second peak, which is difficult to understand in terms of transport along a standard Archimedean spiral magnetic field or a second injection near the Sun. Here we present an analysis of selected polar monitors, a subset of the present-day Spaceship Earth network, which provide a clean measurement of the directional distribution of solar energetic particles at ~ 1-3 GV. The omnidirectional intensity dips after the initial spike, followed by a nearly isotropic hump and a slow decay. The intensity and anisotropy data are fit by simulating the particle transport for various magnetic field configurations and determining the best-fit injection function near the Sun. The data are not well fit for a magnetic bottleneck beyond Earth or for particle injection along one leg of a closed magnetic loop. A model with simultaneous injection along both legs of a closed loop provides the best explanation: particles moving along the near leg make up the spike, those coming from the far leg make up the hump, and trapping in the loop accounts for the slow decay of the intensity. This work was supported by the Thailand Research Fund, the Rachadapisek Sompoj Fund of Chulalongkorn University, and NSF grant ATM-0000315.

SH31A-05 0830h POSTER

Finite Time Shock Acceleration at Interplanetary Shocks

Chanruangrit Channok[1,2] (physics007@yahoo.com)

David Ruffolo[1,2] (david_ruffolo@yahoo.com)

Mihir I. Desai[3] (desai@uleis.umd.edu)

Glenn M. Mason[3] (Glenn.Mason@umail.umd.edu)

[1]Chulalongkorn University, Department of Physics, Faculty of Science, Bangkok 10330, Thailand

[2]Mahidol University, Department of Physics, Faculty of Science, Rama 6 Road, Bangkok 10400, Thailand

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

Observations of energetic ion acceleration at interplanetary shocks sometimes indicate a spectral rollover at ~ 0.1 to 1 MeV nucl^{-1}. This rollover is not well explained by finite shock width or thickness effects. At the same time, a typical timescale of diffusive shock acceleration is several days, implying that the process of shock acceleration at an interplanetary shock near Earth usually gives only a mild increase in energy to an existing seed particle population. This is consistent with a recent analysis of *ACE* observations that argues for a seed population at substantially higher energies than the solar wind. Therefore an explanation of typical spectra of interplanetary shock-accelerated ions requires a theory of finite-time shock acceleration, which for long times (or an unusually fast acceleration timescale) tends to the steady-state result of a power-law spectrum. We present analytic and numerical models of finite-time shock acceleration. For a given injection momentum p_0, after a very short time there is only a small boost in momentum, at intermediate times the spectrum is a power law with a hump and steep cutoff at a critical momentum, and at longer times the critical momentum increases and the spectrum approaches the steady-state power law. The composition dependence of the critical momentum is different from that obtained for other cutoff mechanisms. The results are compared with observed spectra. Work in Thailand was supported by the Commission for Higher Education, the Rachadapisek Sompoj Fund of Chulalongkorn University, and the Thailand Research Fund. Work at the University of Maryland was supported by NASA contract NAS5-30927 and NASA grant PC 251428.

SH31A-06 0830h POSTER

Sharp Trapping Boundaries in the Random Walk of Interplanetary Magnetic Field Lines

David Ruffolo[1] (david_ruffolo@yahoo.com); Piyanate Chuychai[1,2,3] (piyanate@corona.phys.sc.chula.ac.th); Jakapan Meechai[1,2] (jefuka@hotmail.com); Peera Pongkitiwanichkul[1,2] (peerious@yahoo.com); Nimit Kimpraphan[1,2] (mit@astro.phys.sc.chula.ac.th); William H. Matthaeus[3] (yswhm@bartol.udel.edu); George Rowlands[4] (G.Rowlands@warwick.ac.uk)

[1]Mahidol University, Department of Physics, Faculty of Science, Rama 6 Road, Bangkok 10400, Thailand

[2]Chulalongkorn University, Department of Physics, Faculty of Science, Bangkok 10330, Thailand

[3]University of Delaware, Bartol Research Institute, Newark, DE 19716, United States

