Position Resolution - 2

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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, centered along the width of the scintillator bar of interest.

1 Position Relationships

All of the following was done with paddle CD on top and with the source over bar 2-3.

Table 1: 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	
Run	Position (cm)	Centroid (ns)	σ (ns)	Centroid (ns)	σ (ns)	Centroid (ns)	σ (ns)	Centroid (ns)	σ (ns)
86	3.0	-1.301	0.243	-0.522	0.299	1.306	0.29	0.296	0.289
88	5.0	-1.267	0.253	-0.72	0.302	1.285	0.309	0.484	0.297
89	7.0	-0.983	0.261	-0.864	0.299	1.005	0.317	0.62	0.307
90	9.0	-0.499	0.269	-0.55	0.299	0.466	0.323	0.353	0.312
91	11.0	-0.414	0.271	-0.845	0.296	0.416	0.318	0.614	0.317
92	13.0	-0.252	0.271	-0.769	0.294	0.105	0.314	0.688	0.321
93	15.0	-0.265	0.272	-1.212	0.289	0.191	0.308	1.062	0.310
94	17.0	0.087	0.27	-1.101	0.288	-0.162	0.295	0.947	0.298

Table 2: Width plot fit parameters for boards 2, 3, 6, and 7 with the source directly over the scintillator with 2-3.

		w2		w3		w6		w7	
Run	Position (cm)	Centroid (ns)	σ (ns)	Centroid (ns)	σ (ns)	Centroid (ns)	σ (ns)	Centroid (ns)	σ (ns)
86	3.0	43.637	6.552	36.446	7.022	48.325	5.945	49.878	5.985
88	5.0	40.281	6.904	35.193	7.113	47.653	5.885	48.113	5.948
89	7.0	38.598	6.905	35.762	7.121	48.315	5.908	47.766	5.692
90	9.0	38.303	7.266	37.091	7.107	49.023	5.92	47.293	5.824
91	11.0	38.328	6.948	38.018	7.159	49.751	6.034	46.864	5.963
92	13.0	37.325	7.092	39.591	6.574	50.236	6.131	45.681	7.376
93	15.0	37.028	7.104	41.031	6.235	50.514	6.091	45.296	6.435
94	17.0	36.896	7.115	41.831	6.243	51.047	6.202	44.838	7.362

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

	Slope (ns/cm)	u(Slope) (ns/cm)	y-Intercept (ns)	u(y-Intercept) (ns)
t2 - (t6+t7)/2	0.1	0.02	-1.6	0.2
t3 - (t6+t7)/2	-0.04	0.02	-0.4	0.3
t6 - (t2+t3)/2	-0.11	0.02	1.7	0.3
t7 - (t2+t3)/2	0.05	0.02	0.2	0.3
w2	-0.4	0.09	42	1
w3	0.47	0.07	33.4	0.8
w6	0.24	0.03	46.99	0.3
w7	-0.33	0.03	50.3	0.3

The difference between the results presented here and in the first iteration of this report is this version has better matched gains, as seen in Figures 5-12 where we can see the full rise and fall of the peak. We still see the same mismatched slopes on the time centroid vs position plots in Figure 1 where across one bar and along one side of the stacked set up one slope is twice the other. We only see matching slopes when we compare diagonally across the set up (i.e. top right and bottom left). However, now we are much closer to having matched slopes in the width centroid vs position plots of Figure 2, with them agreeing within uncertainty for the top scintillator bar (2-3) as shown in Table 3.

An interesting consistency is seen when comparing the time centroid vs position plots to those seen in Figures 3 and 4 where we plot the fits for a given quantity from all runs together. Here, we see that the times that had a similar slope show similar a spreading out of the Gaussians for each run when comparing the amount of overlap between functions of neighbouring runs and overlap between the first and last (shaded) runs. This tells us that the time plots with the greater slope indicate better position resolution. Additional investigations are needed into the odd behaviour seen at boards 3 and 7.

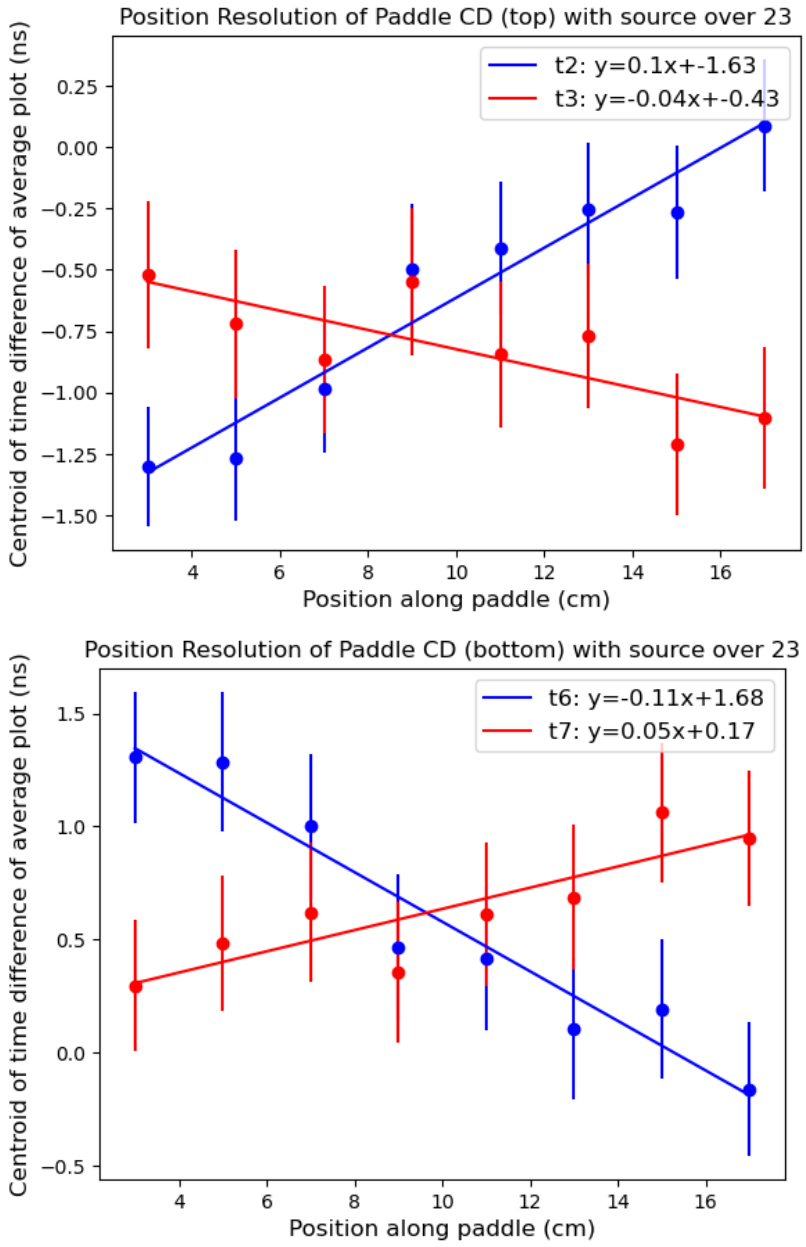

Figure 1: Time versus source position for the source over 23, showing the data for the upper board in the top plot and the lower board in the bottom plot.

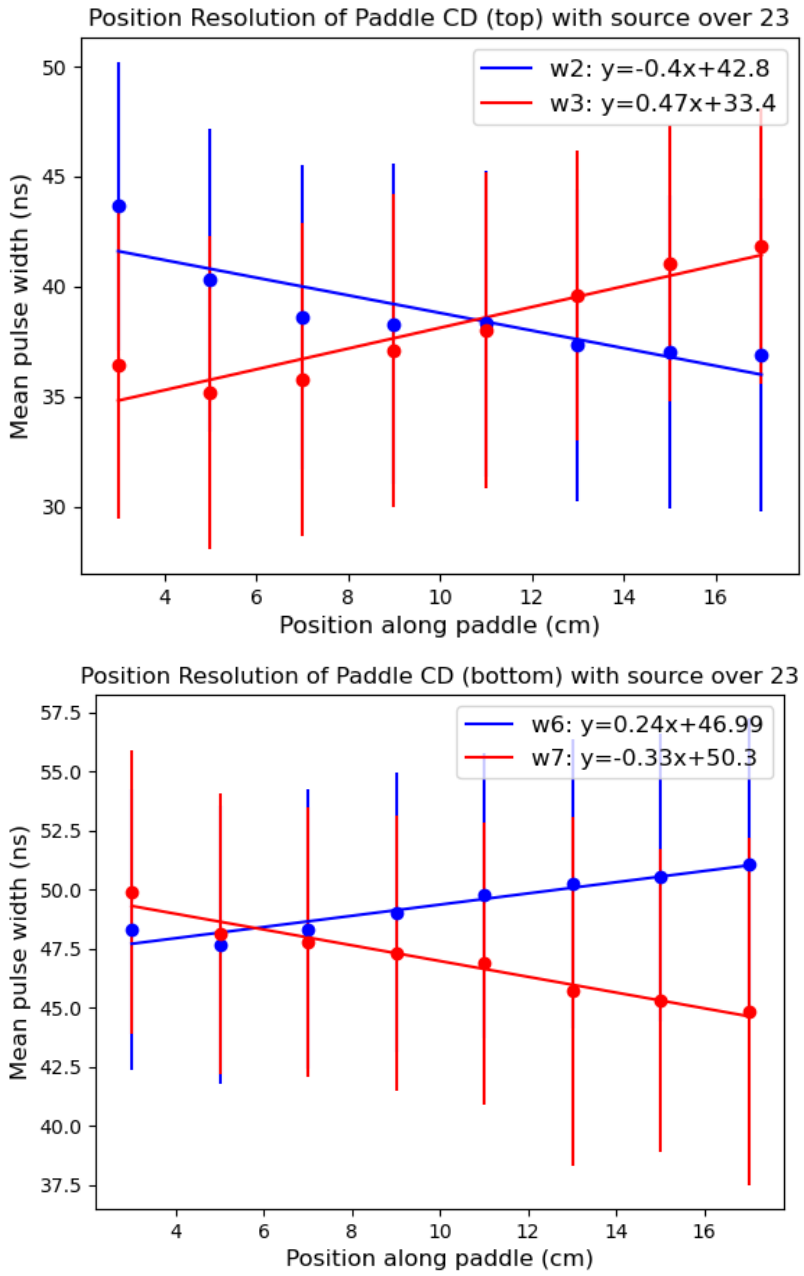

Figure 2: Pulse width vs source position for the source over 23, showing the data for the upper board in the top plot and the lower board in the bottom plot.

