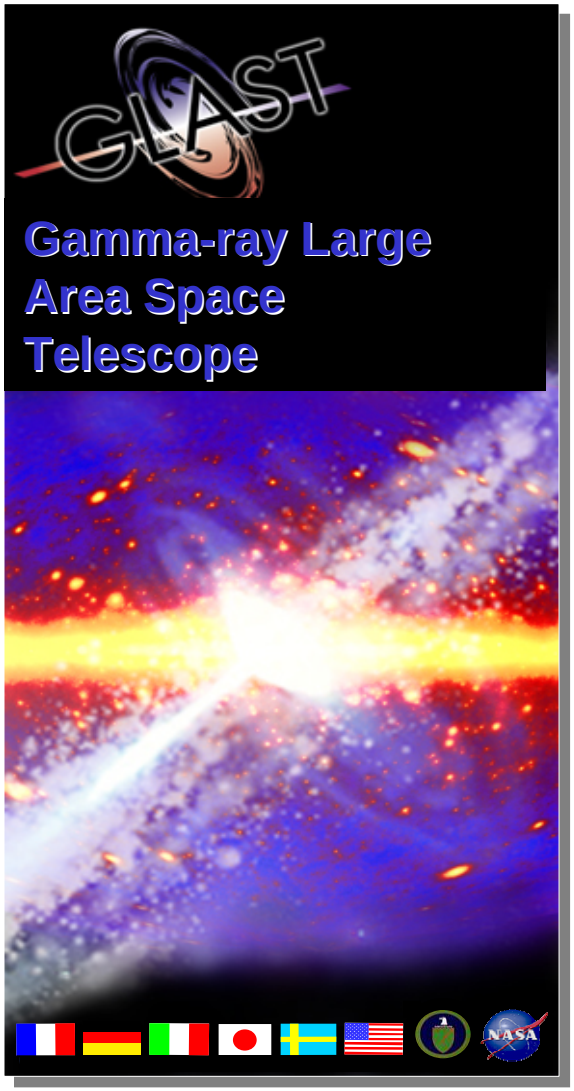

GLAST Large Area Telescope

Pre-Environmental Test Review

LAT Test Results

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Purpose / Contents

- Demonstrate LAT functionality
- Monitor LAT performance via CPT and calibrations from Baseline forward through Environmental test
  - CPT
    - Detector subsystems
    - Copper paths, interfaces
  - Calibrations
    - Detector subsystems

- Performance baseline successfully established at SLAC prior to shipment

Data Products, Analysis, and Reports

- "Online" analysis – Mobile Computing Rack
  - Data converted from CCSDS to LSF to LDF
    - Same data format used in LATTE era (i.e. prior to FSW)
  - Analysis scripts and reports from LATTE
- "Offline" analysis – SLAC computer farm
  - Two reports produced for all runs, corresponding to data products
    - Digi report (basic detector quantities)
      - Trigger info: Total rate; Rates of trigger types; Arrival times
      - ACD: Occupancy; Threshold info; Hit map
      - CAL: Occupancy
      - TKR: Number of strips and layers hit; Time over threshold
    - Reconstruction report (derived quantities)
      - Number of tracks
      - Reconstructed energies, directions, positions
      - TKR-CAL alignment, track extrapolation to ACD
  - Full GLAST community has access and tools for offline products

