

Position Resolution

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Goal: to determine the positions resolution along the scintillators.

Paddles are arranged parallel to each other with one on top of the other and board 1 above 8, and 2 above 7. The Sr-90 source was varied along the length of the paddle, positioned with the center of the short end of one of the scintillators in the paddle.

1 Initial Studies

All of the following were done with paddle CD on top.

Table 1: Time difference of absolute time and the average time from the corresponding scintillator used for coincidence determination fit parameters, for boards 1, 4, 5, and 8 with the source directly over the scintillator with 1-4.

	$t1 - (t5+t8)/2$		$t4 - (t5+t8)/2$		$t5 - (t1+t4)/2$		$t8 - (t1+t4)/2$	
Position (cm)	Centroid (ns)	σ (ns)	Centroid (ns)	σ (ns)	Centroid (ns)	σ (ns)	Centroid (ns)	σ (ns)
1.0	-0.308	0.307	0.455	0.324	0.240	0.324	-0.615	0.365
5.0	0.104	0.311	0.141	0.328	-0.312	0.352	-0.177	0.385
8.0	0.438	0.314	0.203	0.309	-0.435	0.351	-0.458	0.363
10.0	0.536	0.315	-0.004	0.305	-0.582	0.339	-0.181	0.348
12.0	0.969	0.327	-0.088	0.300	-0.947	0.334	-0.168	0.340
15.0	0.708	0.491	-0.278	0.462	-0.597	0.482	-0.062	0.501

Table 2: Time difference of absolute time and the average time from the corresponding scintillator used for coincidence determination fit parameters, for boards 2, 3, 6, and 7 with the source directly over the scintillator with 2-3.

	$t2 - (t6+t7)/2$		$t3 - (t6+t7)/2$		$t6 - (t2+t3)/2$		$t7 - (t2+t3)/2$	
Position (cm)	Centroid (ns)	σ (ns)	Centroid (ns)	σ (ns)	Centroid (ns)	σ (ns)	Centroid (ns)	σ (ns)
5.0	-2.749	0.275	0.579	0.343	1.261	0.317	0.701	0.319
7.0	-2.285	0.284	0.456	0.341	0.912	0.334	0.715	0.326
9.0	-1.982	0.277	0.346	0.338	0.653	0.331	0.774	0.33
11.0	-1.794	0.282	0.157	0.335	0.505	0.326	0.929	0.328
13.0	-1.503	0.281	-0.031	0.324	0.24	0.319	1.086	0.324
15.0	-1.095	0.274	-0.215	0.319	-0.039	0.308	1.135	0.311
17.0	-0.854	0.273	-0.416	0.312	-0.19	0.294	1.245	0.303

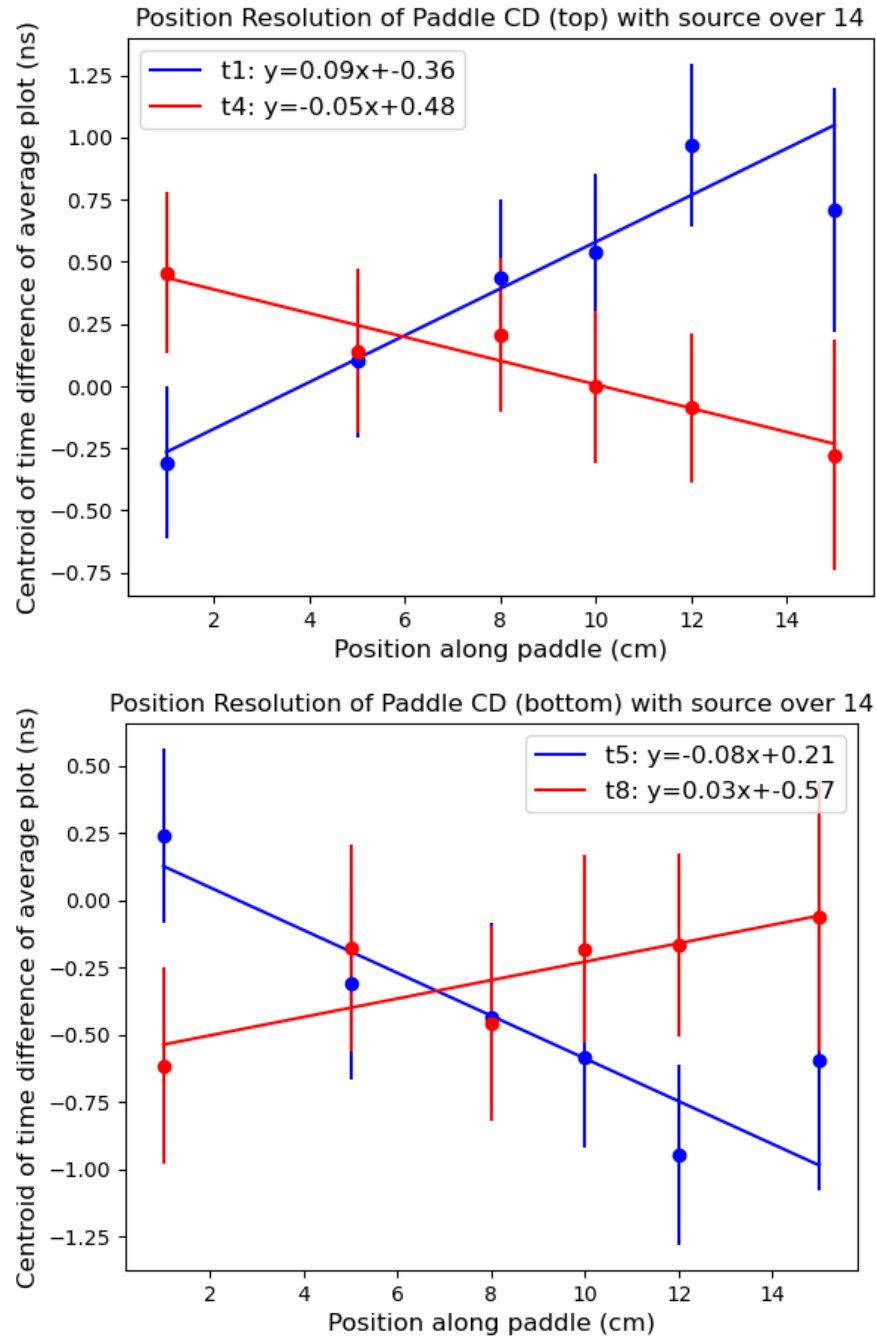


Figure 1: Time versus source position for the source over 14, showing the data for the upper board in the top plot and the lower board in the bottom plot.

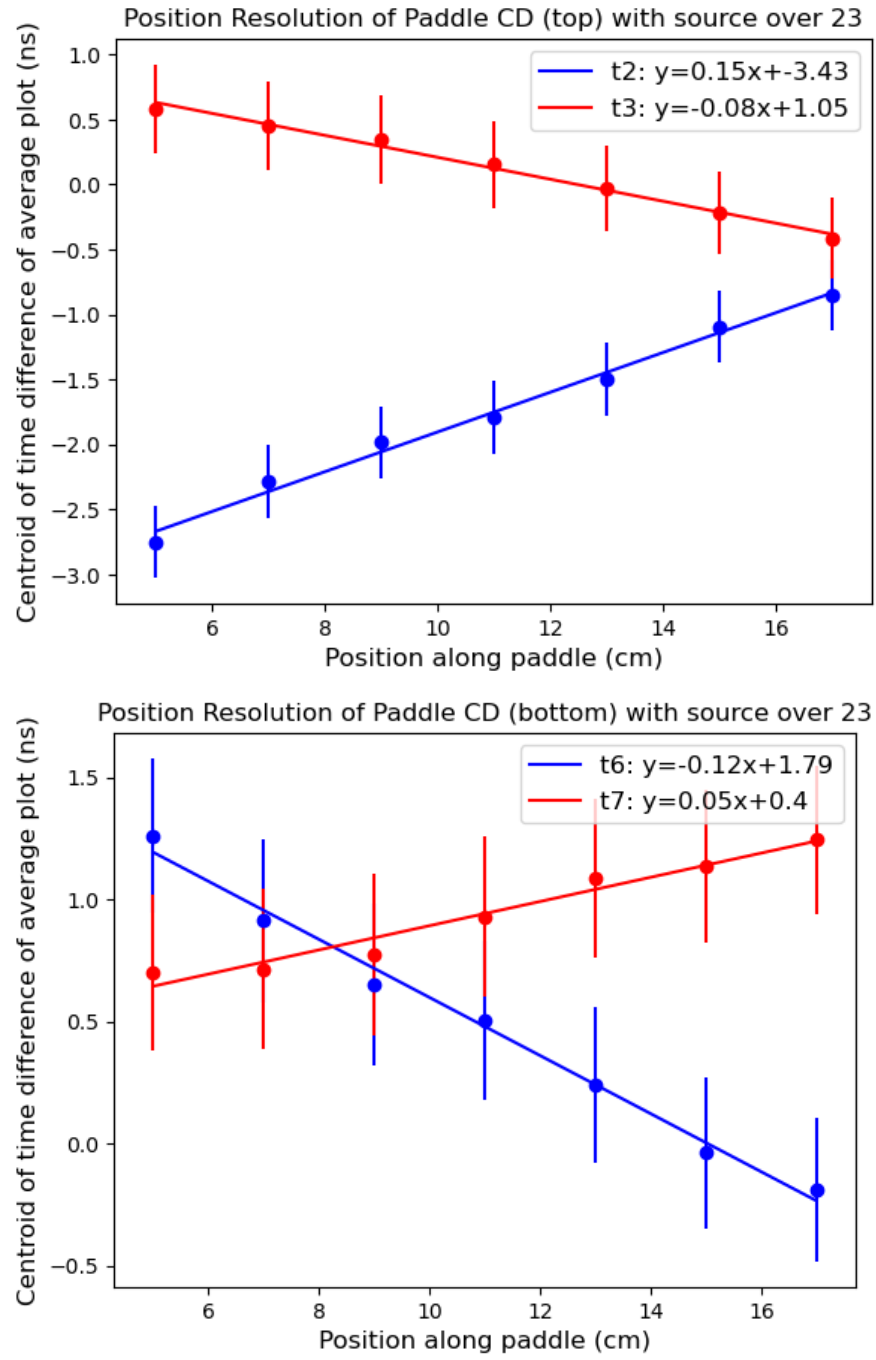


Figure 2: Time versus source position for the source over 23, showing the data for the upper board in the top plot and the lower board in the bottom plot.

