Target for the forward photon detector system

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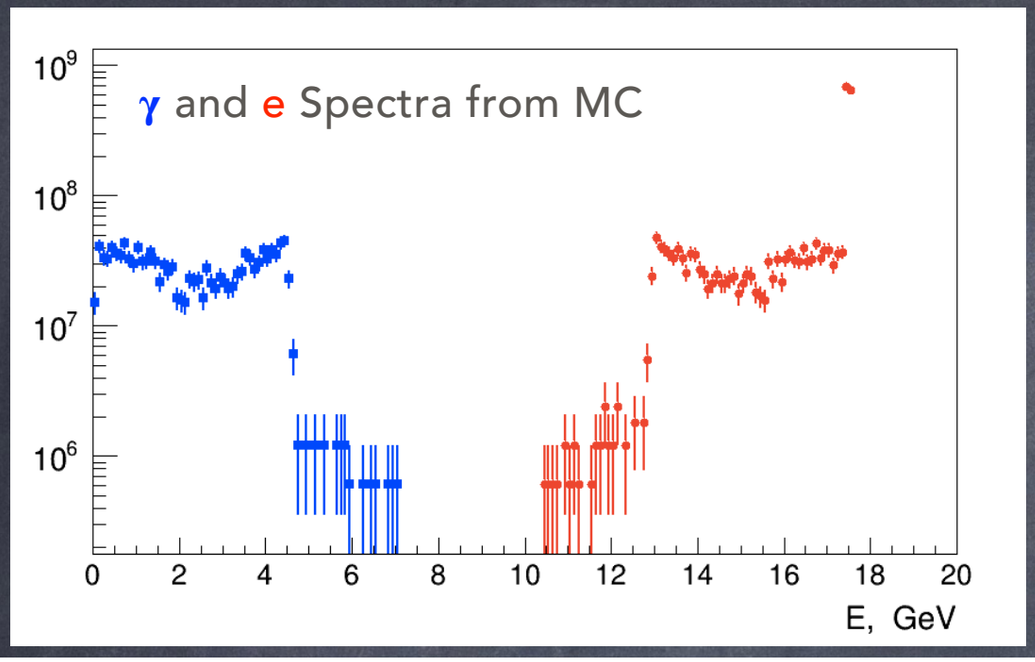
LUXE weekly technical meetings

