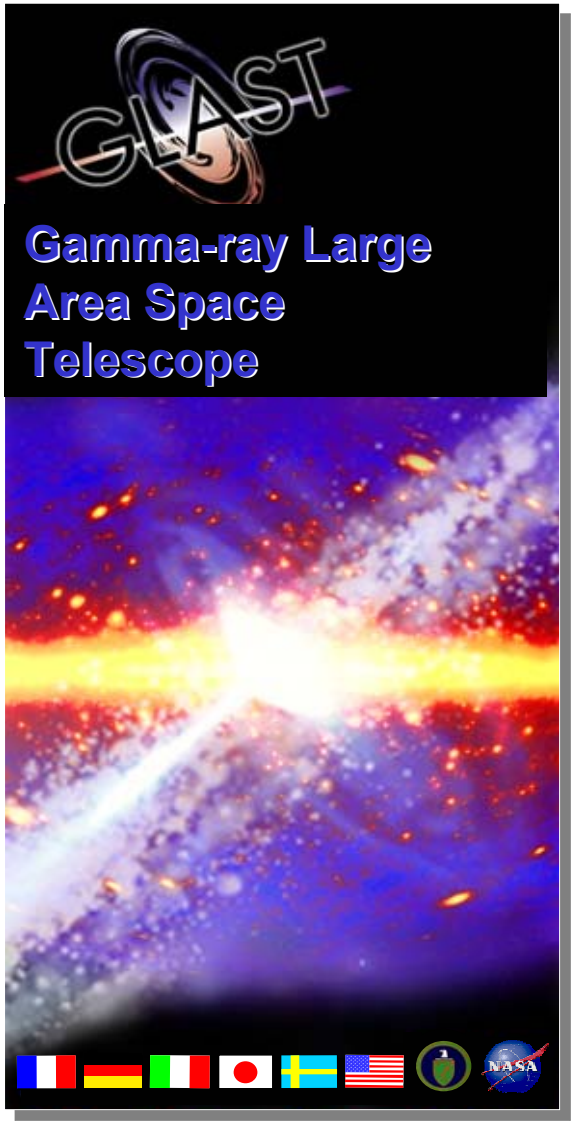


GLAST Large Area Telescope:

Tracker, W.B.S 4.1.4

October Status Meeting

Robert Johnson
rjohnson@scipp.ucsc.edu

Tracker Tower Status

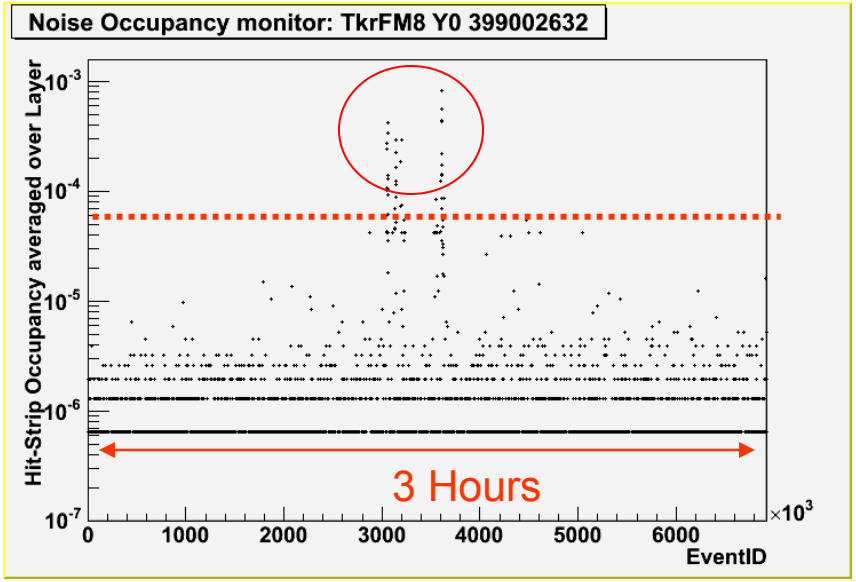
Tower	Assembly	Vibe	T/V	Status
A,B,1-7	✓	✓	✓	Integrated into the Grid.
8	✓	✓	✓	Flight spare, at SLAC, still being used to study some noise issues.
9-15	✓	✓	✓	Integrated into the Grid.
16	✓	NA	NA	Non-flight tower. Shipping from Italy.

Noise Flares

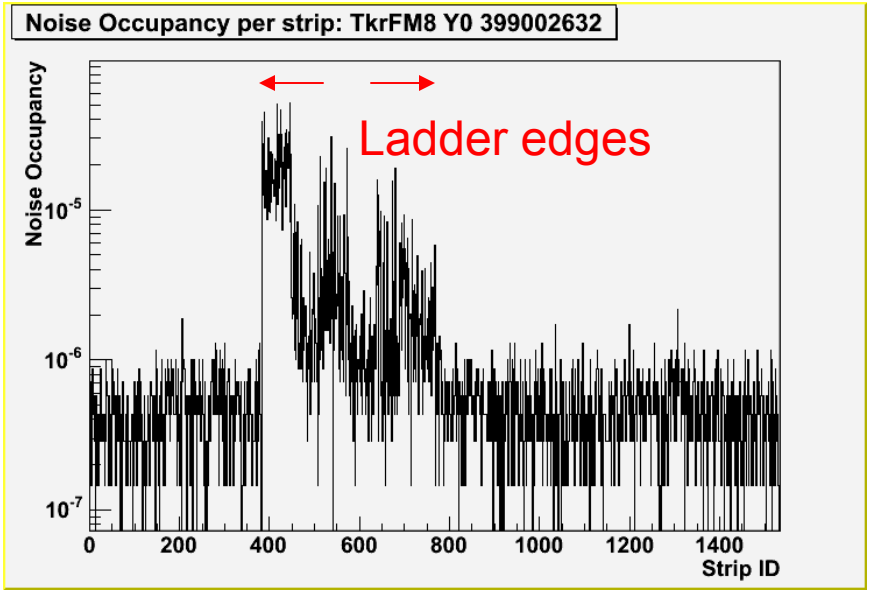
- Tracker modules 7, 8 and 11 were found at SLAC to have occasional out-of-spec noise occupancy in isolated layers
  - 3 layers in module 11
  - 1 layer in module 8
  - 1 layer in module 7
- The noise is transient and generally not repeatable.
  - Typically one has to wait for hours to see it happen.
- Similar noise flares were observed in Tower Modules A, #1, #4, #7, #8, & #11 TVAC test by INFN (L. Latronico NCR/FM/INFN/PI-592).
  - At the time they were considered to be due to pickup of external noise during the TVAC testing, because they were observed to coincide with the time of the temperature changes in the test cycles.
  - INFN observed such noise in a few more layers than observed at SLAC.

