

$\text{Br}(\text{H} \rightarrow \gamma\gamma)$ measurement

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Optimization

ilc17_slc6_arbor25May15.sh

- 1 energy deposit

$$E_{meas}^{en} = a(f_1 E_{odd20} + (1-f_1) E_{even20}) + b(f_2 E_{odd10} + (1-f_2) E_{even10})$$

$$\chi^2 = \sum_{events} \left(\left(E_{meas}^{en} - E_{MC} \right) / \frac{16\%}{\sqrt{E_{MC}}} \right)^2 \quad \chi^2\text{-minimized}$$

- 2 number of hit

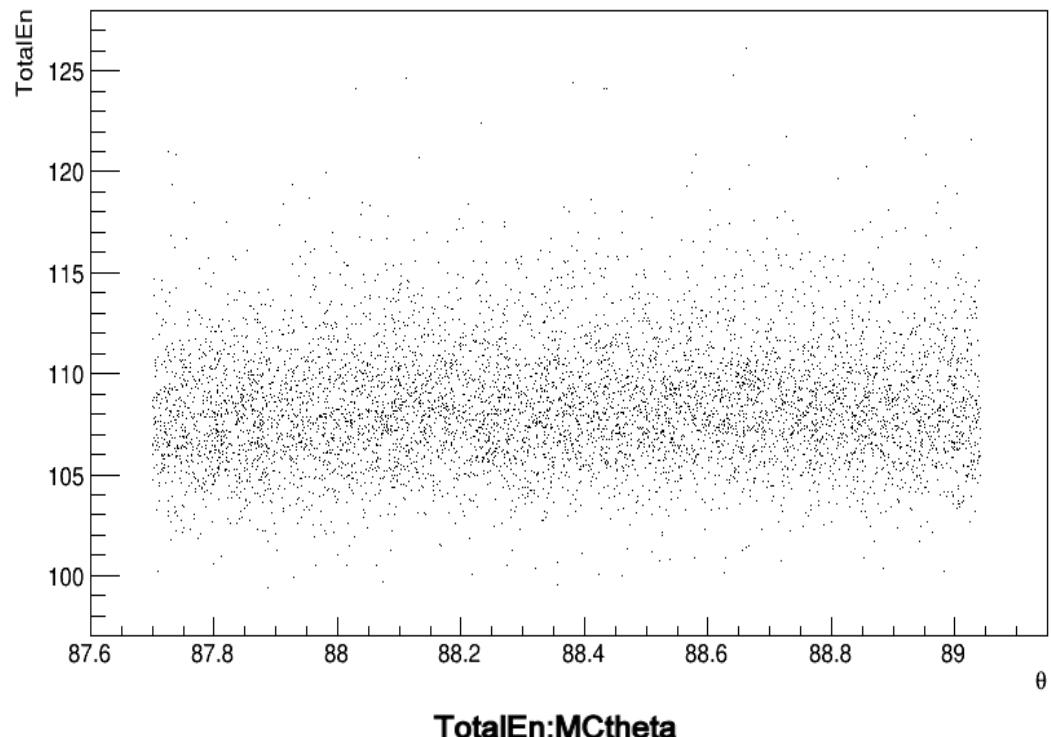
$$E_{meas}^{hit} = \gamma(N_{odd20} + N_{even20}) + \delta(N_{odd10} + N_{even10})$$

- 3 combining the two measurements

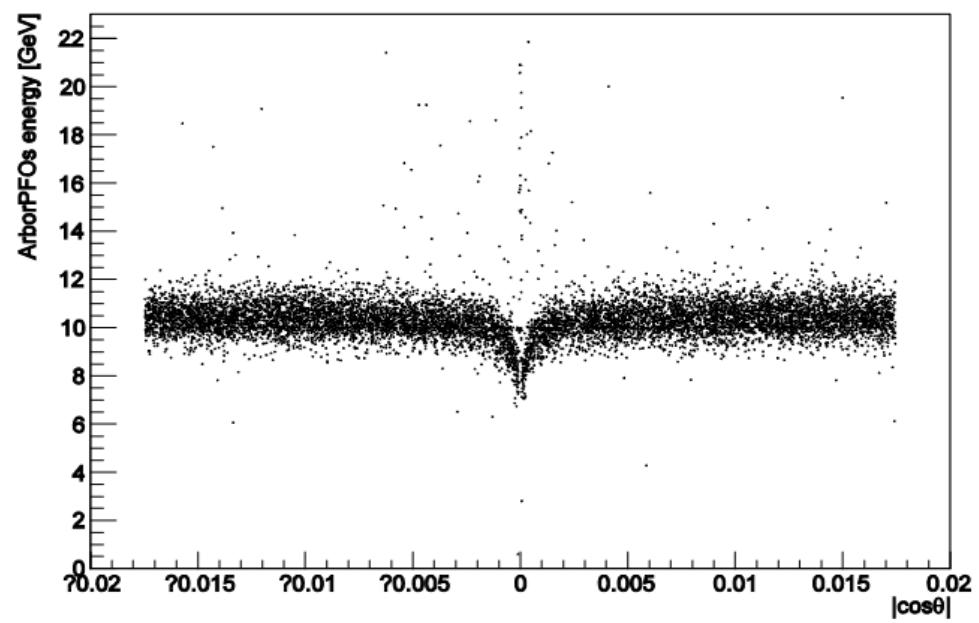
$$E = \lambda E_{meas}^{en} + (1-\lambda) E_{meas}^{hit}$$

$$\chi^2 = \sum_{events} \left(\left\{ \lambda (\textcolor{red}{E}_{mean}^{en} - E_{meas}^{en}) + (1-\lambda) (\textcolor{red}{E}_{mean}^{hit} - E_{meas}^{hit}) \right\} / \frac{16\%}{\sqrt{E_{MC}}} \right)^2 \quad \chi^2\text{-minimized}$$

```
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[ ] /gun/position 0 0 0 mm  
[ ] /gun/direction 0.0 1.0 0.035  
[ ] /gun/energy 10 GeV  
[ ] /gun/momentumSmearing 0.0 GeV  
[ ] /gun/phiSmearing 1 deg  
[ ] /gun/thetaSmearing 1 deg  
[ ] /gun/directionSmearingMode uniform  
[ ] /gun/particle gamma  
[ ] /run/beamOn 10000
```



```
[ ] /generator/generator particleGun  
[ ] /gun/position 0 0 0 mm  
[ ] /gun/direction 0.0 1.0 0.0  
[ ] /gun/energy 10 GeV  
[ ] /gun/momentumSmearing 0.0 GeV  
[ ] /gun/phiSmearing 1 deg  
[ ] /gun/thetaSmearing 1 deg  
[ ] /gun/directionSmearingMode uniform  
[ ] /gun/particle gamma  
[ ] /run/beamOn 10000
```



E_γ deposite in Ecal (ArborPFOsCollection)

Reconstruction energy (deposit E)

$$E_{meas}^{en} = a \left(f_1 E_{odd20} + (1-f_1) E_{even20} \right) \\ + b \left(f_2 E_{odd10} + (1-f_2) E_{even10} \right)$$

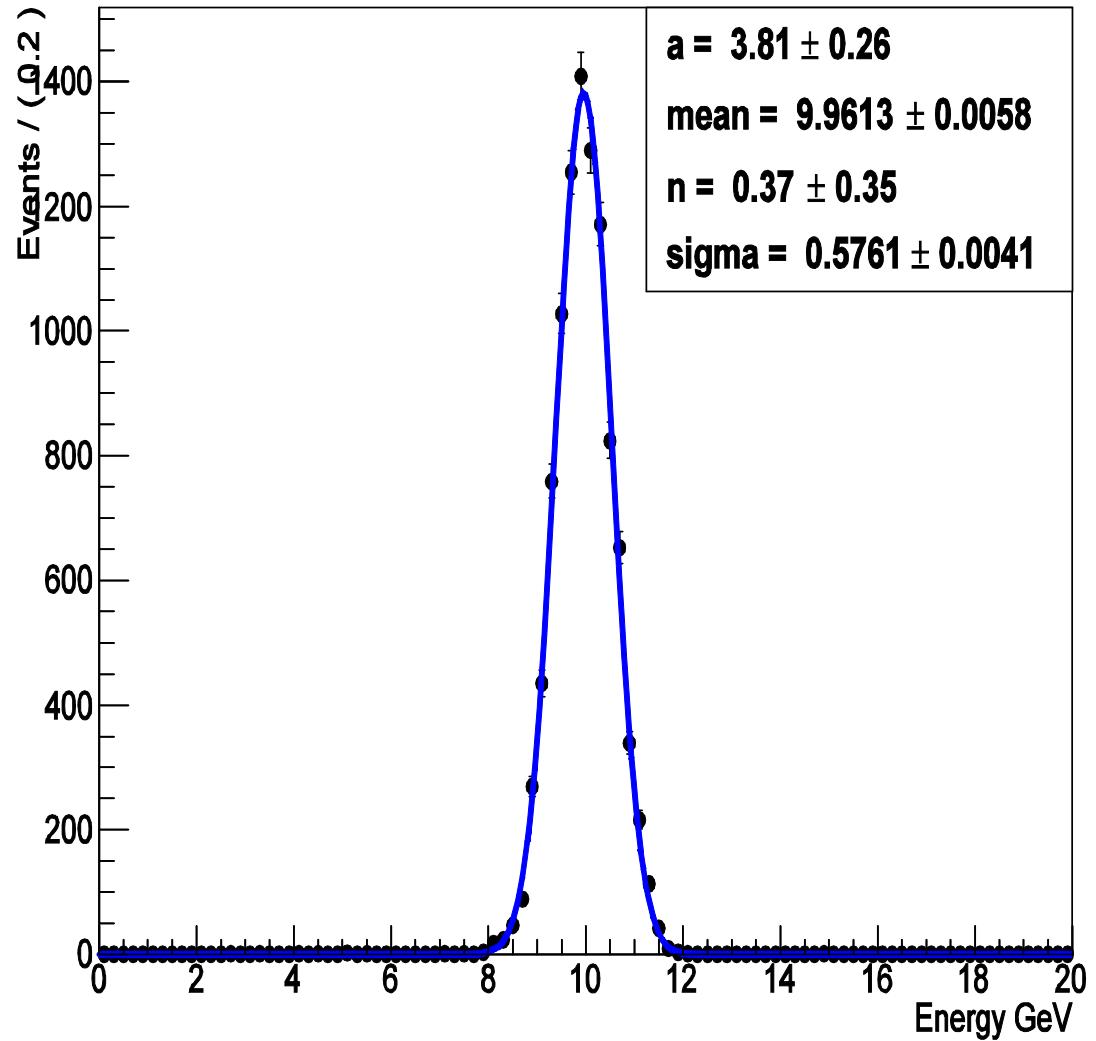
χ^2 -minimized

$$\chi^2 = \sum_{events} \left(\left(E_{meas}^{en} - E_{MC} \right) / \frac{16\%}{\sqrt{E_{MC}}} \right)^2$$

$$\frac{\sigma}{E_{meas}^{en}} = 0.0578 \approx \frac{18.28\%}{\sqrt{E}}$$

pre:

$$\frac{\sigma}{E_{meas}^{en}} = 0.0611 \approx \frac{19.31\%}{\sqrt{E}}$$



No. of hit in Ecal (ArborPFOsCollection)

Reconstruction energy (No. of hit)

$$E_{meas}^{hit} = \gamma(N_{odd20} + N_{even20}) \\ + \delta(N_{odd10} + N_{even10})$$

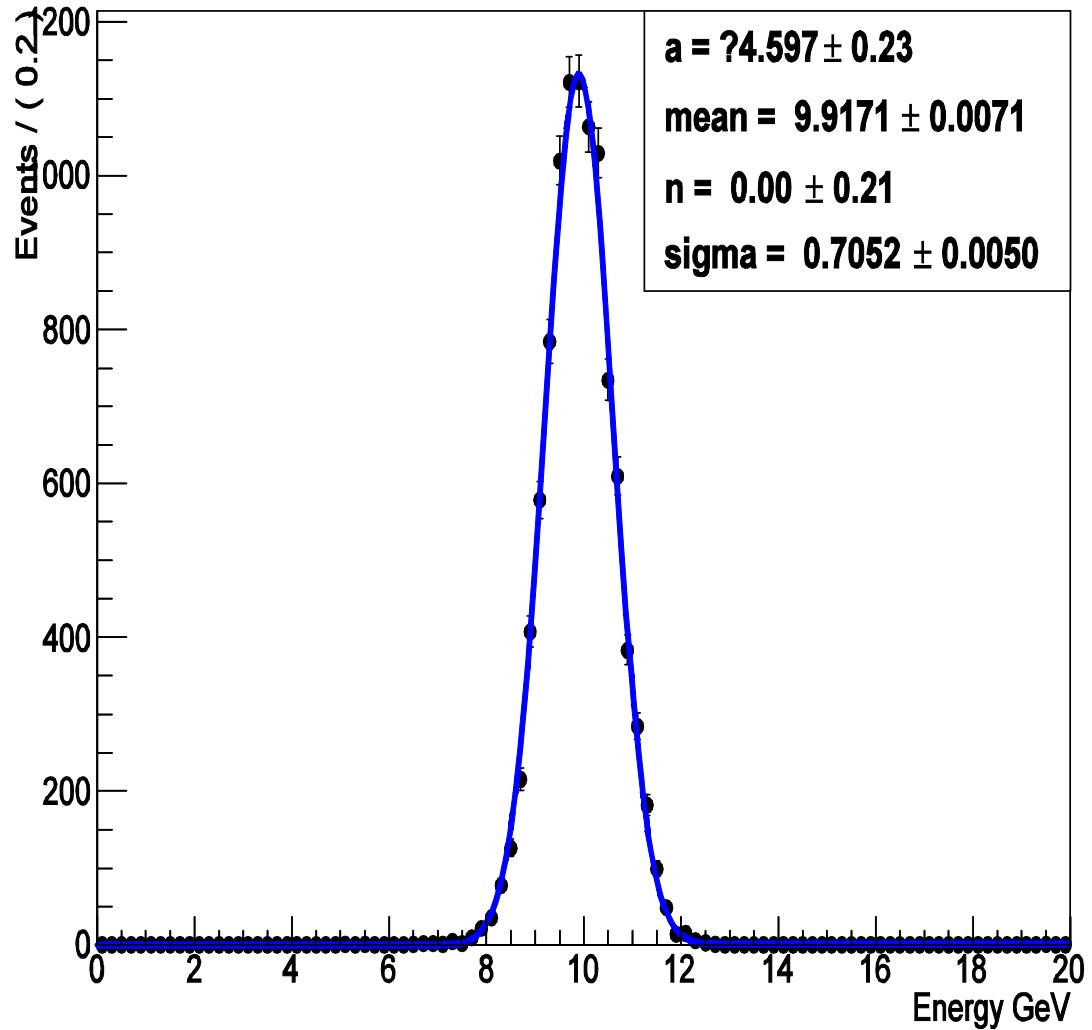
χ^2 -minimized

$$\chi^2 = \sum_{events} \left(\left(E_{meas}^{hit} - E_{MC} \right) / \frac{16\%}{\sqrt{E_{MC}}} \right)^2$$

$$\frac{\sigma}{E_{meas}^{en}} = 0.0711 \approx \frac{22.48\%}{\sqrt{E}}$$

pre:

$$\frac{\sigma}{E_{meas}^{en}} = 0.07208 \approx \frac{22.79\%}{\sqrt{E}}$$



Combining result in Ecal

(ArborPFOsCollection)

