We have previously shown [Wang et al., 2003] that the UCLA/NOAA global model is very well capable of reproducing the structure of the magnetosheath for two case studies. This result now gives us the confidence to attempt a study similar to Spreiter's description of the magnetosheath. With the introduction of MHD and a self-consistent model significantly more free parameters enter the problem compared to a study based on a gasdynamic model. At a minimum, the IMF strength and orientation need to be considered besides the gasdynamic parameters (mostly the solar wind Mach number). In this study, we first introduce the parameters for the model runs for this PDL dependence study. Then we will discuss some more detailed issues about the definition of the PDL boundary. After that, we will show the dependence of the PDL and the slow mode front on the solar wind Mach number, the IMF clock and tilt angles, and the Earth dipole tilt. Finally, we will summarize the results from this study.

SM31B-1113 0830h POSTER

How does the solar wind power the magnetosphere during geoeffective high speed streams?

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We compare and contrast two mechanisms explaining the source of enhanced Pc5 energy in the magnetosphere during the high speed stream beginning 30 March 2002. In the first mechanism fast solar wind streams lead to an enhanced Kelvin-Helmholtz (K-H) instability on the magnetopause flanks causing enhanced Pc5 power inside the magnetosphere. In the second mechanism compressional fluctuations intinsic to the solar wind drive Pc5 power in the magnetosphere, either directly at the same frequencies or indirectly where the input frequencies are broadband and cause random boundary motion that excites magnetospheric cavity eigenfrequencies. We use observations from ACE and Wind to show the power intrinsic to the solar wind. Geotail and Cluster, at the magnetopause, together with MHD simulations highlight the K-H instability. GOES data and ground-based data from the SAMNET, IMAGE, or SAMNET arrays are used to show the magnetospheric response. We compare the wave frequencies in all regions focusing particularly on the existence of cavity eigenfrequencies. Results from these analyses will be presented.

SM31B-1114 0830h POSTER

Particle entry through sash in the magnetopause with a dawndard IMF as simulated by a 3-D EM particle code

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We report a new progress in the long-term effort to represent the global interaction of the solar wind with the Earth's magnetosphere using a three-dimensional electromagnetic particle code with the improved resolutions using the HPF Tristan code. After a quasi-steady state is established with an unmagnetized solar wind we gradually switch on a northward interplanetary magnetic field (IMF), which causes a magnetic reconnection at the nightside cusps and the magnetosphere to be depolarized. In the case that the northward IMF is switched gradually to dawnward, there is no signature of reconnection in the near-Earth magnetotail as in the case with the southward turning. On the contrary analysis of magnetic fields in the magnetopause confirms a signature of magnetic reconnection at both the dawnside and duskside. And the plasma sheet in the near-Earth magnetotail clearly thins as in the case of southward turning. Arrival of dawnward IMF to the magnetopause creates a reconnection groove which cause particle entry into the deep region of the magnetosphere via field lines that go near the magnetopause. This deep connection is more fully recognized tailward of Earth. The flank weak-field fan joins onto the plasma sheet and the current sheet to form a geometrical feature called the cross-tail S that structurally integrates the magnetopause and the tail interior. This structure contributes to direct plasma entry between the magnetosheath to the inner magnetosphere and plasma sheet, in which the entry process heats the magnetosheath plasma to plasma sheet temperatures. These phenomena have been found by Cluster observations. Further investigation with Cluster observations will provide new insights for unsolved problems such as hot flow anomalies (HFAs), substorms, and storm-substorm relationship. 3-D movies with sash structure will be presented at the meeting.

URL: http://gammaray.nsstc.nasa.gov/~nishikawa

SM31B-1115 0830h POSTER

Measurements of the Geomagnetic Cutoff Rigidity-Dependence for Solar Energetic Particle Events

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During large solar energetic particle (SEP) events, charged particles can ionize the atmosphere and alter atmospheric chemistry. Geomagnetic cutoff latitudes bound the polar regions of the atmosphere exposed to solar particles. The size of the exposed polar regions may change significantly during SEP events, correlating well with geomagnetic activity. During SEP events, the geomagnetic cutoff latitude can vary by more than 10 degrees. Using data from the MAST instrument on SAMPEX, we have measured geomagnetic cutoffs for 17 large SEP events, including the 4/21/02 event. We will combine these measurements with data from other SAMPEX instruments to investigate how the size of the polar regions depends on particle rigidity, how this dependence may change with time during an event, and how the measurements compare with models.

