TOF Performance

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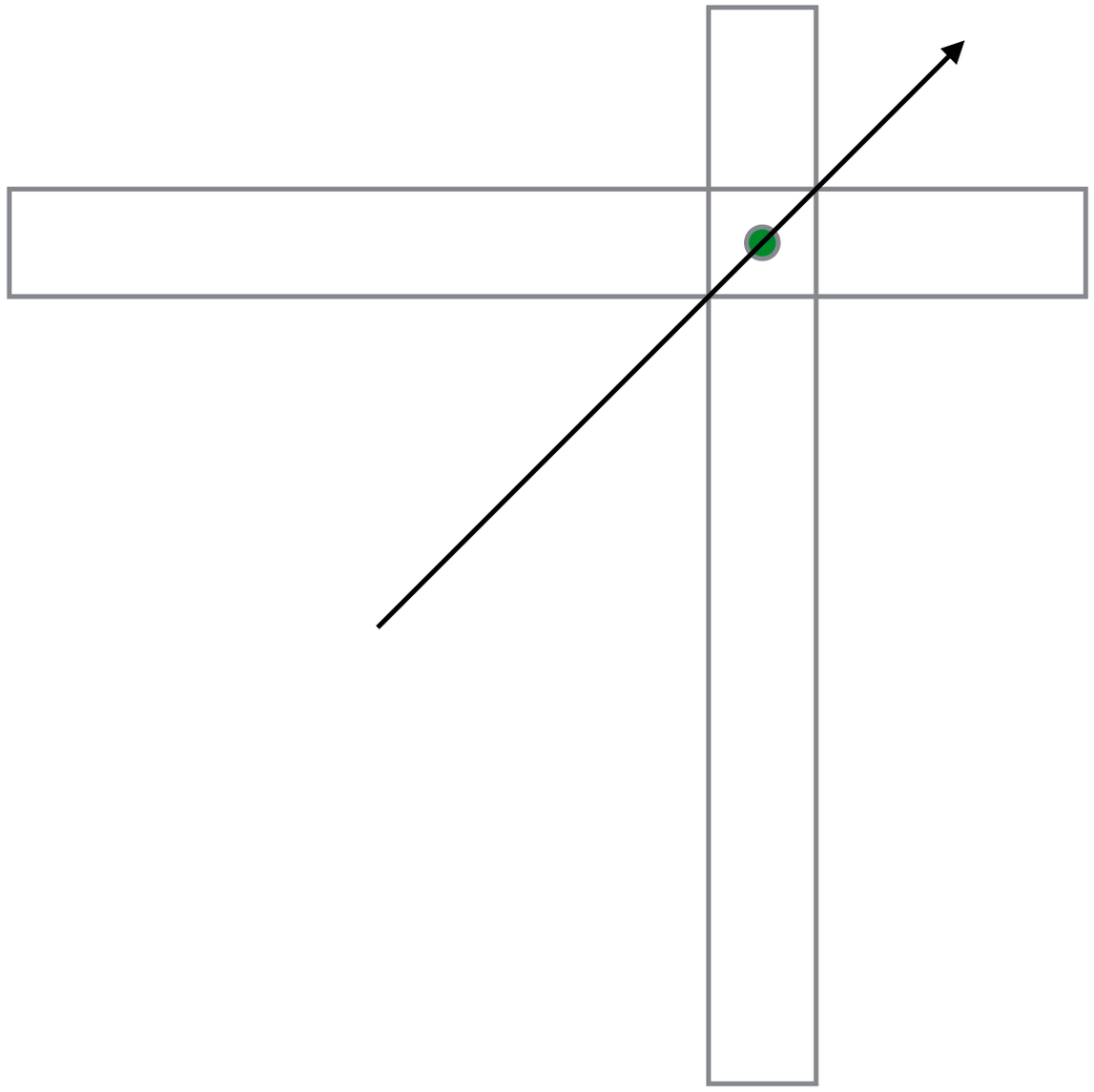
Introduction

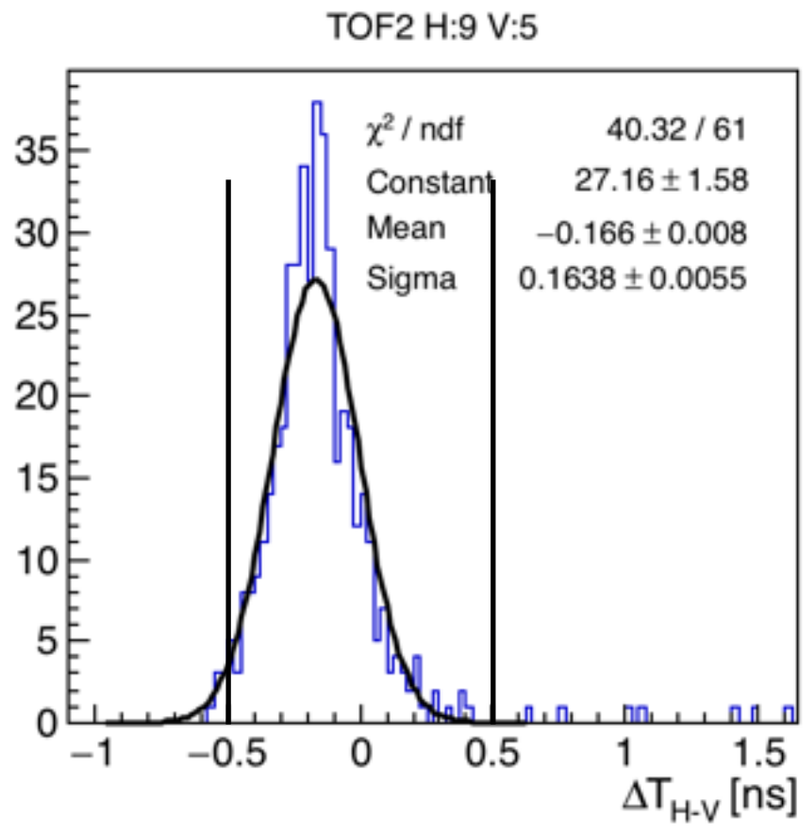
- Chris R. initiated closer look at some aspects of TOF efficiency
- Several issues have been identified
- The most striking will be presented
- We have not arrived to a final solution yet

Space point creation

- Particle passes through 2 slabs
- Creates hits in both
- The 2 slabs create a space point
- BUT:
  - multiple particles at different times?
  - matching done by requirement on slab DT



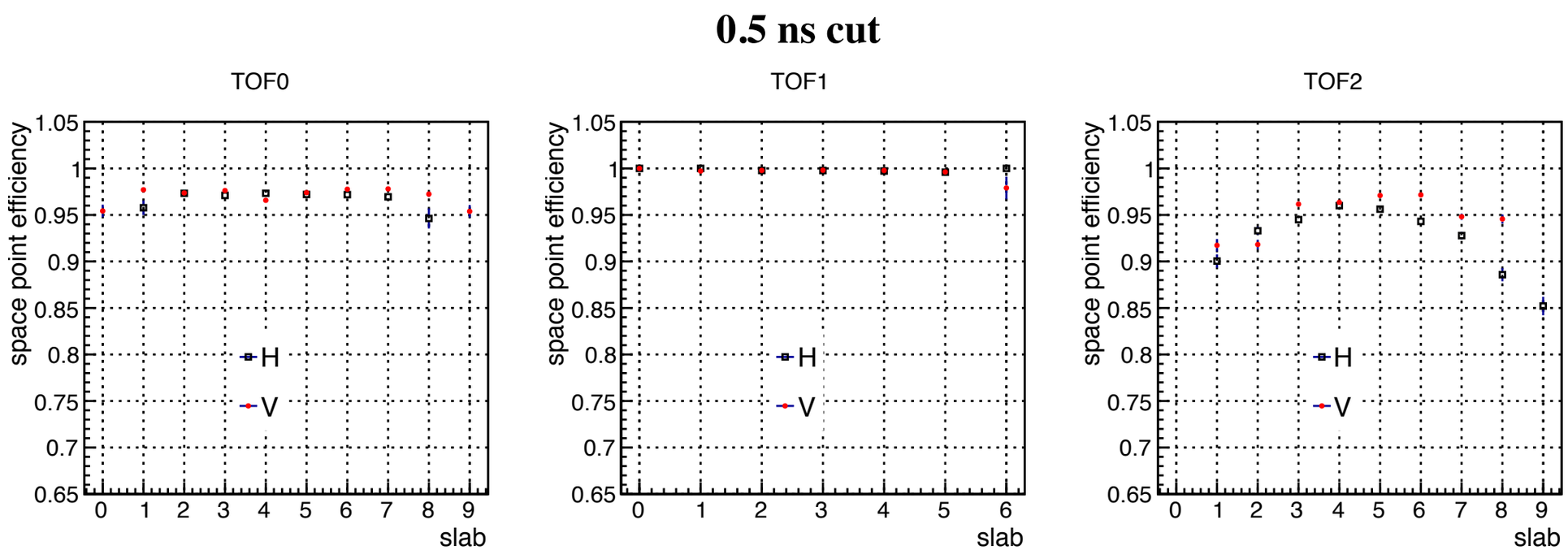
Space Point Creation
Slab DT Cut



- Pixel at Horizontal slab 9 and Vertical slab 5
- Space point is created if abs(DT) < 0.5 ns
- Setting 2 ns instead avoids cutting off substantial number of events in improperly calibrated slabs

