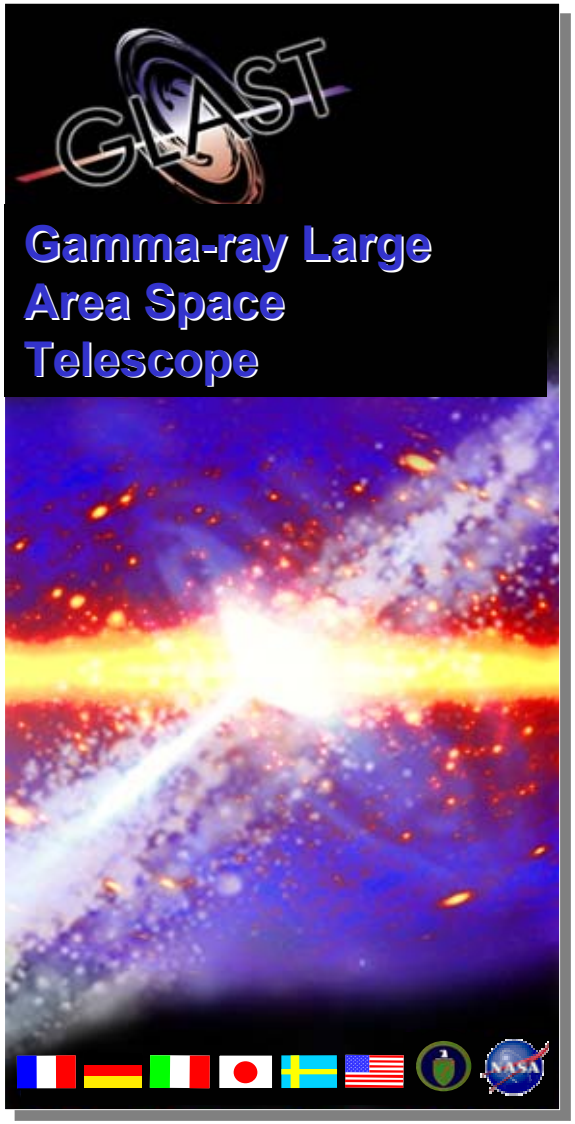

GLAST Large Area Telescope:
Planning Meeting
January 21, 2004
AntiCoincidence Detector (ACD) Subsystem
WBS: 4.1.6

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Outline

- Near-Term Milestones
- Recent Progress
- Interdependencies
- Open design issues
- Issues/concerns
- Parts
- Schedule Variance
- Cost Variance
- Threats to Cost and Schedule

Near Term Milestones - updates

Milestone Description	Date	New Date	Status/Notes
Base Frame Channel Fabrication start		9/20/03	Plating has caused additional delay, new plating tanks required. CR for cost $25K. Due 1/23/03
Complete Fab of TDA tiedowns	August	1/23/04	In fabrication. Minor issues during inspection
Receive/Test Flight ASICs (rapid-package)	Sept./Oct.	1/8/04 GAFE	GAFE received and is in screening. GARC is still missing.
Start Fab Flight HVBS PCBs	August	1/13/04	Submitted to fabrication, due to complete on 1/30/04
Complete Flight Mechanical Drawings	September	3/05/04	Delayed by interference fixes. Receiving additional engineering and design support to complete.
Complete Design on MGSE and EGSE	October	1/31/03	Completing purchase of EGSE materials
Complete Assembly of Flight Shell	October	2/15/04	In progress, side panels in assembly, top panel in inspection, (due to finish today) Expect miimum 2-3 week delay due to panel damage. Flight shell assembly will slip out to early February
Start Testing on BEA EU	November	11/20/03	Testing has started, vibration completed, TVAC preparations underway
Complete Fab of Clear Fiber Cables	August	3/15/04	Problem during assembly, fibers damaged by cleaning process. Estimate 2-3 week delay New materail to be received on 2/10.
System Test w/ two FREE Boards, HVBS, PMTs and TDAs		1/13/03	Completed on 1/13/04
Complete Fab of Flight TDAs	November	3/15/04	Recieving first shipmnet on 12/23. Have received 21 TDAs and they are in testing. 40 TDAs in wrapping, remainder in fabrication/assembly
Complete PMT Assembly	January, 2004	5/30/04	Need to resolve workmanship and PMT anomaly issues before beginning full flight production.

Recent Accomplishments - NEW

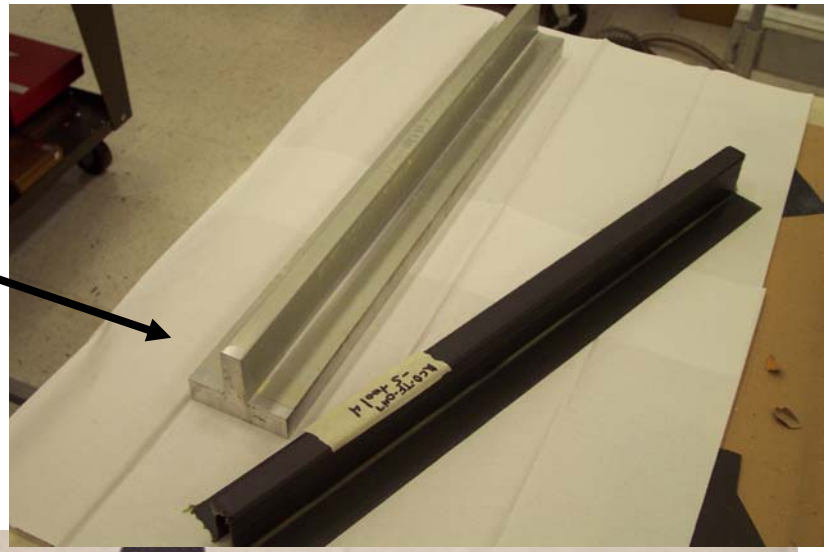
- Tile Detector Assembly
  - 65 of 89 TDA Assembly drawings complete
  - 85 of 89 Tile drawings complete
  - All remaining drawings in review.
  - First set (21) of flight TDA's delivered and are being tested
- FREE Boards
  - Assembled FREE ETU chassis. Functional testing successful. Vibration test started (completed yesterday?), TV test starting soon.
  - FREE Flight PCBs received and passed coupon testing, ready for assembly
  - All FREE Parts (except ASICs) prepared for flight assembly.
- Composite Shell
  - Side panels arrived and are having flexures installed
  - Top panels arrived without the shipping container and have been inspected for damage – Panels can be used "as is" after repairs are made
  - TDA flexure fabrication nearing completion
- Clear Fiber Cables
  - ~50% have been bonded into connectors and are being polished
  - Waiting on new fibers (replacement for damaged fibers)

