SM22B-0253 1330h POSTER

Whistler-Mode Resonance-Cone Emissions Generated by Jupiter's Moon Io

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During the Galileo flyby of Jupiter's moon, Io, that occurred on October 6, 2001, a well-defined electric field emission was detected by the plasma wave instrument as the spacecraft approached the moon. The spectral characteristics of this emission are very similar to a type of whistler-mode emission called 'auroral hiss' that is commonly observed in the Earth's auroral region. This paper gives a detailed analysis of the 'auroral hiss' observed near Io. The electric field spectrum of the auroral hiss emission observed near Io has a sharp high-frequency cutoff at the electron cyclotron frequency and a funnel-shaped low-frequency cutoff similar to terrestrial auroral hiss. Strong magnetic field perturbations associated with the moon occur near the onset of the electric field noise. We propose that the observed emission is generated by an electron beam in a nearly field-aligned current sheet induced by the interaction of Io with the magnetic field of Jupiter. Using a ray-tracing analysis the position of the emission source is located assuming that the radiation source has either a point- or sheet-like geometry. The ray tracing analysis shows that the whistler-mode radiation originates very close to Io, at an altitude of about 0.15 R_{Io}.

SM22B-0254 1330h POSTER

Excitation of whistler-mode waves and resonant electron scattering in the Jovian magnetosphere

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In-situ measurements from the Galileo spacecraft suggest that there is a direct association between enhanced electron fluxes and the presence of whistler-mode plasma waves. A detailed study is presented of a magnetospheric injection event that occurred on day 257 of 1999 at 7.6 R_J using concurrent measurements from the Galileo Energetic Particle Detector (EPD) and Plasma Wave Subsystem (PWS). Simultaneous enhancements are seen in both electron flux and plasma wave power spectral density. Electrons in the energy range 15keV to several hundred keV are enhanced by up to a factor of six over a of nine minute interval. During this period, the plasma waves in the frequency range of a few kHz appear to intensify by factor of up to 10^2 V^2 m^{-2} Hz^{-1}. The source for these waves may be the free energy associated with anisotropic distributions of injected electrons. At this radial distance, we find that B' $\sim$ 100 pT, which is sufficient for strong diffusion scattering. Pitch-angle distributions during the injection provide additional evidence of strong pitch-angle scattering, which may provide the mechanism for appreciable filling the atmospheric loss cone, leading to Jupiter's diffuse aurora.

SM22B-0255 1330h POSTER

Results from the Galileo Energetic Particle Detector during Amalthea Flyby on November 5, 2002

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The Galileo orbiter recorded the responses of EPD instrument to electrons and protons for about 4 hours prior to and about 20 minutes following its closest approach to Amalthea on orbit 34 at 6:18 SCET on November 5. Energetic electrons penetrating the passive shielding of the EPD sensors complicated the identification and interpretation of responses. However, some facts are clear: a.) there is a significant absorption of 1 to 10 MeV electrons evident in the approximate drift shell of Amalthea; b.) 1 to 2 MeV protons show only a small or possibly non-existent absorption feature in the drift shell; c.) there may be absorption of protons below 1 MeV based on the time-of-flight channels showing a feature which will need further analysis to account for rate-dependent effects. We will evaluate and report on the effective loss and transport rates for electrons and protons at Amalthea.

SM22B-0256 1330h POSTER

Radio Emission Direction Finding During the Galileo Almathea-34 Flyby

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The Galileo spacecraft observed distinct spin modulation of plasma wave emissions during the flyby of Almathea (A34). The modulations occurred in the frequency range from a few hundred hertz to a few hundred kilohertz and probably include at least two distinct wave modes. Assuming transverse EM radiation, we have used the swept-frequency receivers of the electric dipole antenna to determine the direction to the source of these emissions. Additionally, with knowledge of the magnetic field some constraints are placed on the wave mode of the emission based on a comparative analysis of the wave power versus spin phase of the different emissions. The results are helpful in understanding the overall physics of this interesting encounter with the Jovian inner magnetosphere.

SM22C MCC: 2008 Tuesday 1340h

Dynamic Aurora: The Role of Alfvén Waves in I-M Coupling III *(joint with SA, AE)*

Presiding: **C A Kletzing,** University of Iowa**; D J Knudsen,** University of Calgary

