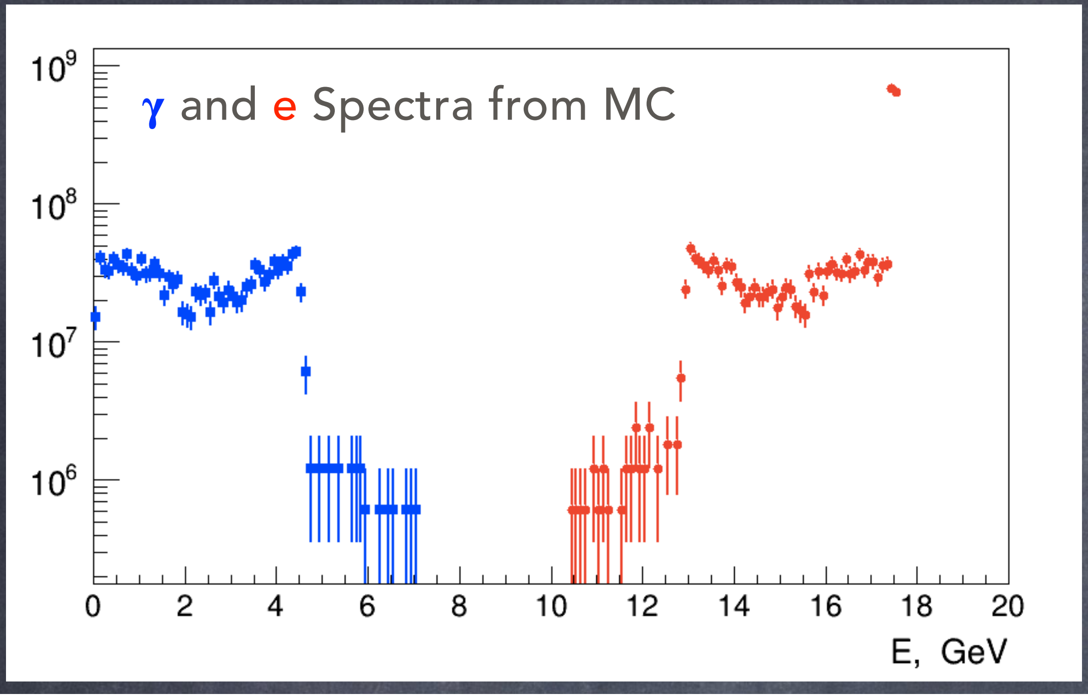
Compton edge measurement

Borysova Maryna (KINR)

