IMPACT Status and Data Updates

SWG Dublin, 22-26 March 2010

Janet Luhmann
for the IMPACT team

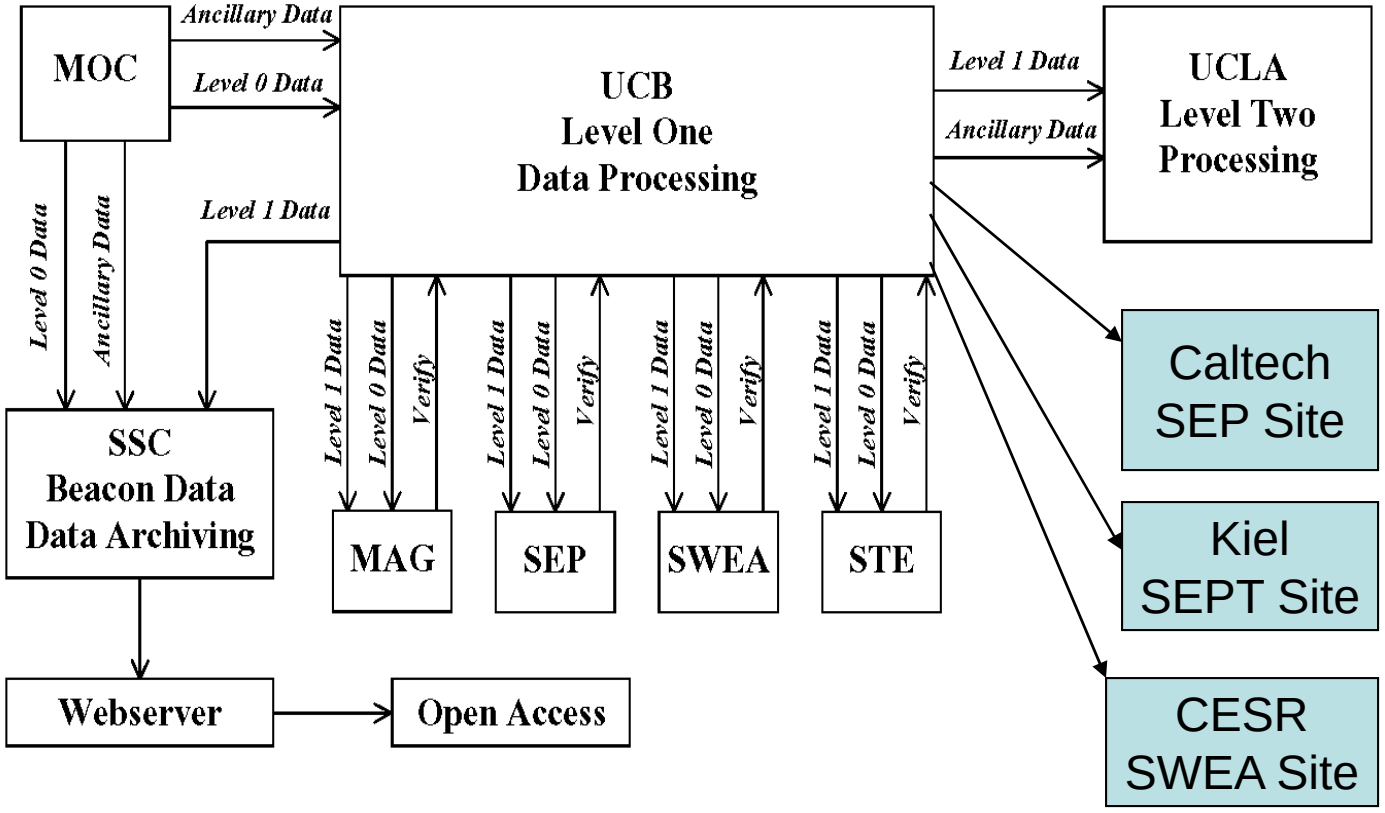
IMPACT Instrument Status Summary

- SWEA biases have been set at 0 eV and the investigation of the cause of the compromised core distribution measurement has been determined.
- Boom suite burst mode criterion has changed as follows: the largest Btotal increases within a 4 hr period are the current trigger for ~20 min of 32 Hz MAG and SWEA data.
- Two hour fixed daily intervals of ‘high rate’ (32 Hz) MAG data will be taken routinely as IMPACT data rate allows, starting March 21.
- MAG offsets slowly drifting but manageable.
- SEP instruments (SEPT, LET, SIT, HET) all operating nominally.

Data Status Report
SWG Mar 2010

From Peter Schroeder,
with inputs from the IMPACT Team

IMPACT Data Flow



Current IMPACT Level 1 Data Holdings@UCB

Instrument	1st Date (A)	1st Date (B)	Last Date
MAG	2006 Nov 2	2006 Nov 2	2010 Jan 31
SWEA	2006 Oct 28	2006 Oct 28	2010 Jan 31
STE	2006 Oct 28	2006 Oct 28	2010 Jan 31
LET	2006 Nov 14	2006 Nov 13	2010 Jan 31
SEPT	2006 Dec 12	2006 Dec 12	2010 Jan 31
SIT	2007 Mar 15	2007 Mar 15	2010 Jan 31
HET	1min, 15 min and 1hour averages through 2009 Sep 30		