SM31B-1116 0830h POSTER

Variable Contributions of Solar Energetic Protons, Helium, Heavy-Ions and Electrons to the Ionization of the Upper Atmosphere

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During large Solar Energetic Particle (SEP) events such as that on April 21, 2002, particles precipitating into the upper atmosphere can have significant effects on atmospheric chemistry. Using data from ACE and SAMPEX the composition and energy spectra of SEPs from H to Fe with energies from $\sim$0.1 to $\sim$100 MeV/nuc and electrons from $\sim$0.04 to 14 MeV were measured during the April 2002 "Storms" period. Of these species, protons made the largest contribution to the ionization of the upper atmosphere at all energies, as is commonly assumed. However, electrons of similar penetrating power contributed $\sim$10% to $\sim$40% of protons, depending on energy, and He and heavier ions contributed $\sim$10% and $\sim$1-2% of protons, respectively. We have surveyed the relative contributions of these species in a number of other large events from 1997 to 2002 and find that the relative contributions of He and heavier ions are sometimes several times greater than in the 4/21/02 event, while electron contributions (relative to protons) can be up to $\sim$10 times greater. These results suggest that models of SEP energy deposition and associated chemical effects in the atmosphere may need to include other SEP species besides protons.

SM31C MCC: Level 2 Wednesday 0830h

Solar Wind-Magnetosphere Coupling: Comparative Magnetospheres II Posters *(joint with P, SH)*

Presiding: **J L Green,** NASA Goddard Space Flight Center**; F J Crary,** Southwest Research Institute

SM31C-1117 0830h POSTER

The Effects of the IMF Bx Component on the Earth's Magnetosphere

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We have used a 3-dimensional global magnetohydrodynamic (MHD) simulation of the interaction between the solar wind and the magnetosphere to study the effects of the IMF Bx component on magnetospheric structure and dynamics. In the upstream solar wind, we assumed that the IMF field lines are in the plane of the Parker spiral which is inclined by 45 degrees to the y-z plane. We found that including an IMF Bx component in the simulation creates transient phenomenon with dawn-dusk and north-south asymmetry in the earth's magnetosphere and that the asymmetric structure is maintained even when the magnetosphere reaches a quasi-steady state. The asymmetries persist when Bx is small. The asymmetric structure in the magnetosheath and magnetosphere is enhanced when the IMF is large and the Alfven Mach number becomes small (<2). Since the IMF grows at the expense of the flow across the bow shock the flow is easily influenced by the IMF asymmetry in the magnetosheath. The existence of the IMF Bx component as well as the IMF By and Bz components precludes any symmetry in the magnetospheric structure. Thus an asymmetric configuration appears in the magnetosphere and this tendency is enhanced for strong IMF. For non-zero IMF Bx magnetopause magnetic reconnection occurs differently on the dawn and dusk sides. IMF lines on the dusk side are straighter than those on the dawn side. This increases the magnetic pressure and pushes the plasma sheet toward dawn. On the other hand, the IMF lines on the dawn side are bent sharply. This decreases the magnetic pressure. This dawn-dusk asymmetry in dayside reconnection and the related magnetospheric convection are the main reasons the plasma sheet is inclined, and the magnetotail is rotated about the sun-earth line. This also causes asymmetric plasma flows.

SM31C-1118 0830h POSTER

Modelling Mercury's Magnetosphere

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There have been many attempts to model the magnetosphere of Mercury based on simply scaling models of the Earth's magnetosphere. This approach has had many successes, but it remains physically unsatisfactory, as it ignores the different boundary conditions that apply at the two planets. The higher Solar Wind dynamic pressure and smaller dipole moment at Mercury make its magnetosphere very small and highly dynamic; Solar Wind driven convection is the dominant plasma transport process. The higher interplanetary magnetic field means that reconnection may be able to proceed more efficiently, making the magnetosphere adopt a very open configuration. In the absence of trapped particles, no ring current forms at Mercury. In addition, field aligned currents may be insignificant due to the lack of a significant ionosphere. We have analysed existing magnetospheric modelling techniques, particularly those of Tsyganenko, and have applied them directly to Mercury with these different boundary conditions. The lack of data has made the parameterisation of the model very difficult. However, the advantage of the model is that it will be possible to use new data as it becomes available from Messenger and BepiColombo. In the meantime, we have explored the possibility of using the results of MHD simulations to constrain the various parameters of the model.

