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Radio observations in decameter wave band are known to be subject to strong man-made interference signals that make difficult the detection of comparatively weak emissions of cosmic origin. The efficient methods of filtering out the interferences have been recently proposed that utilize the differences in characteristic time scales of the analyzed signals. Those methods, however, restrict the sensitivity of observations by imposing the limitation on the integration time in the post-detector signal analysis procedures. In this paper we demonstrate that effective sensitivity of such observations can be substantially increased by the statistical analysis of tails in the distribution function of short-time-integrated amplitudes. We apply the proposed signal processing technique to the analysis of data obtained in the recent experiment on the search for millisecond-type bursts from exoplanetary magnetospheres. The search was based on the conjecture that auroral regions of magnetized planets can be the sources of powerful radio bursts with characteristic timescales of the order of tens of milliseconds (similar to Jupiter S-burst storms). Although the power of the known by far planetary radio emissions in the Solar system seems to be insufficient for being detected from the distances greater than 2-3 parsec, the detection would be feasible for the so-called "hot Jupiters" (strongly magnetized giant planets located closely to their parent stars) mainly detected by far in optical searches for exoplanets. Our observations have been performed in 1999-2001 at the world-largest decameter radio telescope UTR-2 (Kharkov, Ukraine) used in combination with acousto-optical spectrometer as a receiver system. The observational targets included a list 20 candidate exoplanetary systems known from optical measurements and located not very far (within 15 parsec distance) from the Earth. The proposed statistical method has been tested and tuned with the data from several known radio pulsars recorded in parallel with observations of exoplanetary targets. Despite the absence of the positive result (detection of planetary bursts) by now, the proposed statistical technique allows obtaining an estimate from above on the expected radio flux densities from several known exoplanetary systems.

SM31D MCC: 2002-2004 Wednesday 0900h

Van Allen Lecture *(joint with SA, SH)*

Presiding: **D Baker,** Laboratory for Atmospheric and Space Physics, University of Colorado**; R Strangeway,** Institute of Geophysics and Planetary Physics, University of California, Los Angeles

SM31D-01 0910h INVITED

New Insights Into Magnetospheric Physics From Recent Multi-Spacecraft Observations

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With its four spacecraft traversing the magnetosphere and its environs in a three-dimensional formation at variable separation distances, Cluster is the first mission that permits unambiguous resolution of space and time. By exploiting this unique opportunity, Cluster is rapidly providing fascinating new insights into magnetospheric and solar wind phenomena. Examples are the first determinations of the spatial scales, some of them quite different from expectations, of transient 3D structures, such as the short large amplitude magnetic structures ahead of the parallel bow shock, the perturbations of the bow shock known as hot flow anomaly, the bursty bulk flows in the plasmasheet; the first 3D description of mirror-mode structures in the magnetosheath; the identification of the thickness, structure and and evolution of the magnetopause and magnetotail current sheets, down to ion and electron scales; the localization of the source region of upstreaming ion beams; the identification of different wave modes propagating in different directions at the same frequency; the determination of the source regions of the auroral kilometric radiation using Cluster as a very-long-baseline interferometer. But Cluster is also part of ISTP, which enables Cluster's small-scale observations to be placed into the larger context provided by other ISTP missions and ground-based observatories. A particularly illustrative example is the brief transit by Cluster through the source of the proton beams that cause bright spots in the dayside aurora observed for many hours by IMAGE.

SM31E MCC: 2002-2004 Wednesday 1020h

Magnetotail and Plasma Sheet II

Presiding: **M M Kuznetsova,** NASA Goddard Space Flight Center**; J Buechner,** Max-Planck-Institut für Aeronomie

SM31E-01 1020h

Plasma sheet formation from solar and ionospheric sources

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The population of the plasma sheet with ions is considered in the framework of collisionless particle motions in 3D magnetospheric fields. Simulation results are compared with observations of the near-Earth plasma sheet from the Polar spacecraft, during 2001 and 2002. To support comparison of velocity distributions, large numbers of particle trajectories are initiated in two regions representative of the solar wind source (within the LLBL) and the ionospheric photothermal H+ ion source (outside the plasmasphere). All trajectories run until they either precipitate into the atmosphere or escape from the magnetospheric simulation space, leading to a database of particle characteristics in each volume of the magnetosphere, yielding velocity distributions where sufficient numbers of particles pass through a volume. We report results reflecting steady conditions of modest activity, corresponding to IMF Bz approximately zero. The results exhibit structuring of the magnetospheric plasmas according to source region, with some mixed regions as well. The Polar observations appear consistent with the simulations, while the simulations help us discriminate between solar and ionospheric H+ ions in the Polar measurements.

