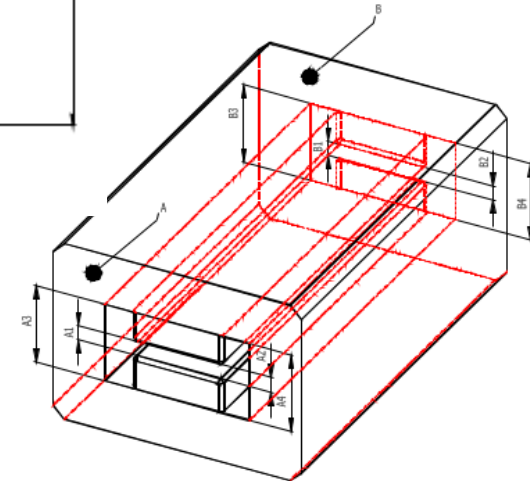# Update on LUXE GEANT4 Simulation

Oleksandr Borysov

LUXE S&A Meeting
August 24, 2021
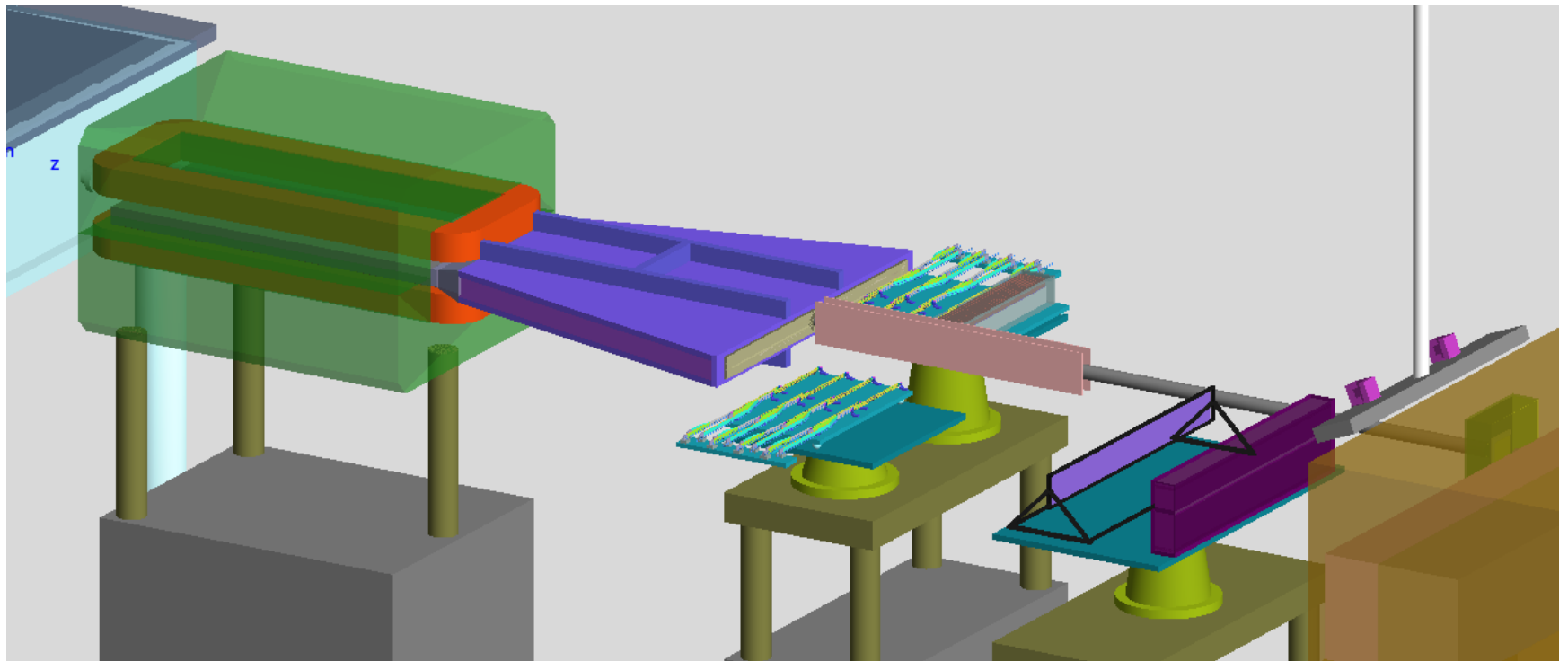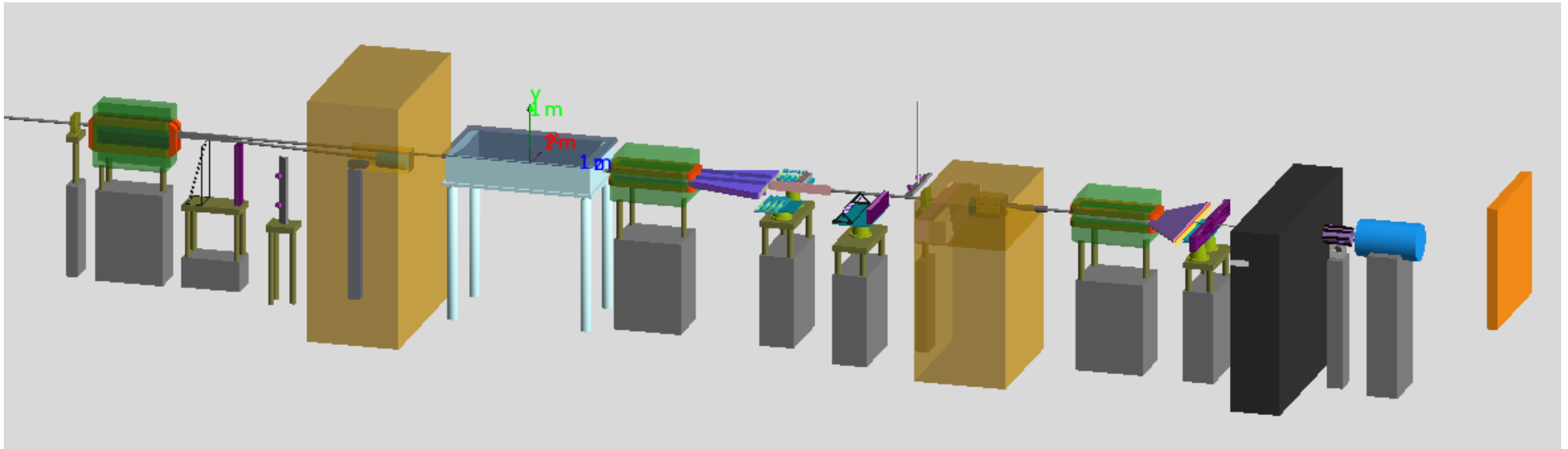
# FLASH magnet

FLASH – Free-electron LASer in Hamburg



Fig.13

Table No.17

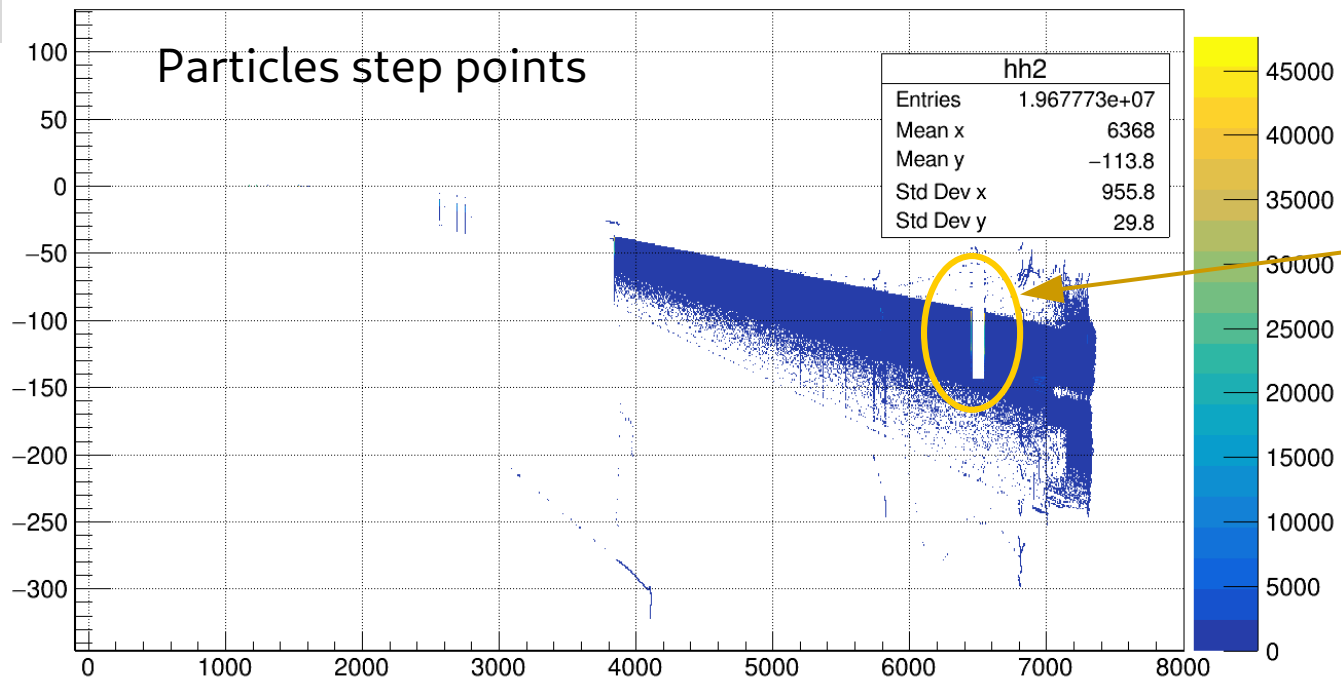| Dimension | Value | Dimension | Value |
|-----------|-------|-----------|-------|
| $A_1$ | 59,91 | $B_1$ | 59,92 |
| $A_2$ | 59,92 | $B_2$ | 59,92 |
| $A_3$ | 310,32 | $B_3$ | 310,33 |
| $A_4$ | 310,32 | $B_4$ | 310,32 |

