Longitudinal non-uniformality

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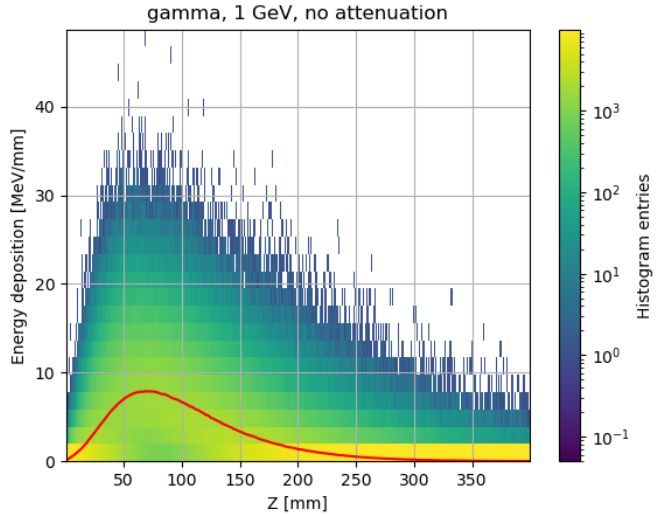
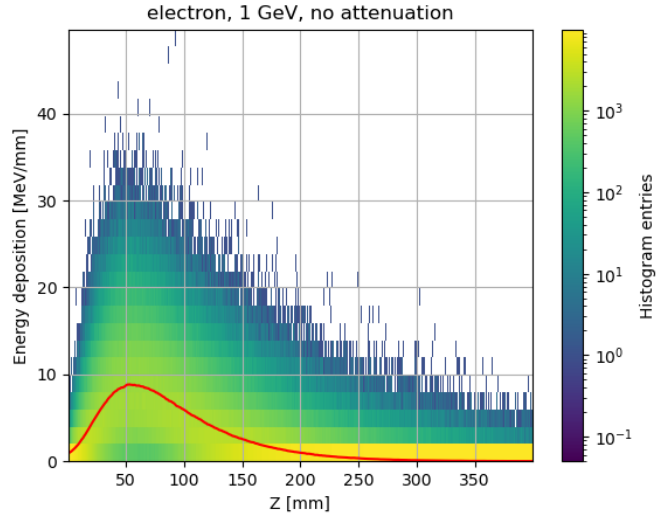
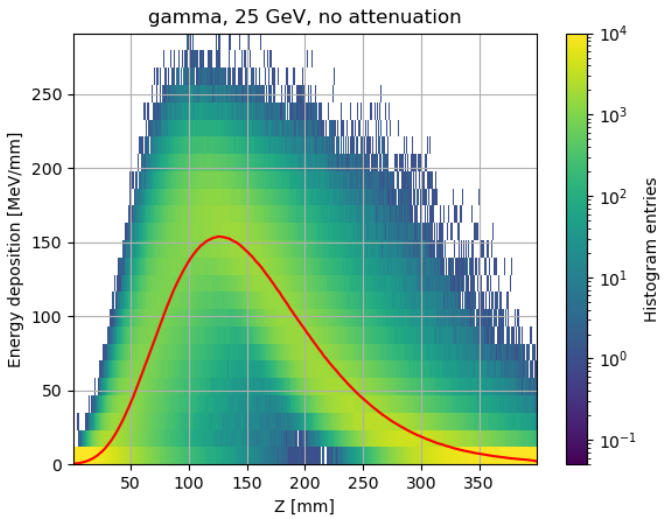
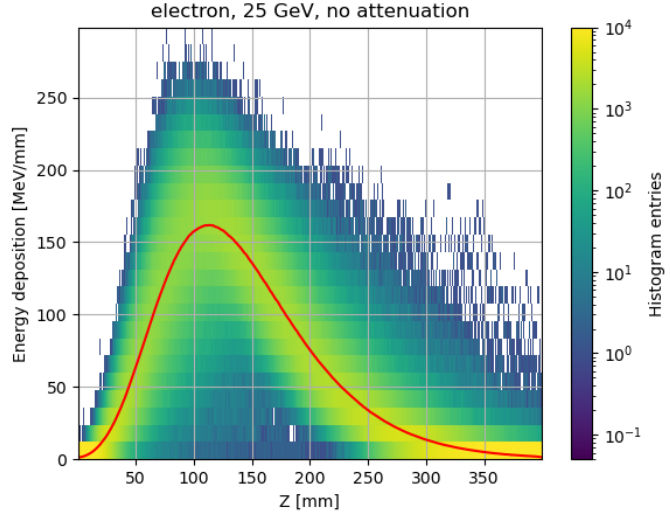
Shape of average shower energy deposition.

- $\bar{E}(z_i) = \frac{1}{10000}\sum_{k=1}^{10000} E_k(z_i)$
- $E_k(z_i)$ - energy deposited in the i-th slice during k-th event.









Event wise weighted deposited E. distribution .

- $E_k = \sum_{i=1}^{400} E_k(z_i)$
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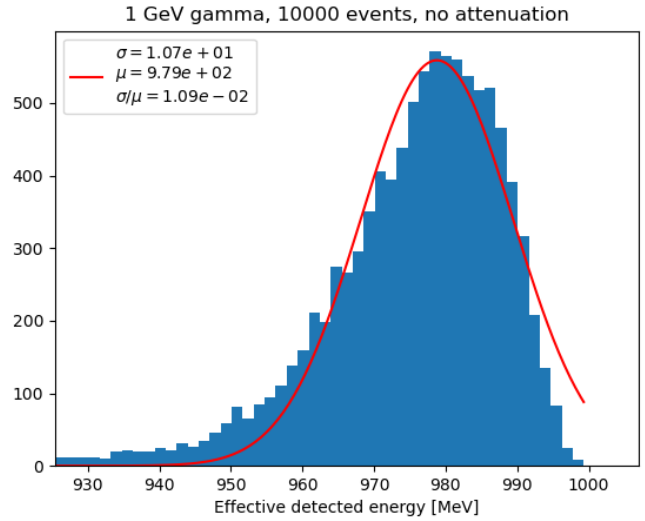
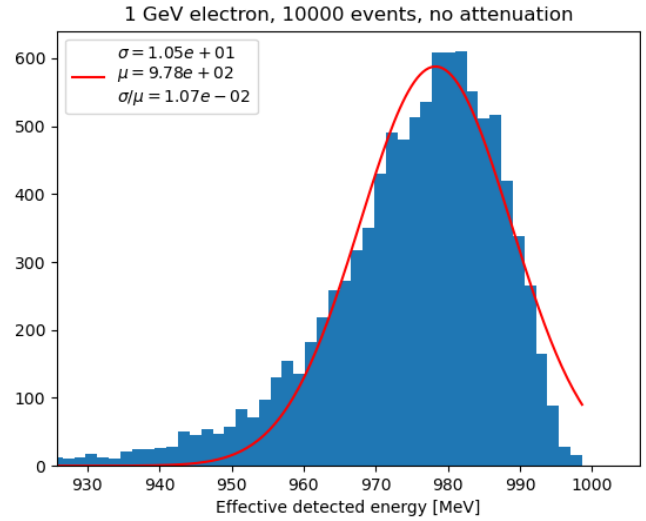
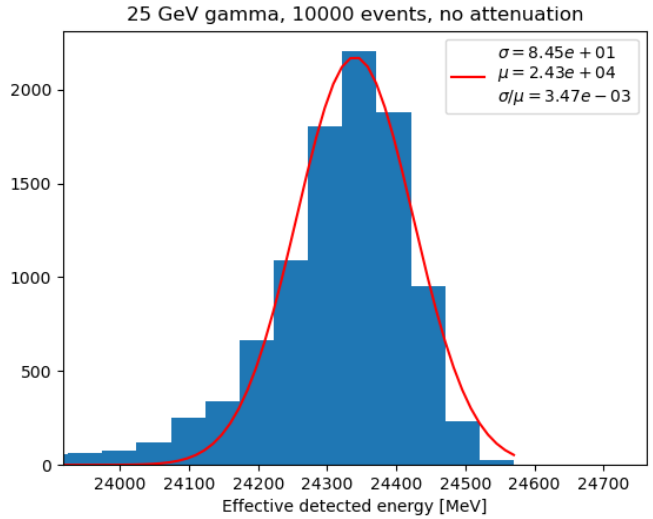
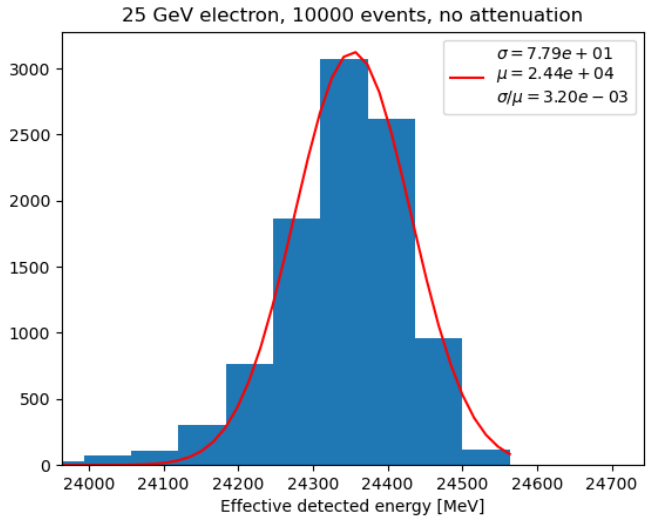




