

Forward detector system for the LUXE experiment

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28/11/19

Luxe Technical meeting

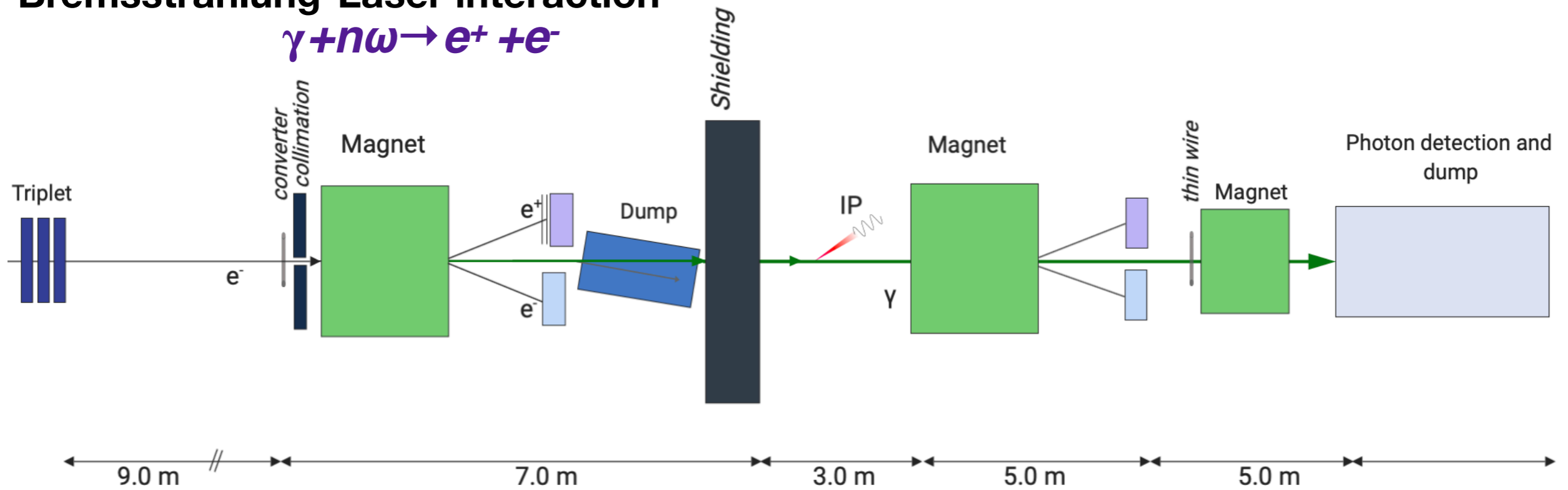
DESY Hamburg

The logo for the LUXE experiment, featuring the word "LUXE" in a bold, blue, sans-serif font. The letter "X" is stylized with a white starburst or spark effect at its center.

LUXE Set Up

Bremsstrahlung-Laser interaction

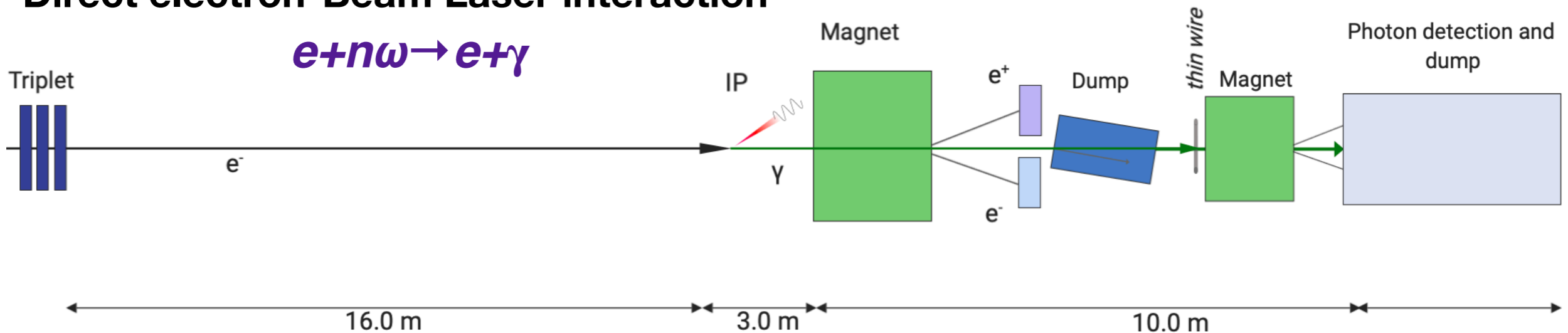
$$\gamma + n\omega \rightarrow e^+ + e^-$$



the non-linear pair-production process

Direct electron-Beam Laser interaction

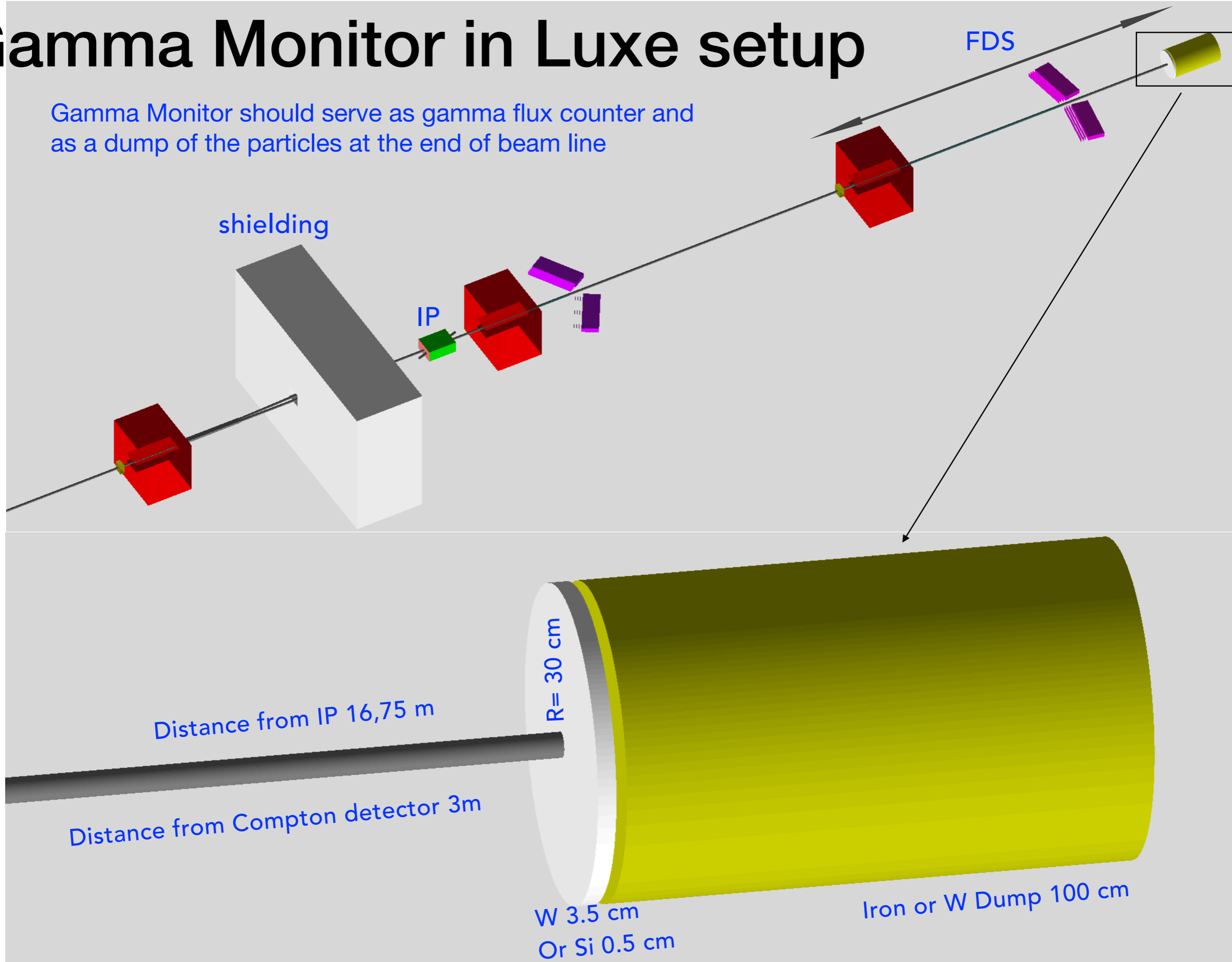
$$e + n\omega \rightarrow e + \gamma$$



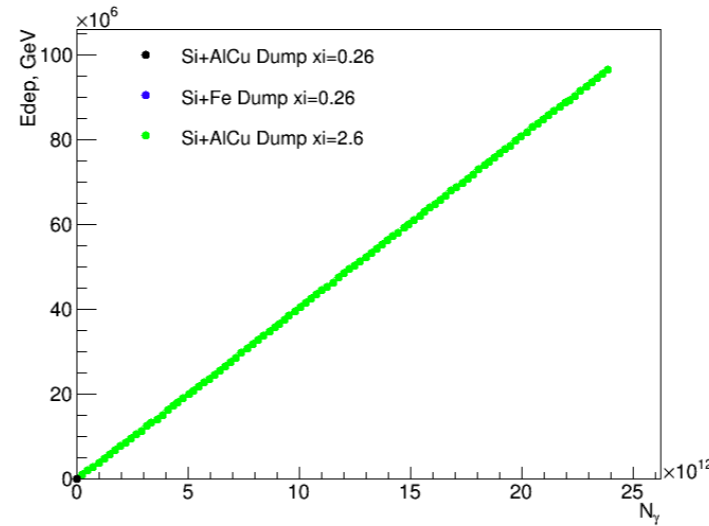
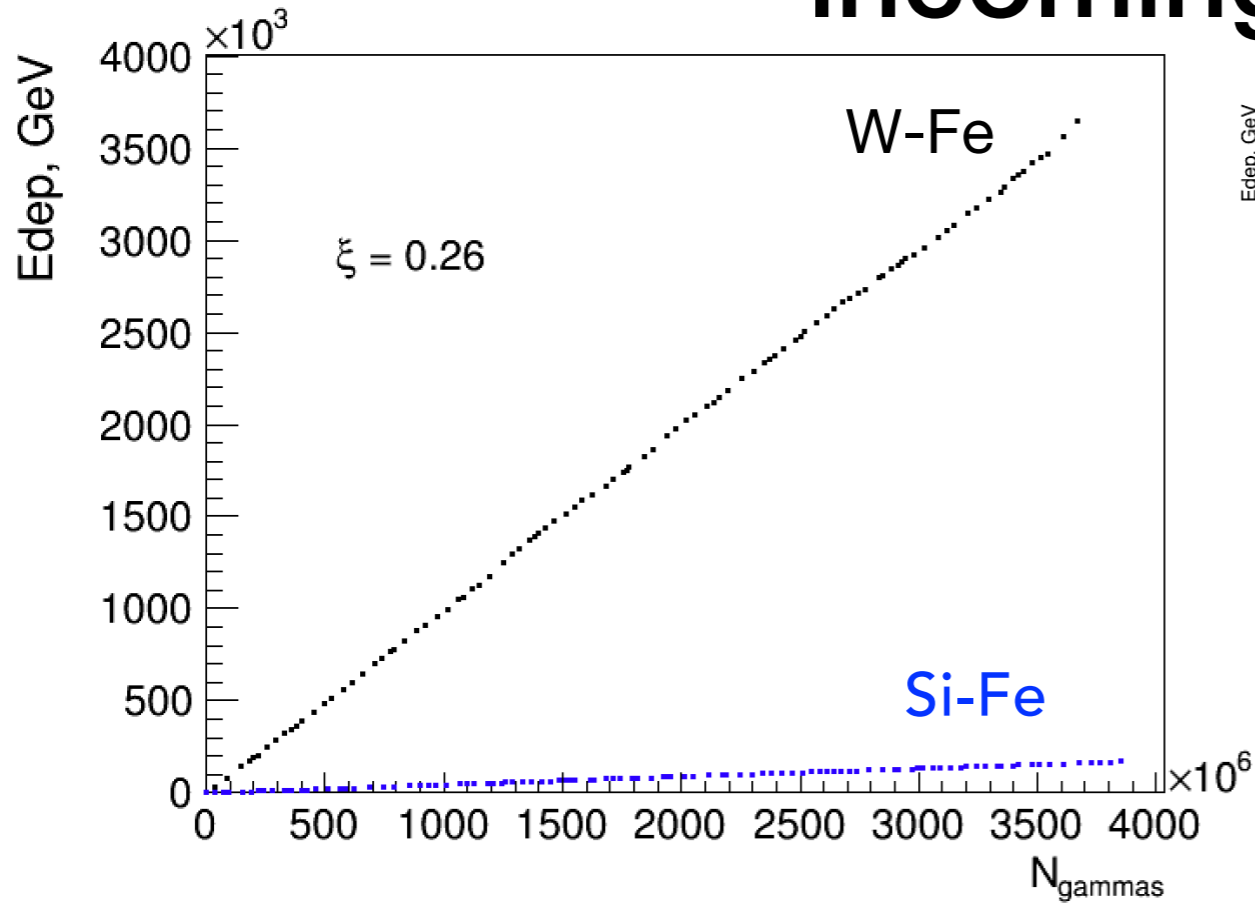
one-step and two-step trident
the non-linear Compton processes

