

HCal Energy Calibration Quality Checks

GMn, All Configs, for Pass 2, via SBS 4 LH2 Only

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1 How to Read this Document

This document details the energy calibration results for GMn over SBS4 before 2021-10-24 04:30:00 constituting the first of two HV sets employed during GMn. For information regarding the calibration process, see the [overleaf](#).

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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

- This calibration results from analysis of LH2 data exclusively.
- As a matter of record, this second set differs from the first (prior to 2021-10-24 04:30:00) in order to address a set of low signal channels whose cause, at the time of this report, is not fully understood. In order to separate signal from pedestal, several channels saw HV increase and in order to reduce the rate of saturation, a few channels saw HV reduction. See the [GMn HCal Settings](#) record for details.
- While better cluster selection is possible with various methods which can improve these calibrations, only the primary cluster information has been used for calibrations on this pass. This choice is due to the lack of individual block information included in the data for clusters beyond the primary which would be needed to verify the quality of calibrations. Data volume constraints permitting, it is recommended that all HCal cluster information be included for future passes.
- The final section, **Supplemental**, gives a list of elastic cuts and experimental parameters for each of the four 48D48 magnetic field settings employed during SBS8. Where the adc time σ is specified, the cut for this calibration is set to 6σ pending future passes where a coincidence time between HCal and BBCal will provide better elastic selection.

This section also contains a copy of the database file db_sbs.hcal.dat for record.

3 Quality Plots

3.a Number of Events Available for Calibration

Number of available SBS4 events per HCal channel after elastic cuts.

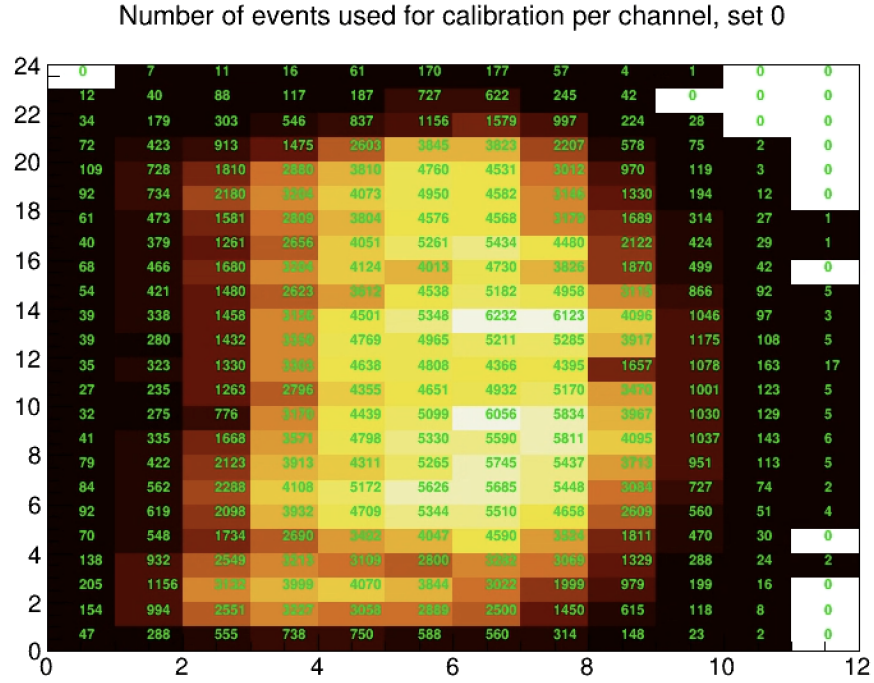


Figure 1: HCal row vs col, total number of elastic events used

3.b MC / Data Comparison, Sampling Fraction

HCal sampling fraction over all channels, primary block. Data and monte carlo comparison.

