



Simulation Statistics

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Contents

Histograms for energy resolution of detectors by applying manual clustering and incorporating recalibration, for the following detector-particle pairs:

- Electron: CEMC, EEMC, FEMC
- Pion: FEMC + FHCAL, CEMC + HCALIN + HCALOUT

Some histograms with the magnetic field disabled are also included.

Simulation Parameters

- Particles: e^- , π^-
- Events: 125,000 e^- (100,000 \rightarrow 0-30 GeV/c, 25000 \rightarrow 0-2 GeV/c),
100,000 π^- (50,000 for the ones without magnetic field)
- momentum (p): 0 to 30 GeV/c
- Pseudorapidity (η): -4 to 4
- Azimuth (Φ): $-\pi$ to π

Cuts:

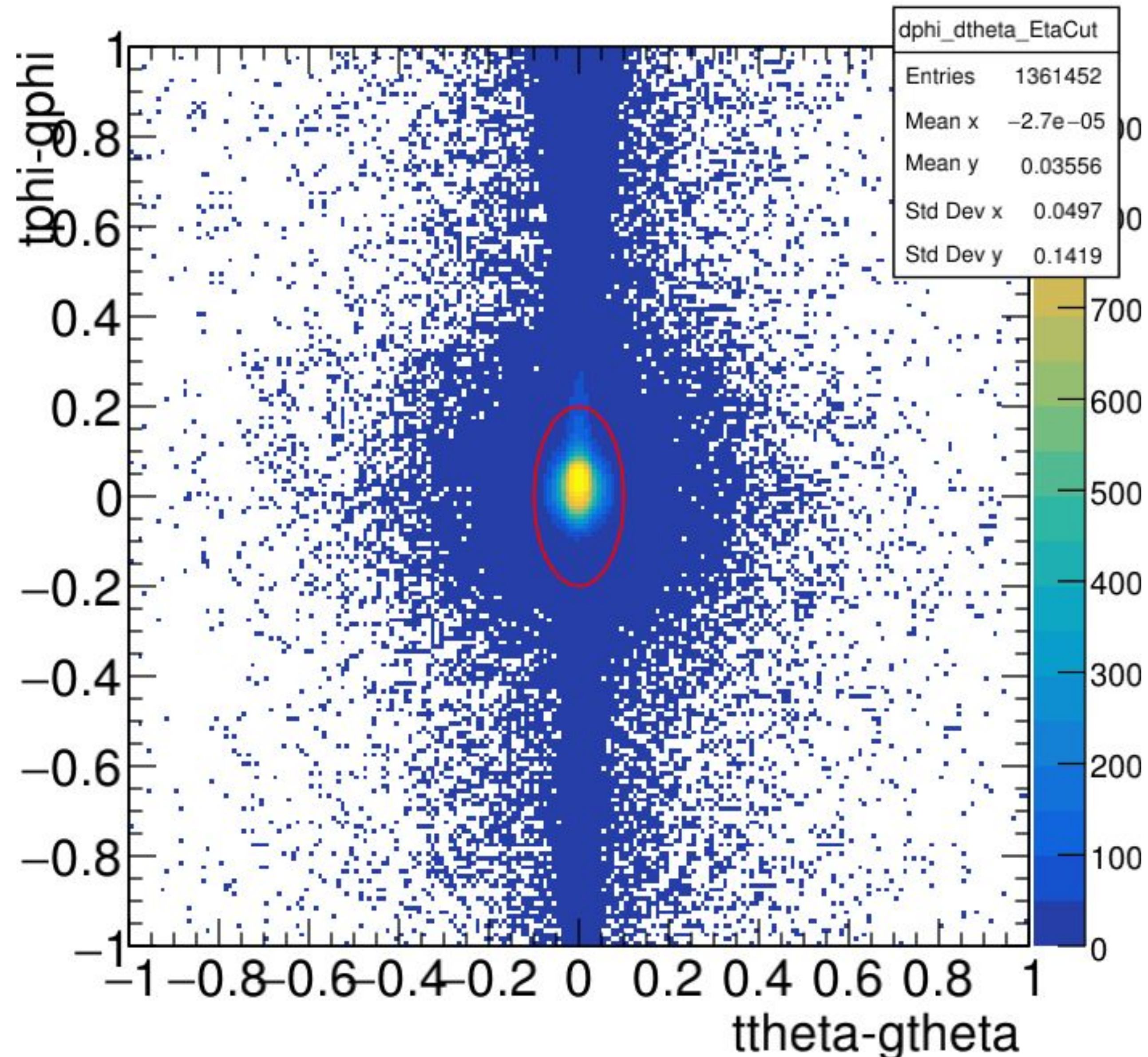
- Detector-wise η cuts (intersection of η ranges in case of detector combinations)
- Detector-wise elliptical cuts in $d\phi$ vs $d\theta$ plots (simultaneously included in case of detector combinations)

A teal geometric graphic consisting of several overlapping triangles and quadrilaterals, creating a complex, faceted shape on the left side of the slide.

CEMC (e^-)

CEMC (e^-)

Elliptical cut on dphi vs dtheta, Explicit η cut: -1.5 to 1.2



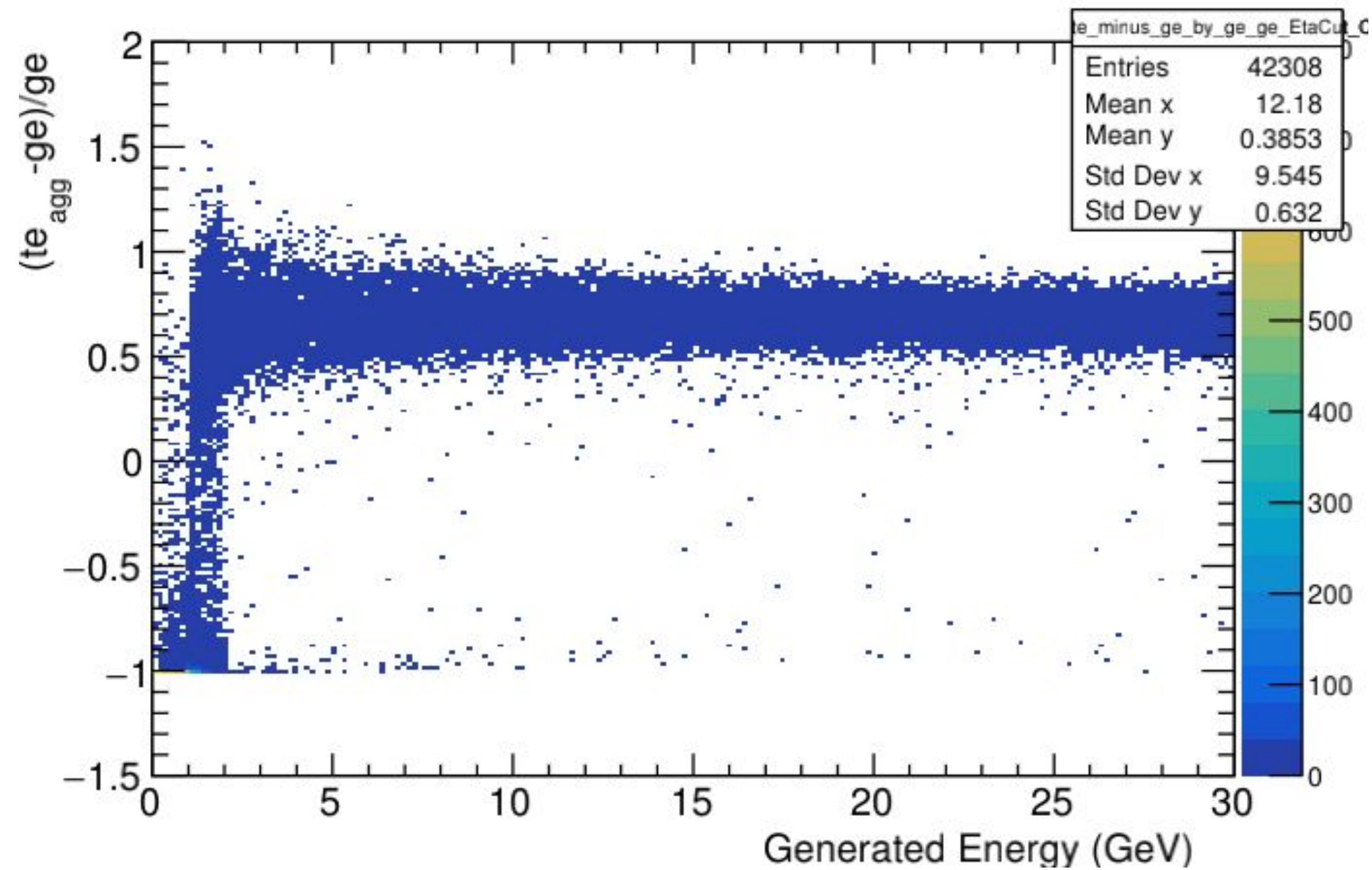
Elliptical Cut: Only the towers within the elliptical region (centered at origin) are considered for further analysis.

Dimensions:

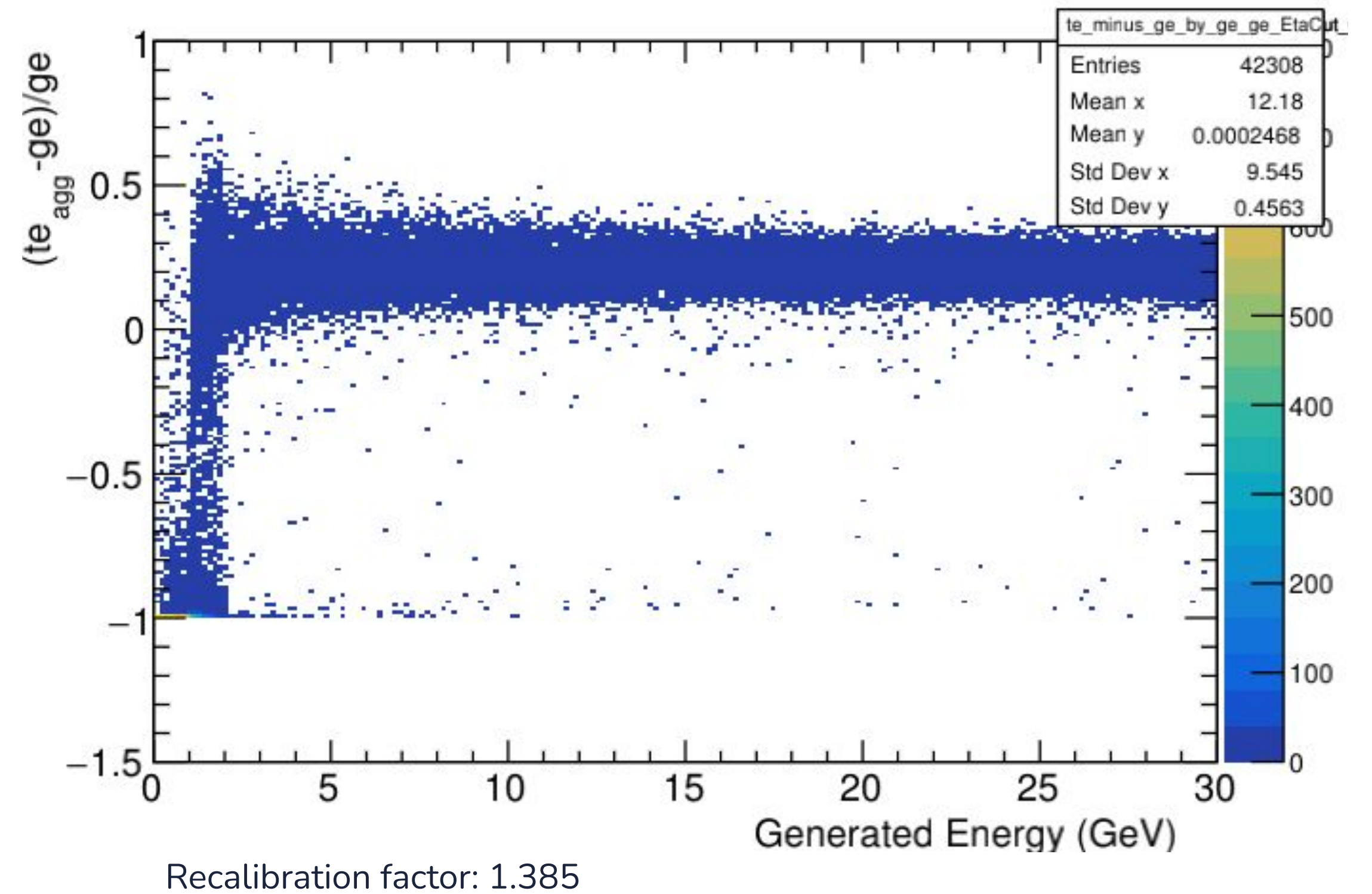
semi-minor axis = 0.10 units
semi-major axis = 0.20 units

CEMC (e^-)

$(te_{agg} - ge)/ge$ vs ge
Explicit η cut: -1.5 to 1.2
no energy cut

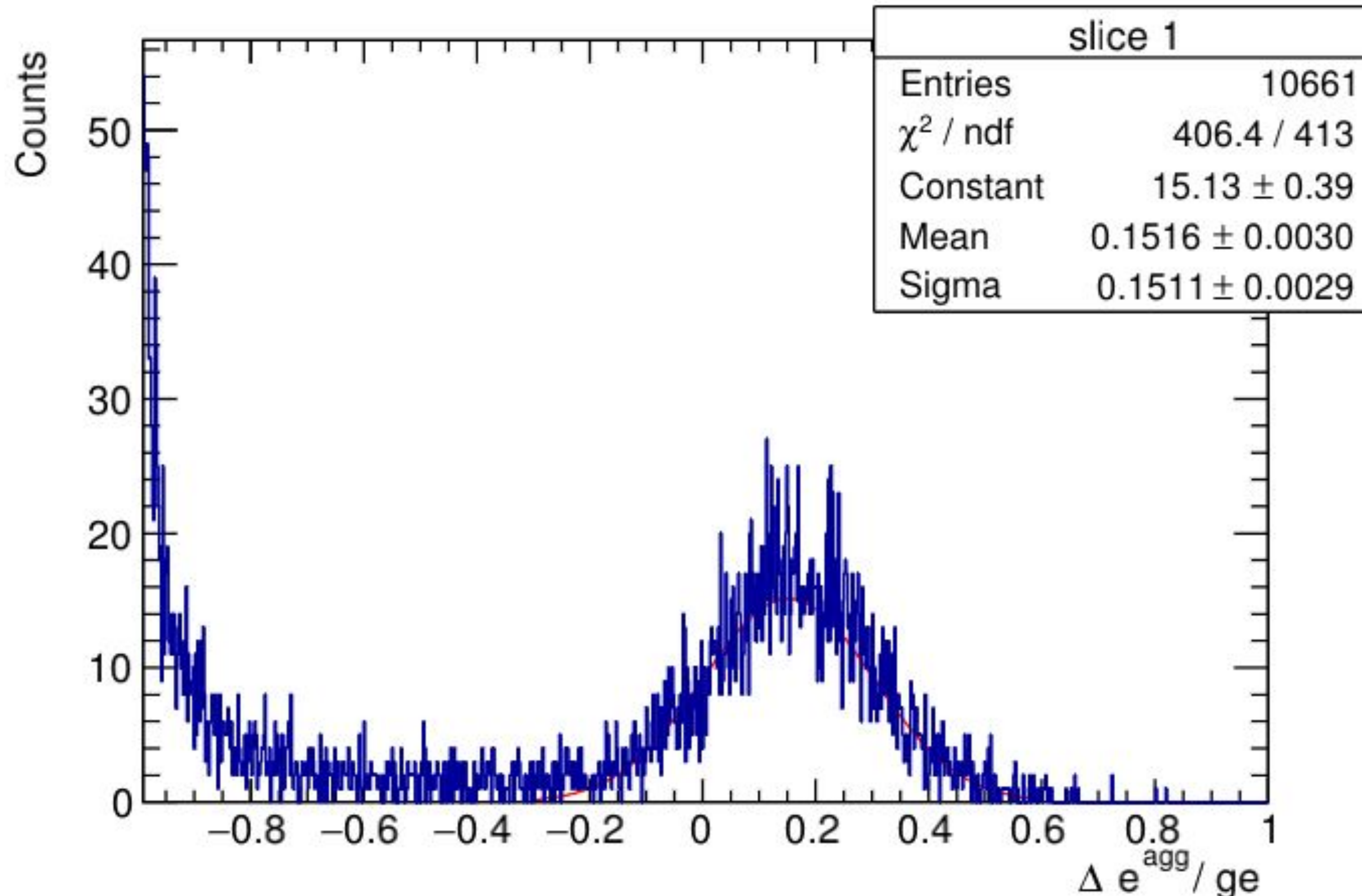


After Recalibration ($te \rightarrow te/recalibrationFactor$)



CEMC (e^-)

$(te_{agg} - ge)/ge$ vs ge
Gaussian fit of the first slice (0-2 GeV)



This is the gaussian fit of the first slice of the recalibrated $(te_{agg} - ge)/ge$ vs ge plot.
(shown on the previous slide)

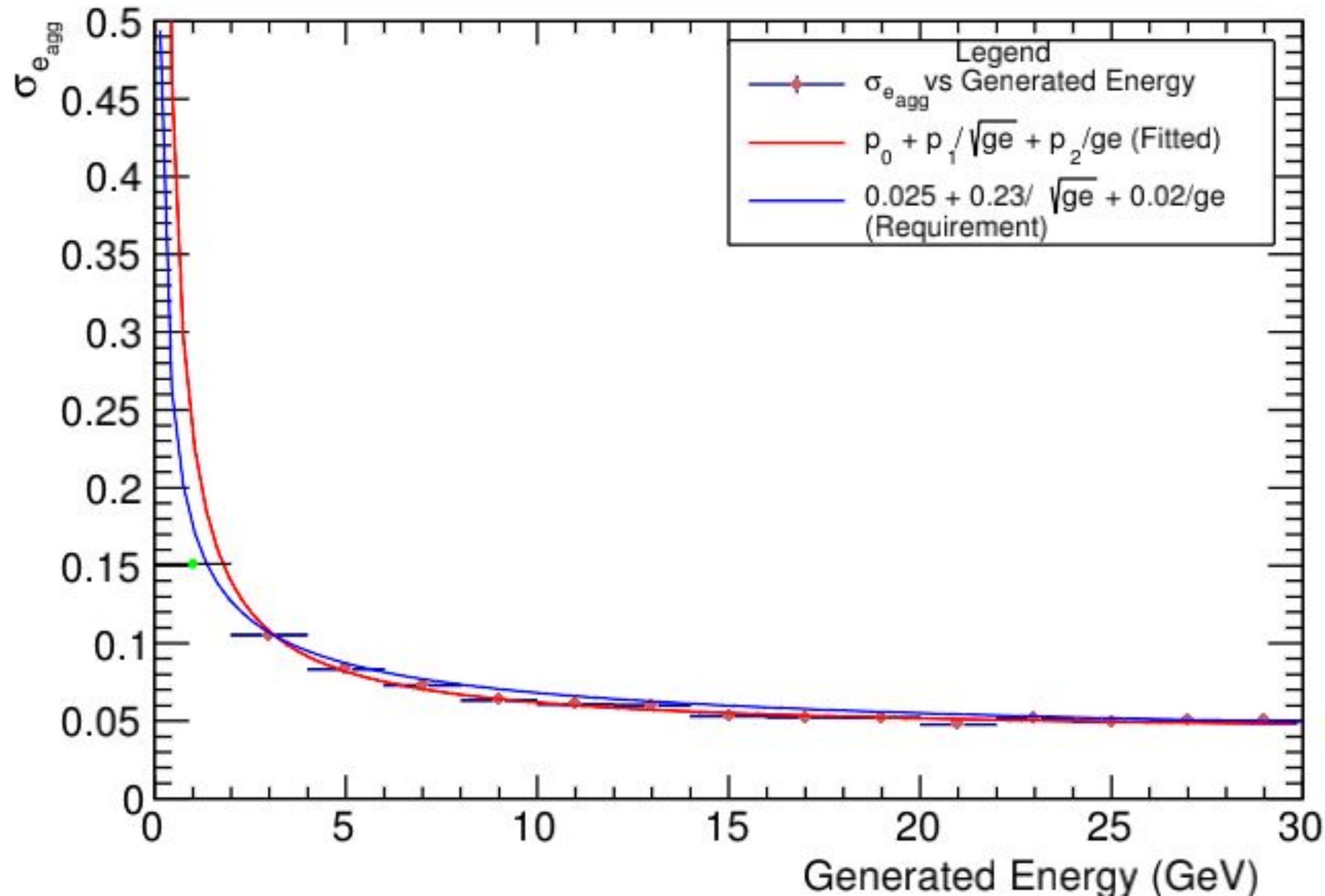
This fit has been done manually by restricting the fit range of the gaussian from -0.30 to 0.60

*All other gaussians have been fit over the entire range.

Number of bins = 1000 from -0.99 to +1.0

CEMC (e^-)

$\sigma_{e_{agg}}$ vs ge
Explicit η cut: -1.5 to 1.2
Elliptical cut



σ_e refers to the standard deviation of the Gaussian fitted to a slice of the recalibrated $(t_{e_{agg}} - ge) / ge$ vs ge plot.
(shown on the previous slide)

Number of bins = 15
Bin Width = 2 GeV

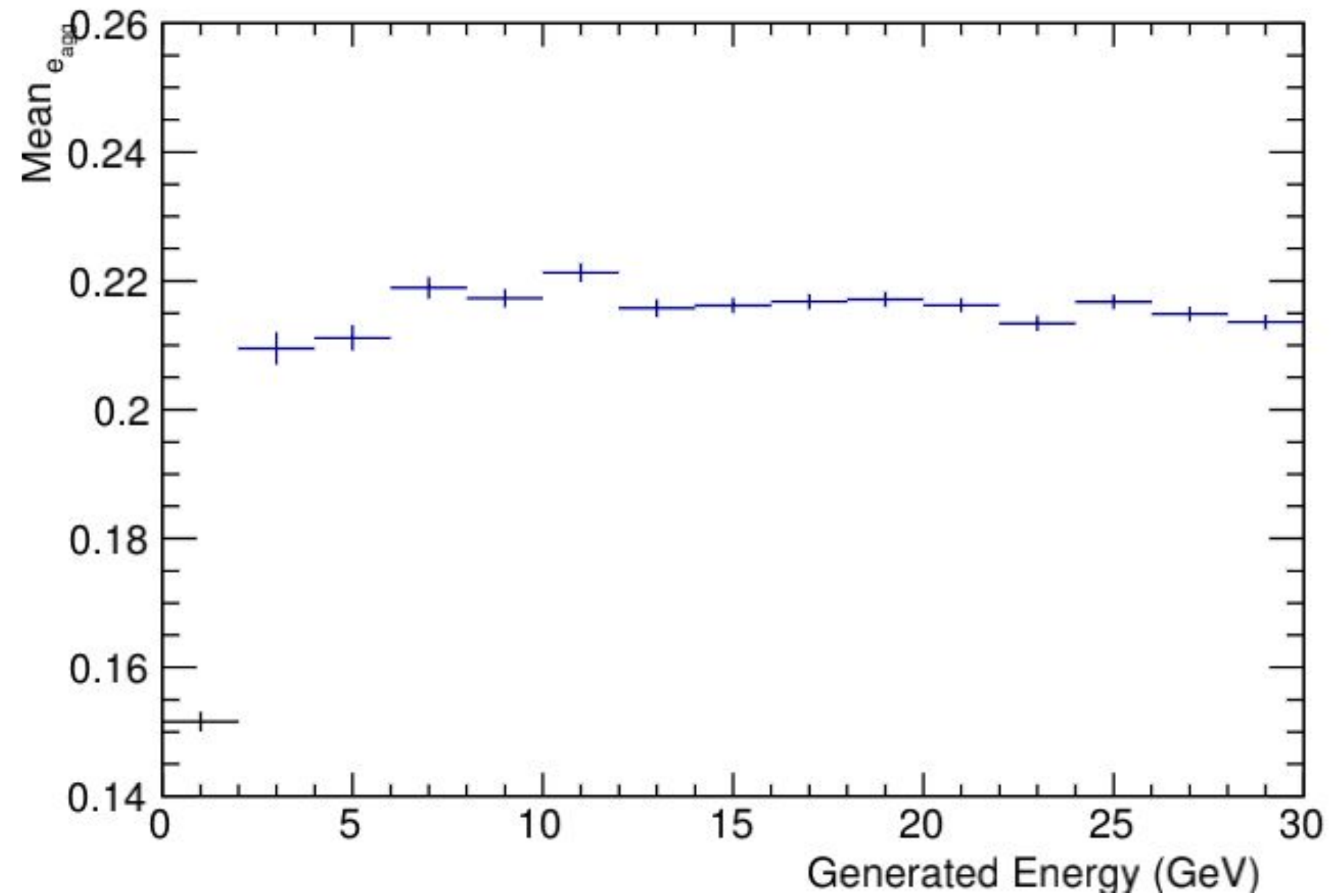
Fit Parameters:

$p_0 = (0.0397813 \pm 0.00314467)$
 $p_1 = (0.0124181 \pm 0.0208545) \text{ GeV}^{0.5}$
 $p_2 = (0.182235 \pm 0.0315639) \text{ GeV}$

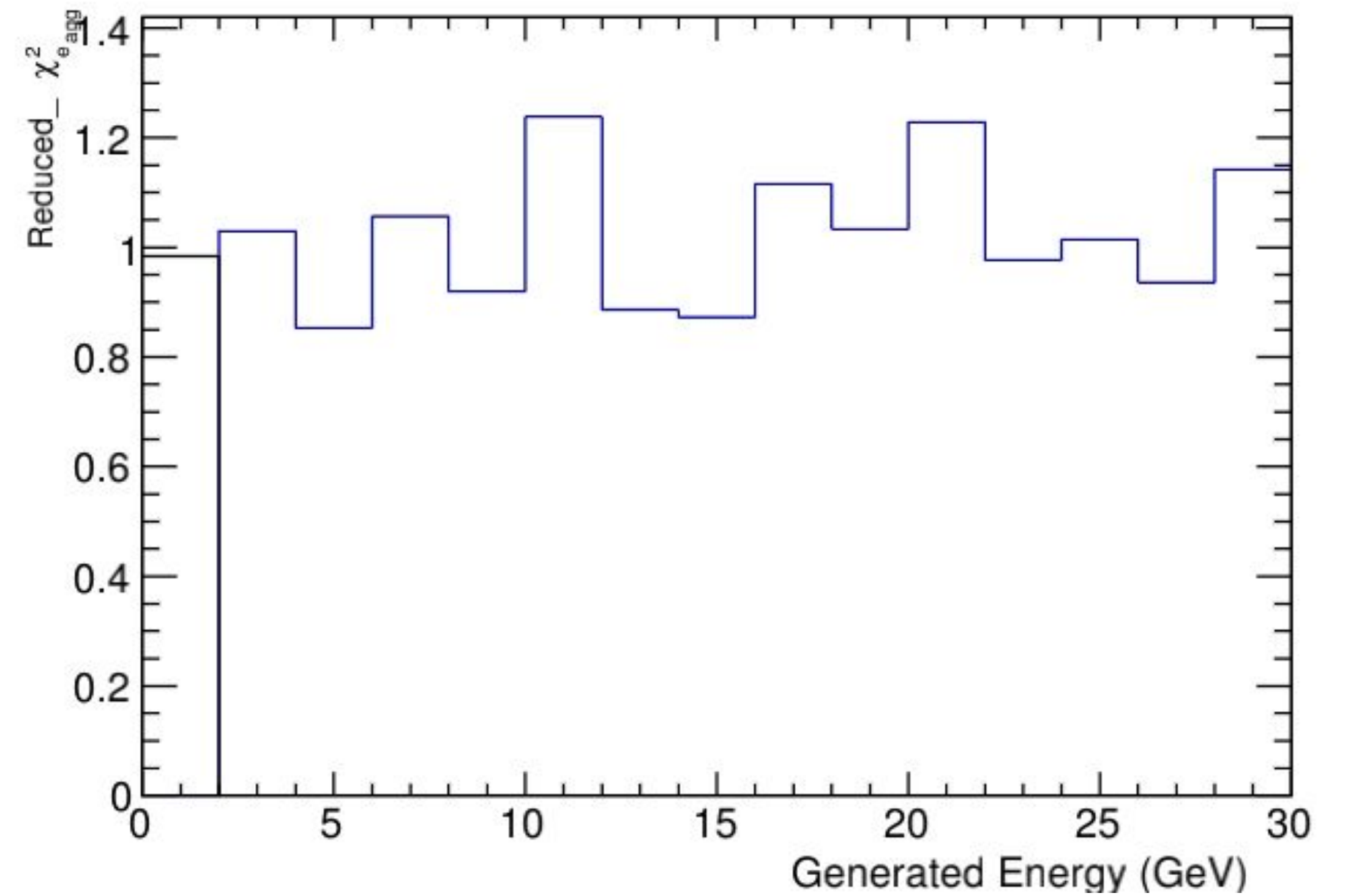
The fit does not account for the first slice. The first slice was overlaid manually over the plot.

CEMC (e^-)

Explicit η cut: -1.5 to 1.2



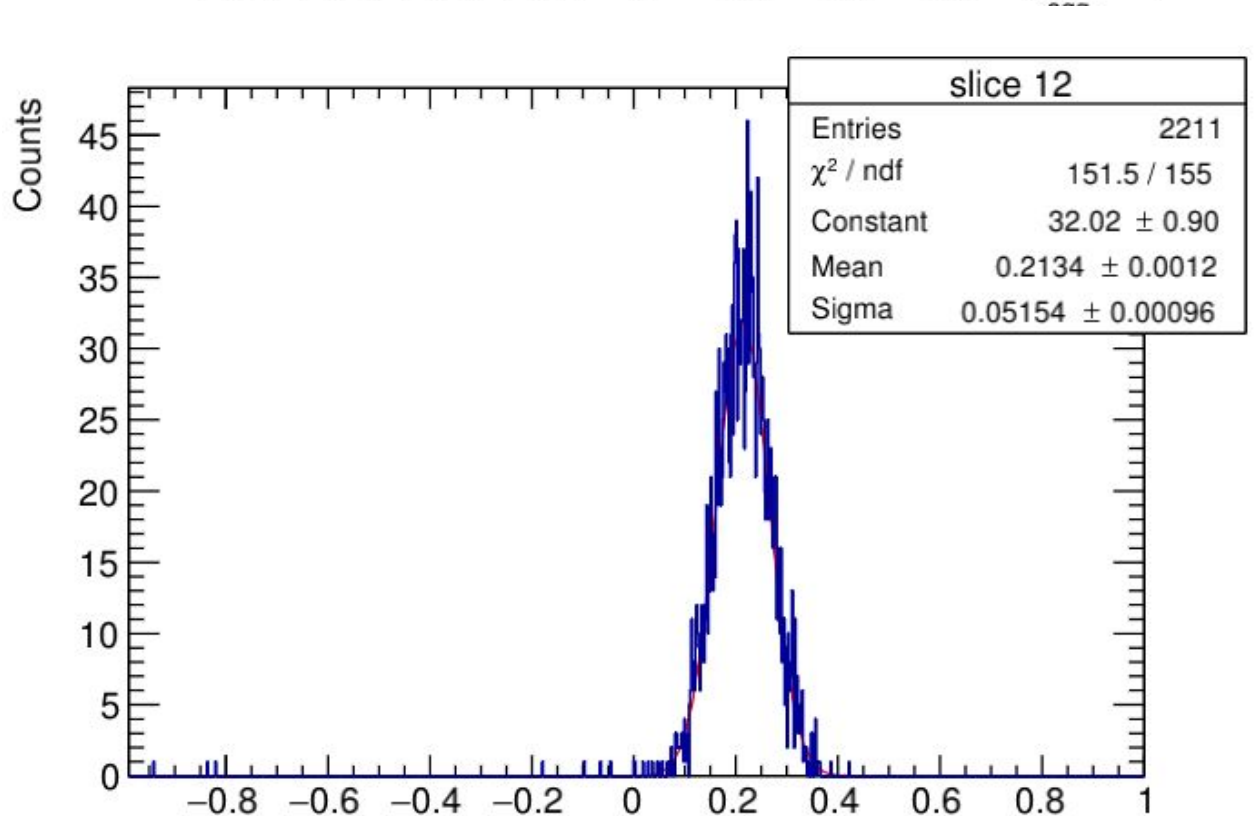
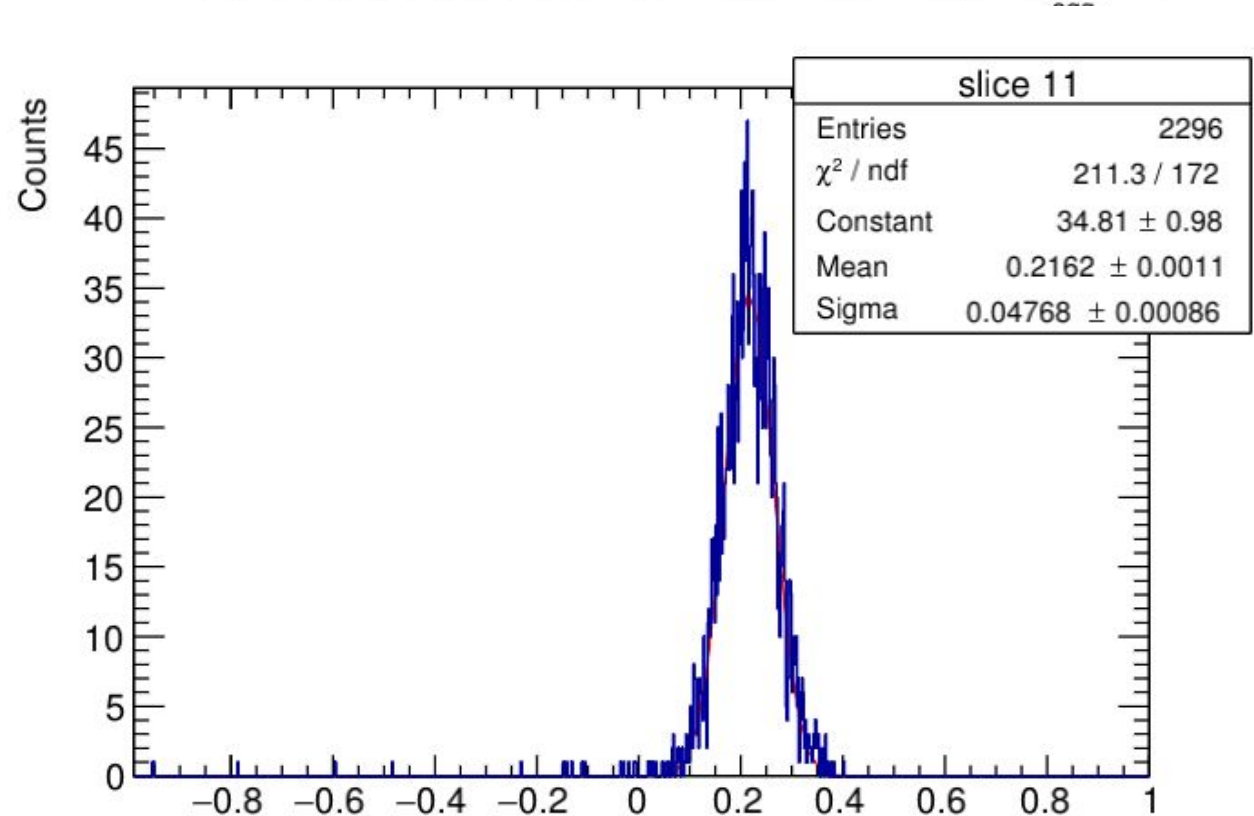
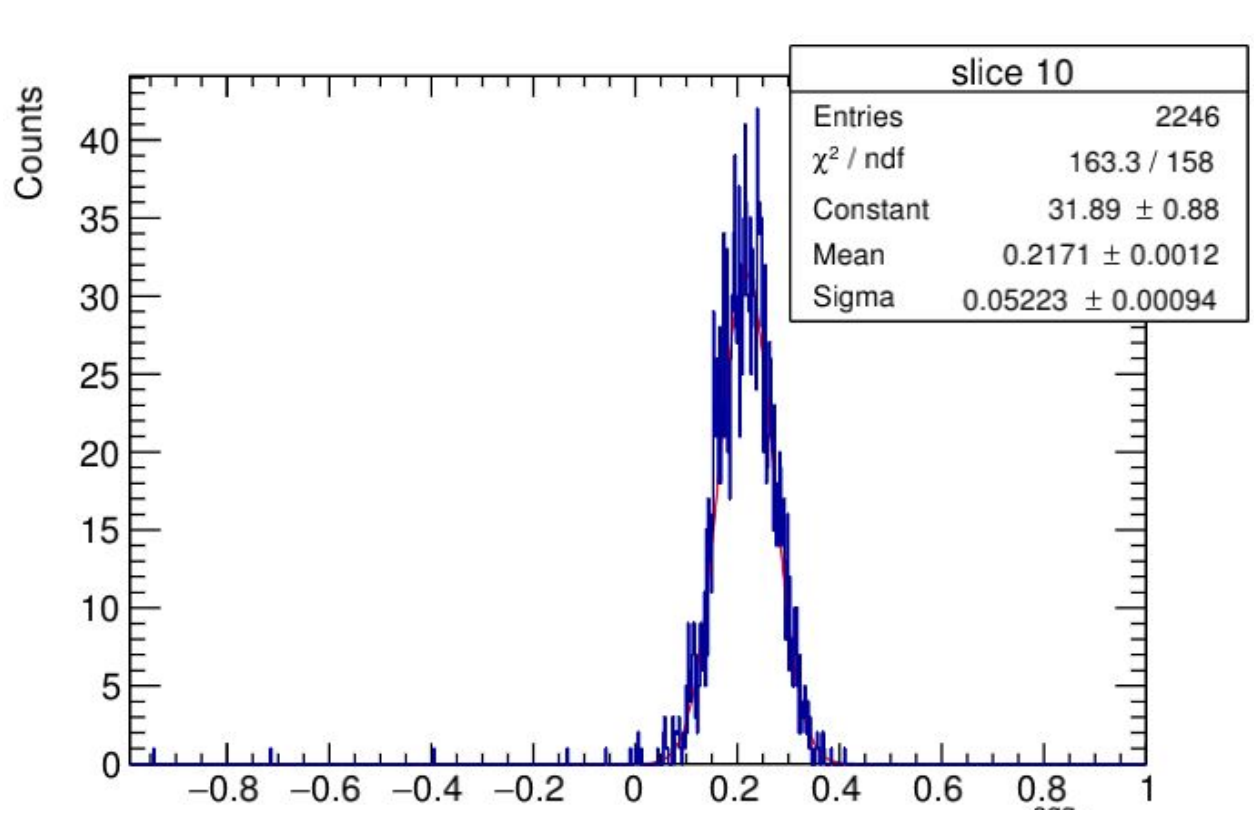
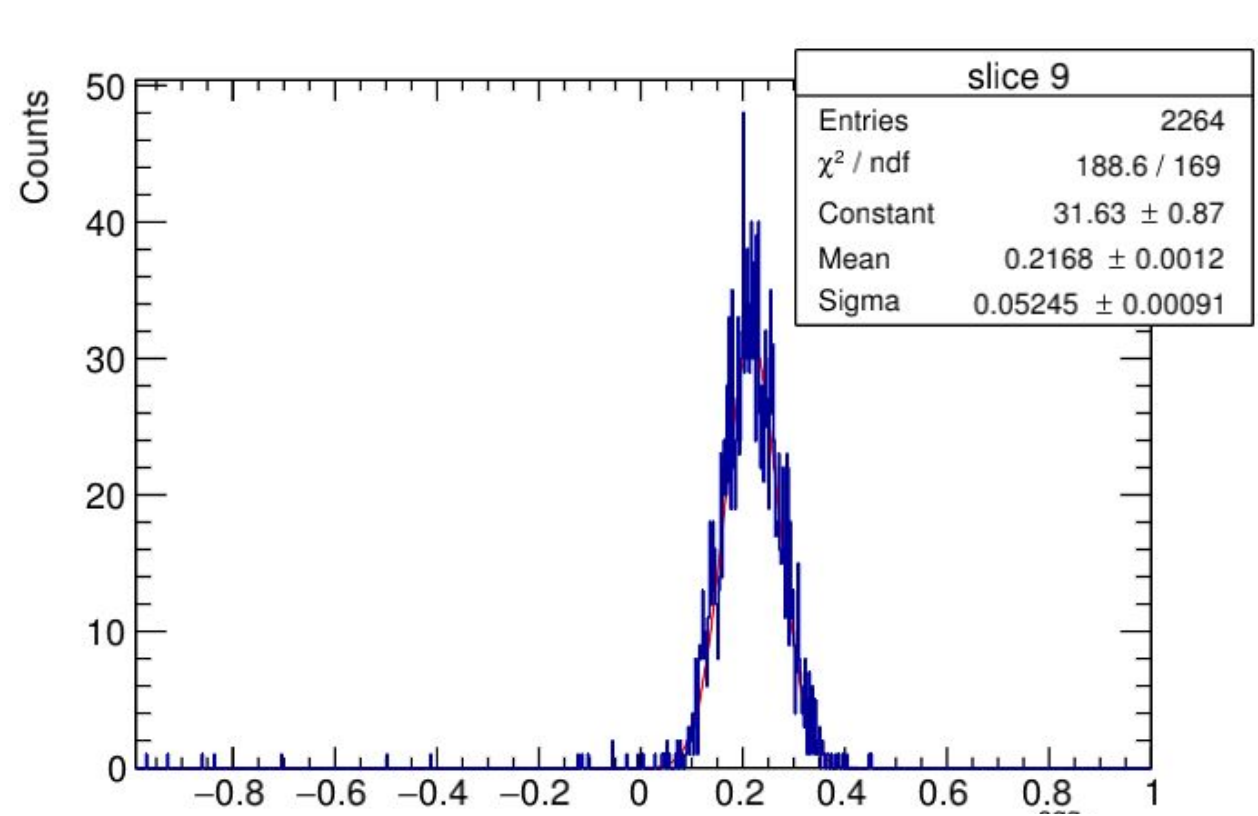
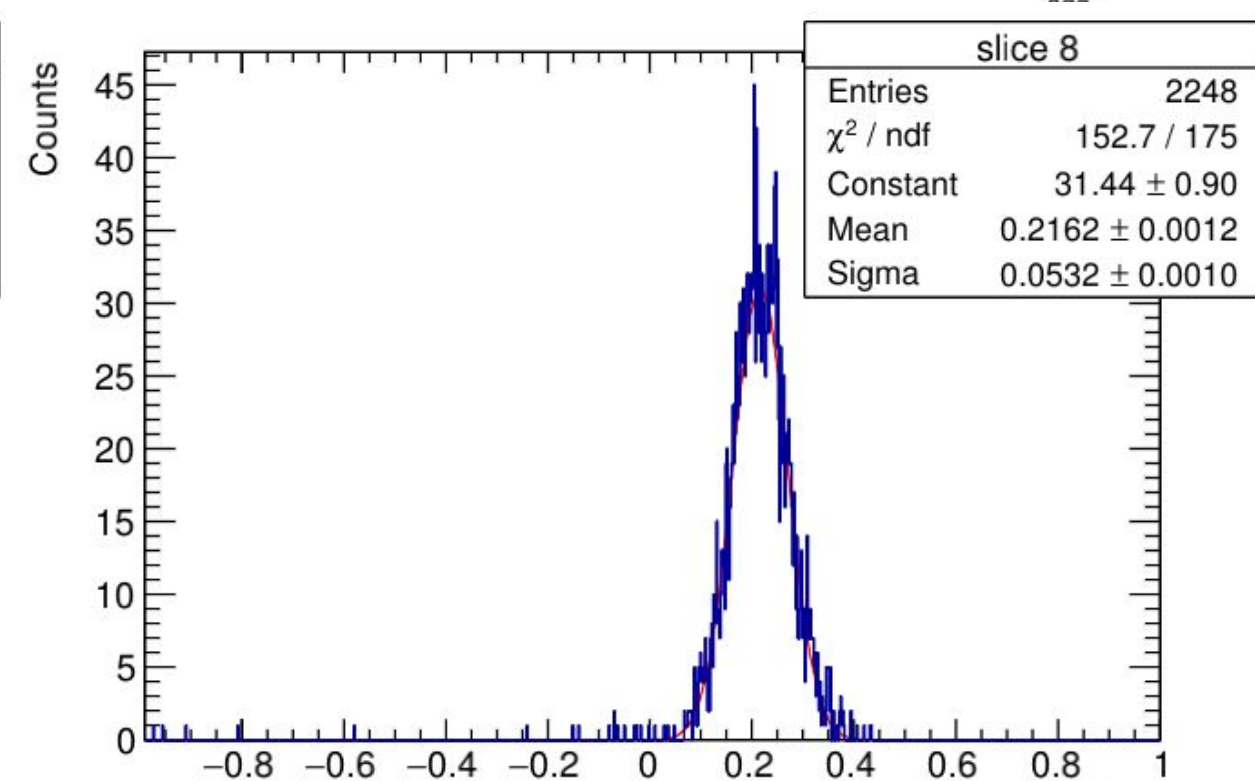
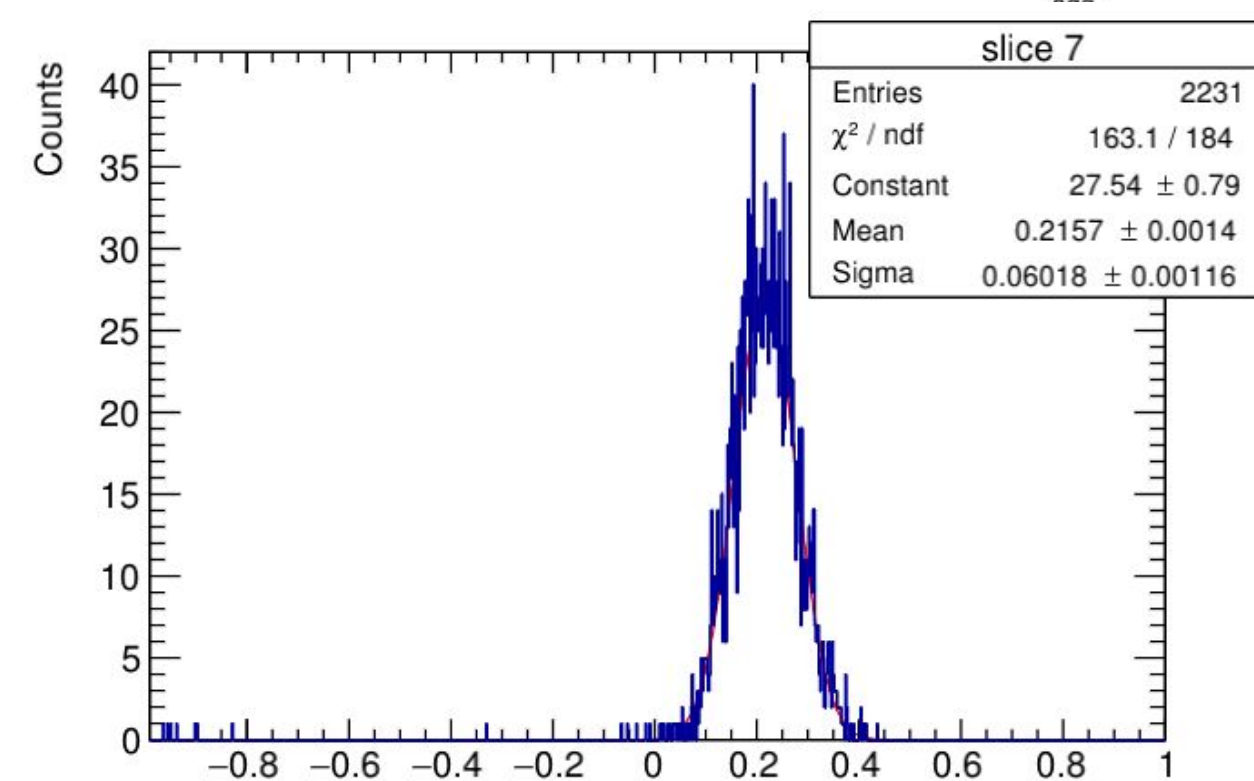
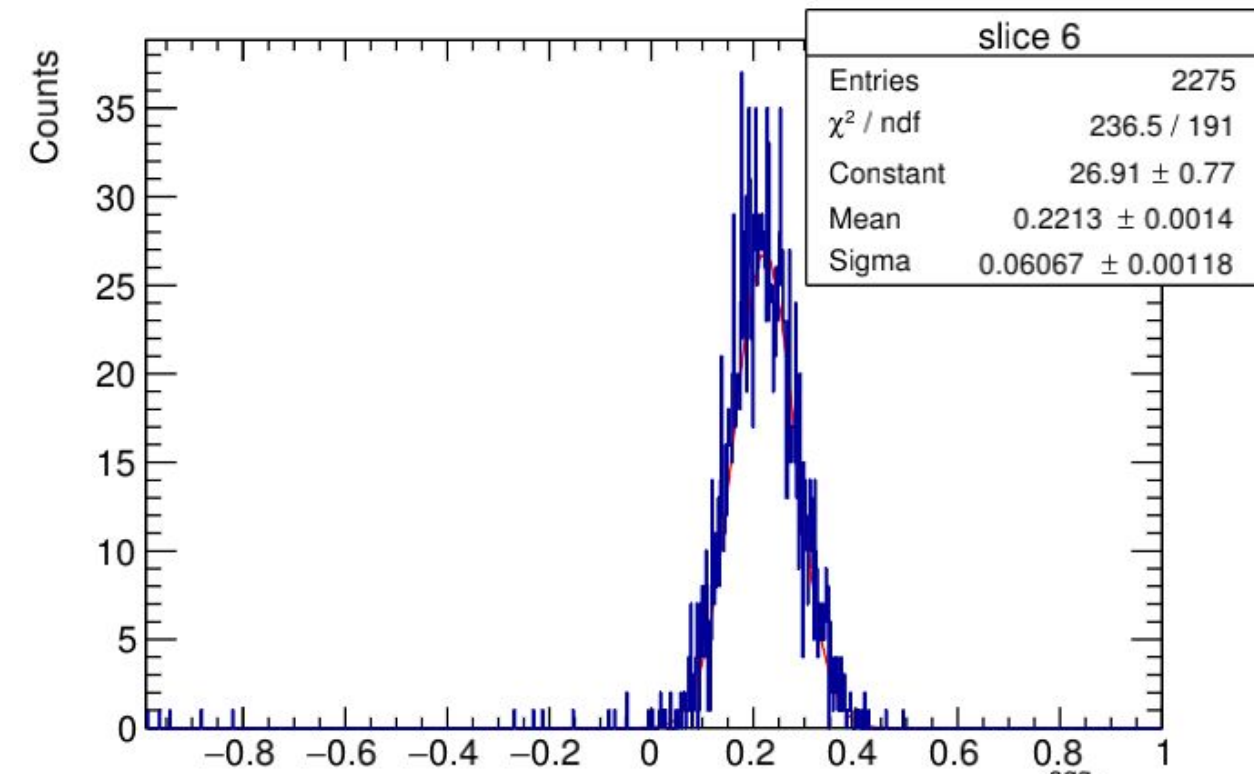
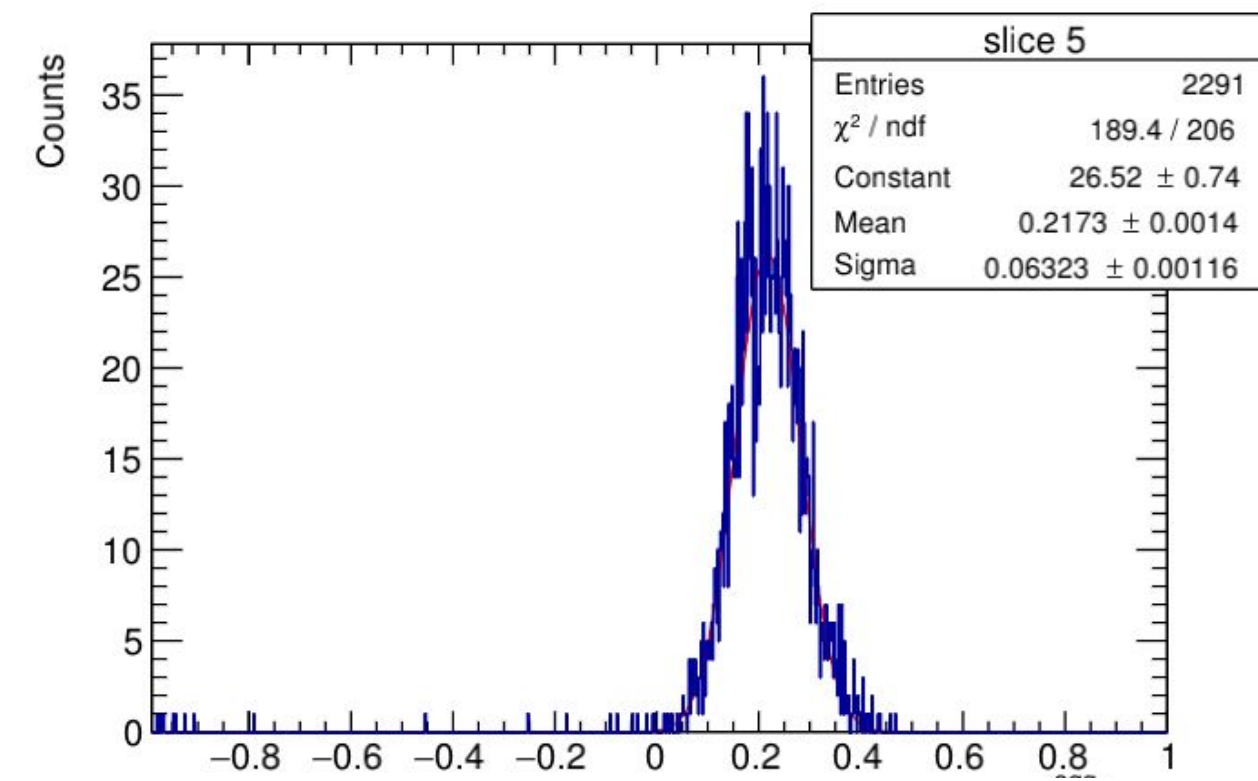
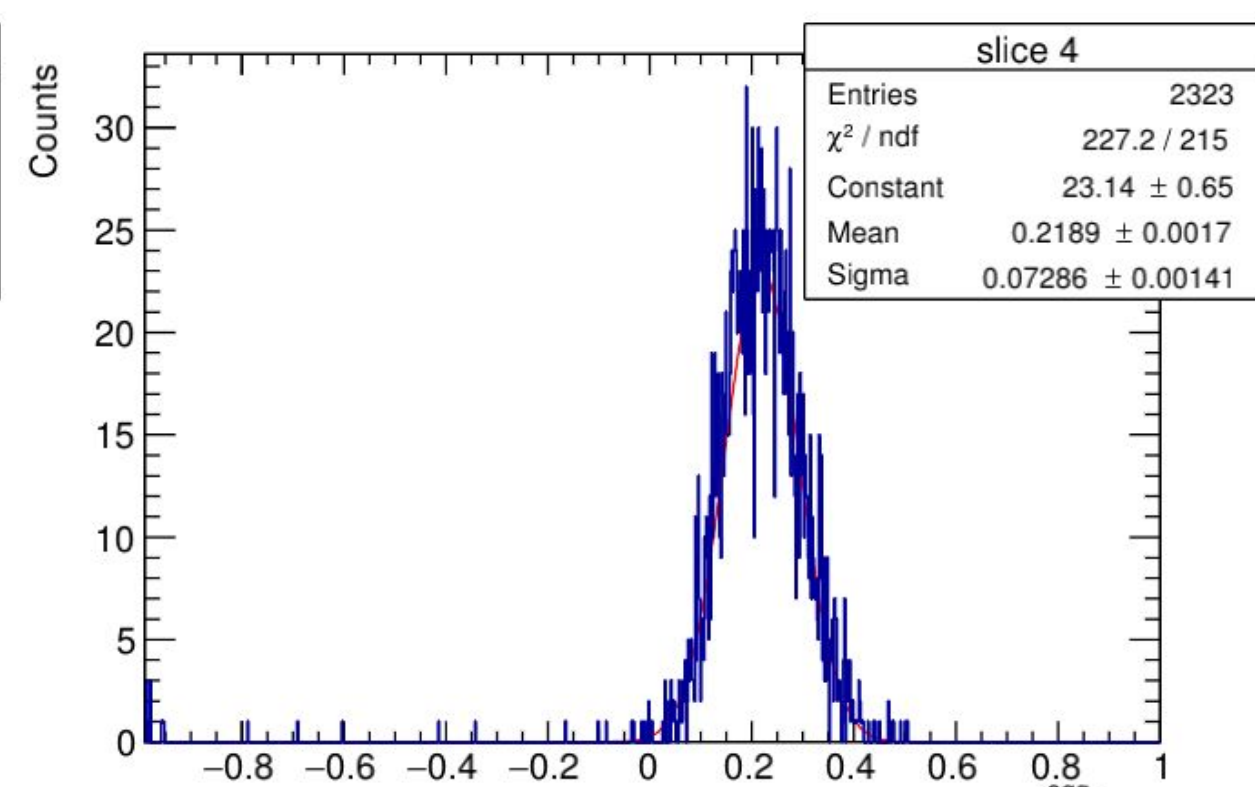
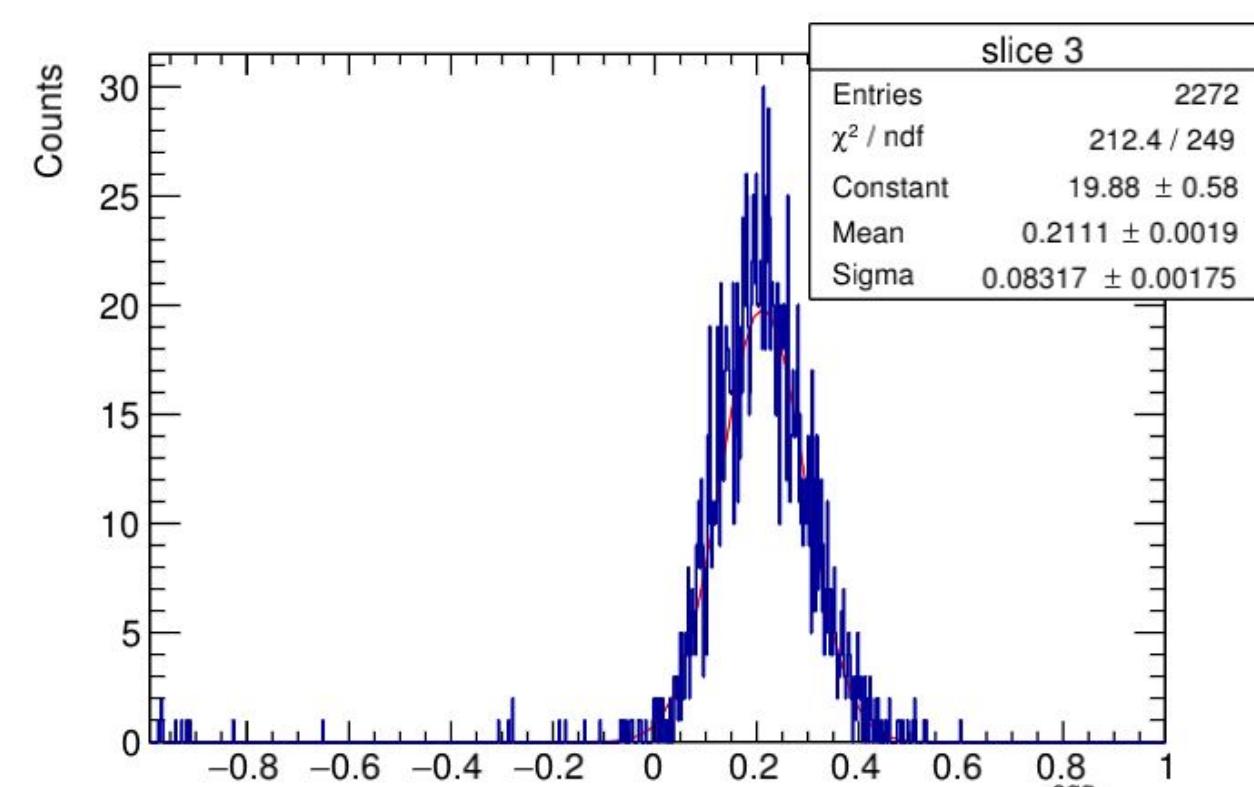
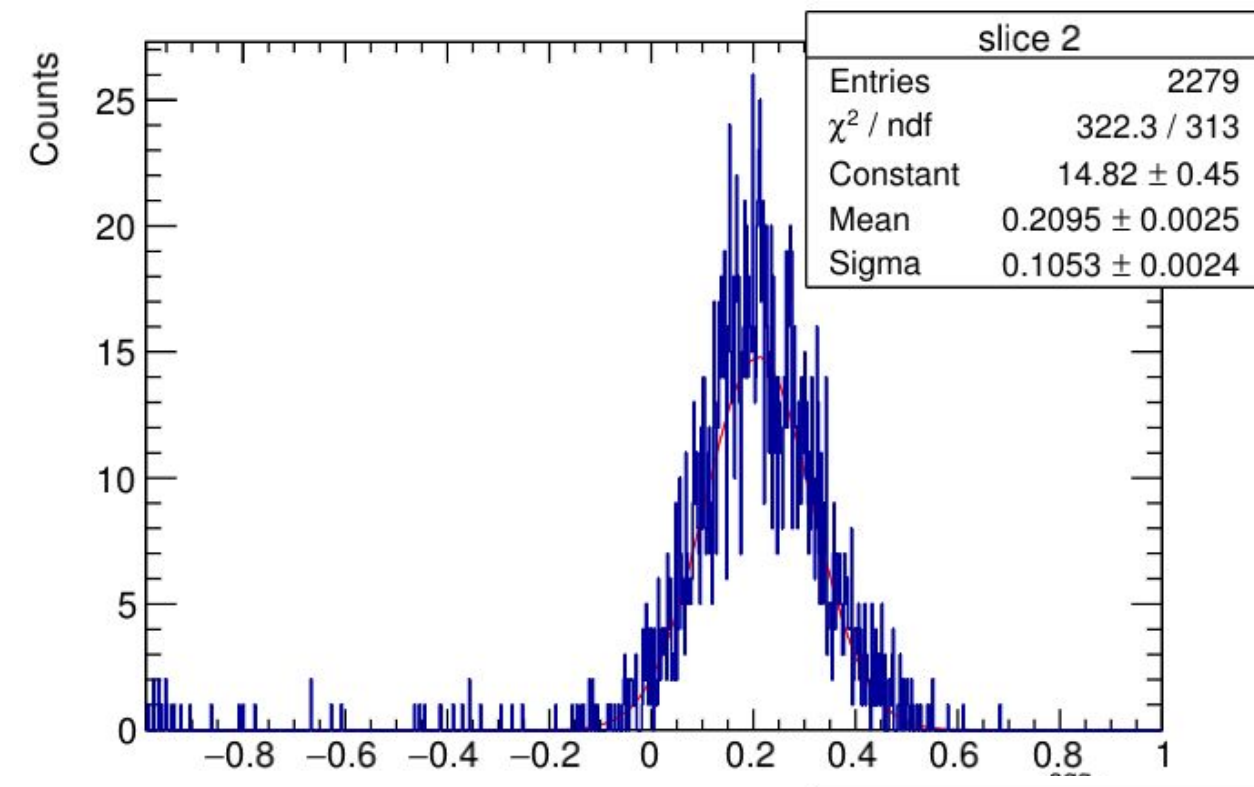
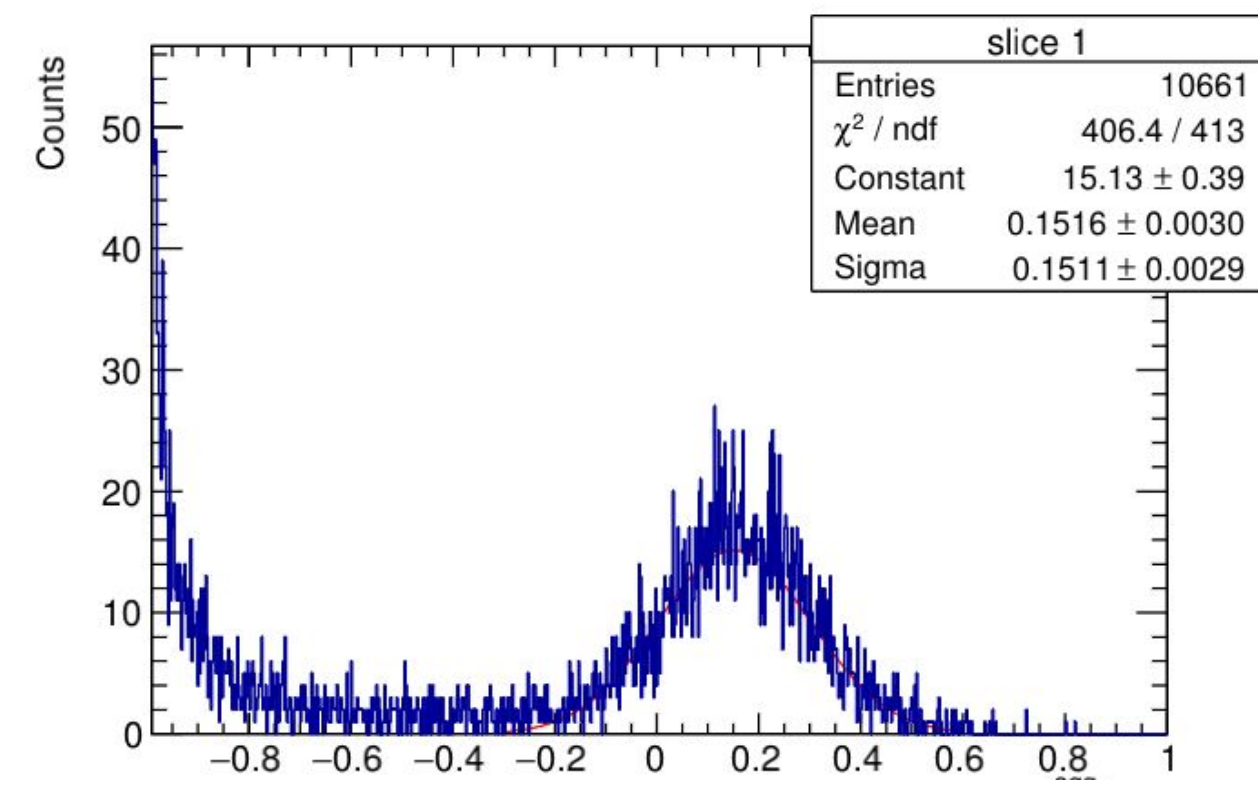
Mean of the Gaussians fitted to the slices of the recalibrated $(te_{agg} - ge) / ge$ vs ge plot.



