

GLAST Large Area Telescope: Tracker Subsystem WBS 4.1.4

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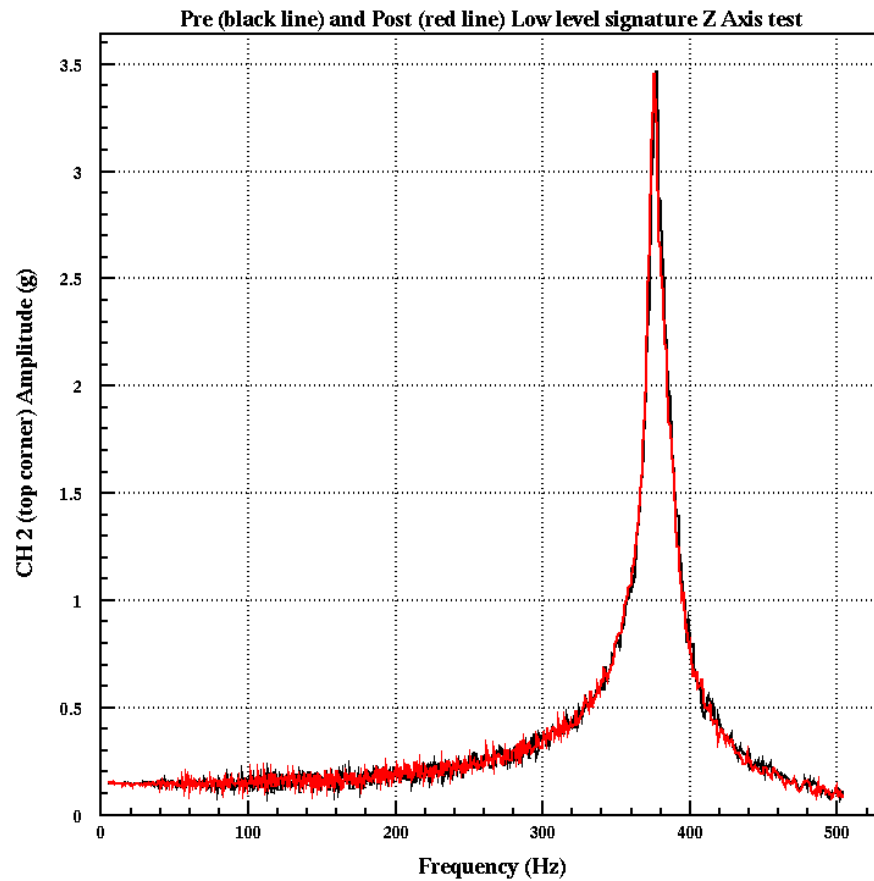