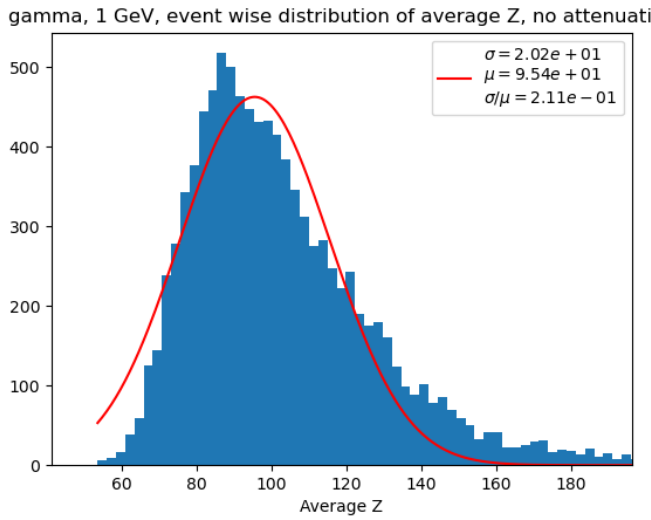


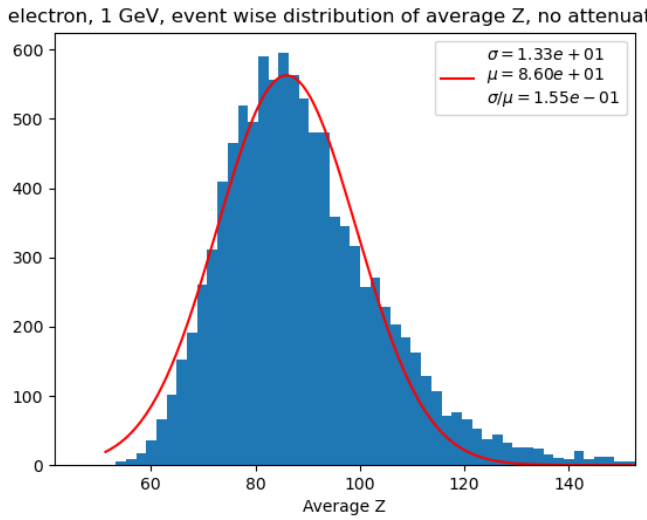


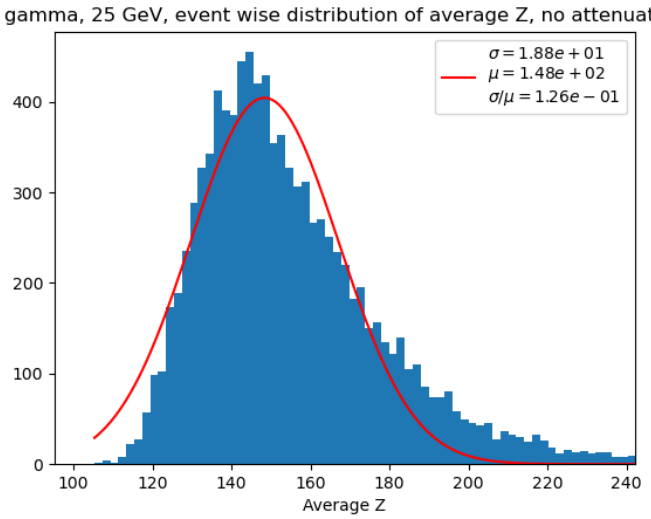
Average Z coordinate of the shower

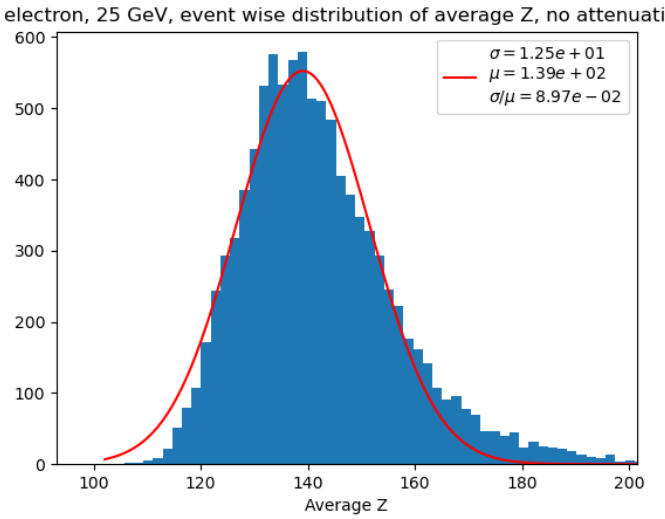
- $\overline{Z_k} = \frac{\sum_{i=1}^{400} z_i \, E_k(z_i)}{\sum_{i=1}^{400} E_k(z_i)}$

- $E_k(z_i)$ - energy deposited in the i-th slice during k-th event.









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4X0/25X0 vs 25X0 correlations

- Correlation of two variables:

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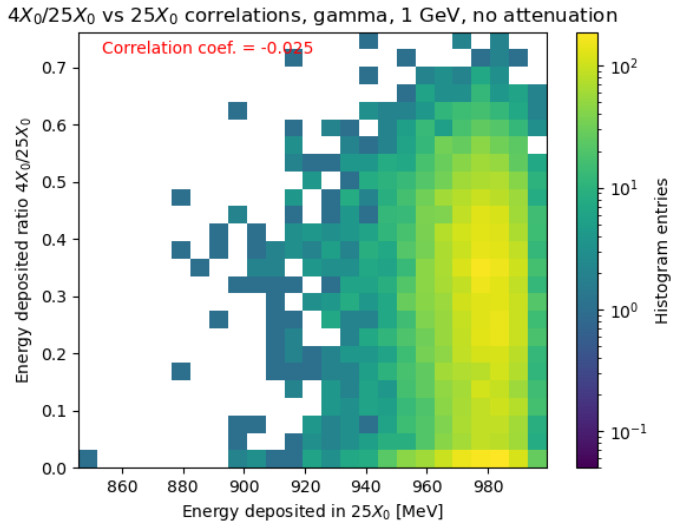

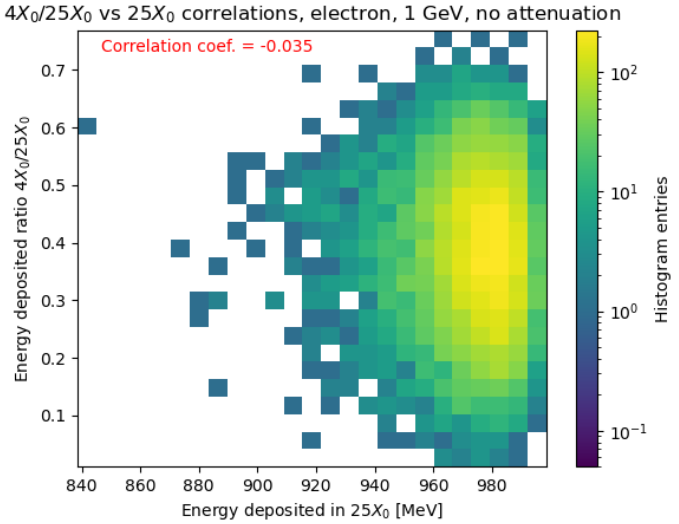

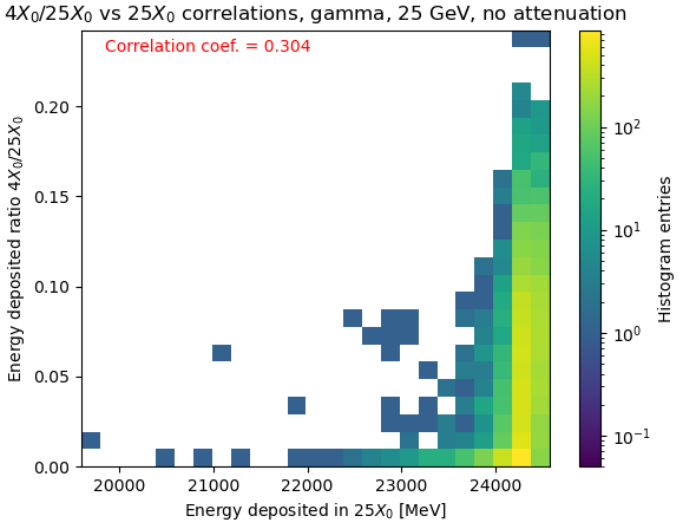

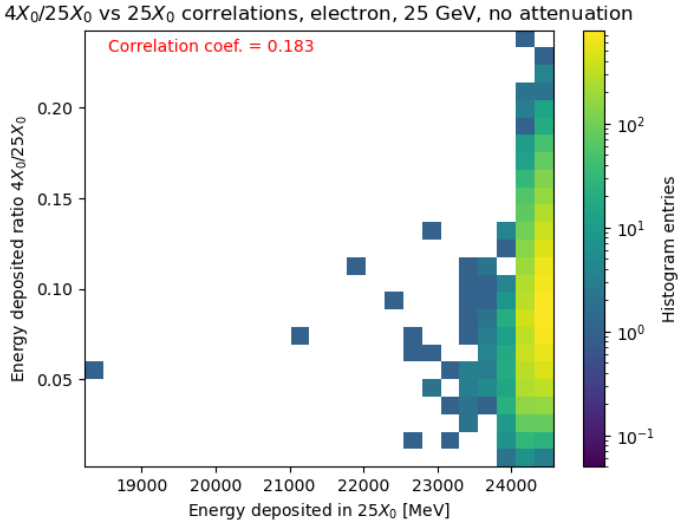

Slice weight calculation

- No mirrors at the entry facet:

$$W(z_i) = Ae^{-\frac{500[mm]-z_i[mm]}{L}}$$

- With mirrors at the entry facet:

$$W(z_i) = A\left(e^{-\frac{500[mm]-z_i[mm]}{L}} + 0{,}7e^{-\frac{500[mm]+z_i[mm]}{L}}\right)$$