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

CEMC (e^-)

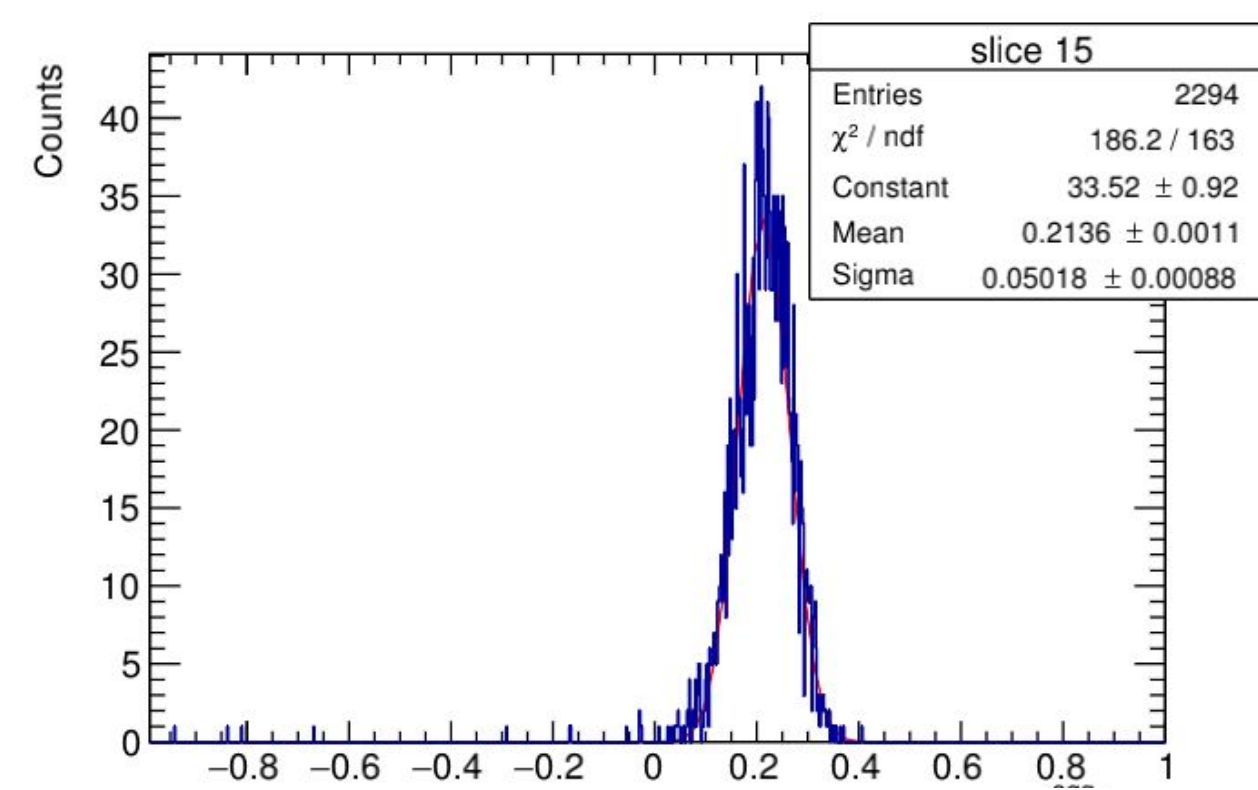
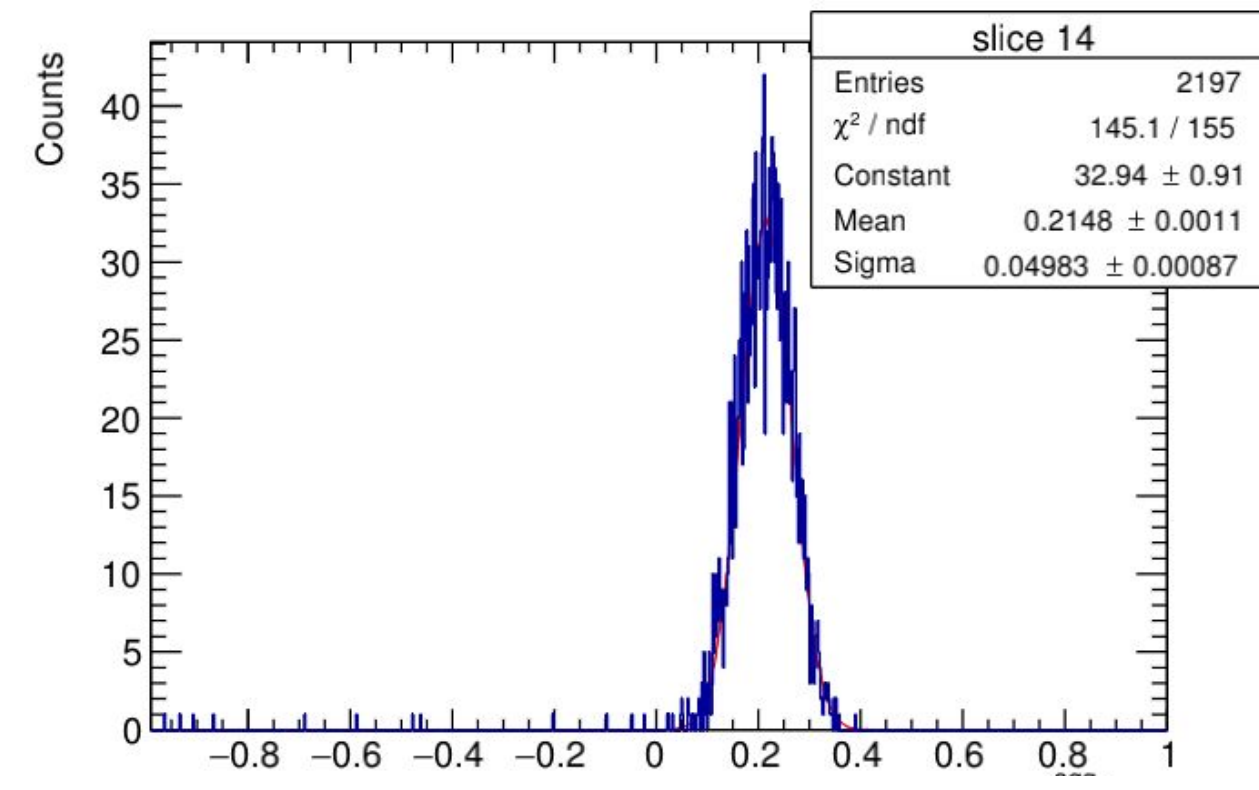
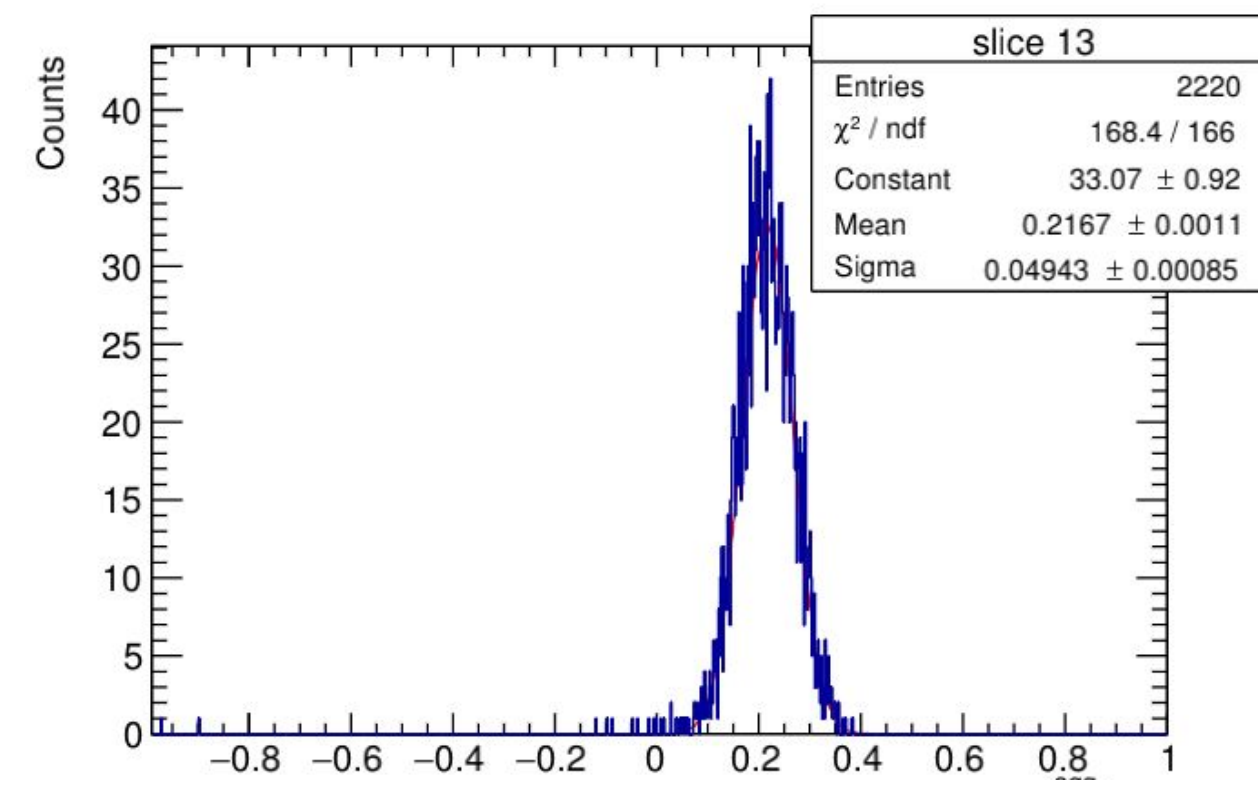
Fitted Gaussians



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

CEMC (e⁻)

Fitted Gaussians



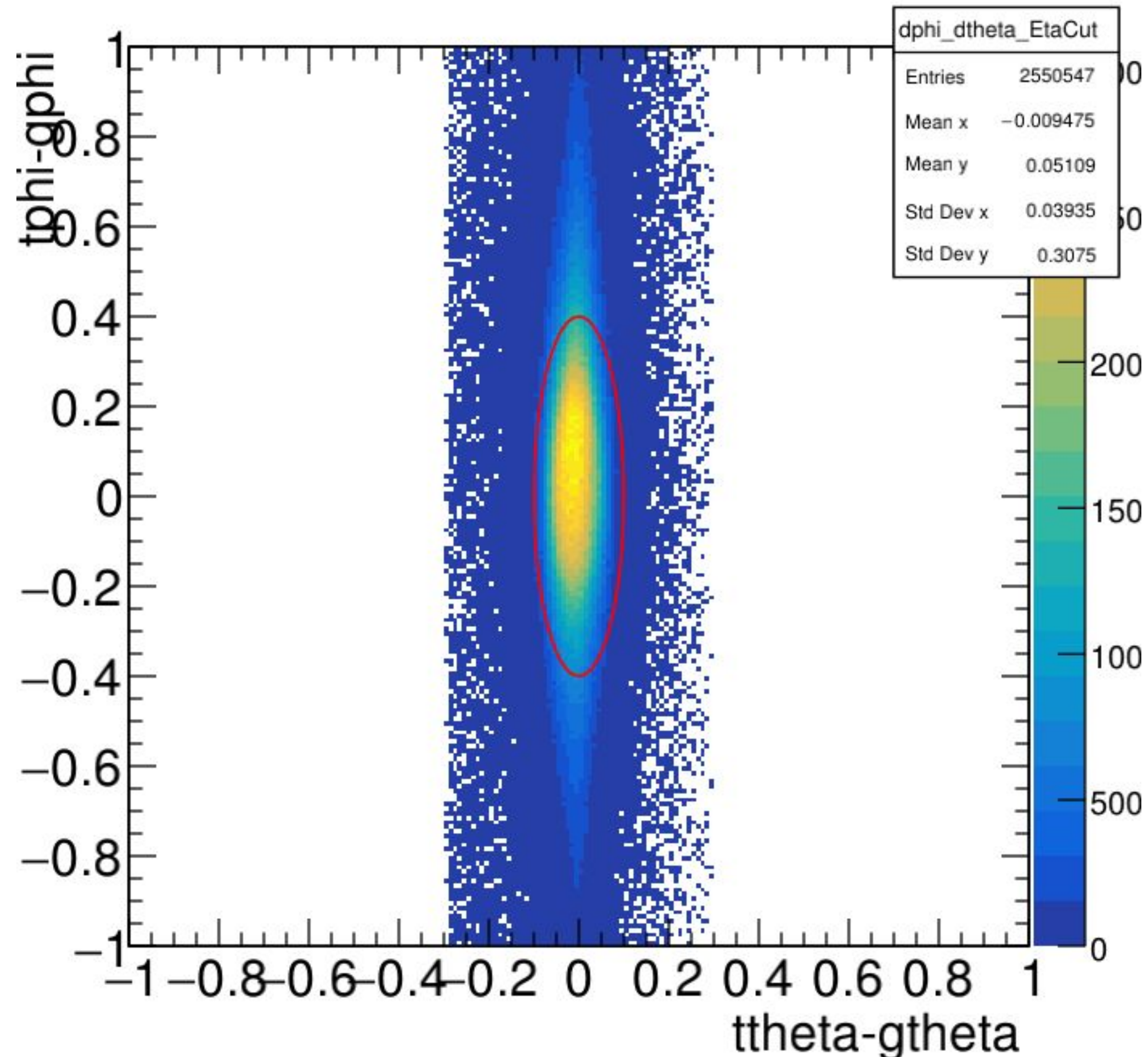
The x-axes denote $\Delta e_{\text{agg}}/g_e$

A teal geometric graphic consisting of several overlapping triangles and quadrilaterals, creating a complex, faceted shape on the left side of the slide.

EEMC (e^-)

EEMC (e^-)

Elliptical cut on dphi vs dtheta, Explicit η cut: -3.5 to -1.7



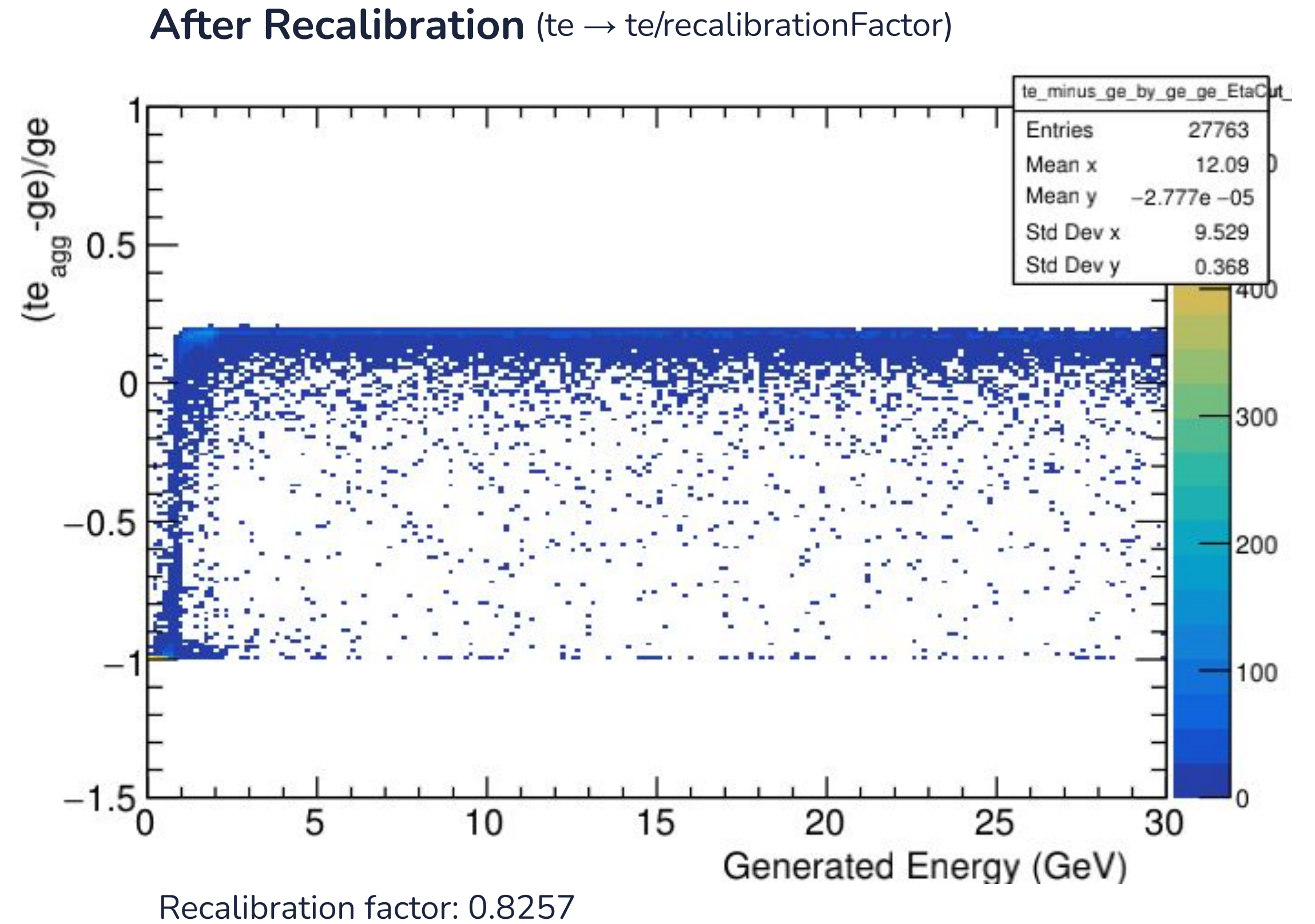
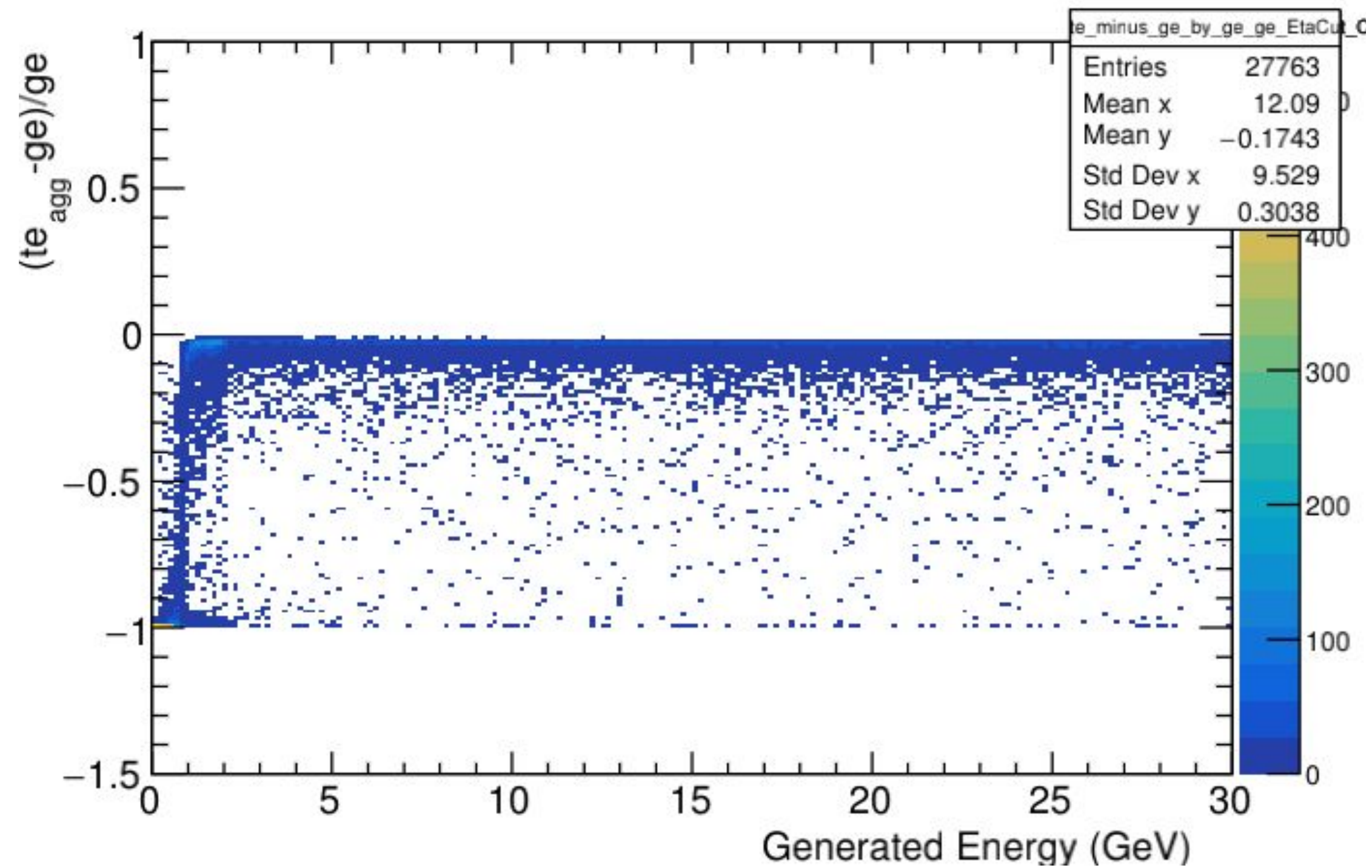
Elliptical Cut: Only the towers within the elliptical region (centered at origin) are considered for further analysis.

Dimensions:

semi-minor axis = 0.10 units
semi-major axis = 0.40 units

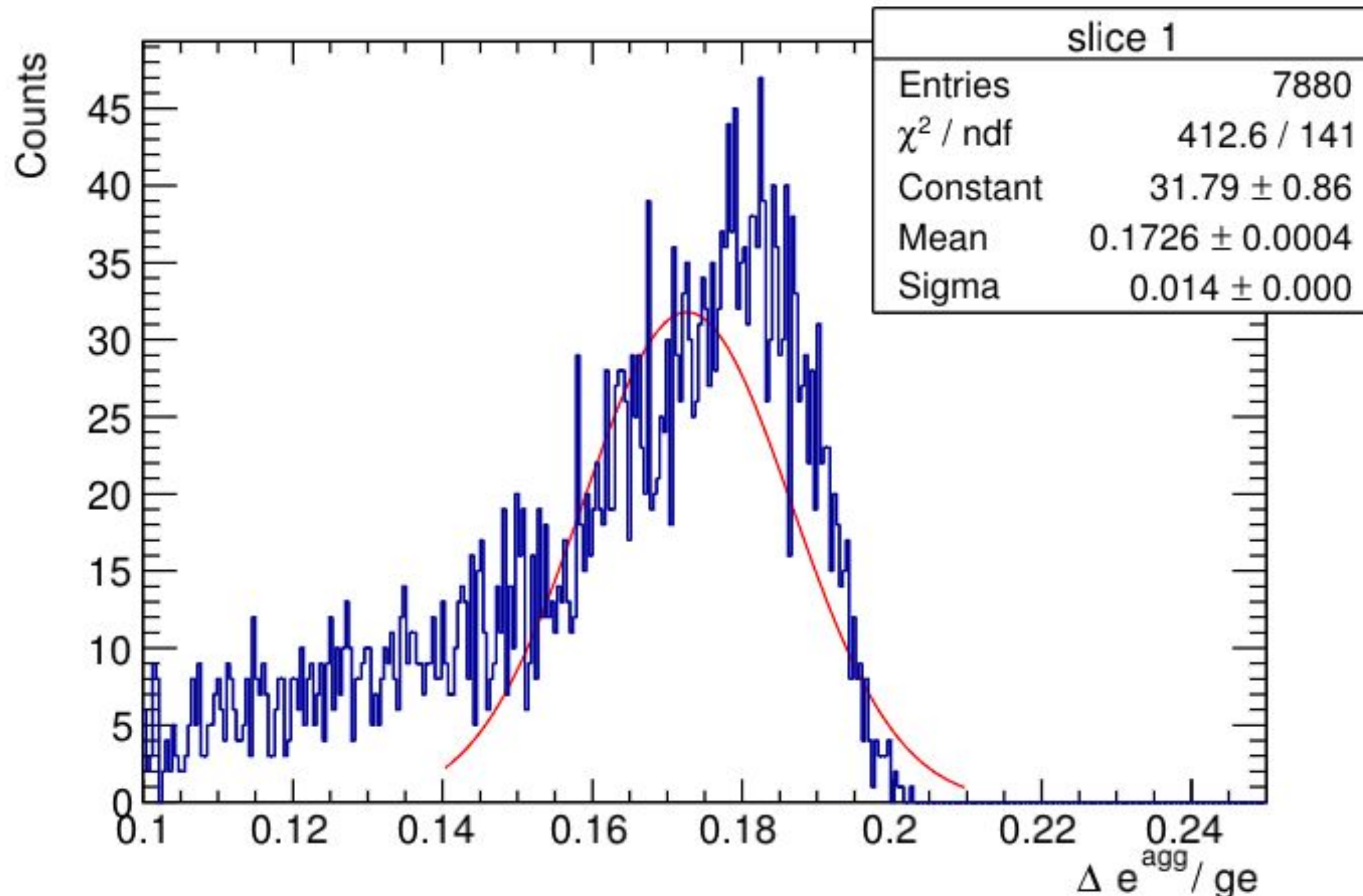
EEMC (e^-)

$(te_{agg} - ge)/ge$ vs ge
Explicit η cut: -3.5 to -1.7
no energy cut



EEMC (e^-)

$(te_{agg} - ge)/ge$ vs ge
Gaussian fit of the first slice (0-3 GeV)



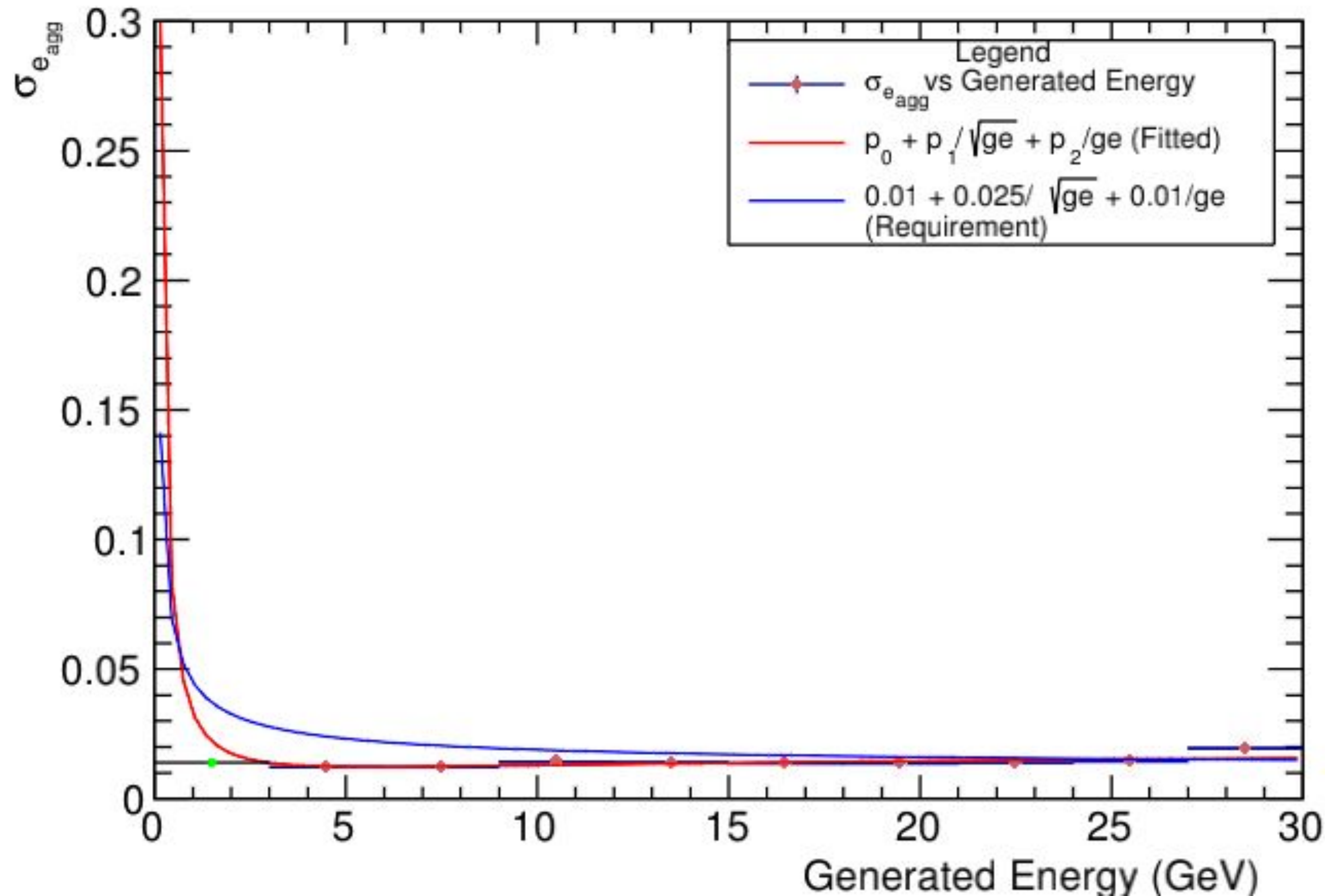
This is the gaussian fit of the first slice of the recalibrated $(te_{agg} - ge)/ge$ vs ge plot.
(shown on the previous slide)

This fit has been done manually by restricting the fit range of the gaussian from 0.14 to 0.21

*All other gaussians have been fit over the entire range.

