SM32B-07 1540h

Spatially Resolved WINDMI Substorm Model

W. Horton[1] (512 471 1594; horton@physics.utexas.edu)

R. S. Weigel[2] (301 286 3545; Robert.S.Weigel)

C. Crabtree[1] (512 471 5552; ccrab@physics.utexas.edu)

I. Doxas[3] (303 492 7988; doxas@colorado.edu)

[1]Institute for Fusion Studies, The University of Texas at Austin, Austin, TX 78712, United States

[2]NASA/GSFC, Code 692, Greenbelt, MD 20771, United States

[3]Department of Physics, University of Colorado, Boulder, CO 80308, United States

A new high-dimensional Solar Wind Driven Magnetosphere-Ionosphere model called WINDMI.SR has been constructed to address the issue of the propagation of compressional Alfven pulses and mini-shocks up and down the magnetotail. The Tsyganenko-96 model is used to calculate a large inductance matrix that describes, along with the local central plasma sheet polarization capacitance vector, the solar wind driven interactions in the geotail and their coupling through field aligned nightside current loops to the auroral and polar cap ionosphere. The diagonalization of the large, symmetric inductance matrix gives the eigen modes of the system ranging from the global one hour mode of the Global WINDMI model to one minute modes. For large substorm energy releases the compressional pulse fronts steepen forming mini-shocks. For a midtail unloading event an N-shaped pulse travels both Earthward and tailward. The Earthward traveling pulse is partially reflected and partially transmitted to the dissipative ionosphere. The communciation between the two substorm onset regions –auroral field lines and the midtail NENL region– are studied in some detail in the new model. When supplemented with an external northward turning trigger, this substorm model can successfully compete with neural networks in reproducing the essential features of the standard substorm databases. The model is based on plasma physics equations and has properties such as charge and energy conservation and causality intrinsic to the physical laws.

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SM32B-08 1555h

Double Layers, Electron Scattering and Anomalous Resistivity in 3-D Magnetic Reconnection

James F Drake[1] (301-405-1471; drake@plasma.umd.edu)

Marc Swisdak[1]

Michael A Shay[1]

Andreas Zeiler[2]

Barrett N Rogers[3]

[1]University of Maryland, Department of Physics, College Park, MD 20742, United States

[2]Max Planck Institut fuer Plasmaphysik, Center for Interdisciplinary Plasma Science, Garching D-85748, Germany

[3]Dartmouth College, Department of Physics and Astronomy, Hanover, NH, United States

In the case of a simple reversed magnetic field, simulations in three dimensions have revealed that collisionless magnetic reconnection remains nearly two-dimensional. The strong current layers which form near the x-line in 2-D simulations remain completely stable in 3-D while the slow shocks which bound the outflow region downstream of the x-line exhibit weak lower-hybrid-drift turbulence which does not significantly impact the rates of reconnection. Reconnection in the presence of a guide field is much more dynamic. The guide field slows the convection of electrons away from the x-line, which enables the reconnection electric field to accelerate electrons in this region to very high velocity. The resulting magnetic-field-aligned electron beams are two-stream unstable. The instability nonlinearly develops into distinct double layers, in which regions of locally intense electric fields form on spatical scales of 10's of Debye lengths. These intense electric fields scatter the electron beams, causing strong electron heating and a large effective resistivity. The nonlinear development of the system is being explored with full particle simulations using up to one billion particles to understand the conditions under which these structures develop and their impact on electron energization and the rates of reconnection in magnetospheric and astrophysical systems.

SM32B-09 1610h INVITED

Direct Observation of Parallel Electric Fields of the Aurora

R. E. Ergun[1] (303 492-1560; ree@fast.colorado.edu); L. Andersson[1] (Laila.Andersson@lasp.colorado.edu); Y.-J. Su[1] (ysu@lasp.colorado.edu); C. W. Carlson[2,3] (cwc@ssl.berkeley.edu); J. P. McFadden[2] (mcfadden@ssl.berkeley.edu); F. S. Mozer[2] (fmozer@ssl.berkeley.edu); D. L. Newman[3] (David.Newman@colorado.edu); M. V. Goldman[3] (goldman@spot.colorado.edu); R. J. Strangeway[4] (strange@igpp.ucla.edu)

[1]The Laboratory for Atmospheric and Space Physics, University of Colorado, Boulder, CO 80309, United States

[2]Space Sciences Laboratory, University of California, Berkeley, CA 94720, United States

[3]The Center for Integrated Plasma Studies, University of Colorado, Boulder, CO 80309, United States

[4]Institute for Geophysical and Planetary Physics, University of California, Los Angeles, CA 90055, United States

