HCal Timing Calibration Quality Checks

GMn, Config: 9, Prior to Pass 2

Sebastian Seeds*

June 25, 2024

Contents

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1 How to Read this Document

This document details the timing calibration results for the above experiment, configuration, and replay pass. For information regarding the calibration process, see the overleaf.

Each kinematic has been calibrated separately for timing and the database will reflect this moving forward. All time vs energy plots used for this calibration are generated using updated ADC gain parameters and timing offsets for accuracy.

Each of the sections contains a brief description of the calibration results that follow. Any and all questions/concerns regarding these plots should be directed to the author at the email provided.

2 Special Considerations

- A significant time shift in TDC time data is evident on this kinematic and as such TDC time offsets are divided into two sets. All runs excluding 13682 are **set 1** and run 13682 is **set 2**. This second set of one run was calibrated using an alternative method where all channels were first aligned using set 1, then a uniform offset was passed to shift each channel to zero using a fit to the overall TDC time from all channels (on run 13682). As a result, no channel fit data are shown here for that run, but the report file is attached at the end of this document.

- Evaluation of various timewalk fits are presented here as a preliminary assessment of a new timewalk calibration added to SBS-offline. Changes to SBS-offline to add this timewalk calibration are commensurate with this calibration. It is recommended that future passes consider a $\Delta t = \alpha + \beta/E^N$ timewalk fit to the data where N is constrained to be very close to 0.5.

3 Timing

3.a ADC Time Offsets

- Fits to ADC time spectra, by HCal Channel.

