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Composition instruments have made themselves indispensable in the study of heliospheric plasmas, since only they are able to identify particle "tracers" that reveal secrets of plasma origin and transport. However, future mission opportunities are likely to put severe constraints on present instrument designs, requiring a radical rethinking of mass spectrometry techniques. Time-of-flight methods currently give the highest mass resolution for the solar wind, but at the cost of limited dynamic range. Likewise magnetic deflection and quadrupole techniques have limitations that preclude their use for heliospheric studies.

We present a novel SW mass spectrometer design that is capable of a breakthrough mass resolution M/ΔM>3000, in a 1 liter, 1 kg package with a huge geometric factor of 0.03cm^{2}sr. Such capabilities enable new heliospheric science, such as the molecular identification of cometary or LISM constituents, the plasma composition of magnetic holes, or the triple isotopes of oxygen. Scaling this design down to more typical SW composition instrument abilities, we can achieve a mass resolution of M/ΔM=100 with a 5×10^{-4}cm^{2}sr in a 5 cm package weighing less than 100 grams. Such a miniature detector would be ideal for multiple space probes or a Pluto flyby.

We will present the first preliminary data from a modulated ion beam demonstrating the mass resolution capabilities of this breakthrough design as well as some of the challenges in the implementation.

URL: http://cspar181.uah.edu/RbS/

SH31B-0713 0830h POSTER

The European Grid of Solar Observations (EGSO)

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Access to solar data is becoming an increasing problem. Although the Internet has made it much easier to share data, the volume and complexity of the data are increasing rapidly, and it is often difficult to identify datasets of interest, and then locate and retrieve them.

In April 2001, a proposal to create a Grid of solar data archives was submitted to the European Commission under the Information Society Technologies (IST) program. The European Grid of Solar Observations (EGSO) will provide the tools and infrastructure needed to create the data grid that will form the fabric of a virtual solar observatory. EGSO will allow a user to identify solar observations covering a given time interval, active region, or type of feature; it will locate the selected observation and then return them after any necessary pre-processing; it will also provide the facility of analyze large volumes of data at the data source.

The EGSO consortium comprises 10 groups in Europe and the US, including experts in both solar data and IT. The project has been positively evaluated and has been selected for negotiations. Inputs from the solar community are now needed in order to formulate the details of the project.

URL: http://www.mssl.ucl.ac.uk/grid/egso

SH31B-0714 0830h POSTER

Multiscale Image Processing of Solar Image Data

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It is often said that the blessing and curse of solar physics is too much data. Solar missions such as Yohkoh, SOHO and TRACE have shown us the Sun with amazing clarity but have also increased the amount of highly complex data. We have improved our view of the Sun yet we have not improved our analysis techniques. The standard techniques used for analysis of solar images generally consist of observing the evolution of features in a sequence of byte scaled images or a sequence of byte scaled difference images. The determination of features and structures in the images are done qualitatively by the observer. There is little quantitative and objective analysis done with these images. Many advances in image processing techniques have occured in the past decade. Many of these methods are possibly suited for solar image analysis. Multiscale/Multiresolution methods are perhaps the most promising. These methods have been used to formulate the human ability to view and comprehend phenomena on different scales. So these techniques could be used to quantitify the imaging processing done by the observers eyes and brains. In this work we present several applications of multiscale techniques applied to solar image data. Specifically, we discuss uses of the wavelet, curvelet, and related transforms to define a multiresolution support for EIT, LASCO and TRACE images.

SH31B-0715 0830h POSTER

3D Coronal Observations and Sun Earth Connections : from SOHO to STEREO data

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Recent progress in 3D visualization and reconstruction made possible to follow the evolution of coronal plasma structures frozen by the magnetic field. As optically thin coronal emission lines introduce uncertainties on the reconstructions, it is needed to develop constraints on stereoscopic methods to be able to use them in the solar case. Basic geometric assumptions on structures made possible to determine the main parameters on loops - including their twists -, arcade loops structures or filament shapes, using the difference angle due to solar rotation with SOHO/EIT. Tomographic techniques are being adapted to coronagraphic data such as SOHO/LASCO. 3D analysis of flare formation on April 7th, 1997 shows emerging flux near a sigmoid loop with magnetic fields reconnection. October 13th, 1999 a twisted filament becomes instable and creates a limb CME. April 6-7th, 1998 at the limb, several ejections of twisted structures are observed. In all of these cases, the role of the helicity in these instabilities formations is analyzed. Consequences of the observed detwisting processes in ejections of material into the interplanetary space up to aurora formations are described. Then improvements expected in dynamical cases due to simultaneous observations at various angle, provided by the STEREO mission (launched in December 2004) are presented in the context of the space weather forecast.

