HCal Energy Calibration Quality Checks
GMn, All Configs, for Pass 2, via SBS 8 LH2 Only

Sebastian Seeds*

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Contents

*email: sseeds@jlab.org

1   How to Read this Document

This document details the energy calibration results for GMn over all kinematics. This set considers the ADC gain parameters obtained from SBS8 (all available data of integrity) applied to the last third of SBS4 (after 2021-10-24 04:30:00) and all remaining GMn data. This constitutes the second high voltage set of two for HCal during GMn. For information regarding the calibration process, see the overleaf.

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.

2.a Number of Events Available for Calibration

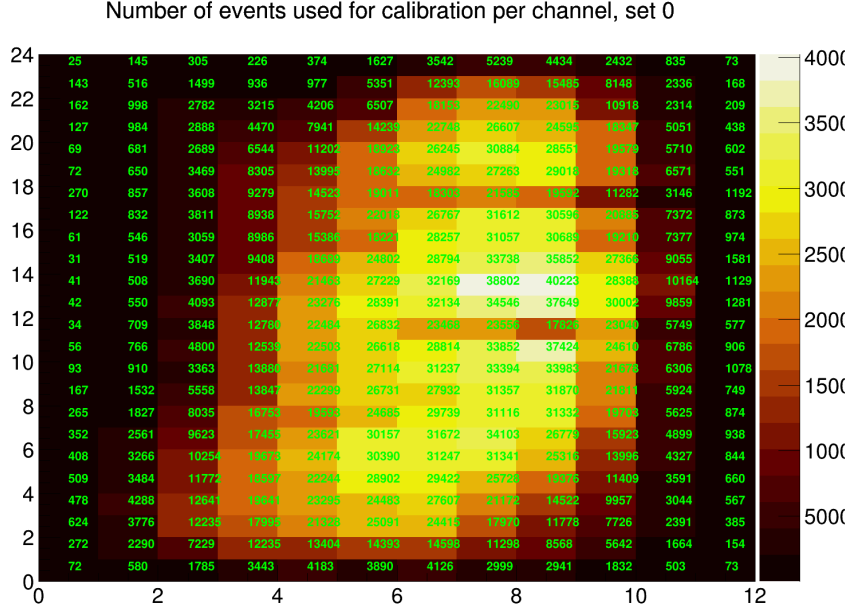Number of available SBS8 events per HCal channel after elastic cuts.

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

2.b MC / Data Comparison, Sampling Fraction

HCal sampling fraction over all channels, primary block. Data and monte carlo comparison.
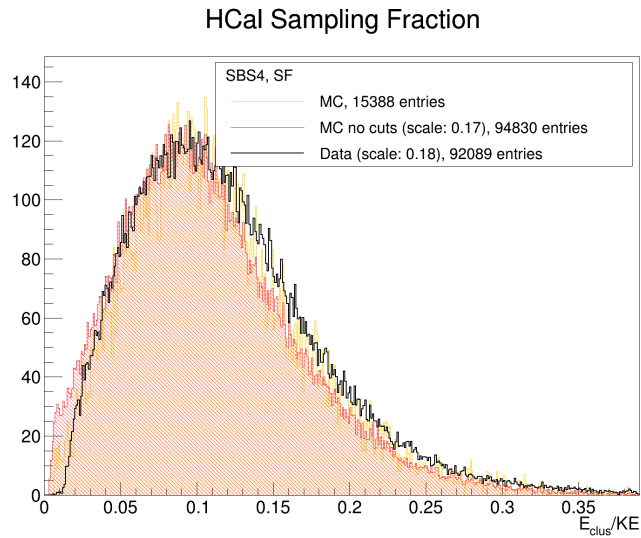
2.b.1 SBS4, Post 2021-10-24 04:30:00

Figure 2: HCal Sampling Fraction, Data/MC Comparison
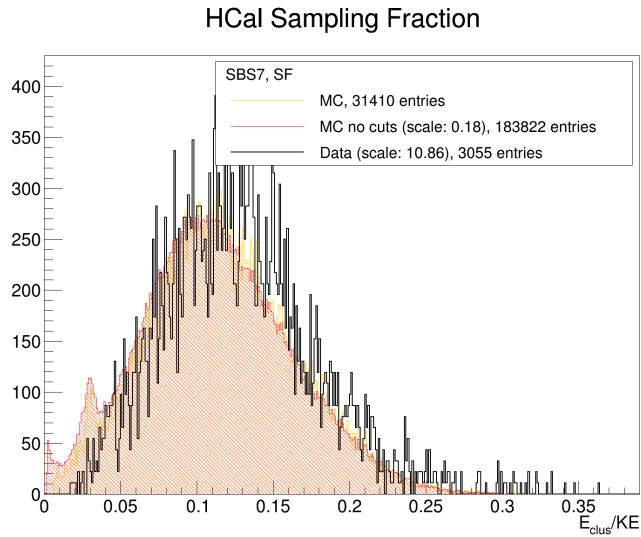
2.b.2 SBS7

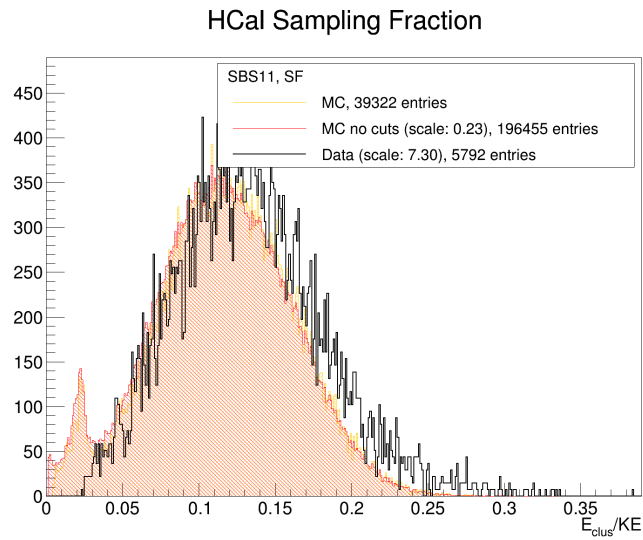Figure 3: HCal Sampling Fraction, Data/MC Comparison

