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**SH2.2-3 + SH3.1-3**

**SH2.2** : CME, ESP, FDs & structures (O*16/P*14)
**SH2.3** : Particle acceleration (O*7/P*9)
**SH3.1** : Outer heliosphere (O*5/P*3)
**SH3.2** : Modulation in global structure (O*14/P*9)
**SH3.3** : Outer heliosphere + global modulation (O*14/P*16)

107 papers
56 Oral + 51 Poster
Measurements nearby TS

- Unusual enhancements seen during ’02 to ’03 by V1 (85-88 AU), but not by V2 (67-70 AU).
- Series of “spikes” in V1 & V2 prior to the enhancement.
- Anti-sunward streaming in enhanced intensity.

SH3.1-2 Hill et al.  SH3.1-5 Cummings et al.
SH3.3-13 Krimigis et al.  SH3.3-1 Stone et al.

- V1 might be connected with acceleration region in TS, located downstream of SW.
- S/IP ions in GMIRs reaccelerated in TS.
- TS moved inward responding to SW disturbances.
- V1 might have passed TS.

irregular incursion
Most of modulation during $A>0$ sol.min occurs near TS or in the heliosheath.
Modulation during sol.max occurs inside TS.

$\kappa \sim R^{0.95}r^{1.21}$ for GCR & ACR during sol.max

Reacceleration of GCR at TS during $qa<0$.
Additional modulation in heliosheath.
CR distribution in heliosphere (2/2)

Large-scale structure & CR modulation

SH3.2-14 Florinski & Zank
• Self-consistent approach (MHD, nH, turbulence + GCR/ACR).
• Hydrogen- & magnetic-walls in nose region.
• Acceleration in heliotail due to $\nabla \cdot u < 0$.

SH3.1-3 Florinski et al.
• ACR has small impact of on heliosphere.

SH3.1-2-P-153 Berezhko et al.
• Impact on heliosphere is sensitive on ACR injection efficiency.
Modulation models (1/2)

SH3.2-1 Kota & Jokipii

- Heliosheath is a modulation barrier for GCR
- Modulation depends on energy, magnetic polarity and solar activity

SH3.2-9 Potgieter & Langner

- GCRs still modulated outside TS, due to adiabatic decel. in downstream of TS
- ACR modulation increases in sol.max due to the decreasing SW comp. ratio
Modulation models (1/2)

SH3.2-5 Ferreira et al.

- t-dependent model with $\kappa_A \sim (B_0/B(t))^{\alpha(t)/\alpha_0}$ is successful.
- But drift must be reduced during solar maximum.

SH3.2-8 Henize et al.

- Ulysses electron profile requires time dependences of Jovian source & $\kappa_\perp / \kappa_\parallel$ around solar maximum.

SH3.2-2 Parhi et al.

- Ab-initio modulation model with 2D CR transport.

Conjunction of Jupiter & Earth

- 13 months variation shows changes in phase & amplitude.
- provides a good opportunity to test modulation model.
Particle acceleration (1/2)

**SH2.3-2 Ruffolo**

- Finite-time shock acceleration.
- Temporal evolution of spectrum.

**SH2.3-3 Jokipii et al.**

- 1D DC equation with gradual dU/dx.
- Diffusive compression acceleration occurs, if κ/U ≥ Lc.
- Important mechanism in region without shock.


- CIR injection

**SH2.3-1 Malakit et al.**

- 1D Boltzmann eq. with PA diffusion.
- Density peak occurs due to mirroring.
- Spectrum becomes softer at higher energy & in wider compression.
Particle acceleration (2/2)

SH2.3-4 Ho et al.
- ACE obs. of ESP ($\geq$40keV) accelerated in IP shock is consistent with weak (single-interaction) shock drift acceleration.
- Expected activity in waves is not observed.

SH2.3-1-P-225 Nakata et al.
- GEOTAIL observed e (<40keV) accelerated by whistler waves associated with the Bastille-day IP shock.
- Whistler waves are generated by interaction of shock accelerated protons with low-frequency alfvén waves.

SH2.3-1-P-226 Den et al.
- Spectrum of p (ACE 47keV-4.7MeV) accelerated in IP shock (255doy 1999) evolved softer in time.
- Simulation of this event suggests insufficiently accelerated p existing around 1 AU.

SH2.3-1-P-227 Terasawa et al.
- p ($\leq$40keV) by GEOTAIL is accelerated in nose upstream region of bow-shock.
- Anisotropy tells ExB drift to predawn region.
Modulation potential (1/2)

SH3.2-6 Scott et al.
- Direct measurement of adiabatic energy loss in SW, by using energy dependent e-capture-decay isotopes.
- No assumption of interstellar spectrum is needed.
- Derived $\phi$ is consistent with spectral fits.

$\phi \sim 350-400$ MV  
$\phi \sim 800-1100$ MV

SH3.2-2-P-156 Komori
- Charge-dependent modulation seen between F-F parameter $\phi$ for e (0.1-1GV) & NM count rate.
- Simple analytical expression for $\phi$ is also derived.

