SM51A-04 0830h POSTER

Simulation/Data Comparisons of Ganymede's Magnetosphere

Carol S Paty[1] (carol@ess.washington.edu)

Robert Winglee[1] (winglee@ess.washington.edu)

Erika Harnett[1] (eharnett@ess.washington.edu)

[1]University of Washington, Earth and Space Sciences Box 351310, Seattle, WA 98195-1310, United States

Multi-fluid simulations in 3D were performed of Ganymede to gain further understanding of its near space environment and the dynamics resulting from interactions between Ganymede's magnetosphere and ionosphere and Jupiter's corotational plasmasphere. This study incorporates the effects of different local orientations of Jupiter's magnetosphere as well as different incident plasma densities on the location and amount of flux into Ganymede's ionosphere. It is shown that the location of penetration of Jupiter's magnetospheric plasma is effected by the dynamic pressure of the incident flow; at higher pressures the location is nearer to the equator, while at lower pressure the penetration latitude is closer to the poles. Simulation results are compared to and explained in terms of observations made of Ganymede's UV aurora. Ion dependent mass loading and mass loss in the coupled Ganymede-Jupiter system were also tracked so as to provide a more complete interpretation of the dynamic role played by Ganymede's magnetosphere and ionosphere imbedded in the Jovian system.

SM51A-05 0830h POSTER

Charged Particle Losses near the Inner Galilean Satellites

Chris Paranicas[1] ((240)228-8652; chris.paranicas@jhuapl.edu)

Andreas Lagg[2] (lagg@linmpi.mpg.de)

Norbert Krupp[2] (krupp@linmpi.mpg.de)

Joachim Woch[2] (woch@linmpi.mpg.de)

Barry H Mauk[1] ((240)228-6023; barry.mauk@jhuapl.edu)

[1]Applied Physics Laboratory, 11100 Johns Hopkins Rd., Laurel, MD 20723, United States

[2]Max Planck Institut fuer Aeronomie, Max-Planck-Strasse 2, Katlenburg-Lindau 37191, Germany

To study the losses of energetic charged particles in the inner magnetosphere of Jupiter, we have calculated proton phase space densities from the Galileo Energetic Particles Detector (EPD) data. The phase space density as a function of L shell is believed to obey a diffusion equation. In previous calculations, the phase space density in the inner magnetosphere has been shown to decrease inward toward the planet, suggesting sources at large distances, and losses due to satellite sweeping and other effects. The Galileo data reveal features indicating a loss process near the satellites Io and Europa. We also verify a region of strong loss just outside the orbital radius of Io. We will present loss rate estimates for the relevant physical processes within a diffusion context. These loss rate calculations, for instance, allow us to place an upper bound on the neutral gas distribution in radius (or L shell).

SM51A-06 0830h POSTER

A Voyager Statistical Analysis of Satellite Phase with Jupiter's Radio Emission

Chuck Higgins[1] (615-898-5946; higgins@physics.mtsu.edu)

Kelley Klecker[1] (615-898-2130; blackhole1200@hotmail.com)

Doug Menietti[2] (319-335-1919; jdm@space.physics.uiowa.edu)

[1]Middle Tennessee State University, Dept. of Physics Astronomy Box 71 1301 E. Main St., Murfreesboro, TN 37132, United States

[2]University of Iowa, Dept. of Physics and Astronomy, Iowa City, IA 52242, United States

Recent observations from the Galileo spacecraft show the influence of the satellite phase of Callisto and Ganymede on the radio emission generated in the Jovian magnetosphere. Our current analysis shows that Voyager 1 and 2 data also show correlations. In an attempt to quantify the significance of these correlations, we have completed a statistical analysis of Jupiter's emission intensity and occurrence probability with all four Galilean satellites. We analyzed the peak correlations on an occurrence probability graph of satellite phase versus Jovian longitude, and present the significance as standard deviations (sigma) above background. Our analysis shows peaks of significance of at least 2 sigma for Io, Ganymede, and Callisto. Results of all four Galilean satellites are displayed and discussed.