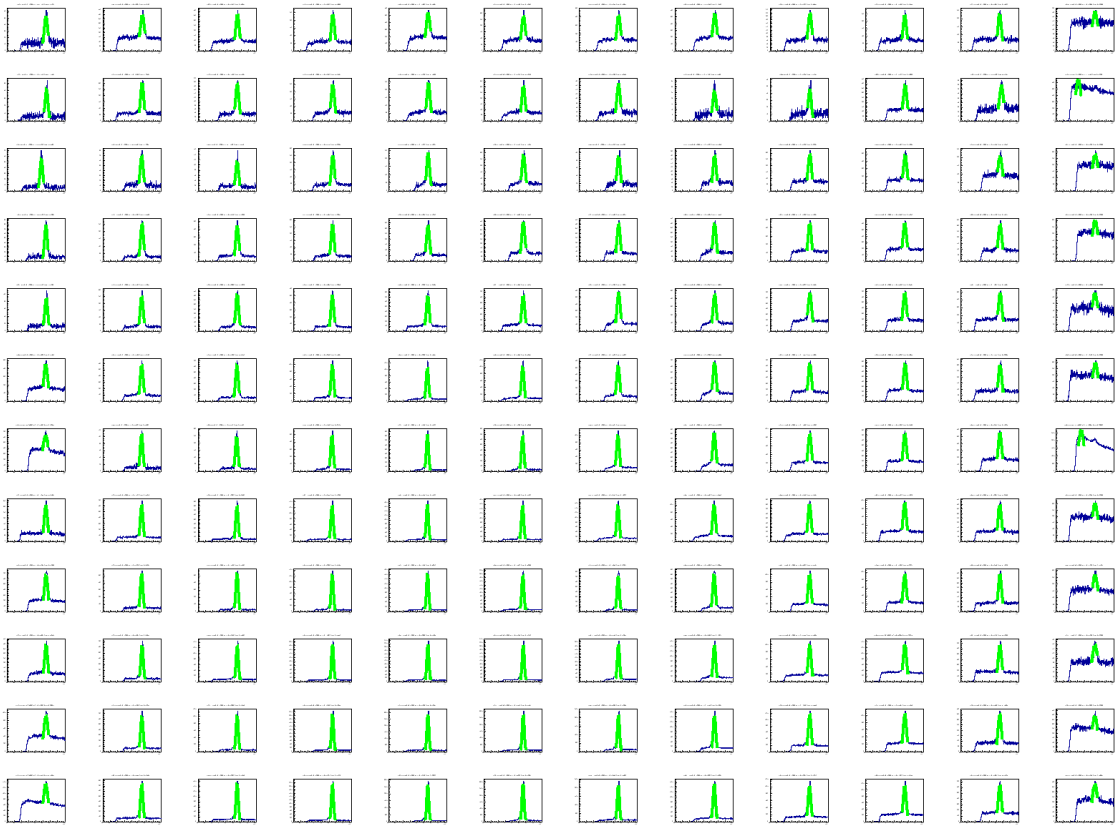

Figure 1: ADCt Spectra Fits vs. Channel, Top Half

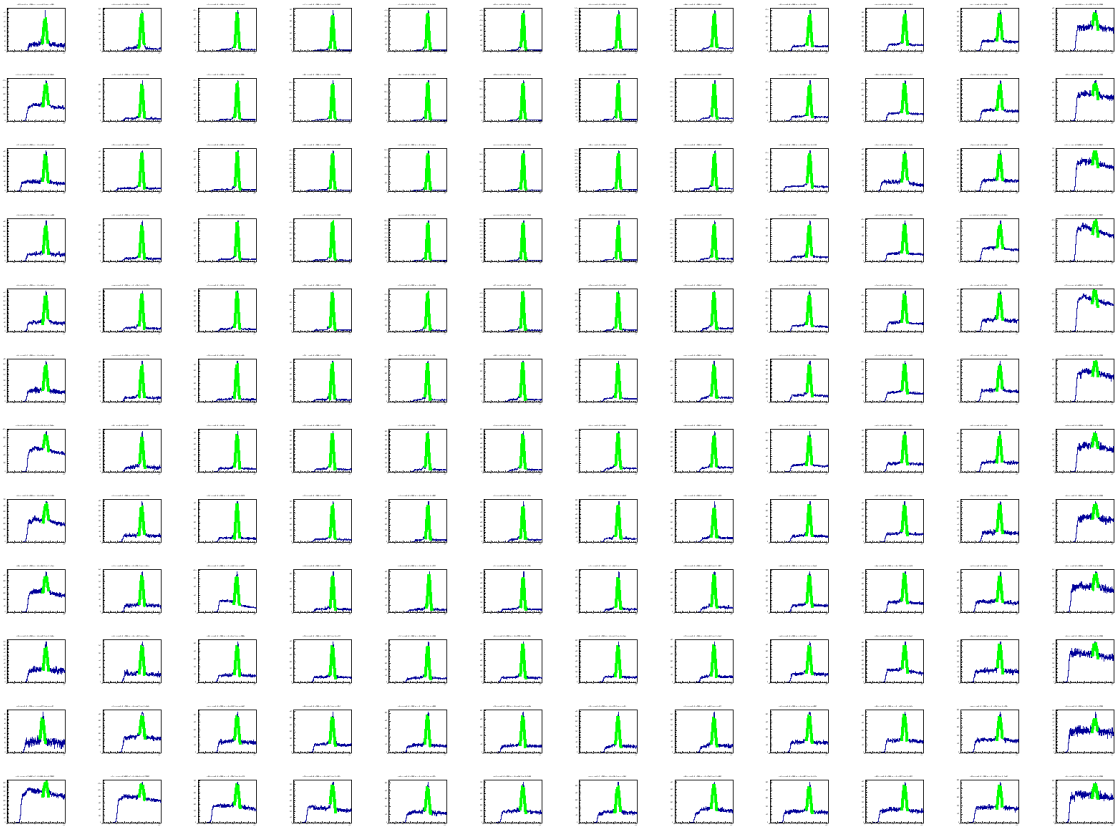

Figure 2: ADCt Spectra Fits vs. Channel, Bottom Half

- Mean/std. dev. comparisons before/after calibrations.

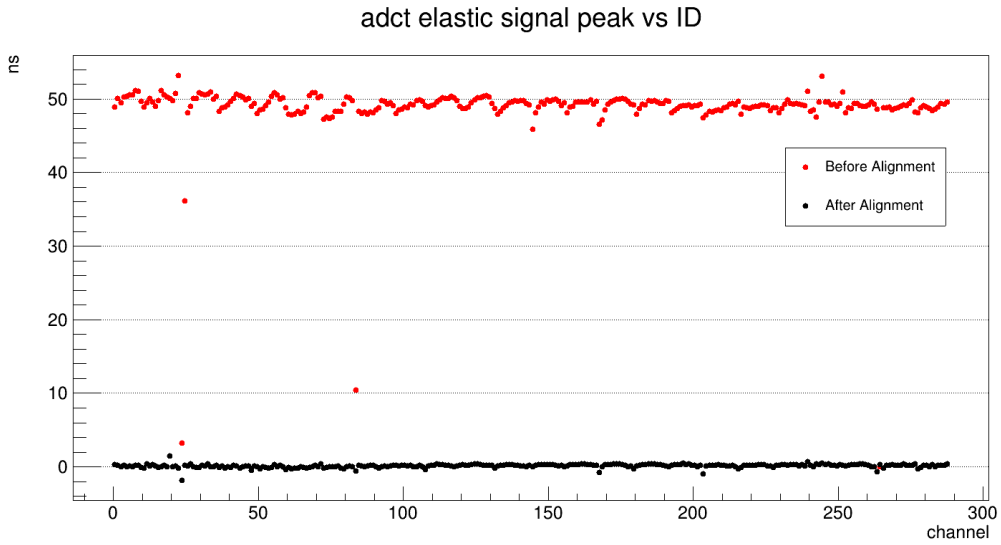

Figure 3: ADCt Fit Comparison, Post-Cal in Black

3.b TDC Offsets

- Fits to TDC spectra, by HCal Channel.