Tower 8 Noise Flares, Layer Y0

Time profile

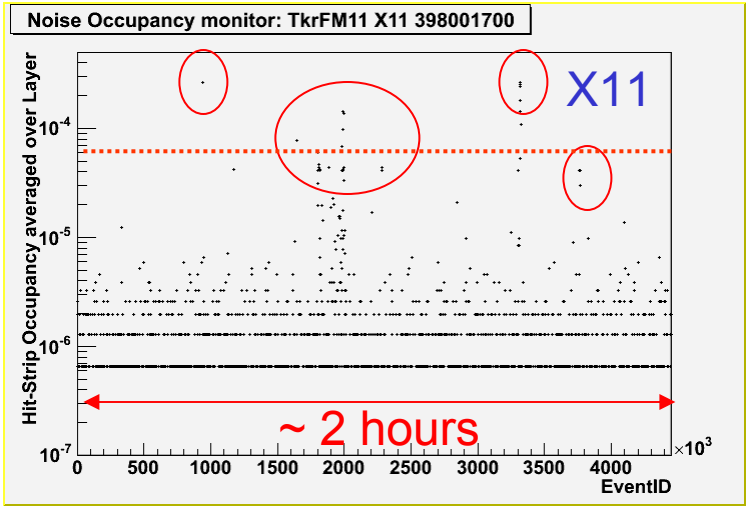


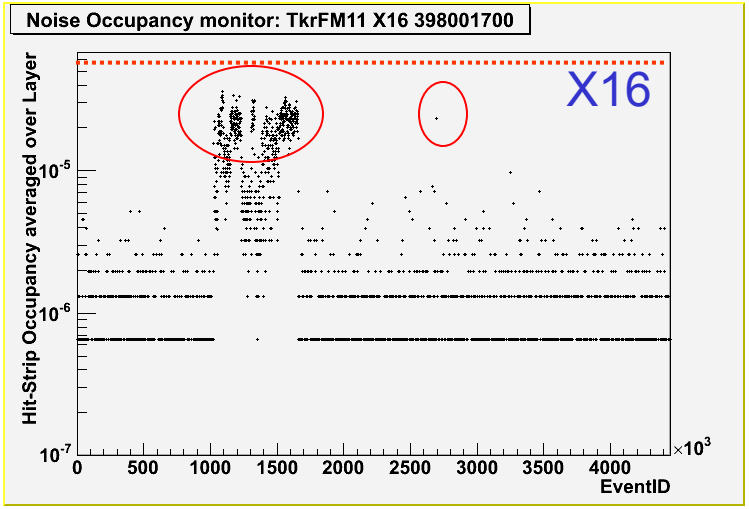
Strip profile

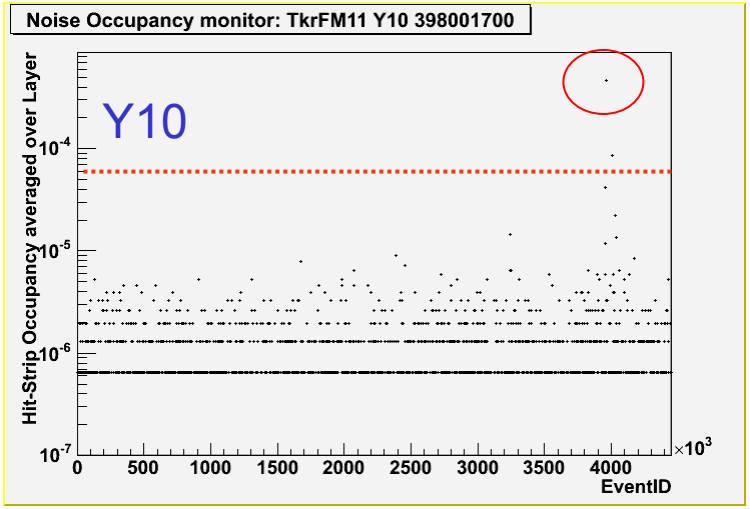


- The specified maximum occupancy is 5×10^{-5}.
  - But this requirement was derived under the assumption that the noise is randomly distributed in time and is uniform across the entire LAT.
- The noise appears to be restricted to one ladder at a time.
  - This suggests that it is correlated somehow to the SSD bias node. In any case, the SSD bias node, following the MCM filter resistors, is directly seen by the amplifiers, which are sensitive to microvolt fluctuations.

3 Tower-11 Layers Show Noise Flares



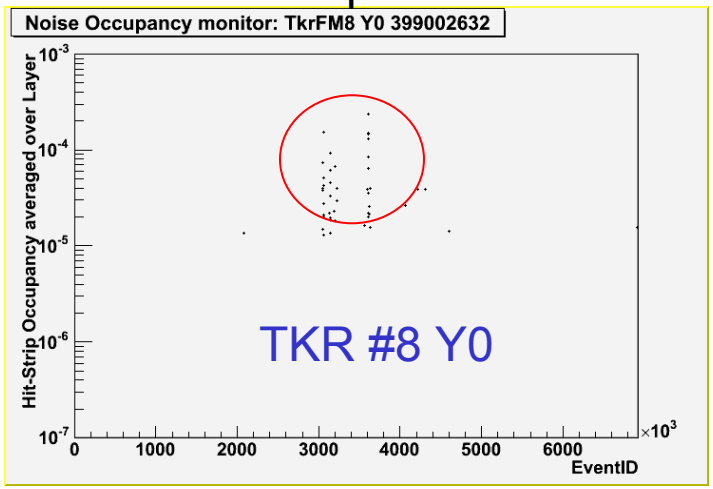




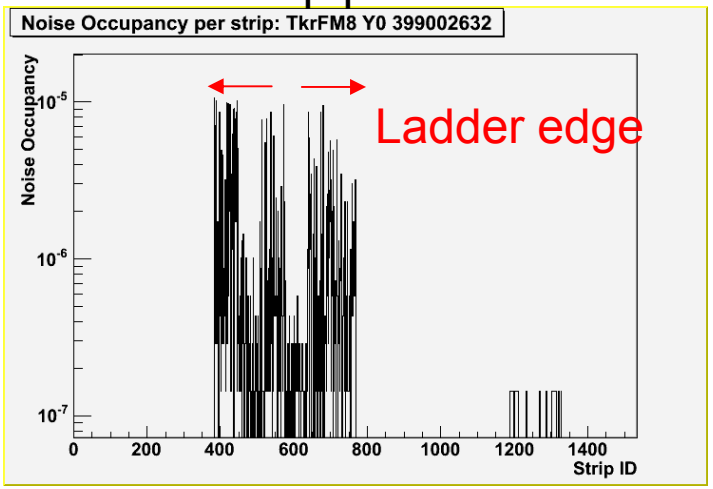
- Note that the longest flare in these plots is actually within the occupancy specification.
- Not all 2-hour runs show this behavior. Often nothing is seen.
- There does not appear to be any time correlation between layers.