June Progress

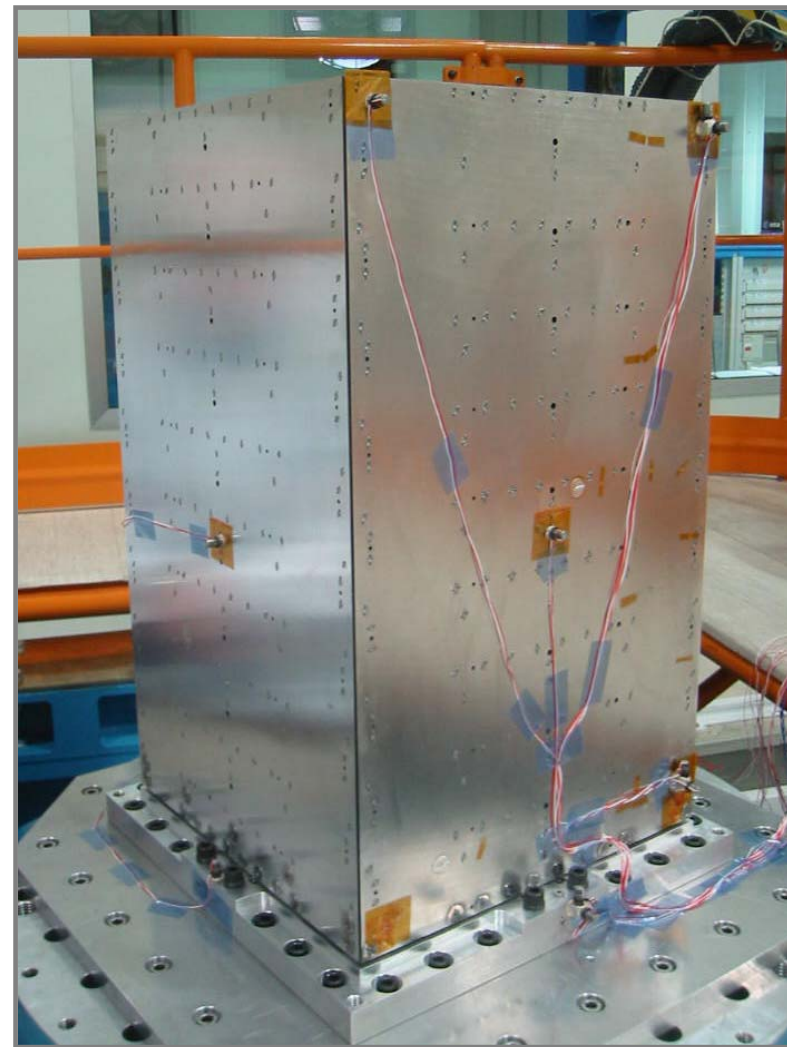
- **New EM bottom tray with the flight design and flight interface:**
 - **Fabrication completed with good dimensional results.**
 - **Static test completed to full qualification levels.**
 - **Vibration testing completed using this tray and the EM tower to protoflight qual levels in all cases:**
 - **Major effort on both sides of the Atlantic to build the tray and bring together all of the interface and MGSE hardware necessary to carry out the test.**
 - **Good experience for Tower A: the complete test, including setup, required only 4 days.**
 - **All preliminary results point to 100% success of validation of the static and dynamic mechanical structure.**
 - **Week of July 5: we plan to test in Pisa the alignment procedure on the EM tower, which is the final validation needed for the Tracker-Grid interface.**

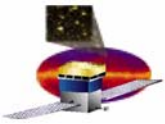


EM Vibration Test

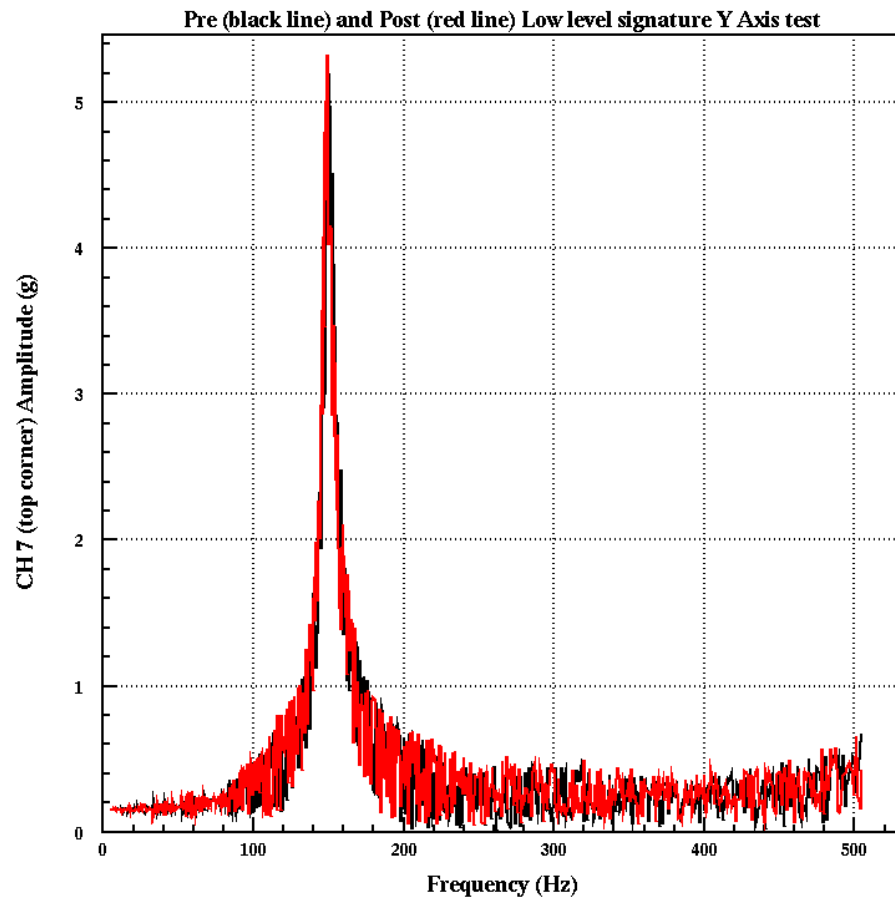


Z-axis signature sweeps before and after the Z-axis random vibration.

