Magnet and Detector Geometry for Spectrometer

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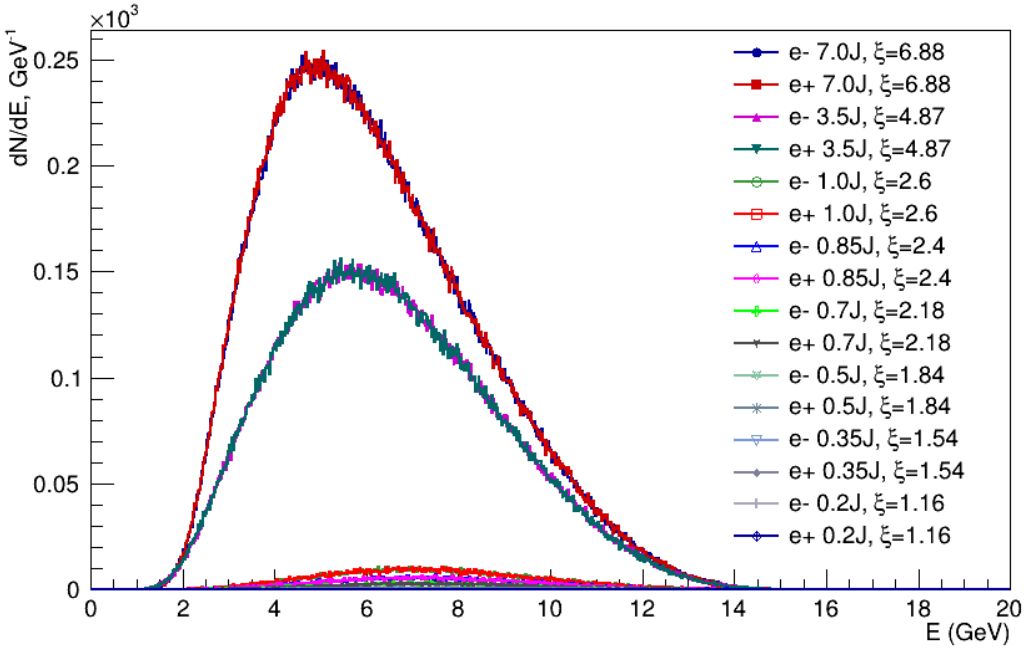
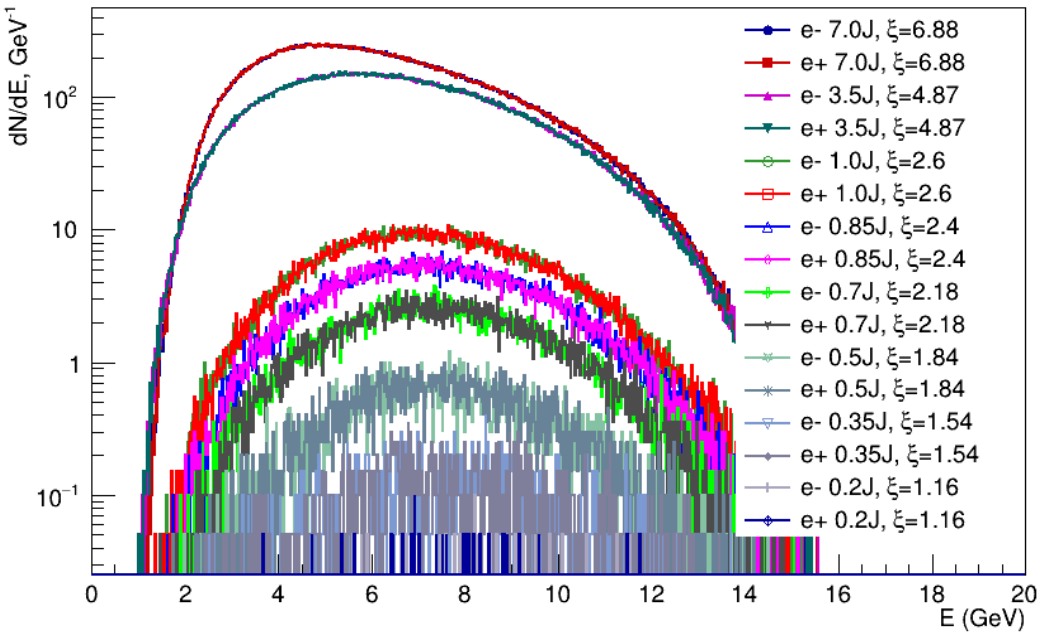
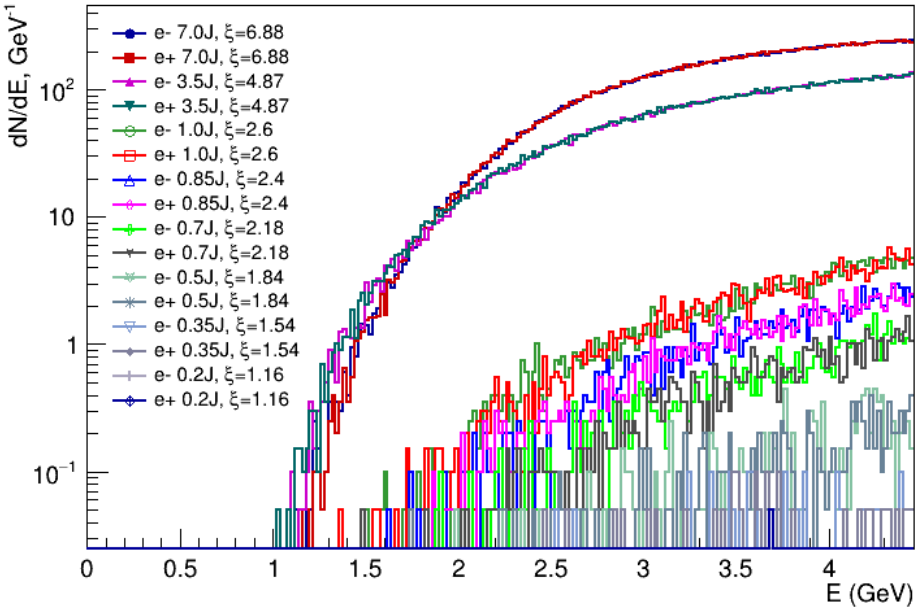
LUXE meeting
DESY 28.05.2020