$$E = \lambda E_{meas}^{en} + (1 - \lambda) E_{meas}^{hit}$$

χ^2 -minimized

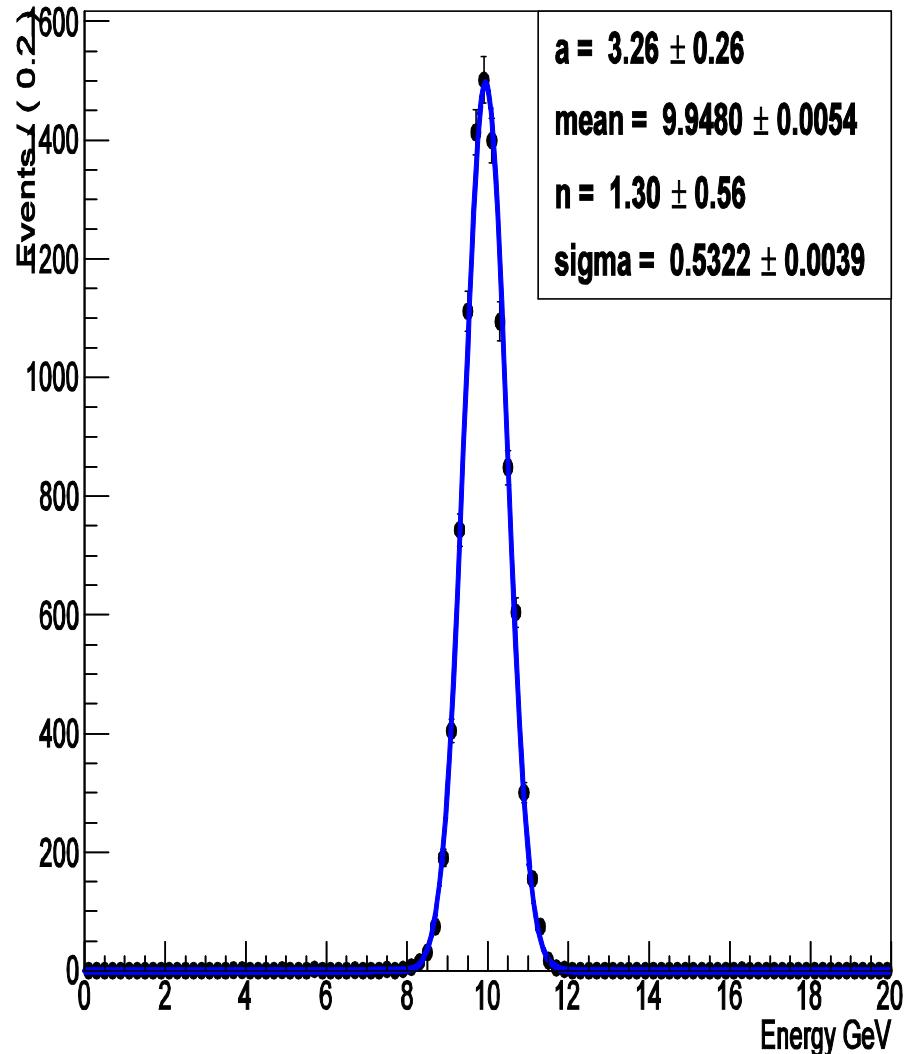
$$\chi^2 = \sum_{events} \left(\left\{ \lambda (E_{mean}^{en} - E_{meas}^{en}) + (1 - \lambda) (E_{mean}^{hit} - E_{meas}^{hit}) \right\} / \frac{16\%}{\sqrt{E_{MC}}} \right)^2$$

$$\frac{\sigma}{E} = 0.05349 \approx \frac{16.91\%}{\sqrt{E}}$$

pre:

$$\frac{\sigma}{E} = 0.05625 \approx \frac{17.79\%}{\sqrt{E}}$$

Reconstruction energy (combining E & hits)



E_γ deposite in Ecal (ArborPFOsCollection)

Reconstruction energy (deposit E)

$$E_{meas}^{en} = a(f_1 E_{odd20} + (1-f_1) E_{even20}) \\ + b(f_2 E_{odd10} + (1-f_2) E_{even10})$$

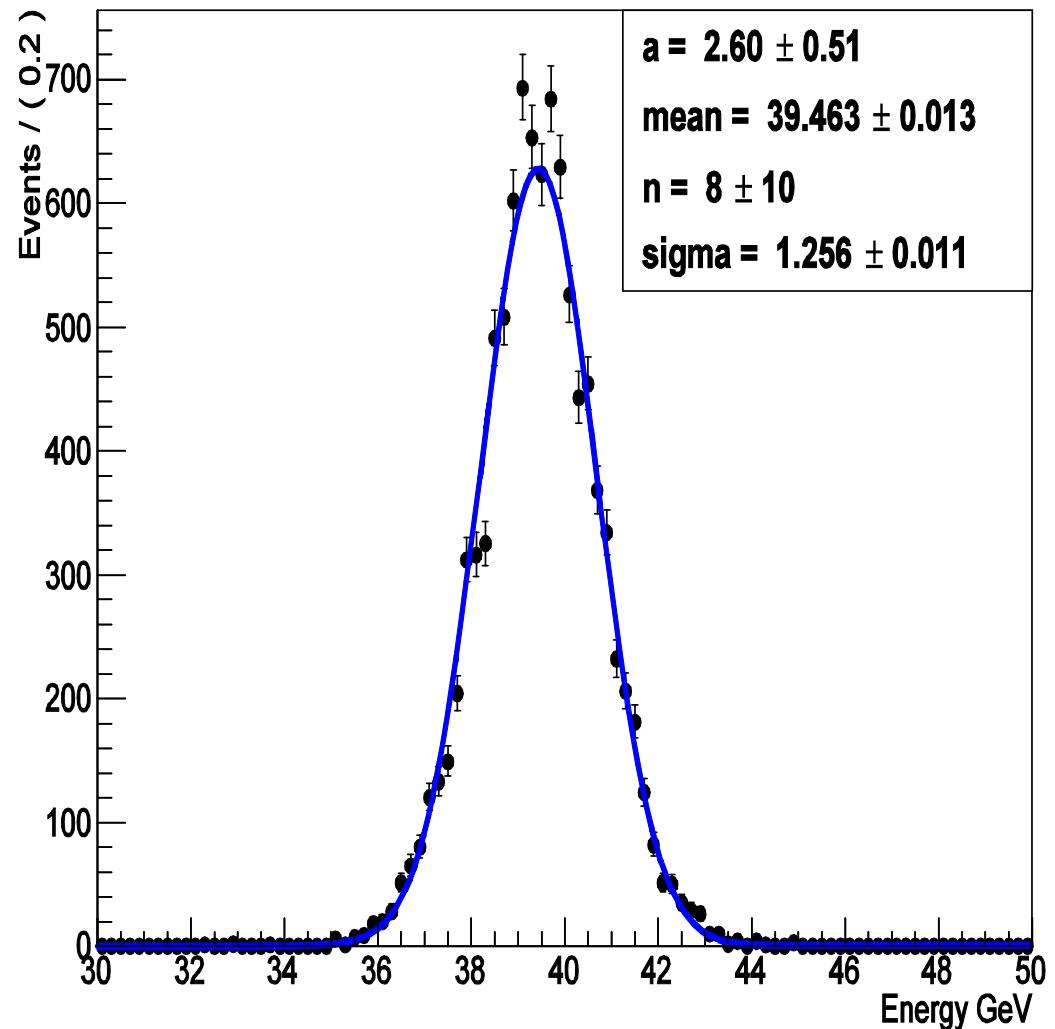
χ^2 -minimized

$$\chi^2 = \sum_{events} \left((E_{meas}^{en} - E_{MC}) / \frac{16\%}{\sqrt{E_{MC}}} \right)^2$$

$$\frac{\sigma}{E_{meas}^{en}} = 0.03182 \approx \frac{20.12\%}{\sqrt{E}}$$

pre:

$$\frac{\sigma}{E_{meas}^{en}} = 0.03291 \approx \frac{20.82\%}{\sqrt{E}}$$



No. of hit in Ecal (ArborPFOsCollection)

$$E_{meas}^{hit} = \gamma(N_{odd20} + N_{even20}) \\ + \delta(N_{odd10} + N_{even10})$$

χ^2 -minimized

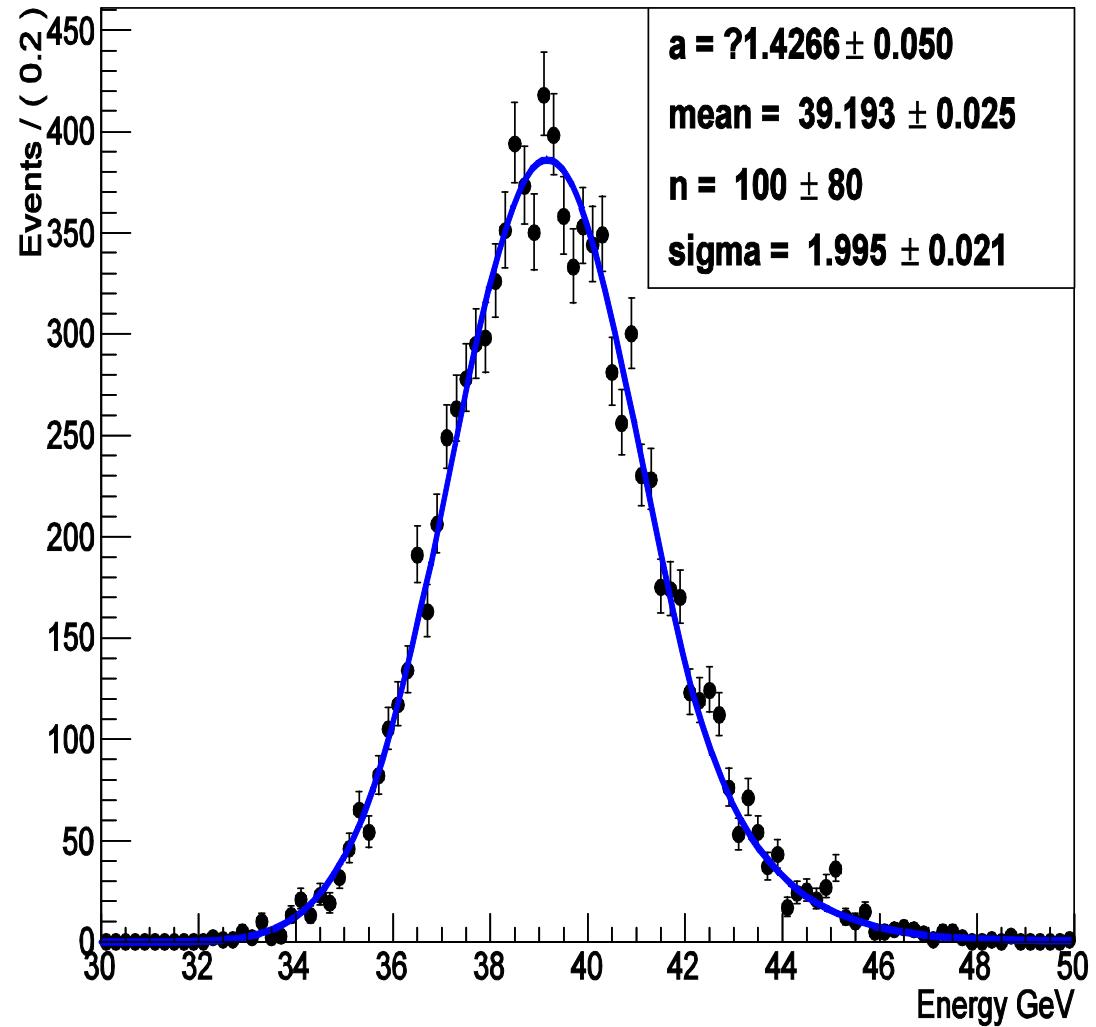
$$\chi^2 = \sum_{events} \left(\left(E_{meas}^{hit} - E_{MC} \right) / \frac{16\%}{\sqrt{E_{MC}}} \right)^2$$

$$\frac{\sigma}{E_{meas}^{en}} = 0.0509 \approx \frac{32.19\%}{\sqrt{E}}$$

pre:

$$\frac{\sigma}{E_{meas}^{en}} = 0.05317 \approx \frac{33.63\%}{\sqrt{E}}$$

Reconstruction energy (No. of hit)



Combining result in Ecal

(ArborPFOsCollection)