Table 3: Summary of fit parameters for average time as a function of source position.

	Slope (ns/cm)	u(Slope) (ns/cm)	y-Intercept	u(y-Intercept) (ns)
$t1 - (t5+t8)/2$	0.09	0.03	-0.36	0.3
$t4 - (t5+t8)/2$	-0.05	0.03	0.48	0.3
$t5 - (t1+t4)/2$	-0.08	0.03	0.21	0.3
$t8 - (t1+t4)/2$	0.03	0.04	-0.57	0.3
$t2 - (t6+t7)/2$	0.15	0.03	-3.43	0.3
$t3 - (t6+t7)/2$	-0.08	0.03	1.05	0.4
$t6 - (t2+t3)/2$	-0.12	0.03	1.79	0.4
$t7 - (t2+t3)/2$	0.05	0.03	0.4	0.4

From the slopes of the graphs in Figure 1 and 2 we can find the position resolution of the triggers by dividing the slope by the time resolution of the system. Since each trigger set up (collection of scintillator paddle and two boards) is symmetrical, I expect that the slopes of the time vs position plots for the boards associated with each end of a single scintillator bar to be equal in magnitude. This is not the case. We do not see slope matching along a side of the set up either, which would be if the slopes of the plots for $t1$ and $t8$, and $t2$ and $t7$ matched for example. Instead, for each bar we consistently see the best slope matching between a given board and the board opposite to it on the other paddle (i.e. the time associated with the left bar on the top paddle best matching that of the right bar on the bottom paddle). The reason for this lack of matched slope is not yet known.

The pulse widths were also examined. At this time, these plots are prepared using the mean of the data and not the mean from a fit because fitting the width plots is a more involved process than fitting the time plots. Fitting of the width plots will be done and presented with uncertainties at a later date.

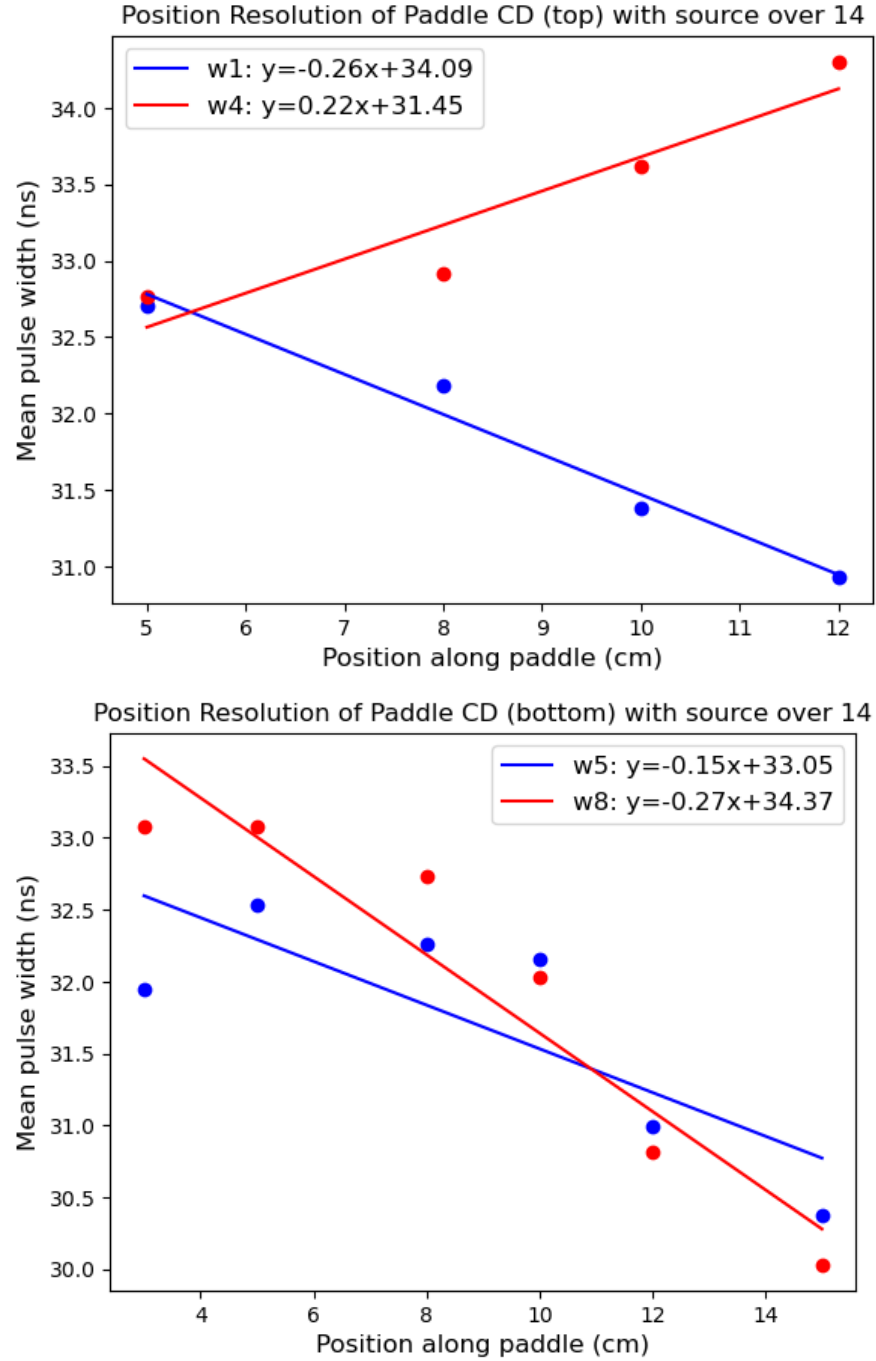


Figure 3: Pulse width vs source position for the source over 14, showing the data for the upper board in the top plot and the lower board in the bottom plot.

