ST Calibration Update

Eric Pooser

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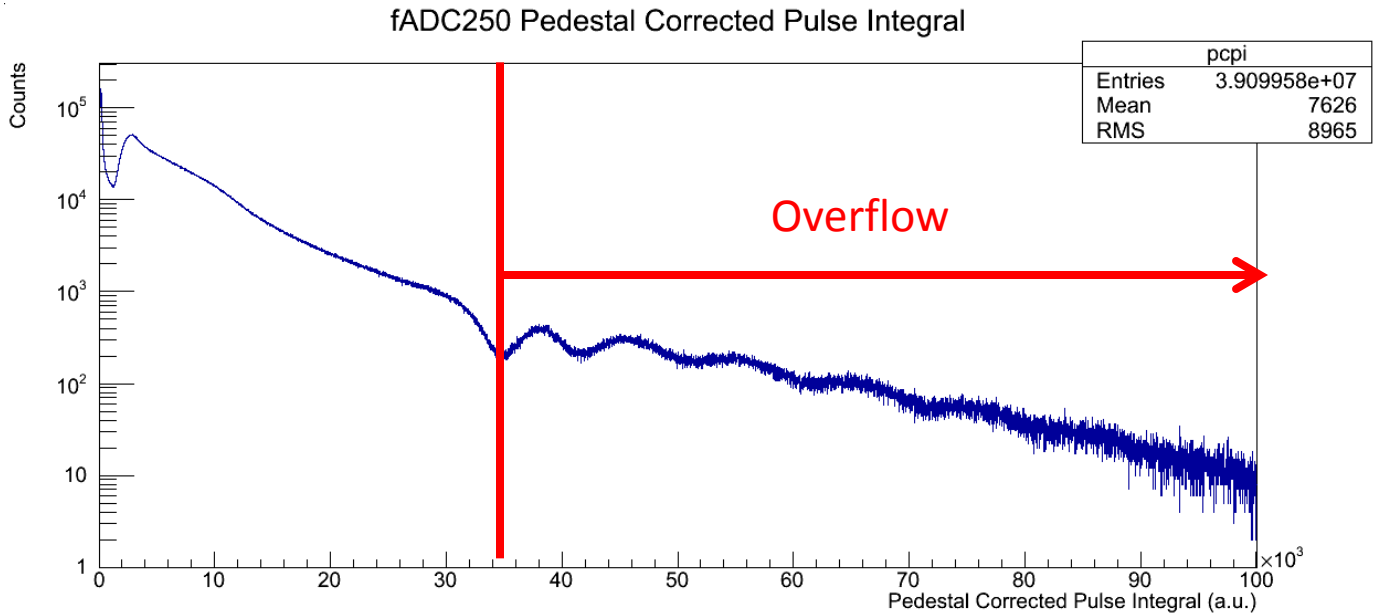
Runs Used for the following Calibrations

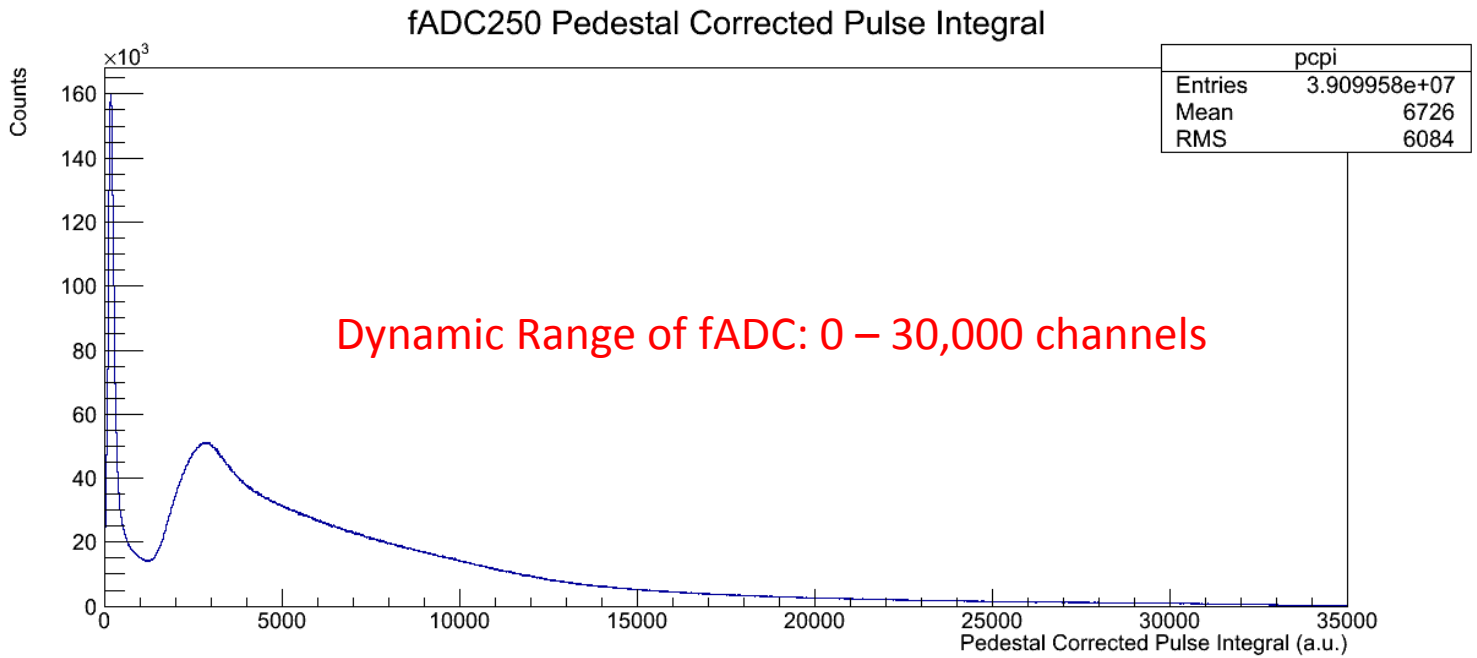
- FCAL Trigger
  - Runs (1505 – 1525): ≈ 12 M events
  - 50 nA, 10 GeV, 1200 A, 10 mm CH2, 5.0 mm hole
  - PC = Retracted, Radiator: 2 x 10-5 RL
- FCAL/BCAL Trigger
  - Runs (2397 – 2420): ≈ 125 M events
  - 100 nA, 10 GeV, 1200 A, 10 mm CH2, 5.0 mm hole
  - PC = 5 x 10-3 RL, Radiator: 2 x 10-5 RL

