HPS Pile-Up Pulse Updates: Phase Studies

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HPS TS Meeting 1/20/23

An Overview:

- Difference between All and On Track Hits
- On Track Event Time Phase Separated T0 Distributions
- On Track Event Time Phase Separated CT vs FT Contours
- Single Pulse distributions
- Projected Multi Pulse Distribution

A Reminder: P1 vs P2 for On Track and All Hits

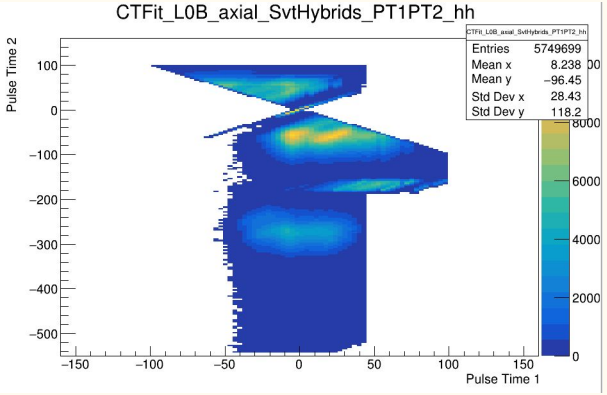
Here we plot the closest time to zero (kept time) vs farthest for PileUp

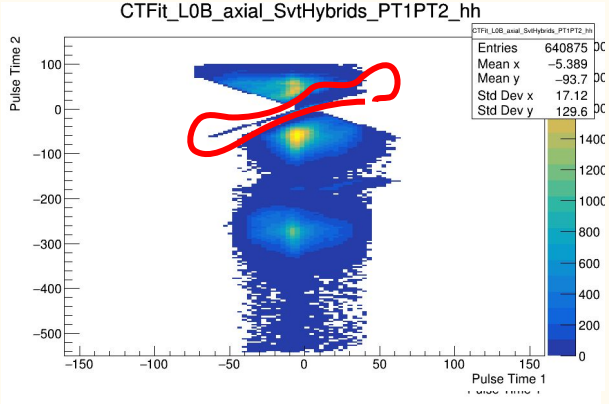
The top plot is all hits, while the lower one it hits on track.

Previous work has shown the region circled in red is largely understood.

Note that we have a 10 fold reduction of pileUp events for hits on track in layer 1.

This is compared to 1 pulse, where its 2 fold reduction.



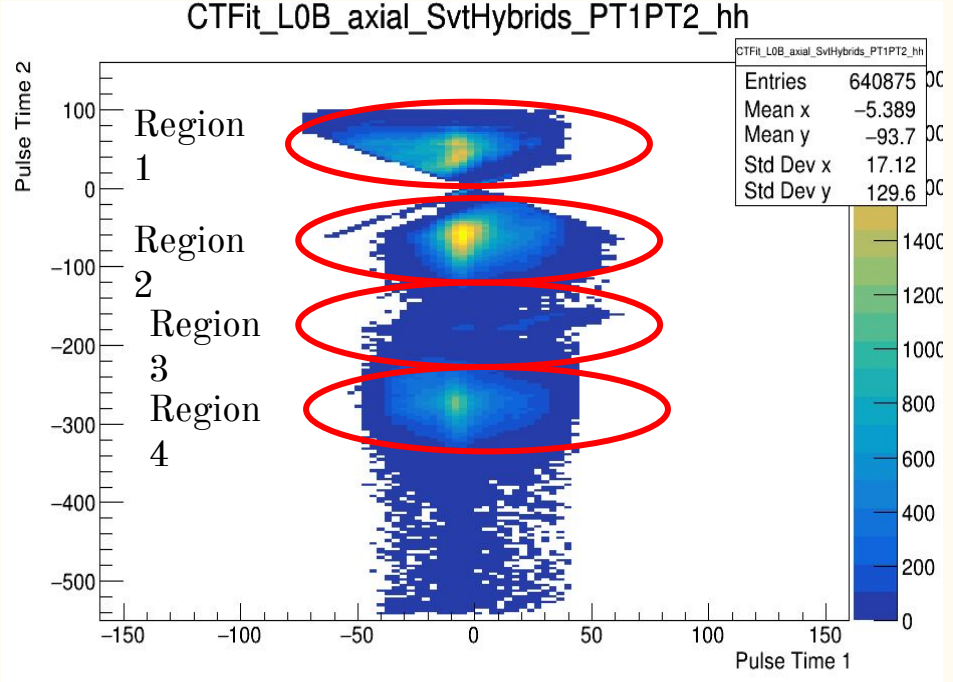


Event Phase Separated Plots

In the following plots we separate events into bins depending on what 4 ns time sample of the event clock our pulse arrives arrives per 24 ns readout.

Red will denote 0, Green will denote 2, and Blue will denote 5

The other phases are removed for the visual clarity.



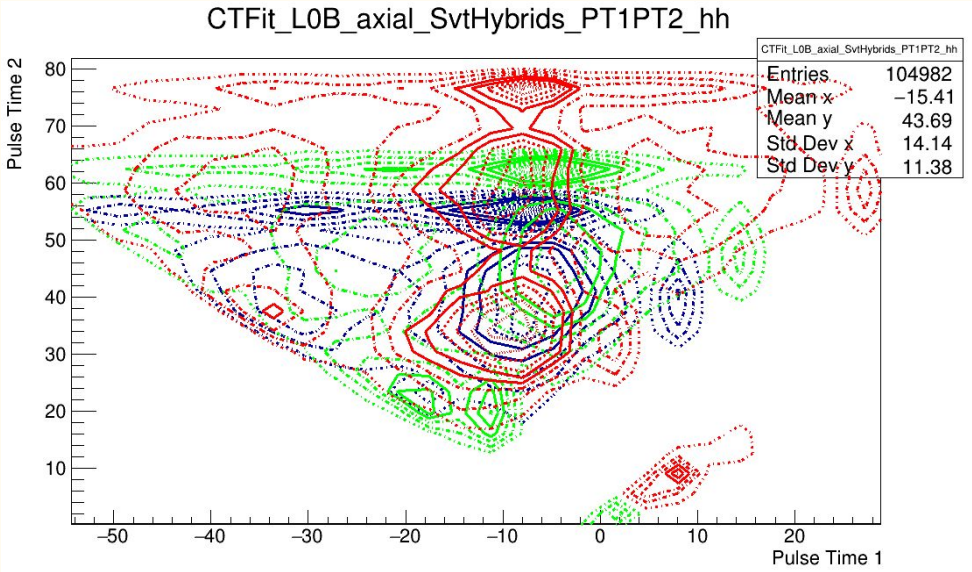
Region 1 Event Phase Separated Plots

Here is region one, wherein the pulse time of the Farther pulse is positive.

Here the farther pulse travels downwards as event time progresses.

It is a general trend that one may identify features between contour plots that are non-uniformly displaced.

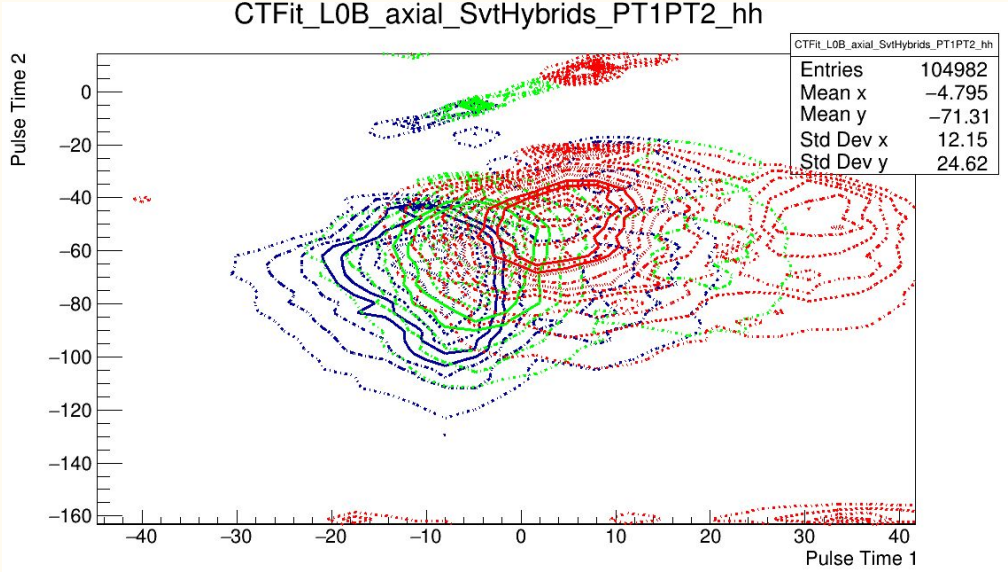
As you get closer to the axis PT1=PT2, the horizontal displacement becomes much more pronounced.



