

Position Resolution - Update 2-1

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May 28, 2024

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. All of the following data was collected with paddle CD on top and with the source over bar 2-3, **this document works with different plots from the same runs that were presented in update 2.**

1 Position Relationships

Table 1: Time difference of boards opposite each other along a scintillator bar plot fit parameters for boards 2, 3, 6, and 7 with the source directly over the scintillator with 2-3. No coincidence conditions between the upper and lower bars are imposed.

Run	Position (cm)	t23		t23 twc		t67		t67 twc	
		Centroid (ns)	σ (ns)	Centroid (ns)	σ (ns)	Centroid (ns)	σ (ns)	Centroid (ns)	σ (ns)
86	3.0	1.128	0.319	0.751	0.315	-1.003	0.414	-1.061	0.396
88	5.0	0.817	0.343	0.496	0.336	-0.809	0.452	-0.852	0.428
89	7.0	0.453	0.352	0.062	0.344	-0.513	0.484	-0.432	0.456
90	9.0	0.152	0.353	-0.119	0.341	-0.247	0.52	-0.169	0.478
91	11.0	-0.117	0.349	-0.499	0.34	0.02	0.536	0.139	0.488
92	13.0	-0.51	0.345	-0.579	0.334	0.353	0.516	0.51	0.485
93	15.0	-0.826	0.34	-1.006	0.329	0.615	0.479	0.804	0.454
94	17.0	-1.058	0.334	-1.255	0.321	0.779	0.43	1.046	0.411

Table 2: Time difference of boards opposite each other along a scintillator bar plot fit parameters for boards 2, 3, 6, and 7 with the source directly over the scintillator with 2-3. Coincidence between the upper and lower bars is required.

Run	Position (cm)	t23 2367		t23 2367 twc		t67 2367		t67 2367 twc	
		Centroid (ns)	σ (ns)	Centroid (ns)	σ (ns)	Centroid (ns)	σ (ns)	Centroid (ns)	σ (ns)
86	3.0	1.106	0.31	0.730	0.293	-1.021	0.377	-1.081	0.359
88	5.0	0.816	0.327	0.497	0.310	-0.822	0.416	-0.865	0.395
89	7.0	0.457	0.335	0.069	0.320	-0.52	0.439	-0.443	0.413
90	9.0	0.162	0.33	-0.106	0.315	-0.251	0.455	-0.170	0.423
91	11.0	-0.105	0.331	-0.486	0.316	0.026	0.459	0.146	0.427
92	13.0	-0.496	0.324	-0.572	0.314	0.365	0.456	0.531	0.43
93	15.0	-0.809	0.316	-1.00	0.309	0.633	0.429	0.831	0.402
94	17.0	-1.029	0.314	-1.242	0.303	0.795	0.388	1.07	0.367

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

	Slope (ns/cm)	Slope Uncertainty (ns/cm)	y-Intercept (ns)	y-Intercept Uncertainty (ns)
t23	-0.16	0.03	1.59	0.3
t23 twc	-0.14	0.03	1.15	0.3
t67	0.13	0.03	-1.43	0.4
t67 twc	0.16	0.03	-1.56	0.4
t23 2367	-0.16	0.02	1.57	0.3
t23 2367 twc	-0.14	0.02	1.14	0.3
t67 2367	0.14	0.03	-1.46	0.3
t67 2367 twc	0.16	0.03	-1.59	0.3

The results are the most promising yet! We finally see slope consistency with the slopes on the centroid vs source position plots agreeing within uncertainty both with and without a coincidence condition between the upper and lower bars imposed. To me, this suggests that there is a either delay in one of the boards in each paddle or something wrong with how we collect timing information (software or cabling issue). I think the second is more likely since I doubt that between two paddles we perfectly two chose boards with the same defect.

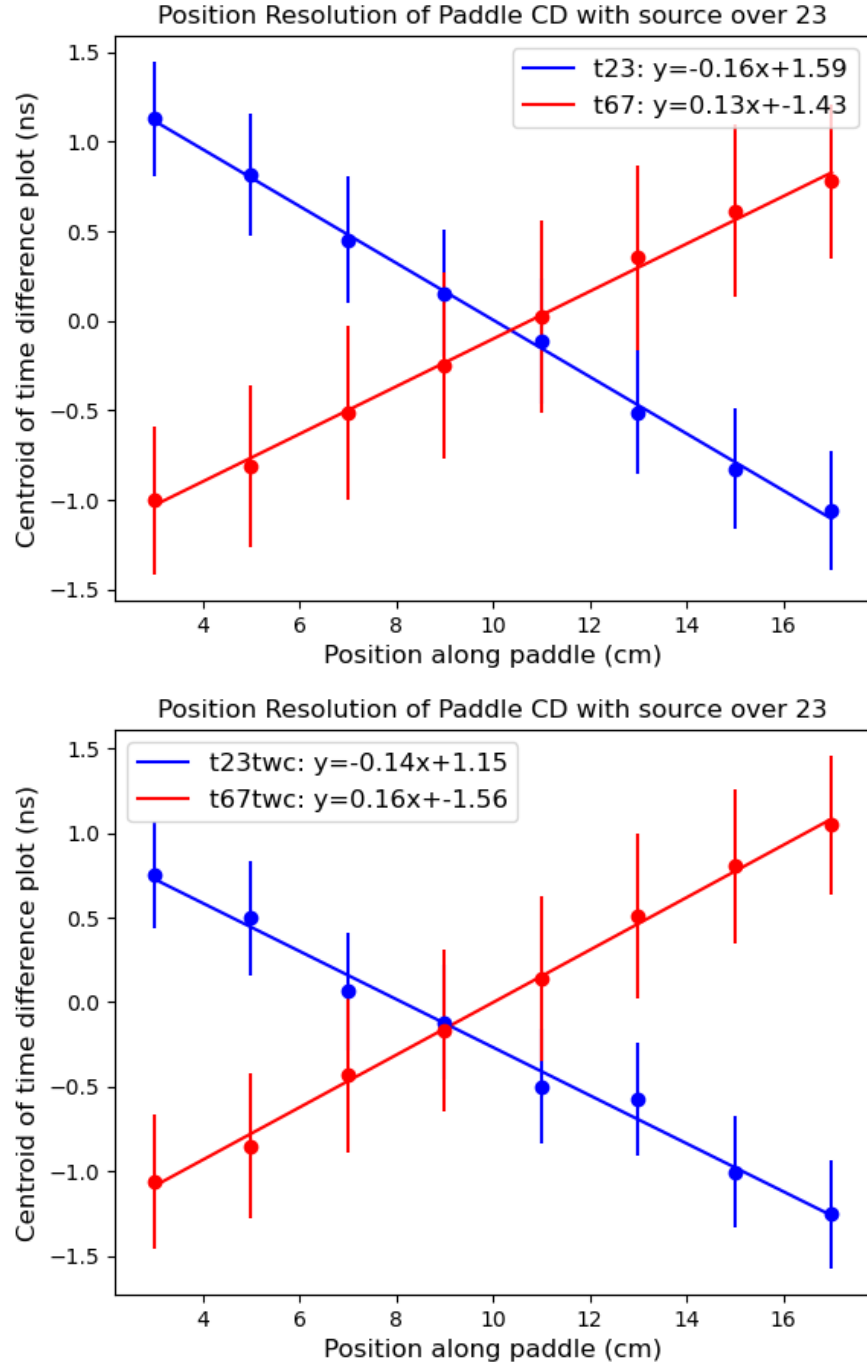


Figure 1: Time difference centroid versus source position comparing $t_3 - t_2$ and $t_7 - t_6$ with no coincidence considerations, and the time walk corrected data shown in the lower plot.

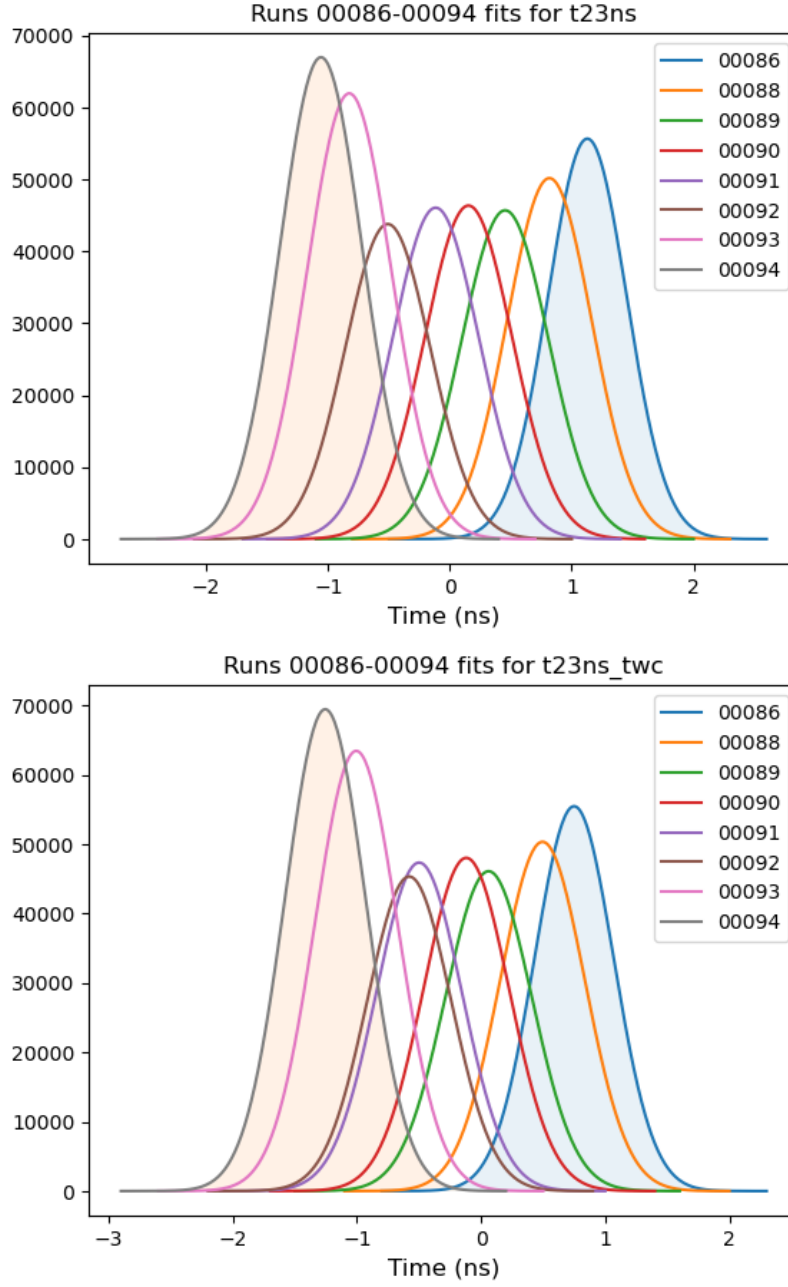


Figure 2: Fits for the plots of $t_3 - t_2$ before (top) and after (bottom) time walk correction over all source runs done for this test. The first and last run are shaded in, where in run 86 the source was closest to board 2 (farthest from board 6). No coincidence condition with the bottom board is imposed here.