18/06/19

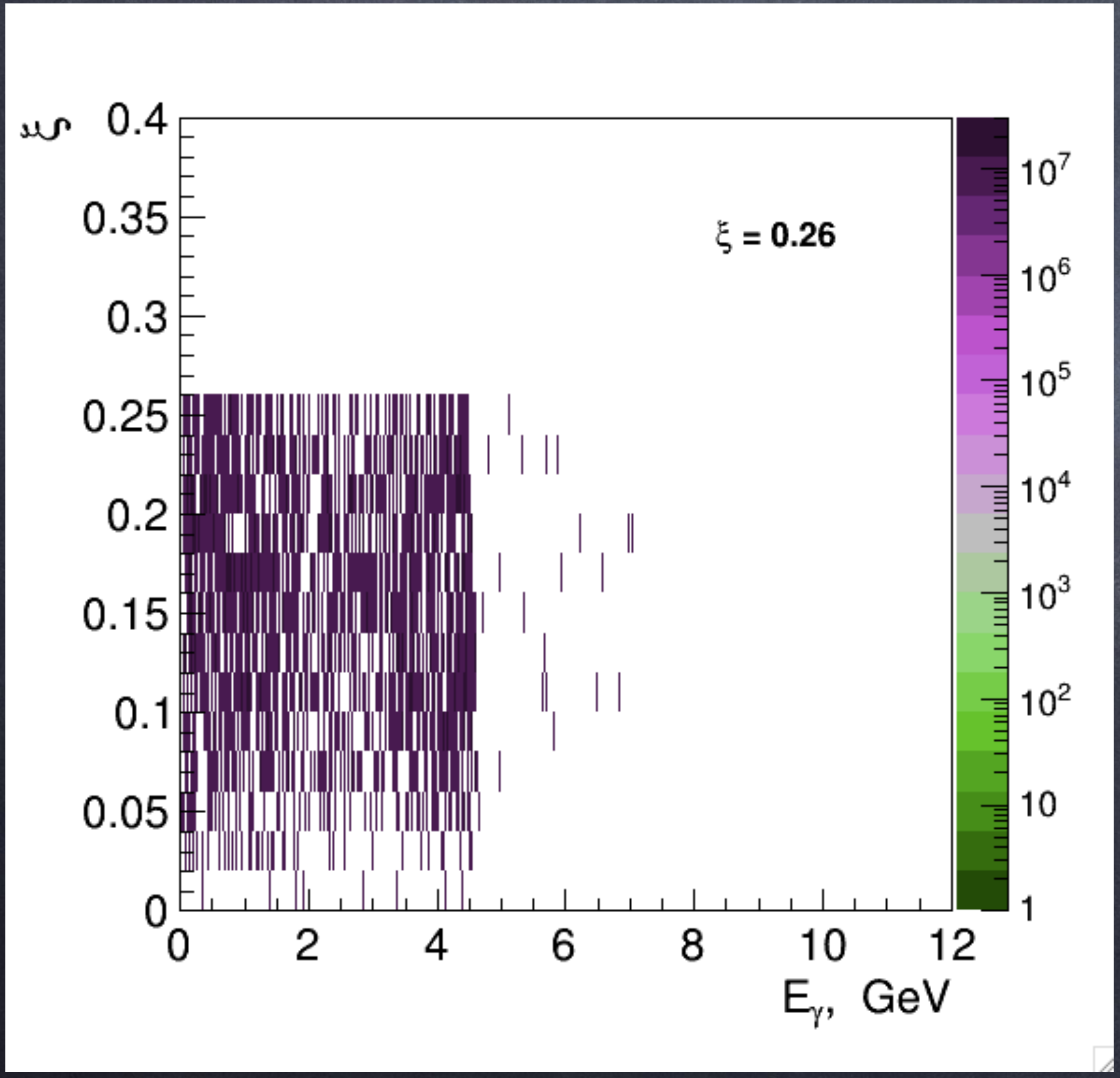
LUXE fortnightly meeting

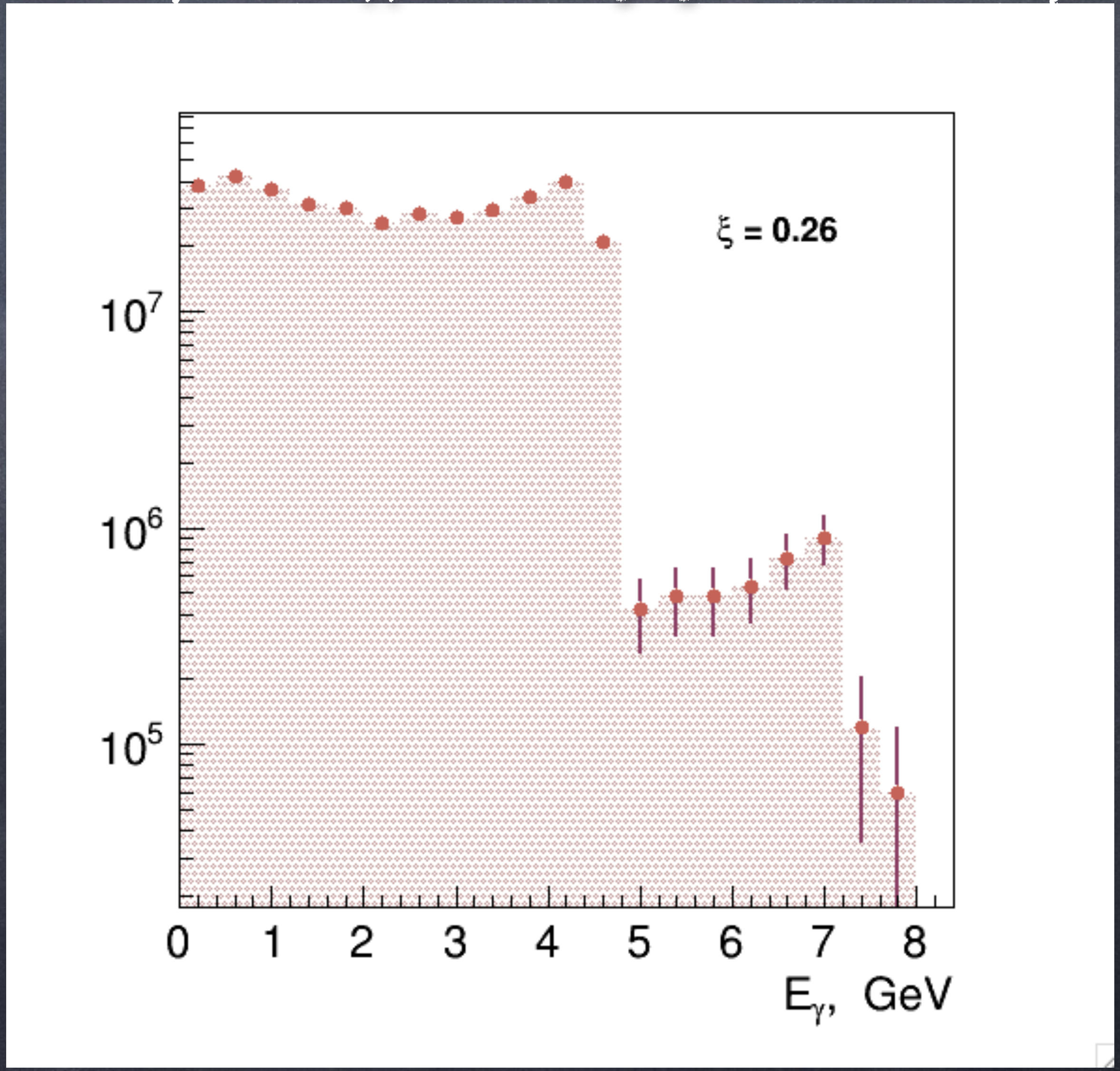
ξ vs Eγ FROM MC



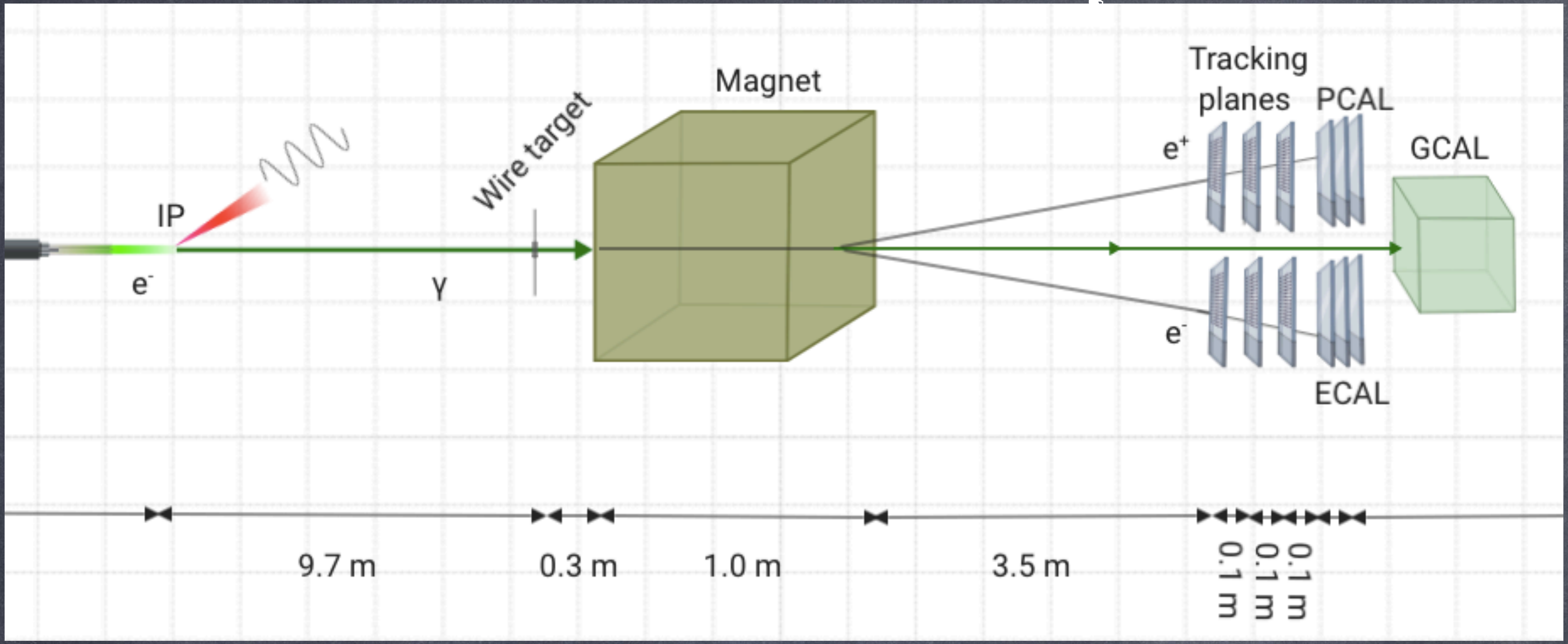
Peak ξ = 0.26 (0.01 J)
10000 bunches

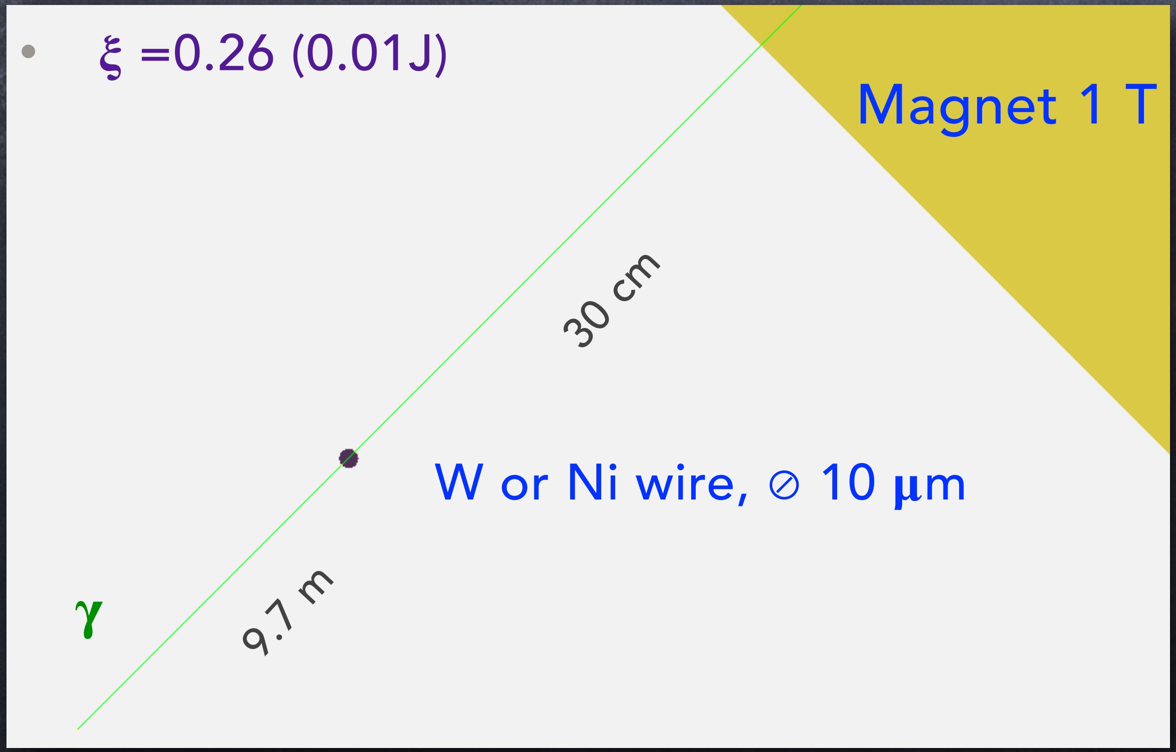
For 800 nm laser, 17.5 GeV electrons:
Compton edge ~ 5.14 GeV
the first kinematic edge is shifted
approximately by 200 MeV

