IMPACT Data Plans
May 2006

Peter Schroeder
UC-Berkeley
peters@ssl.berkeley.edu
IMPACT Team Member Institutions and Primary Roles

- University of California, Berkeley-Space Sciences Laboratory (IMPACT Management, SWEA, STE, IDPU)
- NASA Goddard Space Flight Center (MAG, SEP-LET, HET)
- California Institute of Technology (SEP-LET, HET)
- University of Maryland (SEP-SIT)
- University of Kiel (SEP-SEPT)
- Centre d'Etude Spatiale des Rayonnements CESR (SWEA)
- Los Alamos National Laboratory (Science Integration, SEP-SIT)
- Max Planck Institut fur Aeronomie (SEP-SIT)
- Jet Propulsion Laboratory (SEP-LET, HET)
- ESTEC-European Space Agency (SEP-SEPT)
- DESPA Observatoire de Paris-Meudon (SWAVES/IMPACT coordination)
- University of California, Los Angeles (MAG, IMPACT Data Web)
- SAIC-Science Applications International Corporation (IMPACT Modeling)
- NOAA Space Environment Center (IMPACT Modeling, Space Weather Applications)
- University of Michigan (IMPACT Modeling)
- KFKI-Hungarian Research Institute for Particle and Nuclear Physics (SEP Modeling)
What IMPACT contributes to the content of STEREO data

• **SECCHI (PI Russ Howard, NRL)** - Remote Sensing Package that will track Coronal Mass Ejections (CMEs) from the Sun to the Earth.
  - Two White Light Coronagraphs (**COR1, COR2**) - COR1 explores 1.4 – 4 Rsun. COR2 explores 2 – 15 Rsun
  - Extreme Ultra Violet Imager (**EUVI**) - Observes chromosphere and inner corona
  - Heliospheric Imager (**HI1, HI2**) - Observes Coronal Mass Ejections from the Sun to the Earth (12 – 300 Rsun)

• **IMPACT (PI Janet Luhmann, UCB)** - will sample the 3-D distribution of solar wind plasma electrons, the characteristics of the energetic particle ions and electrons, and the local magnetic field.
  - Solar Wind Experiment (**SWEA**) - Measures ~0-3 keV electrons with wide angle coverage
  - Suprathermal Electron Telescope (**STE**) - Measures electrons from 2-100 keV with wide angle coverage
  - Magnetometer Experiment (**MAG**) - Measures the vector magnetic field at 65,536 nT and 500 nT ranges
  - Solar Energetic Particle Experiment (**SEP**) Suite
    - Measures electrons from 0.02-6 MeV
    - Measures protons from 0.02 – 100 MeV
    - Measures helium ions from 0.03 – 100 MeV/nucleon
    - Measures heavier ions from 0.03 – 40 MeV/nucleon

• **PLASTIC (PI Toni Galvin, UNH)** - will provide the plasma characteristics of protons, alpha particles, and heavy ion. Provide composition measurements of heavy ions and characterizes the CME plasma

• **SWAVES (PI Jean-Louis Bougeret, Paris Obs.)** - in-situ as well as remote sensing instrument. Tracks CME Driven Shocks from the Corona to the Earth.
## Basic IMPACT Measurements