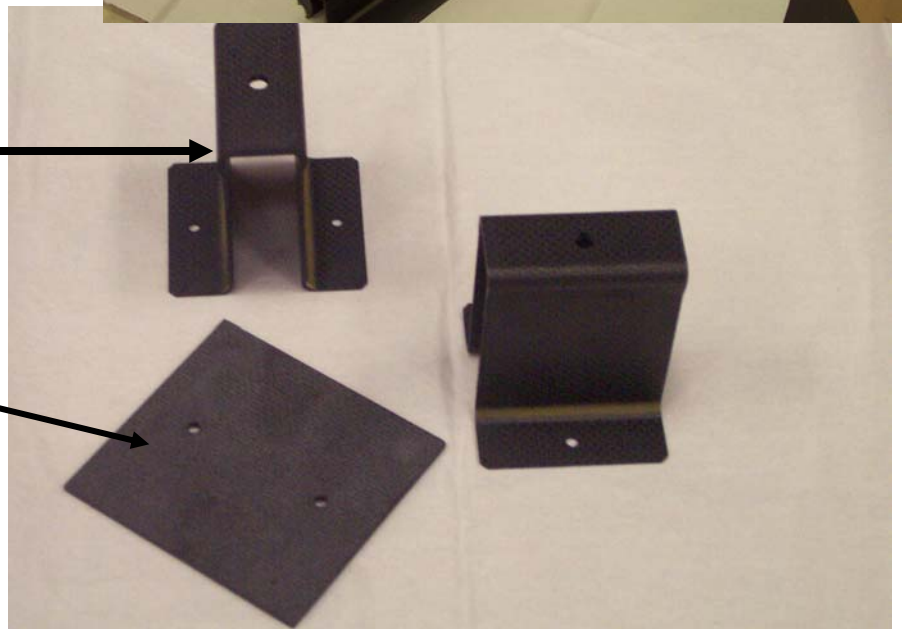
Recent Accomplishments - NEW

- ASICs
  - GAFEs received, now in screening
  - Performed laser testing on GARC at NRL
- Base Frame
  - Plating of electroless nickel in progress. Plating vender had to build new tank large enough for channels to fit in.
  - Tooling required for assembly has been fabricated and is ready for use
- HVBS
  - PCB design completed and submitted to fabrication. Expected in by the end of January

TSA Flight Fabrication

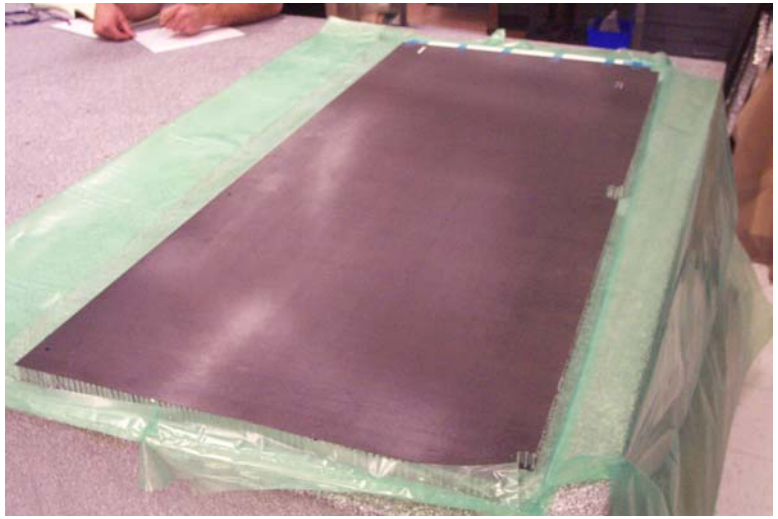
- TSA Fabrication In Progress:
  - Flexure Fabrication
    - All Blanks Made
      - In-process Inspections Complete Are All Acceptable
        - » Fiber Volume
        - » Void Content
        - » Photomicrographs
    - ~250 Flexures Complete
  - ~ 250 Flexure Doublers Complete



