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Earlier a frequency analysis was carried out of the short–period GCR modulation as seen by Ulysses (EPAC, KET) for the time period from December 1993 to May 1994 (Blake et al. GRL 24, 671, 1997). During the five month period, the modulation of GCR protons with E>230 MeV was not the usual 26 days but more than 29 days, and the CIR–associated ∼MeV ions did not exhibit this period shift. Using data from the Energetic Particle Composition (EPAC) instrument on Ulysses, we have searched for other intervals in which the short period modulation of the GCRs deviates from its average value of ∼26 days. The data examined in this study were acquired between January 1992 and December 2001. Using more than one algorithm, we have derived frequency spectra from the data and have compared the results. We have also examined the behavior of the CIR–associated ∼MeV He flux from EPAC during the same time periods. Finally, we have looked for periodicity in the ratios of GCR proton fluxes from the 4 telescopes in the EPAC detector. We discuss the implications of the combined results from each of these analyses. This work was supported at The Aerospace Corporation by JPL under contract 958748 and at MPAe by the Max–Planck–Gesellschaft zur Förderung der Wissenschaften e.V.

SH11C-1128 0830h POSTER

Fisk-type Heliospheric Magnetic Fields and Short-Term Variations in Cosmic-Ray Intensities

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The Fisk model of the heliospheric magnetic field (HMF) has proven to be quite difficult to implement in three-dimensional numerical modulation codes. To overcome certain difficulties, we have developed a divergence-free hybrid HMF, which is a Fisk HMF at mid-latitudes, but changes to a Parker HMF in the solar equatorial plane and above the solar poles. Although this field will under-estimate the effects of the Fisk field, its use should give some insight into the effect of an HMF with a periodic meridional and azimuthal components on cosmic-ray modulation. To study the properties of this hybrid field, we solve the three-dimensional steady-state TPE in a system corotating with the Sun, using spherical coordinates in an ADI numerical scheme which covers the entire heliopshere. In this paper we investigate 27-day recurrent variations of both protons and electrons with our model. We find that the amplitude of these variations is directly proportional to the latitudinal gradient in the intensity, in agreement with observational studies. Moreover, we find that this relation becomes less clear if drift effects are reduced in the model. We also consider variations in the magnitude of the components of the HMF observed by the Ulysses spacecraft during its 1994/5 Fast Latitude Scan. Based on a theoretical analysis which predicts a long-term variation in the azimuthal component of the Fisk field, we searched for such variations in Ulysses magnetic field data. Our preliminary analysis shows quasi-periodic variations with periods of the order of several times the solar equatorial rotation period.

SH11D MCC: Level 2 Monday 0830h

Abundance Variations in the Solar Corona, Solar Wind, and Solar Energetic Particles II Posters *(joint with SA)*

Presiding: **G Li,** Institute of Geophysics and Planetary Physics, University of California, Los Angeles

SH11D-1129 0830h POSTER

Alfvén Waves in Multi-ion Coronal Plasma: Observational Implications

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We investigate low-frequency Alfvén waves in a multi-ion coronal plasma by deriving the dispersion relation of the linearized three-fluid equations in magnetized plasma with coronal parameters. We study the effect of collisions on the velocity amplitude of minor ions due to the Alfvén waves compared to the proton wave amplitude. We find that in the collisionless plasma the minor ion velocity is reduced by the factor Z/A compared to protons, where Z is the ion charge, and A is mass in units of proton mass. When the collision frequency is much larger then the Alfvén wave frequency the velocity amplitude of the minor ions is equal to the proton velocity amplitude. We show the effects of minor ions and collisions on the dispersion relation of Alfvén waves in the three fluid plasma. In view of our results we show how the observed nonthermal line broadening of minor ions relates to the wave motions of protons as a function of heliocentric distance, and the plasma physical parameters.

