IMPACT Status and Data Updates

SWG, April 14 2011

Janet Luhmann, Peter Schroeder, Dick Mewaldt, and Chris Russell

for the IMPACT team

IMPACT Instrument Status Summary

- Three hour fixed daily intervals of ‘high rate’ (32 Hz) MAG data are taken routinely as IMPACT data rate allows (in addition to regular “burst” periods).
- MAG offsets slowly drifting but manageable.
- LET has been adjusting their “dynamic thresholds” which adjust the geometric factors for H and He at high count rates.
- SIT uploaded new matrix tables
- SEP instruments (SEPT, LET, SIT, HET) all operating nominally.
- IMPACT IDPU continues support for PLASTIC operations.

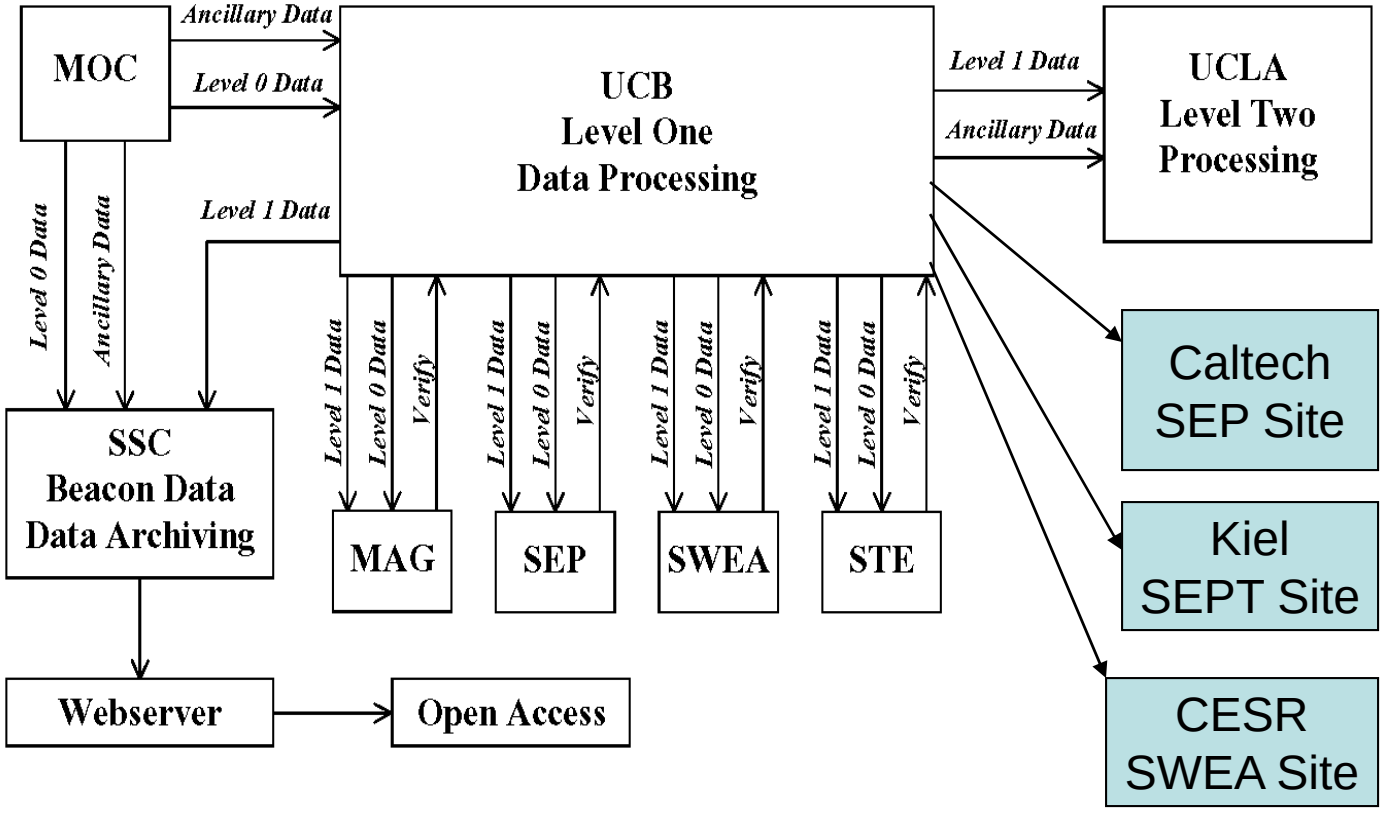
Jan 8, 2011 SEU/Power Shutdown of IMPACT and PLASTIC on STB

- On STEREO Behind, IMPACT experienced an SEU on Jan 8, 2011, triggering a spacecraft autonomy rule (#64, when the IDPU/MAG circuit consumes more than 8 watts) which shut off power to the IMPACT and PLASTIC suites. This is the only SEU of this kind we have experienced so far in the mission. Other SEU's on both spacecraft have caused bit flips in memory or latch-ups in the SWEA instrument. IMPACT (and PLASTIC) fully recovered by Jan 13, and no residual effects were observed.

Data Status Report
SWG April 2011

From Peter Schroeder,
with inputs from the IMPACT Team

IMPACT Data Flow



Current IMPACT Level 1 Data Status

Instrument	1st Date (A)	1st Date (B)	Last Date
MAG	2006 Nov 2	2006 Nov 2	2010 Dec 31
SWEA	2006 Oct 28	2006 Oct 28	2011 Jan 31
STE	2006 Oct 28	2006 Oct 28	2011 Jan 31
LET	2006 Nov 14	2006 Nov 13	2010 Dec 31 (ascii), new CDF format pending
SEPT	2006 Dec 12	2006 Dec 12	2010 Oct 31
SIT	2007 Mar 15	2007 Mar 15	2010 Oct 31
HET	1min, 15 min and 1hour averages thru 2011 Feb 20, CDF product pending Co-I approval		

Level 1 Data Release Schedule

- Why the delay in the appearance on the website?
  - IMPACT (and the rest of STEREO) does not receive “final” Level 0 telemetry files until 30 days after any given date.
  - Our Co-I’s generally like to validate data one month at a time. This means, for example, that they won’t begin validation of January data until the beginning of March.
  - Then it requires a couple of weeks or more to validate.

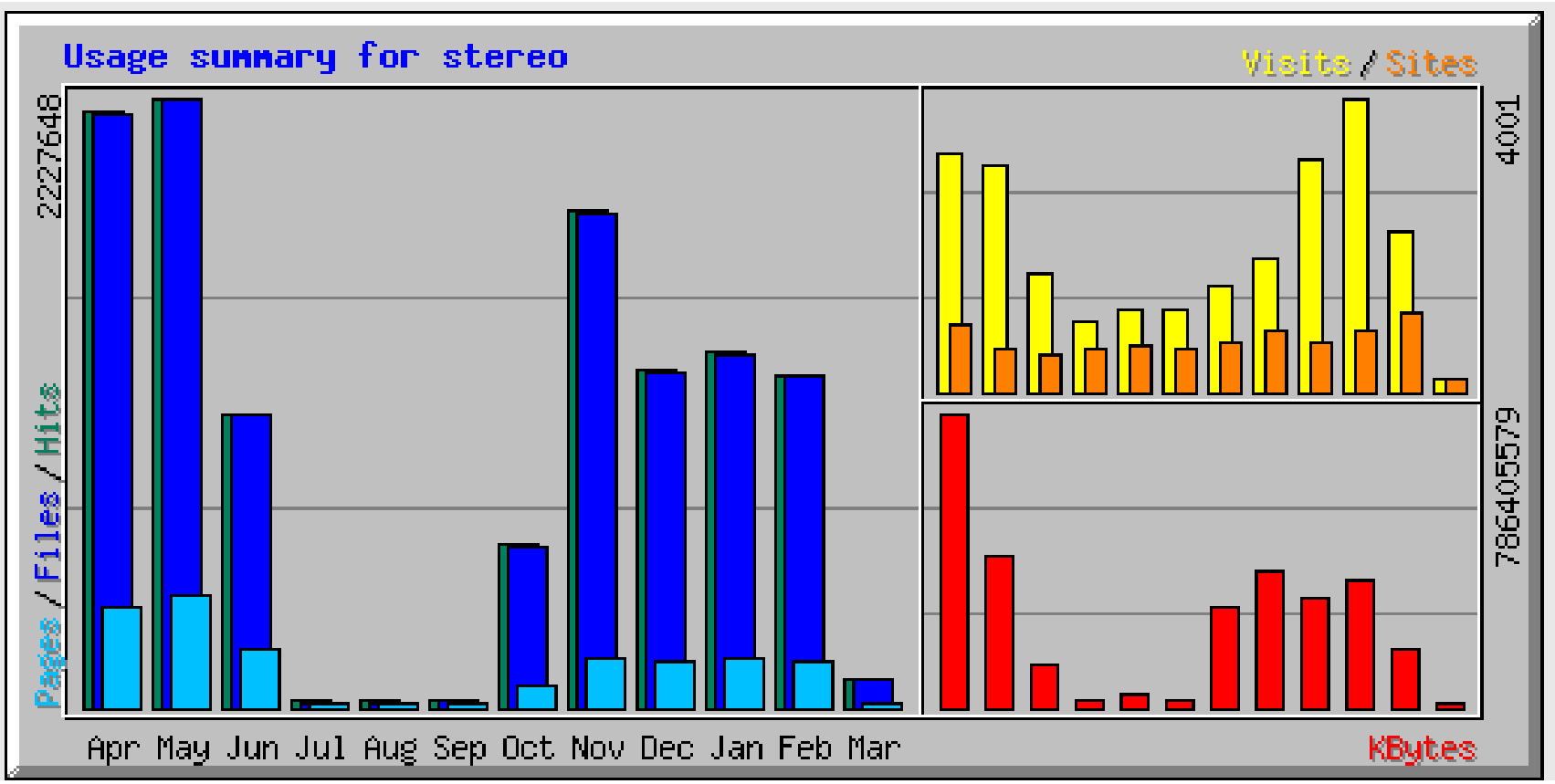
Level 2 STEREO IMPACT and PLASTIC Data and Level 3 Event Lists

- Level 2 merged 1 min MAG and PLASTIC ascii data available@ucla to 11/30/2010
- Level 3 event lists at UCLA/STEREO site and Caltech SEP site:
  - List of interplanetary shocks: STA updated to May 2010, STB updated to Oct 2010 (UCLA)
  - Lists of stream interaction regions (SIRs) and interplanetary CMEs: STA updated to May 2010, STB updated to Oct 2010 (UCLA)
  - List of heliospheric current sheet: in the to-do list (UCLA)
  - List of SEP Events (Caltech, also at UCLA merged with ICME event list (in work))

