

Tiger & Mu2E merging, [2023-09-15 Fr]

Straw TB team

September 19, 2023

Tiger+Mu2E Merging:

Procedure:

- 1 Tiger clusterizing
- 2 Mu2E – Selection pulser and scintillator
- 3 Splitting by spills
- 4 Merging procedure
- 5 Merging efficiency
- 6 Merging efficiency – fakes
- 7 Mu2E vs Tiger Sci0 efficiency
- 8 Adding straw hits

Examples

Examples done on

- o TIGER run 40, subrun 4 (and 5)
- o Mu2E run 46

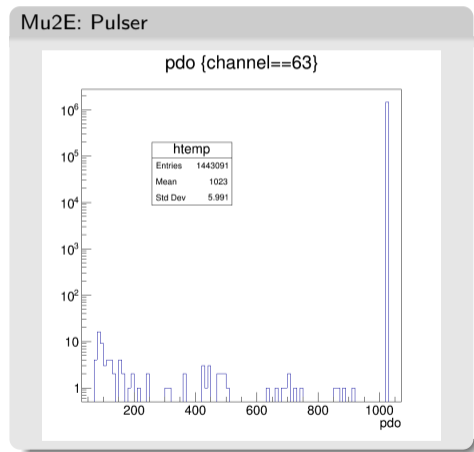
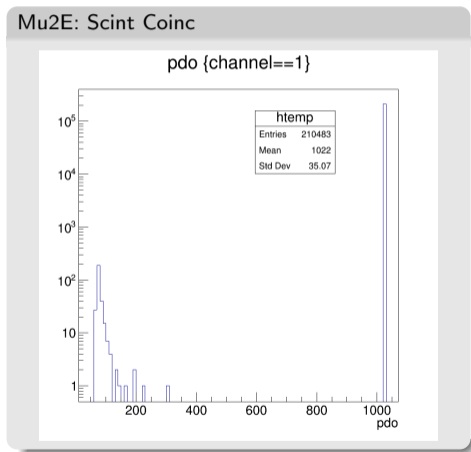
Tiger clusterization

I will prepare clusterization presentation once more, both for now, our default procedure:

- We take tiger file
- Using scintillator coincidence hits
- Time corrected to "mean" time of all 4 scintillators
- Only hits with clusters in all 3 X-axis MM are taken
- Clusterization weighted with hit charge

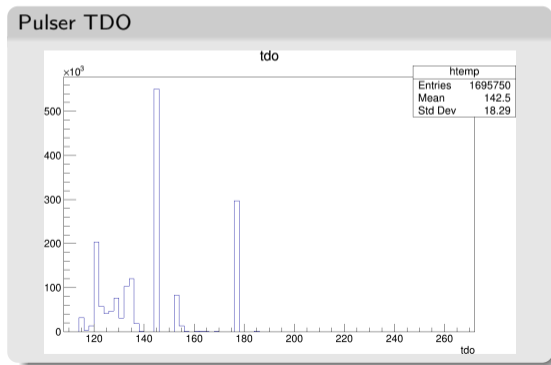
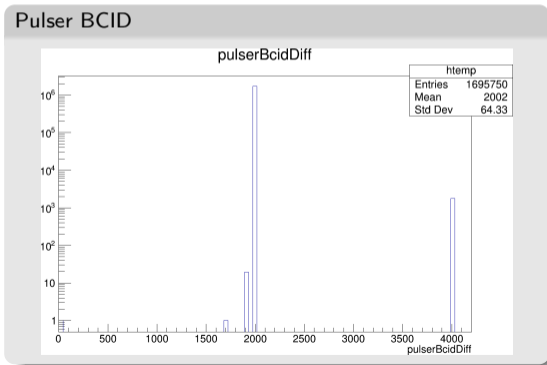
Mu2E pulser & scintillator selection

Selected by pdo: $pdo > 1020$ for bont, pulser and scintillator



Mu2E: Calculating time

- Continuous time calculated based on BCID
- Time scale calculated:
 - Each 20kHz pulser hit as $20\mu s$
 - Time between pulsers: each BCID $\sim 25ns$
- No TDO cuts on pulser hits was applied

