



Simulation Statistics

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March 11, 2022

IIT Indore

Outline

Investigating the energy resolution of pions detected by the calorimeter combination CEMC + HCALIN + HCALOUT. The Magnetic Field is **switched OFF** to study low energy pions that are otherwise deflected. The energy contribution of individual calorimeters is also investigated in each calibration step.

Simulation Parameters

- Particle: π^-
- Events: 150,000 π^- (100,000 \rightarrow 0-30 GeV/c, 50,000 \rightarrow 0-3 GeV/c)
- Pseudorapidity (η): -0.96 to 0.92
- Azimuth (Φ): $-\pi$ to π

Cuts:

- Detector-wise η cuts, intersection for combinations
- Detector-wise Elliptical cuts in $d\phi$ vs $d\theta$ plots
- Energy cut of 100 MeV on aggregate tower energy
- Theta-parametrized energy cut on individual towers of CEMC

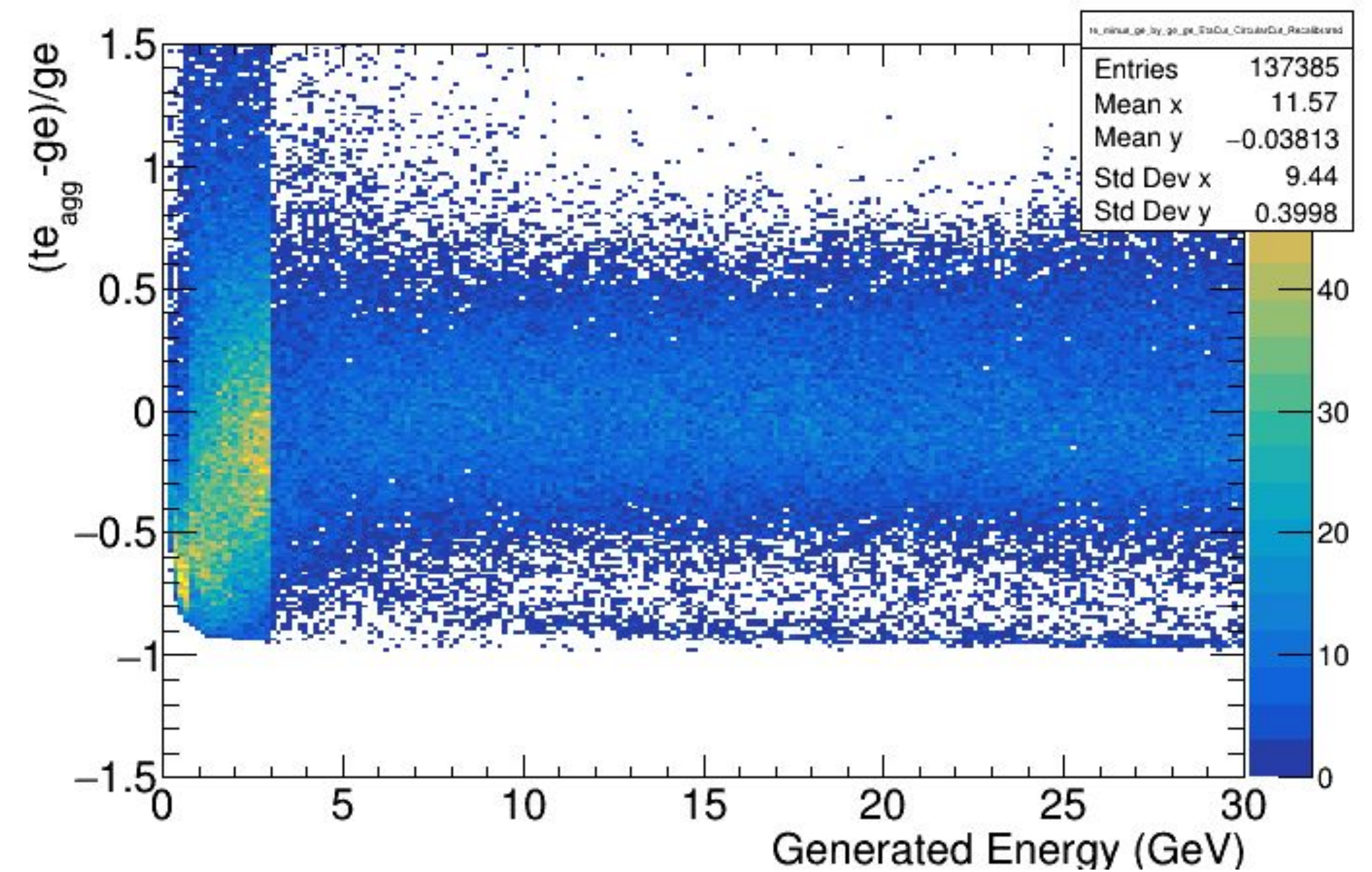
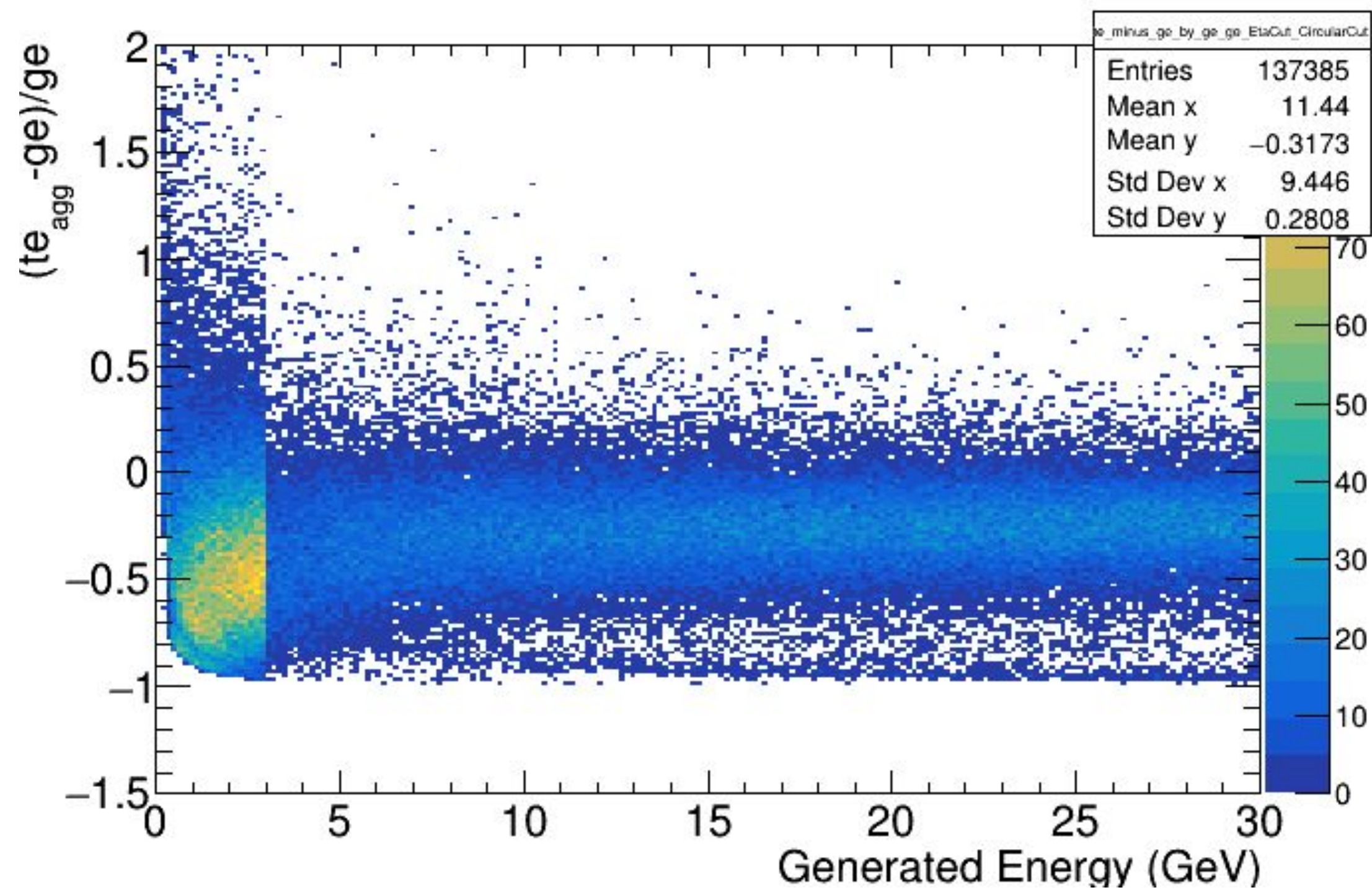


CEMC + HCALIN + HCALOUT (p_i^-)

CEMC + HCALIN + HCALOUT (π^-)

Explicit η cut: -0.96 to 0.92
 Elliptical Cut for Manual Clustering
 gtheta-parametrized Energy Cut on Individual EMC Towers
 100 MeV Aggregate Energy Cut

After calibration



$$(te_{agg} \rightarrow \sum(\text{weight} * te / \text{calibrationFactor}) / \text{mean}(\sum(\text{weight} * te / \text{calibrationFactor}))$$

calibrationFactor(ge) = mean(te/ge) ; detector-wise; function of ge

weight = mean(te/ge) ; detector-wise; independent of ge

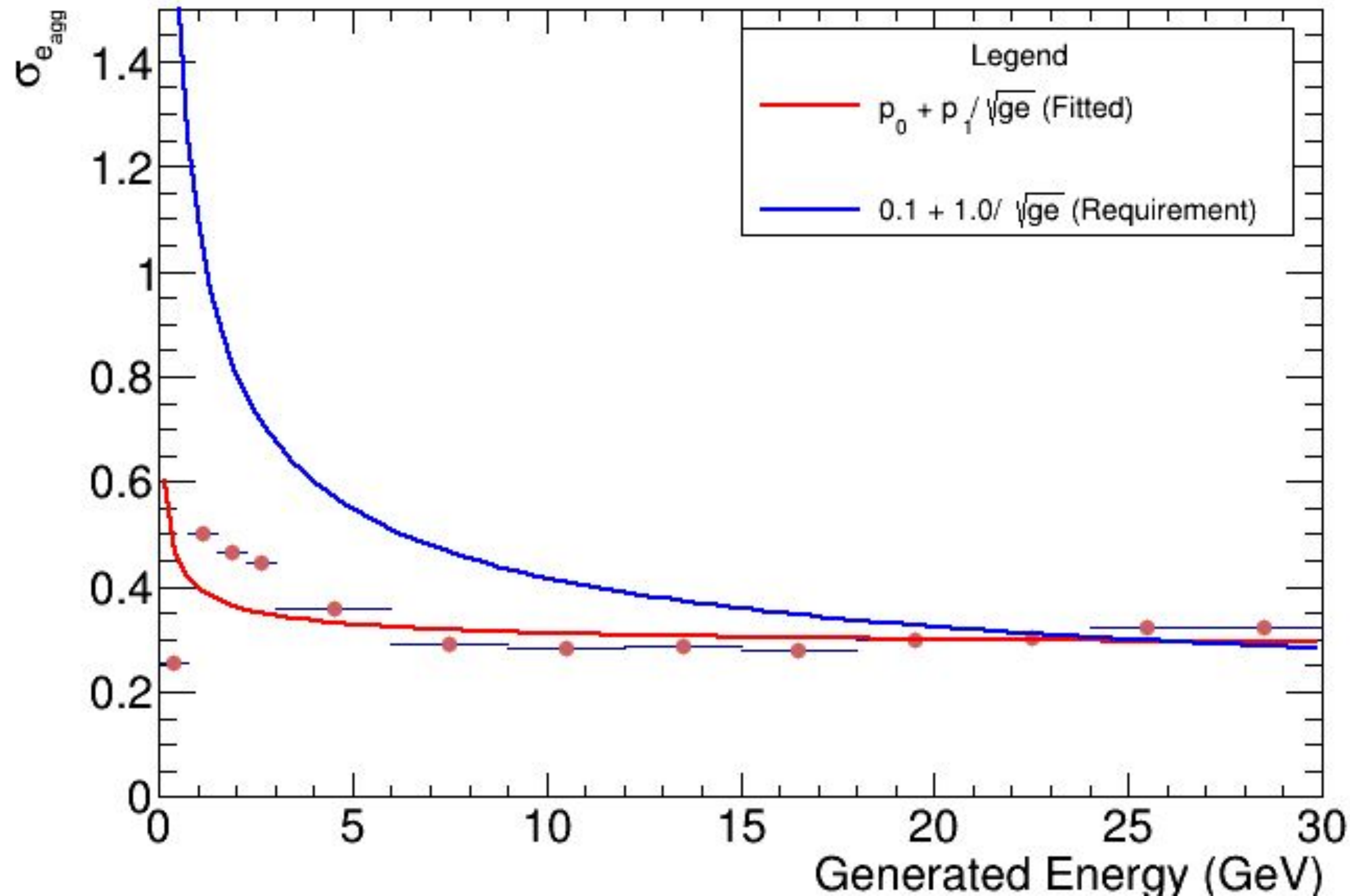
CEMC + HCALIN + HCALOUT (π^-)

Explicit η cut: -0.96 to 0.92

Elliptical Cut for Manual Clustering

gtheta-parametrized Energy Cut on Individual EMC Towers

100 MeV Aggregate Energy Cut



σ_e refers to the standard deviation of the Gaussian fitted to a slice of the calibrated $(te_{agg}-ge)/ge$ vs ge plot.

Number of bins = 13

Bin Width = 0.75 GeV

3.0 GeV

$ge \in [0,3)$

$ge \in [3,30]$

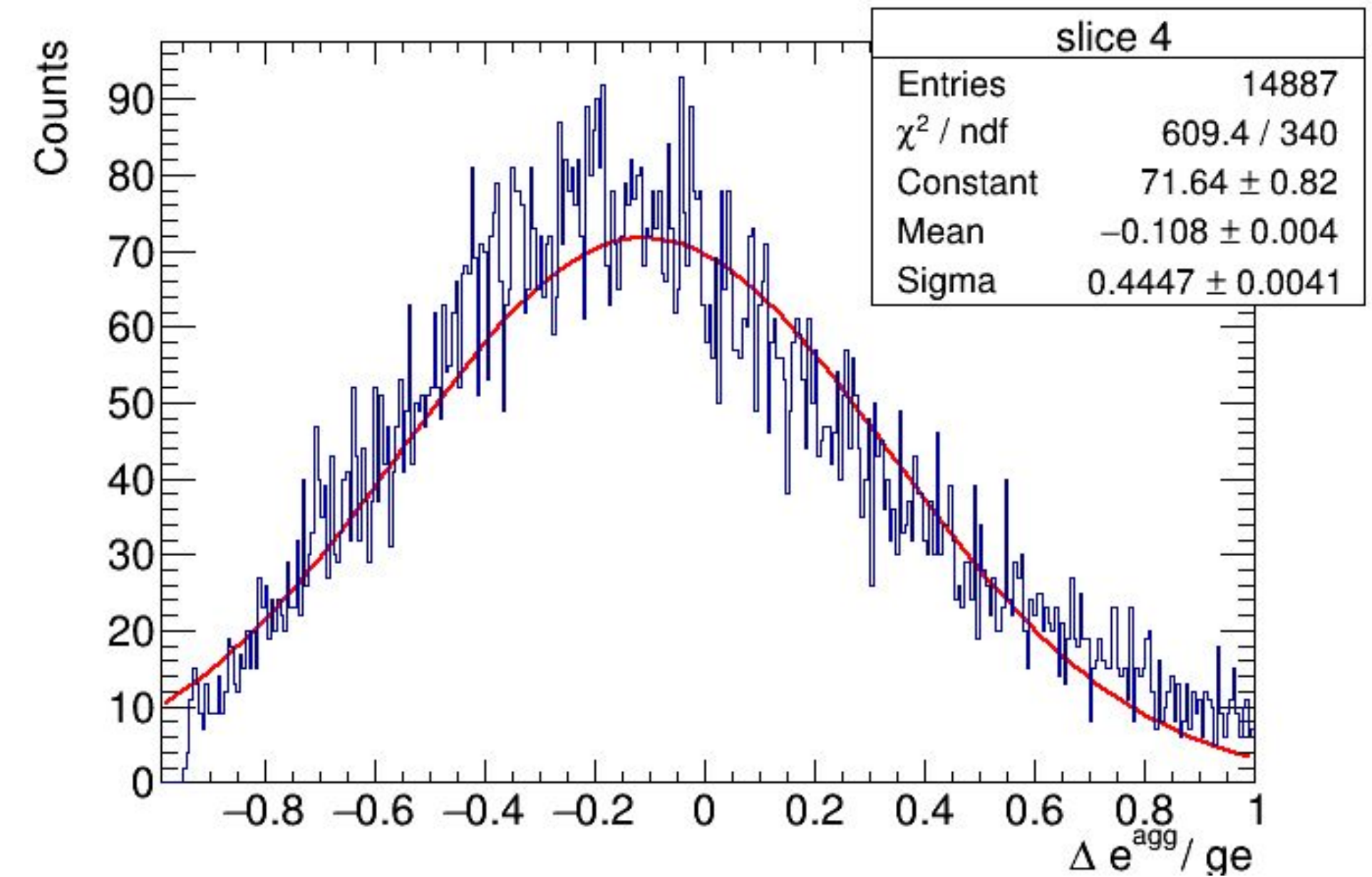
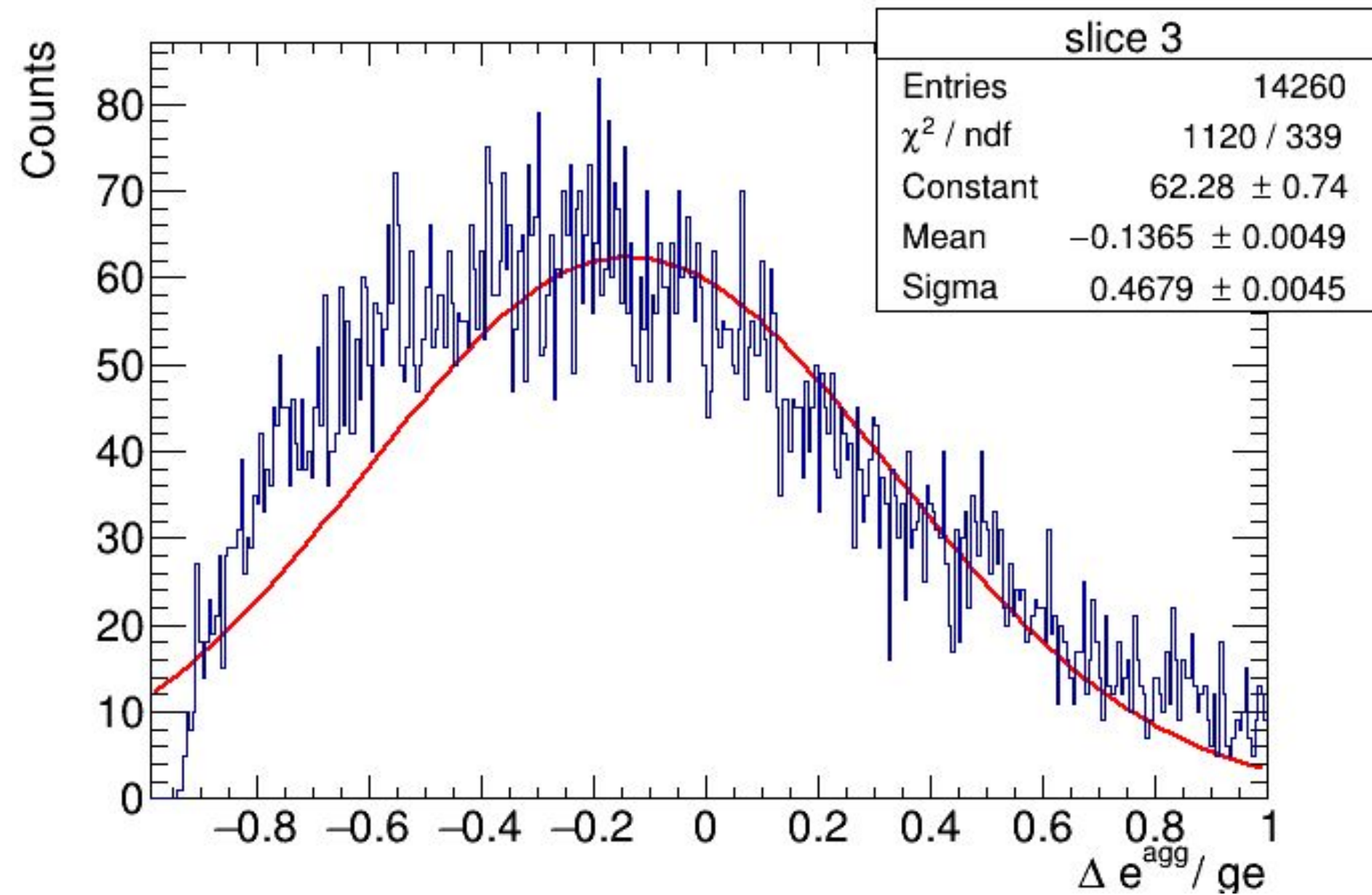
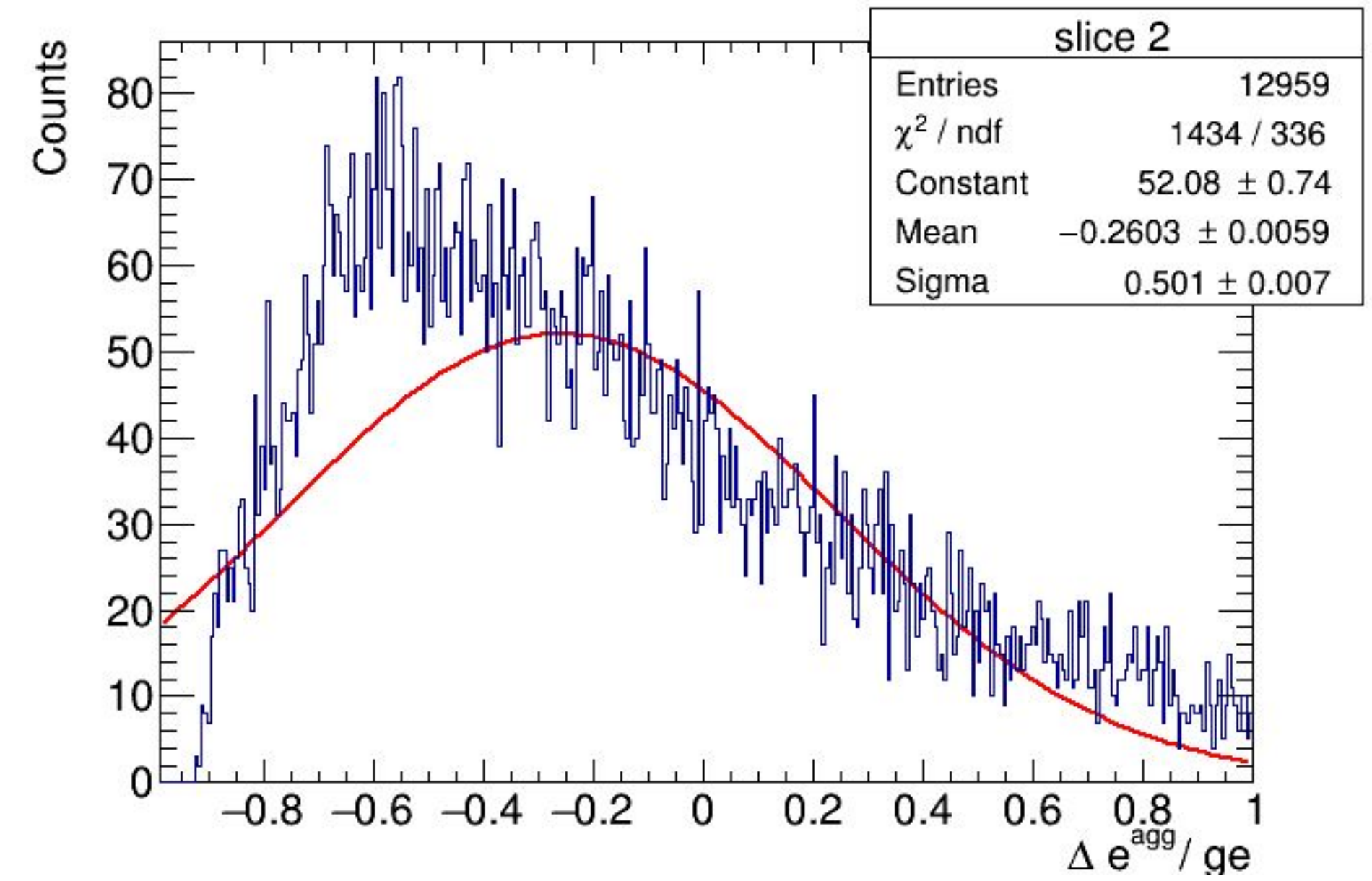
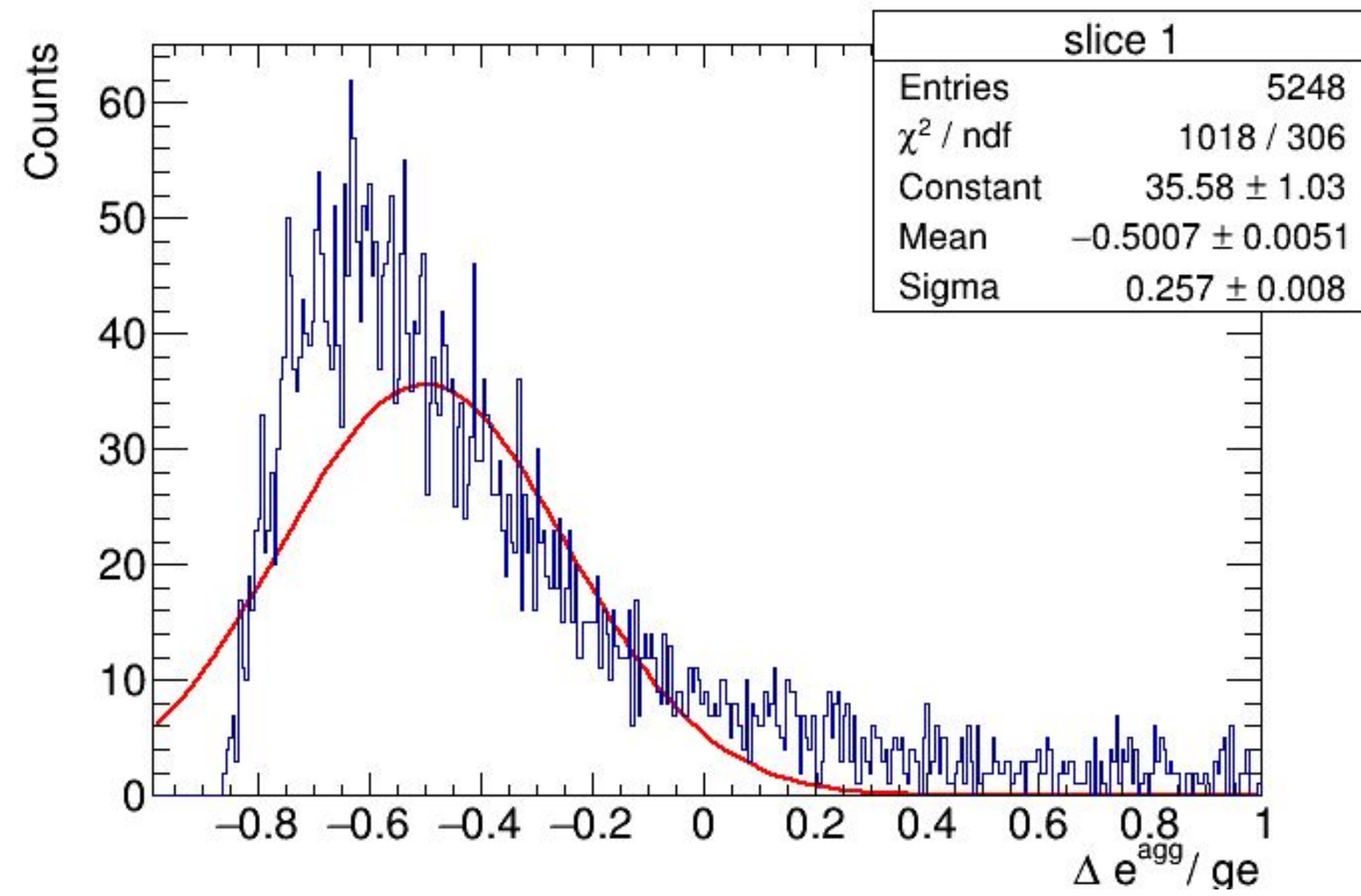
Fit Parameters:

$p_0 = (0.271192 \pm 0.00147575)$

$p_1 = (0.128080 \pm 0.00395574) \text{ GeV}^{0.5}$

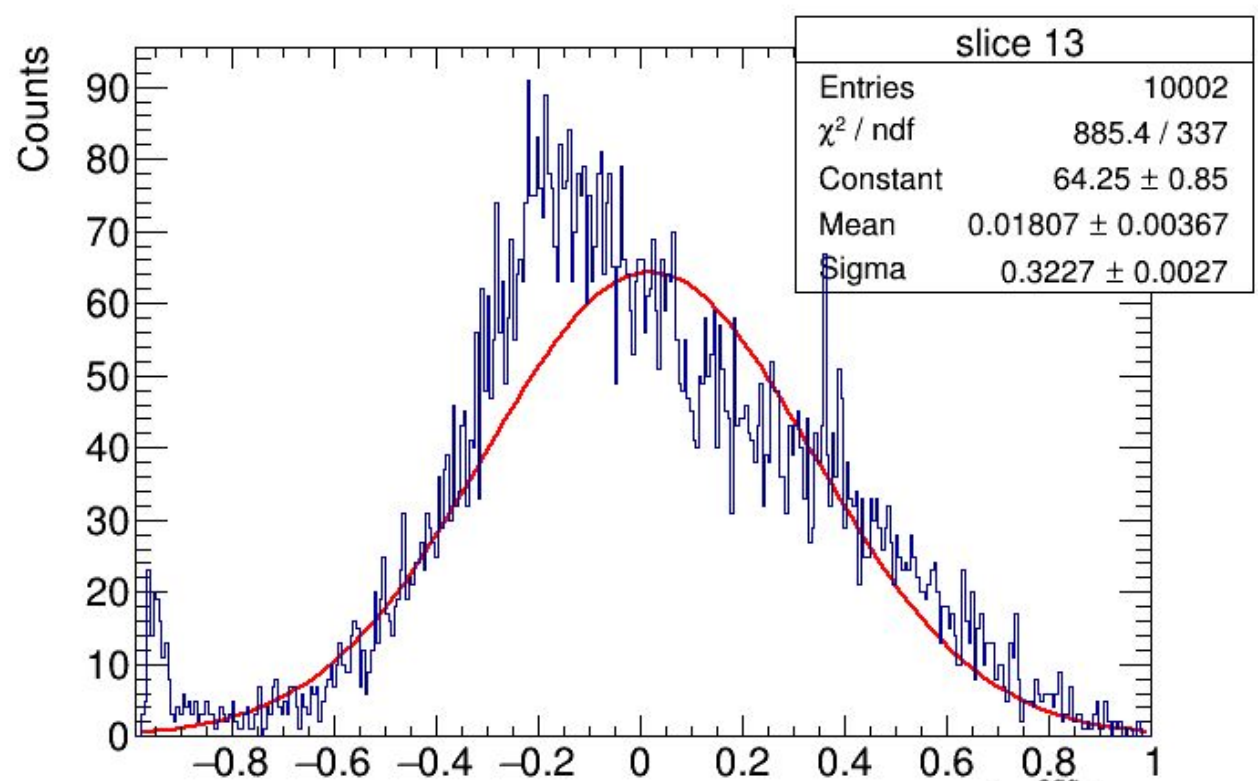
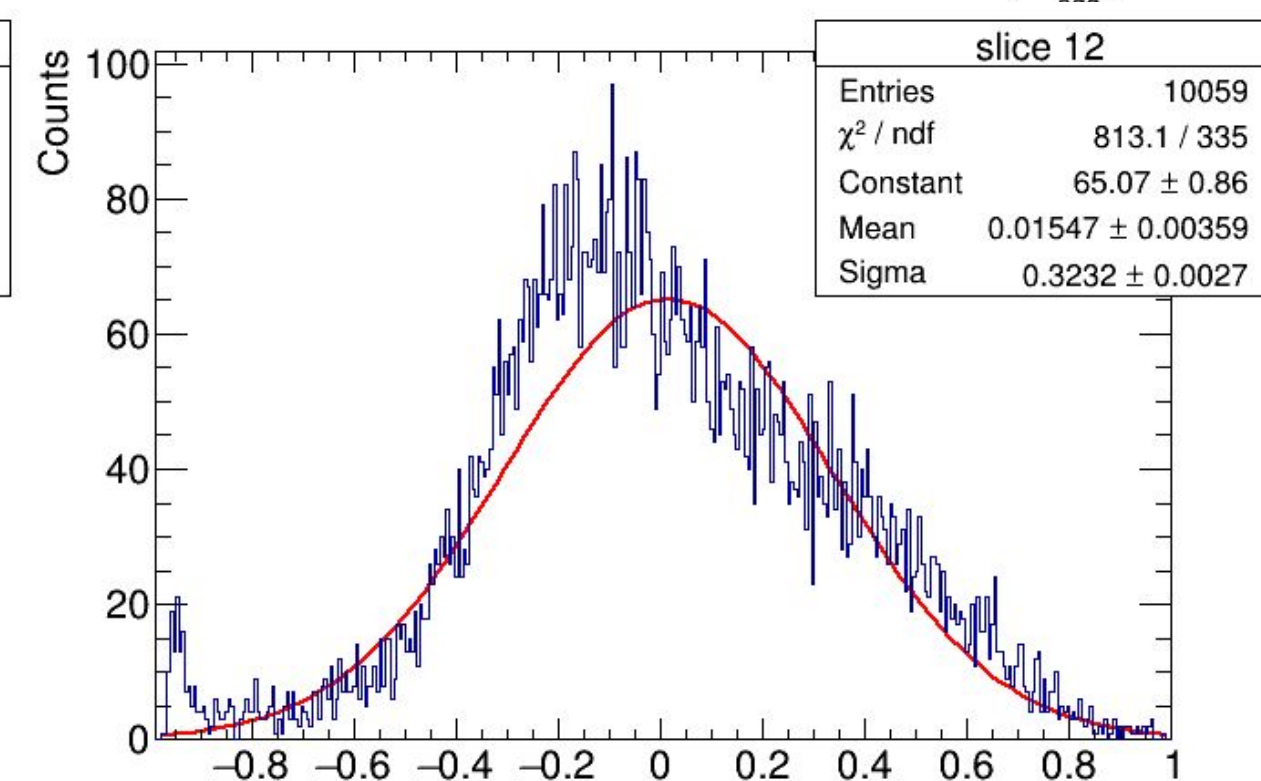
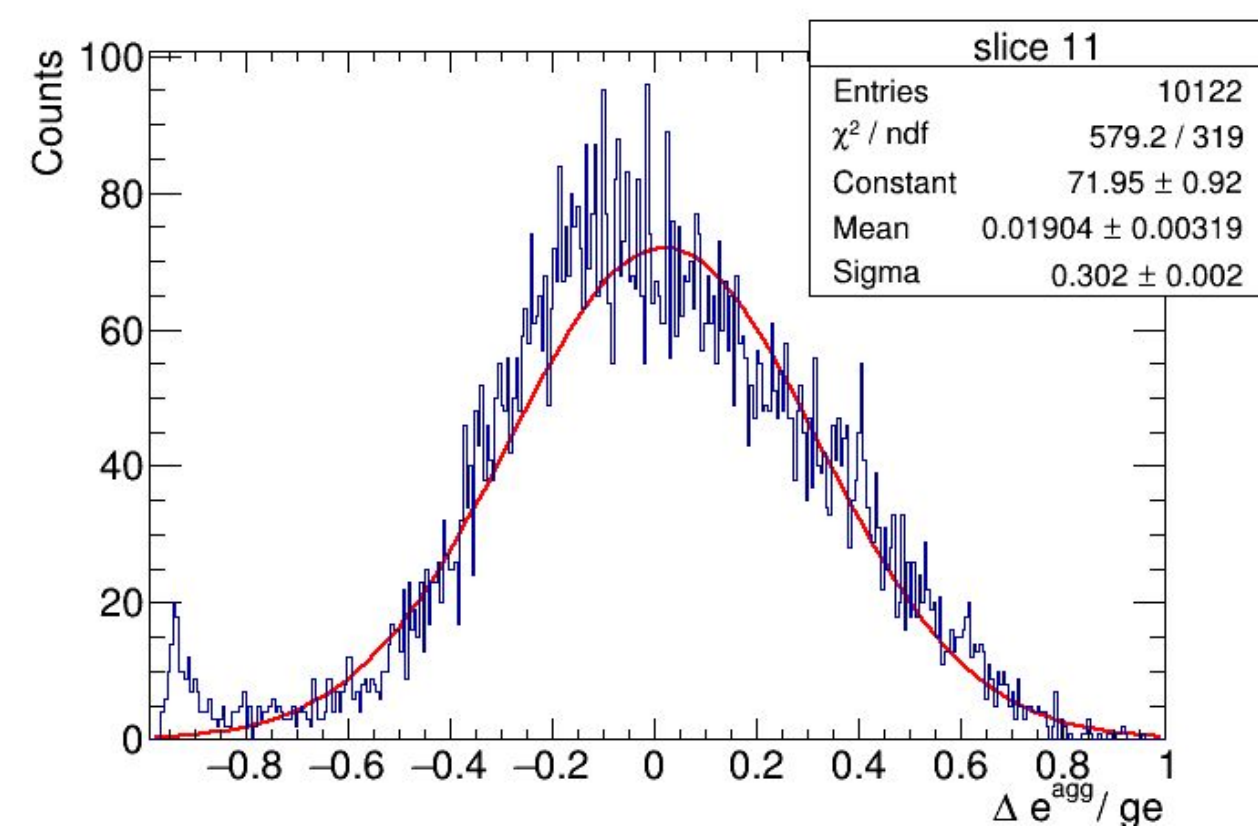
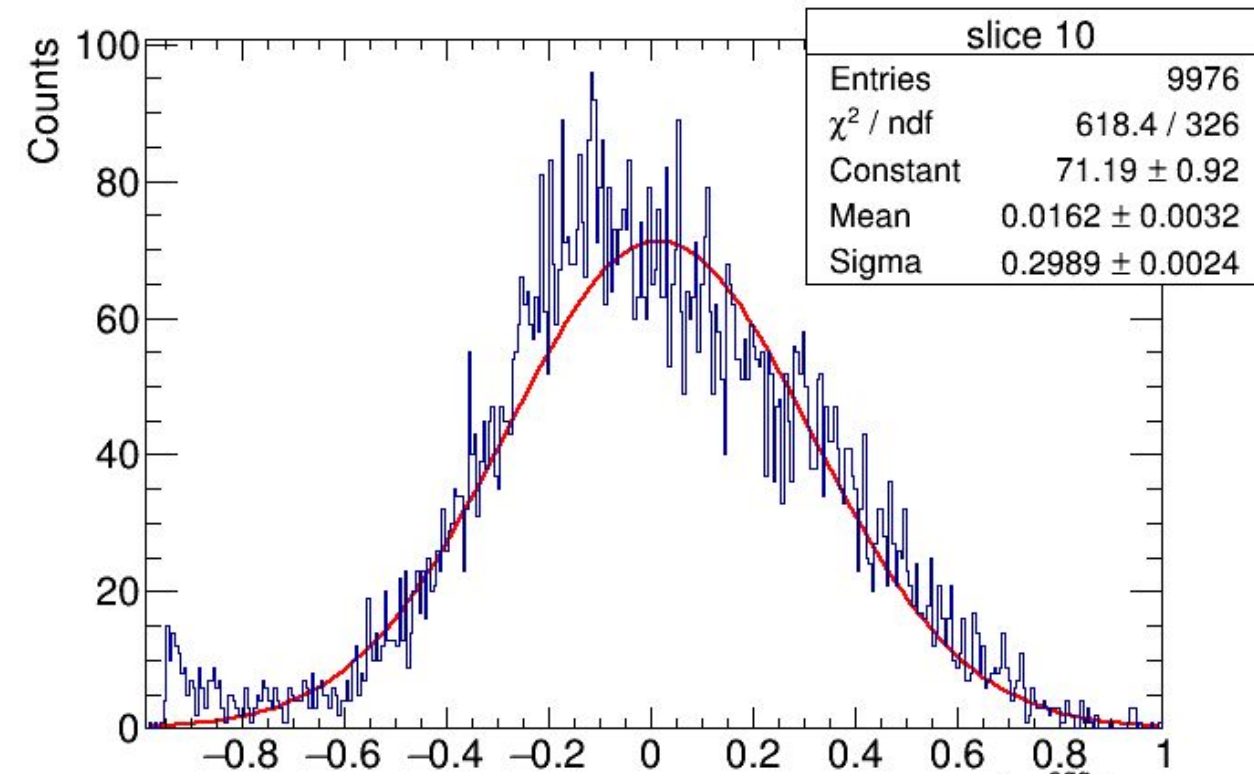
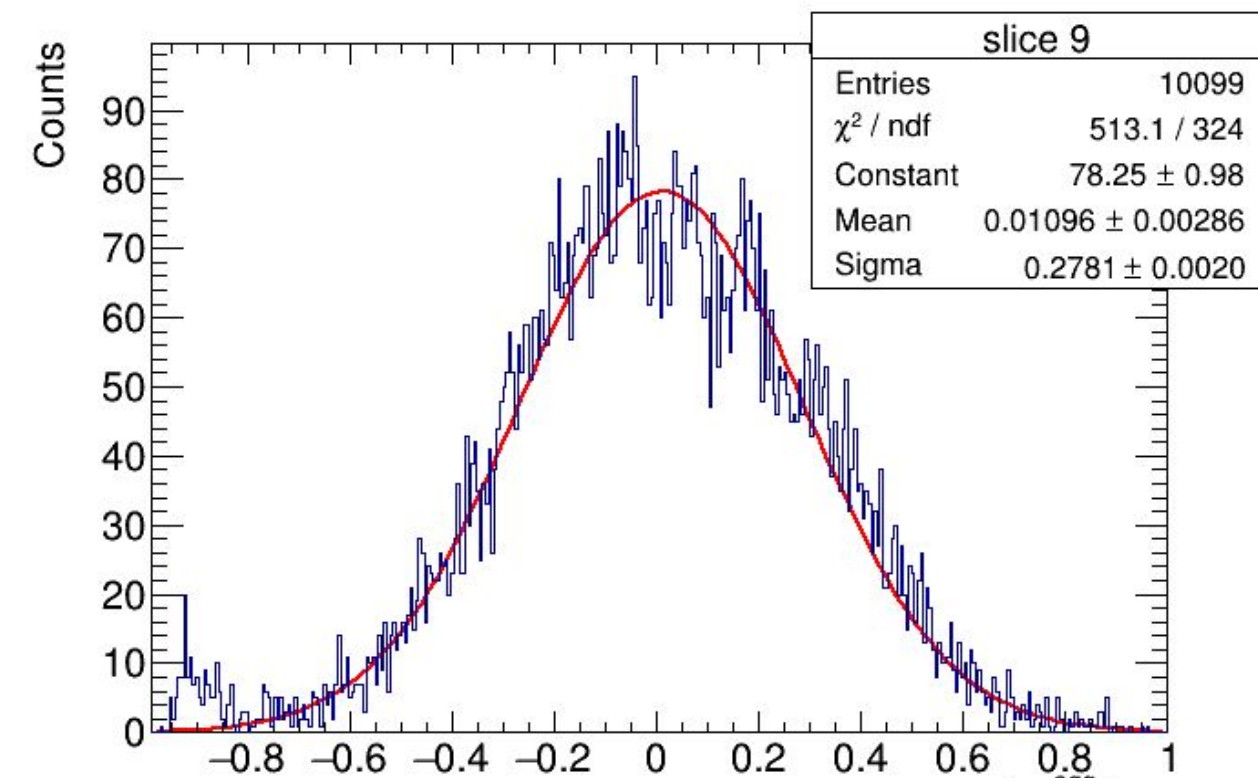
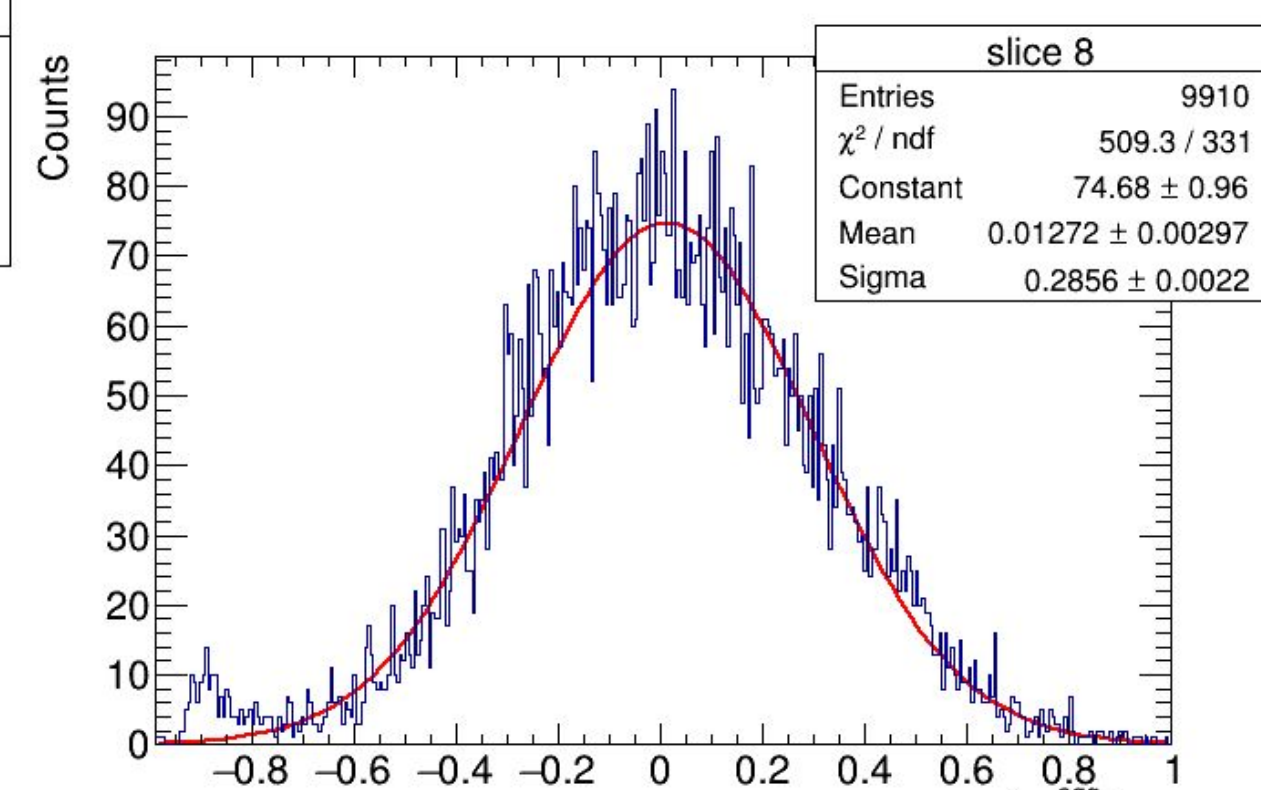
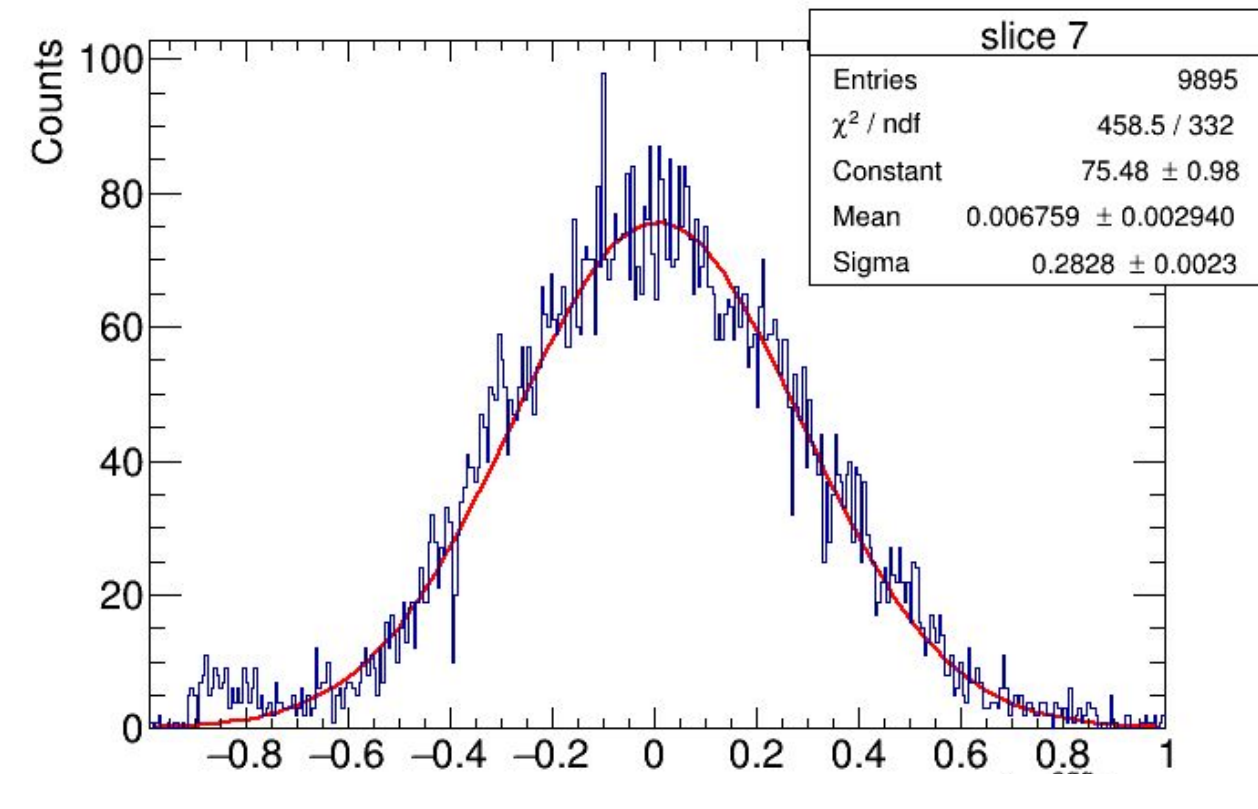
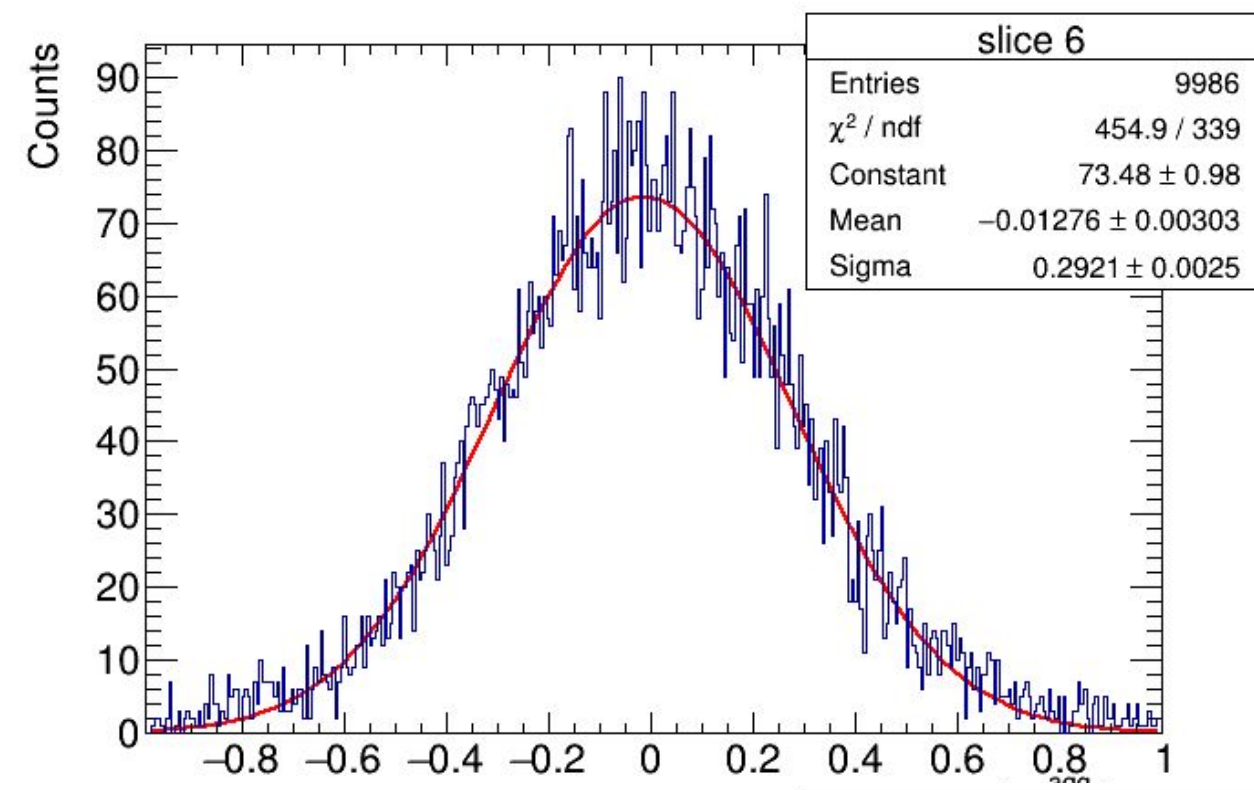
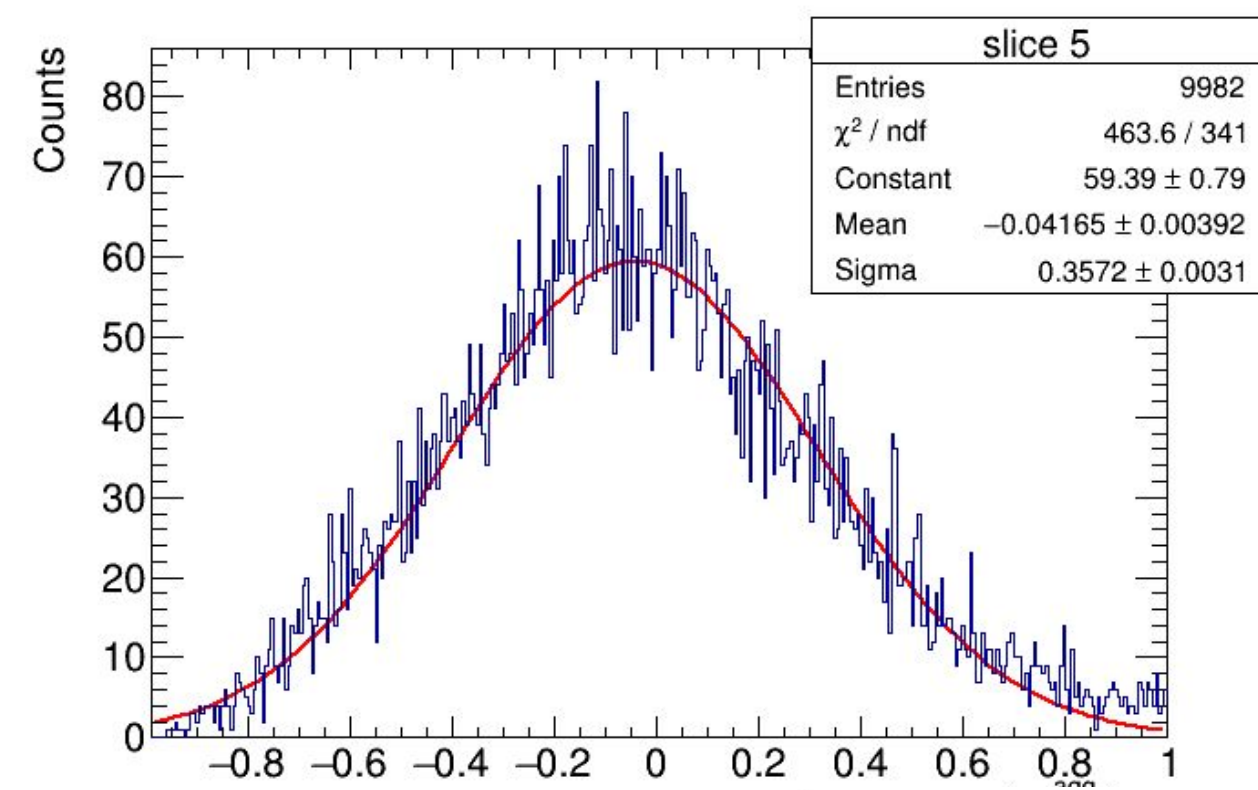
CEMC + HCALIN + HCALOUT (π^-)

Fitted Gaussians (0 - 3 GeV)



CEMC + HCALIN + HCALOUT (π^-)

Fitted Gaussians (3 - 30 GeV)



The x-axes denote $\Delta e_{\text{agg}} / \text{ge}$

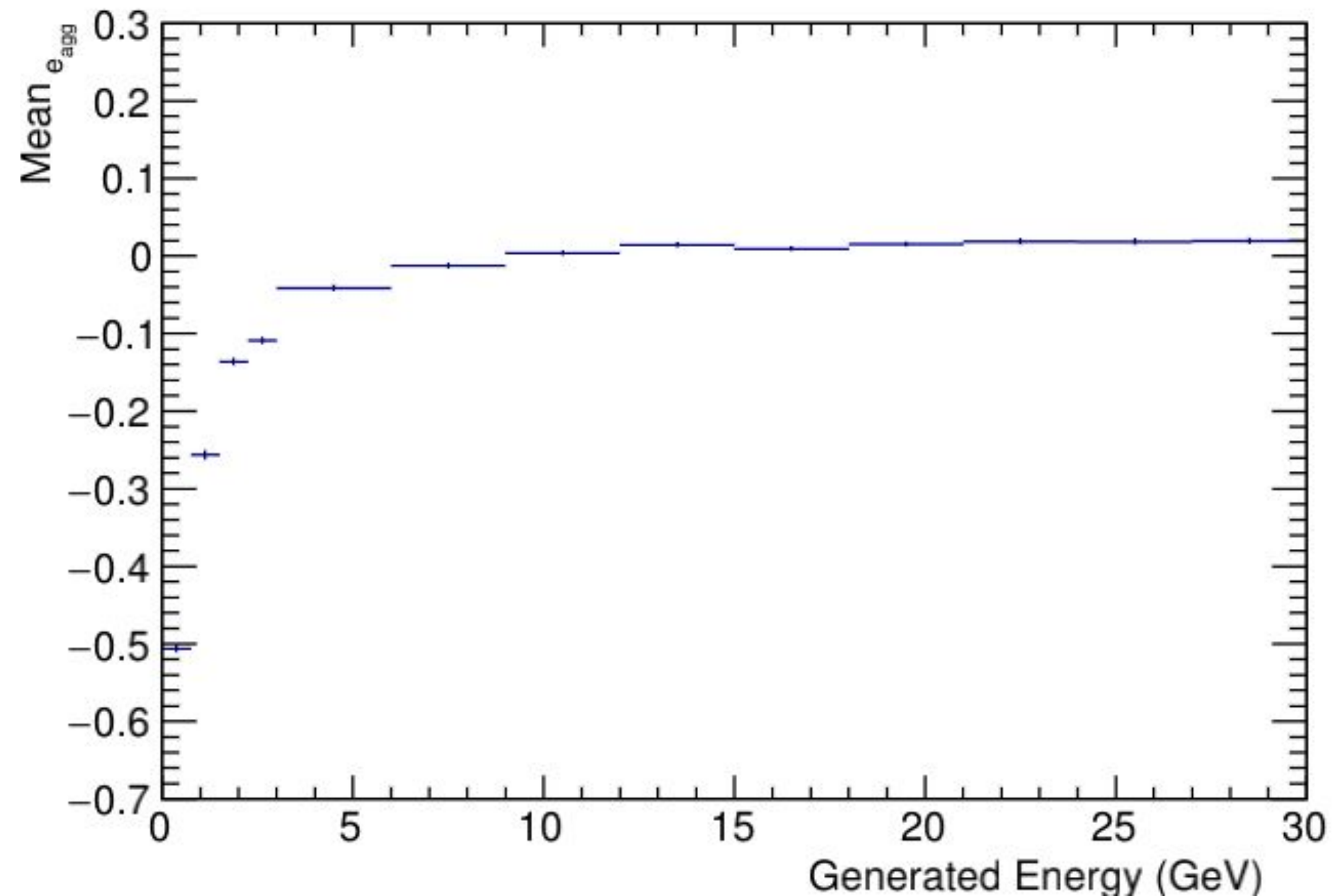
CEMC + HCALIN + HCALOUT (π^-)

Explicit η cut: -0.96 to 0.92

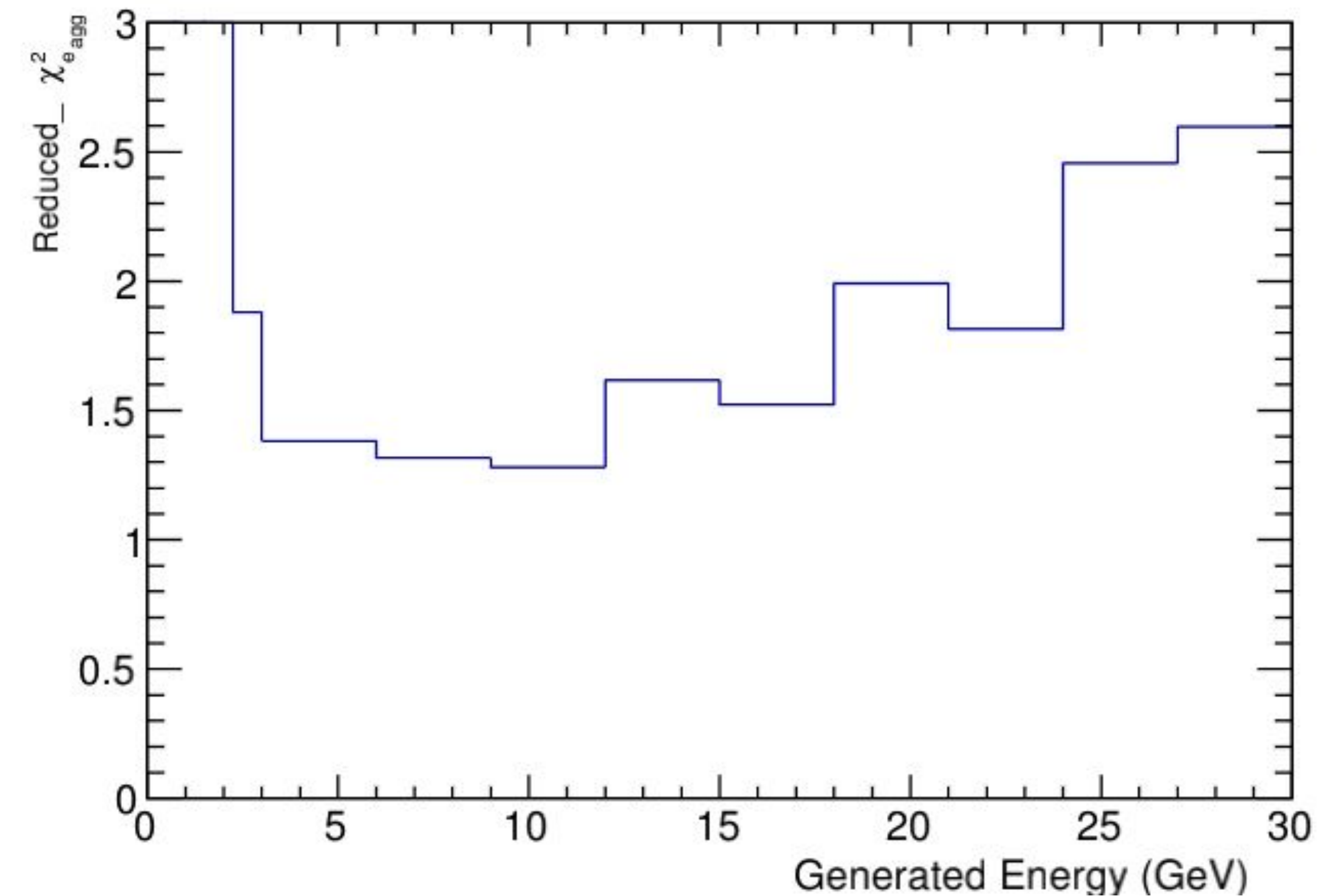
Elliptical Cut for Manual Clustering

gtheta-parametrized Energy Cut on Individual EMC Towers

100 MeV Aggregate Energy Cut



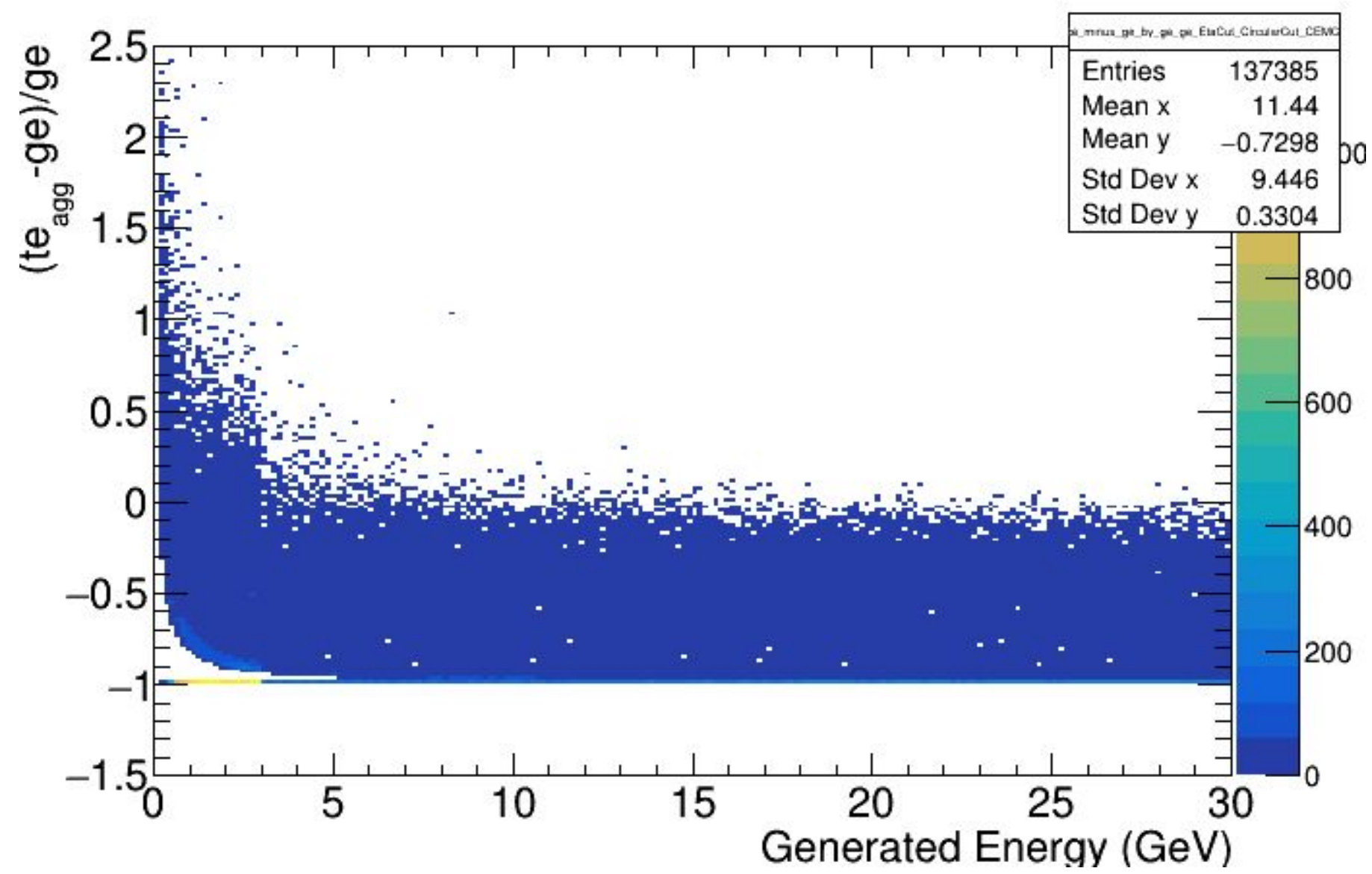
Mean of the Gaussians fitted to the slices of the calibrated $(te_{agg} - ge)/ge$ vs ge plot.