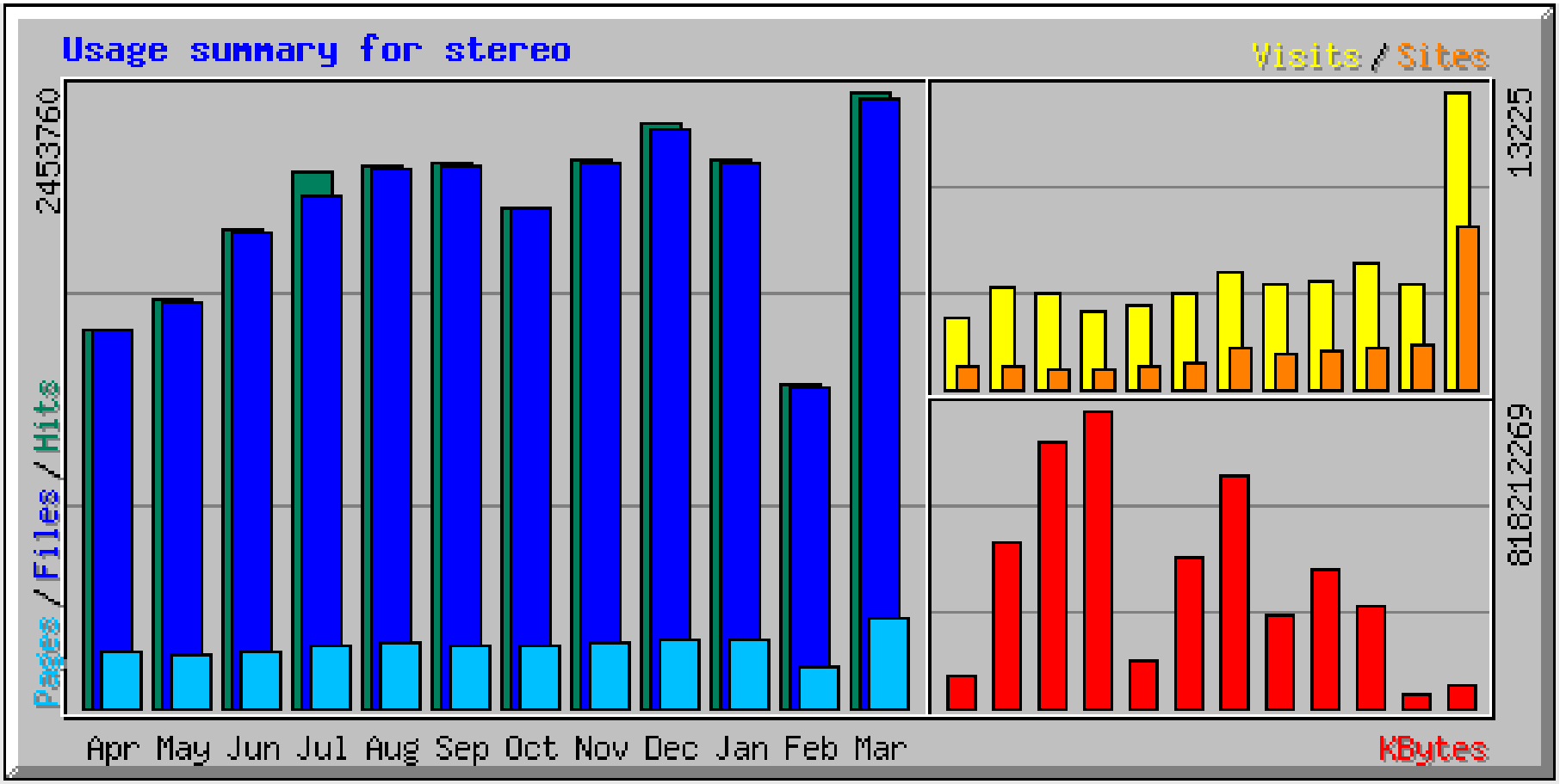
IMPACT website/data access@UCB

Summary by Month										
Month	Daily Avg				Monthly Totals					
	Hits	Files	Pages	Visits	Sites	KBytes	Visits	Pages	Files	Hits
Mar 2011	79153	78340	11564	426	7158	63835909	13225	358484	2428553	2453760
Feb 2011	80464	79875	10181	290	2020	35467558	4644	162907	1278011	1287436
Jan 2011	70265	70007	8723	181	1879	276880520	5641	270430	2170239	2178233
Dec 2010	74875	74459	8622	155	1712	378607594	4815	267307	2308231	2321146
Nov 2010	72549	72402	8499	153	1592	253144565	4594	254991	2172062	2176479
Oct 2010	64225	64020	8094	166	1823	638907824	5146	250923	1984644	1990982
Sep 2010	72252	71890	8076	140	1133	409741127	4214	242300	2156715	2167576
Aug 2010	69696	69045	8280	120	1010	126117696	3741	256705	2140418	2160603
Jul 2010	68637	65514	7967	112	934	818212269	3496	247006	2030963	2127754
Jun 2010	63356	62862	7475	140	845	729490617	4211	224259	1885877	1900695
May 2010	52354	52197	6817	147	994	452194619	4586	211346	1618107	1622985
Apr 2010	50354	50249	7401	103	1029	85083830	3119	222049	1507477	1510629
Totals						**4267684128**	**61432**	**2968707**	**23681297**	**23898278**

IMPACT website/data access@UCB prior SWG



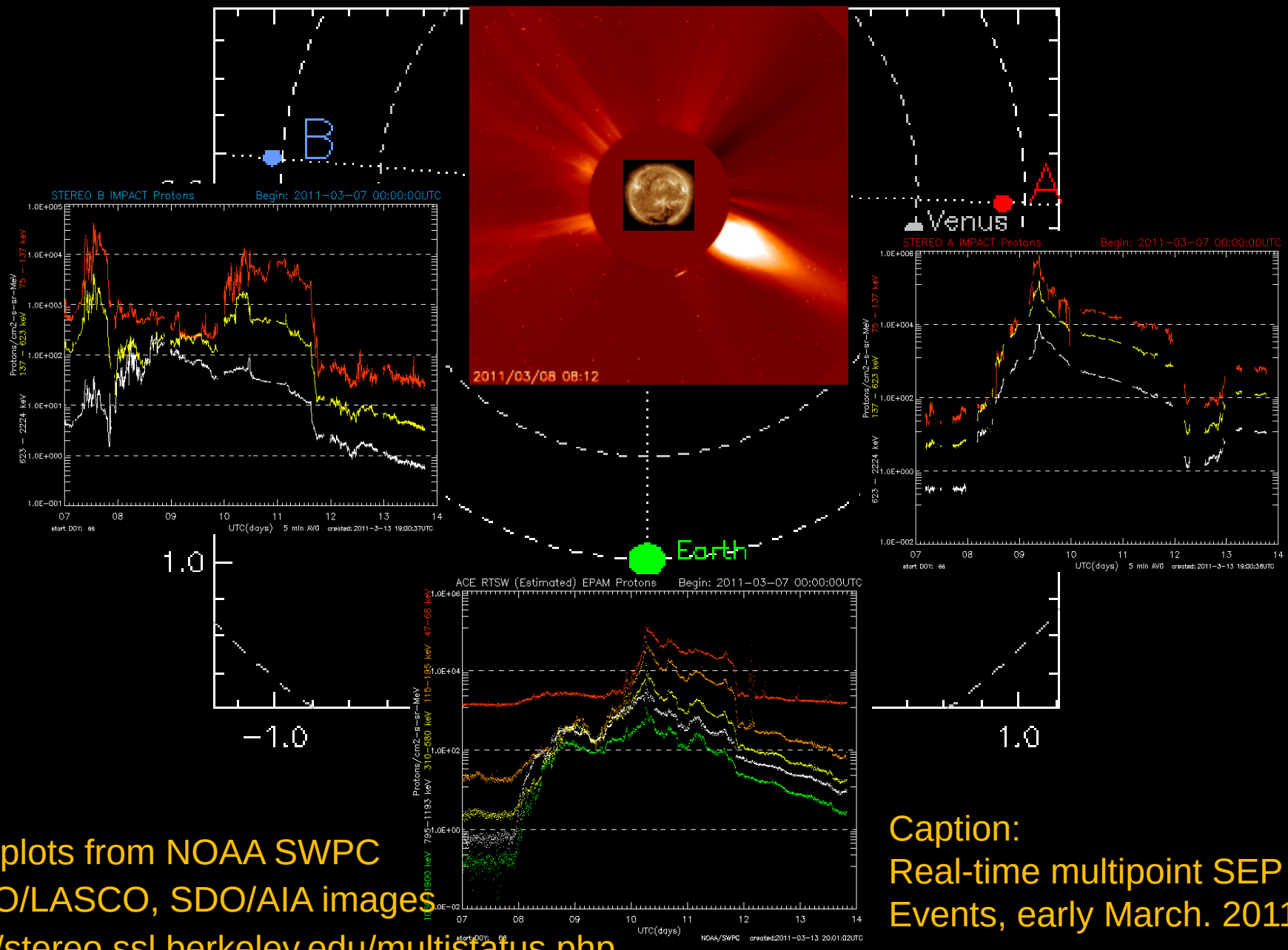
IMPACT website/data access@UCB update



Delivered Since Last Update

- HET Level 1 software to produce CDF's has been integrated into our processing stream and is currently being validated by our Co-I's before final release.
- A new release of the LET Level 1 software for the changed sectored data products has been integrated and is awaiting validation by Co-I's.
- CDAW is now serving IMPACT data thru Oct 31 2010 for most products
- UCB now hosts a real-time browse page integrating selected SOHO and SDO 'latest' images with solar wind and SEP data plots from STEREO and ACE (updated at NOAA SWPC)

now available: STEREO (and ACE) real-time multipoint perspectives at 1 AU



Data plots from NOAA SWPC
SOHO/LASCO, SDO/AIA images
http://stereo.ssl.berkeley.edu/multistatus.php

Caption:
Real-time multipoint SEP Events, early March. 2011

Magnetometer Data Processing
STEREO SWG

from Chris Russell for the SWG Telecon
April 14, 2011

STEREO Magnetometer Issues

- The x-sensor of the STEREO magnetometer has a random step that occurs with an amplitude of about 0.2 nT, or a multiple of this value. The field decreases and then shortly recovers, steps down and then returns shortly afterwards.
  - We developed an algorithm to detect and correct the data and applied it. The corrected data are still noisier than unaffected measurements but not much noisier than other noise sources.
  - In 2008, the properties of the stepping changed, and the algorithm was no longer as successful. We did not detect the change in operation until 2009.
  - The data are no longer as easy to correct. A completely new way of doing the corrections was instituted but it took much of a year to optimize the algorithm. We are now using the new algorithm with nearly optimized parameters.
- We also found a small timing error in all the IMPACT data as well as some times when our timing was off by one second due to the time of the clock tick relative to the sampling of the data. We have developed the algorithm to fix these timing issues.
- We need to apply these to all the data from launch. Version 6 of the processing code has all these new corrections. These corrections should only affect those doing high-time resolution studies (waves). Average values (1m, 10m) will not change noticeably.

Zero Level Determination

- We use the Alfvénic fluctuations in the solar wind to determine the zero levels of the magnetometer. Over a day, this is probably good to about 0.2 nT and over a week to about 0.1 nT. We assume that the offsets are slowly drifting and therefore average them over several orbits to maintain a 0.1 nT accuracy. This technique does not require rolls.
- Since launch, the zero levels have varied over the following ranges:

A Sensor 1	4.0 nT	B Sensor 1	3.1 nT
A Sensor 2	1.7 nT	B Sensor 2	2.1 nT
A Sensor 3	4.0 nT	B Sensor 3	5.6 nT

- In 2010, the zero levels varied over the following ranges:

A Sensor 1	0.1 nT	B Sensor 1	1.1 nT
A Sensor 2	0.3 nT	B Sensor 2	0.7 nT
A Sensor 3	0.2 nT	B Sensor 3	0.6 nT

- Lessons to be learned:
  - STEREO A sensors zero-levels are relatively stable and STEREO B less so.
  - Zero level determination continues to be essential to maintaining accuracy.
  - Since Beacon-mode data require several months of data acquisition before the zero levels can be adjusted, they can be in error by about 0.5 nT in any component for STEREO B, but within 0.2 nT on STEREO A.
- The level 1 data meet the measurement objectives of the mission.

Analysis of Burst Trigger Used on STEREO (L. Jian)

- The burst mode data are useful for studying shock properties and waves associated with them, the fine structures at sharp boundaries including those of reconnection exhausts,and ion cyclotron waves and mirror mode waves in the solar wind.

- The Burst trigger criterion is a weighted average of 8 components. Among these, the PLASTIC criteria caused a lot of false triggers so it was zeroed out in May 2008. One burst data interval centered at the time of the “best” characteristics determined by the trigger is collected every 4 hours.
- By switching the MAG trigger criterion from the rapid change of the ***B*** vector to the change of ***B*** magnitude in 2009, the capturing rate of shocks **increases from 31% to 68%**. Normalized by the random data acquisition rate, the success rate increases by **35%**.
- After disabling the STE burst data, the burst mode data coverage increases from 6% to 10% of the time, and the data interval increases from 12 to 24 minutes.
- We need to continue to study the interaction of multiple trigger components to increase the capturing rate because the telemetry rate will decrease as the two spacecraft become farther away from the Earth.

IMPACT Magnetometer: Level 1 MAG Data Processing Summary

- UCLA is in charge of calculating the zero levels of the magnetometer, processing the level 1 (full resolution) magnetic records, rotating from spacecraft to rtn coordinates, averaging to lower resolution and displaying level 2 data.
- We process the data monthly, once a full month becomes available. Thus we are at least about 2 months behind real time.
- We make the data available via plots and ascii files on our website. We also make CDF files at full resolution and send them to Berkeley.
- We maintain a level 2 data server that has PLASTIC data at 1 minute, 10 min and 1 hour resolution together with magnetometer data at the same cadence. We intend to add SWEA and SEP data shortly but still have magnetometer work in progress at higher priority. We have added Wind and ACE magnetometer data in RTN coordinates for correlative studies to our STEREO data base. We also have Wind and ACE plasma and magnetic field data as near-Earth data.

STEREO Level 2 in-situ data Web Servers

- We reduced our programming support for the STEREO web servers in 2009.
- The new webmaster has been trying to make the web servers more robust and faster. (We would appreciate feedback on any surprises you find on the website.)
- Magnetometer data are available up to January 31, 2011.
- Merged Level 2 PLASTIC data are available up to November 30, 2010.
- We very much need STEREO B vector solar wind velocity measurements to do our intended science.