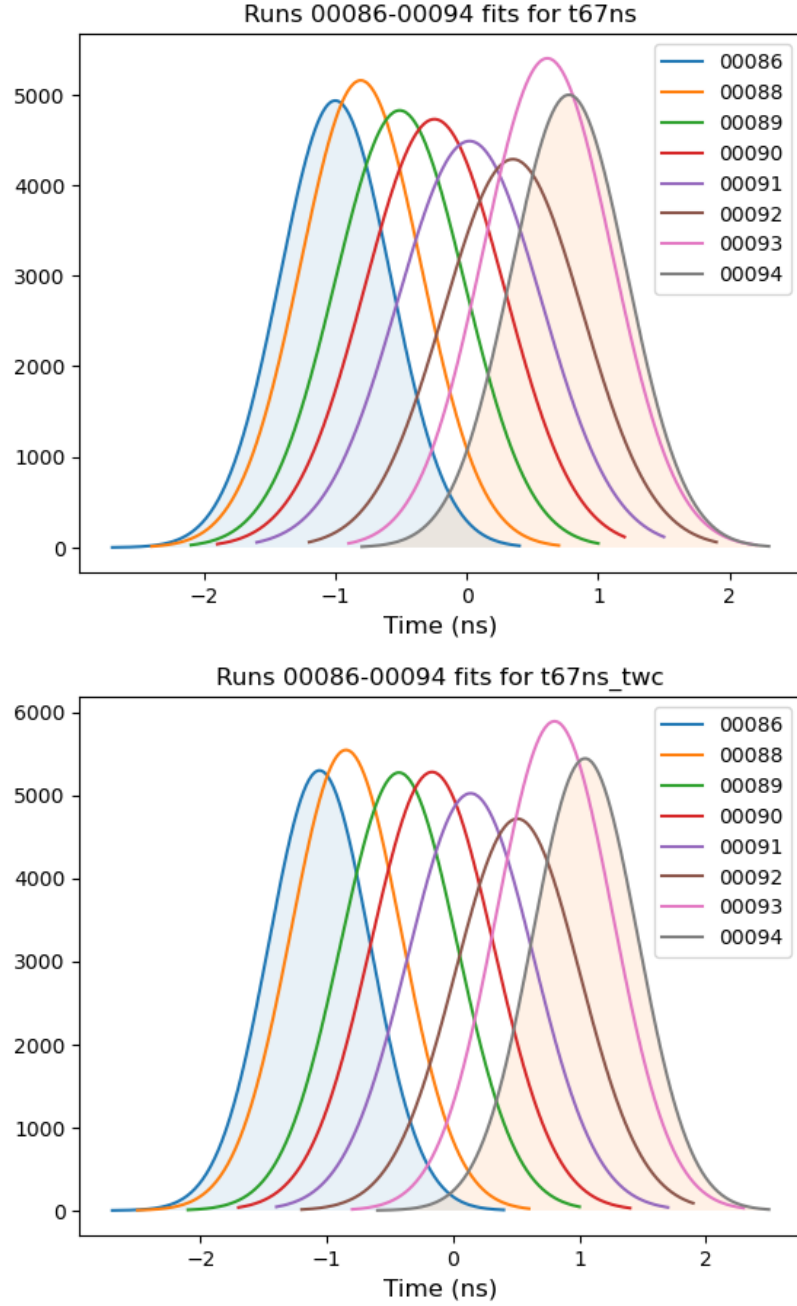


Figure 3: Fits for the plots of $t_7 - t_6$ before (top) and after (bottom) time walk correction over all source runs done for this test. The first and last run are shaded in, where in run 86 the source was closest to board 2 (farthest from board 6). No coincidence condition with the top board is imposed here.

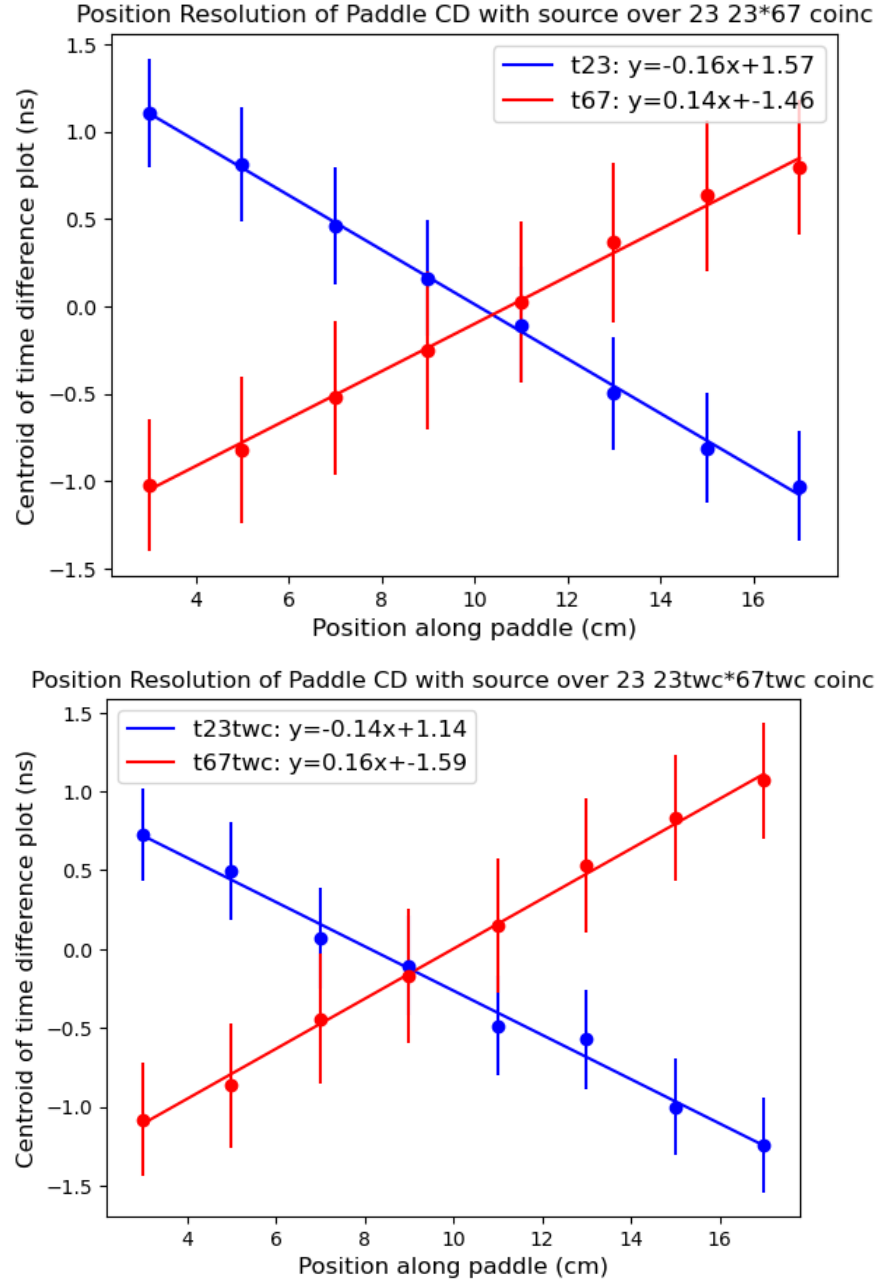


Figure 4: Time difference centroid versus source position comparing $t_3 - t_2$ and $t_7 - t_6$ with a coincidence condition between the top and bottom board, and the time walk corrected data shown in the lower plot.

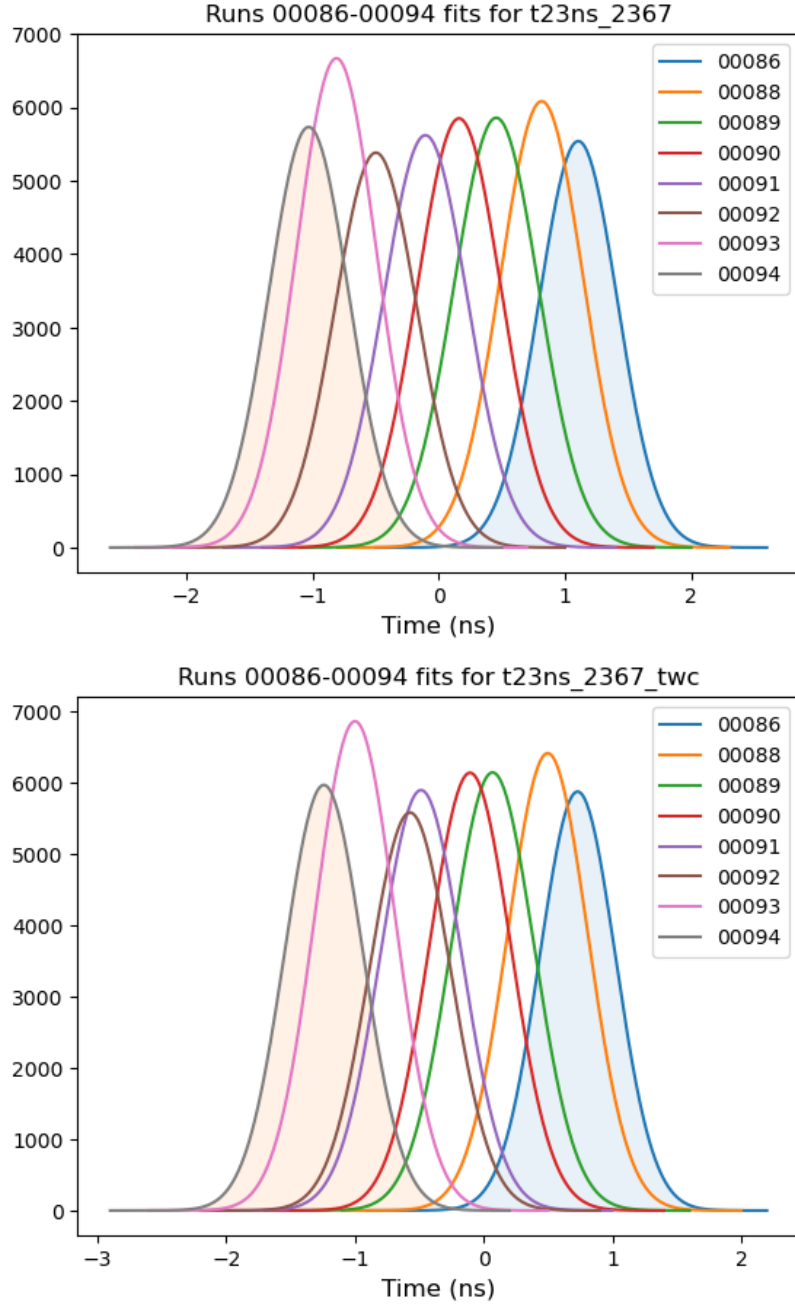


Figure 5: Fits for the plots of $t_3 - t_2$ before (top) and after (bottom) time walk correction over all source runs done for this test. The first and last run are shaded in, where in run 86 the source was closest to board 2 (farthest from board 6). The coincidence condition with the bottom board is imposed here.