Noise Coherence

Time profile



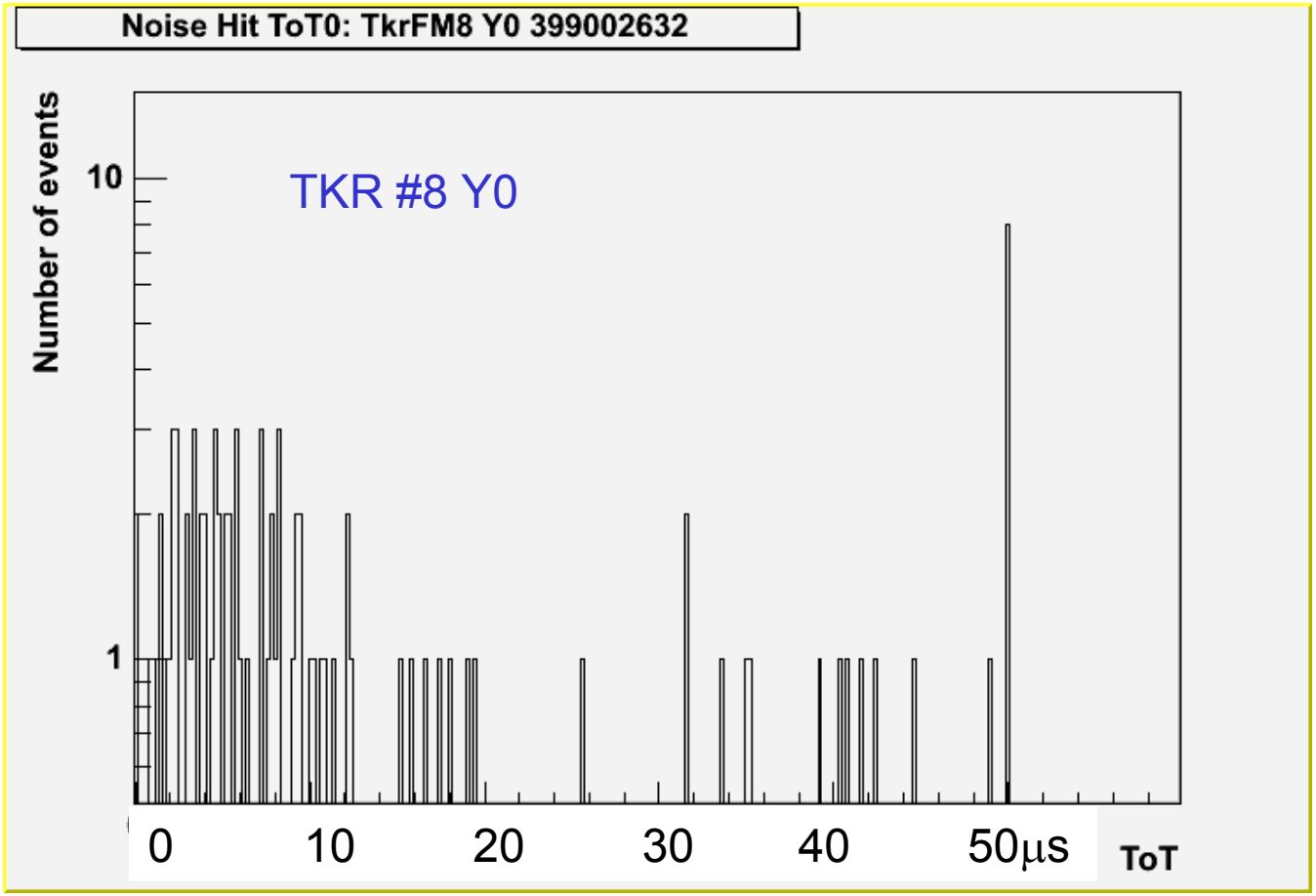
Strip profile



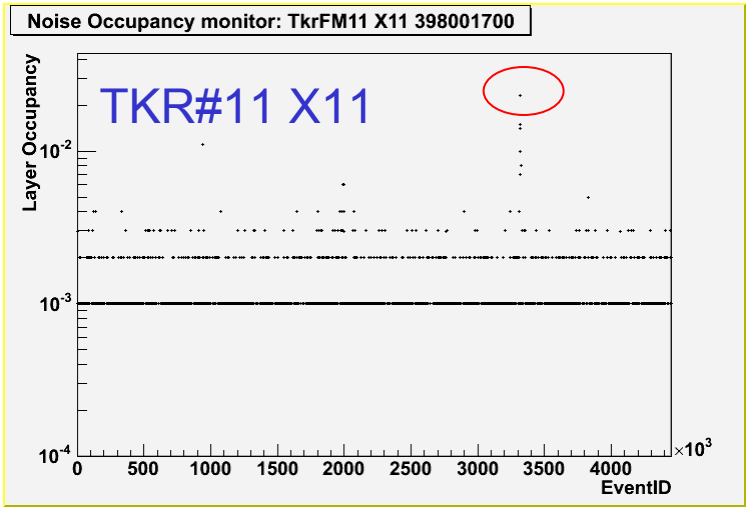
- In the above plots, only events with >20 hits in layer Y0 were selected.
- This, plus other evidence, makes it clear that when the noise occurs, many or most strips in the ladder fire simultaneously (but the GTRC buffer truncates at 64 hits).
- This means that even during a noise flare, most events have negligible noise, while the occasional event has one ladder saturated with hits.
  - This is good news. It means that the vast majority of data events will not be affected at all. The probability of overlapping with a noise burst is very low.
  - Furthermore, these noise bursts are unlikely to trigger, as they are isolated to a single layer. It would be difficult even to notice them if we did not take the random-trigger runs displayed here.