Gamma Monitor in Luxe setup

Gamma Monitor should serve as gamma flux counter and as a dump of the particles at the end of beam line

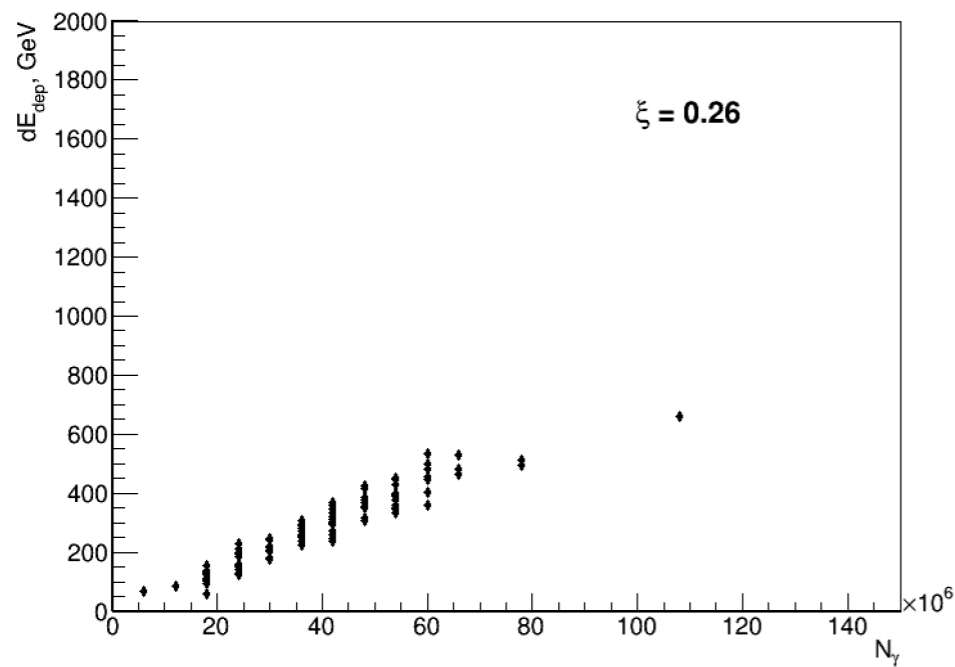


Energy dependence on number of incoming photons

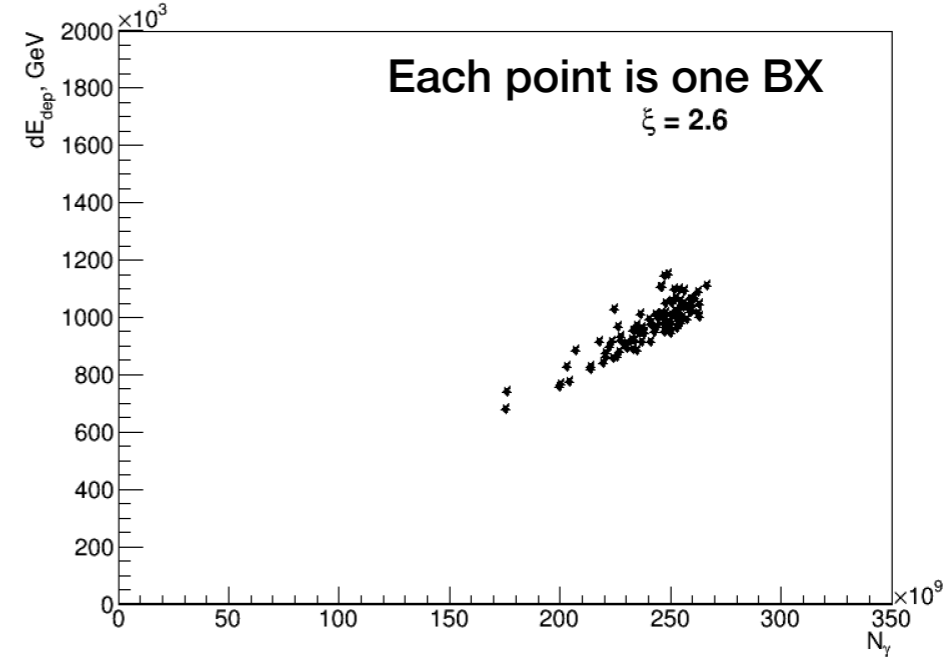


The linear dependence of deposited energy on number of incoming photons allows the usage of backscatters for estimating the photon flux

Histogram of deposited energy vs Ngamma Si+AlCu



Histogram of deposited energy vs Ngamma Si+AlCu



In average one γ deposits ~ 1 keV; w/ the sigma 0.2 keV

Lead glass blocks from Hermes Experiment

Available: 6 calorimeter blocks w/ measures $9 \times 9 \text{ cm}^2$, length is 50 cm

TABLE 1. Chemical composition and calorimetric properties of F101 Lead Glass. Cerium is making the Lead Glass radiation hard, while also reducing its transparency.

Chemical Composition F101	weight %
PB_3O_4	51.23
SiO_2	41.53
K_2O	7.0
Ce	0.2
Radiation Length	2.78 cm
Critical Energy	17.97 MeV
Refraction index	1.65
Molière Radius	3.28 cm