EEMC (e^-)

$\sigma_{e_{agg}}$ vs g_e
Explicit η cut: -3.5 to -1.7
Elliptical cut



σ_e refers to the standard deviation of the Gaussian fitted to a slice of the recalibrated $(t_{e_{agg}} - g_e) / g_e$ vs g_e plot.
(shown on the previous slide)

Number of bins = 10
Bin Width = 3 GeV

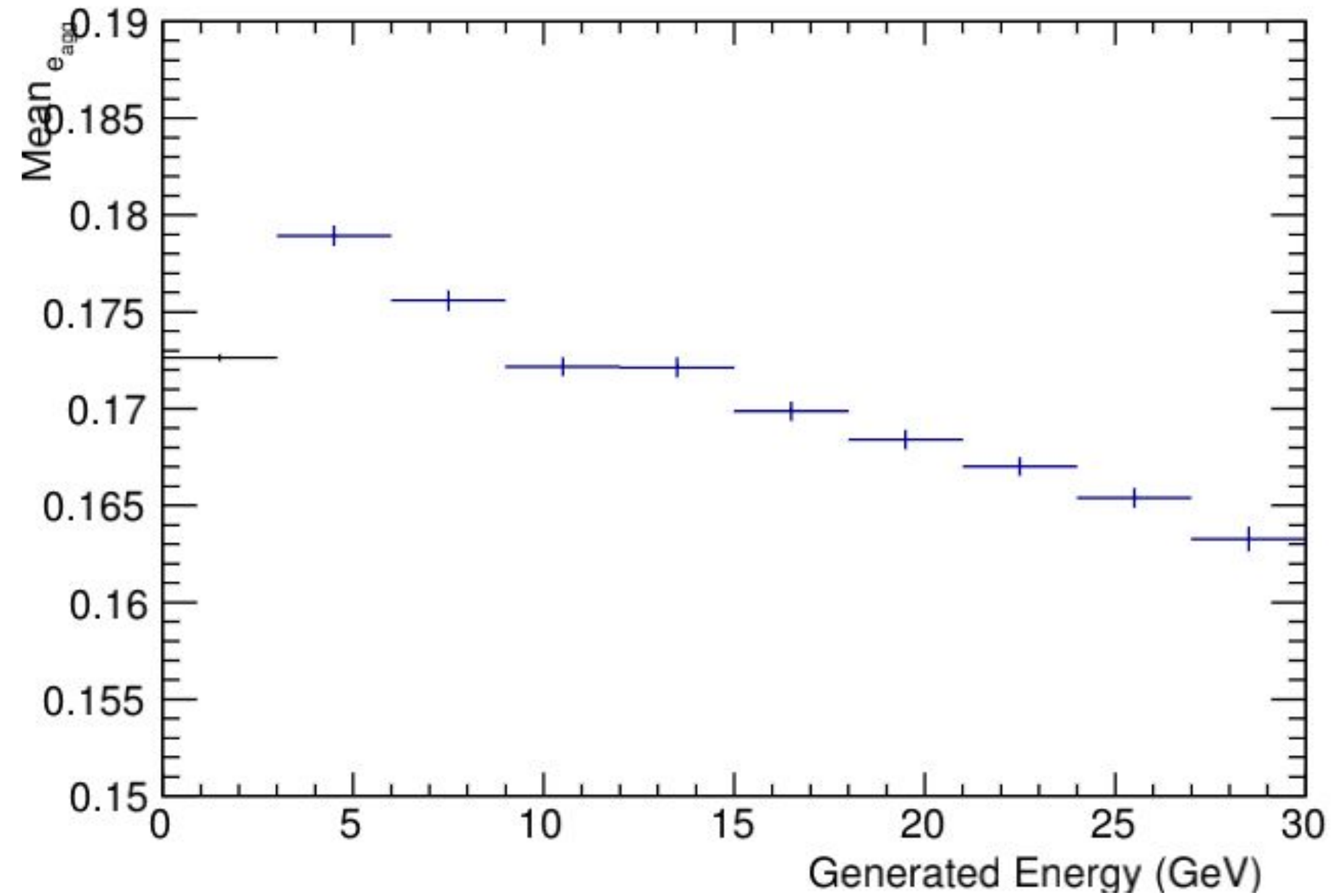
Fit Parameters:

$p_0 = (0.0229192 \pm 0.00276235)$
 $p_1 = (-0.0510187 \pm 0.0184972) \text{ GeV}^{0.5}$
 $p_2 = (0.0612565 \pm 0.0288292) \text{ GeV}$

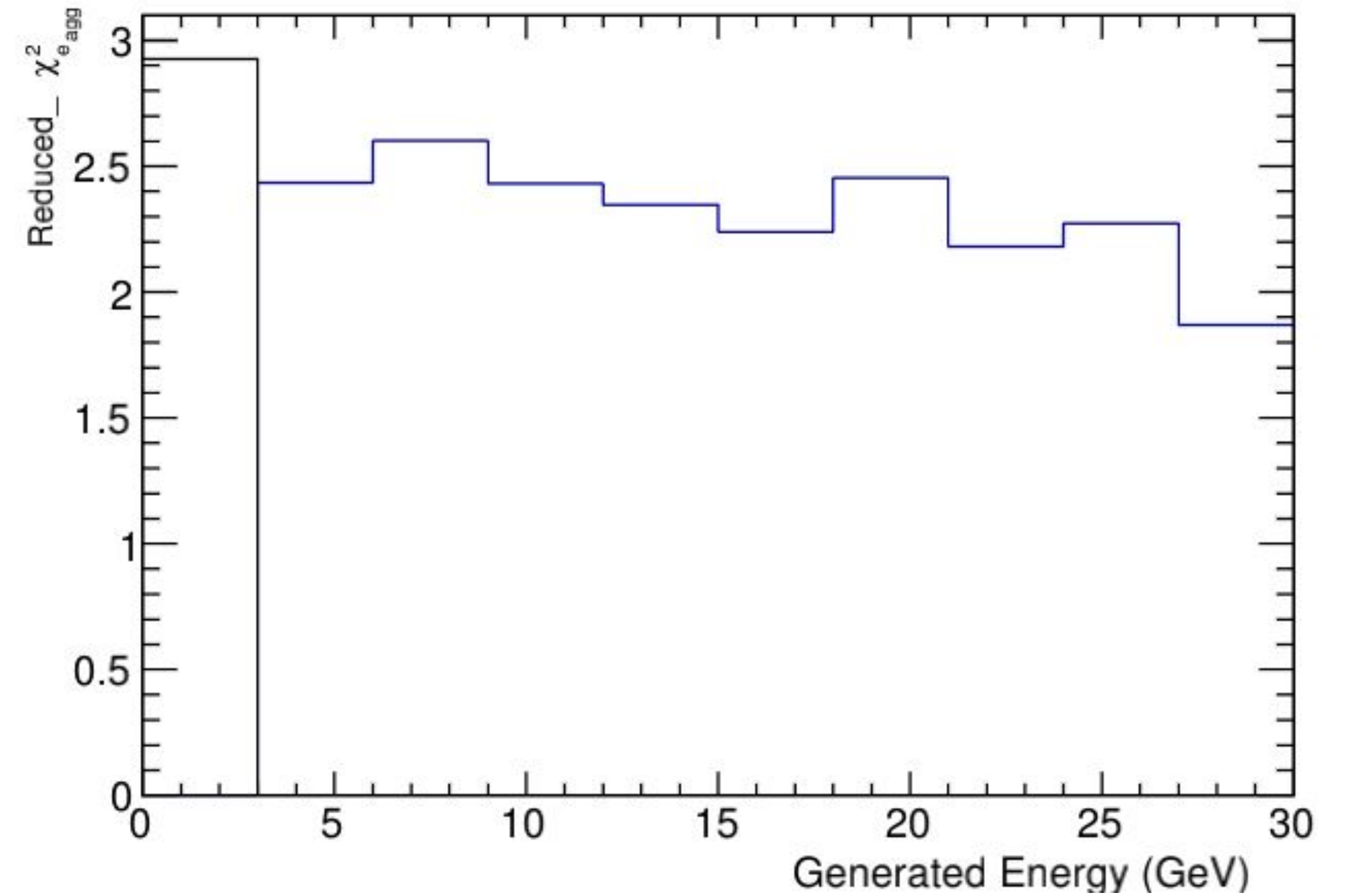
The fit does not account for the first slice. The first slice was overlaid manually over the plot.

EEMC (e^-)

Explicit η cut: -3.5 to -1.7



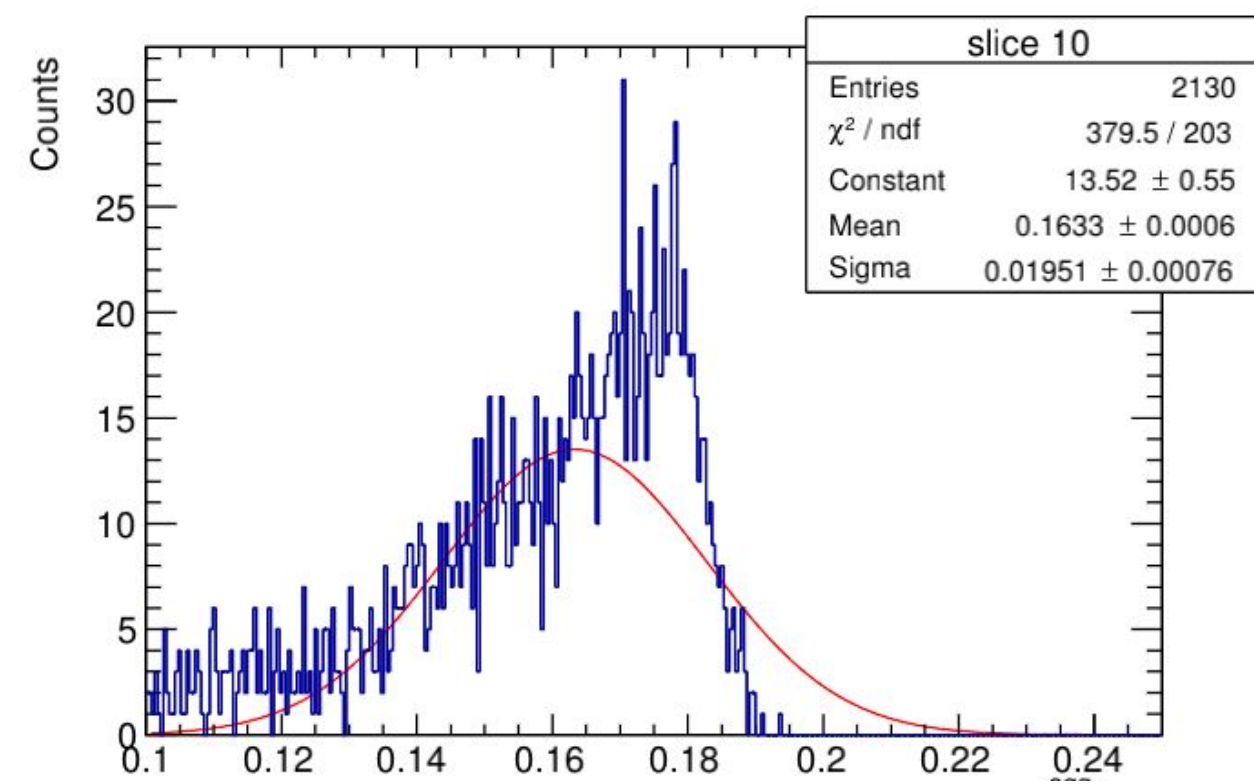
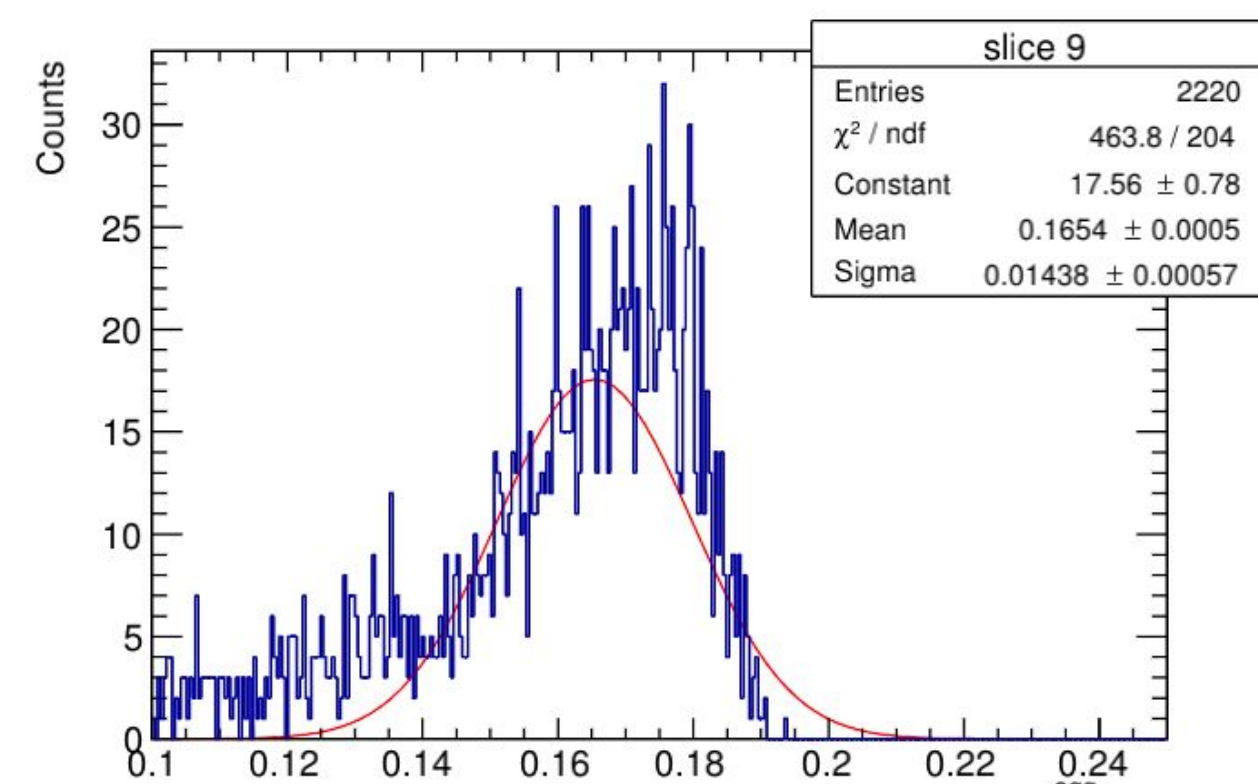
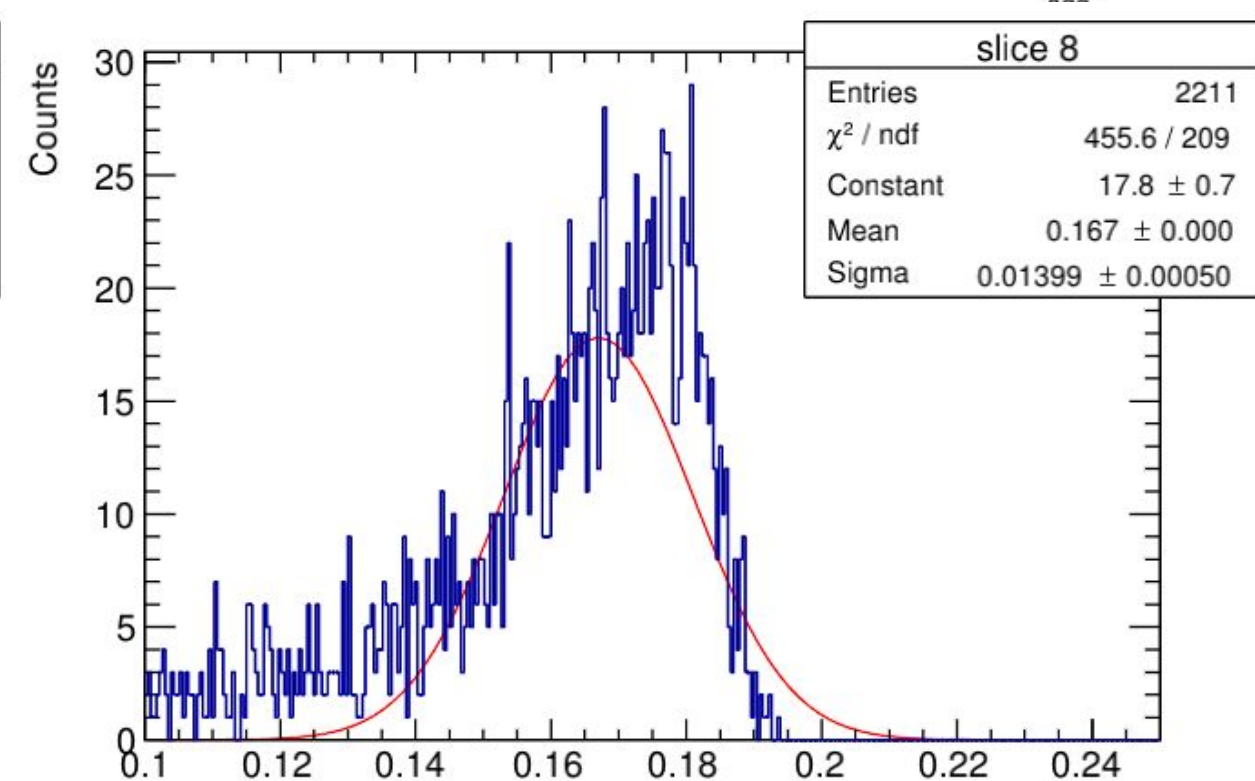
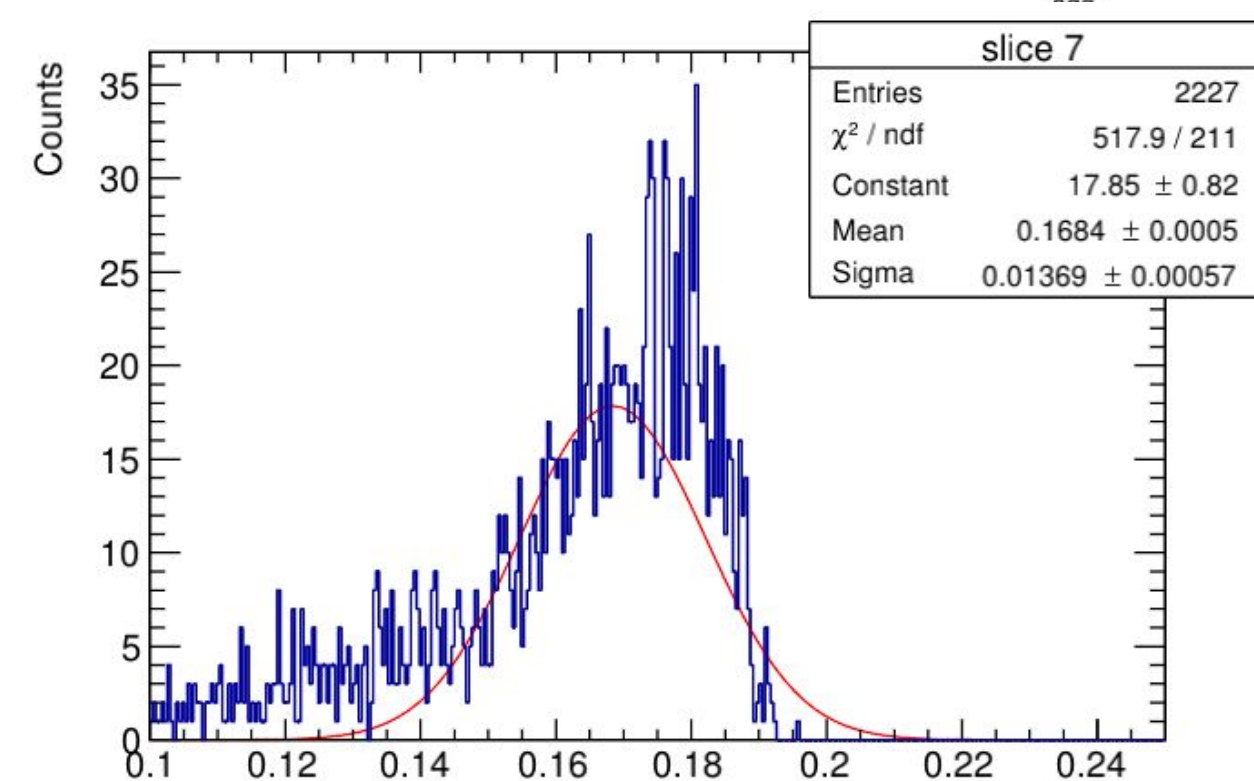
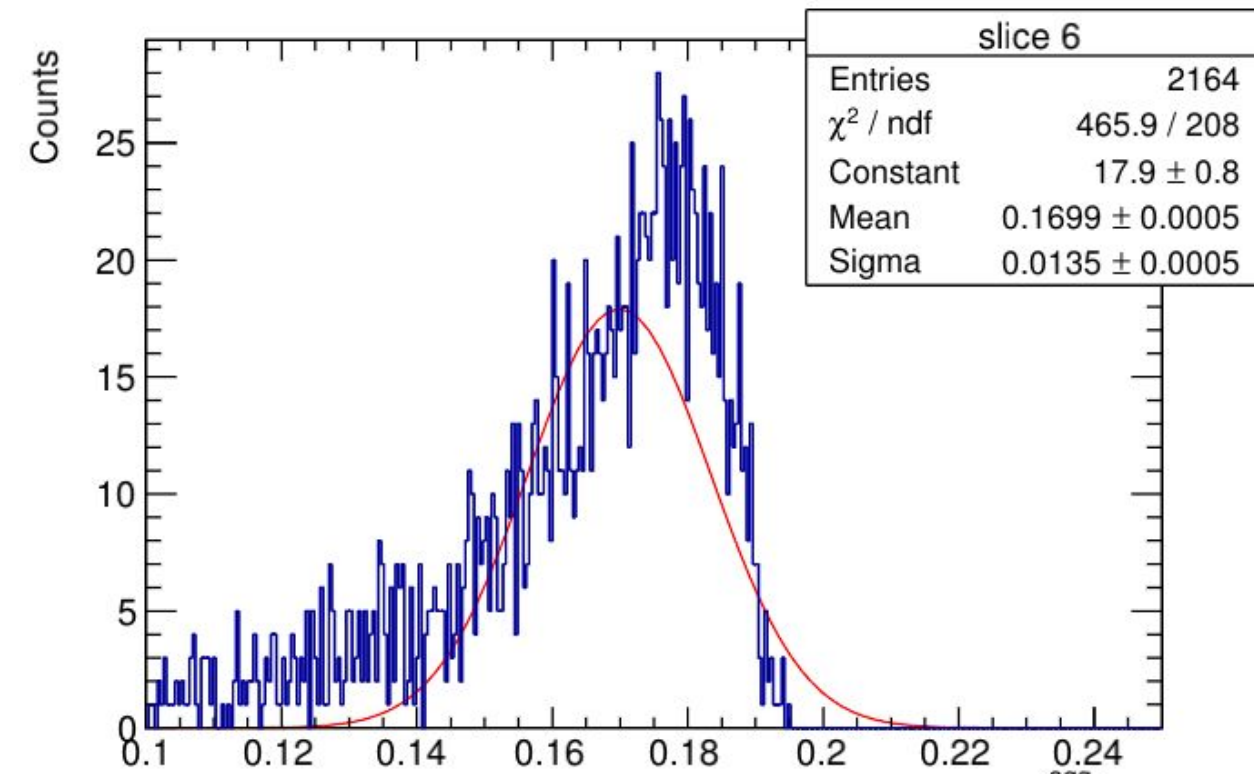
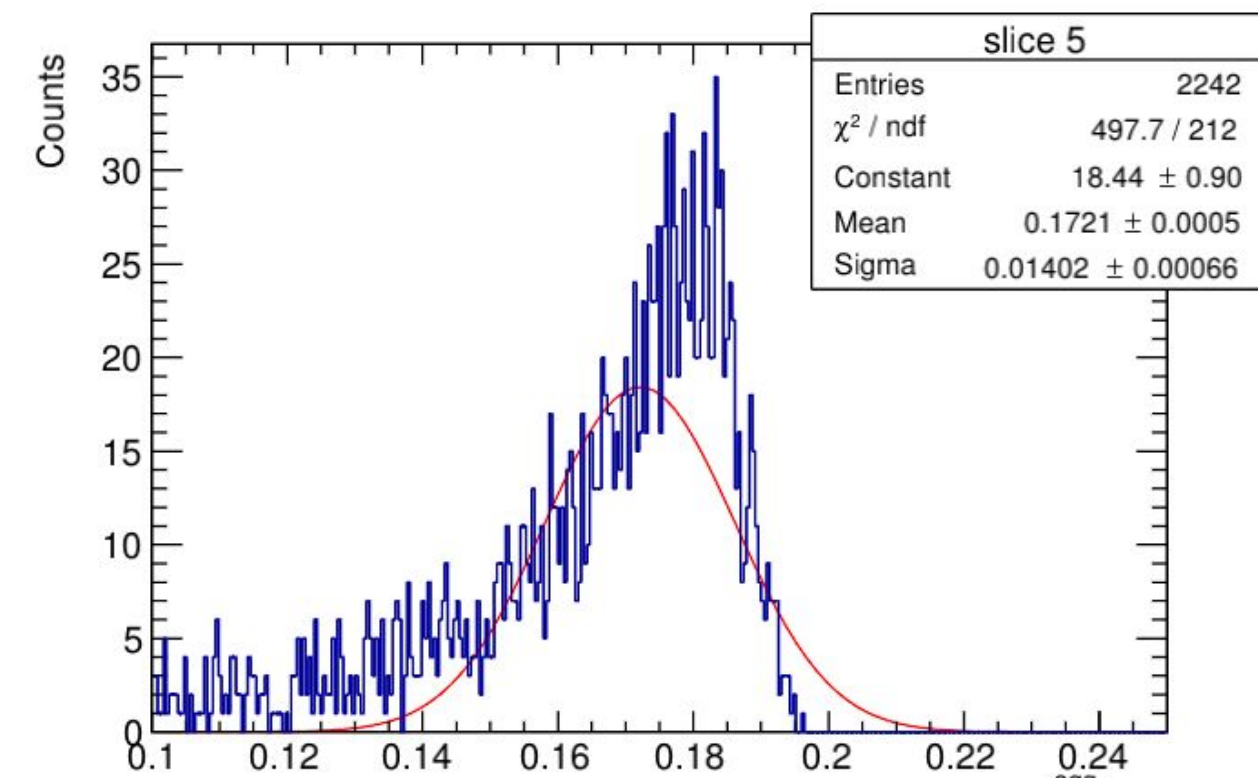
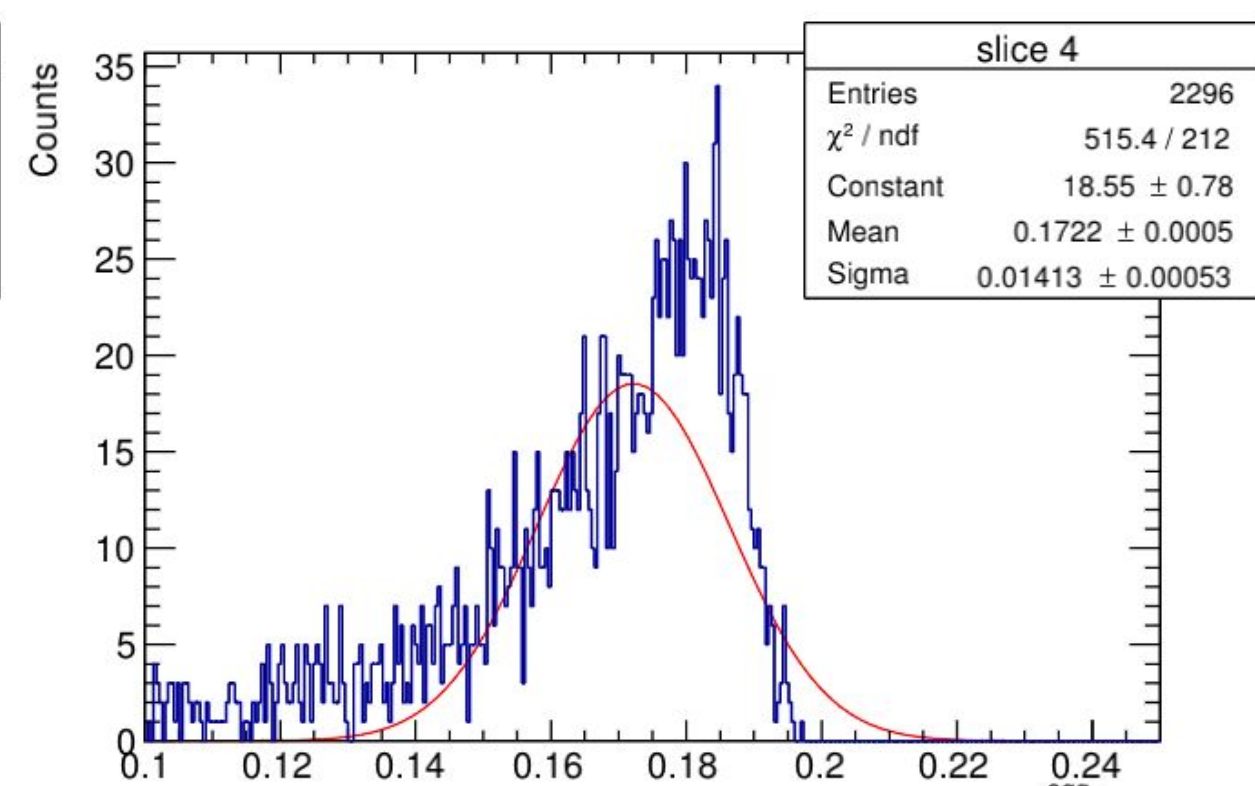
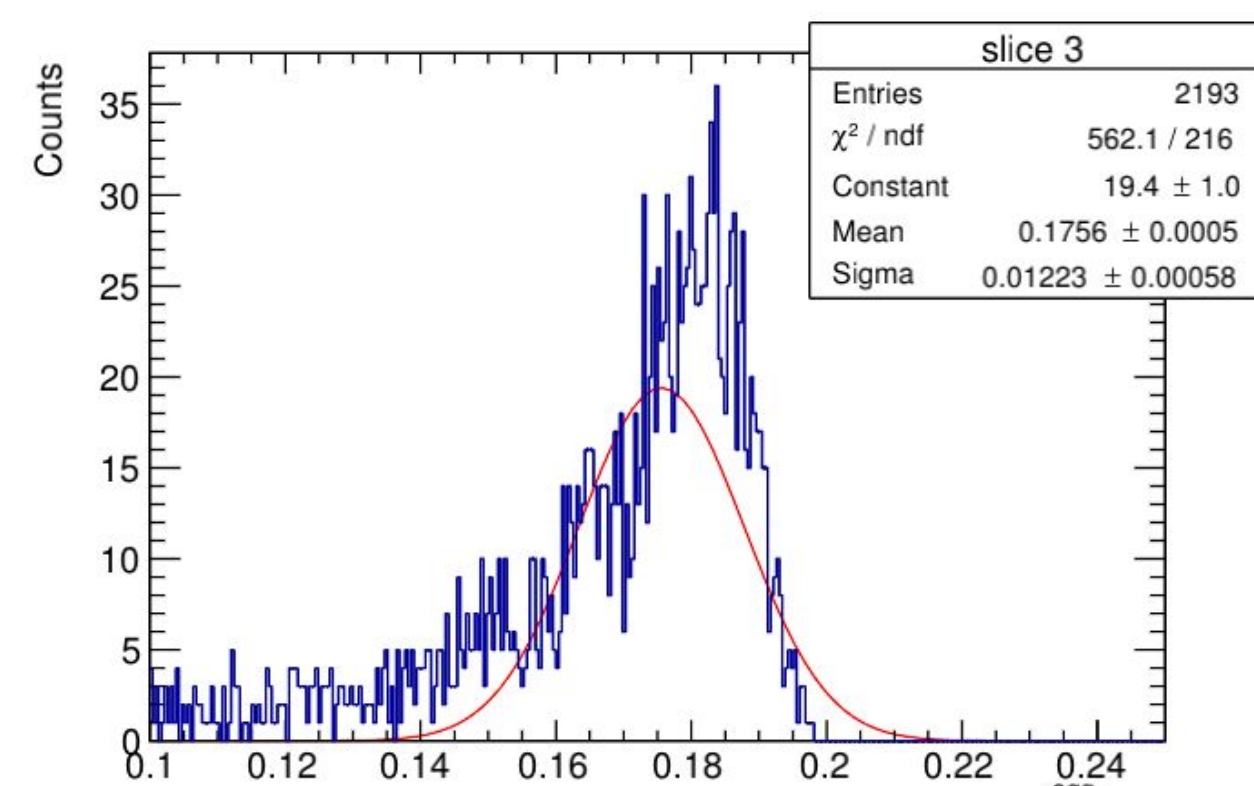
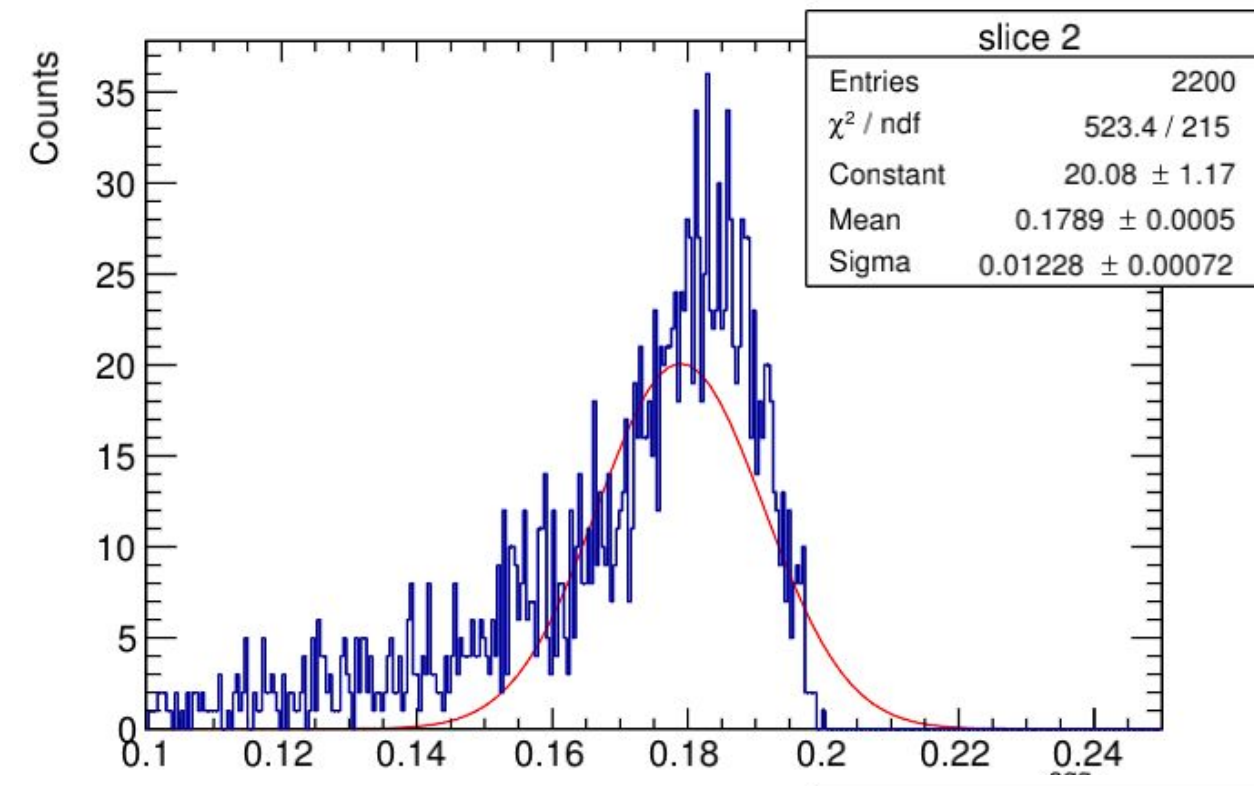
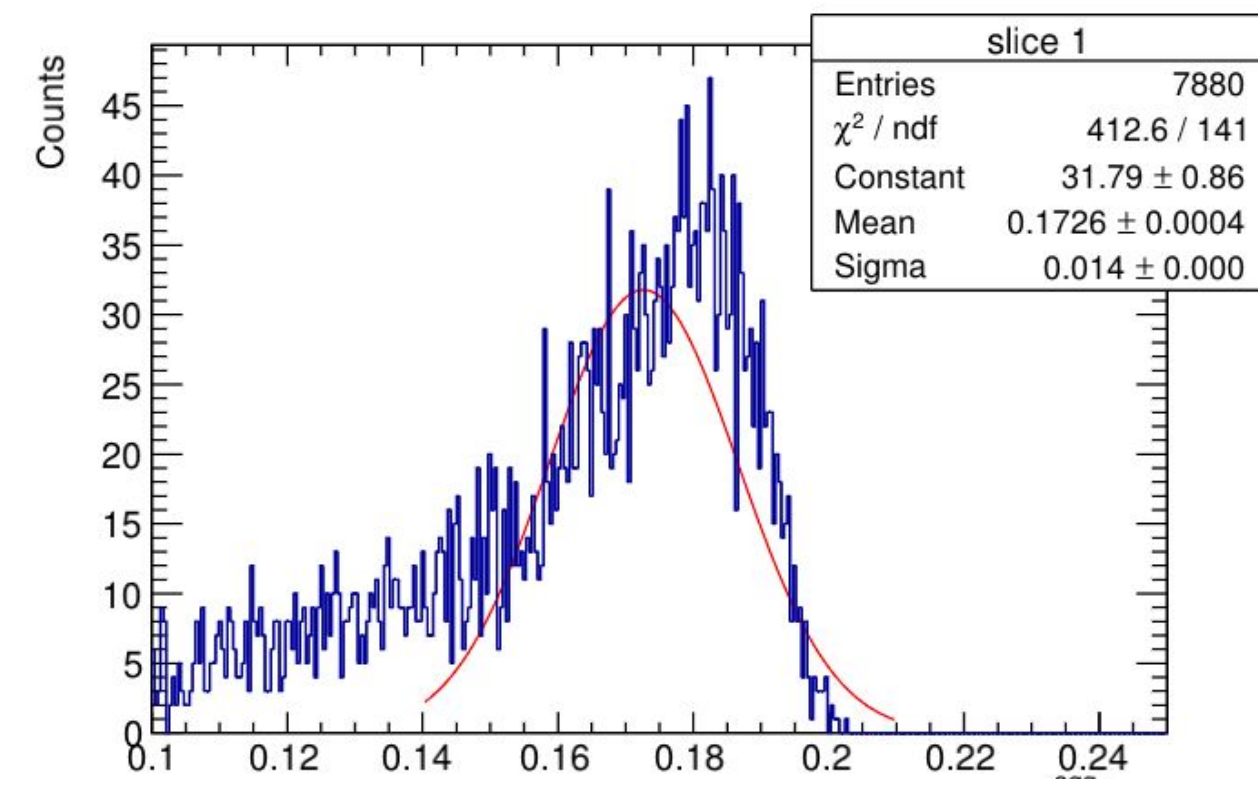
Mean of the Gaussians fitted to the slices of the recalibrated $(te_{agg}-ge)/ge$ vs ge plot.



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

EEMC (e^-)

Fitted Gaussians



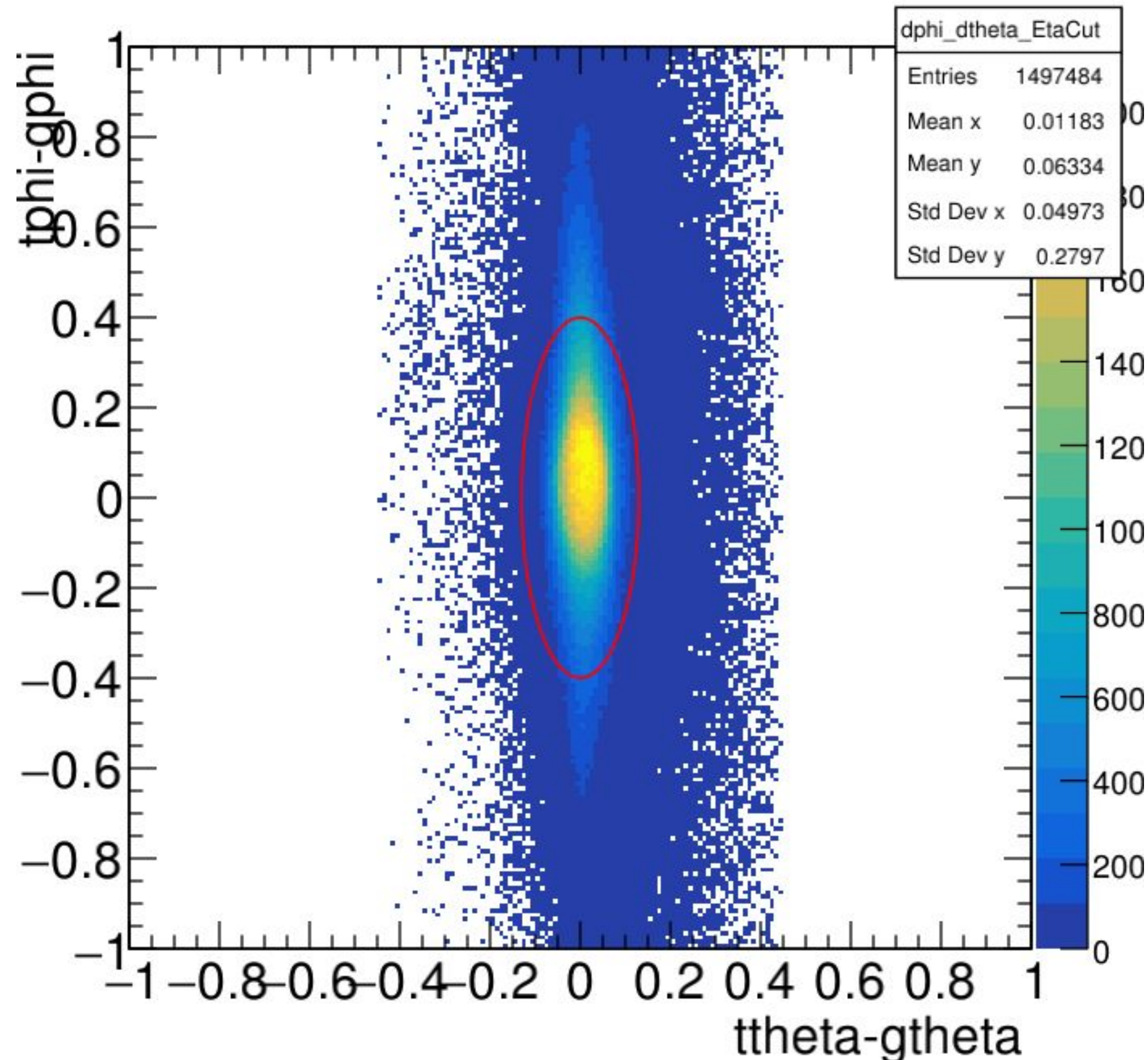
The x-axes denote $\Delta e_{\text{agg}}/ge$

A teal-colored geometric graphic on the left side of the slide, consisting of several overlapping triangles and quadrilaterals that form a downward-pointing arrow-like shape.

FEMC (e^-)

FEMC (e^-)

Elliptical cut on dphi vs dtheta, Explicit η cut: 1.3 to 3.3



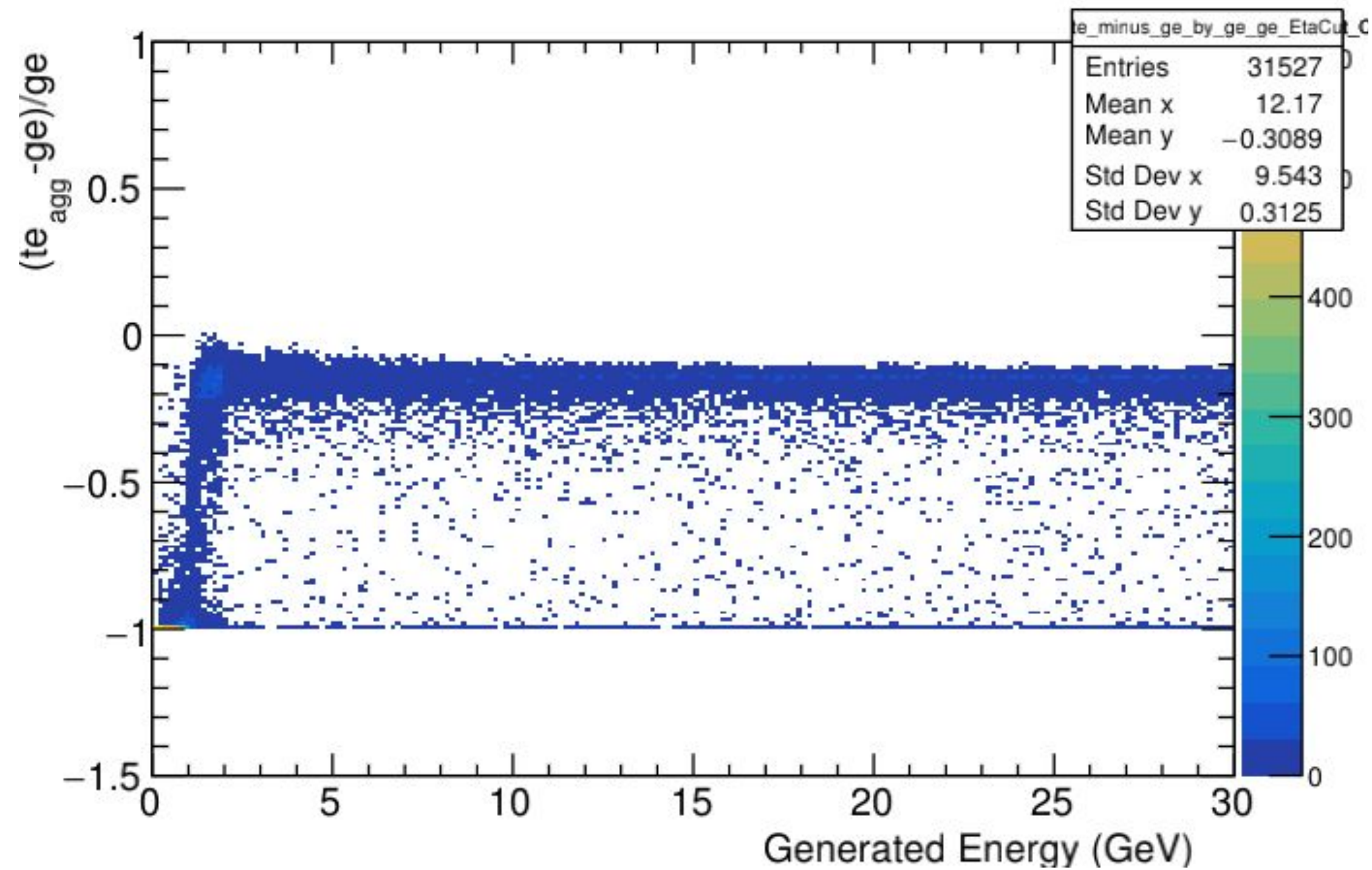
Elliptical Cut: Only the towers within the elliptical region (centered at origin) are considered for further analysis.