Test Matrix

			Configurations									TT	V&V	LAT	Status/Liens
Tier	ID	Name	1	2	3	4	5	6	7	8	9				
1	LAT00x	LAT Power On	1	1	1	1	1	1	1	1	1	X	X	X	
	LAT01x	LAT Power Off	1	1	1	1	1	1	1	1	1	X	X	X	
	LAT04x	Establish Science Operations Config	1	1								X	X	X	
	LAT22x	Science Operations Demo	1	1	2	2	2	2				X	X	X	Scripts demonstrate that FSW gamma filter can be selected, but effect of filter is not as intended.
2	LAT30x	ACD CPT	1	1								X	X	X	
	LAT40x	CAL CPT	1	1								X	X	X	
	LAT50x	TKR CPT	1	1								X	X	X	
3	LAT07x	LAT Energy Measurement Calibration	2									X	X	X	
	LAT21x	LAT Timing Measure & Adjust	1	2								X	X	X	
4	LAT03x	Electrical Power Subsystem Performance	1	1								X	X	X	
	LAT13x	LAT/Spacecraft Interface Test	1	1	2	2						X	X	X	
	LAT14x	LAT/Spacecraft Interface Test (SIIS)	2									X	X	X	
5	LAT02x	LAT Reinitialization	2	2	2	2		2				X	X	X	
	LAT06x	SIU/EPU Hardware Functional	1	1								X	X	X	
6	LAT15x	LAT Ambient TCS Test	2	2								X	X	X	Copper path check completed successfully.
	LAT16x	LAT Survival Heater Test	2	2								–	–	–	Procedure (No Script); Grist planning TT
	LAT52x	LAT Light Tight Test	2									–	–	–	Demo of existing likely scripts was successful
7	LAT65x	LAT False Triggers	1	1								-	-	X	Test is additional analysis of LAT22x data
	LAT66x	T&DF Transport Errors	1									X	X	X	
	LAT70x	LAT SVAC Flight Config on Ground	1	2								X	X	X	
	LAT71x	LAT SVAC Muon Calibration	2									X	X	X	
	LAT8xx	SVAC Runs (High rates, voltage margins)	1	1								X	X	X	Needs retest at NRL to add run time
8	LAT12x	LAT Science Modes	2	2								X			Part of FQT; Review Requirements with R. Baun
9	LAT20x	LAT Science Performance Diagnostics	2	2											3 reqmts depend on FSW to be released before TVAC
	LAT23x	LAT GRB Handling	2	2		2	2					X	X	X	Copper check successful. Depends partially on FSW not yet deployed. NCR.
10	LAT17x	LAT Conducted & Radiated Emissions	2	2								X			ECD 6/1
	LAT18x	LAT Conducted & Radiated Susceptibility	2									X			ECD 6/1
	LAT31x	ACD LPT	2	2								X	X	X	
	LAT41x	CAL LPT	2	2								X	X	X	
	LAT51x	TKR LPT	2	2								X	X	X	

Config Codes:		Color Codes:
1	Executed before shipment to NRL	Successful Run on LAT
2	Executed before TVAC at NRL	
		Dry Run on LAT
TT	Table Top Complete	
V&V	Verification and Validation Complete	Debug on LAT
LAT	Script has been run on the LAT	
		Required for LAT Level CPT

Script/Test Status

- Liens against LAT CPT
  - LAT-22x (Science Ops Demo)
    - Needs follow-up analysis of on-board filter output
  - LAT-23x (GRB Handling)
    - Tests existing FSW. Awaiting future FSW deliveries.
- Current script work
  - LAT-15x, 16x (Thermal control)
    - Scripts have been developed, V&V is pending
    - Plan: Test after radiator installation
  - LAT-17x, 18x (EMI/EMC)
    - Data acquisition script defined and demoed on LAT
    - Realtime displays, offline analysis being worked
  - LAT-52x (Light Tight)
    - Data acquisition script defined and demoed on LAT
    - Plan: Test after Vibe

Data Integrity

- **Data integrity issues**
  - Three open issues were identified at PSR
    1. Dropped word at 256-byte boundary within packet
    2. Dropped word at end of packet
    3. Compression error in LCI
  - All three have been fixed. Issues 1 and 2 have been verified. Issue 3 is planned to be verified 5/23/06.
    - Fixed in FSW updates or VSC firmware update
    - Final fix installed after post-ship CPT
  - No known issues in current data taking

T&DF Performance

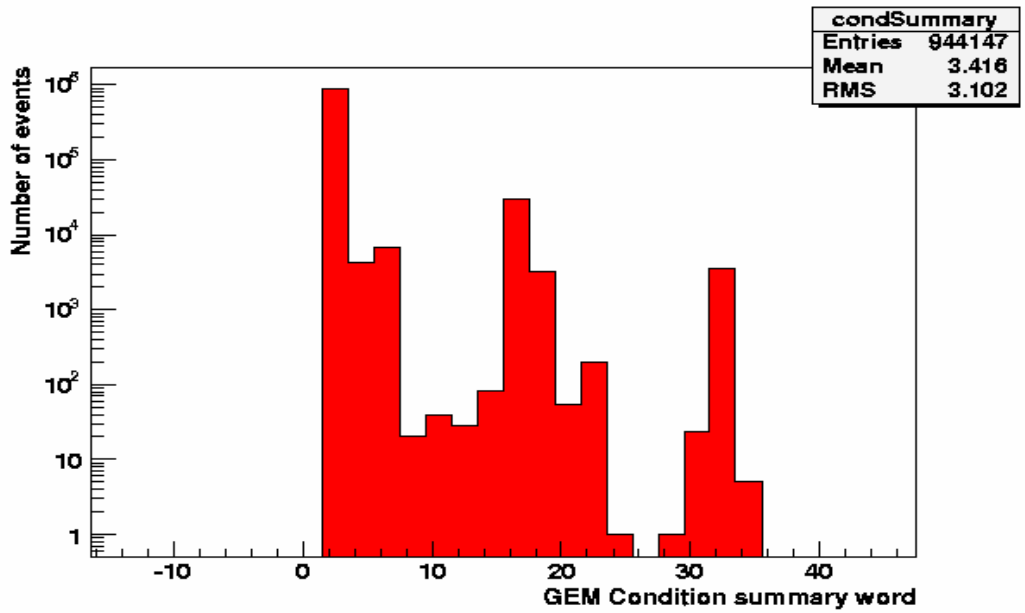
- **T&DF functionality**
  - Trigger system demonstration in CPT and LPT
    - Trigger primitive aliveness
    - Scheduler, Engine, and Messaging functionality
  - Trigger and veto efficiency (calibration)
    - Collected with LATTE, analysis on-going
    - Collected with FSW, analysis on-going

