

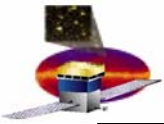
# **Trigger Tests for partially populated LAT**

**Systems Engineering Meeting 11 AM**

**GLAST 1 conference room**

**Su Dong, Eduardo do Couto e Silva and Pat Hascall**

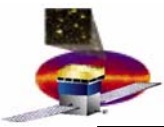
**March 7, 2005**



# Why this meeting?

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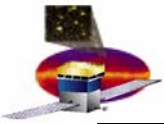
- After the E2E Committee and I&T revisited the recent proposal for 1 and 2 tower tests some configurations were eliminated
  - the rationale was that they were already part of the current trigger tests
- Today we will
  - Revisit the trigger tests
    - To justify the statement above
  - Identify overlaps/issues
  - Propose a plan for Tower A and Tower AB tests



# Muon Data Taking Configuration for Trigger Tests

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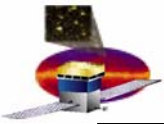
- **Single towers outside/inside the flight grid and LAT**
  - **Main Register settings**
    - CAL FLE setting: **to trigger on muons (< 100 MeV)**
    - CAL Readout range: **FOUR**
    - CAL High energy muon gain: **ON**
    - Zero suppression: **ON**
    - TEM trigger diagnostic data: **ON**
    - TKR threshold setting: **NOMINAL**



# Trigger Tests (1)

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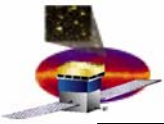
- **1.0 GEM Timing Alignment (2 x 4h = 8 h)**
  - **Purpose**
    - To verify the timing alignment and jitter for each GEM trigger input
  - **Duration**
    - 4 hours (EXT\_MU\_Telescope AND CAL\_LO with low FLE settings)
    - 4 hours (EXT\_MU\_Telescope AND TKR)
  - **Configuration**
    - muon data taking configuration.
      - » CAL\_LO efficiency for muons is reasonably good ~ 70% (number is being revised as we speak)
  - **Procedure**
    - Scan TREQ delay for the trigger test (across the allowable range)
    - Take 5000 events for each of the 16 allowed points
      - » Investigating whether it can be reduced for future tests but not Tower A
    - Compute the coincidence of external trigger and trigger under test at each step
    - Compute center time and jitter.



# Trigger Tests (2)

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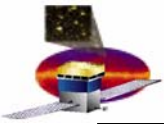
- **2.0 Subsystem TACK Delay Test (1 x 4h = 4 h)**
  - **Purpose**
    - To determine the optimal trigger output (TACK) delay for each subsystem simultaneously
      - » they do not interfere with each other because we trigger on the muon telescope.
  - **Duration**
    - 4 hours
  - **Configuration**
    - muon data taking configuration.
    - Trigger on EXT trigger ONLY (muon telescope)
  - **Procedure**
    - Scan TACK delays for the TKR and CAL over the applicable range simultaneously
    - Record 5000 events for each of the 8 steps
      - » In the future one could conceive reducing statistics depending on results
    - Determined the optimal TACK delay will by analysis
      - » Use pulse heights for the CAL and hit multiplicity for the TKR



# Trigger Tests (3)

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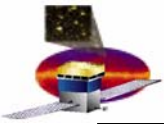
- **3.0 FLE Muon Scan (3 x 4h = 12 h)**
  - **Purpose**
    - To determine the optimal setting for the FLE for some of the muon data taking.
  - **Duration**
    - 12 hours
  - **Configuration**
    - muon data taking configuration.
    - Trigger on EXT (muon telescope), TKR and CAL\_LO trigger
  - **Procedure (currently there are 2 or 3 procedures and we need a plan to converge in one single procedure for 2 tower tests)**
    - There is a procedure from CAL documented in LAT-MD-04187-01
    - Alternative proposal1
      - » Scan FLE DAC setting for the CAL over the applicable range
      - » Record 5000 (TBR) EXT triggered events for each of the 3 steps (TBR)
      - » Determined the optimal FLE by analysis
    - Alternative proposal2
      - » CALIBCAL scripts implemented by I&T