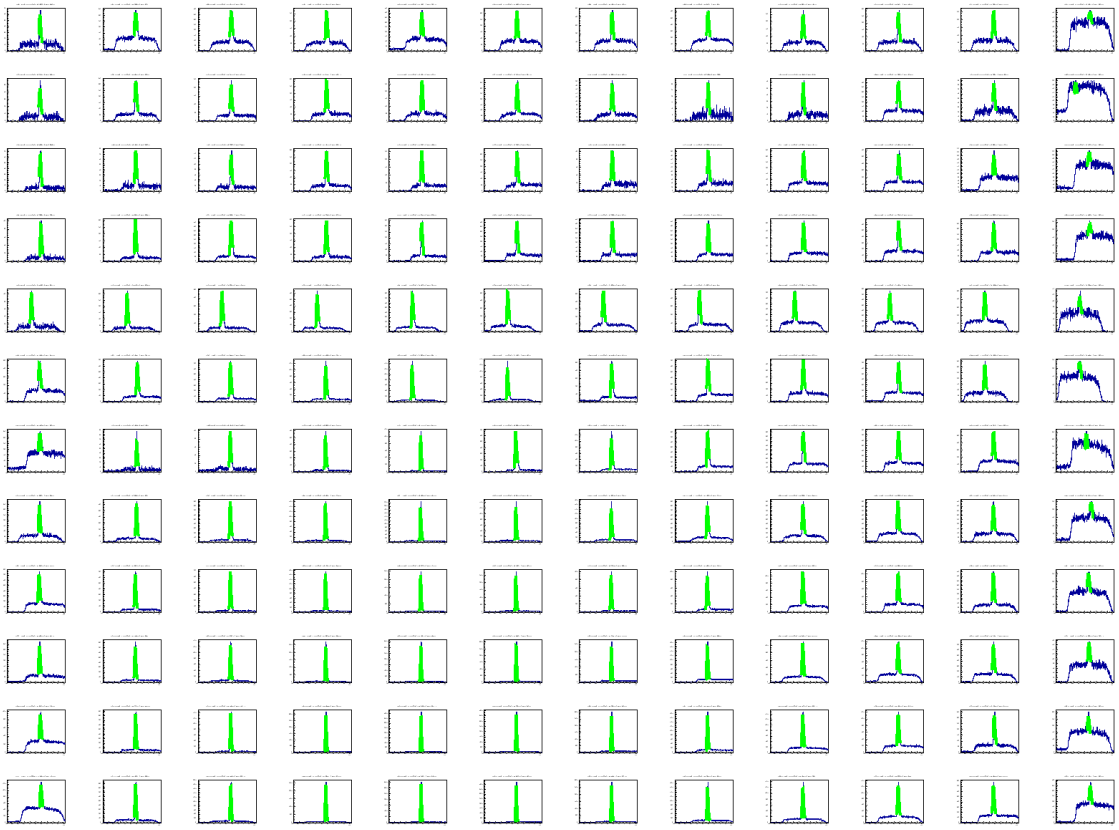

Figure 4: TDC Spectra Fits vs. Channel, Top Half

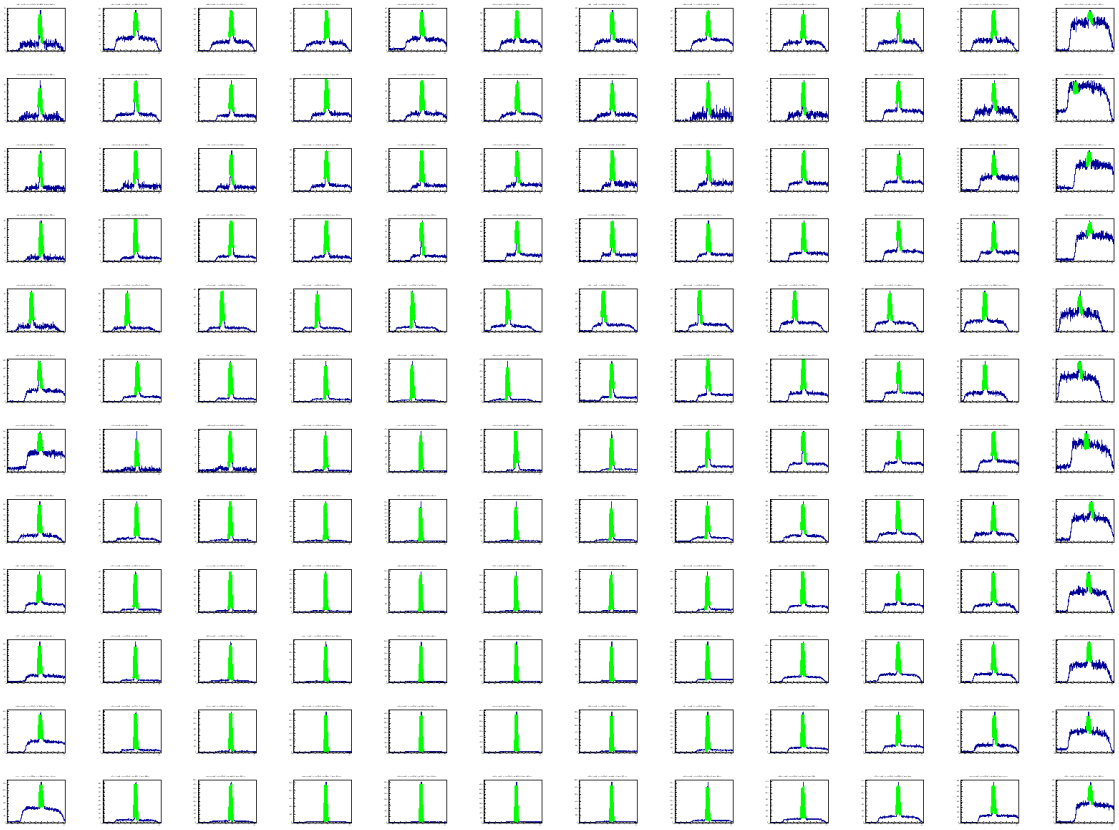

Figure 5: TDC Spectra Fits vs. Channel, Bottom Half

- Mean/std. dev. comparisons before/after calibrations.

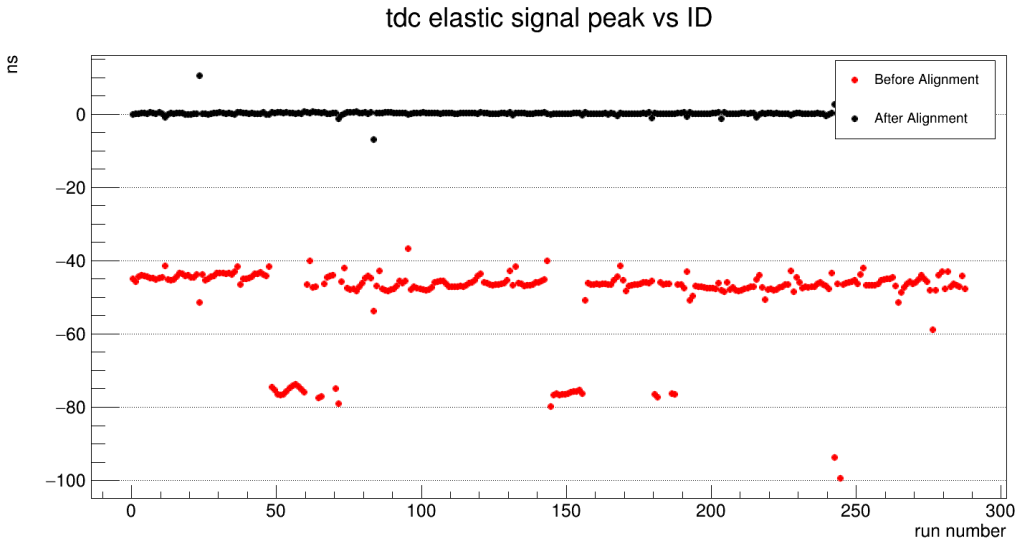

Figure 6: TDC Fit Comparison, Post-Cal in Black

3.c ADC Time Aggregate Comparison

All blocks post-alignment ADC time fit and comparison with ADC time from data before per-channel alignment.

