

mechanisms of the energy dissipation and particle acceleration. Two possible effects are shown to play an important role: the growth of the efficiency of the surfing acceleration mechanism and direct acceleration due to the explosive growth of the electric field.

SH12A-0424 1330h POSTER

Kinetic simulation of ion heating by ion cyclotron waves

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The heating of ions by ion cyclotron waves in a low beta collision-less plasma such as the inner corona is investigated by fully non-linear kinetic simulation. It will be shown that ions are preferentially in the direction perpendicular to the magnetic field in the first stage leading to a strong temperature anisotropy. However, ions in the parallel direction will also be strongly heated. Detailed ion velocity distributions will be presented. Ion cyclotron waves are able to make ion velocity distributions extremely non-Maxwellian. The implications for the coronal heating by ion cyclotron waves will be discussed.

SH21A MCC: Hall D Tuesday 0830h

Heliospheric and Interplanetary Physics Posters (joint with SM)

Presiding: N U Crooker, Boston University

SH21A-0473 0830h POSTER

ICME Identification from Solar Wind Ion Measurements

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In the solar corona, coronal mass ejections are generally identified as an outward moving density enhancement. At 1 AU their interplanetary counterparts are generally identified as a twisted and enhanced magnetic structures lasting of the order of a day. In an effort to better classify ICMEs we attempt herein to identify their start and stop time by their signatures in ion data obtained by Wind and ACE solar wind instruments. We search for periods in which the solar wind speed is linearly decreasing and the ion temperature is cool, with a thermal speed of less than 20 km/s. We required a simultaneous enhanced magnetic field but required no special signature of this enhancement. We compared these identifications with those made by D. Larson and R. P. Lepping and published on the web. Of 14 events, 4 were not identified as ICMEs by either Larson or Lepping. Similarly they identified many events that we did not, often because the ion temperature was above our classification threshold, but also because there was no clear speed decrease as the event crossed the spacecraft as would signal an expanding structure. The best events in Larson and Lepping's list had a rate of speed decrease that, if due to the expansion of the structure with distance from the sun moving at the average observed speed, would bring the structure from zero width to the present size in its calculated transit time. We conclude that cold ion temperatures and a declining solar wind velocity are frequent ICME signatures but are neither necessary nor sufficient for ICME identification.

SH21A-0474 0830h POSTER

Halo CME's Will They Hit or Miss Earth?

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To optimize the information from maps of the sky that cover large elongations we have developed a Computer Assisted Tomography (CAT) program that models these using a time-dependent three-dimensional heliospheric model to fit Thomson scattering or STELab

(Nagoya University) interplanetary scintillation (IPS) observations. The duration of a CME event (typically several days) imposes the restriction that the reconstruction model primarily uses outward solar wind motion to give perspective views of each point in space. The results to date are commensurate with the observational coverage, temporal and spatial resolution, and signal to noise available from the original data. We provide remote observer views of IPS-based reconstructions of halo CMEs also observed by the LASCO coronagraphs. We practice our modeling techniques by making these views available in real time to forecast halo CME Earth-arrival. Here we explore the locations and shapes of a few select halo CMEs and their three-dimensional velocity structure in order to determine whether they will hit or miss the Earth.

This work is supported by NASA grant NAG5-8504 and AFOSR grant F49620-01-1-0054.

URL: <http://casswww.ucsd.edu/solar/>

SH21A-0475 0830h POSTER

How Magnetically Open are Magnetic Clouds Beyond 1 AU?

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From suprathermal electron measurements, we know that magnetic clouds at 1 AU contain a mix of primarily open and closed magnetic field lines and that the open field lines constitute roughly 40%, on average. Presumably these open field lines are created gradually by interchange reconnection in one leg of the cloud back at the Sun, where an open field line reconnects with a field line in the cloud that is attached to the Sun at both ends, thus interchanging a closed loop in the heliosphere for a closed loop in the corona. What is not known is whether interchange reconnection continues well beyond 1 AU until clouds become completely open. The answer to this question has important implications for the heliospheric magnetic flux budget, since closed fields in interplanetary coronal mass ejections (ICMEs) build up flux in the heliosphere. Although clouds are a small fraction of all ICMEs, they provide more accurate measures of total open flux because their boundaries are independent of the counterstreaming electron signatures used to identify closed fields. We analyze the clearest clouds in Ulysses data to determine the percentage of open flux in each case, taking into account the fact that the percentage of open flux in clouds at 1 AU decreases with increasing cloud size and that cloud size increases with distance from the Sun. Preliminary results suggest that clouds beyond 1 AU are only slightly more open, implying that the rate of interchange reconnection in the leg of an ICME slows significantly when its leading portion is not far beyond 1 AU.

SH21A-0476 0830h POSTER

Numerical Test of a Three-Dimensional Flux Rope Model for Coronal Mass Ejections Based on Ideal MHD Processes

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A series of simulation runs in Cartesian coordinates are carried out, using the BATS-R-US code, to investigate the loss of equilibrium of the 3D flux rope configuration of Titov & Démoulin (1999) as a potential CME initiation mechanism. All numerical experiments are fully 3D and involve ideal magnetohydrodynamics.

Our results show that the criterion $R > \sqrt{2}L$, derived in the earlier study by neglecting the effects of line-tying of the poloidal field, may be a necessary condition for a loss of equilibrium, but it is not a sufficient one. The line-tying of the ends of flux rope leads to a much more stringent condition for an eruption to occur.

The question remains whether it is possible to get a loss of equilibrium with the Titov & Démoulin model which will lead to a CME-like eruption. We do find evidence for a loss of equilibrium, but the resulting evolution of the system more closely resembles an impulsive-type flare rather than a CME. Whether there is a region of the model's parameter space where CME-like eruptions can occur remains to be determined.

SH21A-0477 0830h POSTER

The First Year of Solar-Wind Data From the GENESIS Mission

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The GENESIS mission was launched in August, 2001, and has been in an L1 halo orbit for over a year. The primary purpose of the mission is to collect solar-wind samples that will be returned to Earth in 2004 for high-precision isotopic and elemental analyses. GENESIS uses conventional ion and electron spectrometers to record solar-wind conditions during collection, and to make real-time determinations of the solar-wind regimes to facilitate collection of separate samples of interstream (IS), coronal hole (CH), and coronal mass ejection (CME) flows. Of particular interest is the use of a bi-directional electron (BDE) index to determine the presence of CMEs. And although GENESIS lacks a magnetometer, the field vector, with sign ambiguity, is determined by the electron direction, and matches other spacecraft magnetometer data well. GENESIS in-situ data and on-board regime determinations are available on the web.

The data from Fall, 2001 were characterized by numerous CME regimes (comprising 32% of the time in the 4th quarter, based on the on-board algorithm), with little CH flow (only 2%). A strong CH flow was observed every solar rotation from mid-January through late May. June was quiet, nearly all IS flow. The first and second quarters of 2002 were approximately 28% CME flow, with CH flow dropping from 18% to 6%. The discovery of unexpectedly noticeable BDE signals during CH flows at 1 AU (Steinberg et al., 2002) caused us early on to modify our regime selection algorithm to accommodate these. The on-board algorithm intentionally errs on the side of overestimating CME flows in order to keep the CH sample more pure. Comparisons have been made of various compositional parameters determined by Genesis (Barraclough et al., this meeting) and by ACE SWICS (Reisenfeld et al., this meeting) for times corresponding to the Genesis collection periods for each of the three regimes.