$$E = \lambda E_{meas}^{en} + (1 - \lambda) E_{meas}^{hit}$$

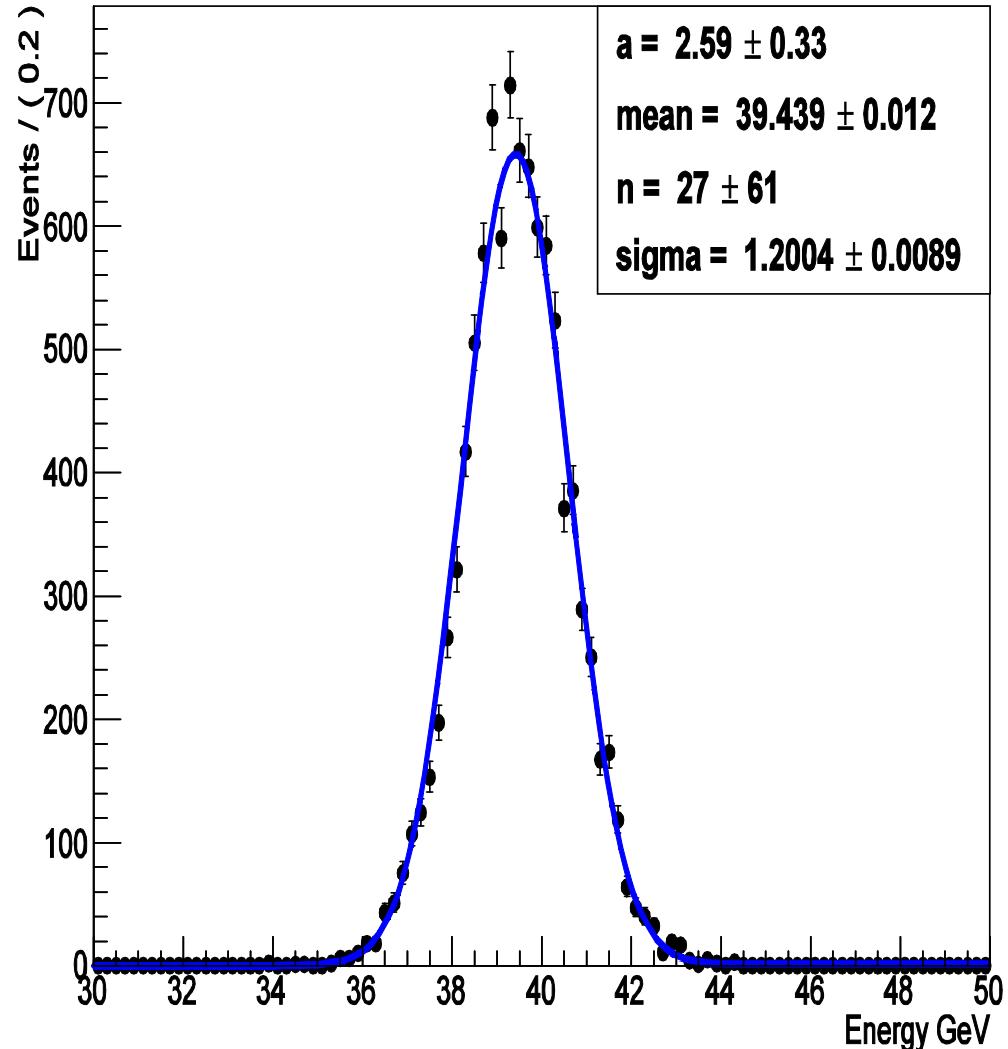
χ^2 -minimized

$$\frac{\sigma}{E} = 0.03042 \approx \frac{19.24\%}{\sqrt{E}}$$

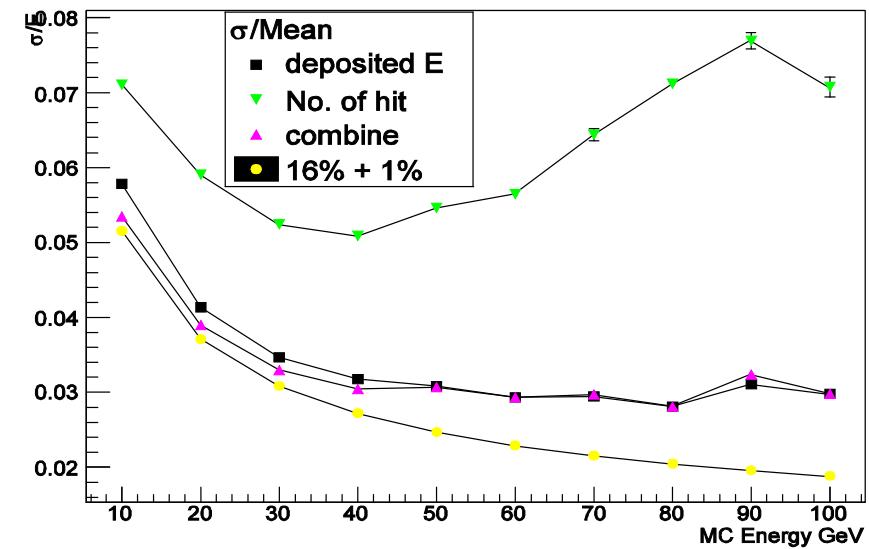
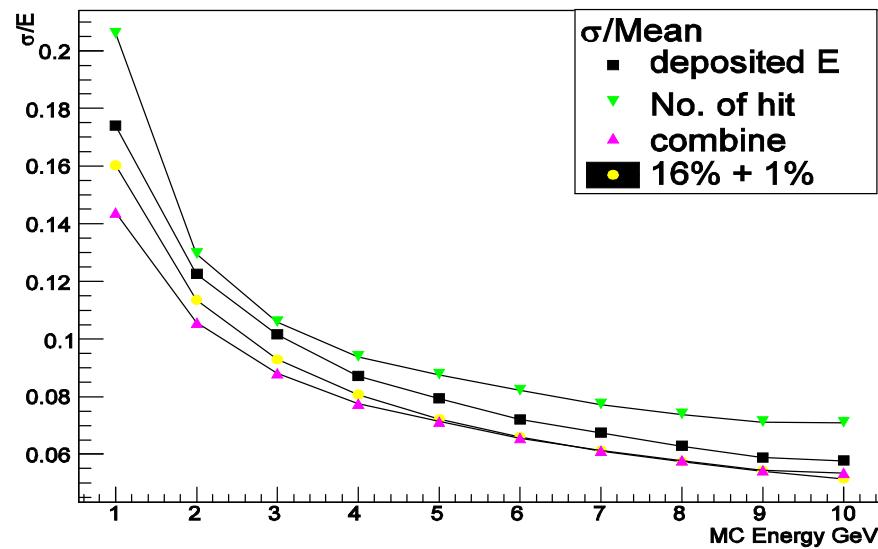
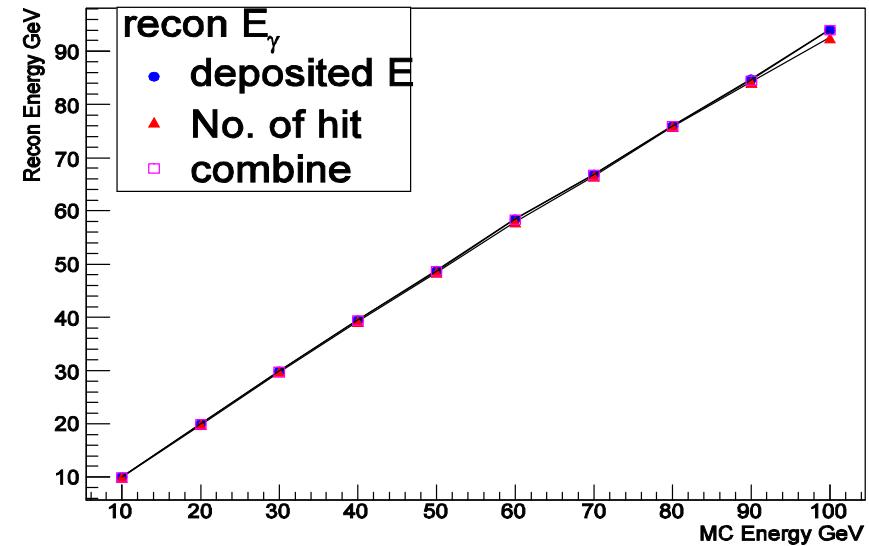
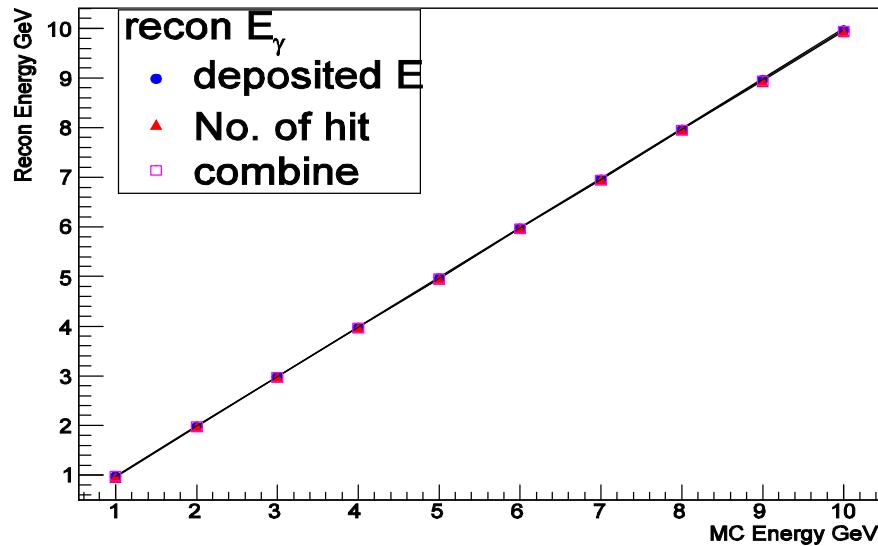
pre:

$$\frac{\sigma}{E} = 0.03343 \approx \frac{21.14\%}{\sqrt{E}}$$

Reconstruction energy (combining E & hits)

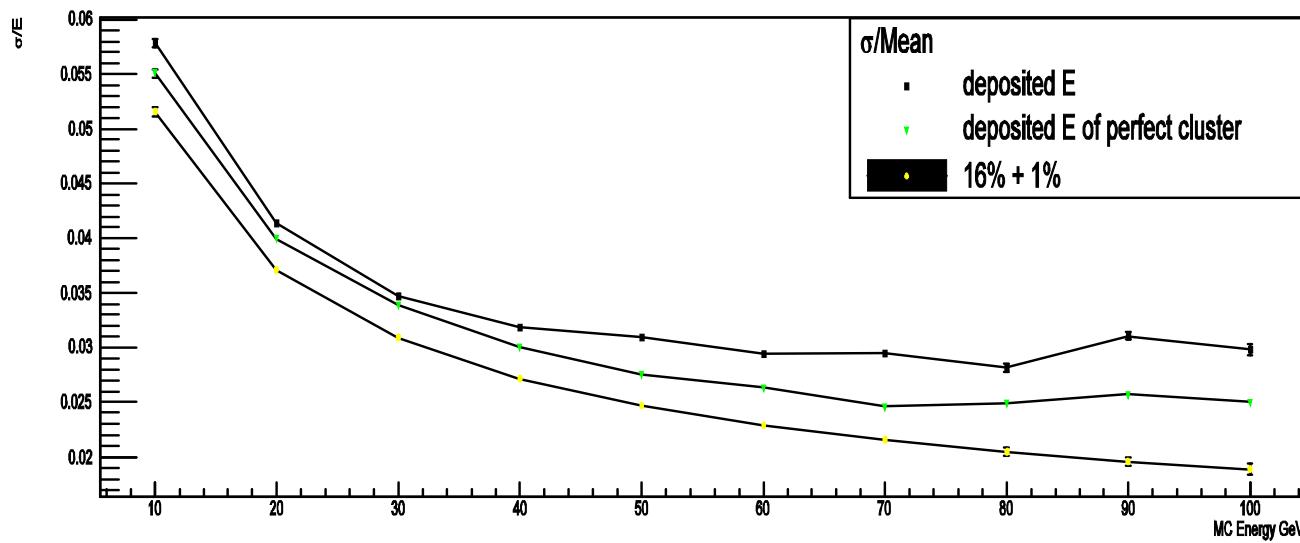
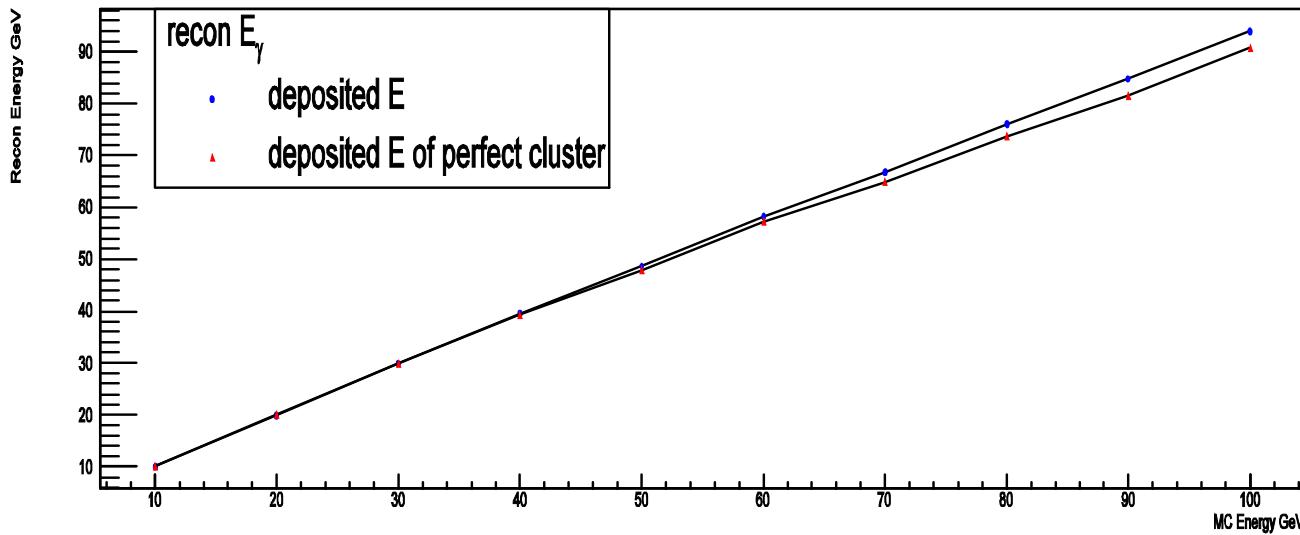


E_γ resolution with calibration (ArborPFOsCollection)

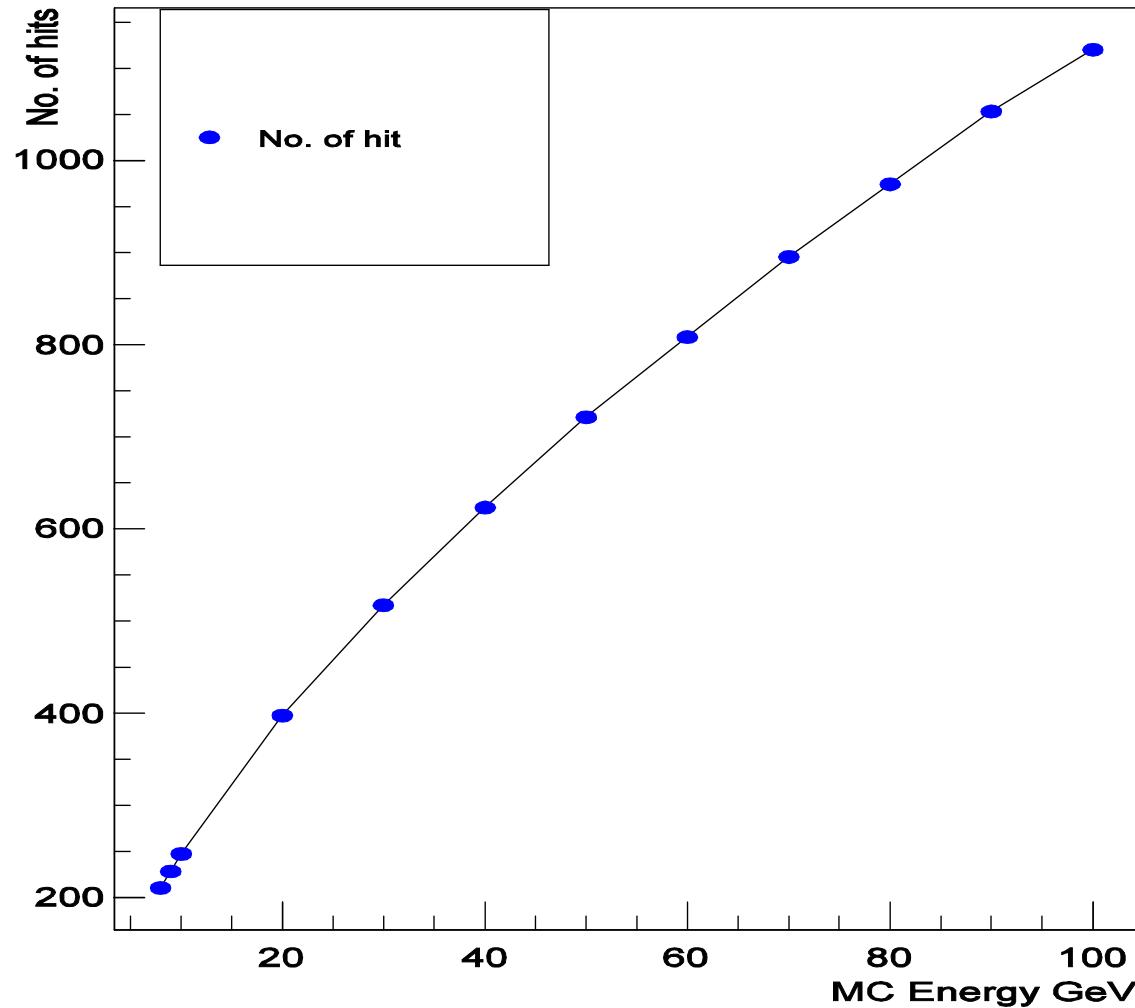


10

E_γ resolution with calibration (perfect cluster)



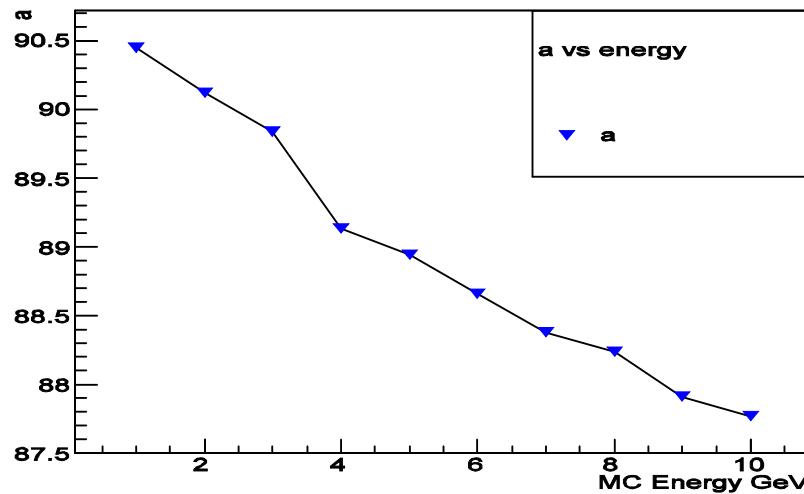
E_γ vs No. of hit (ArborPFOs)



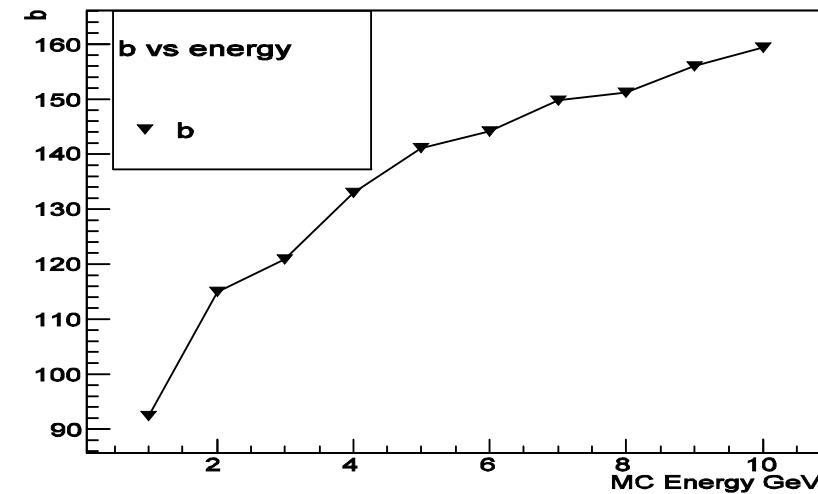
back up

Parameter vs E (ArborPFOsCollection)