# Trigger Tests (4)

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- **4.0 Trigger efficiency (1 x 4h = 4 h)**
  - **Purpose**
    - To determine the trigger efficiency
      - » Retriggering is not an issue for the efficiency
    - Trigger on EXT (muon telescope), TKR and CAL\_LO trigger
  - **Duration**
    - 4 hours
  - **Configuration**
    - muon data taking configuration.
    - Can use data produced by the SVAC test B7
      - » B7: needs to be modified to do CAL 4 range readout
      - » Needs to capture FLE settings recommended by trigger group
    - SVAC test B7
      - » **Is NOT part of the current Tower A and 2 tower test plan**

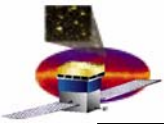


# Trigger Test (5)

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- **4.0 Trigger window test (1 x 4h = 4 h)**
  - **Purpose**
    - For a sample of good muon events what fraction of each trigger type is latched within the window for different window widths
  - **Duration**
    - 4 hours
  - **Configuration**
    - Need new GASU and LATTE 4.8
    - Vary window widths (currently 3 settings)
    - Still deciding whether to Trigger on EXT (muon telescope) only or on everything (TKR and CAL\_LO too)

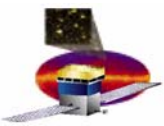




# Trigger Test Plans

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- **Tower A**
  - **Need Flexibility, high statistics and time to understand the instrument**
    - Would like to do them outside and inside the flight grid for tower A only
- **Two Towers AB**
  - **Repeat all tests but the TREQ scan**
    - Need the New GASU and LATTE 4.8
    - Devote particular attention do the trigger efficiency test
      - » inclined tracks may create different pulse heights and may change nominal timing settings
- **For n towers and new GASU**
  - **Trigger tests may happen only inside the flight grid**
    - What if there are problems? We need to remove towers and that maybe less efficient that if we were test outside first.
  - **Desirable to have muon telescope able to reach every bay in the flight grid**
    - If not possible we will need to change a bit the current procedures
  - **Perform 3 out of 5 tests, namely**
    - TACK Scan, Trigger efficiency and FLE muon scan

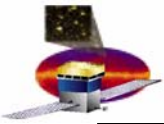


# Proposal to consolidate – keep Trigger tests only

## E2E Test Matrix

## Trigger tests

- **1/2: Baseline cosmic rays low FLE (1h)**
  - All registers nominal except CAL FLE ~ 20 MeV
- **3/1: Only TKR is allowed to open the trigger window (1h)**
- **3/2: Only CAL is allowed to open the trigger window (1h)**
  - FLE is set to 100 MeV
- **3/3: Only CAL HI is allowed to open the trigger window (1h)**
  - FHE is set to 1 GeV
- **2/5: Increase time to latch data in TKR (1h)**
  - TKR TACK DELAY = 6 ticks (0.3  $\mu$ s) nominal is 0 ticks (0  $\mu$ s)
- **2/10 and 2/11: Increase time to latch data in CAL (1h each)**
  - CAL TACK DELAY = 34 ticks (1.7  $\mu$ s) and 54 ticks (2.7  $\mu$ s)
- **C1 to C4: (6h)**
- **Scan FLE with muons to find operational thresholds for triggering on muons**
- **4.0 Trigger efficiency or SVAC B7**
  - Trigger on muons with TKR, CAL-LO ~few MeV and muon telescope
- **1.0 Trigger GEM alignment - TKR**
  - Trigger on muons with TKR, and muon telescope for different TREQ values
- **1.0 Trigger GEM alignment - CAL**
  - Trigger on muons with CAL\_LO, and muon telescope for different TREQ values
- **2.0 Trigger TACK delay**
  - Trigger on external muons only and scan TACK delays ( 8 points)
- **3.0 FLE Muon scan**
  - To determines the optimal setting for the FLE for some of the muon data taking.



# Issues/Questions

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- **What is the plan to converge from 3 to 1 procedure for the FLE muon scan**
  - **Who will take the lead?**
  - **Recommend no changes for tower A**
    - **Could cause schedule delays**
  - **Propose to consolidate them for 2 tower tests**
- **How well are we testing CAL FHE?**
  - **a CAL presentation in the near future would not be a bad idea...**
- **As the flight GASU becomes available we need to revisit all tests**
  - **TREQ procedure may change**
  - **Window width tests may be shorter or even eliminated**
- **Muon telescope**
  - **Would prefer to have access to all bays in the flight grid**