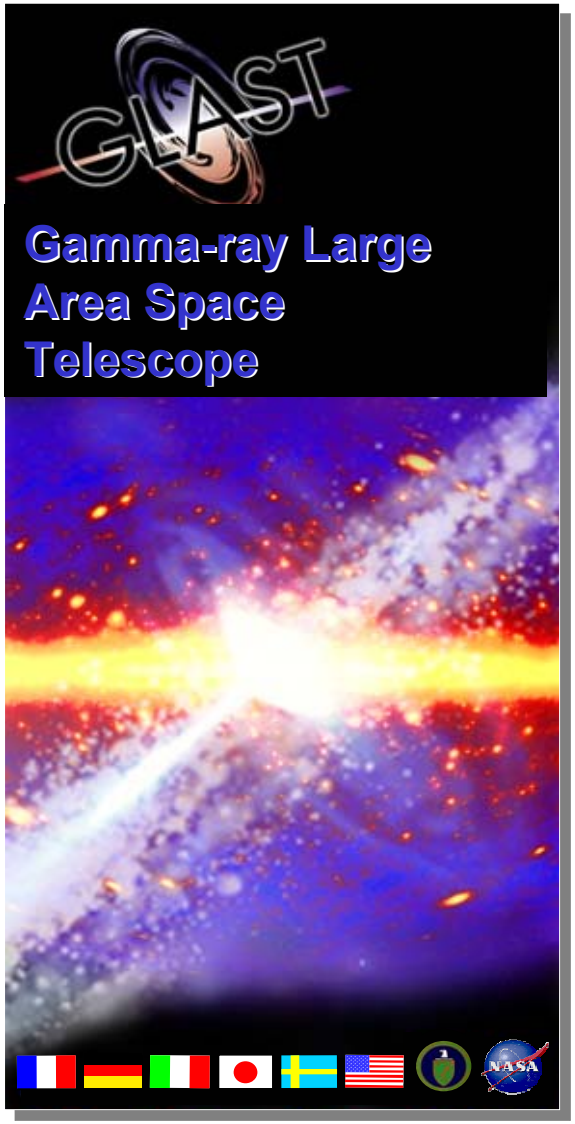

GLAST Large Area Telescope:
Project/Cost/Schedule Review
October 29, 2003
AntiCoincidence Detector (ACD) Subsystem
WBS: 4.1.6

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Outline

- Recent accomplishments
- Near-term milestones
- Issues and concerns
- Open design issues
- Fabrication, Assembly, and Testing Status
- Parts and qualification program
- Cost and schedule variances
- Threats to cost and schedule

Recent Accomplishments – Updates in Red

- ASIC, FREE card, and End-to-End testing
  - GAFEv5G, v7, and v6B (analog ASIC) delivered (rapid package)
    - All versions work reasonably well, with minor concerns
    - Plan to flight-package at least two versions. Decision soon.
    - Preparing ASICs for radiation testing.
    - S&Q test boards designed, fabricated, and assembled.
    - Procurements for test equipment and hardware placed.
  - GARCv3 (digital ASIC) delivered (rapid package)
    - Key problem of switching from A to B side corrected
    - All functionality appears to meet requirements
    - S&Q parametric test board complete, in assembly.
    - Test equipment being calibrated and/or repaired.
  - Vibration and thermal cycle testing performed on a populated FREE (FRont End Electronics) Card. FREE Card successfully completed all tests.
  - New FREE card in assembly, will use flight-type ASICs

Recent Accomplishments - Update

- **Phototube Assembly Testing**
  - **Began assembly of first set of tubes (non-flight). Minor start-up glitches found.**
  - **Completed phototube assembly trailer preparations (low helium area)**

Recent Accomplishments – TDA Fabrication

Tile machining

Connector Polishing

Tile Cleaning

Light tight testing

Recent Accomplishments – TDA Fabrication (Slide 2)