Slab Efficiency vs Slab DT Cut

Run 09799

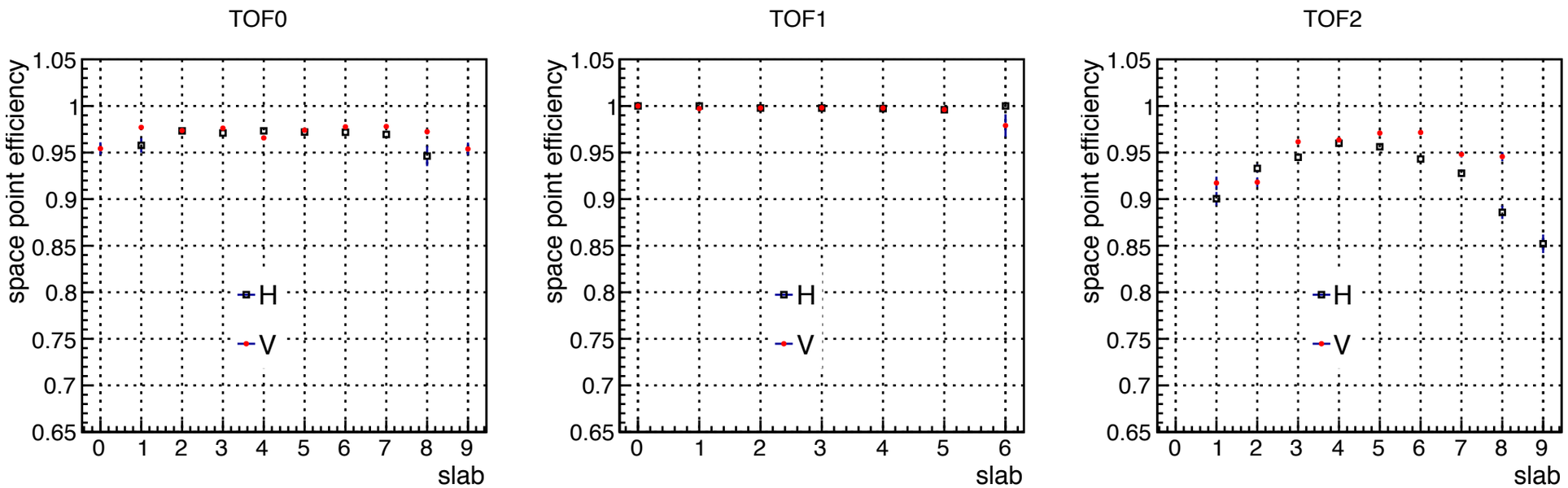


- Example of extremely bad calibrations in TOF2
- Efficiency of space-point creation heavily affected by the 0.5 ns cut

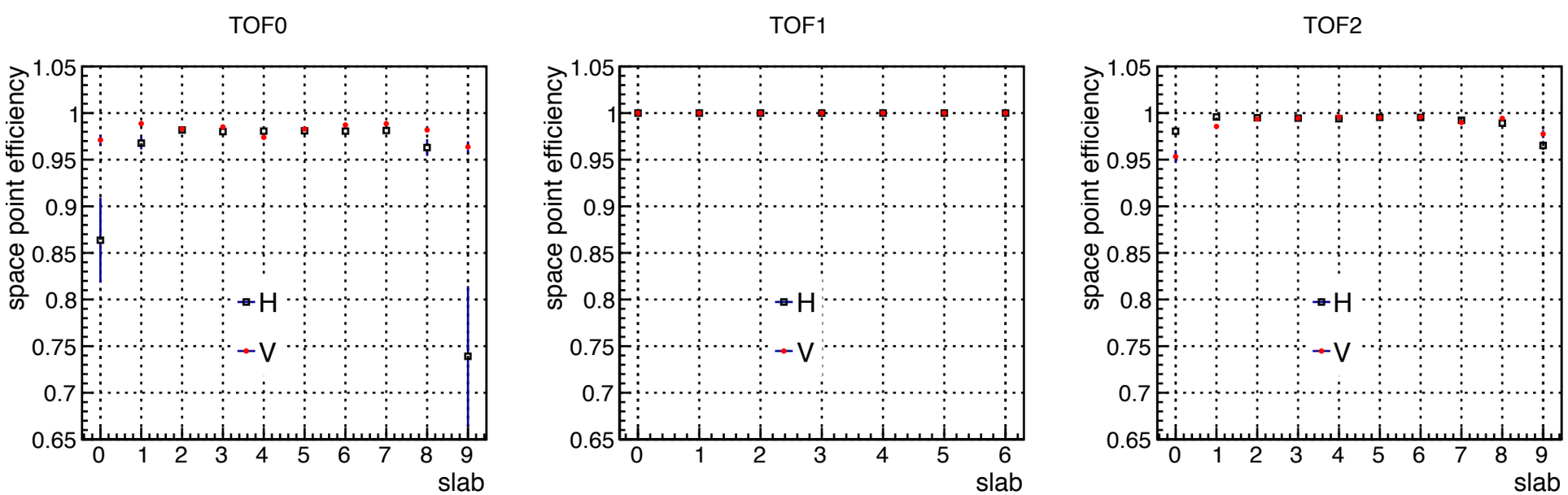
Slab Efficiency vs Slab DT Cut

Run 09799

0.5 ns cut



2 ns cut



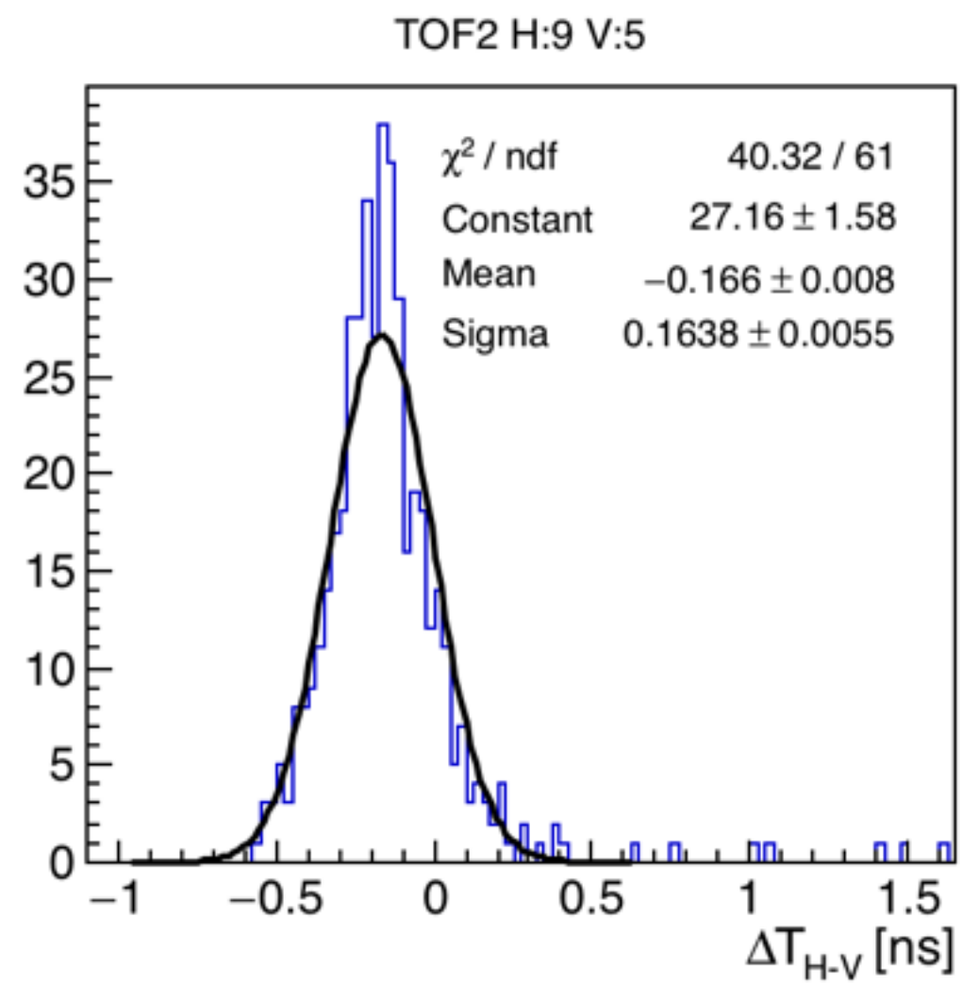
Improvement in all TOFs

Slab Efficiency vs Slab DT Cut Summary

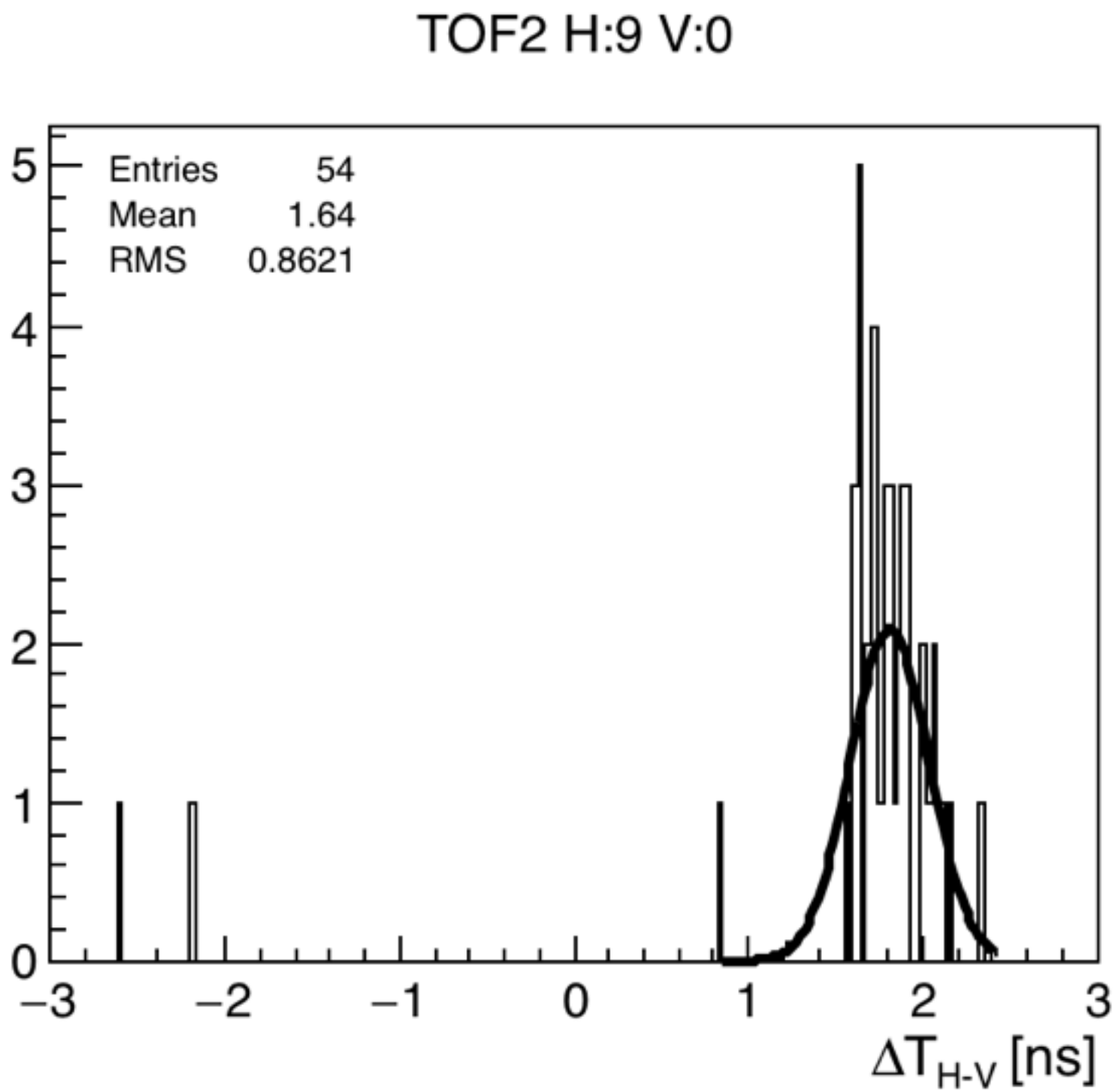
- Loosening slab DT cut from 0.5 ns to 2 ns
  - helps improving efficiency in TOF2 significantly
  - also improves efficiency in TOF1
- Additional effects on the efficiency are being investigated
- Cause of inefficiency: mostly improper slab calibration which distorts the slab DT distribution
- Scott is working on improving the calibrations — main issue is low statistics

