the cusp. Matching the convection patterns with the particle data shows that most field lines are converted from closed regions to open away from noon. Merging is thus active throughout the frontside magnetosphere. Field lines which merge well away from noon do not experience enough particle inflow against the solar wind velocity to produce anything more than a weak, deenergerized (mantle) precipitation in the ionosphere. The sign of IMF By also controls where most of the nightside conversion of flux from open to closed occurs. For example, Bz<0 and By>0, 31 kV reconnects from 1800-2400 MLT, and 14 kV reconnects from 0000-06000 MLT.

SM52B-06 1145h

A Comparison Of Cluster And Polar Energetic Particle Fluxes On November 13, 2003

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Unusual energetic electrons Pitch Angle Distributions (PADs) were found on the dusk side of the magnetotail of the earth's magnetosphere using data collected by the Cluster and Polar satellites on November 13, 2003. Both satellites at 0830 UT were located at approximately 20 MLT and at radial distances of about 9 and13 RE, respectively, when both Polar and Cluster observed a significant increase in the fluxes of energetic electrons and ions. The Cluster C2 (Salsa) spacecraft was being operated in a special mode known as NM3 for the RAPID investigation that permitted the detailed three-dimensional distribution of energetic electrons to be fully resolved. The period of the observations showed initially a peaked at 90-degree pitch angle distribution that first evolved into an isotropic distributions for the electrons and then the PAD distribution further evolved into a distinct butterfly distribution. The most straightforward interpretation of the Cluster measurements was that these fluxes were demonstrating pitch angle dependent drift dispersion as the electrons drifted from the location of the magnetopause. The differences and physical implications between Polar and Cluster measurements will be presented and discussed in detail.

SM53A CC: 220 C-E Friday 1330h

Double Layers in Space and Astrophysical Plasmas III Posters *(joint with SA)*

Presiding: **R J Strangeway,** University of California, Los Angeles**; M E Koepke,** West Virginia University

SM53A-01 1330h POSTER

The Local Time Propagation of Electron and Proton Shock-Induced Aurora and the Role of the Interplanetary Magnetic Field and Solar Wind

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Shock-induced aurora observed with satellite-borne ultraviolet imagers shows distinct characteristics from the more common and extensively studied aurora generated during magnetospheric substorms. It is initiated in the noon sector immediately following dynamic pressure pulses associated with the arrival of enhanced solar wind plasma at the front of the magnetosphere. The brightness enhancement rapidly propagates toward the dawn and dusk sectors and may trigger the development of an auroral substorm on the nightside. The FUV imaging system on board the IMAGE satellite has the ability to discriminate between proton and electron precipitation. This feature has been used to study the morphology and dynamics of the electron and proton precipitation following pulse-induced magnetospheric perturbations. A set of 14 cases occurring during positive and negative Bz periods has been selected and studied. A different dynamics is observed for aurora caused by electron and proton precipitation. The important role played by the Bz component of the interplanetary magnetic field is analyzed as well. A correlation between the precipitated power deduced from FUV images and solar wind (SW) and interplanetary magnetic field (IMF) measured by ACE is presented. The effect of SW and IMF conditions prevailing before and during the shock on shock aurora is studied separately in order to distinguish the role of the preconditioning of the magnetosphere and the effects induced by the shock itself. The time evolution of the injected power is also studied in the entire oval and in individual MLT sectors.

SM53A-02 1330h POSTER

Details on Parallel Electric Fields and Shocks in Downward Auroral-Current Regions From Theory and Satellite Data

