



## Excess “Discarded” Counts

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All plots are from Anders Borgland, Warren Focke

I just wrote the text





# What are "discarded" counts?

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- GEM maintains a counter of discarded trigger primitives
  - Counts "window turns" during "busy"
    - Trigger requests during deadtime
    - No information on trigger source
      - To find which primitive type, need to enable and disable various trigger sources (TKR, CAL-LO, CAL-HI)
- From GEM timers, can deduce time of *last* discarded count
  - Time since close of trg window of previous event
    - See cartoon from Anders Borgland in Appendix
  - No other information on time structure
- Observation by Tune's group, Eduardo's group
  - As number of towers is increased, in flight config
    - Discarded event count increases
    - Time of last-discarded-count "gets later"
      - The worry: will time move after deadtime, into live time?
      - CAL, ELX groups' expectation: nope

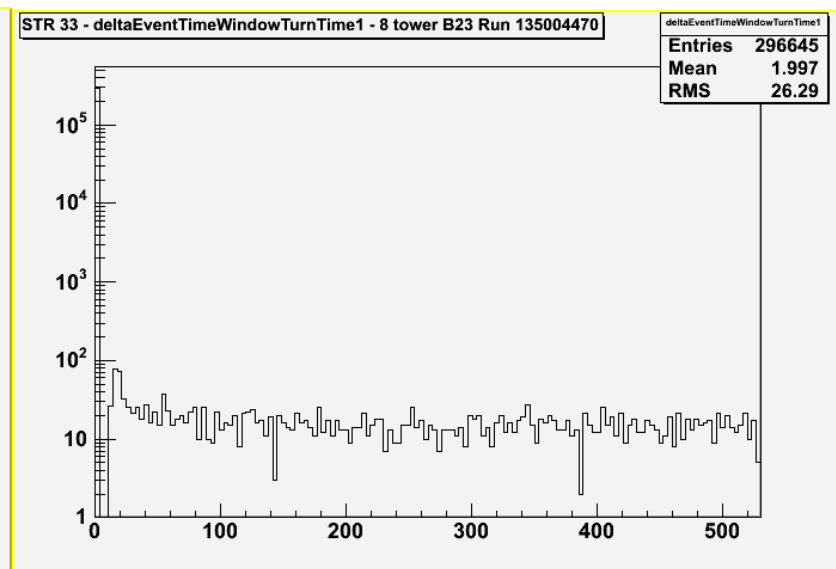
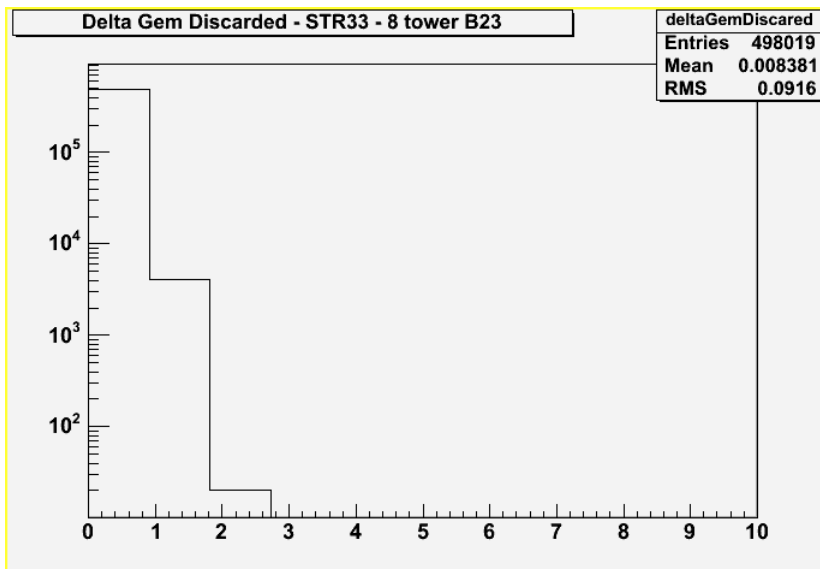