Fiber grooves with bend

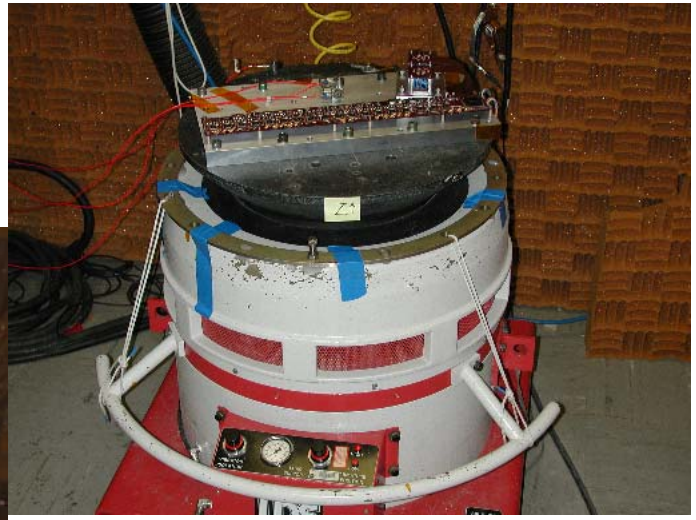
Fiber gluing station

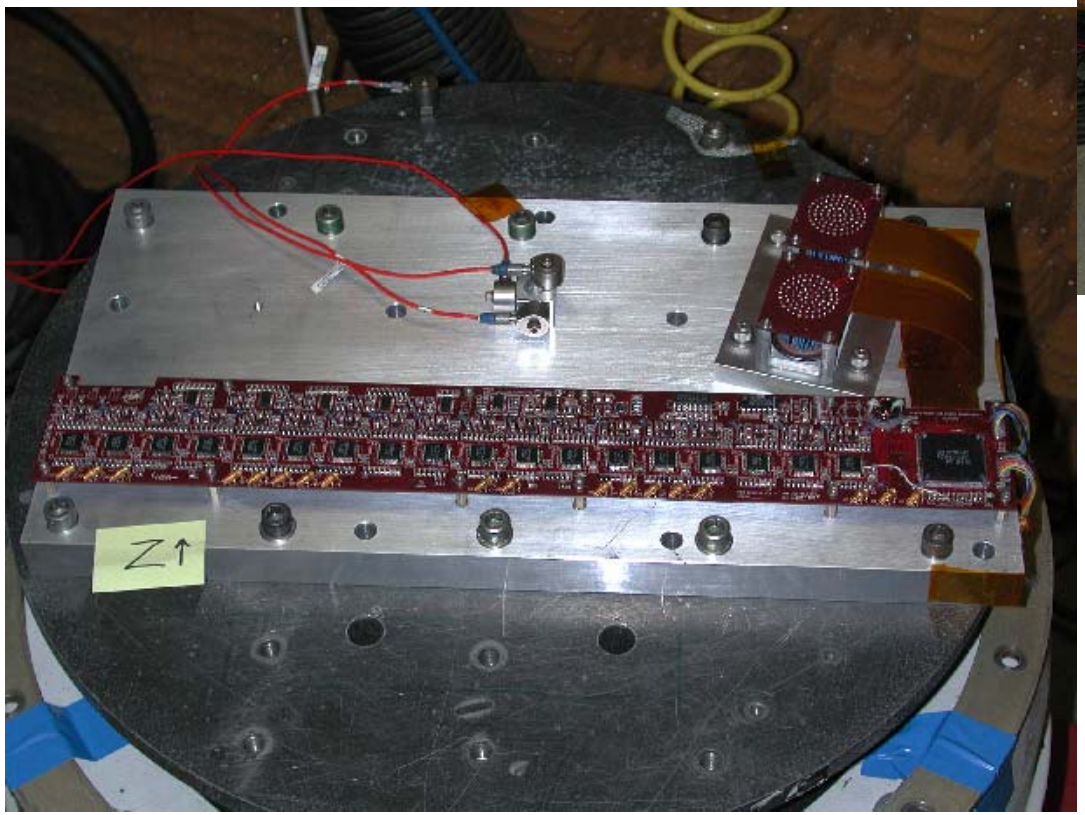
Polished connector

Completed TDA's (without wrapping)