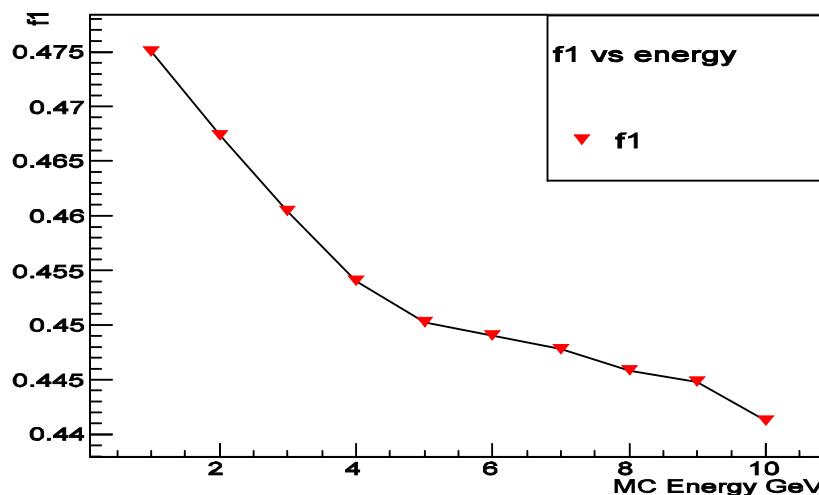
Graph



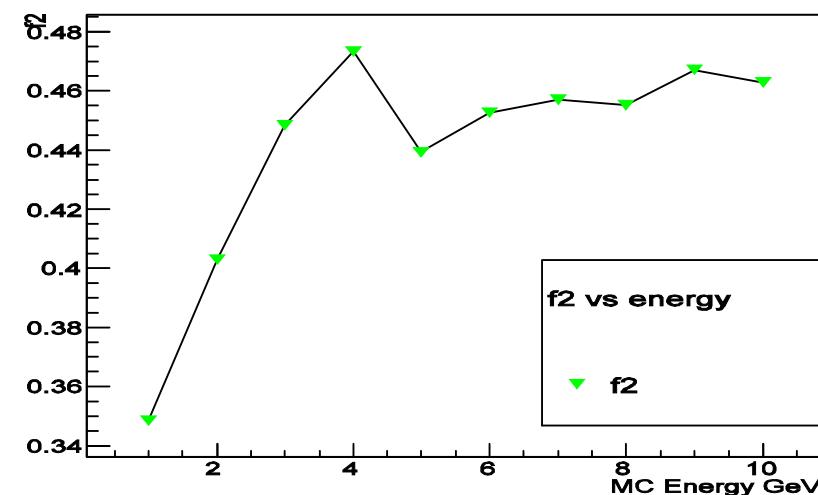
Graph



Graph

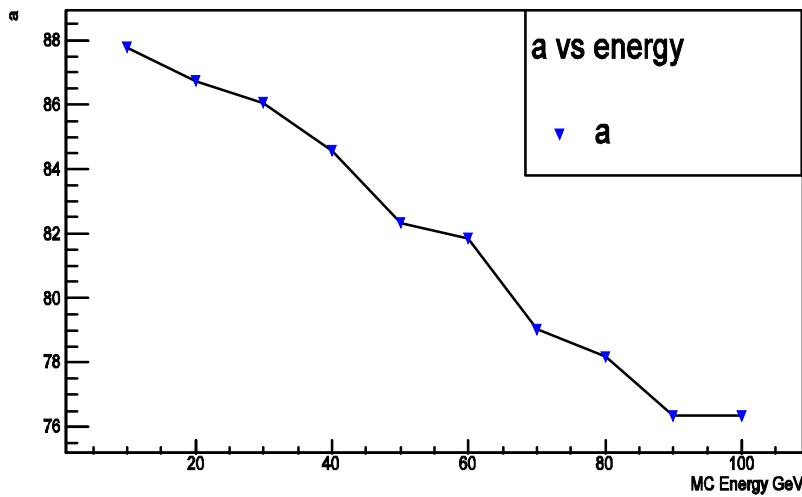


Graph

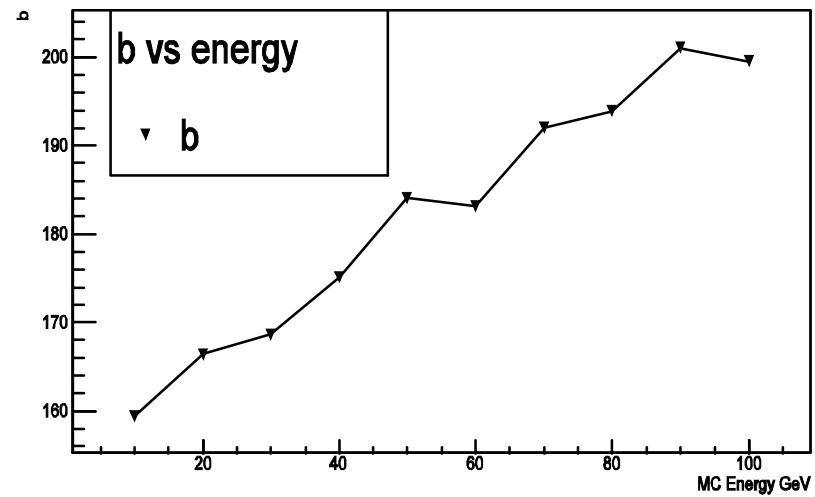


Parameter vs E (ArborPFOsCollection)

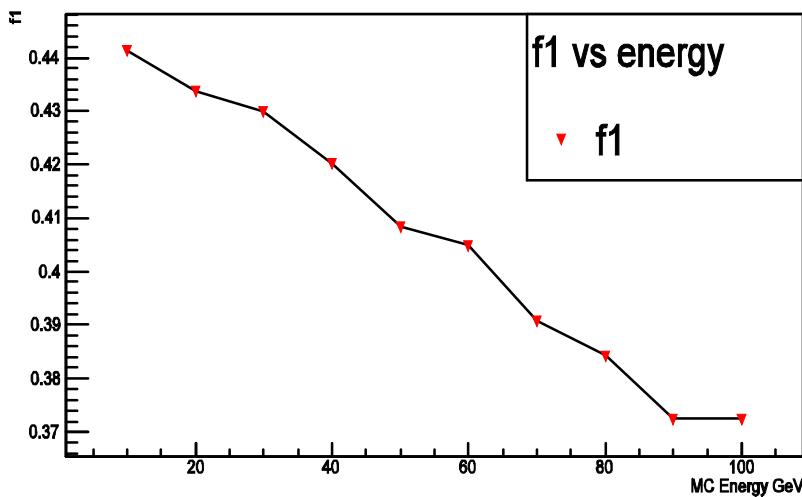
Graph



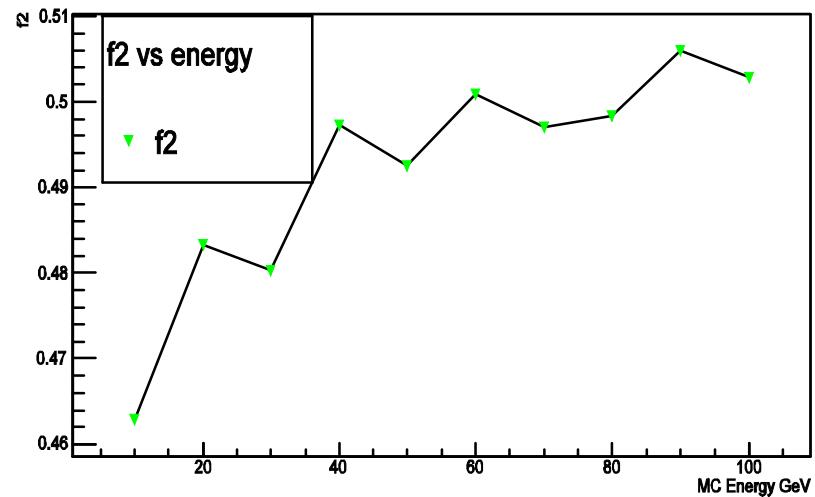
Graph



Graph

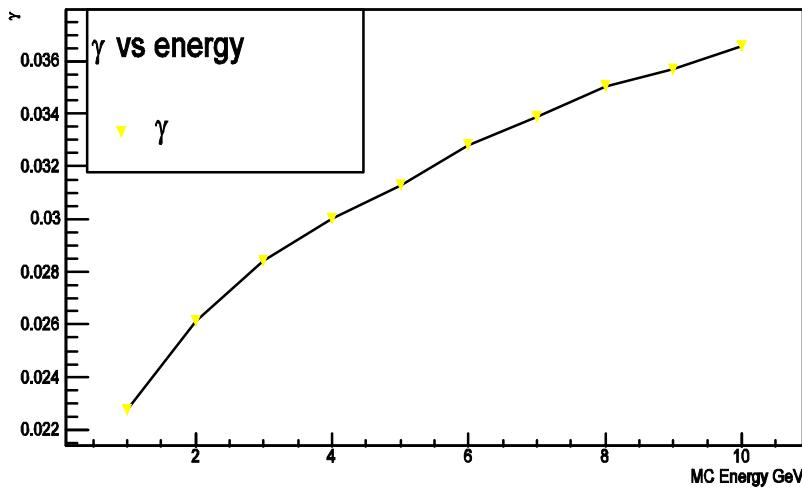


Graph

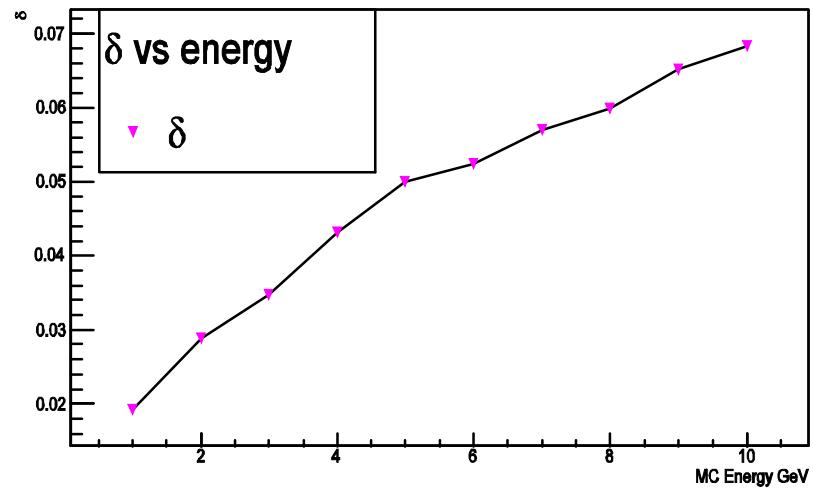


Parameter vs E (ArborPFOsCollection)

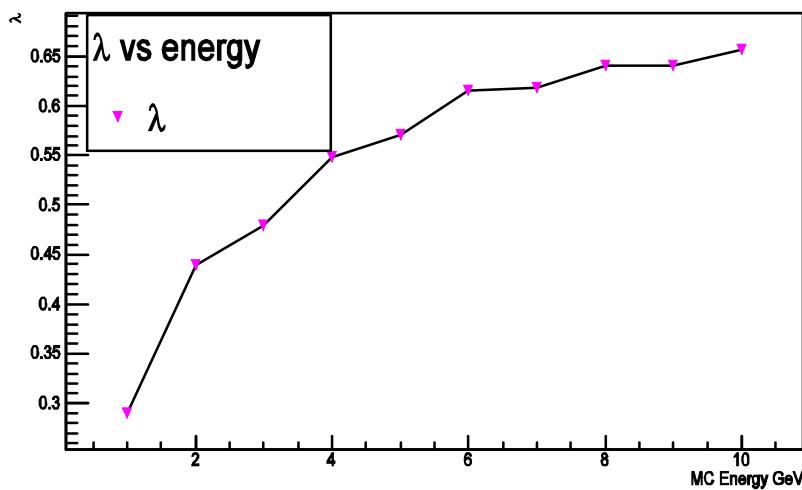
Graph



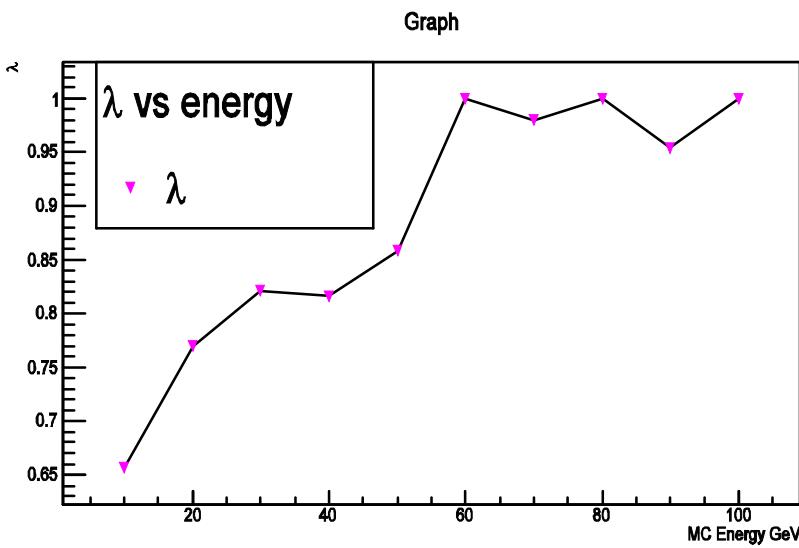
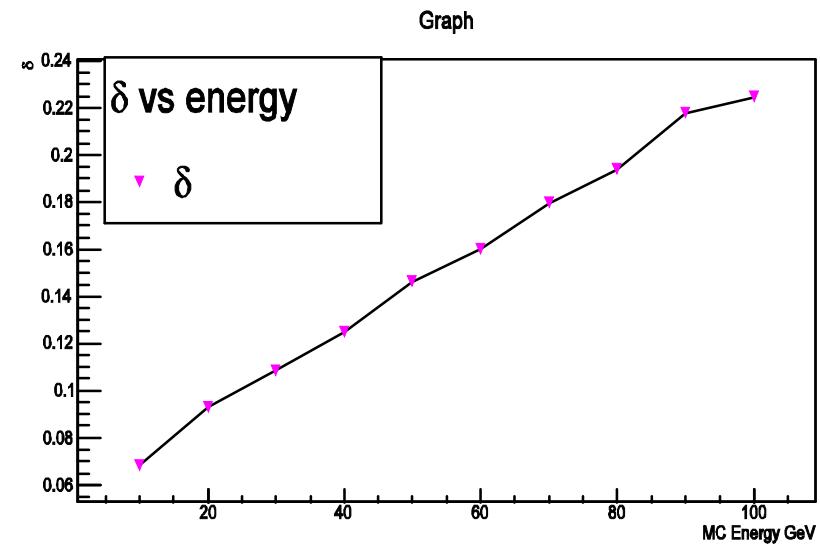
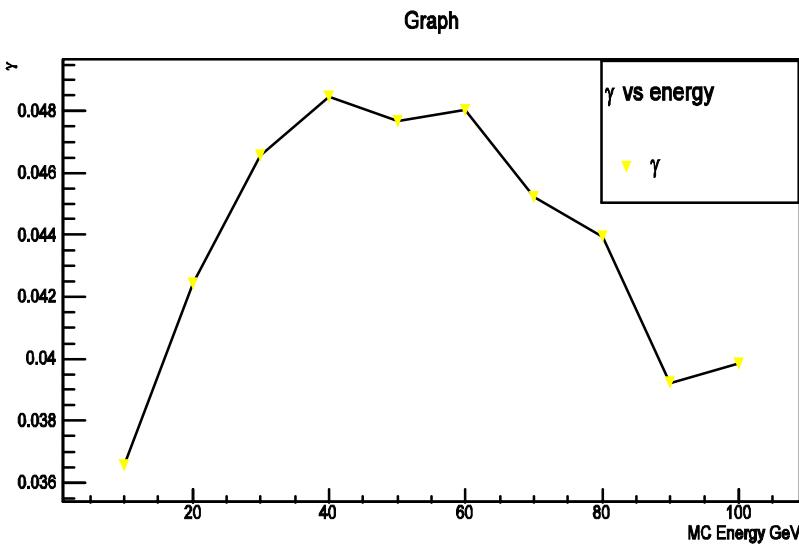
Graph



