LUXE calibration target in GEANT4 Geometry

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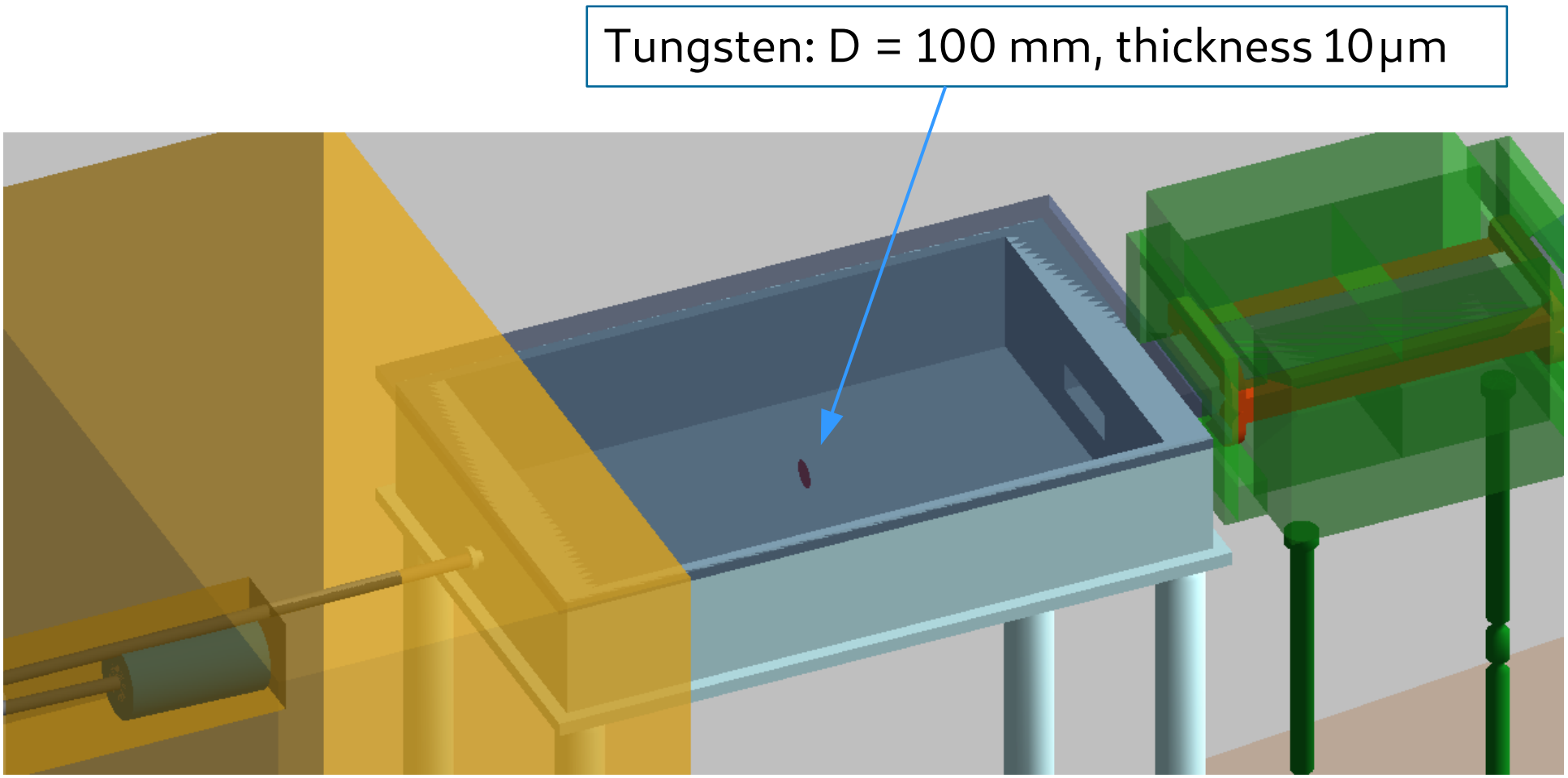
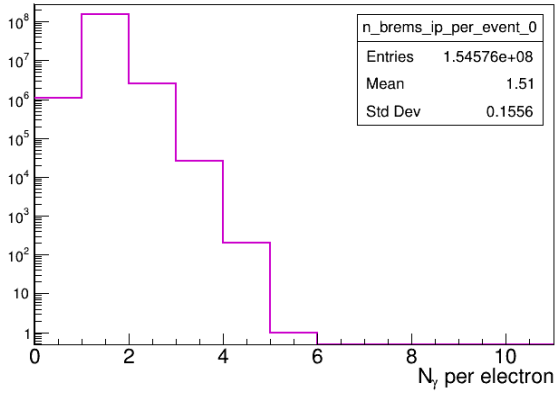
Target for calibration in γ-laser setup

