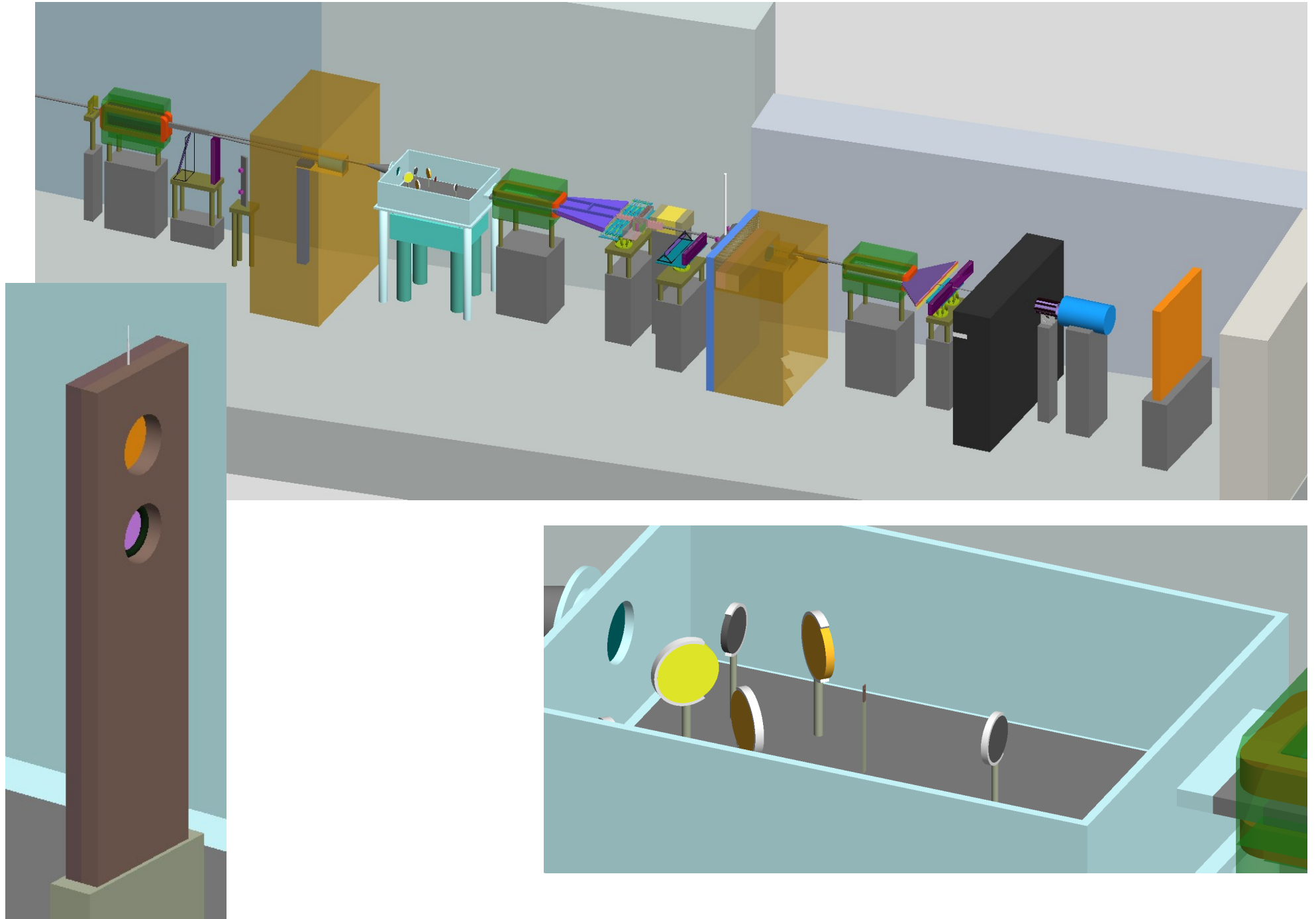


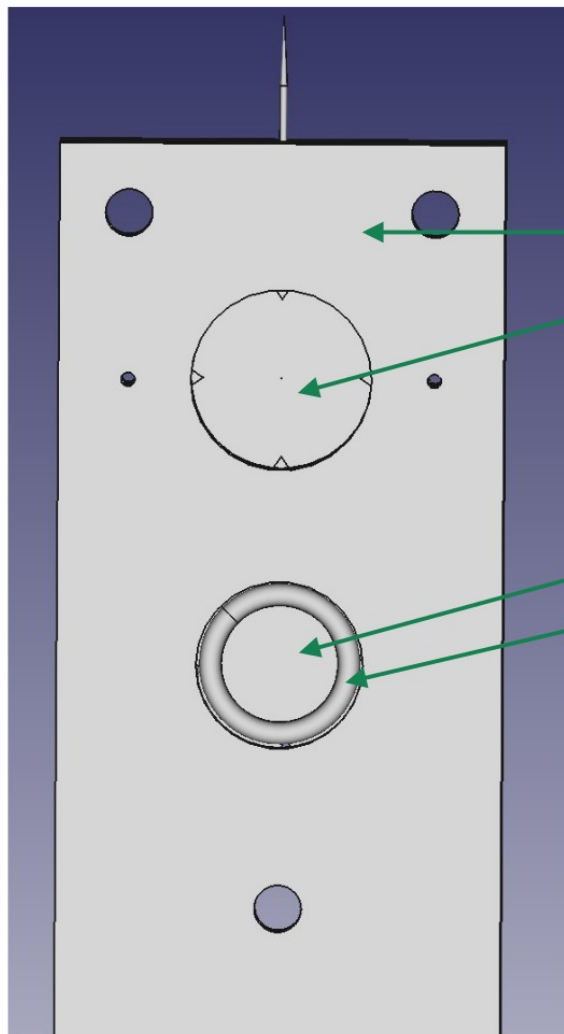
Simulation of LUXE calibration target in GEANT4 Geometry

