HCal Timing Calibration Quality Checks

GMn, Config: 4, Prior to Pass 2

Sebastian Seeds*

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Contents

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.

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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

- 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.

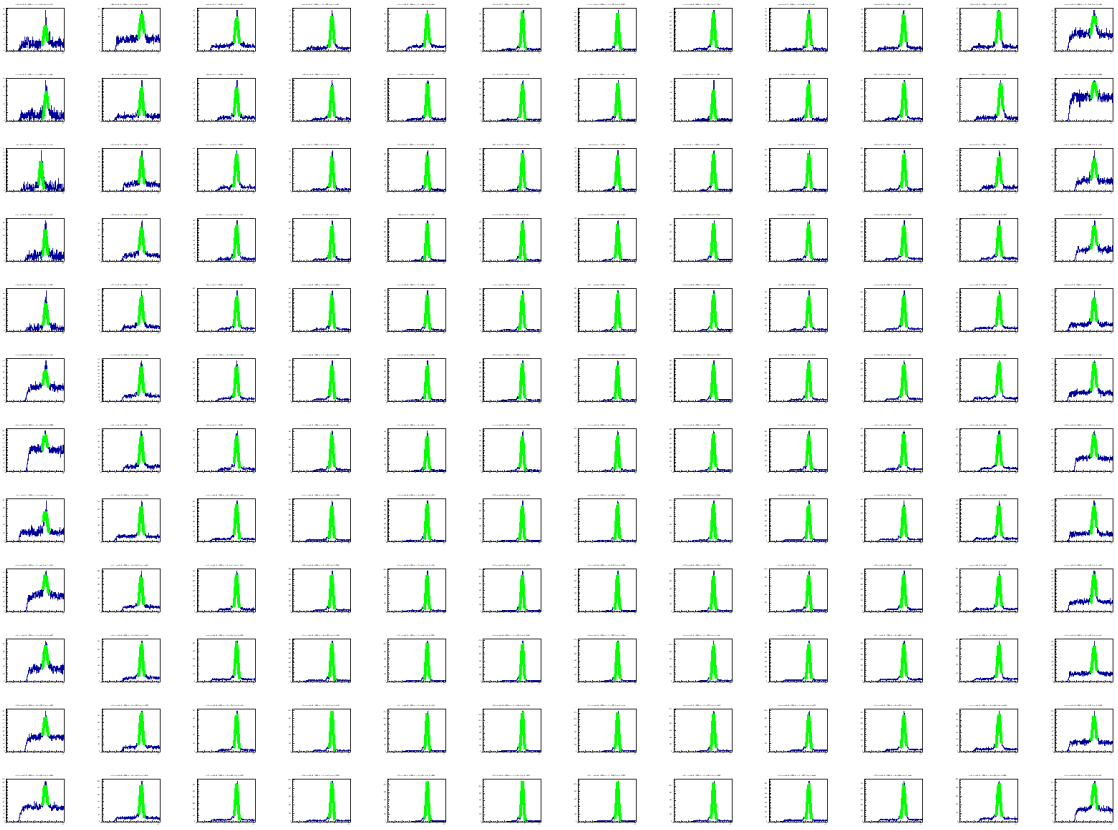

Figure 1: ADCt Spectra Fits vs. Channel, Top Half

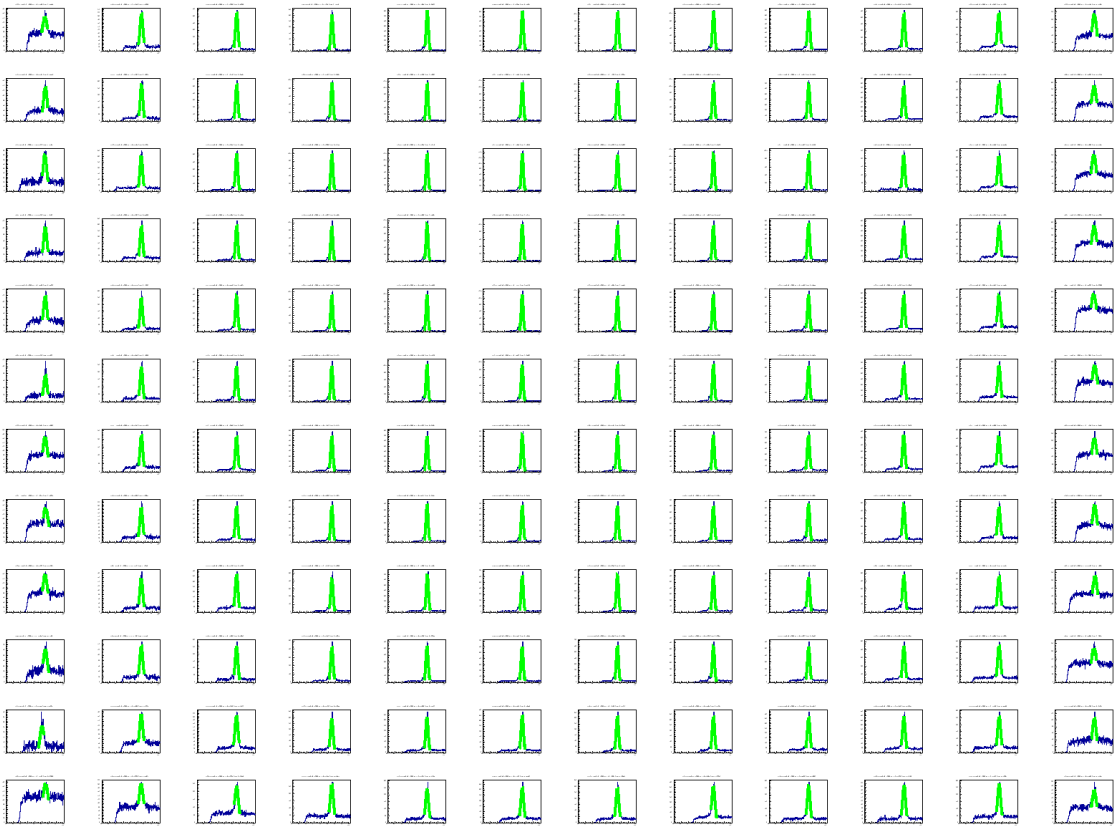

Figure 2: ADCt Spectra Fits vs. Channel, Bottom Half

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

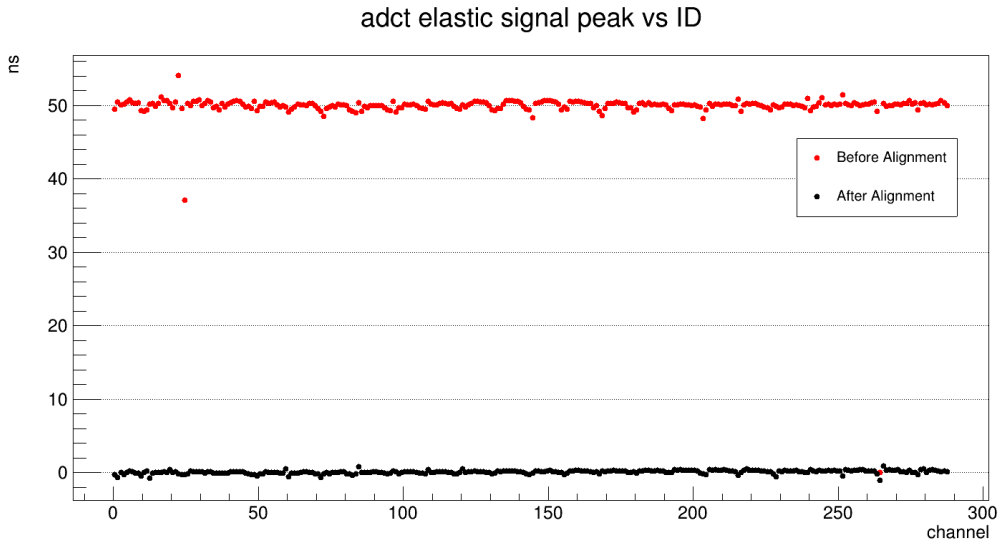

Figure 3: ADCt Fit Comparison, Post-Cal in Black

3.b TDC Offsets

- Fits to TDC spectra, by HCal Channel.