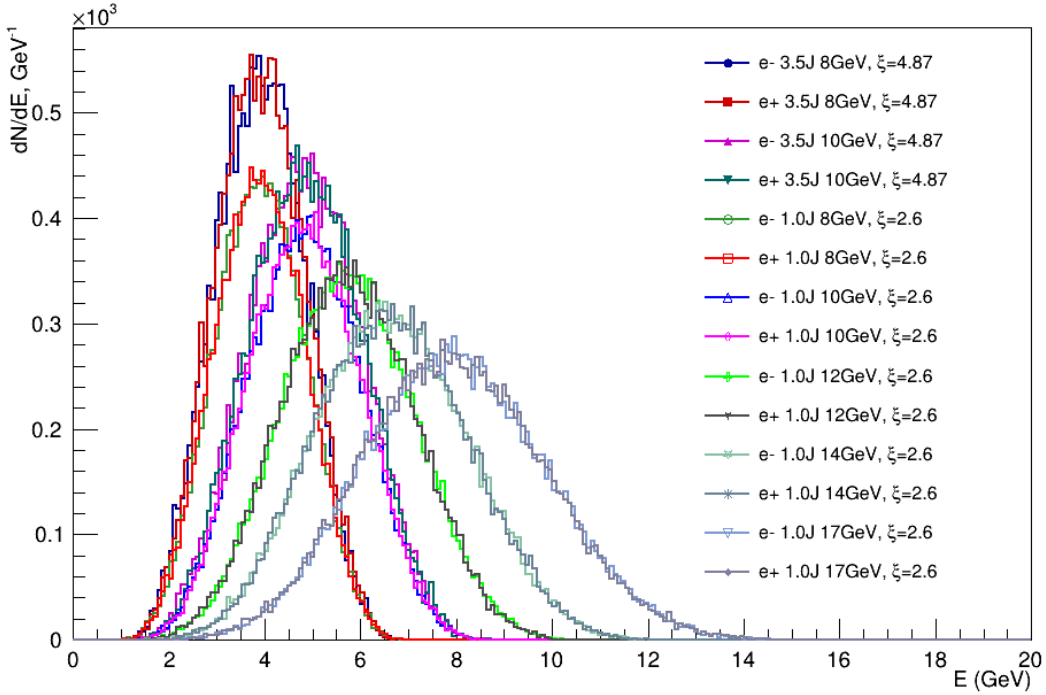
BPPP spectra

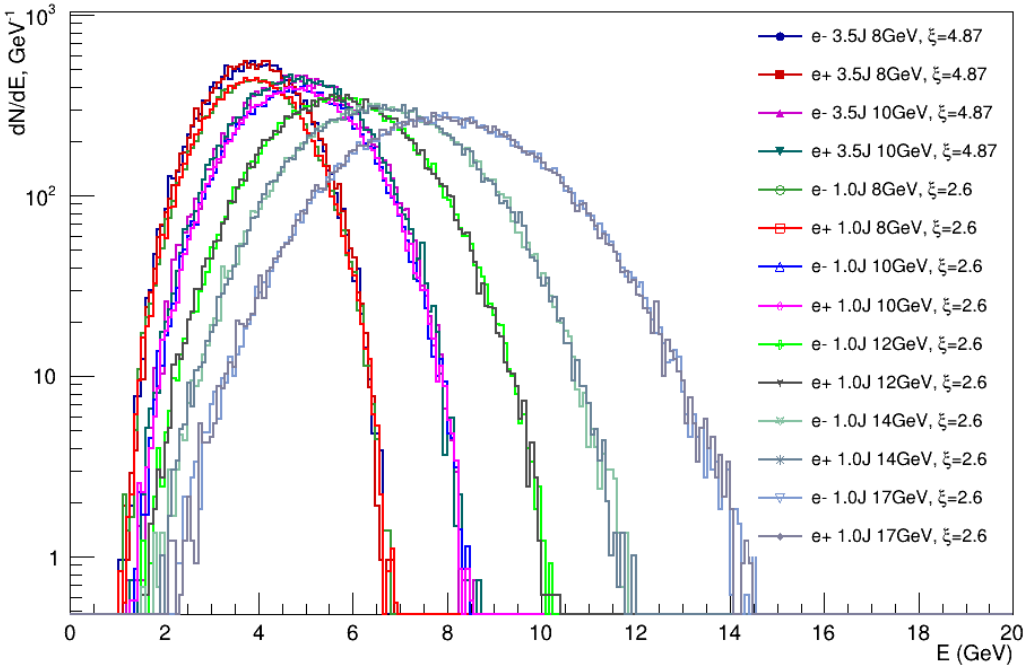




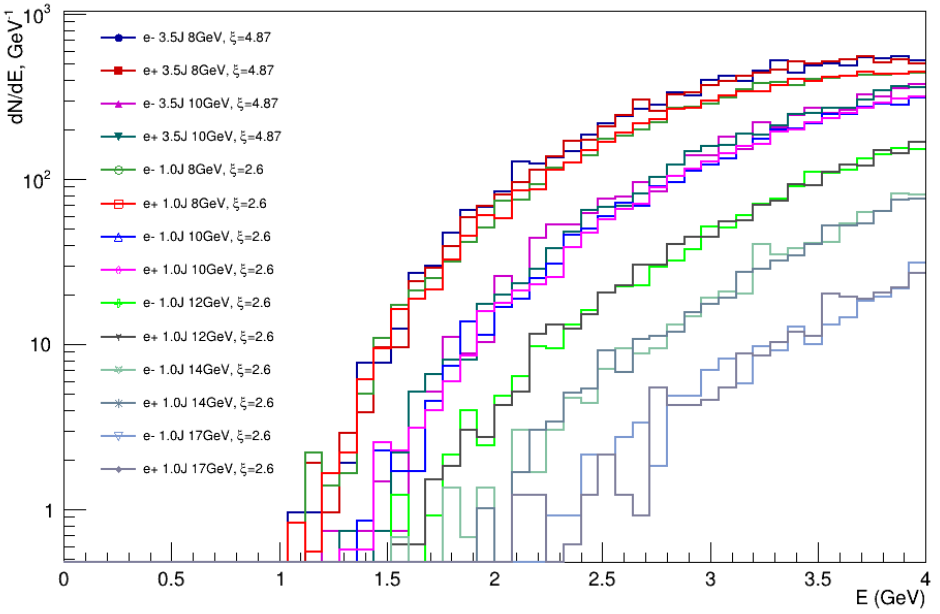


OPPP for gamma 8, 10, 12, 14, 17 GeV and laser 3.5J and 1J (ξ: 4.87 and 2.6)

