STEREO/IMPACT Team Meeting

GSFC/IMPACT Status Report

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UC Berkeley
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GSFC/IMPACT Tasks

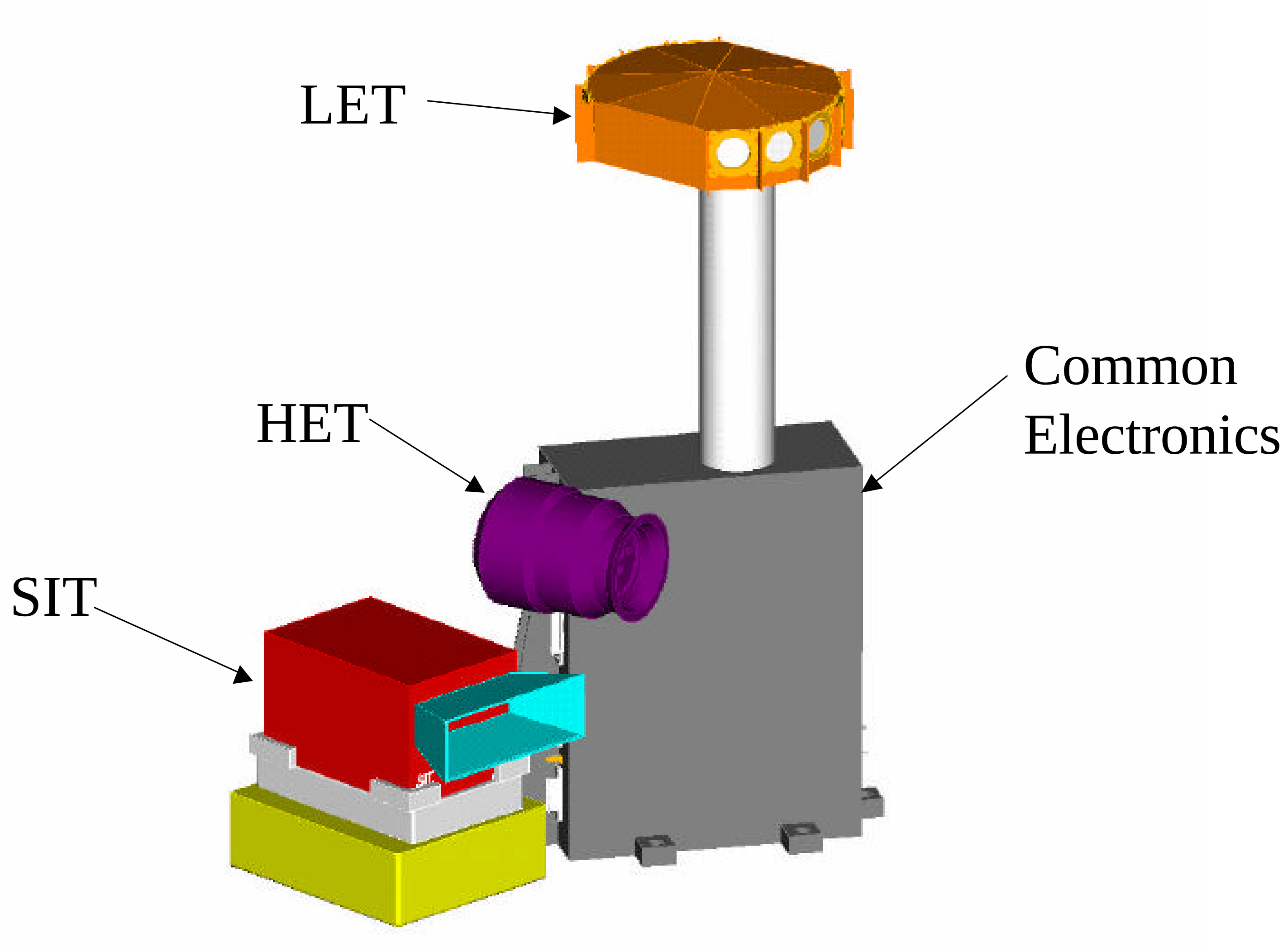
- HET
- SIT
  - Mechanical
  - ACTEL Chip: MISC + Front-End Logic
  - MISC Software
- SEP
  - Mechanical design of SIT, LET, HET + Common
  - Thermal design of SIT, LET, HET + Common
  - Act as SEP Coordinator

