SH11B MCC: 2010 Monday 0800h

Interplanetary Physics I

Presiding: **L J Milano,** Bartol Research Institute, University of Delaware**; C W Smith,** University of New Hampshire

SH11B-01 0800h

A New Method for Studying the Solar Wind Using Radio Scintillations (IPS)

William A Coles[1] (858 534 2703; bcoles@ucsd.edu)

John K Harmon[2] (787 878 2612 x284; harmon@naic.edu)

Barney J Rickett[1] (858 534 2731; rickett@ece.ucsd.edu)

Arun Venkataraman[2] (787 878 2612 x340; arun@naic.edu)

[1]University of California, E.C.E. Dept., La Jolla, CA 92093-0407, United States

[2]Arecibo Observatory, HC3 Box53995, Arecibo, PR 00612, United States

Intensity scintillations (IPS) have been used to measure the velocity and the micro-structure of the solar wind for many years. Observations with a single antenna are simple and easily arranged, but they provide only one-dimensional information on the microstructure and they are subject to bias if the microstructure is anisotropic or the scattering becomes "strong." Observations with two or more antennas provide a two-dimensional measure of the microstructure; a vector velocity; and they are more robust in the onset of strong scattering. However there are few suitable arrays and they are difficult to schedule. In either case a reliable estimate requires that many time scales be observed - typically about 10 minutes of observation. Here we report a robust new method which requires only one antenna, but is not sensitive to either anisotropic structure or strong scattering. Furthermore a reliable speed estimate can be made in about 2 s. The method obviously requires additional data - the intensity must be measured with a multi-channel spectrometer. Fortunately such spectrometers are standard equipment at radio observatories. The resulting dynamic spectra can be processed to show the 2-dimensional microstructure and the flow speed. Theory, simulations, and observations will be presented to demonstrate the method. It appears particularly suitable for measuring transients such as coronal mass ejections (CME's) in the interplanetary medium. It will be possible to track many sources with a single antenna, spending only a few seconds on each source, and thus to map the space-time evolution of the CME in turbulence level, flow speed, and anisotropy.

SH11B-02 0815h

Interplanetary Coronal Mass Ejections Observed at Earth and Voyager 2

Chi Wang[1,2] (cw@space.mit.edu)

John D. Richardson[2] (jdr@space.mit.edu)

[1]Lab. for Space Weather Chinese Academy of Sciences, P.O. Box 8701, Bejing 100080, China

[2]MIT Center for Space Research, 77 Mass. Ave., Cambridge, MA 02139, United States

While spacecraft such as ACE, IMP8, Wind are monitoring the solar wind near Earth, Voyager 2 continues to explore the outer heliosphere. The ability to match solar wind features at widely separated points in the heliosphere provides us detailed information on the evolution of the solar wind. In this study, we present a survey of interplanetary coronal mass ejections (ICMEs) observed during time periods when Earth and Voyager 2 are within about 60 degrees in longitude from 1998 to present. We try to track the evolution of the ejecta from the inner to outer heliosphere by using a numerical model. Preliminary results show that boundaries of the ejecta region are difficult to determine as the structure undergoes significant evolution and interacts with other solar wind structures. Many ICMEs found at Earth did not have obvious counterparts at Voyager 2. For some cases, however, we are able to identify the heliospheric remnants of the ICMEs in the Voyager observations based on numerical results and, when available and relevant, helium abundances. These events are invaluable for the study of the dynamical processes of ICMEs in the heliosphere. Our numerical results demonstrate that, in general, ICMEs expanding to 2∼5 times of their original widths near Earth within a distance of ∼30 AU, then maintain a roughly constant width outside this distance.

SH11B-03 0830h

Wavelength and decay scale of the density overshoot at collisionless shocks

Rishik Saxena[1] (rsaxena@ssl.berkeley.edu)

Stuart D Bale[1] (bale@ssl.berkeley.edu)

Forrest S. Mozer[1] (fmozer@ssl.berkeley.edu)

Tim Horbury[2] (t.horbury@ic.ac.uk)

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

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

Using spacecraft potential data from the Cluster spacecraft, we study the overshoot/undershoot density structure at 71 crossings of the quasi-perpendicular bow shock. The envelope of the absolute value of the density, in most cases, decays exponentially. We have fitted these envelopes to a decaying exponential function, $|n| \exp(-Bx)$, from which we are able to calculate the decay length as 1/B. For those shocks without sufficient data points (3 or more) necessary to do an exponential fit, we defined the decay length to be the length it takes for the density to fall to 1/e of the y-intercept on our plots, where the x = 0 value is arbitrary. At all 71 shocks we also estimate the overshoot/undershoot wavelength using the zero-crossings of the density profile. Comparing the average wavelength to the ion gyro radius v_{sh}/Ω_{ci}, we find that there is a good correlation between the two: $\lambda \approx 2.64\ v_{sh}/\Omega_{ci}$. We also find the wavelength to be $\lambda \approx 2.81\ c/\omega_{pi}$ ion inertial lengths, although this correlation is not as strong. We attempt to parameterize the scales with solar wind Mach number and plasma β.

SH11B-04 0845h

Three dimensional correlations in the solar wind: the two component model revisited.

