[5]University of Michigan, 2455 Hayward St., AOSS, Ann Arbor, MI 48109

The Solar Wind Ion Mass Spectrometer (SWIMS) on ACE has successfully measured the elemental abundance of nitrogen in the solar wind, N/O $\approx$ 0.121 $\pm$ 0.014, in excellent agreement with the photospheric value of N/O $\approx$ 0.123 and with the SEP-dervied coronal value. The abundance of nitrogen in the heliosphere is an enigma. Laboratory analysis of lunar soils shows that trapped nitrogen is overabundant in them by about one order of magnitude relative to the heavy noble gases, which in turn are efficiently trapped in the lunar regolith. In this work we investigate the variability of N/O in the solar wind. Since Ne/O is known to vary little, variations in N/O would translate directly to variations of N with respect to noble gases. Small variations in N/O will therefore provide further evidence for a non-solar origin of most of nitrogen in lunar soils. Nitrogen is not readily measured in the solar wind because it is not very abundant and it is neighbored in mass and in mass per charge by the most abundant heavy ions, oxygen and carbon. For this reason, previous elemental abundance determinations of nitrogen in the solar wind have had large intrinsic uncertainties. However, with SWIMS, nitrogen is cleanly separated from its neighbors and its abundance can be accurately measured.

SH41B-0469 0830h POSTER

Second Encounter of Ulysses With Jupiter

Edward J Smith[1] (818 354 2248; edward.j.smith@jpl.nasa.gov)

Richard G Marsden[2] (31 71 565 3583; richard.marsden@esa.int)

Steven T Suess[3] (256 961 7611; steve.suess@nsstc.nasa.gov)

Robert J MacDowall[4] (301 286 2608; robert.j.macdowall@nasa.gov)

[1]Jet Propulsion LAboratory, 4800 Oak Grove Dr., Pasadena, CA 91109, United States

[2]Space Science Department, European Space Science and Technology Centerr, Noorwijk 2200 AG, Netherlands

[3]NASA/MSFC, National Space Science and Technology Center, Huntsville, AL 35812, United States

[4]NASA/GSFC, Goddard Space Flight Center, Greenbelt, MD 20771, United States

Between November 2003 and April 2004, the Ulysses spacecraft will again be in the proximity of Jupiter creating an opportunity for more in-situ and correlated remote -sensing observations. The first encounter in February 1992 took place at a distance of closest approach of 6 Jupiter radii (Rj) and changed the inclination of the Ulysses trajectory so that it would pass above the sun's polar regions. Twelve years later, Jupiter has returned to near its previous location and Ulysses is again approaching aphelion near the orbit of Jupiter at 5.3 AU. This encounter is at much larger distances and Ulysses does not enter, but remains upstream of, the Jovian magnetosphere. However, the spacecraft travels from high to low Jovigraphic latitudes and covers a wide range of local times. On 19 November 2003, the Jovigraphic latitude is 75.5 deg at a distance of 2128 Rj and a local time (LT) near noon. The closest approach of 1683 Rj occurs on 4 February 2004 at 49.5 deg latitude near 17 hours LT. The formal encounter ends on 1 April 2004 at 1926 Rj, a latitude of 21.5 deg and a LT near 17:30. Jupiter is a prolific source of radio waves, energetic charged particles, dust and neutral gas, all of which can be detected by Ulysses. Simultaneous measurements of the solar wind and magnetic field will provide the nearly instantaneous conditions affecting Jupiter's magnetosphere and influencing the production of these emissions. Remote sensing observations by other missions or observers are encouraged to investigate the effect of changing solar wind conditions and structures on Jupiter's dynamic magnetosphere.