Over 25 completed

Recent Accomplishments – FREE Board Testing

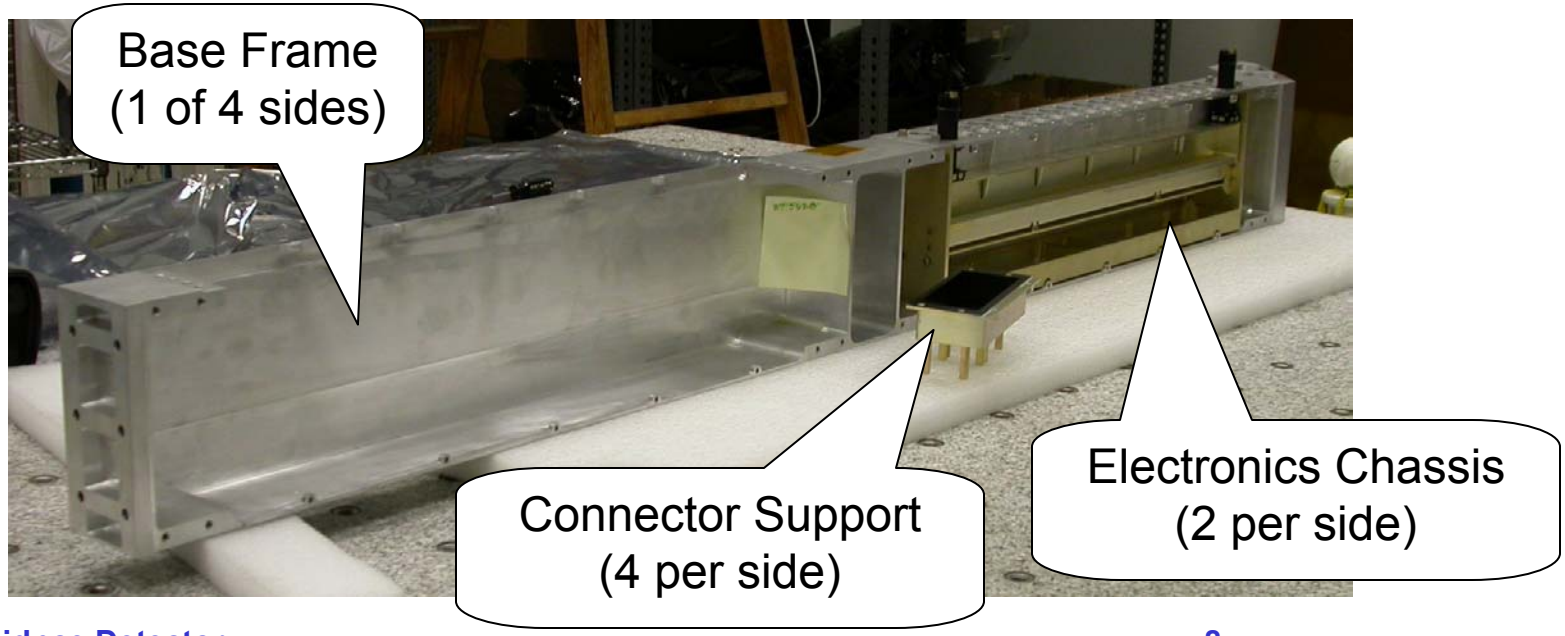
- **FREE Board Vibration Testing**
  - **Successfully passed testing!**