SM31C-1119 0830h POSTER

Mercury-Solar Wind Interaction and Mercury's Current System

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The Hermean magnetosphere is anticipated to have certain unique features compared with other planetary magnetospheres. The planet's intrinsic magnetic field is strong enough to form a magnetosphere around the planet. However, it is not clear how the processes in the Hermean magnetosphere resemble the processes that take place in the other magnetospheres. Especially questions how effectively the magnetosphere can shield the planet against the solar wind particles, how much the magnetosphere can store energy in the magnetotail, the role of the direct interaction between the magnetosphere and the planet's surface, and the closure of magnetospheric electric currents call for more detailed studies. We have developed a global three-dimensional (3-D) quasi-neutral hybrid model to study Mercury-solar wind interaction [*Kallio and Janhunen, GRL, 2003*]. The self-consistent model includes ions that are moved by the Lorentz force, while electrons are a massless charge neutralizing fluid. The approach takes into account the finite ion gyroradius, the velocity difference between different ion species, the large ion loss cone, the non-Maxwellian velocity distribution function, and ions hitting the surface of the planet. In the presentation we use the quasi-neutral hybrid model to study (1) the response of the Hermean magnetosphere to the upstream solar wind parameters, (2) the ion impact at the surface due the direct plasma-surface interaction, and (3) the closure of Hermean magnetospheric currents.

SM31C-1120 0830h POSTER

Hybrid Simulations of the Interaction Between Solar Wind Flow and the Hermean Magnetosphere

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We examine the magnetosphere of Mercury using global three dimensional hybrid plasma simulations. Hybrid simulations treat ions as particles and electrons as a fluid. Having ions as particles allows ion kinetic behavior and waves to be included in the physical treatment of the plasma as compared to magnetohydrodynamic (MHD) modeling that treats the plasma as a single magnetized fluid and does not include such kinetic effects. Kinetic effects are essential for understanding magnetospheric physics. Hybrid simulations scale to the ion inertial length and thus on a global scale are somewhat limited in spatial extent compared to an MHD simulation. We note effects caused by the scalling of the numerical model of the magnetized obstacle interacting with the solar wind flow with the full scale simulation. Hermean magnetosphere is estimated to be only a few times the planetary radius, it can fit within a hybrid simulation system. The overal structure of the interaction between a magnetized obstacle in the solar wind flow is determined by few basic parameters (namely the solar wind density, background magnetic field, and the speed of solar wind, and also the strength of the magnetic dipole of the obstacle and its radius). The structure of the interaction of the solar wind flow with Mercury is to a large extend unique when compared to other planets. For example, the magnetic moment of the Mercury is over 1000 times smaller than that of the Earth and also the solar wind is stronger nearby Mercury than at Earth's vicinity. The typical magnetosperic scales are comparable to the ion gyroradii and hence kinetic effects are important for the overall structure of the interaction between the Hermean magnetospere and the solar wind. In this paper we shall focus on the study of the overal structure of the bow shock and magnetosheath of Mercury. We shall examine the formation of the magnetospheric tail. We shall study particle distribution functions in different locations of the numerical model of the Hermean magnetosphere and we make qualitative comparison of the results with the available measurements of the Mariner 10 spacecraft.

SM31C-1121 0830h POSTER

3D Hybrid Simulation of the Cometary's Plasma Environment with Adaptive Mesh and Particle Refinemen

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The comets play important role as a simulation laboratory for multiscale kinetic plasma processes which are key-role processes in space and laboratory plasmas. A development of multiscale combined numerical methods allows us to use more realistic cometary plasma models (see, e.g. [Häberli et al., 1997; Delamere et al., 1999; Bagdonat and Motschmann, 2002; Lipatov et al., 2002]). In this report, we develop a Particle-Ion–Fluid-Ion–Fluid–Electron method of kinetic ion-neutral simulation (see, e.g. [Lipatov, 2002]), which is based on a multiscale adaptive mesh, particle and algorithm refinement. This method takes into account charge-exchange and photoionization processes. The first results of such simulation of the dynamics of ions near comet Borrelly are discussed in this report.