SM51B CC: 220 C-E Friday 0830h

Comparative Magnetospheres II Posters *(joint with P)*

Presiding: **K Kabin,** University of Alberta**; S Ledvina,** University of California, Berkeley

SM51B-01 0830h POSTER

The Ionosphere of Titan

John D Clark[1] ((785)864-4042; jdclark@ku.edu)

Tom Cravens[1]

Ned Keller[2]

Loren Acton[3]

[1]University of Kansas, Dept. of Physics and Astronomy 1251 Wescoe Hall Dr., Rm. 1082, Lawrence, KS 66045, United States

[2]The King's College, Dept. of Physics 350 Fifth Ave., New York, NY 10118, United States

[3]Montanta State University, Dept. of Physics, 264 EPS Bldg. POB 173840, Bozeman, MT 59717, United States

Titan has an atmosphere consisting mainly of molecular nitrogen and methane. Solar extreme ultraviolet and x-ray radiation and energetic electrons from Saturn's magnetosphere interact with the upper atmosphere producing an ionosphere. We will review our current understanding of Titan's ionosphere and will emphasize the energy deposition in the atmosphere from solar ionizing radiation and from magnetospheric electrons. We will present results from a two-dimensional suprathermal electron model that includes Auger electrons produced by K-shell ionization processes. We will compare our results for a Titan ionosphere at solar maximum conditions that correspond to Voyager encounter with results for solar minimum conditions that correspond to the expected arrival of Cassini orbiter.

SM51B-02 0830h POSTER

A comparison of the plasma interaction at Io, Pluto and comet Borrelly

Peter Delamere[1] (delamere@lasp.colorado.edu)

Fran Bagenal[1] (bagenal@colorado.edu)

[1]Laboratory for Atmospheric and Space Physics University of Colorado, CB 392 Duane Physics D133, Boulder, CO, United States

Coupling between spatially separate, but magnetically linked plasmas is a general problem in space plasma physics. Familiar examples include the Io-Jupiter interaction and the solar wind interaction with Pluto's escaping atmosphere and cometary environments. Standard magnetohydrodynamic (ideal MHD) treatments provide a basis for understanding the coupling processes; however, in many cases kinetic and other "non-ideal" processes modify the nature of the interaction. Io represents an example where local ion kinetics are relatively unimportant and an MHD approach may be adopted to study the Alfvenic coupling between Io and Jupiter. Interestingly though, Io's plamsa coupling is modified by high latitude parallel electric fields. Pluto, on the other hand, is dominated by local ion kinetic effects and the coupling is spatially varied. At Pluto the ion gyroradius of both solar wind protons and pickup ions is much larger than the obstacle scale size, but the solar wind ion inertial length is comparable to Pluto's diameter. Finally, comets represent an interesting intermediate case where at large distances from the sun the interaction is kinetic dominated and closer to the sun the interaction can be understood with a fluid description. In situ observations of comet Borrelly at 1.4 AU suggest that ion kinetic effects may be responsible for asymmetries in its plasma environment.

SM51B-03 0830h POSTER

Multispecies Hybrid Simulations of Titan's Plasma Interaction

S. A. Ledvina[1] ((510)643-1352; ledvina@ssl.berkeley.edu)

S. H. Brecht[2] (sbrecht@pacbell.net)

J. G. Luhmann[1] (jgluhman@ssl.berkeley.edu)

T. E. Cravens[3] (cravens@ku.edu)

K. C. Hansen[4] (kenhan@umich.edu)

[1]Space Sciences Lab, University of California, Berkeley, CA 94720, United States

[2]Bay Area Research Corp, 93 Moraga Way 200, Orinda, CA 94563, United States

[3]Department of Physics Astronomy, University of Kansas, Lawrence, KS 66045, United States

[4]Space Physics Research Lab, University of Michigan, Ann Arbor, MI 48109, United States

The interaction of Titan's ionosphere with Saturn's magnetospheric plasma is complicated by the significant size of the ion gyroradii relative to the size of Titan. Voyager 1 found a two species plasma consisting of H^+ and N^+ with number densities of 0.1 and 0.2 cm^{-3} respectively, near Titan. The gyroradii of the incident N^+ was found to be 2.25 R_T (1 R_T = 2575 km), while the gyroradii of the H^+ was smaller at 0.16 R_T. In addition Voyager detected the presence of several pickup ion species. The heavy pickup ion species (N_2^+, H_2CN^+, $C_2H_5^+$) are expected to have gyroradii 4-5 R_T. The scale of the interaction region is dominated by the size of the ambient and pickup ion gyroradii rather than the size of Titan. We investigate Titan's interaction with its surrounding plasma environment using multispecies hybrid simulations. We use a H^+ and N^+ upstream plasma and represent Titan's ionosphere by three generic ion species, a light, medium and heavy using the same formalism as Cravens et al.(1998). The magnetospheric plasma parameters (density, temperature, magnetic field and velocity) near Titan are based on 3-D MHD simulations of Saturn's magnetosphere (Hansen, 2001). We apply our results to the conditions expected at Titan during the first flyby of Cassini in October later this year.

