SH52B-04 1415h

High Frequency Waves and Associated Electron Heating in the Foot of Quasi-Perpendicular Collisionless Shocks

Shuichi Matsukiyo[1] (matsu@ipp.mpg.de)

Manfred Scholer[1] (mbs@mpe.mpg.de)

Iku Shinohara[2] (iku@stp.isas.ac.jp)

[1]Max-Planck-Inst. f. extraterr. Physik, P.O. Box 1312, Garching 85741, Germany

[2]Inst. Space and Aeronautical Science, Sagamihara, Kanagawa 229-8510, Japan

We have studied the dynamics of ions and elelctrons in the foot and ramp of almost perpendicular shocks in the supercritical Mach number regime by particle-in-cell (PIC) simulations.In the past, nonrealistic ion to electron mass ratios have been used in such simulations in order to reduce the computational strain. It is found that when a realistic mass ratio is used oblique whistler waves are generated in the foot region via the interaction of incoming and reflected ions with the solar wind electrons. The linear instability has been investigated by three-fluid analysis and exhibits a growth rate which increases strongly with the mass ratio. Since low beta shocks exhibit a cyclic reformation process this instability has not yet been seen in low mass ratio PIC simulations. We have analyzed the nonlinear development of the instability and the associated parallel and perpendicular electron heating.

SH52B-05 1430h

Simulation of Foreshock Strcutures at the Bow Shock

Yu Lin ((334)844-4683; ylin@physics.auburn.edu)

Auburn University, Physics Department 206 Allison Laboratory, Auburn, AL 36849-5311, United States

A 2-D global hybrid simulation is carried out to study the kinetic structure of the bow shock. In the simulation, the bow shock is formed by the interaction between the supersonic solar wind and the geomagnetic field. The simulation domain contains the dayside plasma regions from the geocentric distance of $r = 5R_E$ to $30R_E$. Strong temperoal electromagnetic wave activities are found in the shock transition and foreshock regions due to reflected ions at the bow shock. Later, spatial structures with alternate temperature increases and decreases develop around quasi-parallel shocks, where reflected ion beams and diffuse ions are present in the foreshock regions. These structures are elongated along field lines, both upstream and downstream of the bow shock, some with a high temperature and low ion density, magnetic field, and flow speed, and others with a low temperature and high density, magnetic field, and flow speed. Those with temperature increases and density, magnetic field, and the flow speed decreases appear like weak hot flow anomalies (HFAs), but without strong flow deflections. While HFAs can be generated by the arrival of external, interplanetary discontinuities at the bow shock, the existence of these foreshock cavities are due to the internal kinetic processes in the bow shock. The structure of the foreshock cavities are investigated and compared with that of HFAs. The ion velocity distributions around the foreshock cavities are examined. The relation between the foreshock structures and the upstream ion beams and associated waves is also discussed. The simulation results will be compared with recent satellite observations of the foreshock.

SH52B-06 1445h

Energetic Ions and Foreshock Cavities

David G Sibeck[1] (1-301-286-5998; david.sibeck@gsfc.nasa.gov)

Tai D Phan[2] (1-510-643-5505; phan@ssl.berkeley.edu)

Ronald P. Lepping[1] (1-301-286-5413; ronald.lepping@gsfc.nasa.gov)

[1]NASA/GSFC, 8800 Greenbelt Rd, Greenbelt, MD 20771, United States

[2]SSL/UCB, Centennial Drive and Grizzly Peak, Berkeley, CA 94810, United States

Kinetic processes within the foreshock greatly perturb solar wind plasma and magnetic field parameters shortly prior to their interaction with the bow shock and magnetopause. Although few in number, Fermi accelerated ions exert pressures comparable to those of the ambient interplanetary magnetic field (IMF) and solar wind thermal plasma. The ions excavate cavities of depressed magnetic field strength and density on bundles of magnetic field lines connected to the bow shock. We use observations from Wind?s perigee passes to quantify the magnitude of these perturbations as functions of radial distance, local time, and ion flux levels outside the Earth?s bow shock. The perturbations first become noticeable some 60 RE upstream from Earth, while their effects are pronounced (factor of 2-3 variations) immediately outside the bow shock. As ion fluxes are bounded, the resulting density and magnetic field strength perturbations are most pronounced during intervals of low solar wind density and magnetic field strength, corresponding to high solar wind velocities. The foreshock cavities are an important (perhaps the most important) source of transient events in the outer dayside magnetosphere and high-latitude ionosphere.