Time Walk Calibrations

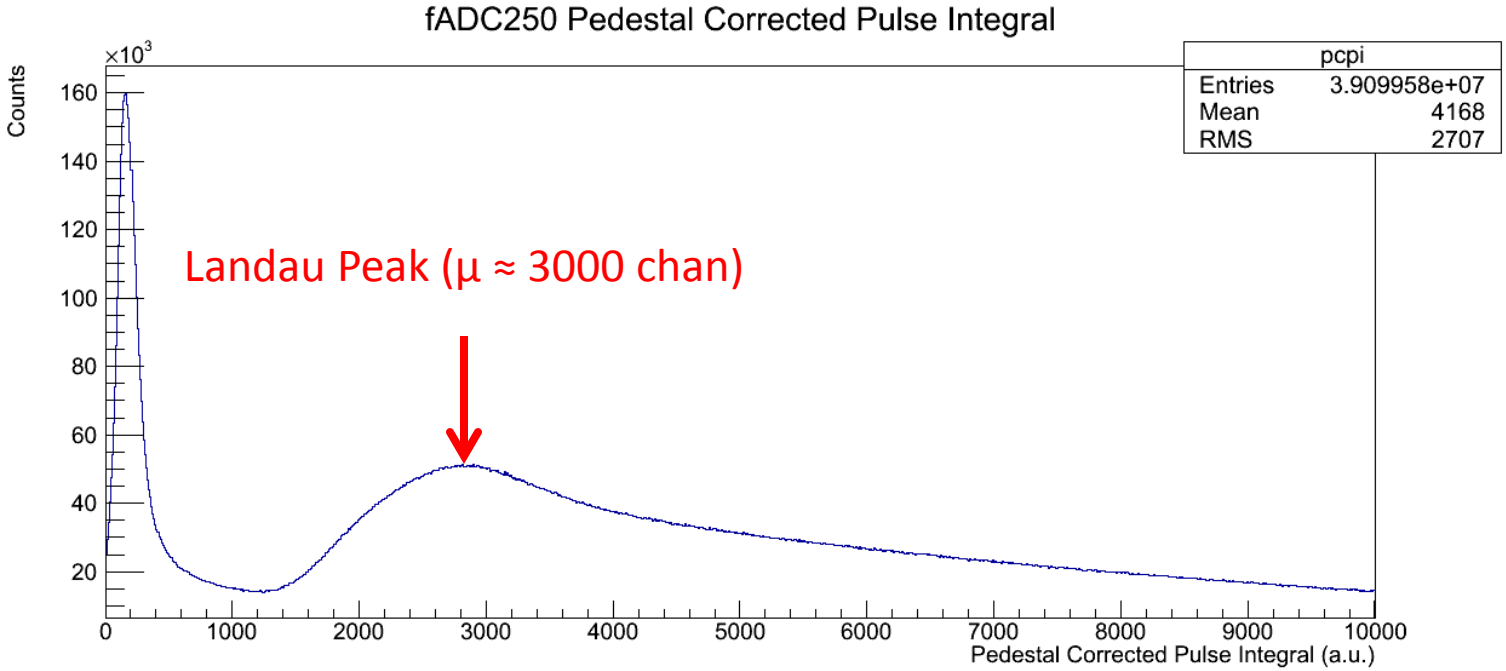
- Functional Form
  - $T_{corr} = T_{hit} - C_1(A^{c_2} - {A_0}^{c_2})$
  - A ≡ Pedestal Corrected Pulse Integral
  - A_0 ≡ Mean of minimum ionizing Landau Peak
- For now, A_0 is hard coded to be 3000
  - Nothing is gained by allowing this value to be a parameter
- Future calibrations could implement a fitting procedure which would accurately feed A_0 into the time walk fits on a channel by channel basis