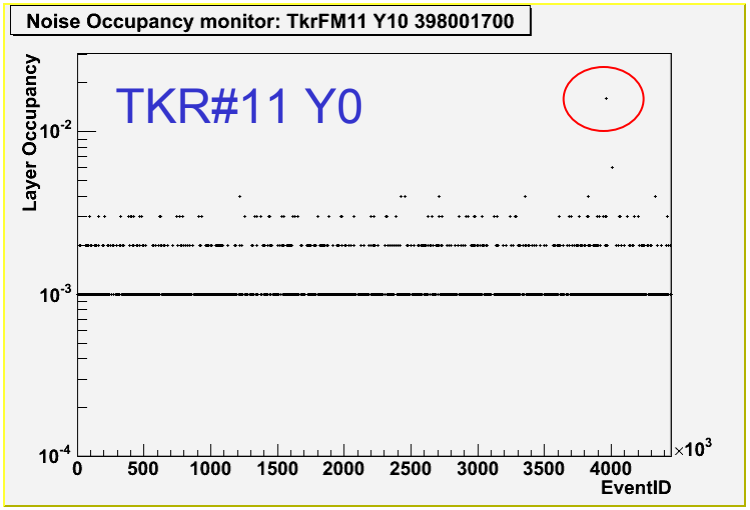
TOT of Noise

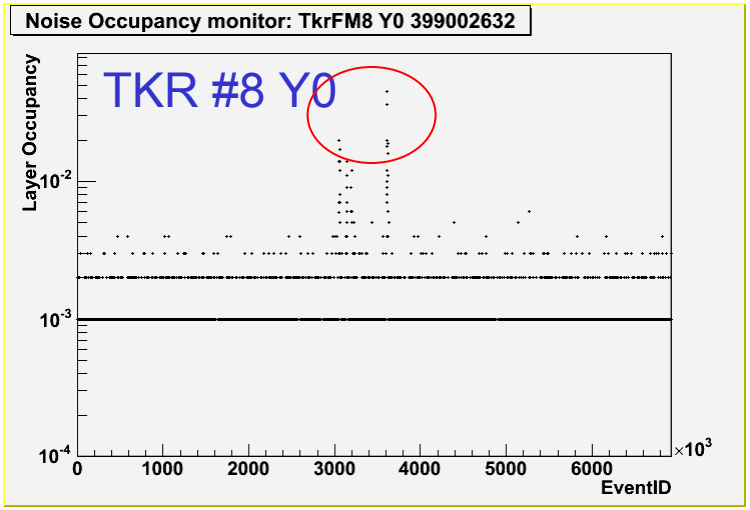
- Same data as in the previous slide (i.e. high multiplicity events).
- The TOT is not very different from that of particles (typically ~8 μs)



Layer OR Noise Rates







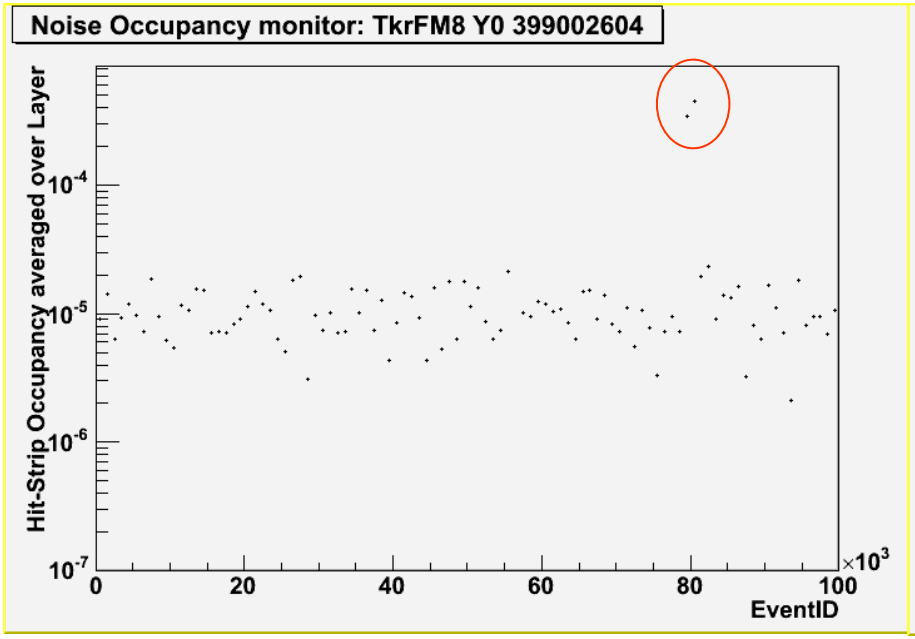
- Because of the coherence of the noise, the Layer-OR occupancy is much lower than the unity that the strip occupancy might suggest.
- The Layer OR Occupancy is << 0.1, which corresponds to a single-layer trigger rate of << 50 kHz.

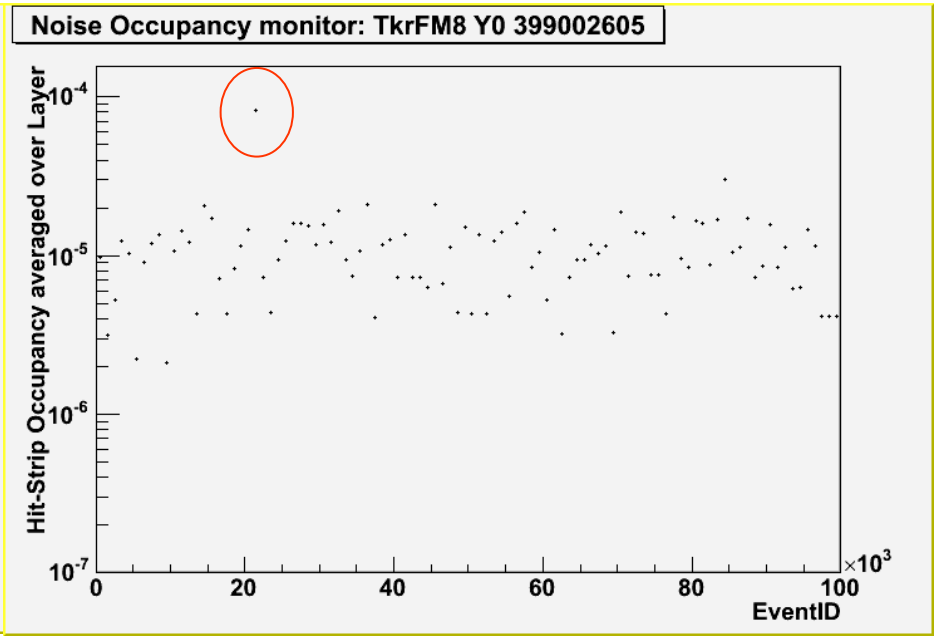
  (0.1 / 2μs = 50 kHz is the worst case).
- This worst-case would still meet the trigger specification.