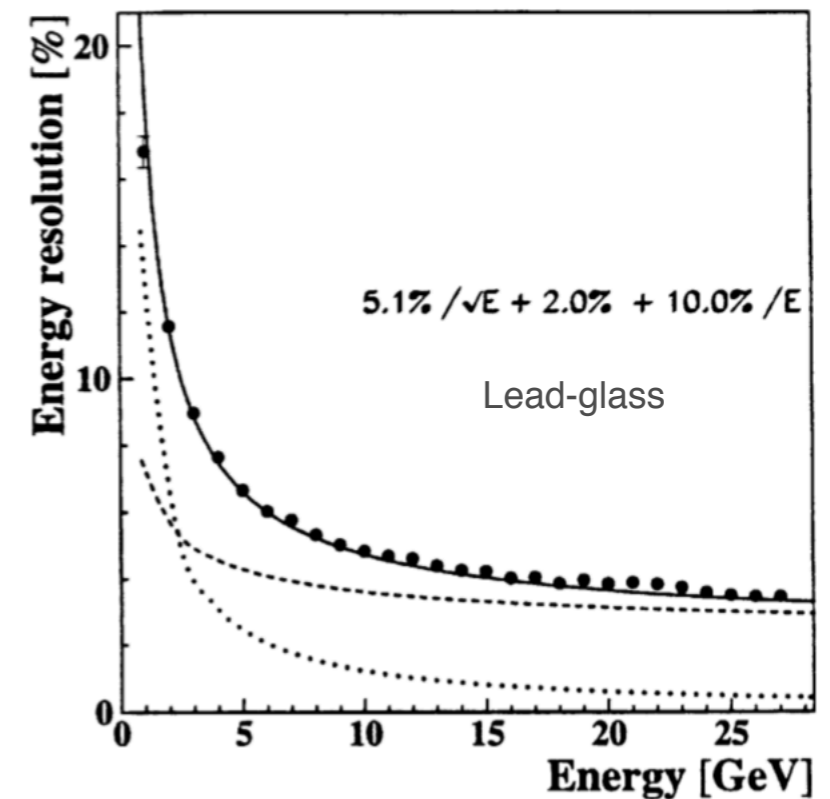
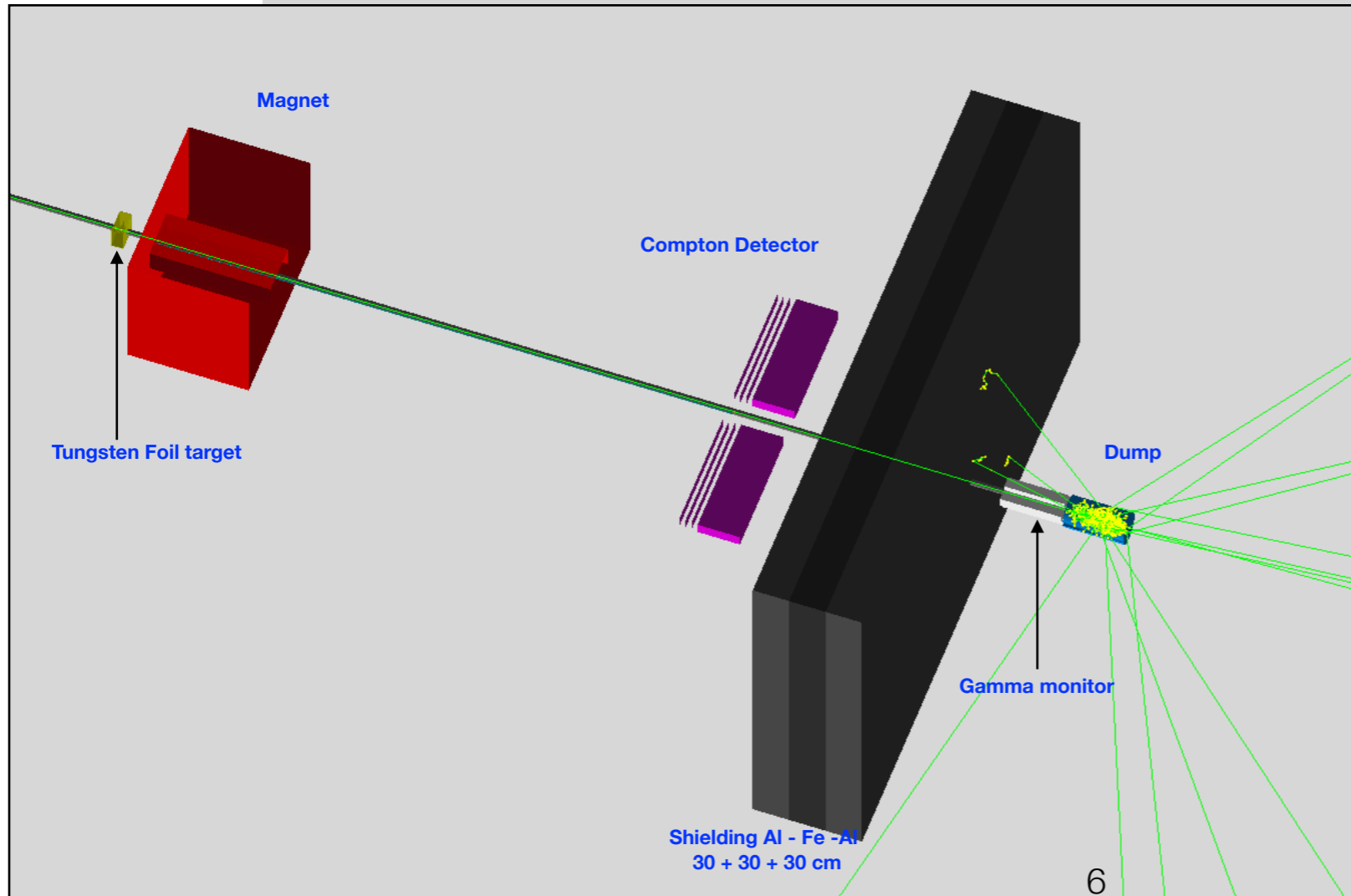
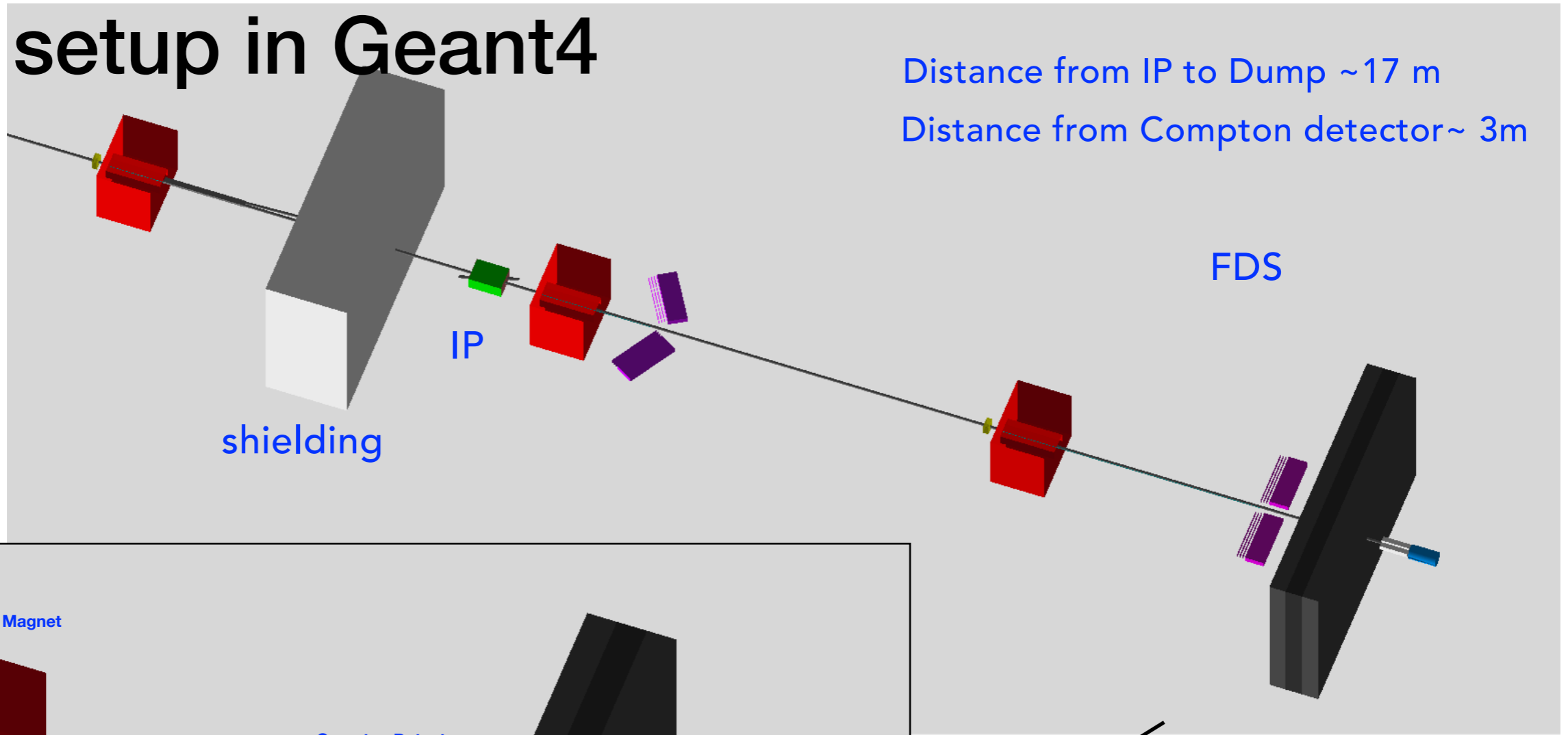
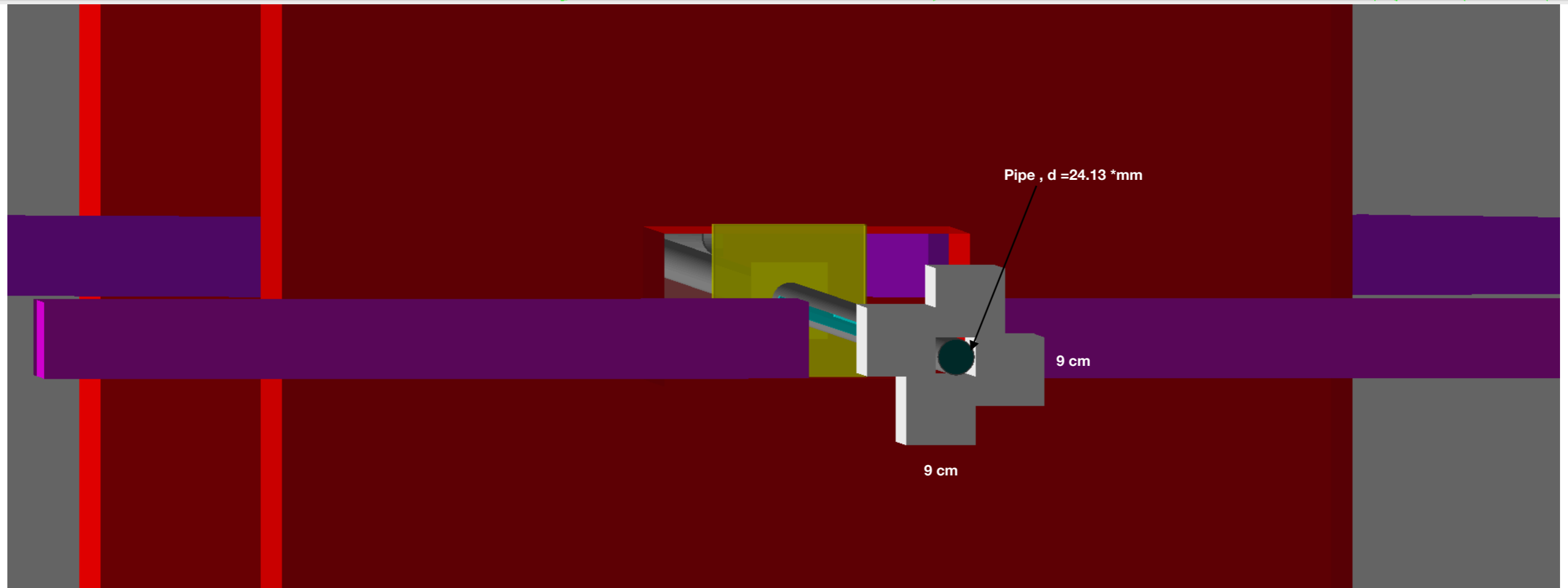
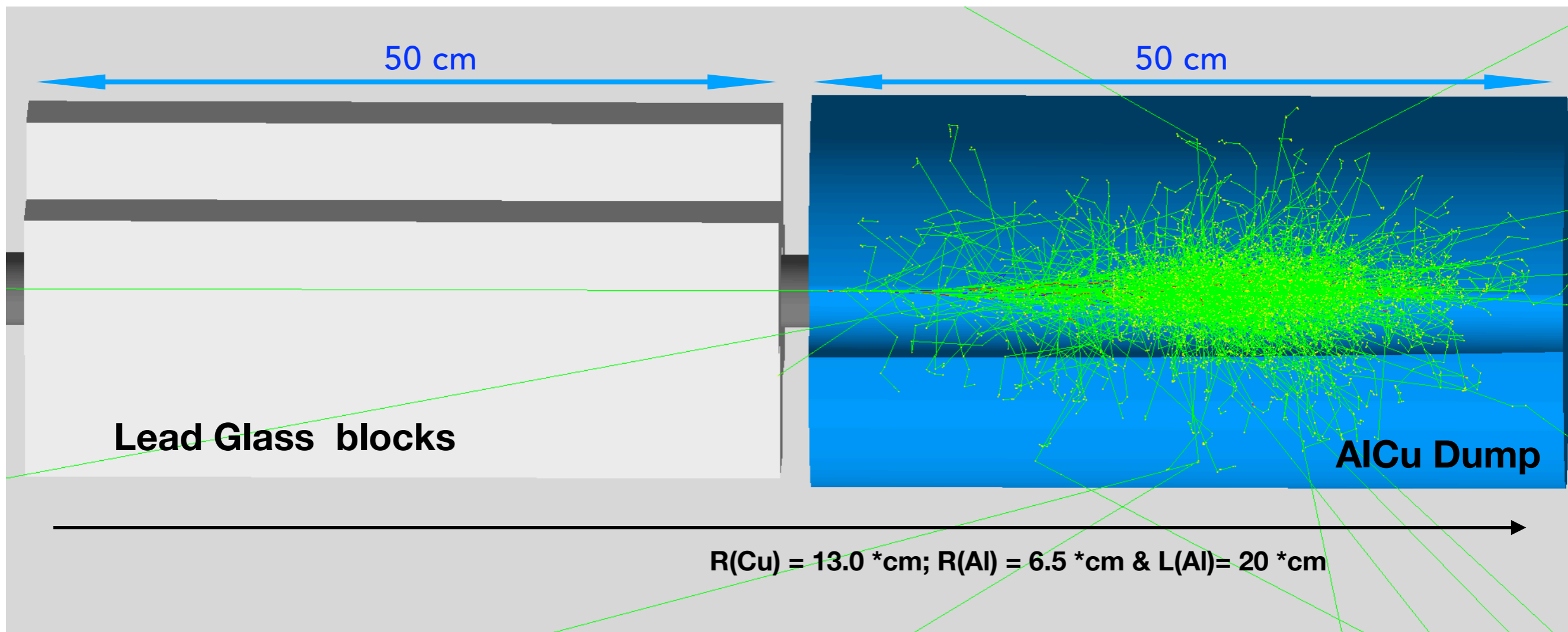


Fig. 5. Energy resolution of the calorimeter; the circles correspond to the 1996 data, the solid curve is the sum of the contributions from the lead-glass (dashed curve) and from the pre-shower (dotted curve) provided at test beam measurement [7].