Dimensions:

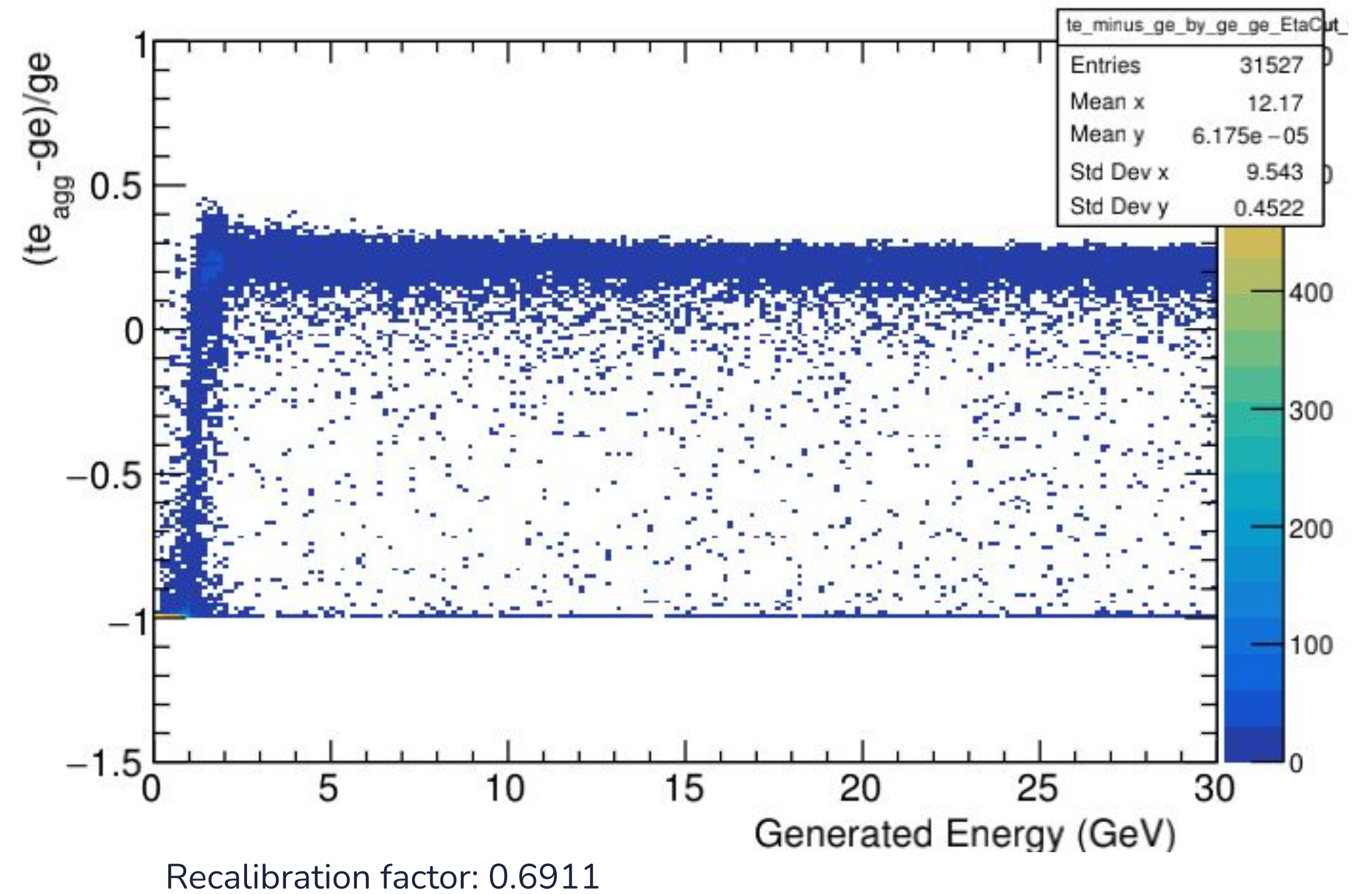
semi-minor axis = 0.13 units
semi-major axis = 0.40 units

FEMC (e^-)

$(te_{agg} - ge)/ge$ vs ge
Explicit η cut: 1.3 to 3.3
no energy cut

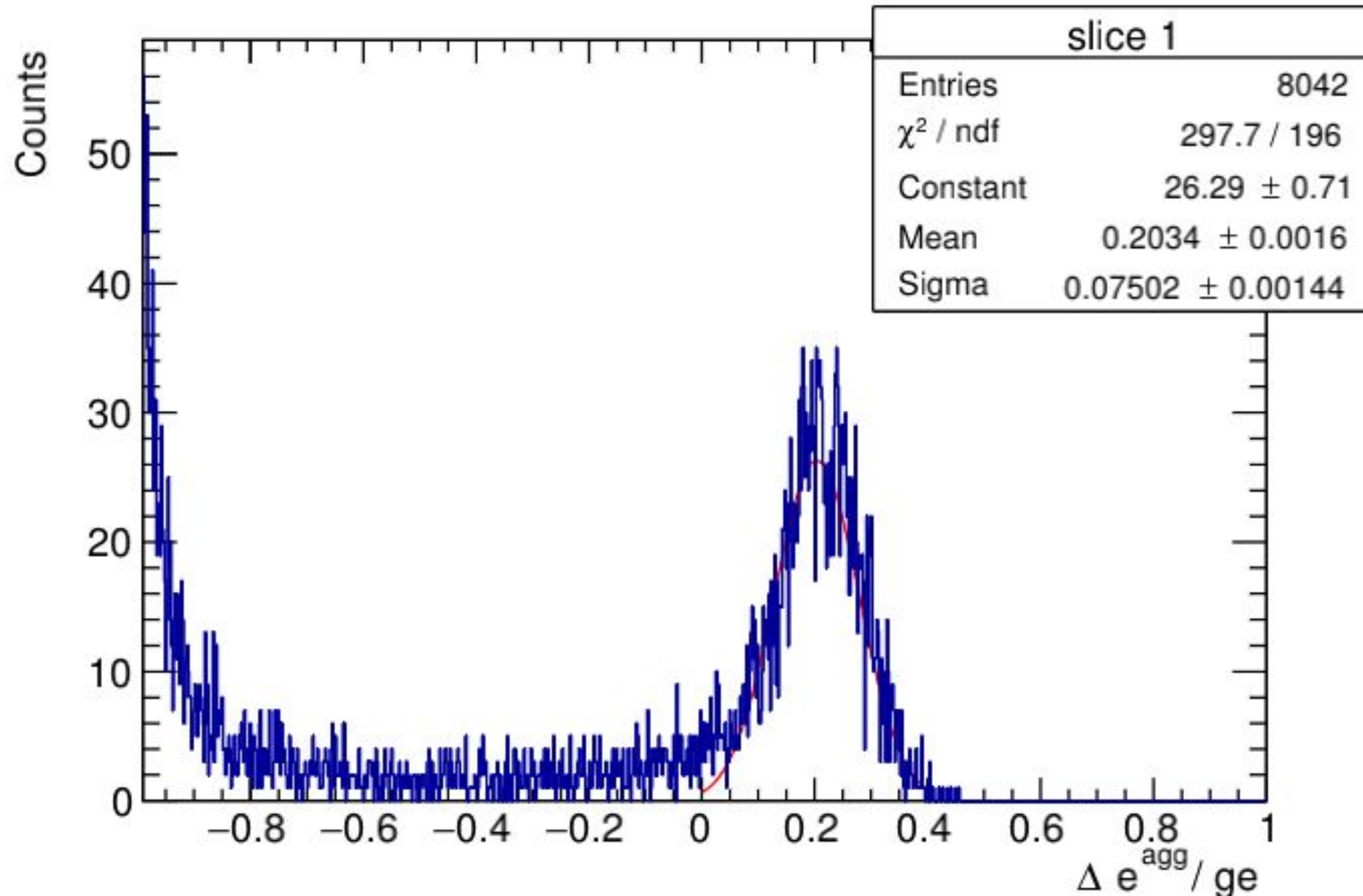


After Recalibration ($te \rightarrow te/recalibrationFactor$)



FEMC (e^-)

$(te_{agg} - ge)/ge$ vs ge
Gaussian fit of the first slice (0-2 GeV)



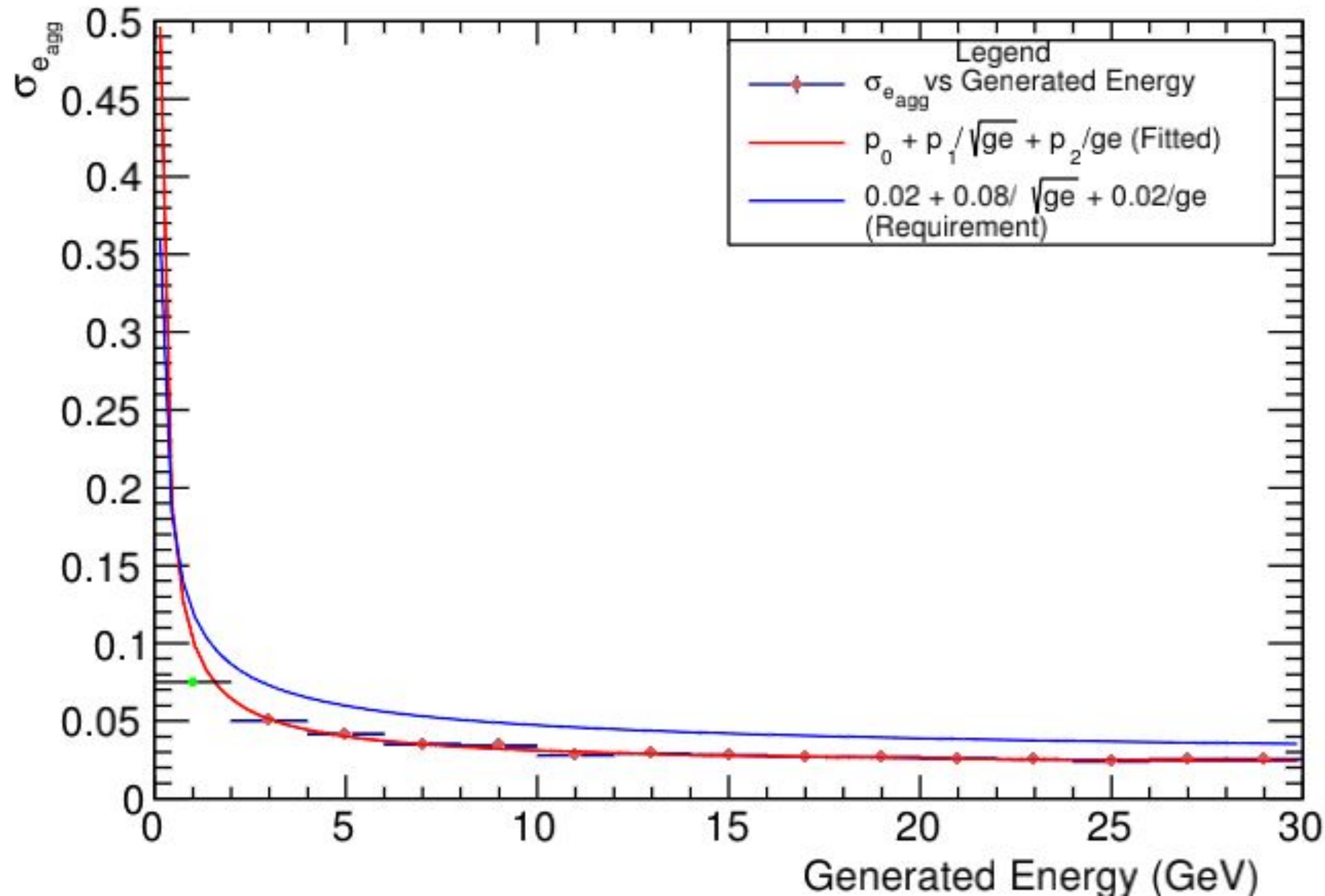
This is the gaussian fit of the first slice of the recalibrated $(te_{agg} - ge)/ge$ vs ge plot.
(shown on the previous slide)

This fit has been done manually by restricting the fit range of the gaussian from 0.00 to 0.40

*All other gaussians have been fit over the entire range.

FEMC (e^-)

$\sigma_{e_{agg}}$ vs ge
Explicit η cut: 1.3 to 3.3
Elliptical cut



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

Number of bins = 15
Bin Width = 2 GeV

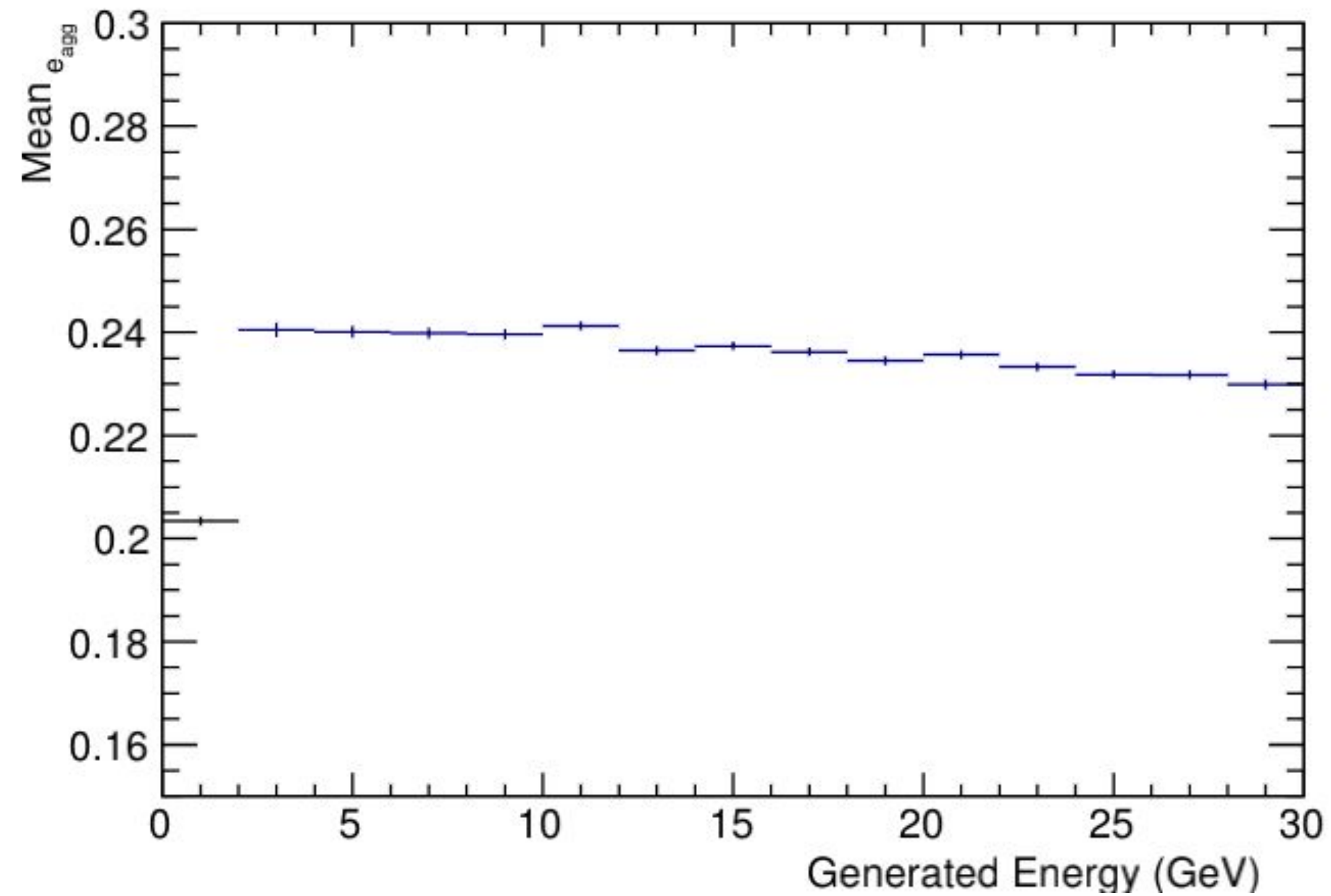
Fit Parameters:

$p_0 = (0.0184915 \pm 0.00208869)$
 $p_1 = (0.0196041 \pm 0.0133210) \text{ GeV}^{0.5}$
 $p_2 = (0.0640745 \pm 0.0192794) \text{ GeV}$

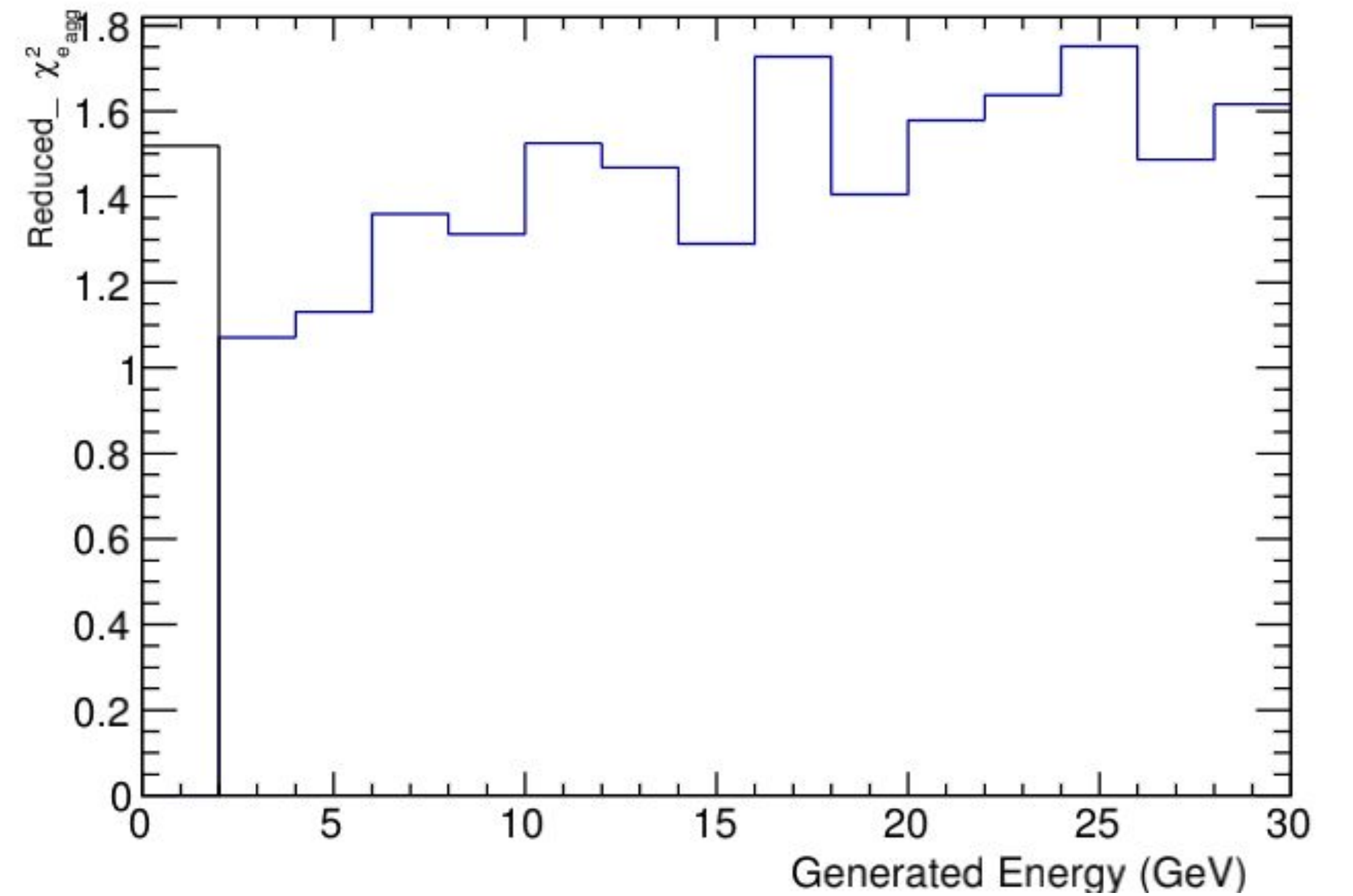
The fit does not account for the first slice. The first slice was overlaid manually over the plot.

FEMC (e^-)

Explicit η cut: 1.3 to 3.3



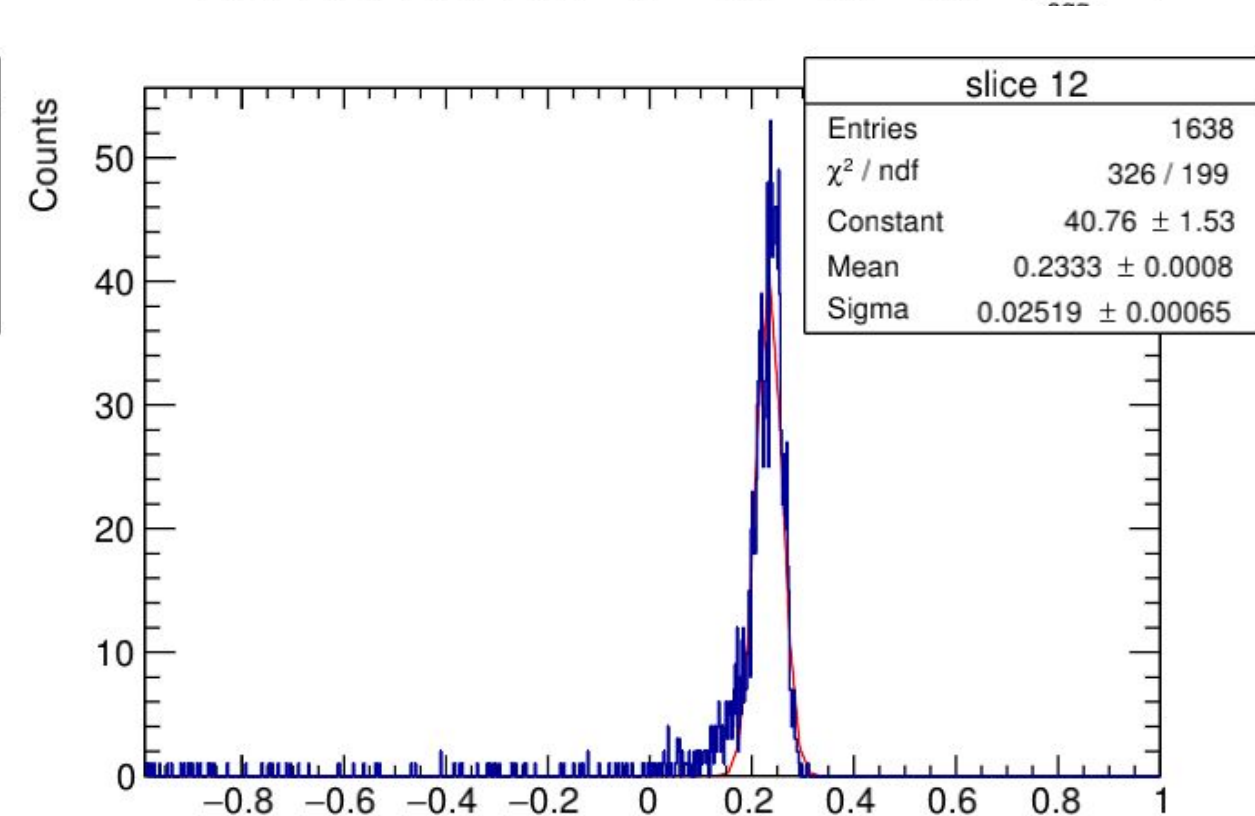
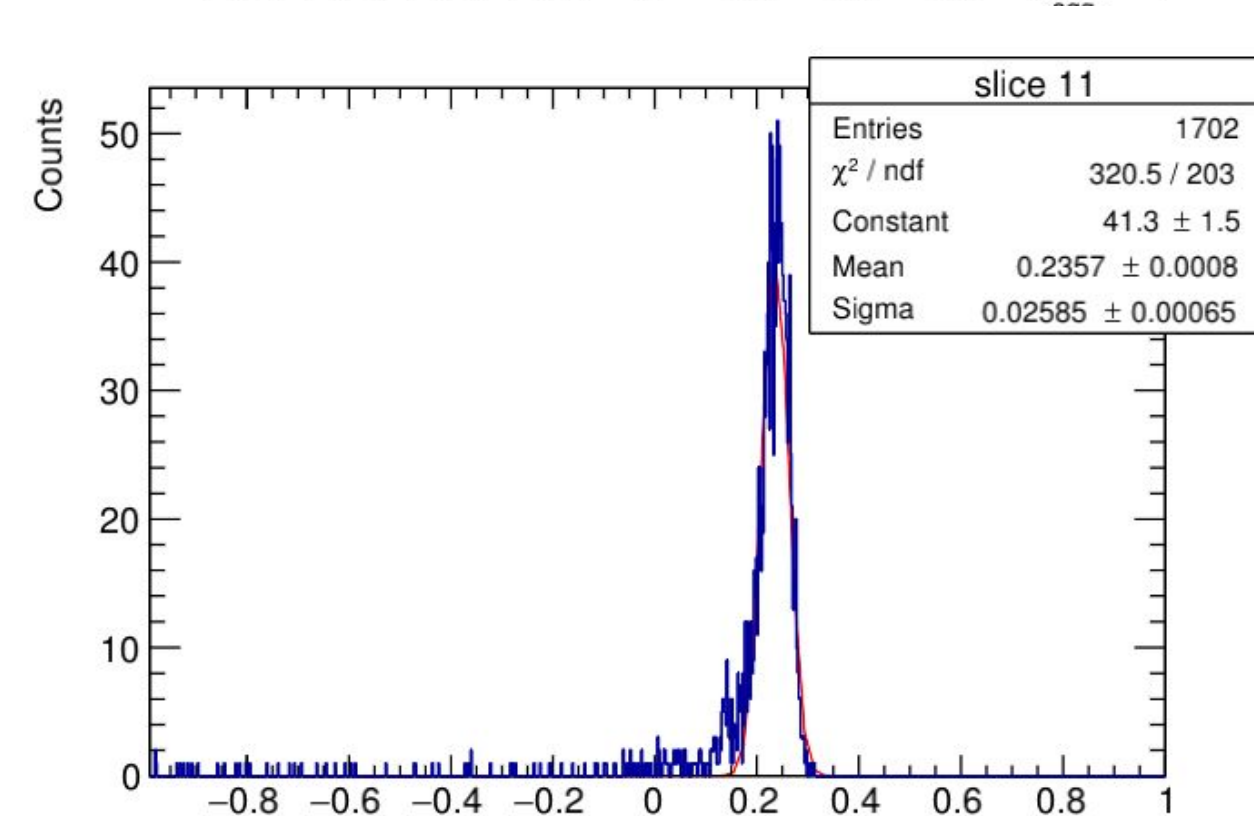
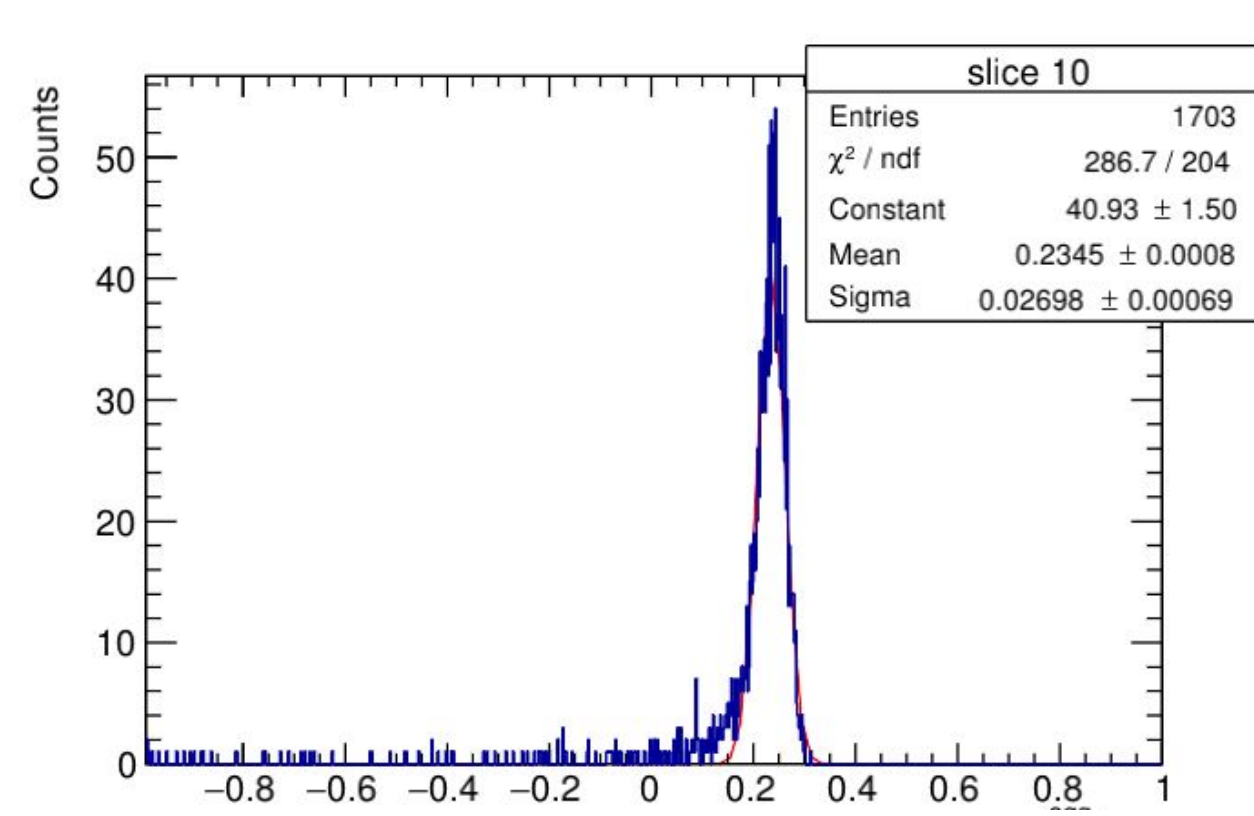
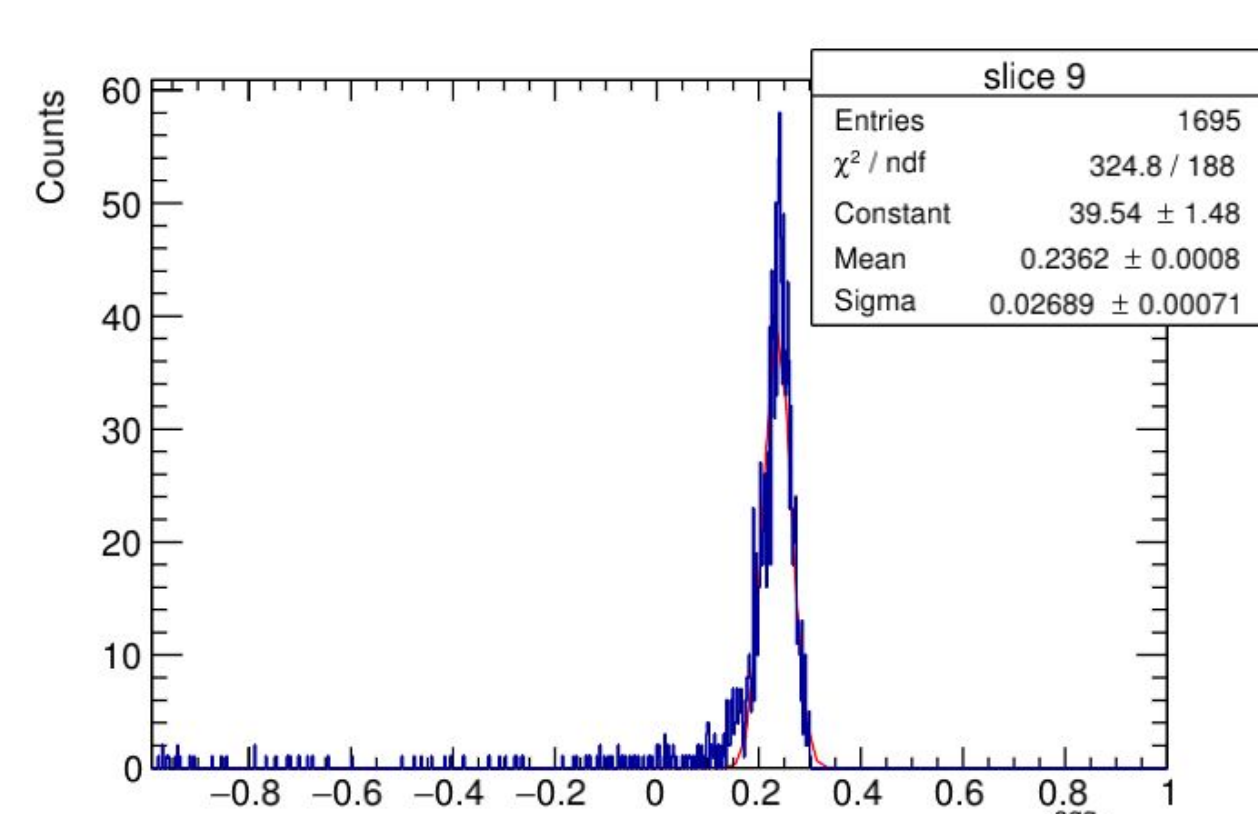
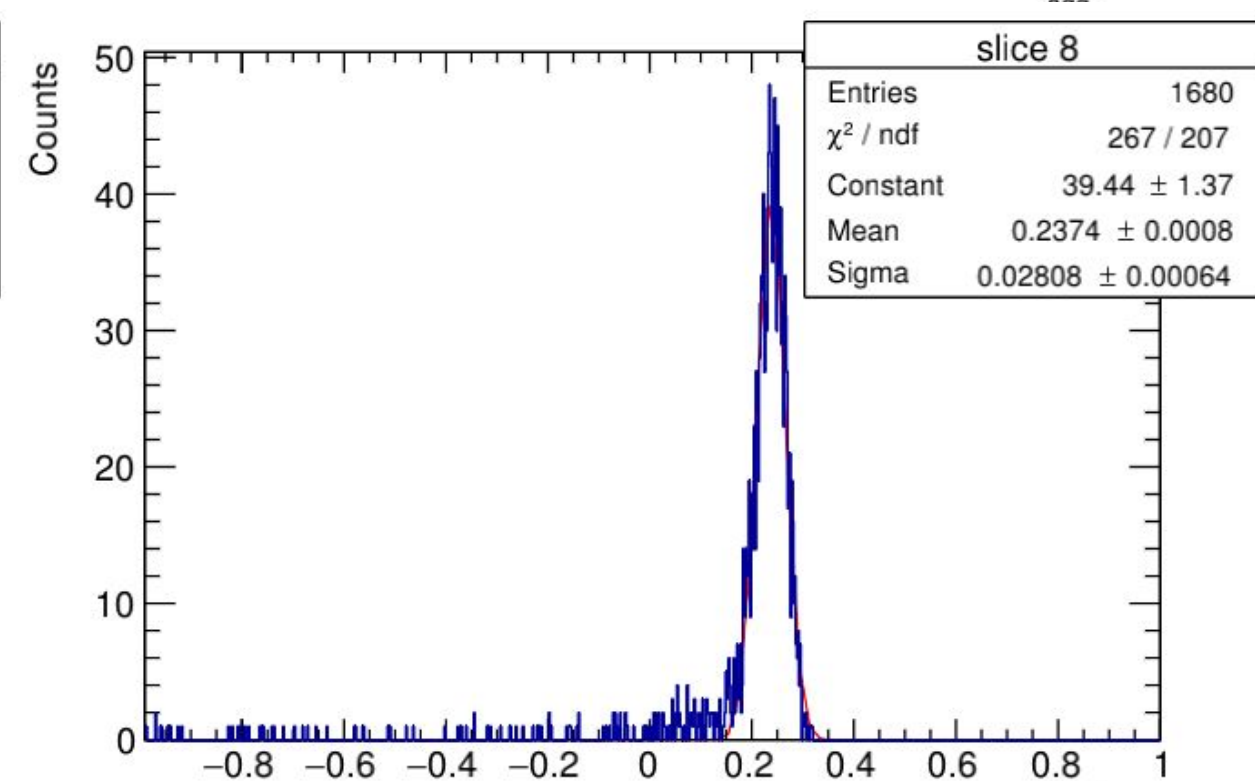
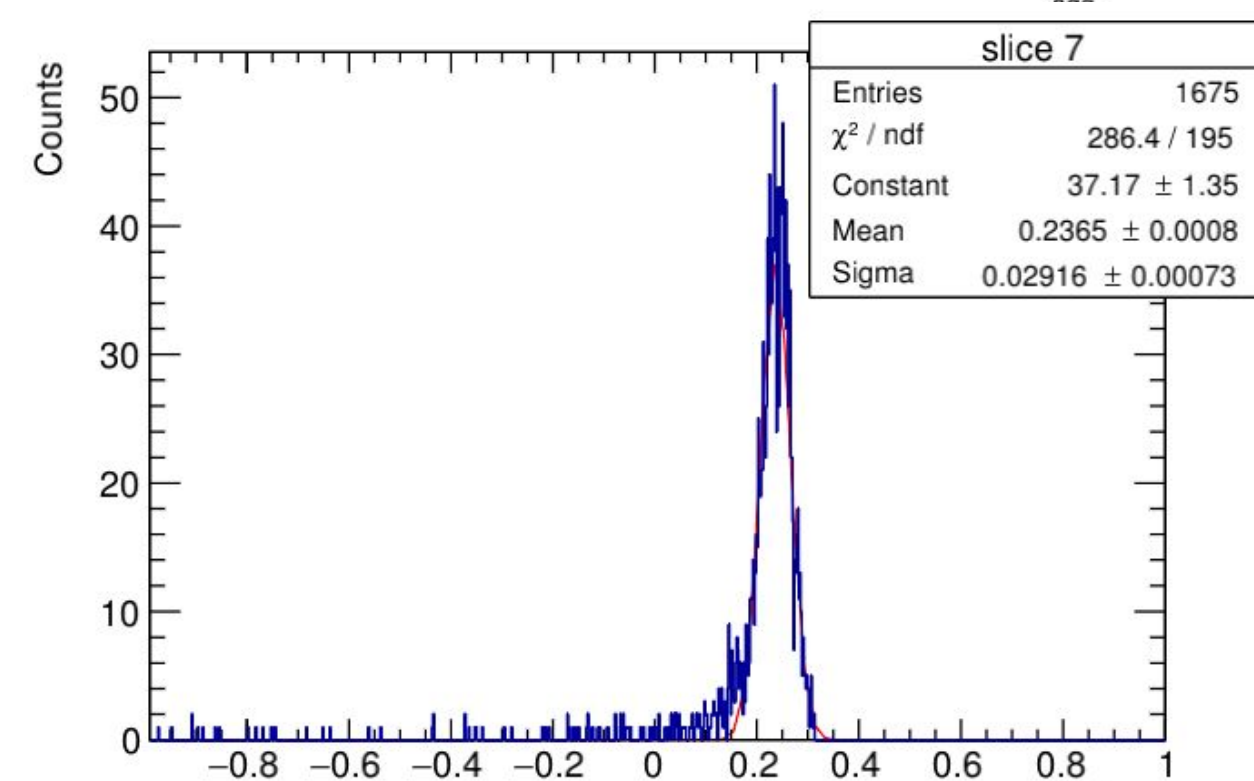
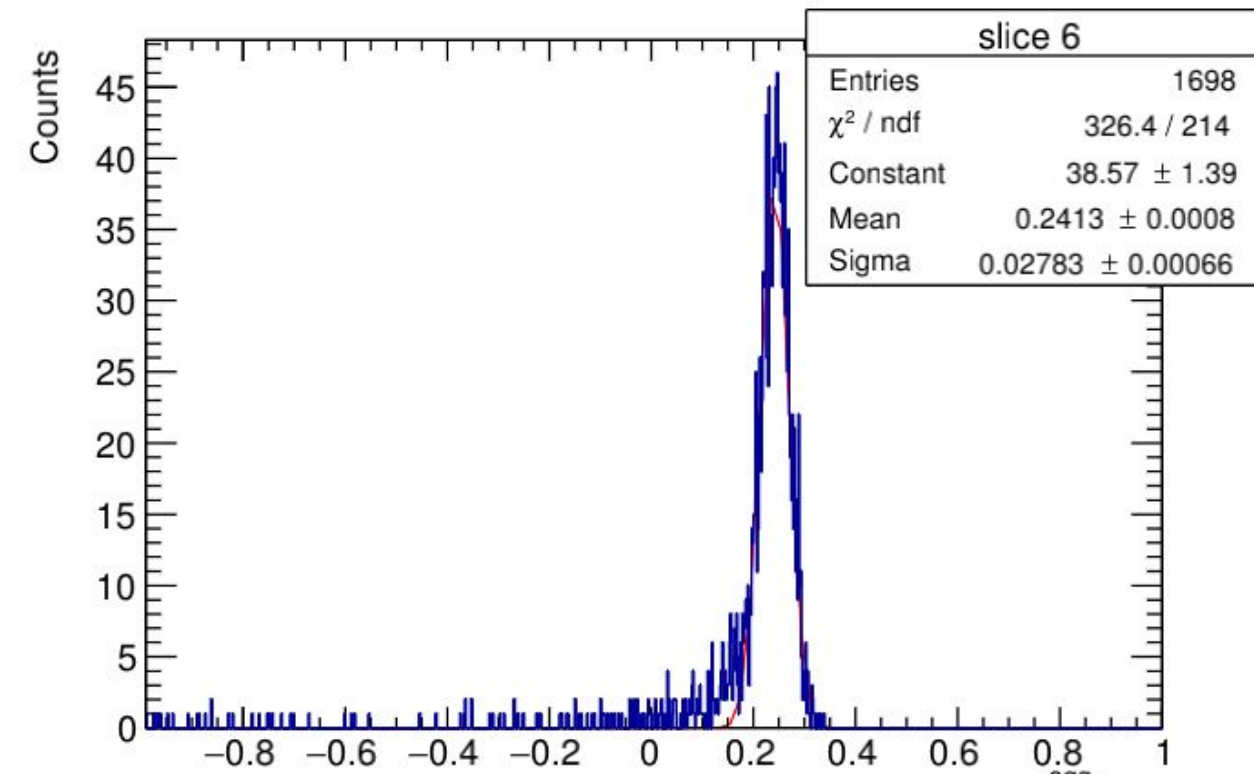
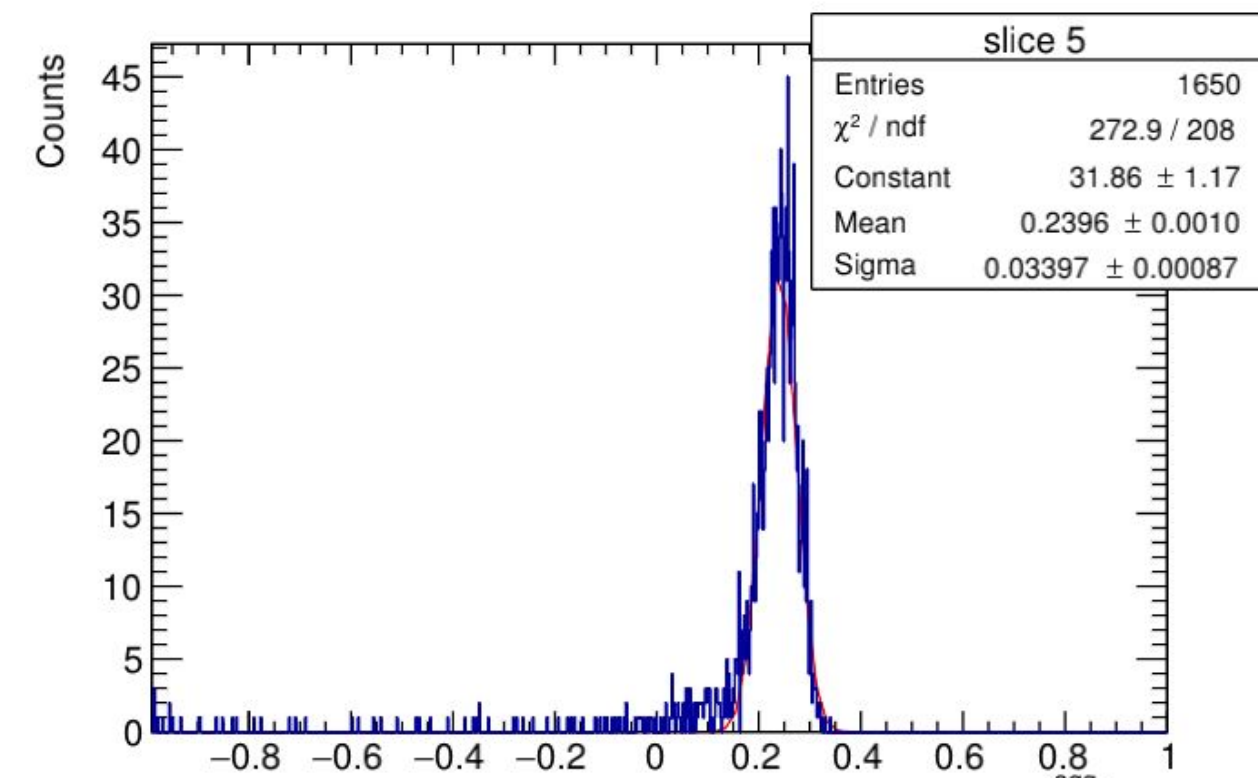
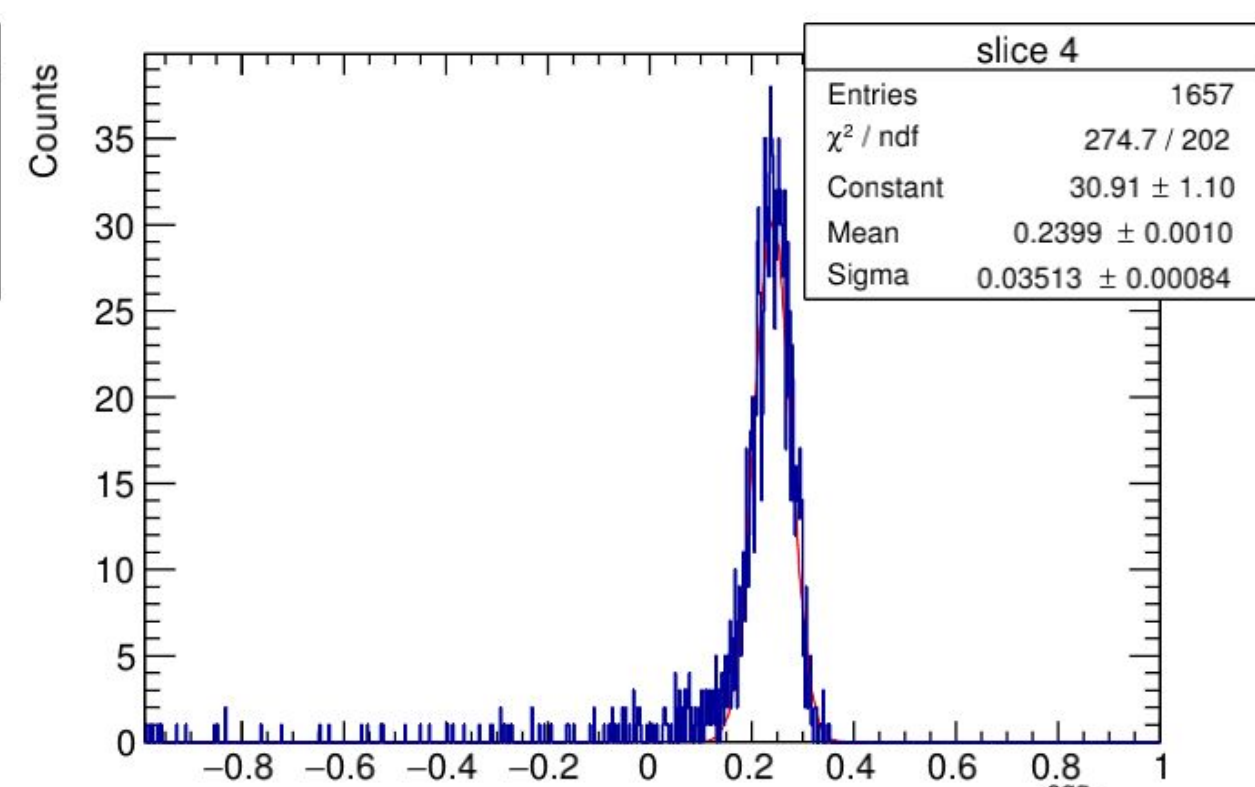
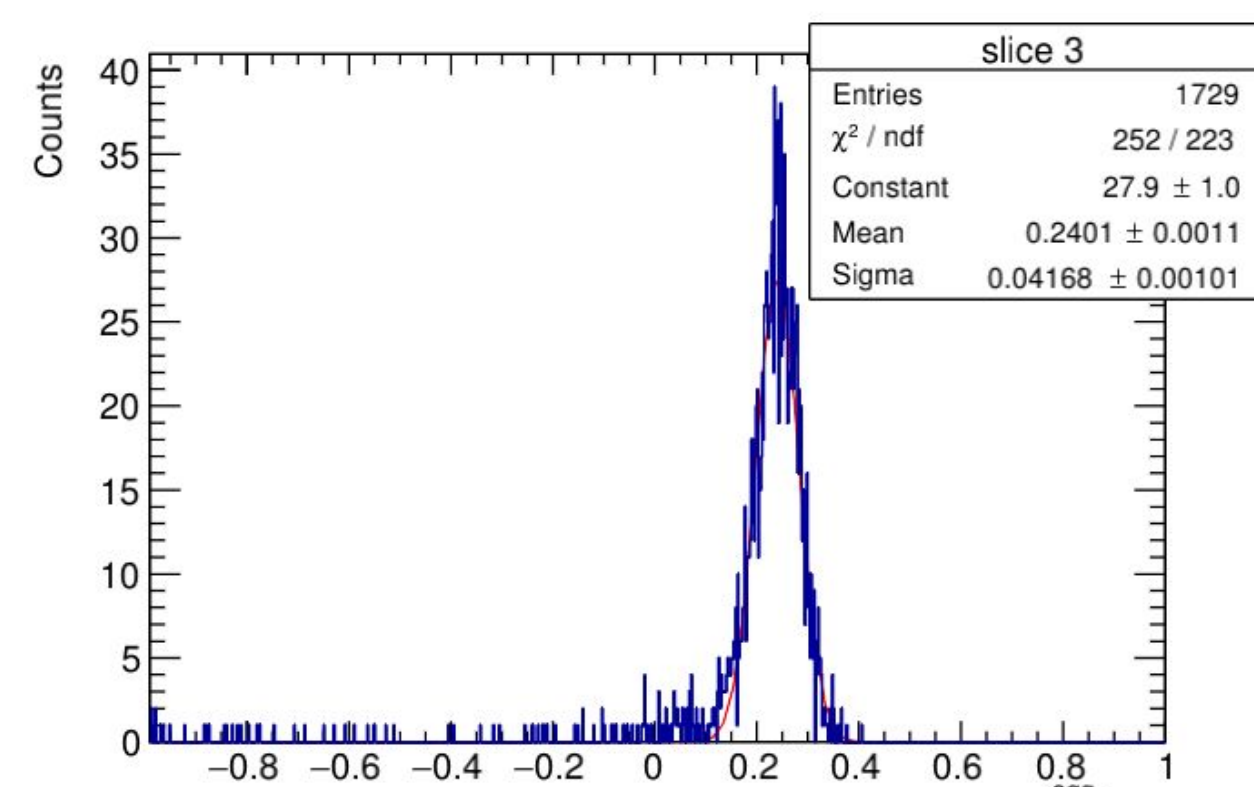
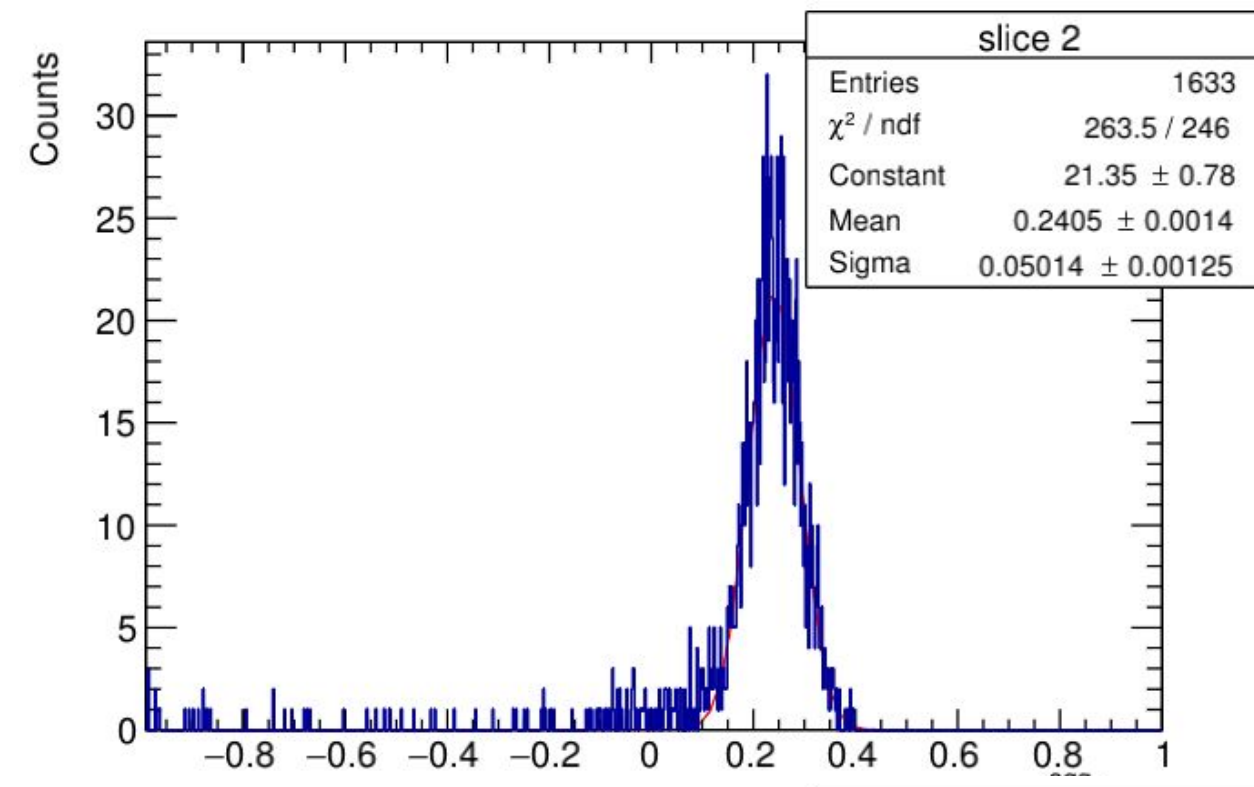
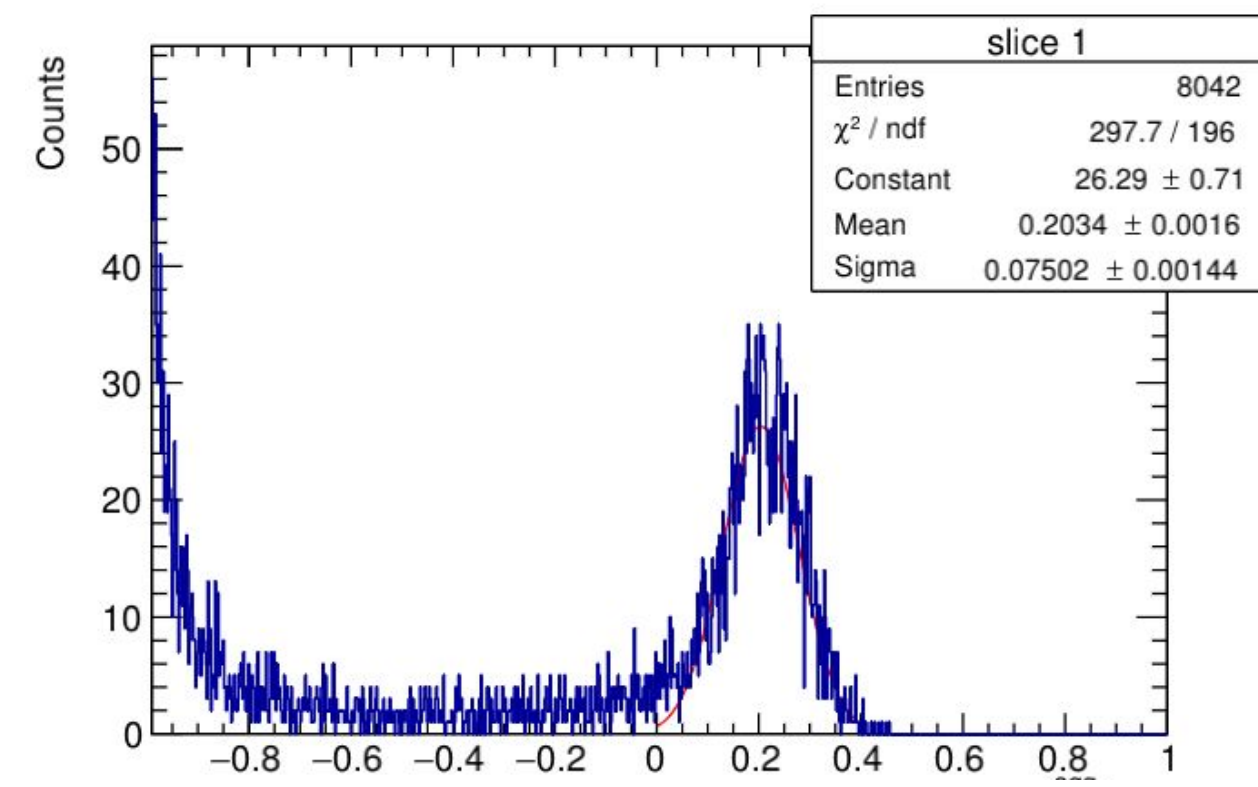
Mean of the Gaussians fitted to the slices of the recalibrated $(te_{agg} - ge) / ge$ vs ge plot.