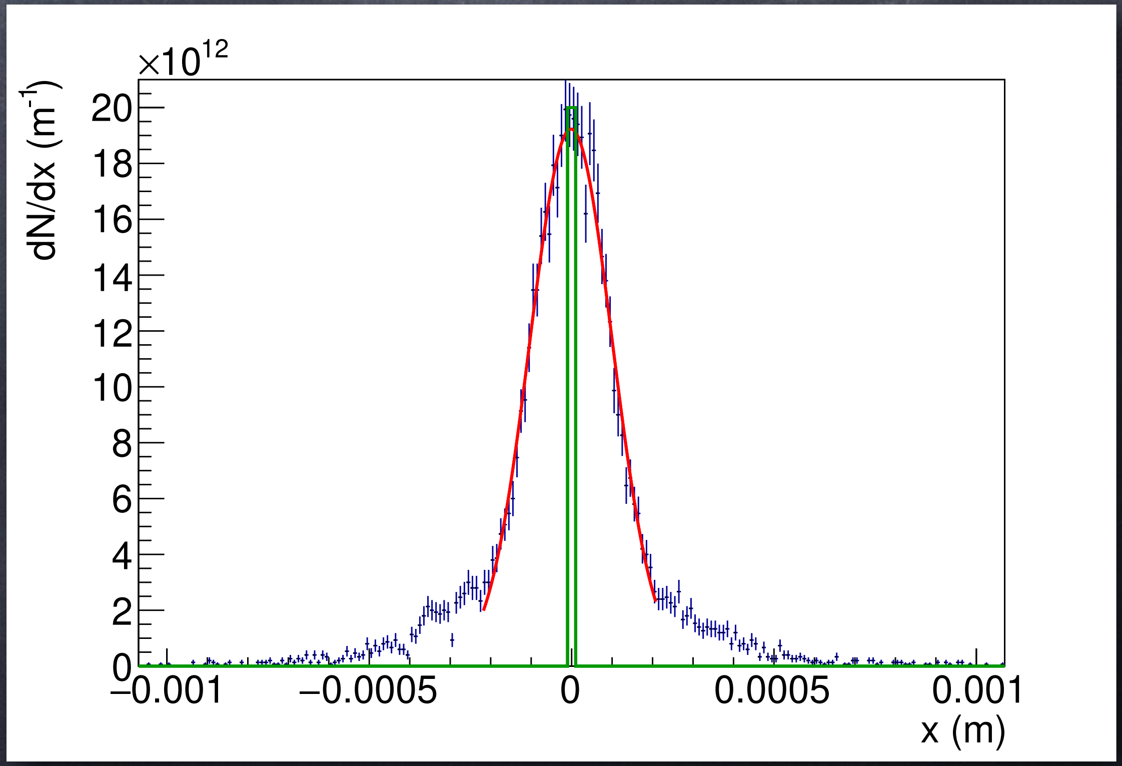




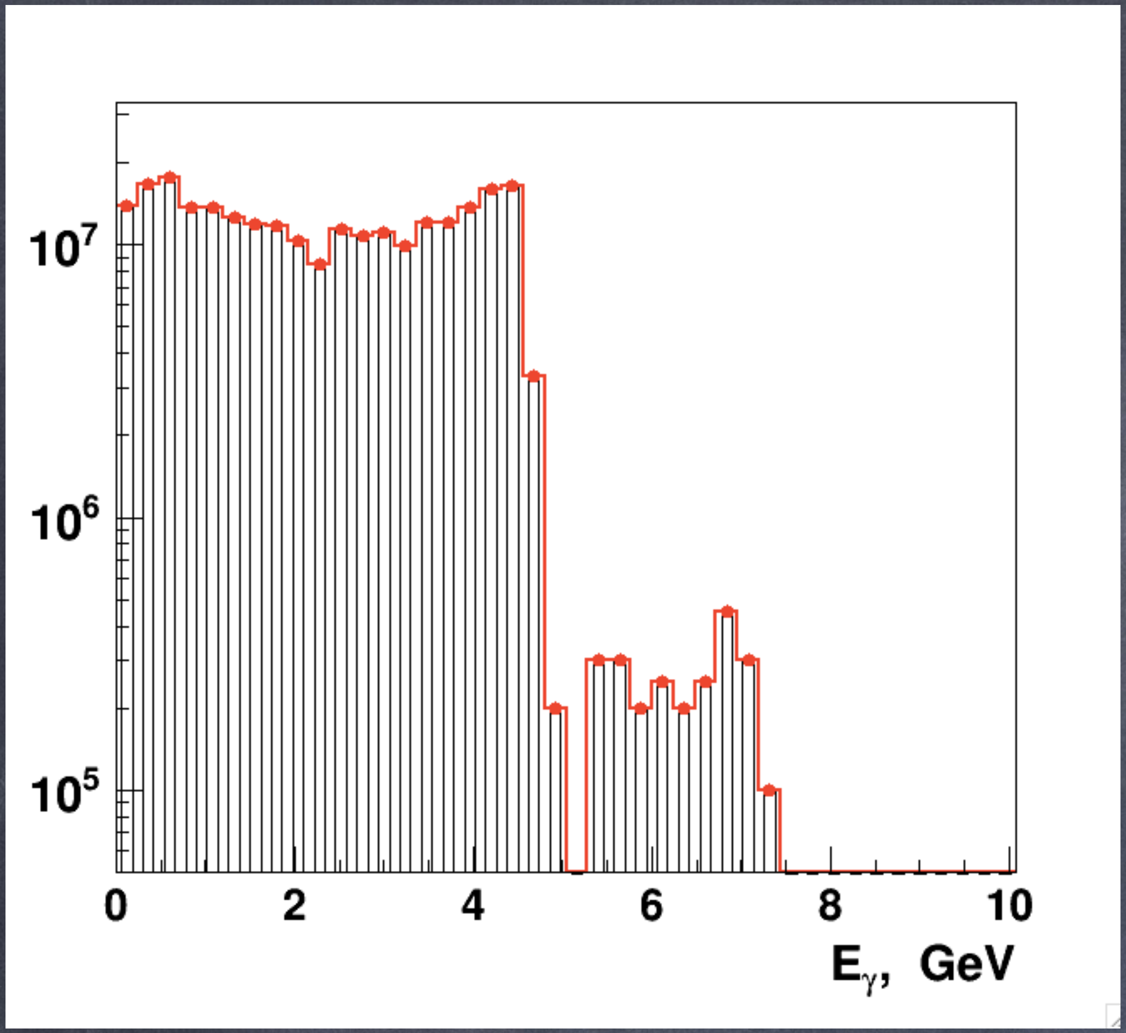
Schema of the experiment





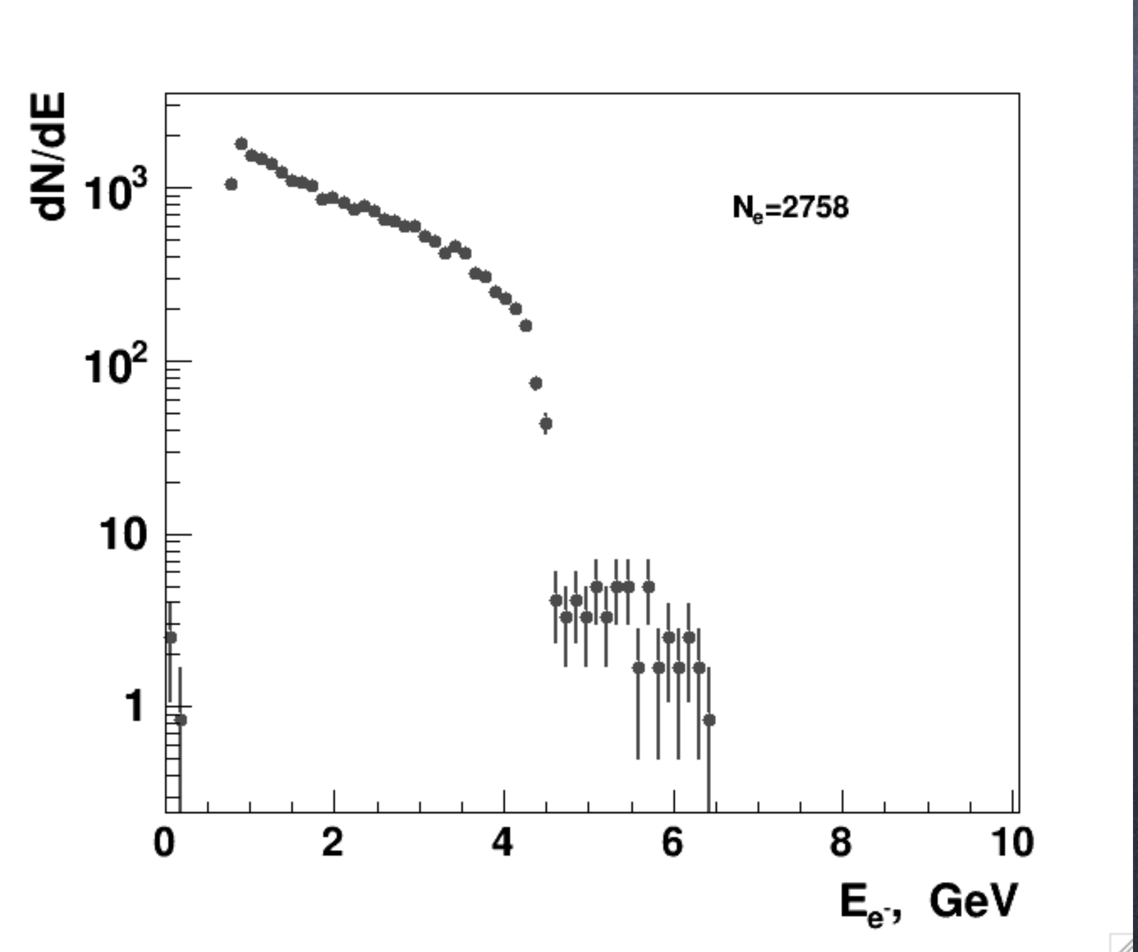


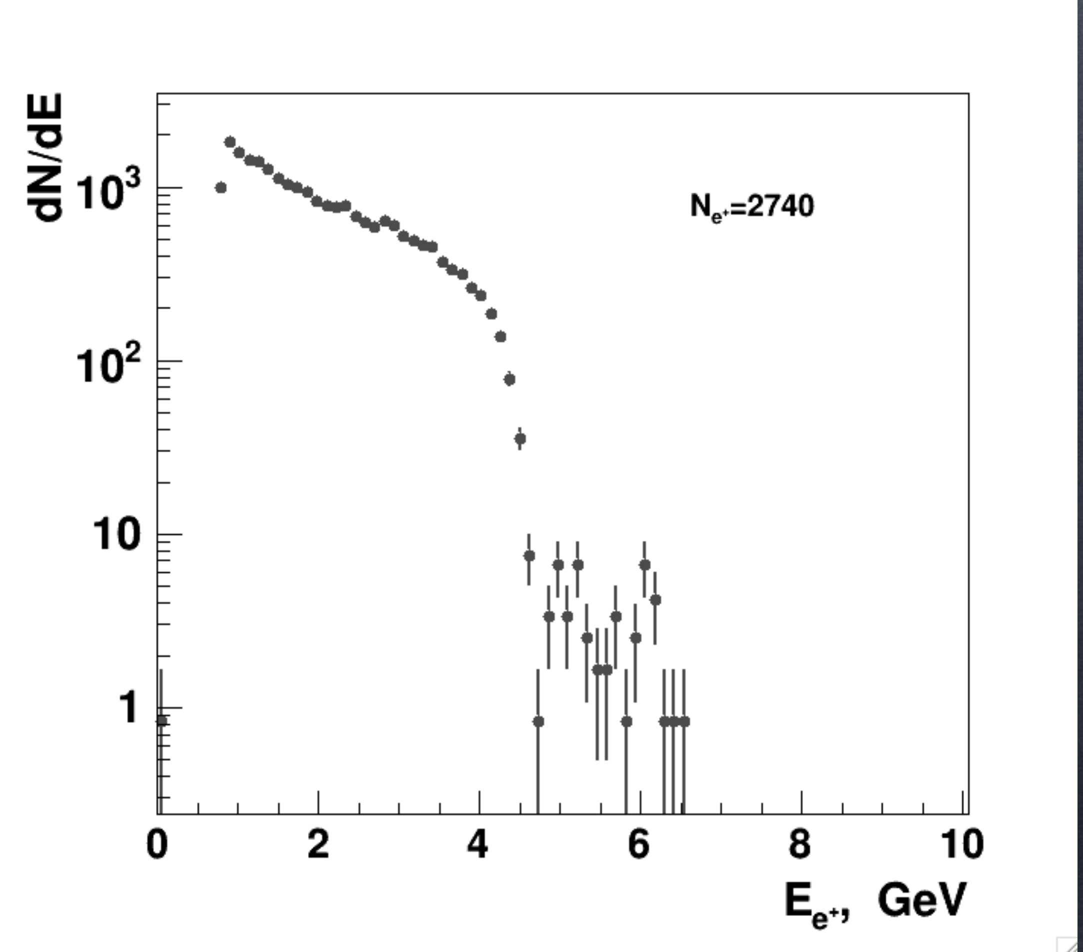
Geant4 simulation for the W wire converter