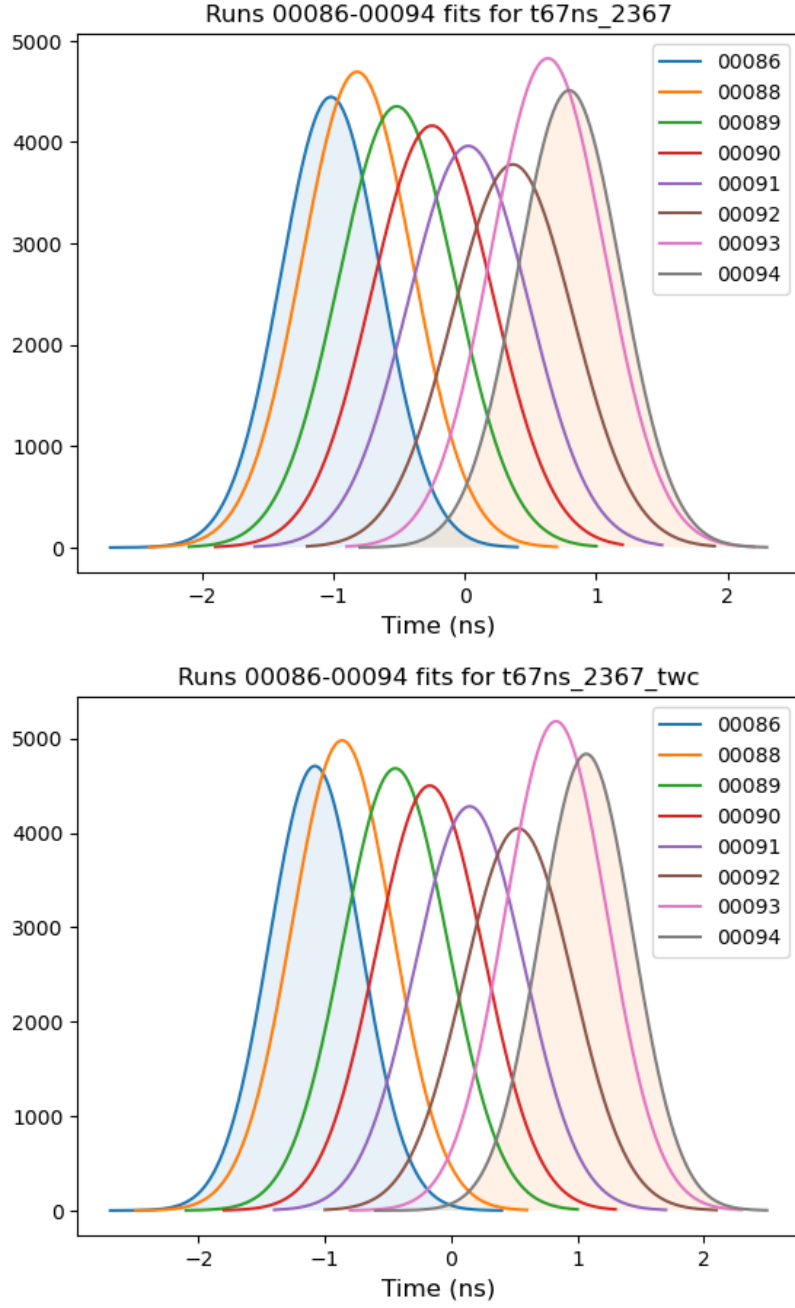


Figure 6: Fits for the plots of $t_7 - t_6$ before (top) and after (bottom) time walk correction over all source runs done for this test. The first and last run are shaded in, where in run 86 the source was closest to board 2 (farthest from board 6). The coincidence condition with the top board is imposed here.

2 Time Difference Histograms

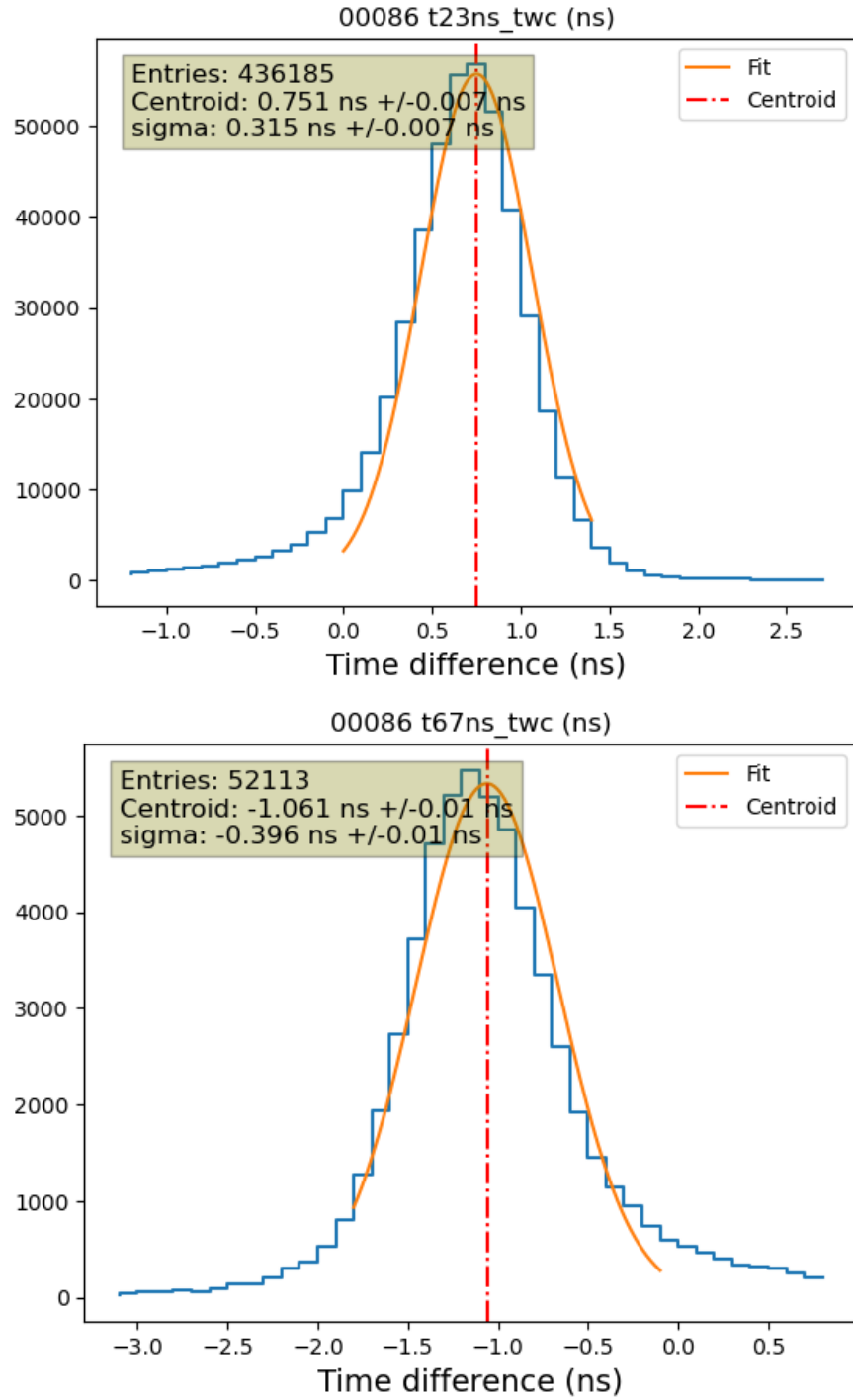


Figure 7: Time difference plot for $t_3 - t_2$ and $t_7 - t_6$, time walk corrected without the coincidence condition between the upper and lower bar, for run 86.

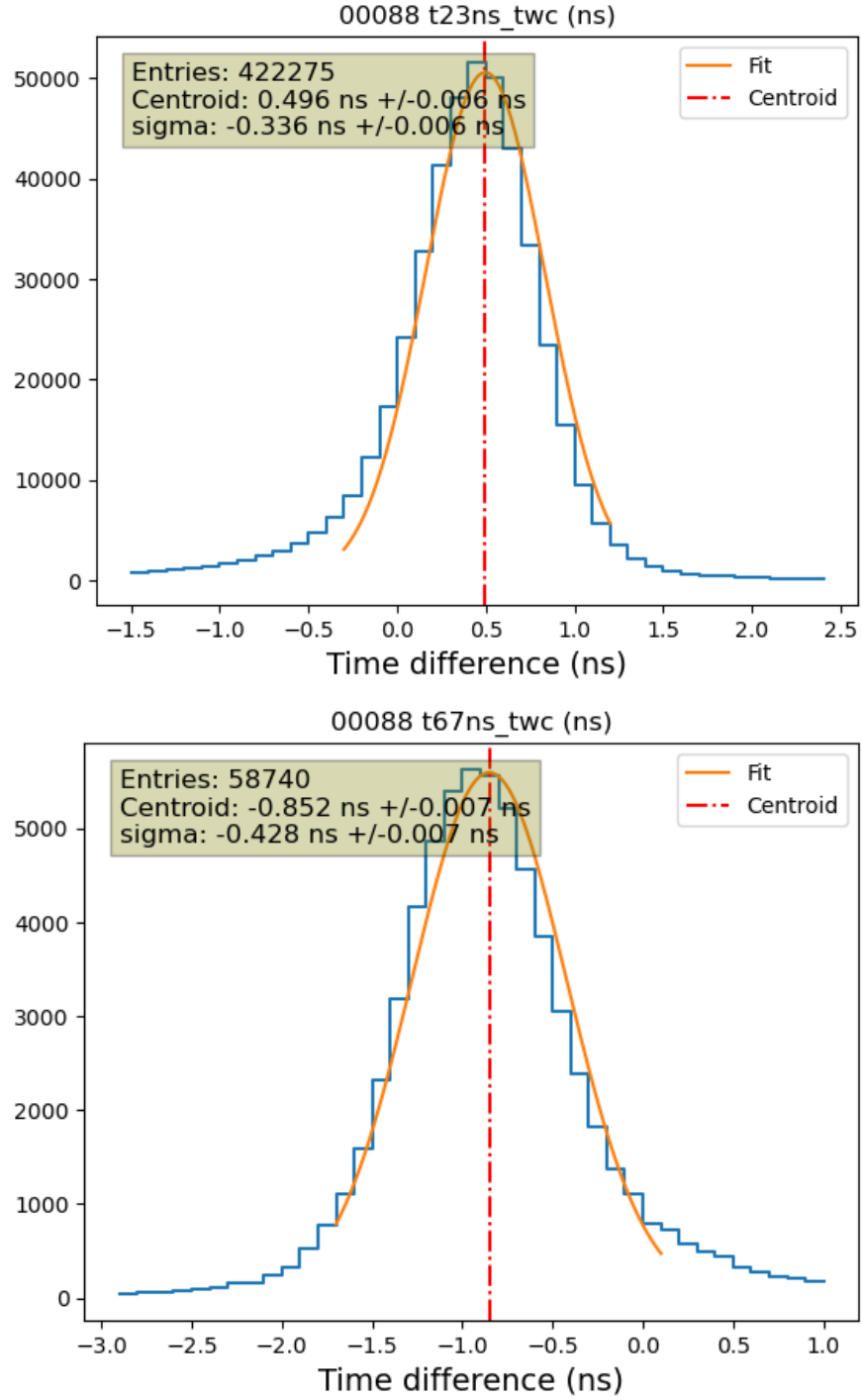


Figure 8: Time difference plot for $t_3 - t_2$ and $t_7 - t_6$, time walk corrected without the coincidence condition between the upper and lower bar, for run 88.