- Coefficient A ensures that $\int W(z)\,dz = 1$

- L = 667 mm for O2 fibers
- L = 1500 mm for Y11 fibers

25 GeV Gamma

Average weighted energy deposition shape. 25 GeV, γ

- $\overline{E}(z_i) = \frac{1}{10000}\sum_{k=1}^{10000} E_k(z_i)\, W(z_i)$
- $E_k(z_i)$ - energy deposited in the i-th slice during k-th event.
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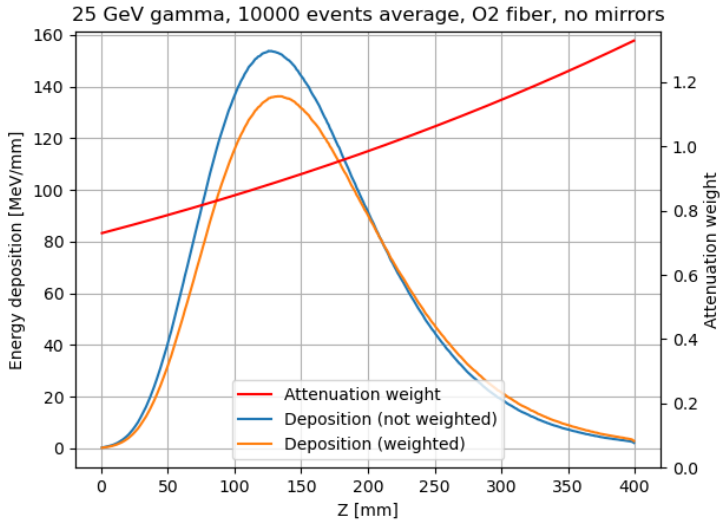

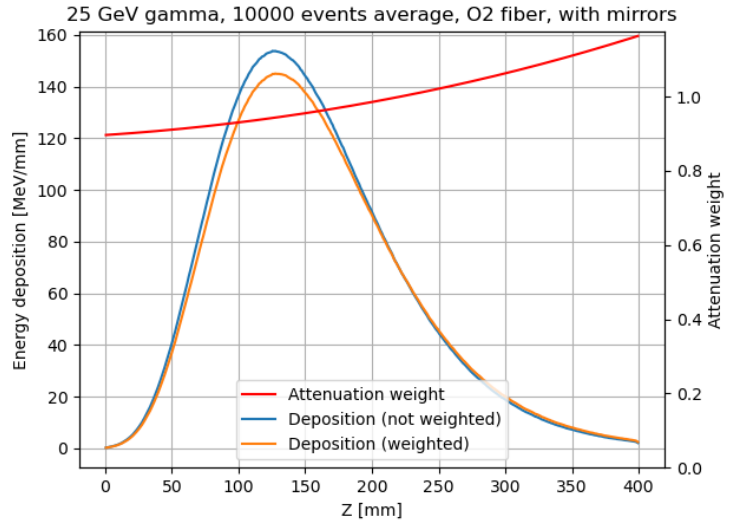

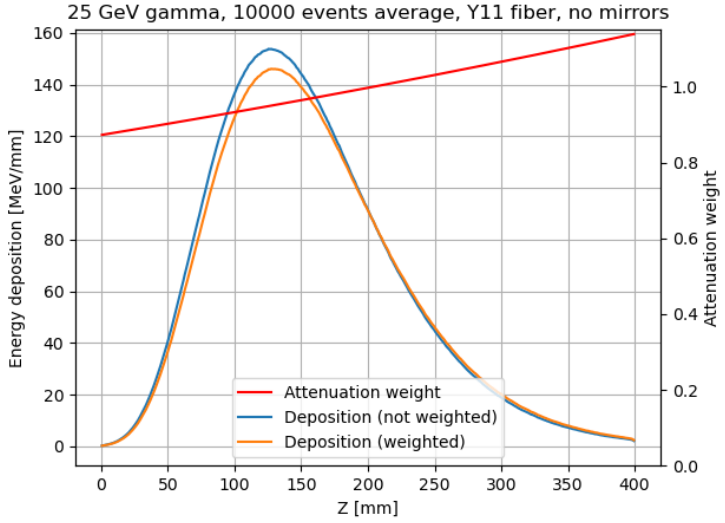

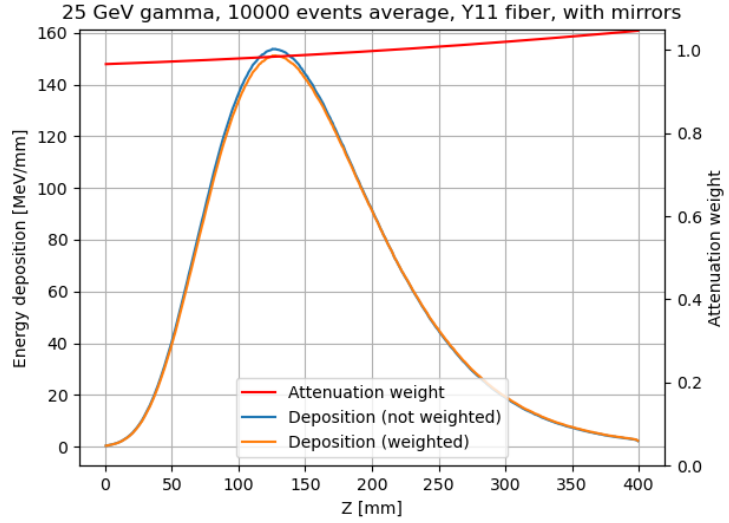

Event wise weighted deposited E. distribution . 25 GeV, γ

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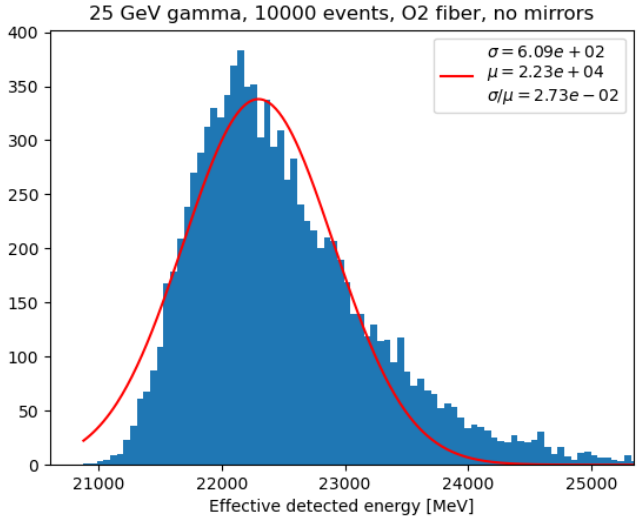