[4]University of Warwick, Department of Physics, Coventry CV4 7AL, United Kingdom

Although magnetic field lines in space are believed to undergo a diffusive random walk in the long-distance limit, observed dropouts of solar energetic particles, as well as computer simulations, indicate sharply defined filaments in which interplanetary magnetic field lines have been temporarily trapped. We identify mechanisms that can explain such sharp boundaries in the framework of 2D+slab turbulence, a model that provides a good explanation of solar wind turbulence spectra and the parallel transport of solar energetic particles. Local trapping boundaries (LTBs) are empirically defined as trajectories of 2D turbulence where the mean 2D field is a local maximum. In computer simulations, the filaments (or "islands" in the two dimensions perpendicular to the mean field) that are most resistant to slab diffusion correspond closely to the mathematically defined LTBs, that is, there is a mathematical prescription for defining the trapping regions. Furthermore, we provide computational evidence and a theoretical explanation that strong 2D turbulence can inhibit diffusion due to the slab component. Therefore, while these filaments are basically defined by the small-scale topology of 2D turbulence, there can be sharp trapping boundaries where the 2D field is strongest. This work was supported by the Thailand Research Fund, the Rachadapisek Sompoj Fund of Chulalongkorn University, and NASA Grant NAG5-11603. G.R. thanks Mahidol University for its hospitality and the Thailand Commission for Higher Education for travel support.

SH31A-07 0830h POSTER

Analytic Forms of the Perpendicular Diffusion Coefficient in Magnetostatic Turbulence

A Shalchi[1] (302-831-8118; shalchi@bartol.udel.edu)

J W Bieber[1] (302-831-2240; john@bartol.udel.edu)

W H Matthaeus[1] (302-831-2780; whm@udel.edu)

[1]Bartol Research Institute, University of Delaware, Newark, DE 19716, United States

Recently a nonlinear theory for perpendicular diffusion of charged particles was presented [1]. This theory is called the Nonlinear Guiding Center (NLGC) theory and provides an integral equation for the perpendicular mean free path. Here we report on analytical solutions of this equation in the case of magnetostatic turbulence. The resulting formulas for the perpendicular mean free path are discussed. We also compare these new results with results of the quasilinear theory (QLT) for parallel diffusion and with observational results [2]. This research supported in part by NSF grant ATM-0000315 and NASA grant NAG5-11603. [1] W H. Matthaeus, G. Qin, J. W. Bieber and G. P. Zank, Astrophys. J., 590, L53 (2003) [2] I. D. Palmer, Rev. Geophys. Space Phys., 20, 2, 335 (1982)

SH31A-08 0830h POSTER

Transport of Turbulence Throughout the Heliosphere and Determining its Impact on Solar Modulation of Cosmic Rays

S. Parhi[1] (sparhi@udel.edu); J. Minnie[2] (fskjm@puknet.puk.ac.za); B. Breech[1] (breech@udel.edu); J. W. Bieber[1] (john@bxclu.bartol.udel.edu); W. H. Matthaeus[1] (yswhm@bartol.udel.edu); R. A. Burger[2] (fskrab@puknet.puk.ac.za)

[1]University of Delaware, Bartol Research Institute, Newark, DE 19716, United States