URL: http://tem692.gsfc.nasa.gov

SM31E-02 1035h

Statistical properties of cold ion populations in the plasma sheet: GEOTAIL observations

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Recent GEOTAIL observations have revealed that there sometimes exists cold ion component that has density comparable to the "ordinary" hot plasma sheet component even in the central plasma sheet [Seki et al., *Nature*, 2003]. It is also reported that during extended intervals of northward IMF, plasma entry from the magnetosheath through LLBL seems to be enhanced and the ion distribution functions show the 2-composition structure in the dawn-side plasma sheet [e.g., Fujimoto et al., *ASR*, 2002]. These dense ions can be transported into the inner magnetosphere under certain solar wind conditions [Thomsen et al., *JGR*, 2003]. In this study, conditions for cold ion existence in the plasma sheet are investigated based on statistics of 4 years of GEOTAIL data in the central plasma sheet ($-5 < X_{GSM} < -35$, $|Y_{GSM}| < 15$ R_E), aiming at getting clues to supply and transport mechanisms of these cold populations.
The results show that the observational probability of the cold ion population having density above 0.1 [1/cc] is about 0.25 and decreases with increasing tailward distances. In the near-Earth regions of $X_{GSM} > -15$ R_E, the probability goes up to 0.42. The observation also shows that there are two types of cold ion events in the plasma sheet: One is the detection of a dense sheath-like ion component primarily seen in the flank regions, and the other is observations of the colder component with a moderate density. The latter type of the cold population often has the velocity along the local magnetic field, which may suggest the direct supply of the ionospheric ions. The former type has properties similar to cold dense plasma sheet observations reported by previous studies, and primarily seen during/after the northward IMF periods. The cold dense ion observations in the GEOTAIL is often coincide or followed by the dense plasma observations by the Los Alamos Magnetospheric Plasma Analyzer (MPA) at the geosynchronous orbit.

SM31E-03 1050h

Ion Dynamics of the Inner Tail and Reconnection Signatures

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During active times, the magnetotail current layer thins to below the thermal ion gyro radius, over a large distance from just past the transition to dipolar field lines to beyond 20R_E. These scales and the simultaneous presence of cold lobe ions, current-carrying hot central plasmasheet ions, as well as highly energized ions create an environment rich in ion-kinetic effects that often dominate the dynamics of the tail. While crucial, ion-kinetic physics is not contained in local or global fluid (MHD) descriptions. It is argued that the ions also play a larger role than previously assumed in communicating perturbations earthward. Our 3-D hybrid simulations (kinetic ions, electron fluid) have demonstrated that earthward transport of energetic, essentially unmagnetized ions is fast and efficient, and can be associated with a large heat flux that initially is located close to the neutral sheet. Both the energetic ions and parallel currents can arrive long before the dipolarization front on what corresponds to relatively low-latitude field lines. Understanding the characteristics of these ions has recently become of greater interest, considering improved methods of monitoring and imaging near-Earth and precipitating energetic ions. However, in previous studies we used a traditional equilibrium, which does not provide a good description of the inner tail. Using techniques that generate numerical equilibria, we have now improved our model by including the transition to the dipolar region. We discuss the stability of these equilibria and present results that show the passive and active impact of the near-Earth region on reconnection signatures.