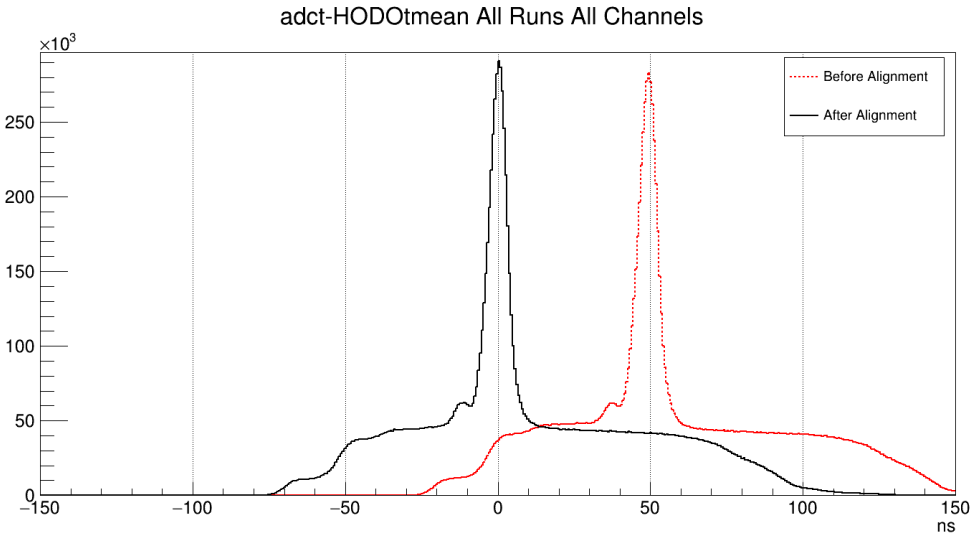

Figure 7: ADCt Comparison, All Channels. Post-alignment Mean: **-0.008 ns**

4 Time vs Run

No significant deviations occur on either ADCt or TDC data as a function of run number.

4.a ADCt vs Run

HCal adc time (all blocks) vs run number, before and after. Includes direct comparison.