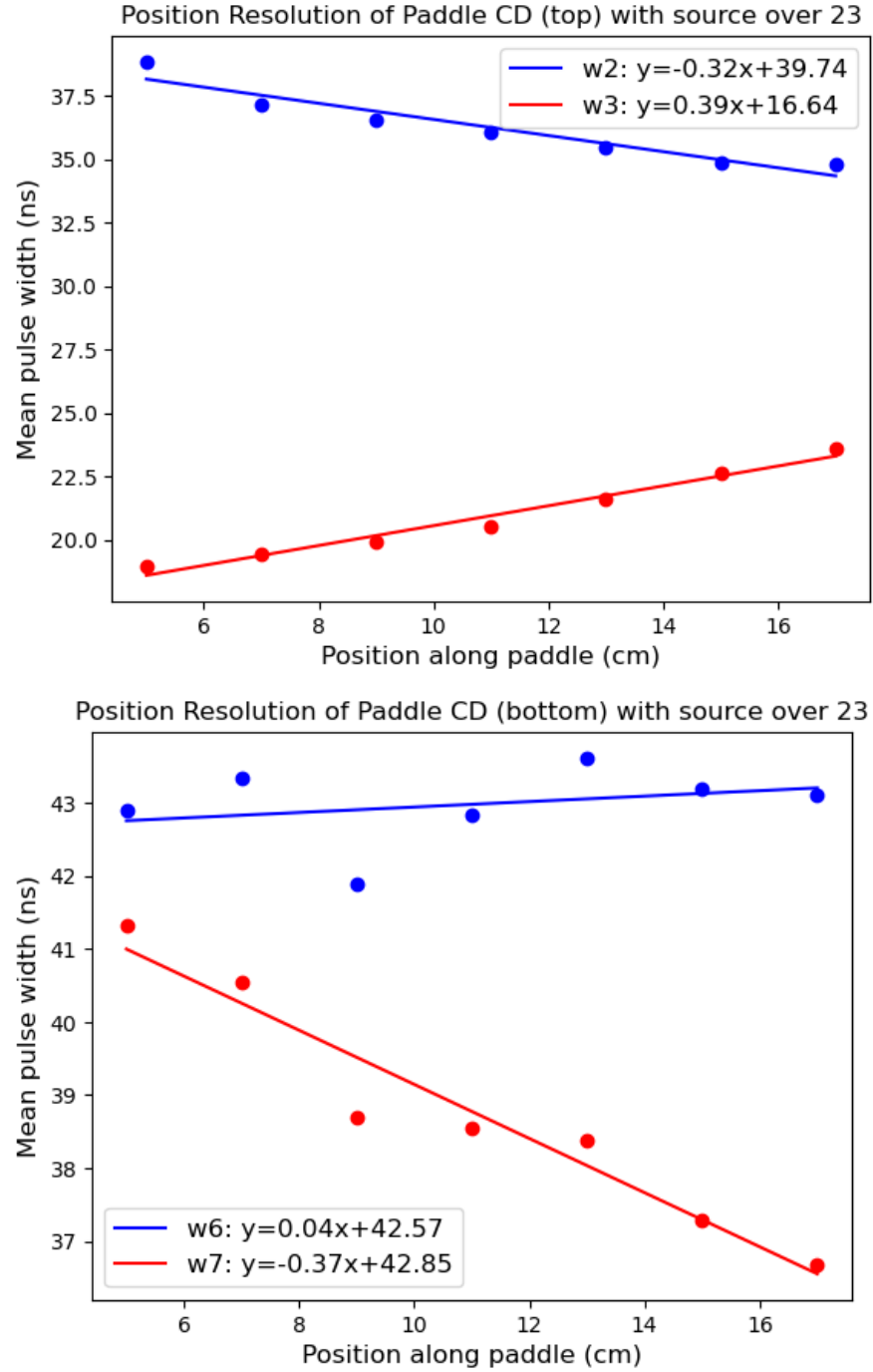


Figure 4: Pulse width vs source position for the source over 23, showing the data for the upper board in the top plot and the lower board in the bottom plot.

1.1 Histograms used to make the above plots

1.1.1 Widths

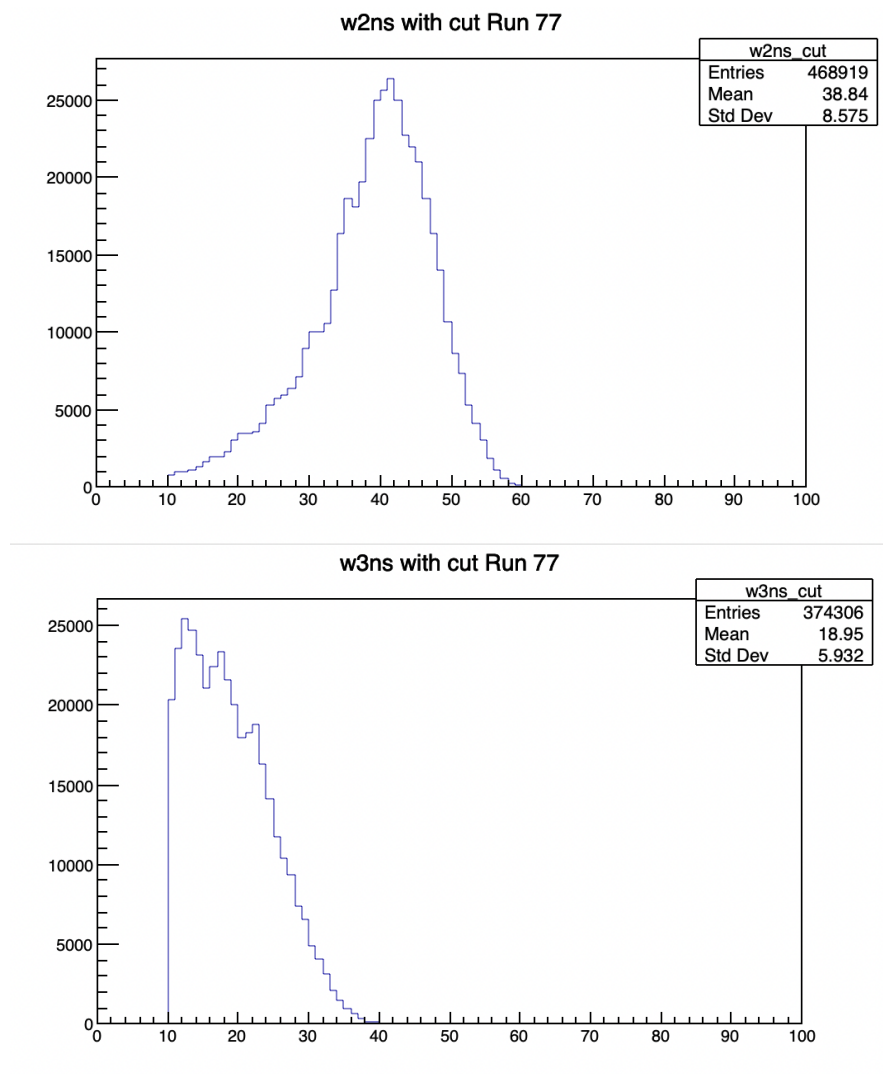


Figure 5: Pulse width for 2 and 3 with the source over 23 for run 77.

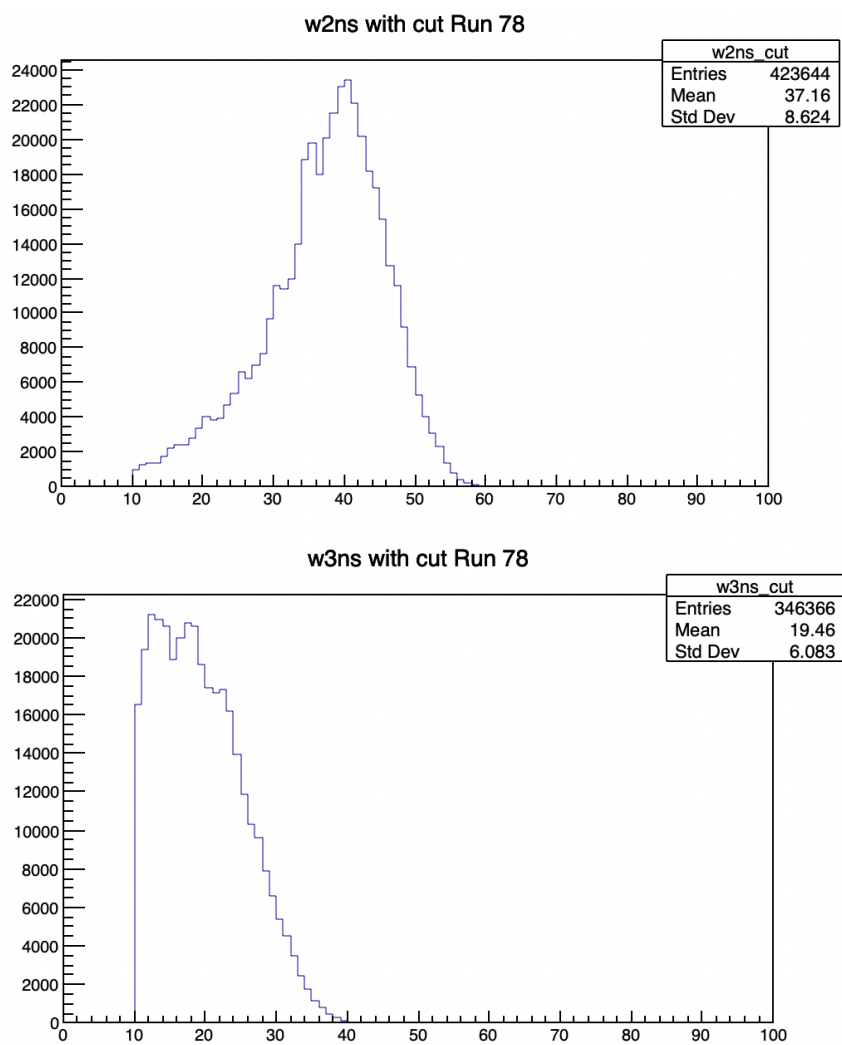


Figure 6: Pulse width for 2 and 3 with the source over 23 for run 78.