Graph



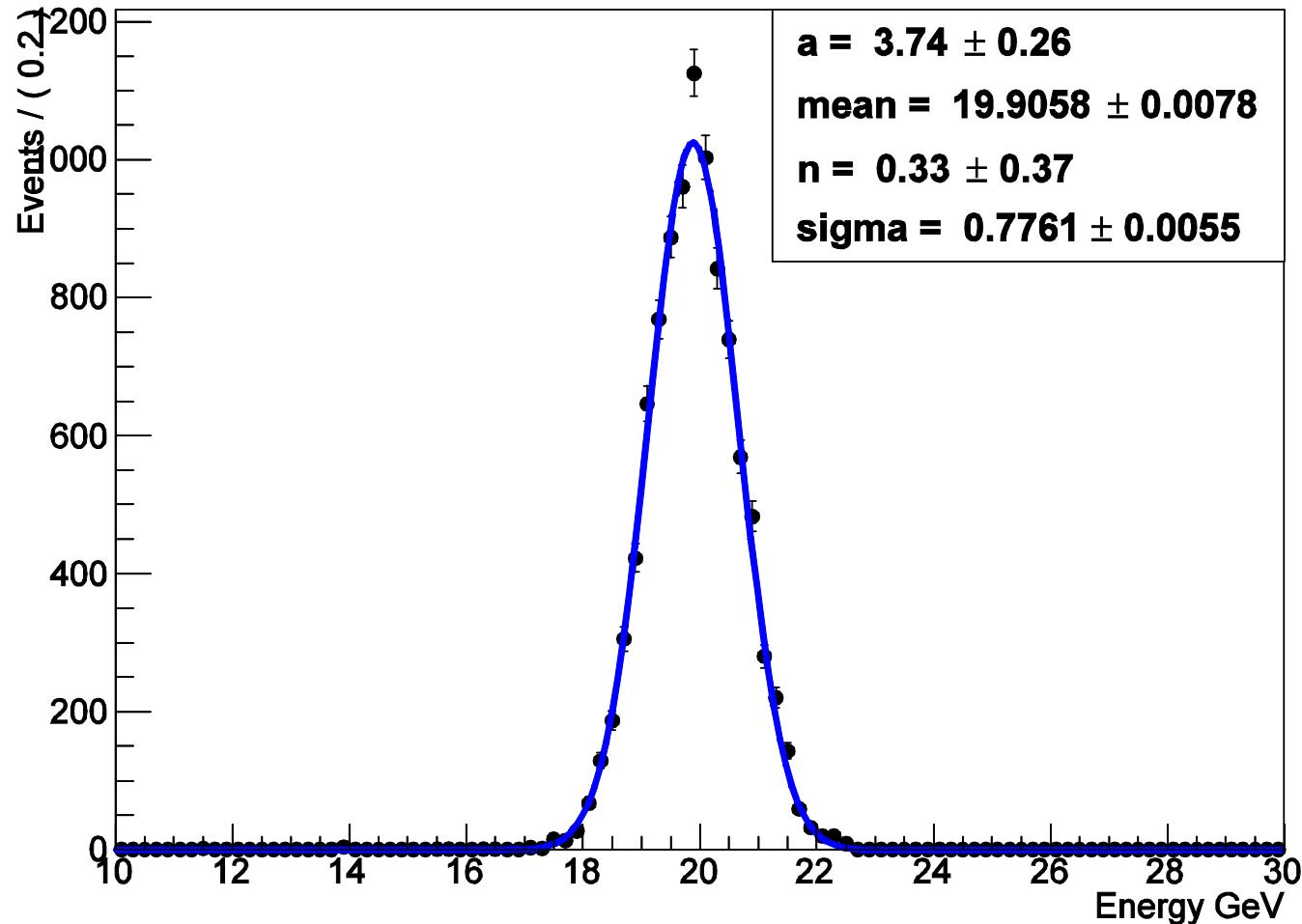
Parameter vs E (ArborPFOsCollection)



Combining result in Ecal

(ArborPFOsCollection) $E = \lambda E_{meas}^{en} + (1 - \lambda) E_{meas}^{hit}$

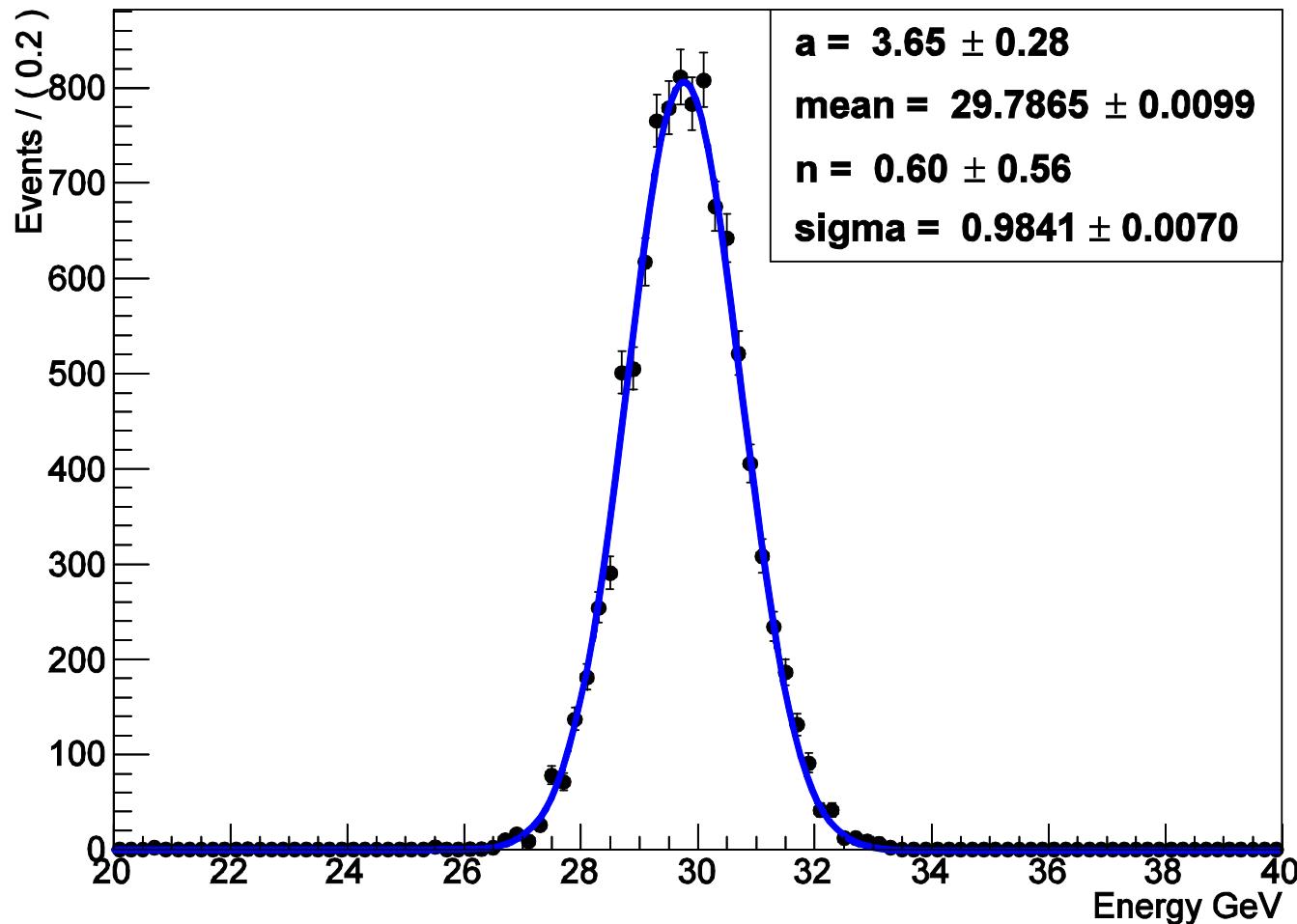
Reconstruction energy (combining E & hits)