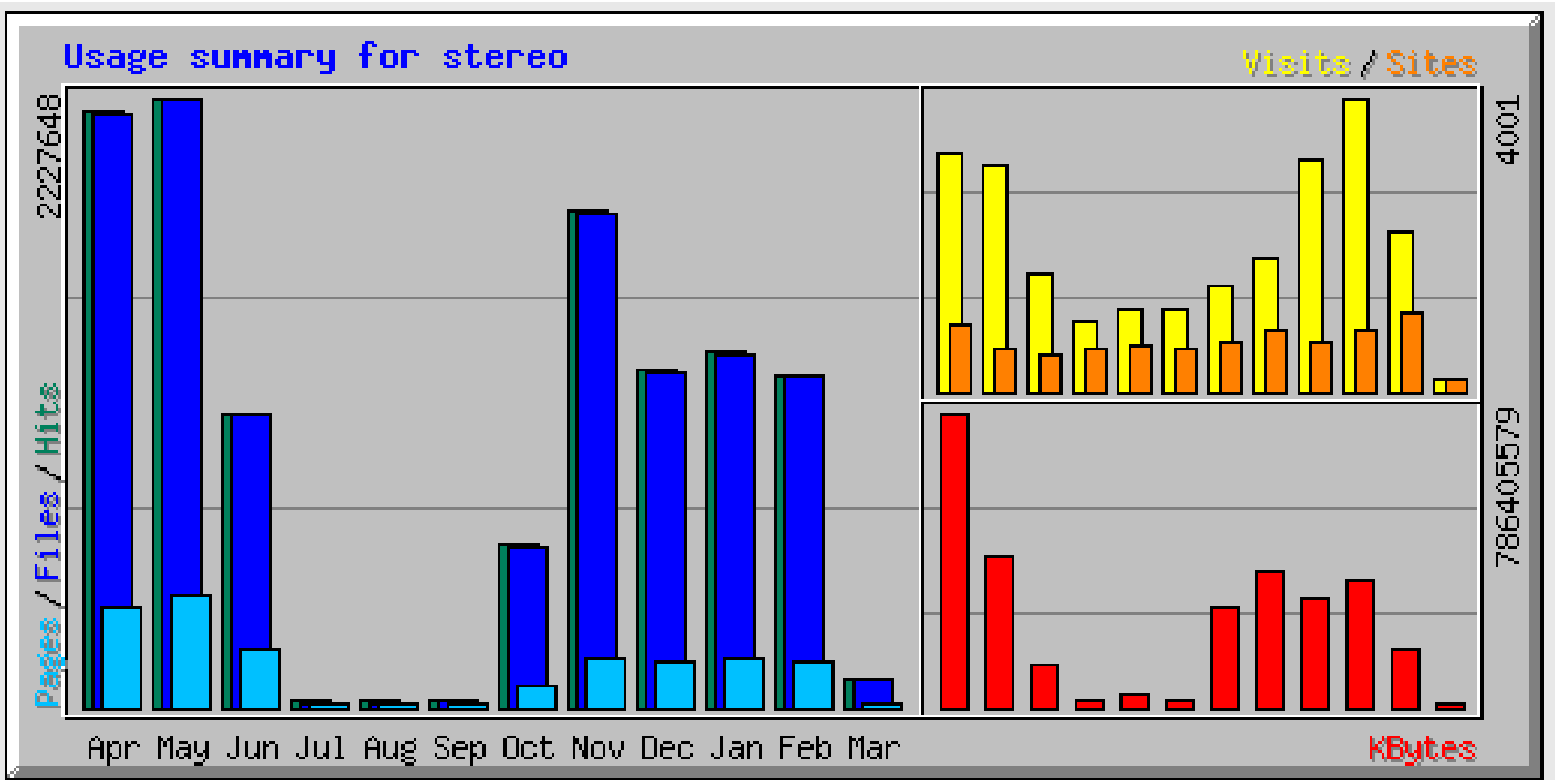
Reason for Level 1 Data Release Delay

- 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.

IMPACT website/data access@UCB

Summary by Month										
Month	Daily Avg				Monthly Totals					
	Hits	Files	Pages	Visits	Sites	KBytes	Visits	Pages	Files	Hits
Mar 2010	33747	33700	4799	58	195	10495692	176	14399	101102	101242
Feb 2010	43454	43152	6193	77	1100	157789888	2167	173416	1208280	1216719
Jan 2010	42003	41562	5956	129	853	344201194	4001	184662	1288451	1302104
Dec 2009	39799	39398	5452	102	671	289015729	3181	169017	1221364	1233781
Nov 2009	60419	60106	6153	60	833	363473254	1824	184603	1803190	1812590
Oct 2009	19161	18885	2593	47	673	265704889	1469	80413	585450	593997
Sep 2009	976	796	427	37	582	22120590	1118	12824	23909	29284
Aug 2009	886	612	476	35	639	39880536	1108	14783	19002	27479
Jul 2009	739	646	415	30	605	19709882	953	12889	20054	22928
Jun 2009	35738	35586	7179	54	527	116397805	1632	215370	1067595	1072155
May 2009	71859	71752	13313	99	607	402073110	3088	412715	2224322	2227648
Apr 2009	72450	72271	12394	108	924	786405579	3243	371832	2168137	2173504
Totals						**2817268148**	**23960**	**1846923**	**11730856**	**11813431**

IMPACT website/data access@UCB



Delivered Since Last Update

- HET Level 1 software has been delivered to UCB, integration of the software into the UCB processing pipeline is underway
- Improvements have been made to the UCB web data interface, making navigation more intuitive throughout (both the data browser and data portal)
- SWEA PADs created at CESR have been delivered to UCB; final prep for public release from UCB as cdf files is almost complete (these PADs are already available in ascii format from CESR Toulouse's site)

Magnetometer Status and MAG Data Processing

contributed by C.T. Russell

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.
- Early in the mission it would step down and then return shortly afterwards.
- We developed an algorithm to detect and correct the data and applied it. The data were noisier than they should have been after correction but not at a serious level.
- 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. Our new algorithm is complete but occasionally misses a correction or makes a correction that it should not make.
- We will have to reprocess much of the STEREO A data from 2008 to the present. That includes all STEREO A magnetometer data products.

Zero Level Determination

- We use the Alfvenic 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	2.1 nT
A Sensor 2	1.4 nT	B Sensor 2	2.1 nT
A Sensor 3	4.0 nT	B Sensor 3	5.6 nT

- In 2009, the zero levels varied over the following ranges:

A Sensor 1	0.2 nT	B Sensor 1	0.5 nT
A Sensor 2	0.2 nT	B Sensor 2	0.2 nT
A Sensor 3	0.7 nT	B Sensor 3	1.1 nT

- Lessons learned:
  - All sensors have become more stable over time.
  - 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.
- The level 1 data do meet the measurement objectives of the mission.

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 usually 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 the to Berkeley.
- We are developing 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 data to our level 2 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, 2009.
- Merged Level 2 PLASTIC data are available up to October 31, 2009.

SWEA Status and Data Summary

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

STEREO-SWEA ISSUES: REVIEW OF TIMELINE AND RESOLUTION

> At the beginning of the STEREO mission (launch on 25th October 2006) the SWEA instruments (first light on 29th October 2006) were operating correctly.

> After the deployment of the boom on 1st November 2006 (STA 16:30 and STB 19:45) both performed good solar wind electron measurements.

➢***Core and secondary electron spectrum start looking compromised on both spacecraft on November 3 and continue to have shape alterations that cannot be readily understood or corrected (report available).***

Bottom Line: SWEA data above a few hundred eV (e.g. super-halo and heat flux electron science) can be used without unusual corrections or modifications. Data at lower energies, including the core of the solar wind electron distribution and the moments derived from it, require special handling and are subject to significant errors from internal instrument charging effects. Due to this their archiving requires special caveats and documentation (see presentation by A. Opitz)

SWEA instrument status

- Instrument charging on tophat (~-4V)

  ⇨ SW electrons <45eV suppressed

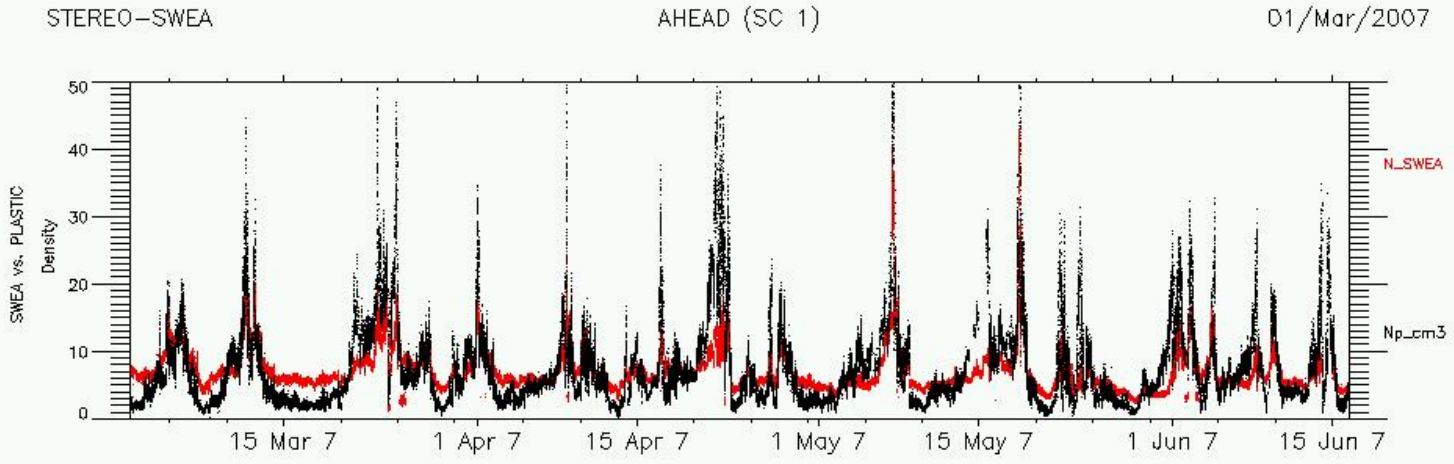
  – No electron core distribution 👎
  – At low energies secondary electrons unveiled 👍
  – Excellent SW electron halo and strahl measurements 👍