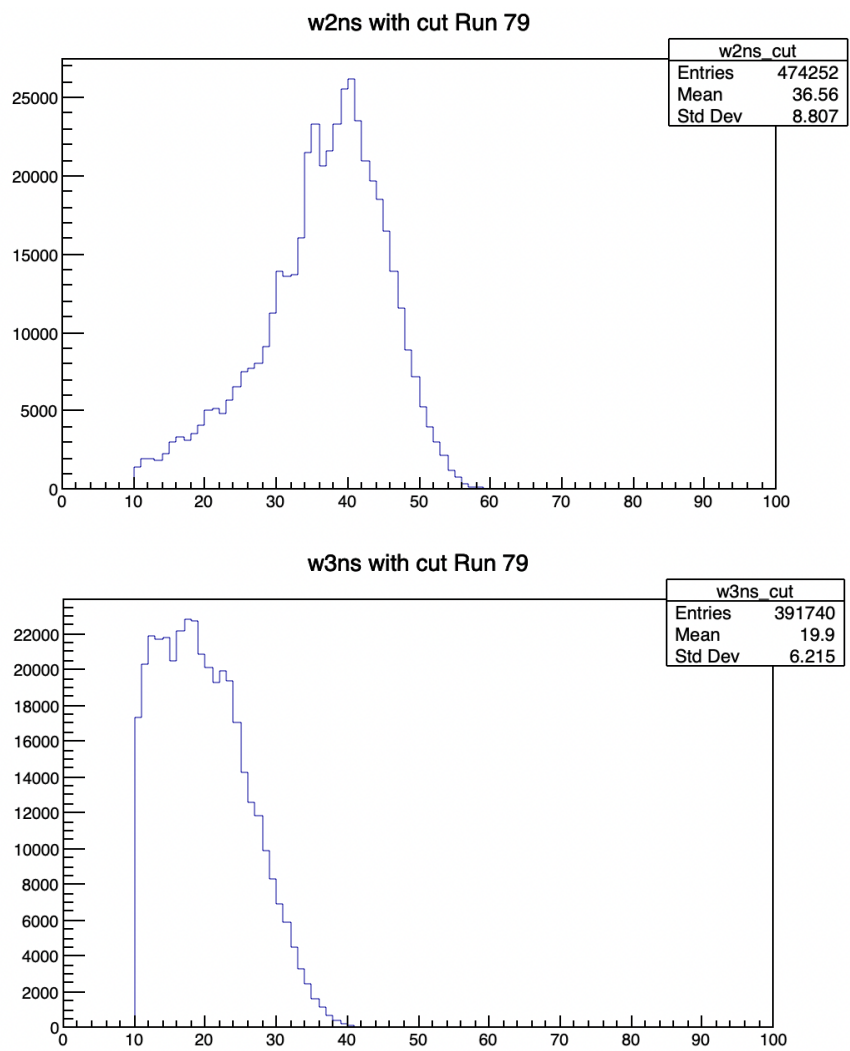


Figure 7: Pulse width for 2 and 3 with the source over 23 for run 79.

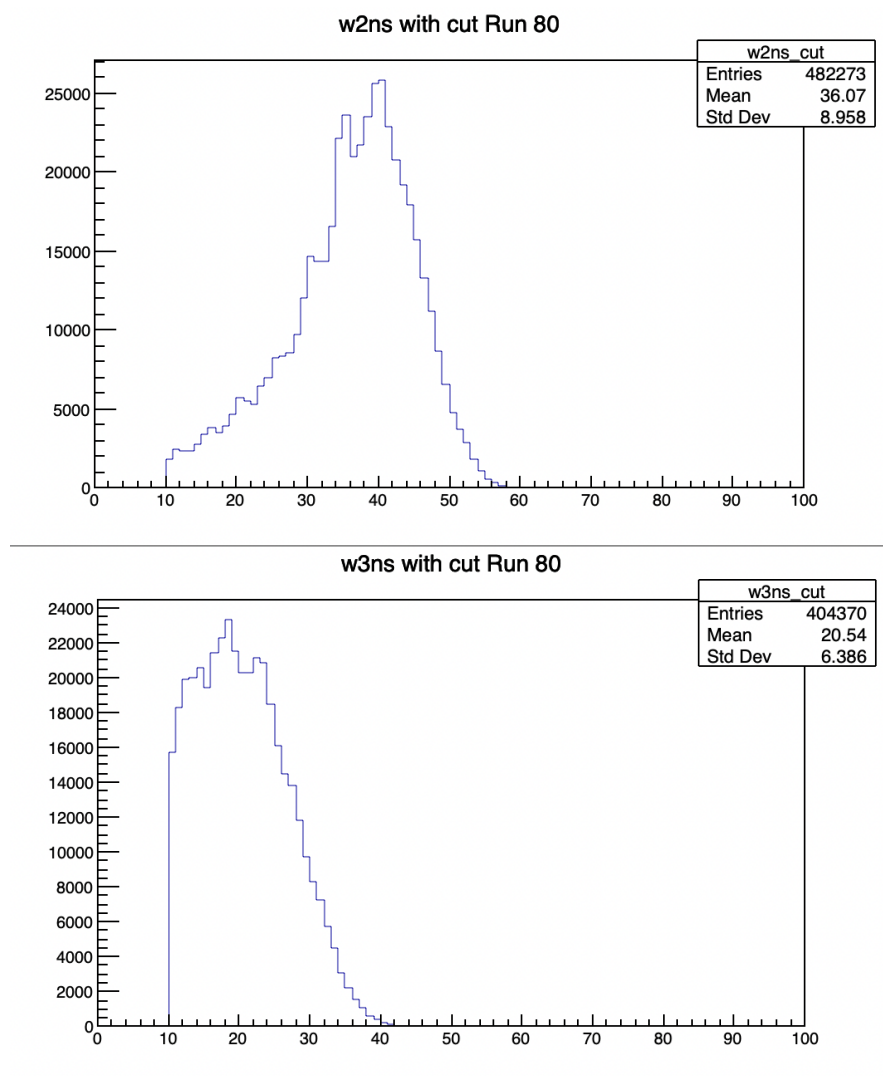


Figure 8: Pulse width for 2 and 3 with the source over 23 for run 80.

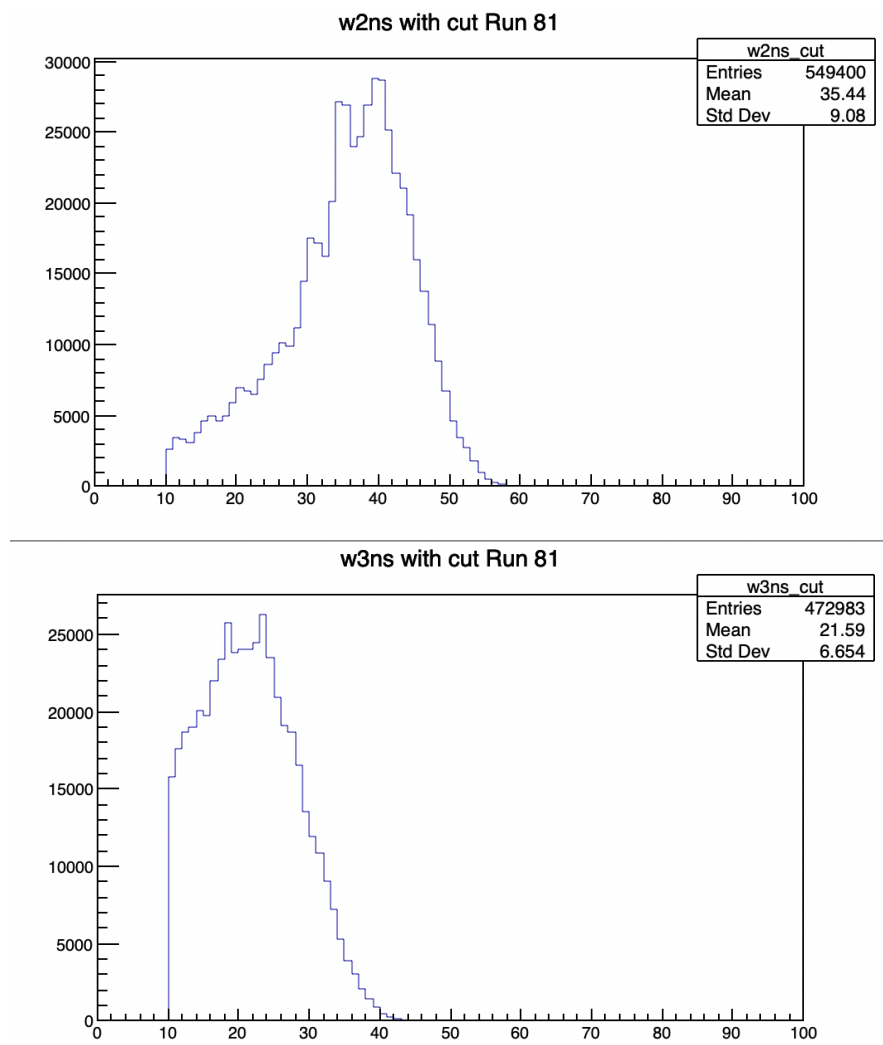


Figure 9: Pulse width for 2 and 3 with the source over 23 for run 81.