SM31E-04 1105h

Multispacecraft Observations of Energetic Electron Anisotropies in the Plasma Sheet using CLUSTER/RAPID Data

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We have used the Research with Adaptive Particle Imaging Detectors (RAPID) experiment onboard the four-spacecraft CLUSTER constellation to study the anisotropies of energetic (E>20 keV) electrons in the

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Earth's magnetotail during the magnetospheric substorms. We use the fully three-dimensional Imaging Electron Spectrometer (IES) sensors to examine both streaming (unidirectional) and trapped (pancake or cigar) anisotropies during the course of substorm expansion phase onsets and during substorm recovery phases. Our visualization software allows us to identify and track boundary regions and current sheet structures using the unique CLUSTER constellation. We present several detailed analyses of substorm events in August 2001 and in July 2002.

SM31E-05 1120h

New Behavior of X lines Inside a Thick Near-Earth Plasma Sheet and Evolution of the Reconnection into Lobe Merging

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It is proposed that short-lived reconnection can occur in the center of a thick near-earth nightside plasma sheet and evolve into lobe merging. For reconnection to occur there must be outflow on both the earthward and tailward sides of an X line. The outflow on the earthward side is provided by the well-known azimuthal convection around the earth. The inner bondary of azimuthal convection is at the Alfven shielding layer, and the outer boundary is at the transition to flux tubes which are too tail-like to convect to the dayside due to the geometry of the magnetosphere. The X line is located at the outer boundary of this azimuthal convection channel; hence reconnection creates azimuthally convecting flux tubes from tail-like flux tubes by removing plasma and energy. The outflow from the tailward side of the X line occurs by earthward motion of the X line (that is there is tailward flow in a reference frame moving with the X line) and the reconnected flux forms a magnetic island on the tailward side. It is argued that the above type of reconnection is suppressed during the growth phase of substorms because the azimuthal outflow on the earthward side is blocked due to the changing topology. Both the shrinking of the dayside magnetopause and the increasing tail-likeness of nightside field lines support the idea that the outer boundary of the azimuthal convection channel moves earthward away from any newly-forming X line. When the rate of change of the topology becomes small, due to either a northward turning of the IMF or an approach to a steady-state, the above nightside reconnection is no-longer suppressed. The expansion phase commences with reconnection of the above type (earthward propagation of the X line and formation of a magnetic island). Two possible options for the further development of the expansion phase are considered. In the first, the above reconnection at the X line eats through the plasma sheet and the configuration evolves into the usual lobe-merging picture. In the second, the earthward-moving X line reaches the Alfven layer. The magnetic island coalesces with nearer-earth field lines creating a rapid inflow into the nightside and producing the outflow conditions for a second X line to form near the tailward end of the island. Reconnection at this second X line eats through the plasma sheet and the configuration evolves into the usual lobe-merging picture.

SM31E-06 1135h

Wind Observations of Asymmetric Magnetic Reconnection in the Distant Magnetotail

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Unlike dayside magnetopause reconnection, reconnection in the magnetotail is usually considered to be symmetric, involving the southern and northern lobes with similar plasma and field properties. The reconnection layer with such symmetric boundary conditions consists of a pair of slow shocks that compress, heat and accelerate the incoming (lobe) plasmas. The resulting outflow plasma jets are typically sub-Alfvenic. Here we report observations of asymmetric reconnection in the distant tail (at $X_{GSE} \sim -90$ R_E) between a nearly empty lobe and one that is loaded with plasma (the mantle). Such conditions occur when the IMF B_y component is large. This asymmetric reconnection configuration is somewhat similar to the dayside magnetopause. The observed reconnection jet is Alfvenic and the plasma density in the outflow region (the plasma sheet) is intermediate between those of the lobe and the mantle.

SM31E-07 1150h

Near-Earth Reconnection Confined in the Plasmasheet during the Substorm Growth Phase: A Study of the November 24, 1996, Event