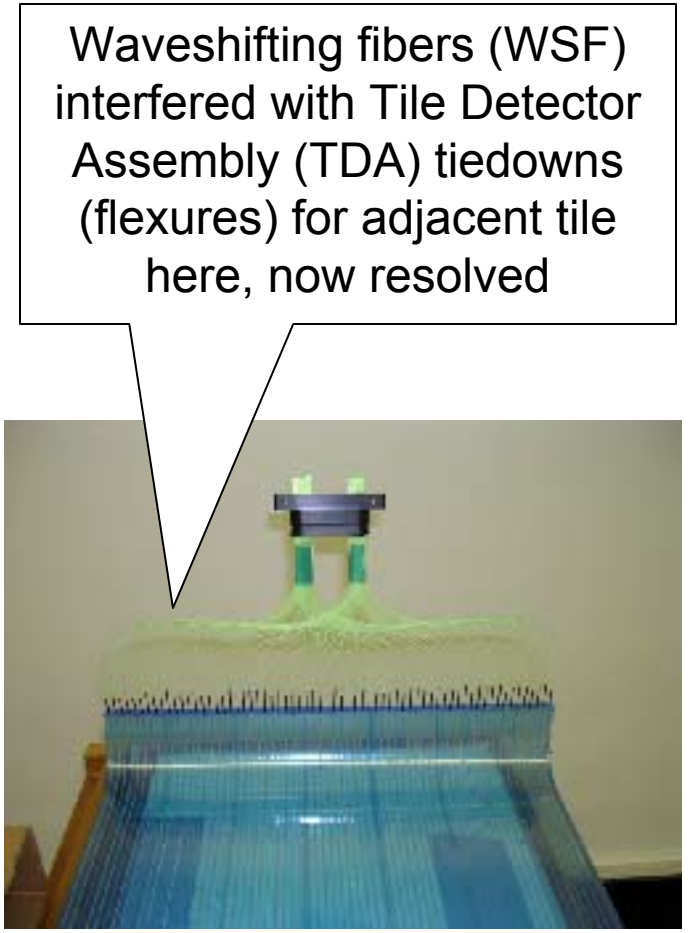
Recent Accomplishments - Update

- **Base Frame**
  - **New Base Frame channel design is complete. Sent out for fabrication, vendor selected, and had a Manufacturing Readiness Review with the vendor.**
  - **Funding for fabrication delayed by Goddard procurement problem.**
  - **Rough cutting of aluminum channel has started.**
  - **Electroless nickel plating will require a Change Order.**
  - **Discovered problem with connector placement that will require minor modification and a Change Order.**



Interference Problem on Tiles - Updated

- **Continue TDA fabrication – Completion of fabrication of first flight detectors has slipped to October, due to recent problem.**
- **Interference problem on 85 of the 89 tiles is resolved, and fabrication of side TDA's has resumed.**
- **Use of titanium flexures for mounting bottom four tiles has been approved, and design is being verified. Will increase mass by ~ 5 kg.**



Near Term Milestones - 3 Month Plan - Updates

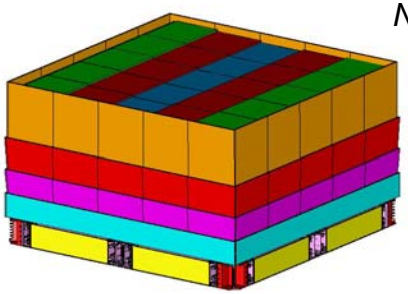
Milestone Description	Date	Status/Notes
First System Test w/ one FREE Board, HVBS, PMTs and TDAs	8/15/2003	*Completed*
Base Frame Channel Fabrication start	8/29/2003	*In fabrication. Small change needed for connector locations and nickel plating.*
Complete Fab of TDA tiedowns	9/30/2003	*Delayed by interference fixes*
Receive/Test Flight ASICs (rapid-package)	9/30/2003	*ASICs received 10/2/03. Testing in progress*
Fab Flight HVBS PCBs	10/13/2003	*Minor change following review.*
Complete Flight Mechanical Drawings	10/31/2003	*Delayed by interference fixes.*
Complete Design on MGSE and EGSE	10/31/2003	*New designer working on MGSE*
Complete Assembly of Flight Shell	10/31/2003	*Receive Nov03; delayed by interference fixes*
Start Testing on BEA EU	11/10/2003	*Assembly of electronics chassis started.*
Complete Fab of Clear Fiber Cables	11/20/2003	*Connectors complete; work started on assembly*
System Test w/ two FREE Boards, HVBS, PMTs and TDAs	11/28/2003	*Preliminary test Sept, delayed to Nov.*
Complete Fab of Flight TDAs	12/31/2003	*Completion January 04 by Fermi.*
Complete PMT Assembly	1/30/2004	*Started PMT bonding into housings.*