Level 3 Event Lists: Update on List Coverage and Statistics of SIRs, ICMEs, and Shocks (from L. Jian)

	2006 Nov - Dec	2007	2008	2009	2010	Sum	Comment	
ICME								
STEREO A	1	4	6	9	Jan-May: 3	2006 Nov - 2010 May: 23	STB observed more ICMEs than STA, probably due to small number of events	
STEREO B	1	5	8	14	Jan-May: 3, Jan-Nov: 15	2006 Nov - 2010 May: 28, 2006 Nov - 2010 Nov: 43		
SIR								
STEREO A		Mar-Dec: 33	29	31	Jan-May: 18	2007 Mar - 2010 May: 111	34% of SIRs associated with shocks	
STEREO B		Mar-Dec: 32	34	29	Jan-May: 18, Jan-Nov: 38	2007 Mar - 2010 May: 113, 2007 Mar - 2010 Nov: 133		
Shock								
STEREO A		22	22	18	Jan-May: 7	2007 Jan - 2010 May: 69	71% forward	68.5% forward, 31.5% reverse shock
STEREO B		24	17	24	Jan-May: 12, Jan-Nov: 28	2007 Jan - 2010 May: 77, 2007 Jan - 2010 Nov: 93	67% forward	

SWEA Status and Data Summary

(from J-A. Sauvaud, A. Opitz, et al., CESR)

April 2011

SWEA status - 2011 April

- Calibrated SW electron energy spectra: ~45 eV - 2000 eV
- Public data available at CESR website: http://stereo.cesr.fr
  - Energy spectrogram: ~45 eV - 2000 eV
  - Pitch angle distribution at ~150 eV
  - Density by moment calculation from electrons >45 eV
  - Temperature (parallel and perpendicular) for electrons >45 eV
  - Heat flux for electrons >45 eV
  - (Preparation of core electron density proxy, available Summer 2011)
- Contact SWEA team: sauvaud@cesr.fr
  - Data base and analysis software: http://stereo.cesr.fr/clweb/
- Update paper on SWEA: Fedorov et al. 2011 SSR is under revision

STE Status and Data Summary

(from Linghua Wang and Bob Lin, SSL UCB)

April 2011

STE Instrument Status and Data

- STEREO A/STE measurements: January 2007 to the present;

  STEREO B/STE measurements: November 2006 to the present.

- Electron fluxes from 2 to 100 keV; Proton/ENA fluxes from ~4 to 100 keV

- IDL codes are developed to remove the background due to diffusive X-rays or on-board calibration source when the door is open.

SEP Suite Status and Data Summary

For April 14, 2011 SWG

contributed by Dick Mewaldt and IMPACT SEP suite members

LET & HET Status
4/8/11

• Both LET and HET continue to operate as designed on both STEREO A & B.

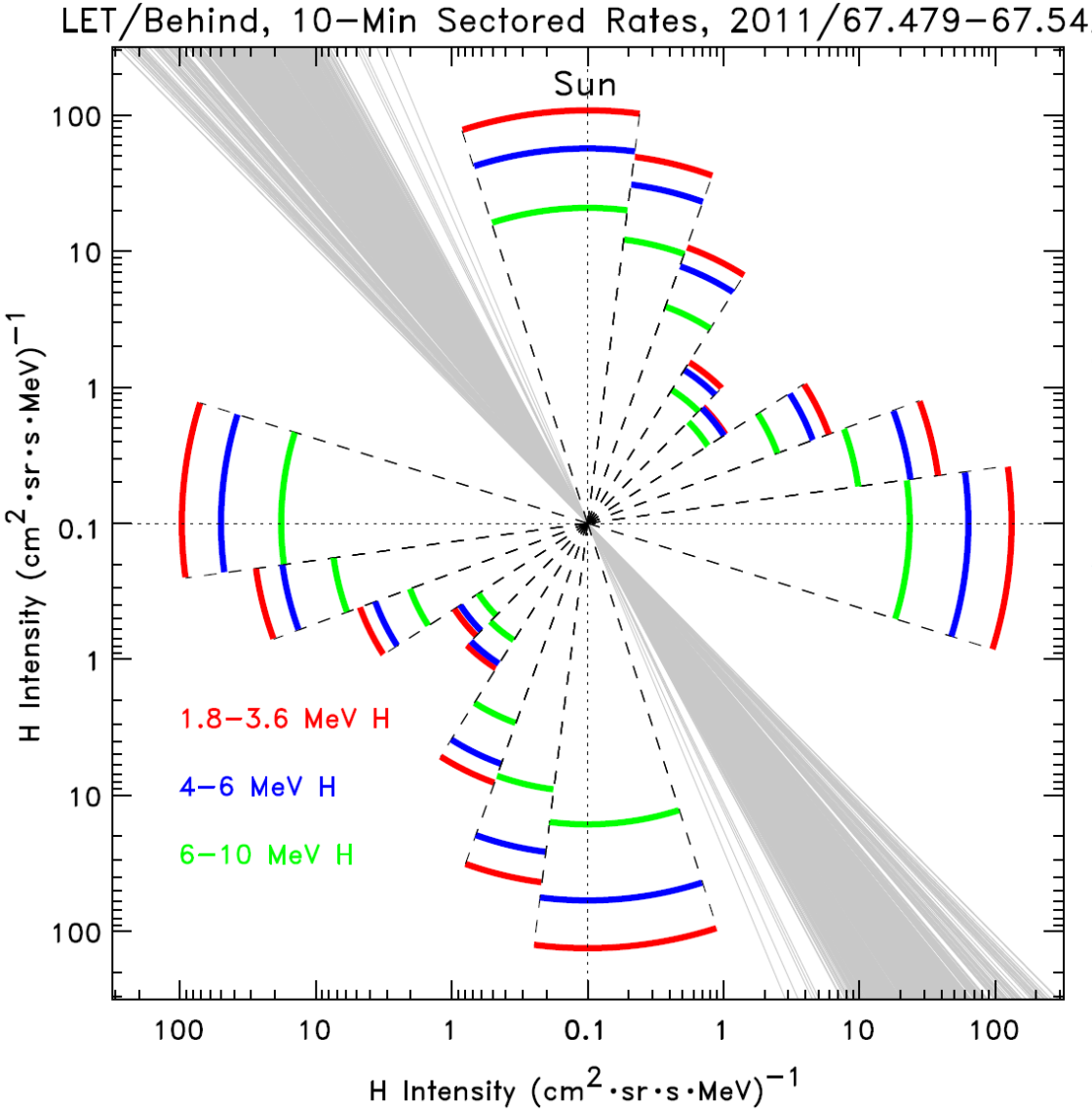
• Late in 2010 we decided to substitute two new sectored rates for protons, for two existing sectored rates (1 for ^{3}He and a second for heavy ions). The new 1.8–3.8 and 6-10 MeV proton rates will have much better statistical accuracy than the original rates, and can be used in smaller SEP events. Examples of the new data products, which are available as of 1/1/11, are shown below.

• We have also been making adjustments to the LET "dynamic thresholds", which close down the geometry factor for H and He during high count rate periods. This process has been aided by several larger events than observed since December 2006.

• Validated LET Data for all species are presently available on-line through December 2010.

• Validated HET proton and electron data for all species are presently available on-line through March 2011.

Recent LET Commanding to Optimize Data Return:



Highly anisotropic, bidirectional period with B-field (grey lines) nearly orthogonal (projected into ecliptic) to nominal Parker spiral

Changes in Sectored Rates:

On 22 Nov 2010 we replaced 2 heavy-ion rates with proton rates at lower (1.8-3.6 MeV) and higher (6-10 MeV) energies than the single proton sectored rate we'd had until then. This allows better characterization of anisotropies during small events. In the example shown, note that the anisotropy *is* energy-dependent, with relatively greater variation with energy in the higher-intensity directions.

Changes in Dynamic Threshold levels:

At high count rates, LET's geometry factor for H and He is automatically reduced. While maximizing livetime for heavy ions, drawbacks include reduced angular coverage for H and He and unintended misidentification of CNO onboard (which we are investigating). We expect to raise the dynamic threshold trip levels in April.

SIT Status
4/11

-SIT-B new matrix box tables loaded Nov 2010

-New efficiencies used for processing

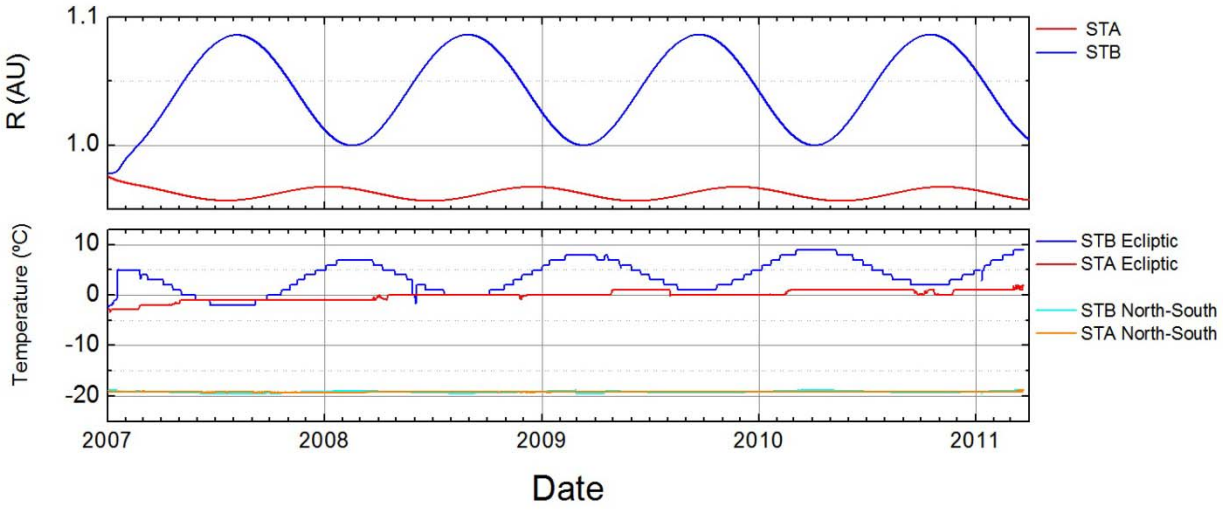
-On-line data set reprocessed

-new data product for STEREO/SEP web site: SIT-B- ULEIS - SIT-A 20 day spectrograms for entire mission; updated as new data become available; url is: http://www.srl.caltech.edu/STEREO/scripts/mkuleissitmpanel.cgi?LATEST=1

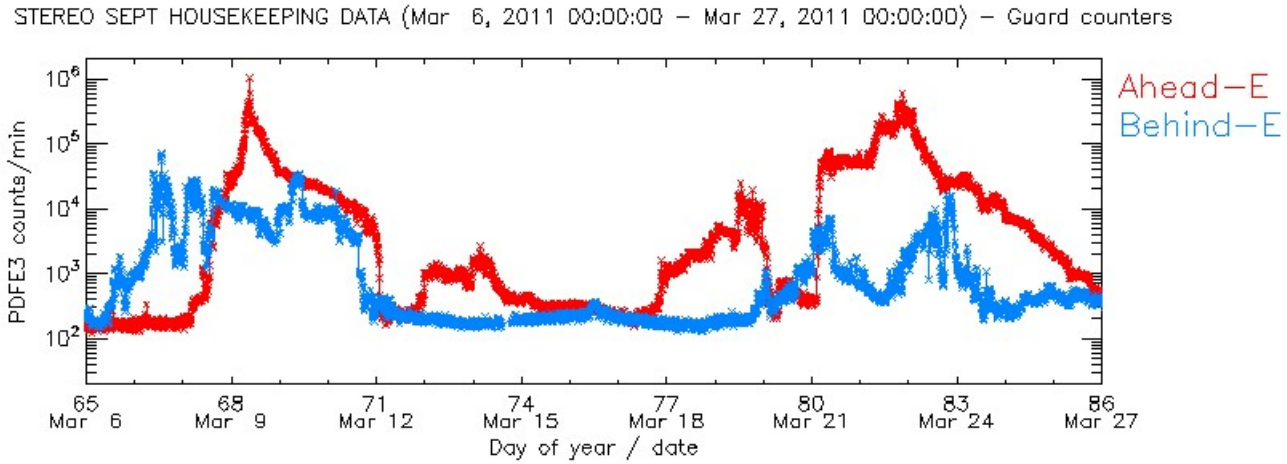
IMPACT / SEPT – Instrument Status (March 2011)

- SEPT aboard STEREO-A
  - SEPT-E temperature stable at +1.0 °C, op. heater power cycling 0 %
  - SEPT-NS temperature stable at -19.2 °C, op. heater power cycling 30-40 %
  - All leakage currents OK
  - All single detector rates OK
- SEPT aboard STEREO-B
  - SEPT-E temperature stable at +8.9 °C, op. heater power cycling 0 %
  - SEPT-NS temperature stable at -19.7 °C, op. heater power cycling 30-40 %
  - All leakage currents OK
  - All single detector rates OK
- No Instrument changes since October 2009
- STEREO-B successfully recovered after IMPACT power-off on Jan. 8, 2011. SEPT was back to nominal mode on Jan. 11, 2011

