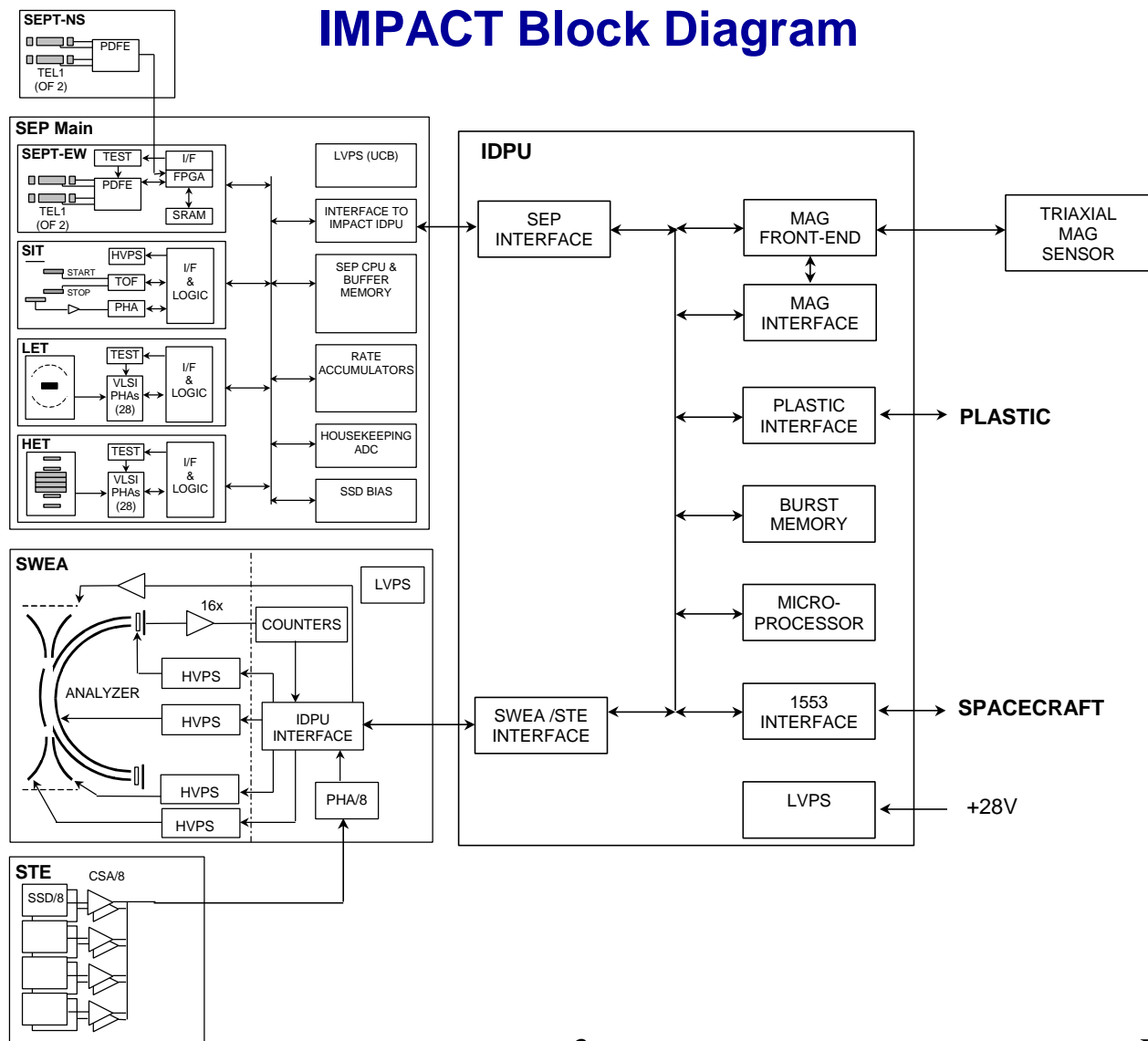# STEREO IMPACT

Ground System Requirements Review

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David Curtis

IMPACT Overview

- **IMPACT is a suite of 7 instruments built at 9 institutions by 31 Co-Investigators.**

- **IMPACT is served by a single interface to the spacecraft C&DH system via the IMPACT IDPU**