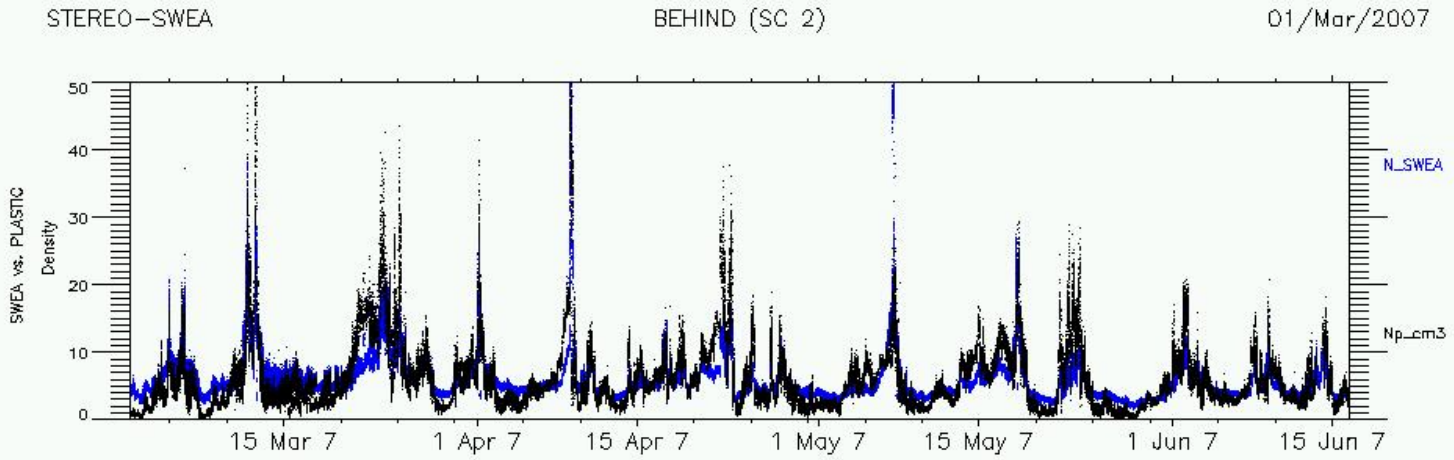
- Data products
  – Calibrated SW electron energy spectra (45 - 2000 eV) 👍
  – Pitch angle distributions (SWEA + MAG & PLASTIC) 👍
  – Moments >45eV: density, temperature, heat flux vector 👍
  – Halo properties from fit 👍
  – Core density proxy: full time series after 2007 January 👍
  – Core temperature proxy: 2007Jan - 2008Febr and after 2009Apr 👍

SWEA data products

- Public
  - http://stereo.cesr.fr
    - present: plots of E spectra, PADs, moments >45eV (routinely produced by CL software at CESR)
    - ASCII files available containing moments (CESR halo fit density, temperature proxies, heat fluxes), and PADS
    - Future: CDF files with ASCII file contents (produced by Berkeley); Level 2 merged data set version of SWEA data (produced at UCLA)
  - http://stereo.cesr.fr/clweb
    - CL software and SWEA binary data on server
    - access by requesting password

Density comparison SWEA-Plastic





SEP Suite Status and Data Summary

For Dublin 2010 SWG

contributed by Dick Mewaldt and IMPACT SEP suite members

SEP-suite data additions/improvements in 2009/2010

The SEP-suite website with many ascii files available is http://www.srl.caltech.edu/STEREO/index.html

LET 10-minute and 27-day averaged-data are now available, in addition to the previously-available 1-minute, hourly, and daily averages.
http://www.srl.caltech.edu/STEREO/Level1/LET_public.html

A new version (July 2009) of the HET electron and proton data are now available, in 1-minute, 15-minute, and hourly averages at:
http://www.srl.caltech.edu/STEREO/Level1/HET_public.html

SEP-suite data additions/improvements in 2009/2010

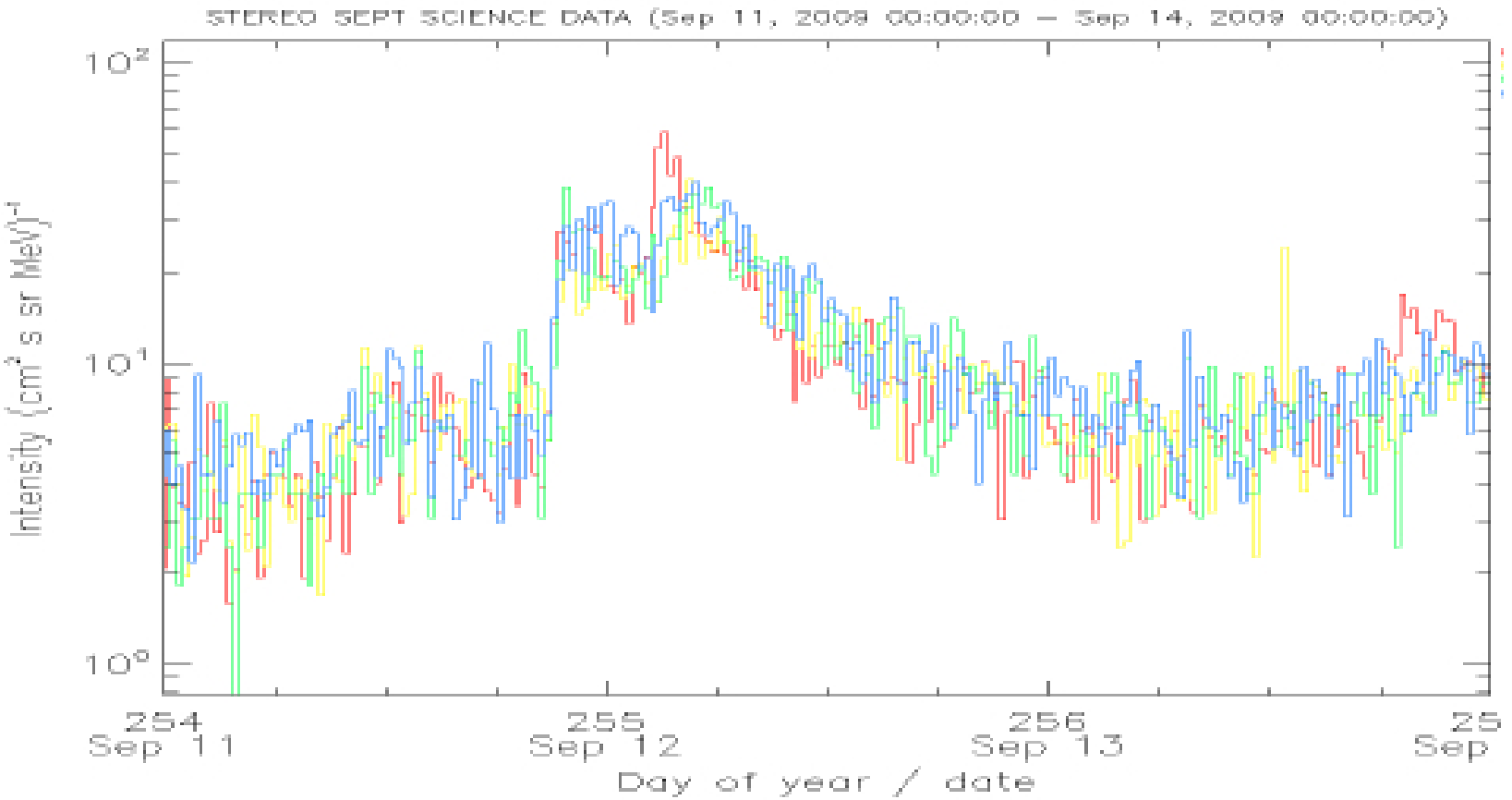
An interactive plotting tool for SIT browse plots is available:
http://www.srl.caltech.edu/STEREO/scripts/mksitmpanel.cgi?LATEST=1
(SIT does not provide Level-2 SIT files to Caltech, but does provide the Level-1 (1-min) data to UCB regularly, and these are available now from CDAWEB.)