IMPACT / SEPT – Instrument Status (March 2011)



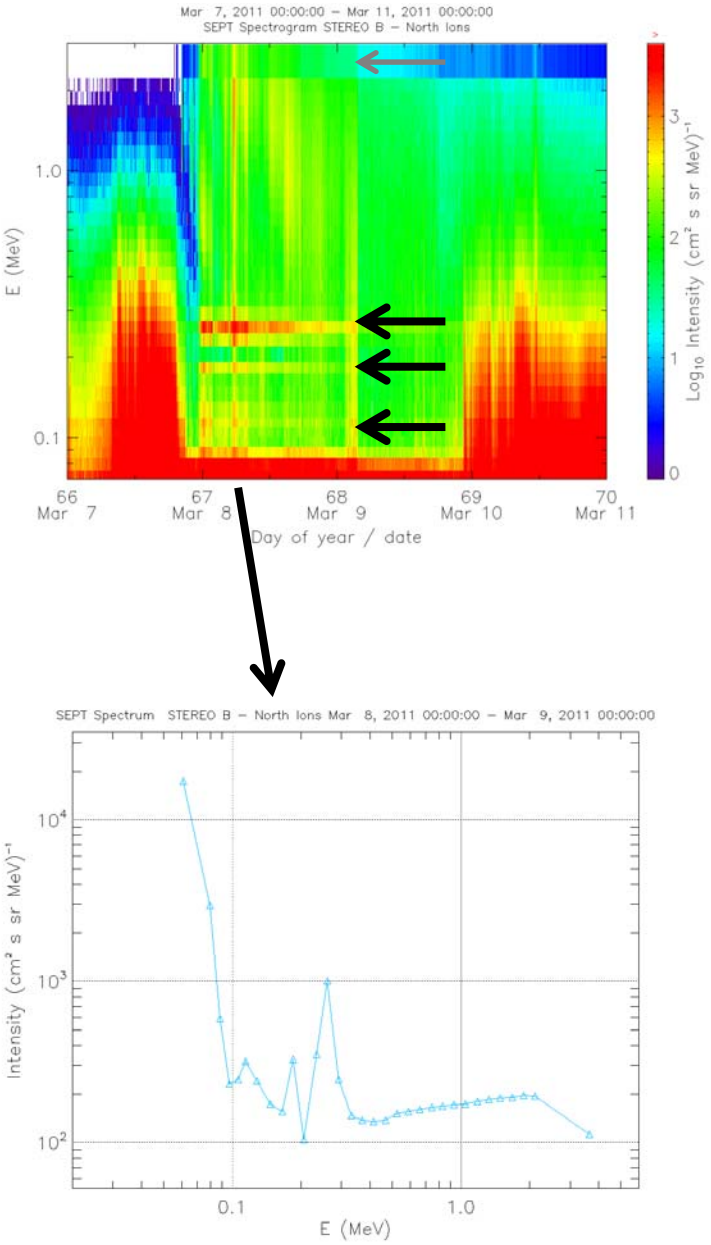
Temperatures of telescopes looking in the ecliptic plane show periodic variations due to variations of the heliocentric distance
A very slow long-term increasing trend (due to degradation) is also visible



As the activity increases, large events showing single detector rates > 1E6 counts / minute become more frequent
(2E6 counts / minute would imply ~13% dead times)

IMPACT / SEPT – Issues

- SEPT low energy measurements are disturbed when large pulses (counted in the >2.2 MeV channel) become dominant
- Narrow horizontal “strips” in the low energy part of the dynamic spectrum (<350 keV) can be identified
- The problem is probably due to limitations in the electronics: A pulse-height overflow can cause extra-trigger of lower energy bins because the analog electronics is not reset fast enough
- All SEPT telescopes are effected but it is only important during periods of a flat energy spectrum as for example during the early phase of a SEP event with a significant flux of >2.2 MeV ions
- Working to define a simple criterion in order to label “bad periods”



IMPACT / SEPT – Special Data Products

- Special data products (generated at Kiel) available at:

  http://www2.physik.uni-kiel.de/stereo/

  This URL includes links to:

  – SEPT browse plots (1 min, 10 min and 1 hour resolution) available online through March 5, 2011
    http://www2.physik.uni-kiel.de/stereo/browseplots/
  – Latest 10-days browse data summary plots:
    http://www.ieap.uni-kiel.de/et/data/stereo/latest_browse_plots/
    (generated using the latest ptp data available, normally ~2 days delay)
  – Latest ASCII data (27 days , ~2 days delay, 10 min resolution, not verified):
    http://www.ieap.uni-kiel.de/et/data/stereo/latest_ascii_data/
  – Verified level 2 ASCII files:
    http://www2.physik.uni-kiel.de/stereo/data/sept/level2/
  – Electron event list:
    http://www2.physik.uni-kiel.de/stereo/downloads/sept_electron_events.pdf

STEREO IMPACT
Some Work in Progress

STEREO SWG 22
April, 2011

Projects Using STEREO IMPACT MAG and PLASTIC Data at UCLA

- Solar cycle variations of the above large-scale solar wind structures: a paper on the solar min 23/24 is in press; will study the solar wind in the rising phase of cycle 24.

- Multi-s/c observations and modeling of SIRs including their associated shocks: published a paper in 2009; submitted a paper in 2011; comparing more events to obtain the statistics of the predictive capability of the models.

- Ion cyclotron waves in the solar wind: published two papers; will survey more events and study the correlation between wave parameters and plasma/field conditions; is working with Nick Omidi on the hybrid simulation of these waves.

- Burst mode trigger: found the success rate of capturing shocks increased after changing the trigger in Aug. 2009, and reported at Solar Orbiter workshop.

Shocks and IFEs Studies: H.R. Lai (UCLA student)

Formation of shocks inside 1 AU

- Survey of Occurrence 0.3-1.0 AU includes new STEREO data sets
- Determines Cause of Interplanetary Shocks inside 1 AU
  - ICME driven-solar activity dependent
  - SIR driven
- Paper in preparation, will be submitted shortly.

Interplanetary Field Enhancements

- Survey of Occurrence 0.3-1.0 AU includes new STEREO data sets
  includes STEREO A, B 2006 – 2009 44 IFEs
- Location Distribution

Generally uniform in HAE latitude

- Pressure Compensation

No significant disturbance in plasma velocity, density, and temperature

Most of the total pressure enhancement comes from the magnetic field

- Size/Mass Distribution

Size: most IFEs are around 10^5 km in radial dimension

Mass: most IFEs are around 10^8 kg in mass

Work is ongoing.

SWEA science update – from CESR

- Far tail (255 RE) fast response to very weak magnetic activity
  - Sauvaud et al. 2010 *JGR* vol.116, A03215
- Multipoint connectivity analysis of the May 2007 solar energetic particle events
  - Chollet et al. 2010 *JGR* vol.115, A12106
- Temporal evolution of the solar-wind electron core density at solar minimum by correlating SWEA measurements from STEREO A and B
  - Opitz et al. 2010 *SolPhys* vol.266, p369
- Intermittent release of transients in the slow solar wind: 2. In situ evidence
  - Rouillard et al. 2010 *JGR* vol.115, A04104
- Statistics of counter-streaming solar wind suprathermal electrons at solar minimum: STEREO observations
  - Lavraud et al. 2010 AnnGeophys vol.28, p233
- Multiple, distant (40° azimuthal separation) in situ observations of a Magnetic Cloud and a Corotating Interaction Region Complex
  - Farrugia et al. 2010 *JASTR* in press
- Analysis and study of the in situ observation of the June 1st 2008 CME by STEREO
  - Chinchilla et al. 2010 *JASTR* in press

IMPACT SEPT Work in progress (Kiel team)

- SEPT team at Kiel is working in the analysis of several periods of interest. Since the rising phase of cycle 24 provided several SEP events observed by one STEREO and near-Earth s/c (SOHO, ACE, Wind), Solar Energetic Particle (SEP) events are the main focus:
  - January 17, 2010 (SEP event seen by three s/c)
  - August 18, 2010 (SEP event seen by three s/c)
  - Sequence of SEP events in May 2009
  - Spike-like (near scatter-free) electron events associated with type III burst and EUVI jets
  - Co-rotating electron events
  - Almost-monoenergetic ions from interplanetary shocks

LET/HET/SIT projects (Caltech, GSFC, APL):

-Multispacecraft comparisons of both large, gradual and small, impulsive events with ACE (timing/profiles, Composition and energy spectra).

-Studies of event anisotropy evolution

-Multipoint SEP event modeling with the PATH code

-Jovian electron multipoint studies

Current IMPACT science projects at SSL UCB:

-Event reconstructions and tracking (Y. Liu leading)

-Using STE for solar electron events and ENAs (L. Wang leading), and electron foreshock studies (M. Pulupa)

-Solar Wind Structure and electron heat flux (J. Luhmann led student project)

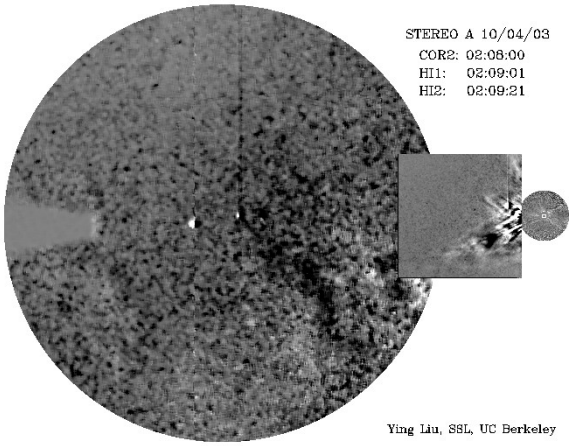
-Multipoint SEP event modeling using STEREO and ACE data (J. Luhmann leading)

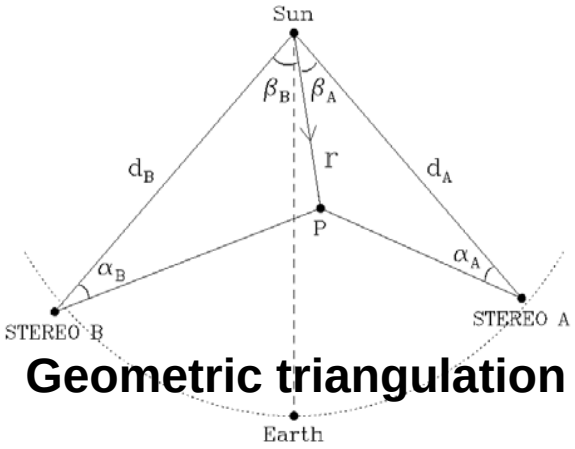
-Space weather studies at planets using STEREO (J. Luhmann led student projects)

-Solar cycle effects (J. Luhmann with other IMPACT team members)

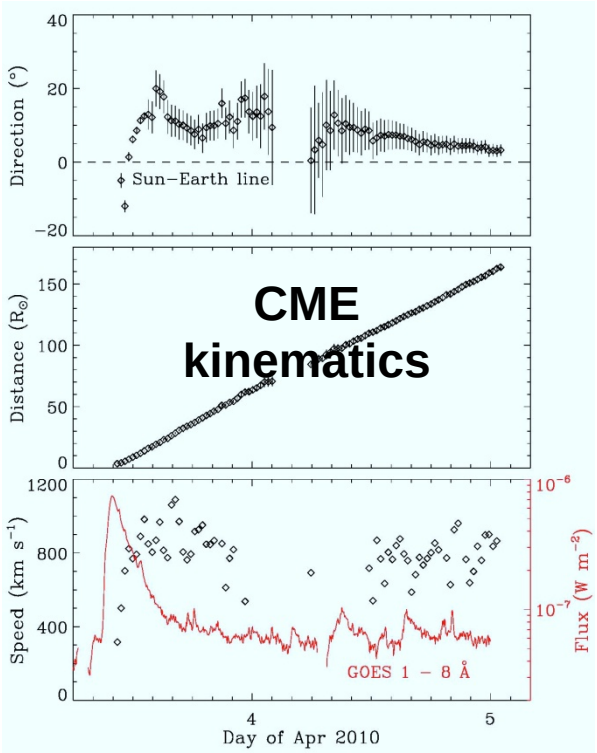
IMPACT ‘nuggets’: April 2011

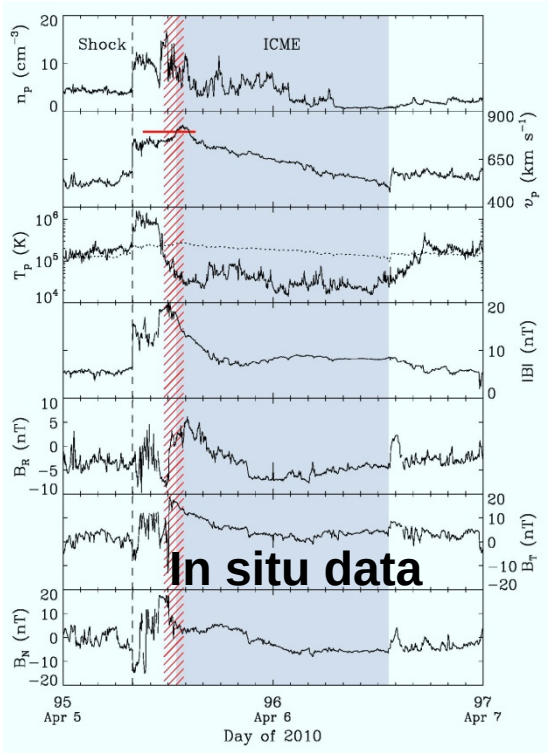
CME kinematics and comparison with in situ data