SH52C MCC: 124 Friday 1515h

Toward an Integrated Solar-Terrestrial Data Environment II

(joint with A, SA, SM)

Presiding: **T G Onsager,** NOAA Space Environment Center**; G D Reeves,** Los Alamos National Laboratory

SH52C-01 1520h INVITED

Planning for the Future: The Decadal Survey as an Expression of Community Data Needs

Louis J Lanzerotti[1,2] (908-582-2279; ljl@science.lucent.com)

[1]Bell Laboratories, Lucent Technologies, Rm.1E-439 600 Mountain Avenue, Murray Hill, NJ 07974, United States

[2]Center for Solar Terrestrial Research, Department of Physics, New Jersey Institute of Technology, Newark, NJ 07102, United States

The members of the Committee and of the Panels of the just-completed Solar and Space Physics Decadal Survey found, both in their numerous dialogs with the research community and in their deliberations, that a strongly integrated and innovative data environment will be required to make the next leaps in scientific understanding from the data and in practical applications of the data. Further, together with an increasingly integrated data environment, new emphasizes must also be placed on such infrastructure matters as the support and operations of guest investigator programs for both ground-based and space-based national research facilities. There is considerable optimism that the coming decade will see numerous innovations in the integrated handling of data and of their use for new science and new applications. This talk will outline the conclusions and related recommendations for solar and space physics data from the Decadal Survey for the coming years.

SH52C-02 1540h INVITED

The State of the Solar Terrestrial Data Environment

Raymond J. Walker[1,2] (310-825-7685; rwalker@igpp.ucla.edu)

Steven P. Joy[1] (sjoy@igpp.ucla.edu)

Todd A. King[1] (tking@igpp.ucla.edu)

[1]Institute of Geophysics and Planetary Physics, University of California, Los Angeles, Los Angeles, CA 90095-1567, United States

[2]Department of Earth and Space Science, University of California, Los Angeles, Los Angeles, CA 90095-1567, United States

The data from space missions are national treasures. Many of these data are irreplaceable. In solar terrestrial physics data from current missions provide us with state of the art observations with which to address the complex problems of space plasma physics while data from older missions help us place current observations in perspective by providing continuity through time. Data that are prepared so that outside scientists can readily use them have a better chance of being useful years from now than data prepared just for the investigation team. In this talk we will evaluate the state of space physics data activities from the perspective of scientists who were not involved with the data collection. We have asked whether the data meet the needs of scientists today and whether they meet the requirement to provide a long lasting archive. We have evaluated the data from solar terrestrial missions against 4 criteria: 1.) Accessibility- is it easy for scientists to identify and locate the data needed for a given study? Once the data have been located are they readily available to the scientific community? Are they available online or on distributable media? Is needed calibration data readily available? 2.) Documentation- are the data documented so that knowledgeable scientists who are not instrument experts can use them? Does the documentation adhere to recognized standards? Does the documentation explain how the data were collected, and how they were processed as well as the format of the data? Is data quality including sources of contamination carefully documented? 3.) Preservation- is a system in place to assure that the data are not lost? Are the data archived to long lasting media? Are there copies of the data? Is there a program to test and refresh media? 4.) Scaleability- are the technologies being used meeting the demands of today's users? Are the current data system technologies scaleable to planned data rates from future missions? How are the data systems addressing anticipated data demands?

SH52C-03 1555h INVITED

The Right Amount of Glue: Technologies and Standards Relevant to a Future Solar-Terrestrial Data Environment

Joseph B Gurman[1] (3012864767; gurman@gsfc.nasa.gov); George Dimitoglou[1] (george@esa.nascom.nasa.gov); Richard S Bogart[2] (rbogart@spd.aas.org); Karen Qing Tian[2] (ktian@stanfordalumni.org); Frank Hill[3] (fhill@noao.edu); Steven Wampler[3] (swampler@noao.edu); Petrus C. Martens[4] (martens@solar.physics.montana.edu); Alisdair Davey[4] (ard@solar.physics.montana.edu)

[1]NASA Goddard Space Flight Center, Lab. for Astronomy and Solar Physics Code 682.3, Greenbelt, MD 20771, United States