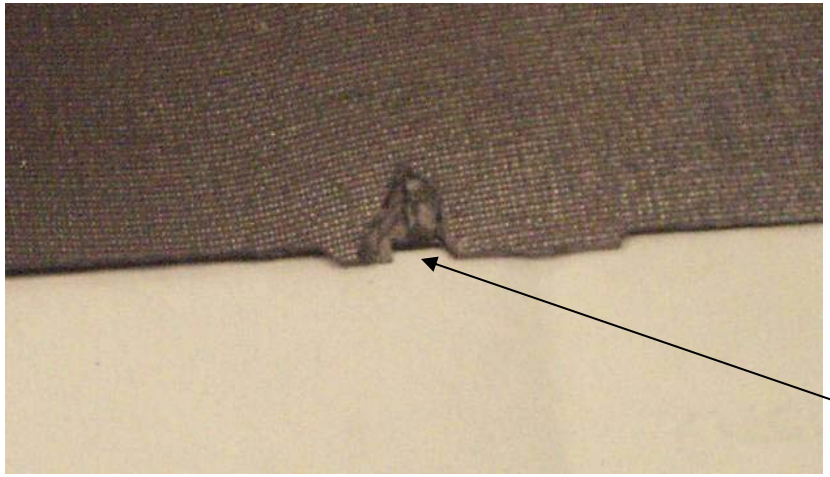


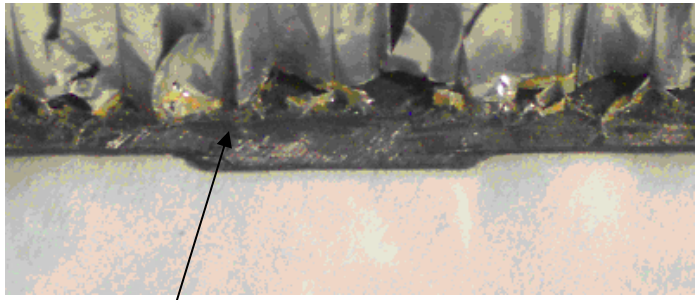
Side Shell Panels

- **TSA Shell Assembly Development**
  - ✓ **All side panels delivered. Minor repairs required (see two photos below) and performed.**
  - ✓ **Starting to attach doublers and tile mounting flexures.**



Side Panel (1 of 5)

