GLAST Large Area Telescope:

Tracker Subsystem
WBS 4.1.4

Tracker Status Overview

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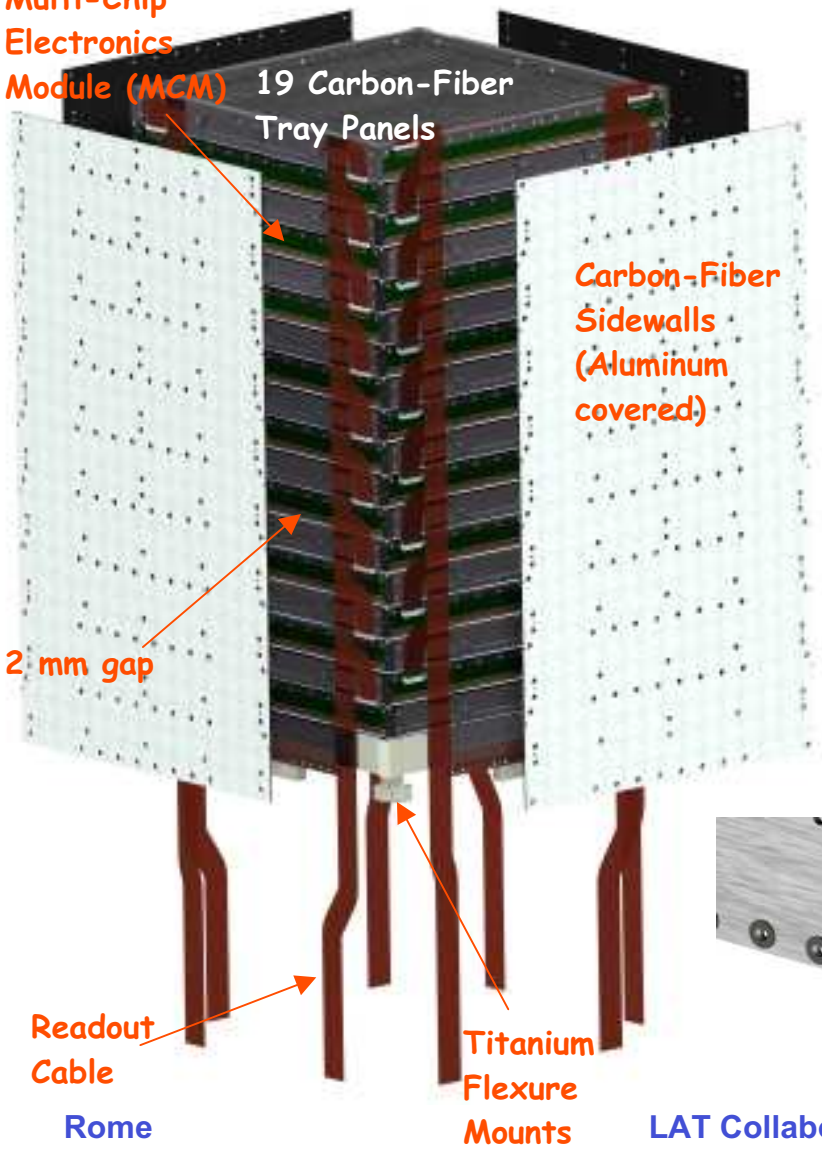
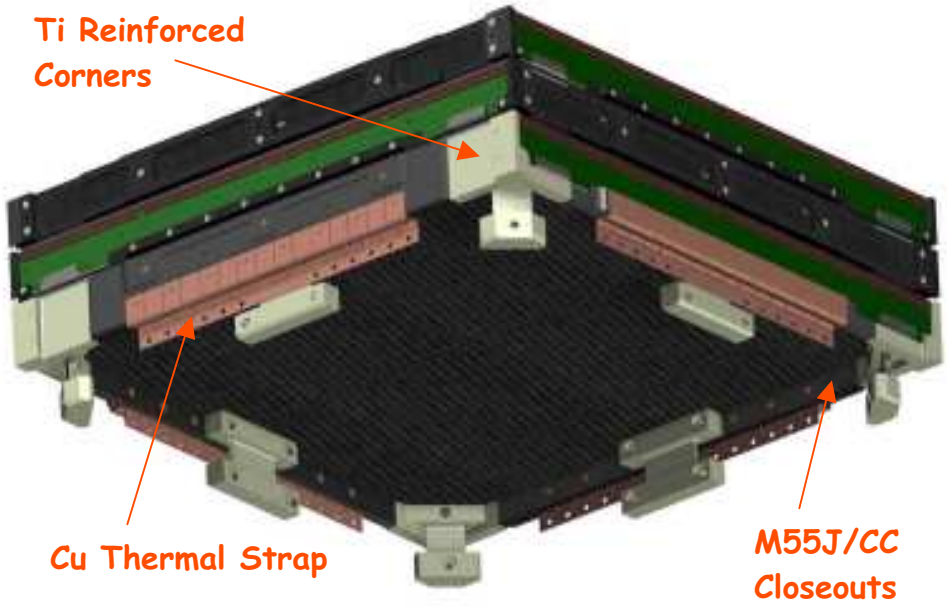
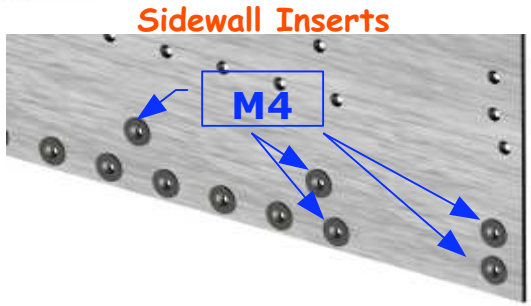
Outline

- CDR Design
- Engineering Model Status
  - EM Mechanical/Thermal Tower
  - Mini-Tracker Tower
- Flight Fabrication Status
  - SSD Receiving and Ladder Production
  - Tray Panel Production
  - ASICs and MCM Production
  - Tray Assembly
- Milestones