SH3.2-2-P-161 Caballero-Lopez et al.
- F-F approximation doesn’t work in outer heliosphere, particularly for ACRs.
- Should use numerical solution for DC equation, which works much better even in 1D model.
- Get the code at...

http://www.puk.ac.za/physics/Physics%20Web/Research/modl1Dsimple.f
Modulation potential (2/2)

SH3.2-4 Usoskin et al.

\[ \Phi(t) = \Phi_0 + \Phi_1 \cdot \frac{F(t-\tau)}{F_0} \cdot \left(1 + \frac{\alpha(t-\tau)}{\alpha_0}\right) \cdot (1 + \Phi(t-\tau)) \]  

\( \phi(t) \) : mod. potential  
\( \alpha(t) \) : HCS tilt angle  
\( F(t) \) : open solar B flux

(1) Only 5 free parameters for a NM count rates over 30 years!!

- Obtain free parameters using actual \( \phi(t) \) & \( F(t) \).
- Inversely solve above equation for \( \alpha(t) \) using the reproduced \( \phi(t) \).
- Then tracing NM count rate back to 400-y ago becomes possible!

Usoskin et al., JGR 2002
CMEs & CR modulation (1/2)

SH2.2-3 Ihara et al. July 14, 2000

- Local IMF data by ACE/NOZOMI are consistent with a single large-scale flux rope.

SH2.2-4 Munakata et al. August 27, 2001

- High-energy CR observation allows “remote-sensing” over large gyro-radius.
- Deduction of CME geometry is possible.

SH2.2-1 Gopalswamy et al.

- High-intensity SEP events preceded by other CME.
- Preceding CMEs are faster & wider.
- Primary CME propagate through medium disturbed by preceding CME.

SH2.2-9 Belov et al.

- High-efficiency events causing big FDs with minor IMF disturbance.
- CRs are affected by much larger structure than measured in situ.
CMEs & CR modulation (2/2)

Muon hodoscopes

SH2.2-6 Nonaka et al.
- 560m² array of PC recording $1.8 \times 10^8$ muons/h with $\sim 10^\circ$ angular resolution (GRAPES3).
- Clearly detected the loss-cone precursor twice, $\sim 24$h preceding to a CME-event on April 11, 2001.
- Significant deviation of loss-cone center from sunward IMF is observed half a day preceding the SSC.

SH2.2-5 Fujimoto et al.
- 25m² PC array observed the same precursor.
- Loss-cone is $15^\circ$ wide

SH2.2-1-P-214 Petrukhin et al.
- 9m² GMC array with $\sim 7^\circ$ angular resolution.
- “Tomography” of fluctuation in CME

SH2.2-7 Szabelski et al.
- 0.65m² GM array in operation in Poland.

SH1.5-1-P-197 Yasue et al.
- New recording system developed for muon telescope using FPGA & VHDL.
CR interaction with $\delta B$

**SH2.2-10 Alania et al.**
- Rigidity spectral index of FD is derived.
- The average index suggests the rigidity dependence of $\kappa$.
- It is also suggested that the large scale IMF fluctuations created by SW disturbance is the source of modulation.

**SH3.2-P-164 Alania et al.**
- Rigidity spectral index of 11-y variation.
- Relation between 11-y variation & the large scale IMF fluctuations is suggested.

**SH3.3-5 Usoskin et al.**
- Total power of CR scintillation (0.17-1.7×10^{-3} Hz) changing in phase with sol. acitivity.
- Possibly related to the IMF fluctuation spectrum.
High-energy CR anisotropy

- Tibet II & III air shower arrays successfully observed the Compton-Getting anisotropy in solar time due to earth’s revolution around the sun at ~10TeV.
- Observation of this anisotropy with an extremely small amplitude (~0.03%) offers a good opportunity for a crucial test of observation and data-analysis systems.
- Observed anisotropy starts deviating from the expectation at lower-energy down to multi-TeV region.
- Sidereal anisotropy (~0.1%) at ~10TeV is significant & consistent with the Mt. Norikura AS experiment.

Geomagnetic effects

SH2.2-11 Kudela & Storini

- Tibet NM (Rc~14.1GV) observed abrupt intensity increases.
- These increases are consistent with sudden decreases in Rc.

SH2.2-16 Miyasaka et al.

- 4 NMs data are correlated with 83 Dst events.
- Average $I_{NM}(t)$ over $t-1h$ ~ $t-25h$ show best correlation with Dst(t).
- However no correlation found with IMF Bz polarity.

SH3.6-7 Humble & Duldig

- Distortion of geomagnetic field by SW disturbance causes the viewing direction of NM to vary according to local-time & season.
- Computing for each hour is needed for low Rc stations.
Spaceweather “prediction” & nowcast using CR

- L~0.1\lambda R^\alpha (Roffolo, 1999) & RL~R.
- High-E GCR measurements give us an unique opportunity for the remote sensing of the CME over long distance.

Success rate (S) evaluated for nowcasting IMF sector polarity by Nagoya-GG.
- S depends on the different SW regimes.

SH2.2-2 Dorman et al.

SH2.3-1 Malakit et al.

SH3.3-2-P-165 Storini et al.

Loss-cone’s here
Thank you for your attention!