http://cdaweb.gsfc.nasa.gov/cgi-bin/eval2.cgi?dataset=STA_L1_SIT&index=sp_phys
http://cdaweb.gsfc.nasa.gov/cgi-bin/eval2.cgi?dataset=STB_L1_SIT&index=sp_phys

SEP-suite data additions/improvements in 2009/2010

SEPT ASCII data files with 1 minute, 10 minute, 1 hour and 1 day time resolution will be available publicly soon (currently in beta-test).

SEPT data for the SEPT 11 SEP Event



SEP-suite data additions/improvements in 2009/2010

LET and SEPT Level 1 data (1-minute) are also now on CDAWeb:
http://cdaweb.gsfc.nasa.gov/cgi-bin/eval2.cgi?dataset=STA_L1_LET&index=sp_phys
http://cdaweb.gsfc.nasa.gov/cgi-bin/eval2.cgi?dataset=STB_L1_LET&index=sp_phys
http://cdaweb.gsfc.nasa.gov/cgi-bin/eval2.cgi?dataset=STA_L1_SEPT&index=sp_phys
http://cdaweb.gsfc.nasa.gov/cgi-bin/eval2.cgi?dataset=STB_L1_SEPT&index=sp_phys

We continue to provide attitude and orbit data to the community in convenient ascii formats and multiple coordinate systems at
http://www.srl.caltech.edu/STEREO/attorb.html

STEREO IMPACT
Some Works in Progress

STEREO SWG Meeting 21
Trinity College
Dublin, Ireland
March 22-26, 2010

Lan Jian's Projects
Using STEREO IMPACT and PLASTIC Data

- Providing Level 3 scientific products at UCLA/STEREO site
  - The lists of interplanetary shocks, interplanetary CMEs, stream interaction regions (SIRs) → *currently updated to Oct 2009*
  - The list of heliospheric current sheet (HCS) → *plan to work on it as some scientists requested*
- Solar cycle variations of the above large-scale solar wind structures by comparing with our previous Wind/ACE study, such as the unusual behavior of solar minimum 23/24
- Multi-spacecraft observations of SIRs including their associated shocks → *published one paper on this in Solar Physics 2009 special issue of STEREO*
- Comparison of multi-s/c observations of SIRs and HCSs with the simulation results from the heliospheric models at CCMS → *abstracts submitted, plan to report preliminary results in EGU, COSPAR, and other meetings*
- Study of ion-cyclotron waves (ICWs) in the solar wind → *published one paper in ApJ 2009, plan to study these waves further and also compare them with the ICWs observed closer to the Sun*
- Study of especially large-amplitude whistler waves at the interplanetary shocks → *plan to write a GRL paper on the characteristics of these waves for a couple of events*

UCLA/IGPP: H.R. Lai

1. Formation of shocks inside 1 AU
   - Radial variation of shock strength and occurrence
     - Helios 1, 2 1974 – 1980
     - MESSENGER 2007 – 2008
     - STEREO A, B2006 – 2010
   - Cause of Interplanetary shocks inside 1 AU
     - ICME-driven
     - SIR-driven
2. Interplanetary Flux Enhancements
   - Survey of Occurrence
     - STEREO A, B2006 – 2010
     - Helios 1, 2 1974 – 1980
     - Venus Express 2006 – 2009
     - MESSENGER 2007 - 2008
   - Pressure Compensation
   - Size distribution

Andrea Opitz et al. (CESR, Toulouse)

- Temporal evolution of solar wind ☞ EGU talk:

  STEREO increasing spacecraft separation up to 180-degree allows a complete time scan of the solar wind evolution in the ecliptic: timelags of 0.1 day up to several Carrington rotations.

  – PLASTIC proton bulk velocity: Opitz et al. 2009 SolPhys paper
  – SWEA electron core density: Opitz et al. 2010a submitted at SolPhys ☞ SWG talk on Friday ~11:00
  – STEREO ⇔ VEX / SOHO / MEX: Opitz et al. 2010b submitted at SolPhys
- Fast evolution events: multi-spacecraft analysis ☞ Cospar talk
- STEREO in the terrestrial magnetosheath and tail

Benoit Lavraud et al. (CESR, Toulouse)

- Study of magnetic cloud ‘peeling off’ through magnetic reconnection

- Statistics of Heliospheric Current Sheet and true/false polarity reversals

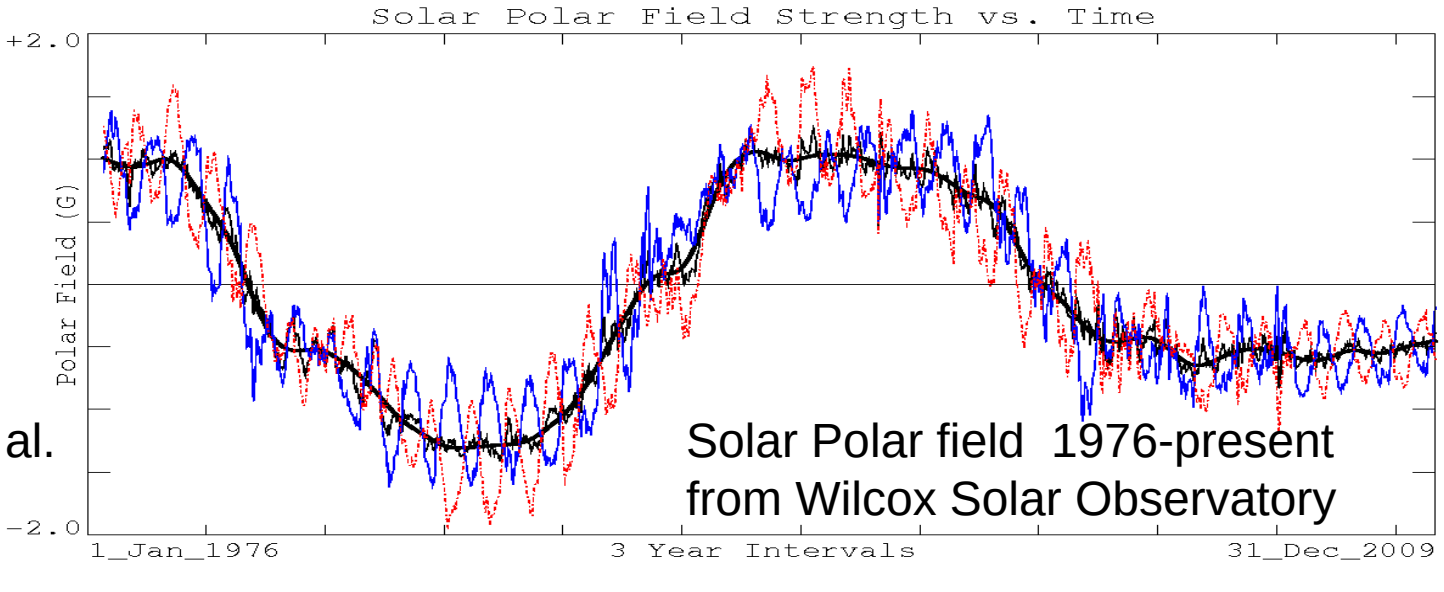
Emilia Kilpua et al. (Univ. of Helsinki)