- **Detector subsystems timed-in at Baseline (calibration)**
  - TREQ aligned
    - ACD veto and TKR time-aligned with CAL-LO
  - TACK delay optimized
    - ACD and CAL MIP peaks maximized
      - Analysis of ACD re-acquisition is in progress
    - TKR hit occupancy maximized

Trigger Summary

SVAC Report: SVAC Report - Microsoft Internet Explorer

Address http://www.slac.stanford.edu/exp/glast/ground/LATSoft/nfsLinks/u25/Integration/rootData/077003165/v6r070305p9/digiReport/v3r4p15/html/index.html



GEM Condition summary word

Trigger bit	0	1	2	3	4	5	6	7
Summary	ROI	TKR	CAL Low	CAL High	CNO	Periodic	Solicited	External
Number of events	719008	906603	11472	197	33212	3560	0	0

ACD Performance

- **Subsystem performance**
  - **Minimum-ionizing particle (MIP) peaks**
  - **Veto rates**
  - **Veto thresholds**

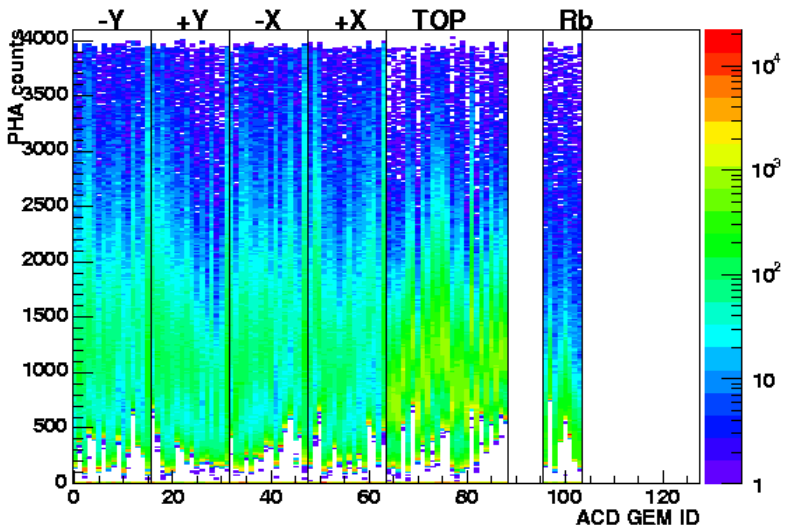
Baseline established for all quantities at SLAC by the end of Pre-Ship CPT.

All PHA, Veto, and CNO chans within spec except: one Veto, but no flight impact

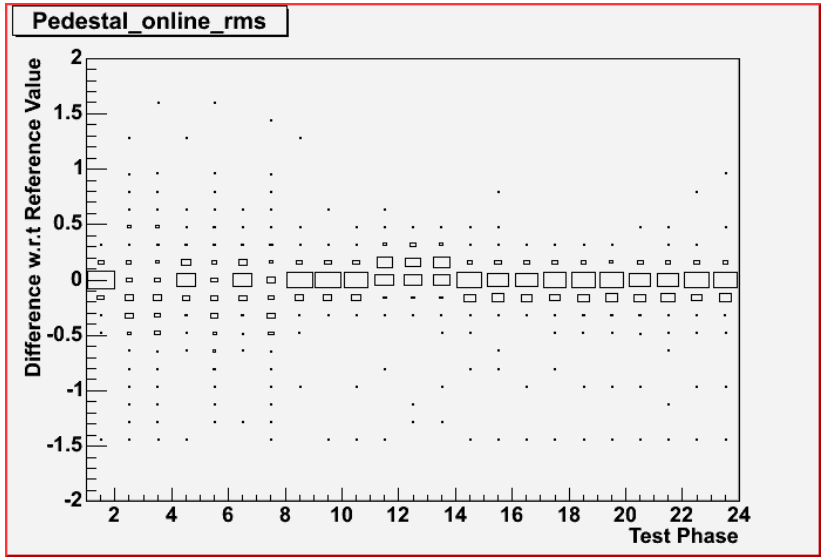
- **Electronics performance**
  - **Pedestal centroids and widths**
    - **Width is measure of noise**
  - **Gain**