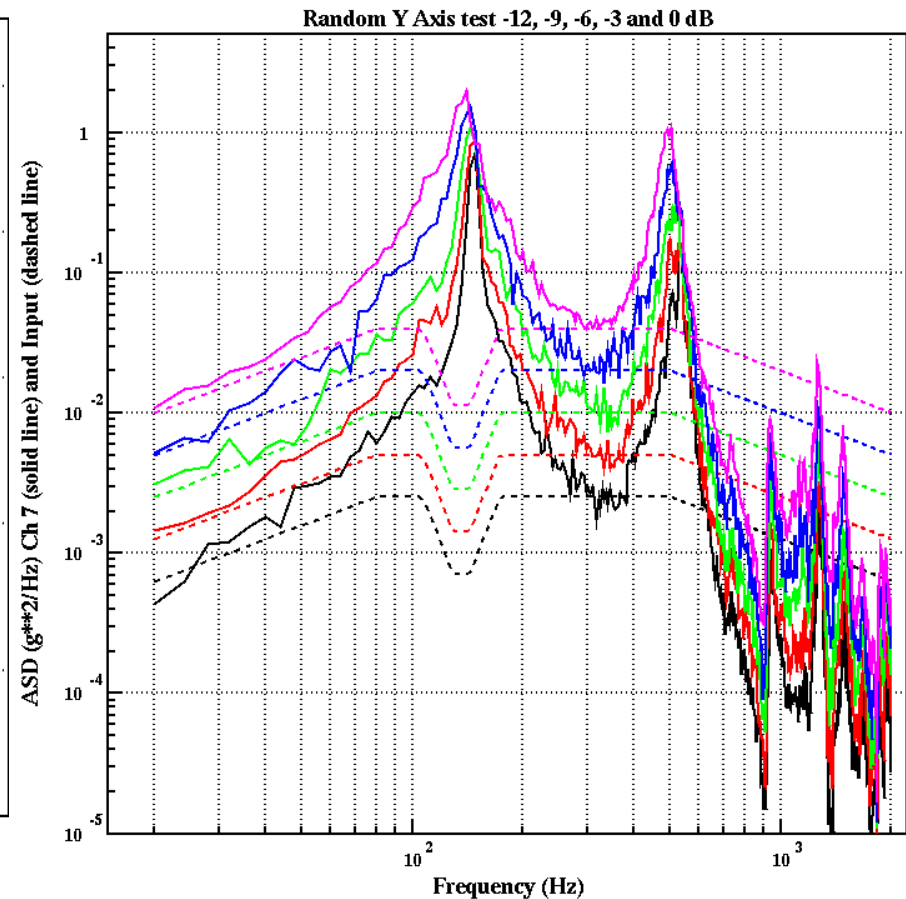




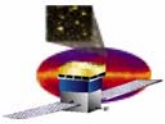
EM Vibration Test



Y-axis signature sweeps before and after the Y-axis random vibration.