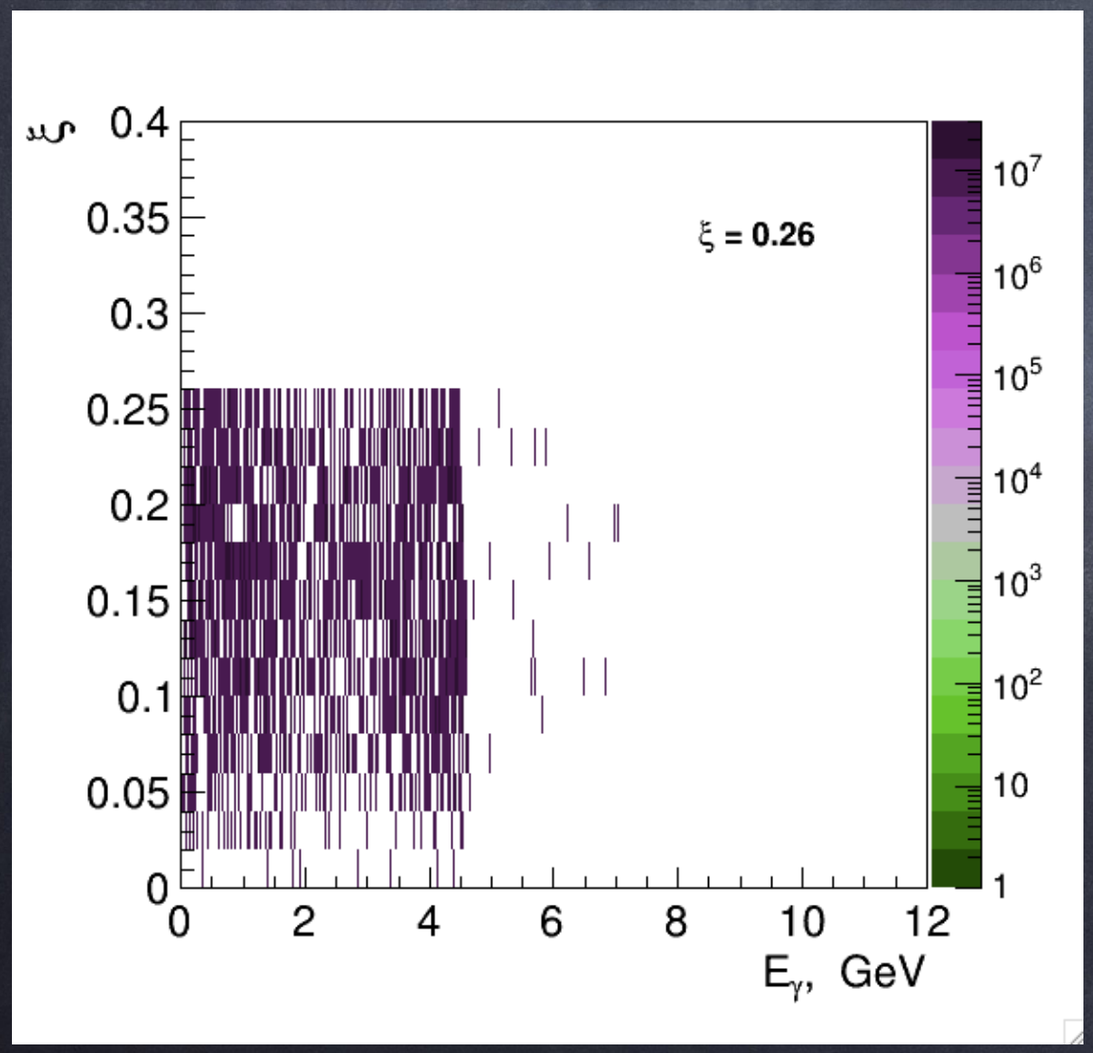
LUXE

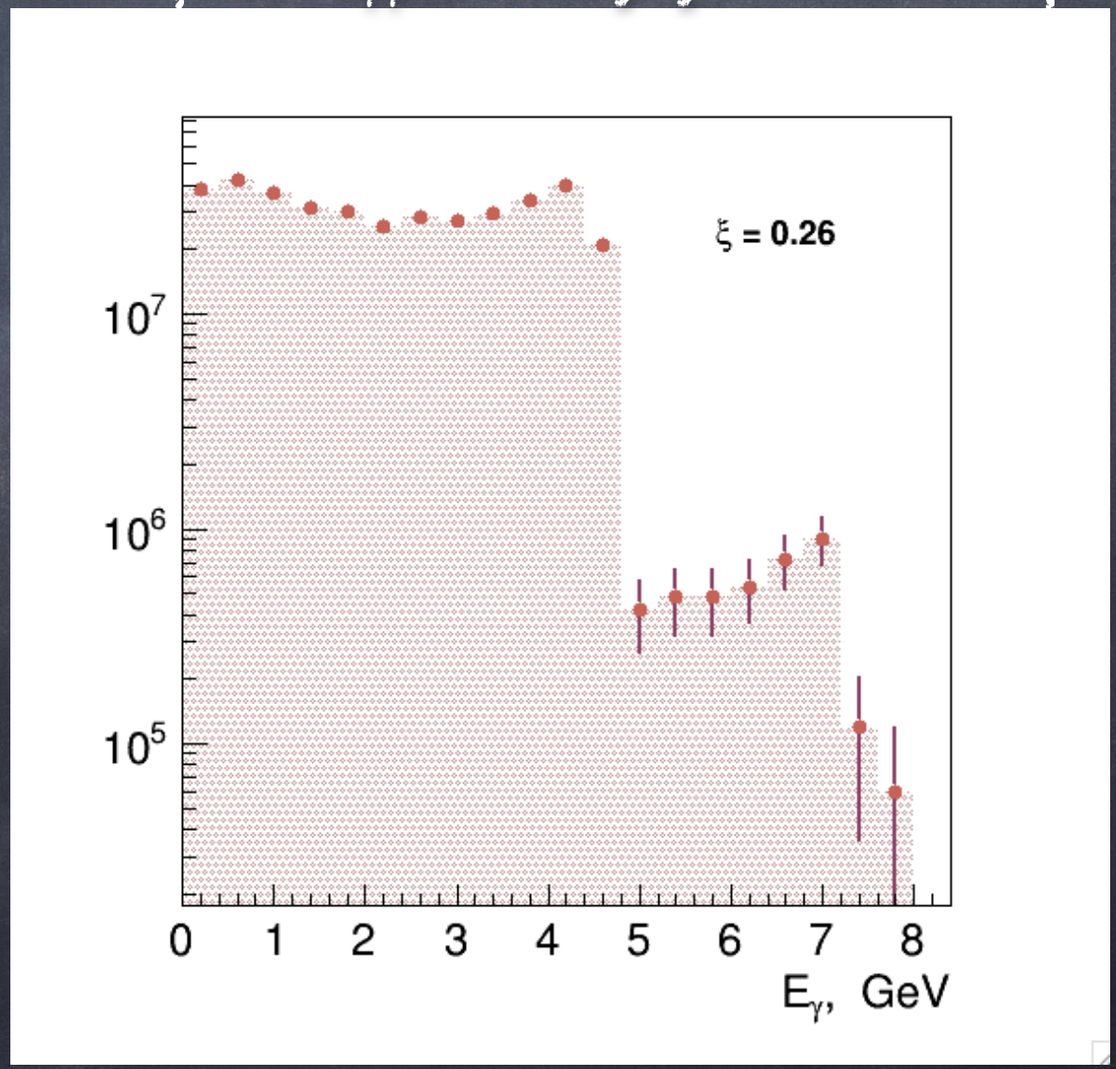
ξ vs Eγ FROM MC



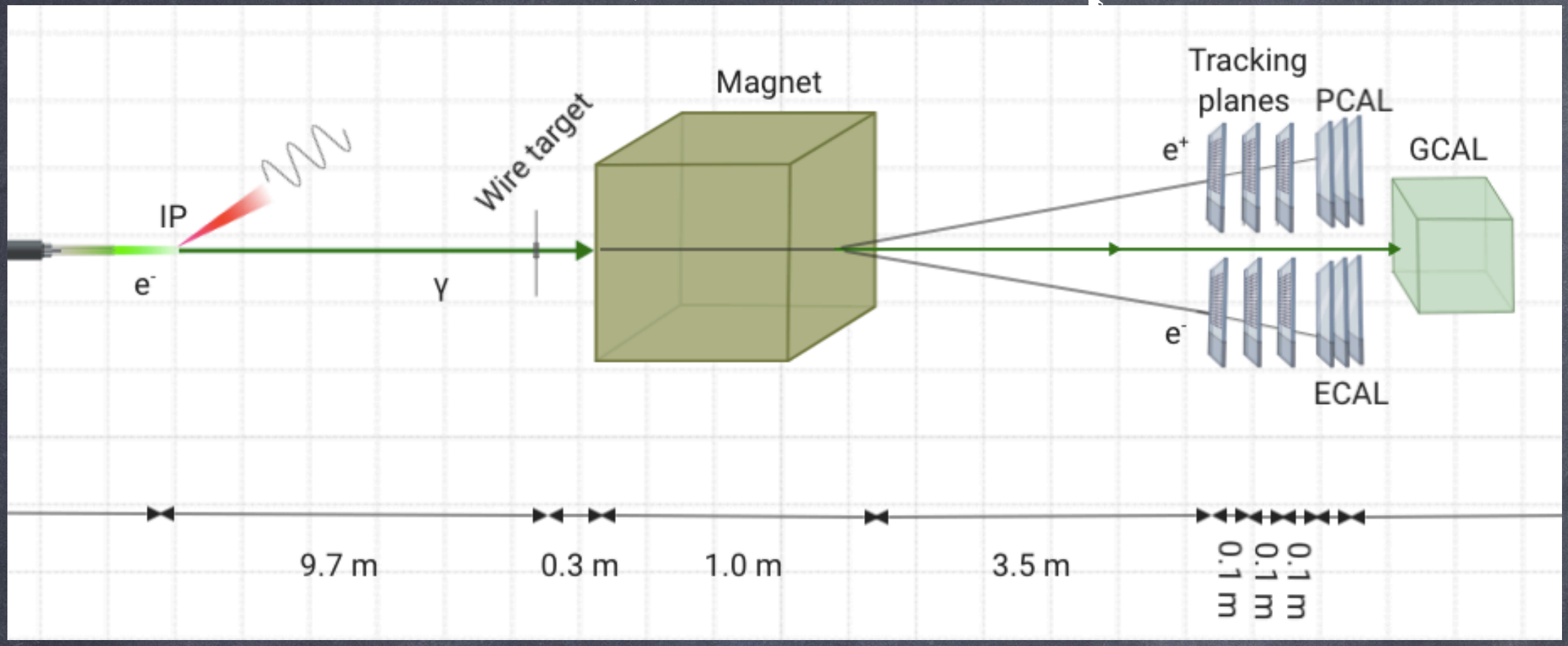
Peak ξ = 0.26 (0.01 J)
10000 bunches

For 800 nm laser, 17.5 GeV electrons:
Compton edge ~ 5.14 GeV
the first kinematic edge is shifted
approximately by 200 MeV

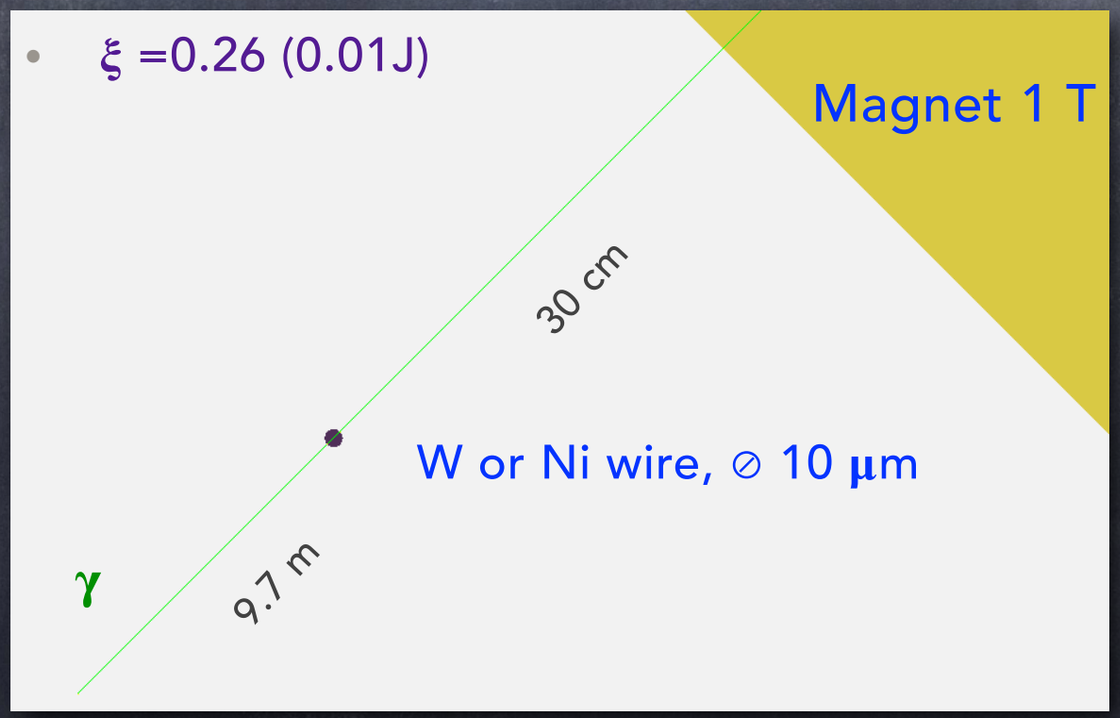




Schema of the experiment



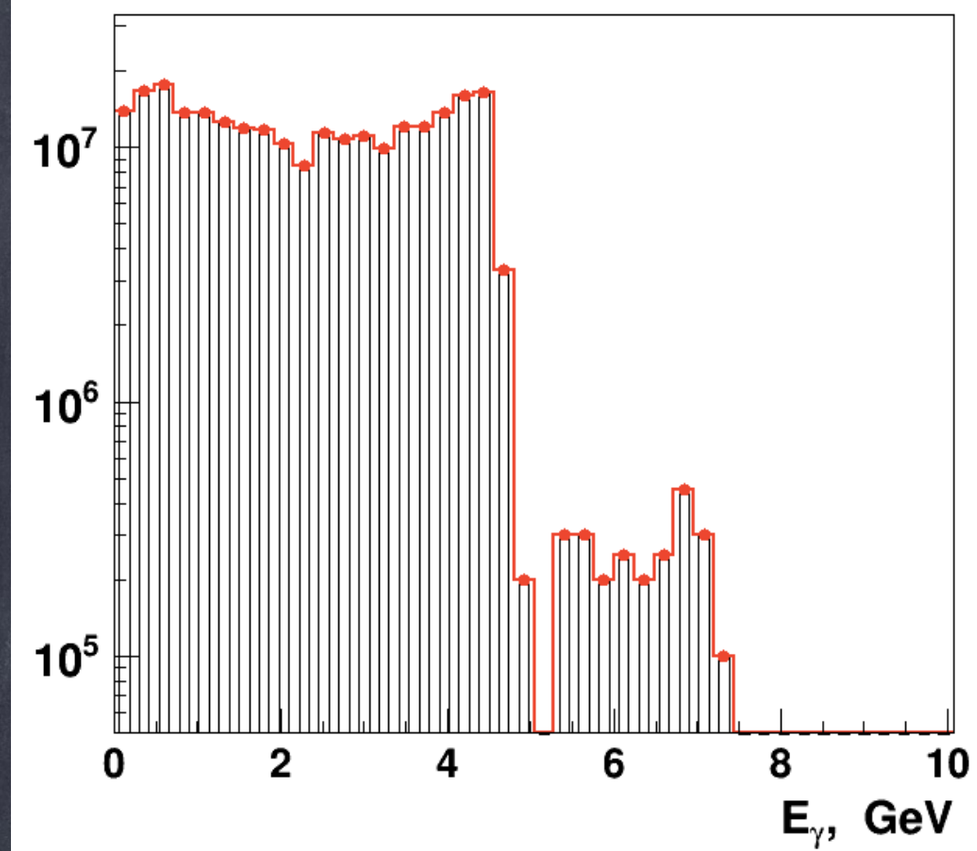
- ξ =0.26 (0.01J)