R Häberli, M R Combi, T I Gombosi, D L De Zeeuw, K G Powell, *Icarus*, **130**, 373, 1997.
P A Delamere, D W Swift, H C Stenbaek-Nielsen, *Geophys. Res. Lett.*, **26(18)**, 2837, 1999.
T Bagdonat, U Motschmann, *Earth, Moon and Planets*, **90**, 305, 2002.
A S Lipatov, *The Hybrid Multiscale Simulation Technology. An Introduction with Application to Astrophysical and Laboratory Plasmas*, Springer-Verlag, Berlin, Heidelberg, New York, 2002, p.p. 1-403.
A S Lipatov, U Motschmann, T Bagdonat, *Planet. Space Sci.*, **50**, 403, 2002.

SM31C-1122 0830h POSTER

X-ray Emission From Planets Venus and Mars: Theoretical Model and Numerical Simulations

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Recently X-ray emission from non-magnetic planets Venus and Mars have been discovered by Chandra X-ray telescopes [1,2]. Analysis of observational data shows that either charge exchange model or fluorescent scattering of solar x-rays cannot explain the whole set of observational data. The premise of this paper is that x-ray emission of both planets is a combination of line k-shell radiation and Bremmstrahlung produced by energetic electrons interacting with planetary atmospheres. Due to the absence of their planetary magnetospheres, planetary bow shocks are located quite close to the ionospheres and on both planets their ionospheres are directly exposed to the shocked solar wind flow. In situ observations revealed the existence at the ionospheric boundaries of strongly turbulent layer – the so-called plasma mantle. Previous hybrid simulations (kinetic ions and hydro dynamical electrons) have shown that mantle turbulence is produced by interaction of counterstreaming ion populations of the solar wind and planetary ionospheres. Recently developed particle in cell (fully kinetic) code demonstrated that mantle turbulence is responsible for electron acceleration in an agreement with in-situ observations that revealed the presence in mantle electrons with energies up to several hundred eV.[3] In the present paper we incorporated energetic electron distribution obtained by numerical simulations into ADAS code [4] and compared results with observations.

1. K. Dennerl et.al. A&A 286, 319 (2002). 2. K. Dennerl, A&A 394, 1119-1128 (2002). 3. K. Szego et.al. J6R 112, 2175 (1997) 4. http: adas.phystretch ac.uk

SM31C-1123 0830h POSTER

Asymmetries in the Martian magnetotail plasma as seen in 3D fluid simulations.

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Previous 3D single fluid simulations showed that the strong magnetic anomalies on the Martian surface can lead to the formation of a mini-magnetopause either in place of or in addition to the magnetic pileup boundary. The anomalous magnetic field also leads to asymmetries in the tail plasma that change when the location of the strongest anomalies are rotated off of local noon. 3D multifluid simulations of a magnetize Mars in the solar wind show the relative importance of solar wind and ionospheric ions in the formation of the tail asymmetries and that ionospheric outflow plays a large role in the formation of the asymmetries. Tracking changes in the ionospheric outflow rate for different orientations of the surface magnetic field both relative to the noon meridian and the IMF shows the variation in relative outflow of atomic and molecular oxygen.

SM31C-1124 0830h POSTER

Unusual bow shock crossing events at Jupiter

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The Cassini spacecraft on its way to Saturn explored the plasma environment of Jupiter near the ecliptic plane, on the dusk side of the planet. The first bow shock (BS) crossing took place on 30 December 2000, and it was followed by about 40 more bow shock crossing events in the distant flanks. The CAPS sensor onboard Cassini, dedicated to measure charged particle spectra up to 50 keV, monitored almost continuously these crossings. We classify a few of these as "unusual", because during those crossings the bulk plasma velocity between quiet upstream and quiet downstream conditions reached higher values than upstream in the unperturbed SW. Here we focus on these "unusual" events and we investigate in detail the plasma parameters as a function of time as Cassini crossed the Jovian bow shock. We use the measurements of the ion beam sensor (IBS) of CAPS and the data measured by the magnetometer, and the radio and plasma wave science (RPWS) instrument. One of the possible explanations we put forward here is that we possibly observed the interaction of interplanetary shocks with the bow shock of Jupiter. We summarize what is known in the literature for shock interactions, and we compare the observations with those models.