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This poster provides the details for a companion paper by a similar title given in session SM03. In that presentation, a method for determining the parallel electric field ($E_{ìì}$) and/or electrostatic shocks for downward auroral-current regions that includes wave-particle interactions was given. We derive the multi-moment fluid equations for a weakly inhomogeneous, magnetized plasma where the Vlasov-Maxwell hierarchy is used to treat the particle dynamics and the Fokker-Planck method is used to calculate the momentum (anomalous resistivity) and energy (anomalous heating) transfer rates between the waves (turbulence) and the particles. Two major assumptions are necessary: (1) a renormalized kinetic theory for the turbulence either exists or can be developed; and (2) both the length and frequency scales between the single-particle distributions and the fluctuations are separable. Some implications of these assumptions are briefly discussed: for example, we can show that the multimoment fluid equations for a plasma in thermal equilibrium obey the Fluctuation-Dissipation Theorem. For electrostatic turbulence, both the momentum and energy transfer rates are functionals of the renormalized spectral density of the fluctuating electric field and the renormalized dielectric function. For downward currents, we may approximate the momentum and energy transfer rates by using FAST satellite data for the renormalized spectral density, the conservation laws, and a scaling assumption for the renormalized dielectric function. Using FAST data for the particle velocity moments as a boundary condition, we may integrate the multimoment fluid equations both upward and downward from the satellite altitude in order to determine the potential and the particle velocity moments as functions of distance along the geomagnetic field line. We analyzed a winter FAST satellite pass near local midnight at ∼4130 km which shows a downward current region having a latitudinal width of about 45 km. At each subinterval (∼1.5 km) along the pass, we found a double layer (DL) below the satellite altitude; a transition (T) region just above the DL region where strong electron thermalization and intense ion heating occur; and a long range potential (LRP) region extending from the top of the T region to several earth radii and beyond. In the LRP region, ion conics are produced and further electron thermalization occurs. The average altitude of the DL/T region is in good agreement with experimental observations. Our analysis suggests that the formation of the DL, the particle dynamics, and the turbulence are intermittent in space and time. We also calculated the anomalous resistivity in the LRP region and showed that it has a very small effect on $E_{ìì}$ (< few %) and that $E_{ìì}$ is determined primarily by the velocity-space anisotropy and pressure gradient terms in the momentum balance equation. A similar analysis is in process for an upward auroral-current region.

SM53A-03 1330h POSTER

Nature of Parallel Electric Fields in a Diverging Auroral Flux Tube with Upward Current

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Using one-dimensional (1-D) particle-in-cell (PIC) simulations of a diverging magnetic flux tube we have studied the distribution of parallel electric field in response to an applied potential drop. Hot and cold plasma populations as appropriate for the upward current region are included. When an appropriate warm secondary electron population at the ionospheric boundary is included in the simulations, we find that a rarefaction shock forms near the boundary and it accelerates the ionospheric ions upward. But this feature occurs only in the early stages of the simulation while in the late stages the rarefaction shock disappears when the ionosperic cold electrons are heated by wave particle interactions. We further find that the total potential drop in the flux tube only occasionally occurs in a single strong double layer (DL). Often it is distributed into substructures as multiple double layers (DLs), which are highly dynamic and evolve continually via plasma turbulence consisting of both electron and ion time scales. Averaging the fast fluctuations at the electron time scales, the potential distribution across the DLs yields spiky parallel fields, which evolve with ion-acoustic and ion hole turbulence. We compare our results with observations from satellites.

SM53A-04 1330h POSTER

Perpendicular Fine Structure Associated with Strong Auroral Double Layers

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2-D simulations of strong double layers have shown that fine structure perpendicular to B (e.g., filamentation) can form [Singh and Khazanov GRL 2003 and Newman et al., this meeting]. Here we will present observations by the FAST satellite, when it was on the high potential side of a strong double layer. For the event under consideration, the FAST satellite is moving more or less perpendicular to the normal of the large-scale double layer. However both electric-field and particle measurements indicate the presence of perpendicular fine structure, suggesting that the location (parallel to B) of the strongest parallel electric field (i.e., the potential ramp) is not uniform in the direction perpendicular to B. According to the observations, the perpendicular fine structure of the double layer appears to be less consistent with a continuously varying (e.g., sinusoidal) ramp location and more consistent with a segmented structure. The observations indicate that the perpendicular scale characterizing the transitions between the individual segments is smaller than the parallel distance between two adjacent segments. The distance (parallel to B) between the satellite and the potential ramp at any given time will influence the nature of the observed waves, with turbulent waves typically found closer to the ramp than are coherent field structures indicative of isolated electron phase-space holes. The different wave environments are also correlated with characteristics of the electron distribution. Specifically, turbulent waves are found to be associated with electron spectra that are fluctuating at multiple energies, whereas in regions dominated by electron phase space holes,modulations in the electron spectra are observed to be more mono-energetic. Ion conics are also seen on the high potential side of the double layer. Although these conics are believed to originate from the low potential side, signatures of local heating are also observed during times when the satellite is far from the ramp region. These observations will be discussed in the context of the existing simulation studies.