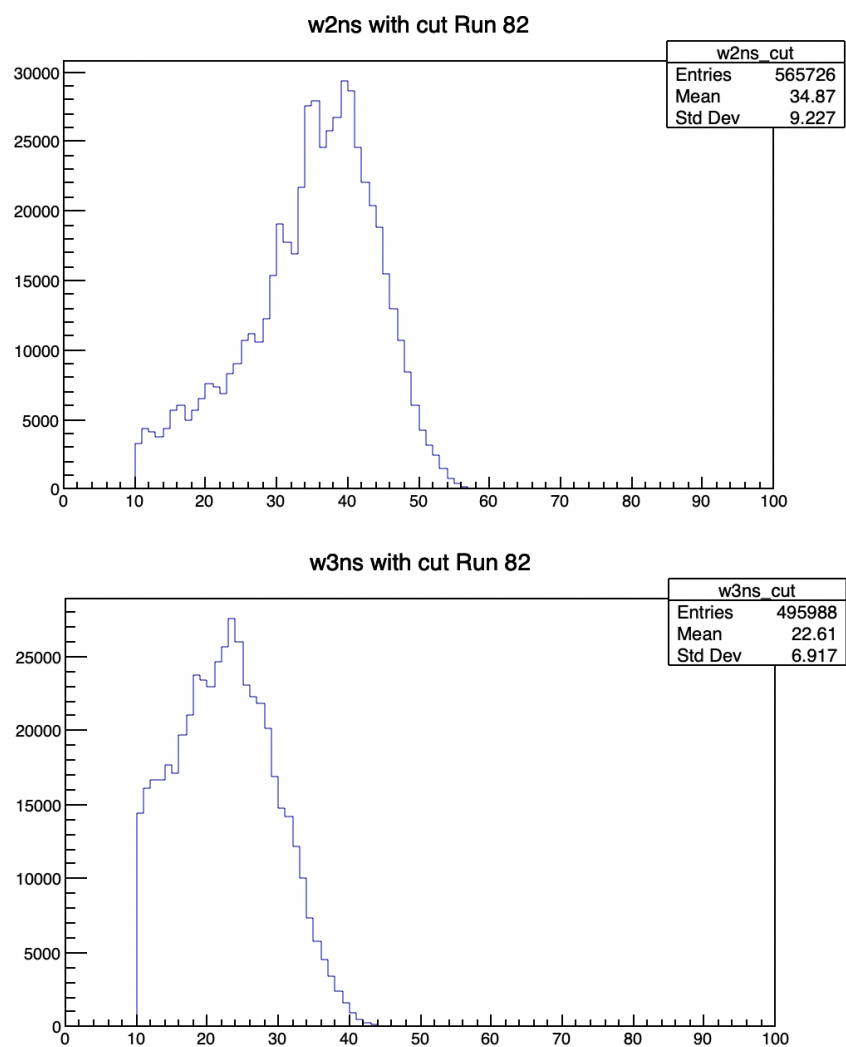


Figure 10: Pulse width for 2 and 3 with the source over 23 for run 82.

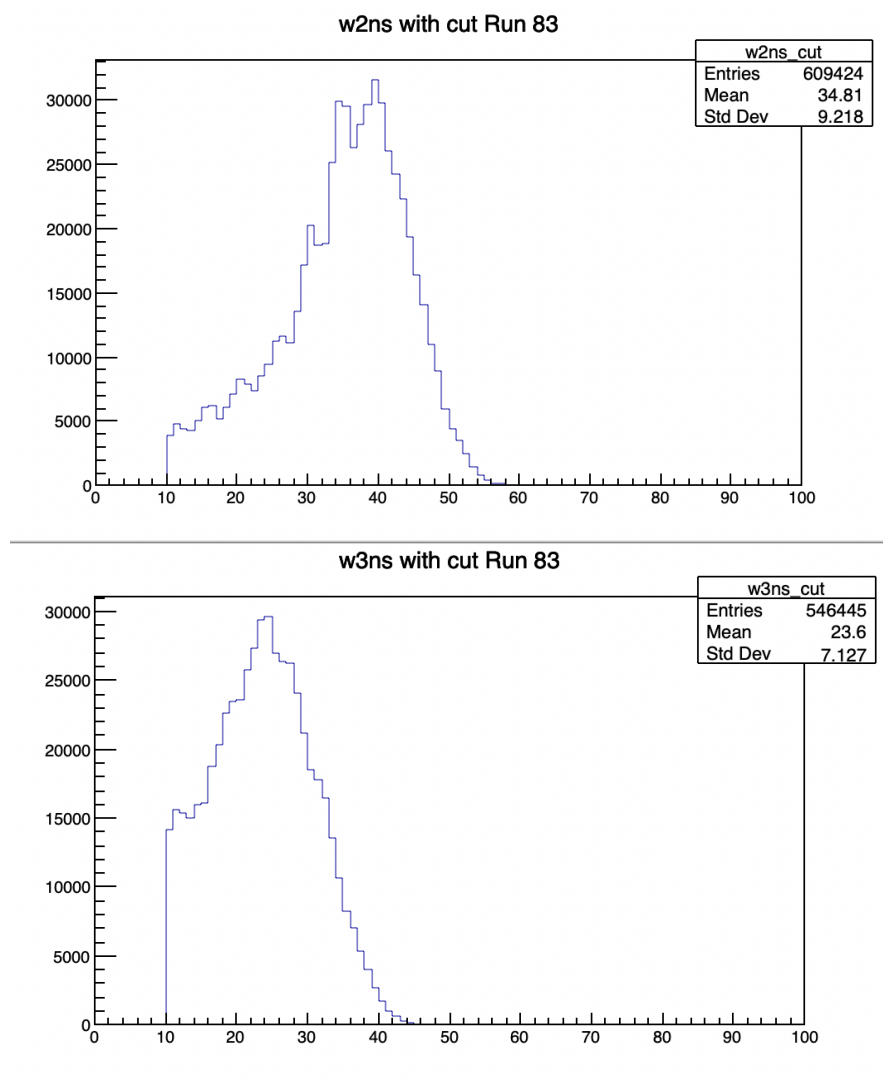


Figure 11: Pulse width for 2 and 3 with the source over 23 for run 83.

1.1.2 Time plots after TWC

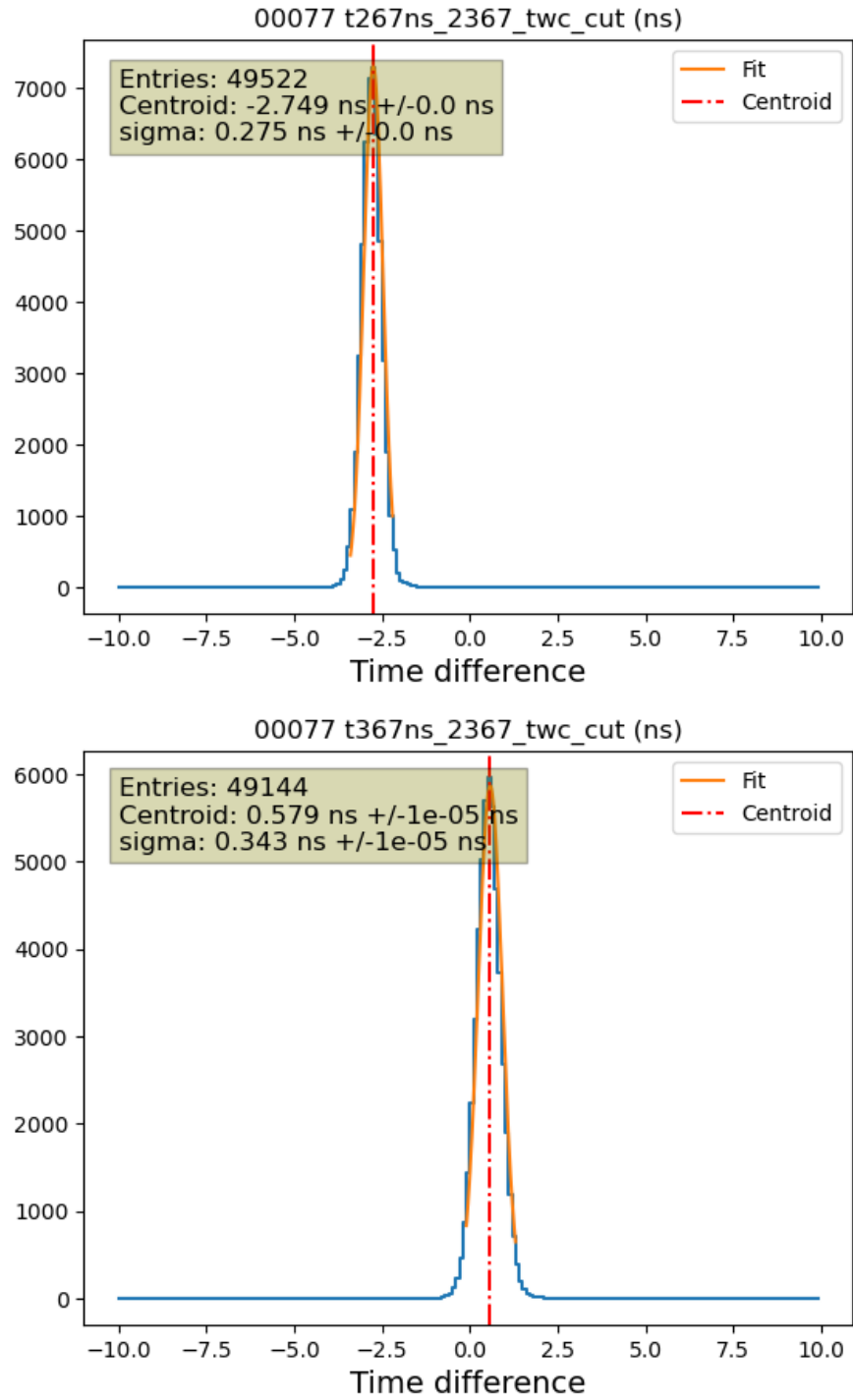


Figure 12: Time difference of the time of interest and the average time for the lower bar for t2 and t3 with the source over 23 for run 77.