- **The IMPACT IDPU also services the PLASTIC instrument, so that PLASTIC requires no separate interface to the spacecraft C&DH system.**

- **IMPACT and SWAVES communicate periodically via the spacecraft 1553 bus.**

David Curtis

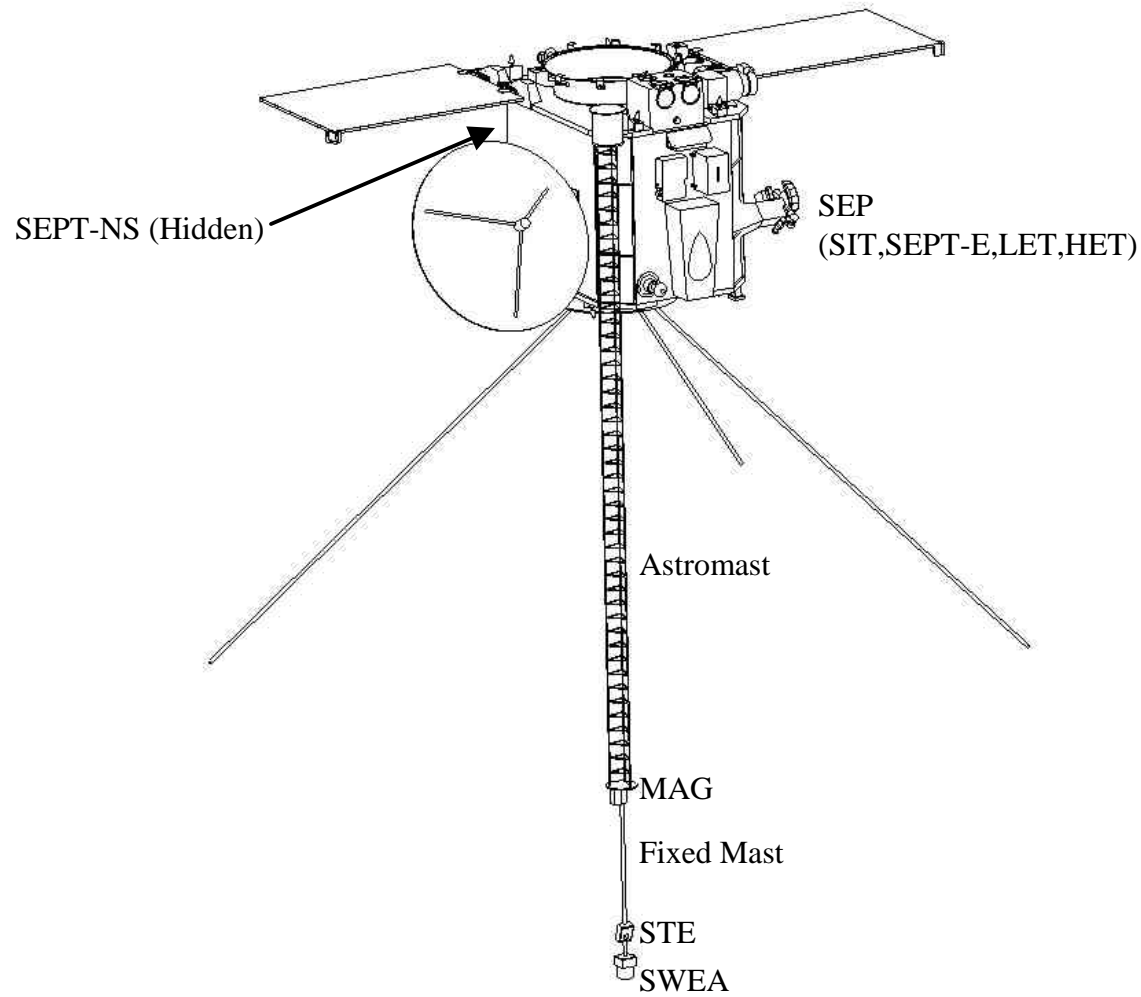## IMPACT Block Diagram

David Curtis

STEREO Trailing Spacecraft, IMPACT Instrument Locations

SEPT-NS (Hidden)

