GLAST Large Area Telescope:

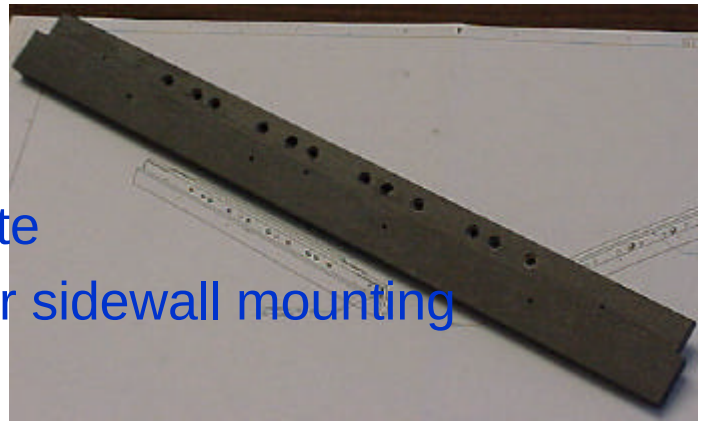
Tracker Subsystem
WBS 4.1.4

Revisions to Tray Design

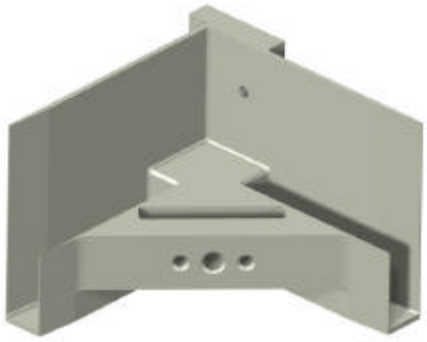
Robert Johnson
Santa Cruz Institute for Particle Physics
University of California at Santa Cruz
Tracker Subsystem Manager

rjohnson@scipp.ucsc.edu

Bottom Tray



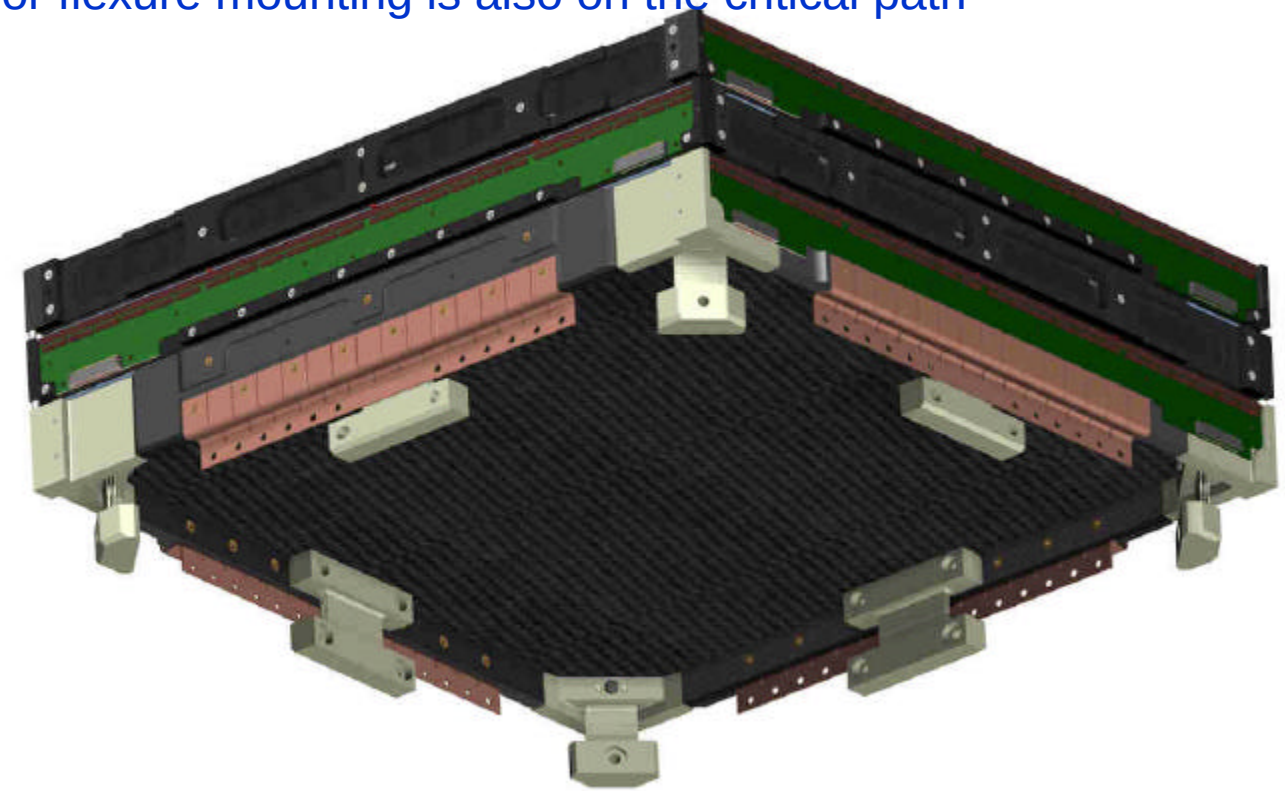
- Substantial redesign:
  - Taller closeouts
  - Closeouts made from M55J/CC laminate
  - Larger M4 inserts in critical locations for sidewall mounting
  - Bonded titanium corner brackets
  - 1-piece 3-blade titanium flexures
  - Bonded joint for side flexures
  - Heavy 3-lb core and 6-ply face sheets
  - Copper thermal straps