Region 2 Event Phase Separated Plots

All of our profiles drift from top right to bottom left.

You can see the region with high degeneracy (P1=P2) has high horizontal displacement.

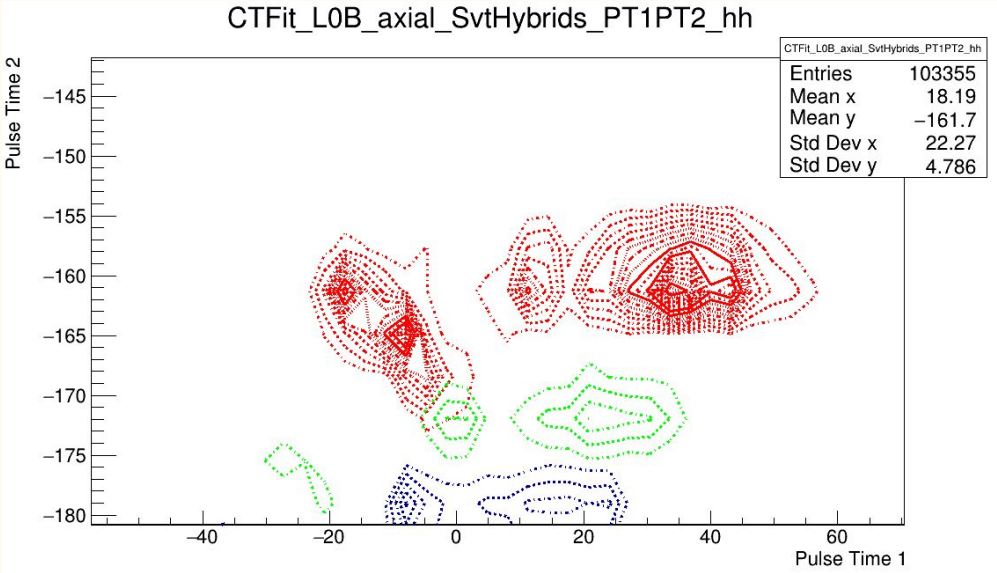


Region 3 Event Phase Separated Plot

Here are the plots for Region 3

We have a large collection of out of time events that also drift downwards

Cameron has an explanation for this plot here.

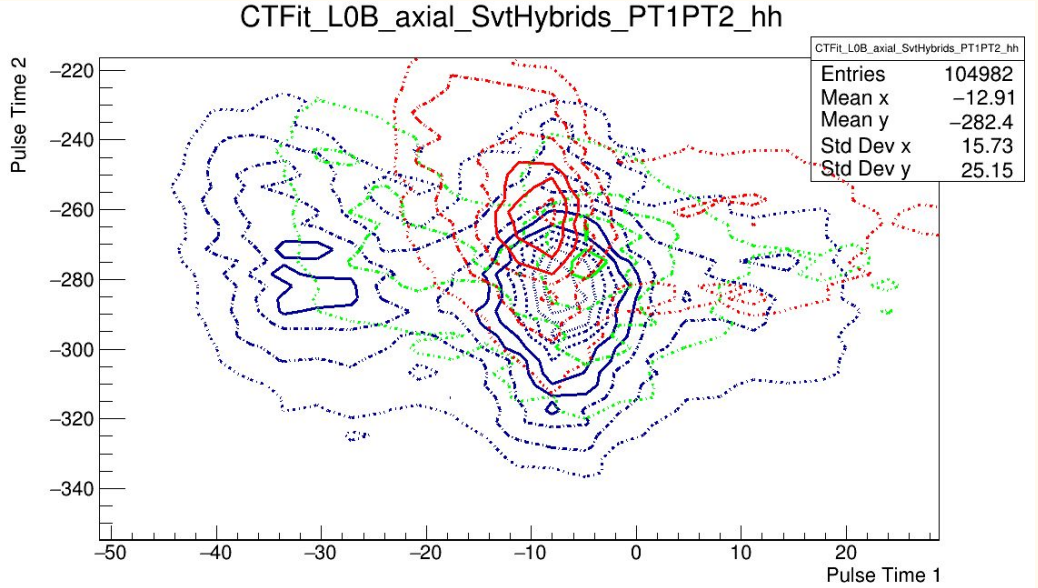


Region 4 Event Phase Separated Plot

In this distribution, we are far removed from a region of high degeneracy.

Again the features in this plot are drifting downwards with phase, but are not displaced horizontally too much

I believe that this is due to it being far from the region of degeneracy.



