Project Overview

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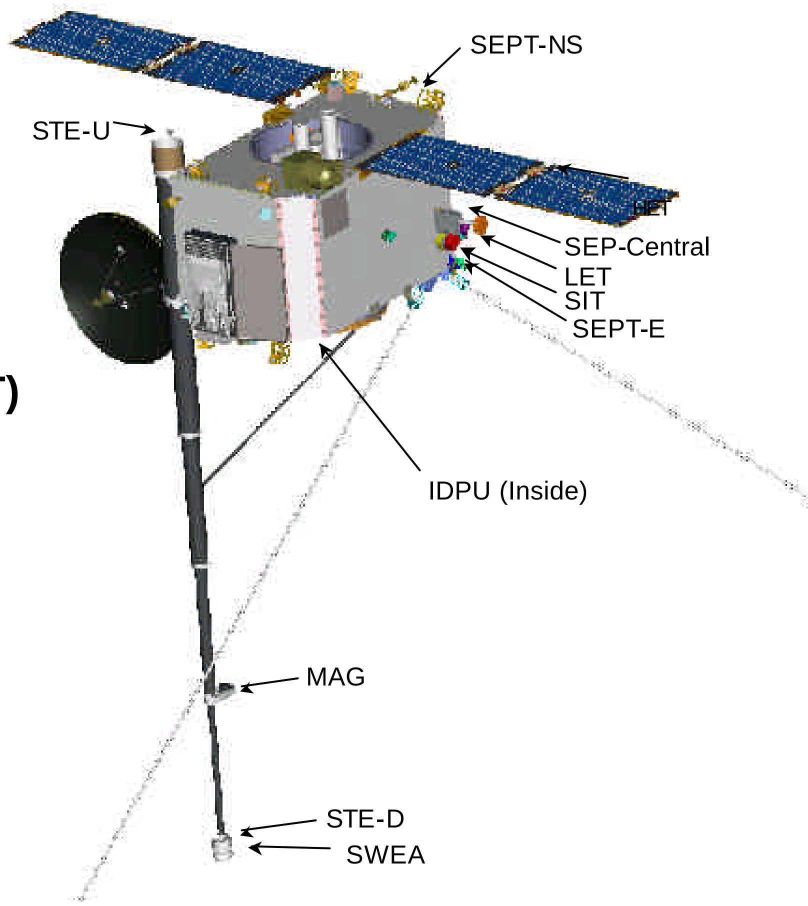
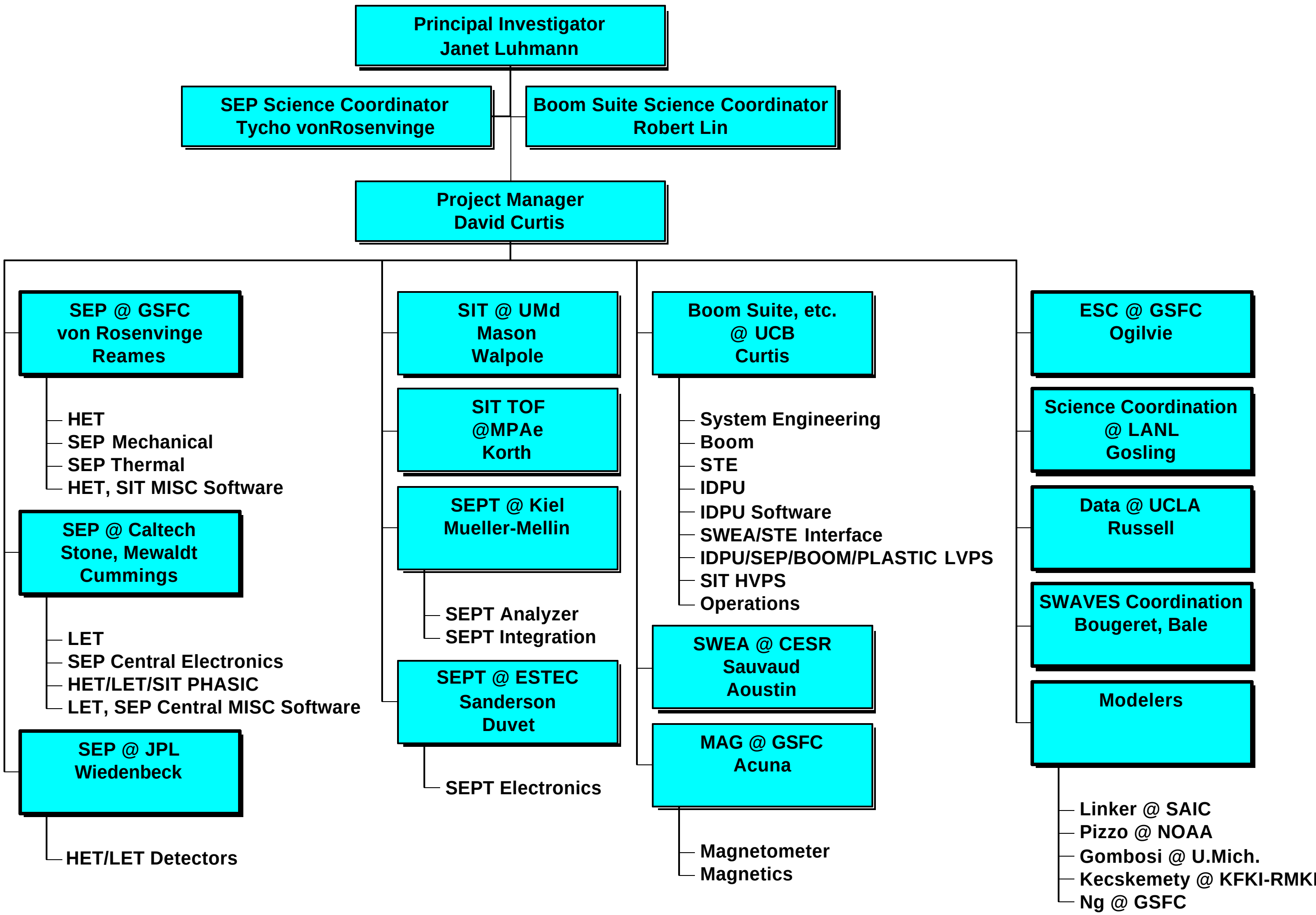
IMPACT (In-situ Measurements of Particles and CME Transients) Instrument Overview

- **Boom Suite:**
  - **Solar Wind Electron Analyzer (SWEA)**
  - **Suprathermal Electron Telescope (STE)**
  - **Magnetometer (MAG)**
- **Solar Energetic Particles Package (SEP)**
  - **Suprathermal Ion Telescope (SIT)**
  - **Solar Electron and Proton Telescope (SEPT)**
  - **Low Energy Telescope (LET)**
  - **High Energy Telescope (HET)**
- **Support:**
  - **IMPACT Boom**
  - **SEP Central**
  - **Instrument Data Processing Unit (IDPU)**



IMPACT Organization Chart



IMPACT Co-Investigators

- Janet Luhmann, PI, UCB
- Mario Acuña, GSFC
- Volker Bothmer, Kiel
- Jean-Louis Bougeret, CNRS
- Jean Dandouras, CESR
- Herbert Funsten, LANL
- Tamas Gombosi , UM
- Jack Gosling, LANL
- Karoly Kecskemety, KFKI RMKI
- Axel Korth, MPAe
- Horst Kunow, Kiel
- Davin Larson, UCB
- Robert Lin, UCB
- Jon Linker, SAIC
- Stephano Livi, APL
- Philippe Louarn, CNRS
- Richard Marsden, ESTEC
- Glen Mason, UMd
- David McComas, LANL
- Richard Mewaldt, Caltech
- Reinhold Mueller-Mellin, Kiel
- Chee Ng, GSFC
- Keith Ogilvie, GSFC
- Vic Pizzo, NOAA
- Donald Reames, GSFC
- Christopher Russell, UCLA
- Trevor Sanderson, ESTEC
- Jean-Andre Sauvaud, CESR
- Edward Stone, Caltech
- Tycho von Rosenvinge, GSFC
- Mark Wiedenbeck, JPL

Contracting

- **Project Contracts UCB**
  - **Phase B/C/D/E Contract in place**
- **UCB Subcontracts Caltech/JPL, University of Maryland, LBNL, UCLA**
  - **Phase B/C/D subcontracts in place**
- **Major subcontracts for parts screening, analysis, design in place**
- **Modeler's subcontracts on hold until closer to launch**
- **GSFC funded directly by Project**
  - **Funding in place**
- **Project contracts with LANL directly**
  - **Phase B/C/D contract in place**
- **CESR funded by CNES (France)**
  - **Funding in place**
- **Kiel, Max Planck funded by DLR (Germany)**
  - **Funding in place**
- **ESTEC funded by ESA**
  - **Funding in place**

Agreements

- LOAs have been signed between NASA and the funding agencies of all non-NASA funded team members:
  - ESA for ESTEC (SEPT)
  - CNES for CESR (SWEA)
  - DLR for the University of Kiel (SEPT)
  - DLR for the Max-Planck-Institut für Aeronomie (SIT)
  - Hungarian Space Office for KFKI-RFKI (Modeling)
- TAAs have been signed between APL and foreign IMPACT team members that require information exchange and access with APL:
  - ESTEC
  - CESR
  - University of Kiel
  - Max-Planck-Institut für Aeronomie

Reviews since PDR

- **IMPACT team has provided responses to all IMPACT PDR RFAs**
  - **29 RFAs: 29 Responses submitted, 19 closed**
- **Since PDR there have been 9 STEREO Project-sponsored IMPACT peer reviews**
  - **Subjects selected by Project**
  - **Project-supplied reviewers**
  - **Minutes and RFAs**

Date	Topic	# RFAs	# Responses
5/21/2002	LET / SEP Central Software Req.	5	5
7/30/2002	Power Converters	15	13
7/31/2002	STE Door Mechanism	4	4
8/21/2002	HET / SIT Software	13	9
8/27/2002	IDPU Software / POC	19	19
9/23/2002	SEPT Door Mechanism	13	5
9/25/2002	SWEA Door Mechanism	7	1
10/29/2002	IMPACT Boom Mechanism	7	
11/15/2002	SIT Door Mechanism		

- **IMPACT has participated in System-level peer reviews (EMC, Contamination Control) and other technical meetings**

PRD RFA Status

IMPACT PDR RFA CLOSURE STATUS (10/23/02) (PDR DATE: SEPT 11-13, 2001)				
RFA No.	RFA TITLE	ORIGINATOR	STATUS	DATE CLOSED
1	C&T EGSE Software	Mocarsky	Submitted 01/09/02	1/14/02
2	Software Development Plan	Whitley	Submitted 11/16/01	1/16/02
3	FSW Review Schedule	Whitley/Ballard	Submitted 11/16/01	1/16/02
4	Boom Un-locked	Gold	Submitted 01/09/02;Response accepted pending results of analysis in May	
5	Minimum Science Requirements	Sizemore/Gold	Submitted 11/30/01 Sizemore Rejected 01/04/02, Resubmitted 10/22/02	Gold 1/11/02
6	Boom Cold Survival Test	Nguyen	Submitted 01/09/02	1/30/02
7	Thermal Analysis on Magnetometer	Nguyen	Submitted 01/09/02	1/30/02
8	IDPU Thermal Analysis	Nguyen	Submitted 11/16/01	01/03/02
9	Stacer Deployment Mechanism	Betenbaugh	Submitted 01/09/02	1/29/02
10	Boom Testing	Devine	Submitted 01/09/02	2/07/02
11	VLSI Delivery	Sizemore	Submitted 09/17/02	
12	SIT Grounding	Shue	Submitted 01/09/02	01/29/02
13	SEPT Magnetic Emissions	Gold	Submitted 01/09/02	02/05/02
14	Level 1 Requirements Flowdown	Gold/Sizemore	Submitted 11/30/01	01/04/02
15	Limiting Resistor For Boom Actuator	Butler	Submitted 01/09/02	01/29/02
16	LVPS Short	Hynes/Hunter	Submitted 07/24/02	
17	Secondary power grounding	Butler	Submitted 06/14/02	
18	Boom Analysis & Test Plan	Eng	Submitted 01/09/02 Rejected; 1/30/02	
19	SIT Foil Breakage	Sizemore	Submitted 01/09/02	1/12/02
20	L1 Detectors	Sizemore	Submitted 08/29/02	
21	PHA ASIC	Shaw	Submitted 01/09/02	1/29/02
22	SEP Software Resources	Mocarsky	Submitted 01/09/02	1/14/02
23	SEP Instrument Test Environment	Mocarsky	Submitted 01/09/02	1/14/02
24	SEP System FMEA	Ho/Venator	Submitted 08/29/02	
25	SEP Power Supply	Shue	Submitted 11/16/01	11/17/01
26	Processor Margins	Ho	Submitted 01/09/02	1/22/02
27	Time Tagging	Bay	Draft response	
28	SEP Survival Heaters	Venator	Submitted 06/14/02	
29	Glint onto SEPT Detectors	Gold	Submitted 06/14/02	

IDPU Flight Software Peer Review RFA Status

IMPACT IDPU Software Design Review CLOSURE STATUS (8/27/02)				
Action No.	**Action Item TITLE**	**ORIGINATOR**	**STATUS**	**DATE CLOSED**
1	RAM Memory SEU rate	Jerry Hengemihle	Response 2002-9-19	
2	SSR status	Jerry Hengemihle	Response 2002-9-18	
3	Triana and Swift Lessons learned	Jerry Hengemihle	Done	
4	80196 Lessons Learned	Jerry Hengemihle	Done	
5	Hold STEREO 1553 Telcon	Jerry Hengemihle	Pending Project	
6	Autonomous reset	Jerry Hengemihle	Response 2002-9-18	
7	IDPU reboot and SEP operation	Jerry Hengemihle	Response 2002-9-19	
8	Health and safety monitoring	Jerry Hengemihle	Response 2002-9-19	
9	PLASTIC HW/SW ICD	Jerry Hengemihle	Response 2002-9-21	
10	Verification of CPU loading	Jerry Hengemihle	Response 2002-9-21	
11	Valid Mode Codes	Harry Culver	Pending APL input	
12	Commercial configuration management tool	Kequan Luu	Response 2002-9-18	
13	Timing Requirement verification	Kequan Luu	Response 2002-9-18	
14	Software Testing	Kequan Luu	Response 2002-9-21	
15	Software ICD’s	Kequan Luu	Response 2002-9-18	
16	CPU Processing time	Kequan Luu	Response 2002-9-21	
17	Critical Commands	Kequan Luu	Response 2002-9-18	
18	Increase number of ground systems	Kequan Luu	Response 2002-9-18	
19	Implement NOOP command	Kequan Luu	Response 2002-9-18	

Status Overview

- **Boom**
  - Design complete: parts drawings 80% complete (out of ~100 drawings)
  - Partial ETU assembled and tested (missing harness, spool, feet, launch restraints)
  - ETU completion and environmental testing pending
- **SWEA**
  - First ETU complete, tested, delivered to UCB (missing door mechanism)
  - All drawings for second ETU (including door mechanism) complete, in fabrication [60 mechanical, 11 electrical, 3 Layout]
- **STE**
  - All mechanical drawings complete, ETU in fabrication
  - All electrical schematics complete, ETU in test [7 schematics, 4/5 layouts, 1 Actel]
  - Preliminary detector testing complete; testing with ETU pending
- **MAG**
  - All mechanical and electrical designs schematics complete, 90% schematics complete, 1/2 layouts complete.
  - Sensors and heater board ETU fabricated

Status Overview, Continued

- **IDPU**
  - **All mechanical drawings complete, and ETU fabricated [10]**
  - **Data Controller Board ETU complete and tested [12 electrical, 1 layout, 1 Actel]**
  - **Flight Software coding in progress, large sections complete and partially tested [8,500 lines complete out of an estimated 12,000]**
- **Power Converters**
  - **SIT HVPS, IDPU LVPS ETUs built and in test [2 electrical, 2 layout]**
  - **SWEA/STE , SEP, PLASTIC ETUs same architecture as IDPU converter (different secondaries). Schematics complete, layout & ETUs pending [3 schematics, 0/3 layouts]**

Status Overview, Continued

- **SEPT**
  - Mechanical design complete, shop drawings 90% complete
  - Electrical schematics 100% complete [3], Actel design complete [1], preliminary layouts complete [2]
  - ETU fabrication in progress; full ETU tested and ready for interface tests with SEP Central 5/2003
- **SIT**
  - Heritage telescope design flown successfully on WIND/EPACT/STEP
  - Electronics design 90% complete, 3/4 layouts complete
  - Mechanical: Complete except sunshade/cover, electronics box
  - Testing: ETU Telescope, TOF, Energy logic, HVPS
- **LET**
  - Electrical schematics done, layout assessments done, layouts in progress [3/3 schematics, 2/3 layouts, 1/1 Actels]
  - LET/HET Detectors in fabrication [3/3 mask drawings]
  - Mechanical: Design 85% complete, parts drawings 40% complete

Status Overview, Continued

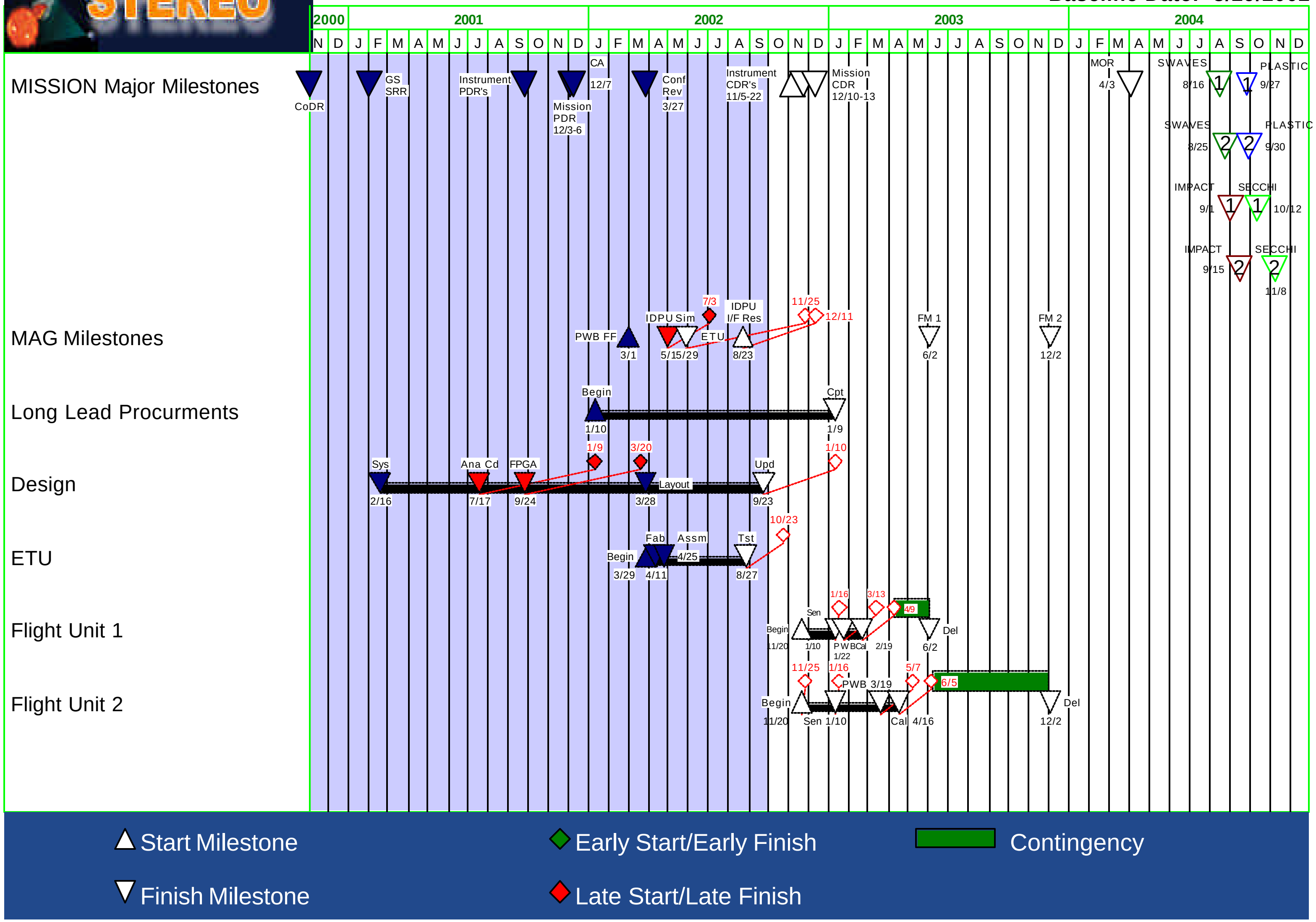
- **HET**
  - **Electrical: Design complete except Actel, Layout in progress**
  - **Mechanical: Design 80% complete, parts drawings 50% complete**
- **SEP Central**
  - **Electrical schematics done, 3 layout assessments done [5/5 schematics, 0/3 layouts, 2/2 Actels]**
  - **ICDs complete**
  - **Mechanical designs 70% complete, parts drawings 25% done**

Status Overview, Continued

- **Overall percentage drawings complete:**
  - **Electrical:**
    - **>95% completed schematics**
    - **>60% layouts complete**
  - **Mechanical:**
    - **Design > 90% complete**
    - **Parts drawings ~50% complete**
      - **SEP mechanical parts drawings lag, but on schedule**
      - **Waiting on final details from electrical layouts**

