TOF Resolution and Efficiency

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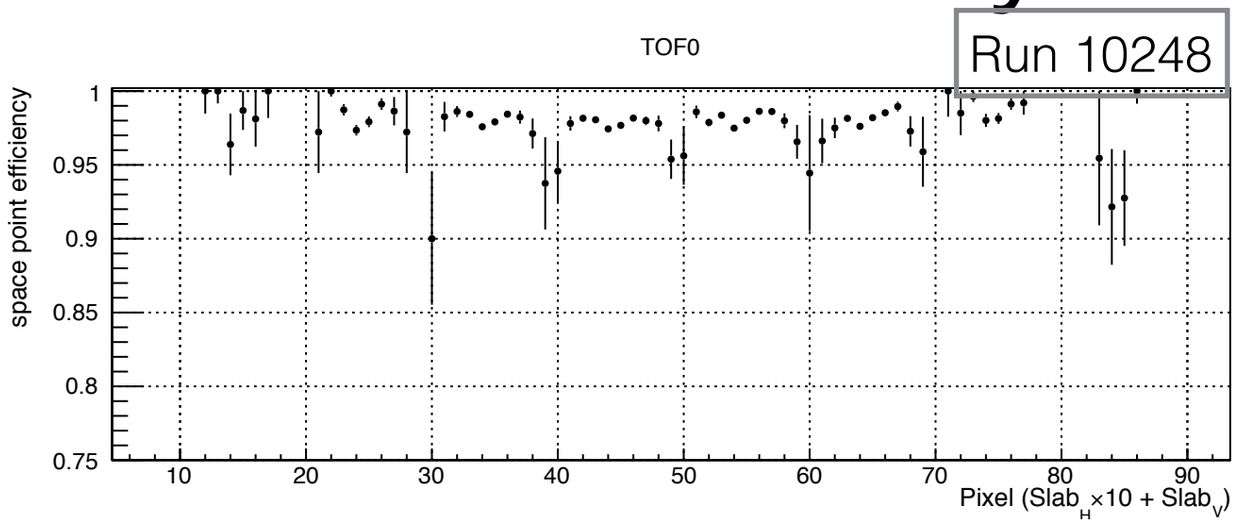
MICE CM51