SEP
(SIT,SEPT-E,LET,HET)

Astromast

MAG

Fixed Mast

STE

SWEA

David Curtis

IMPACT Ground System Requirements

- **APL Spacecraft emulators are required for IDPU development, and suite I&T**

- **Command and Telemetry GSE are needed to send commands and display housekeeping and status information**

- **Science Display GSE to decommutate and display Science data**

- **Minimal external electrical stimulus during spacecraft level tests**
  - **SIT requires a small battery-powered stimulus pulser during instrument functional tests (not Thermal Vac)**
  - **MAG requires a field-nulling GSE inserted into the MAG harness for a system-level sensitivity/compatibility test. A shield-can test may also be required**
  - **Radiation sources are adequate to verify functionality of most instruments**
  - **Internal pulsers provide stimulus for some instruments including those that do not function at ambient (SWEA)**

- **Magnetic screening and Compatibility test equipment**

- **IMPACT Boom deployment off-load fixture and boom re-stowing MGSE**

- **Dry Nitrogen purge is required; APL to provide during spacecraft I&T**

David Curtis

APL Spacecraft Emulator Requirements

- **APL to provide spacecraft emulators that emulate the spacecraft 1553 bus interface to IMPACT**

- **Two emulators to be provided by APL to support two IMPACT flight units**

- **Emulators to provide packet-level interface to Command & Telemetry GSE**

- **One of the emulators should be provided early to support IDPU ETU testing (around PDR).**

  - **This early emulator does not need the software to support the spacecraft 1553 data collection schedule, as it will be used to test the IDPU hardware only.**

  - **This emulator will later be upgraded with software to a full emulator.**

- **The APL emulator does not support two instruments simultaneously, so IMPACT/SWAVES 1553 interface testing will be rudimentary until we reach spacecraft I&T**

  - **Some instrument software changes may be required during I&T if problems arise.**

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Command & Telemetry GSE Requirements

- **Works with Spacecraft Emulator at suite I&T level**

- **Works with MOC at Spacecraft I&T level**

- **Works with SSC at Mission Ops level**

  - **A common network interface for these three environments is highly advantageous and has been assumed in development plans**

- **Runs commands and command scripts**

  - **STOL-like language**

- **Remote commanding & display via secure internet connection**

- **Displays housekeeping and instrument status information with limit-checking/alarms**

- **Decommutates and passes on packets to Science Display GSE and/or remote C&T GSE via network**

- **PLASTIC command scripts may be run on the IMPACT C&T GSE, or on a separate C&T GSE running the same software communicating either to the IMPACT C&T GSE or directly to the MOC/SSC**

David Curtis

Science Display GSE Requirements

- **Decodes and Displays science data from instruments**

- **Provides adequate information to determine the health and functionality of the instrument in the I&T, Commissioning, and mission environment**

- **Receives telemetry packets forwarded by Command & Telemetry GSE at the suite, spacecraft, and mission level via the network**

- **Developed by the instrument builder and UCB.**

- **Runs on a second workstation (PC) in order to provide more display space, separate science and engineering functions, and improve the reliability of the C&T system.**

David Curtis

Radiation Source Requirements

- **Radiation Sources will be required at suite and spacecraft level functional testing to stimulate SEPT, HET, LET, SIT, and STE**
- **Sources will be provided by IMPACT Team**
- **Sources will be handled by qualified IMPACT team members**
- **Sources will need to be temporarily transferred to APL license (and GSFC license during environmental tests)**
- **Sources will be needed in Thermal Vacuum test**
- **Details of sources are TBD. Expected sources include:**
  - **Ni63, Am241, Co60, Th238**
- **Sources shall be relatively weak, with minimal impact on other operations in the vicinity**

David Curtis

STEREO IMPACT

MAG Screening & Compatibility GSE Requirements

- **A magnetic screening station will be made available for the screening of spacecraft and instrument boxes.**

- **A magnetic compatibility test will be performed during the spacecraft I&T flow using GSE provided by the magnetometer group**

  - **preferably early in the flow, shortly after the system is fully integrated, while there is still time to make minor changes**

  - **needs to be run at a time when there is little activity in the vicinity of the spacecraft (often run in the evening)**

