## SH23A-02 1330h POSTER

### Recurring Episodes of Jovian Radio Emission Driven by Magnetospheric Interaction with Corotating Solar Wind Density Structures and Sector Boundaries

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In 2003 and early 2004, the Ulysses spacecraft descended from high heliographic latitudes towards perihelion, bringing it relatively close to Jupiter. The geometry of this distant flyby (0.8 AU closest approach) caused Ulysses to spend more than 6 months above a jovicentric latitude of 50 deg at a range of less than 2 AU, while the spacecraft traversed a considerable range of Jovian local time (9 hrs to 17 hrs). During much of this time interval, Jupiter was intercepted each solar rotation by two corotating high density structures and sector boundaries. From the perspective of Ulysses, the radio response of the magnetosphere to a given corotating structure was the intensification of either Jovian broad-band kilometric (bKOM) emission or of a combination of emissions, including bKOM and Jovian narrow-band kilometric (nKOM) emission. Such enhancements have been studied previously with Voyager, Ulysses, Galileo, and Cassini radio data. For Ulysses observations in 1991 and 1992, in particular, the typical scenario was brightening in the Jovian bKOM emission, followed by a sudden cessation of the bKOM emission and an onset of an nKOM "event" that lasted for some 120 hours (Reiner et al., 2000). For the sequences of events in 2003-2004, the two episodes per solar rotation clearly have different morphologies. These differences provide a unique opportunity to study solar wind and interplanetary magnetic field interaction with the Jovian magnetosphere over a period of 6 months, with upstream data provided by the Ulysses solar wind and magnetic field instruments. The goal is to determine which inputs to the magnetosphere are the most influential, resulting in different magnetospheric and, consequently, radio emission responses.

## SH23A-03 1330h POSTER

### Jovian BHL Emissions Observed During the Ulysses-Jupiter Distant Encounter

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During the Ulysses-Jupiter near-encounter in 1992 several new components of Jovian radio emissions were discovered. One new component, called Bursty High-Latitude (BHL), was observed during Ulysses' brief excursion to high Jovian magnetic latitudes. This radiation component was characterized by its burstiness and its unique elliptical polarization. The northern BHL emissions, which were observed only briefly by Ulysses in 1992, were observed from high magnetic latitudes ($> 40^o$) and in the CML range from $135^o$ to $240^o$. Since the recent 2003/2004 Ulysses-Jupiter distant encounter views Jupiter from high northern magnetic latitudes for an extended time period, it was anticipated that Ulysses might observe many episodes of BHL emission, which would help to further characterize this unique Jovian radiation and establish its possible relationship to other Jovian radio components. However, the relative paucity of these BHL emissions observed during the distant encounter suggests that they may require some triggering agent. Indeed, it is very interesting that the observed episodes of BHL emissions are often found to immediately precede major long-duration nKOM events, which are known to be triggered by interactions of the Jovian magnetosphere with the interplanetary sector structure. During the entire nKOM event there appears to be no further episodes of the BHL emissions. These results are reminiscent of our previous findings that Jovian bKOM emissions abruptly ceased just prior to long-duration nKOM events associated with the passage of sector boundaries.

## SH23A-04 1330h POSTER

### Jovian Modulation of Ulysses HISCALE low–energy Electrons

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Estimates of the power spectrum computed from the various low–energy ($\sim 40 - 300$ keV) electron detectors of the Ulysses HISCALE instrument were computed on overlapping data segments starting in Jan. 2003 as Ulysses approached Jupiter (closest approach in Feb. 2004) towards the end of Ulysses' second orbit. In addition to the usual low–frequency solar modes expected in this data, a peak at 27.99$\mu$Hz, corresponding to Jupiter's rotational period of 9h 55m, becomes evident in mid 2003 and, in the last data segment computed in 2003, was about 3.4$\sigma$ above the background spectrum. Because relative long, $\sim$ 170–day, data blocks were necessary for both sensitivity and to resolve Jovian rotation from the nearby 27.435$\mu$Hz solar mode, it is not possible to give a precise range for the initial detection. It appears that Jovian modulation of the electron fluxes must extend somewhat more than one AU from the planet, further than observed during Ulysses 1992 initial Jupiter pass.

## SH23A-05 1330h POSTER

### Superfine Structure of Jovian Millisecond Radio Bursts

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Jupiter decameter (DAM) radio emission mainly consists of wide-band radio storms with time scales in seconds (L-bursts) and milliseconds (S-bursts), the latter comprising a series of short pulses with duration of a few to tens of milliseconds, and strongly controlled by the satellite Io. First in-depth analysis of the subpulse structure was made by Carr and Reyes (1999) with the discovery of successive deep envelope modulations, with time resolution better than 30 microseconds, and during these subpulse periods the discovery of phase coherence. Recent observations by means of the newly developed waveform receiver (at present unsurpassed in spectral resolution) and connected to the decameter world-largest radio telescope UTR-2 (Kharkov) yielded waveform measurements of Jovian S-bursts which have been analyzed by the wavelet analysis method. Main outcome of the present investigation is the detection of clear signatures of microsecond modulations, providing evidence of a superfine burst structure with the following parameters: a) instantaneous frequency band of one separated microsecond pulse of 100 to 300 kHz, b) time duration of one separated micropulse of 6 to 15 microseconds, and c) time interval between closest subsequent microsecond pulses of 5 to 25 microseconds. The apparent frequency drift of a millisecond burst evidently results from sequentially decreasing frequencies of subsequent subpulses, each representing an island of phase coherent gyrating electron bunches.