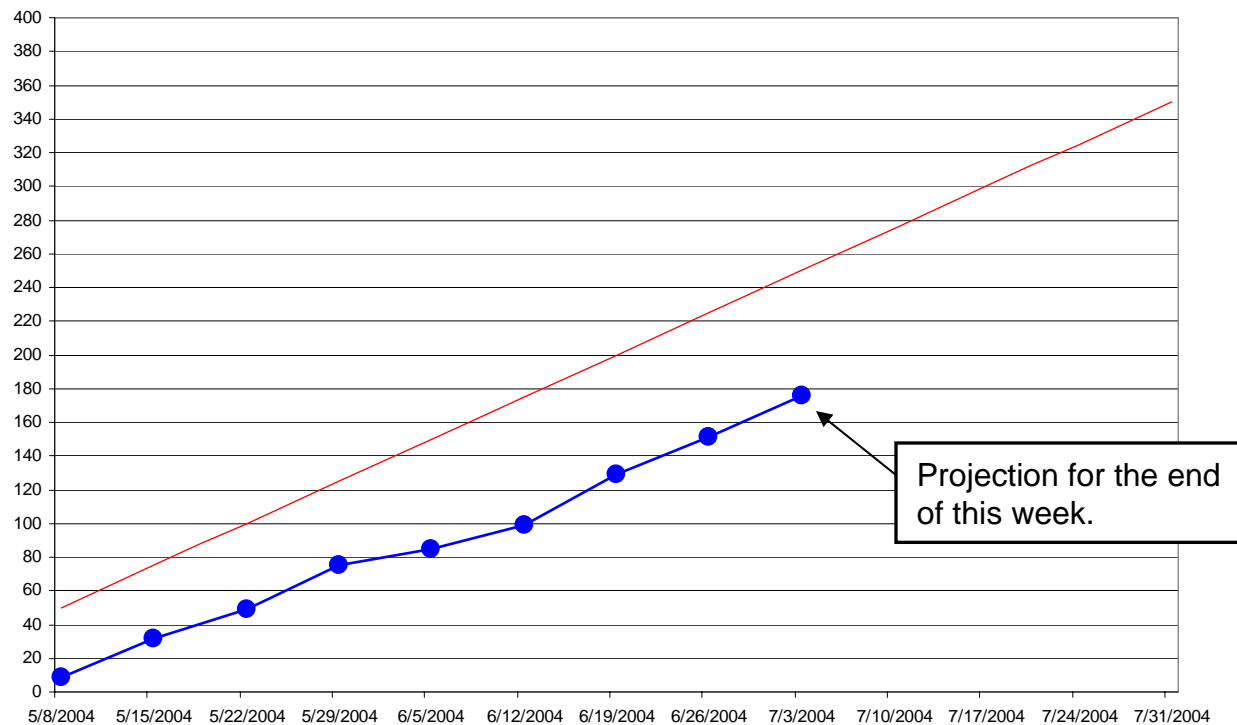


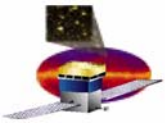
Y-axis random-vibration input and response.



June Progress

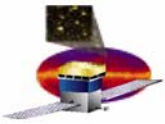
- **MCM Production at Teledyne**
 - Teledyne had shipped 145 flight units as of June 25 (last Friday).
 - We have enough MCMs already for 4 towers.
 - About a week of schedule was lost early this month due to high rejection at the pitch-adapter bonding step, but Teledyne has since then increased manpower for this step.





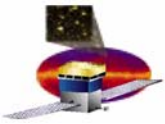
June Progress

- **MCM Production at Teledyne**
 - Working this week to introduce 75-ohm resistors into the Teledyne production line. We have the resistors.
 - Teledyne has quoted on work required to qualify the new pitch adapter design, as needed to reduce the number of rejections at the pitch-adapter bonding step.
 - The new pitch adapter is on order.
- **MCM Burn-In and Test at SLAC**
 - 75 MCMs have completed burn-in and final test
 - First 6 remain in MRB storage for NCR-99 but passed all tests and have no known problems.
 - 4 units failed testing at +60C and are under study.
 - 36 units completed burn-in yesterday and are in final test.



June Progress

- **MCM Register Readback Issue**
 - **A lot of work was done to study this issue, with reports given at 3 MRBs.**
 - **Replacing the 100-ohm clock termination resistors with 75 ohms was found to robustly fix the problem.**
 - **MRB conclusion:**
 - **Rework existing MCMs with 75-ohm clock termination resistors.**
 - **Two quotes were received last Friday, and this work is now proceeding at Zentek Scientific.**
 - **In the meantime use for Tower A MCMs that pass additional screening to verify that there are no errors over the full possible range of VDD.**
 - **30 MCMs that passed are in Italy, including 4 talls.**
 - **Tower A requires 32 shorts and 4 talls.**



June Progress

- **Mid Tray Panel Fabrication**
 - Closeouts assembled for about 3 towers
 - 19 Facesheet-core sandwiches assembled
 - 19 Bare panels assembled and 15 ESPI tested
 - **Mounting tungsten and Kapton Bias Circuits:**
 - 7 were completed and successfully vibration tested, but Kapton delamination from the tungsten was found during thermal-vacuum testing prior to MCM and SSD mounting.
 - Kapton is being removed from those trays, and surface preparation of the tungsten is being improved.