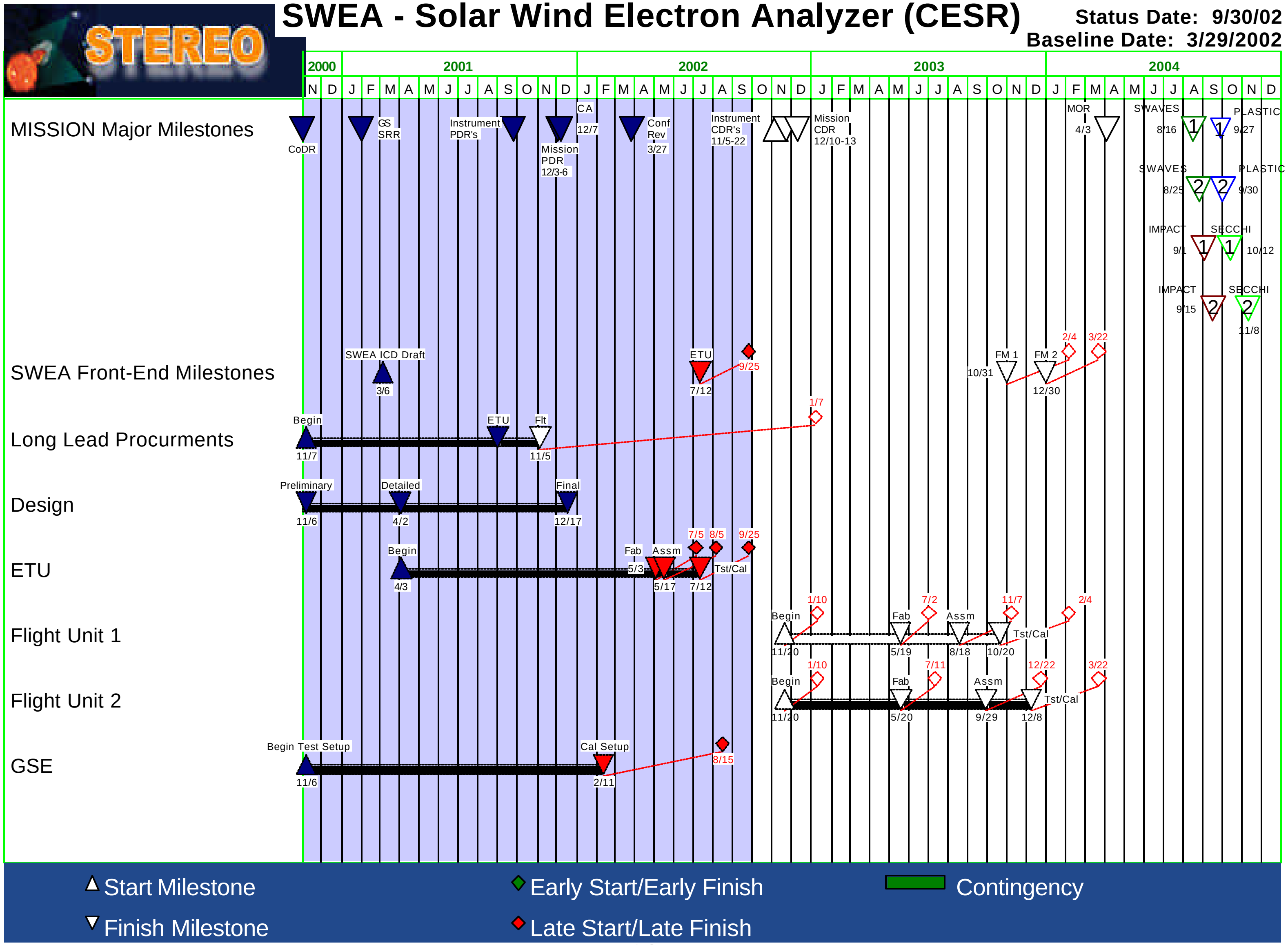
MAG - Magnetometer

Status Date: 9/30/02
Baseline Date: 3/29/2002



SWEA - Solar Wind Electron Analyzer (CESR)

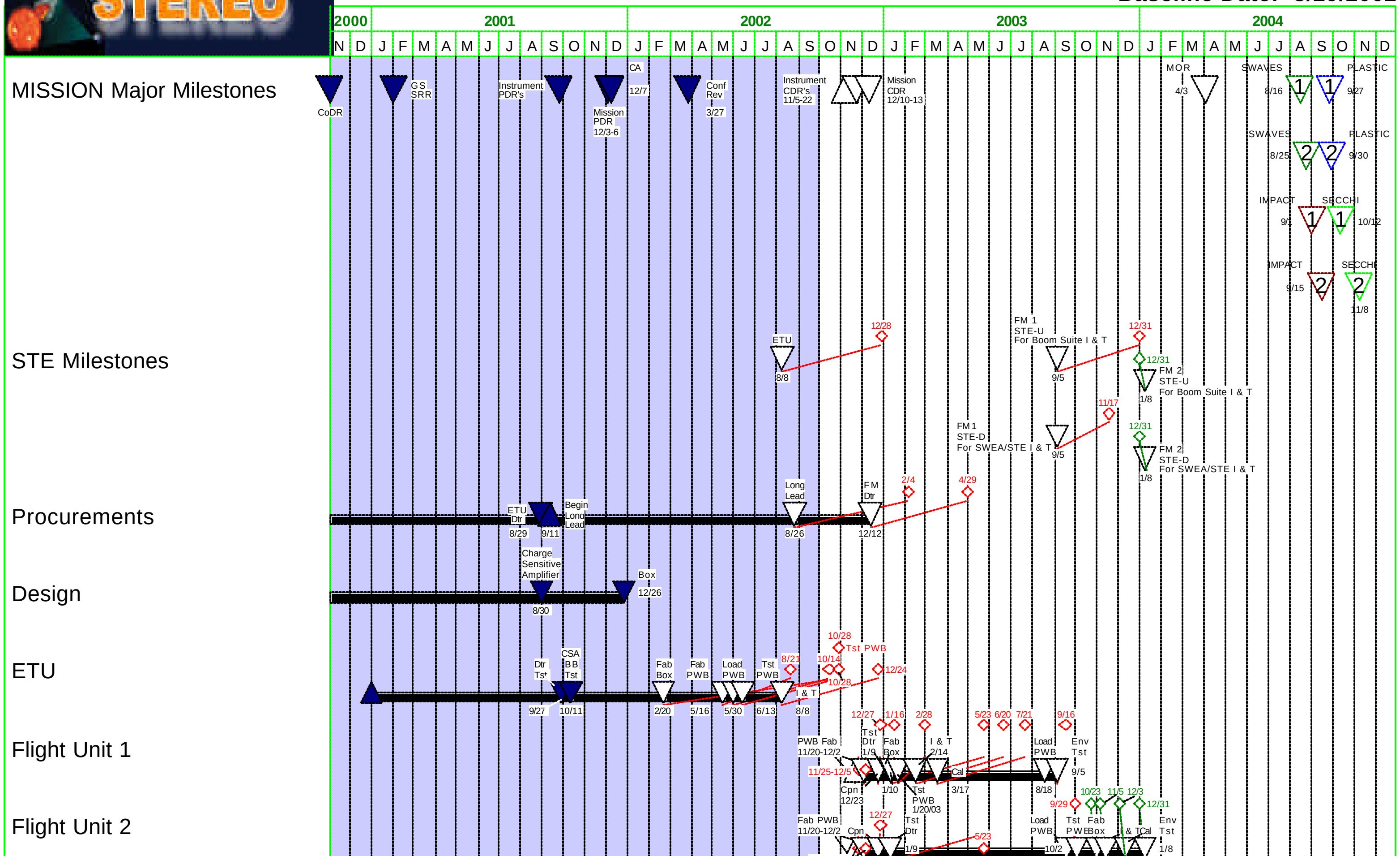
Status Date: 9/30/02
Baseline Date: 3/29/2002



Curtis

STE - Suprathermal Electron Telescope

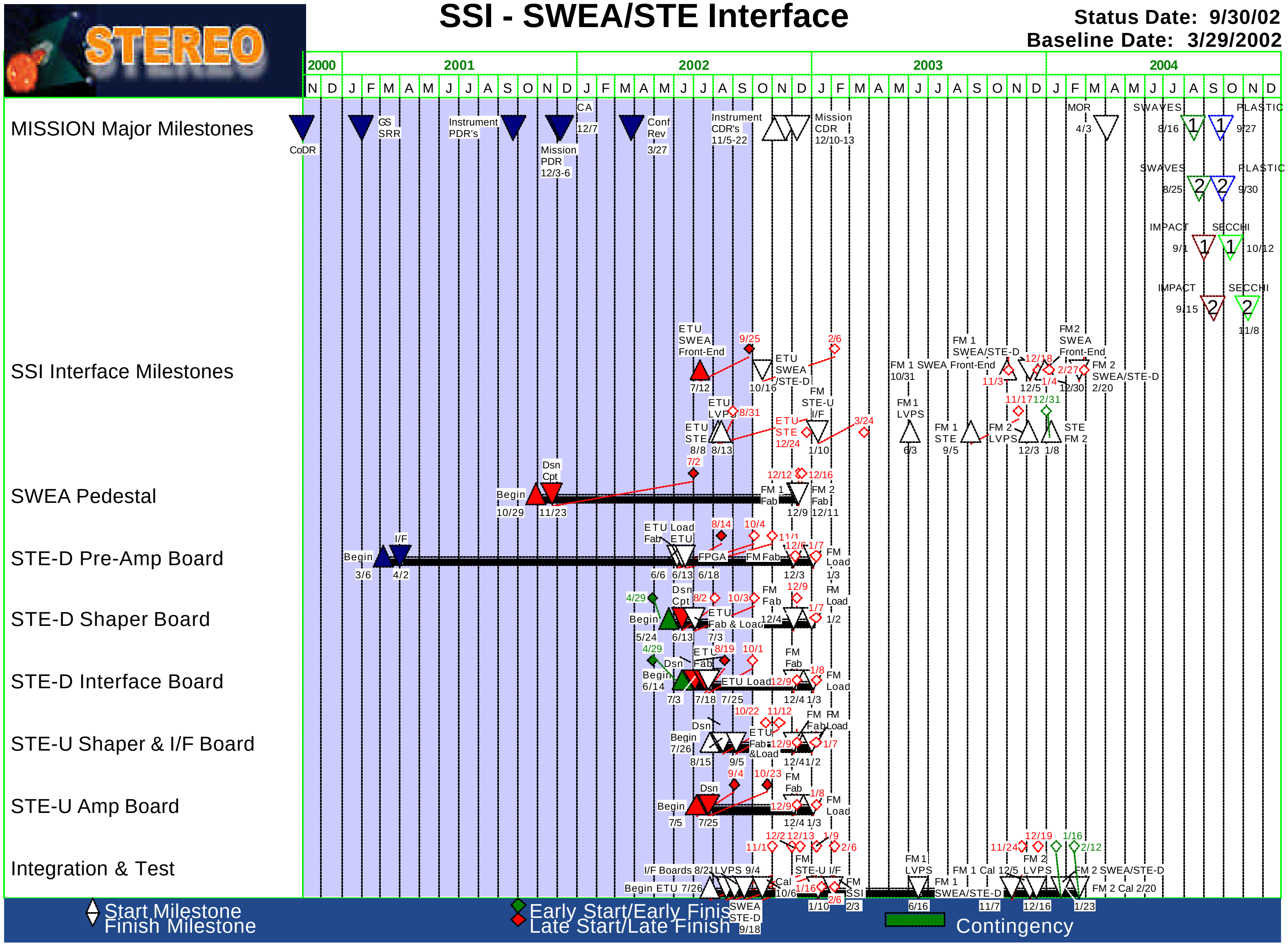
Status Date: 9/30/02
Baseline Date: 3/29/2002

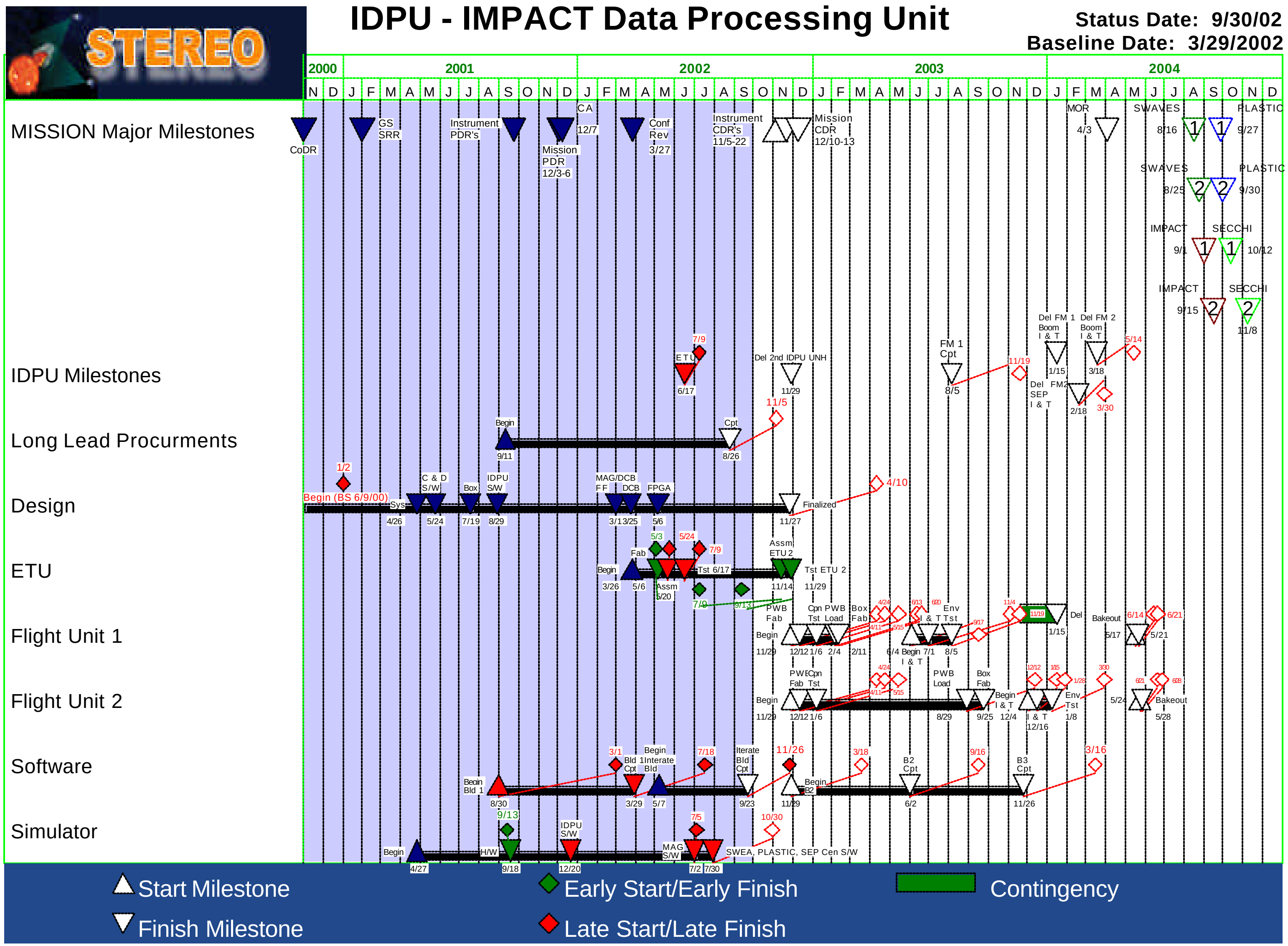


Start Milestone
Early Start/Early Finish
Contingency
Finish Milestone
Late Start/Late Finish

SSI - SWEA/STE Interface

Status Date: 9/30/02
Baseline Date: 3/29/2002

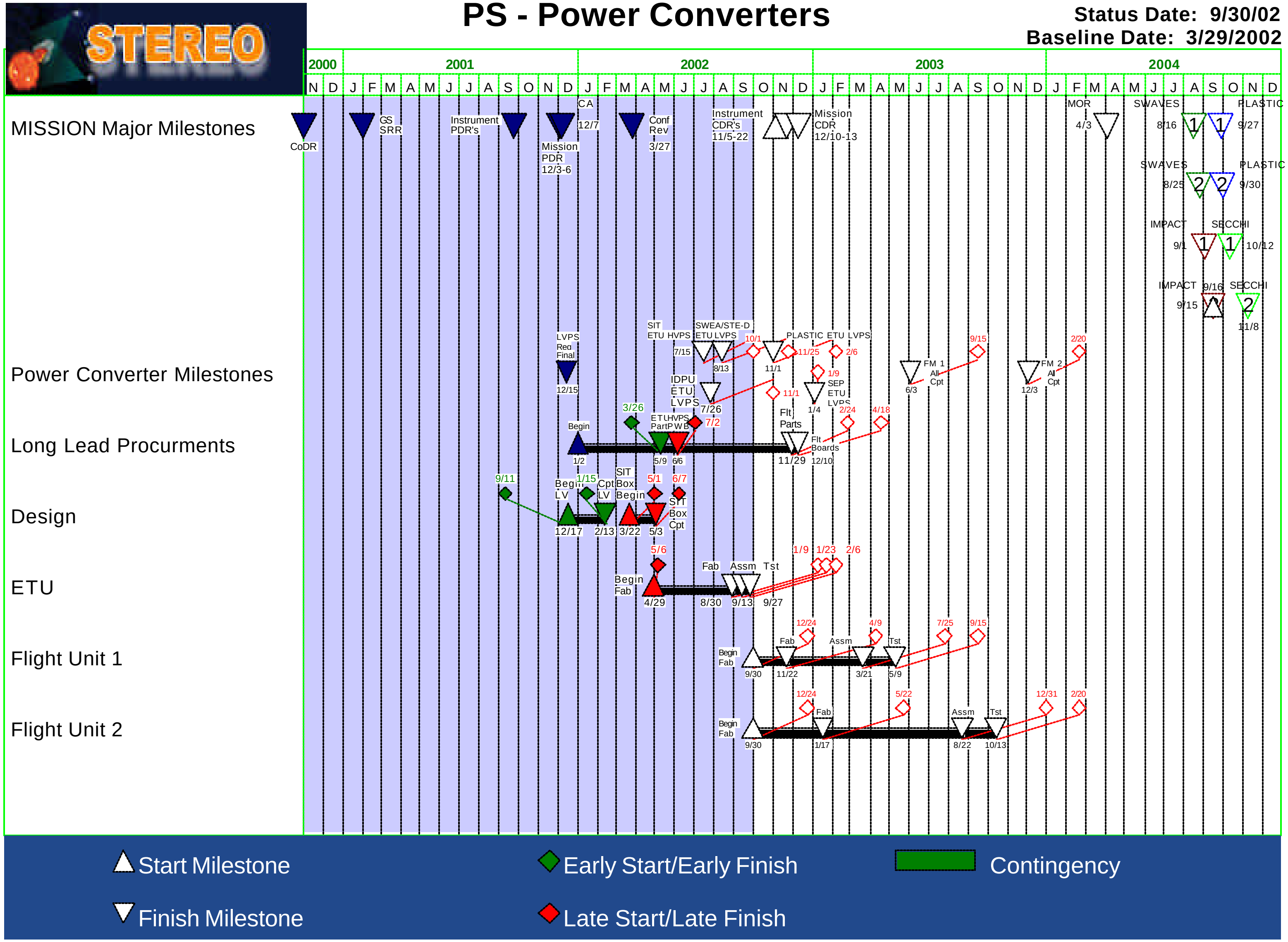



STEREO
IDPU - IMPACT Data Processing Unit
Status Date: 9/30/02
Baseline Date: 3/29/2002
2000
2001
2002
2003
2004
MISSION Major Milestones
IDPU Milestones
Long Lead Procurments
Design
ETU
Flight Unit 1
Flight Unit 2
Software
Simulator
CoDR
GS SRR
Instrument PDR's
Mission PDR 12/3-6
CA 12/7
Conf Rev 3/27
Instrument CDR's 11/5-22
Mission CDR 12/10-13
MOR 4/3
SWAVES
PLASTIC
IMPACT
SECCHI
Begin (BS 6/9/00)
Finalized
Start Milestone
Early Start/Early Finish
Contingency
Finish Milestone
Late Start/Late Finish

STEREO IMPACT

PS - Power Converters

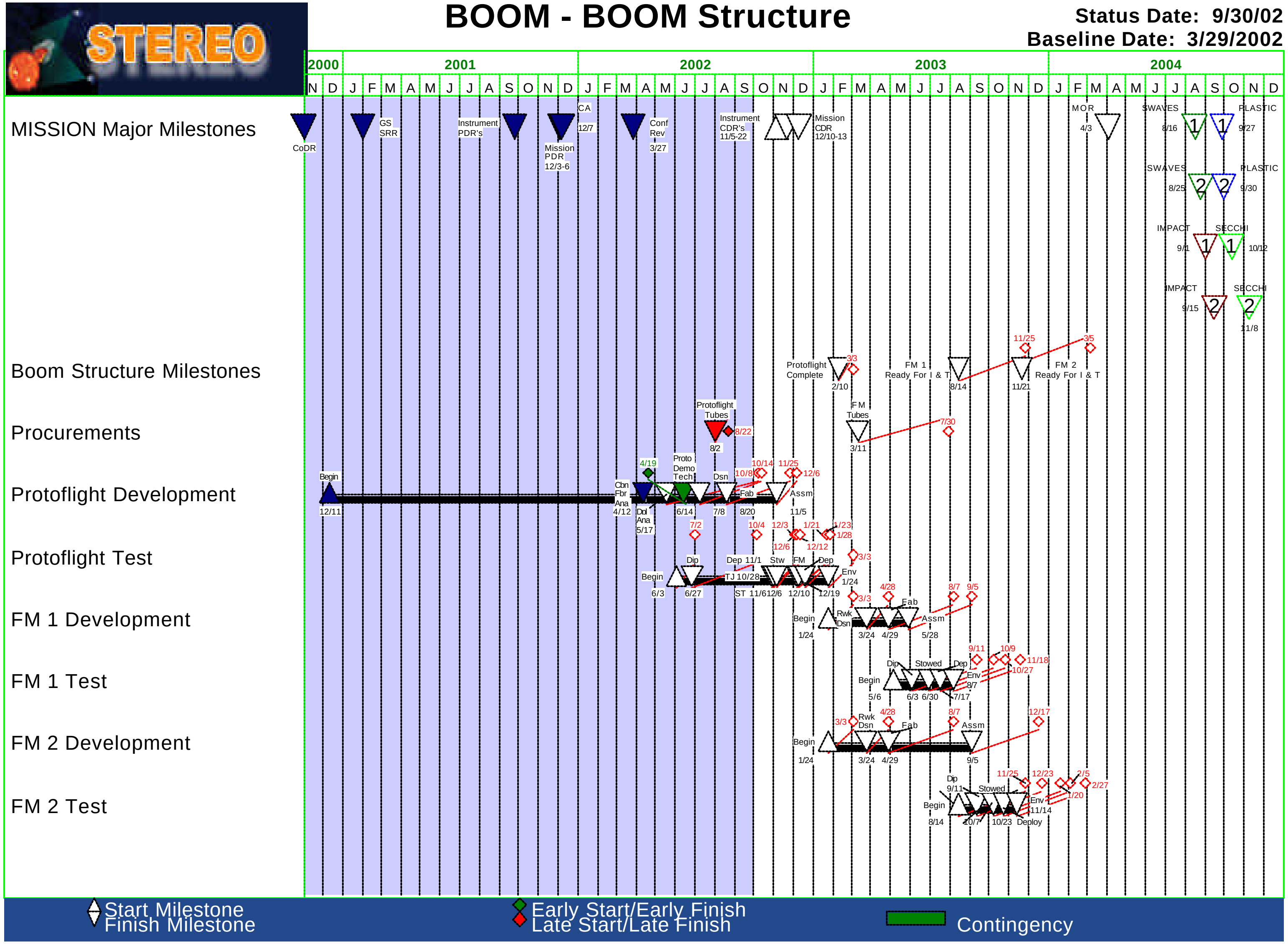
Status Date: 9/30/02
Baseline Date: 3/29/2002



