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
## LAT Test Results

**Presentation 6 of 12**

### Test Matrix

<table>
<thead>
<tr>
<th>Tier</th>
<th>ID</th>
<th>Name</th>
<th>Configs</th>
<th>TT V&amp;V</th>
<th>LAT Status/Liens</th>
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<tbody>
<tr>
<td>1</td>
<td>LAT00x</td>
<td>LAT Power On</td>
<td>1</td>
<td>X</td>
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<td>LAT04x</td>
<td>Establish Science Operations Config</td>
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<td>LAT22x</td>
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<td>2</td>
<td>LAT03x</td>
<td>ACD CPT</td>
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<td>LAT05x</td>
<td>TKR CPT</td>
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<td>LAT Timing Measure &amp; Adjust</td>
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<td>4</td>
<td>LAT03x</td>
<td>Electrical Power Subsystem Performance</td>
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<td>LAT Reinitialization</td>
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<td>LAT06x</td>
<td>SI/EPU Hardware Functional</td>
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<td>6</td>
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<td>LAT Ambient TCS Test</td>
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<td>LAT Light Tight Test</td>
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<td>LAT10x</td>
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<td>LAT SVAC Moon Calibration</td>
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<td>SVAC Runs (High rates, voltage margins)</td>
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<td>LAT21x</td>
<td>LAT Science Modes</td>
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<td>LAT22x</td>
<td>LAT Science Performance Diagnostics</td>
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<td>LAT23x</td>
<td>LAT GRB Handling</td>
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<td>LAT17x</td>
<td>LAT Conducted &amp; Radiated Emissions</td>
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<td>LAT Conducted &amp; Radiated Susceptibility</td>
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<td>LAT51x</td>
<td>TKR LPT</td>
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<td>X</td>
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</tbody>
</table>

### Config Codes:

- **1**: Executed before shipment to NRL
- **2**: Executed before TVAC at NRL
- **3**: Dry Run on LAT
- **4**: Tested on LAT
- **5**: Table Top Complete
- **6**: V&V Verification and Validation Complete
- **7**: LAT Script has been run on the LAT
- **8**: Required for LAT Level CPT

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Scripts demonstrate that FSW gamma filter can be selected, but effect of filter is not as intended.

Copper path check completed successfully.

Copper check successful. Depends partially on FSW not yet deployed. NCR.

3 reqmts depend on FSW to be released before TVAC

Part of FQT: Review Requirements with R. Baun

Needs retest at NRL to add run time

ECD 6/1

ECD 6/1
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

- **condSummary**
  - Entries: 644147
  - Mean: 3.416
  - RMS: 3.102

- **GEM Condition summary word**

<table>
<thead>
<tr>
<th>Trigger bit</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
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<th>7</th>
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<tbody>
<tr>
<td>Summary</td>
<td>ROI</td>
<td>TKR</td>
<td>CAL Low</td>
<td>CAL High</td>
<td>CNO</td>
<td>Periodic</td>
<td>Solicited</td>
<td>External</td>
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<tr>
<td>Number of events</td>
<td>719006</td>
<td>906603</td>
<td>11472</td>
<td>197</td>
<td>33212</td>
<td>3560</td>
<td>0</td>
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</tbody>
</table>
ACD Performance

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

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

- **Calibration quantities**
  - MIP peaks
  - 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.

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

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

- Calibration quantities
  - Gain
  - 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
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

- **Electronics**
  - Noise occupancy

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

Baseline established for all quantities at SLAC by the end of Pre-Ship CPT.
Efficiency, bad chan count within spec.

Hit occupancy
Disconnected channel trend
- Increase in disconnects < 1.5% since delivery of TKR towers.
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
LAT Test Results
Presentation 6 of 12

GLAST LAT Project
May 25, 2006: Pre-Environmental Test Review

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