[2]Stanford University, Ctr. for Space Science and Astrophysics, Stanford, CA 94305-4805, United States

[3]National Solar Observatory, P.O. Box 26732, Tucson, AZ 85726-6732, United States

[4]Montana State University, Physics Dept. P.O. Box 172840, Bozeman, MT 59717-3840, United States

In order to meet the challenge of developing a new system science, we will need to employ technology that enables researchers to access data from fields with which they are at least initially unfamiliar as well as from sources they use more regularly. At the same time, the quantity of data to be obtained by missions such as the Solar Dynamics Observatory demands ease and simplicity of data access. These competing demands must in turn fit within severely constrained funding for data analysis in such projects.

Based on experience in only a single discipline but with a diversity of data types and sources, we will give examples of technology that have made a significant difference in the way people do science. Similarly, we will show how adoption of a well-dcoumented data format has made it easier for one community to search, reduce, and analyze data. We will also describe a community-supported data reduction and analysis software tree with useful features.

We will attempt to generalize the lessons learned in these instances to features the broader, solar-terrestrial community might find compelling, while avoiding overdesign of a common data environment.

URL: http://umbra.nascom.nasa.gov/

SH52C-04 1610h INVITED

The Roles and Needs of Models in the Future Solar-Terrestrial Data Environment

Charles C Goodrich[1] (617-353-6658; ccg@bu.edu)

John Lyon[2] (603-646-1242; lyon@tinman.dartmouth.edu)

Michael Wiltberger[2] (603-646-0428; wiltbemj@tinman.dartmouth.edu)

[1]Department of Astronomy, Boston University, 725 Commonwealth Ave, Boston, MA 02215, United States

[2]Department of Physics and Astronomy, Dartmouth College, 6127 Wilder Lab Dartmouth College, Hanover, NH 03755, United States

We have recently embarked on two projects to model the Solar Terrestrial environment through linking the regional codes together. We discuss here, from the perspective of our projects, the characteristics of the individual codes. These are well known and respected in the SPA community: the SAIC corona code, the NCAR solar wind code, the LFM magnetosphere code, the Rice RCM, and NCAR ITM code (TING). We further discuss the issues important for coupling of these codes, and explore briefly the methods from the computational and computer sciences that may help address them.

SH52C-05 1625h INVITED

The Living with a Star Data Environment

Therese A Kucera (301-286-0829; terry.kucera@gsfc.nasa.gov)

NASA/ GSFC, Code 682 NASA/GSFC, Greenbelt, MD 20770, United States

Living with a Star (LWS) is a program of applied scientific research geared towards understanding and predicting the effects of the Sun on human society. The LWS data environment is key to the success of the program. We will have to combine diverse data sets from a wide array of sources, including ones beyond the formal LWS missions. Data must be integrated with models and across disciplines. The size of some of the data sets will be unprecedented in our field, requiring innovations in data searching and selection techniques. We will have to work together as a community to develop easy data access, metadata standards, community software trees, and other essentials to the free sharing of data needed to attain LWS goals.

SH52C-06 1655h INVITED

Next Steps Toward an Integrated Solar-Terrestrial Data Environment: A Summary View

D. N. Baker (303-492-4509; daniel.baker@lasp.colorado.edu)

Laboratory for Atmospheric and Space Physics, U. of Colorado , 1234 InnovationDrive , Boulder, CO 80303, United States

The goal of solar-terrestrial research is to obtain information about the connected Sun-Earth system. However, the key to scientific success is to convert this information (data) into knowledge and, ultimately, to transform knowledge into wisdom. It has rightly been noted that research and development agencies such as NASA (as well as NSF, NOAA, and DOD) with new missions and new data collection platforms have been transformed into knowledge agencies. In order to make major new advances in solar-terrestrial research, it will be necessary to couple physical models from the Sun to the Earth and to assimilate vast data sets in a rapid and efficient way. As a summary of the preceding panel discussion and this session overall, this talk will attempt to identify our best consensus understanding of the next steps that should be taken to achieve a modern, well-integrated solar-terrestrial data environment.