Curtis

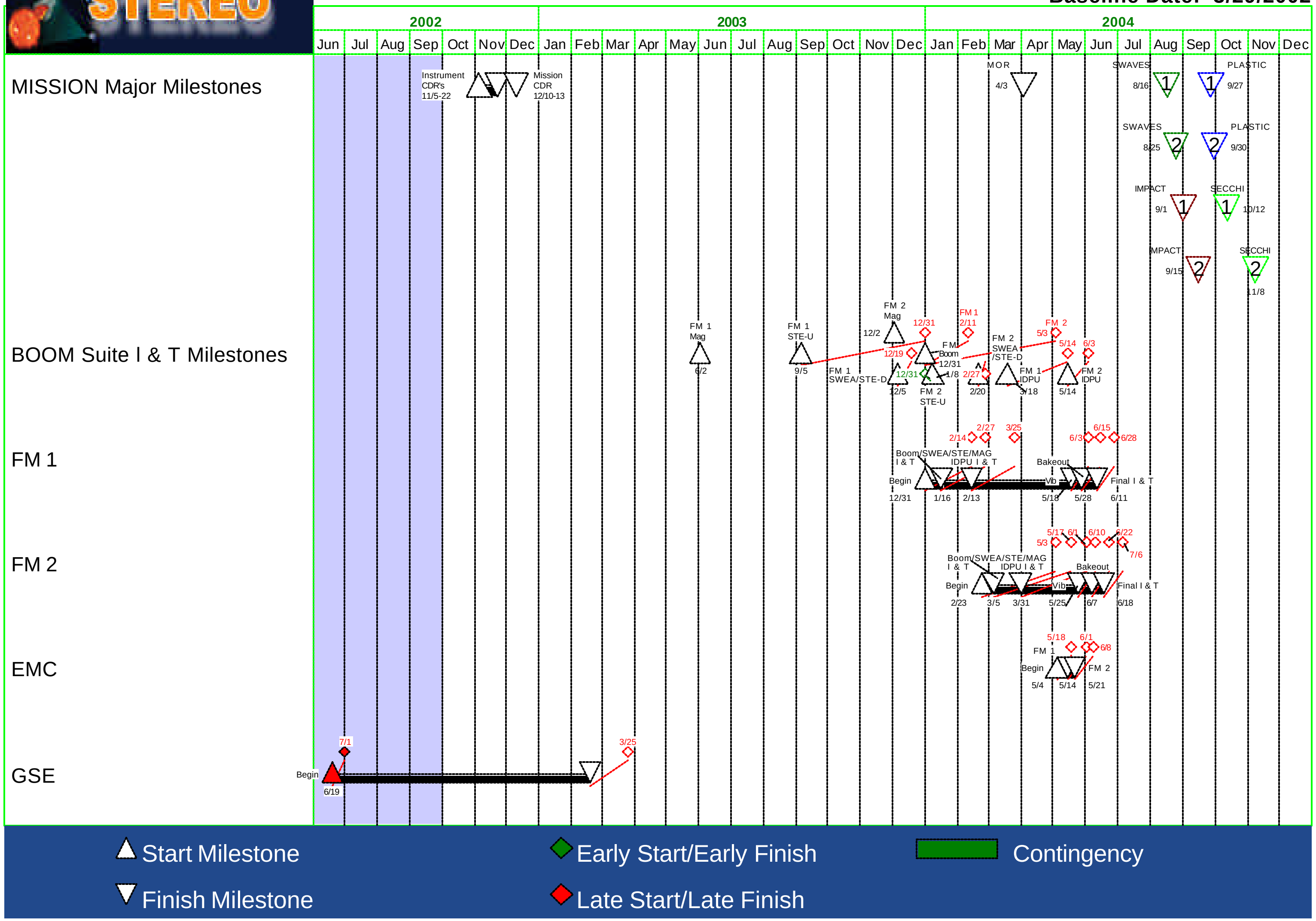
BOOM - BOOM Structure

Status Date: 9/30/02
Baseline Date: 3/29/2002



BOOM I & T - BOOM Suite I & T

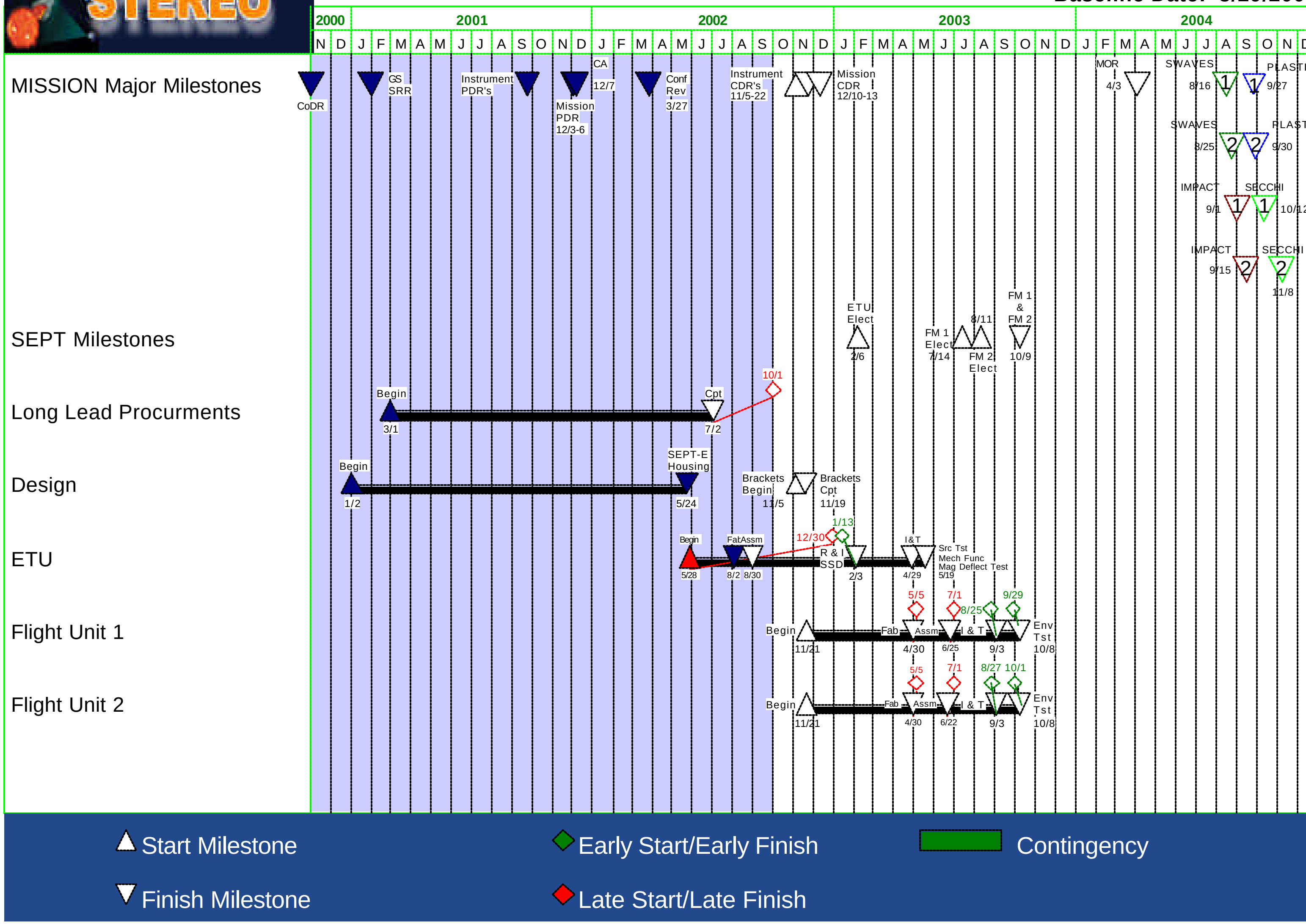
Status Date: 9/30/02
Baseline Date: 3/29/2002



STEREO IMPACT

SEPT - Solar Electron and Proton Telescope (Kiel)

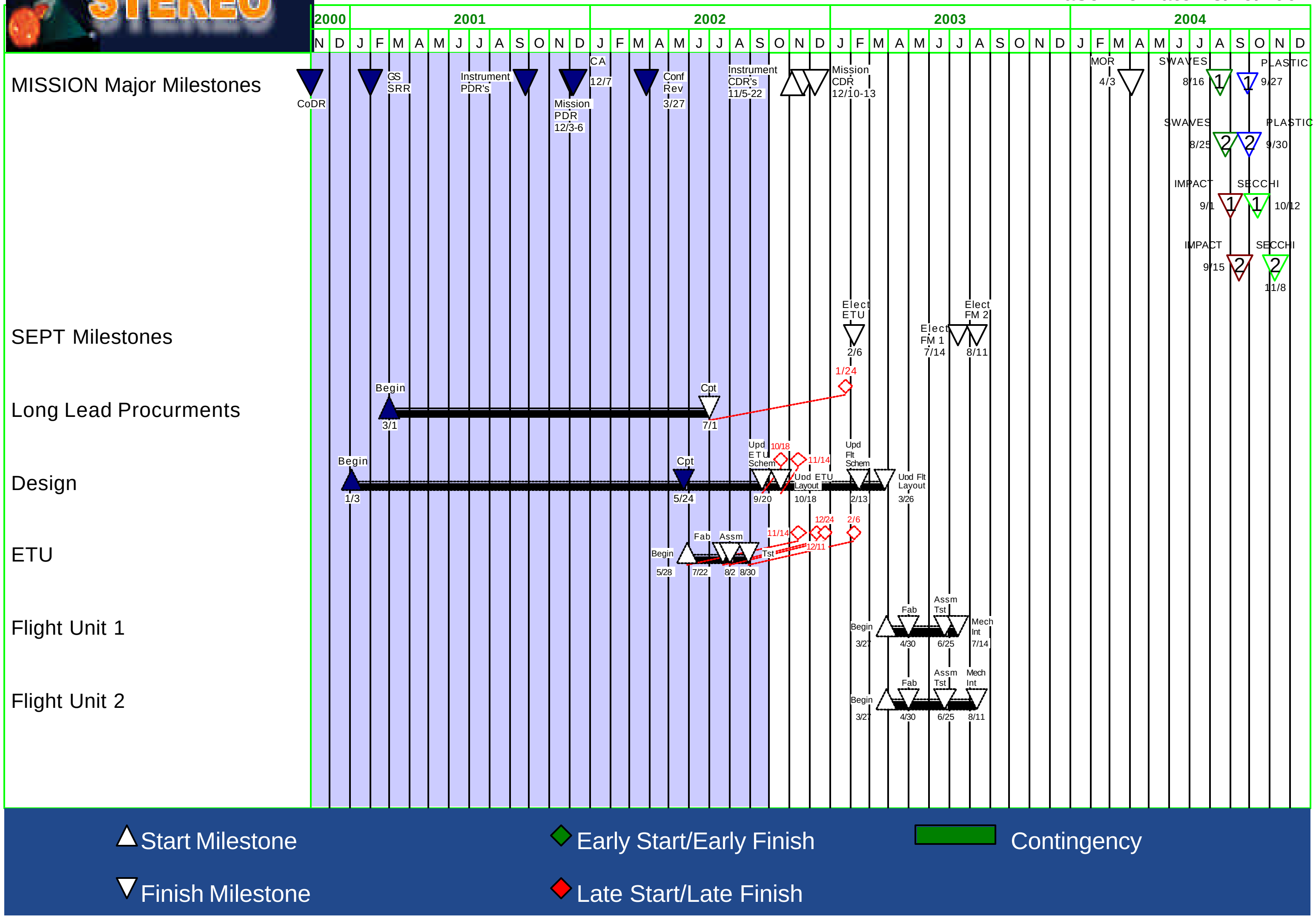
Status Date: 9/30/02
Baseline Date: 3/29/2002



Curtis

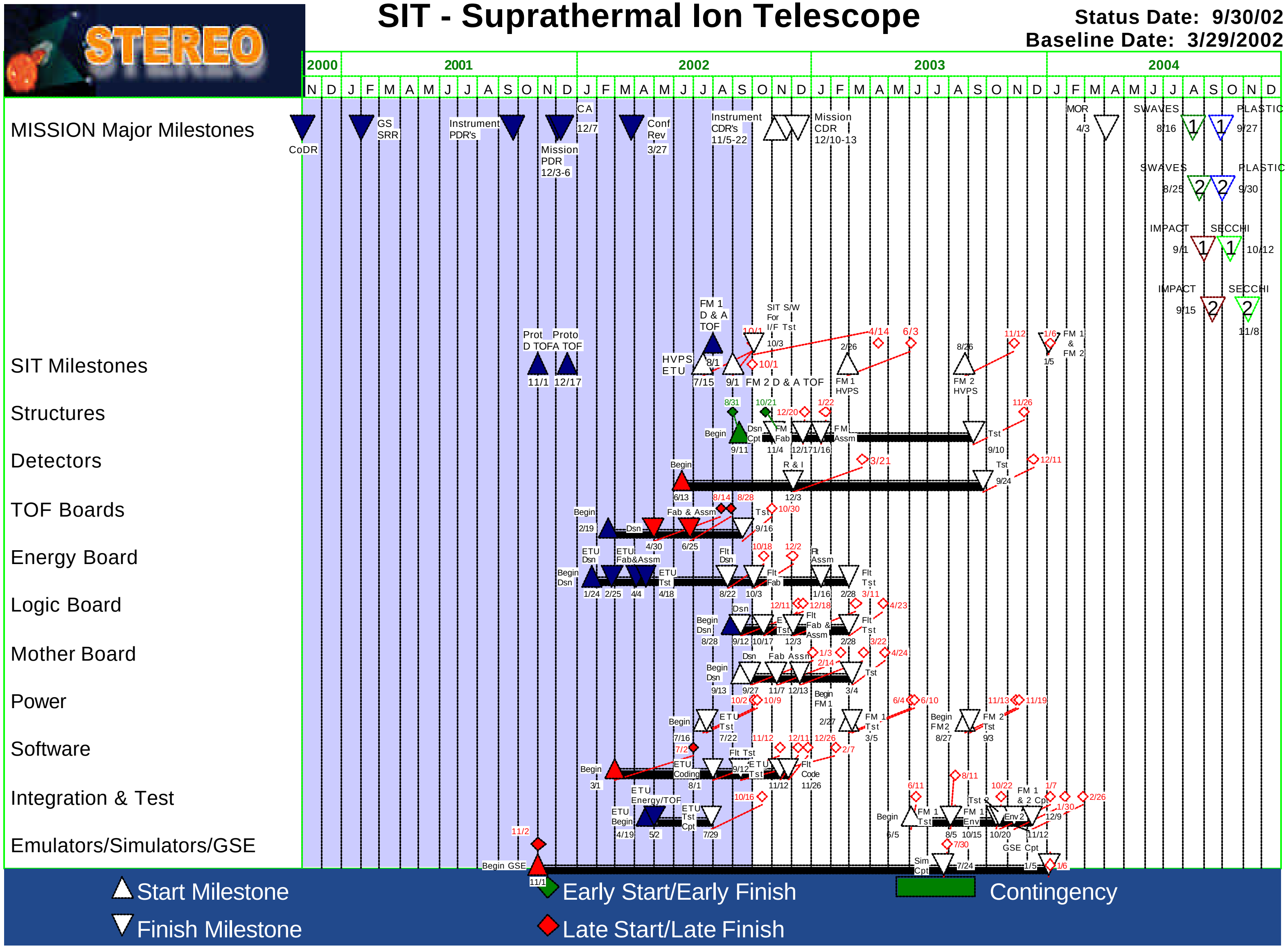
SEPT - Solar Electron and Proton Telescope (ESTEC)

Status Date: 9/30/02
Baseline Date: 3/29/2002



SIT - Suprathermal Ion Telescope

Status Date: 9/30/02
Baseline Date: 3/29/2002

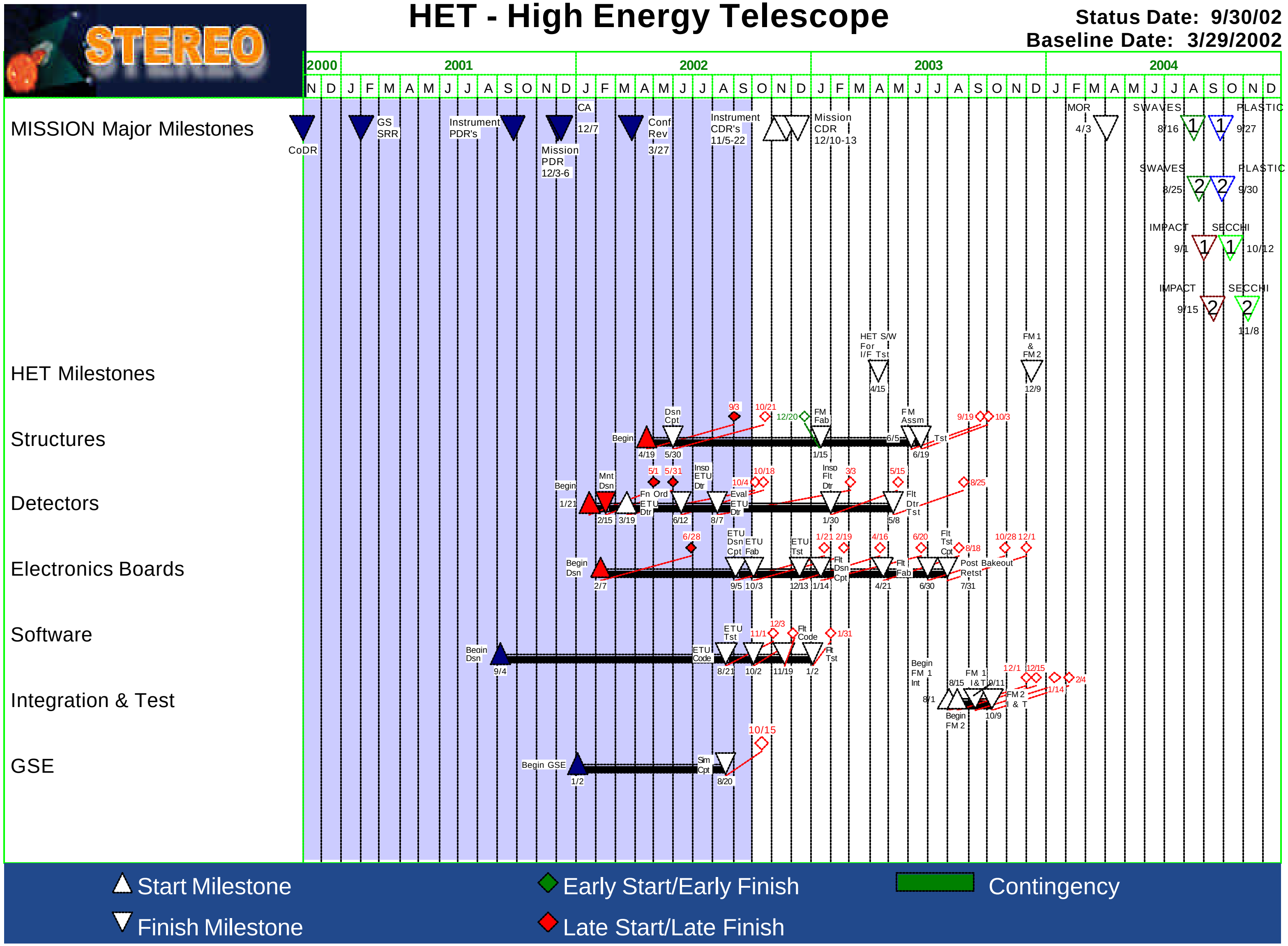


STEREO IMPACT

Critical Design Review
2002 November 20,21,22

HET - High Energy Telescope

Status Date: 9/30/02
Baseline Date: 3/29/2002



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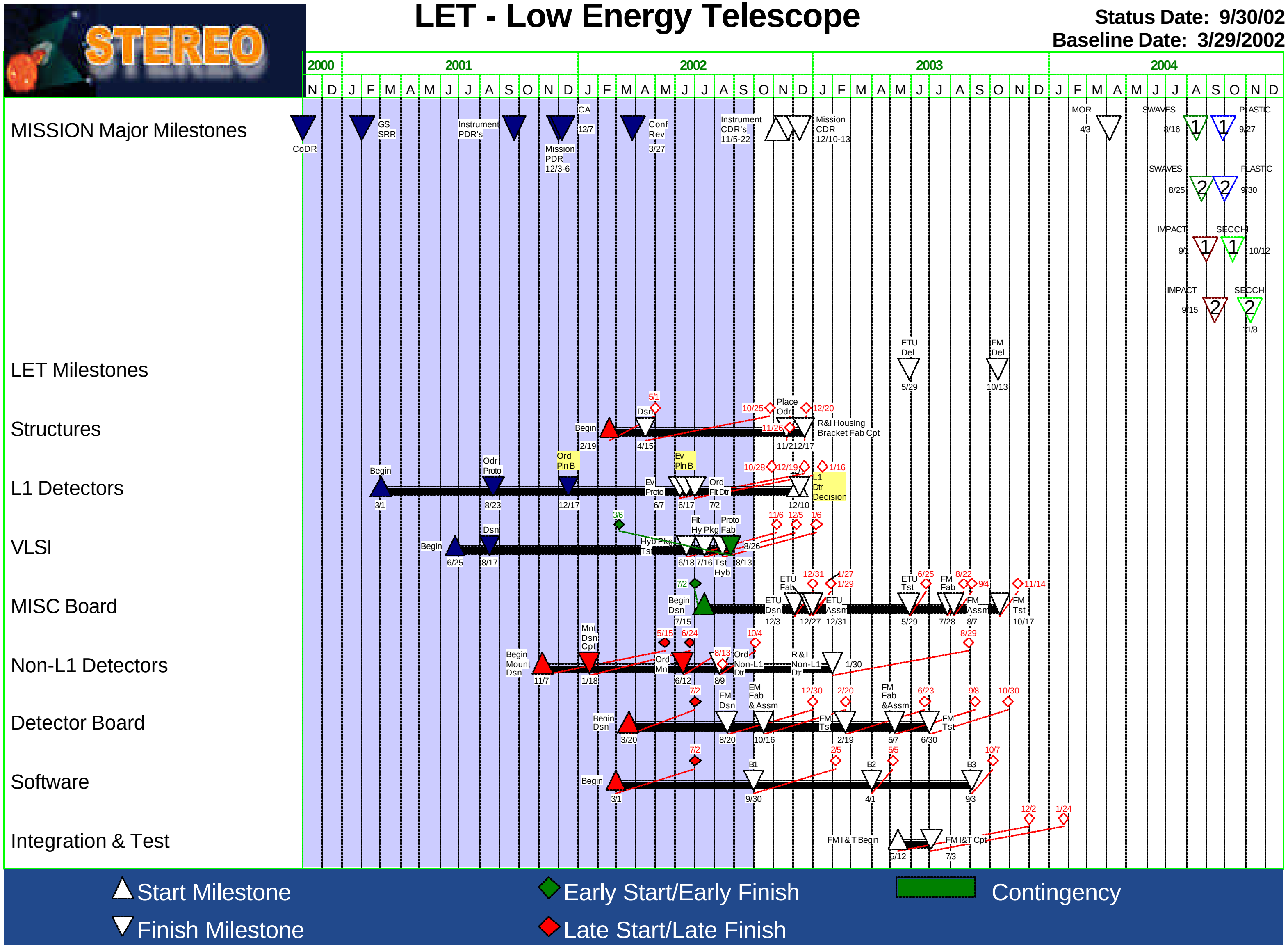
LET - Low Energy Telescope