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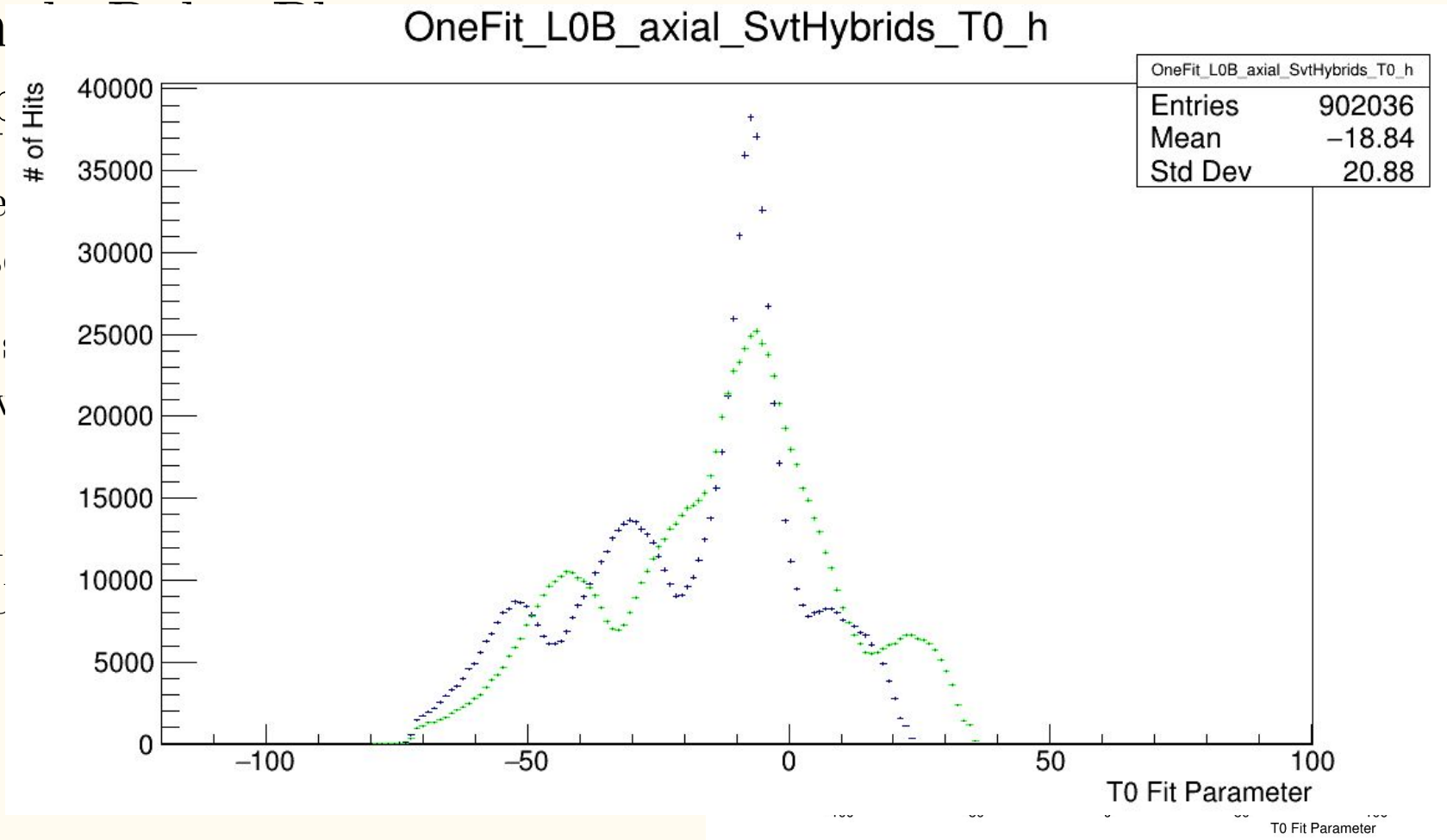
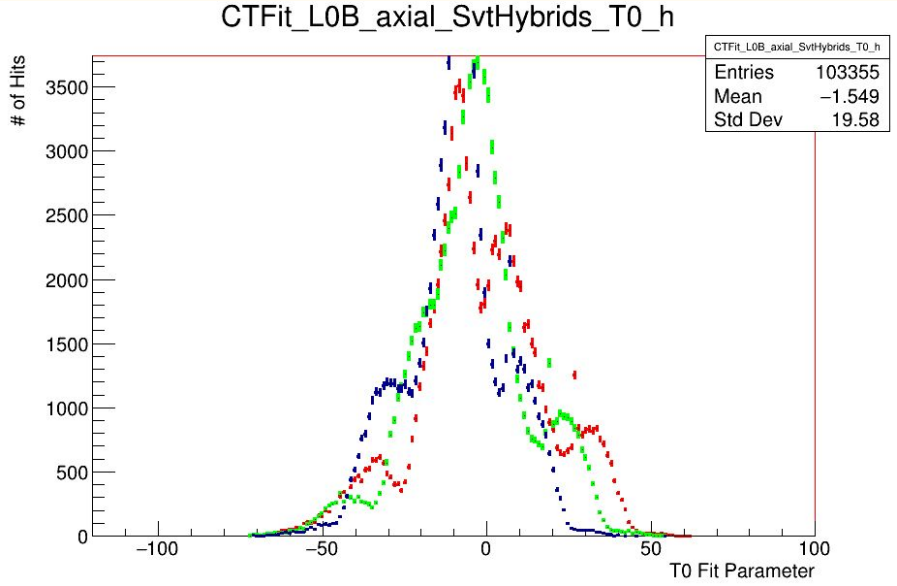


T0 Fit Parameter

Projection of P1-P2 onto P1

It is not evident that you have translating pulses here.

A similar plot is seen if you project onto the farthest pulse and if you look into regions.



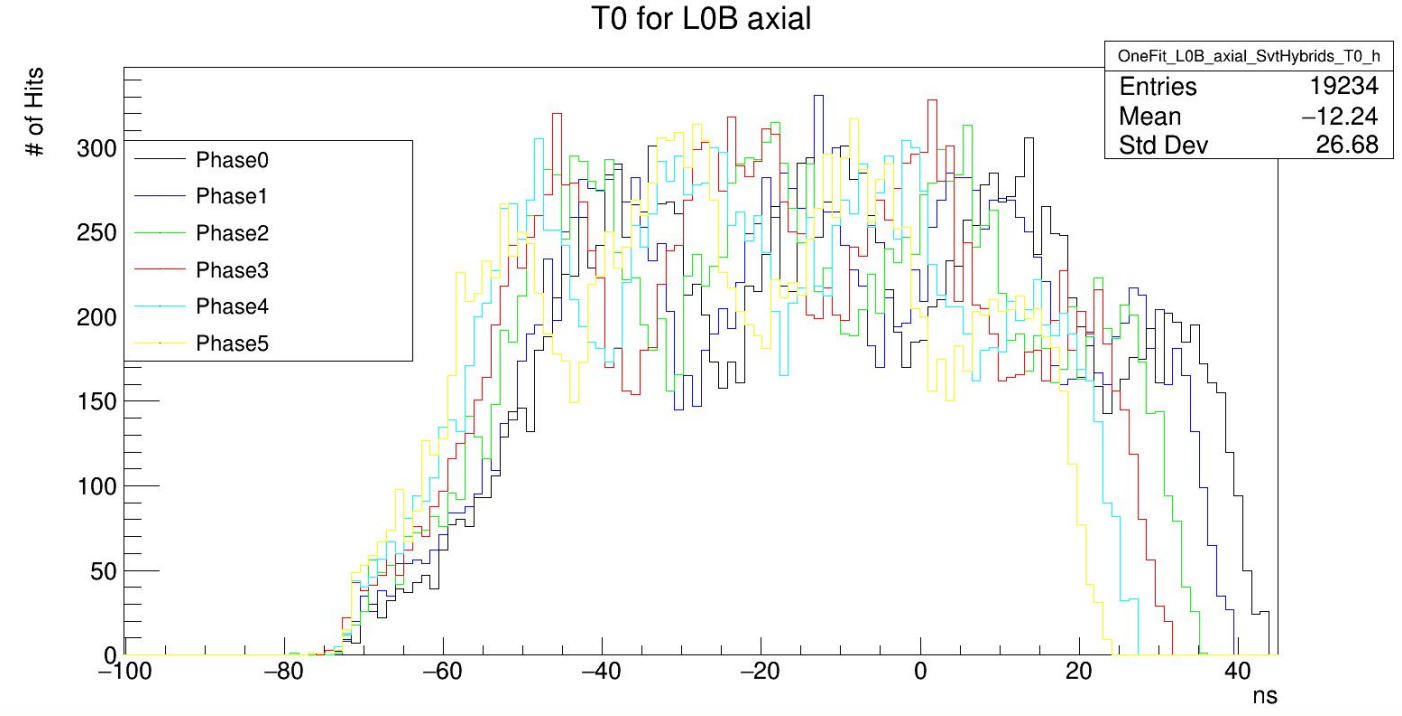
What to do next

I will apply a time translation to our pulses centering each one dimensional feature to the on-time T0