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

FEMC (e^-)

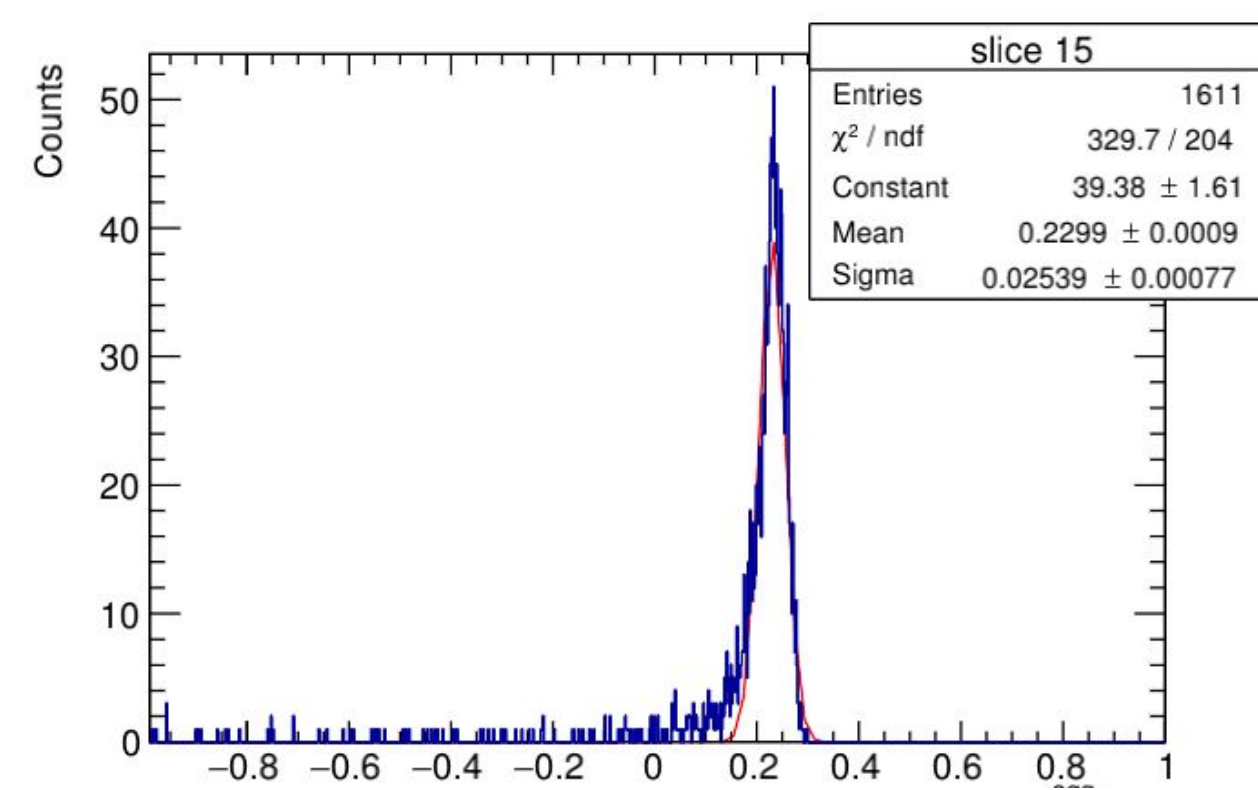
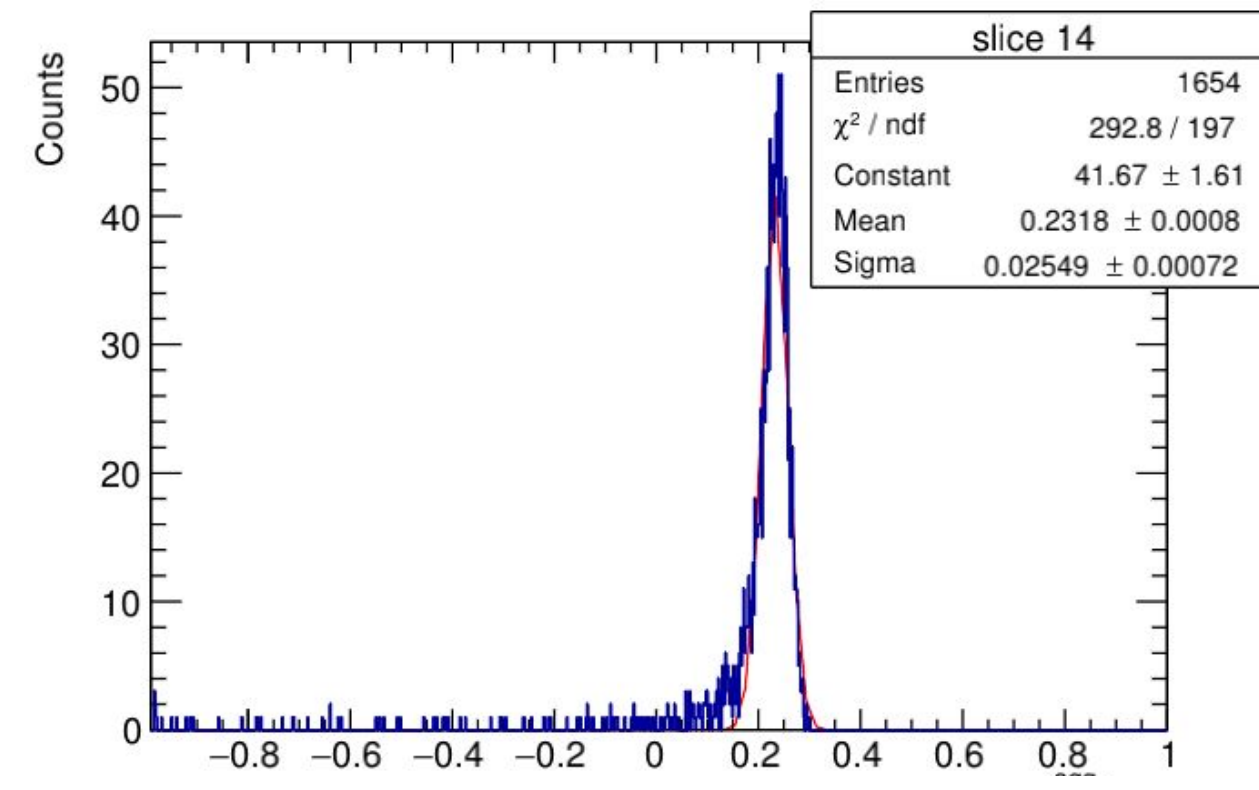
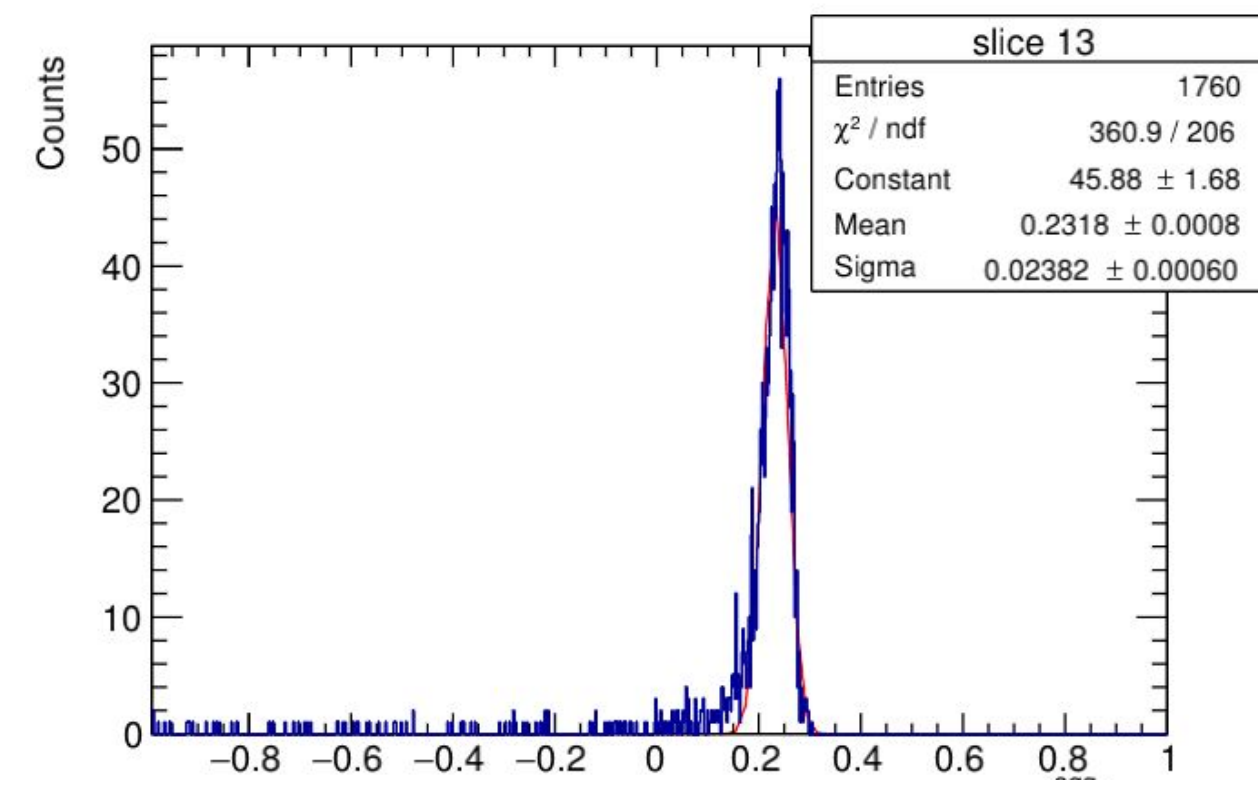
Fitted Gaussians



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

FEMC (e⁻)

Fitted Gaussians



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

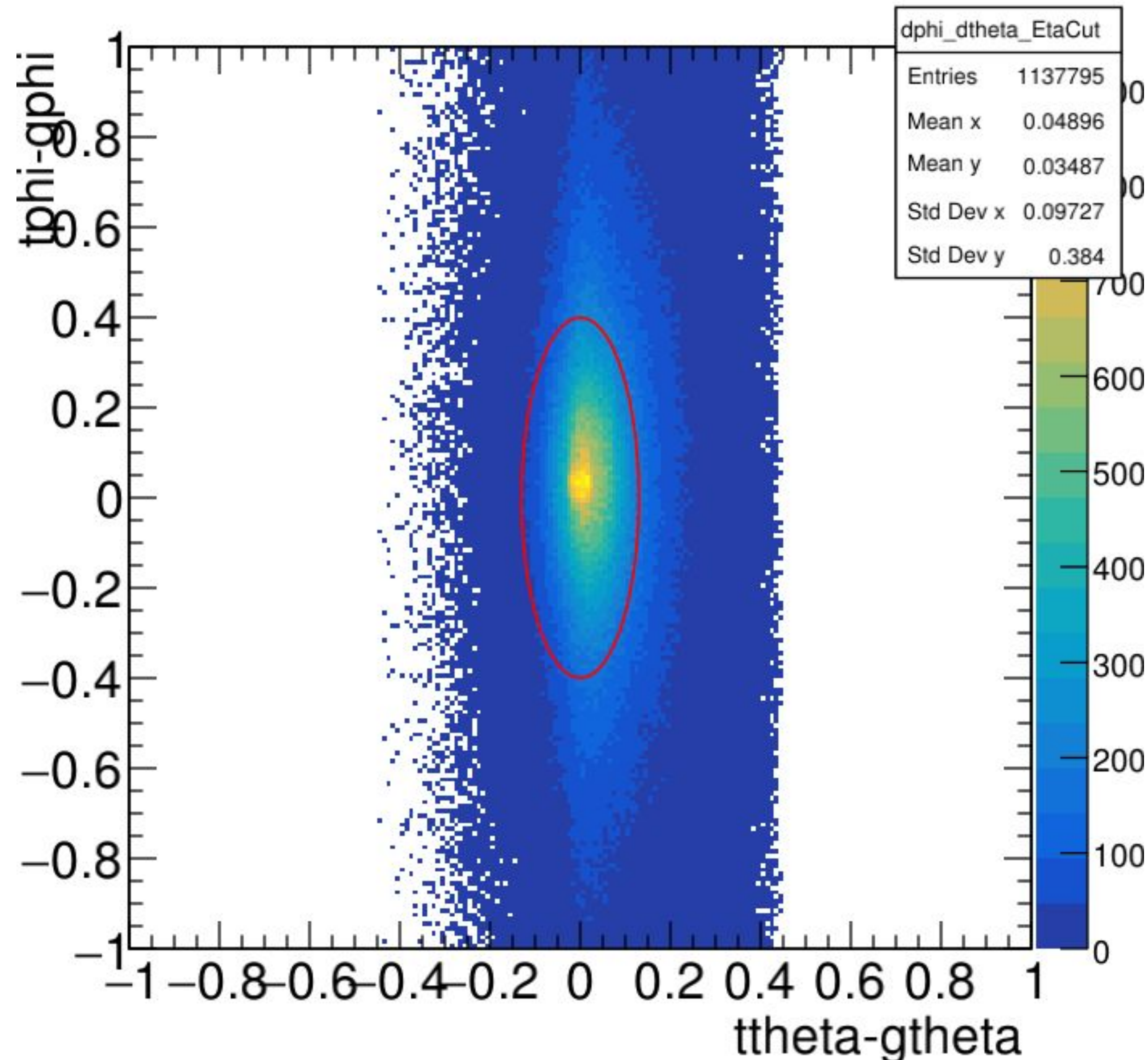
A teal geometric graphic consisting of several overlapping triangles and quadrilaterals, creating a faceted, shield-like shape on the left side of the slide.

FEMC + FHCAL (π^-)

FEMC (π^-)

Elliptical cut on dphi vs dtheta, Explicit η cut: 1.3 to 3.3

Magnetic Field Turned OFF



Elliptical Cut: Only the towers within the elliptical region (centered at origin) are considered for further analysis.

Dimensions:

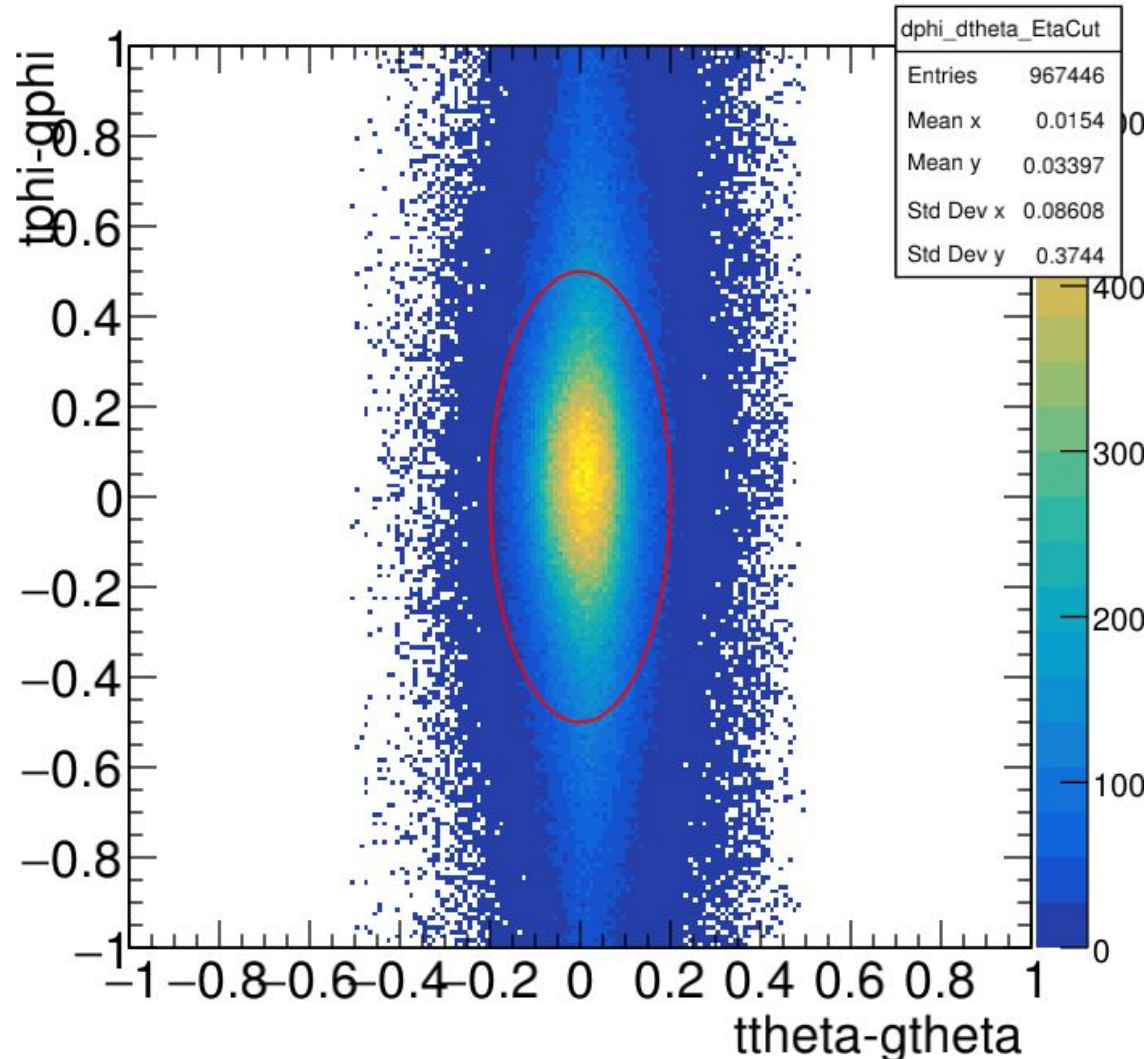
semi-minor axis = 0.13 units

semi-major axis = 0.35 units

FHCAL (π^-)

Elliptical cut on dphi vs dtheta, Explicit η cut: 1.3 to 3.3

Magnetic Field Turned OFF



Elliptical Cut: Only the towers within the elliptical region (centered at origin) are considered for further analysis.

Dimensions:

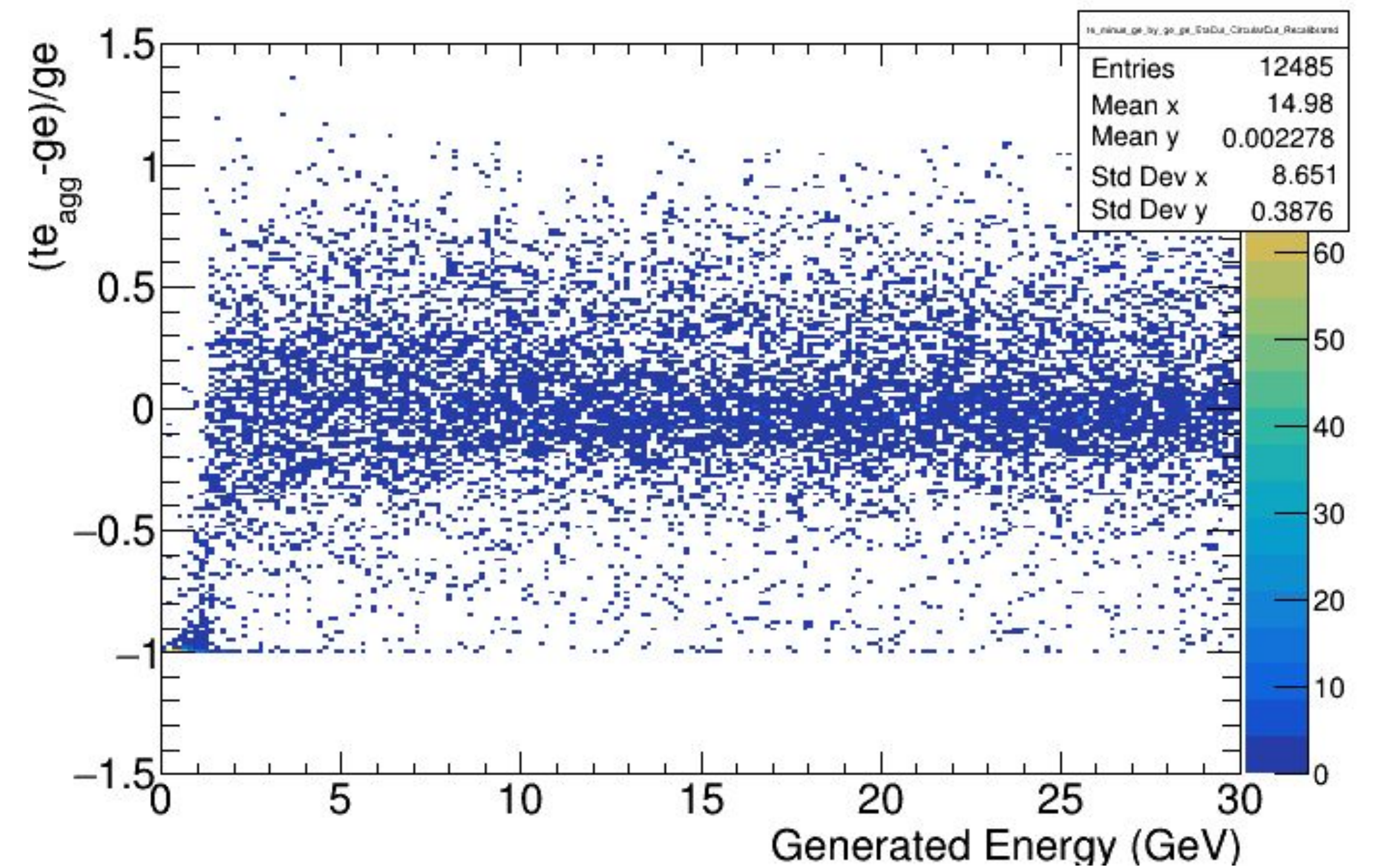
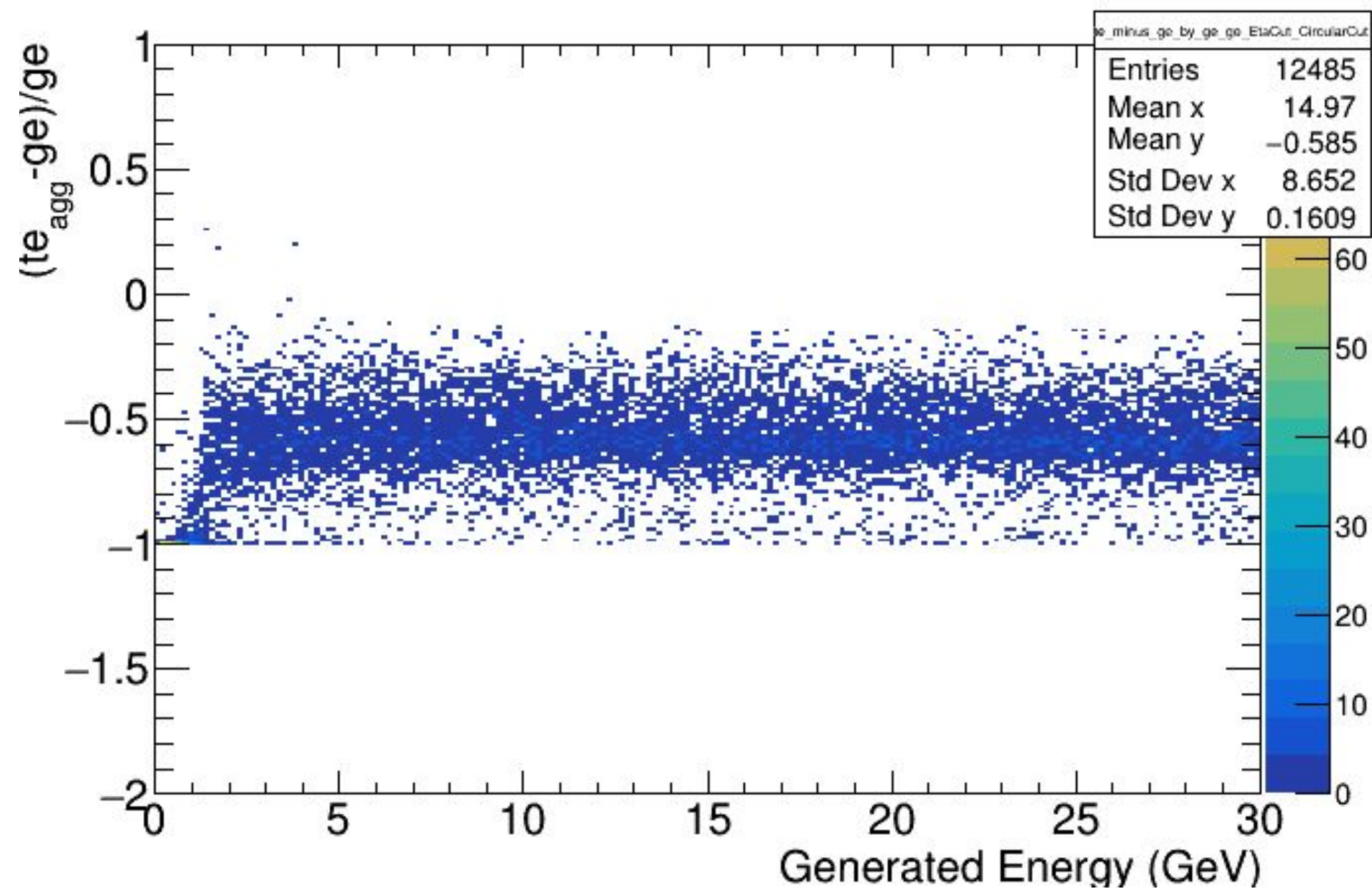
semi-minor axis = 0.15 units
semi-major axis = 0.45 units

FEMC + FHCAL (π^-)

$(te_{agg} - ge)/ge$ vs ge
Explicit η cut: 1.3 to 3.3
no energy cut

Magnetic Field Turned OFF

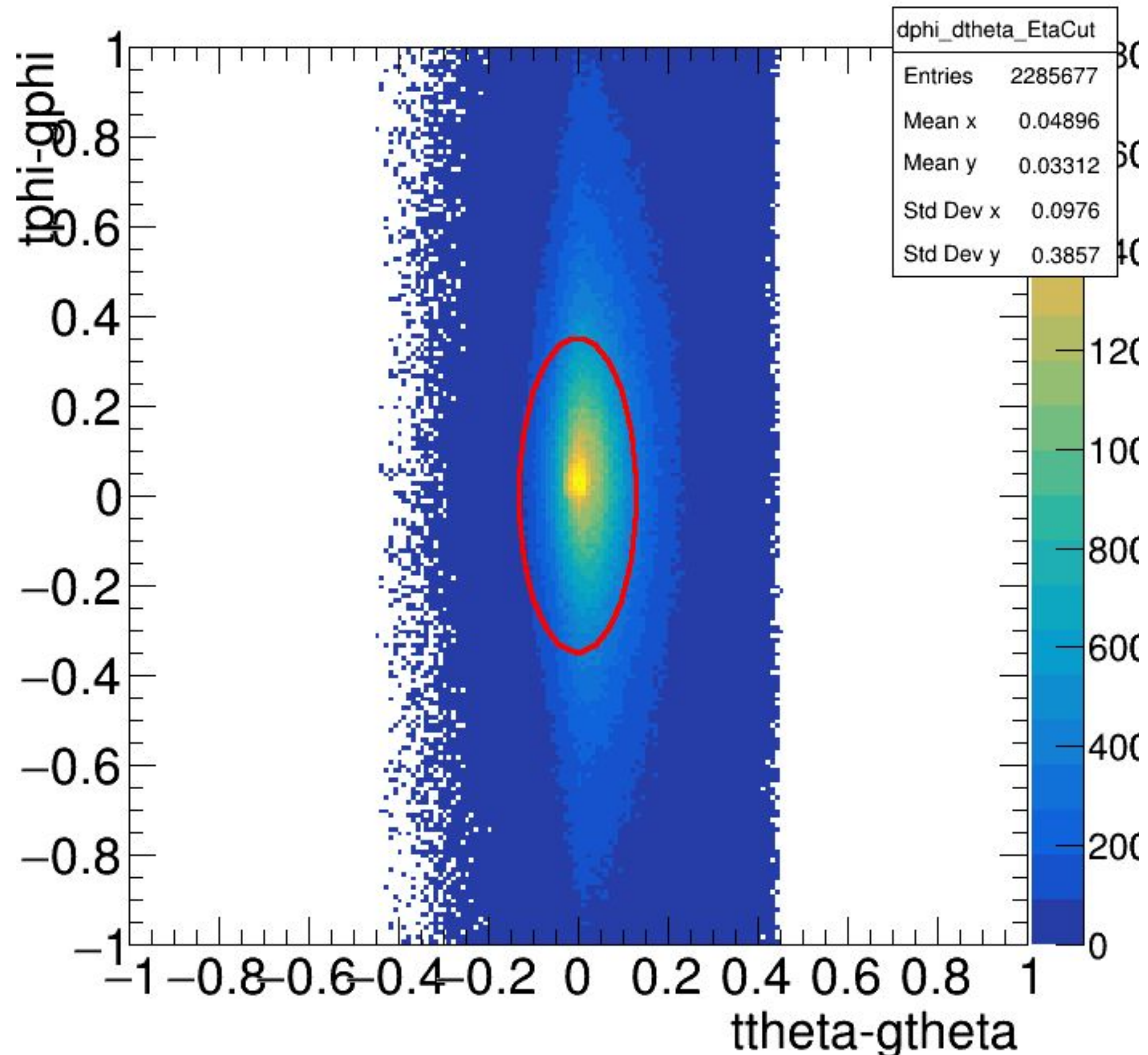
After Recalibration ($te \rightarrow te/recalibrationFactor$)



Recalibration factor: 0.4139

FEMC (π^-)

Elliptical cut on $d\phi$ vs $d\theta$, Explicit η cut: 1.3 to 3.3



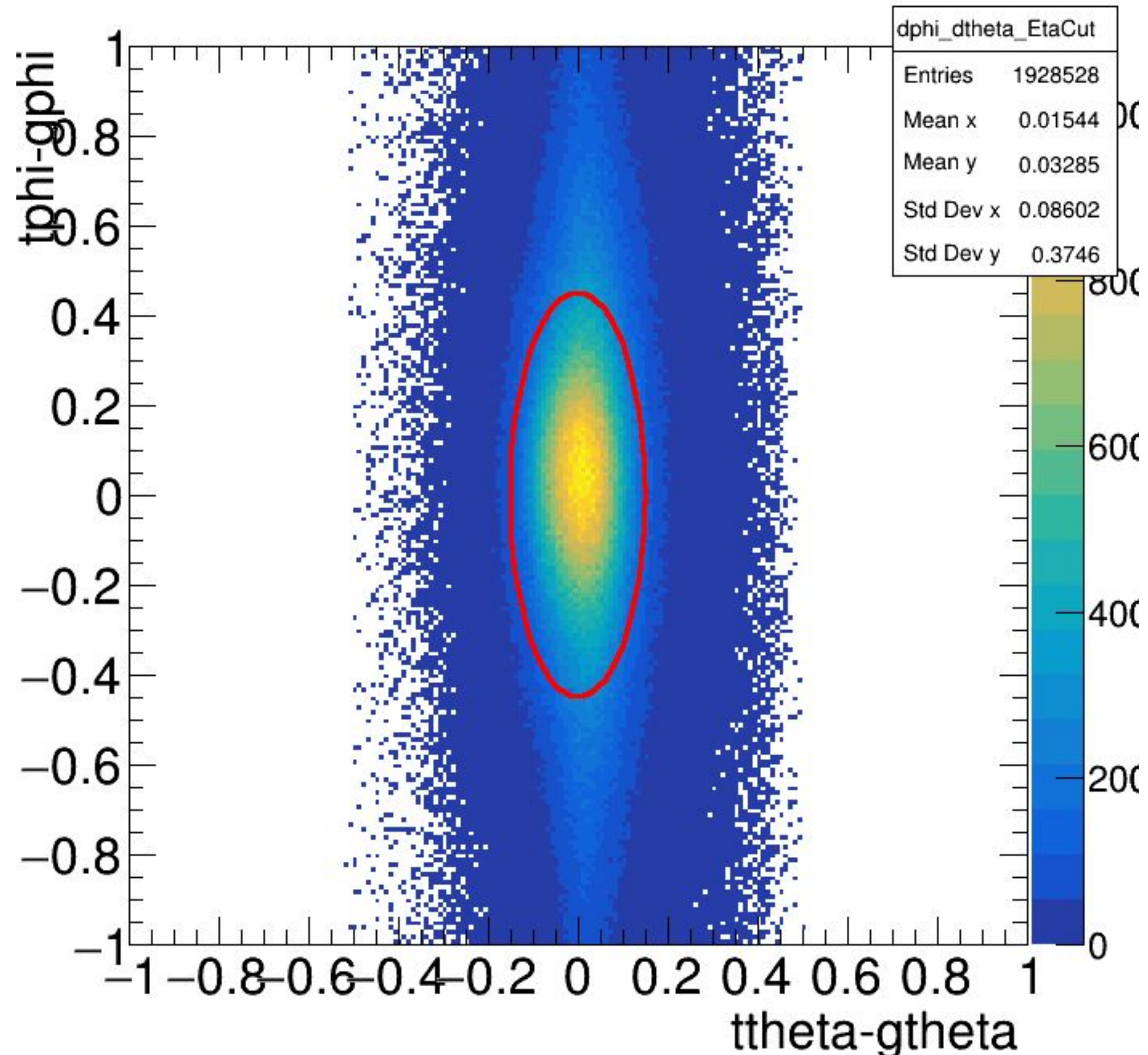
Elliptical Cut: Only the towers within the elliptical region (centered at origin) are considered for further analysis.

Dimensions:

semi-minor axis = 0.13 units
semi-major axis = 0.35 units

FHCAL (π^-)

Elliptical cut on dphi vs dtheta, Explicit η cut: 1.3 to 3.3



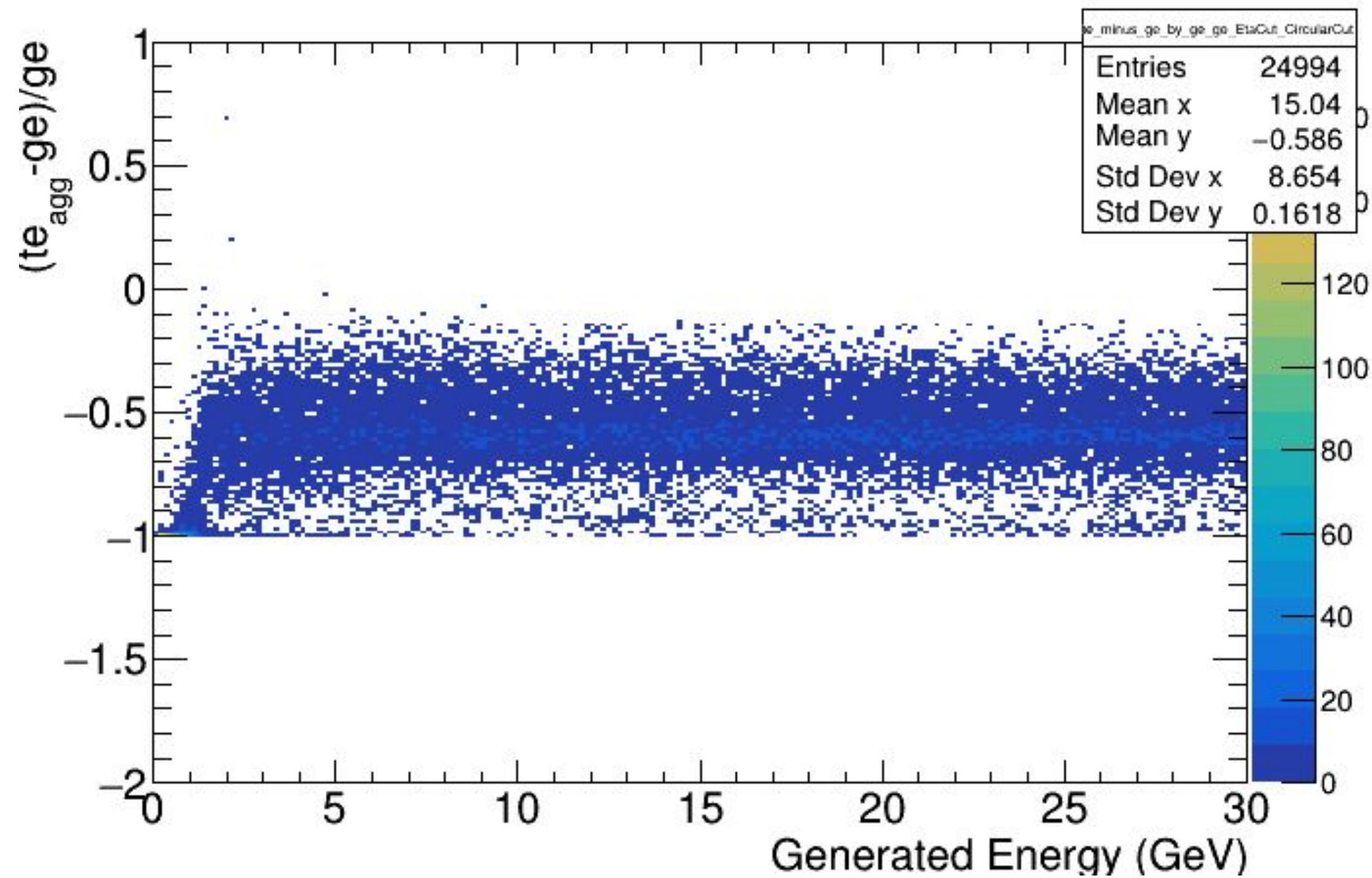
Elliptical Cut: Only the towers within the elliptical region (centered at origin) are considered for further analysis.

Dimensions:

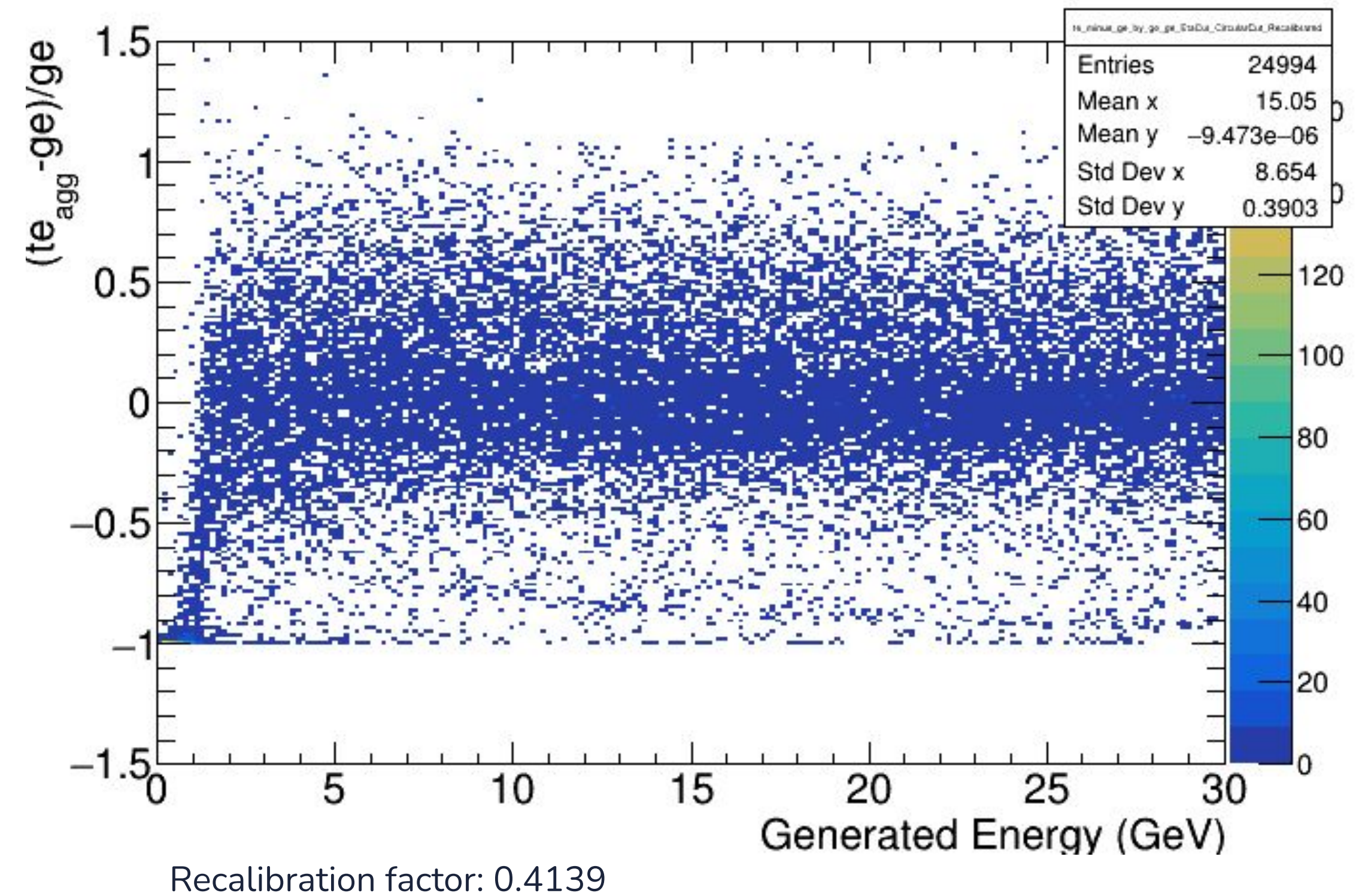
semi-minor axis = 0.15 units
semi-major axis = 0.45 units

FEMC + FHCAL (π^-)

$(te_{agg} - ge)/ge$ vs ge
Explicit η cut: 1.3 to 3.3
no energy cut

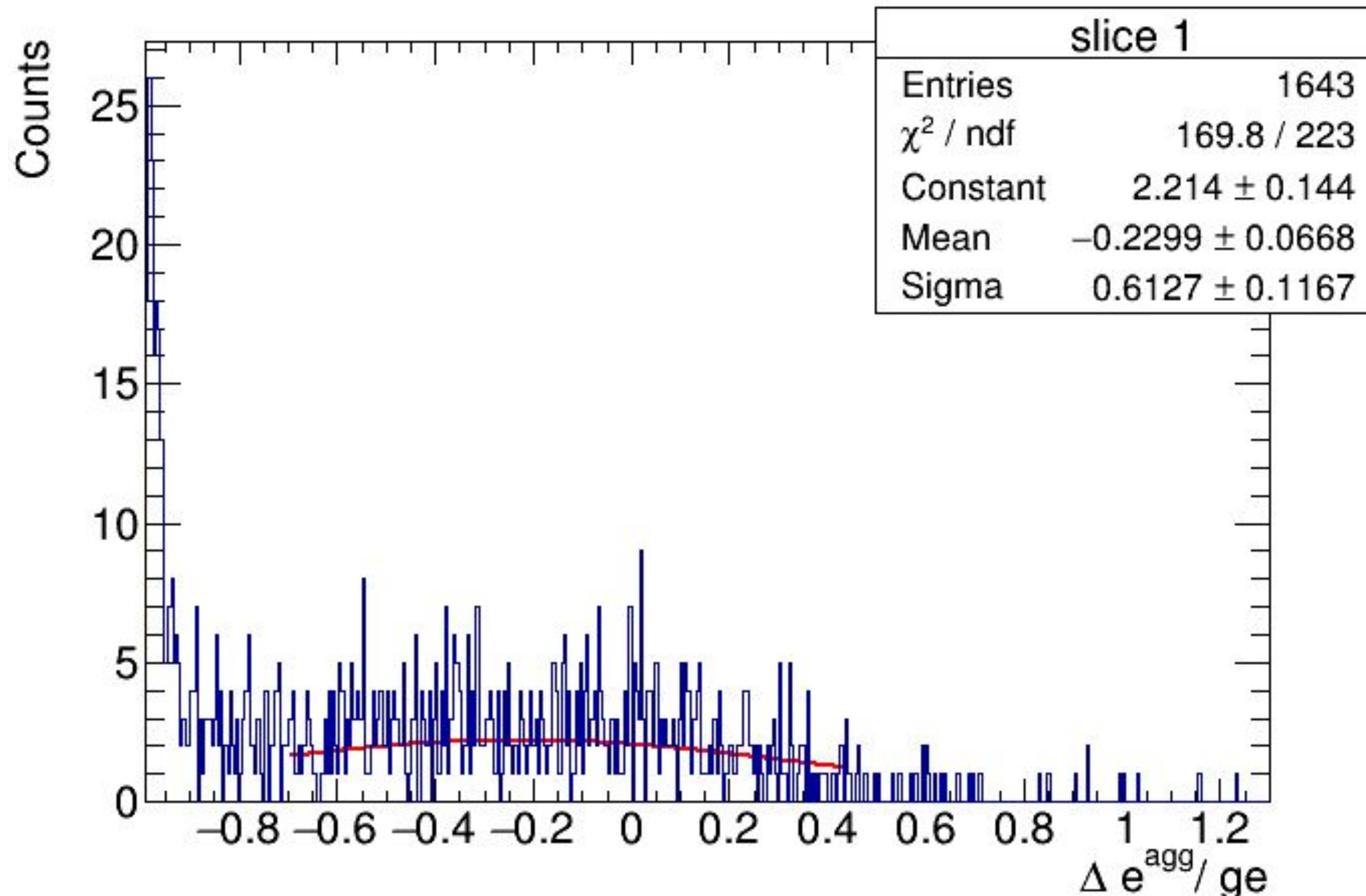


After Recalibration ($te \rightarrow te/recalibrationFactor$)



FEMC + FHCAL (π^-)

$(te_{agg} - ge)/ge$ vs ge
Gaussian fit of the first slice (0-2 GeV)



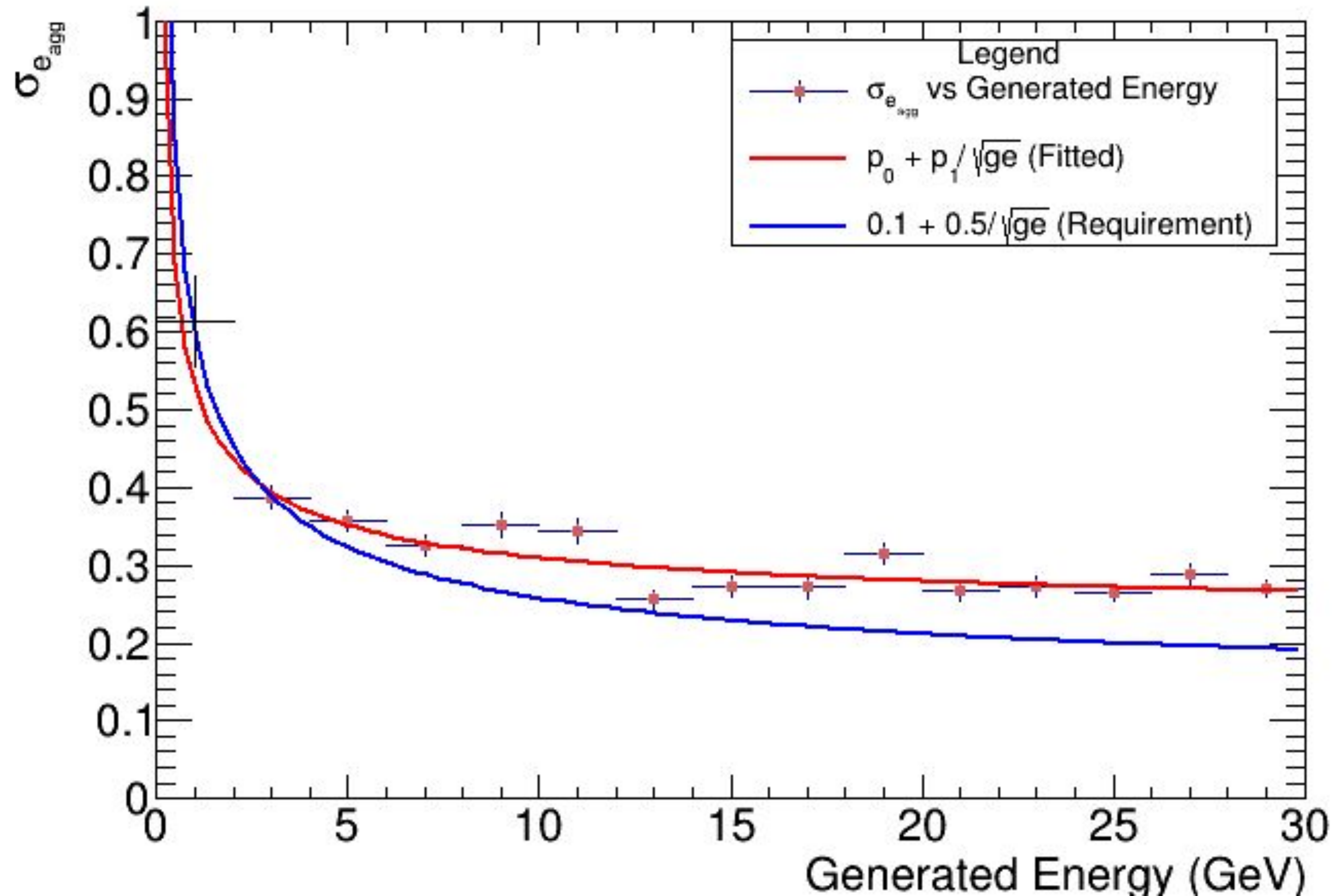
This is the gaussian fit of the first slice of the recalibrated $(te_{agg} - ge)/ge$ vs ge plot.
(shown on the previous slide)

This fit has been done manually by restricting the fit range of the gaussian from -0.70 to 0.45

*All other gaussians have been fit over the entire range.

