

GLAST Large Area Telescope: Tracker Subsystem WBS 4.1.4

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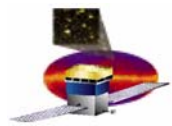
Outline

- **Technical Status- last month's accomplishments**
 - Issues identified and closure plans
 - Status of flight hardware
- **Cost and Schedule Status**
 - Tower A Campaign
 - Winning the War
 - Delivery schedule for Tower B—Tower 16



Accomplishments and Issues Identified in July/Aug Tower A Build

- **Fabricated 19 Trays: flight design, process and procedures**
 - **36 layers with MCMs**
 - **27 layers with silicon**
- **Bias Circuit Bonding Failure**
 - **During tray panel fabrication in July and August problems were found with bonding Kapton bias circuits to W converter foils**
 - **Delaminations occurred in tray T/V testing at 55C**
 - **Preventative measures (pre-cuts to bias circuits) resulted in HV shorts on trays**
 - **<50% yield on tray fabrication due to this problem**



Bias Circuit Bonding Failure

TOP 001:

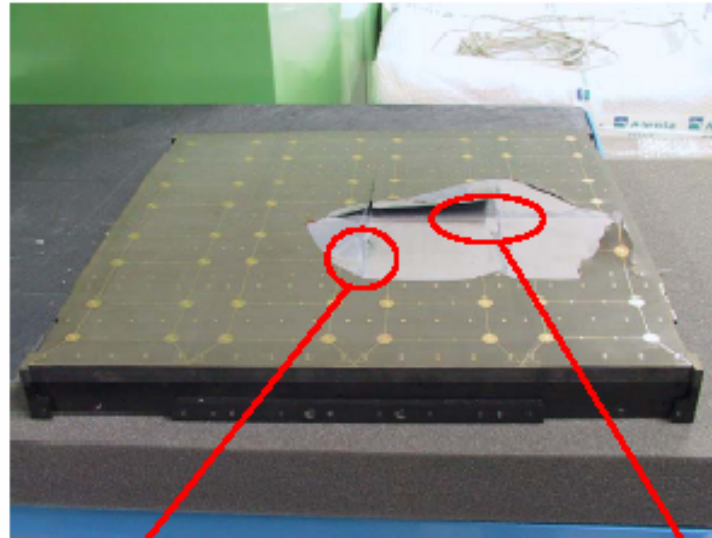


Fig.1

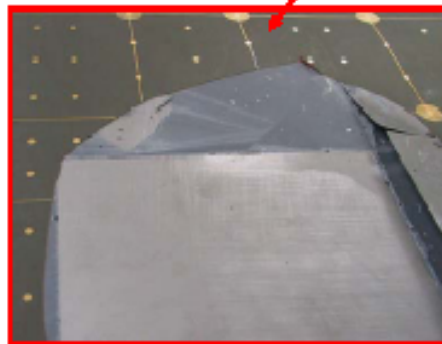


Fig.2

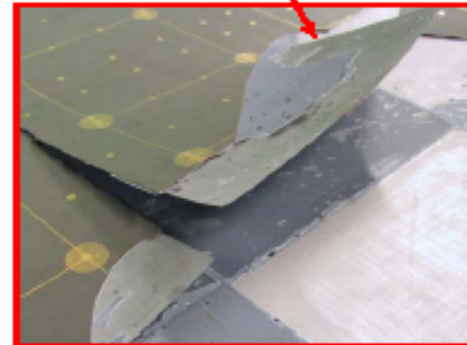
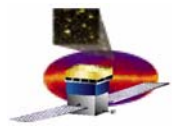
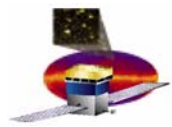