- Assembly:
  - Minor adjustments on fixtures used for top-tray assembly
  - Closeout walls and corner brackets assembled simultaneously
  - Drill fixture is being made to locate the flexures to the Grid
  - Static load test to verify workmanship of the flexure attachment

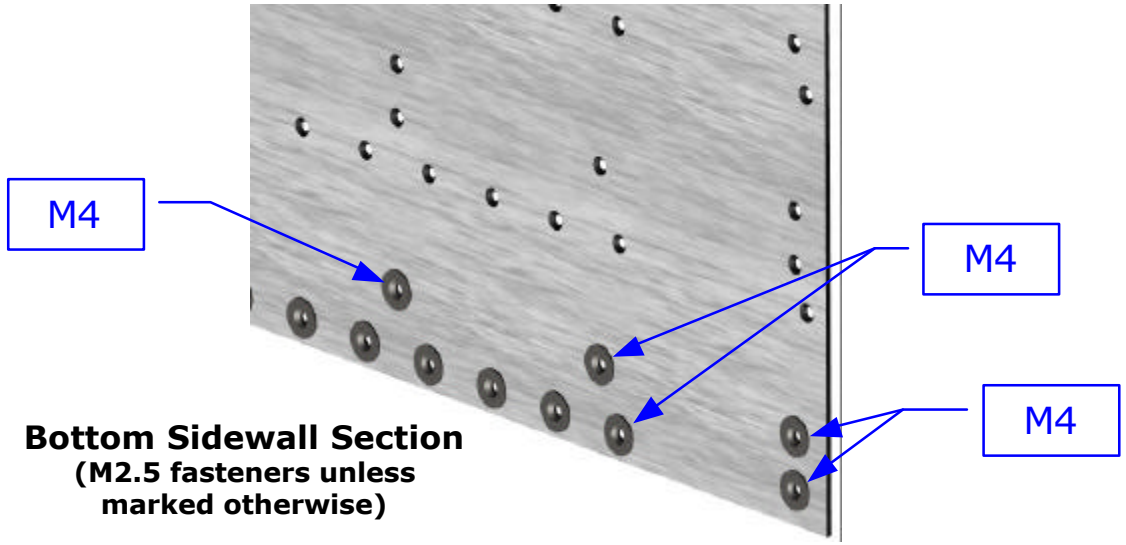
Bottom Tray and Interfaces

- Status:
  - Design completed: all positive margins from FEA.
  - Machined bottom tray closeouts ship tomorrow from COI
  - Titanium corner brackets and flexures June 2; Static test fixture June 9
  - Drill template for flexure mounting is also on the critical path



Sidewalls

- YS90 replaced by K13D for better thermal conduction
  - Prepreg is in Italy for Plyform to begin panel assembly
  - Short panels are needed quickly for static test fixture
  - Coupons will be tested to obtain allowables
    - Smallest tower margins are in the sidewall-tray interface
    - Existing margins are based on testing of YS90 coupons