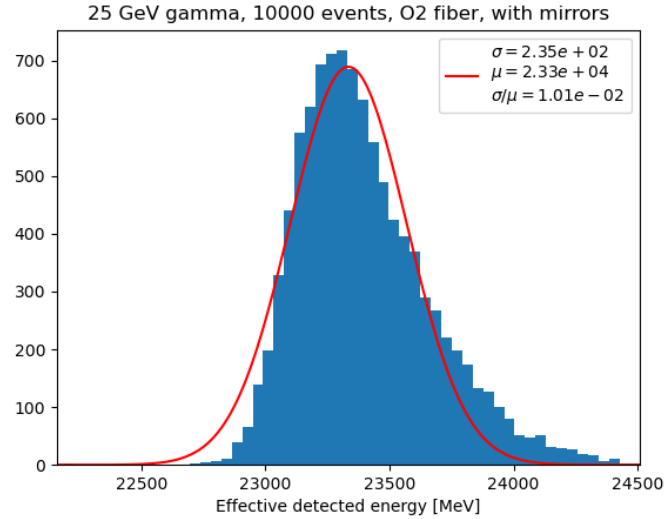

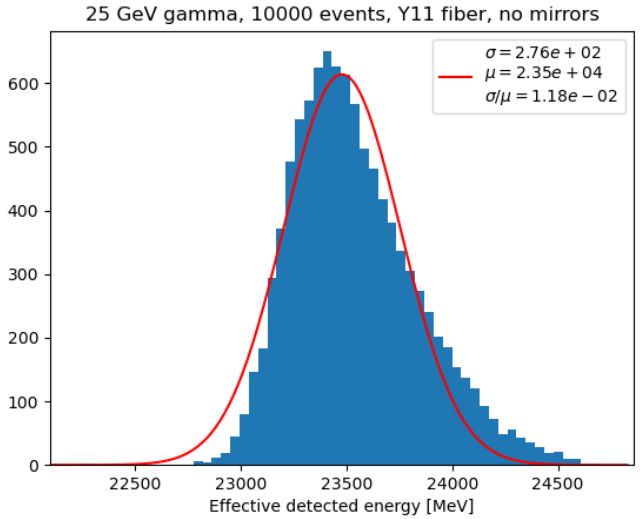

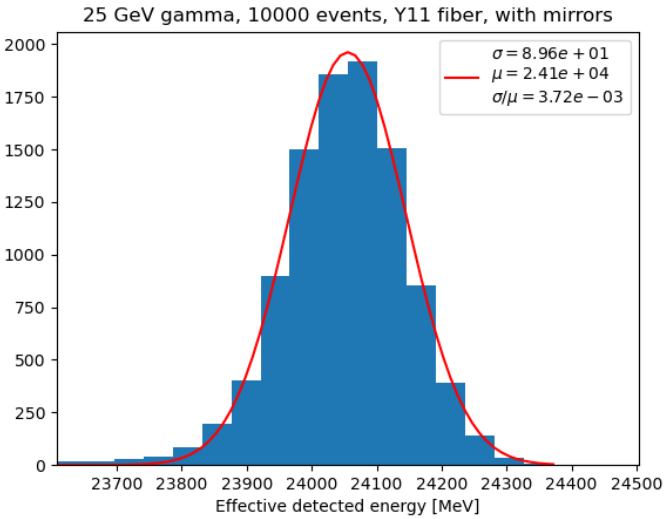

4X0/25X0 vs 25X0 weighted correlations. 25 GeV, γ

- Correlation of two variables:

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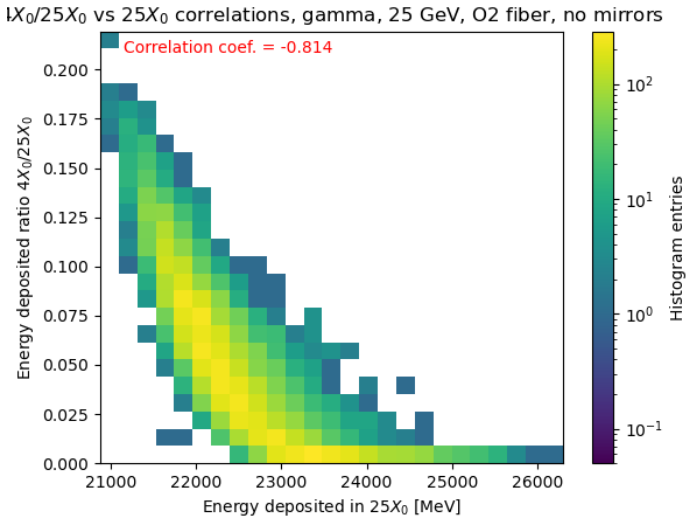

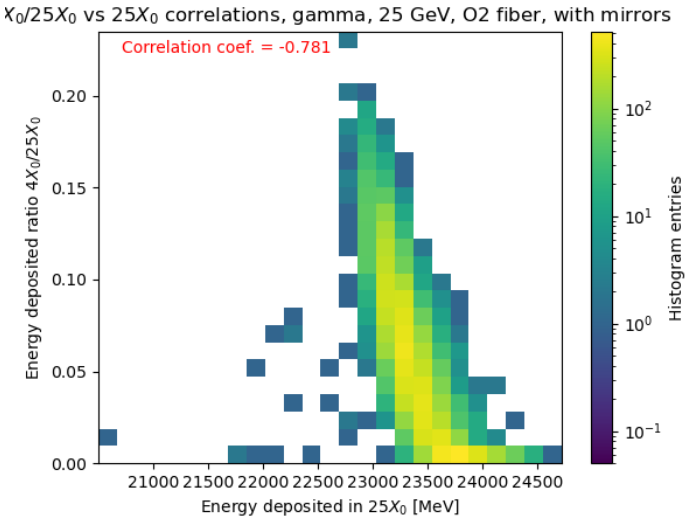

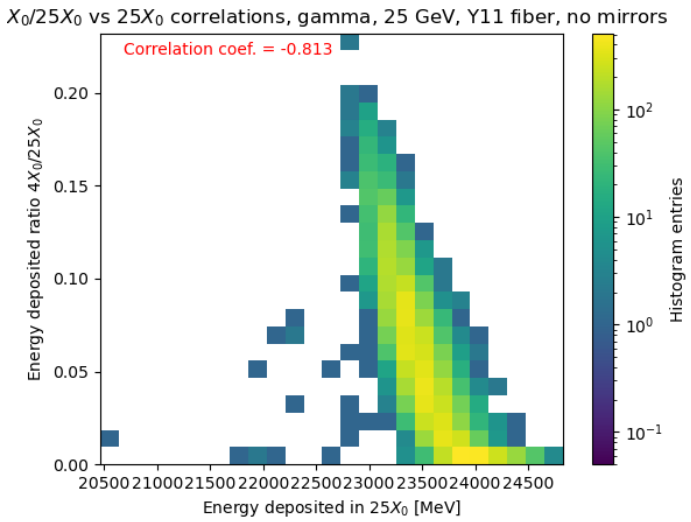

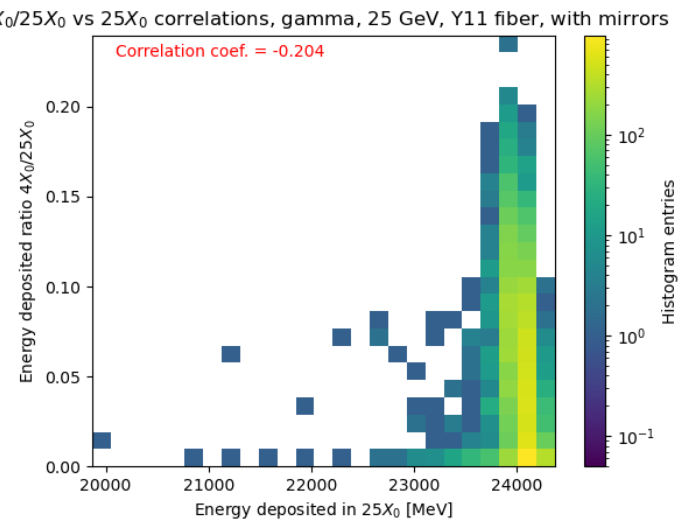

Aggregated numbers

Variable	Fiber type	Mirror	25 GeV gamma	25 GeV electron	1 GeV gamma	1 GeV electron
Energy resolution σ/μ	no attenuation		3,47E-03	3,20E-03	1,09E-02	1,07E-02
	O2	no mirror	2,73E-02	1,85E-02	3,40E-02	2,47E-02
		with mirror	1,01E-02	7,07E-03	1,57E-02	1,32E-02
	Y11	no mirror	1,18E-02	8,13E-03	1,86E-02	1,49E-02
		with mirror	3,72E-03	3,38E-03	1,14E-02	1,09E-02
Correlations 4X0/totval vs total	no attenuation		0,304	0,183	-0,025	-0,035
	O2	no mirror	-0,814	-0,781	-0,814	-0,756
		with mirror	-0,781	-0,698	-0,604	-0,445
	Y11	no mirror	-0,813	-0,742	-0,695	-0,548
		with mirror	-0,204	-0,227	-0,281	-0,190

Conclusions

- The system with O2 optical fiber gives energy resolution worse than 2%.
- The energy resolution for gammas is slightly worse than for electrons.
- The energy deposited in the first 4X0 (64 mm) is correlated with totally deposited energy. Interesting: the worse the resolution is the better the correlation.
- The characteristics of the system with Y11 fibers are close to the system without attenuation at all.

Thank you for your attention

1 GeV Gamma

Average weighted energy deposition shape. 1 GeV, γ

- $\overline{E}(z_i) = \frac{1}{10000}\sum_{k=1}^{10000} E_k(z_i)\, W(z_i)$
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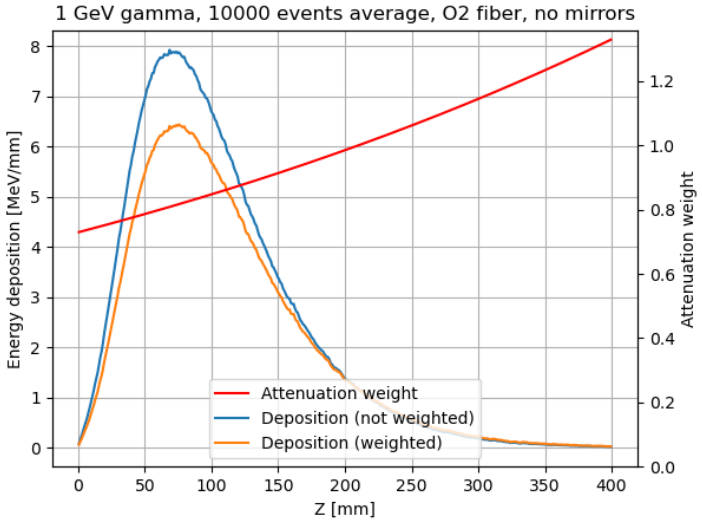