Oleksandr Borysov

Calibration target implementation



Calibration target CAD

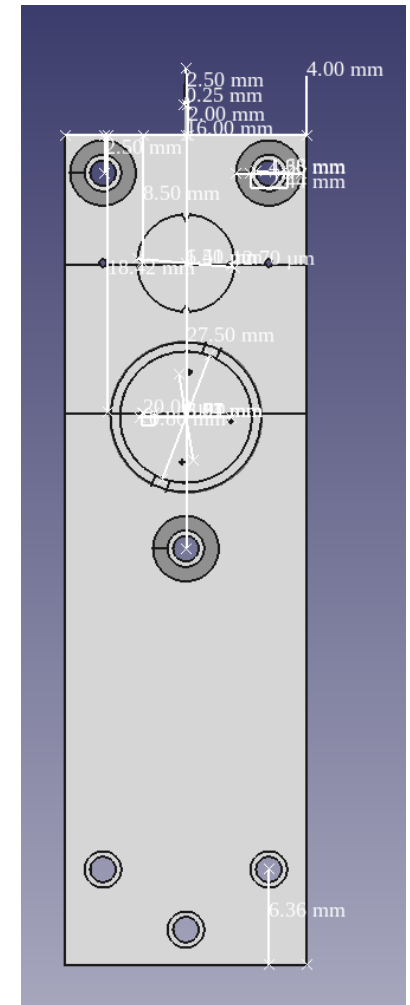


Material_1 ? Frame: Aluminum

Material_2 ? Pinhole: Aluminum

Material_3 ? YAG:Ce scintillation screen

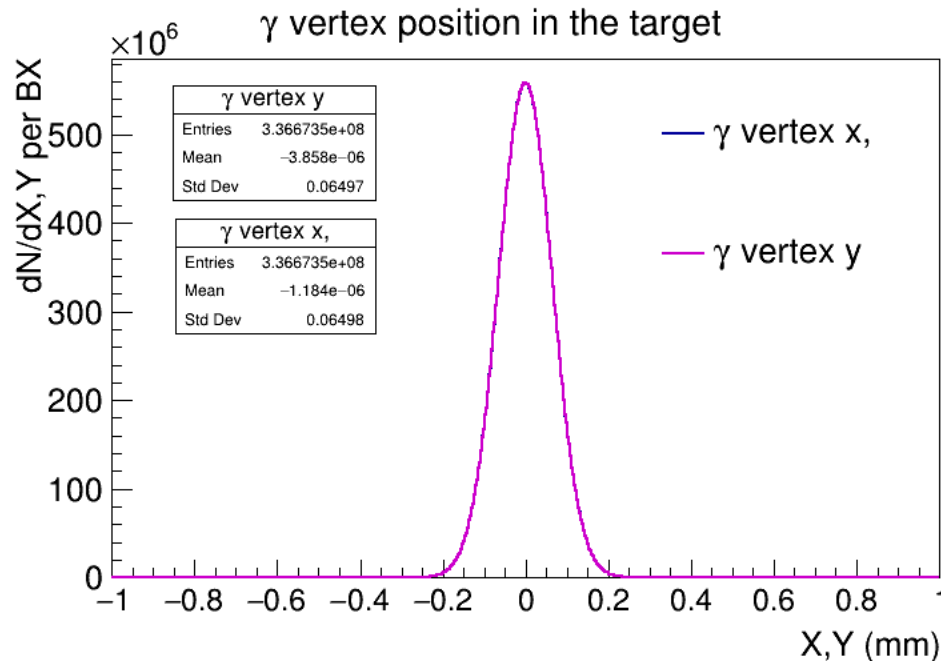
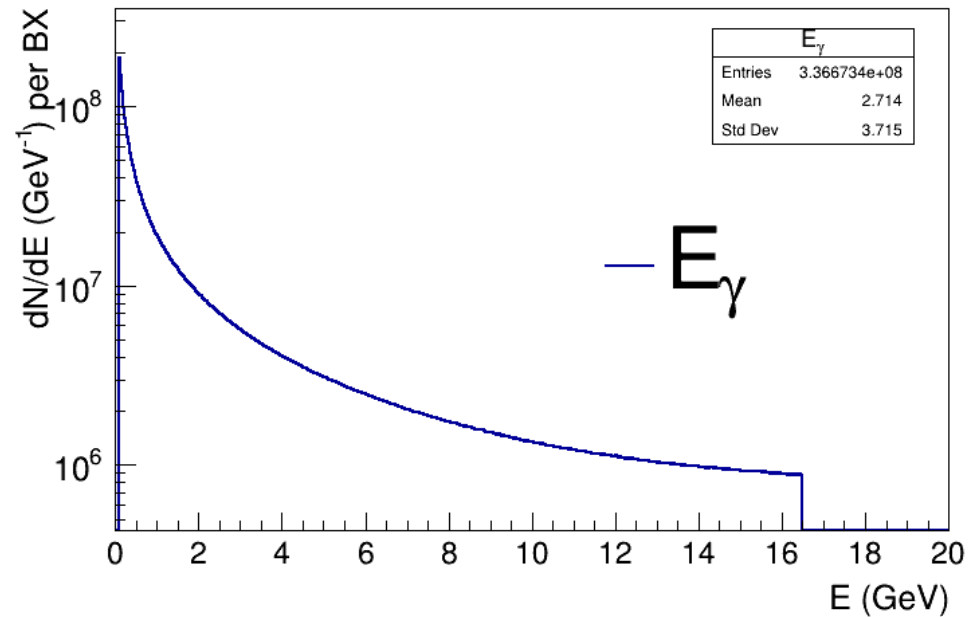
Material_4 ?
O-ring rubber: :NBR 60, but
can be another grade



Bremsstrahlung photons

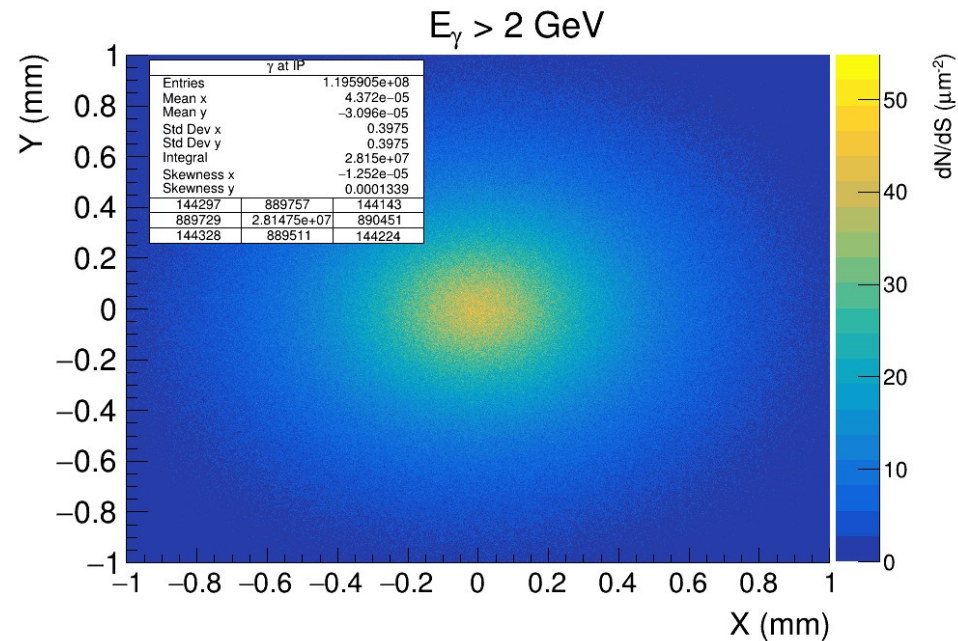
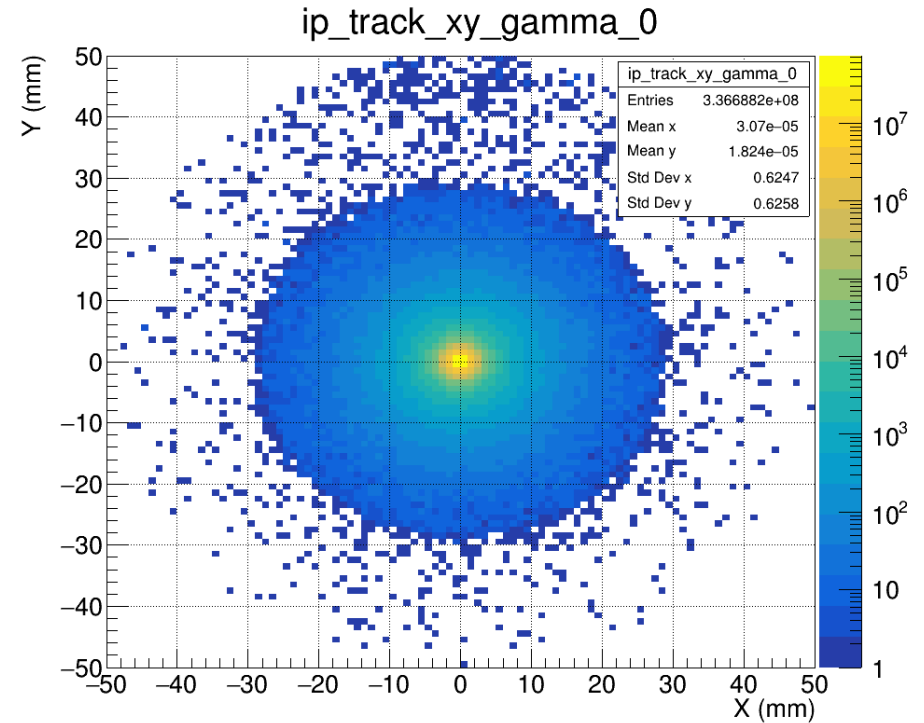
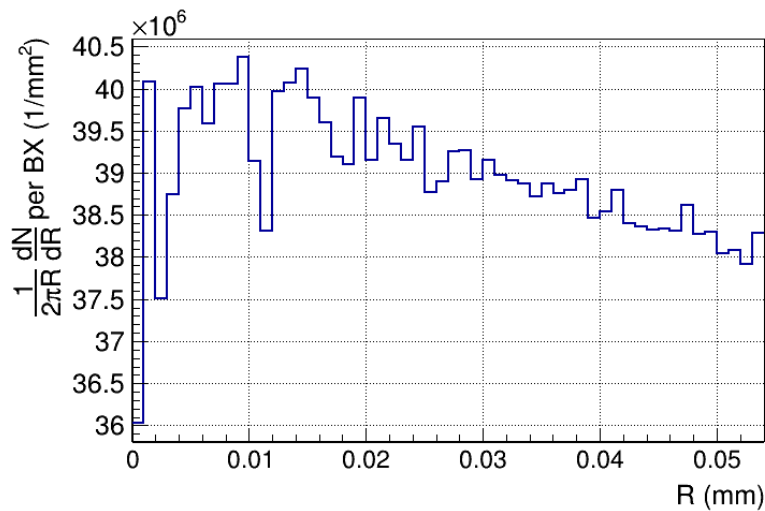
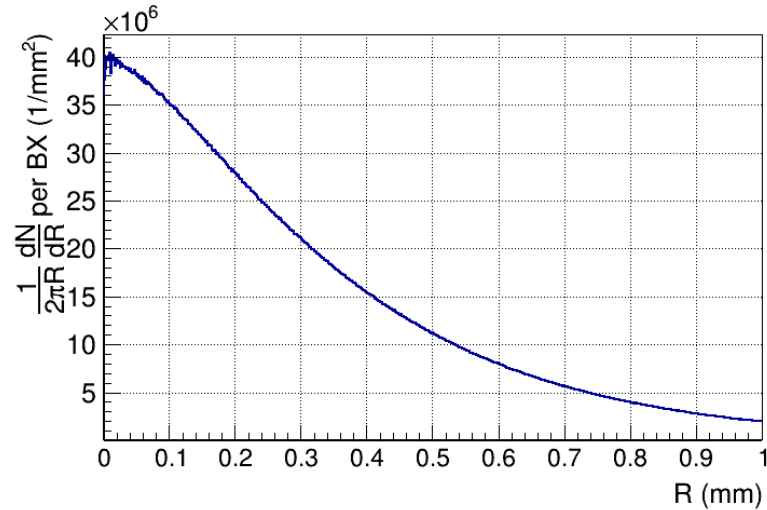
- Simulated 3.7 BX electrons;
- 35 μm tungsten target;
- Particles reaching electron beam dump and shielding are assumed to be absorbed completely (killed);