Slab DT

- Example of slab DT distribution for hits in one particular pixel
  - TOF2, last horizontal slab (9), central vertical slab (5)
- Especially in outer slabs, the distribution has offset from 0 ns
- Calibration supposed to set DT to 0 ns

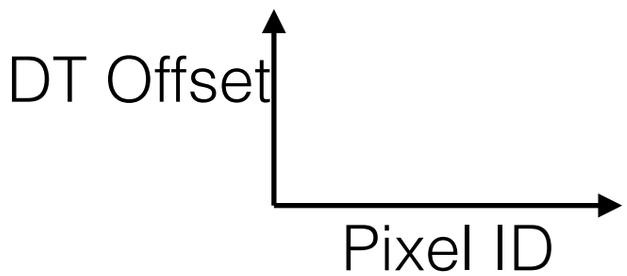


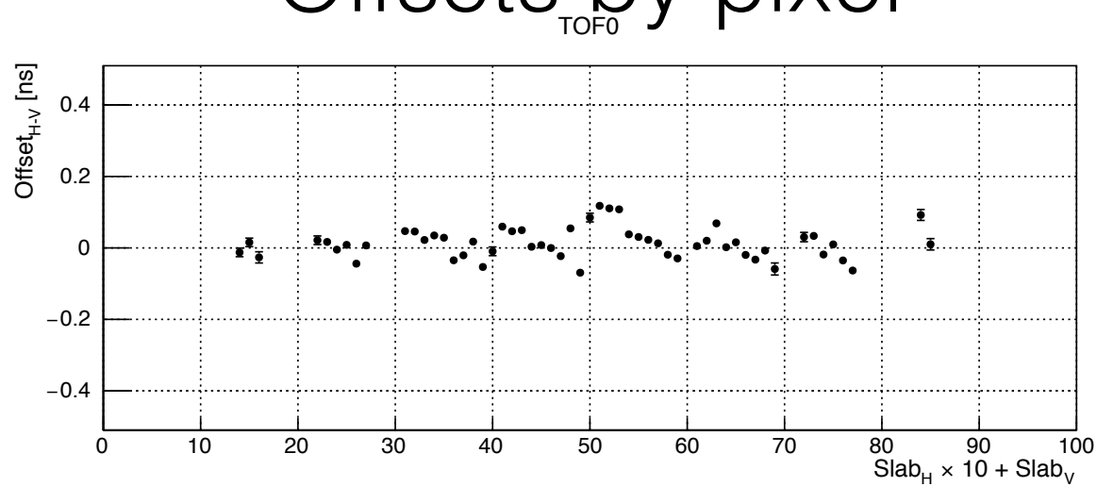
Example DT with large offset run 10248



Slab DT

Offsets by pixel





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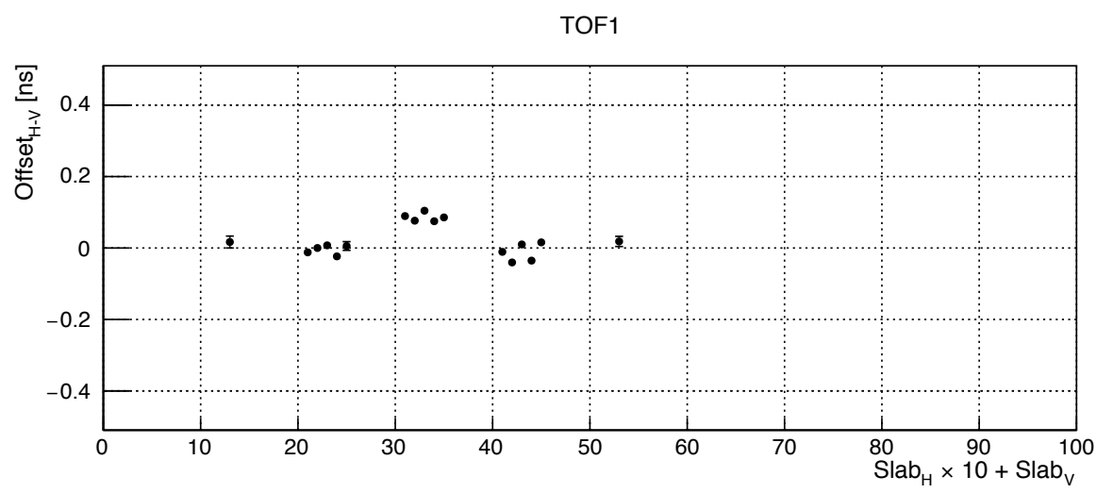
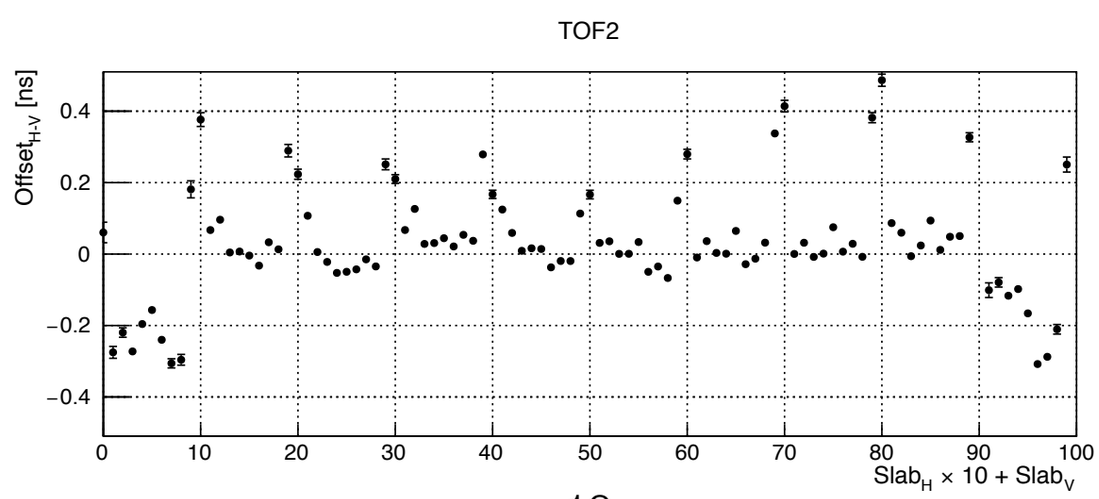
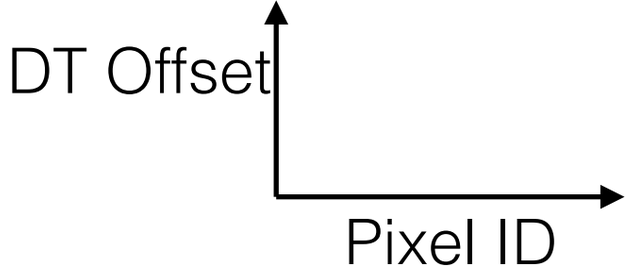
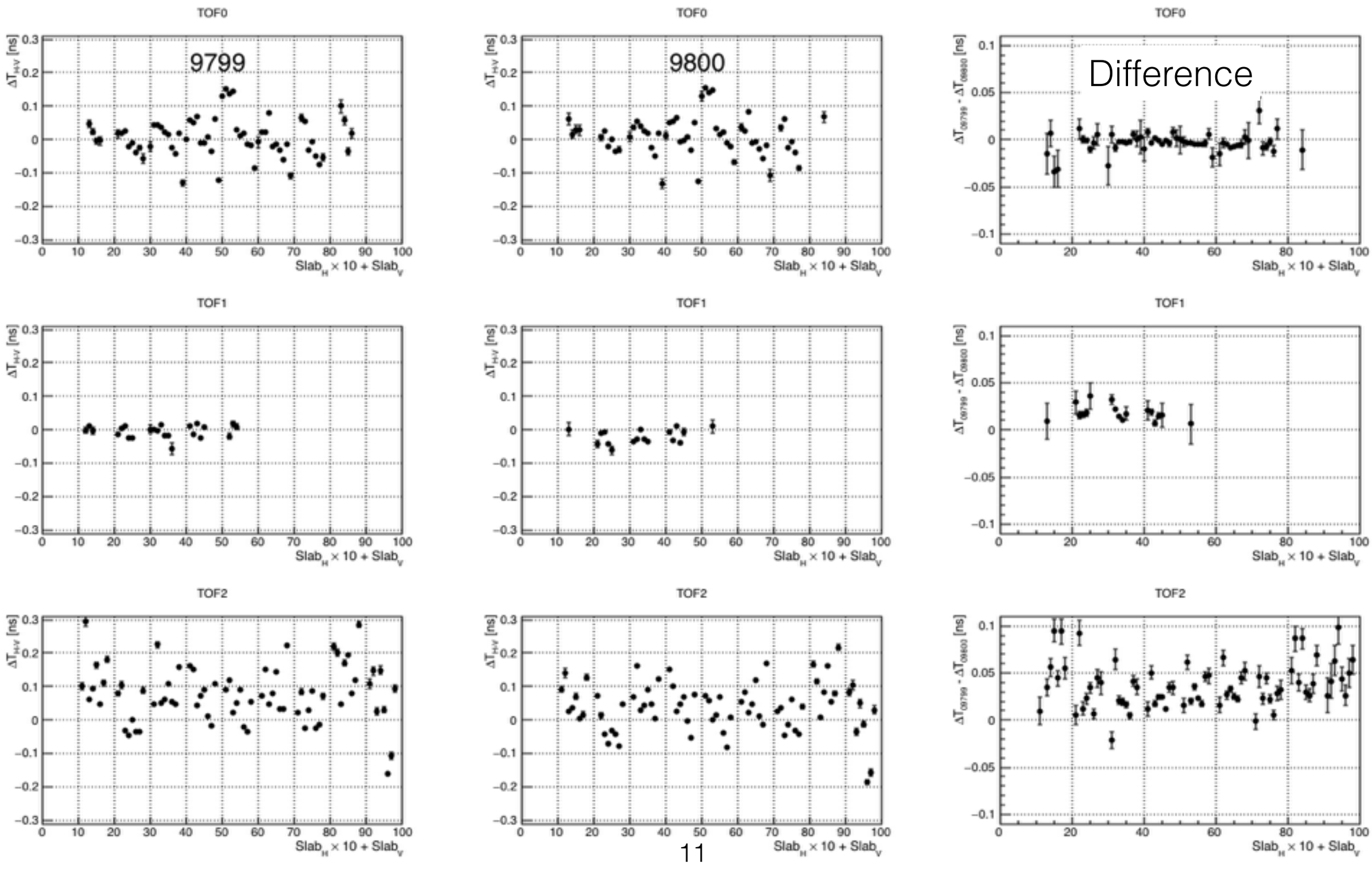






