Forward detector system for the LUXE experiment

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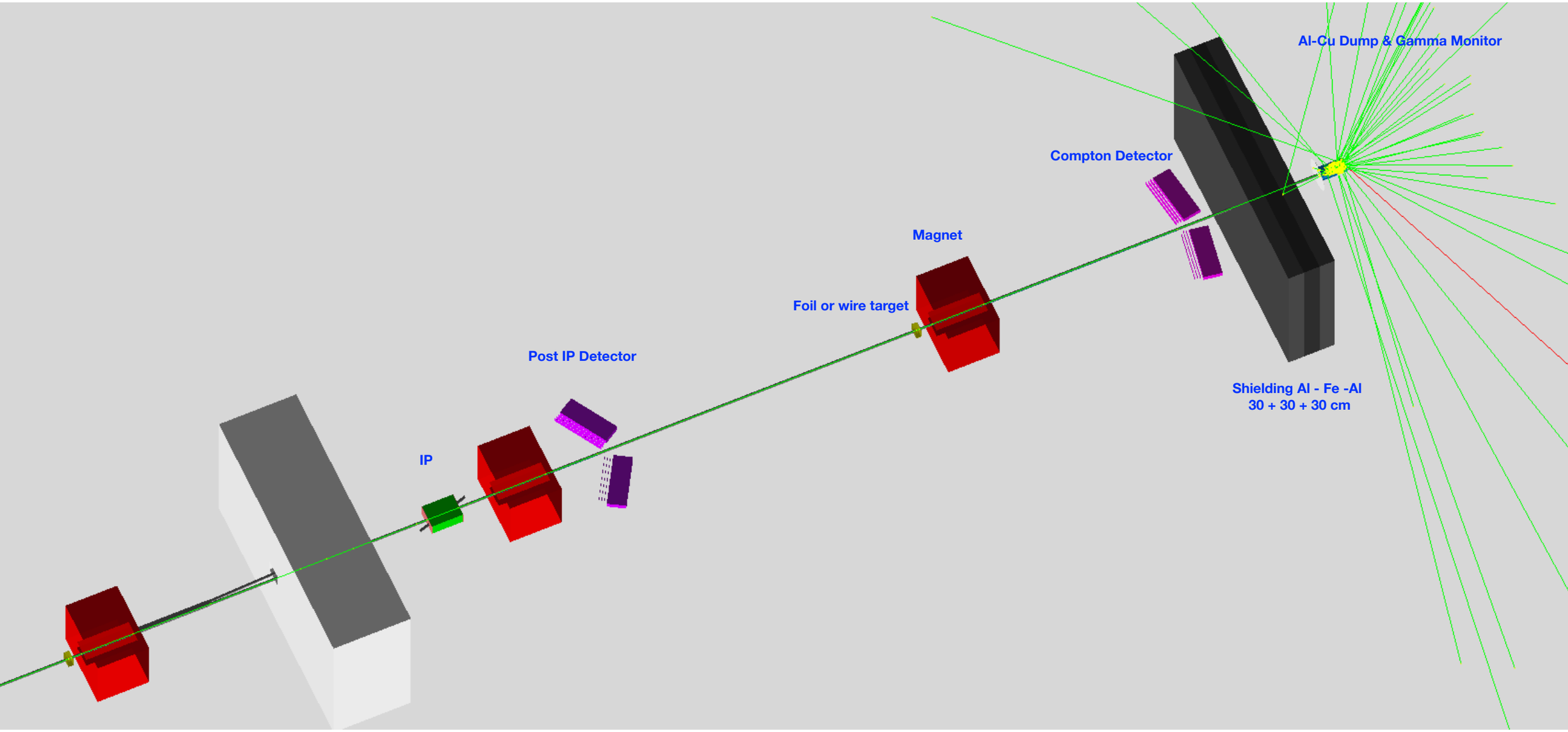
21/10/19