γ energy spectrum



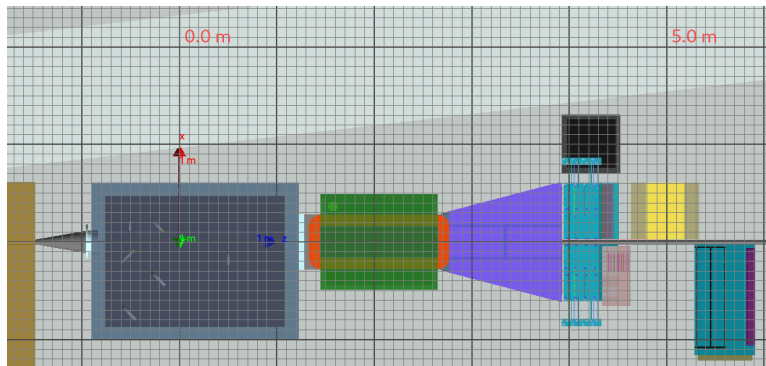
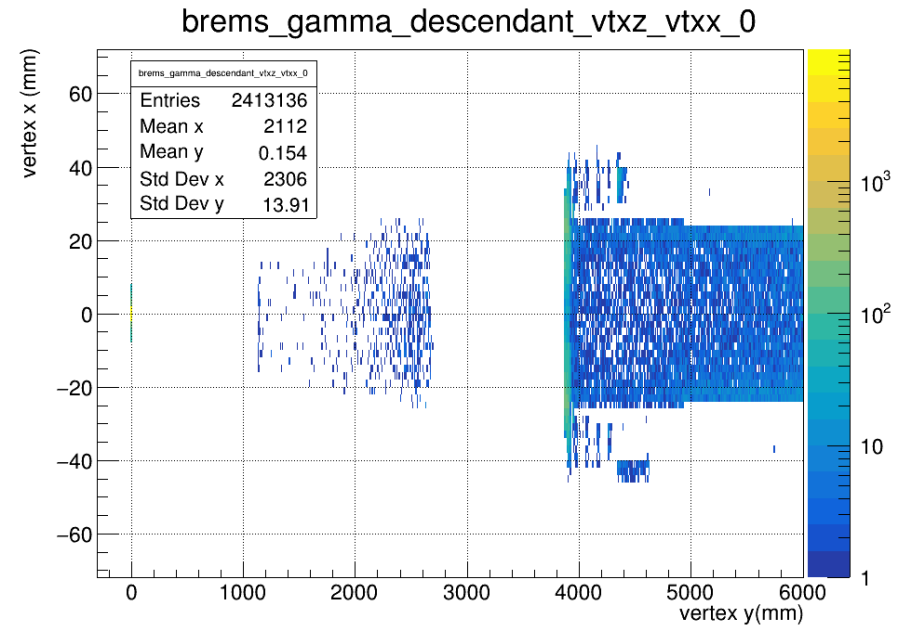
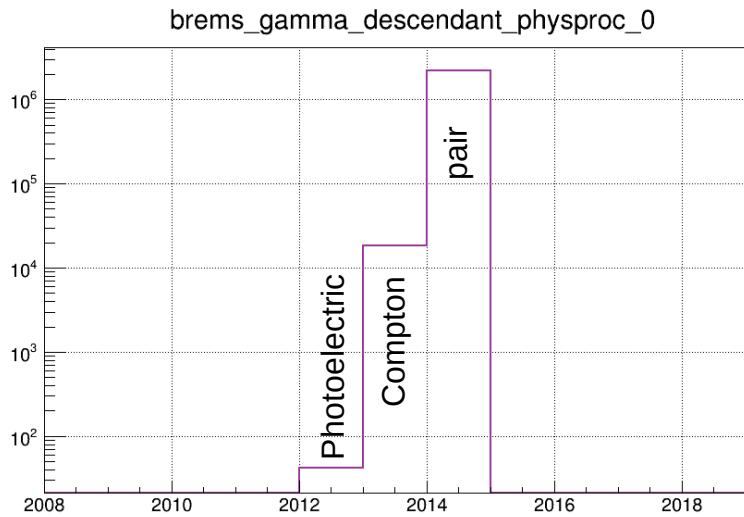
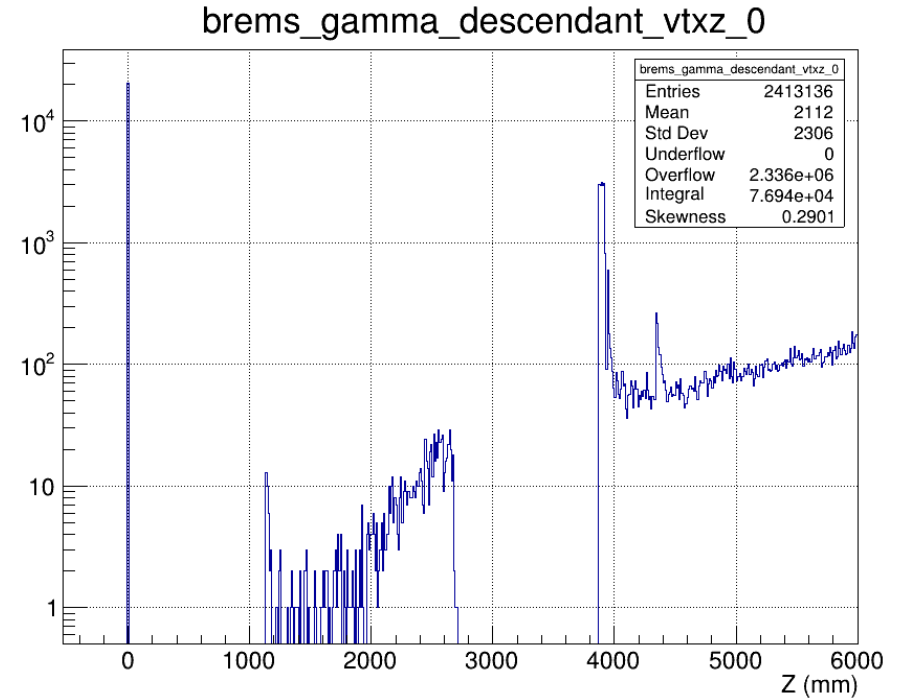
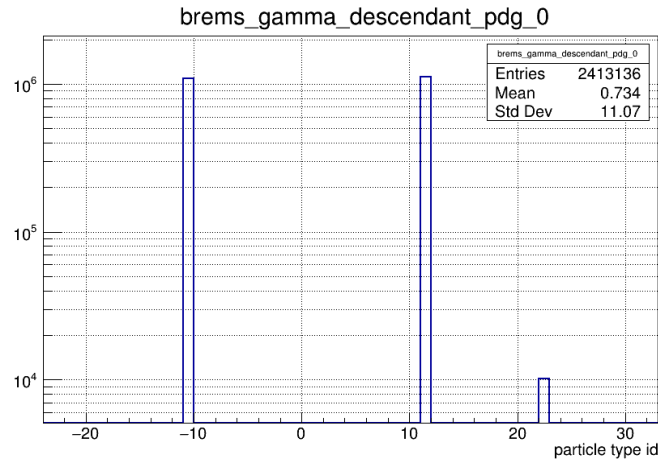
Bremsstrahlung photons position at the IP