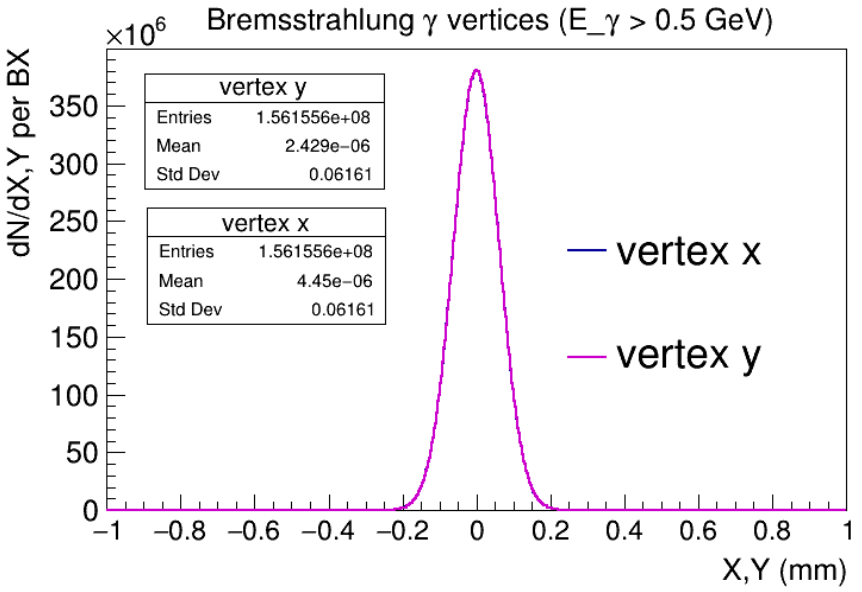
Simulated 3.988e9 primary electrons (2.66 BX)

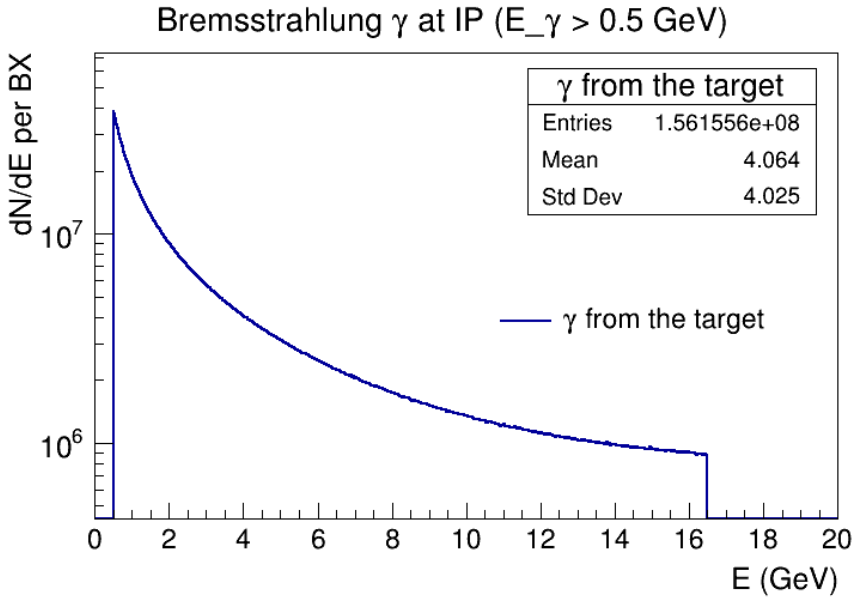


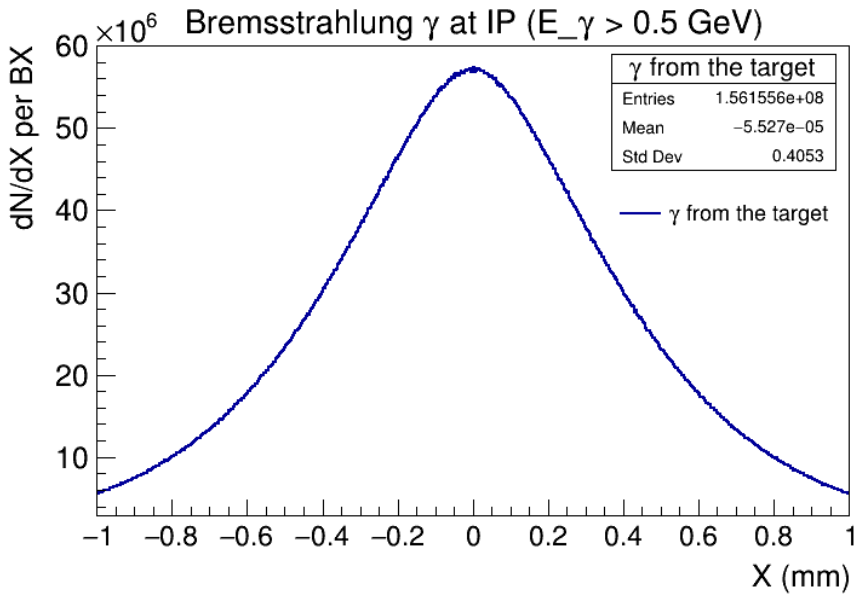
Bremsstrahlung photons at IP

- Photons produced by primary electron in the target;
- Actually vertices are not observed in any other place.