2.b.3 SBS11

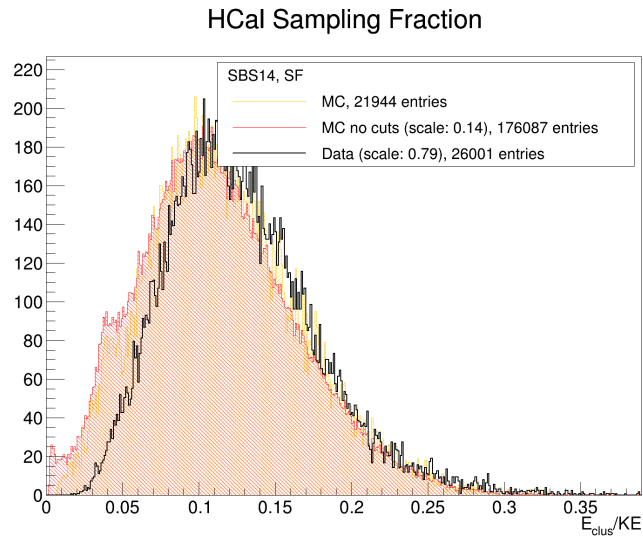Figure 4: HCal Sampling Fraction, Data/MC Comparison

2.b.4 SBS14

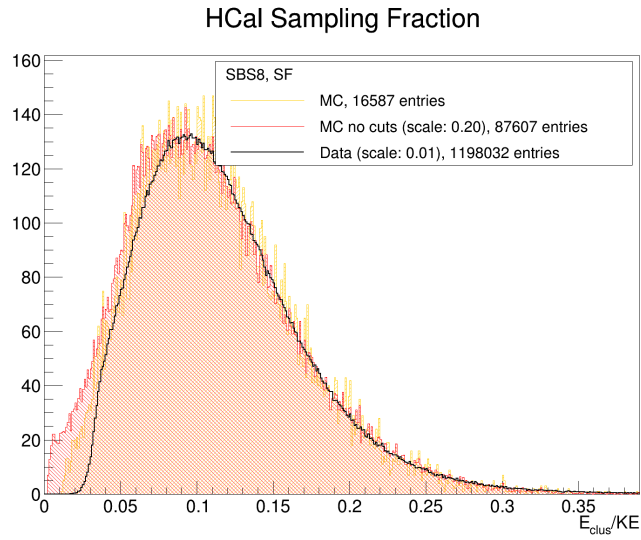Figure 5: HCal Sampling Fraction, Data/MC Comparison

2.b.5   SBS8

Figure 6: HCal Sampling Fraction, Data/MC Comparison
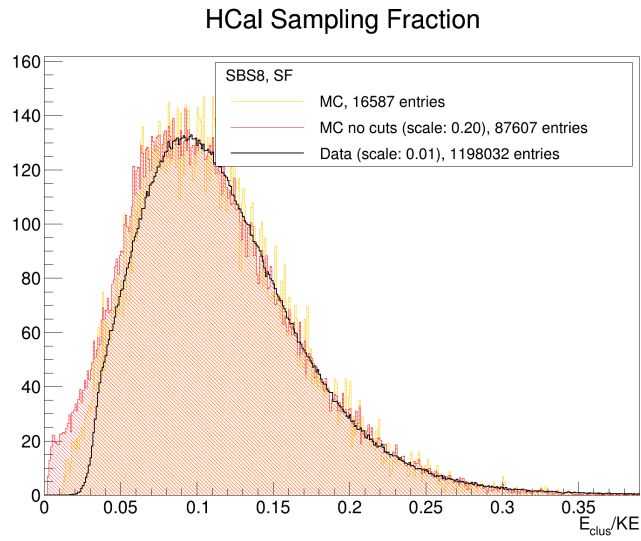
2.b.6   SBS9

Figure 7: HCal Sampling Fraction, Data/MC Comparison

2.c MC / Data Comparison, Energy

HCal Energy spectrum over all channels, primary block. Data and monte carlo comparison.
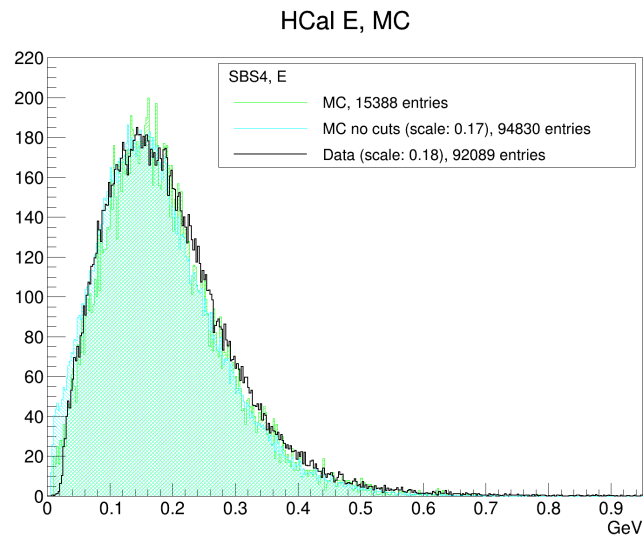
2.c.1 SBS4, Post 2021-10-24 04:30:00

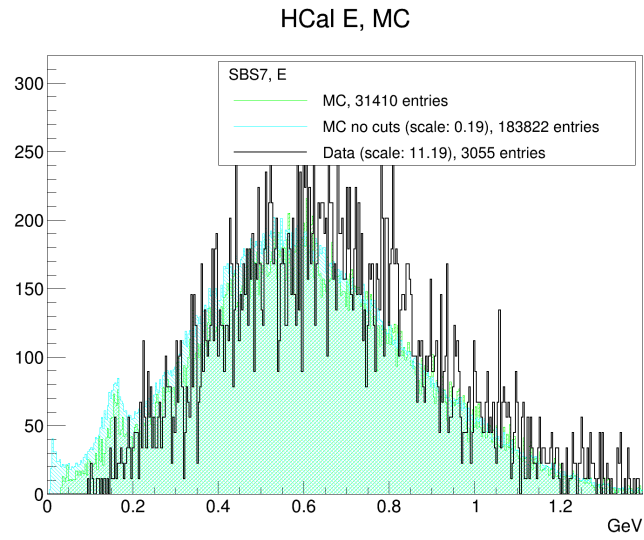Figure 8: HCal Cluster E, Data/MC Comparison

