electrons in the lower solar corona, *Geophys. Res. Lett.*, **23**, 2785-2788, 1996., L. A. and N. A. Schwadron, *Eos. Trans. AGU*, **82** (20), S302, 2001.

SH42B-04 1415h

Kinetics of Ions in the Solar Corona With Wave-Particle Interaction and Coulomb Collisions

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A kinetic model for the ions in the solar corona is presented. The model describes the wave-particle interaction within the framework of quasilinear theory and guarantees conservation of energy between waves and ions. The Coulomb collisions are evaluated using the Landau collision integral. Integration of the ion velocity distribution functions (VDFs) over the velocity components perpendicular to the background magnetic field introduces "reduced VDFs". Since the coupled Vlasov equations for these reduced VDFs depend only on the spatial coordinate, s, and speed component, $v_\parallel$, parallel to the background magnetic field, they can be solved with reasonable numerical effort. Results for ions in a coronal funnel are presented. It is found that the heavy ions are heated preferredly and form strong temperature anisotropies, consistent with observations of the solar coronal plasma. The anisotropies increase with height, as the density and thus the efficiency of the Coulomb collisions decreases. The reduced VDFs develop pronounced deviations from a Maxwellian. Calculating the wave growth rate γ shows that the VDFs can reach the limit of marginal stability over a wide range of resonance speeds. The effects of the choice of the heavy ion species in the model plasma on the simulation results are also studied.

SH42B-05 1430h

Solar Wind Acceleration Mechanisms: Suprathermal Electron Effects Versus Wave-Particle Interactions

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Various physical mechanisms have been considered as possible drivers of the solar wind. One of the possible acceleration mechanisms was suggested to be due to the heat flux generated by the suprathermal electrons in the solar wind [Olbert, 1982]. Such an idea has been applied to the ionospheric polar wind with photoelectrons playing the role of the suprathermal population [Tam et al., 1995, 1998], and has successfully addressed the various features observed by satellites. It has been shown that in the absence of wave-particle interactions, the suprathermal electron population can increase the ambipolar electric field, leading to higher ion velocities in the polar wind.

More recently, we have investigated the effects of kinetic wave-particle interactions as a solar wind acceleration mechanism [Tam and Chang, 1999]. Our study also took into account Coulomb collisions and the global kinetic effects due to the suprathermal electron population. The study showed that these combined effects may account for the bulk acceleration of the solar wind. The wave-particle interactions, in particular, can lead to the preferential heating of the helium ions over the protons, as well as the occasionally observed double-peaked proton velocity distributions.

In this study, we investigate the role of the suprathermal electron population in the acceleration of the solar wind. The results of our studies indicate that in the presence of strong wave-particle interactions, the contribution by the suprathermal electron effects becomes insignificant in the solar wind acceleration. This conclusion, however, may or may not be true for the weak wave-driven case. With strong wave-particle interactions, a recently introduced semi-kinetic model [Vocks and Marsch, 2001] which was based on reduced ion distributions, massless electron fluid, and an assumed electron temperature profile seems to be able to generate results that are consistent with those obtained with our more complete solar wind description.

SH42B-06 1445h

The Kinetic Shell Model of Coronal Heating and Acceleration by Ion Cyclotron Waves: Dispersive Waves

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The kinetic shell model of resonant cyclotron heating and acceleration results from taking this wave-particle interaction to be much faster than the non-resonant response to the gravity, electric field and mirror force in coronal holes. Under these conditions, the coronal protons are distributed on constant-density shells in velocity space along surfaces which conserve their energy in the reference frame moving with the phase speed of the resonant wave. In previous work, we considered the resonant waves to be dispersionless, so this phase speed was the same for all protons at a given position. In that case, we obtained shells which were spherical sections centered at that speed, either toward or away from the Sun along the radial magnetic field.