# G4 Geometry

# Target chamber



x:z

Particles step points

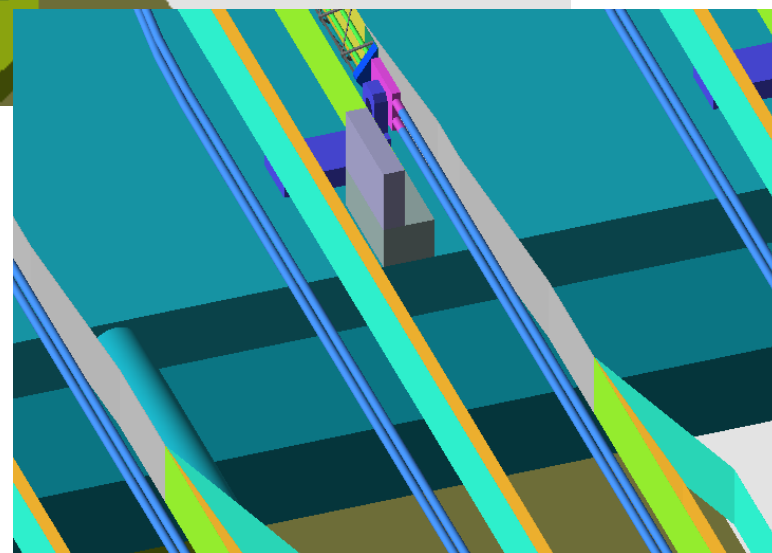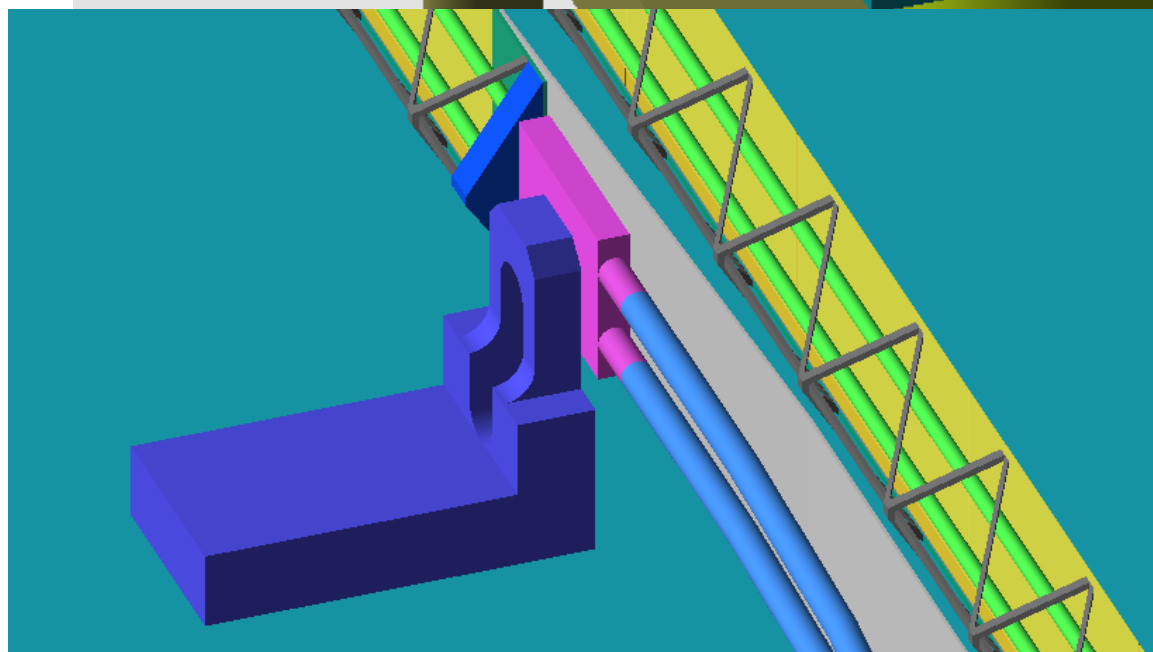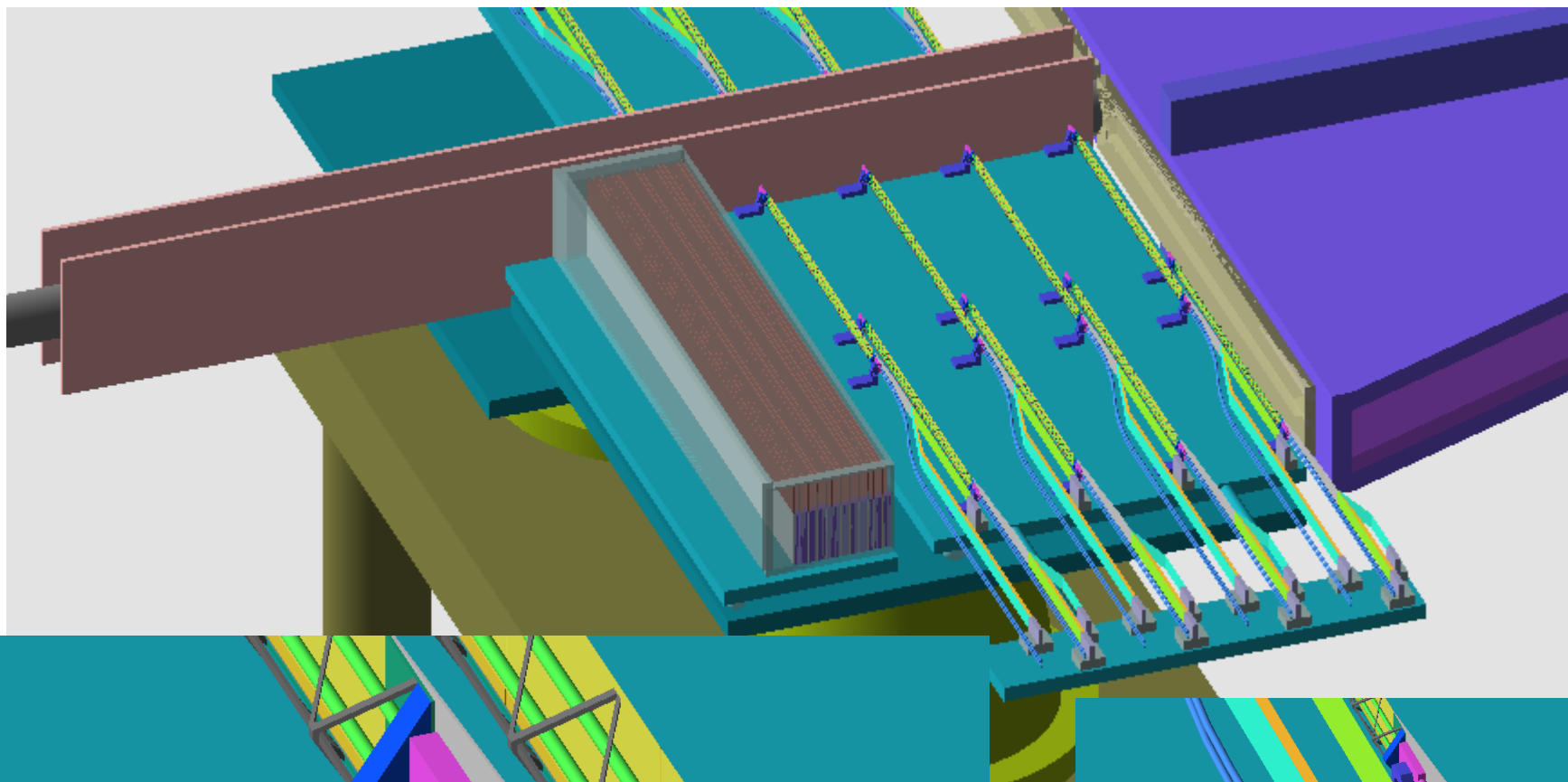| hh2 | |
|---|---|
| Entries | 1.967773e+07 |
| Mean x | 6368 |
| Mean y | −113.8 |
| Std Dev x | 955.8 |