  - **the spacecraft should be powered up, and all potentially magnetically noisy systems (moving systems, and systems taking significant or variable current) should be on**

  - **a hand-held GSE magnetometer sensor is used to map the spacecraft fields and identify any source of fields. This typically takes several hours.**

- **A system-level Mag sensor sensitivity/compatibility test requires a small field-nulling EGSE inserted into the MAG harness and/or removal of the MAG from the boom and insertion into a shield can.**

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IMPACT Boom Deployment Off-Load MGSE Requirements

- IMPACT team recommends and has assumed that there will be a system-level deployment test for the IMPACT boom during Spacecraft Integration and Test (TBR)

- UCB shall provide an off-load fixture to support the IMPACT boom during a deployment in 1G, simulating a zero-G environment as closely as reasonably possible

- The spacecraft will need to be oriented such that the IMPACT boom deploys horizontally, with sufficient space for a full deployment (extends 4.5m from the spacecraft)

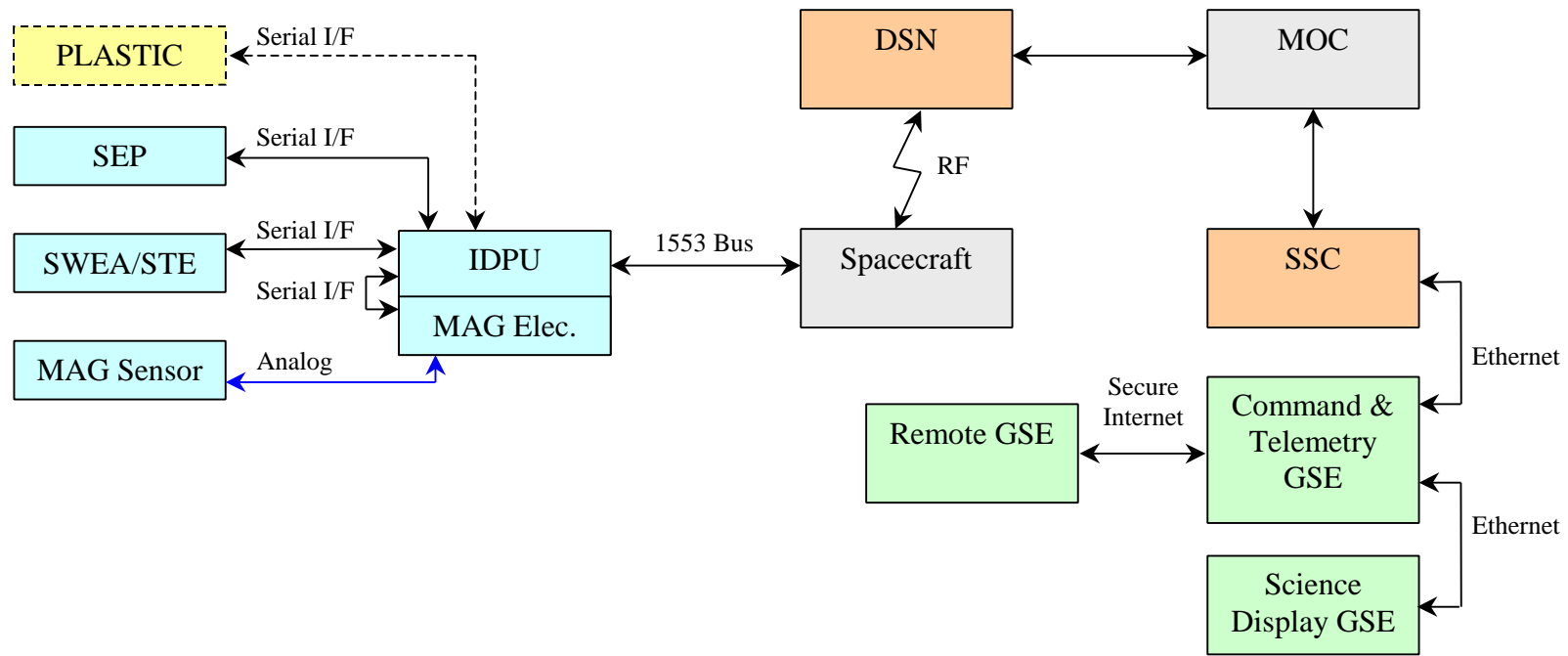- MGSE required for re-stowing the boom after deployment shall also be provided by UCB or its subcontractor.