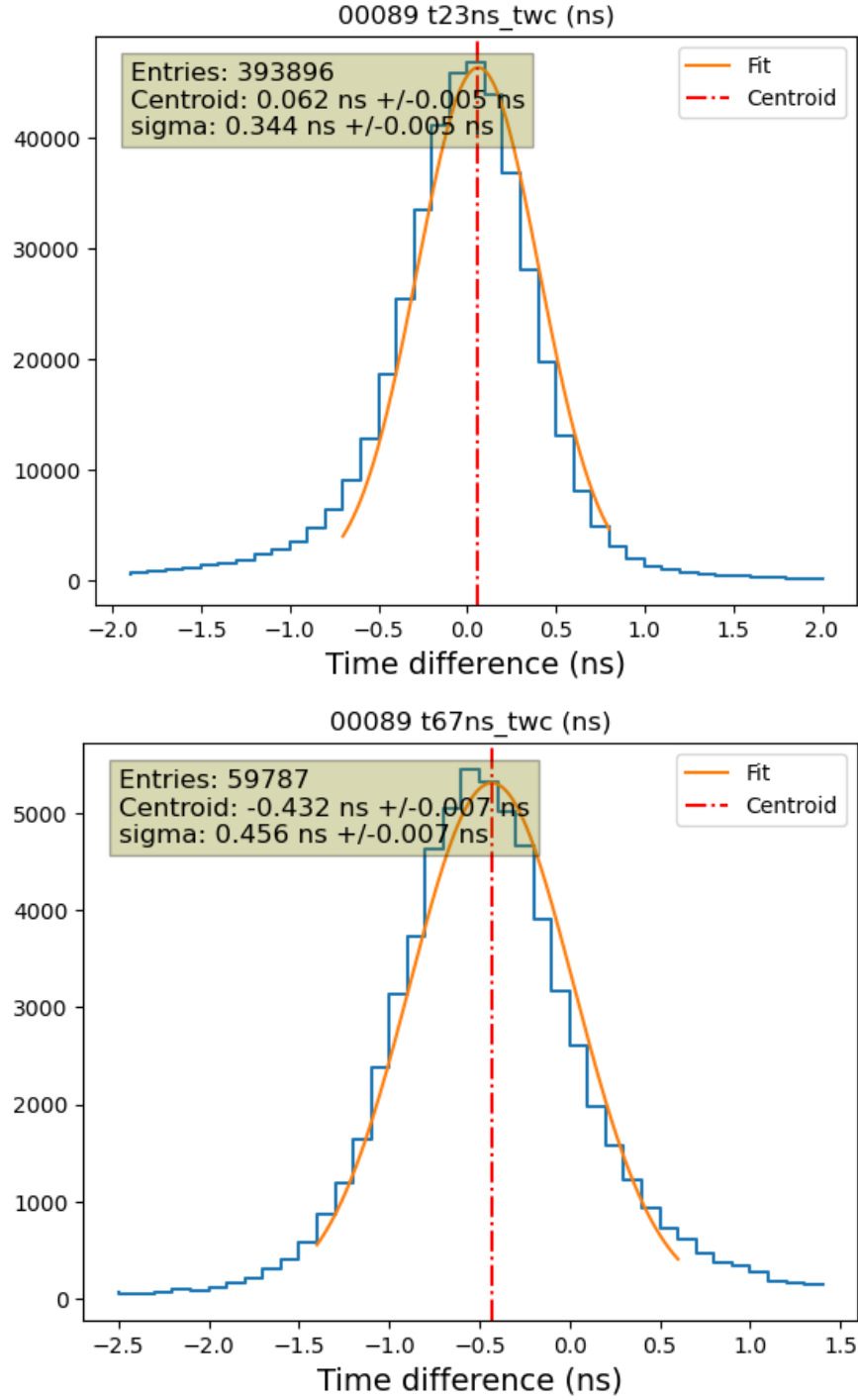


Figure 9: Time difference plot for $t_3 - t_2$ and $t_7 - t_6$, time walk corrected without the coincidence condition between the upper and lower bar, for run 89.

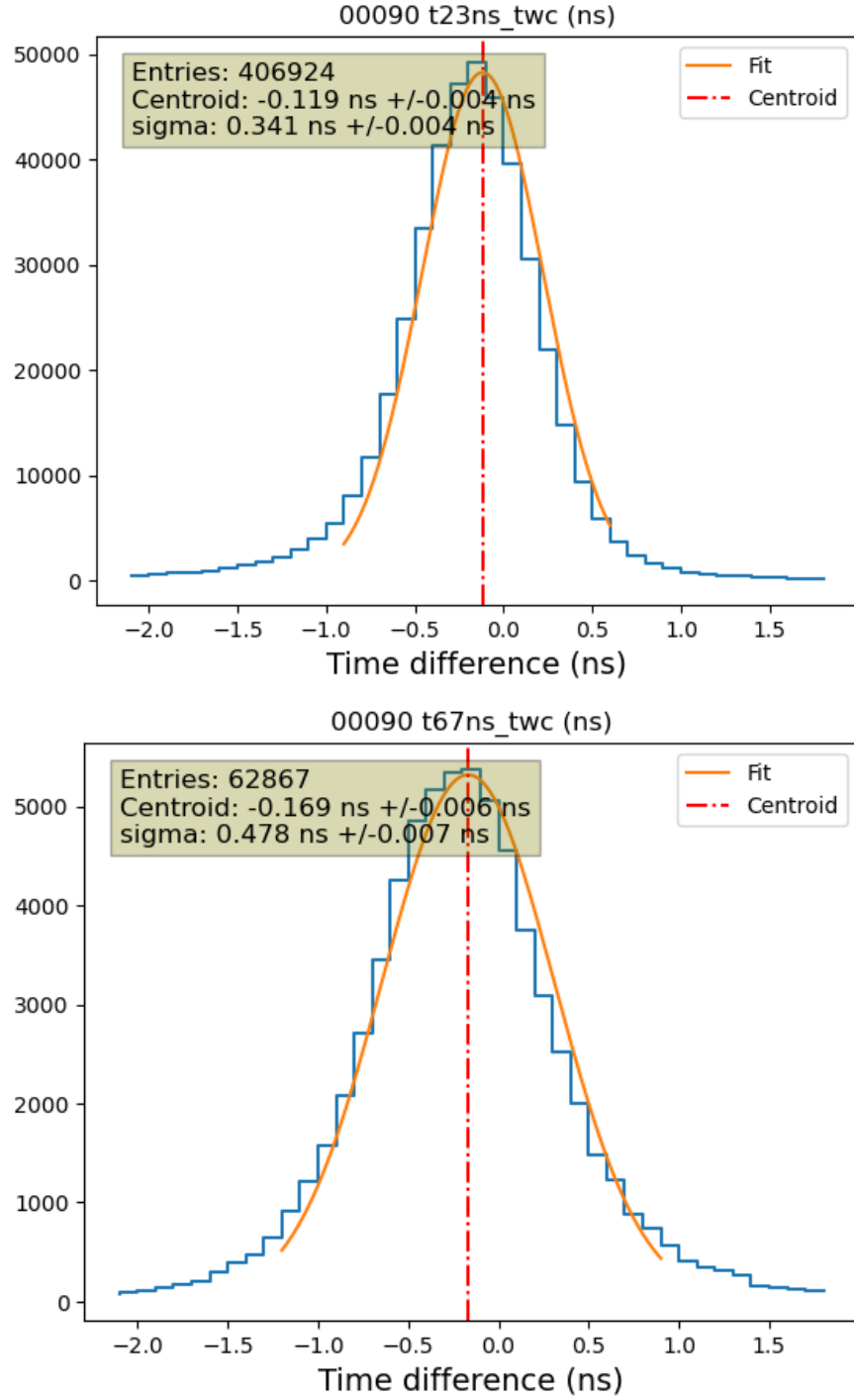


Figure 10: Time difference plot for $t_3 - t_2$ and $t_7 - t_6$, time walk corrected without the coincidence condition between the upper and lower bar, for run 90.

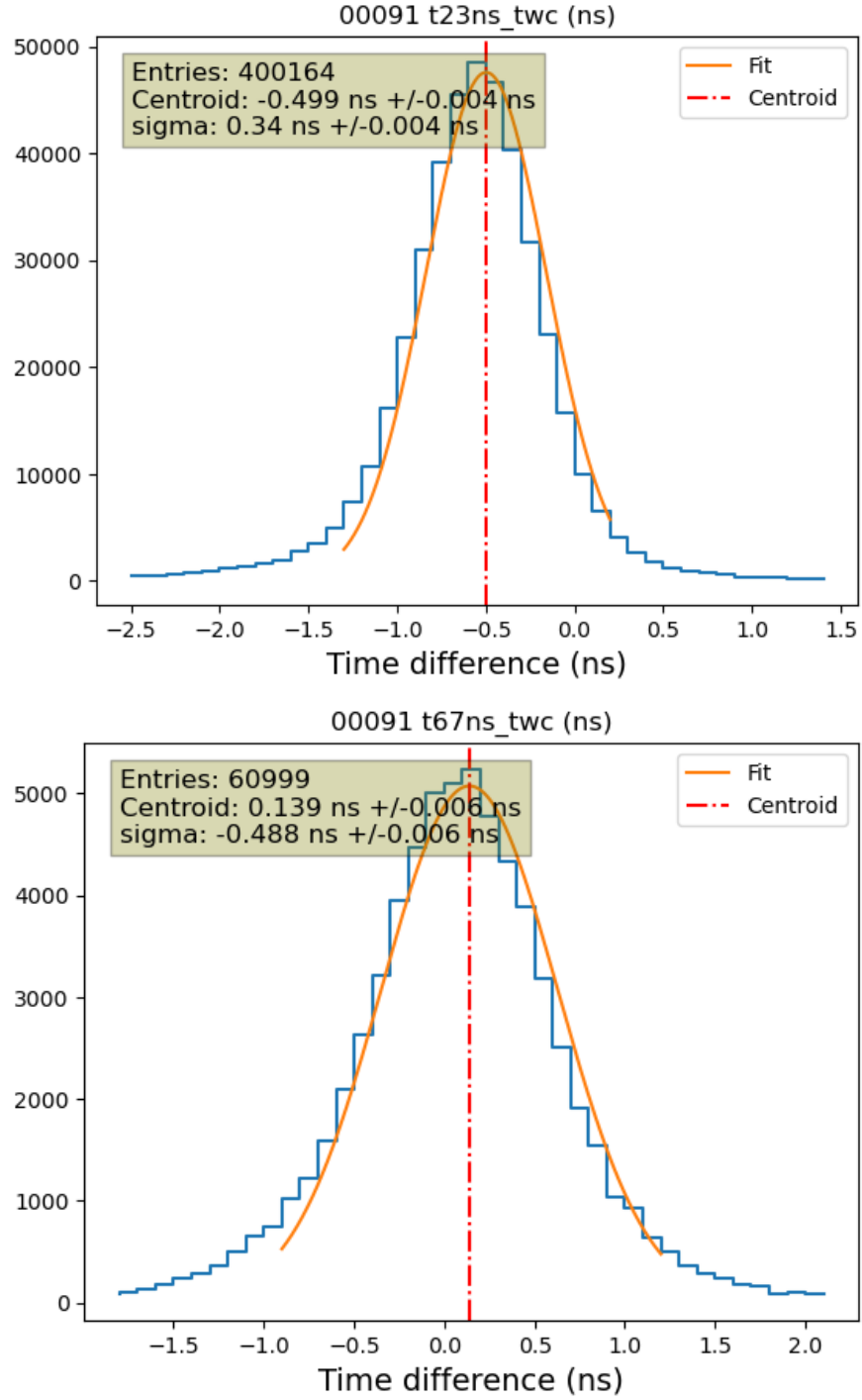


Figure 11: Time difference plot for $t_3 - t_2$ and $t_7 - t_6$, time walk corrected without the coincidence condition between the upper and lower bar, for run 91.

