

# Solar Probe Plus

*A NASA Mission to Touch the Sun*

## Integrated Science Investigation of the Sun Energetic Particles

### Preliminary Design Review

05 – 06 NOV 2013

## Ground Support Equipment

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# Outline



- Board Level GSE
- Spacecraft emulators
- GSEOS
- Safe / Arm plugs
- Calibration GSE
- Mechanical GSE
- Summary



# Board-Level GSE (EPI-Lo)



- Each EPI-Lo lead engineer is responsible for developing their own board-level GSE
  - **Power Board:** Load board, active load, HV load, breakout box, breakout board, I2C stimulus
  - **Event Board:** energy and TOF preamp boards, test port box, breakout box, I2C slave, commercial pulsters
  - **Anode Board:** Commercial pulsters, scope, HV power supply
- All GSE is peer reviewed. Custom GSE is calibrated as needed.



# Board-Level GSE (EPI-Hi)



- EPI-Hi engineering team develops a board-level GSE for Caltech-designed boards that can be shared between boards based on common subsystems (MISC, I/F to a PC)
- Test procedure written for each board, all GSE calibrated
- EPI-Hi subcontractors develop their own board-level GSE for LVPS and Bias Supply
- EPI-Hi mechanical GSE holds the rigid-flex board stack in binder style, allowing individual boards to “open” like book pages for testing before installation into the flight E-box.





# Spacecraft Emulator

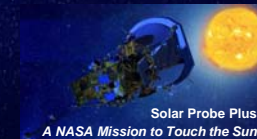


- Mini emulator
  - Provides Instrument Data Interfaces only, No Power Interfaces, No Temperature Interfaces
  - Provides virtual 1PPS
  - GSEOS Interface is fully compliant
  - Non-flight use only
- Full emulator
  - Provides Instrument Data, Power and Temperature Interfaces (no power supply)
  - Provides virtual 1PPS
  - Designed for use with flight hardware
- GSE verification performed by project
- Spacecraft Emulator Deliveries to ISIS
  - Mini: (2 for EPI-Hi; 1 for EPI-Lo)
    - SN 3 : ISIS-EPI-HI Delivered on 6/28/13
    - SN 7 : ISIS-EPI-HI Delivered on 7/16/13
    - SN 10 : ISIS-EPI-Lo Delivered on 7/11/13
  - Full: (2 for EPI-Hi; 1 for EPI-Lo)
    - April and May 2014