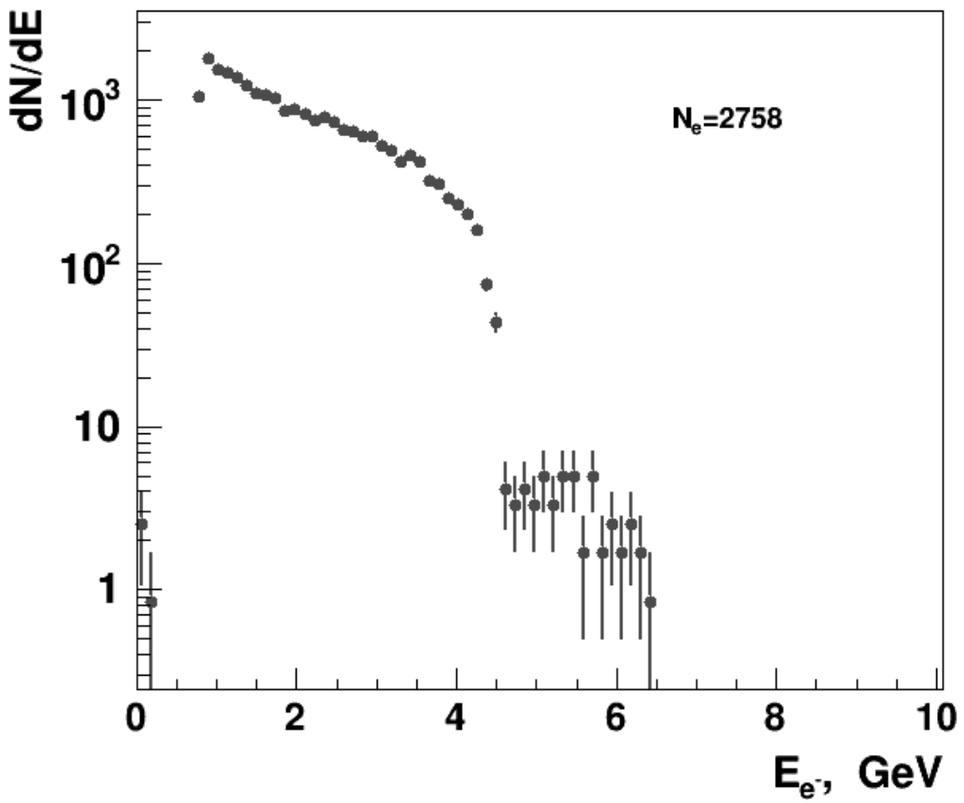


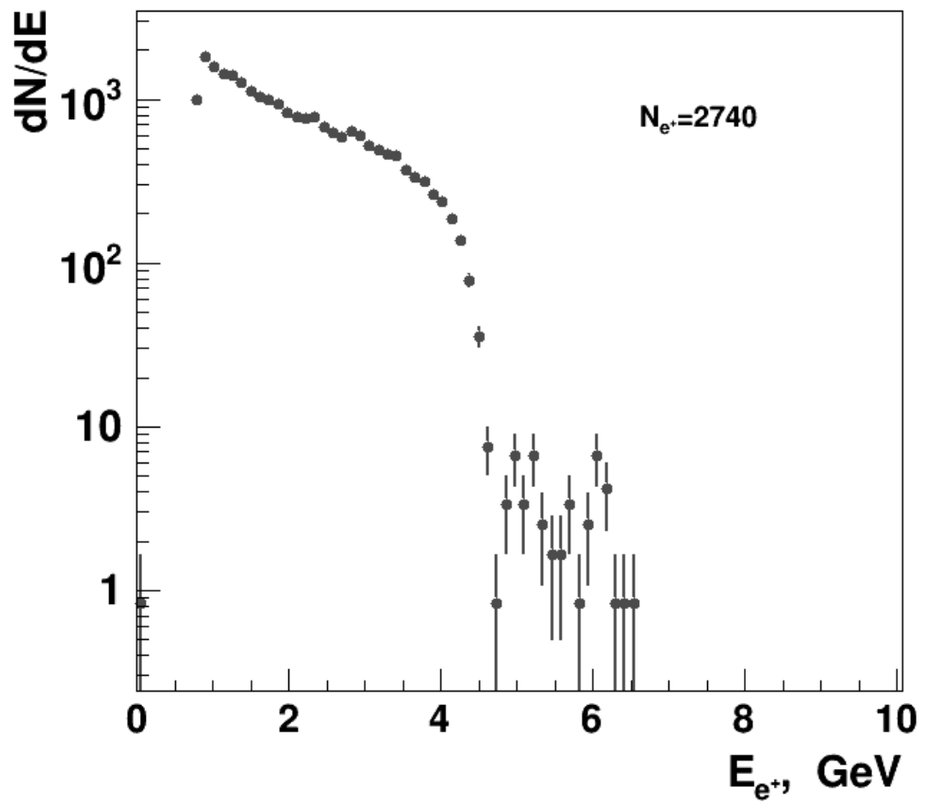
Geant4 simulation for the W wire converter