FABRICATION, ASSEMBLY AND TESTING STATUS

Number needed in parenthesis

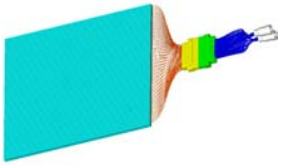
STATUS KEY

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



ACD Assembly (1)

Clear fiber cables (130) 6 130



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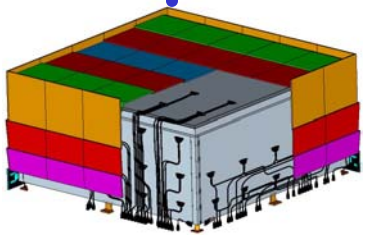
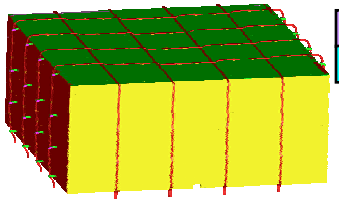
Detector assemblies - TDA - (4 basic types, 89 needed total)



Tile Shell Assembly –TSA (1)



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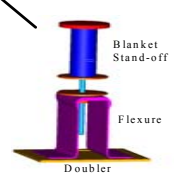
Fiber ribbon detectors (8)



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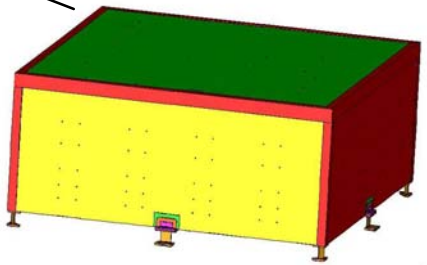
Detector Flexures (366+20 spares)



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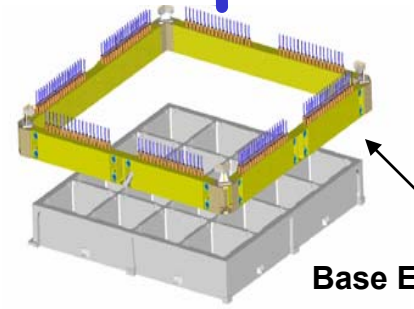
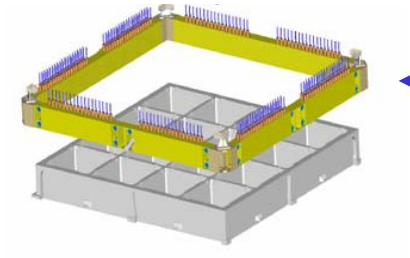
Composite Shell Assembly (1)