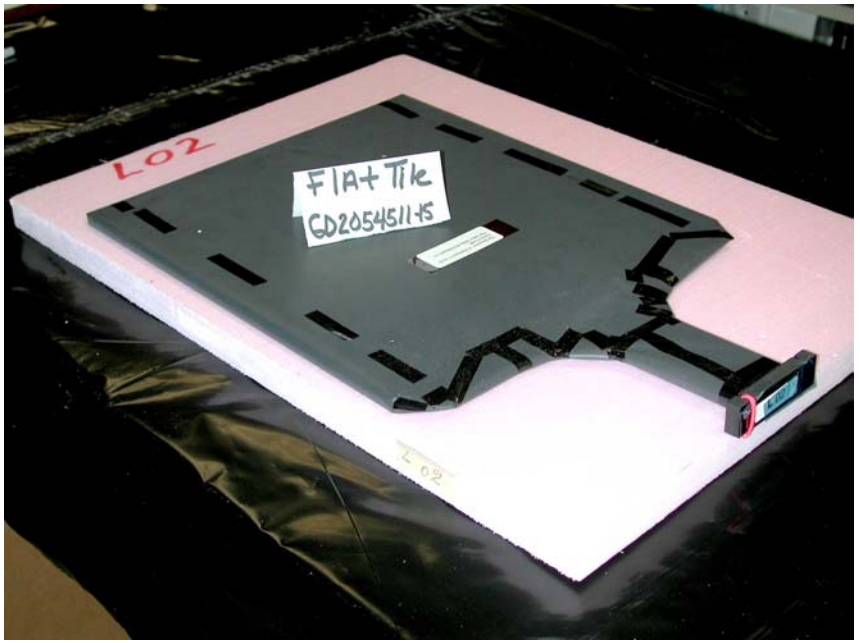




Core push back

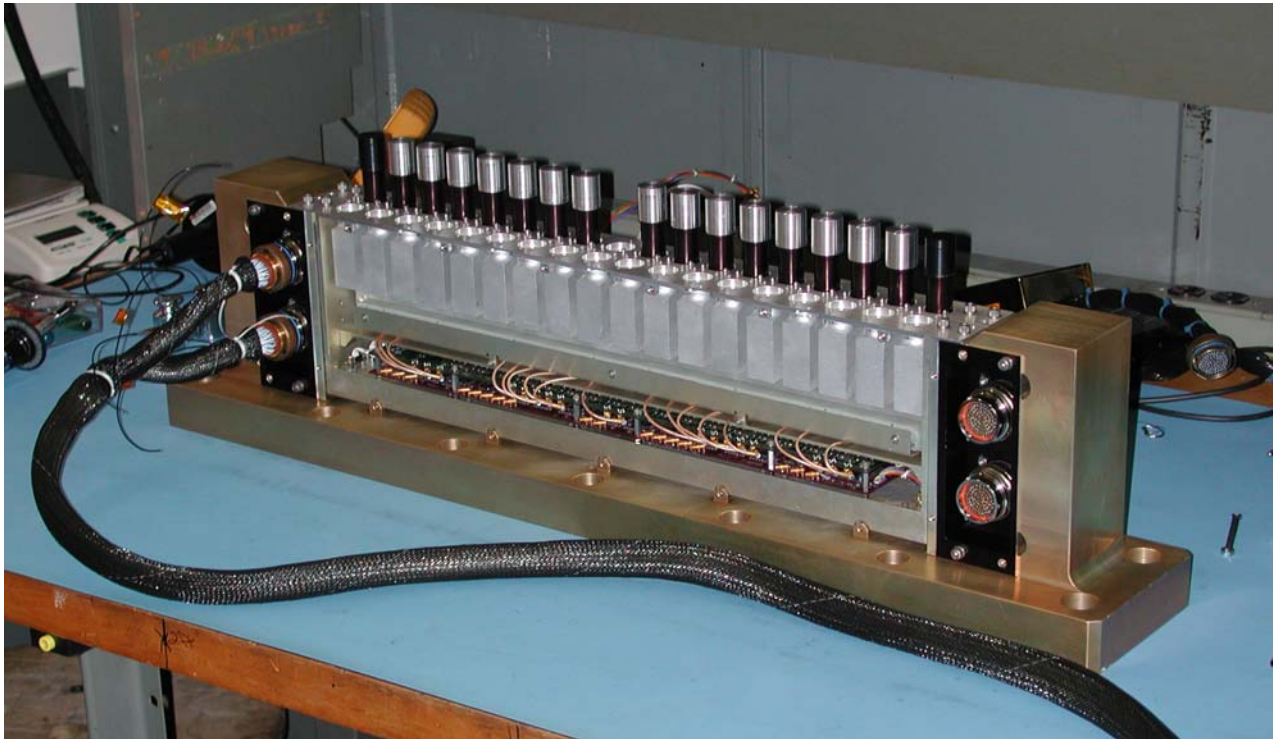
Chip in alignment tab

ACD Tile Detector Assemblies



Flight Tile Detector Assemblies have started to arrive from Fermilab and are in test. Note: small strips of tape on wrapping allow venting of TDA.

ACD Electronics Chassis



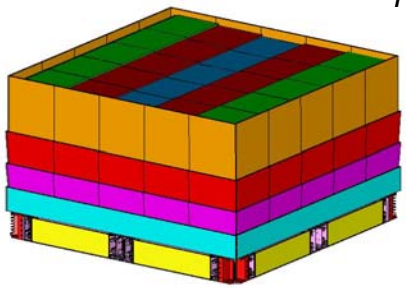
Electronics Chassis – 17 phototubes, 2 FREE cards, 2 HVBS, mass simulators – currently in environmental testing.

Fabrication, Assembly and Testing status

Number needed in parenthesis

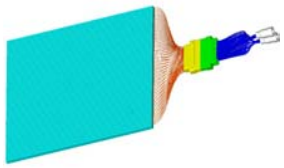
STATUS KEY

- Prototyped
- In Fabrication or Ordered
- Received
- In assembly
- Assembled
- Tested

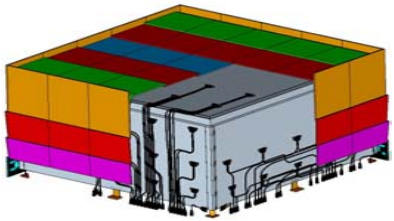


ACD Assembly (1)

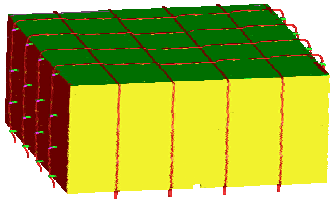
Clear fiber cables (130) — 6 / 130



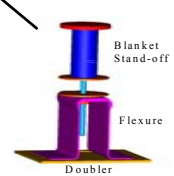
Detector assemblies - TDA - (4 basic types, 89 needed total) — 12 / 77 / 21



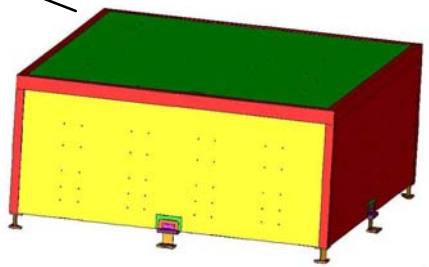
Tile Shell Assembly –TSA (1)



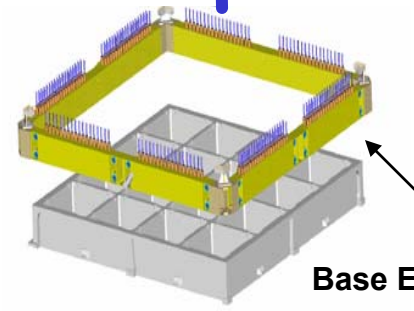
Fiber ribbon detectors (8) — 1 / 8



Detector Flexures (366+20 spares) — 8 / 360 / 250

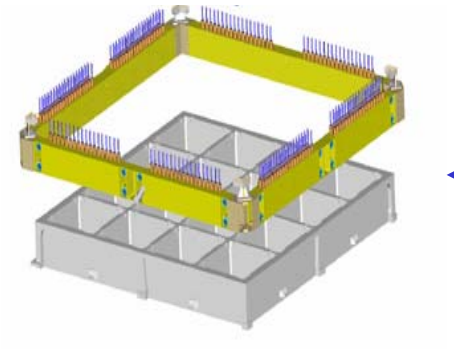


Composite Shell Assembly (1) — 1 / 1

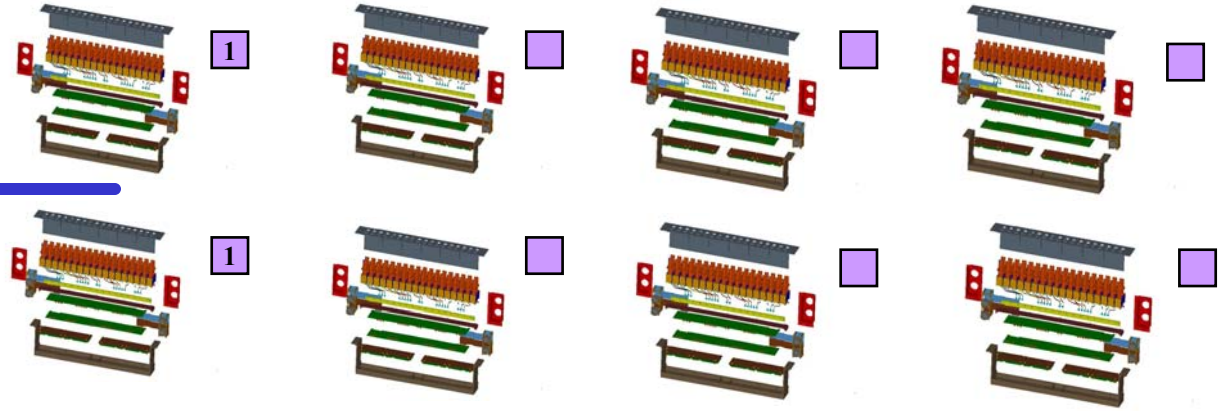


Base Electronics Assembly (BEA) From next page

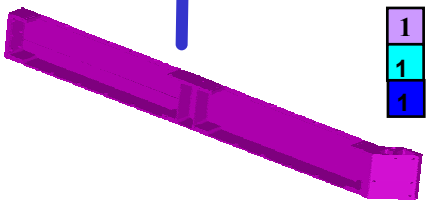
Fabrication, Assembly and Testing status