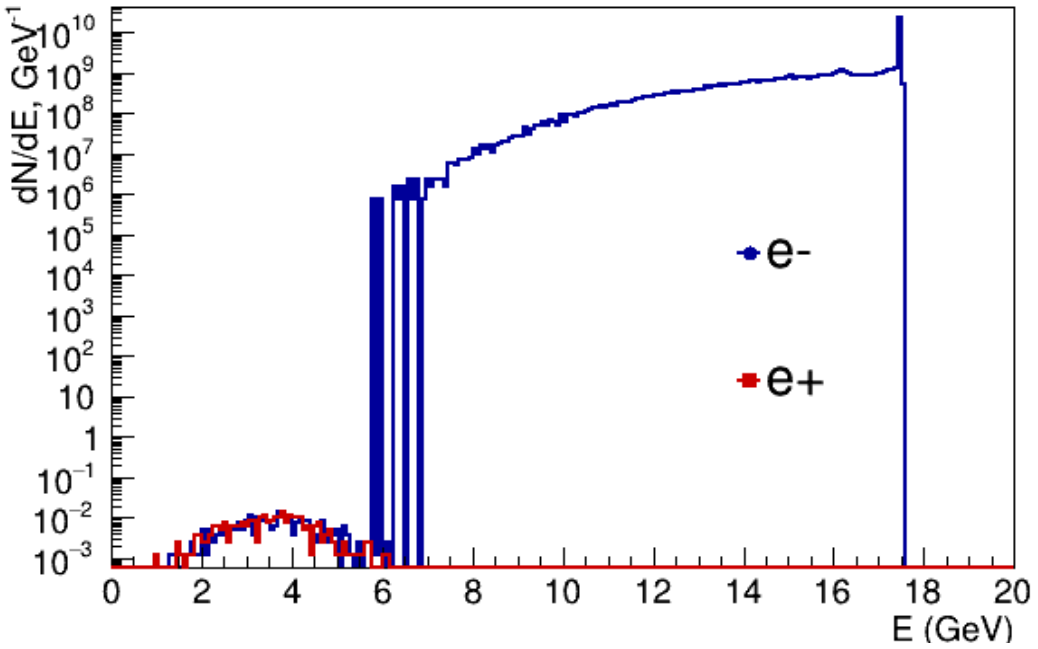


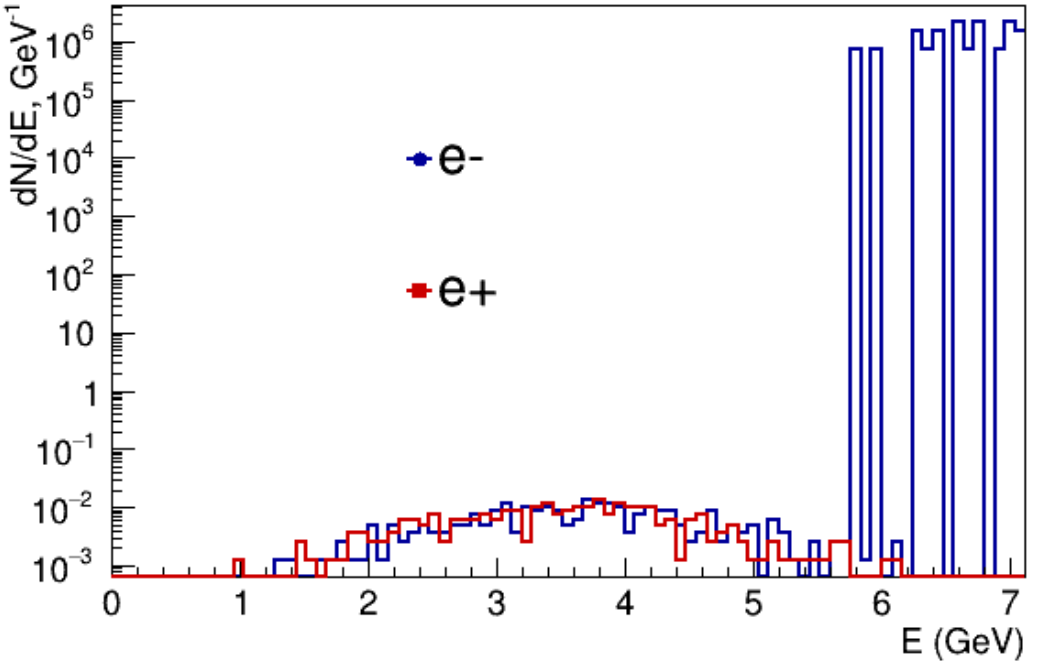


IPStrong v 1.0.0.1
/afs/desy.de/group/flc/luxe/IPstrong_V1.0.01

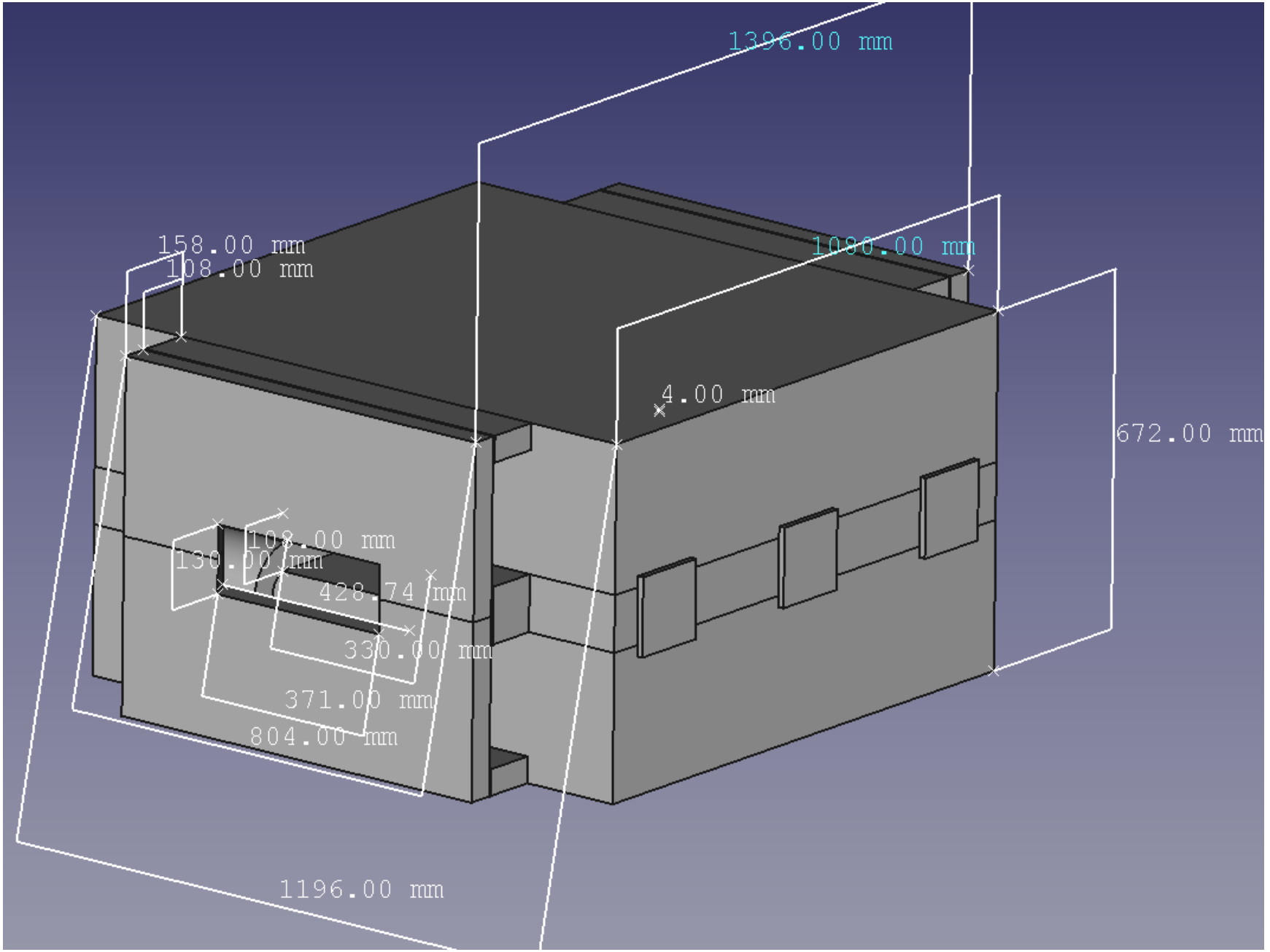


Trident