Fig.3



Accomplishments and Issues Identified in July/Aug Tower A Build

- **Bias Circuit Bonding Failure (cont.)**
 - **Tracker Anomaly Resolution Team (TART) formed**
 - **Chaired by Neil Johnson**
 - **Primary recommendations:**
 - Improved surface prep of W and Kapton
 - Improved process cleanliness and controls, and QA
 - Improved bond joint compression
 - **Tracker Team developed plan and schedule for recovery plan based on TART recommendations**
 - **Critical steps in recovery plan:**
 - **Etched primed W tiles with good coupon tests must be produced in sufficient quantity**
 - **Clean controlled work area at Plyform and recommended cleanliness steps**
 - **New procedures, process controls and MIPs**
 - **Test articles**
 - **On track with plan to resume flight production 10/4**
 - **Bare panel production has continued**
 - **Plyform committed to 20 bare panels (full tower) ready for kapton bonding starting Monday 10/4.**



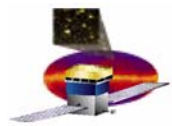
Accomplishments and Issues Identified in July/Aug Tower A Build

- **Wire bond encapsulation issue**
 - **0% yield of heavy trays in thermal cycling after wire bond encapsulation (silicon to MCM) due to breaking of many wire bonds**
 - **Root cause not fully understood**
 - **Encapsulation will be eliminated from MCM-Si joint, design changes in process**

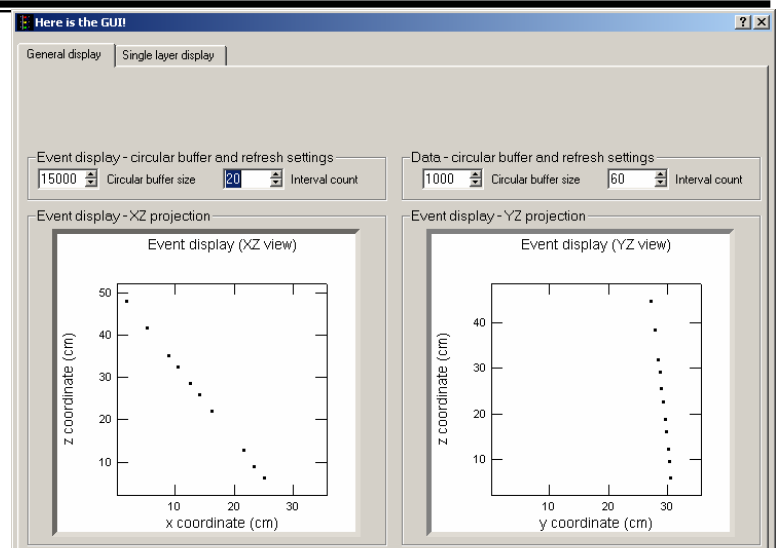


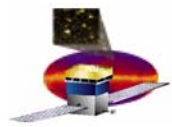
Accomplishments and Issues Identified in September “Tower 0” Assembly

- In parallel with execution of recovery plan, moved forward with assembly of 19 trays (all but 6 non-flight) into ‘Tower 0’
 - Train operators
 - Validate assembly procedures including alignment
- Currently have successful operation of the full tower
 - 23 active layers
- Identified interference between connector on MCM and sidewall on many trays
 - Connector on tray violates stay clear by up to 200 microns
 - Issue being resolved with process change in G&A assembly
 - For Tower 0 alignment exercise, we are using AI sidewalls made to check the drill pattern, relieved to avoid interference
 - Tower 0 has been aligned successfully
- One readout chain (out of 8) is not working
 - Root cause to be determined after alignment of Tower 0



Pictures of Tower 0





Accomplishments and Issues Identified in MCM Production

- 342 units delivered to SLAC
 - 241 through burn in and final test at SLAC
 - Need 686 for 18 towers + electronics group
- MCM Issues
 - Novocap capacitors
 - NCR is closed
 - Tracker will use existing capacitors on existing boards
 - Replacements at Teledyne being kitted for production
 - Pitch adaptor
 - 13.5% drop out at MIP 1 due to broken traces (visual inspection)
 - Brittle Ni plating cracks easily in bend region, sometimes also cracking Cu
 - Two new pitch adaptor concepts in work to eliminate problem
 - New electrical test fixture in fabrication