[2]North-West University, Unit for Space Physics, Potchefstroom, South Africa

A global solar wind turbulence model is considered in a simulation domain which spans from close to the Sun to 100 AU and excludes the effect of termination shock at present. The four governing equations that model the turbulence describe fluctuation energy, correlation scale, temperature, and cross-helicity everywhere in the heliosphere. The transport equation for cross-helicity is new in this simulation [1]. These four equations are solved numerically along every radial direction in our simulation domain. The parameters present in these equations are plasma shear, wind speed, and strength of pick-up ions among others. Magnetic variance, correlation length, cross helicity and plasma temperature have latitudinal dependence along the inner boundary at 0.2 AU. The solar wind speed and velocity shear are varied across the simulation domain. A simple model of pick-up ions is employed at present. The early indication shows that the simulation results thus obtained have a good agreement with observations. Heating is suppressed in the inner heliosphere and at high latitudes by the cross helicity effect, and the Alfvenicity of the turbulence almost completely vanishes by 10 AU. This turbulence model will be combined with a modulation code that integrates Parker's transport equation numerically. This approach gives a better physical basis for the heliospheric distribution of turbulence, and thus it is expected that the physics of the scattering and modulation is improved. The whole exercise is part of our ongoing effort to develop ab initio turbulence and modulation models and integrate them together. The combined effort will enhance our understanding of solar modulation of cosmic rays. Supported by NSF grant ATM-0000315 and NASA NAG5-8134. W H Matthaeus, J. Minnie, B. Breech, S. Parhi, J. W. Bieber and S. Oughton, submitted to Geophys. Res. Lett. (2004)

SH31B CC: 518 A Wednesday 0830h

Violent Sun-Earth Connection Events of October-November 2003: Genesis

(joint with SA, SM)

Presiding: **N Gopalswamy,** NASA Goddard Space Flight Center**; S W Kahler,** Air Force Research Laboratory

SH31B-01 0830h INVITED

Flare Activity during the October-November 2003 Storms

Sam Krucker[1] (krucker@ssl.berkeley.edu)

. The RHESSI team (hessibugs@hesperia.gsfc.nasa.gov)

[1]Space Sciences Laboratory University of California Berkeley, 7 Gauss Way, Berkeley, CA 94720-7450, United States

The high solar activity during the last weeks of October and beginning of November 2003 with 11 X-class flares provides a great opportunity to study particle acceleration in flares. First results of multi-spacecraft and ground-based observations are summarized with a focus on X-ray observations from the Reuven Ramaty High Energy Solar Spectroscopic Imager (RHESSI).

URL: http://plasma2.ssl.berkeley.edu/~krucker/hessi/oct2003.html

SH31B-02 0850h INVITED

Irradiance Observations of the October 28, 2003 X-17 Flare

Gary Rottman[1] (303-492-8324; gary.rottman@lasp.colorado.edu); Thomas Woods[1] (woods@lasp.colorado.edu); Greg Kopp[1] (kopp@lasp.colorado.edu); William McClintock[1] (mcclintock@lasp.colorado.edu); Marty Snow[1] (snow@lasp.colorado.edu); Juan Fontenla[1] (fontenla@lasp.colorado.edu); Jerald Harder[1] (harder@lasp.colorado.edu)

[1]Laboratory for Atmospheric and Space Physics, University of Colorado, 1234 Innovation Drive, Boulder, CO 80303, United States

The Solar Radiation and Climate Experiment, SORCE, carries four instruments that measure solar irradiance – both total solar irradiance, TSI, and spectral irradiance from soft X-rays, ultraviolet, visible and near infrared. During the X-17 flare at 11:00 UT on October 28, 2003 the SORCE instruments were in ideal configurations to record increases in TSI and at most observed wavelengths. The X-ray and UV irradiance originating in the transition region and corona increased by factors as large as fifty. This large flare also provided the first measurement of an increase in TSI, a unique measurement that places an important new constraint on the energy release during the flare. This report is a survey and interpretation of the irradiance variations observed during this X-17 flare.

SH31B-03 0910h INVITED

Coronal Mass Ejections observed by SOHO during the October-November 2003 Storms

Nat Gopalswamy[1] (301-286-5885; gopals@fugee.gsfc.nasa.gov); Seiji Yashiro[2] (301-286-8025; yashiro@cdaw.gsfc.nasa.gov); Angelos Vourlidas[3] (vourlidas@nrl.navy.mil); Alejandro Lara[2] (alara@cspsw6.gsfc.nasa.gov); Guillermo Stenborg[2] (stenborg@kreutz.nascom.nasa.gov); Michael Kaiser[1] (Michael.kaiser@gsfc.nasa.gov); Russell Howard[3] (howard@cronus.nrl.navy.mil)