Bias Voltage Dependence

- The coherent and sporadic nature of the noise suggests some kind of electrical discharge.
  - Since the amplifiers are sensitive to femto-Coulomb charge, even a tiny, microscopic discharge can potentially fire all channels in a ladder if it couples to the bias node.
- Breakdown along the strips internal to the SSDs appears to be ruled out, as it should have a very strong voltage dependence.
  - Changing between 80V to 110V does not show any obvious, repeatable correlation, ruling out a strong voltage dependence.
- Since the effects are in any case difficult to reproduce, without a huge amount of test running we cannot rule out a weak voltage dependence.
- *An electrical discharge problem could potentially be much worse in TVAC, but the Tracker data show that even in TVAC the probability of observing a noise flare in the affected layers during a noise occupancy measurement is at most a few percent and not very different from the atmospheric, room-temperature tests at SLAC.*

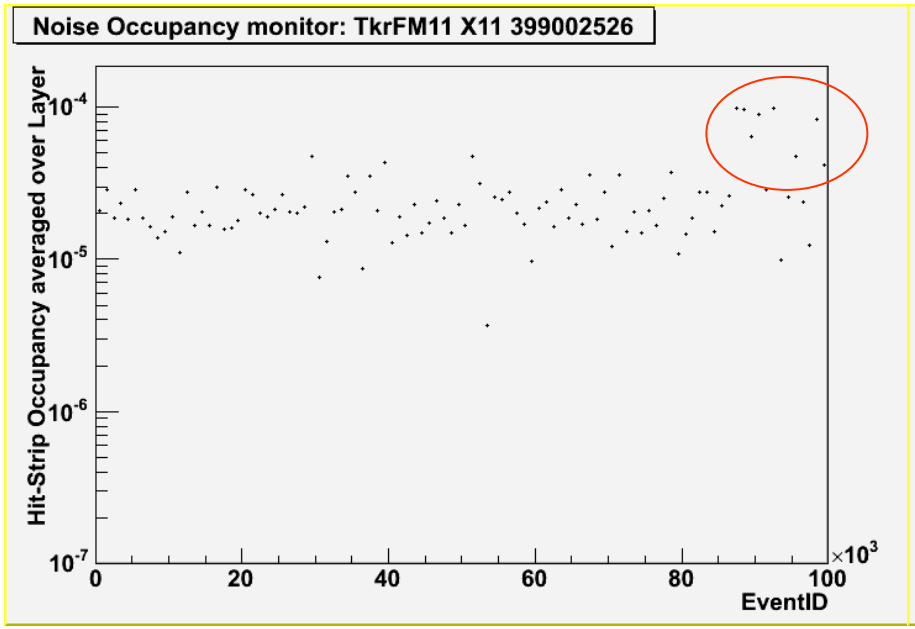
Cosmic-Ray Data

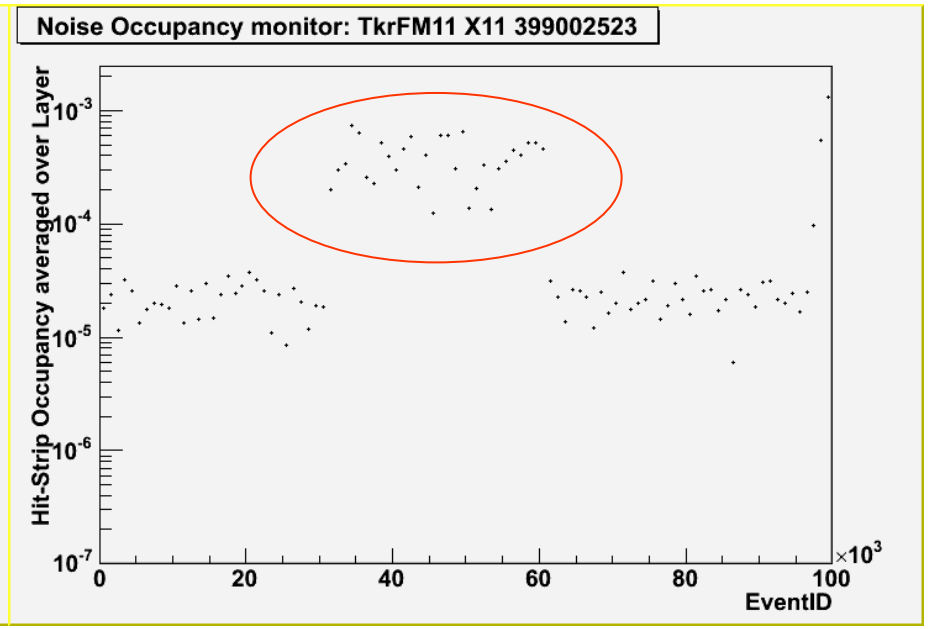




In Tracker Module 8, only two cosmic-ray runs (above) out of 10 analyzed showed some evidence of short-lived noise flares.

Cosmic-Ray Data



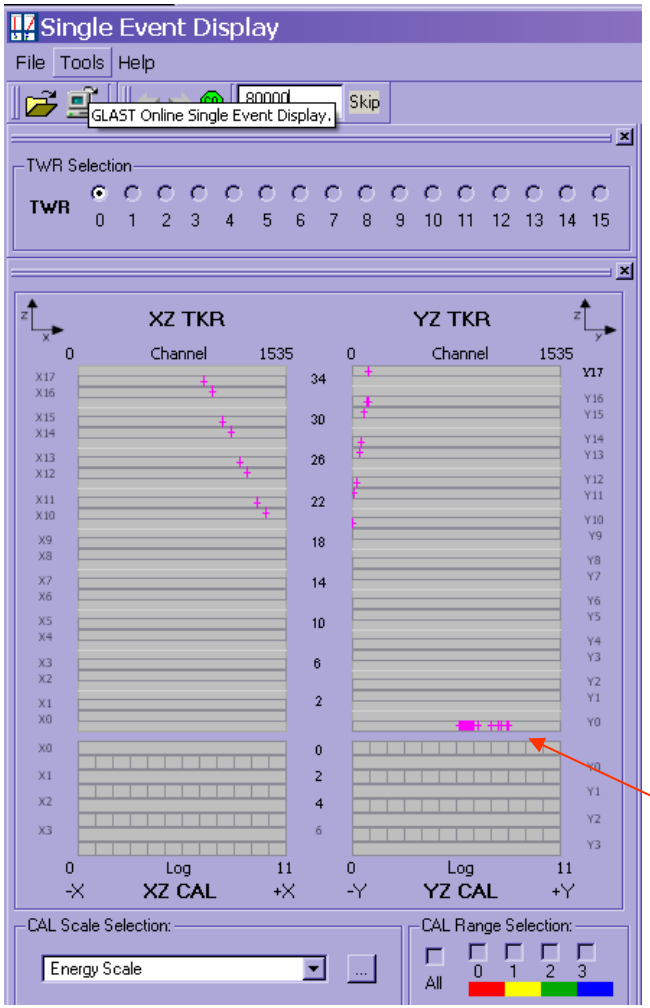


In Tracker Module 11, two cosmic-ray runs (above) out of 11 analyzed showed clear evidence of noise flares.