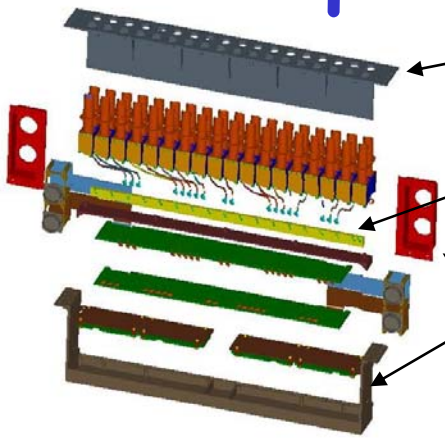
Base Electronics Assembly (1)



Electronics Chassis (8) (4 double + 4 single)



Base Frame Assembly (1)



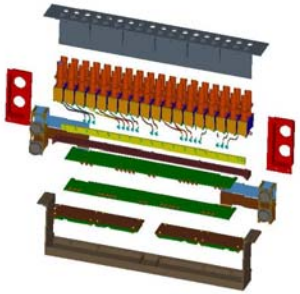
Photomultiplier Tube rails (8 + 2 spares) 1

Power distribution board (8+2 spares) 1

Chassis and connector frames (8) 1

Connectors

Fabrication, Assembly and Testing status



Electronics Chassis (8)

(4 double + 4 single)

Electronic Chassis Subassembly Item	Needed	Proto	Assembled or received	Tested	Ready for higher assembly
Photomultiplier Tube Assemblies	194 + 46 spares	Yes			
Photomultiplier Tube (PMT)	194 + 46 spares	Yes	240	240	230
Photomultiplier Tube housings	194 + 46 spares	Yes	240	5	
Photomultiplier Tube resistor networks	194 + 46 spares	Yes	30		
Front End Electronics (FREE) 'right hand' boards	*8 + 2 spares*	Yes	10	10	10
Front End Electronics (FREE) 'left hand' boards	*4 + 2 spares*	Yes	6	6	6
GLAST ACD Front End chip – GAFE	*194 needed, 650 ordered*	Yes	650		
GLAST ACD Readout Controller chip – GARC	*12 needed, 125 ordered*	Yes			
Digital to Analog Converter - DAC MAX 5121	24 + spares	Yes	36		
Analog to Digital Converter – ADC MAX 145	194 + spares	Yes	300		
High Voltage Bias Supplies (HVBS) boards (24 + 6 spares)	24 + 6 spares	Yes			
High Voltage Capacitors	218 + 52 spares	Yes	218		218

Interdependencies

1. Delivery of FREE Boards and ASICs to Electronics for test bed. – late January/early February
2. EGSE/G3 – Ongoing development with I&T and Electronics groups. Have not received G3 software (due in October) so that we can begin mitigating late delivery of EGSE/G3. Prototype power supply delivery date? Updated delivery date for limited G3 (two of these if possible) and full G3? G3 availability is a bottleneck for testing. Prepared to begin flight electronics assembly, however full system test has not been performed – HIGH RISK
3. Grid to Base Frame match drilling – Outline drawing and available date for work? First window of opportunity in early to mid February, next date in early April, final date at ACD to LAT integration.
4. Delivery of ACD Calibration Unit or subset to LAT I&T – working details for a February delivery.
5. ASICs – GAFEs have arrived, but GARCs are still in transit.

Open Design Issues - update

- OPEN: Outline drawing that defines some interfaces with LAT is still not complete (blanket attachment, grounding, cable tie-downs, optical survey mounts). Action Plan: Work with LAT mechanical design team to resolve open issues. Status: Mechanicals are iterating 3D models.
- OPEN: Need updated interface loads following Grid design changes. Action Plan: Review ACD analysis when updated loads are received. ACD will not delay fabrication of mechanical components due to this open issue (slight risk in doing so). Status: Received new loads from Goddard.
- OPEN: Interference between some waveshifting fibers and TDA flexures. Action Plan: Re-design and re-analyze to resolve. Status: Lower tile flexures finalized. Reviewing final set of drawings
- OPEN: Configuration change on BEA connectors requested by ACD; requires re-routing of some LAT cables.

  Status: Engineering presentation made; formal CR in process. Need to finalize cable routing. Need signed off cable drawing.