Gamma Monitor made of 4 Hermes GL blocks in Luxe setup in Geant4





Outlook

- **Compton detector studies:**
- **Gamma monitor studies:**
 - * **Gamma Monitor was studied in simple configuration in GEANT4 w/ Si Monitor in front of different Dumps (W, Fe, Al-Cu) for different intensities**
 - * **The linear dependence of deposited energy on number of incoming photons allows the usage of backscatters for counting the photon flux for all the configurations**
 - * **The energy spectrum of backscatters is below 1 GeV and for the vast majority is below critical energy for the most detector materials**
 - * **The implementation in Luxe geometry the LG Gamma Monitor made of Hermes LG blocks in GEANT4 in front of Al-Cu Dump**

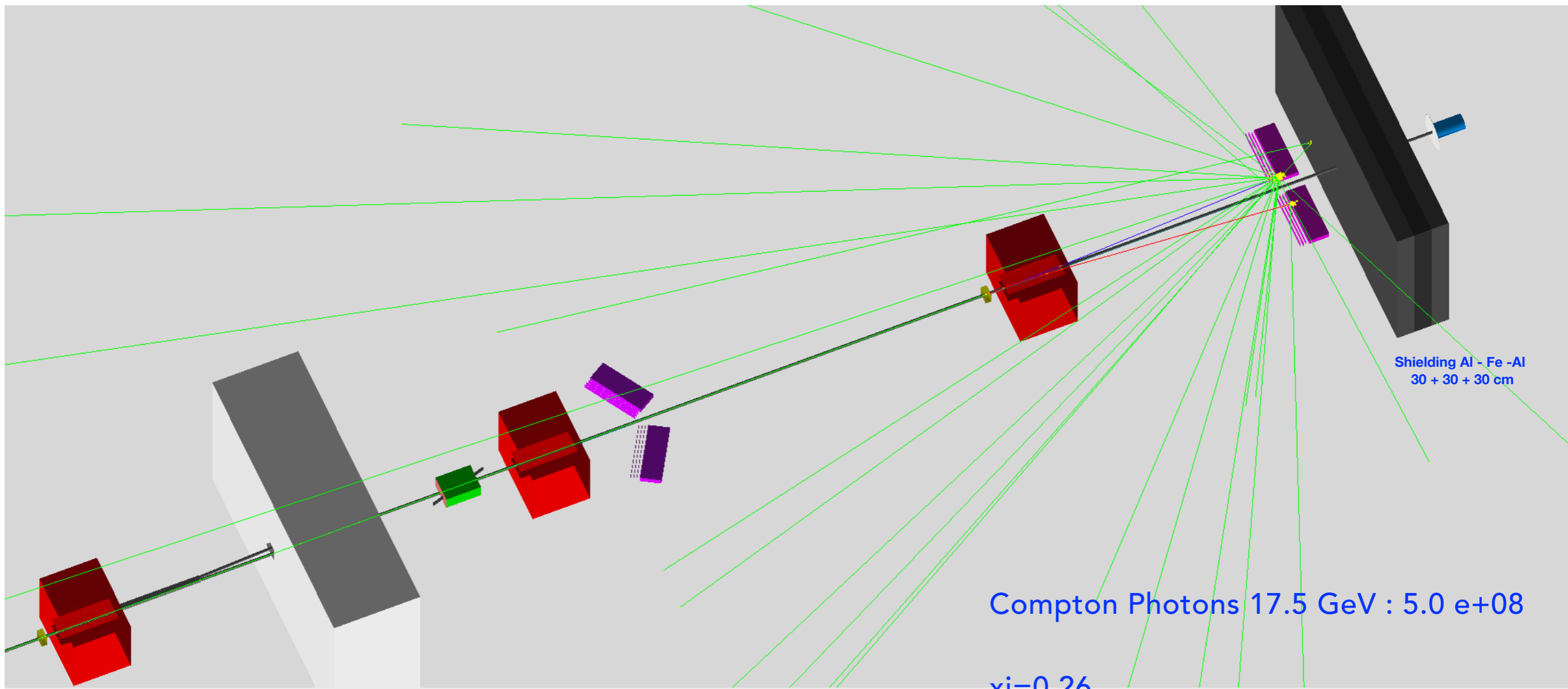
Further studies:

To run the simulation for LG Gamma Monitor

To study background

Back up

Luxe setup with non-tilted Compton Detector



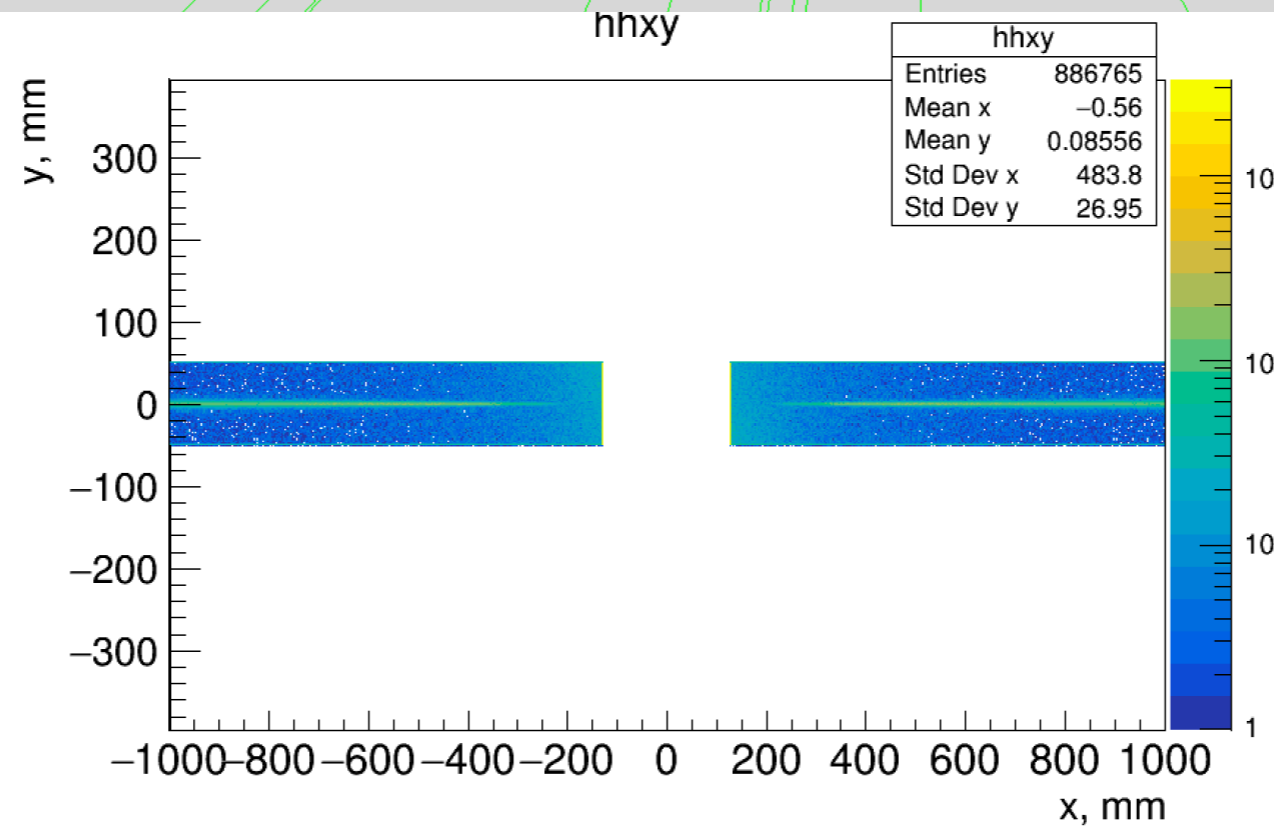
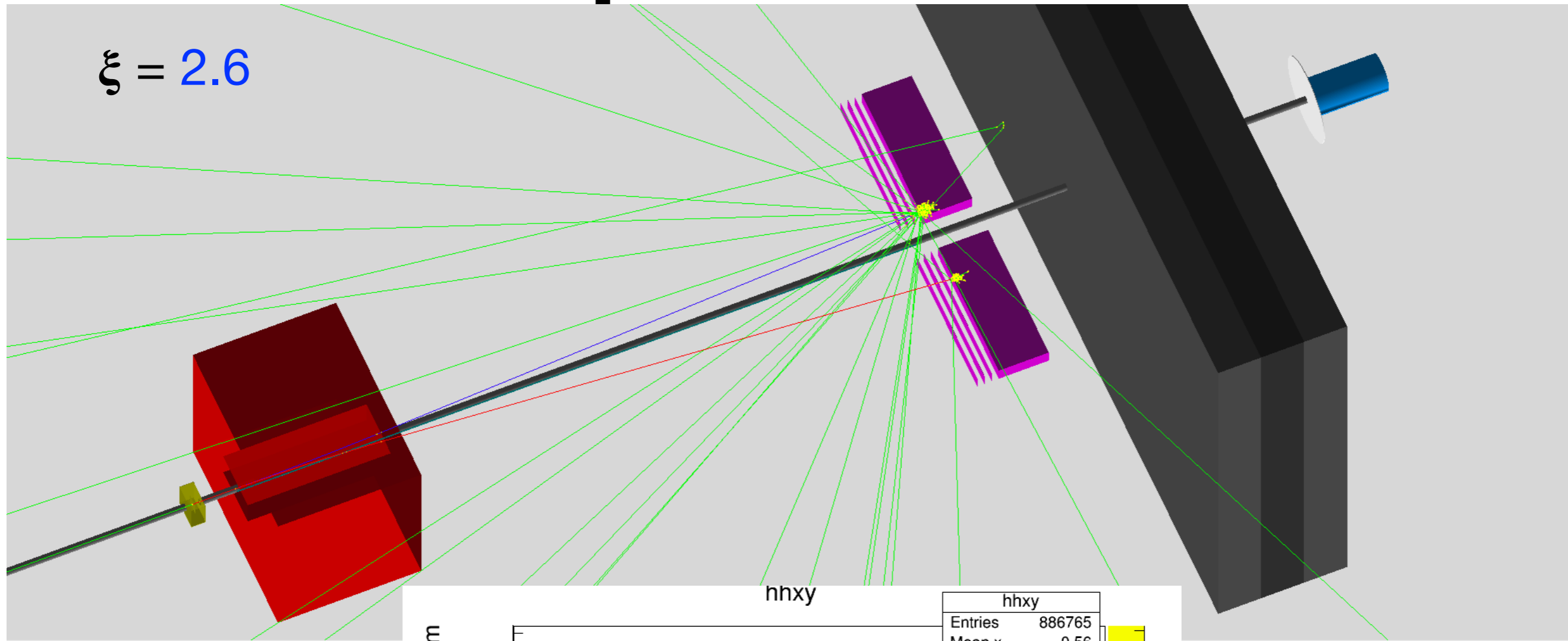
Compton Photons 17.5 GeV : 5.0 e+08