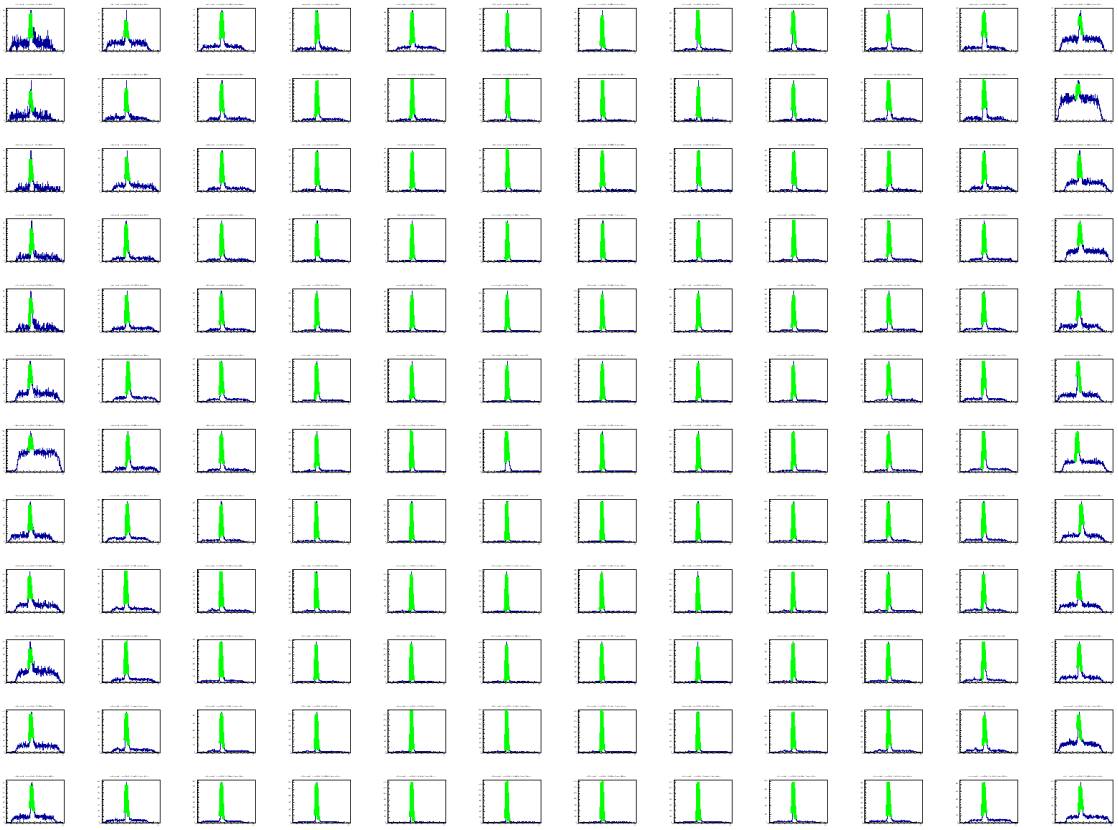

Figure 4: TDC Spectra Fits vs. Channel, Top Half

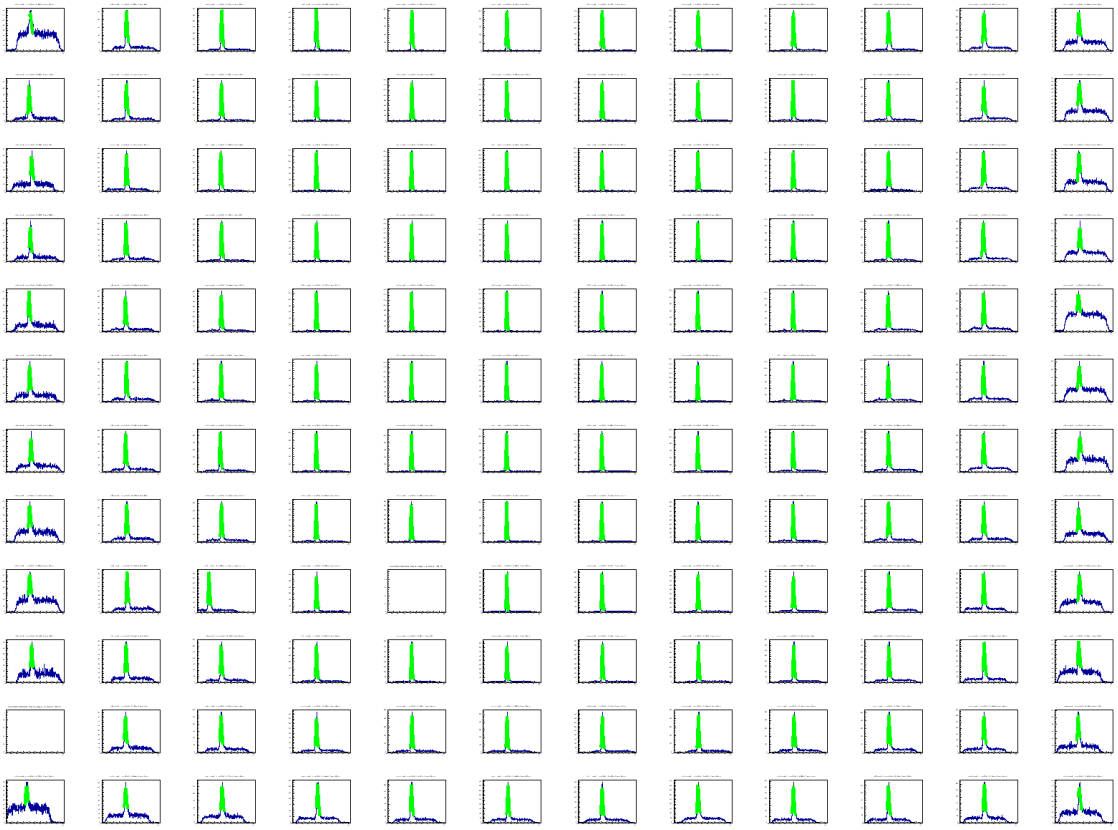

Figure 5: TDC Spectra Fits vs. Channel, Bottom Half

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

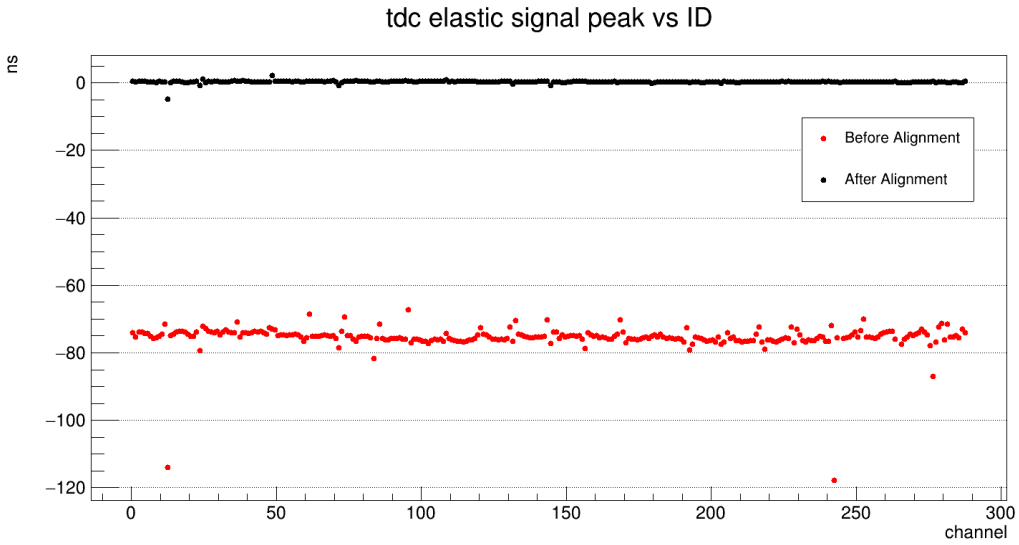

Figure 6: TDC Fit Comparison, Post-Cal in Black

3.c ADC Time Aggregate Comparison