| Std Dev y | 29.8 |
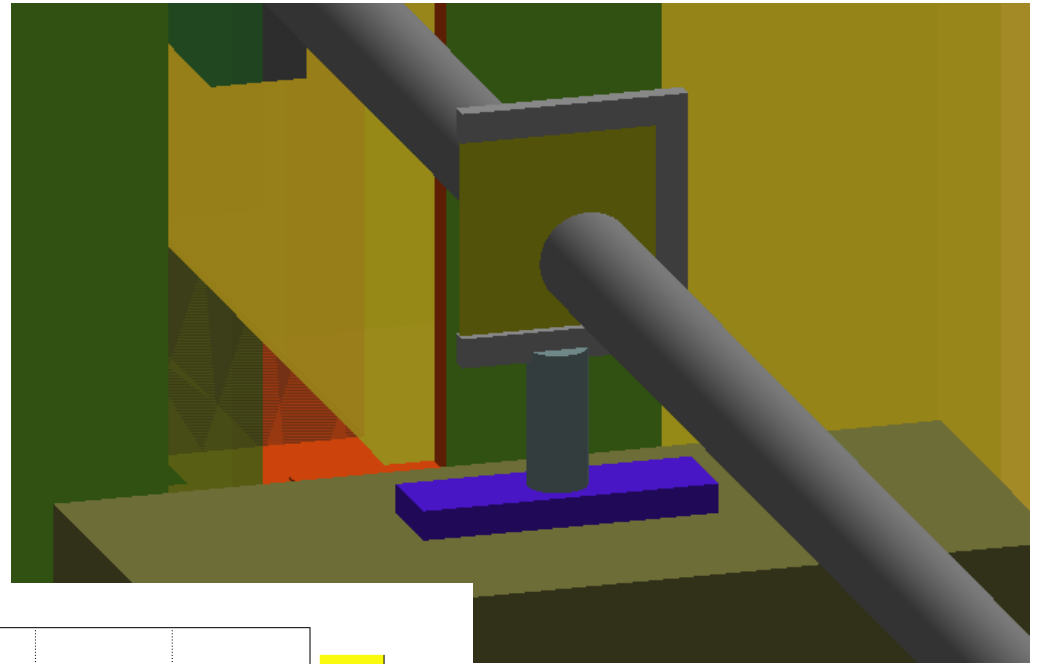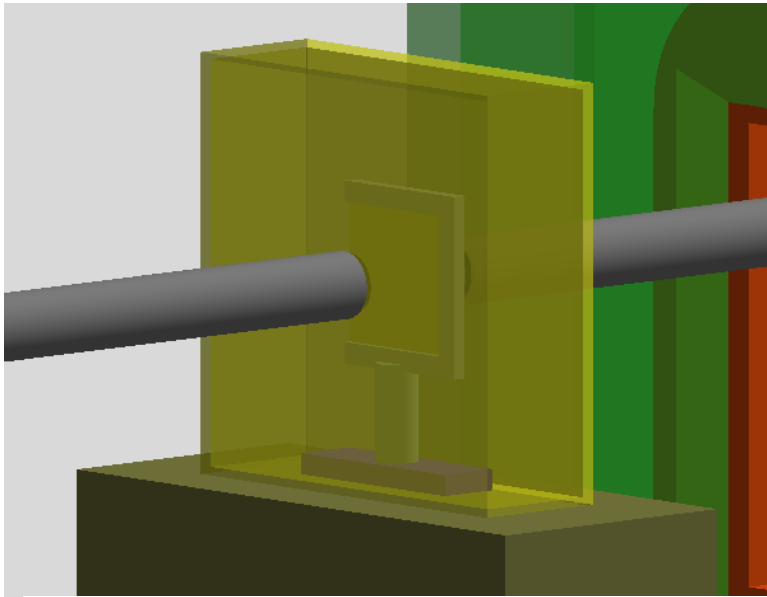
Particles passing through the target chamber
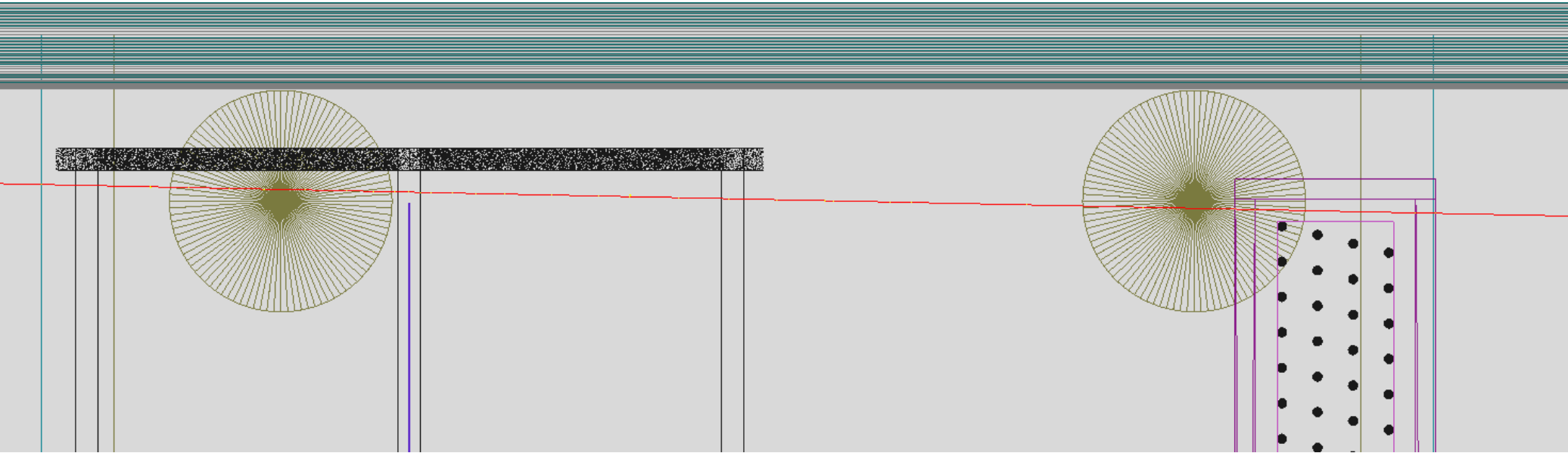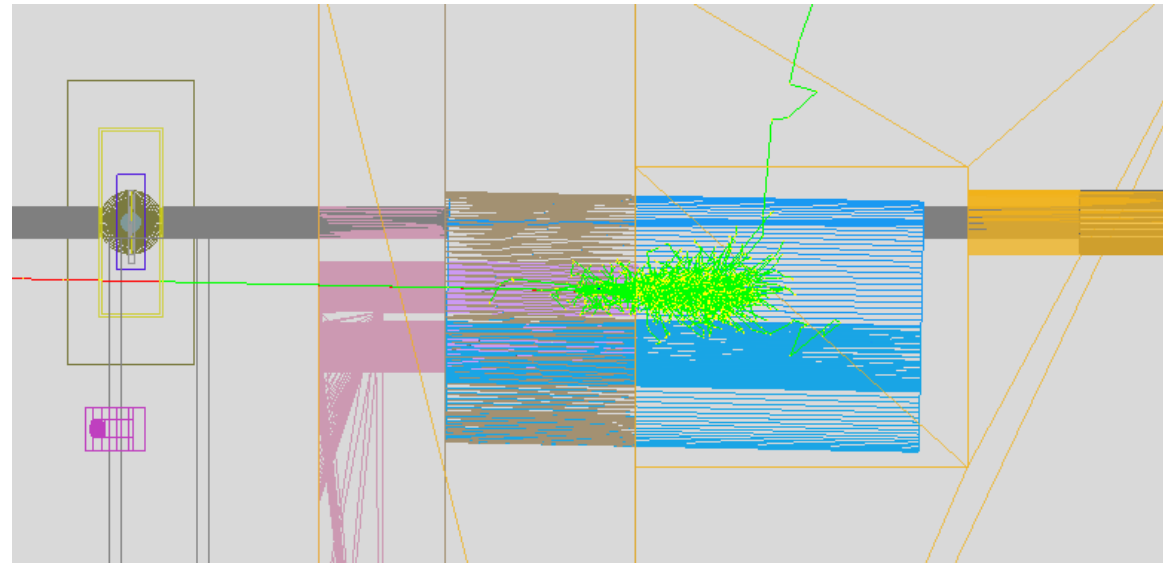
# Tracker and ECal
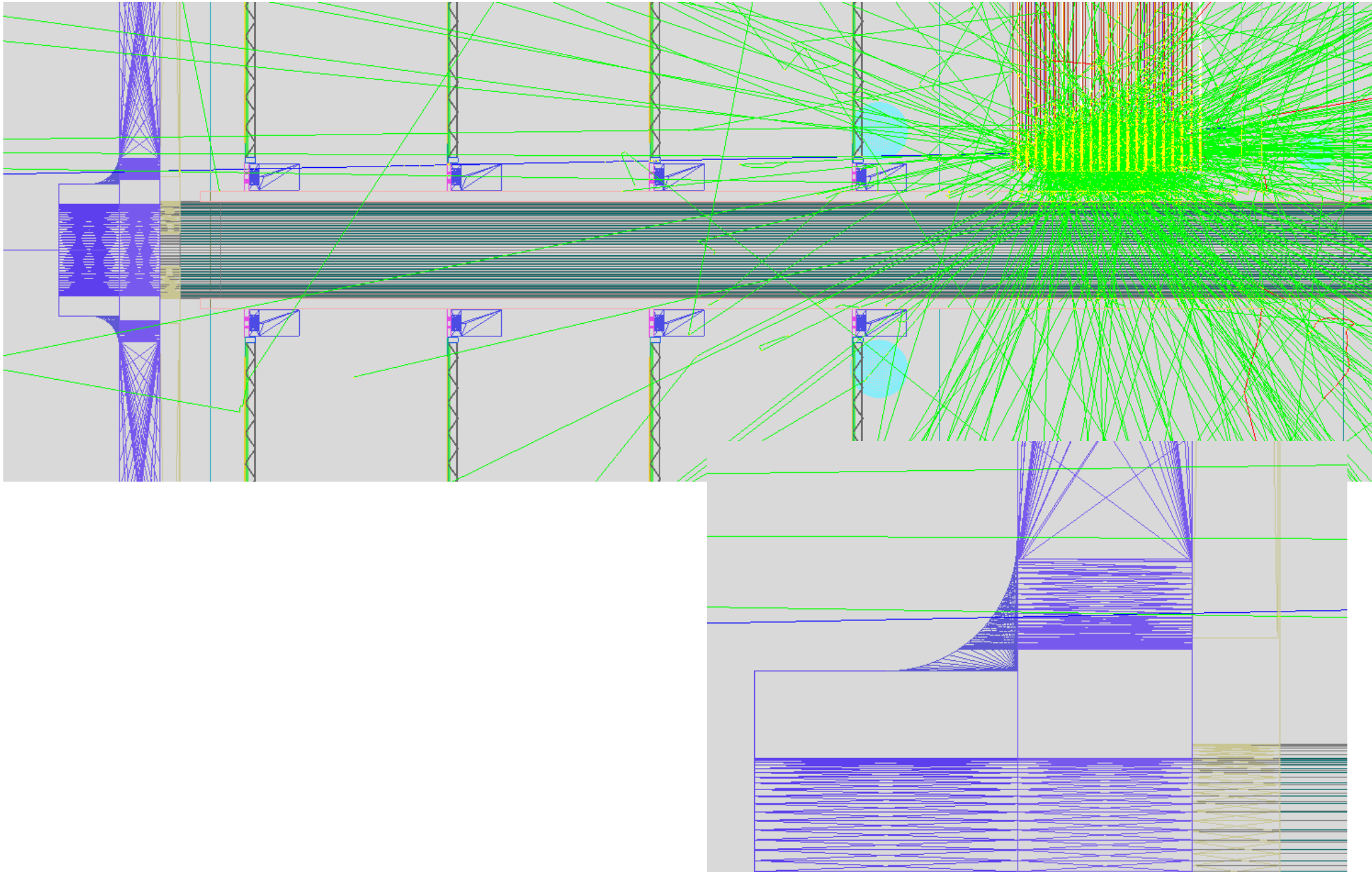
# FLASH magnet at IP