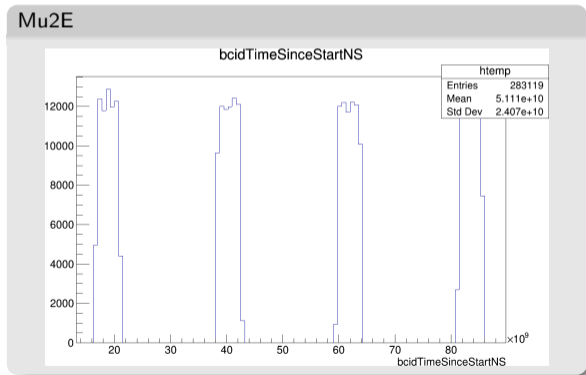
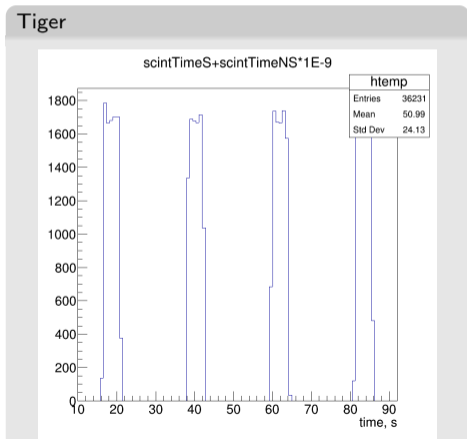


Splitting by spills:

To split by spills:

- Non the less 1s between spills
- Scint hit groups with less then 100 hits removed (noise reduction)

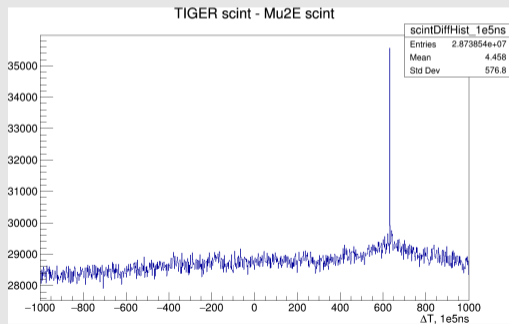
After that, each Tiger spill paired with corresponding Mu2E spill



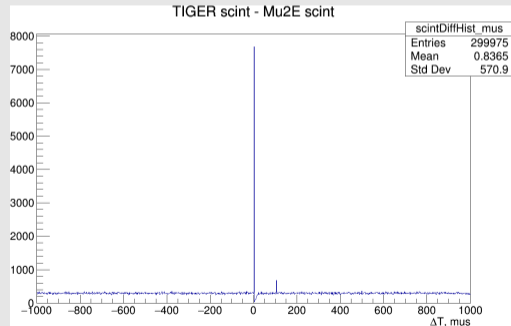
Time difference calculation (per-spill)

- Iterative time estimation method
- Inside time window, plot with time difference between each Tiger and each Mu2E hit is constructed
- Peak position used as the basic estimation for the next step

per 10^5 ns bins



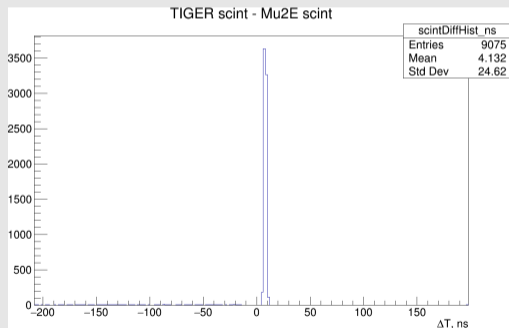
per μ s bins



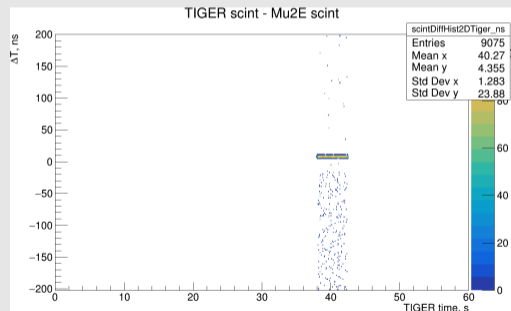
Time difference calculation (per-spill)

- 2D plot can be used to control (and to calculate) time speed difference between Mu2E and Tiger,
- But since Mu2E time based on 20kHz clock, constructed from Tiger external clock, that estimation not used