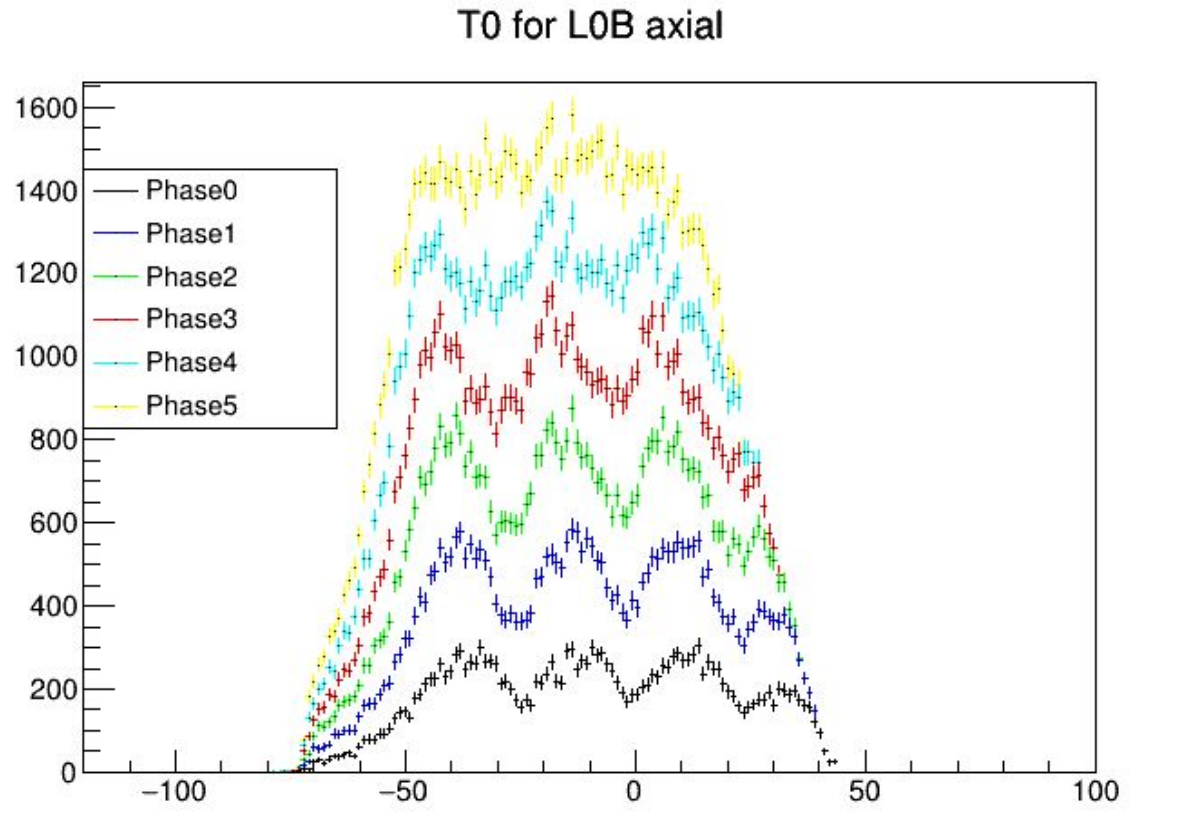
I would like to plot our same distribution above for the pileUp pulse.

Feb 15/2023

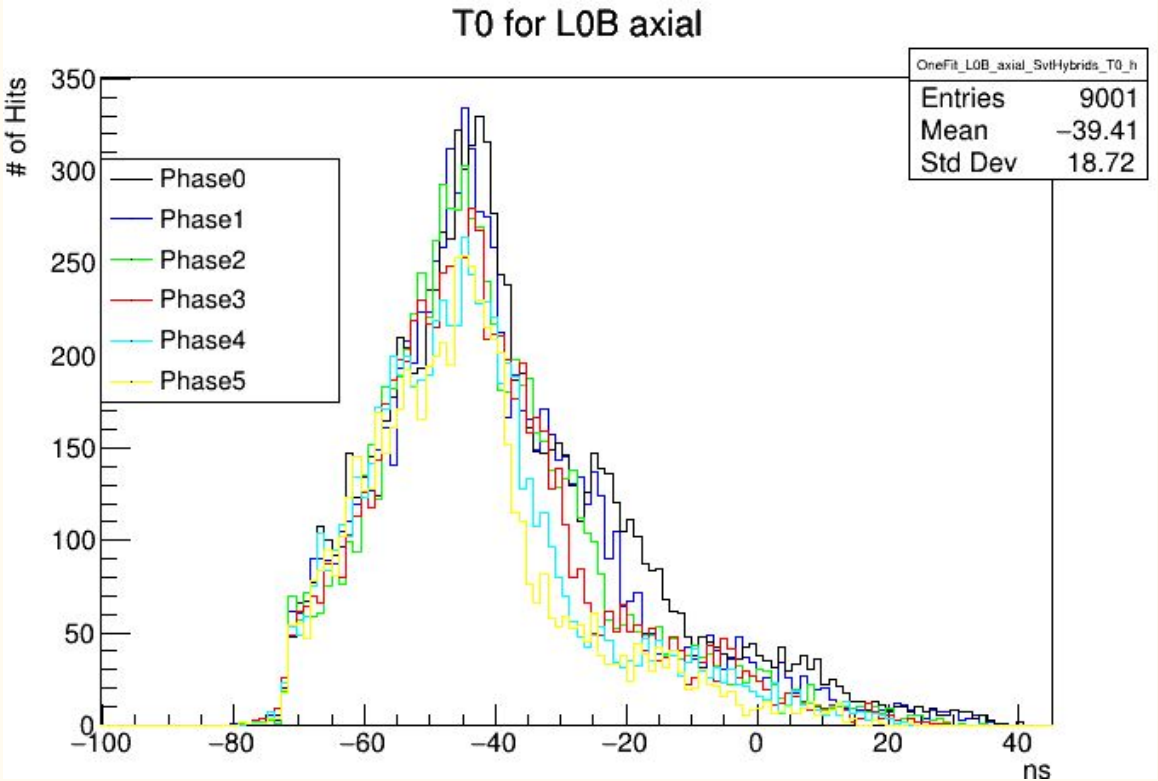
Phase Separated T0 Plots Random Triggers



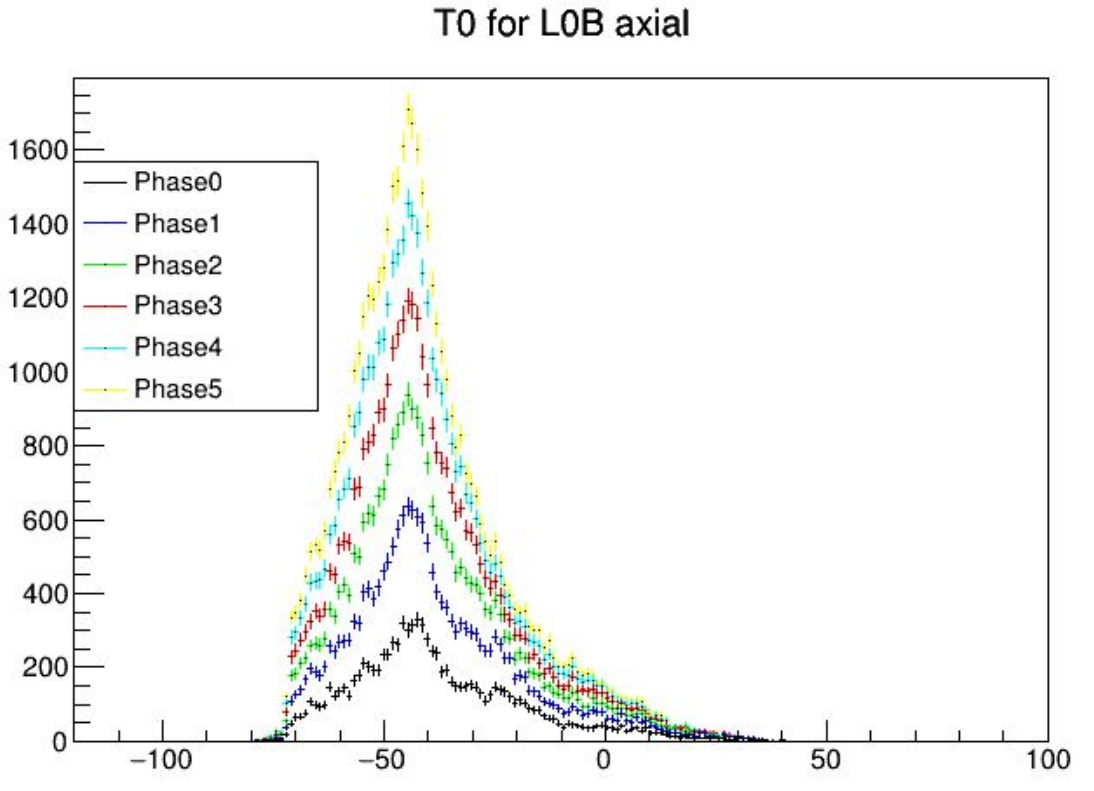
Phase Separated T0 Plots Random Triggers (Stacked)



Phase Separated T0 Plots Random Triggers (RF driver)



Phase Separated T0 Plots Random Triggers (RF driver) stacked.