1000 photons from ~ 160 BX

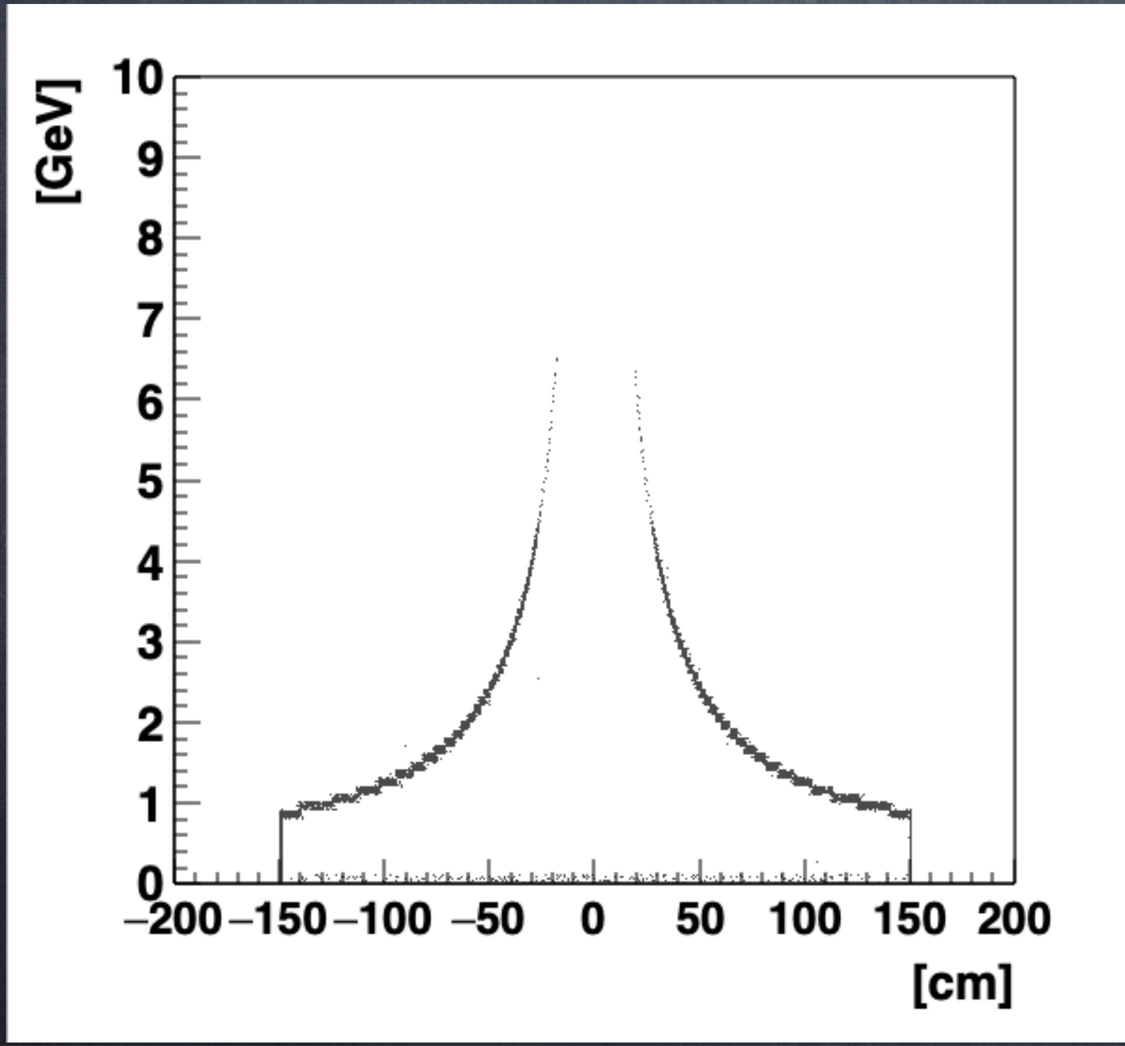
W thickness 10 um

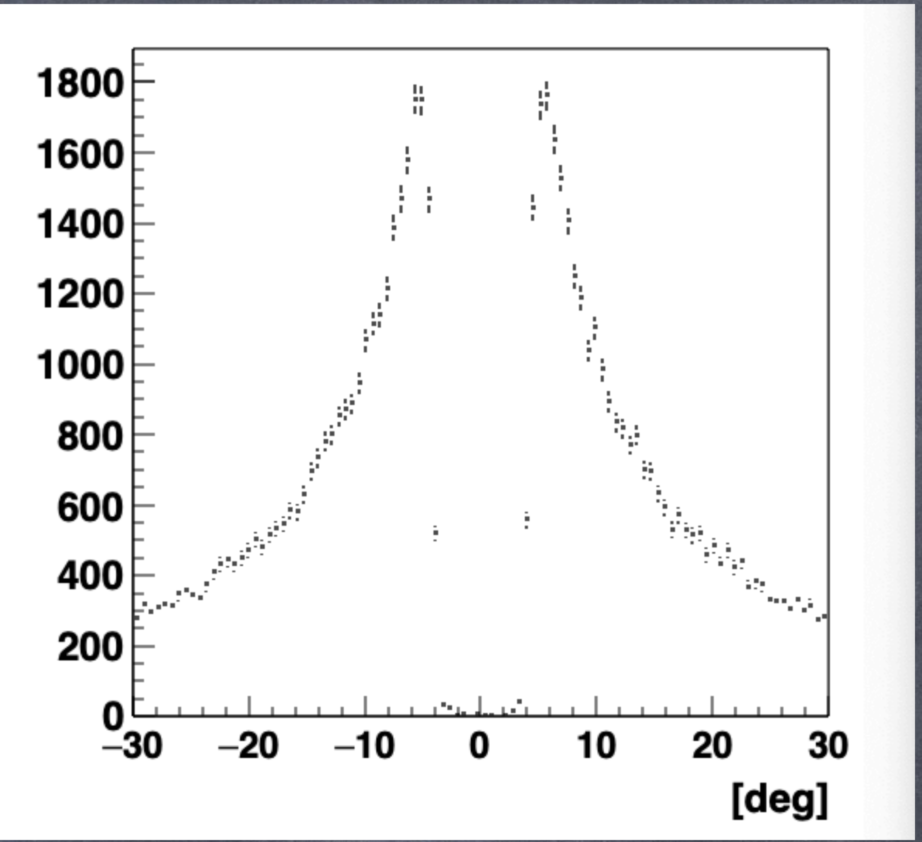


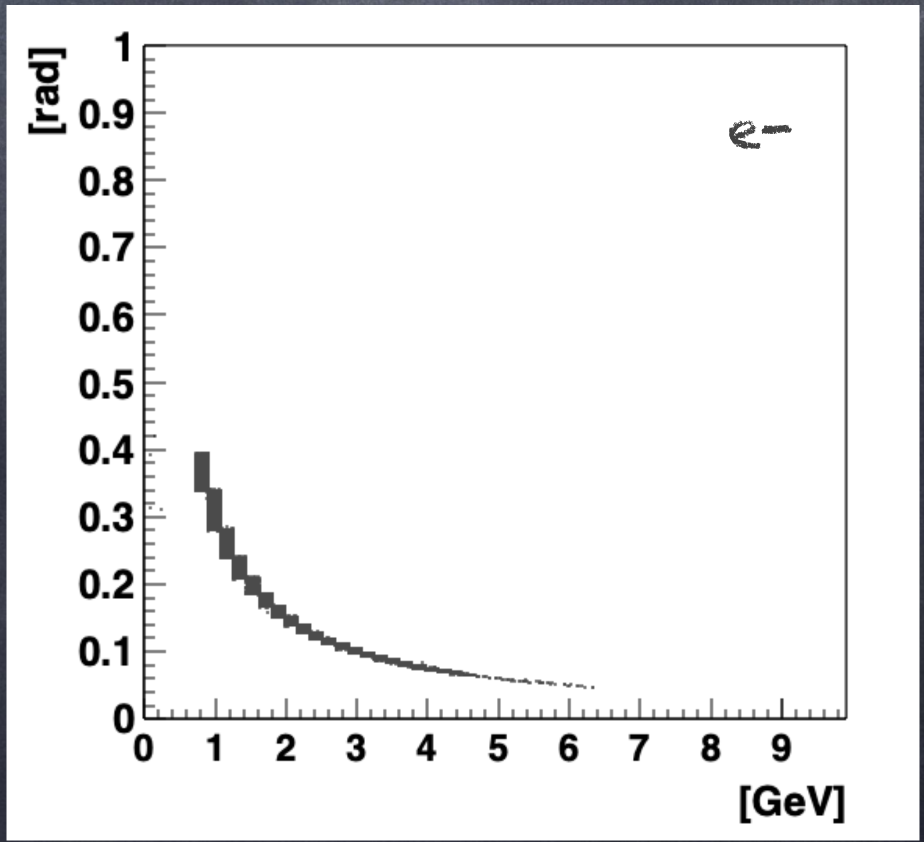


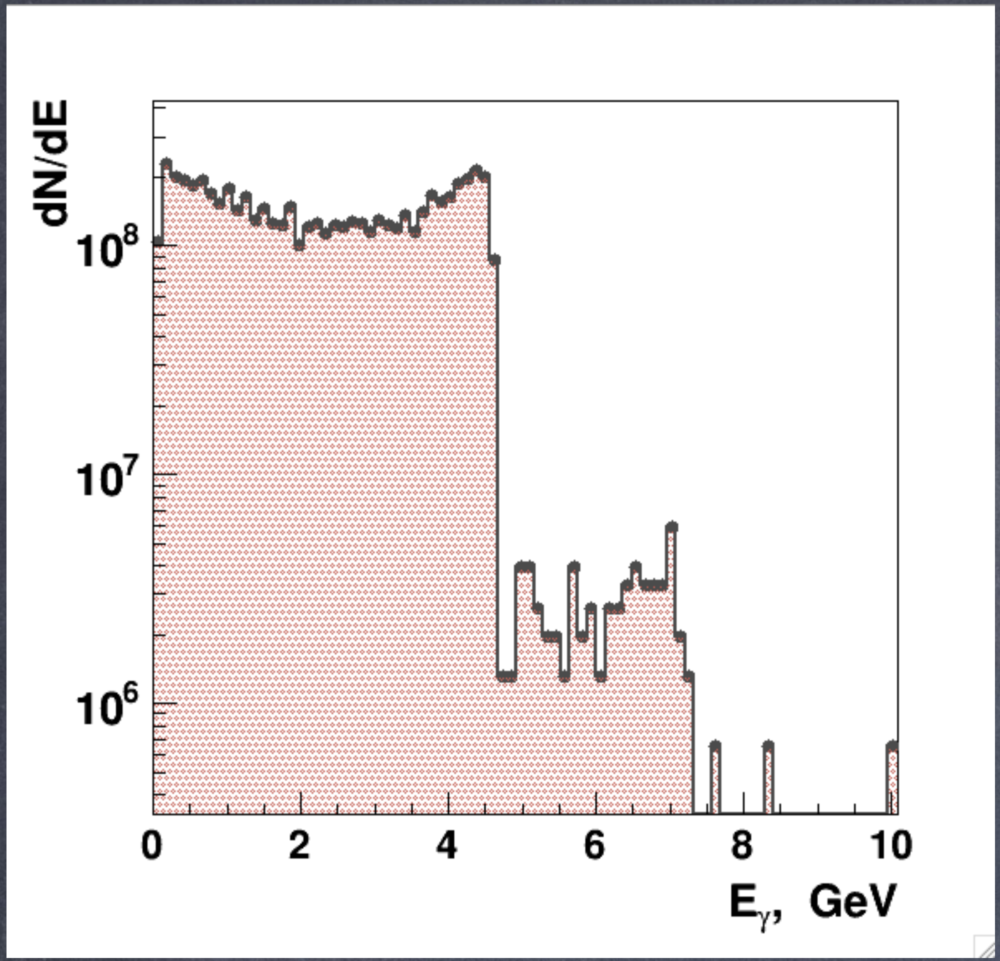
e+/e- from GEANT4