URL: http://www.linmpi.mpg.de/~fabrice/

SH31B-0716 0830h POSTER

First Investigations for the Entrance System / Energy Analyzer of the PLASTIC Sensor on STEREO

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STEREO (Solar TErrestrial Relations Observatory) is the third of five Solar-Terrestrial Probes that will accomplish the goals of the international Sun-Earth Connections program. PLASTIC (PLAsma and SupraThermal Ion Composition) consists of a top-hat E/q analyzer and a Time-Of-Flight–Energy (TOF–E) section. This sensor realizes three functions: a) charge-state and mass measurements of interplanetary ions with a 360° field of view in the ecliptic plane, b) charge-state, mass, and energy measurements of the solar wind (SW) heavy ($Z > 2$) ions in the 45° centered on the SW direction and $\pm20°$ out of the ecliptic plane, and c) charge-state, mass, and energy measurements of the solar wind protons and alpha particles by a separate low-gain entrance with the same field of view as in b). This way, PLASTIC will cover a large dynamical range from bulk solar wind protons to suprathermal particles. In order to accomplish the three functions, the entrance system consists of a complex geometry involving multiple toroidal sections. The use of protruding deflection plates allows to scan for directions up to $\pm20°$ out of the ecliptic plane. We will present the results of our first measurements with the laboratory prototype and compare them with the electrostatic simulations.

SH31C MC: 303 Wednesday 0830h

High-Energy Views of Solar Flares and Coronal Mass Ejections I

Presiding: **H S Hudson,** Institute of Space and Astronautical Sciences**; S W Kahler,** Air Force Research Lab/VSBS

SH31C-01 0835h INVITED

Solar Energetic Particle Events: Flares and CME-Driven Shock Waves

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During the past 15 years, a new paradigm has been developed for solar energetic particle (SEP) events in which the particles observed in space following solar activity are thought to be accelerated either in flares (small impulsive SEP events with high-Z abundance anomalies and high Fe charge states) or at CME-driven coronal/interplanetary shock waves (large gradual events with normal abundances and low Fe charge states). Observations from the Advanced Composition Explorer (ACE), however, have shown that at energies > 10 MeV/amu, certain large gradual events have event-averaged abundances and charge states that look remarkably impulsive (e.g., Cohen et al., GRL 26, 2697, 1999). Recently-analyzed large events observed by the IMP-8 spacecraft since 1973 exhibit similar behavior (Dietrich and Lopate, Proc. 27th ICRC, 8, 3120, 2001). I review the various suggestions that have been made to account for these mixed events in terms of propagation effects and/or seed particle populations.

SH31C-02 0900h

Charge-to-Mass Fractionation during Injection into First-order Fermi Acceleration of Suprathermal Ions at an Interplanetary Shock

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A model for the injection of suprathermal ions into first-order Fermi acceleration at an interplanetary shock associated with a coronal mass ejection is presented. Three source populations are considered: 1) Ions that are pre-accelerated in the turbulence generated by the shock, 2) ions that are statistically accelerated in a magnetic cloud following the shock, and 3) solar energetic particles from impulsive solar flares.

SH31C-03 0915h

Ionization states of heavy ions in large solar particle events: 1998-2001

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Energetic particle ionization states carry information about the particle seed populations, the acceleration processes, and the particle transport through the interplanetary medium.. Using the charge states, we can test for possible dependence of the particle arrival times and energy spectra on rigidity as well as for consistency in the inferred temperature of the source plasma using many elements. We have used the Low-energy Ion Composition Analyzer (LICA) on board the low-Earth orbiting SAMPEX satellite, along with the geomagnetic cutoff technique, to study the ionization states of energetic He-Fe in the energy range of 0.2-5 MeV/nucleon.We will report on a survey of LICA charge state observations in the most intense particle events from 1998 to 2001 at the meeting, updating the low-energy charge states available from SAMPEX through the maximum of solar cycle 23. We will also compare the low-energy measurements from LICA with those also made on SAMPEX above 10 MeV/nucleon recently reported by Labrador et al [2001].