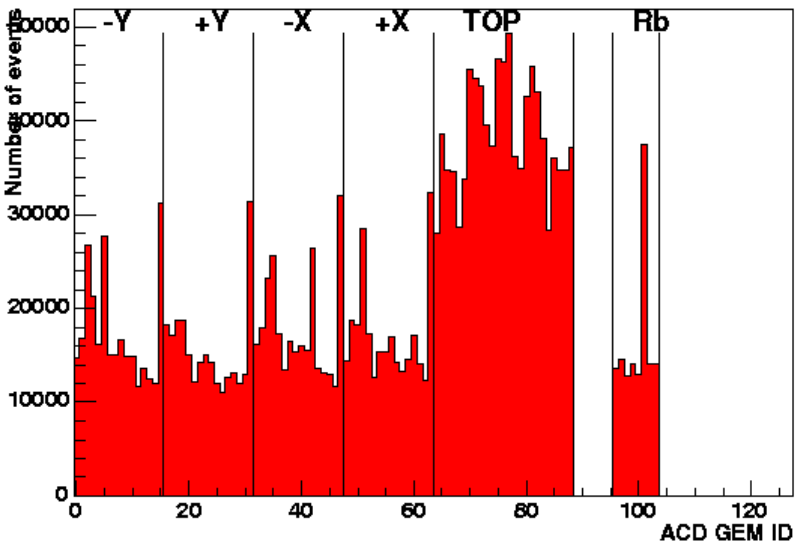
- **Calibration quantities**
  - **MIP peaks**
  - **Veto thresholds**

MIP spectra (PHA)