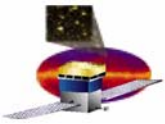


# What it should look like for muons

## TKR-triggered muons

- 8 towers, CAL trig disabled
- Discarded count
  - Most probable number = 0
- Time of last discarded
  - Random, as expected
  - Consistent with rate (?)
    - Actually not yet verified





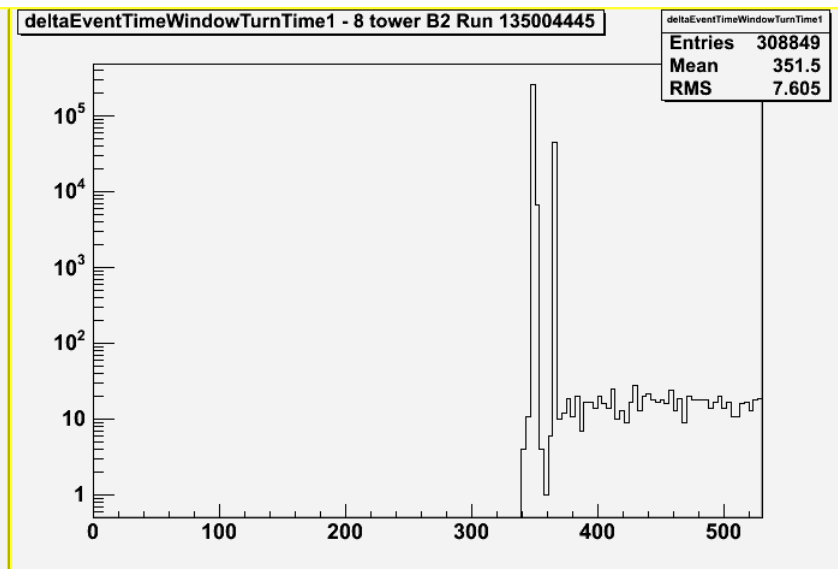
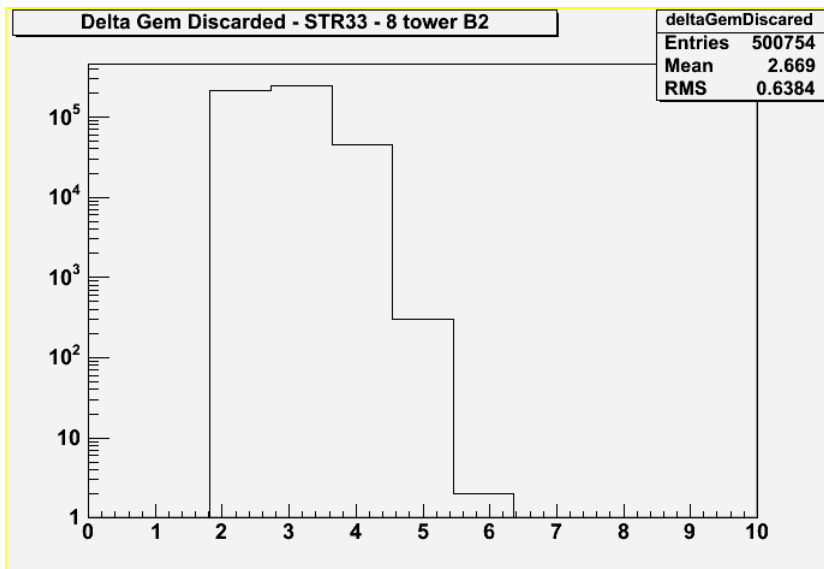
# With CAL-LO, -HI enabled