SM22C-01 1340h

The role of Alfvénic turbulence in Jupiter's M-I coupling

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In our presentation we will discuss the role of Alfvén waves in Jupiter's M-I coupling and their connection to Jupiter's powerful auroral oval, with an emitted UV power about three orders of magnitude larger than Earth's aurora. We will relate the mechanisms in Jupiter's magnetosphere to understanding developed in the Earth context. One of the main differences between Jupiter's and the Earth's magnetosphere is the quasi steady source of Alfvén waves deep inside Jupiter's magnetosphere triggered by radial plasma transport. These Alfvénic fluctuations propagate along the closed field lines in Jupiter's middle magnetosphere and counter propagating waves interact non-linearly to create a turbulent cascade of small scale Alvénic fluctuations. When the scales of the fluctuations reach kinetic scales, the fluctuations are dissipated at high magnetic latitudes. At the presence of a net field-aligned electric current also due to radial mass transport, the dissipation process accelerates electrons to produce Jupiter's main auroral oval. We will discuss these mechanisms in detail. We will also present Galileo spacecraft measurement of the Poynting flux and spectral energy fluxes associated with the Alfvénic fluctuations and compare them with recent Hubble Space Telescope (HST) Observations of Jupiter's main auroral oval. We show that the voltage – energy flux relationship inferred from latest HST observations (private communication J.-C. Gérard) fit well with our theoretical model predictions.

SM22C-02 1355h

Nonlinear 3D Dynamics of Intense Electromagnetic Structures in Low-Altitude Auroral Magnetosphere.

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Results from a numerical investigation of a three-dimensional dynamics of intense electric fields and currents frequently observed by polar-orbiting satellites above the auroral ionosphere are presented. A causal explanation of these electromagnetic structures is given in terms of small-scale Alfvén waves generated below the auroral acceleration region in a process of ULF magnetosphere-ionosphere interaction mediated by large-scale Alfvén waves. These waves curry the electromagnetic power from the nightside plasmasheet boundary layer or equatorial magnetosphere where various energy sources reside to the ionosphere. The field-aligned current in the wave causes a microinstability at about 1 R_E altitude. The instability leads to the formation of a collisionless resistive layer (auroral auroral acceleration region), which serves as an effective upper boundary for the resonator cavity (the lower boundary is formed by the ionospheric E-layer). Inside the cavity small-scale, intense electromagnetic structures can be formed by the ionospheric feedback instability when the ionospheric conductivity is low. This study focuses on a three-dimensional aspects of this process. In particular, we consider effects of the finite Hall conductivity and strong convective nonlinearities of a three-dimensional solution on structure and dynamics of the resonant Alfvén waves. Dependency of these nonlinear effects on parameters of the waves (frequency, amplitude, transverse wavelength) and ionospheric plasma is investigated. Relevance of the numerical results to selected auroral observations and recent theoretical studies is discussed.

SM22C-03 1410h

Alfven Wave Aurora on the Polar cap Boundary:FAST/Cluster Observations

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Aurora on the open/closed field line boundary on the poleward edge of the auroral oval are powered by dispersive Alfven waves. By the use of observations from the FAST and Cluster spacecraft when in magnetic conjunction we identify these waves at different points along the same fieldline. The dispersive nature of the waves at each altitude is tested against existing theories for wave dispersion where finite electron inertia and finite gyro-radii become important. The multipoint observations enable a direct comparison of the electron energy flux and wave Poynting observed at each spacecraft to determine the altitude where most of the observed electron energisation occurs and how

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much of the initial wave energy is dissipated through electron acceleration. Observations from Cluster also allow us to identify a possible source for these waves.

SM22C-04 1425h

Electron Dispersion Below Inverted-V Energies: Resonant Deceleration and Acceleration by Alfvén Waves

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We report on studies of resonant interactions of inertial Alfvén waves with electrons along auroral field lines. The electrons in resonance can be accelerated or decelerated by the parallel electric field of the wave depending on whether the velocity of the electrons is less or greater than the Alfvén wave velocity. In this paper, we emphasize the resonant deceleration process and its effects on electrons that have gone through a parallel potential drop (the inverted-V electrons). When the backscattered population is included, a combination of resonant acceleration and deceleration effects accounts well for rocket observations of electron energy dispersion extending from the inverted-V energies to lower energy. Characteristics of the dispersion tail such as the dispersion time scale and the intensity distribution along the tail may be used to deduce the Alfvén wave properties and the parent electron spectra. Examples of the model wave signatures and their dependence on the electron population will be shown.

URL: http://alpha.physics.uiowa.edu/~lijen/KAWe.html

SM22C-05 1440h

Separating spatial and temporal variations in auroral electric and magnetic fields by Cluster multipoint measurements

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Cluster multipoint measurements of the electric and magnetic field on auroral field lines at an altitude of 4 RE are used to show that it is possible to resolve the ambiguity of temporal versus spatial variations in the fields. We show that the largest electric fields (of the order of several hundreds of mV/m when mapped down to the ionosphere) are of a quasi-static nature, associated with upward electron beams, stable on a time scale of at least half a minute, and located in regions of downward current, and we conclude that they are the high-altitude analogues of the intense return current/black auroral electric field structures observed at lower altitudes by Freja and FAST. Outside of these structures there are temporal fluctuations, which are shown to likely be downward traveling Alfvén waves. The periods of these waves are 20 - 40 s, which is not consistent with periods associated with either the Alfvénic ionospheric resonator or field line resonances. The multipoint measurements enable us to estimate a lower limit to the perpendicular wavelength of the Alfvén waves.