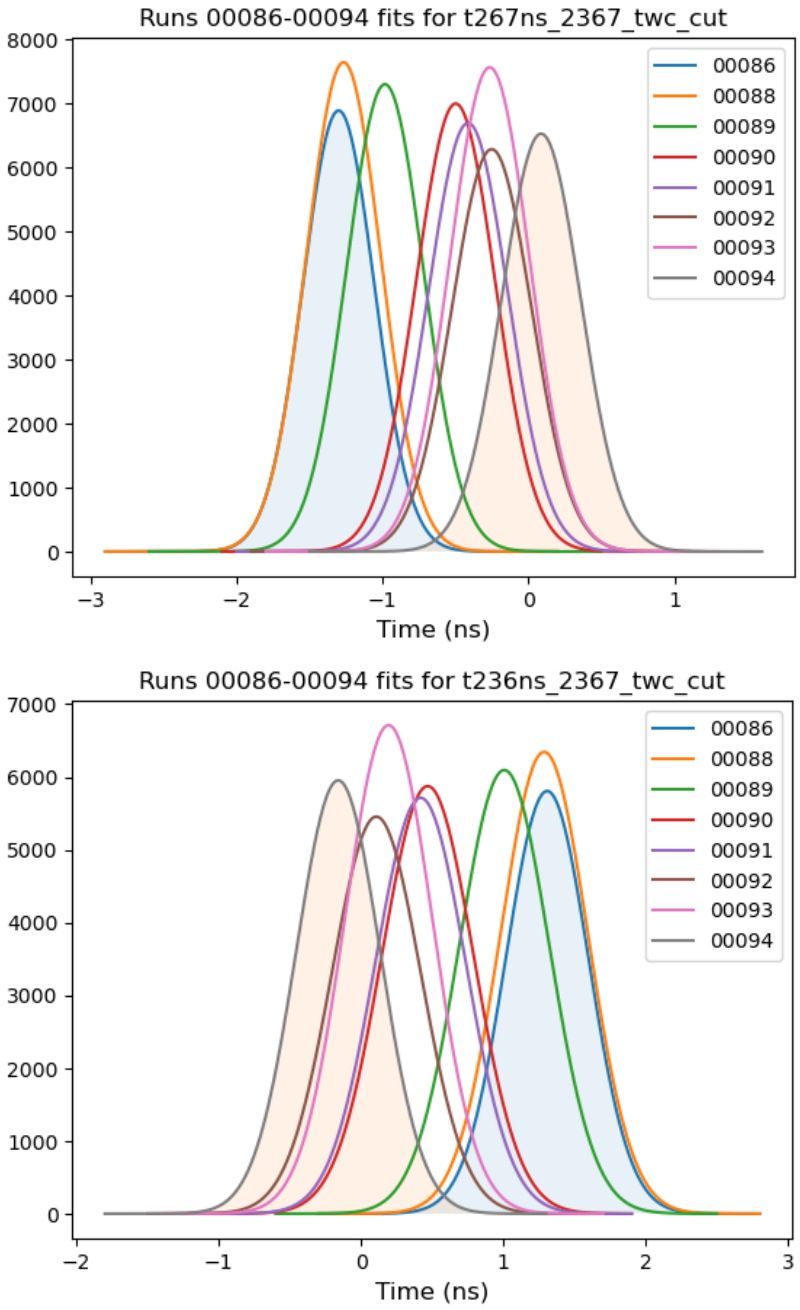

Figure 3: Fits for the plots of $t_2 - \frac{1}{2}(t_6 + t_7)$ (top) and $t_6 - \frac{1}{2}(t_2 + t_3)$ (bottom) over all source runs done for this test. The first and last run are shaded in, where run 86 was closest to board 2 (farthest from board 6).

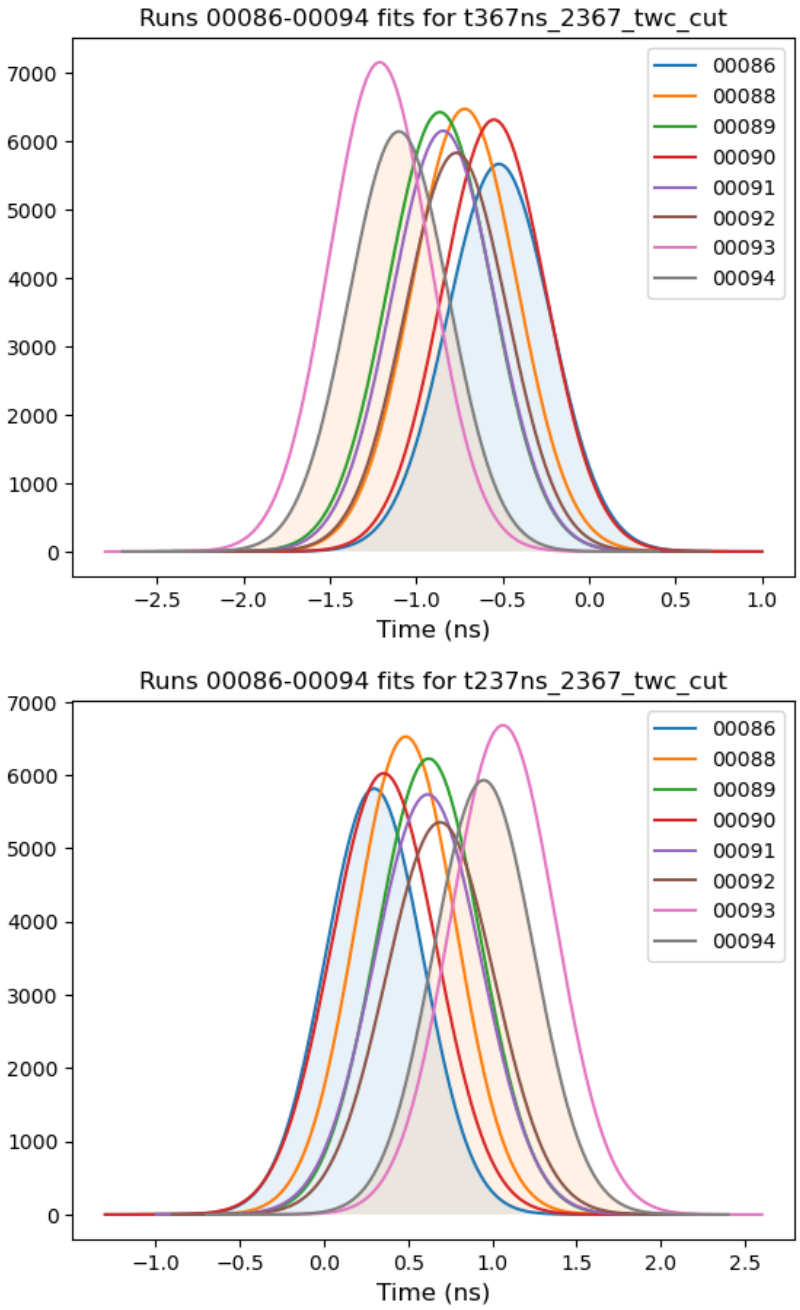

Figure 4: Fits for the plots of $t_3 - \frac{1}{2}(t_6 + t_7)$ (top) and $t_7 - \frac{1}{2}(t_2 + t_3)$ (bottom) over all source runs done for this test. The first and last run are shaded in, where run 86 was closest to board 7 (farthest from board 3).