Accomplishments and Issues Identified in MCM Production

- **MCM Issues (cont.)**
 - **Conformal Coating**
 - Issues identified in QA with peeling, contamination and bubbles
 - Detailed specification for inspection and rework under review
 - Critical path to getting MCM's for Tower A to Italy
 - **MCM board HV shorts**
 - 6 boards have developed low resistance between 2 layers (120V and 0V planes) of the multilayer board during burn-in.
 - Test in process to determine root cause
 - Accelerated life test in progress to evaluate risk
 - **Data readback errors**
 - Some MCMs are too sensitive to clock duty factor
 - Bad MCMs being screened out while investigations continue



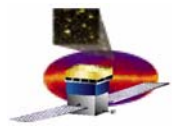
Accomplishments and Issues Identified in EM Tower Testing

- **Concerns were raised about events with large numbers of hits in the tracker EM tower**
 - **Potential source of excess noise and data rate in tracker**
 - **Studies done to eliminate cross talk and other sources of multiple hits in readout chain**
 - **Sources of multiple hits identified**
 - **Showers**
 - **VDG bursting**
 - **Issue will be closed with release of document describing testing and results**



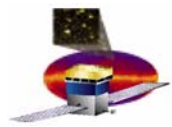
Flight Hardware Drawings Status

- **Top/Bottom Tray Panels (including flexures)**
 - All drawings complete and released.
- **Interface Hardware**
 - All complete and released.
- **Mid Tray Panels**
 - Some rework and improvements of the drawings to reflect as-built condition are in work.
- **Tray Assembly (Bonding MCMs + Ladders to tray panels)**
 - All complete and released.
- **Sidewall Drawings**
 - All complete and released.
- **Heat Straps**
 - Complete and released.



Flight Hardware Drawings Status

- **Flex-Circuit Cables**
 - **All complete and released. Drawing revision to match as built in progress**
- **Top Mount Cable Retainer and Alignment Hardware**
 - **All complete and released.**
- **Tower Assembly Drawing**
 - **Complete and in release cycle**
- **Electronics, including SSDs, MCMs, Bias Circuits, ASICs, etc.:**
all complete and released.
 - **Ladder drawing revised to match as built.**
 - **Ready for release**



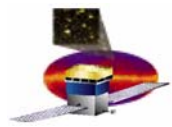
Status of Parts & Materials from SLAC

Item	Status	Issues
MCMs	~40 in will be hand carried to Italy Friday for Tower A	Resolution of conformal coat issues have delayed shipment
Flex-Circuit Cables	No complete flight sets in hand; C4 and C5 missing from 2 partial stes	Plating problem at Parlex Delayed coupon testing
Ti Corner Brackets & Flexures	Flight order complete	
Bottom-tray closeouts	Flight order complete	
Interface cones & studs	The Tower-A set is ready and the remainder is in fab	
Hex nut	In hand	
Shims	Enough in hand for Tower A, but working on Ni plating	



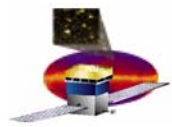
Status of Parts & Materials from SLAC

Item	Status	Issues
Corner Brackets	In fabrication	
Sidewall Prepreg	Italy purchased enough already for at least 2 or 3 towers. SLAC has a PO for the rest.	
Ti Sidewall washers	Sufficient quantities are in Italy	
Sidewall Fasteners	All are in hand and verified	
Cytec BR-127 Primer	A large quantity was shipped last week and arrived okay	
Bias Circuits	Plenty in Italy for tray mass production to begin	Waiver of coupon via plating thickness



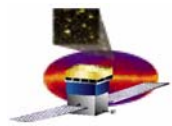
Status of Parts & Materials from SLAC

Item	Status	Issues
Heat straps	Tower A set plus spares are in Italy	
Locktite 401 for heat straps	Being shipped to Italy	
Solithane (for locking screws)	Being shipped to Italy	
Nusil silicone adhesives	Sufficient quantities now in Italy	Replacement being ordered
Aeroglaze paint and primer	Sufficient quantities now in Italy	
Honeycomb	In Italy except for the remaining bottom-tray cores (shipping this week)	
Carbon Carbon for Tray Closeouts	Full flight order is in Italy	