Bottom Sidewall Section
(M2.5 fasteners unless marked otherwise)

Mid Trays

- All EM mid-tray panels have been fabricated and tested
- A PRR was held at Plyform in mid April
  - See http://www-glast.slac.stanford.edu/Tracker-Hardware/readiness/Tray_Panel_PRR.html
  - Issues needing to be resolved before beginning flight production:
    - Loose carbon particles
    - Grounding of the core
    - Update and approval of drawings and procedures
      - Several detailed action items listed in the above referenced web page
    - Implementation of the INFN database for panel fabrication
- Plyform contract is in place and closeout insert procurement is beginning this week

Carbon Particles

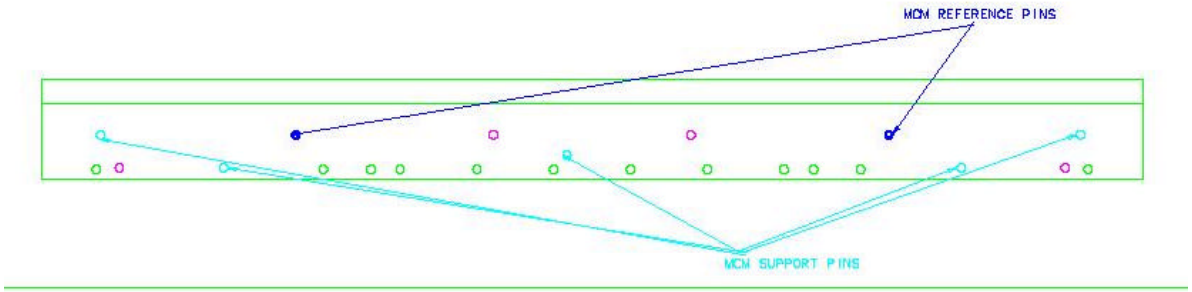
- EM mid tray carbon-carbon surfaces and trimmed face-sheet edges were passivated by dabbing with a thin resin.
- We prefer to use instead the Z-306 non-conductive black paint, as it can be applied by spraying, giving better coverage onto surfaces and into corners. This will be tested on the top and bottom EM trays.
- The original design had MCM mounting screws threading into the carbon-carbon. This is being replaced by an adhesive joint, and the threaded holes are being replaced by smooth bores for alignment pins. This change is required in order to obtain good alignment of the wire-bonding edge of the MCM (see later slide), but it also removes the issue of threading into carbon-carbon.
- All other fasteners thread into inserts.

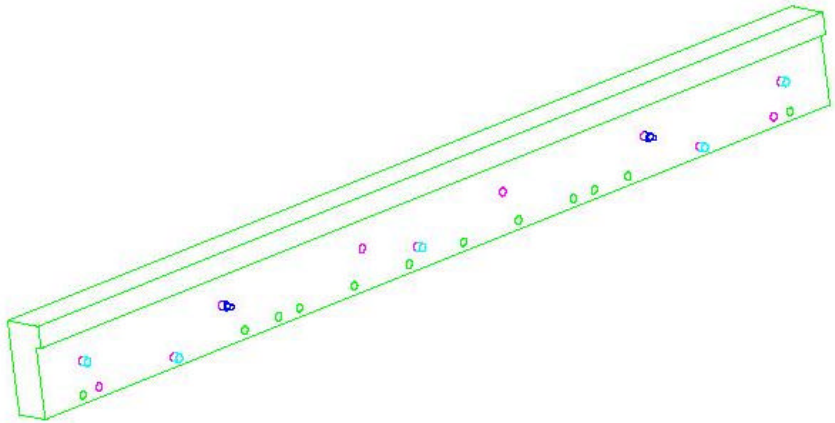
Carbon Particles

- One mini-tower tray had a small protrusion near the tray edge (possibly a carbon fiber from the face-sheet edge or from the screw hole) that shorted the high voltage when the grounding screw was tightened.
  - 5-mil 3M transfer adhesive was not placed between the MCM and tray in this region, so this was a deviation from the intended design
  - However, the new MCM mounting scheme replaces the transfer adhesive by an epoxy joint with less than 100% coverage
- The electrical insulation issue is being resolved by
  - Replacing the back-side MCM solder mask with a full-coverage layer of Kapton
  - Reducing the unfiltered HV plane to a narrow trace and moving the filtered HV plans back from all edges
  - These have already been implemented on the new mini-tower MCMs.
- The protrusion that caused the short could be felt when slipping a piece of plastic behind the MCM and must be further investigated when the mini-tower is disassembled.