SM22C-06 1455h

Temporal and Spatial Characteristics of Acceleration Structures in the Auroral Return Current Region

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Temporal and spatial characteristics of high-altitude auroral electric fields, and, in particular, those which are related to quasi-static auroral electric potential structures, are discussed using Cluster multi-point observations from auroral field line crossings at geocentric distances of about 5 RE. Intense and narrow-structured diverging electric fields, associated with upward accelerated electrons, being fingerprints of quasi-static acceleration structures in the auroral return current region, appear more frequently at these altitudes than their counterpart, converging electric fields, on auroral field lines, for reasons not yet understood. The time needed for evacuating ionospheric electrons at the ionospheric end of the return current flux tube, which depend on the field-aligned current density, represent one characteristic time scale for the accelerating electric fields. We present results from four Cluster encounters with such acceleration structures and how these and their associated field-aligned current and electron distributions, evolve on the different time scales given by different inter-spacecraft separation distances.

SM22C-07 1510h

Polar Study of Ion Outflow Versus its Energy Input

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A statistical study of the ion outflow versus its energy input is performed by using multi-instrument data (TIDE, EFI, MFI, HYDRA) of Polar during its perigee auroral passes in the year 2000. Several important physical quantities connected to the ion outflow have been investigated, among which are the Poynting flux from the perturbation fields (below 1./6 Hz), the electron density, temperature and the electron energy density. The perturbation fields here to calculate the Poynting flux may be associated with the small-scale quasi-static electric field structures of the field-aligned currents or/and time-varying Alfven wave structures, which are both proven to be important energy sources to power the aurora. Our preliminary results show that the field-aligned ion outflow flux correlates best with the Earth-directed Poynting flux and the precipitating electron density, and also with a much weaker correlation with the electron energy density and temperature. The findings from this Polar study are similar to those from FAST. The general corroboration between the independent data sets of the two spacecraft suggests that the empirical ion outflow scaling laws can be established, which will be beneficial to global simulation efforts.

SM22C-08 1525h

A statistical study of the orientation, motion, and thicknesses of density and electric field structures observed by Cluster II above the auroral accleration region

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We present the results of a statistical study of the properties of electric field and density structures observed by the Cluster II spacecraft above the auroral acceleration region. Of particular emphasis is the orientation, motion, and thicknesses of time stationary structures. The multi-point electric field and density measurements from the Cluster II constellation are used to estimate the direction and propagation speed of structures in the electric fields and plasma density (as inferred from spacecraft floating potential measurements), as well as to quantify the thicknesses of those structures. These spatial structures propagate transverse to the magnetic field at speeds of $\sim$10 km/s and are characterized by thicknesses that range from a few hundred kilometers to a few thousand kilometers in extent. Thus with these observations we are probing the high-altitude potential and density structures that are associated with relatively fast (1 km/s) proper motions of fairly large scale (10-100 km) features in the auroral zone. The variation in the properties of these spatial structures with other parameters that characterize the auroral zone, such as altitude, local time, invariant latitude, and geomagnetic activity will also be discussed.

SM22D MCC: 2008 Tuesday 1600h

Substorms I

Presiding: **J D Perez,** Auburn University**; W J Hughes,** Center for Integrated Space Weather Modeling

SM22D-01 1600h

Substorm Onset by Plasma Sheet Divergence

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It is necessary to understand current wedge formation in order to understand the cause of the substorm expansion phase. Geotail spacecraft observations have shown that the inner-plasma-sheet cross-tail current reduction within the current wedge results from a process that leads to a reduction in equatorial plasma pressure and a substantial reduction in flux tube ion content. We use the single-species continuity equation for plasma sheet particles to identify a plausible cause of these plasma reductions. We find that a convection reduction, which follows a growth phase period of enhanced convection, should cause a divergence of plasma sheet particles driven by diamagnetic drift that leads to flux tube content reduction. Such reduction in flux tube content is longitudinally localized to the premidnight to midnight region where the current wedge has been observed to initially form and must initiate within the region of the equatorial mapping of the Harang discontinuity, consistent with ionospheric observations of substorm onset. We also find that the reduction in flux tube content should initially develop slowly, and then develop more rapidly as the current wedge forms. This is consistent with observations which show that expansion phase aurora, and thus also the current wedge, develops slowly for a few minutes before brightening rapidly, and it is as required if plasma sheet divergence driven by diamagnetic drift leads to current wedge formation and initiation of the substorm expansion phase.

URL: http://www.atmos.ucla.edu/~larry