SEP Mechanical Design

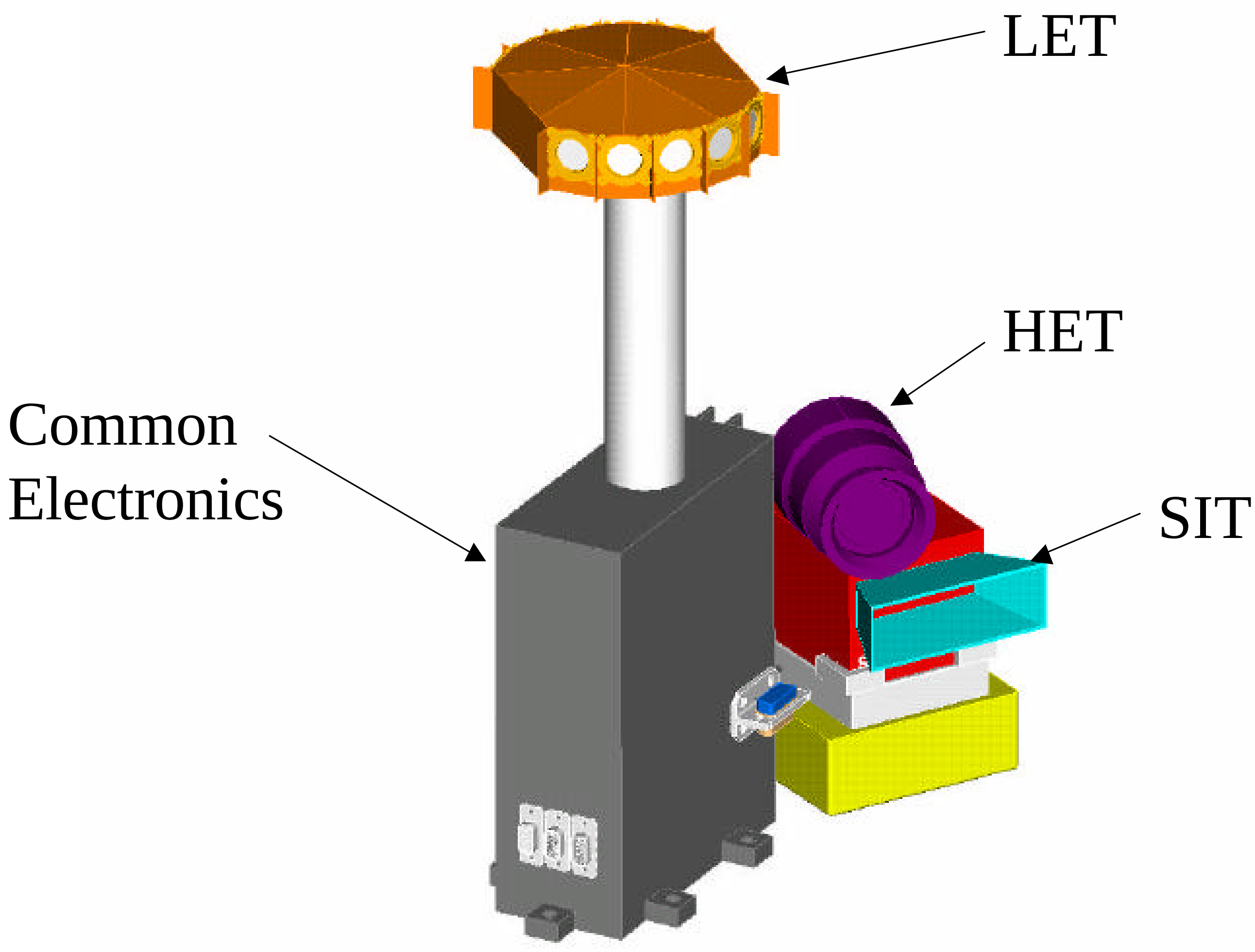
- SIT sensor engineering model has been assembled from WIND spare parts and delivered to UofMD
- Extensive ICD drawings for SEPT, SIT, LET and HET are available at

  http://sprg.ssl.berkeley.edu/impact/dwc/ICD
- LET L1 mounts have been designed and ordered
- Design of remaining HET and LET detector mounts is ongoing