3.b.1 SBS4, Prior to 2021-10-24 04:30:00

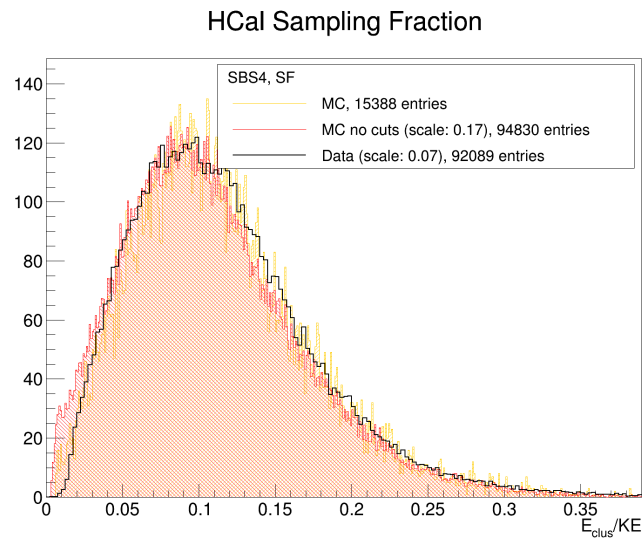


Figure 2: HCal Sampling Fraction, Data/MC Comparison

3.c MC / Data Comparison, Energy

HCal Energy spectrum over all channels, primary block. Data and monte carlo comparison.

3.c.1 SBS4, Prior to 2021-10-24 04:30:00

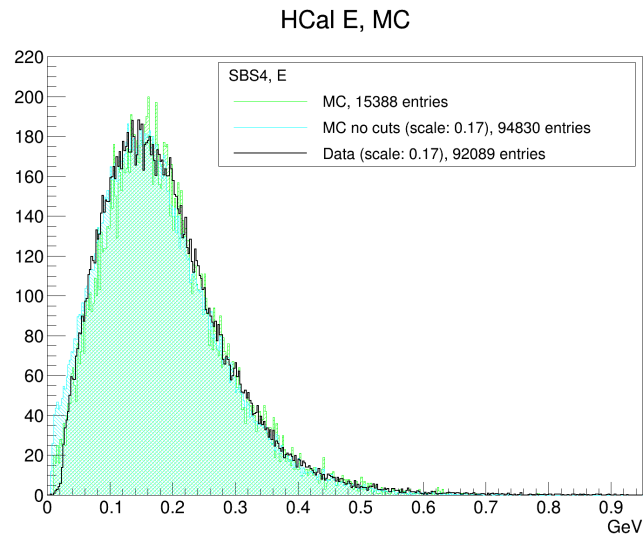


Figure 3: HCal Cluster E, Data/MC Comparison

3.d Dispersive Uniformity

Sampling Fraction vs HCal X (row), after calibration.

3.d.1 SBS4, Prior to 2021-10-24 04:30:00

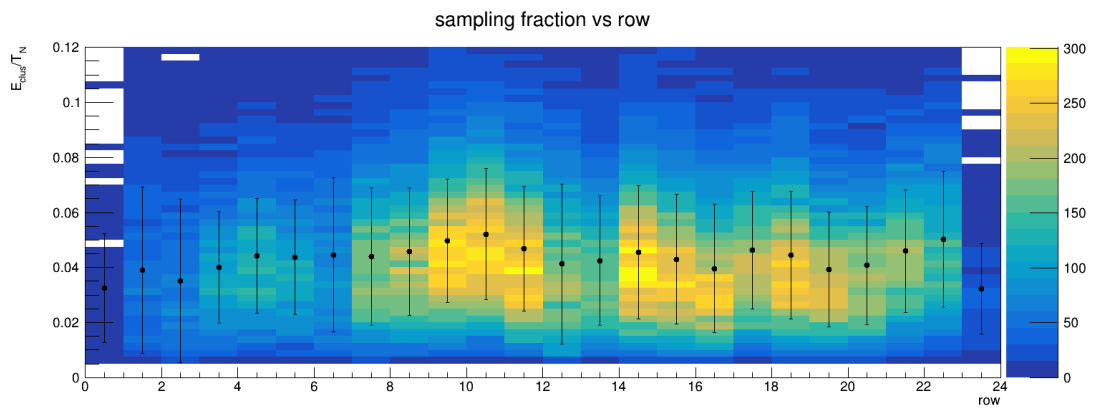


Figure 4: HCal Sampling Fraction vs Row, After Calibration

3.e Transverse Uniformity

Sampling Fraction vs HCal Y (col), after calibration.

