Abstract: The average intensity and center-to-limb variation of active regions, enhanced network (large-scale active region fragments), and quiet-Sun are estimated by minimizing the variance between time series of the Solar-Stellar Irradiance Comparison Experiment (SOLSTICE) far ultraviolet (FUV) irradiance measurements and a model of the solar irradiance that depends on the distribution of solar surface features. The model is constrained by grouping the broad range of solar features into four components that contribute the most to solar irradiance variability over the solar activity cycle. The areas of these components are identified on approximately 800 ground-based Ca II K spectroheliograms with an algorithm that uses criteria of size, filling factor, intensity, and contiguity. These 800 maps are the "known" parameters to the solar irradiance model. The unknown parameters to this model are the average intensities and center-to-limb variation of these four components. Because of systematic uncertainties associated with the SOLSTICE measurements and the Ca II K maps we are limited to reporting the computed intensities and center-to-limb variation of active regions, enhanced network, and quiet-Sun for wavelengths between 120.0 nm and 170.0 nm. We find good spectral agreement between active region center-to-limb variations and image-based measurements of quiet-Sun center-to-limb variations. Intensities for plage, enhanced network, and quiet-Sun are reported with a typical uncertainty of about 8%. This uncertainty is primarily associated with the SOLSTICE FUV calibration.

SH11C-0733 0830h POSTER

Solar Irradiance Variability Modeled Near Mg II Using Plage and Sunspot Contrast Factors Measured by HRTS

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Empirical models of solar spectral irradiance varaibility combine areas and locations of plage and sunspots with wavelength dependent contrast factors in order to estimate the solar spectrum. At UV wavelengths, these models have relied on estimated or calculated contrast factors that are often at low resolution. Using quiet sun, plage, and sunspot spectra near Mg II at $\sim$ 2800Å measured by the NRL HRTS instrument, we have recently determined the wavelength dependent contrast factors for plage and sunspots. In this presentation we will discuss the use of measured contrast factors in a spectral irradiance model of the 2765 - 2885Å region and the preliminary comparisons of model results with SUSIM observations. These comparisons will examine spectral irradiance variations on solar rotational and solar cycle time scales.

SH11C-0734 0830h POSTER

Variations in Total Solar and Spectral Irradiance During Solar Cycle 23

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Observations of total solar and spectral irradiance in near-UV (402 nm), visible (500 nm) and near-IR (862 nm) have been conducted by the SOHO VIRGO experiment since January 1996, providing information about irradiance changes during the minimum, rise, and maximum of solar cycle 23. Solar EUV and UV irradiance measurements are available for the same time interval by the SOHO/CELIAS/SEM and UARS/SUSIM experiments. Analysis of the SOHO/MDI images makes it also possible to compare irradiance variations with the evolution of magnetic structures, such as sunspots, facuale and the network. In this paper we study the spectral distribution of irradiance changes and their relation to magnetic activity. Results on longer-term variations between 1978 and 2001 are also presented.

SH11D MC: 302 Monday 0830h

Interacting CMEs and Their Relationships to Interacting Ejecta I

Presiding: **N Gopalswamy,** The Catholic University of America**; L Burlaga,** NASA/Goddard Space Flight Center

SH11D-01 0830h INVITED

CME Interactions Near the Sun

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The phenomenon of interaction between coronal mass ejections in the near-Sun interplanetary medium is surveyed using data from SOHO and Wind missions. Long wavelength radio data (1-14 MHz) reveal CME-CME and CME-shock interactions. CME interactions may result in change of CME trajectories or merger ("cannibalism"). Typically, slower CMEs are overtaken by faster CMEs. Occasionally, multiple interactions are observed. Solar cycle variation of the CME interaction rate will be presented based on a careful examination of all the available CME data from SOHO. Finally, consequences of the CME interaction in the interplanetary medium will be discussed briefly.

Research supported by NASA, AFOSR and NSF.

SH11D-02 0850h INVITED

Interacting Ejecta and Transient Flow Systems near 1 AU

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There are at least two types of ejecta in the solar wind: magnetic clouds (in which the magnetic field direction rotates smoothly through a large angle) and complex ejecta (in which the magnetic field direction has a complex structure). Ejecta are generally associated with CMEs, but this association is not understood in detail. Near solar maximum, complex ejecta in the form of a single fast stream can be associated with a series of CMEs. Conversely, successive CMEs can interact and merge to form complex ejecta near 1 AU. More generally, a series of ejecta and corotating streams at 1 AU can form a transient flow system in which the individual streams interact and coalesce with increasing distance from the sun, forming larger structures. We shall show examples of the types of flows and flow systems mentioned above, including transient flow systems observed by Helios 1 during 1979, by ACE in May, 1998, and by ACE in July, 2000. Although these phenomena have been studied for many years, significant progress in understanding them is being made based on the recent nearly continuous in situ observations from WIND and ACE at 1 AU, the unprecedented composition observations from ACE, the high sensitivity coronagraph and EIT observations from SOHO, and realistic time-dependent 3-D MHD codes.