1000 BX

W thickness 10 um

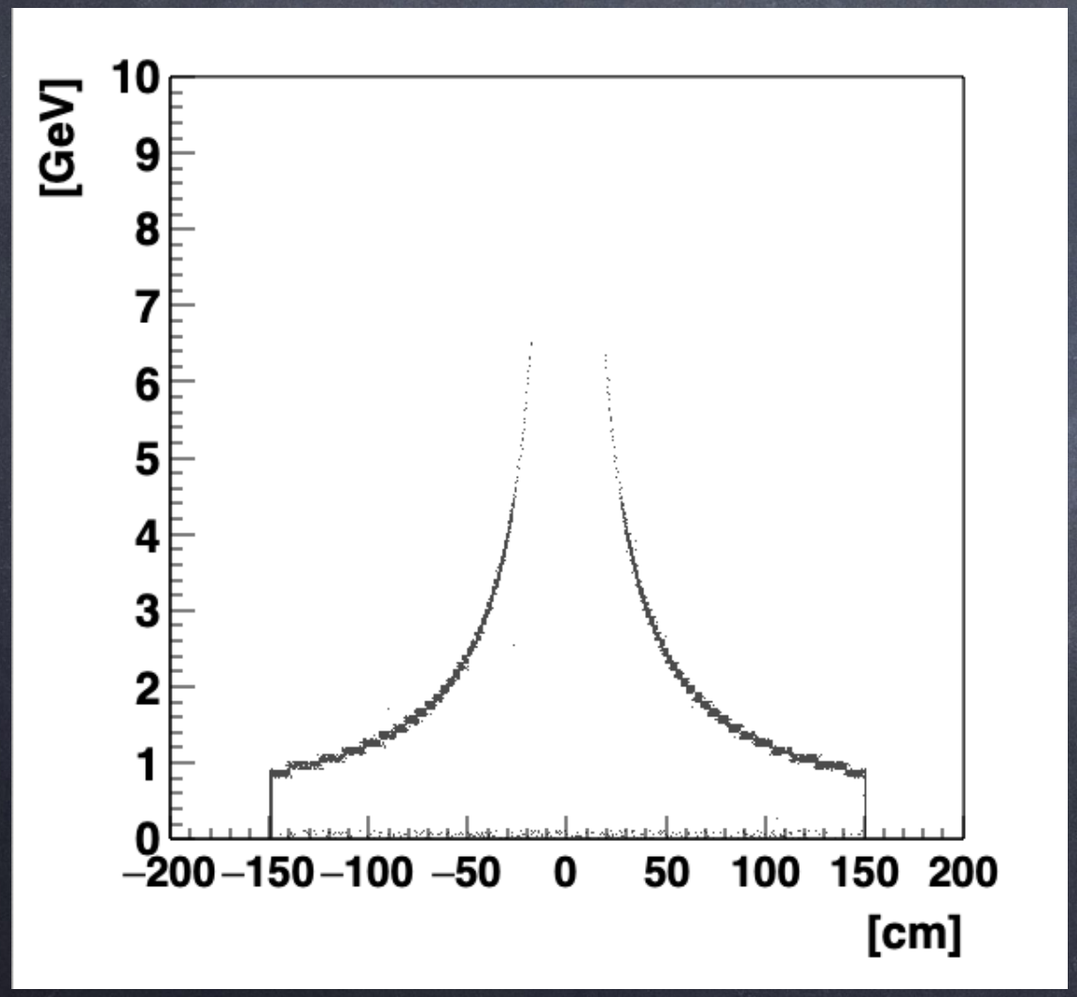


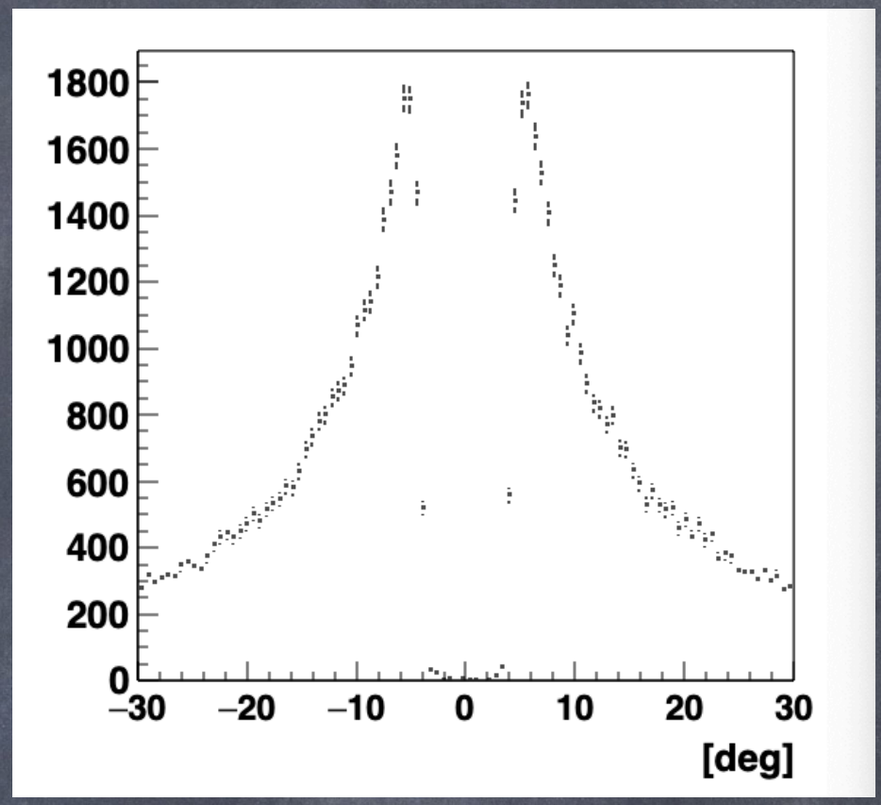


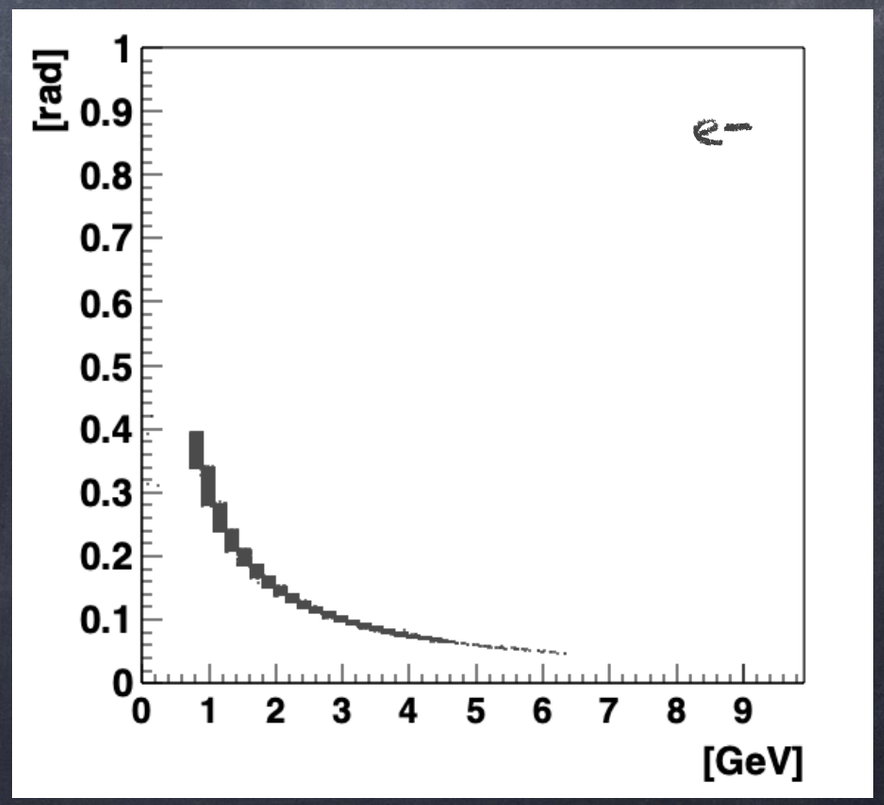


e+/e- from GEANT4

~1000 BX
W thickness 10 um
e+/e- position on a distance of 3.5 m from the magnet:

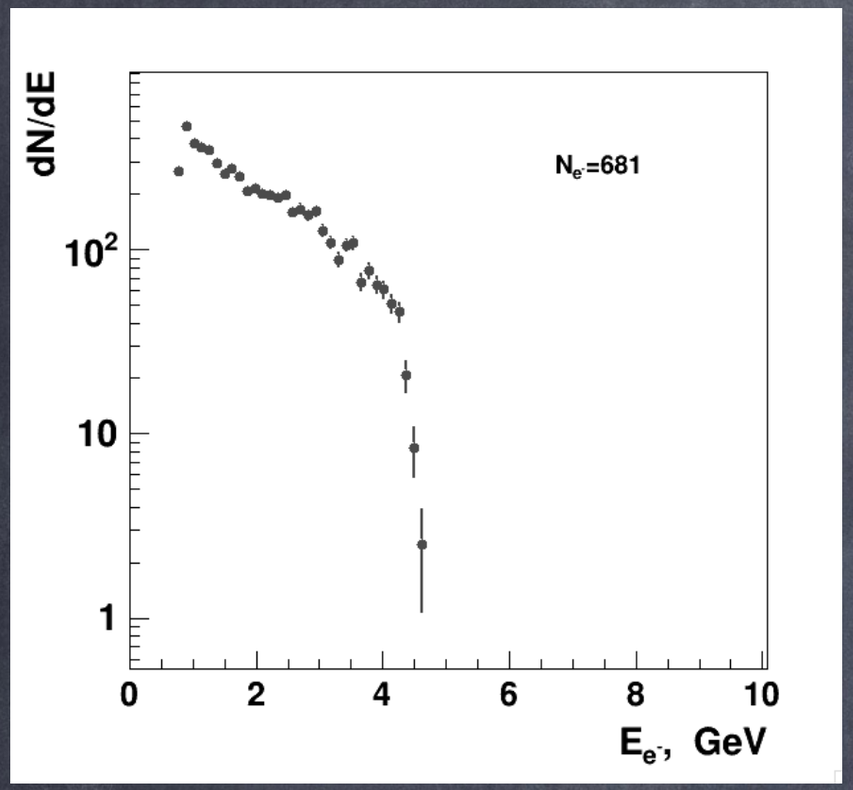


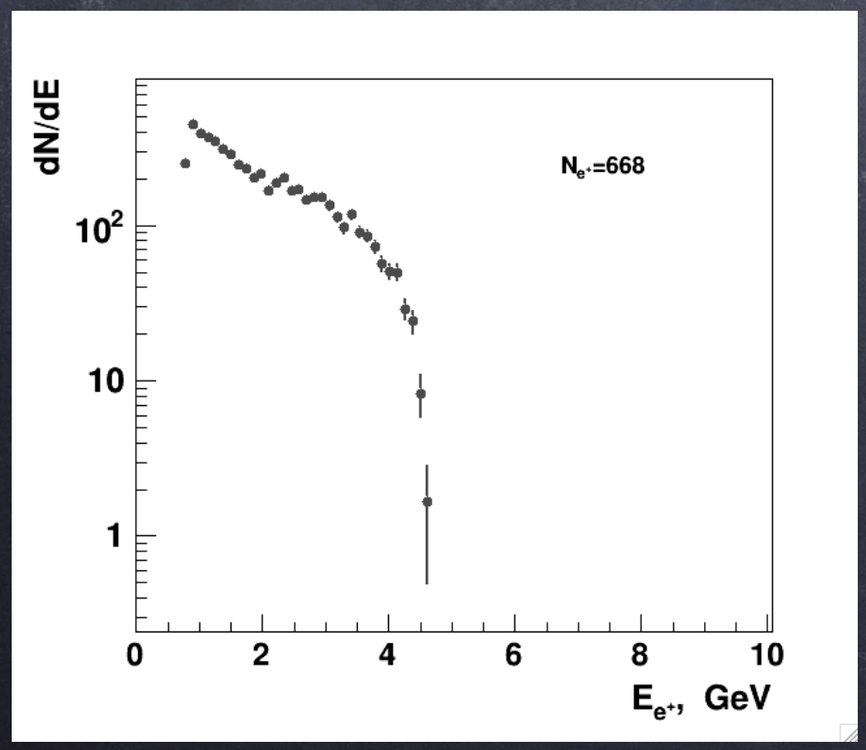


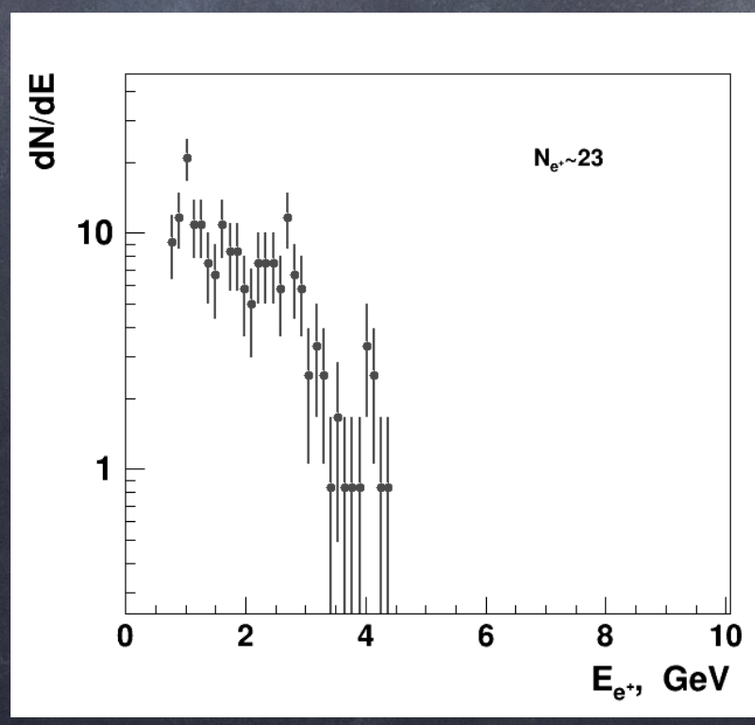


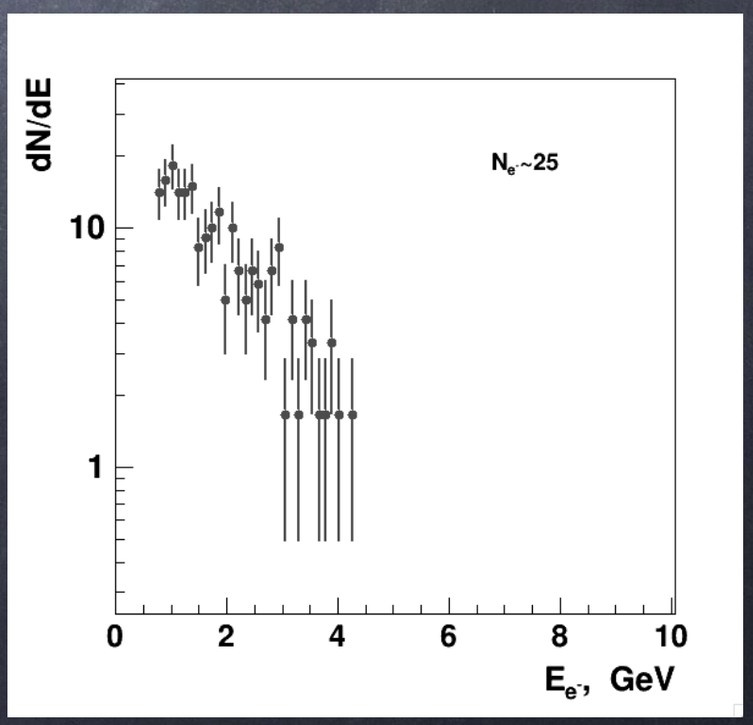
e+/e- spectra for 1 & 5 um wires

d_W, um	e+	e-	Ni, e-
10	2740	2758	148
5	668	681	
1	23	25	7







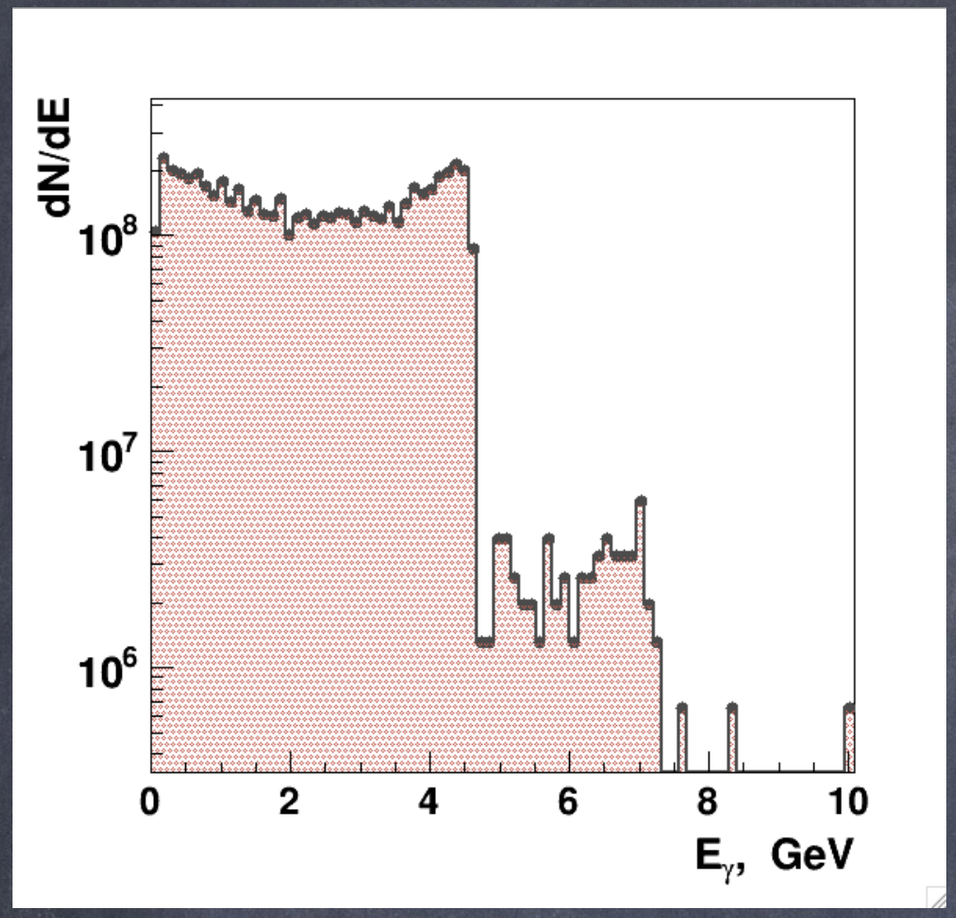


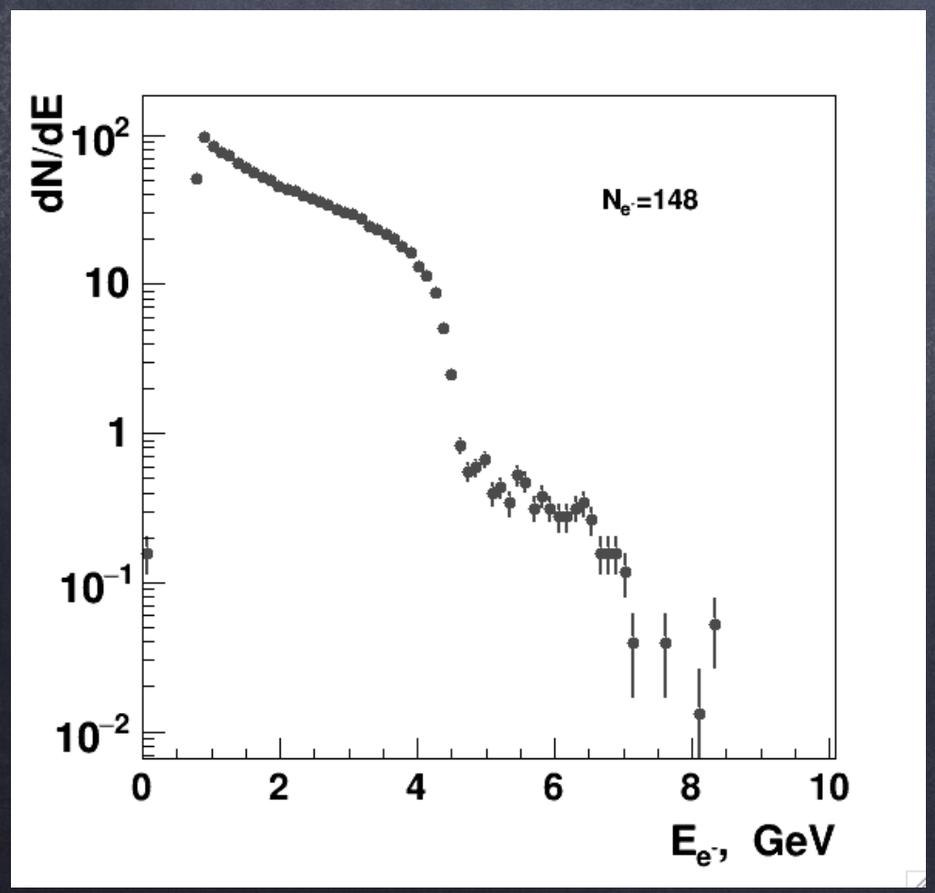
Geant4 simulation for the Ni wire converter spectra