Slab DT

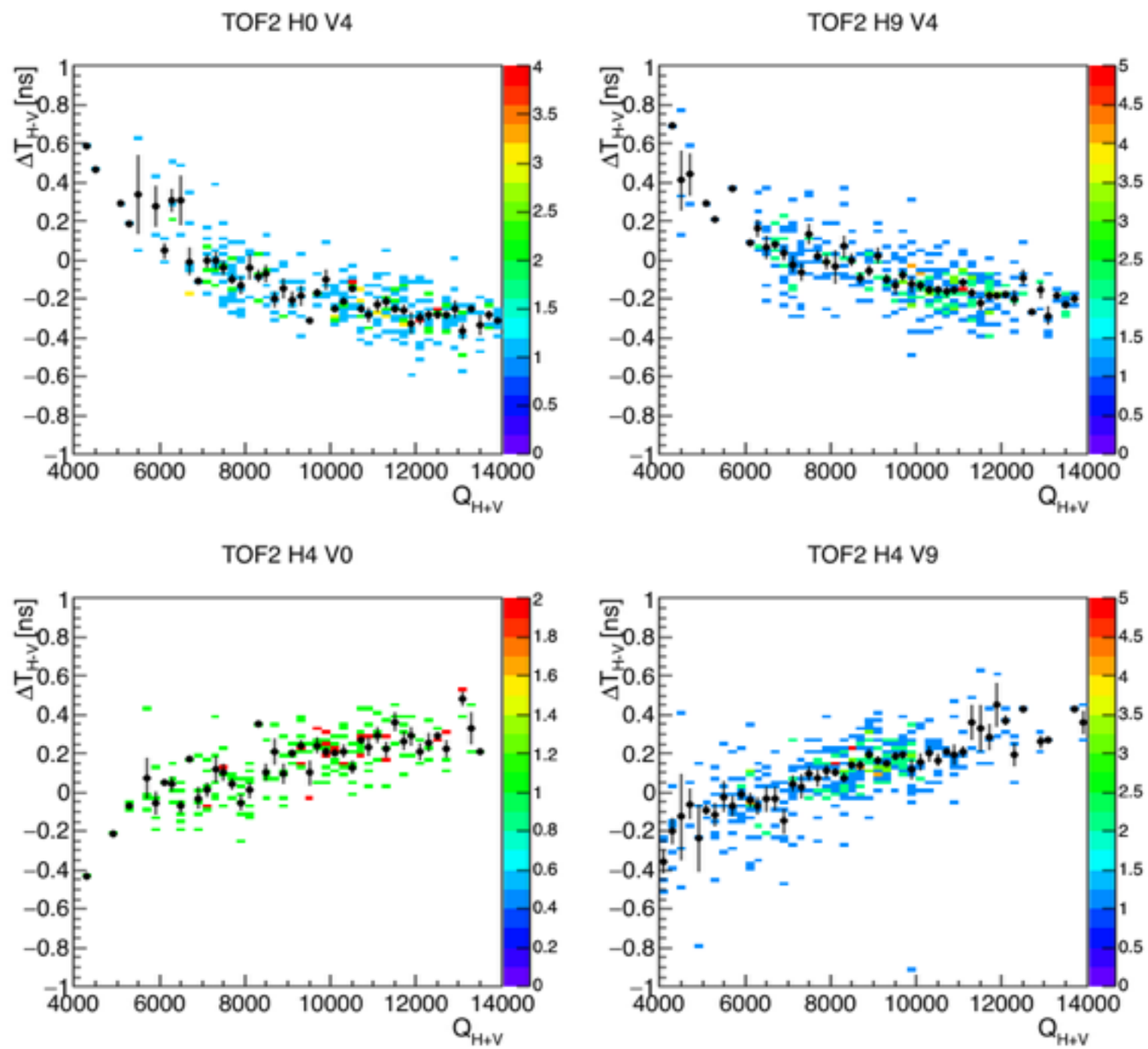
Comparison between runs - different beam settings



Slab DT

Correlation with charge

- DT offset is correlated with total charge seen
- Suggests issues with time-walk correction
- Significant correlation observed only in the outer slabs



Summary

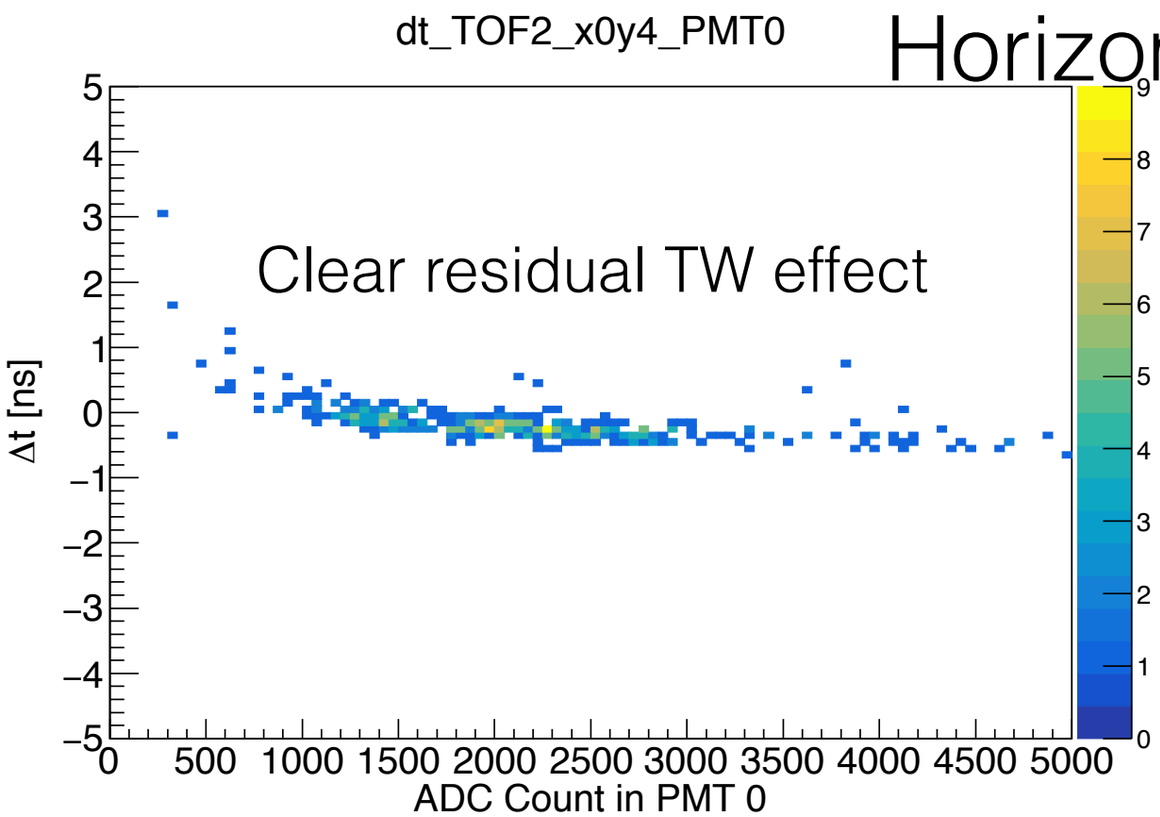
- Space-point creation efficiency
  - dominantly affected by improper time calibration
  - 0.5 ns -> 2 ns in DT cut improves the efficiency
  - will try to improve calibrations
- Slab DT offsets
  - Poor time-walk calibration would explain some of the slab DT offsets, namely in the outer slabs
  - DT offsets in other slabs are within ~0.2 ns
  - Systematic uncertainty in TOF times