FLASH – Free-electron LASer in Hamburg



- Electron of 16.5 GeV;

- $B_y$ = 0.95 T;   Xmin = -616 mm; Xmax = 622;

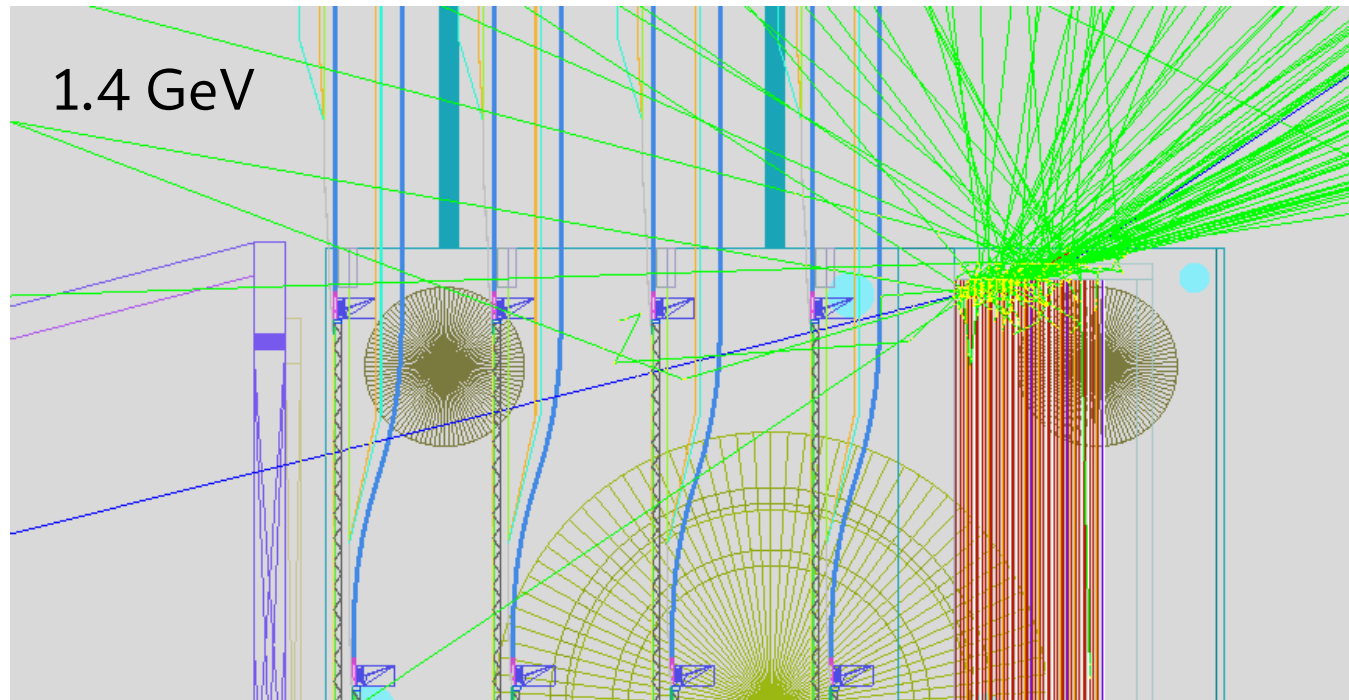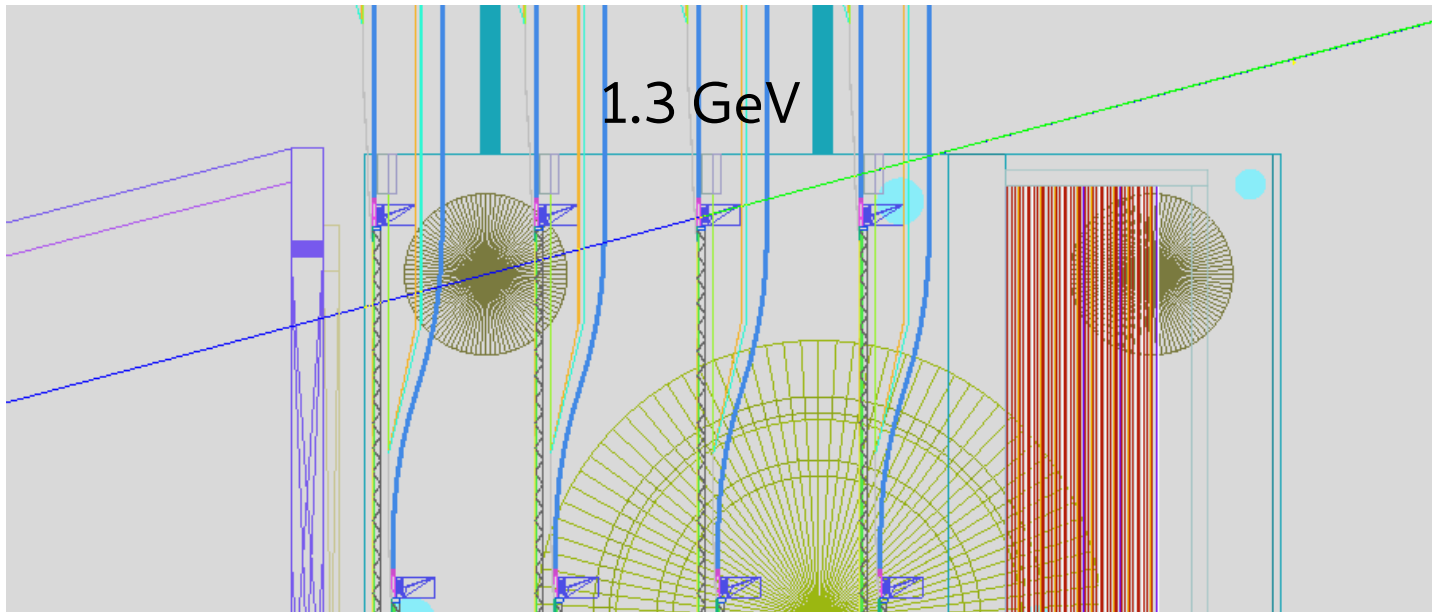- Scree and Cherenkov detectors were moved a bit in x direction.