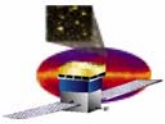
Trig = TKR || CAL-LO || CAL-HI

- 8 towers, flight thresholds

- Discarded count
  - Always 2 or more

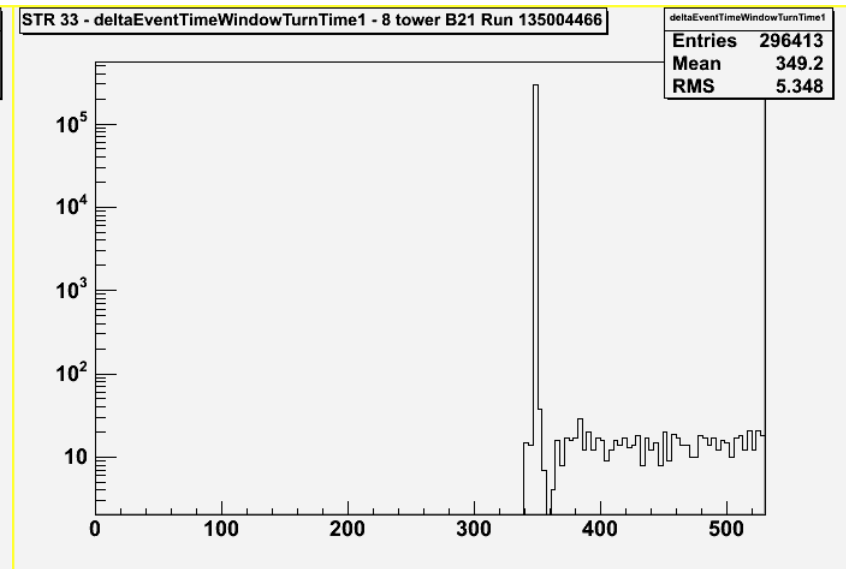
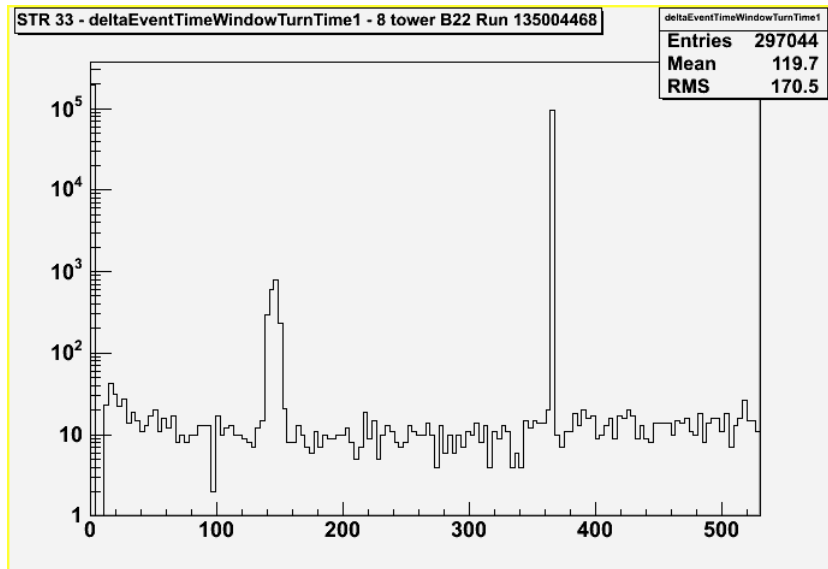
- Time of last discarded
  - Two preferred times
    - CAL-HI = ~345 ticks
    - CAL-LO = ~365 ticks

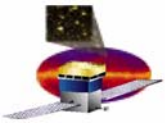




# Detail of CAL-LO, -HI effects

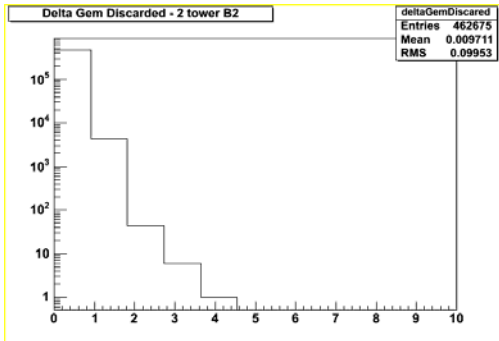
- Trig = TKR || CAL-LO
  - CAL-LO doesn't always fire
  - ~145 ticks and ~365 ticks
- Trig = TKR || CAL-HI
  - Always excess counts
  - ~345 ticks





