

AntiCoincidnce Detector

**GLAST Large Area Telescope:  
Project/Cost/Schedule Review  
August 27, 2003  
AntiCoincidence Detector (ACD)  
Subsystem  
WBS: 4.1.6**

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# Outline

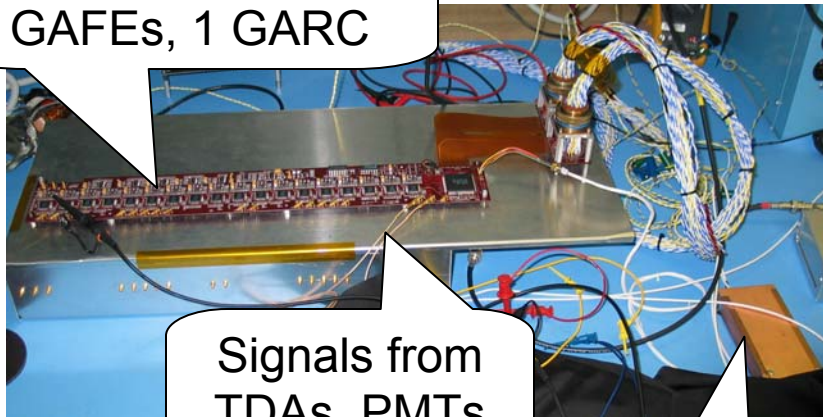
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- **Recent accomplishments**
- **Issues and concerns**
- **Open design issues**
- **Parts and qualification program**
- **Near-term milestones**
- **Cost and schedule variances**
- **Threats to cost and schedule**
- **Plans for coming month**

# Recent Accomplishments - **update**

- ASIC, FREE card, and End-to-End testing
  - GAFEv5 (analog ASIC) operated at  $\geq 3.6$  V meets requirements
    - Acceptable noise, linearity, and recovery after large pulse
    - Completed automated system for GAFE testing, takes approx. 10 minutes to test a GAFE.
    - Additional GAFEv5 batch recently received is being used for a second FREE card. 24 of the 65 received meet all our requirements. We expect a higher yield on the version now in production.

FREE Card with 18 GAFEs, 1 GARC



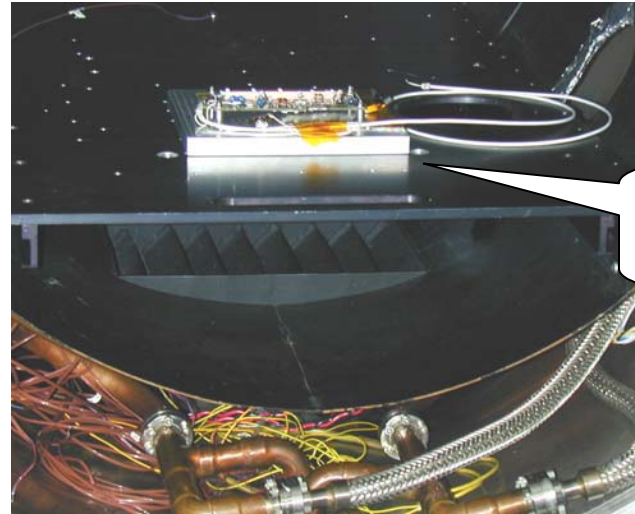
Signals from TDAs, PMTs

HVBS

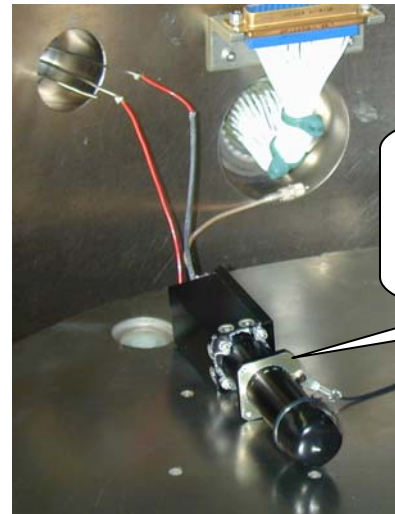
- Good performance with flight-type scintillator Tile Detector Assembly (TDA), phototubes (PMT), High Voltage Bias Supply (HVBS), FREE card (including GAFEv5 operated at 3.6 V and GARCv2).
- New FREE card layout complete and in fabrication.