About 39 photons per μm^2 in the central area $20 \times 20 \mu\text{m}^2$



Particles created by brems photons

Distributions
are not
normalized

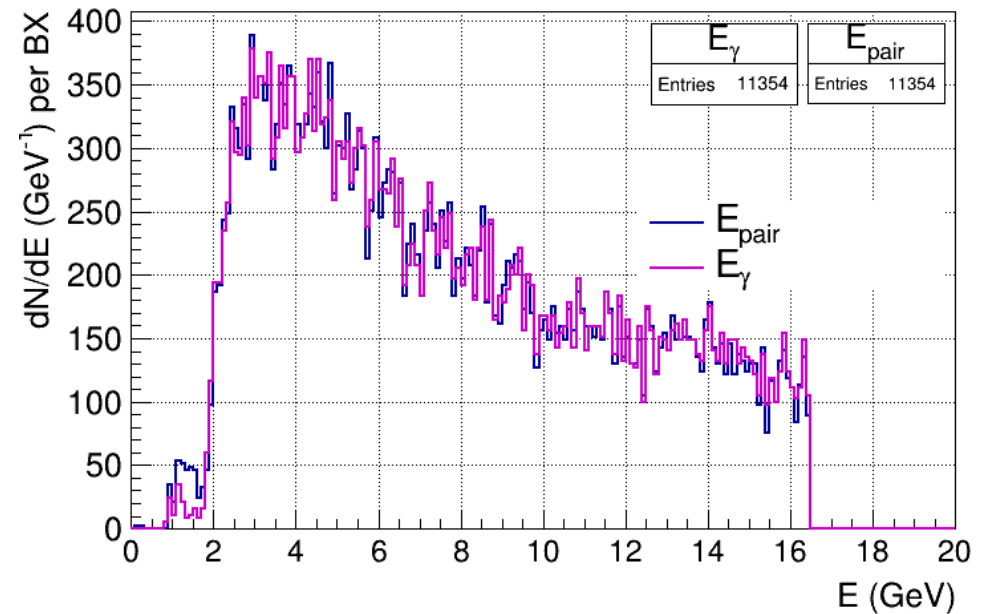


Electron and positron generated by brems photon in the needle

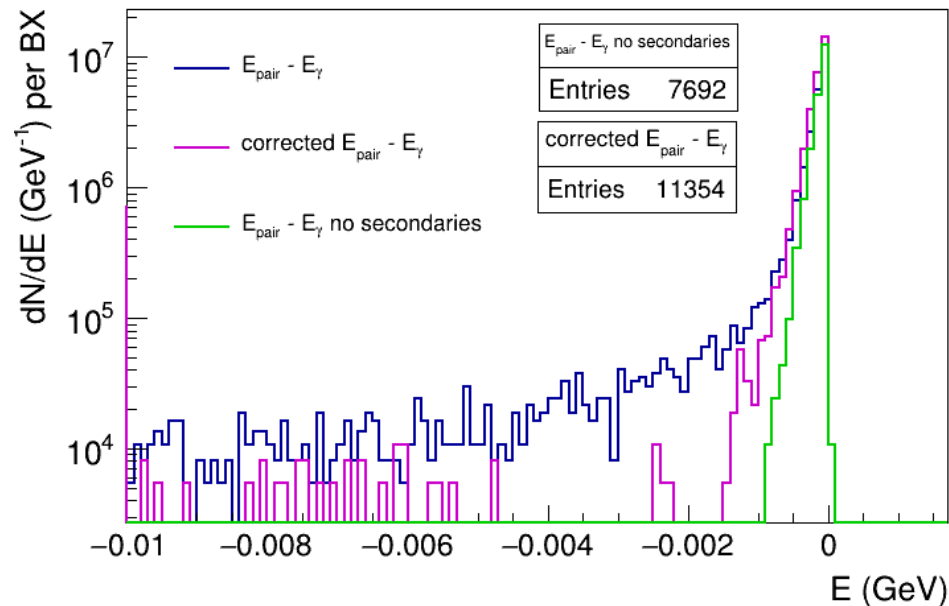
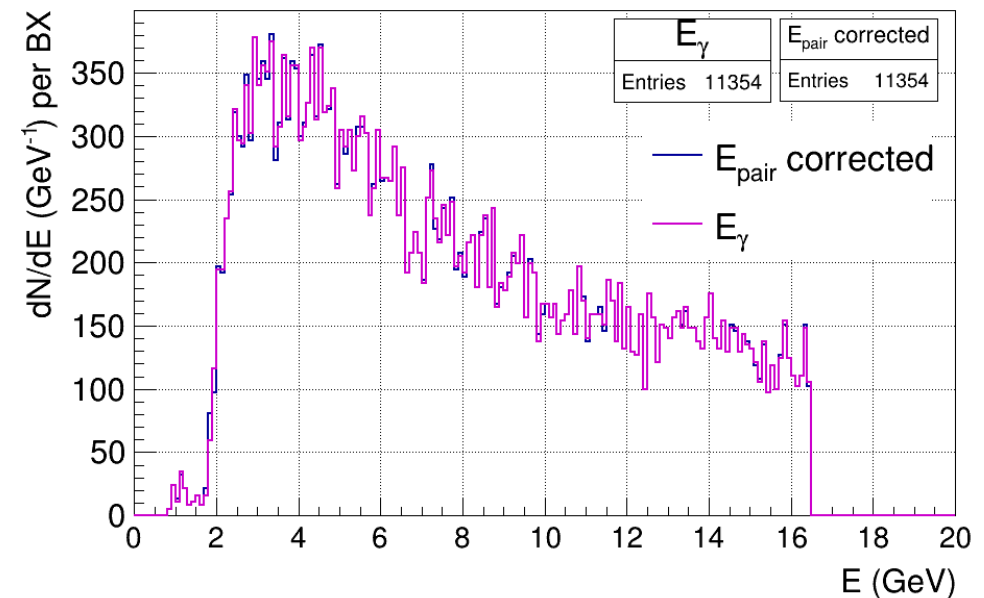
Recorded at the exit of the magnet

Number of pairs matched to photons per BX:
 $11354 / 3.7 = 3065$;