2 Histograms used to make the above plots

2.1 Widths

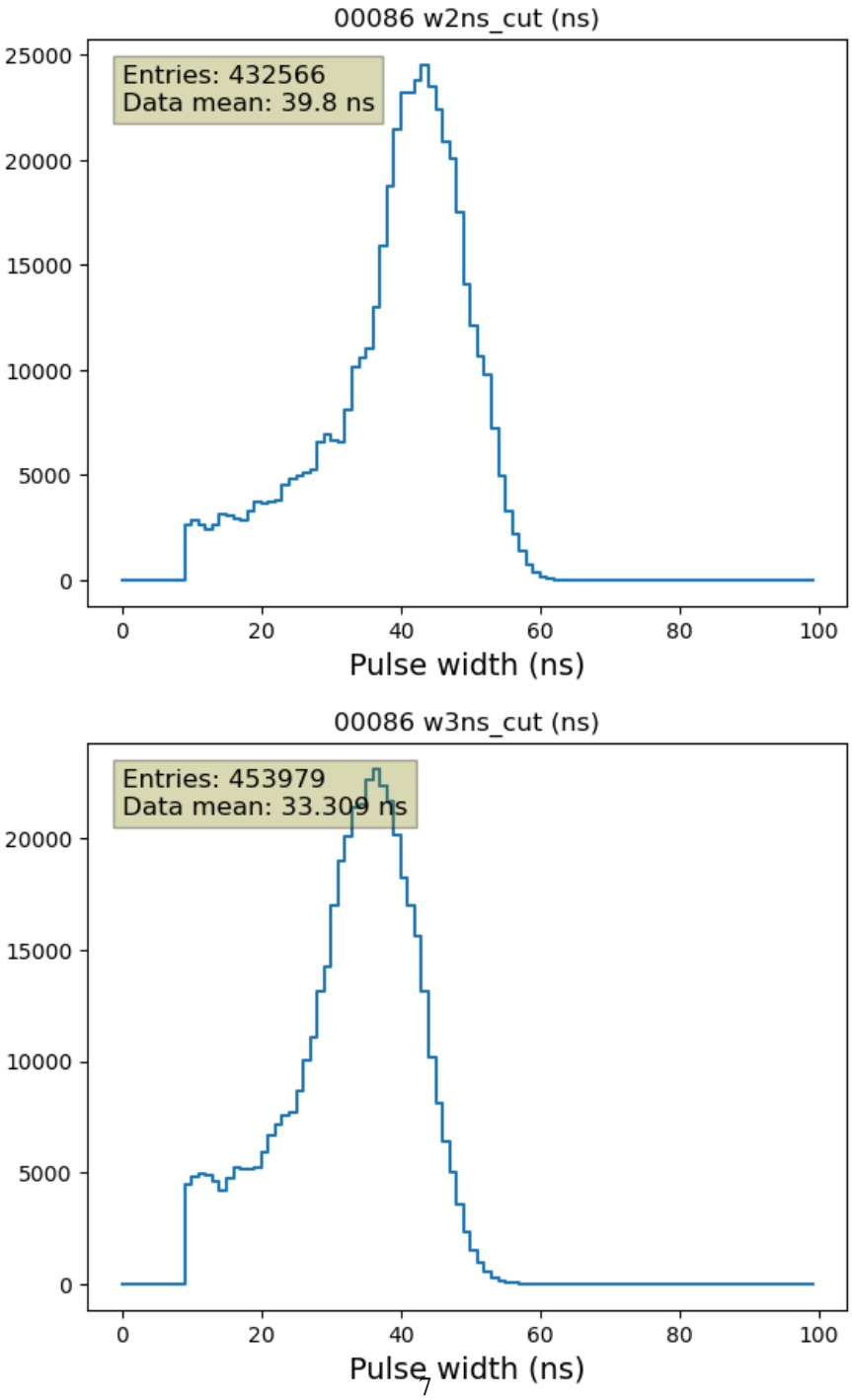

Figure 5: Pulse width for 2 and 3 with the source over 23 for run 86.

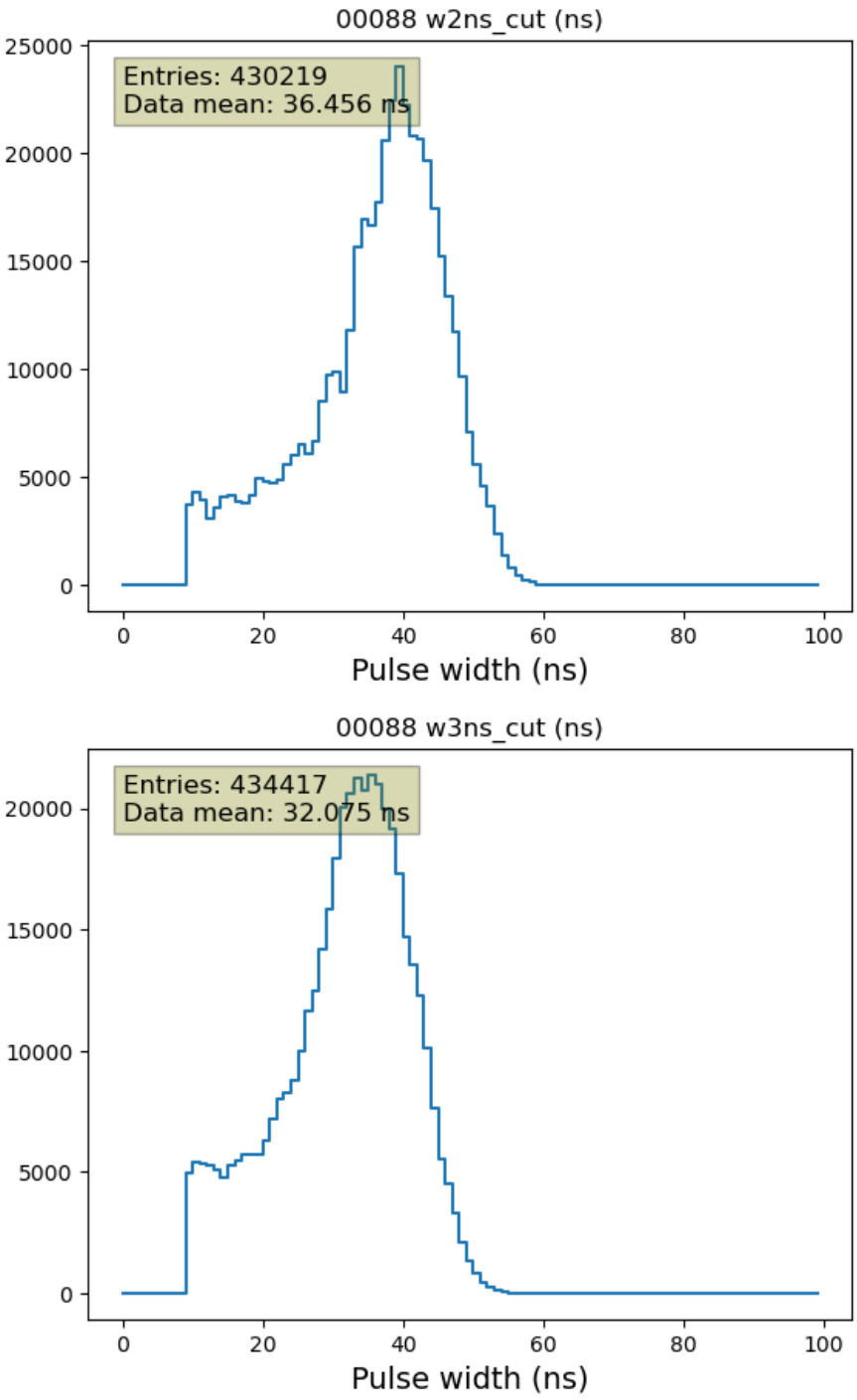

Figure 6: Pulse width for 2 and 3 with the source over 23 for run 88.

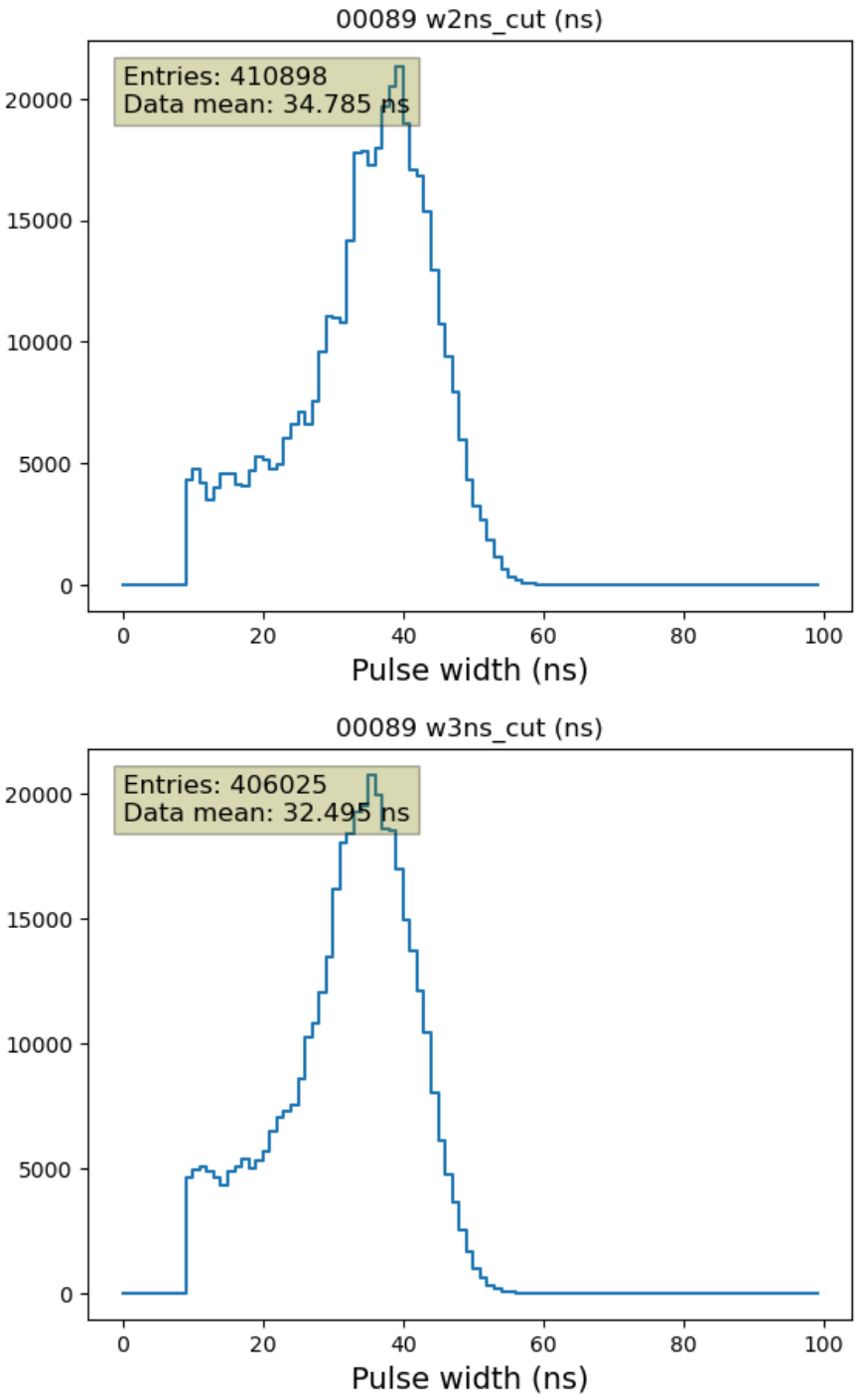

Figure 7: Pulse width for 2 and 3 with the source over 23 for run 89.