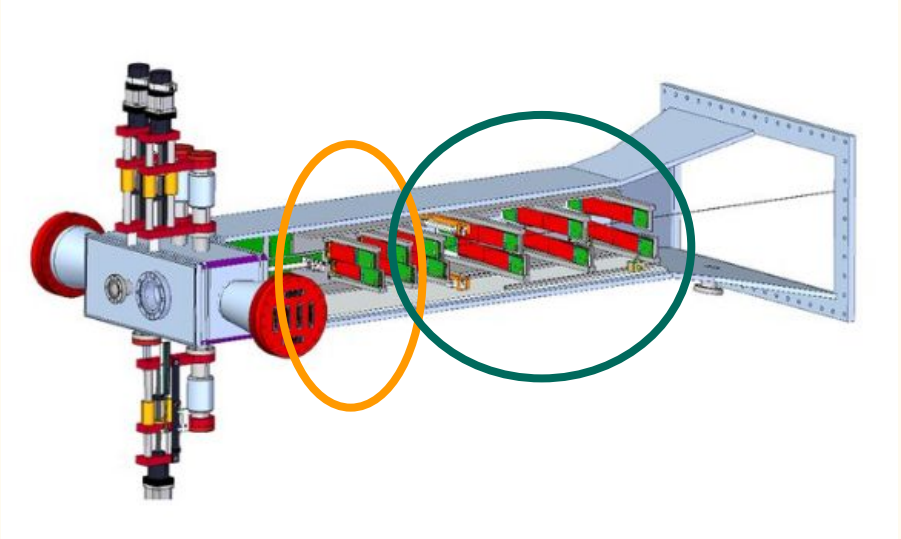
March 7/23

New Pushes: The FSP Processor

The Upcoming Plots were made using the FSP Processor. This processor matches the ECal cluster, track, and its constituent hits into a Particle Object.

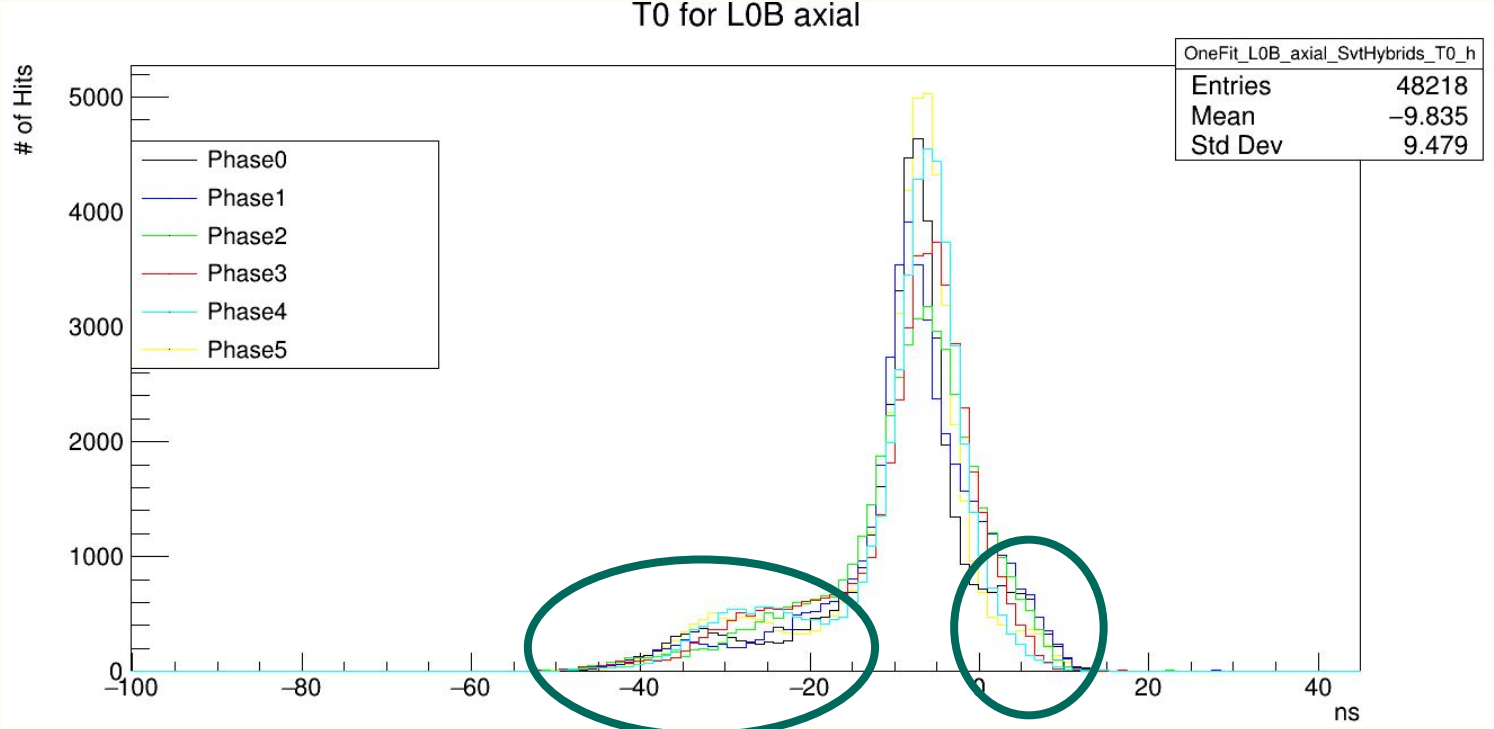
My analyzer then conditions on ECal time (within 2 ns of the trigger peak), and keeps only those hits in Particles with this time.

These are the hits shown in the coming plots.