SH11D-1130 0830h POSTER

The X-ray source region of ^{3}He-rich solar energetic particle events

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The Reuven Ramaty High Energy Spectroscopic Imager RHESSI allows for the first time to study simultaneously the spatial and spectral characteristics of solar hard X-ray emission in detail. In this paper, RHESSI X-ray imaging spectroscopy is used to investigate the source regions of ^{3}He-rich solar energetic particles observed at 1 AU. A series of very large ^{3}He-rich events that occurred between August 19-21, 2002 are investigated. The timing of the simultaneously observed electron events suggests that these particle events are related to a series of GOES M class flares. All events originated from the same active region AR0069 and show a similar behavior: Next to the main flaring loops, TRACE observations additionally show an EUV jet that appears to escape from the Sun with a speed of up to 500 km s^{-1}. X-ray emission is seen from the main flaring loops as well; however, the most prominent source in >30 keV hard X-rays appears to be displaced from the flaring loops, at the footpoint of the field lines along which the jet is moving outward. We investigate the possibility that the HXR footpoint is produced by the downward moving part of the same electron population that escapes to 1 AU, by comparing the derived electron spectrum from the HXR footpoint source with the in situ observed electron spectrum.

URL: http://sprg.ssl.berkeley.edu/∼krucker/hessi/ace/movie/

SH11D-1131 0830h POSTER

First Detection of Hard X-ray Emission From Solar Type III Radio Bursts

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We present the first detection of non-flare related hard X-ray emission from type III radio bursts as observed by the Reuven Ramaty High Energy Solar Spectroscopic Imager (RHESSI). During a period of 15 minutes on 19 July 2002 14:23-14:35 UT, the WAVES instrument on the Wind spacecraft observed interplanetary type III radio bursts approximately every 2 minutes and each was accompanied by a 12-15 keV X-ray brightening observed by RHESSI. The radio and X-rays fluxes were found to be strongly correlated. No flares were reported in the SEC solar event reports during this time and only the strongest brightening is associated with a detectable enhancement in the GOES levels (A3 above a B8 background). Phoenix-2, a ground-based radio spectrometer, observed each interplanetary type III to extend down to 300 MHz (0.1 $R_\odot$) The strongest type III was also accompagnied by a cluster of decimetric radio emission in the frequency range 1 to 2 GHz. A close correlation is found between X-ray fluxes and the decimetric fluxes. X-ray spectra show non-thermal emission (9-30 keV) with an electron spectral power-law index of ∼4, from the footpoint of a TRACE loop observed in FeXII (195 Å). Subsequently, jets are seen to originate from the RHESSI footpoint emission travelling with apparent speeds of ∼ 100 km s^{-1}. The observed RHESSI hard X-ray fluxes require $\sim 10^{33}$ electrons above 10 keV. This work was supported by NASA contract NAS5-98033.

URL: http://sprg.ssl.berkeley.edu/˜schriste/july19/

SH11D-1132 0830h POSTER

Temporal Variability of Gamma-Ray Lines from the X-Class Solar Flare of 2002 July 23

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On 2002 July 23, the Reuven Ramaty High Energy Solar Spectroscopic Imager (RHESSI) detected a GOES X4.8 solar flare, and analysis of the data has produced the first spectrally resolved measurement of nuclear de-excitation gamma-ray lines in a solar flare. These narrow lines result from accelerated ions colliding with the ambient medium (which includes Fe, Mg, Ne, Si, C, and O nuclei), and thus their relative fluxes probe the composition of the solar atmosphere. We investigate the temporal variability of the flux of these lines by analyzing the observed spectrum for two separate time intervals of the flare (00:27:20-00:32:56 UT and 00:32:56-00:43:20 UT). The relative fluxes in the gamma-ray lines change dramatically between these two intervals, suggesting that the circumstances of ion acceleration change as the flare progresses. We consider the possibility of variations in the nuclear abundances, as well as other possible causes such as a varying alpha/proton ratio or a varying energy spectrum for the accelerated ions. Finally, we compare these variations with the source locations as determined by RHESSI's gamma-ray imaging. The work at the University of California, Berkeley, was supported by NASA contract NAS 5-98033.