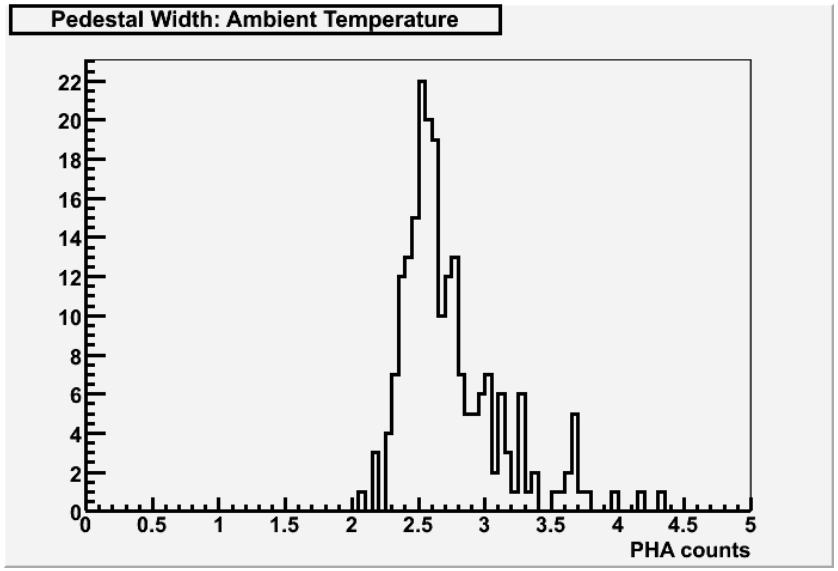
ACD Trending

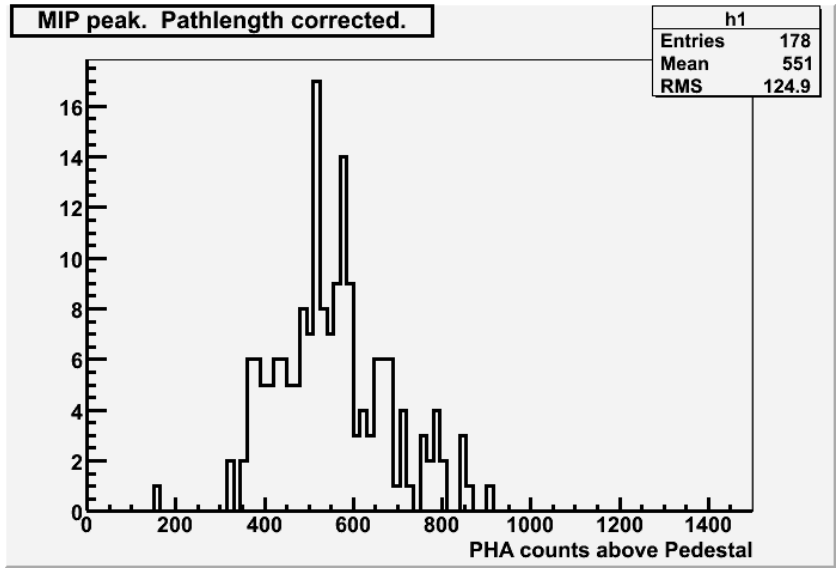




- **Pedestal width trend**
  - **Essentially no changes to electronic noise since ACD was completed**
  - **Final phase shown is Baseline CPT**
- **Veto occupancy**
  - **Aliveness test for all Veto signals**
    - **"GEM Veto List"**
  - **Muons during LAT CPT and LPT show all channels are alive**

ACD Performance at Baseline





- **Pedestal width baseline**
  - **Low electronic noise**
    - **~½% of MIP peak**
  - **Measured in each CPT, LPT**
- **MIP peak baseline**
  - **PMT gains are adequately balanced**
  - **Measured with 4 hrs of muons**

CAL Performance

- **Subsystem performance**
  - **Gain ("MeV/bin")**
  - **Linearity**

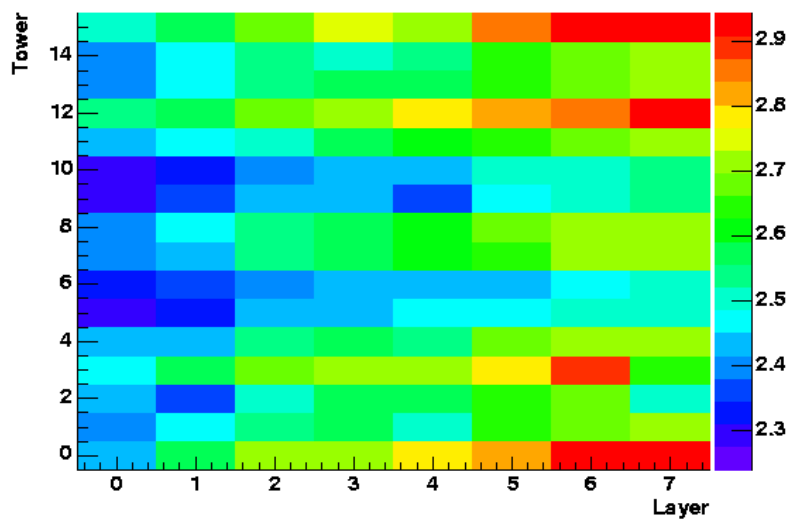
Baseline established for all quantities at SLAC by the end of Pre-Ship CPT.
except: Threshold DAC gains

All spectr chans and thresholds in spec

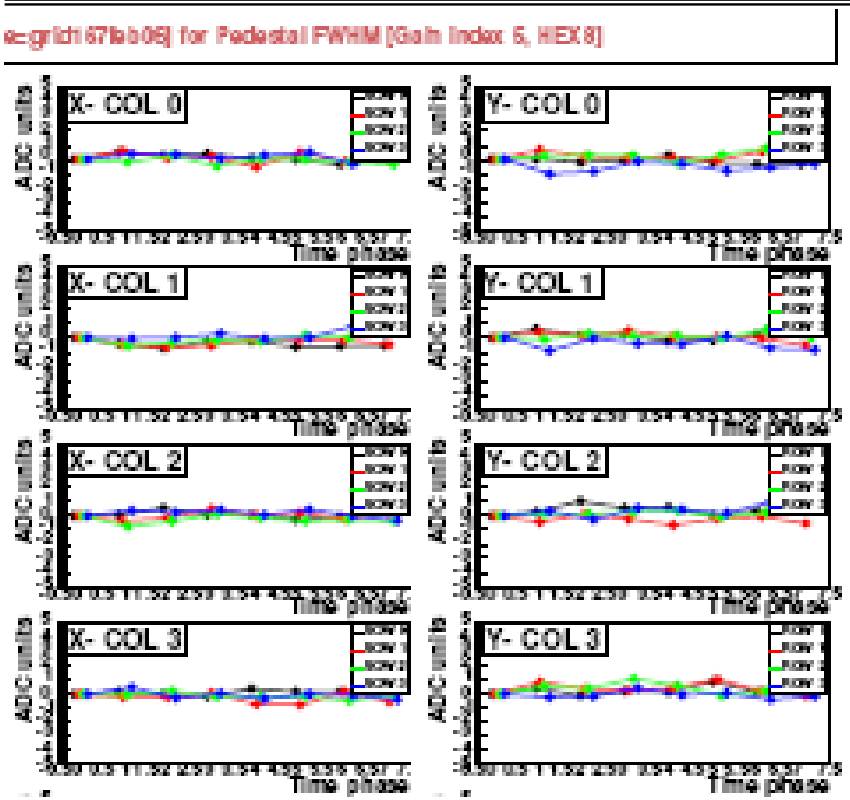
- **Electronic performance**
  - **Pedestal centroids and widths**
    - **Width is measure of noise**
  - **Gains**
  - **Front-end linearity**
  - **Threshold DAC gains**