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

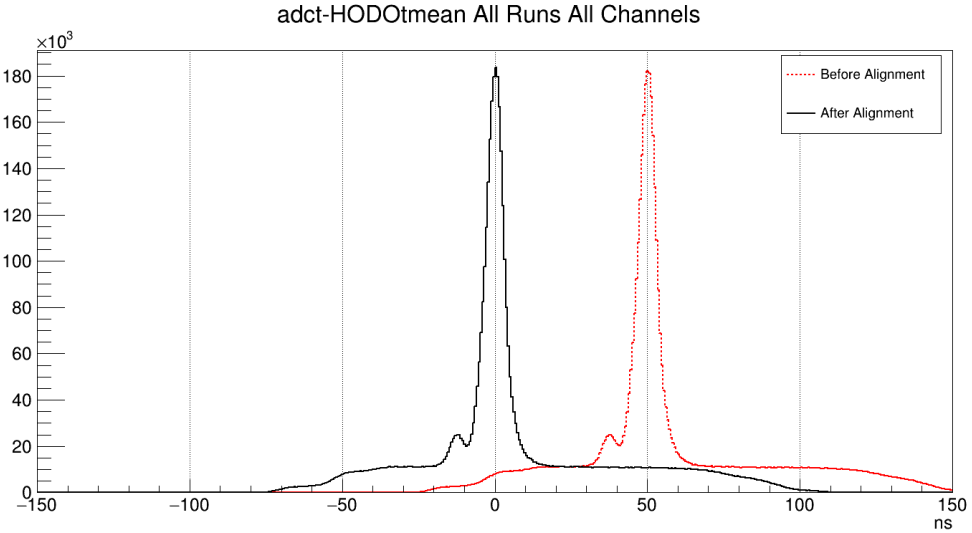

Figure 7: ADCt Comparison, All Channels. Post-alignment Mean: **0.04 ns**

4 Time vs Run

No significant deviations occur on either ADCt or TDC data as a function of run number. One set of alignment offsets used for each of TDC and ADCt for this kinematic.