MCM Mounting

- To avoid Carbon Carbon chipping, the MCM will be not mounted by means of M1.6 screws.
- There will be smooth holes in the closeout, and glued pins will replace the screws.
- The MCM will be bonded to the closeout with Scotchweld 2216 A/B gray (nonconductive).
- A clamping tool will be used to hold in place the MCM while the adhesive cures.

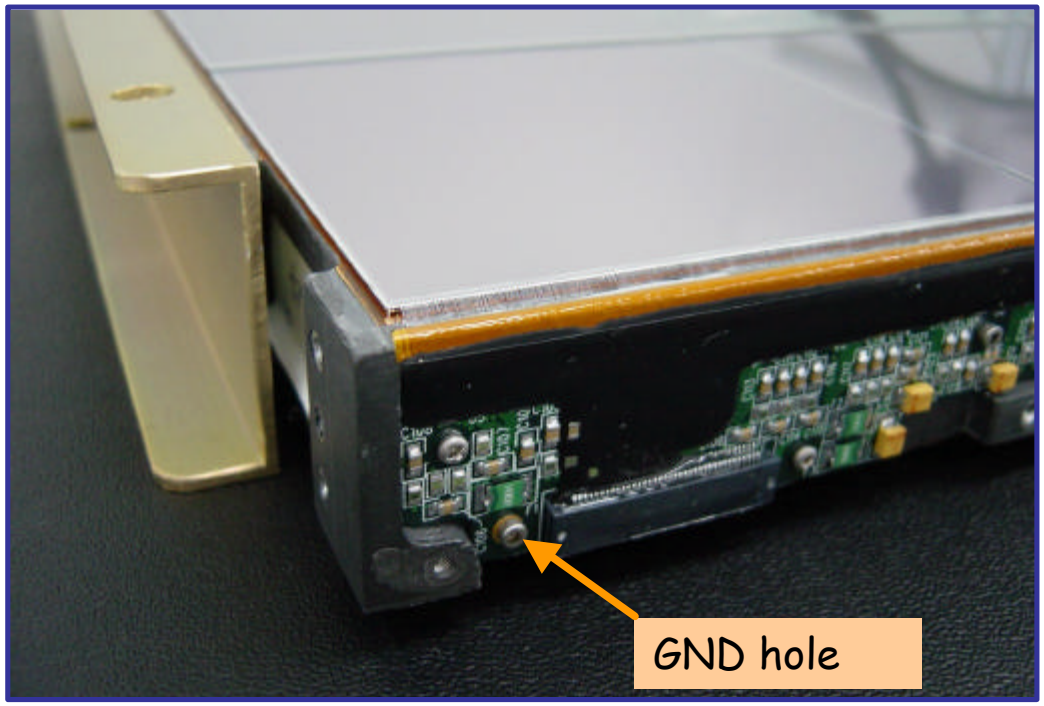


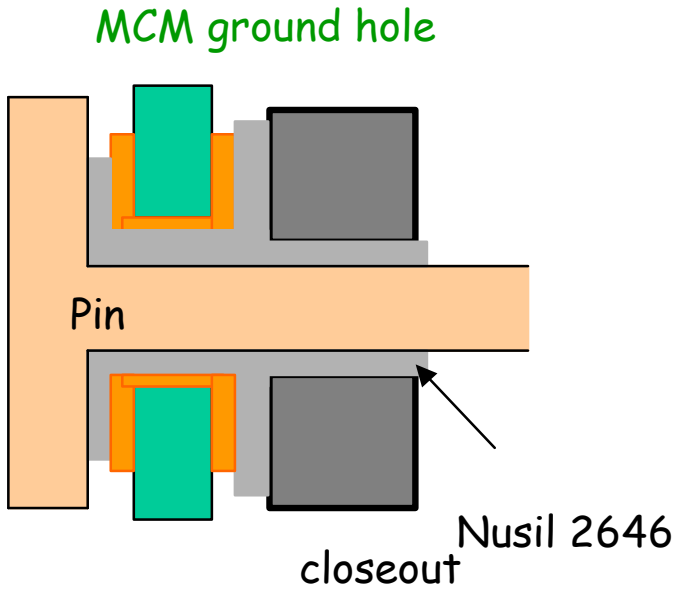


New clamping tool bolts to the inserts in the closeout thermal boss, aligns to the MCM with 2 pins, and presses the top edge of the MCM into place to ensure a straight edge for wire-bonding.

Closeout Grounding

- The MCM ground will be electrically connected to the closeout using pins with conductive glue in the 3 plated-through ground holes.
- Beads of non-conductive glue will keep the conductive glue localized around the ground hole to increase the electrical isolation of the Kapton-covered MCM backside.