SH11D-1133 0830h POSTER

Multiple Ions Resonant Heating and Acceleration by Alfven/cyclotron Fluctuations in the Solar Wind

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We study the interaction between protons, and multiple minor ions (O5+, He++) and a given cyclotron resonant spectra in coronal hole plasma. One-dimensional hybrid simulations are performed in initially homogeneous, collisionless, magnetized plasma with waves propagating parallel to the background magnetic field. The self-consistent hybrid simulations are used to study how multiple minor species may affect the resonance interaction between a spectrum of waves and the solar wind protons. The results of the simulations provide a clear picture of wave-particle interaction under various coronal conditions, which can explain 1) how multiple minor ions affect the resonant heating and the temperature anisotropy of the solar wind protons by a given wave spectrum; 2) how energy is distributed and transferred among waves and different ion species; 3) the growth and damping of different beam microinstability modes, including both inward and outward waves; 4) the formation of proton double-peak distribution in the solar wind.

SH11D-1134 0830h POSTER

Solar Wind Scaling Law

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We discuss a simple, robust scaling law, 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 unified theory 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. The scaling law is not an extension, or a new variant of previous solar wind models, but rather, a requirement on all solar wind models, which should apply quite generally to magnetically driven winds. Thus, this presentation reveals an underlying connection between the solar wind and its coronal source.

SH11D-1135 0830h POSTER

Diagnostics of the Solar Wind Composition by X-Ray Spectroscopy of Comets from Chandra X-Ray Observatory

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X-rays are excited in comets by charge exchange of the solar wind heavy ions with cometary neutrals, which are mostly H_2O, OH, and O. The excitation cross sections are known with a reasonable accuracy from theory and laboratory studies. The advanced capabilities of the Chandra X-ray Observatory (CXO) and the recently developed method of analysis [Krasnopolsky et al. Icarus 160, 437, 2002] of the CXO observations of comets result in identification of the emissions excited by the solar wind ions O^{+8}, O^{+7}, C^{+6}, C^{+5}, Ne^{+9}, Ne^{+8}, Mg^{+10}, Mg^{+9}, Mg^{+8}, and Si^{+9}. The CXO observations of comets McNaught-Hartley (MH) and LINEAR S4 (S4) have been processed using this method to compare X-rays from these comets and the composition of the solar wind. The X-ray isophotes are crescent-like in S4 and more circular in MH because of the different phase angles (98^o and 44^o, respectively). The peak X-ray brightness is greater in S4 than that in MH by a factor of 1.5 and smaller by a factor of 1.7 after the correction for heliocentric distance. The X-ray luminosities of MH and S4 are equal to 8.6 and 1.4×10^{-15} erg s^{-1} inside the apertures of $\rho = 1.5$ and 0.5×10^4 km, respectively. (Brightness is 0.2 of the peak value at these ρ.) Efficiencies of X-ray excitation corrected to the solar wind flow are similar and equal to 4.3×10^{-14} erg AU$^{3/2}$ in both comets. This confirms the solar wind excitation of X-rays in comets. The line identification is given. Ion ratios in the solar wind have been extracted from the spectra. O^{+8}/O^{+7} is equal to 0.29±0.04 and 0.14±0.03 in MH and S4. These ratios correspond to $T = 2.17$ and 1.93×10^6K and correlate with the solar wind speed of 390 and 500 km s^{-1} in MH and S4, respectively. Ne^{+9}/O^{+7} is $(15 \pm 6) \times 10^{-3}$ and $(19 \pm 7) \times 10^{-3}$, and C^{+6}/O^{+7} is 0.7±0.2 in both MH and S4. X-ray spectroscopy of comets may be used as a diagnostic tool to study the solar wind composition.

SH11D-1136 0830h POSTER

Relating Interplanetary Helium Variation to Coronal Magnetic Fields and Solar Wind Formation

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We have recently identified two new features in the variation of the relative abundance of helium in the solar wind relative to hydrogen as observed by the Wind spacecraft. First, the *He/H* ratio is a linear function of speed for solar wind speeds ranging from 250-550 km/s. This signal is most evident during the previous solar minimum from 1995 through 1997. Secondly, during that same quiet interval we have identified a six-month periodic modulation of the *He/H* ratio which can be seen at all solar wind speeds. This modulation is in phase with the orbit of the Earth about the Sun, and maxima in *He/H* occur at the times when Earth is most distant from the heliographic equator. As we shall demonstrate, these effects are partly in agreement with theoretical models of the magnetic topology of the corona and of the formation of the solar wind. However, these features present challenges to the currently accepted paradigm of solar wind, with helium-poor wind emerging from coronal streamers and fast, helium-rich wind emerging from coronal holes. The abundance of helium is a sensitive test of models of solar wind formation and of the connection between photospheric, coronal, and interplanetary magnetic fields. The observed variations of *He/H* will be discussed in terms of existing models of coronal magnetic field topology and solar wind acceleration. This research is supported by the NSF/SHINE grant ATM-0327723.