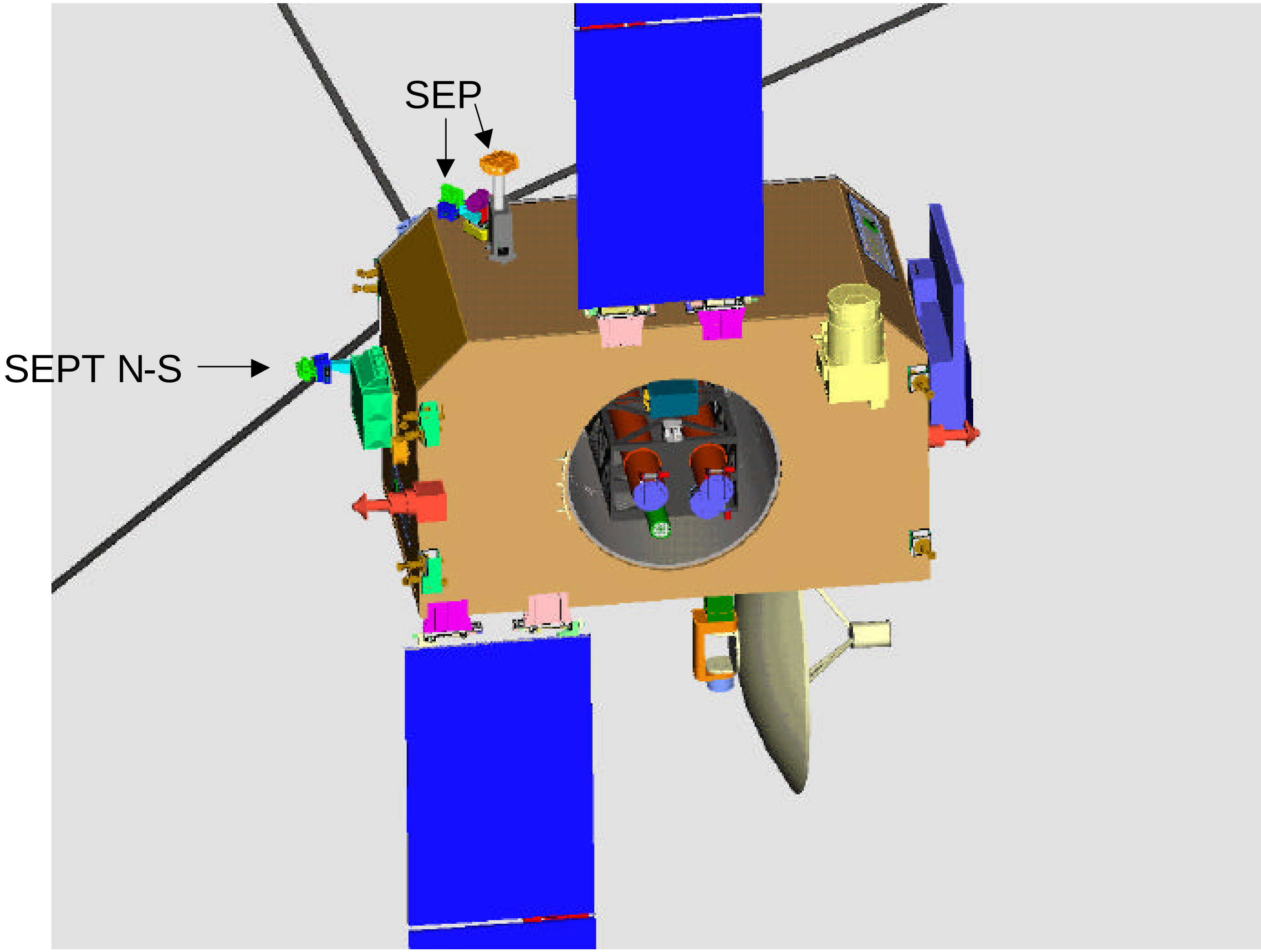
Ahead SEP Configuration



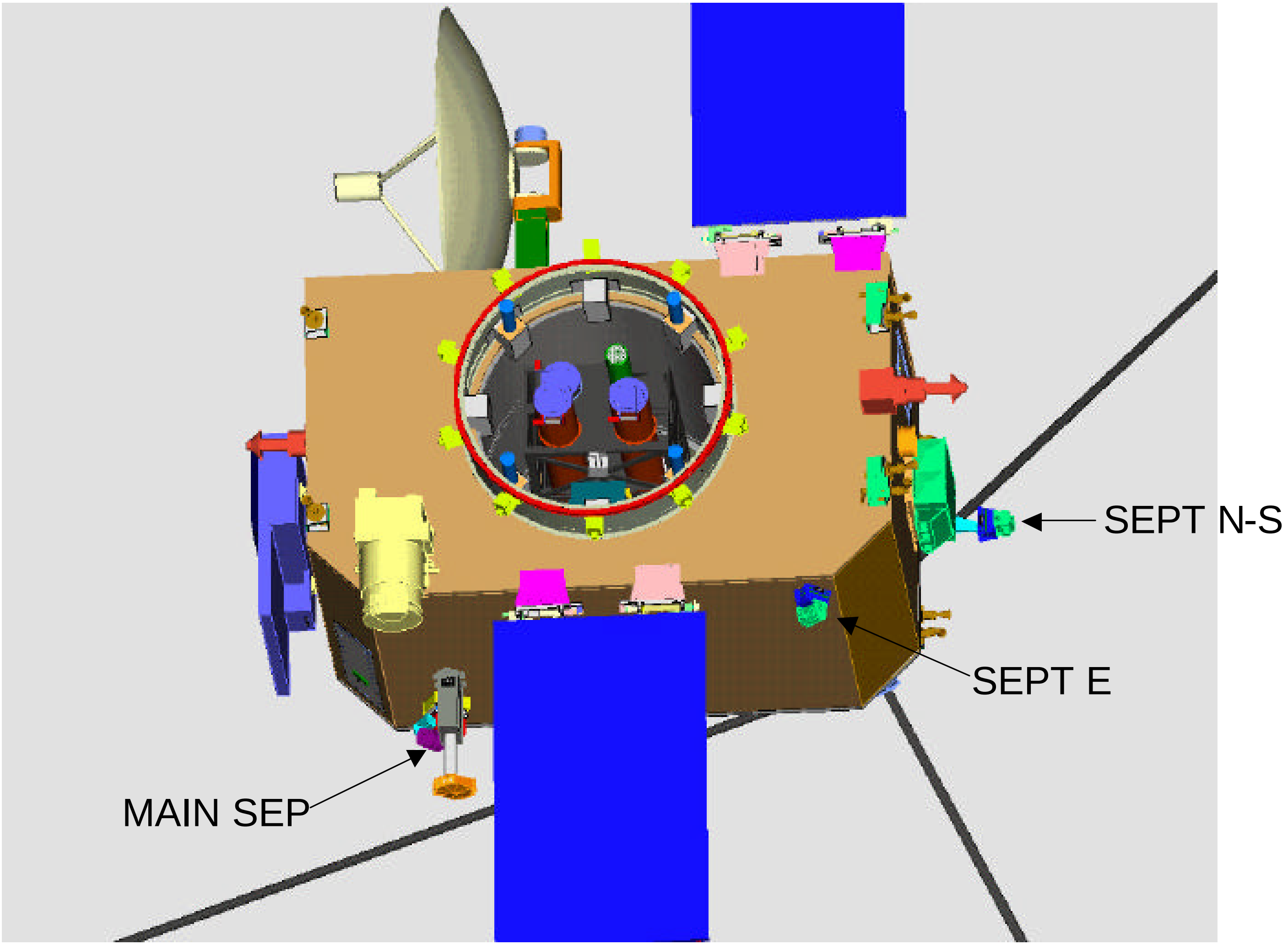
Behind SEP Configuration



SEP Locations on the Ahead Spacecraft



SEP Locations on the Behind Spacecraft



MISCs for SIT and HET

- 4 Minimum Instruction Set Computers (MISCs) are being used to control SIT, LET, and HET, to process data from each on-board, and to provide a Central DPU for SEPT, SIT, LET and HET
- This distributed architecture minimizes the interaction between sensors and facilitates independent testing of each sensor
- The SIT, LET, and HET MISCs each reside on a single Actel chip together with the corresponding sensor front-end logic
- EEPROM for the SIT, LET, and HET MISCs resides with the Central DPU

MISCs for SIT and HET, cont.