- Small ICME-like structures in the slow solar wind and their coronal counterparts
- Multispacecraft ICME observations
- (Future) Effect of ambient solar wind on ICME travel time, using quadrature observations

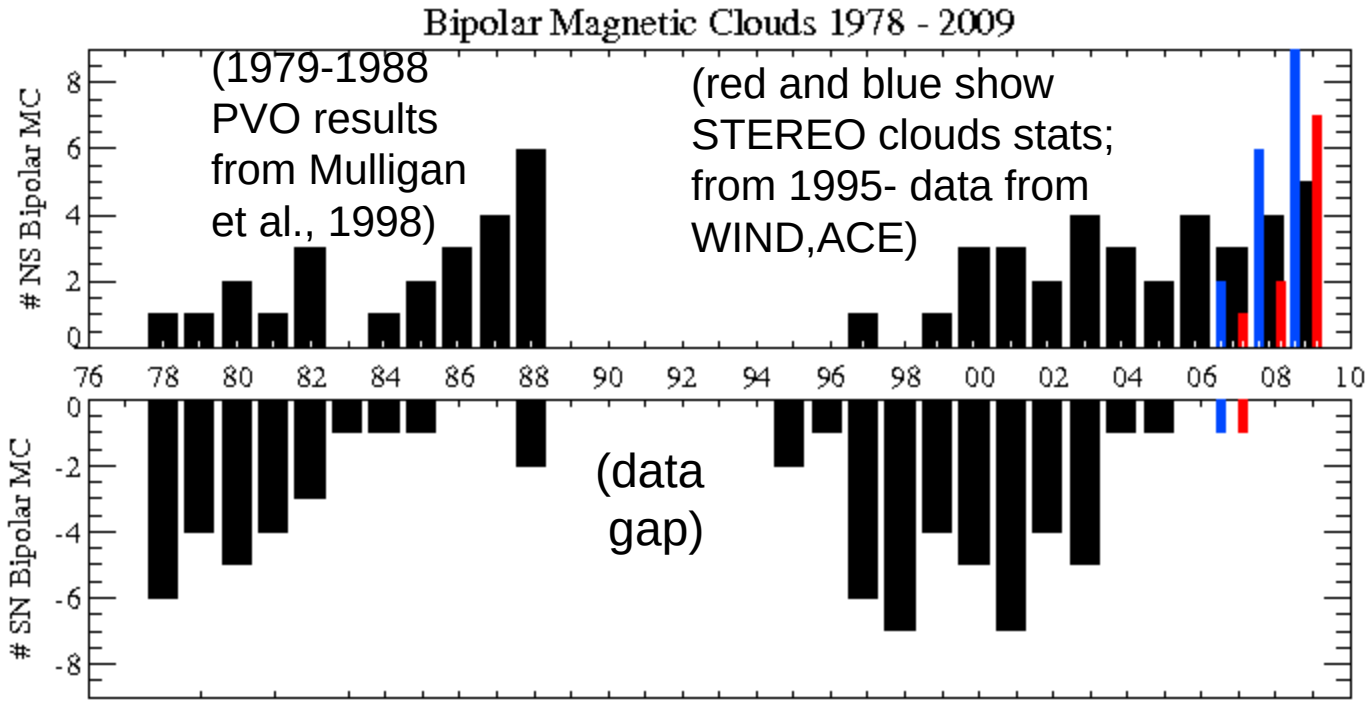
UCB/SSL: Christina Lee, Yan Li, Ying Liu

- Study of the weak interplanetary field source for cycle 23/24 minimum phase (C.O. Lee, part of PhD thesis)
- Study of ICMEs and their (CME) source regions (Yan Li et al.)
- Study of CME/ICME propagation (Ying Liu et al.)
- Solar wind stream structure organization of SWEA heat fluxes (with M. Ellenburg (UCB undergrad)

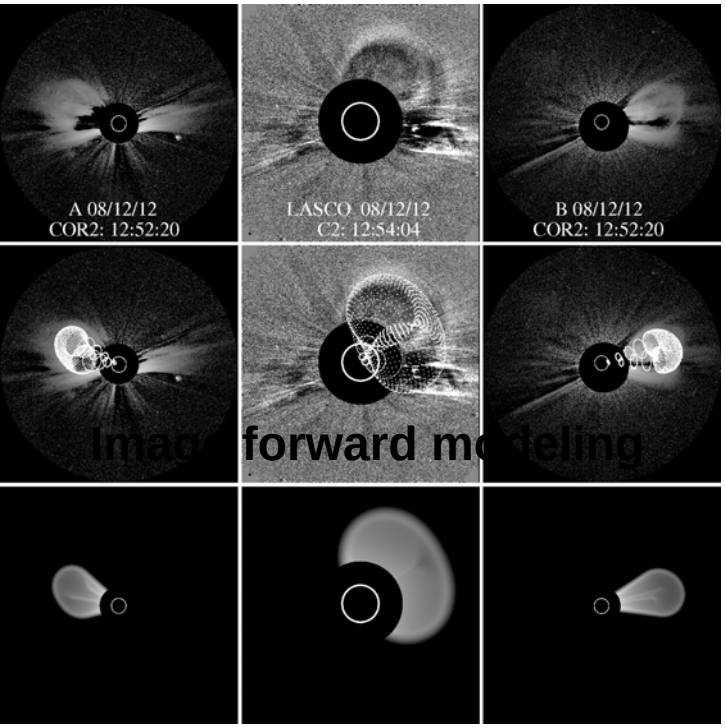
Yan Li et al. analysis of ICME cloud occurrence and polarities with solar cycle (SSL)