Geometric triangulation

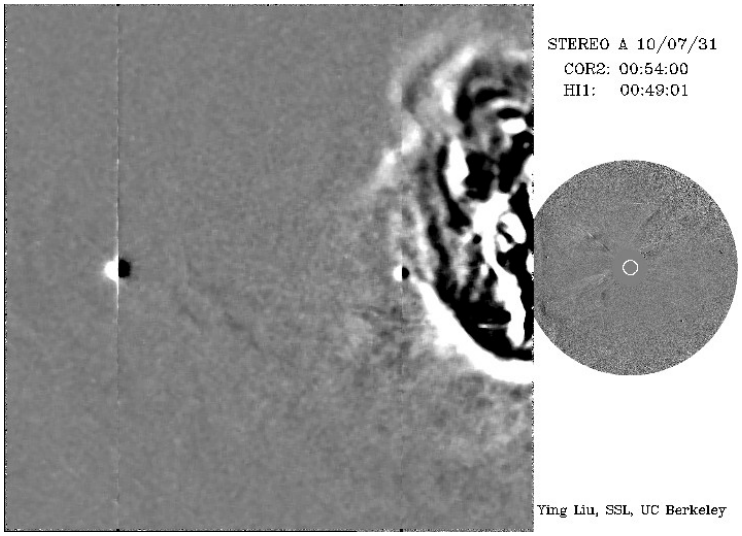




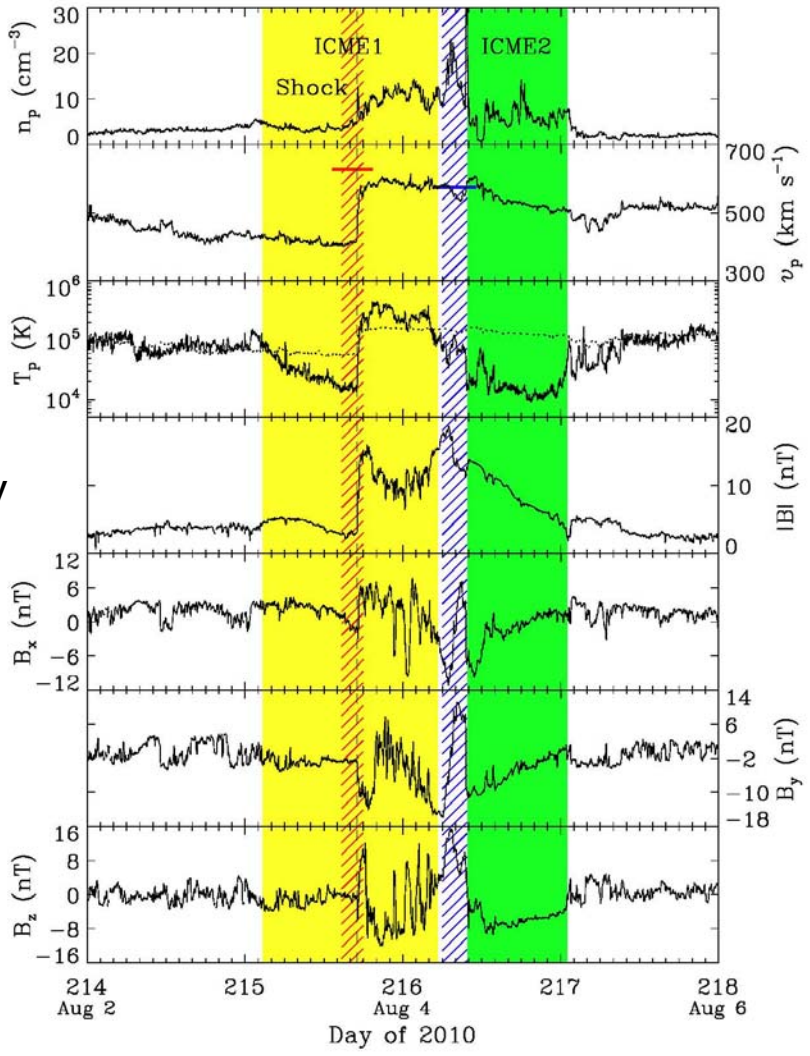
- Geometric triangulation gives propagation direction, radial distance and speed;
- The predicted arrival time and speed at 1 AU can be compared with in situ data;
- We have studied about 10 Earth-directed events with merged imaging and in situ data;
- The arrival time predications are generally good to a few hours and speed predictions good to several tens of km/s;
- We have a catalog of STEREO Earth-directed CMEs: http://sprg.ssl.berkeley.edu/~liuxying/CME_catalog.htm

(from Ying Liu, SSL)

CME-CME interaction



August 1, 2010 CME-related events

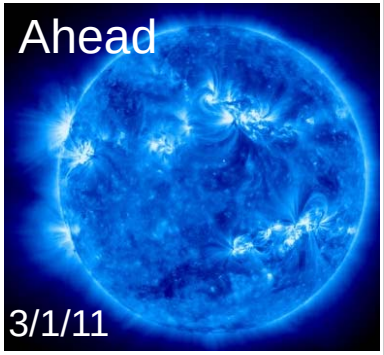


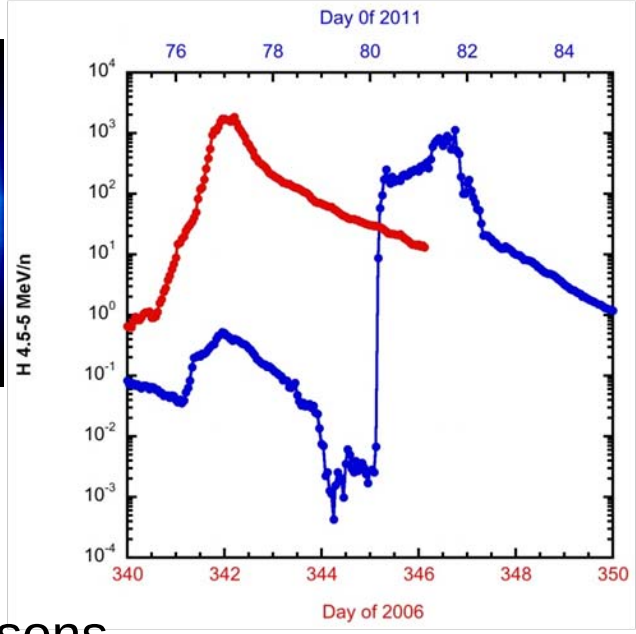
- CME-CME interaction signatures are revealed by both imaging and in situ observations;
- The in situ data suggest the shock driven by the second ICME is propagating into the first one, causing enhanced density, temperature and field strength due to shock compression;
- Peculiar magnetic field signatures (sudden changes in the direction with an indication of rotation) are observed in the interface, so the fields are likely pressed against or drape around the ejecta due to CME-CME interaction (or magnetic reconnection at the interface).

(From Ying Liu, SSL)

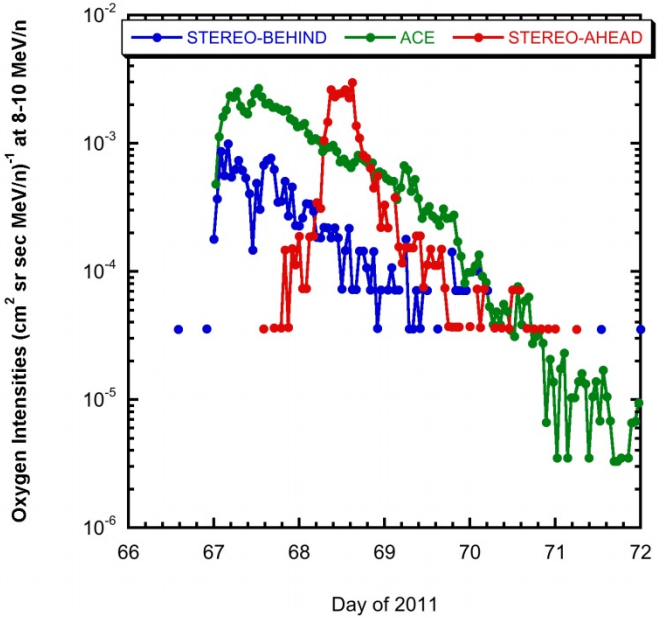
The Return of Larger SEP Events

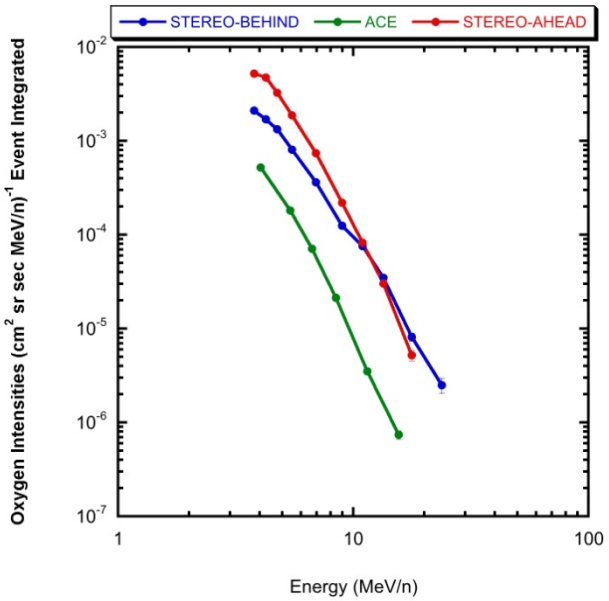
(from Dick Mewaldt et al., Caltech)

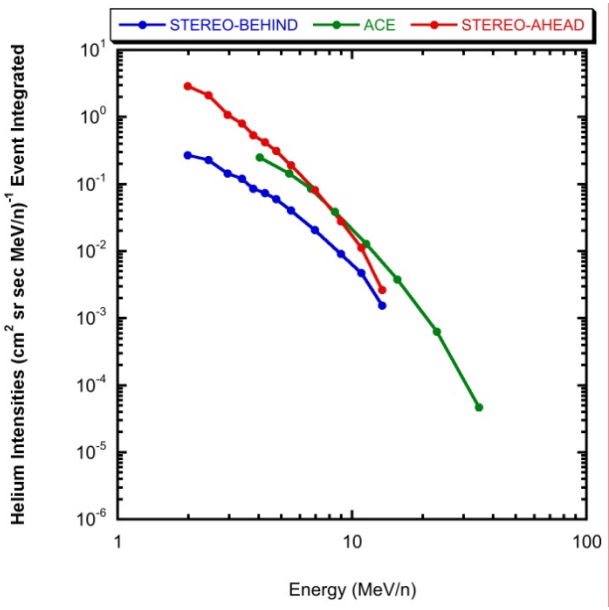




- Increasing solar activity is bringing larger SEP events
- Events in March 2011
  - -Mar 21 event at STEREO-A was similar in size to Dec ‘06
  - -Mar 8 event was well observed by STEREO and ACE allowing composition & spectra comparisons



