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)
IMPACT Boom (Stowed)
STEREO IMPACT

SWG 2005 May 2-4, Hamburg

Boom Suite

[Images of the Boom Suite]
STEREO IMPACT

SWG 2005 May 2-4, Hamburg

SEP
STEREO IMPACT

SWG 2005 May 2-4, Hamburg

Testing
FM1 IDPU
Pre-ship review
March 2, 2005
Highlights
# IDPU Verification Matrix

Verification Matrix for STEREO/IMPACT/IDPU

<table>
<thead>
<tr>
<th>Hardware Description</th>
<th>Test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>C PWB, EM</td>
<td></td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I IDPU EM</td>
<td></td>
<td>C</td>
<td></td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C PWB, F</td>
<td></td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I IDPU, FM1</td>
<td></td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>A</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>X</td>
<td>C</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I IDPU, FM2</td>
<td></td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>A</td>
<td>C</td>
<td>C</td>
<td>X</td>
<td>X</td>
<td>C</td>
<td>X</td>
<td>C</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Legend:**

- **Level of Assembly**
  - C = Component
  - I = Instrument
  - H = at higher level of assembly

- **Unit Type**
  - BB = Breadboard
  - EM = Engineering Model
  - PT = Prototype
  - PF = Protoflight
  - F = Flight

- **X** = Test required
- **A** = Analysis

**Test Completed**

Full IMPACT Verification Matrix at:

Performance Data

- Mag, STE-U and Power Supply measurements were trended throughout testing
  - MAG and STE-U analog interfaces included in the IDPU
  - No significant trends were found
- All performance measurements met or exceeded the requirements
  - Current processor load is 58%, code space is 54% of available memory
    - Anticipate no problems accommodating remaining PLASTIC software tasks
- MAG and STE-U performance details to be reported at the boom Pre-Ship review
Operating Hours

- Most of the FM1 IDPU has operated for over 1,000 hours trouble free
- Since the last change (reverse biased capacitor, PFR1032)
  - Thermal Vac #2: 135.6 Hours
  - Post Vib CPT: 2.4 Hours
  - Software Load, Test: 34.5 Hours
  - Boom Suite I&T: ~48 hours so far, expect ~200 before shipping
Outstanding Issues

- IMPACT FM1 EMC Waiver not signed off
  - Official waiver should be into approval cycle shortly
- IDPU Flight Software is not complete
  - Will be loaded from the POC via the commanding system when it is complete and passed acceptance tests
  - Should be in place prior to PLASTIC integration on the spacecraft
- IDPU does not currently have the required connector identifiers attached
  - Will be kapton-taped to the box to avoid violating outgassing certification
- Final mass properties and surface contamination screening still to be performed.
GSE Status

- IDPU GSE includes:
  - APL Spacecraft Emulator computer and software, used during bench tests
  - POC Command and Telemetry GSE and Science GSE computer and software
    • Includes Command and Telemetry Database
    • Displays all housekeeping, sends all commands
    • Has been in use for more than a year
    • Software & Database passed acceptance tests and under configuration control
  - Data Logger, power switching for bench testing
    • Simulates spacecraft functions
  - ETU MAG sensor and cable
    • Must be connected to IDPU when IDPU is powered until flight MAG is attached.

- All this GSE will be shipped to APL prior to delivery
  - Use in bench tests
  - Use POC (connected to Spacecraft ground system) after integration
Immediate Plans

- FM1 Boom Suite is currently integrated and collecting operating hours
- Kelly Henderson will come to UCB March 8 to do final contamination inspection
- While the instrument is de-bagged we will do final FM1 IDPU Mass Properties
  - Measured Mass is 1.90kg, Not to Exceed = 2.25kg
  - Still need CG
- Deliver to APL March 10
  - Hand-carried
    - Triple-bagged in lumalloy
    - Connector savers extend through inner bag
    - Outer bags are sealed, dry N2 back-filled.
    - All inside an Aluminum briefcase packed with bubble-wrap
    - Shock and humidity monitors will be included
  - Project to provide paperwork and advance warning to TSA, Airlines
IDPU Post-Delivery at APL