  To pass through the dedicated channels fine tuning of field, and positions is might be needed;

# Positron 16.5 GeV

# Positrons



1.3 GeV

1.4 GeV

# IP field G4 configuration settings

```
#### IP magnet settings
/lxphoton/det/magnet_field/value IP Bx  0.0 tesla
/lxphoton/det/magnet_field/value IP By -0.95 tesla
/lxphoton/det/magnet_field/value IP Bz  0.0 tesla

/lxphoton/det/magnet_field/distribution  IP  Bx  x  const  -165.0   165.0  mm
/lxphoton/det/magnet_field/distribution  IP  Bx  y  const  -30.0    30.0   mm
/lxphoton/det/magnet_field/distribution  IP  Bx  z  const  -616.0   622.0  mm

/lxphoton/det/magnet_field/distribution  IP  Bz  x  const  -165.0   165.0  mm
/lxphoton/det/magnet_field/distribution  IP  Bz  y  const  -30.0    30.0   mm
/lxphoton/det/magnet_field/distribution  IP  Bz  z  const  -616.0   622.0  mm

/lxphoton/det/magnet_field/distribution  IP  By  x  f_fd  -165.0   165.0  7.7   7.7    mm
/lxphoton/det/magnet_field/distribution  IP  By  y  const  -30.0    30.0   mm
/lxphoton/det/magnet_field/distribution  IP  By  z  f_fd  -616.0   622.0  28.66 28.91  mm
```
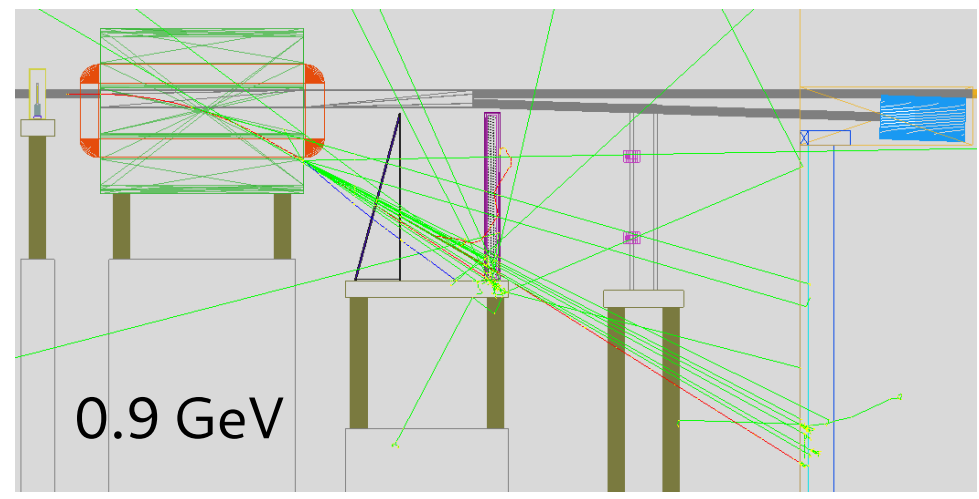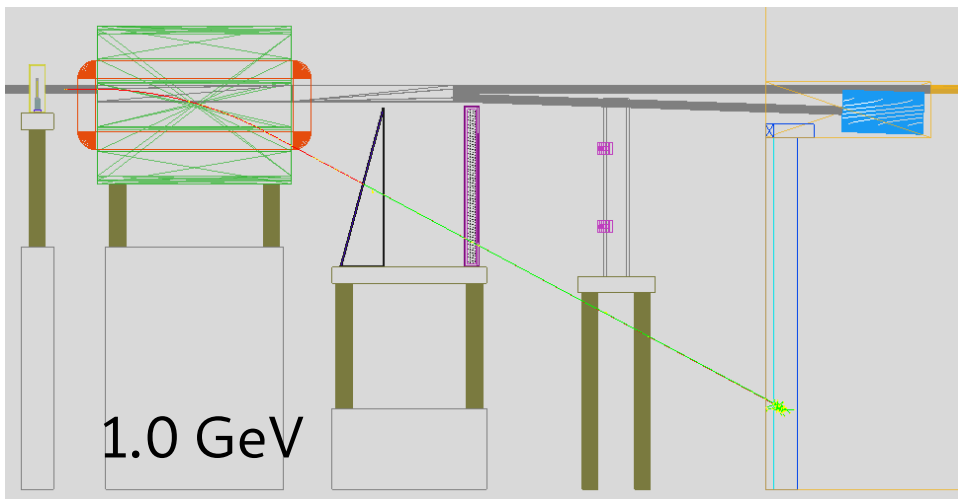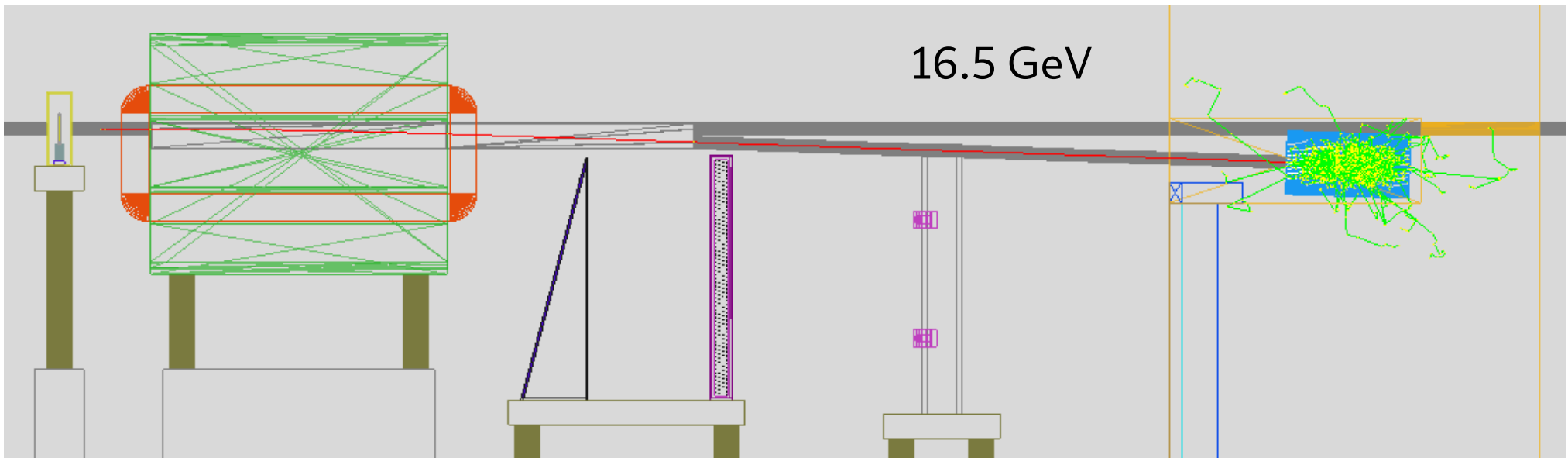
# FLASH magnet after the brems target

Bx: 1.5 T
Bx x const -30.0  30.0  mm
Bx y f_fd -165.0  165.0  7.7  7.7  mm
Bx z f_fd -616.0  622.0  28.66 28.91 mm