[1]NASA/GSFC, Mail Code 695.0, Greenbelt, MD 20771, United States

[2]The Catholic University of America, 620 Michigan Ave. NE, Washington, DC 20064, United States

[3]Naval Research Laboratory, 4555 Overlook Ave. SW, Washington, DC 20375, United States

Fast coronal mass ejections (CMEs), X-class flares, solar energetic particles, and interplanetary shocks were abundantly observed during the solar eruptions of October-November 2003. The Large Angle and Spectrometric Coronagraph (LASCO) on board SOHO detected more than five dozen CMEs from three active regions (NOAA ARs 0484, 0486, and 0488). We compare the statistical properties of these super-storm CMEs with those of the general population observed during cycle 23. We find that (i) the super-storm CMEs are faster and wider than average, and hence possess enormous energy, (ii) nearly 20 percent of the ultra-fast CMEs (speed > 2000 km/s) occurred during the October-November interval, including the fastest CME of cycle 23 (2700 km/s), and (iii) the rate of full-halo CMEs was nearly four times the average rate during cycle 23. We discuss the implications of these extreme properties for the solar energy source. We also discuss the interplanetary consequences of these CMEs, such as shocks, radio bursts and solar energetic particles.

SH31B-04 0930h

Remote Sensing Observations of the late October 2003 Geoeffective Halo CMEs

David F. Webb[1] (781-377-3086; david.webb@hanscom.af.mil)

. The SMEI Team

[1]ISR, Boston College, 140 Commonwealth Ave., Chestnut Hill, MA 02467, United States

Eleven major (X-class) flares with accompanying coronal mass ejections (CMEs) occurred over the 2-week period in late October and early November. These were part of a series of major events centered around 3 huge sunspot groups. The largest geoeffective event occurred on October 28, had the third highest peak X-ray flux (X17) ever recorded, and was followed by another energetic event (X10) on October 29. At least 3 of the CMEs from this activity were Earth-directed ("halos"), which erupted when the sunspot regions were near Sun center, and caused geomagnetic storms. The 2 strongest storms, driven by the fast CMEs from the X17 and X10 events, occurred on October 28-30 yielding peak Dst values of -363 and -401, resp. The earliest halo CME was associated with M-class flares and at least two erupting filaments on October 22. It produced only minor storminess at Earth because its magnetic field was mostly northward. The Air Force Solar Mass Ejection Imager (SMEI) on the Coriolis satellite captured images of two of the 3 halo CMEs, on October 23 and 29. We compare the SMEI observations with SOHO LASCO coronagraph and EIT observations and Interplanetary Scintillation (IPS) observations of the events to study their structure and kinematics. SMEI observed these halo CMEs starting at angular distances of 28 and 21 deg. from the Sun, or about 1/3 of the way from the Sun to Earth. These observations demonstrate that SMEI can detect even fast, Earth-directed CMEs up to a day before their arrival.

SH31B-05 0945h

A High-Speed Erupting Prominence CME:A Bridge Between Types

Joan Feynman[1] (818-354-2881; joan.feynman@jpl.nasa.gov)

Alexander Ruzmaikin[1] (818-393-3953; alexander.ruzmaikin)

[1]Jet Propulsion Laboratory, California Institute of Technology,, 4800 Oak Grove Dr., Pasadena, CA 91109, United States

Several studies have indicated that there may be two distinct types of Coronal Mass Ejections (CMEs): a high velocity bright energetic type associated with flares, and a smaller slower less impressive type associated with erupting prominences. How valid is this distinction? We analyze a CME combining attributes of both types, a high velocity bright CME associated with an erupting prominence. A study of this event and several others allows us to argue that the apparent differences separating the two types may be an observational effect. Our results are consistent with a single CME process for both flare associated and filament associated CMEs. This process consists of three stages. The initial stage is brought about by the emergence of new magnetic flux, which interacts with the pre-existing magnetic configuration and results in a slow rise of the magnetic structure, which later becomes the CME. The second stage is a fast reconnection phase with flaring and a sudden increase of the rise velocity of the magnetic structure. It also includes a rapidly increasing CME acceleration followed by a rapidly falling acceleration. The third stage or CME propagation stage shows only slow changes in the acceleration and finally the velocity becomes constant. LASCO observes only the third stage. The differences found between observed flare-associated and prominence-associated CME velocity behavior appears to be primarily due to the relative heights in the corona at which the erupting structures form.