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The present study examines a substorm event of November 24, 1996, with an emphasis on magnetic field and plasma flow measurements in the magnetotail during the growth phase. The unique and most intriguing feature of this event is a systematic change of the flow direction from earthward to tailward observed by the Geotail satellite at X = -21 Re. Good correlation between Vx and Bx suggests that observed variations of the flow velocity were spatial rather than temporal and that the earthward and tailward flows lasted at least 9 and 5 min, respectively. The signs of Bz and By variations also changed systematically along with the sign of Vx, which suggests that the observed flow reversal was caused by the earthward movement of a neutral line. This neutral line might be formed in association with a preceding pseudobreakup, and it is inferred that the associated reconnection did not reach the lobe magnetic field. Interestingly, during the interval of the flow reversal, other satellites observed typical growth-phase features. Geosynchronous magnetic field continued to be stretched in the midnight sector. The Interball and IMP-8 satellites observed continuous increase of the lobe field strength at X = -20 and -34 Re, respectively, in the premidnight sector. It is therefore concluded that the tail current intensification during the growth phase is a global process, whereas the near-Earth reconnection is a local process and at its early stage, it can proceed independently from the overall storage of the tail magnetic energy.

SM31E-08 1205h

The Electron Diffusion Region in Component Magnetic Reconnection

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The reconnection of anti-parallel magnetic field is facilitated by the demagnetization of electrons in the inner diffusion region. Inertial effects due to electron bounce motions in the field reversal region have as their macroscopic manifestations nongyrotropies in the electron pressure tensor. The electric field maintained by the intermittent electron acceleration in the inner diffusion region, or, equivalently, by the divergence of the electron pressure tensor, provides the reconnection electric field. In the case of a significant guide magnetic field, however, electron may be magnetized and thus not able to execute bounce motions in the inner diffusion region. As a result, the structure of the diffusion region is quite different from that of anti-parallel reconnection. We will present a detailed investigation of the reconnection layer for component reconnection, based primarily on analytical arguments and supported by particle-in-cell simulations. We will demonstrate that mixing of electron distributions from within and from adjacent to the thin, central electron current layer can provide electron nongyrotropies, with similar macroscopic consequences as in the anti-parallel case.

SM32A MCC: Level 2 Wednesday 1330h

Substorms II Posters

Presiding: **T Hsu,** Institute of Geophysics and Planetary Physics, University of California, Los Angeles**; E L Kepko,** Boston University Center for Space Physics

SM32A-1132 1330h POSTER

Constellation Strategies of the THEMIS Mission From 2006 Through 2008 and Beyond

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The Constellation class mission dedicated to the Time History of Events and Macroscale Interactions during Substorms (THEMIS) is a new NASA Medium Class Explorer (MIDEX) mission to be launched in 2006. Primarily, THEMIS will monitor the onset and evolution of the macroscale substorm instability. Additionally, the production of energetic electrons during storm time in the radiation belts, and the control of the solar wind - magnetosphere coupling by upstream processes at the dayside magnetopause will be investigated. Thus, THEMIS will significantly contribute to our understanding of the solar wind - magnetosphere energy coupling and mass transport. THEMIS combines a fleet of 5 small probes equipped to measure particles and fields together with a set of about 20 ground observatories capable to monitor auroral breakups aligned over Northern America. In order to time and localize substorm onsets THEMIS utilizes conjunctions between the probes on multiple period, near-equatorial orbits with apogees between 10 and 30 Re. These nightside conjunctions will occur near the substorm meridian at times of local midnight of the ground observatories. Three inner probes ($\sim$1day period) monitor current disruption and two outer probes ($\sim$2day and $\sim$4day periods) monitor lobe flux dissipation. To maintain high recurrence of conjunctions the outer orbits are actively adjusted. Active orbit maintenance will also be used to rearrange the inner probes for dayside observations. In our presentation, we will give a detailed overview of the orbit strategy, which is primarily driven by the scientific goals of the mission but also follows a concept of cost efficiency. We will also evaluate the potential scientific return from the orbit strategy using high-fidelity orbit prediction and common magnetospheric models.

SM32A-1133 1330h POSTER

Survey of Ion Beams Observed Near Substorm Onset by Polar/TIDE in the Nightside Magnetosphere

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We investigate characteristics of ionospheric ion beams before, during, and after substorm onsets in the near-Earth ($\sim$6-9.6 Re) nightside magnetosphere using Polar spacecraft observations and minute resolution AE and Dst indices. The ionosphere continually supplies low energy ions to the plasma sheet. Ionospheric ion outflow increases strongly with increasing geomagnetic