Noise Bursts in Cosmic-Ray Events

These 2 consecutive events demonstrate that the noisy region is alive during flares.

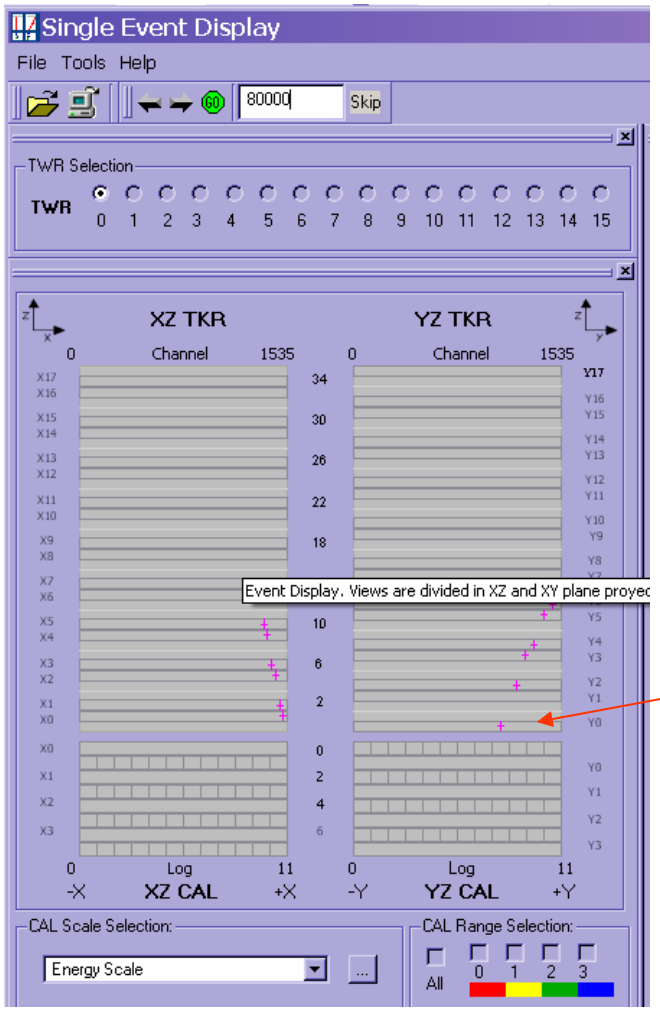
Event 80045



Tower 8

Noise

Event 80046

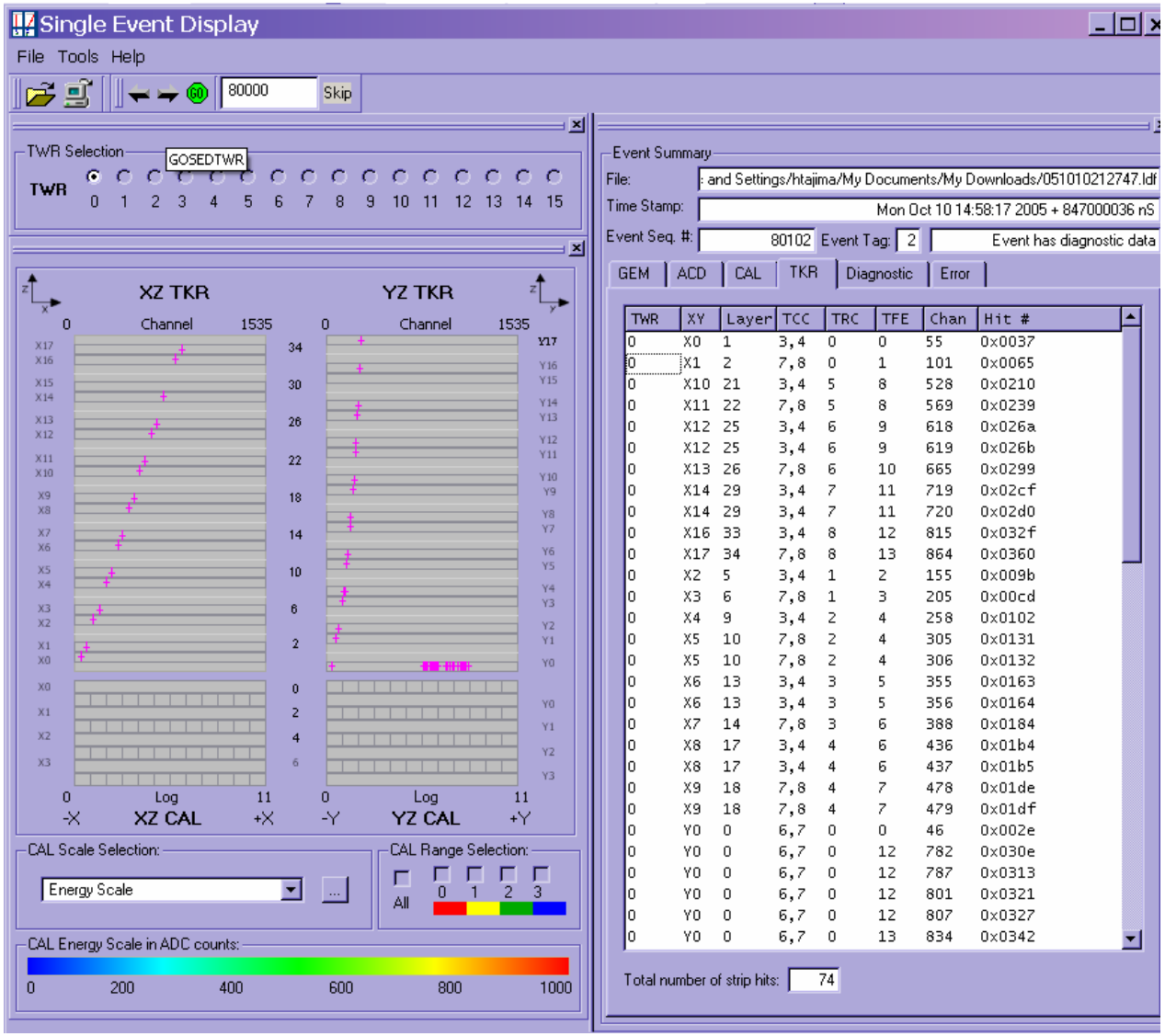


Noisy region is alive!

Noise Bursts in Cosmic-Ray Events

Tower 8

This event demonstrates that the MCM is functionally detecting particles even when there is a noise burst somewhere in that same layer.