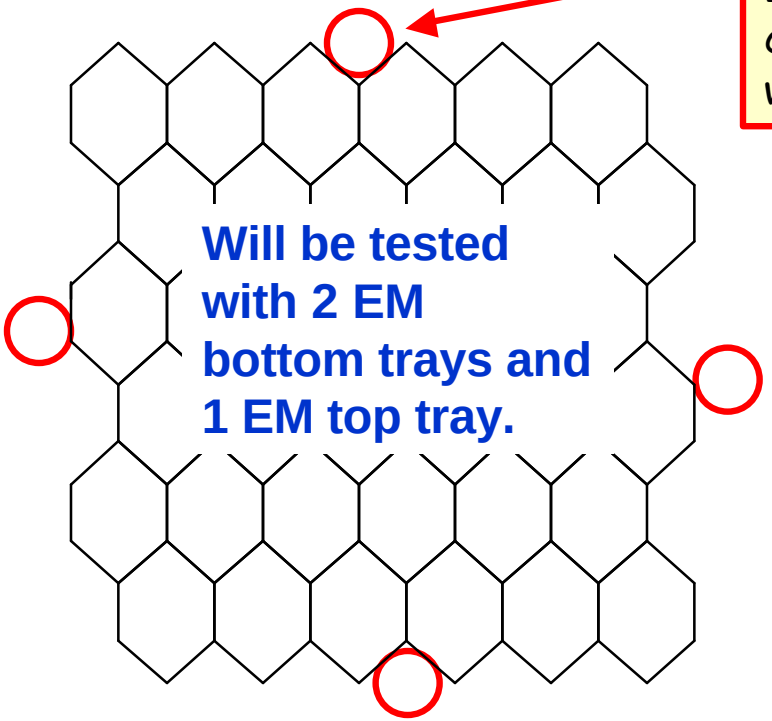


Core Grounding

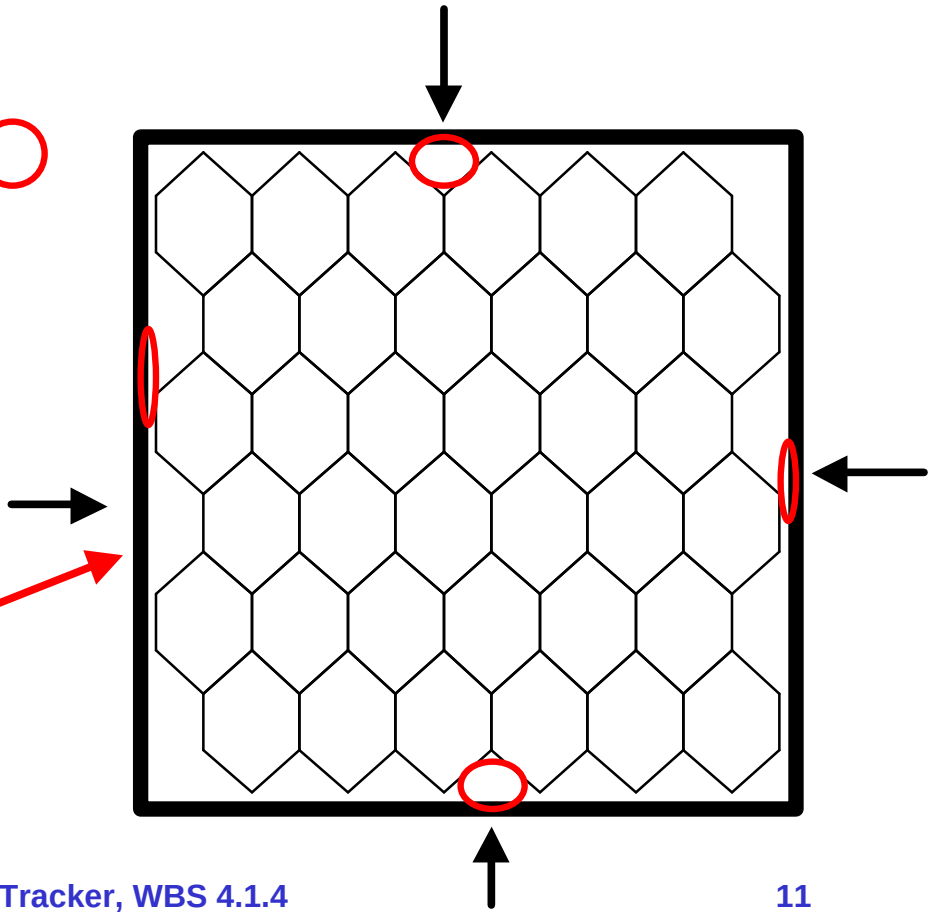
- EM tests demonstrated the need to have good grounding of the conductive tray parts
- Tray electrical conductivity:
  - Carbon-carbon, carbon-fiber and Aluminum core have good electrical conductivity, but are connected together with non conductive glue. The result is a poor electrical connection, 10-100 ohms, from element to element.