γ and matched pair spectra



γ and matched pair spectra

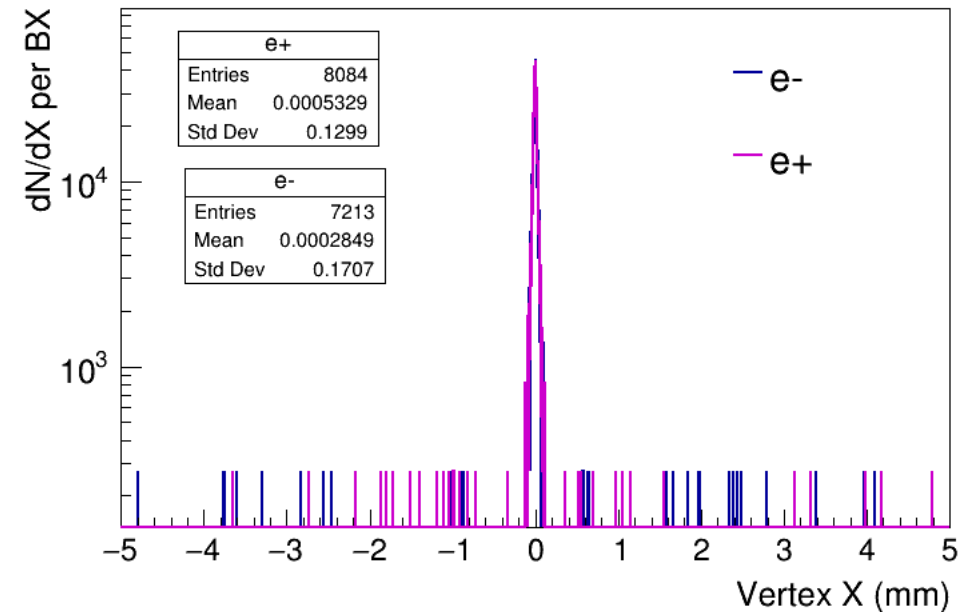


e^- , e^+ generated by photon in calibration target when only one e^- or e^+ found

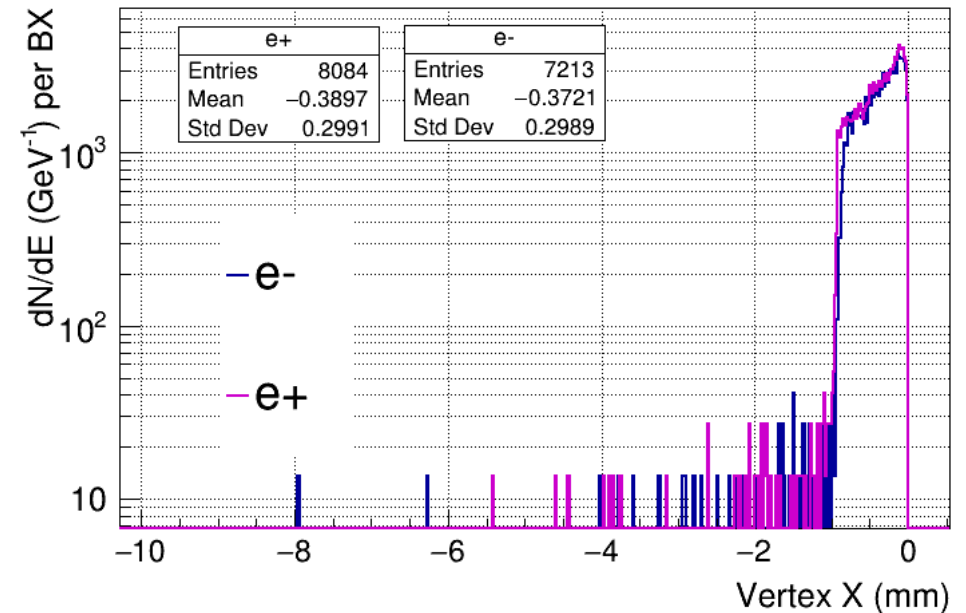
- Missing partner has $E < 1\text{GeV}$, lost in the magnet;
- Number of e^- (e^+) in this case per BX:
- e^+ $8084 / 3.7 = 2182$;
- e^- $7213 / 3.7 = 1947$;

Total expected number of e^+ , e^- is
 $\sim 5\text{k}$ per BX

Vertices when no matching found

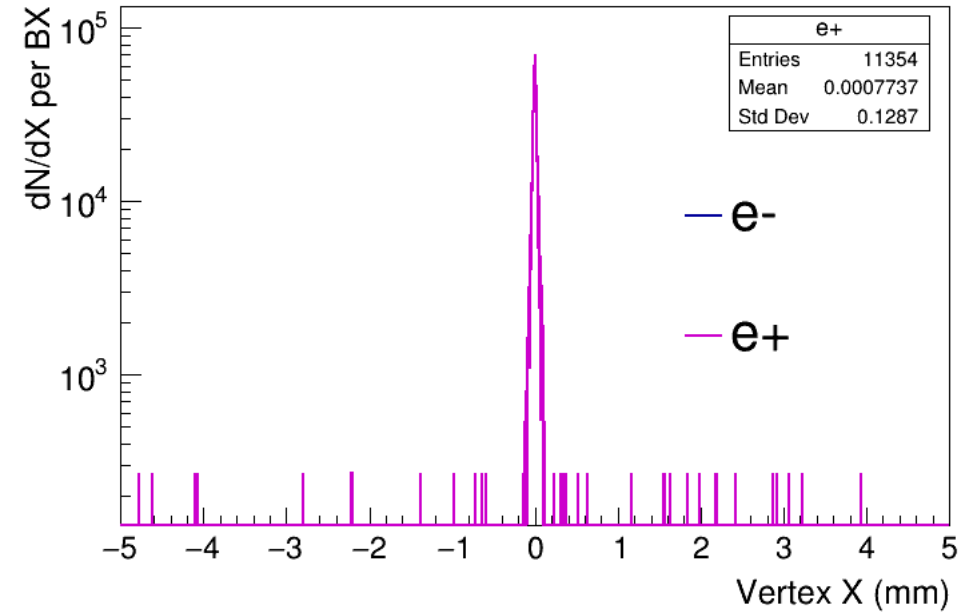


$(E_e - E_\gamma)$ - Energy of the missing pair partner

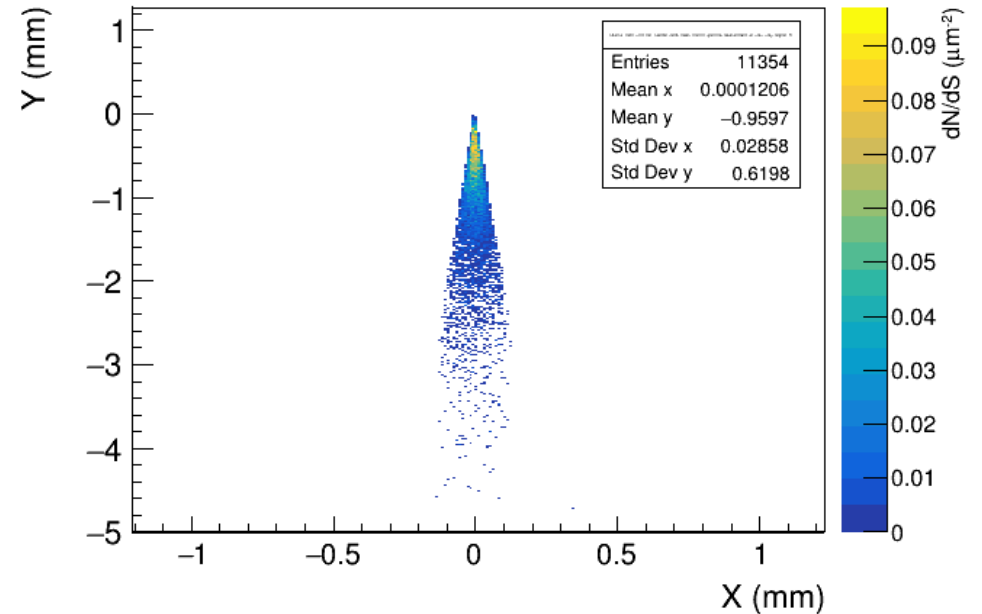
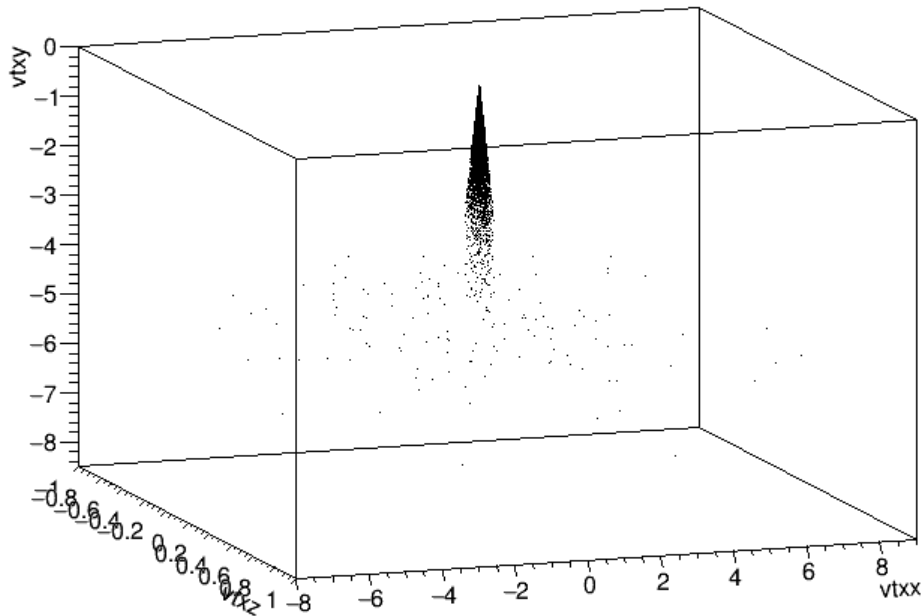


