

TOF Rate-effect

Durga Rajaram

CM 36

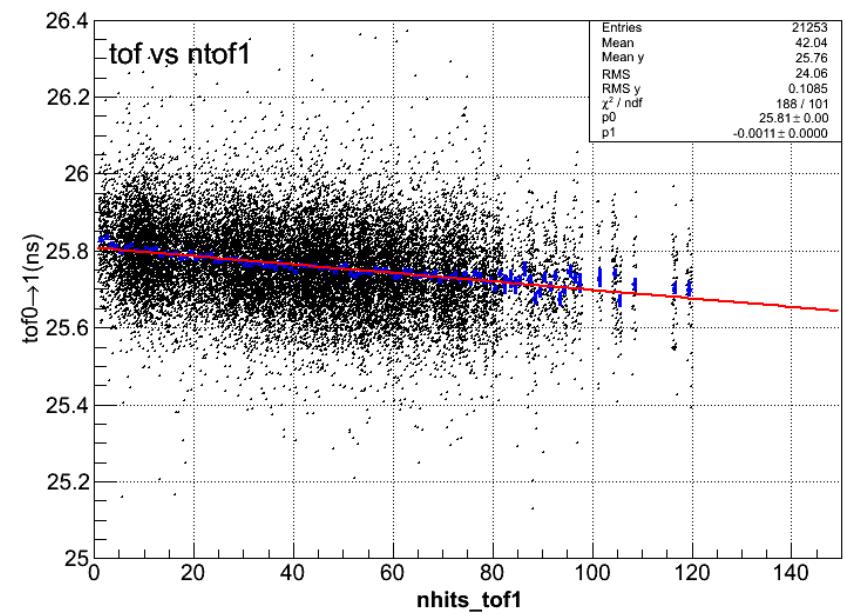
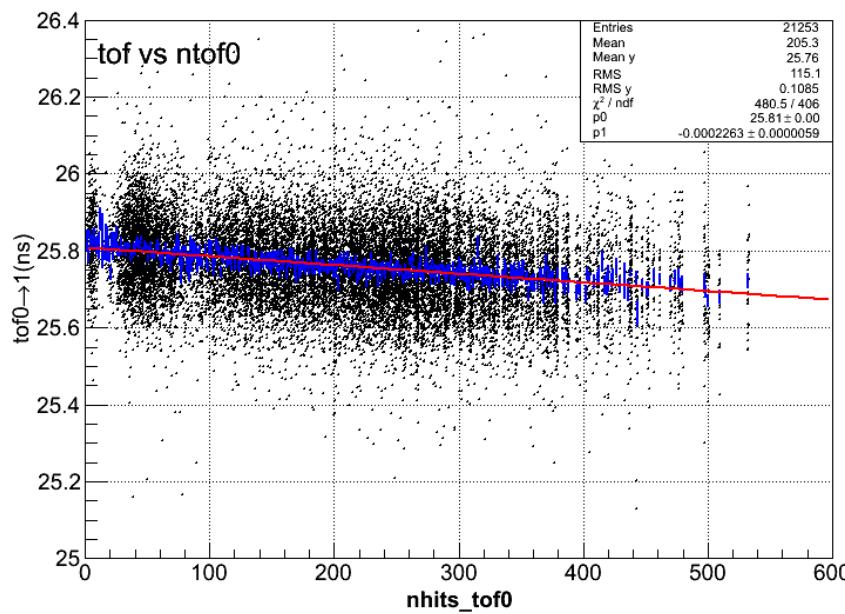
June 17, 2013

Overview

- Summary of rate-effect analyses done so far
- Intention is to have the analyses and the hardware tests described and summarized
- Maurizio is not able to attend..so, only analysis summary today
- Rate-effect studies
 - Dependence on hit position
 - Dependence on time within spill
 - Comparison of positives and negatives
 - Comparison of low and high rate data
 - Study with raw uncalibrated times

The Rate-effect

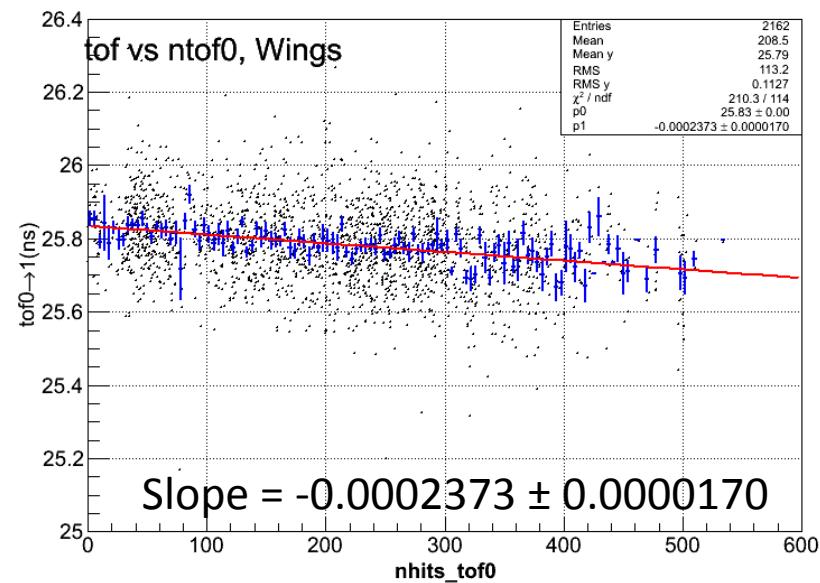
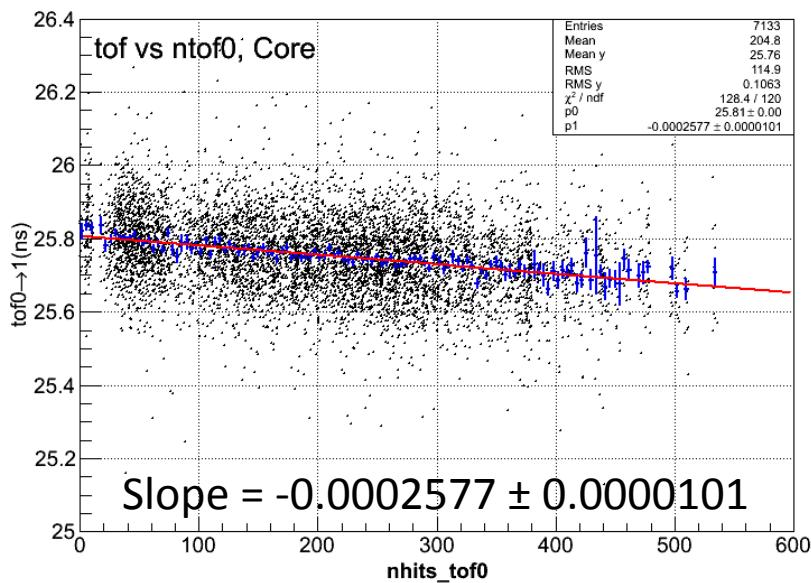
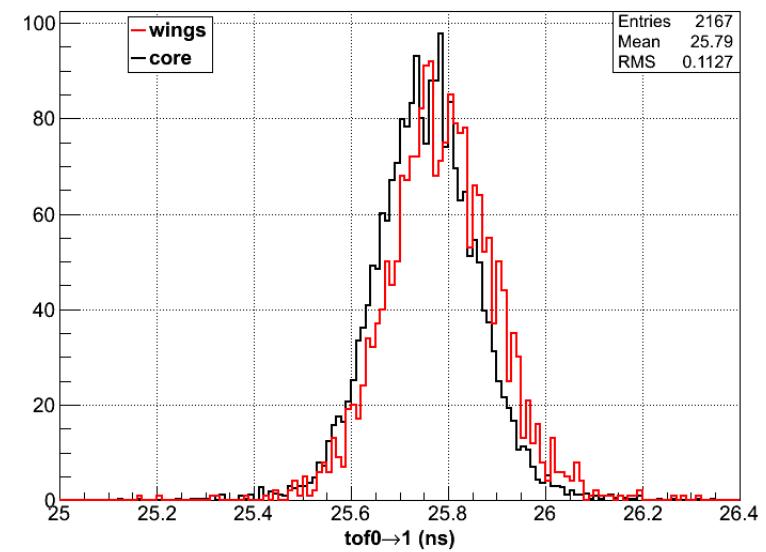
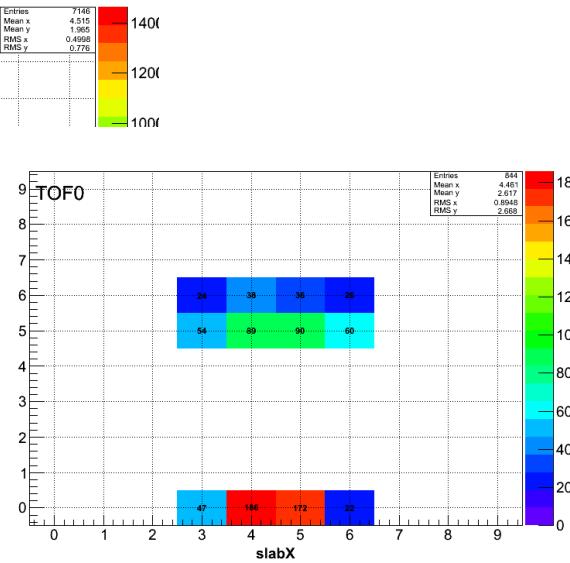
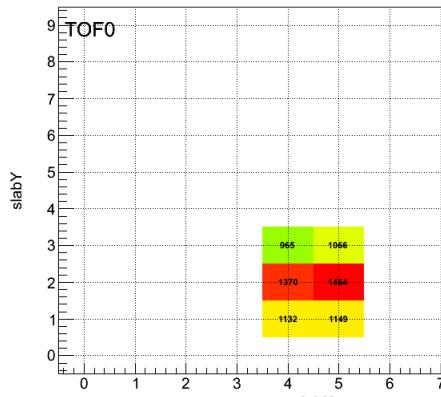
- Mark Rayner had observed that the e+ and e- times of flight were different
- Yordan showed that this difference was due to a rate-dependence