SH32A CC: 518 A Wednesday 1030h

Violent Sun-Earth Connection Events of October-November 2003: Solar Plasmas *(joint with SA, SM)*

Presiding: **D Ruffolo,** Mahidol University**; J C Kasper,** Massachusetts Institute of Technology

SH32A-01 1030h

The Suns Halloween Scare and the Media Frenzy

Paal Brekke (301 286 6983; pbrekke@esa.nascom.nasa.gov)

European Space Agency, NASA/Goddard Sapce Flight Center, Mailcode 682.3, Bld. 26, Room G-1, Greenbelt, MD 20771, United States

SOHO appeared to be in everyone's focus this fall as the Sun turned from an almost spotless orb into an ominously scarred source of mighty fireworks in just a few days. Over two weeks, it featured three unusually large sunspot groups (including the largest one of this solar cycle), 11 X-class flares (including the strongest ever recorded), numerous halo CMEs (two with near-record speeds) and two significant proton storms which lasted for a combined five days. Satellites, power grids, radio communication and navigation systems were significantly affected in this period. The events caused unprecedented attention from the media and the public. Images from SOHO as well as quotes from SOHO scientists appeared in nearly every major news outlet (CNN, BBC, Associated Press, Reuters, to mention a few). Stories including SOHO images made the front page of newspapers and were featured prominently on including USA Today and The Washington Post. NASA estimated that the story reached "all" US newspapers and 2000 US TV channels. Media coverage in Europe was also impressive. The attention wiped out all existing SOHO web traffic records

URL: http://sohowww.nascom.nasa.gov/hotshots/pastshots.html#Halloween2003

SH32A-02 1045h INVITED

Fast, Hot and Furious: The October/November CMEs observed by ACE and WIND

Thomas H Zurbuchen[1] (thomasz@umich.edu); Adam Szabo[2] (Adam.Szabo-1@nasa.gov); Ruth Skoug[3] (rskoug@lanl.gov); Charles Smith[4] (Charles.Smith@unh.edu); Keith Ogilvie[2] (Keith.Ogilvie@gsfc.nasa.gov); Alan Lazarus[5] (ajl@mit.edu); Justin Kaspar[5] (jck@mit.edu)

[1]University of Michigan, Ann Arbor, MI, United States

[2]NASA Goddard Space Flight Center, Greenbelt, MD

[3]Los Alamos National Laboratory, Los Alamos, NM

[4]University of New Hampshire, Durham, NH

[5]Massachusetts Institute of Technology, Center for Space Research, MA

We discuss, using the ACE and WIND data, the solar activity during a period of approximately 10 days starting in late October 2003. The solar events of interest were associated with a very large cluster of highly complex active regions and resulted in coronal mass ejections causing a number of the most spectacular events ever observed in situ. This time-period includes the fastest CME ever directly observed, the hottest charge states observed to our knowledge, and the largest shock velocity jump observed in the solar wind to date. ACE observed the events from L1, and WIND observed then from the magnetospheric tail, successively emerging into the far magnetosheath during times of high dynamic pressure. We will also discuss electron data from both, WIND and ACE. In addition to excellent solar wind data, WIND also provided a unique measure of the time-variability of magnetosphere. We will use ACE and WIND data to discuss these events, as well as the interactions between various ejecta.