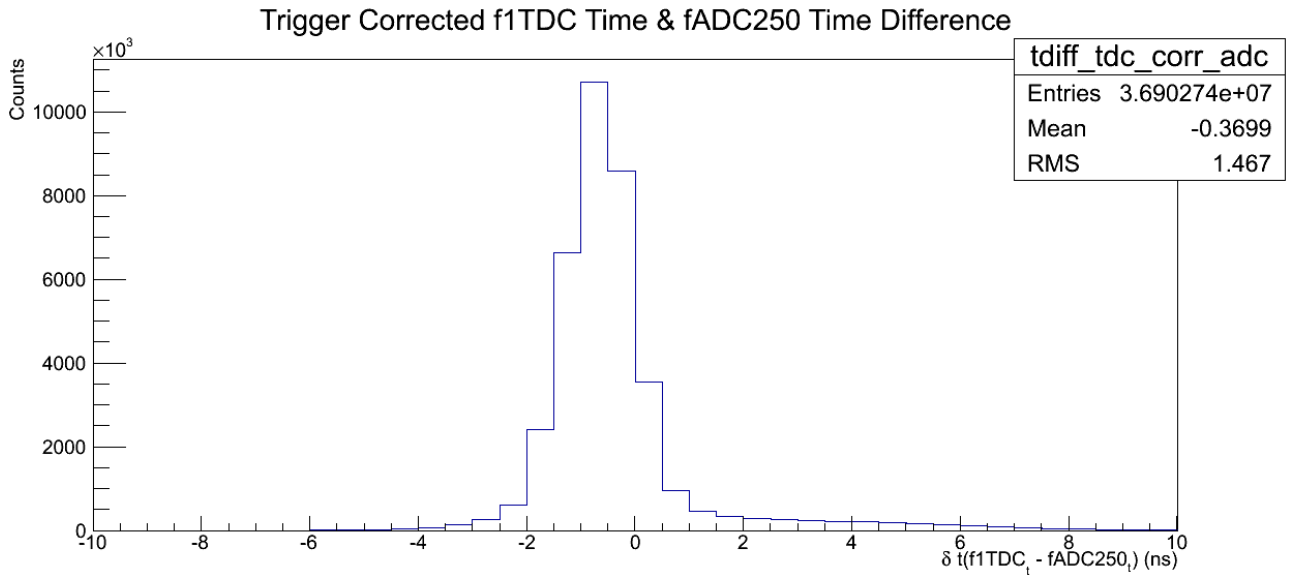
Pedestal Corrected Pulse Integral



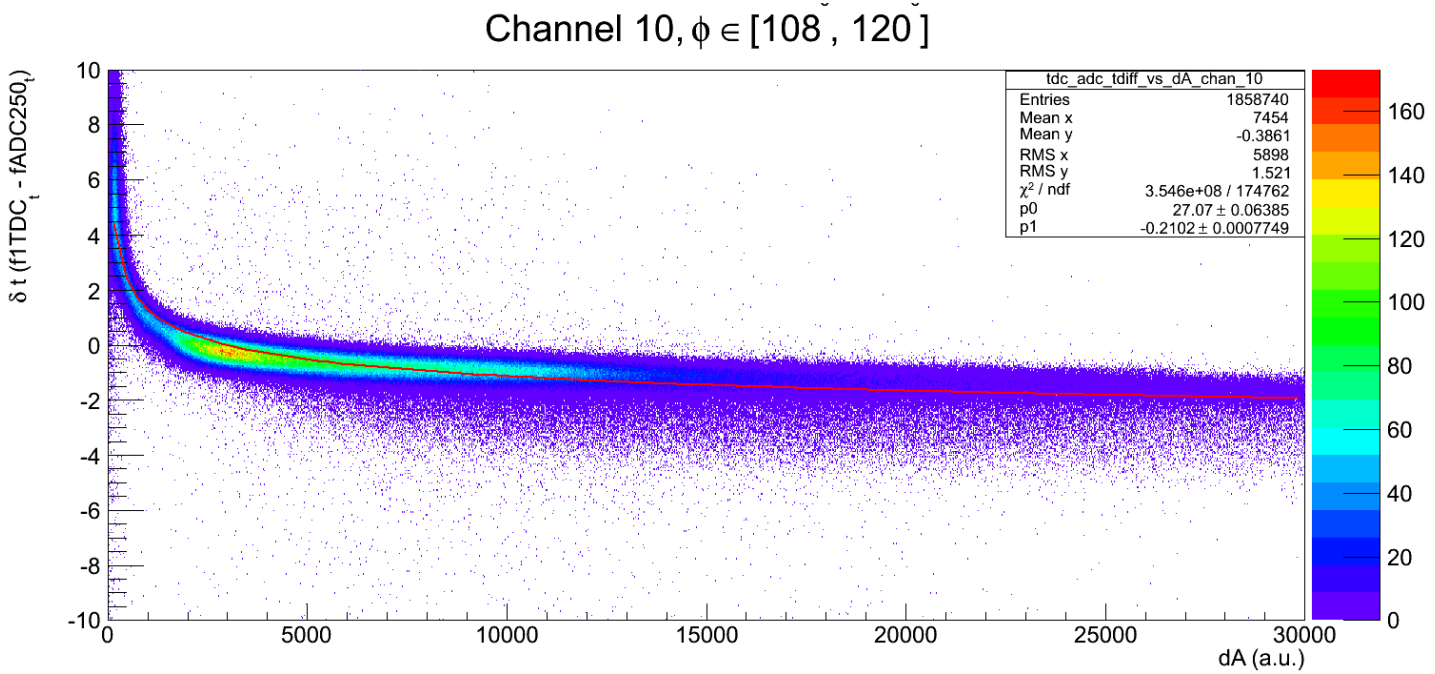


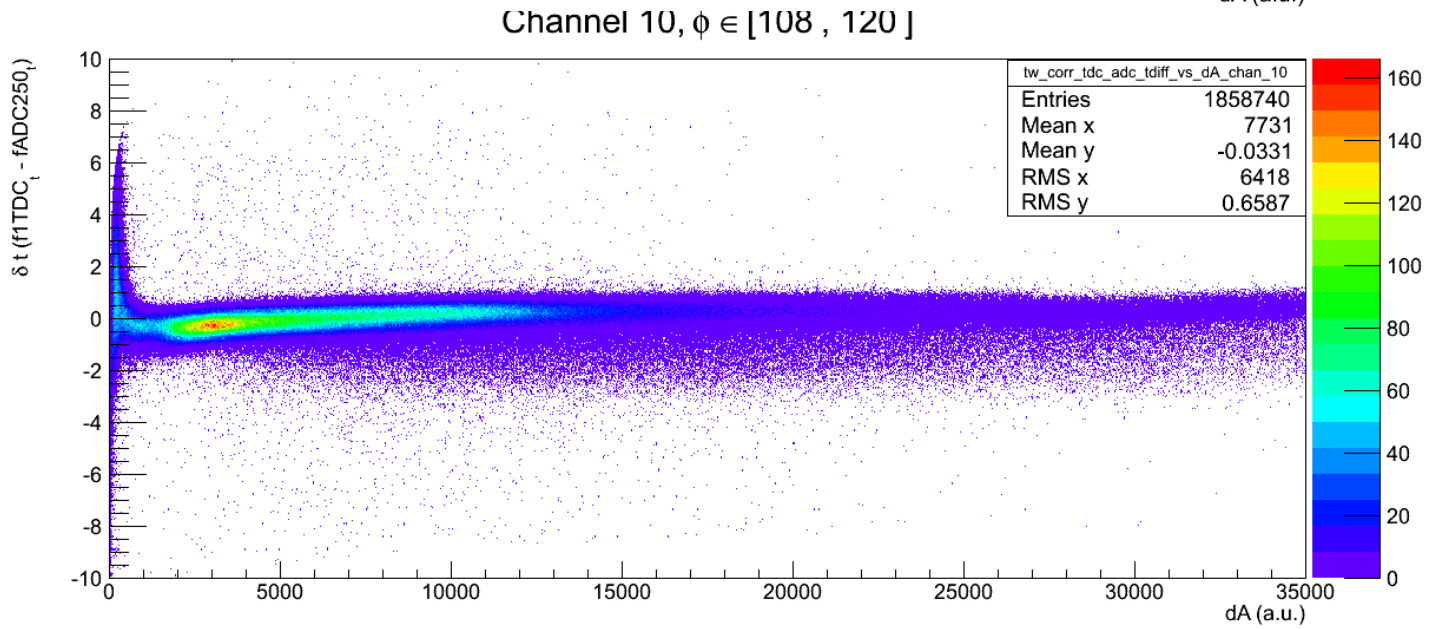