2.c.2   SBS7

HCal E, MC

Figure 9: HCal Cluster E, Data/MC Comparison
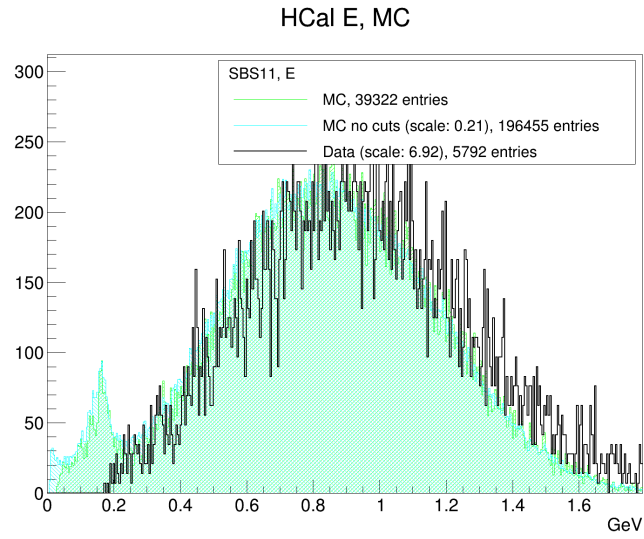
2.c.3   SBS11

HCal E, MC

Figure 10: HCal Cluster E, Data/MC Comparison
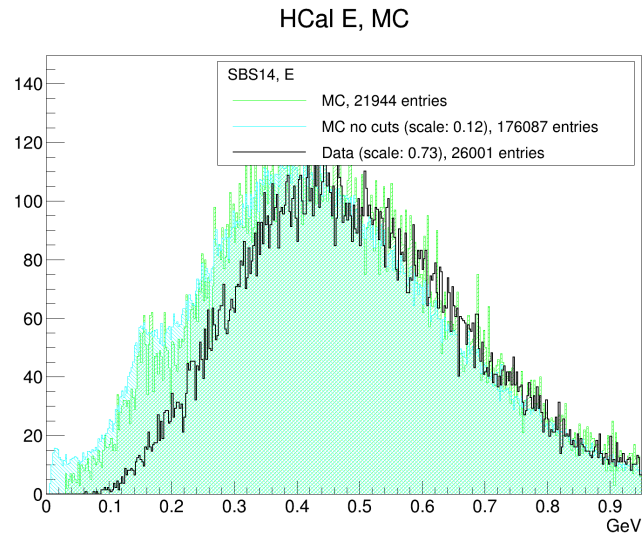
2.c.4   SBS14

HCal E, MC

Figure 11: HCal Cluster E, Data/MC Comparison

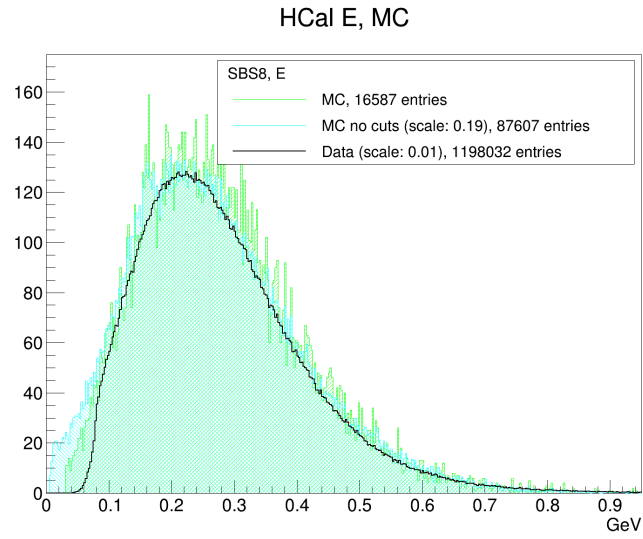## 2.c.5   SBS8

HCal E, MC

Figure 12: HCal Cluster E, Data/MC Comparison

2.c.6   SBS9

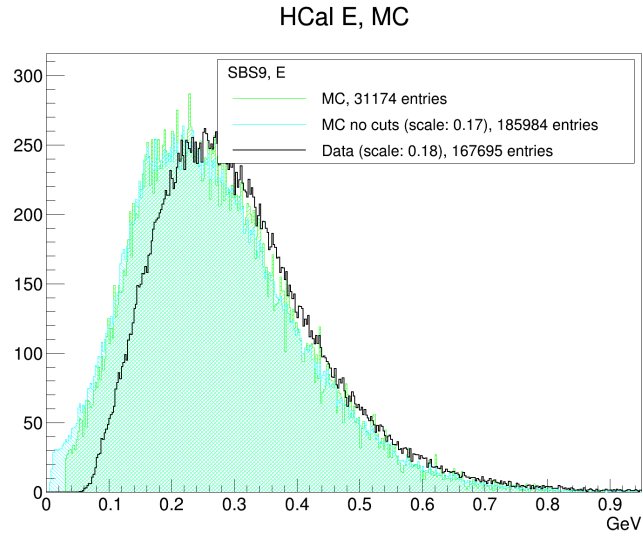Figure 13: HCal Cluster E, Data/MC Comparison