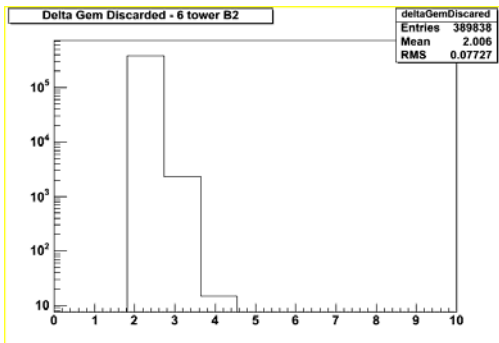
# From 1 tower to 8 towers

- Evidence for increasing probability of discard?
  - Number of discards increases
  - Rate of discards increases



2 towers

- 4 towers (no plot)

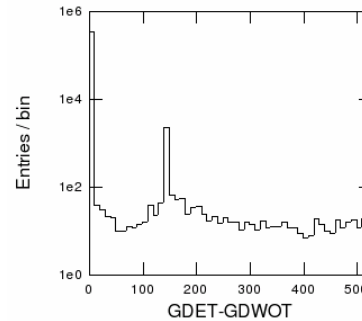


6 towers

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- Evidence for increase in time of last discard?
  - None. It's just more likely that the last discard occurs at ~365 ticks.

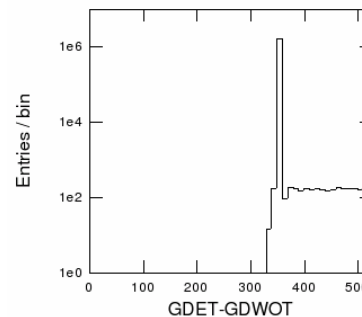
2 tower 1/1 and b/2



2 towers

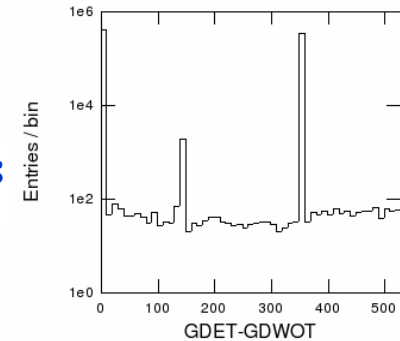
- 4 towers

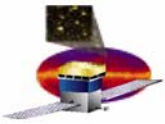
6 tower b/2



6 towers

4 tower 1/1 and b/2



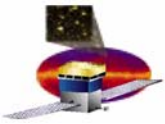


# From Module-level tests

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- ❑ Plausible argument that we've seen this before
  - **LRS counters (count FLE, FHE at TEM)**
    - Excess counts in chg injection, timed readout
      - Also seen by ELX, trigger groups at SLAC
        - » Huffer with testbed, Kocian with EM CAL
    - No knowledge of time structure
      - No GEM at NRL
  
- ❑ Plausible understanding of time structure
  - **~140 ticks**
    - Time of start of ADC conversion
  - **~350 ticks**
    - Clocking data out of ADC
  - **Discarded events appear at times of particular signals on AFEE**
  - **No evidence (yet) for empty events during live time**
  
- ❑ Plausible understanding of rate
  - **Some GCFEs are more sensitive than others**
    - Recall retriggering at low thresholds
    - FM105, 117 together have 4 "noisy" FLEs
      - Retrigger with FLE below muon peak (12 MeV)





# What's next

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- STR34: Single-Module test of discarded events
  - Look for discards in single Modules not yet inserted
    - Try FM117, because it's got 3 noisy FLEs
    - Try one other Module, chosen at random
    - Test plan
      - Use GEM periodic trigger to force readout
      - Set FLE, FHE to flight values and enable CAL-LO, -HI
      - Vary the enabling, thresholds, and timing
        - » Disable CAL-LO; disable CAL-HI; disable both
        - » Thresholds = flight; half-flight; double-flight
        - » GCRC delays = nominal; lengthened; maximum