• On arrival at APL, FM1 IDPU went through a bench CPT and contamination inspection prior to mating with the spacecraft
• An APL procedure was used for spacecraft mating
• A safe-to-mate was performed prior to electrical mating
• A post-mating functional was run using the POC/MOC/Spacecraft/IDPU
• The SEP and Boom instruments are being shipped and integrated separately
  – SEP Suite is still in environmental tests
  – The FM1 Boom shipped, installed on the spacecraft, uninstalled
• Other than loading software, there are no other post-delivery operations required on this unit and no safety issues.
IMPACT IDPU on the spacecraft@APL
Boom Suite
FM1 PSR
March 31 ‘05
Highlights
IMPACT FM1 BOOM
IMPACT FM1 MAG Sensor
FM1 Boom Test History

- 09 Jan 2004  Assembly Begins.
- 14 Jun 2004  Assembly Completed.
- June 2004    Magnetometer and STE-U Installed.
- 28 Jun 2004  Vibration Test. Completed. Loose Pin found (PFR-1010)
- 30 Jun 2004  STE-U Uninstalled.
- 18 Oct 2004 – 1 Nov 2004
  - EMC test with the full IMPACT Suite. Completed.
- EMC test exceedances have been accepted by the EMC committee; the official waiver is in process.
- 03 Mar 2005  SWEA Harness Failure (PFR-1038).
- 17 Mar 2005  SWEA Final Integration. Boom Complete.
# Boom Verification Matrix

**Verification Matrix for STEREO/IMPACT/Boom**

**Revision Date:** 1/6/2004

**Revision Number:** 5

<table>
<thead>
<tr>
<th>Hardware Description</th>
<th>Test</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level of Assembly</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C Proto</td>
<td>P P</td>
</tr>
<tr>
<td></td>
<td>C EM</td>
<td>P P</td>
</tr>
<tr>
<td></td>
<td>C PF/FS</td>
<td>P P P P P P P P P P</td>
</tr>
<tr>
<td></td>
<td>C FM1</td>
<td>P P P P P P P P P</td>
</tr>
<tr>
<td></td>
<td>C FM2</td>
<td>P P P P P P P P P</td>
</tr>
<tr>
<td></td>
<td>S FM1</td>
<td>P P P P S P P P P P</td>
</tr>
<tr>
<td></td>
<td>S FM2</td>
<td>P P P P S P P P P P</td>
</tr>
</tbody>
</table>

**Legend:**

- **Level of Assembly**
  - C = Component
  - S1 = with MAG, STE-U
  - S = with all instruments
- **Unit Type**
  - PT = Prototype
  - PF/FS = Protoflight / Flight Spare
  - FM1 = Flight unit #1
  - FM2 = Flight unit #2
- **Status**
  - X = Test required
  - A = Analysis
  - P = Performed
Boom FM1 Problem/Failures

- **PFR1010, FM1 Vibration – Loose Pin**
  - Locating Pin found in the bagging between vibration runs
  - Replaced Magnetometer Tray Locating Pin
  - Staked FM 1 and 2 pins
  - This PFR has been signed-off and closed

- **PFR1028, FM1 SWEA Harness Fault**
  - SWEA clocking intermittent following installation
  - Harness checked and fault localized
  - Harness opened and checked, wires fell apart at solder joint
  - New soldering procedure used to rejoin AWG 36 Coax to lead wire
  - This PFR has been signed-off and closed
FM1 Boom Test Results