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

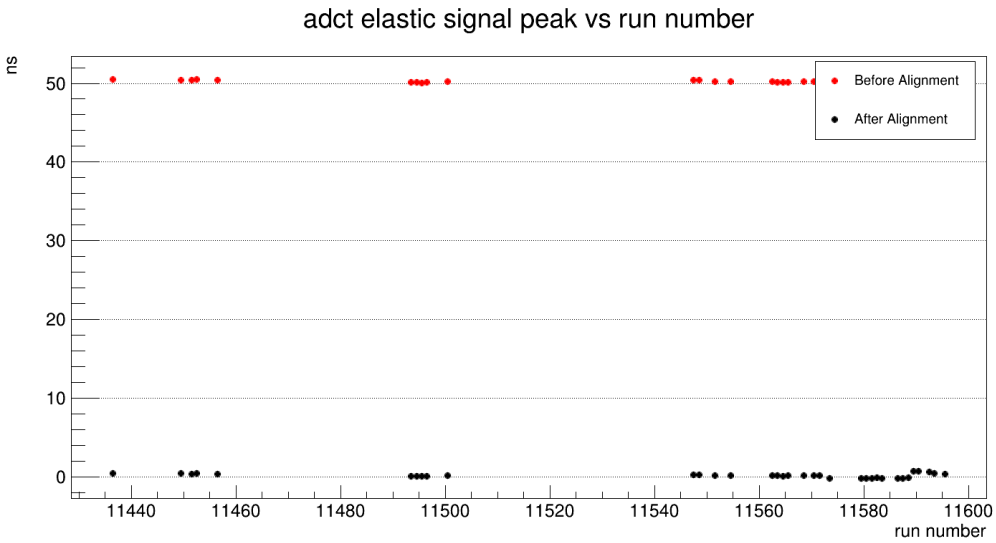

Figure 10: HCal ADCt vs Run Number All Channels, Comparison

4.b TDC vs Run

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

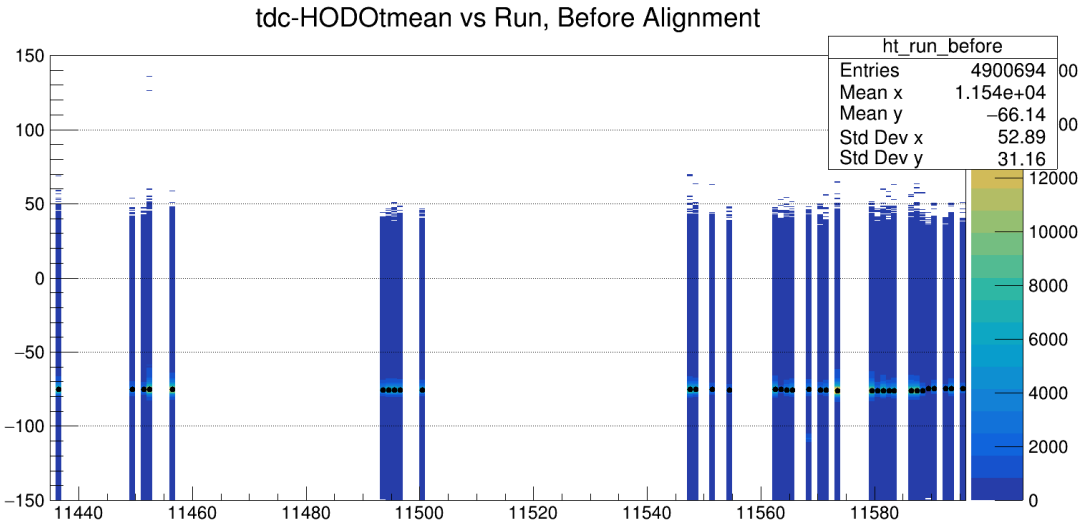

Figure 11: HCal TDC vs Run Number All Channels, Before Alignment