CDR Tracker Design







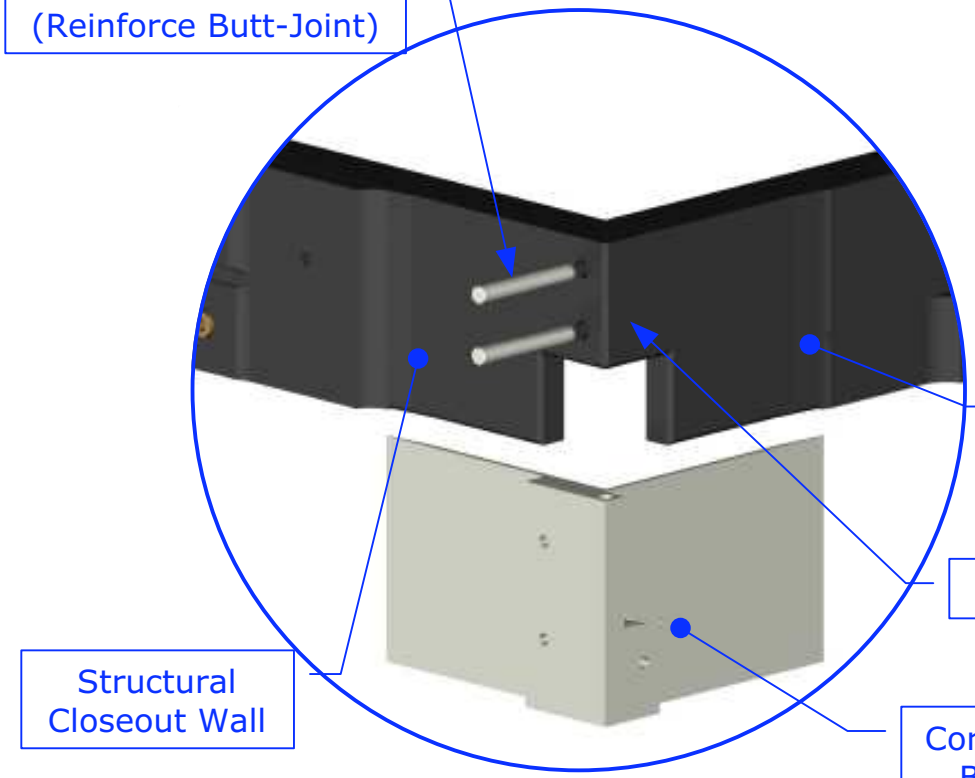
New Features:

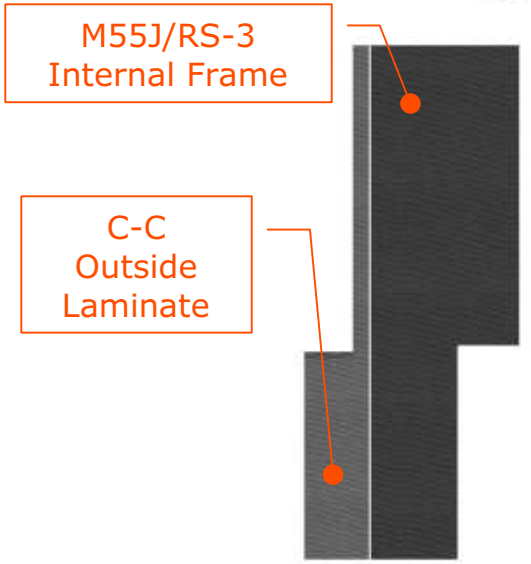
- **Copper thermal straps**
- **Greatly reinforced bottom tray**

Bottom Tray Reinforcing

MCM Closeout Wall

Structural Closeout Wall



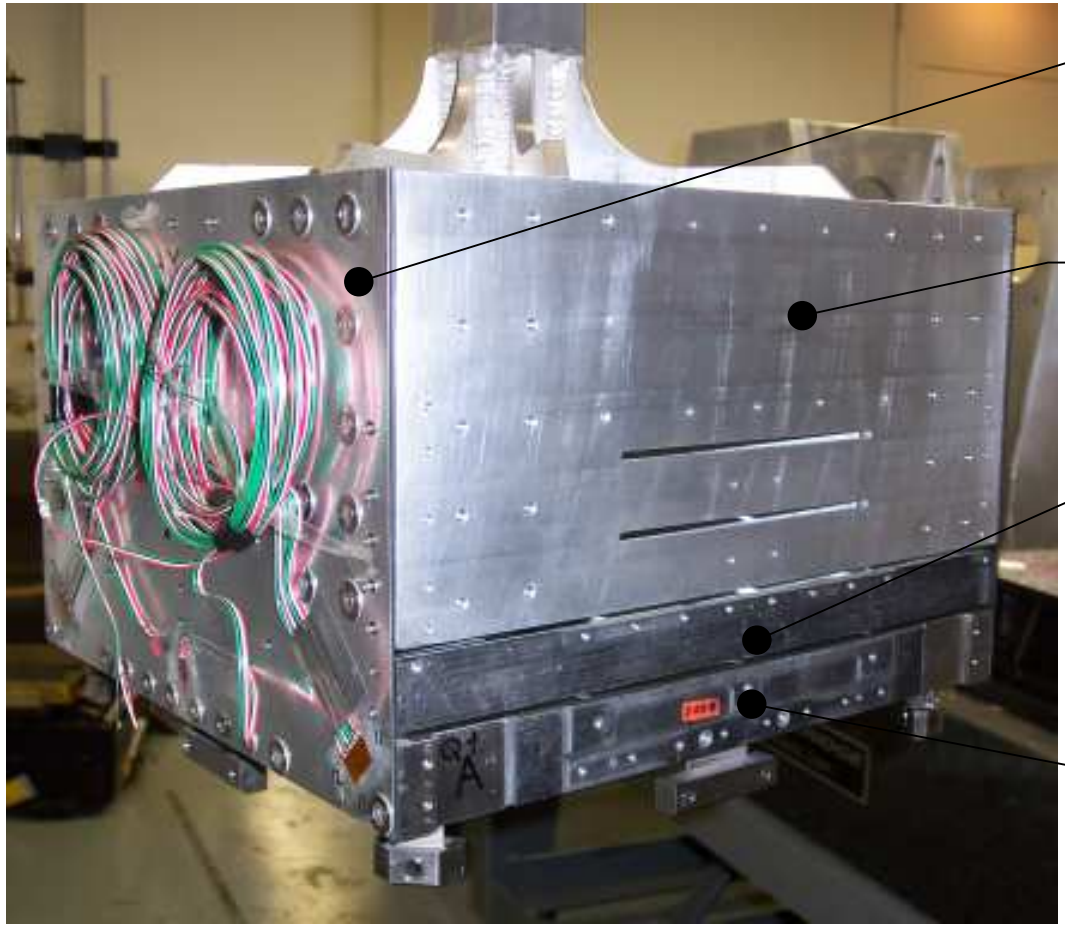


Engineering Model Status

Engineering Model Tracker Module, upside down in the assembly fixture.