The Genesis L1 halo orbit is $\sim 0.8 \times 0.25$ million km radius, somewhat larger than the $\sim 0.3 \times 0.2$ and $\sim 0.7 \times 0.2$ million km orbits of ACE and SOHO, respectively, presenting excellent opportunities for multi-spacecraft observations at L1.

URL: <http://genesis.lanl.gov>

SH21A-0478 0830h POSTER

A Density Model of Flux-Rope Coronal Mass Ejections

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A density model is developed for a coronal flux rope with a specified magnetic field configuration. We find that the flux-rope plasma density is depleted on axis, where the magnetic field lines are least twisted. Assuming that a flux-rope coronal mass ejection (CME) results from the eruption of a pre-existing coronal flux rope, the CME density is obtained.[1] The resulting model CME is tested against the data by computing synthetic coronagraph images.[2] In the case that these model CMEs are consistent with both the analytical calculation and with prior simulations of "flux

rope CME" events[2,3] we find that many characteristics found in observed CME images are reproduced. This result explains the rim-cavity morphology often observed in CMEs.

- [1] Krall, J. and Chen, J., 2002, ApJ Lett, submitted
 [2] Chen, J. et al., 2000, ApJ, 533, 481
 [3] Krall, J. et al., 2001, ApJ, 562, 1045
 Supported by ONR and NASA.

SH21A-0479 0830h POSTER

The Interaction of Heavy Interstellar Atoms with the Heliosphere

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The global structure of the heliosphere is determined by the interaction of the solar wind and the partially ionized local interstellar medium (LISM). The presence of neutral interstellar hydrogen, because it is the most abundant particle species, plays an essential role in determining the global heliospheric morphology. Like neutral hydrogen, heavy interstellar atoms respond through charge-exchange coupling to the heliosphere and the LISM-heliosphere boundaries in an often complex way. We use kinetic models that include heavy elements such as He, C, N, O, and others, to study the heliospheric distribution of neutrals and the singly charged ions of these species, besides H. We describe the evolution of heavy neutral atom distributions throughout the heliosphere, and include the interaction of heavy particles with neutral hydrogen and protons through charge exchange (i.e., the creation of pickup ions), and of course the heavy neutrals are subject to photoionization and gravity. We use improved, recently published charge exchange cross-sections as well as recently identified LISM boundary conditions. A realistic description of the basic heavy element distribution will provide an important theoretical basis for interpreting observations of pickup ions made by Ulysses and ACE.

SH21A-0480 0830h POSTER

Structure of the Temporal Heliosphere

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The solar cycle leads to important changes in the solar wind, which can have an important effect on the structure of the global heliosphere. In the ecliptic, the ram pressure can vary from one cycle to the other, being greater during periods of maximum activity. During solar minimum periods, the polar solar wind speed is far higher than that in the ecliptic, but the solar wind reverts to a more isotropic state during solar maximum. We investigate the response of the heliosphere to a temporally varying solar wind. Since neutral hydrogen is a key component in determining the global structure of the heliosphere, we employ a multi-fluid model in which the self-consistent charge-exchange interaction between neutral hydrogen and protons is included self-consistently. The variability of the termination shock location is described and the weak response of the hydrogen wall to the temporal solar wind is discussed. Both two-shock and one-shock models are considered.

SH21A-0481 0830h POSTER

Quantitative Theory for Generation of 2-3 kHz Emissions beyond the Heliopause

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Radio emissions observed at 2-3 kHz by the Voyager spacecraft are associated with global merged interaction regions (GMIRs) reaching the vicinity of the heliopause. A recent theory [Cairns and Zank, GRL, 29(7), 10.109/2001GL014112,2002] predicts that the radiation is generated in foreshock regions upstream of the GMIR shock, turning on when the shock enters a region primed with a superthermal electron tail beyond and near the heliopause nose. In this theory the tail is produced by "lower hybrid-drive" associated with

pick-up ions. In this paper we combine a recent theory for type II solar radio bursts [Knock et al., JGR, 106, 25041, 2001] with the Cairns & Zank theory, resulting in a semianalytic, quantitative theory for the 2-3 kHz radiation. The new theory treats electron reflection and shock-drift acceleration at the shock, formation of electron beams in the foreshock, generation of Langmuir waves, and conversion of Langmuir energy into radiation near the fundamental and harmonic of the electron plasma frequency. The theory predicts the characteristics of electron beams and radio emissions throughout the foreshock, as well as the flux observed by a distant observer. We show that the new theory predicts (1) fluxes of fundamental radiation of order those observed ($\approx 3 \times 10^{-17} \text{ W m}^{-2} \text{ Hz}^{-1}$ for nominal shock and plasma parameters for the outer heliosheath, (2) the superthermal electron tail produced by lower hybrid-drive increases the fundamental flux by ≈ 2 orders of magnitude compared with predictions that neglect the tail, and (3) fundamental emission dominates harmonic emission. The latter two results confirm the theoretical predictions of Cairns & Zank [2002], while the first suggests that this theory is viable for generation of 2-3 kHz radiation beyond and near the heliopause.

SH21A-0482 0830h POSTER

Solar wind encounter with strongly magnetized interstellar medium

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Uncertainties in the value of the magnetic field in the local interstellar cloud and its direction with respect to the solar system ecliptic plane stimulate the analysis of the solar wind (SW)-interstellar medium (LISM) interaction problem, where these quantities act as free parameters. The range of their variation is defined by available observation data interpreted on the basis of different theoretical models describing the origin and evolution of the interstellar cloud. Most previously obtained results dealt with magnetic field values below 3 microgauss. Since the LISM flow is super-fast magnetosonic in this case, the heliospheric interface involves two shock waves: a SW termination shock and a bow shock. Conversely, for stronger magnetic fields Parker's solution for the supersonic source inflow into the uniformly magnetized interstellar gas at rest contains only a termination shock. Crossing it, the solar wind moves along the symmetry axis to infinity pushing aside magnetic field lines. There exist strong physical arguments in favor of substantially sub-Alfvénic LISM velocities nearly parallel to the magnetic field direction. We study the axially symmetric SW-LISM interaction under such conditions both in the purely MHD and two-fluid model including the presence of the LISM neutral particles. We found that the solution is in many aspects similar to Parker's. In order to reveal its consistency with currently available observation data, an analysis is presented of the neutral particle distribution throughout the heliosphere.