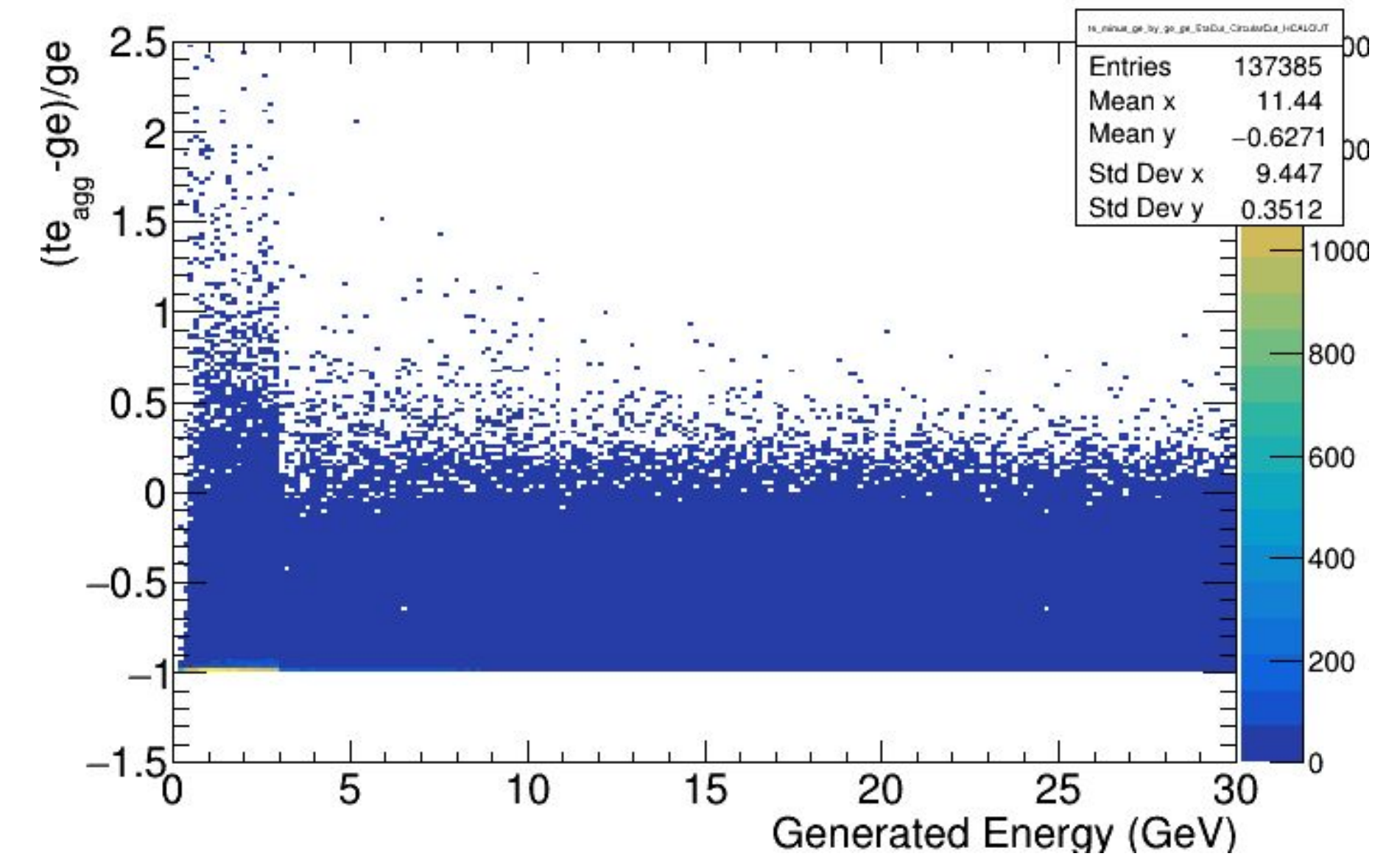
Reduced_ χ^2 of the Gaussians fitted to the slices of the calibrated $(te_{agg} - ge)/ge$ vs ge plot.

CEMC + HCALIN + HCALOUT (π^-)

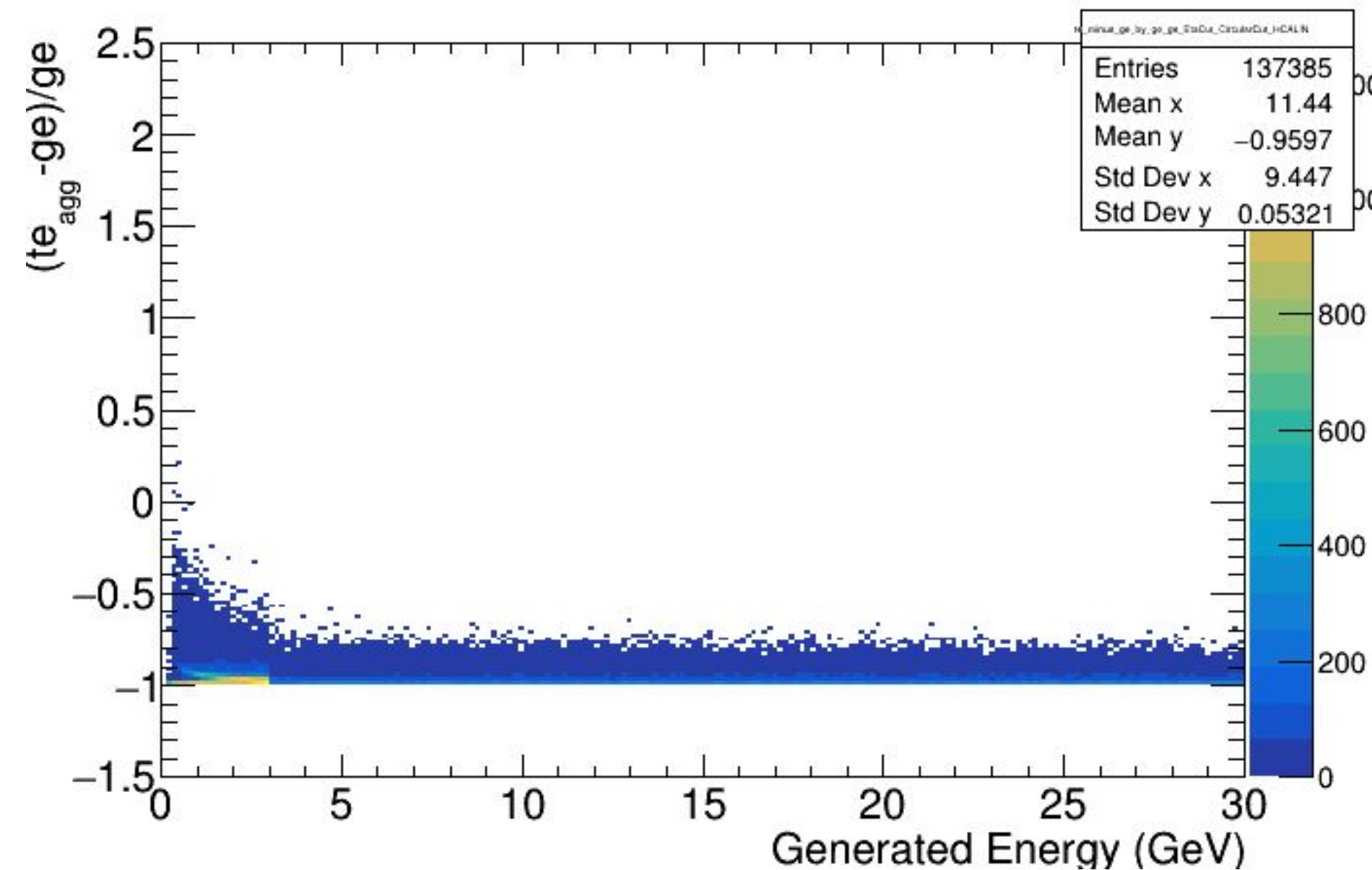
Raw Plots (L0)



CEMC



HCALOUT

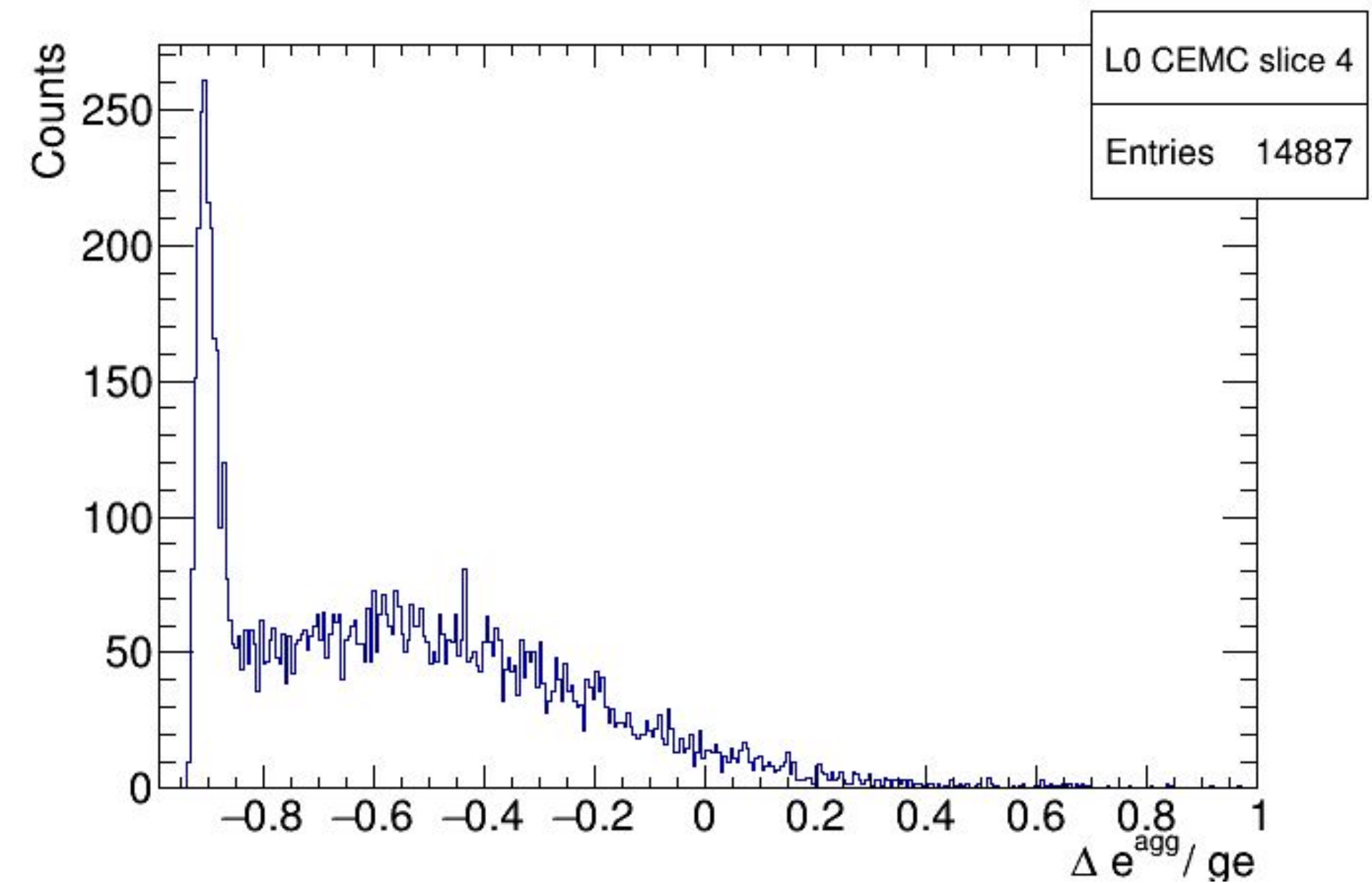
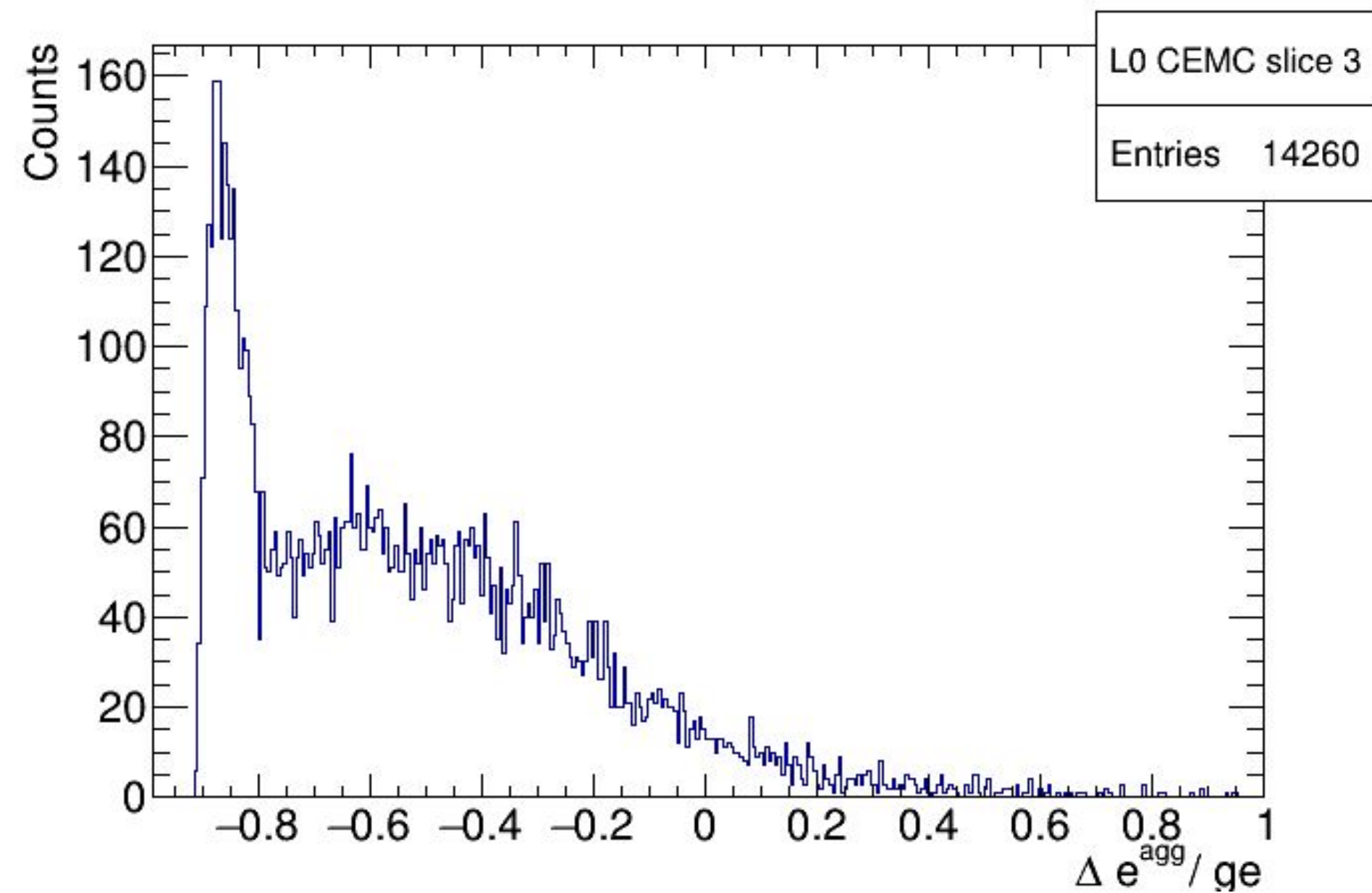
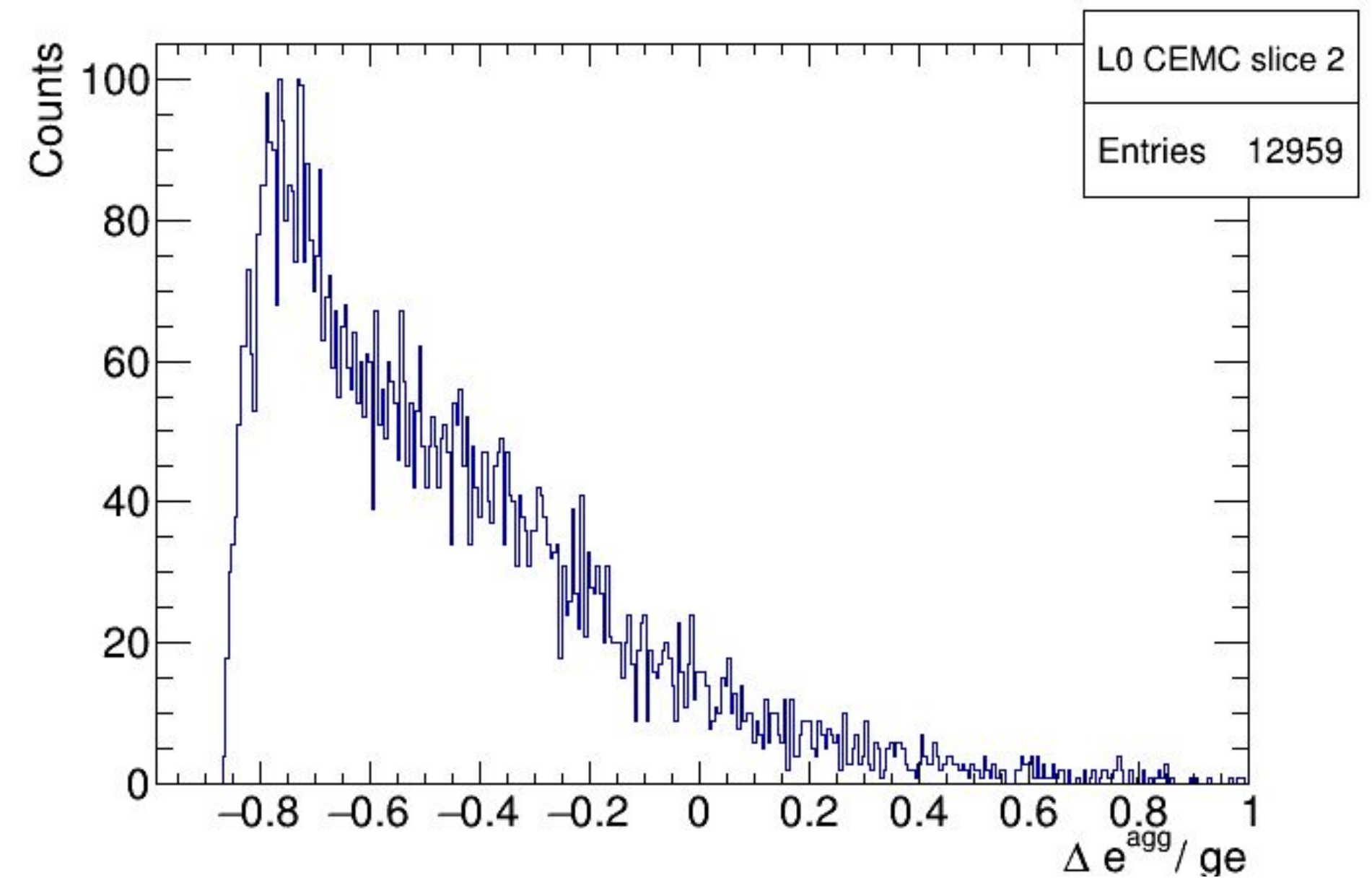
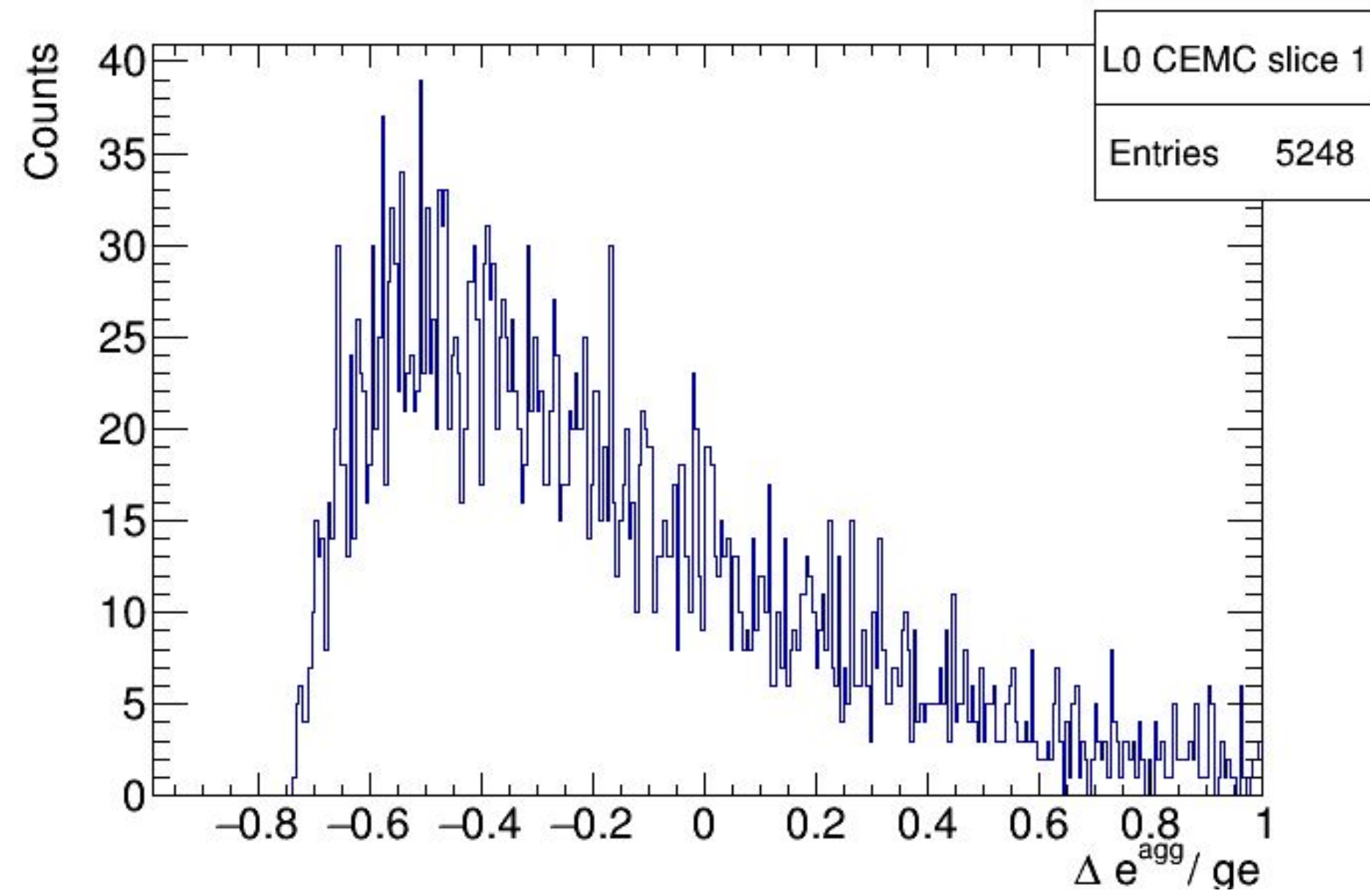


HCALIN

* Nomenclature for slices
L0 -> Raw
L1 -> Level 1 Calibration
L2 -> Level 2 Calibration

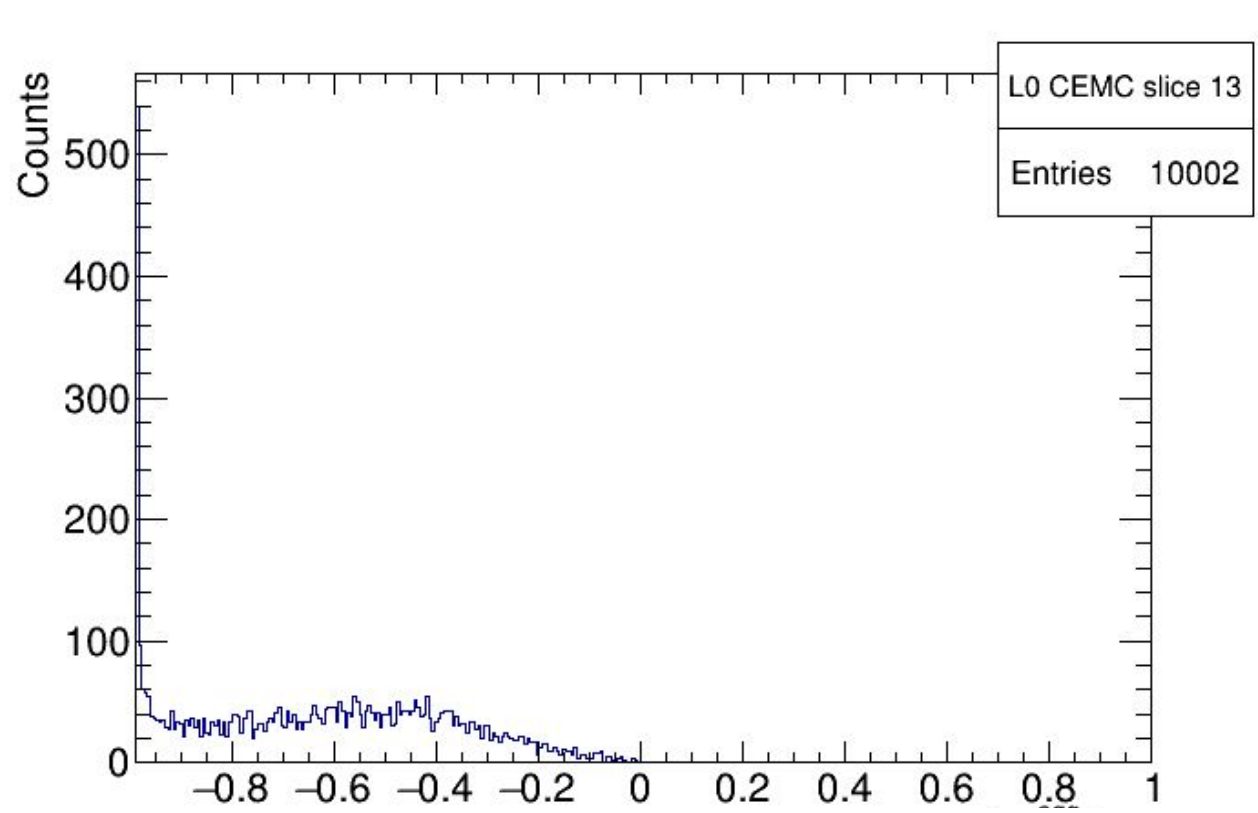
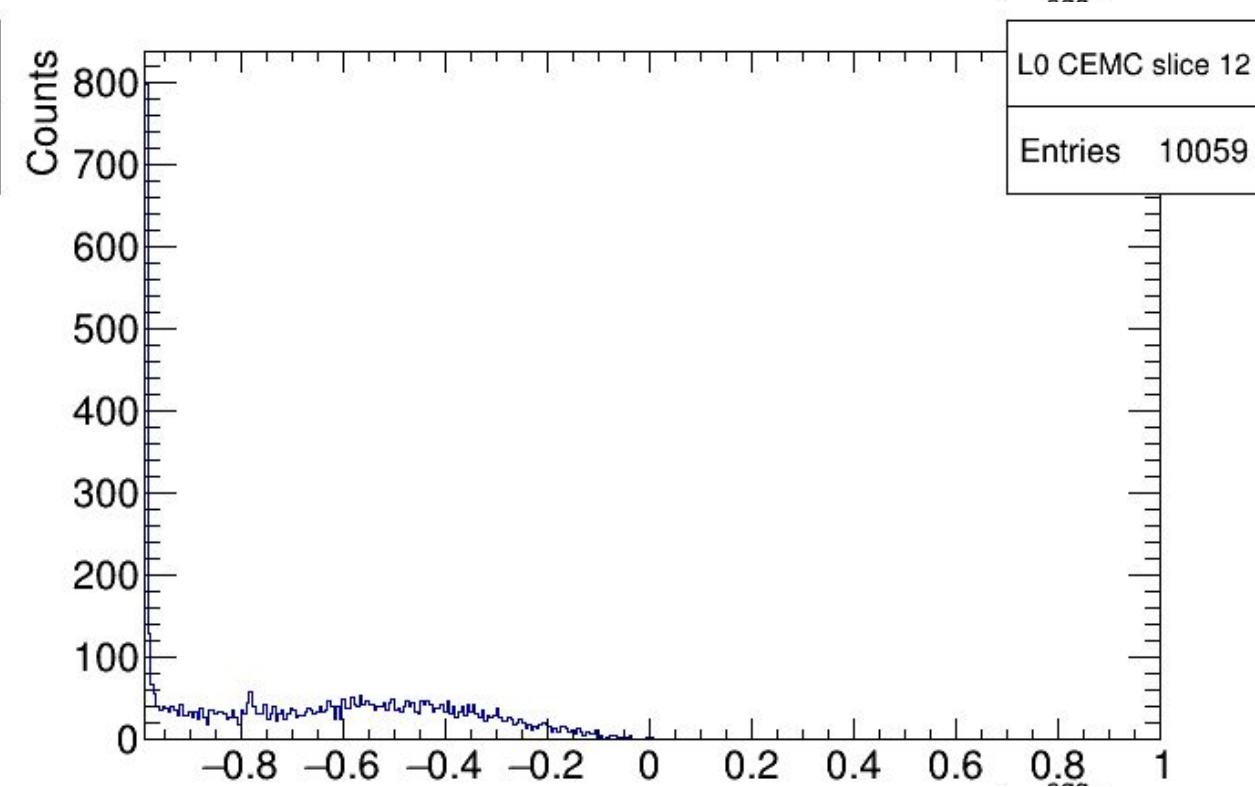
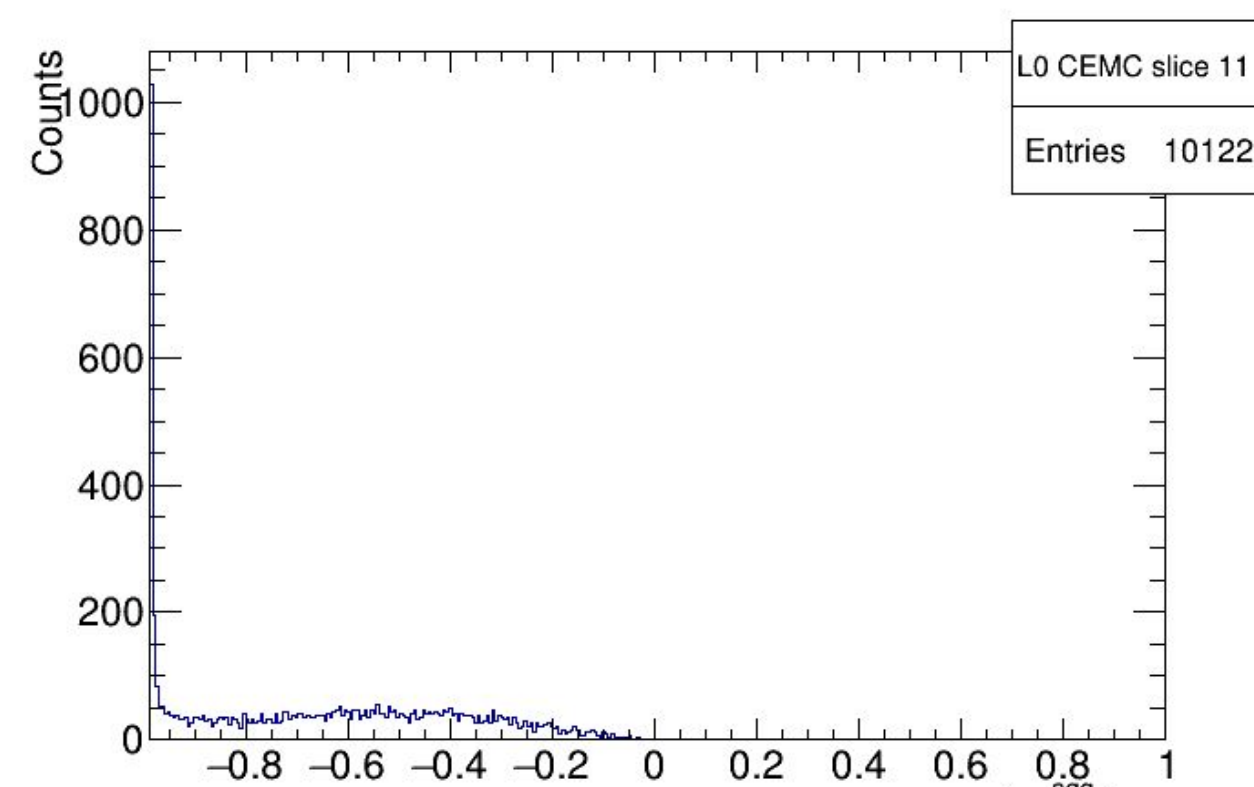
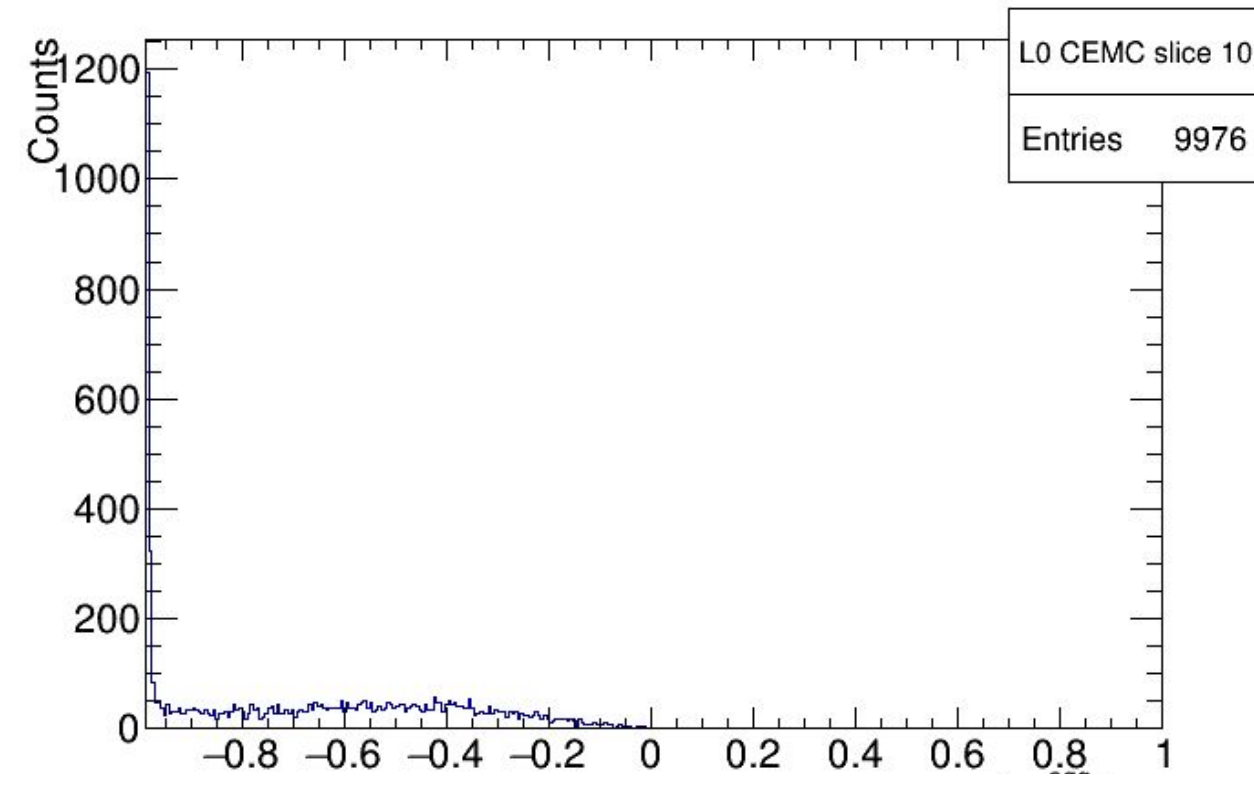
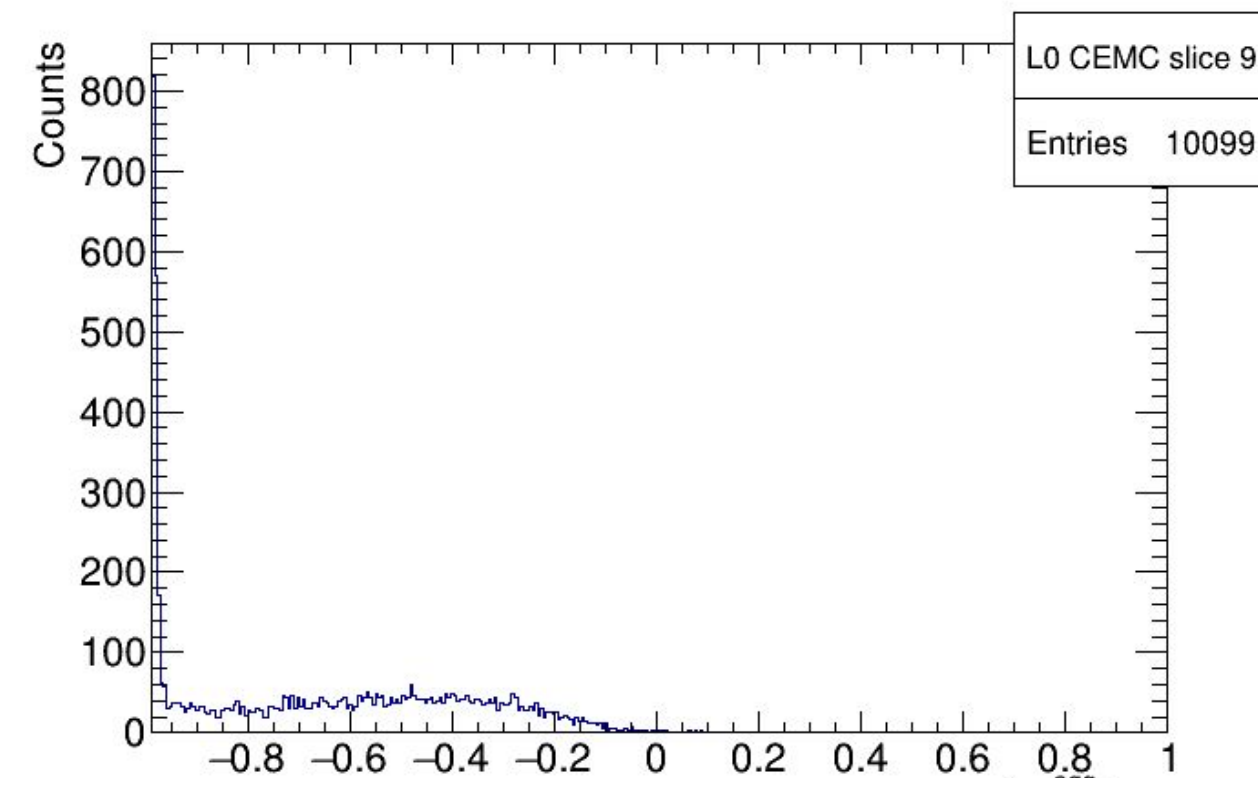
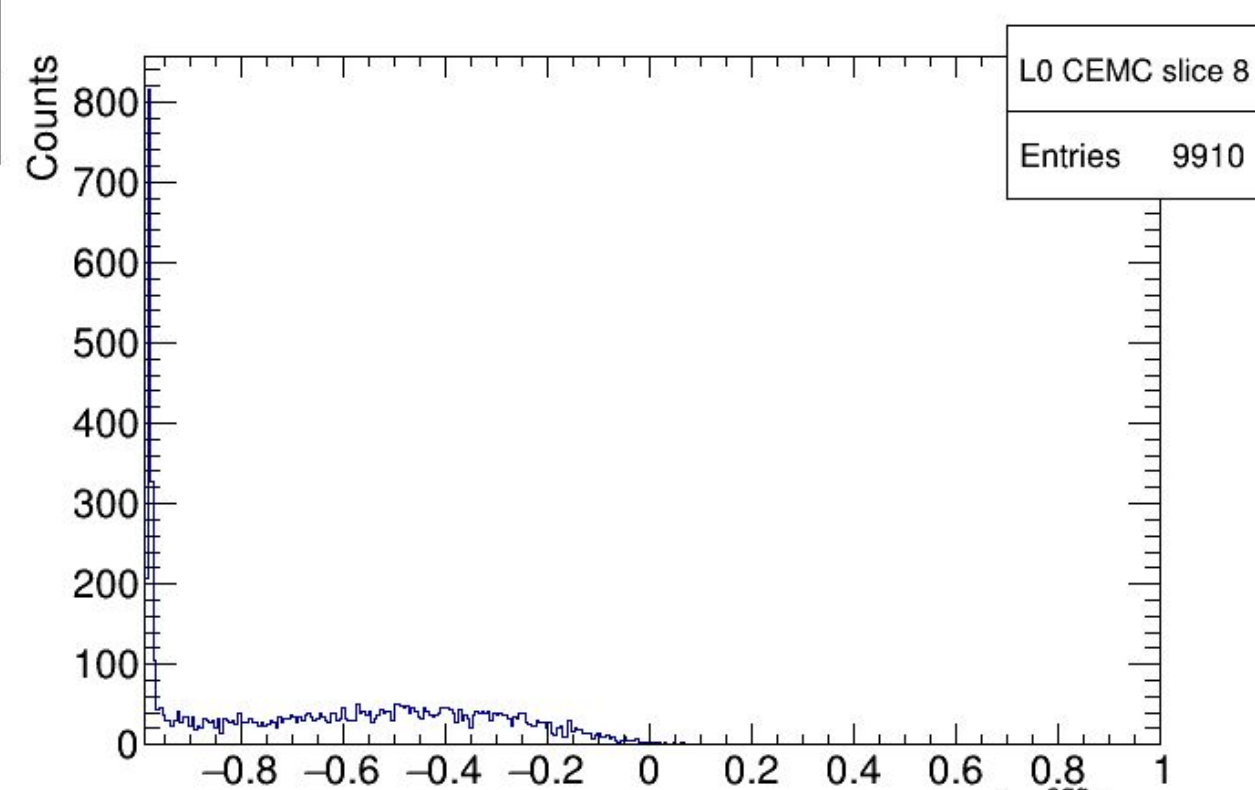
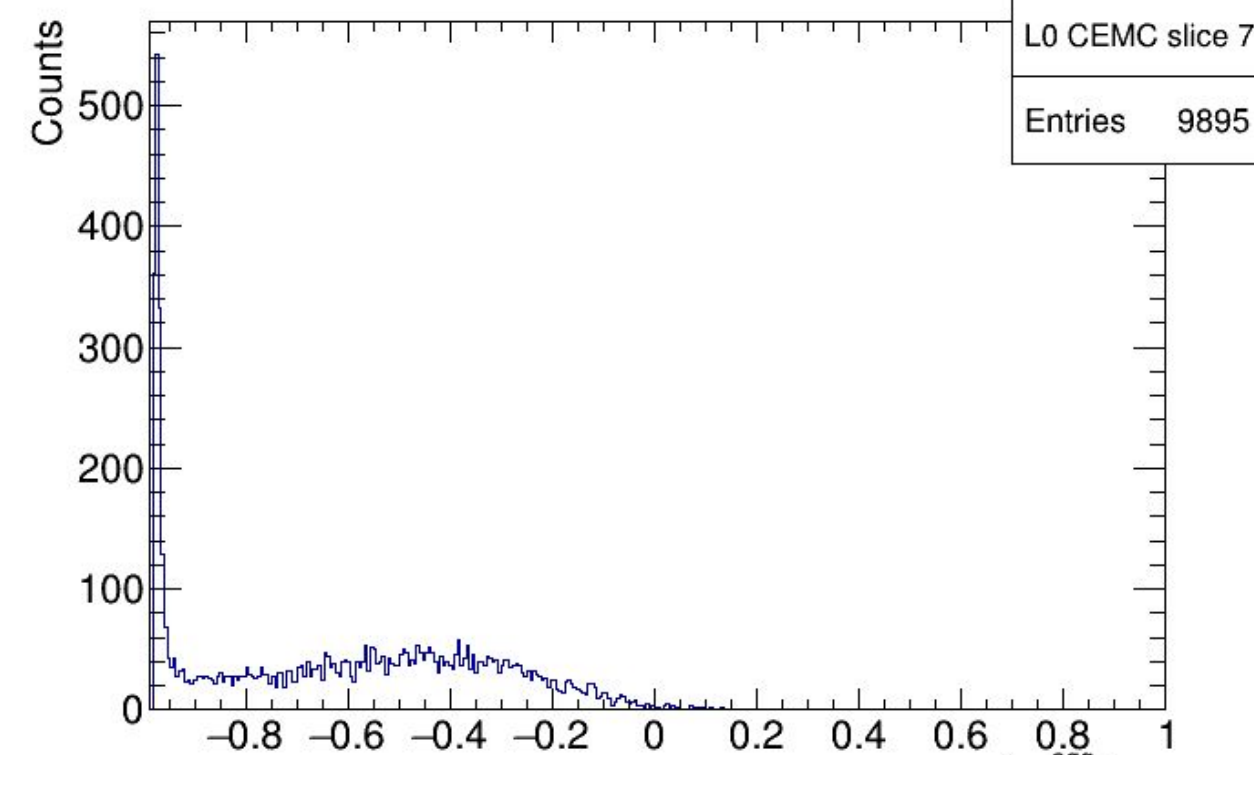
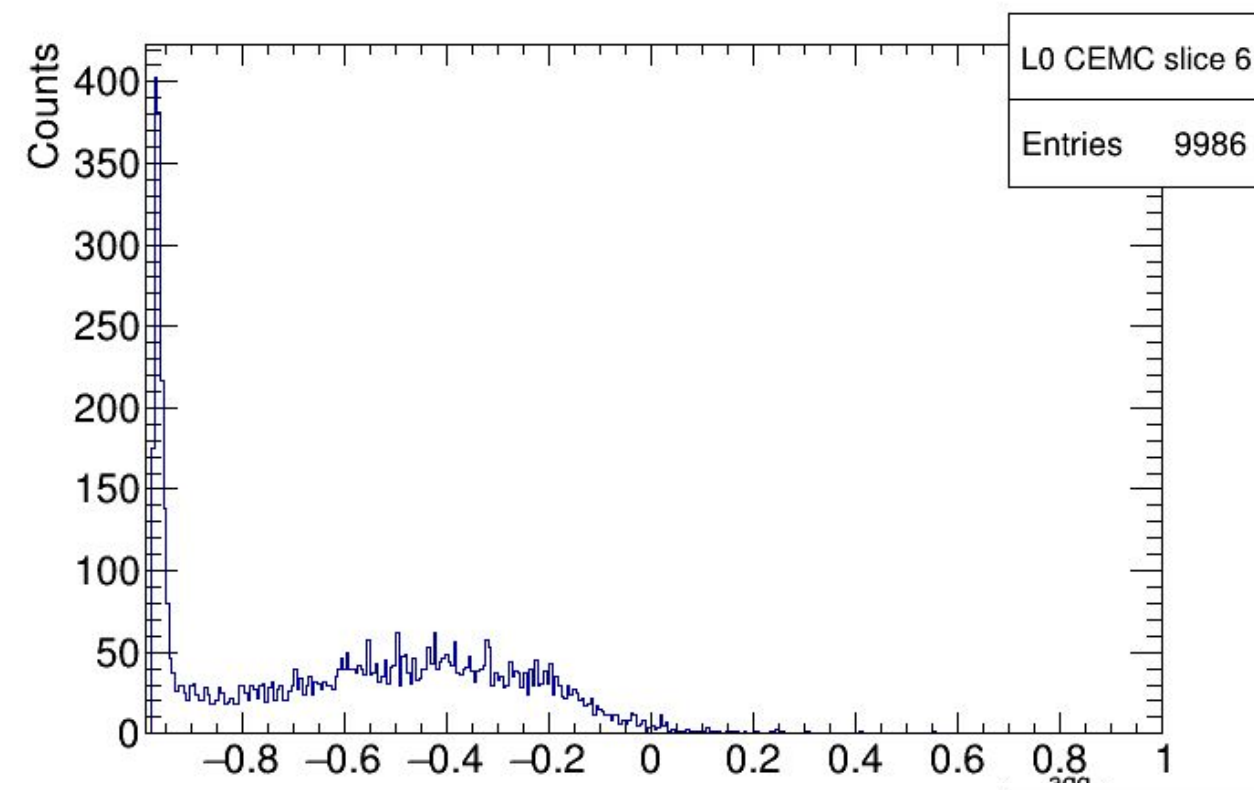
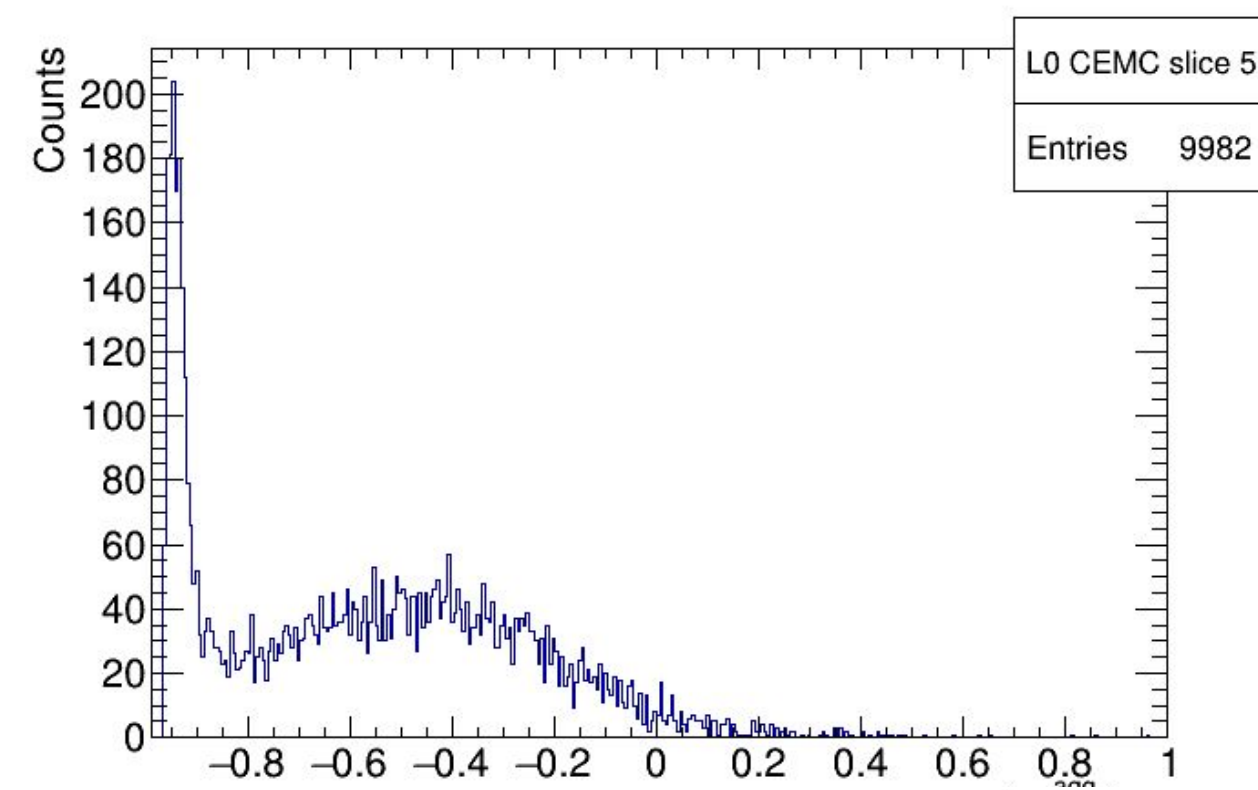
CEMC (π^-)

L0 Fitted Gaussians (0 - 3 GeV)



CEMC (π^-)