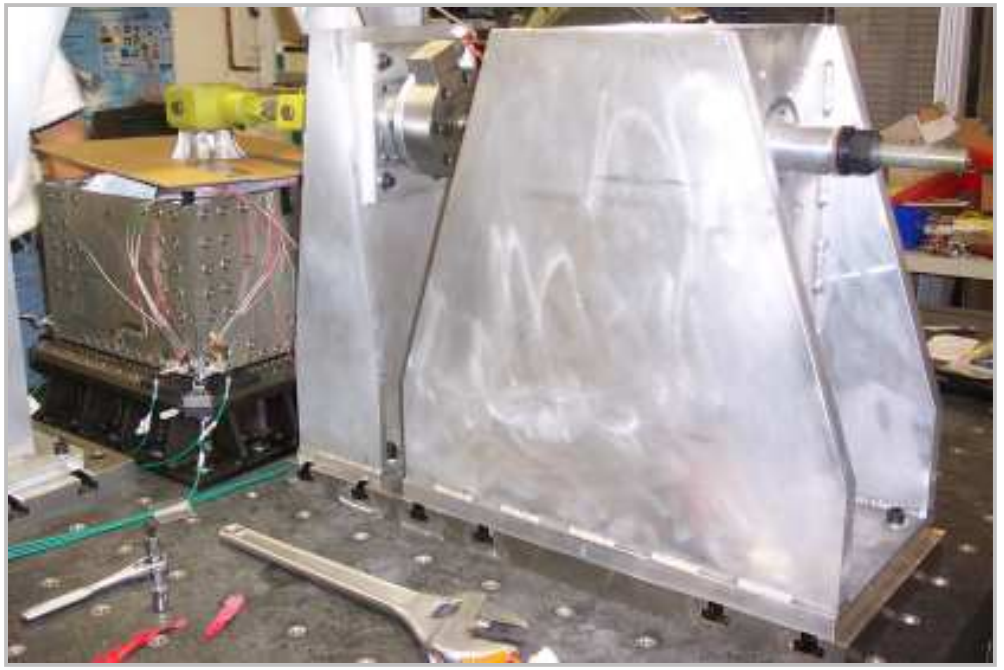
This photo was taken at G&A before installation of the readout cables and sidewalls.

Bottom-Tray Static Test



Bottom-Tray Static Test

- Tests equivalent to the maximum loads from the random vibration levels were successful in the vertical and horizontal axes, including the xy direction (not shown).
- Testing this month will simulate the coupled-loads analysis maximum flexure loads.



EM Sidewalls

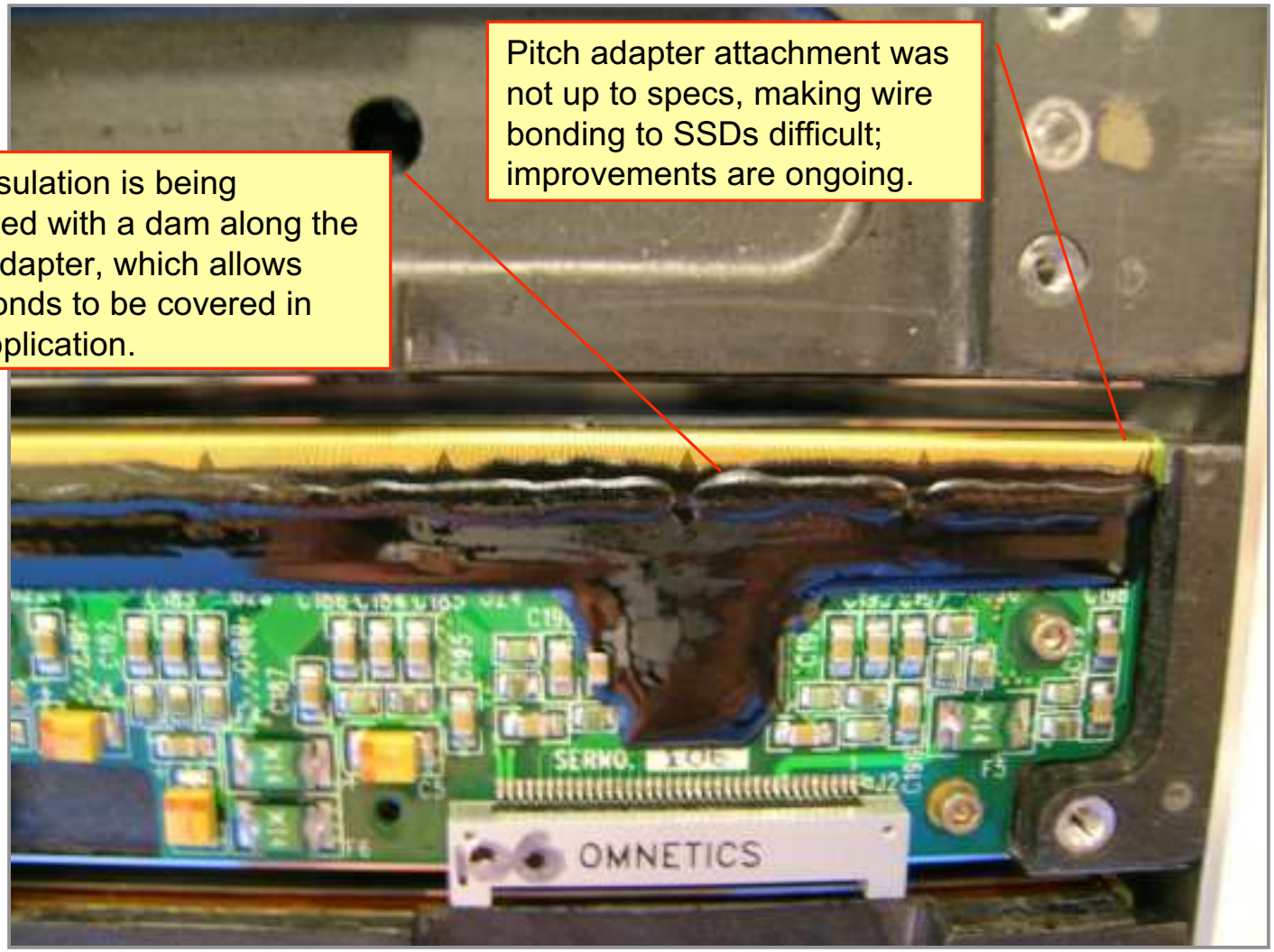
- Our first attempt at K13D sidewalls failed
  - Drawings lacking sufficient clarity and specifications
  - Resin loss at panel edges
  - Problems obtaining good or valid coupon test results
- A major program has been underway since then to correct these problems
  - New coupon tests at Plyform (photo)
  - Updated drawings and specifications with extensive review by composites experts
  - New prepreg orders and fabrication of new EM sidewalls by mid to late October.