Luxe Technical meeting

DESY Hamburg

Luxe Setup with Al-Cu dump analogous to the one before IP



Shielding Al - Fe -Al
30 + 30 + 30 cm

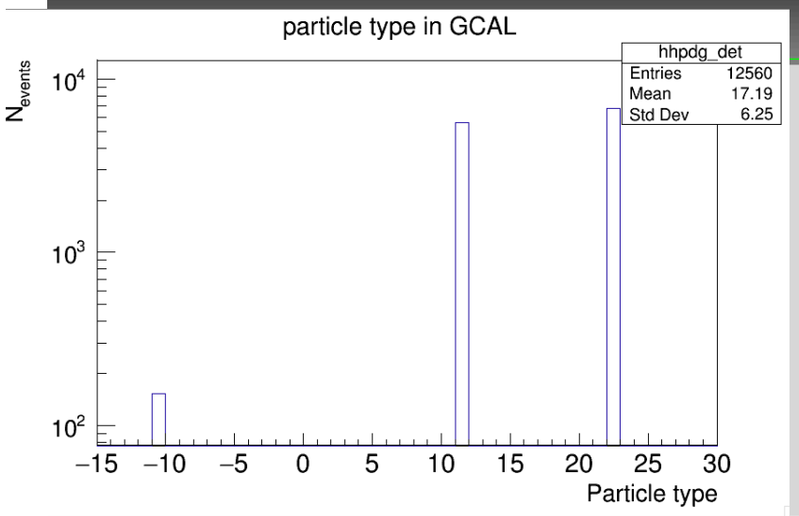
R= 30 cm

Si 0.5 cm

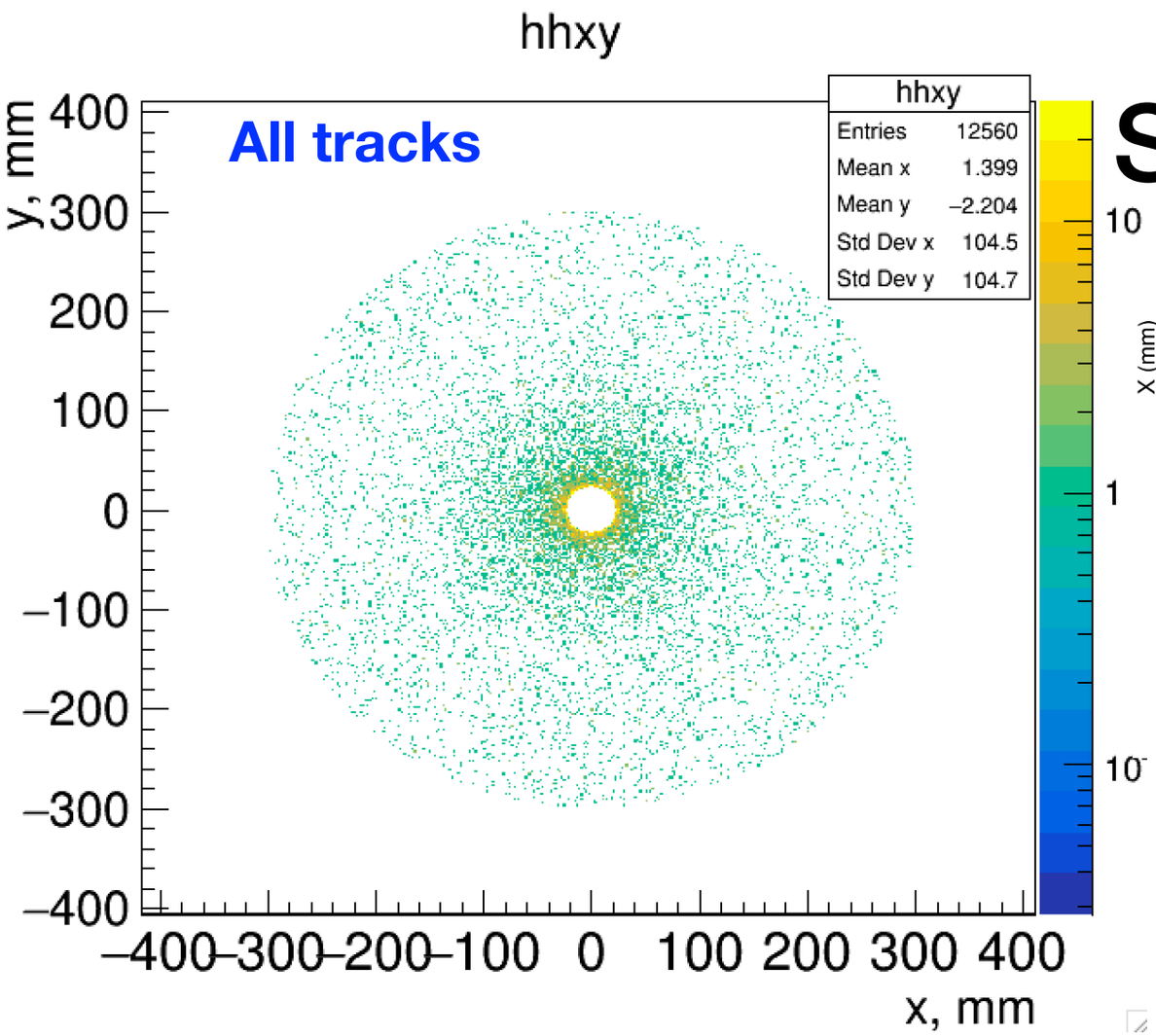
Cu R= 13 cm

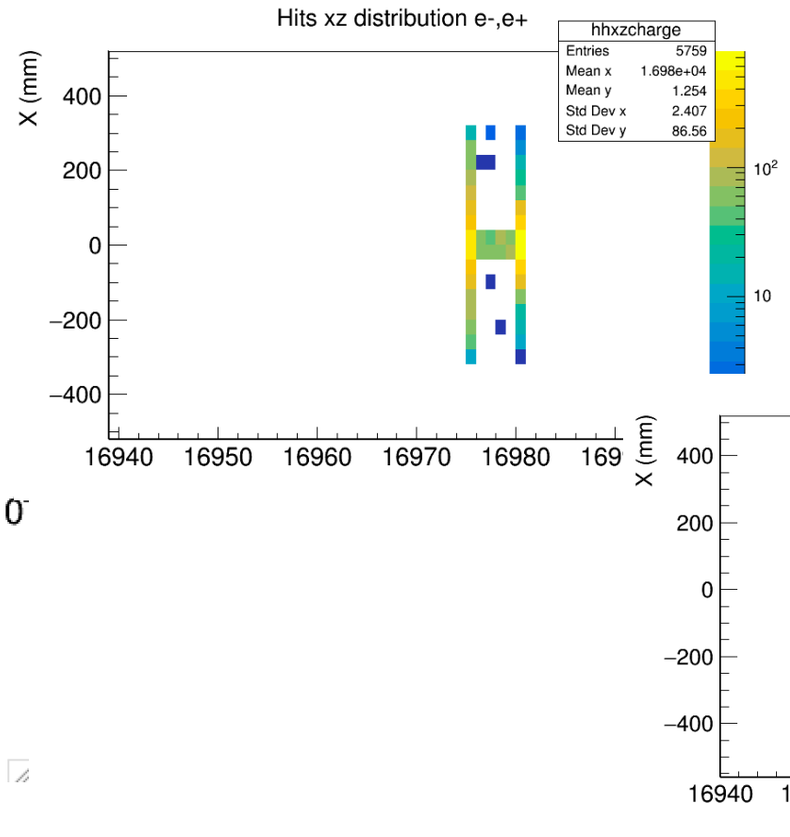
Al R= 6.5 cm

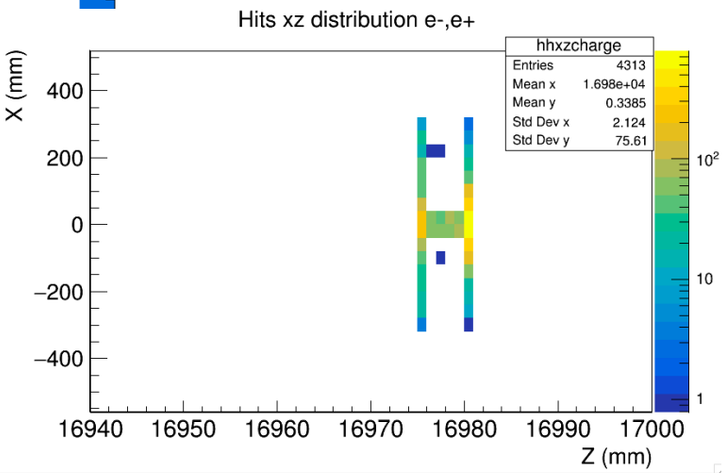
CuAl dump 50 cm

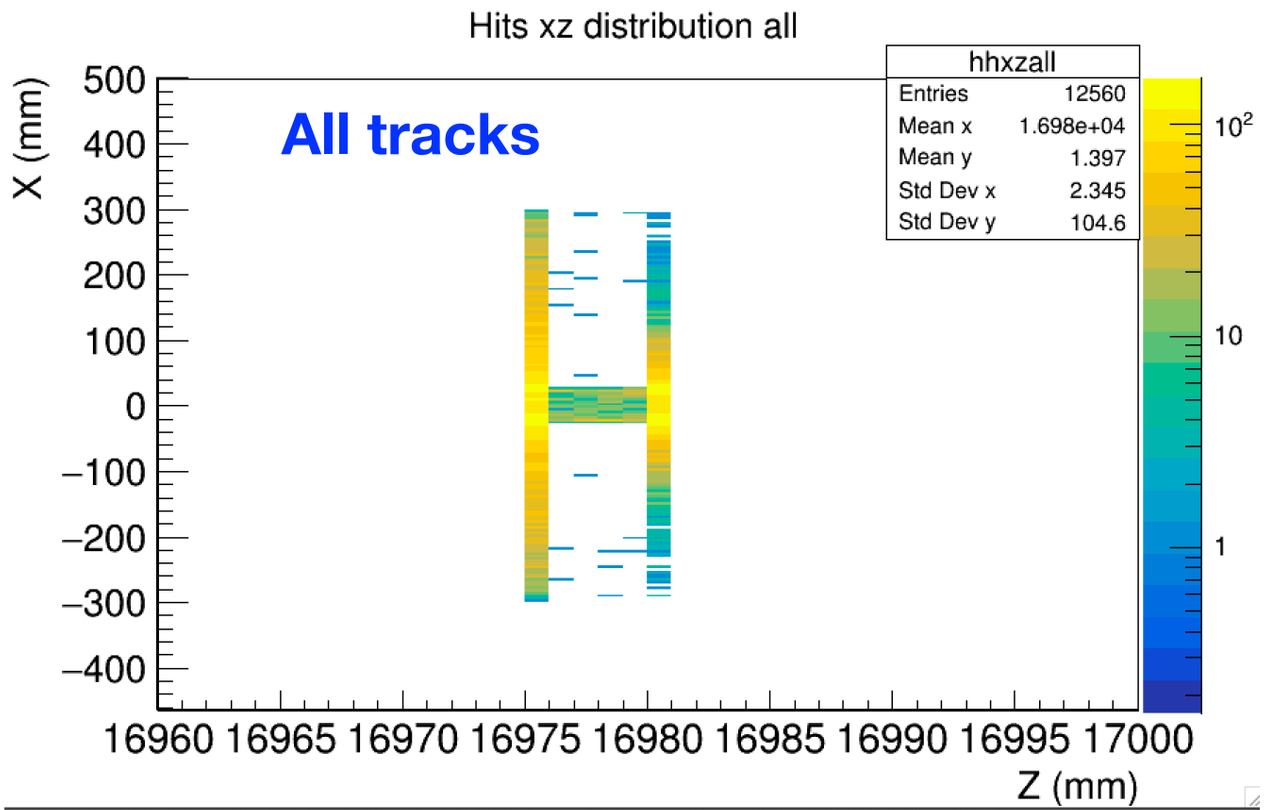


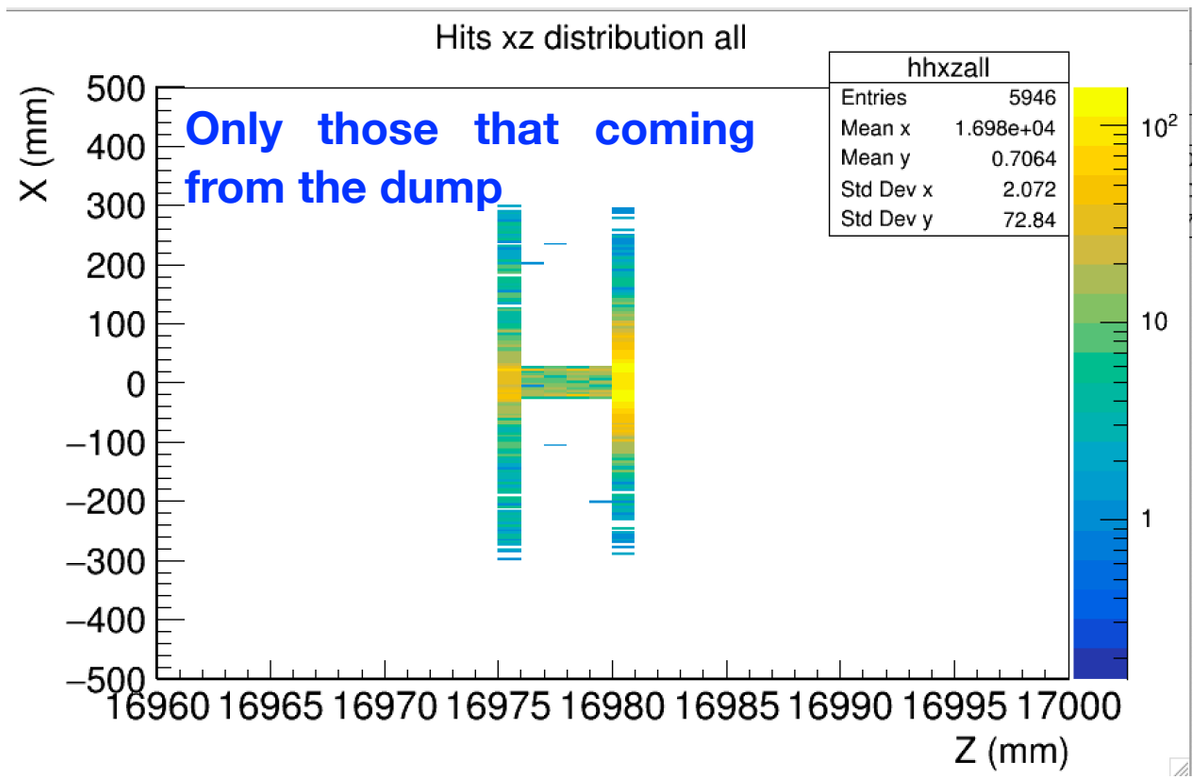
Si Monitor & Al-Cu dump



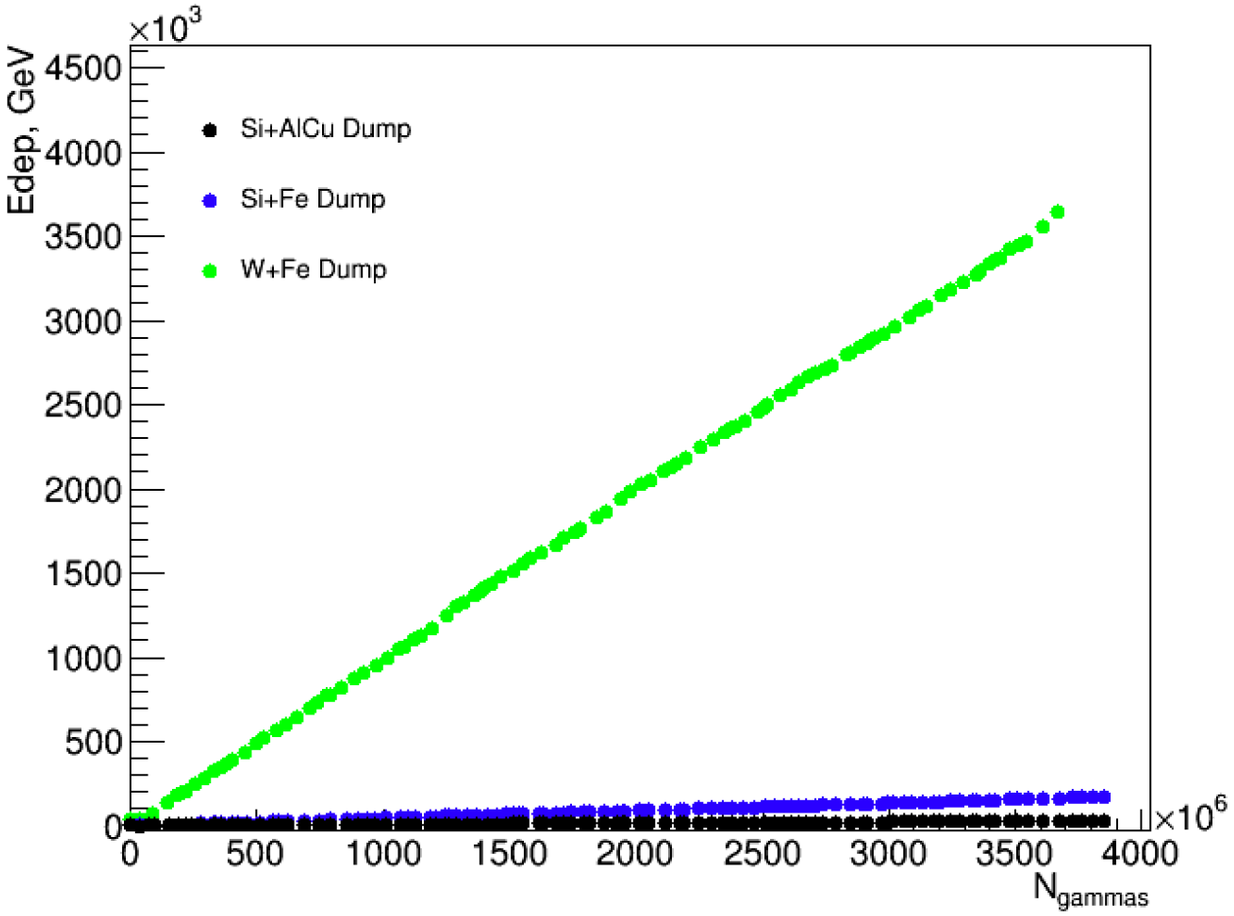


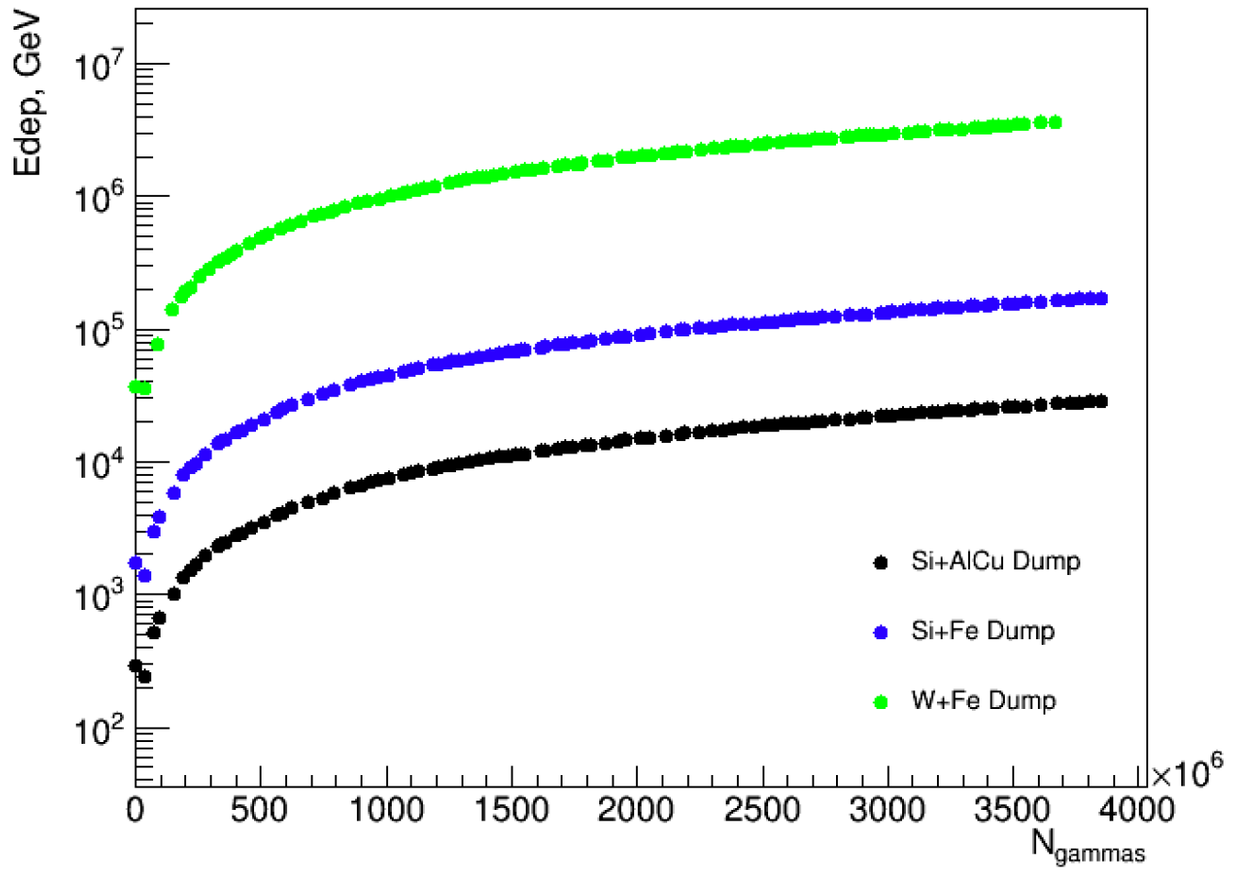


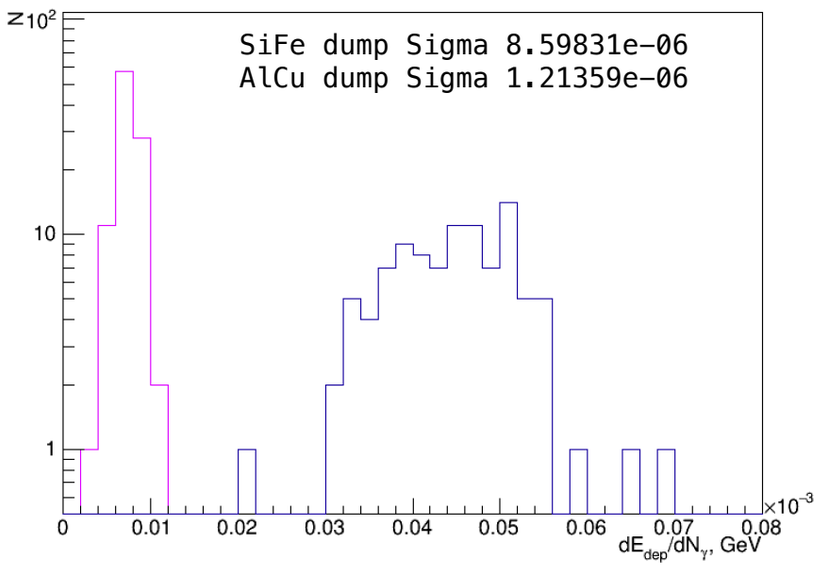


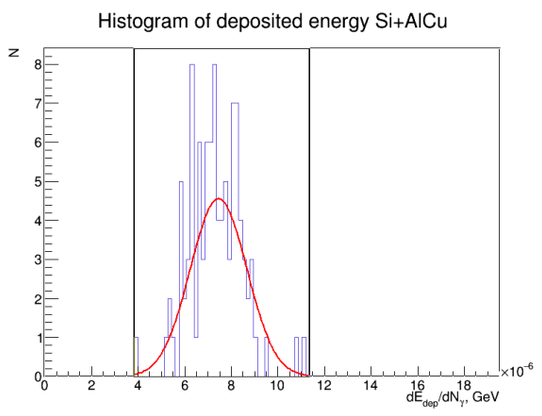


The dependence of deposited energy on number of incoming photons for Si monitors & different dumps



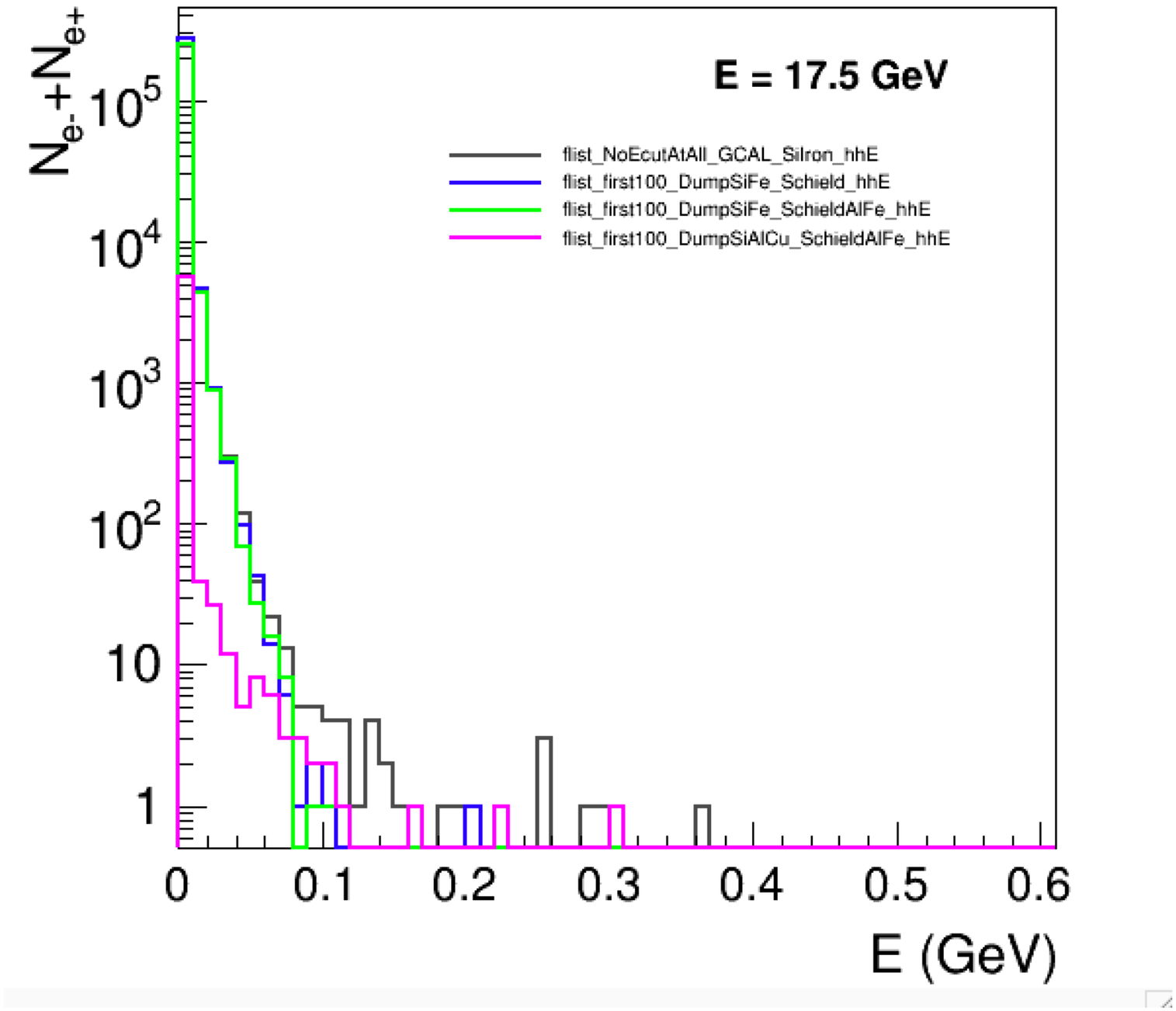




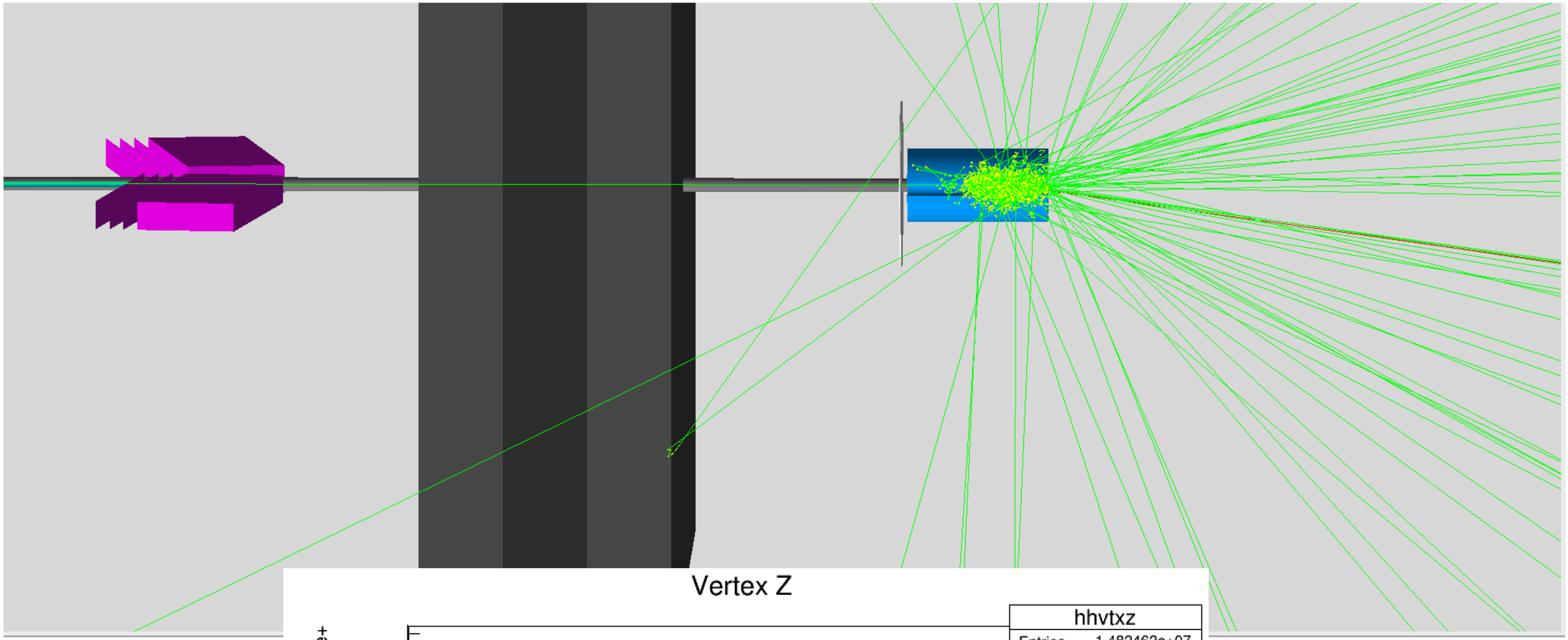


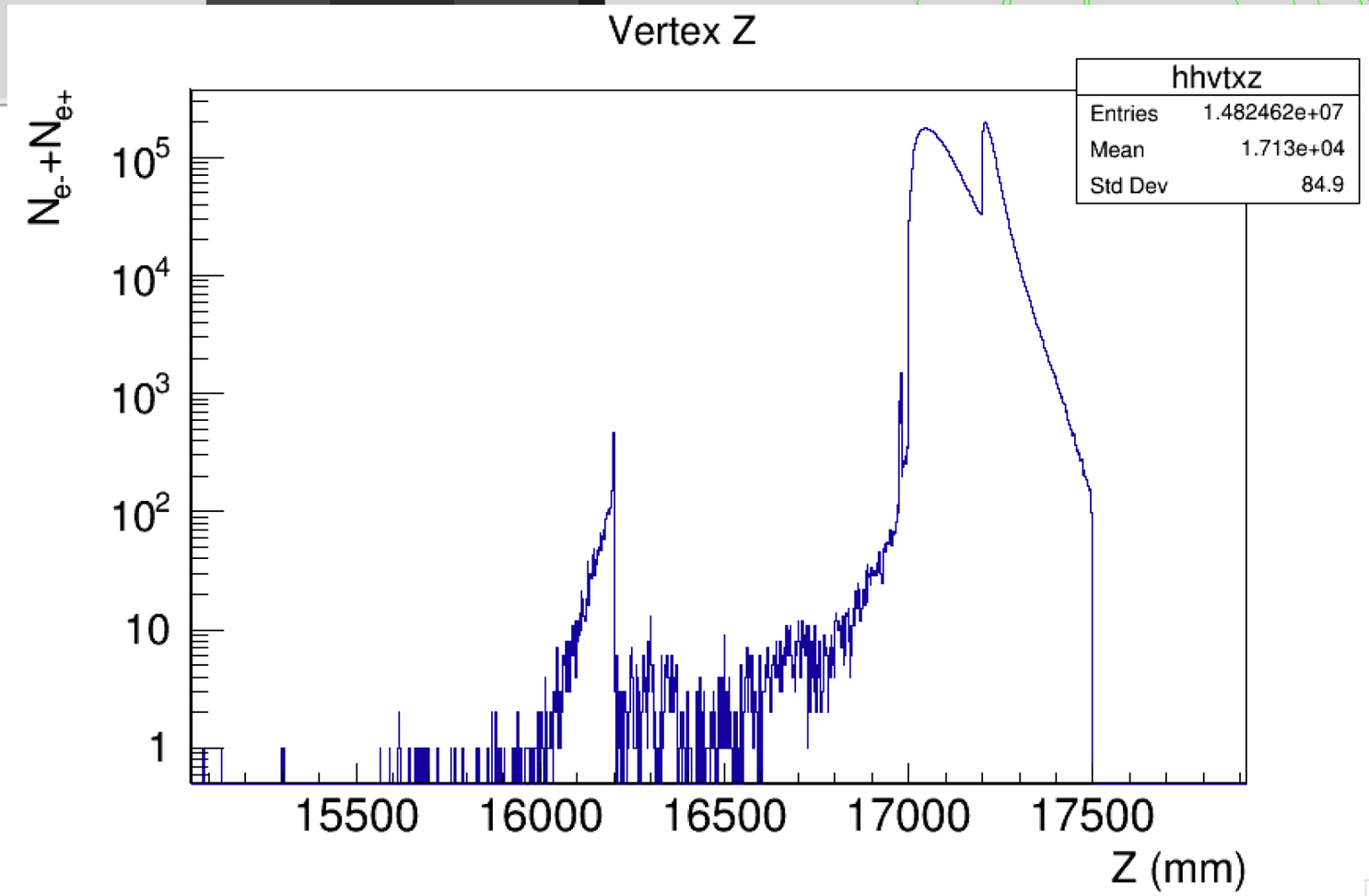
The linear dependence of deposited energy on number of incoming photons allows the usage of backscatters for estimating the photon flux

Energy of tracks hitting the Si monitor

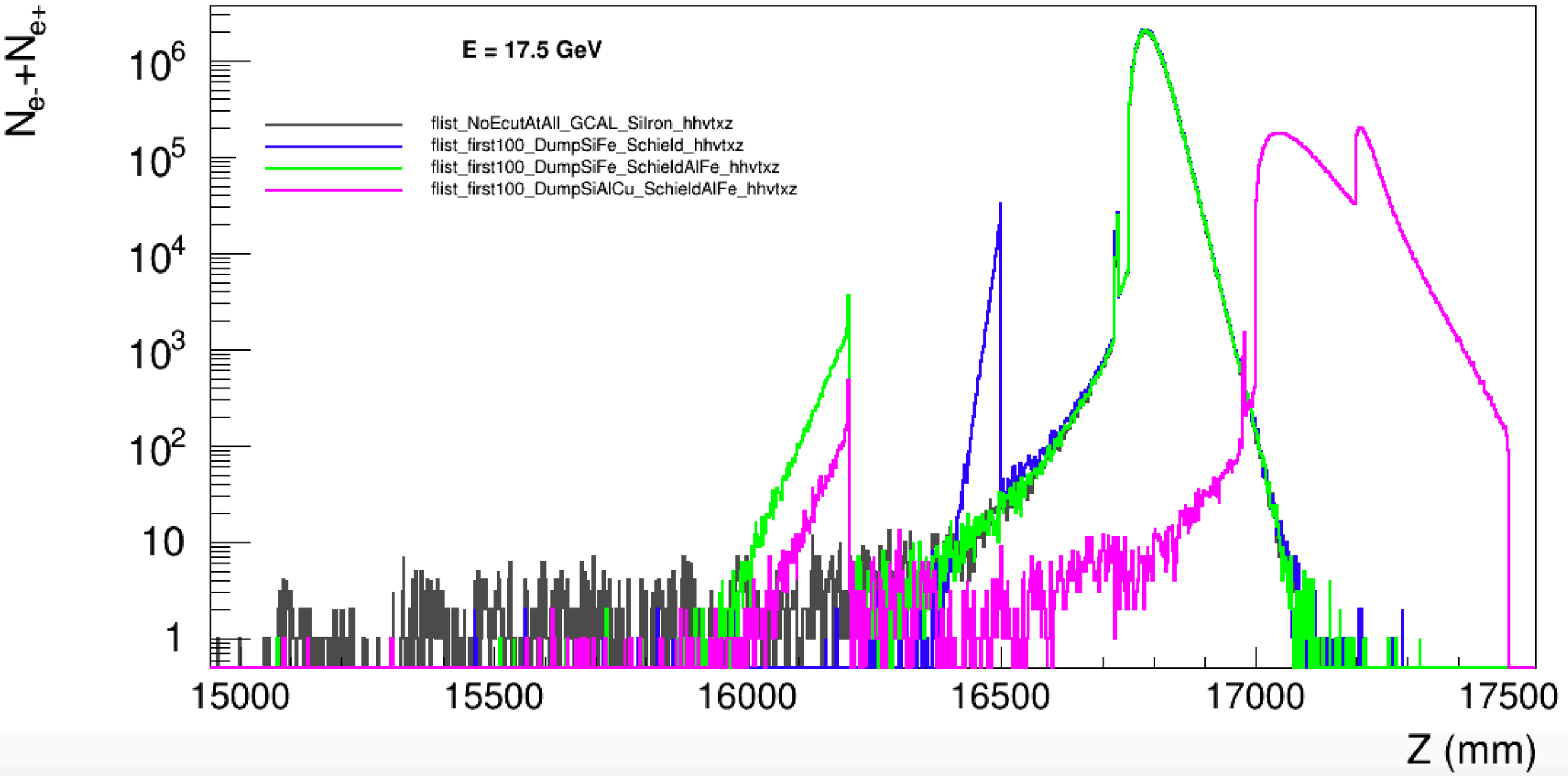


The energy spectrum of backscatters is below 1 GeV and for the vast majority is below critical energy for the most detector materials

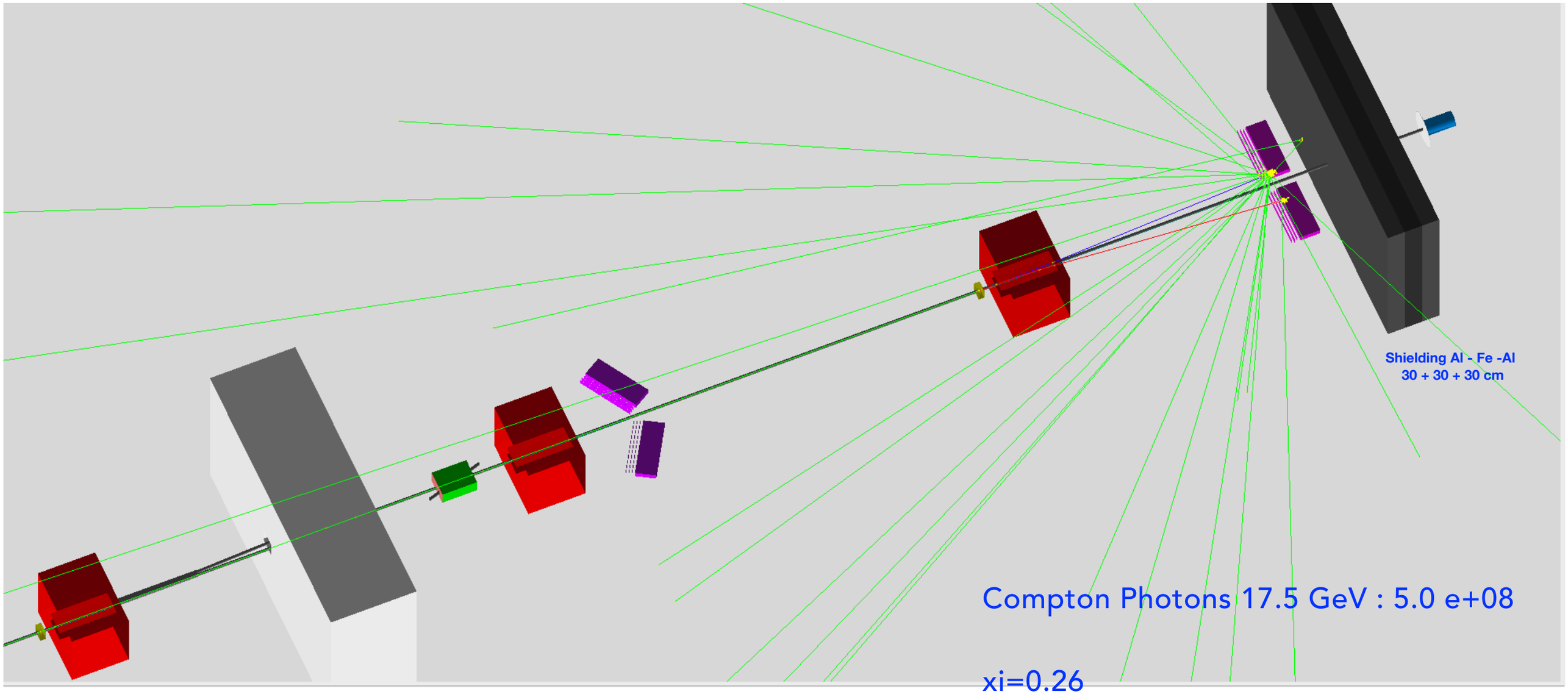



Vertex Z
hhvtxz
Entries 1.482462e+07
Mean 1.713e+04
Std Dev 84.9
$N_{e^-}+N_{e^+}$
10^5
10^4
10^3
10^2
10
1
15500
16000
16500
17000
17500
Z (mm)

