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Following the lead of K. Shatten in work done for Solar Wind 2, we use the assumption of a stationary heliospheric structure to find the magnetic field pattern over significant regions of the ecliptic plane under quiet solar conditions. A measured dataset is time lagged to form sets for different heliolongitudes, and each of these sets is then kinematically projected to yield radial coverage. This can be done with one spacecraft (or OMNI data), but at times data from two Helios spacecraft can be combined with the 1 AU data to yield a richer set that also checks the consistency of the assumption of stationarity. The resulting pictures will be qualitatively compared to simulations. We will also examine to what extent these methods can be applied to Ulysses data to get a better view of fields over the solar poles, as well as combining that data with measurements from constellations near the Earth (including Cluster, Wind, ACE, and Geotail) for a more global view. This work will help us to sort out spatial and temporal effects in the heliosphere, and will be relevant to predicting the geoeffectiveness of solar events.

SH13A-06 1450h

Solar Wind Heating by Pickup Protons

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We review observations of solar wind heating in the outer heliosphere as measured by the Voyager and Pioneer spacecraft and described previously by a theory of pickup ion wave excitation and turbulent transport. That theory was most recently applied to observations by Smith et al. [2001] and with significant revision of the pickup proton component by Isenberg et al. [2003]. We extend the application of the theory to include time variation of solar wind parameters as recorded by the Omnitape dataset of 1 AU measurements. By averaging Omnitape observations over several solar rotations and using the resulting values as input to the theory, we are able to reproduce the variability of the thermal proton temperatures observed in the outer heliosphere. This is seen to be a direct result of the dependence of energy injection by pickup protons upon bulk solar wind parameters such as Alfven speed and wind speed and the fact that these parameters persist in a predictable manner from 1 AU to the outer heliosphere. Smith et al., JGR, A106, 8253-8272 [2001]
Isenberg et al., ApJ, 592, 564-573 [2003]

SH14A CC: 518 C Monday 1530h

Fresh Perspectives in Solar-Heliospheric Science II

Presiding: **A Posner,** Southwest Research Institute**; I G Richardson,** NASA Goddard Space Flight Center

SH14A-01 1530h INVITED

Coronal Heating and Solar Wind Acceleration: From MHD Turbulence to Kinetic Effects

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The heating and acceleration of the solar wind remains a basic unsolved problem in solar and heliospheric physics. The dynamics of the solar corona and the interplanetary medium is dominated by the presence of the magnetic field and its capability of storing and transporting energy originating in solar convection. This energy is then released in the form of heating, accelerated particles and kinetic energy of the solar wind forming the interplanetary medium. Because of the low densities and high temperatures of the medium, collisional dissipation coefficients are very small and dissipative processes occur at scales which are microscopic when compared to the observed structures, and of the same order or less than the ion gyration radius (or skin depth) in the underlying magnetic field. In the open regions of the solar corona, outward propagating Alfvén waves are one way in which mechanical energy may be transported. In this scenario, the cascade to higher frequencies and then dissipation by wave-particle interactions of the initial outward spectrum would heat the corona and accelerate the solar wind. Alternatively, very high frequency waves and/or electron beams might be generated directly in the lower corona by reconnection events. Here we introduce and critically discuss the many puzzles/questions these scenarios leave open.

SH14A-02 1550h INVITED

Constant Energy Source for Solar Wind: Observations and Theory

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A simple, robust scaling law, was recently derived which explains naturally how the well known anti-correlation between final solar wind speed and freezing-in temperature results from loss of radiated energy in the corona. Further, if the Sun injects roughly fixed electromagnetic energy per particle, this law provides a constant energy model for the source of solar wind: fast tenuous solar wind from dark coronal holes; slow dense wind from hotter, brighter regions; and bound but unstable plasma in extremely hot regions, which may be related to solar transients. We discuss here the scaling law, and explore observational implications of solar wind composition and plasma properties for the constant energy model of the solar wind.

SH14A-03 1610h

3D MHD simulations of the May 2, 1998 halo CME: Comparison of CME initiation models and their characteristics at L1

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We present the results of two numerical models of the partial-halo CME event associated with NOAA AR8210 on May 2, 1998. Our simulations are fully three-dimensional and involve compressible magnetohydrodynamics with turbulent energy transport. We begin by first producing a steady-state solar wind for Carrington Rotation 1935/6, following the methodology described in Roussev et al. (2003). For the first model, we superpose the Gibbson-Low magnetic flux rope into the helmet streamer of AR8210. In the second newer model, instead, we impose shearing motions along the polarity inversion line of AR8210, followed by converging motions, both via the modification of the boundary conditions at the Sun's surface. In the first model, a magnetic flux rope exists in the corona prior to the eruption, whereas in the second model, a flux rope forms from reconnection within the sheared arcade during the CME. In either case, flux ropes are expelled from the Sun, manifesting a partial-halo CME through a highly structured, ambient solar wind. We follow the ejected plasma flows from the corona to the Earth's orbit and compare the time evolution of the solar wind parameters predicted by the two models with satellite observations at the L1 point. With such a comparison, we hope to address much debated issue of whether magnetic flux ropes are a component of the pre-event corona.

SH14A-04 1625h

A THREE-DIMENSIONAL MHD SIMULATION OF THE SOLAR ERUPTION ON 1998 MAY 2

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We present modeling results on the initiation and evolution of the coronal mass ejection which occurred on 1998 May 2 in NOAA AR8210. Our calculations are fully three-dimensional and involve compressible magnetohydrodynamics. We begin by first producing a steady-state solar wind for Carrington Rotation 1935/6, following the methodology described in an earlier publication. Shearing motions are then applied along the polarity inversion line of AR8210, complemented by converging motions, resembling an episode of flux emergence, once enough stress is built in the field for an eruption to occur. The flux rope formed in this process gradually accelerates, leaving behind the ashes of a flare loop system that results from an ongoing magnetic reconnection in the naturally formed current sheet. The rope marches away from the Sun, manifesting a partial-halo CME through a highly structured, ambient solar wind. For this event, diffusive-shock-acceleration theory predicts a distribution of solar energetic protons with a cut-off energy of about 10 GeV. Thus, there appears to be no need to introduce an additional acceleration mechanism to account for solar energetic protons with energies below 10 GeV. We conclude that a CME-driven shock can develop close to the Sun sufficiently strong to account for energetic particles at such high energies.

SH14A-05 1640h

MHD Modeling of the Solar Wind with a North-South Asymmetry

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We present simulation results from a fully three-dimensional steady-state solar wind model with a magnetic field on the Sun composed of a tilted-dipole and a quadrupole. The quadrupole contribution is a source of north-south asymmetry and we study how the asymmetry translates into solar wind properties. The single-fluid MHD equations, which incorporate momentum and energy addition from Alfvén waves, are solved by a time-relaxation method in the region from $1-20$ solar radii and by integration of steady-state equations along radius from 20 solar radii to 1 AU. We show that while a north-south asymmetry in plasma parameters persists up to 1 AU, the asymmetry in magnetic field intensity decreases with heliocentric distance and virtually disappears by about 10 solar radii.

SH14A-06 1655h

Neutral hydrogen distributions in the heliosphere

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The numerical modeling of the interaction of the partially ionized local interstellar medium with the solar wind is complex and rich in details. This nonlinear interaction gives rise to an essentially non-Maxwellian neutral distribution function in the heliosphere, which requires a complex treatment of the neutrals in the numerical models. We report on recent developments in the numerical treatment of neutral hydrogen.