Combining result in Ecal

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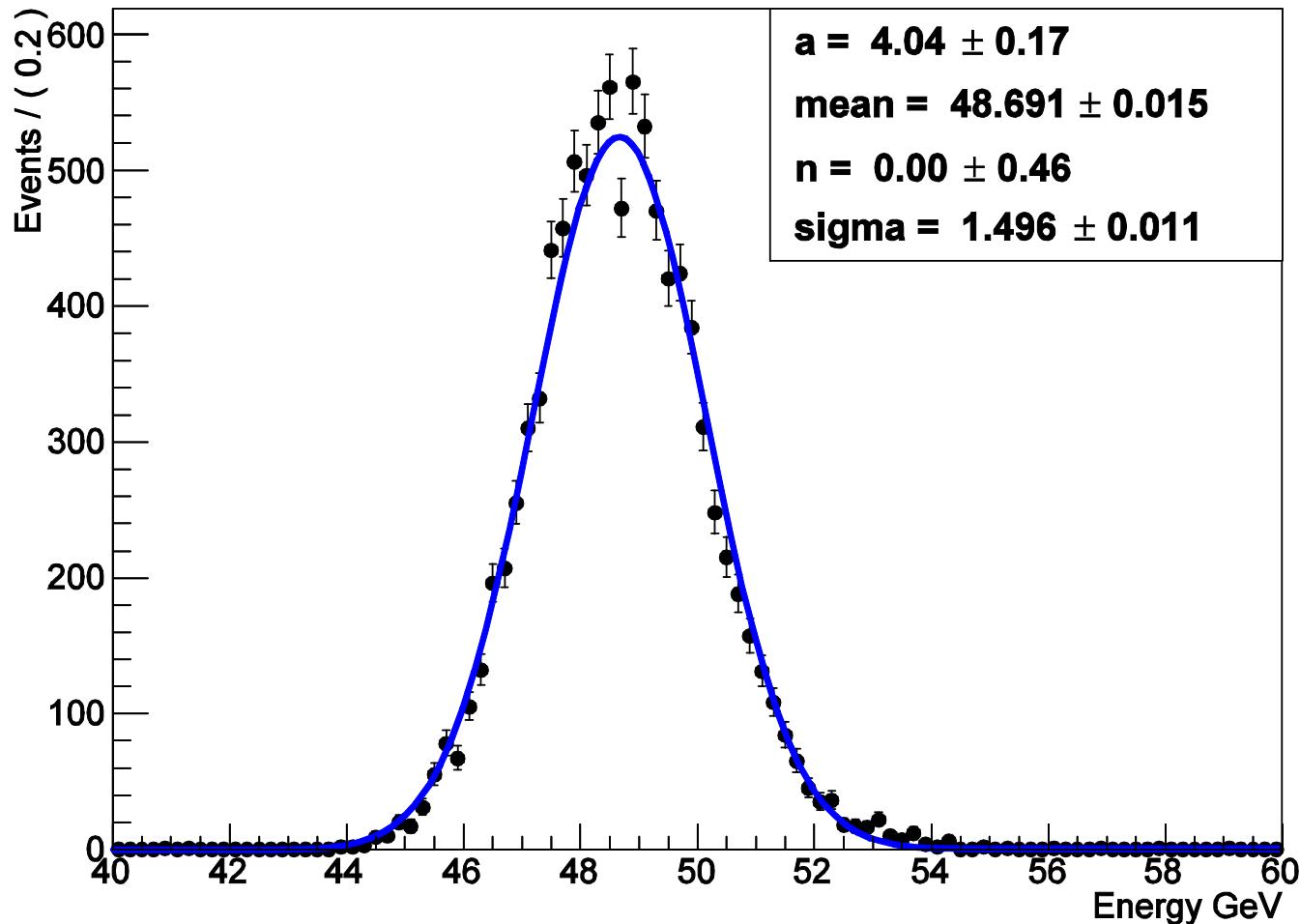
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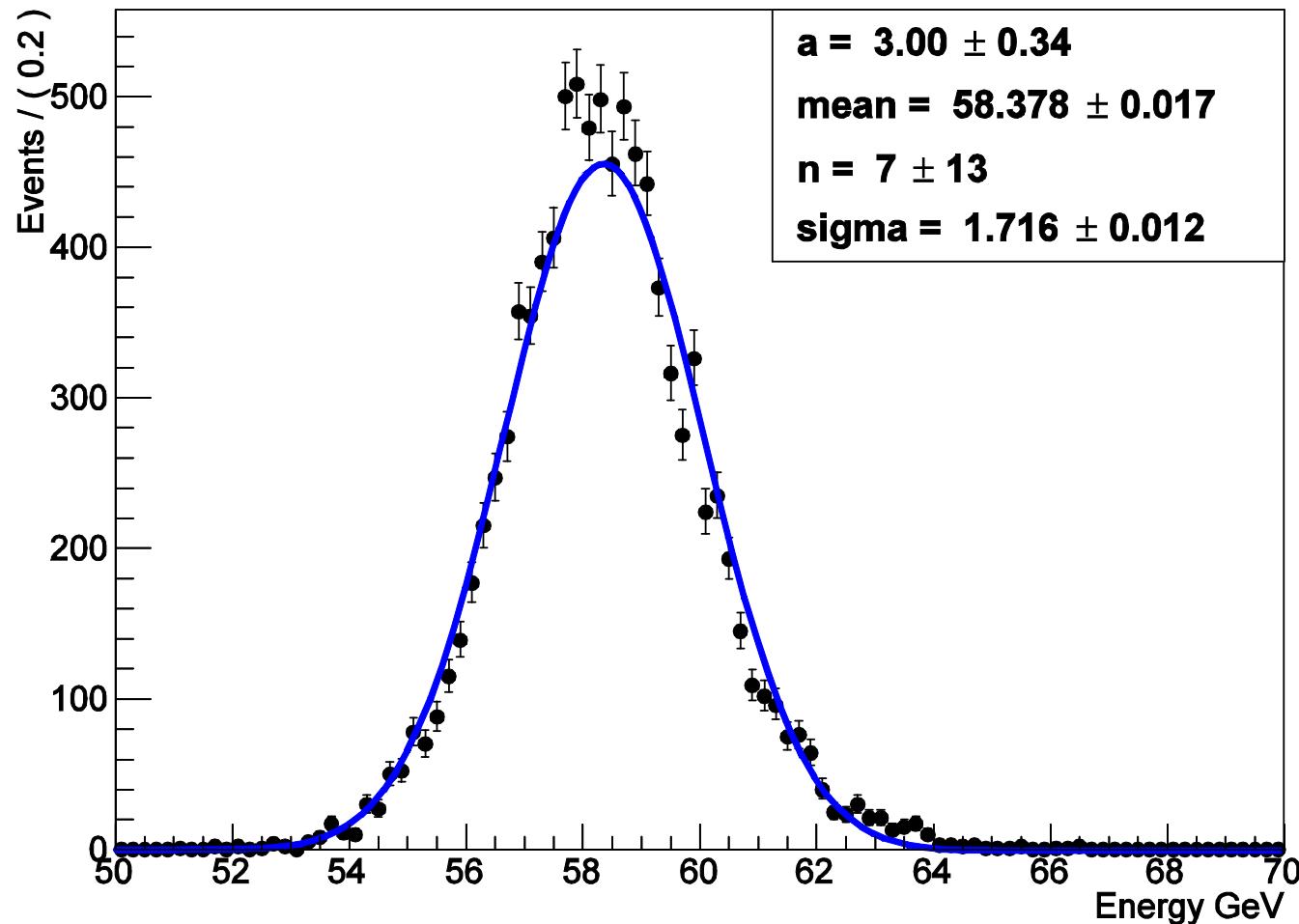
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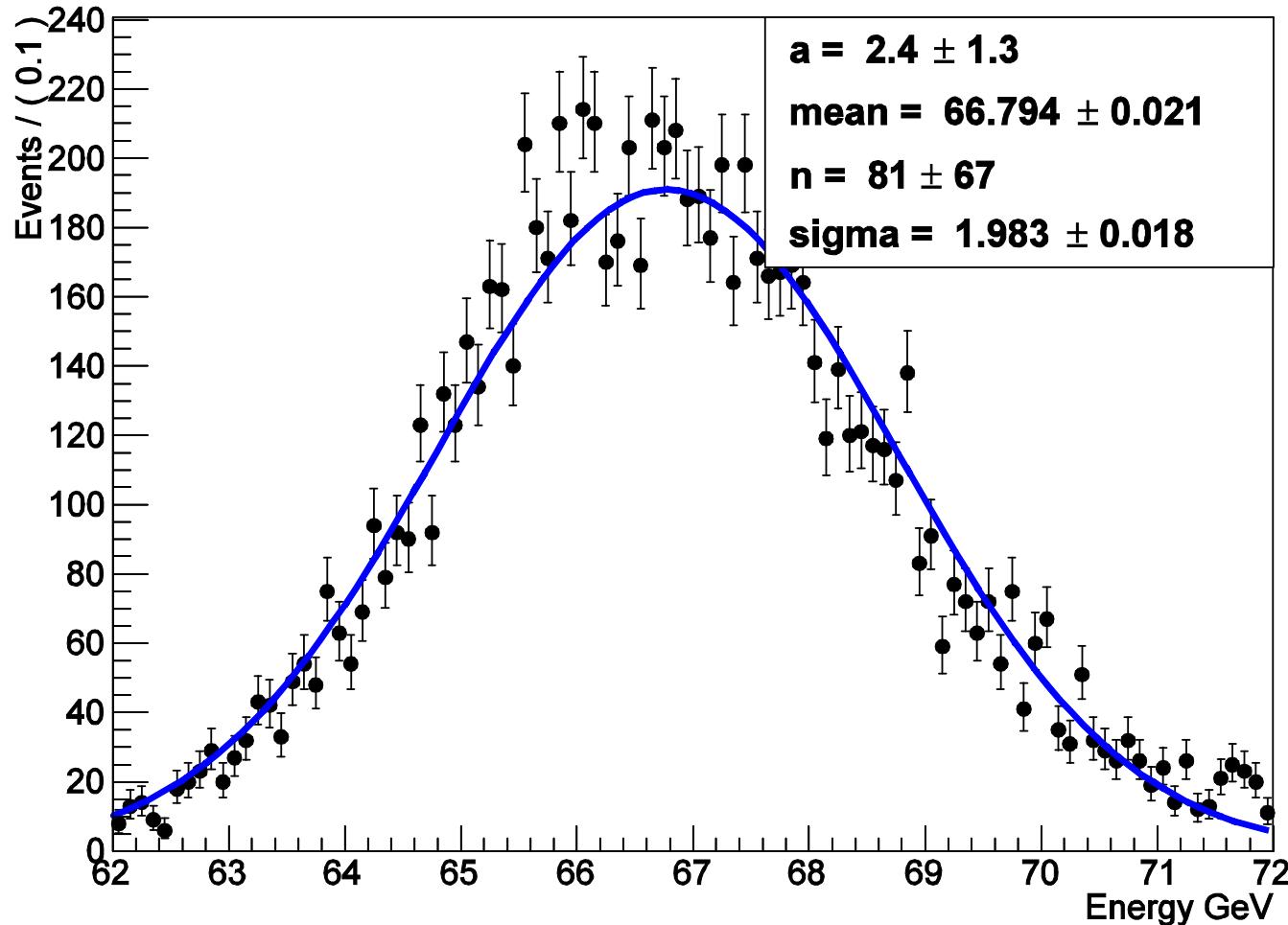
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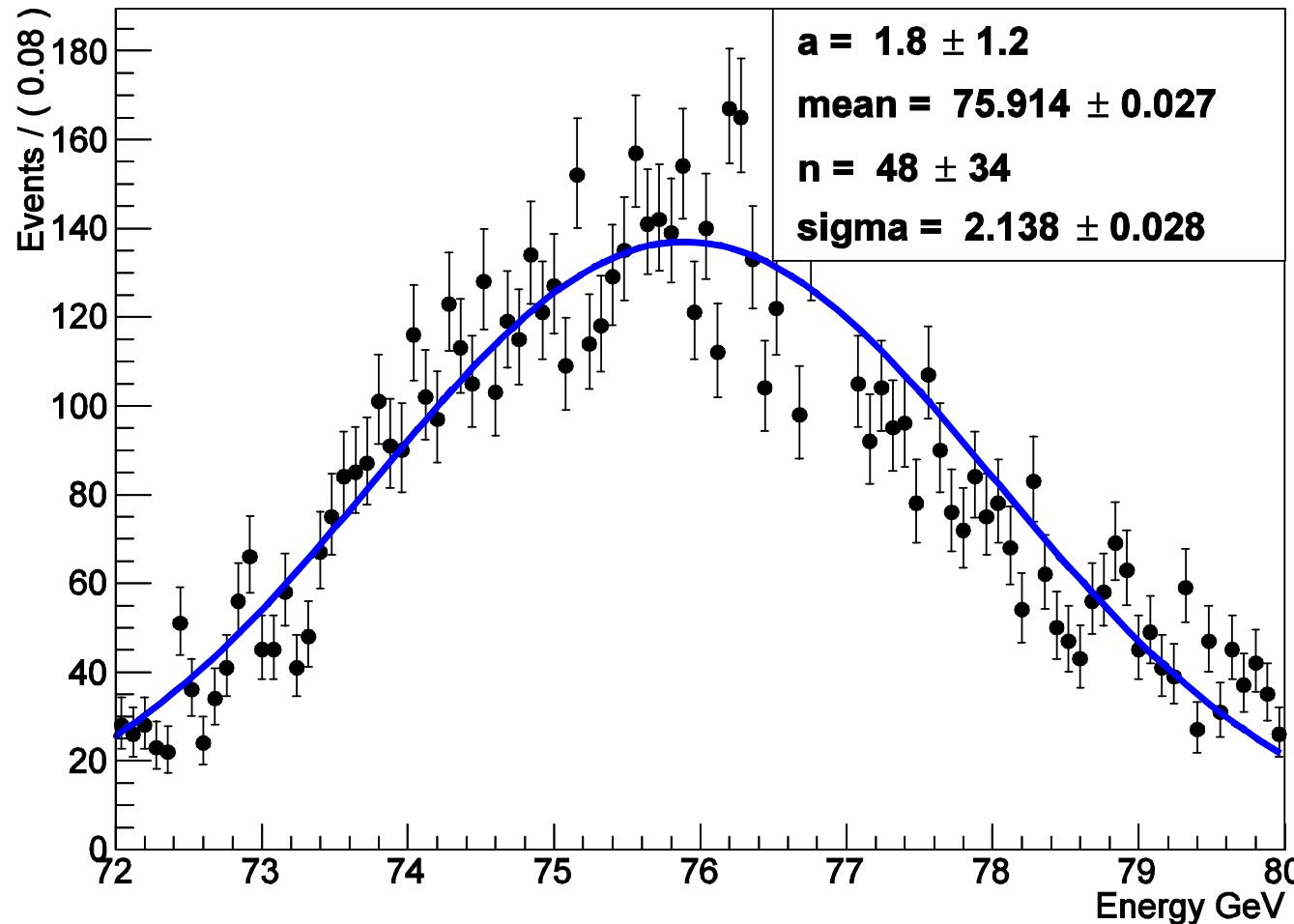
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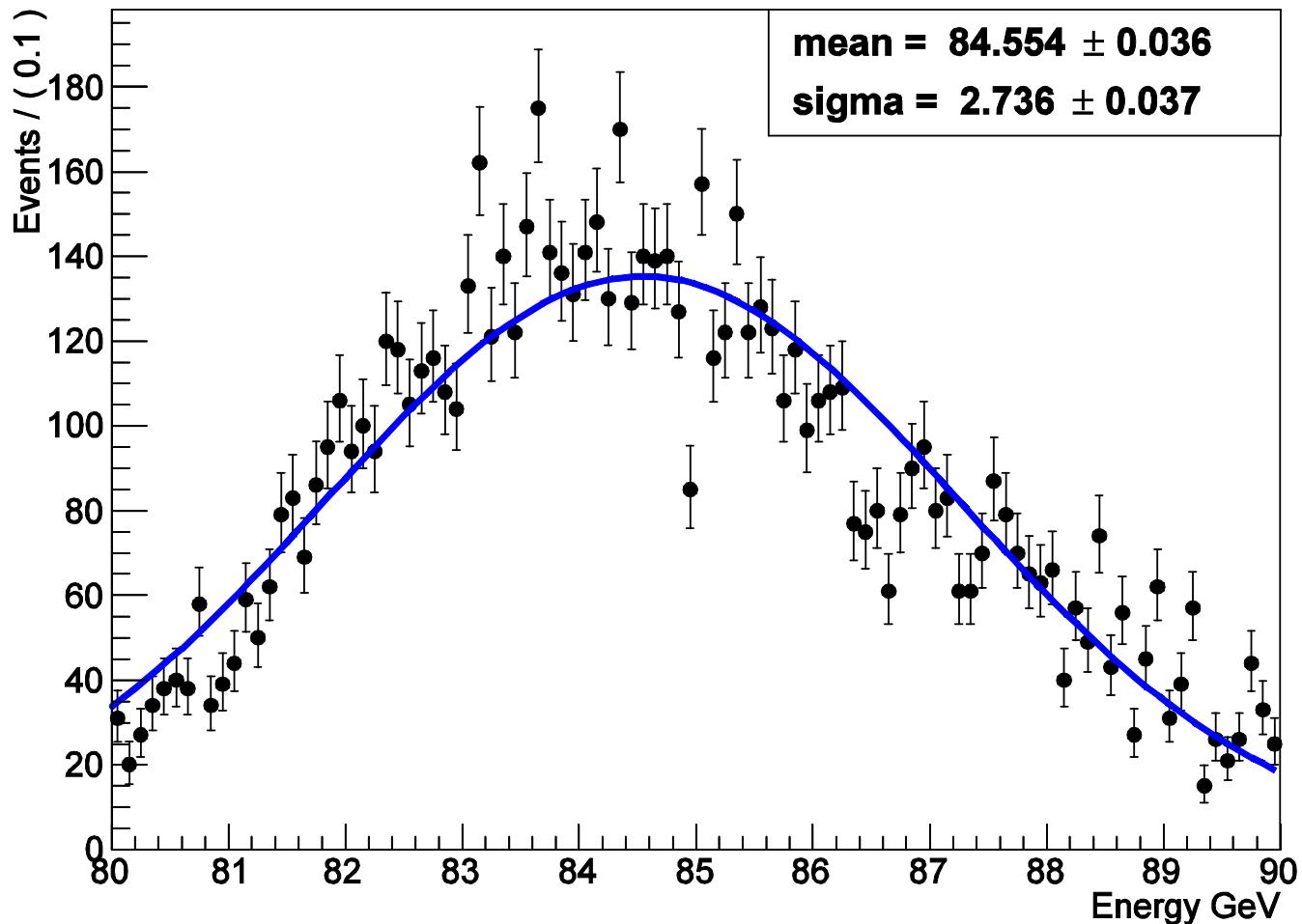
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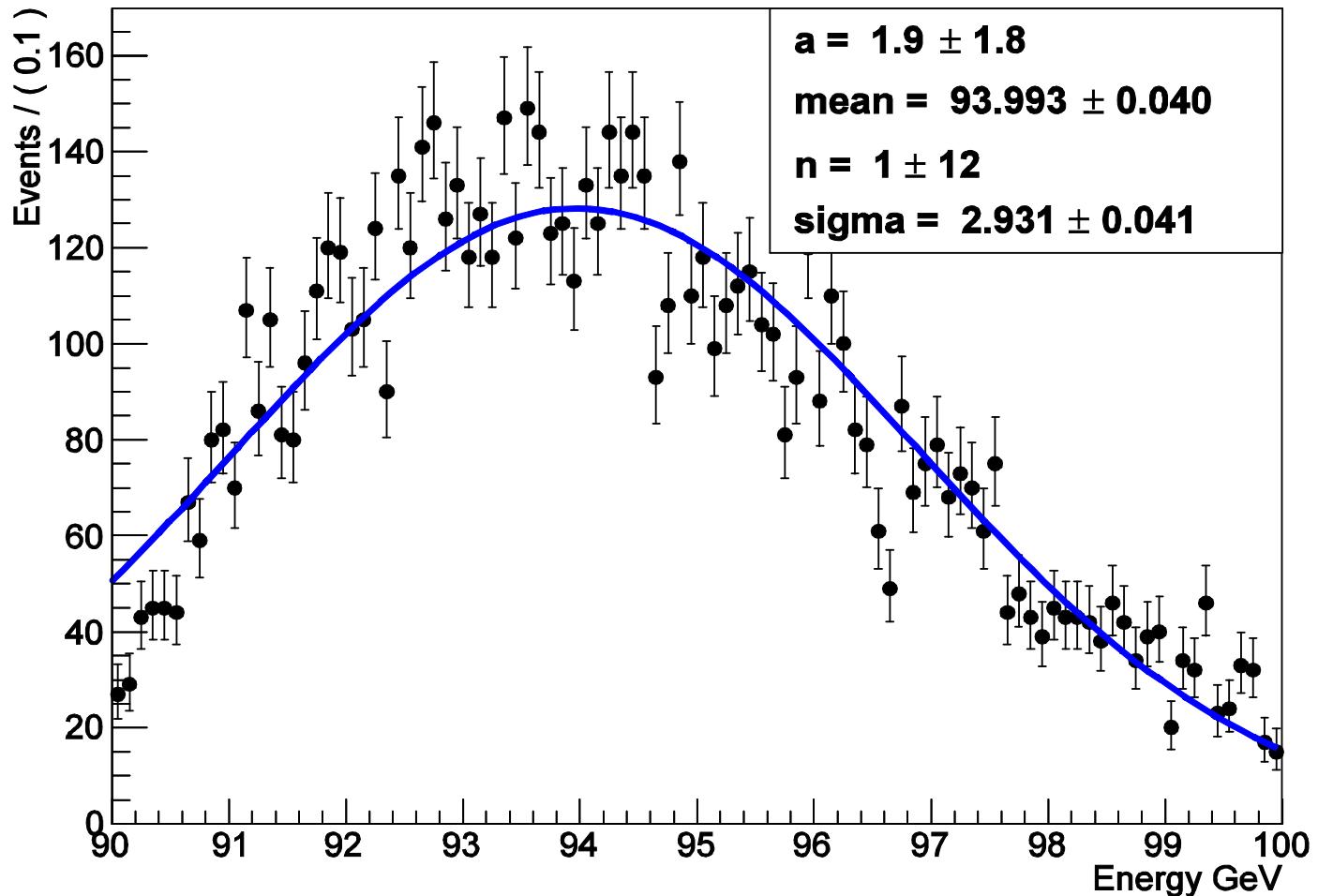
Reconstruction energy (combining E & hits)



Combining result in Ecal

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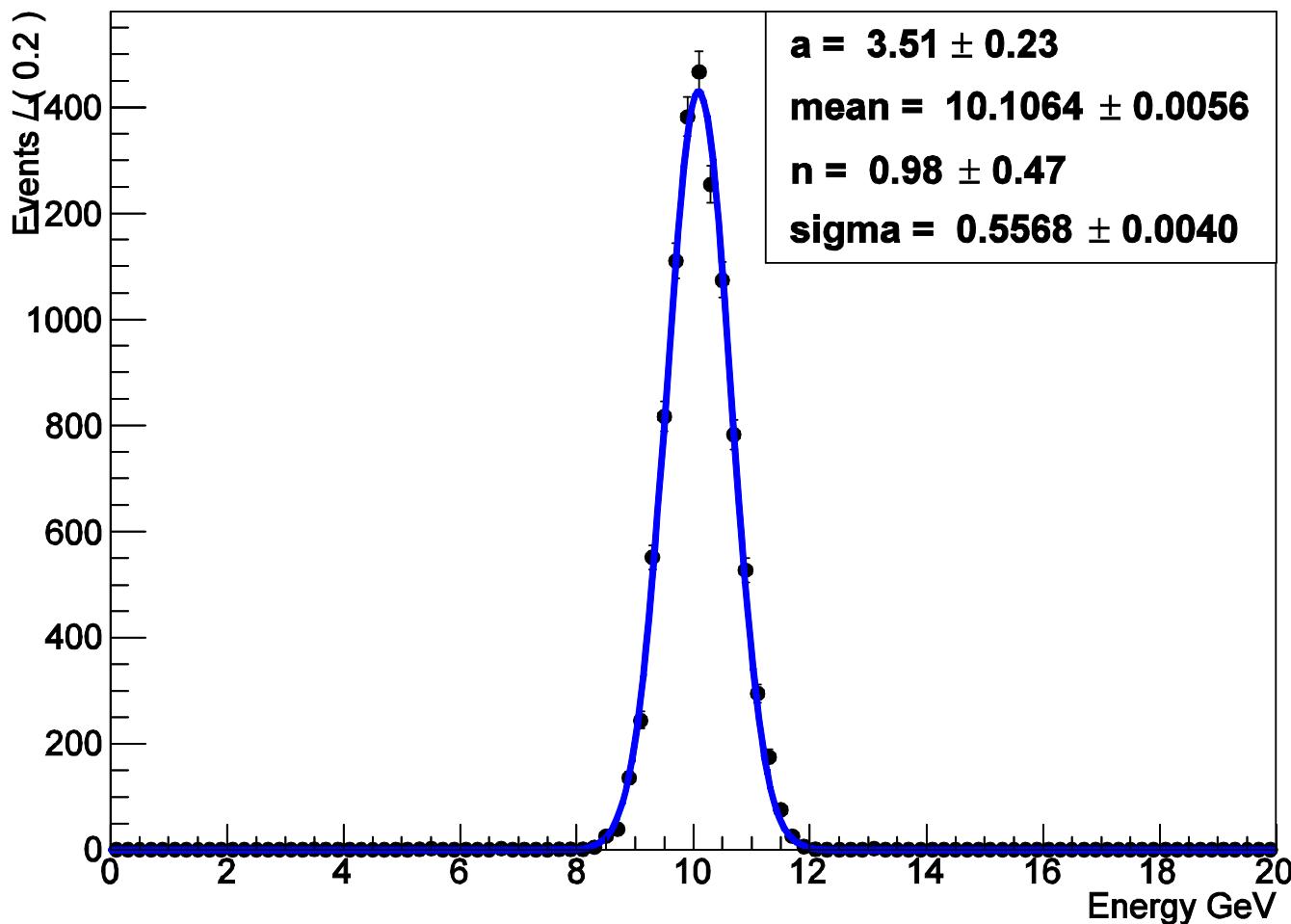
Reconstruction energy (combining E & hits)