SH41B-0470 0830h POSTER

What do Measurements of Abundance Variations Tell us About the Origin and Evolution of the Solar Wind

Richard Woo[1] (1-818-354-3945; richard.woo@jpl.nasa.gov)

Shadia Rifai Habbal[2,3] (44 1970 622 218; sdh@aber.ac.uk)

Uri Feldman[4,5] (1-202-767-3286; uri.feldman@nrl.navy.mil)

[1]Jet Propulsion Laboratory, 4800 Oak Grove Drive MS 238-725, Pasadena, CA 91109, United States

[2]University of Wales at Aberystwyth, Department of Physics, Aberystwyth SY23 3BZ, United Kingdom

[3]Harvard Smithsonian Center for Astrophysics, 60 Garden Street, Cambridge, MA 02138, United States

[4]Artep Inc., 2922 Excelsior Springs Ct., Ellicott City, MD 21042, United States

[5]E.O. Hulbert Center for Space Research , Naval Research Laboratory, Washington, DC 20375, United States

Connections between the Sun and solar wind have recently been made based on observations of density, velocity, and magnetic field. These have led to fundamental changes in our understanding of coronal magnetic topology and the origin and evolution of the solar wind. During solar minimum, polar coronal holes are neither the only regions of open magnetic field lines nor the sole source of fast solar wind. Instead, open magnetic field lines thread the entire corona, and solar wind flowing along them carries the imprint of coronal holes, quiet Sun, and active regions into interplanetary space. The purpose of this paper is to show how measurements of abundance variations in the corona and solar wind reinforce and complete this picture, providing key insight into where and how the solar wind, especially the slow wind, is produced.

SH41B-0471 0830h POSTER

Macroscopic Instability of the Ion Shell Distribution Function in the Divergent Solar Wind

Valentin I. Shevchenko[1] (1-858-534-8547; vshevchnko@ucsd.edu)

Vitaly L. Galinsky[1] (1-858-534-2585; vit@ucsd.edu)

Roald Z. Sagdeev[2] (1-301-405-8051)

Dan Winske[3] (winske@lanl.gov Dan Winske (winske@lanl.gov)

[1]University of California, San Diego, 9500 Gilman Drive, La Jolla, CA 92093-0407, United States

[2]University of Maryland, Department of physics, College Park, College Park, MD 20742-3280, United States

[3]Los Alamos National laboratory, Los Alamos NATL LAB, Applied Theoretical Physiscs Division, Los Alamos, Los Alamos, NM 87545, United States

As a result of cyclotron interaction with Alfven waves propagating from the sun, pitch angle diffusion of resonant particles takes place and shell-like distribution function of resonant ions (protons) is formed at each distance from the sun [V. Galinsky and V. Shevchenko, Phys. Rev. Lett., 85, 90, 2000]. Stability of the solar wind ion shell-like distribution function with respect to excitation of waves at larger distances is addressed. It is shown in linear approximation, that in case when the phase velocity of Alfven waves decreases with distance, ions with shell distribution excite outward propagating Alfven waves with smaller phase velocities when they advance to larger distances. The real problem, how the shell distribution, created at some distance from the sun, is changed due to interaction with Alfven fluctuations with smaller phase velocities at larger distances in the divergent solar wind, is studied in quasi-linear approximation and by numerical simulations.

SH41C MCC: 3020 Thursday 1020h

The Solar Mass Ejection Imager (SMEI) and Related Remote-Sensing Heliospheric Observations II *(joint with SM)*

Presiding: **B V Jackson,** Center for Astrophysics and Space Physics, University of California, San Diego**; S Kahler,** Air Force Research Laboratory

SH41C-01 1020h INVITED

The Solar Mass Ejection Imager (SMEI) and Related Remote-Sensing Heliospheric Observations

Richard Radick[1] ((505) 434-7035; radick@nso.edu)

Janet Johnston[2] ((781) 377-2138; Janet.Johnston@hanscom.af.mil)

Joel Mozer[1] ((505) 434-7037; mozer@nso.edu)