1000 photons from ~ 160
BXW thickness 10 um
e+/e- position on a
distance of 3.5 m from the
magnet (1T):







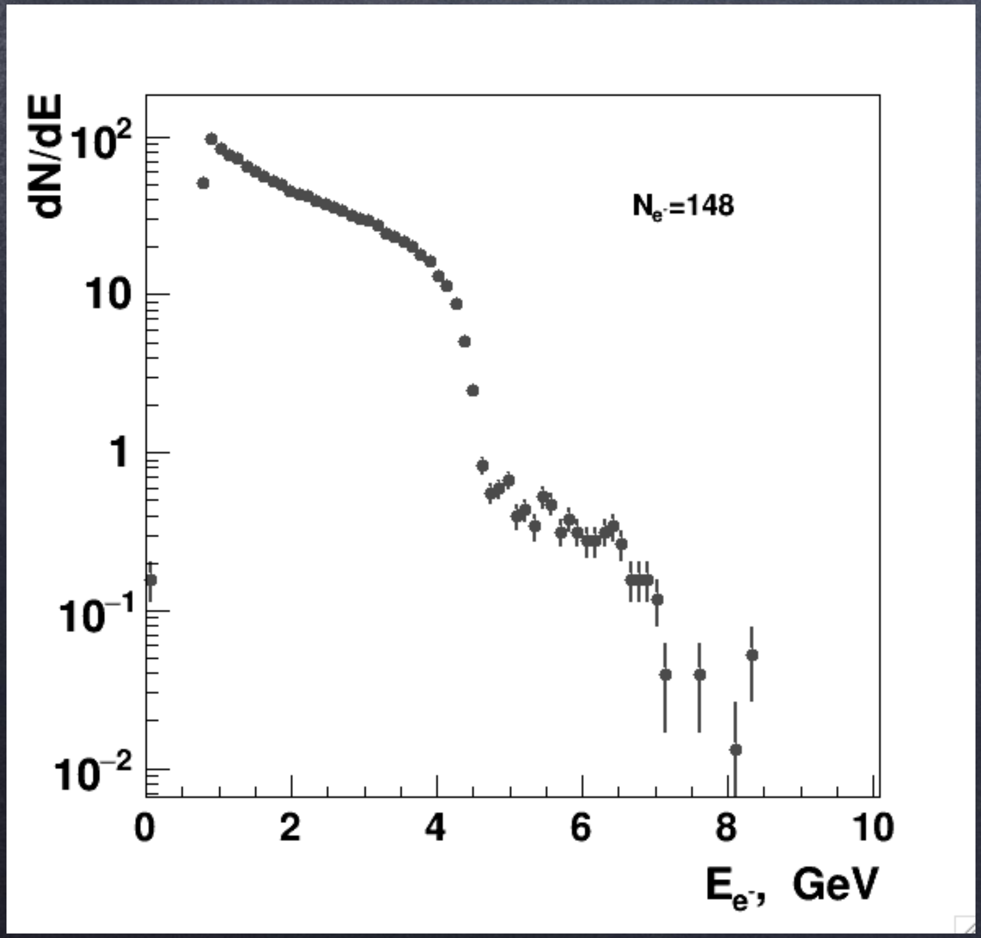


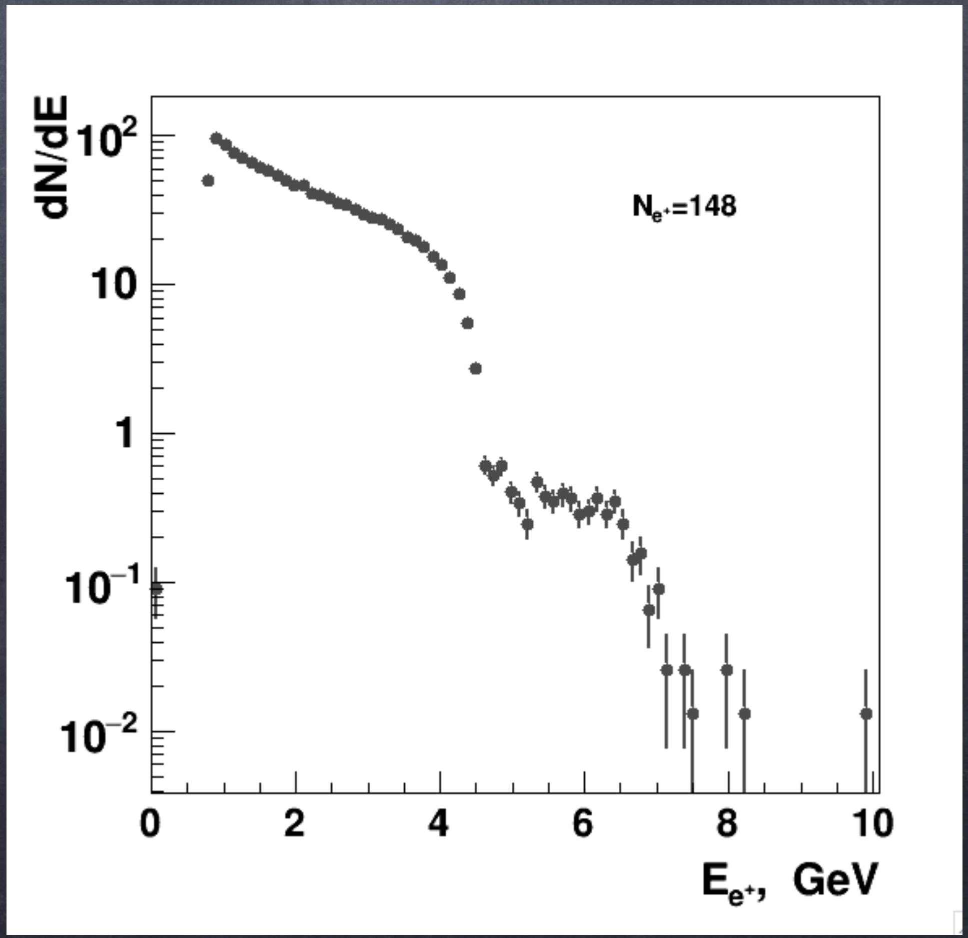
Geant4 simulation for the Ni wire converter spectra