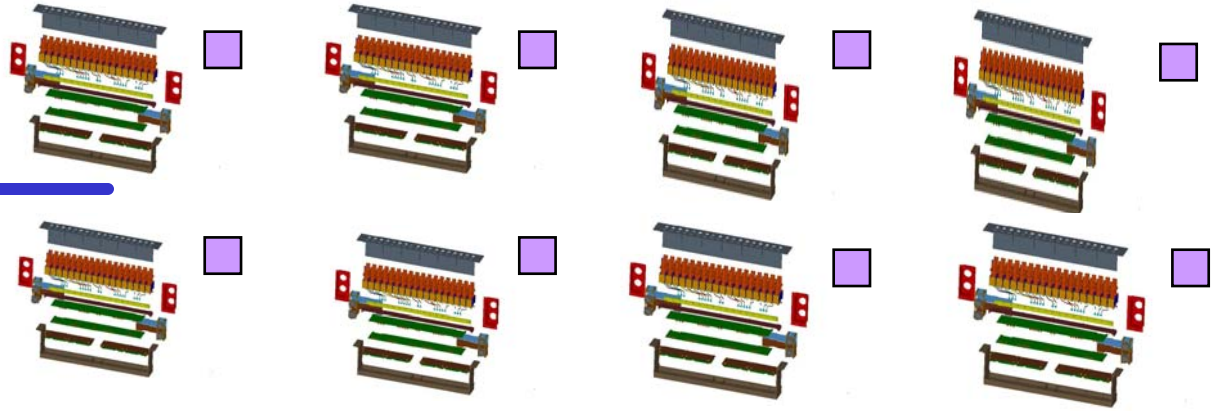


Base Electronics Assembly (BEA) From next page

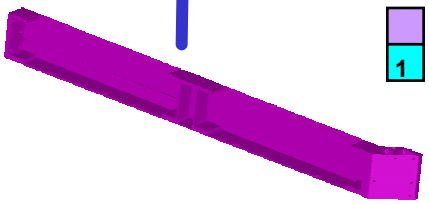
FABRICATION, ASSEMBLY AND TESTING STATUS



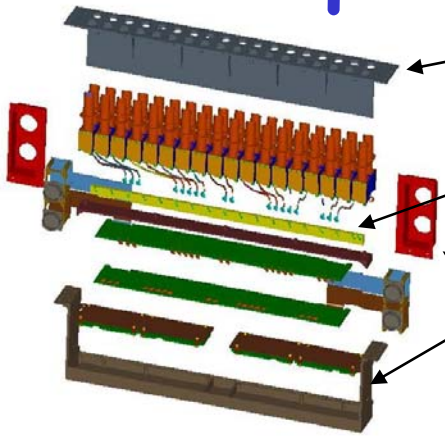
Base Electronics Assembly (1)



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



Base Frame Assembly (1)



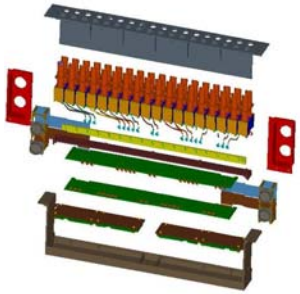
Photomultiplier Tube rails (8 + 2 spares)

Power distribution board (8+2 spares)

Chassis and connector frames (8)

Connectors

FABRICATION, ASSEMBLY AND TESTING STATUS



Electronics Chassis (8)

(4 double + 4 single)

Electronic Chassis Subassembly Item	Needed	Pro to	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	30		
Photomultiplier Tube resistor networks	194 + 46 spares	Yes			
Front End Electronics (FREE) 'right hand' boards	*8 + 2 spares*	Yes			
Front End Electronics (FREE) 'left hand' boards	*4 + 2 spares*	Yes			
GLAST ACD Front End chip – GAFE	*194 needed, 650 ordered*	Yes			
GLAST ACD Readout Controller chip – GARC	*12 needed, 125 ordered*	Yes			
Digital to Analog Converter - DAC MAX 5121	24 + spares	Yes			
Analog to Digital Converter – ADC MAX 145	194 + spares	Yes			
High Voltage Bias Supplies (HVBS) boards (24 + 6 spares)	24 + 6 spares	Yes			
High Voltage Capacitors (218 + 52 spares)	218 + 52 spares	Yes	40*	Failed a req	