Status Date: 9/30/02
Baseline Date: 3/29/2002



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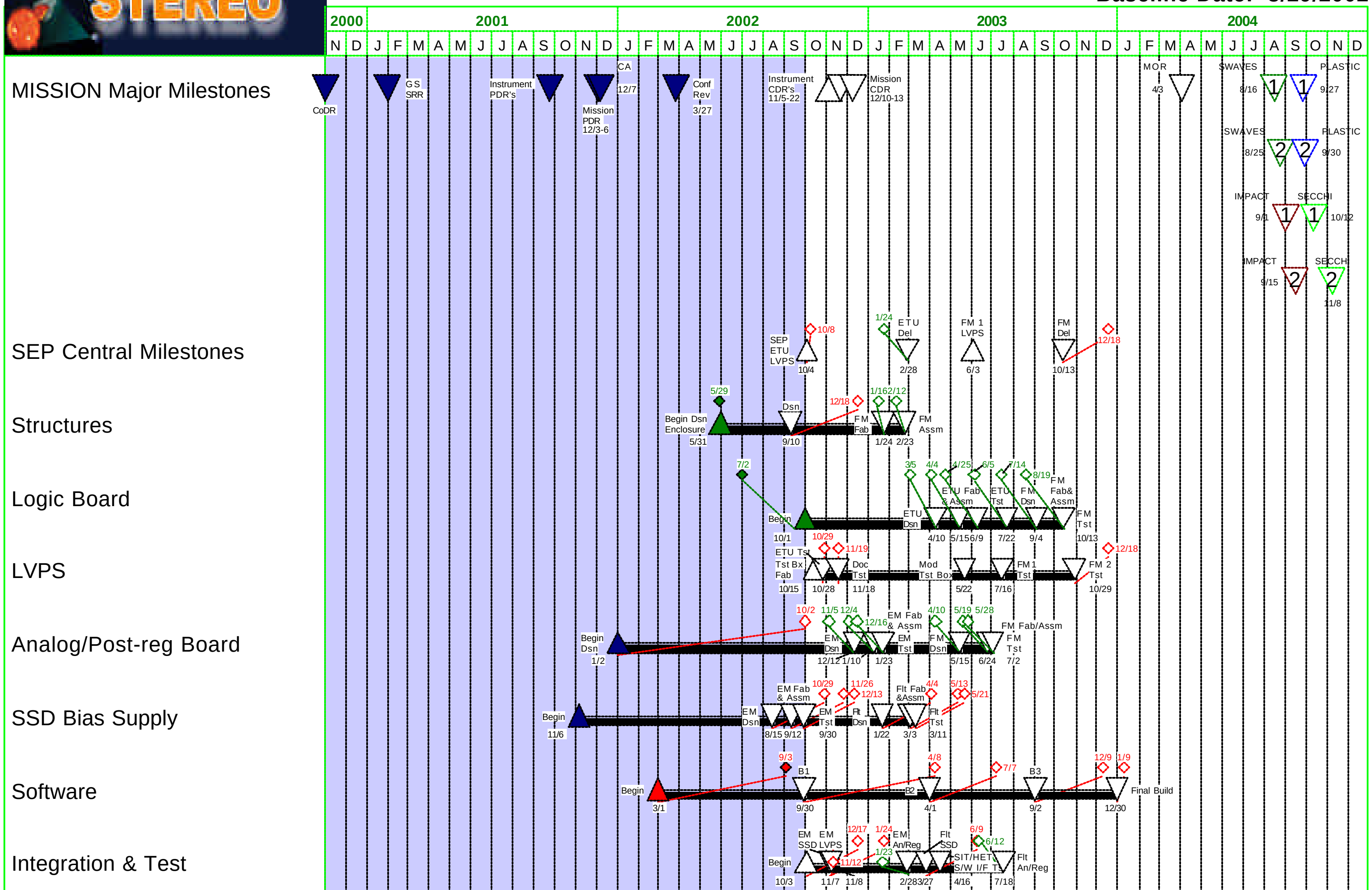
SEP Cen - Solar Energetic Particles Central

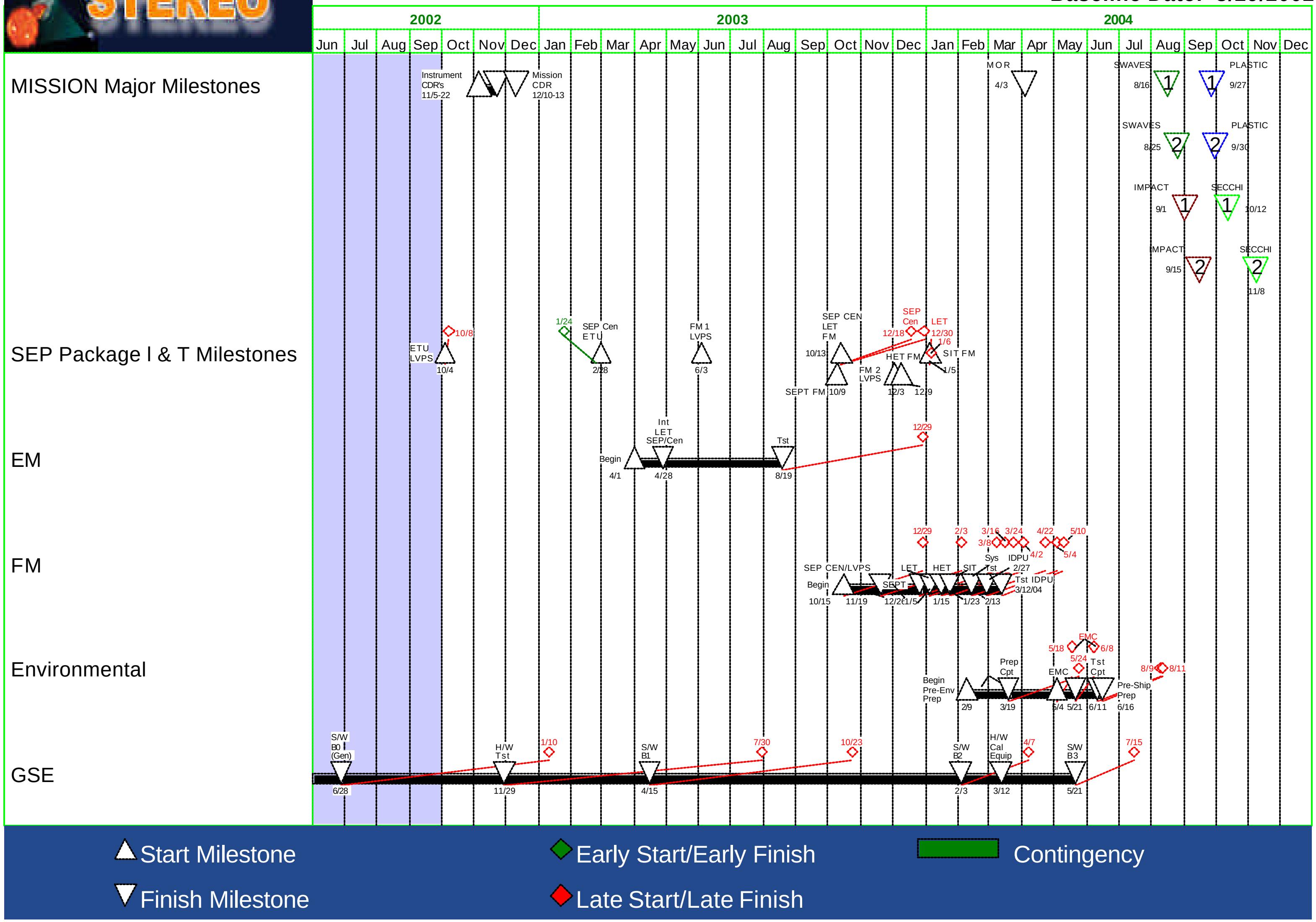
Status Date: 9/30/02
Baseline Date: 3/29/2002



Start Milestone
Finish Milestone
Early Start/Early Finish
Late Start/Late Finish
Contingency

SEP I & T - Solar Energetic Particles Package I & T

Status Date: 9/30/02
Baseline Date: 3/29/2002



Schedule Analysis

- **Schedule contingency to delivery as indicated by current schedule is about 15 working days**
- **The IMPACT schedule is in need of re-baselining based on**
  - **Experience with ETUs**
  - **Re-prioritizing critical path tasks**
  - **Taking a closer look at the Flight Manufacturing, I&T flows**
  - **Correcting mistakes in links**
- **We expect this to improve the IMPACT schedule slack**
  - **Target is 40 working days (20 working days per year)**
  - **Some specific schedule fixes will be presented in the instrument presentations**
- **We plan to do this before the end of the year**
  - **Because of the integrated nature of the schedule, this requires a series of meetings between planners and the IMPACT team members**
- **Note that the Project integrated schedule will tend be out of sync**
  - **We are constantly reprioritizing work and shifting tasks around in response to changes in delivery dates, etc.**
  - **There is reluctance to rebaseline Integrated schedule frequently**
    - **Hard to compare schedules, identify slips**

Risk Management

- Risk Management per Project plan 460-PLAN-0007
- Risks are tracked monthly
  - New risks added
  - Top 10 risks reported to Project
  - Risk mitigation trigger points are checked
  - Work prioritized to higher risk tasks
- Resources allocated to mitigating risks
  - Project has provided funding for risk mitigations
    - More manpower
    - Backup detectors

IMPACT Top 10 Risks

No.	Risk Item	Score	Mitigation	Mitigation Schedule						
				PDR	EM Test	CDR	Sub-system Test	System Test	Env test	Early Orbit Test
UCB_5	IMPACT boom is a new design. Failure could affect Imager pointing requirements as well as boom-mounted instruments.	MEDIUM	Design for reliability. Early prototype testing. Adequate force margins.	MEDIUM	MEDIUM	MEDIUM	MEDIUM	MEDIUM	MEDIUM	LOW
UCB_4	The IDPU is a single point failure mechanisim for the IMPACT suite and PLASTIC	MEDIUM	IDPU is a simple, reliable system. Extra attention will be paid to ensuring its reliability, minimizing the risk of fault propagation. Early prototype testing	MEDIUM	MEDIUM	MEDIUM	MEDIUM	MEDIUM	MEDIUM	MEDIUM
UCB_23	Non-standard parts qualification failure could impact delivery schedule	MEDIUM	Early parts selection and screening	MEDIUM	MEDIUM	MEDIUM	LOW	LOW	LOW	LOW
UCB_27	Actel timing differences between flight & ETU parts may cause failures late in testing impacting delivery schedule	MEDIUM	Do FM Thermal Vac early to allow time for finding and fixing timing problems; for designs on the critical path, consider installing a flight Actel in the ETU & thermal cycle.	MEDIUM	MEDIUM	MEDIUM	MEDIUM	LOW	LOW	LOW
UCB_11	Stringent EMI requirements may delay schedule if testing fails	MEDIUM	Careful design, ETU power converter testing, early system testing	MEDIUM	MEDIUM	MEDIUM	MEDIUM	LOW	LOW	LOW
UCB_28	Thermal limitations of detectors result in a low bakeout temperature which might require a very long bakeout impacting delivery schedule	MEDIUM	Bakeout subsystems prior to detector integration to reduce time of instrument-level bakeout; early bakeout	MEDIUM	MEDIUM	MEDIUM	MEDIUM	LOW	LOW	LOW
UCB_19	Concern about fragility of ITO surfaces required to meet ESC requirements; failure will impact SWEA science	MEDIUM	Replace ITO with more robust solution where possible; test ITO surfaces during I&T and replace when required	MEDIUM	MEDIUM	MEDIUM	MEDIUM	MEDIUM	MEDIUM	LOW
UCB_10	Complex Interlocking IMPACT schedule increases risk of late delivery to spacecraft	MEDIUM	Detailed fully integrated schedule developed and maintained with Project support. Monthly tracking of status.	MEDIUM	MEDIUM	MEDIUM	MEDIUM	LOW	LOW	LOW
UCB_21	PHASIC Custom VLSI used in SEP may has schedule and cost risk	LOW	Early development to prove design; use Amptek in place of VLSI in SIT (stll use VLSI in HET, LET); first run looks good, but a second run will be required	MEDIUM	LOW	LOW	LOW	LOW	LOW	LOW
UCB_18	LET Detectors from a new process	LOW	Backup L1 detectors; low risk, meet requirements; Decision point 1/2003	MEDIUM	LOW	LOW	LOW	LOW	LOW	LOW

IMPACT Risk UCB_5 (Boom Deployment)

- **Failure of IMPACT boom to fully deploy could affect Imager pointing requirements as well as boom-mounted instruments.**
- **Mitigations:**
  - **Design for reliability: adequate force margins, eliminate failure modes**
  - **Design to maximize stiffness in worst case partial deployment**
    - **Waiting results of APL analysis of spacecraft FEM with UCB-supplied FEM of partially deployed boom**
    - **One possible solution might be to delay deployment until heliocentric orbit is achieved if the spacecraft cannot handle a partially deployed boom during delta-V maneuvers (undesirable).**
  - **Testing of EM boom to determine reliability, verify FEM, further eliminate failure mechanisms**
    - **Project has funded extra effort to move this testing forward**
- **Project has been looking at alternative boom designs as a contingency plan**
  - **Trigger point for some of these schemes is coming up soon**
  - **Berkeley has technical and scientific issues with the candidate backups**

IMPACT Risk UCB_4 (IDPU)

- **IDPU is a single-string box. Failure would eliminate IMPACT and PLASTIC science**
- **Mitigations:**
  - **Design for reliability; minimize the risk of failure propagation from an instrument to the IDPU (or from the IDPU to the spacecraft)**
    - **Only the Data Controller Board and Power Converter are critical**
  - **High reliability parts (grade 2 or better)**
    - **Project approved a change to a memory with a lower SEU sensitivity, requiring more power.**
  - **Testing. Build early, test extensively.**
    - **ETU has been in test and software development since August**
    - **FM will be built early in 2003.**
- **No contingency plans currently being considered**

IMPACT Risk UCB_23 (Non-standard parts qualification)

- **Failure of non standard parts qualification could impact schedule**
- **Mitigations:**
  - **Coordinate screening specifications with PCB to ensure adequate screening**
  - **Get screening started early (all in progress, most done)**
  - **Have backup parts lots available in case of screening failure**
  - **Have backup part types in mind in case of screening failure**
- **To date only one real failure**
  - **16 bit DAC (LT1599) failed radiation badly**
  - **One of the last part types tested**
  - **No qualified or previously tested candidate**
  - **Contacted manufacturer to see if there are multiple foundries – no response**
  - **Planning a quick test of all candidate backup parts for radiation sensitivity to select best part**
    - **Quick dose at GSFC followed by a bench test**
  - **Will require modifications to SWEA/STE interface design**
    - **Schedule impact will depend somewhat on what part we can get to work**
- **Some concern with 16-bit ADC SEL sensitivity**
  - **Protection circuit in place, but issue of latent damage from latchup**
  - **Further latchup testing planned**
  - **Backup parts identified with somewhat better SEL, but does not meet all needs**

IMPACT Risk UCB_27 (Actel Timing)

- **Flight Actels have different timing characteristics from prototype parts. Risk of discovering problems late causing schedule delays**
  - **Other issues like ground bounce might also be different on flight parts**
- **Mitigations:**
  - **Design to avoid problems (good practice design guidelines have been followed)**
  - **Do worst case timing simulations**
  - **Stress test the EM (thermal, supply, input timing)**
  - **Get at least one design into a flight Actel ASAP to get experience with the differences**
    - **DCB Actel a likely candidate, early 2003.**
  - **Identify Actels in systems on the critical path and consider testing a flight Actel in the ETU for those systems to reduce schedule risk**
    - **Cost and logistical difficulties doing this for all Actel designs**
  - **Do stress testing on flight units with Actels early to identify problems**

IMPACT Risk UCB_11 (EMI/EMC)

- **Stringent EMI/EMC Requirements. Risk is that failure in test will result is schedule delays**
- **Mitigations:**
  - **Design to EMC Requirements and guidelines**
  - **Bring all deviations to EMC committee for approval**
  - **Present design details at EMC peer reviews**
  - **Power Converter Peer Review**
  - **Early CE testing of EM power converters**
  - **CE/CS testing of integrated EM models where possible**
  - **Early CE testing of FM power converters**
  - **Move FM1 EMC testing as soon as possible**
- **Contingencies:**
  - **Failure during early tests leaves time for corrections**
  - **Failures in final test must be mitigated quickly (adjust shielding, filtering, or grounding) or waived**

IMPACT Risk UCB_28 – (Bakeout)

- **Bakeout TQCM requirements are fairly stringent. Some detectors limit the bakeout temperature which might result in a very long bakeout, impacting schedule**
- **Mitigations:**
  - **Use low outgassing materials**
  - **Use good fabrication and handling procedures**
  - **Bakeout subassemblies (without sensitive detectors) at higher temperatures**
  - **Bakeout early to allow time for contingencies**
    - **current schedule has them late; should be moved up to be done in Thermal Vac testing or earlier**
  - **Bakeout only flight hardware; remove GSE**
- **Contingincies (If bakeout proceeds slowly)**
  - **Identify what is being outgassed and mitigate source**
  - **Elevate bakeout temperature (may require removal of a sensitive part)**

IMPACT Risk UCB_19 (ITO Fragility)

- **There is a history of ITO coatings used for Electro Static Charging control being damaged in I&T. SWEA is very sensitive to spacecraft charging effects.**
  - **This issue is complicated by thermal and contamination issues**
- **Mitigations (working with APL)**
  - **Spacecraft has limited the use of ITO to a fraction of the surface area**
    - **Most blankets are "Black Kapton"**
  - **The more robust ITO process shall be used**
    - **Some testing at APL indicates they have robust material**
  - **Work is still being done to see if the more robust Goddard Composite can be made to meet the Electrostatic requirements**
  - **Any ITO-coated surfaces will be tested periodically during I&T to verify conductivity**
- **Contingency (failure during I&T):**
  - **Replace any surface that fails to meet conductivity requirements**

IMPACT Risk UCB_10 (Complex Schedule)

- **Complex multi-institutional schedule (including APL & Project). Risk of delays at one location impacting delivery to spacecraft**
- **Mitigations:**
  - **Monthly tracking of schedule**
  - **Identify critical paths and concentrate effort there**
    - **Project has allocated funds to extra manpower where needed**
  - **Re-allocate work between institutions where possible**
  - **Restructuring of schedule (trade schedule and technical risks or other resources)**
    - **Include Project in decision**
- **Trigger points:**
  - **When critical path causes schedule contingency to fall below 20 working days/year (to delivery to APL)**
  - **When critical milestones get out of sync between institutions (one institution waiting on another)**

IMPACT Risk UCB_21 (PHASIC)

- **PHASIC Custom VLSI development schedule and cost risk**
- **Mitigation:**
  - **Early development, simulations, analysis**
  - **Early first run**
    - **Mostly works, some problems, second run in progress**
    - **Good enough for ETU interface tests**
    - **Meets radiation requirements (tested)**
  - **Don’t use in SIT**
    - **SIT development schedule is tight, manpower limited**
    - **Simple alternative using off-the-shelf AMPTEK parts**
- **Contingencies (if second run does not work):**
  - **Continuing to pursue work-arounds to first lot problems. May be useable.**
  - **Should be time for a quick-turn third run (cost and schedule impact)**
  - **Decision can wait till after testing of next run, around 2/2003**

IMPACT Risk UCB_18, (LET Detectors)

- **LET L1 Detectors from a new process. Obtaining required performance is not assured**
  - **Thin L1 detectors with uniform thickness is challenging**
- **Mitigations:**
  - **Pursuing multiple techniques to achieve goal; various detectors currently in test (see LET presentation)**
  - **Backup detectors that meet requirement but not goal**
- **Decision point for selecting flight detector style by January 2003 so an order for flight detectors can be placed**