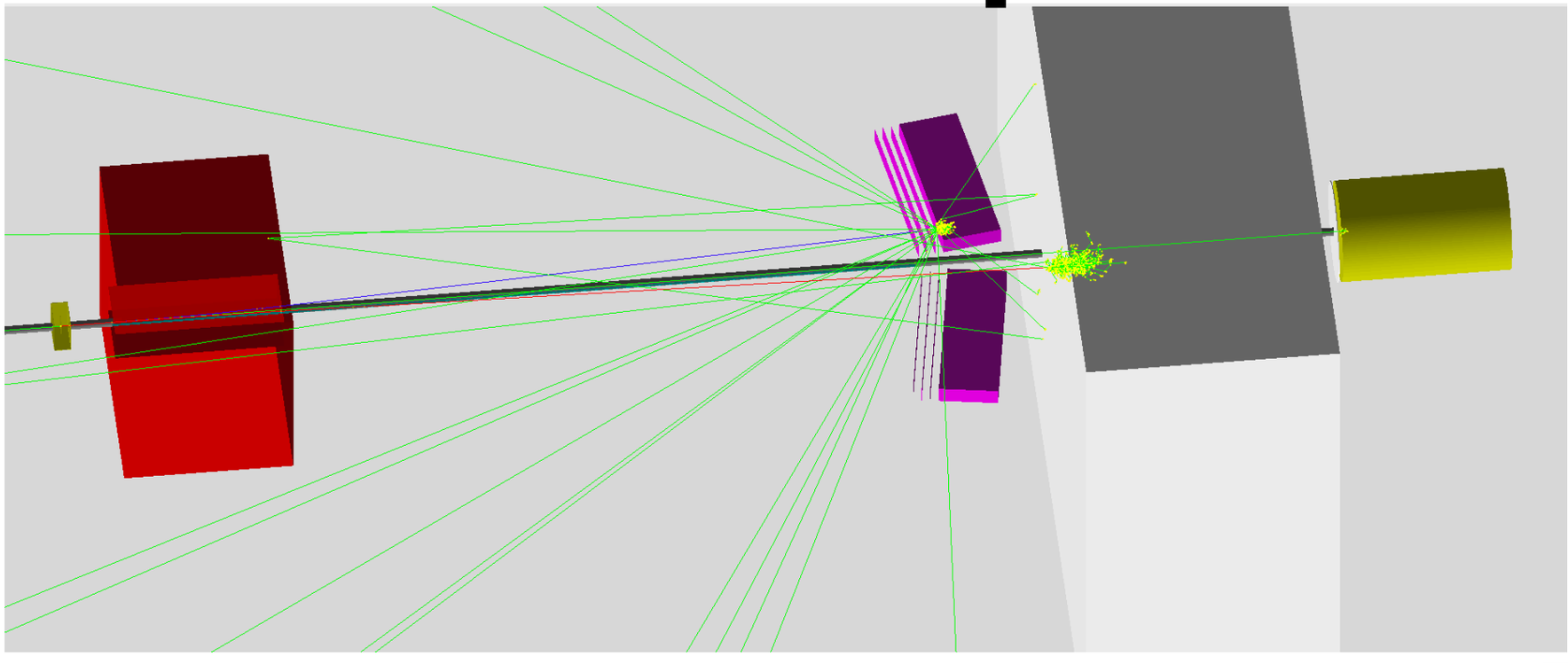
Vertexes


E = 17.5 GeV
flist_NoEcutAtAll_GCAL_Silron_hhvtxz
flist_first100_DumpSiFe_Schield_hhvtxz
flist_first100_DumpSiFe_SchieldAlFe_hhvtxz
flist_first100_DumpSiAlCu_SchieldAlFe_hhvtxz
$N_{e^-}+N_{e^+}$
10^6
10^5
10^4
10^3
10^2
10
1
15000
15500
16000
16500
17000
17500
Z (mm)

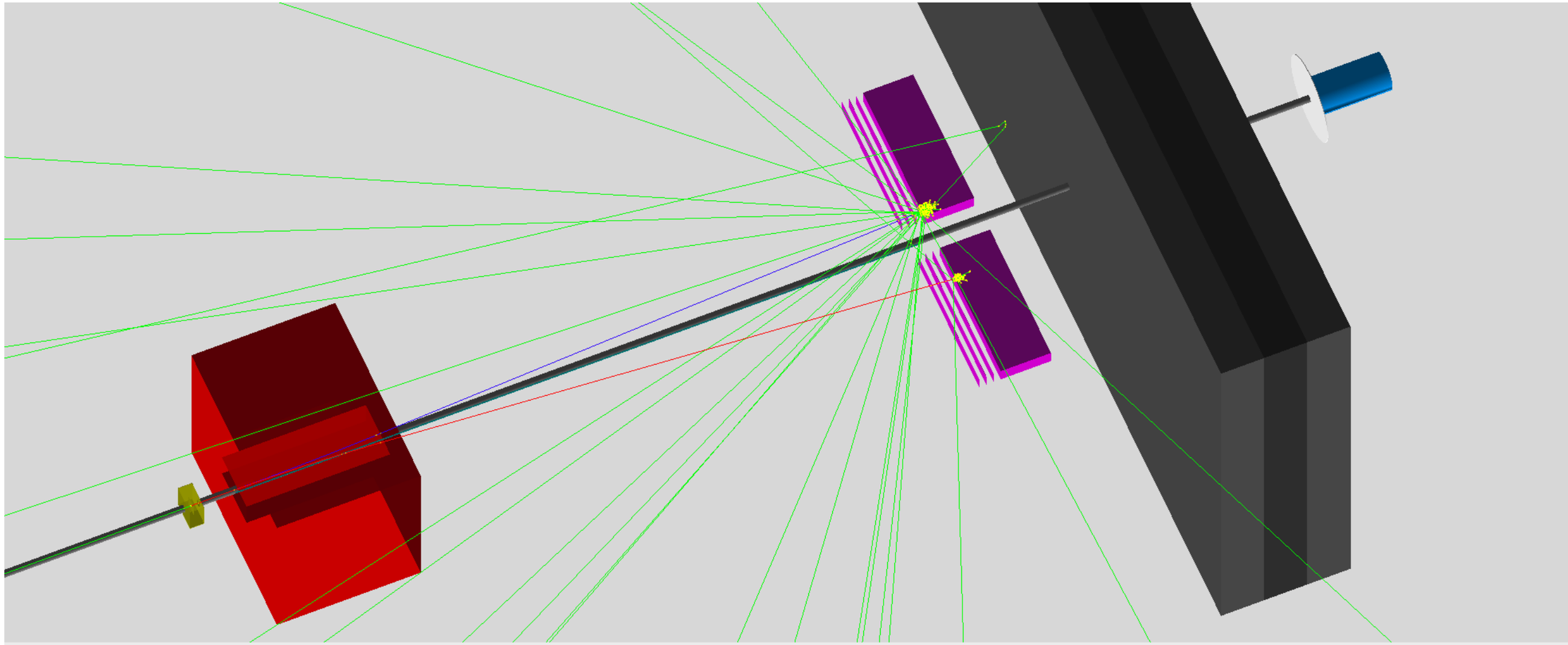
Luxe setup with non-tilted Compton Detector