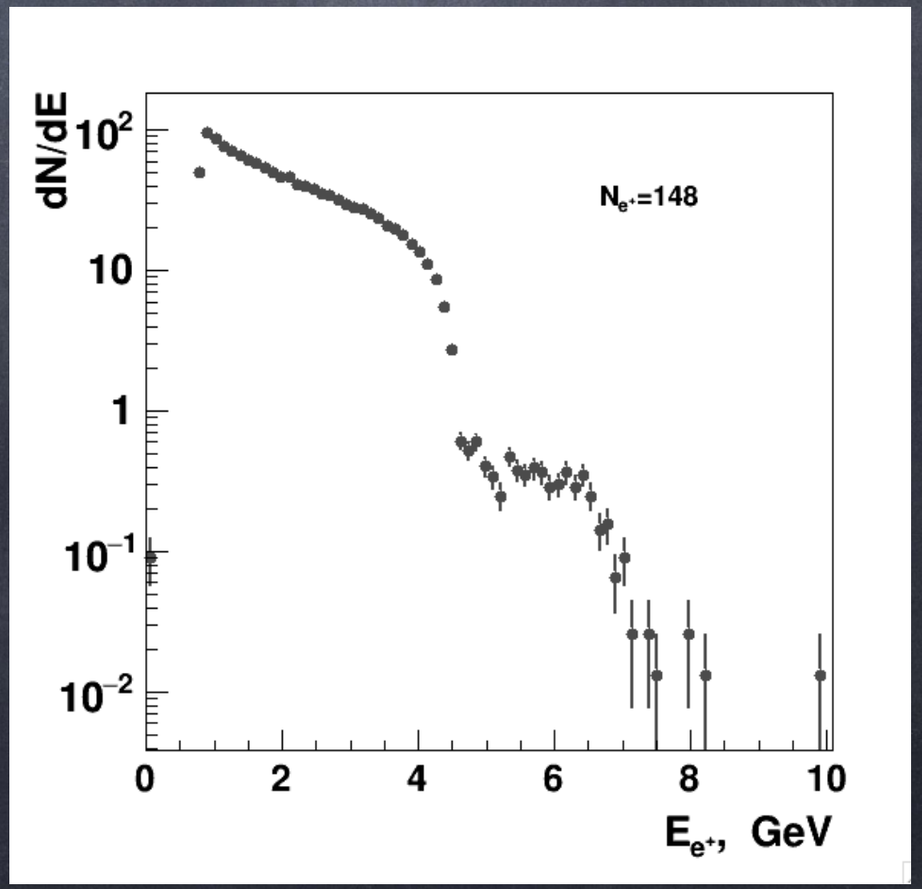
~63000 BX

Ni thickness 10 um

d_W um	Ni, e-
10	148
1	7





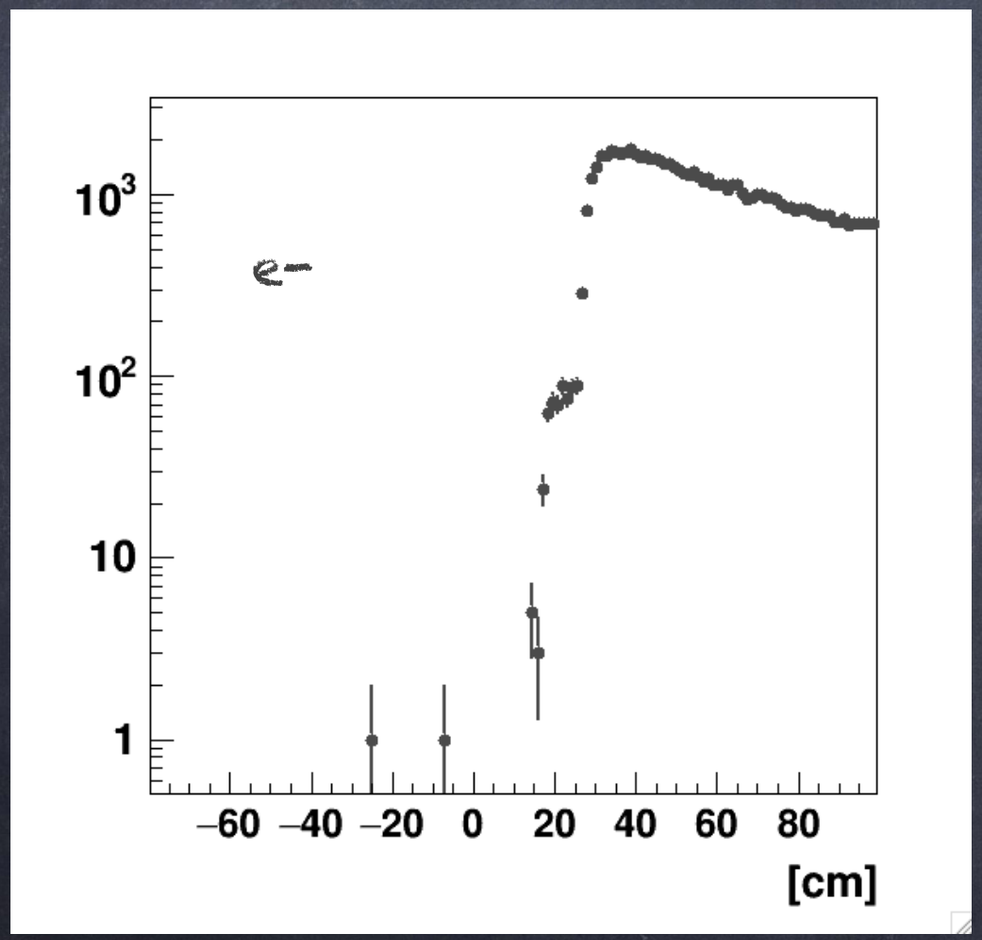


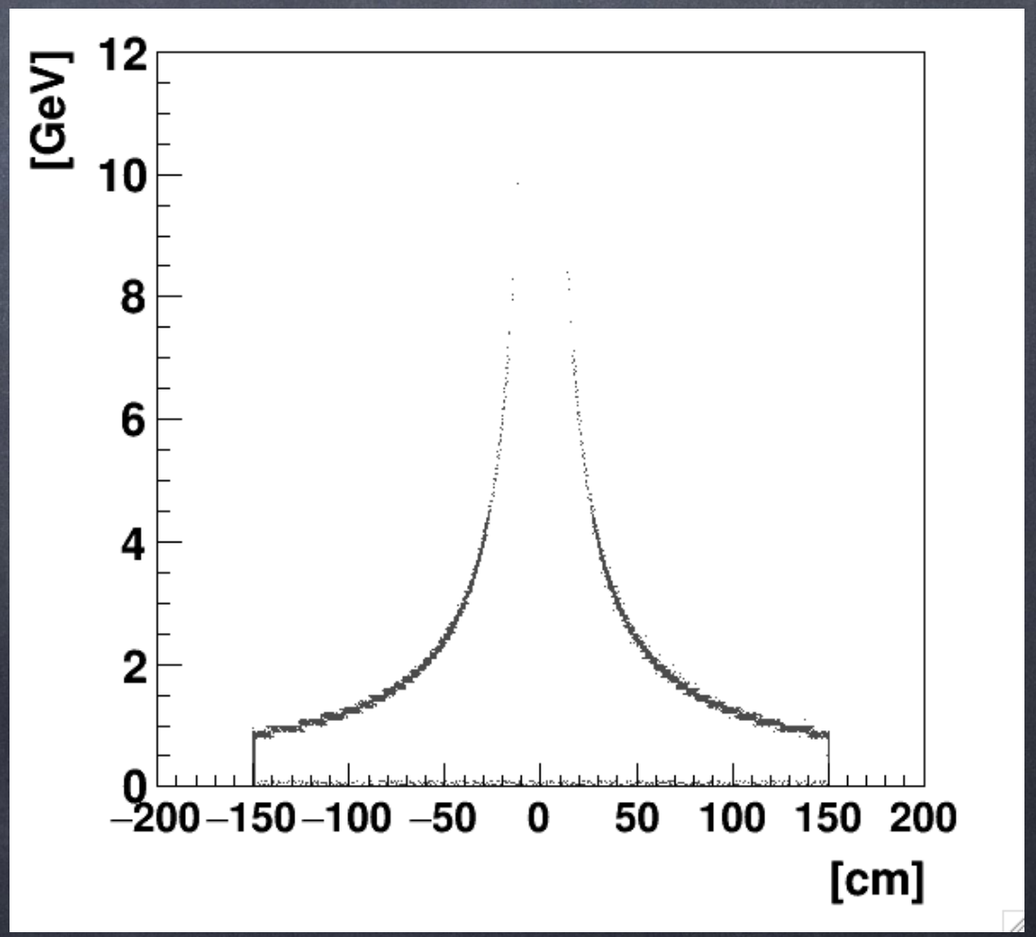
Geant4 simulation for the Ni wire converter

~63000 BX

Ni thickness 10 um

e+/e- position on a distance of 3.5 m from the magnet:

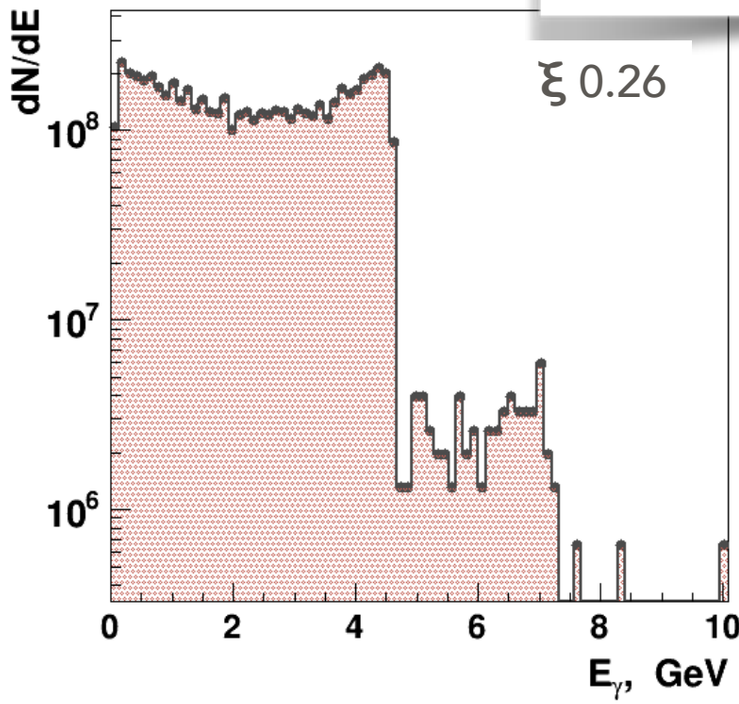


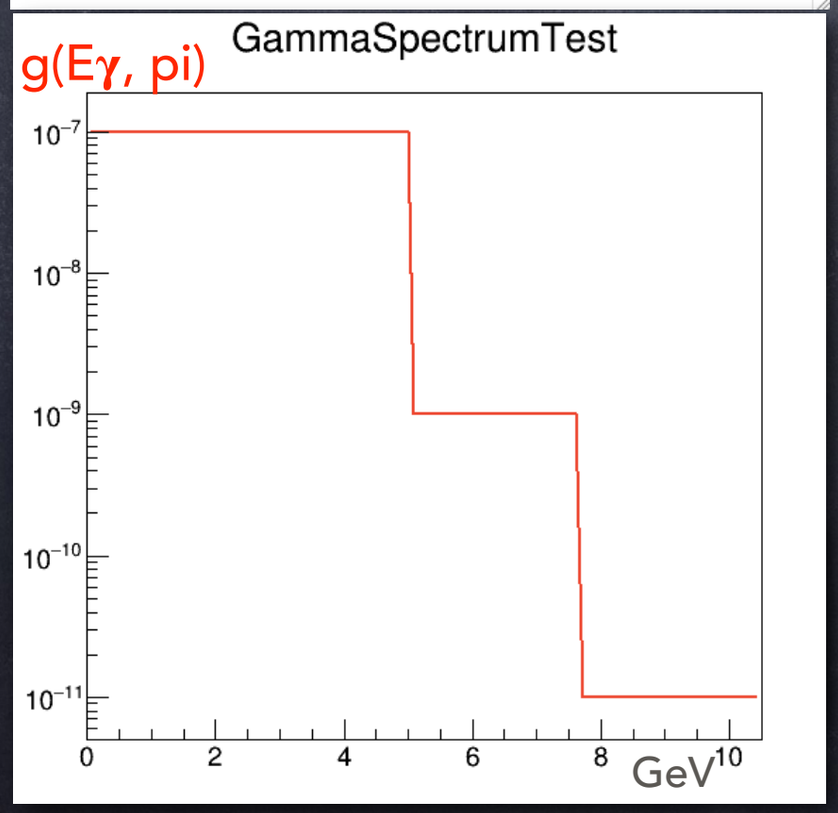


METHOD of photon spectrum restoration

$$f(Ee) = \int \sigma(E\gamma, Ee)\, g(E\gamma)\, dE\gamma$$

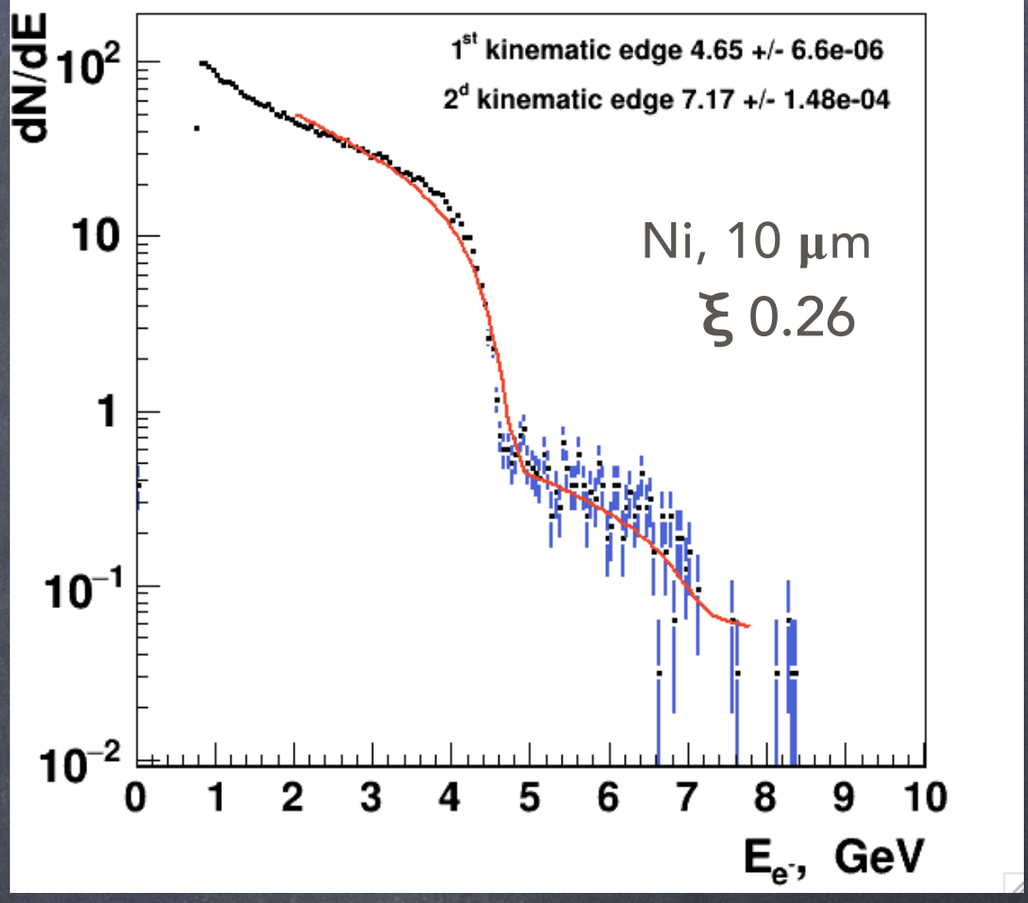
g(Eγ)





The single-particle spectrum obtained in GEANT4 is compared to a **model spectrum** calculated by convolving the trial **photon spectrum** with the **Bethe-Heitler cross section**

f(Ee)



$$\int \sigma(E\gamma, Ee)\, g(E\gamma, p1, p2)\, dE\gamma$$

fitting allows finding the **the kinematic edges** quite well

What's done & What's next

- @ MC for HICS + trident with primary electrons: well visible first and 2nd (!) kinematic edges for the lowest ξ=0.26 (corresponds to 0.01 J) for the Ni target of ~10 μm

- Using wire targets of Ni, W w/ the thickness ~1-10 μm number of pairs could be varied 10-10^4. E.g. for Ni 10 μm, 10m from IP Number of pairs ~150 (ξ=0.26)

➡ Move to realistic geometry w/ detector implementation (tracker +calorimeter)

➡ Perform the simulation for 14 GeV

Back up

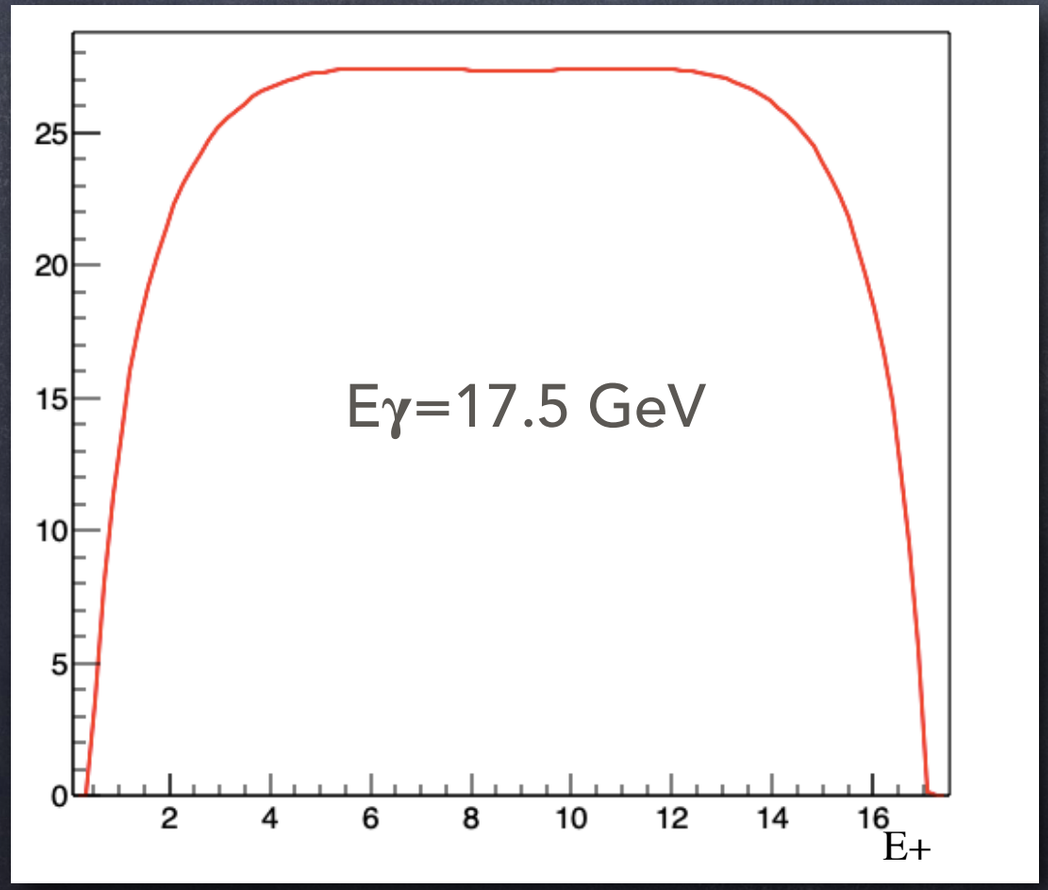
Bethe-Heitler pair spectrum

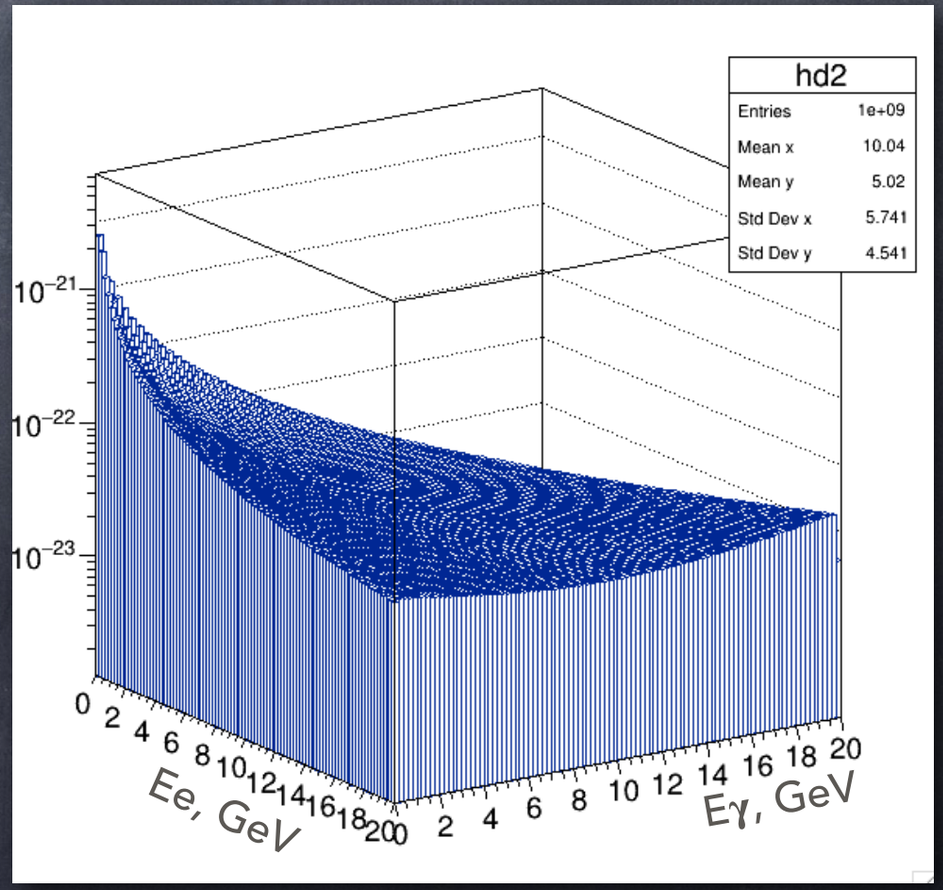
The classical Bethe-Heitler formula (H.Bethe, W.Heitler, Proc.Roy.Soc.A146 (34)83)

$$\Phi(E_0)\,dE_0 = \frac{Z^2}{137}\left(\frac{e^2}{mc^2}\right)^2 4\,\frac{E_{0+}{}^2E_+{}^2 + \frac{2}{3}E_0E_+}{(h\nu)^3}\,dE_0\left(\log\frac{2E_0E_+}{h\nu mc^2} - \tfrac{1}{2}\right).$$