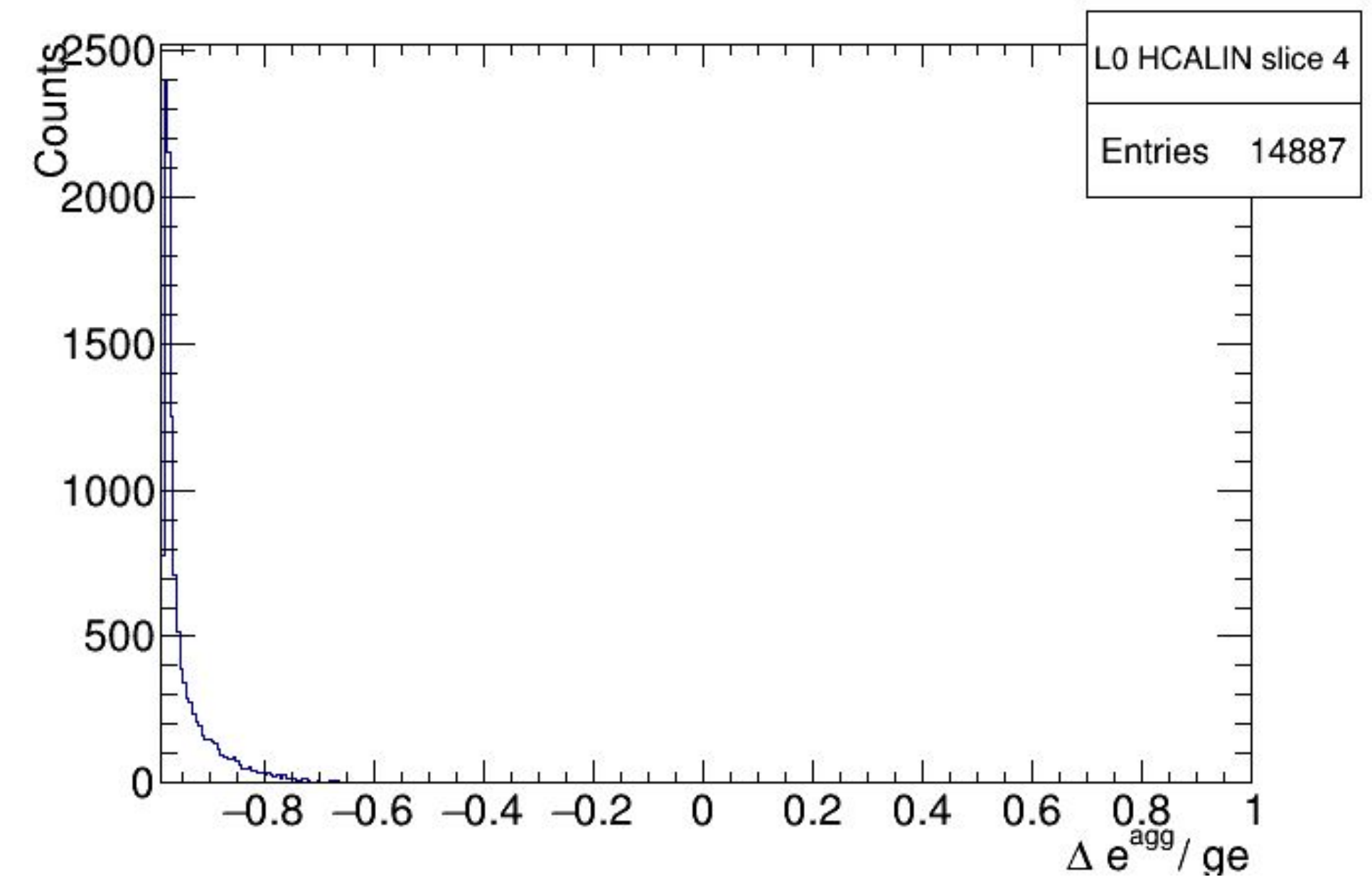
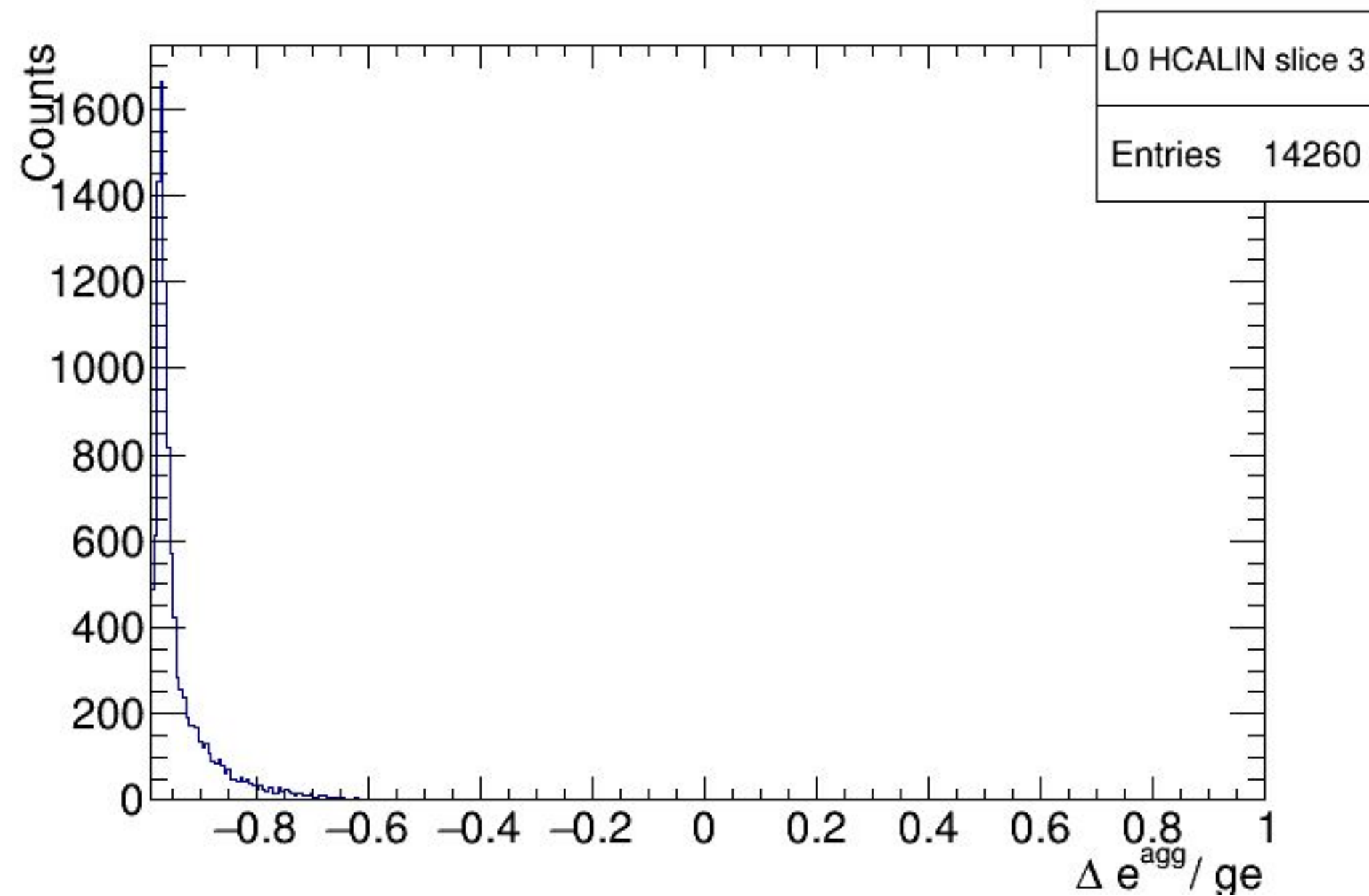
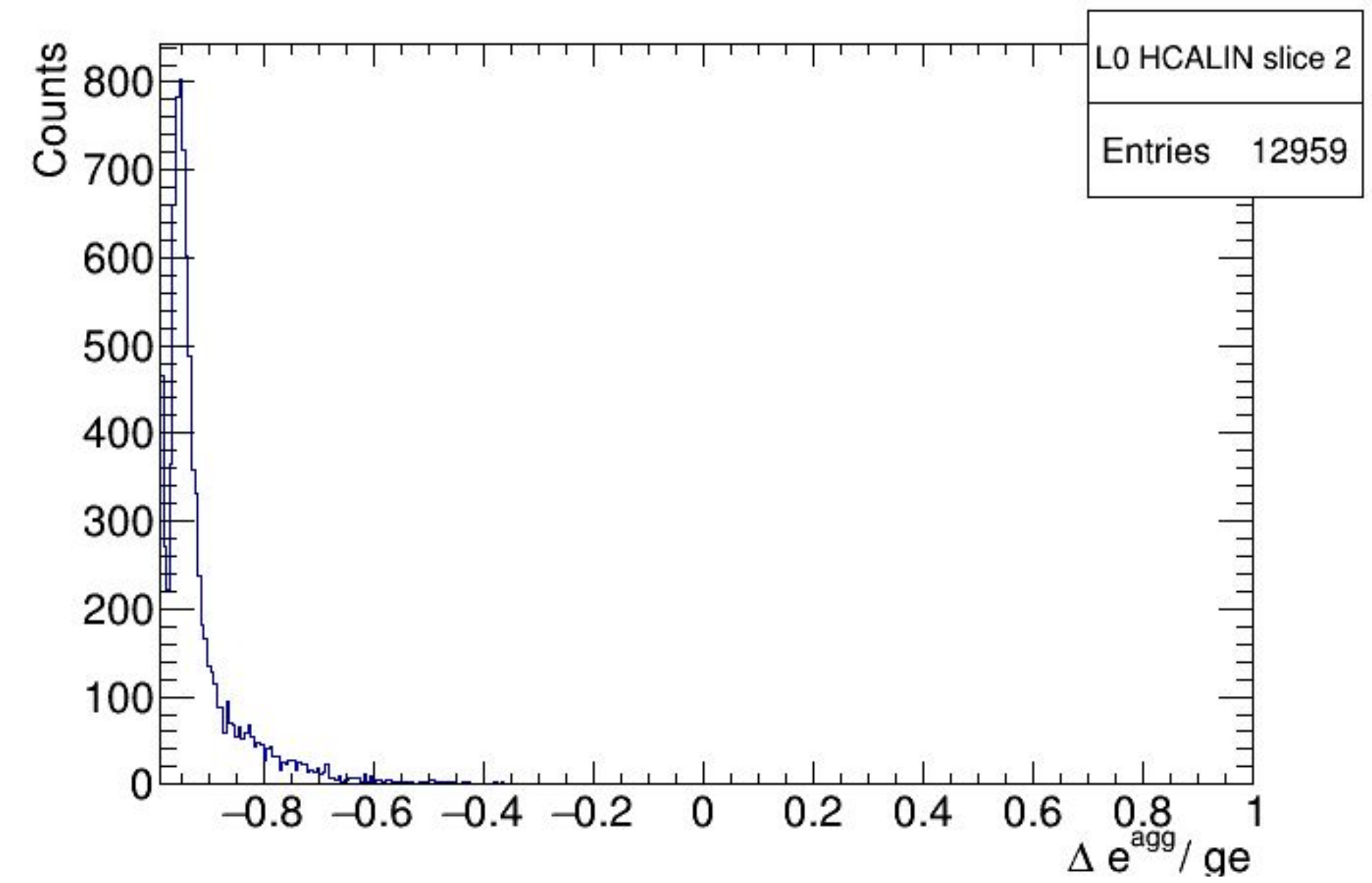
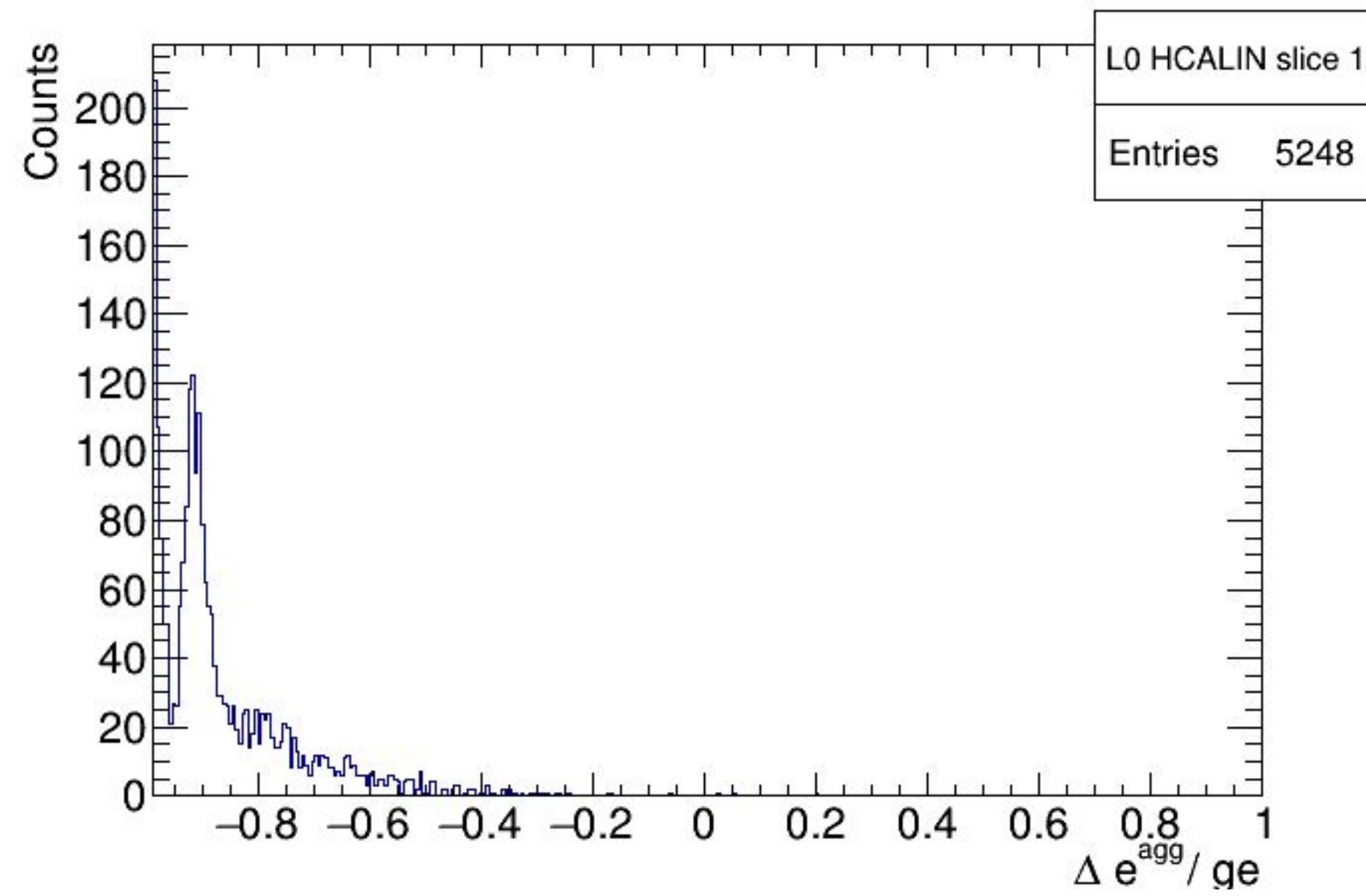
L0 Fitted Gaussians (3 - 30 GeV)



The x-axes denote $\Delta e_{\text{agg}}/ge$

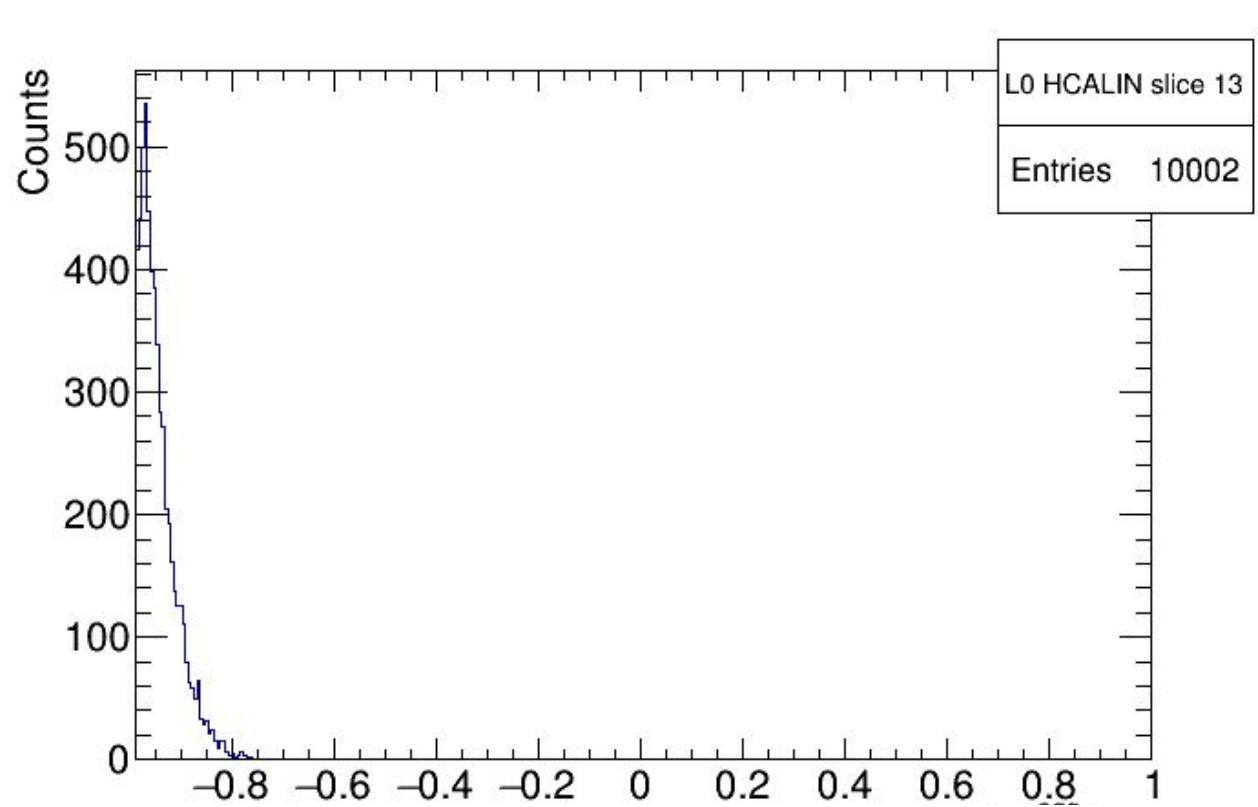
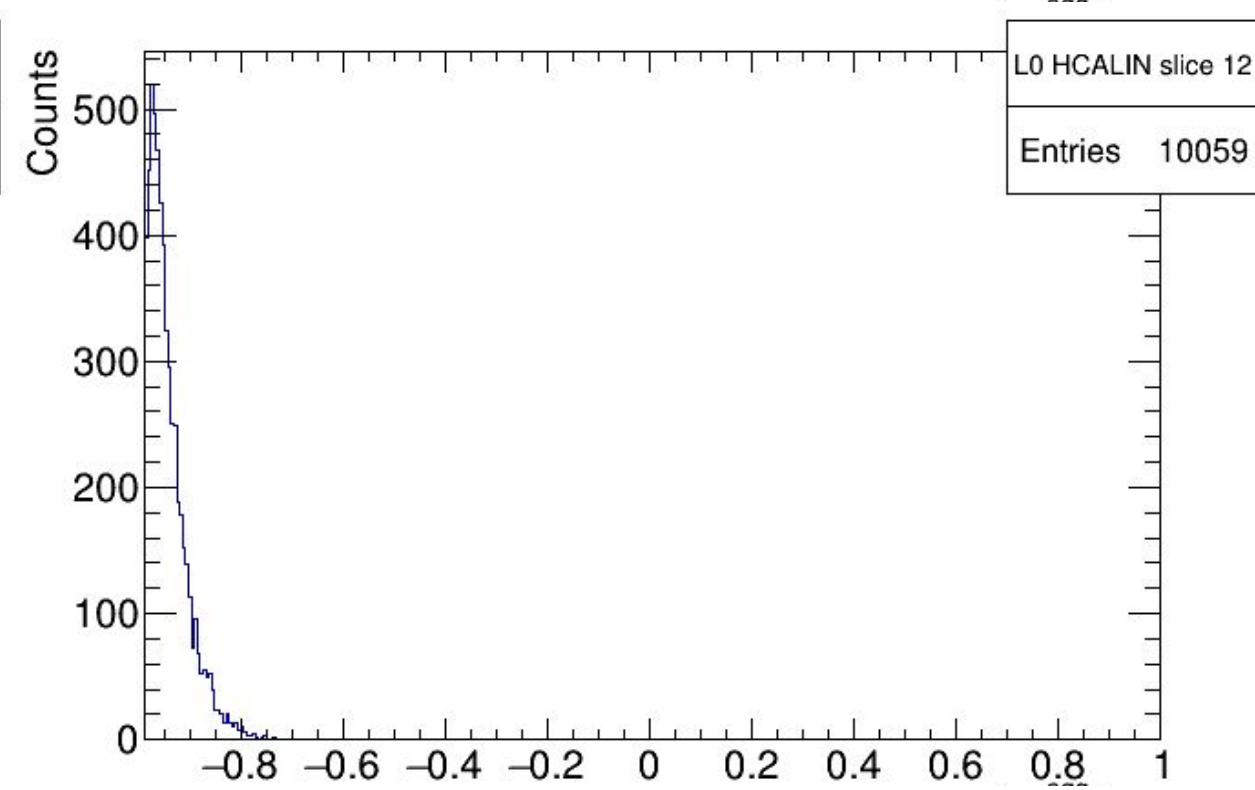
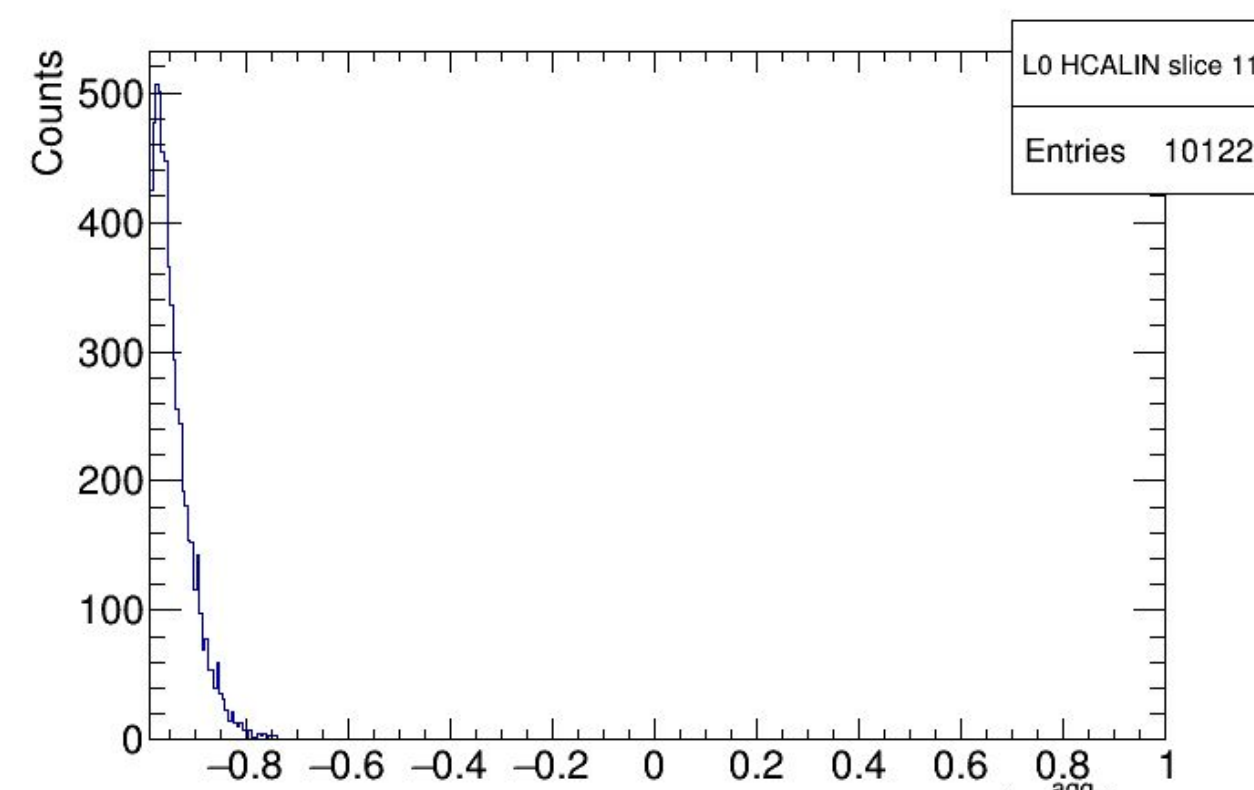
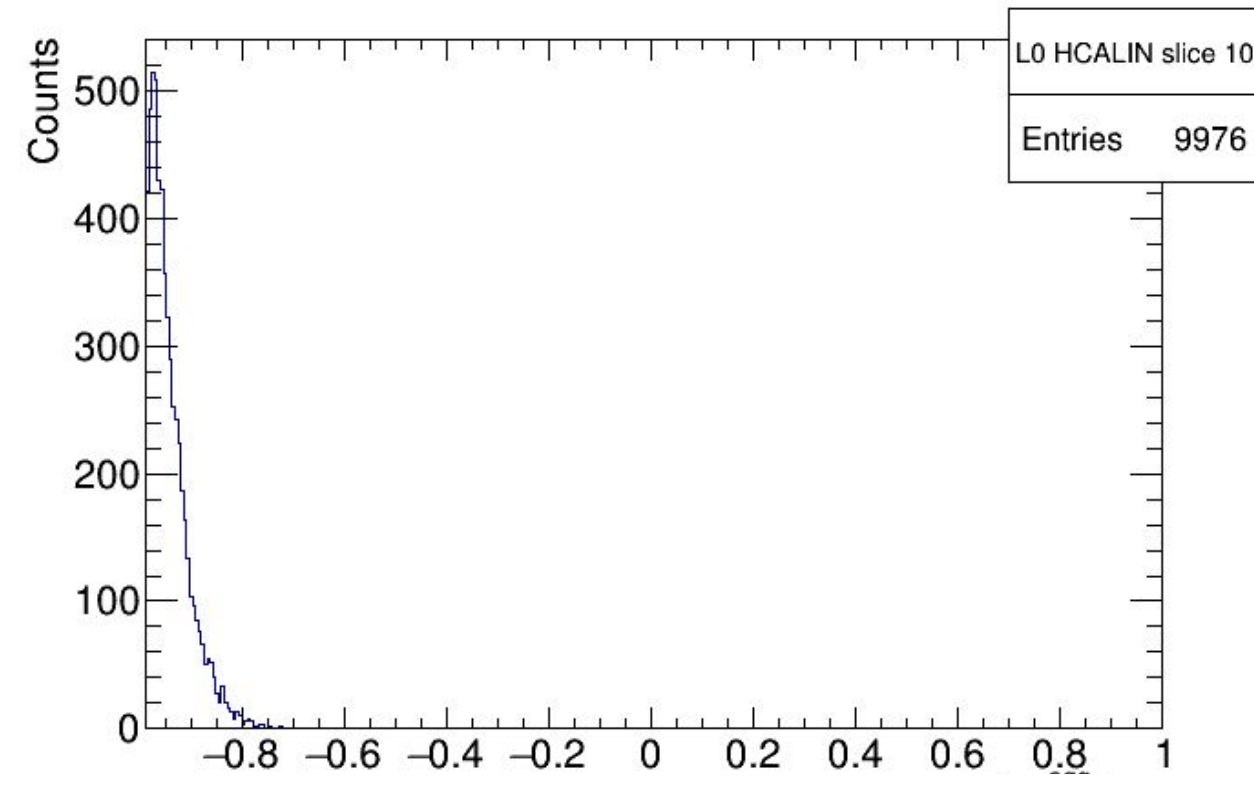
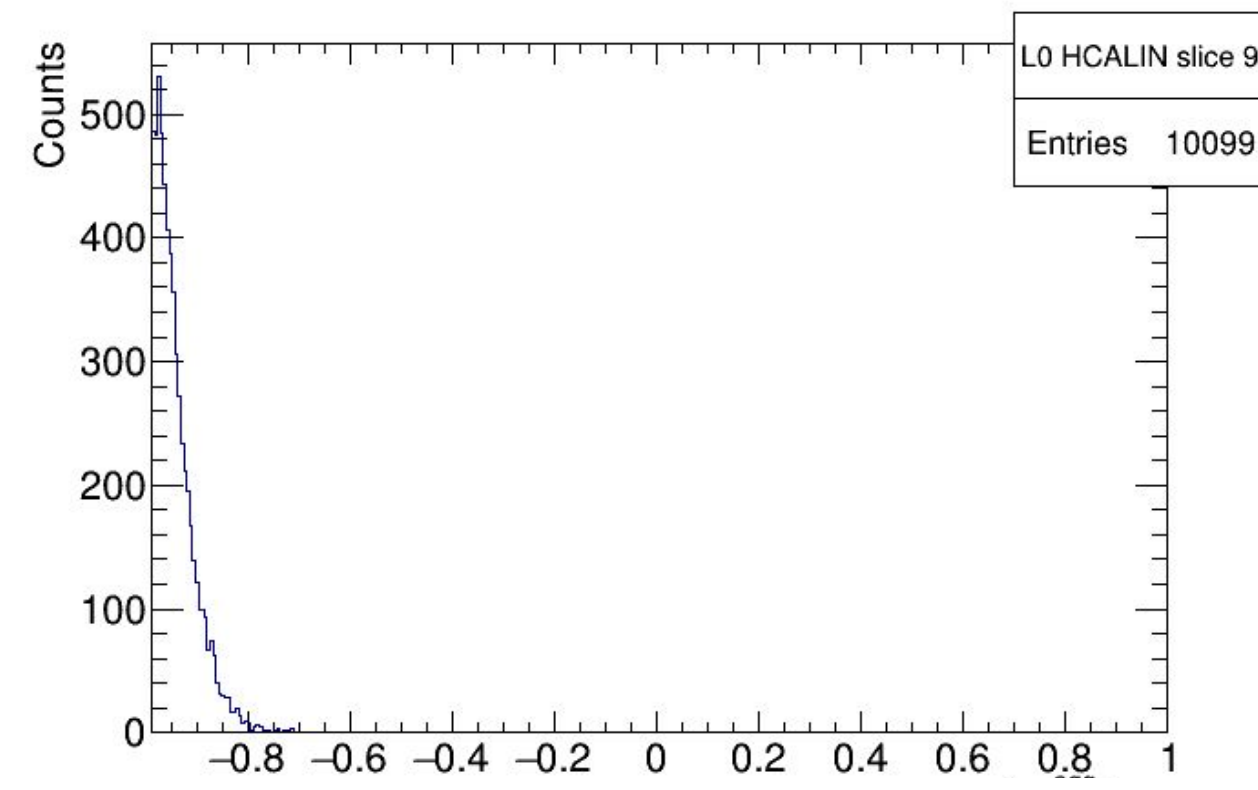
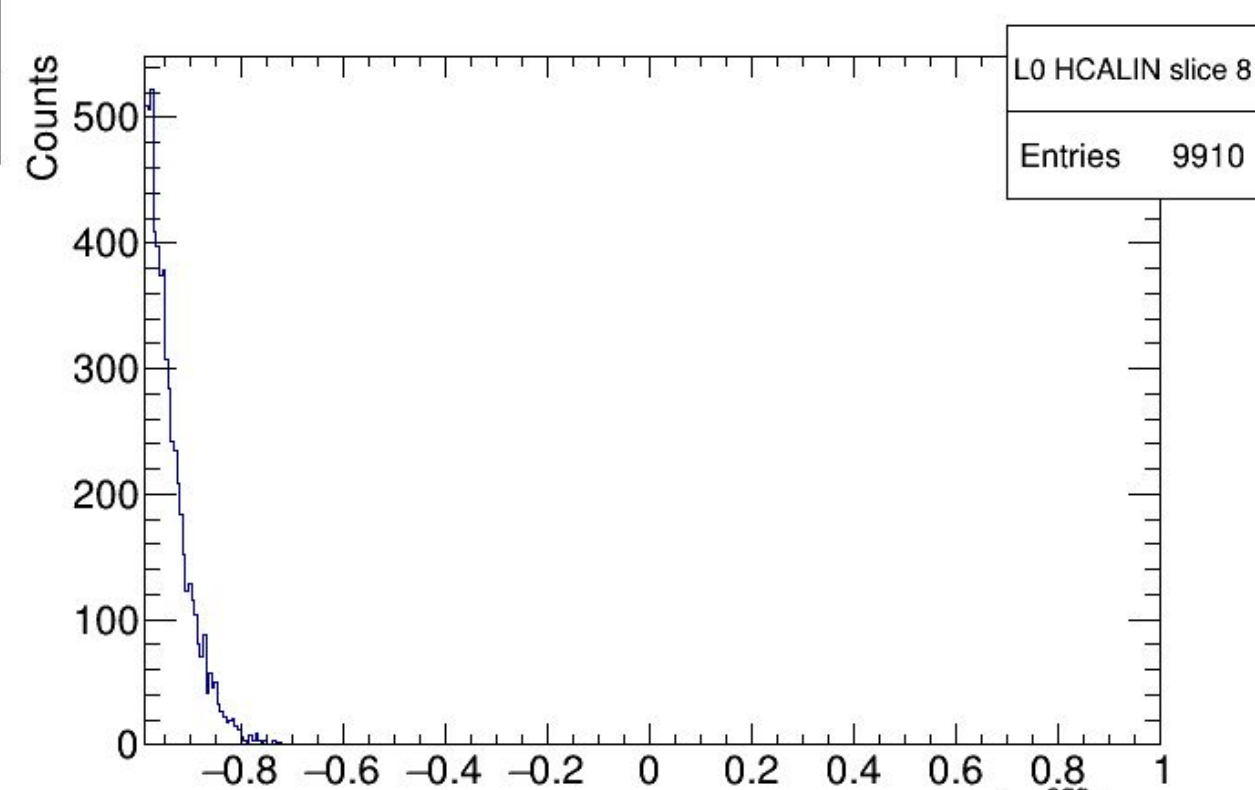
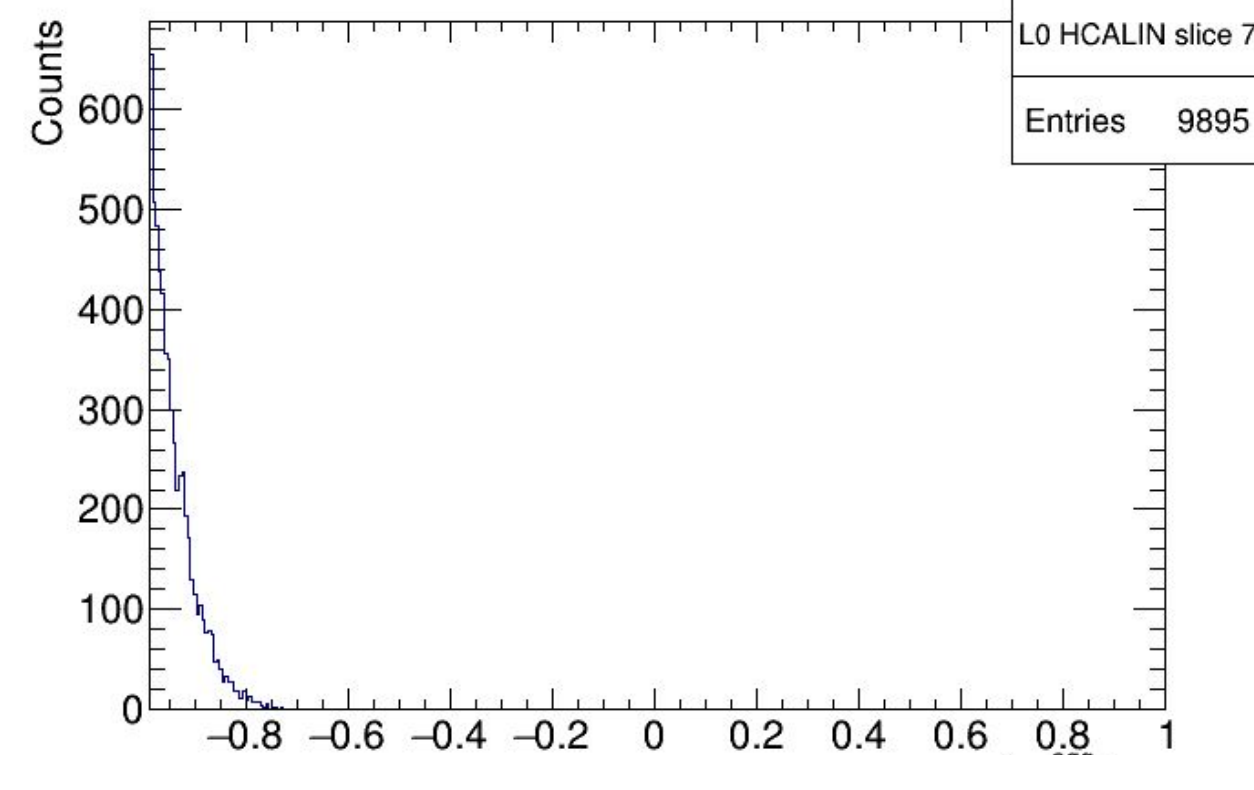
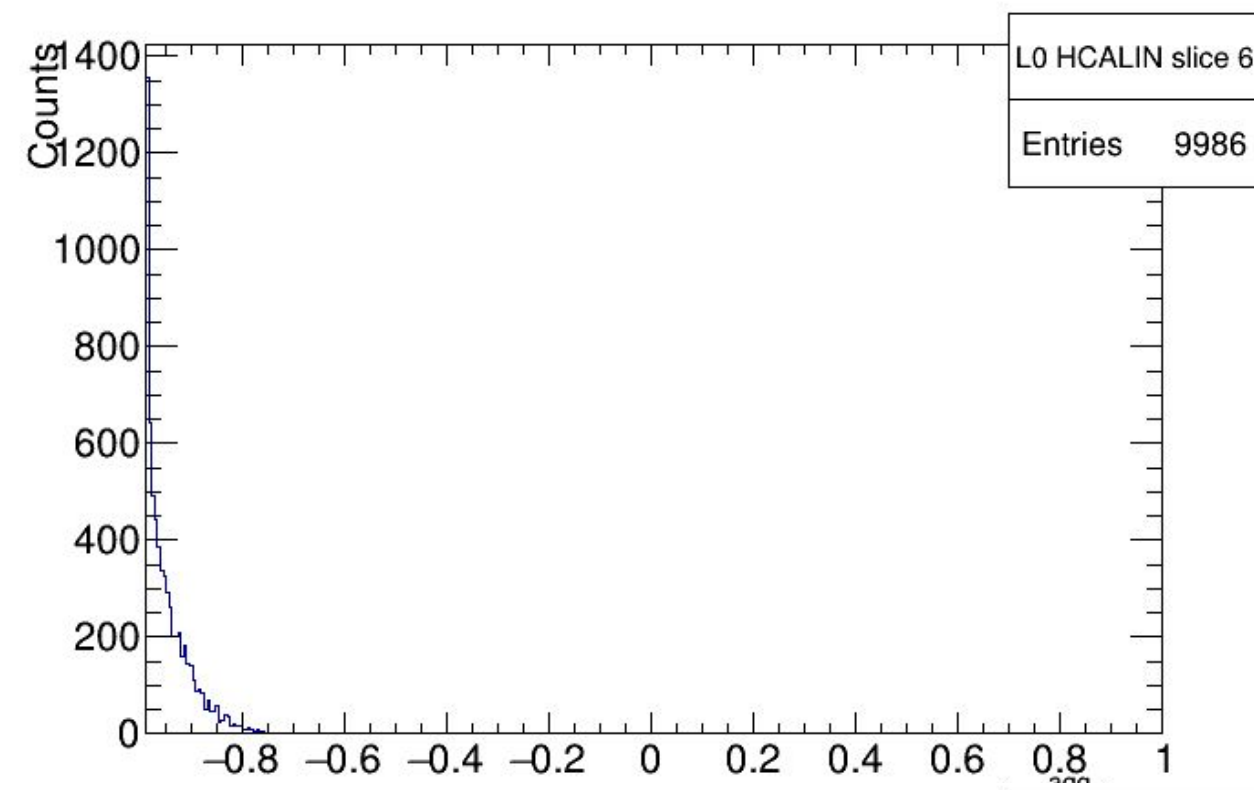
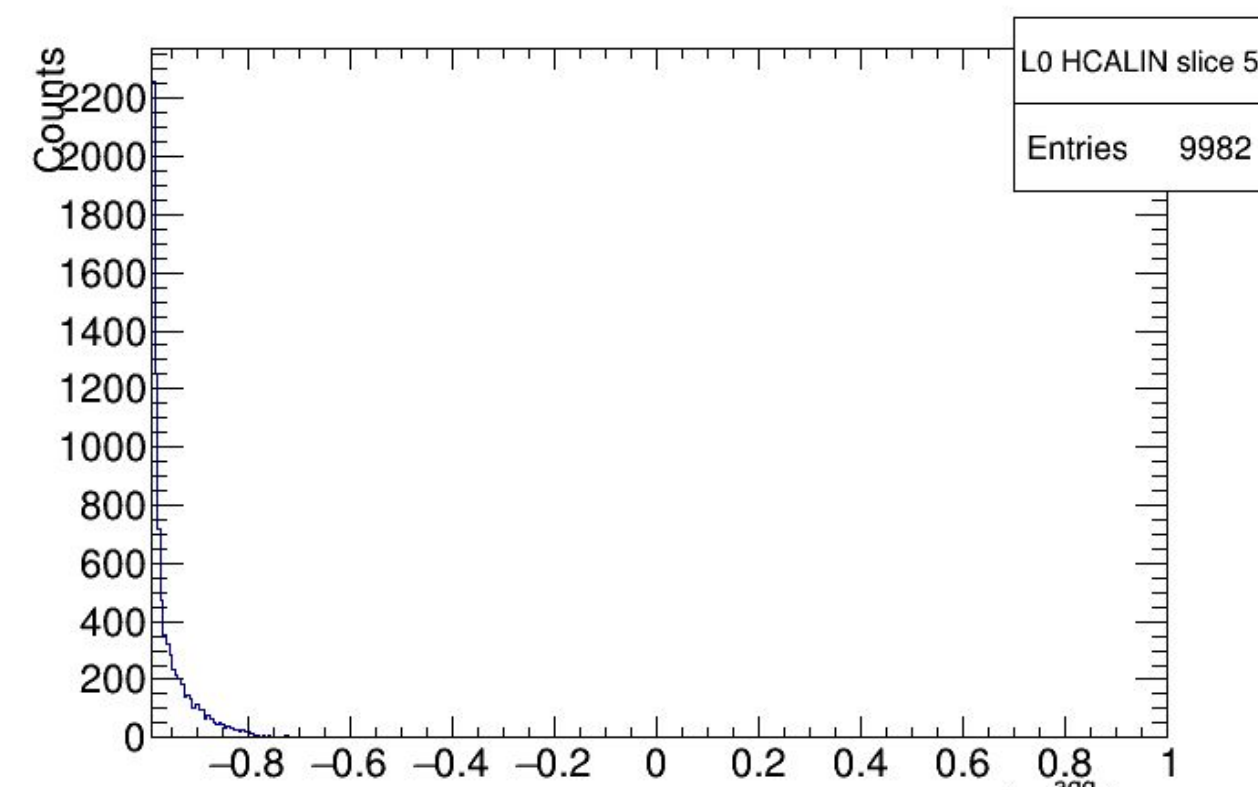
HCALIN (π^-)

L0 Fitted Gaussians (0 - 3 GeV)



HCALIN (π^-)

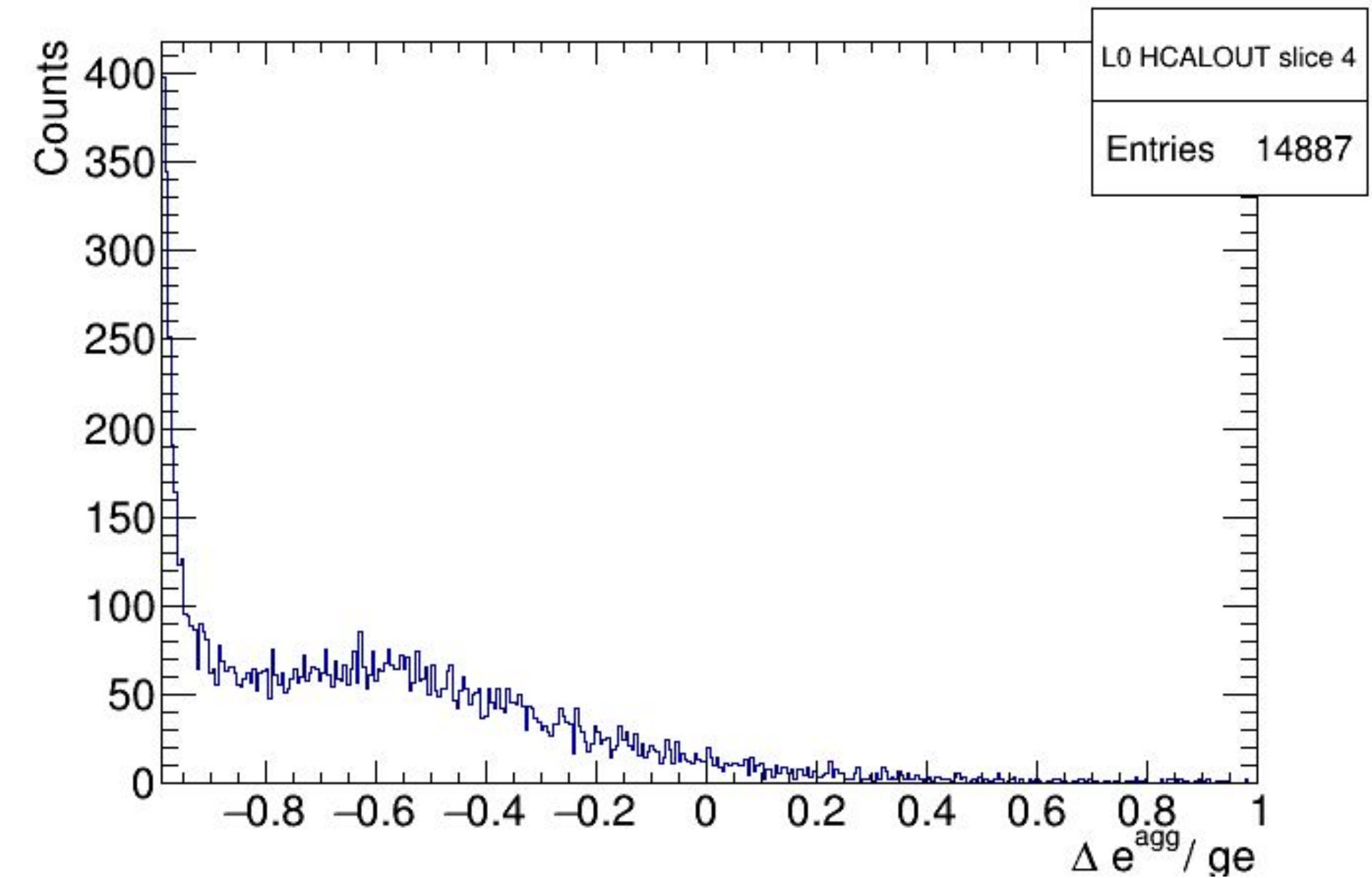
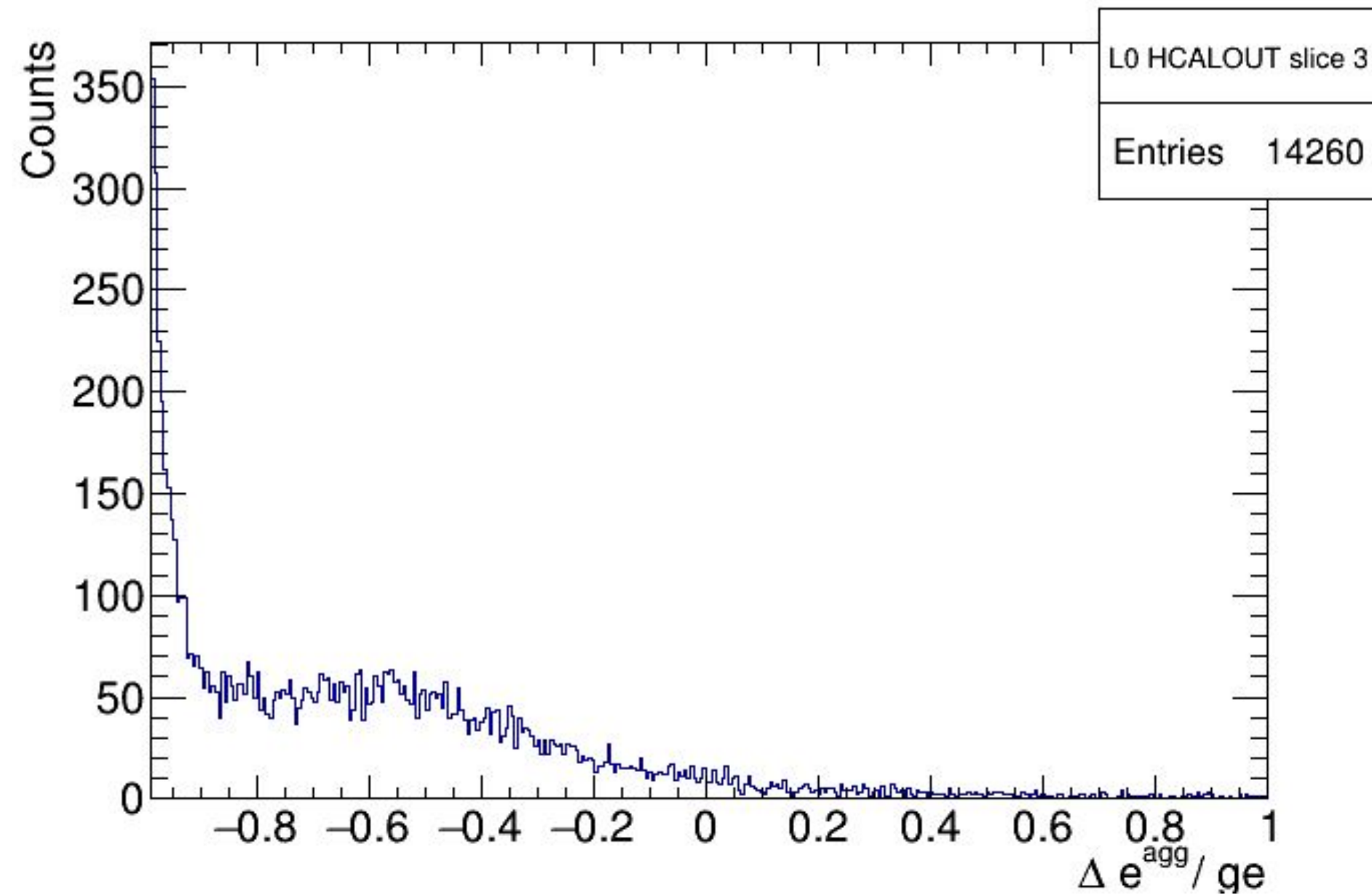
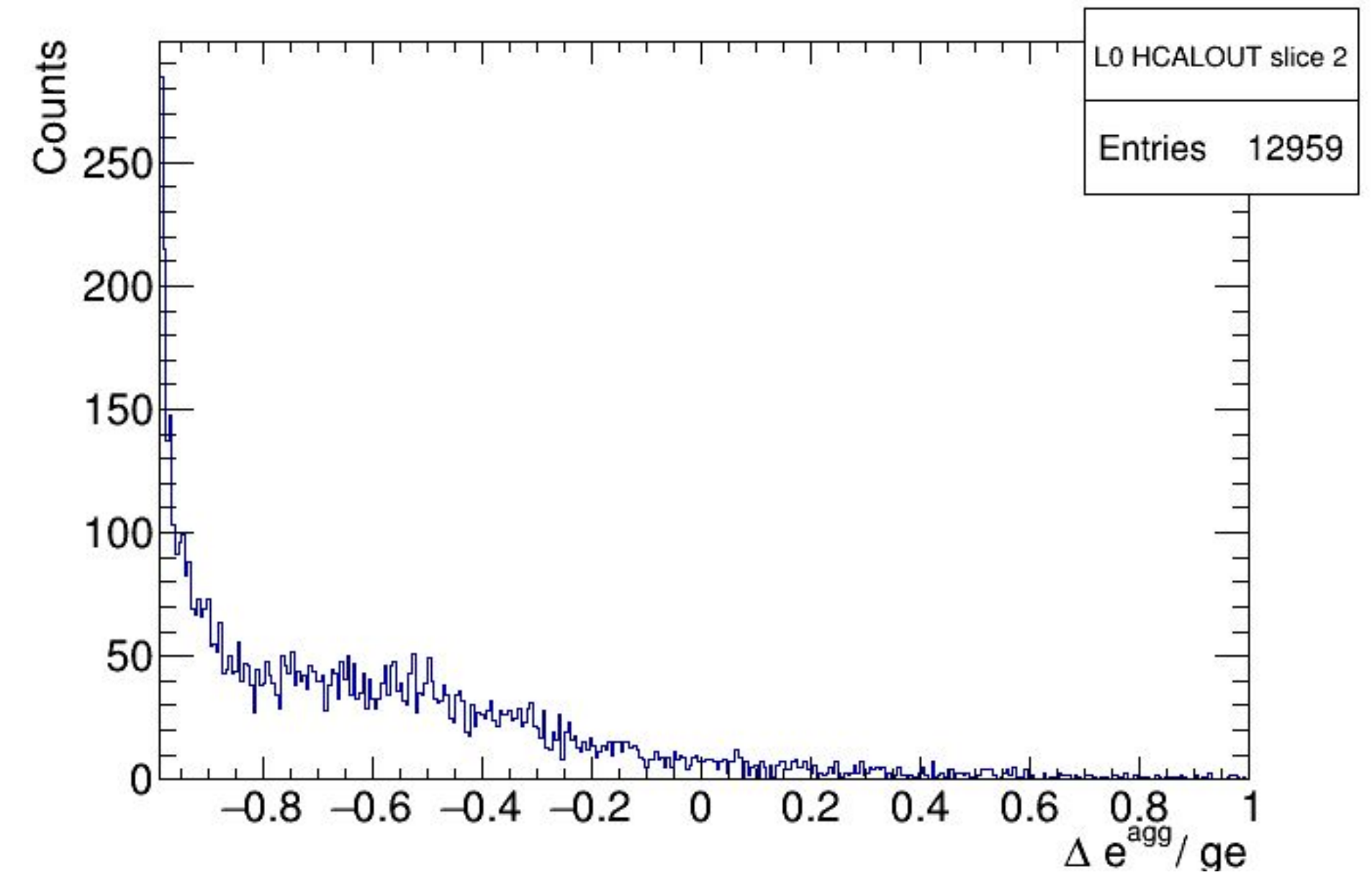
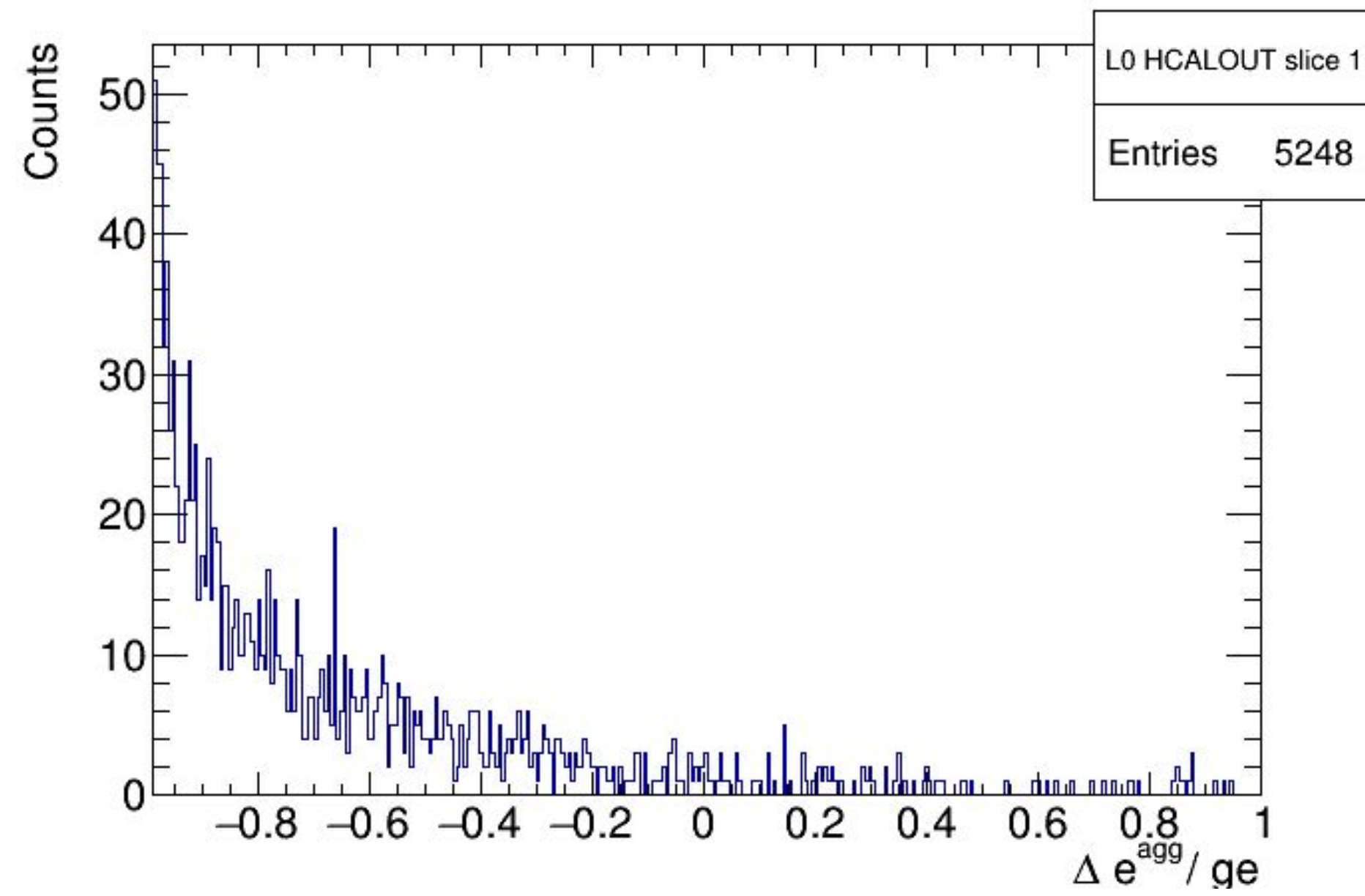
L0 Fitted Gaussians (3 - 30 GeV)