Issues and Concerns - Update

- Late delivery of G3 Test Stand/EGSE from LAT Electronics and I&T is a concern
  - Scheduled for August, recently slipped to January/February
  - Developing workarounds, using older G2 Test Stands and bench electronics. Interfaces are less like the flight interface, but should allow FREE card testing. G2 can test half a FREE card at one time.
  - Developing the G3 software before the arrival of the hardware, to minimize the startup delay once the G3 Test Stands arrive. Have not received transition software yet (due in October)
  - Will not impact assembly of ACD flight electronics. For Electronics Chassis testing, the G3s have been identified as a bottleneck due to parallel testing requirements.
  - Additional software support will be needed. Meeting at GSFC in January with Jim Panetta, LAT software developer - useful.
- Slow response of GSFC procurement has been a concern
  - A Program Specialist, who tracks and expedites procurements and reports to the ACD, has been assigned and is already helping.
  - Recently got a procurement through in less than 2 weeks! Amazing especially since it was over the Christmas and New Year holidays

Top Honeycomb Panel Shipping Damage

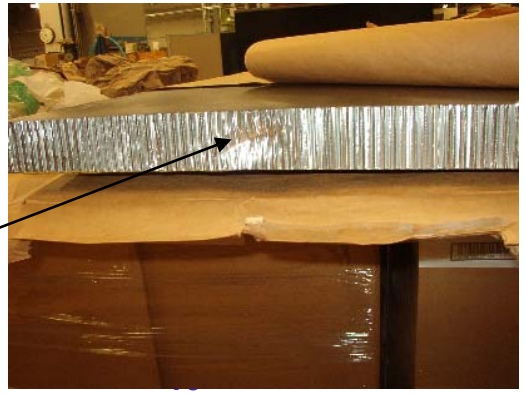
- **TSA Top Honeycomb panels (1 flight + 1 spare) damaged during shipment from vender to the GSFC**
  - **Shipping container destroyed. Only the base and one side were received.**
  - **Inspected panels to determine extent of damage. Panels can be used as is with repairs**
  - **Cost of inspecting and repairing/replacing panels to be deducted from existing contract.**
  - **Recovery plan on the next page.**
  - **Side panels arrived safely in an earlier shipment**

Honeycomb panels

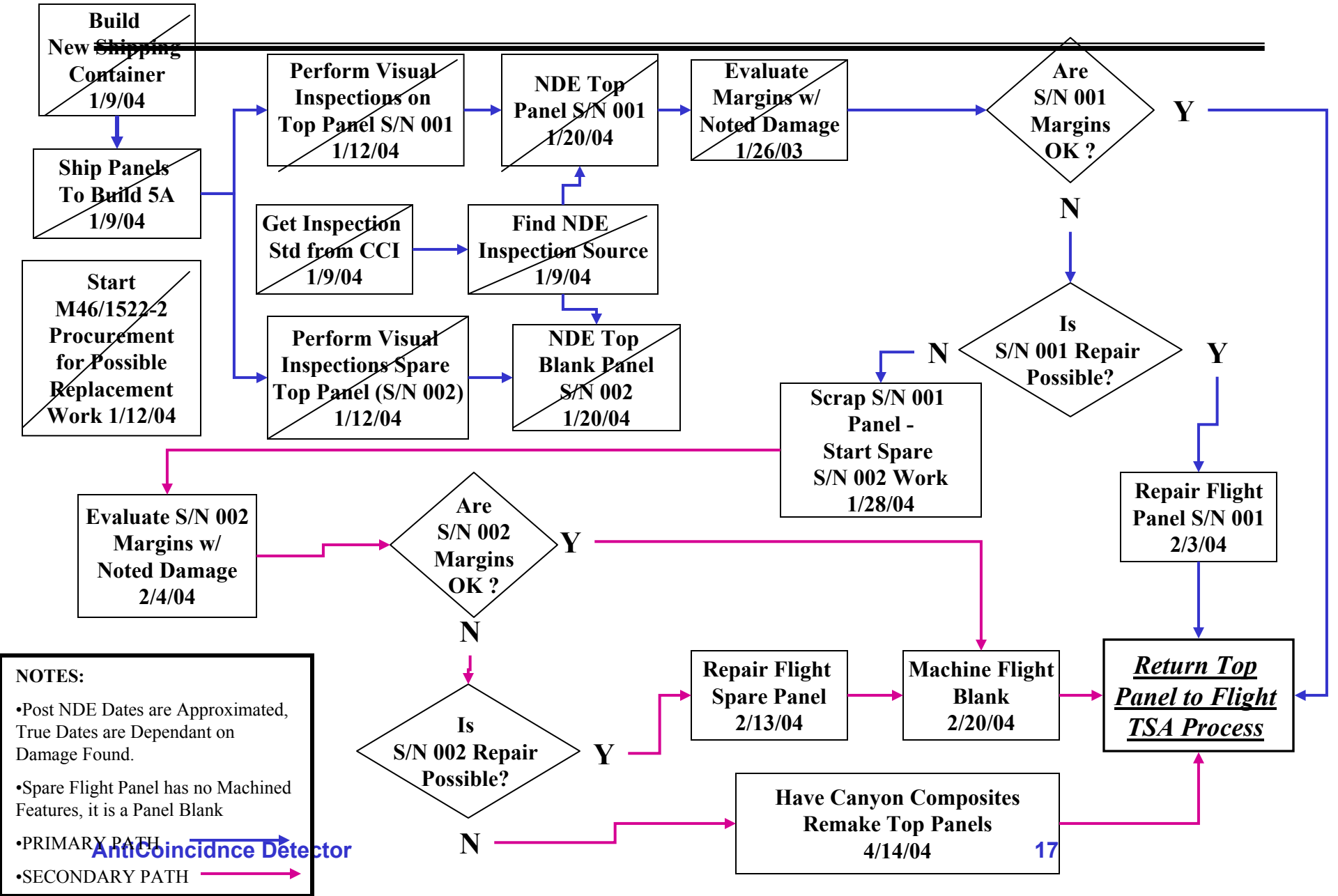
One side of the shipping container

Core crushed in corner

Core damage on edge



Top Panel Shipping Damage Recovery Plan



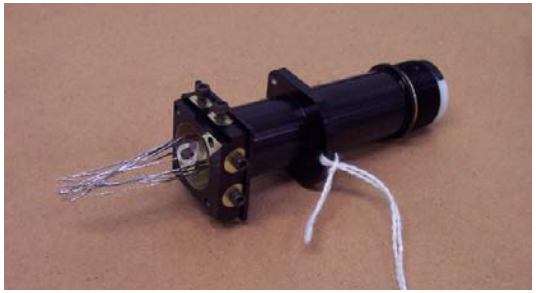
NOTES:

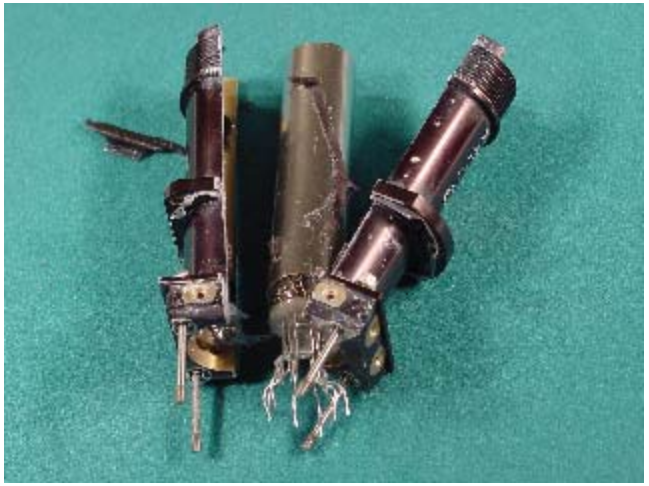
- Post NDE Dates are Approximated, True Dates are Dependant on Damage Found.
- Spare Flight Panel has no Machined Features, it is a Panel Blank
- PRIMARY PATH →
- SECONDARY PATH →

Issues and Concerns - Update

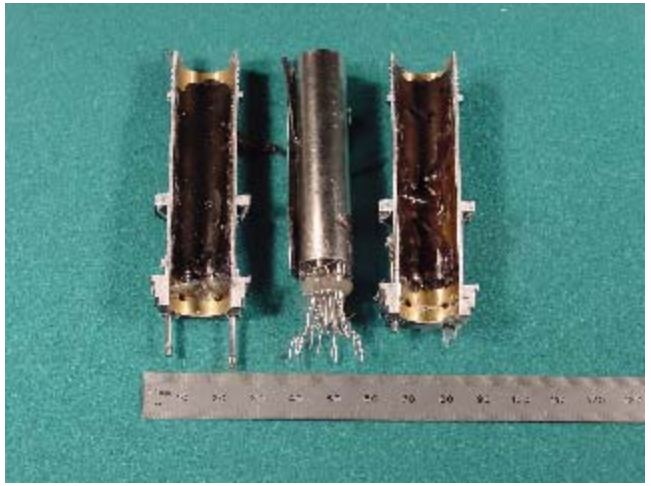
- **OPEN: ASIC Radiation Issue. STATUS: Waiting on report and data from GSFC Radiation Group. Laser testing on GARC showed possible explanations for results seen at TAMU.**
- **OPEN: PMT Workmanship and Anomaly. STATUS: Workmanship issues addressed and are being worked. 5 more EU PMT's will be assembled soon. Working on determining root cause of PMT failure. Most probable causes of problem are mechanical mounting combined with part defect.**

Photomultiplier Tube (PMT) Anomaly





- Still looking for root cause. PMT did not fail at score line as expected
- Designing a modified mount
- Purchasing 30 more PMTs from Hamamatsu