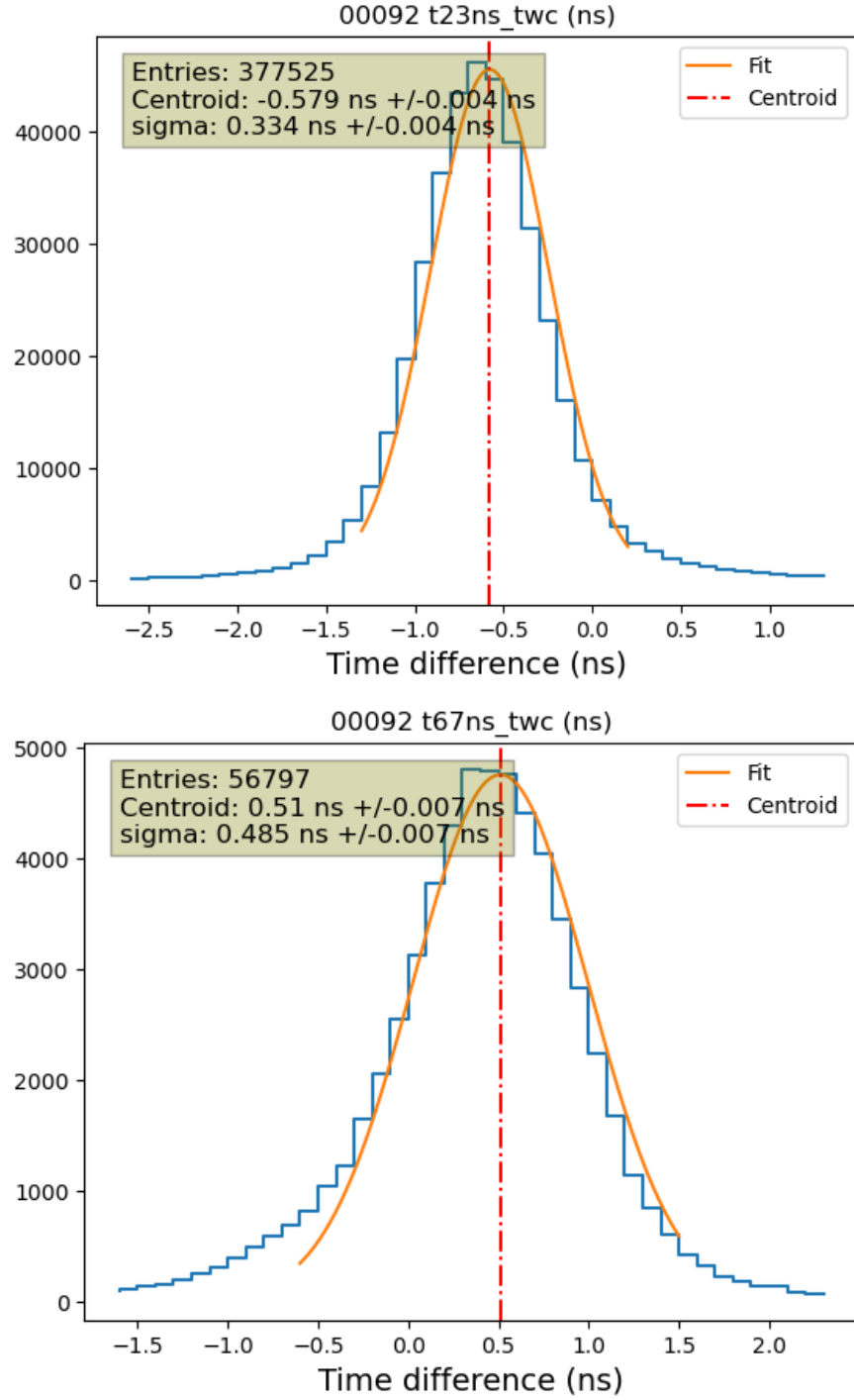


Figure 12: Time difference plot for $t_3 - t_2$ and $t_7 - t_6$, time walk corrected without the coincidence condition between the upper and lower bar, for run 92.

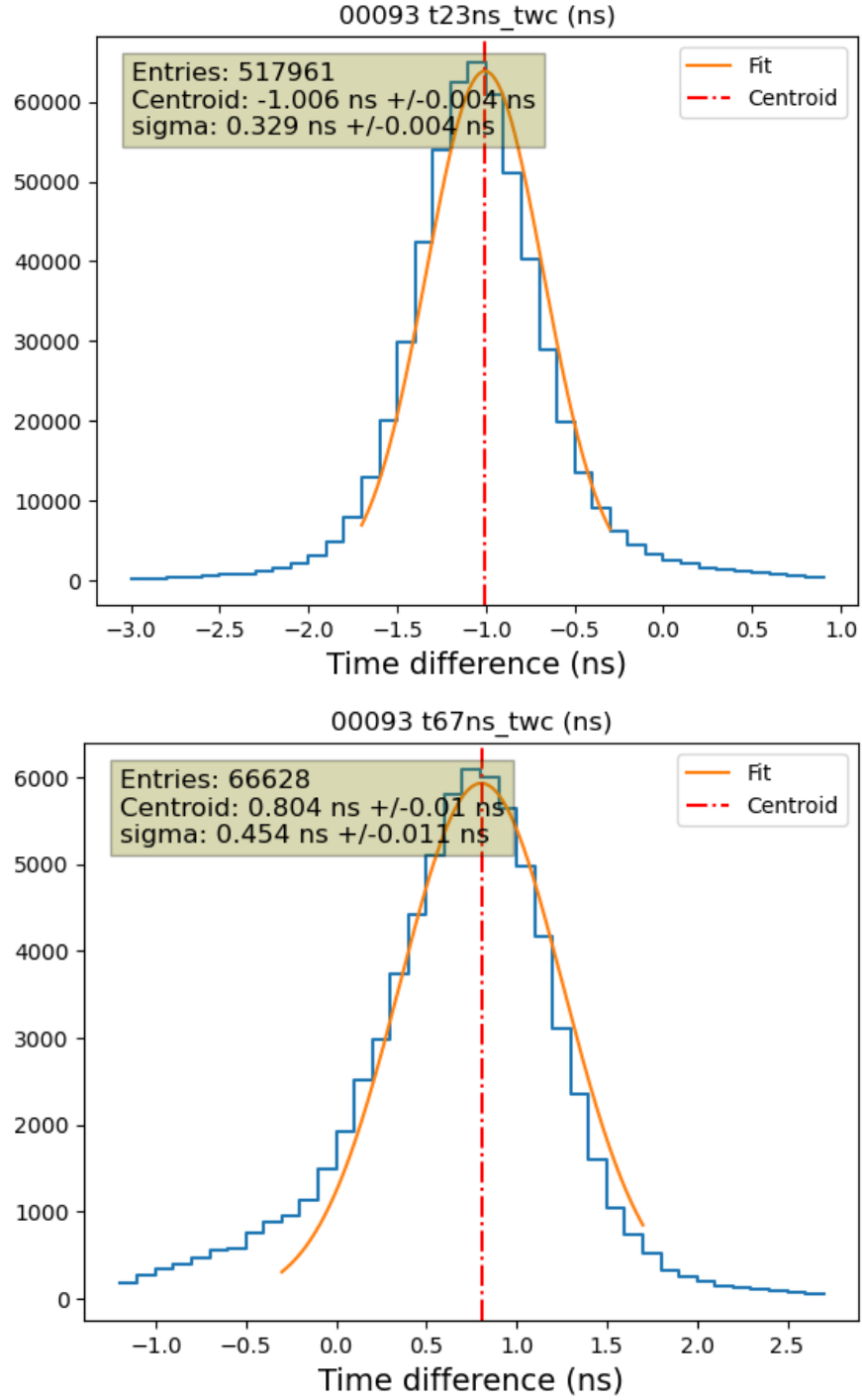


Figure 13: Time difference plot for $t_3 - t_2$ and $t_7 - t_6$, time walk corrected without the coincidence condition between the upper and lower bar, for run 93.