SH11D-1137 0830h POSTER

Acceleration and transport of heavy ions at CME-driven shocks

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CME-driven shocks are now widely accepted as the site for large solar energetic particle (SEP) events. Particles are often accelerated to MeV energies (and perhaps up to GeV energies) at shock waves driven by coronal mass ejections (CMEs). These shock-accelerated particles, can propagate to 1AU and interact with the earth's geomagnetic field, often preceding to space storms. Questions remain however about the basic particle acceleration mechanism by CME driven shock and where the exact accleration site is and what the accelerated particle composition is? Various observations have been caried out to answer these questions. For example, gamma ray lines of the de-excitation of heavy nuclei in the sun's atmosphere as well as hard X-ray and gamma ray continuum when the heavy ions percipitated to the surface of the sun are sometimes used to identify the ion composition and the location of the acceleration site. Direct observations of in-situ particles by various spacecraft such as WIND, ACE,etc. allow us to investigate the charge states of various heavy ions, constraining the temperature of the acceleration site; to examine the relative abundance of various heavy elements to infer how much flare material, if any, must be present as the seed particle population, etc. To understand these observations, one needs a sophisticated model to follow the acceleration and transport of heavy ions. Here, we report our current progress on the acceleration and transport of heavy ions at CME-driven shocks. We show time intensity profiles and time-interval spectra for two groups of heavy ions: CNO and Fe respectively, and discuss the role of the wave field generated by accelerated protons at the shock.

SH11D-1138 0830h POSTER

Extended Injection Histories of Near-Relativisitic Solar Electrons and Their Relation to SEP Ion Events

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Energetic solar electrons provide important information on the acceleration and release of all classes of solar energetic particles (SEPs). The relationships of their intensities to ion abundances and isotopic composition (e.g., $^3He/^4He$) have been studied for decades. Their near-light speed and nearly scatter-free propagation out to 1AU preserve many details of their injection into the solar wind. Recently we have been exploiting the high timing and angular resolution of the ACE/EPAM measurements of 38-315 keV electrons [Haggerty and Roelof, *ApJ.*, *579*, 841, 2002]. We now are able to reconstruct the injection histories of beam-like electrons extending well into the SEP events. This is accomplished by subtracting out the back-scattered electrons that have returned from magnetic irregularities beyond 1 AU, mirrored inside 1AU, and then returned to 1AU. The difference between the total outgoing intensity and that of this mirrored component (time delayed) gives the intensity of the electrons that are still arriving directly from the Sun. The mathematical relation is $j_S(\mu,t-s/v)=j(\mu,t)-j(-\mu,t-2\tau)$, where μ is the pitch cosine (measured positive anti-sunwards), s is the trajectory distance traveled at velocity v, and τ is the time for a particle with pitch cosine $\mu<0$ at 1AU to reach its mirroring point inside 1AU. We find that the injection of solar electrons often lasts for considerably more than an hour at significant intensities. This analysis yields new diagnostics of the acceleration/release process, which we have ascribed to CME-associated shock acceleration [Simnett, Roelof, and Haggerty, *ApJ, 579*, 854, 2002]. The relation of electron injection to ion injection and $^3He/^4He$ variations is the subject of an ongoing joint study [Mewaldt et al., *28th ICRC, SH1.3*, 17, 2003].

SH11D-1139 0830h POSTER

Testing Shock Acceleration in Solar Particle Events: Composition of Suprathermal Onsets

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Energetic particle events are typically associated with solar activity, i.e. flares and coronal mass ejections (CMEs). Observationally, relativistic particles arrive at 1 AU within an hour of such activity. In contrast, suprathermal ions, that form the link between the highly energized ions and their seed population, take up to two days to reach Earth. Inner source pickup ions, a population of singly ionized particles believed to originate from the interaction of the solar wind with small dust grains, are formed in the inner heliosphere at and beyond ten solar radii. Fast CME shocks must encounter inner source pickup ions within three hours of propagation. We discuss implications of suprathermal ion composition on near-Sun acceleration processes and seed populations. A critical test is the contribution of inner source pickup ions in the readily identified suprathermal ion onsets at 1 AU.