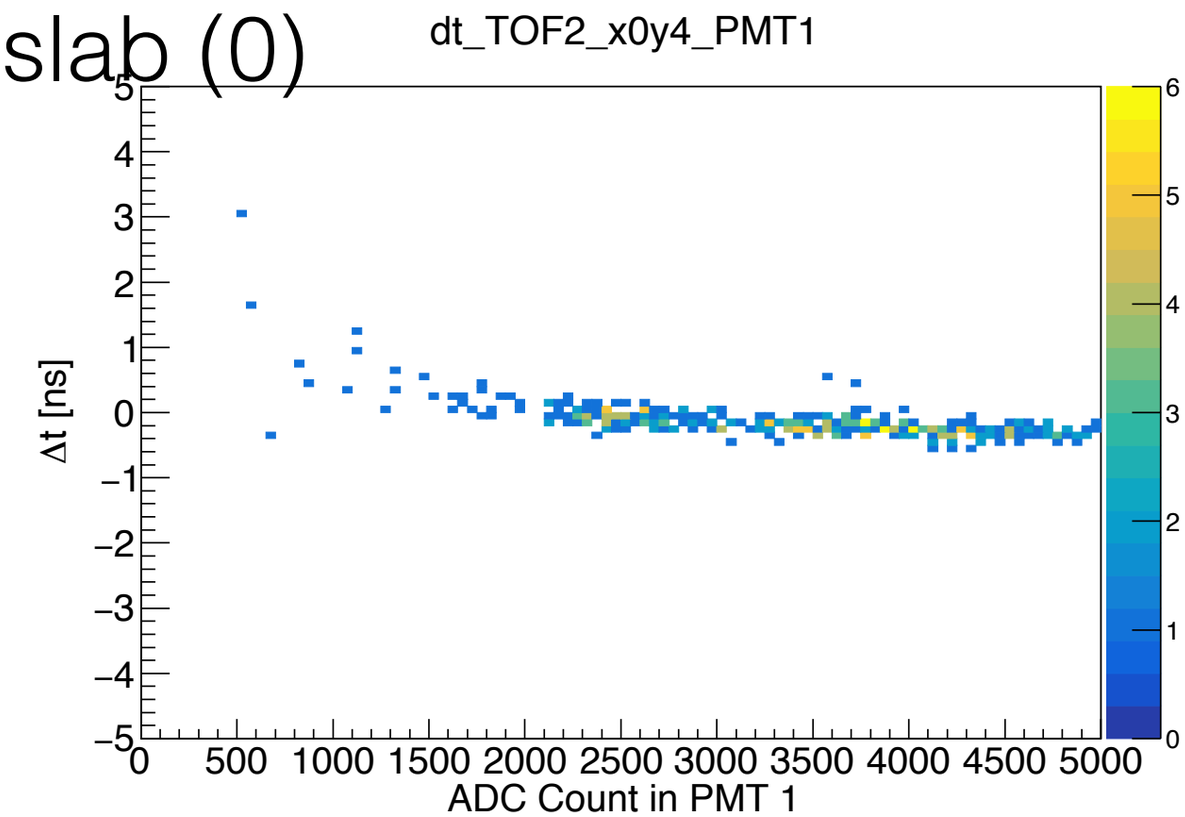
Backup

Time-walk demonstration for individual PMTs

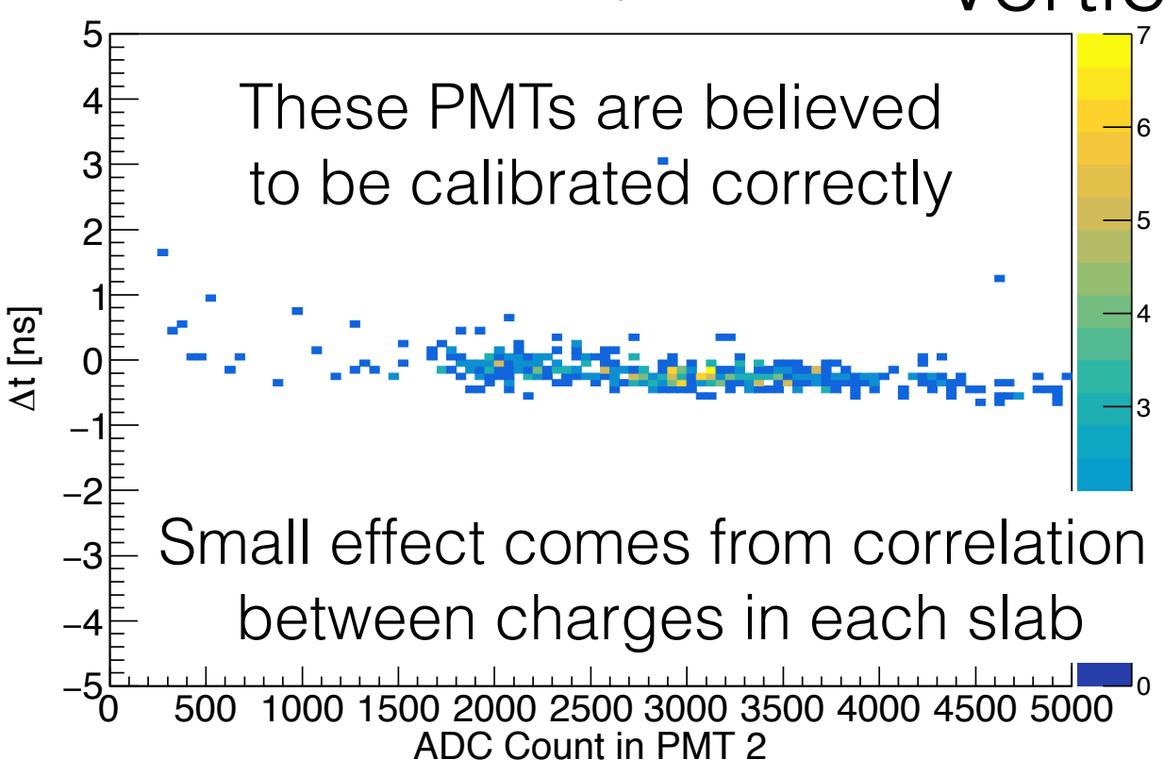
- In the following slides:
  - slab DT (calibrated) vs charge in separate PMT
  - 1st shows outer slab exhibiting residual TW effect
  - 2nd shows example of a “properly” corrected TW

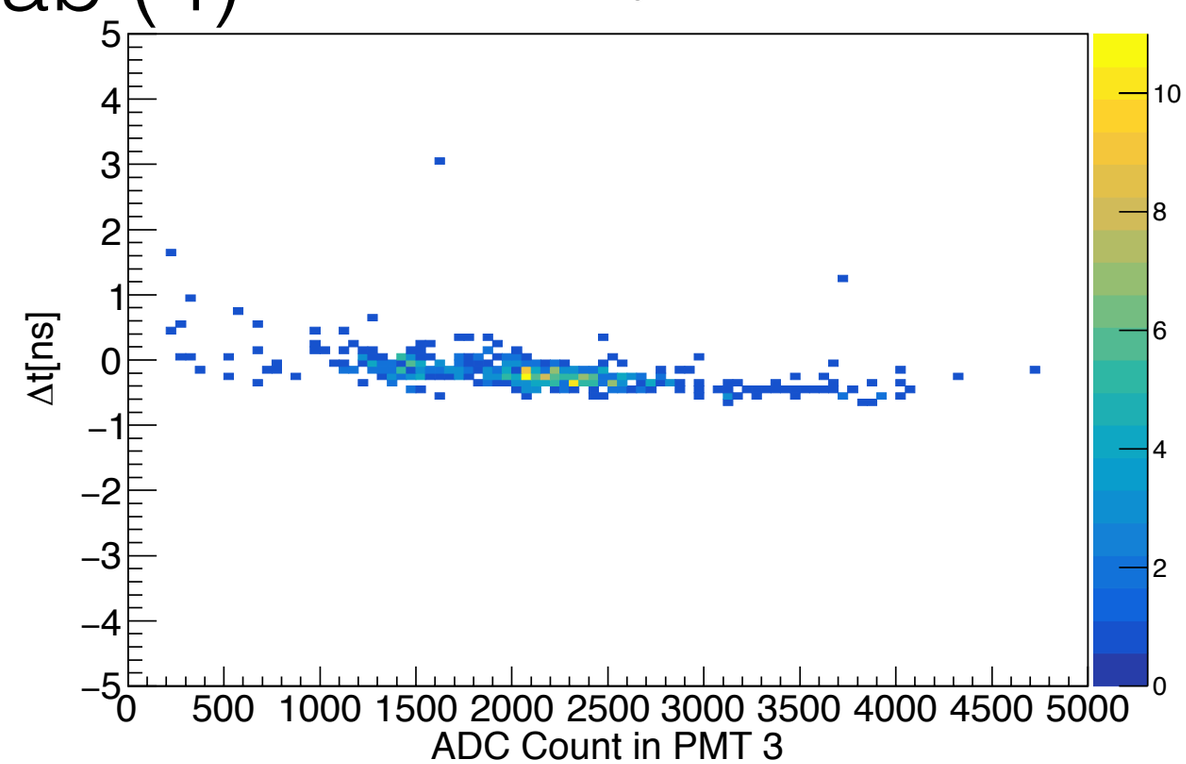
Horizontal slab (0)