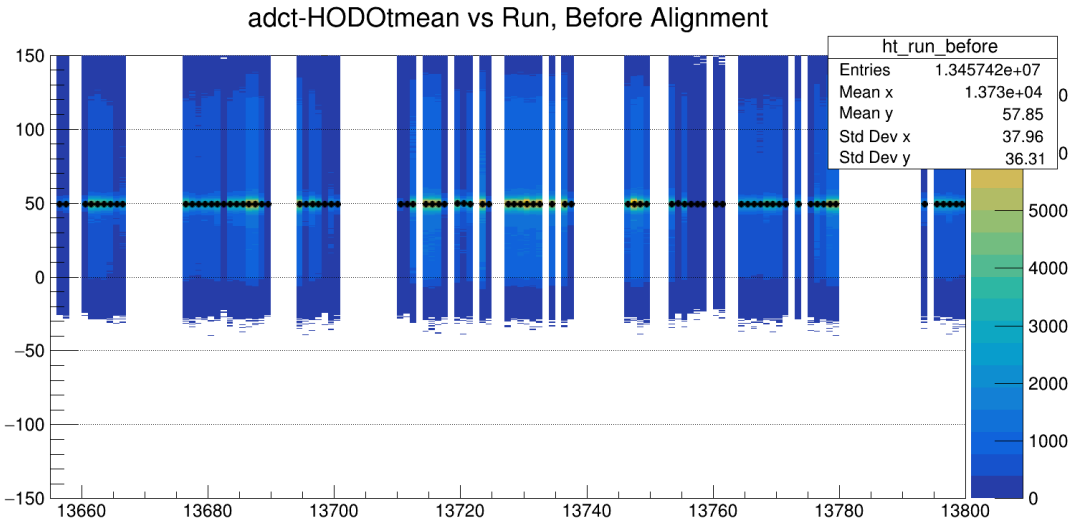

Figure 8: HCal ADCt vs Run Number All Channels, Before Alignment

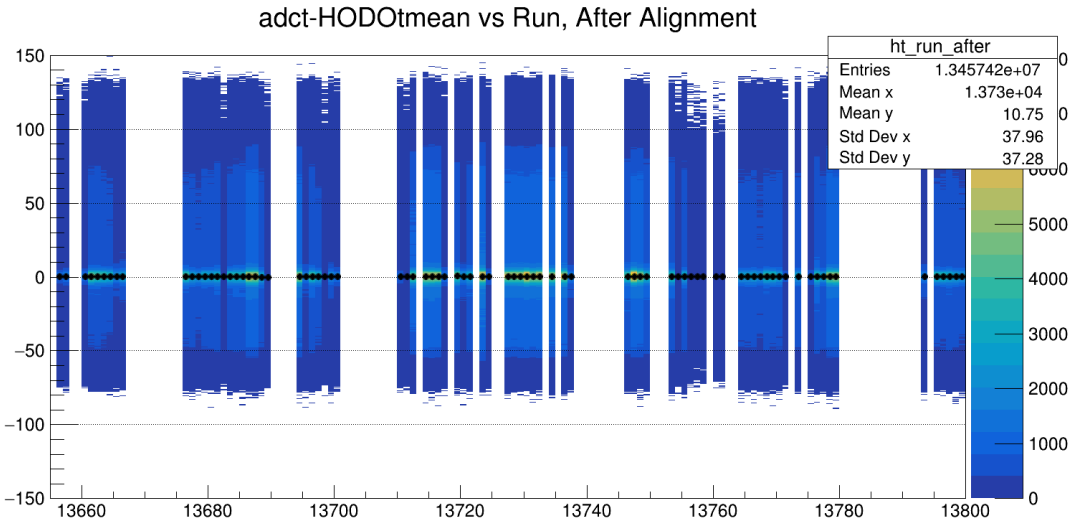

Figure 9: HCal ADCt vs Run Number All Channels, After Alignment

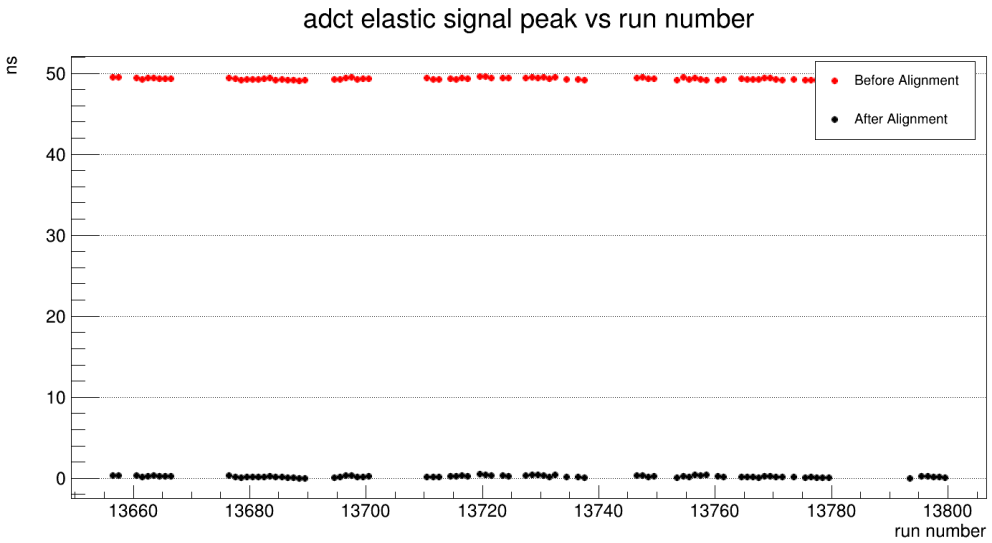

Figure 10: HCal ADCt vs Run Number All Channels, Comparison

4.b TDC vs Run

HCal tdc time (all blocks) vs run number, before and after. Includes direct comparison.

