of these net currents is caused by incomplete cancellation of the region-1 and the region-2 Birkeland currents over each local time. The Results of detailed analysis of these net currents in the polar region will be discussed.

**SM42A-0828 1330h POSTER**

## Solar Wind Disturbances Related to Geomagnetic Storms

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We used the superposed epoch method to reconstruct a typical behavior of solar wind parameters before and during strong isolated geomagnetic storms. For this analysis we used 130 such geomagnetic storms during the period of 1966-2000. The results obtained show that a typical disturbance in the solar wind responsible for geomagnetic storm generation is associated with the propagation of high-speed plasma flow compressing ambient solar wind plasma and interplanetary magnetic field (IMF) ahead of this high-speed flow. This gives rise to enhanced magnetic field, plasma density, plasma turbulence and temperature, which start to increase several hours before geomagnetic storm onset. However, the IMF Bz (responsible for geomagnetic storm onset) starts to increase significantly later (approximately 6-7 hours after maximal variations in plasma density and IMF By). The time delay between peaks in IMF Bz and plasma density (and IMF By) may be a result of draping of high-speed plasma streams with ambient magnetic field in the (z-y) plane as discussed by some authors. This leads to an increase first in plasma density and IMF By ahead of a high-speed flow, which is followed by an increase in IMF Bz. This simple model allows us to predict that the probability for geomagnetic storm generation should depend on which edge of a high-speed flow encounters the Earths magnetosphere. The probability for geomagnetic storm generation is expected to be maximal when the flow encounters the magnetosphere by its north-west edge for negative IMF By and south-west edge for positive IMF By.

**SM42A-0829 1330h POSTER**

## On the Global Relationship Between Characteristic Parameters Associated with Geomagnetic Storms

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The knowledge of the relationship between the different parameters characterizing the solar wind magnetosphere coupling is an important goal in Solar Terrestrial Physics. It has been widely accepted that the principal cause of the enhanced magnetospheric convection during the main phase of geomagnetic storms is due to increasements in the dawn dusk component of the interplanetary electric field, which depends on the negative Bz-component (Bs) of the interplanetary magnetic field and on the solar wind velocity.

This work shows results focused to find out a general relationship between Bs, the intensity of the magnetic storm characterized by the low latitude geomagnetic index Dst, and the associated time intervals. In this research, the period when the Bz-component is negative below a certain threshold value, the duration of the main phase, and the half time of the recovery phase are estimated and tested.

**SM42A-0830 1330h POSTER**

## Inner Magnetosphere Simulations - Coupling the Michigan MHD Model with the Rice Convection Model.

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The adaptive-grid Michigan MHD model (BATSRUS) has been coupled to a new high performance Rice Convection Model (RCM). This fully coupled code allows us to self-consistently simulate the physics in the inner magnetosphere, including Region 1 and Region 2 currents. We will describe the two models and how they are coupled, report on the results of a synthetic event with the coupled code and show a comparison with and without coupling.

**SM42A-0831 1330h POSTER**

## Guiding-Center Simulations of Stormtime Ring Current Electrons

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We simulate electron transport in order to examine the stormtime injection of electrons to the ring current. We use the same method and magnetic and electric field model that has been previously used to account for the stormtime injection of ring current ions, to determine the extent to which that model can also account for observed stormtime electron injections. The model traces the guiding-center motion of representative particles, having selected first adiabatic invariants $\mu$, in response to a series of impulsive enhancements in the convection electric field. The magnetic field model is a dipole field plus constant southward IMF. Over this magnetic field model we impose corotation and a 25-kV quiescent Stern-Volland cross polar cap potential. We model a storm by applying an additional enhanced impulsive cross polar cap potential that is less well shielded than the Stern-Volland potential. The average enhancement of this storm-associated potential is 125 kV, and lasts for 6 hours. We performed simulations for representative equatorially-mirroring electrons for $\mu$ = 1 MeV/G to 200 MeV/G. Using the simulation results, we map stormtime phase space distributions by invoking Liouvilles Theorem modified by losses. We consider electron loss due to precipitation via a model having a MLT-dependent loss rate that is less than strong everywhere in the plasma sheet. We also look at a model with strong diffusion losses within the plasma sheet. We apply a boundary spectrum at geosynchronous orbit that is based on averaging 12 years of geosynchronous LANL/MPA electron data and is parameterized by Kp and binned in 0.5 hr MLT increments. The initial quiescent electron distribution for trapped electrons is taken from the steady-state balance between radial diffusion and weak-pitch-angle-scattering losses. From the simulation results, we find significant stormtime enhancements of ring current electrons at equatorial radial distance r = 2.6 to 6.6 $R_E$ for energies from tens of keV up to 180 keV. We compare qualitatively features of our stormtime electron flux distribution with previously published observations of ring current electron distributions.