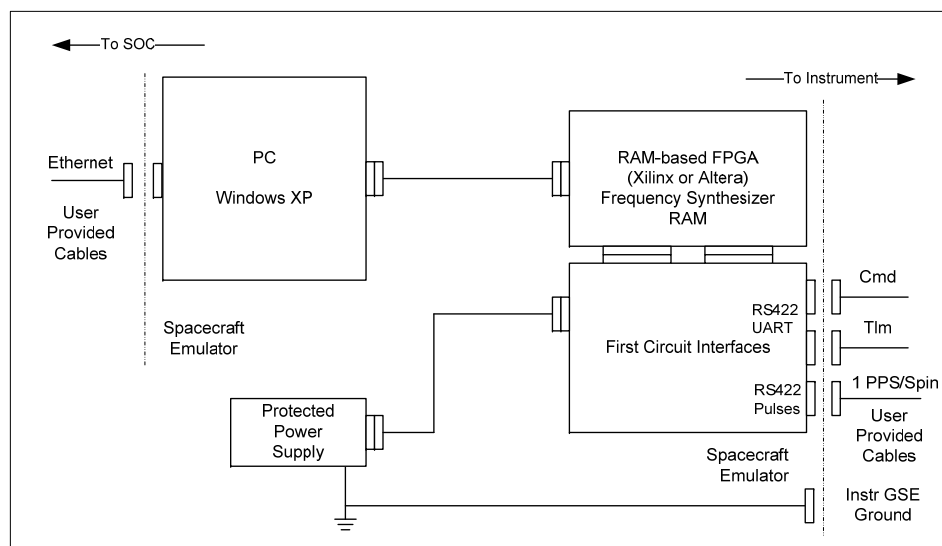
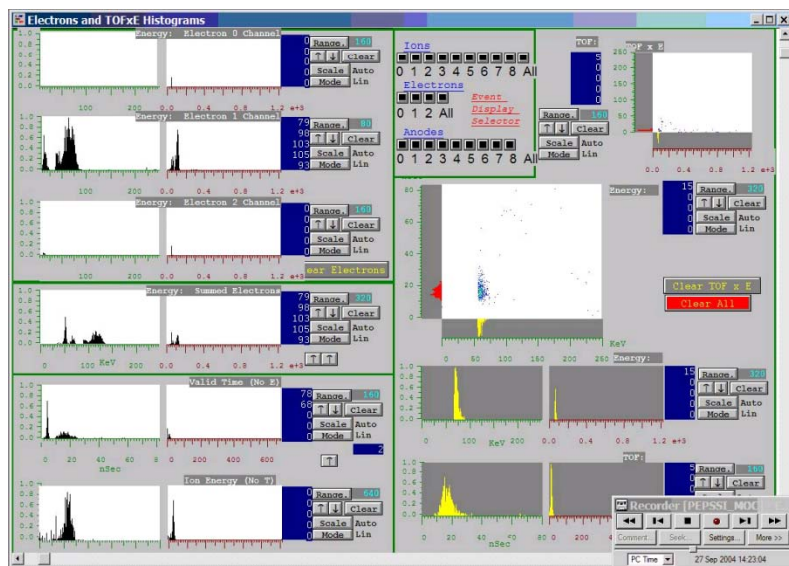




# GSEOS



- Common GSE software for all instruments
- Display screens and instrument customizations can be used through all development cycles from bench testing, I&T deployment, to flight operations
- Same platform used for EM, Flight, and Spacecraft operations
  - Test scripts can be developed by individual teams, tested on EMs, and then executed at the S/C level
- Software verification performed by project





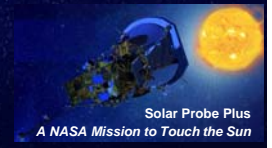
# Safe / Arm Plugs



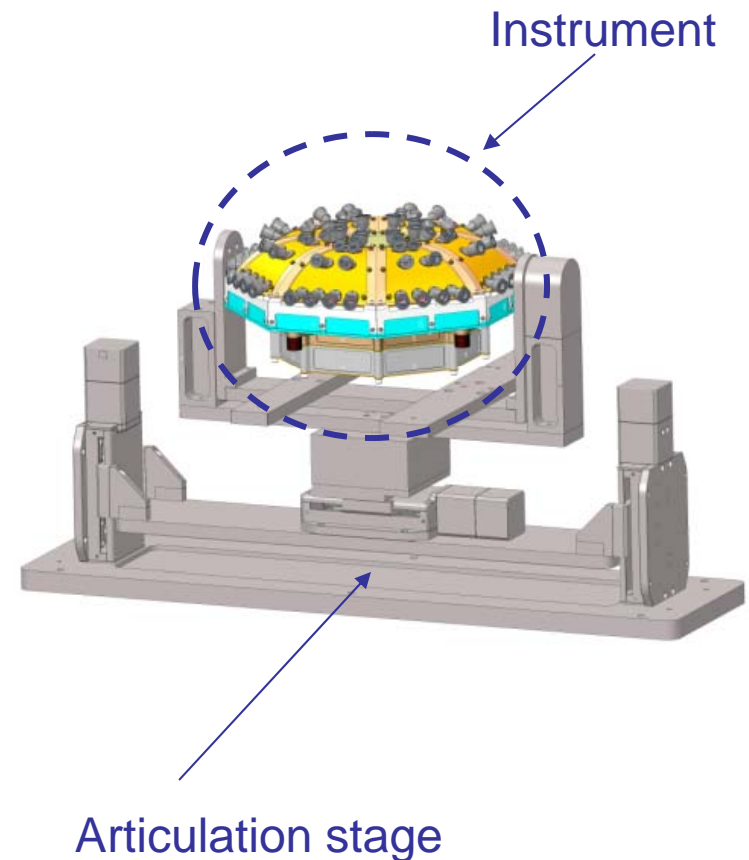
- EPI-Lo has a HV air-safe plug
  - When installed HV is limited to air safe levels (hardware and software limited)
  - Plug will be removed for S/C TV testing
  - Plug will be permanently removed during final closeout
- Instrument covers
  - ISIS instruments will have red-tag covers to protect the apertures
  - Covers will be temporarily removed for S/C TV testing
  - Covers will be permanently removed during final closeout