SM53A-05 1330h POSTER

Modelling the Lower Boundary of the Upward Current Region as an Oblique Double Layer: Effects on the Evolution of the O^+ Density of Ionospheric Origin

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Understanding the coupling between the plasma sheet dominated magnetosphere and the auroral ionosphere is a key problem in the auroral physics community. The region of space where this coupling occurs is known as the auroral cavity in the upward current region. Previous research has shown that two boundaries may exist: one between the ionosphere and auroral cavity and the other between the magnetosphere and auroral cavity. We present work that explores the boundary between the ionosphere and auroral cavity known as the lower boundary which we model as an oblique double layer (DL). This work shows how O^+ and H^+ populations of ionospheric origin evolve as they travel antiearthward through an oblique DL. We inject distributions of O^+ ions, which are weakly magnetized, and H^+ ions, which are strongly magnetized compared to O^+, and show that the O^+ distributions gain greater perpendicular energy than H^+ distribution. The O^+ distributions gain greater perpendicular energy than H^+ because the first adiabatic moment is weakly conserved for O^+ and strongly conserved for H^+. In addition, the amount of perpendicular heating of the O^+distribution is a function of the obliqueness angle, with the greatest perpendicular heating occurring at some angle between 45 and 60 degrees. To understand how this optimum heating of the O^+ ions feeds back into the DL solution, we first present O^+ density profiles as a function of the obliqueness angle of the DL. We then use the resulting O^+ density profiles in BGK solutions to examine how the perpendicular heating of the O^+distributions affects the self-consistent nature of the DL. This will help us understand how the obliqueness angle is chosen: whether there are micro-physical reasons or global external drivers that cause the obliqueness angle. An oblique DL at the lower boundary may partially explain why the O^+ion beams in the auroral cavity are wider than the H+ ions beams, something that has been observed by FAST, Freja, Polar, DE-1, and S3-3. The oblique DL model that we use here is a particle tracer with an externally imposed electric field that is based on FAST observations. Moreover, the altitude at which the DL is assumed to form is also based on observations and is much lower than previous work (Borovksy, JGR 1988, pg 5713 and references therein) on oblique DL's, which affects the amount of perpendicular heating that the O^+ions gain.

SM53A-06 1330h POSTER

High Resolution Measurement of Auroral "Hiss" and "Roar"

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In December 2002, a Versatile Electromagnetic Wave Receiver (VIEW) together with a new digitization system was deployed at South Pole station. The motivation was to measure three types of auroral radio emissions: Auroral Roar, a relatively narrowband ($\Delta f/f < 0.1$) emission near 2 and 3 times the F region ionospheric electron cyclotron frequency (f_{ce}); Auroral Hiss, a whistler mode wave emission with frequencies lower than 1MHz ; and Auroral medium frequency (MF) burst, broadband impulsive radio emissions observed at ground level during the breakup phase of auroral substorms. High resolution broad band structure of those three emissions are recorded automatically at South Pole, and are crucial to our understanding the mechanism and relations of auroral radio emissions. This experiment uses a 3x3 meter square magnetic dipole antenna, located 1.7 km away from the South Pole station. A pre-amplifier is buried right below the eastern pylon of the antenna, connected by a 1.7 km long coaxial cable to a LF-HF receiver in the station. The output of the receiver is fed into the Versatile Electromagnetic Wave Receiver (VIEW) and Windows system equipped with a digitization board. Software is written to digitize the selected signals at 1 or 2 MHz. This data acquisition system was designed so that researchers at Dartmouth College can review the data from South Pole weekly and save interesting parts according to instructions sent from Dartmouth. In the year of 2003, the experiment concentrated on the auroral roar frequency band. With 3 hours window per day, it captured more than 30 auroral roar events at South Pole station. The data show detailed structure of Auroral Roar, which is comprised of multiple narrow band features drifting in frequencies in a complicated pattern. (LaBelle et al., 1995; Shepherd et al., 1998) Starting in 2004, the experiment is concentrating on the auroral hiss frequency band. This mode promises to caputure the first detailed structure of auroral hiss at LF/MF (above 50 kHz). LaBelle, J., M.L. Trimpi, R. Brittain, and A.T. Weatherwax, Fine structure of auroral roar emissions, *J. Geophys. Res., 100*, 21953, 1995. Shepherd, S.G, J. LaBelle, and M.L. Trimpi, Further investigation of auroral roar fine structure *J. Geophys. Res., 103*, 2219, 1998.