Mini-Tracker Tower

- 3x, 3y SSD layers.
- 2nd iteration MCM assembly with "flight" ASICs.
- 2nd iteration flex-circuit cables with "flight" connectors.
- 4 of 5 trays are the same as in the 1st Mini-Tracker, but with improved core grounding.


Assembly of the Mini-Tracker Tower in Pisa

Mini-Tracker Tower MCMs



Mini-Tracker Issues

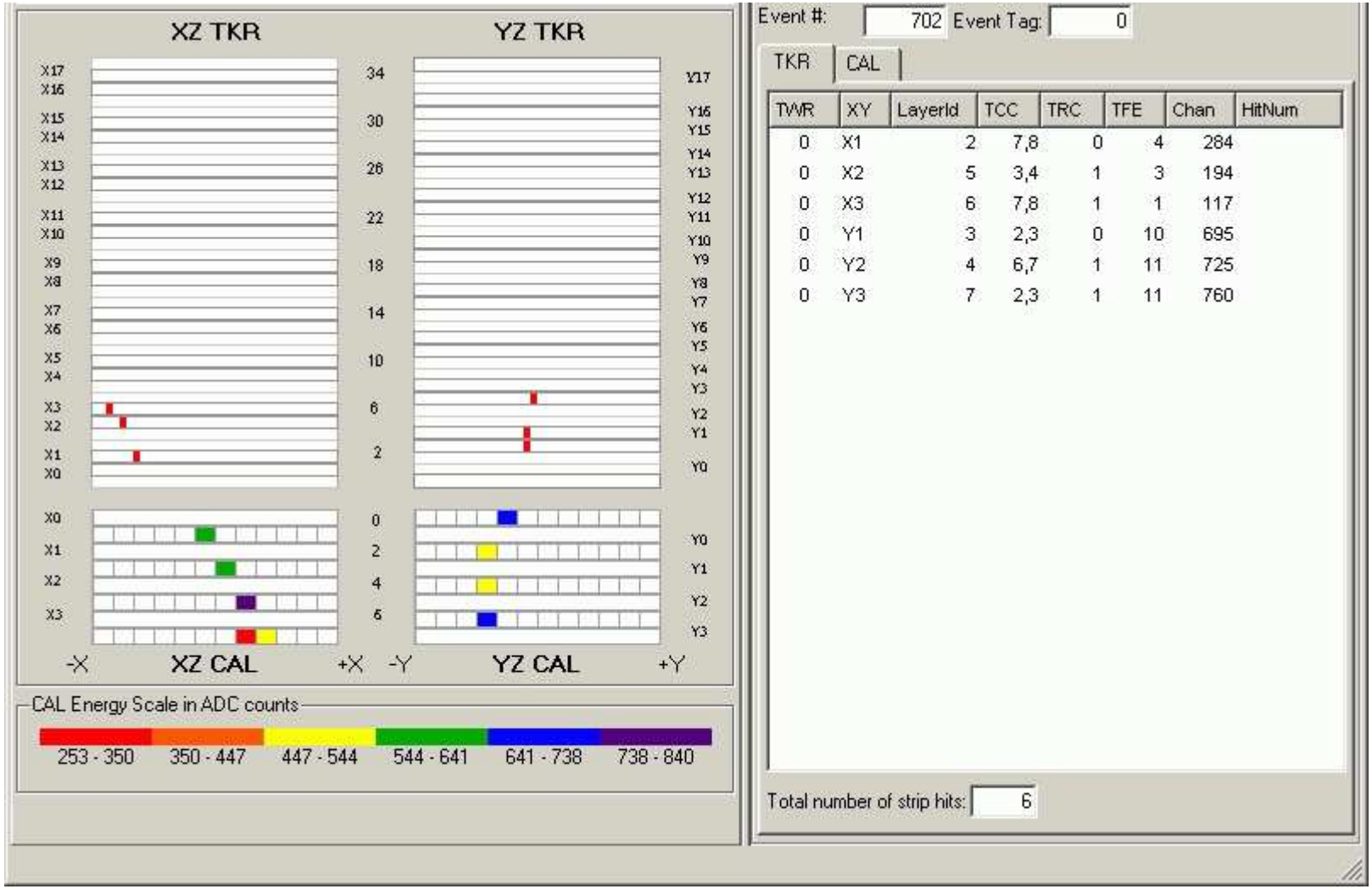
Time-Outs

- GTRC fails to send its data if a trigger-acknowledge signal from the TEM arrives 2, 3, or 4 clock cycles before the falling edge of the TOT.
- The problem can be avoided by disabling the TOT in the GTRC configuration register, but then we have no TOT information.
- Work is in progress to fix the design and fabricate new GTRCs, but schedule exigencies may not allow us to delay MCM fabrication until new wafers are ready, tested, and diced.