Landau Peak Mean & Hit Times



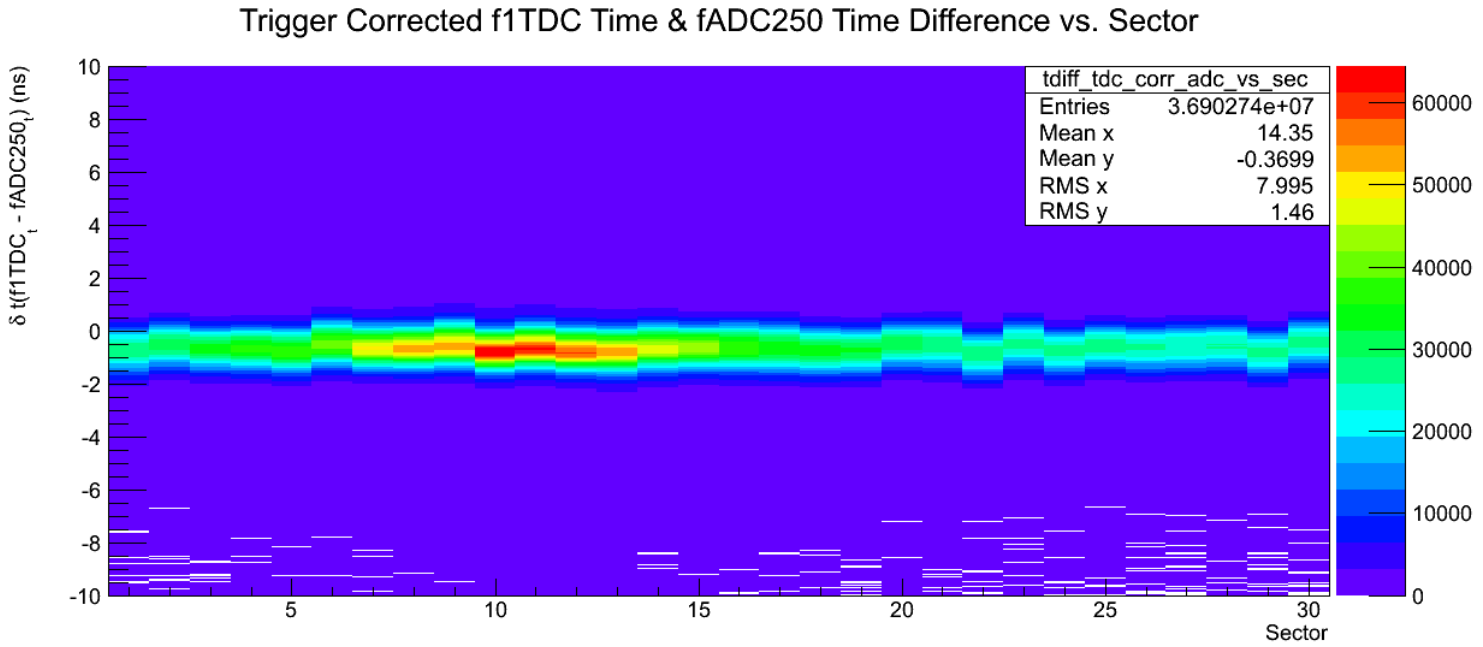


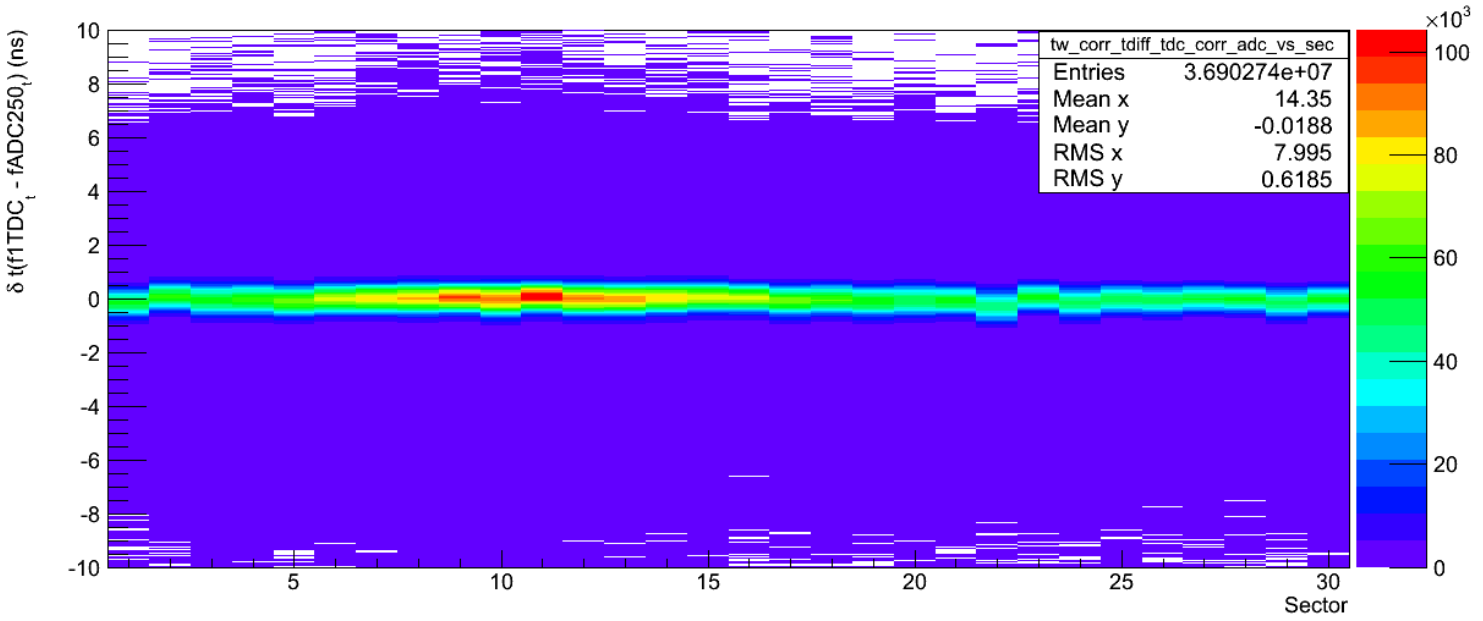
Time Walk Corrections (Before & After)