Study I

- Goal: to study the dependence of the rate-effect on hit position in the detector
- Prompted by Maurizio's suggestion that the effect may be due to spurious beam backgrounds
- Isolated the “core” and “wings” of the detector and looked at dependence in both regions
- *Data-set: e^+ from variable-rate run*

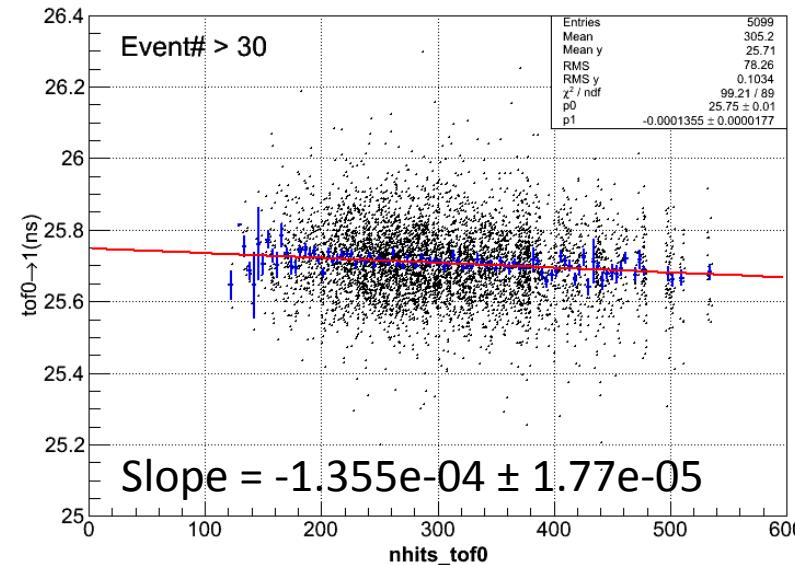
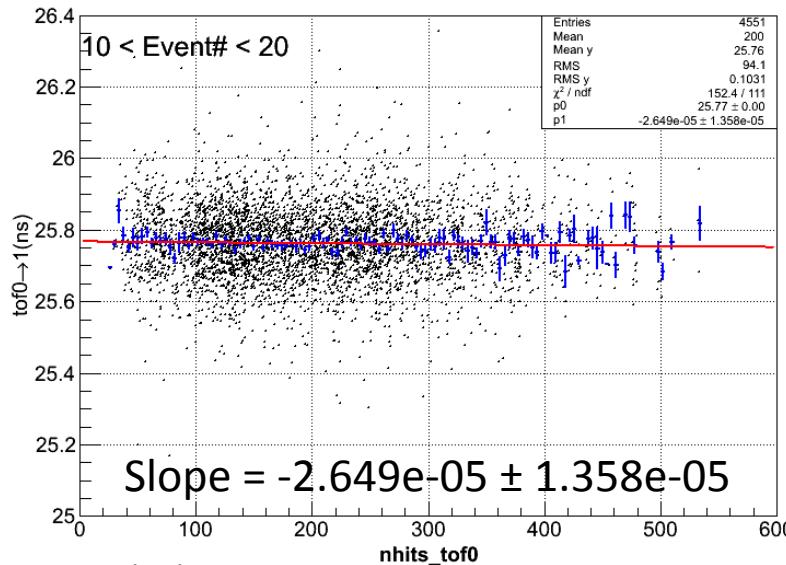
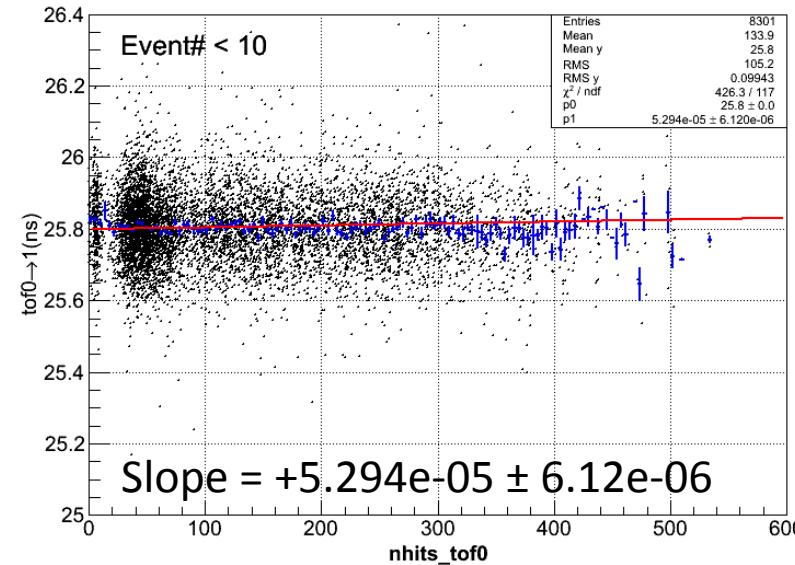
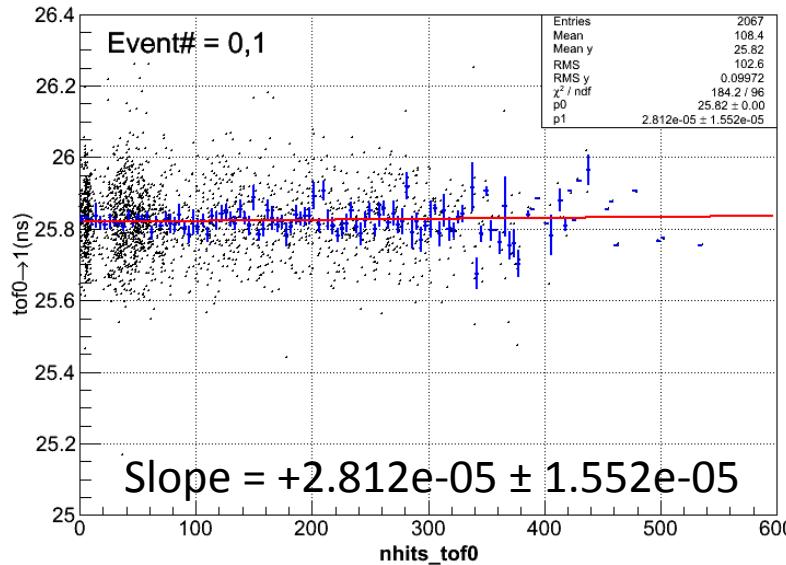
- Both the “core” and “wings” show the effect