16.5 GeV

1.0 GeV

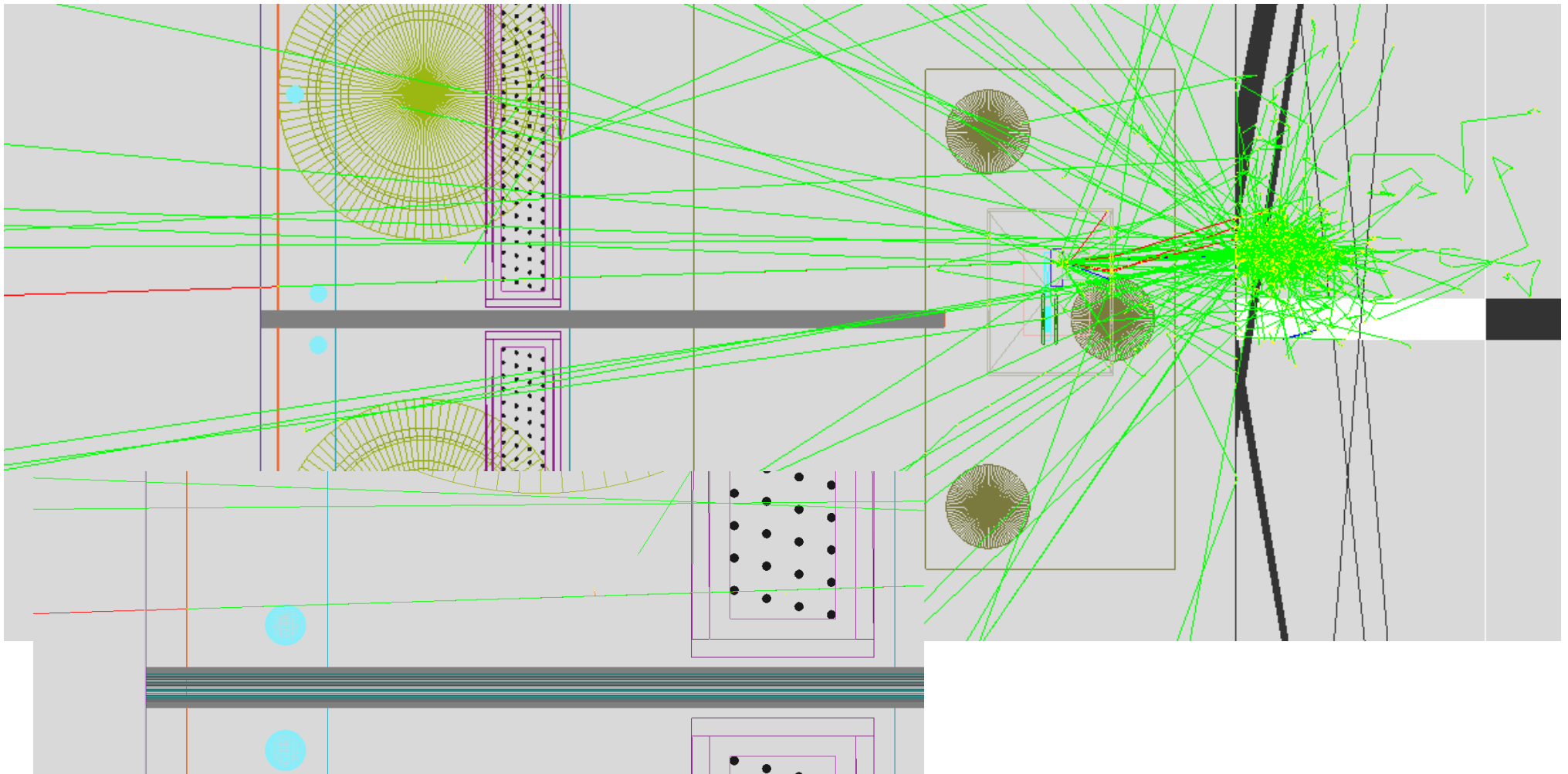0.9 GeV

# FLASH magnet in gamma spectrometer
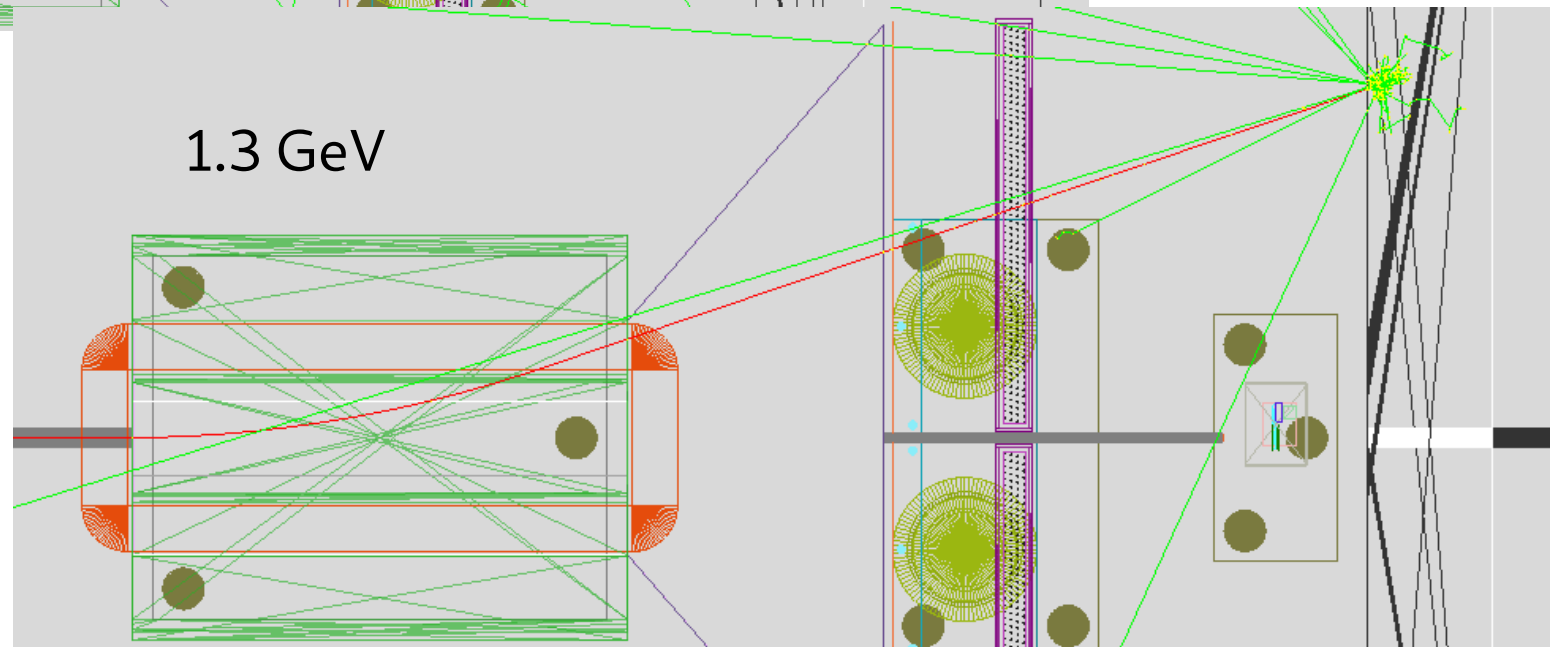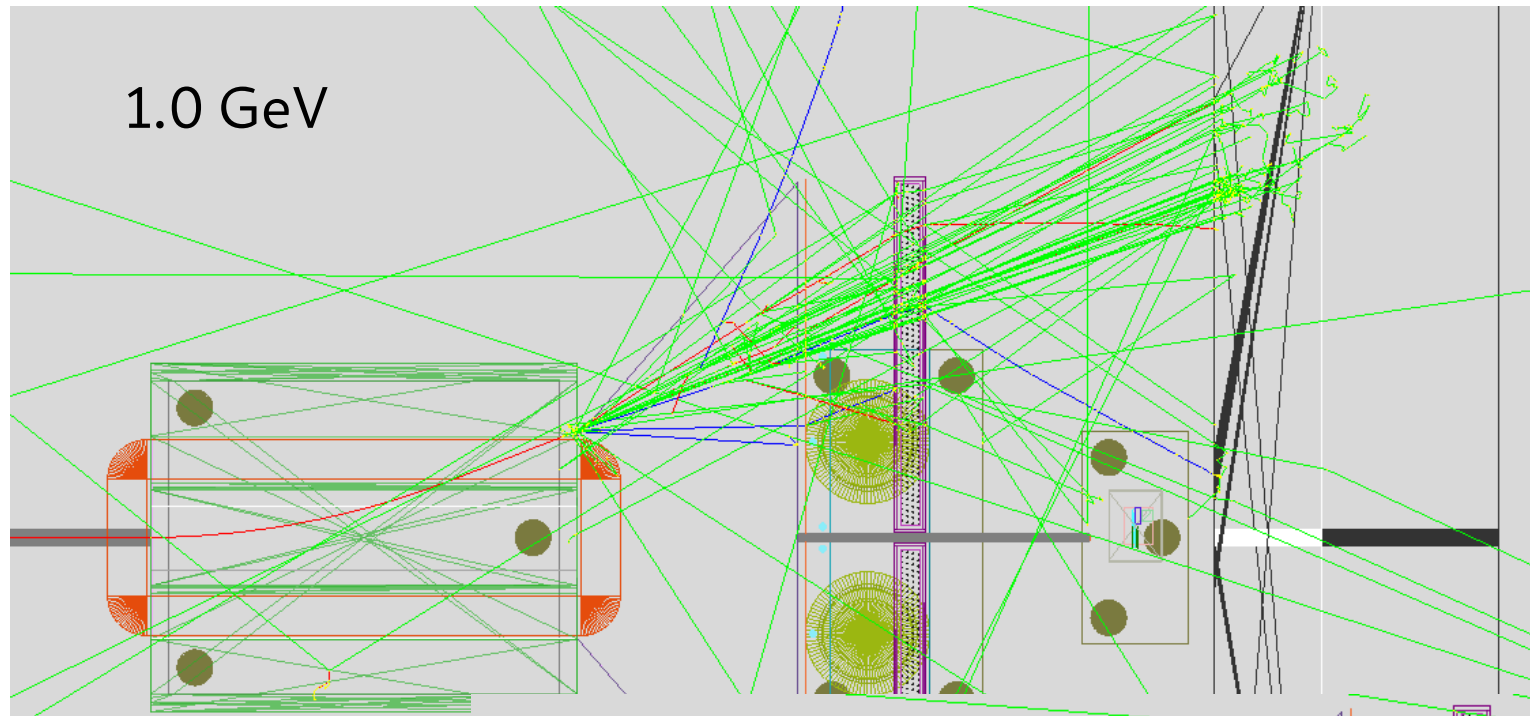
By: 1.4 T
By x f_fd    -165.0  165.0  7.7   7.7   mm
By y const  -30.0   30.0  mm
By z f_fd    -616.0  622.0  28.66 28.91 mm
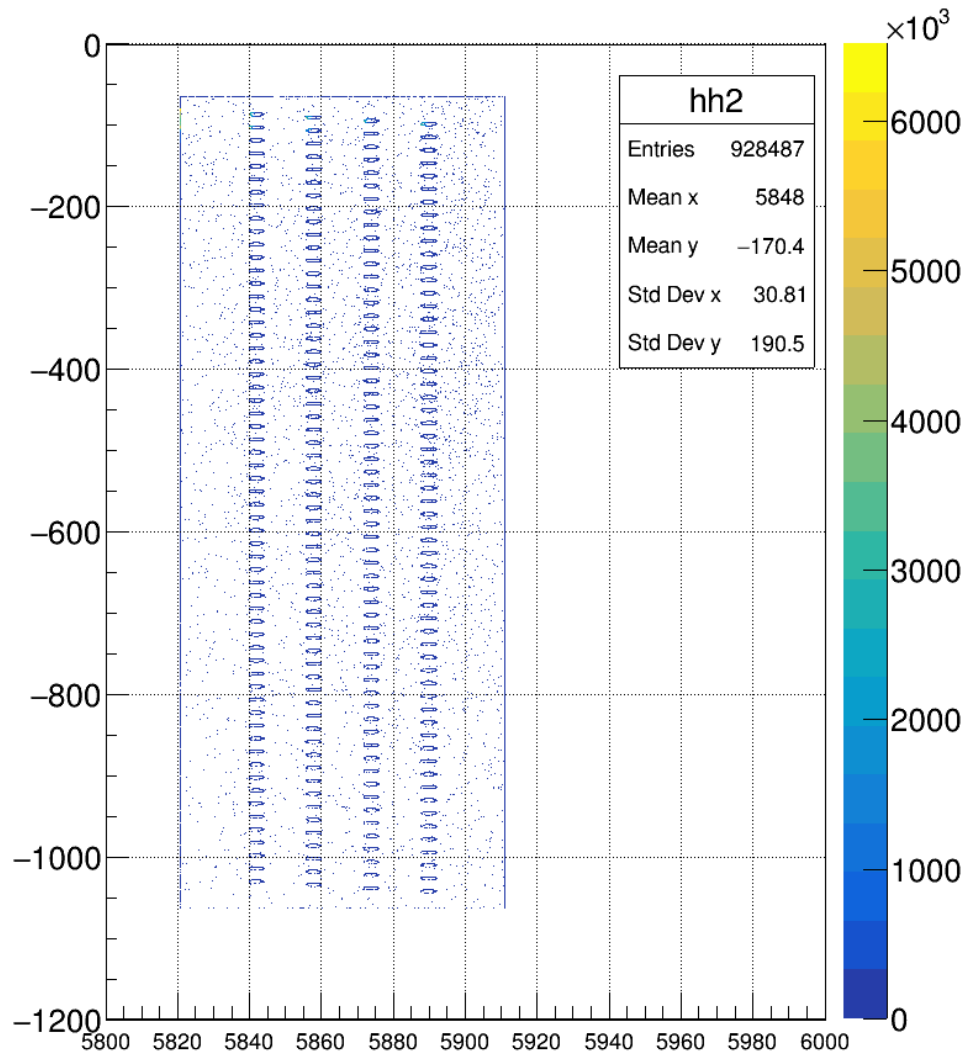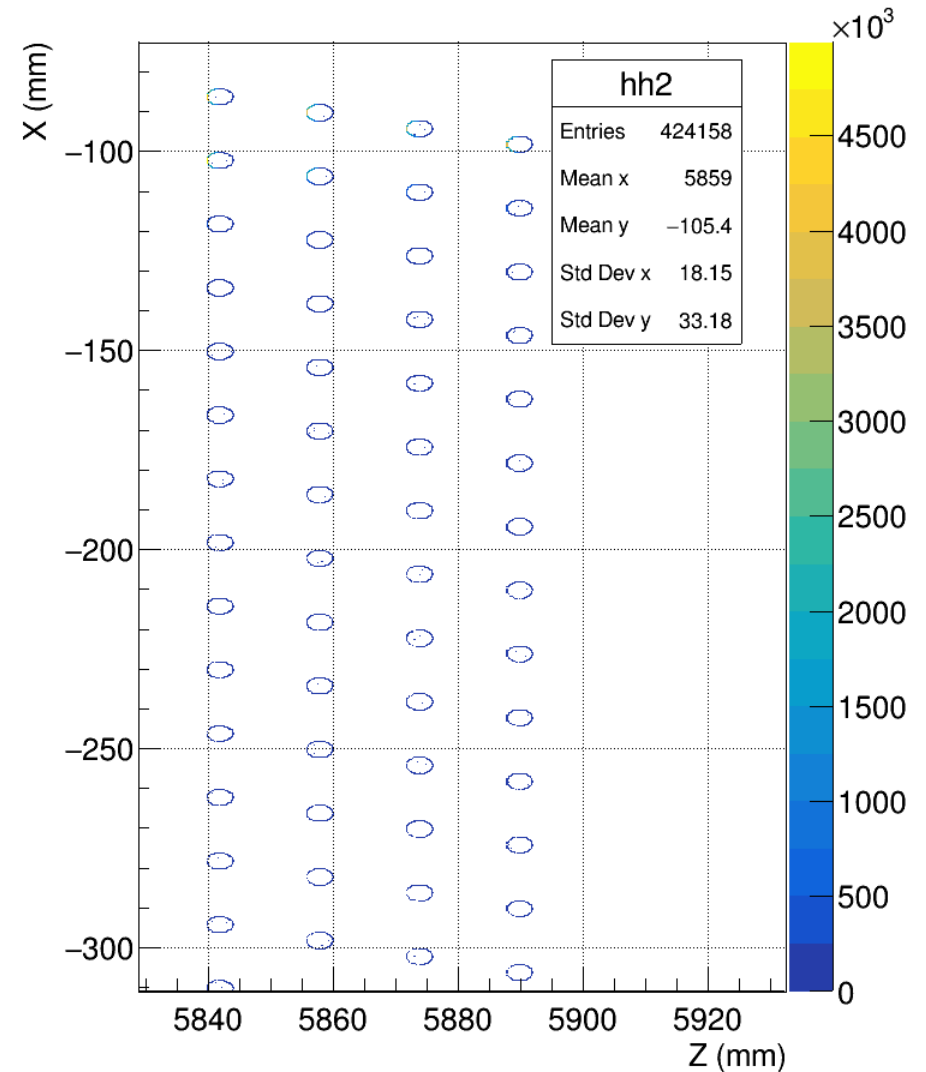
# FLASH magnet in gamma spectrometer



1.0 GeV

1.3 GeV

# HICSElectronCerenkov and CerenkovStrawPhysical

| waist $w_0$ (micron) | e-beam energy (GeV) | $\xi$ | $\chi_e$ | N primaries | BXs | ident | Comments | Updated |
|---|---|---|---|---|---|---|---|---|
| 47.3 | 16.5 | 0.5 | 0.0958 | 1e6 | 10 | e0gpc_0.5_{0-9} | test run, low xi Compton edge | 2021/08/19 |

# CerenkovStrawPhysical

### x:z {detid==11177 && y>-50.0 && y<50.0}

| hh2 | |
|---|---|
| Entries | 896 |
| Mean x | 5787 |
| Mean y | -124.1 |
| Std Dev x | 1.024 |
| Std Dev y | 1.222 |