FEMC + FHCAL (π^-)

$\sigma_{e_{agg}}$ vs g_e
Explicit η cut: 1.3 to 3.3
Elliptical cuts



σ_e refers to the standard deviation of the Gaussian fitted to a slice of the recalibrated $(t_{e_{agg}} - g_e) / g_e$ vs g_e plot.
(shown on the previous slide)

Number of bins = 15
Bin Width = 2 GeV

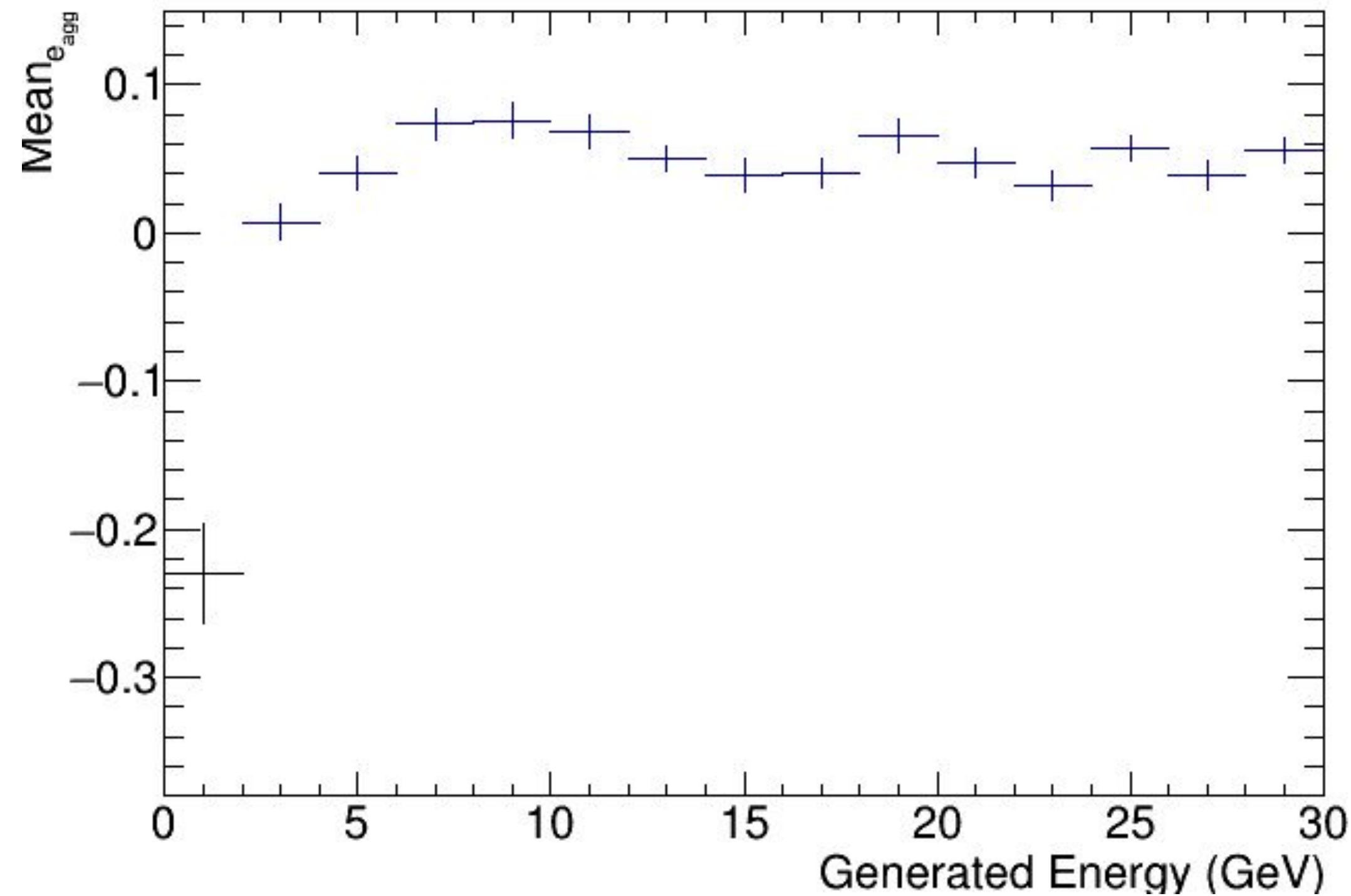
Fit Parameters:

$p_0 = (0.207077 \pm 0.0102293)$
 $p_1 = (0.323210 \pm 0.0345614) \text{ GeV}^{0.5}$

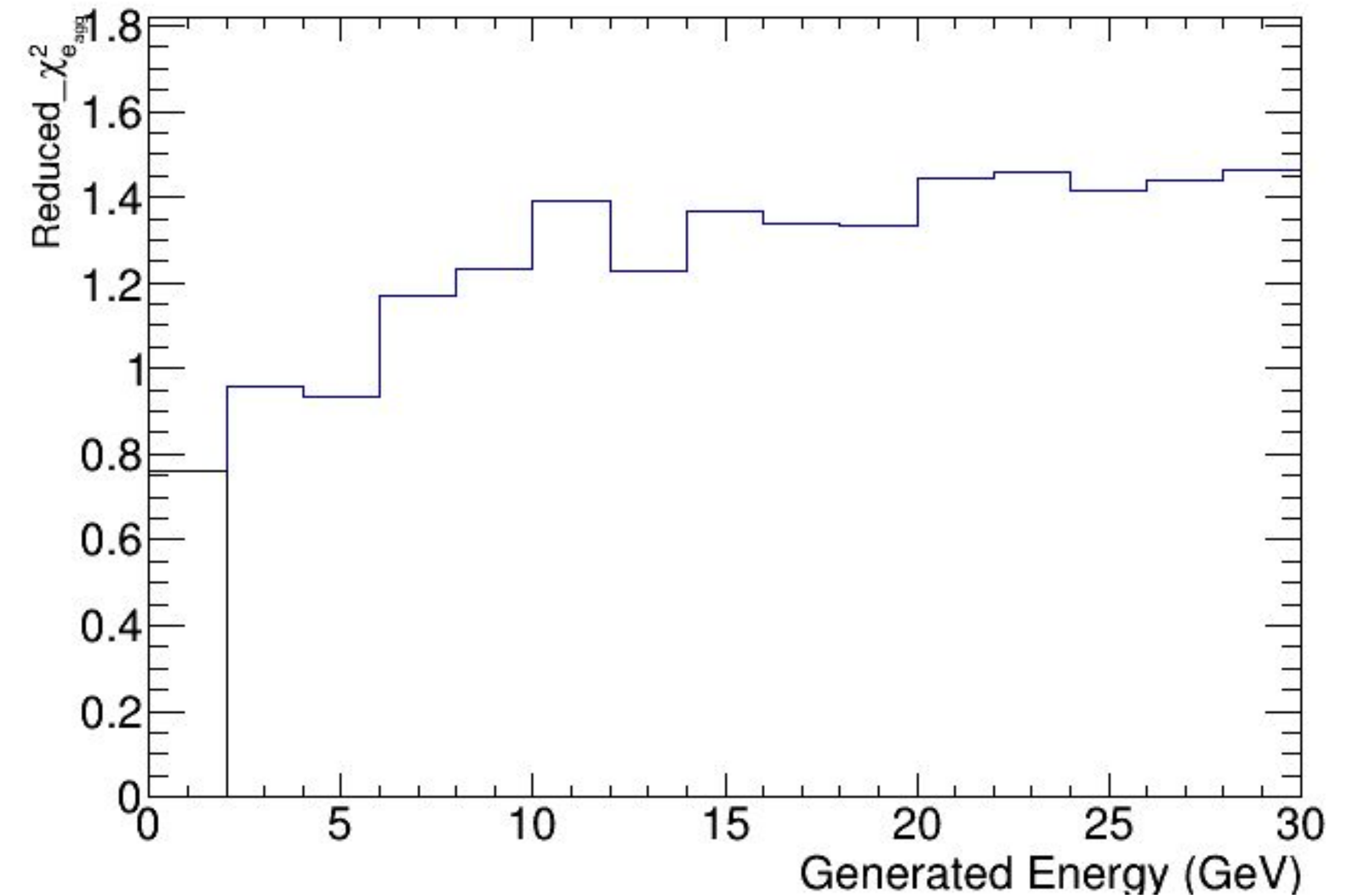
The fit does not account for the first slice. The first slice was overlaid manually over the plot.

FEMC + FHCAL (π^-)

Explicit η cut: 1.3 to 3.3



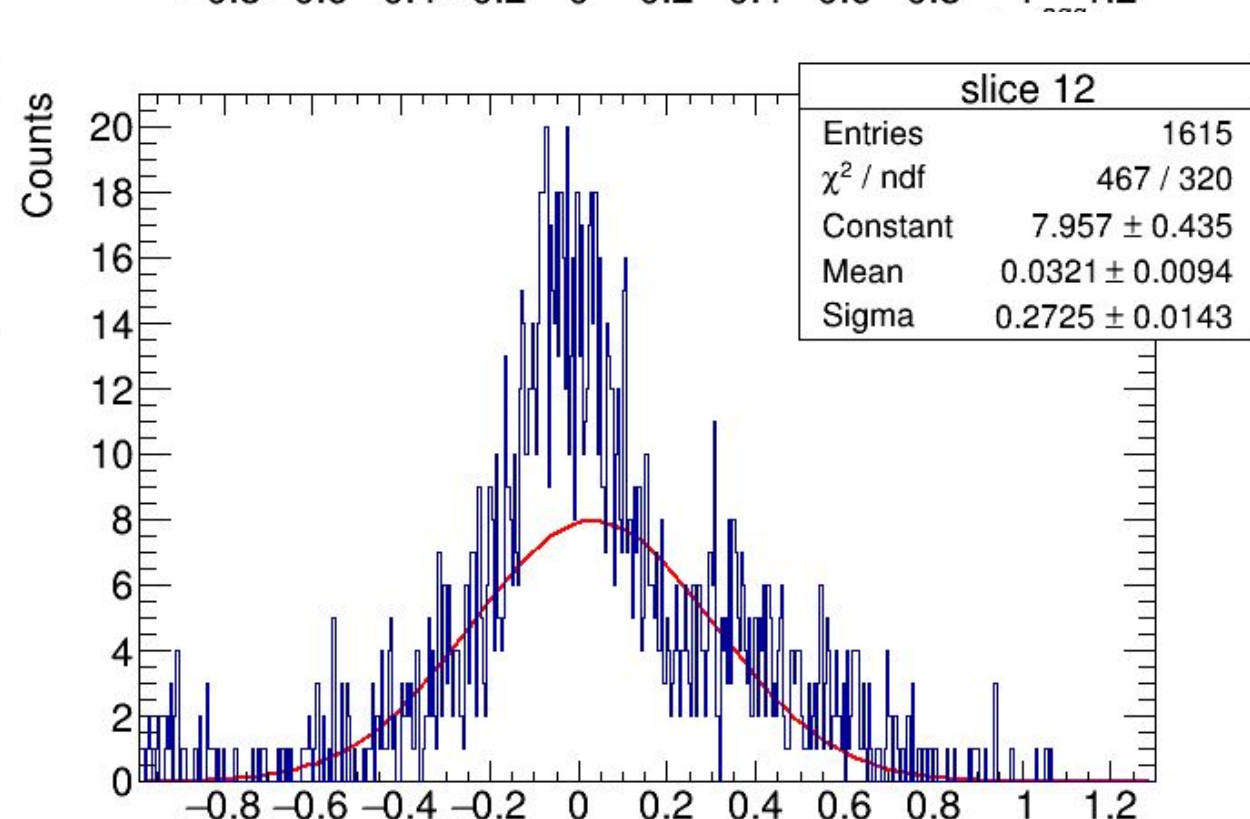
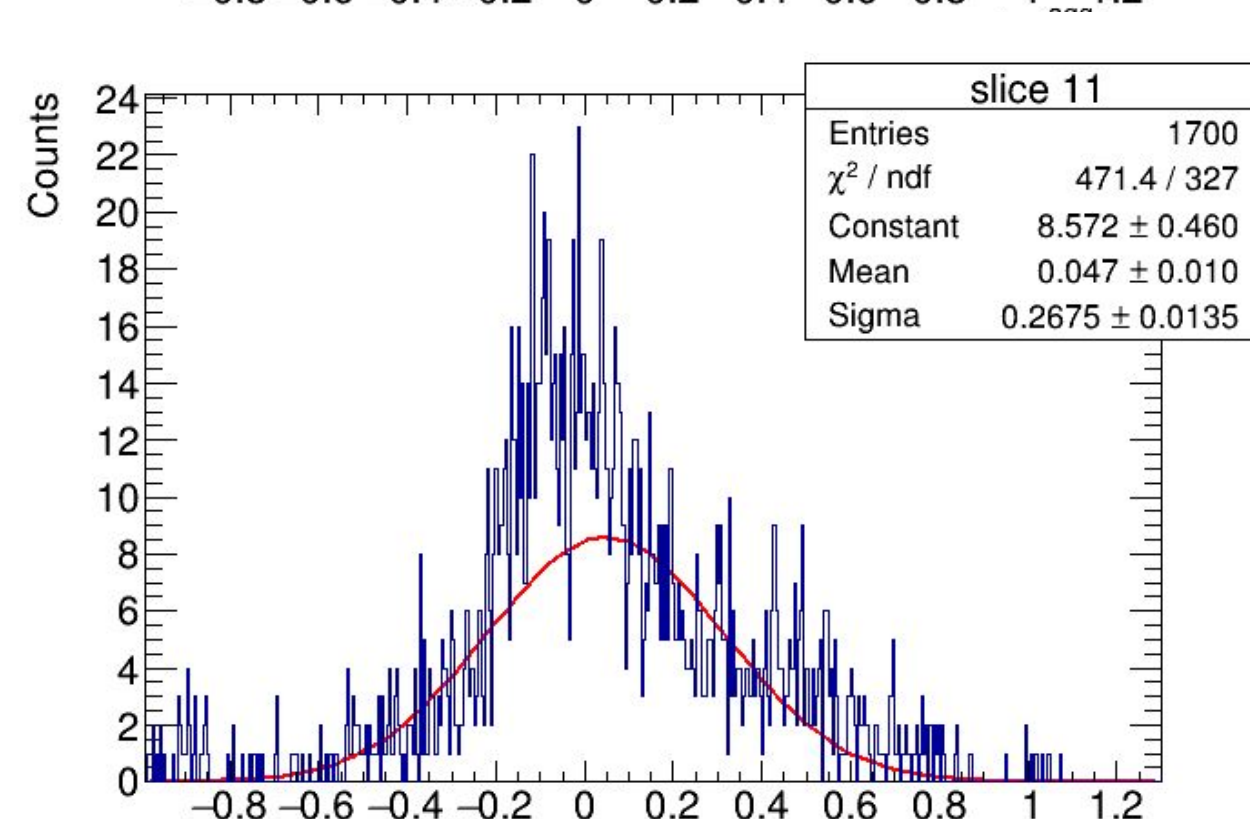
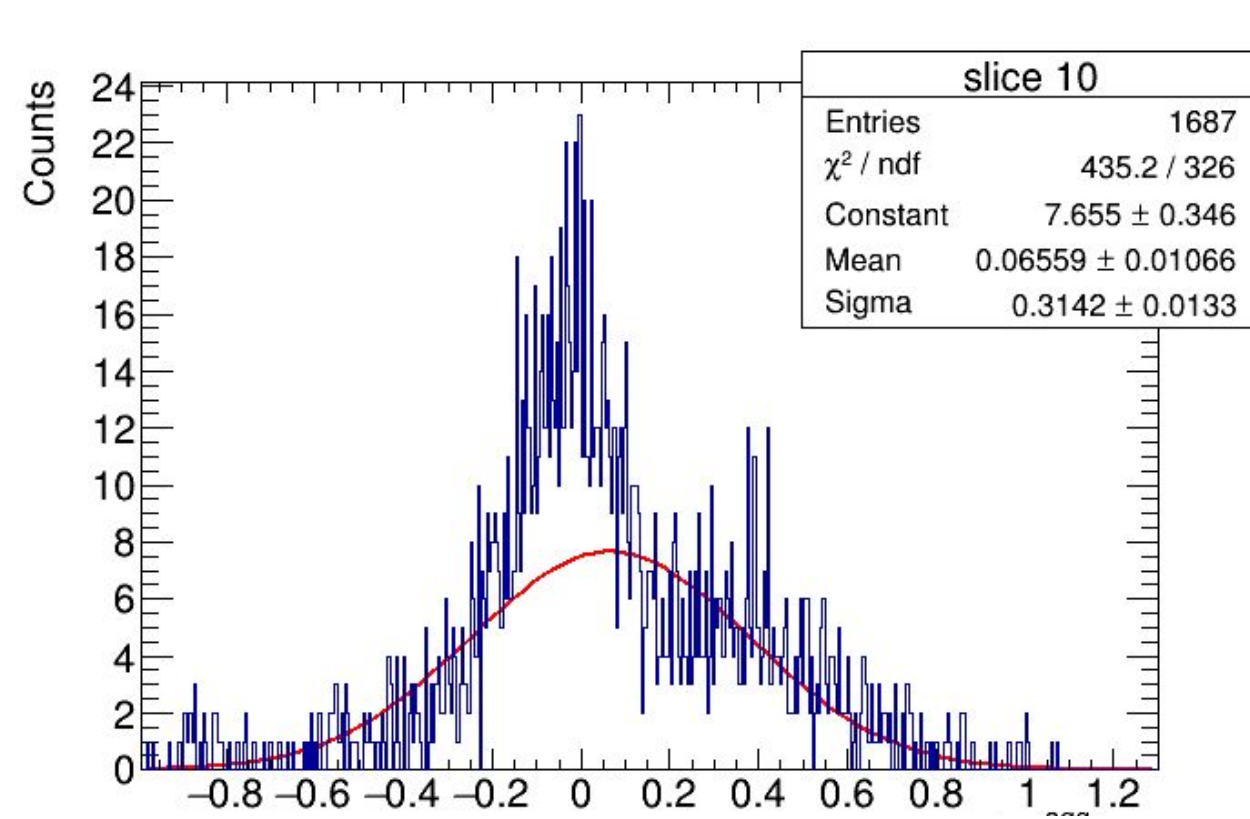
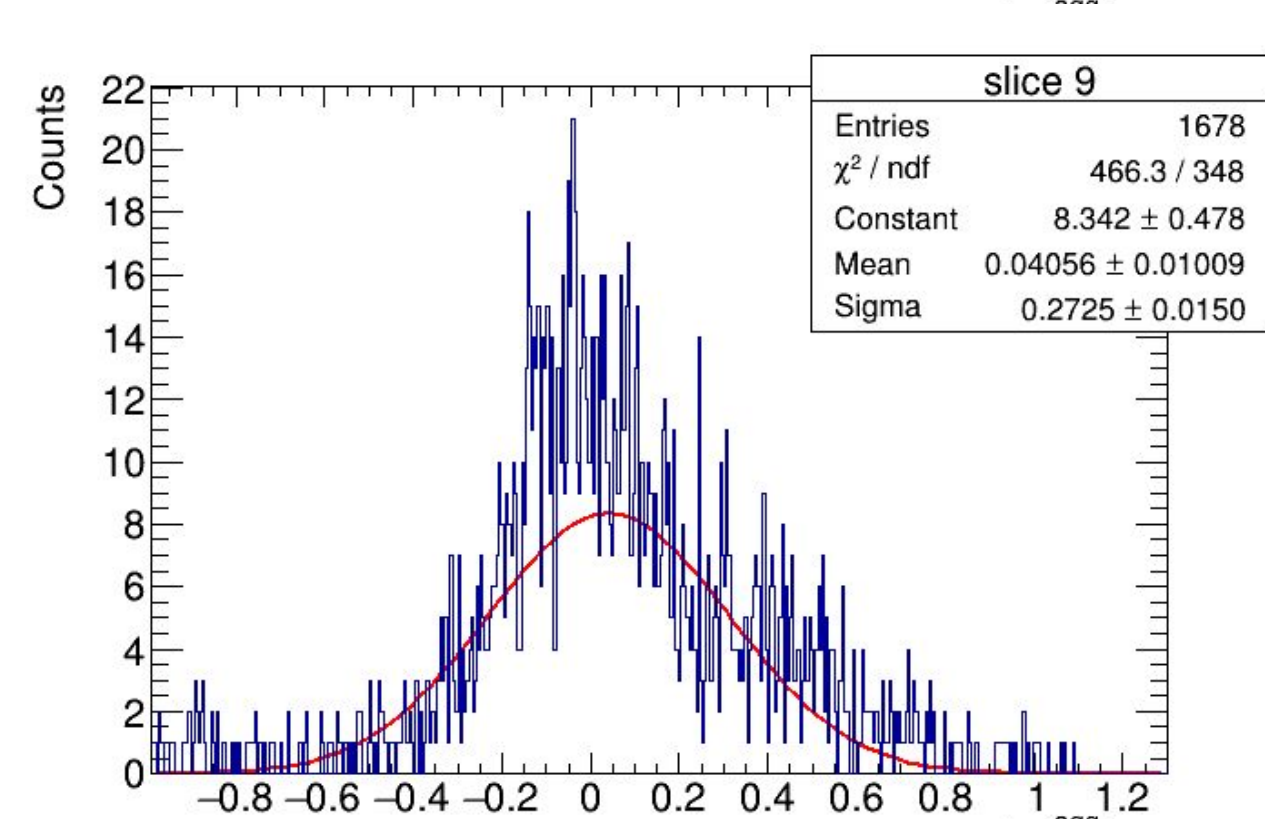
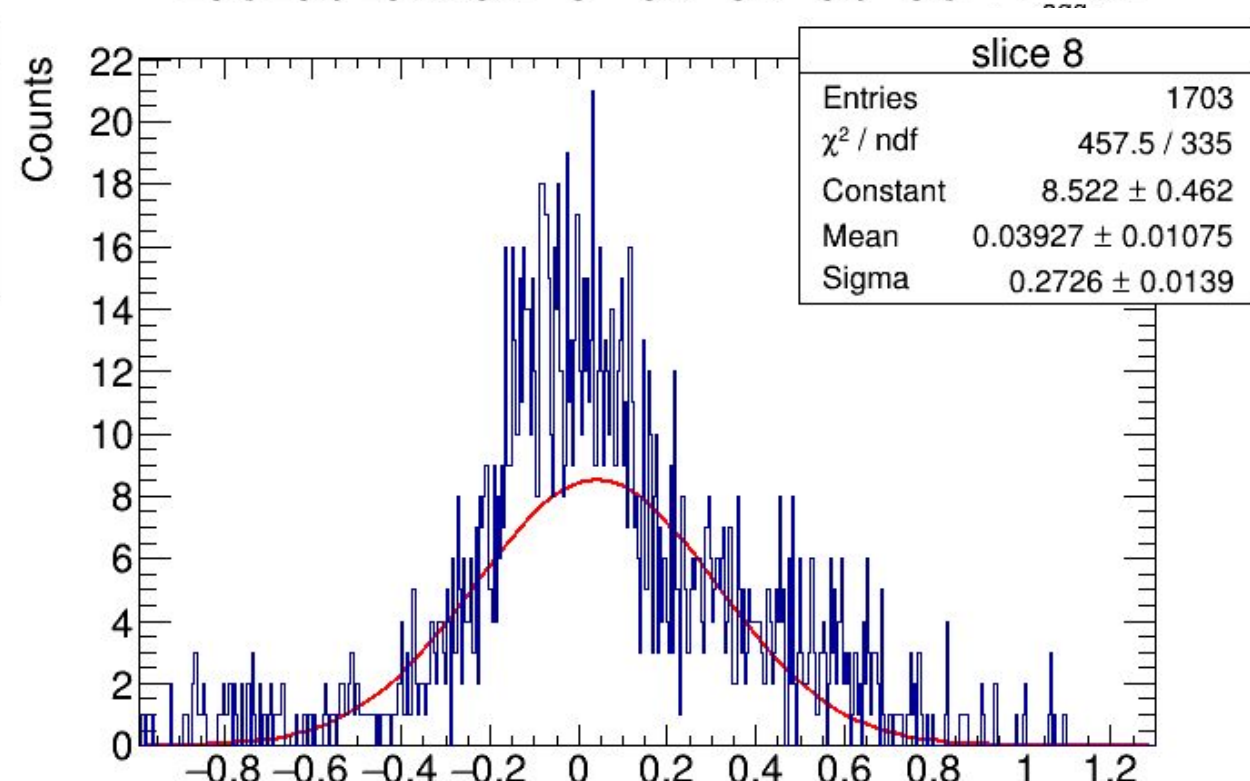
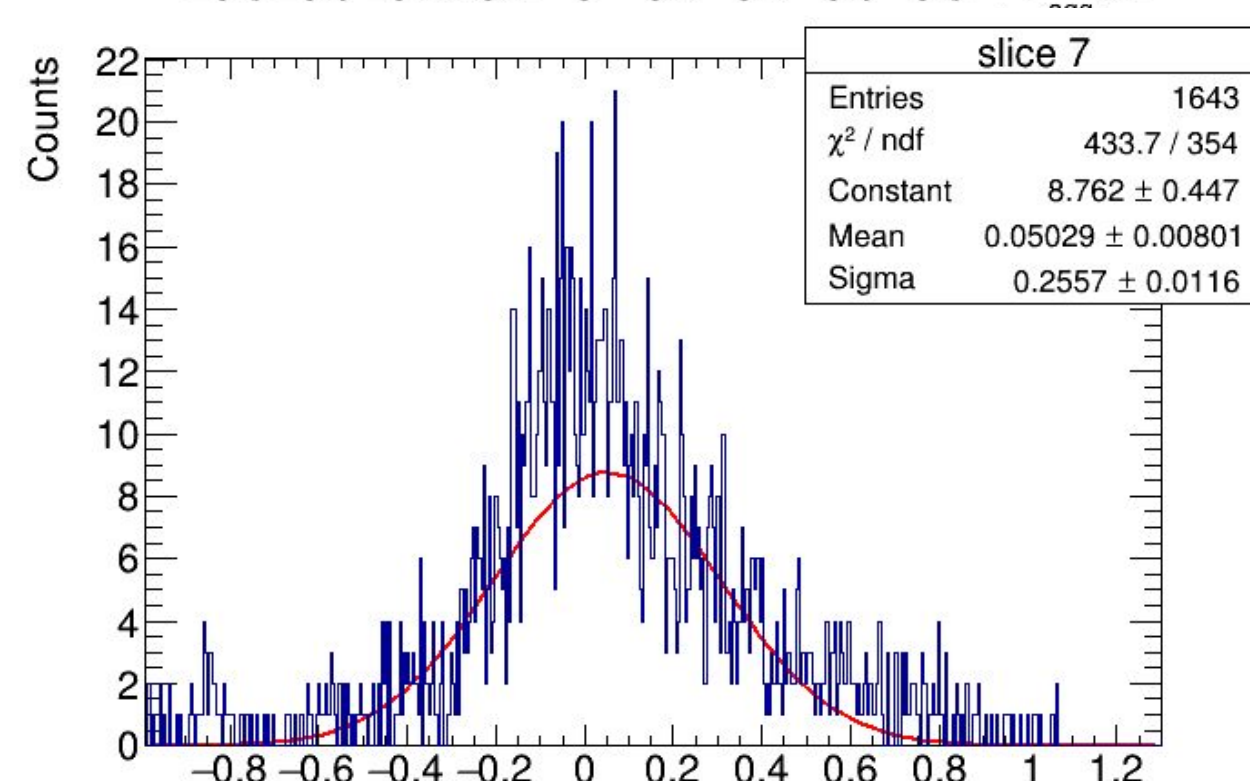
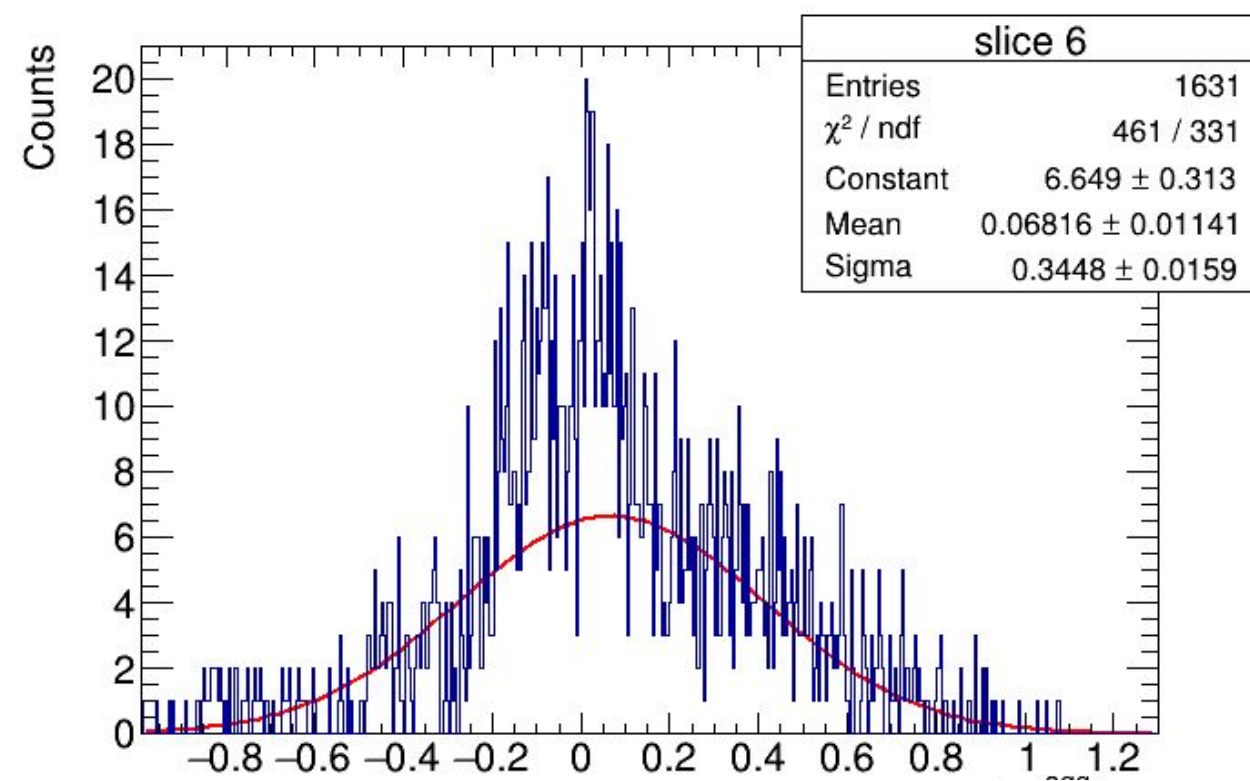
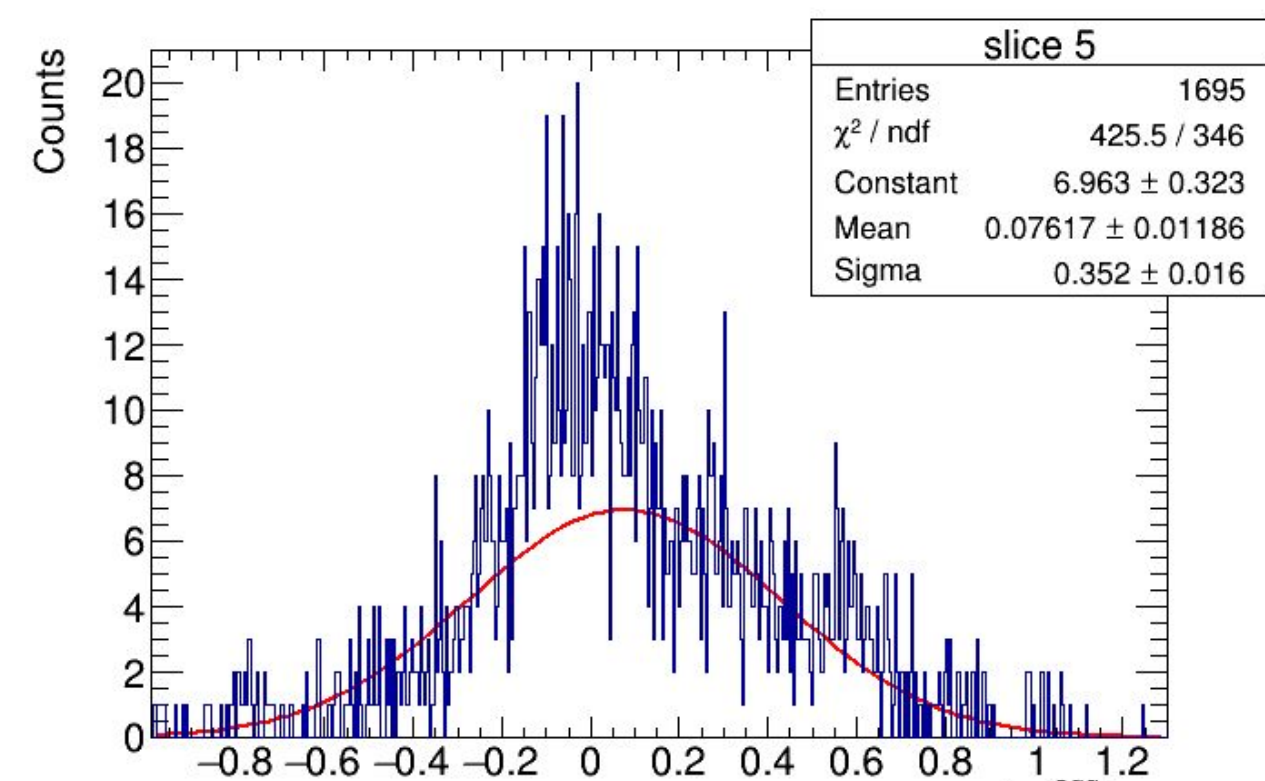
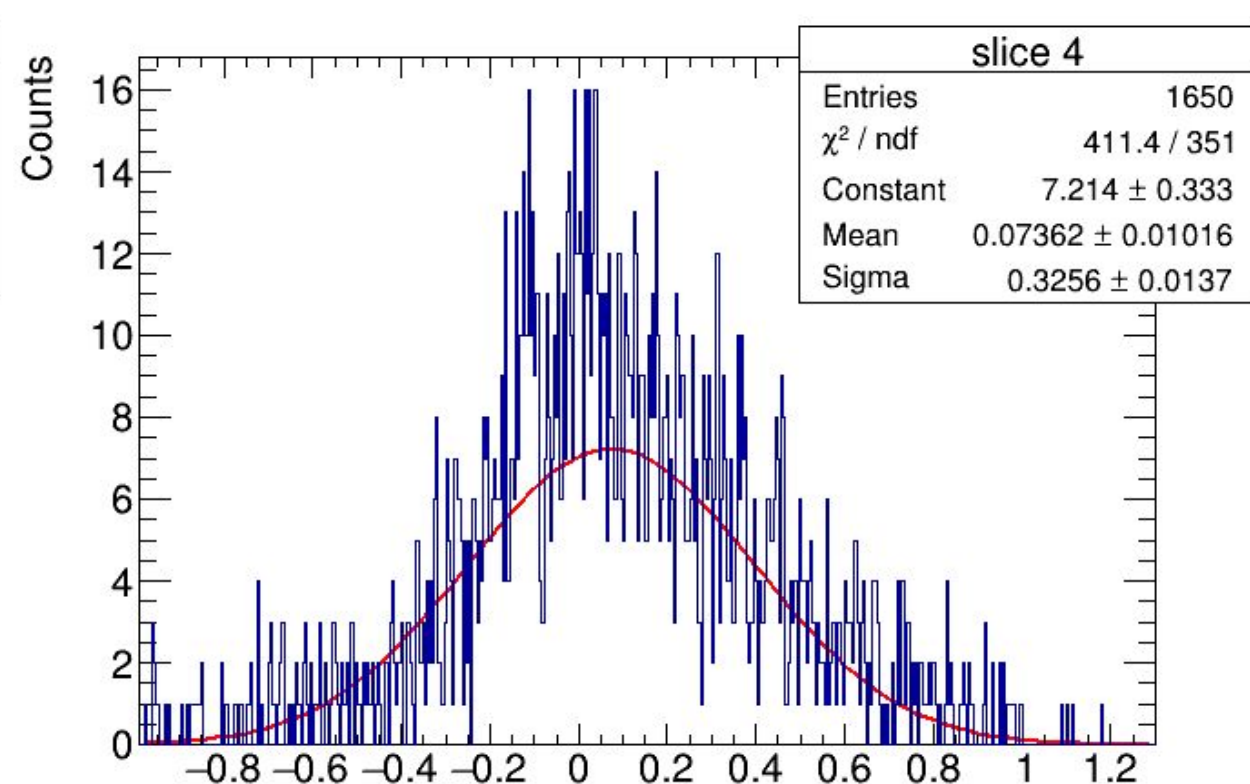
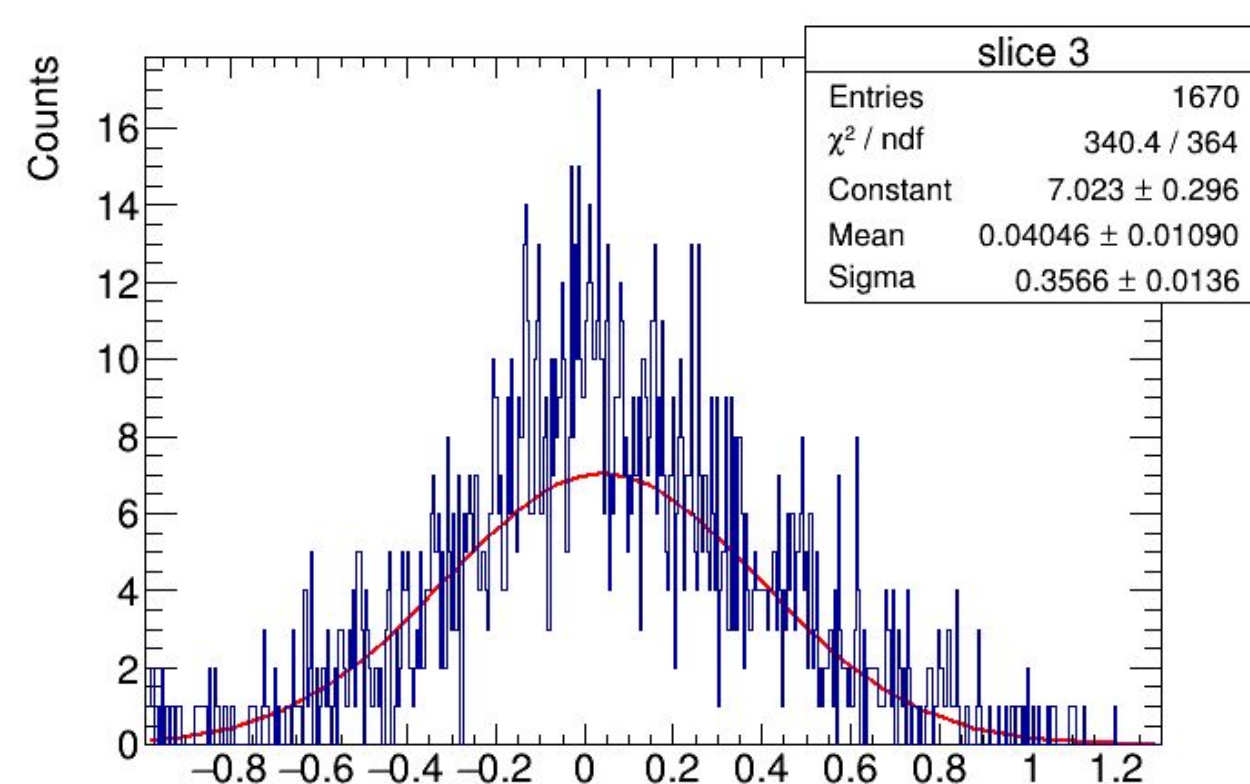
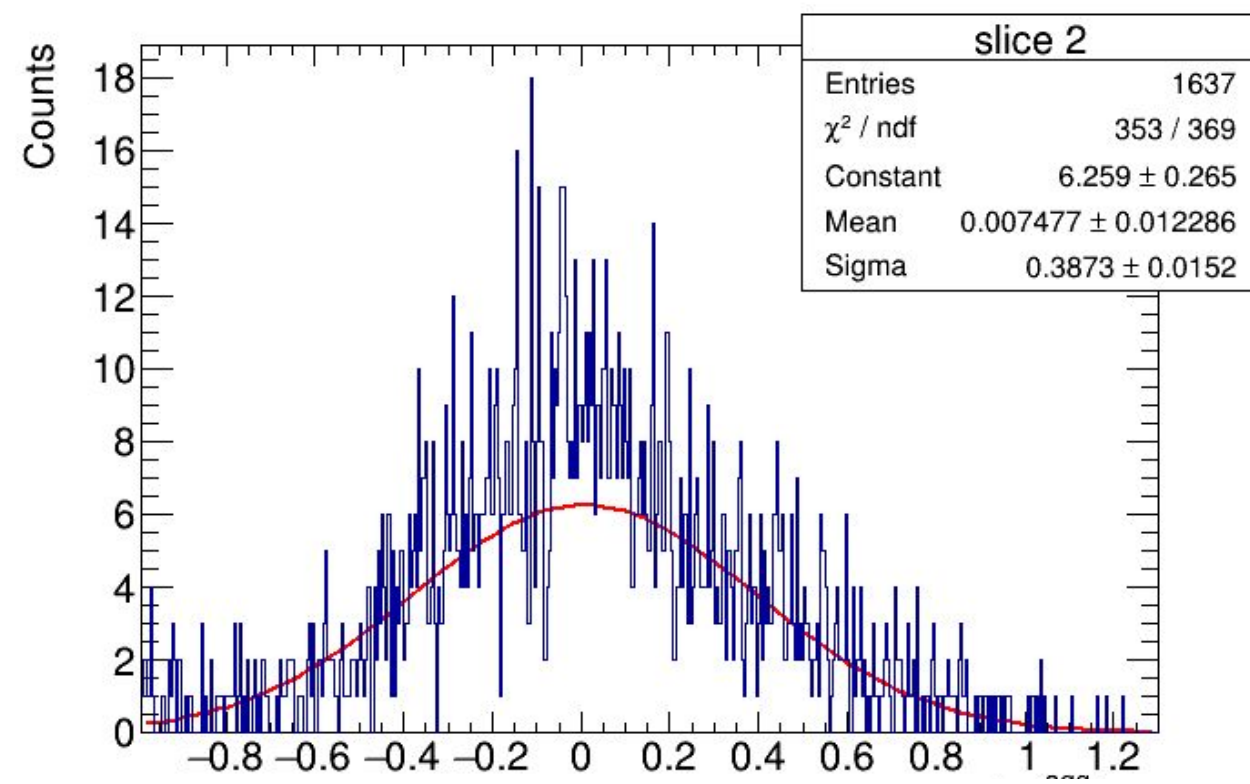
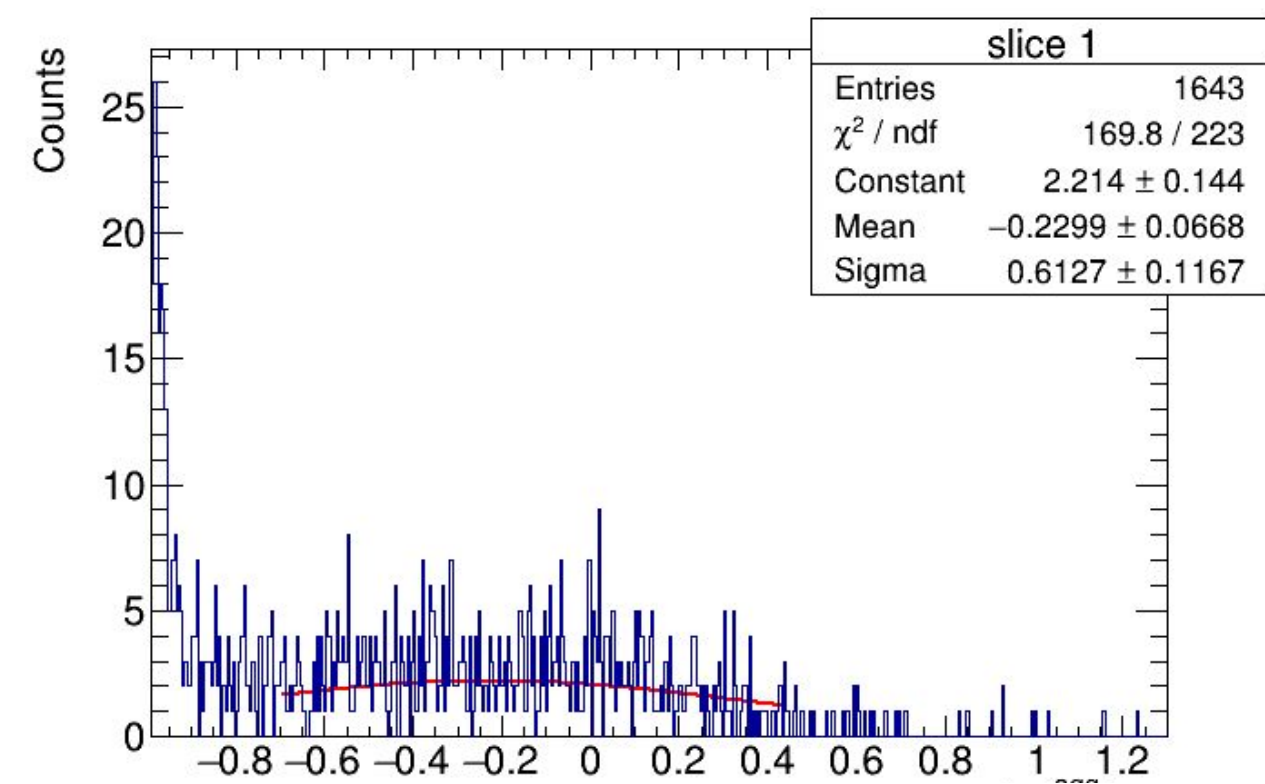
Mean of the Gaussians fitted to the slices of the recalibrated $(te_{agg} - ge) / ge$ vs ge plot.