# Recent Accomplishments - new

- **High Voltage Bias Supply (HVBS) Environmental Testing**
  - **Vibration testing completed with no problems**
  - **Thermal vacuum test in progress**
- **Phototube Assembly Testing**
  - **New design is light-tight**
  - **Corona test in progress**
  - **PMT housings and RN covers awarded**
  - **Populated first batch of Resistor Networks using flight process.**



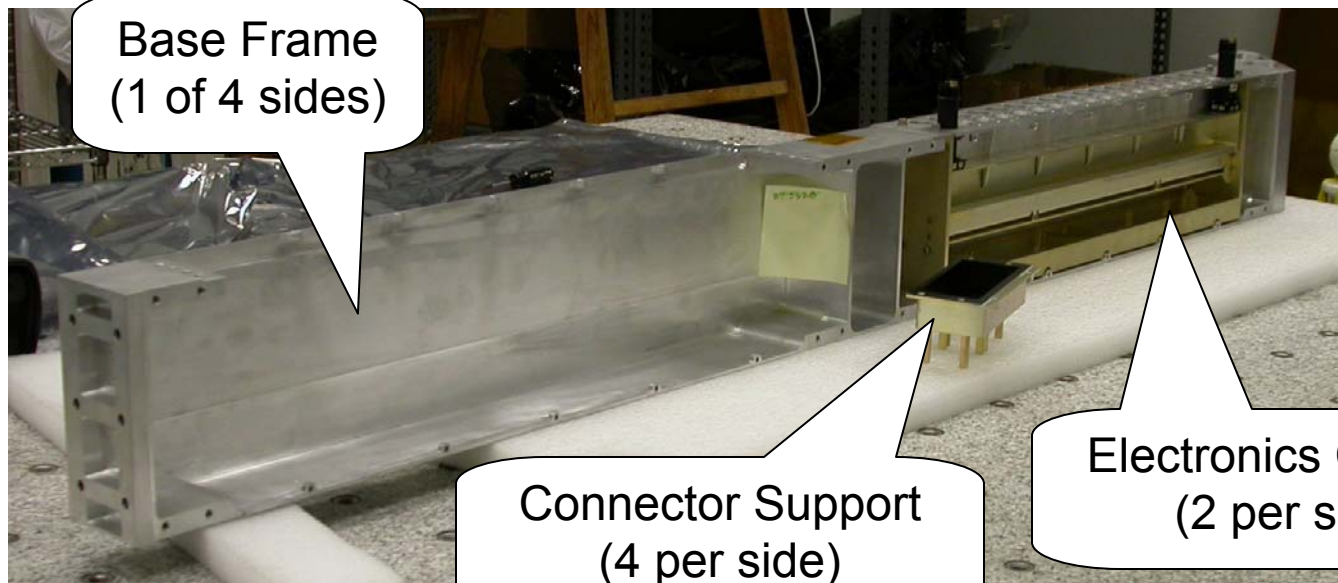
**HVBS in TV chamber**



**Phototube assembly in vacuum chamber for corona test.**

# Recent Accomplishments - **update**

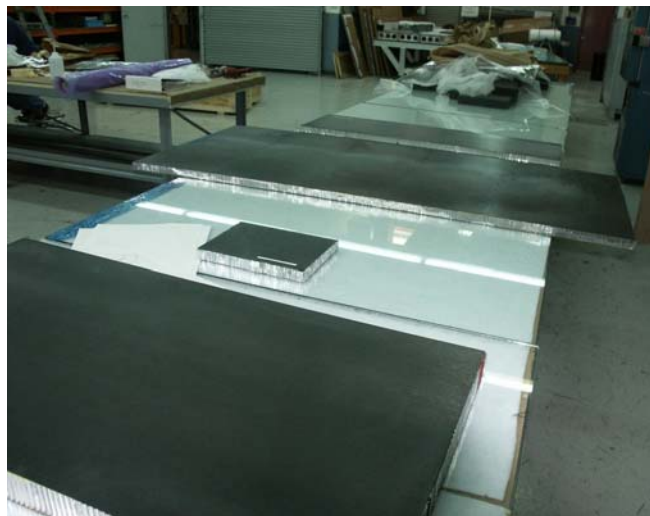
- **Base Frame Fit Test**
  - **Mechanical housing for Electronic Chassis/Mechanical interface to LAT grid**
  - **Minor issues with design.**
  - **Resolved issues found during BEA fit check, updated drawings, and began submitting parts for fabrication.**
- **New Base Frame channel design is complete. Sent out for fabrication.**





# Recent Accomplishments

- **Fabrication of flight composite shell**
  - **One full-size panel has been completed**
  - **Manufacturing Readiness Review was conducted on August 21.**
  - **We have authorized Canyon Composites to proceed up to the point of machining, subject to a more complete inspection of the first panel.**



Left: blank composite panels

Below: ACD shell side panel



# Additional Accomplishments for August

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- Continue to complete mechanical drawings.
- Continue TDA fabrication – **Completion of fabrication of first flight detectors has slipped to September, possibly October, due to recent problem.**
- **Completed fabrication of TDA waveshifting fiber and clear fiber connectors.**
- **Began fab and assembly of clear fiber cables**
- **Completed tooling and procedures for the fabrication TDA tiedowns (flexures)**
- **Preparing for screening and qual of ASICs (tests to be performed, test board design, etc). A draft version of the ACD ASIC Qualification and Screening Plan is being circulated.**