SM31C-1125 0830h POSTER

Dual Spacecraft Observations of a Compression Event Within the Jovian Magnetosphere

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By using Cassini as an upstream solar wind monitor we were able to infer increases in the interplanetary dynamic pressure upstream of Jupiter as the spacecraft approached the planet. Observations are made of the effect that these pressure increases had upon both the fields and particles within the Jovian magnetosphere as measured by the Galileo orbiter, which had subsequently re-entered the magnetosphere on the dusk side. As the external pressure increased, so too did the total field magnitude at Galileo (in particular the B-z and B-phi components). In addition strongly leading field angles were observed subsequent to the onset of the compression and strongly lagging fields during re-expansion, this being consistent with the concept of external control of the angular velocity of the magnetospheric plasma due to conservation of angular momentum within the system. Heating of the plasma can be seen clearly as a pronounced increase in particle flux as measured by the EPD instrument aboard Galileo. Changes in plasma velocity as inferred from energetic particle anisotropies at Galileo appear to be well correlated with the behavior of the changing magnetic field angle. The overall behavior and response time of the system appears to be comparable to that predicted by recent theoretical modeling of the Jovian magnetosphere-ionosphere coupling system.

SM31C-1126 0830h POSTER

The Electron Density in the Jovian Magnetosphere from Galileo Plasma Wave Measurements

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An overview of Jovian magnetospheric electron density is presented from data gathered by the Galileo plasma wave instrument. Two techniques are employed. The first uses the low-frequency cutoff of trapped continuum radiation existing at the local electron plasma frequency, $f_p = 8980\sqrt{(N_e)}$ Hz, where N_e is the electron density in cm^{-3}. The second uses a narrowband emission at the upper hybrid resonance frequency, $f_{uh} = \sqrt{(f_p^2 + f_c^2)}$, where f_c = 28B Hz defines the electron cyclotron frequency, and is primarily used inside approximately 15 R_J, where the first method fails. Analyzed data covers between December 1995 and November 2002. Covered radial distances range approximately from 4 R_J, near the inner edge of the cold torus, to 145 R_J, and local times approximately extend from 0400 hours local morning to 2000 hours local evening via local midnight. Electron densities vary from approximately 4×10^3 cm^{-3} in the Io torus' most dense region to 10^{-2} cm^{-3} in the distant magnetotail. The radial electron density profile has a distinct break at approximately 25 R_J and varies as approximately $(1/R)^{6.5}$ inside 25 R_J and $(1/R)^{2.1}$ beyond 25 R_J. The north-south thickness of the plasma sheet is usually well resolved at radial distances from 25 R_J to 50 R_J, and is typically within the range of 4 to 8 R_J. The plasma sheet broadens considerably, however, beyond 50 R_J to an irresolvable state. Efforts are currently focused on investigating the local time dependence of the plasma sheet thickness.

SM31C-1127 0830h POSTER

Saturn's Polar Ionospheric Flows and Their Relation to the Main Auroral Oval

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We consider flows and currents in Saturn's polar ionosphere implied by the large-scale magnetospheric flow driven by planetary rotation and the solar wind interaction. With increasing radial distance in the equatorial plane, the components are the region where planetary plasma sub-corotates on closed field lines, a surrounding region where plasma is lost down the dusk tail by the stretching out of closed field lines followed by plasmoid pinch-off, as first described for Jupiter by Vasyliunas, and an outer region driven by the solar wind interaction, specifically reconnection, first discussed for Earth by Dungey. Observations show the sub-corotating flow on closed field lines in the dayside magnetosphere falls to around half of rigid corotation in the outer magnetosphere, while here we provide arguments that the flow should drop to much smaller values on open field lines in the polar cap. The implied ionospheric current system requires a four-ring pattern of field-aligned currents, with distributed downward currents on open field lines in the polar cap, a narrow ring of upward current near the boundary of open-closed field lines, and regions of distributed downward and upward current on closed field lines at lower latitudes associated with the transfer of angular momentum from the atmosphere to the sub-corotating magnetospheric plasma. Recent work has shown that the upward current associated with sub-corotation is not sufficiently intense to produce significant auroral acceleration and emission. Here we suggest that the observed auroral oval at Saturn instead corresponds to the ring of upward current bounding the region of open and closed field lines. Estimates indicate that auroras of brightness from a few kR to a few tens of kR can be produced by precipitating accelerated magnetospheric electrons of a few keV to a few tens of keV energy if the current flows in a region which is sufficiently narrow, of order or less than ~1000 km (~1° latitude) wide. We also suggest that the auroras should be significantly brighter on the dawn side of the oval than at dusk, and additionally displaced somewhat towards dawn by the down-tail outflow at dusk.