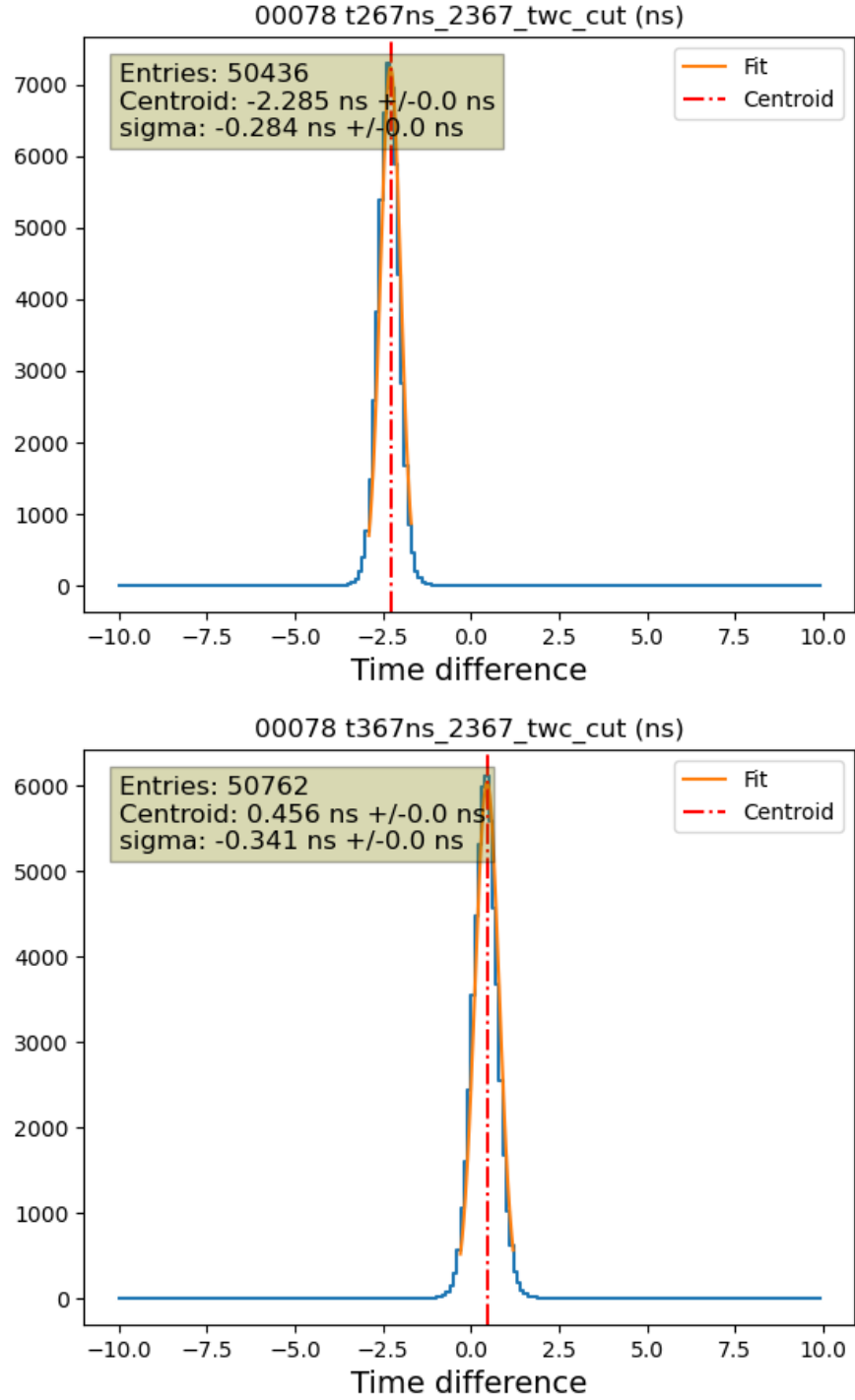


Figure 13: Time difference of the time of interest and the average time for the lower bar for t2 and t3 with the source over 23 for run 78.

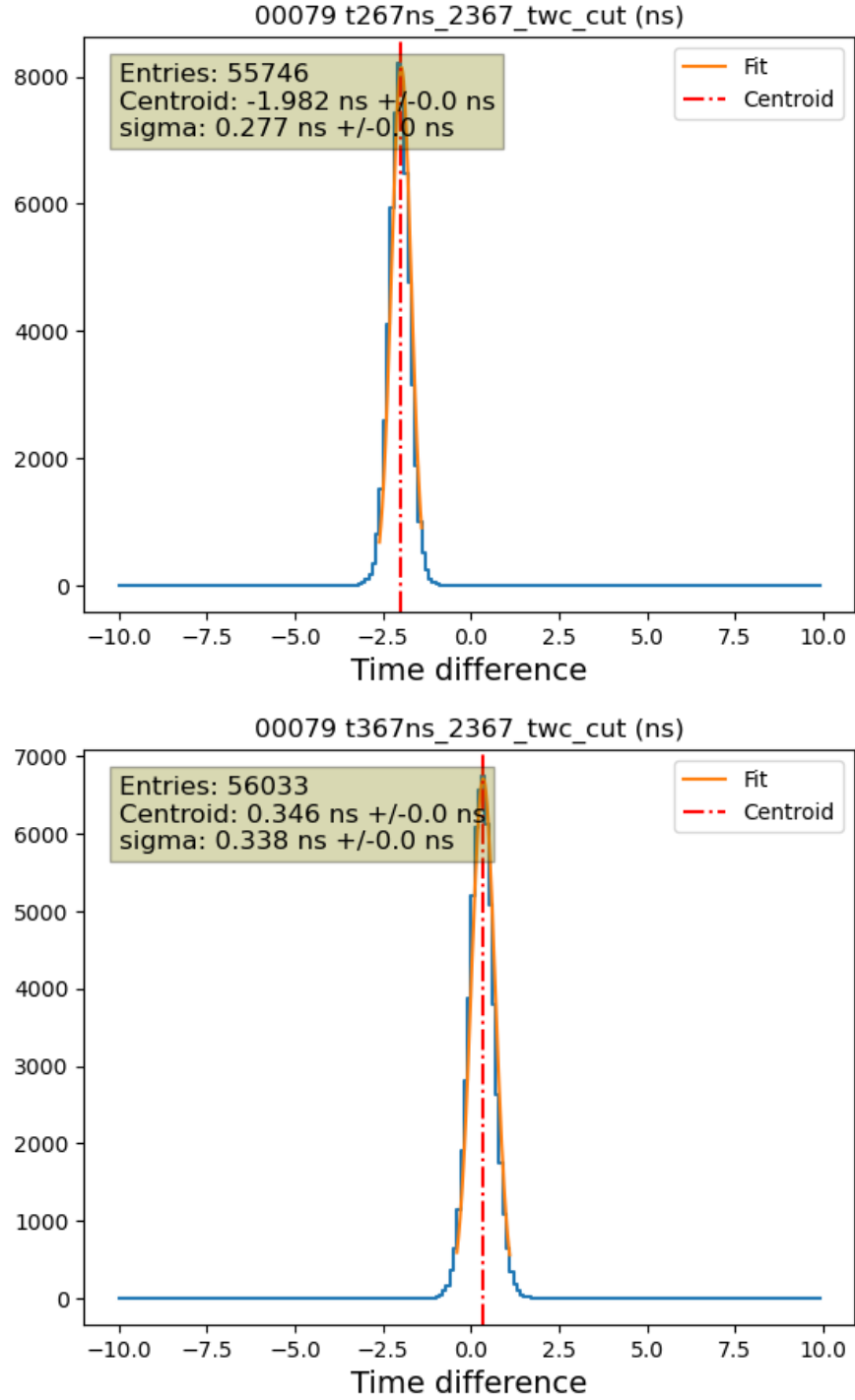


Figure 14: Time difference of the time of interest and the average time for the lower bar for t2 and t3 with the source over 23 for run 79.