per ns bins – 1D



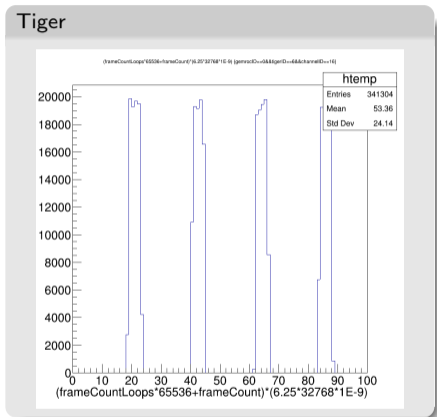
per ns bins – 2D



Adding hits in Mu2E

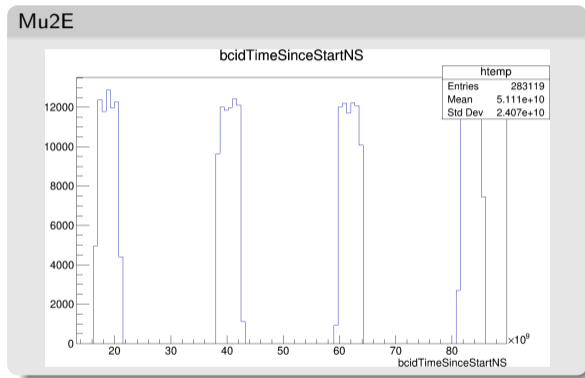
- For each Tiger hit, searched closest Mu2E scith hit in 100 ns window
- For selected Mu2E hit, all straw hits in the same TTree record are used
 - No drift time cut on straw hits applied
 - That can cause existing hits with \sim ms time difference
 - but that hits will not appear on RT curve
- Straw drift time calculated as time difference with Mu2E scintillator hit

Efficiency: Tiger with Mu2e – Sci Coinc



In 4 spills:

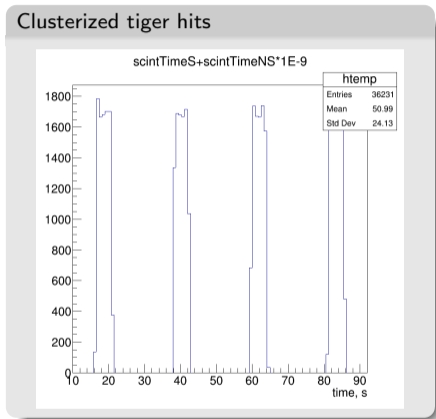
- Tiger – 341K
- Mu2E – 283K (83%)



In last 3 spills:

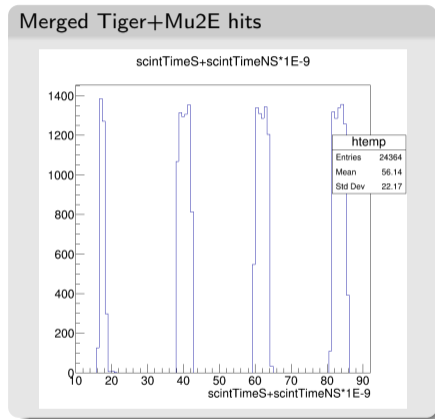
- Tiger – 256K
- Mu2E – 212K (83%)

Efficiency: Tiger with Mu2e – Merged



In 4 spills:

- Clusterized – 36K
- Merged – 24K (66%)



In last 3 spills:

- Clusterized – 27K
- Merged – 21K (77%)

Noise check:

To check for wrongly merged events:

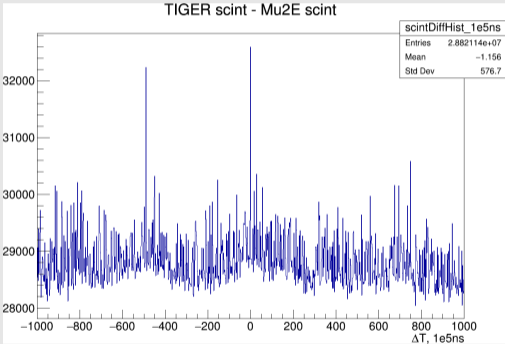
- Merged Run40, subrun 4 with start time from subrun 4
- Merged Run40, subrun 4 with start time from subrun 5
- Merged Run40, subrun 5 with start time from subrun 4
- Merged Run40, subrun 5 with start time from subrun 5

type	spill0	spill1	spull2	spull3
subrun4, time 4	3097	7147	7066	7055
subrun4, time 5	34	32	41	49
subrun5, time 4	35	27	39	36
subrun5, time 5	7238	7022	7199	7171

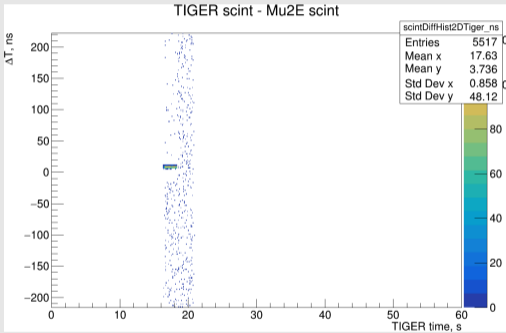
We have (estimated) around 0.5% wrongly merged hits

What happened with first spill

Time difference calculation, 1D



Time difference calculation, 2D



- Seems, time due to wrongly accepted pulser hit, we have timing problem
- For July data, that was solved by applying cuts on pulser TDO