## SH23B CC: 518 C Tuesday 1330h

### Acceleration, Release, and Propagation of Solar Energetic Ions and Electrons: When, Where, and How? II

*Presiding:* **S Krucker,** University of California, Berkeley**; W H Matthaeus,** Bartol Research Institute, University of Delaware

## SH23B-01 1330h

### Time Scales of Solar Energetic Particle Events and Speeds of Source CMEs

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Solar Energetic Particle (SEP) events are characterized primarily by their peak intensities or fluences. Event temporal characteristics and their associations with solar phenomena are less frequently considered. We measure the times to SEP event onsets, rise times and event durations of E = 20 MeV solar proton events observed with the NASA/GSFC Epact instrument on the Wind spacecraft. The approximately 140 SEP events, observed from 1998 through 2002, were accompanied by associated coronal mass ejections (CMEs) observed with the Lasco coronagraph on the SOHO spacecraft. The timing characteristics of the SEP events are compared with the speeds and widths of the associated CMEs to determine whether any of the characteristics of the SEP intensity-time profiles can be related to CME properties. The longitude dependence of the temporal profiles is considered separately to determine the geometric extents of the shocks producing the SEP events at 1 AU.

## SH23B-02 1345h

### Investigation of the Acceleration Sites for Types II and III Radio Bursts during Solar Eruptions

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Energetic properties of fast coronal mass ejections (CMEs) and the correlation of CMEs with flares suggest the production of high energy particles and CME-driven fast shocks in major solar eruptive processes. It is generally believed that the high energy particles, especially the energetic electron beams, are responsible for type III radio bursts, and that CME-driven shocks produce type II radio bursts. Observations show that type II bursts do not appear below a certain height. On the other hand, type III burst may be observed at both high and low altitudes. This indicates that acceleration sites of the electron beams may exist at both the CME-driven shock surface and the current sheet in the wake of CME, according to the catastrophe model of CMEs. The former could account for type III bursts at higher altitudes and the latter for those at lower altitudes. Both observations and theory show that the main acceleration phase of CMEs occurs in the lower corona, where the local Alfven speed (or the magnetosonic speed) is large, so that the CME-driven shocks may not develop until the CME reaches higher altitudes. On the basis of the catastrophe model of CMEs, we estimate that the highest frequency of type II burst is around 300 MHz, which corresponds to an altitude of $\sim 1.5 \times 10^5$ km. This result is consistent with similar estimates based on observations that bring the corresponding frequency to a few hundred MHz.

## SH23B-03 1400h

### The Isotopic Composition of Solar Energetic Particles in Large Events of Solar Cycle 23

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During this solar cycle we have found that solar energetic particle (SEP) isotopic composition in large gradual events can vary greatly from event to event. It is an open question how much of this fractionation is present in the source material and how much occurs during particle acceleration or propagation out of the corona. 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 seem to be required for most events to completely account for the observed abundances, for example in the case of Fe isotopes. Determining 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 NASA's Advanced Composition Explorer (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 attempt to characterize 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.

### SH23B-04 1415h

## Upper Limit on $^3$He Fluences in Solar Energetic Particle Events

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We investigated 96 $^3$He -rich ($^3$He/$^4$He $> 0.004$ at 0.2-2.0 MeV/nucleon) solar energetic particle (SEP) events from September 1997 through December 2002 using the ULEIS instrument on ACE. Both "impulsive" (flare-related) and "gradual" (CME-related) events are included. The $^3$He fluences varied only by a factor of 100 above our sensitivity threshold while the $^4$He fluences varied by factor of 100,000 above the same threshold. Moreover, we find no significant correlation between the $^3$He and $^4$He fluences. We find it striking that with more than 5 years of continuous SEP data, we could not found any SEP event that has a $^3$He fluence higher than $10^5$/cm$^2$-sr-MeV/nucleon, while the largest $^4$He fluence observed was $1.6x10^7$/cm$^2$-sr-MeV/nucleon (two orders of magnitude larger than the $^3$He upper limit). Since the event fluence should be same fraction of the particle net flux from the Sun at 1 AU, the observed upper limit for $^3$He fluence indicates that there is a limit to the number of energetic $^3$He ions that can be released from the Sun in a SEP event.