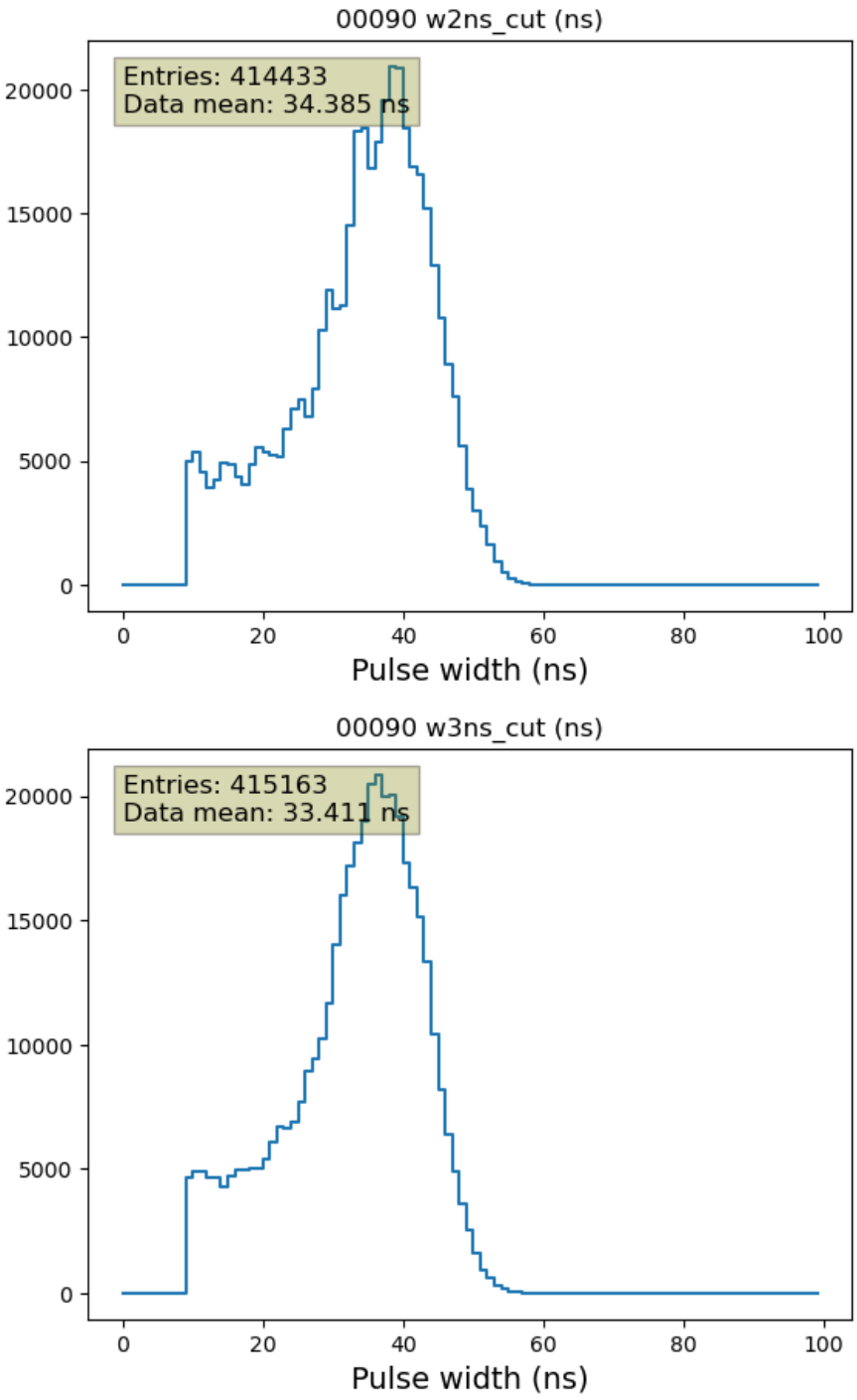

Figure 8: Pulse width for 2 and 3 with the source over 23 for run 90.

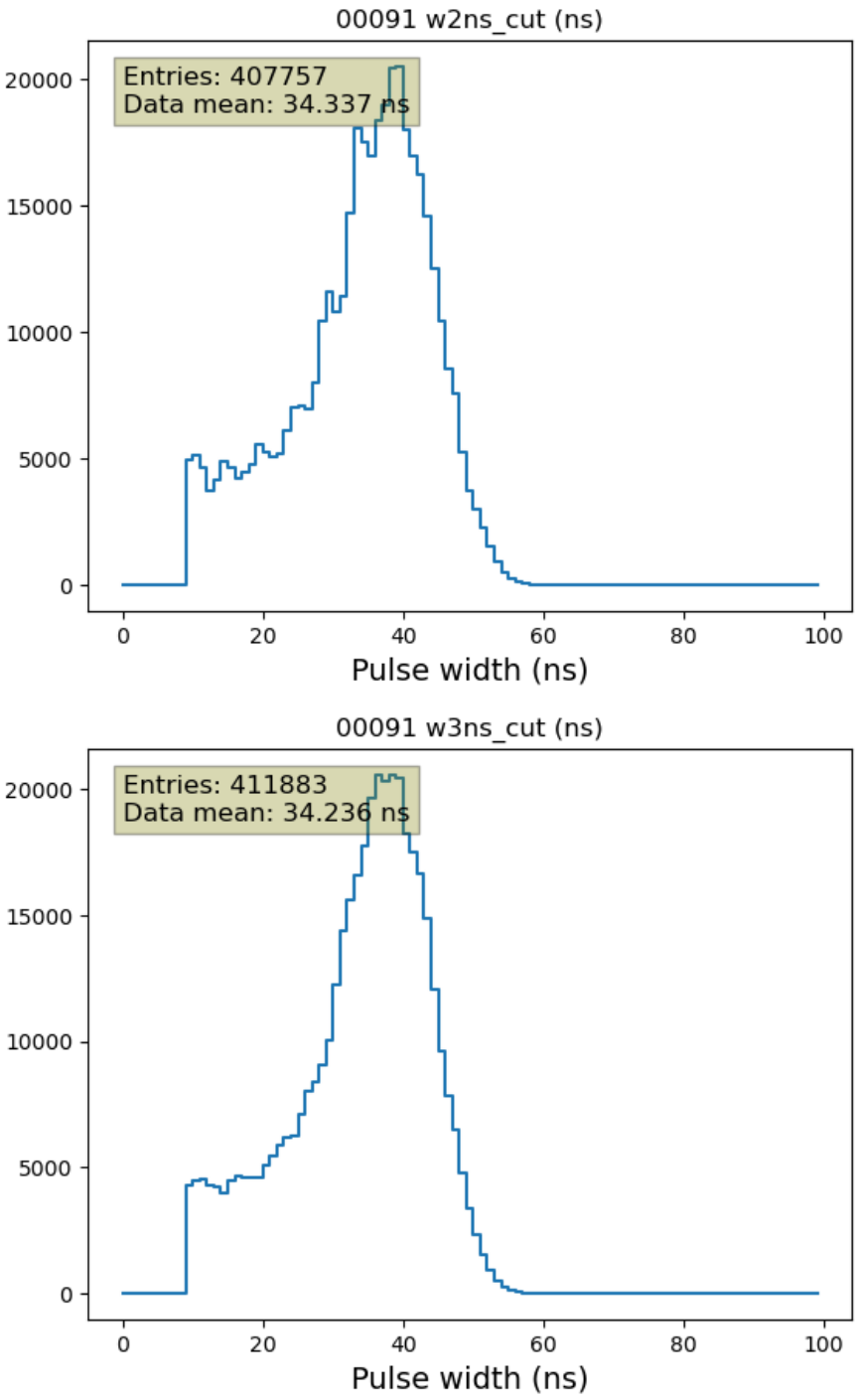

Figure 9: Pulse width for 2 and 3 with the source over 23 for run 91.

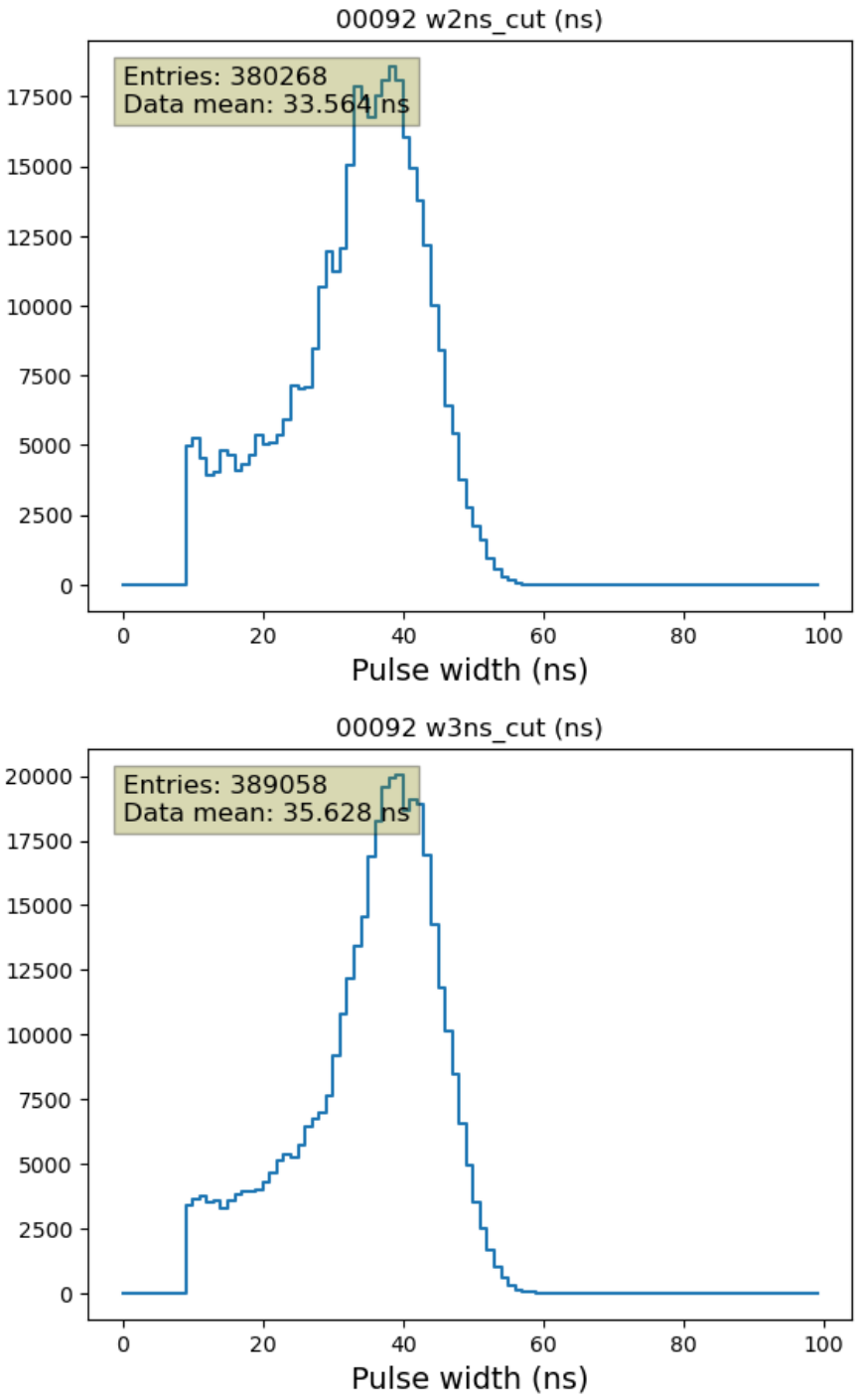

Figure 10: Pulse width for 2 and 3 with the source over 23 for run 92.