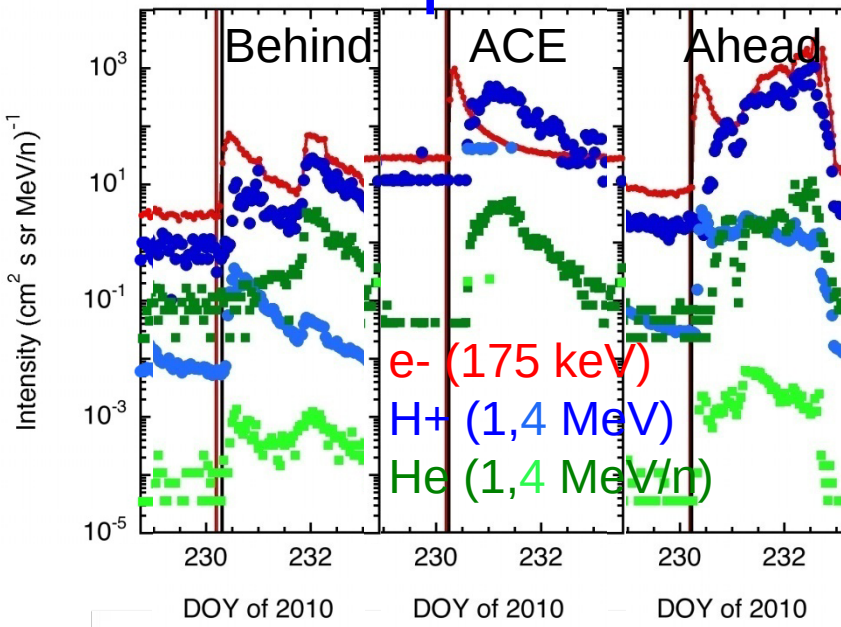


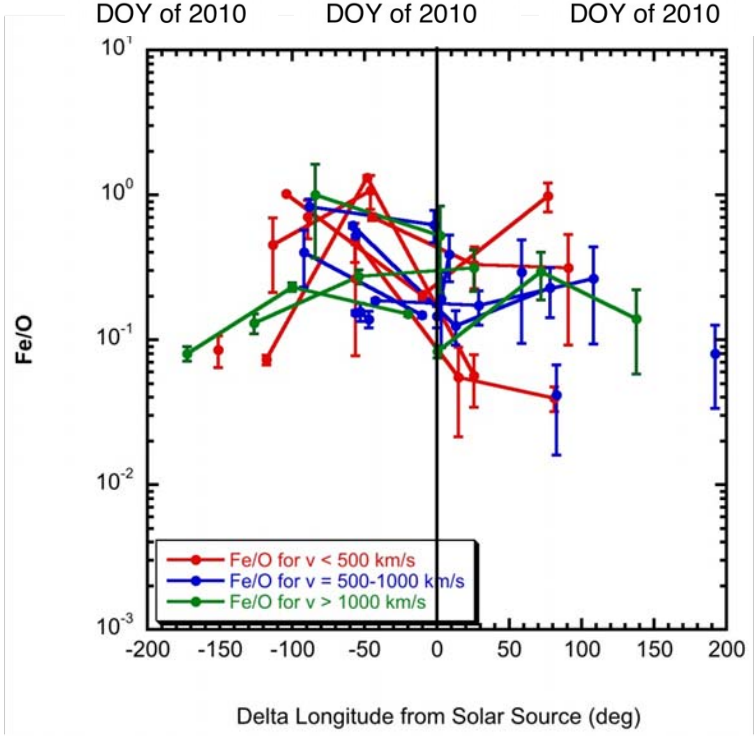


Longitude Dependence of SEP Composition

- Examined 22 multi-spacecraft, small SEP events
  - Found active regions for all
  - Found CMEs and flares for 20
- Used STEREO/SIT, STEREO/LET, ACE/ULEIS to determine H/He and Fe/O
- Composition was dependent on longitude distance from the source for some events but not all
  - Dependence was not clearly correlated with either CME speed or CME width
  - Still examining flare properties

(from Dick Mewaldt et al., Caltech)





Broad Heliolongitude Spreads in ^{3}He-rich SEP Events (from Mark Wiedenbeck et al., 2010)

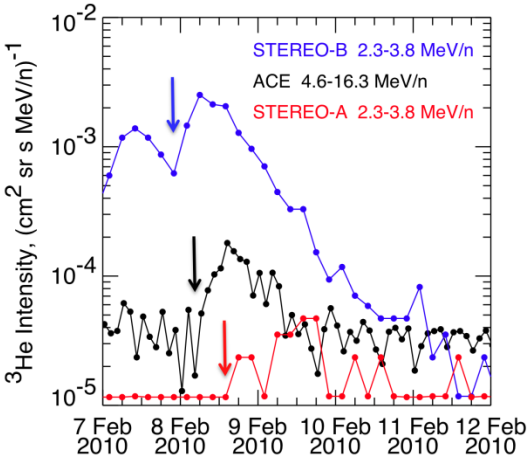
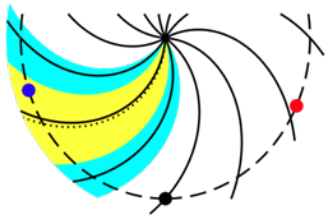


Figure 1



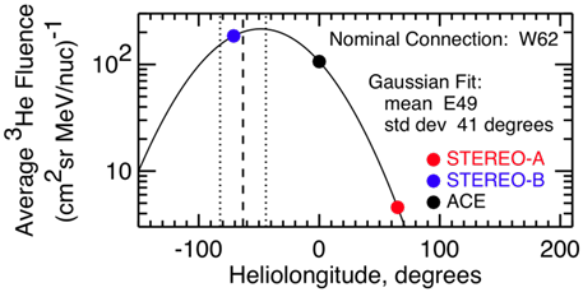


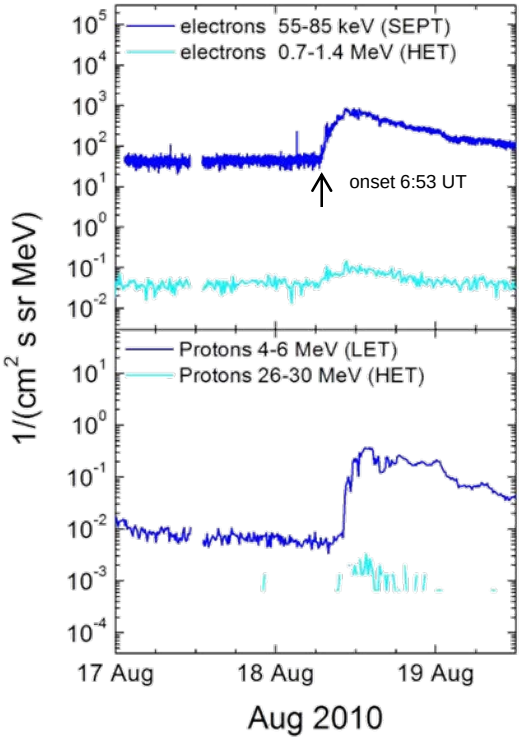
Figure 2

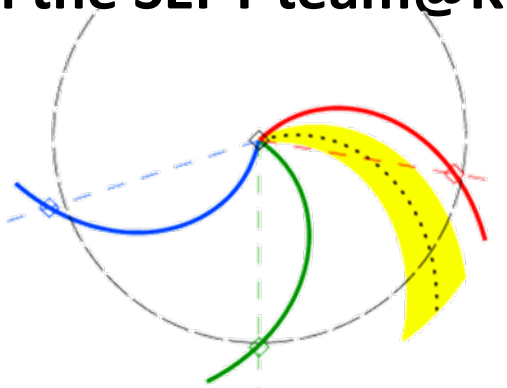
- the widely accepted view of flare-acceleration events, based on single-spacecraft studies, has been that a point-like injection at the Sun leads to relatively narrow (~20° rms, Reames 1999) longitudinal spreads in the heliosphere
- the STEREO and ACE instruments have been observing ^{3}He from these events even when the spacecraft are widely separated—for the example from February 2010 shown in Figure 1 the two STEREOs were 136° apart
- at a given ^{3}He energy we observe a strong dependence of event fluence on separation from the longitude that is best connected to the flare site, as illustrated in Figure 2
- the intensity dependence on longitude combined with the finite threshold sensitivity of observing instruments could lead to an apparent narrow longitudinal spread of events—events observed far from the best connected longitude may be too weak to detect
- more than half of the ^{3}He-rich events detected by at least one of the STEREO LETs in 2010 were also detected at ACE
- a key open problem is the identification of the physical mechanism for the longitudinal transport in these events

August 18, 2010 SEP event: Angular Spread of Solar Energetic Electrons

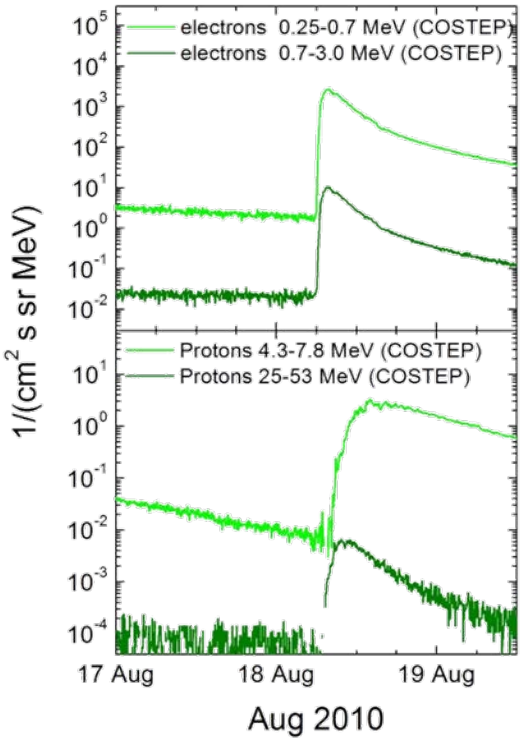
(from the SEPT team@Kiel)

STEREO B

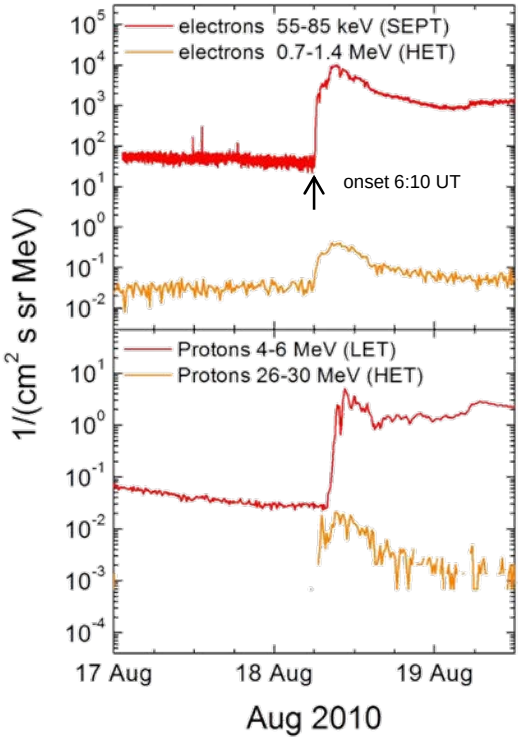




SOHO

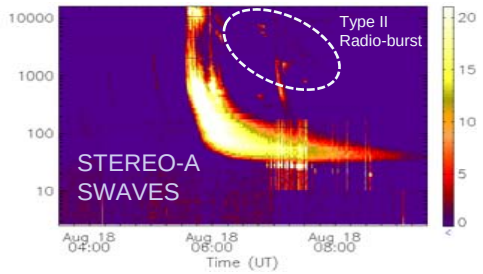


STEREO A



Separations of footpoints wrt active region

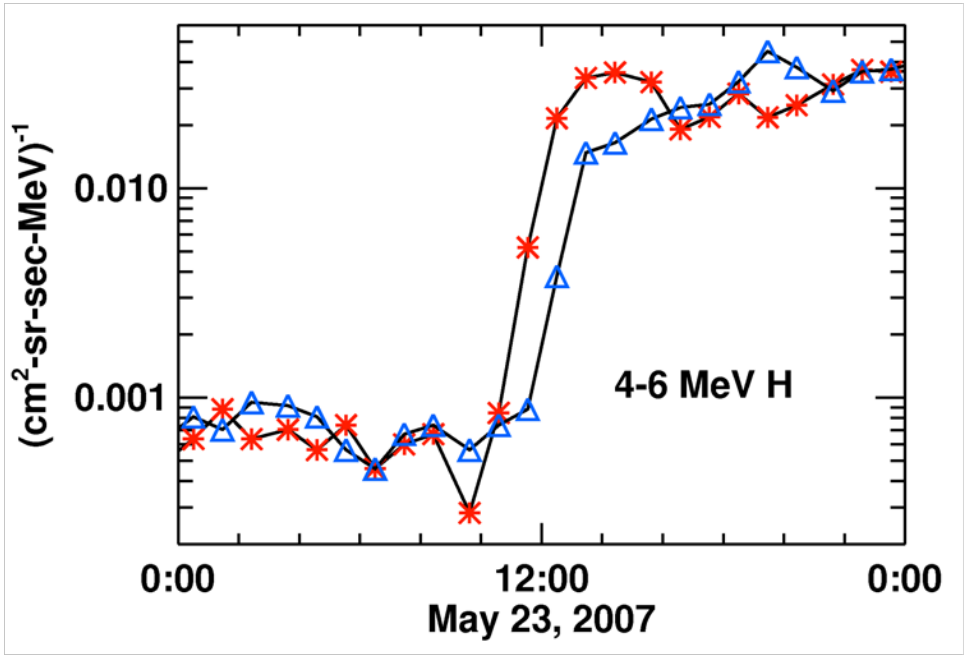
latitudinal	longitudinal	angular
17.7	108.4	107.8
10.2	39.7	40.1
13.3	37.5	39.1



The May 23, 2007 Solar Energetic Particle Event:
Particles In a Structured Solar Wind (Chollet et al., 2010)

- STEREO-A (red) and STEREO-B (blue) observe the particles arriving at different times and having different time-intensity profiles, despite the two spacecraft being only 10º (20 million km) apart.