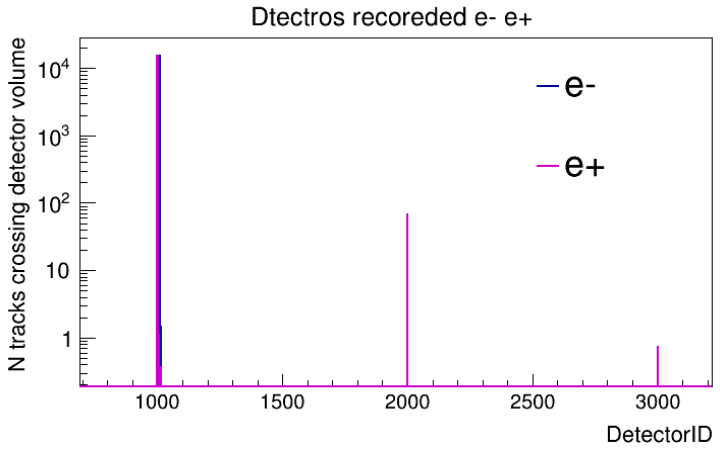


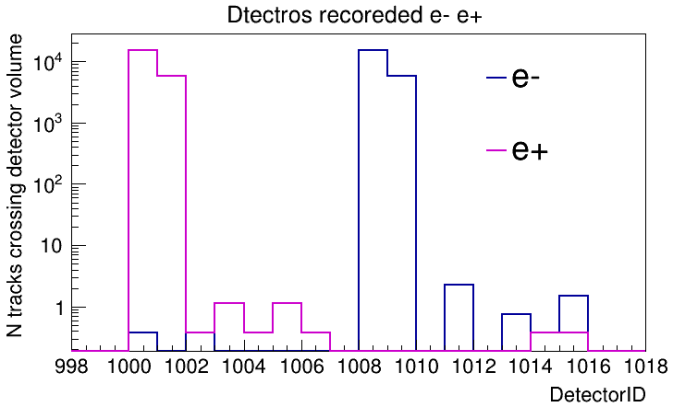


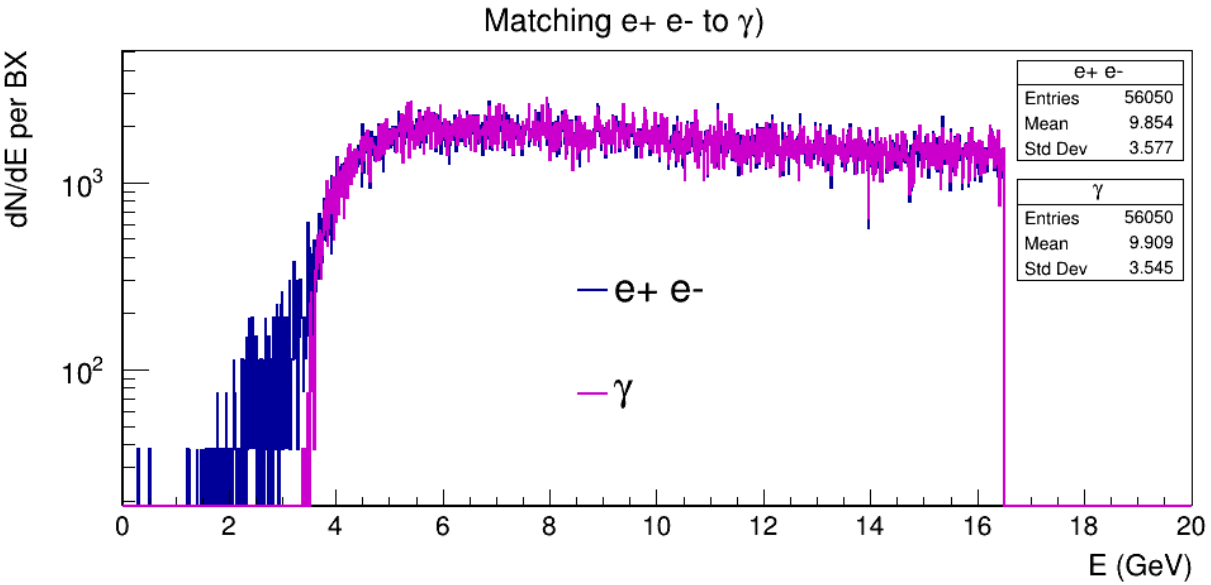
Matching e+e- to γ

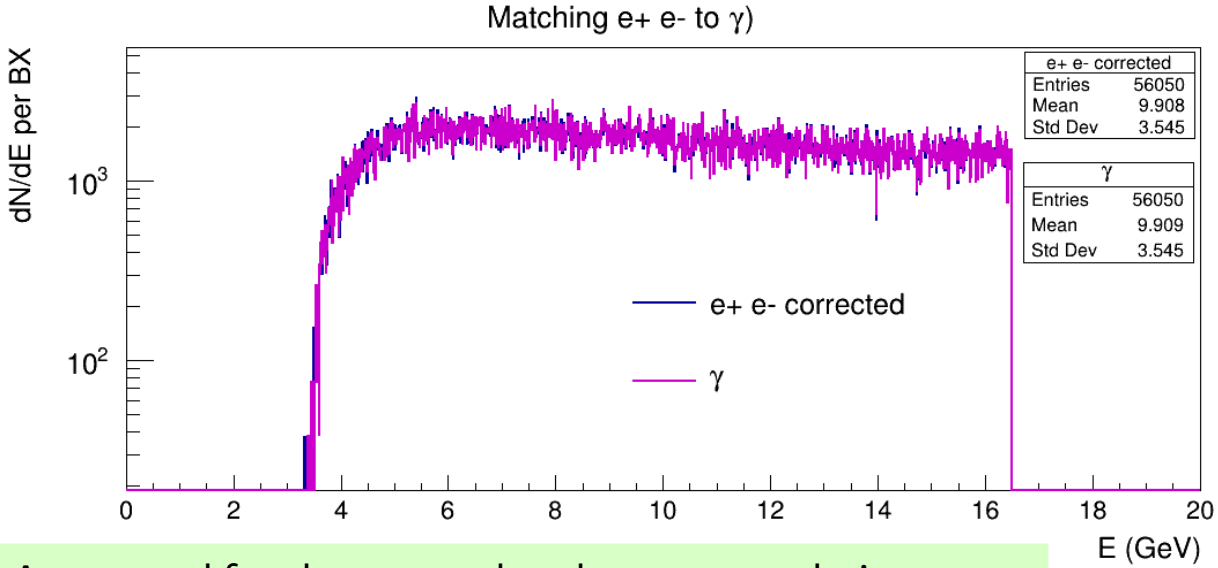
Selection:

1. Photon produced by primary electron in the target
2. e+, e- produced by the photon (1) in calibration target
3. Both e+,e- reach detectors (tracker)







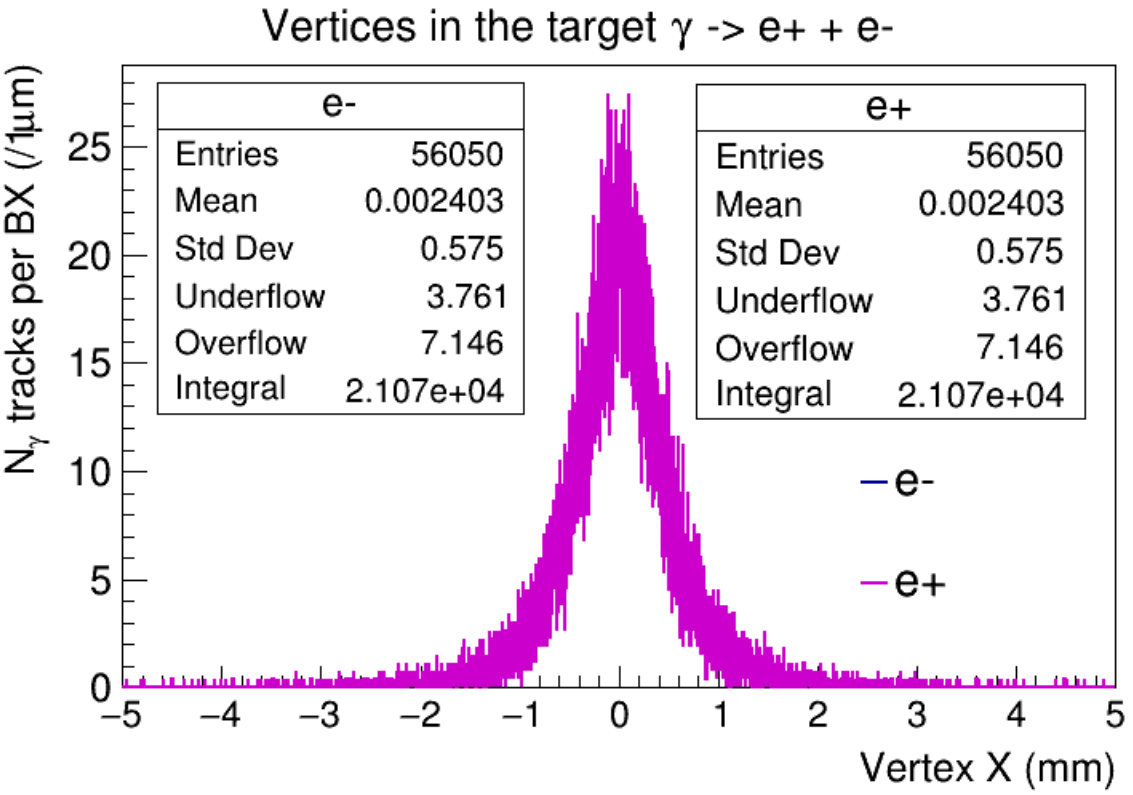


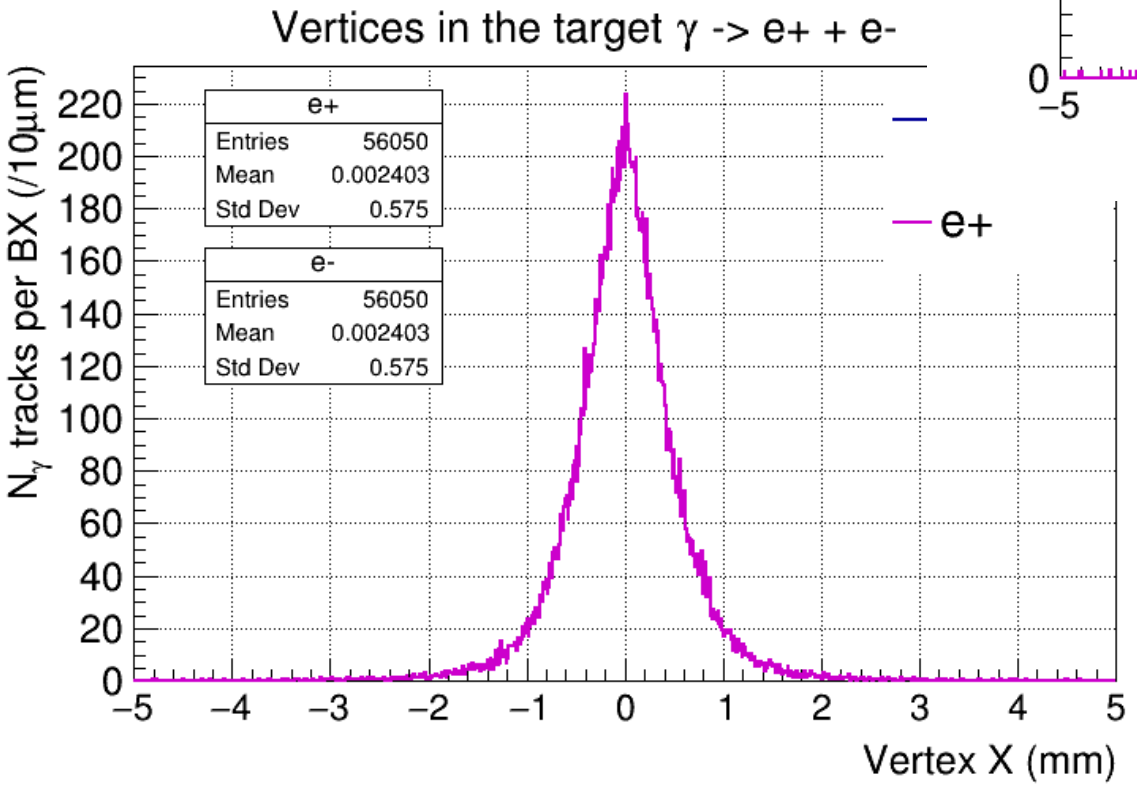
Accounted for the energy lost by e+ e- on their way to detectors (but not on producing secondaries).