$\xi=0.26$

100 BX

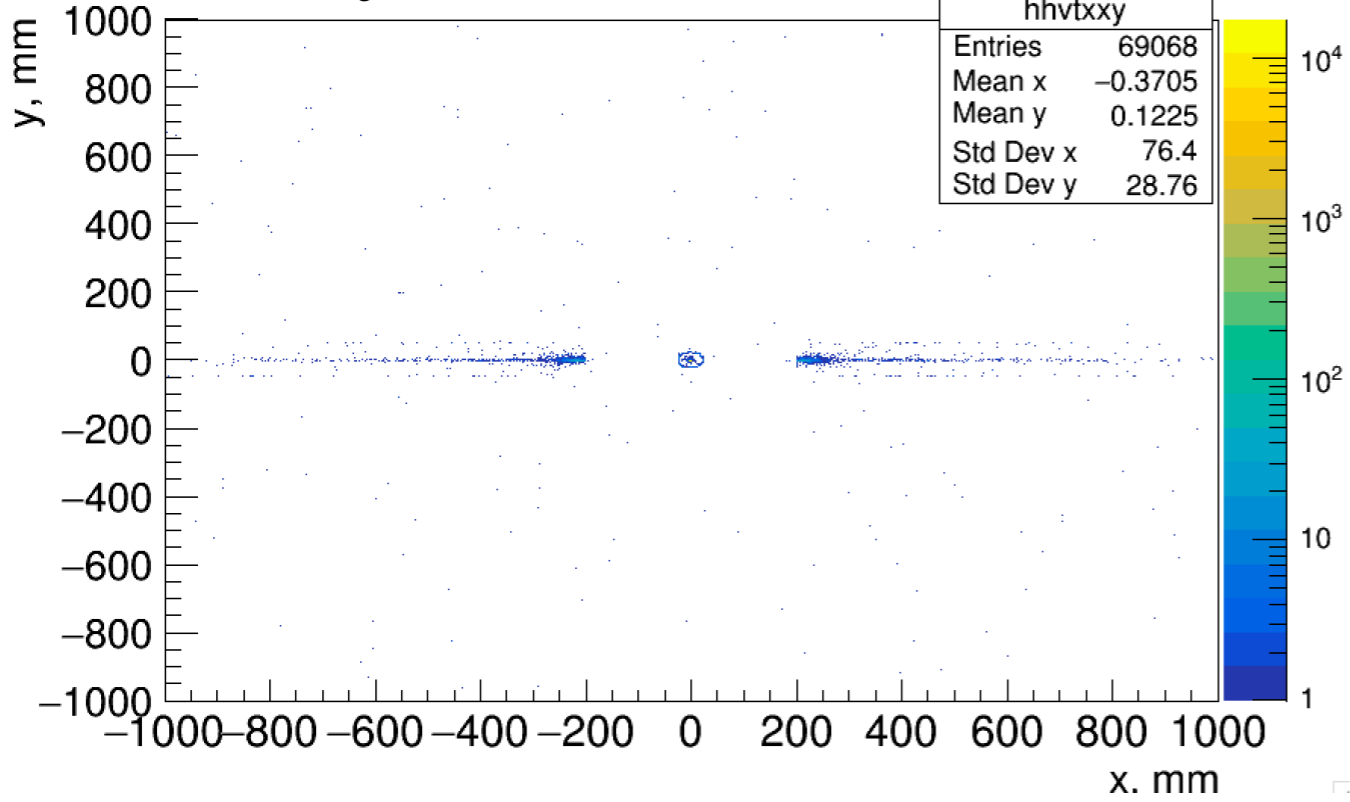
Target: W foil 10 um

Compton detector

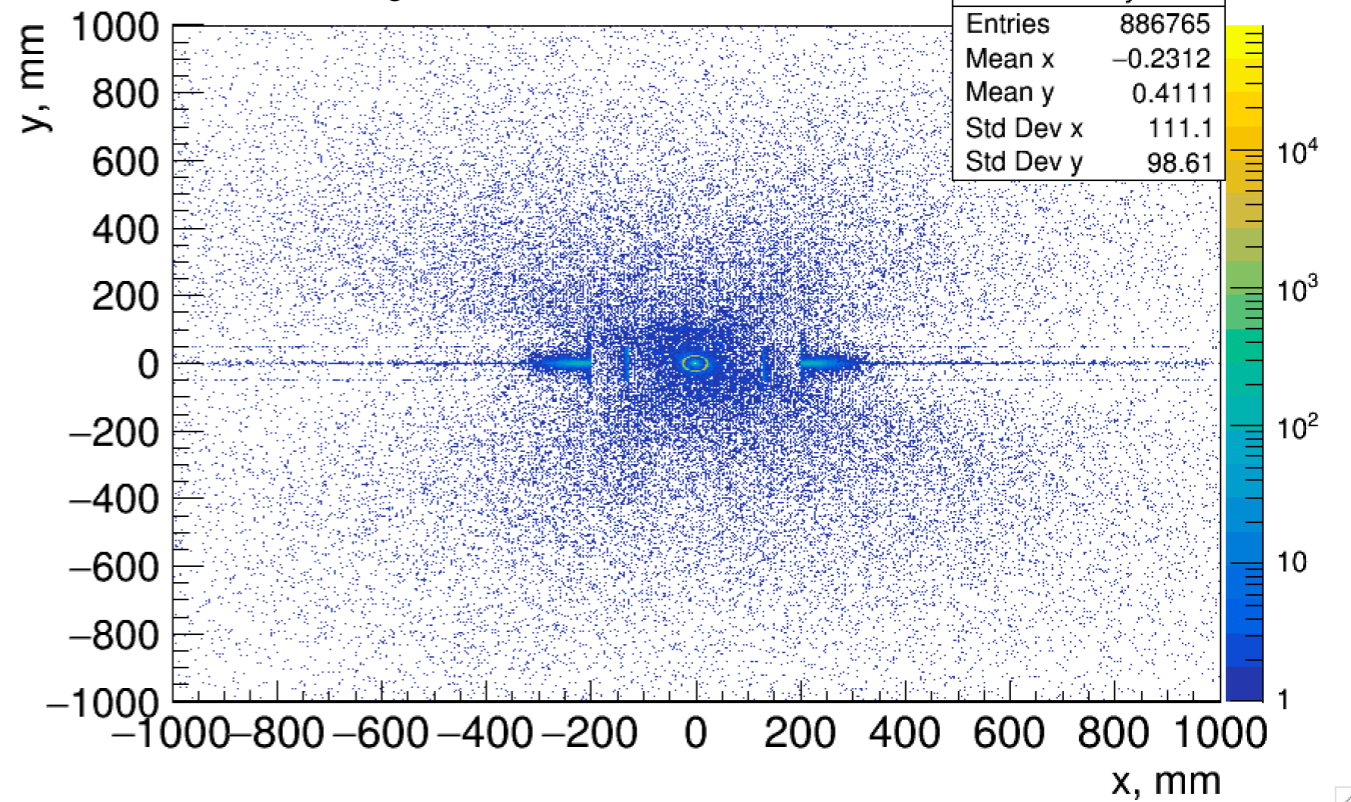


Vertexes in Compton detector

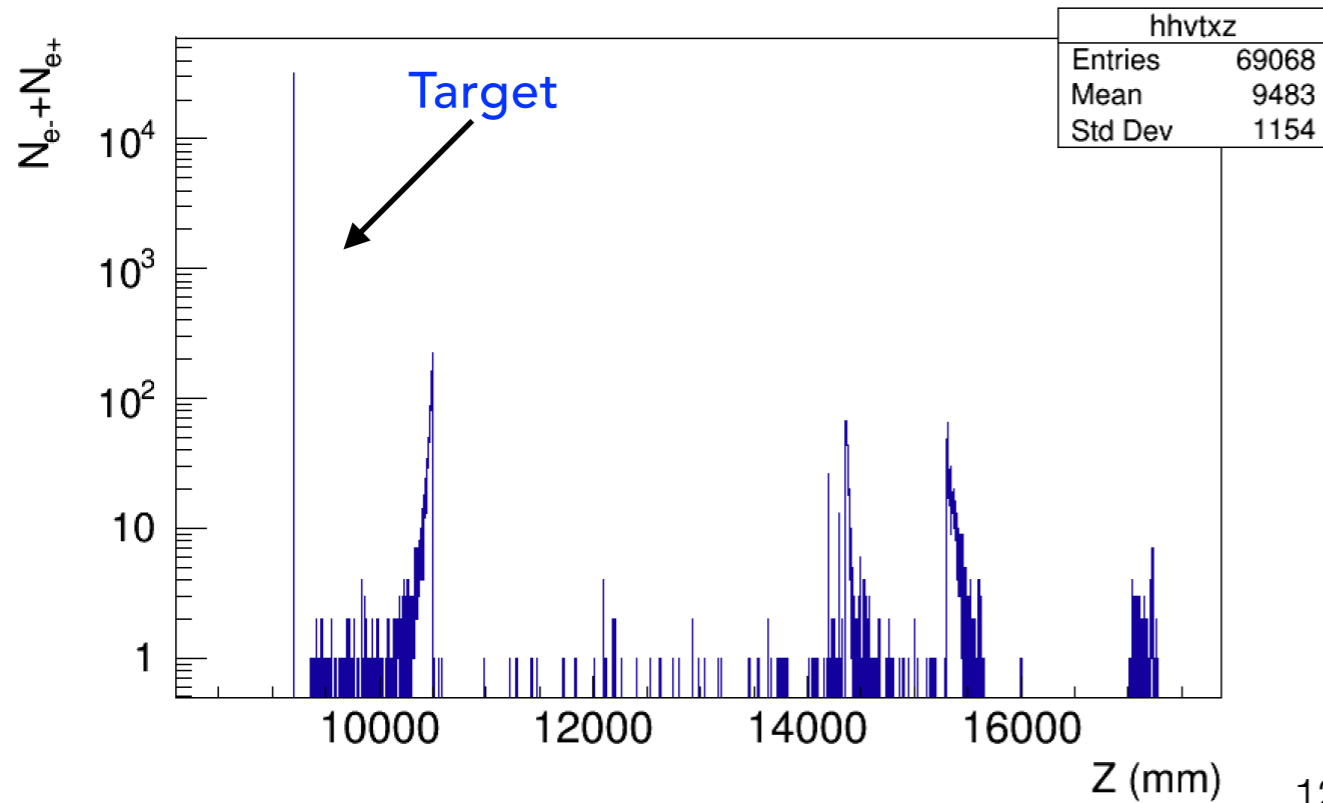
$\xi = 0.26$ nhvttxy