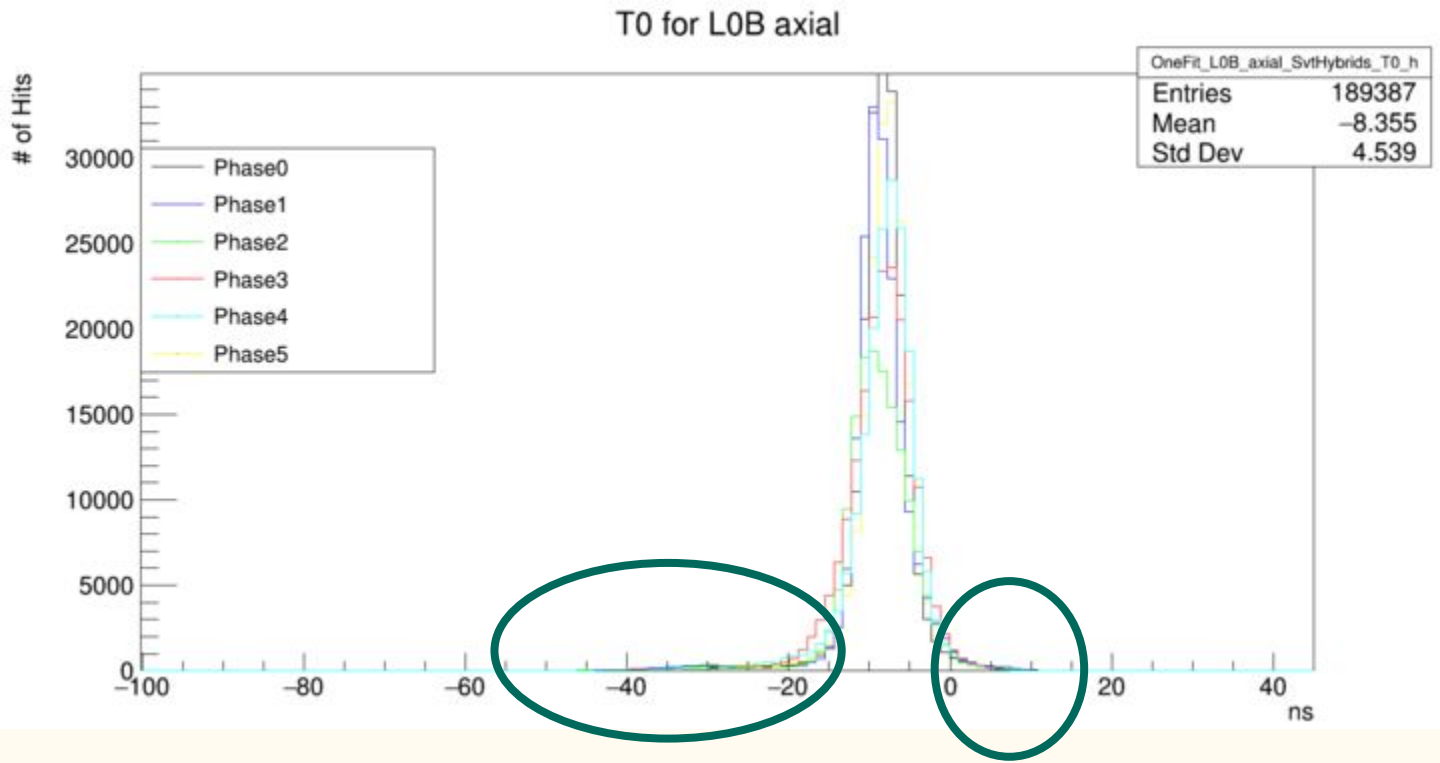


HPS SVT subsystem, orange first two layers

T0 Plot for One Fit On Time w/ Trigger 14552



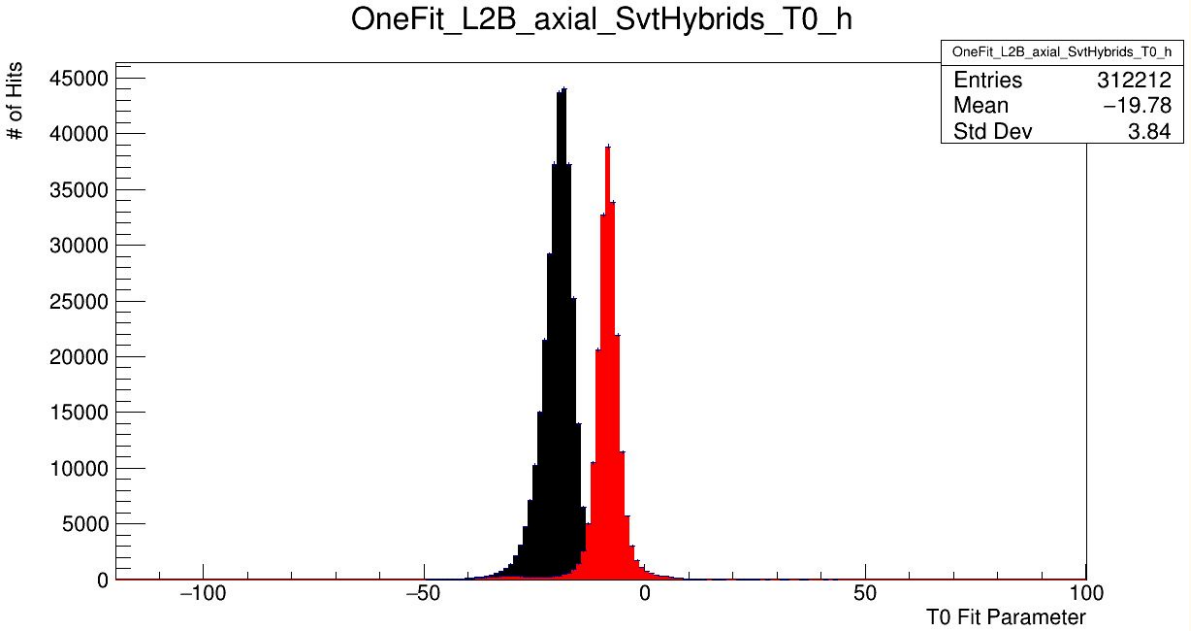
T0 Plot for One Fit On Time w/ Trigger 14166



So this is a luminosity dependent effect. This could suggest a high rate of accidentals or an error with the DT.

Before proceeding further, I was tasked to ensure that this was not occurring due to misalignment between the first two layers, and the other 6.

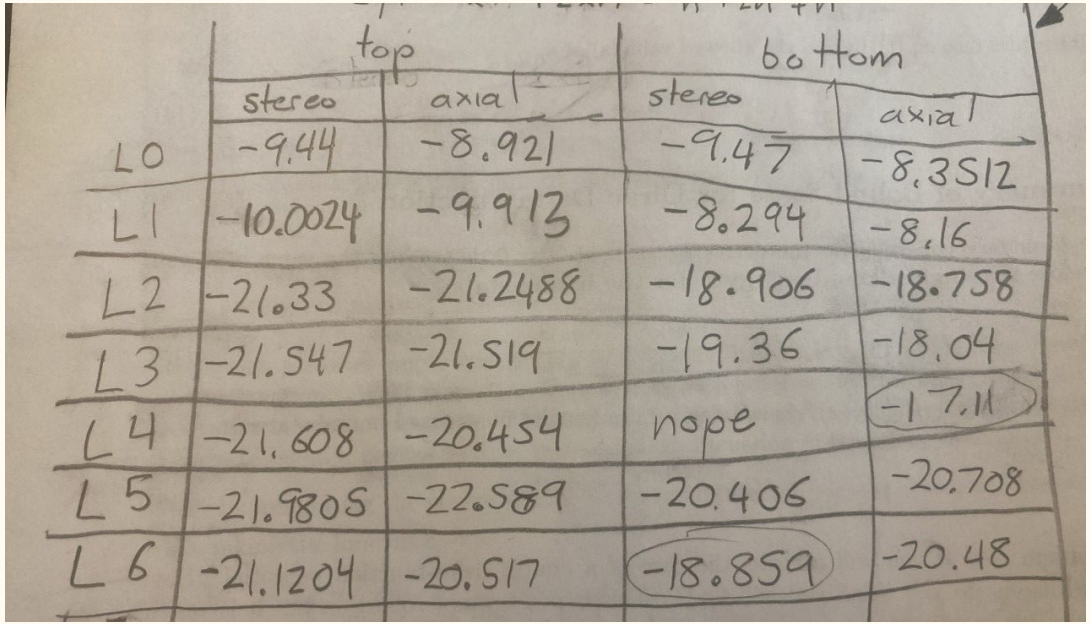
Using clean low lumi samples, I determined the peaks were at -8.3 and -18.78 ns



Peak Locations

Here is a table of peak locations determined by eye from 14166 low lumi runs.

These will be used to roughly align the peaks, and evaluate whether the secondary structure we are seeing is due to misalignment.