- RFA from the peer review requires a better scheme than used in the present mini-tower.
- Also, the MCM mounting scheme is being modified for other reasons.

Core Grounding Solution

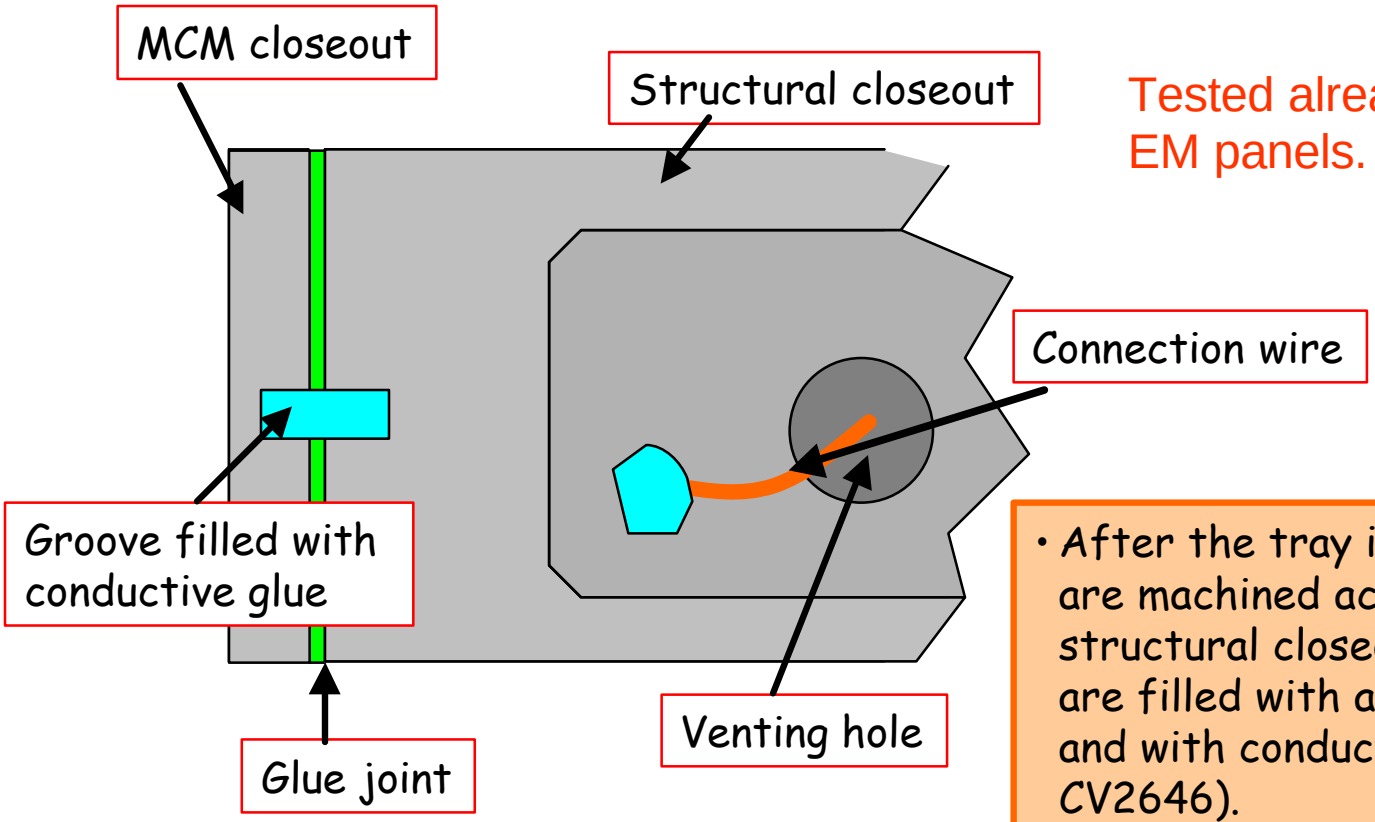
1) Add to the honeycomb conductive cylinders (gold plated kapton tubes) glued with conductive adhesive