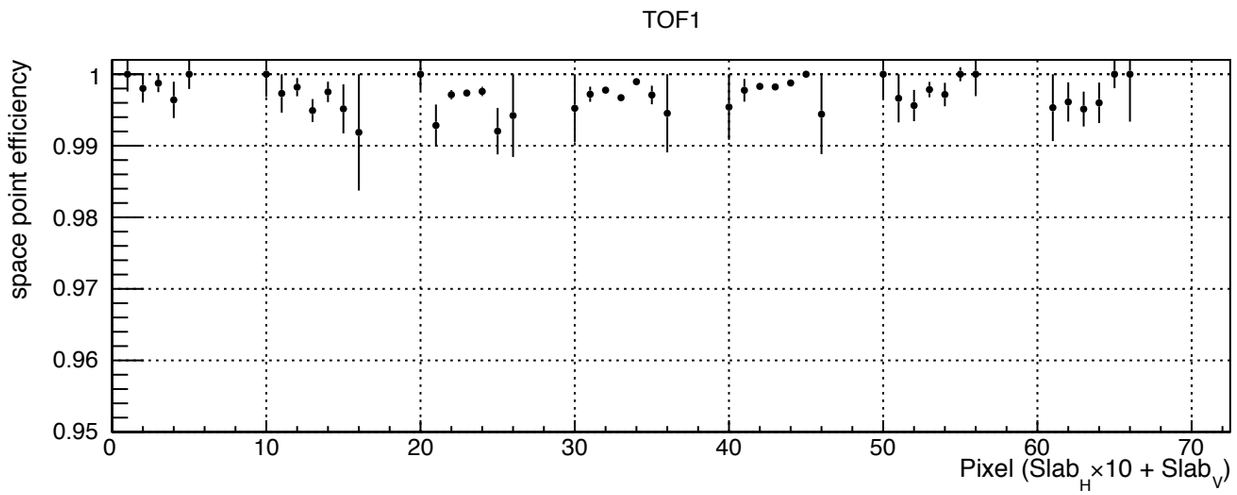
Since last CM

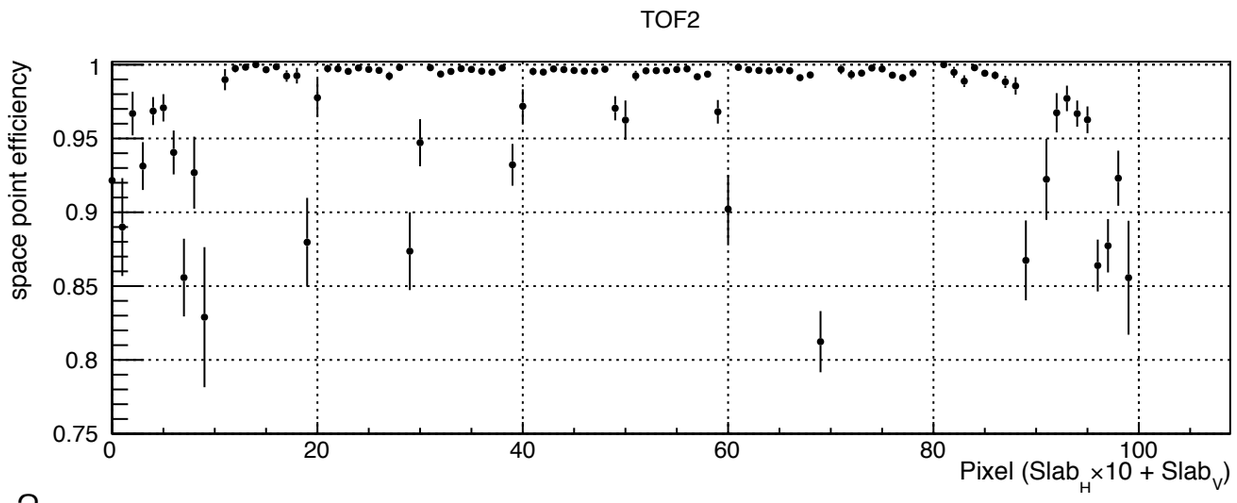
- 2 PMT channels in TOF1 identified with features in their ADC readings
- Both channels kept in reconstruction, ADC readings of one can be corrected
- New calibration constants produced for a subset of runs
- 2 runs were reprocessed with new calibrations for testing purposes

Space point creation “efficiency”

- “Efficiency” = if there are 2 slab hits, how often is a SP created
- ΔT cut was **0.5 ns**
- “Inefficient” events:
  - slab ΔT is in the distribution’s tails and does not make the cut (**0.5 ns**)
  - 2 distinct particles give have hits in 2 slabs => they don’t make slab ΔT cut
- Low “efficiency” in quite many pixels was worrisome!
  - mostly from offsets in slab ΔT
  - We had to loosen the ΔT cut from **0.5 ns to 3 ns**