We report direct measurements of parallel electric fields, electron distributions, and ion distributions related to particle acceleration in the downward current region of the aurora. The observations suggest three distinct, narrowly-confined regions along the magnetic field (B) that are related to a strong double layer. In the "ramp" region, the parallel electric fields are hundreds of millivolts per meter and indicate a monotonic potential ramp localized to $\sim$10 Debye lengths along B. On the high-potential side of the ramp, an unstable electron beam is seen for roughly another $\sim$10 Debye lengths along B. In this "beam" region, the characteristic energy of the electrons matches the potential of the ramp. The electron beam is rapidly stabilized in a region with intense electrostatic waves and nonlinear structures interpreted as electron phase-space holes. The region of electrostatic turbulence is spatially separated from the ramp by the beam region. The parallel electric field structures are observed to move along B in the same direction as the accelerated electrons at roughly the ion-acoustic speed. Numerical simulations reproduce similar spatial makeup, electrostatic structure, and plasma characteristics of the observations. These results suggest that large double layers can account for the parallel electric field in the downward current region and that intense electrostatic turbulence rapidly stabilizes the accelerated electron distributions. These results also demonstrate that parallel electric fields are associated with the generation of large-amplitude electron phase-space holes and plasma waves.

SM32B-10 1630h

Simulation of Current-Driven Double Layers in the Auroral Ionosphere

David L. Newman[1] (303-492-6967; David.Newman@colorado.edu)

Martin V. Goldman[1] (Martin.Goldman@colorado.edu)

Robert E. Ergun[2] (ree@fast.colorado.edu)

[1]CIPS, University of Colorado 390 UCB, Boulder, CO 80309, United States

[2]LASP, University of Colorado 392 UCB, Boulder, CO 80309, United States

Recent FAST satellite observation [Ergun et al., *PRL*, **87**, 045003 (2001)] provide detailed measurements of a strong localized parallel electric field in the downward-current region of the auroral ionosphere. The results of new 1-D Vlasov simulations show that a strong electrostatic double layer, possessing a DC electric field with a spatial structure that is in good agreement with the FAST observations, develops from a weak density depression in a current-carrying plasma. The double layer produces a beam of accelerated electrons that interact with background electron on the high-altitude side resulting in a near-continuous series of electron holes via the electron two-stream instability. The electric-field signature of these holes is also in agreement with the FAST observations, including a characteristic gap between the location of DC field and the hole turbulence. Stages in the formation and eventual disruption of the double layer will be illustrated using phase-space and field diagnostics.

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SM32B-11 1645h

The role of electron-ion instabilities in the development of phase space holes from localized self-consistent electric fields (double layers)

Martin V. Goldman[1] (303-492-8896; goldman@spot.colorado.edu)

David L. Newman[1] (303-492-6967; David.Newman@colorado.edu)

Robert E. Ergun[2]

[1]CIPS, Campus Box 390 University of Colorado, Boulder, CO 80309, United States

[2]LASP, Campus Box 392 University of Colorado, Boulder, CO 80309, United States

One-dimensional Vlasov simulations have shown that a localized self-consistent electric field (double layer) can develop in a current-carrying plasma when an initial density depression is imposed (Newman, contributed paper, this conference; Newman, et al. 2001). The localized field accelerates electrons in one direction and ions (much more slowly) in the opposite direction. The accelerated electrons interact with a slower electron component to create growing waves via a two-electron-stream instability. These waves then trap the electron beams and create fast-moving electron holes. On a slower time scale, after the ions have been accelerated in the opposite direction an electron-ion instability occurs. The growing waves move slowly in the direction of the ions and trap both ions and electrons leading to an alternating train of ion and electron phase space holes (Goldman, et al, 2001). We interpret the simulations in terms of these electron-ion instabilities and further describe how yet another electron-ion instability, (a cold Buneman instabilty) may play a role in the destruction of the double layer.

D.L. Newman, M.V. Goldman, R.E. Ergun and A. Mangeney, "Formation of Double Layers and Electron Holes in a Current Driven Space Plasma, submitted to Phys. Rev. Lett., 2001

M.V. Goldman D.L. Newman and R.E. Ergun, "Phase space holes due to electron and ion beams accelerated by a current-driven potential ramp," submitted to Nonlinear Processes in Geophysics, 2001

This work was supported by NASA and NSF.

SM41A MC: 135 Thursday 0830h

Van Allen Lecture - Magnetospheric Imaging: Promise to Reality

Presiding: **J T Gosling,** Los Alamos National Laboratory

SM41A-01 0835h INVITED

Magnetospheric Imaging: Promise to Reality

James Burch (jburch@swri.edu)

Southwest Research Institute, P.O. Drawer 28510, San Antonio, TX 78228, United States

There is no abstract available for this presentation.

SM41B MC: Hall D Thursday 0920h

Magnetosheath, Magnetopause, and Dayside Magnetosphere

Presiding: **S Wing,** The Johns Hopkins University Applied Physics Lab**; D G Sibeck,** JHU/APL

SM41B-0781 0920h POSTER

INTERBALL-1 Observations of Turbulent Plasma Upstream to the Earth's Bow Shock

Lubomir Prech[1] (+420 2 21912304; lubomir.prech@mff.cuni.cz)

Jana Safrankova[1] (+420 2 21912301; jana.safrankova@mff.cuni.cz)

Zdenek Nemecek[1] (+420 2 21912301; zdenek.nemecek@mff.cuni.cz)