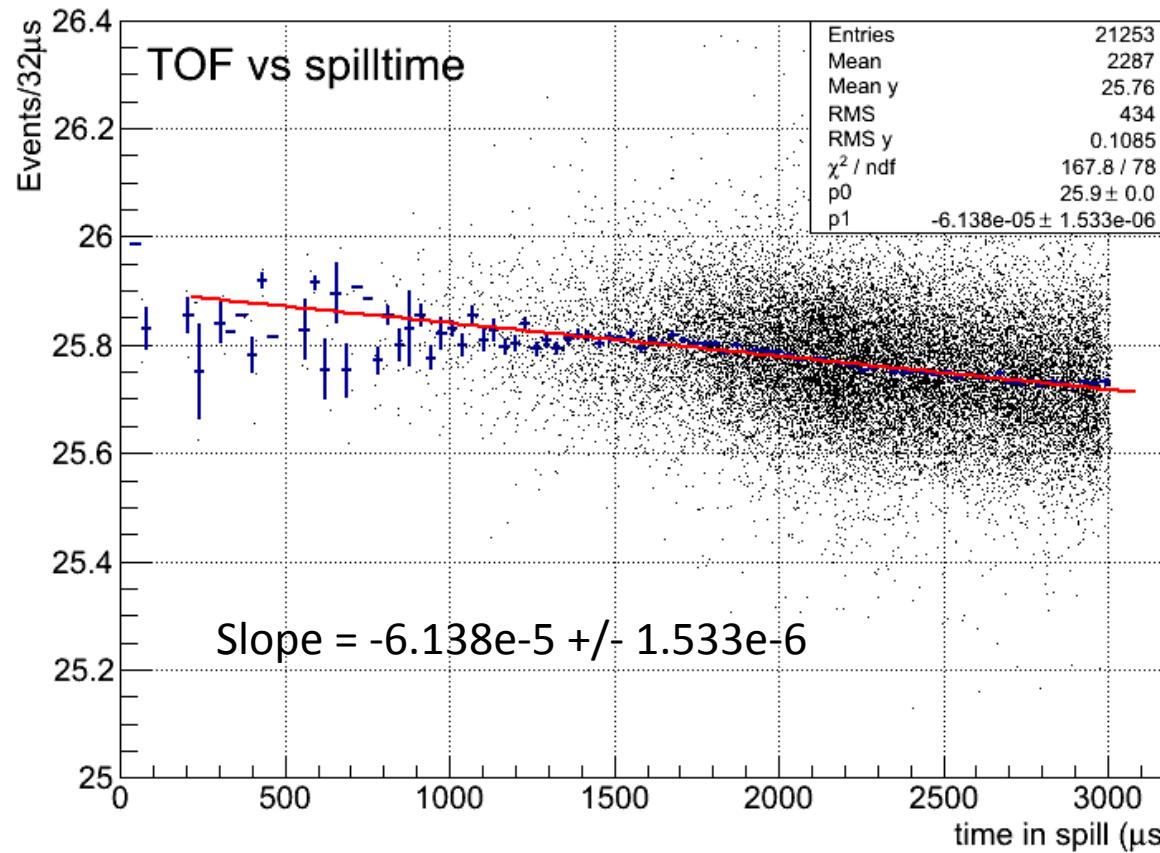
Study II

- Goal: to study dependence on the event's occurrence within a pill
- Studied this in two ways
 - a) By looking at the dependence on event-number
 - b) By looking at the dependence on the event's time with a spill
- *Data-set: e^+ from variable-rate run*

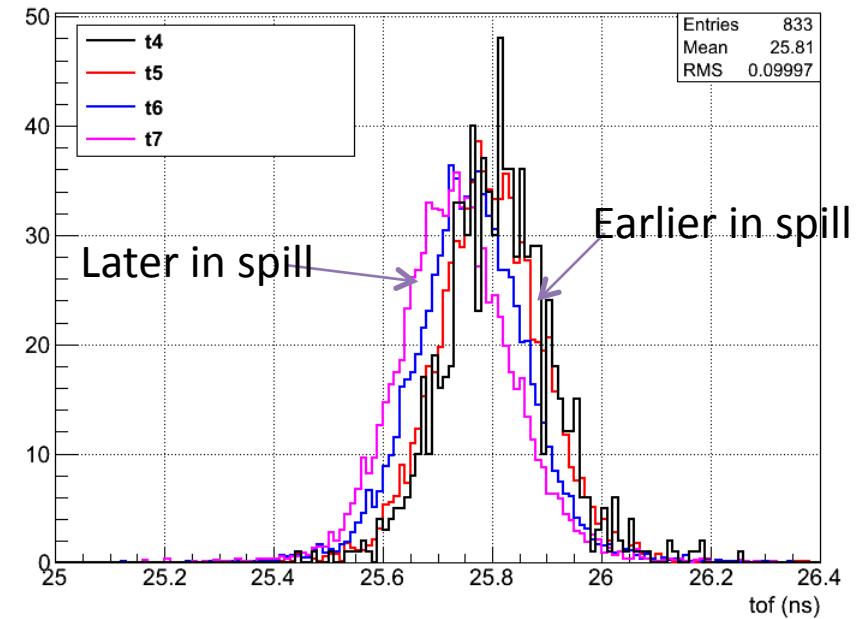
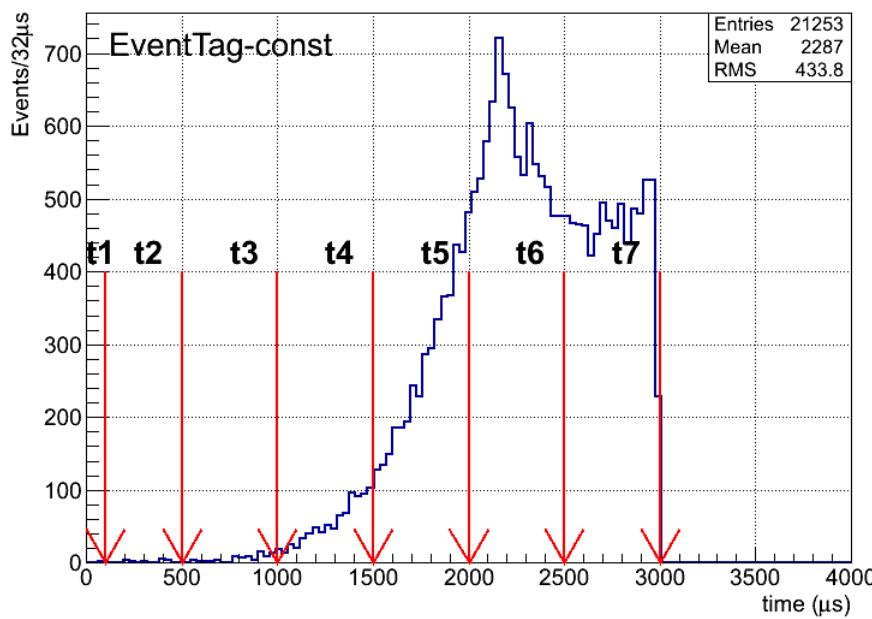
- **II.a** -- looking at slices of events, the effect becomes more pronounced as the spill progresses