Vertices position of $\gamma \rightarrow e^+e^-$

Vertices in the calibration target



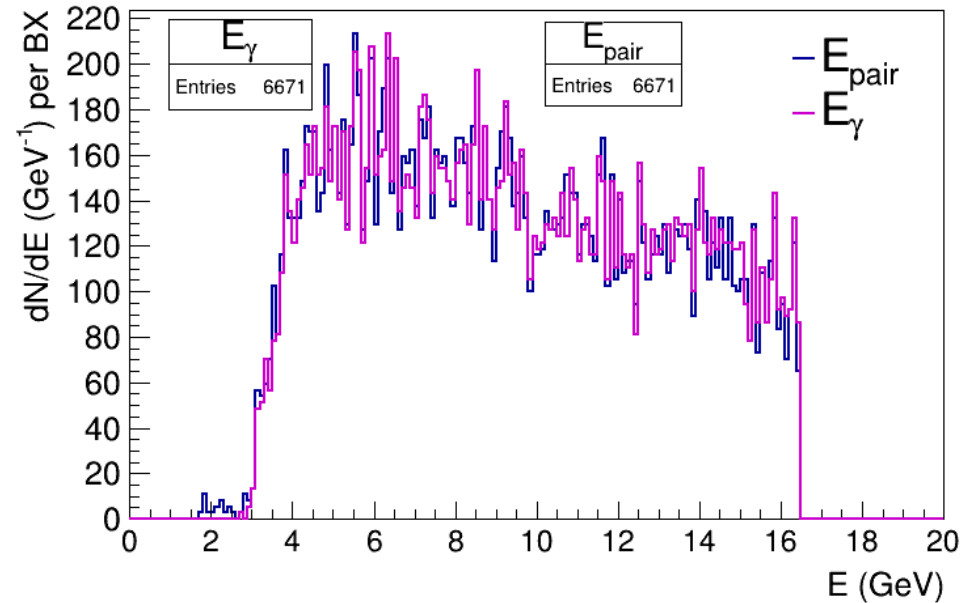
vtxy:vtxx:vtxz {(detid==1000 || detid==1008) && abs(pdg)==11 && fabs(vtxz)<1.0}



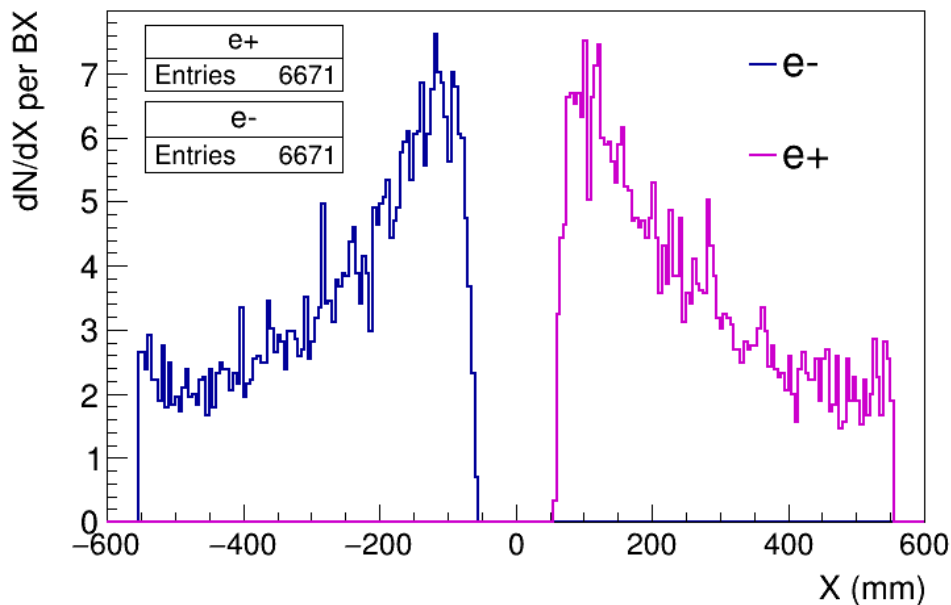
e^+ , e^- in tracking layers

Number of pairs matched to photons per BX
and observed in tracking layers:
 $6671 / 3.7 = 1800$;