~63000 photons from 10000 BX

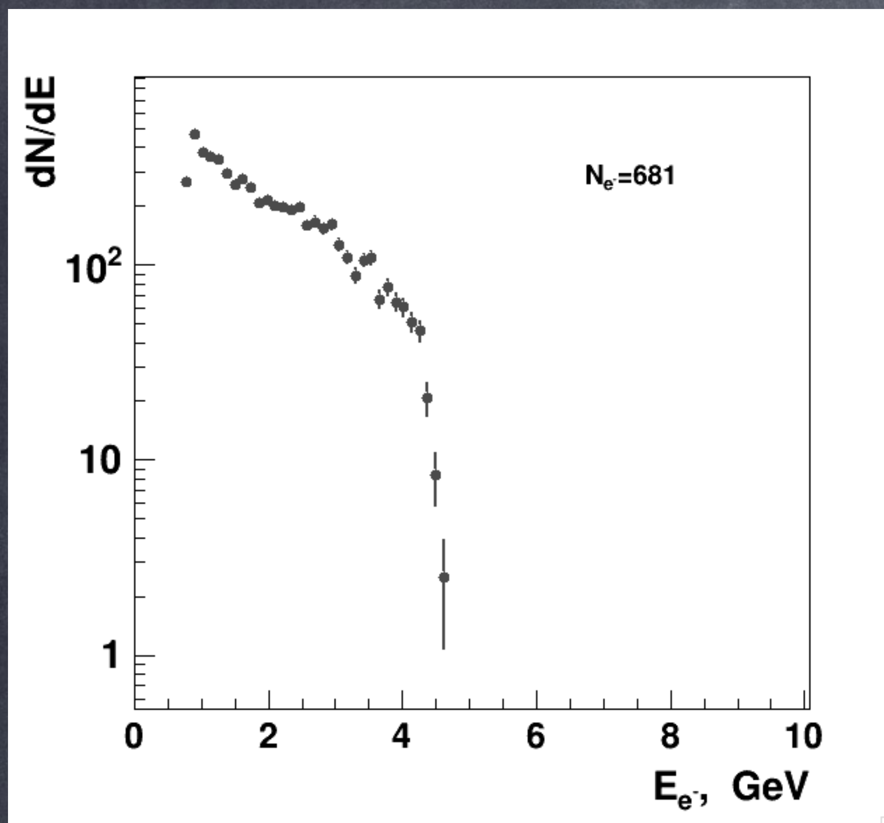
Ni thickness 10 um

d_W, um	Ni, e-
10	148
1	7



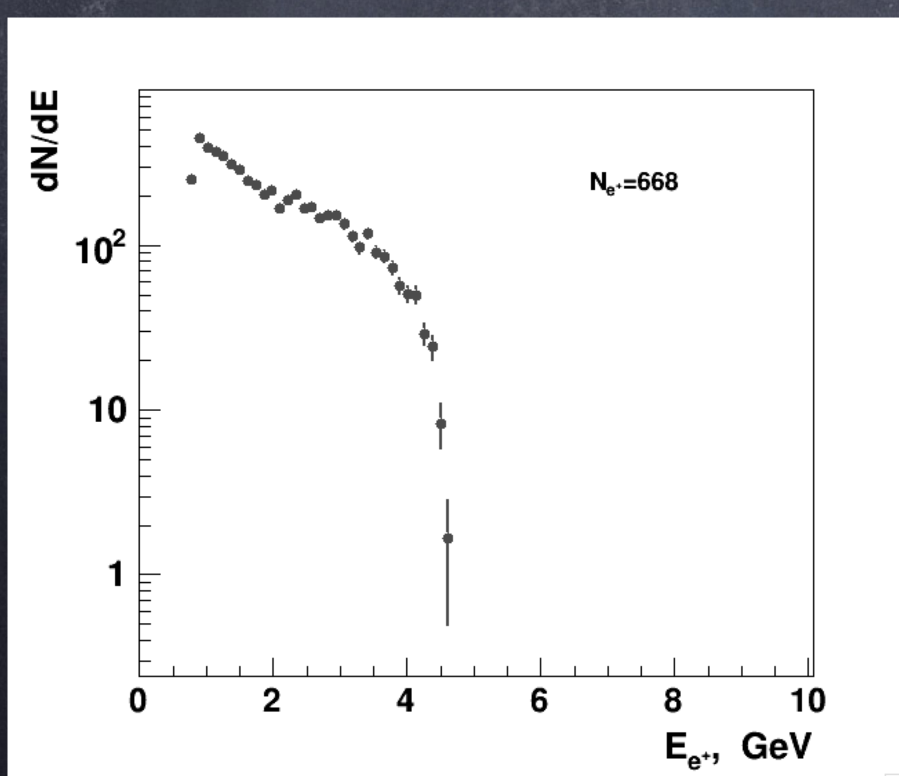


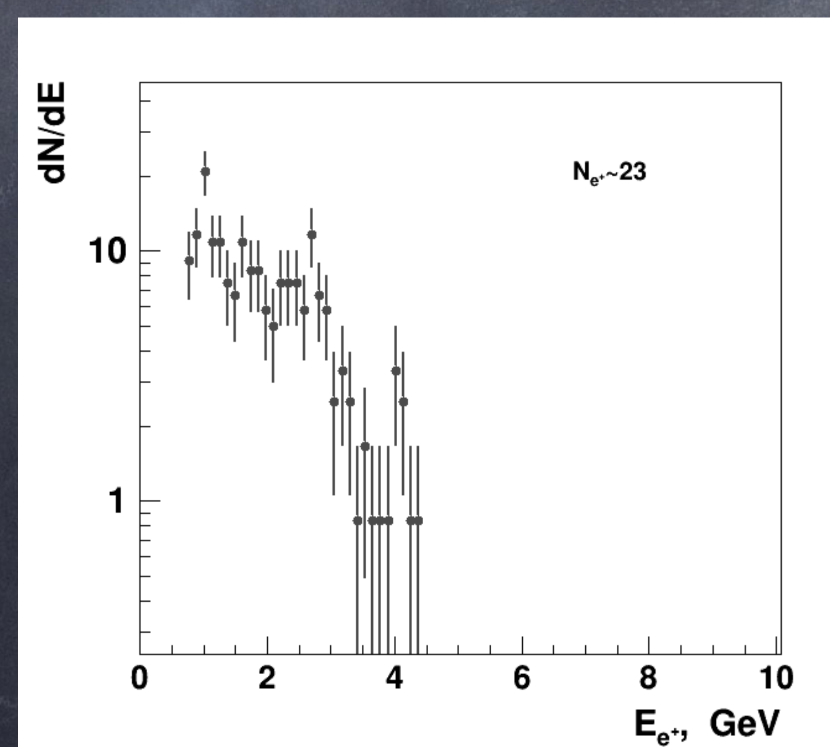
e+/e- spectra for 1 & 5 um wires

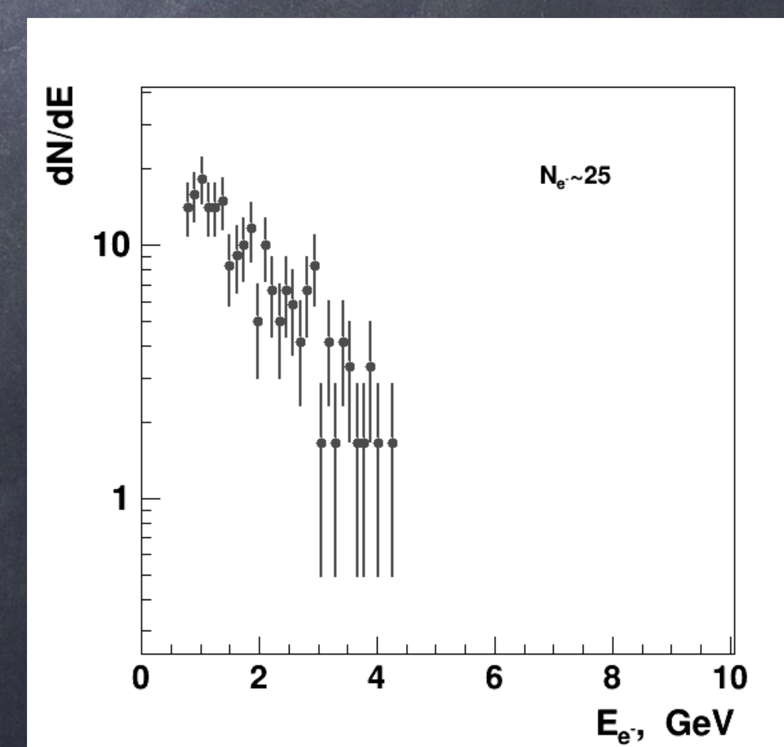


5000 photons from ~ 800 BX

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

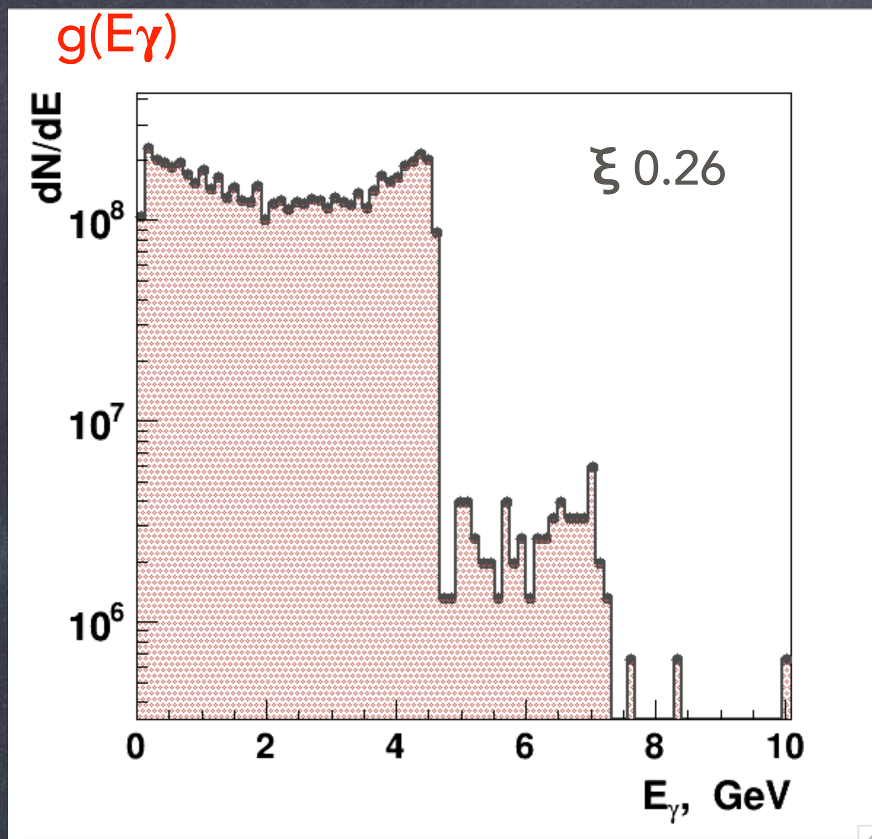


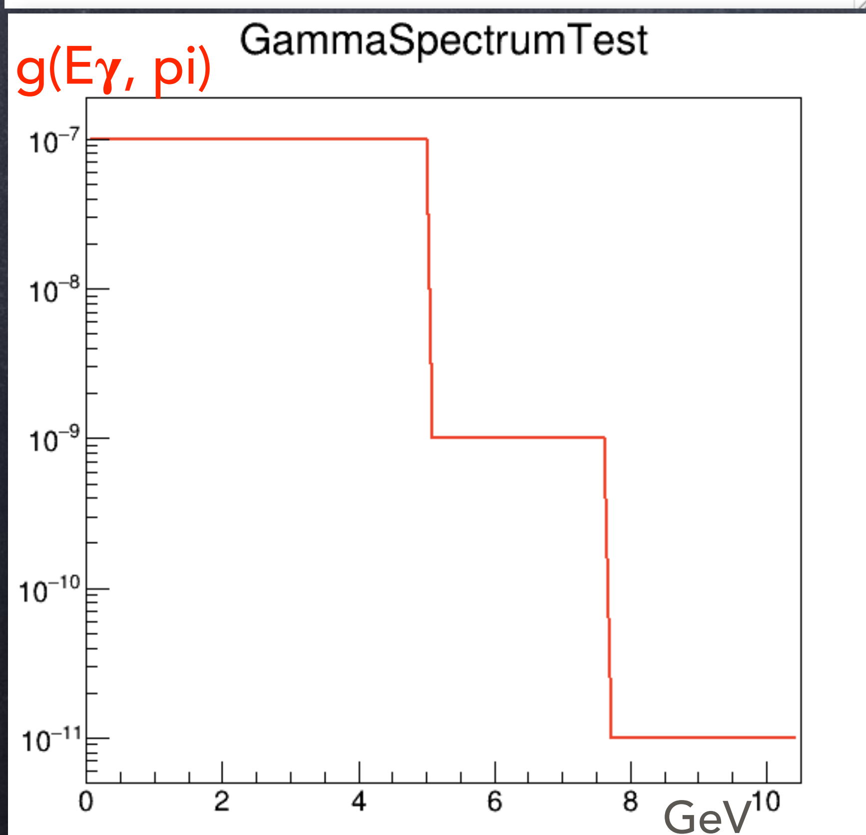