# Issues and Concerns - updates

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- **Need for a final Qualification and Screening Plan for ASICs is a concern**
  - **LAT has a general Q&S Plan for ASICs**
    - **Issue has been the specific implementation (particularly testing) needed for the ACD ASICs**
- **Working with LAT Parts Control Board in consultation with Goddard parts engineers to finalize details of the plan. Agreed in principle, but documentation is still needed. Test boards are being designed.**
- **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.**
- **Requested Goddard funding (~\$60K) for additional equipment. None provided yet, requiring unbudgeted expenditures to keep testing program on schedule.**



# Issues and Concerns - **new**

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- **Reduction of support for ACD TDA production at Fermilab is an issue.**
  - **Accelerator shutdown, required vacation, and extended medical leave have seriously reduced the staffing available to continue the TDA fabrication.**
- **Working with Fermilab associates (with much-appreciated help from Lowell Klaisner) to restore enough support to maintain schedule.**
  
- **Reduction of support for ACD mechanical engineering at GSFC is an issue.**
  - **Problem in another flight project (XRS on Astro E2) has siphoned off some of the time of ACD mechanical engineers**
- **Working with Goddard management to retain enough support to maintain schedule.**

# Issues and Concerns - unchanged

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- **Late delivery of G3 Test Stand/EGSE from LAT Electronics and I&T is a concern**
  - **Scheduled for August, recently slipped to November/December**
    - **Planned for testing of multiple FREE cards and Electronic Chassis, scheduled for August - 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.**
  - **Developing the G3 software before the arrival of the hardware, to minimize the startup delay once the G3 Test Stands arrive.**
  
- **ACD cost increases and availability of FY03 funding is an issue**
  - **Cost to Complete exercise identified increased costs for ACD**
  - **Goddard Engineering Directorate has provided additional Civil Service support, replacing contractors with CS personnel wherever a qualified Civil Servant could be found.**
  - **GLAST Project has offered some support.**
  - **Additional ACD funding included in the current LAT request.**

# Open Design Issues - update

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- **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.**
- **CLOSED:** LAT Electronics group requested a change in the backshell of the connector to the ACD. This change requires a change in the bracket that holds the connector, and this bracket is a structural element. Modification should be straightforward, but must be analyzed. **Action: Decided to stick with original design.**
- **CLOSED:** FREE Board design updates and finalization. **Action: Design complete and in fabrication.**
- **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.**
- **OPEN: Discovered interference between some waveshifting fibers and TDA flexures. Action Plan: Re-design and re-analyze to resolve.**

# Mechanical and EEE Parts - **update**

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- Mechanical Parts and Materials - ALL APPROVED
- PMTs – Qualified, tested, and screened (**final report in draft form now**)
- EEE Parts
  - **FREE - 36 different part types; approximately 830 parts per board. All parts approved by PCB with the following exceptions.**
    - MAX145 and MAX5121 being qualified by GSFC parts group (chips provided by Calorimeter).
    - ASICs in fabrication. S&Q plan is complete and has been reviewed by members of the PCB. Detailed GARC test procedure in review and **draft GAFE test procedure is being circulated**
    - **MAX494 was recently approved following radiation testing**
  - **HVBS - 38 different parts types; 108 total parts per board**
    - **4 parts are not yet approved (DPA needed on 3 capacitors, screening needed for one wire)**
  - **Resistor network - 9 different parts types; 26 total parts**
    - **One connector is not yet approved, waiting for screening**

# Near Term Milestones - 3 Month Plan

Milestone Description	Date	Status/Notes
First System Test w/ one FREE Board, HVBS, PMTs and TDAs	8/15/2003	<i>Completed</i>
Base Frame Channel Fabrication start	8/29/2003	<i>Ready for fabrication</i>
Complete Fab of TDA tiedowns	9/30/2003	<i>Drawings, procedures in signoff</i>
Receive/Test Flight ASICs (rapid-package)	9/30/2003	<i>Test procedures and test equipment ready</i>
Fab Flight HVBS PCBs	10/13/2003	<i>Vibration Testing complete. Currently preparing for TVAC testing.</i>
Complete Flight Mechanical Drawings	10/31/2003	
Complete Design on MGSE and EGSE	10/31/2003	<i>New designer just started</i>
Complete Assembly of Flight Shell	10/31/2003	<i>Receive Sep03; Strength test Oct03.</i>
Start Testing on BEA EU	11/10/2003	<i>We will test 3 HVBS eus during this test.</i>
Complete Fab of Clear Fiber Cables	11/20/2003	<i>Connectors complete; work started on assembly</i>
System Test w/ two FREE Boards, HVBS, PMTs and TDAs	11/28/2003	<i>Preliminary test Sept</i>
Complete Fab of Flight TDAs	12/31/2003	<i>Completion December 03 by Fermi. Delay due to manpower issue @ Fermi.</i>
Complete PMT Assembly	1/30/2004	<i>PMT Housings and Bonding to complete 9/5. PMT assembly area is ready. PMT Assembly to start 9/8.</i>