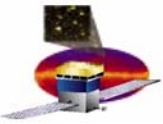
June Progress

- **Top/Bottom Tray Panels**
 - Only the non-flight EM bottom tray was assembled so far; the flight bottom tray will be identical.
 - All parts and materials are ready to go.
 - Drawings are all released.
 - Procedure document was updated based on the EM bottom tray experience.
 - Assembly should be starting today.
- **SSD Receiving and Testing**
 - This step was completed 100% for the full SSD order of >11,000 wafers!
- **Ladder Assembly**
 - 1200 ladders assembled to date, with 1100 tested (16 rejected; 1.3%).
 - This is enough for >8 towers.

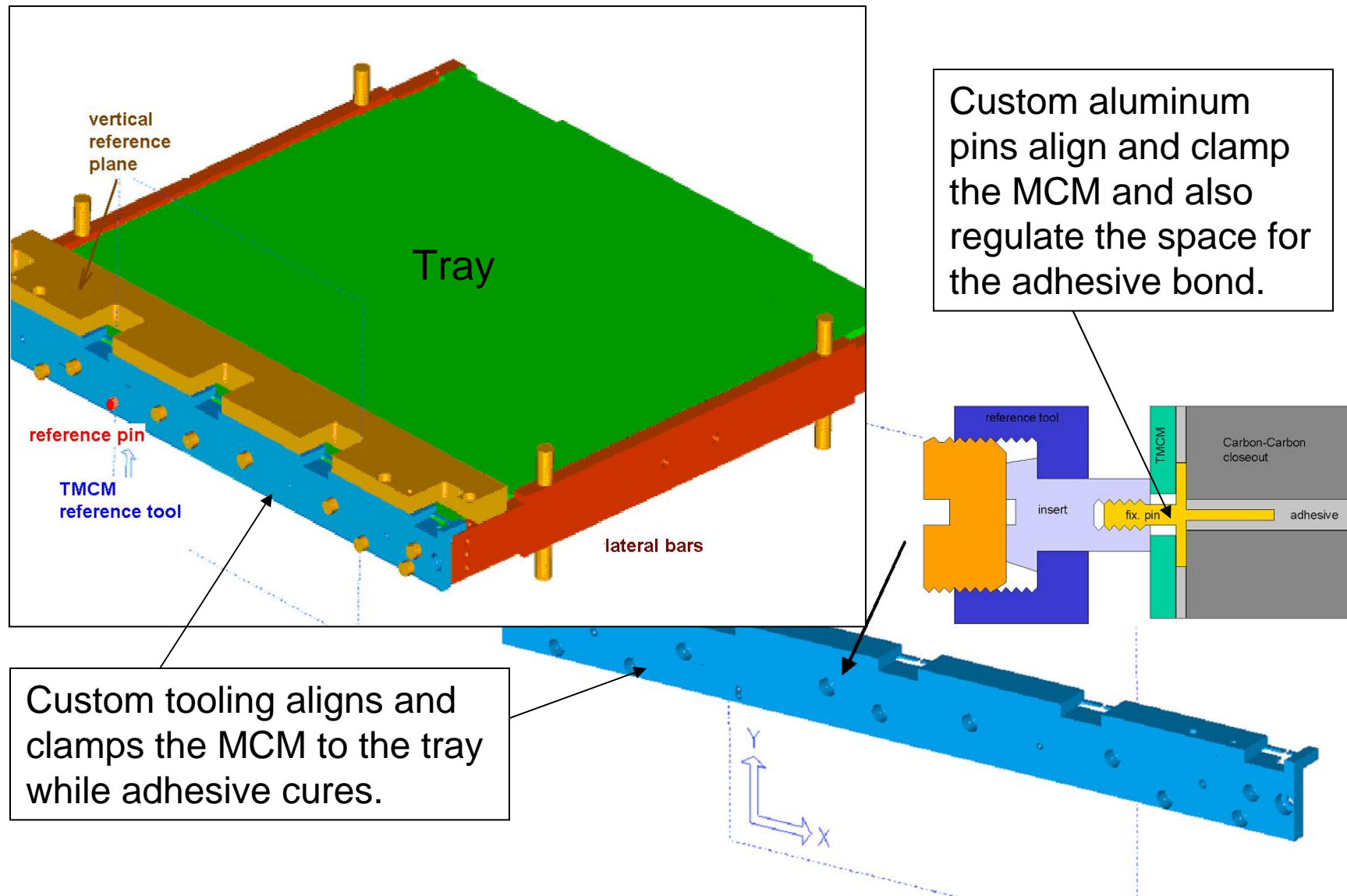


June Progress

- **Integration of MCMs and Ladders onto Trays at G&A**
 - Due to bad experiences with the process for mounting and wire bonding MCMs in the EM, the process has been extensively retooled to facilitate wire bonding.