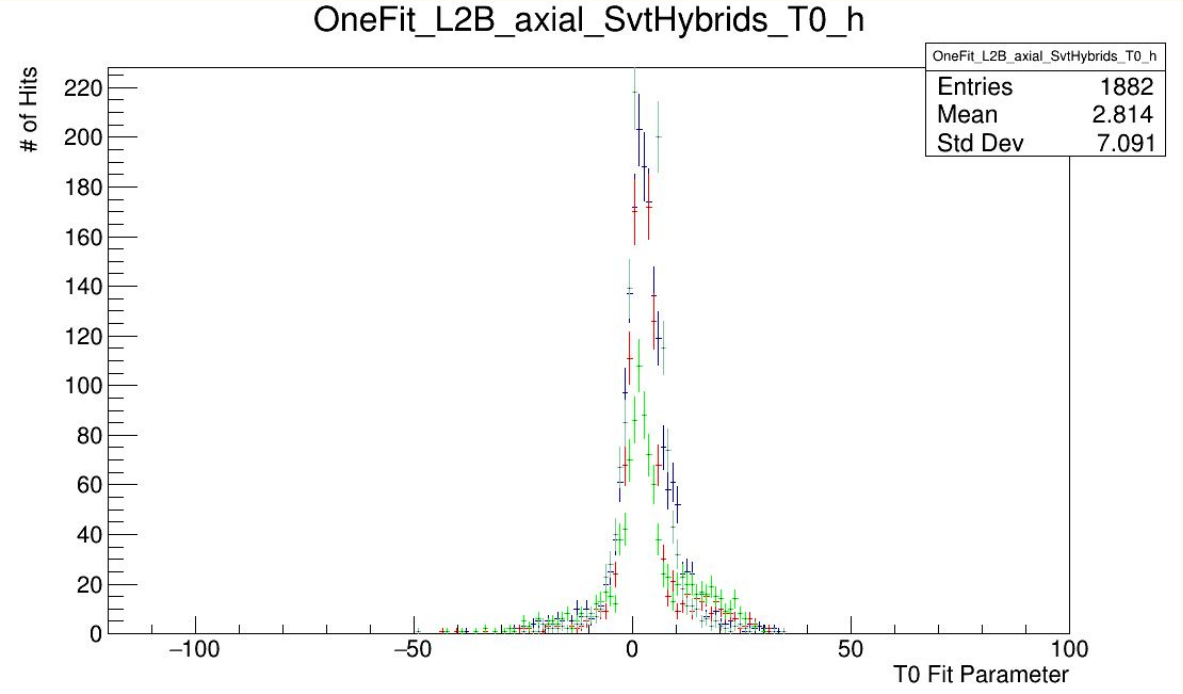


	top		bottom	
	stereo	axial	stereo	axial
L0	-9.44	-8.921	-9.47	-8.3512
L1	-10.0024	-9.913	-8.294	-8.16
L2	-21.33	-21.2488	-18.906	-18.758
L3	-21.547	-21.519	-19.36	-18.04
L4	-21.608	-20.454	nope	-17.11
L5	-21.9805	-22.589	-20.406	-20.708
L6	-21.1204	-20.517	-18.859	-20.48

Aligned Layer 0,1,2,3 Bottom Axial 14552 OneFit T0

Here blue is L2B, grey is L3B, red is L1B, and gree in L0B.

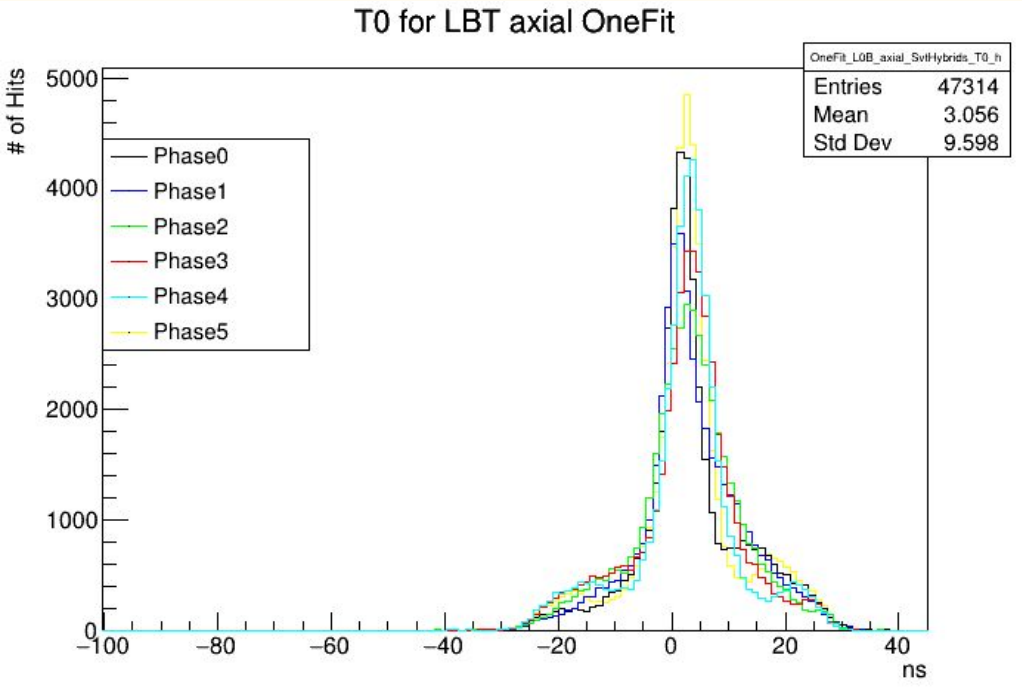
Using the numbers I eyeballed from the previous slide, they seem to peak within 1-2 ns of zero for each pulse



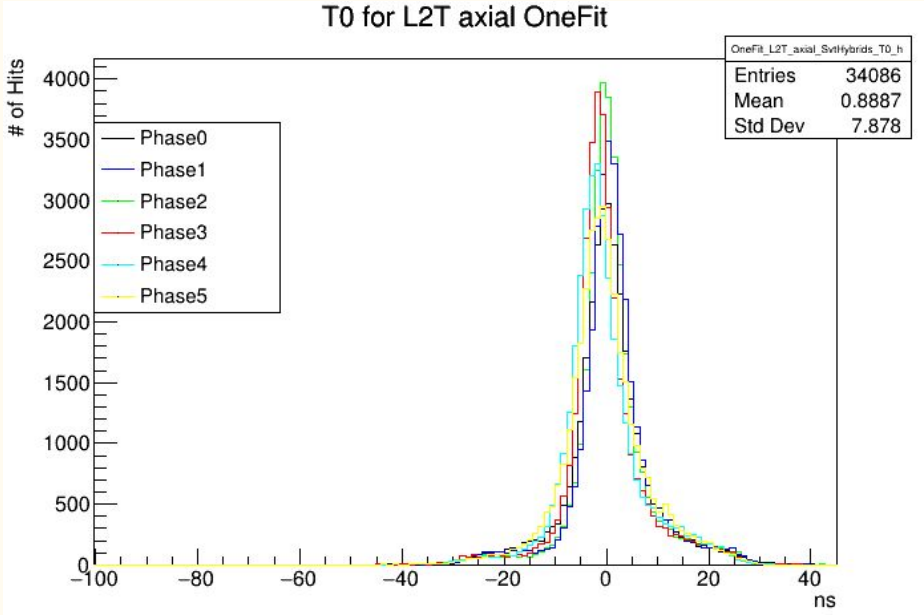
After Time Translation (Phase 0) OneFit.

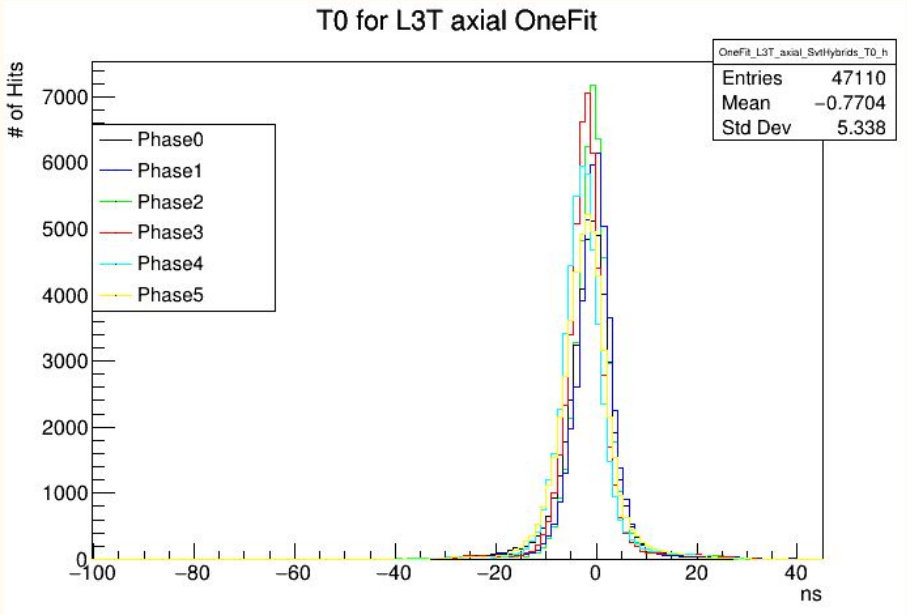
It is alot cleaner now, but there is a clear weird bumps in places

I was not able to produce all phases before this meeting; I began running yesterday evening.



