CAL retriggering study.

Alexandre Chekhtman
NRL/GMU
What is retriggering?

• When FLE/FHE trigger is enabled, sometimes shortly after normal muon events we get another event, caused by previous one

• Probability of retriggering depends on
  - FLE thresholds
  - Readout mode (shorter event - higher probability):
    • 4 range readout zero suppression OFF
      - Cannot work with FLE thresholds less than 8 MeV
    • 1 range readout zero suppression ON - most affected
      - For some modules (FM117) even at FLE = 15 MeV the trigger rate is too high (much more than normal muon rate) - we had to disable trigger from some channels
    • 1 range readout zero suppression OFF - intermediate case
**Why we study retriggering?**

- Some people say: in flight we plan to set FLE threshold at 100 MeV, so we don’t care about retriggering.
- Our main worry is the possible retriggering of FHE discriminators, because flight value of 1 GeV is not very high.
  - We saw retriggering during GSI tests when collecting data with FHE trigger enabled and FHE threshold = 1 GeV.
  - We don’t really understand the reasons for retriggering and the factors defining its probability.
Conditions of this study

- CAL module FM115
- Long muon run 050429204208 (few million triggers) collected at NRL
  - 1 range readout
  - zero suppression OFF
  - FLE thresholds ~ 10 MeV (more exactly, 10 fleDac steps above the FLE pedestal)
  - We do not have the GASU and real time stamp, so we use the TIMEBASE - 16 MHz clock added to the event in VME processor when event readout finished.
Time from previous event

retriggered events
dt < 0.22 ms
Retriggered events rate: time pattern

FM115, 1 range readout, zero supp OFF, run 050429204208

muons (time from previous event dt > 0.22 ms)

retriggered events (time from previous event dt < 0.22 ms)
Retrigger probability vs event number

FM115, 1 range readout, zero supp OFF, run 050429204208
Retrigger probability vs event number: first two periods

FM115, 1 range readout, zero supp OFF, run 050429204208

fraction of retriggered events per bin (1024 events)

0.00 0.05 0.10 0.15 0.20 0.25

0.0 0.5 1.0 1.5 2.0

event number/131072
Some thoughts

- There is strong correlation between event number and retrigger probability.
- It looks like retrigger probability increases with the number of bits in the event number, set to 1. The highest probability happens for event number $2^{17}-1$.
- The 17-bit event number is contained in the first word of the event, being transferred from TEM to VME.
- For 1 range readout event the TEM has enough space for more than 1 event
  - Trigger is enabled at the same time when TEM=> VME transfer starts.
- May be a crosstalk from TEM => VME data transfer back to front-end electronics causes retriggering?
Conclusion

- The retrigger probability strongly correlated with event number, showing the pattern with period $2^{17}$
- It could be caused by a crosstalk from TEM$\rightarrow$VME data transfer
- To understand this strange and unexpected effect we need help from trigger/TEM experts
- It would be extremely useful to collect the same data run at SLAC with GASU having information about the exact trigger time
- We need big event numbers ($>2^{17}$) - 1-2 hours run is required
- We plan to analyze the retrigger data collected at NRL for other modules