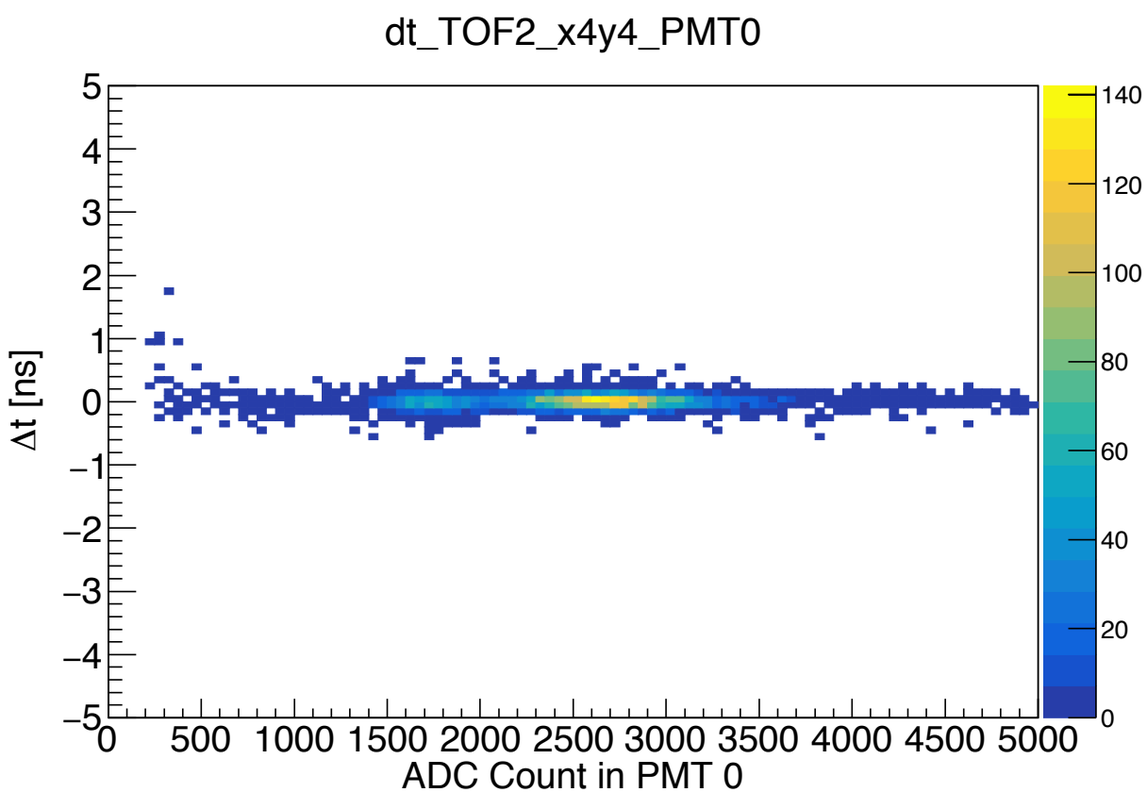


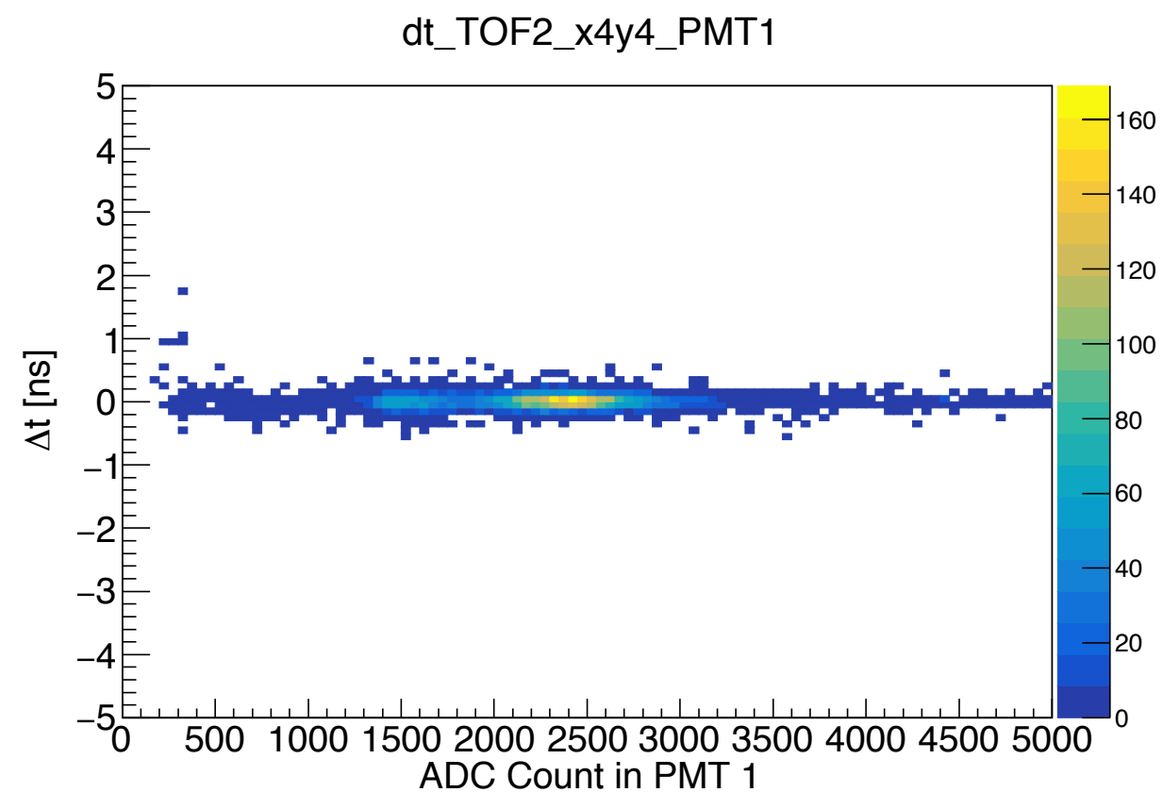


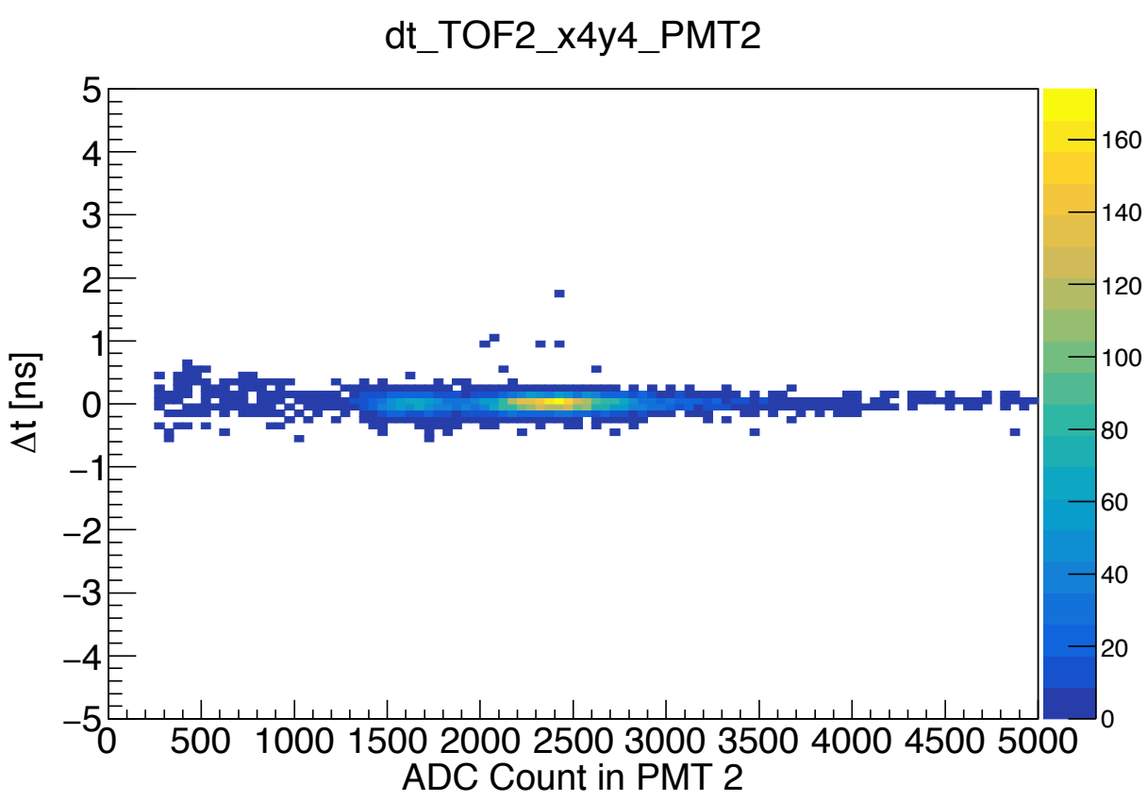
Vertical slab (4)