SH11D-1140 0830h POSTER

Effects of pitch-angle scattering and magnetic mirroring beyond 1 AU on solar energetic particles

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We have developed a Monte-Carlo technique to study the time-dependent transport of energetic particles in the interplanetary medium. We use the guiding center approximation between discrete finite pitch-angle scatterings to quantify the competing effects of focusing and pitch-angle scattering on energetic particles propagating along a Parker spiral magnetic field. The problem is formulated in terms of the parallel mean-free-path ($\lambda_{\|}$) and the distance traveled along a particle trajectory (s), so using the relation s=vt the results can be easily converted to time-intensity profiles and particle anisotropies observed at various distances from the Sun for electrons, protons and ions of different species. The effects from the presence of a reflecting (mirroring) magnetic boundary beyond 1 AU are discussed and compared with the effects that differential pitch-angle scattering processes produce on ions of different species and energies. The work at APL was partially supported by NASA under grant NAG5-10787. The work at DAM/UB was supported by DGYCT under contract AYA-2001-3304.

SH11D-1141 0830h POSTER

Using SEP Elemental Abundance Measurements to Infer Coronal Composition

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The composition of solar energetic particle (SEP) events has been observed to be quite variable. At energies above 25 MeV/nucleon the event-averaged Fe/O ratio may differ by 2 orders of magnitude from one event to the next. It is necessary to understand such variability to extract the composition of initial seed population which presumably originates in the solar corona. With the high statistical accuracy of today's SEP composition measurements, the elemental composition can be studied both as a function of time and energy within a given event for 13 or more elements from carbon to nickel. We present the observed elemental composition (above 12 MeV/nucleon) of more than 50 SEP events as measured by the Solar Isotope Spectrometer on the ACE spacecraft. Accounting for different fractionation mechanisms believed to occur during the acceleration and/or transport of the ions, we obtain the seed populations and compare them to solar wind and coronal abundances. This work was supported by NASA at Caltech (under grants NAG5-6912 and NAG5-12929), JPL, and GSFC.

SH11D-1142 0830h POSTER

Updated Measurements of the Isotopic Composition of Solar Energetic Particles

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Recent results from the Advanced Composition Explorer (ACE) have shown that solar energetic particle (SEP) isotopic composition in large gradual events can vary considerably (by factors of $>$ 3) from event to event, apparently due to mass fractionation processes during particle acceleration and/or transport. To first order, this mass fractionation seems to scale as a power law in the ionic charge to mass ratio, Q/M, similar to what is observed for SEP elemental fractionation. However, differences from power-law scaling are required for most events to completely account for the observed abundances. Characterizing the actual fractionation patterns is necessary in order to use these data to better constrain the coronal source abundances and to understand the fractionation processes. In the >6 years since the launch of ACE, we have obtained SEP isotope measurements of abundant elements from C to Ni in >40 large SEP events. We find that the isotopic and elemental abundance enhancements are strongly correlated. By assuming isothermal conditions and using calculated equilibrium charge states, we examine deviations in the fractionation patterns from simple power-law scaling. This work was supported by NASA at Caltech (under grants NAG5-6912 and NAG5-12929), JPL, and GSFC.

SH11D-1143 0830h POSTER

Survey of ^{3}He Abundances in Large, Gradual Solar Particle Events: 1997-2002

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During large Solar Energetic Particle (SEP) events such as that on April 21, 2002, particles precipitating into the upper atmosphere can have significant effects on atmospheric chemistry. Using data from ACE and SAMPEX the composition and energy spectra of SEPs from H to Fe with energies from ~0.1 to ~100 MeV/nuc and electrons from ~0.04 to 14 MeV were measured during the April 2002 "Storms" period. Of these species, protons made the largest contribution to the ionization of the upper atmosphere at all energies, as is commonly assumed. However, electrons of similar penetrating power contributed ~10% to ~40% of protons, depending on energy, and He and heavier ions contributed ~10% and ~1-2% of protons, respectively. We have surveyed the relative contributions of these species in a number of other large events from 1997 to 2002 and find that the relative contributions of He and heavier ions are sometimes several times greater than in the 4/21/02 event, while electron contributions (relative to protons) can be up to ~10 times greater. These results suggest that models of SEP energy deposition and associated chemical effects in the atmosphere may need to include other SEP species besides protons.