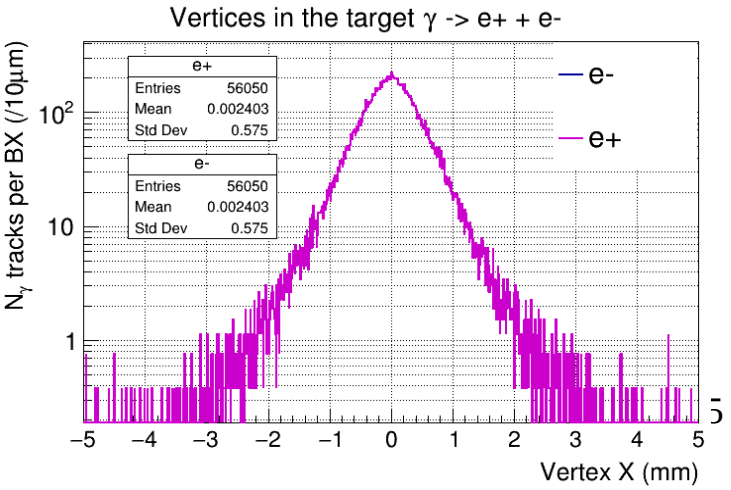
Matching e+e- to γ, vertices X in the target

Vertex X position in the calibration target for bremsstrahlung photons converted to e+ e- in case both e+ and e- reached detectors.

Total number e+(e-) 2.1e4 (integral)