2.d   Dispersive Uniformity

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

2.d.1   SBS4, Post 2021-10-24 04:30:00
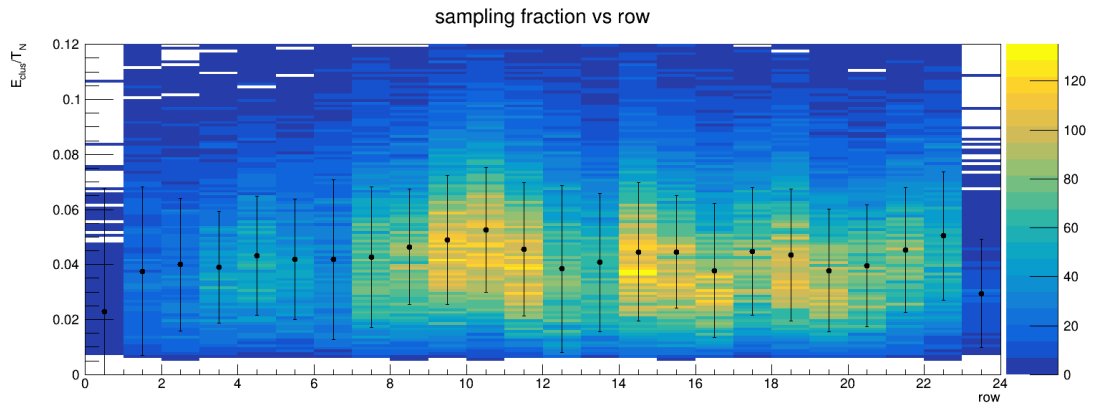

Figure 14: HCal Sampling Fraction vs Row, After Calibration

2.d.2 SBS7

Figure 15: HCal Sampling Fraction vs Row, After Calibration

2.d.3 SBS11

Figure 16: HCal Sampling Fraction vs Row, After Calibration

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2.d.4 SBS14

Figure 17: HCal Sampling Fraction vs Row, After Calibration

2.d.5 SBS8

Figure 18: HCal Sampling Fraction vs Row, After Calibration

2.d.6   SBS9

Figure 19: HCal Sampling Fraction vs Row, After Calibration

2.e   Transverse Uniformity

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

2.e.1   SBS4, Post 2021-10-24 04:30:00
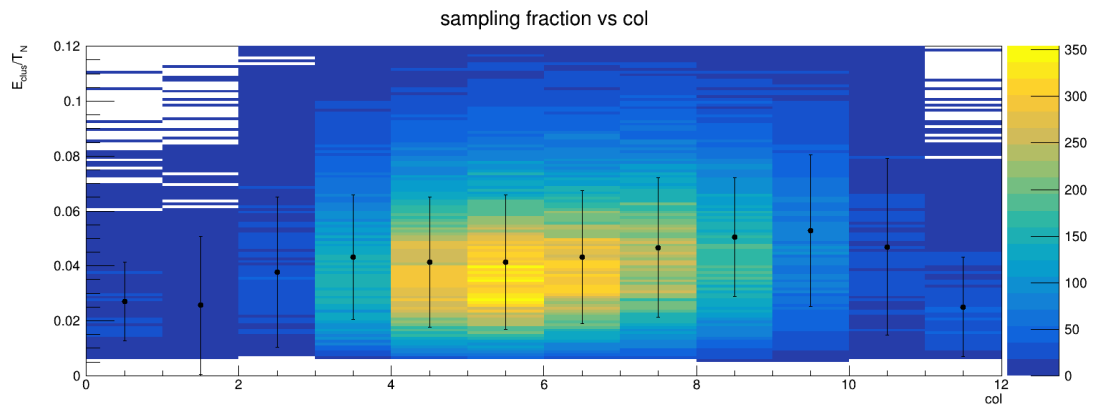
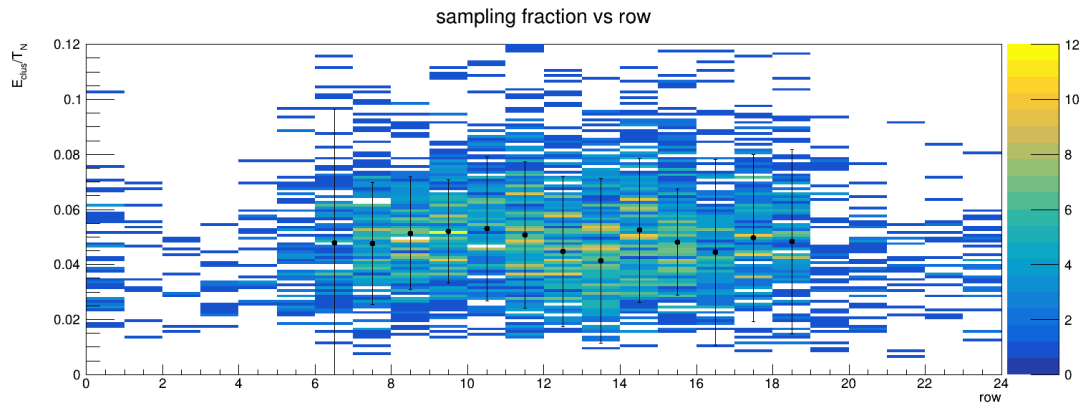Figure 20: HCal Sampling Fraction vs Col, After Calibration