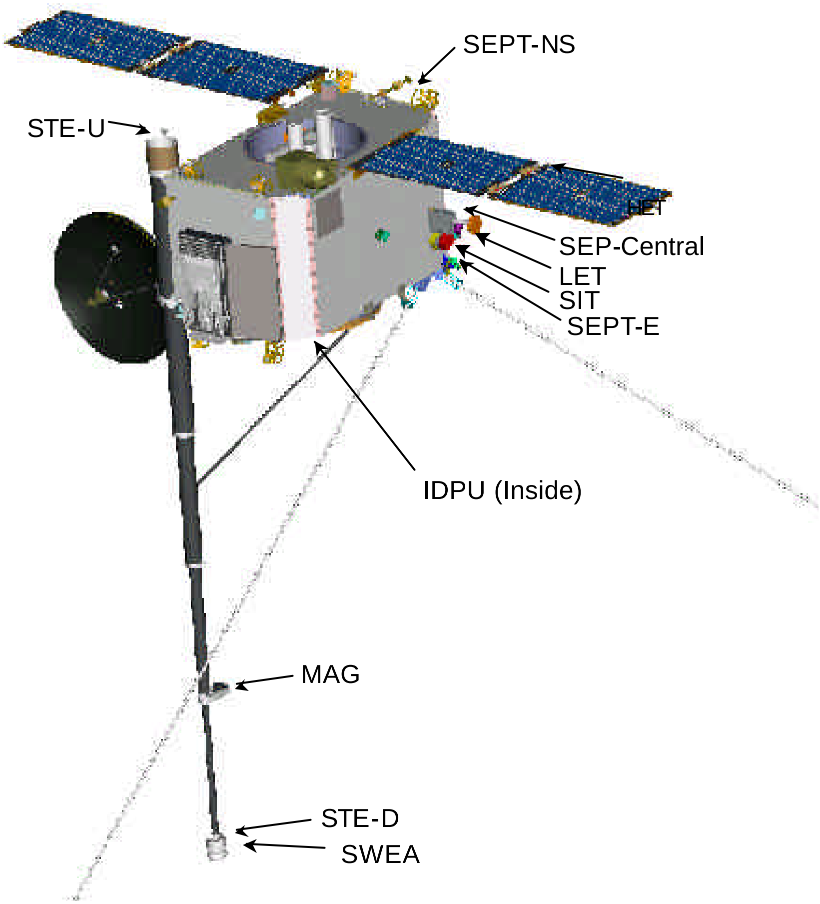
IMPACT Deliverables by CDR

- **Configuration Management Plan**
- **Performance Assurance Implementation Plan**
- **Software Management Plans**
- **Performance Specification**
- **Environmental Test Plans**
- **Requirements Verification Plans**
- **Data Management/Processing Plan**
- **Preliminary Instrument Users Manuals**
- **Thermal & Structural Analytical Models**
- **FMECA inputs**
- **Parts & Materials Lists**
- **Block & Grounding Diagrams**
- **SWAVES/IMPACT ICD**
- **PDR Presentation**
- **CDR presentation**

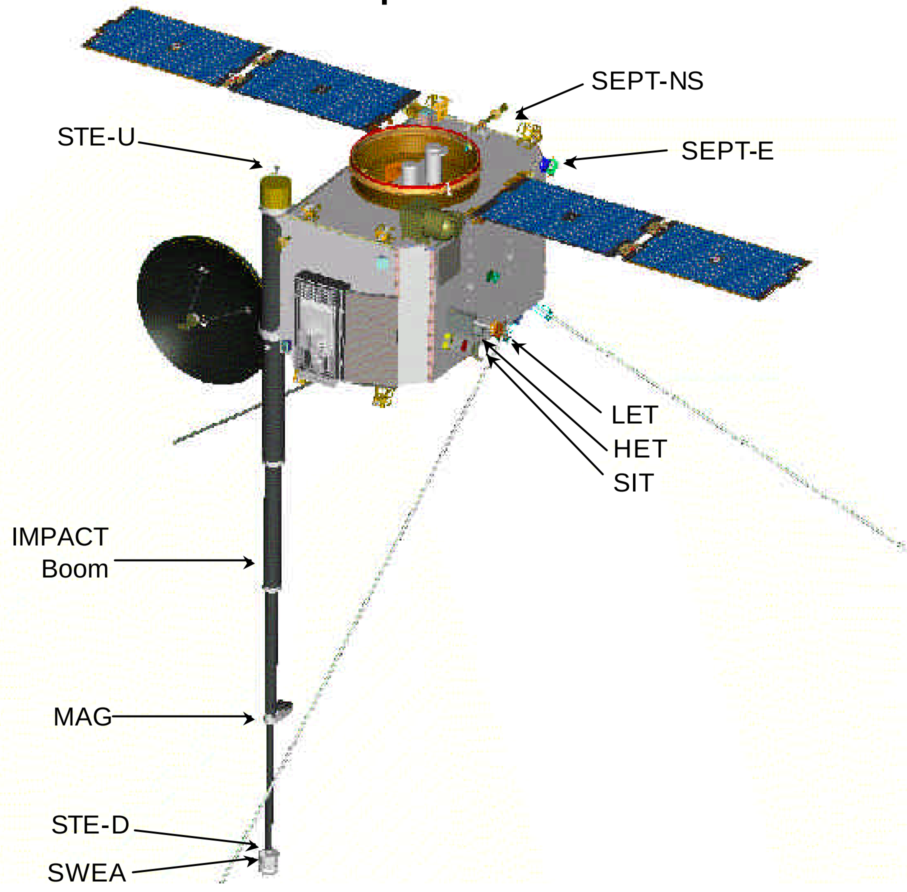
SYSTEM ENGINEERING

IMPACT Instrument Locations on the Spacecraft

Ahead Spacecraft

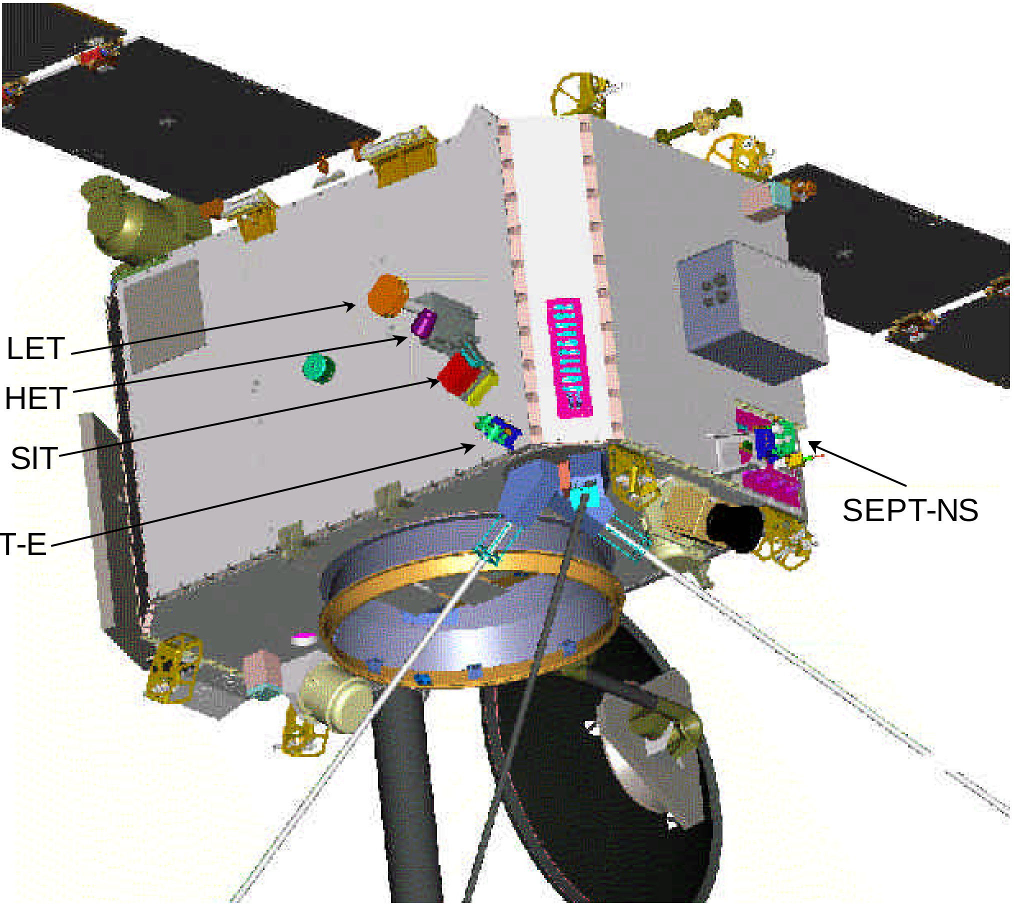


Behind Spacecraft

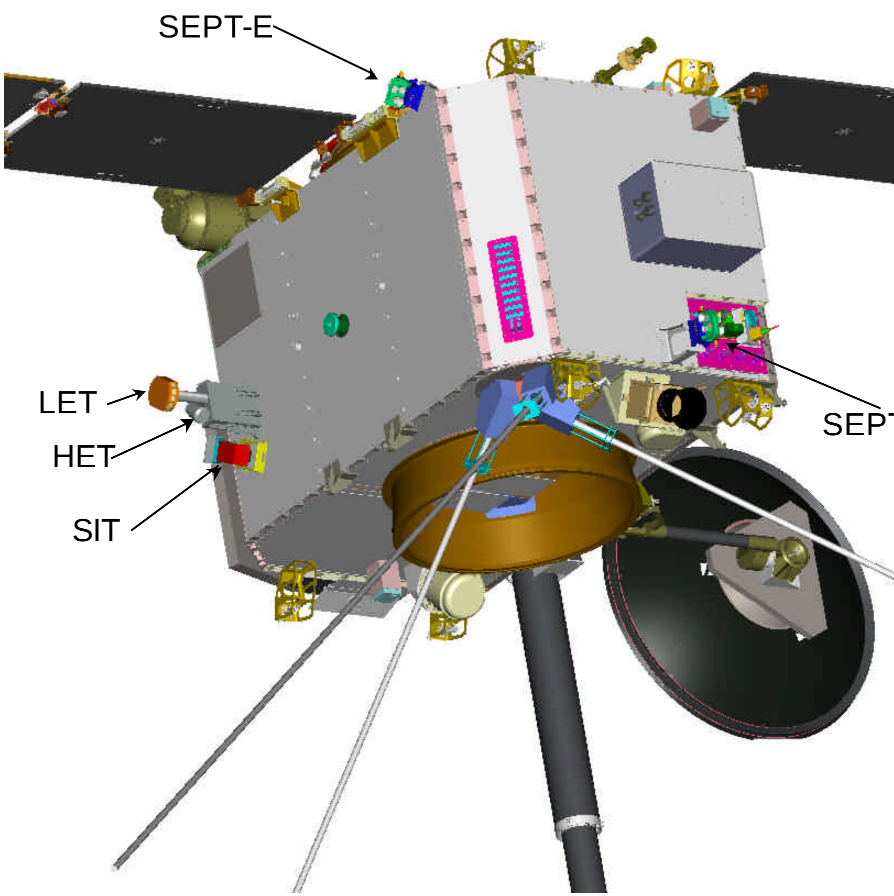


IMPACT Instrument Locations on the Spacecraft

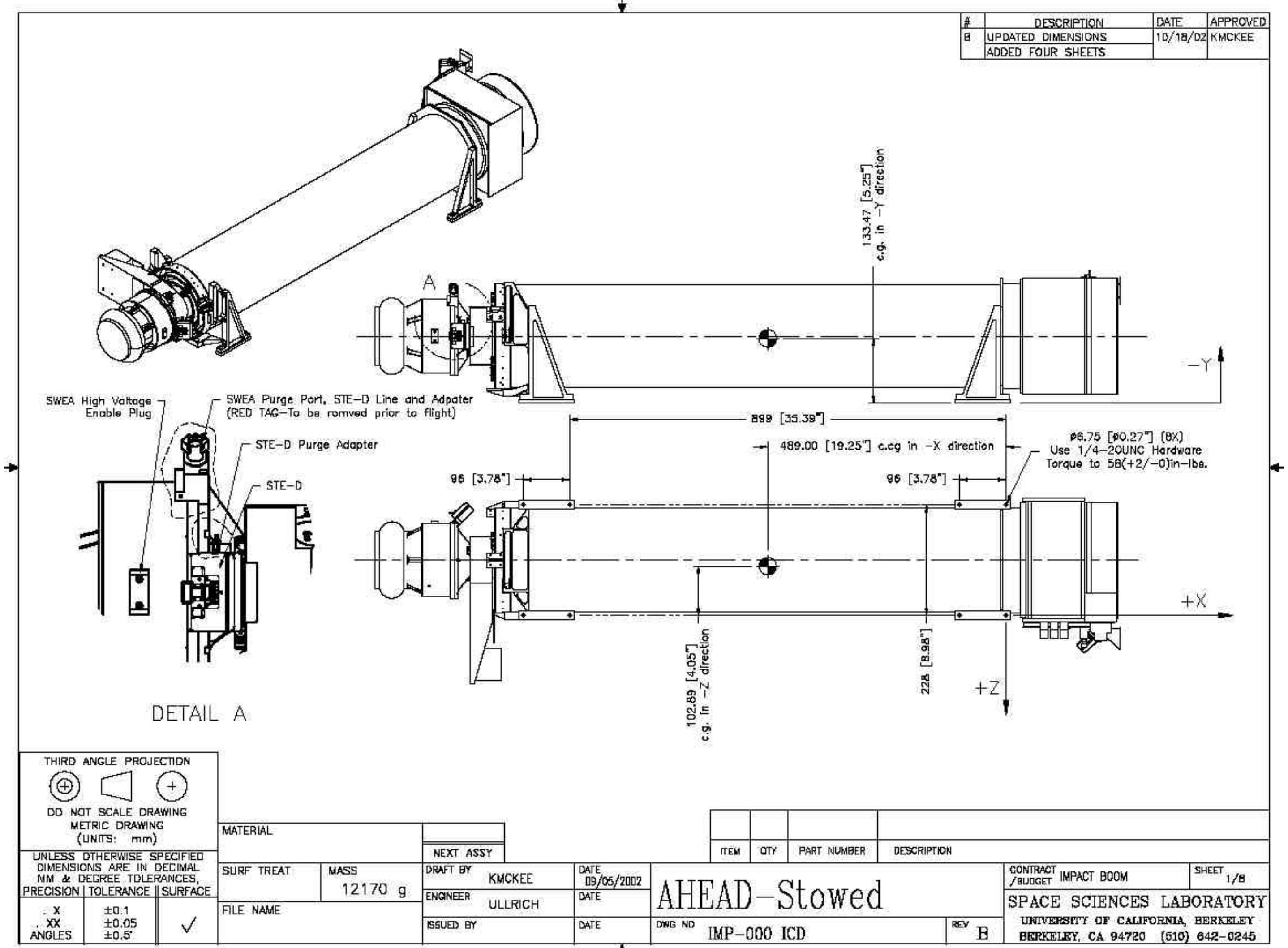
Ahead Spacecraft



Behind Spacecraft

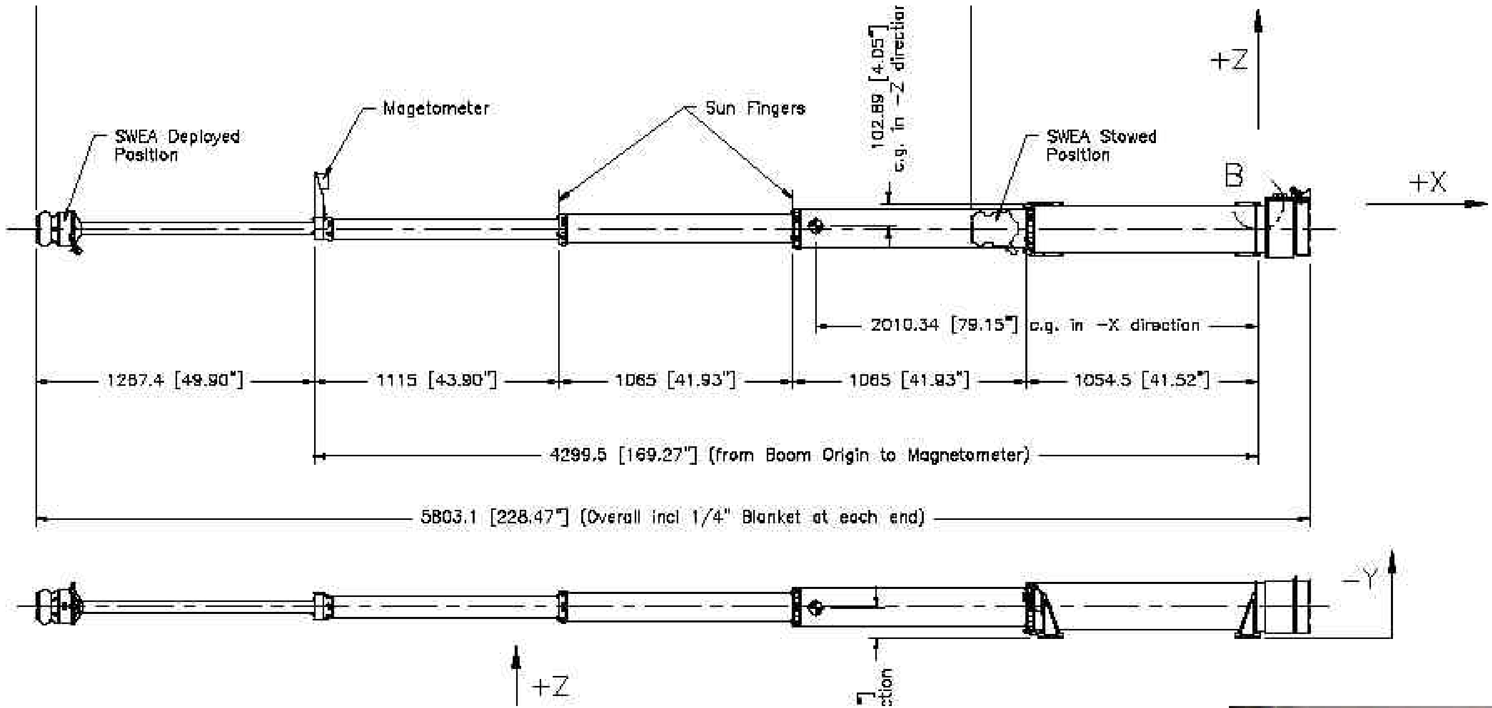


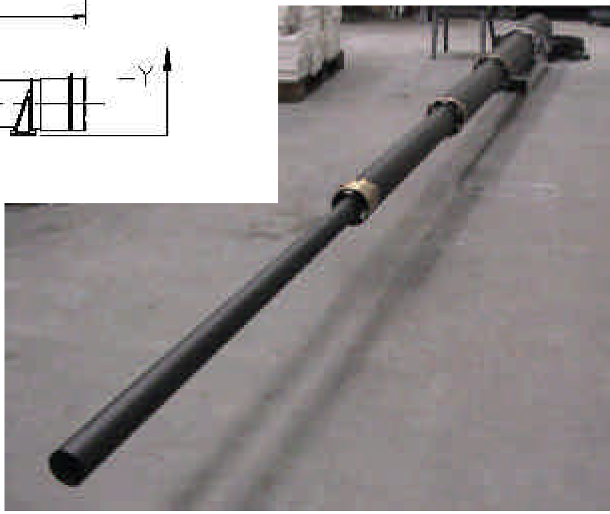
Boom Suite (Stowed)



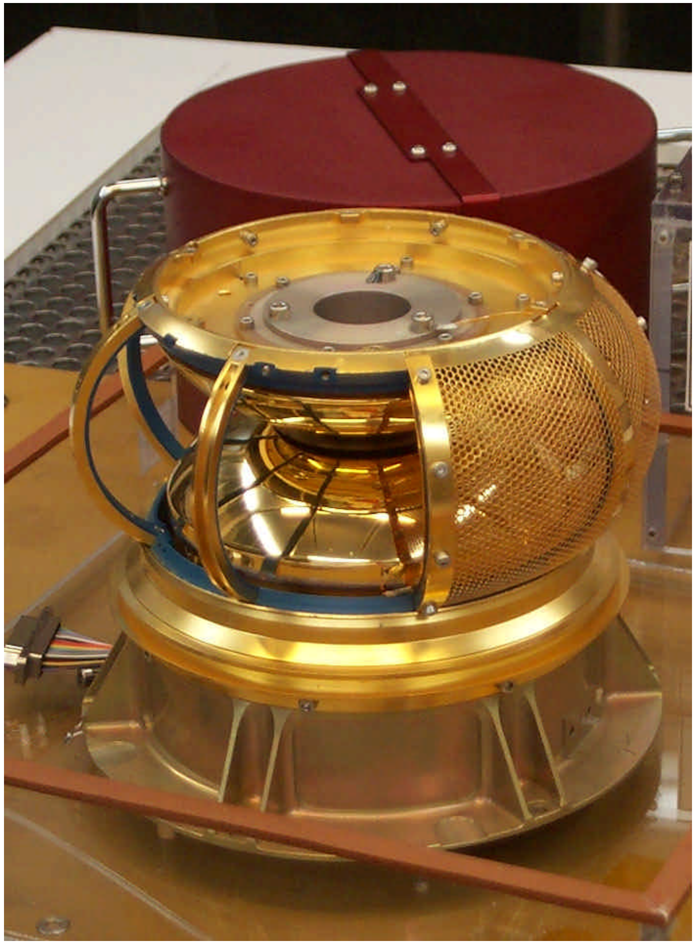
Curtis

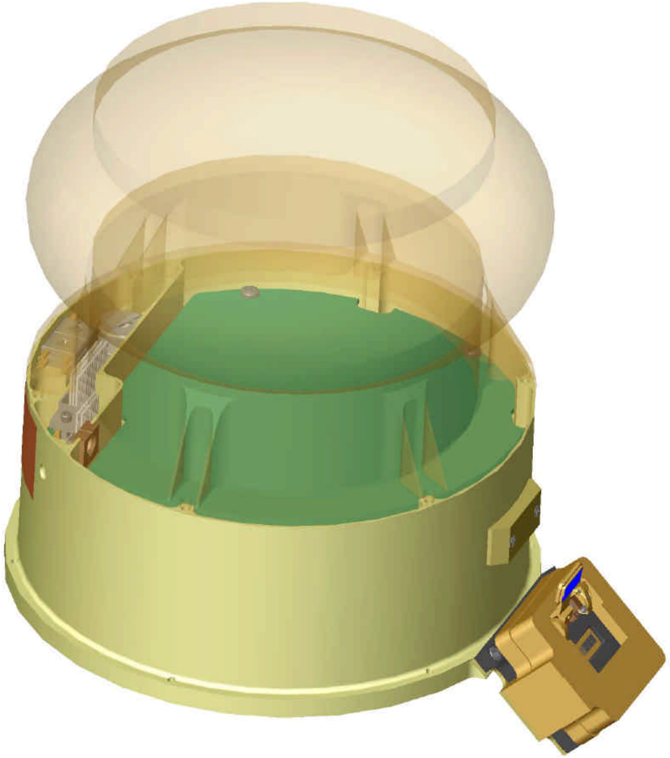
Boom Suite (Deployed)