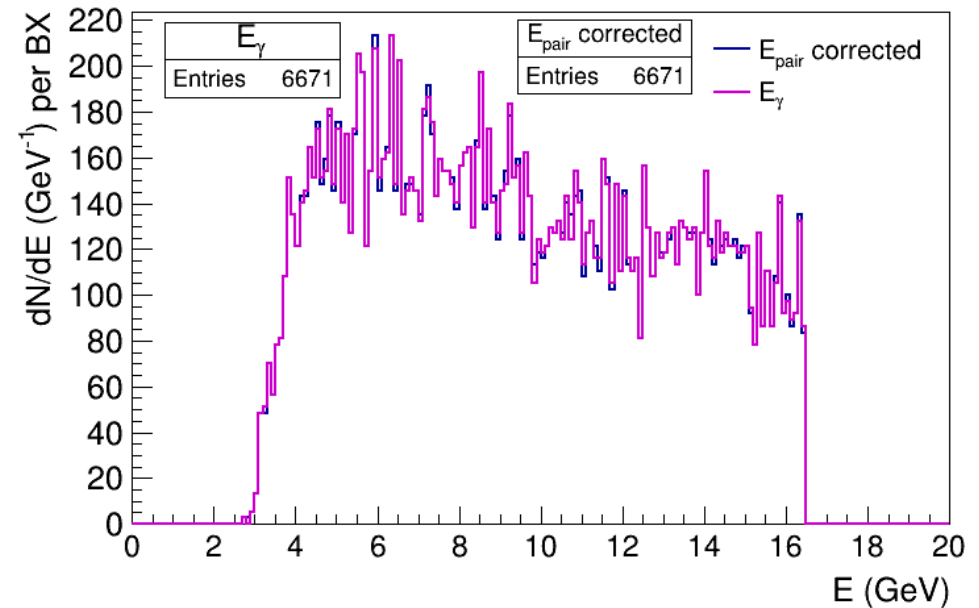
γ and matched pair spectra



$e^- e^+$ position in tracking layers



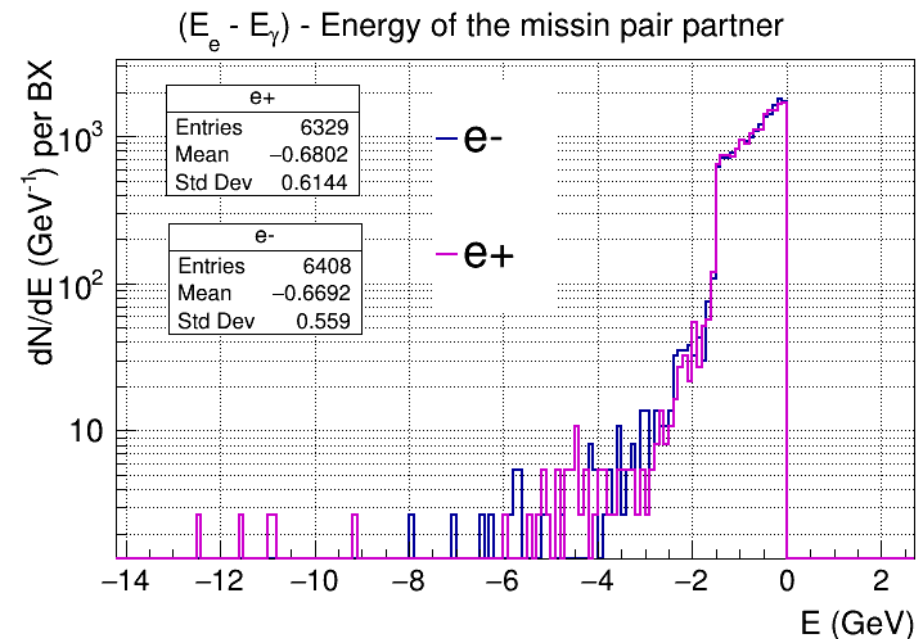
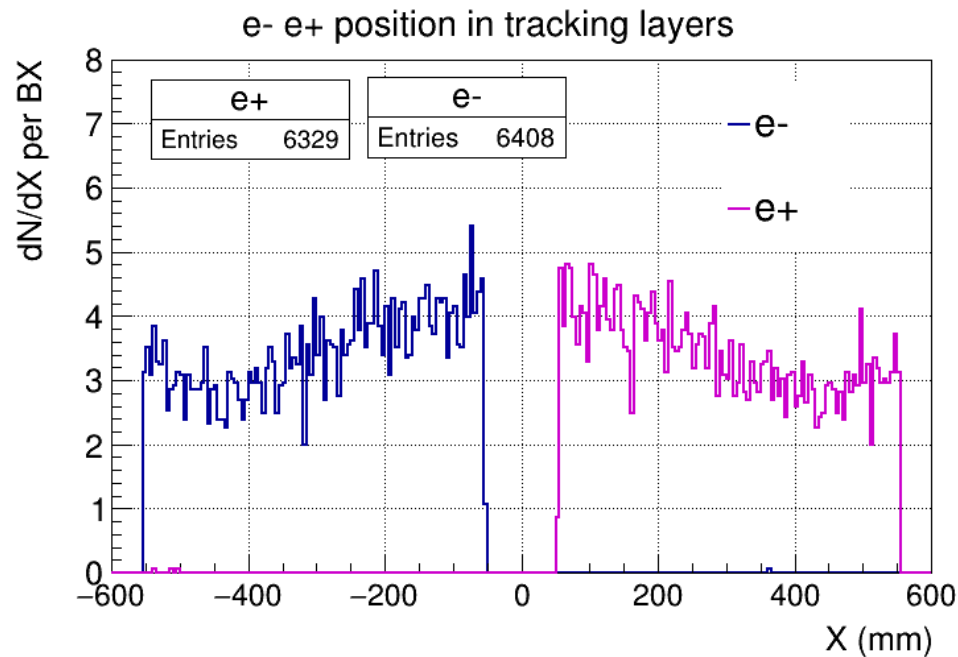
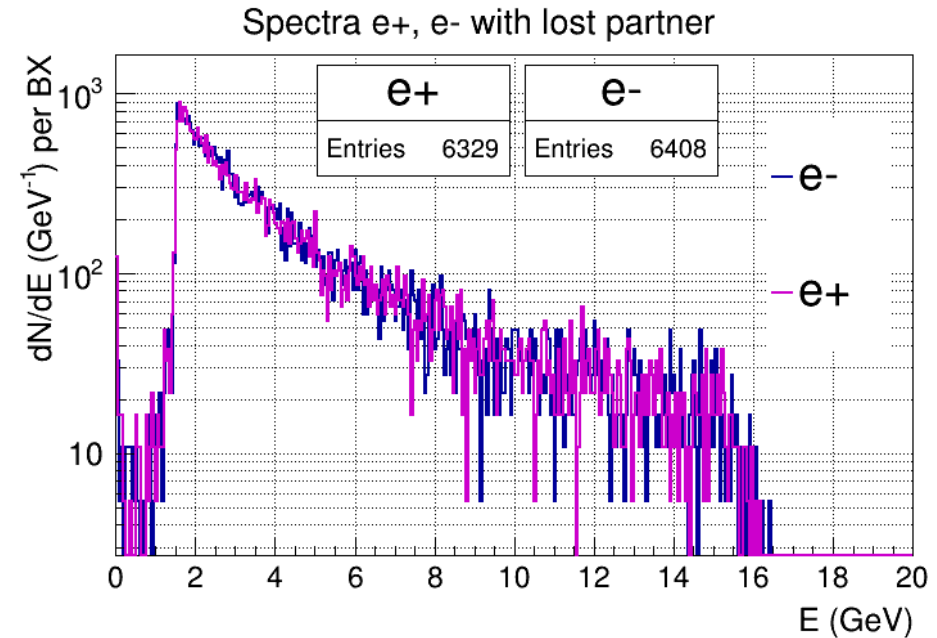
γ and matched pair corrected spectra



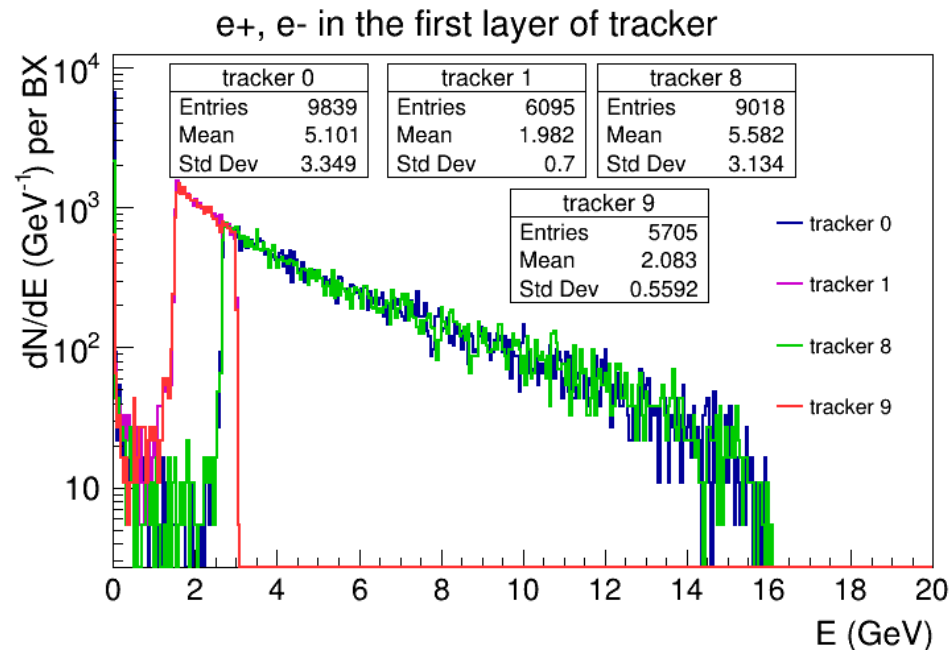
e^- , e^+ generated by photon in calibration target when only one e^- or e^+ found in tracker

Number of e^+ , e^- per BX observed in tracking layers, when only one particle of the pair reach the detector is around:
 $6400 / 3.7 = 1728$;