2) Put conductive glue on the closeout walls when the tray is assembled, in correspondence to the conductive cylinders. Push in place the closeout walls to compress the cylinders



Backup Core Grounding Solution



Tested already with existing EM panels.

- After the tray is completed, 4 grooves are machined across the MCM-structural closeout walls. The grooves are filled with a short conductive wire and with conductive glue (Nusil CV2646).
- The honeycomb is connected to the structural wall trough the venting hole by means of a glued wire.

Experimental result: all the tray parts (closeouts, face sheet, honeycomb) are connected with low resistance <1Ω.

Bias Circuits

- Incremental improvements to enhance tray manufacturing:
  - Solid (not hatched) and ¼ oz. Cu (not ½ oz.) shield plane, to facilitate gluing to the tray panel.
  - Removable top Mylar film to protect the circuit during assembly.
  - Reverse Bias and GND connections at the two edges (and on the MCM) to correct alignment with the SSD bias pads.
  - Move the GND pad via away from the bonding region and increase the pad clearance from the SSDs and from the cut edge.
  - Remove narrow Cu border at the cut edge (interfered with trimming).
- These are presently being verified with a prototype run of the circuit. These prototypes can be used on the top/bottom EM trays.

Tray Electronics

- GTFE ASIC (G3 version; 123 wafers in hand)
  - Corrected the comparator instability problem (no sign of this problem in >20 wafers of chips probed and >100 chips on MCMs and mini-MCMs, including some connected to live ladders).
  - Corrected the timing margin in the register readback: with VDD=2.5V we can read registers up to 28 MHz.
- GTRC ASIC (Version 6; 20 wafers in hand)
  - Corrected the timing margin in the data readback: with VDD=2.5V we can read data up to about 30 MHz.
  - TOT buffering corrected
  - Parity checking corrected except that a data-field parity error in commands sent to the GTRC is not flagged.
- 100% wafer probe testing of functionality and I/O ports is in progress on both ICs at 22 MHz and VDD=2.4V. Automatic inking of bad dice.
- Specifications and vendor in place for wafer lapping, dicing, acceptance testing, and thorough optical inspection.