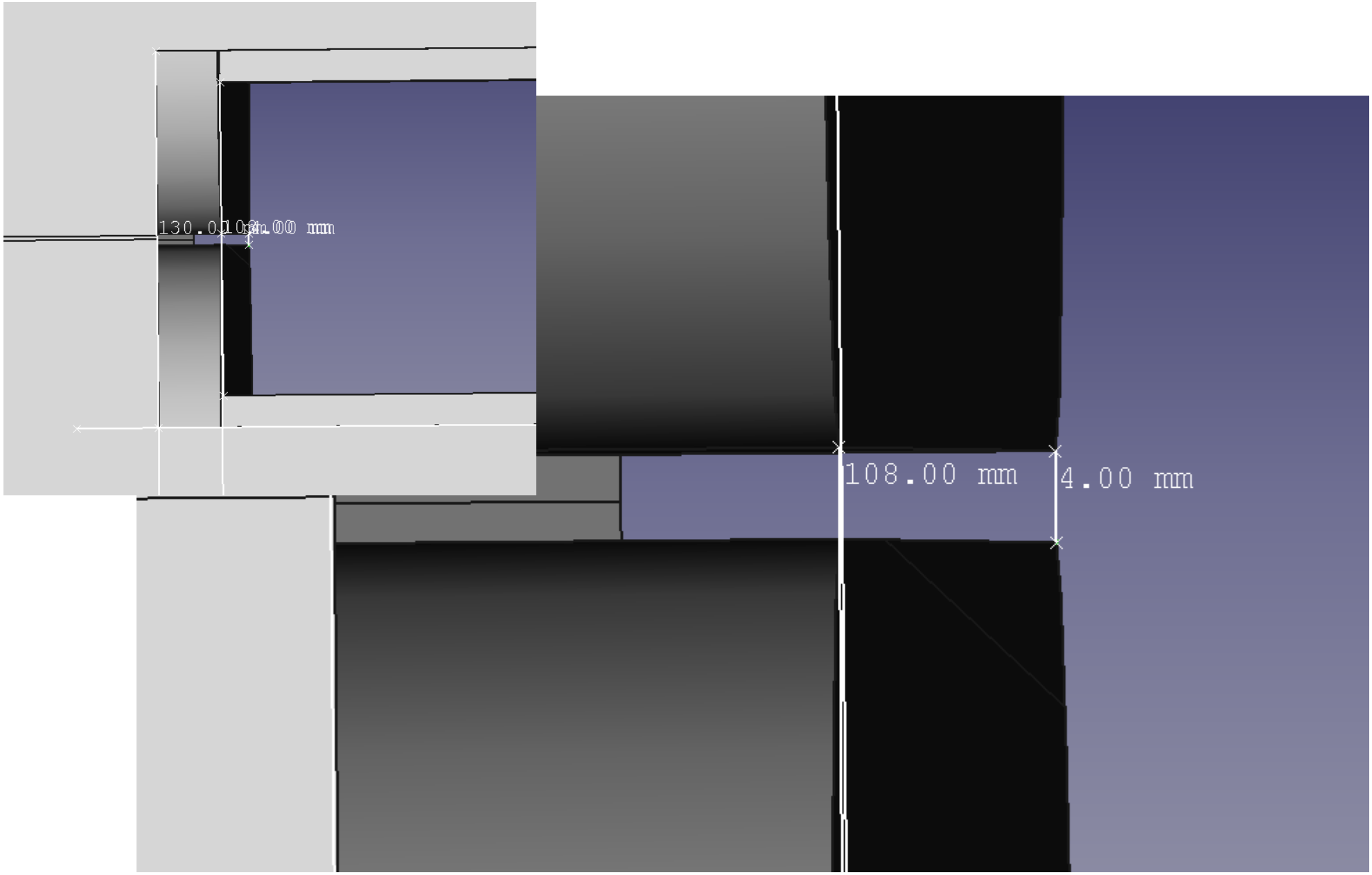

dN/dE, GeV^{-1}
10^{10}
10^{9}
10^{8}
10^{7}
10^{6}
10^{5}
10^{4}
10^{3}
10^{2}
10
1
10^{-1}
10^{-2}
10^{-3}
e-
e+
0
2
4
6
8
10
12
14
16
18
20
E (GeV)