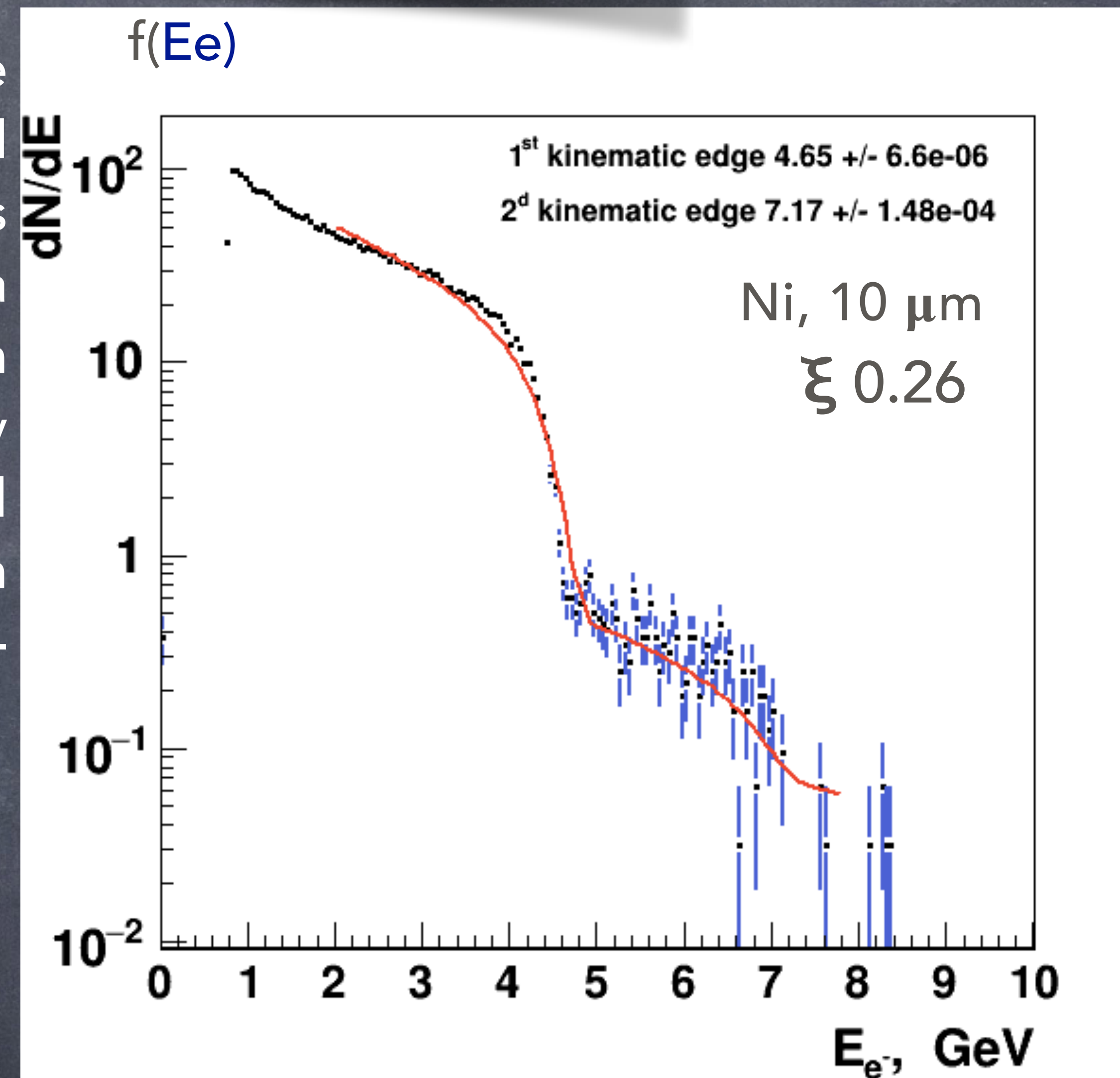
METHOD of photon spectrum restoration

$$f(E_e) = \int \sigma(E_\gamma, E_e)\, g(E_\gamma)\, dE_\gamma$$





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**



$$\int \sigma(E_\gamma, E_e)\, g(E_\gamma, p1, p2)\, dE_\gamma$$

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 detailed geometry in simulations w/ detector implementation (tracker +calorimeter)