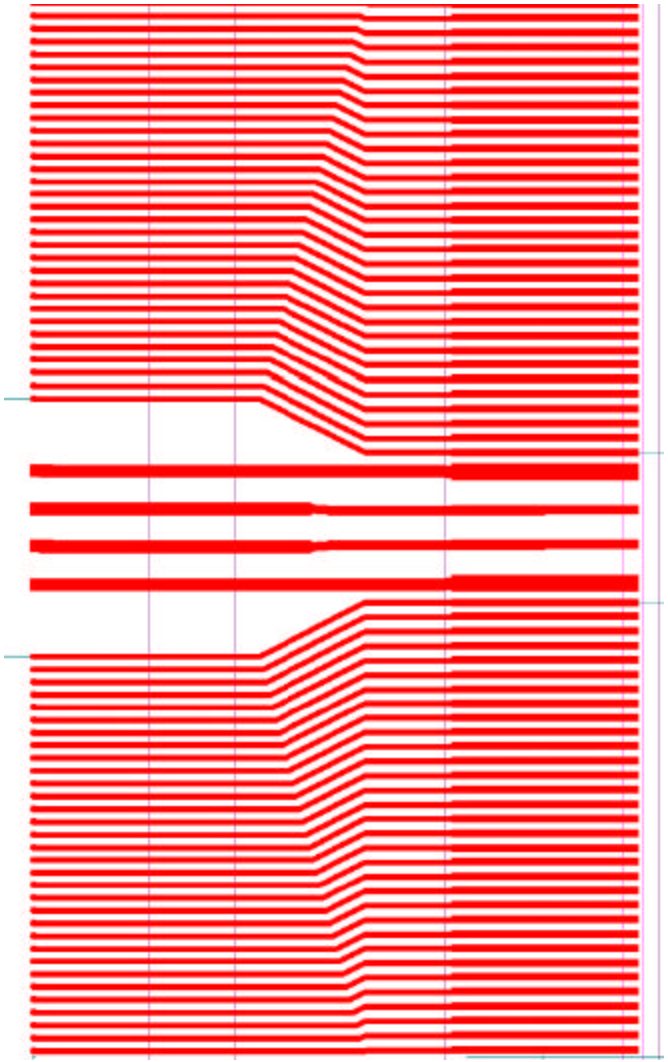
MCM PWB

- No change in schematic or SMT parts placement.
- Correction of routing of two signals that required crossed wire bonds in the previous version. No other routing changes.
  - Should be no change in electrical behavior.
- IC pad sizes adjusted to match the flight-production dice.
- Kapton cover on the backside for improved electrical isolation, plus reduction of HV bias planes on the backside.
- Omnetics connectors: a huge improvement and GSFC approved!
- Pitch-adapter radius increased from 0.64 mm to 1.0 mm, to reduce stress.

- 15 boards from a recent preproduction run are being used to make MCMs for the mini-tower.
  - Include all of the above improvements.
  - Fabricated to the latest LAT PWB specifications, with all certifications and coupons in hand.
  - One board has already been assembled by us and tested.

MCM Pitch Adapter

- Removed cover layer
  - Stress riser cracked traces
  - Required high precision alignment
- Increased trace length at both ends
  - Trim after bonding to the PWB
  - Eliminates tight alignment tolerance and ensures room for wire bonds (biggest source of dead channels in the mini-tower)
- Move zig-zag away from ASICs
  - Facilitates wire bonding at Teledyne
- Increase bend radius on PWB
  - Reduce chance of cracked traces
- Eliminate glass beads from glue
  - These were clumping and making bumps that cracked individual traces
- 4 new prototypes bonded to PWBs at Teledyne with excellent results



MCM Assembly

- We are adding a new process to stake the two large tantalum capacitors.
- Work is in progress to improve the electrical test program:
  - Faster test execution
  - Better user interface
  - Addition of a few new tests
  - Better and faster analysis of errors
- Assembly of 10 new boards for the mini-tower is in progress this week.
- Work is in progress on the contract with Teledyne; the SOW was just drafted.
  - The first lot of 50 MCMs will be a preproduction run and will include the 36 boards for the electronics and flight software groups.

Flex-Circuit Cables

- The first mini-tower cables had several flaws that have been fixed in the design:
  - TEM connector on the wrong side of the cable
  - Inverted TREQ differential signal lines
  - Clock line breaks easily at the TEM connector due to a gap in the metal planes underneath
- New cables are on order that fix these problems plus
  - Use Omnetics connectors for the MCMs
  - Add a stiffener under the TEM connector
  - Move vias well away from the bend regions
  - Hatch the metal planes in the cactus arms
- In addition, for the full-size flight cables we are narrowing the cactus arms to make them much less stiff. This will facilitate installation (they will be more like the old BTEM cables).