GLAST Large Area Telescope:

Tracker Subsystem
WBS 4.1.4

November 12 Management Meeting

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

rjohnson@scipp.ucsc.edu
# Key Milestones to Tower A

<table>
<thead>
<tr>
<th>September</th>
<th>October</th>
<th>November</th>
<th>December</th>
<th>January</th>
<th>February</th>
<th>March</th>
<th>April</th>
<th>May</th>
<th>June</th>
</tr>
</thead>
<tbody>
<tr>
<td>EM Completion</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sidewall Fabrication</td>
<td>Vibration Testing</td>
<td>T/V Testing</td>
<td>New mini-Tower</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Static Test</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<td></td>
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| MCMs |
| Production Preparations | Preproduction Run | Burn In | 1st Production Run & Burn-In |

| |
| New GTRC |
| Update Design and Verify | Wafer Fabrication | Test & Dice | System and Radiation Testing |

| |
| Tray Panels |
| Machine Closeouts; Bias Circuits, etc | Assemble Panels for Tower A and Test |

| |
| Flex Cables |
| Complete Design and PRR | Manufacture and Test First Flight Cables |

| Flight Sidewall Fabrication |

| Tower A |
| Assemble Ladders on Trays | MCMs on Trays | Test Trays & Assemble Tower A | Tower A Testing and Shipping |
EM Vibration Test

- Test Readiness Review held November 4.
- Documents have been updated and are being released, including analysis predictions.
- COI has made and tested sidewall coupons and has made mini-sidewalls for the static test and shipped them to Hytec. Static testing will begin today or tomorrow.
- Plyform has made EM sidewalls and is testing coupons. The sidewalls will arrive in Pisa by tomorrow morning.

- The fixtures are in Italy and have been tested.
- The new sidewalls will be installed in Pisa and the tower moved to Rome on Monday for testing at Alenia starting next week.
COI Sidewall Coupon Results

- Tensile, compressive, and shear strength were measured.
- Six specimens were pulled for each case.
- B-allowables (not shown) were derived.
- These allowables show adequate margin with respect to simulated stresses, including a safety factor of 1.4 and MUF of 1.15.

![COI Coupon Average Ultimate Strength](chart.png)
Sidewall Joint Coupons

- COI has been pulling sidewall coupons with inserts. In all cases the fastener is breaking before any damage occurs to the sidewall.
- The M4 screws (see below) are breaking at an excess of 800 lbs shear load, far above our requirements for this joint!
EM T/V Test

- Detailed plans are now coming together.
- Fixtures for mounting in the T/V chamber are being made.
- Still need to resolve some issues on time needed for thermal balance and so forth, so the total test time is still unknown.
- The test cannot span the Christmas break, so we would like to keep the tests short enough to be completed in December.
Shipping Container

- Shock testing was completed (2 foot drop).
- Loaded with a mass model in place of the inner shipping container and tower.
- Environmental monitoring device included.
- Is being shipped this week to Italy like this.
Flex-Circuit Cables

• Design review was completed.
• IDD is still not released, but an agreement has been reached between Tracker and Mechanical on the flex-circuit cable length.
• We are now proceeding with completing the detailed layouts of the cables. The probability of further change in the IDD is considered to be small.
• Sign off on C0 mechanical drawing and SOW this Friday.
• Sign off C1 to C7 mechanical drawings by Nov 21.
• Complete assembly drawings and prepare PO.
• C0 to C7 electrical drawings by Nov 21. Order mini-tower cables.
• Receive mini-tower cables Nov 28 and assemble.
• PRR Dec 1.
• Test mini-tower cables Dec 5.
• Start production of first articles at Parlex.
• Receive and inspect first articles by the end of January.
Mid Tray Fabrication

• Nov 17 start is delayed to Dec 9 due to materials:
  – Bias circuits are finally on order and should be in Italy by Dec 1.
  – Thick tungsten is still being cut and should be ready by early Dec.
  – Plyform is procuring primer and thinner needed for the black paint to be used for covering the carbon surfaces.

• But the documentation is still not ready either:
  – We reviewed the status Monday.
    • See http://www-glast.slac.stanford.edu/Tracker-Hardware/readiness/Tray_Panel/Tray_Panel_PRR.html
  – Drawings and procedure documents are undergoing the (hopefully) final round of reviews before release.
  – Plans afoot to make another survey of the Plyform internal documents.

• Procurement of inserts and machining of closeouts has been proceeding in preparation for the start of tray-panel assembly.
• A significant number of aluminum cores will probably be scrapped, but plenty of good ones are on hand to get the production rolling.
Bottom Tray Fabrication

• Pisa is developing new panel assembly fixtures that will allow the assembly to take place with flexures installed in the corner brackets and also correct some deficiencies found during the EM bottom tray assembly.