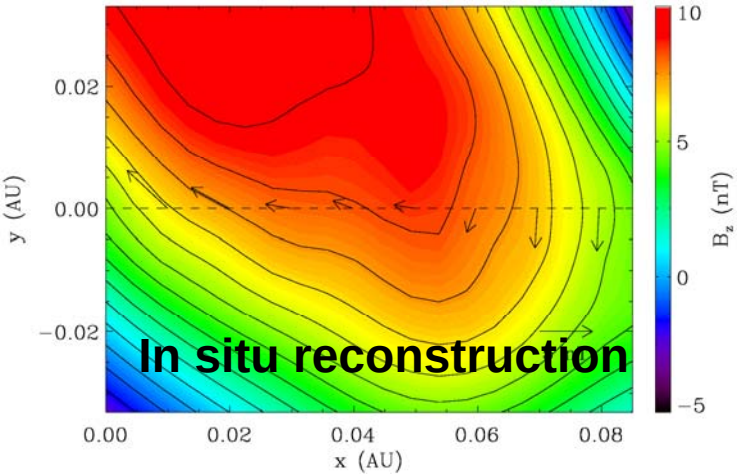


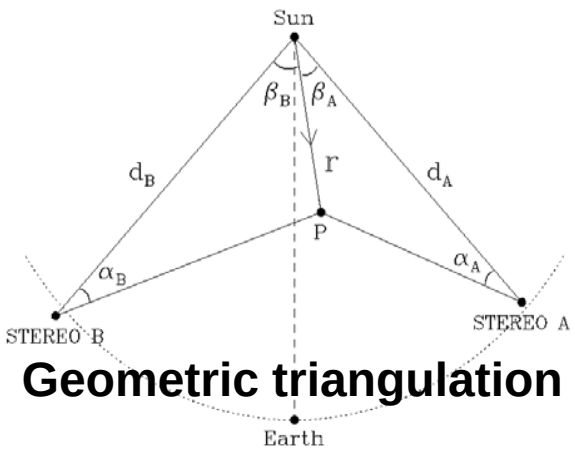
Solar Polar field 1976-present from Wilcox Solar Observatory

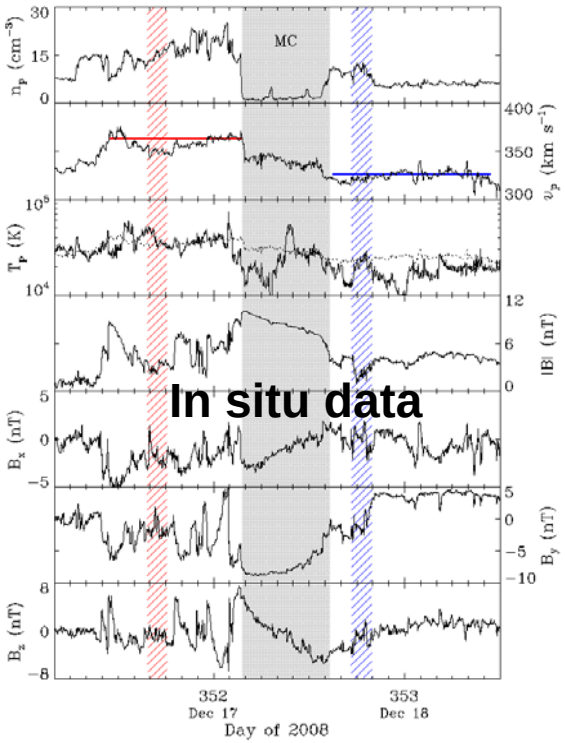


Y. Liu: Tracking CMEs with coordinated imaging and in situ data







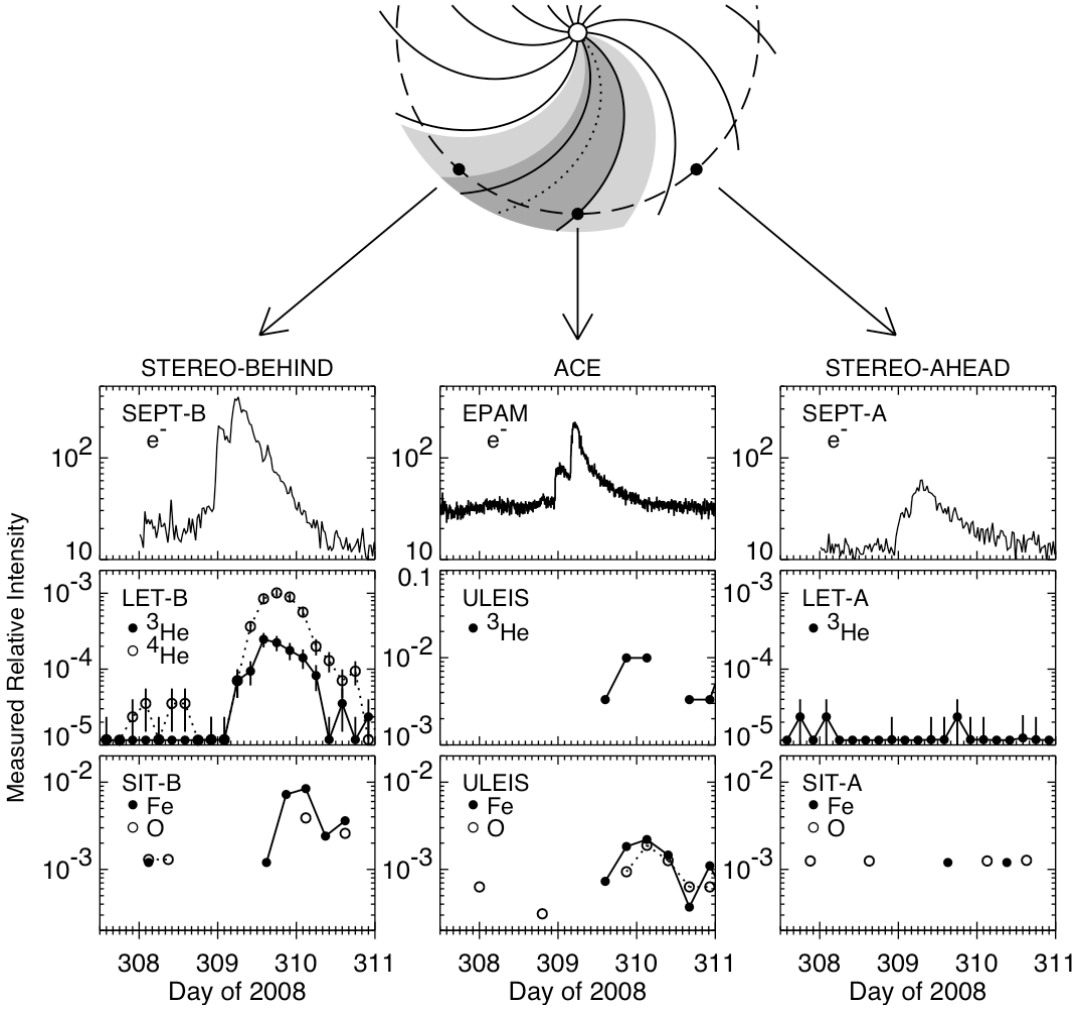


Combine images with in situ data to constrain the global structure and kinematics:

- Image modeling gives a propagation direction (Thernisien);
- Geometric triangulation gives additional propagation direction information for calculating arrival time and velocity consistent with in situ data at 1 AU ;
- In situ reconstruction gives a flux-rope tilt angle and a propagation direction above the ecliptic (consistent).