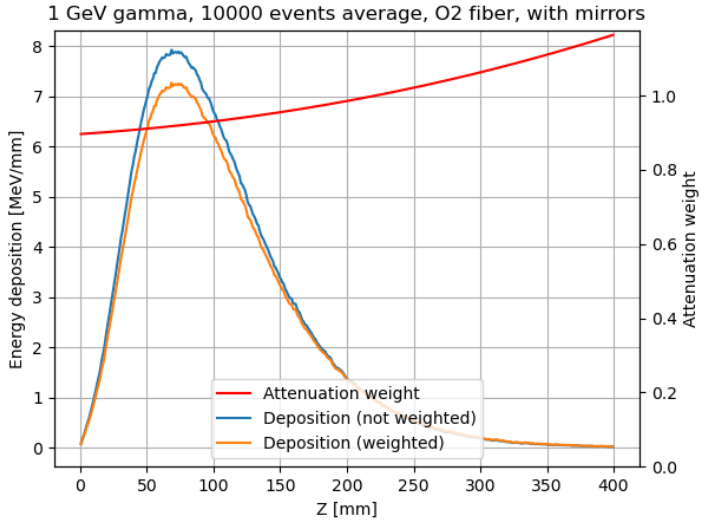

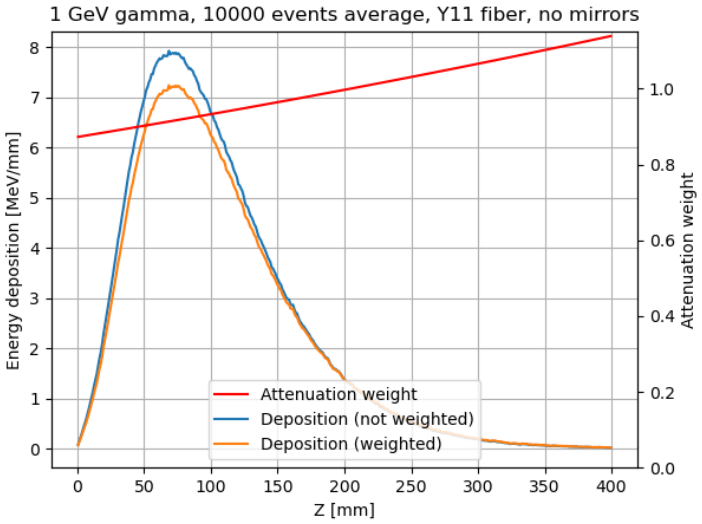

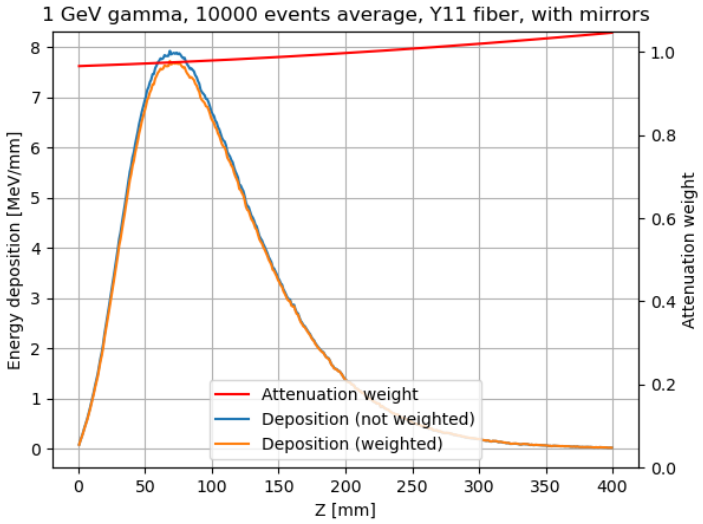

Event wise weighted deposited E. distribution . 1 GeV, γ

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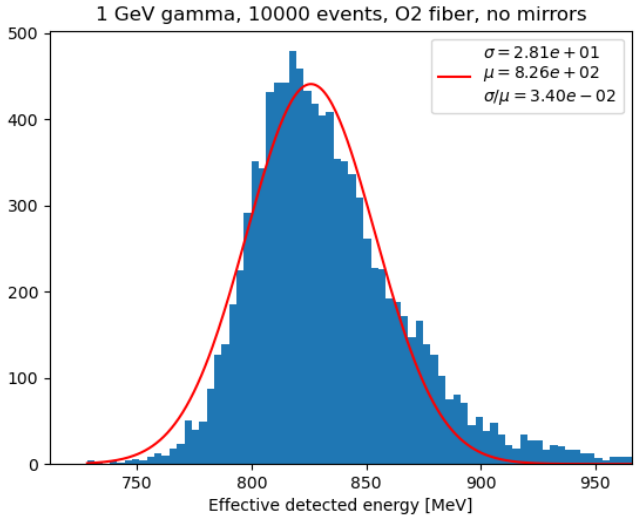

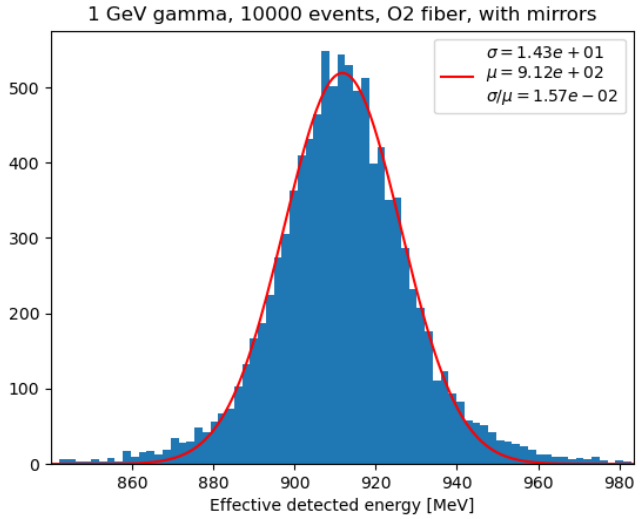

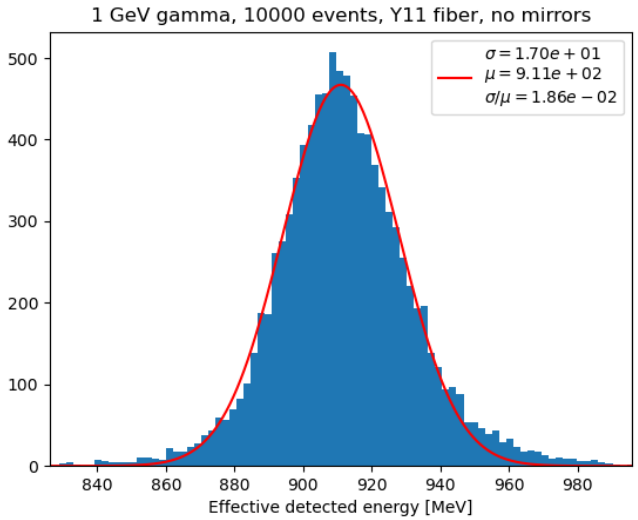

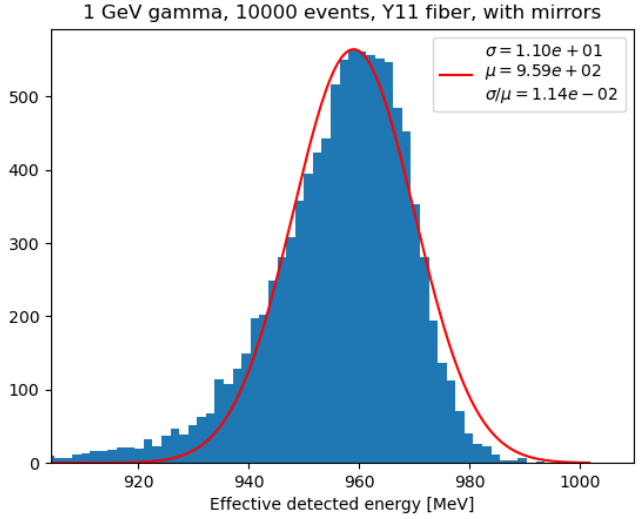

4X0/25X0 vs 25X0 weighted correlations. 1 GeV, γ

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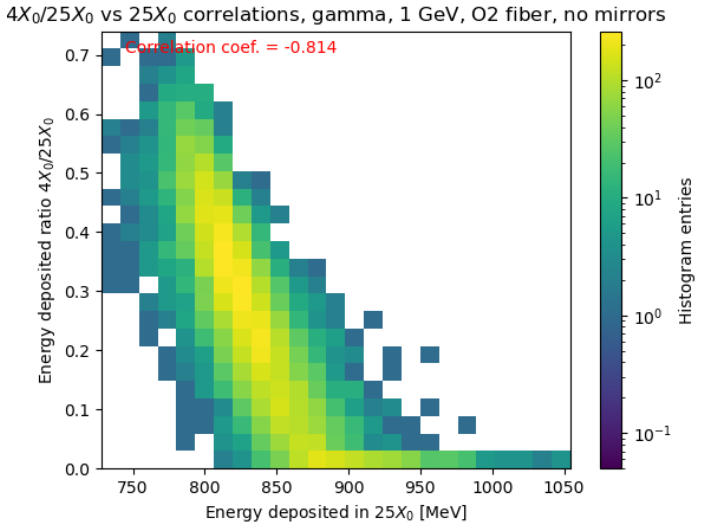