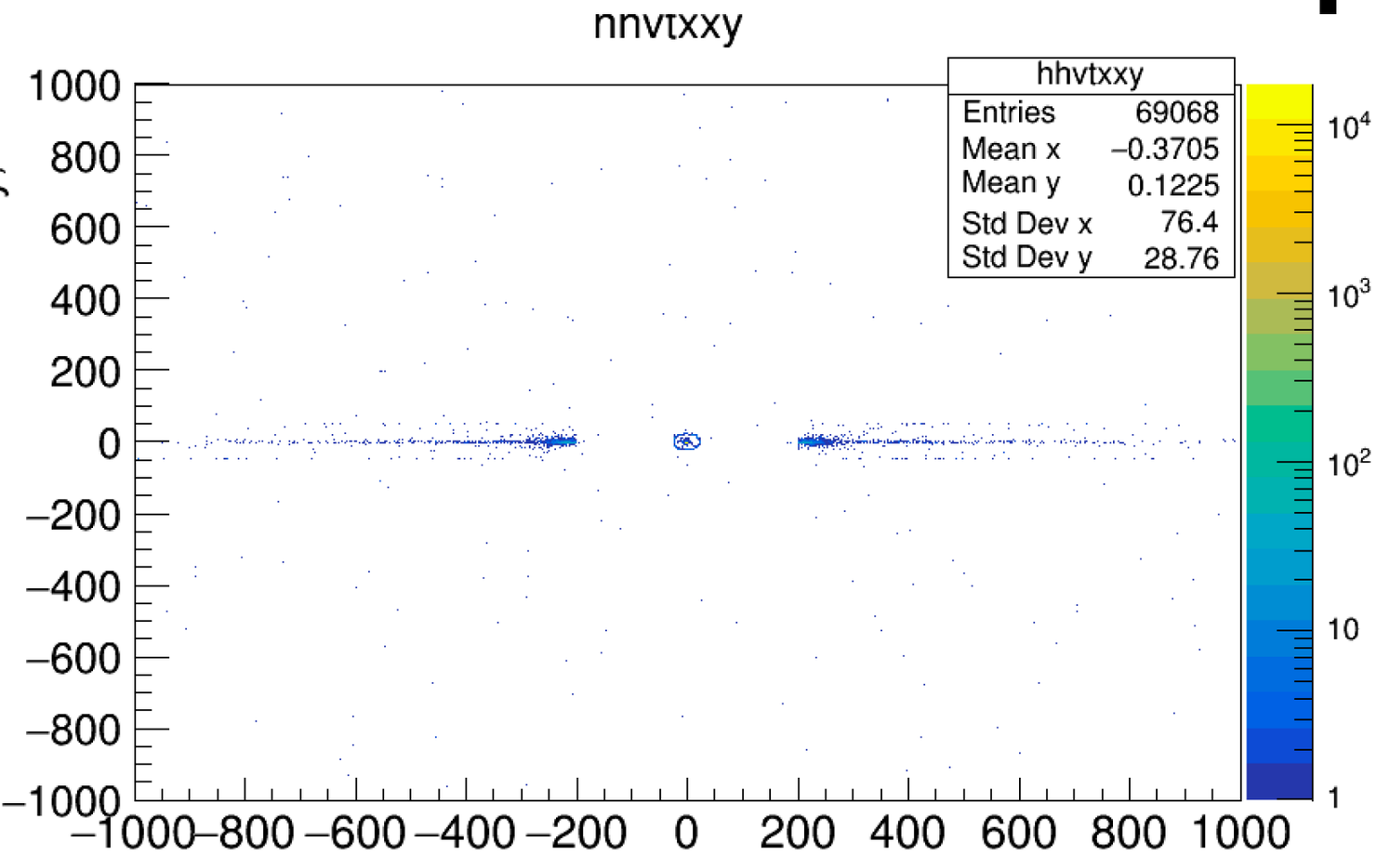
Compton detector

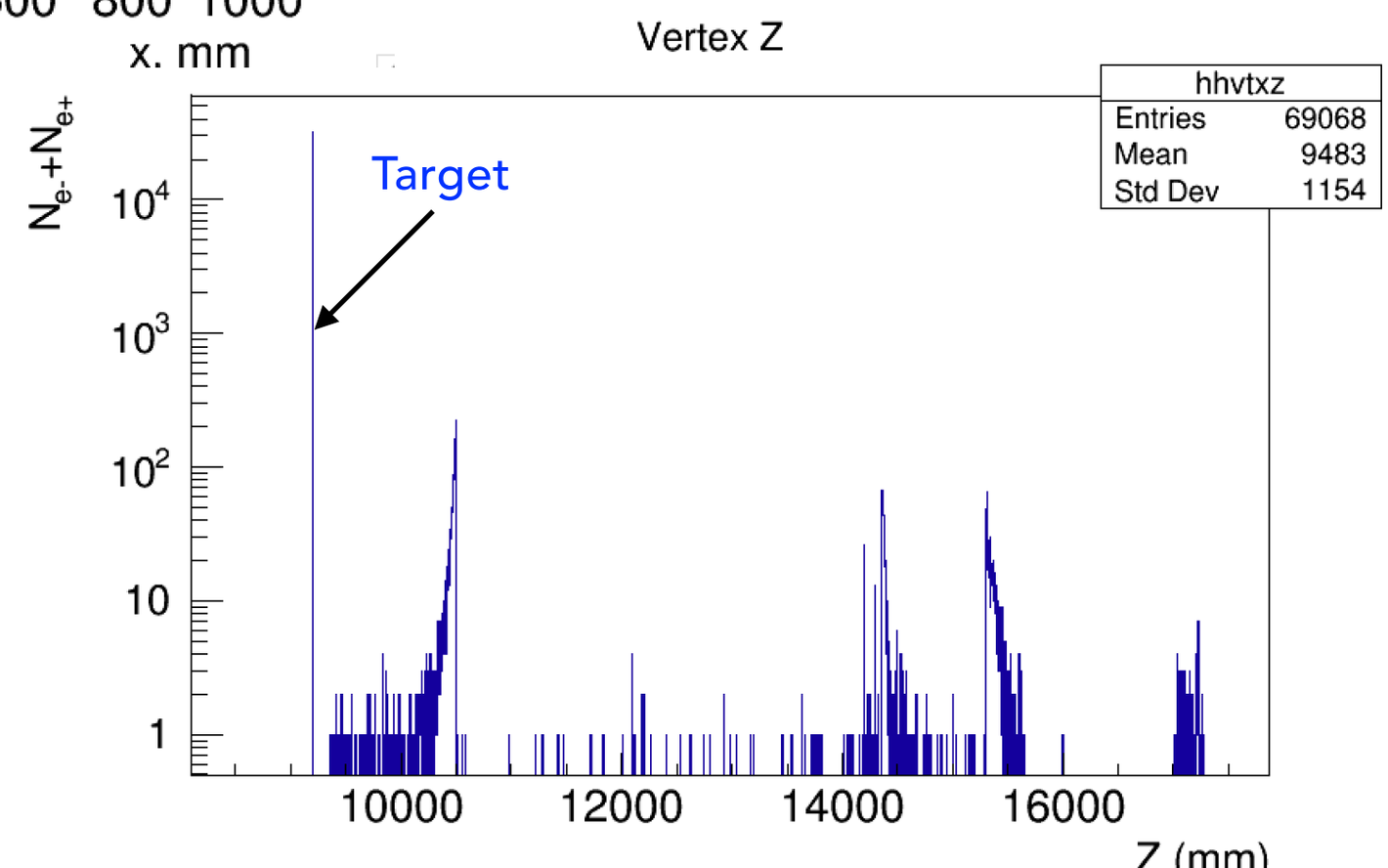


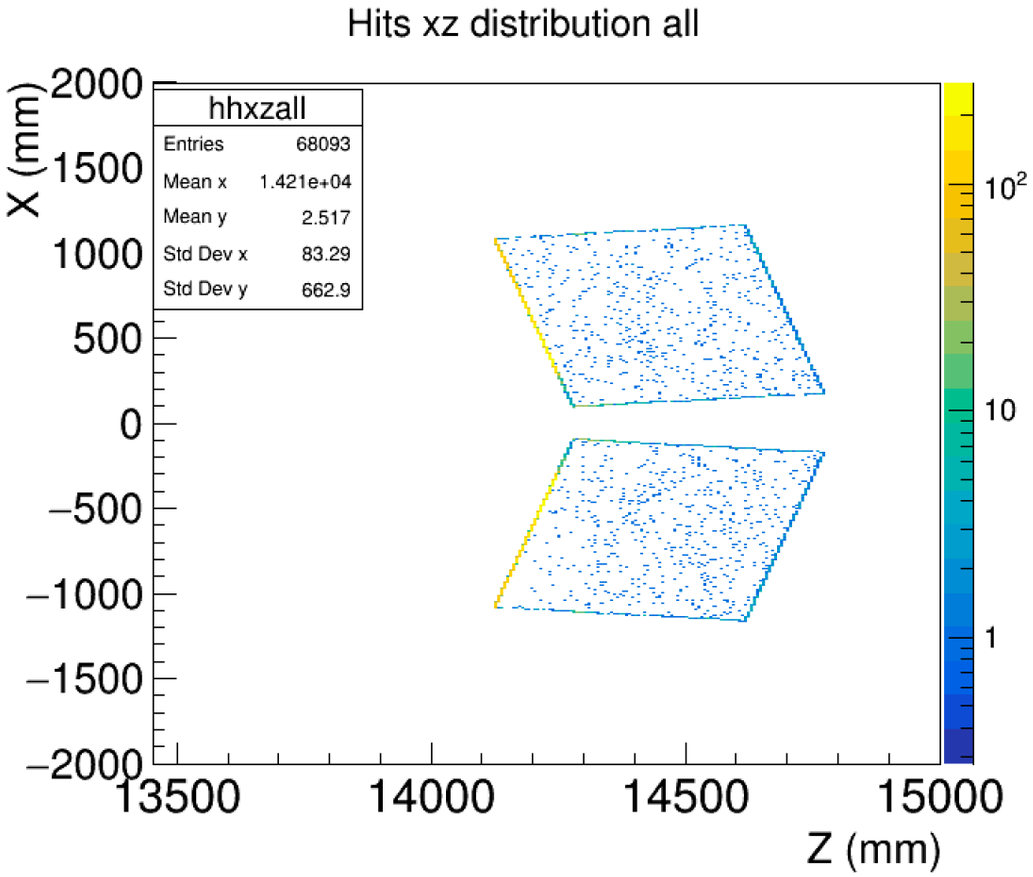
: tilted vs not-tilted

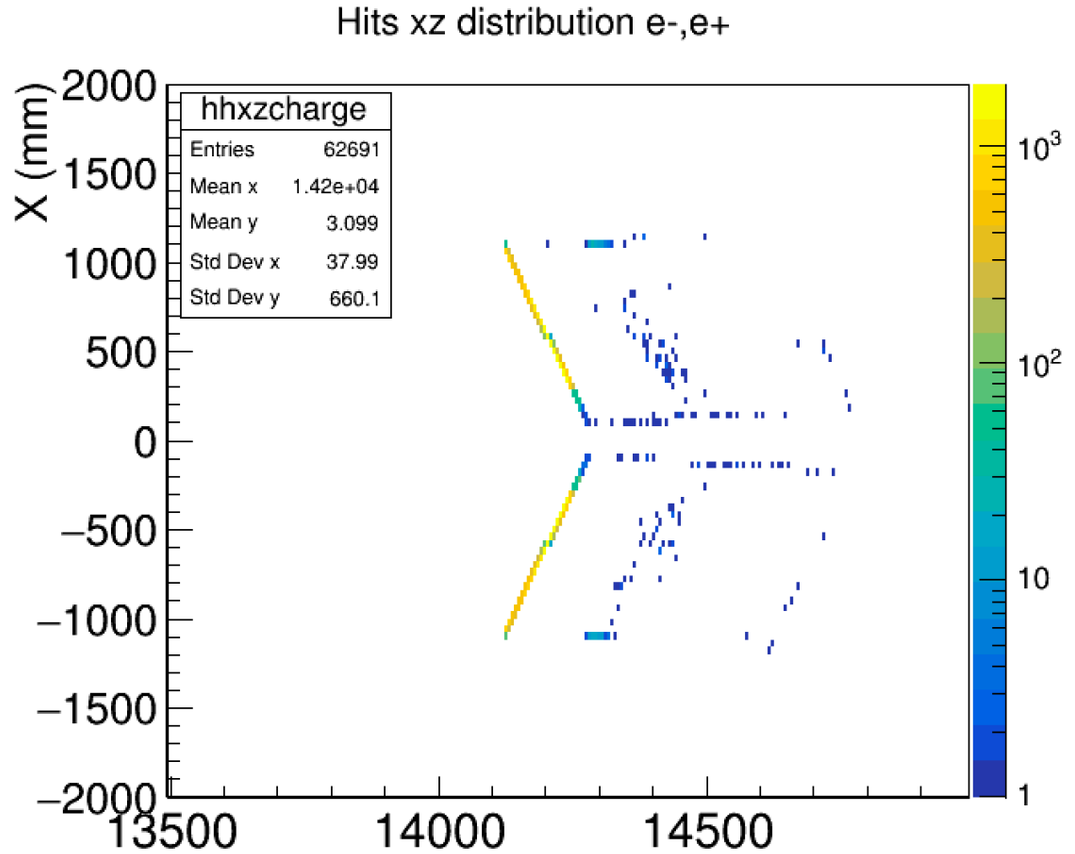


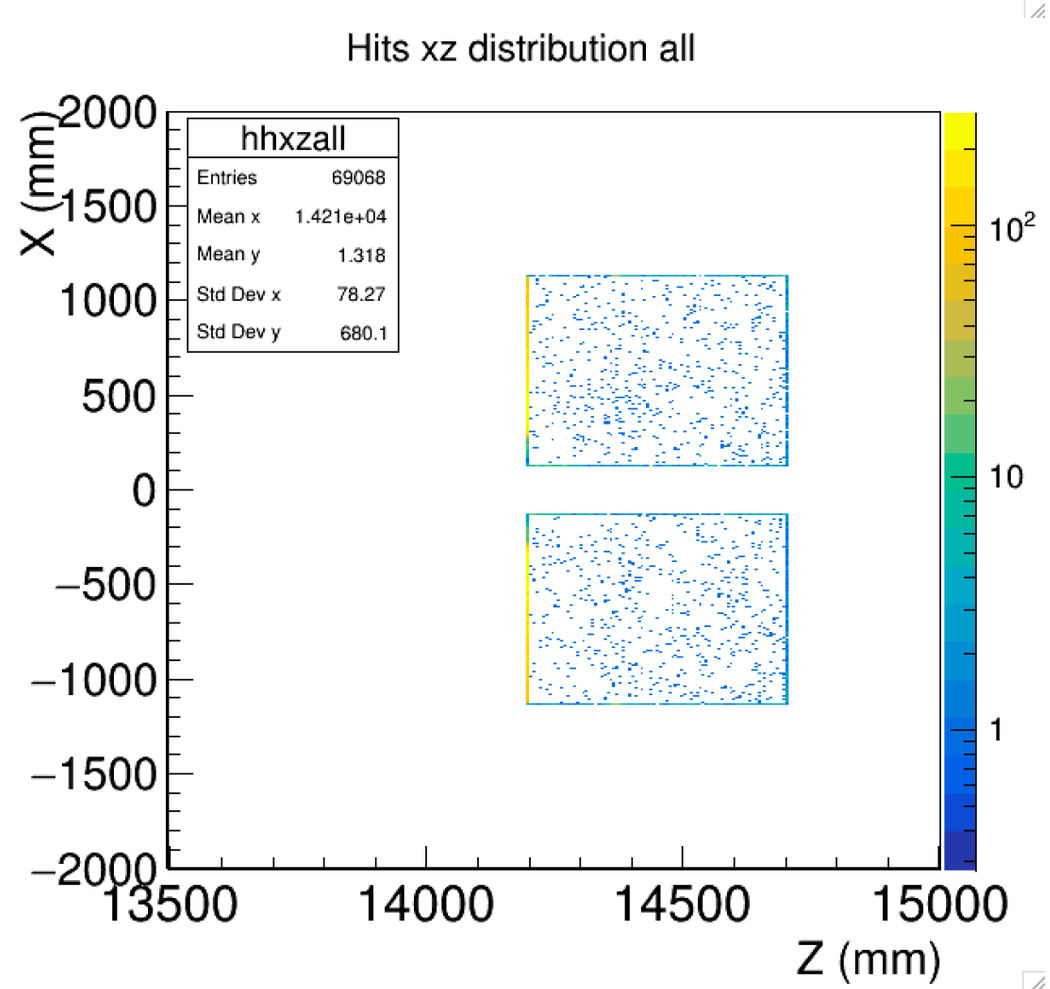
Vertexes in Compton detector






Hits xz distribution all
hhxzall
Entries 68093
Mean x 1.421e+04
Mean y 2.517
Std Dev x 83.29
Std Dev y 662.9
X (mm)
Z (mm)


Hits xz distribution e-,e+
hhxzcharge
Entries 62691
Mean x 1.42e+04
Mean y 3.099
Std Dev x 37.99
Std Dev y 660.1
X (mm)
Z (mm)


Hits xz distribution all
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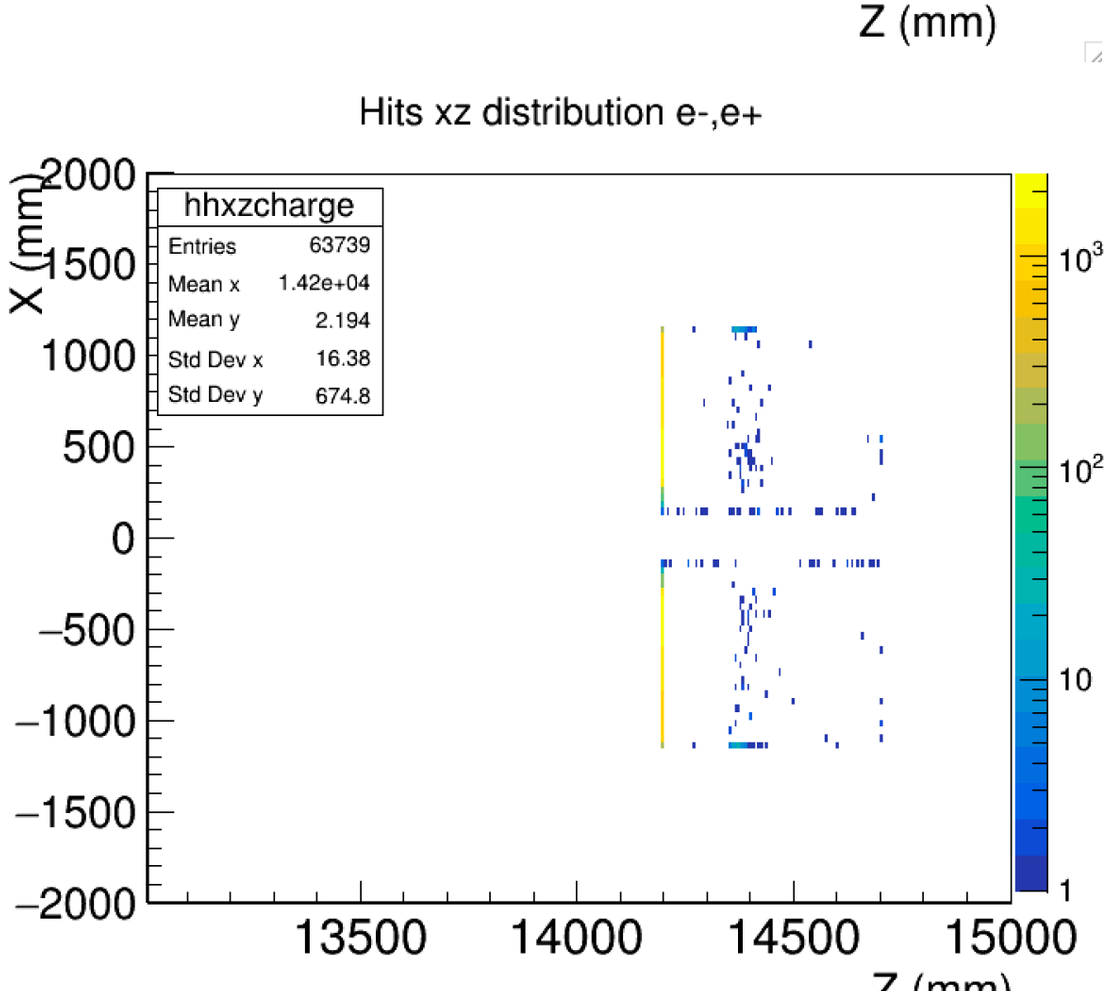
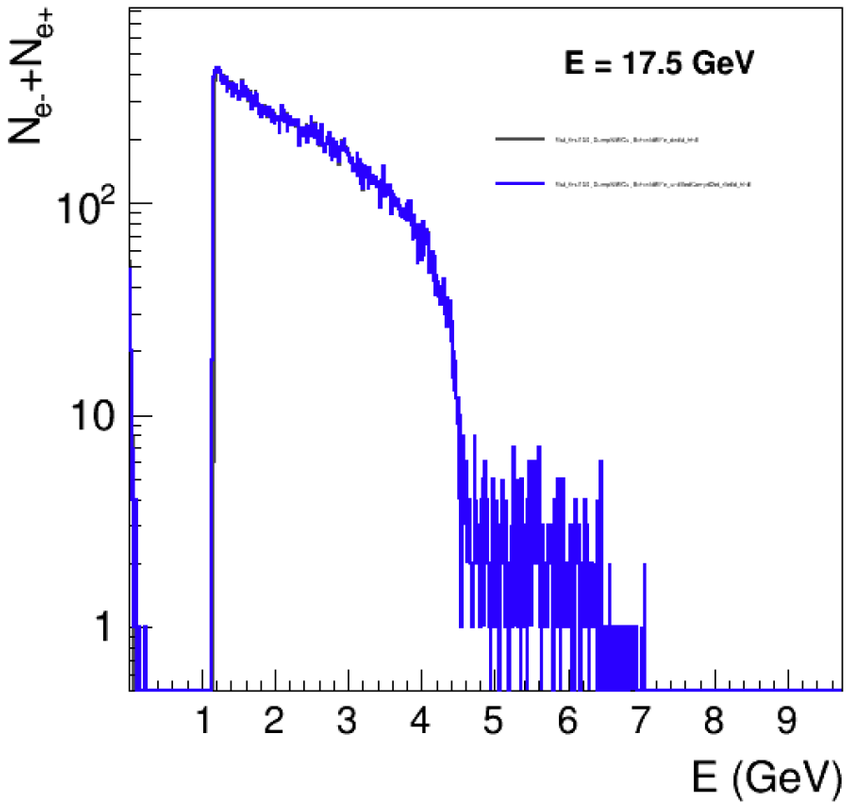
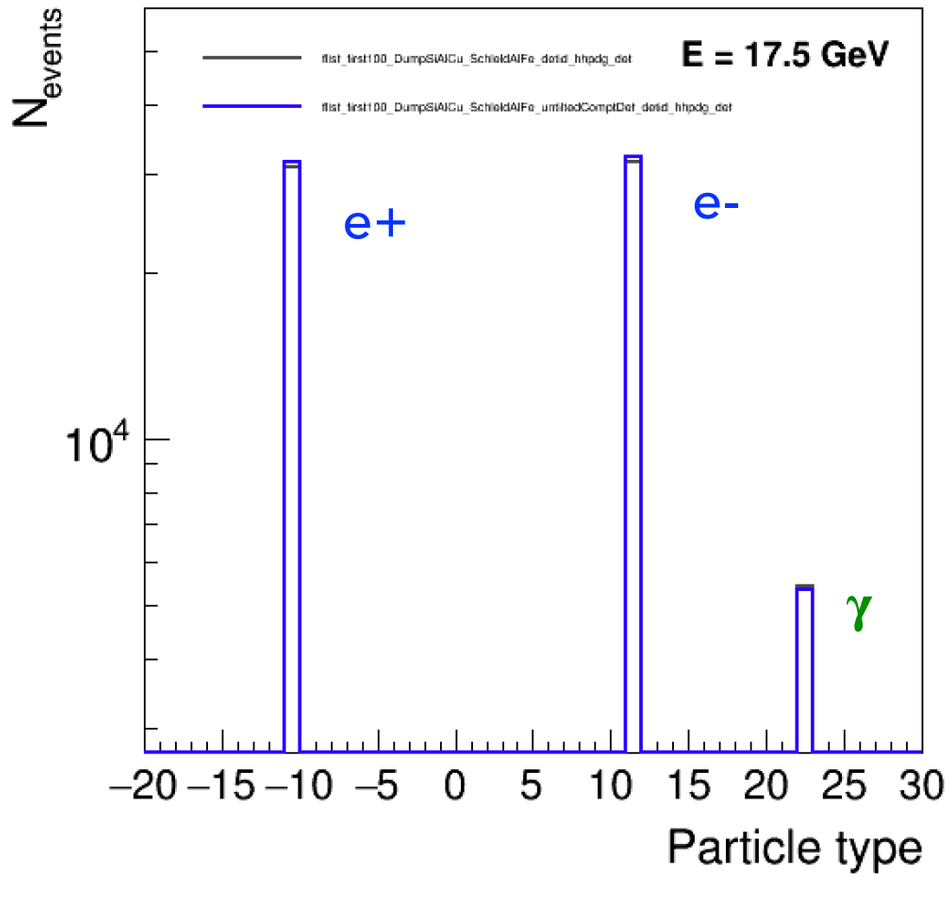
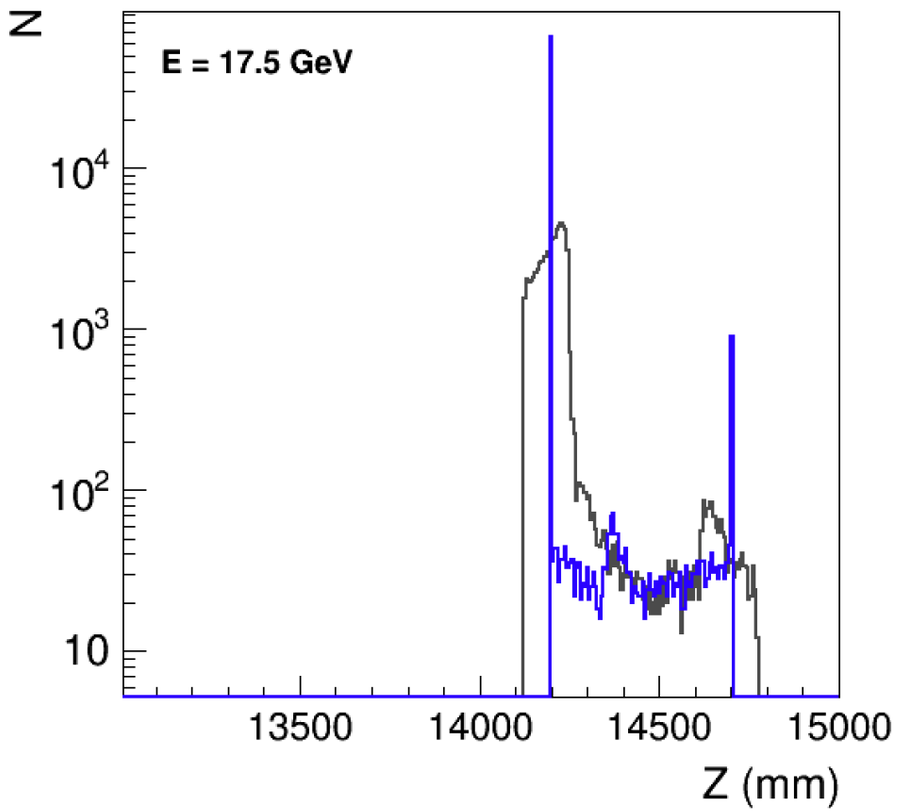
Entries 69068
Mean x 1.421e+04
Mean y 1.318
Std Dev x 78.27
Std Dev y 680.1
X (mm)
Z (mm)

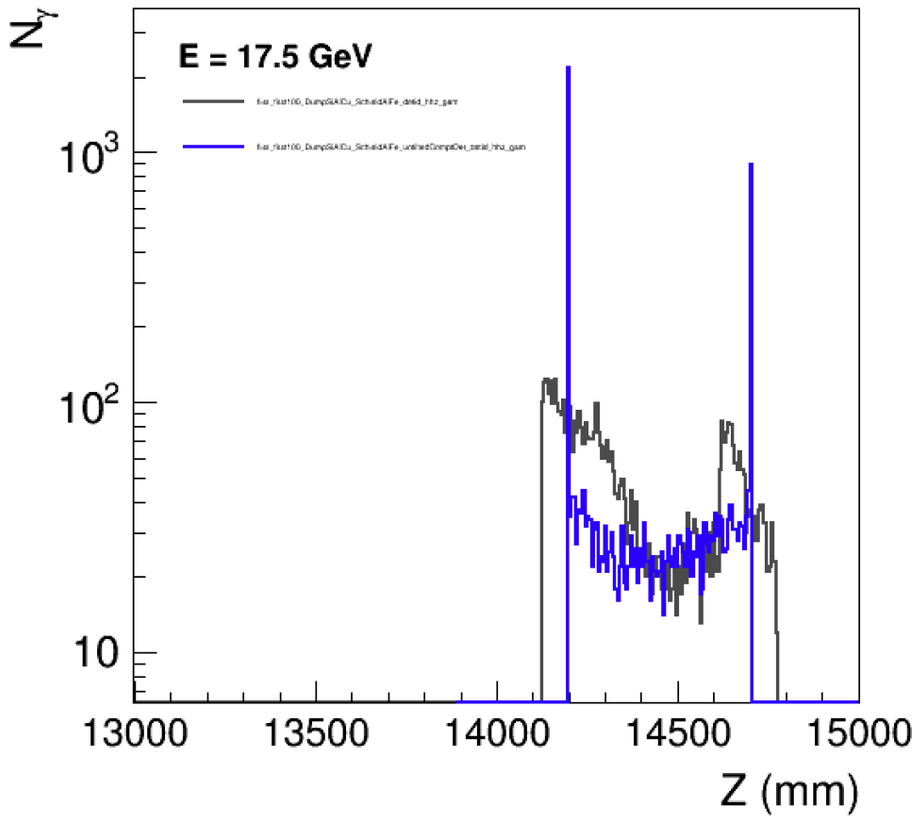

Hits xz distribution e-,e+
hhxzcharge
Entries 63739
Mean x 1.42e+04
Mean y 2.194
Std Dev x 16.38
Std Dev y 674.8
X (mm)
Z (mm)

Compton detector: tilted vs not-tilted









Outlook

- **Gamma monitor studies:**

✴ **Gamma Monitor is studied in simple configuration in GEANT4 w/ Si Monitor in front of different Dumps (W, Fe, Al-Cu)**

✴ **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 distribution of track entering the W calorimeter in XZ plane has non-negligible background, particles hit the Gamma Monitor directly and the introduction of the Shielding do not improve much the situation for Gamma Monitor**

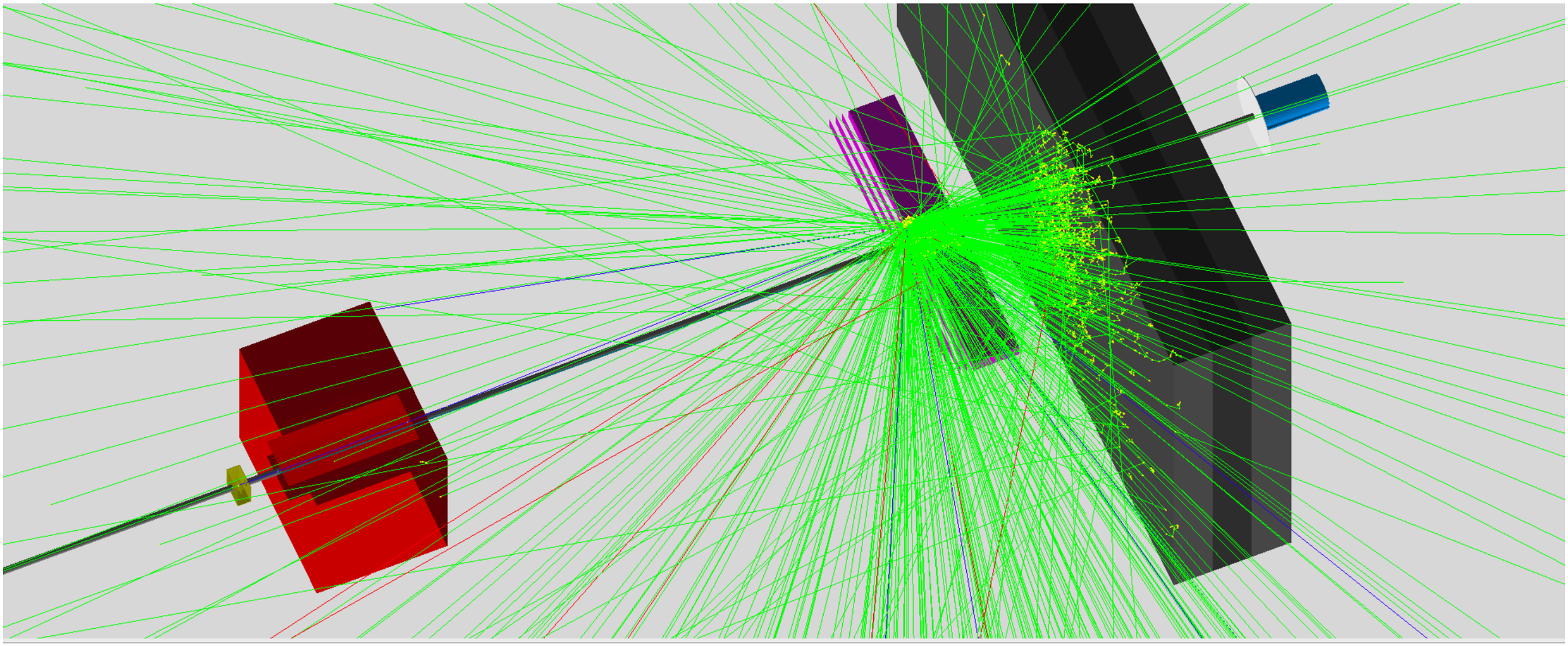
Further studies:

To consider BGO or Sapphire (Al2O3) for Gamma Monitor

To study background

Back up

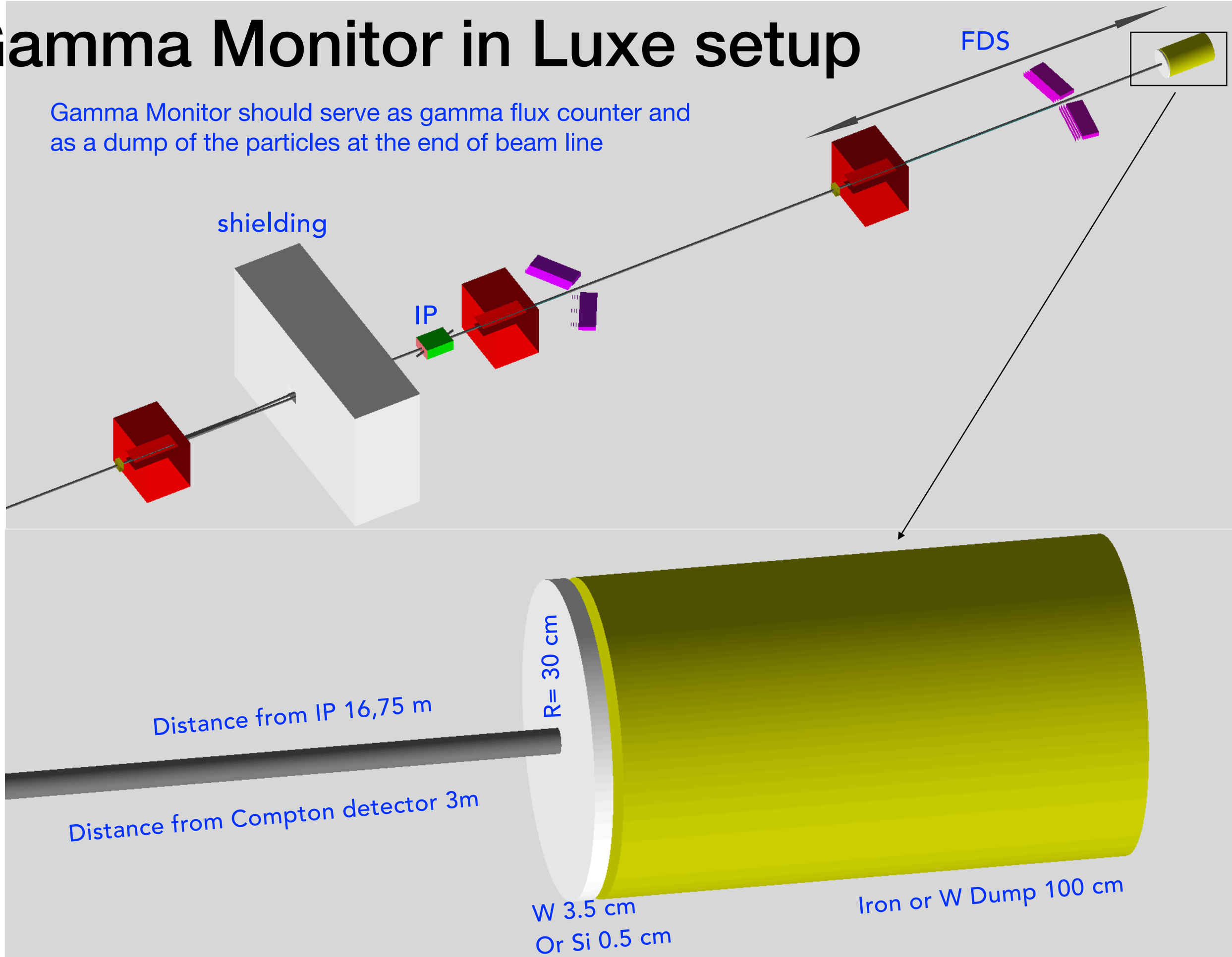
One event of 17.5 GeV photon in Compton detector



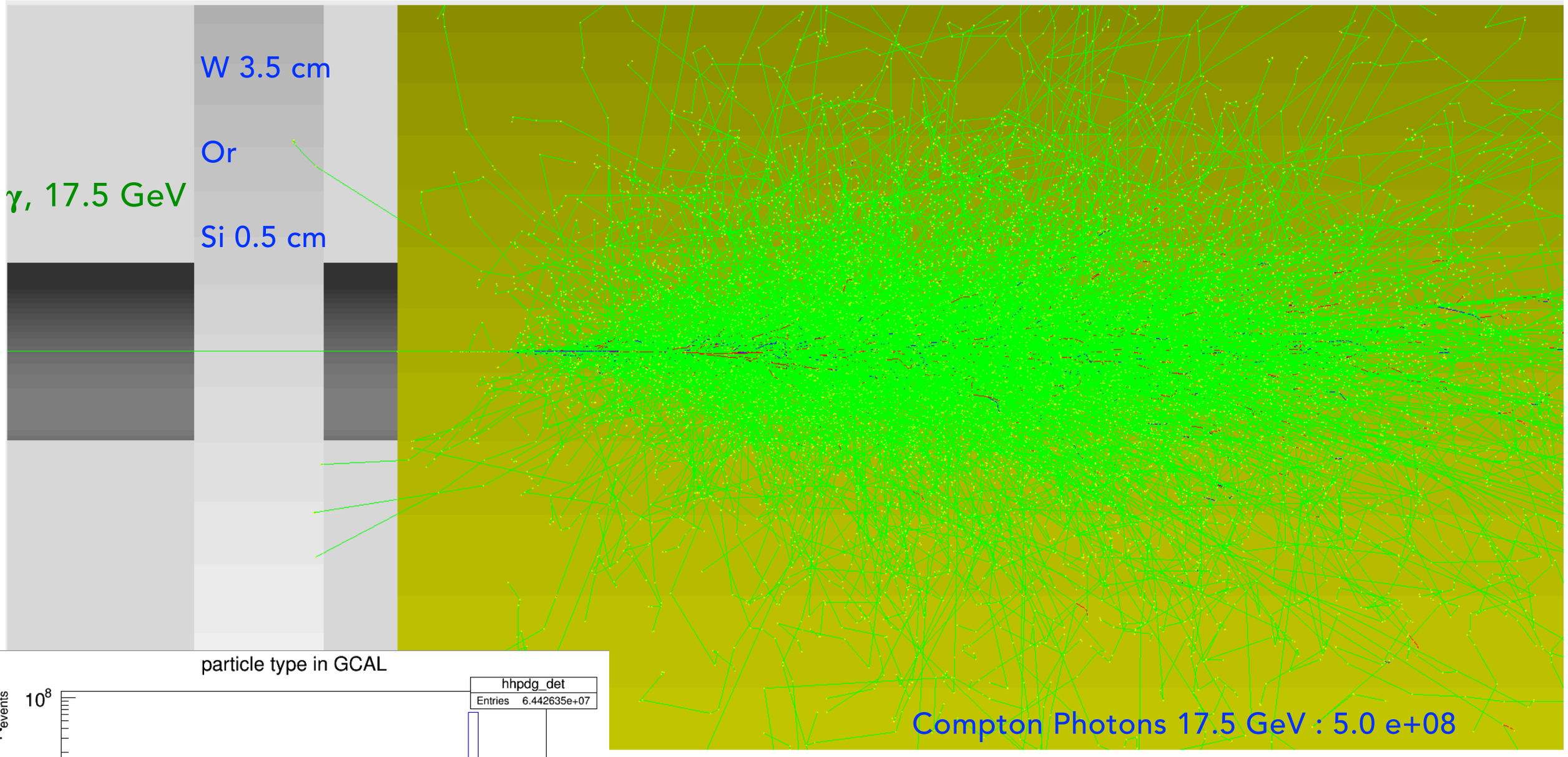
Number of secondaries per event : Gammas = 1.725e+04; electrons = 3.434e+04; positrons = 976

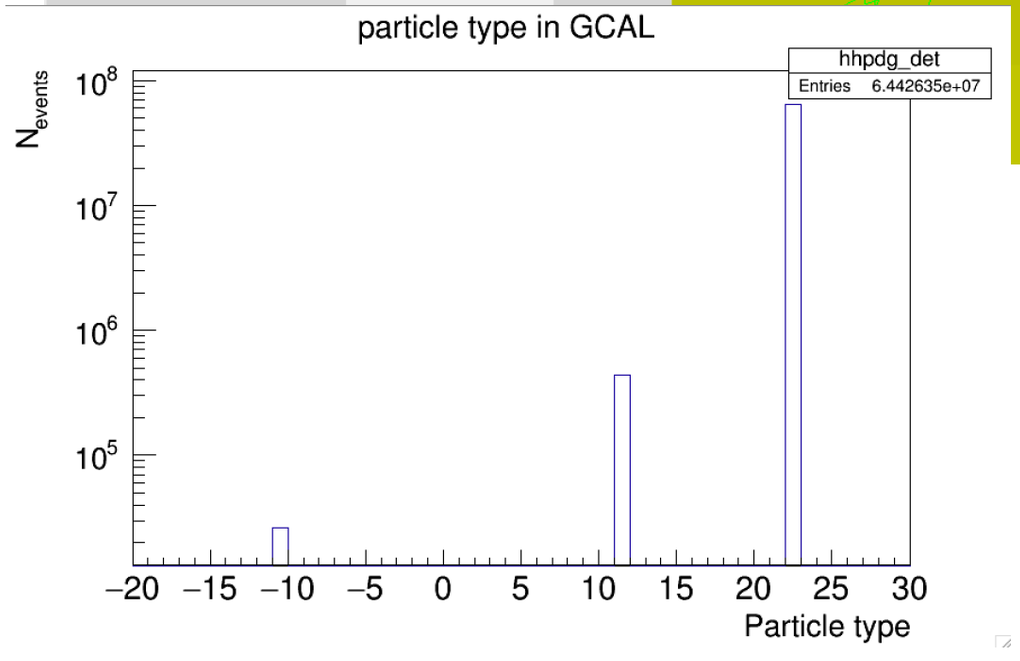
Gamma Monitor in Luxe setup

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



One event of 17.5 GeV photon in Gamma Monitor



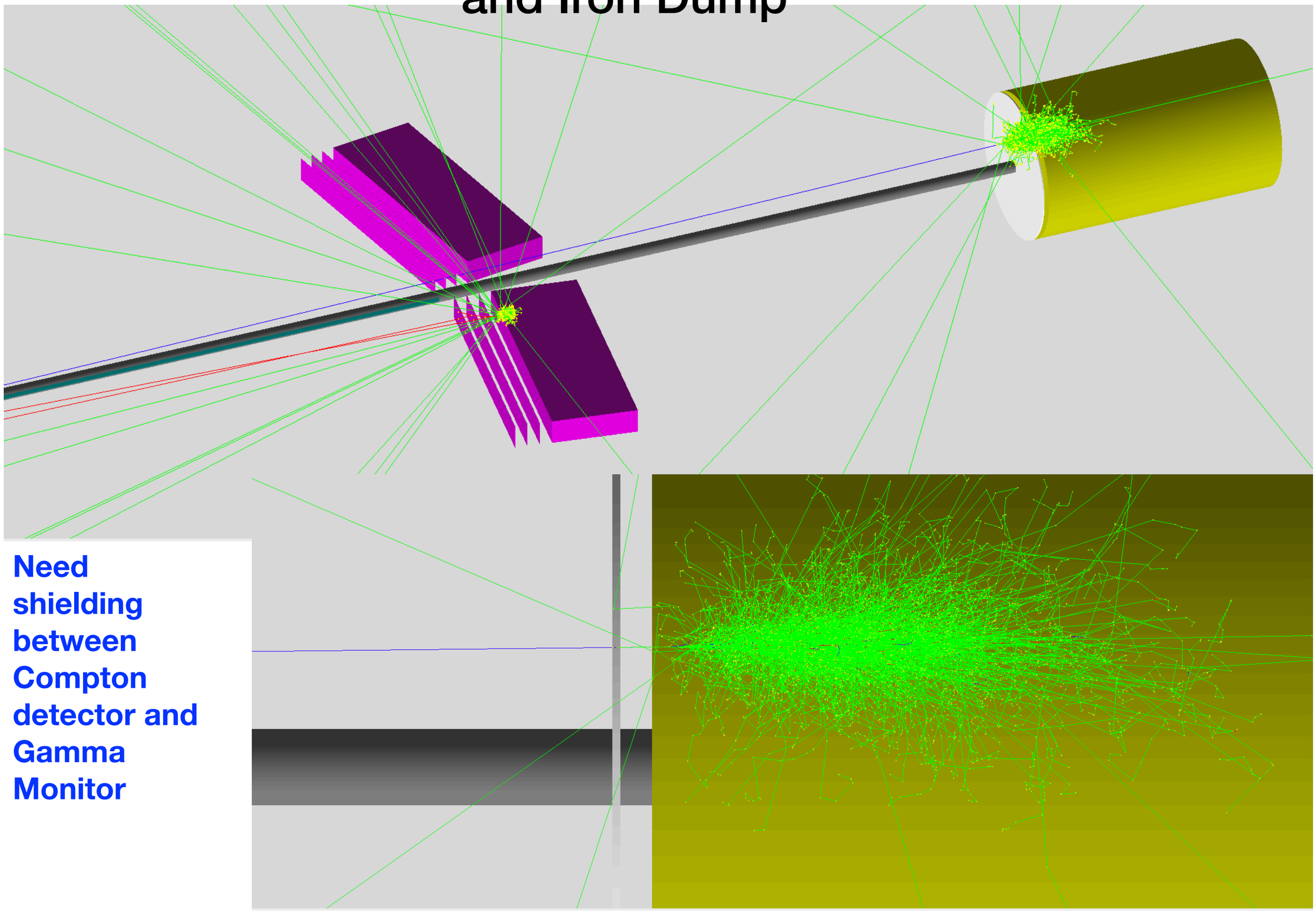


xi=0.26

100 BX

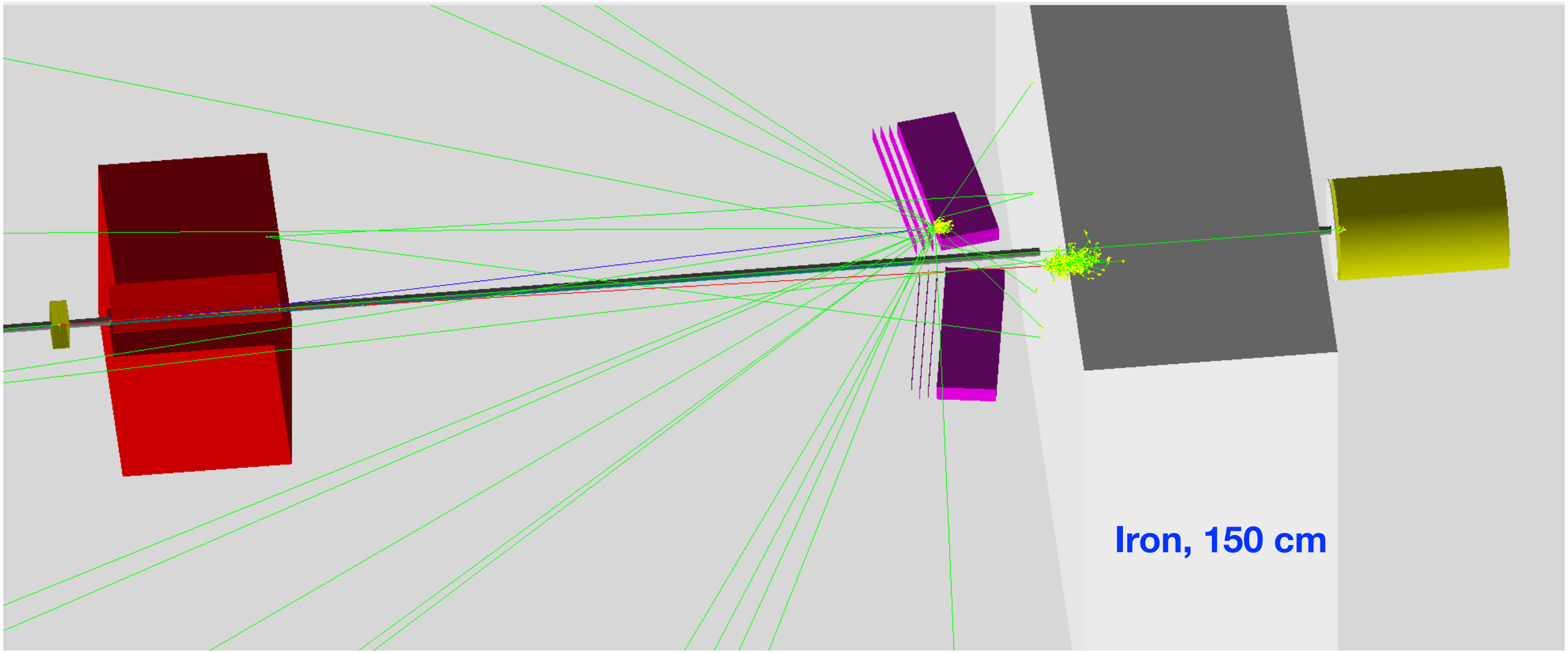
Target: W foil 10 um

One event of 17.5 GeV photon in 5 mm Si Gamma Monitor and Iron Dump

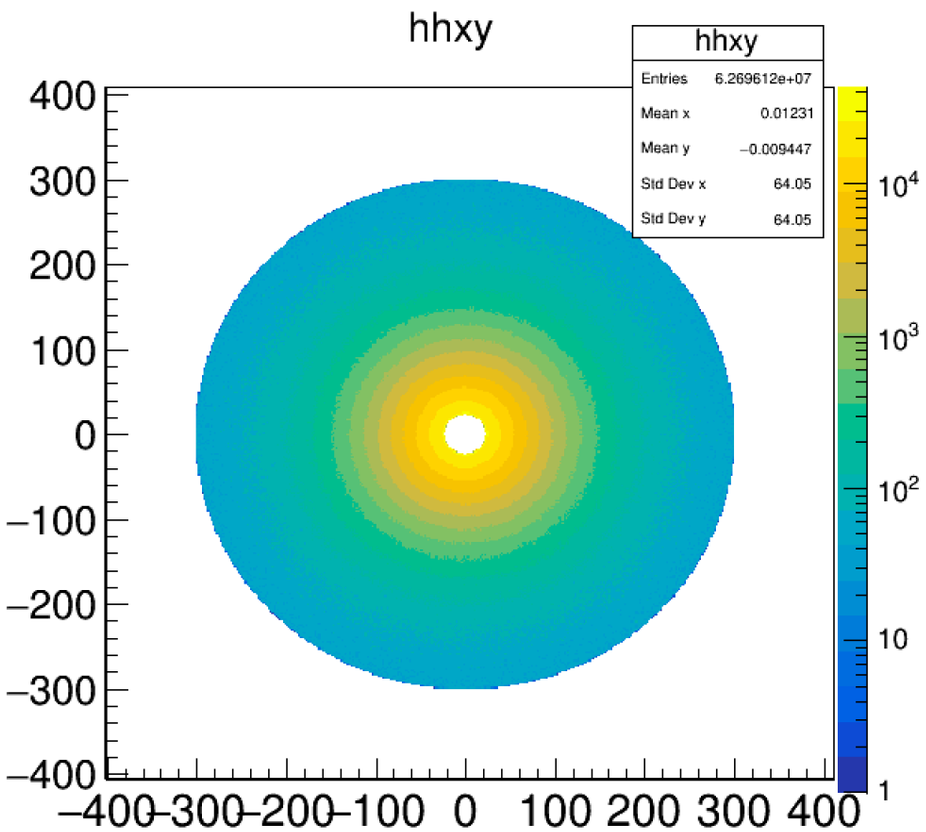


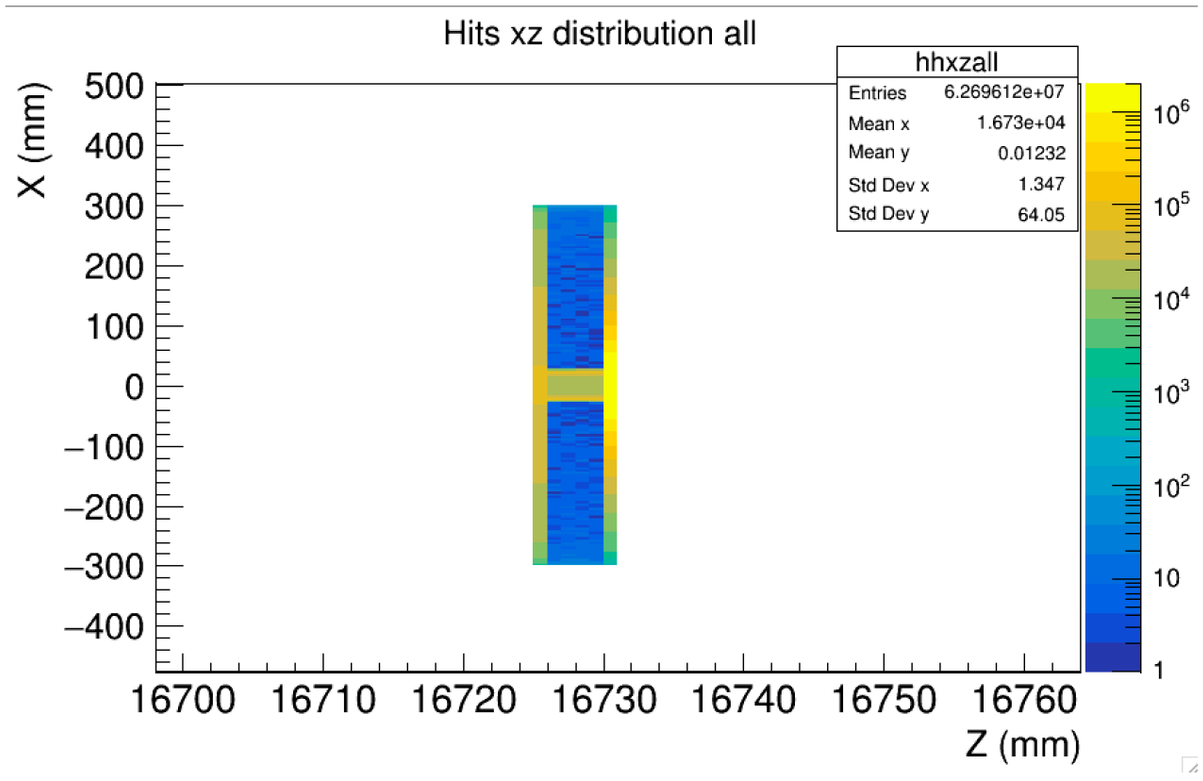
Need shielding between Compton detector and Gamma Monitor