MECHANICAL AND EEE PARTS - Updated

- **Mechanical Parts and Materials - ALL APPROVED**
- ***Photomultiplier Tubes* (PMTs) – All 240 Qualified, tested, and screened**
- **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 - ECD Slipped from 9/15/03 to 9/24/03. MRB required due to problem
    - MAX5121 - ECD Slipped from 10/15/03 to 10/27/03.
    - ASICs – Can not be approved until they pass screening and qualification. ECD 1/15/04
  - **HVBS - 38 different parts types; 108 total parts per board**
    - **6 parts are not approved, issues are well understood and are being worked.**
      - **3 capacitors waiting on DPA (Destructive Physical Analysis). ECD 10/17/03**
      - **1 capacitor failed screening – see backup slide for more details**
      - **1 part waiting on a drawing review. ECD 10/03/03**
      - **1 part added to parts list – high voltage wire**
  - **Resistor network - 9 different parts types; 26 total parts**
    - **Connector was approved on 8/27/03**
    - **4 parts reopened for further analysis and testing – 2 resistors, 1 capacitor, 1 wire**

Issues and Concerns - Updates

- Need for a final Qualification and Screening Plan for ASICs is a concern
  - LAT has a general Q&S Plan for ASICs
- Worked with LAT Parts Control Board in consultation with Goddard parts engineers to finalize details of the plan. Plan has been signed off.
- ISSUE CLOSED.

- Shortage of test equipment at Goddard is a concern
  - In particular, equipment needed for the ASIC Q&S program seems to be in short supply
- Working with Goddard local laboratory and Engineering Directorate to locate or repair needed equipment. Not much success so far. Received $25K for calibration and repair of test equipment from Code 600.
- Requested Goddard funding (~$60K) for additional equipment. None provided yet, requiring unbudgeted expenditures to keep testing program on schedule.
- Purchases of computers for test stands held up by Goddard procurement freeze.

Issues and Concerns - Updates

- **Procurement difficulties related to the new financial management system and procurement shutdown at Goddard are threatening the ACD schedule.**
  - **Examples of this are the delay of our Base Frame Channel fabrication by nearly 4 weeks, difficulties calibrating, repairing and purchasing test equipment required for ASIC testing, and a procurement for our micrometeoroid shield being routed incorrectly. Mitigating problems by close communication with procurement, using emergency procurement requests, and schedule workarounds.**

- **Reduction of support for ACD mechanical engineering at GSFC is an issue.**
  - **Working with Goddard management to retain enough support to maintain schedule.**
  - **Micrometeoroid Shield/Thermal Blanket work has been staffed once again. New engineer and designer working on coming up to speed.**
  - **New MGSE designer reassigned to helping complete flight mechanical drawings (due to interference problem). A second new MGSE designer came on-board on 9/15 and has already completed 2 designs.**

Issues and Concerns - Updates

- Late delivery of G3 Test Stands/EGSE from LAT Electronics and I&T is a concern
  - Scheduled for August, slipped to November/December, now maybe January for two-FREE-card version and February for full G3.
    - Planned for testing of multiple FREE cards and Electronic Chassis, scheduled for October - November
  - Developing workarounds, using older G2 Test Stands and bench electronics. Interfaces are less like the flight interface, but should allow much of the testing. Test conductors are exercising test scripts on a FREE card with the G2.
  - Plan to develop the G3 software before the arrival of the hardware, to minimize the startup delay once the G3 Test Stands arrive. Ric Claus plans to visit Goddard in December.
  - Identified as a risk item at ACD electrical peer review.