- Study background

- Perform the simulation for 14 GeV

Back up

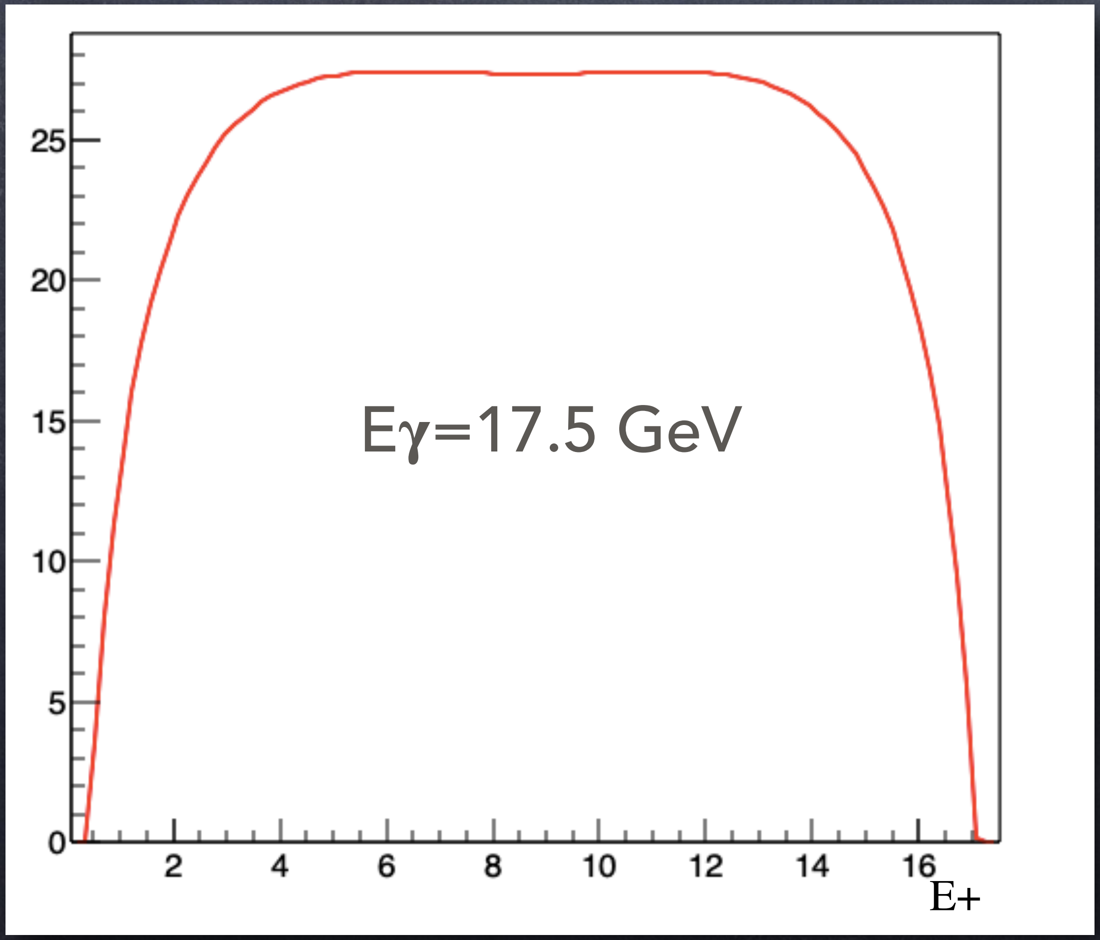
Bethe-Heitler pair spectrum

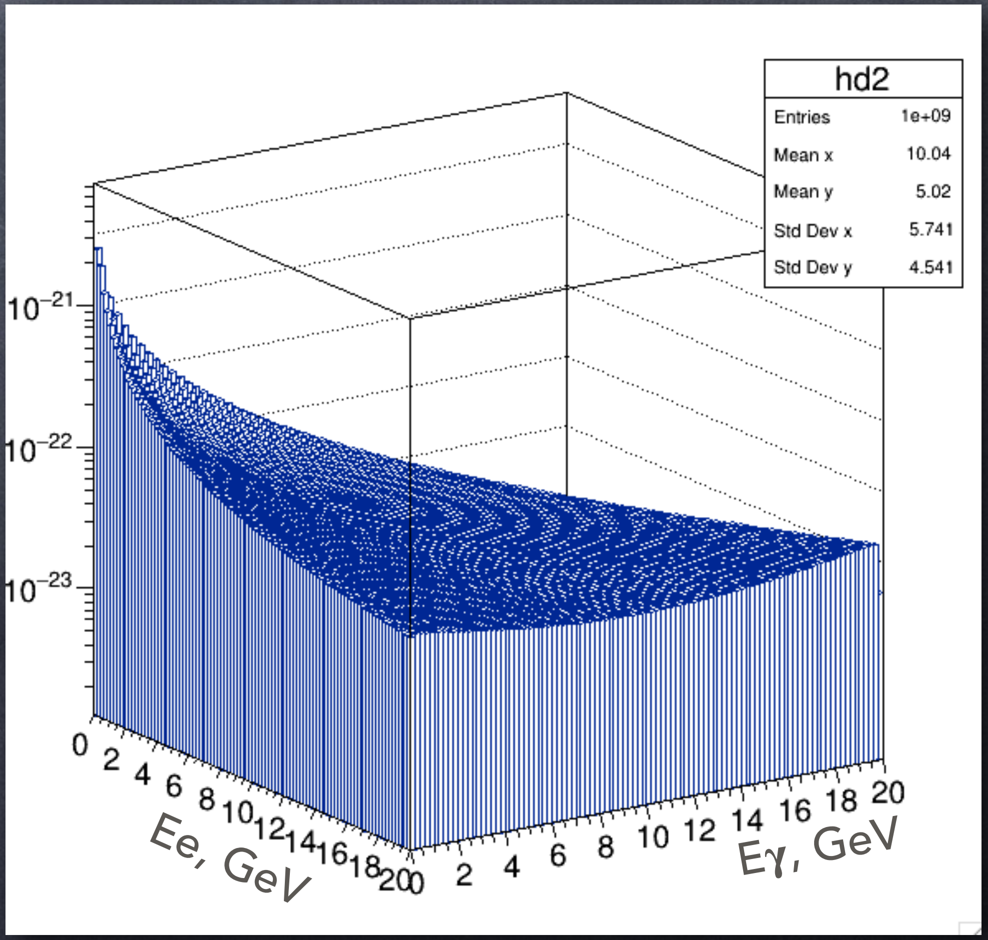
The classical Bethe-Heitler formula (H.Bethe, W.Heitler, Proc.Roy.Soc.A146 (34)83)

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

energies involved are large compared with mc^2

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



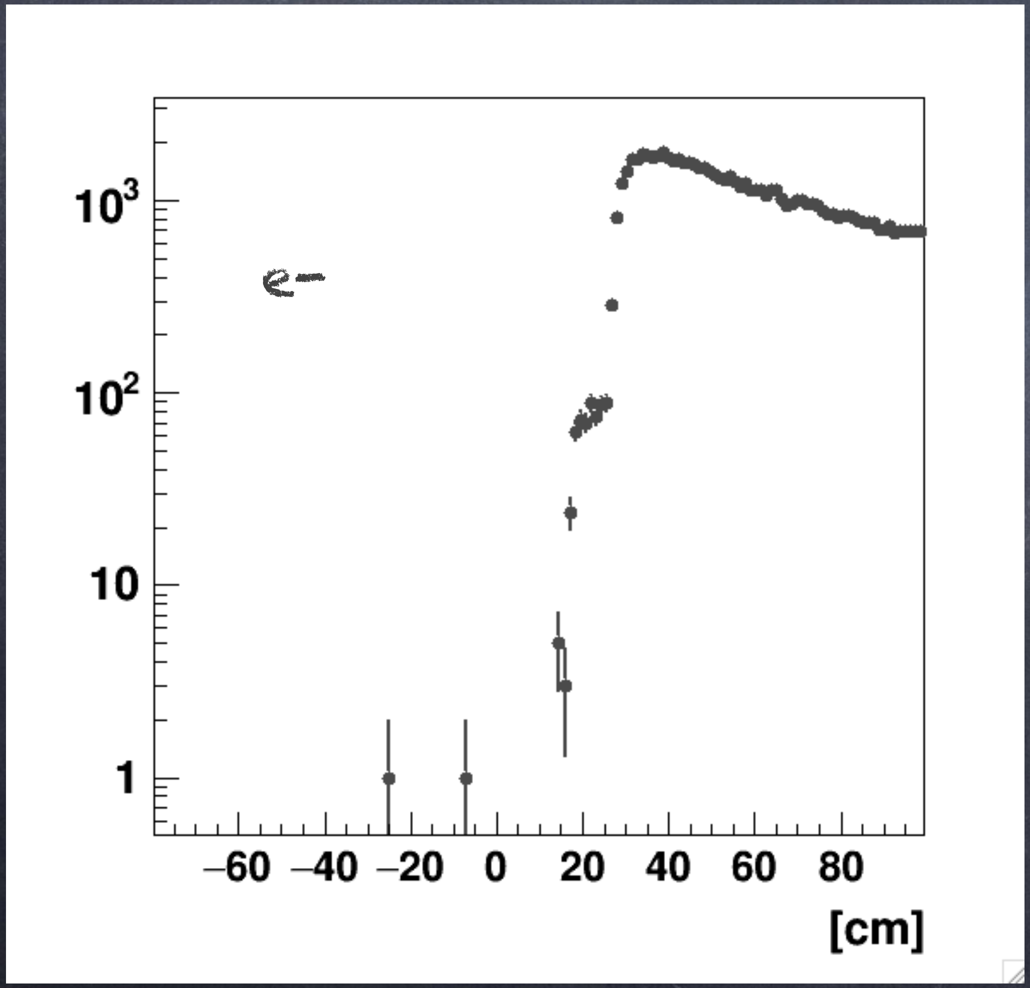


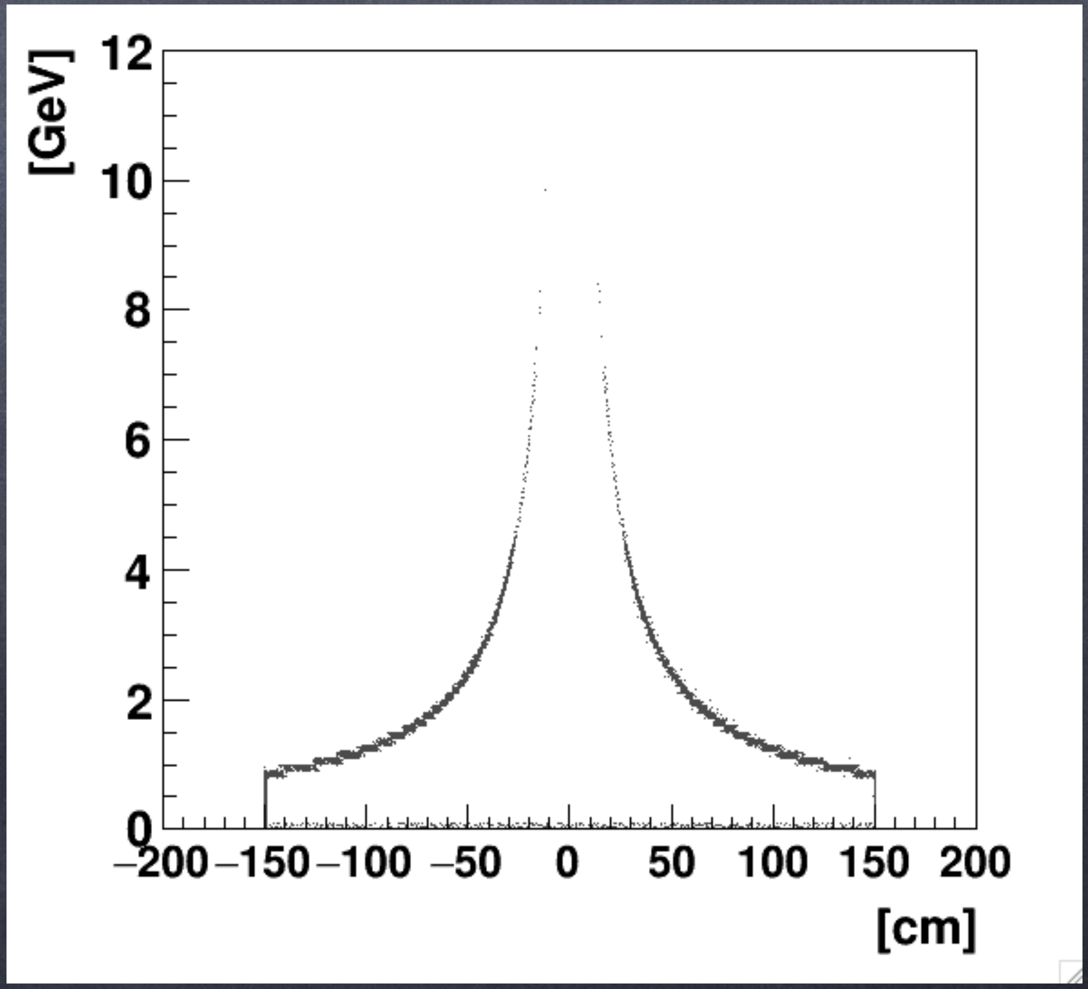
Geant4 simulation for the Ni wire converter

~63000 BX

Ni thickness 10 um

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





ξ vs E_γ from MC