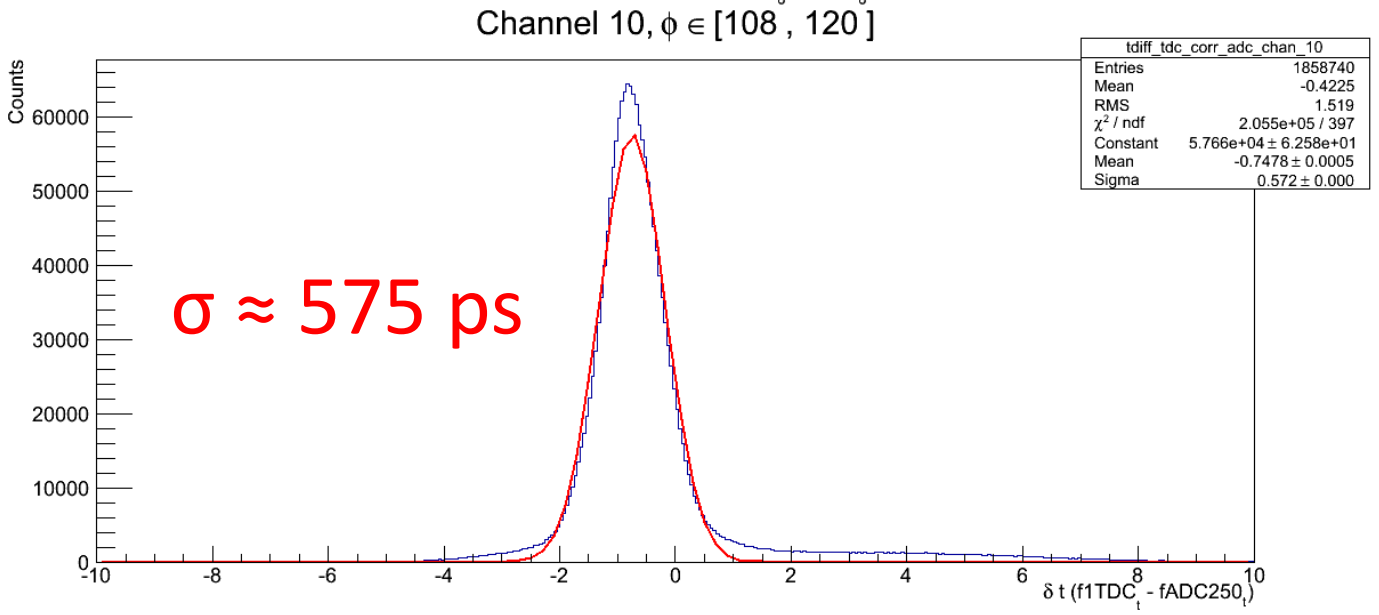


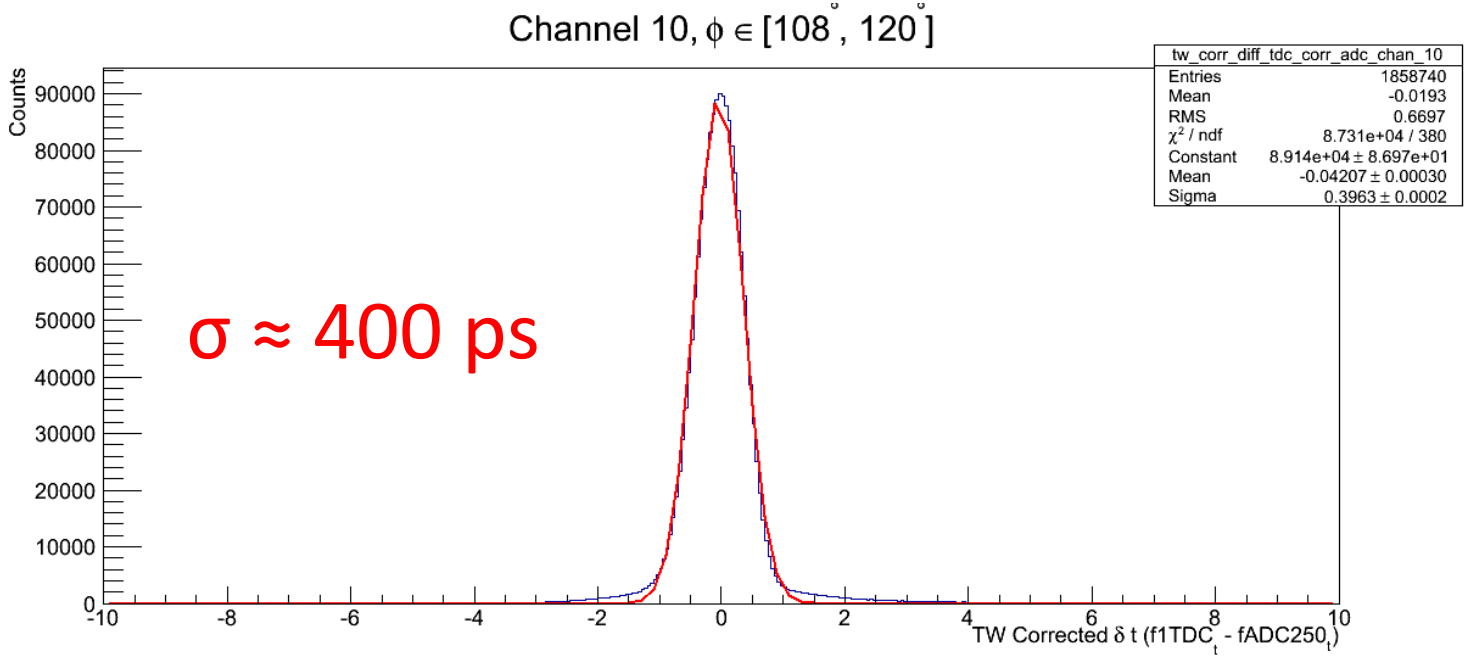
Time Walk Corrections (Before & After)