Open Design Issues

- **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 by August 29. Status unchanged. Not resolved. Would have been helpful when change in connector location became an issue this month.**
- **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 unchanged.**

Cost and Schedule Variance Introduction

- Overall Cost Variance (-$1053K Cum, +$92K Sep)
- Overall Schedule Variance (-$1435K Cum, -$15 Sep)

ACD Schedule Variances

- 4.1.6.3 - TSA Schedule Variances (-$644K cum, -$5K Sep)
  - Majority of variance is due to late delivery of purchased hardware. Hardware is being purchased late because of late completion of design
  - $422K of this variance is due to the late scheduled delivery of the Flight Shell and TDA tiedown. Both of these items are not expected to be schedule drivers.
  - TDA interference problem has impacted design and drawing completion
- 4.1.6.4 BEA Schedule Variances (-$433K cum, -$10 Sep)
  - Variance due to not receiving flight ASICs ($20K), flight FREE boards ($40K), and flight HVBS parts ($48K)
  - Remainder of schedule variance is due to late delivery of ASICs to populate and test EU FREE Boards and the late receipt of parts that have been purchased.
  - (-$65K) HVBS FU Assy – All parts available except HV Cap and PWB. Will wait on HV Cap. Possible grounding issue that needs to be resolved prior to PWB procurement. Interface issue with the GASU.
  - (-$83K) RN FU Assy and Populate – All parts available except HV Cap. Will populate 2/3 of RN's when RN PWB's arrive
- 4.1.6.6 Mech Qual and Cal Unit (-$146K cum, $0K Sep)
  - Variance is due to not having an ACD mechanical subsystem available to test. This variance will continue to get worse until the mechanical Subsystem completes qualification testing, currently estimated to complete in December.
- 4.1.6.B GSE Schedule Variances (-$193K cum, $8K Sep)
  - Designs will continue and be completed in FY03, but funding shortfall will push out hardware procurements until FY04
  - Hired an experienced MGSE designer recently. Finally seeing progress!

ACD Cost Variances

4.1.6.1 ACD Project Management/Sys Eng/Science (+$527K cum, +$109K Sep)

- +$203K Labor support lower than planned due to using more CS support than planned
- +$335K MPS/Lab Tax lower than planned.

- **4.1.6.2 Safety and Mission Assurance (+$98K cum, +$15K Sep)**
  - GLAST project covering costs

- **4.1.6.3 Tile Shell Assembly (-$988K cum, -$53K Sep)**
  - Labor cost is $648K higher than planned. Due to higher labor rates and increased manpower, primarily for mechanical analysis.
    - ($76K) Swales FY02 labor cost higher by $16.20/hr
    - ($75K) Swales FY02 labor 0.7FTE higher than base lined
    - ($432K) Swales FY03 labor costs higher than planned
    - ($34K) Work planned under 4.1.6.6 charged to 4.1.6.3
    - ($31K) Schedule variance
    - ($23K) – Fiber Ribbons (Univ. Washington)
    - ($23K) – performed more composite testing than planned
    - ($199K) – Fabrication support
    - ($96K) – TDA Fab and Assy – 50/50 earned value

ACD Cost Variances

- 4.1.6.4 Base Electronics Assembly (-$1,174K cum, -$29K Sept)
  - ($444K) Labor
    - ($217K) FY03 contractor labor
    - ($122K) FY02 contractor labor
    - ($105K) schedule variance
  - ($521K) M&S
    - ($70K) - Have not received credit for all parts purchased
    - ($119K) parts screening, $57K for MAX494 radiation test
    - ($247K) Early purchase of parts due to GSFC procurement shutdown
  - ($211K) ASICs SLAC BEA
    - ($70K) SLAC labor
    - ($141K) ASIC M&S
- 4.1.6.5 MS/TB (+$40K cum, +$10K Sept)
  - $35K – JSC cost reporting behind actual work performed.
- 4.1.6.B Ground Support Equipment (+$411K cum, +$40K Sept)
  - $293K Labor - Utilizing civil servant manpower instead of contractor manpower
  - $116K Materials – Using existing hardware as opposed to planned procurement
  - Latest estimate to complete in this area did not show the savings that were expected for this WBS element

Threats to Schedule and Cost

1. Electronics assembly and test – functional testing, environmental testing
2. ASICs – Must meet flight requirements, qual, screen, test, etc
3. Mechanical analysis & design (drawing completion)
4. Late Delivery of G3 Test Stand/EGSE
5. PMT Assembly