SH21A-0483 0830h POSTER

The Proximity of Voyager 1 to the Termination Shock

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The two Voyager spacecraft have observed the radial dependence of the modulation of anomalous cosmic rays (ACRs) during three solar maxima for radial distances ranging from ~ 10 to ~ 80 AU. At solar maximum, the large scale gradient for ~ 2 GV ACR oxygen is about four times that observed during solar minimum. Gradients between Voyager 1 and 2 were also determined for individual periods during the most recent solar minimum and solar maximum as the location of Voyager 1 increased from 65 to 84 AU. Comparison of the outward extrapolation of these gradients indicates that at the beginning of 2002 the termination shock was within ~ 92 AU, assuming that the source intensity at the shock at the latitude of Voyager 1 has not increased

since solar minimum. With Voyager 1 approaching 87 AU, there should be increasing evidence for the proximity of the shock. This work was supported by NASA under contract NAS7-1407.

SH21A-0484 0830h POSTER

On the Statistical Structure of the Magnetic Field in the Outer Heliosphere

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We use a multi-fluid, spherically symmetric, MHD model with neutral hydrogen and pickup protons, with 1999 solar wind data at 1 AU as input, to calculate the magnetic field strength (B) profiles that would be observed at various points between 1 and 60 AU with a resolution of 1 day over an interval of 1 year. The model predicts the following statistical results for daily averages of B: 1) the distribution functions of B are approximately lognormal at all distances from 1 to 60 AU; 2) the standard deviation of B divided by the mean value of B, $\langle B \rangle$, for a magnetic field profile at a given distance is approximately a constant, independent of distance between 10 and 60 AU; and 3) the power spectrum of $B/\langle B \rangle$ evolves such that a) at small scales the power spectral density decreases with increasing distance from the Sun, b) at large scales the power spectral density increases with distance, and c) there is a range of frequencies in which the power spectrum is a power law, the power law extending to lower frequencies with increasing distance. All three of these results have been observed by the Voyager 1 and 2 spacecraft over the last 20 years, between 1 and 60 AU. The agreement between the observations made over many years and the results of the model with input from 1 AU during 1999 suggests that the statistical state of the heliosphere is not very sensitive to the initial conditions.

SH21A-0485 0830h POSTER

3D MHD description of the region beyond the termination shock: The behaviour of the Current Sheet

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A fully self consistent MHD study of the heliosheath region is carried out, using BATSRUS, a three dimensional time dependent adaptive grid magnetohydrodynamic (MHD) model. The heliosheath, located between the termination shock and the heliopause, has not been studied in detail. At the termination shock the solar wind passes from a supersonic to a subsonic regime decelerating until it reaches the heliopause where it is diverted to the heliotail. This region is intersected in the equatorial plane (assuming a no-tilt for the dipole field) by a current sheet as the solar magnetic field changes polarity. One of the major questions is whether the current sheet remains at the equatorial plane. The magnetic field of the solar wind is included. In order to isolate the effects at this region we assumed no magnetic field in the interstellar medium. We observe a much faster flow of the current sheet, where the compressed azimuthal magnetic field is absent, leading to large velocity shear. With BATSRUS, we were able to obtain high resolution needed to analyze the behavior of this complicated regime, in particular the stability of the current sheet. We report the results and comment on the major processes responsible.

SH21A-0486 0830h POSTER

Voyager 1/UVS data and model computations of the interplanetary Lyman alpha background in the outer heliosphere: 1993 to 2002.

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The analysis of the latest Voyager 1 scans from mid-1998 to mid-2002 has shown a steep increase of the Lyman alpha background in all the observed directions. It is likely that this increase is linked to the 11-year solar cycle flux variation. Yet the increase obtained from the Voyager 1 UVS data is larger than the increase obtained by the direct measurements of the solar Lyman alpha flux obtained by UARS/SOLSTICE. Comparison with the measurements of the SWAN/SOHO instrument at 1 AU from the sun during the same period of time gives an indication on how the solar Lyman alpha flux at line center has actually changed. This study is essential to correctly derive the actual upwind Lyman alpha intensity gradient seen by UVS/Voyager 1.

In this study we show comparisons of the interplanetary Lyman alpha background data obtained by UVS/Voyager 1 in the outer heliosphere and corrected for solar flux variations with a model of the Lyman alpha background emission in the outer heliosphere based on hydrogen distributions derived from a model describing the effects of the heliospheric interface.

In this presentation, we will show how intensity gradients in the upwind direction are modified by the effects of the heliospheric interface on the hydrogen atoms. Although no data are available on lineshifts (apparent velocity) and linewidths (apparent temperature) in the outer heliosphere, we show model computations of these parameters and how they change as the heliosphere interface gets closer to the spacecraft.

SH21A-0487 0830h POSTER

SOLAR WIND TEMPORAL AND LATITUDINAL VARIATIONS FROM SOHO-SWAN

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Full-sky maps of backscattered solar Ly-alpha radiation recorded routinely by SOHO-SWAN between 1996 and 2002 are compared with models allowing for any latitude dependence of the ionization of the interstellar hydrogen flow by the solar wind. Recent work on the calibration of the SWAN sensors for this period of time (Quemerais & Bertaux, 2002) as well as on the cleaning of the data and correction from stellar contamination allow to quantify the anisotropy degree of the solar wind mass flux, north-south asymmetries and the temporal evolution of the fluxes.

SH21A-0488 0830h POSTER

Ulysses GAS Measurements of the Solar Wind Mass Flux North-South Asymmetry

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The Ulysses GAS experiment has been obtaining full-sky Lyman alpha maps since launch in 1990. The maps can be used to assess the distribution of heliospheric neutral H. Since the major loss process for H atoms in the interstellar medium is charge exchange with solar wind protons near the sun, the H distribution provides information on the time-averaged solar wind flux and its latitudinal variations. For this study we have systematically varied the model parameter A that characterizes the latitudinal variations in H atom lifetime against charge exchange. A separate A parameter is used for each solar hemisphere (AN and AS). A grid search was conducted in AN and AS on the model for each Ulysses GAS Lyman-alpha map to optimize agreement with the data. We will report on the derived AN and AS values and their variations with time, and compare these with actual solar wind measurements from Ulysses SWOOPS to test the utility of Lyman alpha remote sensing as a way to monitor hemispheric differences in the Sun's solar wind output.

SH21A-0489 0830h POSTER

NASAs Sun-Earth Connection Theory Program into 3rd Decade

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NASAs Sun-Earth Connection Theory Program (SECTP) is now in its first year of a new triennial cycle of funded research, with all the research awards beginning in 2002. The focus of the current research efforts and the accomplishments of the previous 3-year (1998-2001) cycle of research, just terminating, will be described. The SECTP, formerly the Space Physics Theory Program (SPTP), was initially established by the (former) Solar Terrestrial Division in 1980 to redress a weakness of support in the theory area. It has been a successful evolving scientific program for long-term funding of relatively large critical mass groups pursuing theory and modeling on a scale larger than that available within the limits of traditional NASA Supporting Research & Technology (SR&T) awards. The results of the program over the years has contributed to ever more cutting edge theoretical understanding of all parts of the Sun-Earth Connection chain, from the core of the sun out into the corona, through the solar wind into the Earth's magnetosphere and down to the ionosphere and lower atmosphere. In addition, it continues to support the development of more and more realistic computer models that have become the workhorses for analyzing satellite and ground-based measurements and in helping to plan and implement NASA spacecraft missions. The focus of the program and the applications of its research results are viewed in this paper from the perspective of recent program activities.