SM53A-07 1330h POSTER

Analysis of Ionospheric Waves Observed with the SIERRA Sounding Rocket

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On January 14, 2002 at 8:23:05 UT the SIERRA sounding rocket was launched into active aurora from Poker Flat, Alaska. The launch occurred after a medium size substorm break up during the expansion phase. Apogee was 735 km and was reached at approximately 492 seconds. Instruments on board the main payload included particle and electric field detectors. The focus here is on the main payload high frequency wave experiment which detected waveforms continuously with a 5 MHz bandwidth. A wealth of waves was detected throughout the period of time when the electron instrument registered auroral electrons, from 200 to 690 seconds flight time. For example langmuir and upper hybrid waves, are observed on both the upleg and downleg, between 1100 and 2000 kHz, lasting about 350 seconds; unstructured whistler mode hiss is observed throughout the aurora and polar cap, between 200-850 seconds; and structured whistler mode signals occur between 100 and 1000 kHz during the downleg lasting for about 200 seconds. Many of these waves are structured and have dispersive features. Because the main payload was in cartwheel mode we can get polarization information for the observed waves, some of which are spin modulated and some not. We propose to use ray tracing in a model ionosphere based on the rocket observations to investigate the locations and motions of the sources producing the observed dispersed features. This investigation may constrain the mode identification even if the source locations and motions cannot be unambiguously inferred.

SM53A-08 1330h POSTER

Weak Double Layers in Space and Heliospheric Plasmas

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We report observations of weak double layers whose time domain signatures are isolated tripolar electric field pulses. The observations are from near-earth space by Cluster spacecraft and from the interplanetary medium up to 8 AU heliospheric distance from Cassini. The heliospheric observations show that these weak double layers are often associated with ion acoustic wave activity. However, their pulse shapes are different from the classical ion acoustic double layers which should appear as asymmetric bipolar pulses in the electric field. We will discuss the possibility that they are dynamically linked to ion acoustic fluctuations. A statistical survey on the interdependence between electric field amplitudes, time durations, and the background magnetic field strength suggests that the double layers are of kinetic nature rather than of fluid nature. Comparisons of our observational findings with existing theories on BGK waves will be made.

SM53B CC: 220 C-E Friday 1330h

What Controls the Degree of Conjugacy in Auroral Phenomena? III Posters *(joint with SA)*

Presiding: **J B Sigwarth,** University of Iowa**; N J Fox,** Applied Physics Laboratory, Johns Hopkins University

SM53B-01 1330h POSTER

On the Conjugacy of Auroral Afternoon Bright Spots

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Using global ultraviolet auroral images from both Polar and IMAGE satellites, we investigate the conjugacy of afternoon aurora. This study is limited to periods between the equinox and northern winter solstice when Polar UVI is imaging the southern auroral zone and IMAGE FUV provides coverage of the northern auroral region. Both instruments are sensitive to LBH emissions produced by electron impact. We find several intervals during which the dayside auroral morphology is not conjugate: multiple spots aligned in longitude in one hemisphere are absent in the other. Hence, the electron access or electron acceleration mechanisms responsible for the auroral emission are likewise not conjugate. The asymmetries in the auroral morphology are related to the direction of the y-component of the IMF. When IMF By is strongly negative (positive), the afternoon aurora is more structured and discrete in the northern (southern) hemisphere. The characteristics of the multiple spots are consistent with them being the result of a Kelvin-Helmholtz instability (KHI). This implies that the KHI may only be operating in one hemisphere.

URL: http://sprg.ssl.berkeley.edu/matt/AGUS2004/

SM53B-02 1330h POSTER

Simultaneous observations of the auroral oval in both hemispheres under various conditions

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Recently, it has been possible to observe the entire auroral oval in both the northern and southern hemispheres simultaneously with the IMAGE FUV imagers and Polar VIS Earth camera, respectively. These rare opportunities allow us to study conjugate and nonconjugate effects on a global scale under various interplanetary conditions; thus enabling us to better understand the transfer of mass and energy from the solar wind to the magnetosphere/ionosphere system. The events we study here are from late 2002 with periods of simultaneous observation lasting between about 30 and 50 minutes. Most events are associated with a steady IMF B_X component, where the IMF B_Y and B_Z components vary. The location of the "centroid" of the auroral ovals, which allow us to track their motion, are determined using a circle fitting routine. Initial results have shown the expected IMF B_Y-dependent asymmetry along the dawn-dusk meridian; however, in the event studied there was also an overall dawnward

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