Liu et al. 2010a, 2010b

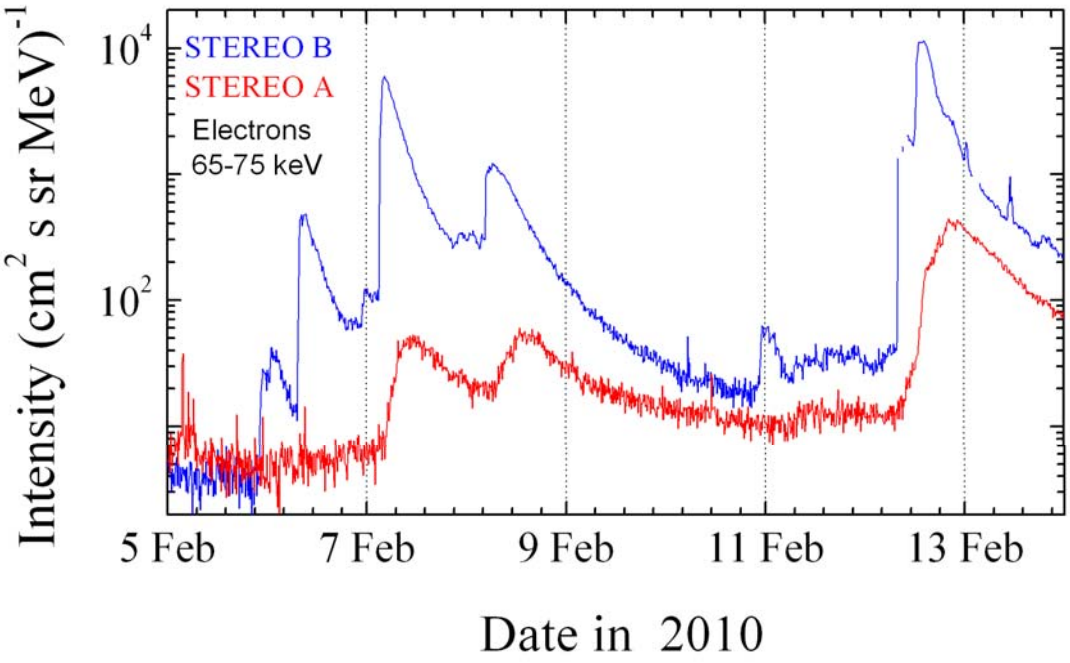
Wiedenbeck et al.: The Heliolongitude Distribution of Impulsive SEPs

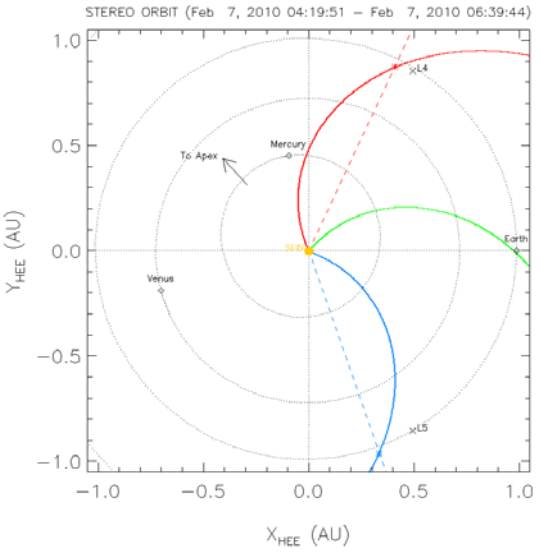


Measurements of energetic particle intensity versus time in the ISEP event of 3-4 Nov 2008. Cartoon shows locations of STEREO-A, STEREO-B, and ACE at the time of the event. The dotted line shows nominally best connected field line to the flare site, with the dark (light) shaded region indicating a ±20° (±40°) spread about this field line. Electrons from the event were detected at all three spacecraft, and heavy ions with enhanced ^{3}He and Fe/O were detected at STEREO-B and ACE.

Recent SEP events observed by SEPT (Gomez-Herrero et al.)

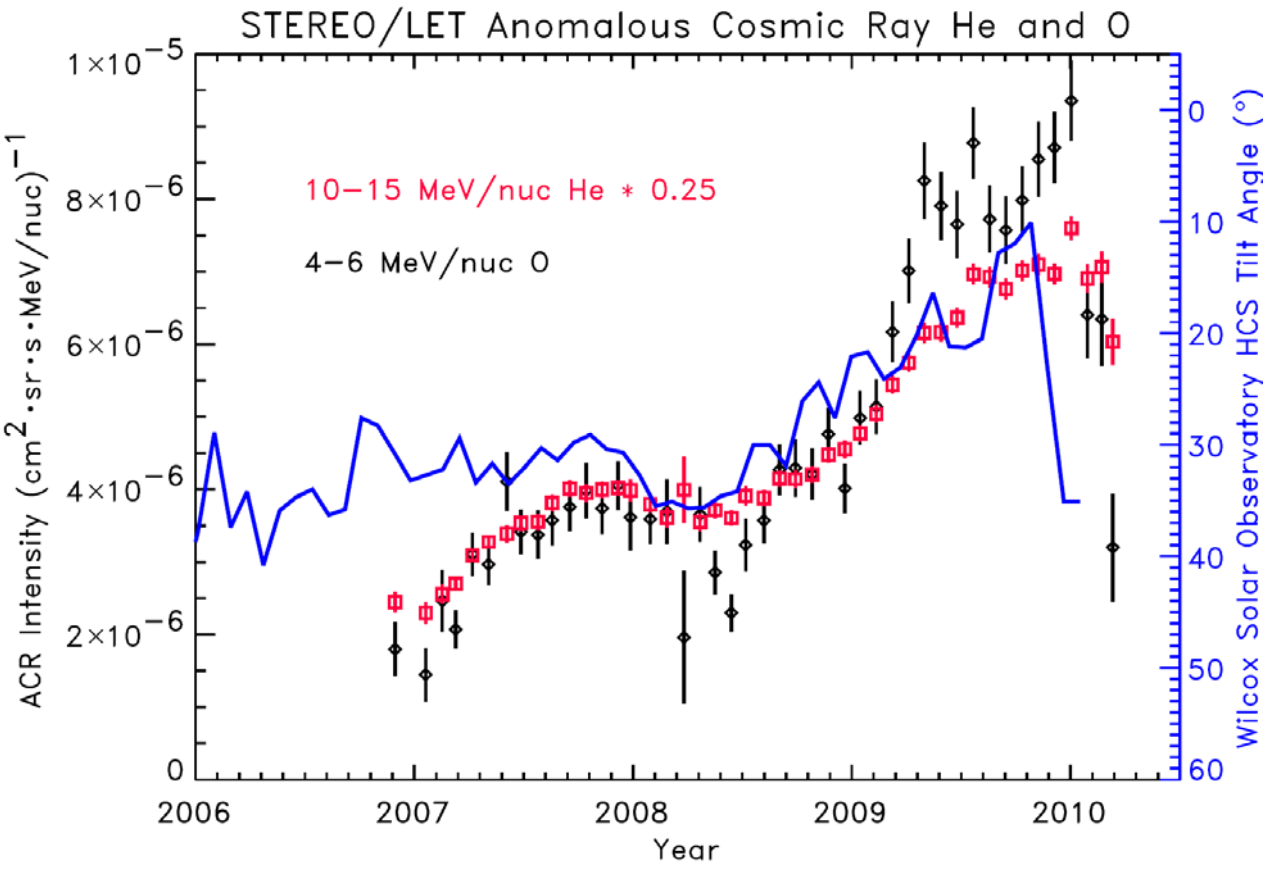
- New multi-spacecraft SEP events observed
  E.g. Dec 22, 2009; Jan 17, 2010; Feb 7, 8, 12, 2010.