 - Gluing of the MCM to the tray, using alignment pins.
 - Fine alignment adjustment during the process.
 - Problems with finalizing tooling and processes for MCM mounting have delayed start of production until this week.
 - Status as of last week:
 - Preproduction MCMs were mounted to dummy trays and successfully wire bonded with acceptable pull strengths.
 - Gluing and encapsulation processes were finalized.
 - This week: first complete test of the tooling using actual (non-flight) trays, MCMs, and ladders.
 - Procedure and assembly drawings are undergoing final review and release this week.

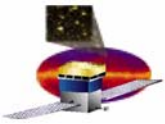


New MCM Mounting Tooling



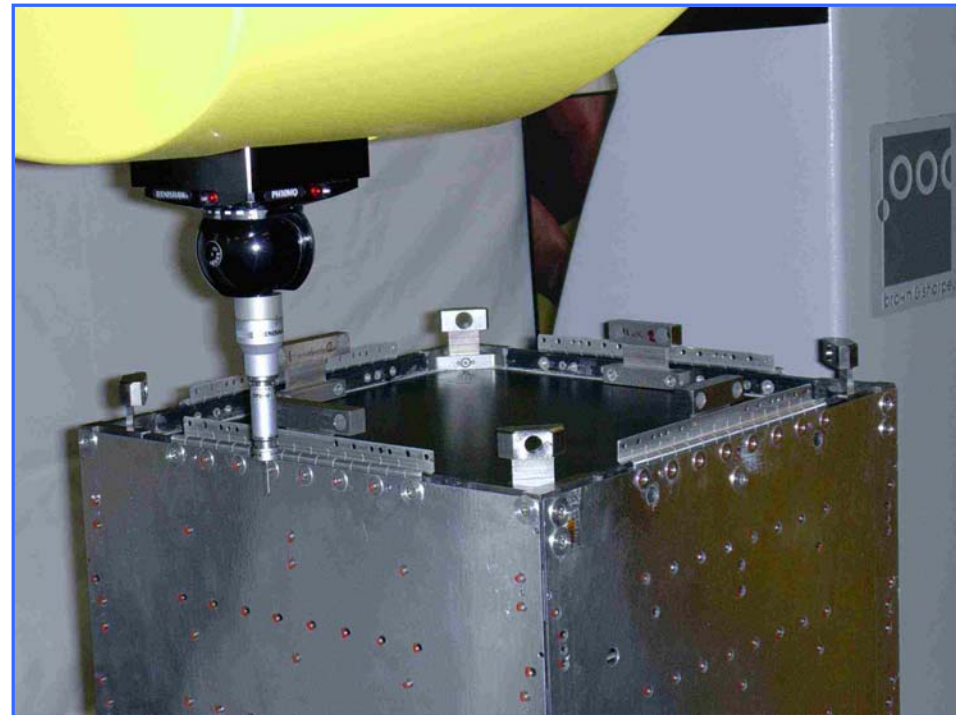
Custom aluminum pins align and clamp the MCM and also regulate the space for the adhesive bond.