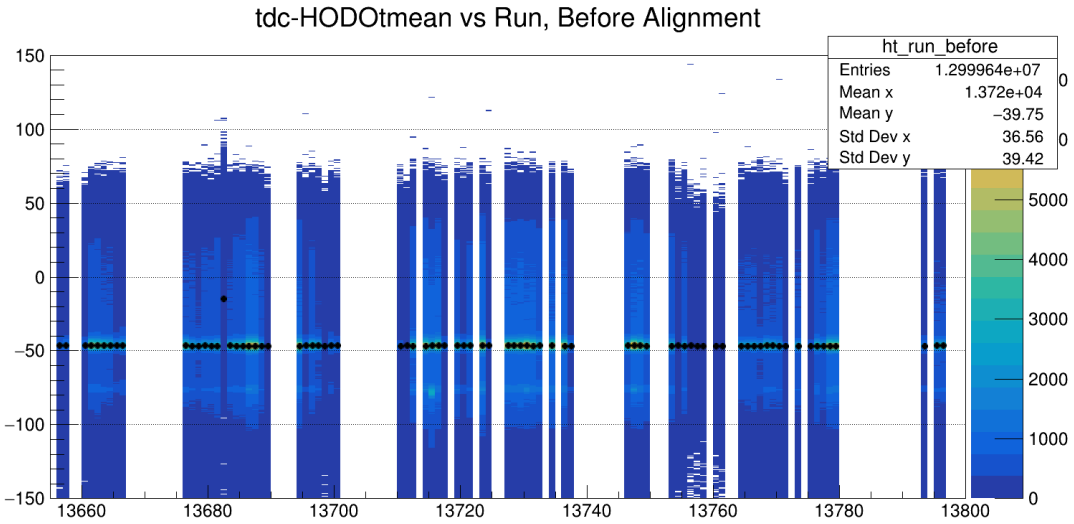

Figure 11: HCal TDC vs Run Number All Channels, Before Alignment

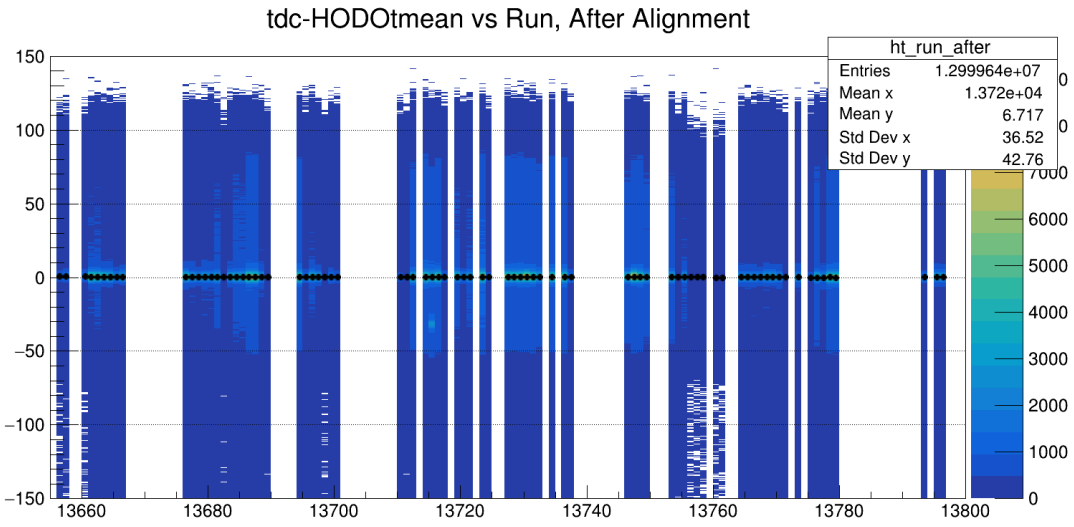

Figure 12: HCal TDC vs Run Number All Channels, After Alignment

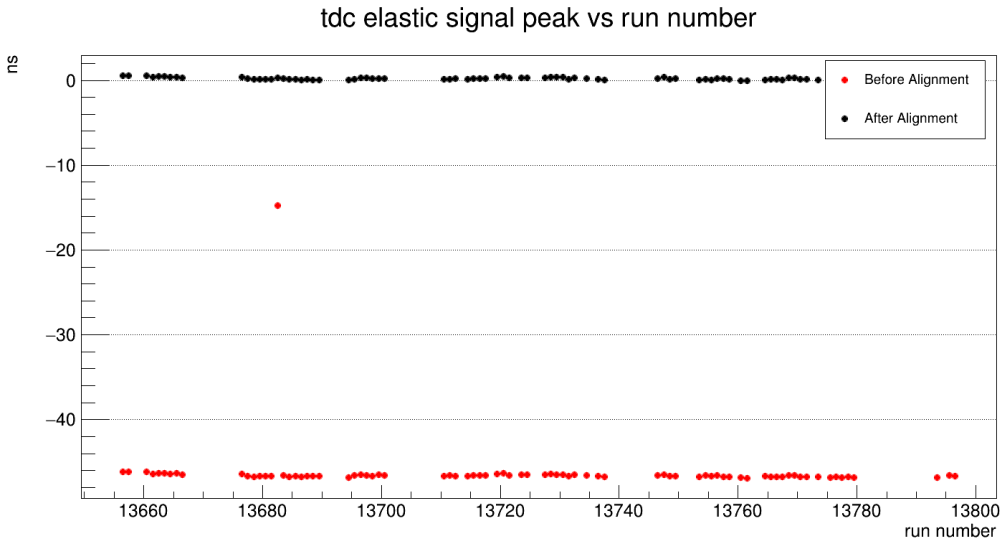

Figure 13: HCal TDC vs Run Number All Channels, Comparison

5 Supplemental Timing

5.a TDC Timewalk, Fits to Data

HCal tdc time (all blocks) vs energy, fit with $\Delta t = p0 + p1 \cdot E$. $p0$ is normal to the data and not passed to the calibration.

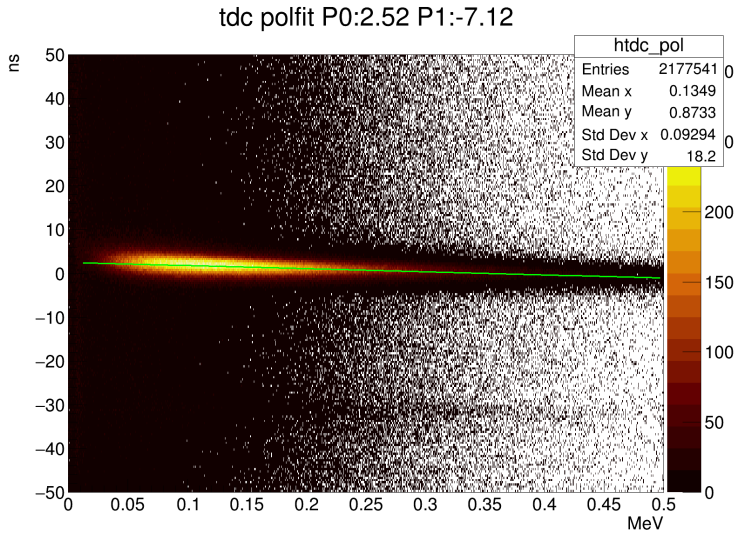

Figure 14: HCal TDC vs E

HCal tdc time (all blocks) vs energy, fit with $\Delta t = P0 \cdot exp(-P1 \cdot E) + p2$. $p2$ is normal to the data and not passed to the calibration.

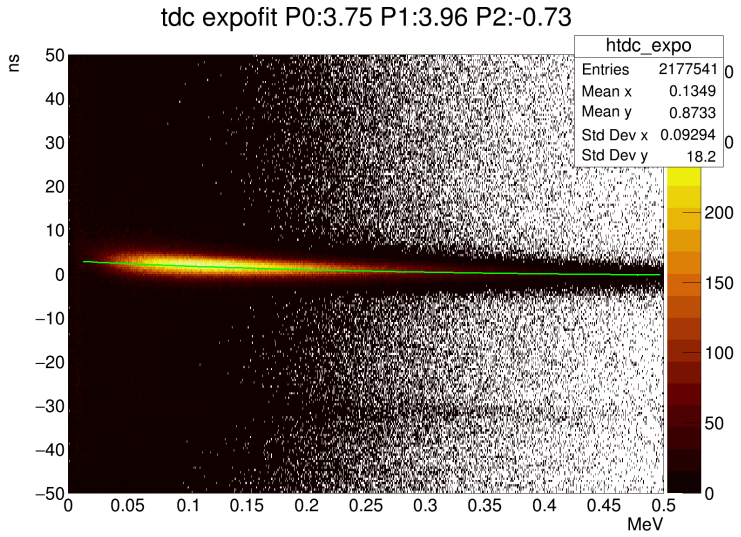

Figure 15: HCal TDC vs E

HCal tdc time (all blocks) vs energy, fit with $\Delta t = p0 + p1/E^{p2}$. $p0$ is normal to the data and not passed to the calibration.

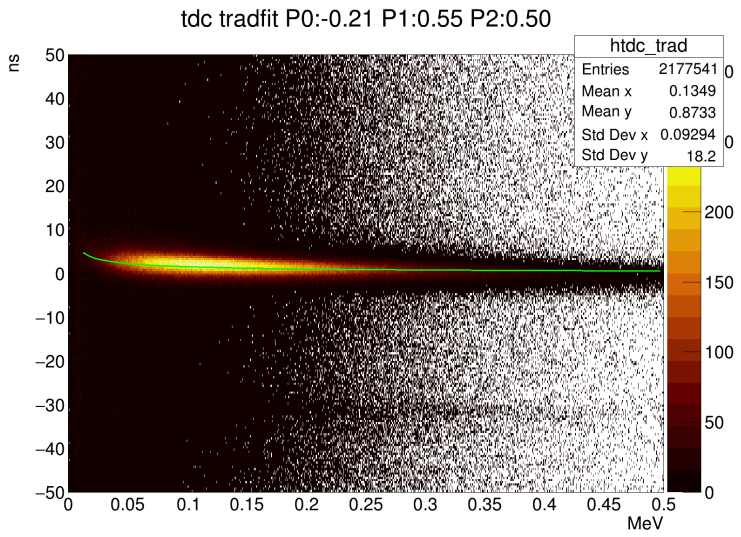

Figure 16: HCal TDC vs E,

5.b ADCt Timewalk, Fit to Data

HCal adct time (all blocks) vs energy, fit with $\Delta t = p0 + p1 \cdot E$. $p0$ is normal to the data and not passed to the calibration.