- All 4 MISCs have the same functional design
- The MISCs for LET and the Central DPU were laid out by Caltech using graphical schematic capture and will be programmed in FORTH
- The MISCs for SIT and HET were laid out by GSFC using Verilog and will be programmed in the MISC native assembly language
- The GSFC MISCs have been tested using a FORTH kernel and FORTH code from Caltech and appear to work identically to the Caltech MISC

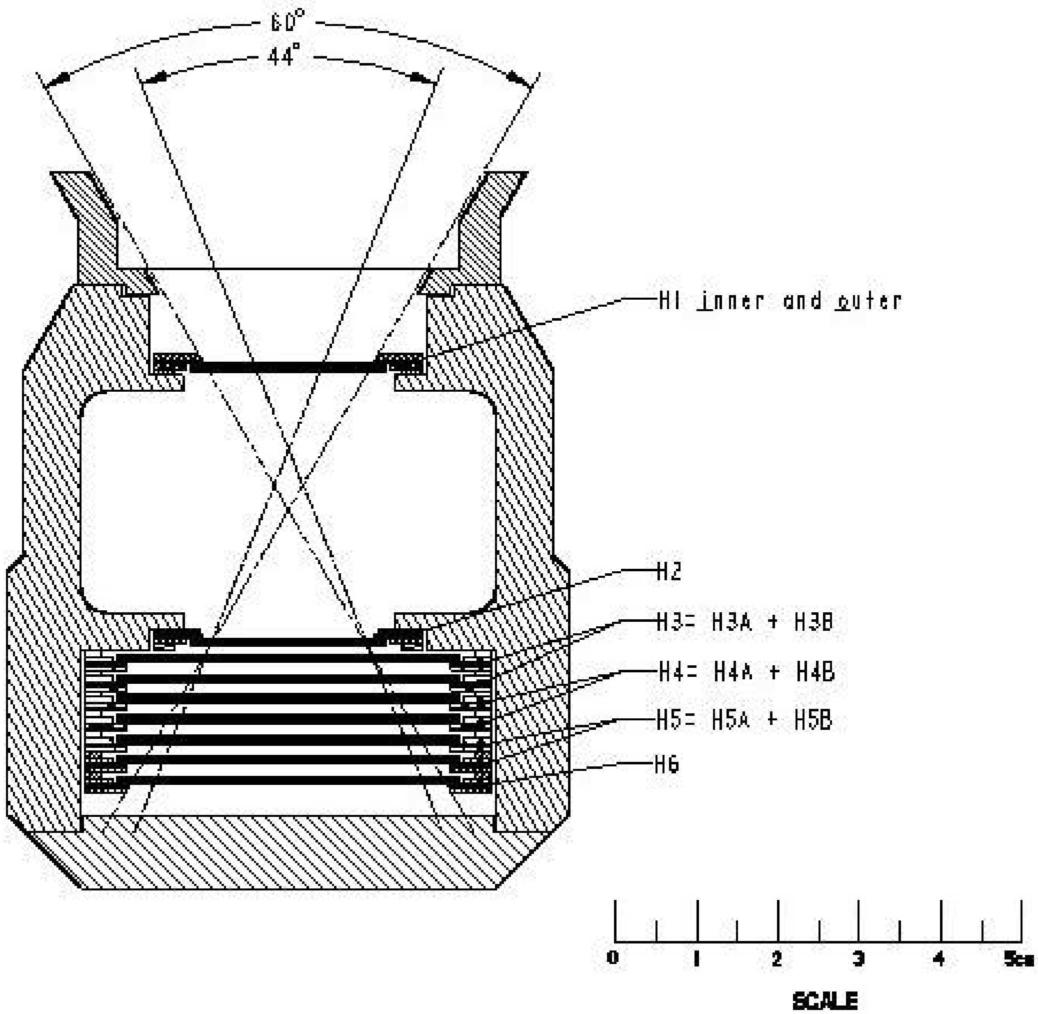
MISCs for SIT and HET, cont.

- An assembler/linker has been written for the GSFC MISC
- An on-board debug monitor and a Windows-based debugger have been completed
- Initial SIT and HET code has been written and tested
- A software development plan has been completed for SIT and HET on-board software