SH61A MCC: Hall D Saturday 0830h

Particle Acceleration at Heliospheric Shocks: Observations, Theory, and Modeling I Posters

Presiding: **G C Ho,** Applied Physics Laboratory

SH61A-0420 0830h POSTER

Acceleration of Electrons by Interacting CMEs

Marek Vandas[1] (420-2-67103061; vandas@ig.cas.cz)

Dusan Odstrcil[2]

[1]Astronomical Institute, Academy of Sciences, Bocni II 1401, Praha 4 14131, Czech Republic

[2]University of Colorado/CIRES and NOAA/Space Environment Center, Broadway, Boulder, CO 80303, United States

There is a growing observational evidence that interactions of coronal mass ejections (CMEs) near the Sun is a common phenomenon. Recently, we have performed 2-D MHD simulations of the interaction between two magnetic flux ropes. The aim was to provide some qualitative picture of the shock-cloud and cloud-cloud dynamic interactions that might be relevant to the interaction of CMEs. A fast CME generates a shock wave which penetrates a slower CME. Enhanced magnetic field in the flux rope and helical structure of field lines may favor acceleration of electrons at the shock by fast-Fermi process: multiple encounters are possible and nearly perpendicular parts of the shock are more abundant. Using results of our MHD simulations, we examine numerically efficiency of electron acceleration during the CME interaction.

SH61A-0421 0830h POSTER

Low Energy Ion Composition Variations in Large Solar Energetic Particle Event

George C Ho[1] (240-228-7083; george.ho@jhuapl.edu)

Edmond C Roelof[1]

Glenn M Mason[2]

Robert E Gold[1]

Joseph E Mazur[3]

[1]Johns Hopkins University Applied Physics Laboratory, 11100 Johns Hopkins Road, Laurel, MD 20723, United States

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

[3]Aerospace Corporation, 2350 E. El Segundo Bl., El Segundo, CA 90245, United States

We have examined the temporal variations of low energy (∼0.3 MeV/nucleon) hydrogen, helium and iron ions within thirty large SEP events using the ULEIS instrument on the ACE spacecraft (November 1997 to December 2002). We only selected clear and isolated events to study the variation in elemental abundances both during the event and averaged over the event. These events originated from different solar longitudes; hence we compare events that have similar magnetic connection to minimize the transport effects. All events exhibited an eventual decrease in the He/H ratio as is suggested by a recent theoretical model [Ng et al., 1999], but the degree of variation of He/H varies from event to event. However, we observed large temporal fluctuations in the Fe/O ratio in most of our events; these large fluctuations were not restricted just to the onset of the events. Even in events that have similar characteristics (magnetic connection, intensity), the Fe/O ratios can vary drastically from one event to another.

SH61A-0422 0830h POSTER

The Outer Source of Pickup Ions and Anomalous Cosmic Rays

Nathan A. Schwadron[1] (nschwadron@swri.edu)

Mike Combi[2] (mcombi@umich.edu)

Walter Huebner[1] (whuebner@swri.edu)

David J. McComas[1] (dmccomas@swri.edu)

[1]Southwest Research Institute, PO Drawer 28510 , San Antonio, TX 78228-0510, United States

[2]University of Michigan , 2455 Hayward, Ann Arbor, MI 48109-2143, United States

The traditionally accepted source of Anomalous Cosmic Rays (ACRs) is neutral atoms penetrating the heliosphere from the local interstellar cloud (LIC). The ACR composition should be depleted in easily ionized atoms such as C, Si, and Fe. However, significant fluxes of these ions are observed in ACRs and their source has not been previously identified. We show that there is an "outer source" of pickup ions, and hence ACRs, caused by sputtered atoms (subsequently ionized and picked up by the solar wind) from small grains generated via collisions of objects in the Edgeworth-Kuiper Belt. The outer source accounts for the abundance and composition of the additional population of ACRs. The discovery that ACRs are generated from material in the Edgeworth-Kuiper Belt provides an exciting new tool for understanding the mass distribution and composition of the Edgeworth-Kuiper Belt, and for probing the plasma-dust interactions in stellar environments.