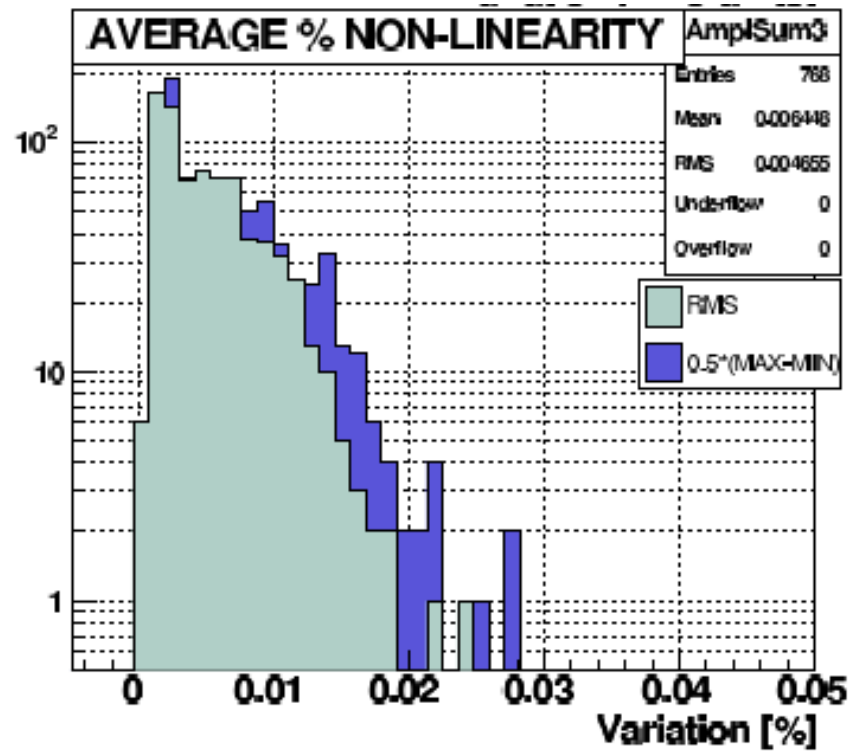
- **Calibration quantities**
  - **Gain**
  - **Linearity**