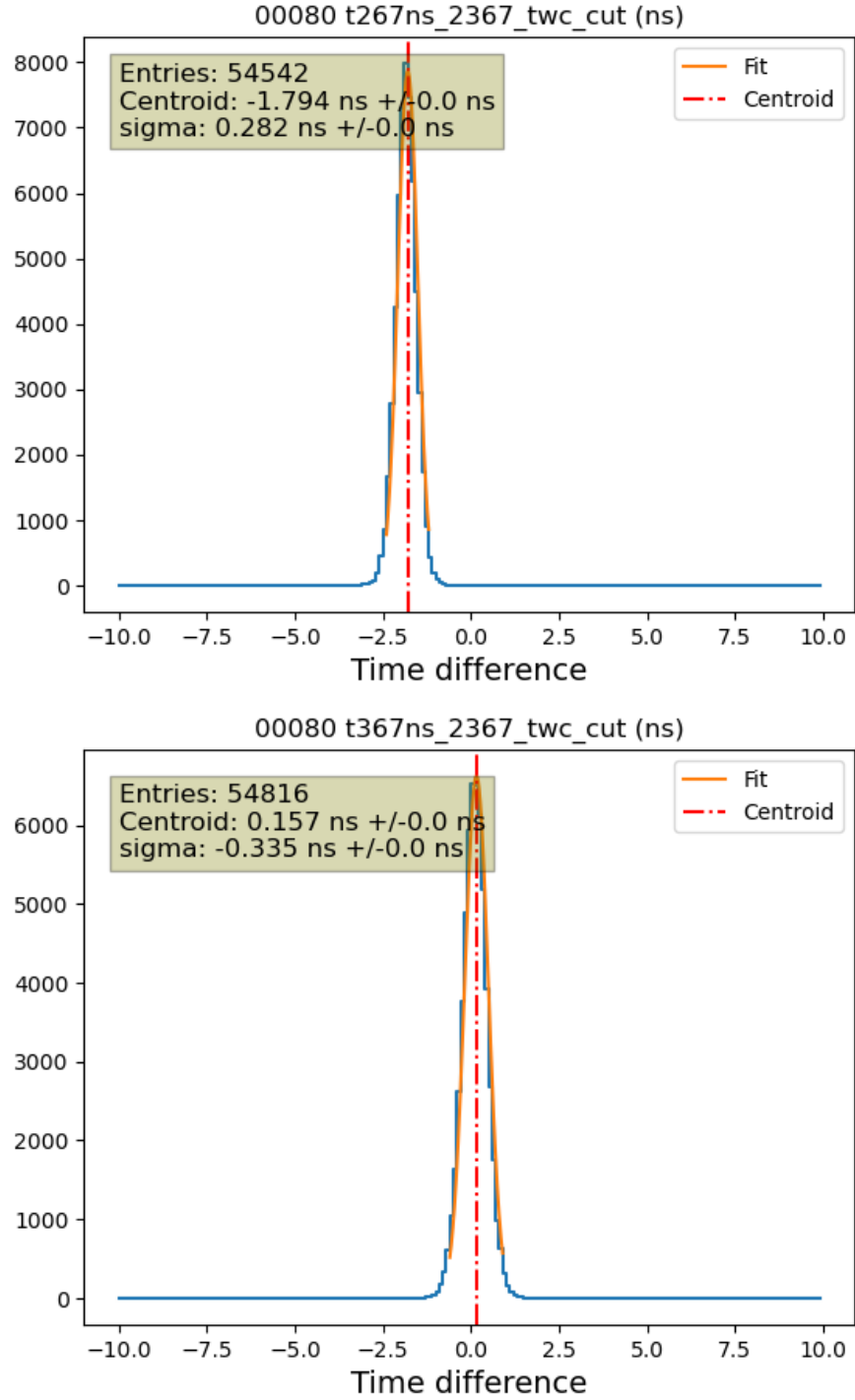


Figure 15: Time difference of the time of interest and the average time for the lower bar for t2 and t3 with the source over 23 for run 80.

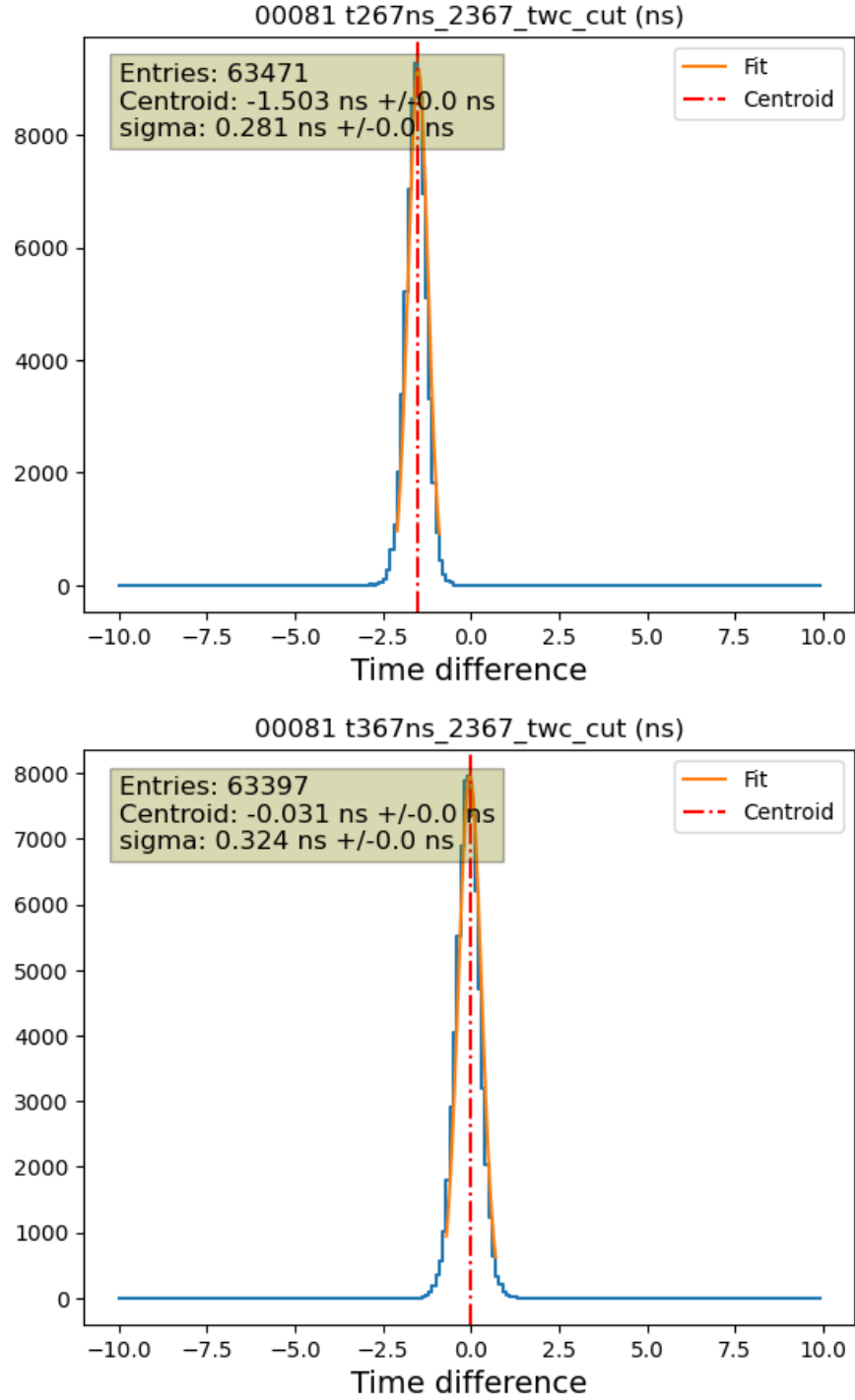


Figure 16: Time difference of the time of interest and the average time for the lower bar for t2 and t3 with the source over 23 for run 81.

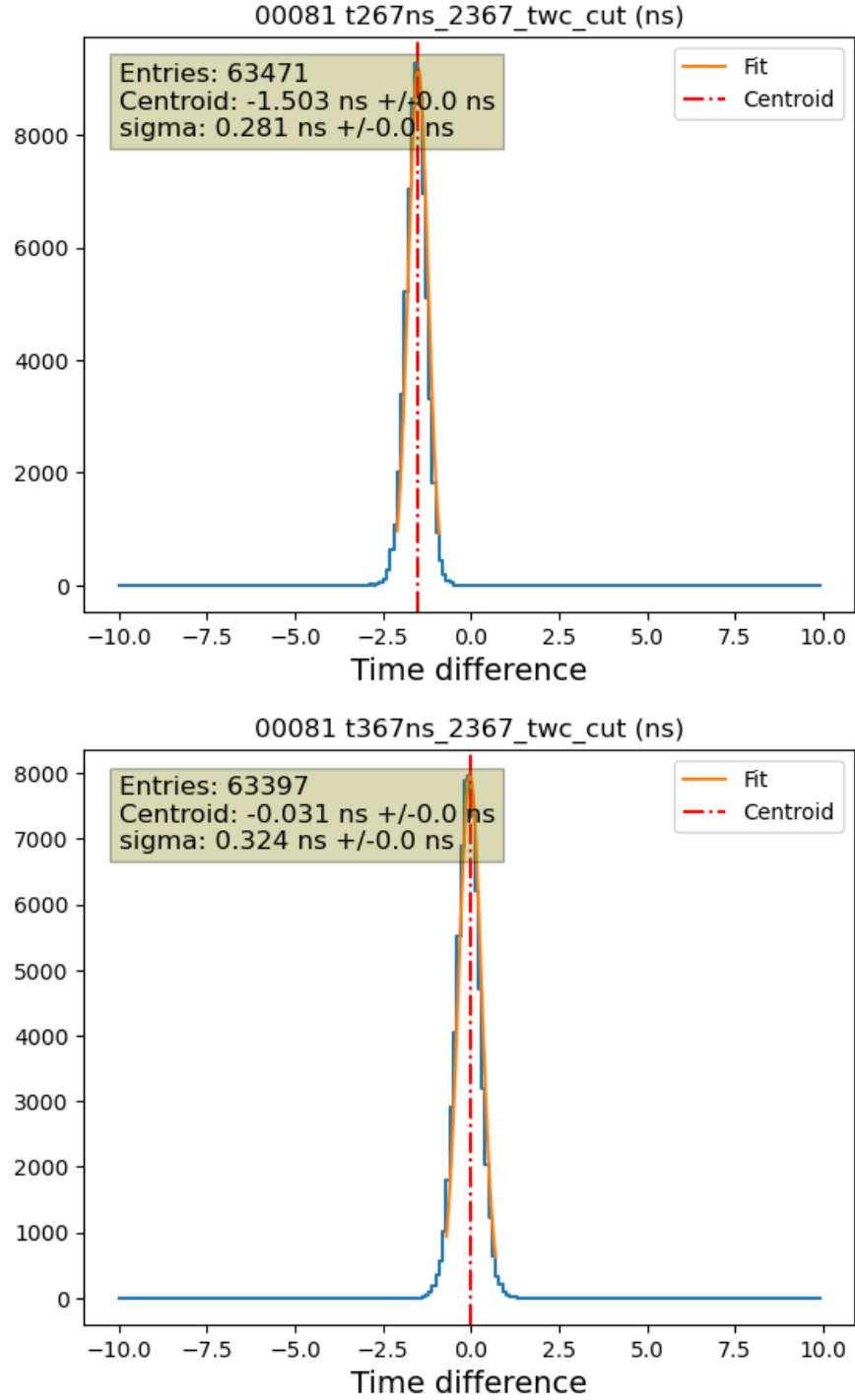


Figure 17: Time difference of the time of interest and the average time for the lower bar for t2 and t3 with the source over 23 for run 81.