. The SMEI Team

[1]AFRL/VSBXS, National Solar Observatory, Sunspot, NM 88349, United States

[2]AFRL/VSBXS, 29 Randolph Road, Hanscom AFB, MA 01731-3160, United States

The Solar Mass Ejection Imager (SMEI) is a proof-of-concept instrument intended to demonstrate the feasibility of space-based heliospheric imaging for detecting and tracking coronal mass ejections (CMEs) and other dense structures in the solar wind. SMEI is a joint effort of the Air Force Research Laboratory, the University of Birmingham (UK), the University of California at San Diego, Rutherford Appleton Laboratory (UK), and Boston College, funded by the AF, NASA and the University of Birmingham. SMEI was launched aboard the DoD Coriolis spacecraft on January 6, 2003, and began returning images in early February. Since launch, the SMEI team has invested considerable effort toward producing photometric all-sky maps of heliospheric brightness from the SMEI data. For the purpose of providing input for space weather forecasting, the SMEI team intends to start making these maps available to the scientific community and the public in near real time. Early quick-look, subtraction sky maps from SMEI's cameras demonstrate that SMEI can detect CMEs and image their structure as they move outward from the Sun, in some cases beyond 1 AU. This special session will include both presentations of initial SMEI results, and related papers on present and future remote sensing heliospheric observations.

SH41C-02 1035h INVITED

The Solar Mass Ejection Imager (SMEI)

George M Simnett[1] (441214146469; gms@star.sr.bham.ac.uk); Christopher J Eyles[1] (cje@star.sr.bham.ac.uk); Mark P Cooke[1] (mpc@star.sr.bham.ac.uk); Nicholas R Waltham[2] (N.R.Waltham@rl.ac.uk); James M King[2] (J.M.King@rl.ac.uk); Bernard V Jackson[3] (bvjackson@ucsd.edu); Andrew Buffington[3] (abuffington@ucsd.edu); Paul P Hick[3] (pphick@ucsd.edu); Paul E Holladay[4] (Paul.Holladay@hanscom.af.mil); Peter A Anderson[5] (panderson@plh.af.mil)

[1]School of Physics and Astronomy, University of Birmingham, Birmingham B15 2TT, United Kingdom

[2]Space Science Dept., Rutherford-Appleton Laboratory, Chilton OX11 0QX, United Kingdom

[3]Center for Astrophysics and Space Sciences, University of California at San Diego, LaJolla, CA 92093

[4]Air Force Research Laboratory/Space Vehicles Directorate (AFRL/VS), Hanscom AFB, Bedford, MA 01731

[5]Astronomy Dept, Boston University, Boston, MA 02467

The Solar Mass Ejection Imager (SMEI) has been designed to detect and forecast the arrival of solar mass ejections and other heliospheric structures which are moving towards the Earth. We describe the instrument, which was launched into a Sun-synchronous polar orbit on 6 January, 2003 on board the US DoD Coriolis spacecrafth. SMEI contains three CCD cameras, sensitive over the optical waveband, each with a field-of-view of 60 degrees x 3 degrees. The sensitivity is such that it will detect changes in sky brightness equivalent to a tenth magnitude star in one square degree of sky. Each camera takes an image every 4s and the normal telemetry rate is 128 kbits/s. SMEI has a photometric accuracy of around 0.1%. In addition to solar mass ejections, images of stars and the zodiacal cloud are measured to this photometric accuracy once/ orbit (102 minutes).

URL: http://www.sr.bham.ac.uk

SH41C-03 1050h INVITED

SMEI: First Results and Future Capabilities

David F. Webb[1,3] (781-377-3086; david.webb@hanscom.af.mil); Joel B. Mozer[2]; Richard R. Radick[2]; Janet C. Johnston[3]; Stephan D. Price[3]; Thomas Kuchar[1,3]; Donald R. Mizuno[1,3]; Bernard V. Jackson[4]; Andrew Buffington[4]; S. James Tappin[5]; George M. Simnett[5]

[1]ISR, Boston College, 140 Commonwealth Ave., Chestnut Hill, MA 02467-3863, United States

[2]Air Force Research Lab, Space Vehicles Directorate, Sacramento Peak Obs., Sunspot, NM 88349, United States

[3]Air Force Research Lab, Space Vehicles Directorate, 29 Randolph Road, Hanscom AFB, MA 01731-3010, United States