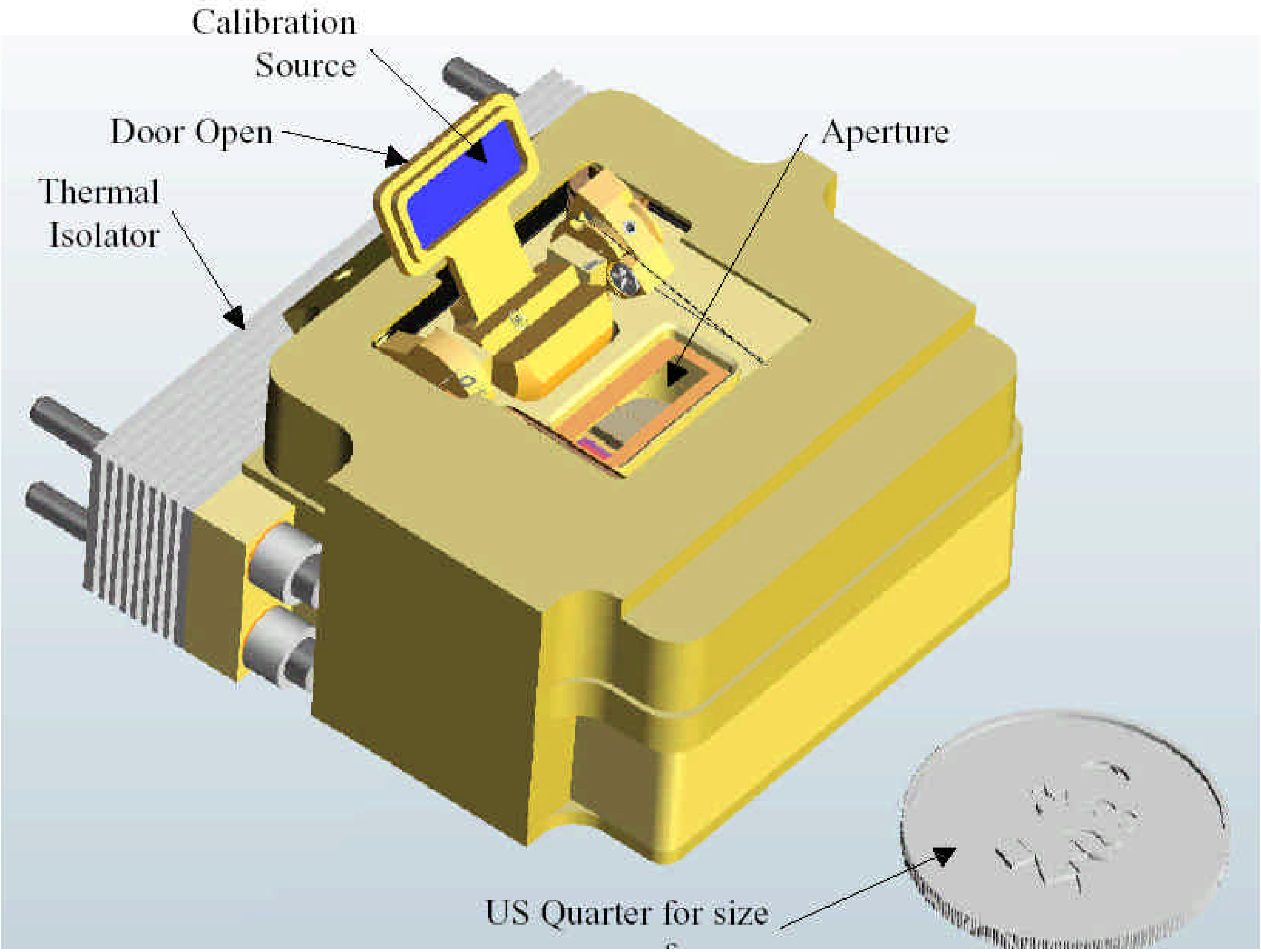


SWEA



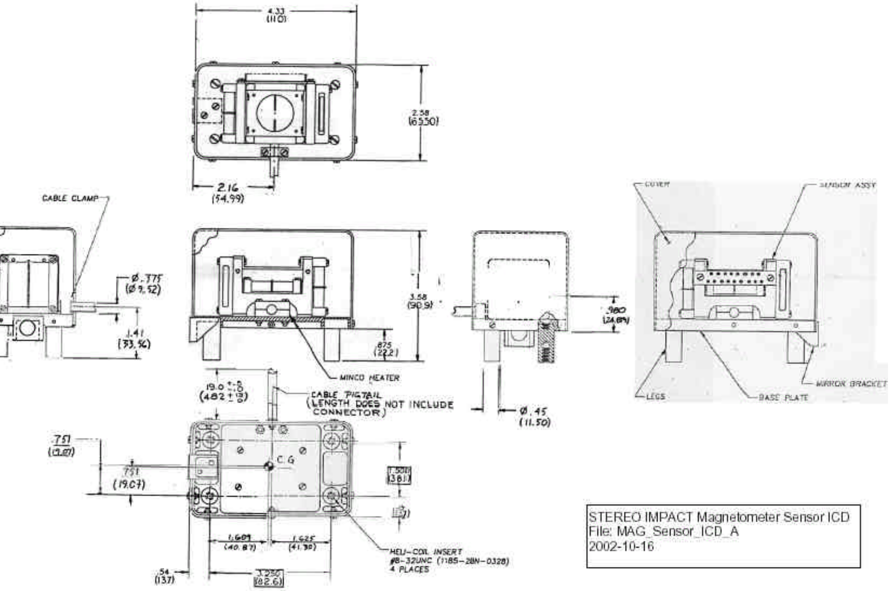


STE


Calibration
Source
Door Open
Thermal
Isolator
Aperture
US Quarter for size

n

MAG



STEREO IMPACT Magnetometer Sensor ICD
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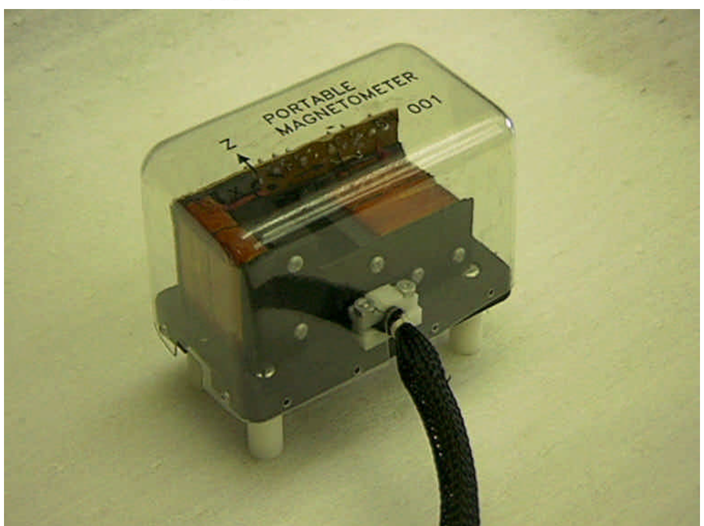
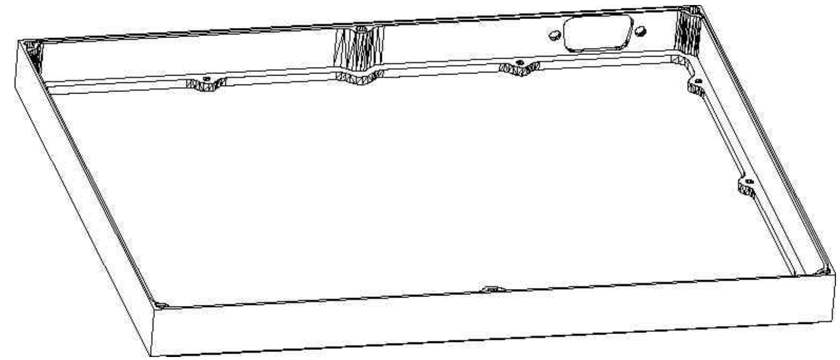
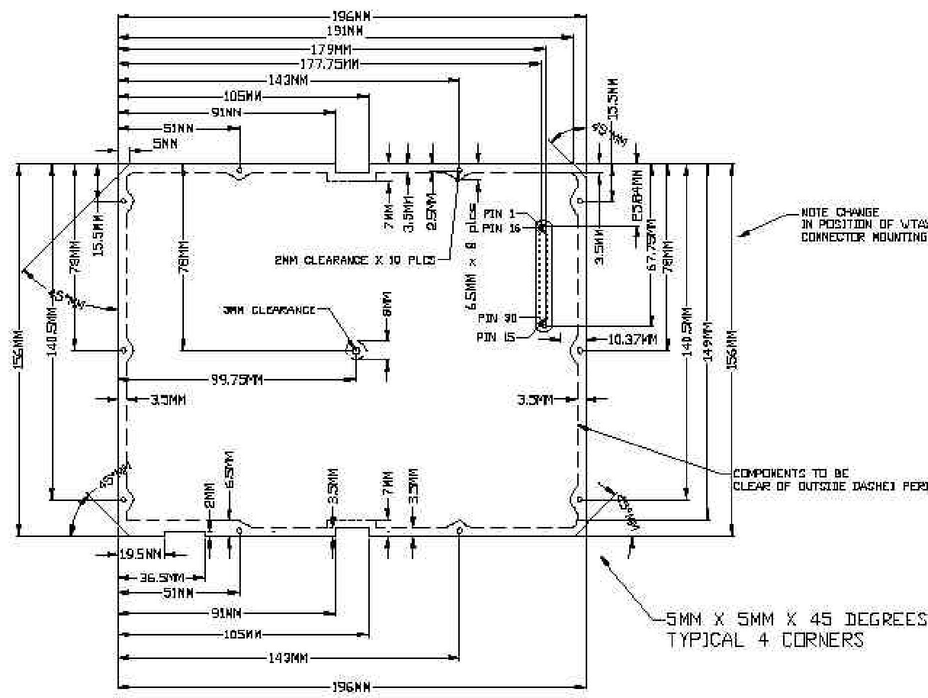
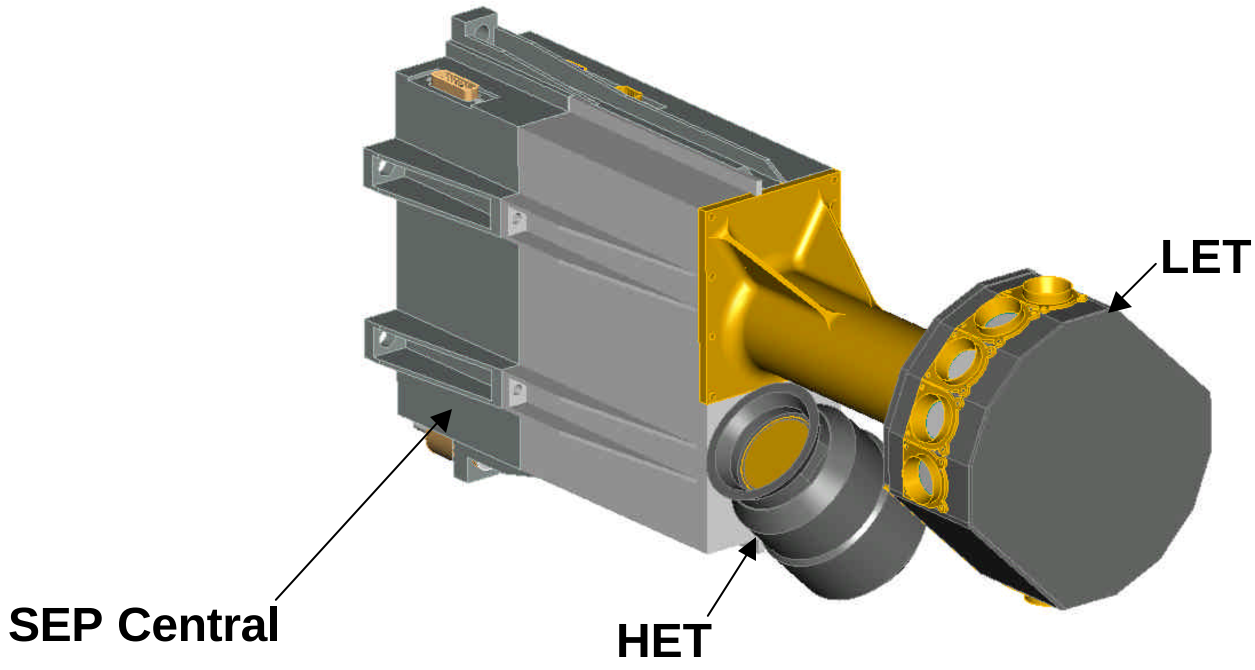
2002-10-16