dN/dE, GeV^{-1}
10^{6}
10^{5}
10^{4}
10^{3}
10^{2}
10
1
10^{-1}
10^{-2}
10^{-3}
e-
e+
0
1
2
3
4
5
6
7
E (GeV)

Magnet 3D CAD

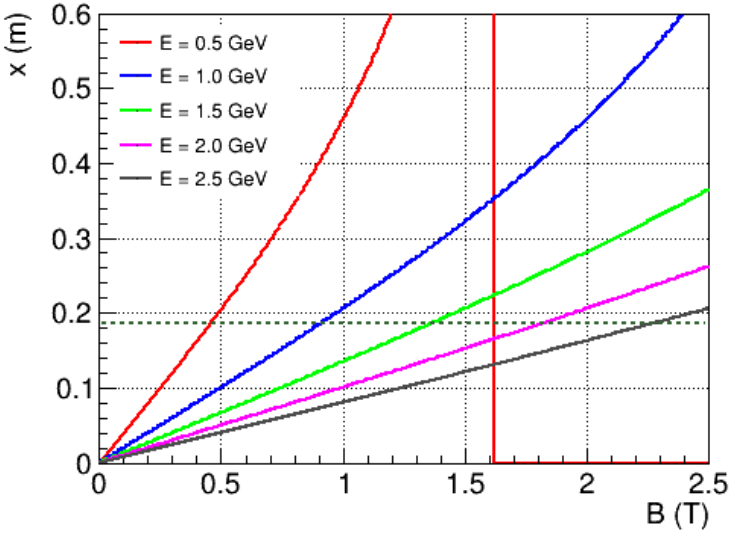


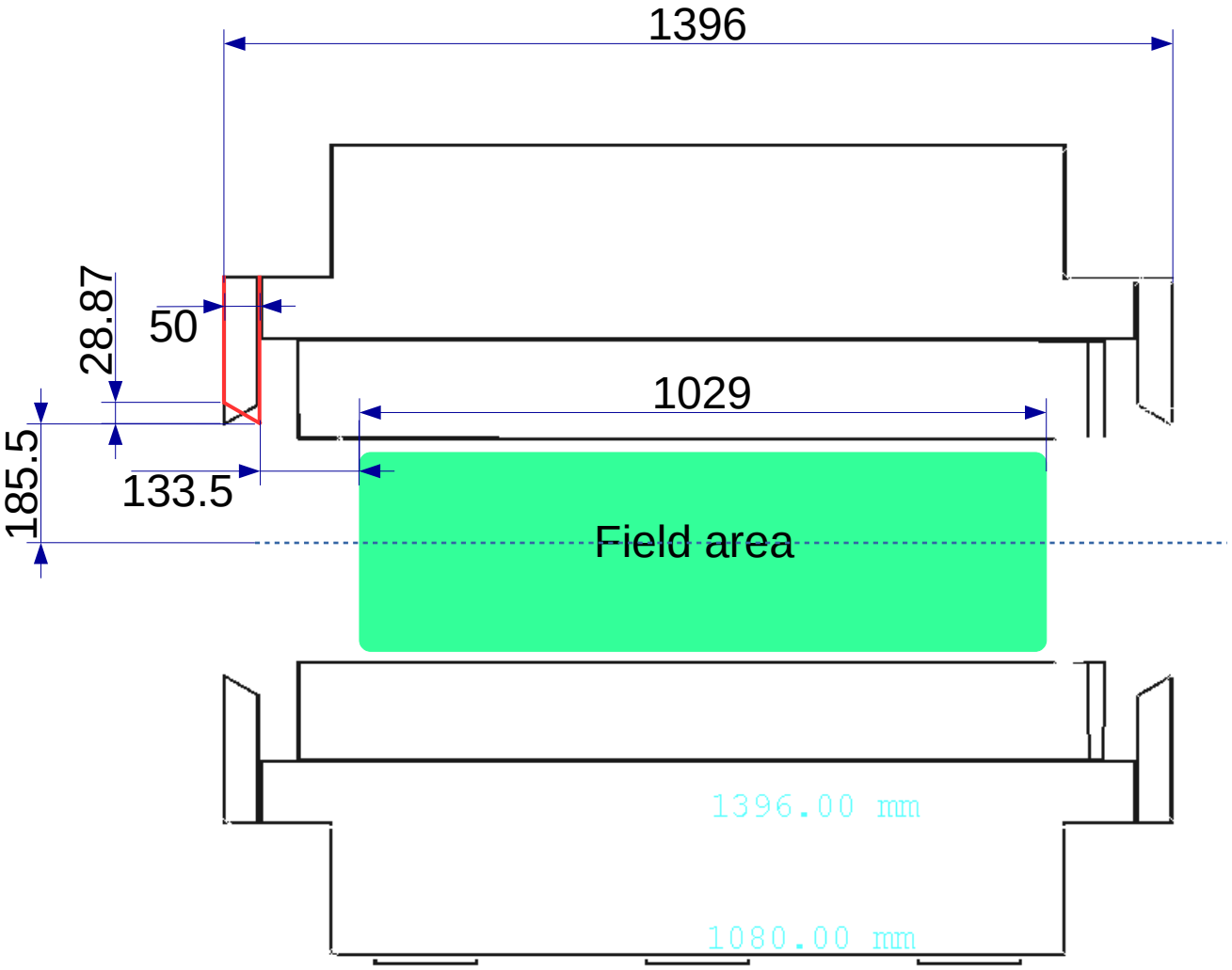
Gap between coils



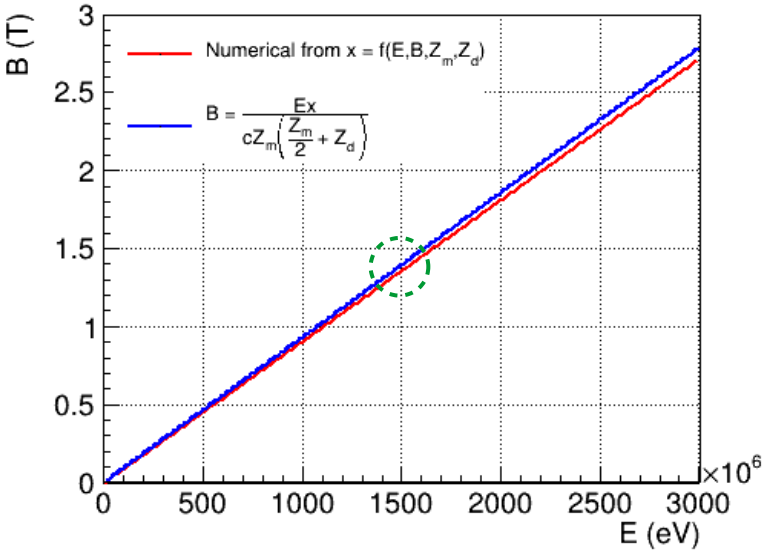
Magnet cross section (middle plane, top view)

3D CAD model is not aligned with coordinate planes...