2.e.2   SBS7
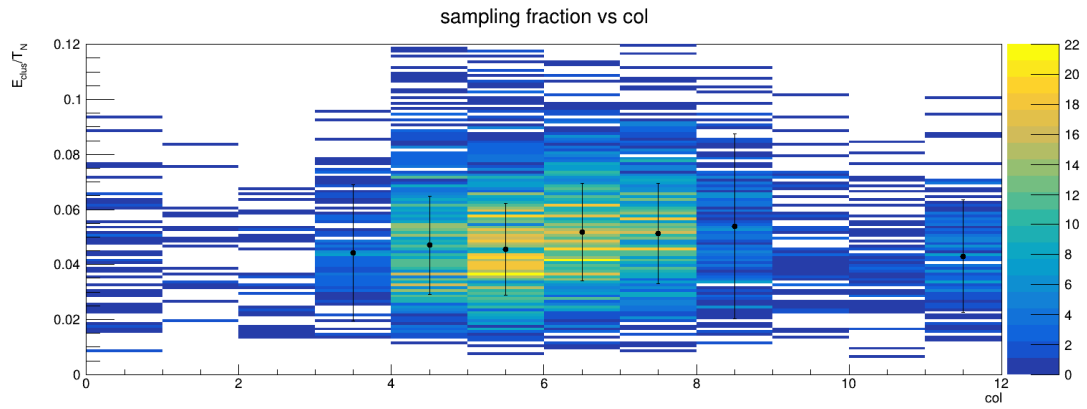
Figure 21: HCal Sampling Fraction vs Col, After Calibration
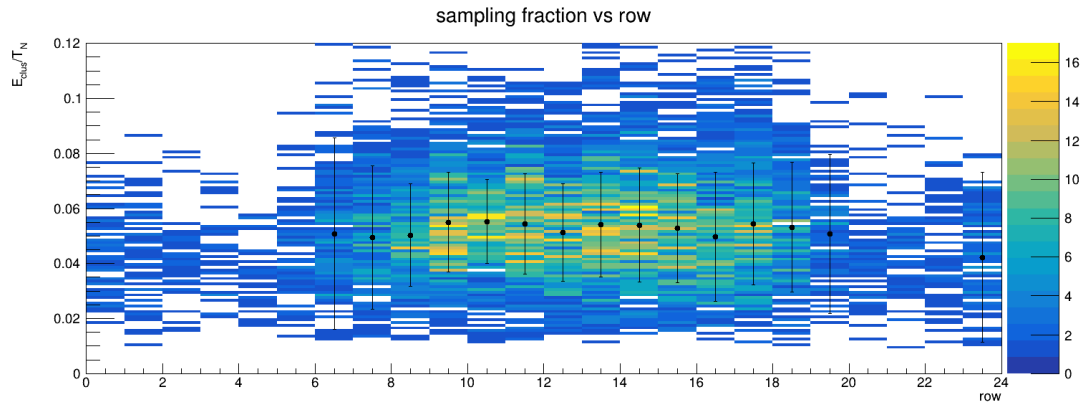
2.e.3   SBS11
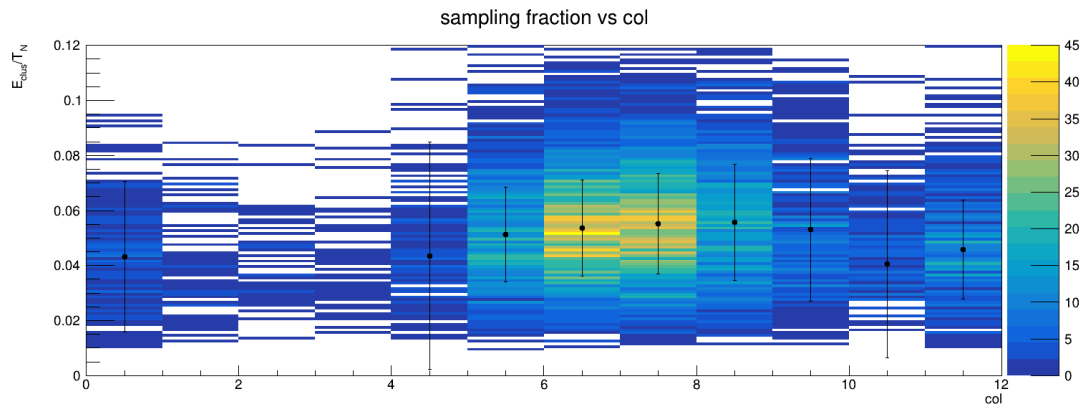
Figure 22: HCal Sampling Fraction vs Col, After Calibration
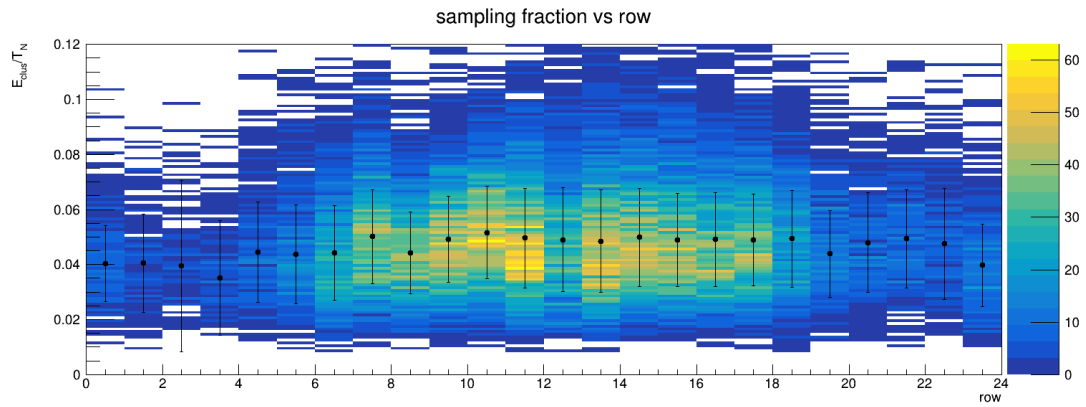
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2.e.4   SBS14
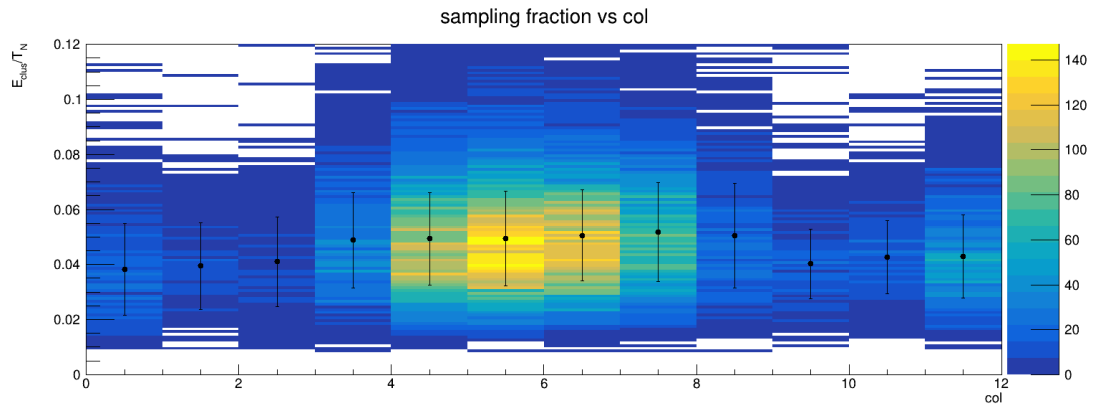
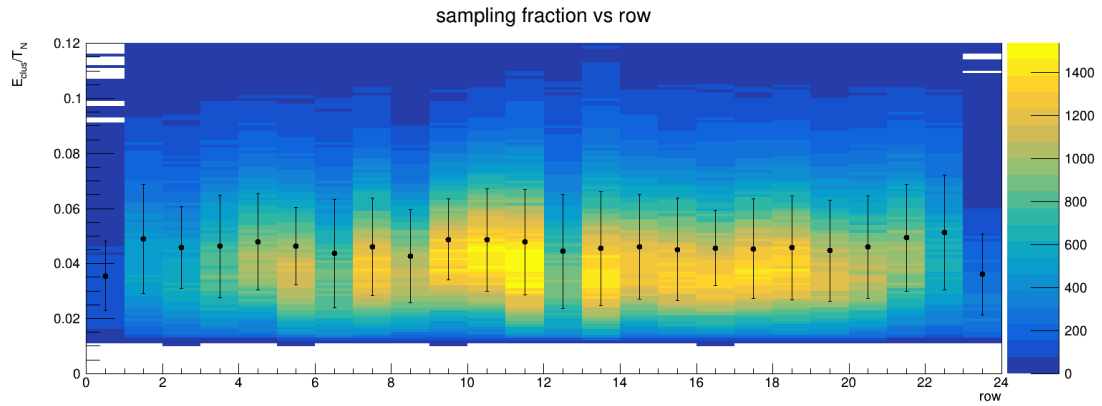Figure 23: HCal Sampling Fraction vs Col, After Calibration