SH21A-0490 0830h POSTER

Inclinations of Large and Sharp Solar Wind Plasma Fronts

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The orientation of large and sharp increases or decreases of the solar wind ion flux was investigated using multispacecraft observations. Only events in which the ion flux changed by more than a factor of two in less than 10 minutes were taken into account. The orientation of these fronts was determined by analyzing the time delays between the arrival of the plasma fronts at two or more spacecraft in the solar wind. For this study we used simultaneous plasma measurements from INTERBALL-1, WIND, IMP 8 and Geotail. The time delays of the sharp fronts ranged from 1-20 min were observed after the advection shift due to the solar wind propagation time was removed. Using these delays, when we had data from 2 spacecraft we calculated the front orientation relative to the Sun-Earth line and

when we had data from 3 (or 4) spacecraft we calculated the 3-D front orientation. The key hypothesis, that such fronts are planar over length scales of tens of R_E , was checked by comparison of front angles when data from multiple spacecraft were available. Contrary to the common view, in most cases the planes of the plasma fronts are not perpendicular to the Sun-Earth line but are inclined to it by a significant value. The distribution of the inclinations is broad and for 50% of cases the angle between the plane of the front and the Sun-Earth line is less than 60 deg. (more than 30 deg. to the YezZee plane).

SH21A-0491 0830h POSTER

The 2-D Curvature of Large Angle Interplanetary MHD Discontinuity Surfaces: IMP-8 and WIND Observations

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This study examines the degree of 2-D curvature of solar wind directional discontinuity (DD) surfaces at 1 AU using magnetic field, density, and velocity data from the WIND and IMP-8 spacecraft for a large number ($N = 134$) of carefully selected events having large "discontinuity angles" of 90° or greater. The discontinuity angle (ω) is measured in the DDs current sheet, the normal to which is estimated by field variance analysis. The fundamental analysis depends on estimates of these DD surface normals at the two spacecraft, and the DDs center-times and positions. On average, the transit time from one DD sighting to the other was 36 minutes, and the associated distance along the normal direction was $137 R_E$. The transition-interval lengths across the DDs are translated into thicknesses and examined for the amount of change between the two spacecraft observing points; average thickness is relatively large, $14 R_E$. All relevant quantities are examined statistically to establish their distributions, average, and degree of change. A weighted average of the radius of curvature is estimated to be $380 R_E$, but its most probably value is $290 R_E$. The average ω is 140° with a relatively large spread ($\sigma = 28^\circ$). The average direction of propagation is: longitude = 194° and latitude = 7° (but $\langle \text{lat} \rangle = 27^\circ$). Various parameters are studied with respect to DD type, defined in terms of the ratio of speed of propagation to net speed ("ratio") of the DD surface, (the RD ratio is high and the TD ratio is very low or zero). The results by this definition of type are favorably compared to those from the more conventional method, which depends on the absolute strength of the normal component of the magnetic field. There is little difference in any average parameter value according to type. However, the average ω appears to depend slightly on type with the $\langle \omega \rangle$ for the RDs being smaller. A DDs type was shown to change in either direction between the two observation positions about 40% of the time. It is not clear if these changes are spatial or temporal. Shortcomings of the analysis are: (1) the need to impose an upper limit on the angular difference of the DD normals between the two observing positions (which eliminated most surfaces of very small radii of curvature), and (2) the inability to distinguish real curvature from shorter-scale surface variations, from only two spacecraft data sets. The results of the study should help to caution us as to the simplistic use of the planar DD surface assumption in projecting, to the distance of Earth's magnetosphere, a distantly observed DD surface (e.g., one near L1), especially for studies that depend on accurately predicting the timing and characteristics of magnetospheric events.

SH21A-0492 0830h POSTER

Measuring the Asymmetry of Halo CMEs

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Coronal mass ejections (CMEs) which appear to mostly or completely surround the occulting disk of a coronagraph during their outward propagation are likely to have a significant amount of mass directed

along the Sun-Earth line. Such "halo" CMEs that are also associated with surface activity on the frontside of the solar disk are likely to be Earth-directed and geoeffective to some degree. Halo CMEs which are symmetrical about the LASCO C2 or C3 occulting disks, of which the Sun-centered 14 July 2000 event is the prototype, are well associated with later geomagnetic storms. Other less symmetrical halo CMEs, however, can accompany flares and other activity offset toward the solar limb. Thus, for space weather purposes it is useful to develop an objective method for determining the degree of asymmetry of a halo CME and its direction. We have developed such a technique and will provide results evaluating its utility as a space weather tool, for example, by comparison with geoeffectiveness indices. Our computerized method also permits automatic detection of asymmetrical CMEs. This technique for detection and measurement of the asymmetry of halo CMEs will be applicable to images returned from the SMEI mission, to be launched in early 2003.

SH21A-0493 0830h POSTER

Comparison of CME ejecta at 10 solar radii and 1 AU

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We present results from a study of CME composition profiles measured by the ACE spacecraft at 1 AU and extrapolated back to 10 solar radii based on the assumption of constant velocity. The results will be compared statistically to LASCO coronagraph CME observations on the limb to determine how CME density features are organized. We will attempt to determine a correspondence between visible CME density features such as leading edge, cavity, and prominence with features at 1 AU.

SH21A-0494 0830h POSTER

Comparison Of The Genesis Solar Wind Regime Algorithm Results With Solar Wind Composition Observed By ACE

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Launched on 8 August 2001, the NASA Genesis mission is now collecting samples of the solar wind in various materials, and will return those samples to Earth in 2004 for analysis. A primary science goal of Genesis is the determination of the isotopic and elemental composition of the solar atmosphere from the solar wind material returned. In particular, Genesis will provide measurements of those species that are not provided by solar and in situ observations. We know from in situ measurements that the solar wind exhibits compositional variations across different types of solar wind flows. Therefore, Genesis exposes different collectors to solar wind originating from three flow types: coronal hole (CH), coronal mass ejection (CME), and interstream (IS) flows. Flow types are identified using in situ measurements of solar wind protons, alphas, and electrons from electrostatic analyzers carried by Genesis. The flow regime selection algorithm and subsequent collector deployment on Genesis act autonomously. We present an assessment of composition variations of O, He, and Mg ions observed by ACE/SWICS concurrent with Genesis observations, and compare these to the Genesis algorithm decisions. Not only does this serve as a test of the algorithm, the compilation of composition vs. regime will be important for comparison to the abundances determined from sample analysis at the end of the mission.

By applying the Genesis algorithm results to ACE/SWICS abundance and charge-state data, we show that the solar wind speed history can be used

to further discriminate between the IS and CH flow types. By using a lower speed threshold for fast-to-slow than for slow-to-fast regime transitions, the Genesis algorithm effectively compensates for evolution effects that are due to transit to 1 AU. Furthermore, we show that for some signatures, CME composition is independent of speed, having a composition most typical of the slow wind $< 400 \text{ km s}^{-1}$. However, differences between CMEs and the slow wind exist for He/H and O^{8+} . Also, it is seen that larger helium enhancements are found in faster CMEs. The algorithm is successfully isolating the CME population, and thus protecting the CH and IS samples from contamination by CME material.