Bias Bonds

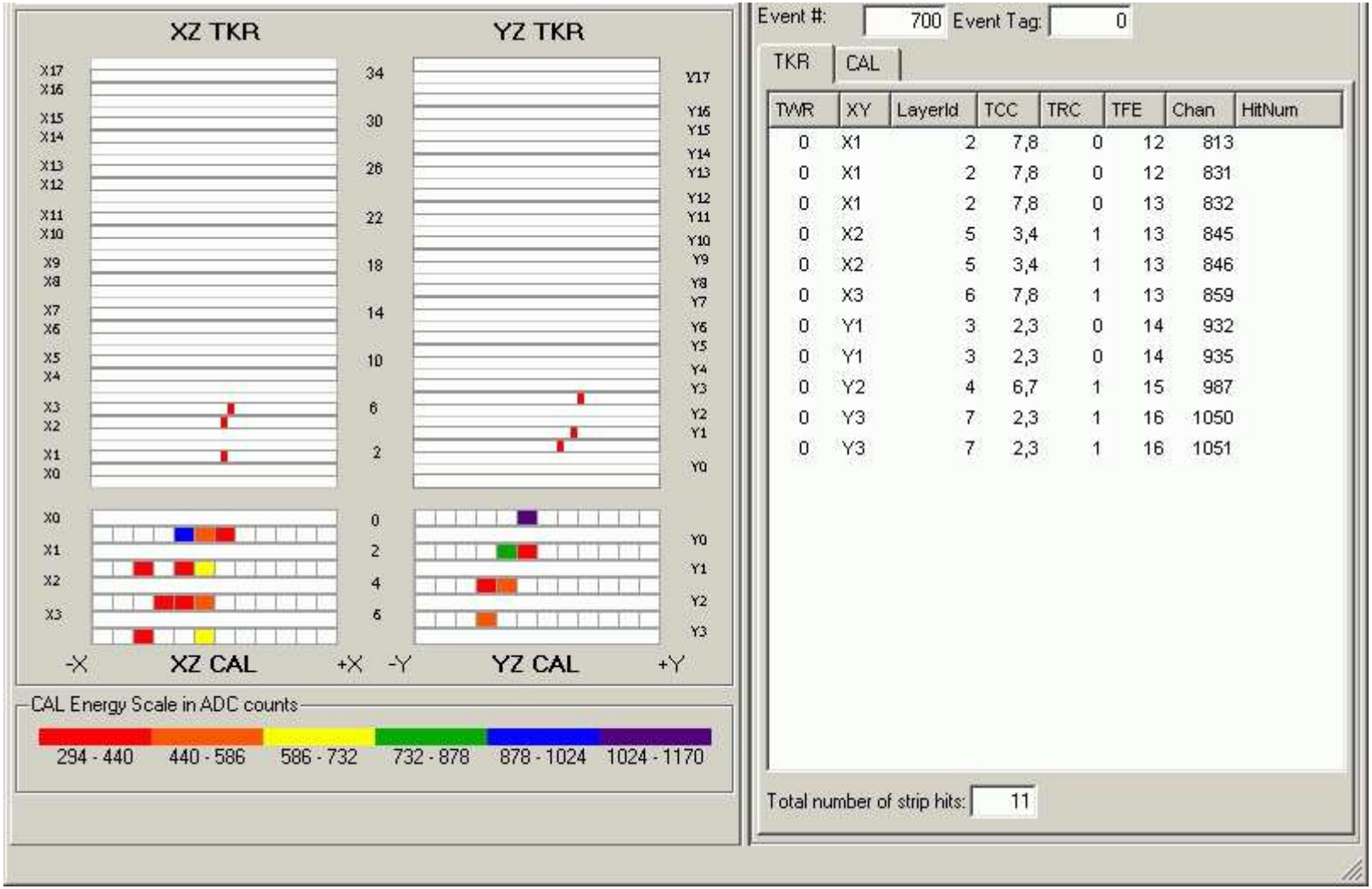
- Ladders are normally connected to bias on both sides, but an incompatibility of the new MCMs and old bias circuits in the Mini-Tracker allowed edge ladders to be connected on only one side.
- This single wire bond failed on one edge ladder, resulting in a nonfunctional ladder.
- In flight production we will double these bonds, giving 4 per ladder, and all bonds will be encapsulated.

Example Cosmic Ray



TWR	XY	LayerId	TCC	TRC	TFE	Chan	HitNum
0	X1	2	7,8	0	4	284	
0	X2	5	3,4	1	3	194	
0	X3	6	7,8	1	1	117	
0	Y1	3	2,3	0	10	695	
0	Y2	4	6,7	1	11	725	
0	Y3	7	2,3	1	11	760	