2.e.5   SBS8

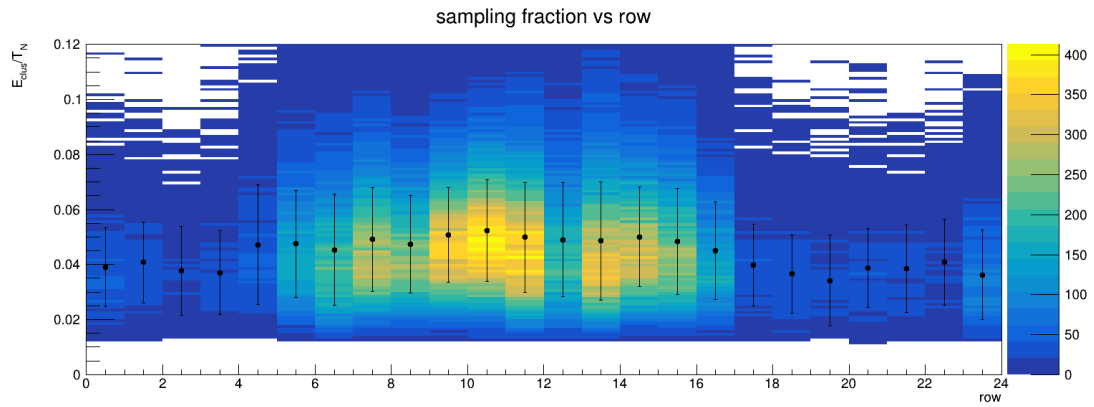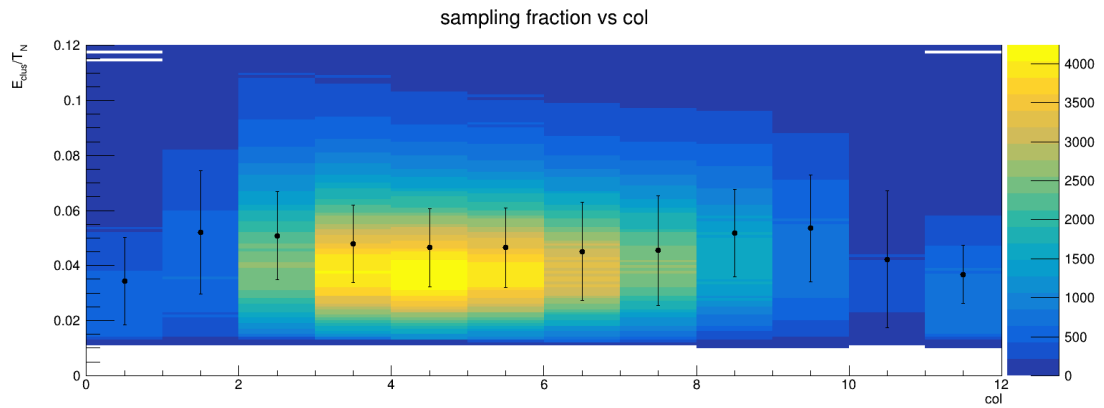Figure 24: HCal Sampling Fraction vs Col, After Calibration

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2.e.6 SBS9
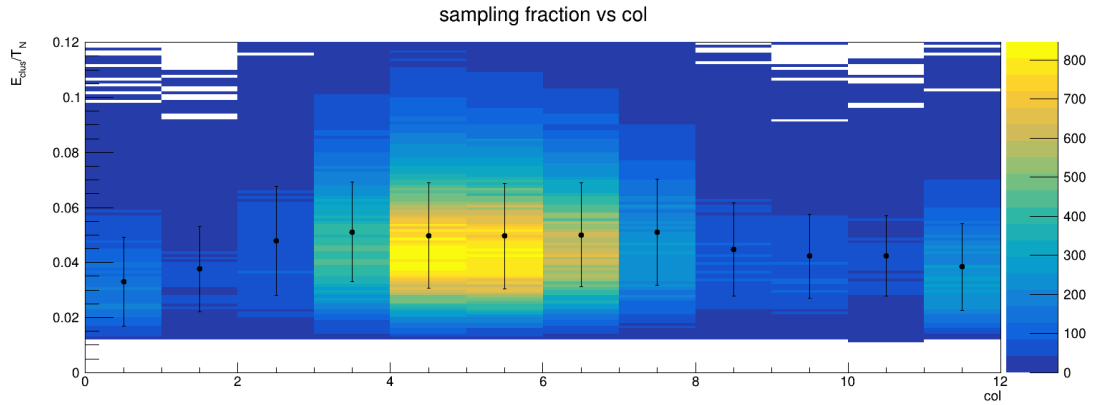
Figure 25: HCal Sampling Fraction vs Col, After Calibration

2.f Run to Run Comparisons

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

Note that the lack of available statistics for SBS7 and SBS11 render these plots of dubious value on these kinematics.