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

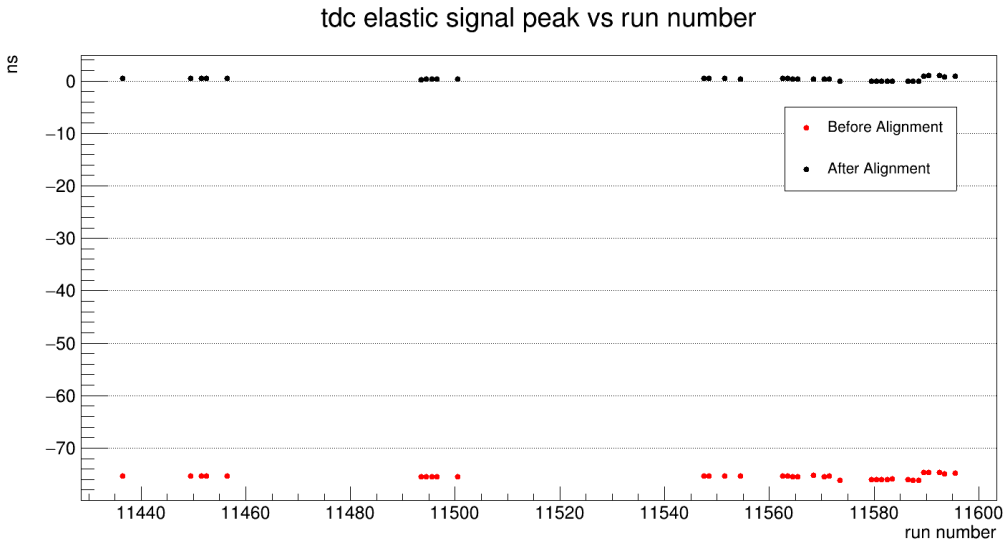

Figure 13: HCal TDC vs Run Number All Channels, Comparison

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.

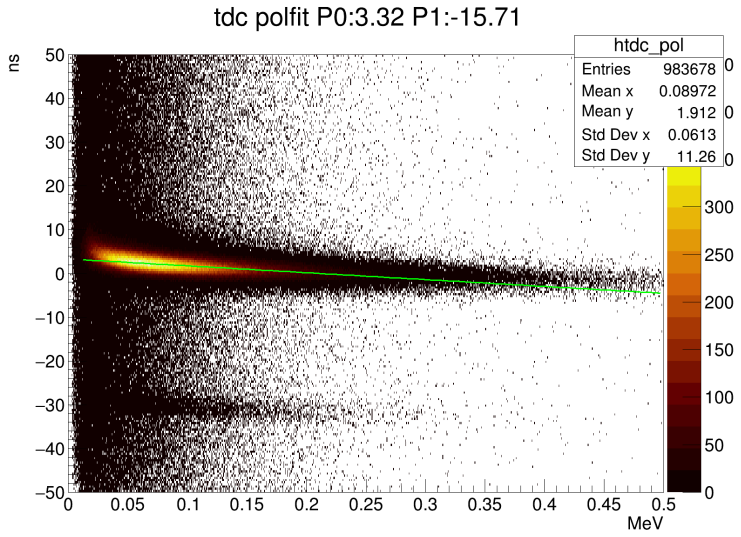

Figure 14: HCal TDC vs E

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.