Custom tooling aligns and clamps the MCM to the tray while adhesive cures.

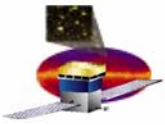


June Progress

- **Tower Alignment**
 - A contractor is working with SLAC this week to develop the software to carry out the tower alignment.
 - The team will go to Italy next week to test the procedure on the EM tower and train our Italian colleagues to use the program.

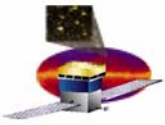


The old prototype tower fitted with an EM bottom tray reworked by I&T to the new interface. The tower is inverted in the SLAC CMM.



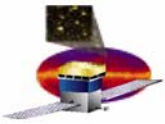
Flight Hardware Drawings Status

- **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)**
 - **5 drawings (tray types). These are in the release process.**
- **Sidewall Drawings**
 - **All complete and released.**
- **Heat Straps**
 - **Complete and released.**



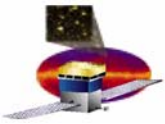
Flight Hardware Drawings Status

- **Flex-Circuit Cables**
 - **All complete and released. Redlines for manufacturing released in the past week to keep Parlex on schedule.**
- **Top Mount Cable Retainer and Alignment Hardware**
 - **New design: 8 drawings in work.**
- **Tower Assembly Drawing**
 - **In work at SLAC.**
- **Electronics, including SSDs, Ladders, MCMs, Bias Circuits, ASICs, etc.: all complete and released.**



Status of Parts & Materials from SLAC

Item	Status	Issues
MCMs	75 completed, but only 30 ready for use	Rework with 75-ohm termination resistors
Flex-Circuit Cables	First two flight sets are due July 8 from Parlex	
Ti Corner Brackets & Flexures	Flight order complete	
Bottom-tray closeouts	Flight order complete	
Interface cones & studs	AMT committed to deliver a set for Tower A this week	PO still in progress for the full flight order
Hex nut	Diamond Tool & Die should deliver this week.	
Shims	Enough in hand for Tower A	



Status of Parts & Materials from SLAC

Item	Status	Issues
Cable Tie-Down Brackets	Design is not yet released, but quotes are being obtained now from the drawings.	Need quick machining to have these ready for Tower A.
Sidewall Prepreg	Italy purchased enough already for at least 2 or 3 towers	New lien on SLAC budget to purchase prepreg for the remaining towers
Ti Sidewall washers	Sufficient quantities are in Italy	
Sidewall Fasteners	M2.5 100° need to be ordered. MJ2.5 120°: need to verify compatibility with M2.5 inserts.	Non-conforming threads on the MJ2.5 120° screws?
Cytec BR-127 Primer	Sufficient quantities in hand for Tower A; more on order	
Bias Circuits	Enough for more than 6 towers are in Italy	Completion of coupon testing



Status of Parts & Materials from SLAC

Item	Status	Issues
Heat straps	Drawings released yesterday. Working to get them fabricated in the SLAC shop	Schedule: delay in agreeing on final design
Loctite 401 for heat straps	In hand at SLAC this week	
Solithane (for locking screws)	In hand at SLAC this week	
Nusil silicone adhesives	Sufficient quantities now in Italy	Need to be notified well in advance if these run low
Aeroglaze paint and primer	Sufficient quantities now in Italy	Need to be notified well in advance if these run low
Honeycomb	In Italy except for the remaining bottom-tray cores	Need to inspect and ship the remaining cores
Carbon Carbon for Tray Closeouts	Full flight order is in Italy	



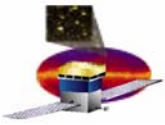
Status of GSE from SLAC

Item	Status	Issues
Vibration Fixture (Grid Simulator)	First delivery from Humboldt July 22, but SLAC-built fixture used for the EM vibe will work	
Cable Holding Plate	Drawings are released and procurement is in progress	Need quick machining to have this ready for Tower A
Static Test Grid Simulator	2 nd unit, coated, delivered this week and in CMM inspection	1 st uncoated unit can't be used for Tower A (rust)
Lifting Fixture	Design will be finalized by end of this week. Fab in SLAC shop.	Need quick machining to have this ready for Tower A
Tools for Cone Alignment and Extraction	Tools are in hand or in work at SLAC for Tower A	
Inner Shipping Container	Drawings are out for release. Will fab in the SLAC shop.	Need quick machining to have this ready for Tower A
Outer Shipping Container	We can use the existing one for Tower A, but it is not ideal	Existing container is too tall and lacks tie-down features