The x-axes denote $\Delta e_{agg}/ge$

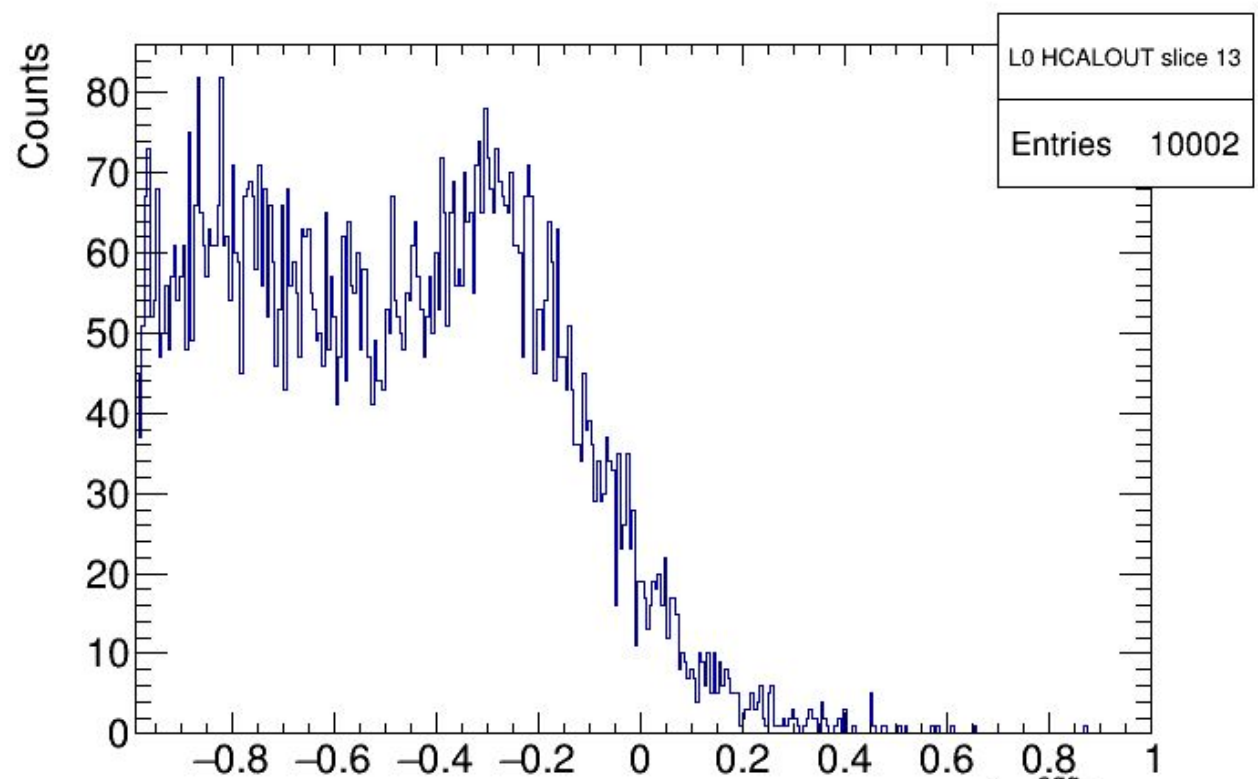
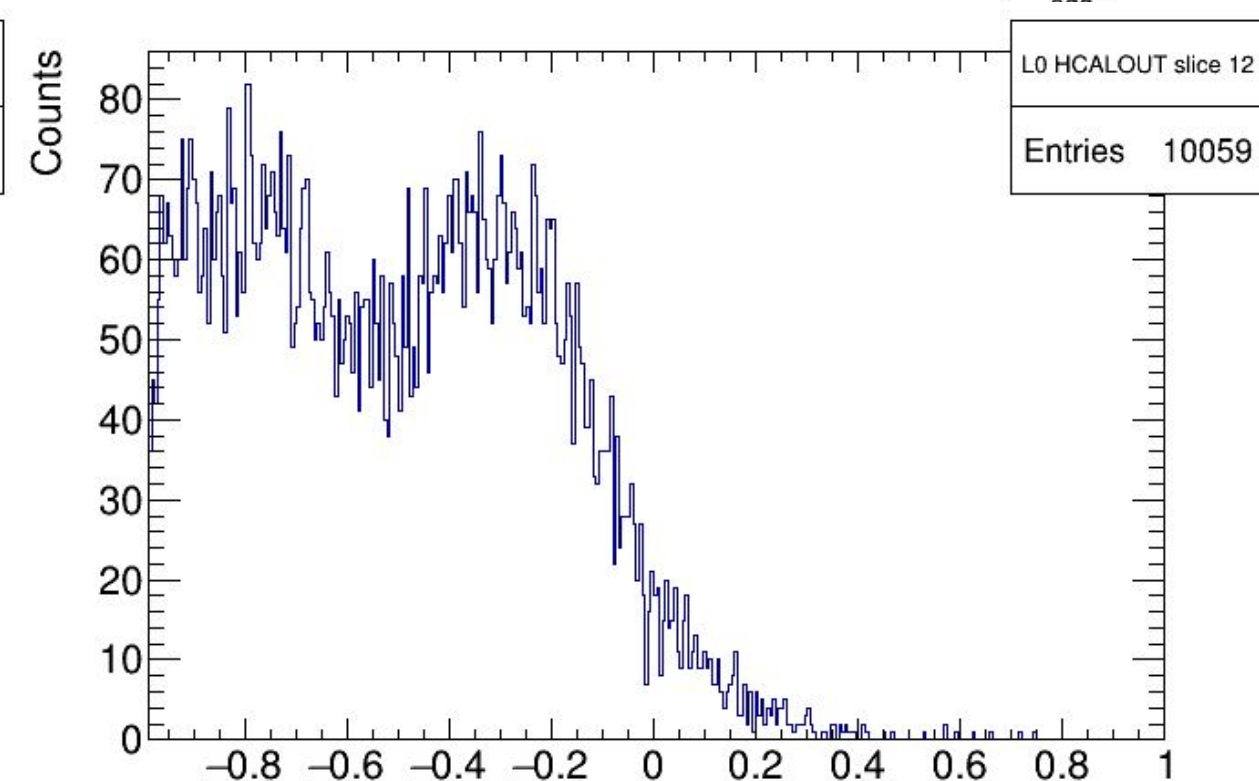
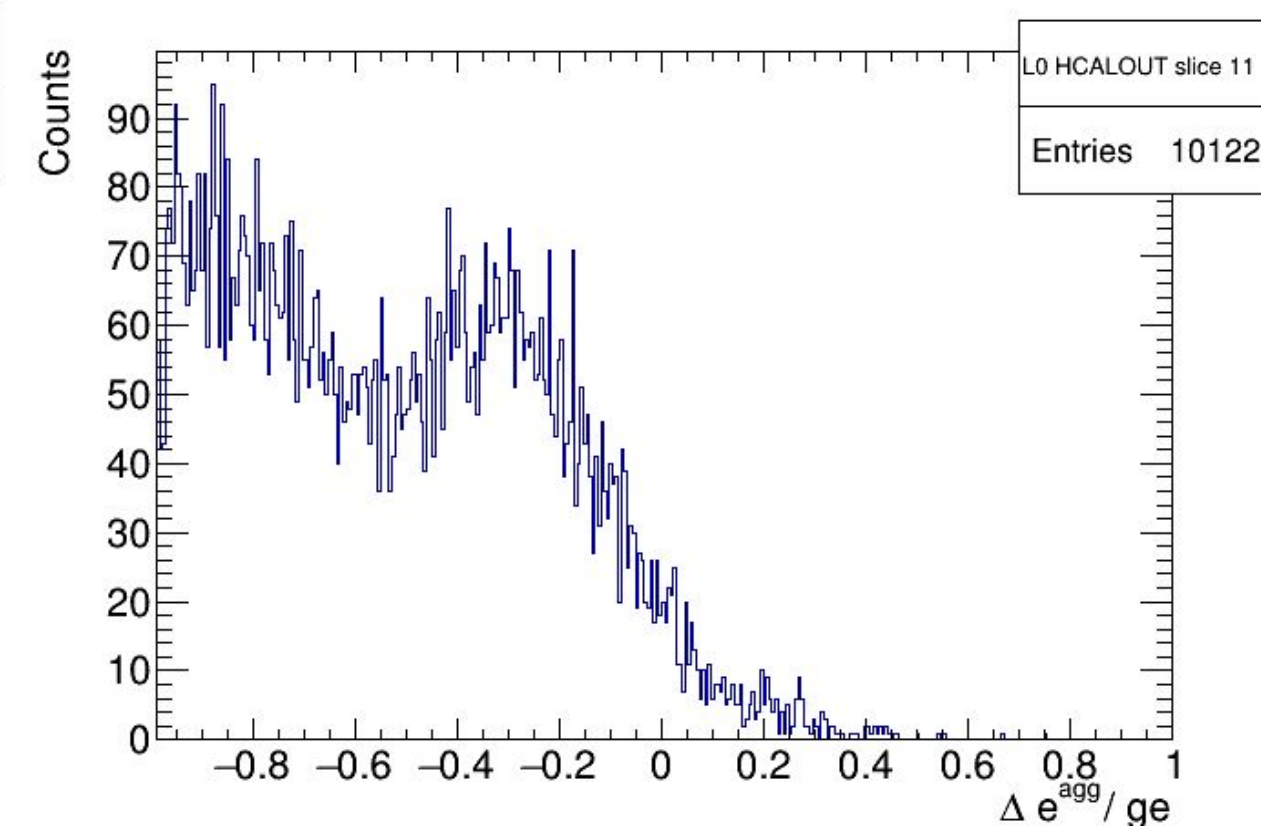
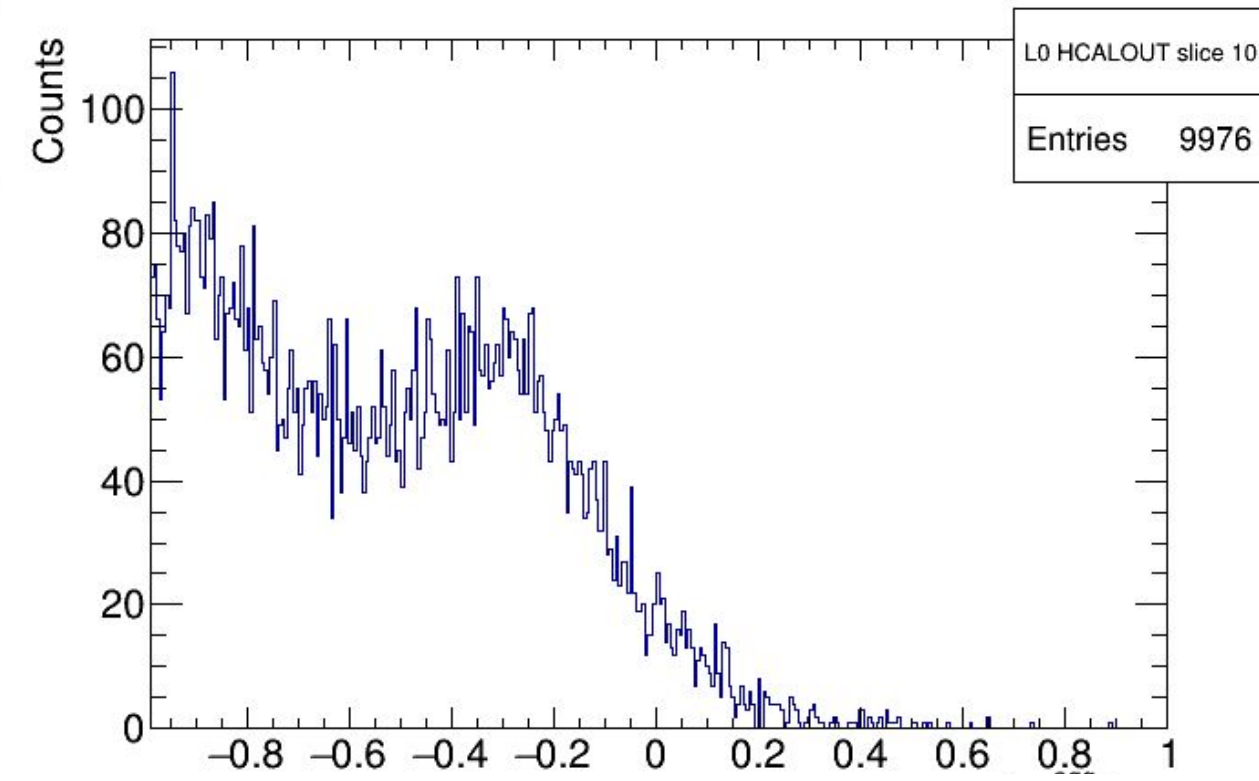
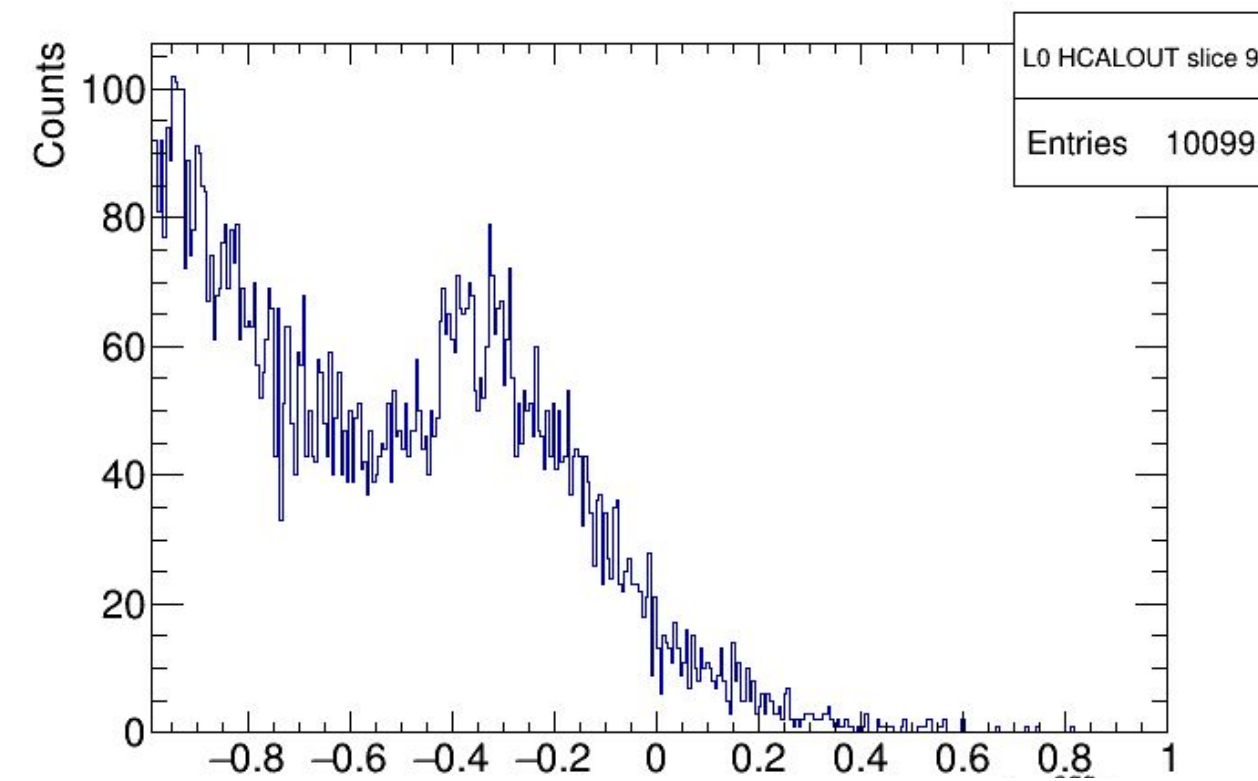
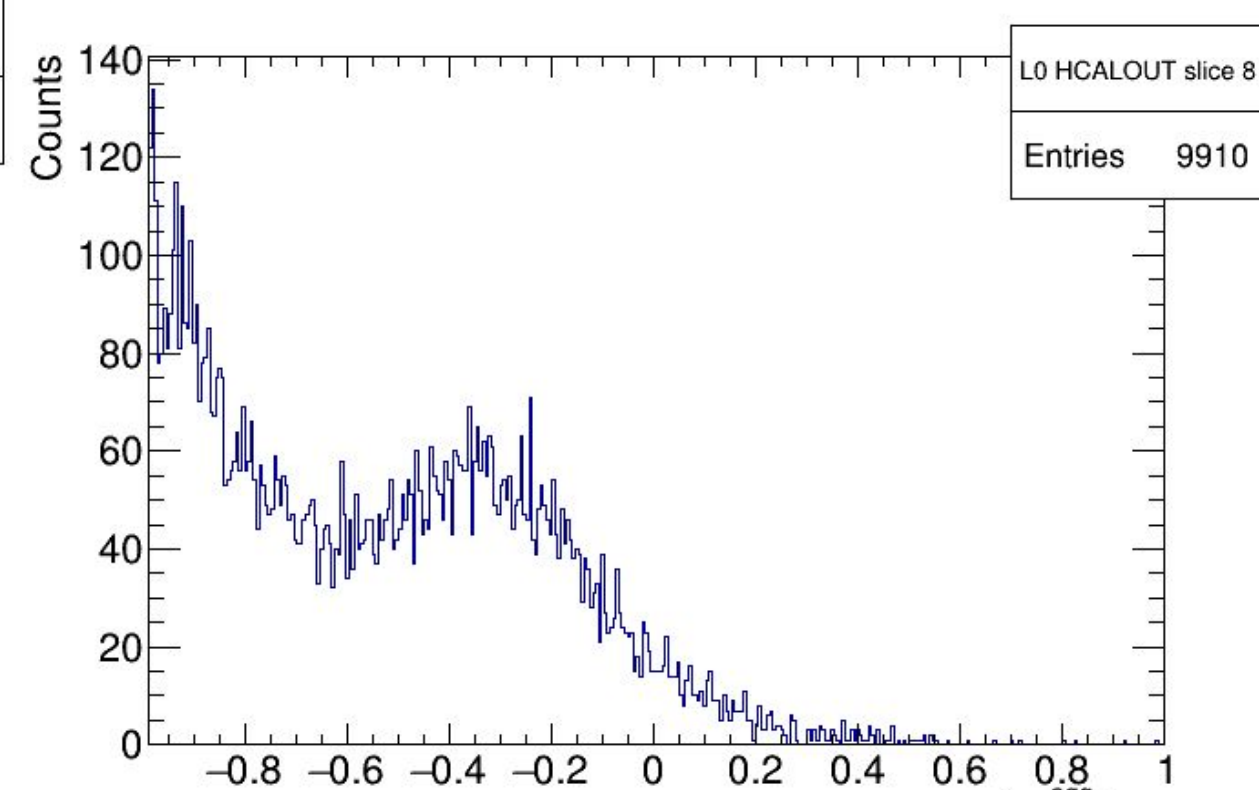
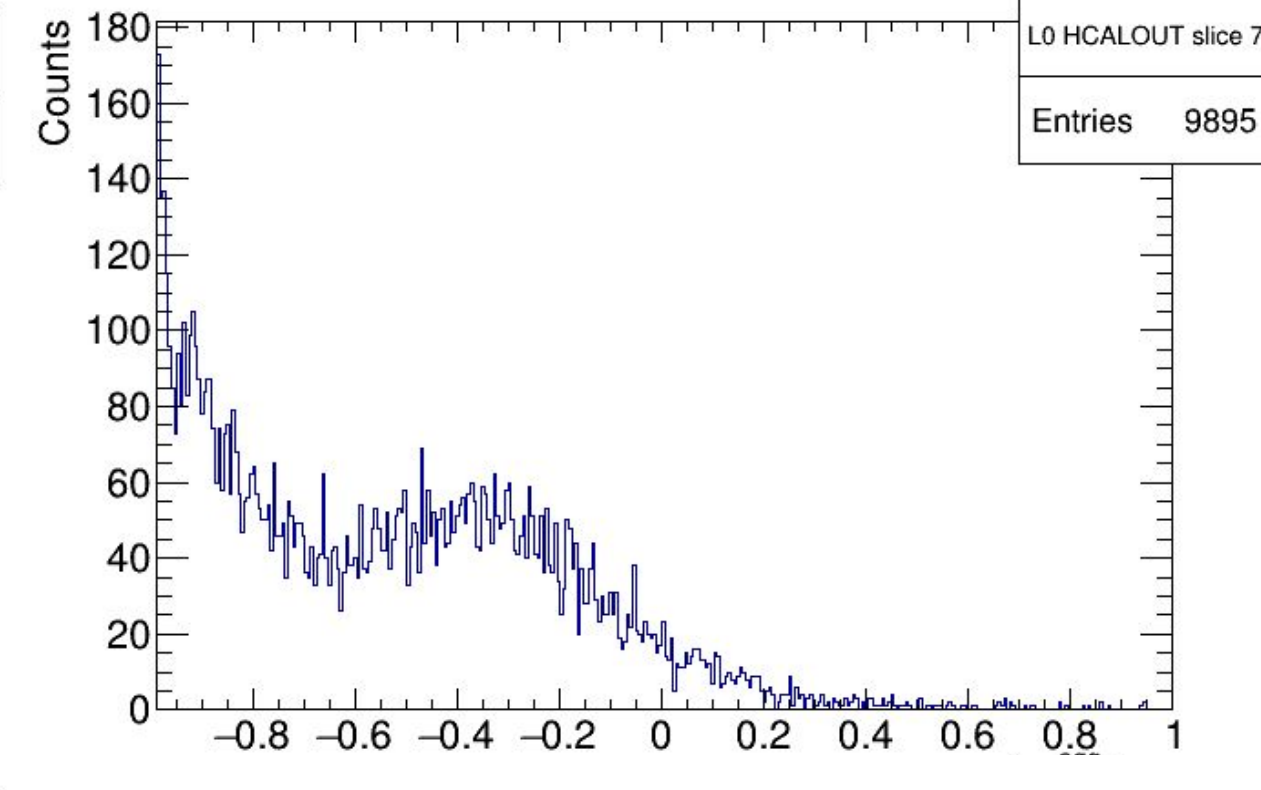
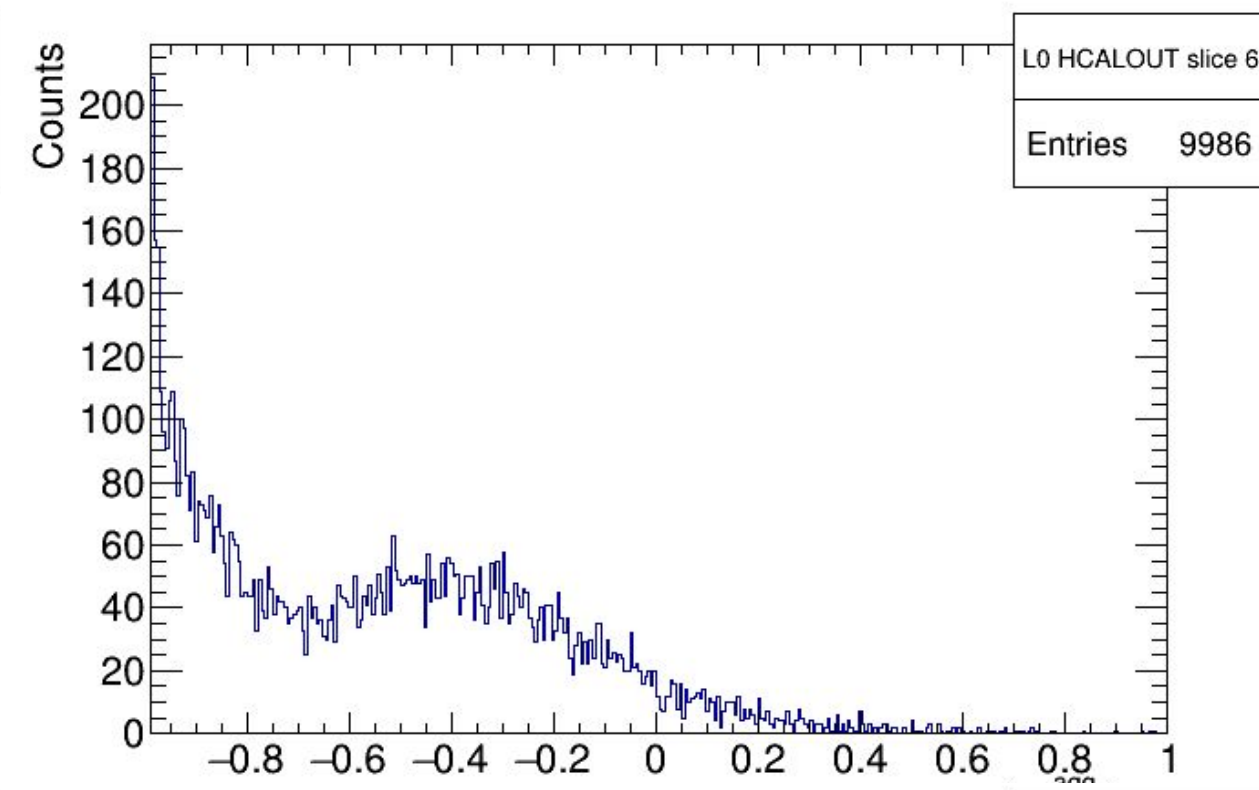
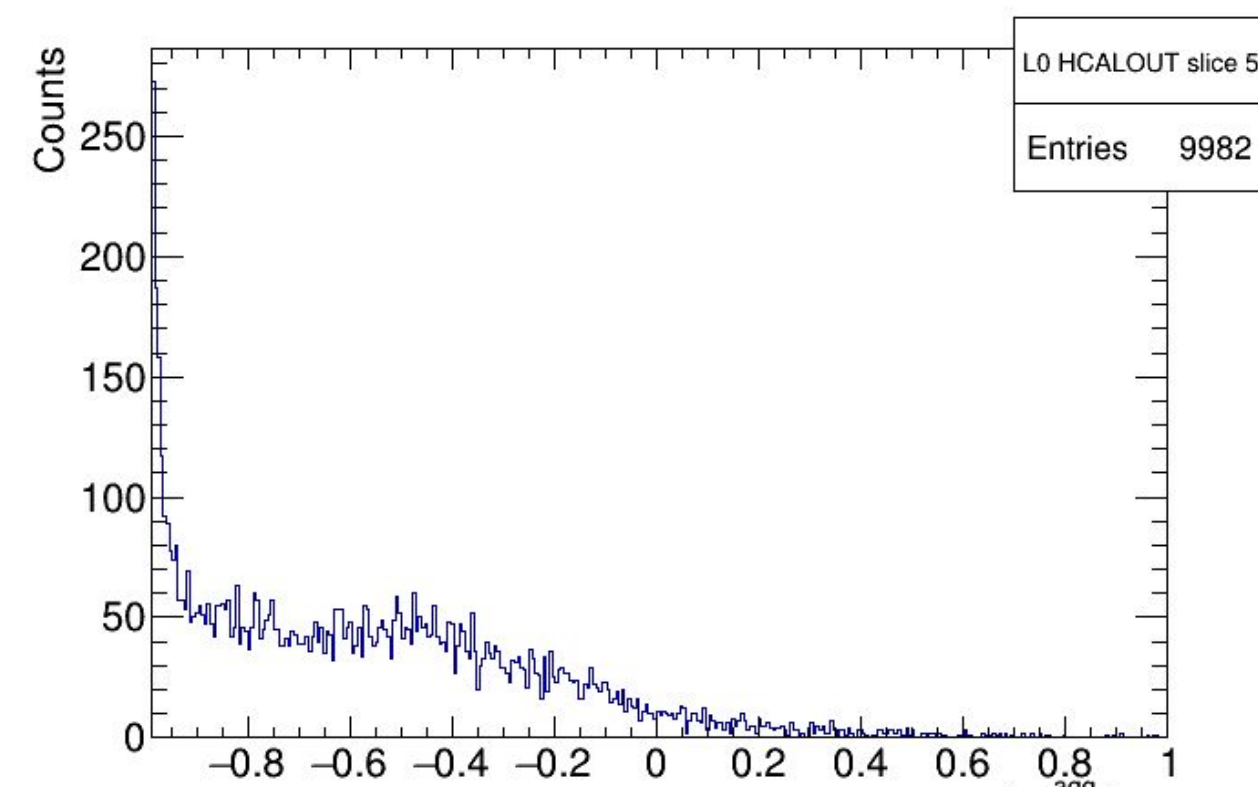
HCALOUT (π^-)

L0 Fitted Gaussians (0 - 3 GeV)



HCALOUT (π^-)

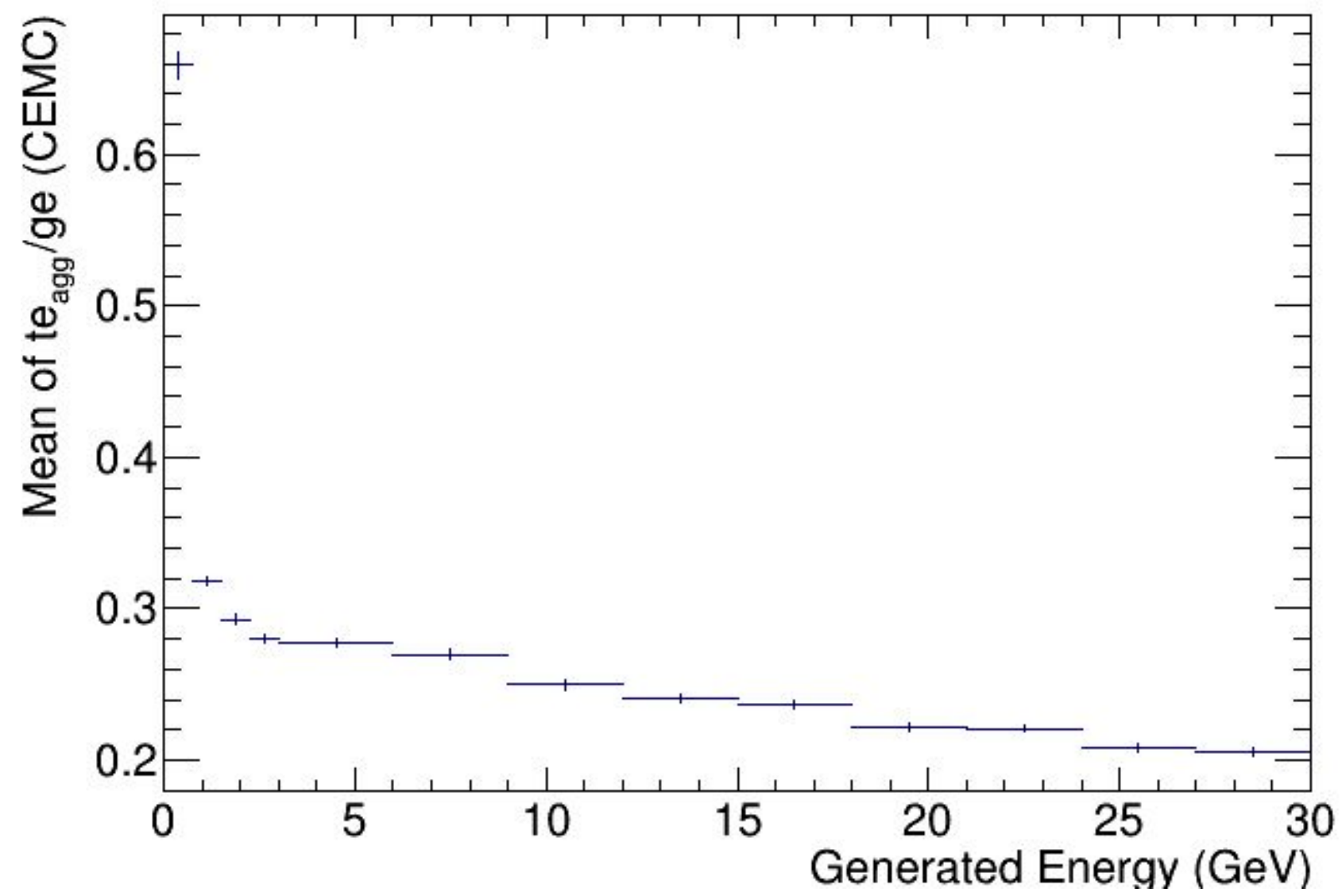
L0 Fitted Gaussians (3 - 30 GeV)



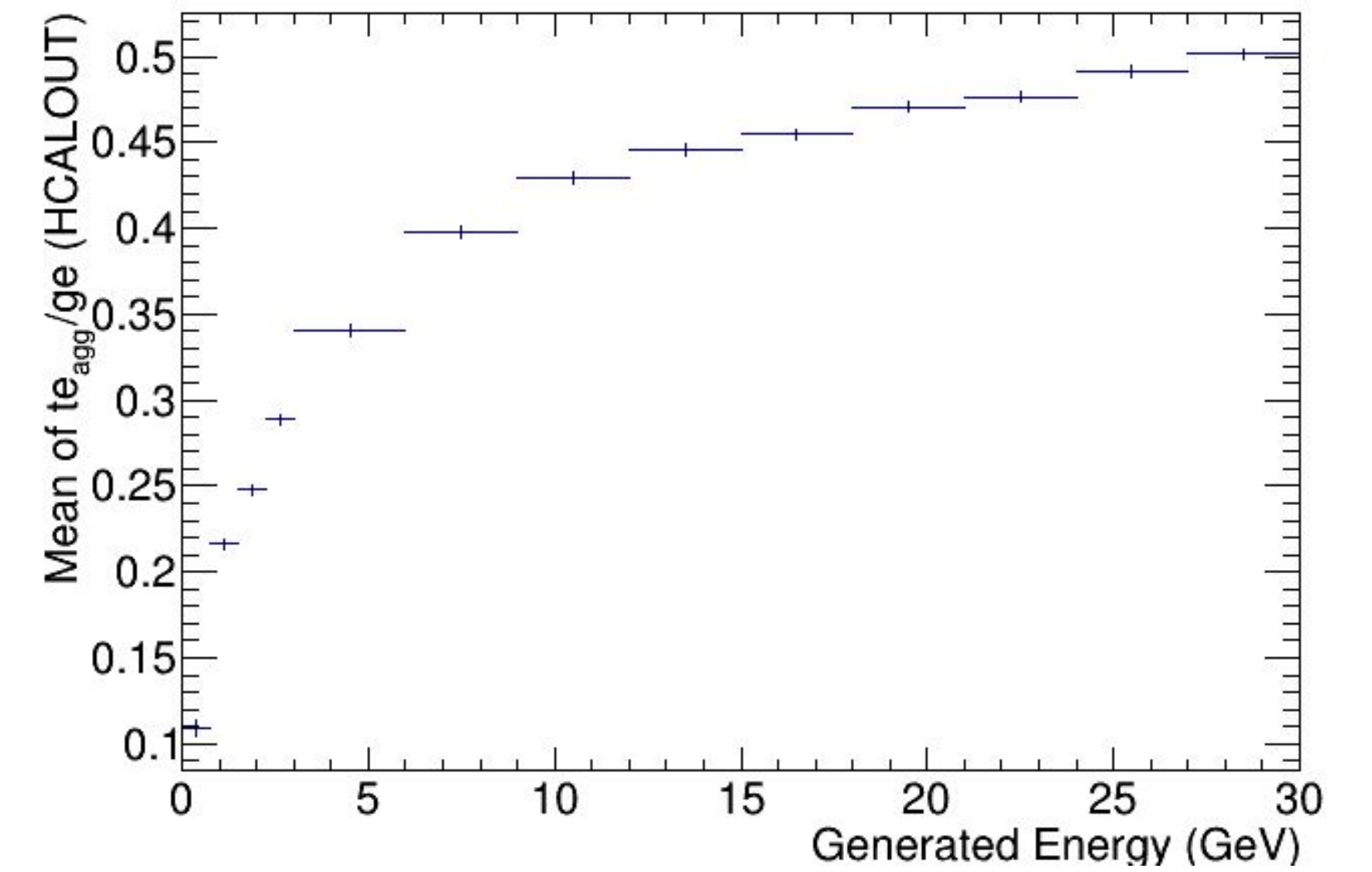
The x-axes denote $\Delta e_{agg}/ge$

CEMC + HCALIN + HCALOUT (π^-)

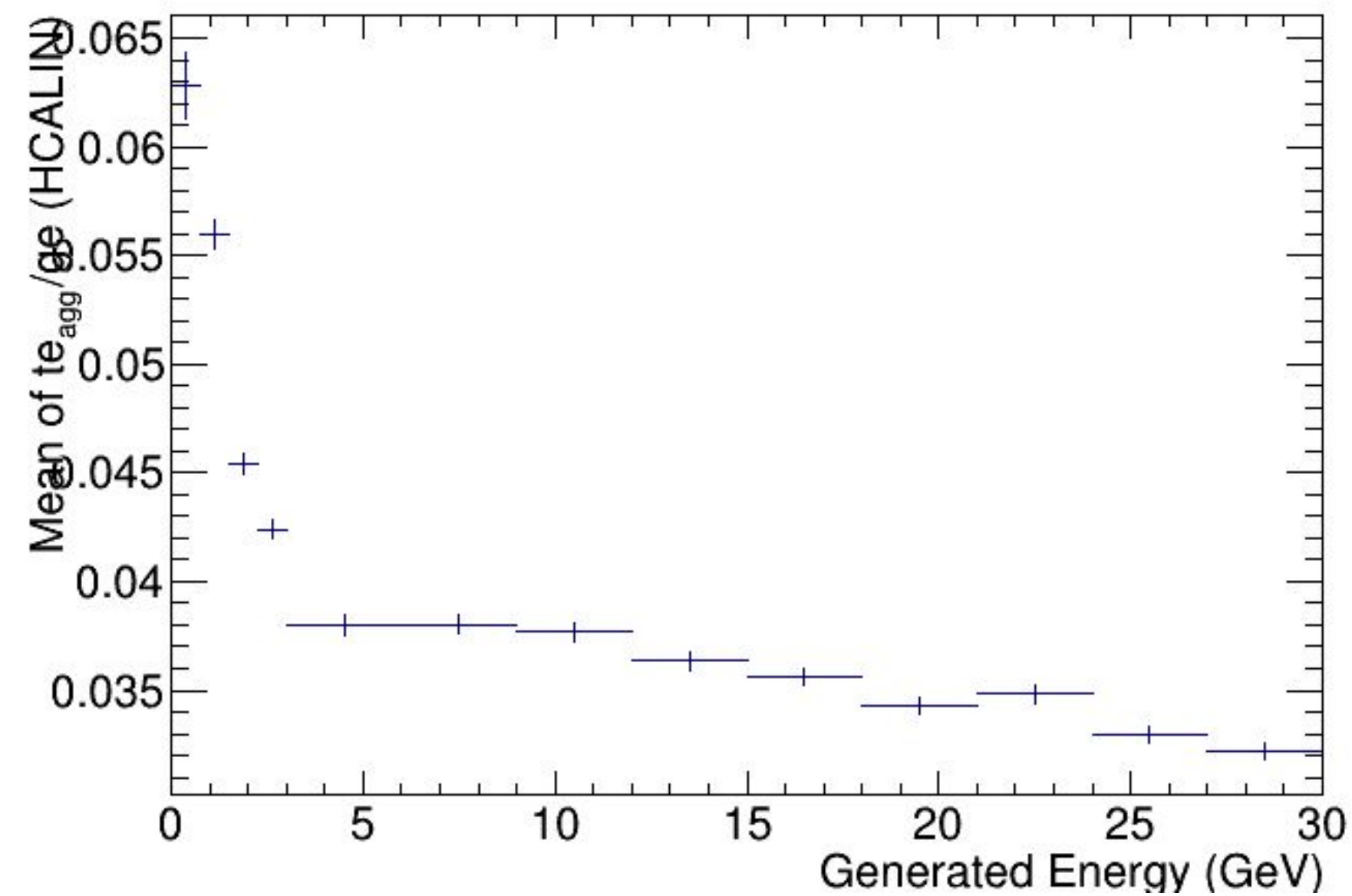
Level 1 Calibration Factors



CEMC



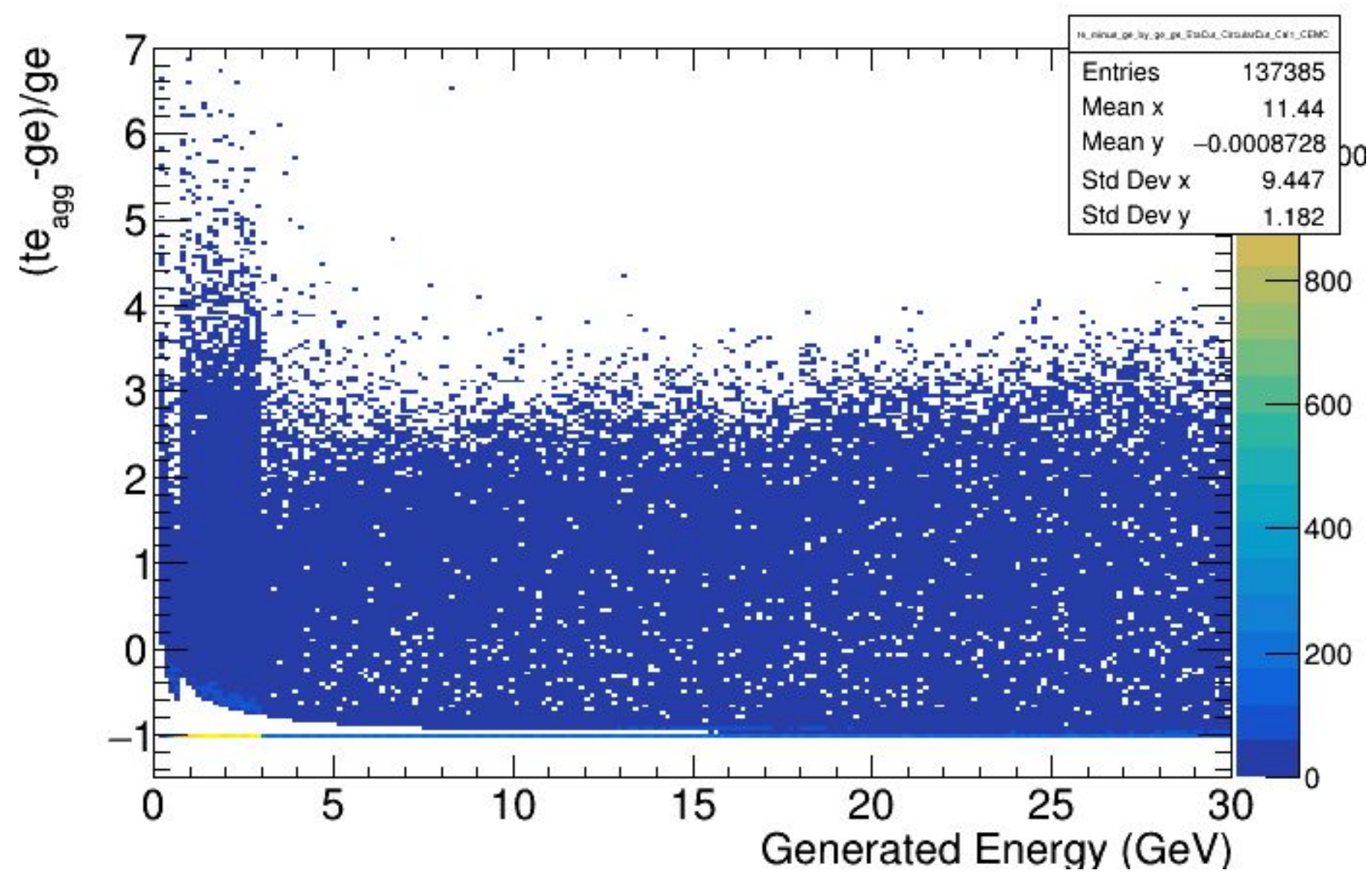
HCALOUT



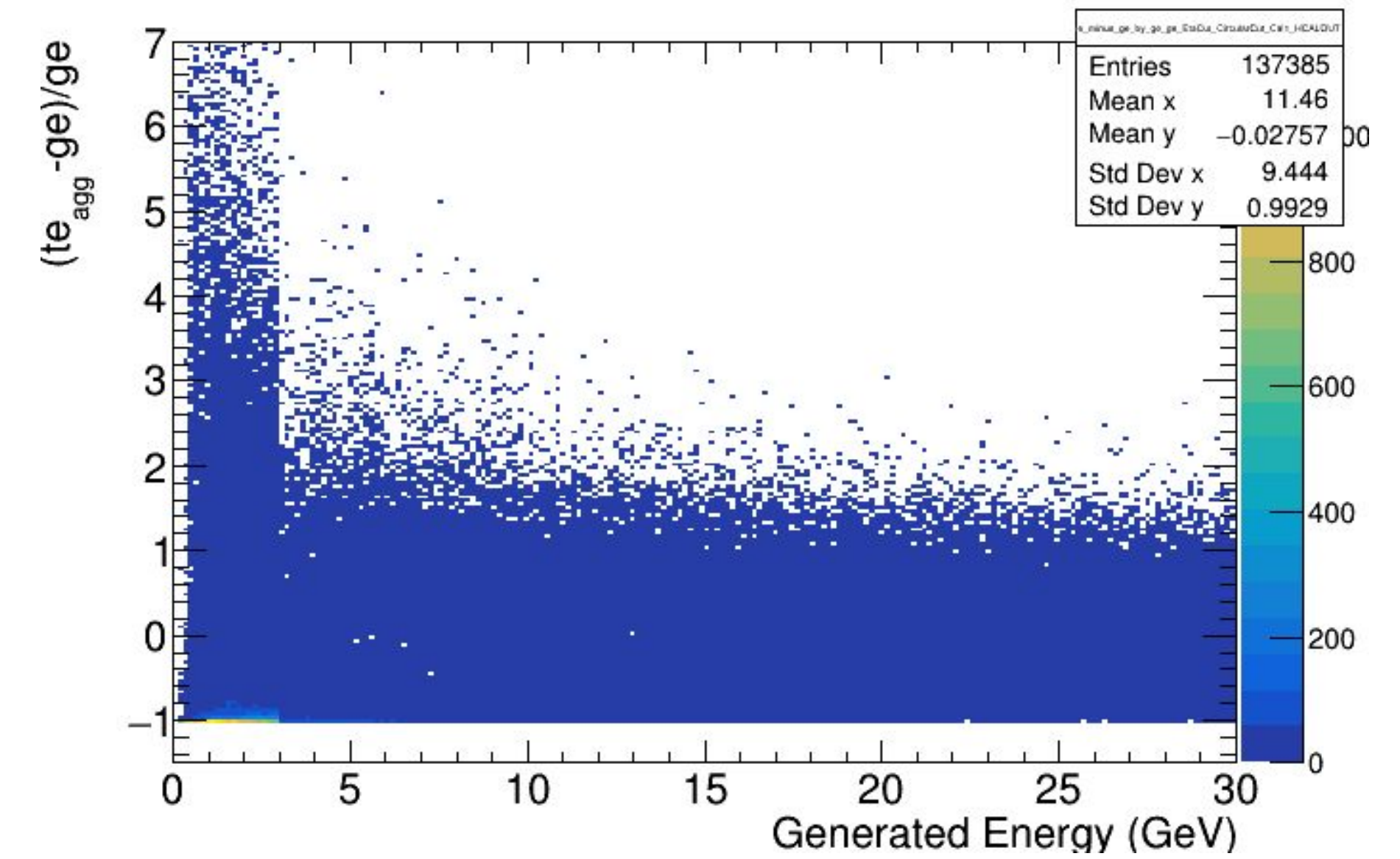
HCALIN

CEMC + HCALIN + HCALOUT (π^-)

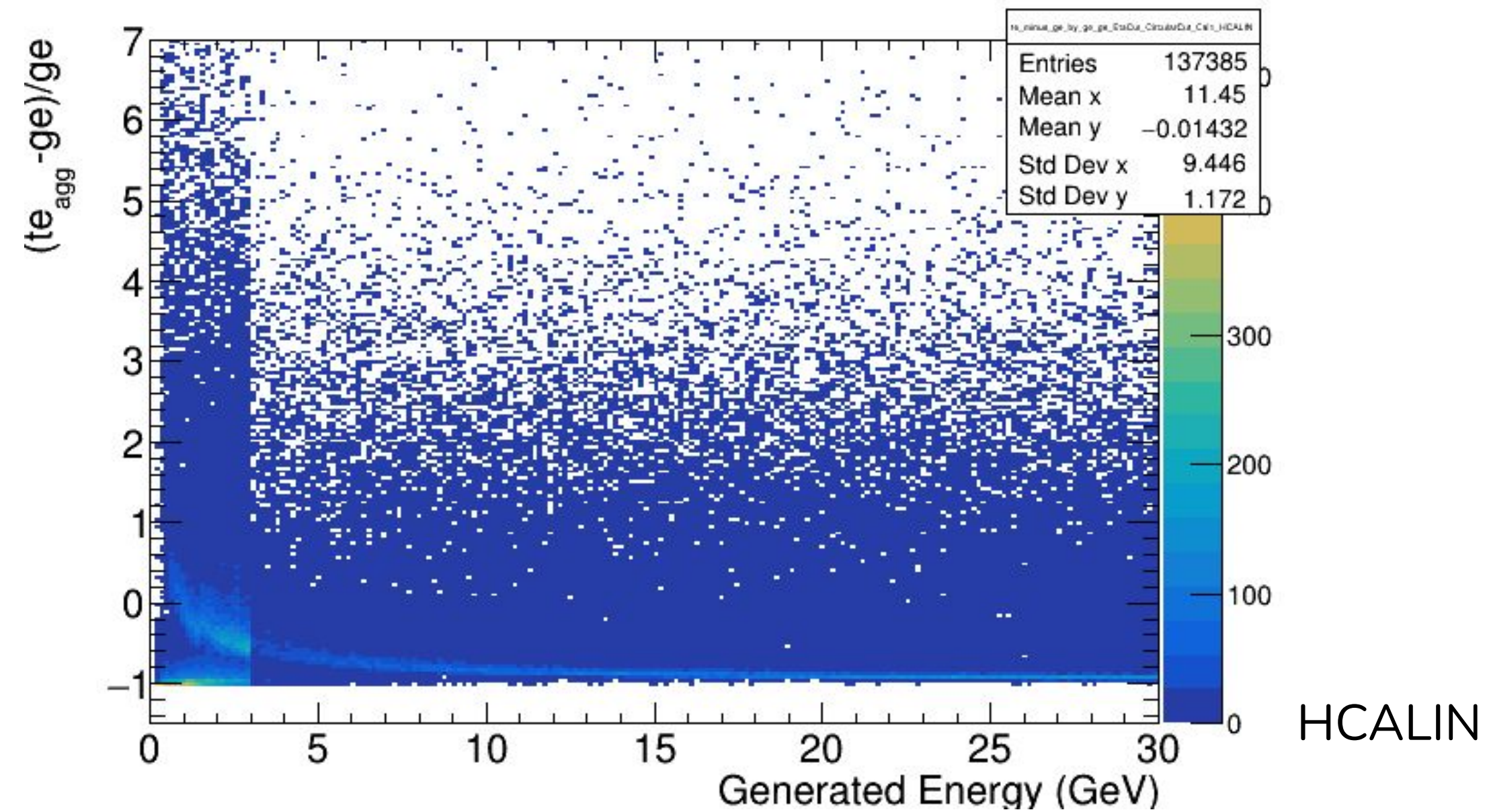
Level 1 Calibration (L1)



CEMC



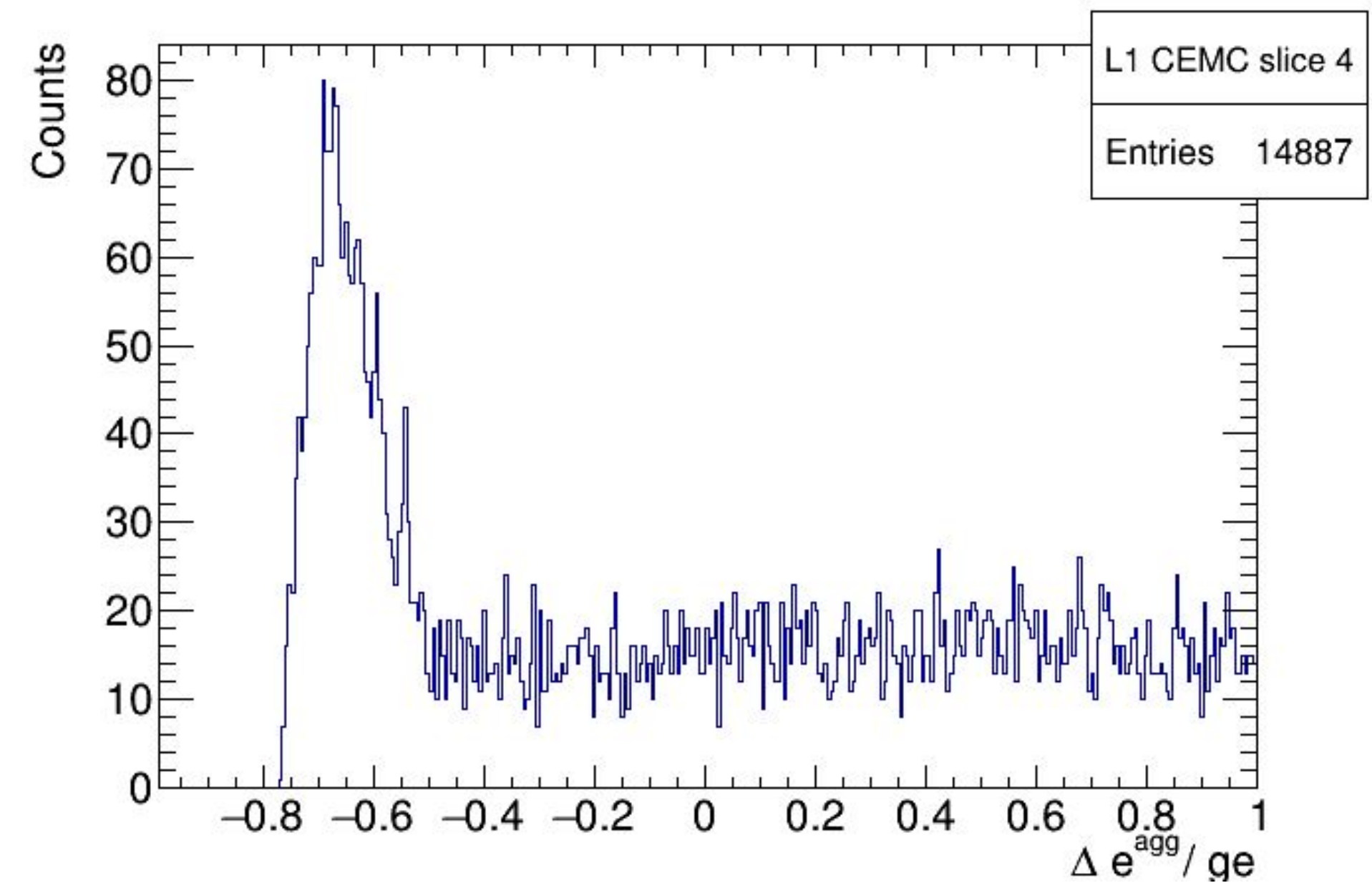
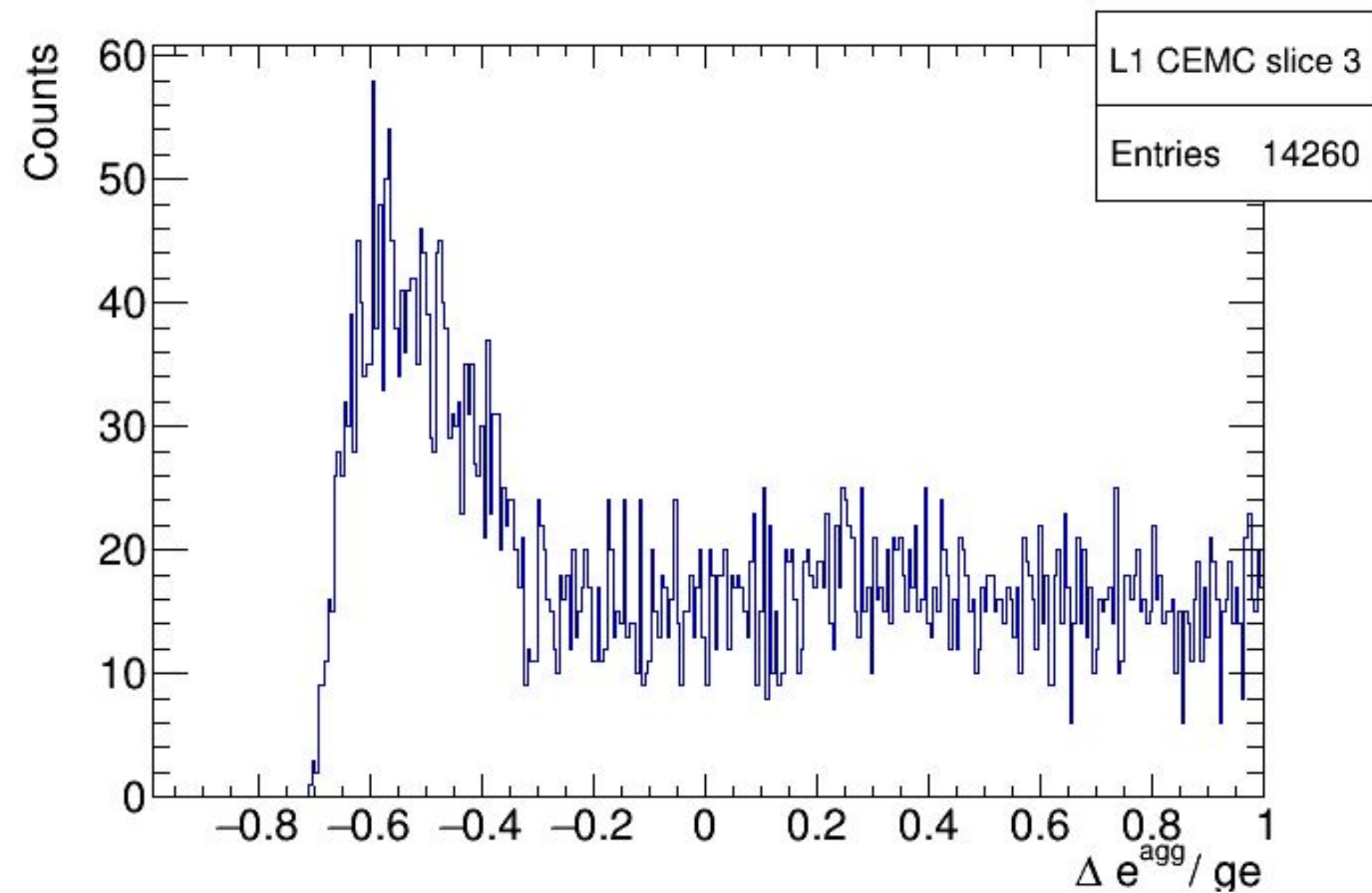
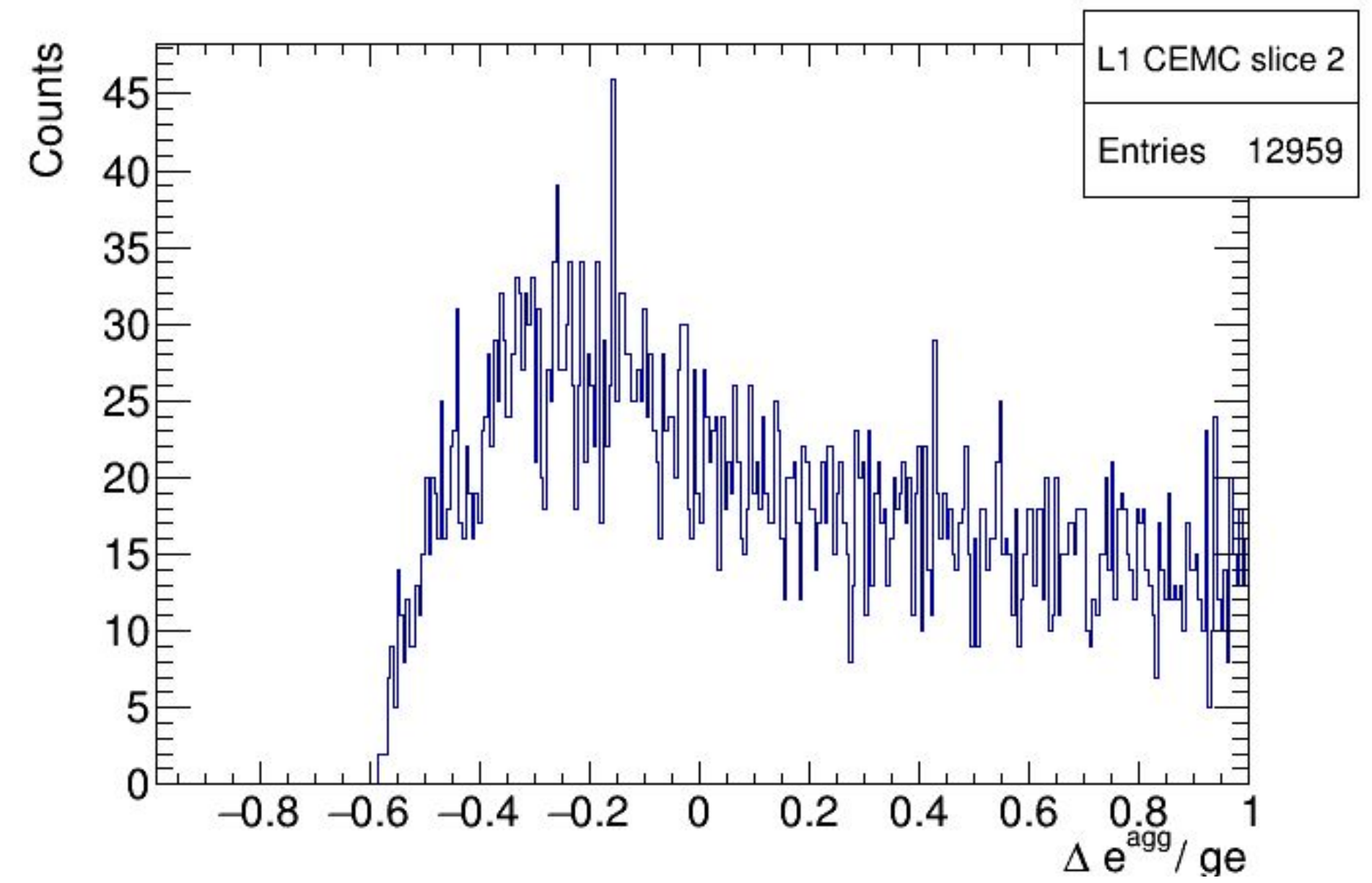
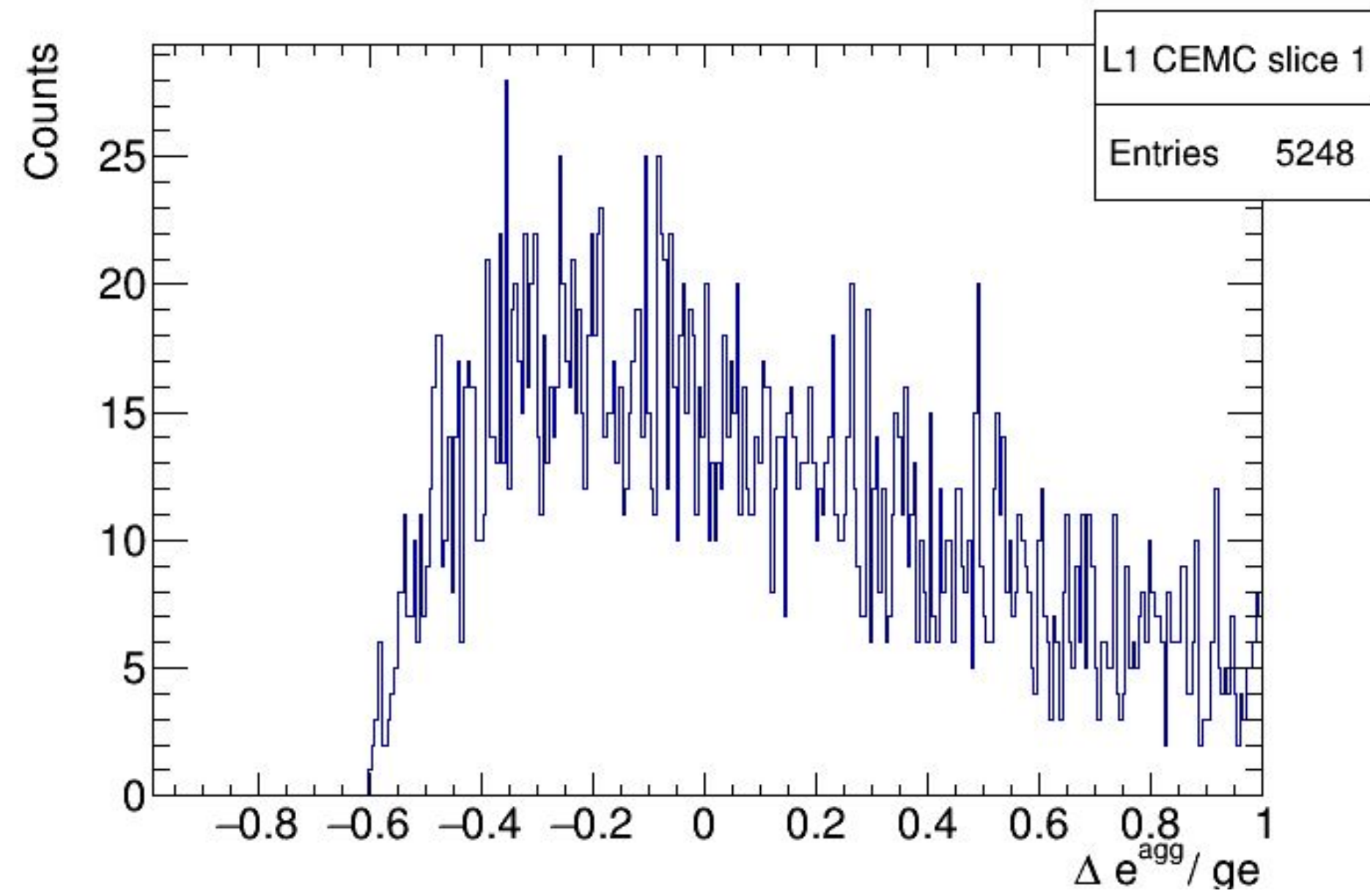
HCALOUT