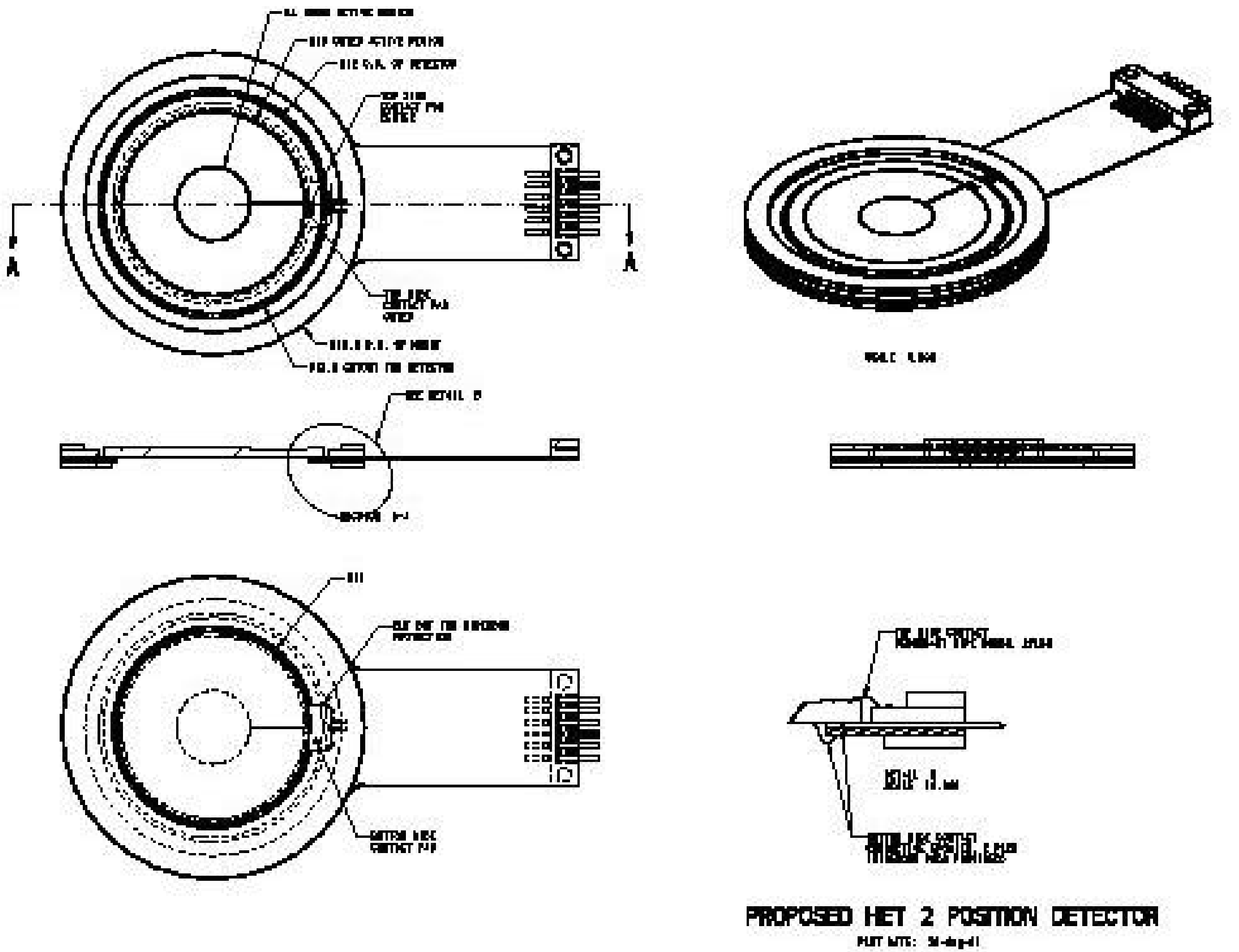
HET

- Measures
  - electrons: 1 – 6 MeV
  - H, He: 13 – 100 MeV/n
  - ^{3}He: 16 – 50 MeV/n (resolution < 0.25 AMU)
  - $5<Z<27$ ~ 30 to 80 MeV/n
- Geometry Factor = 0.7 cm^2-sr
- Maximum event rate: 5000 events/sec
- On-board particle identification and binning
- Beacon Data: H, He, e; 1-minute time resolution