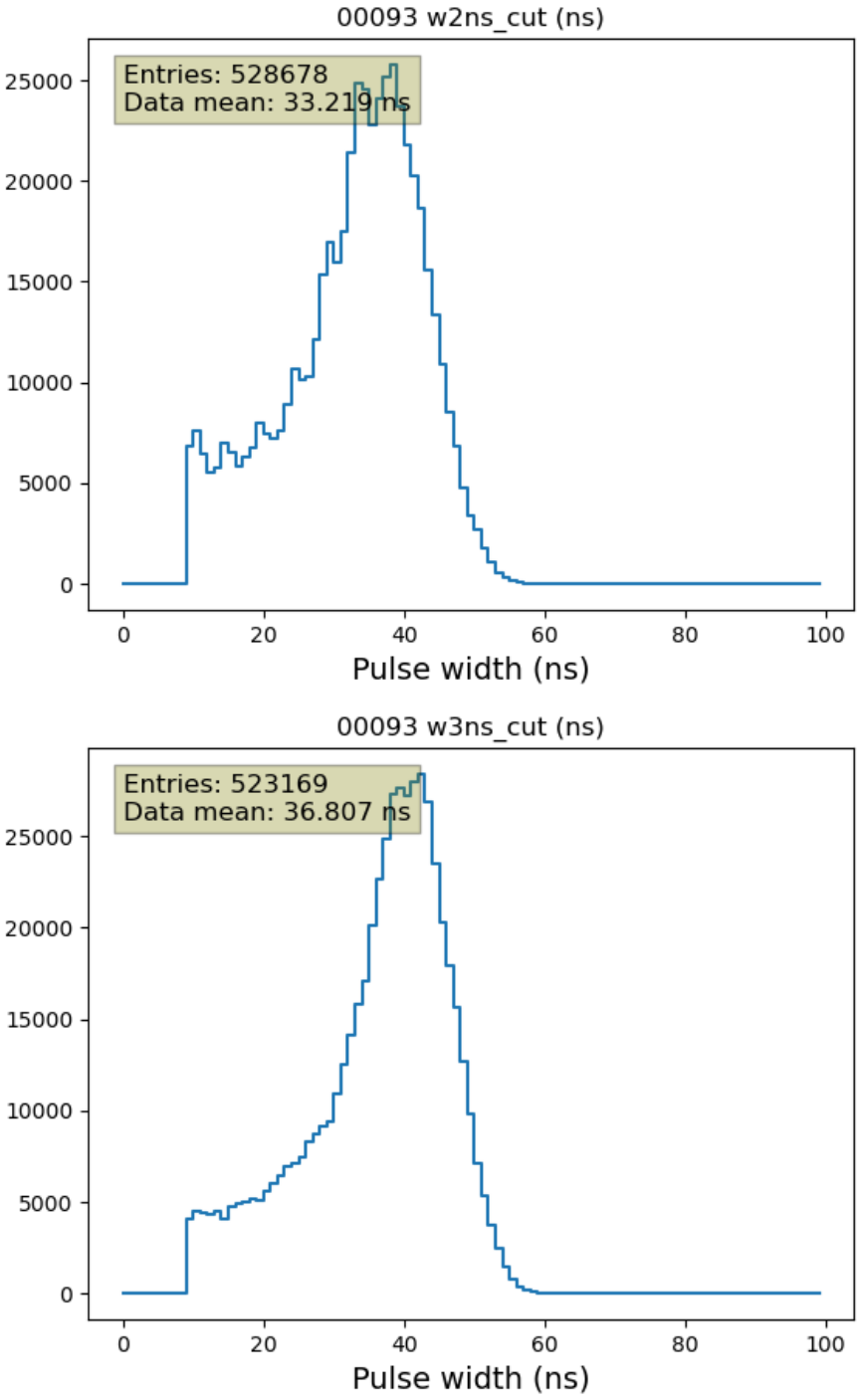

Figure 11: Pulse width for 2 and 3 with the source over 23 for run 93.

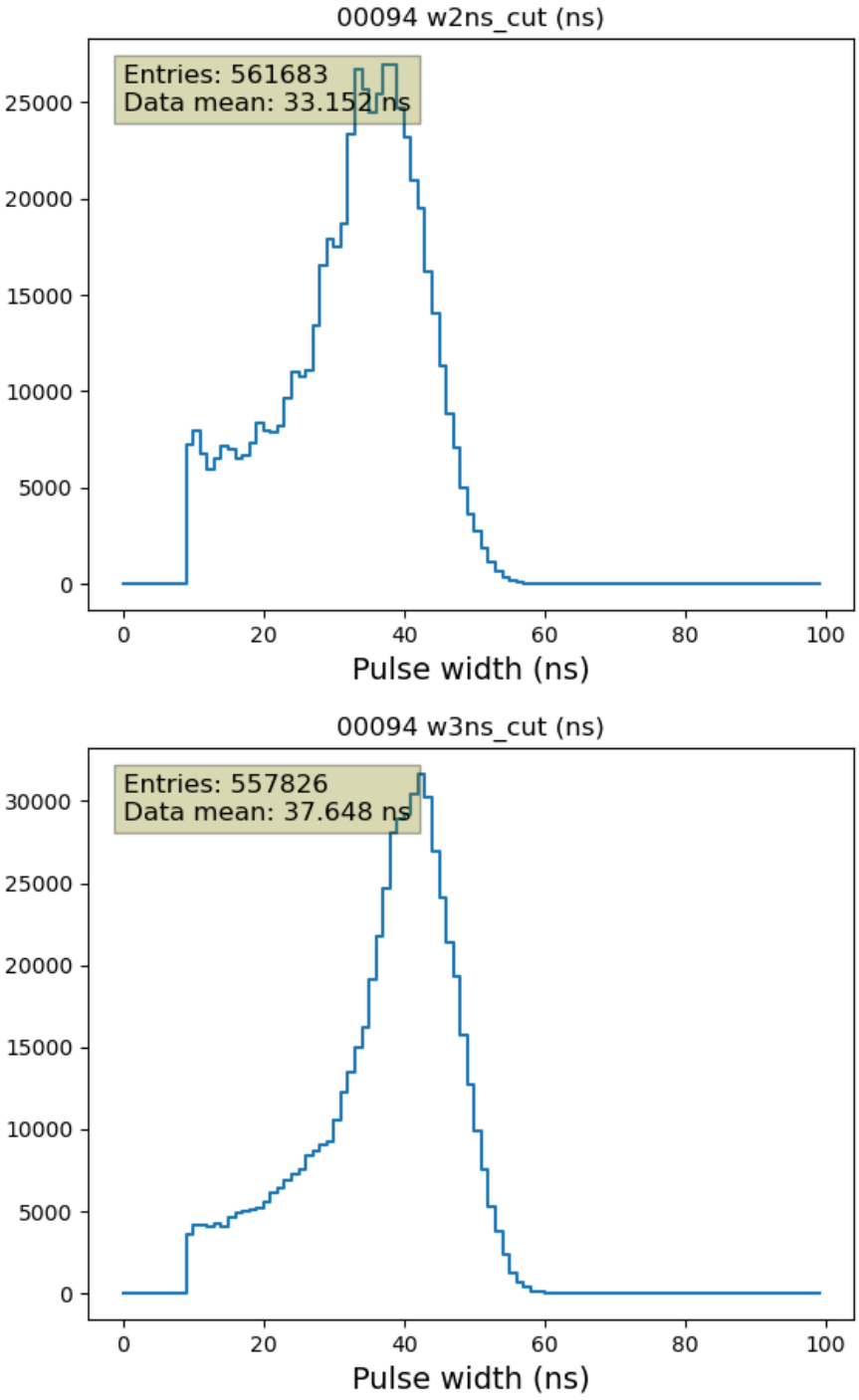

Figure 12: Pulse width for 2 and 3 with the source over 23 for run 94.