3.e.1 SBS4, Prior to 2021-10-24 04:30:00

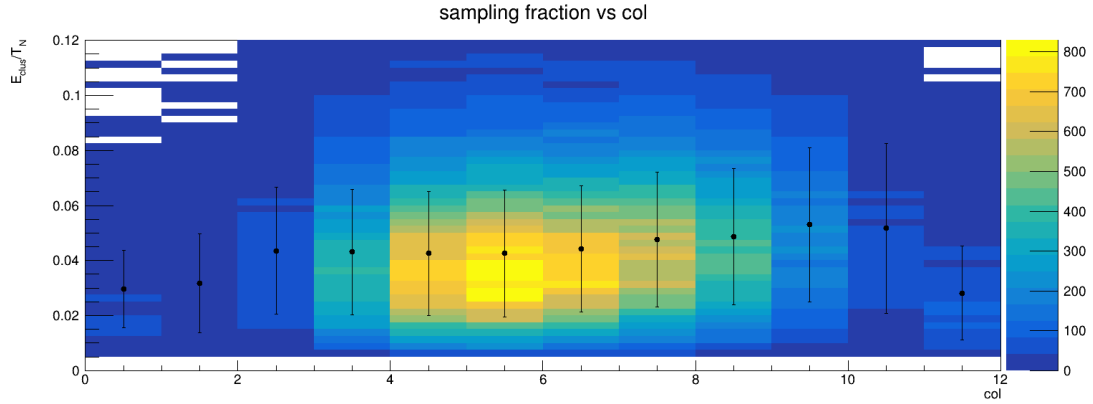


Figure 5: HCal Sampling Fraction vs Col, After Calibration

3.f Run to Run Comparisons

HCal energy spectrum as a function of run number. LH2 and LD2 runs are color-coded for convenience.

3.f.1 SBS4, Prior to 2021-10-24 04:30:00

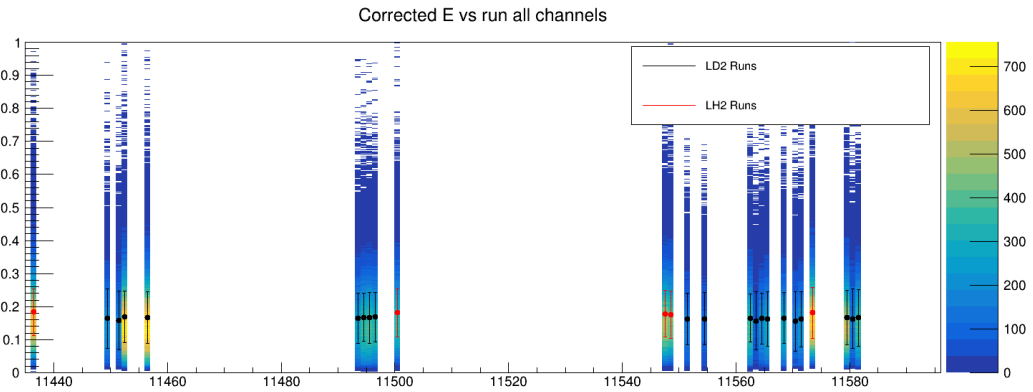


Figure 6: HCal Energy Spectra vs Run Number, After Calibration

3.g SBS-offline Check

Energy and sampling fraction comparisons from small replay from run 11500 using updated SBS-offline libraries with replay_gmn.C to verify integrity of quality replay information above.