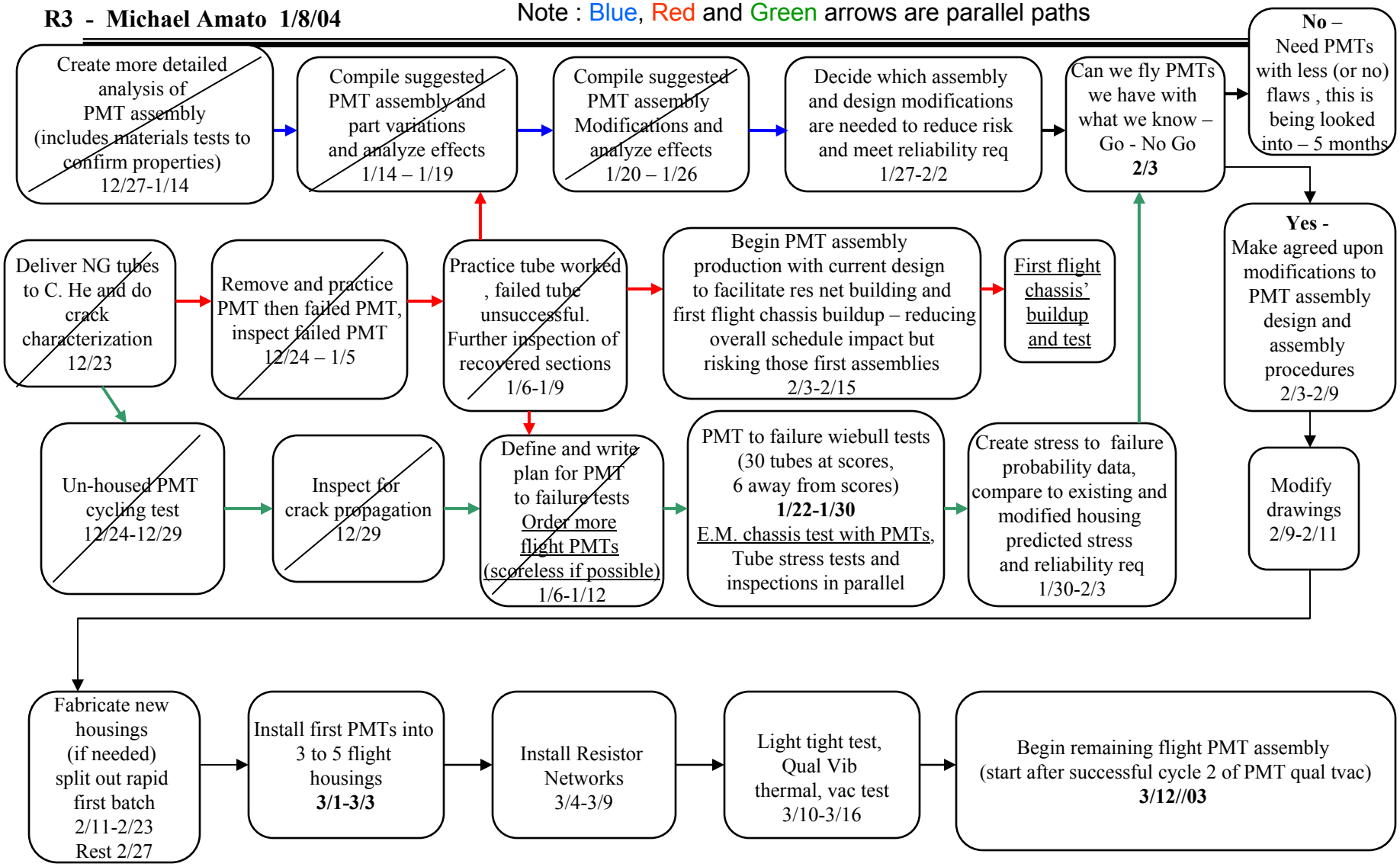


Preparing for PMT boning

PMT Anomaly Resolution Flow

R3 - Michael Amato 1/8/04

Note : Blue, Red and Green arrows are parallel paths



MECHANICAL AND EEE PARTS

- **Mechanical Parts and Materials - ALL APPROVED**
- ***Photomultiplier Tubes (*PMTs) – All 240 Qualified, tested, and screened – Beginning visual inspection of glass this week**
- **EEE Parts**
  - ***Front End Electronics (*FREE) - 36 different part types (5 commercial plastic parts); approximately 830 parts per board. All parts approved by the Parts Control Board (PCB) with the following exceptions.**
    - MAX145 and 5121 – Parts ready for assembly onto FREE Board, but have not completed screen and qual. Parts have been in hand for ~10 months. What is the hold up?
    - ASICs – Screening and qualification has started on the GAFE. Dependant upon LAT/SLAC to resolve radiation issue. Do we need to take any action?
  - **HVBS - 38 different parts types; 108 total parts per board**
    - 2 parts are not approved, issues are well understood and are being worked.
      - 1 part waiting on a drawing review.
      - 1 part added to parts list – high voltage wire
  - **Resistor network - 9 different parts types; 26 total parts**
    - 1 part not approved – 1 wire
    - Just learned yesterday that HV Cap (yes the same one that had to be remade already) may have failed life testing.

ACD Schedule Variances

- 4.1.6.3 - TSA Schedule Variances (-$146K cum, -$136K December)
  - ($75K) – TDA work delayed by design completion as well as earned value method
  - ($62K) – TDA Tiedowns. Will complete in January and receive full credit.
- 4.1.6.4 BEA Schedule Variances (-$96K cum, -$100K December)
  - Base Frame channels late due to plating, did not receive Digital ASIC, flight PMT assembly did not start due to anomaly, and testing of Electronics Chassis was delayed.
- 4.1.6.5 MMS/Thermal Blanket (-$5K cum, -$1K December)
- 4.1.6.6 Mech Qual and Cal Unit ($3K cum, $4K December)
- 4.1.6.B GSE Schedule Variances (-$10K cum, -$6K December)

ACD Cost Variances

- **4.1.6.1 ACD Project Management/Sys Eng/Science (+$733K cum, +$74K Dec)**
  - **+$271K - Labor support lower than planned due to lower than planned science simulations and test support ($148K), systems engineering being covered by GLAST Project ($52K), Science Support lag in accruals ($45K), and charge to labor instead of materials ($26K)**
  - **($31K) – See previous varaince for $26K**
  - **+$487K MPS/Lab Tax lower than planned.**

- **4.1.6.2 Safety and Mission Assurance (+$104K cum, -$14K December)**
    - **GLAST project covering costs**

- **4.1.6.3 Tile Shell Assembly ($235K cum, $299K December)**
  - **($73K) Labor higher than planned to complete drawings, $307K Materials – Invoice for shell panels not submitted and fabrication work not invoiced yet. ($80K) due to 50/50 earned value on TDA's**

ACD Cost Variances

- 4.1.6.4 Base Electronics Assembly (-$607K cum, -$165K December)
  - ($258K) Labor - Design changes (EMI and cabling CR for $98K) and performed additional analysis (model updates and cabling). PMT assembly issues. PMT anomaly charges beginning to show up.
  - ($297K) M&S – Radiation testing, parts screening, FREE and Resistor Network assembly set up
  - ($42K) SLAC ASIC charges (12K this month). This work was completed quite some time ago.
- 4.1.6.5 MS/TB (+$32K cum, -$14K December)
  - $32K – JSC cost reporting behind actual work performed.
- 4.1.6.6 Mech Qual and Cal Unit (+$65K cum, $20K December)
  - $51K Labor - $34K charged to 4.1.6.3 and the remaining $17K is an underrun
- 4.1.6.B Ground Support Equipment (+$398K cum, -$96K December)
  - $163K of labor covered by GLAST project
  - Using CS support instead of contractor support.
  - Have not been invoiced for work completed on handling dollies.

Threats to Schedule and Cost

1. ASICs – Must receive GARC, meet flight requirements, qual, screen, test, etc
2. PMT Anomaly
3. Late Delivery of GASU/G3 EGSE
4. Electronics assembly and test
5. Mechanical analysis & design (drawing completion)
6. PMT Assembly