**SM42A-0832 1330h POSTER**

## Solar Wind Electric Field and Predictability of the Dst Index

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An accurate prediction of the ring current strength and the Dst index can be computed by the Burton et al. (J.G.R., 80, 4204, 1975) formula, that is based on the solar wind upstream conditions. This formula includes in particular one term of ring current variation that corresponds to the injection due to interplanetary-magnetospheric reconnection and the related electric field. In the present study we have calculated the Dst predictions, over the years 1995-2000, considering the two cases in which the electric field involved is the rectified solar wind electric field for southward interplanetary magnetic field, DstB, or the meging electric field, DstE. The comparison among these Dst predictions and the observed Dst shows that DstE is representing the observed Dst equally or better than DstB. In particular, when the interplanetary magnetic field clock angle is around $\pm 90^{\circ}$ the DstE is more disturbed than the DstB. These results are interpreted in terms of the higher reconnection rate expressed by the merging electric field that takes into account the interplanetary-geomagnetic reconnection occurring at the lobes of the magnetosphere.

**SM42A-0833 1330h POSTER**

## Acceleration of Electrons from the Solar Wind to the Inner Magnetosphere During Storms

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During magnetic storm recovery, relativistic electron fluxes are usually enhanced over pre-storm values in the inner magnetosphere near geosynchronous orbit. To examine the acceleration of electrons in the inner magnetosphere and the formation of the seed population that provides the source for the relativistic electrons, a study has been undertaken to follow electrons from the solar wind into the magnetosphere during storm events. Electrons are traced in a global MHD model of the solar wind interaction with the Earth's magnetosphere using upstream data both to set the launch parameters of the electrons and to provide the upstream boundary conditions for the MHD simulation. Electron fluxes will be calculated in the inner magnetosphere in the seed region at an equatorial radial distance of 10 Re, and fluxes will also be calculated in the region near geosynchronous orbit. The acceleration of the electrons is affected by inductive electric fields and ULF waves.

**SM42A-0834 1330h POSTER**

## A Statistical Study on Storm-time Evolutuion of Substorm Indicators

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A statistical study has been carried out in order to investigate the evolution of geosynchronous substorm indicators, energetic particle injections and magnetic dipolarizations, during magnetic storms. The storm Dst index of all storm events of this study is distinguished by three phases: main, early recovery, and late recovery. It is found that the substorm indicators exhibit notable differences in different storm phases. First, during the main phase, the substorm indicators are most intense and occur over wide local time sectors in the nightside, being not limited to near-midnight sector only. As Dst develops into early and then late recovery phases, the substorm indicators become less intense and occur over less wide local time sectors compared to the main phase, and also their occurrence frequency greatly reduces. Further we find that most of the substorm indicators are well associated with the substorm geomagnetic bays. More interesting finding is that the time difference between the geosynchronous onset and the corresponding geomagnetic bay onset, $\Delta t$, is within 5 minutes over wide local time sectors for many events during the main phase. In contrast, for early and late recovery phases, average $\Delta t$ clearly shows classic pattern of local time propagation with time delations. More implications will be discussed in this presentation.