Hit occupancy



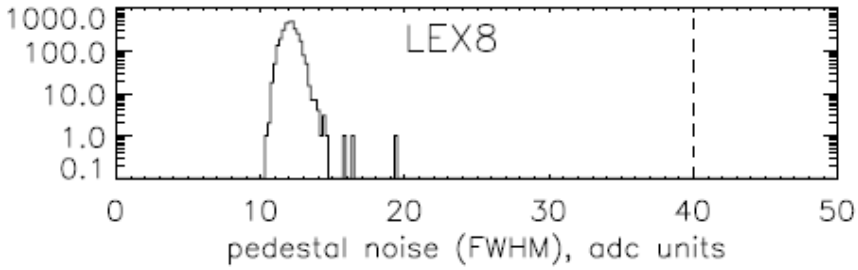
CAL Trending

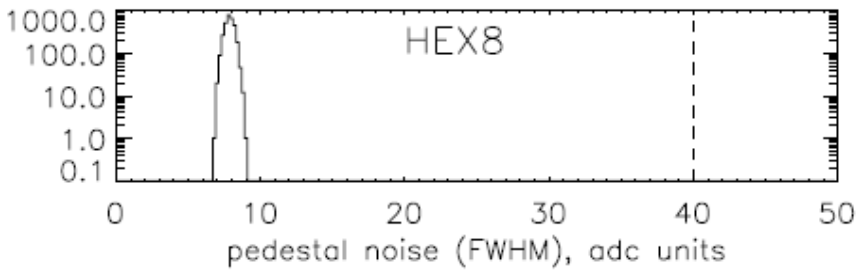


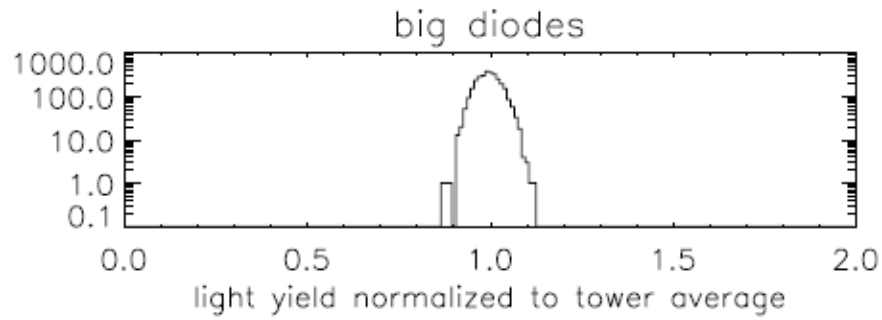


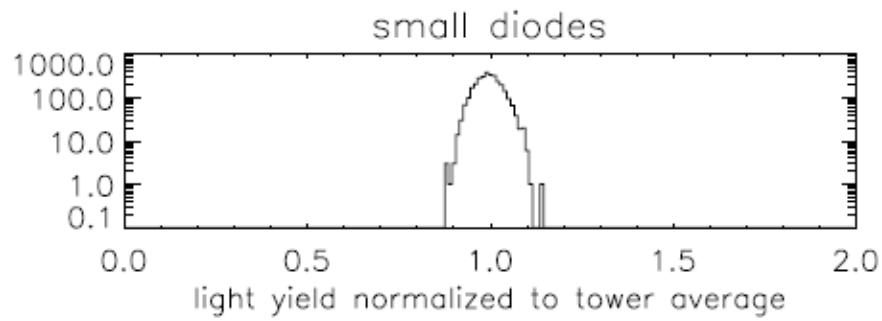
- **Time evolution of pedestal width**
  - **Typical FWHM ~ 8 bins (HEX8)**
  - **Plot shows stability of 32 channels**
  - **Final phase is SLAC Baseline**
- **Front-end linearity**
  - **Typical avg non-linearity ~ 0.2%**
  - **Stable to ~0.02% or better**

CAL Baseline Performance









- **Pedestal width at Baseline**
  - **Actual performance relative to spec**
    - **No issues**
  - **Measured in each CPT, LPT**
- **Diode light yield at Baseline**
  - **No broken optical bonds**
  - **Measured with 4 hrs of muons**

TKR Performance

- **Subsystem performance**
  - **Dead, noisy, and disconnected channel lists**
  - **Trigger efficiency**

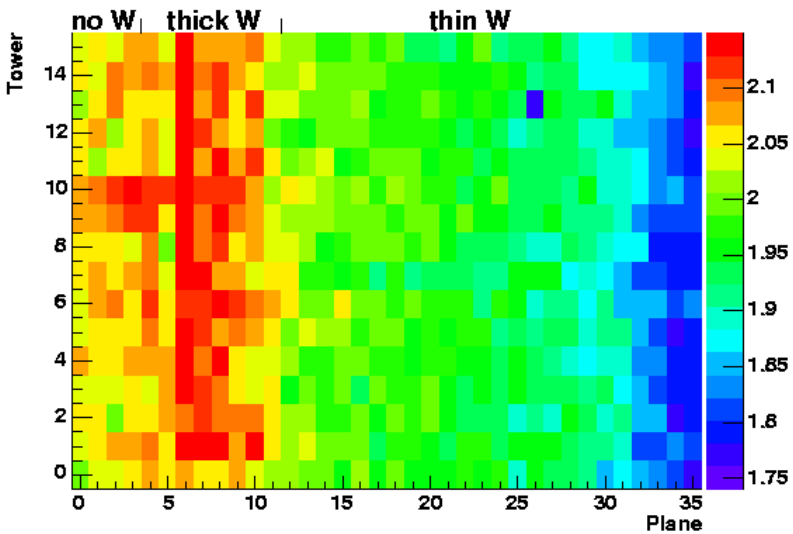
Baseline established for all quantities at SLAC by the end of Pre-Ship CPT.