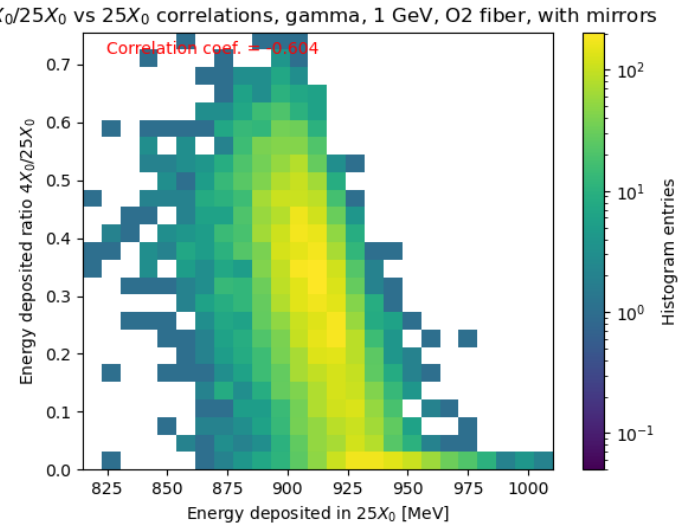

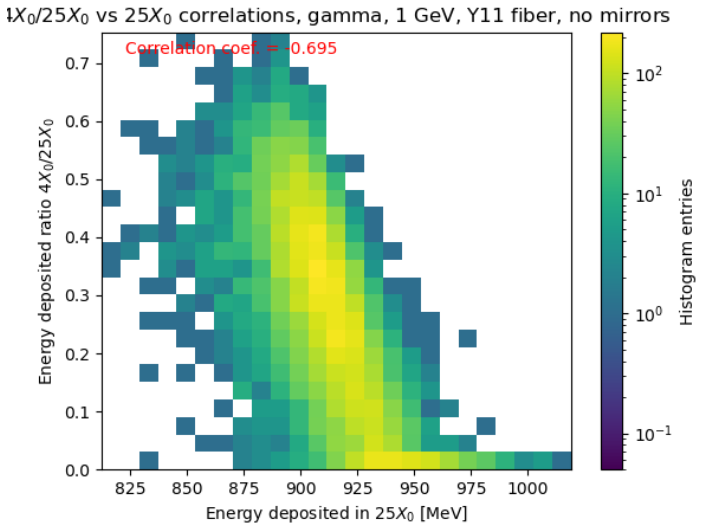

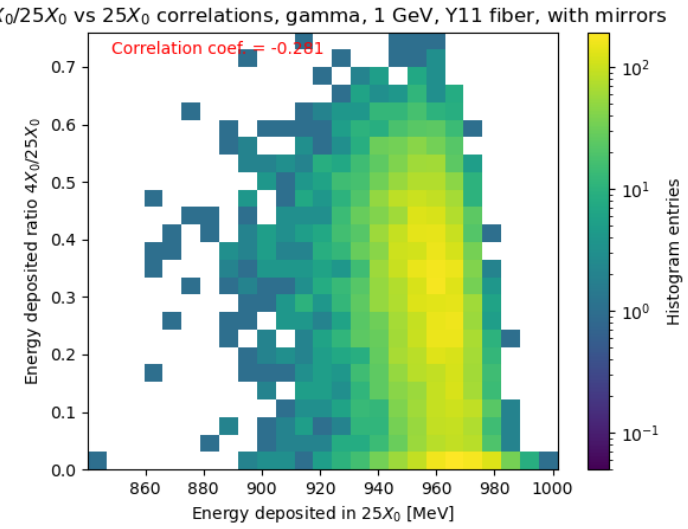

1 GeV Electrons

Average weighted energy deposition shape. 1 GeV, e-

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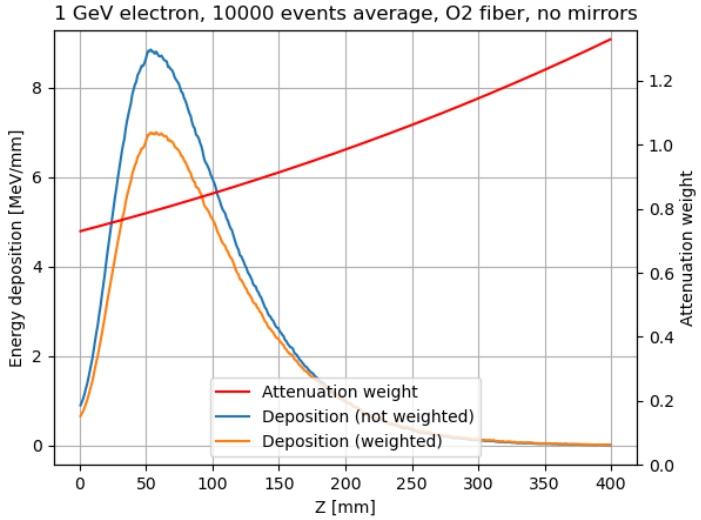

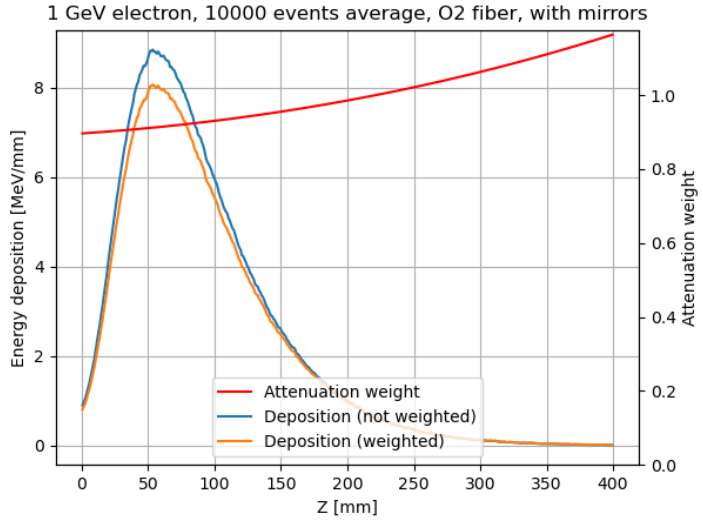

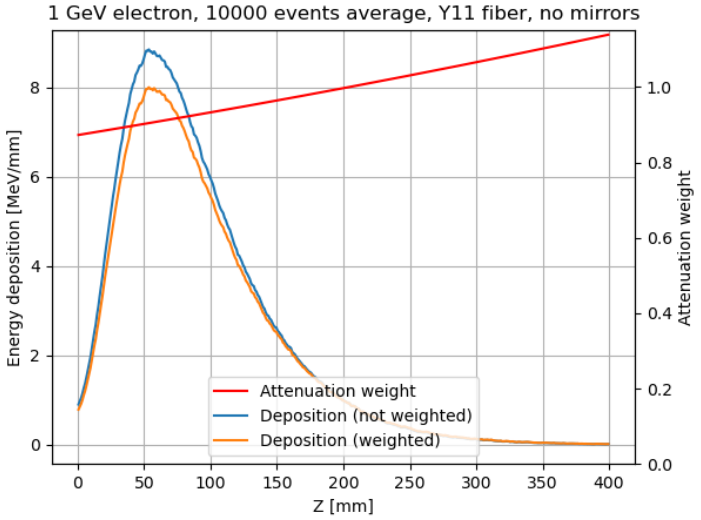

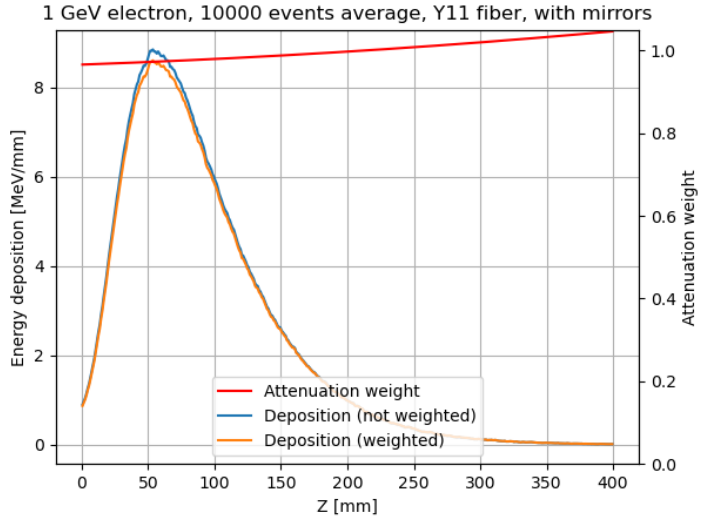

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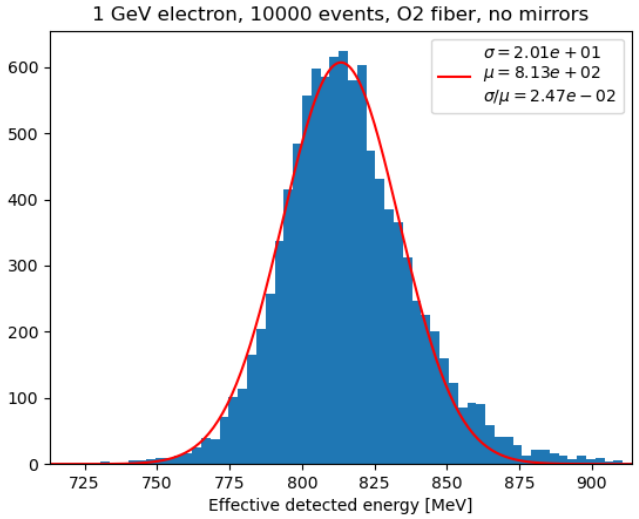