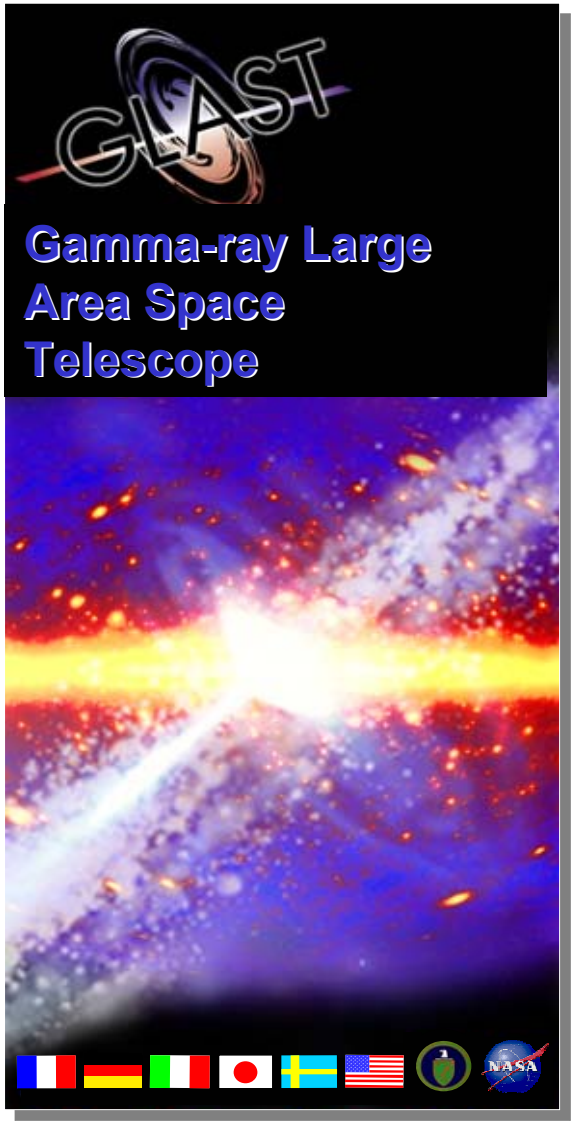


Noise Flare Summary

- The root cause is still unclear. We do not know why it affects just a few selected layers. Long-duration tests on Tower 8 are being planned to try to understand this more.
- Nevertheless, the observed problem is completely insignificant with respect to science operations:
  - Very few ladders are affected at all.
  - Those that are affected are not correlated in time, so the 6-on-a-row trigger is completed unaffected.
  - The noise is concentrated in infrequent bursts that are unlikely to coincide with a cosmic-ray or gamma-ray trigger.
    - Even if a burst does coincide with a gamma-ray, noise in one layer is unlikely to affect the tracking. The tracking is robust with respect to losing information on one layer.
  - Sometimes one can run for days without being able to see the problem at all. There is no evidence of it getting worse with time.
- Operation in vacuum, even hot or cold, does not raise the problem to anywhere near the level that it could significantly affect science data.

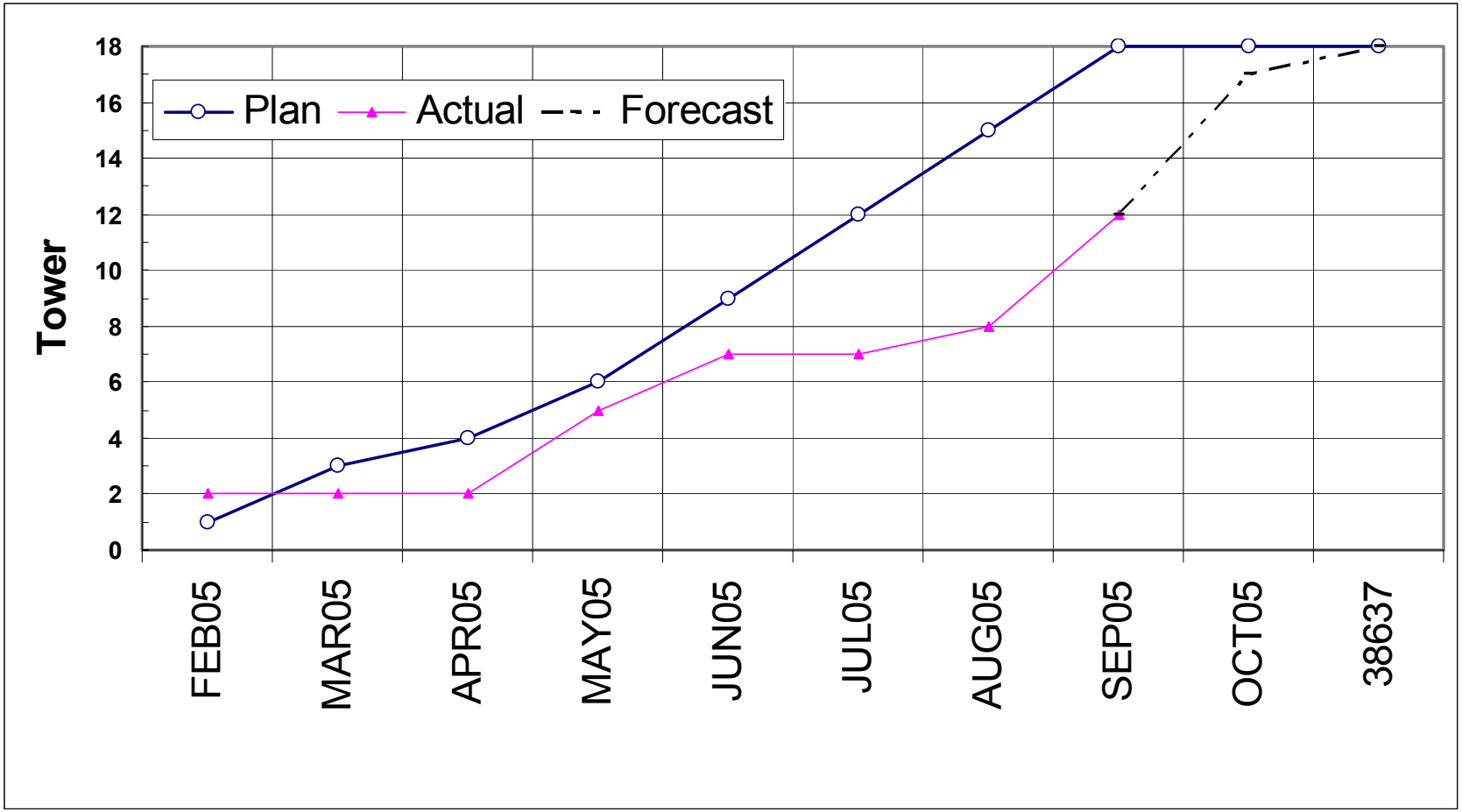
Cable Qualification

- Tests on Parlex cables are still in progress at Trace Labs
  - No problems seen so far, even with the rather drastic bending tests completed.
- GSFC is directing Pioneer to follow much the same test program
  - This is a change of scope in the Pioneer contract with SLAC.
    - Larger number of cables to be tested.
    - More tests on full-size cables that Pioneer had expected to be done only on coupons.
  - Meetings with Pioneer have been held this week to clarify the test requirements.