Status of GSE from SLAC

Item	Status	Issues
Vibration Fixture (Grid Simulator)	First deliveries from Humboldt this week, so SLAC-built fixture used for the EM vibe will not be used for Tower A	
Inner Shipping Container	Tower-A container is hand and is being proof tested	
Cable Holding Plate	In hand and being proof tested this week	
Static Test Grid Simulator	In Italy, already used for Tower A	
Lifting Fixture	One is in hand and proof tested. 2 more will also be made for use in Italy.	
Outer Shipping Container	On order	Delivery in October



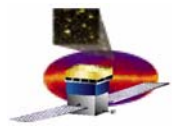
Status of GSE from SLAC

Item	Status	Issues
Cable Bending Tool	Prototype completed, production model in design	
Tools for Cone Alignment and Extraction	Enough tools are in hand for Tower A assembly in Italy	
EGSE Sets	4 sets are in Italy. One more for T/V testing is under test at SLAC prior to shipping.	
Long EGSE Cables for T/V Test	1 set delivered to Italy. 2 more are in work	
C0 Cables for Stacked Tray Tests	Enough in hand for Tower A	Need to equip 3 more test sets in Italy with a less expensive version, in work
Breakout Boxes for Tray Testing	2 are in Italy	



PMCS Schedule & Cost Variance

- **August: our schedule variance increased from -\$635k to -\$716k on a total \$14,761 budgeted cost of work scheduled.**
 - **Most of the cumulative variance is due to the production delays of TMCs, which started up slowly in April but which then went at almost the planned rate. Fewer than planned were produced in August resulting in the increase in the variance.**
 - **A week was spent qualifying new pitch adaptors**
 - **More delaminations than usual**
 - **Keep in mind that most of the Tracker assembly work is to be done in Italy and is therefore not tracked by this schedule variance calculation.**
- **Cumulative Cost Variance: \$237k**
 - **While the cost variance looks good, our commitments are almost equal to the total final budget and unexpected costs keep coming in.**



Schedule Status: Tower Delivery Schedule

- Updated plan:
 - Start production 10/4
 - Plyform produces 4 trays/day starting 11/1
 - G&A going to 2 shifts
 - Extra CMM
 - Extra Wire bonder
- Tower 13,14 arrive in May

TKR Tower prod. Flow; PlyForm 4 trays/day from November - G&A 3 trays/day from dec

	Months											
	July	Aug	sept	oct	nov	dec	Jan (05)	Feb (05)	Mar (05)	Apr (05)	May (05)	June (05)
Plyform tray	Zero	N/A	TART Tests	A,B (10 trays)	B,1,2,3	4,5,6,7	8,9,10,11	12,13,14,15	16			
Trays vibrate Test / ESPI	Zero		A(ESPI bare)	A	B,1,2	3,4,5,6	7,8,9	10,11,12,13	14,15,16			
Bake out	Zero			A	B,1	2,3,4,5	6,7,8	9,10,11,12	13,14,15,16			
G&A installation	Zero	Zero	B	A	A,B	1,2,3	4,5,6	7,8,9	10,11,12	13,14,15	16	
Env. Test on tray	Zero	Zero		A	A,B	1,2	3,4,5	6,7,8	9,10,11	12,13,14	15,16	
Stacked Test			Zero	A	B	B,1	2,3,4	5,6,7	8,9,10	11,12,13	14,15,16	
INFN-P assembling tower	EM	A	Zero		A	B,1	2,3,4	5,6,7	8,9,10	11,12,13	14,15,16	
T/V & vibrate test at Alenia	EM (vibe)				A	B	1,2,3	4,5,6	7,8,9	10,11,12	13,14	15,16
Delivery/shipping					A	B	1,2,3	4,5,6	7,8,9	10,11,12	13,14	15,16

Note: 2 weeks at least are necessary for a tower assembly (included performance tests)

Note: Delivery/shipping is foreseen at the end of month