HCALIN

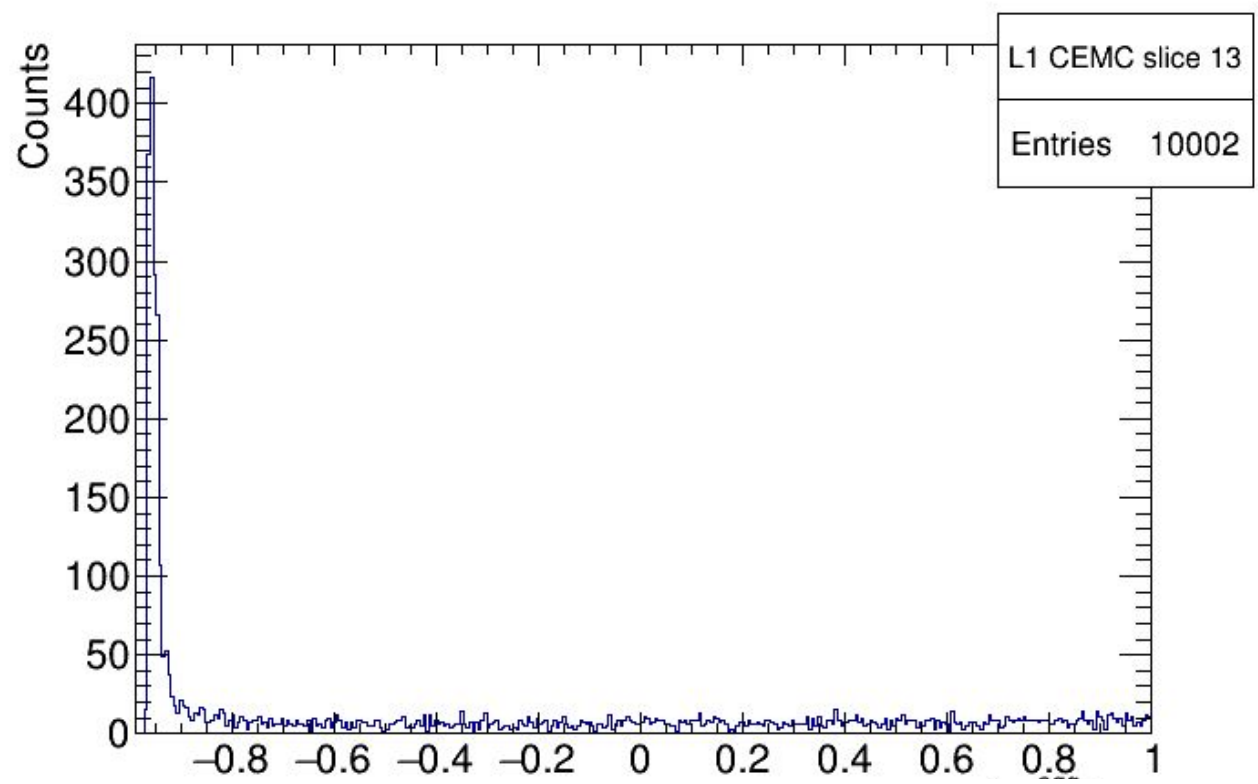
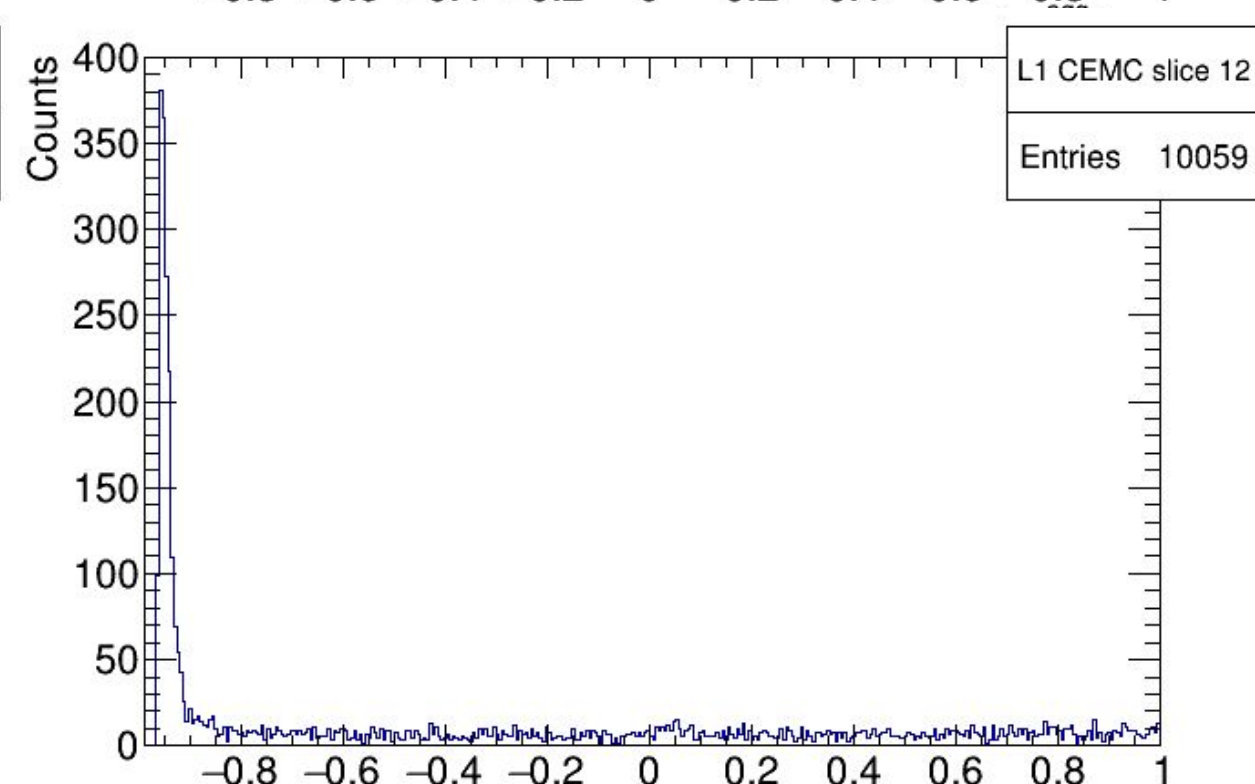
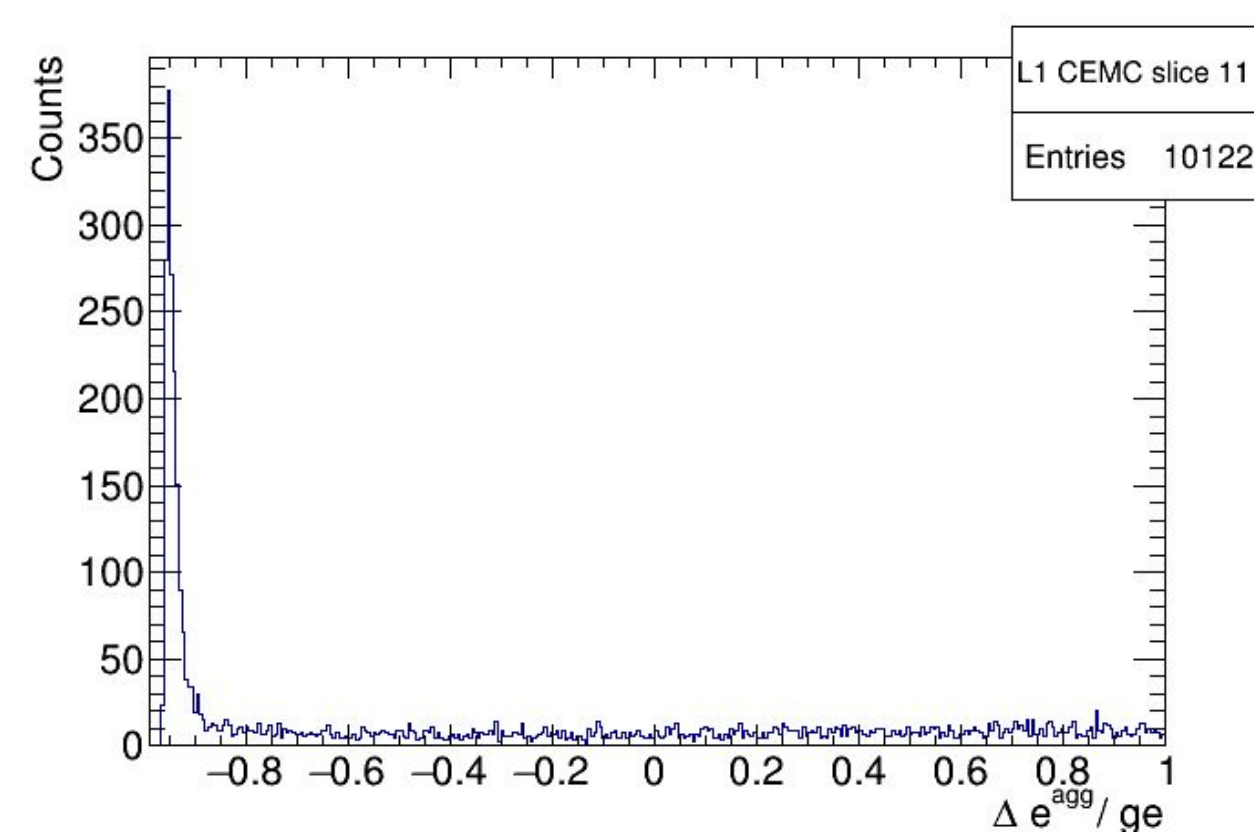
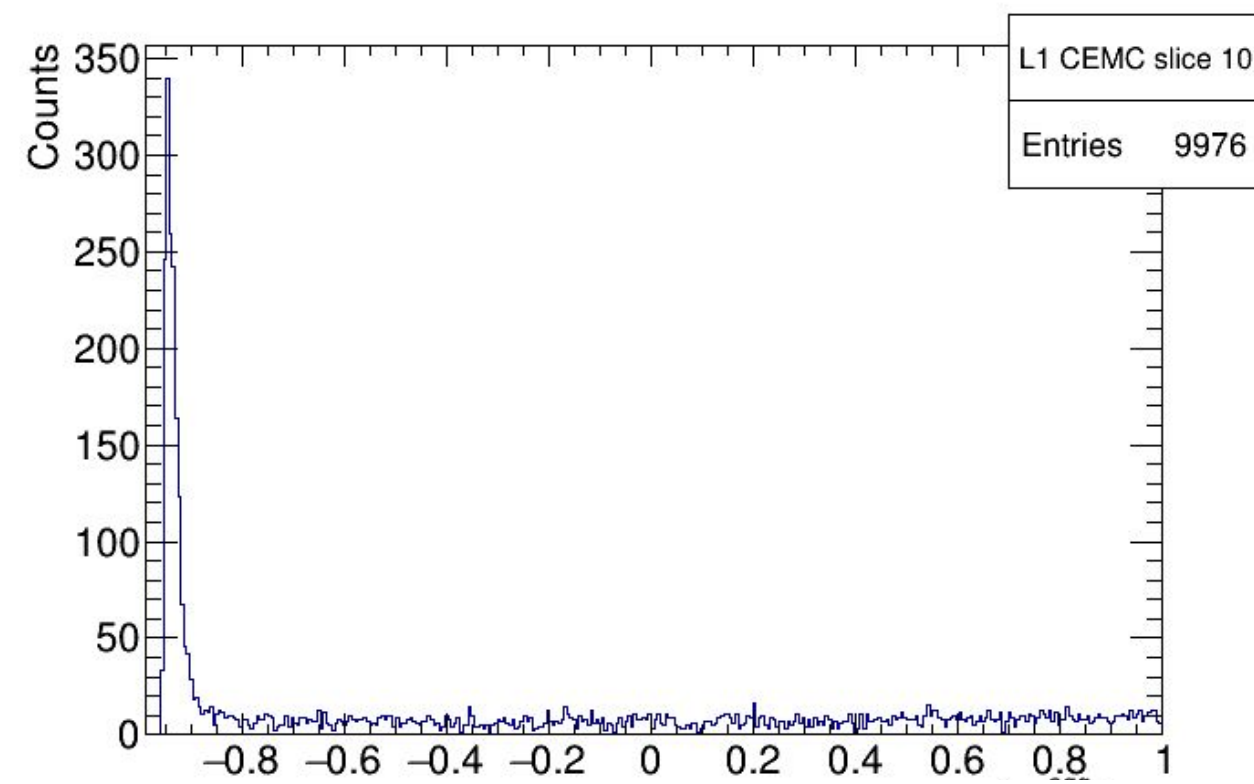
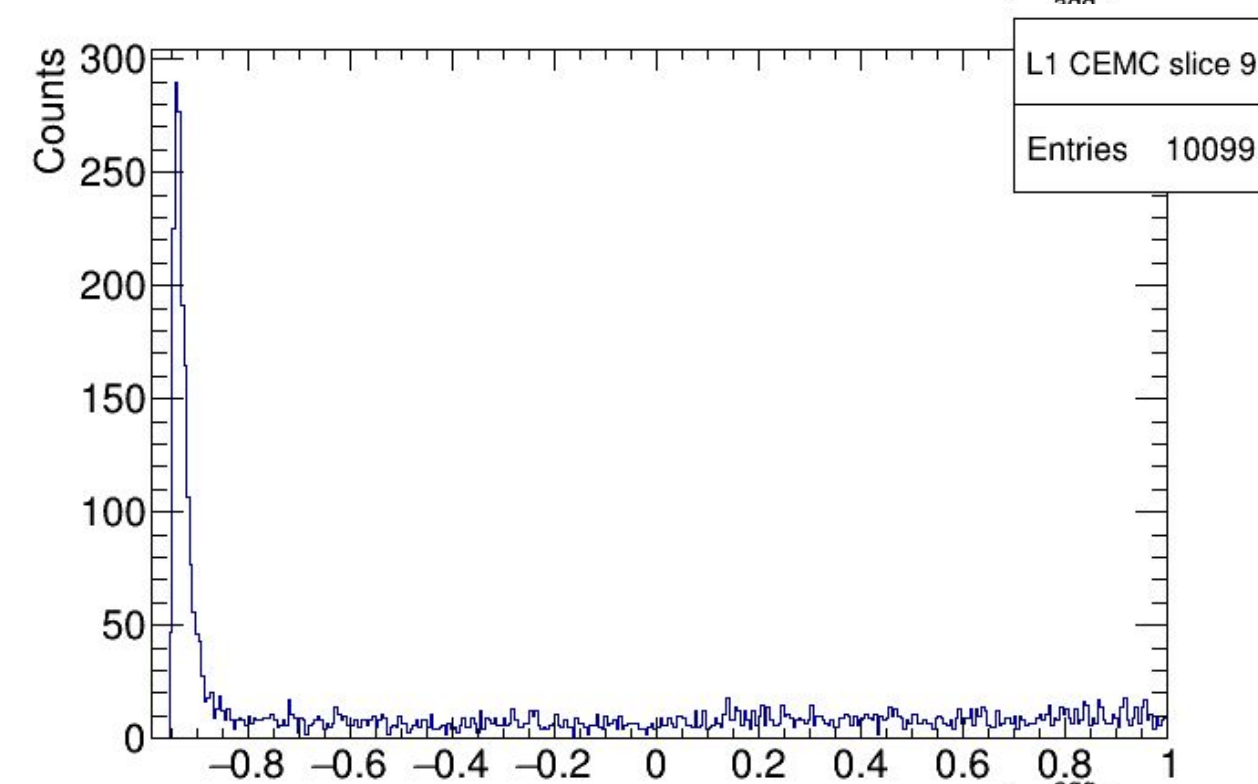
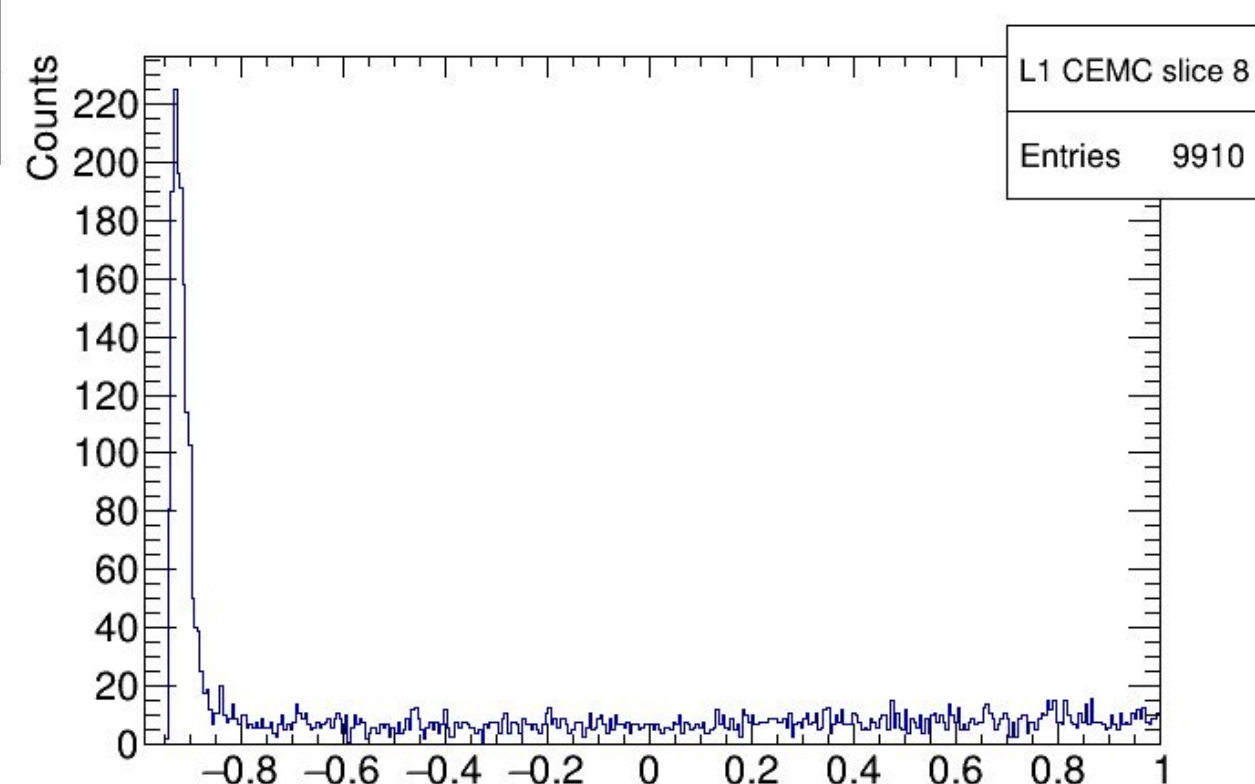
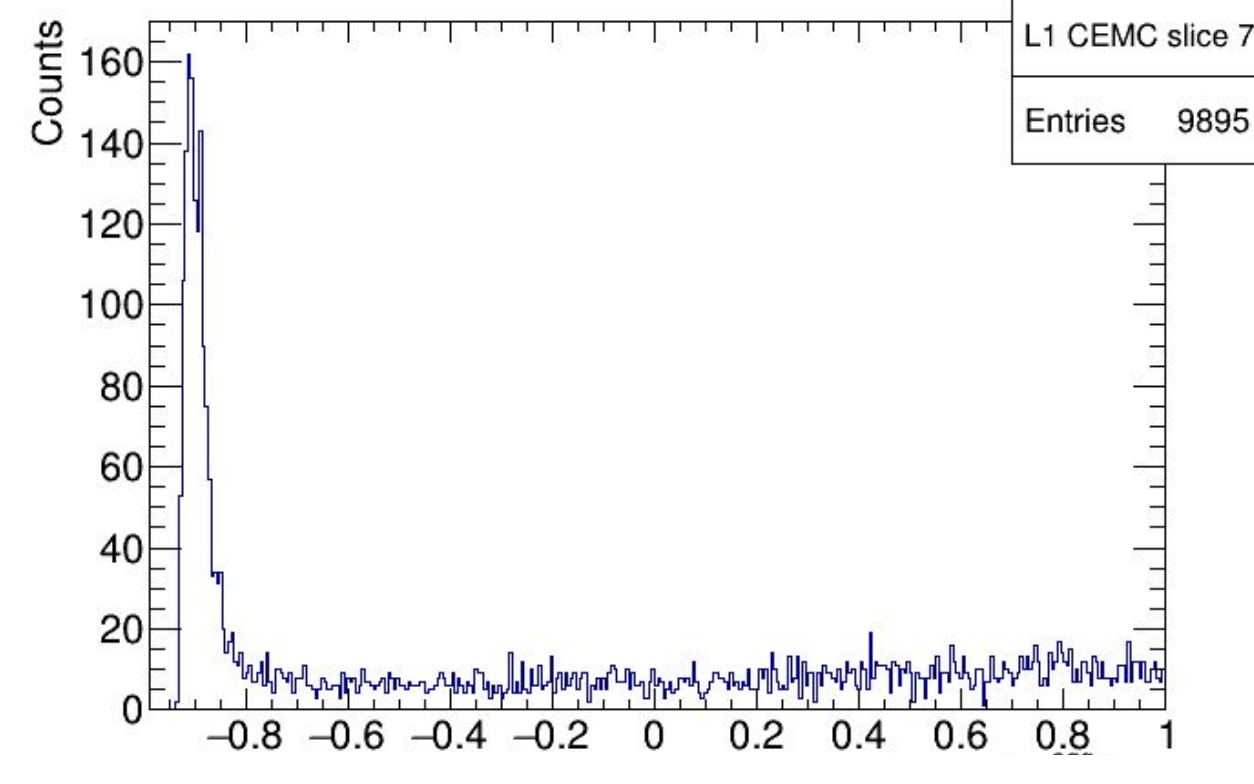
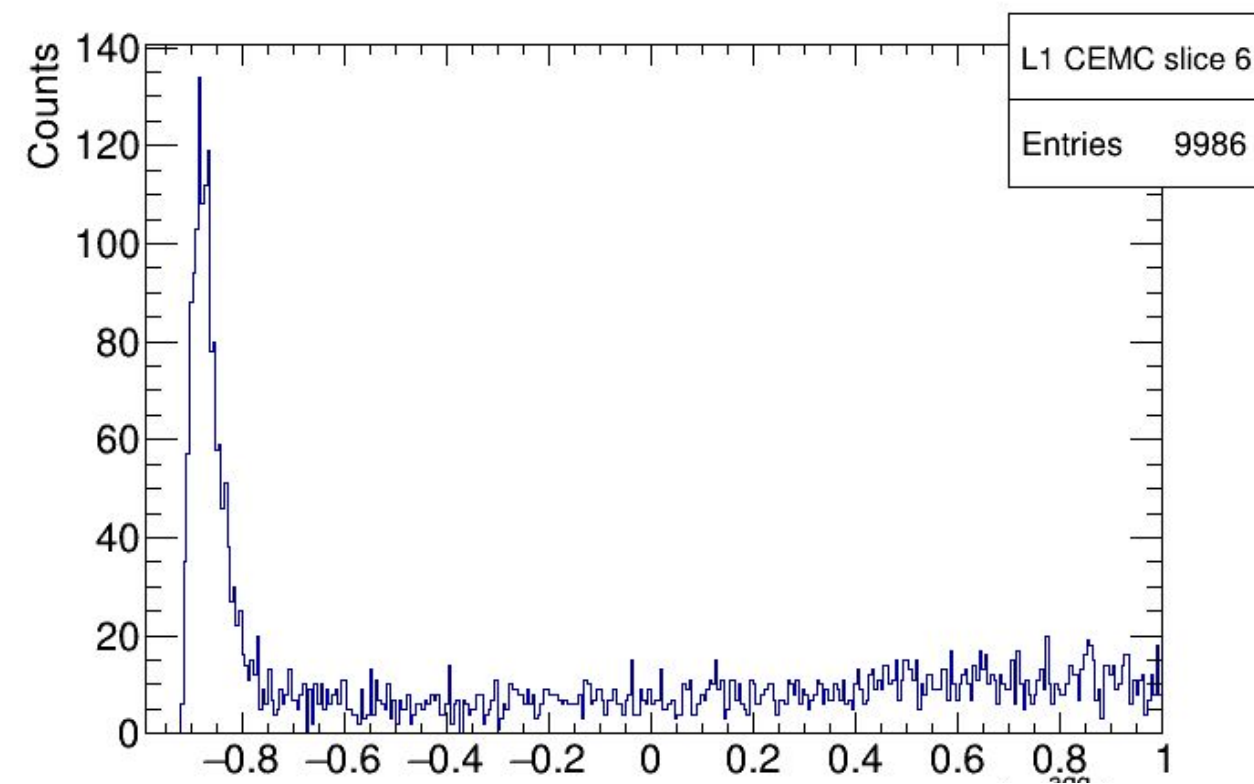
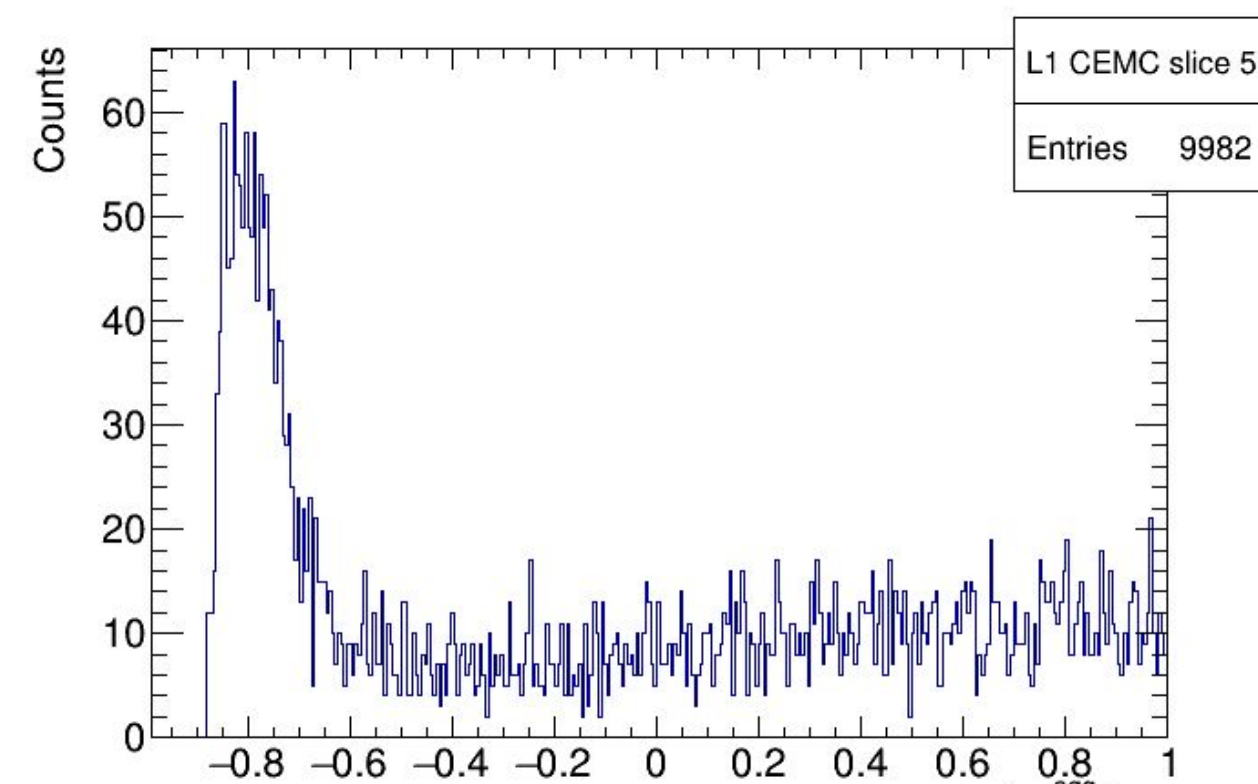
CEMC (π^-)

L1 Fitted Gaussians (0 - 3 GeV)



CEMC (π^-)

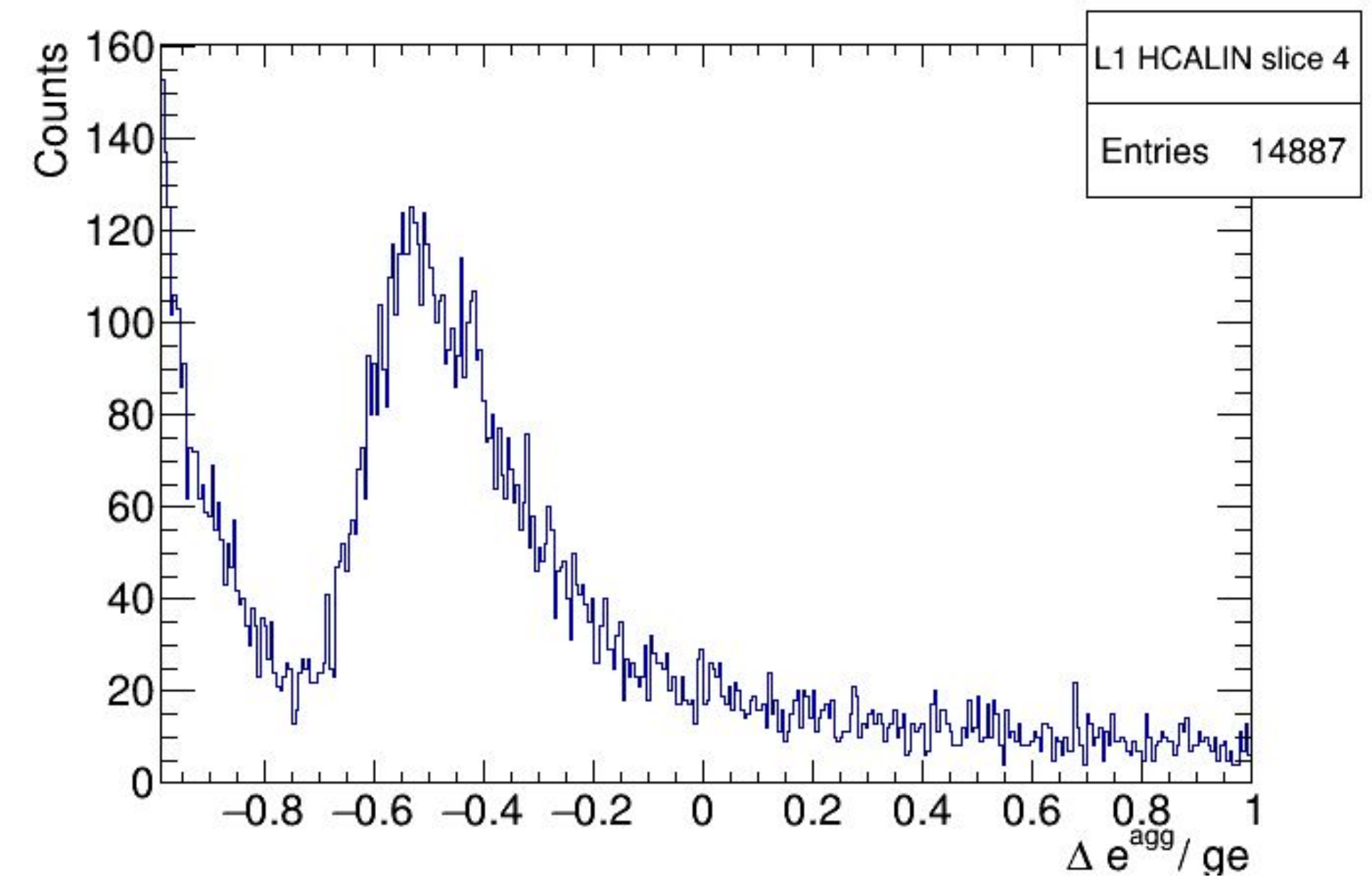
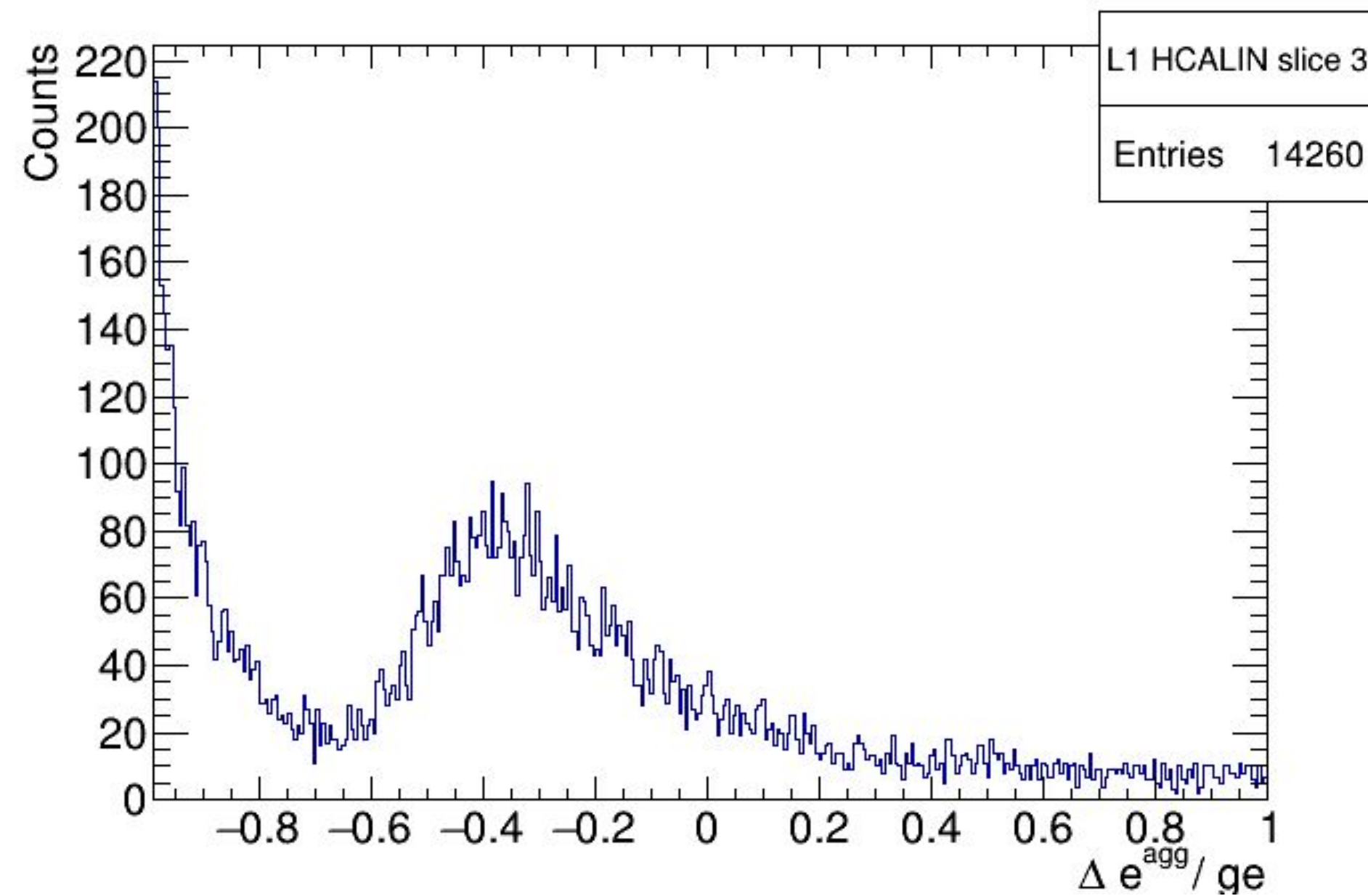
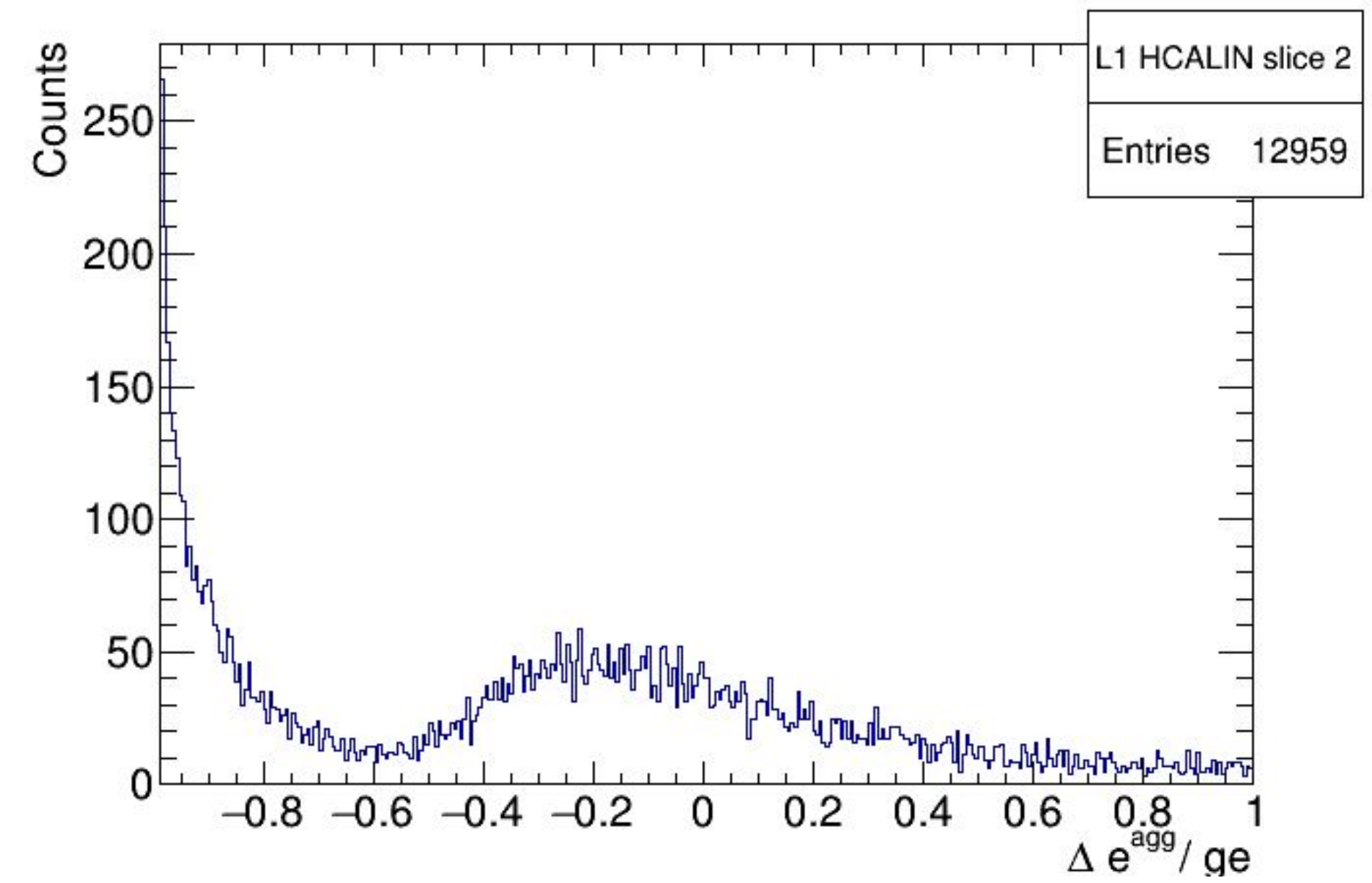
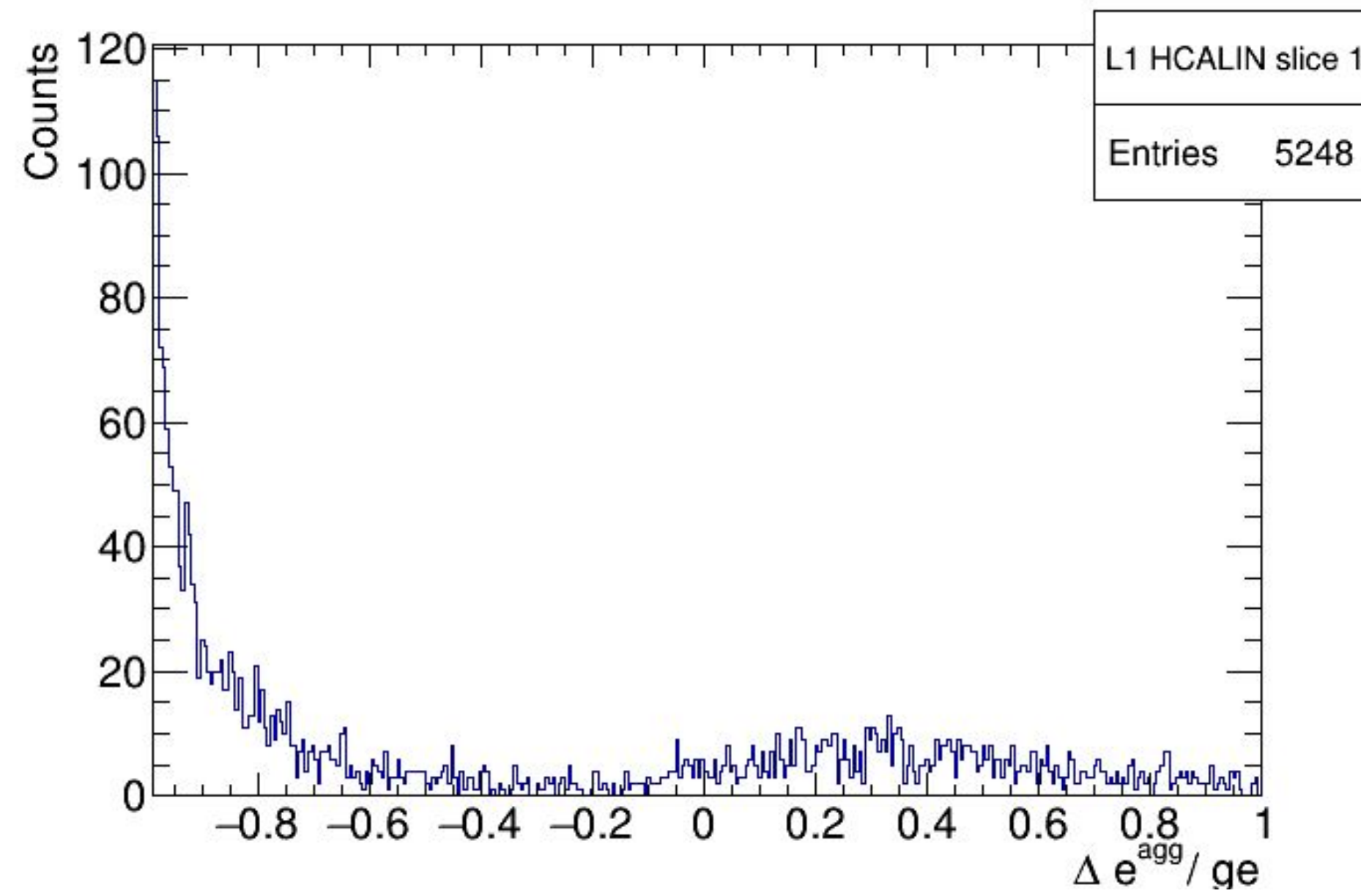
L1 Fitted Gaussians (3 - 30 GeV)



The x-axes denote $\Delta e_{agg}/ge$

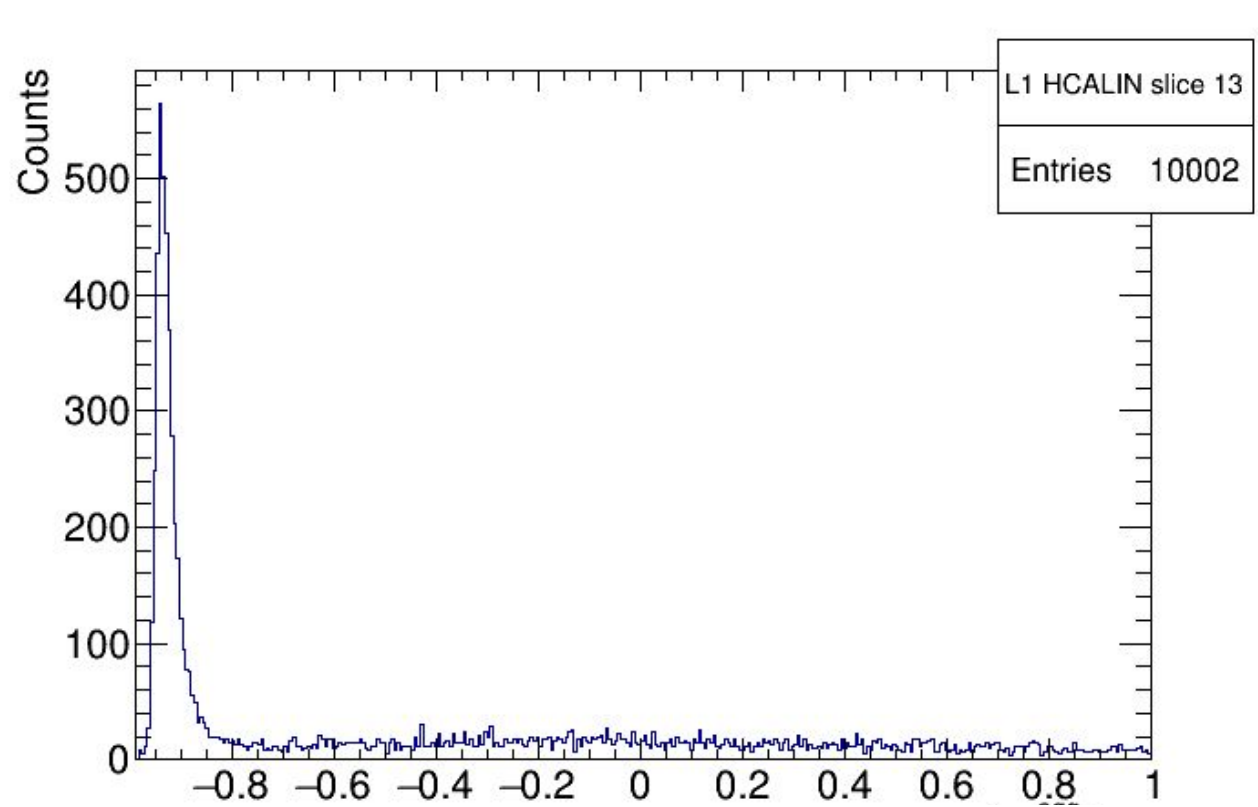
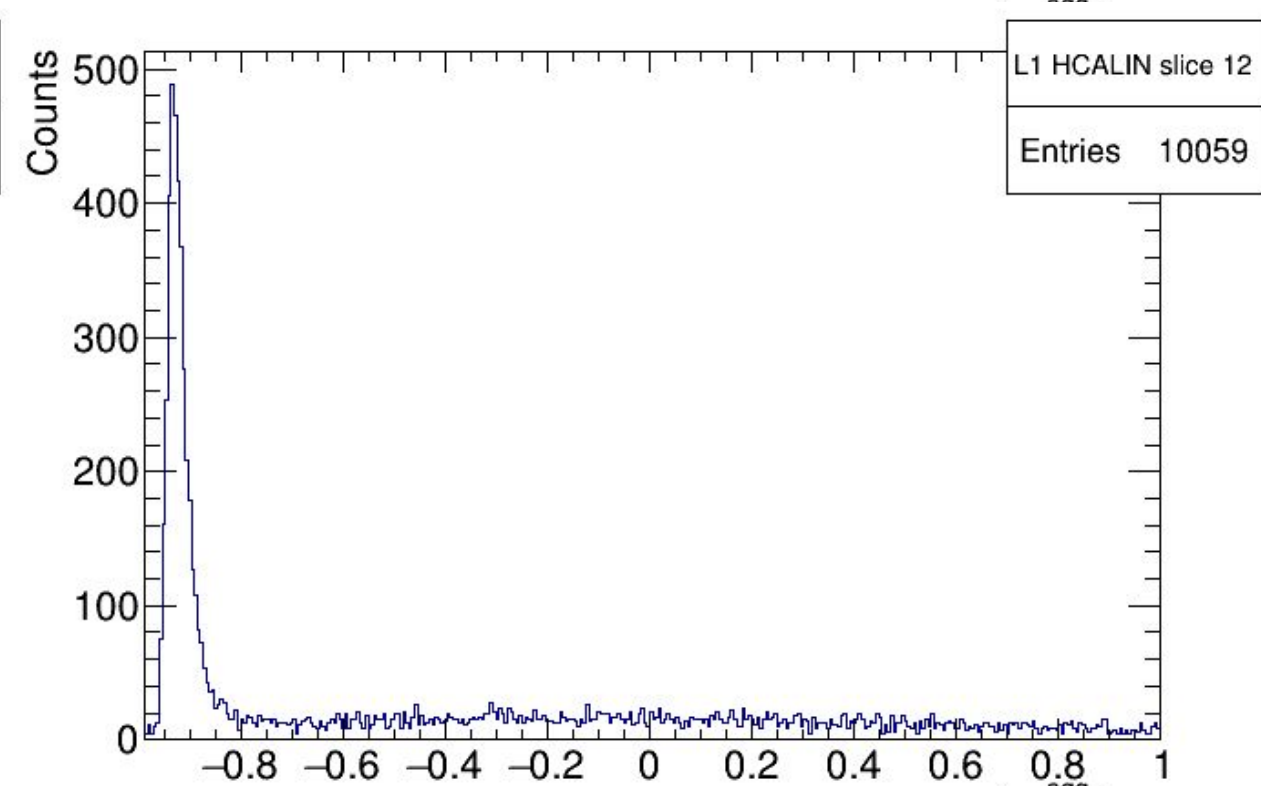
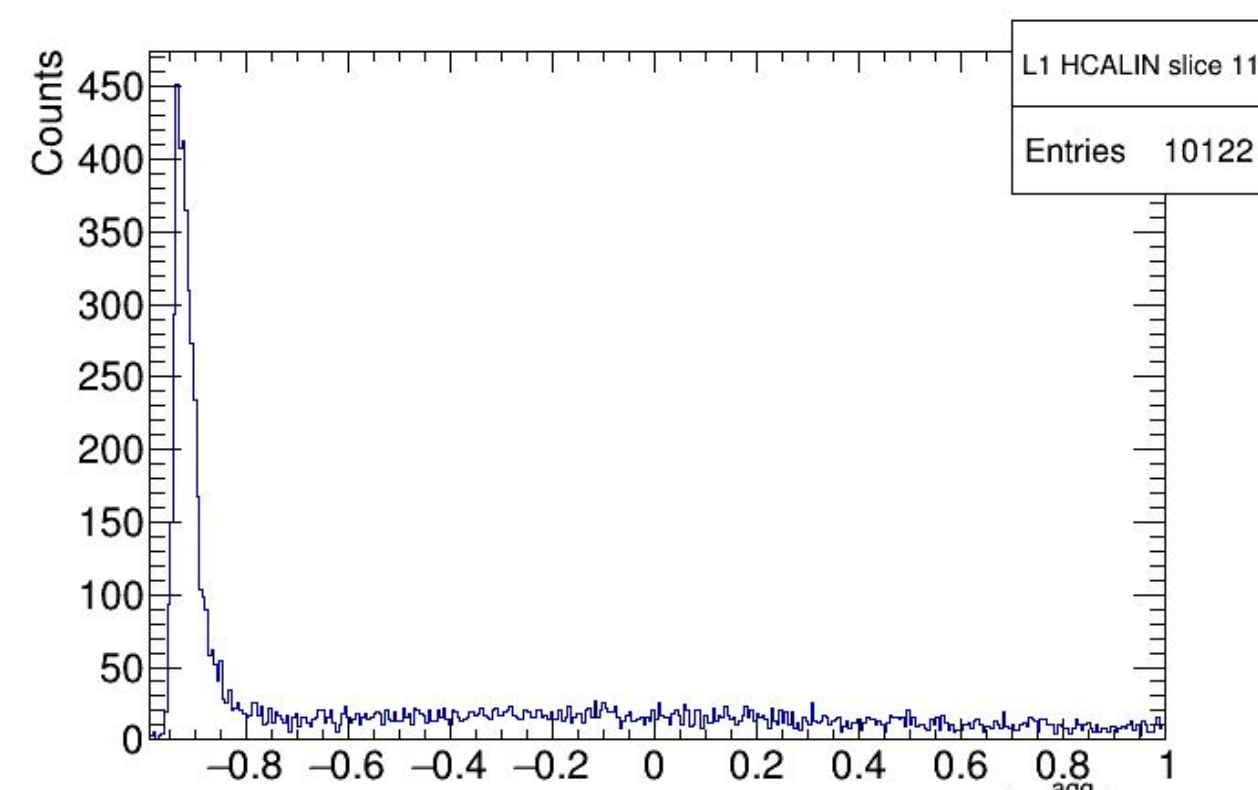
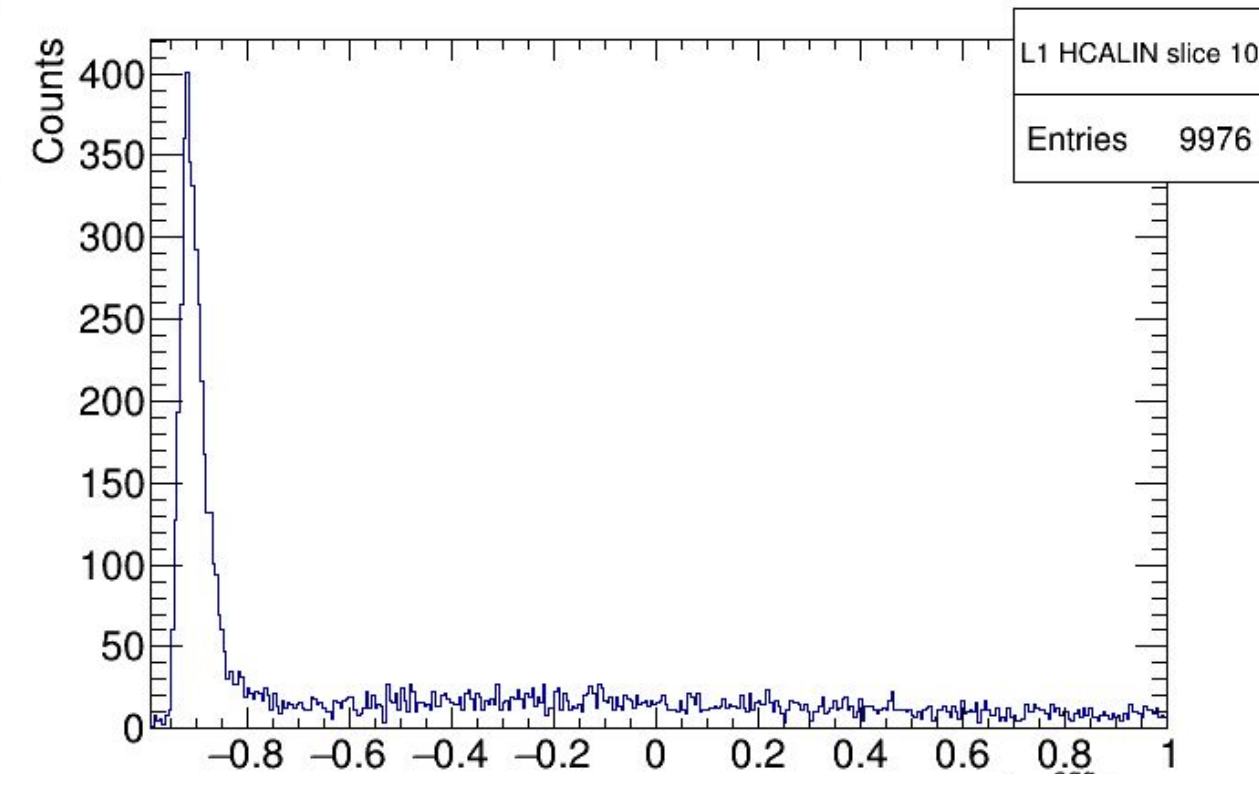
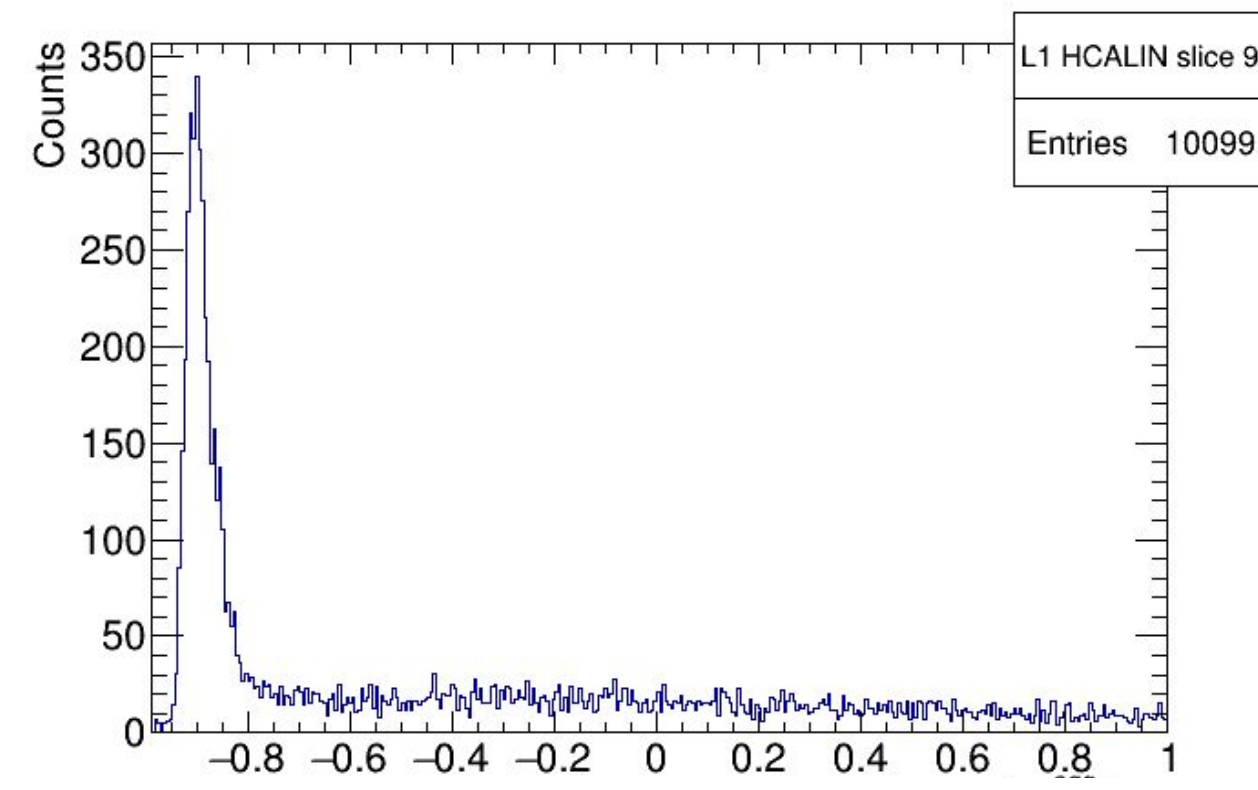
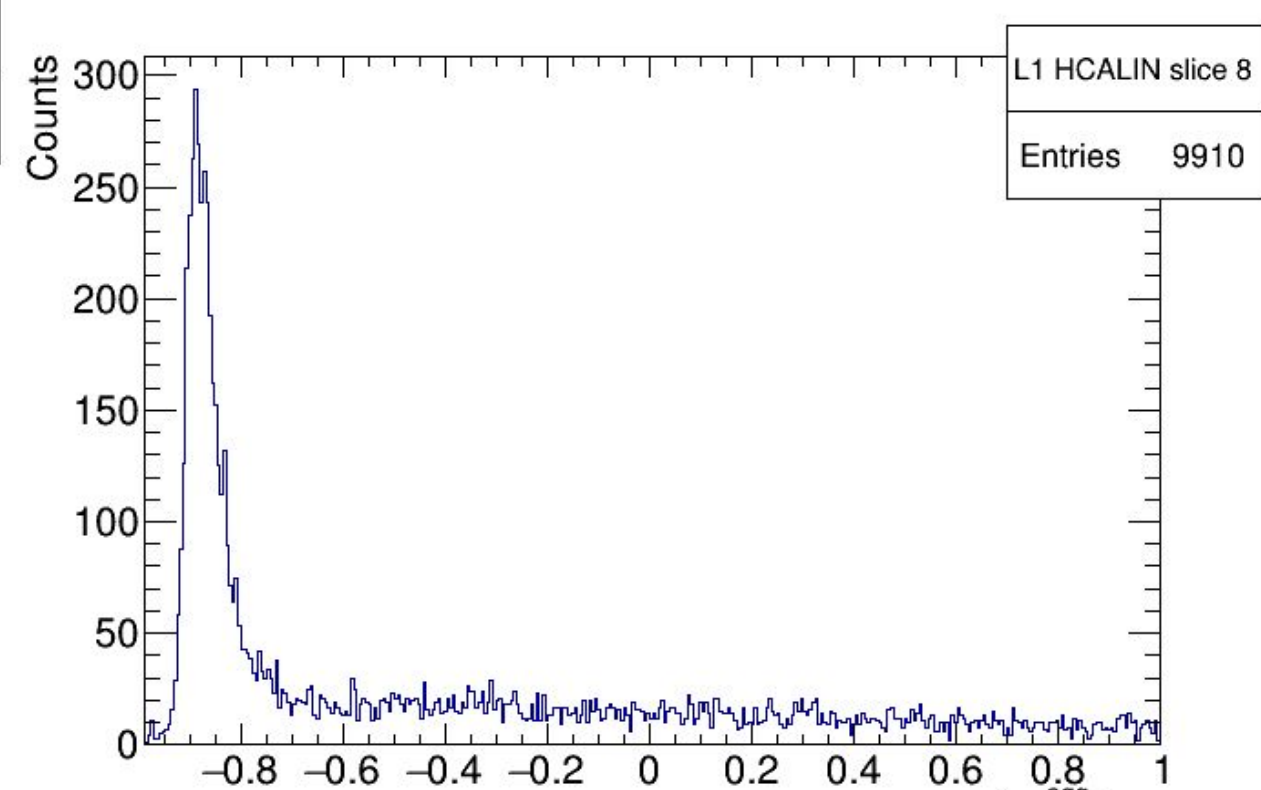
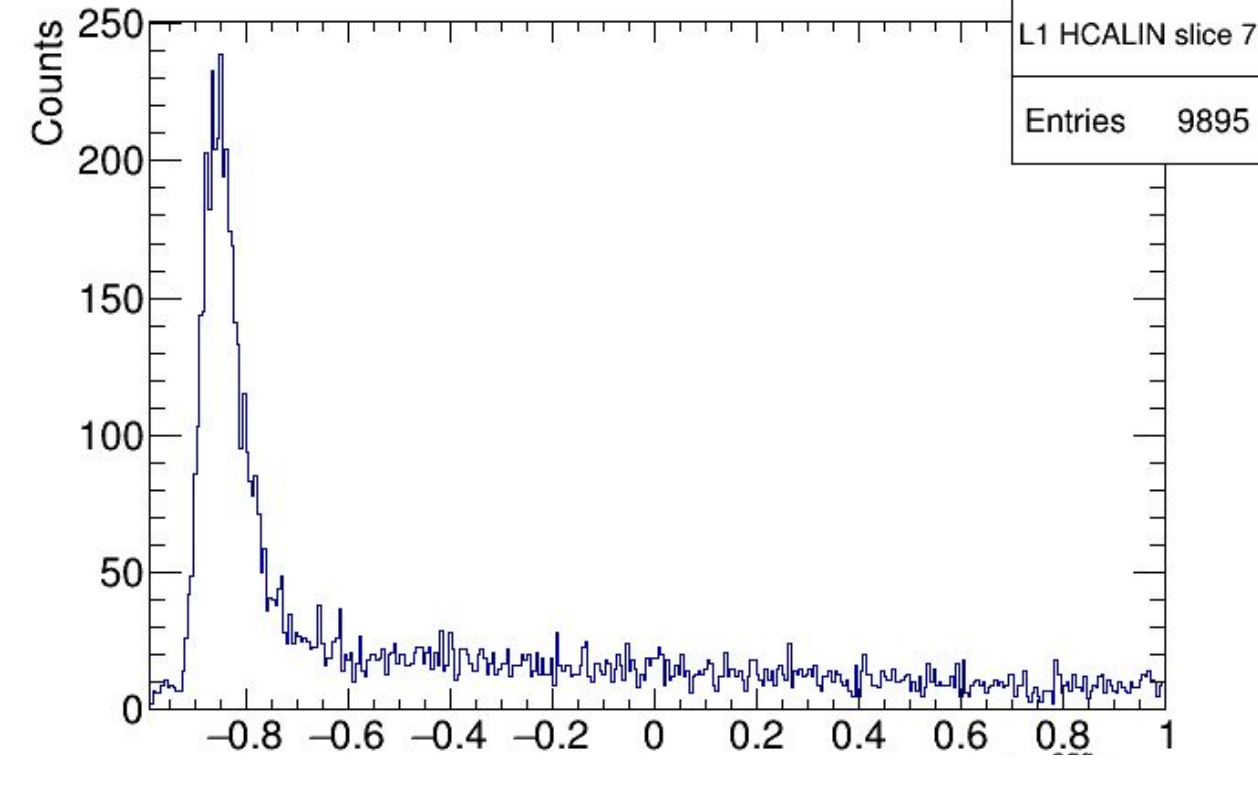
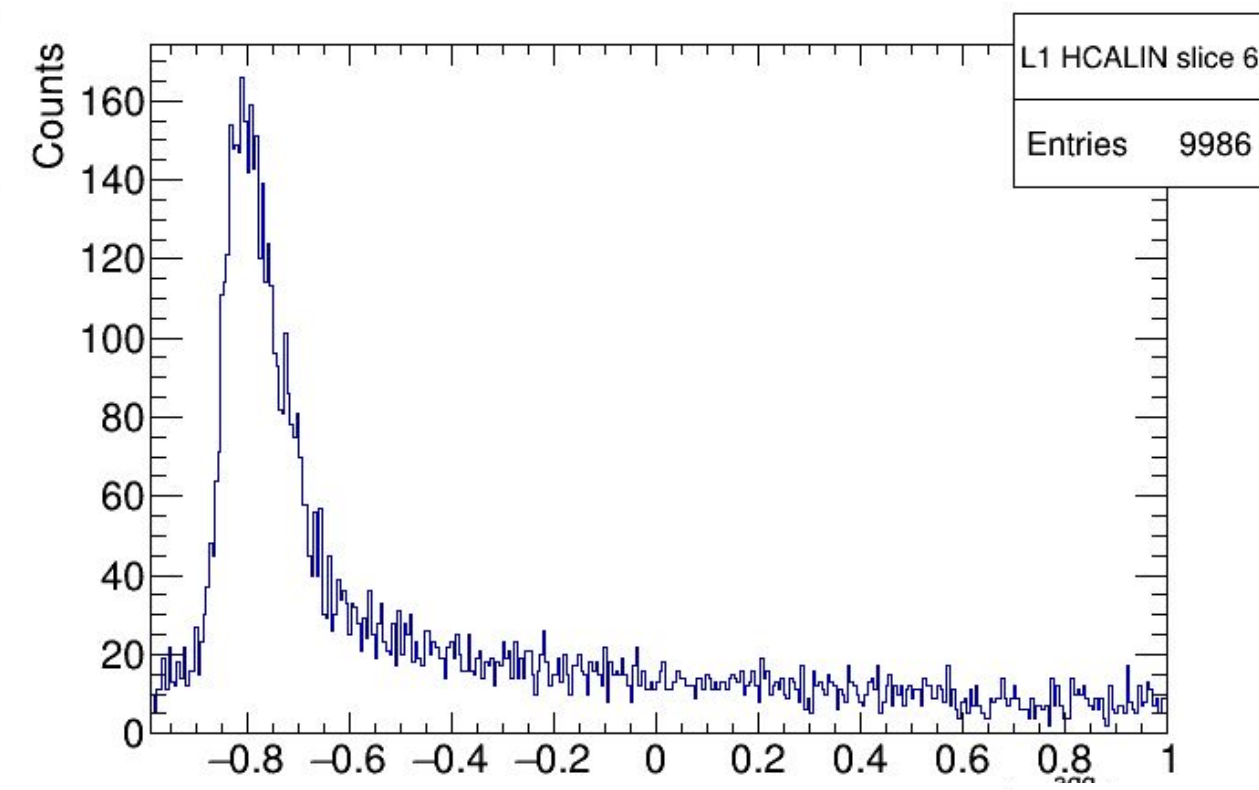
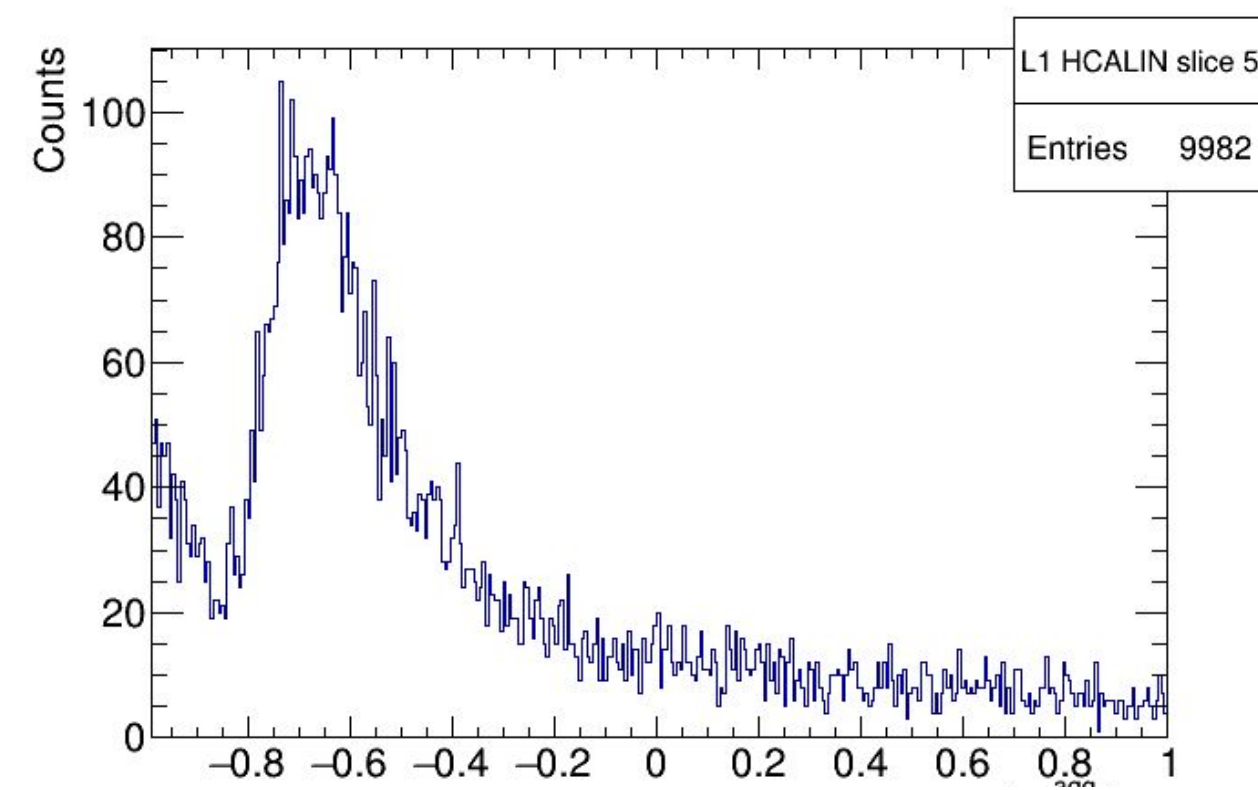
HCALIN (π^-)