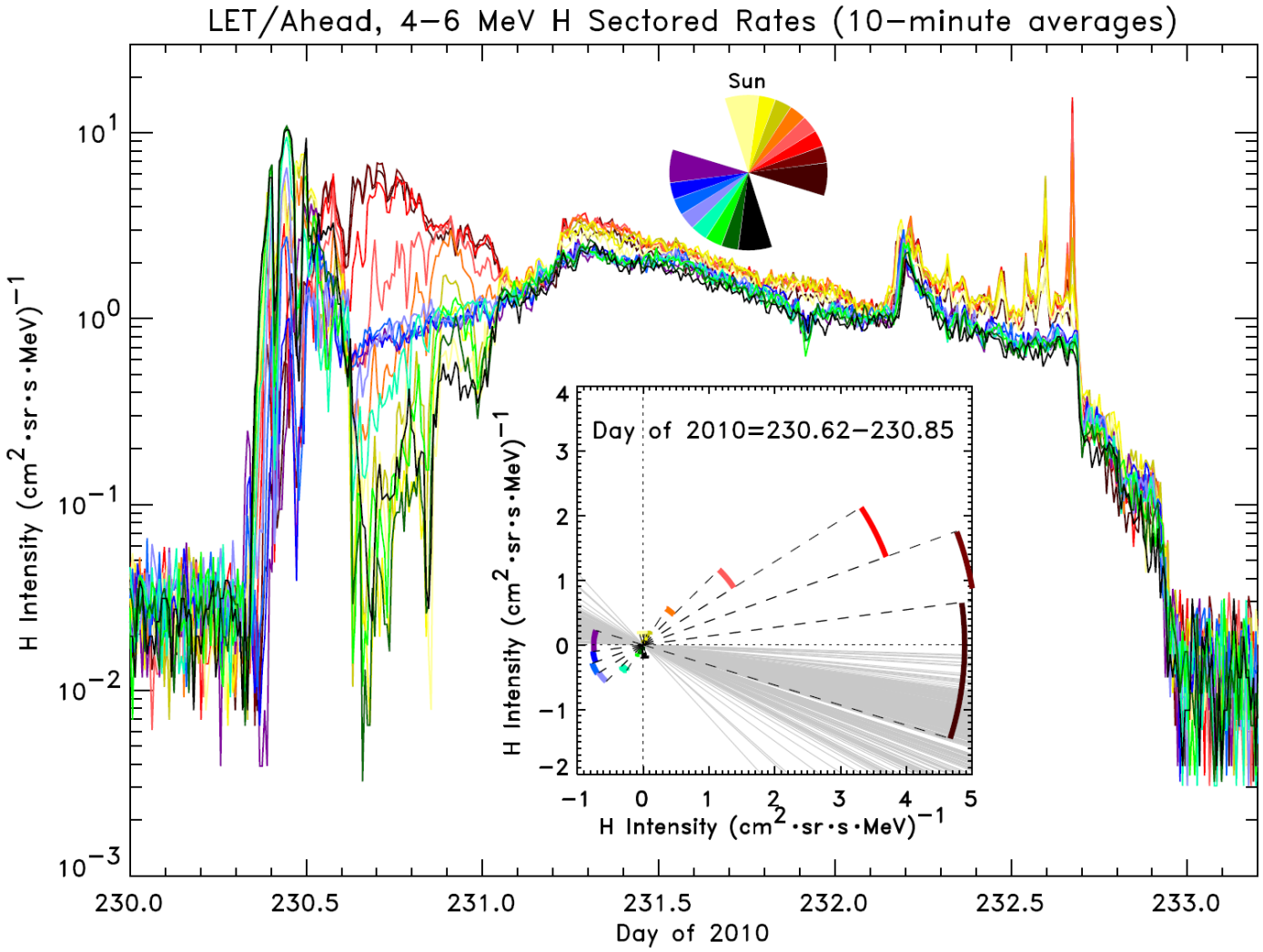
- STEREO-A is embedded in an ICME launched from the Sun several days previously, while STEREO-B is outside the ICME.



If ICMEs are present in the solar wind, observers not far apart can see particle radiation events start at significantly different times. Start time is one of the key parameters that space weather forecasters need to predict in order to mitigate the effects of solar particle events.

Reference: Chollet et al. (2010), “Multipoint connectivity analysis of the May 2007 solar energetic particle events”, Journal of Geophysical Research.

Interesting Anisotropies in 4-6 MeV Protons During the 18 August 2010 SEP Event Observed by STEREO/Ahead/LET:



- **Large, variable anisotropy at the event onset**
- **Very large (~1000:1), bidirectional (see inset) anisotropies, apparently inside a magnetic cloud (from ~230.62-230.85)**
- **A series of narrow, anisotropic spikes just before a shock arrived at ~232.7**

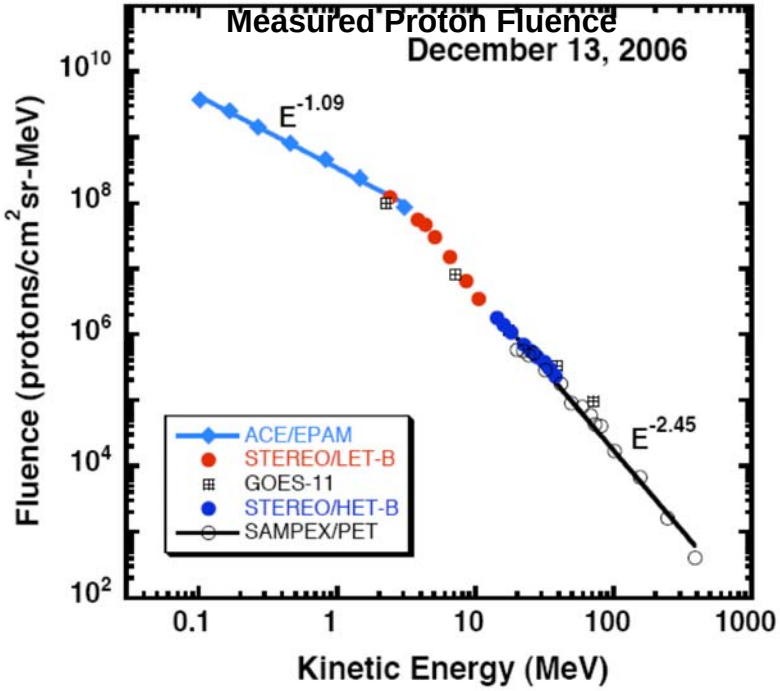
During much of this period, the magnetic field direction (grey lines in inset) was far from the nominal Parker spiral (and LET boresight) direction.

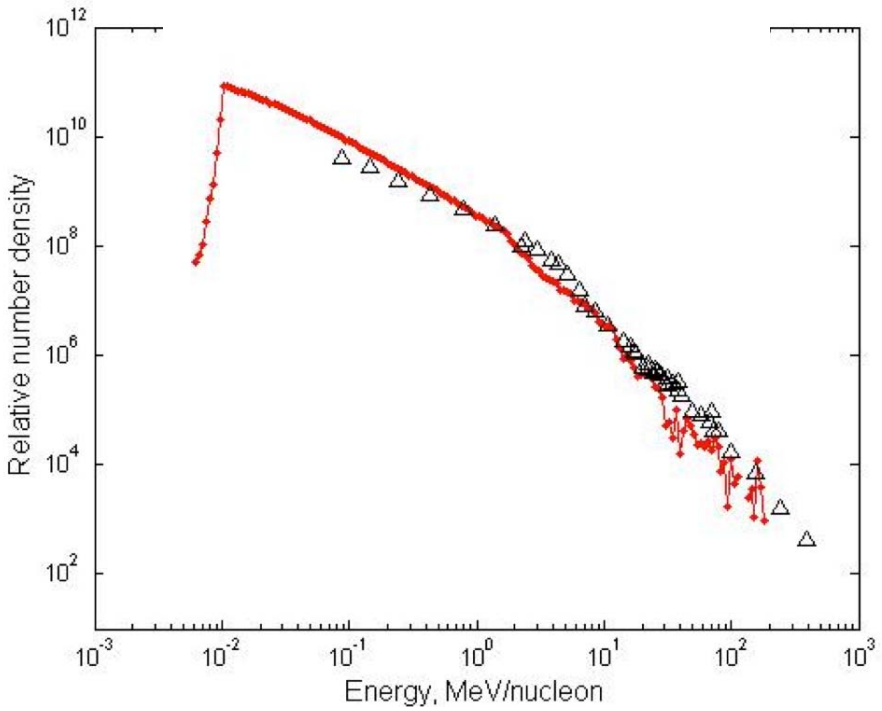
Time profiles of the 16 LET H sectored rates, color-coded by viewing direction (see color wheel)

Analysis is ongoing, and will be presented at the International Cosmic Ray Conference (from the LET team@Caltech).

Modeling the December 13, 2006 SEP Event with the PATH Code

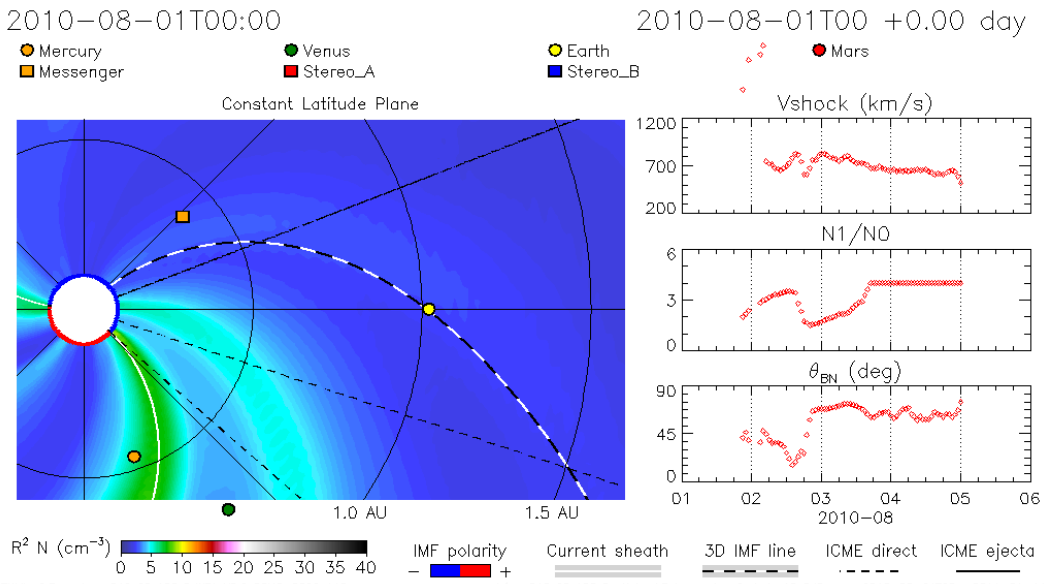
In a recent JGR paper, Verkhoglyadova et al. (2011) used the Particle Acceleration and Transport in the Heliosphere (PATH) numerical code to similate SEP measurements during the December 13, 2006 event. The code models the background solar wind through which a CME-driven oblique shock propagates, accelerating a mixed population of both flare and suprathermal particles. Shock parameters derived from ACE measurements were used as input into the numerical model, and spectra for H, O and Fe ions were derived, together with their time-intensity profiles at 1 AU. The model is in reasonable agreement with *in situ* measurements by ACE, STEREO, GOES and SAMPEX. The results suggest that variations in the seed population and shock geometry are important for modeling time profiles and spectra at 1AU.