- **Electronics**
  - **Noise occupancy**

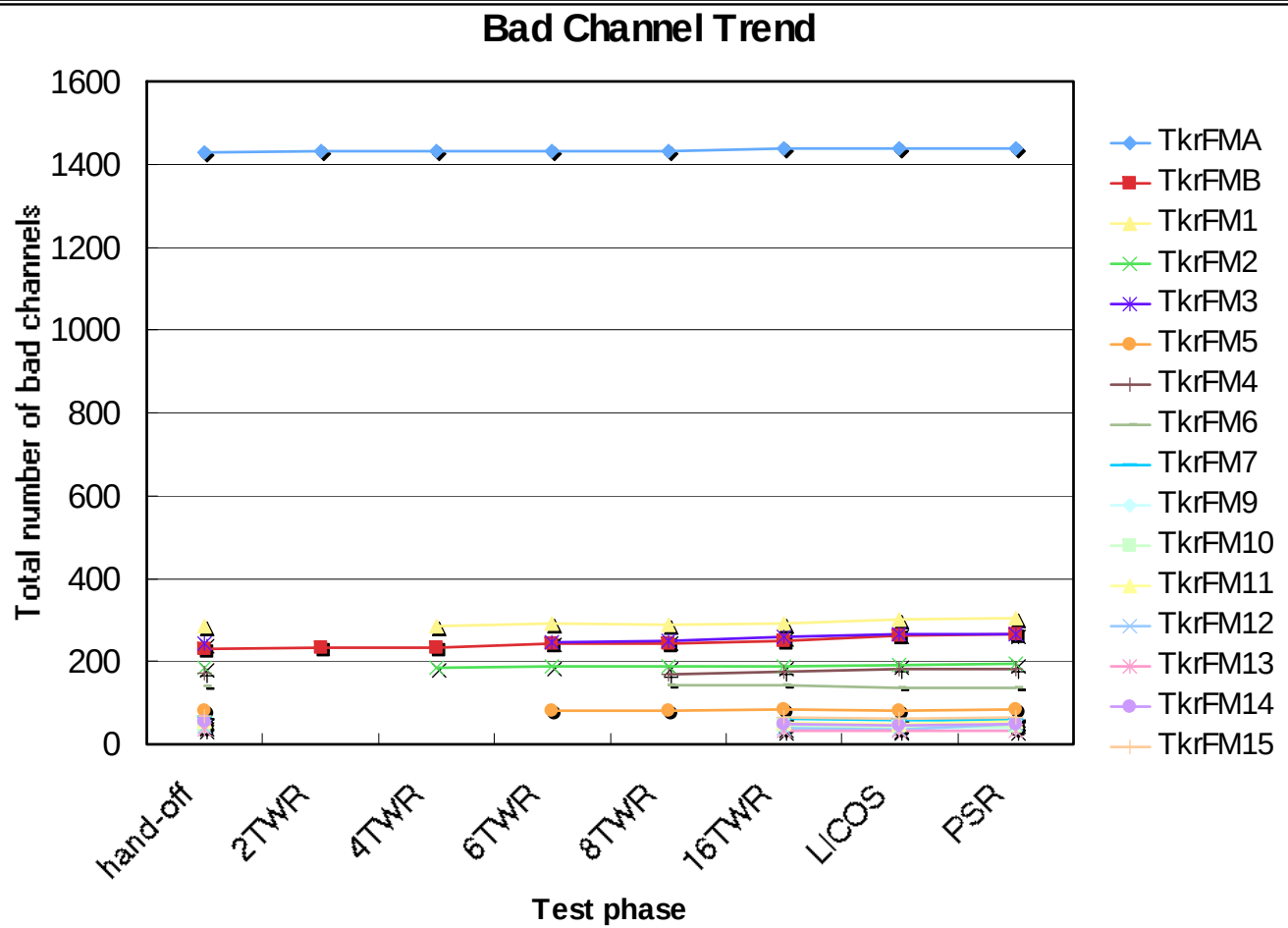
Efficiency, bad chan count within spec.

- **Calibration quantities**
  - **Dead channel list**
  - **Noisy channel list**
  - **Disconnected channel list**
  - **Threshold**
  - **TOT gain**

Hit occupancy



TKR Trending



- **Disconnected channel trend**
  - **Increase in disconnects < 1.5% since delivery of TKR towers.**

Calibration

- **Calibration**
  - Datasets collected with cosmic muons and test charge injection
    - SLAC calibrations under both LATTE and FSW
    - Test cases LAT-07x, LAT-70x, and LAT-71x
      - CAL threshold calibrations done in test gain rather than flight gain
        - » Reacquired at NRL (post-ship) in flight gain
  - Next acquisition at Pre-TVAC phase

- **Analysis**
  - Combination of online (near real time) and offline processing
    - ACD Baseline analysis complete and new constants are in use
    - CAL reanalysis is in progress
    - TKR Baseline analysis complete; new constants not yet in use
  - Output is set of calibration constants for each detector subsystem
    - Trending system for constants is under development

Summary

- **LAT status**
  - **Performance baseline successfully established at SLAC**
    - **Baseline CPT completed and signed off**
    - **Calibrations from LATTE and/or FSW**
  - **Post-ship CPT at NRL**
    - **No known performance issues from shipment**
    - **Data review for sign-off is in progress**
  - **Detectors are operating daily at NRL with flight settings**