L1 Fitted Gaussians (0 - 3 GeV)



HCALIN (π^-)

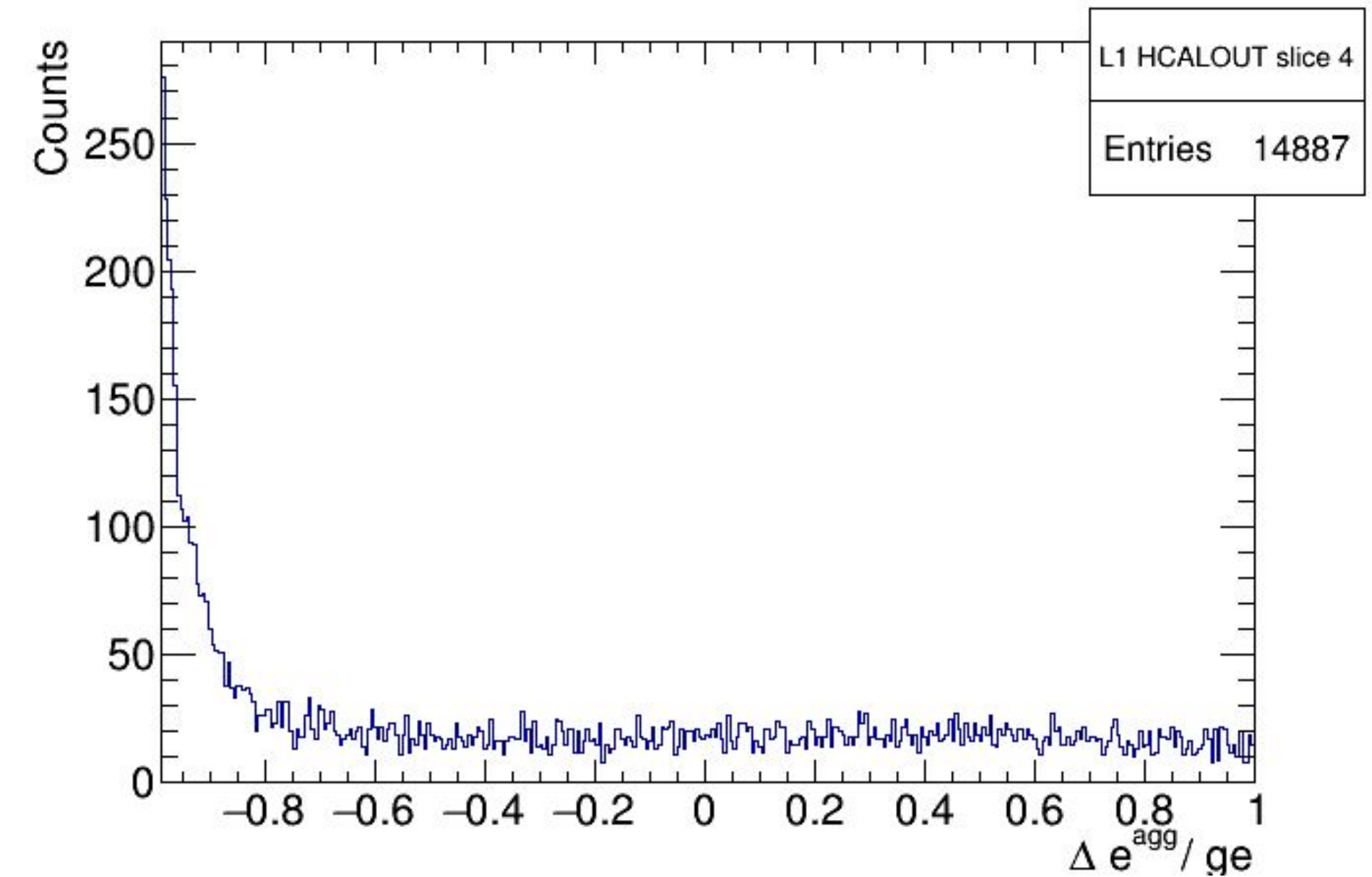
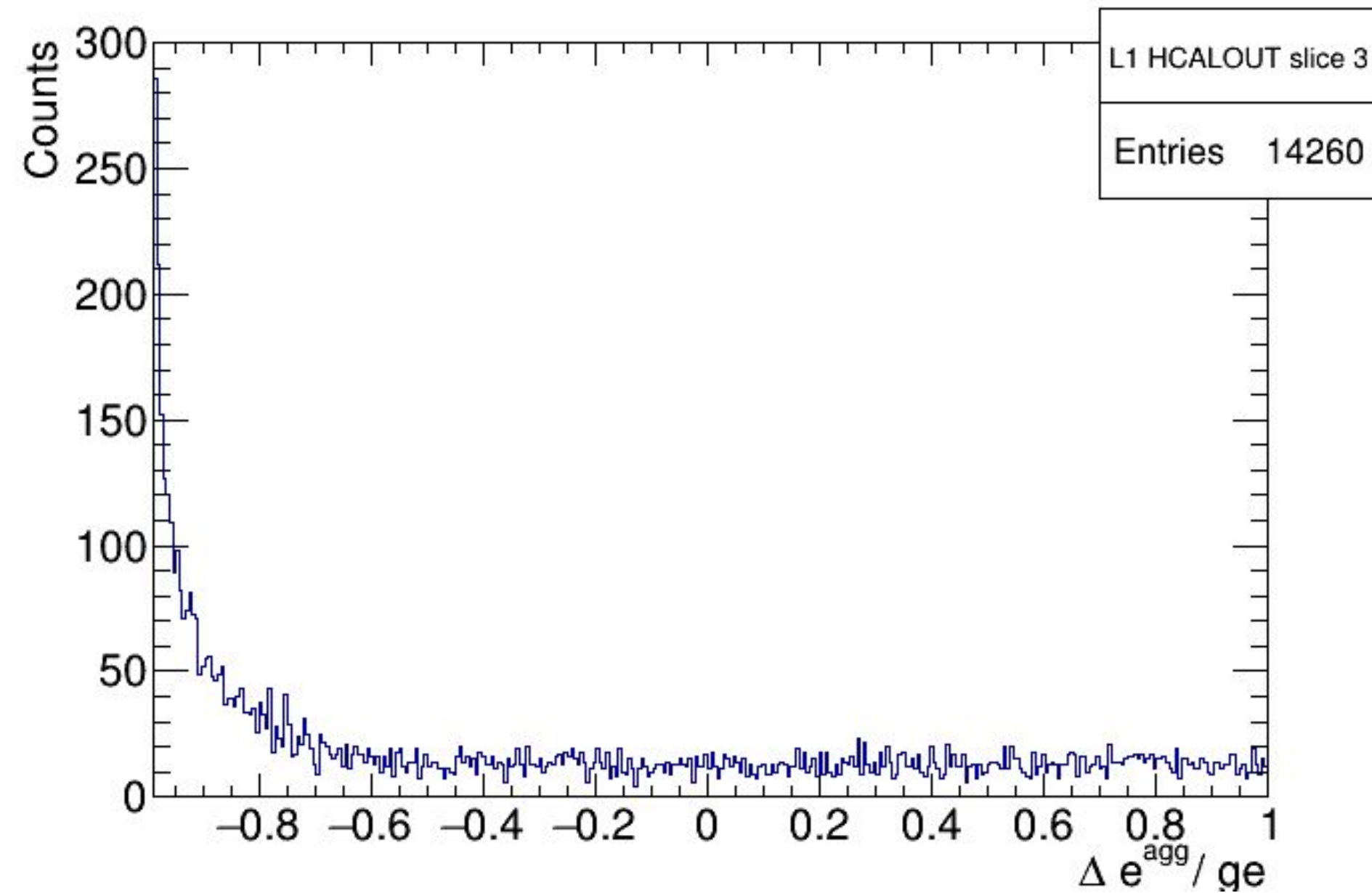
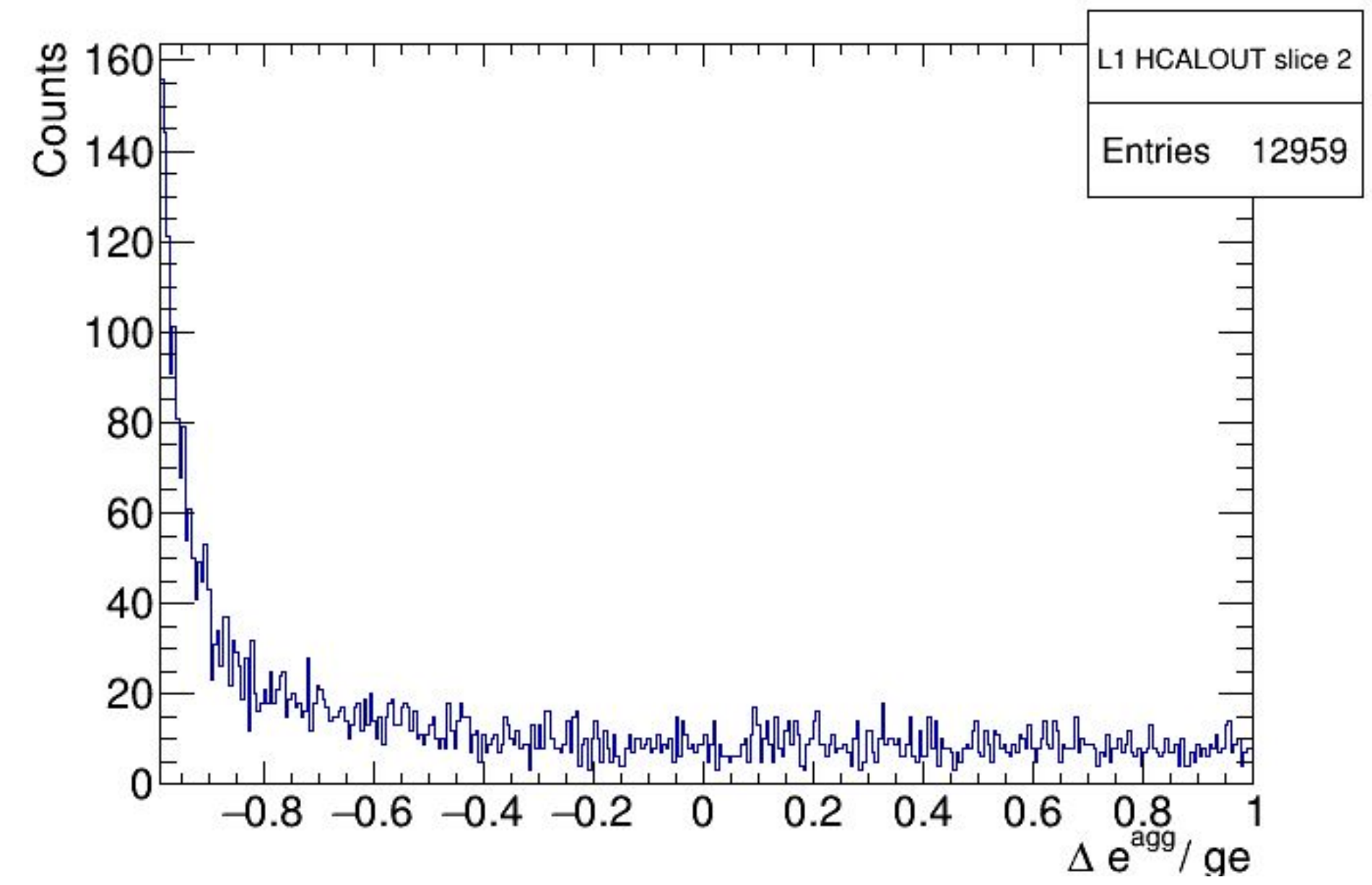
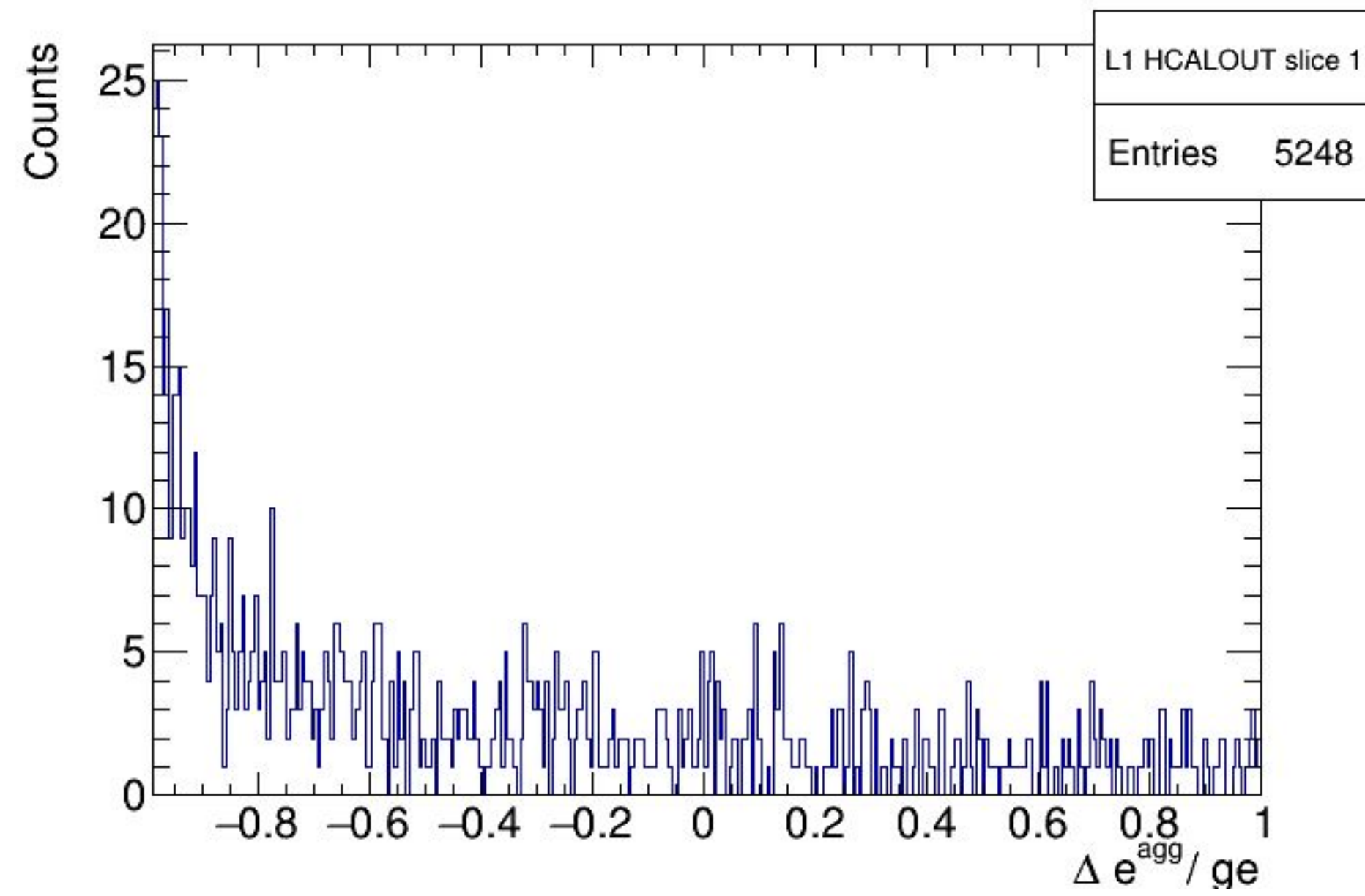
L1 Fitted Gaussians (3 - 30 GeV)



The x-axes denote $\Delta e_{agg}/ge$

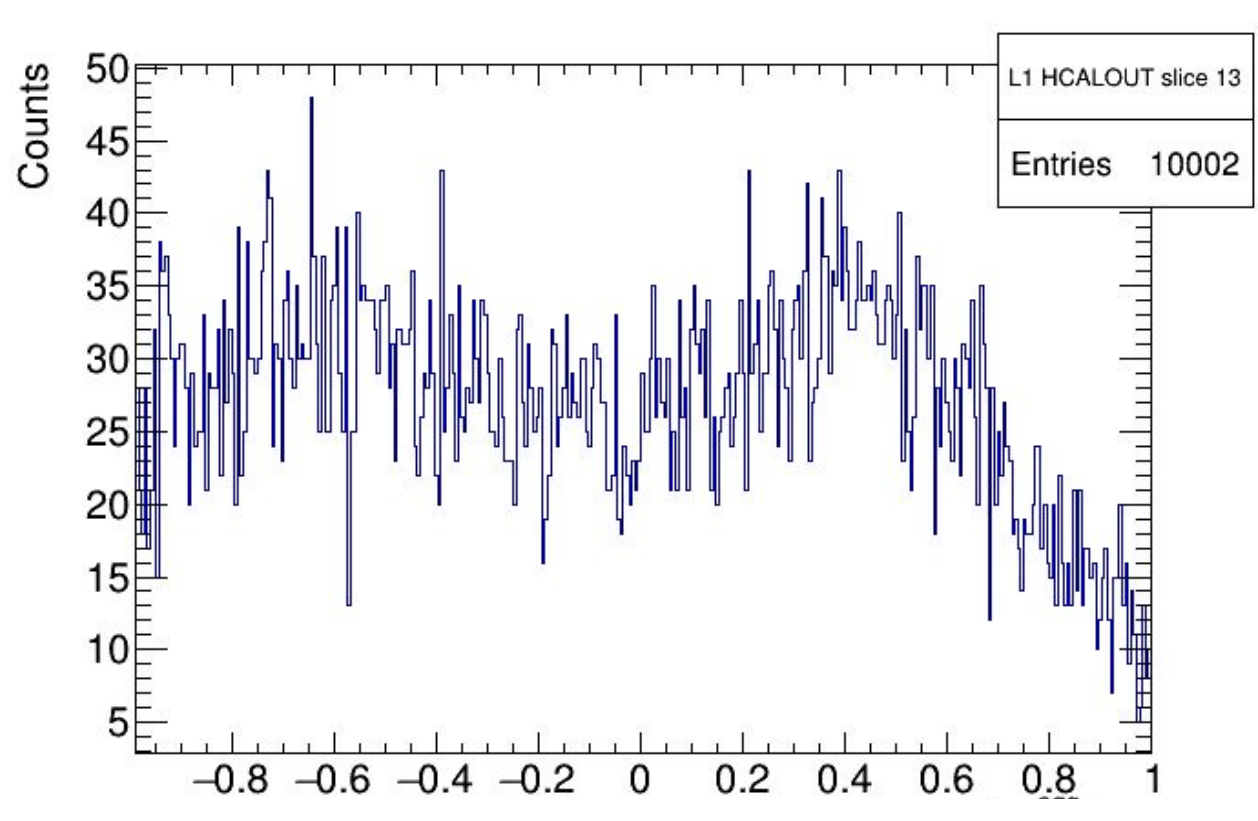
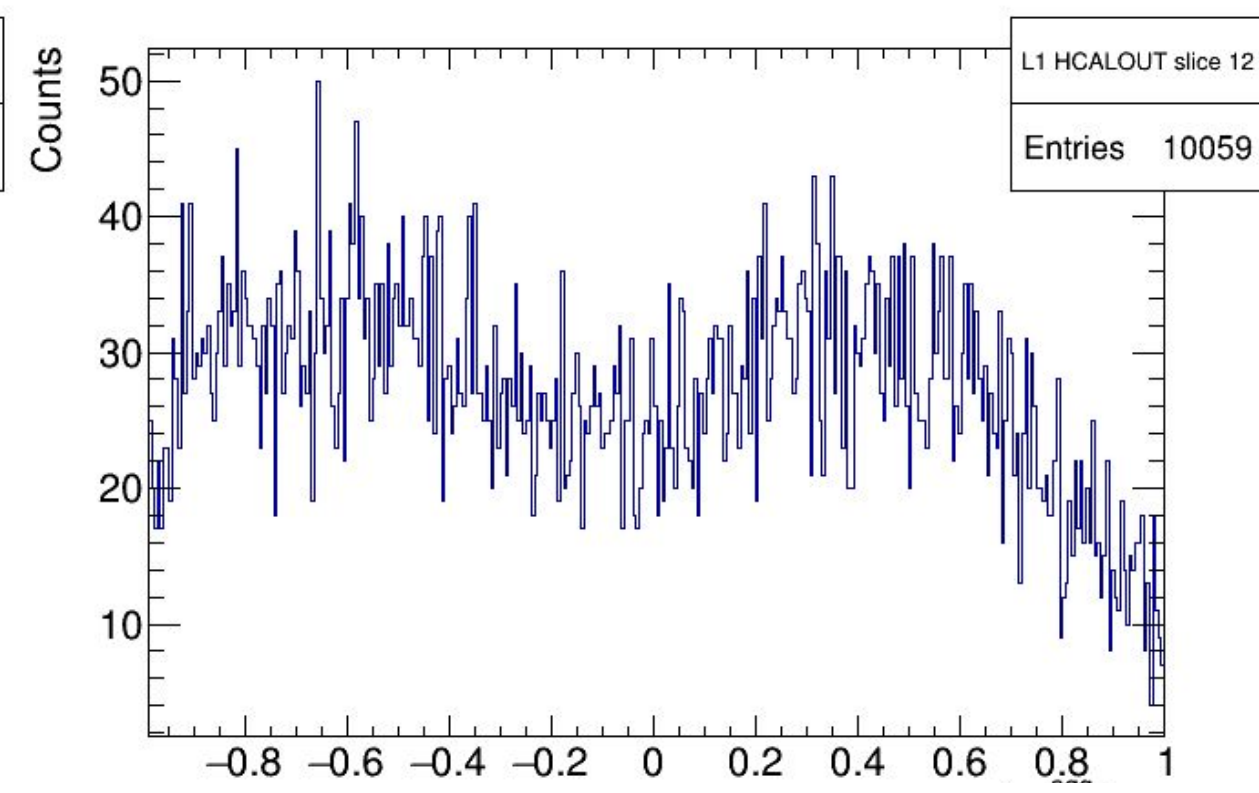
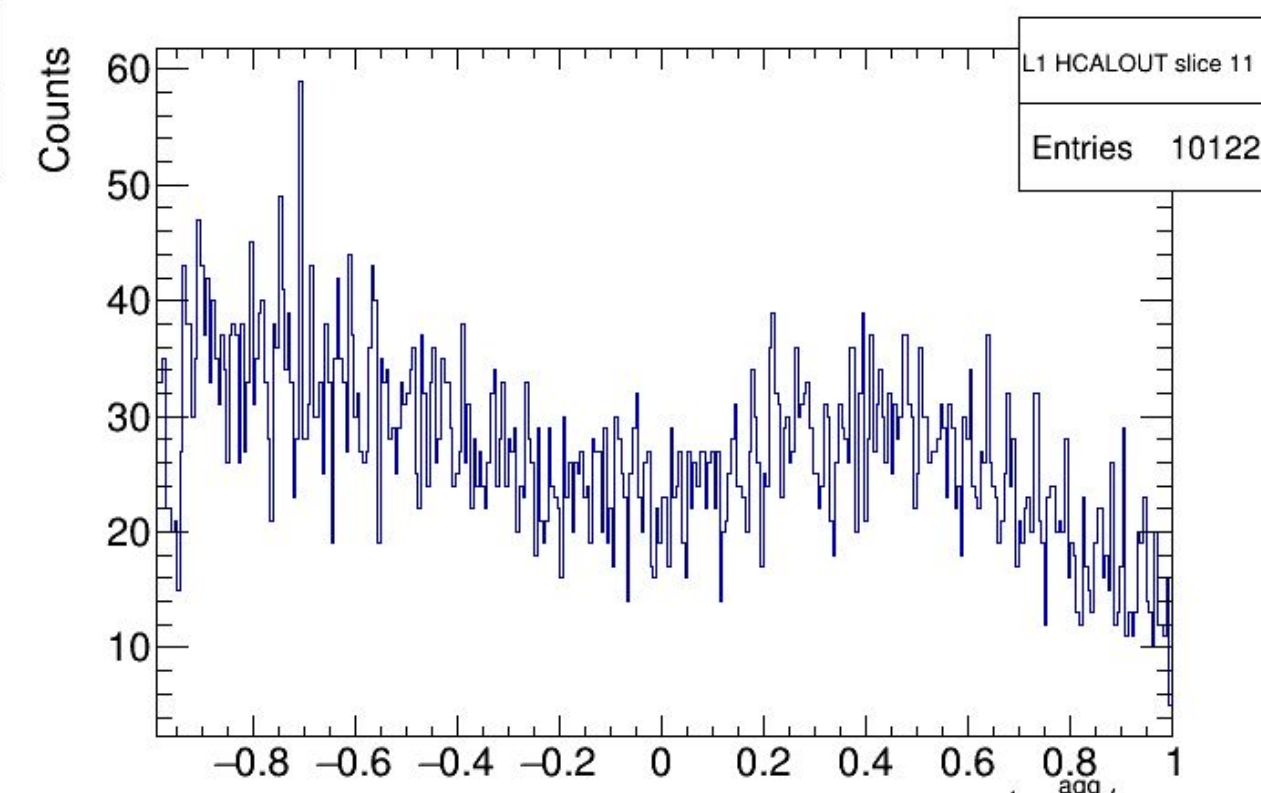
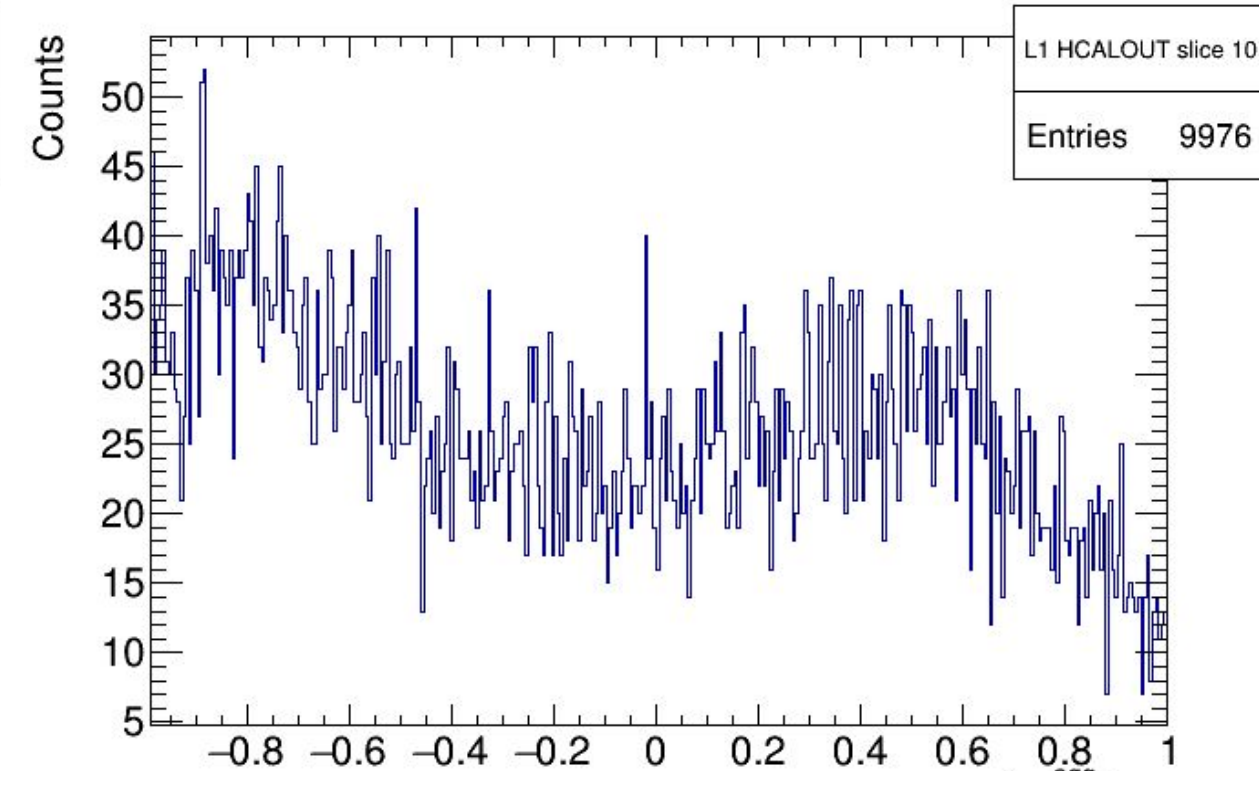
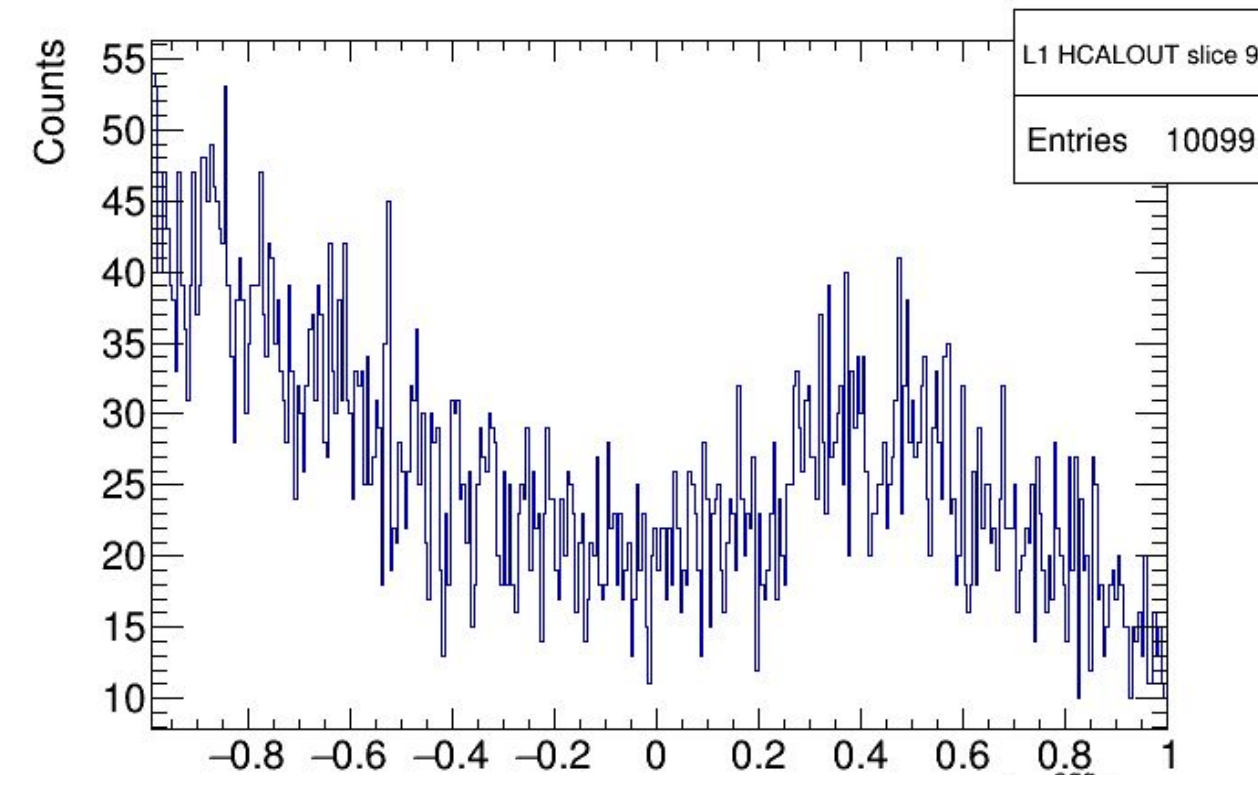
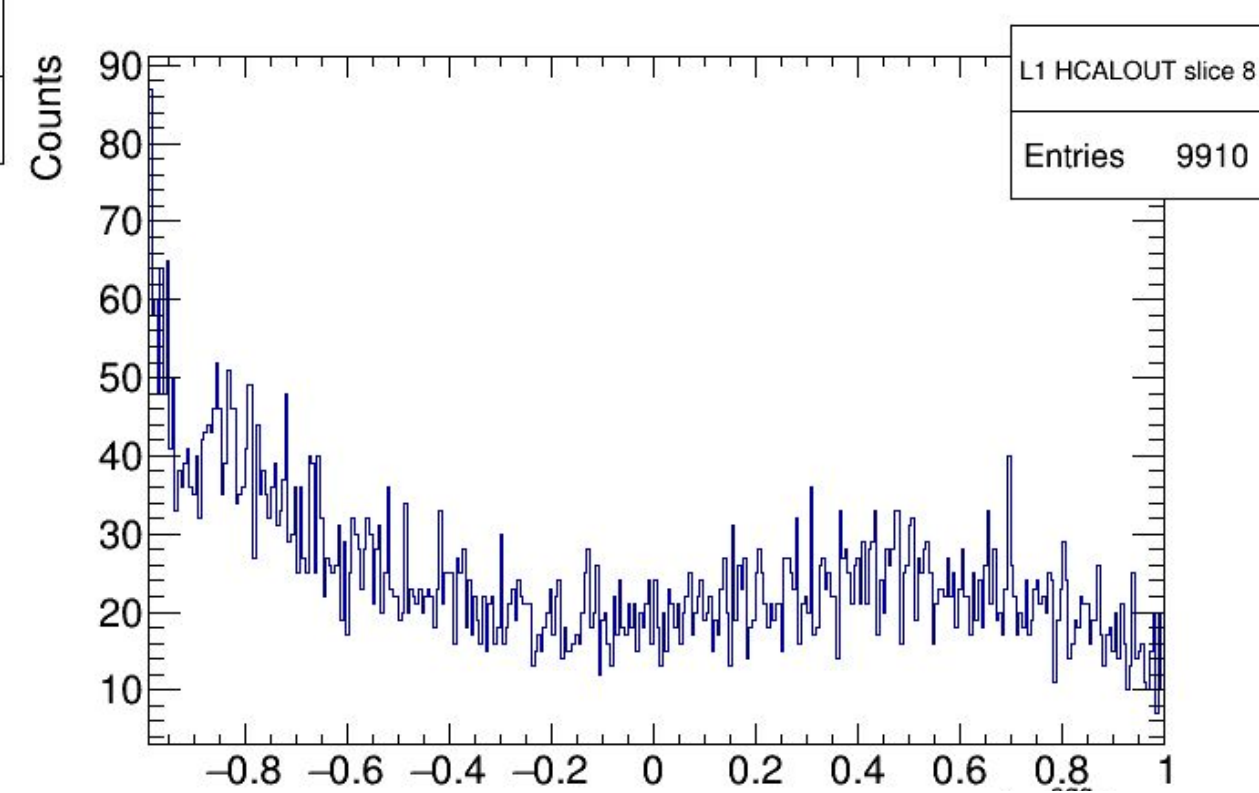
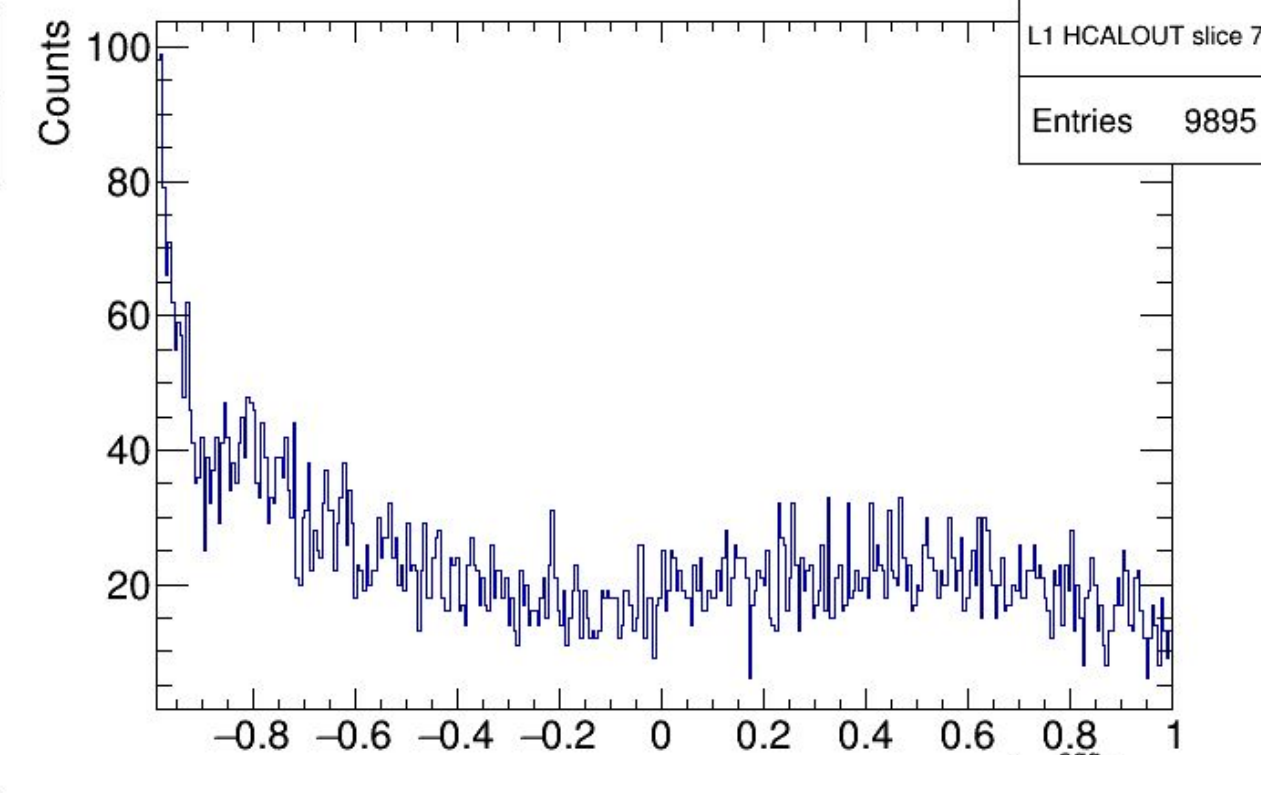
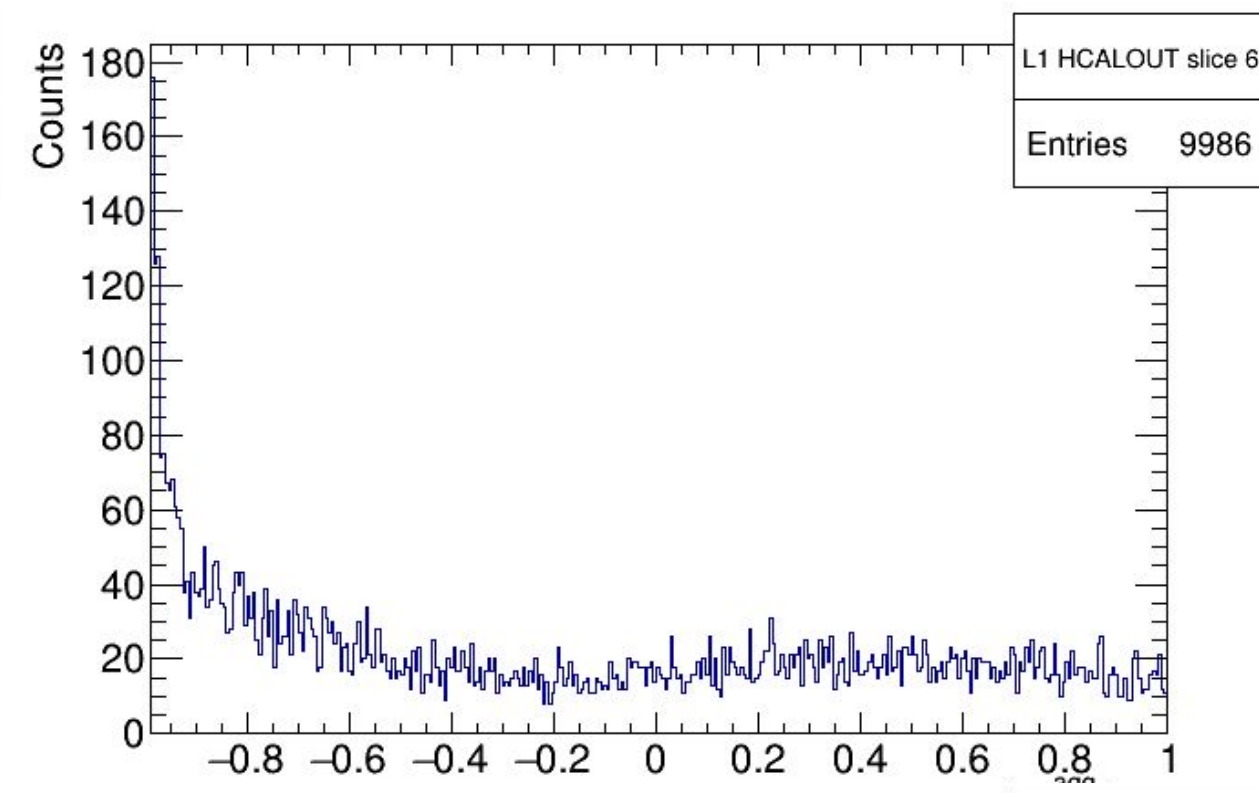
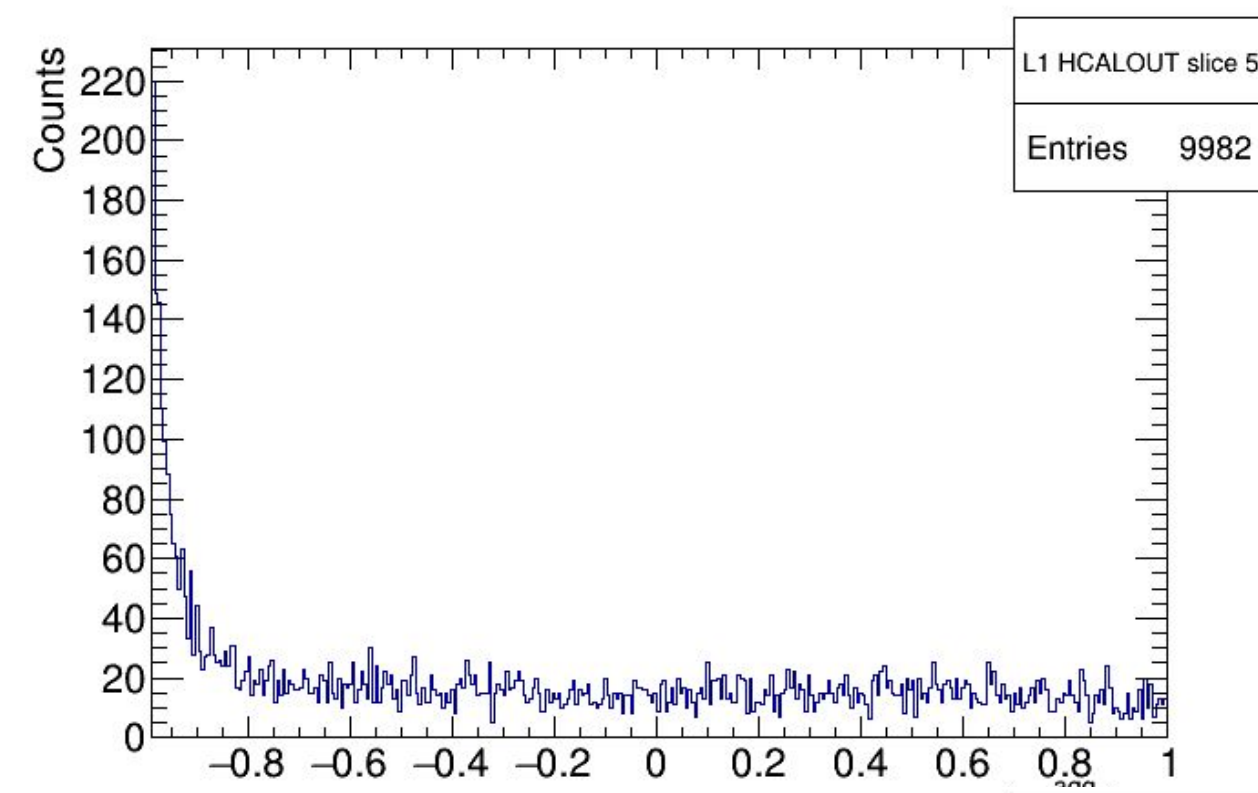
HCALOUT (π^-)

L1 Fitted Gaussians (0 - 3 GeV)



HCALOUT (π^-)

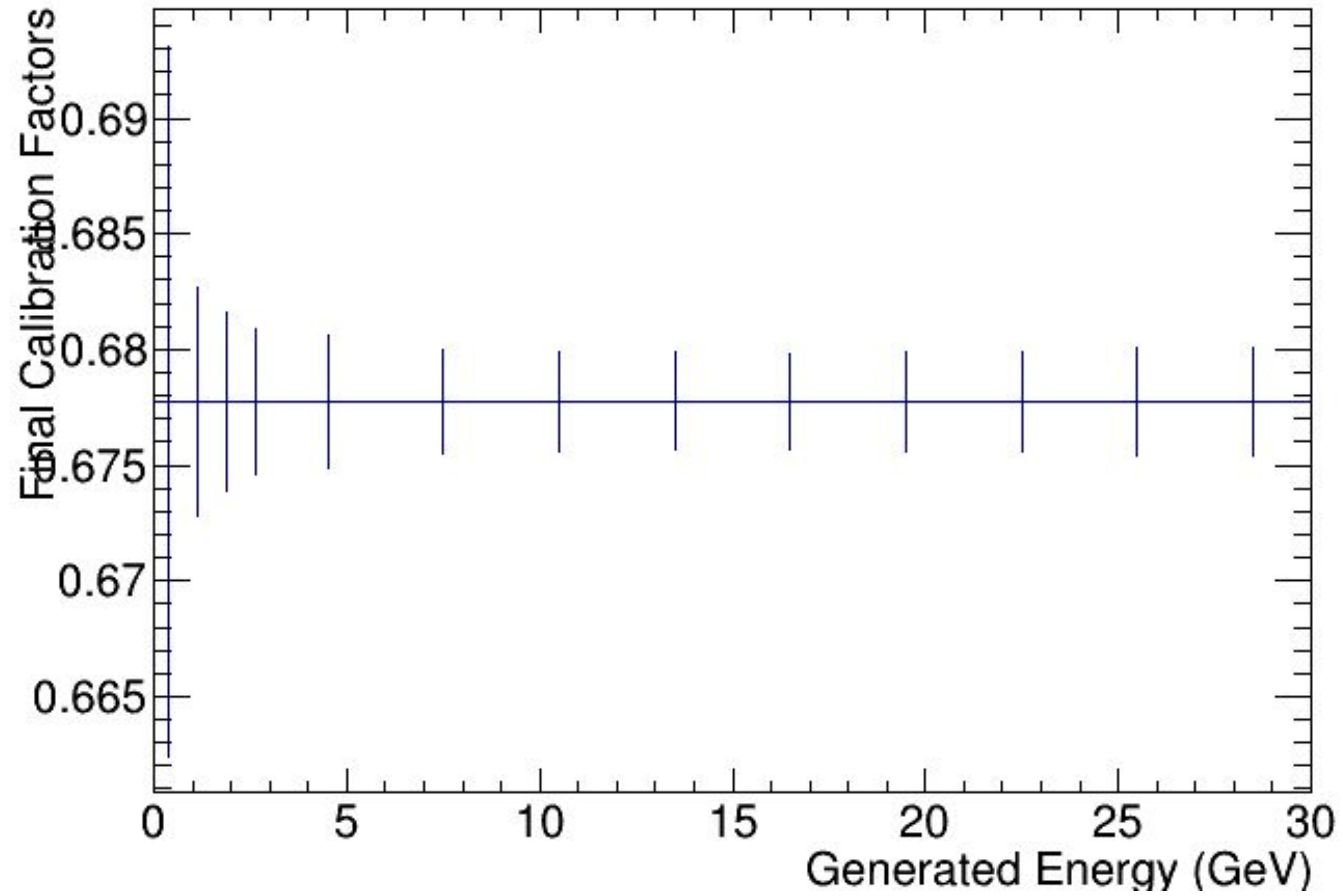
L1 Fitted Gaussians (3 - 30 GeV)



The x-axes denote $\Delta e_{agg}/ge$

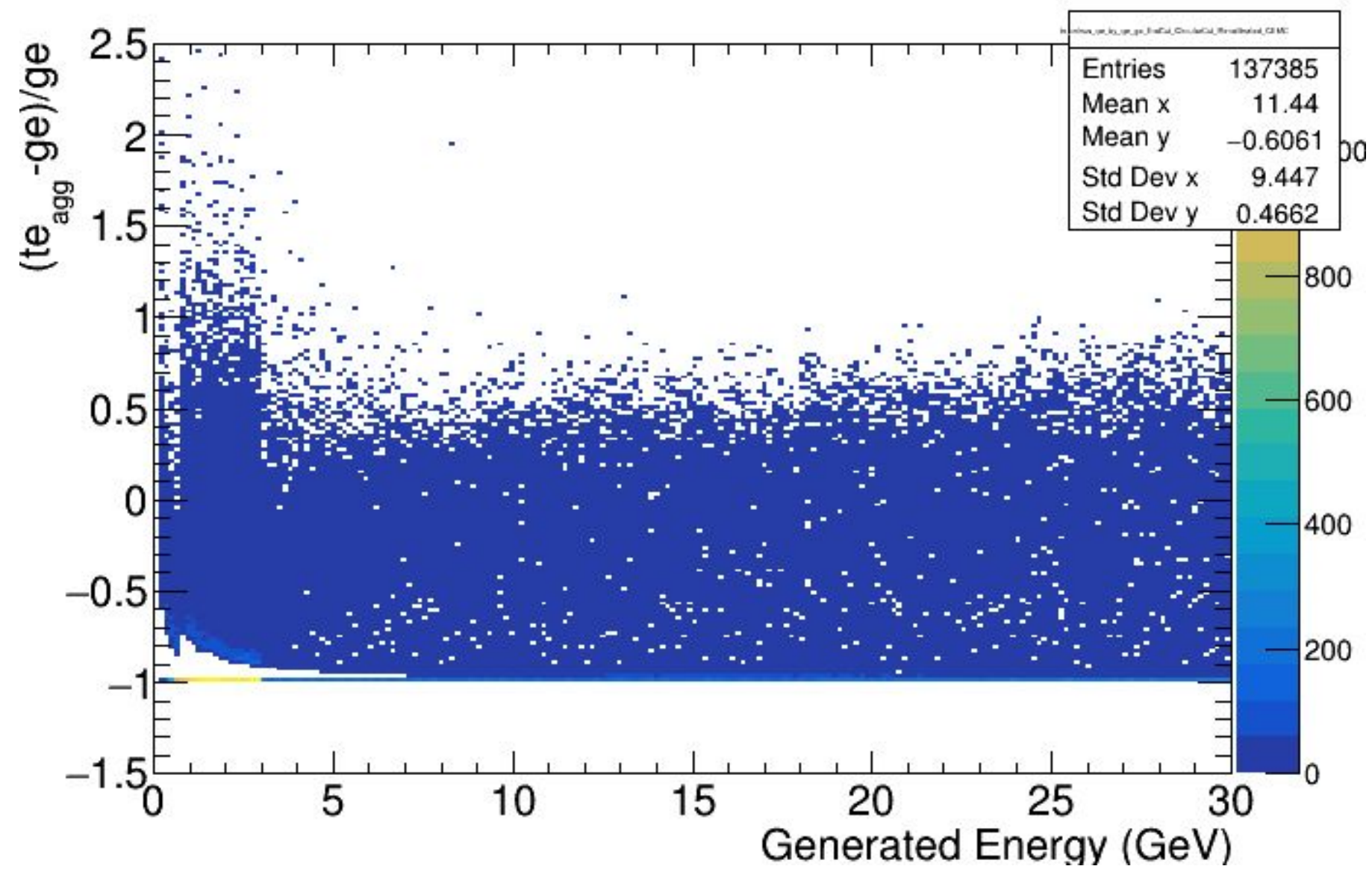
CEMC + HCALIN + HCALOUT (π^-)

Level 2 Calibration Factor

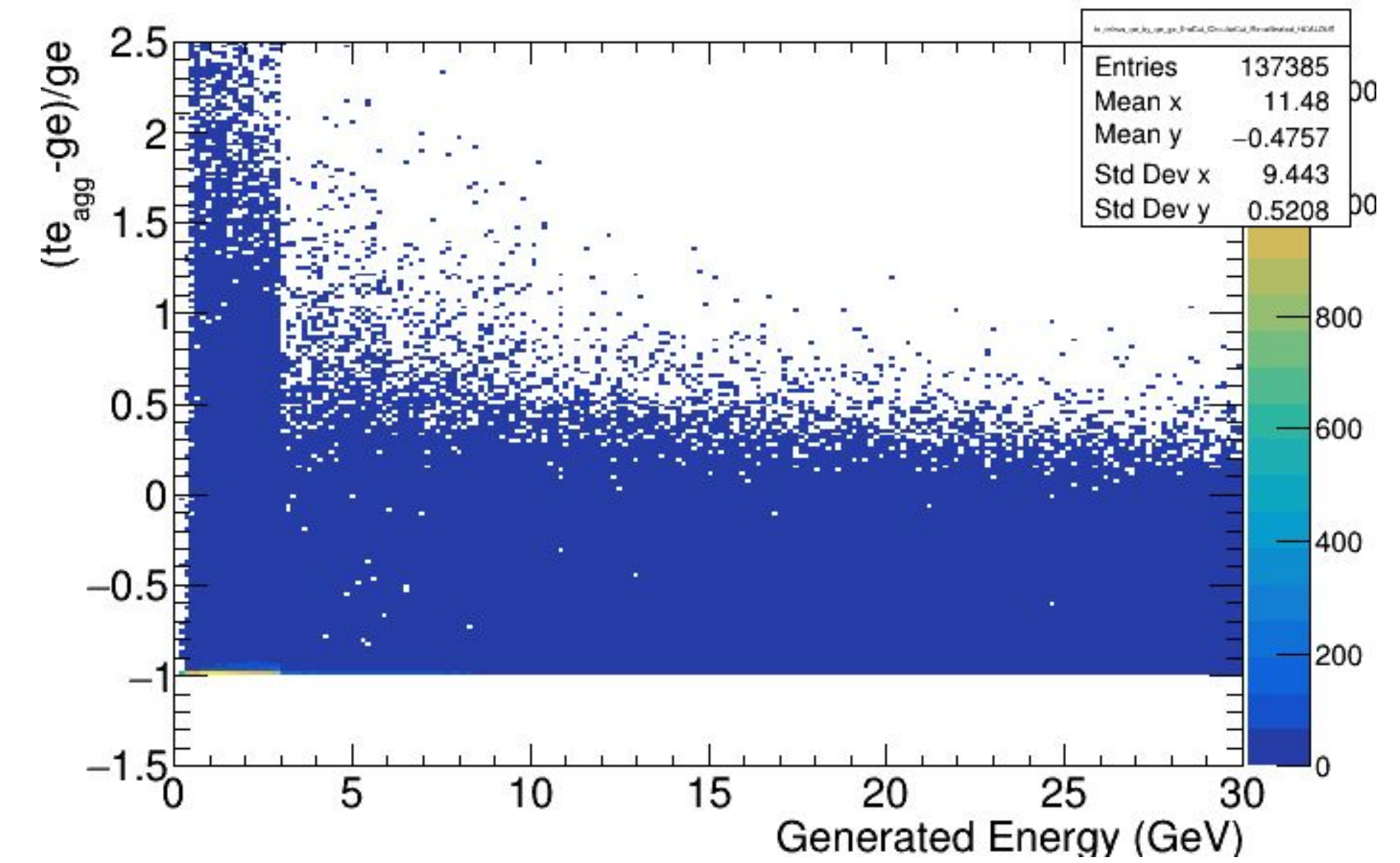


CEMC + HCALIN + HCALOUT (π^-)

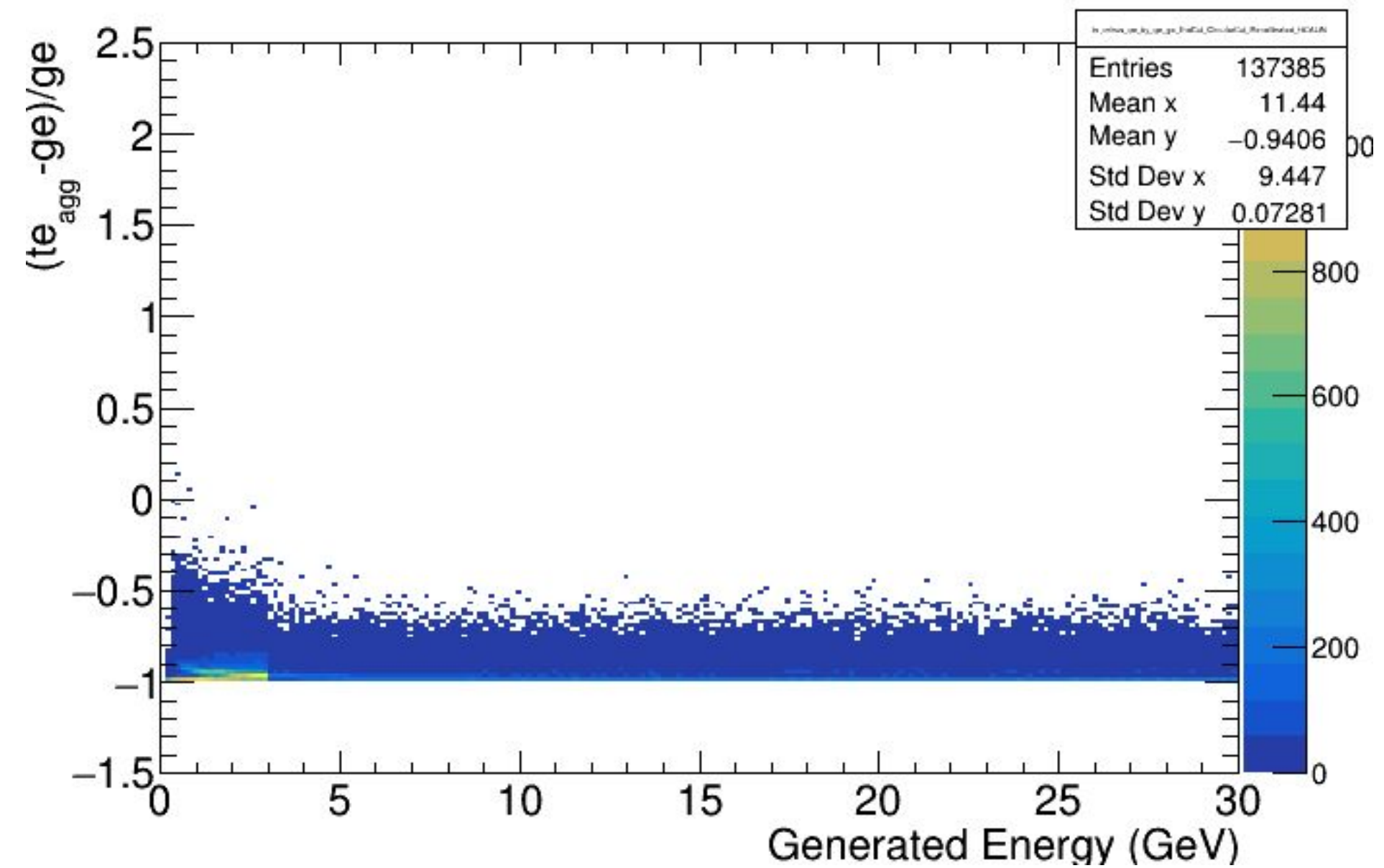
Level 2 Calibration (L2)