### SH23B-05 1430h

## The Q/M-Dependence of Spectral Breaks in the Large Solar-Particle Events of October 28 and 29, 2003

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We report measurements of the energy spectra of ions from H to Fe in the large solar energetic particle (SEP) events of October 28 and 29, 2003. The measurements extend from ∼0.1 to ∼100 MeV/nucleon and were made with the SIS and ULEIS instruments on ACE and the PET instrument on SAMPEX, supplemented by data from NOAA's GOES satellites. In both events the spectra of ten separate species all exhibit rather sharp spectral breaks during the hours just after the passage of the CME-driven shock that accelerated these SEPs. The locations of these breaks (in MeV/nucleon) are correlated with the charge-to-mass ratio (Q/M) of the ions, as measured by the MAST instrument on SAMPEX. The temporal evolution of the spectra and the interpretation of the Q/M-dependence of the observed spectral breaks will be discussed.

### SH23B-06 1445h

## Acceleration and Transport of Shock-accelerated Energetic Ions

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Our model of the shock acceleration and interplanetary transport of energetic ions takes account of magnetic focusing, convection, adiabatic deceleration, pitch-angle diffusion due to resonant interaction with Alfvén waves, as well as self-consistent wave amplification and wave transport. We now include explicit frame transformation of particle distributions across the propagating shock discontinuity and wavenumber increase in wave transmission across the shock. We will present our calculations and discuss their implications on the observation of multi-species energetic ions at 1 AU.

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# SH24A CC: 518 C Tuesday 1530h

## Acceleration, Release, and Propagation of Solar Energetic Ions and Electrons: When, Where, and How? III

***Presiding:*** **S W Kahler,** Air Force Research Laboratory**; G M Simnett,** University of Birmingham

### SH24A-01 1530h

## Correlated Dispersionless Modulations in Suprathermal Electron and Impulsive Energetic Ion Events in the Solar Wind

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Large dispersionless modulations in particle intensity observed in impulsive solar energetic ion events have been interpreted in terms of spatially limited source regions and magnetic field line foot point motions during the 2-4 days it takes solar wind plasma and the embedded heliospheric magnetic field to travel from the Sun to 1 AU. Similar dispersionless modulations in particle intensity are observed within some low-energy (less than 1.4 keV) solar electron bursts at 1 AU. The latter commonly occur in direct association with discontinuous changes in the intensity of the solar wind electron strahl and can also largely be explained in terms of spatially limited burst source regions and magnetic field line foot point motions in the solar atmosphere. Concentrating on impulsive ion modulation events previously reported, we show that there is a close connection between dispersionless modulations in energetic ions and dispersionless modulations in low-energy solar electron bursts and in the electron strahl. This demonstrates that dispersionless modulations in both particle species have a common cause and generally occur on the same field lines. However, we find that a subset of the more dramatic ion modulations reported, which have corresponding dramatic changes in suprathermal electrons, appear to be more closely related to structural boundaries in the solar wind flow than to field line foot point motions.

### SH24A-02 1545h

## Spatial Structure of Solar Electron Bursts: Two-Point Observations using Genesis and ACE

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Recent ACE studies have found that transient solar electron bursts associated with solar type III radio bursts are commonly observed at energies below 1.4 keV. At these energies the bursts appear as anti-sunward-directed electron beams superimposed on the suprathermal electron strahl and halo. Solar electron bursts are typified by their characteristic energy-time and pitch angle-time dispersion. Durations of burst events from onset to decay can vary from less than 1 hour to more than 30 hours, implying that the interplanetary magnetic filaments occupied by solar burst electrons are spatially broad. However, the true spatial extent and uniformity of a burst-carrying filament cannot be established from single spacecraft measurements. In order to explore the spatial characteristics of solar electron bursts, we have examined bursts detected at two spatially separated spacecraft: Genesis and ACE. The Genesis and ACE spacecraft both occupy L1 halo orbits and can be separated by up to 1 million km. We compared measurements from the nearly identical electron spectrometers on the two spacecraft. From November 2001 to May 2003 we found 136 solar electron bursts simultaneously detected by both spacecraft. More than two thirds of the burst events are strikingly similar at the two spacecraft, indicating that bursts are most often spatially uniform across ACE-Genesis separation distances. However, a number of burst events exhibit notable differences in the simultaneous Genesis and ACE observations, consistent with a non-uniform burst structure. Such structure indicates that the two spacecraft, though relatively near one another, are nonetheless found on interplanetary magnetic field lines mapping back to different solar source regions. We conclude that braided intermixing of interplanetary filaments is evident at 1 AU on separation scales of approximately one million km.

### SH24A-03 1600h

## Propagation of Energetic particles to High Heliographic Latitudes

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The Ulysses spacecraft has now almost completed its second orbit, passing for the second time over the southern and then the northern pole of the Sun. Energetic particles associated with CMEs were observed at the highest latitudes over both poles of the Sun, quite unlike the first polar pass when, at the very highest latitudes, neither CME nor CIR accelerated particles were observed. The particle events observed over the two poles were completely different. Ulysses never left the slow solar wind as it passed over the southern pole, and events observed there tended to be similar to events observed at lower latitudes. Over the northern pole Ulysses was in the fast solar wind for several solar rotations. Events observed there differed substantially from events observed over the southern pole. Onsets were slow, particle angular distributions were almost isotropic, and increases were observed when the CME arrived. We discuss these differences in the context of the configuration of the heliosphere at the time.