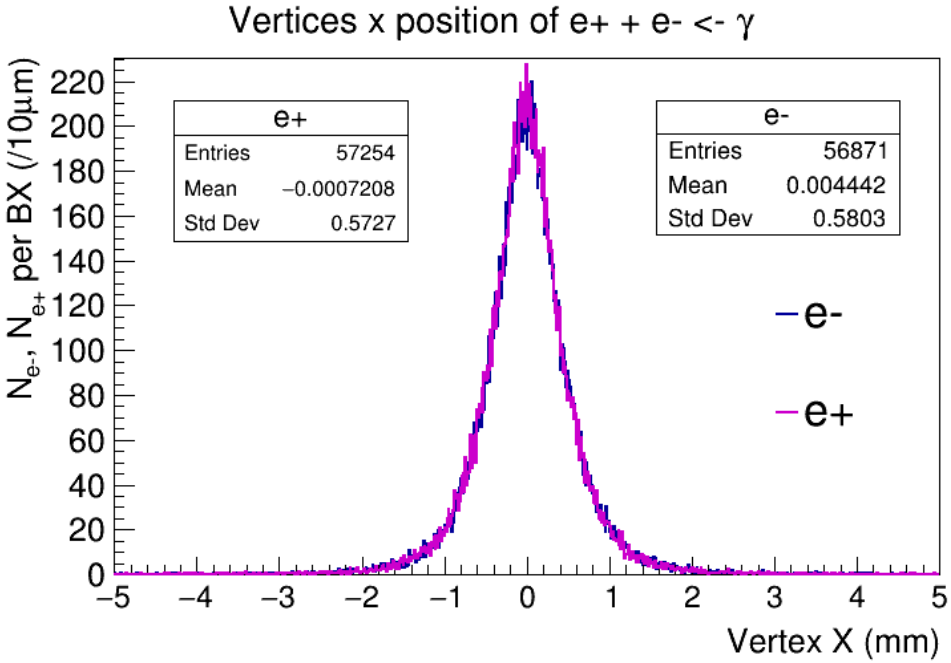


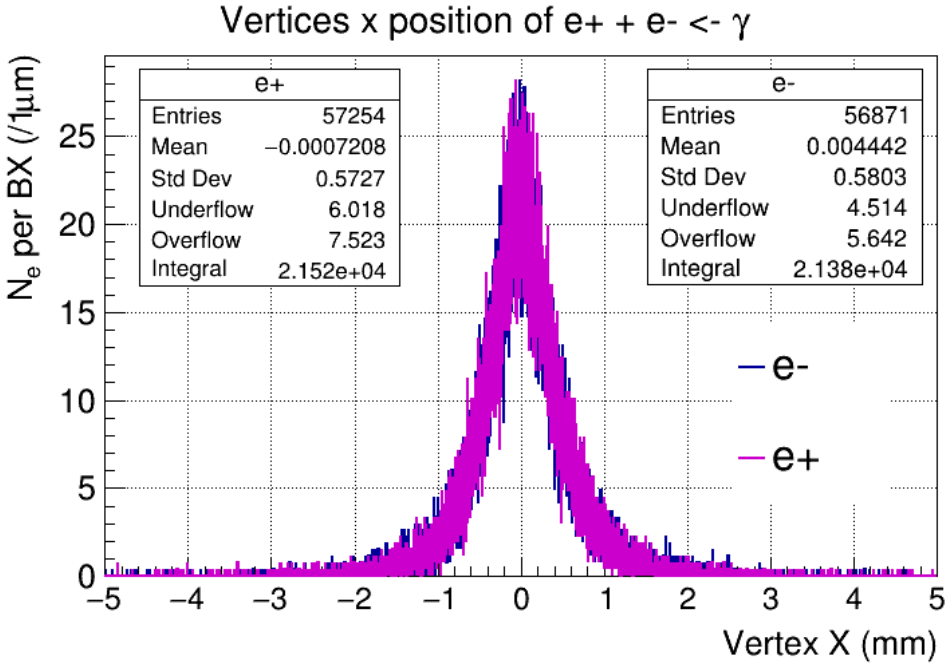


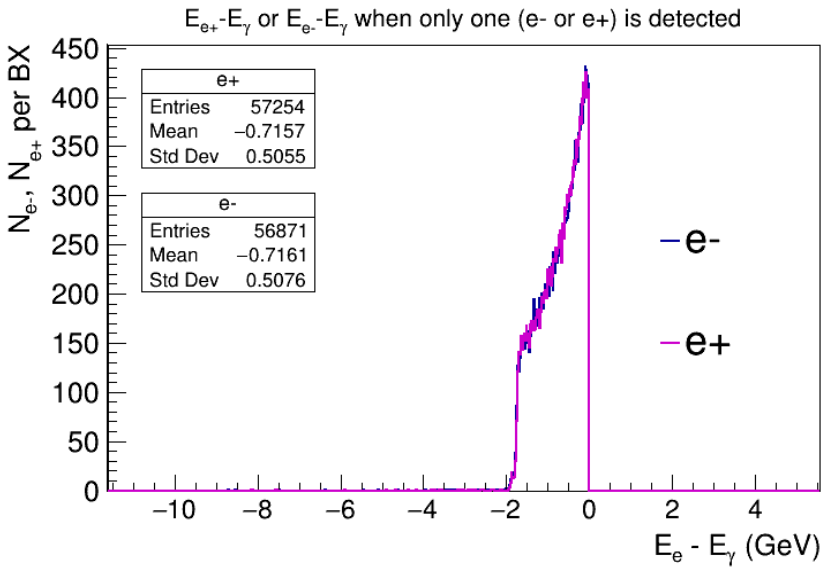
Vertices X in the target when only e+ or e- are detected and assigned to γ

Vertex X position in the calibration target for bremsstrahlung photons converted to e+ e- in case only one e+ or e- reached detectors.