However, when wave dispersion is included, the phase speed varies with wavenumber, and protons with different parallel speeds resonate with waves of different phase speeds. In this work, we apply the formalism of Isenberg and Lee [JGR, 101, 11055, 1996] to calculate the shape of the dispersive shells, and we incorporate this new shell structure into our kinetic model for the generation of the fast solar wind. We find a pronounced improvement in the proton anisotropies obtained by the model. We will present additional results for the solar wind speeds and temperatures, along with the model evolution of the coronal hole proton distribution and the wave intensities for inward and outward propagating ion cyclotron waves.

SH42C MC: 302 Thursday 1530h

Sun and Heliosphere at Solar Maximum

Presiding: **J R Jokipii,** Department of Planetary Sciences**; R G Marsden,** Research and Scientific Support Dept. of ESA

SH42C-01 1530h

First Results From the NOAA GOES-12 Solar X-ray Imager (SXI)

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NOAA's GOES-12 weather satellite, launched into geosynchronus orbit on 23 July 2001, carries NOAA's first Solar X-ray Imager (SXI). When it enters regular operations this instrument will provide nearly uninterrupted, full-disk, broadband soft X-ray solar movies, with a continuous frame rate significantly exceeding that for previous similar instruments. The SXI provides images with a one-minute cadence and a single-image (adjustable) dynamic range near 100. A set of metallic thin-film filters provides a degree of temperature discrimination in the 0.6-6.0 nm bandpass. The spatial resolution of approximately 10 arcseconds FWHM is sampled with 5 arcsecond pixels.

We present first observational results for the SXI from its post-launch check-out period. Observed coronal phenomenology – some of it perhaps unique to SXI's spectral band, cadence and continuity of observations – is presented. Multi-band observations of coronal holes, X-ray bright points, active regions, flares and post-flare loops are presented and qualitatively compared to contemporaneous observations by Yohkoh SXT and SOHO EIT.

URL: http://www.sec.noaa.gov

SH42C-02 1545h

First Results from the Genesis Autonomous Solar Wind Regime Algorithm

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Launched on August 8, 2001, the NASA Genesis mission will collect samples of the solar wind in various materials for approximately two years, and return those samples to Earth for analysis. A primary science goal of Genesis is the determination of the elemental and isotopic composition of the solar atmosphere from the solar wind material returned. Because the solar wind itself is known to exhibit compositional variations across different types of solar wind flows, Genesis will expose 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 ions and electrons from electrostatic analyzers carried by Genesis. The flow regime selection algorithm and subsequent array deployment on Genesis act autonomously, taking into account the proton speed, proton temperature, alpha particle abundance, and the presence of counter-streaming suprathermal electrons as determined onboard. Autonomous determination of counter-streaming electrons is novel, as is the simultaneous utilization of electron information and ion moments in logic that autonomously controls the science payload. We will report on the first four months of algorithm performance, comparing the onboard results to an assessment of regime based on post analysis of the in situ solar wind measurements. At the time of this writing, the regime algorithm has been active for eleven days, choosing regime IS for the first ten days, then transitioning to CH. In addition two interplanetary shocks have been correctly identified.

SH42C-03 1600h

The solar wind's return to a simple three-dimensional structure: Ulysses' second fast-latitude scan

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Ulysses' first orbit, which occurred over the declining phase and through minimum of the solar activity cycle, revealed a regular and quite symmetric global solar wind structure, with fast, uniform solar wind from polar coronal holes at mid- and high-heliolatitudes. In contrast, Ulysses' second orbit exhibited a much more complex mixture of solar wind with both fast and slower flows from numerous smaller coronal holes, more frequent coronal mass ejections, active regions, and slow, dense, streamer belt type flows at all latitudes. Now, as Ulysses again reaches its highest northern latitudes in its second fast latitude scan, longer intervals of more uniform fast solar wind are being observed. These observations suggest that a reforming northern polar coronal hole is again beginning to provide the dominant fast, uniform solar wind observed ubiquitously at mid- and high-latitudes over the first orbit. Solar observations confirm the reformation of a large polar coronal hole. These observations in combination with our earlier results indicate that the highly structured high latitude solar wind may be only a short-lived phase around solar maximum with the large polar coronal hole flows dominant throughout the rest of the solar cycle.