3.g.1 HCal E, Run 11500

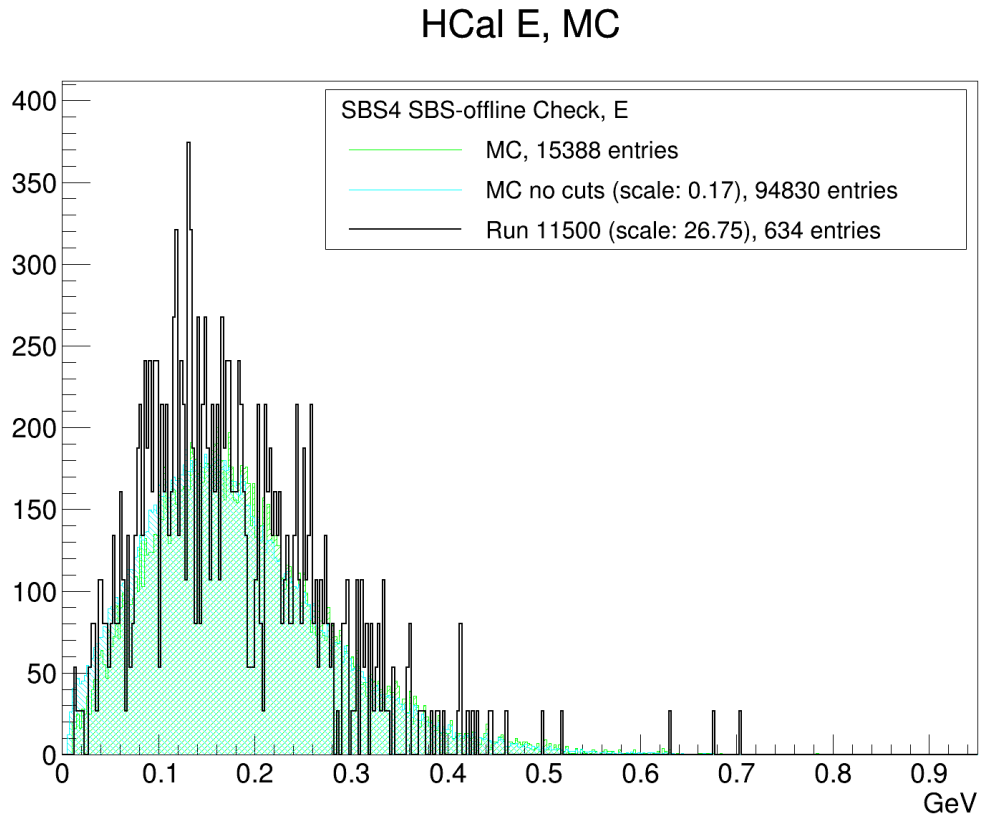


Figure 7: HCal Energy and MC, Run 11500

3.g.2 HCal SF, Run 11500

HCal Sampling Fraction

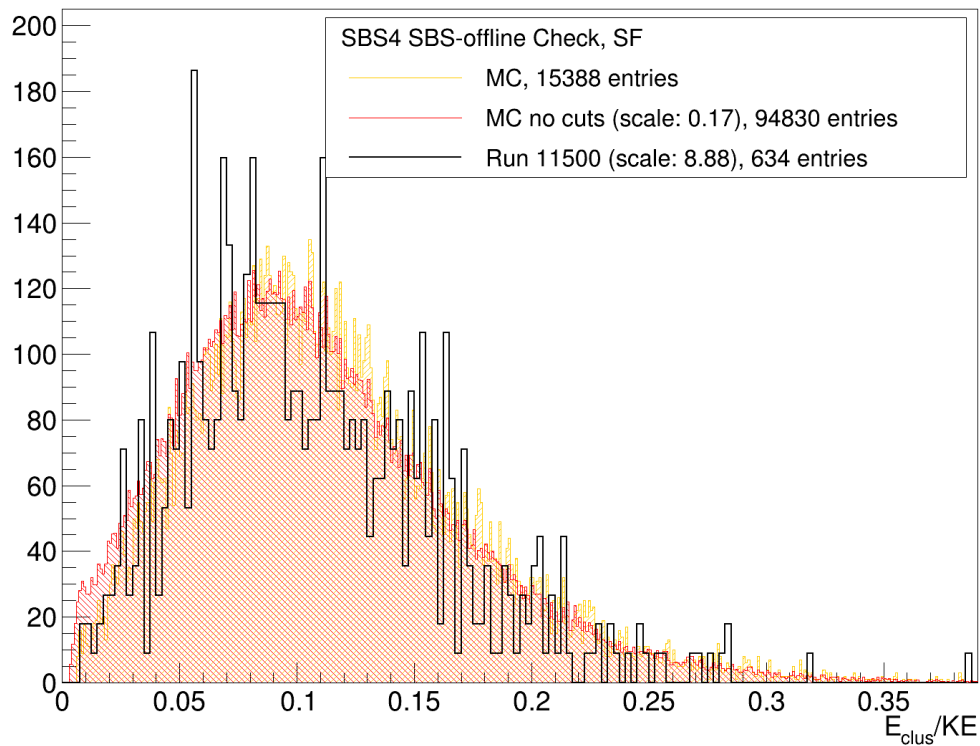


Figure 8: HCal Sampling Fraction and MC, Run 11500

4 Supplemental

4.a Cuts and Experimental Parameters

General HCal Energy Calibration Info
Experiment: gmn, Configuration: 4, Pass: 0
Creation Date: 8_27_2023
Target: lh2
SBS Field: 30%

Elastic Cuts
Global Elastic Cuts: $bb.tr.n==1\&\&bb.ps.e>0.2\&\&abs(bb.tr.vz[0])<0.08\&\&bb.gem.track.nhits>3\&\&abs(bb.etot_over_p-0.92)<0.2\&\&sbs.hcal.e>0.01\&\&bb.ps.e+bb.sh.e>1.7$
W2 mean (GeV): 0.92
W2 sigma (GeV): 0.17
dx mean, proton (m): -0.65
dx sigma, proton (m): 0.07
dy mean (m): -0.02
dy sigma (m): 0.07
adc time mean (ns): 1.20
adc time sigma (ns): 4.35

Other Cuts/Information
Minimum Ev per Cell : 100
Minimum Energy Deposited in Cell (factor, vs expectation) : 0.01
Sampling Fraction Target, Modified MC: 0.0282
HCal Active Area (Projected Nucleon 1 row/col Within HCal Acceptance)

Figure 9: SBS4 30% field cuts and experimental parameters.

General HCal Energy Calibration Info
 Experiment: gmn, Configuration: 4, Pass: 0
 Creation Date: 8_27_2023
 Target: lh2
 SBS Field: 0%

Elastic Cuts
 Global Elastic Cuts: $bb.tr.n==1\&\&bb.ps.e>0.2\&\&abs(bb.tr.vz[0])<0.08\&\&bb.gem.track.nhits>3\&\&abs(bb.etot_over_p-0.92)<0.2\&\&sbs.hcal.e>0.01\&\&bb.ps.e+bb.sh.e>1.7$