SH11D-03 0910h

Composition measurements as tracers for interacting CMEs

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Unusually high charge compositions, for Fe and O, have been established to be a very reliable tracer for CME plasma. These charge states indicate the presence of source material with temperatures in excess of 3 MK that become part of the interplanetary CMEs. Some topologically simple CMEs have relatively constant composition throughout the ejecta. However, in many cases, we find abrupt composition changes within the CME. These composition changes can be used to study the heterogeneous nature of many CMEs at Earth. We will use a statistical study of coronal mass ejections to study composition and structure of these composite CMEs. We use publicly available solar wind and remote solar data to associate these composite CMEs with interacting plasma structures in the inner corona.

SH11D-04 0925h INVITED

A Study of Interacting Plasma Phenomena Using the Tomographic 3-Dimensional Reconstruction Techniques Developed for the Solar Mass Ejection Imager (SMEI)

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We are developing tomographic techniques for analyzing remote sensing observations of heliospheric density and velocity structure as observed in Thomson scattering (e.g. using the Helios photometer data) for eventual use with Solar Mass Ejection Imager (SMEI) observations.

We have refined the tomography program to enable us to analyze time-dependent phenomena, such as the evolution of corotating heliospheric structures and more discrete events such as coronal mass ejections. Both types of phenomena are discerned in our data, and are reconstructed in three dimensions. We use our tomography technique to study the interaction of these phenomena as they move outward from the Sun for several events that have been studied by multiple spacecraft in-situ observations and other techniques.

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

URL: http://casswww.ucsd.edu/solar/crew/bjackson / index.html

SH11D-05 0940h

Radio Scintillation Imaging Observations of Interplanetary Disturbances Associated with the July 14, 2000 Event

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Interplanetary scintillation (IPS) measurements made with numbers of the lines-of-sight to radio sources allow us to produce an all-sky map of solar wind plasma. Such imaging observations by IPS are useful for studying the three-dimensional structure and propagation of the coronal mass ejection (CME) in the interplanetary space. In this paper, we report IPS imaging observations taken with the 327 MHz IPS system of the Solar-Terrestrial Environment Laboratory (STEL), Nagoya University, for the July 14 (Bastille Day), 2000 event. The interplanetary (IP) counterpart to the flare/coronal mass ejection (CME) which occurred on July 14, 2000 was found clearly from STEL IPS measurements made on July 14-15. The all-sky map of the solar wind density disturbance factor (so called "g-value") derived from our IPS data exhibits approximately symmetric appearance of IP disturbances in eastern and western hemispheres. Our IPS data show that the latitude extent of IP disturbances was much smaller than the longitude one, implying a torus-shape structure of IP disturbances. The wing part of IP disturbances probed by IPS was found to expand at slower speed than the central part directed to the earth.

SH11D-06 0955h INVITED

Global Simulations of Propagating CMEs

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Recent advances in numerical methods and computer systems have made it possible to address complicated dynamic phenomena occurring in the heliosphere. Simulation of large-scale interplanetary interactions requires consideration of the preexisting structured ambient solar wind, realistic treatment of the launch phase of transient disturbances, and accurate tracking of interactions among multiple ambient and transient structures. We will review recent progress in this area, with special attention being given to the distortion of shocks and CMEs propagating within the streamer belt, to their possible appearance in in-situ and line-of-sight observations, and to phenomena generated by collisions of magnetic flux ropes and interplanetary shocks.

SH11D-07 1035h INVITED

Numerical MHD Simulation of Flux-Rope Formed Ejecta Interaction with Bi-modal Solar Wind

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Recent SOHO and WIND observations have shown that CMEs could be accelerated or decelerated due to their interactions with the solar wind. These interactions will result in different solar wind signatures. In order to understand the physics of CME interaction with non-uniform solar wind during propagation, we combined our previously developed two-dimensional planar bi-modal solar wind model (Wang et al. 1996) and streamer and flux-rope model (Wu et al. 1995) to study the fast and slow wind interactions with the propagating CME. This simulation is carried out up to the inner heliosphere (~30 R_s (solar radii)). The results will show the effect of CME propagation speed by the fast and slow speed solar wind, and the shock formation and their comparison with the uniform solar wind. Also the features of the deflection of CME propagation due to streamer will be discussed.

STW and AHW acknowledge AFOSR, NSF, JPL, and AAMU subcontract of NASA prime contract.

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Wu, S. T., W. P. Guo, and J. F. Wang, Dynamical Evolution of Coronal Streamer Bubble System: I. A Self-consistent Planar Magnetohydrodynamic Simulation, Solar Physics, 157, 325-348, 1995.