CEMC



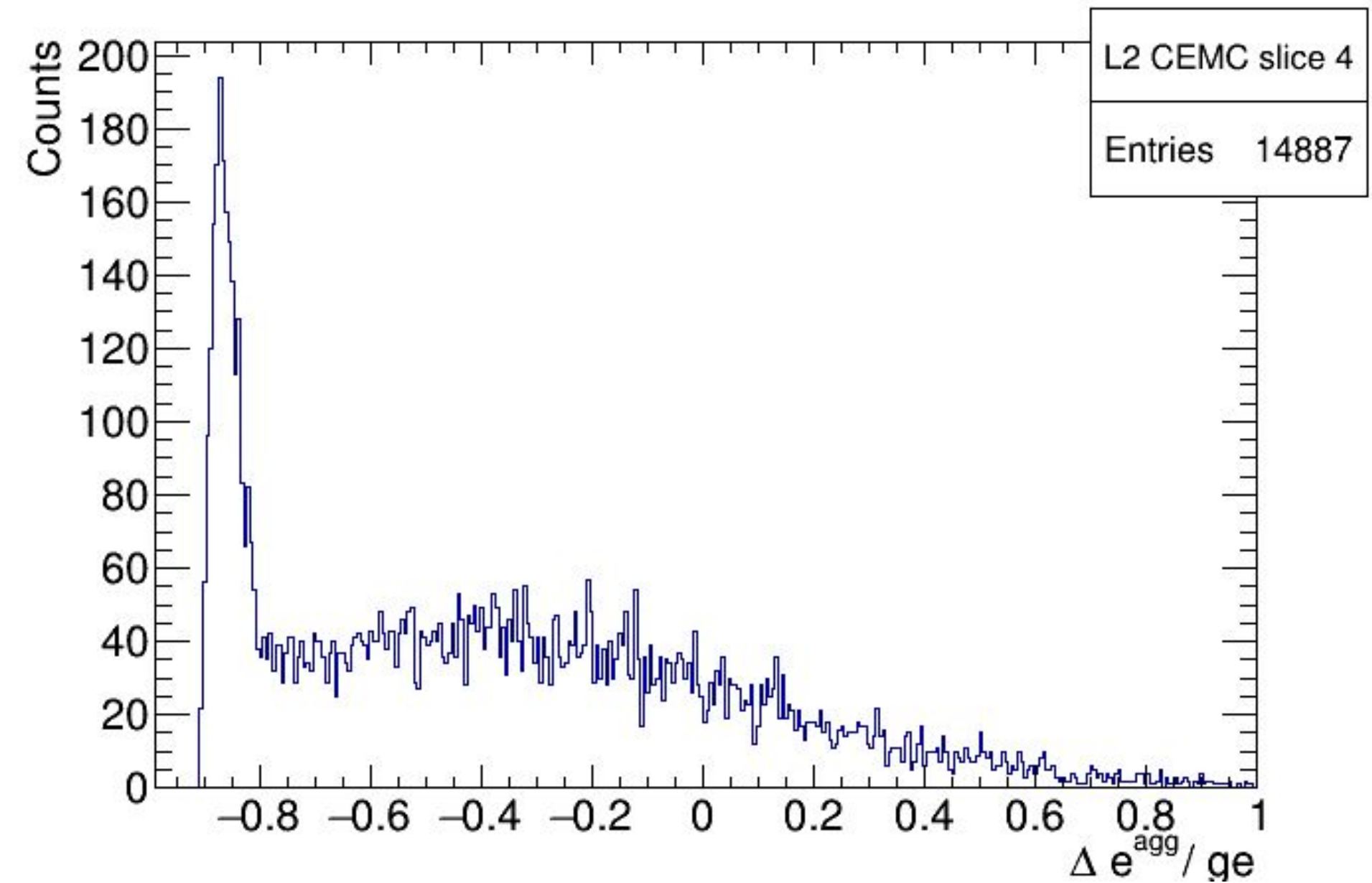
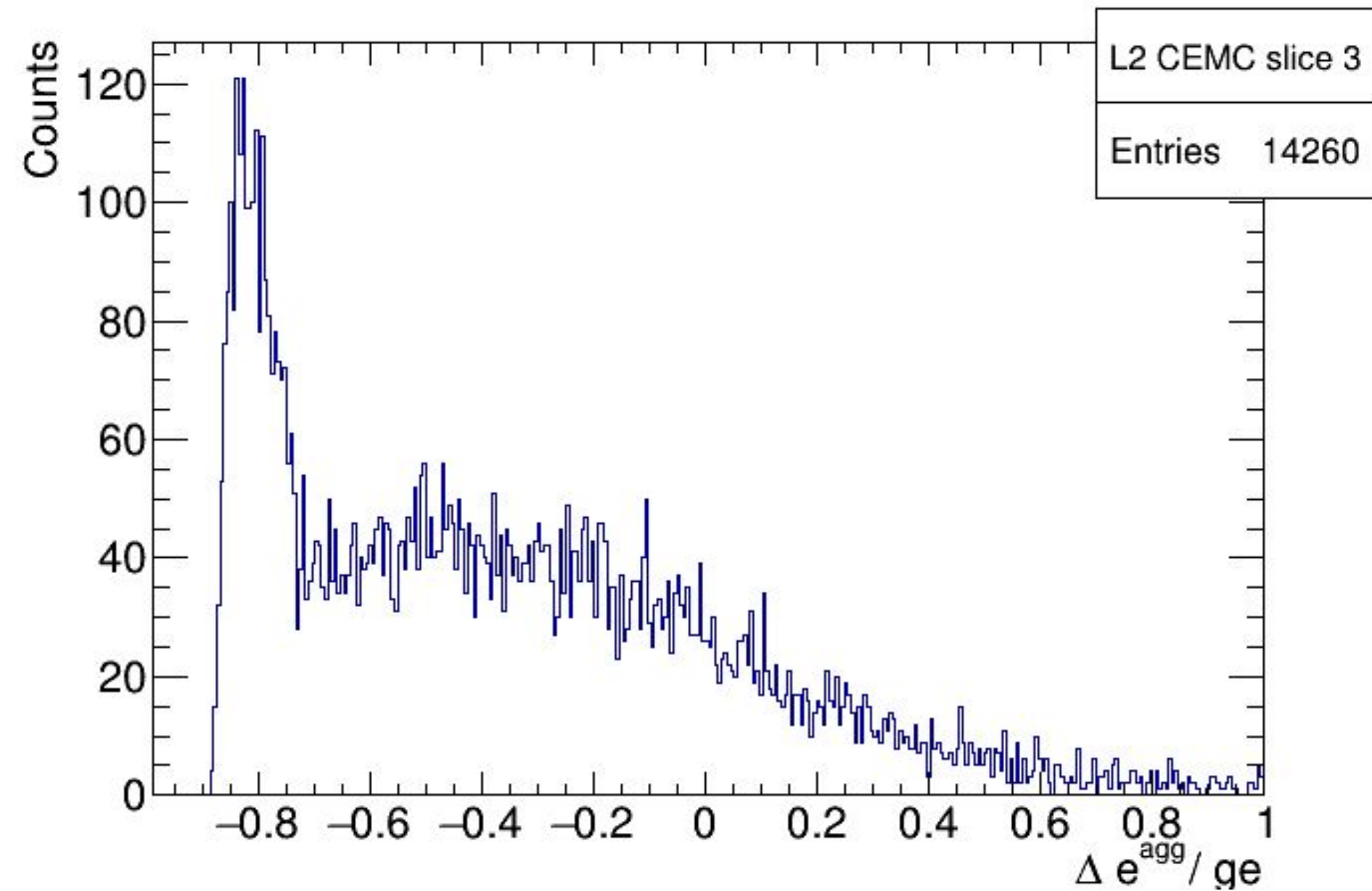
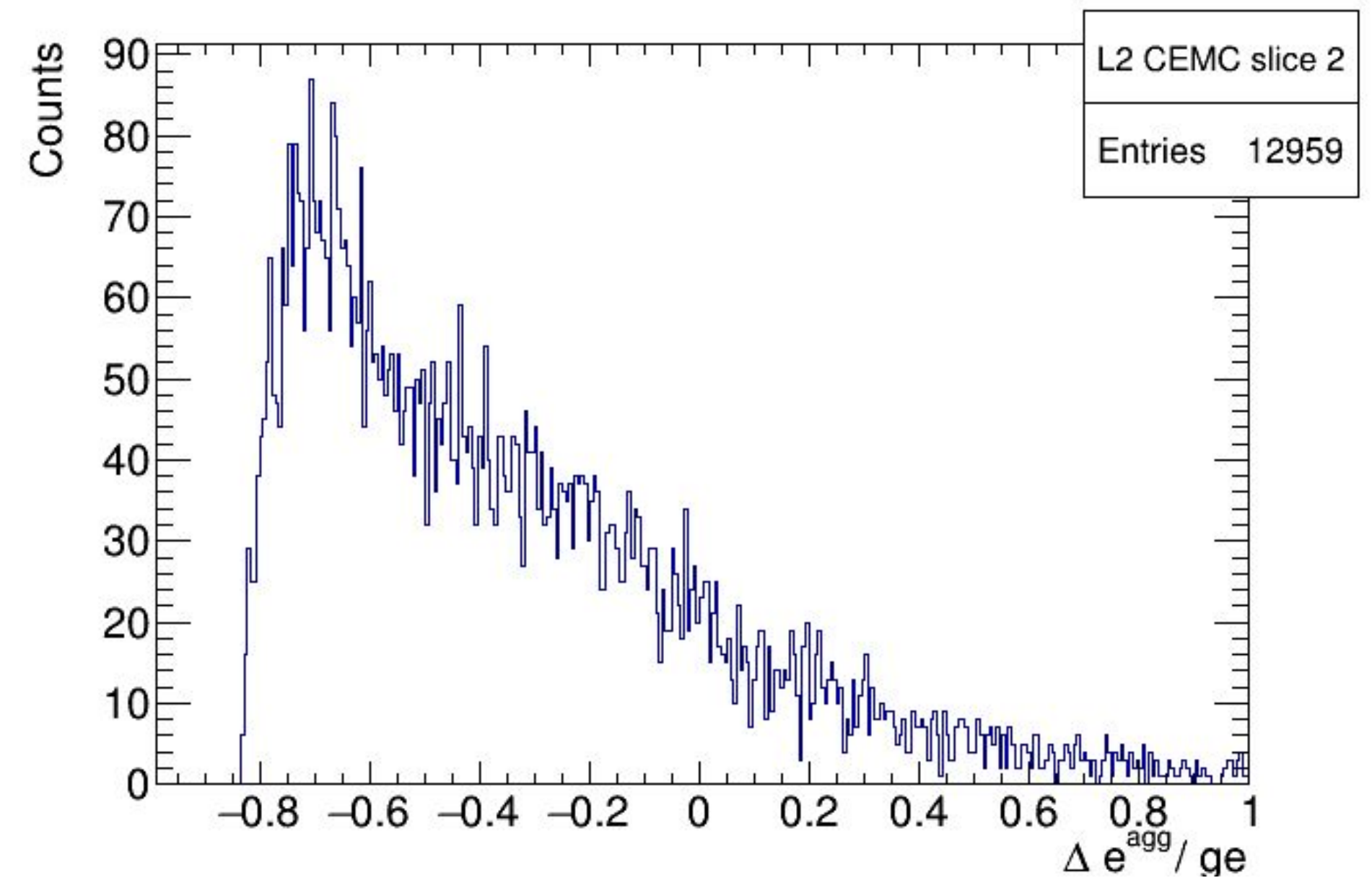
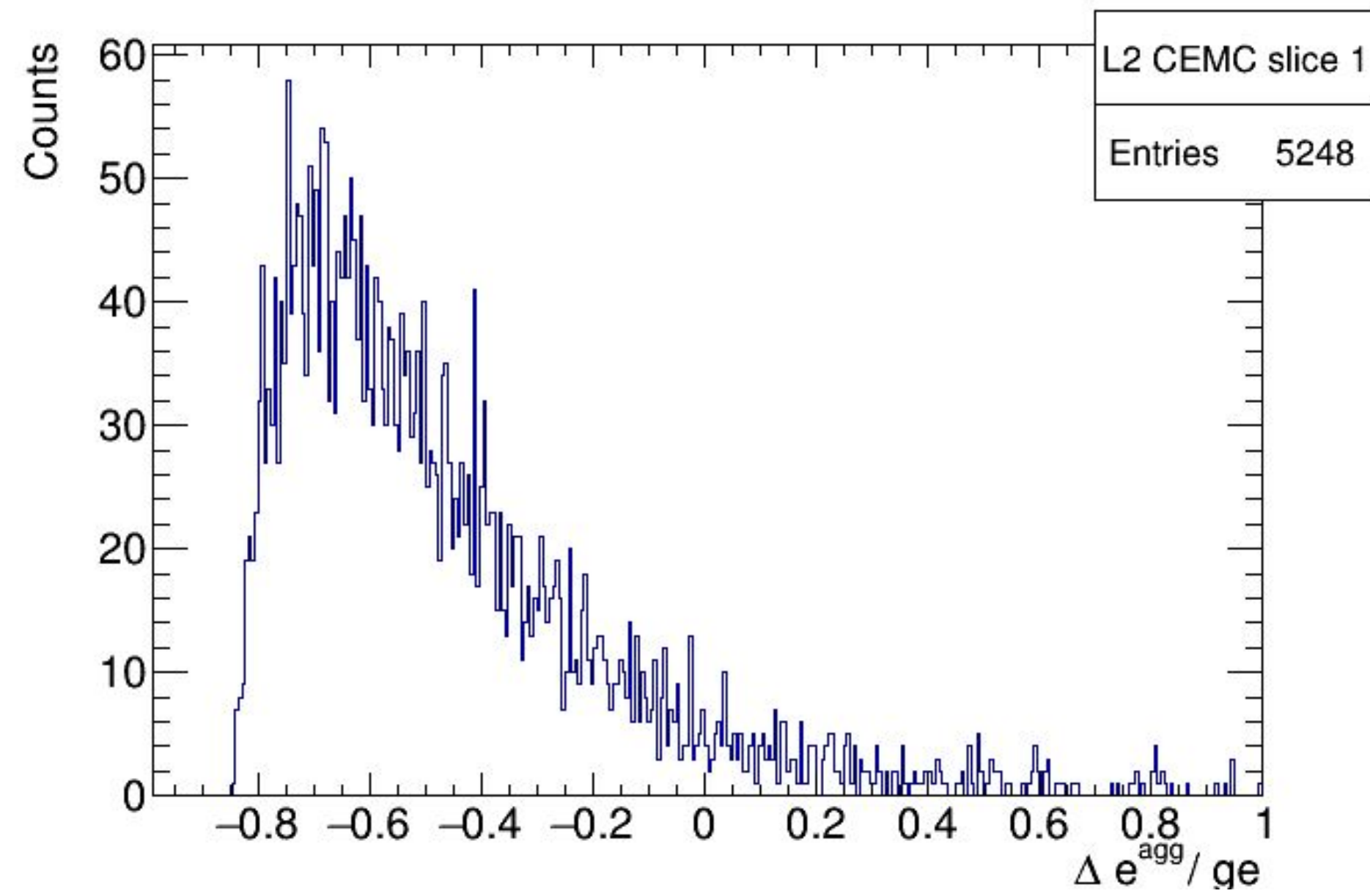
HCALOUT



HCALIN

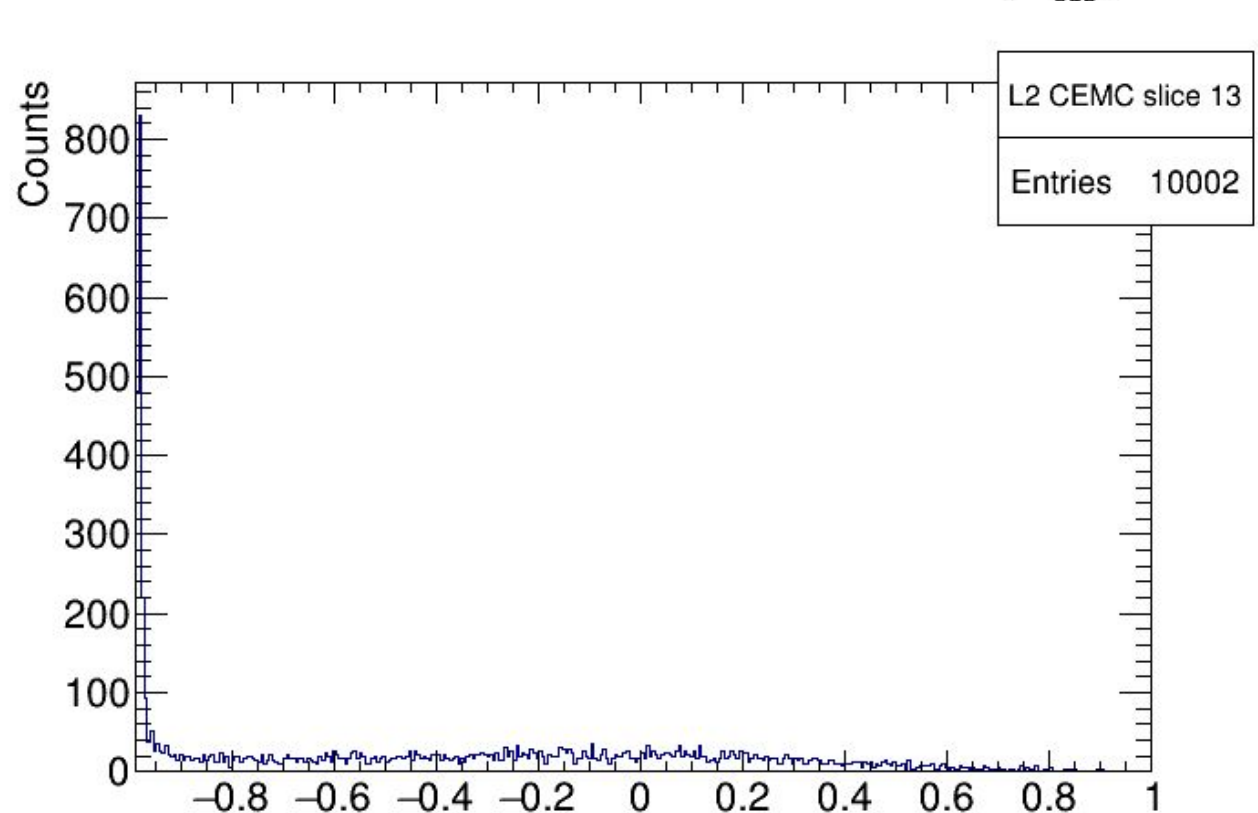
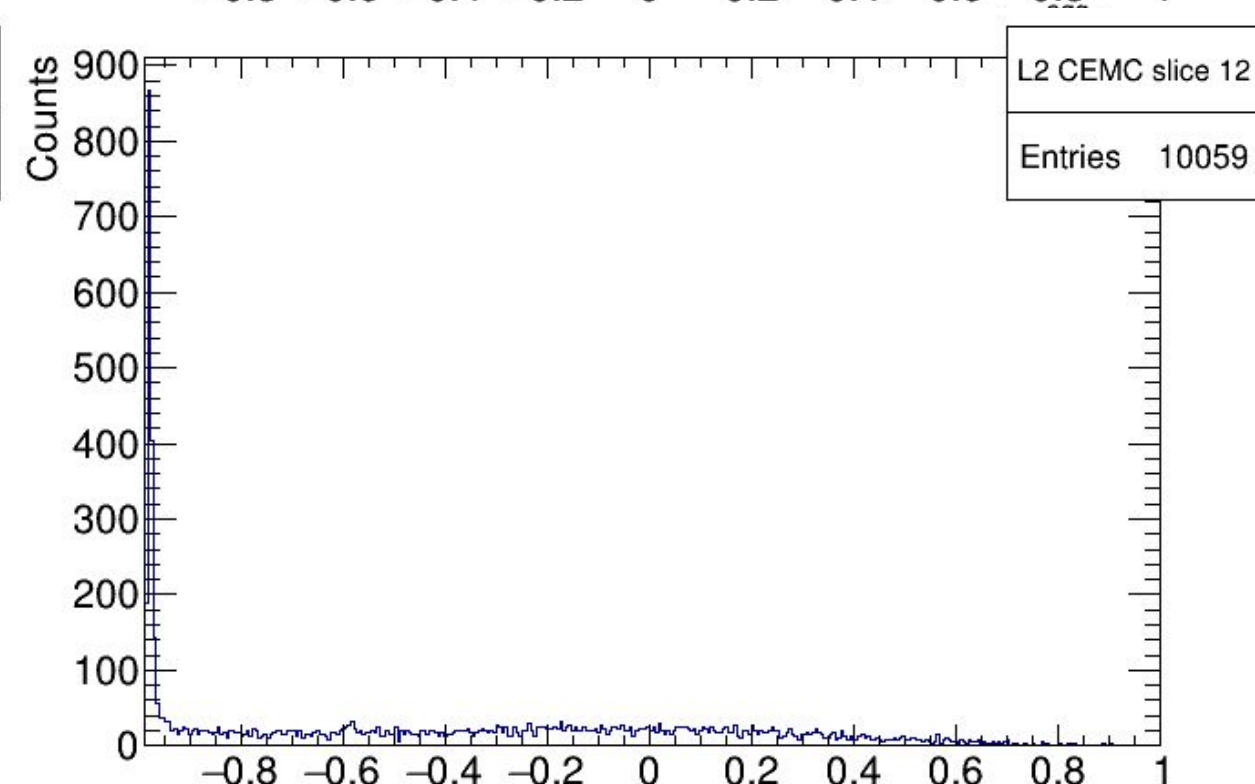
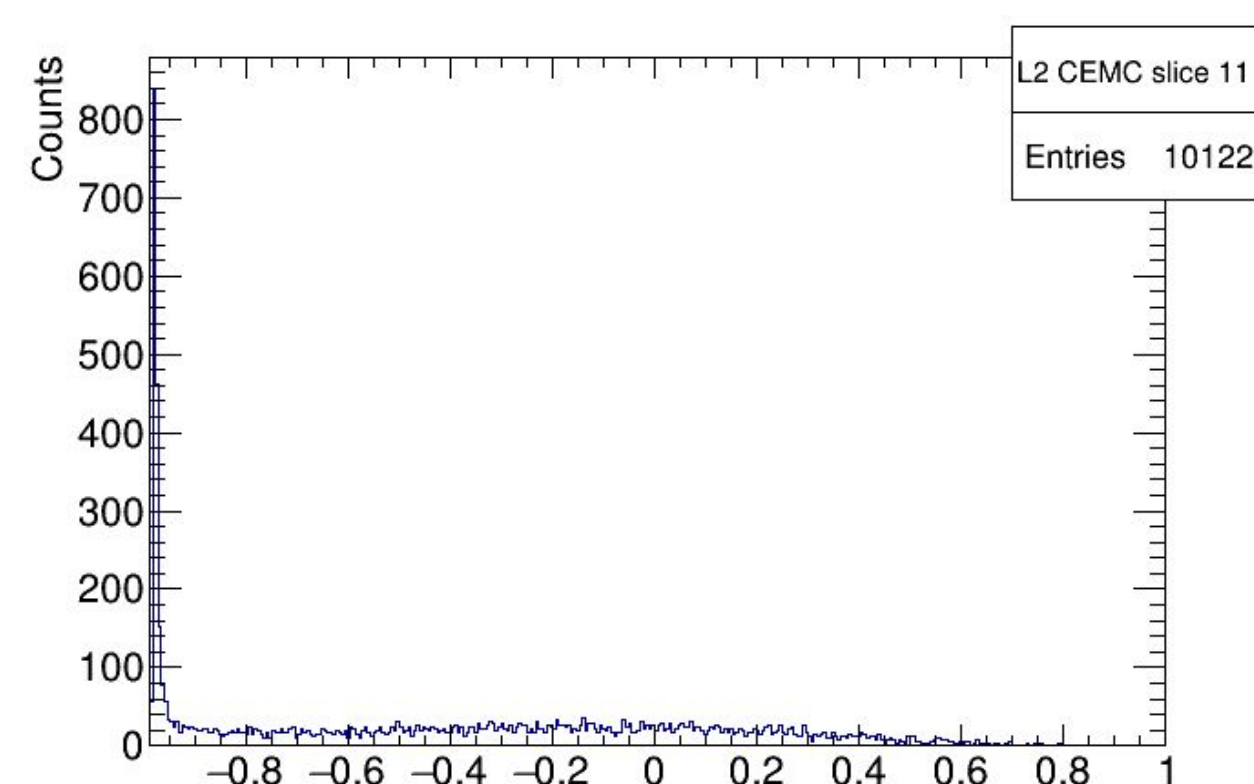
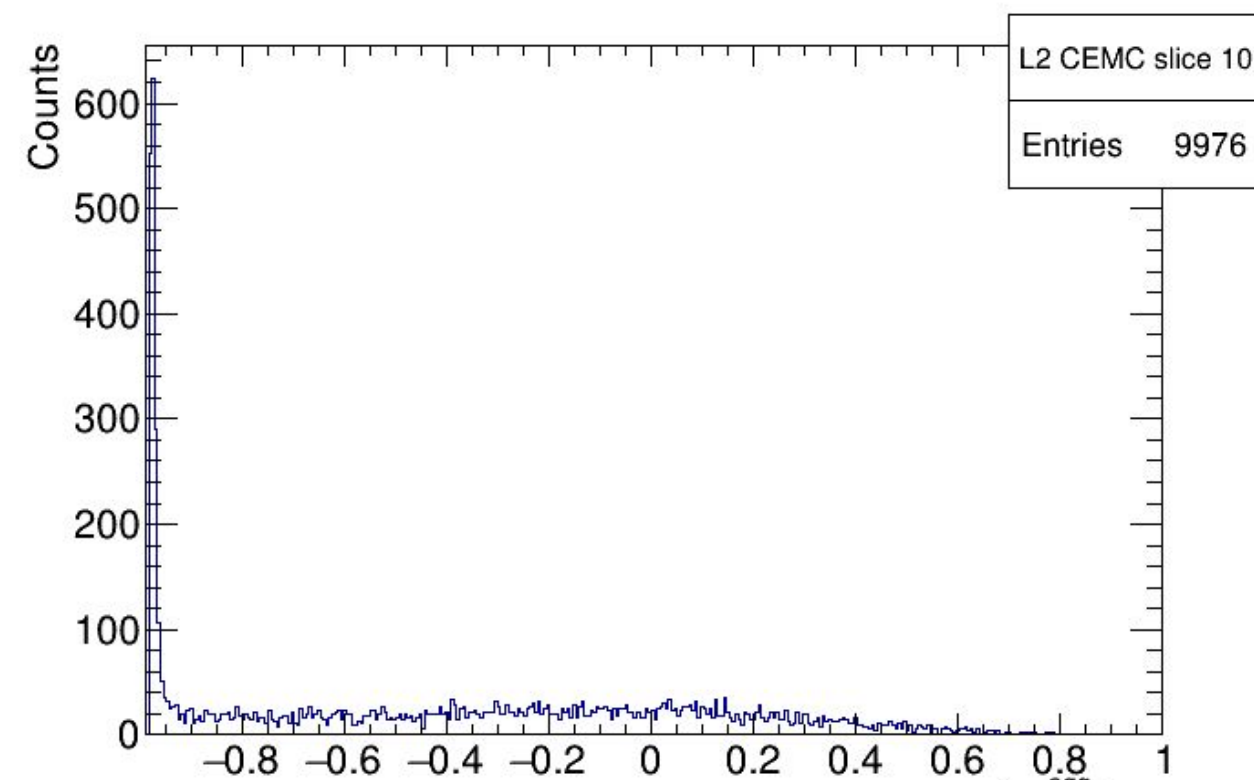
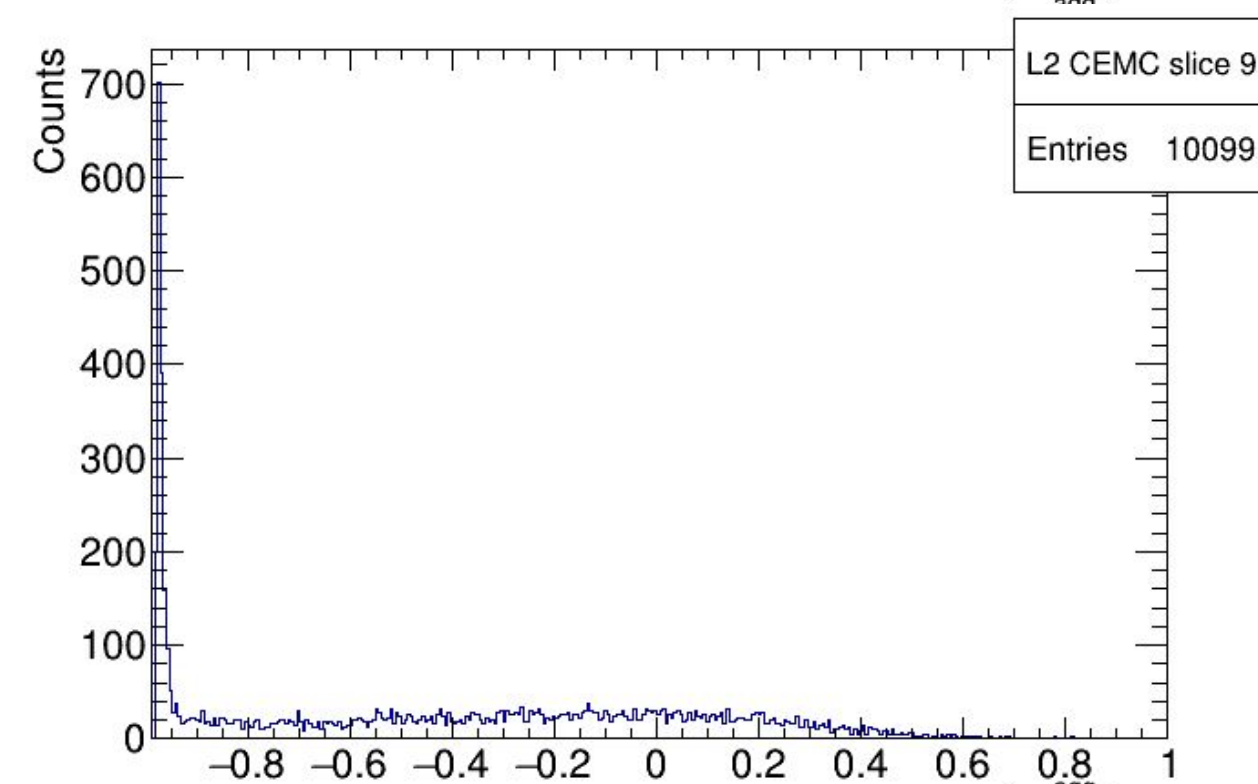
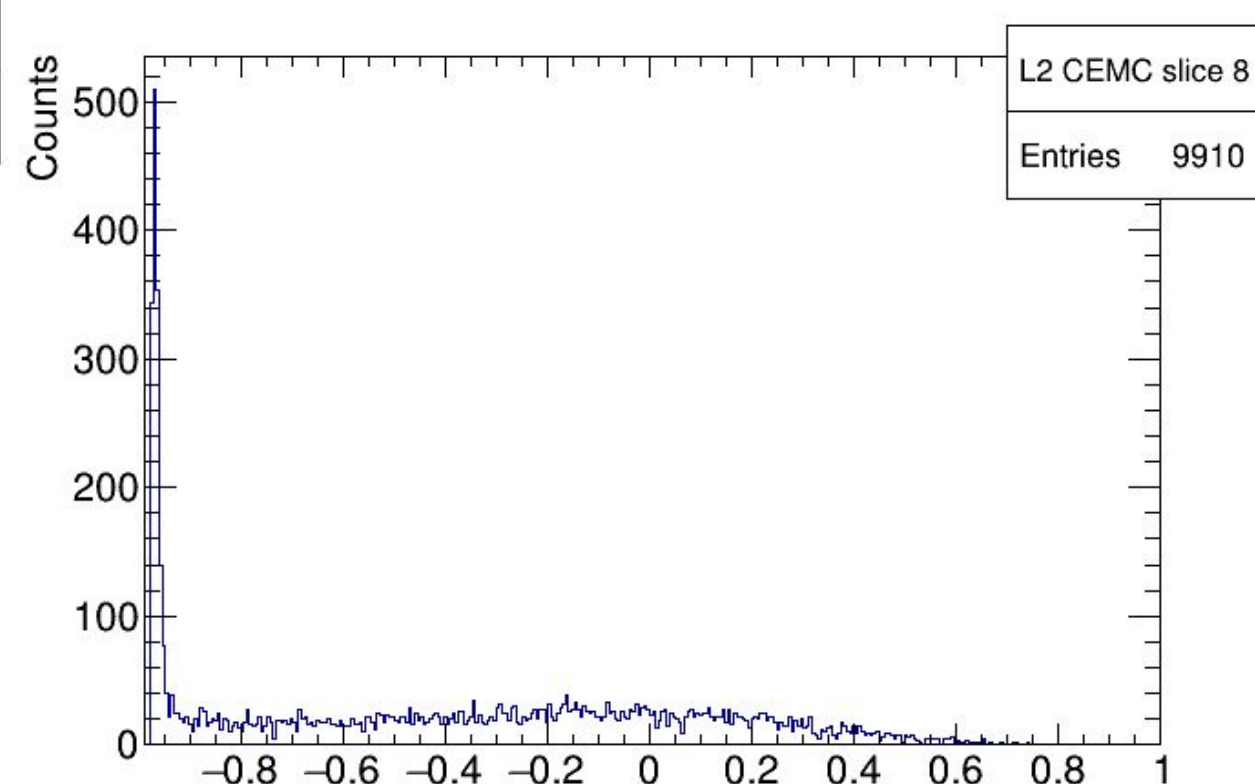
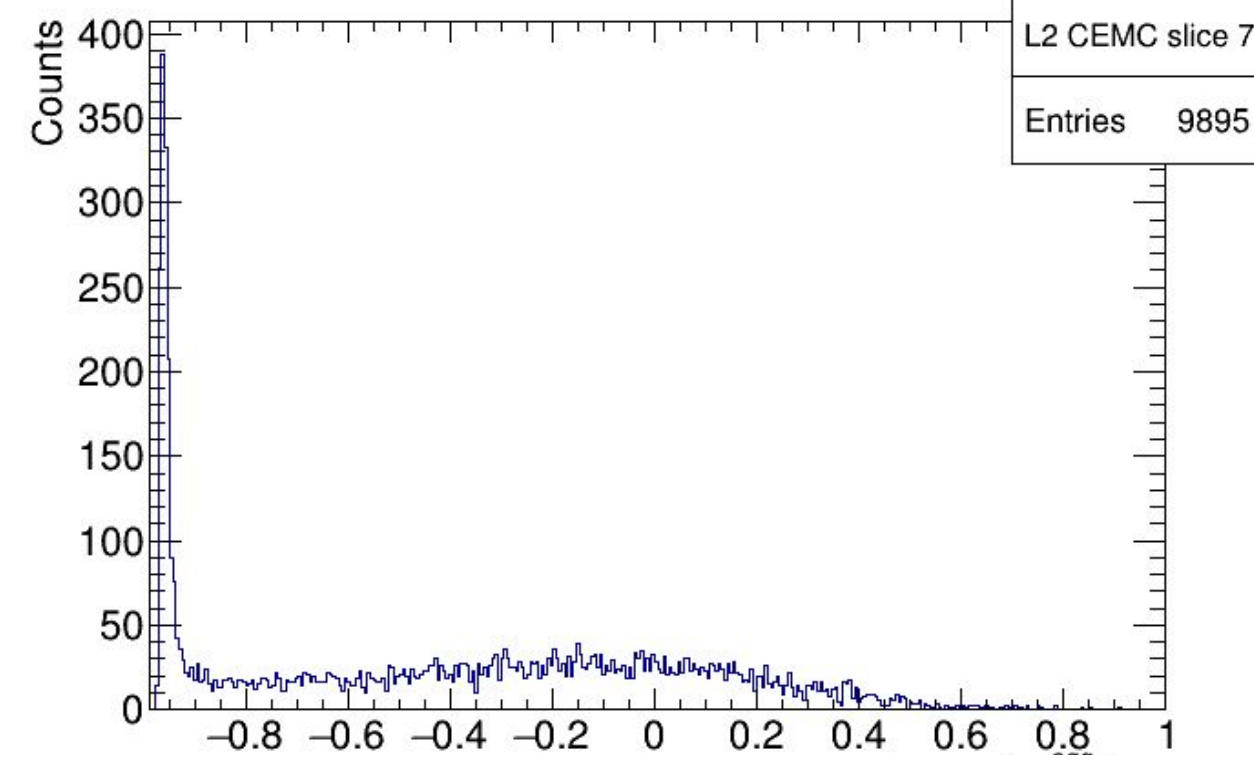
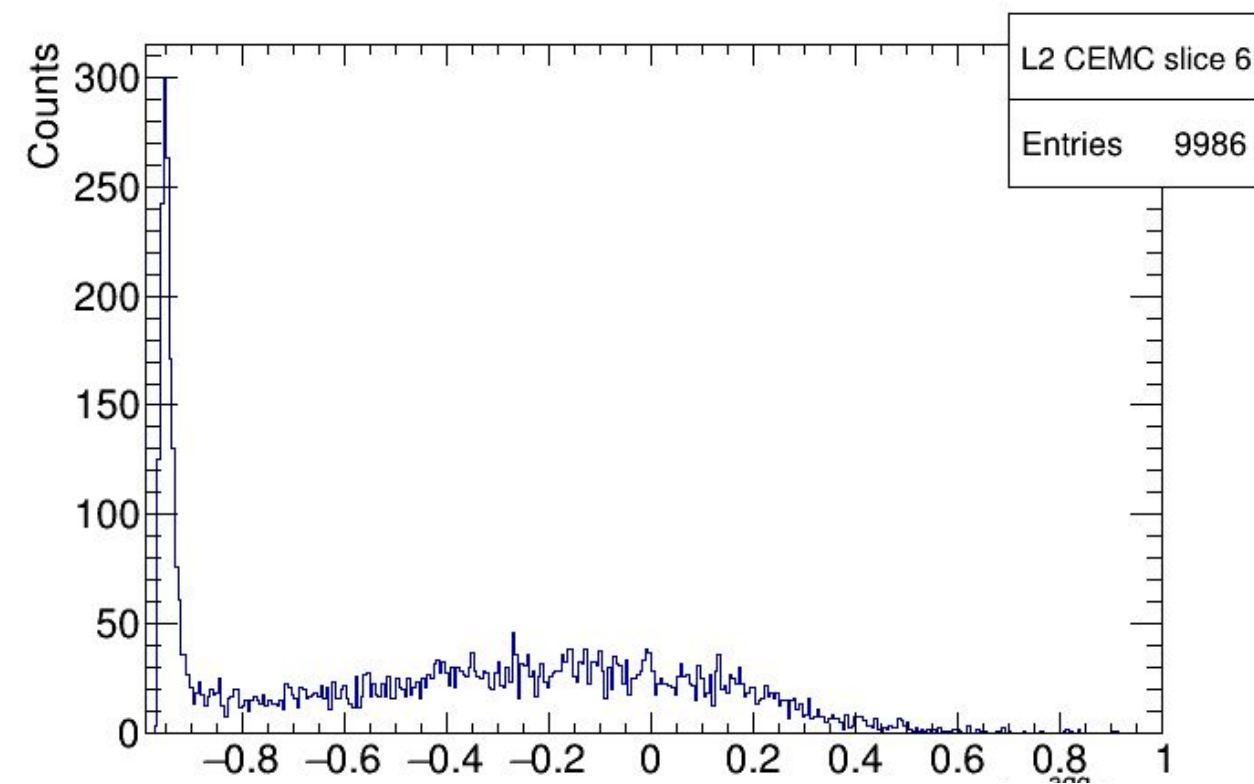
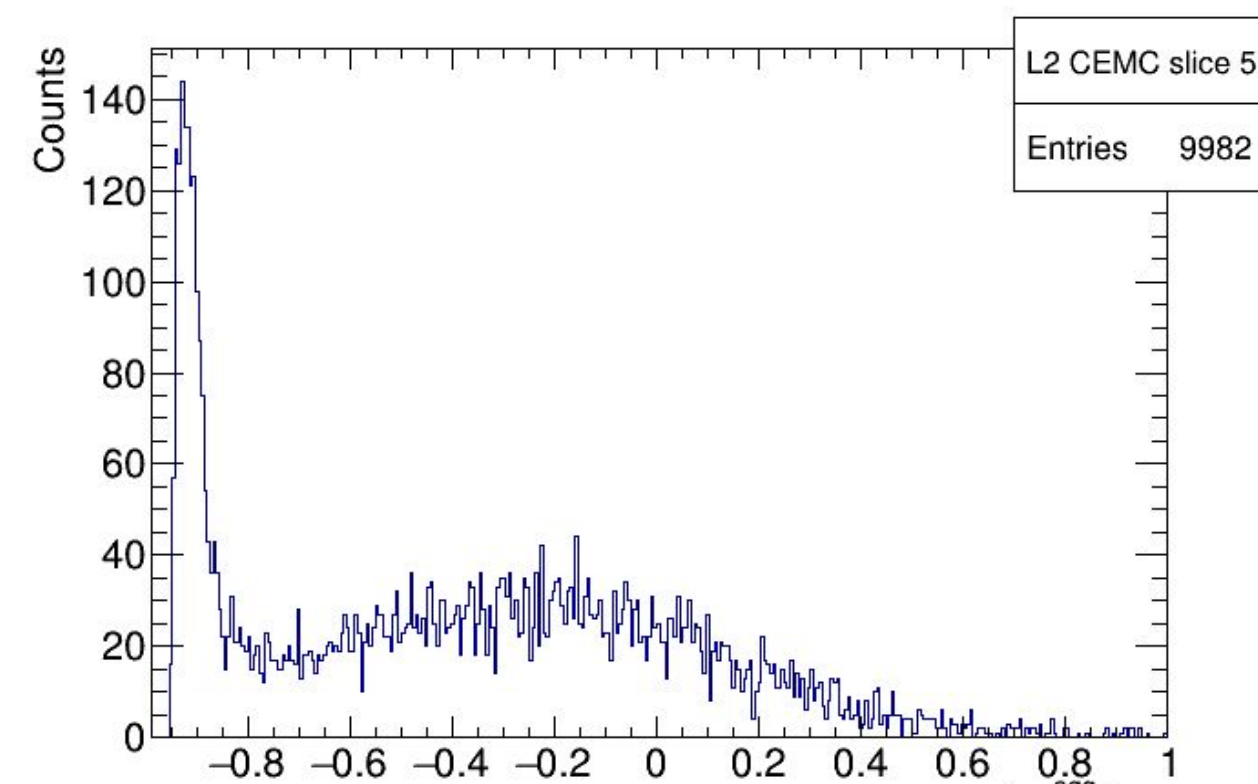
CEMC (π^-)

L2 Fitted Gaussians (0 - 3 GeV)



CEMC (π^-)

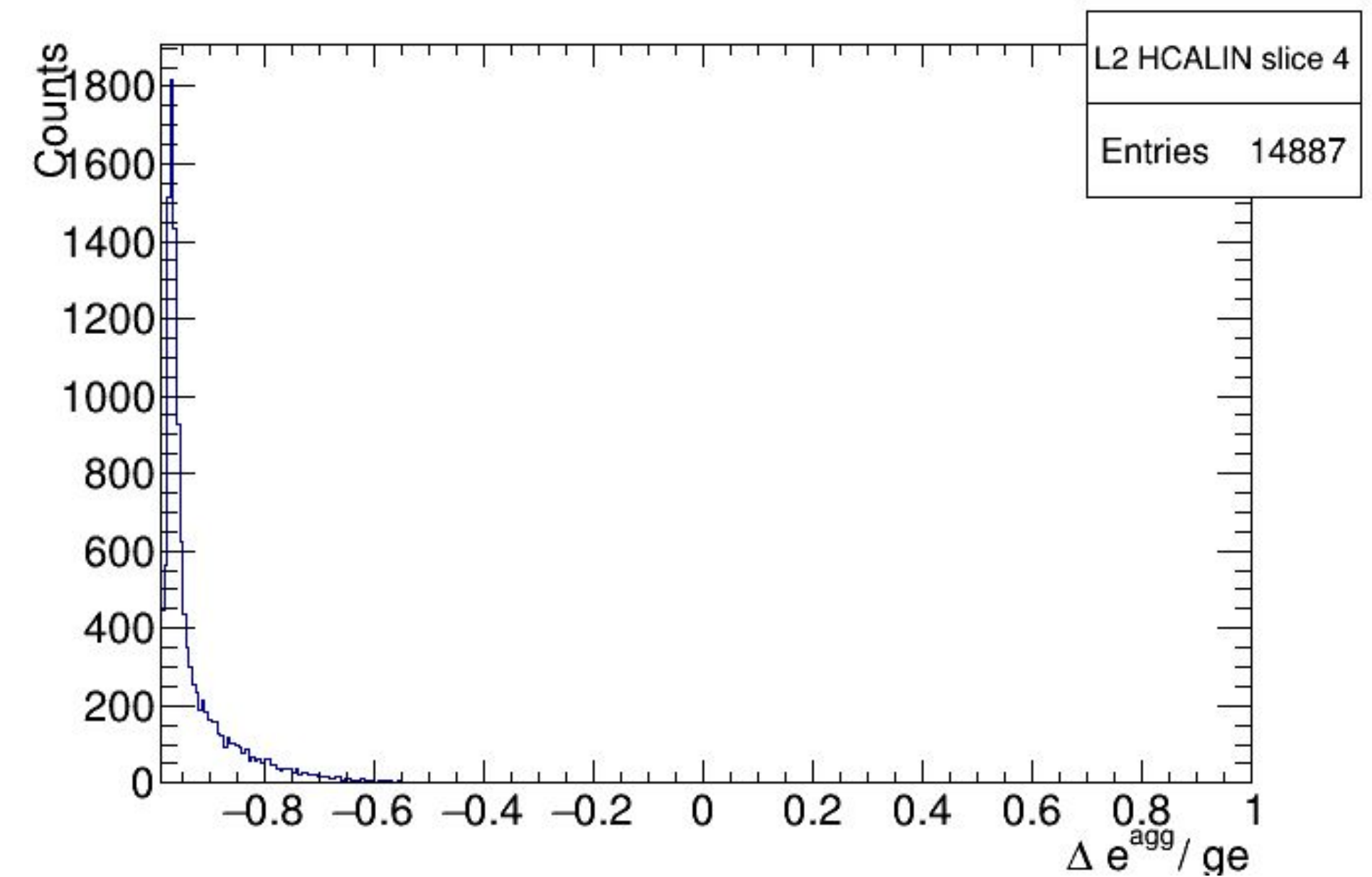
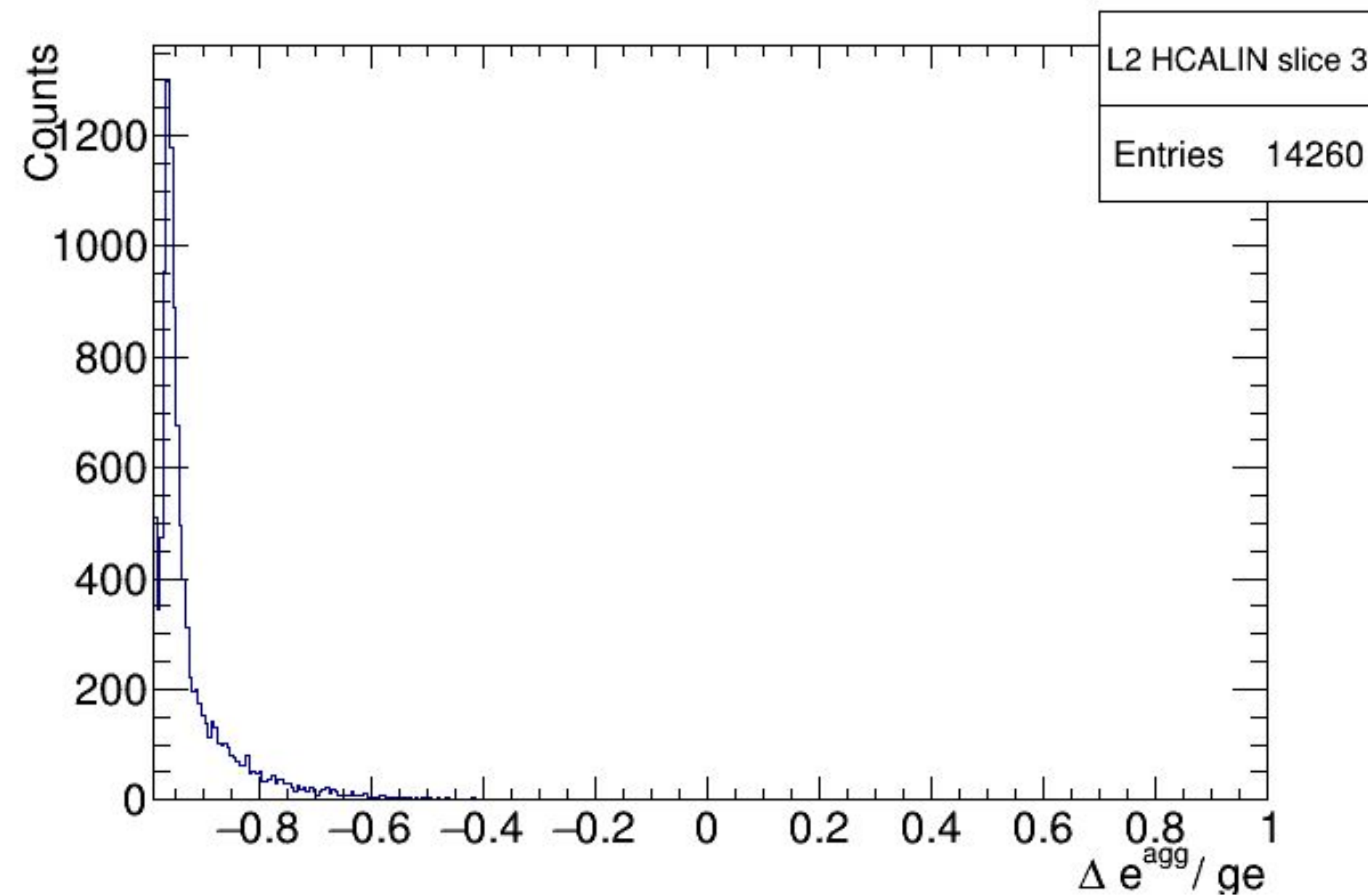
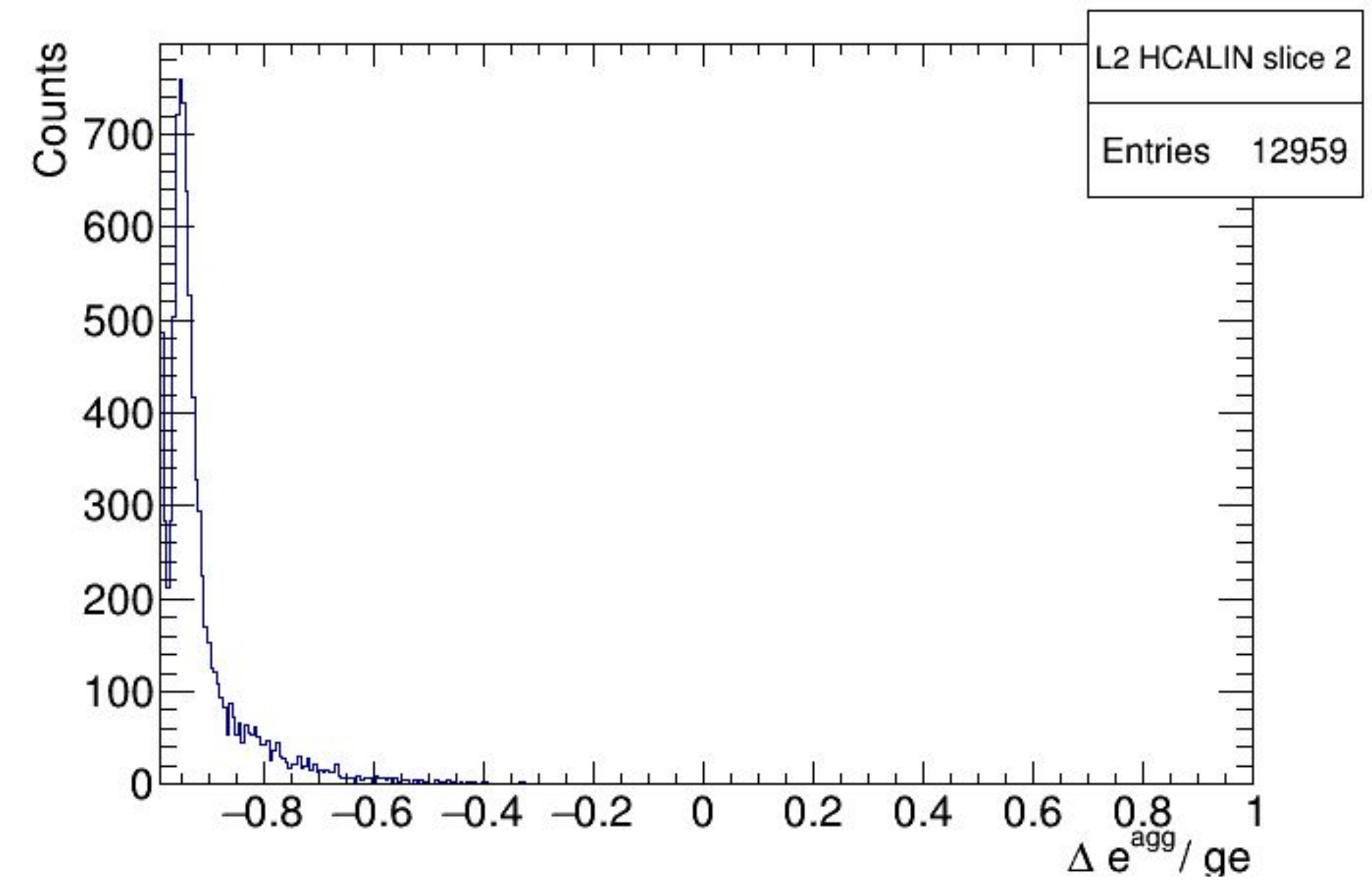
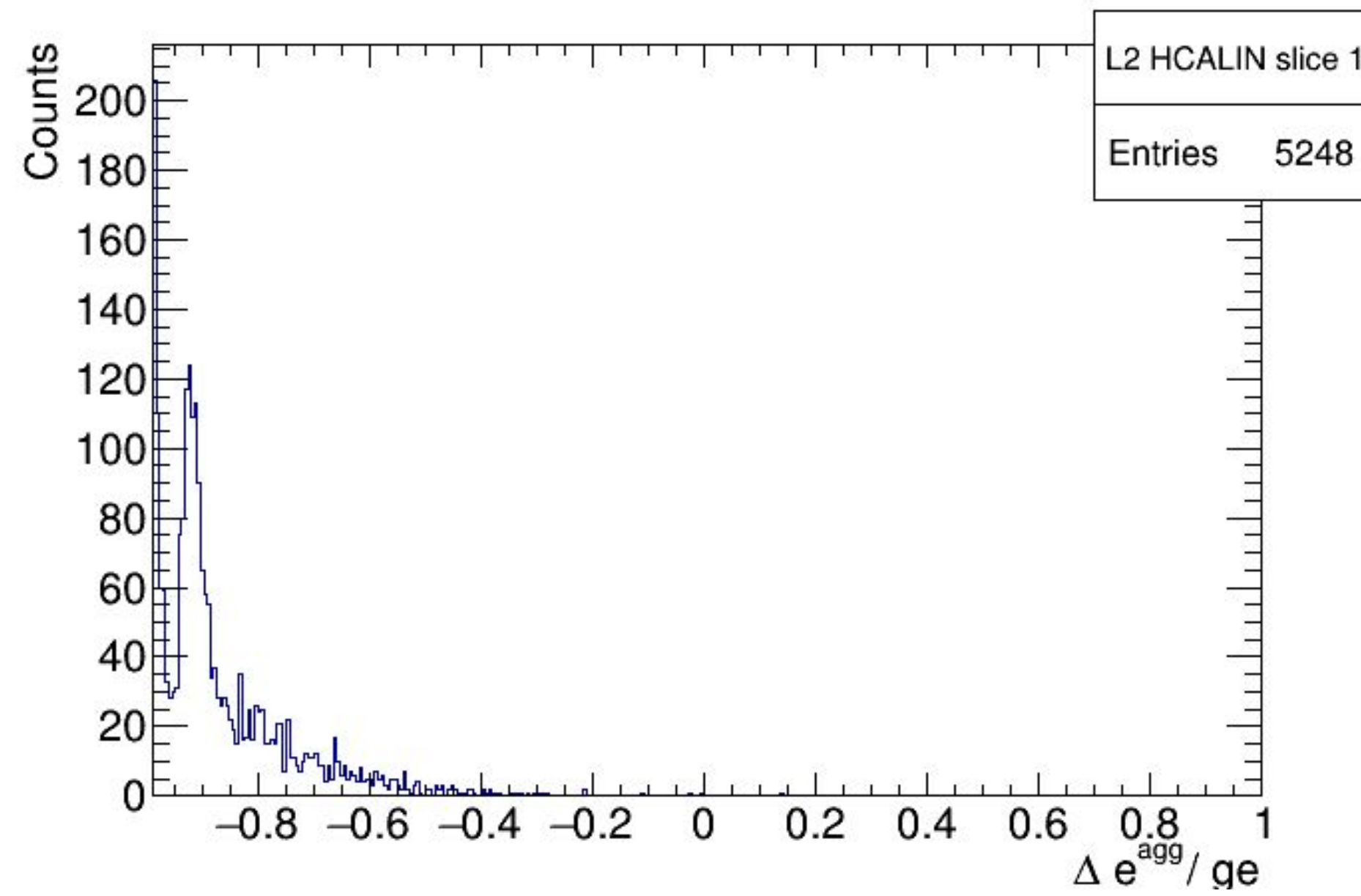
L2 Fitted Gaussians (3 - 30 GeV)



