HCal Timing Calibration Quality Checks
GMn, Config: 8, Prior to Pass 2

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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.

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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 $\Delta t = a + \beta / E^N$ 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.
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
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
5 Supplemental Timing

5.a TDC Timewalk, Fits to Data

HCal tdc time (all blocks) vs energy, fit with $\Delta t = p_0 + p_1 \cdot E$. $p_0$ is normal to the data and not passed to the calibration.

Figure 13: HCal TDC vs Run Number All Channels, Comparison
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.
5.b ADCt Timewalk, Fit to Data

HCal adct time (all blocks) vs energy, fit with $\Delta t = p_0 + p_1 \cdot E$. $p_0$ is normal to the data and not passed to the calibration.
6 SBS-offline check

The following plots repeat checks above, but with a small replay of run 13486 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 13486](image-url)
6.b TDC All Channels

![Graph](image)

Figure 19: TDC All Channels, Run 13486

7 Supplemental

![Graph](image)

Figure 20: SBS4 adct timing cuts and experimental parameters.

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Figure 21: SBS4 tdc timing cuts and experimental parameters.