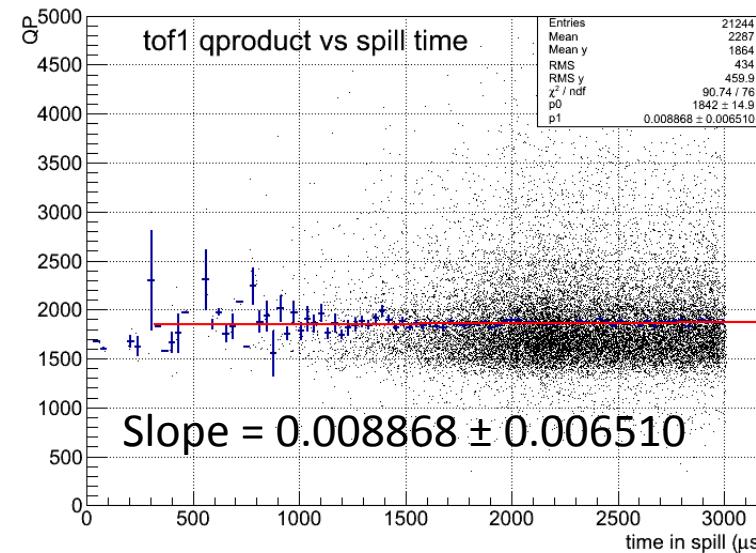
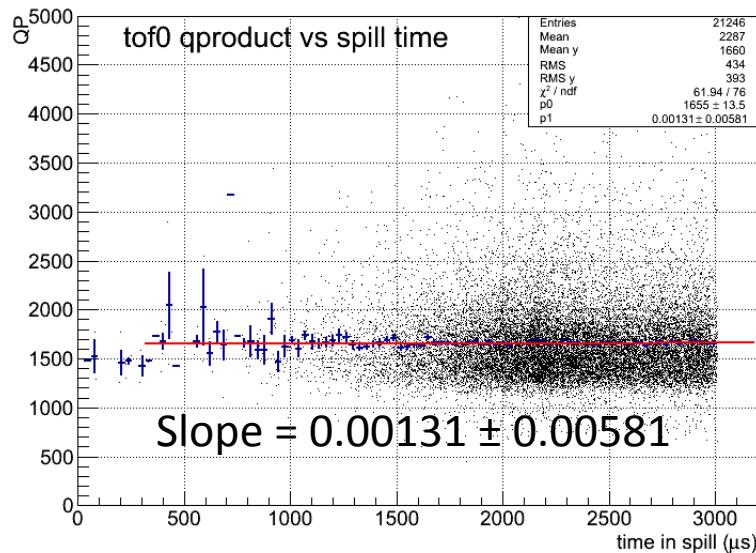
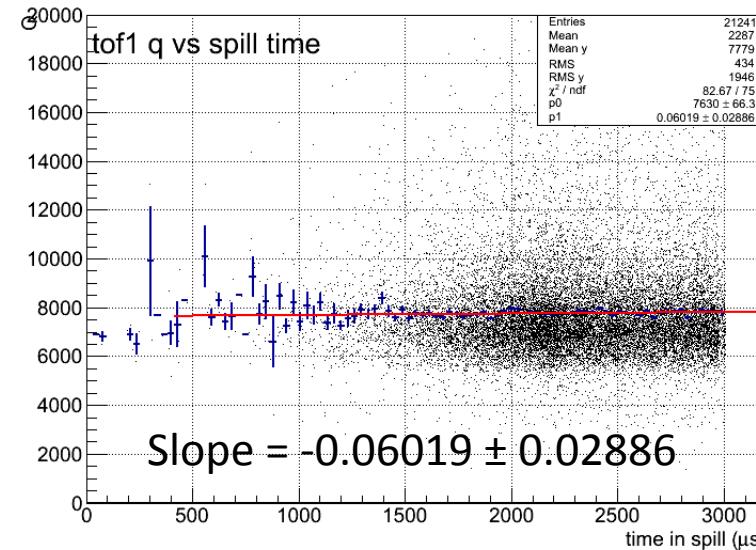
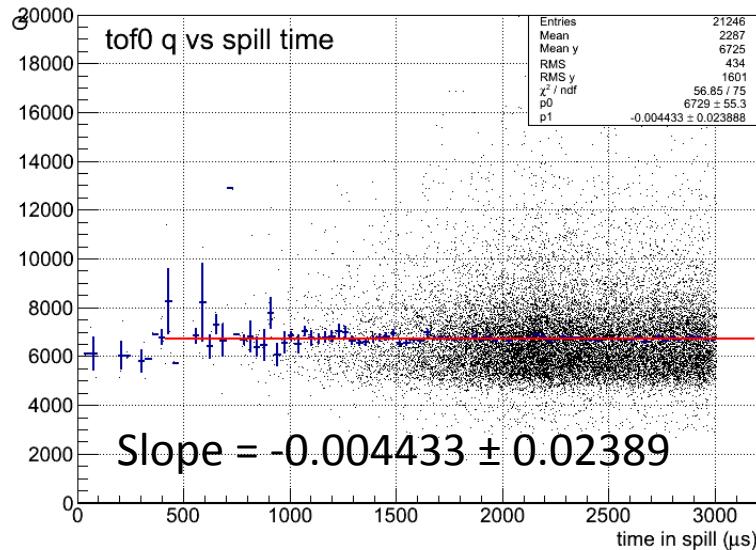
- **II.b** -- variation with trigger time within spill
- similar to the dependence on #hits
 - Cf. slope for #hits-dependence = $-2.263\text{e-}4 \pm 1\text{e-}7$



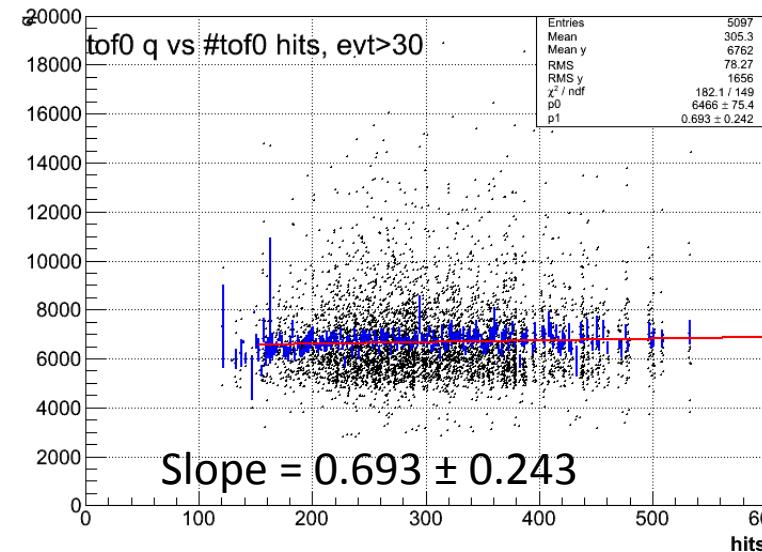
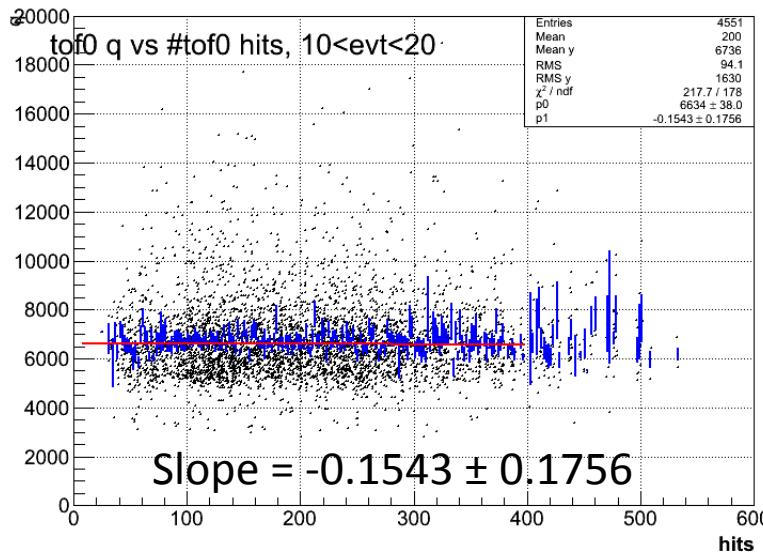
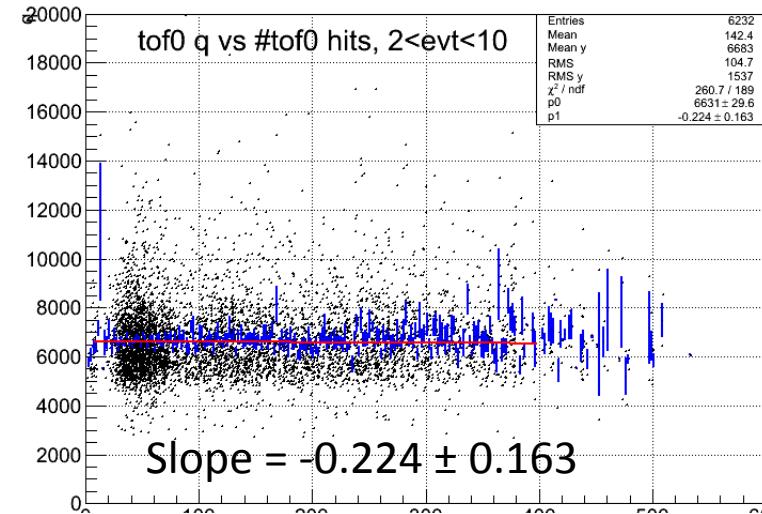
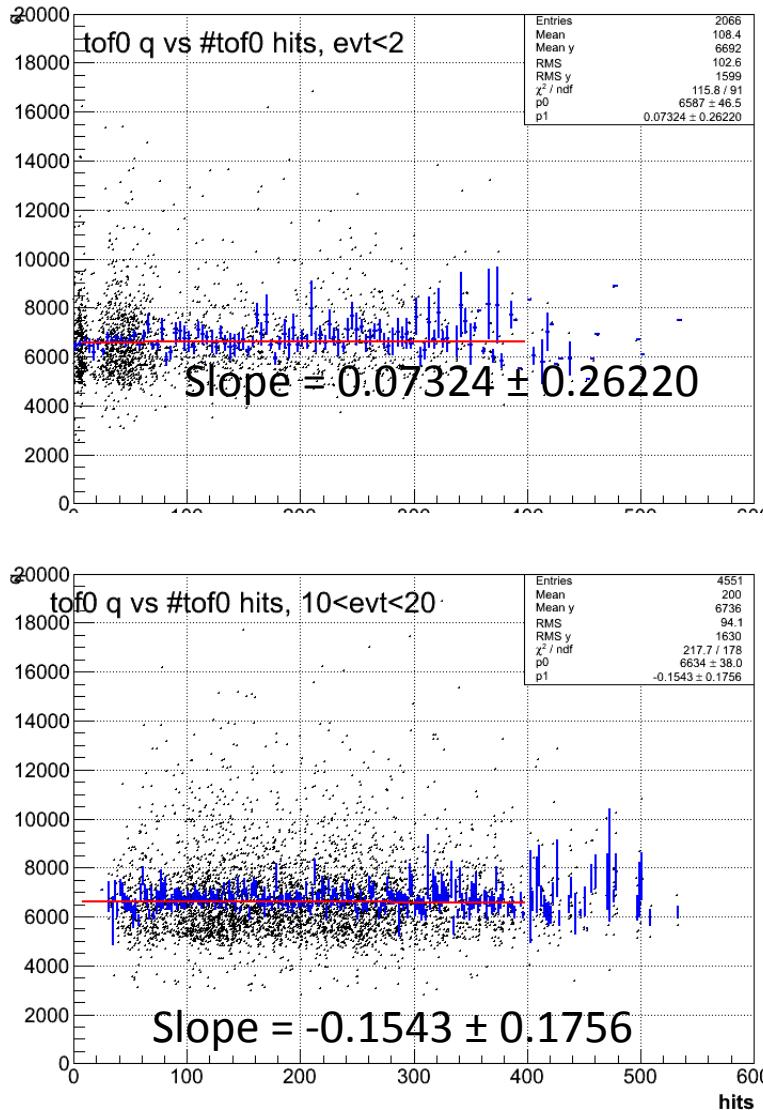
- Another way to look at variation within spill
- Selected different slices of event time within the spill & compared the times of flight from each slice