The x-axes denote $\Delta e_{agg}/ge$

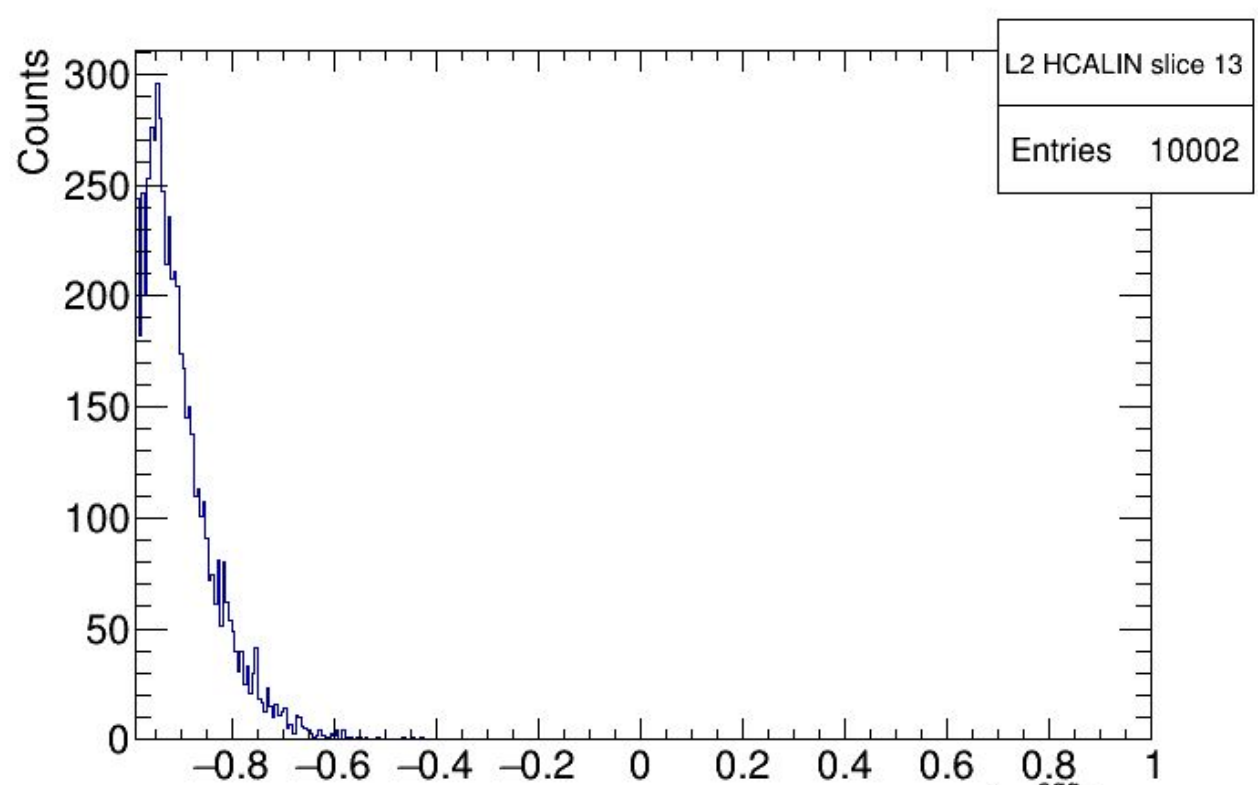
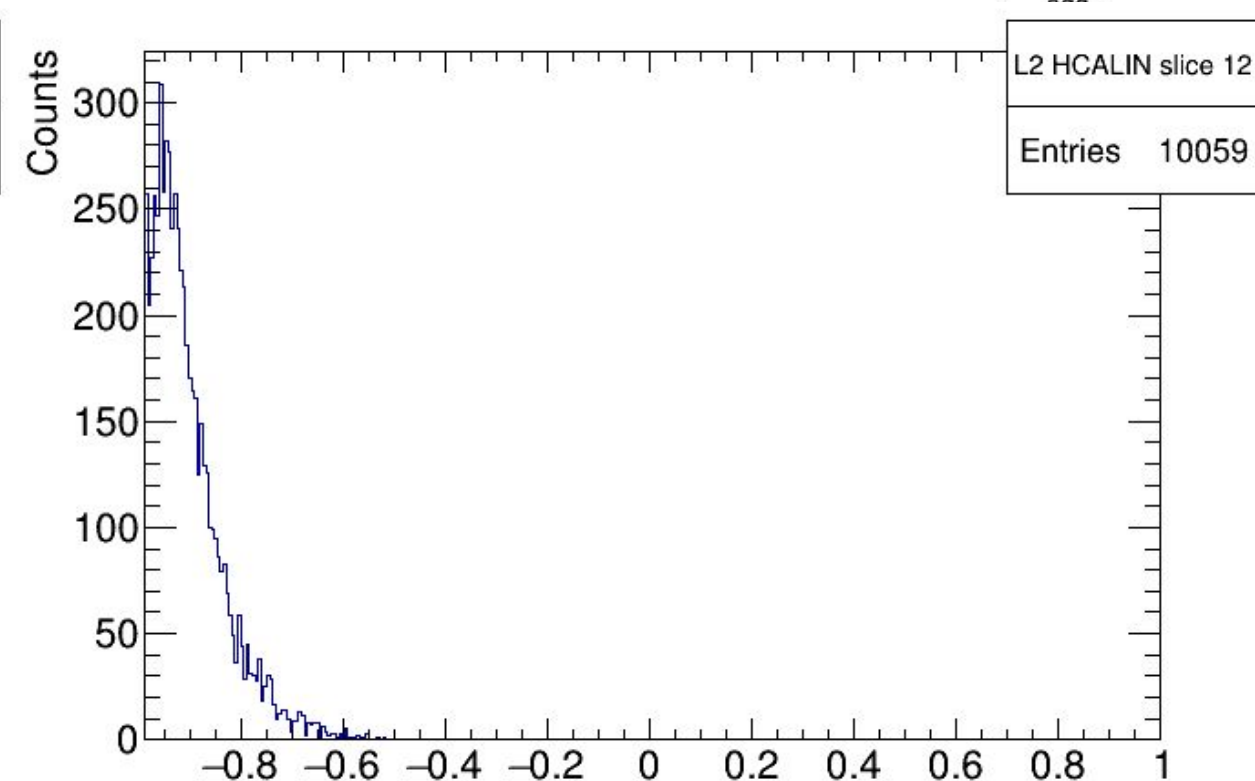
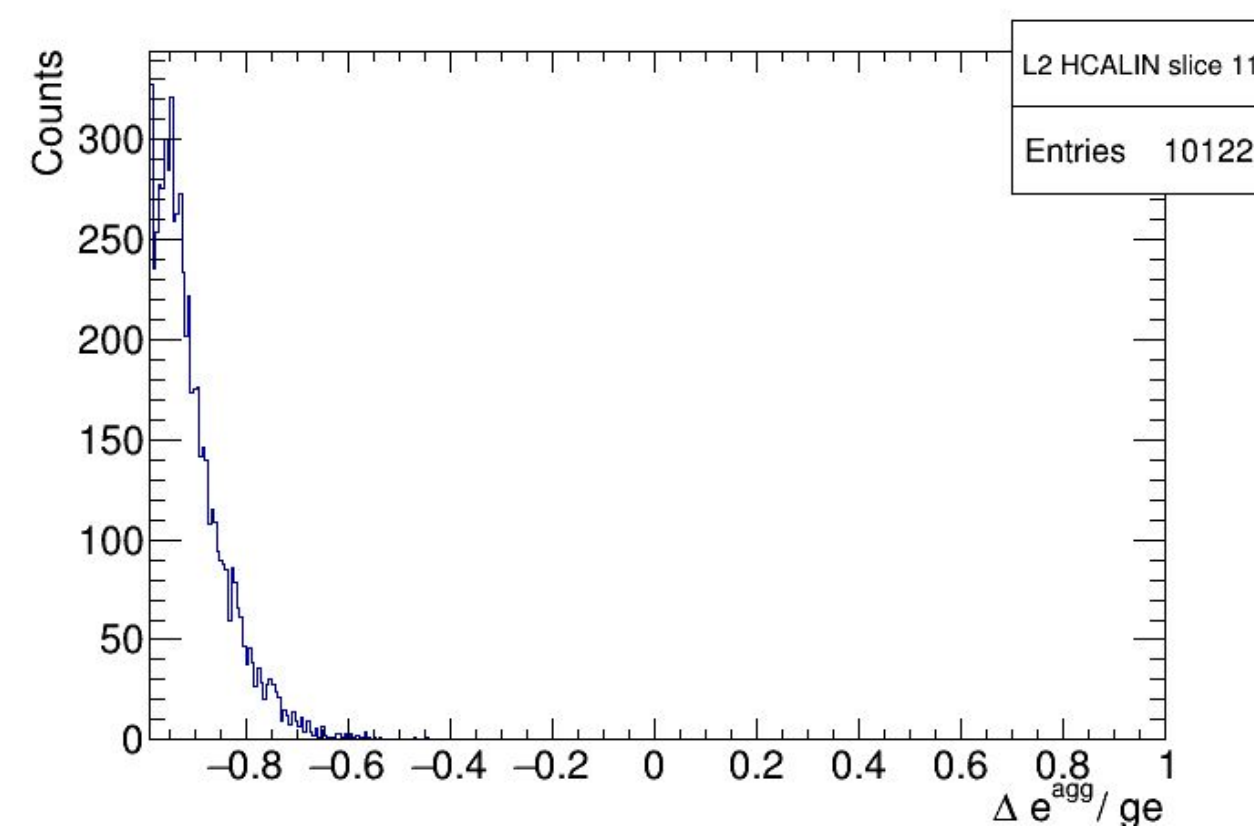
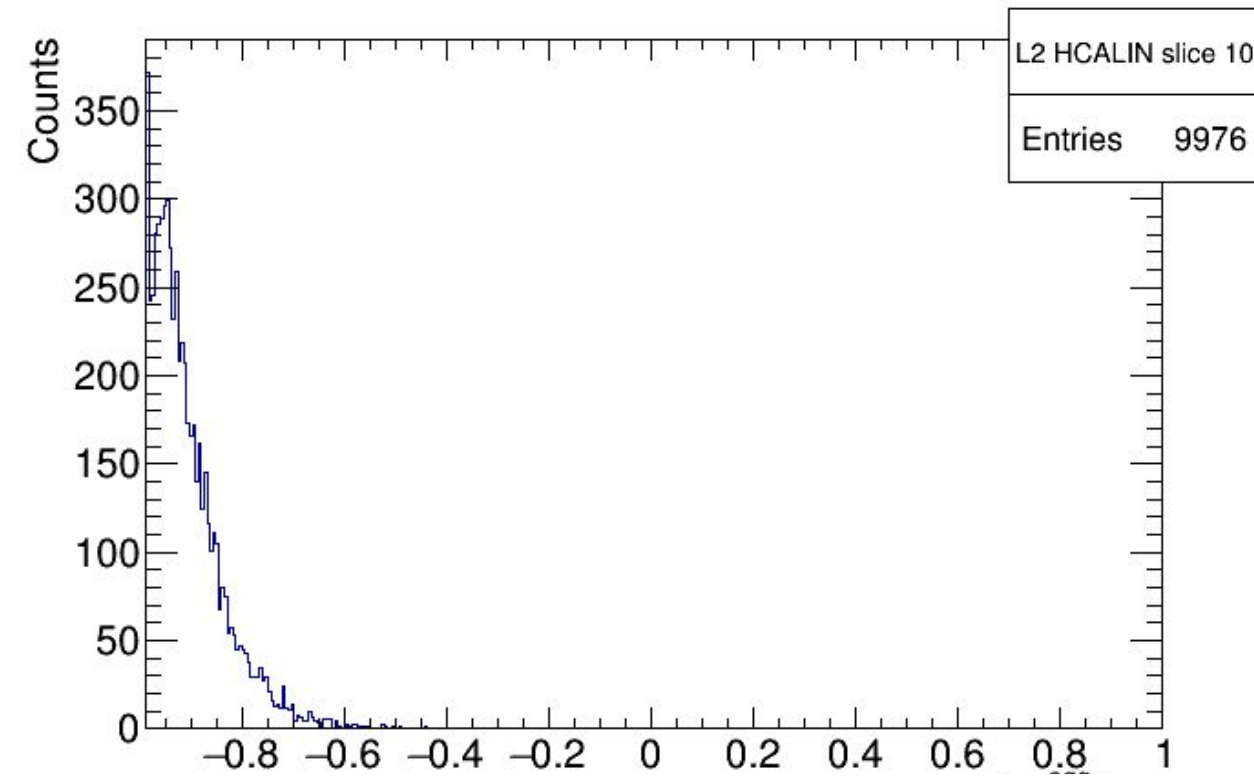
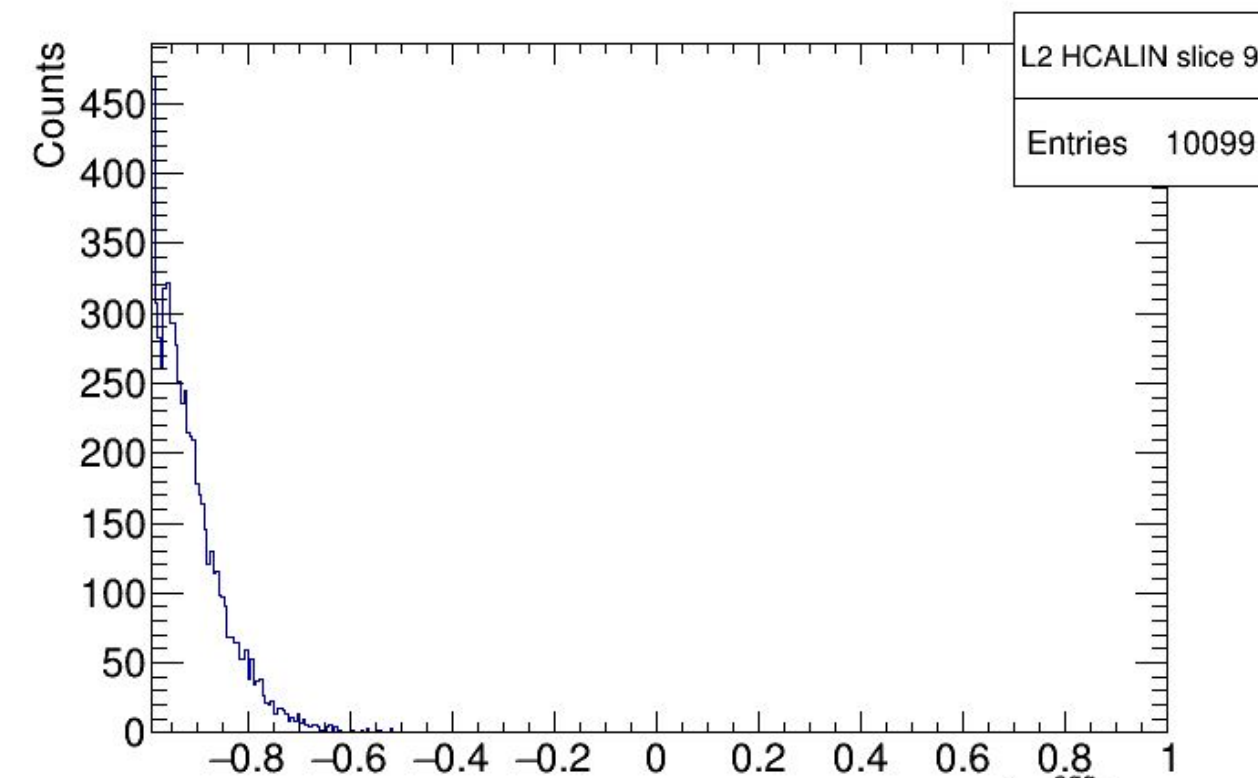
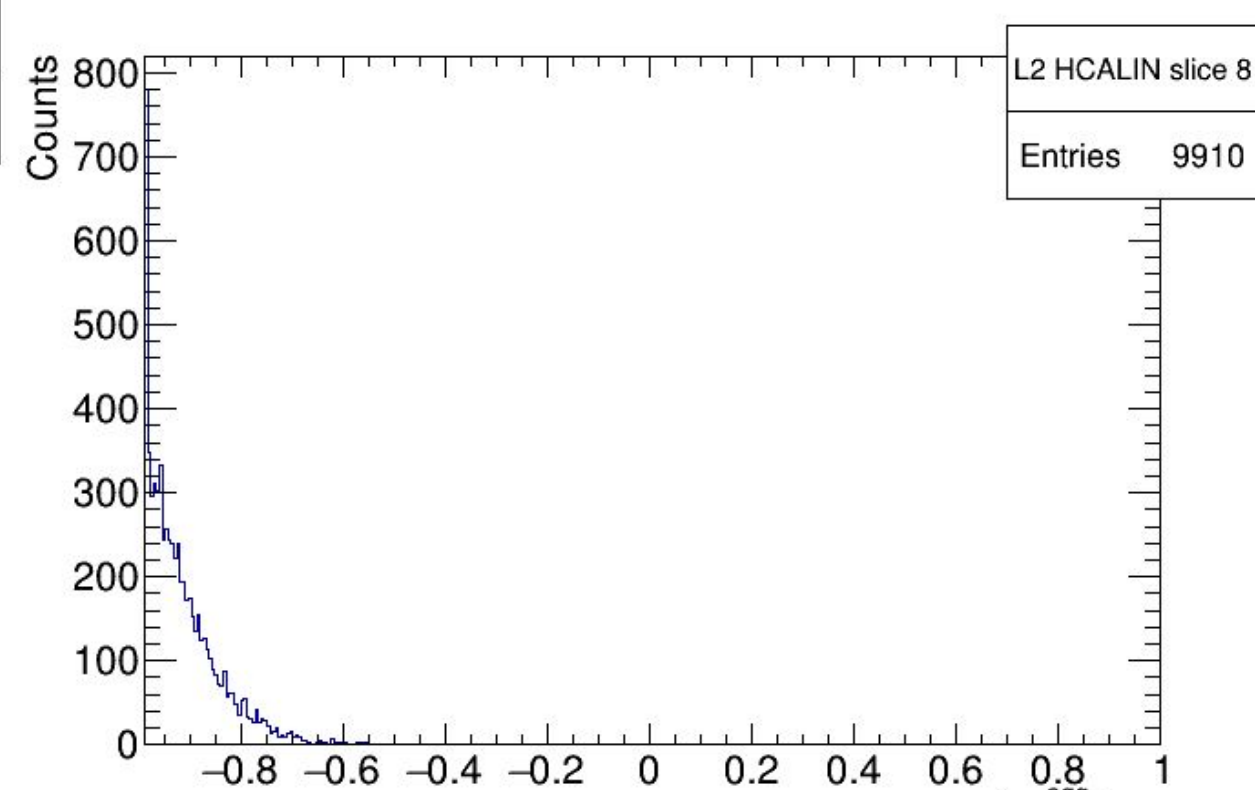
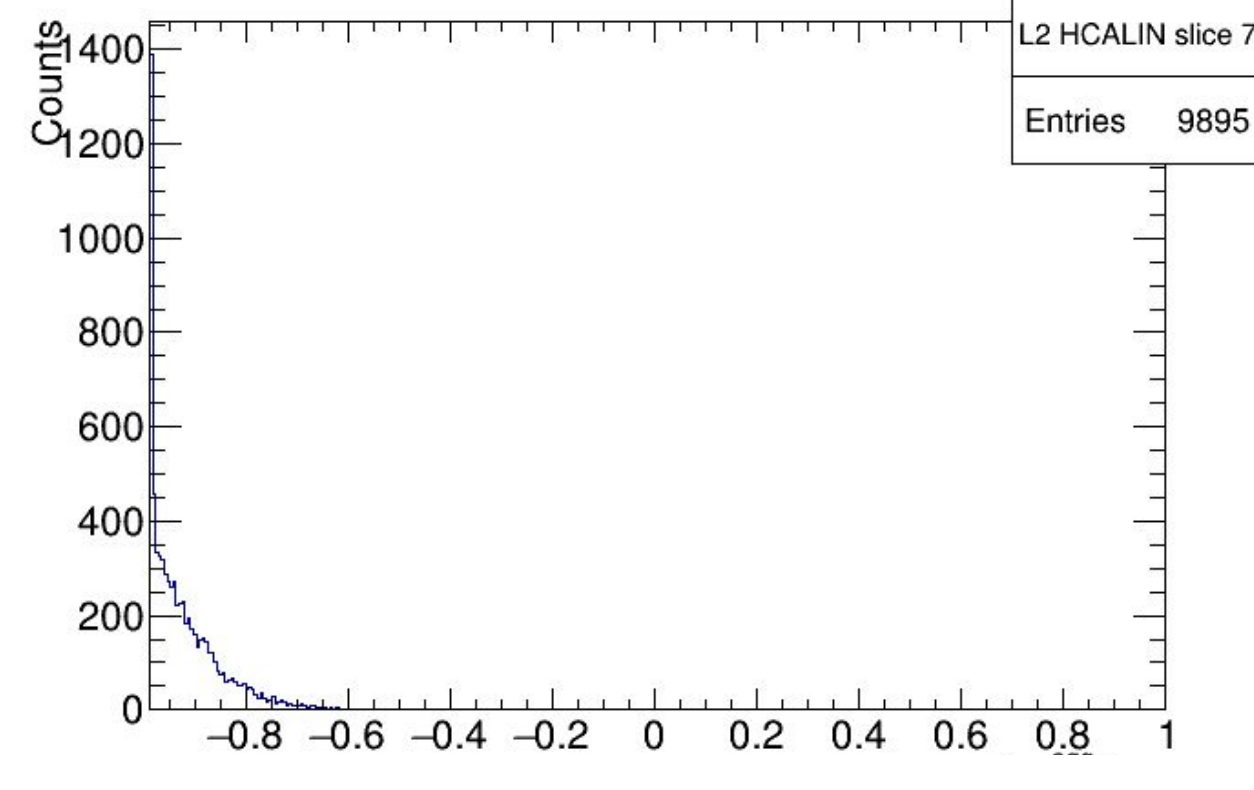
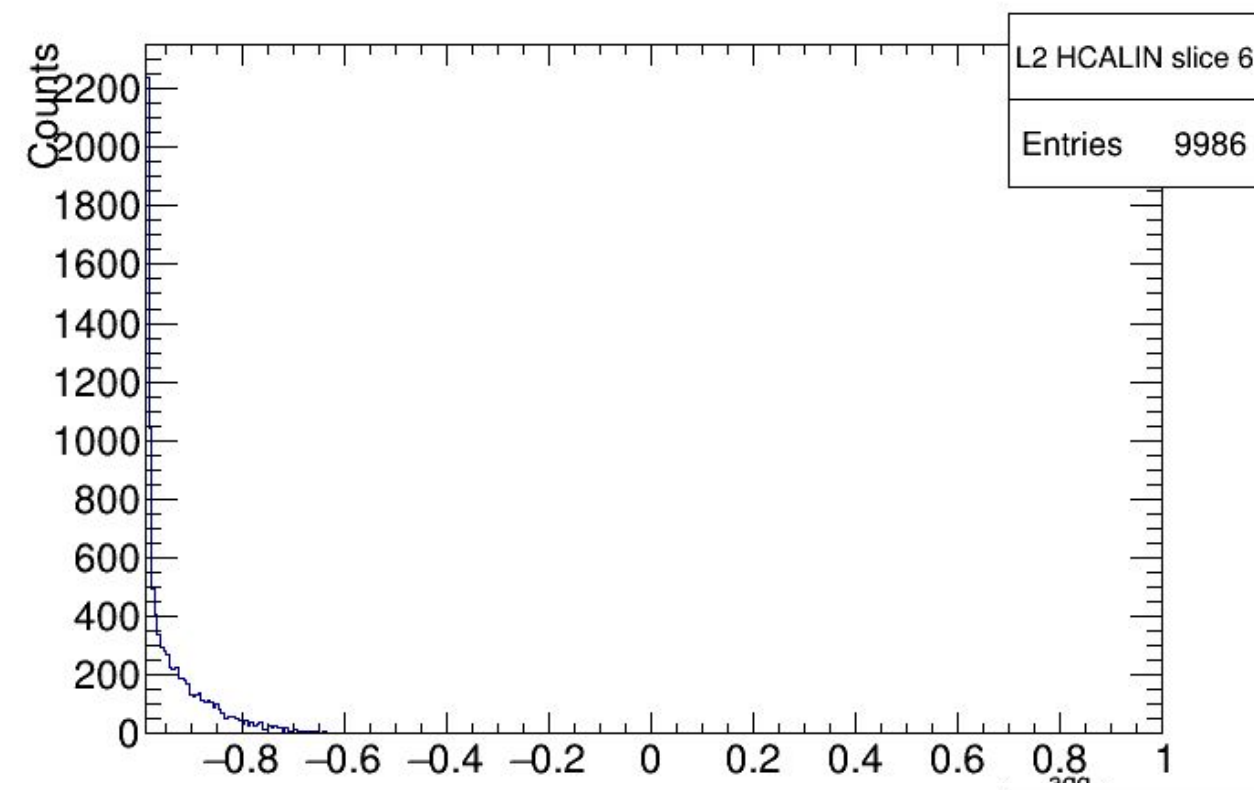
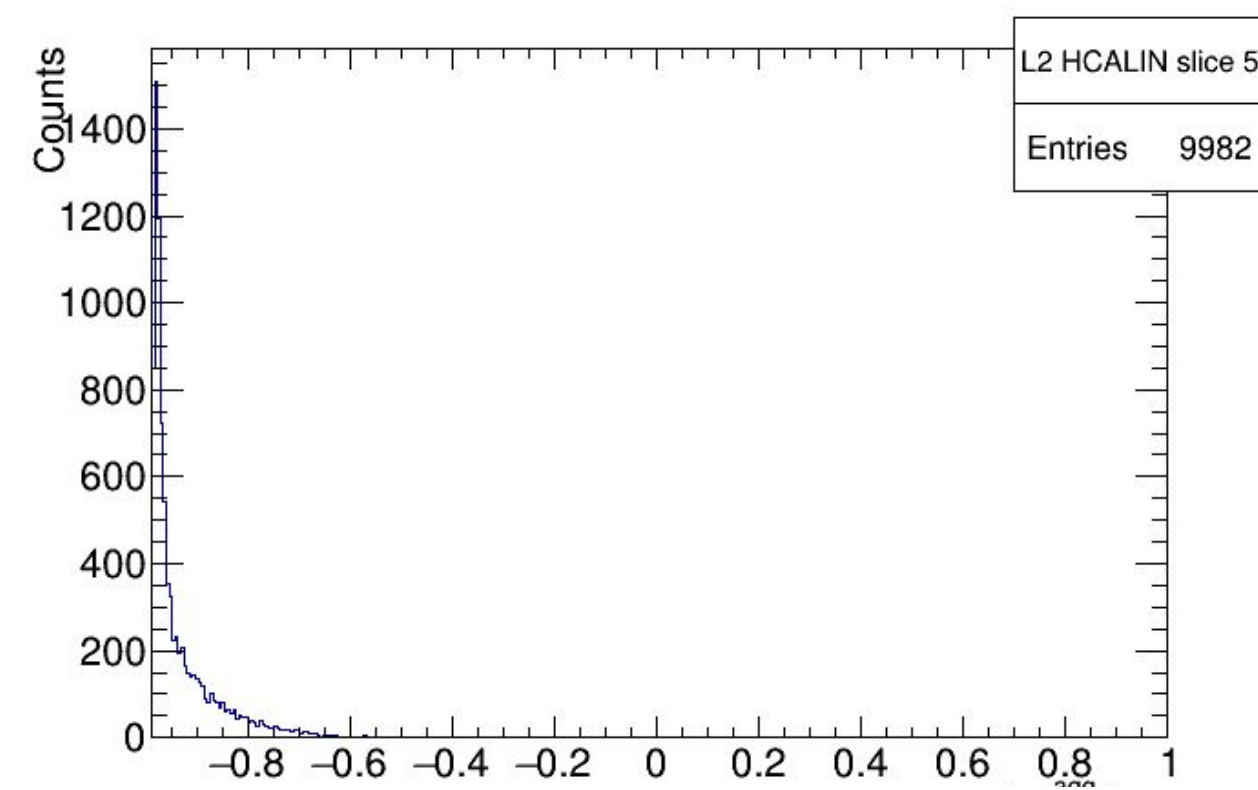
HCALIN (π^-)

L2 Fitted Gaussians (0 - 3 GeV)



HCALIN (π^-)

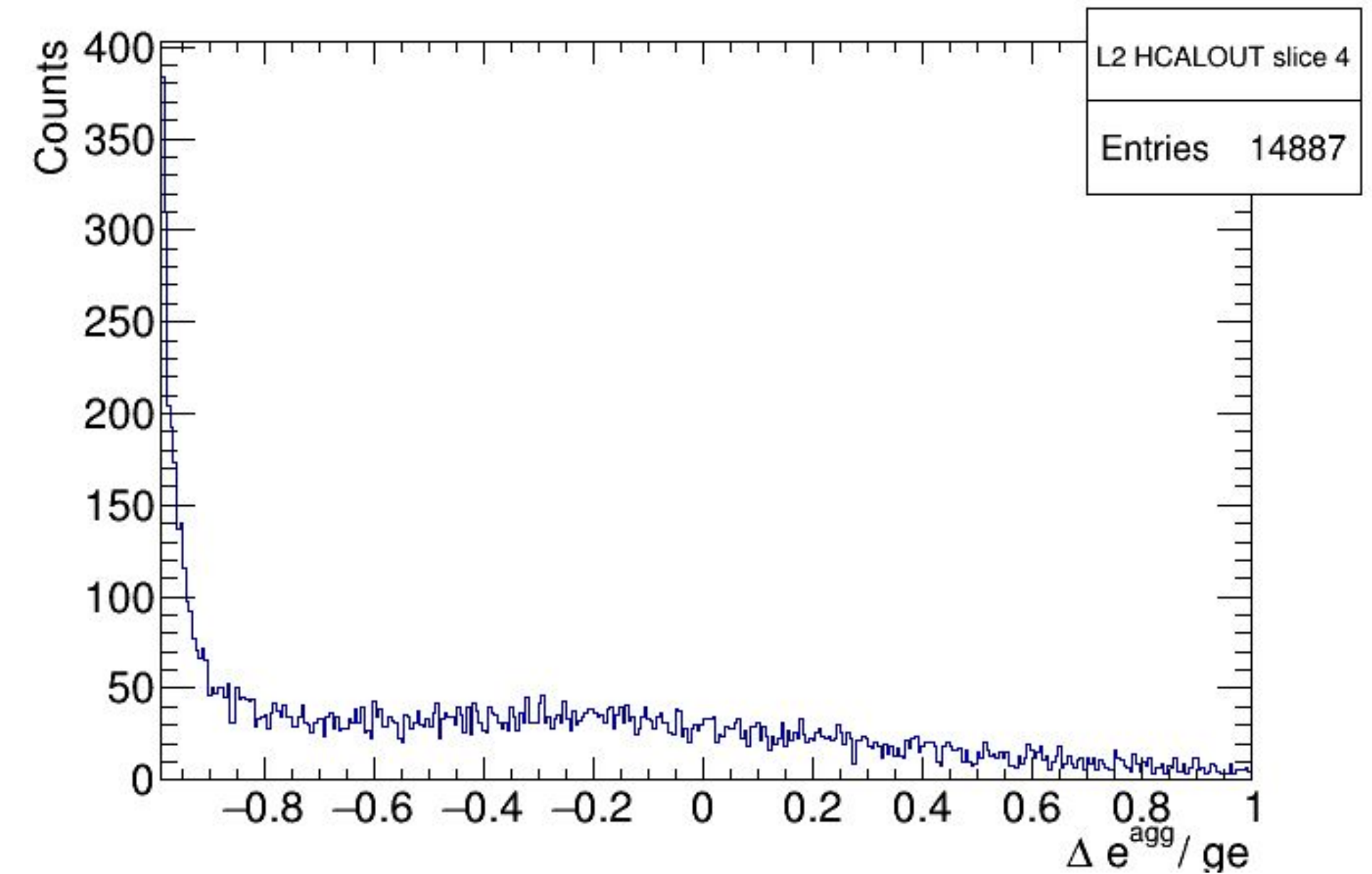
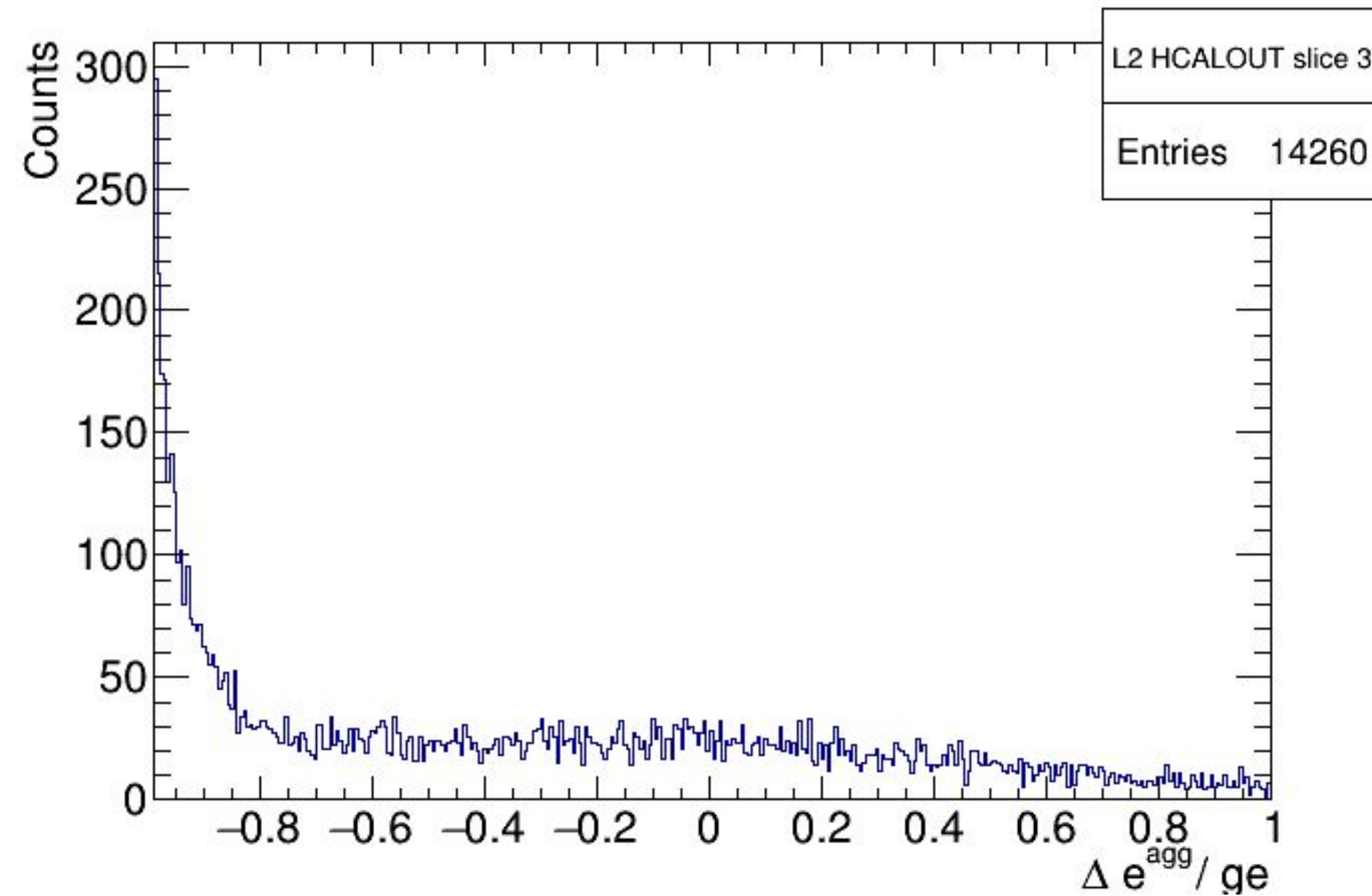
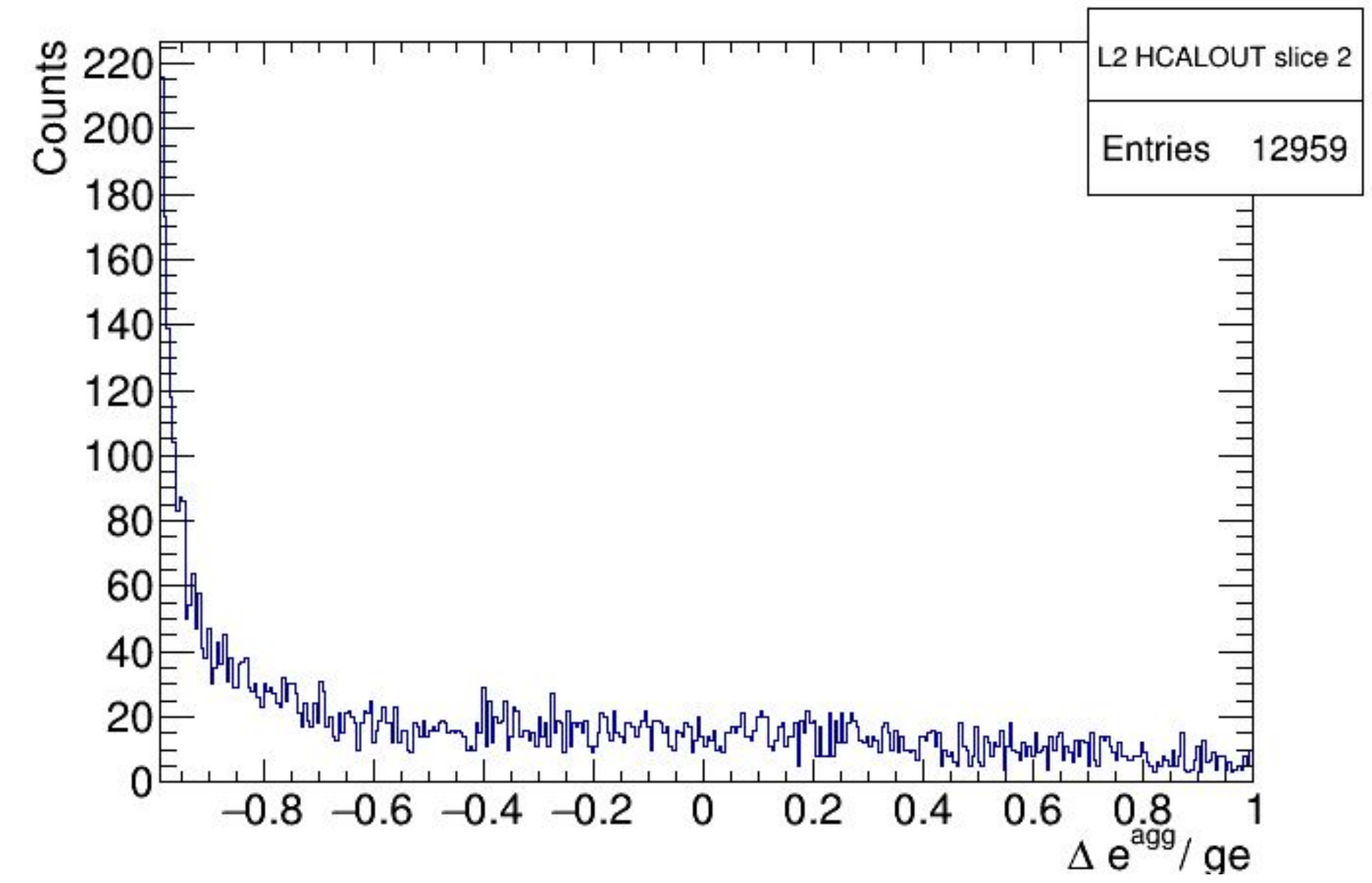
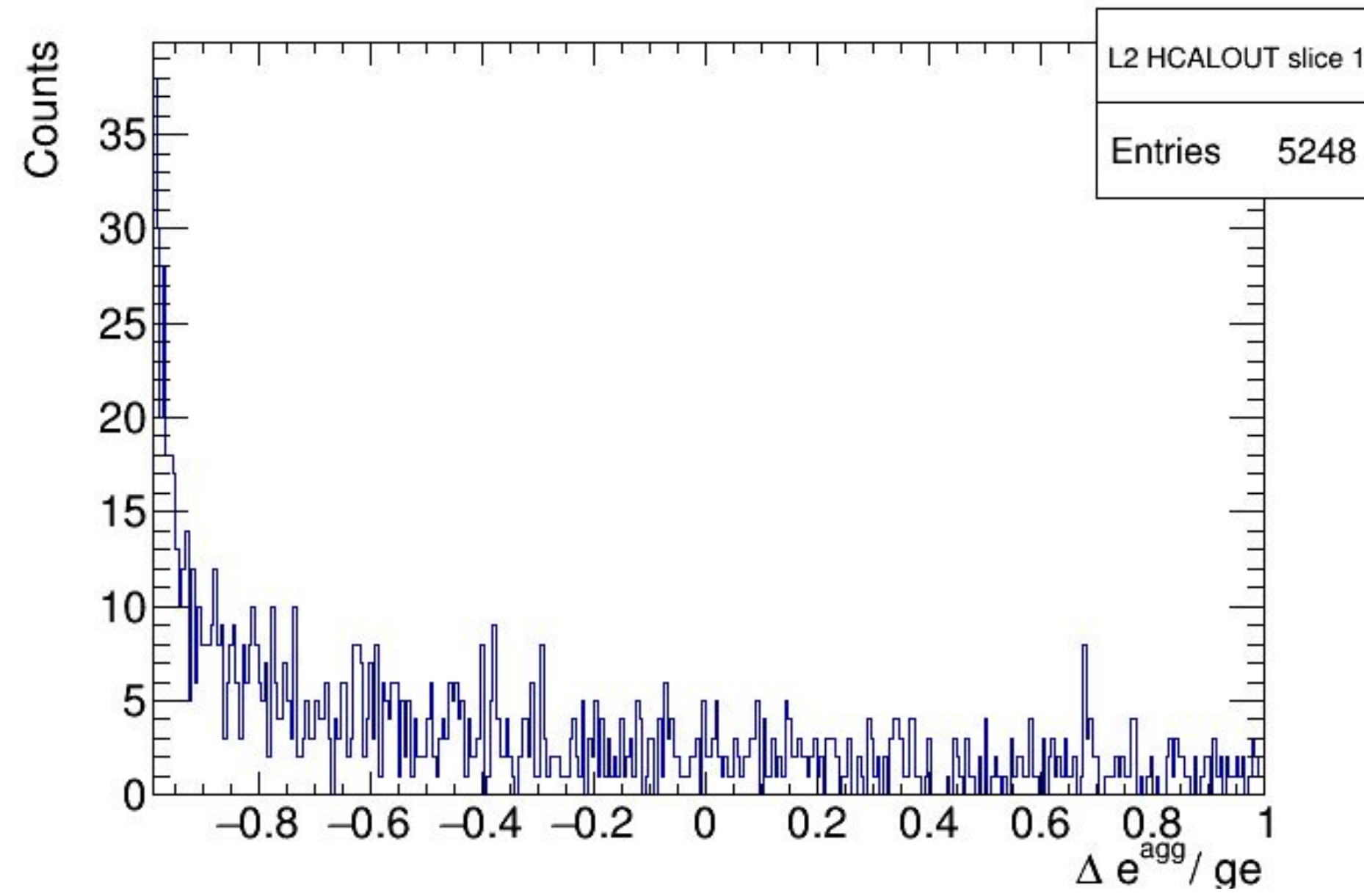
L2 Fitted Gaussians (3 - 30 GeV)



The x-axes denote $\Delta e_{agg}/ge$

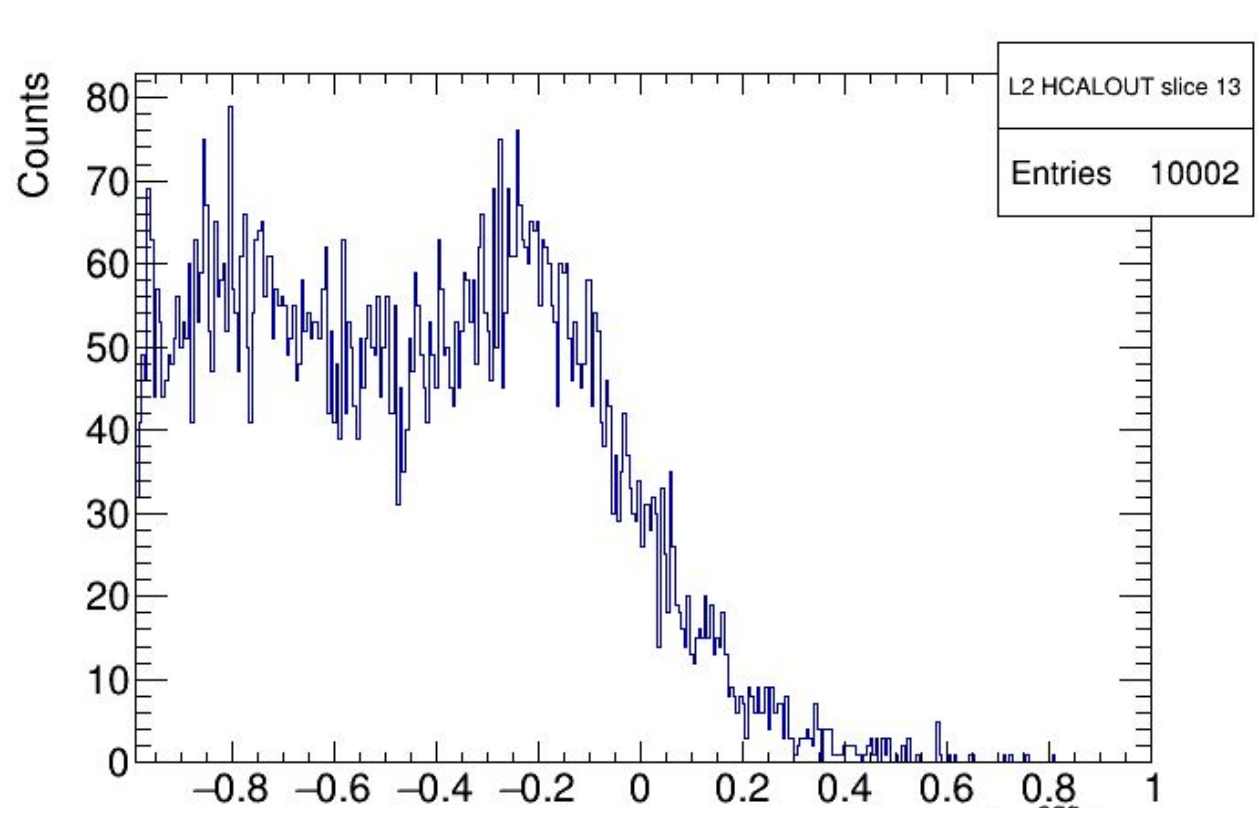
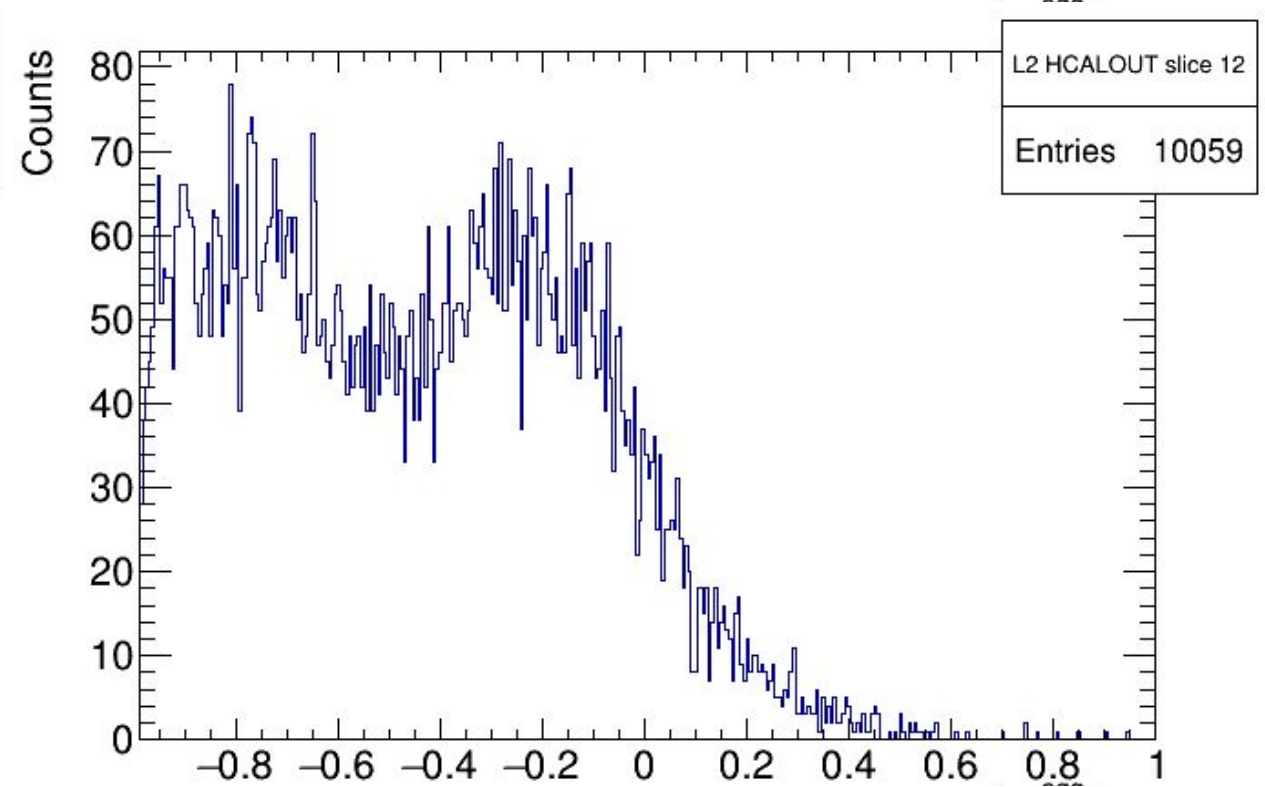
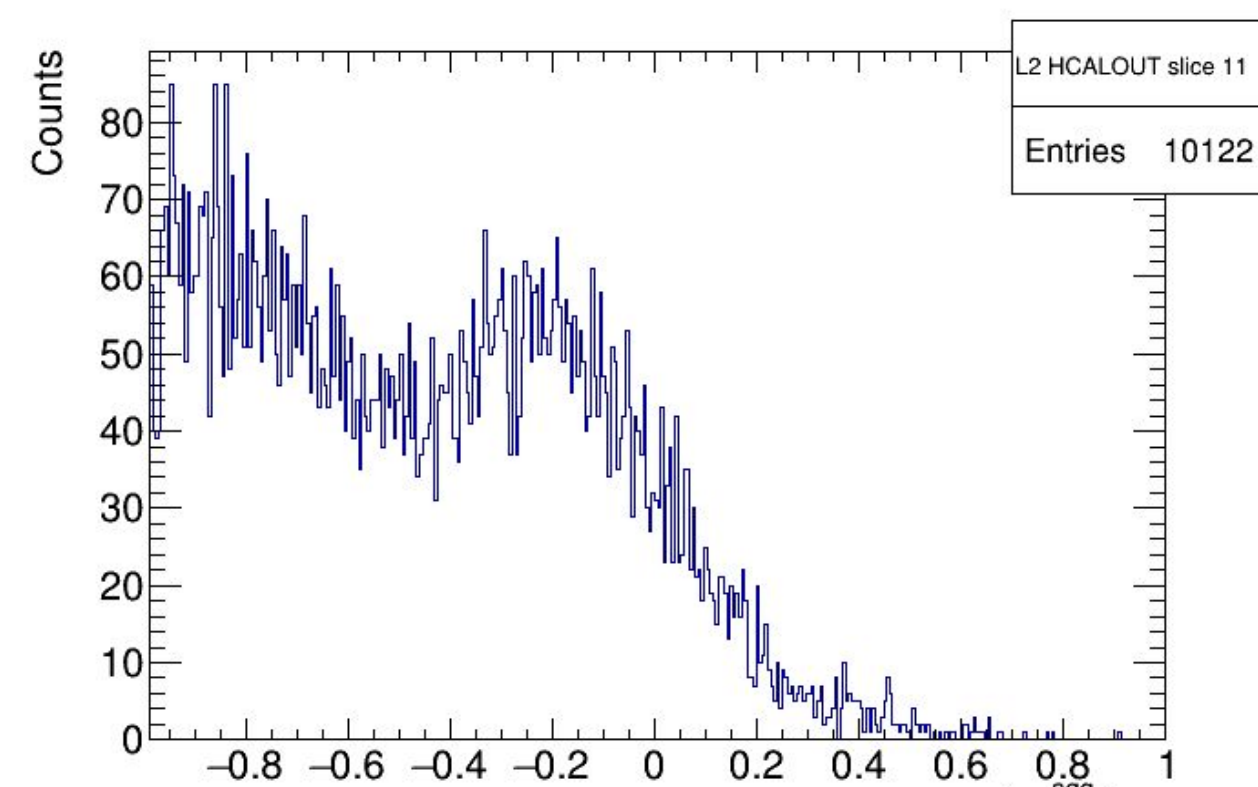
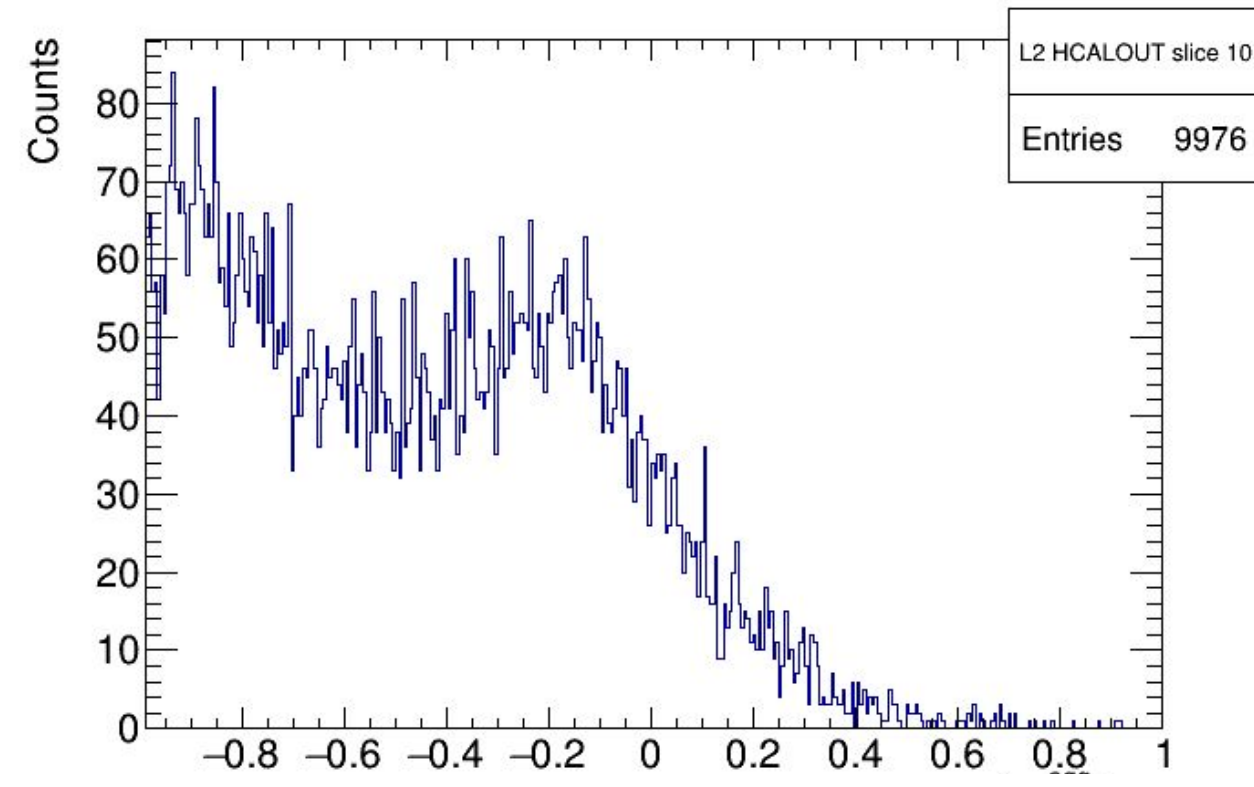
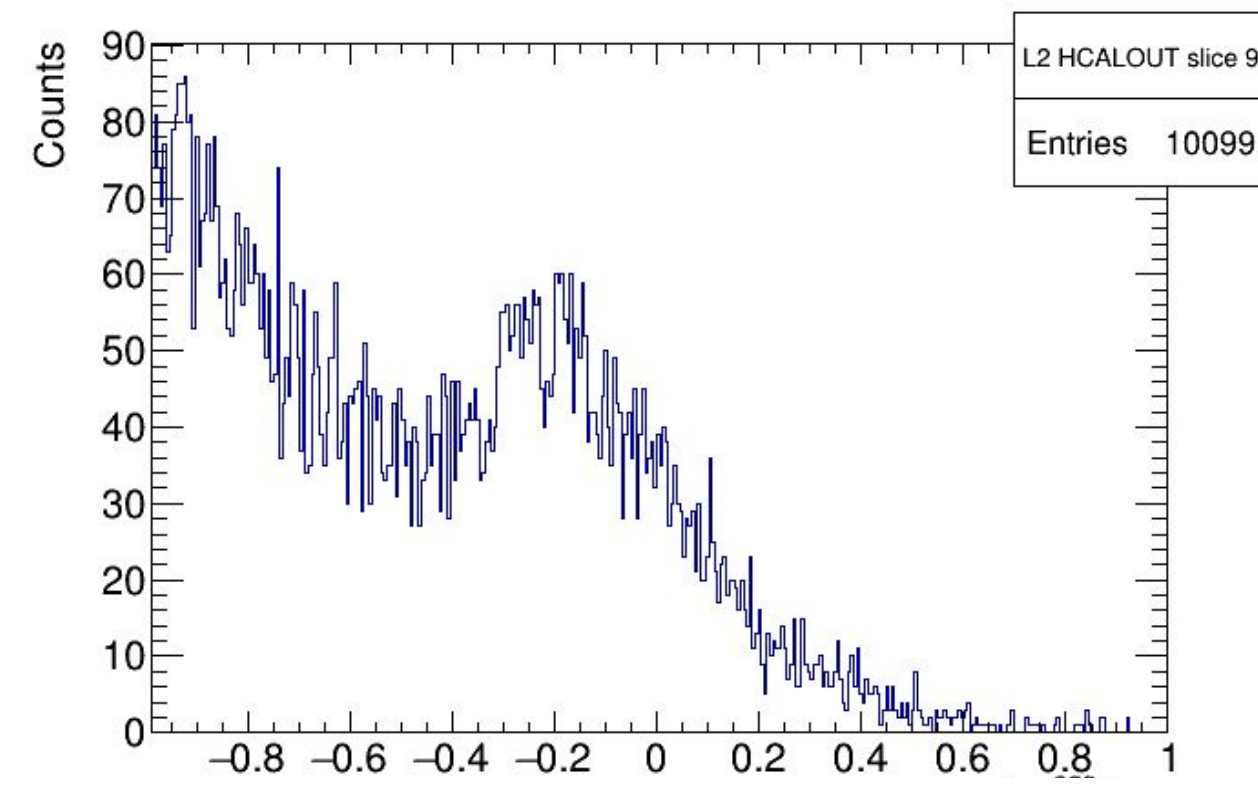
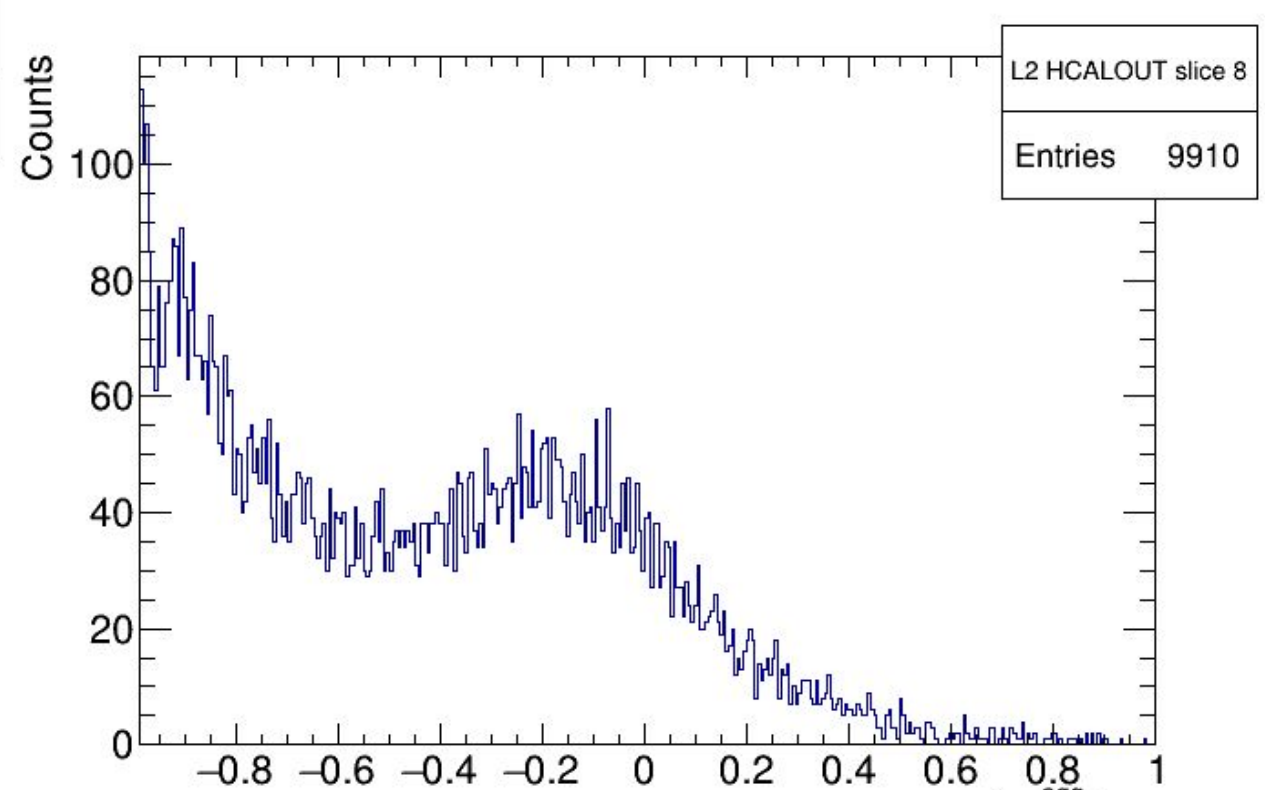
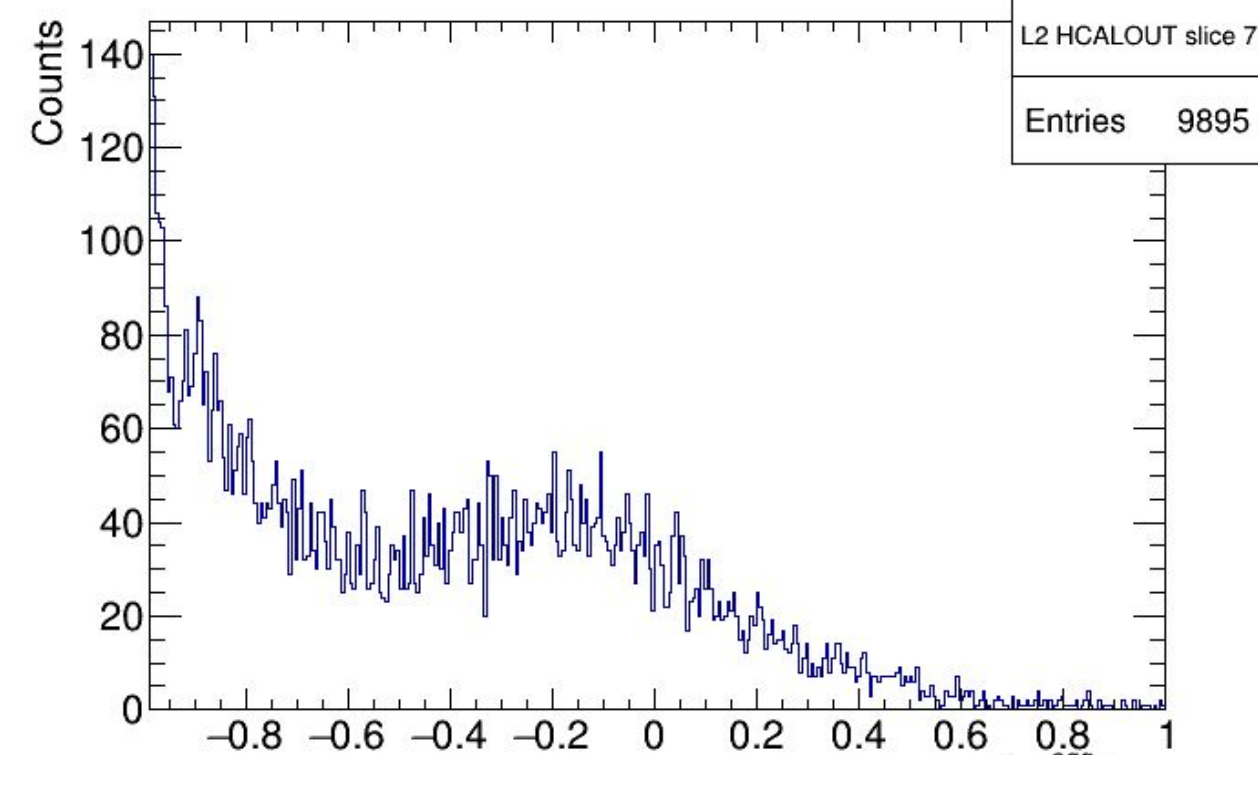
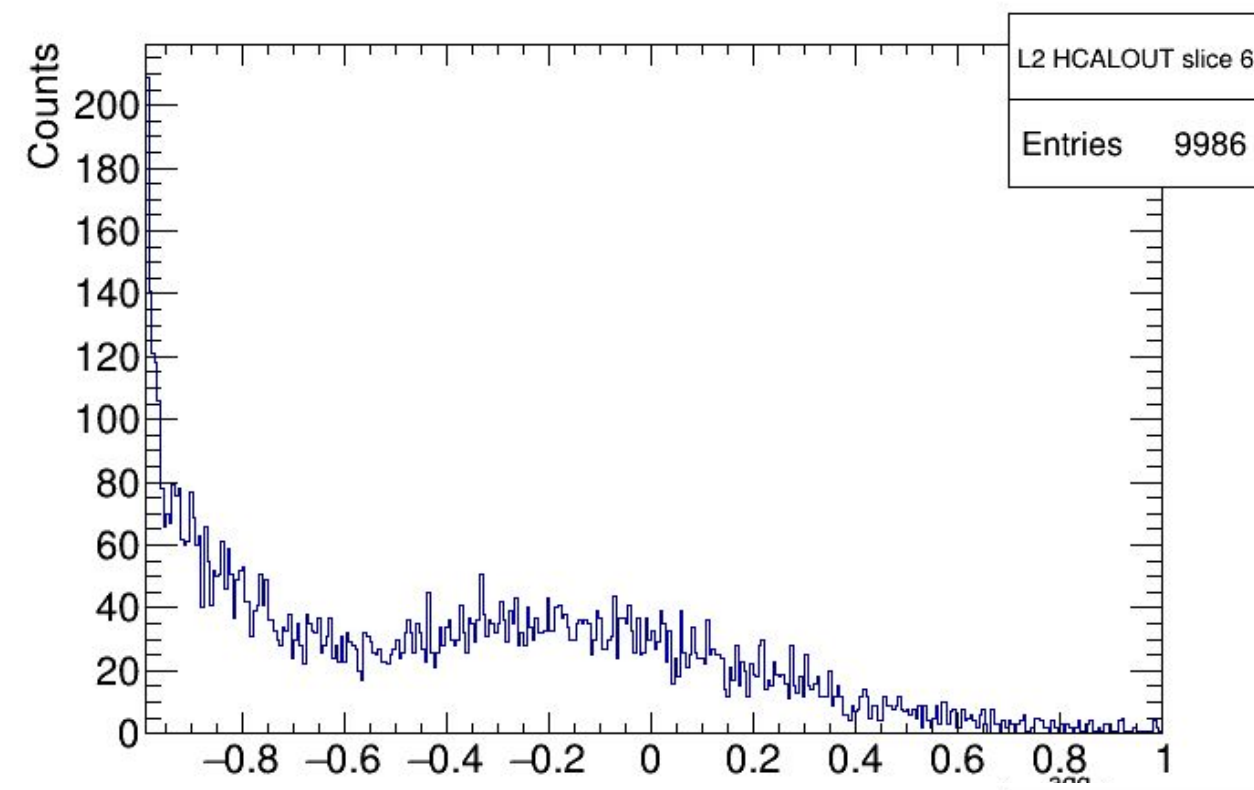
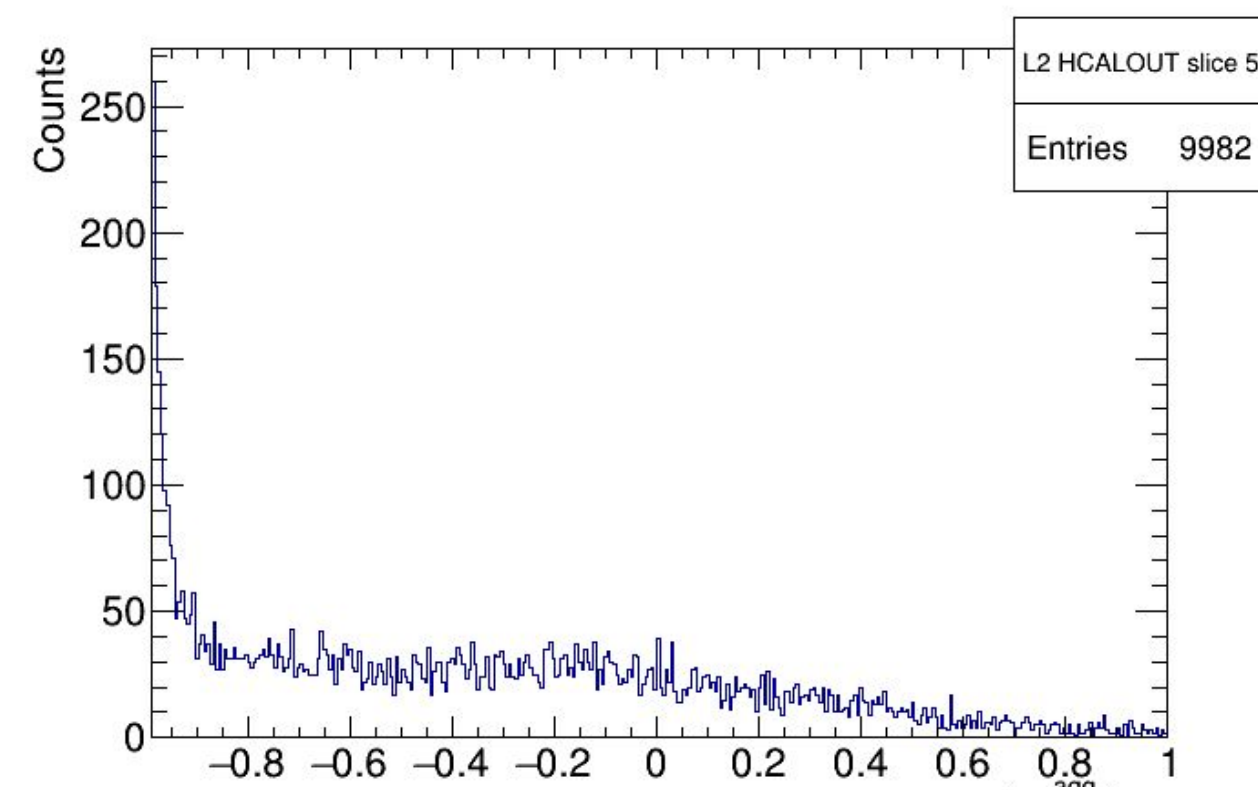
HCALOUT (π^-)

L2 Fitted Gaussians (0 - 3 GeV)



HCALOUT (π^-)

L2 Fitted Gaussians (3 - 30 GeV)



The x-axes denote $\Delta e_{agg}/ge$