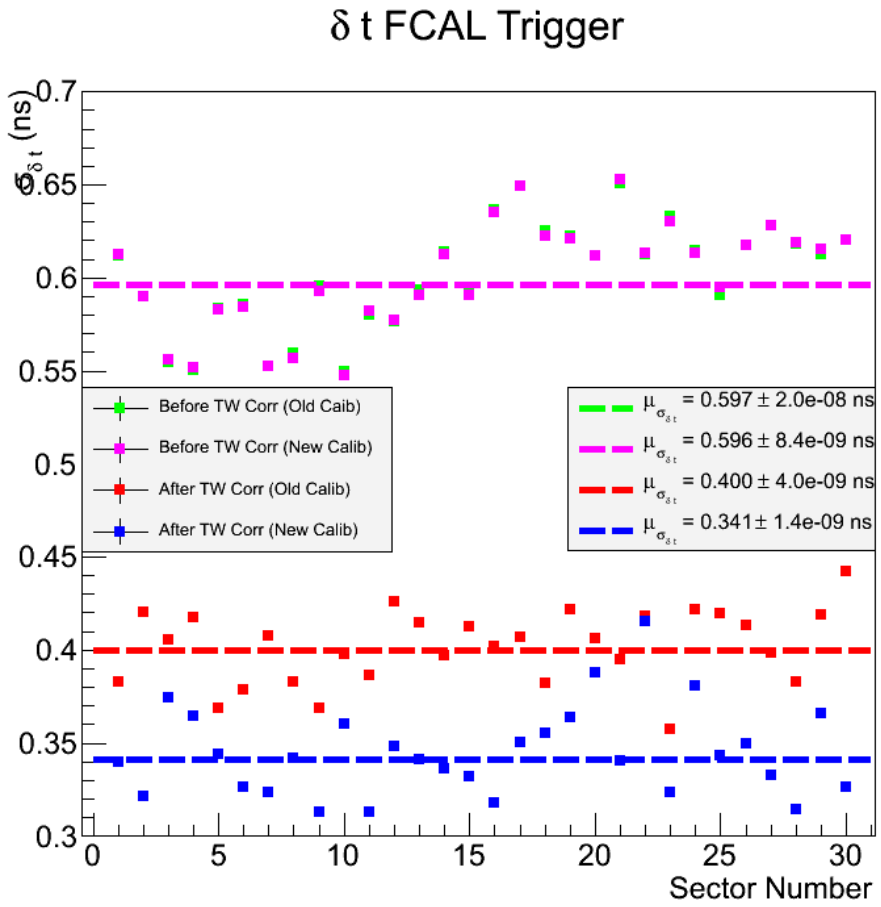


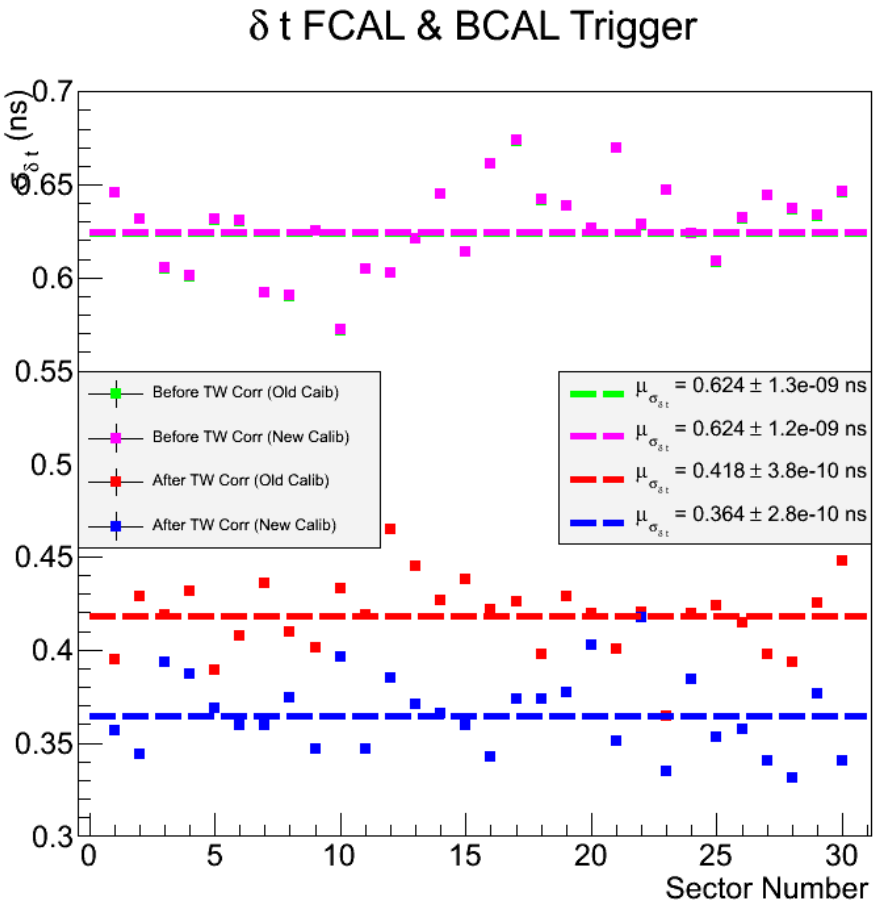
Time Walk Corrections (Before & After)





Time Walk Corrections (Before & After)





Time Walk Corrections (CCDB)

Old TW Corrections

a double	b double	c double	d double
-5.98436	30.6735	-0.197795	3000.
-5.74918	33.2188	-0.215453	3000.
-4.7521	32.0355	-0.229214	3000.
-5.86664	28.292	-0.191438	3000.
-5.33075	33.4868	-0.234219	3000.
-5.89021	29.6068	-0.203112	3000.
-7.2622	27.2912	-0.174095	3000.
-5.28709	26.6639	-0.186224	3000.
-5.41625	34.5643	-0.247462	3000.
-6.07704	31.4354	-0.229177	3000.
-7.02867	32.2889	-0.224661	3000.
-5.65852	37.7507	-0.252702	3000.
-6.46792	36.2135	-0.239898	3000.
-5.95707	37.123	-0.253619	3000.
-7.65571	27.0224	-0.16603	3000.
-6.01246	37.1526	-0.242735	3000.
-5.17844	35.9117	-0.237944	3000.
-5.06646	37.3144	-0.259386	3000.
-5.95767	32.0141	-0.211838	3000.
-5.39245	28.516	-0.213607	3000.
-6.22497	29.8432	-0.19569	3000.
-4.98242	34.6354	-0.236865	3000.
-4.98027	31.9185	-0.234256	3000.
-5.83649	30.118	-0.197583	3000.
-7.01937	33.6604	-0.23221	3000.
-6.2376	35.0567	-0.235418	3000.
-5.76925	40.1913	-0.264262	3000.
-6.13015	33.4658	-0.225175	3000.
-7.79206	30.8993	-0.191033	3000.
-8.4125	32.3793	-0.199844	3000.

New TW Corrections

a double	b double	c double	d double
0.0	36.1951	-0.258309	3000.0
0.0	50.6372	-0.348336	3000.0
0.0	33.0807	-0.249816	3000.0
0.0	33.1364	-0.255698	3000.0
0.0	33.8473	-0.248099	3000.0
0.0	30.9373	-0.241712	3000.0
0.0	29.7926	-0.244115	3000.0
0.0	27.7862	-0.221028	3000.0
0.0	30.8224	-0.250627	3000.0
0.0	27.1381	-0.210819	3000.0
0.0	33.6636	-0.271018	3000.0
0.0	31.7141	-0.246943	3000.0
0.0	35.1699	-0.265339	3000.0
0.0	32.518	-0.253512	3000.0
0.0	36.1491	-0.282043	3000.0
0.0	49.3353	-0.335353	3000.0
0.0	31.3982	-0.229874	3000.0
0.0	36.7504	-0.268670	3000.0
0.0	38.9925	-0.280582	3000.0
0.0	24.4279	-0.177818	3000.0
0.0	35.6777	-0.265449	3000.0
0.0	28.1666	-0.182136	3000.0
0.0	42.9469	-0.315678	3000.0
0.0	35.0066	-0.252516	3000.0
0.0	36.5003	-0.281812	3000.0
0.0	38.5882	-0.282000	3000.0
0.0	46.5871	-0.319783	3000.0
0.0	37.956	-0.283098	3000.0
0.0	34.4722	-0.242136	3000.0
0.0	34.8089	-0.266499	3000.0

Propagation Time Correction Event Selection

- Only events where exactly 2 hits in the ST occurred were selected
  - The two hits could not be in the same paddle
- The events were then grouped into 5 possible scenarios such that the two hits occurred in the following sections of the ST:
  - Straight section
  - Bend section
  - Nose section
  - Bend & Nose section
  - Straight, Bend, & Nose section

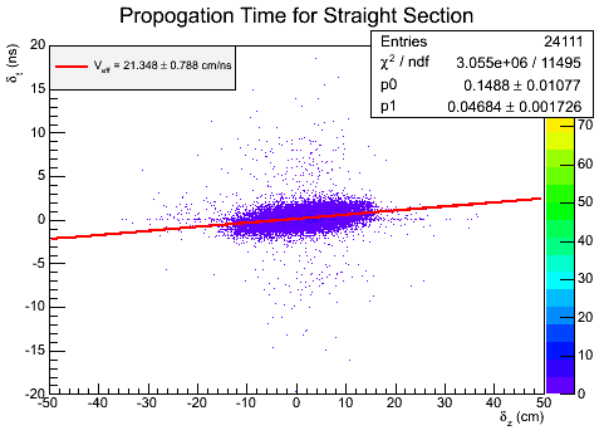
Propagation Time Corrections (cont.)