SM31C-1128 0830h POSTER

Tenuous Ring of Captured Dust at Saturn

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We use numerical simulations to predict the existence of a faint ring of dust particles in retrograde orbits about Saturn. Small dust particles, less than 300 nm in radius, on orbits with low eccentricity and small inclinations are captured from the interplanetary medium. The code uses the Z3 model for the magnetic field and plasma parameters provided by Richardson [1995]. It includes solar radiation pressure, planetary oblateness, and sputtering of the dust grains in the magnetosphere. We conduct both long and short term integrations to study the ring. Short term integrations show that the ratio of retrograde to prograde captured particles is around 2:1 and that the capture efficiency for particles with sizes between 5 and 300 nm is $\approx$ 0.7 %. Long term integrations are used to calculate the equilibrium dust distribution orbiting Saturn. Particles are injected into the system at a steady rate and the simulations continue until an equilibrium number of dust particles has been reached. The major loss mechanism is through ejection from the system by the corotational electric field. This typically occurs when the grain has sputtered down to 50 nm. The predicted ring has a peak density of $\approx 3 \times 10^{-18}$ cm^{-3} and extends from just outside the main ring to about 12 planetary radii (R_S) and is $\approx 3R_S$ thick at its widest point. These predictions will be verified by the Cassini spacecraft?s dust detector.

SM31C-1129 0830h POSTER

Rotation Waves and Strong Turbulence in a Multi-Component Plasma*

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We show that in a three-component plasma, e.g., electrons, ions, and negatively charged dust, such that $n_d \ll n_i \sim n_e$, the light components (electrons and ions) can rotate rigidly with a frequency, $\Omega_r = Zn_d\Omega_i/n_e$, where $n_{i,e,d}$ are ion, electron, and dust densities, Z is the dust charge state, and Ω_i is the ion gyro-frequency. The origin of this rotation is shown to be due to $n_i \neq n_e$, so that there is a current perpendicular to the magnetic field due to ion and electron $\mathbf{E} \times \mathbf{B}$ drift, which induces an electric field in the direction of the current. Hence the plasma is subject to electric forces simultaneously in the two orthogonal directions perpendicular to the magnetic field resulting in a rotation. A new low-frequency resonance at $\omega = \Omega_r$ appears in the MHD limit and affects the dispersion character of the electromagnetic waves. The magnetosonic dispersion relation [$\omega^2 = \Omega_r^2 + k^2(V_A^2 + C_s^2)$, where V_A and C_s are the Alfven and ion sound speeds] is modified and becomes isomorphic to the electrostatic Langmuir wave dispersion relation. We find that the interaction of the fast rotation time-scale with the slow magnetosonic time-scale can be achieved via ponderomotive force and this could lead to a nonlinear Schrodinger equation for the magnetosonic branch. We also find that it is possible to develop nonlinear structures at very large MHD scales with scale-size $L \sim V_A/\Omega_{r0} \sim (c/\omega_{pi})(n_e/Zn_d)(n_i/n_e)^{1/2}$, where ω_{pi} is the ion plasma frequency, which could be comparable to astrophysical dimensions. Linear stability and nonlinear structures that could arise in the frequency regime $\omega \sim \Omega_r$ will be discussed along with some space and laboratory applications. *Work supported by NASA and ONR.

SM31C-1130 0830h POSTER

MHD Simulations of the Magnetosphere of Uranus: Successful Comparison With Voyager 2

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We have successfully simulated the magnetosphere of Uranus for the time period of the Voyager 2 flyby in January 1986. Based on the Voyager measurements, a self-consistent numerical solution is obtained with the parallel block adaptive 3D MHD code BATSRUS. By comparing corotating steady state solutions and fully time dependent 3D simulations with the Voyager data we show that the magnetosphere of Uranus at the time of the flyby can be regarded as stationary relative to the frame corotating with the planet. We obtained excellent agreement with the observed magnetic field along the whole path of the flyby, which includes the close by offset dipole field as well as several current sheet crossings in the tail. The location of the bow shock and the magnetopause also agree to high accuracy. We are confident that our numerical solution is a good representation of the 3 dimensional magnetosphere of Uranus during the flyby. The numerical solution shows a twisted magnetotail and field lines are also stretched due to the flow of plasma in the magnetotail. The time dependent simulations were carried out with an explicit-implicit time integration scheme, while stationary solutions were obtained with the local time stepping scheme. Even with these advanced numerical schemes the time dependent simulation required a full day on 30 CPU-s.

SM31C-1131 0830h POSTER

Search for Exoplanetary Radio-Bursts in Decameter Wave Band: Statistical Enhancement of Sensitivity Under Severe Interference Conditions

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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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