Labrador, A. W. et al.. Proc. 27th ICRC, 3149, 2001.

SH31C-04 0930h

Abundance Anomalies in Impulsive Solar Events: a Possible Pollution by Interstellar Dust Matter

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The anomalous composition of particles emerging from impulsive solar events is currently modeled by first ionization potential fractionation effects and selective acceleration processes. An alternative explanation will be presented, in which the observed enhancements are due to the injection into the flaring loop region of material brought into the inner heliosphere by interstellar micrometeoroids or microms.

The enhancement in heavy elements observed in impulsive solar events demonstrates a clear correlation to the first ionization potential (FIP) of these elements. Therefore, the enhancement in these elements has been related to FIP fractionation effects. Now, it has been noted long ago that FIP and volatility are two characteristics that are very strongly correlated. A low FIP element is also an element with low volatility, or high refractivity, meaning that this element condenses easily and will be found in dust grains and larger solid bodies. This observation, alone, of the fairly close equivalence between low FIP and high refractivity would not be of much significance if it were not suggested by the recent discovery that a large amount of matter, rich in iron and other refractive elements, but also possibly in ^{3}He and Ne, flows towards the Sun. This matter is of interstellar origine, essentially, except for Ne, and is brought into the inner heliosphere by interstellar micrometeoroids (or microms), which are large aggregates of dust grain material, 30 μm in size and larger. These microms might be the reason for the lack of observed low-metallicity stars (Ragot 2001). They have been detected in the Earth atmosphere with the Advanced Meteor Orbit Radar (Baggaley 2000). We will show that they could be at the origine of the abundance anomalies observed in impulsive solar events.

SH31C-05 0945h INVITED

Relationship Between Coronal Mass Ejections and Flares

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We present the results of our observational study about the relationship between CMEs (Coronal Mass Ejections) and flares. We make use of CME events well observed by the LASCO instrument (Large Angle and Spectrometric Coronagraph), which are suitable for studying their detailed kinematic evolution throughout the lower corona (1.1–3 Rsun, the LASCO C1 field of view) and the upper corona (2–30 Rsun, the LASCO C2/C3 field of view). We make height-time and velocity-time plots for these events, giving special attention to the height range of the lower corona where CME acceleration takes place. We find that the evolution of impulsive CMEs can be divided into three phases: initiation phase characterized by slow ascension (less than 80 km/s), impulsive acceleration phase, and subsequent propagation phase. The initiation phase starts earlier than the onset time of the associated flare. However, the onset time of the impulsive acceleration phase coincides with the onset time of the flare, and the acceleration period of the impulsive acceleration phase coincides with the rise phase of the flare. Gradual CMEs, which are not associated with flares, do not show an impulsive acceleration phase. On the other hand, there exists another class of CMEs, which we call explosive CMEs. Explosive CMEs are accelerated extremely fast to reach a great velocity; the acceleration takes place very low in the corona (less than 0.5 Rsun above the surface). They do not show an initiation phase and are associated with major flares. The Nov. 6, 1997 CME/flare event, which is a great particle event, is a typical explosive one and will be discussed in detail in the presentation

URL: http://solar.scs.gmu.edu

SH31C-06 1030h INVITED

The Timing of Radio Emission in Flares and CMEs

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Radio observations are very sensitive to emission by electrons accelerated in the solar corona. This talk will review evidence for acceleration in flares and coronal mass ejections from the radio perspective, focussing on the timing of radio emission in relation to other high-energy phenomena. Amongst other topics, the relationship of coronal type II radio bursts and coronal mass ejections will be discussed in the light of Zhang et al's LASCO data, and recent results on radio emission from CMEs by Bastian et al will be reviewed.