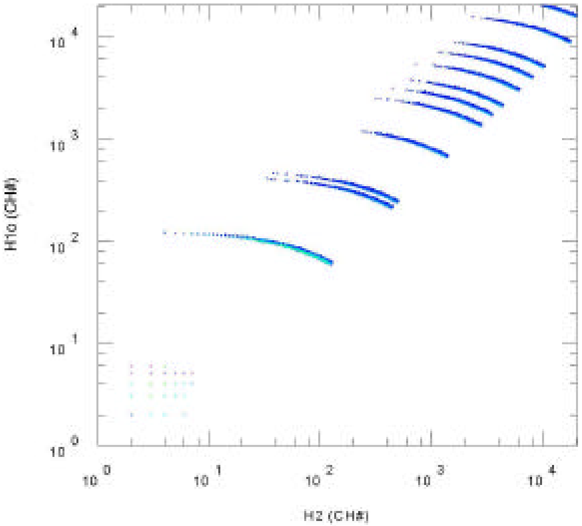
HET Telescope Schematic

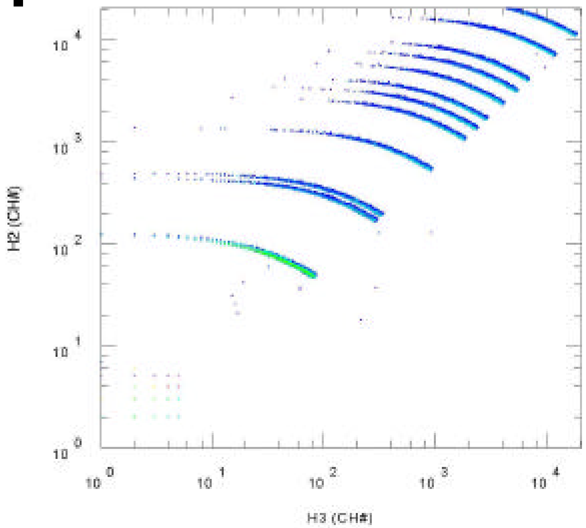


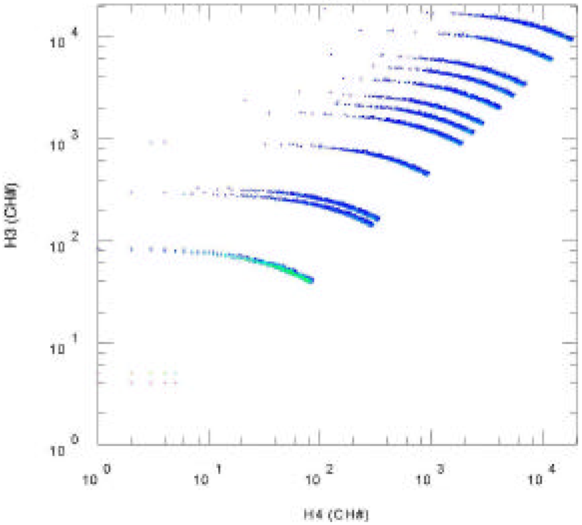
HET H1 Detector Schematic

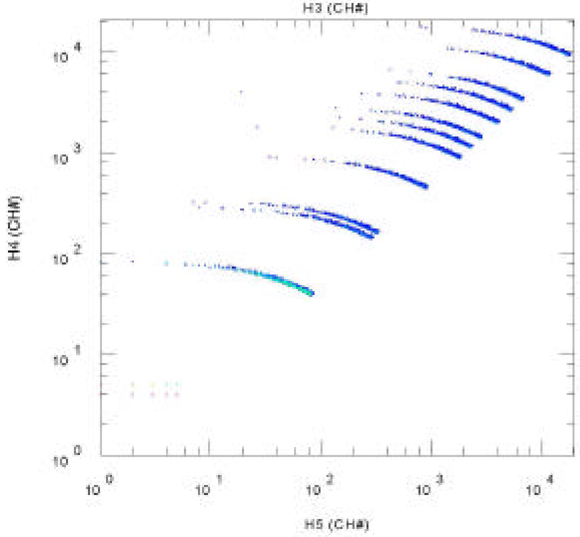


HET Response

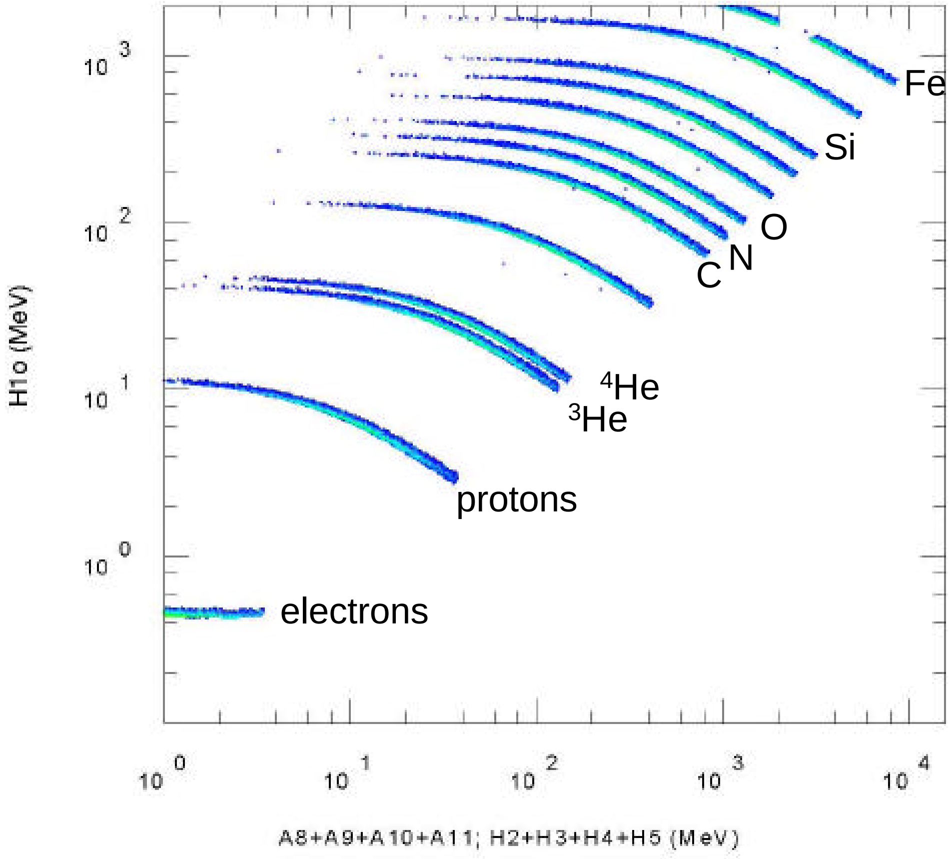








HET Composite Response



SEP Thermal Status

Environmental Heat Inputs

- Incident Solar Flux Determined by Spacecraft Perihelion and Aphelion
  - Solar Flux at 1 AU: 1366.5 W/m^2

Ahead S/C	Extreme	Solar Flux
Perihelion	0.879 AU	1768.6 W/m^2
Aphelion	1.040 AU	1263.4 W/m^2

Behind S/C	Extreme	Solar Flux
Perihelion	0.960 AU	1482.7 W/m^2
Aphelion	1.131 AU	1068.3 W/m^2

Thermal Coatings

- MLI Blanket Outer Layer:
  - ITO Silver Conductive Composite Coating

Optical Properties				Effective Emittance (ε^*)
$a_{(bol)}$	$\varepsilon_{(bol)}$	$a_{(eol)}$	$\varepsilon_{(eol)}$	0.03 - 0.01
0.1	0.68	0.2	0.64	

- Radiators
  - ITO Silver Conductive Composite Coating
    - Deposited on Kapton and Bonded to Aluminum or Deposited Directly on the Aluminum

OPERATIONAL HEATER POWER

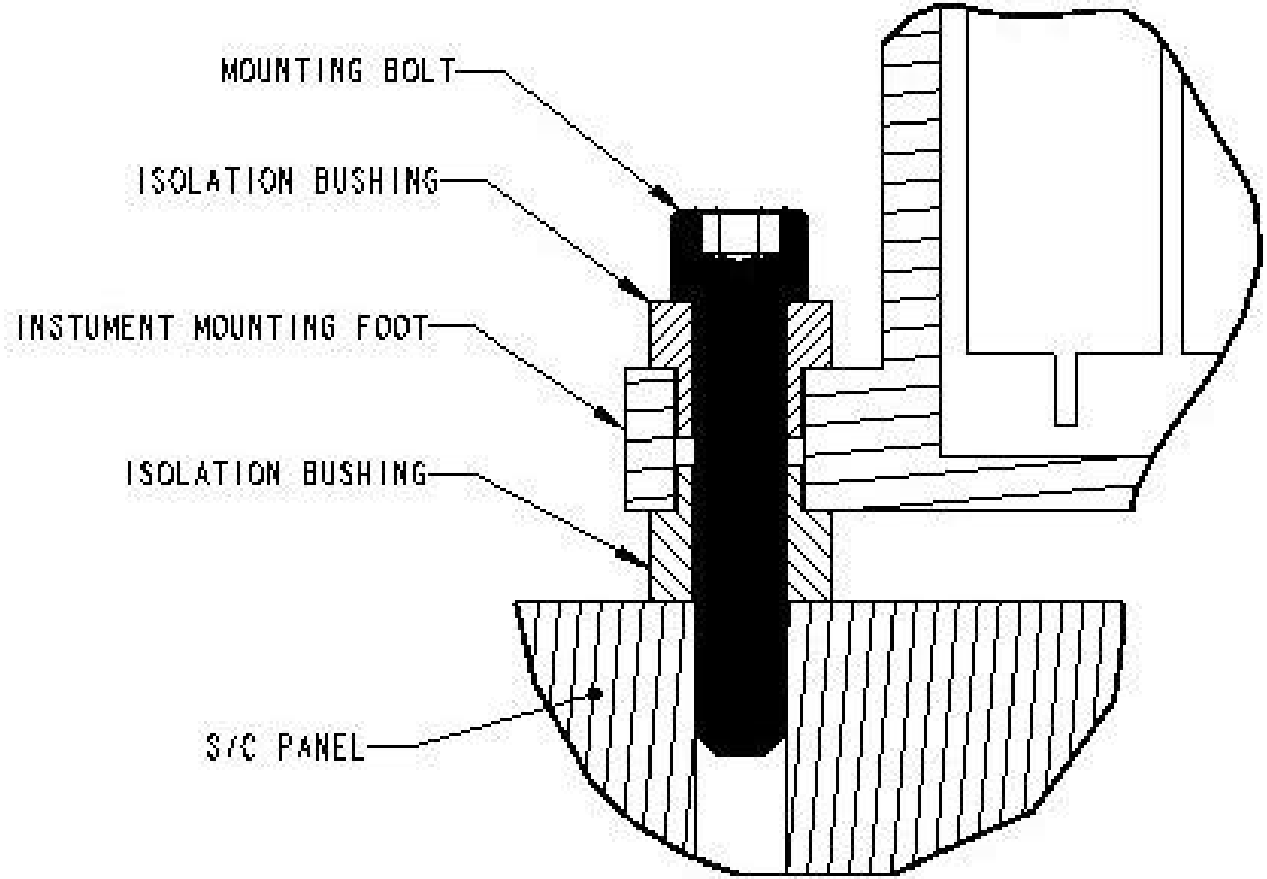
Spacecraft Interface Temp		Interface Resistance		
-23C to 55C		20.0 C/W		
Component	Operating Temp	Heater Power	Operating Temp	Heater Power
	C	watts	C	watts
HET		0.79		0.56
Detectors	-15 T0 +10		-25 T0 +10	
Electronics	-15 T0 +10		-25 T0 +10	
LET		0.82		0.47
Detectors	-15 T0 +10		-25 T0 +10	
Electronics	-15 T0 +10		-25 T0 +10	
SIT		2.64		1.53
Detectors	-15 T0 +10		-25 T0 +10	
Electronics	-15 T0 +10		-25 T0 +10	
SEPT/E		1.90		0.97
Detectors	-15 T0 +10		-25 T0 +10	
Electronics	-15 T0 +10		-25 T0 +10	
SEPT/NS		1.90		1.10
Detectors	-15 T0 +10		-25 T0 +10	
Electronics	-15 T0 +10		-25 T0 +10	
Central Electron	-15 T0 +10	1.98	-25 T0 +10	0.90
TOTAL		**10.03**		**5.53**

