GLAST LAT Calorimeter Subsystem

Redefinition of Performance Test and Calibration Suites

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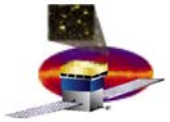

Test and Calibration Documents

- I have revised the LAT documents that define the CAL Module-level functional/performance tests and calibrations to reflect what is now done for Flight Model CALs.
  - Lessons learned *during* test of FM101 (= FMA).
  - Docs are in review cycle within CAL team.
  - CAL Comprehensive and Limited Functional Test Definition
    - LAT-MD-01370-02
  - CAL Electronic and Muon Calibration Definition
    - LAT-MD-04187-02
  - CAL Functional Test and Calibration Procedure
    - LAT-PS-01513-02
    - (Actually, I'm still revising the text of this one…)
- Philosophy
  - Rely on Suites, rather than manual sequences of unit tests
  - Reduce chance of operator error
  - Simplify operation

Functional/Performance Testing

- CPT and LPT are essentially unchanged from version -01.
  - Suites have same goals as before, do the same things.
    - Names of some tests have been changed (to protect the innocent).
    - Sequence of units tests is corrected.
    - Trending data definition is corrected.
    - Text of document is clarified.
- CPT
  - Verify communication between TEM and CAL
  - Measure "noise," electronic gain, and FE (non)linearity
  - Test stability of optical response
  - Characterize FLE, FHE, LAC, and ULD DACs
- LPT
  - Verify communication between TEM and CAL
  - Measure "noise"
  - Test stability of optical response

Calibrations

- Electronic and muon calibrations revised and reorganized to
  - Generate all info necessary for energy calibration
  - Split off once-only or rare calibration elements
  - Energy calibration derived from sequence of two suites and analyzed off line
    - calibGen
      - Suite of charge-injection calibrations in several configs
    - collectMuons
  - Rare or once-only elements
    - calibDAC
      - Suite of chg-inj calibrations of FLE, FHE, LAC, ULD
    - muTrg
      - Suite of muon collections to verify FLE tables
    - muShape, extShape
      - Suite of muon collections to find optimal Tack delay

More calibrations

- Still not working as a suite:
  - MuC
    - Contents
      - collectMuons
      - calf_map_mu
        - » Fits muon peak (with its known energy deposition), gives MeV/bin.
        - » Maps light taper and light asymmetry in each CDE
    - Status
      - Code for calf_map_mu still needs change in units and output structure
    - Same functionality is provided by analysis of calibGen and collectMuons by off-line Root code, calibGenCAL

How to use this stuff

- CAL post-ship test at SLAC
  - CPT
  - calibGen
  - muTrg
  - collectMuons
- Comprehensive test and DAC characterization
  - CPT
- Limited test
  - LPT
- Complete DAC calibration
  - calibDAC
- CAL-only energy calibration
  - calibGen
  - muTrg
  - collectMuons
- Timing-in with TKR or other
  - extShape
- CAL energy calib with TKR
  - (after extShape)
  - calibGen
  - calu_collect_ext

Calibration suite definitions

- calibGen
  - Suite of charge-injection calibrations in 6 configurations chosen to allow measurement of
    - distortion of FE output caused by FLE firing
    - relative between LE and HE channels
  - Analysis is off line (Root macro calibGenCAL)
  - Run time ~ 2 hours

1. CALU_INIT: Initialize the Calorimeter.
2. CALF_TRG_P03: Characterize the FLE DAC settings with charge injection (if required by WOA).
3. genFLEsettings_ADC: Generate FLE DAC settings corresponding to ~5 MeV (if CALF_TRG_P03 has been run).
4. CALU_INIT: Load FLE DAC characterization table, fle2adc (if generated in previous step).
5. CALF_COLLECT_CI_SINGLEX16: Determine front-end integral non-linearity and noise with charge injection. Set FLE DACs to ~5 MeV and Tack delay to optimal value for charge injection.
6. CALF_COLLECT_CI_SINGLEX16: Determine front-end integral non-linearity and noise with charge injection. Set FLE DACs to their maximum value and Tack delay to optimal value for charge injection.
7. CALF_COLLECT_CI_SINGLEX16: Determine front-end integral non-linearity and noise with charge injection. Set FLE DACs to ~5 MeV and Tack delay to optimal value for muons.
8. CALF_COLLECT_CI_SINGLEX16: Determine front-end integral non-linearity and noise with charge injection. Set FLE DACs to their maximum value and Tack delay to optimal value for muons.
9. CALF_COLLECT_CI_SINGLEX16: Determine front-end integral non-linearity and noise with charge injection. Set FLE DACs to their maximum value and Tack delay to optimal value for charge injection. Inject into HE channel only.
10. CALF_COLLECT_CI_SINGLEX16: Determine front-end integral non-linearity and noise with charge injection. Set FLE DACs to their maximum value and Tack delay to optimal value for charge injection. Inject into LE and HE channels. Configure for cross-calibration between LE and HE.