SH31C-07 1055h

The Acceleration and Release of Near-Relativistic Electrons by CMEs

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We have examined transient coronal activity observed by SOHO/LASCO around the solar release time of beams of near-relativistic electrons (~40-300 keV) observed by ACE/EPAM at 1 AU. The majority of west hemisphere CMEs seen by LASCO are not associated with near-relativistic electron beams seen by ACE/EPAM. However, when they are present, strong antisunward beams of electrons may be used to infer reliably the actual solar release time of impulsive events as the intensity is not distorted by the effects of scattering. 52 electron beams were observed between the launch of ACE in 1997 through September 2000 at times when there were LASCO observations. Of these, there were 47 observations of an associated coronal transient, of which 33 were "classical" CMEs, as distinct from blobs and jets; it was possible with all events to extrapolate the radius-time plot back to a nominal 1 solar radius to obtain a CME launch time. All but two of the CMEs were seen in projection off the west solar limb. For 37 events there was an associated GOES soft X-ray event, mainly from western active regions. The electron injection time was typically delayed by around 20 minutes from the CME launch. Half the CMEs had projected speeds >600 km/s. There was some anticorrelation between the electron delay time and the CME speed because the altitude of the majority of the CMEs at the electron release time was between 1.5 and 3.5 solar radii. All events had decametric type III emission observed by WIND/WAVES, which were consistent with coronal electron beams having exciter energies of ~3 keV. We suggest that the bulk of the near-relativistic electrons seen by ACE/EPAM are accelerated by the shock driven by the coronal transient and are released at an altitude around 2-3 solar radii. Prompt near-relativistic electrons associated with the chromospheric emissions are not seen by ACE, so we presume that most do not escape into the high corona.

SH31C-08 1110h

On the Velocity Dispersion in Solar Impulsive Electron Events

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A statistical survey of 26 solar impulsive electron events in the 1 to 300 keV range is presented, as observed by the 3D Plasma and Energetic Particle experiment on the Wind spacecraft. This study was triggered by results of ACE/EPAM observations (Roelof et al.) reporting the absence of velocity dispersion in solar impulsive electrons events in the energy range of 40-300 keV.

Here we find that the majority of events show clear velocity dispersion. Events with high peak flux had to be first corrected for spurious counts of electrons depositing only a fraction of their energy before they are scattered out of the detector. Without this correction the onset times wrongly appeared to be almost without velocity dispersion.

For the large events, the reduced distribution functions show positive slopes at high energies (around 100 keV). The calculated linear growth rates are large, but no in-situ waves are observed by the WIND/WAVES instrument.

SH31C-09 1125h

Post-impulsive Coronal Particle Acceleration and its Possible Role in the Large SEP Event of 6 November 1997: Radio Evidence

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The large solar particle event of 6 November 1997 produced energetic electrons and protons up to relativistic energies observed at 1 AU. Solar phenomena comprised an intense flare, a rapid CME and a propagating disturbance seen at EUV ('EIT-wave'). Following widespread practice, the particle signatures detected in space have been discussed in the literature in terms of acceleration by the shock driven by the CME. Coronal processes closer to the flaring active region were mostly disregarded, although high Fe charge states measured at tens of MeV seem to suggest acceleration in a relatively dense plasma.

While hard and soft X-ray and microwave signatures of the flare show a rather impulsive event with duration between ten and a few tens of minutes, spectra and images at decimetric and longer waves reveal that electrons are accelerated in the corona during more than an hour after the start of the flare. The spectral characteristics of these emissions suggest that the thermal electron densities in the source region range from some 10^8 to a few 10^9 cm^{-3}. The radio maps show stable sources above the active region, while the front of the CME and the shock revealed by type II radio emission were at several solar radii above the photosphere.

We discuss the timing and spectral characteristics of the coronal radio emissions, compare them with reported properties of particles at 1 AU, and suggest that the coronal acceleration supplies part of these particles.

SH31C-10 1140h

Relative Timing of Interacting Solar Flare Particles and Particles Seen in Space and at the Earth

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The observations of meson-decay gamma-rays, relativistic electron bremsstrahlung, and high-energy neutrons by spacecraft instruments and ground-level neutron monitors provide crucial diagnostics for identifying the properties of particle acceleration mechanisms. Using available data and analyses from several missions, we have studied the relative timing between particles accelerated and interacting at the sun and the observation of charged particles in space and at ground level. Radio spectrograph and imaging data are used to determine the time of coronal particle acceleration episodes. We will present results, for several events, on the accuracy of determining the earliest time of acceleration of the interacting particles compared with the time particles are observed. Requirements will be presented for future studies of high energy neutral solar emissions.