SH21A-0495 0830h POSTER

Following the Polar Cap Magnetic Field and Heliospheric Current Sheet as Ulysses Descends in Latitude.

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After passing a maximum north latitude of 80.2° in December 2001, Ulysses has been descending gradually back down to 25° N, a time interval corresponding to 17 solar rotations and the on-going decline in solar activity. It is expected that the strength of the sun's axial dipole magnetic field has been increasing steadily, after having recently reversed polarity, while the orientation of the heliospheric current sheet decreases from being almost poleward to a more equatorial inclination. Ulysses provides measures of both the open magnetic flux and the expansion factor associated with the fast wind from the north polar coronal hole. Estimates of the polar cap field strength and its changes over time are obtainable from these two measures (assuming the open flux remains independent of latitude as in the past). These derived values can be compared with estimates obtained by other means. The evolving latitude of the current sheet can also be followed and compared with the sunspot number, with which it has been closely correlated in the past, and with the neutral line predicted by source surface models. Thus, these unique observations can provide quantitative measures, and test our knowledge, of these important properties of the high latitude heliosphere.

SH21A-0496 0830h POSTER

Differences Between Solar Wind Alpha Particle and Proton Temperatures at Times of Proton Temperature Depressions

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Using ACE SWEPAM measurements from February 5, 1998 through October 30, 2001 we have examined hourly averages of the solar wind alpha particle temperature T_A and compared it to the proton temperature T_P . The ratio T_A/T_P ranges from about 1 to 10, with the most probable value near 4, indicating that protons and alpha particles typically have the same thermal speed. We find that this ratio tends to vary with solar wind speed; ratios less than 4 are more common at lower speeds. In this study we investigate the character of the alpha particle temperature during intervals of depressed proton temperature. In general, the solar wind proton temperature increases with increasing flow speed. The temperature is considered depressed when it is much lower (by a factor of approximately 2) than the typical temperature observed at a given speed. For this work, we developed an expression for the expected proton temperature as a function of speed appropriate for the ACE level 2 data, and used this expression to identify intervals of unusually low proton temperature. When proton temperatures are lower than expected, we find that T_A/T_P tends toward values of 1. We conclude that proton temperature depressions usually have corresponding alpha particle temperature depressions, and the relative difference between typical

and depressed temperatures is 4 times greater for alpha particles than for protons. We note that, similar to proton temperature depressions, alpha particle temperature depressions can serve as useful indicators of CME flows.

SH21A-0497 0830h POSTER

Longterm variations of ICMs and their geoeffectiveness

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Solar wind and IMF in situ observations from instruments on board WIND and ACE spacecraft cover over half a solar cycle, the rising phase of cycle 23. Using these data set, we identify magnetic clouds, non-cloud ejecta and some complex transient signatures. The relative frequency of the occurrences of these transients vary when the solar cycle proceeds. Majority of the magnetic clouds and non-cloud ejecta (together we call them ICMs) have bipolar magnetic signatures in the Bz component. The polarity of the Bz component show also a trend to vary with the solar cycle, in particular a correlation with the solar polar magnetic field reversals, but with an interesting phase delay. The geoeffectiveness of these transients are also studied using Kyoto Dst index.

SH21A-0498 0830h POSTER

Dynamic Shock Modelling: MHD With Hysteresis Resistivity and Viscosity

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We numerically analyze a perpendicular MHD shock using the hysteresis model, where the resistivity and viscosity are switched on and off at different steepness of the shock profile. Such behavior may be caused by current driven instabilities which are of threshold character. A compressive fluid with a simple polytropic state equation is considered. It is shown that the hysteresis behavior is responsible for the overshoot formation and weak nonstationarity of the shock profile.

SH21A-0499 0830h POSTER

Studying the solar wind by simultaneous observations of the interplanetary Lyman alpha background with NOZOMI/UVS and SOHO/SWAN

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Interplanetary Lyman alpha data have been obtained by the ultraviolet imaging spectrometer (UVS) on board the NOZOMI spacecraft, the first Japanese Mars mission, cruising on Mars transfer orbits since 1999. The interplanetary Lyman alpha emission (121.6 nm) is due to solar photons backscattered by interplanetary hydrogen atoms. UVS has measured this emission over a 3-year period and we can study its temporal and spatial variations. SWAN onboard SOHO, the

ESA/NASA cooperative mission, has also been observing the Lyman alpha emission since 1996. By comparing SWAN and UVS data obtained at the same time but at different positions in the heliosphere, we can characterize the spatial distribution pattern of the interplanetary Lyman alpha emission. In this study, we have analyzed data from 1999 and 2000, during the solar maximum period. We have also compared results from the measurements with those from numerical models developed by CNRS France [Lallement R., et al., 1985; Quémenerais E., et al., 1993]. According to the comparison of the measurements with model calculation, it is found that an isotropic ionization can more or less reproduce the large scale distribution of interplanetary Lyman alpha emission in the period of solar maximum. The variation of relative intensity of Lyman alpha seen in the model results is almost consistent with that in the observation data. Some discrepancies can be found between the measurements and the calculations, especially in 2000 when the intensity of observational data is 10-20% larger than that from the model in the downwind region and vice versa in the upwind region. We discuss these discrepancies in the light of the hemispheric asymmetry observed by Ulysses and the tomographic analysis of interplanetary scintillation (IPS).

URL: <http://pat.geophys.tohoku.ac.jp/~www/index.html>

SH21A-0500 0830h POSTER

On the Phase-Space Resolution for the Solar Wind Plasma Experiment on Board ESA-Solar Orbiter

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Solar Orbiter is a space mission dedicated to study the solar surface, the corona and the solar wind by means of remote sensing and in-situ measurements, respectively. It will help us to understand in more detail the underlying nature of fundamental plasma kinetic processes acting in the Sun's atmosphere and in the extended corona as it will explore the inner regions of the Solar System with a perihelion of 0.21 AU. In particular, it will help us to understand the role of microinstabilities generated by non-Maxwellian features of the particle velocity distribution function. The best way to study these microinstabilities would be sampling the particle distribution function during their growth phase. In other words, we should be able to sample the whole 3-D velocity distribution function with a time resolution of the order of a few tens of msec, which is the time taken by the s/c to go across a scale length of the order of the typical Larmor gyroradius at 0.21 AU. This implies some restrictions on the maximum phase space resolution given a limited bit-rate for data transmission. In this paper we evaluate consequences of this limitation for solar wind distributions characterized by different values of the relative parameters.