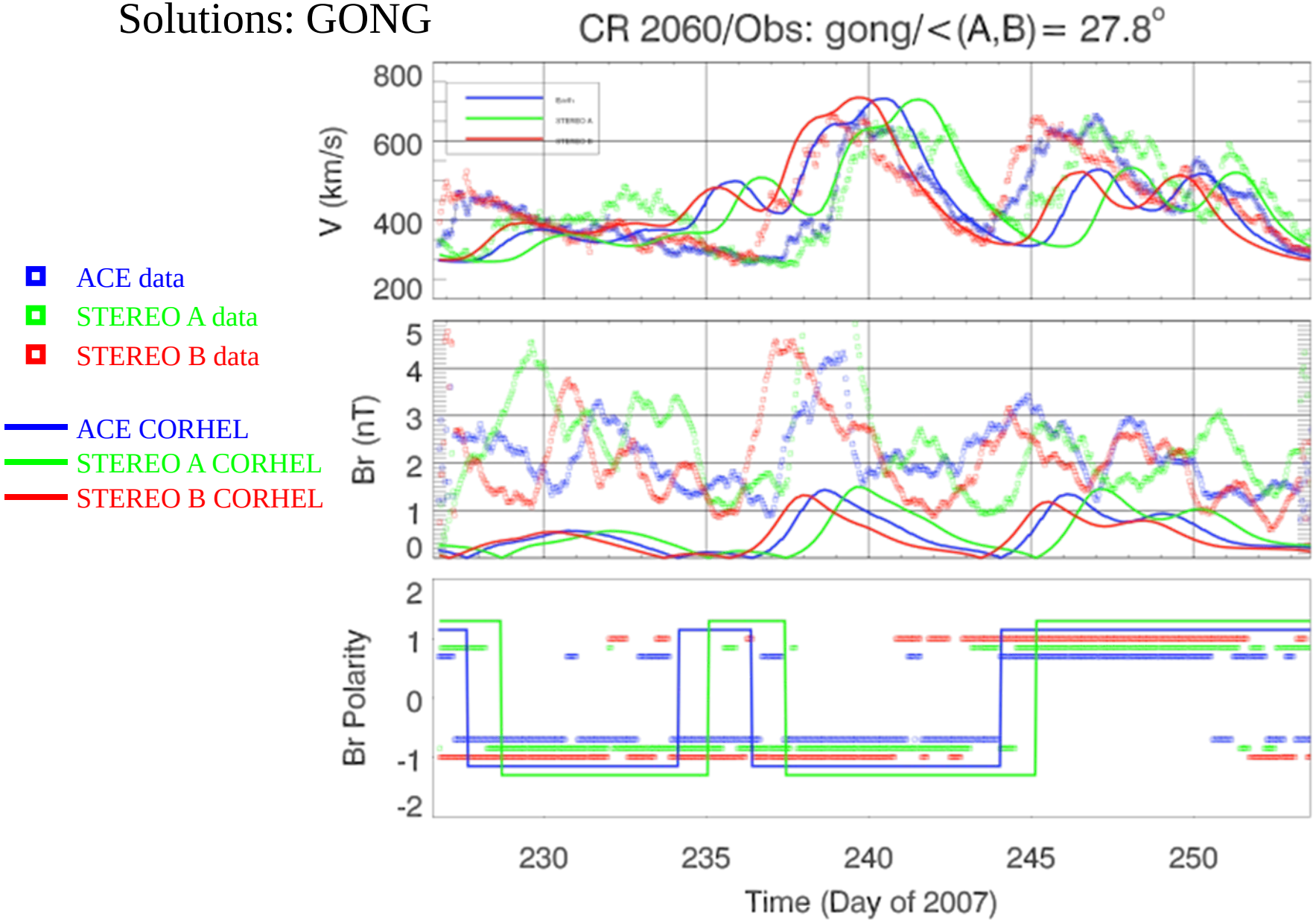
February events associated with C-class and M-class X-ray flares in ARs 1045 and 1046. STB and STA separated more than 135 degrees

Mewaldt et al:
STEREO sees Anomalous Cosmic Rays Coming and Going…



- **Since STEREO was launched, ACR intensities have ~tripled**
- **During A<0 cycles ACRs drift inward along the heliospheric current sheet (HCS); their intensities increase as the HCS tilt angle decreases, and vice versa**
- **The HCS tilt angle abruptly increased late last year; several months later, ACR intensities have dropped**
- ***It seems the minimum of solar modulation has finally passed***

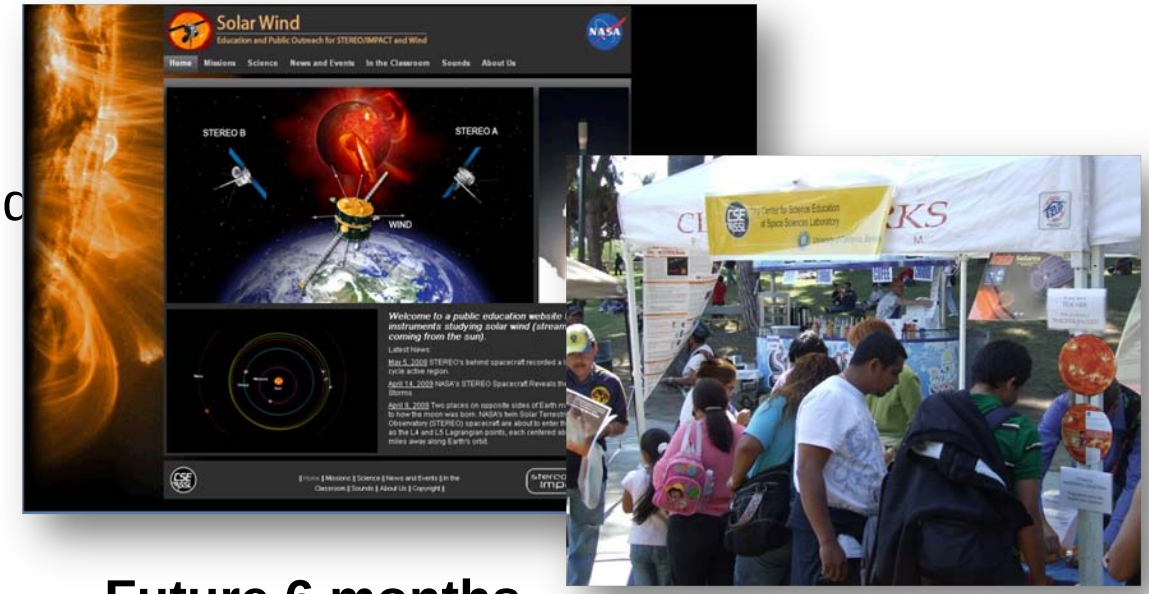
- (P. Riley et al.) Comparison of 1 A.U. Data with CORHEL Model Solutions: GONG



IMPACT EPO Activities *(L. Peticolas, SSL)*

Past 6 months

- New Solar Wind website coordinating with Wind and ACE
- Teacher professional development workshops on Electricity and Magnetism; space weather; solar wind
- Sonification efforts - working on making the IMPACT sonification program more robust
- Public Outreach Events, primarily to Latino populations



Future 6 months

- Continue updating the Solar Wind website; sonification efforts; and public outreach events;
- Work with other NASA efforts to bring magnetism and space weather to science center audiences (partnering with artists “Semiconductor” - created “Magnetic Movie”)
- Update solar wind lesson plan with suggestions from teachers