Added shielding between Compton detector and Gamma Monitor

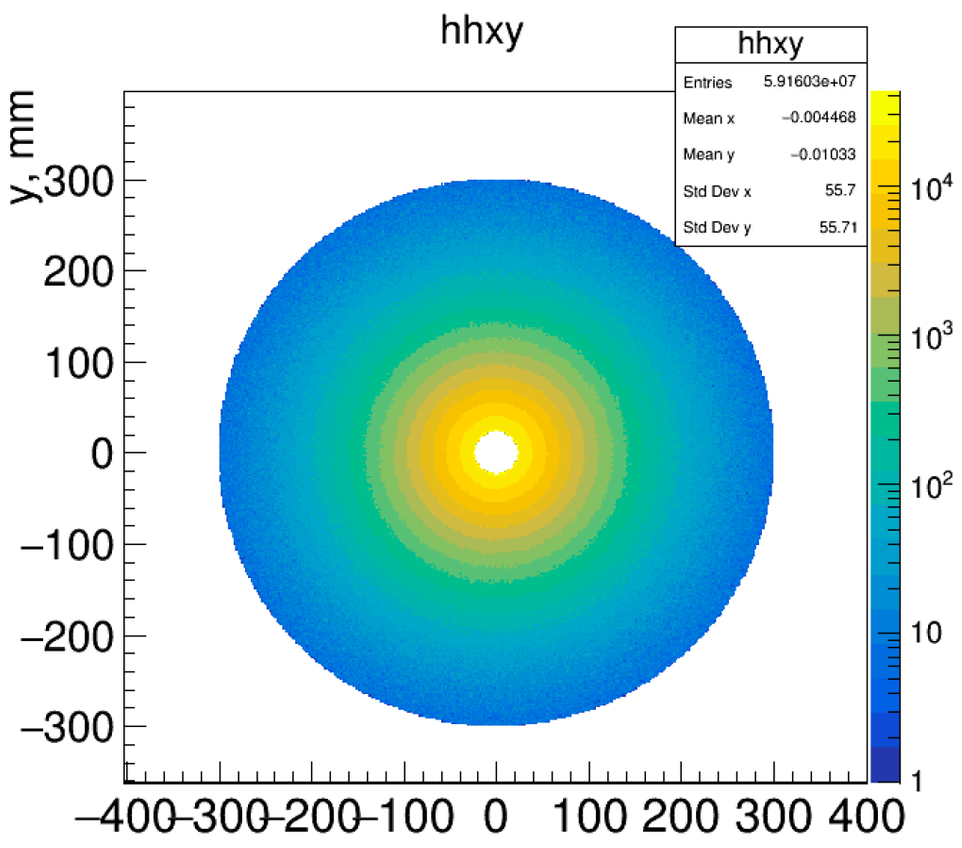


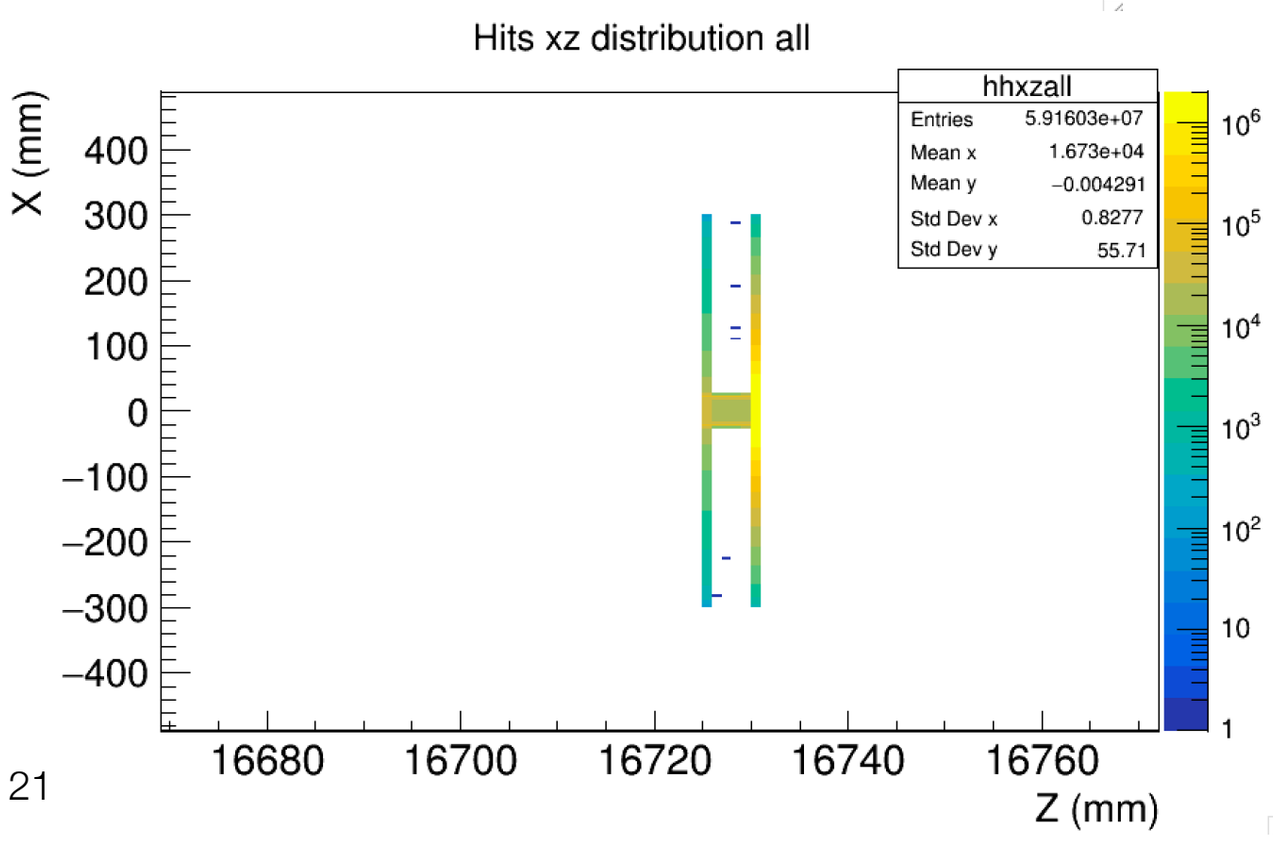
Si-Fe + Iron Shielding

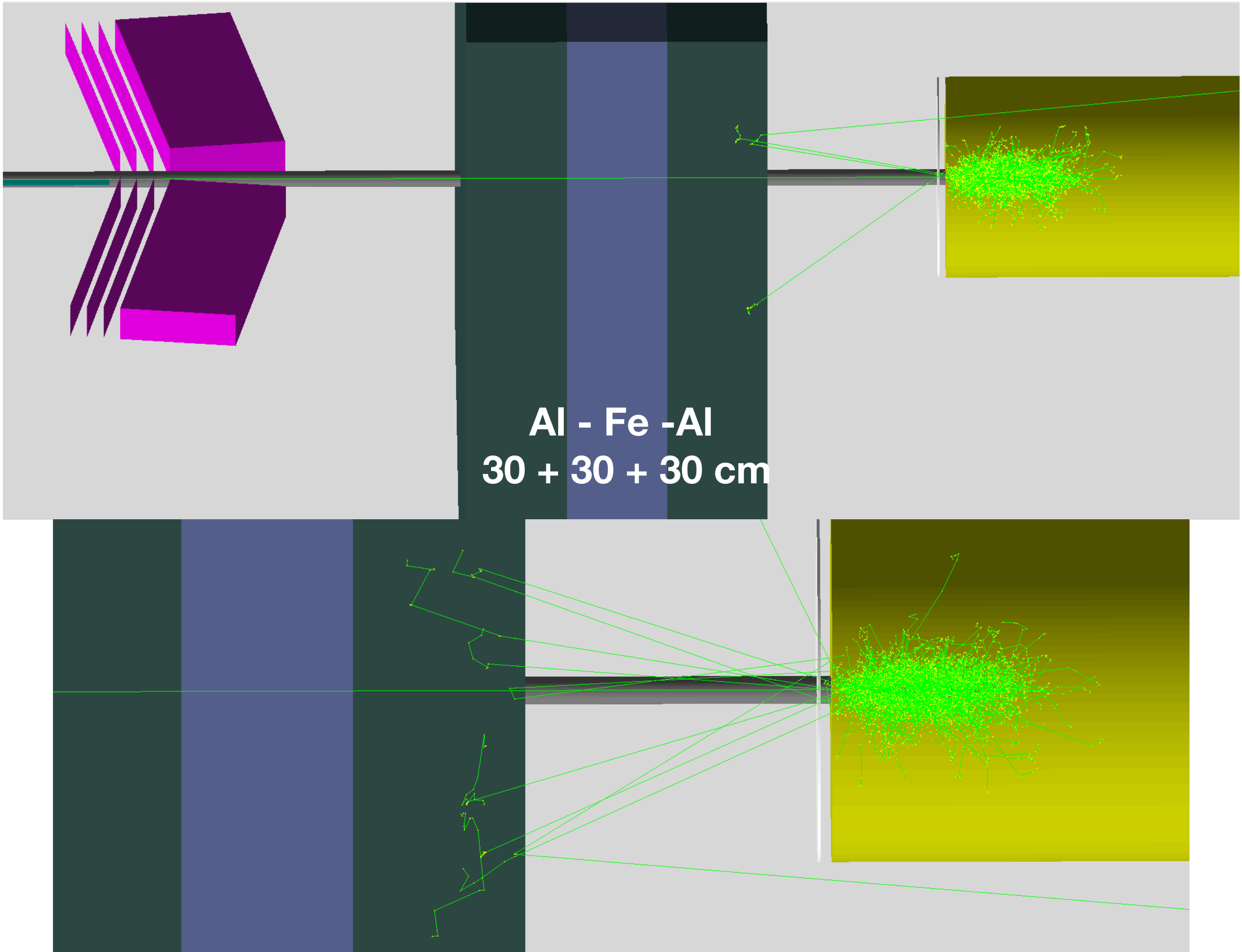




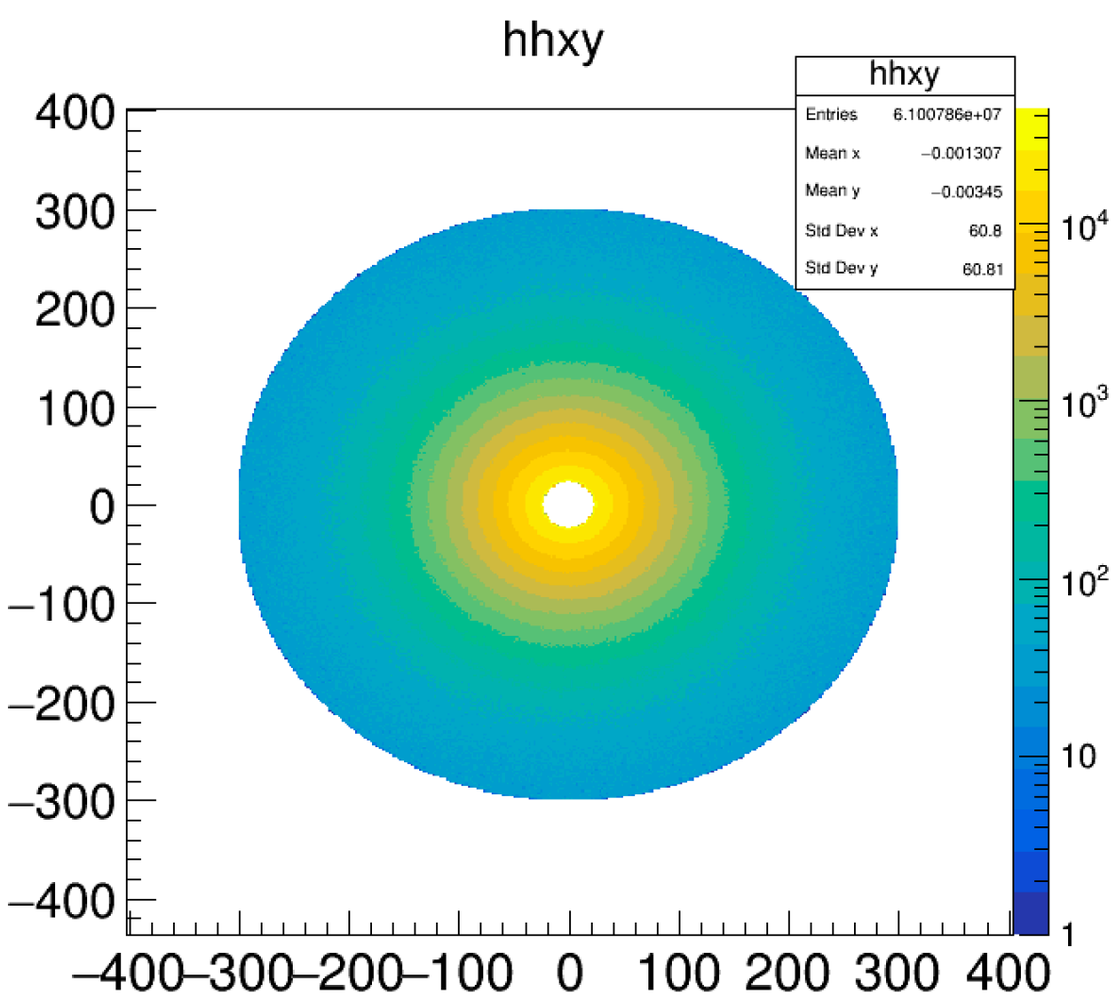
Si-Fe

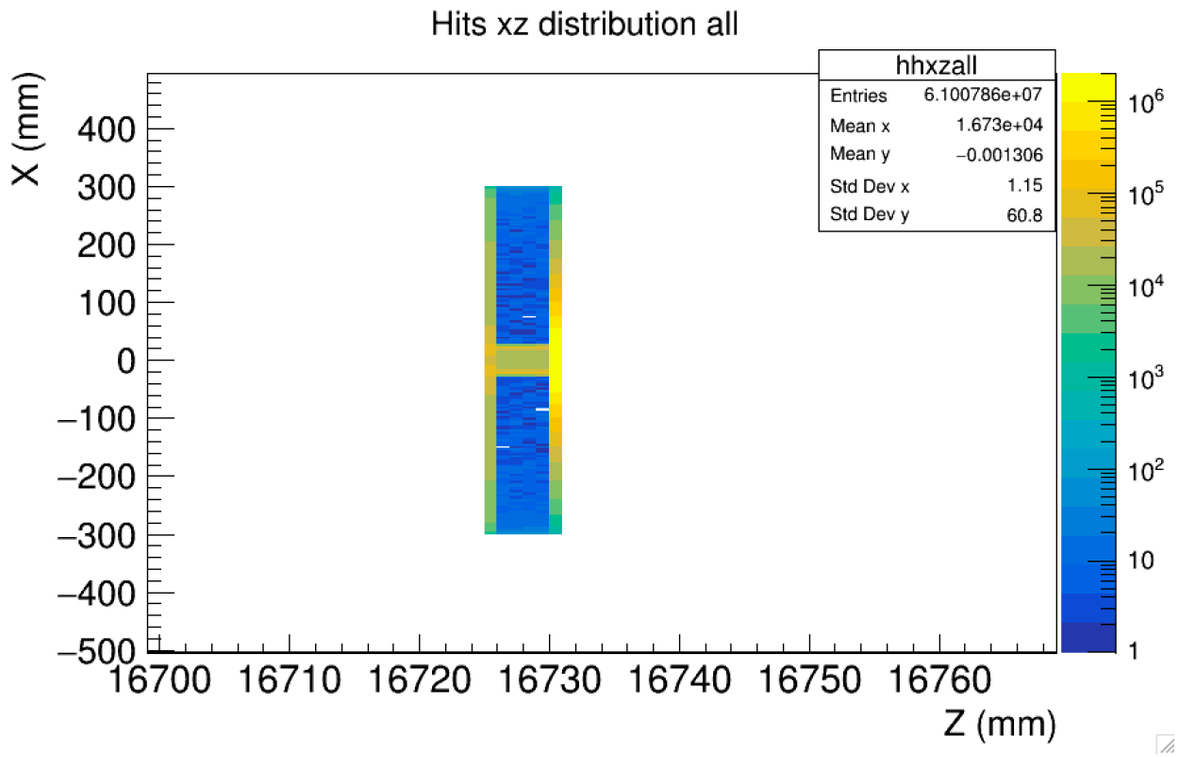


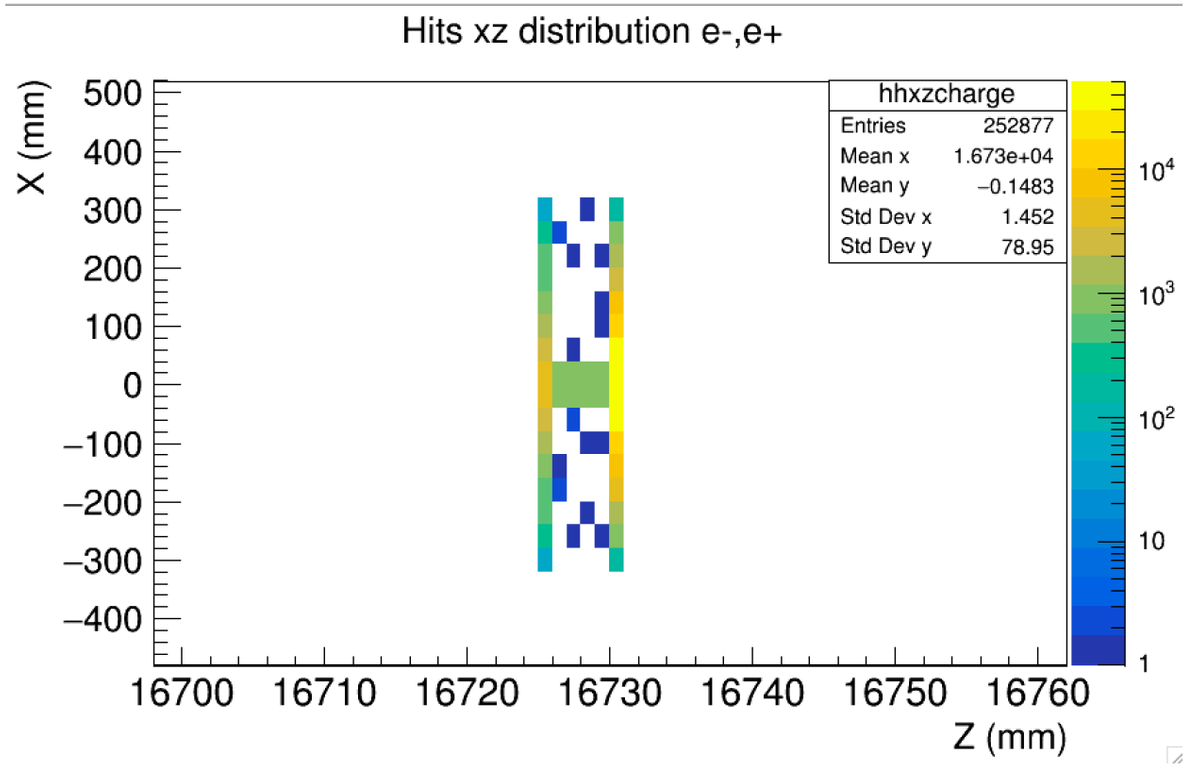


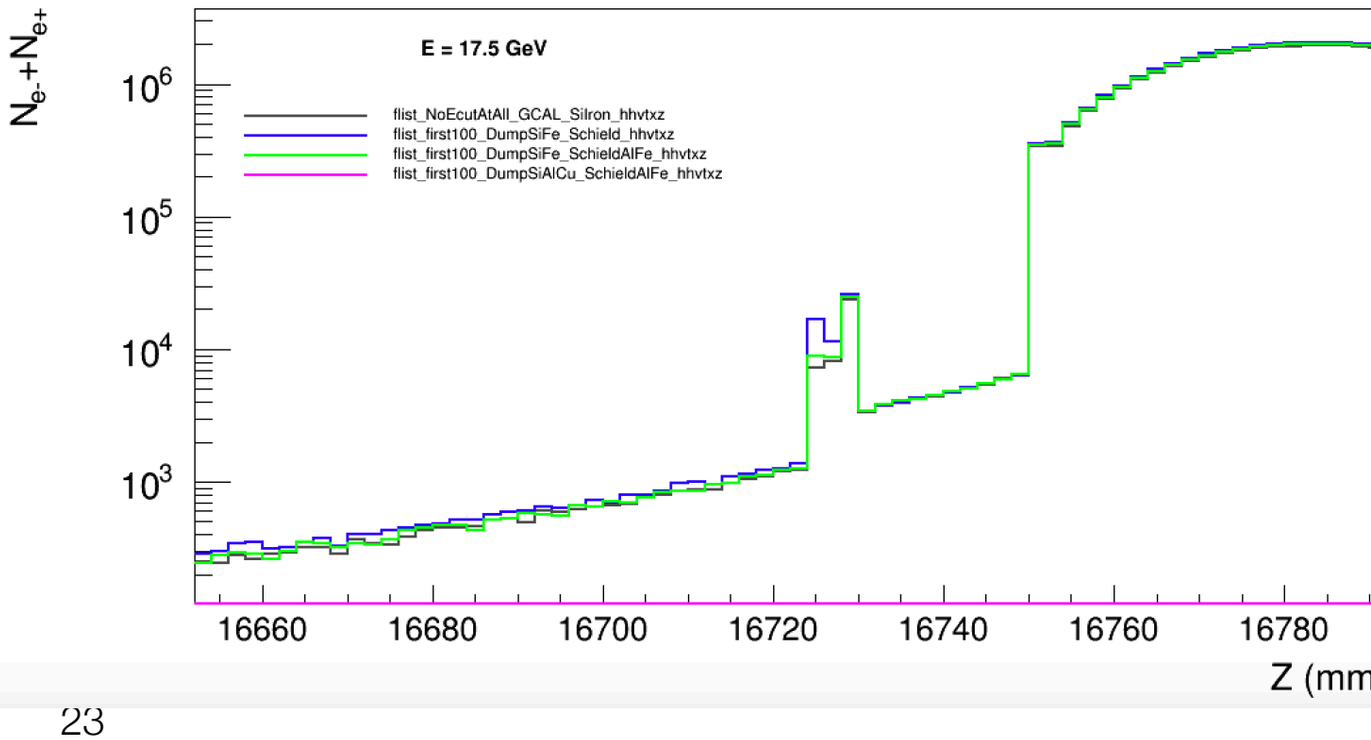

Al - Fe -Al
30 + 30 + 30 cm

Si Monitor & Fe dump + Al-Fe-Al Shielding

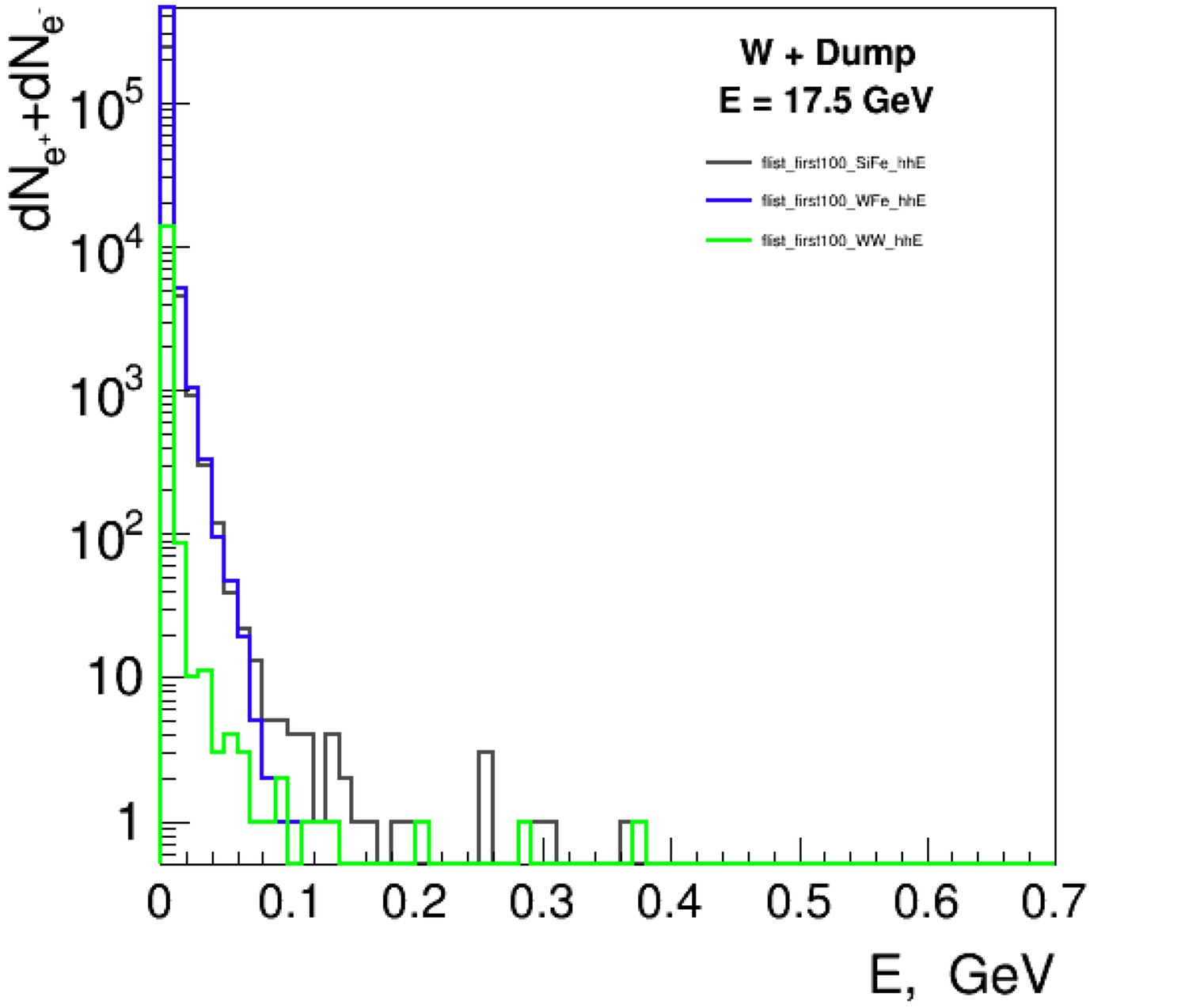






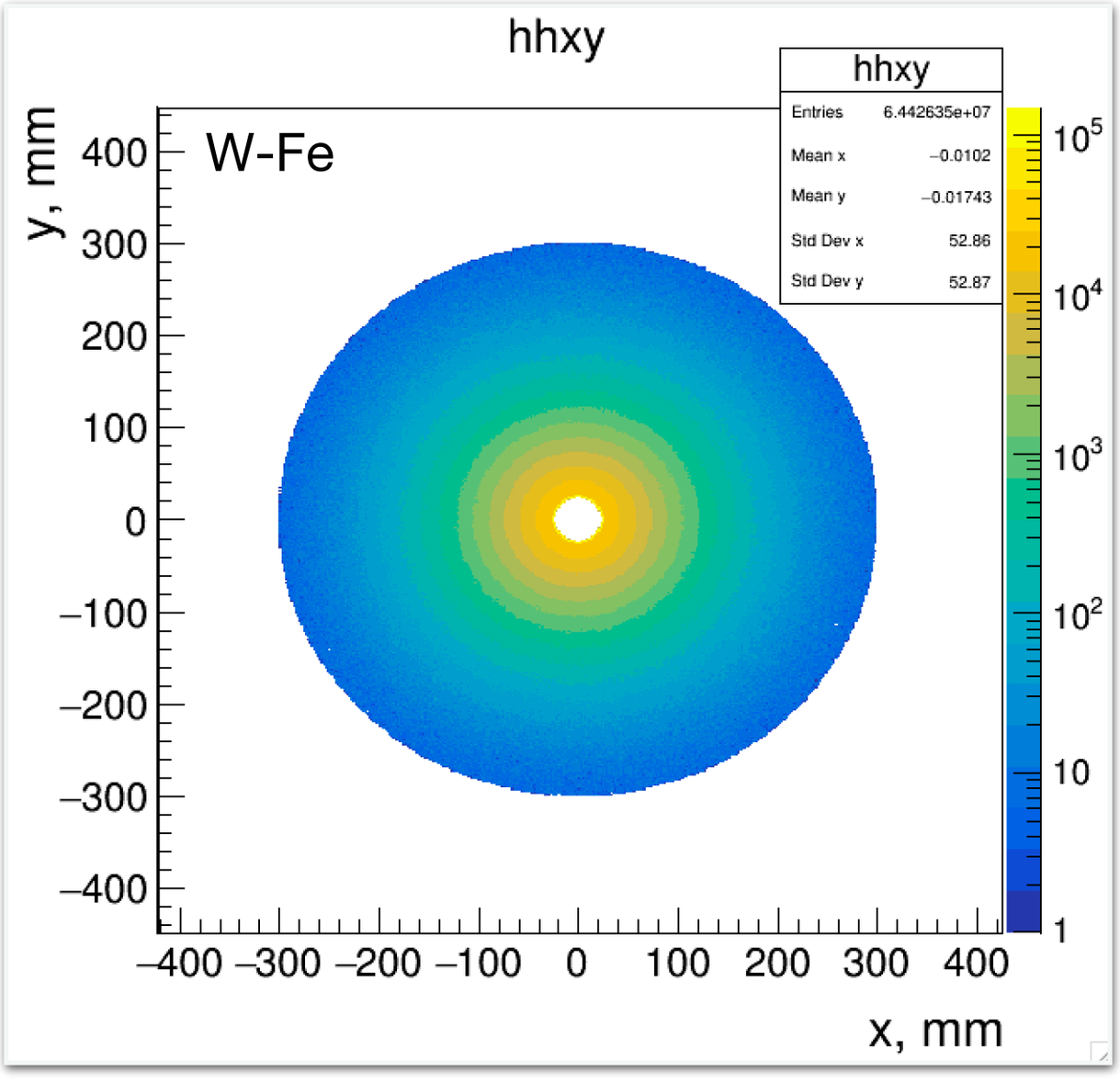