SH21A-0501 0830h POSTER

3D MHD Simulation of CME Propagation from Solar Corona to 1 AU

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We present a three-dimensional (3D) numerical ideal magnetohydrodynamics (MHD) model describing the time-dependent expulsion of a CME from the solar corona propagating all the way to 1 AU. The simulations are performed using the BATS-R-US (Block Adaptive Tree Solarwind Roe Upwind Scheme) code. We begin by developing a global steady-state model of the corona that possesses high-latitude coronal holes and a helmet streamer structure with a current sheet

at the equator. The Archimedian spiral topology of the interplanetary magnetic field is reproduced along with fast and slow speed solar wind at high and low latitudes respectively. Within this model system, we drive a CME to erupt by the introduction of a Gibson-Low magnetic flux rope that is anchored at both ends in the photosphere and embedded in the helmet streamer in an initial state of force imbalance. The flux rope then rapidly accelerates to speeds in excess of 1500 km/sec driving a strong MHD shock as part of the CME. We find that both the shock front and the flux rope are strongly affected by bi-modal solar wind as the CME travels to 1 AU. Physics based AMR allows us to capture the complexity of the CME development and propagation focused on a particular Sun-Earth line. The applied numerical algorithm is designed to use optimal computational resources for the sake of tracing CMEs with very high spatial resolution all the way from Sun to Earth. We compare the model CME plasma parameters at 1 AU to observations and find the event to be geoeffective.

SH21A-0502 0830h POSTER

Empirically Constrained Multidimensional MHD Model for the Solar Corona and Solar Wind

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We are developing a time stationary self-consistent 2D MHD model of the solar corona and solar wind that explicitly solves the energy equation, using a semi-empirical 2D MHD model of the corona to provide an empirically determined effective heat flux q_{eff} (i.e., the term effective means the possible presence of wave contributions) for the energy equation and effective pressure P_{eff} for the momentum equation. Preliminary results indicated that in order to achieve high speed winds over the poles we not only needed to use q_{eff} in the energy equation, but also needed to include the empirically determined effective pressure P_{eff} as a constraint in the momentum equation, which means that momentum addition by waves above $2R_G$ are required to produce high speed winds. A solution which only included q_{eff} showed high acceleration over the poles below $2R_S$, but then drooped above that radial distance indicating we needed momentum addition above that height to get high speed flows over the poles. We will show new results which include the added constraint of P_{eff} in the momentum equation. This method will allow us to estimate the momentum addition term due to waves as a function of height and latitude within the corona. The estimates of P_{eff} and q_{eff} come from the semi-empirical 2D MHD model of the solar corona by Sittler and Guthathakurta (1999, 2002) which is based on Mk-III, Skylab and Ulysses observations. For future model development we plan to use SOHO LASCO, CDS, EIT, UVCS, Spartan 201-05 and Ulysses data as constraints for our model calculations. The model by Sittler and Guthathakurta (1999, 2002) is not a self-consistent calculation. The calculations presented here are a continuing effort to provide a self-consistent calculation based on empirical constraints.

SH21A-0503 0830h POSTER

The Underlying Direction of the Heliospheric Magnetic Field at Solar Maximum

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When Ulysses traversed the south polar regions of the heliosphere during solar maximum in late 2000 the distribution of magnetic field lines about the direction predicted by the Parker spiral model was very much broader than observed at similar latitudes under solar minimum conditions. Large deviations of up to 90 degrees were much more common. The reasons for this behaviour appear to be associated with the presence of the heliospheric current sheet in the high latitude regions. In this paper we extend this study to the north polar regions traversed by Ulysses during 2001 where a fast solar wind stream from the north polar coronal hole had become re-established. We compare the distributions of the magnetic field direction obtained at this time with those obtained at the south pole at solar maximum and those obtained at both poles at solar minimum when fast solar wind was routinely present in these regions. We find that the highly disturbed field direction distributions are unique to the south polar regions dominated by slow and intermediate speed solar wind streams near solar maximum.

SH21A-0504 0830h POSTER

A tilted-dipole MHD model of the solar corona and solar wind

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We simulate the heliospheric structure during solar activity minimum as determined by boundary conditions at the coronal base and compare output from the model with Ulysses observations during its first fast latitude transition in 1994-1995. The polytropic MHD equations are solved for a steady coronal outflow and include Alfvén wave momentum and energy addition in the WKB approximation. A solution for the outflow in a tilted dipole magnetic field in the inner computational region ($1-20 R_\odot$) is combined with a three-dimensional solution in the outer region which extends to 10 AU. The dipole orientation is chosen to match the one inferred from observations during the Ulysses observations. The bimodality of solar wind with a rapid change in flow parameters with latitude and the observed extension of the slower wind belt are reproduced fairly well.

SH21A-0505 0830h POSTER

The North-South Offset of the Heliospheric Current Sheet

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The evidence of north-south asymmetries in the heliosphere has been recognized in the galactic cosmic ray flux in the heliosphere (Simpson et al., 1996) and in the long-term, near ecliptic solar wind speed (Ziegler and Mursula, 1998). The asymmetries has been suggested to be associated with the north-south offset of the heliospheric current sheet that was confirmed by the solar wind measurements from Wind during March 1995 and Ulysses' fast latitude scan during early 1995 (Crooker et al., 1997).

By examining the distribution of magnetic polarities on the source surface obtained using WSO observations over 25 years and the potential field-source surface model, we find that: (1) Significant north-south offset of the heliospheric current sheet occurs around minimum solar activity; (2) the north-south offset largely follows the 22-year solar cycle; (3) The north-south offset is mainly caused by the north-south asymmetry of the magnetic flux in polar regions.

SH21A-0506 0830h POSTER

Correlating CME Indicators in Genesis Solar Wind Data: Cross-Comparison of Low Proton Temperature, Helium Abundance Enhancements and the Presence of Counter-Streaming Electrons

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The Genesis spacecraft, currently located at L1, has been making in-situ solar wind measurements since August 2001. For operational purposes, an autonomous onboard algorithm analyzes measurements taken by the plasma ion and electron spectrometers and determines whether the type of solar wind flow being encountered is of coronal hole, streamer belt or CME origin. To identify CME flows, the algorithm looks for three signatures that have previously been found to be useful CME indicators: helium abundance enhancement, lower-than-expected proton temperature, and the presence of counter-streaming suprathermal electrons. CMEs can typically exhibit one or more of these signatures, but it is unusual for any given CME interval to carry all three signatures simultaneously.

For this study, we examine the degree to which these three CME indicators are coincident in the Genesis data. Some preliminary results are as follows. Alpha particle enhancements (where the number density ratio to protons is >8%) nearly always occur together with either counter-streaming electrons or depressed proton temperatures. However, the total time alpha particles are enhanced is usually much less than the amount of time counter-streaming electrons or temperature depressions are found. Counter-streaming electron intervals show a relatively poor correlation with depressed temperature intervals: the fraction of time counter-streaming electrons are found within intervals of depressed temperatures (30%) is only slightly higher than the fraction of time bidirectional electrons are observed for all times (20%). More complete results on CME indicator correlation for the first full year that Genesis has spent at L1 will be presented at the meeting.