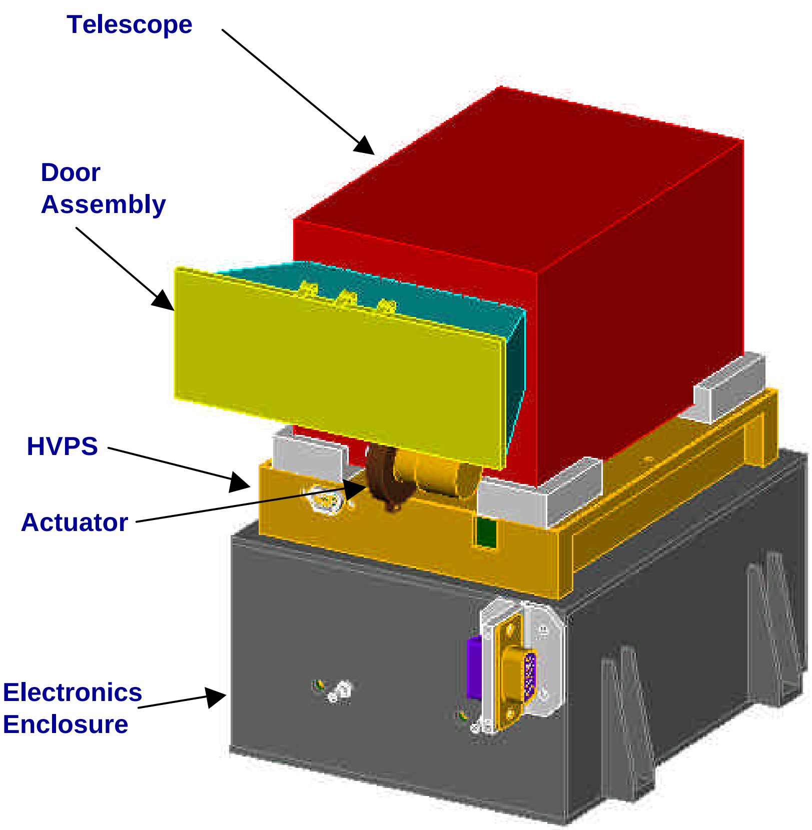




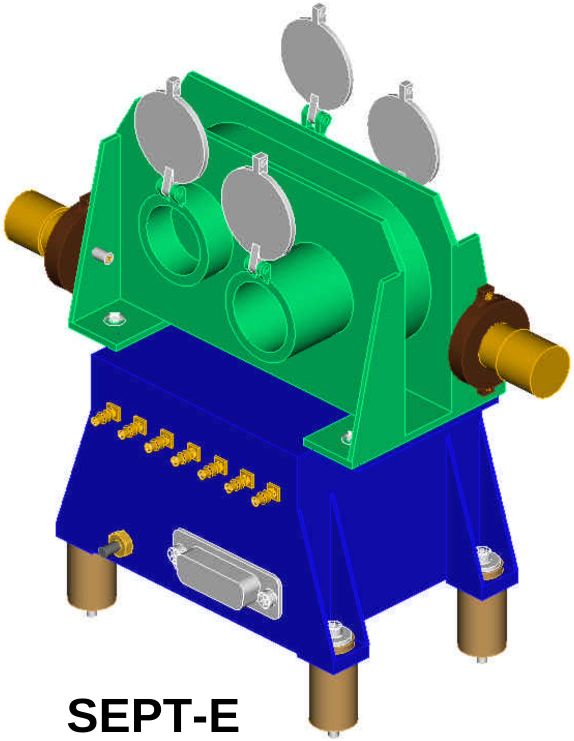
HET/LET/SEP Central



SEP SIT

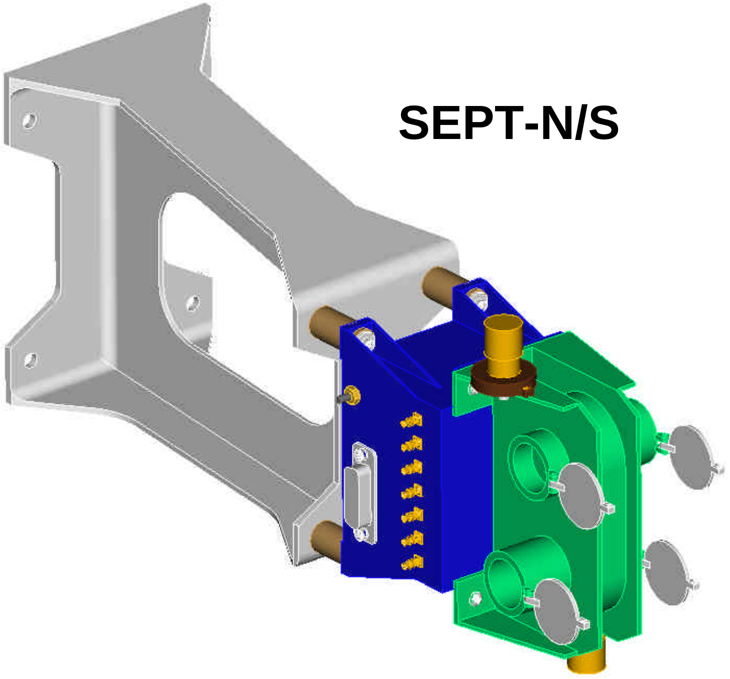

Telescope
Door
Assembly
HVPS
Actuator
Electronics
Enclosure

SEPT

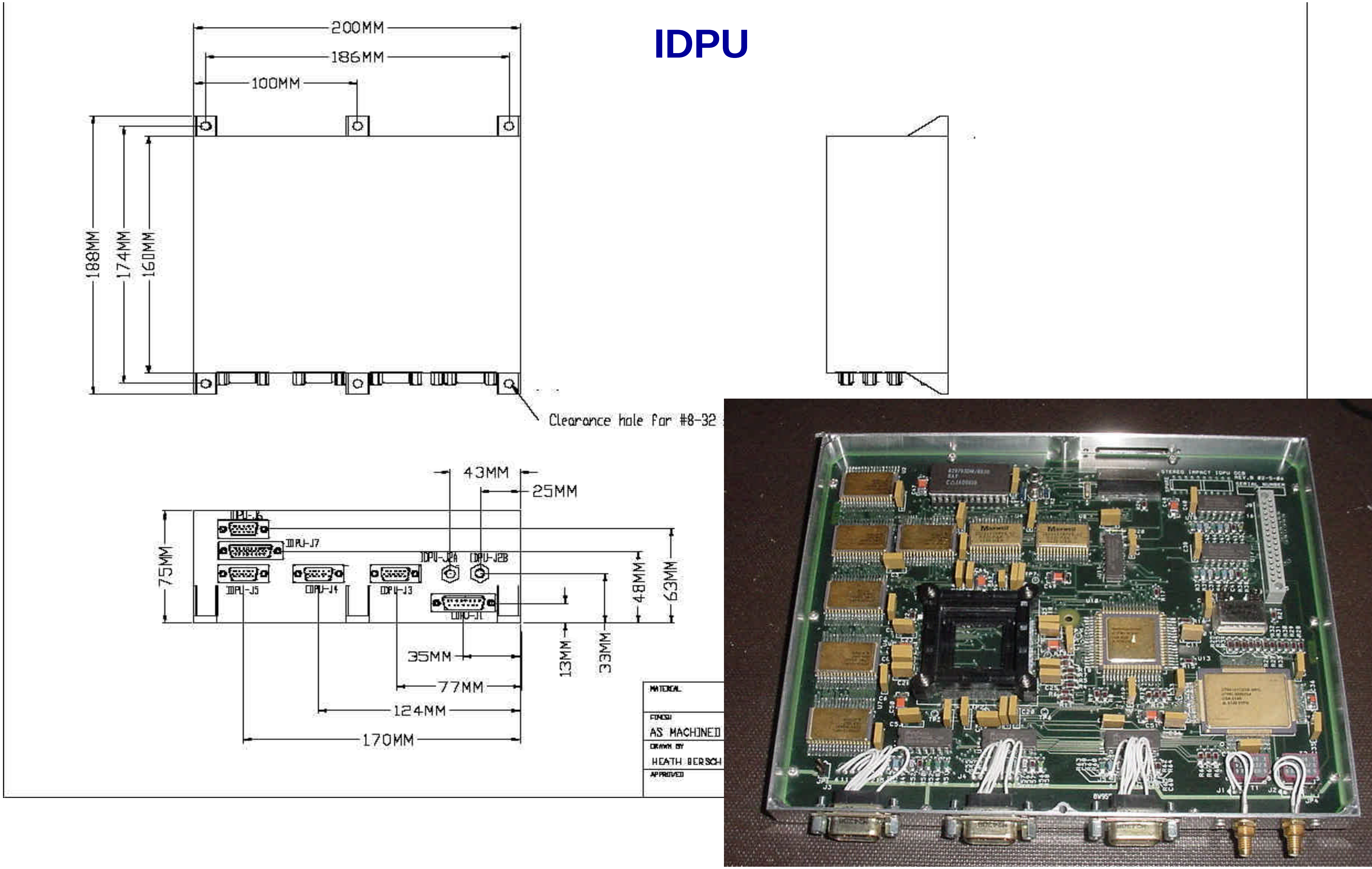


SEPT-E

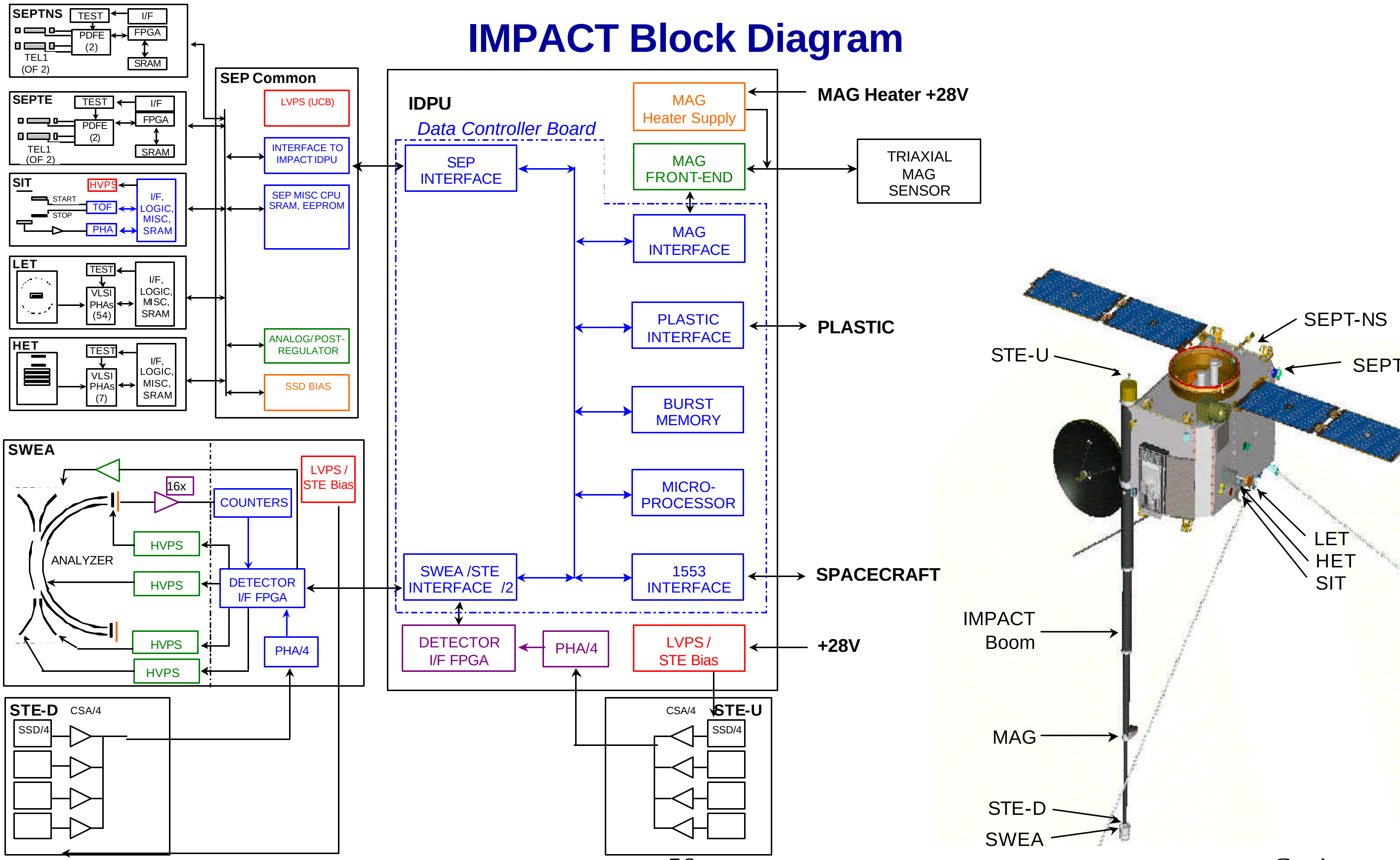
SEPT-N/S



IDPU


200MM
186MM
100MM
188MM
174MM
160MM
Clearance hole for #8-32
43MM
25MM
75MM
IDPU-J6
IDPU-J7
IDPU-J5
IDPU-J4
IDPU-J3
IDPU-J2A
IDPU-J2B
IDPU-J1
48MM
63MM
35MM
77MM
124MM
170MM
13MM
33MM
MATERIAL
FINISH
AS MACHINED
DRAWN BY
HEATH BERSCH
APPROVED

IMPACT Block Diagram



Instrument Top Level Requirements

- Top Level Mission Requirements documented in Mission Requirements Document, 460-RQMT-001
  - which flow down to Instrument Performance Requirements documented in IMPACTPerformanceSpec_H
  - Verification Plan IMPACTRequirementsVerification_B
- Instrument Interface documented in IMPACT/Spacecraft ICD, 7381-9012
- Instrument Resource Requirements documented in 460-RQMT-0034
- Environmental test requirements documented in 7381-9003
  - Implemented in IMPACTEnvTestPlan_B
- Contamination Control requirements documented in 7381-9006
  - IMPACT Contamination Control Plan (In work)
- EMC requirements documented in 7381-9030
- Mission Assurance Requirements based on 460-RQMT-022
  - Implemented in STEREO-IMPACT-PAIP_E
- Programmatic requirements (deliverables, cost, schedule, etc.) covered in IMPACT contract

Magnetometer Performance Specification

Description	Requirement	Goal	Source
Noise level	0.05nT	0.01 nT	Derived from MRD 4.7(K) and solar wind characteristics
Absolute Accuracy	+/-0.1nT	+/- 0.1 nT	MRD 4.7(K)
Range	+/-512 nT	+/-512 nT, +/-65536 nT	MRD 4.7(K)
Drift	+/-0.2nT/yr	+/-0.2 nT/yr	Derived from Absolute accuracy & MRD 4.6.2.6.1
Time Resolution	1 sec	1/4 sec. 1/32 sec. (Burst)	MRD 4.7(K)

SWEA Performance Requirements

Description	Requirement	Goal	Source
FOV	360 x 60 degrees	360 x 130 degree	MRD 4.7(H,I,J)
Resolution	45 degrees	22.5 degree	MRD 4.7(H,I,J)
Energy	20 to 1000eV	1 to 5000eV	MRD 4.7(H,I,J)
Energy Resolution (Telemetry)	100%	65%	Derived from MRD 4.7(H,I,J) & solar wind characteristics
Geometric Factor	0.001 cm^2 ster E(eV)	0.01 cm^2 ster E(eV)	Derived from MRD 4.7(H,I,J) & solar wind characteristics
Max Count Rate (per 22.5 degree sector)	1E5 counts/sec	1E6 counts/sec	Derived from MRD 4.7(H,I,J) & solar wind characteristics
Time Resolution	1 minute	1 minute (3D) to 2 seconds (moments, burst)	MRD 4.7(H,I,J)

STE Performance Requirements

Description	Requirement	Goal	Source
FOV	60 x 60 degree	Two opposite 80 x 80 degree	Derived from MRD 4.7(F,G) & solar wind characteristics
Resolution	60 x 20 degrees	80 x 20 degrees	Derived from MRD 4.7(F,G) & solar wind characteristics
Energy	5 – 100 keV	2 - 100 keV	MRD 4.7 (F,G)
Energy Resolution (Telemetry)	100%	35%	Derived from MRD 4.7(F,G) & solar wind characteristics
Energy Resolution (Electronic)	2keV	300eV FWHM	Derived from lower energy and resolution requirements above.
Geometric Factor	0.1 cm^2 ster	0.4 cm^2 ster	Derived from MRD 4.7(F,G) & solar wind characteristics
Background	<30c/s /detector	<1c/s/detector	Derived from MRD 4.7(F,G) & solar wind characteristics
Max Count Rate (per detector)	10,000 counts/sec	100,000 counts/sec	Derived from MRD 4.7(F,G) & solar wind characteristics
Time Resolution	1 minute	16 seconds 2 seconds (burst)	MRD 4.7 (F,G)

SIT Performance Requirements

Description	Requirement	Goal	Source
FOV	17 x 44 degrees	17 x 44 degrees	Derived from MRD 4.7(F,G) & CME characteristics
Energy	30-2,000 keV/nuc He-Fe	30-2,000 keV/nuc He-Fe	MRD 4.7 (F,G)
Mass Resolution	0.85 AMU (^{4}He at 1MeV/Nuc)	0.85 AMU (^{16}O at 100keV/nuc)	Derived from MRD 4.7(F,G) & CME characteristics
Energy Resolution	35keV FWHM @ 22C	20keV FWHM	Derived from MRD 4.7(F,G) & CME characteristics
Geometric Factor	0.4 cm^2 ster	0.4 cm^2 ster	Derived from MRD 4.7(F,G) & CME characteristics
Background	10^{-2} events/sec during vac test	10^{-2} events/sec in quiet time	Derived from MRD 4.7(F,G) & CME characteristics
Max Event Rate	1000 events/sec	1000 events/sec	Derived from MRD 4.7(F,G) & CME characteristics
Time Resolution	15 Minutes	1 Minute	Derived from MRD 4.7(F,G) & CME characteristics

SEPT Performance Requirements

Description	Requirement	Goal	Source
FOV	2 sets for electrons and protons, each with: 2 oppositely directed view cones in-ecliptic, 2 oppositely directed view cones off-ecliptic, 45 degree full opening angle	2 sets of oppositely directed 52 degree cones each for electrons and protons	Derived from MRD 4.7(F,G) & CME characteristics
Energy	30-400 keV, electrons 60-2000 keV, protons	20-400 keV electrons, 20-7000 keV protons	MRD 4.7(F,G)
Energy Resolution (Telemetry)	30%, electrons 30%, protons	20% electrons, 20% protons	Derived from MRD 4.7(F,G) & CME characteristics
Geometric Factor	0.4 cm^2 ster, electrons, 0.4 cm^2 ster, protons	0.52 cm^2 ster, electrons, 0.68 cm^2 ster, protons	Derived from MRD 4.7(F,G) & CME characteristics
Background	< 2 counts/s on ground, 20°C	< 0.2 counts/s on ground, 20°C	Derived from MRD 4.7(F,G) & CME characteristics
Max Event Rate	25,000 counts/s at 2.2 MeV 250,000 counts/s at 55 keV	25,000 counts/s at 2.2 MeV 250,000 counts/s at 55 keV	Derived from MRD 4.7(F,G) & CME characteristics
Time Resolution	60 sec	60 sec	Derived from MRD 4.7(F,G) & CME characteristics

LET Performance Requirements

Description	Requirement	Goal	Source
FOV	2 oppositely directed 100 x 30 degree fans	2 oppositely directed 130 x 30 degree fans	Derived from MRD 4.7(F,G) & CME characteristics
Energy Range (MeV/nucleon)	H: 1.5 - 3 He: 1.5 - 13 O: 3 – 25 Fe: 3 - 25	H: 1.4 - 6 He: 1.4 - 13 O: 2.5 – 25 Fe: 2.5 - 50	MRD 4.7 (F,G)
Geometric Factor cm^2 ster	H, He: 0.5 5<Z<27: 2	H, He: 0.9 5<Z<27: 4.5	Derived from MRD 4.7(F,G) & CME characteristics
Element Resolution	Resolve H, He, C, N, O, Ne, Mg, Si, Fe	Also resolve Na, Al, S, Ar, Ca	Derived from MRD 4.7(F,G) & CME characteristics
^{4}He Mass Resolution	<0.35 AMU	<0.25 AMU	Derived from MRD4.7(F,G) & CME characteristics
Max Event Rate	1000 events/sec	5000 events/sec	Derived from MRD 4.7(F,G) & CME characteristics
Energy Binning	6 intervals per species forZ>1 3 intervals for H	8 intervals per species for Z>1 4 intervals for H	Derived from MRD 4.7(F,G) & CME characteristics
Species Binning	H, ^{3}He, ^{4}He, C, N, O, Ne, Mg, Si, Fe	Add S, Ar, Ca	Derived from Element Resolution above.
Time Resolution	15 minutes 1 prioritized event/sec	1 minute H, He, 15 minutes Z>5 4 prioritized events/sec	Derived from MRD 4.7(F,G) & CME characteristics
Beacon Telemetry:	1 minute for H, He, 5<Z<27	1 minute for H, He, 5<Z<27	Derived from MRD 6.7.1 & CME charateristics

HET Performance Requirements

Description	Requirement	Goal	Source
FOV (full angle)	50 degree cone	58 degree cone	Derived from MRD 4.7(F,G) & CME characteristics
Energy Range (MeV/nucleon)	1 – 6 13 – 40 16 – 40 ~30 to 80 for 5<Z<15	e: 1 - 8 H, He: 13 - 100 ^{3}He: 16 – 50 ~30 to 80 for 5<Z<27	MRD 4.7(F,G)
Geometric Factor, cm^2 ster	0.5	0.7	Derived from MRD 4.7(F,G) & CME characteristics
Element Resolution, dZ (rms), for stopping particles	< 0.2 for 1<Z<15	< 0.3 for 15<Z<27	Derived from MRD 4.7(F,G) & CME characteristics
^{4}He Mass Resolution	<0.25 amu	<0.20 amu	Derived from MRD 4.7(F,G) & CME characteristics
Max Event Rate	1000 events/sec	5000 events/sec	Derived from MRD 4.7(F,G) & CME characteristics
Energy Binning	Six intervals per species	Eight intervals per species	Derived from MRD 4.7(F,G) & CME characteristics
Species Binning	H, ^{3}He, ^{4}He, 5<Z<15, Electrons	Add 15 < Z < 27	Derived from Element Resolution above.
Time Resolution	15 minutes 0.3 prioritized event/sec	15 minutes 1 prioritized events/sec	Derived from MRD 4.7(F,G) & CME characteristics
Beacon Telemetry:	1 minute H, He, e	1 minute H, He, e	Derived from MRD 6.7.1 & CME charateristics

Resource Utilization

Resource	Current	Max	Margin	Max CDR
Mass	23.7 kg	26.3 kg	10%	23.7 kg
Power	18.2 W	20.3 W	10%	18.2W
Processors				
IDPU CPU	55%	100%	45%	
IDPU RAM	1893 kB	3072 kB	38%	
IDPU Code	19 kB	64 kB	71%	
LET CPU	46%	100%	54%	
LET RAM	66 kW	128 kW	48%	
SIT CPU	60% (*)	100%	40%	
SIT RAM	38 kW	128 kW	70%	
HET CPU	60% (*)	100%	40%	
HET RAM	42 kW	128 kW	67%	
SEP Central CPU	40%	100%	60%	
SEP Central RAM	34 kW	128 kW	73%	
SEP EEPROM Utilization	127 kW	256 kW	51 %	

(*) At max event rate; 18% usage nominal.

Resource Allocations

Stereo Instrument Resource Estimates

2002-Nov-1

Instrument	Mass CBE, kg	Mass NTE, kg	Mass Margin, %	Power CBE, W	Power NTE, W	Power Margin, %	bps
SEP:							
LET	0.87			0.94			557
LET Bracket	0.60						
HET	0.74			0.40			209
SEP Common Elec.	2.45			0.40			
SEP LVPS	0.48			2.23			
SEP Main Total	5.14	5.70	10%	3.97	4.50	12%	766
SIT	1.46	1.63	10%	1.36	1.51	10%	418
SEPT-E	0.67	0.74	10%	0.51	0.57	10%	35
SEPT-NS	0.67	1.04	10%	0.51	0.57	10%	35
SEP-NS Bracket	0.27						
SEP Operational Heaters				3.75			
SEP Blankets	0.12	0.13	10%				
SEP packet headers							53
SEP Grand Total	8.32	9.23	10%	10.11	7.15	11%	1306
BOOM:							
SWEA:							
SWEA (CESR)	1.04			0.55			513
SWEA/STE I/F	0.82			0.30			
SWEA/STE LVPS	0.20			0.64			
SWEA Total	2.06			1.49			513
STE (STE-D)	0.04			0.10			230
SWEA Op Htr				1.00			
STE Op Htr							
MAG Sensor	0.25						398
Mag Op Htr				0.50			
SWEA/STE/MAG Blanket	0.10						
Sunward STE (STE-U)	0.32			0.10			
Boom Harness	0.10						
Boom	9.40						
Boom Totals	12.27	13.57	10%	2.59	1.90	11%	1140
IDPU:							
Mag Card	0.30			0.38			
DIB Card (STE)	0.30			0.20			
DPU Card	0.30			2.30			
S/C Interface (on DPU card)				0.50			
IDPU LVPS	0.40			1.49			
Mag Heater Control	0.07						
BOX	0.65						
IDPU Total:	2.02	2.25	10%	5.47	5.40	10%	113
Total Op Heater				5.25	5.85	10%	
Burst Telemetry							641
Harness (average of A&B)	1.12	1.25	10%				
TOTAL	23.73	26.30	10%	18.17	20.30	10%	3200

Other Resource Issues

Actuator Firing Current	Type	Current@	Time	Who Fires		Type
SWEA Cover	TiNi P5-403	.75A	<100ms	IMPACT		1-time
SIT Cover	TiNi P5-403	.75A	<100ms	S/C		1-time
SEPT Covers	TiNi P5-403	.75A	<100ms	S/C		1-time
STE Cover	SMA	50mA	500ms	IMPACT		Reclosable
BOOM Release	TiNi P50-810-1	3A	<100ms	S/C		1-time
Survival Heaters						
Circuit	**Location**	**Power, W**				
IDPU/MAG	MAG	0.50	(Note 0.75W if in shadow)			
SWEA/STE	SWEA/STE	2.00	Eby estimate 9/2002			
SEP/SEPT-NS/SEPT-E	SEP/SEPT-NS	10.10	CBE 10/2002; Driven by off-pointing			
Total		12.60	NTE	14.4	Margin 13%	

IMPACT Beacon Telemetry Allocation

11/8/2002

Instrument	Data (1 minute averages except MAG)	Bits/Second
MAG	6 vectors/minute	4.80
SWEA	Moments, Pitch Angle Distribution (12A x 2E)	6.67
STE	Flux (3A x 5E)	2.13
HET	Flux (5M x 1-3E)	3.73
LET	Flux (5M x 1-2A x 2-4E)	6.13
SIT	Flux (3M x 4E)	3.20
SEPT	Flux (2M x 4A x 4E)	5.87
Overhead		3.73
Total		36.27

A=Angles, E=Energies, M=Masses

System Verification Matrix

System	EMC	Bakeout	Thermal Vac Cycling (Op/NonOp)	Thermal Balance	Sine Vib	Random Vib	Mass props	Failure Free Hours
SEP								
- SEPT-NS	Mag Screening	√	-25 - +35C -30 - +50C	√	√	√	√	24
- SEPT-E	Mag Screening	√	-25 - +35C -30 - +50C	√	√	√	√	24
- SIT	Mag Screening	√	-20 - +30C -35 - +35C	√	√	√	√	24
- HET, LET, Common Elec.	Mag Screening	√	-20 - +35C -40 - +50C	√	√	√	√	24
Boom Assy		√			√	√	√	
- Boom	Mag Screening		-10 - +20C -70 - +40C	√			Mass	N/A
- SWEA	Mag Screening		-25 - +30C -30 - +50C	√			Mass	24
- STE	Mag Screening		-50 - -30C -50 - +40C	√			Mass	24
- Mag Sensor			-20 - +45C -20 - +45C	√			Mass	24
IDPU	Mag Screening	√	-23 - +55C -30 - +60C		√	√	√	24
Flight Harness		√						
IMPACT Suite	RS,RE,CS,CE per EMC Requiurements							100

SWEA Verification Matrix

HARDWARE DESCRIPTION	TEST	ETU 1	ETU2	FM	SPARE
1/ Component Level					
MCP	Gain			X(CESR)	x (CESR)
Preamplifier	Threshold			x (CESR)	x (CESR)
	Dead Time			x (CESR)	x (CESR)
Optocouplers	Current transfert ratio	X (CESR)	X (CESR)	x (CESR)	x (CESR)
2/ Subsystem Level					
Preampli – board	Electrical tests (gain, threshold)	X (CESR)	X (CESR)	x (CESR)	x (CESR)
HVPS board	Electrical tests	X(CESR)	X(CESR)	x (CESR)	x (CESR)
	Thermal tests & calib.	X(CESR)	X(CESR)	x (CESR)	x (CESR)
All boards (3)	Bake-out			x (CESR)	x (CESR)
3/ Instrument	Vibrations		X(CESR)	X(UCB)	
	Electrical tests	X(CESR)	X(CESR)	x (CESR)	x (CESR)
Environmental tests on complete unit at UCB	Gain and noise tests (in vacuum)	X(UCB)		x (CESR)	x (CESR)
	Beam calibration	X(UCB)	X(CESR)	x (CESR)	
	Interface verification	X(UCB)		x (UCB)	
	Thermal balance	X(UCB)		X(UCB)	
	Thermal test in vacuum	X(UCB)		X(UCB)	X(CESR)

STE Verification Matrix

Verification Matrix for STEREO/IMPACT/STE

Revision Date: 11/7/2002
Revision Number: 2

Hardware Description		Test																		
Level of Assembly	Item	Elect. test, rm. Temp	Bench Calibration	Elect. Test, hot	Elect. Test, cold	Vibration, Sinusoidal	Vibration, Random	Self Shock	Acoustics	Thermal Vacuum	Voltage margins	Thermal cycle	Thermal balance	Life Test	EMC/EMI	Magnetics	Beam Calibration	Bakeout	Contamination	Comments
C	Detector, EM	X																		
C	Detector, F	X																	X	
C	Preamp, BB	X	X																	
I	Instrument, ETU	X	X	X	X			X	A		X						X			
I	Instrument, PF (FM1)	X	X	X	X	H	H	X		X	X		X	X	H	X	X	X	X	
I	Instrument, F (FM2)	X	X	X	X	H	H	X		X	X			X	H	X	X	X	X	

Legend:

Level of Assembly	Unit Type		
C = Component	BB Breadboard	X =	Test required
I = Instrument	EM Engineering Model	A =	Analysis
	PF Protoflight	H =	Test at higher level of assembly
	F = Flight		

MAG Verification Matrix

Verification Matrix for STEREO/IMPACT/MAG

Revision Date: 9/7/01
Revision Number: 1

Hardware Description		Test																	
Level of Assembly	Item	Elect. test, rm. Temp	Bench Calibration	Elect. Test, hot	Elect. Test, cold	Vibration, Sinusoidal	Vibration, Random	Shock	Acoustics	Thermal Vacuum	Voltage margins	Thermal cycle	Thermal balance	>100 hours Operation	EMC/EMI	Magnetics	Bakeout	Contamination	Comments
C	Sensor, EM	X	X																
C	Sensor, F	X	X	X	X	H	H	H		X		X	H	H	H		H	X	
C	Electronics, EM	X	X	H	H									H					
C	Electronics,F	X	X	X	X	H	H	H		H	X	H	H	H	H		H	X	