[4]CASS, University of California - San Diego, La Jolla, CA 92093-0424, United States

[5]Astrophysics and Space Research Group, University of Birmingham, Edgbaston, Birmingham B15 2TT, United Kingdom

The Solar Mass Ejection Imager (SMEI) experiment was launched on the STP Coriolis mission 6 January 2003 and is now recording all-sky, white light images on each 101-minute orbit. SMEI is fixed to the spacecraft and views the sky above Earth using sunlight-rejecting baffles and CCD camera technology. When fully calibrated, sky maps of structures having enhanced electron density in the inner heliosphere will be routinely produced. We will present some preliminary results of the early analysis of SMEI data. These include observations of several dozen coronal mass ejections (CMEs) as confirmed by the SOHO LASCO coronagraphs. One of these was a halo event which propagated to and beyond 1 AU and was associated with a major geomagnetic storm at Earth. Tomographic techniques are being developed to analyze the SMEI observations of the heliospheric plasma, including the transient CMEs and corotating interaction regions. SMEI also detected Comet NEAT inbound to and outbound from the Sun and the asteroid Vesta. With SMEI data we also can study solar and solar wind processes, and the experiment is capable of observing various other astronomical phenomena, such as variable stars, the Zodiacal light, near-Earth objects and extrasolar planetary transits.

SH41C-04 1105h INVITED

LASCO/SMEI Potential Joint Observations

Russell A Howard (202-767-3137; russ.howard@nrl.navy.mil)

Naval Research Laboratory Naval Research Laboratory , 4555 Overlook Ave., SW , Washington, DC 20375-5352, United States

The SOHO LASCO complement of coronagraphs has observed many halo CMEs. A subset of these events is the source of geomagnetic storms. A major question is to understand the propagation of CMEs through the interplanetary medium and their interaction with the Earths environment. LASCO observes the lateral expansion of Earth directed CMEs and can only infer the speed in the direction of Earth. Thus, determination of the time of impact at Earth from LASCO observations requires an extrapolation from the near-Sun environment. Combining observations from instruments such as SMEI will enable the tracking of such events as they propagate toward Earth, providing reliable predictions of the time of impact. Comparing the measurements from LASCO with SMEI will permit a number of studies. For example, the volumetric electron density of CMEs can be tracked from the Sun to the vicinity of Earth assuming the velocity field. One study would be to determine the electron density of the leading edge of the CME. From LASCO observations, the frontal electron density decreased according to the expansion into a volume (declined by R^{-3}) and no sweeping up the ambient solar wind material could not be observed out to the edge of the C3 field (30 solar radii). We believe that this was because the electron density in the CME was much greater than the ambient and only became comparable to the ambient at the edge of C3. Thus SMEI observations should be able to detect if there is a snow plow effect occurs.

SH41C-05 1120h INVITED

IPS/SMEI potential joint observations

Munetoshi Tokumaru[1] (81-533-89-5176; tokumaru@stelab.nagoya-u.ac.jp)

Masayoshi Kojima[1] (kojima@stelab.nagoya-u.ac.jp)

Ken'ichi Fujiki[1] (fujiki@stelab.nagoya-u.ac.jp)

Bernard V. Jackson[2] (bvjackson@ucsd.edu)

Paul Hick[2] (pphick@ucsd.edu)

[1]STE Lab., Nagoya Univ., 3-13 Honohara, Toyokawa 442-8507, Japan

[2]CASS/UCSD, 9500 Gilman Dr., La Jolla,, San Diego, CA 92093-0424, United States