SH11D-1144 0830h POSTER

On the Temporal Evolution of Energetic Particle Beams

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The temporal evolution of energetic particle beams is studied using the propagating source method. The method was proposed recently [*Zank et al.*, 1999, 2000] and is based on the separation of the total particle distribution function into a main beam component (unscattered part) and the secondary component produced by the scattered beam particles. Here, we have generalized the propagating source method, which allows us to map the temporal evolution of the primary beam component more precisely. The result of this change is that it alters the source term in the scattered particle distribution equation and modifies the spectrum. While a more detailed study of the proposed mechanism will be described elsewhere, here we elaborate on the direct implications of the generalization of the propagating source method and discuss how it can be applied to spacecraft measured data directly.

SH11D-1145 0830h POSTER

Pickup ions generated near the sun during solar maximum

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In situ measurements have identified two main sources of pickup ions (PUIs): the interstellar source that dominates beyond ~ 0.5 AU, and the inner source that dominates inside ~ 0.5 AU. The inner-source PUIs are currently thought to be generated when solar wind passes through extremely small grains. The exiting solar wind particles, mainly neutrals at solar wind energies, are then ionized and picked up by the solar wind. The IDPs in this case must be small enough, a few tens of a nm at most, to act as thin foils by allowing the solar wind ions to pass through the grains without sputtering significant mass. The inner-source PUIs have been studied thus far at solar minimum. However, during solar maximum the solar wind pressure, the solar radiation pressure, and the number of coronal mass ejections increase. These effects may either push the minuscule inner source grains further out into the heliosphere or significantly deplete the grain population. As a consequence, we can use the differences in the inner-source PUI distribution functions observed during solar max and min to infer properties of the source population.

SH11D-1146 0830h POSTER

Enrichment of suprathermal $^{3}He^{++}$ associated with interplanetary coronal mass ejection events

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Three types of suprathermal helium are identified by the CELIAS/(H)STOF mass spectrometer onboard SOHO: 1) solar wind $^{4}He^{++}$, 2) $^{4}He^{+}$ pick-up ions, and 3) ^{3}He from impulsive flares (Bamert et al, 2003, Kallenbach et al., 2003). In this work we analyze the spectra of the He isotopes, and their ratio in the energy range 0.035–2 MeV/amu associated with coronal mass ejection events. We study the fractionation during propagation in interplanetary space, and during injection and acceleration at coronal mass ejection driven shocks. The $^{3}He/^{4}He$ ratio strongly depends on the energy per mass. It varies from 0.01 at 50 keV/amu to almost 1 above 600 keV/amu. The ^{3}He spectrum matches a model on stochastic acceleration in electron firehose waves in the source plasma of impulsive flares (Paesold et al., 2002) and subsequent transport through interplanetary space.

SH11D-1147 0830h POSTER

Correlating Solar Wind Type as Determined by Genesis with Solar Wind Composition as Observed by ACE

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The NASA Genesis spacecraft was launched in August 2001 with the primary operational goal of collecting pristine samples of the solar wind (SW) in ultra-pure materials and returning these samples to Earth in 2004 for precision elemental and isotopic analysis in ground-based laboratories. It is well known that there can be compositional variations in the solar wind, depending on the origin of the plasma flows. What is not certain is if there are also isotopic variations that can be tied to flow type. To help resolve this question, Genesis has three SW regime-specific collectors that are either shielded or exposed to the SW flow, depending on the type of wind flowing past the spacecraft. The three SW regimes the different collectors sample are coronal hole, coronal mass ejection and interstream flows. Changes in the SW regime are autonomously determined in real-time using plasma parameters (proton speed and temperature, helium abundance and counterstreaming electron signatures) obtained from plasma ion and electron spectrometers onboard the spacecraft, and the collectors are then deployed accordingly. The question we wish to address in this talk is: do the solar wind regime determinations based on plasma parameters correlate with distinct variations in SW elemental abundances? The answer to the question of whether there are isotopic variations among the different SW regimes will have to wait for analysis of the SW samples once they are returned to Earth next year. As the Genesis plasma spectrometers were not designed to measure compositional variations in the SW, we will utilize the abundance and charge state measurements for O, Mg, Fe, etc. that have been made by the SWICS instrument on the ACE spacecraft and correlate these with the three SW flow types as determined by Genesis. Attempting a correlation of these two data sets is thought to be valid for a large percentage of the study period as both Genesis and ACE are located near the L1 point and likely sample the same flows. Preliminary analysis of the data suggests that there is no distinct compositional transition that divides the slow and fast SW regimes, and that CME composition is independent of flow speed and most resembles that of the slow solar wind. Further results of our attempts to correlate elemental abundance variations with solar wind regime type will be presented at the meeting.