# Cost and Schedule Variance Introduction

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- **Both Cost and Schedule Variances are continuing to worsen. However, majority of flight hardware has been procured, is in fabrication, or is being assembled! The problem is that we do not receive credit until the hardware is completed, so we received very little credit this month.**
- **New tasks and the associated costs for those tasks that were identified in our grass roots estimate are not included in the PMCS, they will be added during the re-baseline exercise.**
- **Some costs that had accumulated during the three-month Goddard financial system shutdown appeared this month.**



# ACD Schedule Variances

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- **4.1.6.3 - TSA Schedule Variances (-\$617K cum, -\$24K July)**
  - 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.
  - \$86K due to schedule slip for TDA's and fiber ribbons
- **4.1.6.4 BEA Schedule Variances (-\$177K cum, -\$84 July)**
  - 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.
- **4.1.6.6 Mech Qual and Cal Unit (-\$146K cum, \$0K July)**
  - 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 (-\$246K cum, \$0K July)**
  - Designs will continue and be completed in FY03, but funding shortfall will push out hardware procurements until FY04

# ACD Cost Variances

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- 4.1.6.1 ACD Project Management/Sys Eng/Science (+\$252K cum, -\$111K July)
  - +\$71K Labor support lower than planned due to using more CS support than planned/\$76K labor accrued for July represents costs incurred during shutdown (3 months)
  - +\$175K MPS/Lab Tax lower than planned.
  - +\$6K Travel/Materials
- 4.1.6.2 Safety and Mission Assurance (+\$68K)
  - GLAST project covering costs
- 4.1.6.3 Tile Shell Assembly (-\$871K cum, -\$195K July)
  - Labor cost is \$573K 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
    - (\$422K) Swales FY03 labor costs higher than planned
    - (\$34K) Work planned under 4.1.6.6 charged to 4.1.6.3
    - (\$27K) Schedule variance
    - (\$23K) – Fiber Ribbons (Univ. Washington)
    - (\$23K) – performed more composite testing than planned
    - (\$191K) – Fabrication support/\$140K in July represents costs incurred during shutdown (3 months)

# ACD Cost Variances

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- 4.1.6.4 Base Electronics Assembly (-\$1,180K cum, -\$153K July)
  - (\$715K) Labor
    - (\$120K) erroneously charged to labor as opposed to materials/correction next month
    - (\$381K) FY03 contractor labor
    - (\$122K) FY02 contractor labor
    - (\$92K) schedule variance
  - \$5K Travel
  - (\$276K) M&S
    - \$120K erroneously charged to labor as opposed to materials/correction next month
    - (\$95K) - Have not received credit for all parts purchased
    - (\$96K) parts screening, \$57K for MAX494 radiation test
    - (\$205K) **Early purchase of parts due to GSFC procurement shutdown**
  - (\$195K) ASICs
    - (\$71K) SLAC labor
    - (\$124K) ASIC M&S
- 4.1.6.5 MS/TB (+\$42K)
  - \$37K – JSC cost reporting behind actual work performed.
- 4.1.6.B Ground Support Equipment (+\$297K cum, +\$61K July)
  - **Negative accrual on Swales contract this month/anticipate correction next month**
  - **\$201K Labor - Utilizing civil servant manpower instead of contractor manpower**
  - \$90K 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

# Cost and Schedule Recovery Plan

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- **Receiving additional CS manpower support**
- **Extensive testing, evaluation and review being performed on the GAFE. Next submission must meet flight requirements!**
- **Complete electrical subsystem qualification testing so that we can proceed to flight builds**
- **Complete drawings so that fabrication of flight mechanical parts can proceed**
- **Have identified and prioritized list of activities required to maintain schedule. An additional \$600K in FY03 funding is being provided by the GLAST Project to fully support these activities.**

# Threats to Schedule and Cost

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

# Plans for September

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- **Test rapid packaged “flight” version ASICs**
- **Complete TDA Tiedown fabrication.**
- **Receive flight shell panels**
- **Complete assembly of first batch of 20 PMTs (qual)**
- **Perform electrical system end to end testing with multiple FREE boards (one populated using flight process)**
- **Continuing TDA fabrication – Complete first qual unit**
- **Procure flight HVBS PCBs in preparation for flight build**
- **Procure flight FREE PCBs in preparation for flight build**