2.f.1 SBS4
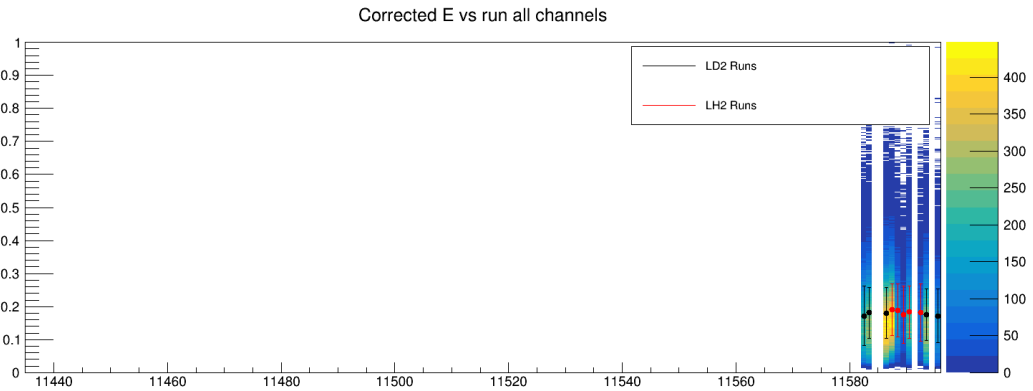
Figure 26: HCal Energy Spectra (GeV) vs Run Number, After Calibration

2.f.2 SBS7
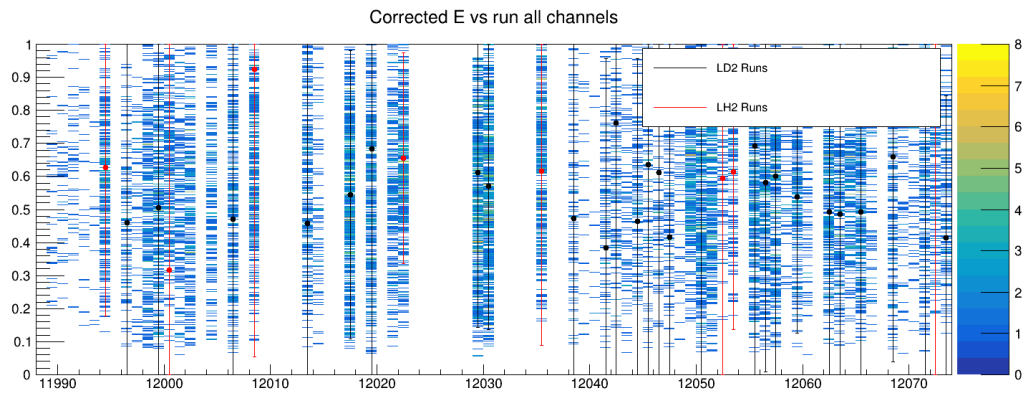
Figure 27: HCal Energy Spectra (GeV) vs Run Number, After Calibration

2.f.3 SBS11
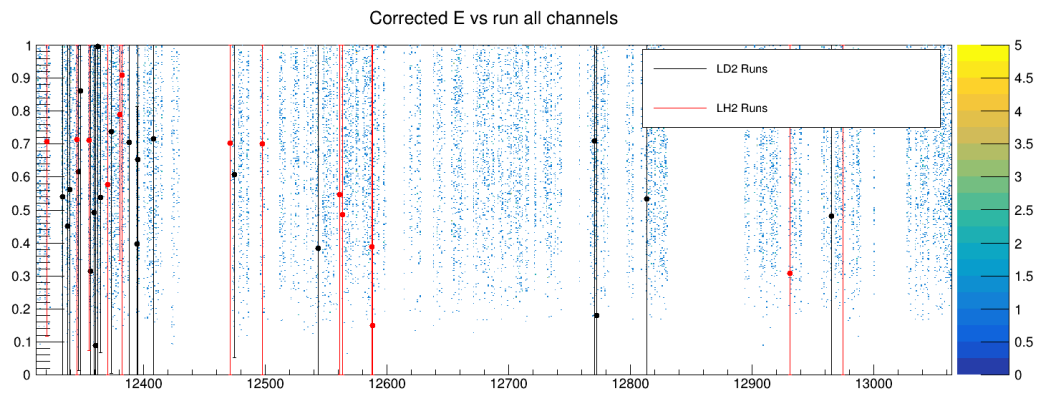
Figure 28: HCal Energy Spectra (GeV) vs Run Number, After Calibration

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2.f.4 SBS14
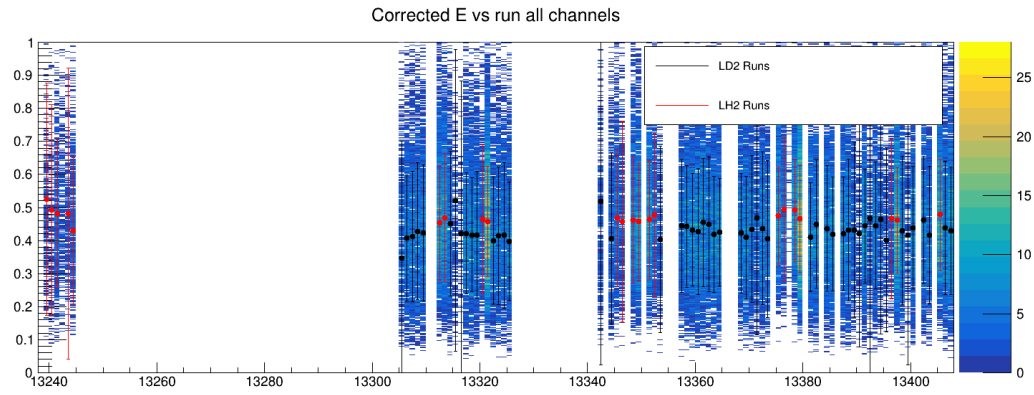
Figure 29: HCal Energy Spectra (GeV) vs Run Number, After Calibration

2.f.5 SBS8
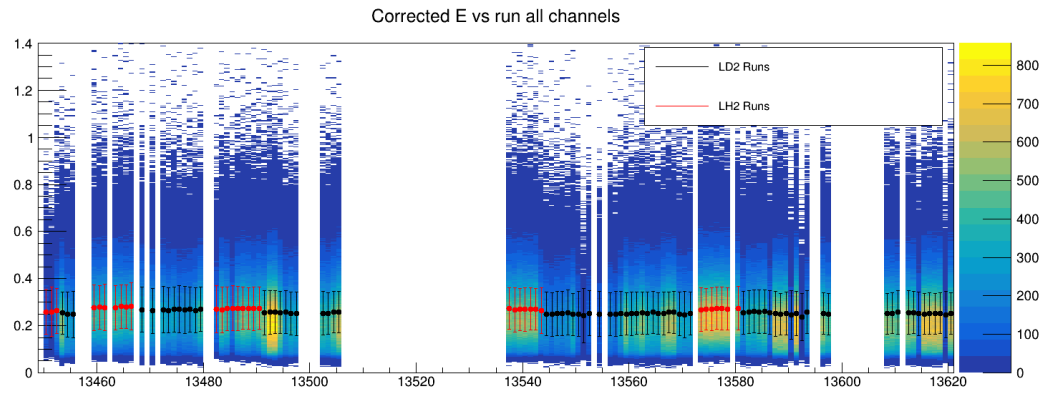
Figure 30: HCal Energy Spectra (GeV) vs Run Number, After Calibration