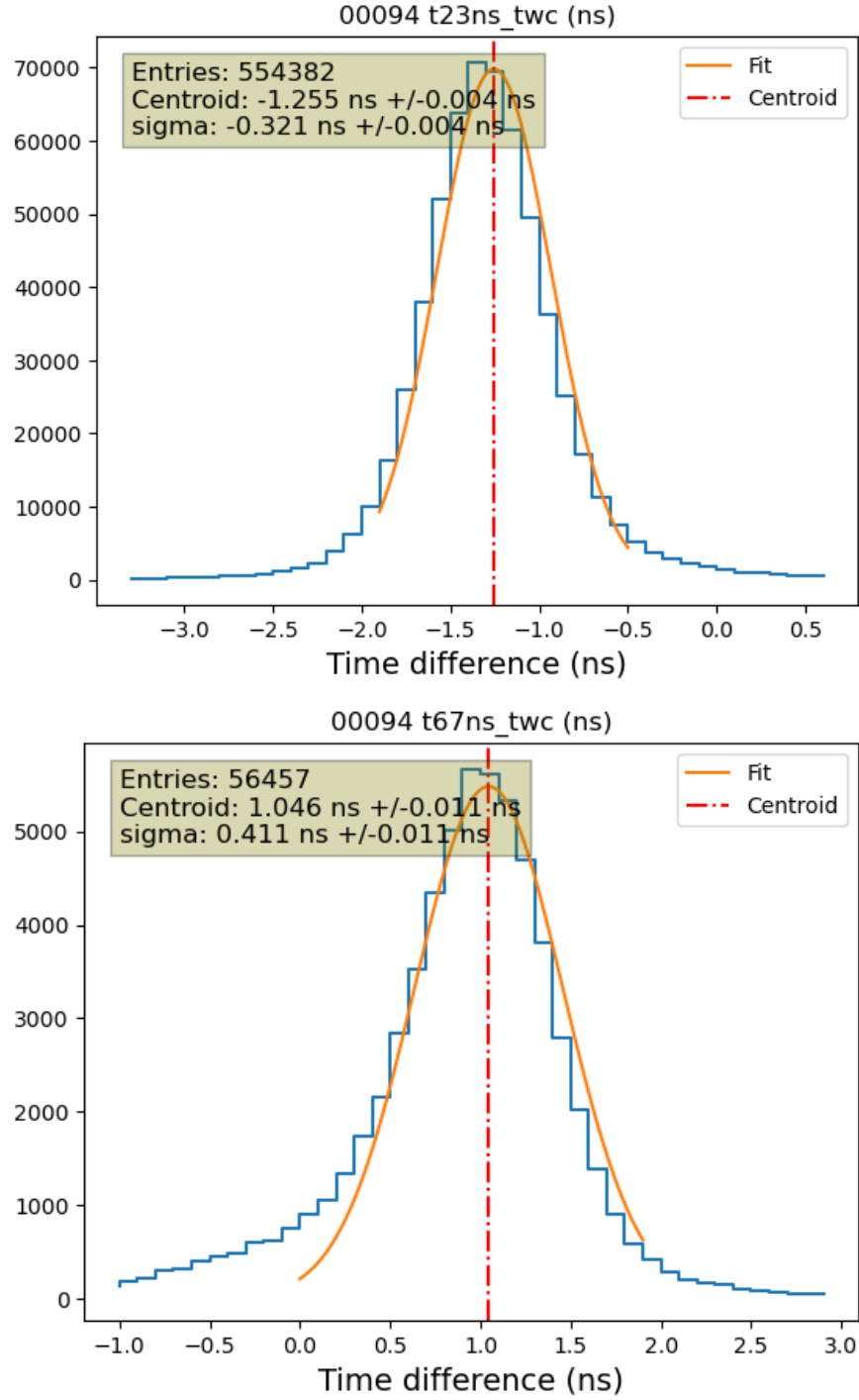


Figure 14: Time difference plot for $t_3 - t_2$ and $t_7 - t_6$, time walk corrected without the coincidence condition between the upper and lower bar, for run 94.

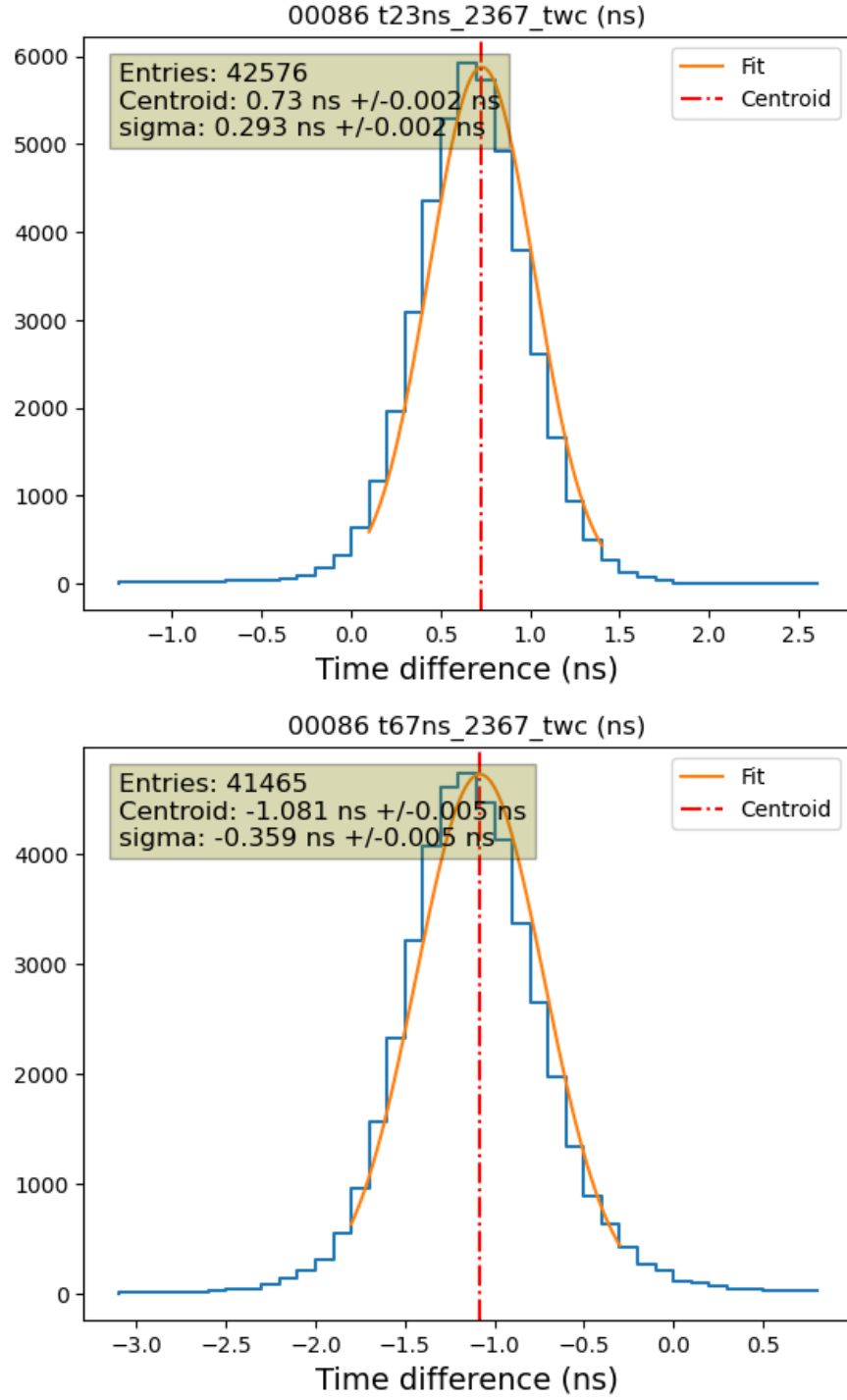


Figure 15: Time difference plot for $t_3 - t_2$ and $t_7 - t_6$, time walk corrected with coincidence condition between the upper and lower bar, for run 86.

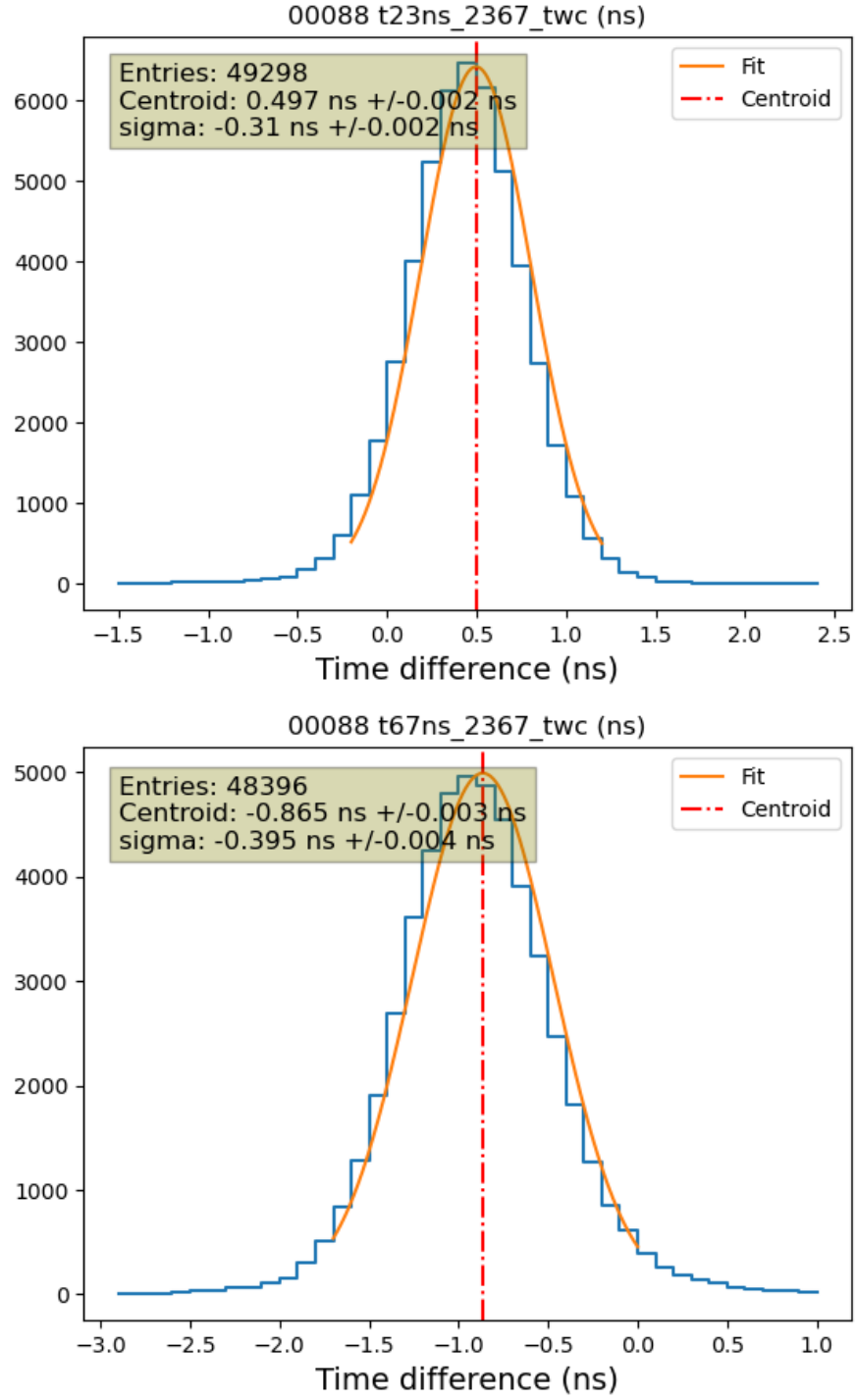


Figure 16: Time difference plot for $t_3 - t_2$ and $t_7 - t_6$, time walk corrected with coincidence condition between the upper and lower bar, for run 88.