Installed heaters would be 25% larger than heater power shown for required margin.

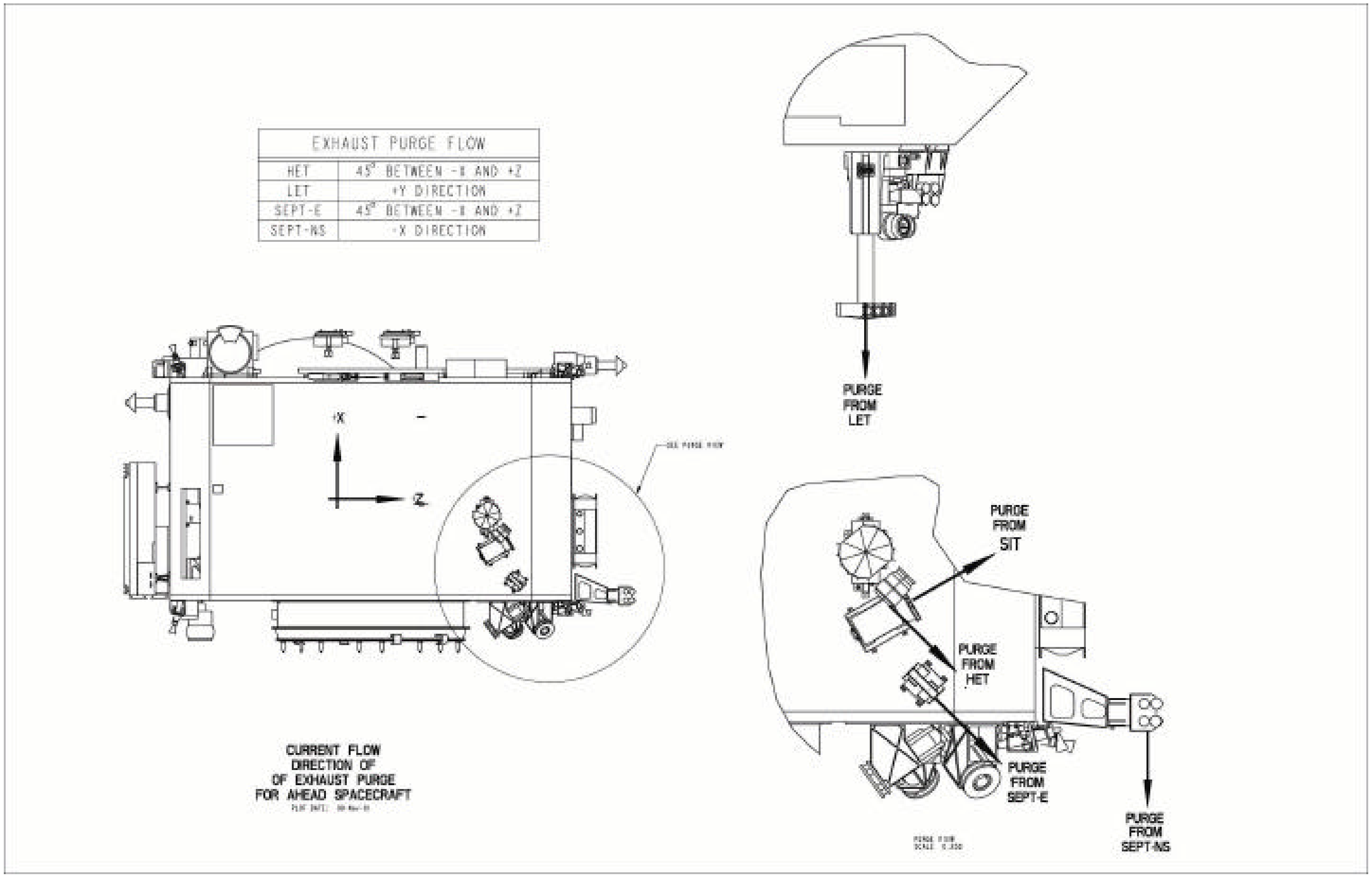
Current Efforts to Reduce Operational Heater Power