SH61A-0423 0830h POSTER

ACE/SEPICA Observations of Energetic He^+ Associated With Interplanetary Disturbances at 1AU

H. Kucharek[1] (Harald.Kucharek@unh.edu); E. Moebius[1]; W. Li[1]; C. Farrugia[1]; M. Popecki[1]; A. Galvin[1]; B. Klecker[2]; M. Hilchenbach[3]; P. Bochsler[4]

[1]Dept. of Physics and Inst. for the Study of Earth, Oceans and Space, University of New Hampshire, 39 College Road, Durham, NH 03824, United States

[2]Max-Planck-Institut fuer extraterrestrische Physik, Postfach 1603, Garching 85741, Germany

[3]Max-Planck-Institut fuer Aeronomie, Max-Planck-Str. 2, Katlenburg-Lindau 37819, Germany

[4]University of Bern, Sidlerstrasse 5, Bern 3012, Switzerland

Solar Energetic Particle (SEP) events with unusually high abundance in He^+ that have been observed between 1998 and 2000 with ACE/SEPICA have been investigated in detail. Usually He^+/He^{2+} abundance ratio in the solar wind/corona is of the order of $10e^{-4}$. However during SEP events the He^+/He^{2+} ratio can be closer to one. This survey has shown that the increase of the He^+/He^{2+} abundance ratio coincides with the arrival of the shock (either driven by a CME or associated with a CIR) or a discontinuity. The analysis strongly suggests local acceleration of these ions and it is also shown that interstellar pickup ions are the main source for the He^+ enhancement. We have identified the types of discontinuities which are predominantly associated with an increase of the He^+/He^{2+} ratio. A representative sample of CMEs, CME-related disturbances as well as corotating/transient streams has been examined in detail. We have investigated the observed temporal and energy dependence of the He^+/He^{2+} ratio at the disturbances and we will describe the implications for the acceleration of He^+ pickup ions in the Heliosphere.

SH61A-0424 0830h POSTER

Electron Energization Process through the Electron-ion Coupling in the Shock Transition Region

Nobue Shimada[1] (+81-42-327-7538; non@crl.go.jp)

Masahiro Hoshino[2] (+81-3-5841-4584; hoshino@eps.s.u-tokyo.ac.jp)

[1]Communications Research Lab. (JSPS), 4-2-1 Nukui-Kitamachi, Koganei, Tokyo 184-8795, Japan

[2]University of Tokyo, 7-3-1 Hongo, Bunkyo-ku, Tokyo 113-0033, Japan

Collisionless shock waves convert ion inflow energy to the electron and ion thermal and non-thermal energy through electromagnetic field-particle interaction (shock dissipation process). In what way the ion inflow energy is transferred to the fields and electrons (or energy partition process) has been a long-standing problem. Recently, both of the observational and theoretical study indicate that electron scale (order of the electron inertia) coherent structure like electron phase holes and they play an important role to the electron energization process. Buneman instability between the inflow electron and the reflected ion is representative for the rapid electron-ion interaction through the electrostatic field which evolves nonlinear state of the formation of the large amplitude electrostatic structures (electron phase hole). Further, the electron phase hole couples with the inflow ion as well as the reflected ion on the branch of the ion-acoustic mode. Under some plasma conditions, we discuss this strong electron hole-ion coupling state from the point of view of the energy dynamics and exchange process between the electron and ion in the shock transition region by applying particle-in-cell simulation.

SH61A-0425 0830h POSTER

Cosmic-ray Spectra at Spherical Shocks

Vladimir Florinski[1] (1-909-787-3943; vflorins@citrus.ucr.edu)

J. R. Jokipii[2] (1-520-621-4256; jokipii@lpl.arizona.edu)

[1]Institute of Geophysics and Planetary Physics, University of California, Riverside, 900 University Avenue, Riverside, CA 92521, United States

[2]Lunar and Planetary Laboratory, University of Arizona, 1629 E. University Blvd., Tucson, AZ 85721, United States

We discuss the nature of the spectra of particles accelerated at spherical shocks, such as the solar wind termination shock. We show that, in addition to the two well-known spectral regions characterized by a power-law momentum dependence and an exponential high-energy cutoff caused by the spherical geometry, a new region can be identified. This consists of an enhancement of the cosmic-ray intensity ("bump") just below the cutoff. Similar features have been seen previously in multi-dimensional models and cosmic-ray modified shocks,where they were explained by acceleration in the latitudinal direction along the shock face and decreasing effective shock compression ratio, respectively. We show that a similar "bump" may be obtained in a purely spherically-symmetric geometry with no drifts. We attribute this effect to increased shock acceleration efficiency at certain energies. We also demonstrate that a one-dimensional planar shock with a reflecting wall upstream can give a similar effect.