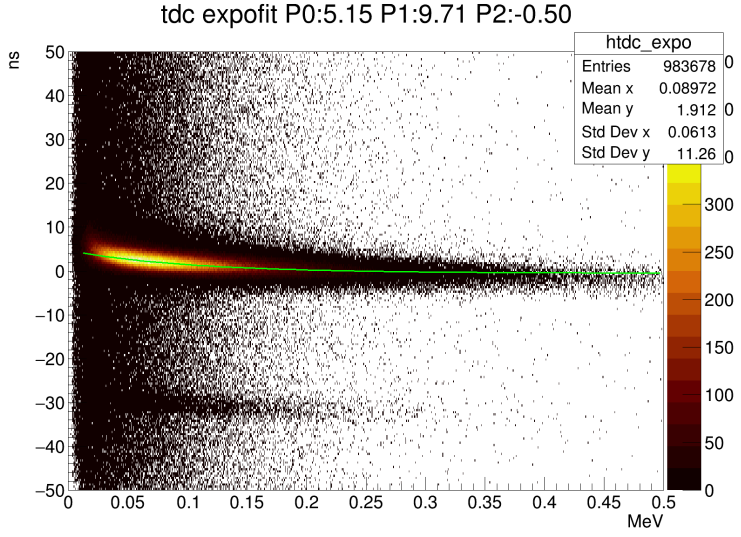

Figure 15: HCal TDC vs E

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.

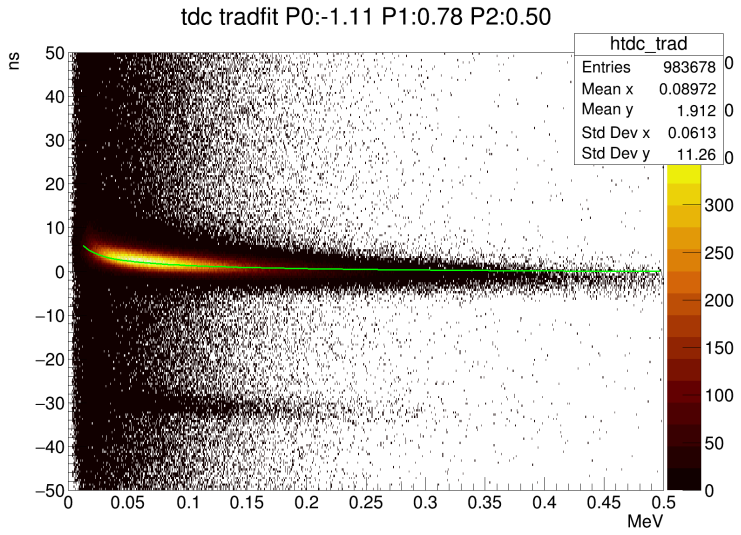

Figure 16: HCal TDC vs E,

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.

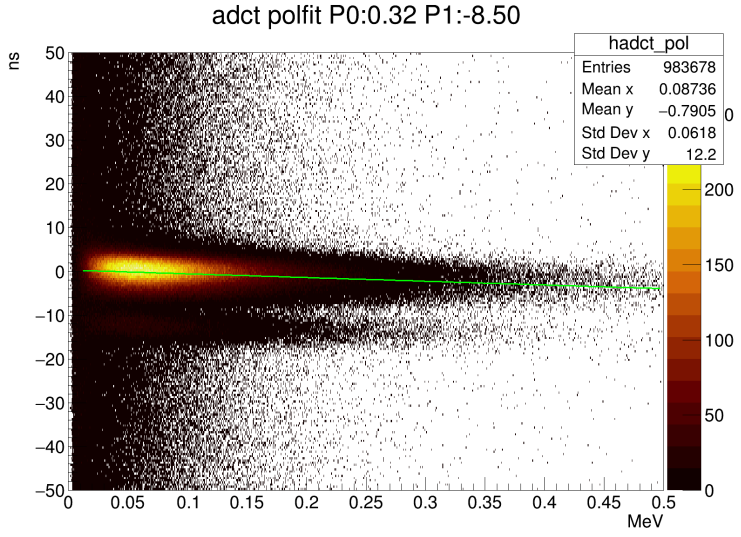

Figure 17: HCal ADCt vs E

6 SBS-offline check

The following plots repeat checks above, but with a small replay of run 11587 data using replay_gmn.C with SBS-offline associated libraries updated with timewalk and with new offsets included in the database.