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Instrument</th>
<th>Measurement</th>
<th>Energy or Mag. field range</th>
<th>Time Res.</th>
<th>Beacon Time Res. (*)</th>
<th>Instrument provider</th>
</tr>
</thead>
<tbody>
<tr>
<td>SW</td>
<td>STE</td>
<td>Electron flux and anisotropy</td>
<td>2-100 keV</td>
<td>16 s</td>
<td>2D x 3E, 60s</td>
<td>UCB (Lin)</td>
</tr>
<tr>
<td>SWEA</td>
<td></td>
<td>3D electron distrib., core &amp; halo density, temp. &amp; anisotropy</td>
<td>~0-3 keV</td>
<td>3D=1 min 2D=8s Mom.=2s</td>
<td>Moments, 60s</td>
<td>CESR (Sauvaud) + UCB (Lin)</td>
</tr>
<tr>
<td>MAG</td>
<td>MAG</td>
<td>Vector field</td>
<td>±500nT, ±65536 nT</td>
<td>1/4 s</td>
<td>10s</td>
<td>GSFC (Acuna)</td>
</tr>
<tr>
<td>SEP</td>
<td>SIT</td>
<td>He to Fe ions</td>
<td>0.03-2 MeV/nuc</td>
<td>1 min</td>
<td>3S x 2E, 60s</td>
<td>U. of Md. (Mason) + MPAE (Korth) + GSFC (von Rosenvinge)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$^3$He</td>
<td>0.15-0.25 MeV/nuc</td>
<td>1 min</td>
<td>----</td>
<td></td>
</tr>
<tr>
<td>SEPT</td>
<td></td>
<td>Diff. electron flux</td>
<td>20-400 keV</td>
<td>1 min</td>
<td>3E, 60s</td>
<td>U. of Kiel (Mueller-Mellin) + ESTEC (Sanderson)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Diff. proton flux</td>
<td>60-7000 keV</td>
<td>1 min</td>
<td>3E, 60s</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Anisotropies of e,p</td>
<td>As above</td>
<td>15 min</td>
<td>----</td>
<td></td>
</tr>
<tr>
<td>LET</td>
<td></td>
<td>Ion mass numbers 2-28 &amp; anisotropy</td>
<td>3-30 MeV/nuc</td>
<td>1-15 min</td>
<td>2S x 2E, 60s</td>
<td>Caltech (Mewaldt) + GSFC (von Rosenvinge) + JPL (Wiedenbeck)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$^3$He ions flux &amp; anisotropy</td>
<td>2-15 MeV/nuc</td>
<td>15 min</td>
<td>1E, 60s</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>H ions flux &amp; anisotropy</td>
<td>1.5-6 MeV</td>
<td>1-15 min</td>
<td>1E, 60s</td>
<td></td>
</tr>
<tr>
<td>HET</td>
<td></td>
<td>Electrons flux</td>
<td>1-6 MeV</td>
<td>1-15 min</td>
<td>1E, 60s</td>
<td>GSFC (von Rosenvinge) + Caltech (Mewaldt) + JPL (Wiedenbeck)</td>
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<tr>
<td></td>
<td></td>
<td>H</td>
<td>13-100 MeV</td>
<td>1-15 min</td>
<td>1E, 60s</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>He</td>
<td>13-100 MeV</td>
<td>1-15 min</td>
<td>1E, 60s</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>$^3$He</td>
<td>15-60 MeV/nuc</td>
<td>15 min</td>
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<td></td>
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<tr>
<td>SEP</td>
<td></td>
<td>----</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td>Caltech (Mewaldt) + GSFC (von Rosenvinge)</td>
</tr>
<tr>
<td>Common</td>
<td>IDPU (+Mag Analog)</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td>UCB (Curtis)</td>
</tr>
</tbody>
</table>
IMPACT Particles Domain: Solar Wind, Suprathermal and SEP electrons, SEP ions
IMPACT Data Products

• Beacon
  – Produced at SSC (GSFC)
  – Uses NOAA antenna partners for 24/7 space weather monitoring
• L1
  – Produced at UCB
  – Highest time resolution data in physical units of all measured quantities
  – Available in variety of formats (CDF, ASCII, FITS, …)
  – Reside natively in ISTP-compliant CDF’s
• L2
  – Produced at UCLA
  – Key parameter (1-minute cadence) data in physical units
  – Includes PLASTIC and SWAVES
  – Available in ASCII
• L3
  – Produced at UCLA
  – Higher level products such as event lists
  – ASCII
Data Flow Block Diagram

- **NOAA SWx Antenna Partners**
- **DSN**
- **STEREO Ahead/Behind S/C**
- **MOC-POC-SSC Telemetry Interface**
- **SDAC (GSFC)**
  - Network Admin
  - System Admin
  - Programming
  - Graphic Arts
- **MOC-P0C-SSC Telemetry Interface**
- **SWx Capture, Processing, Display, Merge, & Browse**
- **VHO**
- **VSO**
- **SDON**
- **NSSDC (GSFC)**
  - Disaster Recovery
  - Final Archive
  - Mirror Sites
- **RAL MEDOC**
- **L2 & L3 Data Space Science Center (UCLA)**
- **Public Internet Access**

- **DSN SWx Real-time SCI**
  - SWx Capture, Processing, Display, Merge, & Browse
  - SWx, Level-0, and Mission Support Data

- **Level-0 Data Mission Data (30 day archive)**
  - MOC (APL)

- **SECCHI (NRL)**
  - SECCHI Higher Level Data & Analysis Software

- **PLASTIC (UNH)**
  - PLASTIC Higher Level Data & Analysis Software

- **IMPACT (UCB)**
  - IMPACT L1 Data & Analysis Software

- **VSO**
  - SWAVES Higher Level Data & Analysis Software

- **VSO**
  - SWAVES Higher Level Data & Analysis Software

- **VHO**

- **TRACE**

- **L2 & L3 Data Space Science Center (UCLA)**

- **Public Internet Access**
Beacon Data Processing Software Update

• IMPACT delivered first version of Beacon processing software to SSC in November

• Outstanding issues:
  – Need calibration data to finish conversion to physical units (SWEA and STE)
  – Not all status codes have been fully defined (SEP)
  – Still need to check-out MAG code
  – All instruments: Need to convert from instrument coordinates to STEREO HGRTN coordinates
L1 Data Processing Software Update