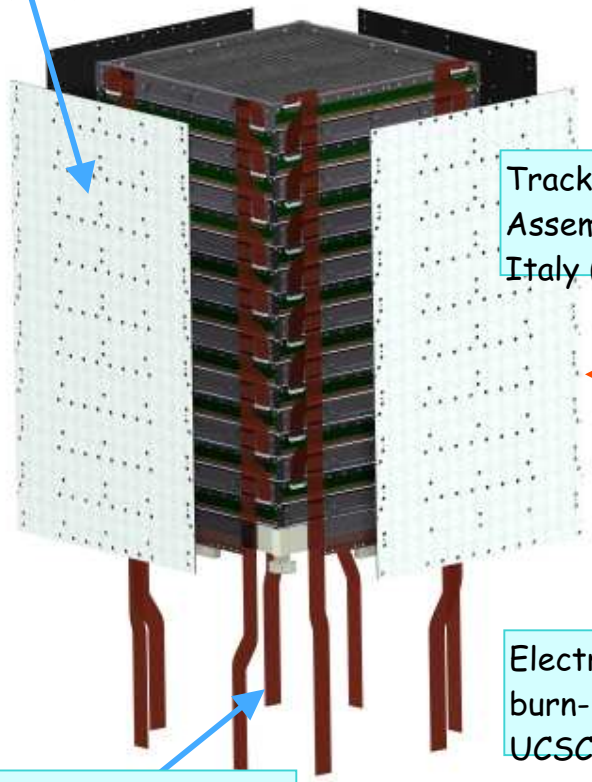
Example Cosmic Ray



TWR	XY	LayerId	TCC	TRC	TFE	Chan	HitNum
0	X1	2	7,8	0	12	813	
0	X1	2	7,8	0	12	831	
0	X1	2	7,8	0	13	832	
0	X2	5	3,4	1	13	845	
0	X2	5	3,4	1	13	846	
0	X3	6	7,8	1	13	859	
0	Y1	3	2,3	0	14	932	
0	Y1	3	2,3	0	14	935	
0	Y2	4	6,7	1	15	987	
0	Y3	7	2,3	1	16	1050	
0	Y3	7	2,3	1	16	1051	

Tracker Production Overview

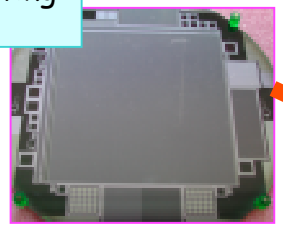
Module Structure Components
SLAC: Ti parts, thermal straps, fasteners.
Italy (Plyform): Sidewalls



Tracker Module Assembly and Test
Italy (Alenia Spazio)
18

Readout Cables
UCSC, SLAC (Parlex)

SSD Procurement, Testing
Japan, Italy (HPK)



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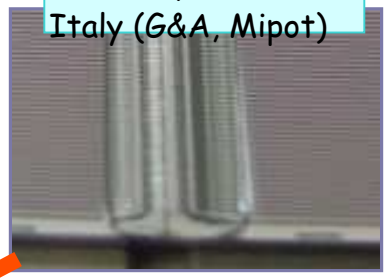
SSD Ladder Assembly
Italy (G&A, Mipot)



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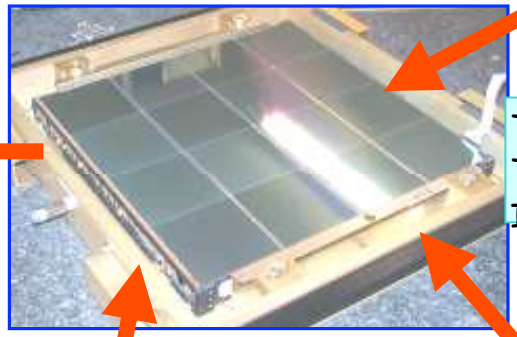

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Tray Assembly and Test
Italy (G&A)

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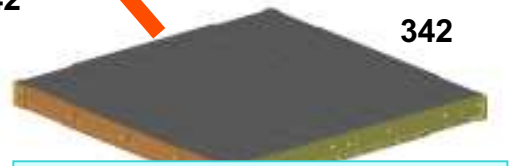

Electronics Fabrication, burn-in, & Test
UCSC, SLAC (Teledyne)

64
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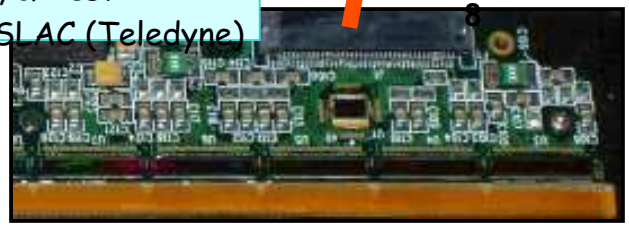
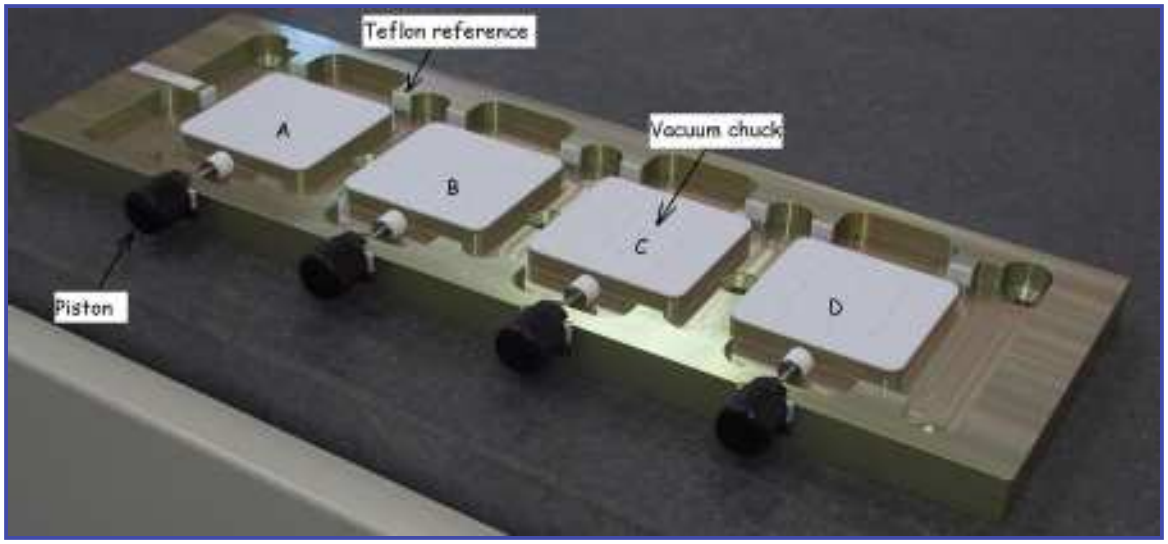
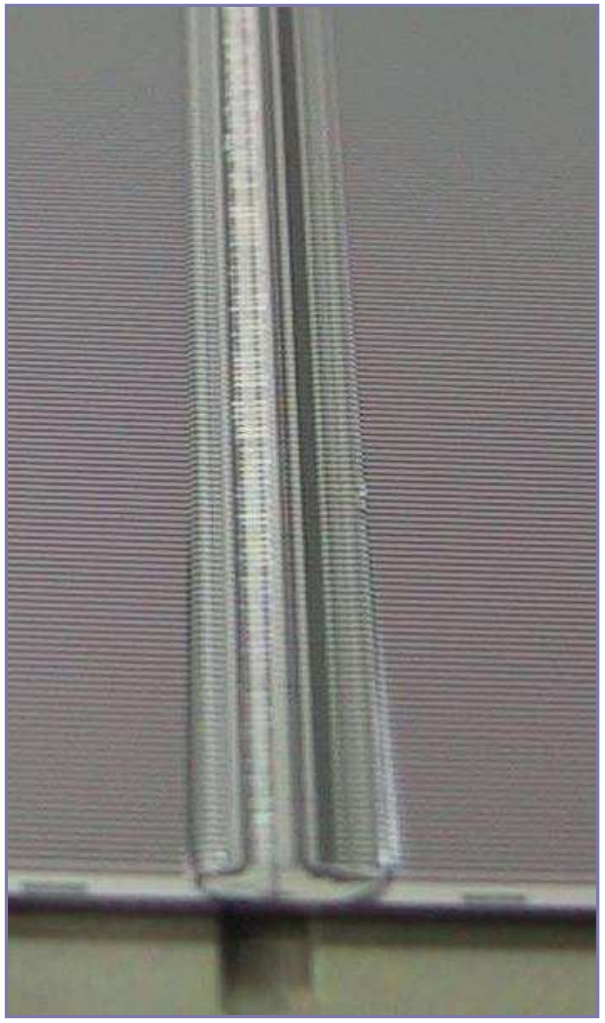