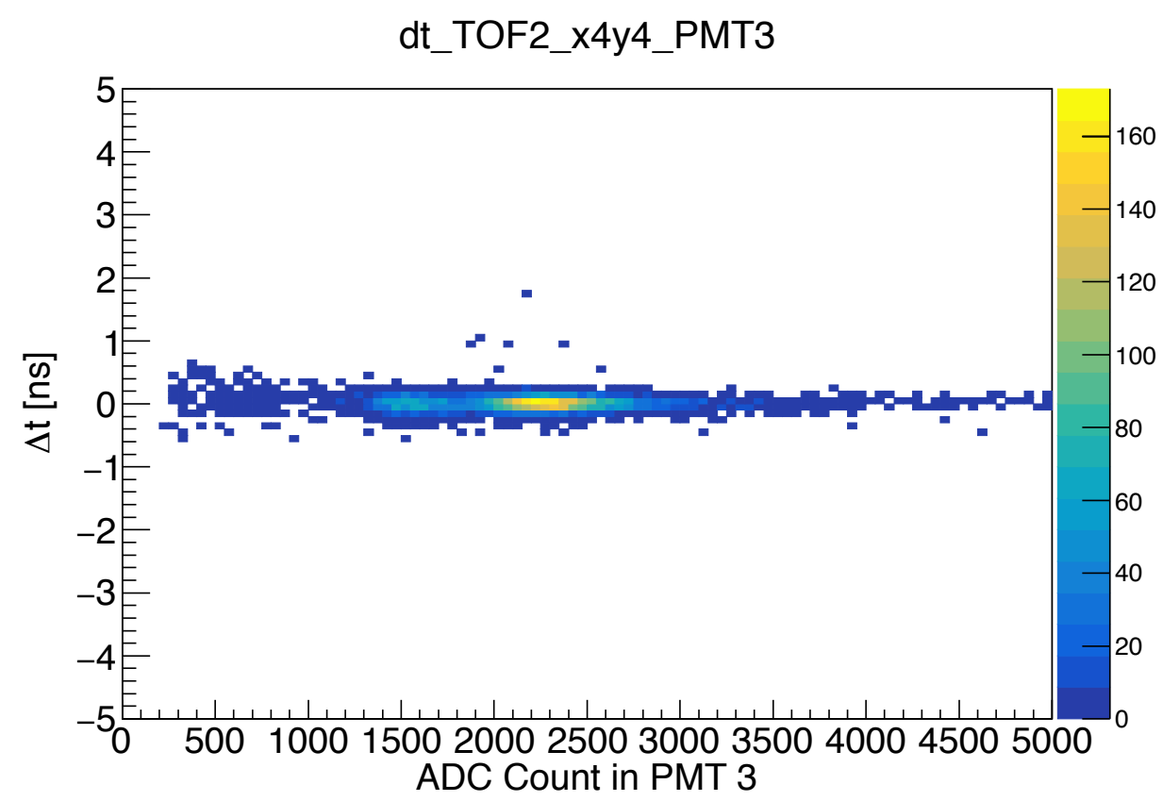





dt_TOF2_x4y4_PMT0
Δt [ns]
ADC Count in PMT 0

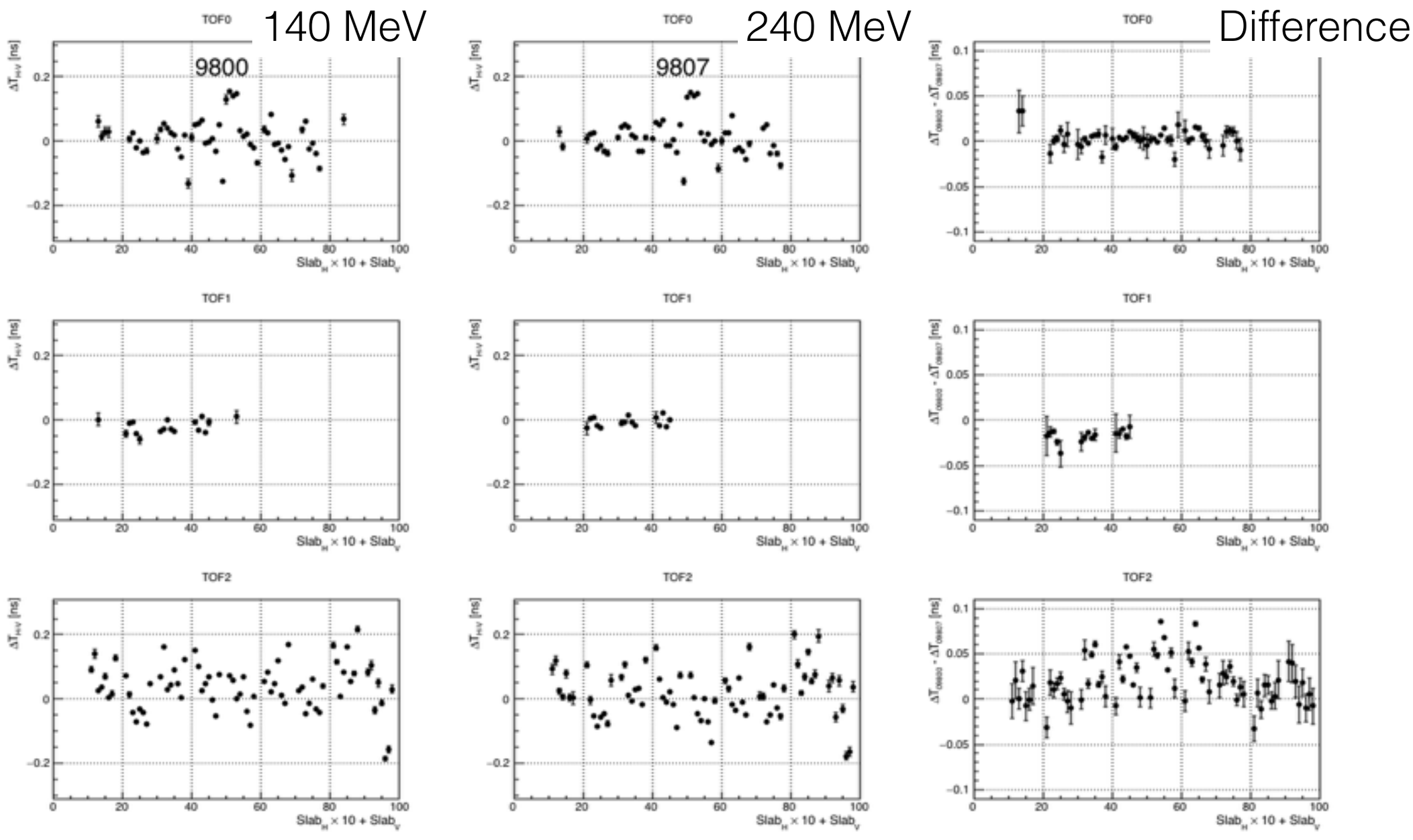

dt_TOF2_x4y4_PMT1
Δt [ns]
ADC Count in PMT 1


dt_TOF2_x4y4_PMT2
Δt [ns]
ADC Count in PMT 2


dt_TOF2_x4y4_PMT3
Δt [ns]
ADC Count in PMT 3

Slab DT

Offsets by pixel
Different momentum runs



Slab DT

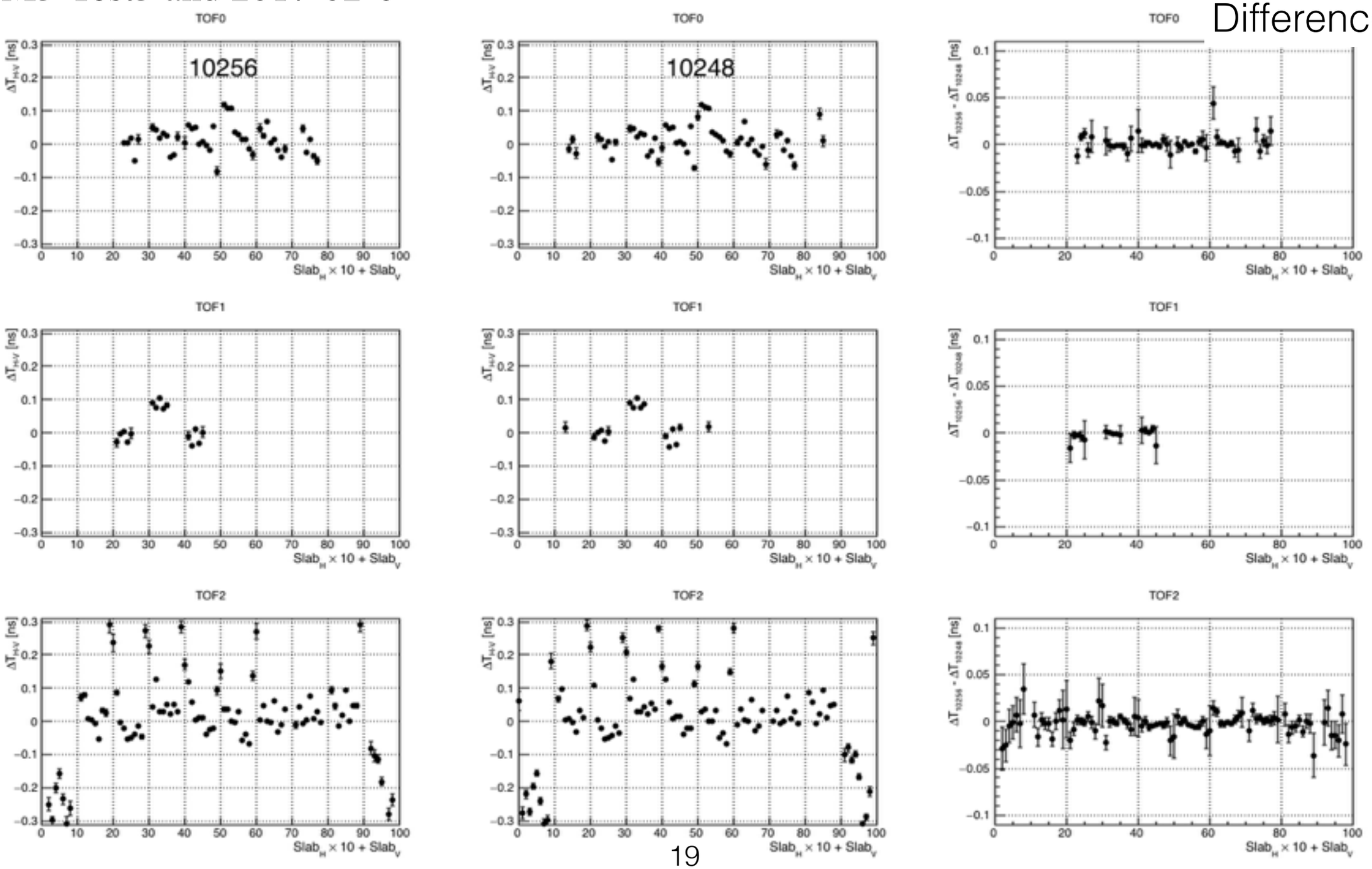
Offsets by pixel

Same beam and cooling channel

different day

3-140+M3-Test3 and 2017-02-6

Difference

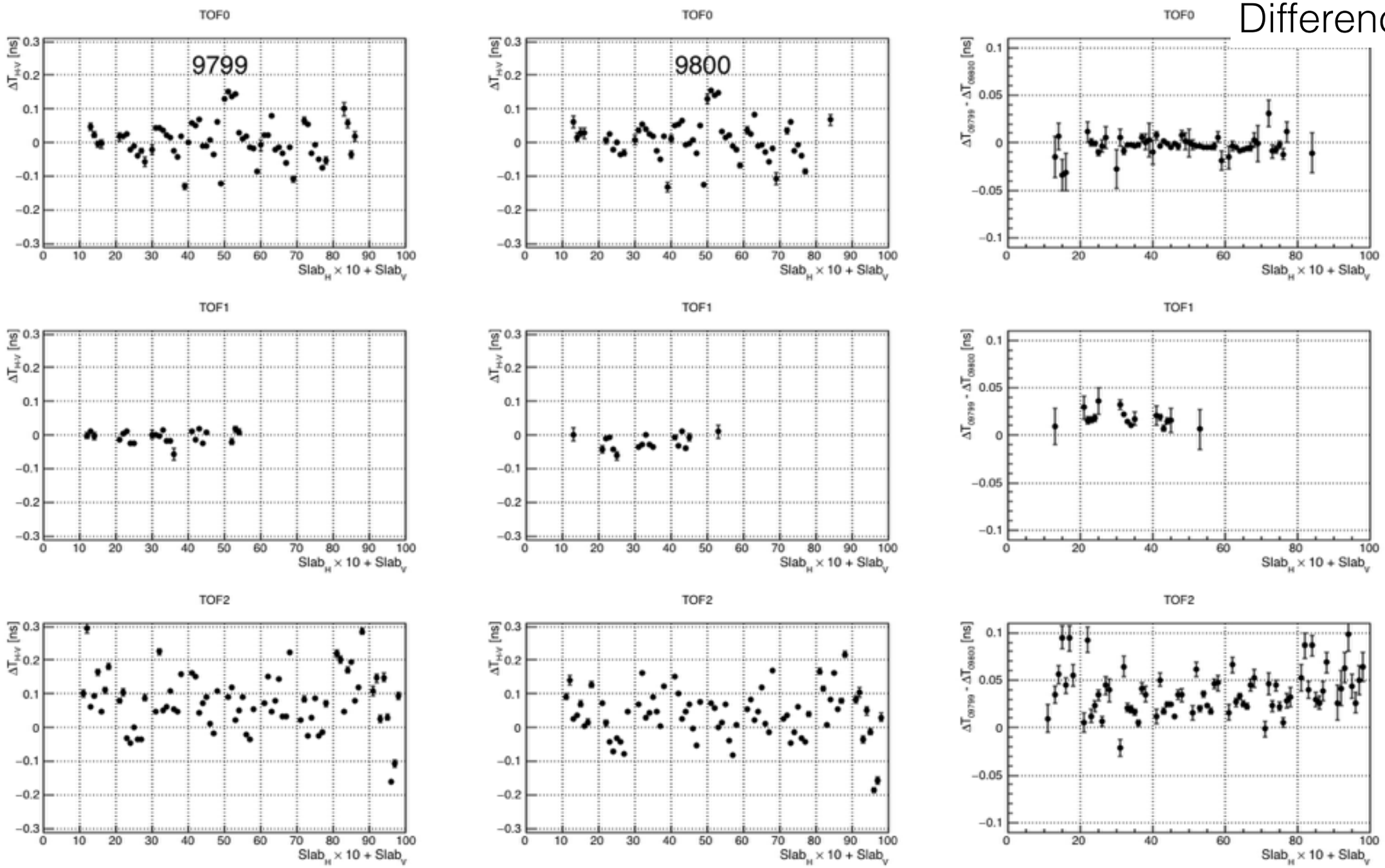


Slab DT