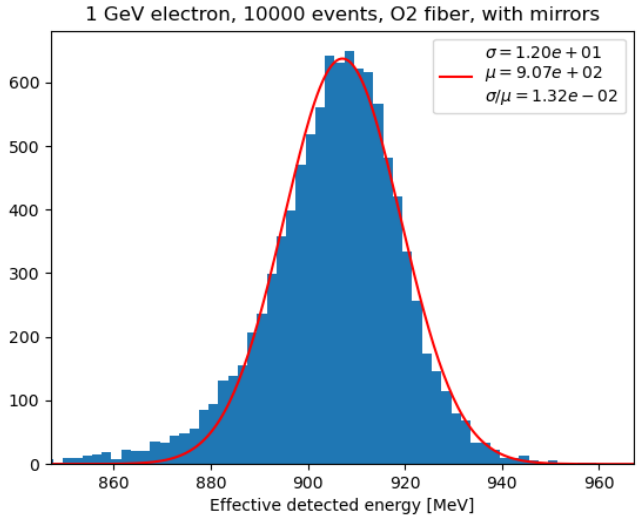

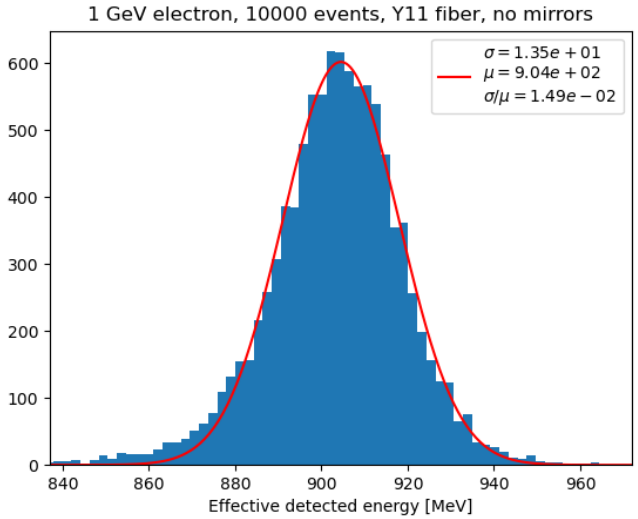

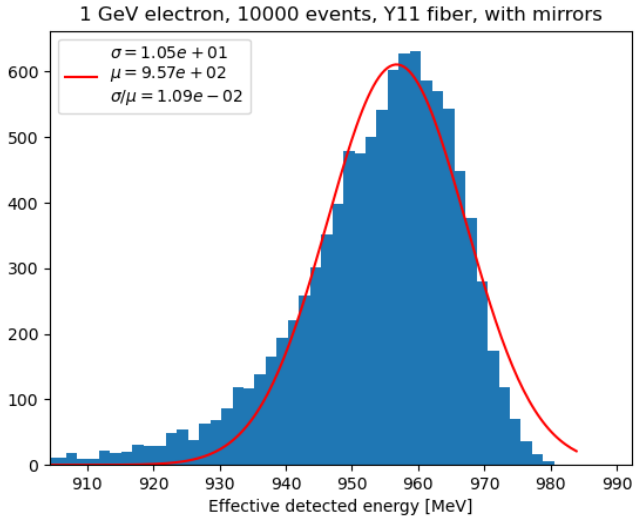

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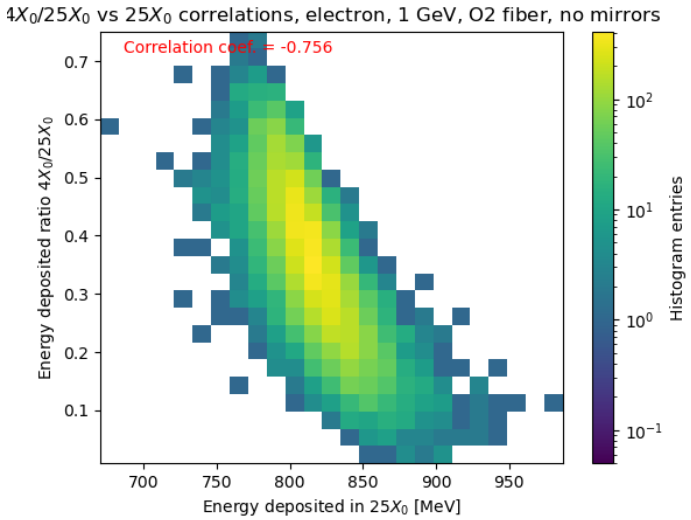
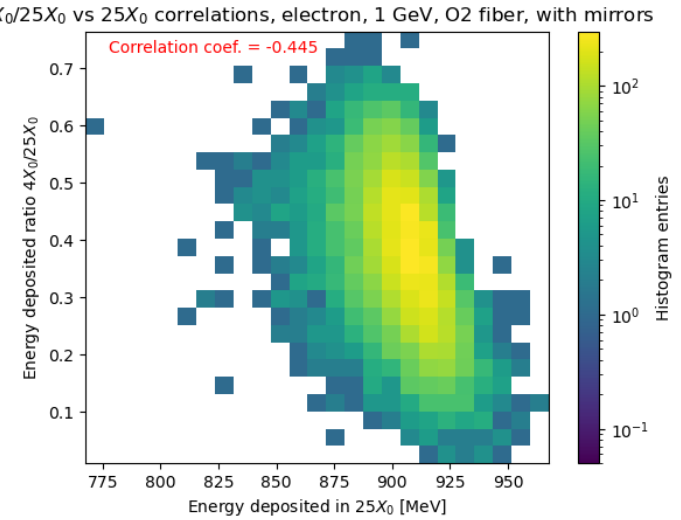
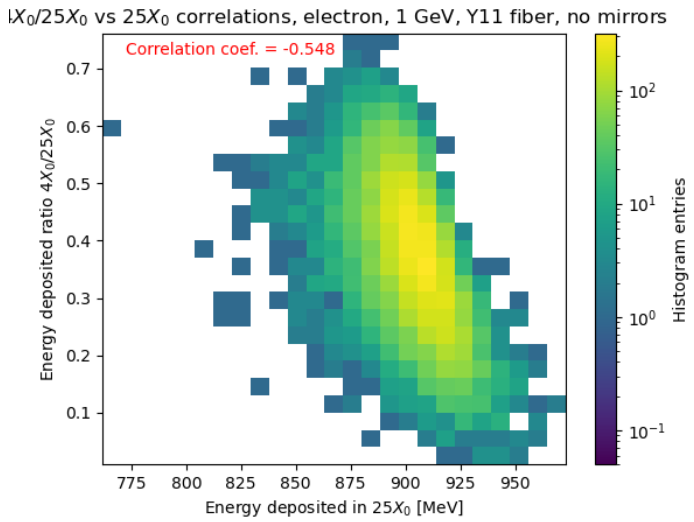
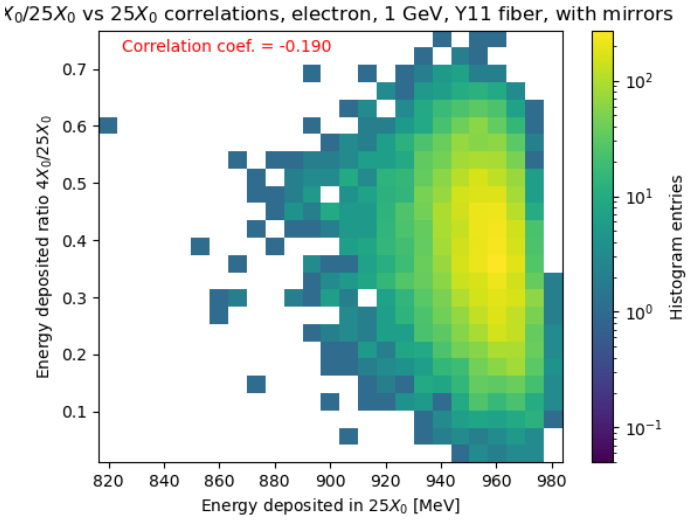