• COI has been preparing the materials for the bottom tray closeouts. Machining them is on hold pending release of the drawings.

• The titanium parts are out for bid. Expensive, so 3 bids are required. Meanwhile, the drawings are being reviewed for release.
MCM Preproduction

- 6+ flex circuits have been bonded to PWBs.
- 6 have been surveyed by CMM at SLAC (next slides).
- The fixtures and processes are being tweaked slightly to try to improve the results on the next 6 (in progress).
- The first set of 6 are now undergoing SMT pick-&-place and solder.
- The UCSC test rack and computer were installed at Teledyne and are ready to go to do the electrical testing.
- Flex-attach results are greatly improved over the previous run (mini-tower) but still not as good as desired by Italy for wire bonding.
  - Trimming looks good and is being further improved.
  - Some horizontal scale errors by as much as 0.05%.
  - Horizontal offsets can probably be kept less than 0.2 mm.
  - Straightness can be held to much better than ±50 microns.
  - We may be able to hold perpendicularity to better than 10%, but the desired 1% is impossible with these techniques and materials.
**MCM Pitch-Adapter Trimming**

Wire Bond Pads used in Italy to Connect to the SSDs

Some scraping of the back side by the cutter will be corrected by reducing the depth of cut.

Flex-circuit cuts made by pizza cutter after installation.

PWB Back Side

The flex-circuit end trim is now made before installation by a custom die.

One of the two gluing fixtures is being tweaked to correct this offset.
Excellent results (better than 25-micron straightness) are now regularly achieved on machining the PWB to height and machining the 1 mm radius (Holt Machining). All 50+ preproduction boards have been machined.

With Kapton, the top edge can be held to better than ±50 micron deviation from a straight line along the full 36 cm length with good parallelism.

Keeping the top edge perpendicular to the MCM face (parallel to SSDs) is more difficult. The 5 microns requested by G&A cannot be achieved with this tooling (perhaps not with any tooling, given the flex-circuit properties).

These data represent the worst case difference between extremes along each 36-cm board.

Perpendicularity is a measure of the deviation over a 500 micron length of the wire-bonding trace. (i.e. 5 microns = 1% slope.)
MCM Pitch-Adapter Alignment

- We are trying to keep horizontal shifts between the pitch adapter and ASICs to less than 200 microns. Since the wire bonds are a few mm in length, this is a small skew angle, which causes no problems. However, too large a shift puts one of the edge bias traces too close to falling off the end.
- Too much stretching or shrinking can cause wire bonding problems, since the bonder is programmed for a fixed step size. These trials show shrinkage in all cases but one, but at less than 200 microns overall. This is less than 50 microns over the width of one ladder, or <0.05%.
- I don’t think we can hope to have much better dimensional stability of this polymer material than what we see here.

Fixture number 2 shows a systematic positive deviation, which is being corrected.
MCM Production Preparation

- Details of the SOW are still being negotiated between all parties.
- A QA survey is taking place at Teledyne this Friday.
- The Teledyne process procedure is still being worked, especially to include special inspection instructions and criteria, such as for the pitch-adapter bonding and trimming. The preproduction is helping us to define those details.
- All parts are in hand, except for some of the PWBs and connectors, which are still in production, *and the new GTRC V7 chips*.
- We are closely monitoring the preproduction work to make sure that process issues get worked out prior to the PRR.
- NASA has told Teledyne that they will have somebody on site 100% during production. The Tracker group has heard different stories on all sides as to how this will be done and would like clarification. We strongly feel that if this is done, it should be a single person whom we can work with, not a rotation of many outsiders.
• Two new GTRC designs have been submitted to MOSIS:
  – V7: new logic core, but no change to the surrounding I/O circuits and memory.
    • Corrects the TOT logic to prevent timeouts.
    • Corrects the timing problem in data transfer between GTRCs
    • Tested in FPGAs using our complete set of GTRC test vectors.
    • Timing correction tested in FIB modified V6 chips mounted on MCMs.
  – V6b: backup solution that implements only the timing correction via hand edits to the V6 layout. This is very similar to the chips edited by FIB.
• MOSIS is presently working on the reticle layout.
• Friday review of the design and test plans.
• Recent GTRC/GTCC interface issue…
GTRC Data Transmission

Both new GTRC versions remove these clock inversions.

Simplified schematic of data transfer between MCMs.

The logic change doubles the time available for the data transfer, yielding large timing margins.