Composite Panel, Converters, and Bias Circuits
Italy (Plyform): fabrication
SLAC: CC, bias circuits, thick W, Al cores

SSDs and Ladder Assembly

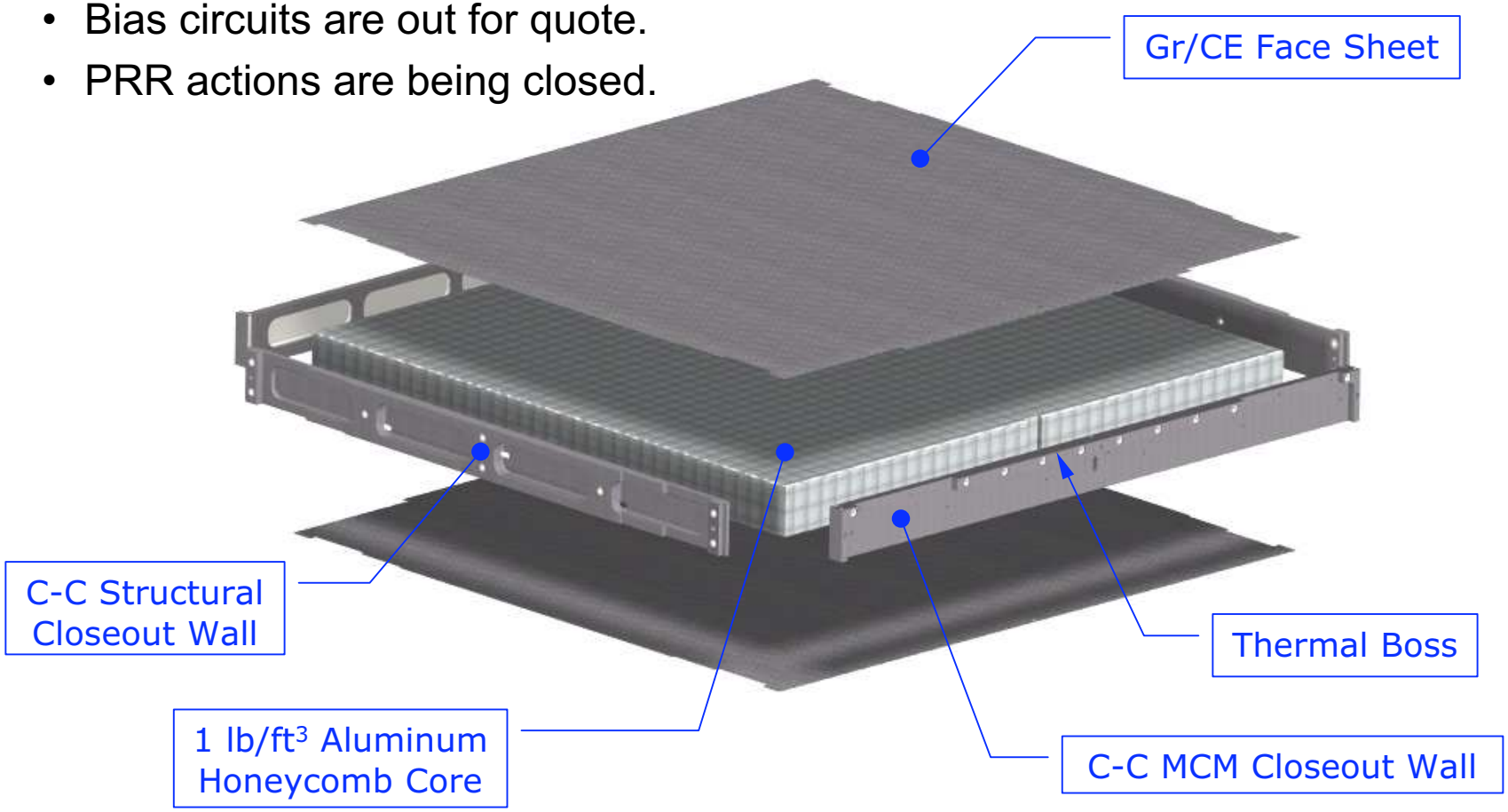




- All SSDs have been manufactured at HPK.
- Enough SSDs have been procured and tested to fabricate the full flight instrument.
- Ladder assembly is in progress at both G&A and Mipot.
- Enough ladders have been assembled and tested to build a few towers.

Tray Panel Fabrication

- Machining of the Carbon-Carbon closeout material is just starting.
- Face sheets, cores, inserts, and tungsten are in hand.
- Bias circuits are out for quote.
- PRR actions are being closed.