SM51B-04 0830h POSTER

Effects of the Crustal Fields on the Solar Wind-Martian Ionosphere Interaction: A Global Hybrid Model

Naoki Terada[1] (+81-533-89-5517; teradan@stelab.nagoya-u.ac.jp)

Hiroyuki Shinagawa[1] (sinagawa@stelab.nagoya-u.ac.jp)

[1]Solar-Terrestrial Environment Laboratory, Nagoya University, Honohara 3-13, Toyokawa, Aichi 442-8507, Japan

Effects of the crustal magnetic fields on the Martian plasma environment are investigated using a comprehensive 2-D global hybrid (particle ions/fluid electrons) simulation model. The model includes the entire solar wind-planetary ionosphere interaction region self-consistently, i.e., the region above 100 km altitude with a finest resolution of 5 km in radial direction, with a kinetic ion treatment. We conduct simulations with a variety of crustal field strength; for example, a crustal field that is not able to withstand incoming solar wind by itself, and a strong one that is enough to balance the external pressure around the ionopause altitude. The result indicates that even a weak crustal field can affect the interaction significantly, because of the field compression occurring just above the ionopause. We will also discuss the modification of ion escape rate, mass and momentum transport efficiency across the ionopause, and relationship with the ejection of ionospheric plasma clouds.

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SM51B-05 0830h POSTER

The Local Time Variations of Jupiter's Current Sheet Location and Thickness

Krishan K Khurana[1] (3108258240; kkhurana@igpp.ucla.edu)

Hannes K Schwarzl[1] (3108251995)

[1]Institute of Geophysics and Planetary Physics, Slichter Hall, UCLA, Los Angeles, CA 90095, United States

The six spacecraft that have traveled through the magnetosphere of Jupiter have encountered Jupiter's current sheet over all local times and varying solar wind ram directions. We use magnetic field data from these

spacecraft and new techniques to determine the prime longitude (the system III direction in which the current sheet has its highest elevation), elevation angle and thickness of the current sheet. We show that the prime longitude of the current sheet varies both as a function of radial distance and local time. As previously discovered, the current sheet is delayed (i.e. its RH system III longitude is reduced) proportionally to the radial distance but we now show that the delay is systematically larger in the dawn sector compared to its value in the dusk sector. We relate the delay of the current sheet to the structure of Jupiter's magnetospheric field and to the Alfven wave travel time. Next, we determine the elevation angle of the current sheet and show that the current sheet becomes parallel to the solar wind flow at large distance. Finally we determine the thickness of Jovian current sheet by modeling the magnetic field and show that the current sheet is much thicker on the dusk side compared to its value in other local time sectors. We speculate on physical mechanisms that cause local time variations in the thickness of Jupiter's current sheet.

SM51B-06 0830h POSTER

Langmuir Wave Observations by the Cassini Spacecraft

George B. Hospodarsky[1] (319-335-1957; george-hospodarsky@uiowa.edu)

William S. Kurth[1] (319-335-1926; william-kurth@uiowa.edu)

Donald A. Gurnett[1] (319-335-1697; donald-gurnett@uiowa.edu)

Philippe Zarka[2] (Philippe.Zarka@obspm.fr)

Patrick Canu[3] (patrick.canu@cetp.ipsl.fr)

[1]The University of Iowa, Department of Physics and Astronomy, Iowa City, IA 52242, United States

[2]Observatoire de Paris, ARPEGES, Meudon 92195, France

[3]CNET/Centre d'etude des Environnements Terrestre et Planetaires (CETP), 38/40 rue du General Leclerc, Issy-les-Moulineaux 92131, France

The voyage of Cassini from its launch in 1997 to its arrival at Saturn in July 2004 has allowed observation by the same instruments of a variety of plasma and radio wave emissions at different planets, and in the solar wind at different distances from the sun. Langmuir waves (also known as electron plasma oscillations) are one of these plasma wave emissions that has been detected by Cassini at a variety of locations, including upstream of Venus, Earth, Jupiter, and in the solar wind. Langmuir waves produced at the Saturnian bowshock are also expected to be detected as Cassini approaches Saturn. The characteristics of the Langmuir waves detected by Cassini will be examined and compared to previous observations by other spacecraft. The electric field amplitude and the amplitude probability distribution of the Langmuir waves will also be determined and compared to the various theories of Langmuir wave production and propagation, including strong turbulence and stochastic growth theory.