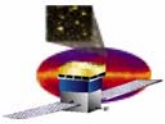
Status of GSE from SLAC

Item	Status	Issues
Cable Bending Tool	First article ready this week	
EGSE Sets	4 sets are in Italy. One more for T/V testing will be ready in 1 week at SLAC.	
Long EGSE Cables for T/V Test	1 set delivered to Italy. 2 more are in work	
C0 Cables for Stacked Tray Tests	Enough at SLAC for Tower A	Need to equip 3 more test sets in Italy
Breakout Boxes for Tray Testing	2 are in Italy	



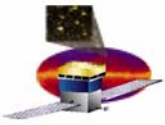
Tracker Design/Manufacturing Issues

- **Bias Circuit bonding onto tungsten**
 - Vacuum bake at 55C caused some delamination of the Kapton from the tungsten foils.
 - INFN is testing bead blasting of foils prior to assembly.
 - Increased abrasion and cleaning to be used on trays already assembled with tungsten foils.
- **MCM NCR 104 (register readback errors)**
 - Extensive testing over temperature, frequency, clock duty cycle, voltage, and radiation dose shows that changing the clock termination resistors to 75 ohms eliminates the problem.
 - Rework of existing MCMs is in progress at Zentek.
 - We are changing the Teledyne production to 75 ohms as quickly as possible to minimize rework.



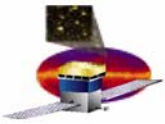
Tracker Design/Manufacturing Issues

- **MCM NCR 107**
 - About 5% of MCMs show errors in event readback in one direction or another at +60C and 20 MHz.
 - Testing at Teledyne is done only at room temperature, up to 22 MHz, so the problem is caught only after delivery to SLAC.
 - This appears to be an issue of timing margin, but it is under study at UCSC to be sure of the root cause.
- **MCM High Voltage Capacitors**
 - Common CAL/TKR issue
 - Novacap parts appear not to conform to two MIL-PRF-123 requirements:
 - Minimum dielectric thickness
 - Insulation resistance (leakage current)
 - Tracker always uses 2 parts in series, with a maximum operational voltage of 120V (the parts are rated at 250V), so it is not yet clear whether the nonconformance is an issue.



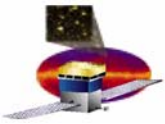
Tracker Design/Manufacturing Issues

- **MCM Pitch-Adapter Bonding Failure Rate**
 - We lose about 25% of MCM boards in the first manufacturing step, due to cracking of pitch-adapter traces on the bend radius.
 - Parlex is making a sample of new pitch adapters with a flexible solder mask over the bend region. These will be delivered today, and we have worked out a qualification plan with Teledyne for 25 units.
 - Schedule is tight to complete this plan and get an order filled for new flight pitch adapters before Teledyne runs out of the existing parts.



PMCS Schedule & Cost Variance

- **May: only a +8k change in schedule variance since April**
- **Cumulative: schedule variance of $-\$704k$ from $\$13,121k$ 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 progressed at close to the planned rate in May.
 - 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: $-\$696k$**
 - This went from positive to negative in May as invoices for electronics and other parts started coming in rapidly.
 - A large set of Tracker budget liens is queued up for CCB action. A significant portion of that has already been committed and is starting to get invoiced.



Schedule Issues

- **The Tracker team is focused on delivery of Tower A to I&T**
 - **Problem with bias circuit bonding to W introduced a delay last week**
 - **Current plan in Italy supports beginning (but not completion) of environmental testing before the Alenia August shutdown**
 - **Current plan supports September 13 delivery of Tower A to I&T consistent with the May PMCS report**
- **The Tracker team is mindful of the production-line schedule**
 - **Working to develop stockpile of critical parts for Tower B manufacturing, and beyond**
- **Robert and Persis are going to Pisa week of July 12**
 - **Will work to develop a manufacturing schedule based on Tower A experience**
 - **Plan to have updated production schedule by next monthly**