2.1.1 Time plots after TWC

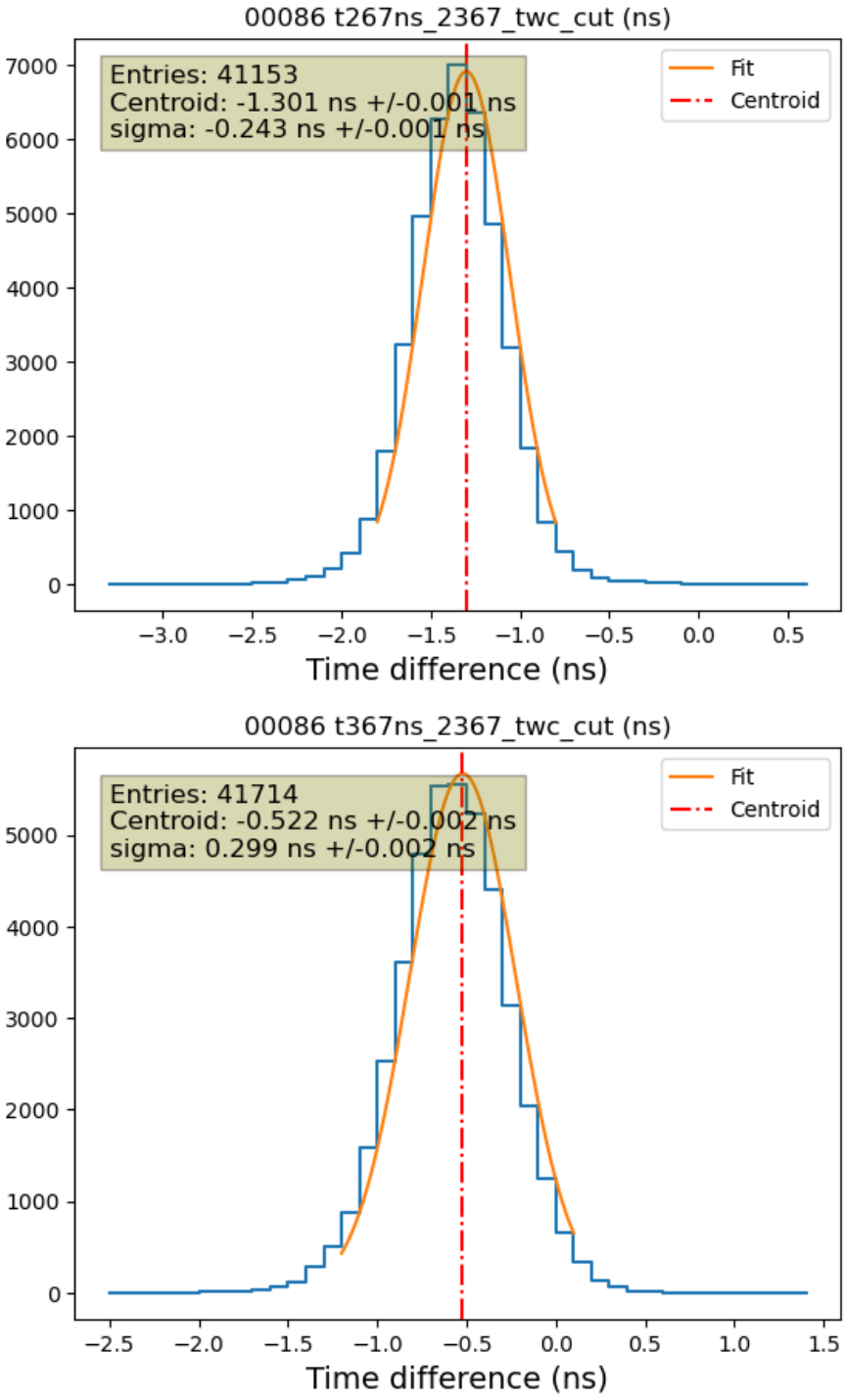

Figure 13: Time difference of the time of interest and the average time for the lower bar for t2 and t3 with the source over 23 for run 86.

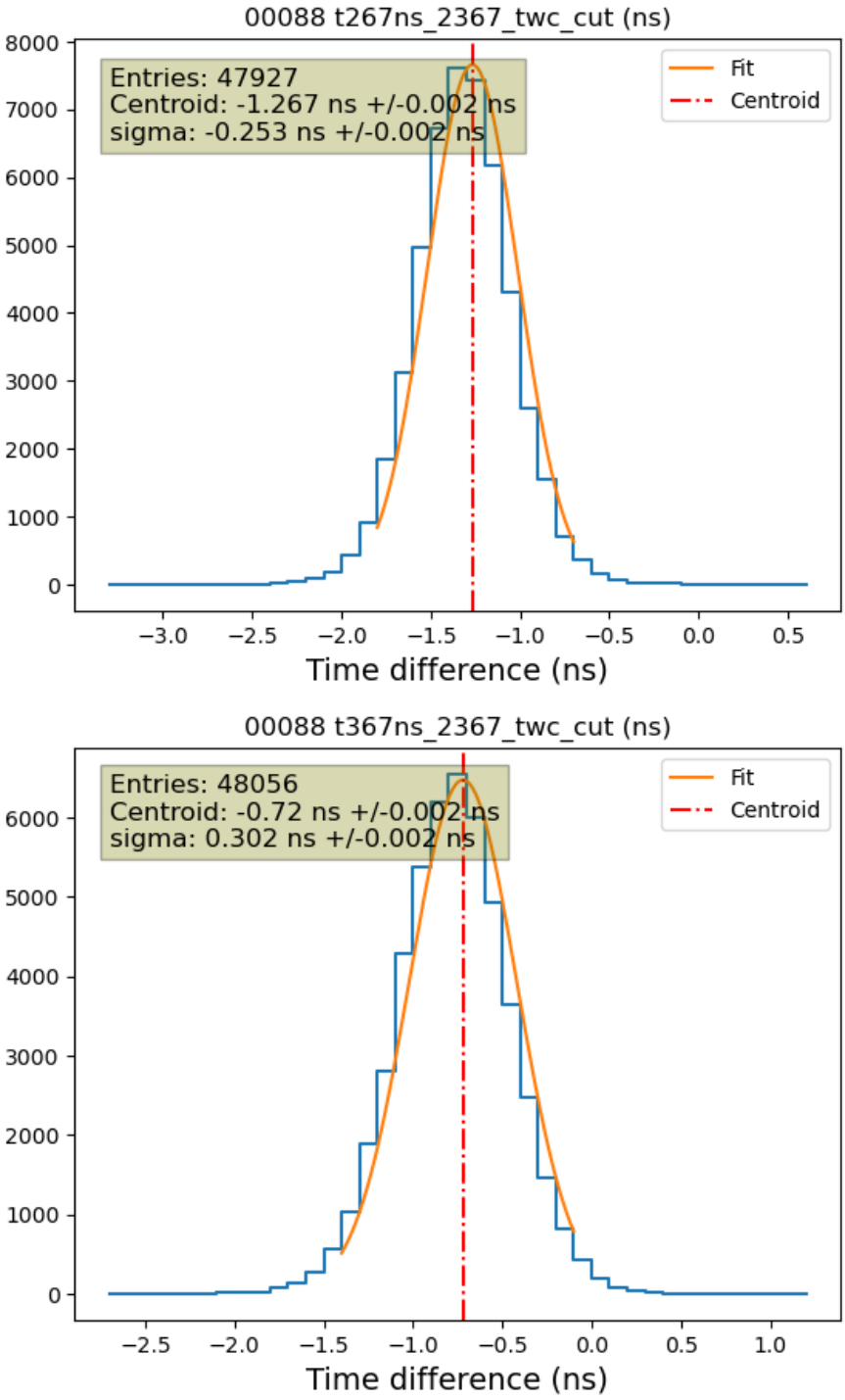

Figure 14: Time difference of the time of interest and the average time for the lower bar for t2 and t3 with the source over 23 for run 88.

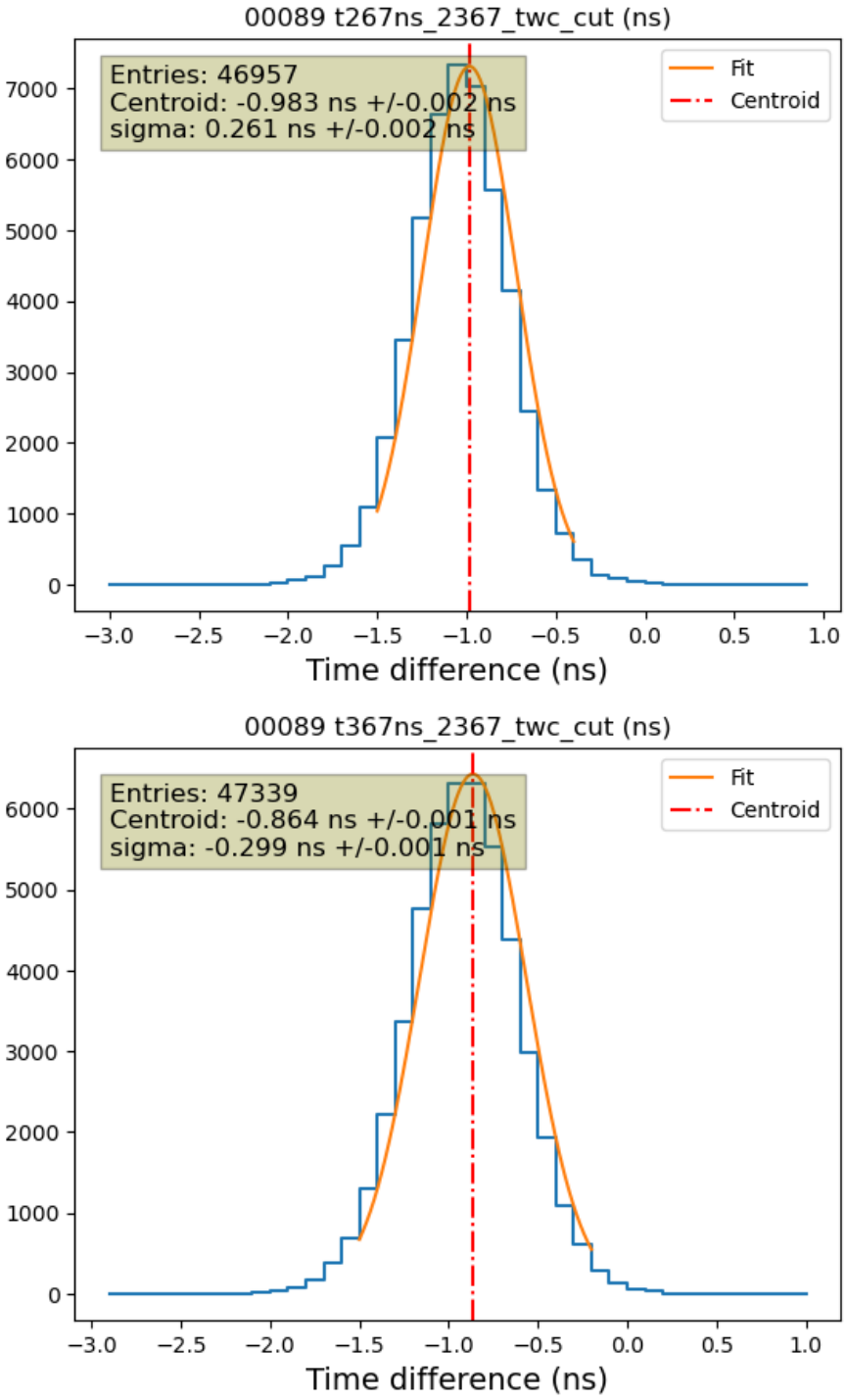

Figure 15: Time difference of the time of interest and the average time for the lower bar for t2 and t3 with the source over 23 for run 89.