David Curtis

IMPACT Suite Integration GSE Configuration (at UCB)

David Curtis
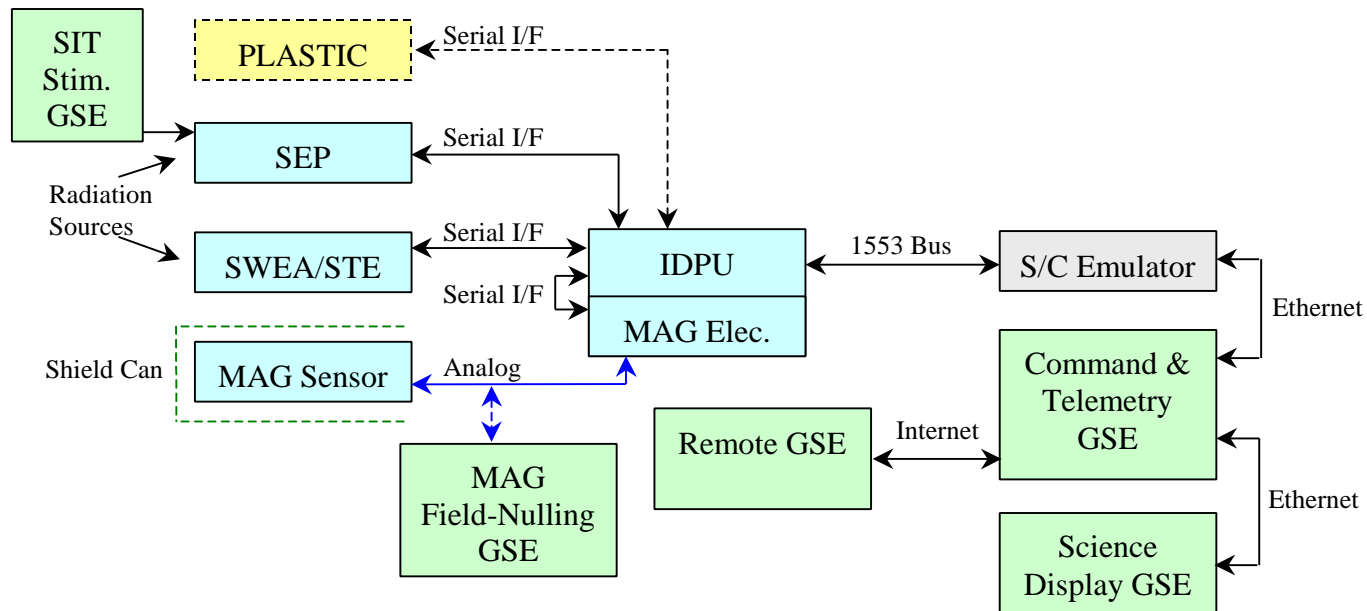
IMPACT Spacecraft Integration GSE Configuration