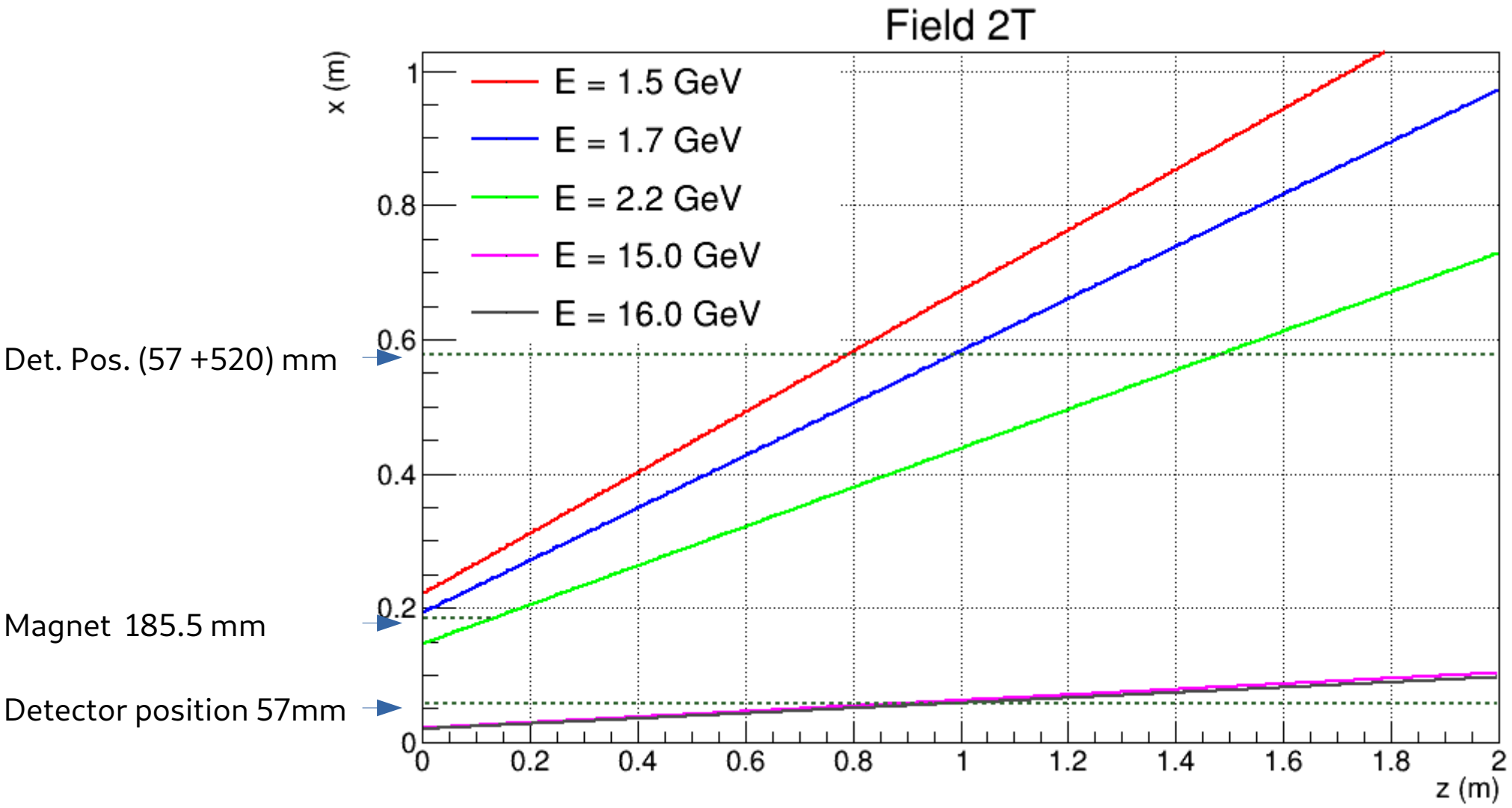


X = 185.5 mm; Z_d = 133.5 mm

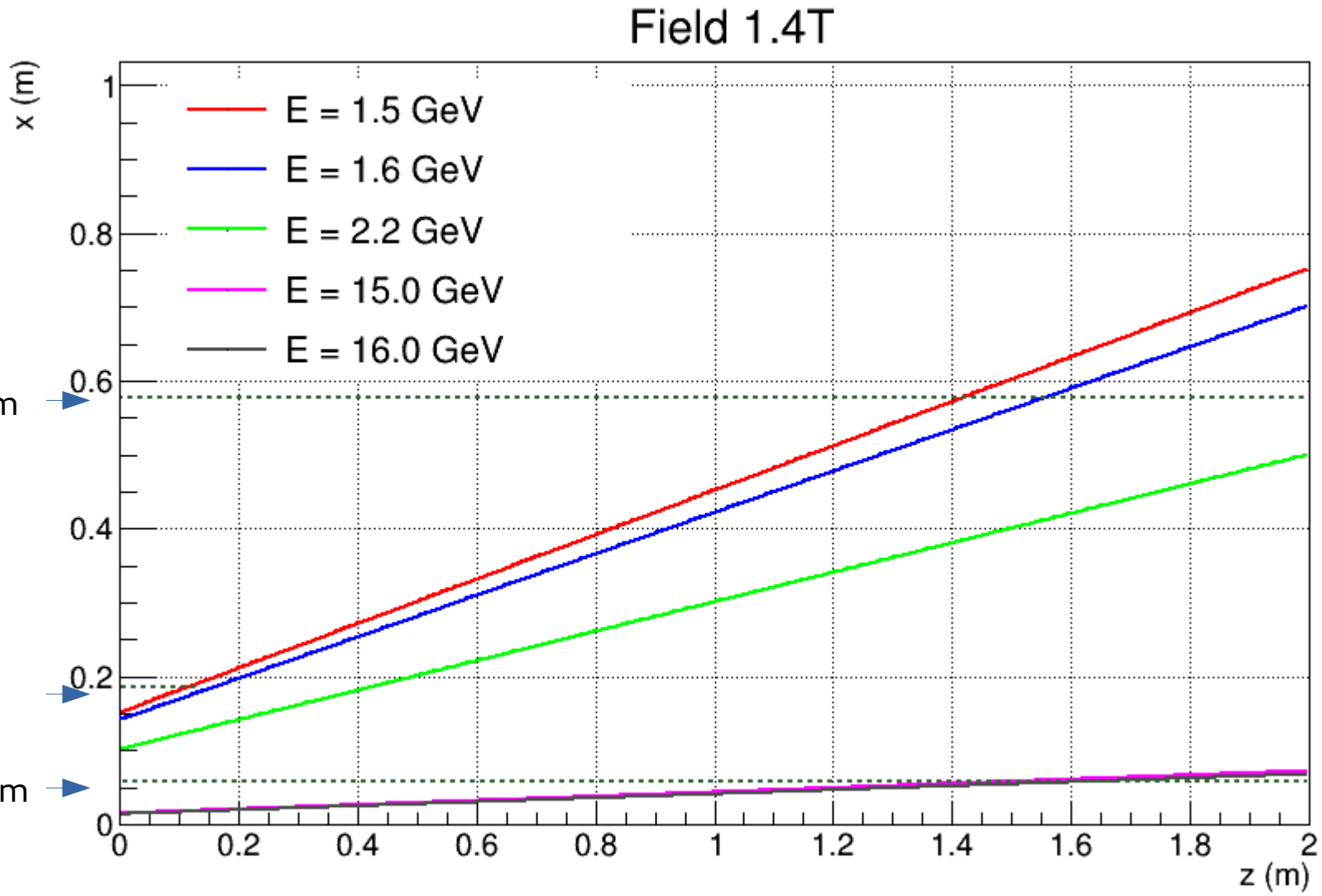



```
Elelctron energy (Ev):  2.208e+09
Magnetic field (T): 2
Curvature radius (m):   3.68255
Displacement at the exit from the magnet (m):0.146686
Angle (rad): 0.283196
Displacement at 0.1335 m from the magnet (m): 0.185537
```