Layer 2T Axial and Layer 3TAxial OneFits





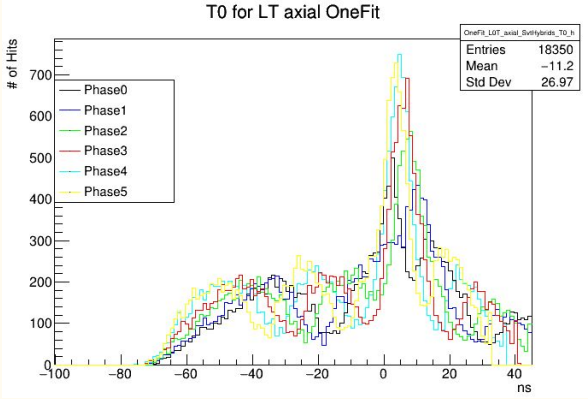
Opening the Window on Kalman Tracks to 70 ns

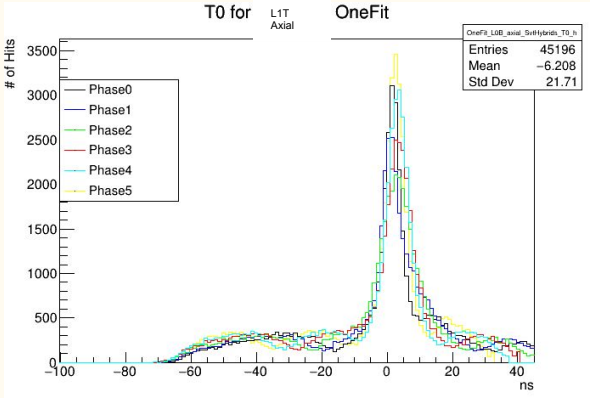
From the previous plots, there was the supposition that if we increased the window of times for acceptance of hits on Kalman Tracks, we'd get a secondary peak.

We do indeed see this peak, especially in the closest layer. Could be pileUp

Here is a spreadsheet of all the hit no for all our cuts we've tried:

https://docs.google.com/spreadsheets/d/1fai4v_HCvH6w9l5VLaO8_76uc19GlIfnQZ0552J0LaQ/edit#gid=0





Event Numbers as a Function of Our Cuts

	L0T axial OneFit			L0T axial CTFit		
	UnAligned	Time Aligned	Aligned 70 W	UnAligned	Time Aligned	Aligned 70 W
Phase 0	13758	14360	16522	1554	1974	1897
Phase 1	14458	14317	16549	1868	2112	1936
Phase 2	14705	14184	17257	2101	2270	2082
Phase 3	15309	14354	17723	2255	2411	2138
Phase 4	15522	15105	18350	2284	2528	2329
Phase 5	15835	15968	18768	2444	2823	2505
Total	89587	88288	105169	12506	14118	12887

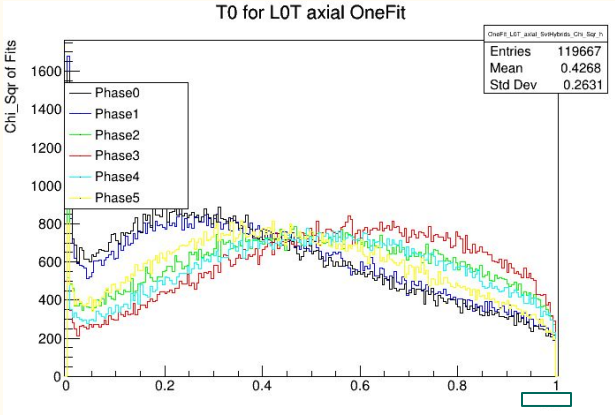
	L3T axial OneFit			L3T axial CTFit		
	UnAligned	Time Aligned	Aligned 70 W	UnAligned	Time Aligned	Aligned 70 W
Phase 0	47376	44606	30382	578	530	336
Phase 1	48750	45655	31005	643	600	385
Phase 2	50531	47108	32475	743	639	458
Phase 3	52247	47994	33785	832	802	505
Phase 4	52513	48457	34095	876	845	549
Phase 5	52991	48642	34802	1094	1089	739
Total	304408	282462	196544	4766	4505	2972

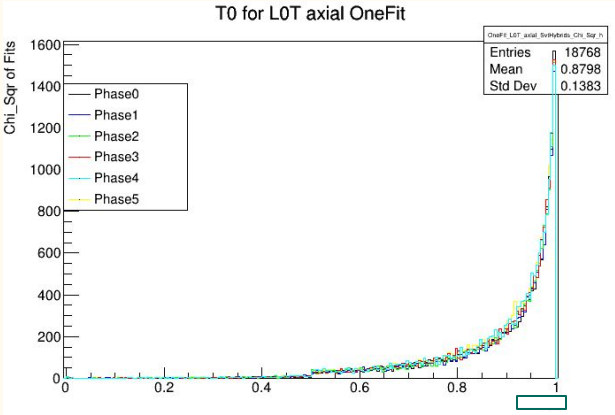
Weird Chi Sqr Distributions for the Open Cuts

Here are the Chi Sqr Distributions for the 14166 and 14552 runs with the opened windows.

It seems that while 14166 had reasonable error values, our 14552 has errors that are far too loose

It is overfitting; we can try decreasing errors and seeing if T0 distribution improves.



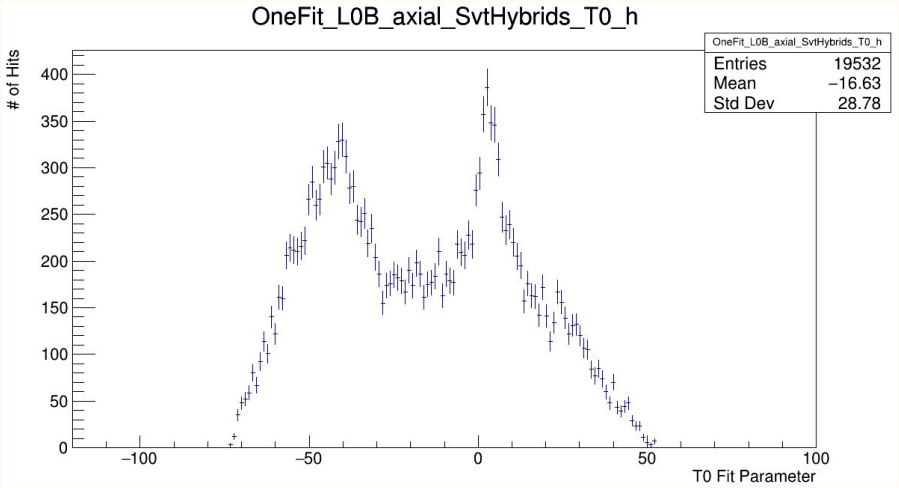


The Money Plot

Before doing the more difficult task of changing the pulse number DT, we wanted to see if we were simply choosing the wrong pulse.

We selected on those times where hits were <-30 and plotted all other hits in the same module and layer

We obtain this 1 d plot:



2D plots of 14552 Strip Distance vs T0