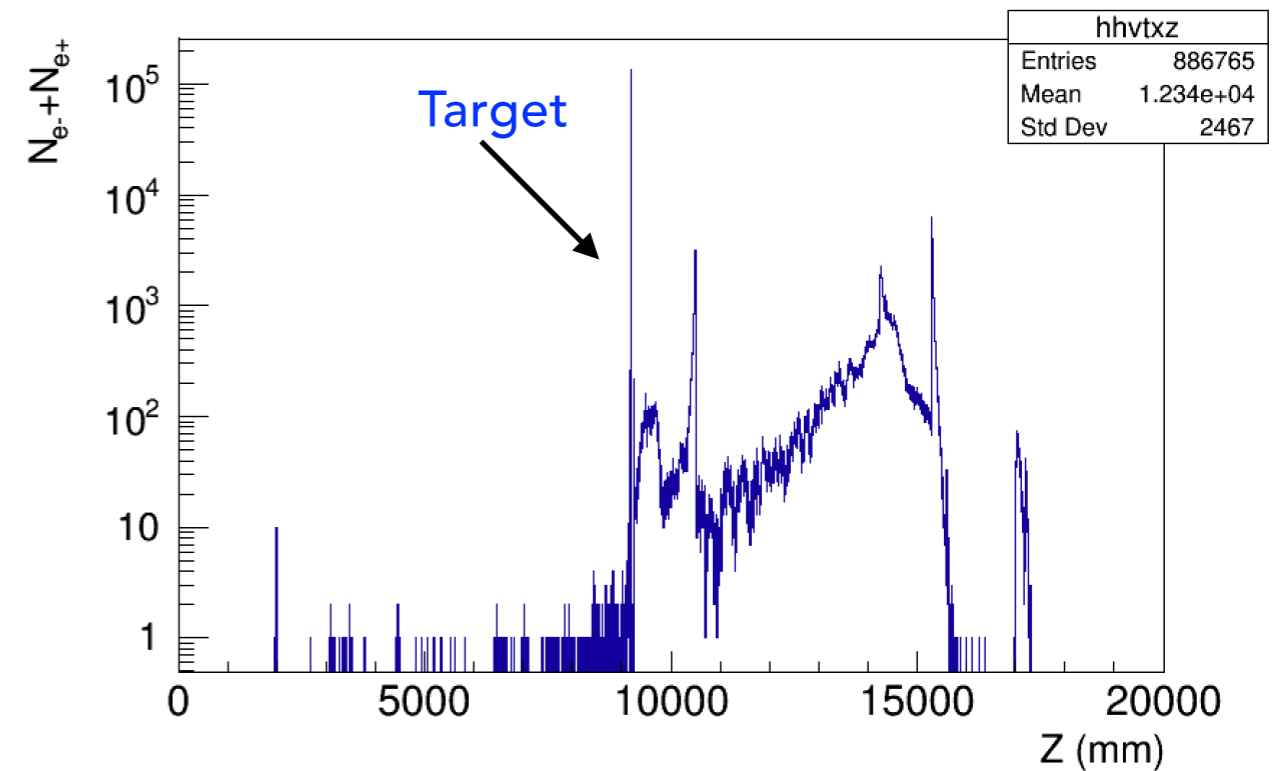
$\xi = 2.6$ hhvttxy



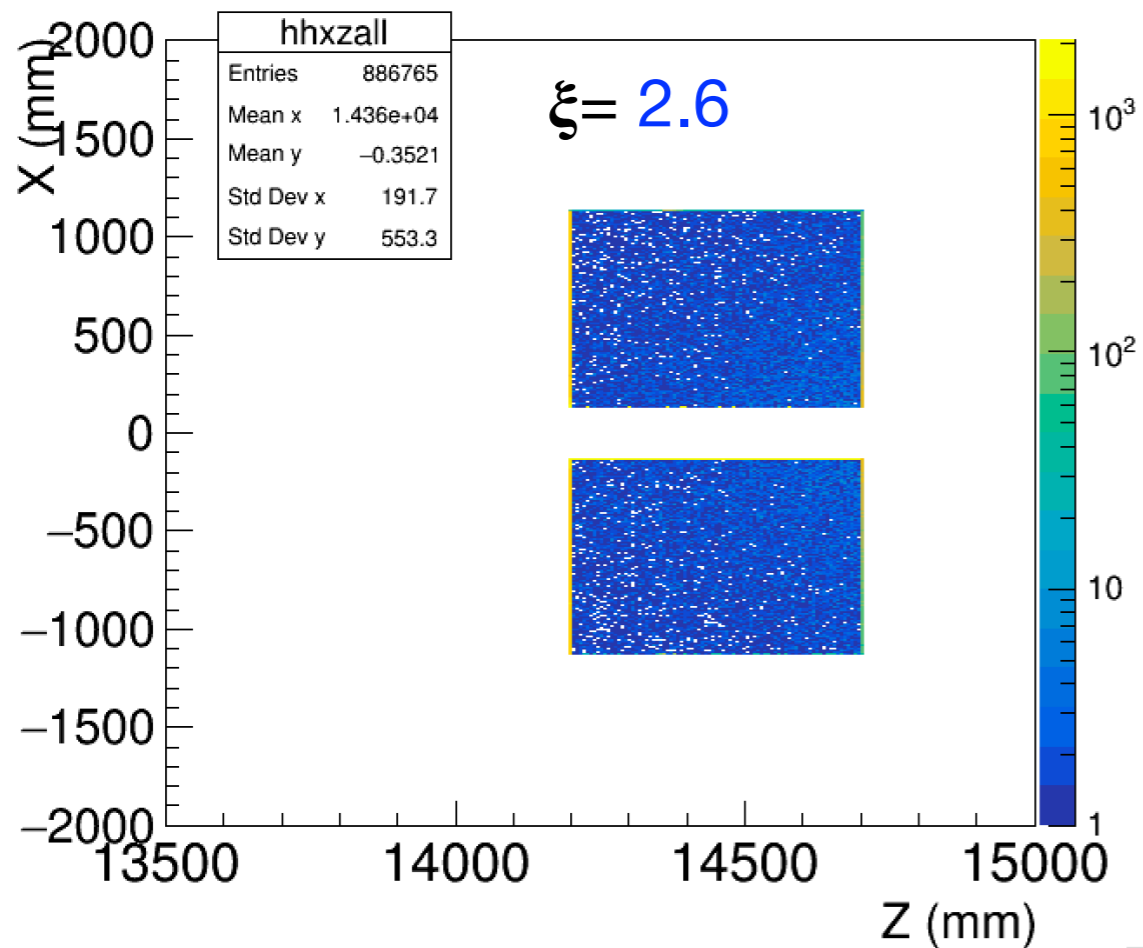
Vertex Z



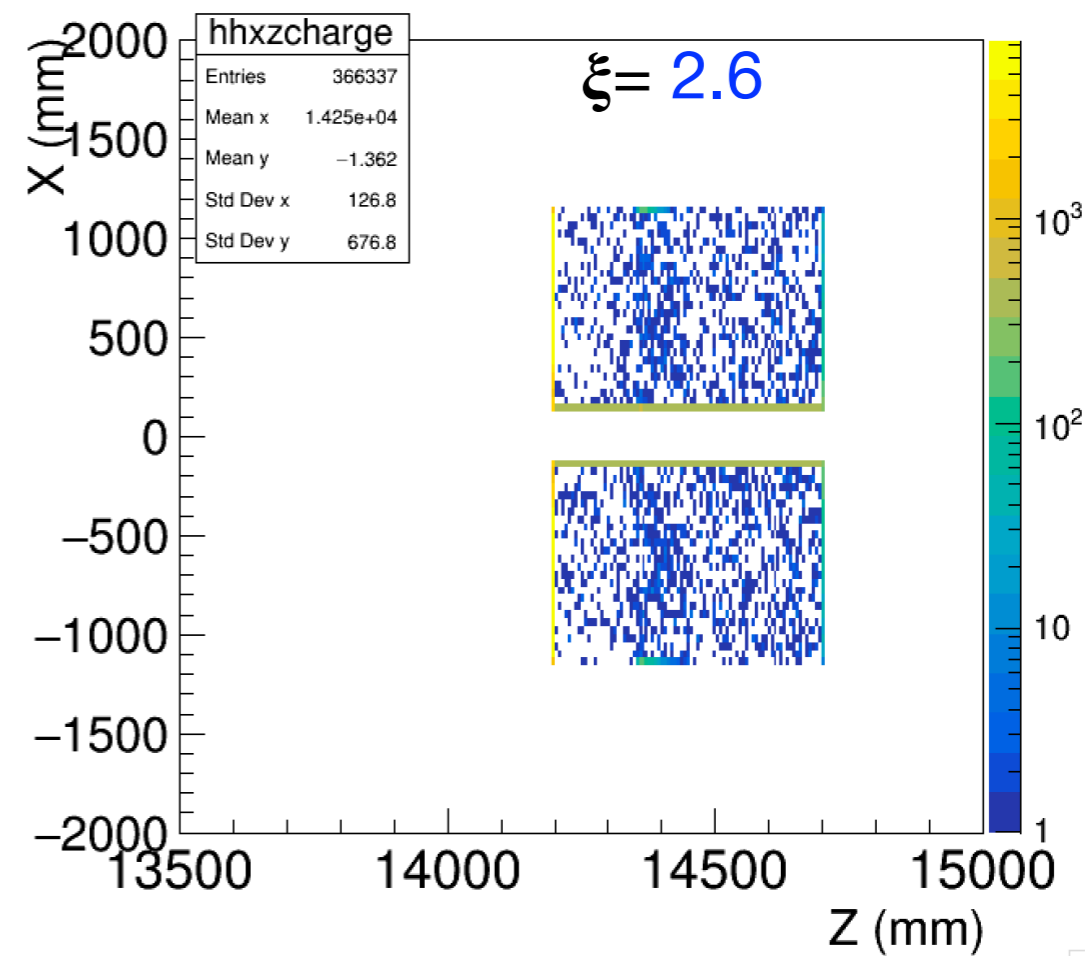
Vertex Z



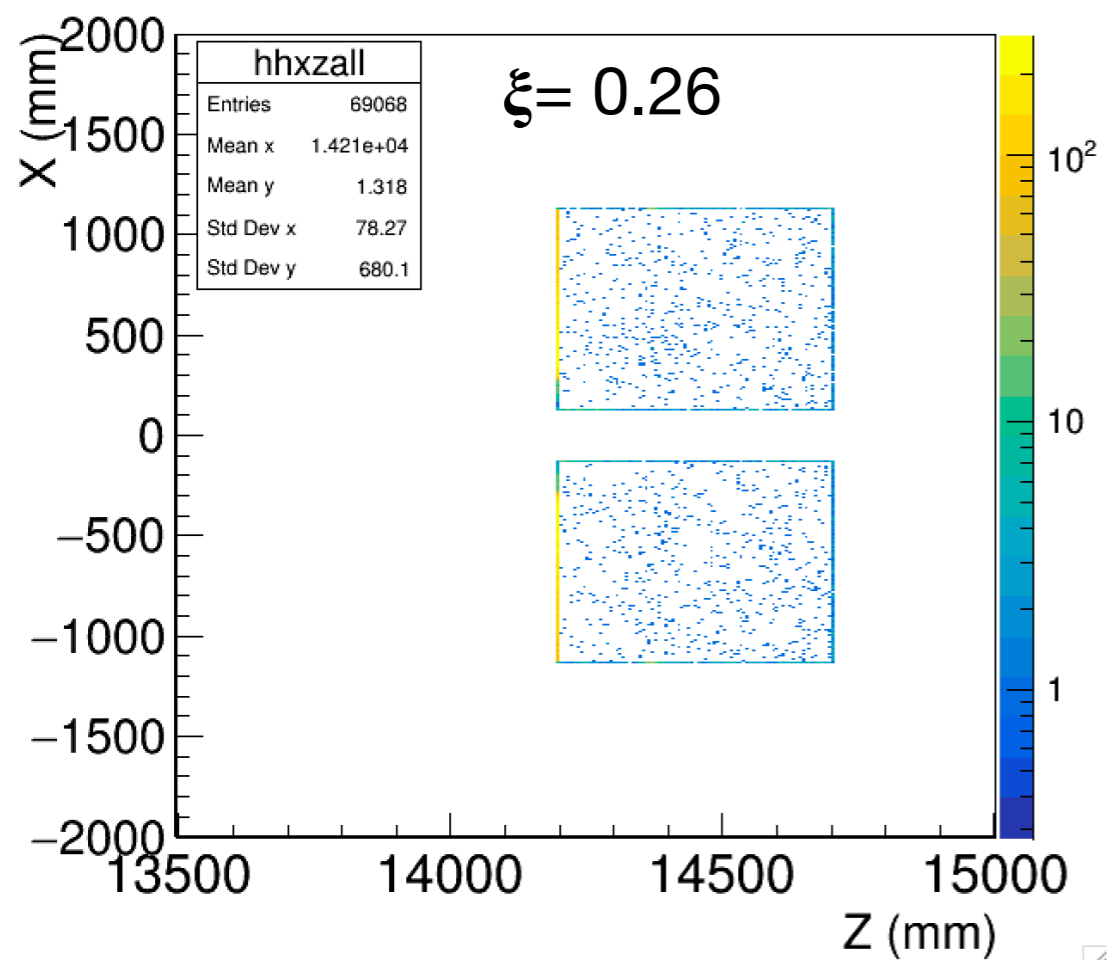
Hits xz distribution all