- Use Updated Spacecraft Interface Temperatures
  - Instrument Thermal Interface Parameters in Requirements Documents would need to be Revised
- Relax Operating Temperature Limits
  - Internal Operating Limits in Requirements Documents would need to be Revised
- Increase Interface Resistance
- Demonstrate Reduced End of Life Heater Power Requirements

Typical Mounting Foot Showing Thermal Isolation

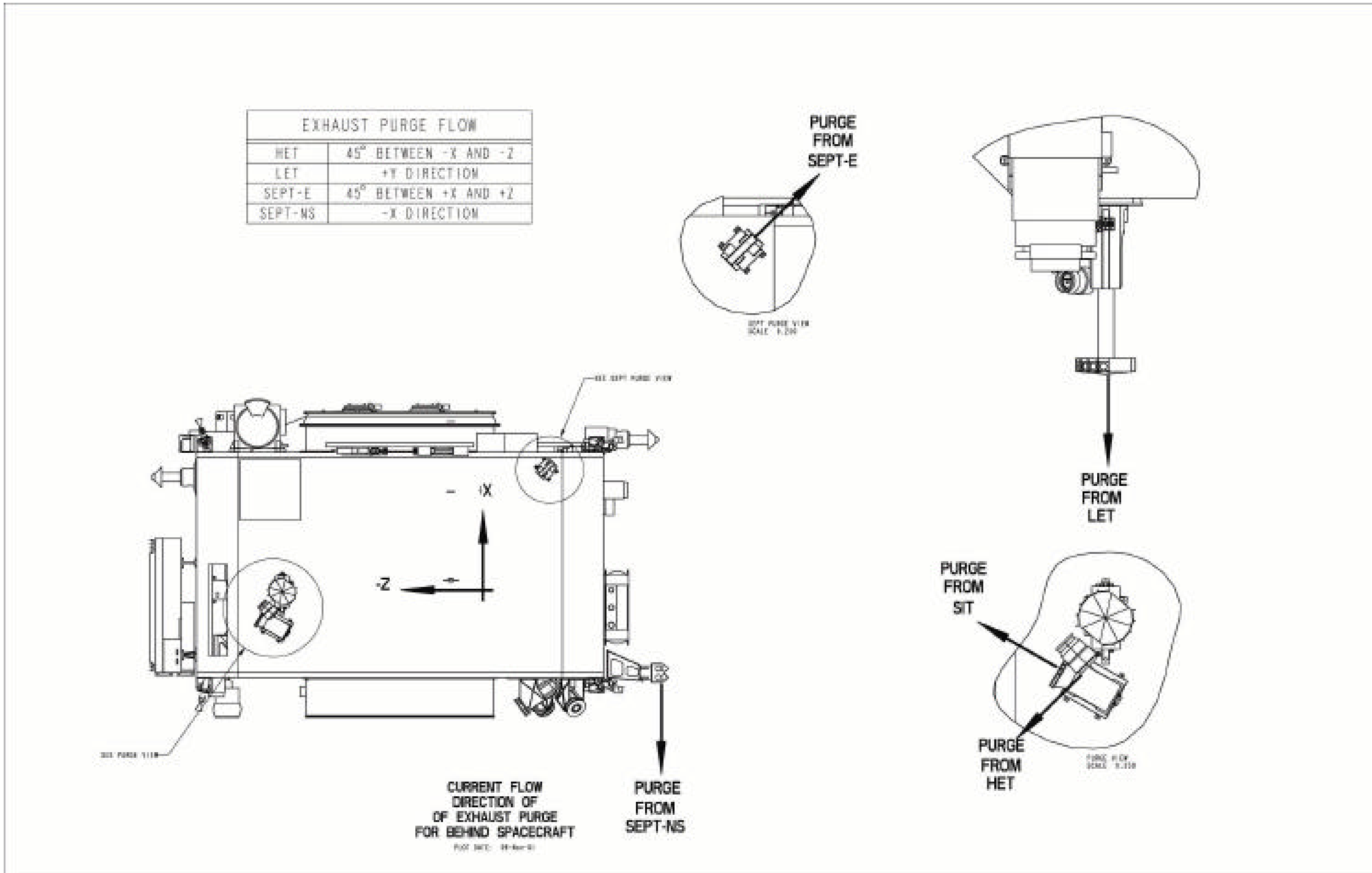


SEP Purge Flows on the Ahead Spacecraft



SEP Purge Flows on the Behind Spacecraft

EXHAUST PURGE FLOW	
HET	45° BETWEEN -X AND -Z
LET	+Y DIRECTION
SEPT-E	45° BETWEEN +X AND +Z
SEPT-NS	-X DIRECTION



SEP Issues

- Low Voltage Power Supply
  - Weight delta due to separate windings for SEPT
  - Will need to revise design for SEP Central Electronics and revise ICD drawings accordingly
- Thermal Design
  - VLSI lower operating temperature limit is TBD
  - Survival Heater Requirement
    - Survival Power Requirement is TBD
    - Survival heaters and their cables must be shielded to meet EMC requirements
    - Expected APL to be responsible for providing survival heaters and thermostats; this responsibility has been shifted to us; will require additional weight

SEP Issues, cont.

- Surface Cleanliness at Delivery
  - 300 A being requested by APL versus 500 B proposed by us
- The SEP teams want to be able to send commands and receive telemetry remotely using internet connections
  - This will significantly reduce the need for personnel to be located at APL during integration and test and hence reduce costs
- SEPT-N/S Location
- L1 Detectors (see LET presentation)