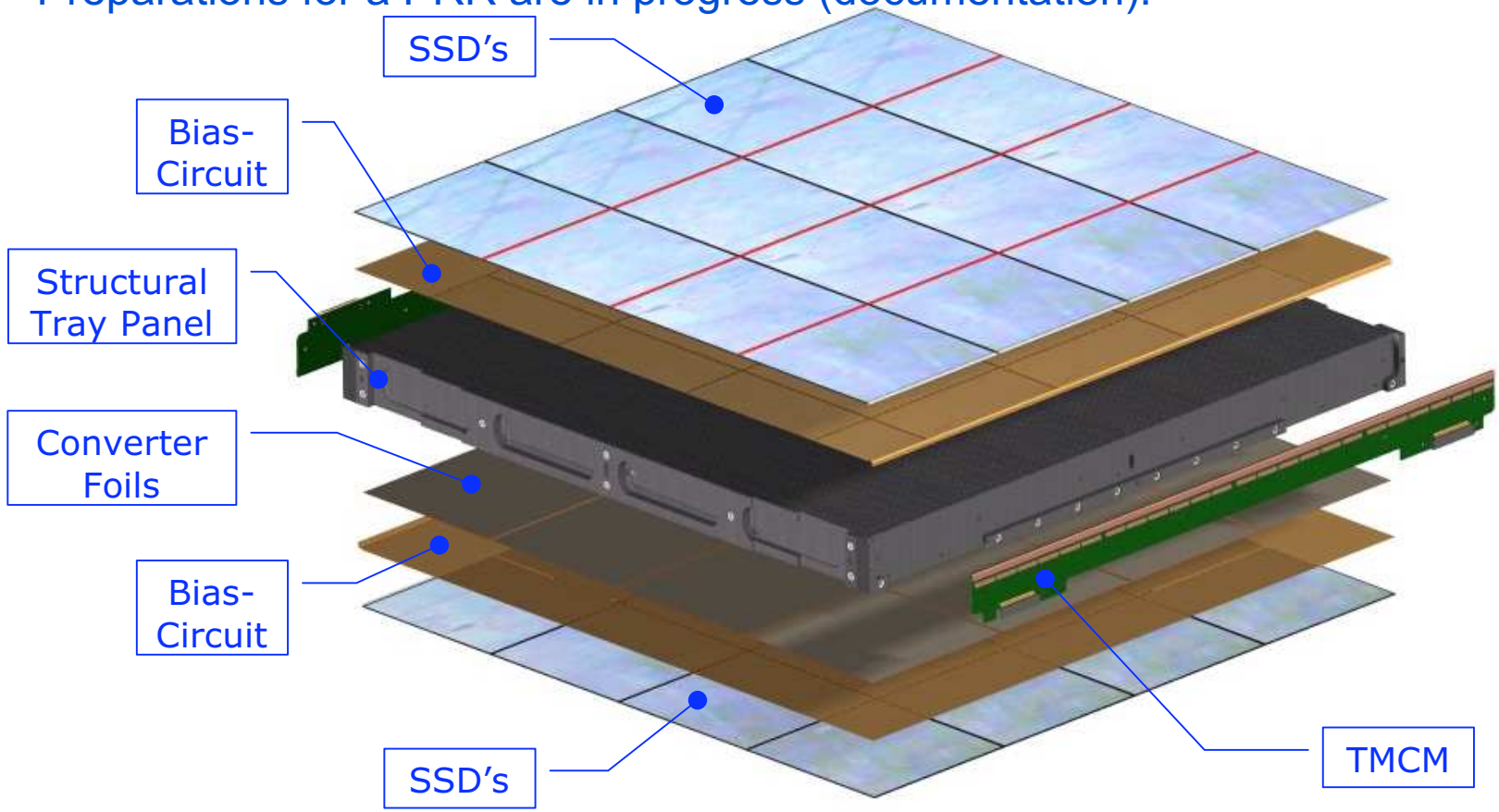


ASICs & MCM Assembly

- GTFE and GTRC ASIC wafers have been fabricated, tested, lapped diced, and inspected. The yield is about 95%.
- Successful radiation testing completed, including SEE (INFN Padova)
- New GTRC wafers will probably be made, but preproduction of MCMs will start in a few weeks with existing chips.
- Tests of production details modified since the previous Mini-Tracker Tower MCM assembly are being tested at Teledyne this week.
- Preproduction printed wiring boards are being manufactured at DDI (we rejected the first iteration, but that problem was resolved).
- MCM test system is updated and nearly ready for flight production.
- MCM burn-in system is close to being ready for first tests at SLAC.
- Production Readiness Review (PRR) is still needed.

Tray Assembly

- Ladder attachment development is complete and works well.
- Some process details for MCM mounting, wire bonding, and encapsulation are being finalized with continuing testing at G&A.
- Preparations for a PRR are in progress (documentation).



Other Tasks…

- Flex circuit cables
  - Interface issues and exact length are being intensively worked at SLAC
- Tray testing with cosmic rays (4 stations in Italy)
  - Software scripts are being developed on the Mini-Tracker Tower
  - 4 EGSE systems, cables, and some special hardware still need to be procured or fabricated
- Tower assembly
  - Basic fixture worked well with the EM tower
  - Needs still some more development for safety and tower rotation
  - Documentation and PRR
- Tower functional testing
  - Software scripts are similar to those needed for tray testing
- Environmental testing
  - EM vibration plan is close to completion; need pretest review
  - Still need a lot of work on the thermal-vacuum plan; review
- Shipping
  - Prototype container is in hand; needs analysis, testing and review

Near-Term Milestones

- New EM sidewalls: end of October
- Completion of EM environmental testing: Christmas
- Completion of the MCM preproduction: end of November
- First flight-like trays: Christmas

- Additional engineering manpower recently added by SLAC to help ensure success as we move into flight production (all with extensive experience in space-flight programs):
  - Roger Williams — Test engineer
  - Nanda Menon — QA liaison between SLAC & Italy
  - David Rich — Tracker system engineering for flight manufacturing and test