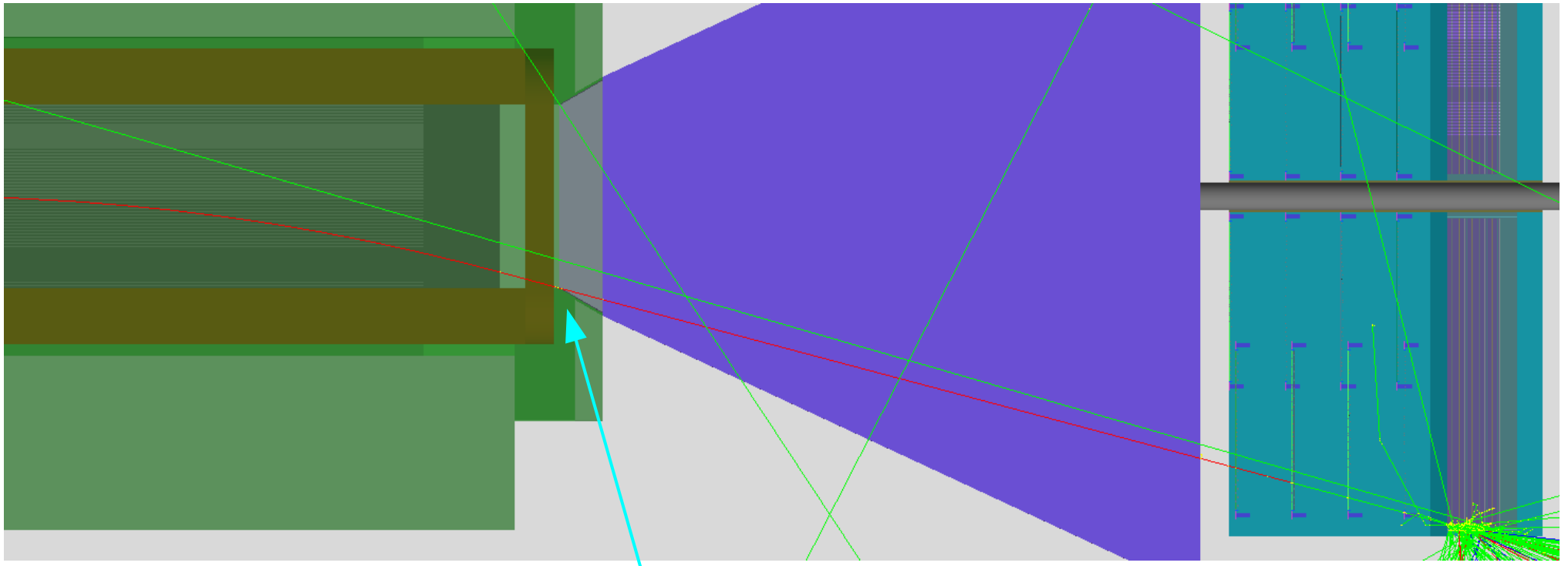
Total number e+(e-) ~2.1e4 (integral)





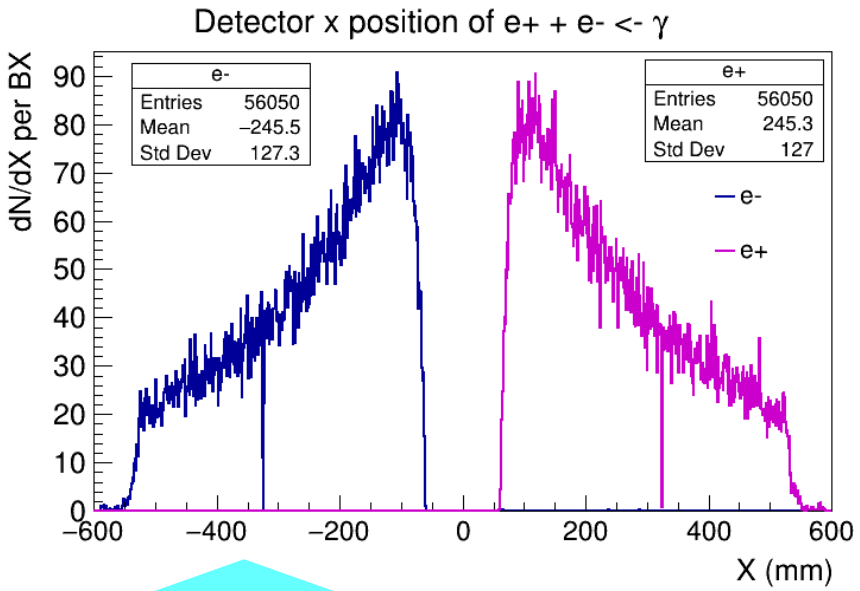


Electron of 1.9 GeV

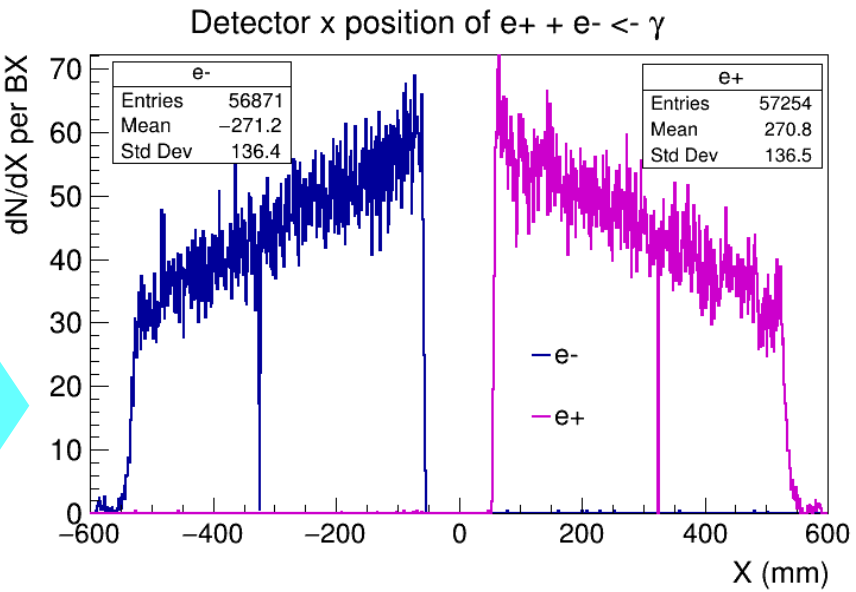


- Electron of 1.9 GeV slightly cross material of the corner of the vacuum chamber;
- It is about lower limit for particles capable to exit the magnet towards detectors.