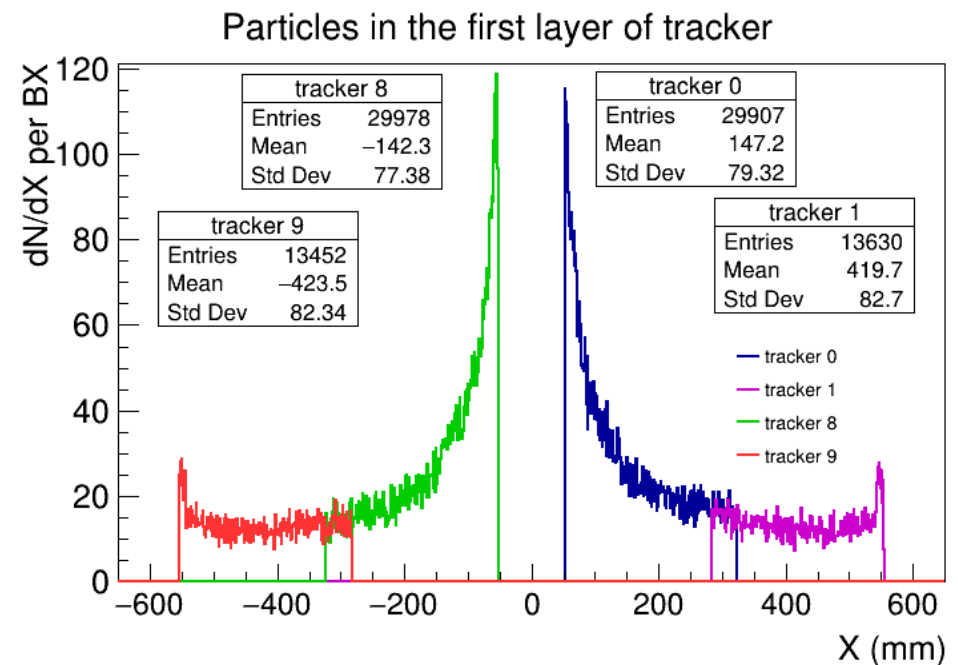
Total expected number of e^+ , e^- is
 $\sim 3.5\text{k}$ per BX



Particles crossing front layers of the tracker



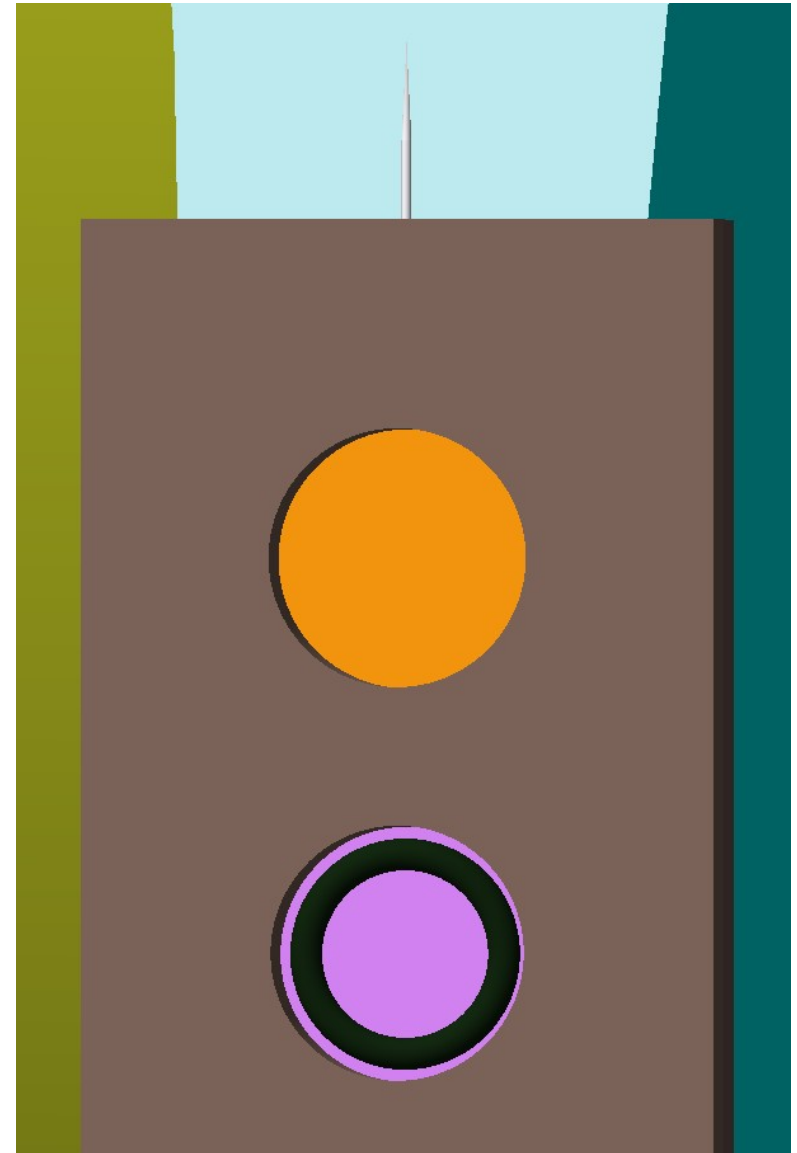
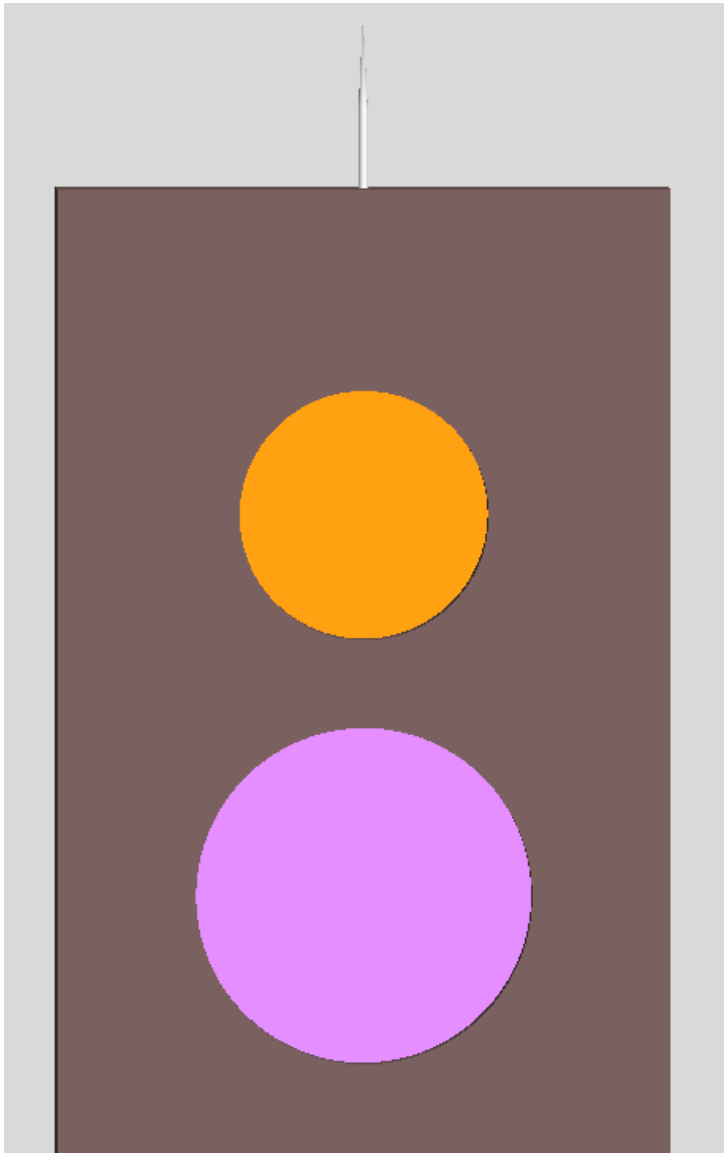
There are ~15% of electrons and positrons hitting tracker which are not particles from the target produced by brems photon.



Summary

- For the XFEL beam and bremsstrahlung 35 μ m tungsten target installed ~7.5m upstream of IP the calibration target with tip aligned with the beam produces:
 - about 1800 $e^+ e^-$ pairs both of which can be matched to the parent bremsstrahlung photon;
 - In addition there are about 1700 e^+ or e^- where one of the partner is missing. Missing e^+ or e^- have energy below ~1.9 GeV and can not reach detectors (tracker);
- Recorded information in Ecal, Profiler, Gamma spectrometer, Backscattering calorimeter, all Screens and Cherenkovs and BSM.

Calibration target CAD



Detectors where the secondary particles generated by brems photons were observed