SH11D-1148 0830h POSTER

Modeling of an Energetic Particle Event Focused on Evolutionary Behavior in Low-Energy Range of a Proton Flux

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Energetic particle acceleration events are thought to be associated with coronal mass ejection (CME)-driven shock waves. In our previous paper (Den, et al., 2001), we insisted that there are at least two types in gradual solar energetic particle (SEP) events. One is that the peak intensities of accelerated particles are below 10 MeV, they often coincide with the shock passage, and behavior of gradual enhancement of a particle flux preceding the shock passage indicates that a particle transport process is not apparent, namely an acceleration close to the sun is ineffective, and certainly no large X-ray flares are related with the source CMEs. The other is that the particles are accelerated to larger than 10 MeV, the large X-ray flares are correlated with the source CMEs very well and feature of a particle flux depends on the solar longitude where the source CME or associated large flare occurred. In this paper, using EPAM data on board the ACE spacecraft, we study time evolution of an energy spectrum of a proton flux in the range of 47 - 4750 keV for the energetic particle event occurred on 255 DOY in 1999, which is regarded as one of typical events of the former type. It is found that the energy spectrum in lower energy range, less than 0.5 MeV, enhanced faster, that is, the spectrum gets softer, which means that the acceleration mechanism is ineffective, and this behavior may give a key concerned with the seed population of the shock acceleration. In order to find energy dependence of a diffusive coefficient, we analyze the magnetic field data observed by MAG on board the ACE and obtain correlation function of the magnetic field. Our result shows that the diffusive coefficient is in proportion to a particle energy. We perform modeling this event including this consequence by numerical simulations using stochastic differential equation method. Our simulation results indicate that insufficiently accelerated particles may exist around 1 AU to explain the evolutionary behavior of the energy spectrum obtained by the observational data.

SH11D-1149 0830h POSTER

Solar Energetic Particle Event Onset as Analyzed From Simulated Data

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Solar energetic particle (SEP) event onset is analyzed using simulated data. A large number of simulations using different coronal and interplanetary (IP) scattering conditions are performed. Protons in the energy range of 0.13–57 MeV are considered. The simulated data are analyzed employing a velocity dispersion analysis (VDA) to the proton-flux onset times in 16 energy channels. As a result of the analysis, the apparent coronal release time, t_0, and the apparent IP path length, s, of the first-observed particles are obtained. It is shown that typical IP scattering conditions, i.e., 1-GV radial mean free path of $\Lambda_{rr} = 0.1$–1 AU with a $\propto P^{1/3}$ rigidity dependence, lead to apparent path lengths of $s \sim 1$–2 AU, consistent with observations. Thus, SEP events with $s \sim 2$ AU can simply be explained as a result of IP scattering. Models with coronal mean free paths small enough to enable shock acceleration to high energies close to the Sun are shown to yield VDA results in agreement with observations, at least with $\Lambda_{rr} > 0.3$. As a result of IP scattering, the inaccuracy of the release times is tens of minutes in events with $s > 2$ AU, which may prevent accurate timing of particle release using the VDA method in such events. Low contrast between the time-of-maximum intensity of the studied SEP event and the pre-event background intensity and/or large difference between the forms of the respective energy spectra may also lead to errors in derived onset times. Best timing results (with errors typically less than 10 min) are obtained for large IP mean free paths, $\Lambda_{rr} > 0.3$ AU (typically resulting in small values of $s < 1.5$ AU), and large intensity contrast between the SEP event and the pre-event background.