- Charge & charge product practically flat across the spill

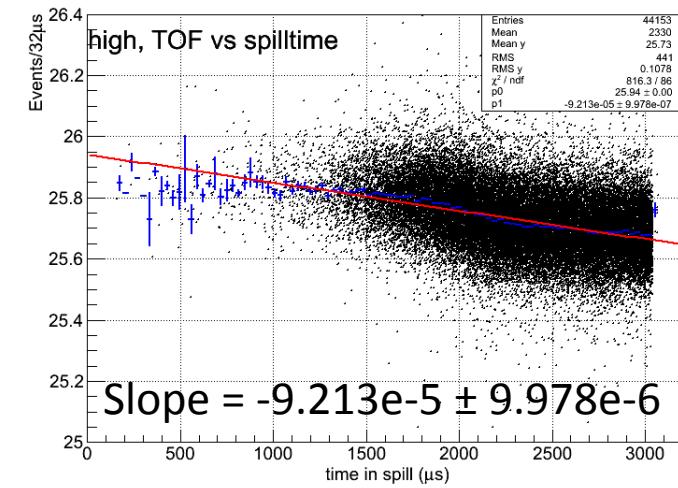
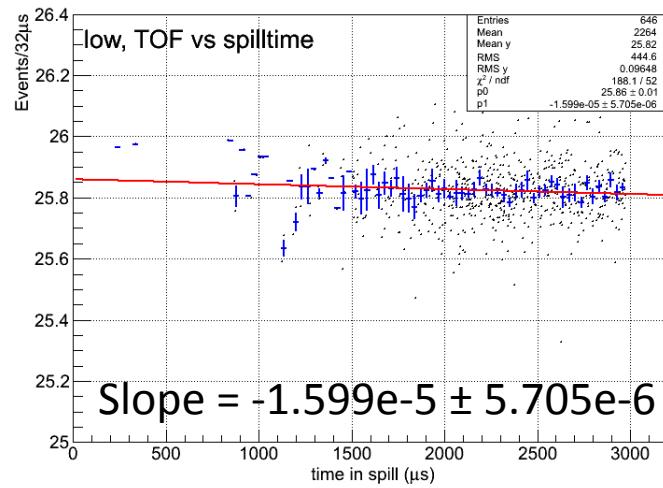
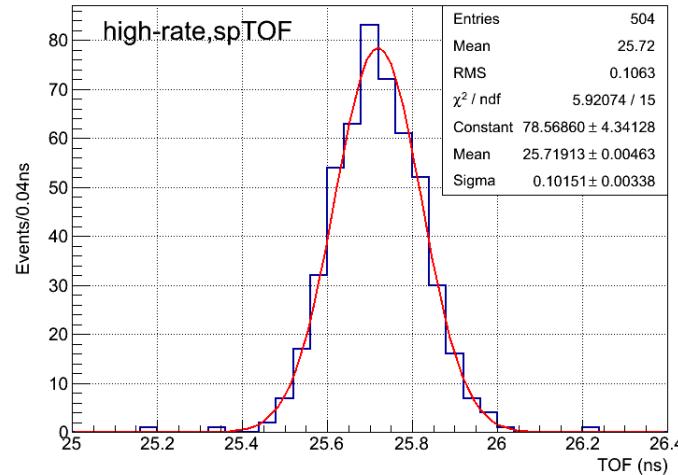
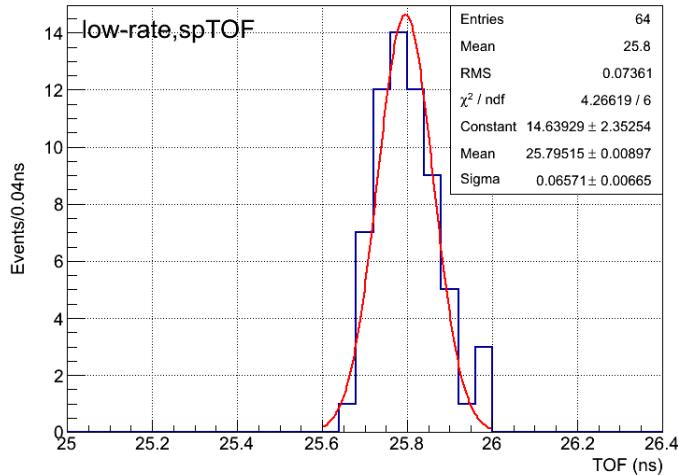


- The charge and charge product are flat across event slices as well
 - Is the slope for evt>30 (near end of spill) significant?



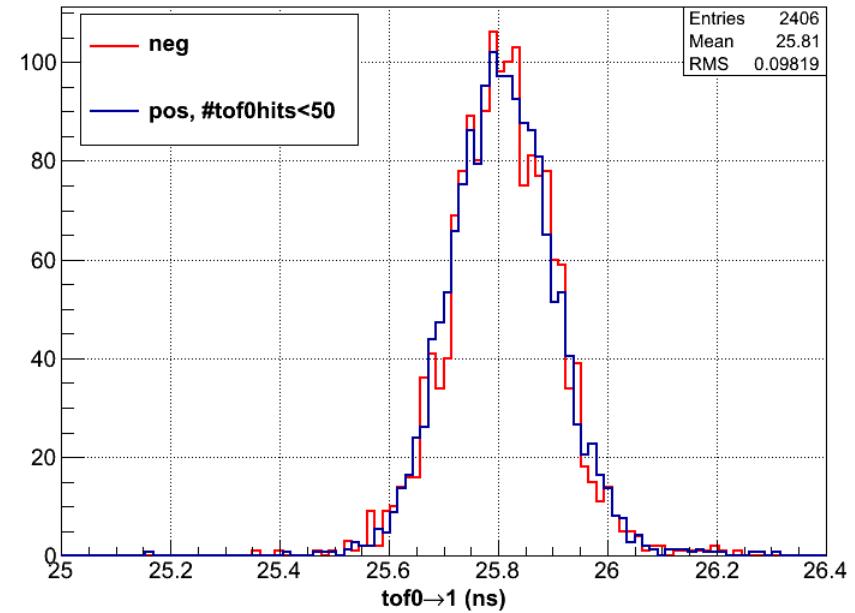
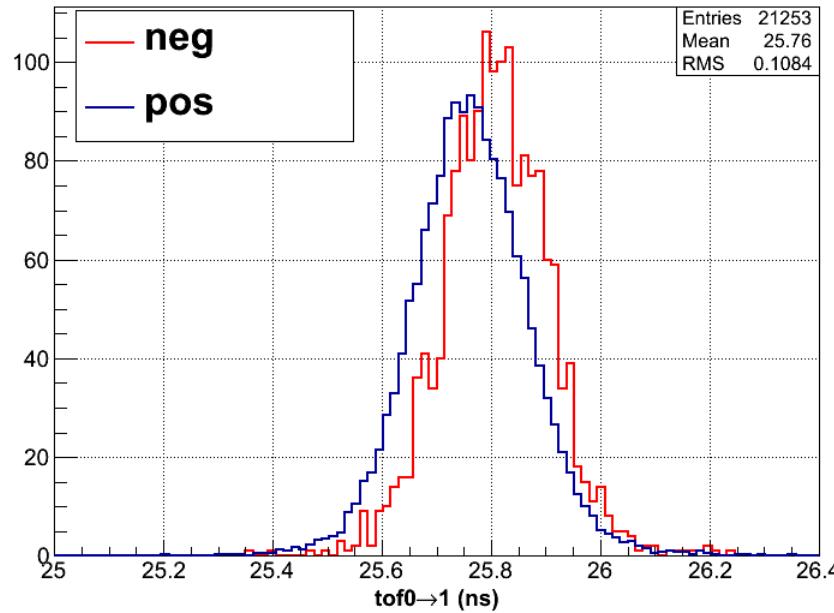
Study III