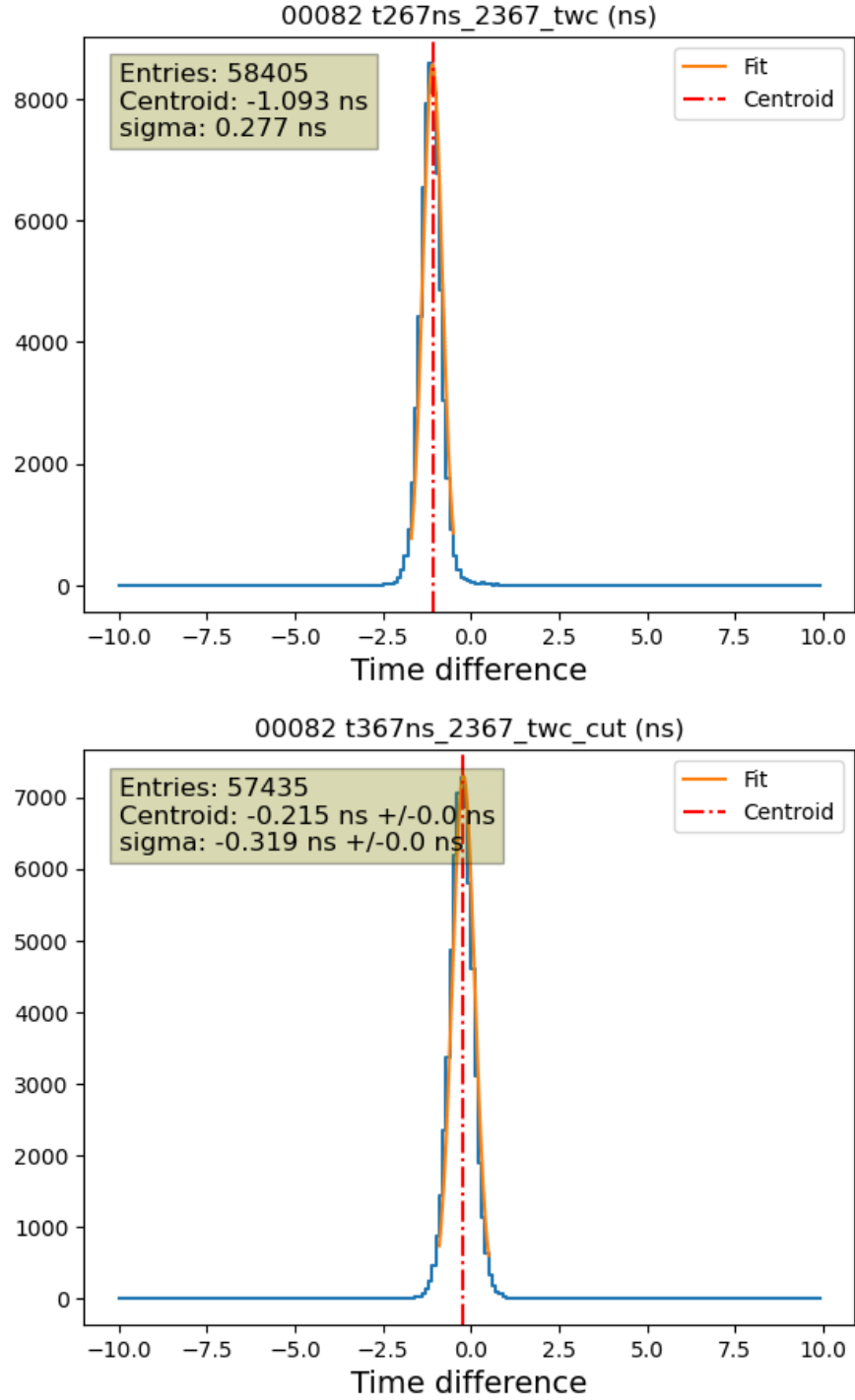


Figure 18: Time difference of the time of interest and the average time for the lower bar for t2 and t3 with the source over 23 for run 82.

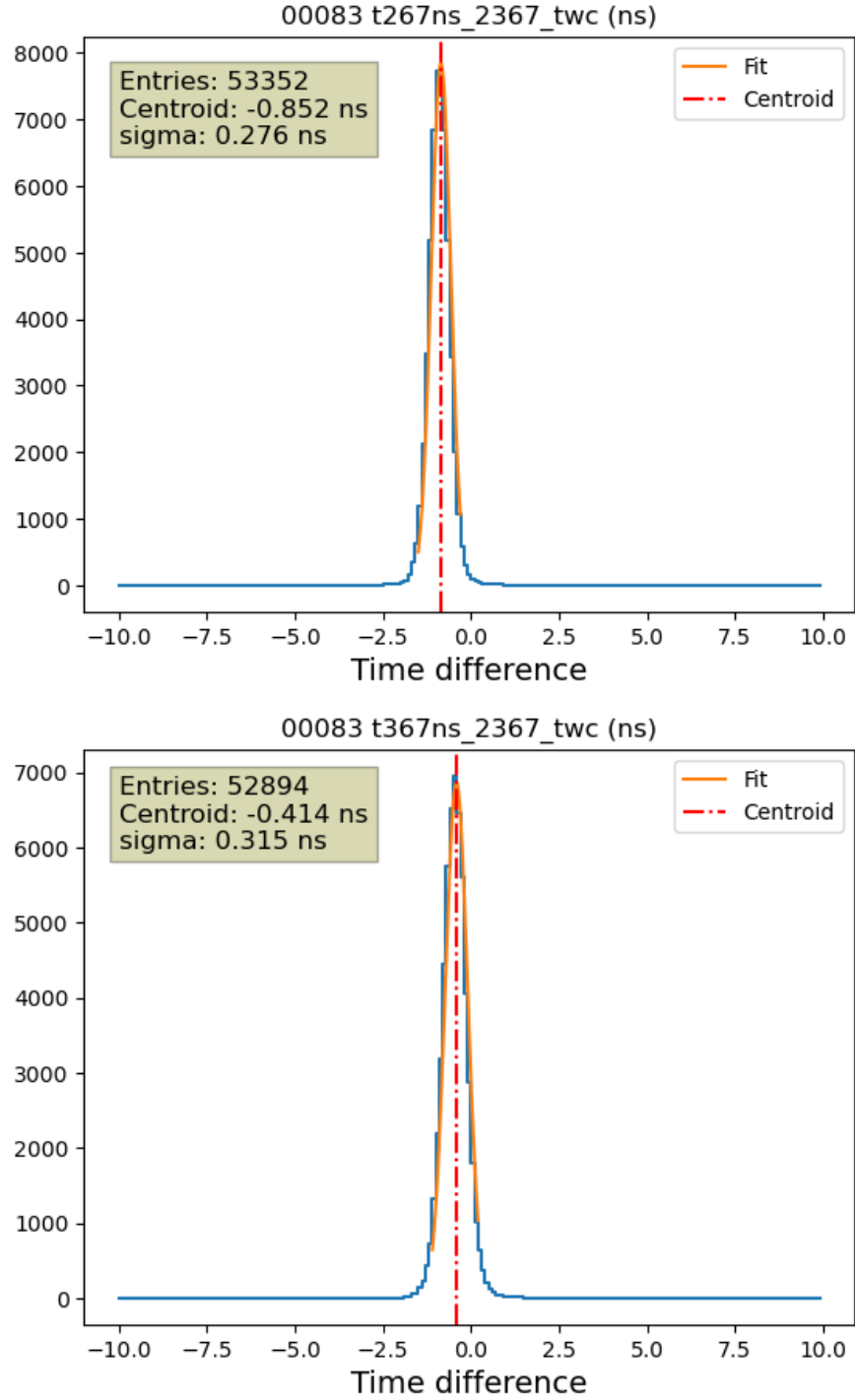


Figure 19: Time difference of the time of interest and the average time for the lower bar for t2 and t3 with the source over 23 for run 83.