# Calibration GSE for Instrument Articulation (EPI-Lo)



- Requirements
  - Use in APL accelerator facility
    - Vacuum compatible (low outgassing)
  - Cover full FOV for one octant
- Status
  - Specified and purchased custom system from Newmark Systems
  - Received January 2009
  - Re-furbished in 2012 at Newmark. Added additional controller and position sensor feedback on all motors
  - Fully set up in vacuum chamber with all feed-throughs and control software
- Future Work
  - Build adaptor plate for EPI-Lo
  - Test with mass prototype



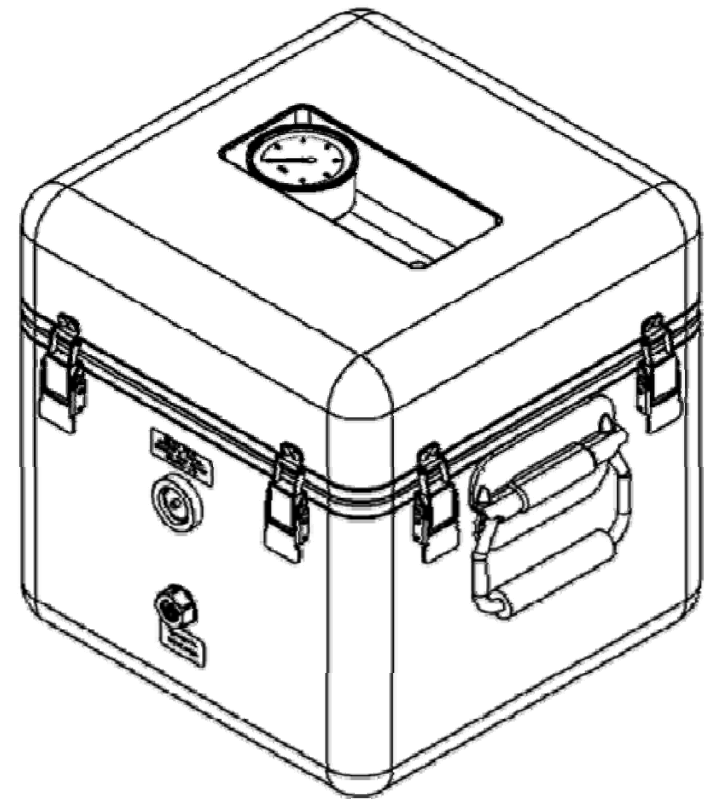




# Mechanical GSE



- Shipping Container
  - Requirements
    - N2 purged, humidity controlled and monitored
    - Low outgassing
    - Shock mounted and monitored
    - Hermetically sealed with pressure relief valve
- Purge Suitcase
- Environmental Test Fixtures
  - Thermal Vacuum Fixture
  - Vibration Plate Fixture





# Summary



- GSE highly leveraged from previous programs
- Most EPI-Lo GSE is built and ready for instrument testing
- EPI-Hi mechanical GSE not designed yet