David Curtis
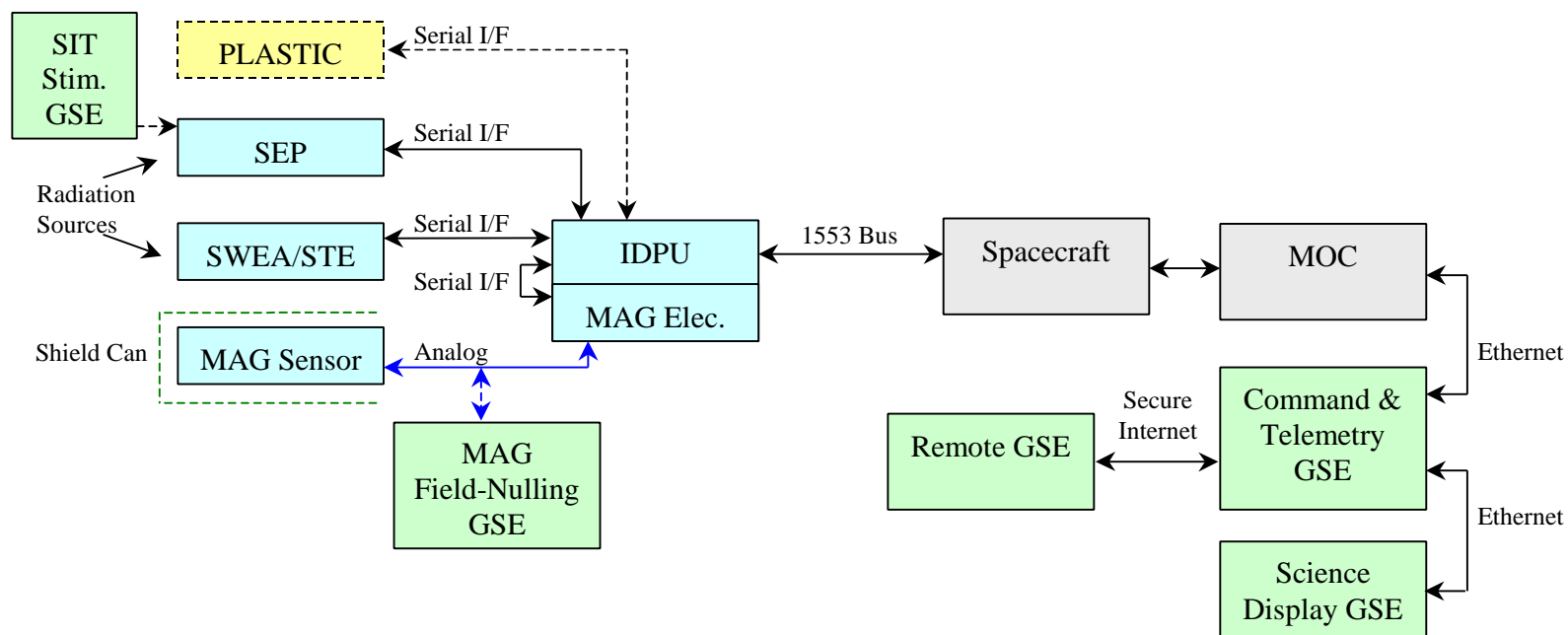
IMPACT Mission Operations GSE Configuration

David Curtis

IMPACT Support Personnel for I&T and Operations

- **During all I&T operations that involve powering or deploying IMPACT hardware, one or more IMPACT team members will be on-site at APL or, for mission tests, at the SSC**
  - **GSE location during GSFC and KSC Ops are TBD**
- **On-site IMPACT personnel will be supported by remote team members who will have access to the I&T data stream in near-real time via secure internet connections to the C&T GSE**
- **During commissioning, one to three IMPACT team members will be at the SSC (more if commissioning two spacecraft simultaneously), supported by remote team members who can access the telemetry in near-real time via a secure internet connections to the C&T GSE**
- **During normal mission operations, IMPACT team will continue to have occasional remote access to near real-time telemetry via a secure internet connection to the C&T GSE at the SSC**
- **It is assumed that secure internet connections will be available to at least one computer at each IMPACT Co-I site**

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IMPACT GSE Software

- **The IMPACT Command & Telemetry and Science GSE are PC-based systems running LabWindows-CVI based software**

- **The software is based on a long series of GSE developed at Berkeley, most recently for Lunar Prospector and HESSI.**

- **The software is modularized so that much of the existing code will be usable**

- **The software already has most of the features required (user interface, command scripting, database-driven command encoding and telemetry decoding, TCP/IP data interface, data decommutation and limit-checking, some science displays)**

- **The programmer who developed the most recent version of the GSE (HESSI) is base-lined to develop the IMPACT version.**

David Curtis

IMPACT Deliverable GSE

- **Two Command and Telemetry GSE**
- **Two Science Display GSE**
- **SIT Stimulation GSE**
- **Radiation Sources required for IMPACT Functional testing**
- **MAG Screening GSE**
- **MAG Compatibility Test GSE**
- **MAG Field-nulling electronics**
- **MAG Shield Can**
- **IMPACT Boom off-load MGSE**
- **IMPACT Boom Re-stowing MGSE**

David Curtis