E_{γ} deposited (perfect cluster)

$$E_{meas}^{en} = a \left(f_1 E_{odd20} + (1-f_1) E_{even20} \right) + b \left(f_2 E_{odd10} + (1-f_2) E_{even10} \right)$$

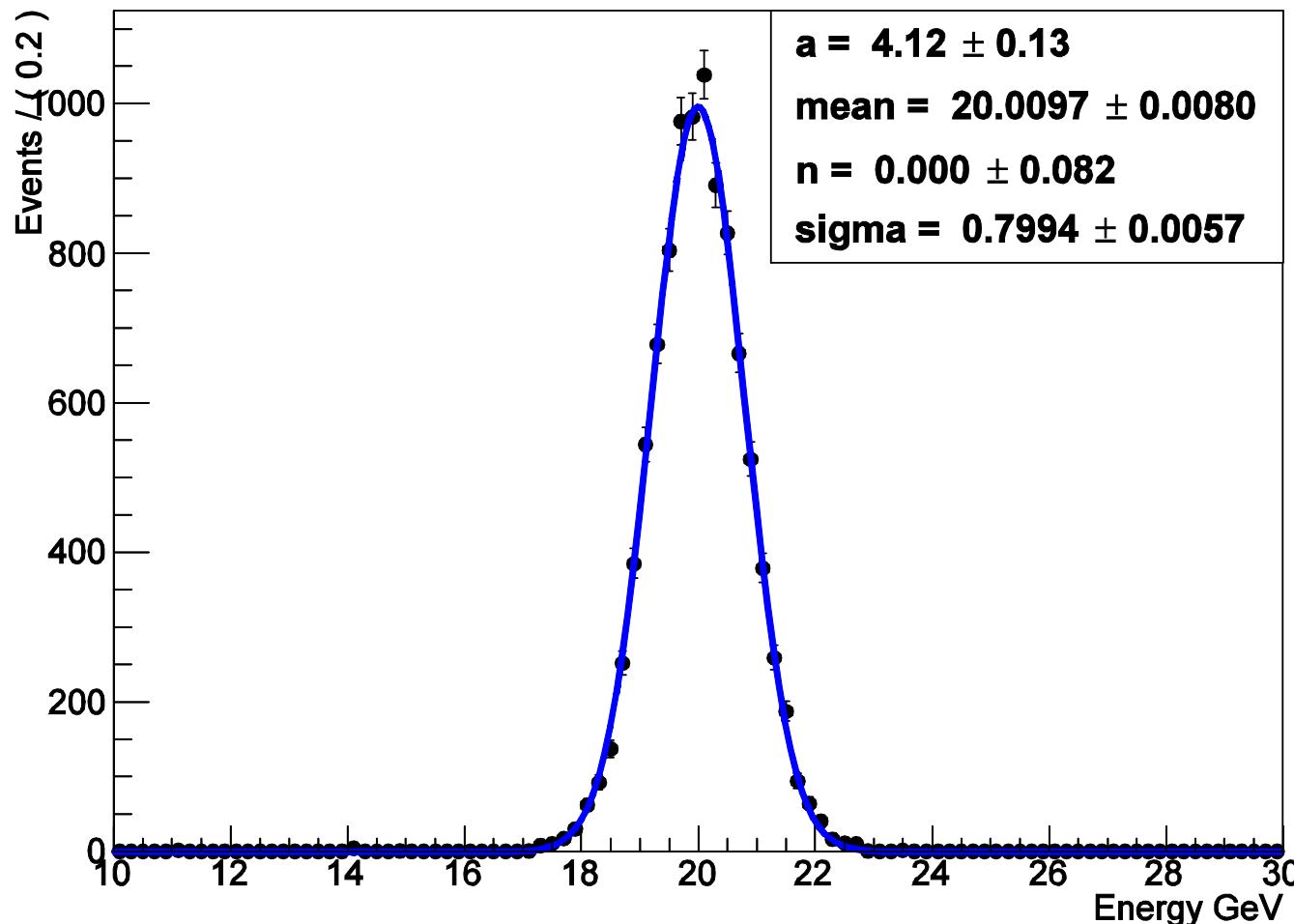
Reconstruction energy (deposit E)



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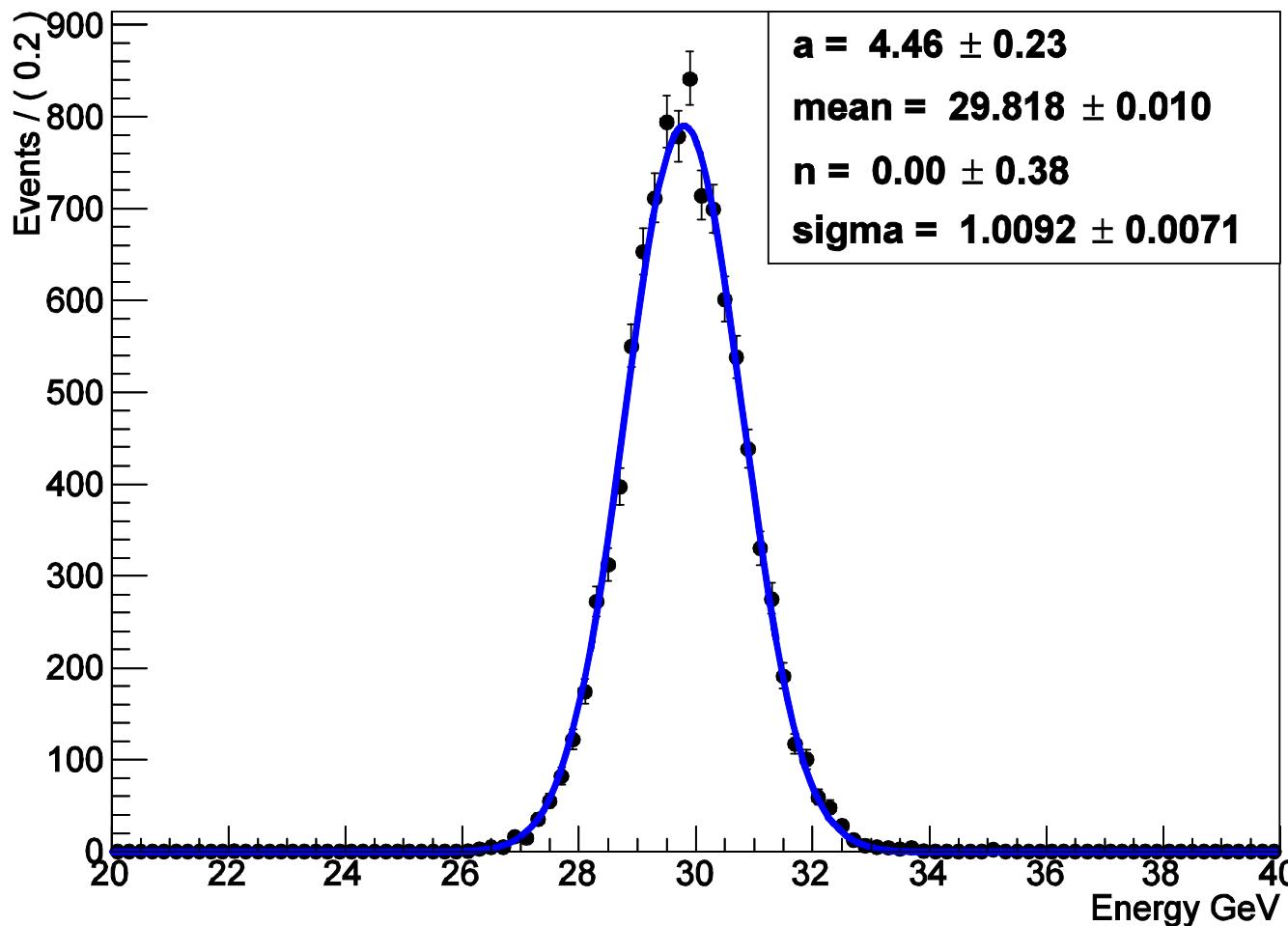
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E_γ deposited (perfect cluster)

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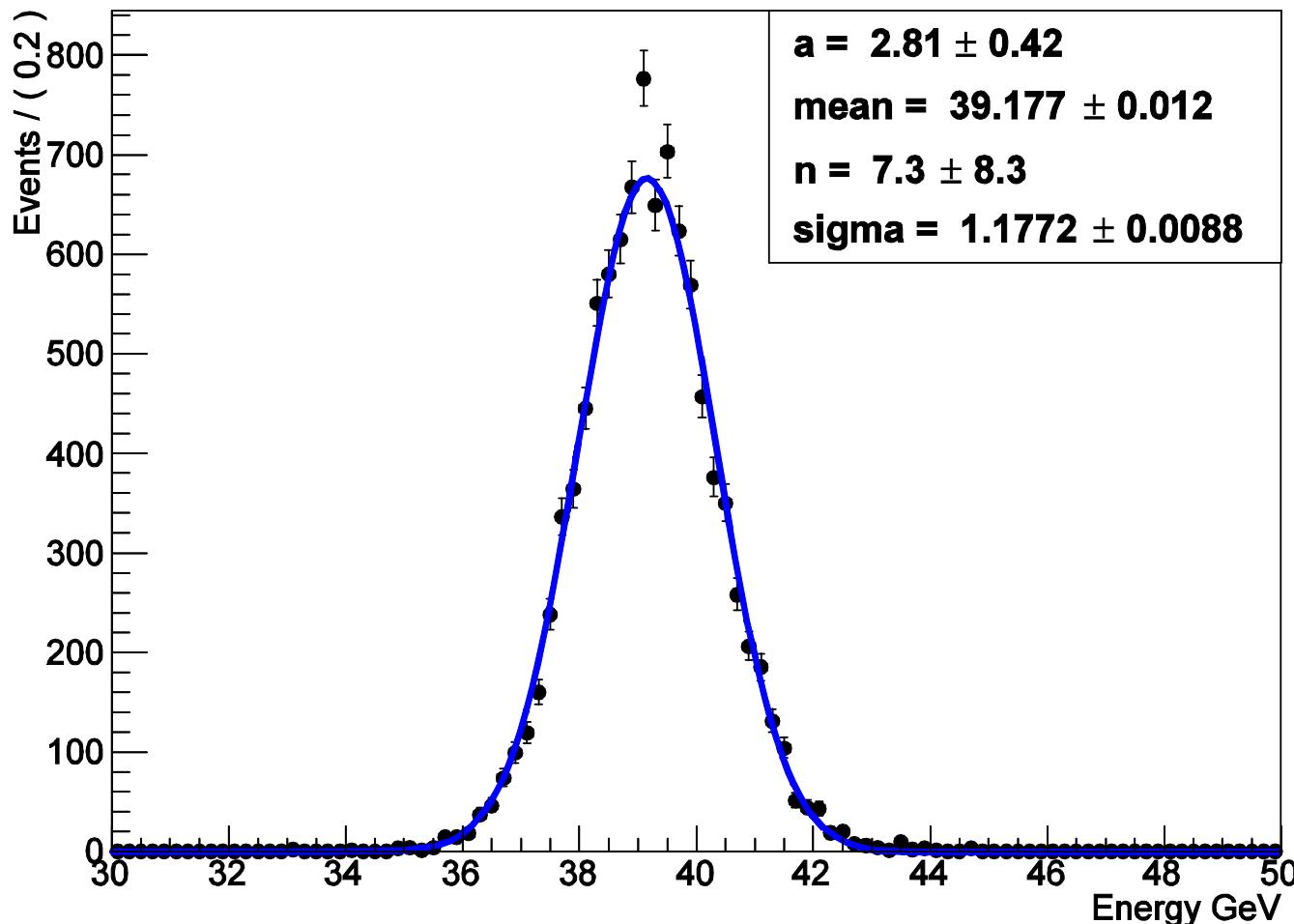
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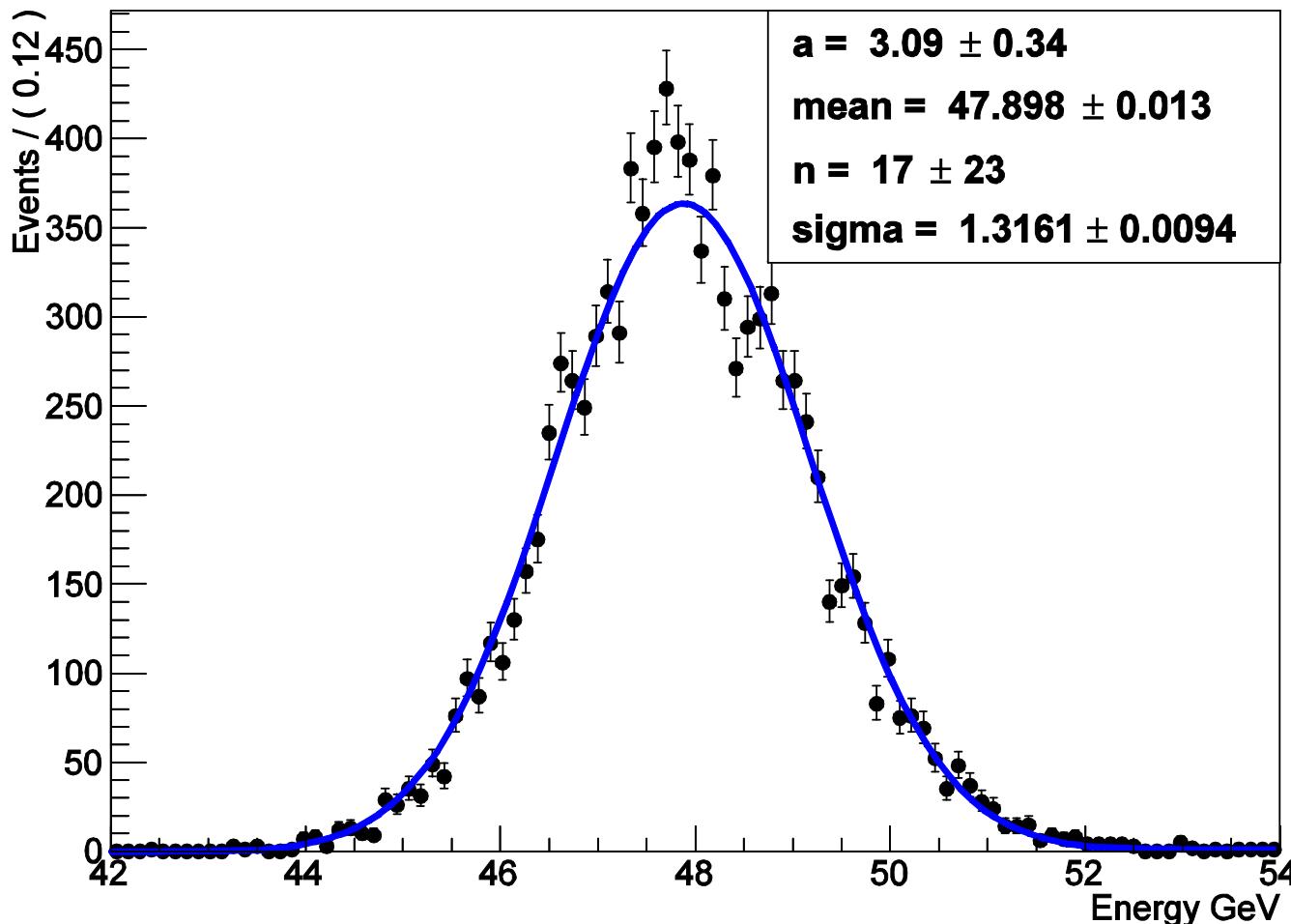
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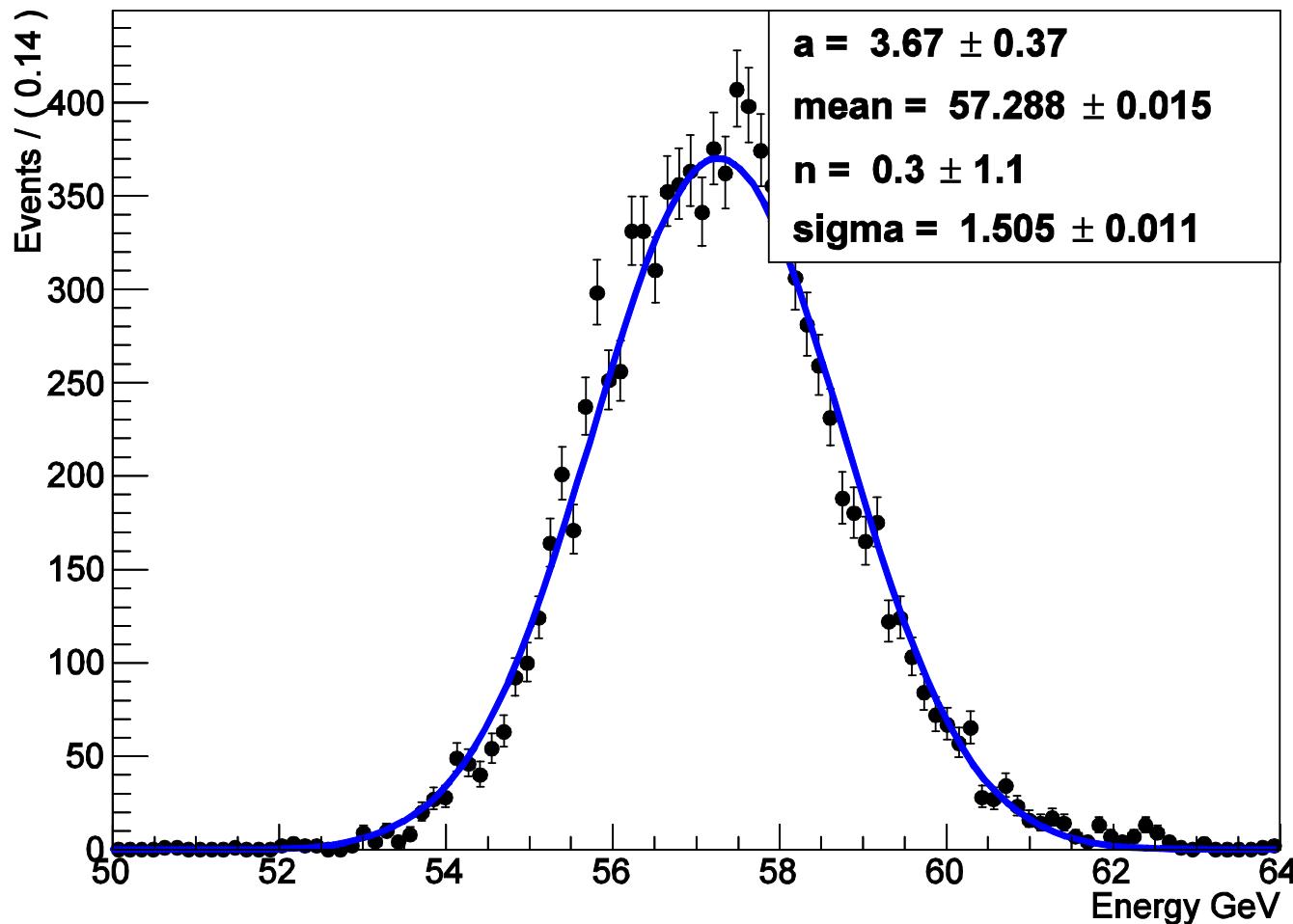
Reconstruction energy (deposit E)