2.f.6 SBS9
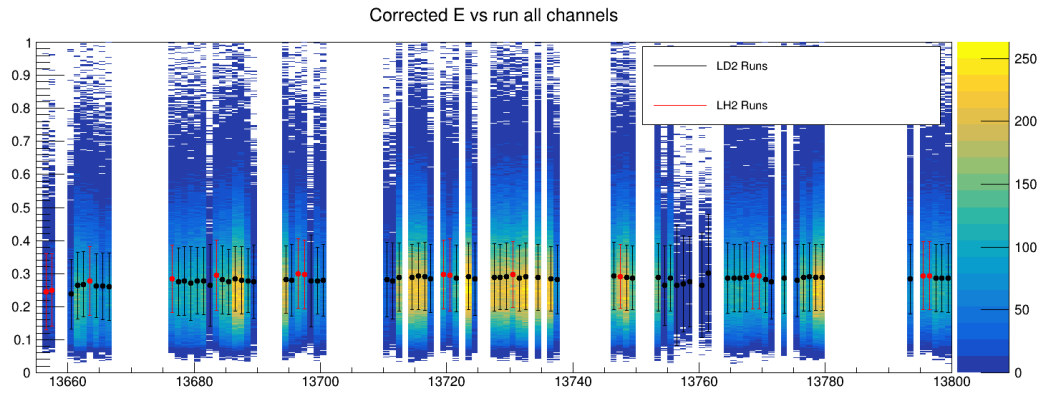
Figure 31: HCal Energy Spectra (GeV) vs Run Number, After Calibration

3 Supplemental

General HCal Energy Calibration Info
Experiment: gmn, Configuration: 8, Pass: 1
Creation Date: 8_6_2023
Target: lh2
SBS Field: 70%

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
W2 mean (GeV): 0.885444
W2 sigma (GeV): 0.158775
dx mean, neutron (m): -0.769036
**dx mean, proton (m): -0.769036**
dx sigma, neutron (m): 0.139637
dx sigma, proton (m): 0.139637
dy mean (m): -0.038111
dy sigma (m): 0.067001
adc time mean (ns): -0.750000
adc time sigma (ns): 5.050000

Other Cuts/Information
Minimum Ev per Cell : 100
Minimum Energy Deposited in Cell (factor, vs expectation) : 0.01
Sampling Fraction Target from Monte Carlo: 0.068600
Observed Energy to Energy Sigma Ratio: 0.480000
HCal Active Area (Projected Nucleon 1 row/col Within HCal Acceptance)

Figure 32: SBS8 70% field cuts and experimental parameters.

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General HCal Energy Calibration Info
Experiment: gmn, Configuration: 8, Pass: 1
Creation Date: 8_6_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&&sbs.hcal.e>0.03&&abs(bb.tr.tg_th[0])<0.15&&abs(bb.tr.tg_ph[0])<0.3
W2 mean (GeV): 0.755055
W2 sigma (GeV): 0.152419
dx mean, neutron (m): 0.109928
dx mean, proton (m): 0.109928
dx sigma, neutron (m): 0.091507
dx sigma, proton (m): 0.091507
dy mean (m): -0.050954
dy sigma (m): 0.063006
adc time mean (ns): -0.750000
adc time sigma (ns): 5.050000

Other Cuts/Information
Minimum Ev per Cell : 100
Minimum Energy Deposited in Cell (factor, vs expectation) : 0.01
Sampling Fraction Target from Monte Carlo: 0.068600
Observed Energy to Energy Sigma Ratio: 0.480000
HCal Active Area (Projected Nucleon 1 row/col Within HCal Acceptance)

Figure 33: SBS8 0% field cuts and experimental parameters.

General HCal Energy Calibration Info
Experiment: gmn, Configuration: 8, Pass: 1
Creation Date: 8_6_2023
Target: lh2
SBS Field: 100%

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
W2 mean (GeV): 0.934896
W2 sigma (GeV): 0.151361
dx mean, neutron (m): -1.141730
dx mean, proton (m): -1.141730
dx sigma, neutron (m): 0.158944
dx sigma, proton (m): 0.158944
dy mean (m): -0.034031
dy sigma (m): 0.066806
adc time mean (ns): -0.750000
adc time sigma (ns): 5.050000

Other Cuts/Information
Minimum Ev per Cell : 100
Minimum Energy Deposited in Cell (factor, vs expectation) : 0.01
Sampling Fraction Target from Monte Carlo: 0.068600
Observed Energy to Energy Sigma Ratio: 0.480000
HCal Active Area (Projected Nucleon 1 row/col Within HCal Acceptance)

Figure 34: SBS8 100% field cuts and experimental parameters.

General HCal Energy Calibration Info
Experiment: gmn, Configuration: 8, Pass: 1
Creation Date: 8_6_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&&sbs.hcal.e>0.03&&abs(bb.tr.tg_th[0])<0.15&&abs(bb.tr.tg_ph[0])<0.3
W2 mean (GeV): 0.841783
W2 sigma (GeV): 0.154394
dx mean, neutron (m): -0.523447
dx mean, proton (m): -0.523447
dx sigma, neutron (m): 0.121249
dx sigma, proton (m): 0.121249
dy mean (m): -0.040997
dy sigma (m): 0.061291
adc time mean (ns): -0.750000
adc time sigma (ns): 5.050000

Other Cuts/Information
Minimum Ev per Cell : 100
Minimum Energy Deposited in Cell (factor, vs expectation) : 0.01
Sampling Fraction Target from Monte Carlo: 0.068600
Observed Energy to Energy Sigma Ratio: 0.480000
HCal Active Area (Projected Nucleon 1 row/col Within HCal Acceptance)

Figure 35: SBS8 50% field cuts and experimental parameters.