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

FEMC + FHCAL (π^-)

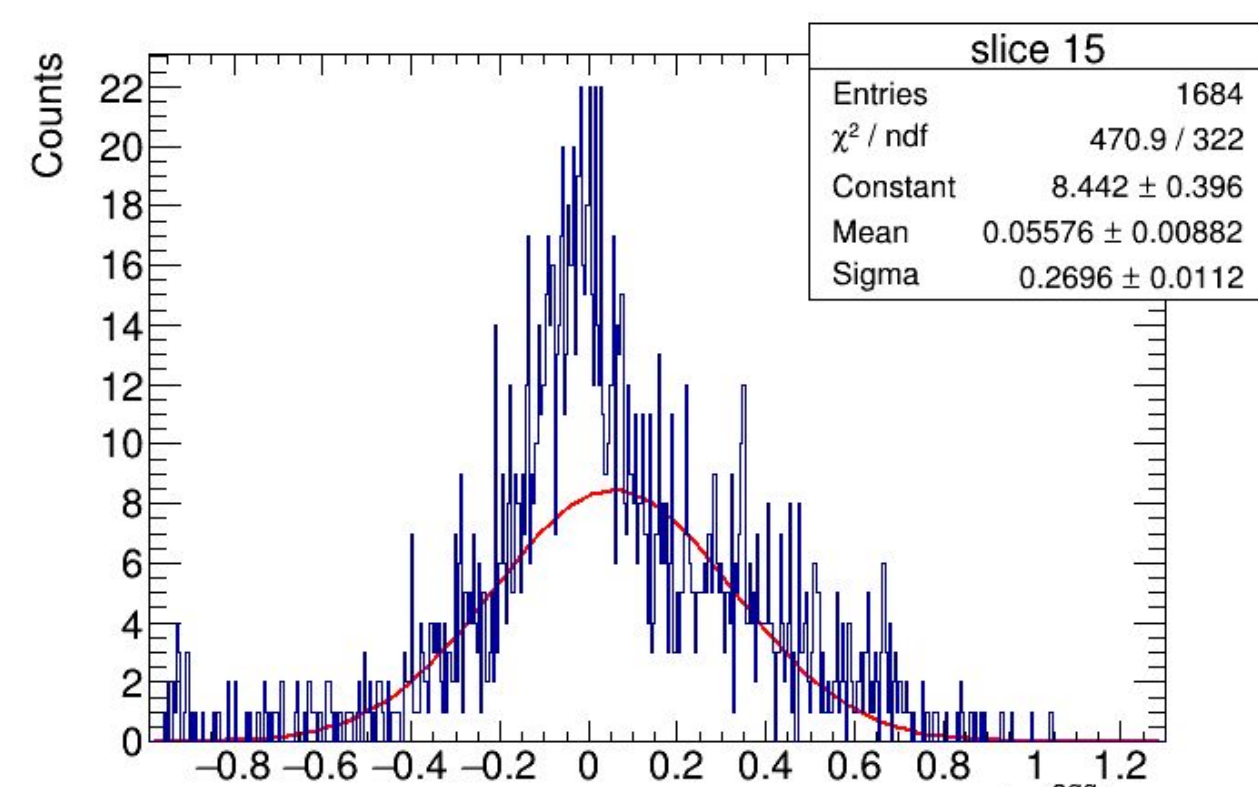
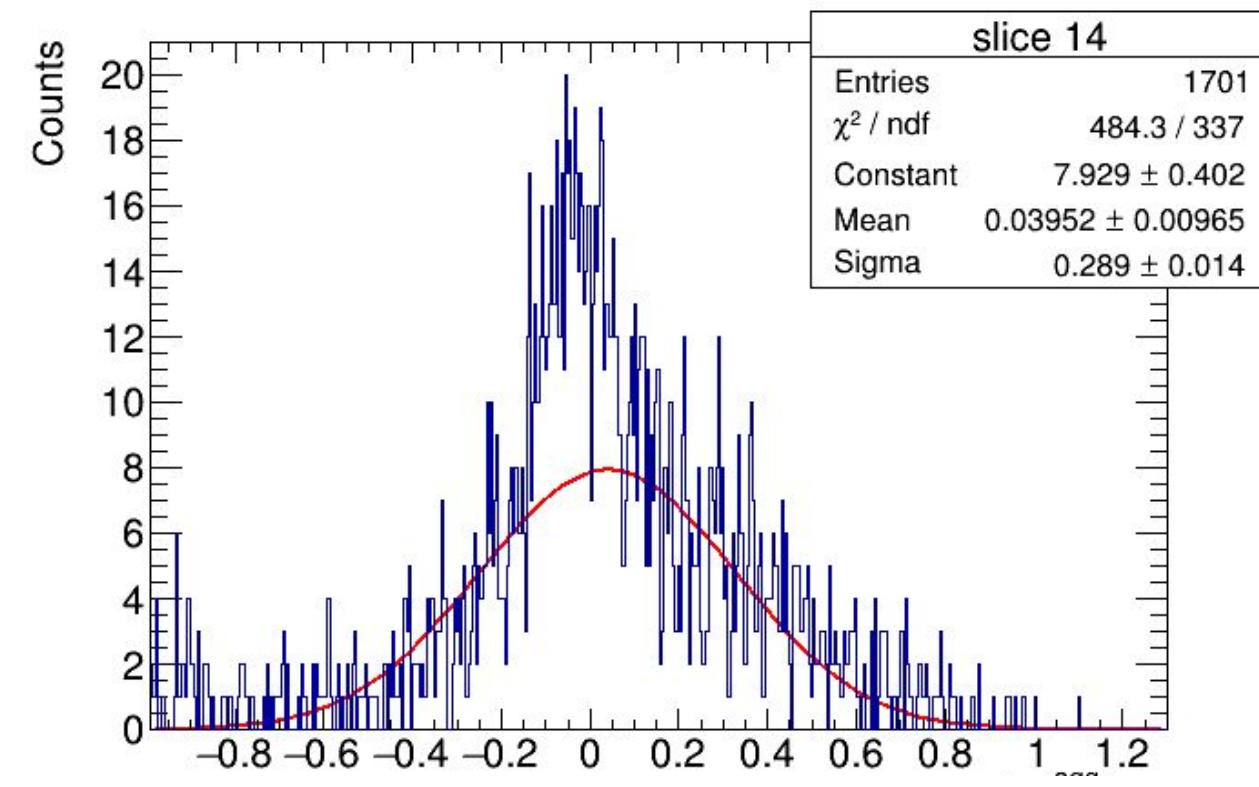
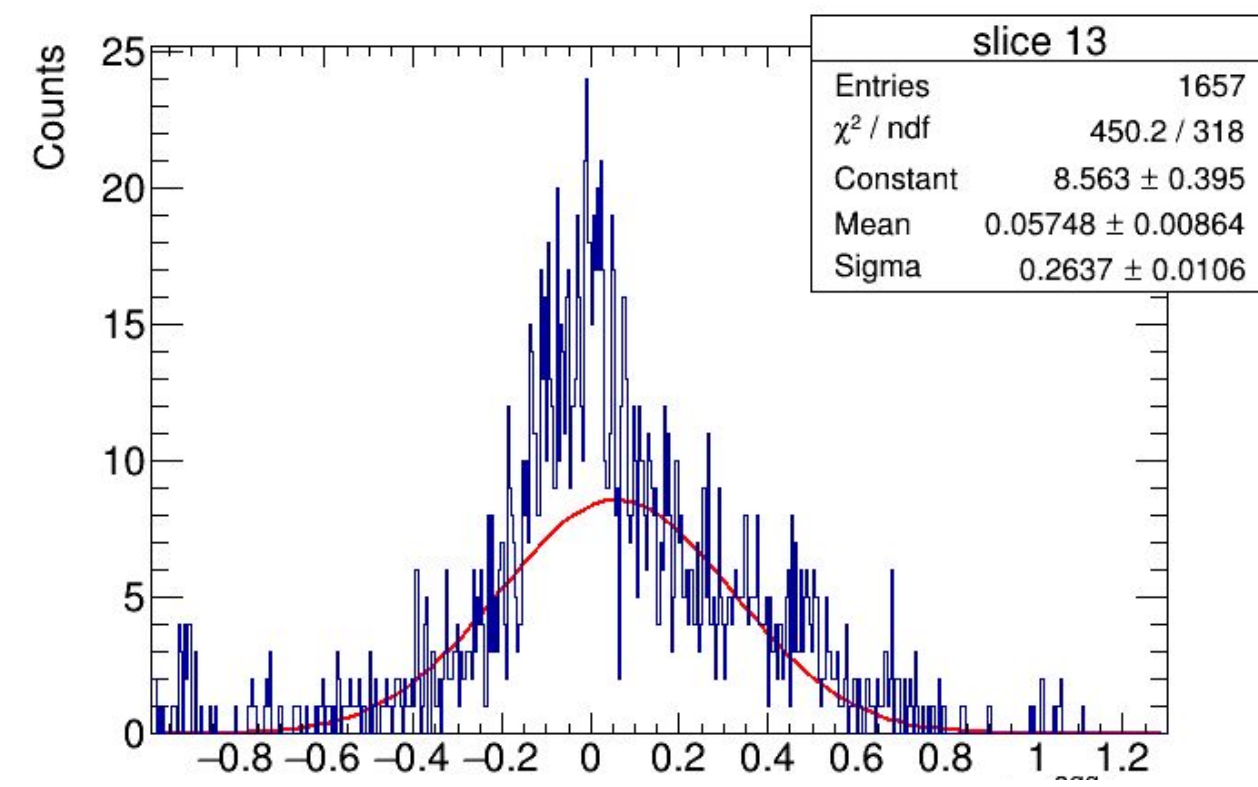
Fitted Gaussians



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

FEMC + FHCAL (π^-)

Fitted Gaussians



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

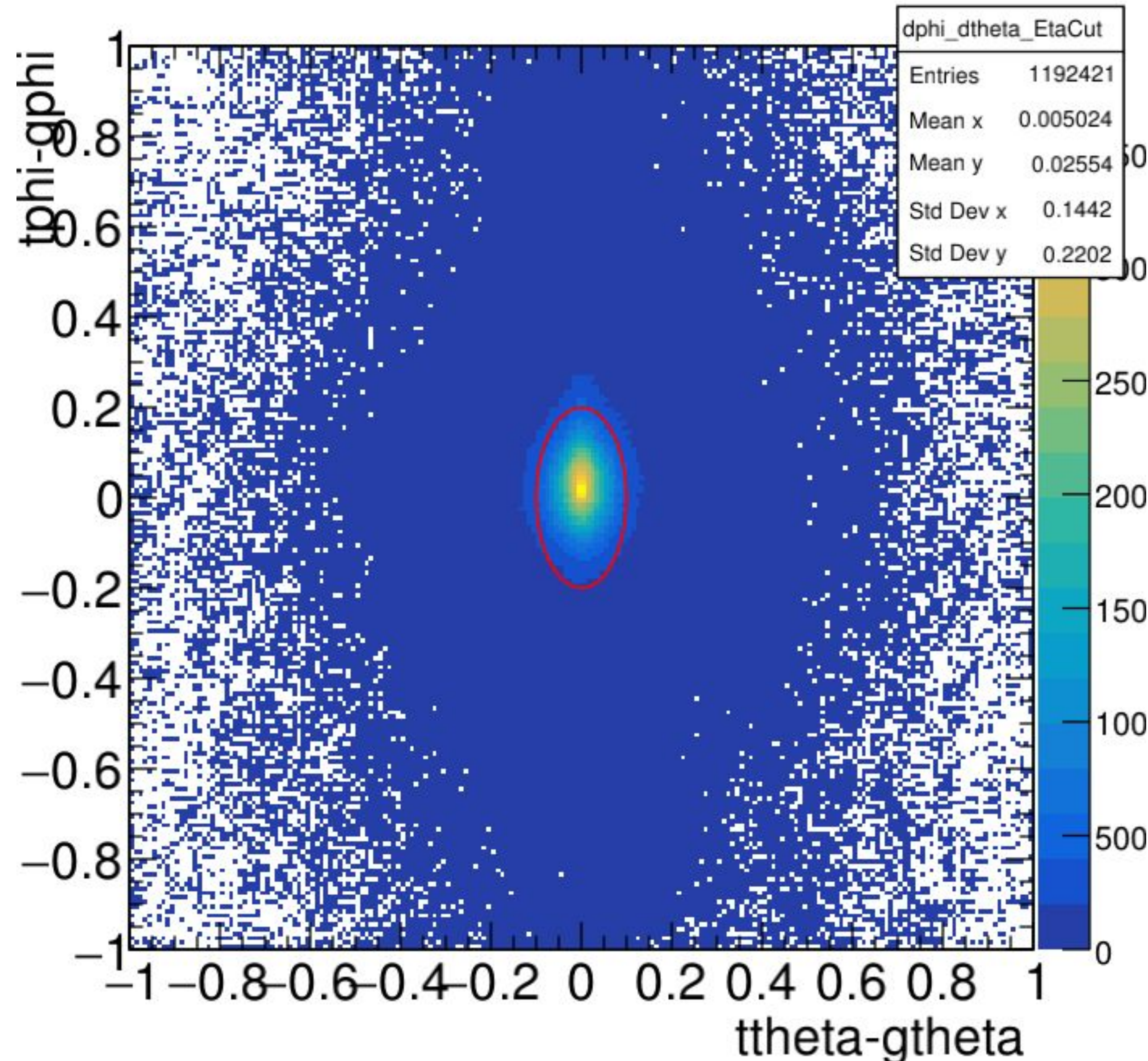


CEMC + HCALIN + HCALOUT (pi⁻)

CEMC (π^-)

Elliptical cut on dphi vs dtheta, Explicit η cut: -1.1 to 1.1

Magnetic Field Turned OFF



Elliptical Cut: Only the towers within the elliptical region (centered at origin) are considered for further analysis.

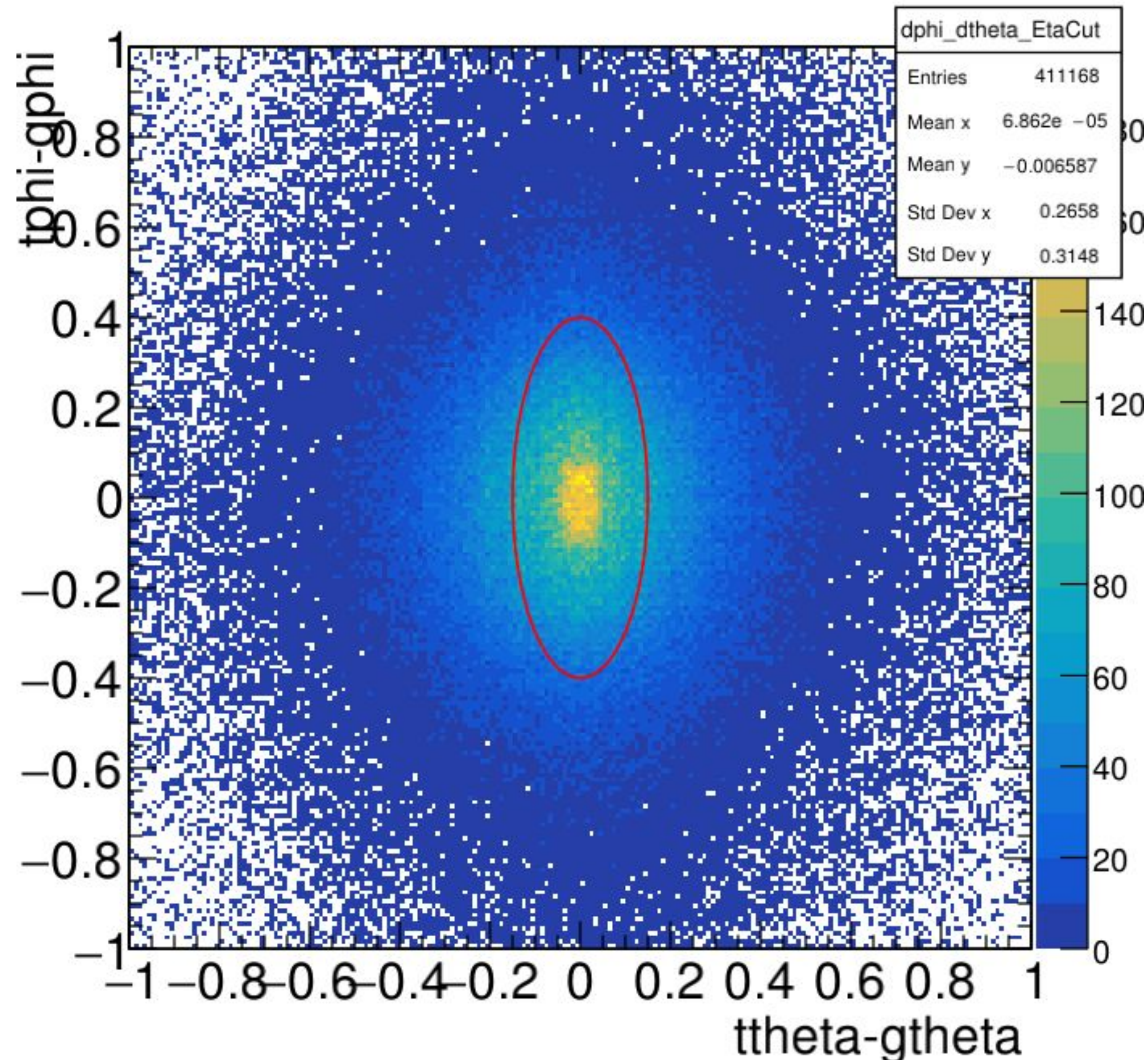
Dimensions:

semi-minor axis = 0.10 units
semi-major axis = 0.20 units

HCALIN (π^-)

Elliptical cut on dphi vs dtheta, Explicit η cut: -1.1 to 1.1

Magnetic Field Turned OFF



Elliptical Cut: Only the towers within the elliptical region (centered at origin) are considered for further analysis.

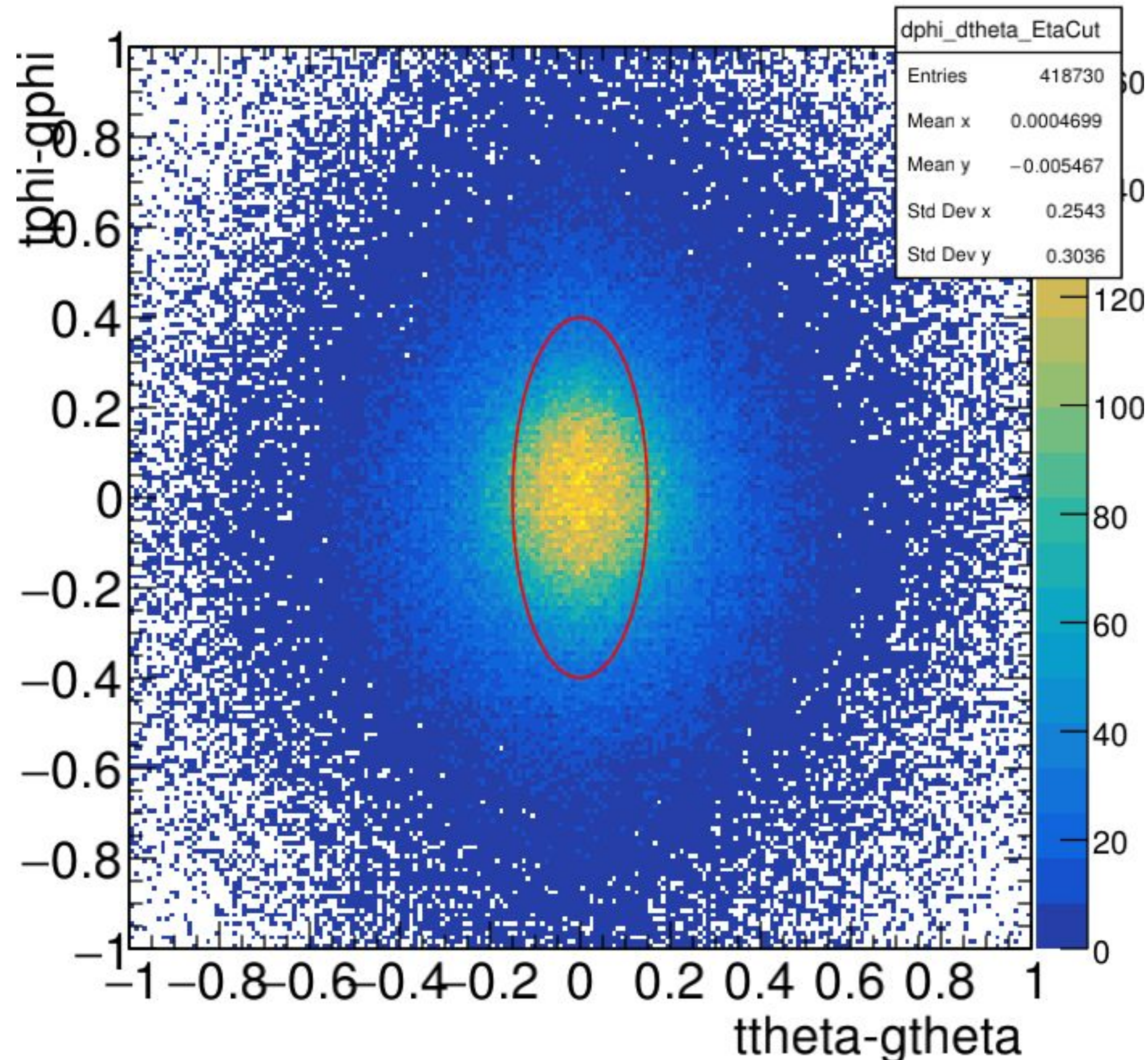
Dimensions:

semi-minor axis = 0.15 units
semi-major axis = 0.25 units

HCALOUT (π^-)

Elliptical cut on dphi vs dtheta, Explicit η cut: -1.1 to 1.1

Magnetic Field Turned OFF



Elliptical Cut: Only the towers within the elliptical region (centered at origin) are considered for further analysis.

Dimensions:

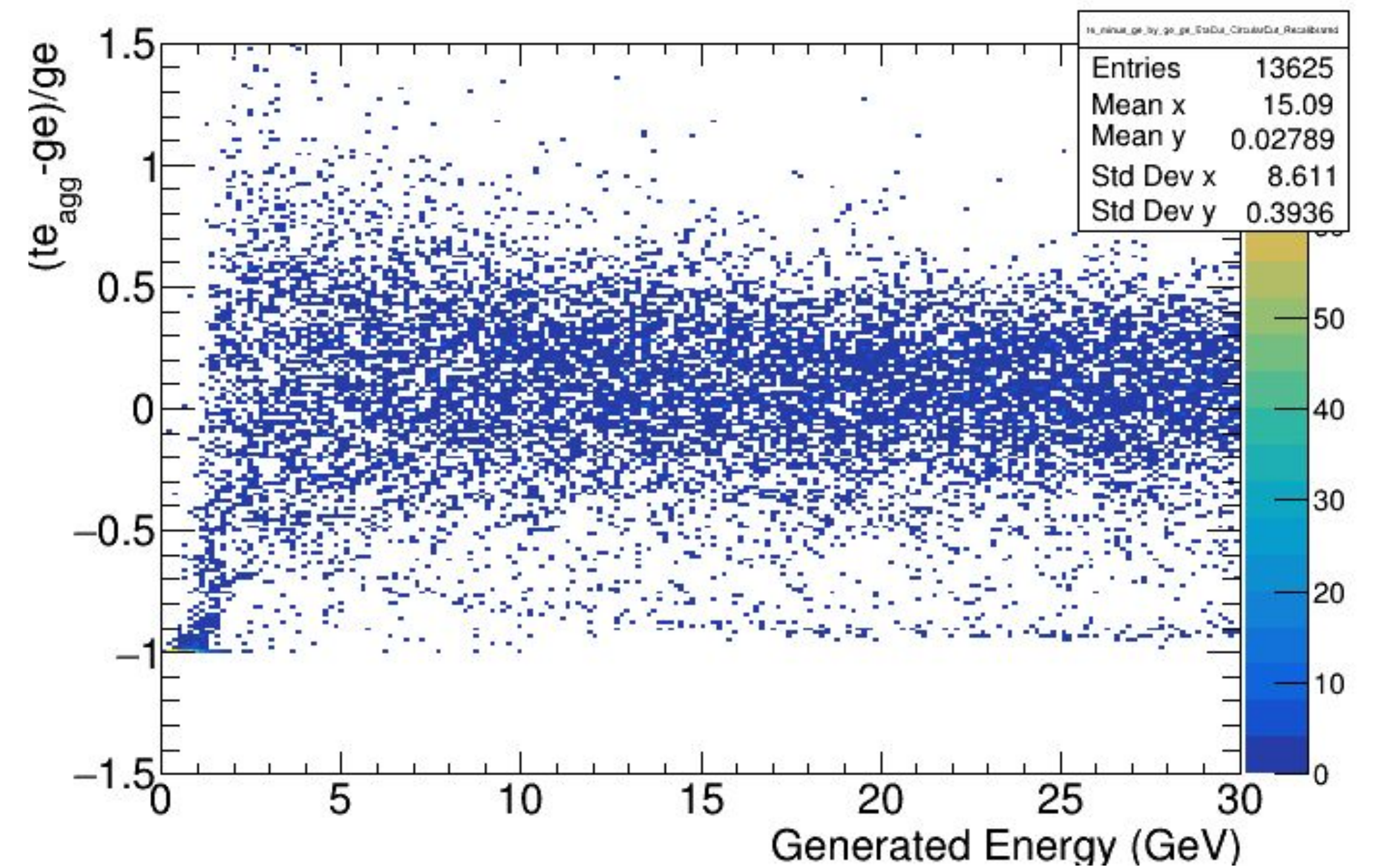
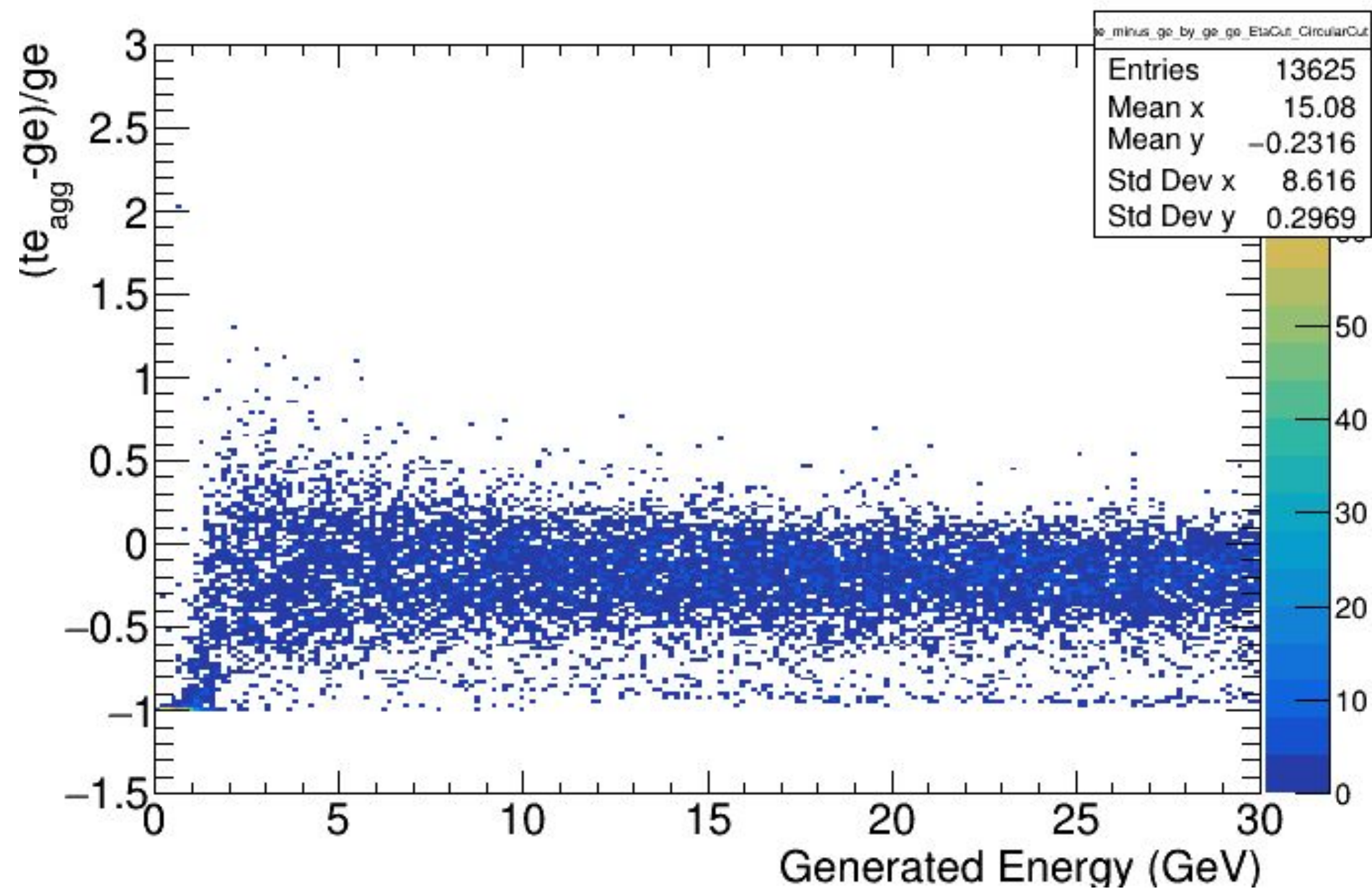
semi-minor axis = 0.20 units
semi-major axis = 0.30 units

CEMC + HCALIN + HCALOUT (π^-)

$(te_{agg} - ge)/ge$ vs ge
Explicit η cut: -1.1 to 1.1
no energy cut

Magnetic Field Turned OFF

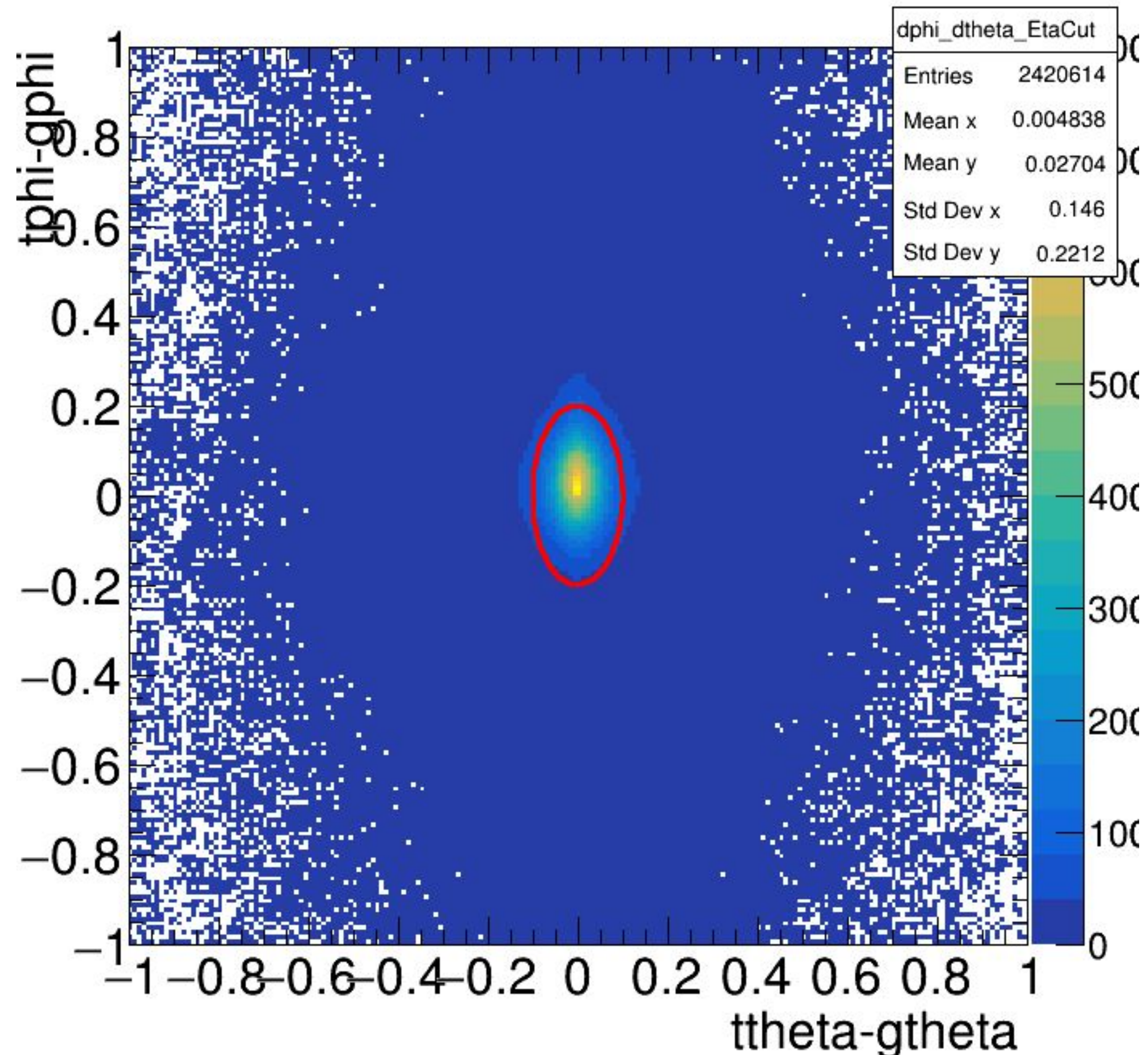
After Recalibration ($te \rightarrow te/recalibrationFactor$)



Recalibration factor: 0.7461

CEMC (π^-)

Elliptical cut on $d\phi$ vs $d\theta$, Explicit η cut: -1.1 to 1.1



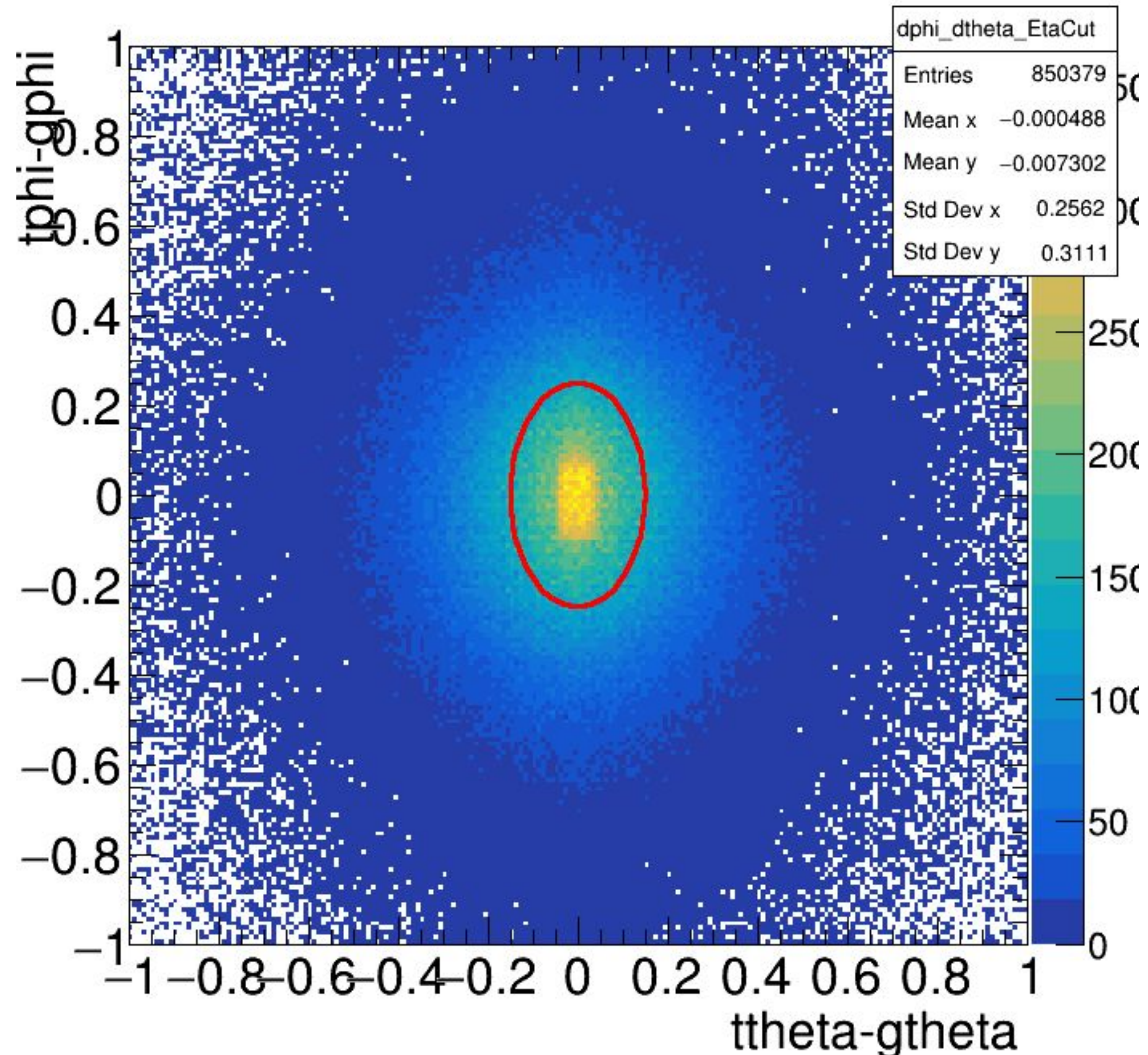
Elliptical Cut: Only the towers within the elliptical region (centered at origin) are considered for further analysis.

Dimensions:

semi-minor axis = 0.10 units
semi-major axis = 0.20 units

HCALIN (π^-)

Elliptical cut on dphi vs dtheta, Explicit η cut: -1.1 to 1.1



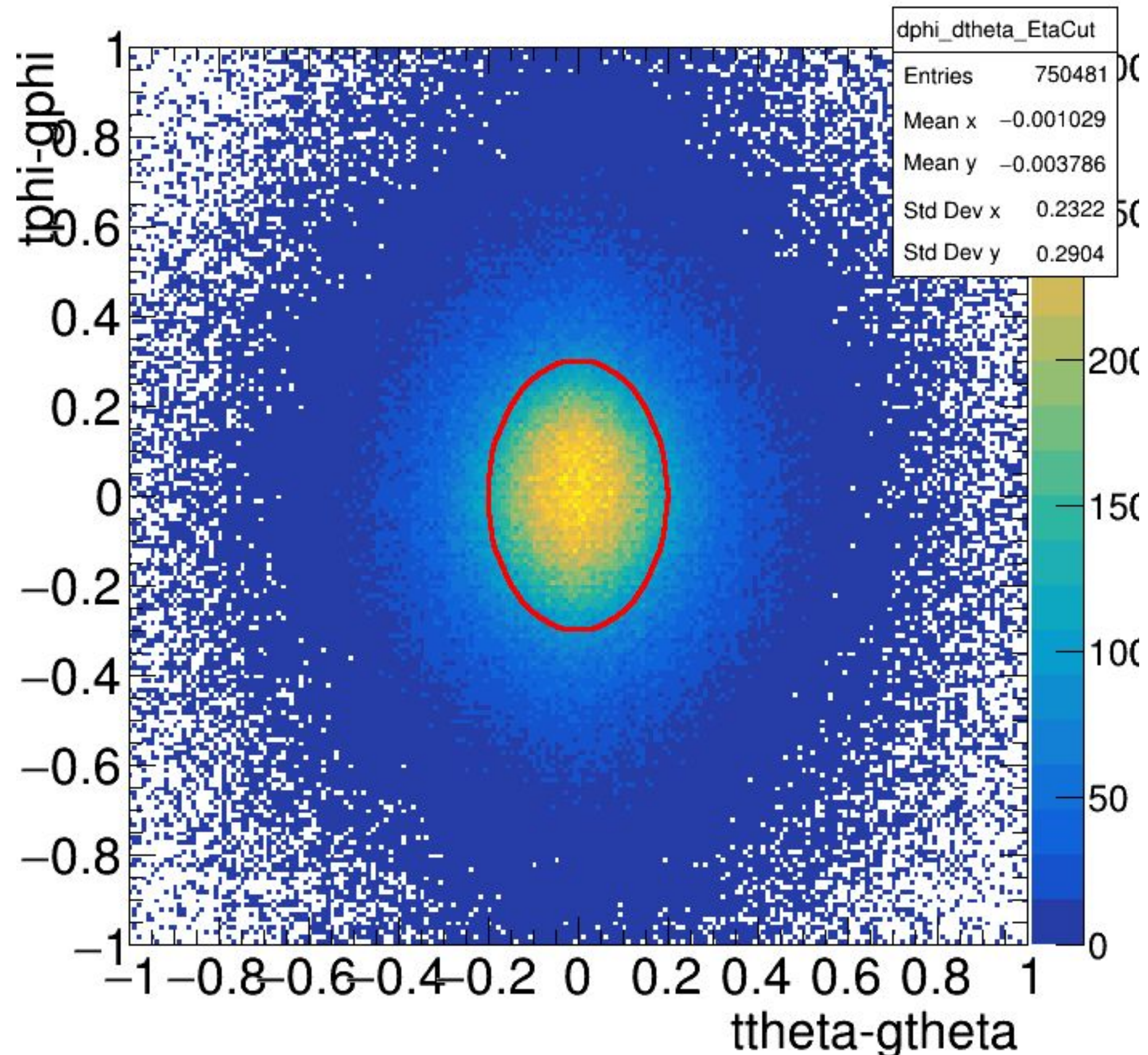
Elliptical Cut: Only the towers within the elliptical region (centered at origin) are considered for further analysis.

Dimensions:

semi-minor axis = 0.15 units
semi-major axis = 0.25 units

HCALOUT (π^-)

Elliptical cut on dphi vs dtheta, Explicit η cut: -1.1 to 1.1



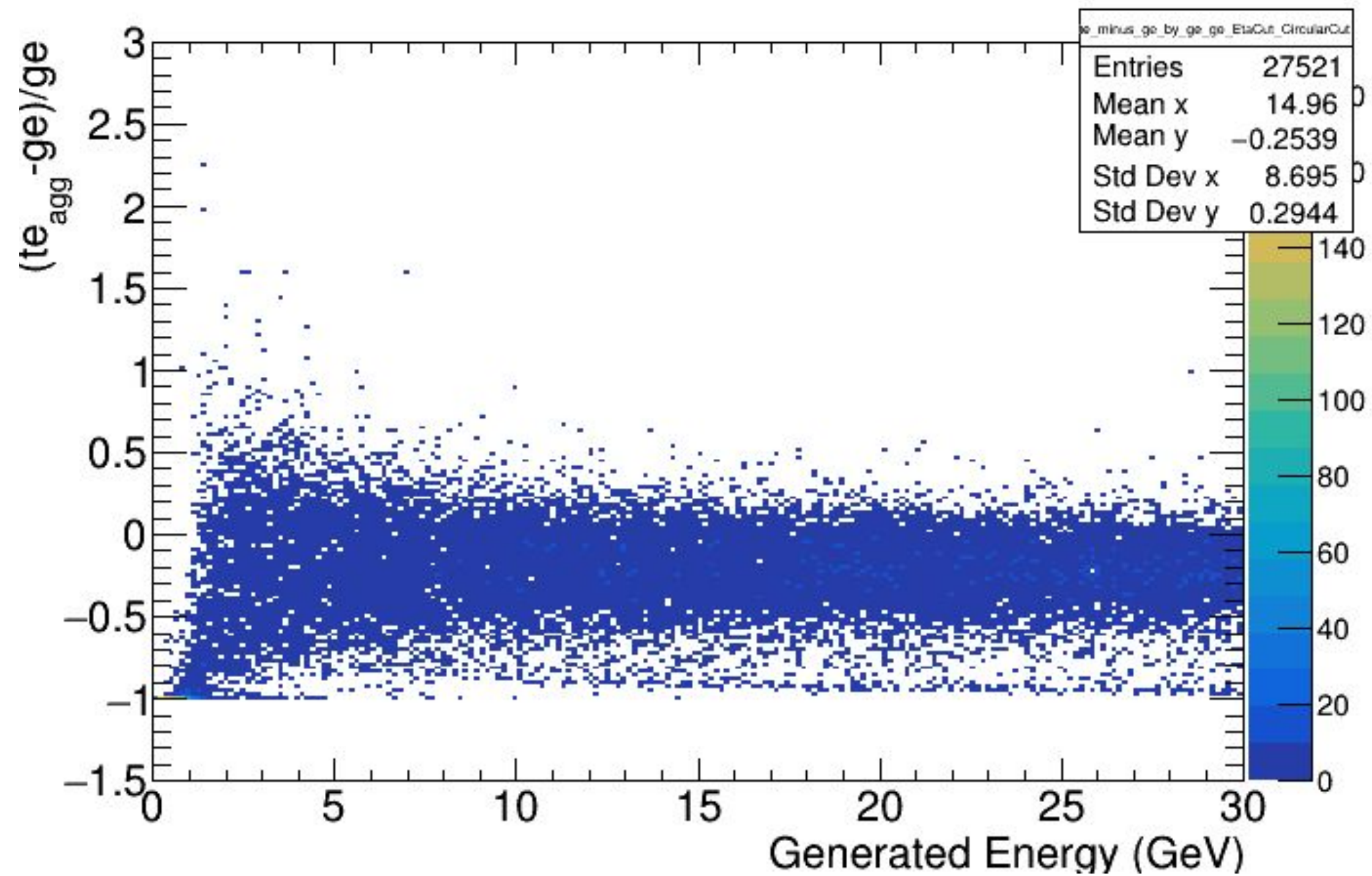
Elliptical Cut: Only the towers within the elliptical region (centered at origin) are considered for further analysis.