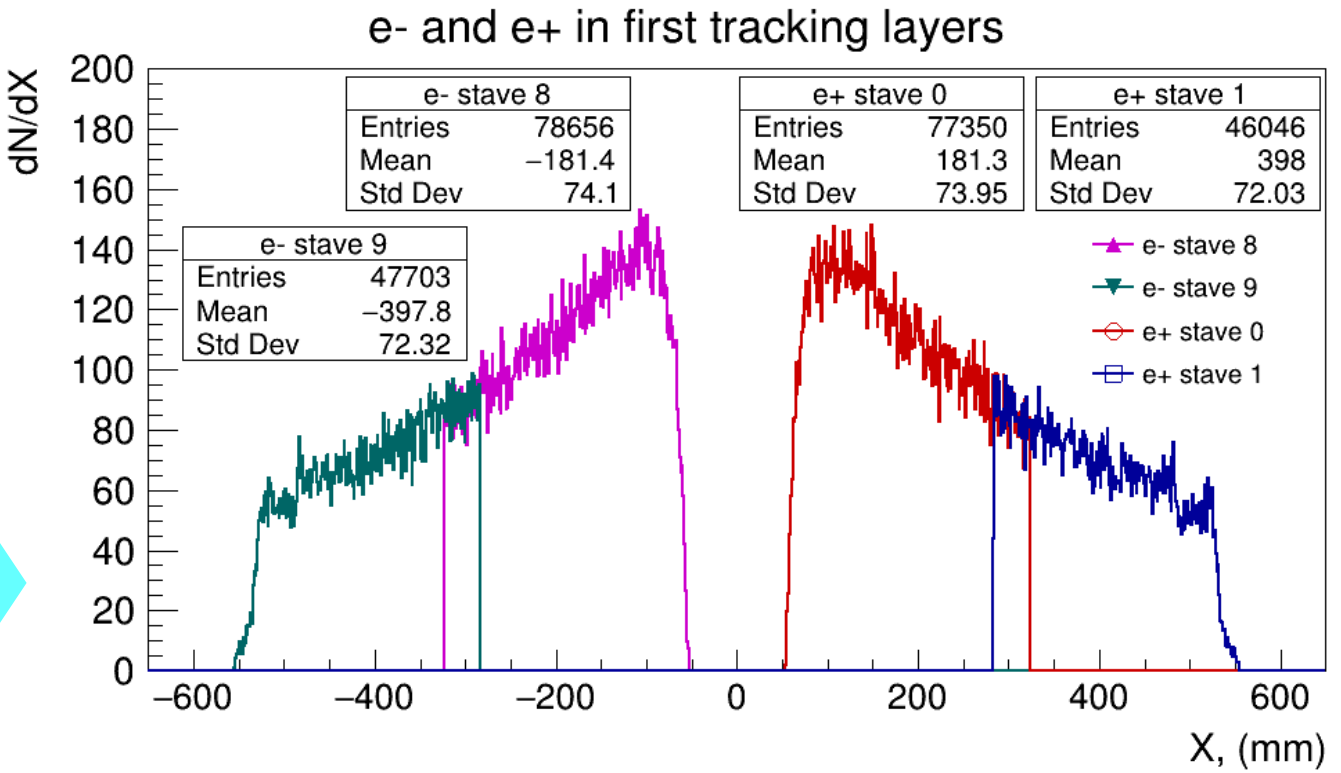
e+ or e- in detectors



Only e+ or e- matched to γ



electrons and positrons generated in the calibration target and matched to bremsstrahlung photons.



First layers of the trackers all electrons and positrons on their side

Low X0 gas target

- Gas target was mentioned as a possible tool for laser power diagnostics.
- If it is possible, the same gas can probably be used as a target for bremsstrahlung photons monitoring and detectors calibration
- There are cases where it is used or planned

INTERNATIONAL LINEAR COLLIDER DETECTOR

LETTER OF INTENT

2009

1.1.5 GamCal

To measure the beamstrahlung spectrum a small fraction of photons will be converted by a thin diamond foil or a gas-jet target about 100 m downstream of the interaction point.

https://www.zeuthen.desy.de/ILC/lcws07/pdf/MDI/morse_bill.pdf

Summary

- For the XFEL beam and bremsstrahlung 35μm tungsten target installed 7.5m upstream of IP the calibration target produces:
  - about 25 e+ e- pairs from linear micron in the middle (x=0) of the beam, both of which can be matched to the parent bremsstrahlung photon;
  - In addition there are about 25 e+ or e- from linear micron in the middle (x=0) of the beam. Missing e+ or e- have energy below ~1.9 GeV and can not exit the magnet;
- For 10 μm tungsten wire in IP the number of e+ (e-) is around 200+220 and 1 mm away from the axis the number is about 10 times smaller.
- Movable wire target can be not exactly in IP, some space close to the back/front wall of IP chamber can be also used.
- If gas target is planned for laser diagnostics, it can be also used as a target detectors for calibration.