 W2 mean (GeV): 0.84
 W2 sigma (GeV): 0.09
 dx mean, proton (m): 0.02
 dx sigma, proton (m): 0.06
 dy mean (m): -0.04
 dy sigma (m): 0.07
 adc time mean (ns): 1.20
 adc time sigma (ns): 4.35

Other Cuts/Information
 Minimum Ev per Cell : 100
 Minimum Energy Deposited in Cell (factor, vs expectation) : 0.01
 Sampling Fraction Target, Modified MC: 0.0282
 HCal Active Area (Projected Nucleon 1 row/col Within HCal Acceptance)

Figure 10: SBS4 0% field cuts and experimental parameters.

General HCal Energy Calibration Info
 Experiment: gmn, Configuration: 4, Pass: 0
 Creation Date: 8_27_2023
 Target: lh2
 SBS Field: 50%

Elastic Cuts
 Global Elastic Cuts: $bb.tr.n==1\&\&bb.ps.e>0.2\&\&abs(bb.tr.vz[0])<0.08\&\&bb.gem.track.nhits>3\&\&abs(bb.etot_over_p-0.92)<0.2\&\&sbs.hcal.e>0.01\&\&bb.ps.e+bb.sh.e>1.7$
 W2 mean (GeV): 0.95
 W2 sigma (GeV): 0.09
 dx mean, proton (m): -1.09
 dx sigma, proton (m): 0.09
 dy mean (m): -0.01
 dy sigma (m): 0.07
 adc time mean (ns): 1.20
 adc time sigma (ns): 4.35

Other Cuts/Information
 Minimum Ev per Cell : 100
 Minimum Energy Deposited in Cell (factor, vs expectation) : 0.01
 Sampling Fraction Target, Modified MC: 0.0276
 HCal Active Area (Projected Nucleon 1 row/col Within HCal Acceptance)

Figure 11: SBS4 50% field cuts and experimental parameters.