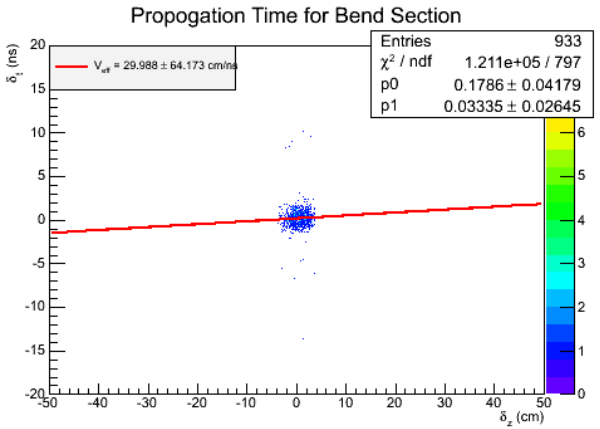
- The same data used for the TW corrections were used for the propagation time correction studies
- Only FCAL/BCAL trigger runs using the new TW corrections are illustrated here
- The time difference of the two hits are plotted against the difference of the hits location along the path of the scintillators

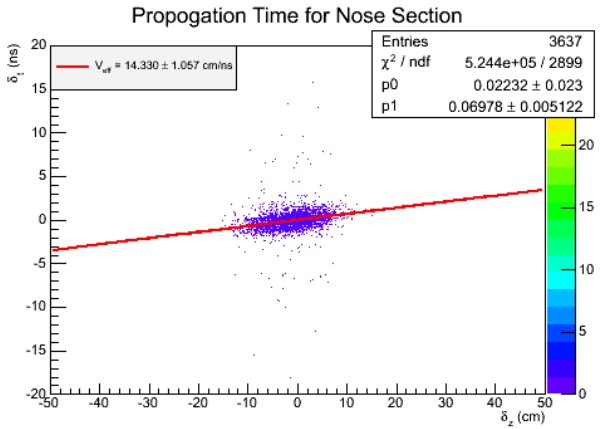
Propagation Time Corrections (cont.)

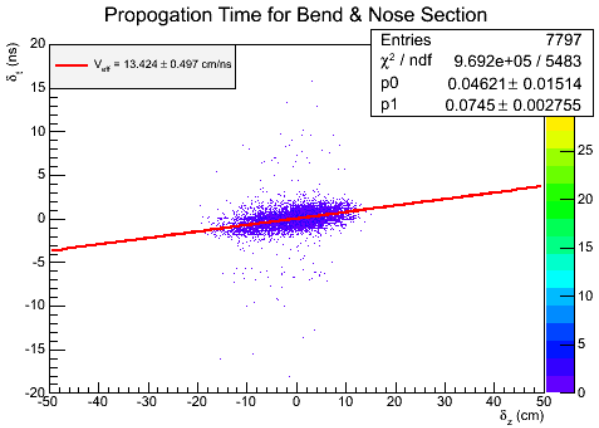
- The δt vs δz data were then fit with a polynomial of order 1 and V_{eff} is determined
- The correction $\delta t_{corr} = \delta t_{hit} - \delta z_{hit}/V_{eff}$ is then applied to the data
- TW corrected and propagation time corrected time resolutions are obtained for selected regions of the Start Counter

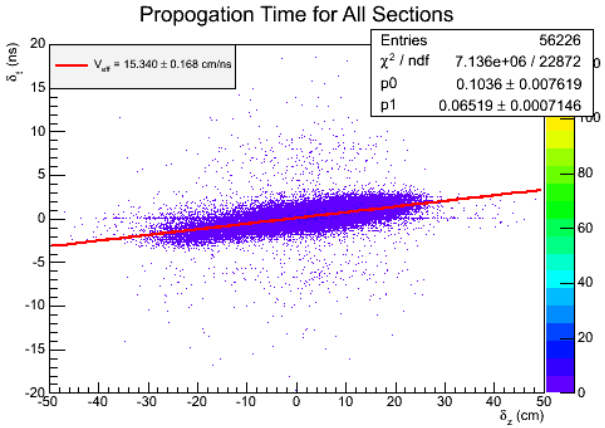
δt vs δz (Uncorrected)





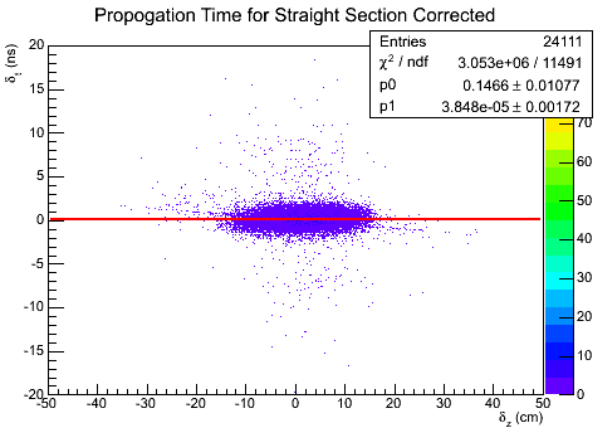


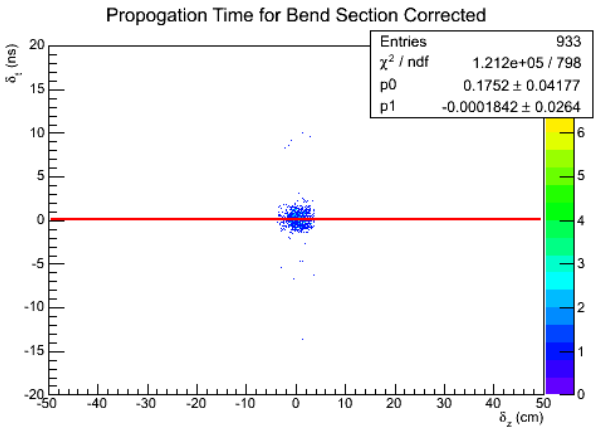


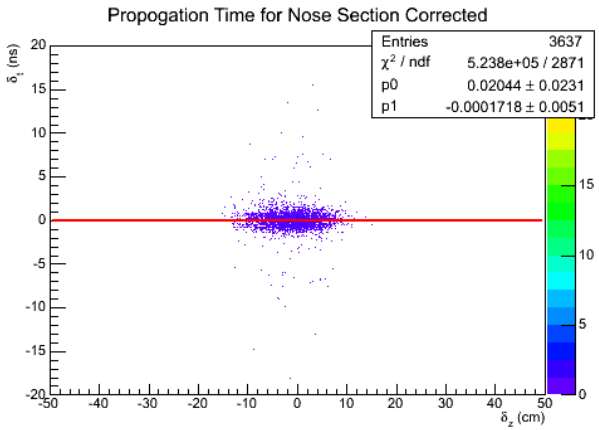


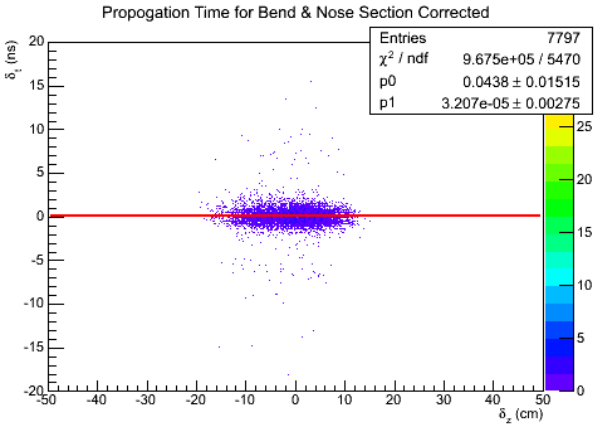
- Some of the data is contradictory to bench mark measurements made at FIU
- This could simply be a lack of statistics