Interplanetary scintillation (IPS) measurements are known as one of remote-sensing techniques which enable us to gain access to global features of the solar wind (e.g. quasi-stationary corotating structures, transient streams associated with CMEs). We have carried out a long-term collaboration on the reconstruction of the heliospheric features from IPS measurements made with the 327 MHz four-station system of the Solar-Terrestrial Environment Laboratory (STEL), Nagoya University. Under the collaboration, we have developed the computer-assisted tomography (CAT) analysis method, which allows us to retrieve the 3D distribution of the solar wind velocity and density from IPS data. We also have been making the real-time reconstruction experiment of heliospheric features using STEL IPS data and the CAT method. Based on these results, we propose here the joint observations of IPS and SMEI. The SMEI is a powerful tool to investigate the global heliospheric features, and its capability is complementary to one of IPS observations; That is, SMEI observations provide a high-resolution image of the solar wind density distribution, while IPS observations provide reliable estimates of the solar wind velocity. Therefore, a combination of IPS and SMEI observations is essential for achieving a precise reconstruction of global heliospheric (velocity and density) features by the CAT analysis.

SH41C-06 1135h INVITED

Solar Mass Ejection Imager (SMEI) - Hectometric/Kilometric Wave Comparisons

Jean-Louis Bougeret (33145077704; jean-louis.bougeret@obspm.fr)

LESIA-CNRS-Observatoire de Paris, 5, place Jules Janssen, Meudon 92195, France

Radio radiation is commonly produced throughout the interplanetary medium at long wavelengths in the decametric/hectometric/kilometric range. It results from plasma radiation mechanisms involving populations of energetic electrons either accelerated at the Sun –for instance during the solar flares–, or in the interplanetary medium –for instance at the front of interplanetary shocks–. These radio emissions are currently observed by several spacecraft including WIND and ULYSSES. They will be monitored in the near future by programs as STEREO. Several types of radiation have been identified. It is currently understood that the so-called interplanetary type III radio emissions trace large scale structures in the solar wind. The interplanetary type II radio emissions are associated with travelling shock fronts, possibly ahead of Interplanetary Coronal Mass Ejections. Long lasting (several days) storms of type III bursts are associated with solar active regions and may trace large scale corotating interplanetary structures. All these radio observations provide unique information on localized energetic phenomena in the solar wind. The comparison with the Solar Mass Ejection Imager will provide for the first time a unique chance to identify large scale structures in the interplanetary medium, either transient or corotating, that can be associated with radio emissions. In this paper we compare the respective capabilities of the instruments and we discuss a number of open questions for which SMEI - hectometric/kilometric comparisons could provide a clue.

SH41C-07 1150h INVITED

The Solar Mass Ejection Imager: Early Results and Prospects for Space Weather Forecasts

Joel B. Mozer[1] (505 434-7037; jmozer@nso.edu); Richard R. Radick[1] (505 434-7035; radick@nso.edu); Janet C. Johnston[2] (781 377-2138; janet.johnston@hanscom.af.mil); David F. Webb[3] (david.webb@hanscom.af.mil); Wei Sun[4] (sun@jupiter.gi.alaska.edu); Charles S. Deehr[4] (cdeehr@gi.alaska.edu); Craig D. Fry[5] (gfry@expi.com); Murray Dryer[6] (murray.dryer@noaa.gov); Zdenka Smith[6] (zdenka.smith@noaa.gov); S. I. Akasofu[7] (sakasofu@iarc.uaf.edu)

[1]Air Force Research Laboratory Space Weather Center of Excellence, AFRL/VSBXS 3004 Solar Physics Way, Sunspot, NM 88349, United States

[2]Air Force Research Laboratory Space Weather Center of Excellence, AFRL/VSBXS 29 Randolph Road, Hanscom AFB, MA 01731, United States

[3]Boston College, AFRL/VSBXS 29 Randolph Road, Hanscom AFB, MA 01731, United States

[4]University of Alaska Geophysical Institute, 903 Koyukuk Drive, Fairbanks, AK 99775, United States

[5]Exploration Physics International, Suite 37-105 6275 University Drive, Huntsville, AL 35806, United States

[6]NOAA Space Environment Center, 325 Broadway Ave, Boulder, CO 80305, United States

[7]International Arctic Research Center, 930 Koyukuk Drive, Fairbanks, AK 99775, United States