SH21A-0507 0830h POSTER

Multispacecraft Observations of Solar Wind Plasma Propagation

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Using measurements from multiple upstream interplanetary spacecraft, including ACE, Wind, Genesis and IMP-8, we examine the variations of plasma parameters (density, speed, and temperature) as the solar wind propagates between spacecraft. Solar wind structures are often imagined to lie along planar phase fronts that propagate radially, but may be oriented at arbitrary angles to the flow. The difference in arrival time of particular structures at different spacecraft, called the lag time, is typically used to infer an orientation of the assumed planar phase front. We find that the lag time appropriate to match observed features between any two spacecraft can vary on short time scales, changing by tens of minutes over intervals of minutes to hours. That variability suggests that either the planar fronts must change speed or direction as they propagate from one spacecraft to another, or the structures themselves are not actually planar. Using three-spacecraft observations, we present examples which do not appear to be consistent with simple planar structures.

SH21A-0508 0830h POSTER

The periodicity of solar wind high-beta structures

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Pressure-balanced structures are a common feature in the solar wind. In these structures, variations in the thermal pressure are matched by opposite variations in the magnetic pressure, keeping the total pressure approximately constant. Recent work has shown

that these PBSs often reoccur at regularly spaced intervals and can directly-drive global magnetospheric pulsations. Interestingly, we show that the solar wind density fluctuations, when converted into length-scales, organize into scale-sizes of L=23, 30, 45, and 80-100 RE. In addition, we have statistically examined these structures using several years worth of WIND data. In particular, we examined the distributions of recurrence-times, scale-sizes and durations of high-beta solar structures in the solar wind, and find that the spectra of duration and recurrence-time are not flat.

SH21A-0509 0830h POSTER

Strongly Under-wound and Near-Radial Magnetic Fields in the Solar Wind

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Observations of the magnetic field orientation in co-rotating rarefaction regions (CRRs) reveal that they are often significantly under-wound compared to the expected Parker spiral, sometimes being almost radial. In particular, CRRs sampled by the *Ulysses* and *Pioneer* spacecraft beyond 4 AU from the sun often show average field orientations deviating by more than 30° from the expected Archimedian spiral. These steady state structures last many days, with very little variance in the magnetic field magnitude or direction.

The observations are explained by a model combining footpoint motion between fast to slow solar wind streams at the source surface, with the effects of velocity shear across coronal hole boundaries. Using reasonable values for the thickness of and the rate of footpoint transport across the coronal hole boundary, the model reproduces our observations. It also predicts that the magnetic field will evolve asymptotically to a fixed angle and not continue to become more tightly wound with distance.

SH21A-0510 0830h POSTER

Ultraviolet Spectroscopy of Narrow CMEs

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Coronal mass ejections (CMEs) are commonly described as new, discrete, bright features appearing in the field of view of a white light coronagraph and moving outward over a period of minutes to hours. Apparent angular widths of the CMEs cover a wide range, from few to 360°. The very narrow structures (narrower than ~15–20°) form only a small subset of all the observed CMEs and are usually referred to as rays, spikes, fans, etc.

Recently, Gilbert et al. (2001, ApJ, 550, 1093) reported LASCO white light observations of 15 selected narrow CMEs. We extended the study and analyzed ultraviolet spectroscopy of narrow ejections, including several events listed by Gilbert et al. The data were obtained by the Ultraviolet Coronagraph Spectrometer (UVCS/SOHO). We present comparison of narrow and large CMEs and discuss the relation of the narrow CMEs to coronal jets and/or other narrow transient events.

This work is supported by NASA under Grant NAG5-11420 to the Smithsonian Astrophysical Observatory, by the Italian Space Agency and by PRODEX (Swiss contribution).

SH21A-0511 0830h POSTER

Visualization of Remotely-Sensed Heliospheric Plasmas

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We demonstrate a software application designed for the display and real-time manipulation of 3D heliospheric volume data, such as solar wind density, velocity and magnetic field. The software exploits the capabilities of the Volume Pro 1000 (from TeraRecon, Inc.), a low-cost 64-bit PCI board capable of rendering a 512-cubed array of volume data in real time at up to 30 frames per second on a standard PC. The application allows stereo and perspective views, and animations of time-sequences. We show several examples of three-dimensional heliospheric volume data derived from tomographic reconstructions based on heliospheric remote sensing observations of the heliospheric density and velocity structure (e.g. Thomson scattering and interplanetary scintillation observations). This work was supported through NASA grant NAG5-9423 and Air Force MURI grant F49620-01-0359.

URL: <http://casswww.ucsd.edu/solar/index.html>

SH21A-0512 0830h POSTER

Impulses of Coronal Activity and Their Relation to the Solar Cycle

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SOHO/EIT Extreme Ultraviolet and YOHKOH soft X-ray data have revealed the close relation between the coronal structures and the photospheric magnetic flux. These data can be considered as a proxy of magnetic field structures in the corona. During the beginning of the solar cycle the evolution of the coronal structures and, therefore, the topological changes of the magnetic field reveal a quasiperiodical process of 'impulses of coronal activity' with a period of approximately 1-1.5 years. This process is represented by the evolution of giant coronal loops of hot plasma (2-3 MK), or by closed lines of magnetic field, which connect the following parts of the complexes of the sunspot activity with the solar polar regions (predominantly of the opposite polarity). The 'impulses of coronal activity' are correlated with the erupted magnetic flux in the mid-latitude zones, and they display non-uniform distributions with longitude. Therefore, the 'impulses' mostly reflect the non-axisymmetrical component of the solar magnetic field. The quasiperiodic behavior of the 'impulses' results from the characteristic lifetime and reappearance of the sunspot complexes in active longitudinal zones (active longitudes). We discuss the physical nature of the 'impulses of coronal activity' and their possible relations to the dynamo process.

SH21A-0513 0830h POSTER

Vector velocity profiles of the solar wind within expanding magnetic clouds at 1 AU: Some surprises

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We investigated the average vector velocity profile of 36 carefully chosen WIND interplanetary magnetic clouds occurring over about a 7 year period since spacecraft launch, to see if a differential pattern of solar wind flow exists. Particular cases were chosen of clouds whose axes were generally within 45 degrees of the ecliptic plane and of relatively well determined characteristics obtained from cloud-parameter (cylindrically symmetric force free) fitting. This study was motivated by the desire to understand the manner in which magnetic clouds expand, a well known phenomenon revealed by most cloud speed-profiles at 1 AU. One unexpected and major result was that, even though cloud expansion was confirmed, it was primarily along the Xgse axis; i.e., neither the Ygse or Zgse velocity components reveal any noteworthy pattern. After splitting the full set of clouds into a north-passing set (spacecraft passing above the cloud, where $Nn = 21$) and south-passing set ($Ns = 15$), to study the plasma expansion of the clouds with respect to the position of the observer, it was seen that the Xgse component of velocity differs for these two sets in a rather uniform and measurable way for most of the average cloud's extent. This does not appear to be the case for the Ygse or Zgse velocity components where little measurable differences exists, and clearly no pattern, across the average cloud between the north and south positions. It is not clear why such a remarkably non-axisymmetric plasma flow pattern within the "average magnetic cloud" at 1 AU should exist. The study continues from the perspective of magnetic cloud coordinate representation.