Dimensions:

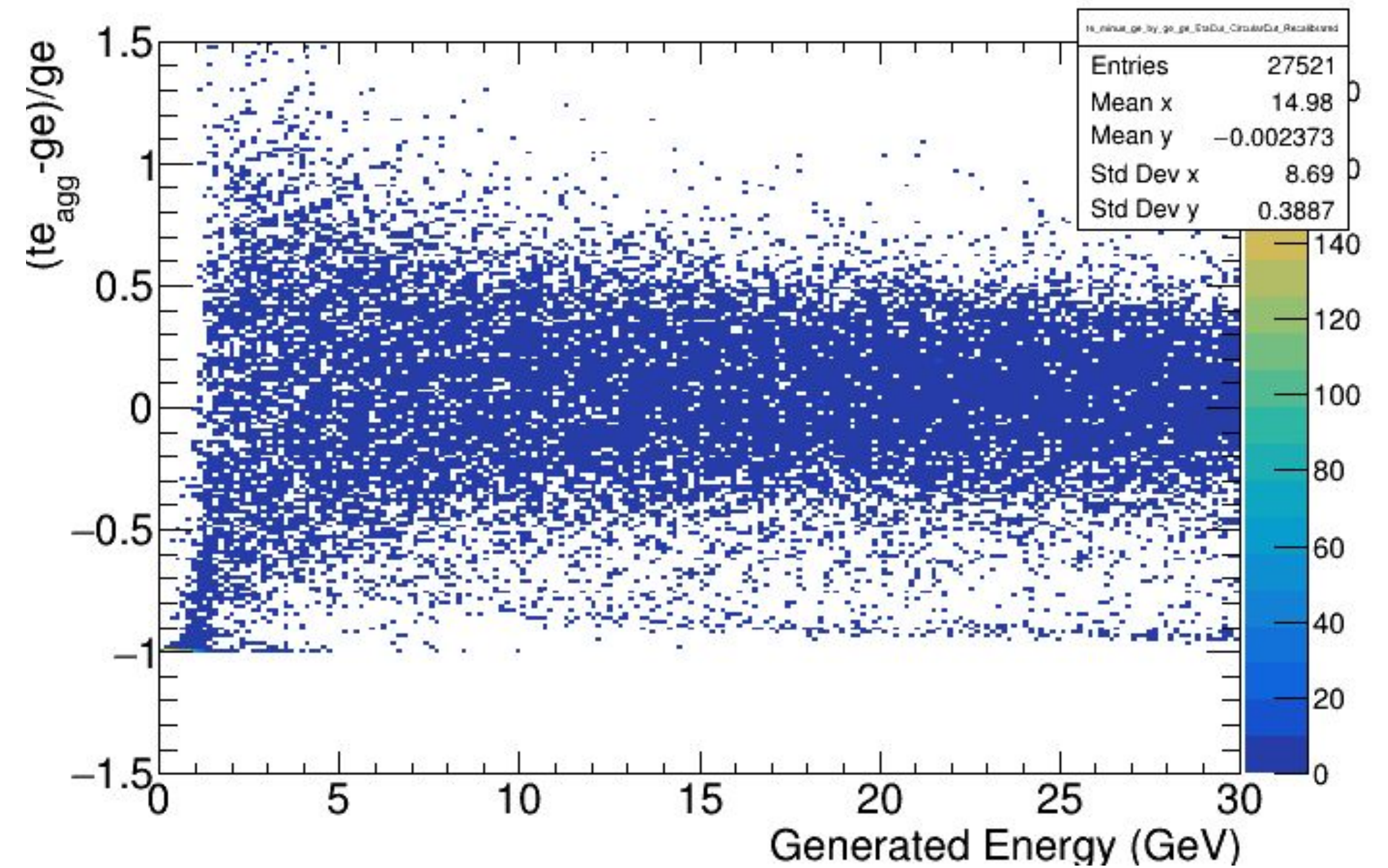
semi-minor axis = 0.20 units
semi-major axis = 0.30 units

CEMC + HCALIN + HCALOUT (π^-)

$(te_{agg} - ge)/ge$ vs ge
Explicit η cut: -1.1 to 1.1
no energy cut



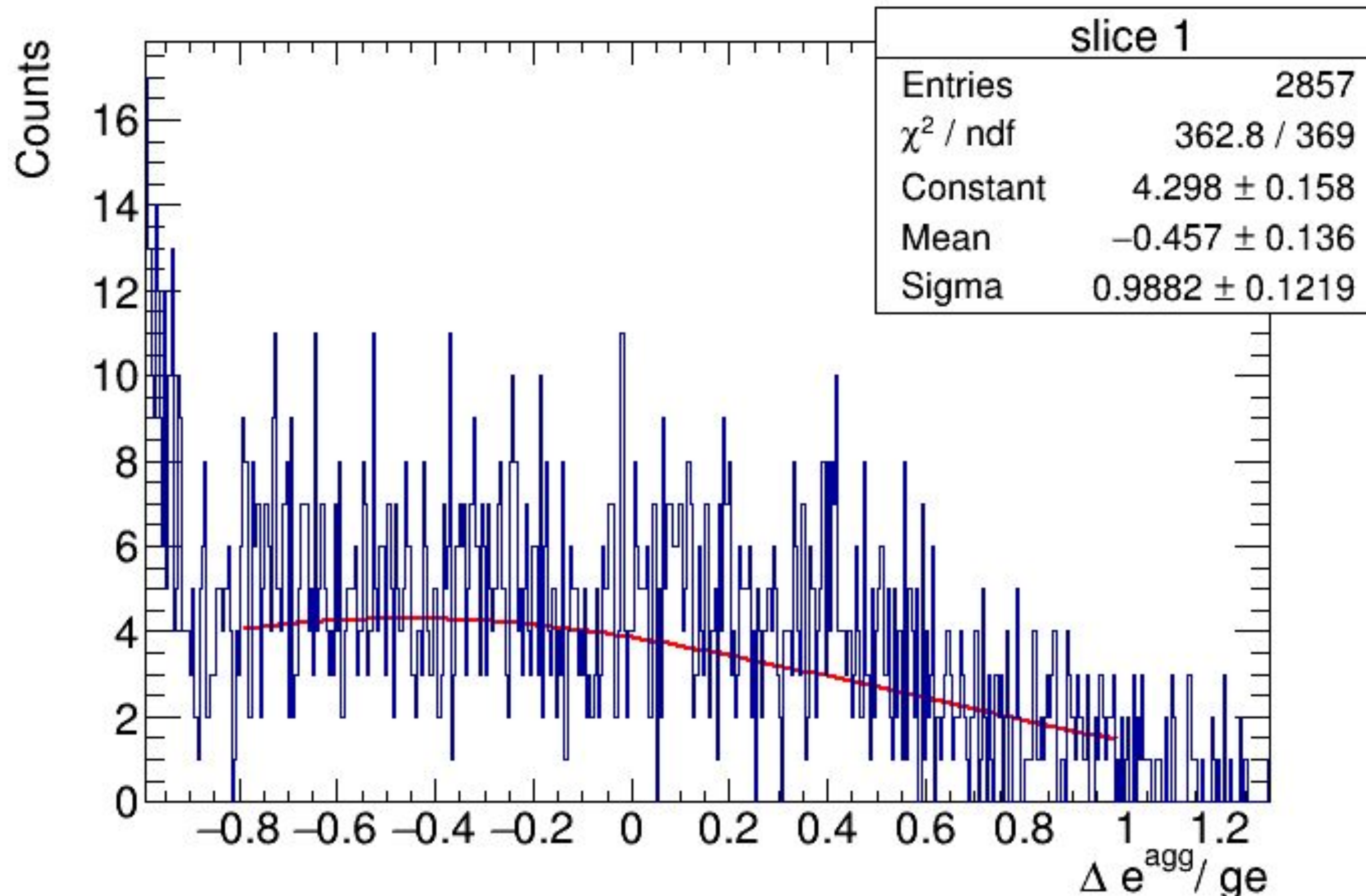
After Recalibration ($te \rightarrow te/recalibrationFactor$)



Recalibration factor: 0.7461

CEMC + HCALIN + HCALOUT (π^-)

$(te_{agg} - ge)/ge$ vs ge
Gaussian fit of the first slice (0-3 GeV)



This is the gaussian fit of the first slice of the recalibrated $(te_{agg} - ge)/ge$ vs ge plot.
(shown on the previous slide)

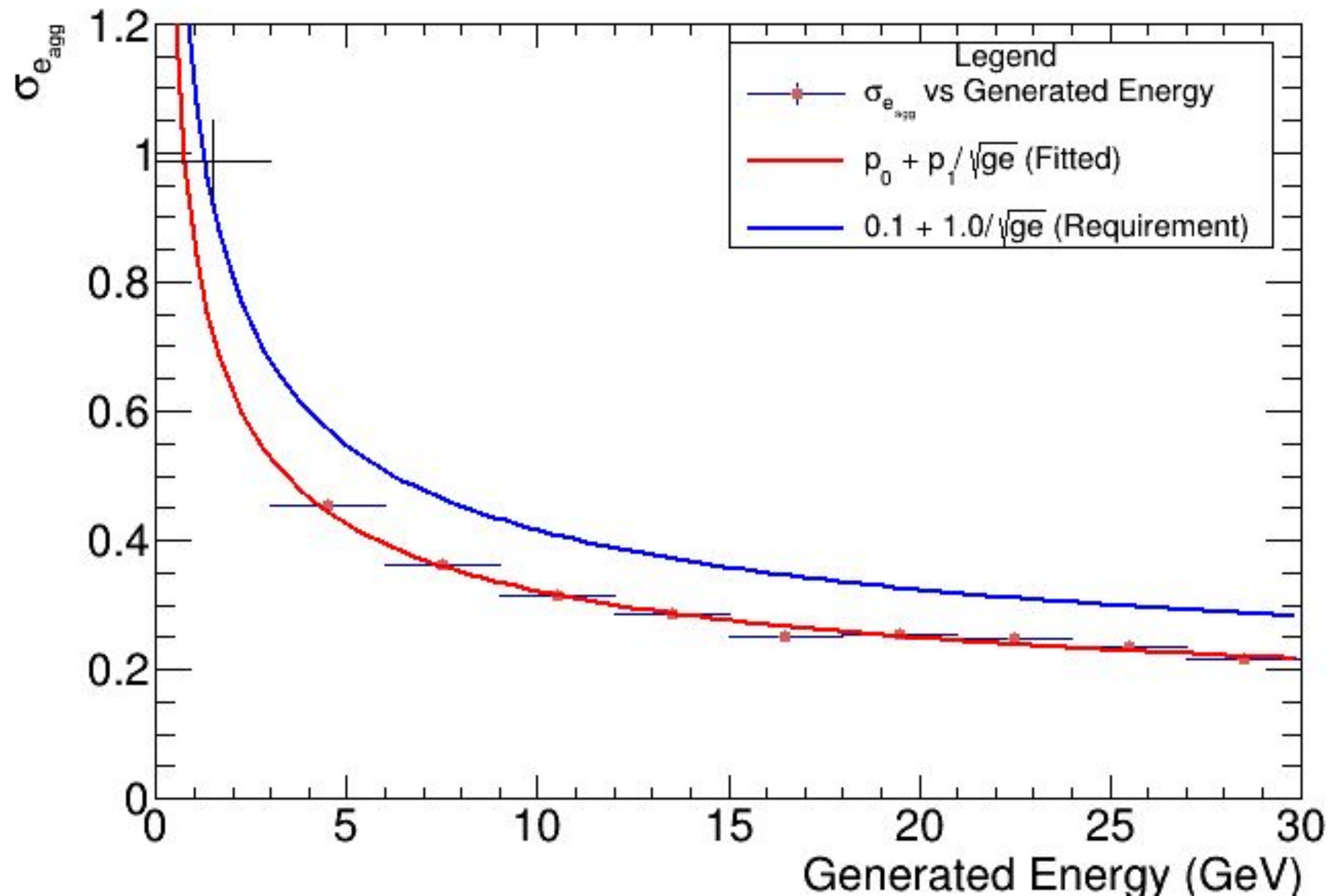
This fit has been done manually by restricting the fit range of the gaussian from -0.80 to 1.00

*All other gaussians have been fit over the entire range.

Number of bins = 500 from -0.99 to +1.30

CEMC + HCALIN + HCALOUT (π^-)

$\sigma_{e_{agg}}$ vs g_e
Explicit η cut: -1.1 to 1.1
Elliptical cuts



σ_e refers to the standard deviation of the Gaussian fitted to a slice of the recalibrated $(t_{e_{agg}} - g_e) / g_e$ vs g_e plot.
(shown on the previous slide)

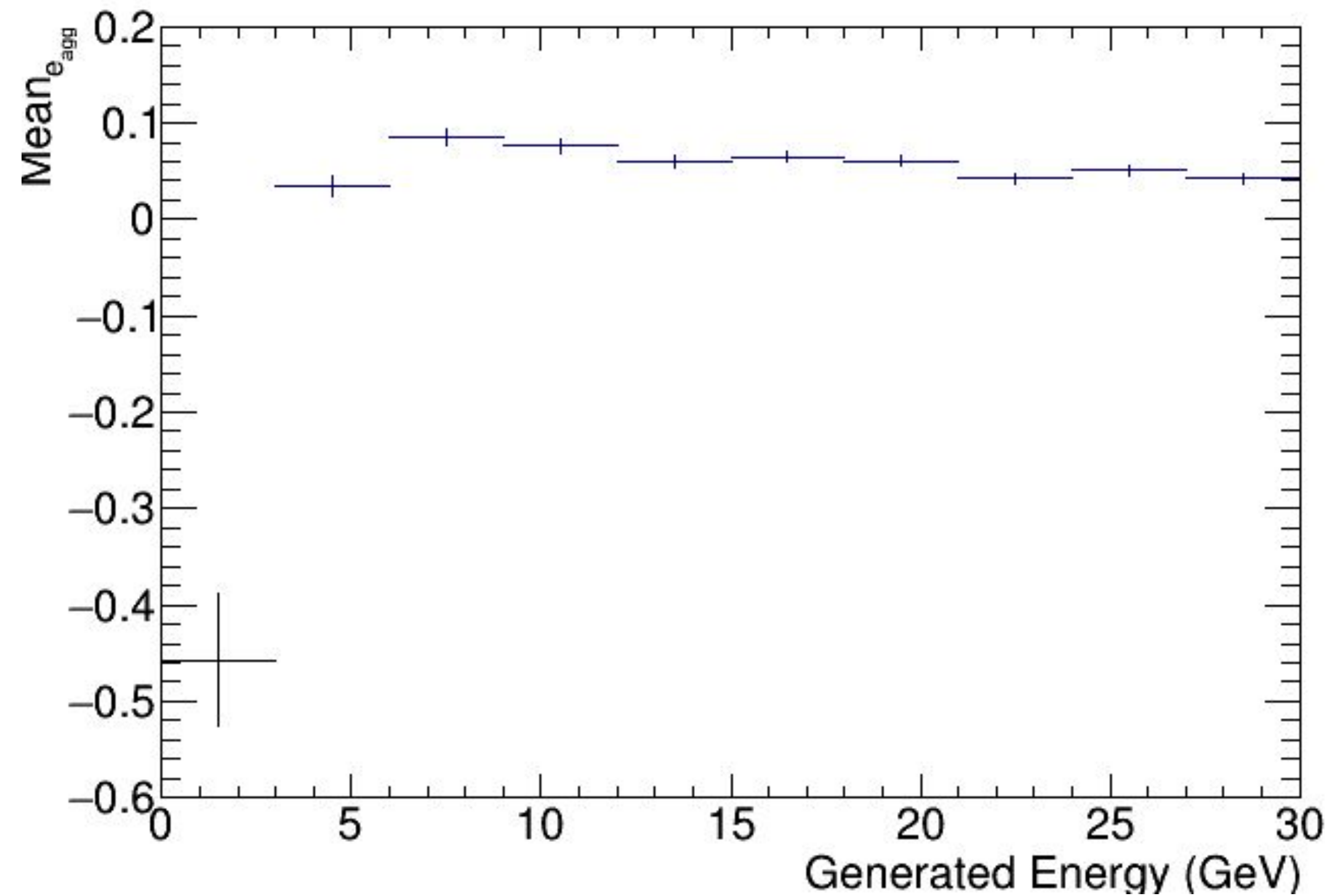
Number of bins = 10
Bin Width = 3 GeV

Fit Parameters:

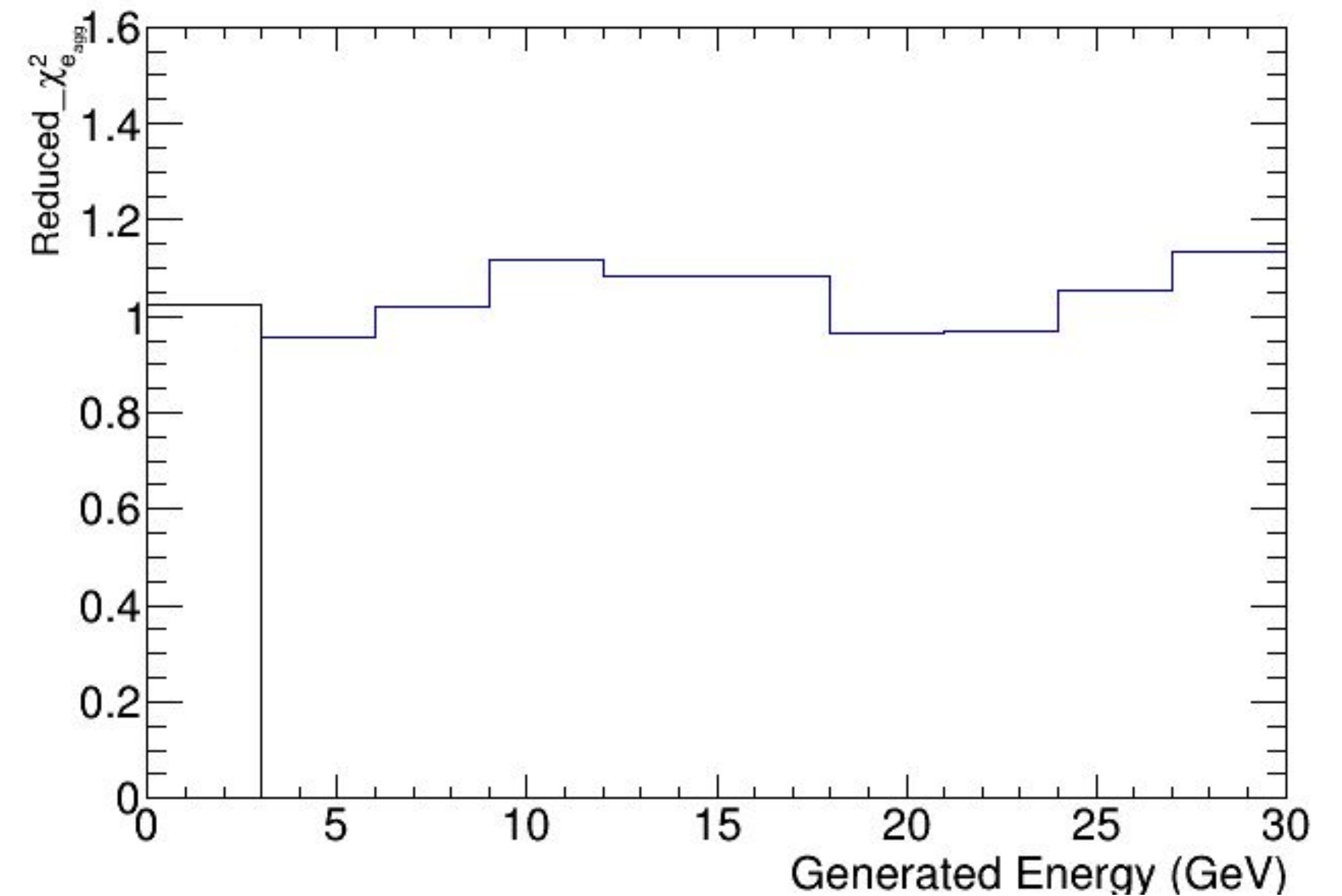
$p_0 = (0.0730367 \pm 0.00684017)$
 $p_1 = (0.787950 \pm 0.0274580) \text{ GeV}^{0.5}$

CEMC + HCALIN + HCALOUT (π^-)

Explicit η cut: -1.1 to 1.1



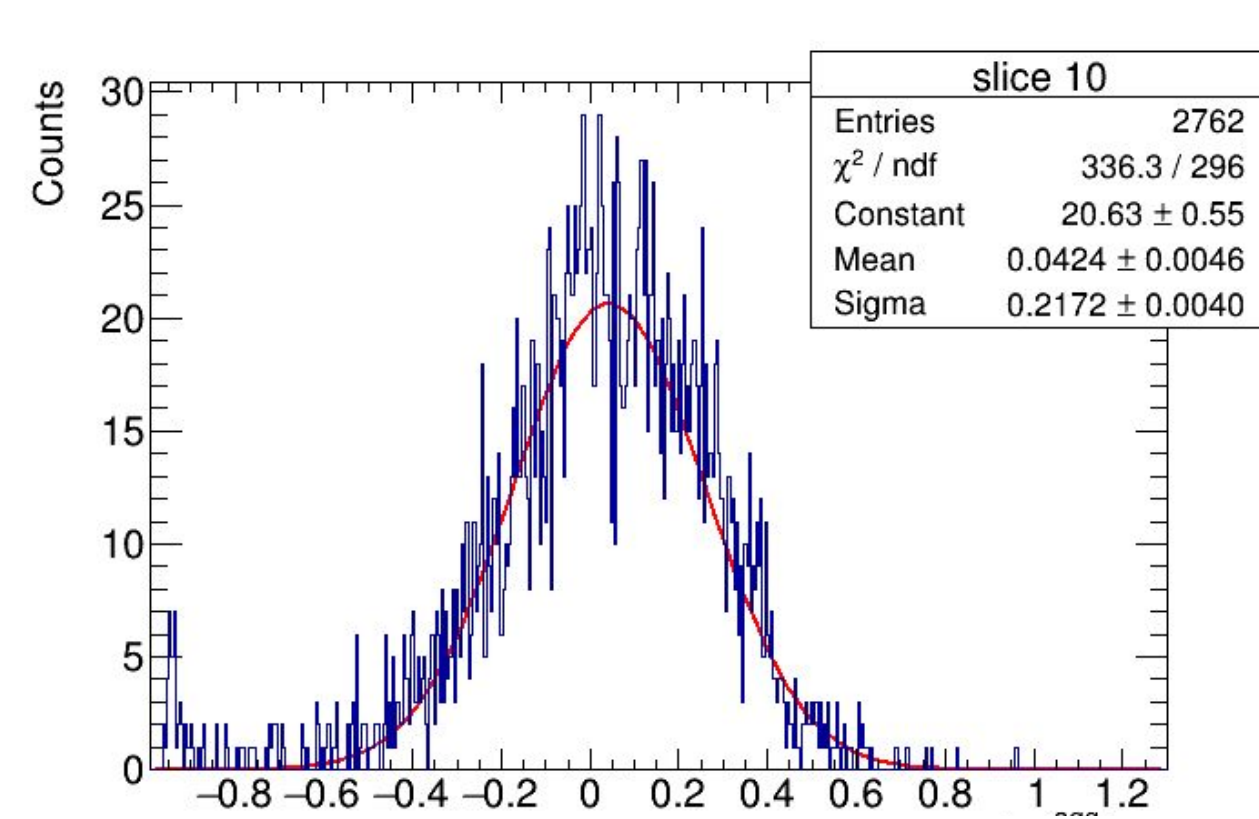
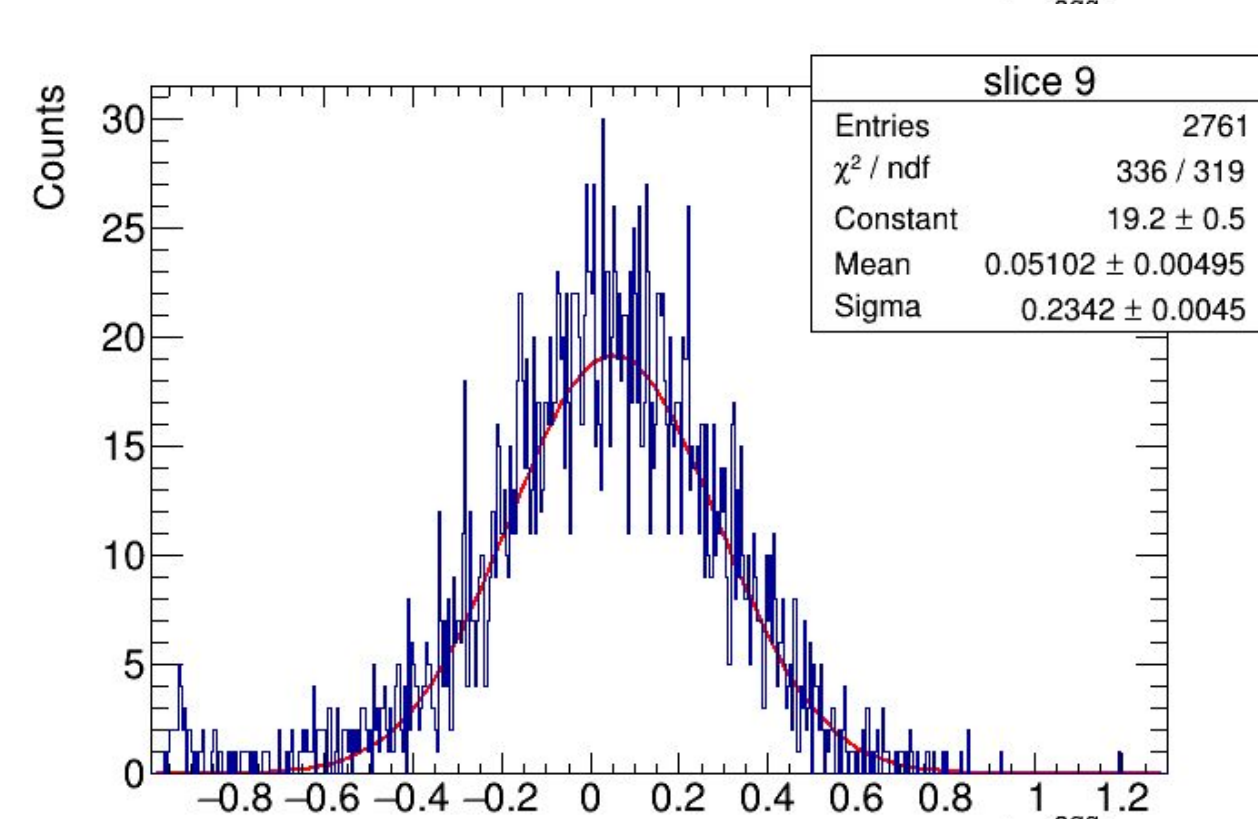
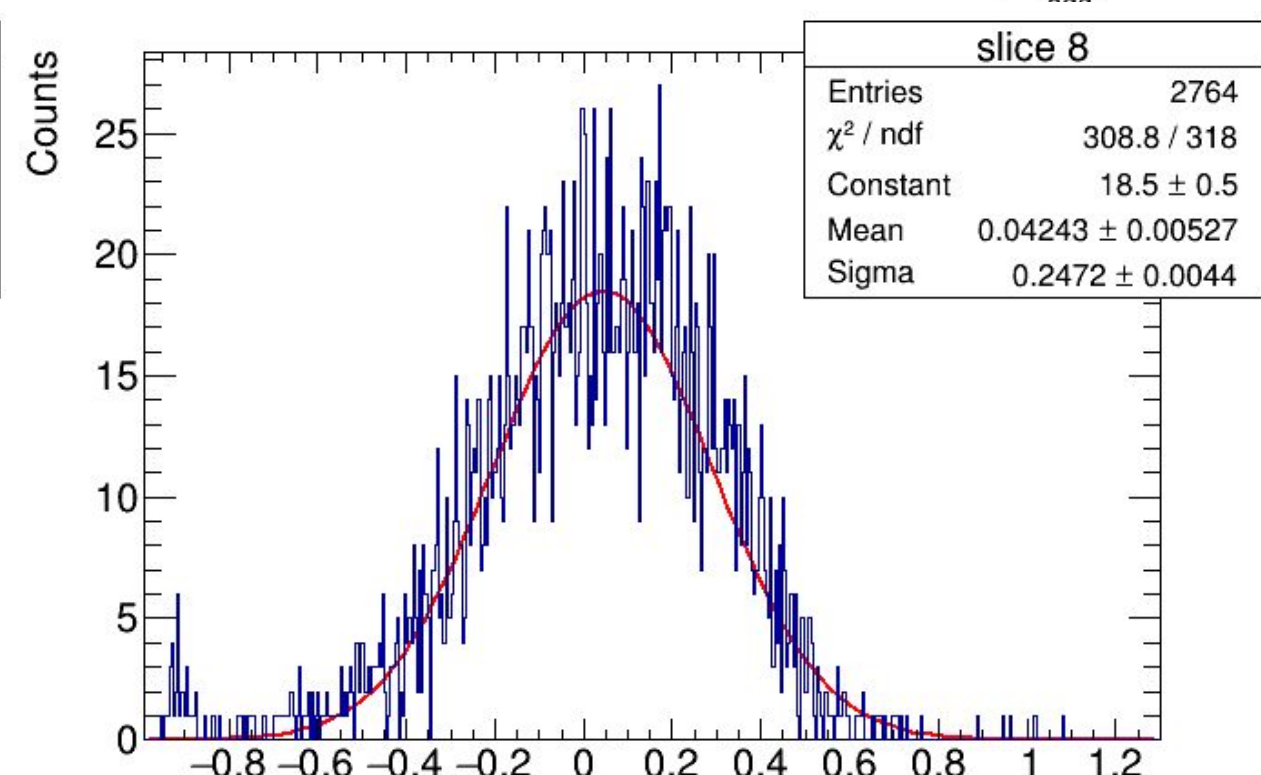
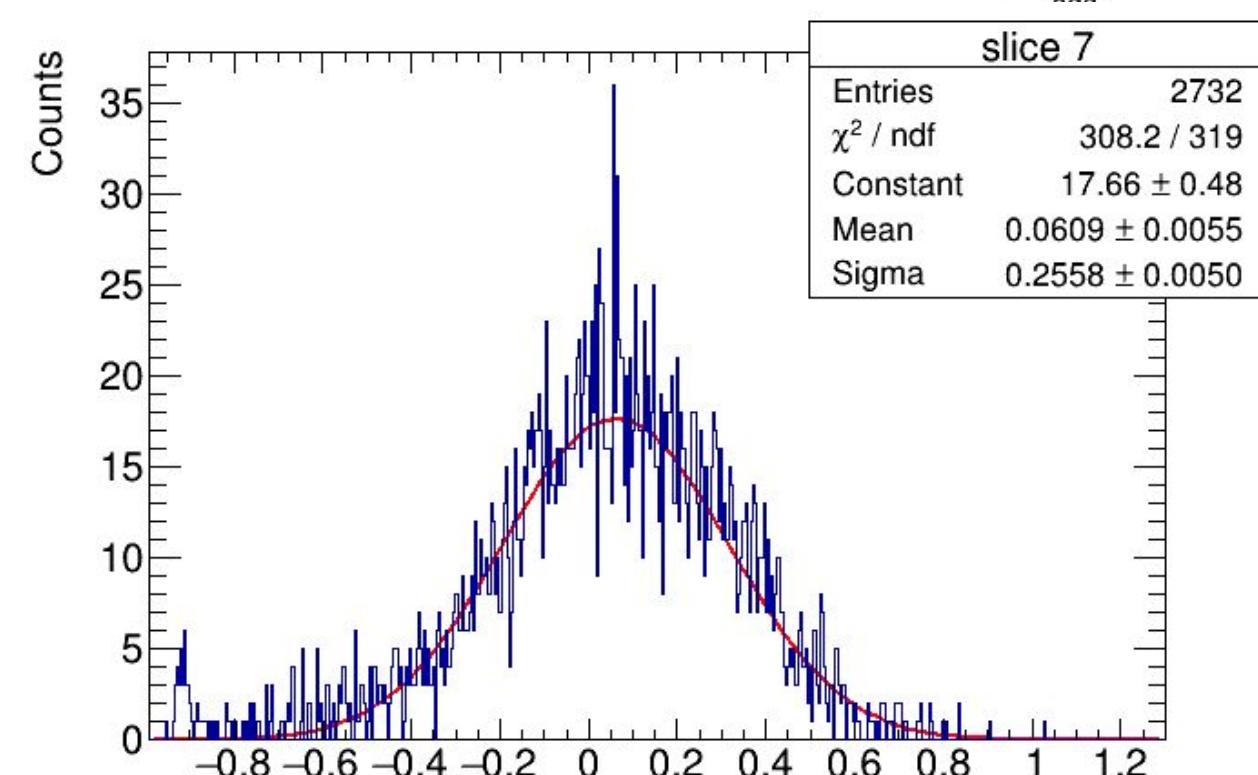
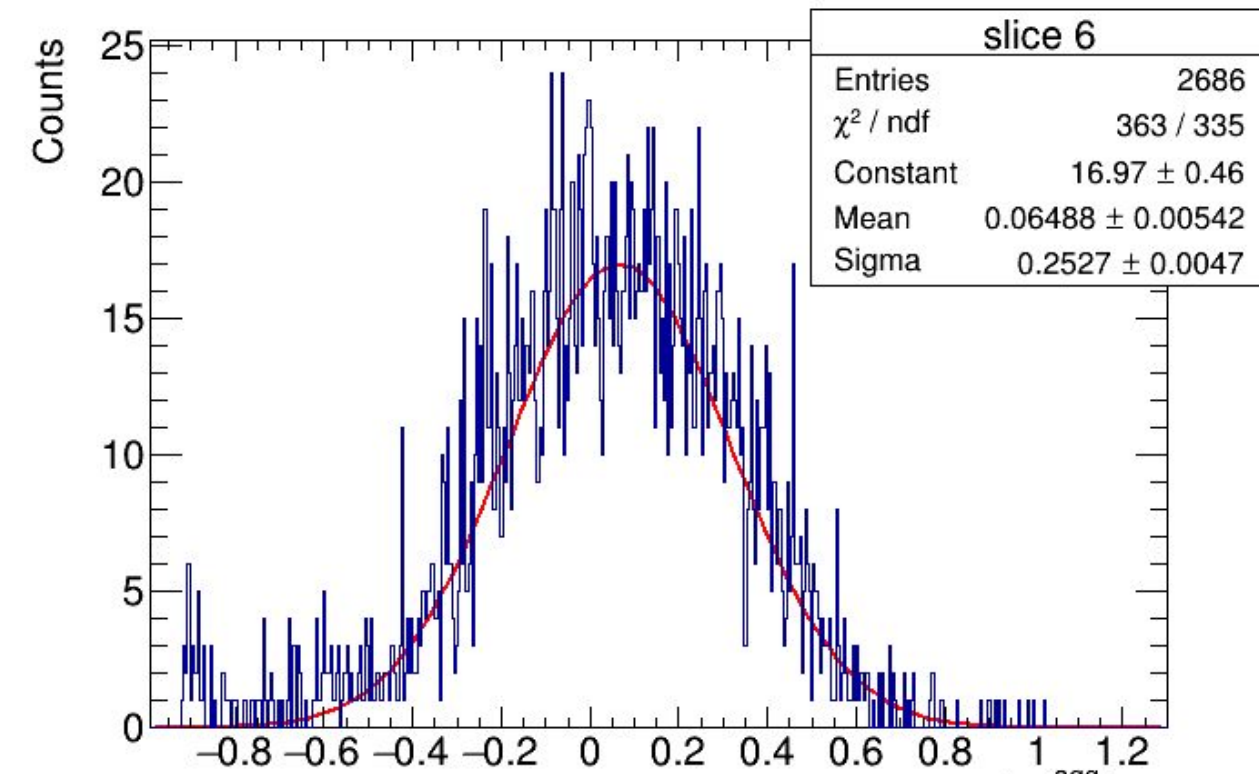
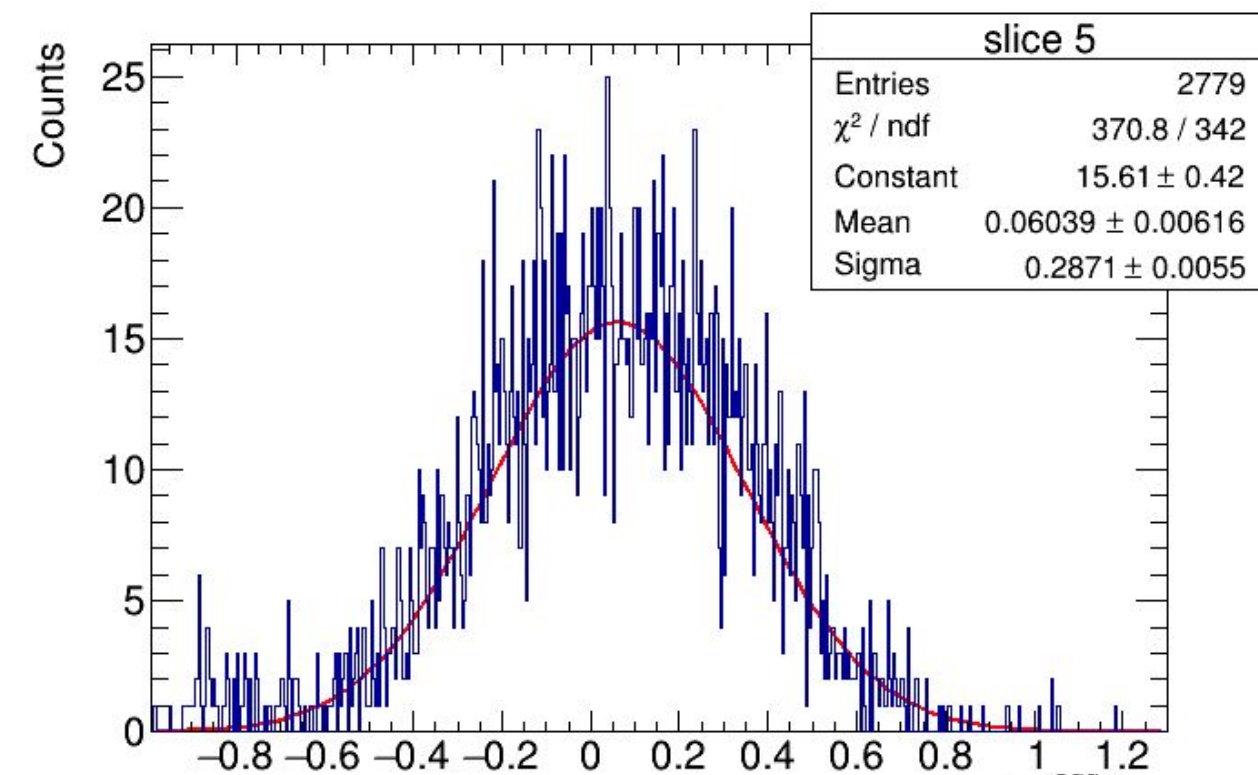
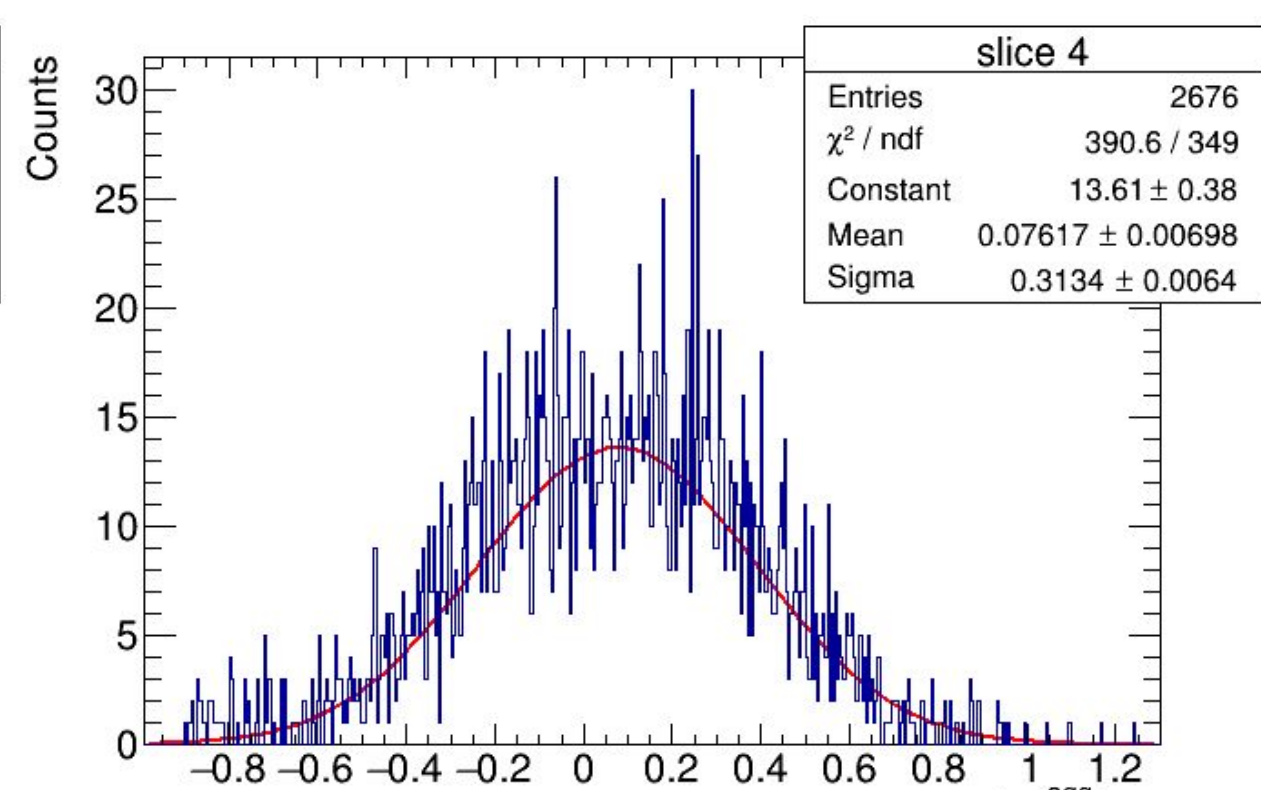
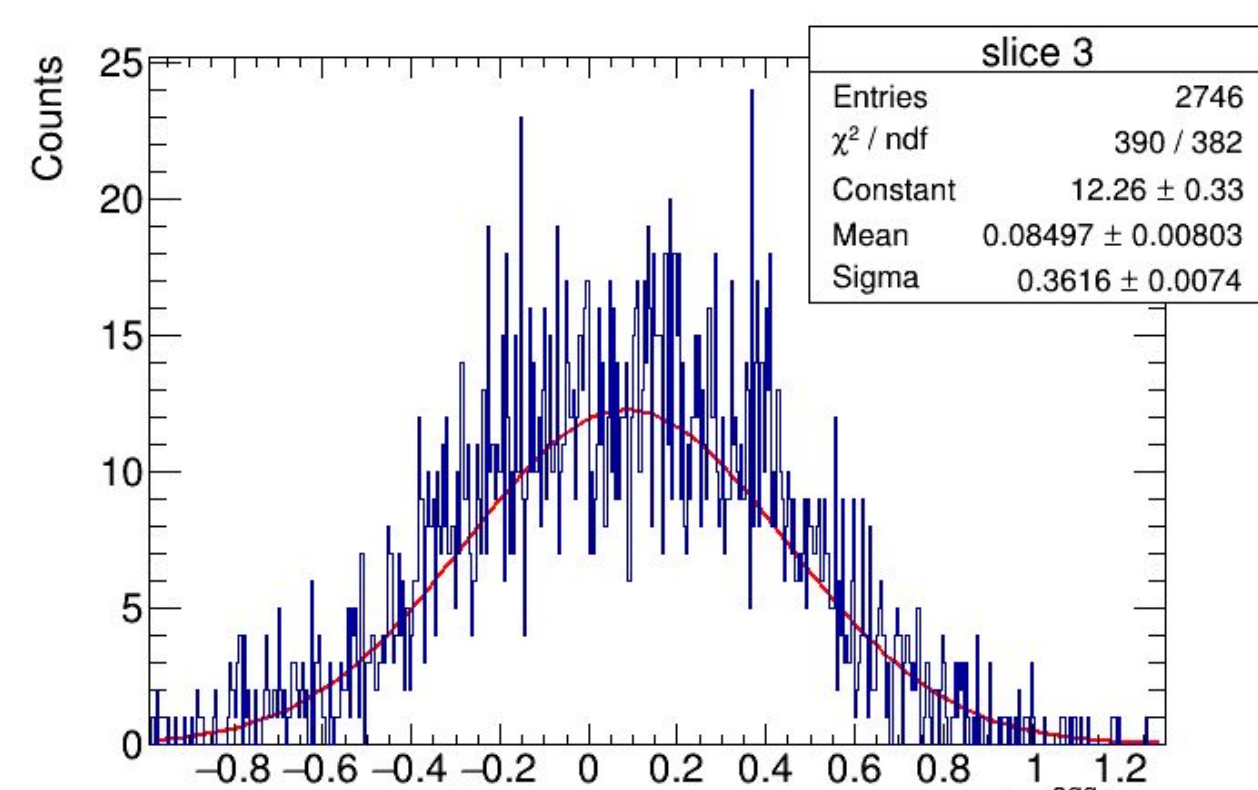
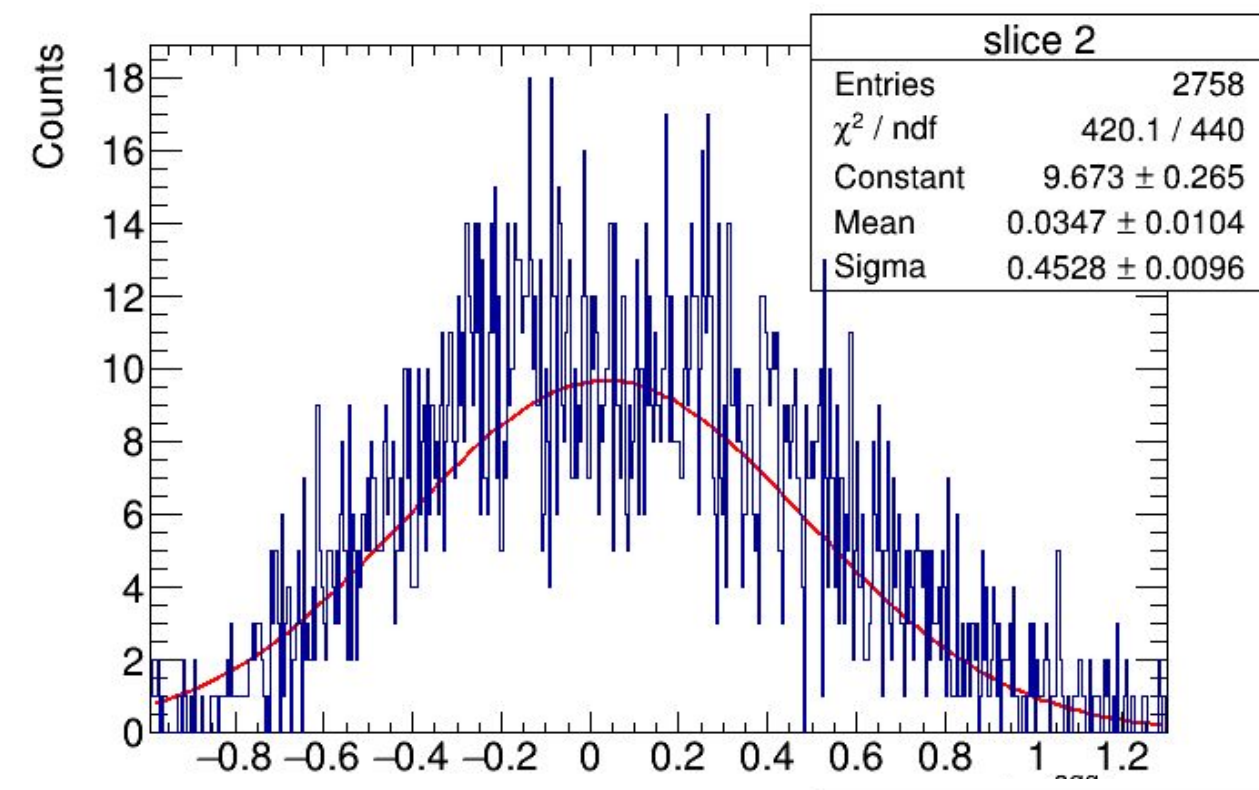
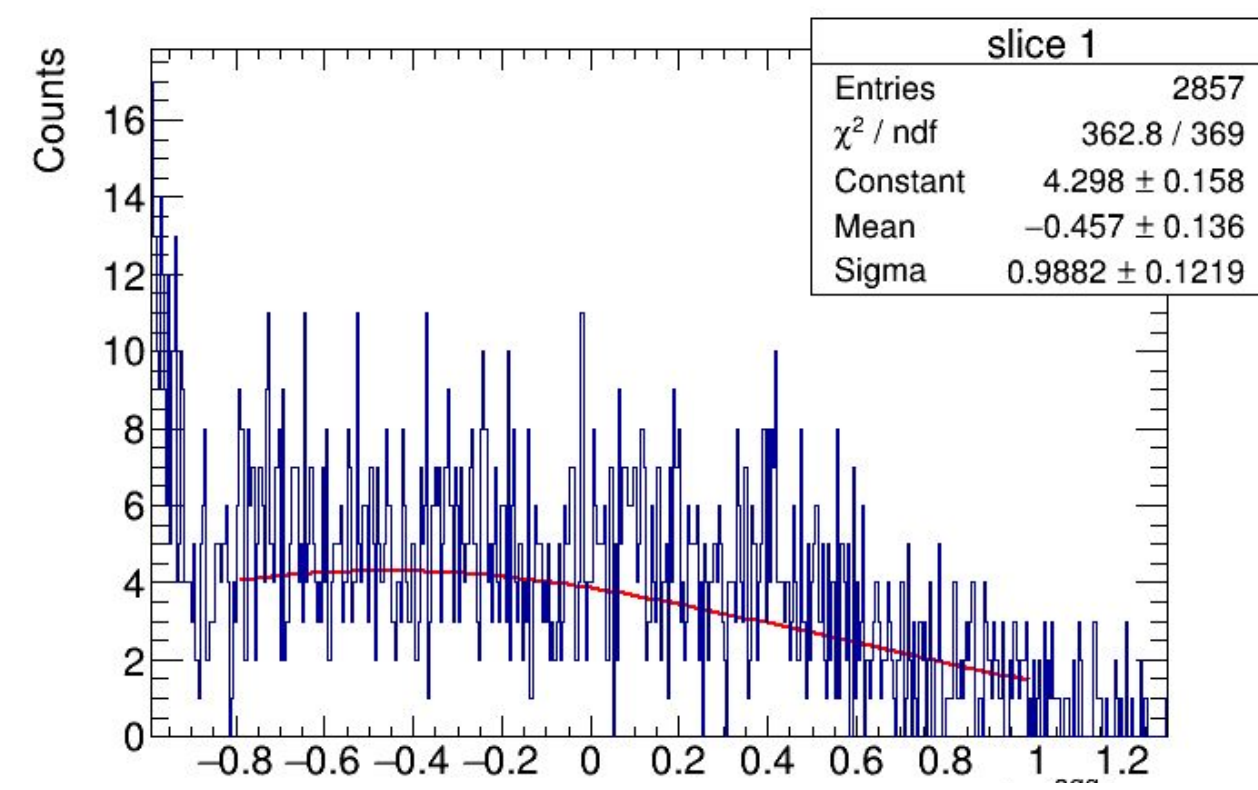
Mean of the Gaussians fitted to the slices of the recalibrated $(te_{agg} - ge) / ge$ vs ge plot.



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

CEMC + HCALIN + HCALOUT (π^-)

Fitted Gaussians



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