SH11D-08 1055h INVITED

Numerical simulations of interplanetary magnetic clouds

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We have carried out MHD simulations of the evolution of the class of CMEs known as magnetic clouds. It has been shown that such CMEs survive as flux ropes during their interaction with the solar wind. However, their shape at 1 AU depends on both their initial density and relative velocity with respect to the solar wind, and in no cases does cylindrical symmetry survive the interaction of the flux rope with the solar wind. We have investigated magentic reconnection between a CME and the solar wind, for the case of propagation in a uni-directional field and along a current sheet. Reconnection happens asymmetrically in the former case, and either on both or neither side in the latter. Finally, we have carried out a systematic study of the effective drag force operating on a CME. The drag coefficient is of order unity, but the actual motion is also influenced by the virtual mass effect.

SH11D-09 1115h

Numerical Study on the Acceleration of Coronal Mass Ejections in the Interplanetary Medium

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Recently *Gopalswamy et al.* [2000] studied observations of ICMEs by WIND spacecraft and correlated these observations with CMEs detected previously by SOHO coronographs. They found that the Sun-Earth mean acceleration of these events was approximately proportional to their initial speeds, and they suggest that this result could be used for space weather forecasting. In this work we perform a parametric study of several CME like disturbances propagating in two different ambient winds using a one dimensional, single fluid, hydrodynamic model, to study the kinematics of the CME fronts near the Sun to 1 AU. These 1-D simulations of interplanetary disturbances have shown to be very useful to understand the basic physical aspects of the injection and heliospheric evolution of these phenomena. In this work we explore how the CME acceleration and transit time from near the Sun to 1 AU varies depending on the CME initial conditions and the ambient solar wind.

SH11D-10 1130h

Interplanetary Acceleration of Coronal Mass Ejections: Comparison between numerical simulations and observations

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For a set of 50 Coronal Mass Ejections (CMEs) observed with the Large Angle and Spectrometric COrongraph (LASCO) on board of the SOlar and Heliospheric Observatory (SOHO) mission, we estimate the density and measure the sky-plane speed at 18 solar radii ($R_\odot$). We feed these parameters to a one dimensional, single fluid, hydrodynamic model to simulate the CME propagation from 18 $R_\odot$ to one AU, and iteratively adjust the initial temperature and ambient solar wind speed using *in situ* measurements by the Wind mission prior to and during the ICMEs that pair with the white-light CMEs. Following the evolution of the nose of the ejecta we are able to construct an acceleration model for the simulated ICMEs. We compare and discuss the simulated acceleration profile with the observed mean acceleration in order to obtain a general ICME acceleration model.

SH11D-11 1145h INVITED

Interplanetary Recycling: the Acceleration of Suprathermals in CME-Related Solar Particle Events and Interplanetary Shocks

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Energetic particle acceleration is one of the key features of fast CME events. It has long been known that in CME-related solar particle events, the peak intensities of particles below 10 MeV/nuc often occur at the shock passage, and not in the initial acceleration process much closer to the sun. This acceleration of energetic particles by interplanetary shocks has been extensively studied and modeled, and yet the seed population for the acceleration mechanism remains to be identified. Because the ion composition of the accelerated particles is roughly similar to solar system abundances, it has been presumed that the solar wind is the source. Yet discrepancies in both composition and spectral form between models and observations show that a complete picture has yet to be synthesized. Recent observations on Ulysses and Wind have shed new light on these questions: first, it has been found that the solar wind continuously exhibits a suprathermal tail; second, singly ionized He – extremely rare in the solar wind – is enhanced by a factor of ~1000 in corotating shocks. More recently, ACE observations have shown that a sizable fraction of interplanetary shock events and CME-related solar particle events show large enhancements of the rare isotope 3He. These tracer ions, He+ and 3He, are evidence that the energetic particle population is not accelerated out of the bulk thermal pool, but rather out of the suprathermal energy region above the solar wind bulk speed. The suprathermal region has numerous ion sources (e.g., solar wind suprathermal tail, pick-up ions, and remnant suprathermals from prior solar and/or interplanetary activity), and varies in intensity more than the solar wind itself. Understanding the properties of this population, including temporal and spatial variations, and the details of the injection mechanism, appears to be a critical challenge for actually predicting or modeling the energetic particle population accelerated by a given shock.

SH12A MC: Hall D Monday 1330h

Interacting CMEs and Their Relationships to Interacting Ejecta II

Presiding: **R Schwenn,** Max-Planck-Institut fr Aeronomie

SH12A-0735 1330h POSTER

Interacting CMEs and Solar Energetic Particles

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We examined the solar sources of a set of large solar energetic particle (SEP) events with mixed (impulsive + gradual) abundance signatures. The SEP events were detected by the Solar Isotope Spectrometer (SIS) on board the Advanced Composition Explorer (ACE) spacecraft. For each of the SEP events, we identified a "primary" coronal mass ejection (CME), detected by