- LET, SIT, SEPT, MAG, SWEA and STE have delivered software but all require further testing (and calibrations)
- Still need HET software (delivery expected very soon)
- Possibility of sharing pre-validated data with PLASTIC and S/WAVES
- Produced preliminary L1 science products during recent Mission Simulation
L2 Data Processing Software Update

• Need to finalize quantities to include in L2
• First cut quantities = Beacon quantities
• Possibility of including derived quantities
• Need to continue working with PLASTIC and S/WAVES
Building from CDAWeb

CDAWeb Data Explorer

Select start and stop times from which to GET or PLOT data:

- Use pre-defined starting times:
  - September 2005 Events 2005/09/17 00:00:00 2005/09/21 00:00:00

- Use custom starting times:
  - Start: 2005/10/30 00:00:00
  - Stop: 2005/10/31 00:00:00

Select an activity:

- Plot Data: select one or more variables from list below and press submit.
- Last Data (ASCII): select one or more variables from list below and press submit. (Works better for <3 days)
- Download oscilloscope CDFs: press submit button to retrieve list of files. (Files 200 days old PDF not the largest requests)
- Get CDFs for download: select one or more variables from the list below and press submit.

Optional Options:

- Use custom filtering to remove values outside 3 deviations from mean of all values in the plotted time interval.
- Double the Y-axis height for time series and spectrogram plots.

Variable parameters (required for Listing, Creating and Plotting data only):

WT_PM_3DP

Ion moments (computed on-board) @ 3 second (spin) resolution (revision 3), PIESA LOW, Wind 3DP - H. Lin (UC Berkeley)

Available dates: 1994/12/01 00:00:00 - 2005/10/21 00:00:00

Closer coverage not guaranteed - check the inventory graph for coverage.

Submit | Reset

- Particle number density
- Particle velocity vector (CDS)
- Normalized Vmin in Particle Velocity (6 components in instrument records)
- Particle temperature
- Alpha number density
- Alpha velocity vector (CDS)
- Normalized Vmin in Alpha Velocity (6 components in instrument records)
- Alpha temperature
- Energy range of electrons (eV)
- Data quality flag (1=good, 0=bad)

Wind 3DP leave page at UC Berkeley (with plotting and data files)

Submit | Reset
CDAWeb+

- Primary access point for IMPACT Level 1 Data
- Ability to save previous plot layouts
- More flexibility with plot titles, axes, linestyles
- Export underlying CDF’s to many other formats (ASCII, FITS, CDFML (XML))
- Tight integration with L1 spacecraft (ACE, WIND, etc.)
- Other possible functionalities? Do we want to include some derived quantities? Other plotting abilities not available in CDAWeb that would be appropriate for multi-spacecraft (time delays)? What about images? Mapping to solar images/movies?
SOAP Interface

• Simple Object Access Protocol is a web services messaging standard used increasingly by industry
• Allows local/custom applications to query and access data over the web
• Will conform to emerging VHO standard (which will interface with the VSO and other VxO’s)
• Current model is the ACE Science Center using a modified version of the SPASE dictionary to define queries, but SPASE needs expanding to fit needs of particle data
Berkeley Static Data Plots

• In addition to CDAWeb-like browser, Berkeley intends to make static plots at different time intervals (daily, 3- and/or 7-day, and Carrington Rotation)
• Primarily intended for internal diagnostic use but will provide interface for the larger community
• HELIOS/IMP-8/ISEE-3 browser as proxies for STEREO/ACE at: http://sprg.ssl.berkeley.edu/impact/data_browser.html
• Again, question of how best to utilize/visualize multi-spacecraft data
Space Weather Beacon Processing

STEREO Beacon data will be on-line within 5 minutes of telemetry receipt.

- APL MOC
- NOAA Antenna Partners
- Real-Time and Off-line
- SSC
  - Packet Handling Application
  - Instrument Specific Applications
  - Display, Serve, Archive, Browse
  - NOAA & Public
- S/C Transfer Frame Handling Application
- S/WAVES
- SECCHI
- PLASTIC
- IMPACT
- (NRL) “C” to assemble image from packets; IDL to decompress
- SWAVESlib IDL package
- (UNH) IDL code for PLASTIC
- (UCB) estimates 5000 lines of “C” for MAG, SWEA, STE
- (Caltech) SEP
- (UCLA) coordinate transforms for MAG
- NOAA & Public
- NOAA Antenna Partners
- Real-Time and Off-line

SPICE kernels

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Real-Time

Off-line
Beacon Data Browser

- IMPACT responsible for “in situ-only” Beacon data browser (SSC will create an “integrated” browser as well)
- How best to display these data? Probably need input from NOAA and other end users.
- Do we make static or dynamic plots? If dynamic, should there be a standard default plot(s)? If so, what should it look like?
- Should we try to include ACE NRT data?
STEREO Beacon Products

• [STEREO Science Operations Plan](#)