SM51C CC: 516 B Friday 0830h

Reconnection? Dayside *(joint with SH)*

Presiding: **M M Kuznetsova,** NASA Goddard Space Flight Center**; J D Scudder,** University of Iowa

SM51C-01 0830h

Resolved Two Dimensional Maps of the Magnetic Separator at the Earth's Magnetopause

Jack D Scudder (319-335-0804; jack-scudder@uiowa.edu)

University of Iowa, Room 203 Van Allen Hall, Iowa City, IA 52240, United States

Analysis of the motion and extent of the electron diffusion region at a site of magnetic reconnection on May 29, 1996 resolved by the Polar spacecraft will be presented. A narrow region of electron skin depth scales is resolved and portrayed with a variety of two dimensional maps. In this innermost region the thermal electrons are directly determined to have gyroradii larger than the scale sizes of this region. Such conditions are highly conducive to demagnetizing the electron fluid and are identified as the source of "non-idealness" that permits magnetic reconnection to proceed. The motion of the magnetic separator has been removed in making this two dimensional picture. The velocities of this pattern along the reconnection normal and transverse to it have radically different speeds. Those transverse to the normal are rather precisely bounded by the Alfven speed using the electron mass; those along the normal are bounded by speed limits involving the ion mass. The time sequences of the measurements have also been interpreted to show that the vicinity of the actual magnetic separator has an "X" topology rather than an chain of "X" and "O"s.

SM51C-02 0845h

Electron signatures from active merging sites

Nelson C Maynard[1] (603-886-8860; nmaynard@mrcnh.com); William J Burke[2]; Jack D Scudder[3]; Daniel M Ober[1]; Keith D Siebert[1]; Daniel R Weimer[1]; Christopher T Russell[4]

[1]Mission Research Corporation, 589 West Hollis St.; Suite 201, Nashua, NH 03062, United States

[2]Air Force Research Laboratory, 29 Randolph Road, Hanscom AFB, MA 01731, United States

[3]University of Iowa, Department of Physics and Astronomy, Iowa City, IA 52242, United States

[4]University of California - Los Angeles, IGPP, Los Angeles, CA, United States

We interpret field aligned electrons with energies between 0.5 and several keV observed at the dayside magnetopause current layer as signatures of active merging somewhere on that field line. Electron gyrotropy breaks down near the merging separator. Trapped plasma sheet fluxes and magnetosheath fluxes entering the separator region loose their source-identity relative to magnetic field lines at active merging sites on the dayside magnetopause. As they exit between the separatrices, electrons re-attach to magnetic field lines with random pitch angles, creating significant fluxes parallel to the magnetic field at all energies. At locations remote from the separator, the higher energy fluxes are seen closest to the separatrices. Electrons with energies between 0.5 and several keV follow the inner separatrix into the ionosphere near the edge of the cusp, where they can excite 557.7 nm emissions. The presence of significant parallel fluxes at these energies is a signature of active merging. Electron fluxes are observed in both parallel directions at the inner separatrix as they are quickly mirrored back from the ionosphere. Near the outer separatrix the fluxes will be away from the separator only. We present Polar data illustrating the above properties when B_Z is nearly southward. When IMF B_Y is present the standard 2-dimensional geometry of the separator region becomes more complicated. MHD simulations and Polar data suggest that active merging signatures in the electrons and ions on the magnetosphere and magnetosheath sides of the local magnetopause current layer may be tied to very different source regions. The presence of accelerated ions at magnetopauses with moderate to high magnetic shear is not a sufficient condition for local component magnetic merging. Merging may be occurring at remote locations, with magnetic field lines on both sides of the current layer exhibiting different signatures from different sources. The signatures are varying with time.