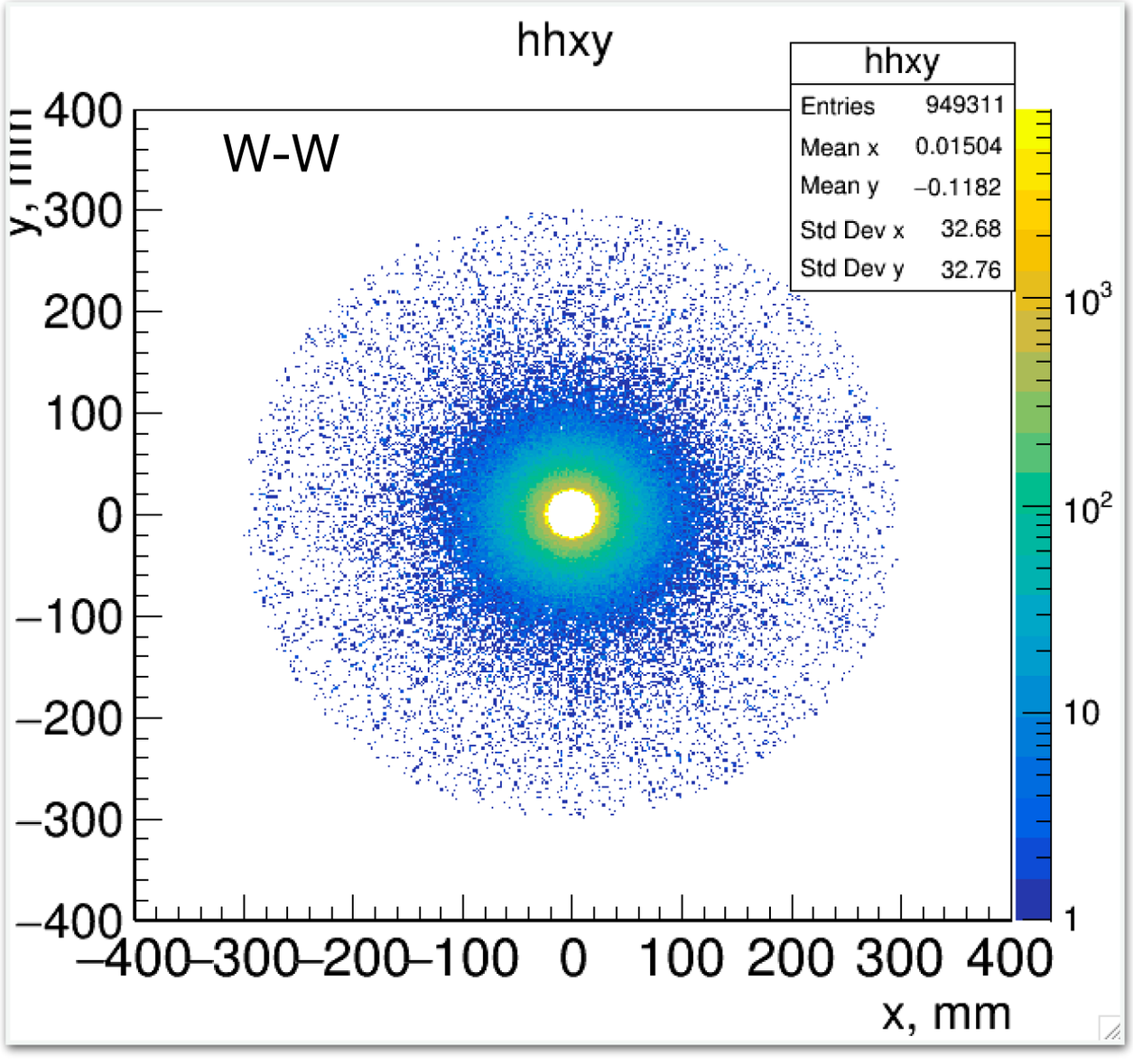
Energy of tracks hitting the W or Si monitor



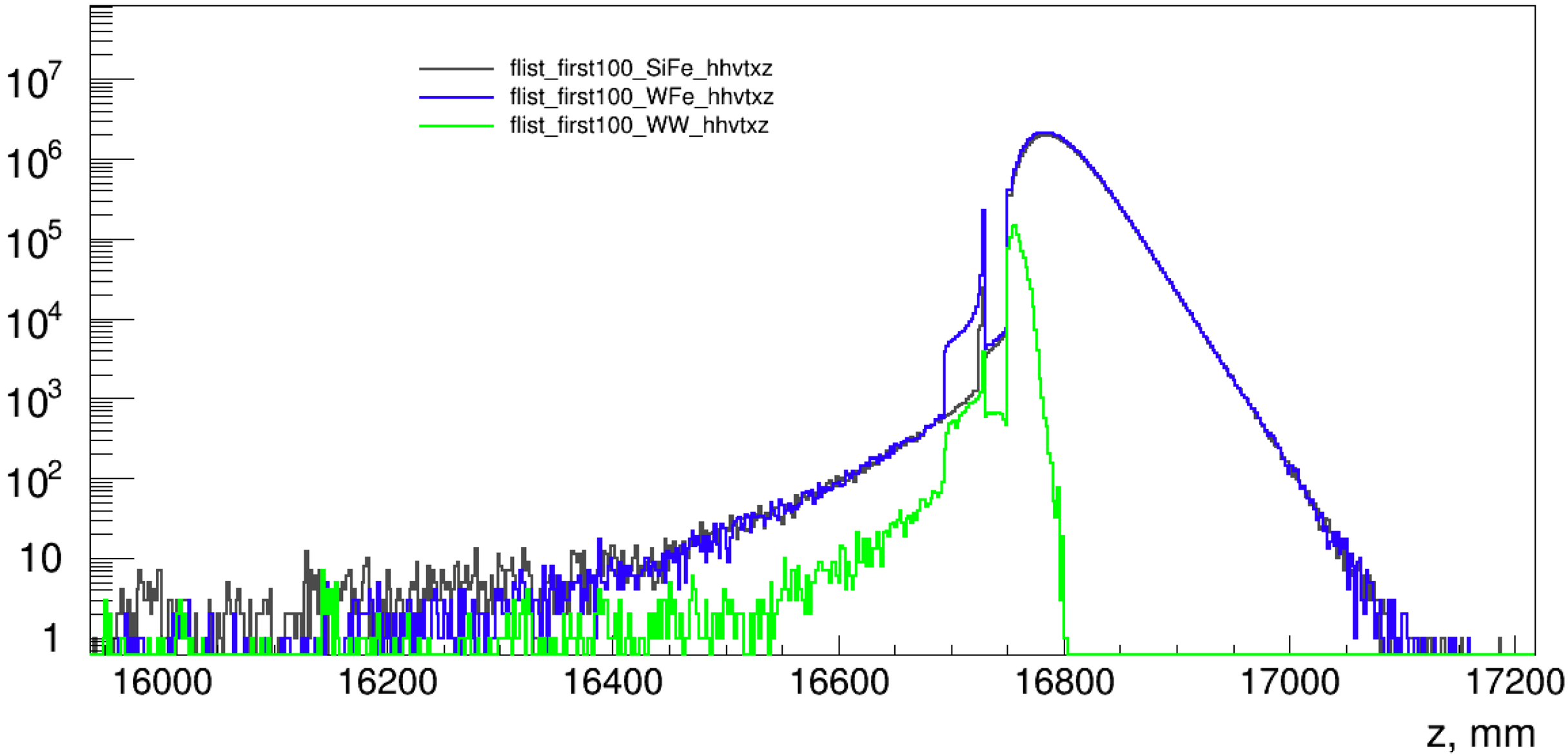
The energy spectrum of backscatters is below 1 GeV and for the vast majority is below critical energy for the most detector materials

Distribution of tracks entering the XY plane of W vs Si Gamma monitors for backscatters

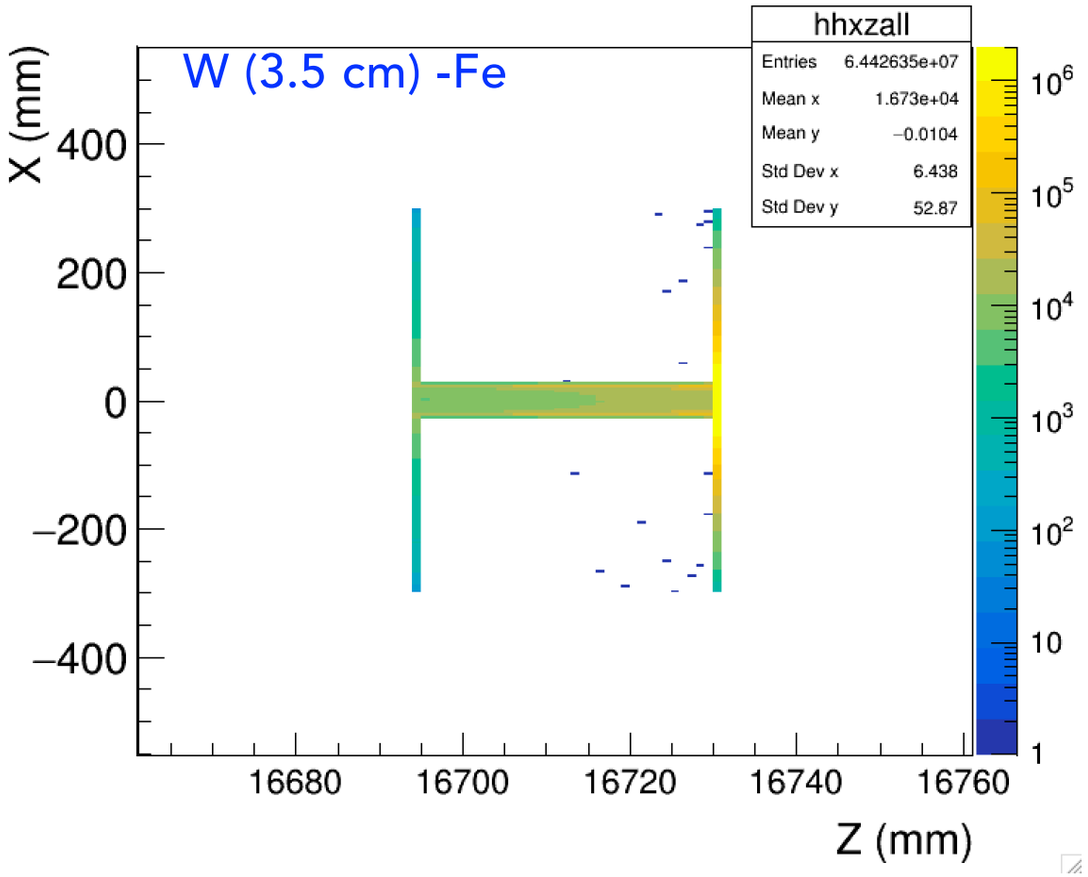


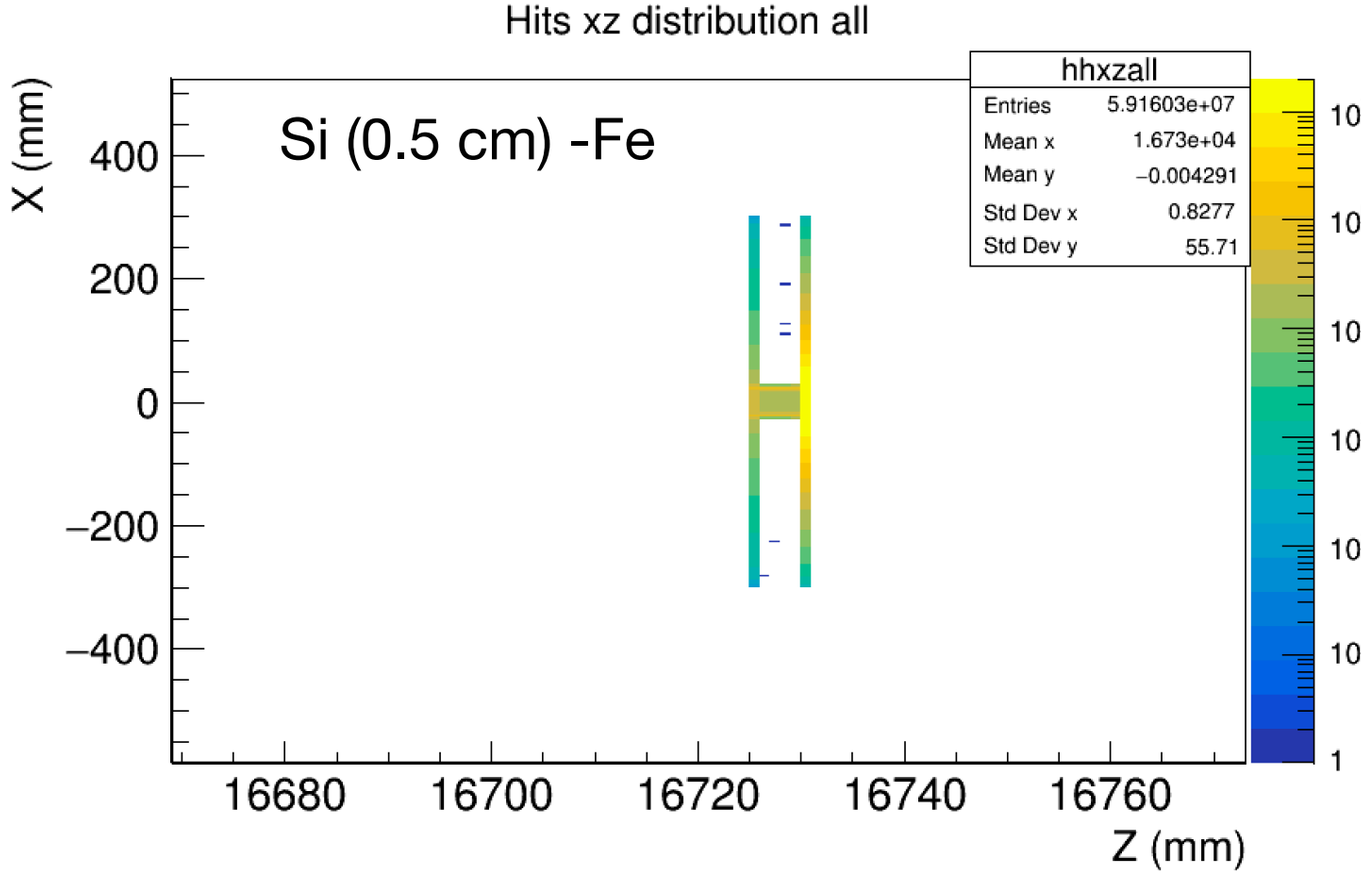


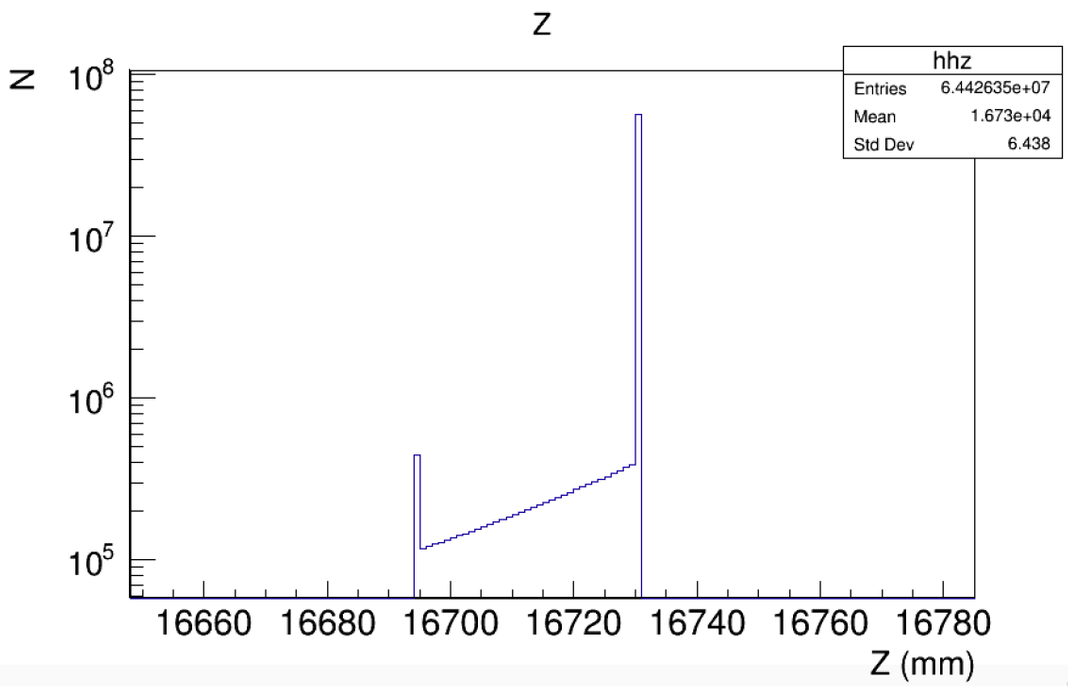
Distribution of vertices Z direction of W & Si monitors for backscatters