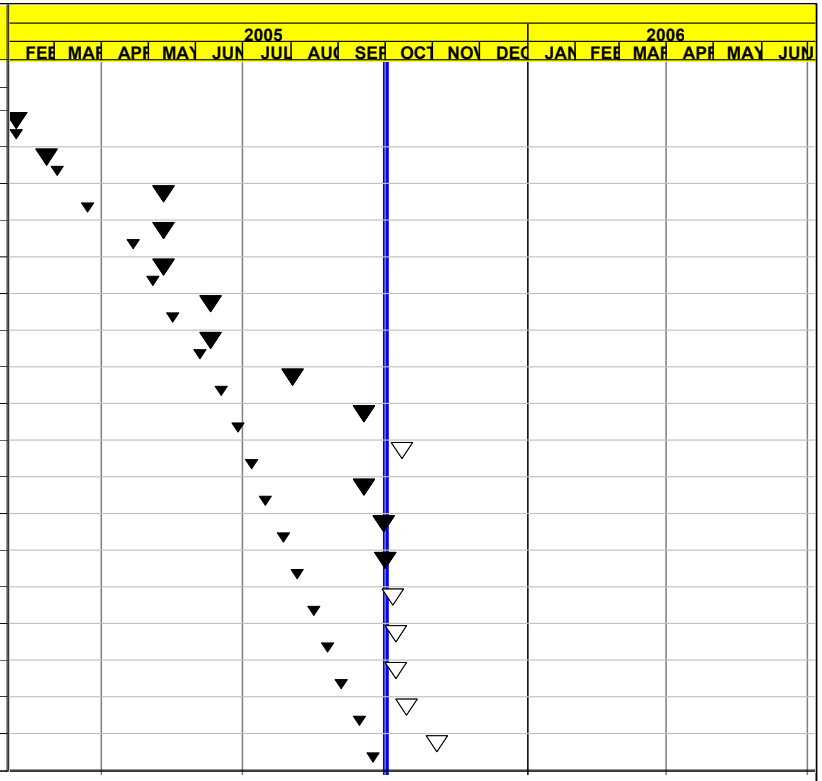
Cost/Schedule Reports for 4.1.4 Tracker Presentation September 2005 Month End

Level 3 Milestone Count



Level 3 Milestone List

Activity Description	Baseline Finish	-2m Var	-1m Var	Bsln Var	Early Finish
4.1.4 Tracker					
Flight Tracker Tower A RFI	02/04/05	0	0	0	02/04/05A
Flight Tracker Tower B RFI	03/02/05	4	4	4	02/24/05A
Flight Tracker Tower 1 RFI	03/22/05	-35	-35	-35	05/10/05A
Flight Tracker Tower 2 RFI	04/20/05	-14	-14	-14	05/10/05A
Flight Tracker Tower 3 RFI	05/03/05	-5	-5	-5	05/10/05A
Flight Tracker Tower 4 RFI	05/16/05	-17	-17	-17	06/09/05A
Flight Tracker Tower 5 RFI	06/03/05	-4	-4	-4	06/09/05A
Flight Tracker Tower 6 RFI	06/16/05	-31	-31	-31	08/01/05A
Flight Tracker Tower 7 RFI	06/27/05	-57	-57	-57	09/16/05A
Flight Tracker Tower 8 RFI	07/06/05	-65	-68	-68	10/11/05
Flight Tracker Tower 9 RFI	07/15/05	-44	-44	-44	09/16/05A
Flight Tracker Tower 10 RFI	07/26/05	-42	-46	-46	09/29/05A
Flight Tracker Tower 11 RFI	08/04/05	-41	-40	-40	09/30/05A
Flight Tracker Tower 12 RFI	08/15/05	-34	-36	-36	10/05/05
Flight Tracker Tower 13 RFI	08/24/05	-29	-31	-31	10/07/05
Flight Tracker Tower 14 RFI	09/02/05	-14	-24	-24	10/07/05
Flight Tracker Tower 15 RFI	09/13/05	-23	-23	-23	10/14/05
Flight Tracker Tower 16 RFI	09/22/05	-18	-29	-29	11/02/05



Run Date 10/28/05 15:32
Data Date 10/01/05

GLAST LAT PROJECT
Level 3 Milestones
Baseline Variance (Organized by Subsystem)

LT-DZ: Baseline Variance
FL-D4: AV: Level 3 Milestones
Report #10
Sheet 2

Cost Report

Reporting Category	Cost Incurred/Hours Worked				Estimated Cost/Hours to Complete			Estimated Final Cost/Hours		Unfilled Orders Outstanding
	During Month		Cum. to Date		Detail		Balance of Contract	Contractor Estimate	Contract Value	
	Actual	Planned	Actual	Planned	OCT05					
4.1.4 TRACKER										
4.1.4.1 TRACKER MANAGEMENT	**88**	**33**	**4,071**	**3,898**			**-172**	**3,898**	**3,898**	**0**
4.1.4.2 RELIABILITY & QUALITY ASSURANCE	**0**	**0**	**4**	**0**			**-4**	**0**	**0**	**0**
4.1.4.3 TRAY SUB-ASSEMBLY	**18**	**17**	**12,989**	**13,499**			**510**	**13,499**	**13,499**	**54**
4.1.4.4 TOWER STRUCTURE & ASSEMBLY	**49**	**121**	**3,697**	**4,284**			**586**	**4,284**	**4,284**	**0**
4.1.4.5 TRACKER TEST & CALIBRATION	**19**	**17**	**215**	**268**			**53**	**268**	**268**	**206**
4.1.4.7 INSTRUMENT INTEGRATION & TEST (SLAC)	**0**	**0**	**59**	**99**			**40**	**99**	**99**	**0**
4.1.4.8 MISSION INTEGRATION & TEST SUPPORT	**0**	**0**	**0**	**0**			**0**	**0**	**0**	**0**
CAPW[3]Totals:	**173**	**188**	**21,035**	**22,048**			**1,012**	**22,048**	**22,048**	**261**

FTE Report (DOE/NASA-funded only)