The Solar Mass Ejection Imager (SMEI) was launched on 6 January 2003 on a proof-of-concept mission to demonstrate the feasibility of a space-based heliospheric imager for detecting and tracking Coronal Mass Ejections (CMEs) and other dense structures in the solar wind. SMEI is comprised of three spaceward-looking push broom imagers that together provide photometric images of the entire sky, minus a small region near the Sun, every 101 minutes. The unique sunlight rejection baffles and high photometric sensitivity of the SMEI cameras allows for the imaging of CMEs via relatively faint Thomson-scattered sunlight from regions of enhanced electron density. Due to its all-sky field-of-regard, SMEI can track and monitor the evolution of CMEs from near the Sun out to and beyond 1 A.U. This capability affords the unprecedented opportunity to study interplanetary CMEs and to forecast the arrival of potentially geoeffective structures at Earth. A number of CMEs have been detected by SMEI since its launch, including a halo event on 28-29 May 2003 that was associated with a geomagnetic storm on 30 May as indicated by both ACE and ground-based measurements. In this talk, we show examples and pertinent statistics of several of the events captured by SMEI and explore prospects for the use of SMEI data in operational space weather forecasting as well as pertinant simulations made using the Hakamada-Akasofu-Fry (HAF) kinematic solar wind model.

SH41C-08 1205h INVITED

Stellar Variability Studies with SMEI

Alan J Penny[1] (+44-1235-445675; a.j.penny@rl.ac.uk); B V Jackson[2]; A Buffington[2]; P P Hick[2]; S W Kahler[3]; S Price[3]; J C Johnston[3]; P Holladay[3]; D Sinclair[3]; R R Radick[3]; J C Mozer[3]; P Anderson[4]; G M Simnett[5]; C J Eyles[5]; M P Cooke[5]; J Tappin[5]; N R Waltham[1]; T Kuchnar[6]; D Mizuno[6]; D F Webb[6]

[1]Rutherford Appleton Laboratory, Chilton, Didcot, Oxf OX1 1TY, United Kingdom

[2]Center for Astrophysics and Space Sciences, University of California at San Diego, La Jolla, CA 92093, United States

[3]Air Force Research Laboratory/Space Vehicles Directorate (AFRL/VS), Hanscom AFB, Hanscom, MA 01731, United States

[4]Boston University, One Sherborn Street, Boston, MA 02215, United States

[5]University of Birmingham, University Road, Birmingham, Bir B15 2TT, United Kingdom

[6]Boston College, Newton Centre, Boston, MA 02459, United States

The Solar Mass Ejection Imager (SMEI) instrument images most of the sky every 105 minutes. From this unique dataset, the brightnesses of stars down to and below the eight magnitude can be measured to investigate their variability. This paper presents the methods developed to extract the stellar brightnesses, and the accuracies obtained as a function of brightness and crowding. Example lightcurves are given.

SH41D MCC: 2010 Thursday 1020h

Coronal Magnetic Fields: Models to Measurements II

Presiding: **R Casini,** High Altitude Observatory, NCAR**; N U Crooker,** Boston University Center for Space Physics

SH

SH41D-01 1020h INVITED

Constraints on the structure and evolution of the coronal magnetic field from in situ observations

Pete Riley[1] (858-826-9550; pete.riley@saic.com)

Jon A Linker[1] (jon.linker@saic.com)

Zoran Mikic[1] (zoran.mikic@saic.com)

[1]Science Applications International Corp., 10260 Campus Point Dr., San diego, Ca 92121, United States

In this talk we briefly review current theories of the large-scale heliospheric magnetic field. We address how measurements of the coronal magnetic field can be connected to in situ observations through numerical models, and likewise, how in situ observations can be connected back to both solar observations and model results. We focus on deviations from the ideal Parker spiral (e.g., radial field lines, under-winding, over-winding, magnetic flux variations, transient phenomena, etc) from near-Earth spacecraft as well as Ulysses, and ask to what extent these observations can place constraints on theories of the structure and evolution of the coronal magnetic field.