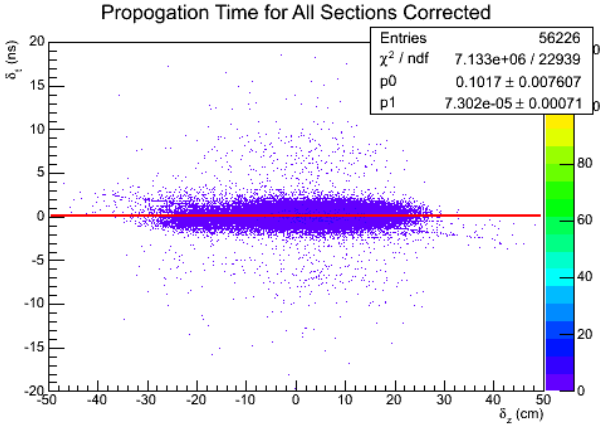
δt vs δz (Corrected)





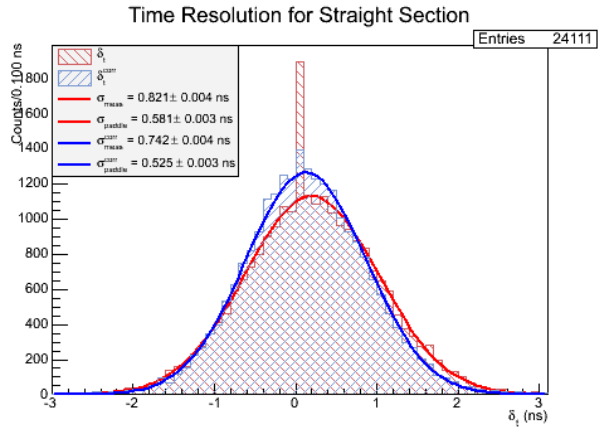


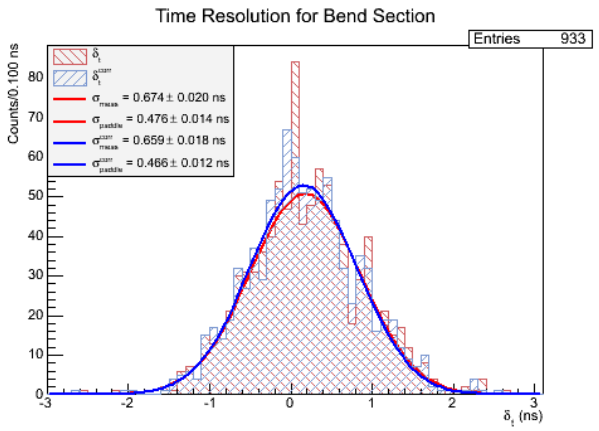


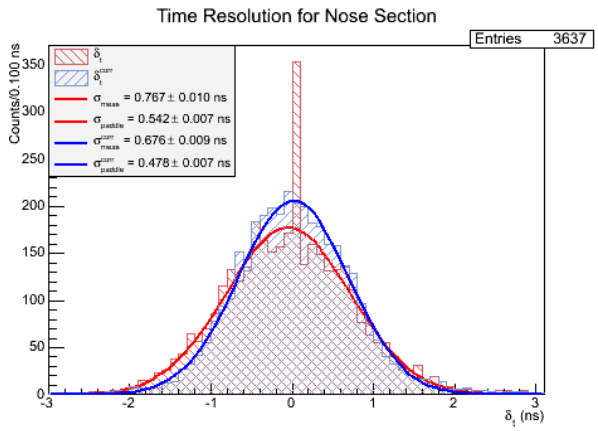


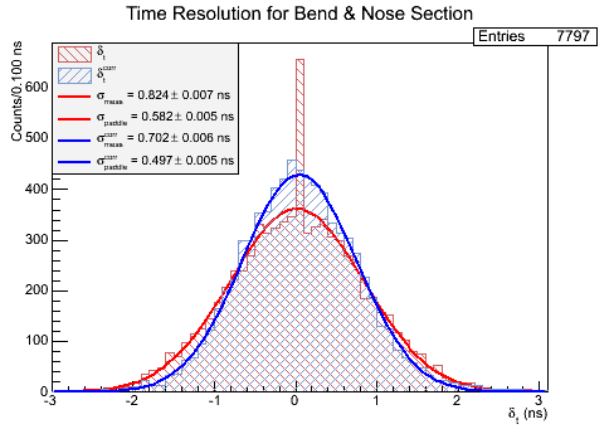
- After the correction, the effective velocity of light in all regions of the ST become essentially infinite

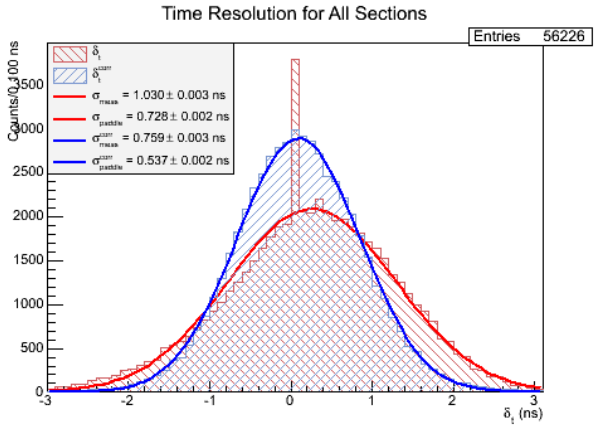
Time Resolutions for Runs (2397 – 2420)











- The aforementioned propagation time corrections substantially improve the time resolution measurements
  - The updated TW corrections provided for better time resolutions (≈ 40 ps)
- These preliminary measurements indicate an average time resolution of the entire ST to be approximately 500 ps

Future Plans

- Further TW correction studies are needed
  - Various functional forms need to be investigated
  - Develop algorithm to locate mean of Landau peak in pedestal corrected pulse integral spectrum
- Fall back on benchmark measurements made at FIU regarding propagation time and implement these into the PID library until we have more statistics from the upcoming Spring run
  - A different algorithm is needed for the two cases (beam data vs. benchmark data)
- Develop algorithm to measure propagation time corrections on a paddle by paddle basis
- Develop algorithm to select events in 5 cm regions of the paddles so that we may investigate time resolution vs. distance plots so that we may compare beam data to FIU benchmark data