- Goal: to study the effect in low- and high- rate runs separately
- Calibrated time of flight, pixel-to-pixel for low and high rate runs: **shift ≈ 75 ps**



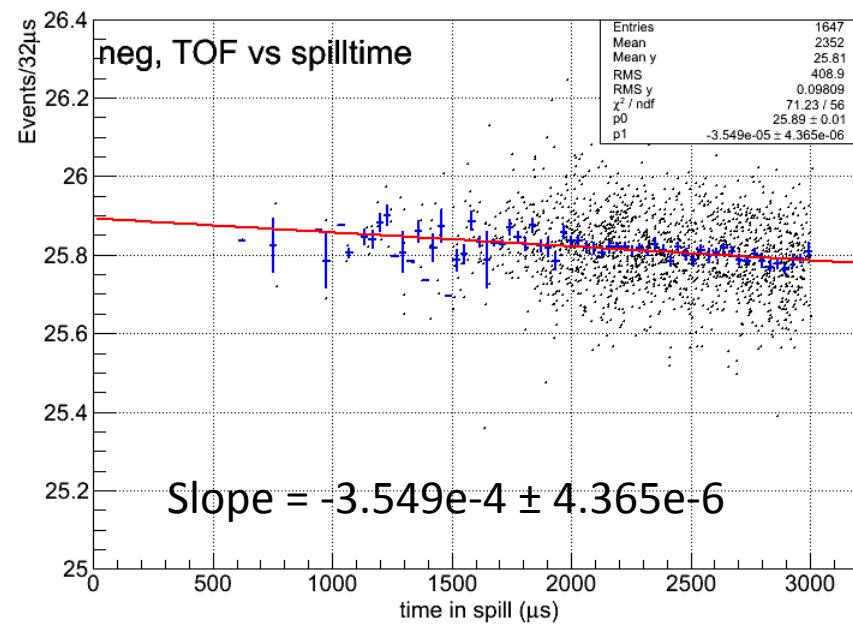
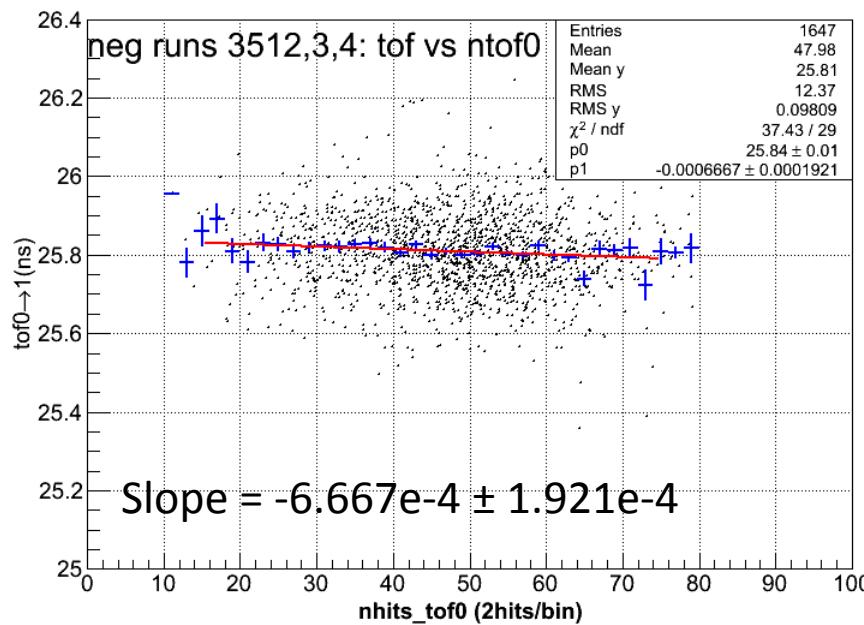
Study IV

- Goal: to study the effect in e^- data and compare with e^+
- *Left:* Obvious shift: e^+ have lower tof than e^-
- *Right:* No difference when only lower hit rate e^+ data is selected

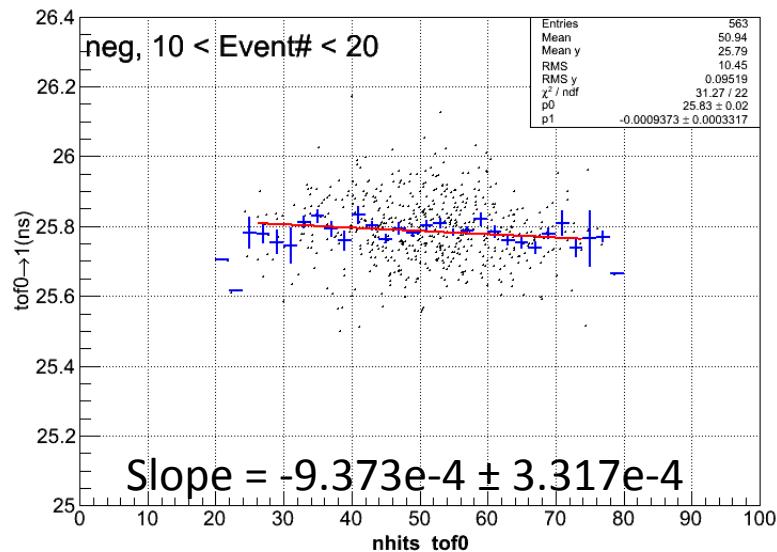
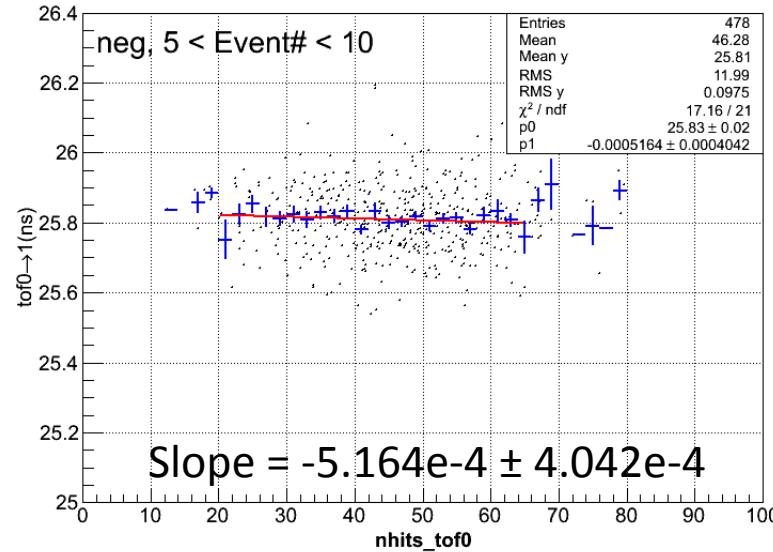
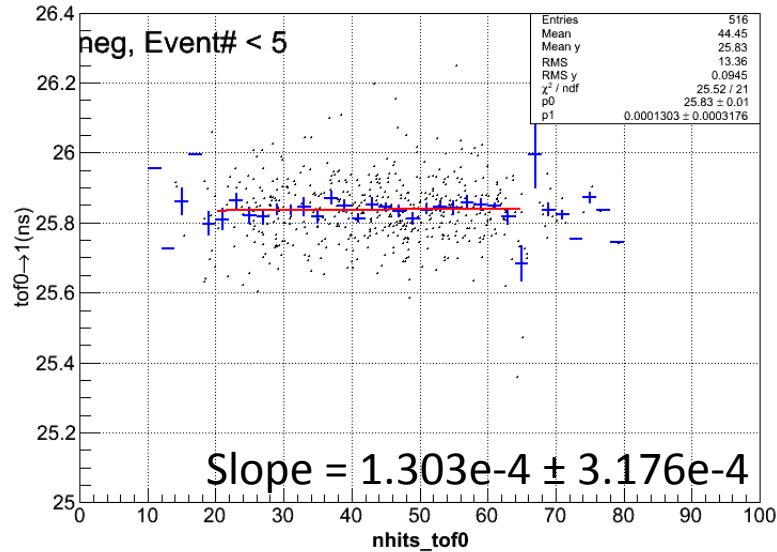


Positives vs. Negatives (contd.)