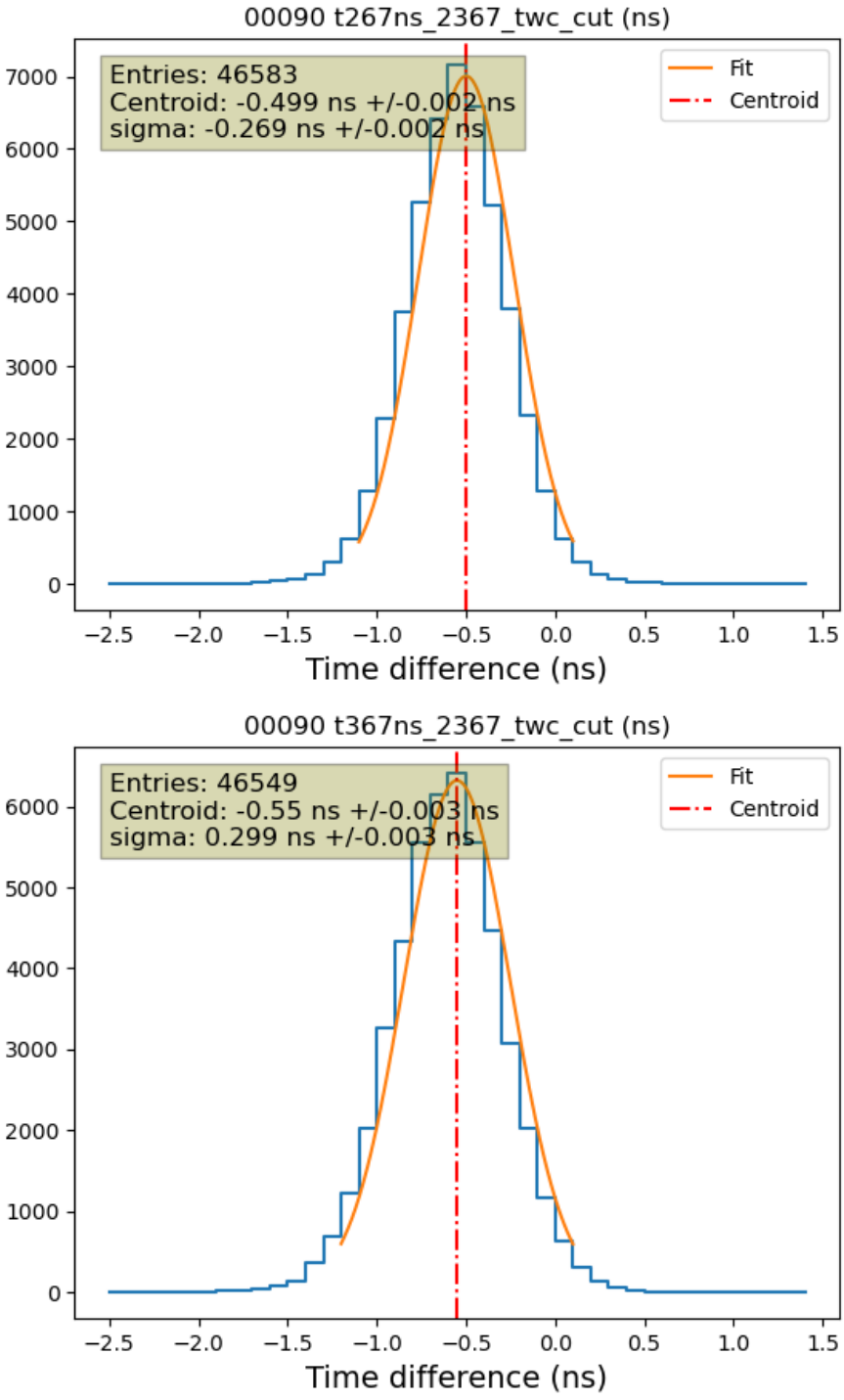

Figure 16: Time difference of the time of interest and the average time for the lower bar for t2 and t3 with the source over 23 for run 90.

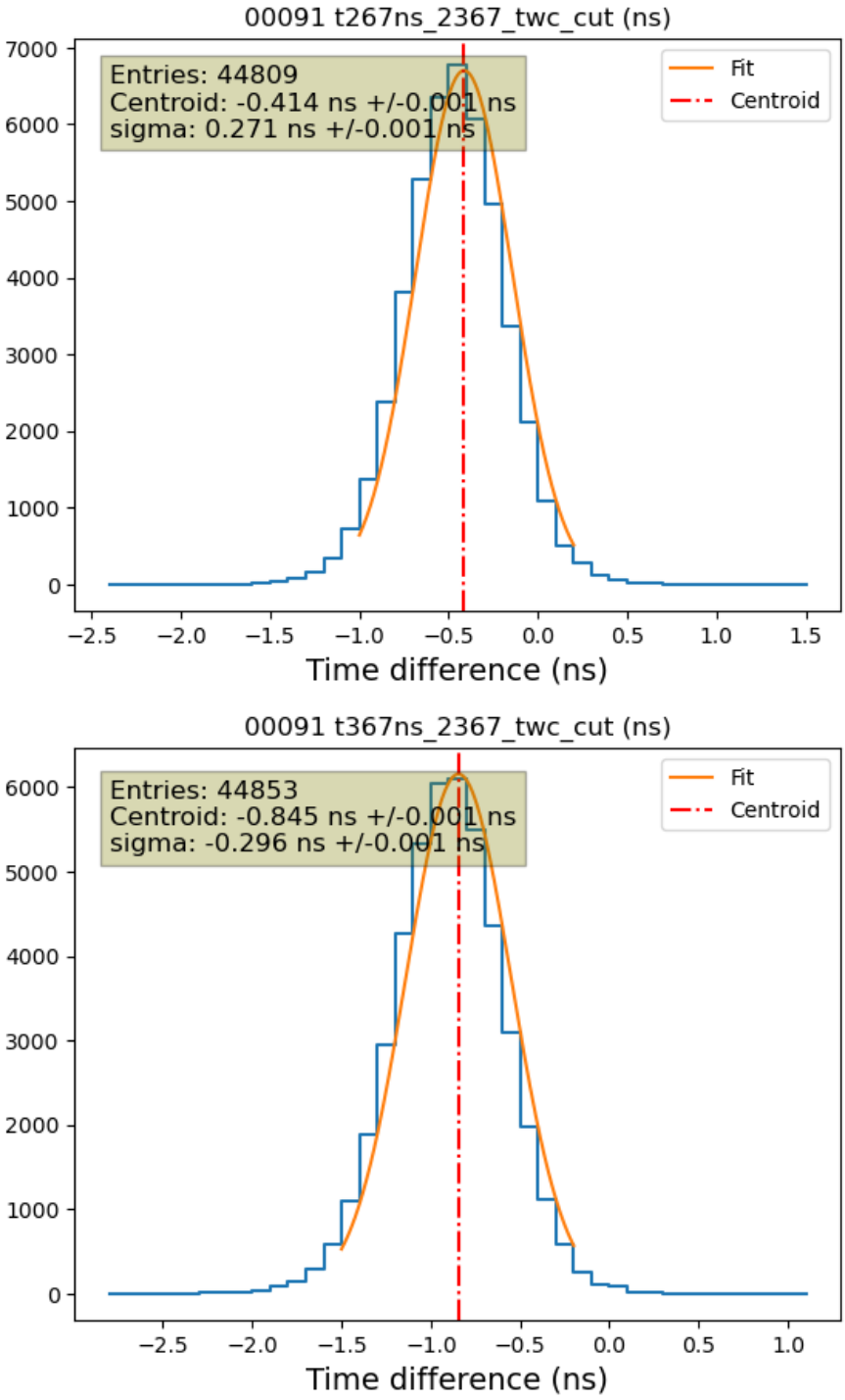

Figure 17: Time difference of the time of interest and the average time for the lower bar for t2 and t3 with the source over 23 for run 91.