Legend:

Level of Assembly
C = Component
I = Instrument

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

X = Test required
A = Analysis
H = Test at higher level of assembly
(Boom for sensor, IDPU for electronics)

SIT Verification Matrix

Verification Matrix for STEREO/IMPACT/SEP/SIT

Revision Date: 2002/11/8
Revision Number: 2

Level of Assembly	Item	Vacuum	Alphas	Elect. test, rm. Temp	Bench Calibration	Elect. Test, hot	Elect. Test, cold	Vibration, Sinusoidal	Vibration, Random	Self Shock	Acoustics	Thermal Vacuum	Voltage margins	Thermal cycle	Thermal balance	Life Test	EMC/EMI	Magnetics	Beam Calibration	Bakeout	Contamination	Comments
C	Detectors, F		X									X										
C	Foils PT										X											
C	Telescope PF,F	X	X																		X	
C	Energy board, EM			X		X	X						X									
C	Energy board, F			X																	X	
C	TOF Board, EM			X		X	X						X									
C	TOF Board, F			X																	X	
C	HVPS EM			X		X	X						X									
C	HVPS F			X																	X	
I	Instrument W/O Telescope																			X		
I	Instrument, PF	X	X	X	X	X	X	X	X	X		X	X	X	X	X	H	X	X	X	X	Protoflight levels
I	Instrument, F	X	X	X	X	X	X	X	X	X		X	X	X		X	H	X	X	X	X	Acceptance levels

Legend:

Level of Assembly	Unit Type	
		X = Test required
		A = Analysis
C = Component	BB Breadboard	H = at a higher level
I = Instrument	EM Engineering Model	
	PT Prototype	
	PF Protoflight	
	F = Flight	

SEPT Verification Matrix

Verification Matrix for STEREO/IMPACT/SEPT

Revision Number 2
Revision Date 2002-11-7

Hardware Description				Tests																	
Level of Assembly	Item	Spacecraft	Quantity	Thermal Analysis	Struct. Analysis	Modal Survey/ Sine Sweep	Random Vibration	Self Shock	Acoustics	Mass Properties	Pressure Profile	Mechanical Function	Life Test	EMC/EMI	Magnetics	Leak	Thermal	Thermal Balance	Thermal Vacuum	Bakeout	Comments
I	SEPT-E (T)		1	A	A							X	X		X		X				Engineering Model
I	SEPT-E (PF)	A	1			X	X	X	X	X		X	X	H	X			X	X	X	Test to qualification level
I	SEPT-E (F2)	B	1			X	X	X		X		X	X	H	X			X	X	X	Test to acceptance level
I	SEPT-NS (F1)	A	1			X	X	X		X		X	X	H	X			X	X	X	Test to acceptance level
I	SEPT-NS (F2)	B	1			X	X	X		X		X	X	H	X			X	X	X	Test to acceptance level

Legend:
- A=Analysis
- X=Test
- H=Test at a higher level

HET Verification Matrix

Verification Matrix for STEREO/IMPACT/SEP/HET

Revision Date: 11/12/02
Revision Number: 3

Hardware Description		Tests																					
Level of Assembly	Item	Noise & Brkdown	Thermal vacuum	Alphas &/or Accelerat	Elect. test, rm. Temp	Elect. Test, hot	Elect. Test, cold	Vibration, Sinusoidal	Vibration, Random	Shock	Acoustics	Pressure change	Voltage margins	Thermal cycle	Thermal balance	Life Test	EMC/EMI	Magnetics	Radiation	Leak	Bakeout	Contamination	Comments
C	Detectors, PT	X	X	X	X	X	X		X		X			X								X	Vibration at manufacturer
C	Detectors, F	X	X	X	X	X	X		X					X									Vibration at manufacturer
C	Hybrids, PT				X	X	X												X				
C	Hybrids, F				X	X	X									X				X		X	Also standard class H tests
C	HET board, EM				X	X	X						X										
C	HET board, F				X	X	X						X								X	X	
C	Connectors F																					X	
I	Instrument F1		H	X	X	X	X	H	H	A		A	X		X	X	H	H			X	X	Protoflight levels
I	Instrument, F2		H	X	X	X	X	H	H	A		A	X			X	H	H			X	X	Acceptance Levels

Legend:

Level of Assembly	Unit Type			
			X =	Test required
			A =	Analysis
C = Component	BB =	Breadboard	H = test at a higher level of assembly	
I = Instrument	EM =	Engineering Model		
	PT =	Prototype		
	F =	Flight		
	F1 =	Flight unit #1		
	F2 =	Flight unit #2		

LET Verification Matrix

Verification Matrix for STEREO/IMPACT/SEP/LET

Revision Date: 11/08/02
Revision Number: 5

Level of Assembly	Item	Noise & Brkdown	Thermal vacuum	Alphas &/or particle accelerator	Elect. test, rm. Temp	Elect. Test, hot	Elect. Test, cold	Vibration, Sinusoidal	Vibration, Random	Shock	Acoustics	Pressure change	Voltage margins	Thermal cycle	Thermal balance	Life Test	EMC/EMI	Magnetics	Radiation	Leak	Bakeout	Contamination	Comments
Hardware Description		Tests																					
C	Detectors, PT	X	X	X	X	X	X		X		X			X								X	Acoustics in BB with windows
C	Detectors, F	X	X	X	X	X	X		X					X									
C	Hybrids, PT				X	X	X												X				
C	Hybrids, F				X	X	X									X				X		X	Also standard class H tests
C	LET detector/MISC board, EM				X	X	X						X										
C	LET detector/MISC board, F				X																X	X	
C	Connectors, F																					X	
C	Windows, BB								X		X			X									Include L1 detectors for vib & acoustics
I	Instrument, F1		H	X	X	X	X	H	H	A	X	A	X		X	X	H	H			X	X	Protoflight levels for vib; full EMC at suite
I	Instrument, F2		H	X	X	X	X	H	H	A	X	A	X			X	H	H			X	X	Acceptance levels for vib; workmanship for EMC

Legend:

Level of Assembly	Unit Type		Key	
			X =	Test required
			A =	Analysis
C = Component	BB =	Breadboard	H =	test at a higher level of assembly
I = Instrument	EM =	Engineering Model		
	PT =	Prototype		
	F =	Flight		
	F1 =	Flight unit #1		
	F2 =	Flight unit #2		

SEP Central Verification Matrix

Verification Matrix for STEREO/IMPACT/SEP/SEP Central

Revision Date: 11/08/02
Revision Number: 3

Hardware Description		Tests																				
Level of Assembly	Item	Noise & Brkdown	Thermal vacuum	Alphas	Elect. test, rm. Temp	Elect. Test, hot	Elect. Test, cold	Vibration, Sinusoidal	Vibration, Random	Shock	Acoustics	Pressure change	Voltage margins	Thermal cycle	Thermal balance	Life Test	EMC/EMI	Magnetics	Leak	Bakeout	Contamination	Comments
C	LVPS, EM				X	X	X						X				X					
C	LVPS, F				X												X				X	
C	Analog Post-reg, EM				X	X	X						X									
C	Analog Post-reg, F				X															X	X	
C	Detector bias supply, EM				X	X	X						X									
C	Detector bias supply, F				X															X	X	
C	Logic board, EM				X	X	X						X									
C	Logic board, F				X															X	X	
C	Connectors, F															X					X	
C	Harnesses, F																				X	
I	Instrument, EM				X	X	X						X									Electrical EM only
I	Instrument, F1		H		X	X	X	H	H	A		A	X		X	X	H	H		X	X	Protoflight levels for vib; full EMC at suite
I	Instrument, F2		H		X	X	X	H	H	A		A	X			X	H	H		X	X	Acceptance levels for vib; workmanship EMC

Legend:

Level of Assembly	Unit Type		Tests	
			X =	Test required
			A =	Analysis
C = Component	BB =	Breadboard	H =	test at a higher level of assembly
I = Instrument	EM =	Engineering Model		
	PT =	Prototype		
	PF =	Protoflight		
	F =	Flight		
	F1 =	Flight unit #1		
	F2 =	Flight unit #2		

IDPU Verification Matrix

Revision Date: 11/06/02
Revision Number: 2

Hardware Description		Test																	
Level of Assembly	Item	Elect. test, rm. Temp	Elect. Test, hot	Elect. Test, cold	Vibration, Sinusoidal	Vibration, Random	Shock	Acoustics	Pressure change	Voltage margins	Thermal Vacuum	Thermal balance	>100 hours Operation	EMC/EMI	Magnetics	Leak	Bakeout	Contamination	Comments
C	PWB, EM	X								X									
I	IDPU EM	X	X	X						X			X	X					EMC CE test on EM
C	PWB, F	X								X							X		
I	IDPU, F	X	X	X	X	X			A	X	X		X	H	X		X	X	EMC at Suite level

Legend:

Level of Assembly
- C = Component
- I = Instrument

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

- X = Test required
- A = Analysis
- H = at higher level of assembly

IMPACT Boom Verification Matrix

Verification Matrix for STEREO/IMPACT/Boom

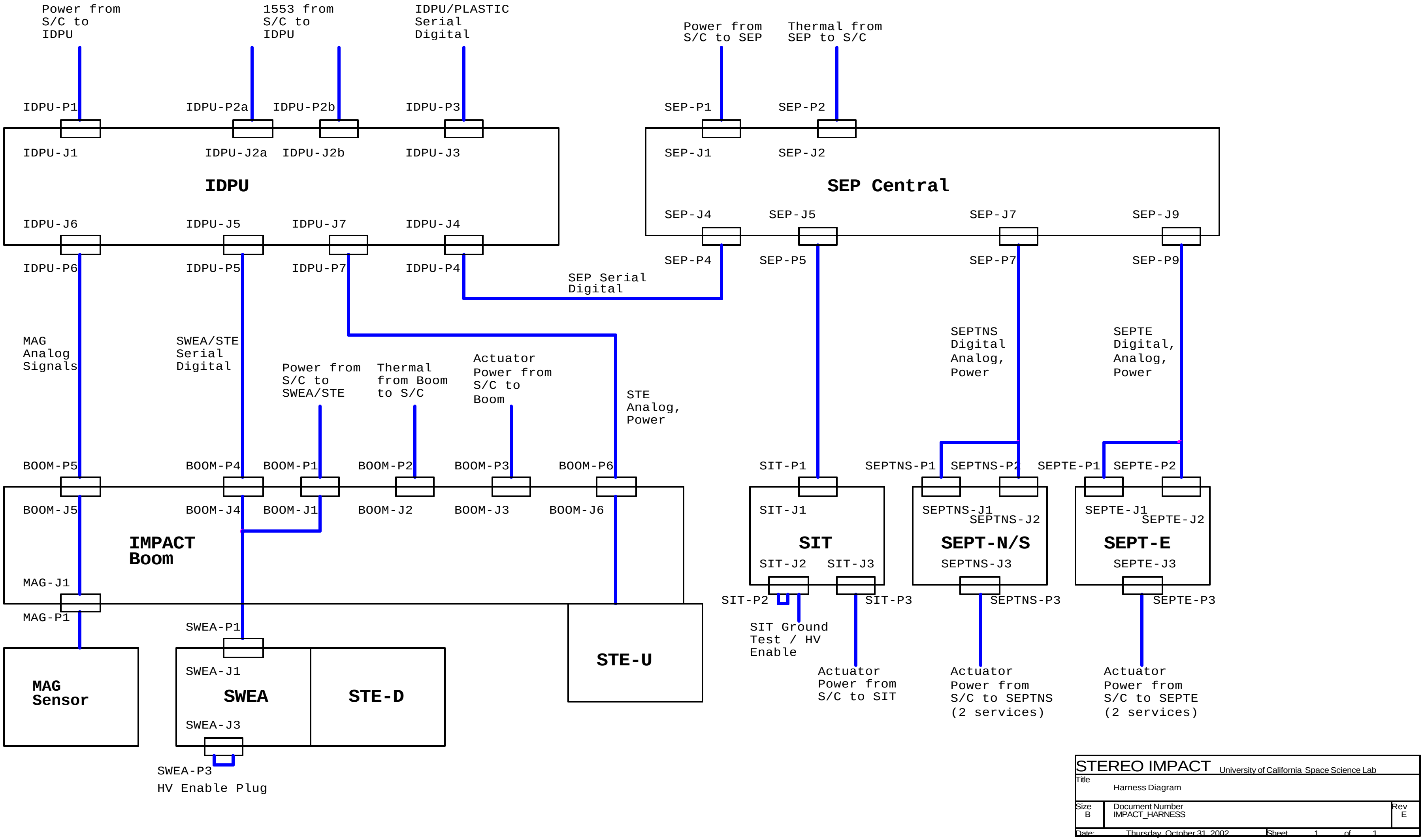
Revision Date: 11/14/02
Revision Number: 3

Hardware Description		Test																
Level of Assembly	Item	Deploy Test, Room Temperature	Deploy test, Thermal Vac	First Motion, Thermal Vac	Stiffness, Proof Load	Vibration, Sinusoidal	Vibration, Random	Shock	Acoustics	Thermal Vacuum	Thermal cycle	Thermal balance	EMC/EMI	Magnetics	Bakeout	Deployment contamination	Contamination Inspection	Comments
C	Proto	X			X													
C	EM	X			X	X	X	X								X		Qual levels
C	PF/FS	X	X		X	X	X	X		X	X			X				Protoflight levels
C	FM1	X		X	X	X	X	H		X	X	X	X	X	H		X	Acceptanec levels
C	FM2	X		X	X	X	X	H		X	X			X	H		X	Acceptance levels

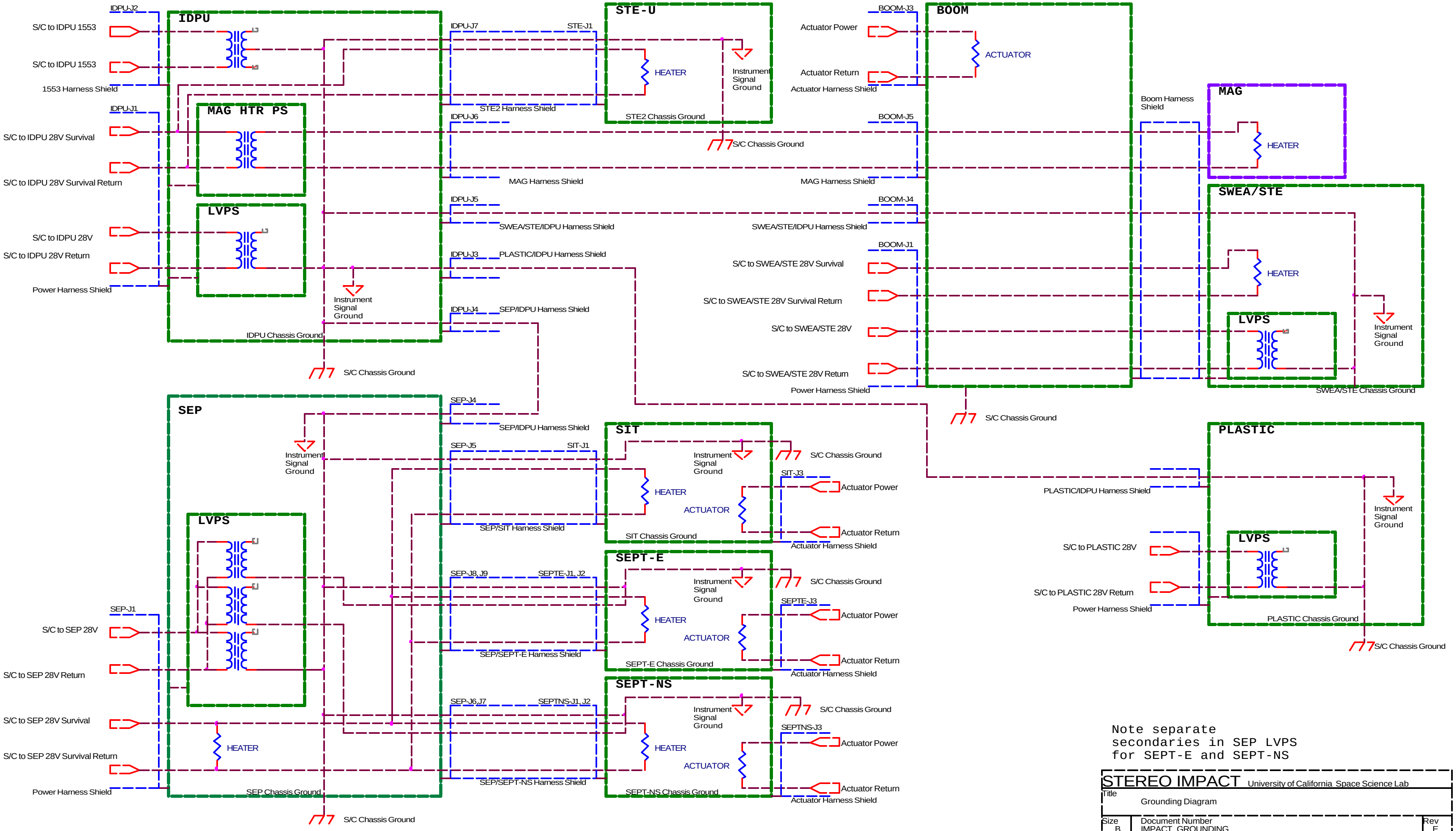
Legend:

Level of Assembly	Unit Type		Test
			X = Test required
			A = Analysis
C = Component	BB =	Breadboard	H = Test at higher level of assembly (with instruments)
I = Instrument	EM =	Engineering Model	
	PT =	Prototype	
	PF/FS =	Protoflight / Flight Spare	
	FM1 =	Flight unit #1	
	FM2 =	Flight unit #2	

IMPACT Harness Diagram



IMPACT Grounding Diagram



EMC

- **IMPACT meets the design requirements imposed in the EMC Requirements Document, 7381-9030, with the following exceptions:**

Waiver	Description	Status
EMC1	IDPU Single-ended interfaces	EMC & CCB Approved
EMC2	SEP to SIT secondary power distribution	EMC & CCB Approved
EMC3A	SEP Bias Supply not synchronized	EMC & CCB Approved
EMC4	IDPU to STE-U secondary power distribution	EMC & CCB Approved
EMC5	IDPU to STE-U Single-ended interface (analog)	EMC & CCB Approved
EMC6	SEP to SEPT single ended interfaces (digital)	Approved by EMC, forwarded to CCB
EMC7	STE Door Actuators	Approved by EMC, forwarded to CCB
EMC8	Use of combined Signal/Power harnesses	EMC & CCB Approved

- **IMPACT will verify that it meets the CE requirements at the power converter subsystem tests**
- **IMPACT will verify it meets the full EMC requirements at a suite-level EMC test**

Electrostatics

- **IMPACT is one of the chief drivers for Electrostatic Cleanliness**
  - **SWEA is measuring electrons down to 1eV, requiring good exterior conductivity**
  - **ESC is also important to reduce the risk of dielectric discharge**
- **IMPACT has performed analyses to help focus the ESD requirements**
  - **Relieved requirement for conductivity of front face of solar arrays and a fraction of the bus sun-facing surface**
- **All IMPACT exterior surfaces shall meet the conductivity requirement**
  - **The boom GrE tubes have been specially prepared to meet the requirement**
  - **The boom GrE tubes ETU have been measured and pass**

Contamination Control

- **IMPACT meets the Contamination Control Plan 7381-9006 requirements**
  - **As documented in the IMPACT Contamination Control Plan (In work)**
- **Materials Lists have been provided to Project**
  - **Some materials issues have been identified and are being worked**
  - **One small quantity non-compliant epoxy may require a waiver / MUA**
- **Instrument internal sensitivities mostly dealt with using covers and purge**
- **Components shall be cleaned prior to integration into higher level assemblies**
- **Assembled units will be kept mostly bagged**
- **An additional final pre-delivery cleaning and bakeout will be require to meet the Observatory level Contamination Control requirements**

Configuration Control

- Configuration Control covered by Project and IMPACT Documents
  - STP document 460-PG-1410.2.1B
  - IMPACT Configuration Control Plan
- Project-level CCB controls Class 1 changes
  - Requirements, Mass, Power, Spacecraft interface, etc.
  - IMPACT PM takes the lead role in interfacing with Project CM
- IMPACT CCB controls Suite-level changes
  - Mass allocations amongst suite, suite interfaces, suite documentation, etc.
  - All documents maintained on a web site
- Subsystem leads control low level design documentation
  - Schematics, As-built drawings, Travelers, Software
  - Plan defines red-line process, requirements and resource controls, etc.
  - Comes under suite-level CM at the time of subsystem delivery
- Problem & Failure reporting as described in the IMPACT PAIP

Interface Control Documents

- **IMPACT/Spacecraft ICD (APL document 7381-9012)**
- **IMPACT/SWAVES ICD (IMPACT-SWAVES-ICD_A)**
- **PLASTIC Flight Software Requirements**
  - **PLASTIC_DPU_July_2002**
  - **PLASTIC_Commands**
- **IDPU/Instruments ICD (IMPACTSerialInterface_G)**
- **UCB/CESR SWEA ICD (SWEAICD_E)**
- **Power Converter Requirements (LVPS_Requirements_B)**
- **MAG Interface Card Outlines**
  - **MAG PC BOARD_REV3**
  - **MAG HEATER PC BOARD**
- **MAG Sensor ICD (MAG_Sensor_ICD_A)**
- **Harness wiring and pinouts (IMPACT_Harness_C)**
- **IDPU Software Requirements (IDPUSoftwareRequirements_C)**

Interface Control Documents, Continued

- HET-SEP_Central ICD (STEREO-CIT-008.A)
- LET-SEP_Central ICD (STEREO-CIT-009.A)
- SEPT-SEP_Central ICD (STEREO-CIT-010.A)
- SIT-SEP_Central ICD (STEREO-CIT-011.A)
- LET & SEP Central Software Requirements (STEREO-CIT-002.E)
- HET Software Requirements (HETRequirements)
- SIT Software Requirements (SITRequirements)

System Design Changes since PDR

- **Normal mass an power growth as design matures**
  - Significant survival and operational heater power growth resulting from detailed thermal analysis
- **SEPT ion energy threshold raised due to measures taken to minimize the risk of glint**
  - Waiver/Deviation Request to MRD requirements submitted to Project
  - Lost energy band covered by PLASTIC
- **Boom deployment heater added (5W)**
  - Ensures the boom deployment mechanism temperature is known at the time of deployment
  - Simplifies design and test of mechanism