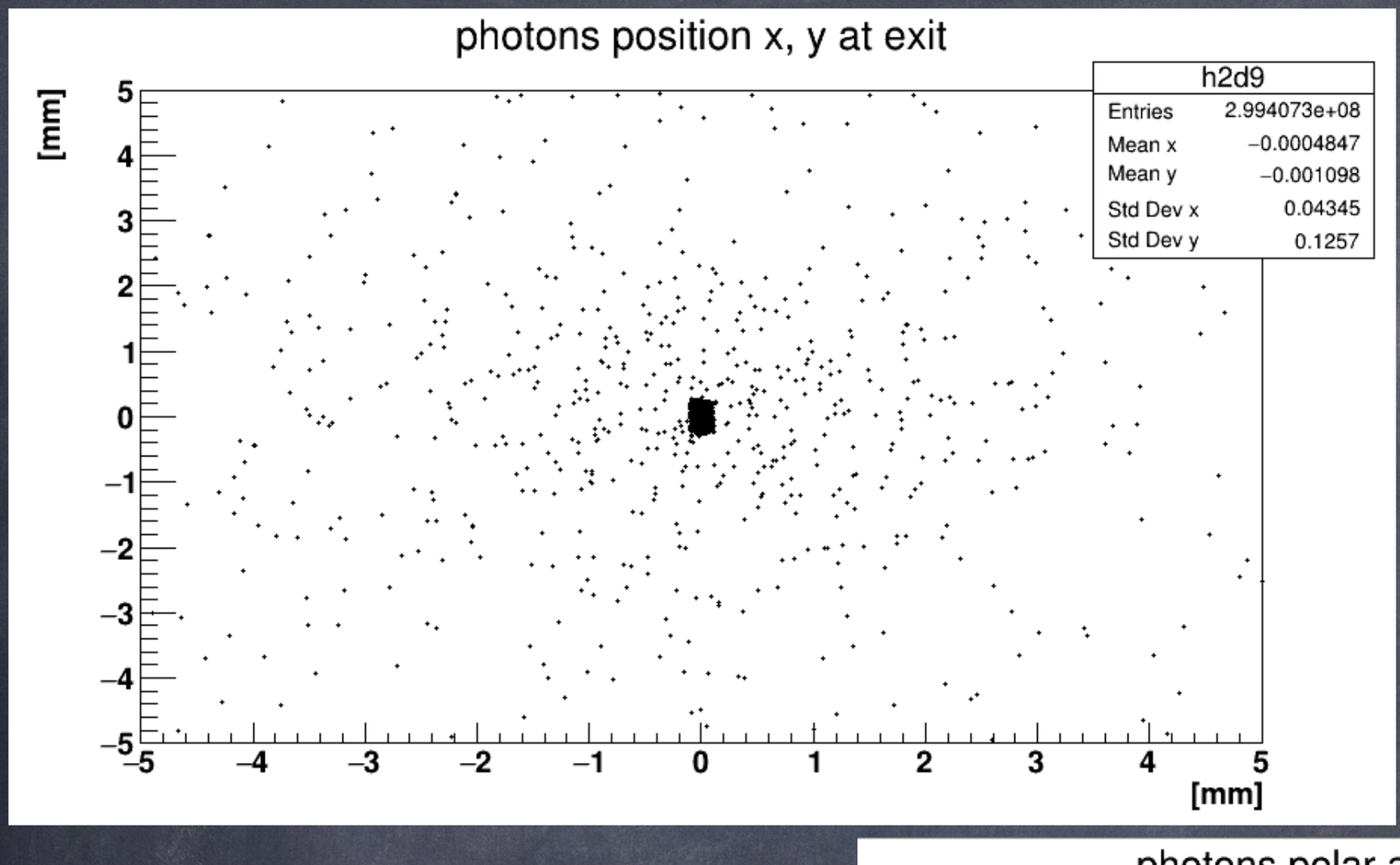
energies involved are large compared with mc^2

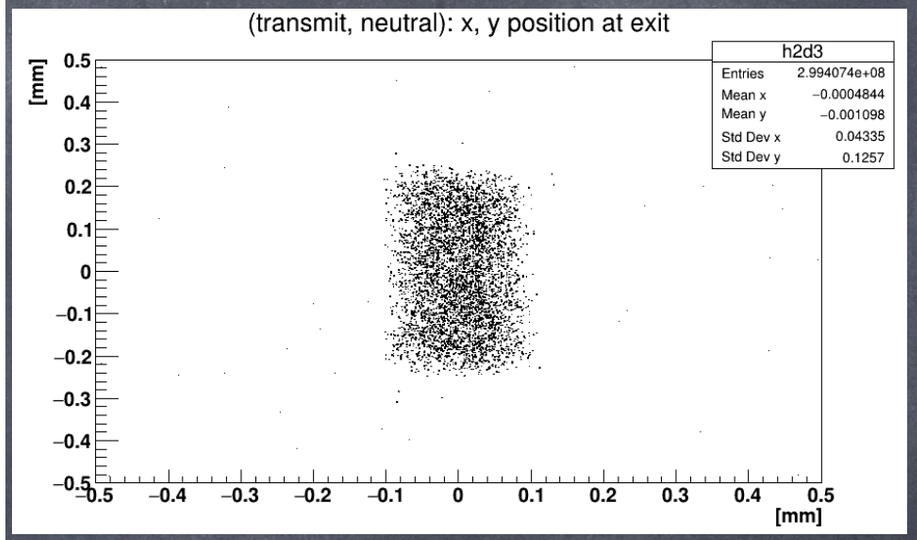
Corrected Bethe-Heitler cross-section from GEANT4 is currently used:

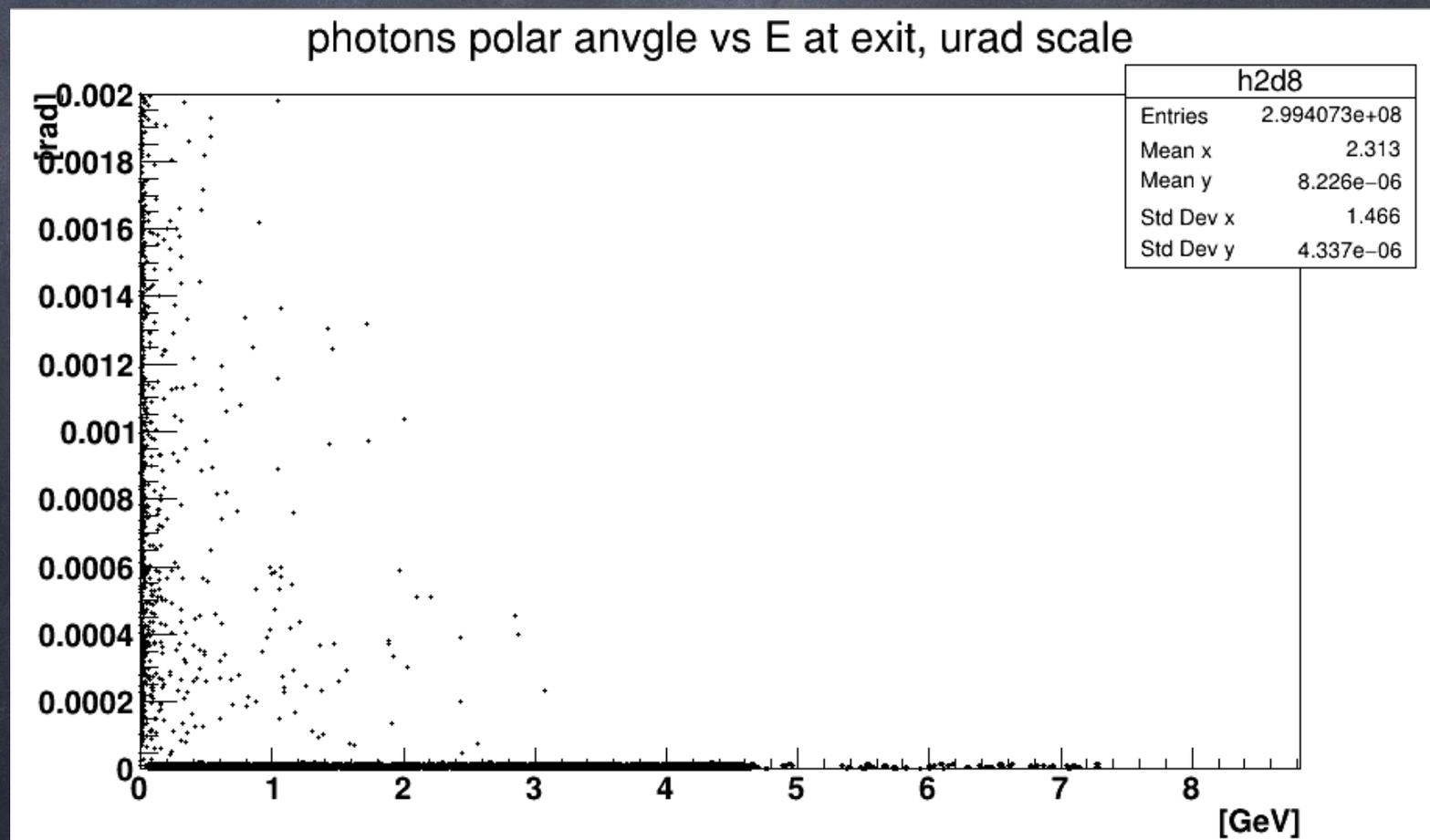




γ from GEANT


photons position x, y at exit
h2d9
Entries 2.994073e+08
Mean x −0.0004847
Mean y −0.001098
Std Dev x 0.04345
Std Dev y 0.1257
[mm]
[mm]


(transmit, neutral): x, y position at exit
h2d3
Entries 2.994074e+08
Mean x −0.0004844
Mean y −0.001098
Std Dev x 0.04335
Std Dev y 0.1257
[mm]
[mm]


photons polar anvgle vs E at exit, urad scale
h2d8
Entries 2.994073e+08
Mean x 2.313
Mean y 8.226e−06
Std Dev x 1.466
Std Dev y 4.337e−06
[urad]
[GeV]

ξ vs Eγ FROM MC