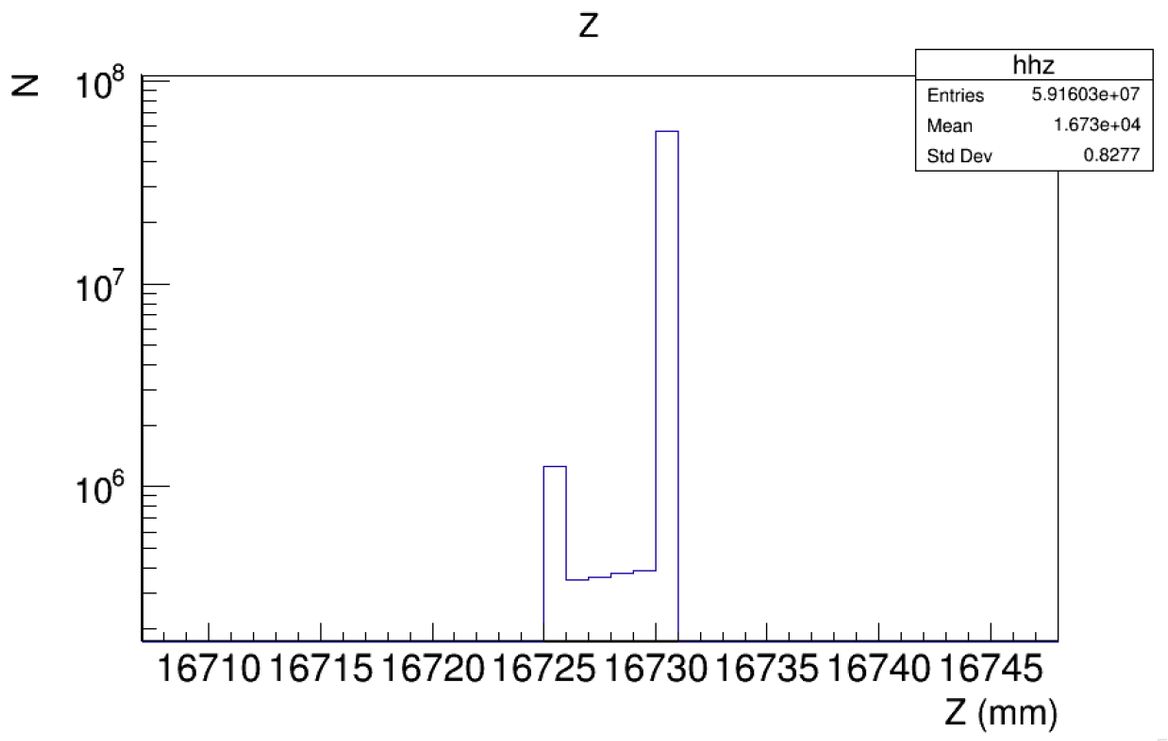


Distribution of tracks entering the XZ plane of W & Si calorimeters for backscatters

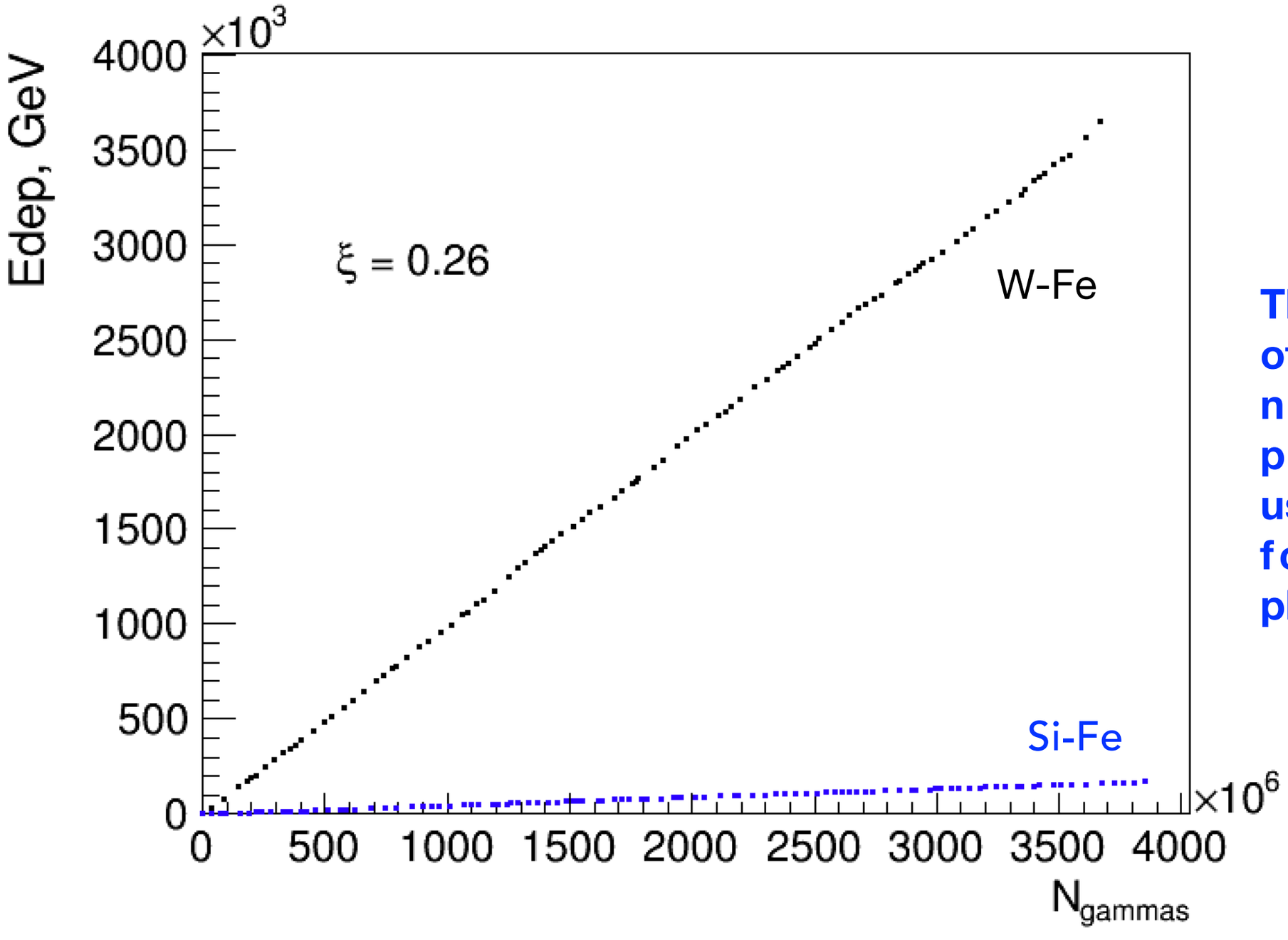








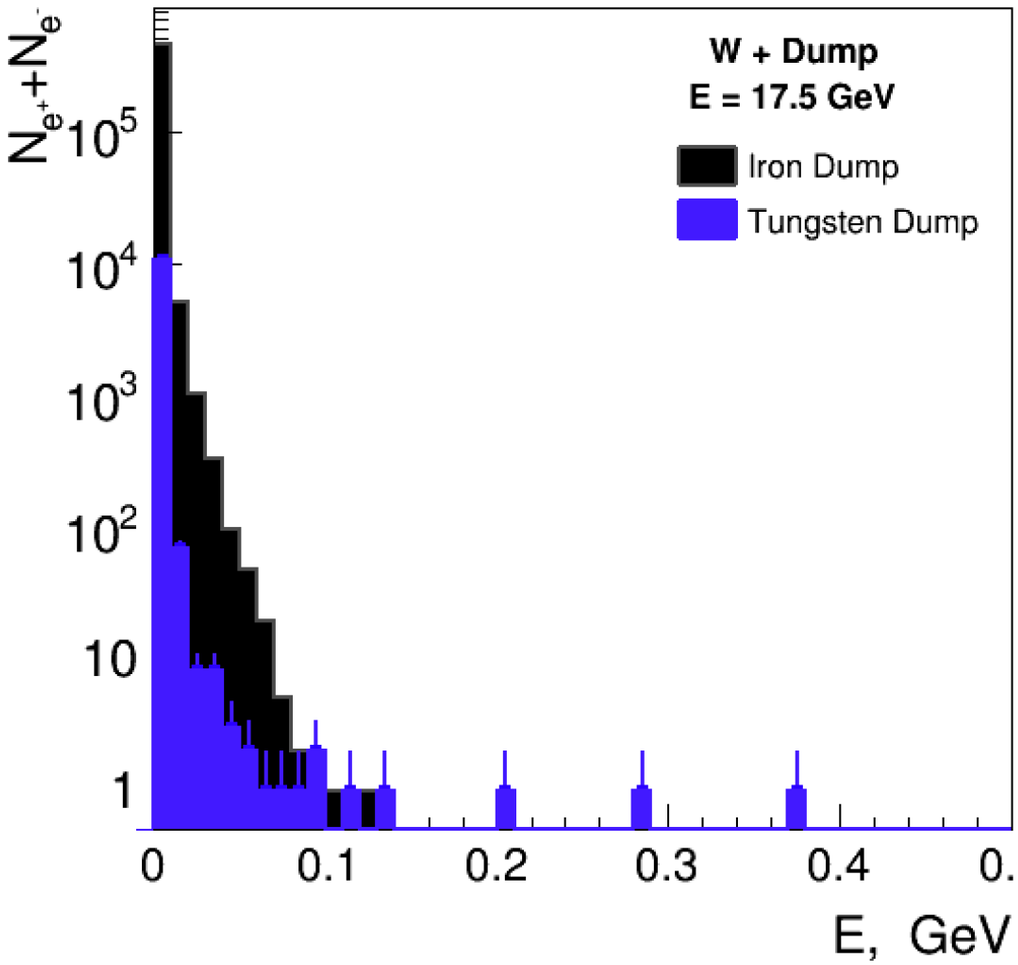
Energy dependence on number of incoming photons for Si vs W Gamma monitors

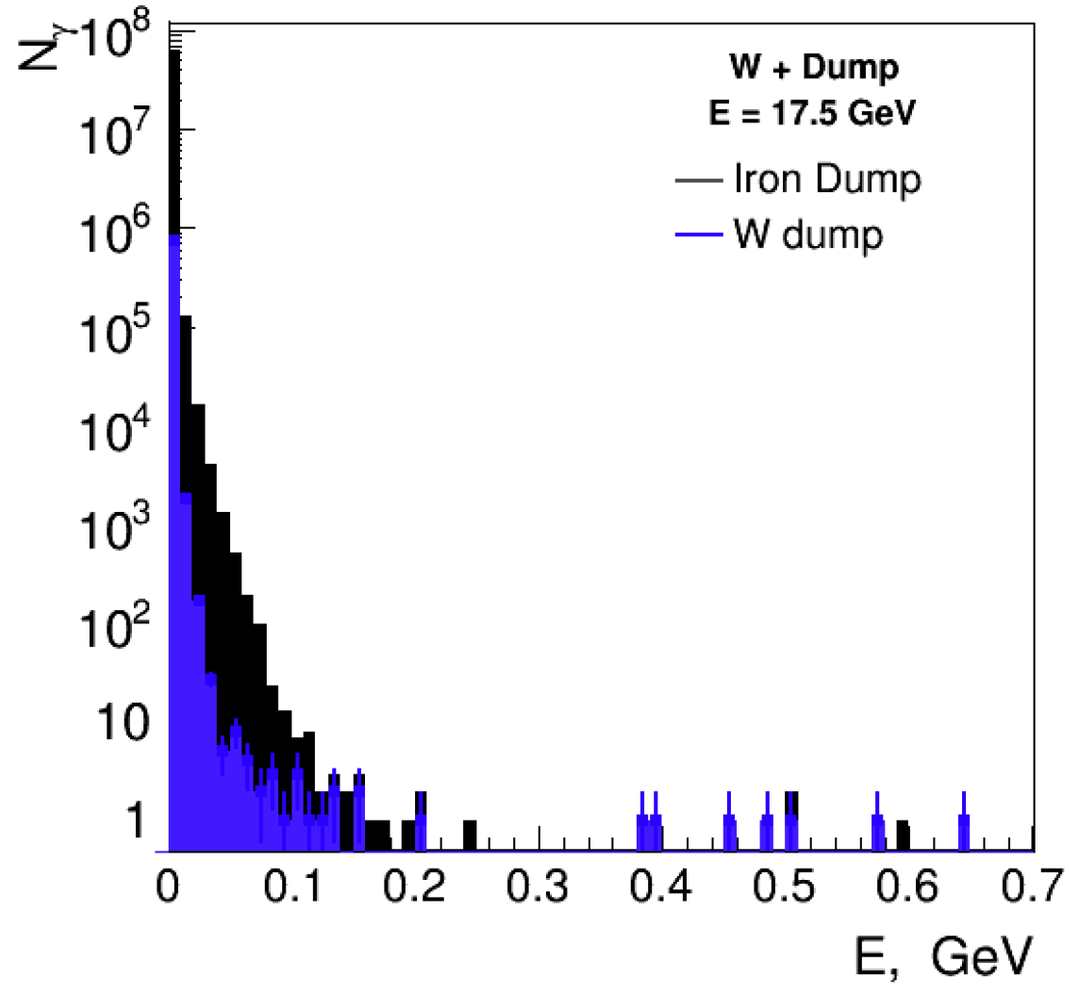


The linear dependence of deposited energy on number of incoming photons allows the usage of backscatters for estimating the photon flux

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

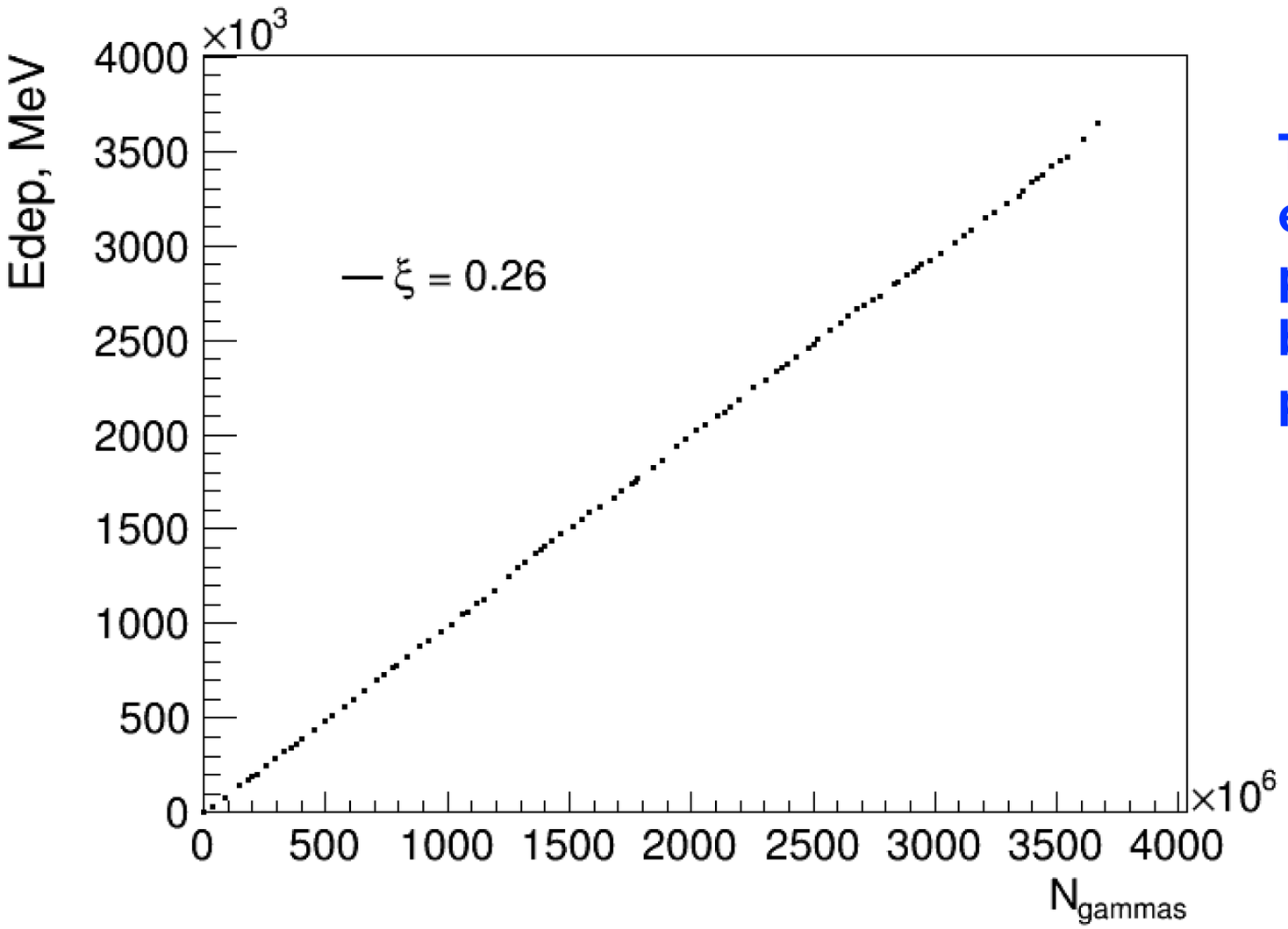
Energy of tracks hitting the W monitor





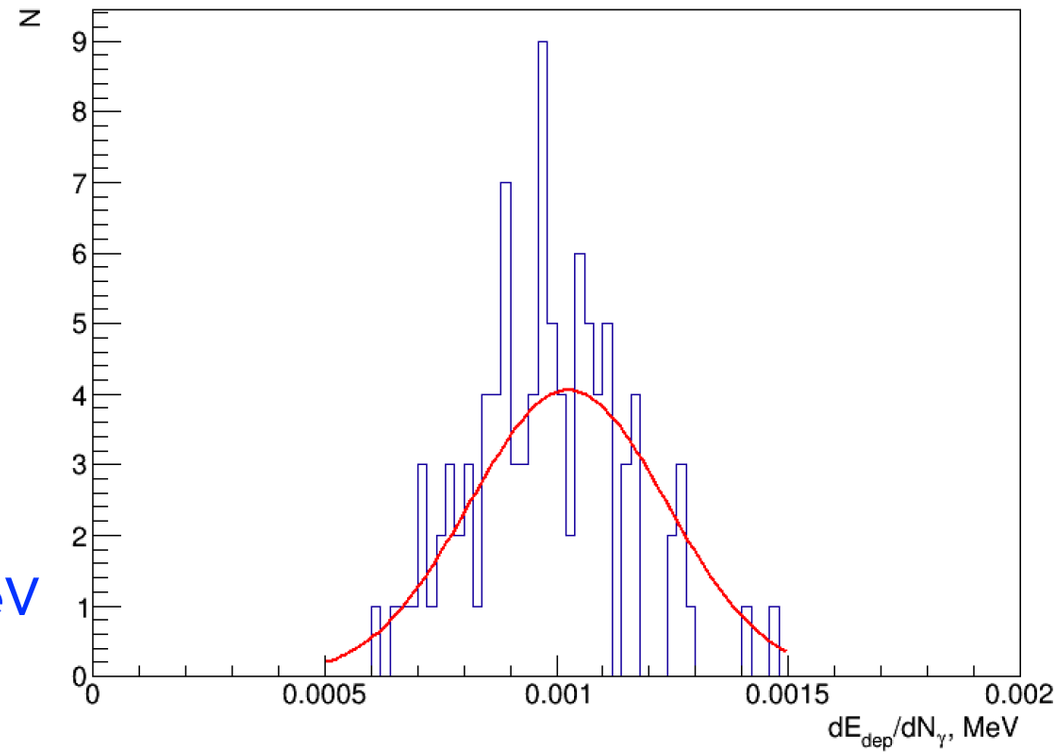
The energy spectrum of backscatters is below 1 GeV and for the vast majority is below critical energy for the most detector materials

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

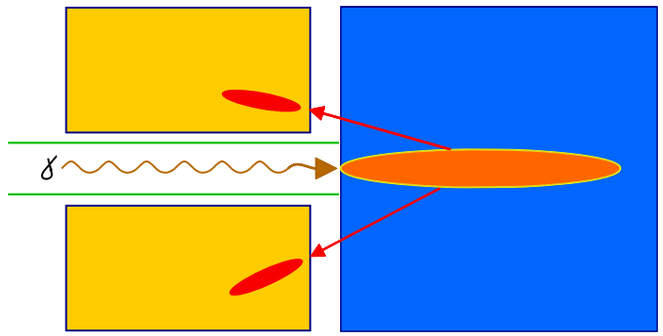
Ratio of deposited energy to the number of photons per BX



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

Possible realisation for GCAL

- **Considering the energies the LumiCal in present configuration couldn't be an option but we could use probably Iron-Si sampling calorimeter (couple of layers)**
- **Sapphire (Al2O3) could be an option , need~10 cm**



Si Gamma Monitor and Iron Dump