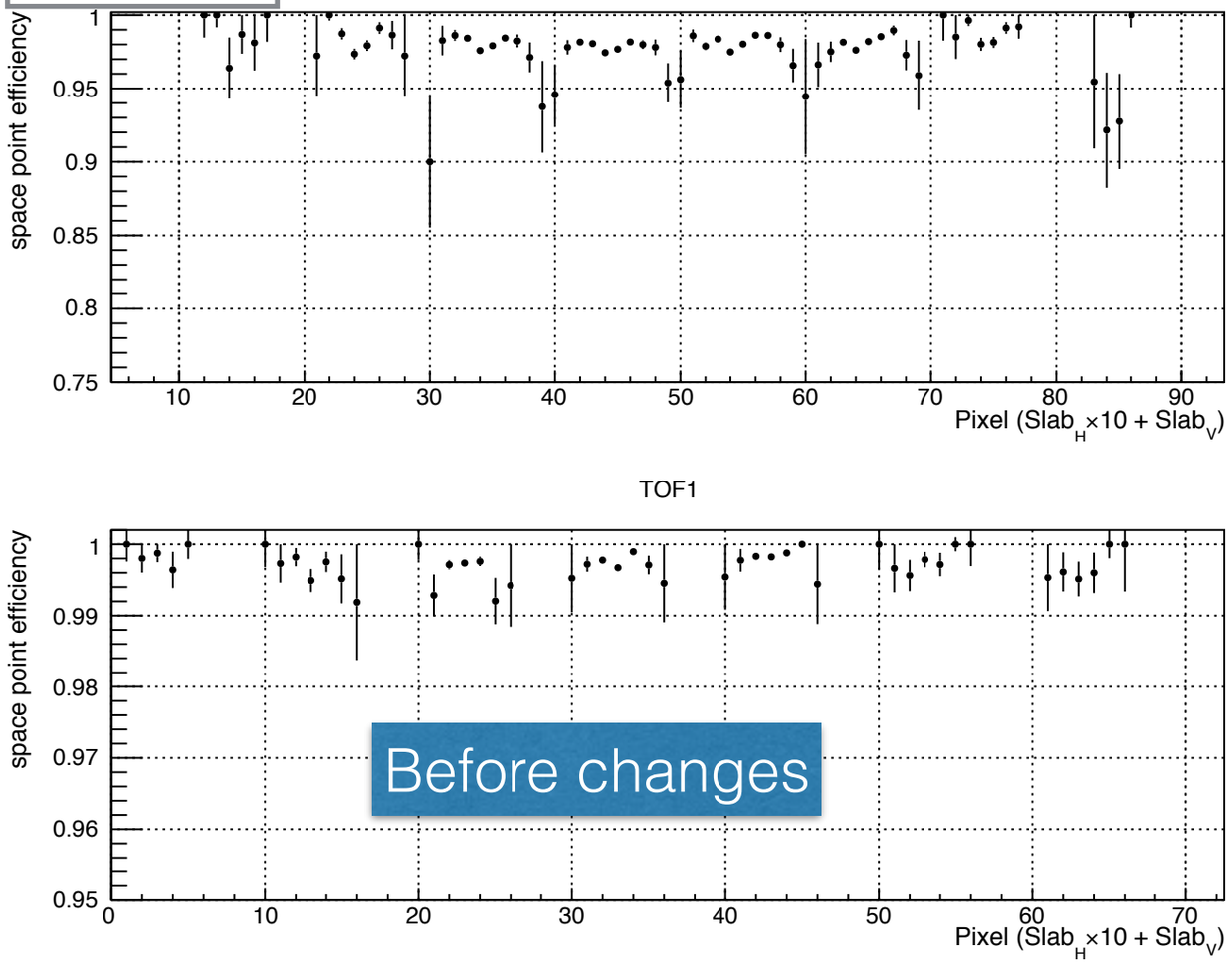




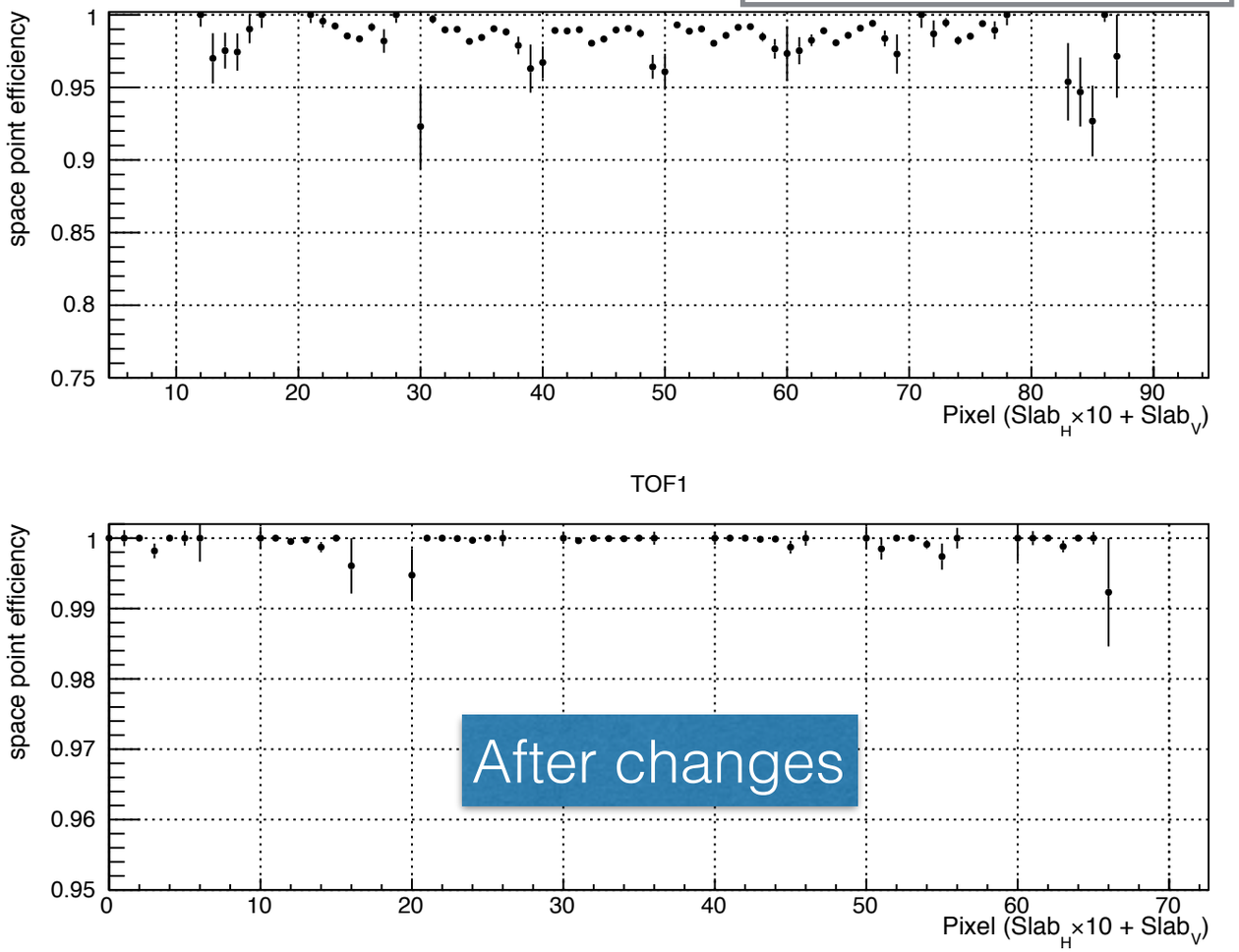


Comparison Before and After New Calibration and Looser Cut

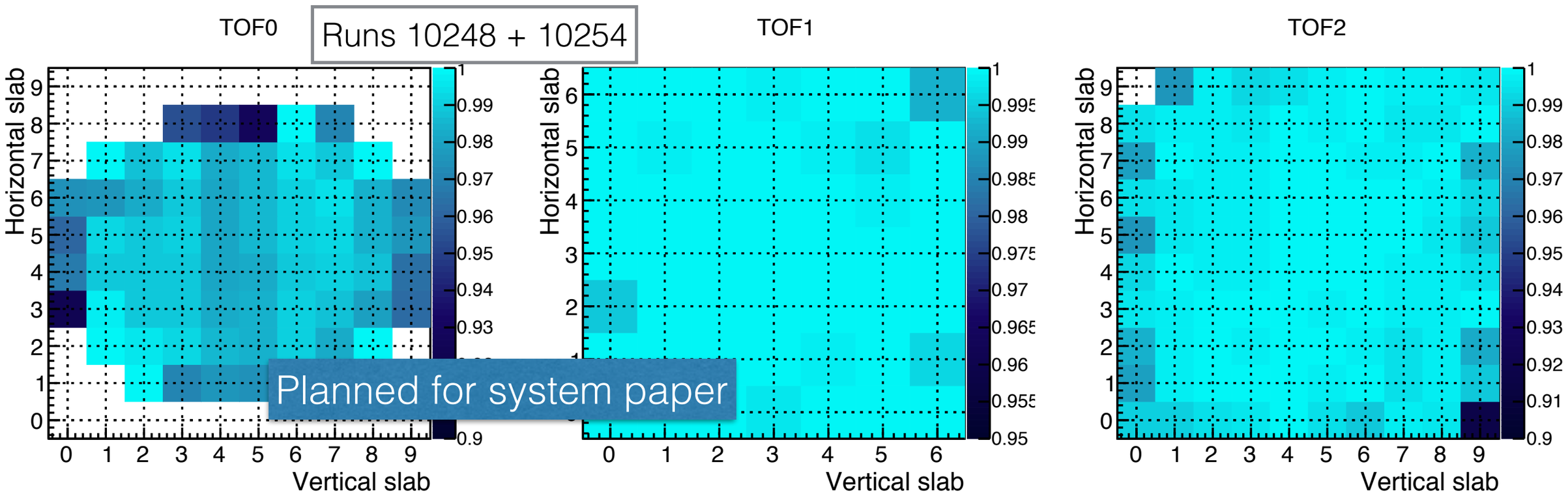
Run 10248



Runs 10248 + 10254



Space point creation “efficiency” after new calibration and looser cut



- “Inefficient” events have hits in slabs from 2 distinct particles => they don’t make slab ΔT cut

- Latest official reconstruction exhibit worse performance:

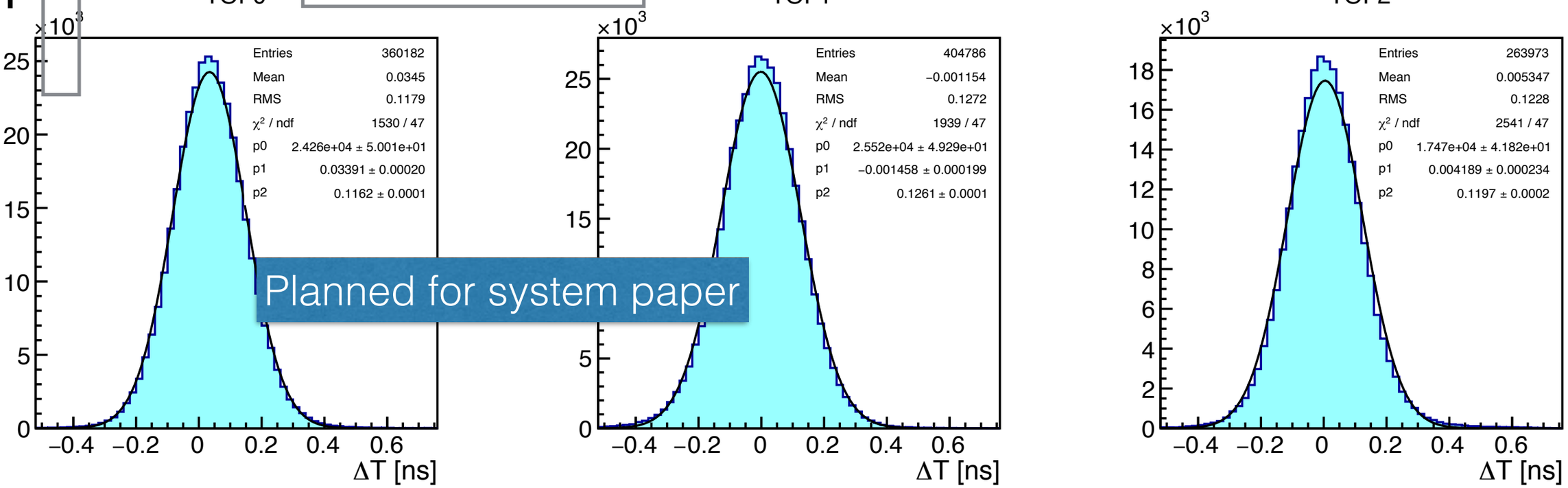
  - We had to loosen the ΔT cut from 0.5 ns to 3 ns

  - Redone calibrations for these runs

TOF overall resolution

ΔT

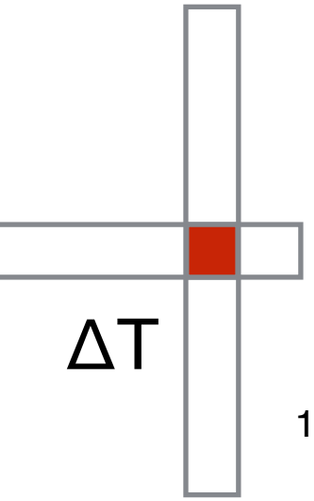
Runs 10248 + 10254



Planned for system paper

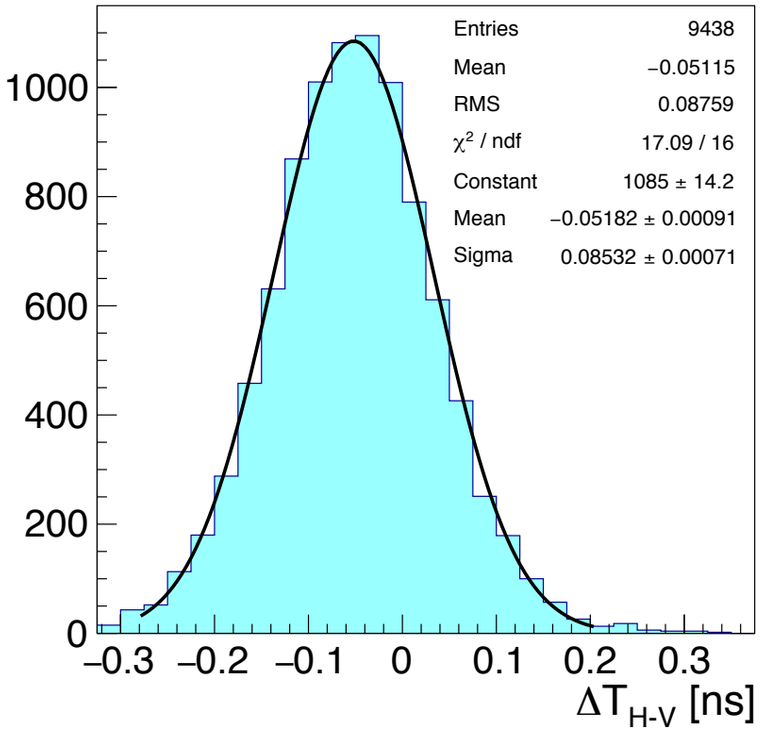
- Estimated from slab ΔT
- After modified calibrations
- $\sigma_{\Delta T}$: TOF0 ~116 ps, TOF1 ~126ps, TOF2 ~120 ps
- $\sigma_{Station} = \sigma_{\Delta T}/2$ = TOF0 ~**58 ps**, TOF1 ~**63 ps**, TOF2 ~**60 ps**
- or $\sigma_{ToF} = \sigma_{\Delta T}/\sqrt{2}$ = TOF0 ~**82 ps**, TOF1 ~**89 ps**, TOF2 ~**84 ps**