- TOF vs. #tof0 hits:
 - Pos data: $-2.263\text{e-}4 \pm 1\text{e-}7$
 - Neg data: $-6.667\text{e-}4 \pm 1.921\text{e-}4$
- TOF vs. time within spill:
 - Pos data: $-6.138\text{e-}5 \pm 1.533\text{e-}6$
 - Neg data: $-3.549\text{e-}4 \pm 4.365\text{e-}6$



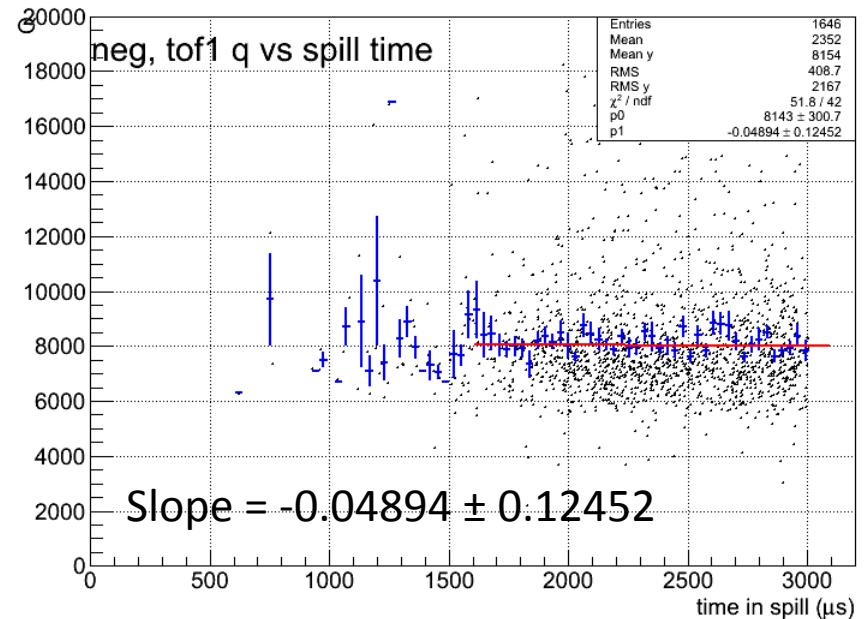
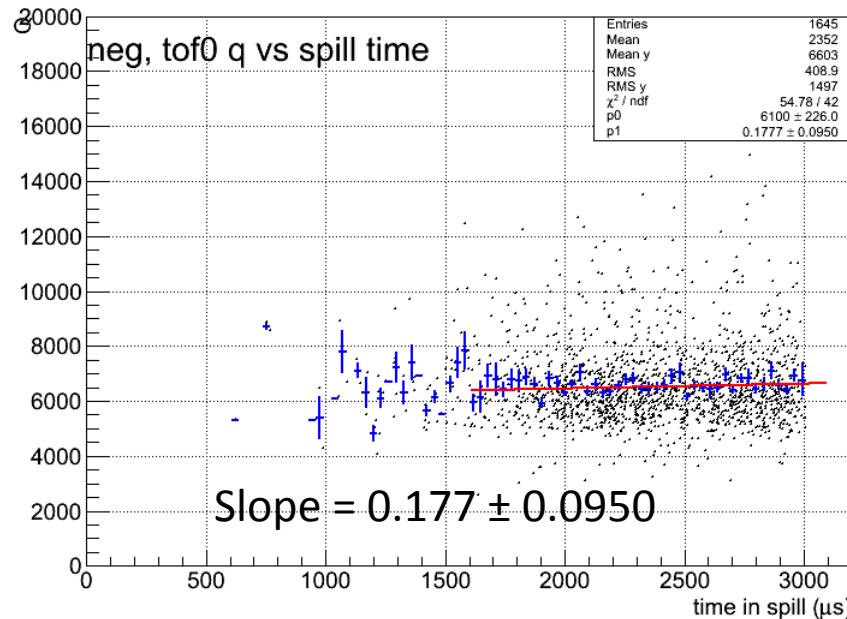
Positives vs. Negatives (event slices)



- Very poor statistics beyond event ~20.
- Difference between evt<5 & evt>10 similar to the trend seen with the positives

Positives vs. Negatives (charge)

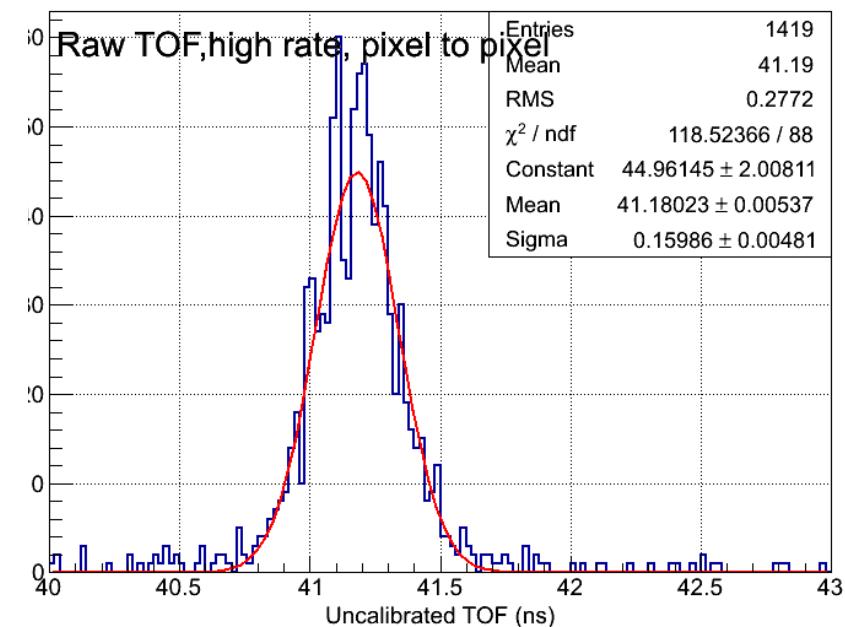
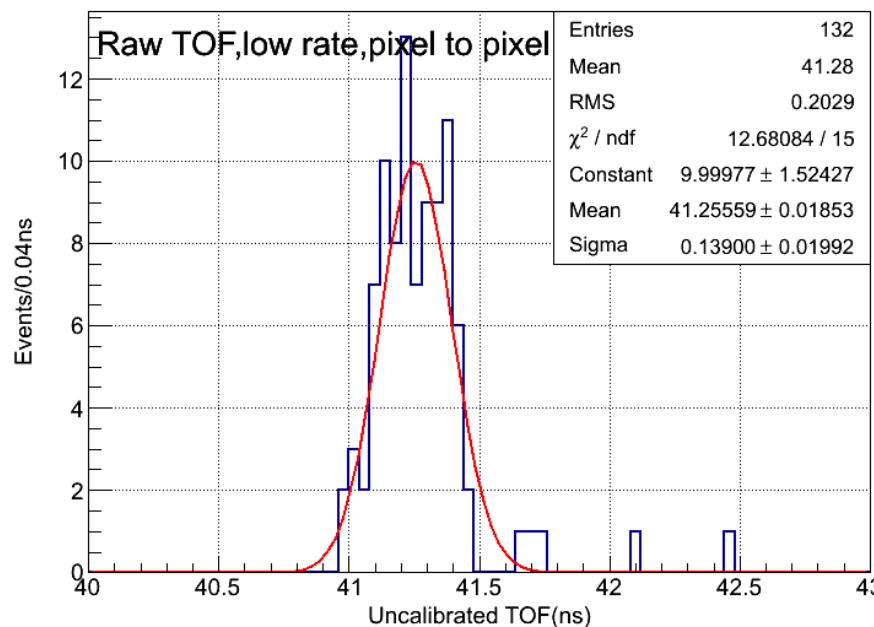
- The charge distributions again look flattish across the spill, similar to what's seen in the + data