SM51C-03 0900h

CLUSTER Observation of Signatures of Continuous Reconnection and Characteristics of Dayside Magnetopause Around Cusp

Yihua Zheng[1] (301-286-4647; yzheng@lepvax.gsfc.nasa.gov); Guan Le[2] (Guan.Le@nasa.gov); James A. Slavin[2] (James.A.Slavin@nasa.gov); Melvyn L. Goldstein[2] (melvyn.l.goldstein@nasa.gov); Cindy Cattell[3] (cattell@belka.space.umn.edu); Andre Balogh[4] (a.balogh@ic.ac.uk); Elizabeth Lucek[4] (e.lucek@ic.ac.uk); Henri Reme[5] (Henri.Reme@cesr.fr); Alessandro Retino[6] (alessandro.retino@irfu.se)

[1]National Research Council, NASA Goddard Space Flight Center, Mailcode 696, Bldg21, Rm C218, Greenbelt, MD 20771, United States

[2]NASA Goddard Space Flight Center, Lab for Extraterrestrial Physics, Greenbelt, MD 20771, United States

[3]University of Minnesota, School of Physics and Astronomy, University of Minnesota, Tate Lab, 116 Church Street, S. E.,, Minneapolis, MN 55455, United States

[4]Imperial College, Department of Space and Atmospheric Physics, London, United Kingdom

[5]CESR, BP4346, 31028 Toulouse Cedex 4, Toulouse, France

[6]Swedish Institute of Space Physics, Uppsala Division, Uppsala, Sweden

In this paper, we will present a case study of continuous reconnection at the dayside magnetopause observed by the Cluster spacecraft. On 1 April 2003, the four Cluster spacecraft experienced multiple encounters with Earth's dayside magnetopause under a fairly stable southwest-ward interplanetary magnetic field (IMF). Accelerated plasma flows whose magnitude and direction are consistent with the predictions of the reconnection theory (Walén relation) were observed at and around the magnetopause current layer for a prolonged interval of 3 hours. Reversals in the Y component of ion bulk flow between the magnetosheath and magnetopause current layer and acceleration of magnetosheath electrons were also observed. This event provides strong in-situ evidence that magnetic reconnection at the dayside magnetopause can be continuous for many hours. However, the reconnection process appeared to be very dynamic rather than steady despite the steady nature of the IMF. Detailed analysis using multi-spacecraft magnetic field and plasma measurements shows that the dynamics and structure of the magnetopause current layer/boundary can be very complex. For example, highly variable magnetic and electric fields were observed in the magnetopause current layer. Minimum variance analysis shows that the magnetopause normal deviates from the model normal. Surface waves resulted from the reconnection may be involved in the oscillation of the magnetopause.

SM51C-04 0915h

The Spherical Tearing Mode

A. Bhattacharjee[1] (603 862 2507; amitava.bhattacharjee@unh.edu)

S. Hu

J. Greene

J. Dorelli[1]

J. Raeder[1]

[1]Space Science Center, University of New Hampshire, Space Science Center 245A Morse Hall, Durham, NH 03824, United States

While our understanding of resistive tearing modes in two-dimensional magnetic configurations is quite complete, relatively little is known is known about the geometry and dynamics of tearing modes in truly three-dimensional magnetic configurations like the Earth's magnetosphere. We present new results on the spherical tearing mode, which is the three dimensional generalization of the classical tearing mode first discovered by Furth, Killeen, and Rosenbluth (FKR). In this model, loops of field lines connecting magnetic nulls play the role of X-lines lines in two-dimensional slab geometry. In the initial equilibrium, a closed spherical surface composed of null-null lines separates an inner region of closed field lines from an outer region of open field lines. A new fast tearing instability of this three-dimensional equilibrium, which contains a closed spherical separatrix composed of null-null lines, is identified. The instability growth rate scales as S-1/4, where S is the Lundquist number, and is thus significantly faster than the FKR tearing mode. The spherical tearing surface breaks up, enabling the closed field lines to break and reconnect with open field lines. The new geometry thus realized is relevant to the type of 3D magnetic geometries realized in global 3D MHD codes in which reconnection is usually forced by the solar wind. Implications for 3D reconnection in the Earth's magnetosphere will be discussed.

SM51C-05 0930h

The Structure of the Electron Demagnetization Layer in Guide-Field Reconnection

Michael Hesse[1] (michael.hesse@nasa.gov)

Masha Kuznetsova[1] (masha@elbrus.gsfc.nasa.gov)

Joachim Birn[2] (jbirn@lanl.gov)

[1]NASA GSFC, Code 696

[2]Los Alamos National Loboratory, NIS-1

We present an analysis based on particle-in-cell simulations and kinetic theory of the electron dissipation region in component merging. Specifically, we will derive scaling laws of the electron demagnetization scale based on electron nongyrotropy effects, which continue to play the dominant role even in the presence of a guide field. We will compare our results to those of other recent and on-going investigations, and derive a general expression of the reconnection electric field for guide-field magnetic reconnection.