SH32A-03 1105h

Extremely fast solar wind observations during October-November, 2003

Ruth M Skoug[1] (505-667-6594; rskoug@lanl.gov); John T Steinberg[1] (jsteinberg@lanl.gov); John T Gosling[1] (jgosling@lanl.gov); David J McComas[2] (dmccomas@swri.edu); Charles W Smith[3] (Charles.Smith@unh.edu); Norman F Ness[4] (nfness@bxclu.bartol.udel.edu); Qiang Hu[5] (qiang.hu@ucr.edu); Leonard F Burlaga[6] (Leonard.F.Burlaga@nasa.gov)

[1]Los Alamos National Laboratory, Space and Atmospheric Sciences, ISR-1, MS D466, Los Alamos, NM 87545, United States

[2]Southwest Research Institute, Space Science and Engineering Division, San Antonio, TX 78228, United States

[3]University of New Hampshire, Institute for Earth, Oceans and Space, Durham, NH 03824, United States

[4]University of Delaware, Bartol Research Institute, Newark, DE 19711, United States

[5]University of California, Riverside, IGPP, Riverside, CA 92521, United States

[6]NASA, Goddard Space Flight Center, Greenbelt, MD 20771, United States

On October 29 and October 30, 2003, the SWEPAM instrument on the ACE spacecraft measured solar wind speeds in excess of 1850 km/s (best estimate of 2100 km/s) and 1710 km/s, some of the highest speeds ever directly measured in the solar wind. These speeds were observed following two large coronal mass ejection (CME) driven shocks. Surprisingly, despite the unusually high speeds, many of the other solar wind parameters were not particularly unusual in comparison with other large transient events. The magnetic field Bz reached -68 nT, large but not unprecedented values. Although the proton temperatures were higher than typical for a CME in the solar wind at 1 AU, the proton densities were moderate, leading to low to moderate plasma beta and dynamic pressure. The solar wind dynamic pressure reached 50 nPa, again not unusual for large events, but, when coupled with the large negative Bz, sufficient to cause intense geomagnetic disturbances at the Earth. The solar wind observations presented here provide the solar wind input to the magnetosphere during these events. We will present an analysis of the October-November 2003 shocks and CMEs using magnetometer observations from the ACE/MAG instrument and ion and electron observations from ACE/SWEPAM.

SH32A-04 1120h

An Unusually Fast CME Observed by Ulysses at 5 AU on November 15, 2003

Curt A de Koning[1] (505-667-3700; dekoning@lanl.gov); John T Steinberg[1] (jsteinberg@lanl.gov); John T Gosling[1] (jgosling@lanl.gov); Daniel B Reisenfeld[1] (dreisen@lanl.gov); Ruth M Skoug[1] (rskoug@lanl.gov); O C St. Cyr[2] (Chris.StCyr@nasa.gov); M L Malayeri[5] (leila@cme.gsfc.nasa.gov); David J McComas[3] (DMcComas@swri.edu); André Balogh[4] (a.balogh@ic.ac.uk)

[1]Los Alamos National Laboratory, Space and Atmospheric Sciences MS D466, Los Alamos, NM 87544, United States

[2]NASA Goddard Space Flight Center, NASA Goddard Space Flight Center Code 682, Greenbelt, MD 20771, United States

[3]Southwest Research Institute, Southwest Research Institue Space Science and Engineering Division, San Antonio, TX 78228, United States

[4]The Blackett Laboratory, Imperial College, London SW7 2BW, United Kingdom

[5]University of Maryland, Department of Physics, College Park, MD

On November 15, 2003, Ulysses was 5.2 AU from the sun and observed a large coronal mass ejection (CME) with a peak solar wind flow speed of 993 km/s and an average flow speed of 832 km/s. This is the fastest solar wind speed recorded by Ulysses SWOOPS at this distance since a similar event in November 1992. We believe this CME originated in the same group of active regions responsible for the extremely fast CMEs that impacted the Earth on October 29 and 30, 2003. The CME took 4.4 days to propagate past Ulysses, and thus had a radial width of ~ 2.1 AU . Using sunward ballistic projection of the CME, we infer a width of $\sim$1 AU at a radial distance of 1 AU, which is well above the average size observed at this distance. The structure of the CME resembles a magnetic cloud, with a depressed

SH