Calibration suite definitions

- calibDAC
  - Suite of charge-injection measurements of FLE, FHE, LAC, and ULD DAC thresholds
  - Tests all DAC settings
    - Slooooooowwwwww…
  - Run time ~ 8 hrs

1. CALU_INIT: Initialize the Calorimeter.
2. CALF_PEDESTALS_CI: Compute pedestals.
3. CALU_INIT: Redefine pedestal table.
4. CALF_GAIN_P01: Calibrate electronic gains with charge injection. Generate *relgain* table.
5. CALU_INIT: Redefine *relgain* table.
6. CALF_TRG_P03: Calibrate FLE and FHE DAC settings with charge injection. Generate *fle2adc* and *fhe2adc* tables.
7. CALF_SUPP_P01: Calibrate LAC DAC settings with charge injection. Generate *lac2adc* table.
8. CALF_RNG_P01: Calibrate ULD DAC settings with charge injection. Generate *uld2adc* table.

Calibration suite definitions

- muTrg
  - Collects muons for 1 hr each at two FLE settings and two trigger masks
  - Run time ~ 4 hours

1. CALU_INIT: Initialize the Calorimeter.
2. CALF_TRG_P03: Characterize the FLE DAC settings with charge injection (if required by WOA).
3. genFLEsettings_ADC: Generate FLE DAC settings corresponding to ~5 MeV (if CALF_TRG_P03 has been run).
4. CALU_INIT: Load appropriate FLE DAC setting and trigger mask. Set FLE DACs to ~5 MeV. Enable even columns of even rows and odd columns of odd rows.
5. CALU_COLLECT_MU: Collect muons under CAL self-triggered readout.
6. CALU_INIT: Load appropriate FLE DAC setting and trigger mask. Set FLE DACs to ~5 MeV. Enable odd columns of even rows and even columns of odd rows.
7. CALU_COLLECT_MU: Collect muons under CAL self-triggered readout.
8. genFLEsettings_ADC: Generate FLE DAC settings corresponding to ~10 MeV (if CALF_TRG_P03 has been run).
9. CALU_INIT: Load appropriate FLE DAC setting and trigger mask. Set FLE DACs to ~10 MeV. Enable even columns of even rows and odd columns of odd rows.
10. CALU_COLLECT_MU: Collect muons under CAL self-triggered readout.
11. CALU_INIT: Load appropriate FLE DAC setting and trigger mask. Set FLE DACs to ~10 MeV. Enable odd columns of even rows and even columns of odd rows.
12. CALU_COLLECT_MU: Collect muons under CAL self-triggered readout.
13. CALU_INIT: Restore FLE DAC setting and trigger mask to initial values.

Calibration suite definitions

- muShape
  - Collects muons for 30 minutes at each of 5 Tack delays
    - muShape uses CAL self-trigger, extShape uses trigger external to CAL (TKR, muon telescope, whatever)
  - Fits shaping amp function to muon signal, finds delay that gives maximum signal
  - Run time ~ 2.5 hours

1. CALU_INIT: Initialize the Calorimeter.
2. CALU_SHAPE_MUONS: Collect muons under CAL self-triggered readout. Collect for 30 minutes each at Tack delays 10, 40, 100, 150, 200.

Functional Test Flow

- Comprehensive Performance Test (CPT)
  - Test suite composed of >20 elements with following goals
    - Verify full functionality of all CAL registers and proper communication with TEM
    - Measure pedestal centroids and widths
    - Verify stability of optical bonds for all CDEs
    - Measure electronic gain, linearity, and integral non-linearity of each GCFE
    - Characterize low and high energy (FLE and FHE) discriminators
    - Characterize zero-suppression (LAC) threshold DAC
    - Characterize auto-ranging (ULD) discriminator DAC
    - Estimate event dead-time
    - Test overload recovery circuitry
  - Defined in LAT-MD-01370
    - Runs in ~1.5 hours
    - Generates test reports, diagnostic plots, trending .csv, …