Electron Tracks



Electron Tracks

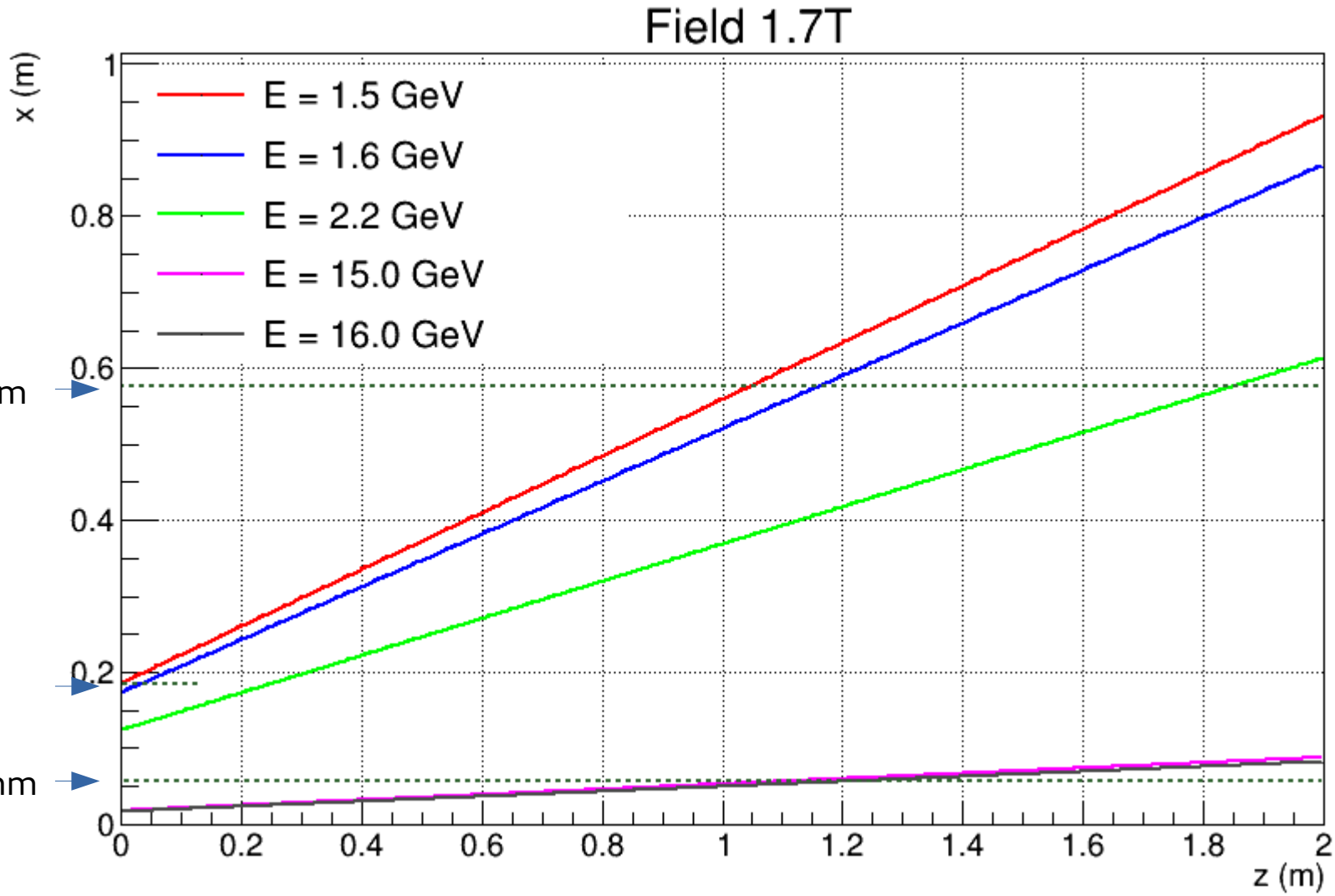


Det. Pos. (57 +520) mm

Magnet 185.5 mm

Detector position 57mm

Electron Tracks



Det. Pos. (57 +520) mm

Magnet 185.5 mm

Detector position 57mm

Summary

- 2T at 1 m requires over 61 cm detector span to cover energy down to 1.5 GeV. Also everything below 2.2 GeV hits the magnet.
- Lower fields 1.4T – 1.7T fit better, but require moving detector further form the magnet (1.2m-1.5m) and increase the aperture of the magnet by 2-3 cm assuming energy range 1.5 GeV-16 GeV.

Beam position after the magnet

```
R[Ee_] = Sqrt[Ee^2 - me^2] / (clight * B)
```

$$\frac{\sqrt{Ee^2 - me^2}}{B\ clight}$$

```
S[Ee_] = R[Ee] - Sqrt[R[Ee]^2 - zm^2]
```

$$\frac{\sqrt{Ee^2 - me^2}}{B\ clight} - \sqrt{\frac{Ee^2 - me^2}{B^2\ clight^2} - zm^2}$$

```
sint[Ee_] = zm / R[Ee]
```

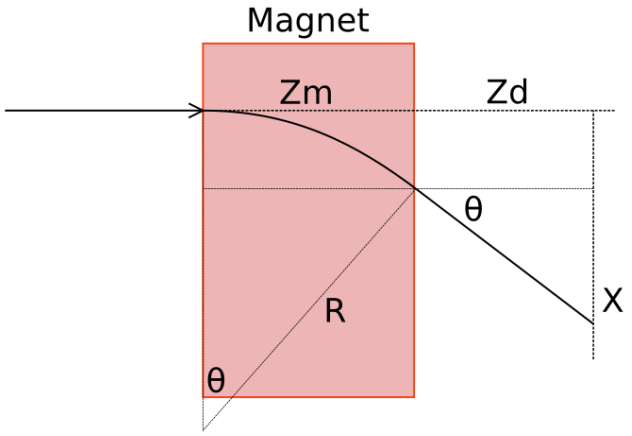