*σ_{ToF} : resolution of T-o-F measurement by 2 stations

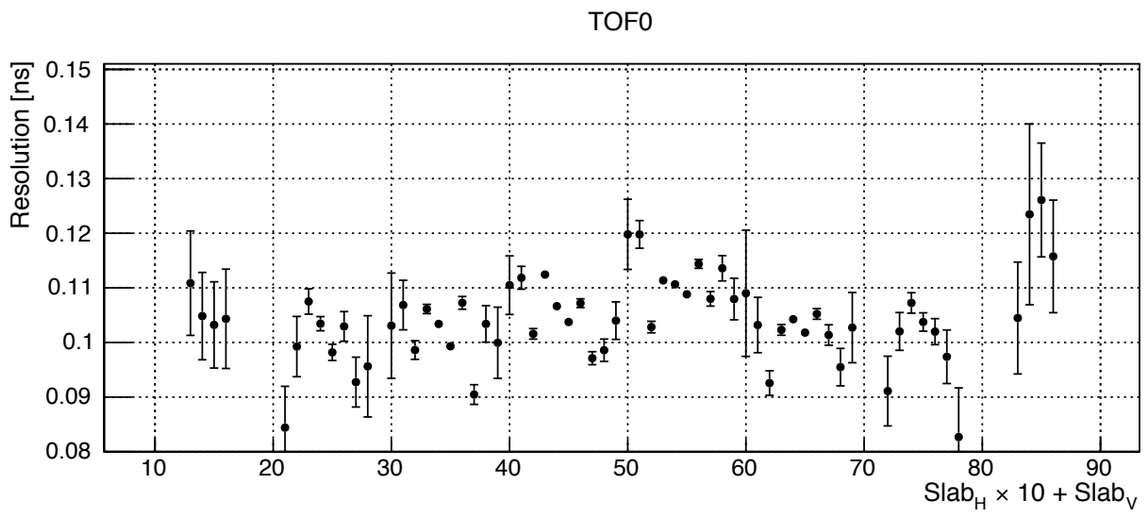


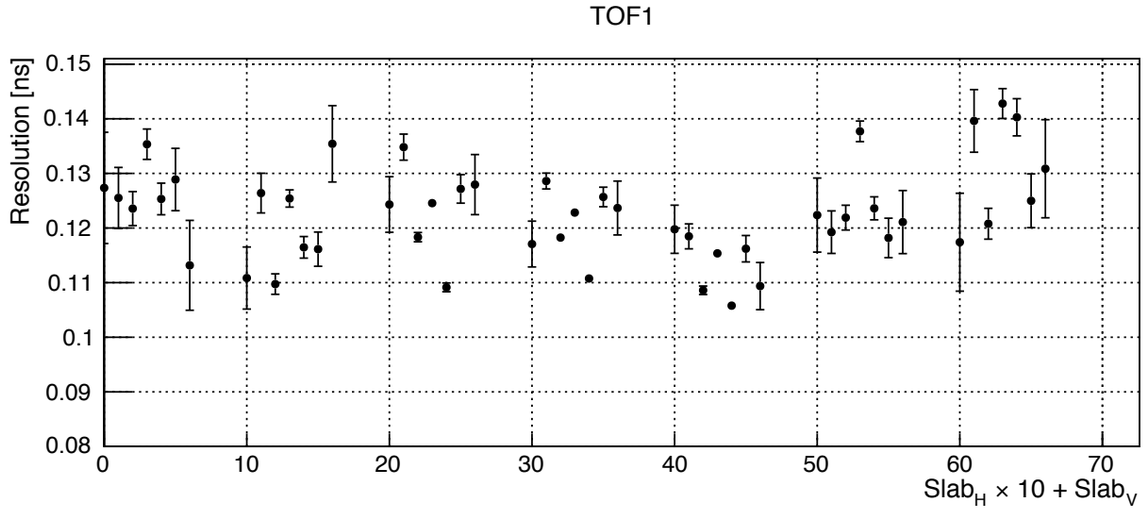
Single pixel resolution

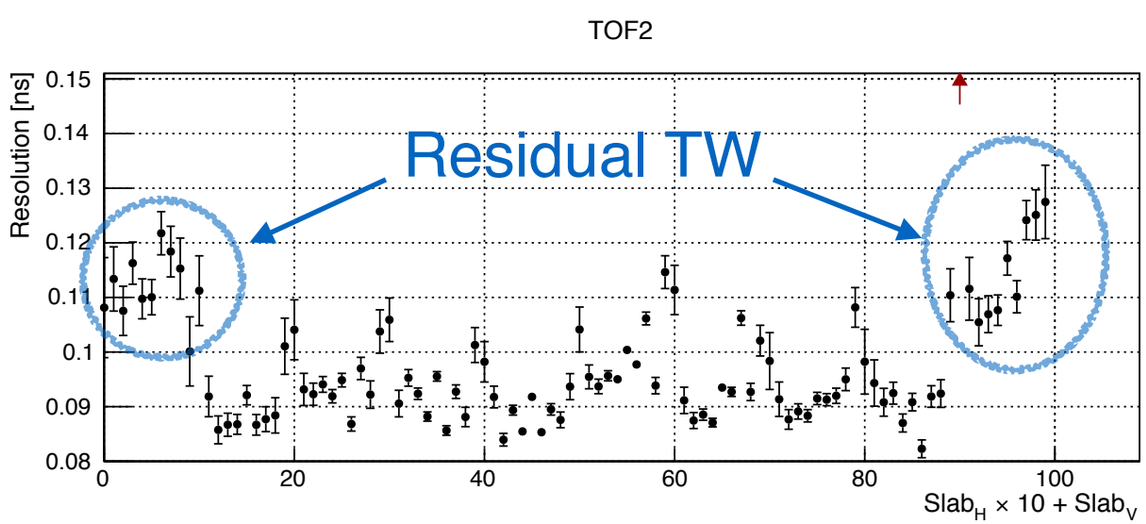
TOF2 H:4 V:6 | Runs 10248 + 10254



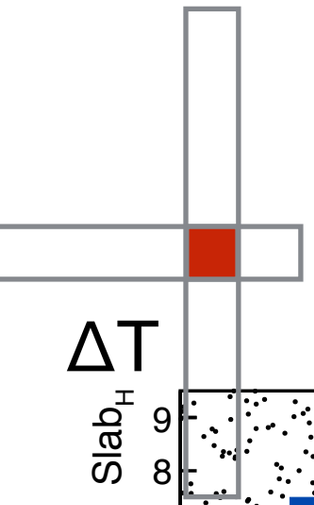
- Resolution of individual pixels varies between ~85 ps to ~140 ps
- Translate to T-o-F resolution ~60 ps to ~100 ps
- Big part of worse resolution comes from residual time walk