6.a ADCt, All Channels

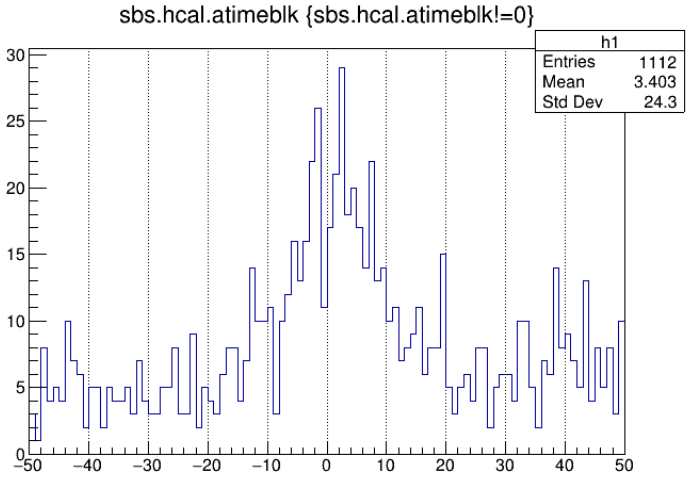

Figure 18: ADCt All Channels, Run 11587

6.b TDC, All Channels

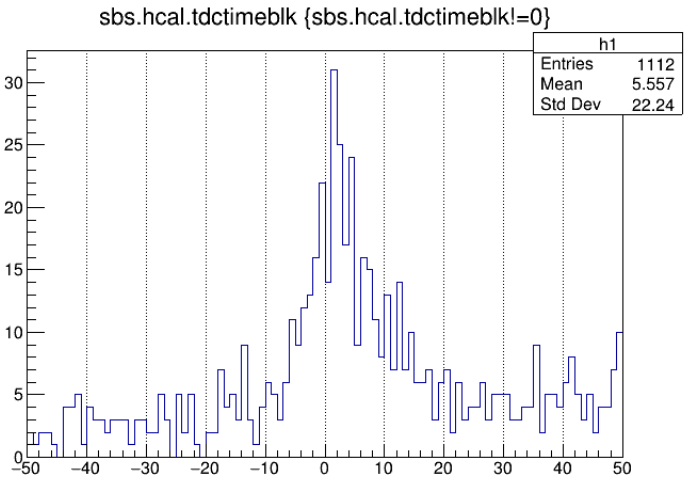

Figure 19: TDC All Channels, Run 11587

7 Supplemental

General Set ADCt Alignment Info

Experiment: gmn, Configuration: 4, Pass: 0

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&&abs(bb.etot_over_p-0.92)<0.2&&sbs.hcal.e>0.01&&bb.ps.e+bb.sh.e>1.7

Other Cuts

Minimum Ev per Cell : 50

HCal Acceptance Match (Projected Nucleon Within HCal Acceptance)

Figure 20: SBS4 timing cuts and experimental parameters.

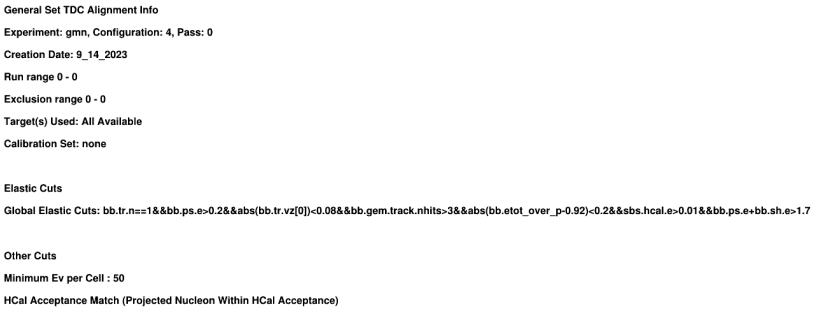

Figure 21: SBS4 timing cuts and experimental parameters.