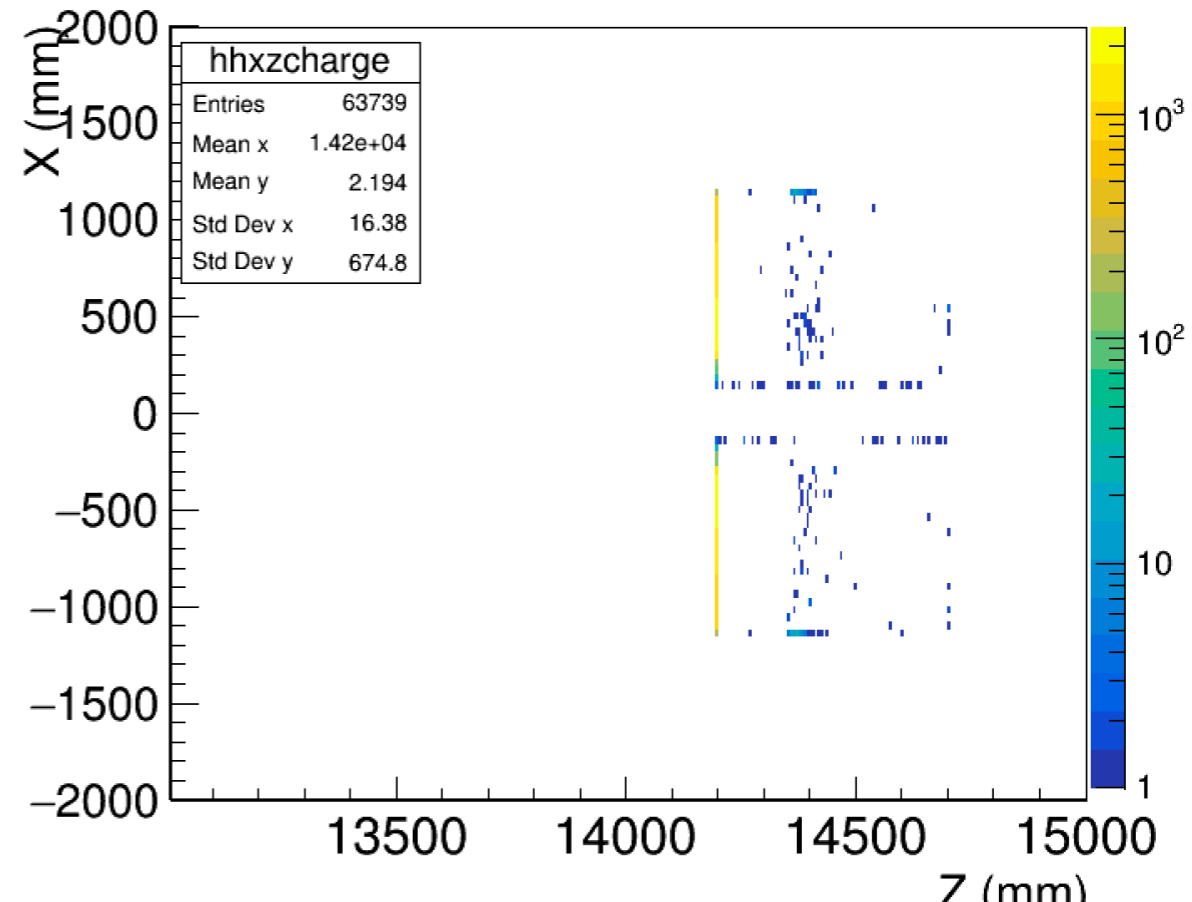
Hits xz distribution e-,e+



Hits xz distribution all

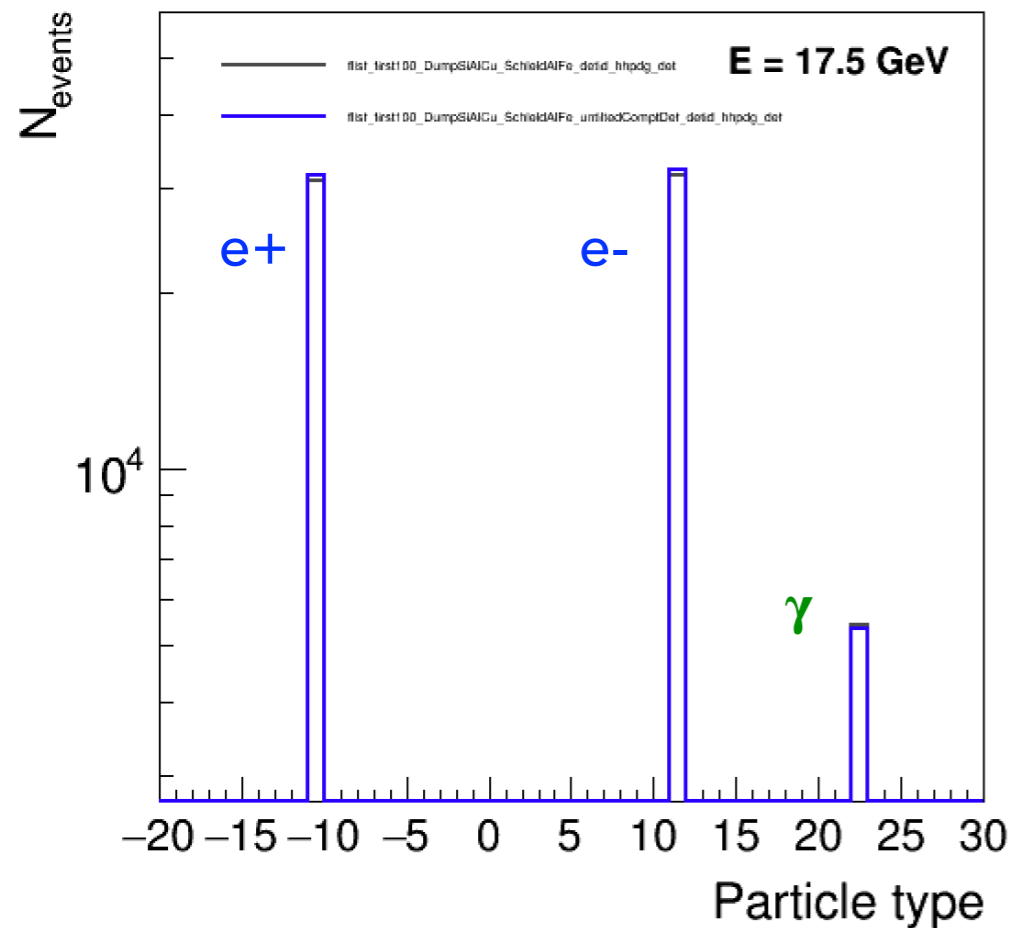
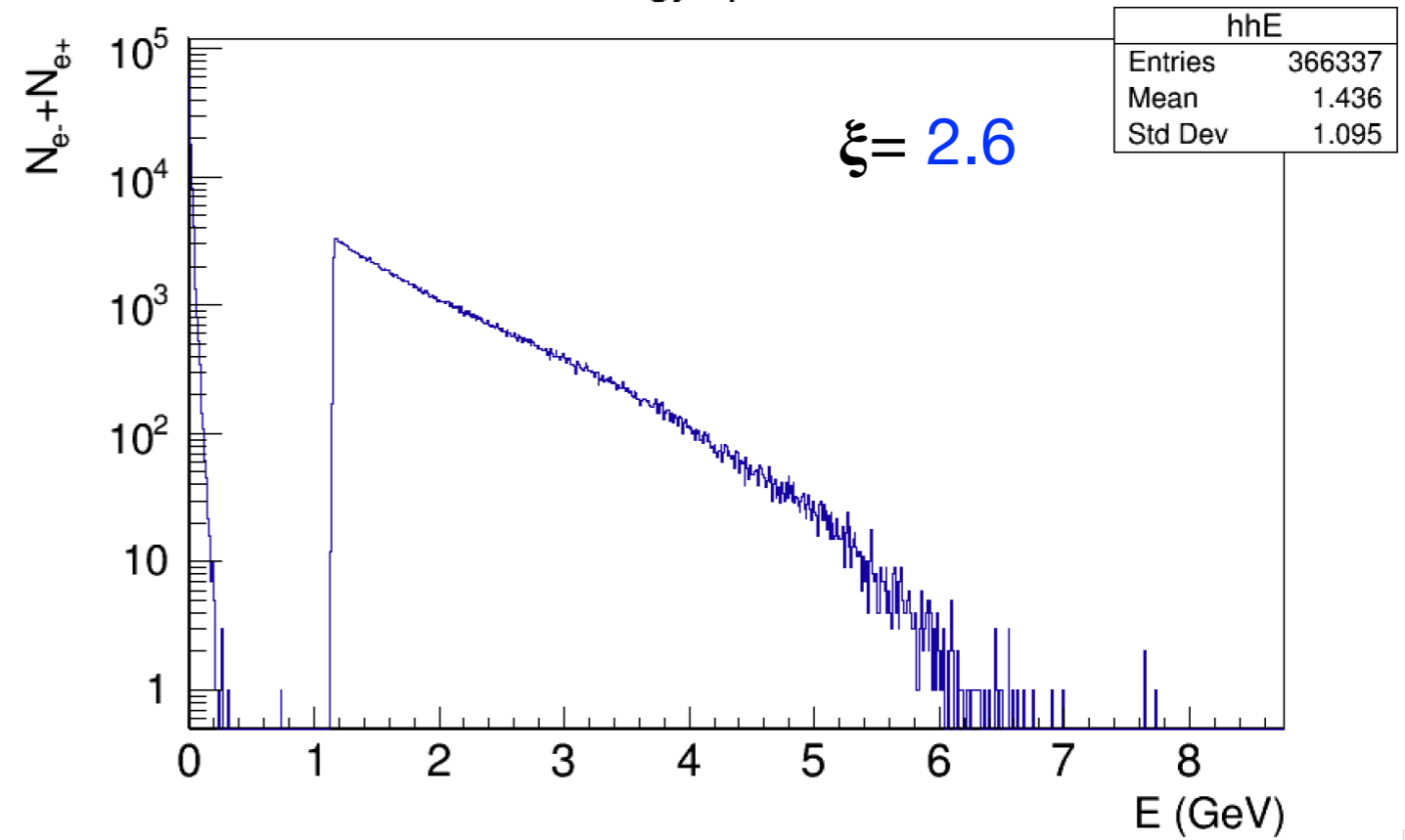
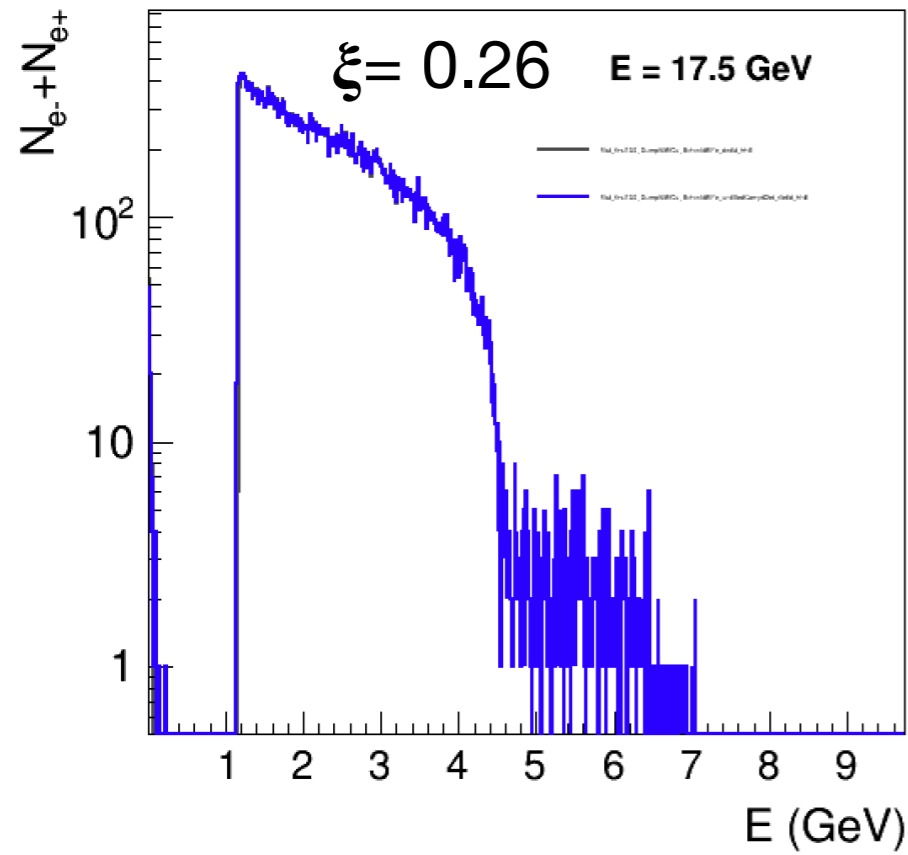