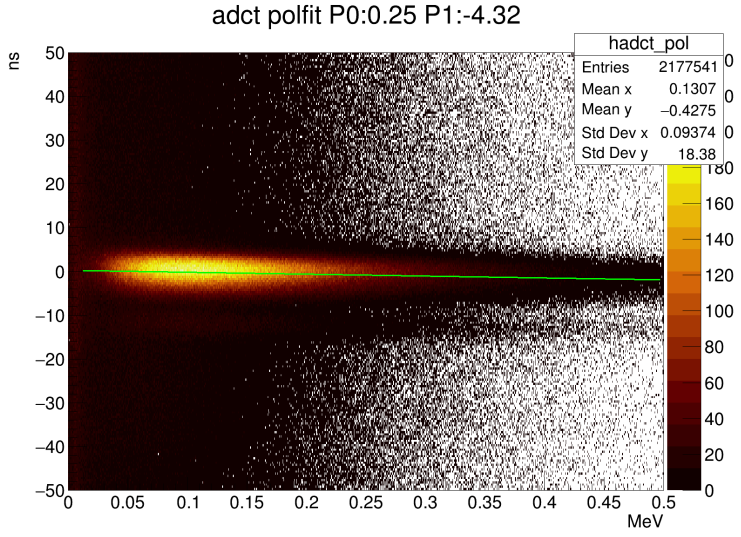

Figure 17: HCal ADCt vs E

6 SBS-offline check, TDC set 1

The following plots repeat checks above, but with a small replay of run 13662 data using replay_gmn.C with SBS-offline associated libraries updated with timewalk and with new offsets included in the database.

6.a ADC Time All Channels

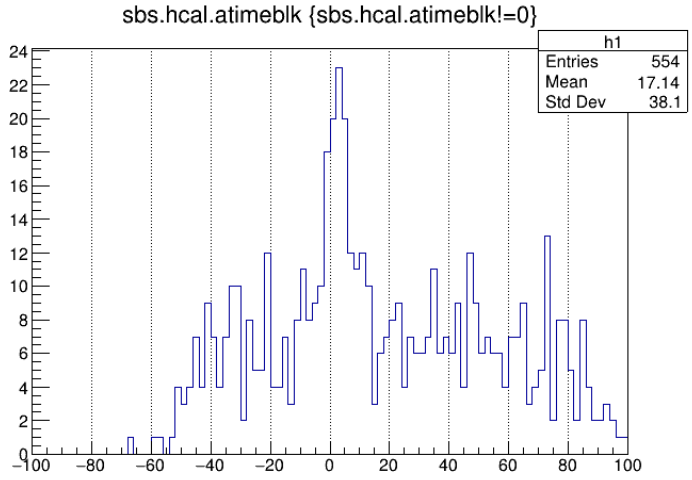

Figure 18: ADCt All Channels, Run 13662

6.b TDC All Channels

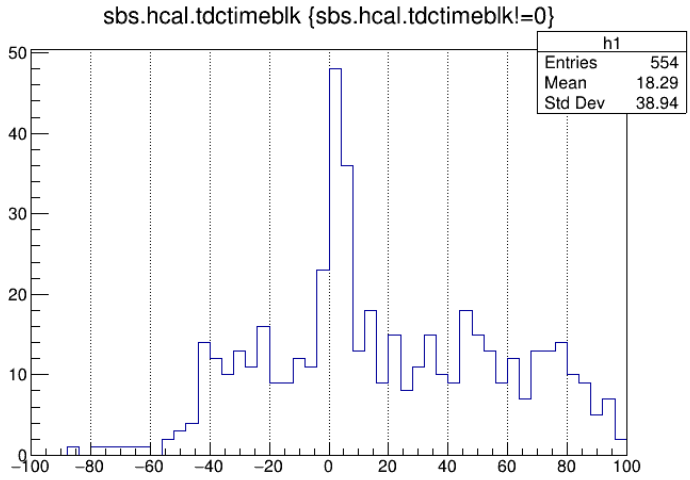

Figure 19: TDC All Channels, Run 13662

7 SBS-offline check, TDC run 13682

The following is over run 13682.