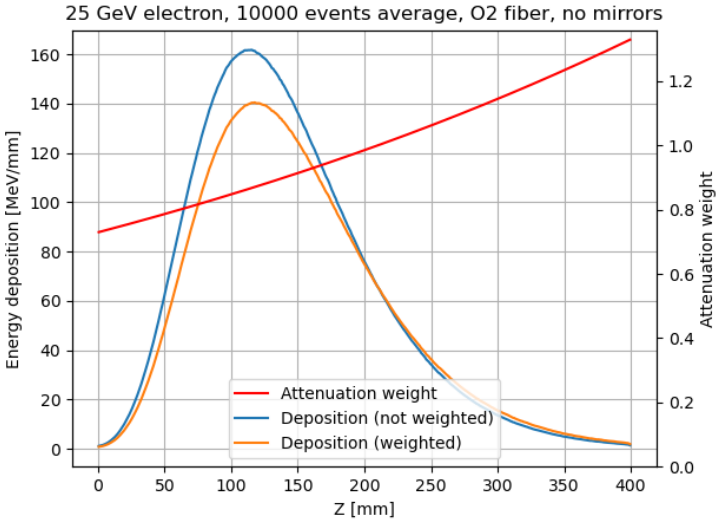


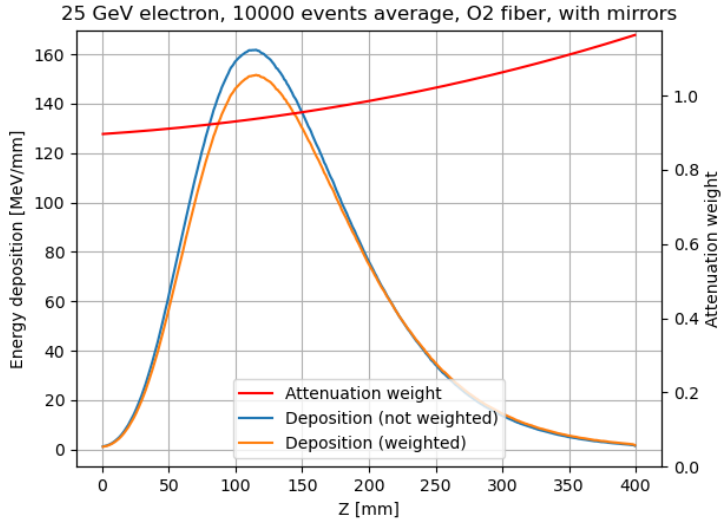


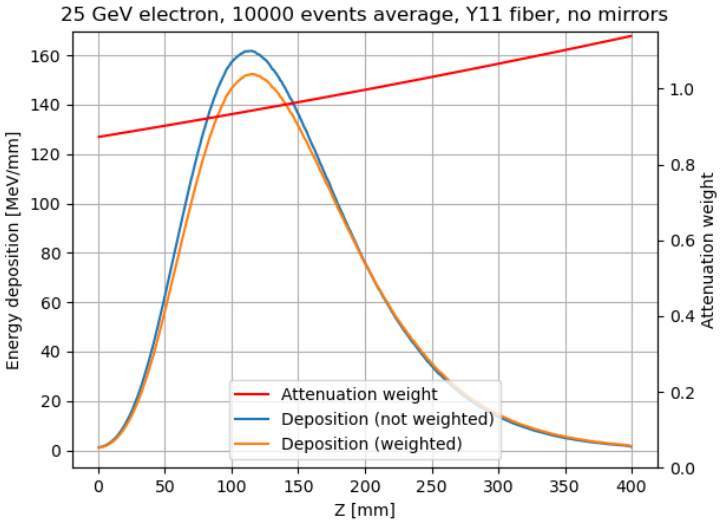
25 GeV Electrons

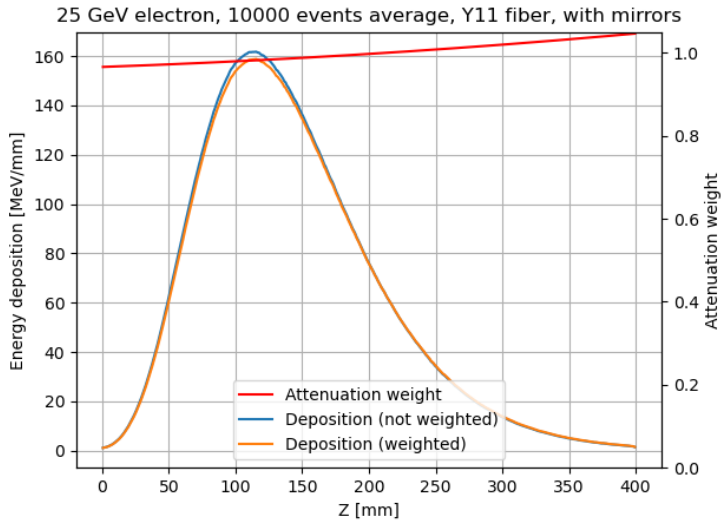
Average weighted energy deposition shape. 25 GeV, e-

- $\overline{E}(z_i) = \frac{1}{10000}\sum_{k=1}^{10000} E_k(z_i)\, W(z_i)$
- $E_k(z_i)$ - energy deposited in the i-th slice during k-th event.
- $W(z_i)$ - attenuation weight



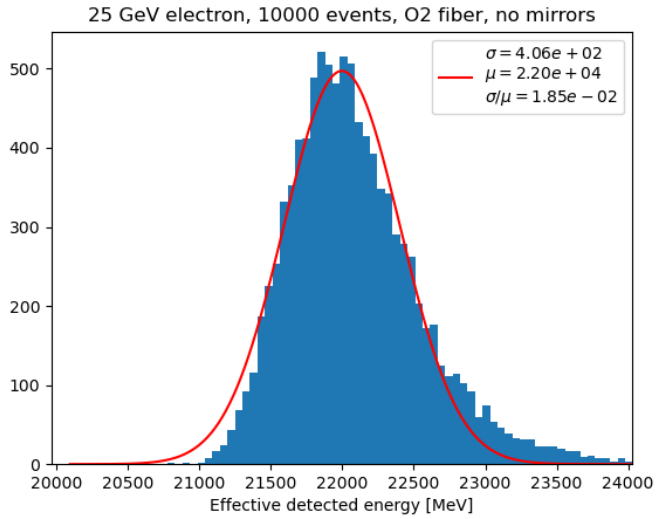


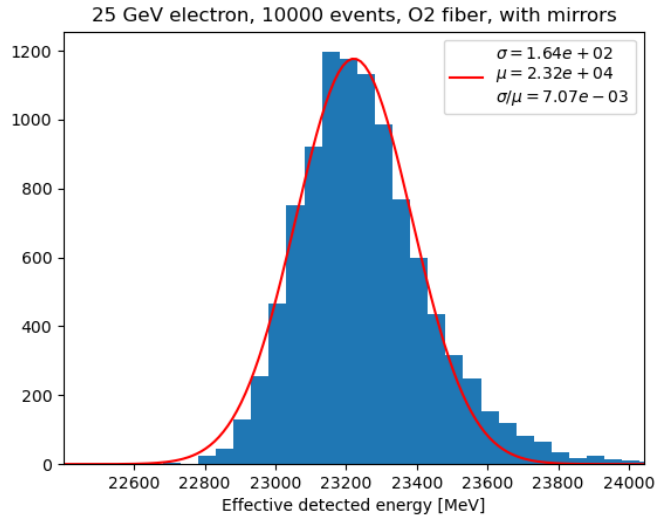


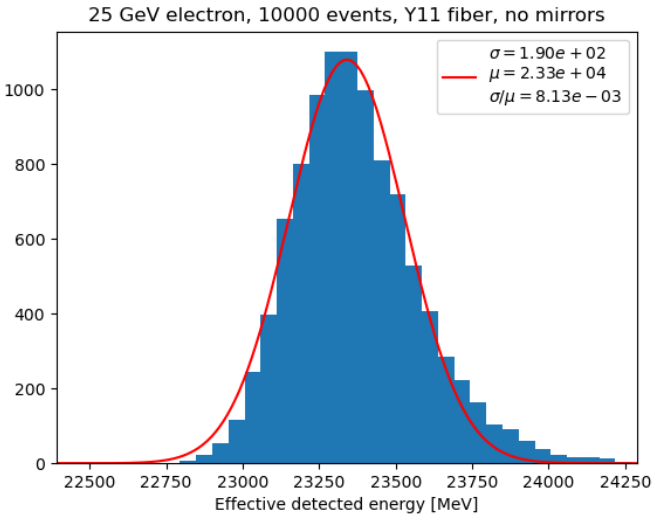


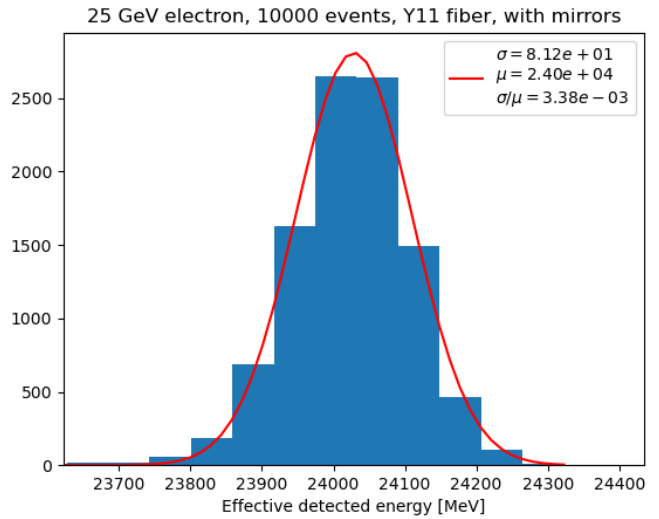
Event wise weighted deposited E. distribution . 25 GeV, e-

- $E_k = \sum_{i=1}^{400} E_k(z_i)\, W(z_i)$
- $E_k(z_i)$ – energy deposited in the i–th slice during k–th
- $W(z_i)$ - attenuation weight









4X0/25X0 vs 25X0 weighted correlations. 25 GeV, e-

- Correlation of two variables:

1. energy deposited in the entire detector
2. ratio of energy deposited in the first 64 mm (4X0) to energy deposited in the entire detector

- Energy deposited for each corresponding slice was weighted