- The FM1 Boom has been deployed 4 times. 3 were full deployments (all subsystems were included).
- The structure has been shown repeatedly to have a first frequency of ~1.9 Hz.
- The structure is stable in thermal cycling.
- The actuation and deployment systems function at survival temperatures.
- The structure, actuation and deployment systems function after sinusoidal and random vibration.
- Vibration levels were determined for all attached instruments.
- The Boom has been found to align the Magnetometer to within 11.8 arcmin (root of sum of squares) in the XY and XZ spacecraft planes. (The requirement is 52.5 arcmin.)
- The deployment system functions with adequate force margin.
FM1 Boom Outstanding Issues

• IMPACT FM1 EMC Waiver not signed off
  – Official waiver should be into approval cycle shortly
• Thermal Blankets and Taping to be applied after Spacecraft EMC
  – Including STE Silver-Teflon
• PFR1038, SWEA Harness Fault awaiting signatures
• Cow Catcher ESC Closeout
FM1 Boom Suite Limited Life Items

• Boom Deployments:
  – Qual boom deployments: 28
  – FM1 boom deployments to date: 4
  – Anticipated boom deployment in spacecraft I&T: 1
  – Anticipated boom deployments on orbit: 1

• SWEA Door Actuations
  – Actuator life (manufacturer): 100
  – FM1 door actuations to date: 14
  – Anticipated actuations in spacecraft I&T: 2
  – Anticipated actuations in orbit: 1

• STE Door Actuations (count motions)
  – ETU Life test, (ambient / cold vacuum): 18,000 / 1,100
  – STE-U FM1 door actuations to date: 520 / 119
  – STE-D FM1 door actuations to date: 128 / 46
  – Anticipated actuations in spacecraft I&T (2 per CPT): ~20
  – Anticipated actuations on-orbit: ~58
  • 2-year mission

• 2-year mission
Boom Suite Safety

• Premature boom deployment
  – Possible personnel hazard, probably damage to unit
  – APL actuation safeing plug
  – Deployment prevention pin will remain in place most of the time

• Radiation sources
  – STE units have very weak calibration radiation sources in their doors
  – Radiation Safety paperwork has been submitted

• SWEA High Voltage
  – No personnel hazard – completely contained, but can damage instrument if powered on except in vacuum
  – Enable plug will not be installed except for thermal vac and launch
    • Delivered with test plug installed in place of flight plug
FM1 Boom Suite Delivery

- FM1 Boom Suite integrated, tested, shipped in “custom” box
- Delivered to APL April 16
  - Shipping preparations
    - Double-bagged in lumalloy
    - Bags sealed, dry N2 back-filled.
    - Shock-mounted inside the boom shipping coffin
    - Shock and humidity monitors will be included
  - Project provided paperwork and advance warning to TSA, Airlines
  - Picked up and driven directly from the airport to APL
    - Arrangements made for late arrival at APL
FM1 Boom-Suite Delivery to APL

- On arrival at APL, unit returned to purge
- Unit underwent a radiation safety wipe-test, bench test, and contamination inspection prior to mating with the spacecraft
- An APL procedure was used for spacecraft mating
- A safe-to-mate was performed prior to electrical mating
- A post-mating functional were run using the POC/MOC/Spacecraft/IDPU
- The SEP instruments will be shipped and integrated at a later date
  - SEP Suite is still in environmental tests
- The boom will be deployed for spacecraft-level EMC tests
  - UCB to provide off-load fixture
  - Verifies no interference to deployment from spacecraft
  - Boom will be removed for stowing after EMC
IMPACT FM1 Boom on the Spacecraft@APL

What’s next for IMPACT?
- Boom Suite FM2 PSR on ~May 11
- SEP Suite instruments to finish environments and PSRs (May-June)
  *FM1 and FM2 SEP/HET/LET passed acoustics, FM1 vibrated, next FM2, then thermal balance, thermal vac
  *SEPT completed tests but needs thermal blanket fix and retest
  *SIT passed thermal balance but has detector issues
- Integration and Test at APL
- Set up and test Data Access sites at UCB and UCLA (including browsers) and support SSC Beacon setup