$$\frac{B\ clight\ zm}{\sqrt{Ee^2 - me^2}}$$

```
tgt[Ee_] = sint[Ee] / Sqrt[1 - sint[Ee]^2]
```

$$\frac{B\ clight\ zm}{\sqrt{Ee^2 - me^2}\ \sqrt{1 - \frac{B^2\ clight^2\ zm^2}{Ee^2 - me^2}}}$$

```
xd[Ee_] = S[Ee] + zd * tgt[Ee]
```

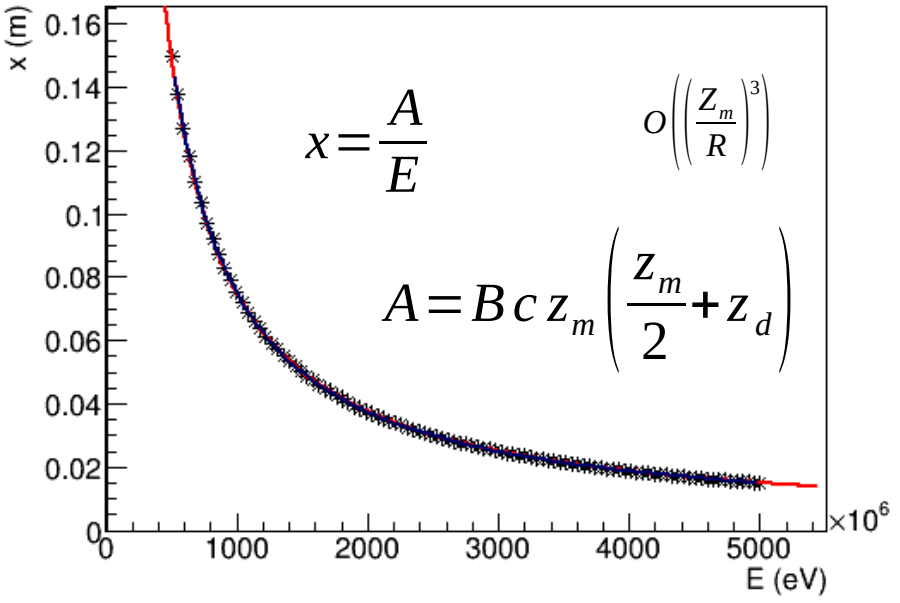
$$\frac{\sqrt{Ee^2 - me^2}}{B\ clight} - \sqrt{\frac{Ee^2 - me^2}{B^2\ clight^2} - zm^2} + \frac{B\ clight\ zd\ zm}{\sqrt{Ee^2 - me^2}\ \sqrt{1 - \frac{B^2\ clight^2\ zm^2}{Ee^2 - me^2}}}$$



$$x(E) = \frac{B c\, z_m}{E}\left(\frac{z_m}{2} + z_d\right)$$

$$\frac{dx(E)}{dE} = -D$$

1. $z_d = z_d(E)$
2. $z_m = z_m(E)$




```
Minimizer is Minuit / Migrad
Chi2                      =  6.30474e-08
NDf                       =            100
Edm                       =  3.34551e-21
NCalls                    =             15
p0                        =  7.4997e+07   +/-   3870.76
B*c*Zm*(Zm/2+Zd): 7.49481e+07
```