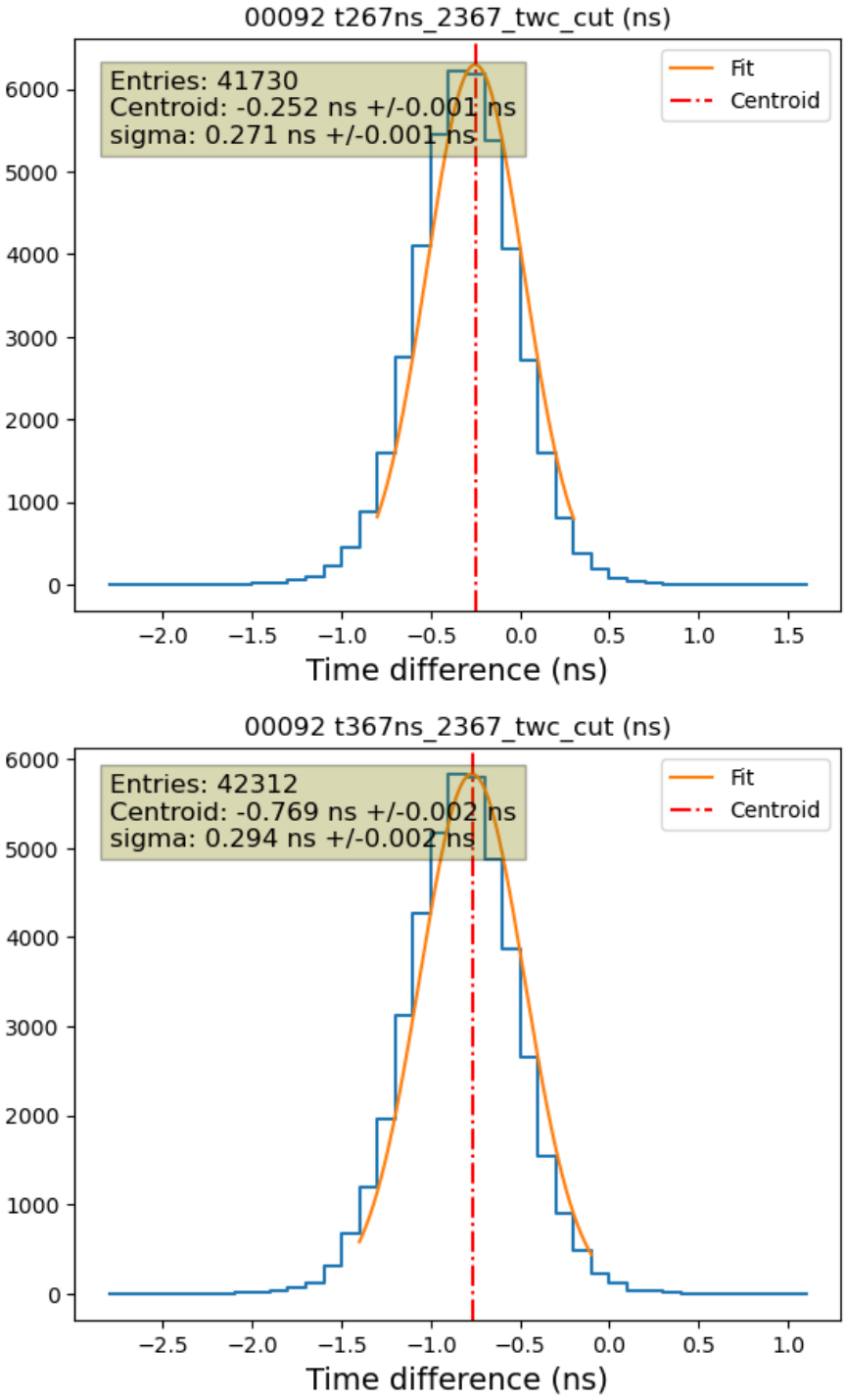

Figure 18: Time difference of the time of interest and the average time for the lower bar for t2 and t3 with the source over 23 for run 92.

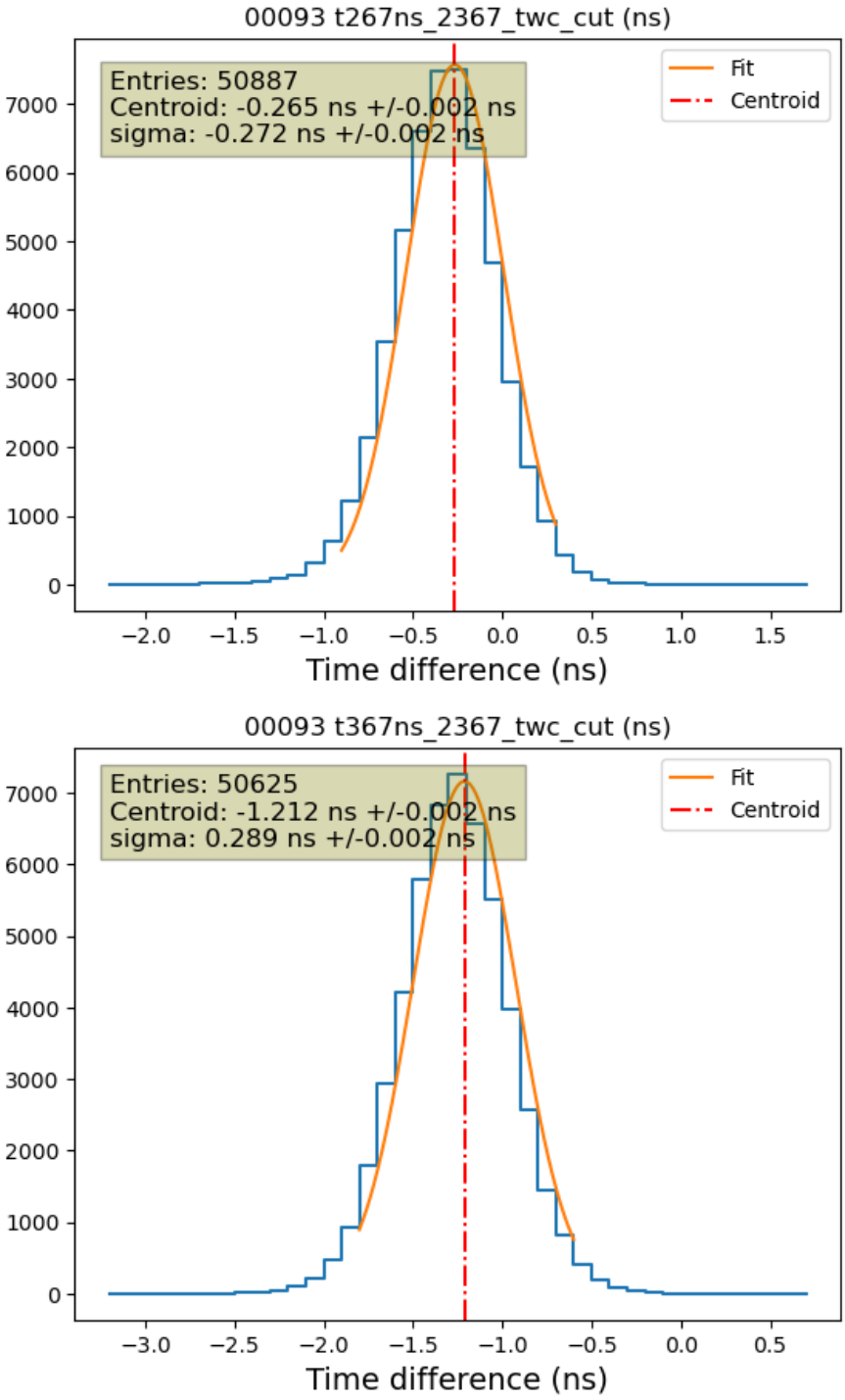

Figure 19: Time difference of the time of interest and the average time for the lower bar for t2 and t3 with the source over 23 for run 93.

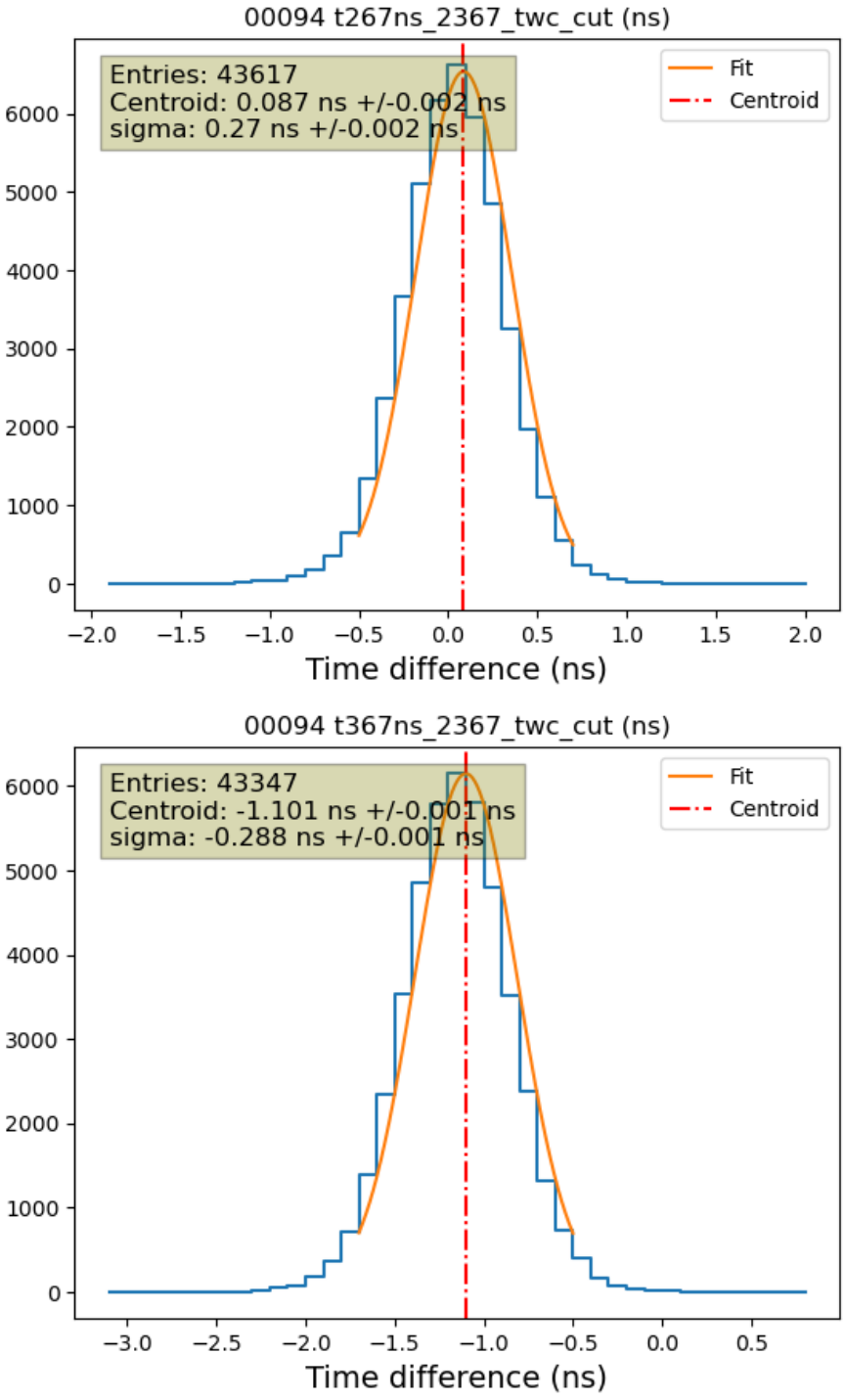

Figure 20: Time difference of the time of interest and the average time for the lower bar for t2 and t3 with the source over 23 for run 94.