SH21A-0514 0830h POSTER

Seasonal Variation in the Interplanetary Magnetic Field

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Due to a tilt of the ecliptic by about 7.25 degrees toward the solar equatorial plane, the Earth appears northward of the Sun's equatorial plane in fall months and southward in spring months that may lead to an annual variation of the interplanetary magnetic field (IMF) near the Earth's orbit. We investigated the behavior of IMF for two minima of solar activity related to 1985-1987 and 1995-1997. The solar magnetic field was sufficiently regular for these two intervals but had opposite polarity; for the first interval the north magnetic pole coincided with the Sun's south pole while for the second interval it moved to the Sun's north pole. We have found clear differences in IMF Bx for fall and spring months: Bx increased from negative (in spring) to positive (in fall) values during the first interval and decreased for the second interval in accordance with the expectations. The amplitude of this variation appears surprisingly high of about 4-5 nT. This dependence is better seen for high solar wind speed. IMF Bz also shows a clear annual variation but differs significantly from that expected from a simple solar magnetic field model with magnetic field lines coming from the Sun and closed through the equatorial plane. Instead, Bz field shows clear correlation with IMF Bx in spring and anti-correlation in fall, which show that magnetic field lines coming from the Sun must have significant divergence from the solar equatorial plane near the Earth's orbit that is especially evident for large IMF Bx. Such behavior of IMF Bz may be important for forecast of geomagnetic activity; it allows us to suggest that Sun's north magnetic polarity is less favorable for increasing geomagnetic activity than Sun's south magnetic field polarity.

SH21A-0515 0830h POSTER

Latitude Dependence of Element Abundances in the Slow Solar Wind

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Since 1992 the Ulysses spacecraft orbits the Sun on a high-inclination orbit with an inclination of 80 degrees to the heliographic equator. The first orbit, in 1992-98, took place around solar minimum and revealed a highly ordered state of the heliosphere with large high-speed streams poleward of about 30 degrees heliolatitude, emanating from the relatively cool polar coronal holes, separated by a band of slow solar wind at low latitudes.

In the slow wind the abundances of elements with a low first ionisation potential (FIP) such as Fe, Mg, and Si, are found to be enhanced over the solar values relative to the high-FIP elements by a significant factor of 2-5. On the other hand, this FIP enrichment factor was found to be less than a factor of two, but still

significantly larger than one, in the polar high speed streams. On the second orbit, which is now taking place around the maximum of solar cycle 23, slow solar wind is found at all heliolatitudes, interspersed with fast streams from fragmented coronal holes and from coronal mass ejections, also at all latitudes.

Using data from the SWICS sensor on Ulysses, we have found that the strength of the FIP fractionation factor appears to depend on the heliographic latitude, even if we restrict ourselves to unequivocal slow solar wind. The strongest FIP enrichments are found at low latitudes, which can also be observed from the ecliptic plane, but they are becoming increasingly weaker at higher latitudes. This was particularly evident during the second fast latitude scan in 2000/01.

We will present the observational data and discuss their possible implications for the underlying coronal structure, specifically in the framework of the Fisk model. In this model the slow solar wind is pictured as made up from a sequence of previously closed magnetic loops that are emptied onto open, migrating field lines. The strength of the FIP fractionation of the loop material may be expected to be a function of loop parameters such as length, temperature, or age, so therefore a systematic variation of the FIP fractionation factor may reveal a dependence of these parameters on heliographic latitude.

SH21A-0516 0830h POSTER

Comprehensive Test of a New Method for Specifying Solar Wind Speed Near the Sun

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We have recently found evidence [Arge et al., 2002] suggesting that, in addition to magnetic field expansion factor, solar wind speed is also influenced by the angular separation (at the photosphere) between an open field footprint and its nearest coronal hole boundary. From this discovery, we have developed a new technique for empirically specifying solar wind flow speed near the Sun (~ 0.1 AU) using a set of three simple interlinked coronal/solar wind models. A preliminary test of the technique, using daily updated polar field corrected Mount Wilson Solar Observatory photospheric field synoptic maps from 1995, has yielded encouraging results. In this paper, we present the results of a more comprehensive and rigorous evaluation of this new method, which is now tested over a much larger fraction of the solar cycle. We also present the results of a preliminary test of our new empirical method using the Odstrcil 3-D time-dependent MHD numerical code.

SH21A-0517 0830h POSTER

MHD Shock Fitting Algorithm

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A variation of the basic Lepping-Argentiero shock fitting algorithm gives fits of the MHD shock jump conditions to magnetic field and velocity data from a single spacecraft that are unique and rapidly convergent assuming that the sources of error in the data are uncorrelated gaussian noise. The algorithm is a simple iterative procedure that enforces coplanarity through the use of a Lagrange multiplier and successively minimizes the residuals between model and data. It typically converges to machine accuracy in a dozen iterations or so and works well for signal to noise ratios as low as about unity. Standard techniques from nonlinear programming theory demonstrate that each numerically determined solution is a strict local minimum. The theory of pseudoconvex functions applied to the Lagrangian and the coplanarity constraint condition then shows that the local minima so determined in the twelve dimensional parameter space are global, i.e. unique. Expressions for error estimates for the shock normal and shock speed as functions of the signal to noise ratio are determined analytically. Quality factors based on noise levels estimated from the data are used to determine an objective measure of the goodness of fit. Numerical solutions for the normal and speed based on simulated shocks with uncorrelated gaussian noise are shown as functions of signal to noise ratio and compared to the results of other methods.

SH21A-0518 0830h POSTER

The International Heliophysical Year (IHY)

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In 1957 a program of international research, inspired by the International Polar Years of 1882-83 and 1932-33, was organized as the International Geophysical Year (IGY) to study global phenomena of the Earth and geospace. The IGY involved about 60,000 scientists from 66 nations, working at thousands of stations, from pole to pole to obtain simultaneous, global observations on Earth and in space. There had never been anything like it before. The fiftieth anniversary of the International Geophysical Year will occur in 2007. We propose to organize an international program of scientific collaboration for this time period called the International Heliophysical Year (IHY). Like its predecessors, the IHY will focus on fundamental global questions of Earth science.

URL: <http://ihy.gsgf.nasa.gov>

SH21A-0519 0830h POSTER

Polar Patrol Balloon (PPB) experiment in Antarctica during 2002-2003

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The Polar Patrol Balloon (PPB) experiment is introduced. This campaign will be carried out at Syowa Station in Antarctica during Dec., 2002 to Jan. 2003. The PPB experiment aims at doing long-duration observations with stratospheric zero-pressure balloons by utilizing a stable circumpolar easterly wind around Antarctica. In this experiment, a total of 4 balloons will be launched for the purpose of making astrophysics observations (1 balloon) and upper atmosphere physics observations (3 balloons). The first payload will carry a very sophisticated instrument that will observe primary cosmic-ray electrons in the energy range of 10 GeV - 1TeV. The payloads of the latter 3 flights are identical with each other. They will be launched in as rapid a succession as weather conditions permit to constitute a cluster of balloons during their flights. Such a "Balloon Cluster" is suitable for observing temporal evolution and spatial distribution of various phenomena in various magnetospheric and ionospheric regions and boundaries that the balloons will traverse during their circumpolar trajectory.