Hits xz distribution e-,e+

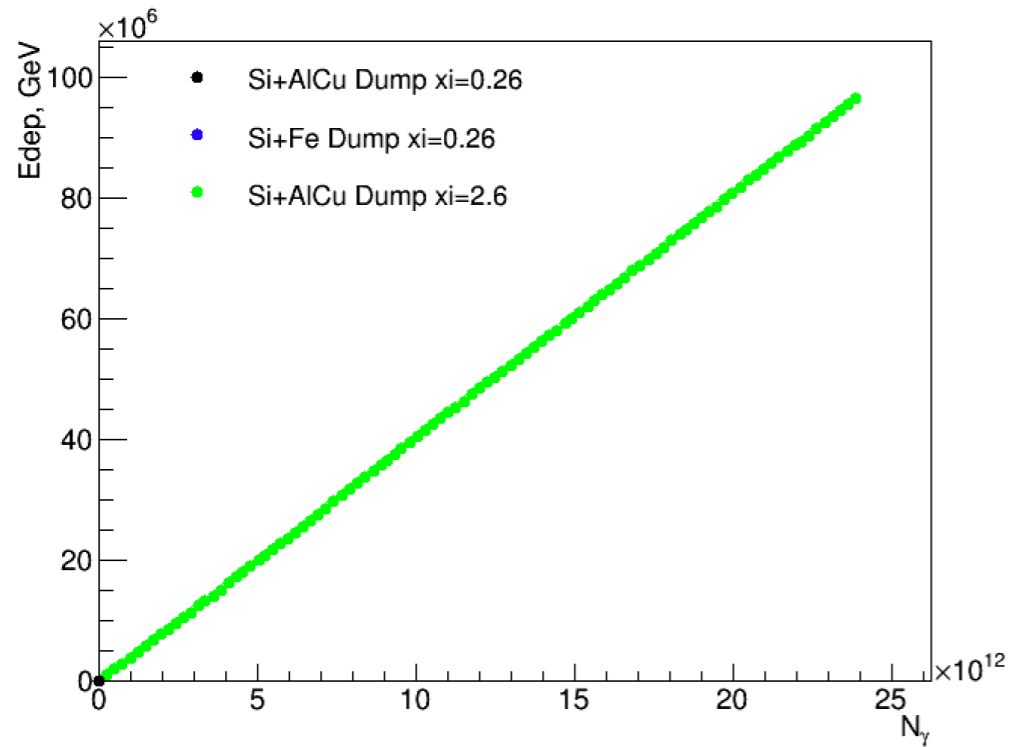


Compton detector: $\xi = 2.6$ vs 0.26

Energy spectrum

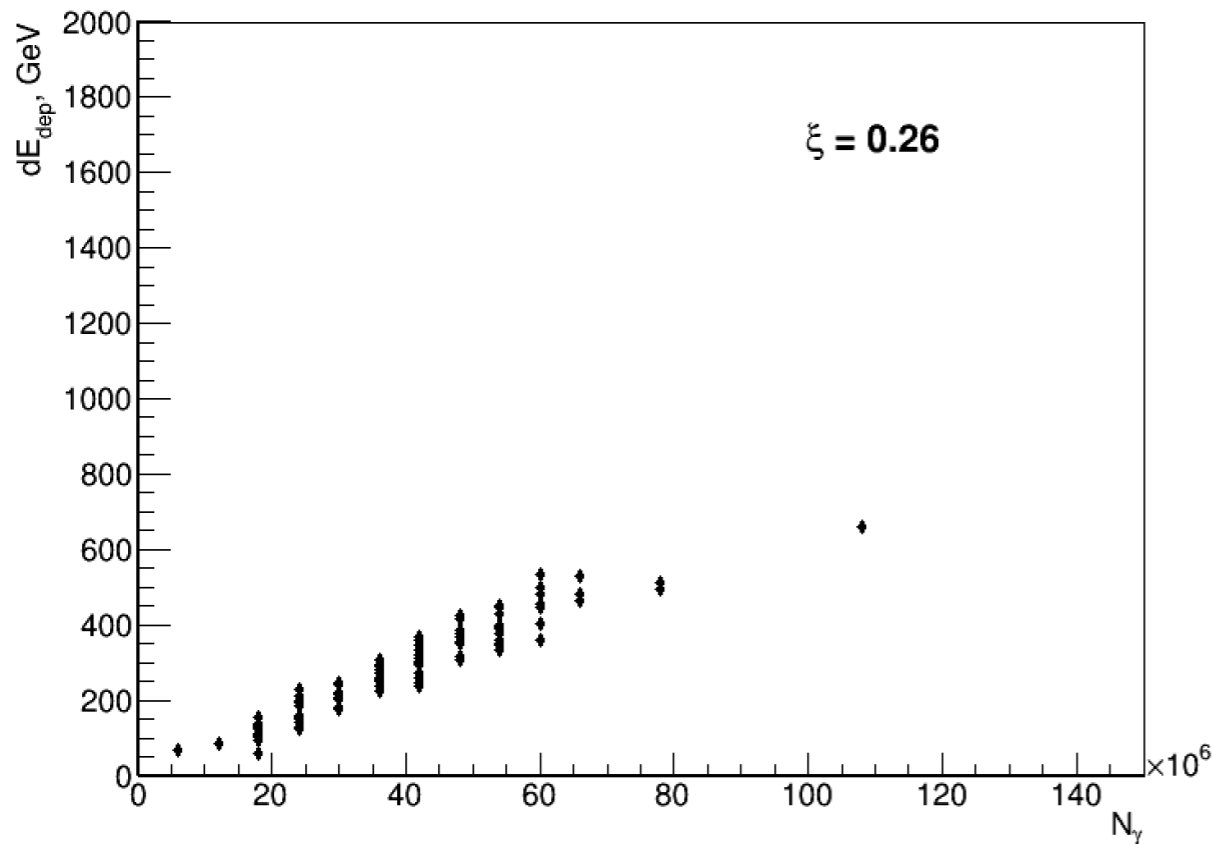


The dependence of deposited energy on number of incoming photons for Si Gamma monitor and AlCu dump for different laser intensities

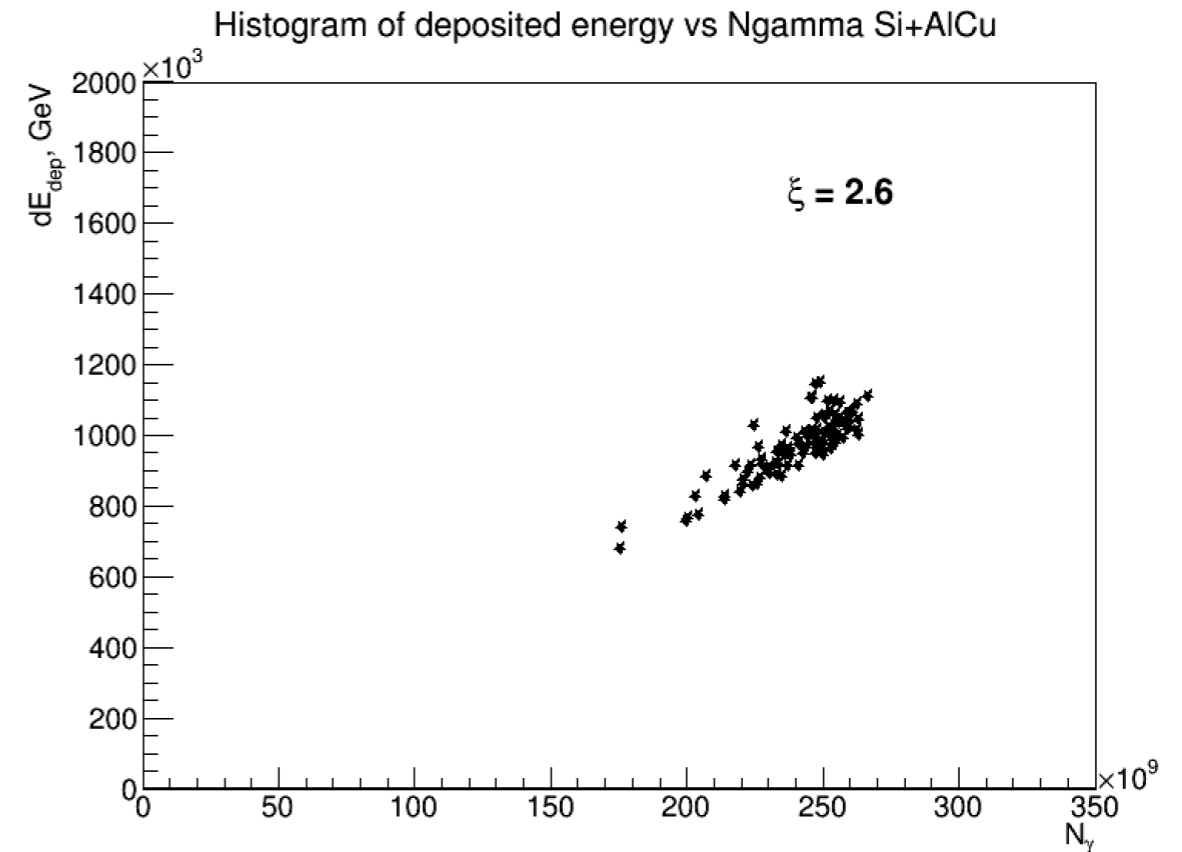


Histogram of deposited energy vs Ngamma Si+AlCu

Energy deposit on Nphotons
Each point is one BX

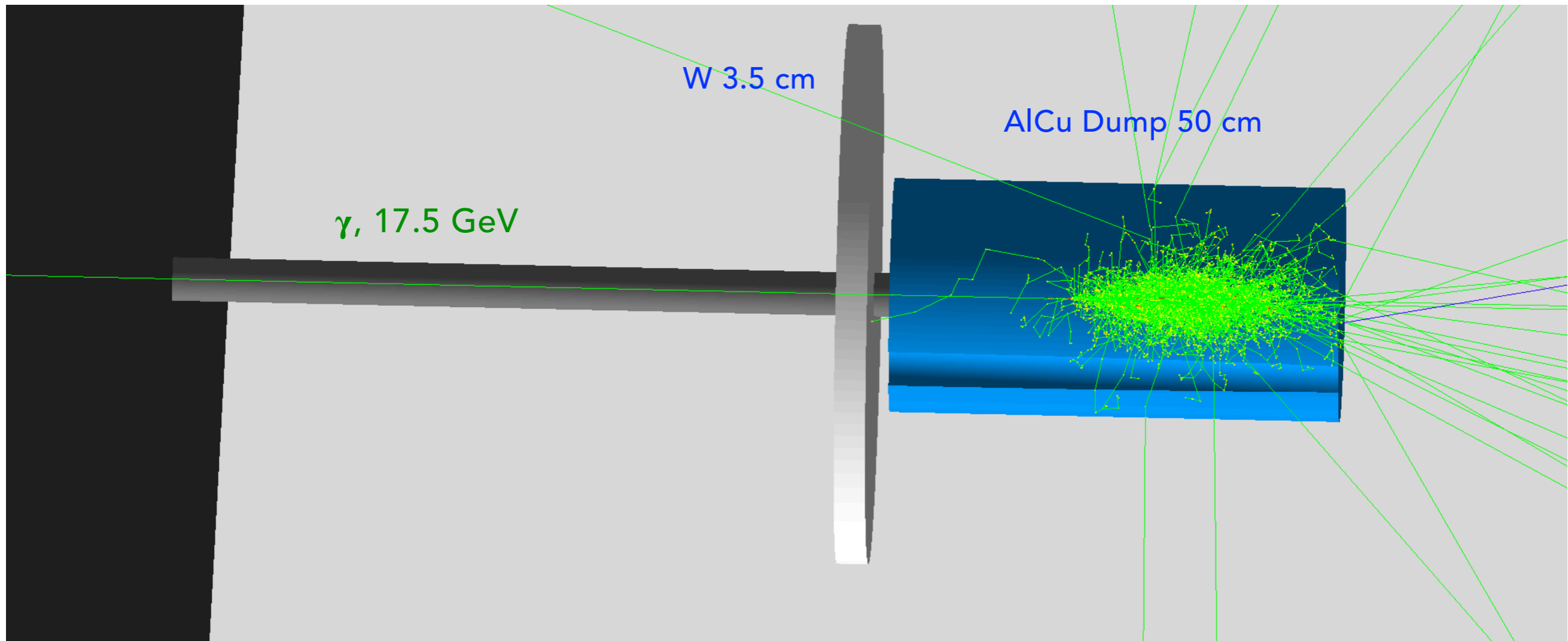


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Tungsten Gamma Monitor in Luxe setup



Compton Photons, 100 BX

$\xi = 2.6$

Target: W foil 10 um

The deposited energy on number of incoming photons for W Gamma monitor and AlCu dump