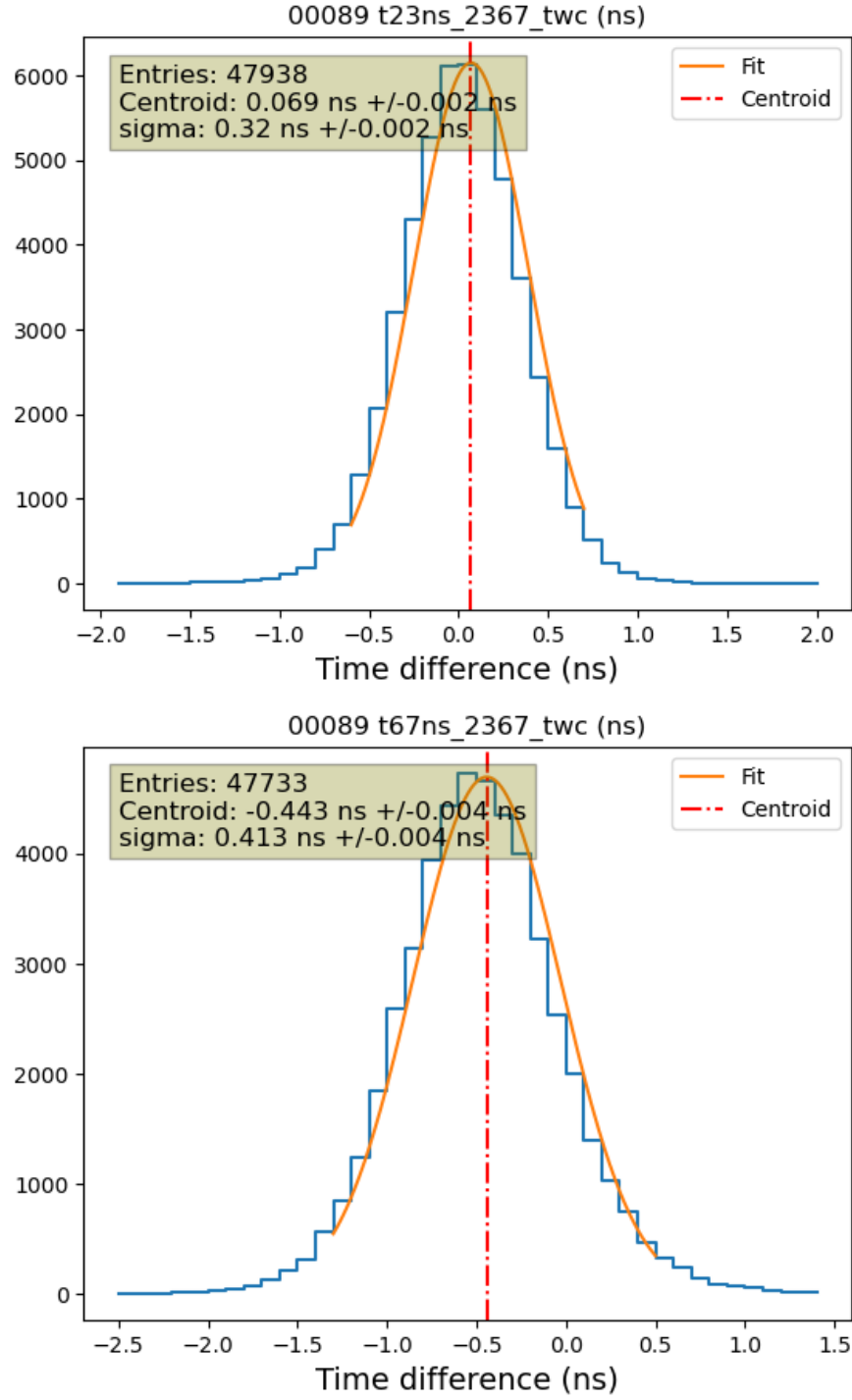


Figure 17: Time difference plot for $t_3 - t_2$ and $t_7 - t_6$, time walk corrected with coincidence condition between the upper and lower bar, for run 89.

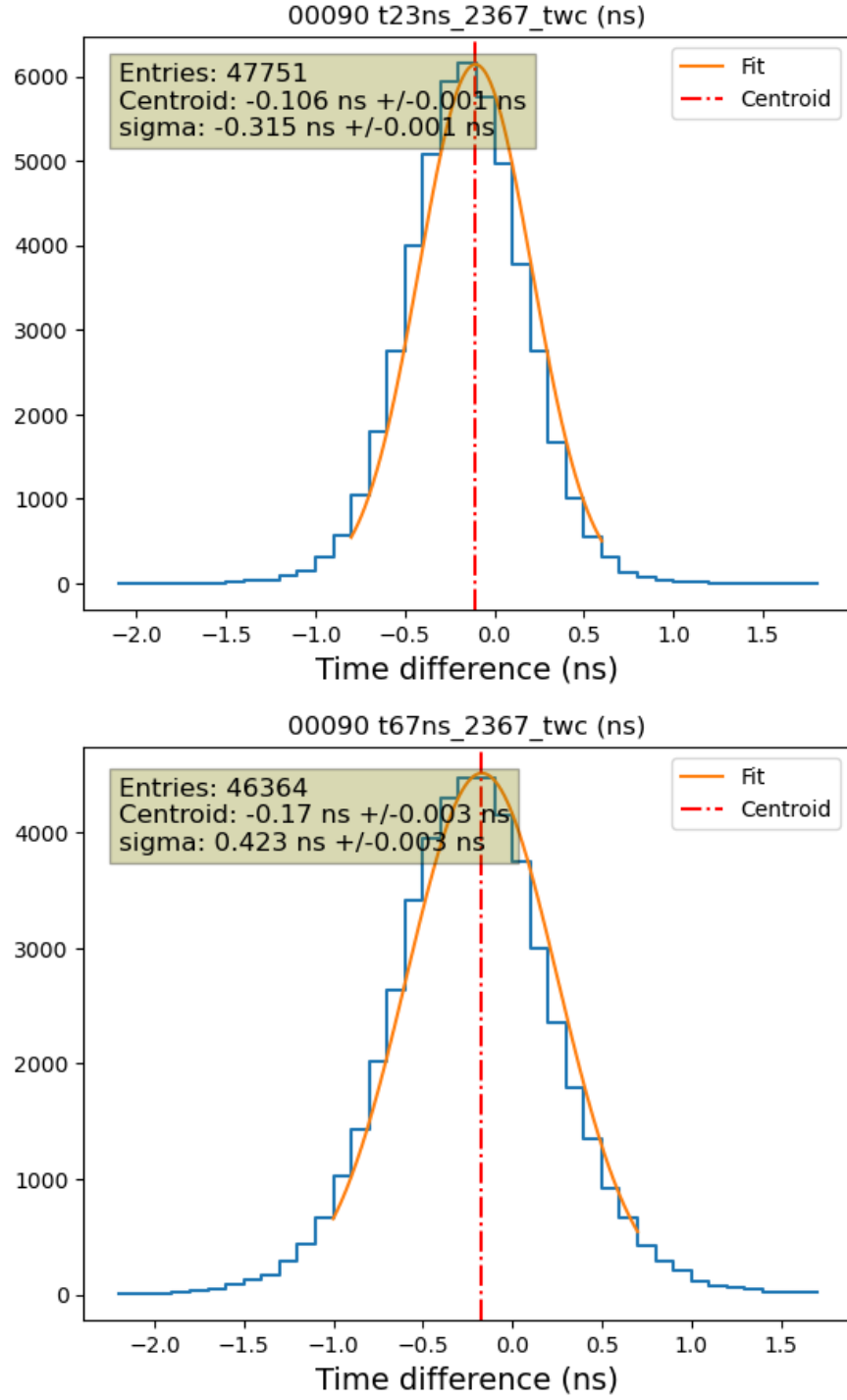


Figure 18: Time difference plot for $t_3 - t_2$ and $t_7 - t_6$, time walk corrected with coincidence condition between the upper and lower bar, for run 90.

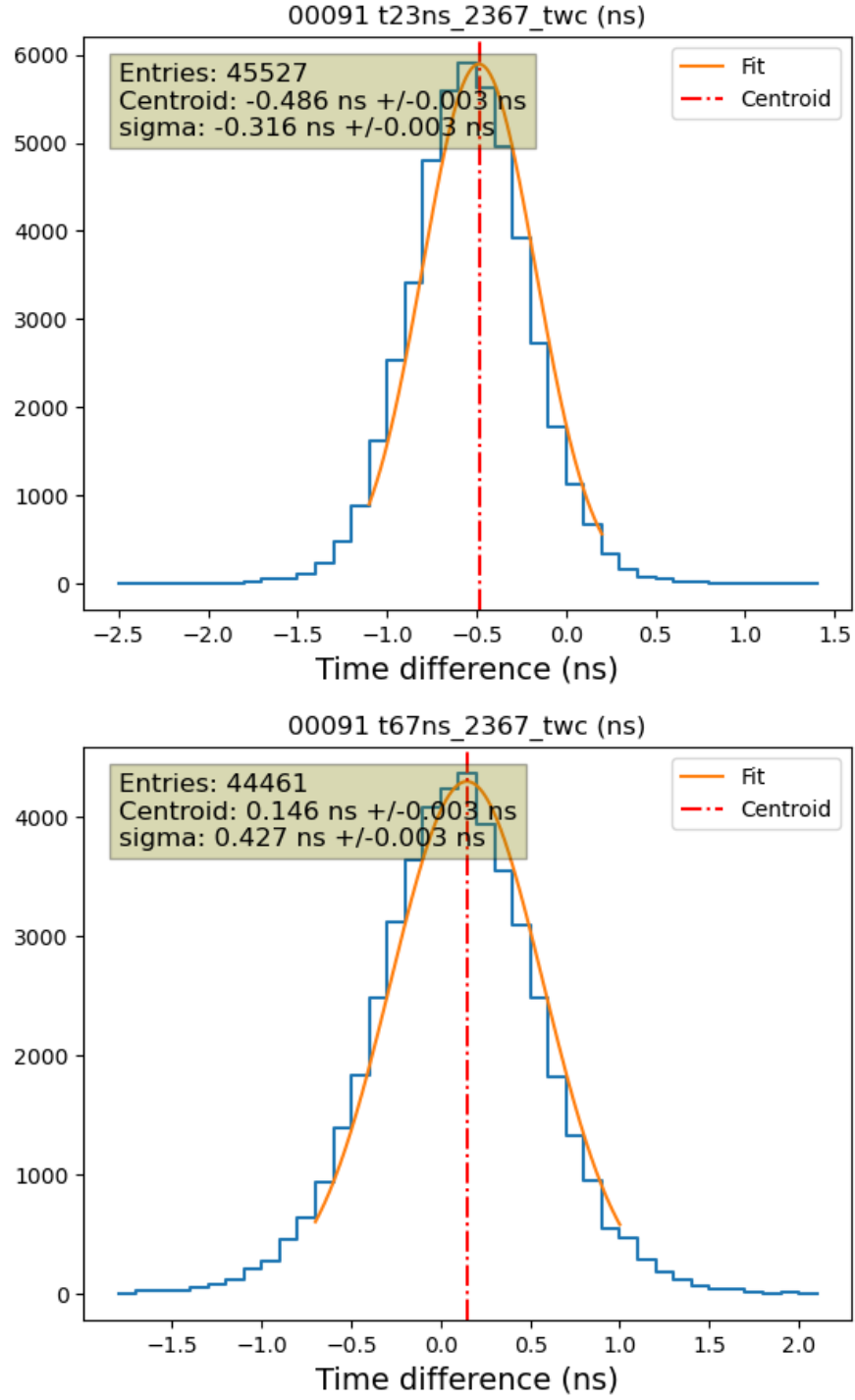


Figure 19: Time difference plot for $t_3 - t_2$ and $t_7 - t_6$, time walk corrected with coincidence condition between the upper and lower bar, for run 91.