7.a ADC Time All Channels

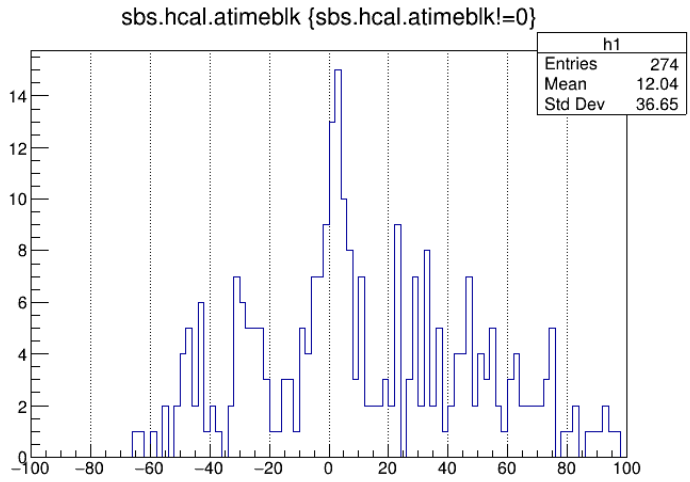

Figure 20: ADCt All Channels, Run 13682

7.b TDC All Channels

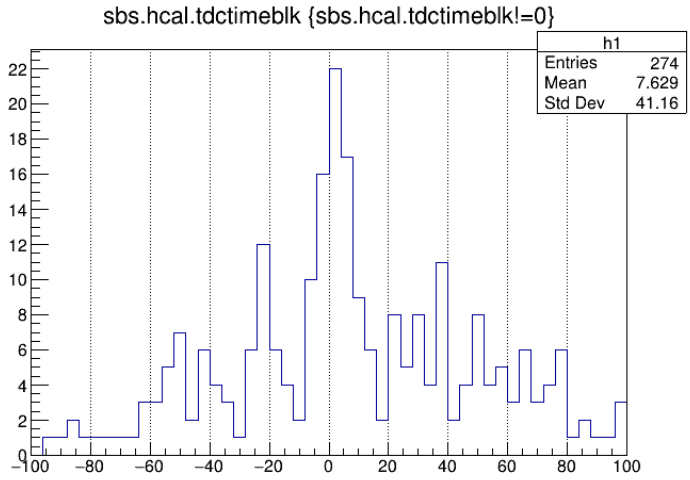

Figure 21: TDC All Channels, Run 13682

8 SBS-offline check, TDC set 1 (after run 13682)

The following is over run 13793.

8.a ADC Time All Channels

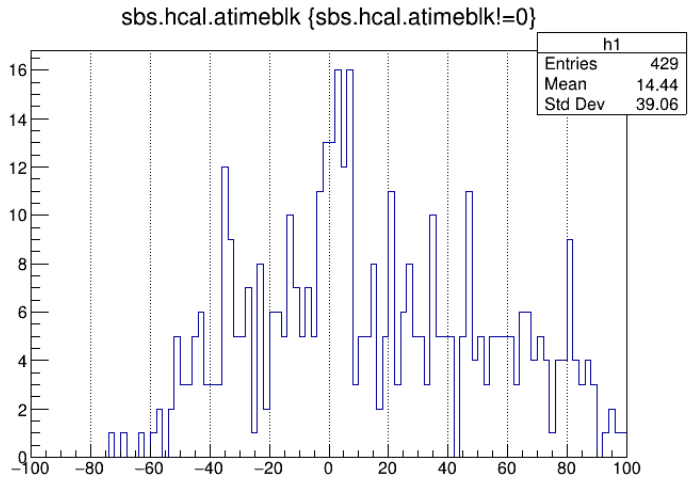

Figure 22: ADCt All Channels, Run 13793

8.b TDC All Channels

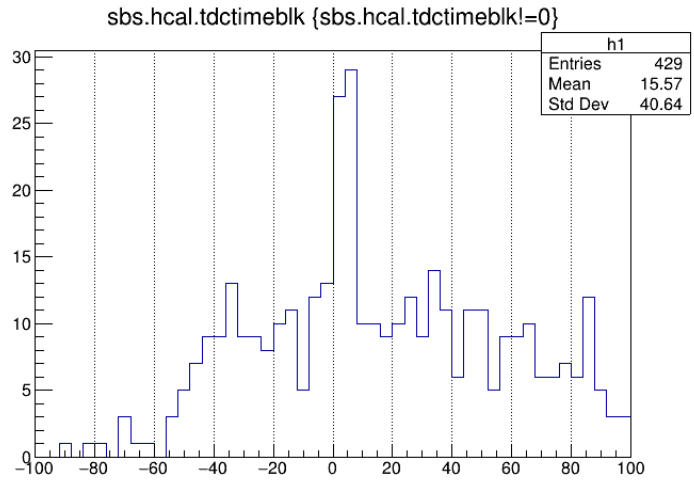

Figure 23: TDC All Channels, Run 13793

9 Supplemental

General Set ADCt Alignment Info

Experiment: gmn, Configuration: 9, Pass: 1

Creation Date: 9_14_2023

Run range 0 - 0

Exclusion range 0 - 0

Target(s) Used: All Available

Calibration Set: none

Elastic Cuts

Global Elastic Cuts: bb.tr.n==1&&bb.ps.e>0.2&&abs(bb.tr.vz[0])<0.08&&bb.gem.track.nhits>3&&sbs.hcal.e>0.03&&abs(bb.tr.tg_th[0])<0.15&&abs(bb.tr.tg_ph[0])<0.3

Other Cuts

Minimum Ev per Cell : 50

HCal Acceptance Match (Projected Nucleon Within HCal Acceptance)

Figure 24: SBS9 adct timing cuts and experimental parameters.

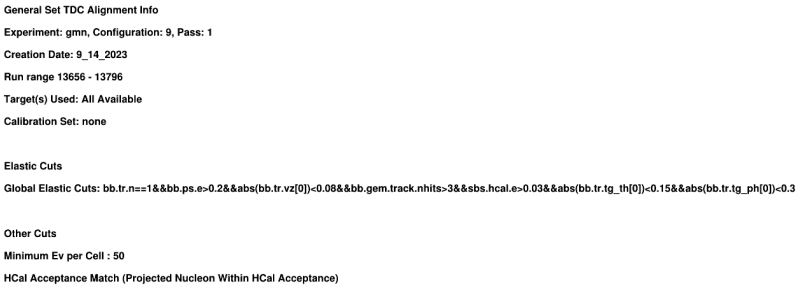

Figure 25: SBS9 all runs excluding 13682 tdc timing cuts and experimental parameters.

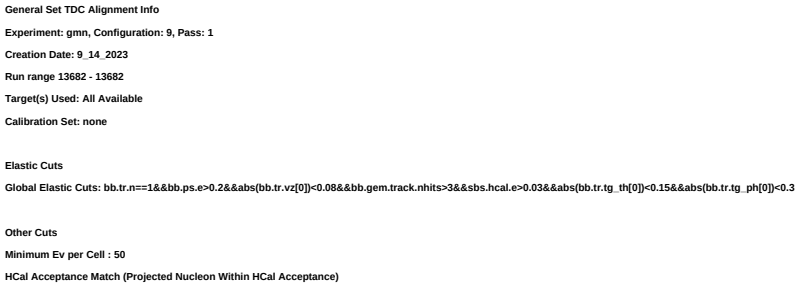

Figure 26: SBS9 run 13682 tdc timing cuts and experimental parameters.