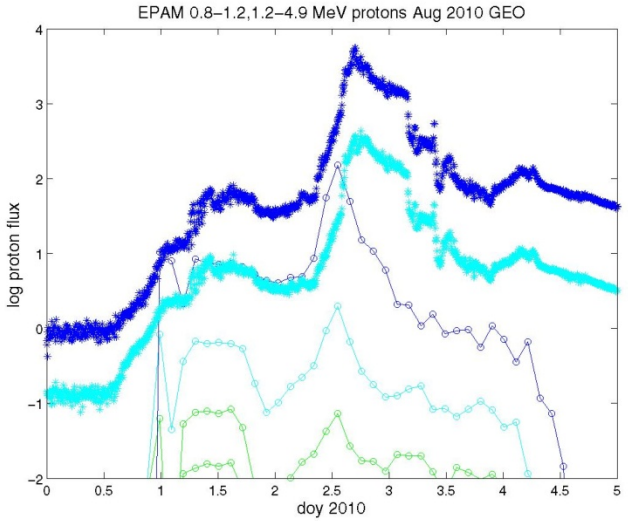


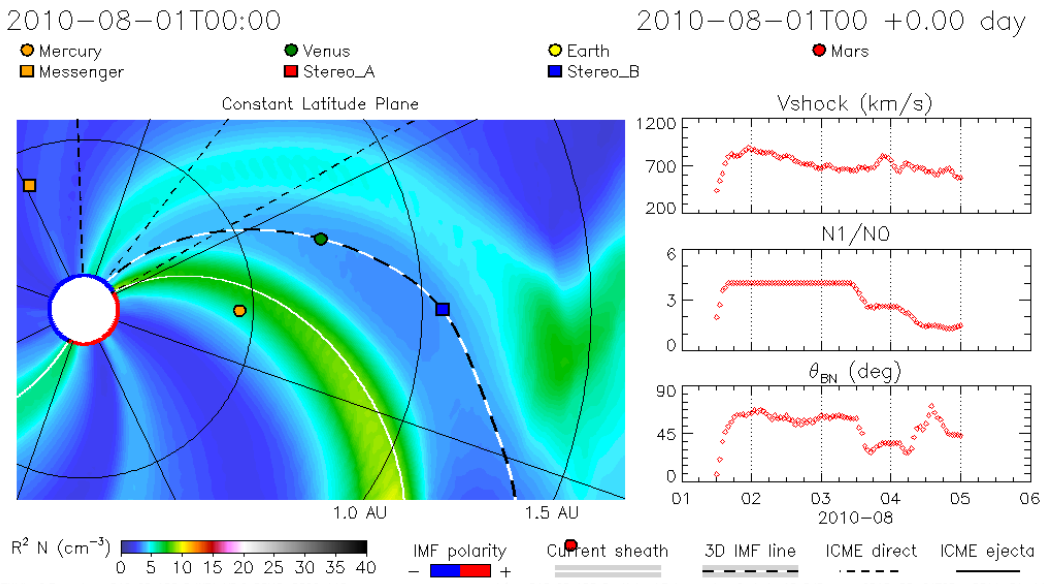


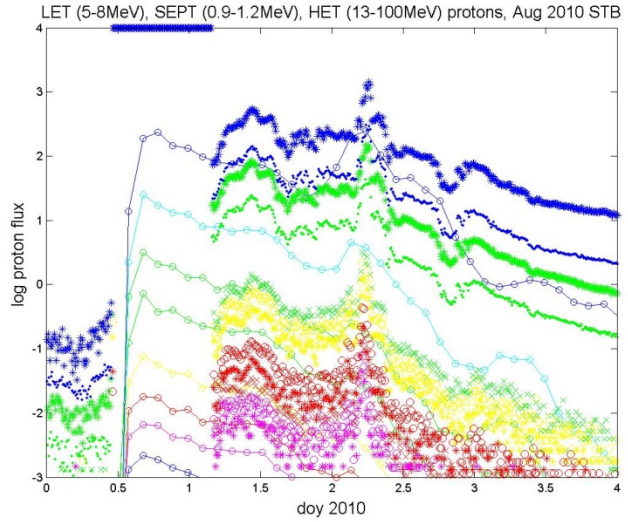
(Studies involving the LET and HET teams and collaborators)

STEREO/CISM Modeling of SEP Events observed at both Earth and STEREO-B: August 1, 2011 CME Case Study with a Cone Model ICME Shock (J. Luhmann et al.)

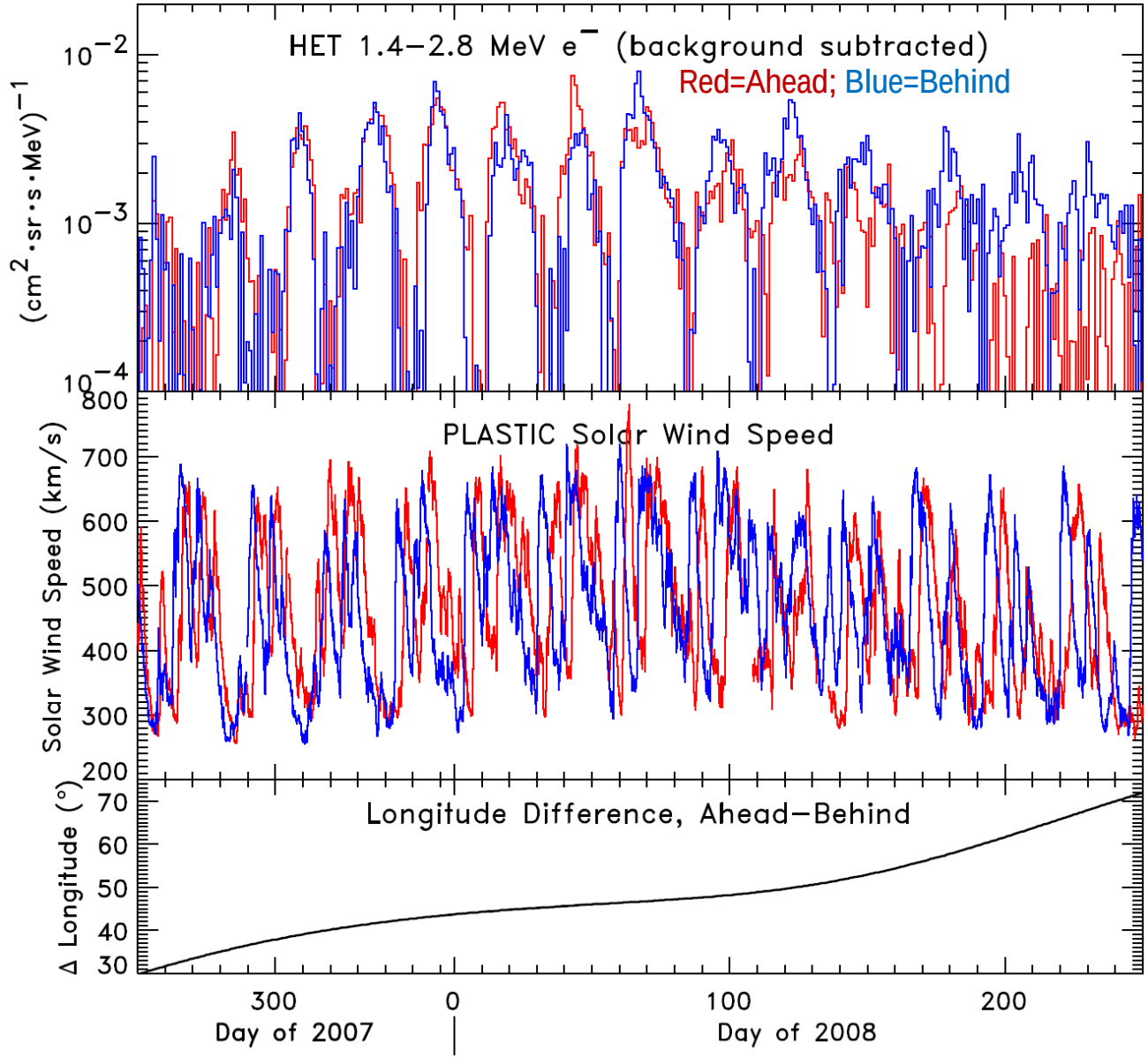








27-Day Variations in Jovian Electrons Are Synchronized at Widely Separated Heliolongitudes (HET data study)



Like many instruments over the past 30 years, HET detects Jovian electrons when magnetically well-connected to Jupiter.

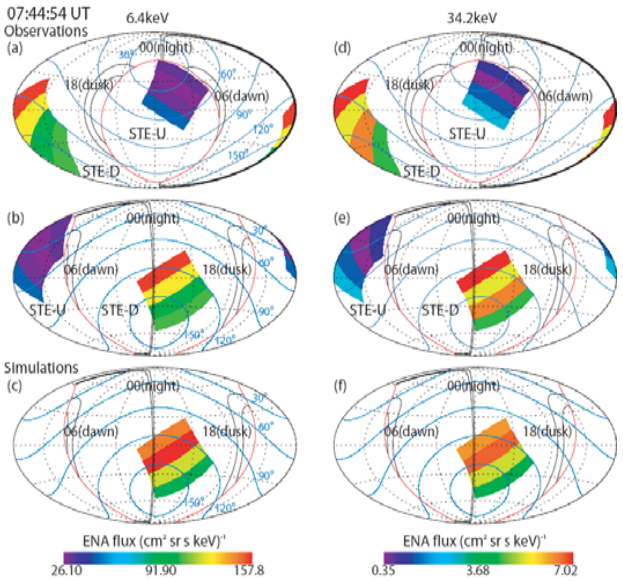
Intensities of Jovian electrons are modulated with a ~27-day period; contributing factors include:

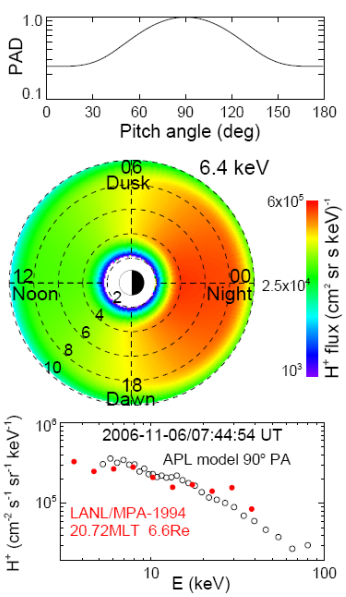
- **magnetic connection**
- **CIRs between Jupiter and observer**
- **intensity variation at the source.**

The 27-day modulation occurs ~simultaneously at both STEREO S/C in different solar wind regimes, so variation at the source must be significant.

Analysis is ongoing, and will be presented at the International Cosmic Ray Conference.

STEREO IMPACT Studies using STE:



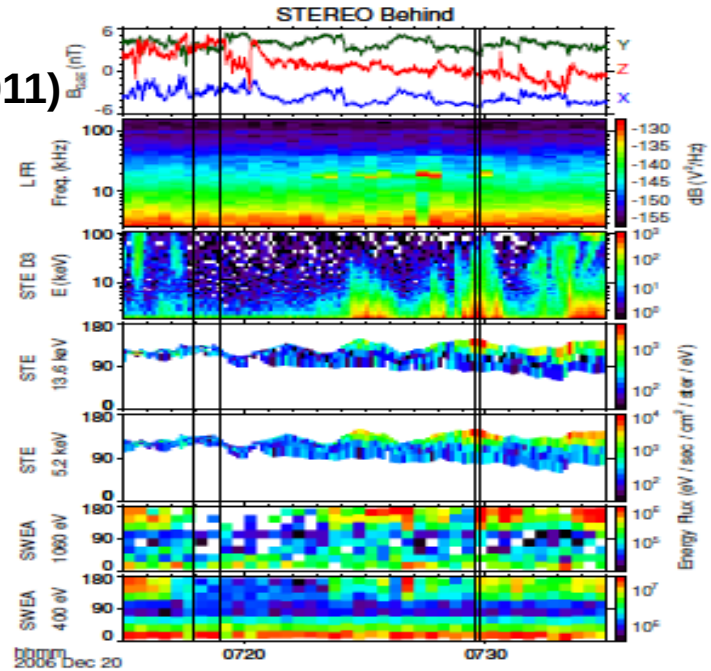


Energetic Neutral Atom Imaging of Earth Ring Current

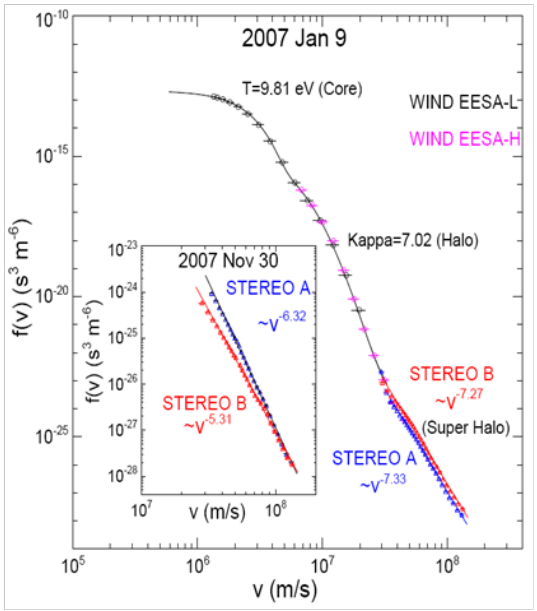
(Wang et al., 2010)

Upstream foreshock electrons measured by STEREO

(Pulupa et al., 2011)



Quiet-time interplanetary superhalo electrons (Wang and Yoon et al.)



Organization of "Sun-360", July 25 – 29, 2011, Kiel (Germany)

For more information visit:

http://www.sun-360.org

IMPACT Team Bibliography Updates

New Publications Involving IMPACT Data and Team members: April 2010-April 2011

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