SH42C-04 1615h

Observations of the global heliospheric magnetic field during the recent Ulysses fast latitude scan

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In the fall of 2000, during the on-going solar maximum, Ulysses passed under the suns south polar cap reaching a maximum latitude of 80.2*. The large scale field was highly structured at all latitudes consisting of solar wind compression and rarefaction regions interrupted by CMEs. The magnetic field polarity was dominated by two sectors at almost all latitudes except for a single negative polarity at the highest latitudes. The observations were consistent with a single current sheet that was highly inclined to the suns rotation axis. No evidence was found of a change to a positive magnetic polarity at the pole as had been inferred from Earth-based magnetographs. The open magnetic flux, given by the product of the radial field component and the square of the radial distance, was found to be independent of latitude the same as observed at solar minimum and with the same average value. Ulysses is now executing another rapid traversal from the south polar cap across the solar equator to enter the north polar cap in September and exit it in December 2001. The large scale properties of the magnetic field, such as the sector structure, the variation of open flux with latitude and the polarity in the north polar cap, will be reported and compared with observations in the southern hemisphere.

SH42C-05 1630h

Solar Energetic Particles Pole-to-Pole: Ulysses COSPIN/LET Observations From the Fast Latitude Scan at Solar Maximum

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Having completed the second survey of the southern polar regions of the heliosphere in late 2000, the Ulysses spacecraft is presently engaged in its second so-called Fast Latitude Scan (FLS). During this phase of the out-of-ecliptic orbit, the spacecraft makes a rapid transit from south to north, covering 160 in solar latitude in 320 days at relatively constant radial distance from the Sun. In contrast to the first FLS in 1994/95 that was characterised by near-minimum solar activity conditions, the current south-to-north transit is taking place near solar maximum. Striking differences in the signatures of energetic particles were already apparent when comparing the first and second south polar passes, and this is also the case for the two FLSs. The recurrent, CIR-related particle increases seen in 1994/95 have been replaced by large numbers of transient events, with flux enhancements up to the highest latitudes. In this paper, we follow the progress of the energetic particle events recorded by the COSPIN/LET experiment on board Ulysses during the FLS, and interpret the observations in the light of the associated solar activity, the local plasma conditions, and the changing position of the spacecraft. Special attention is given to the elemental composition of the measured fluxes.

SH42C-06 1645h

Ulysses and IMP-8 Observations of Cosmic Rays and So-lar Energetic Particles from the South Pole to the North Pole of the Sun near Solar Maximum*

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The High Energy Telescope (HET) of the Ulysses COSPIN experiment measures intensities of galactic cosmic rays and solar energetic particles (SEPs) with good energy and charge resolution at energies above about 30 MeV/n. Since passing over the South Polar regions of the Sun near solar maximum in late 2000 Ulysses has been rapidly traversing solar latitude in its so-called Fast Latitude Scan (FLS), passing through perihelion near the suns equator in May 2001. Maximum northern latitude (80.2 deg N) will be reached in October 2001.

HET observations since the onset of solar activity, including the South Polar pass and the first part of the FLS, show that SEPs from large events were commonly observed at both Ulysses and Earth (IMP-8) regardless of the radial, latitudinal, or longitudinal separations between Ulysses and Earth. During the decay phases of the events intensities were often almost equal at Ulysses and IMP, even when Ulysses was over the Suns South Pole and the associated flare site was in the northern hemisphere. This suggests that propagation of particles across the average interplanetary magnetic field in the inner heliosphere is effective enough to relax longitudinal and latitudinal particle intensity gradients within a few days. For galactic cosmic rays, observations from the FLS so far show that latitudinal gradients resulting from solar modulation at solar maximum are $<1\%$/degree, and are in fact consistent with zero to the accuracy of our measurements. The small gradients also suggest effective propagation in the latitudinal direction.

We will report observations from the continuing FLS, give a first report of Ulysses observations over the suns North Polar Regions, and discuss the significance of the results for models of energetic charged particle propagation through the heliosphere.

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