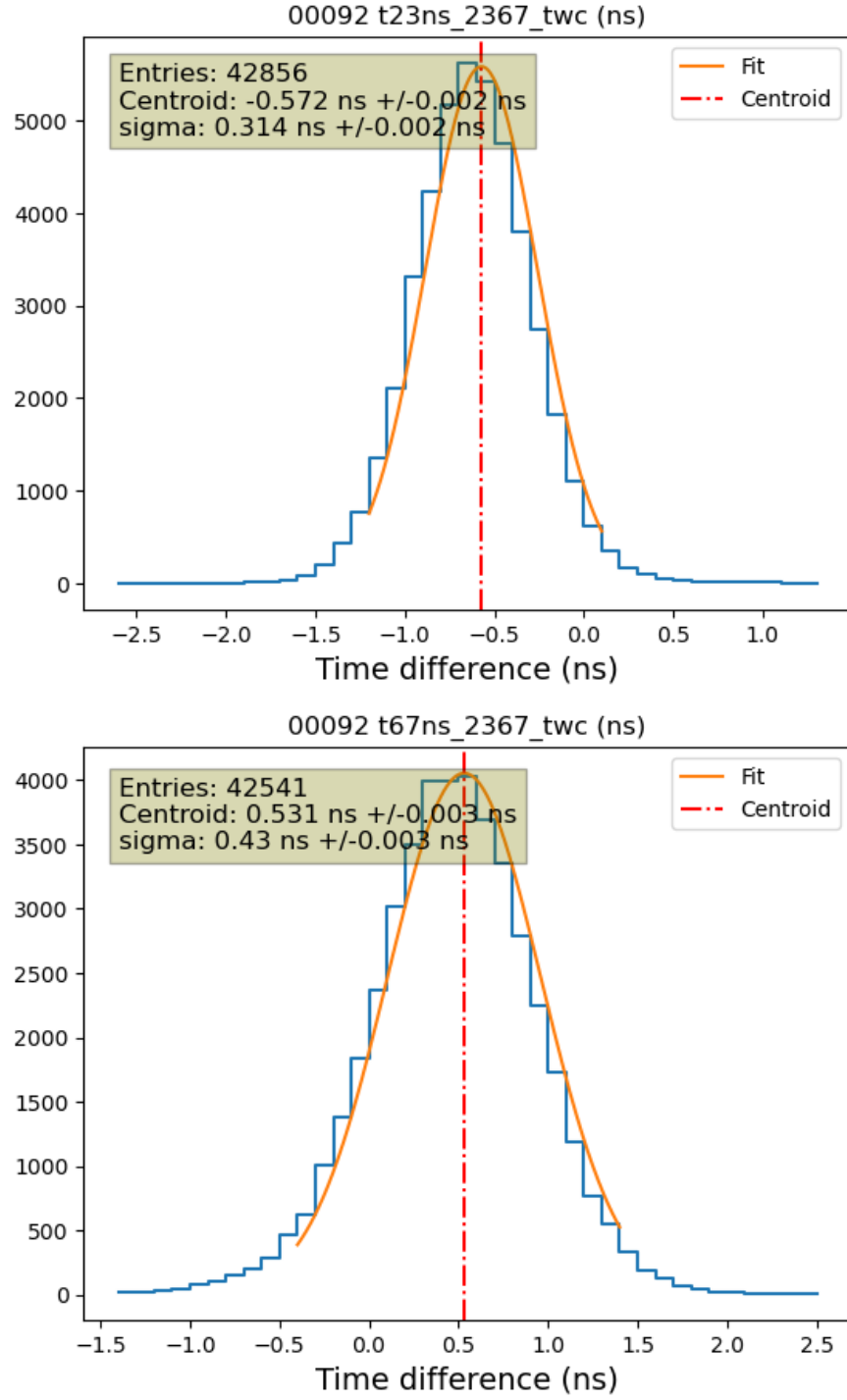


Figure 20: Time difference plot for $t_3 - t_2$ and $t_7 - t_6$, time walk corrected with coincidence condition between the upper and lower bar, for run 92.

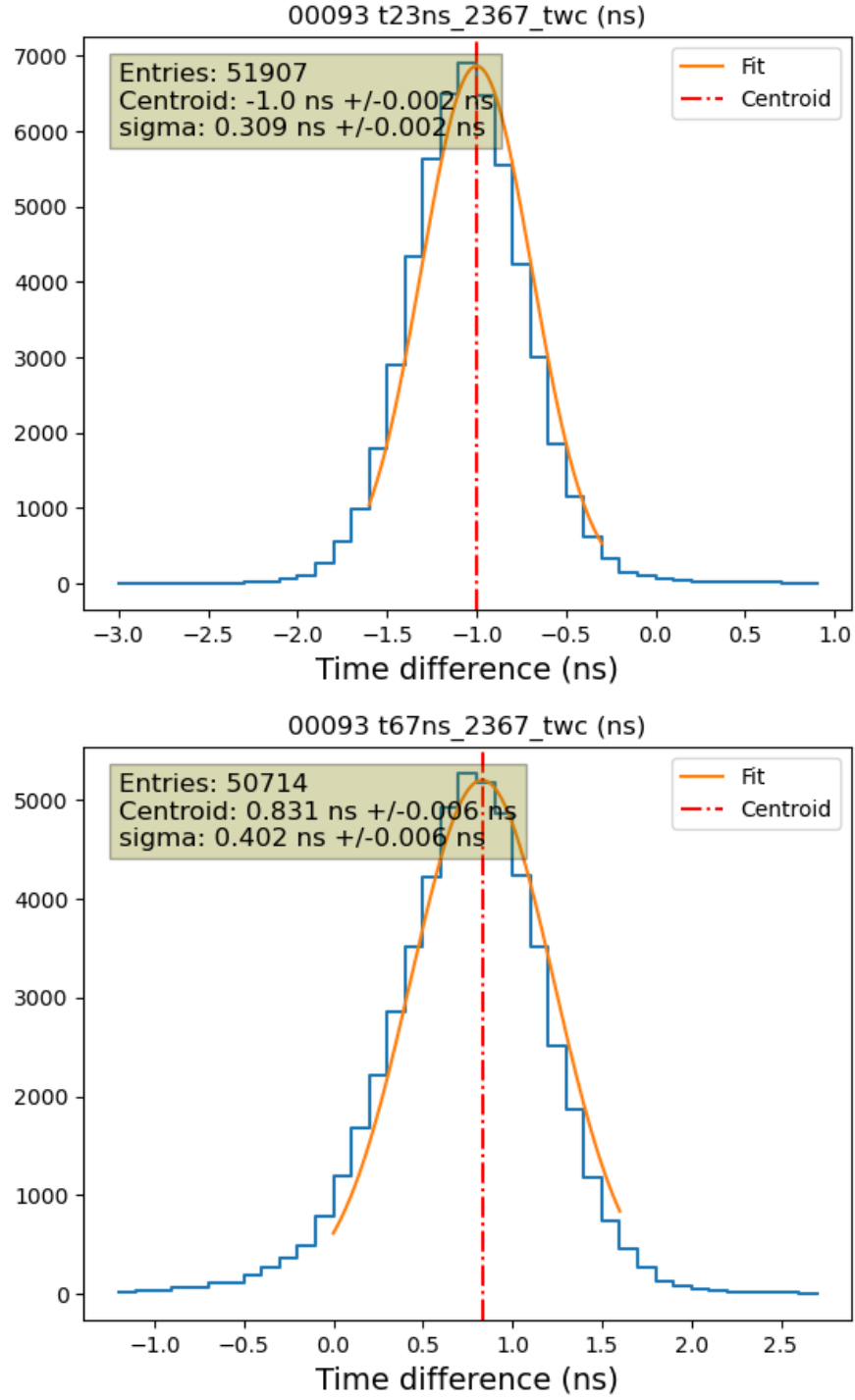


Figure 21: Time difference plot for $t_3 - t_2$ and $t_7 - t_6$, time walk corrected with coincidence condition between the upper and lower bar, for run 93.

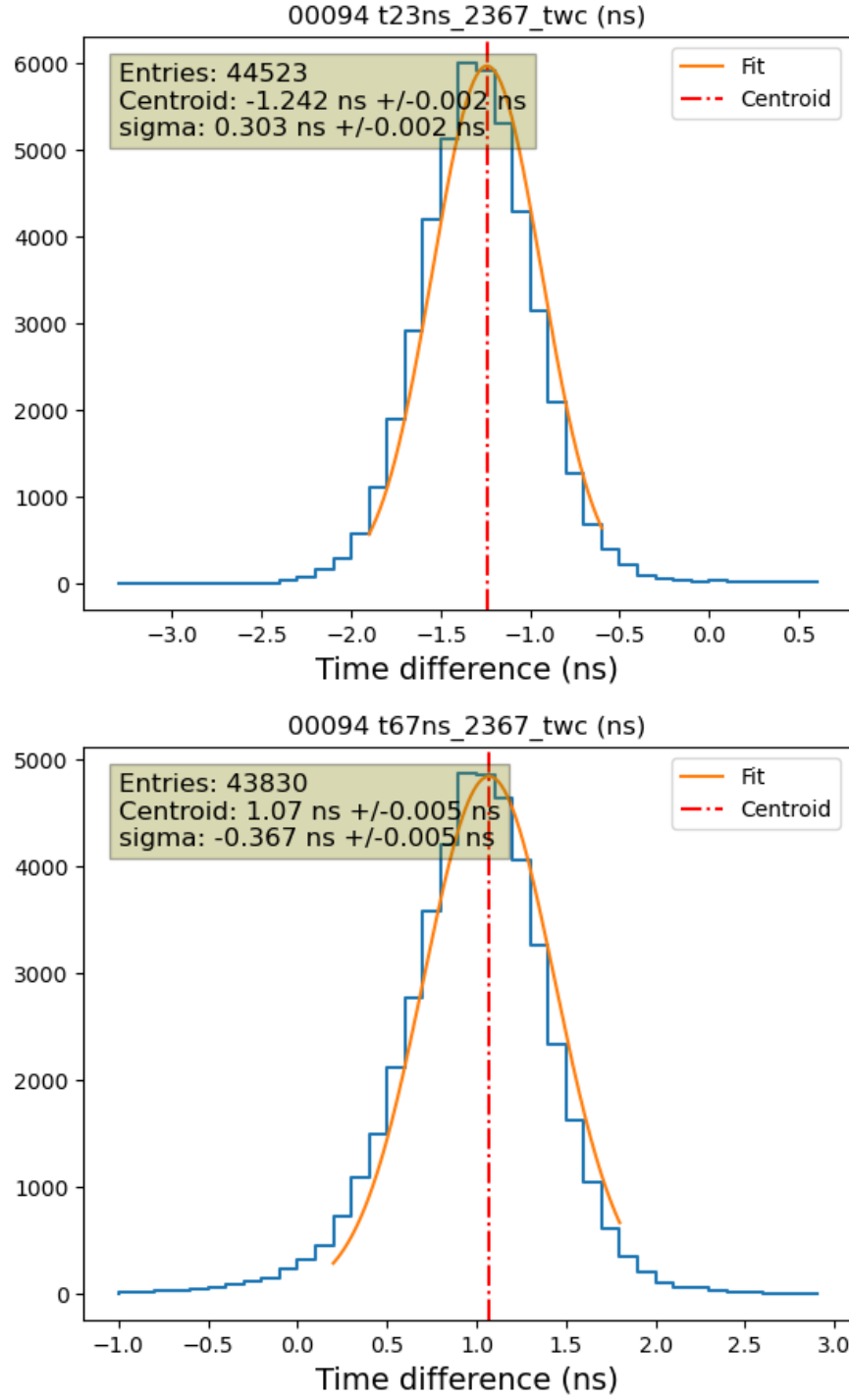


Figure 22: Time difference plot for $t_3 - t_2$ and $t_7 - t_6$, time walk corrected with coincidence condition between the upper and lower bar, for run 94.