Offsets by pixel
Same cooling channel
different beamline settings

2017-02-3 channel both
10-140+M3-Test (9799)
3-140+M3-Test3 beamline (9800)

Difference

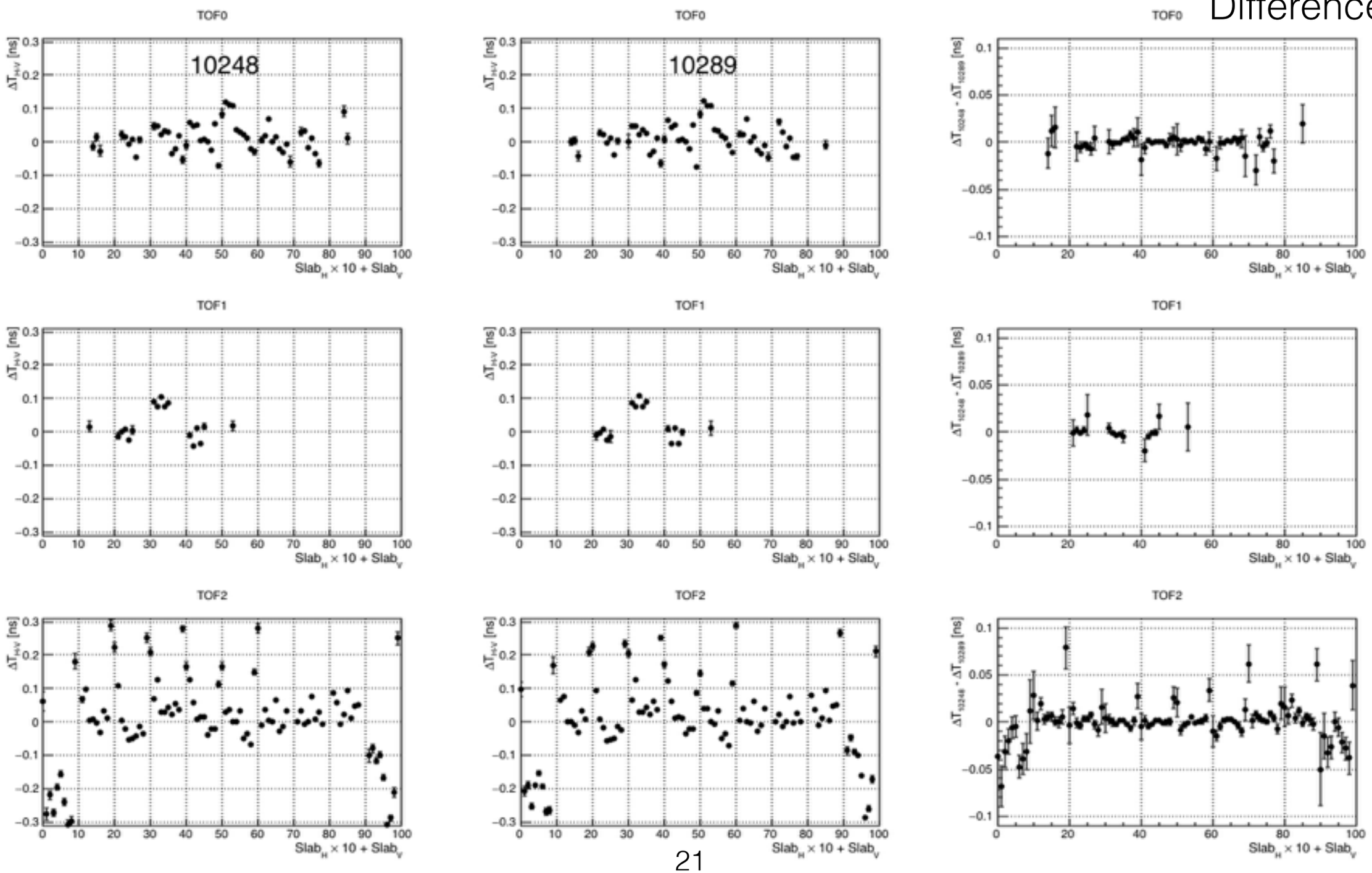


Slab DT

- 3-140+M3-Test3
- 2017-02-6 vs 2017-02-1

Offsets by pixel
Same beamline
Different cooling channel

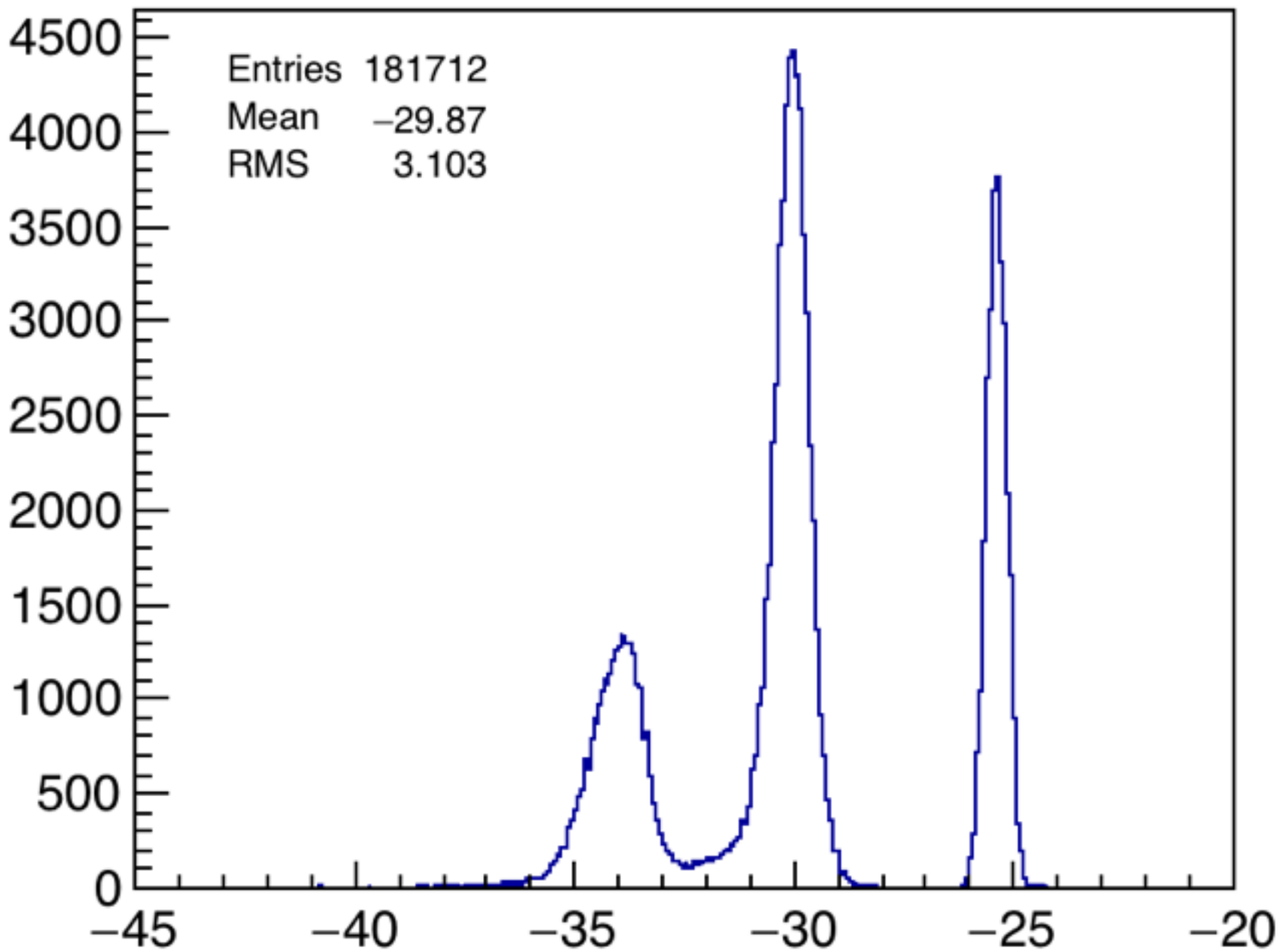
Difference



Slab DT

Offsets by pixel

Differences between particles



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Slab DT

Offsets by pixel

Differences between particles