E_γ deposited (perfect cluster)

$$E_{meas}^{en} = a \left(f_1 E_{odd\,20} + (1-f_1) E_{even\,20} \right) + b \left(f_2 E_{odd\,10} + (1-f_2) E_{even\,10} \right)$$

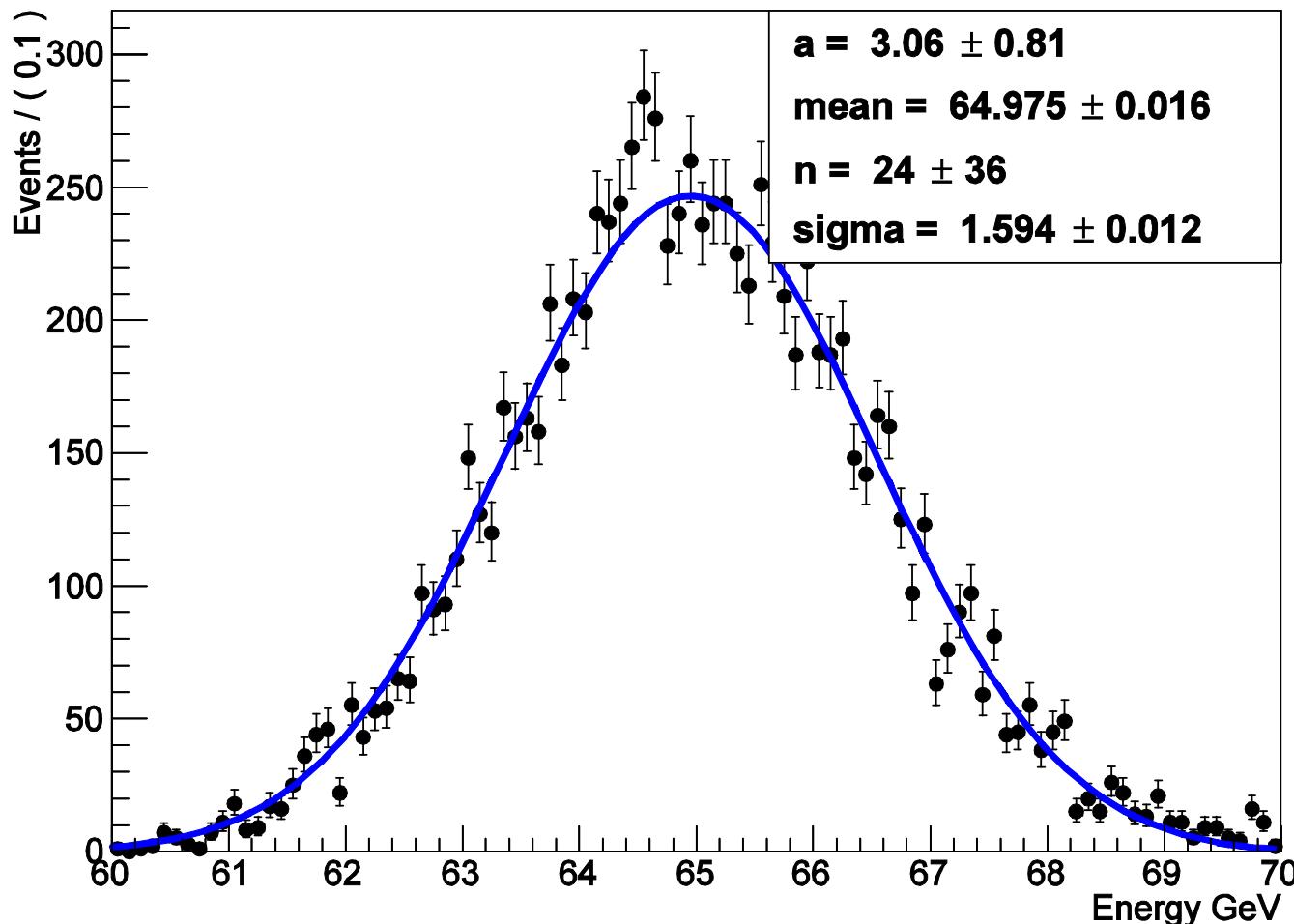
Reconstruction energy (deposit E)



E_{γ} deposited (perfect cluster)

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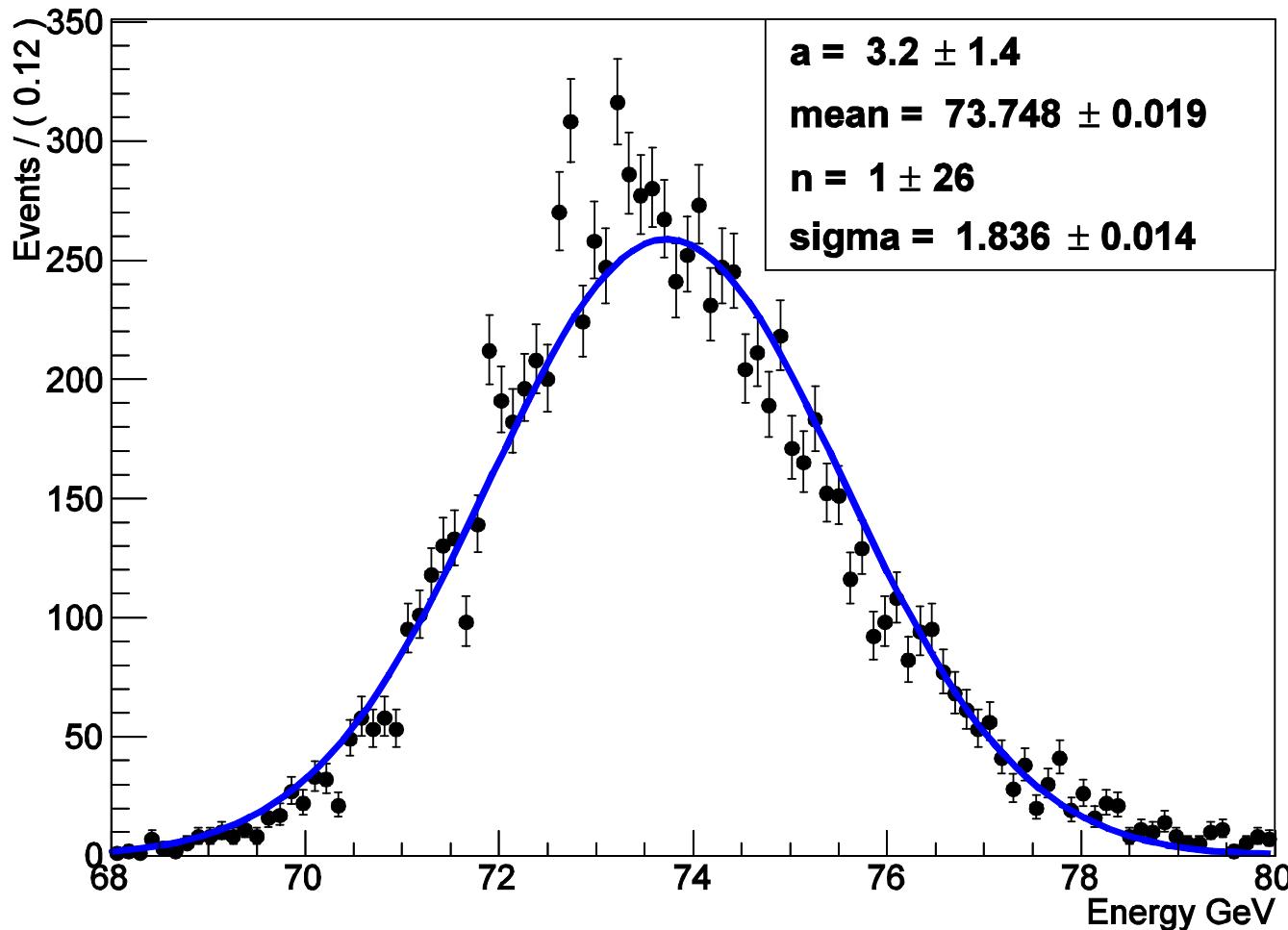
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E_γ deposited (perfect cluster)

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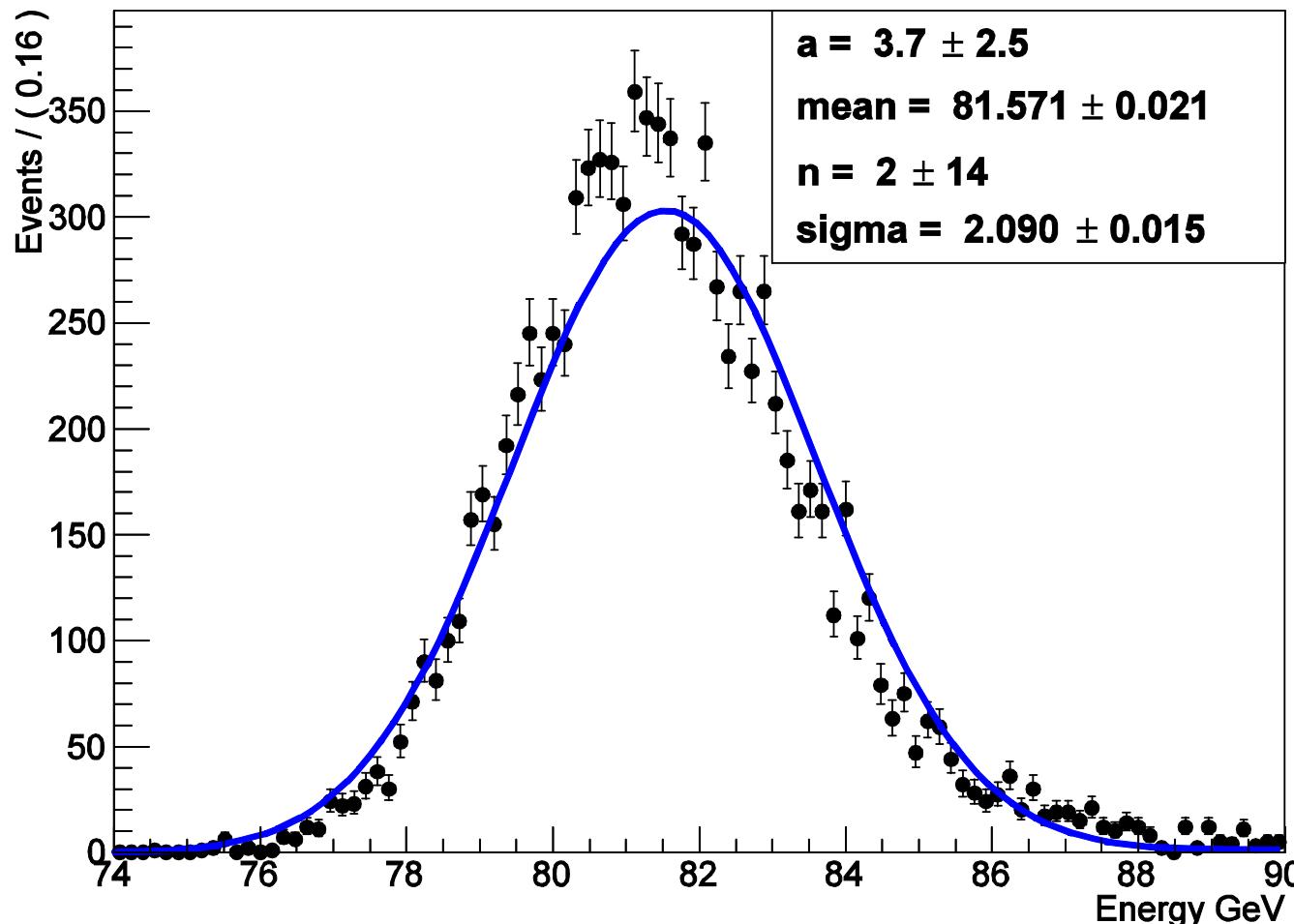
Reconstruction energy (deposit E)



E_γ deposited (perfect cluster)

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Reconstruction energy (deposit E)



E_{γ} deposited (perfect cluster)

$$E_{meas}^{en} = a \left(f_1 E_{odd20} + (1-f_1) E_{even20} \right) + b \left(f_2 E_{odd10} + (1-f_2) E_{even10} \right)$$

Reconstruction energy (deposit E)