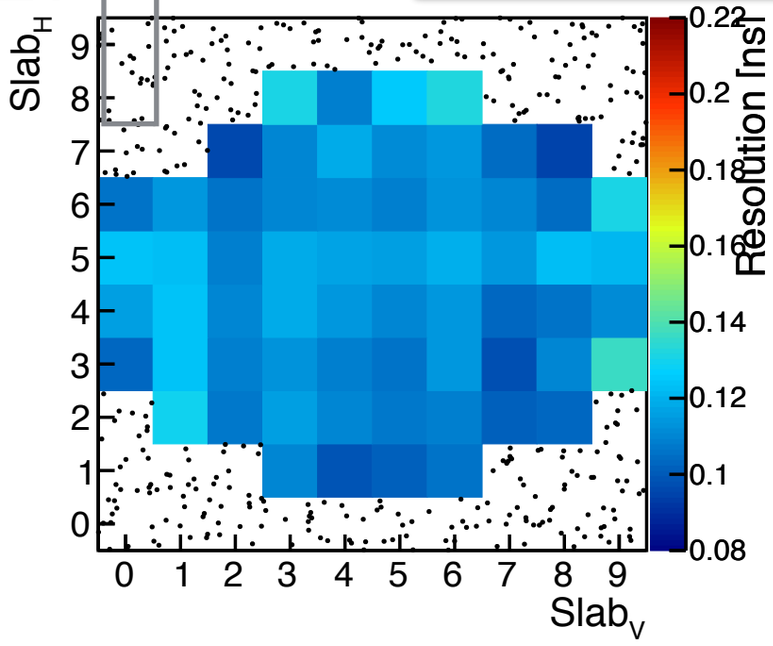


Single pixel resolution



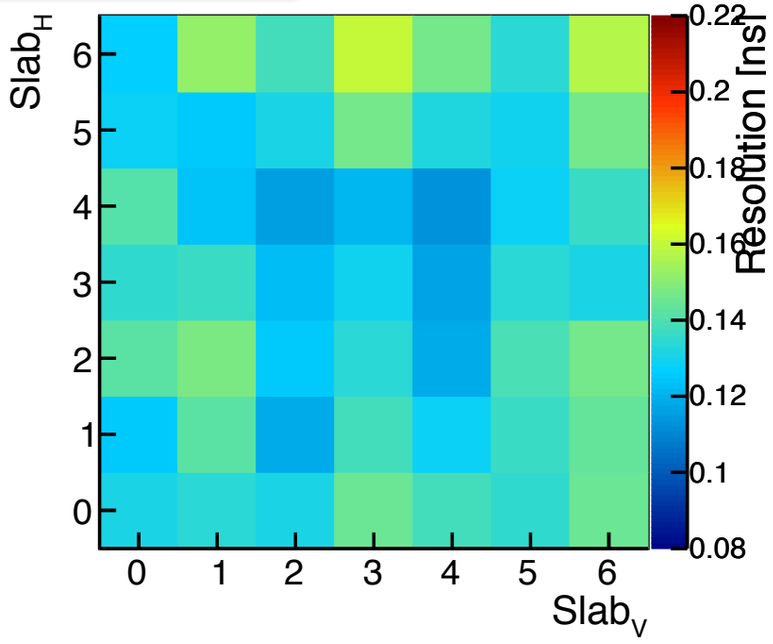
Planned for system paper

TOF0



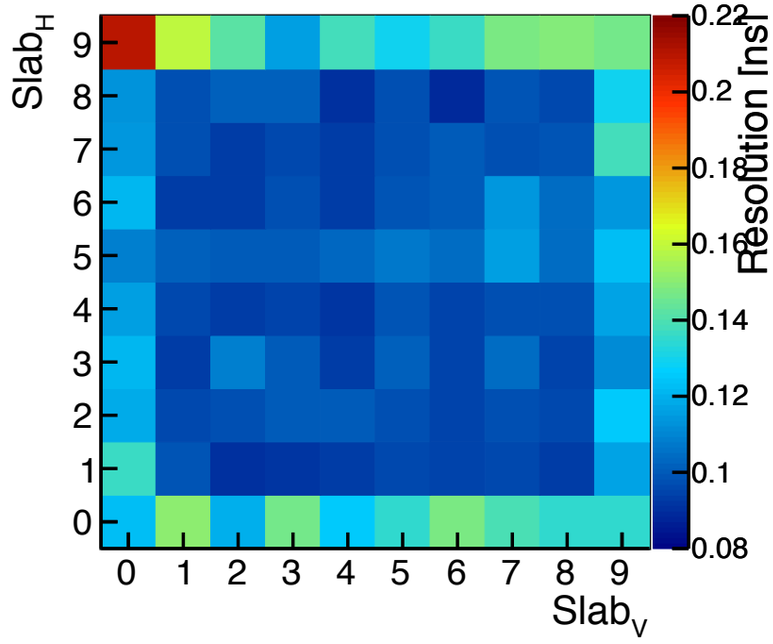
- Resolution of individual pixels varies between ~85 ps to ~140 ps
- Translate to T-o-F resolution ~60 ps to ~100 ps
- Big part of larger resolution comes from residual time walk

TOF1



- Resolution uniform within the central region of each TOF

TOF2



TDC Conversion Factor - possible issue

- Conversion factor used to translate TDC counts to time units
- CAEN's V1290 specification is 25 ps per count
- MICE TOF NIMA* paper claims measured 22 ps per count
- Nominal 25 ps per count used in current MAUS
- Possible deviation from 25 ps/count will affect calibration and T-o-F measurement of muons and pions => TOF momentum measurement
- Do we need to test used TDC boards?

*NIM A 615 (2010) 14

Summary

- We have improved **space-point reconstruction** by loosening cut on the constituent slabs' time difference
- Overall TOF station (T-o-F) **resolution** within about 63 ps(90 ps)
  - does not include systematic uncertainty from calibration
- Individual pixels have **slab ΔT/T-o-F deviations** which are difficult to calibrate out
- TOF figures were proposed to be added to the **System Performance paper** - after some discussions with Paolo
- We need to resolve uncertainty on **TDC conversion factor**
- We will redo calibrations and reconstruction for full Step IV data
- Still need to understand systematics from the calibration method
- We want to include MC for comparison of main performance figures