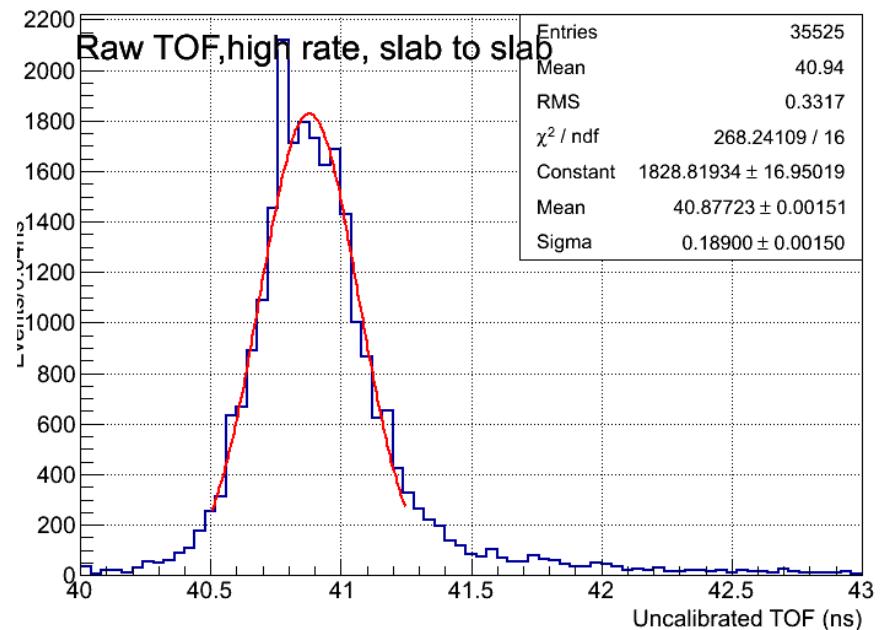
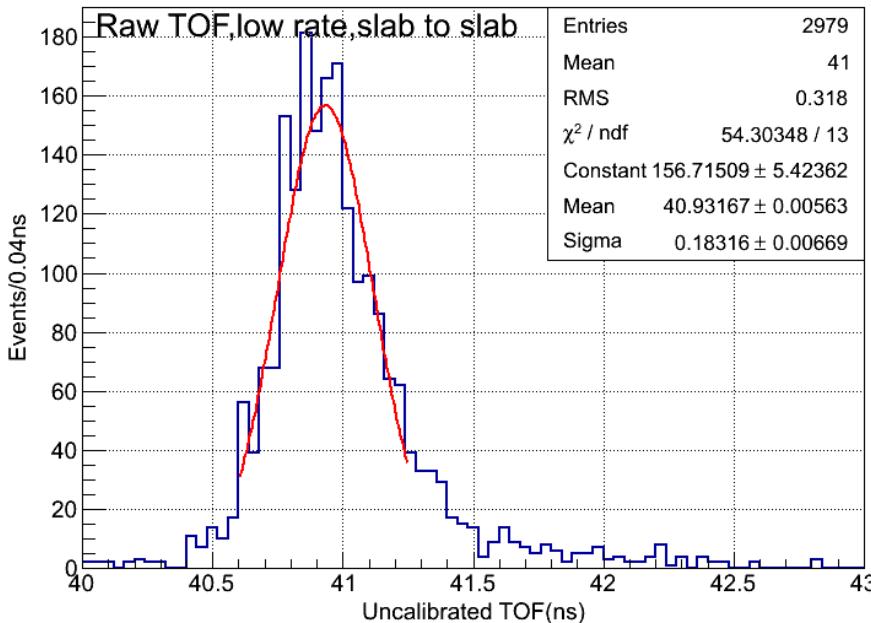
Study V

- Goal: to understand whether the shaper influences the effect
- To disentangle possible effects from the shaper, looked at uncalibrated times from the slab hits.
- No time-walk corrections, so no dependence on the ADC
- Also eliminates any possible effects the calibration may introduce
- To make things easier to understand, look only at times between a single pixel (or slab) in TOF0 and a pixel (or slab) in TOF1

- Uncalibrated time pixel-to-pixel
 - Between a pixel ($x=5,y=2$) in TOF0 and a pixel ($x=3,y=4$) in TOF1
 - A shift of ≈ 75 ps between low-rate (left) and high-rate (right) data

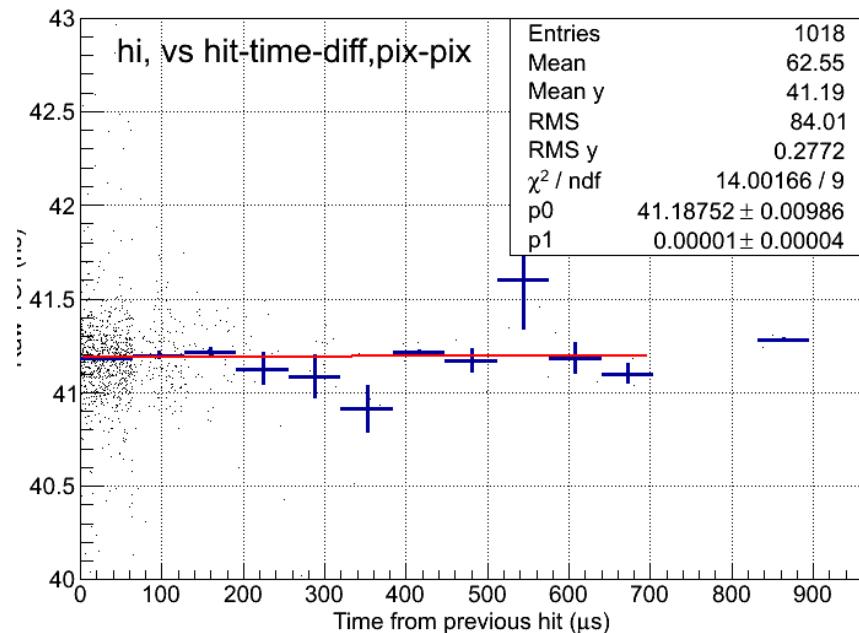
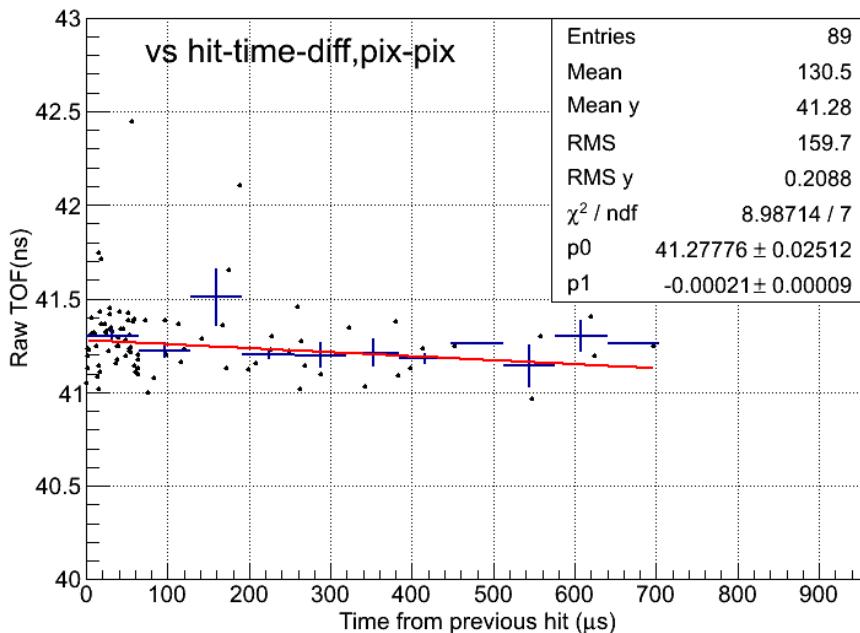


- Uncalibrated time slab-to-slab
 - between a slab ($x=5$) in TOF0 and a slab ($x=3$) in TOF1
 - A shift of ≈ 55 ps between low- & high-rate data
- That the uncalibrated raw time shows a difference between low and high rate data seems to indicate the problem is at the PMT-level – rather than with the shaper (?)
- It is possible there are other/further effects introduced by the shaper



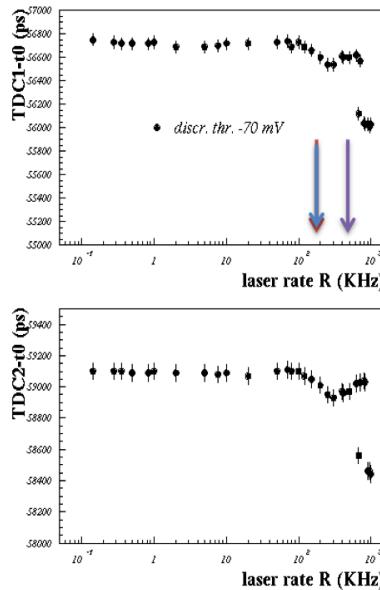
Study VI

- Goal: to study the dependence on time-separation between hits
- Is there any dependence on the time difference between hits?
 - i.e. on time since the previous hit.
- For each slab hit, track the time since this slab was hit previously
- There seems to be a repeating structure?
 - Is it real? Spill structure? Something with the TDC?



Miscellaneous

- At CM35, Maurizio reported on hardware studies with his test setup.
- Hints of an effect at >150-500 KHz
- What is the rate at the TOF?
- For high-rate data: approx. 600 TOFO hits/3 ms => 200 KHz (maybe higher, since the spill is more concentrated near the end...)
- Can we measure the instantaneous rate at the TOFs?
- I think we need a hardware +software meeting with Maurizio to find a way to resolve this



- Some clear effects appear at very high rates > 500 KHz for single PMTs with a -70 mV thr on V895 discr. (results move of about 600 ps) with some hints at lower values (rates > 150 KHz)
- May be PMTs, TDCs, VME discr used (CAEN v895), problems in t0 (stability of photodiode) ...

M. Bonesini – CM 35

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Conclusions

- The time of flight shows a dependence on
 - The hit rate in the detectors
 - The event's time within the spill
- The effect is observed in both e^+ and e^- data
- The charge shows very little dependence on rate or time within spill
- The uncalibrated times (pre-shaper) behave similarly
- Plan a phone meeting with Maurizio -- if any of you would be interested in attending, or have any thoughts on this, let me know.