SH11D-1150 0830h POSTER

Transport of solar energetic particles in non-uniform heliospheric magnetic fields: comparison between test particle simulations and the diffusion approximation

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Solar energetic particles are highly anisotropic, so it is necessary to use an anisotropic equation to study their transport. The simulations of charged particle orbits in the Parker field with model turbulence will be used to study the properties of the magnetic focussing effect, adiabatic cooling, and diffusive transport in pitch angle distribution of solar energetic particles. A derived formula will be shown for the adiabatic cooling effect of particles with an anisotropic distribution. The time profile of particles' pitch angle will be obtained from the numerical computations in order to study the magnetic focussing effect and the particle pitch angle diffusive transport due to turbulence. The time profile of particle momentum will also be obtained from the numerical simulations to study the adiabatic cooling effect; and it will be compared with analytic formulae of the adiabatic cooling rate. This work is partly supported by NSF SHINE Grant 0203252 and NASA Grant NAG5-13514.

SH11E MCC: 2008 Monday 1020h

The Sun's Spectrum and Life on Earth I *(joint with A, SA, GC)*

Presiding: **J Lean,** Naval Research Laboratory**; T Woods,** Laboratory for Atmospheric and Space Physics, University of Colorado

SH11E-01 1020h INVITED

Measurement of the Solar Spectral Irradiance and its Variability

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Solar electromagnetic radiation is the dominant direct energy input to the terrestrial system. Studies of the Earth's atmosphere, land surface, and ocean require a detailed knowledge of this radiation in order to fully understand the global climate system – and in particular to separate natural influences from possible human induced change. Irradiance measurements made today provide the time variations that are necessary input for today's climate studies. Furthermore, future global change research will rely on today's observations as an essential component of the long-term climate forcing. Measurement of solar irradiance variability can only be conducted from space. In the 1970s and 1980s space radiometers provided a first insight that total solar irradiance (TSI) varies on the order of 0.1 to 0.2%. At the same time spectrometers established that the ultraviolet spectral irradiance varies by 10% decreasing to 1% between 200 and 300 nm, and by much larger factors at shorter UV wavelengths. However, at wavelengths longer than 300 nm, in the visible and near infrared, the solar irradiance variation is much less than 1% (as constrained by the TSI observations), and with the exception of a few selected wavelengths, spectral observations had never been capable of establishing the true solar variability for this important part of the solar spectrum. In January 2003 the NASA Solar Radiation and Climate Experiment, SORCE, was launched. This satellite carries four scientific instruments including one that measures TSI and two that measure the solar ultraviolet irradiance. These observations continue the data records of UARS, ACRIMSAT, ERBE, TIMED, and SOHO. Moreover, SORCE carries a new instrument specifically developed to measure the Sun's visible and near-infrared irradiance with sufficient precision and accuracy to detect wavelength dependent variability. This talk describes the SORCE mission and provides an overview of the first nine months of SORCE observations.

SH11E-02 1040h INVITED

Role of Sun in the Forcing of Climate

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Solar irradiance variations and change constitute an important forcing for the Earth's climate system. Sufficiently precise satellite-based measurements in the recent decades have provided information on the total solar irradiance and its variability over the 11-year activity cycle. Variations over longer periods, extending back to the pre-industrial era, are more difficult to quantify. According to the IPCC (2001)assessment, the solar forcing of climate over the period 1750 to present is about one-eighth of that due to the increase in the well-mixed greenhouse gases. Coupled three-dimensional atmosphere-ocean model simulations have been employed to determine the climatic effects of solar irradiance changes, and compare it with the effects due to the well-mixed greenhouse gases and other forcings. Important issues in this regard are: dynamical response of the climate system to different radiative perturbations; climate sensitivity due to solar forcing versus other natural, and anthropogenic forcing agents; response in the vertical profile of climate change; changes induced in stratospheric circulation, stratosphere-troposphere interactions and effects at the polar latitudes.

SH11E-03 1100h INVITED

Displacements of the Aleutian Low and the Hawaiian High Pressure Systems During the Solar Cycle.

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