Leonardo Julio Milano[1] (1-302-831-1579; lmilano@bartol.udel.edu)

Sergio Dasso[2] (sdasso@iafe.uba.ar)

William H Matthaeus[1] (yswhm@bartol.udel.edu)

Charles W Smith[3] (Charles.Smith@unh.edu)

[1]Bartol Research Institute, University of Delaware, 217 Sharp Lab, Newark, DE 19716, United States

[2]Instituto de Astronomia y Fisica del Espacio, Edificio IAFE Ciudad Universitaria, Buenos Aires, BUE 1428, Argentina

[3]Institute for Earth, Oceans and Space, University of New Hampshire, 39 College Road, Durham, NH 03824y, United States

Observations and theory motivate models of solar wind fluctuations consisting of two components– "slab" Alfven waves varying mainly parallel to the ambient dc magnetic field, and a zero-frequency quasi two-dimensional turbulent component varying mainly perpendicular to the magnetic field. We present an extension of the previous analysis, employing ACE plasma and magnetic field data, to examine three dimensional correlations and spectra for the cross helicity, velocity, magnetic and Elsasser fluctuations. We find surprisingly that all quantities have similar anisotropic structure, thus implying that the normalized cross helicity, a measure of the strength of the non-linear terms, is essentially isotropic. This conclusion stands in contrast to the usual assumption that the slab component, as propagating waves, carries most of the cross helicity. This calls for some revision in standard solar wind turbulence models.

SH11B-05 0900h

Analysis of High-Latitude IMF Turbulence

Charles W. Smith (603-862-0890; Charles.Smith@unh.edu)

University of New Hampshire, Space Science Center Morse Hall University of New Hampshire, Durham, NH 03824, United States

We examine measurements of the interplanetary magnetic field (IMF) by the Ulysses spacecraft from launch until after the first solar pass using a variety of tools to characterize the interplanetary turbulence. We resolve systematic changes in the powerlaw index, the fluctuation anisotropy, and wave vector orientation (geometry) of the inertial-range fluctuations associated with high latitude. We find a decrease in the fluctuation anisotropy relative to the mean magnetic field and an increase in wave power associated with wave vectors parallel to the mean field that can be associated with high spacecraft latitude. Wave vectors perpendicular to the mean magnetic field still dominate the statistics. Preliminary analyses show a consistently flatter power spectrum within the inertial range when compared with low-latitude observations.

SH11B-06 0915h

On Correlation Between the Magnetic and the Density Fluctuations in Large Amplitude MHD Turbulence

Tohru Hada (81-92-583-7099; hada@esst.kyushu-u.ac.jp)

ESST, Kyushu University, 6-1 Kasuga Koen, Kasuga 816-8580, Japan

Magnetic and plasma fluctuations are ubiquitous in a space plasma. In particular, those found in the earth's foreshock region have order of unity normalized magnetic field amplitude, so that it is worthwhile looking into correlations among the fluctuations not only at the leading order but also at the second order. By performing hybrid numerical simulations, we evaluate the correlation between the magnetic and the density fluctuations at the second order, and show that this correlation is an important parameter to characterize the turbulence. Possible application of the present analysis to spacecraft obtained data will be discussed.

SH11B-07 0930h

Comparison of Solar Cycles: Mid- and Low-Latitude Solar Wind During the Declining Phase of the Solar Cycle

Heather A Elliott[1] (210-522-6909; helliott@swri.edu)

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

[1]Southwest Research Institute, P.O. Drawer 28510, San Antonio, TX 78228-051, United States

Ulysses measurements now span more than the 11-year solar cycle, and the spacecraft has completed nearly two full polar orbits of the Sun. In 2001, Ulysses was at high latitudes and SWOOPS (Solar Wind Observations Over the Poles of the Sun) solar wind measurements showed that a mid-sized circumpolar coronal hole had formed in the Northern hemisphere near solar maximum. Ulysses then moved towards the equator and encountered a recurrent co-rotating interaction region from 70°N down to 25°N. From 25°N to 20°N SWOOPS observed slow, steady solar wind. Coronal hole maps show that the Northern hemisphere has maintained a large circumpolar coronal hole with a large extension, while in the Southern hemisphere a mid-sized coronal hole has formed at mid-latitudes. The latest Ulysses measurements provide an excellent comparison with the first orbit observations since as in the first orbit Ulysses is crossing the low-latitude region of variability in the descending phase of the solar cycle.

SH11B-08 0945h

Solar Fast-Wind Regions as Sources of Shock Energetic Particle Production

Stephen W. Kahler (1 781 377 9665; stephen.kahler@hanscom.af.mil)

Space Vehicles Directorate VSBXS/Air Force Research Laboratory, 29 Randolph Rd, Hanscom AFB, MA 01731, United States

If production of solar energetic particles (SEPs) near the Sun is due to shocks driven by coronal mass ejections (CMEs), then two factors might favor SEP acceleration in slow rather than fast solar wind streams. The first is that both the Alfven and solar wind flow speeds are higher in the fast-wind streams. The second is that shock seed populations consisting of suprathermal ion tails are generally not present in the fast-wind streams. In an earlier study we used observed fast west-limb or halo CMEs and solar wind O^{+7}/O^{+6} ratios to look for differences in associated SEP events between fast CMEs in fast and slow wind. The limited number of fast CMEs in fast-wind regions suggested a possible bias in terms of associated SEP event size and/or CME speed against shock production of SEPs in fast-wind regions. Here we extend the previous study to include fast CMEs in fast-wind regions for two additional years. The results now show no significant bias against SEP production in fast-wind regions. We discuss the implications of this result for shock seed populations and for shock propagation in coronal fast-wind regions.