### E {detid==11177 && y>-50.0 && y<50.0 && (pdg==11 || pdg==-11)}

| hh1 | |
|---|---|
| Entries | 595 |
| Mean | 8.886 |
| Std Dev | 3.589 |
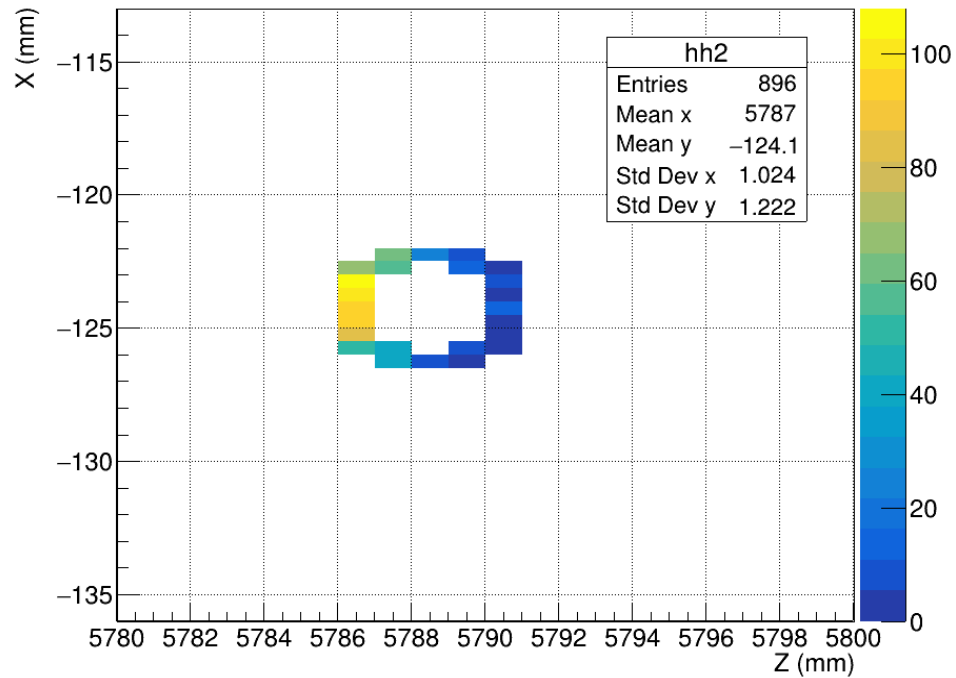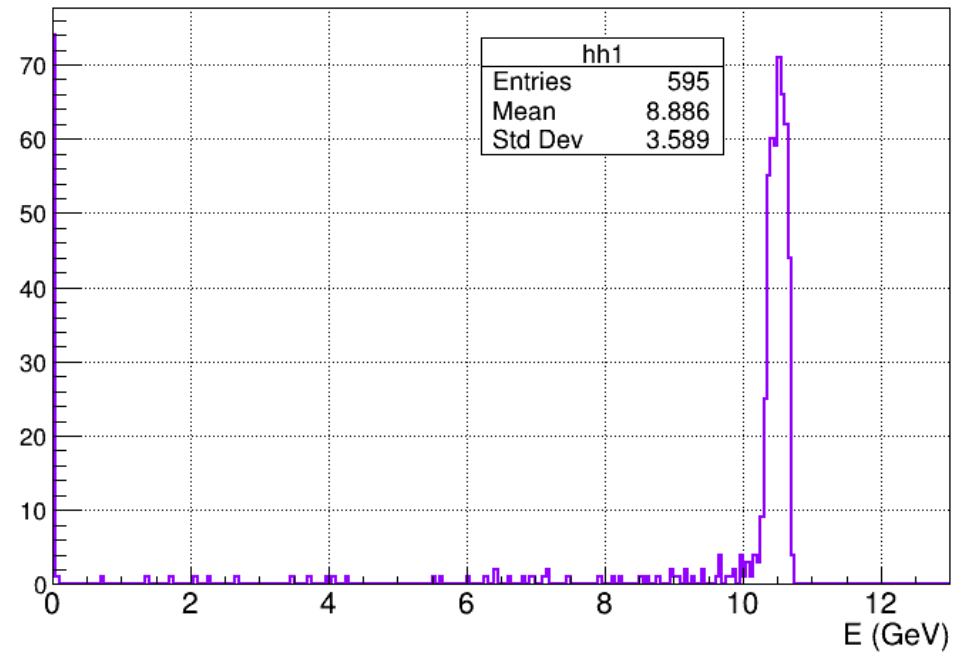
### Spectra of electrons hitting straws of Cherenckov detector
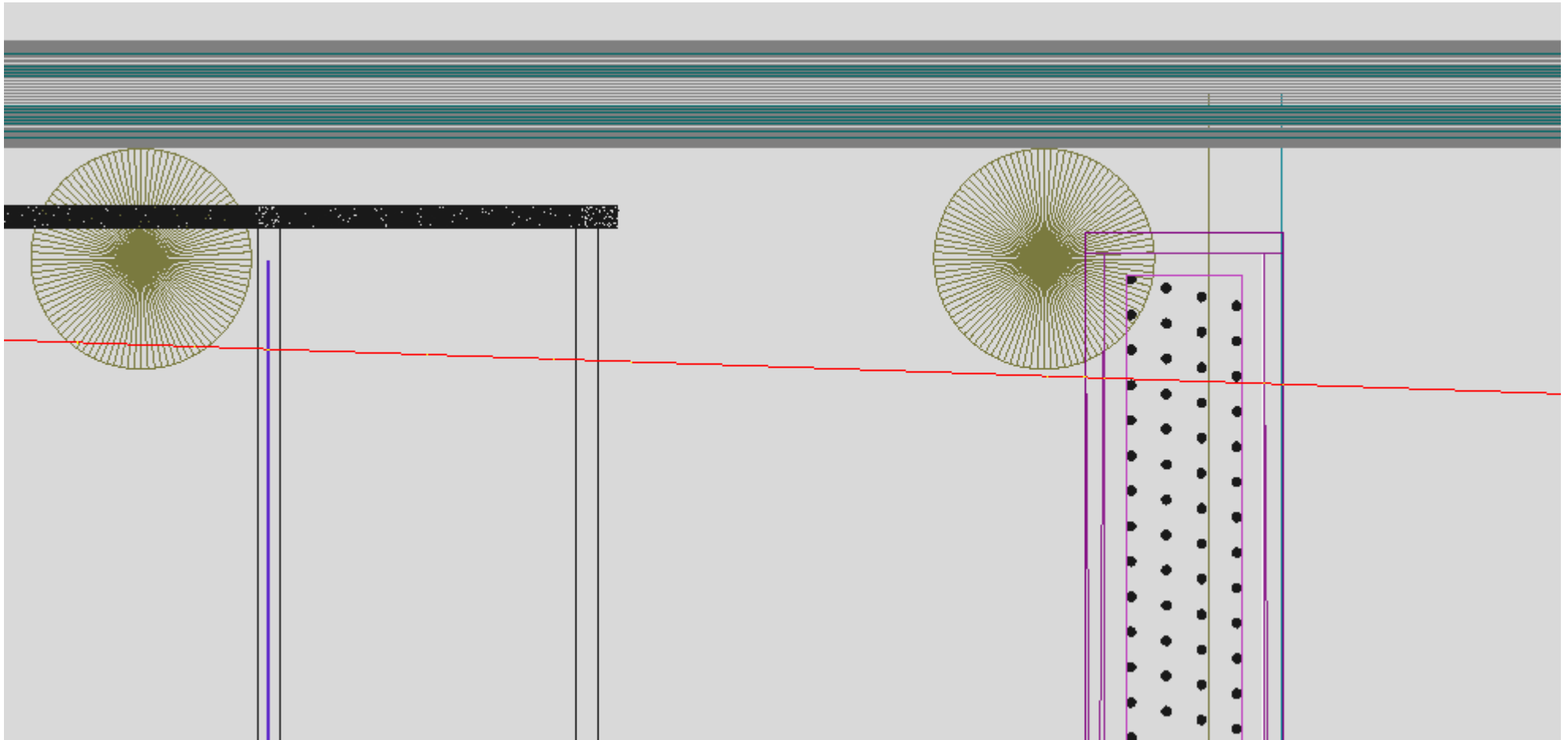
- straw raw 1
- straw raw 2
- straw raw 3
- straw raw 4
- MC true
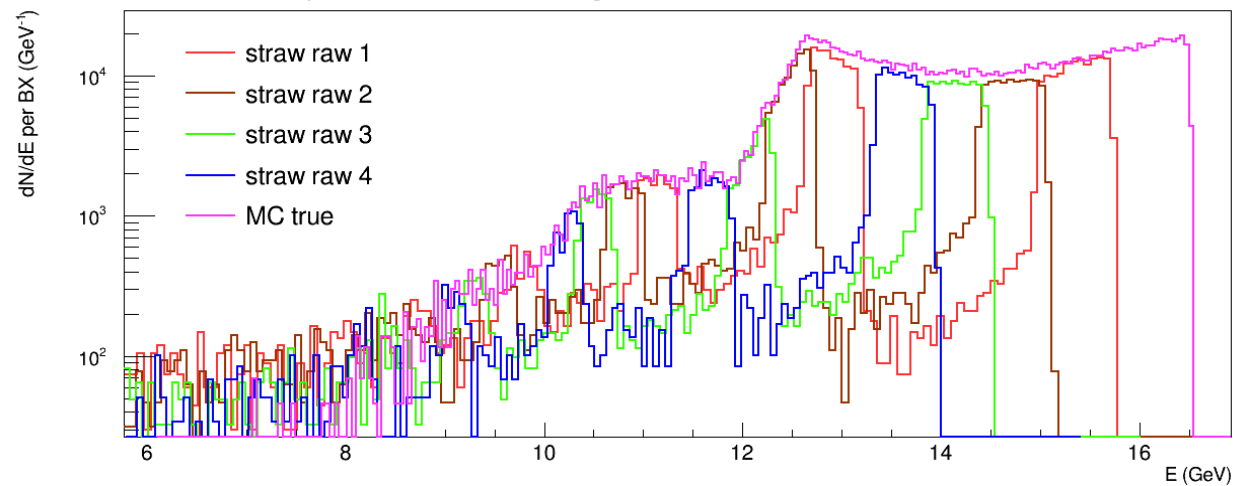
### E {detid==11177 && y>-50.0 && y<50.0 && pdg==11 && physproc==0}

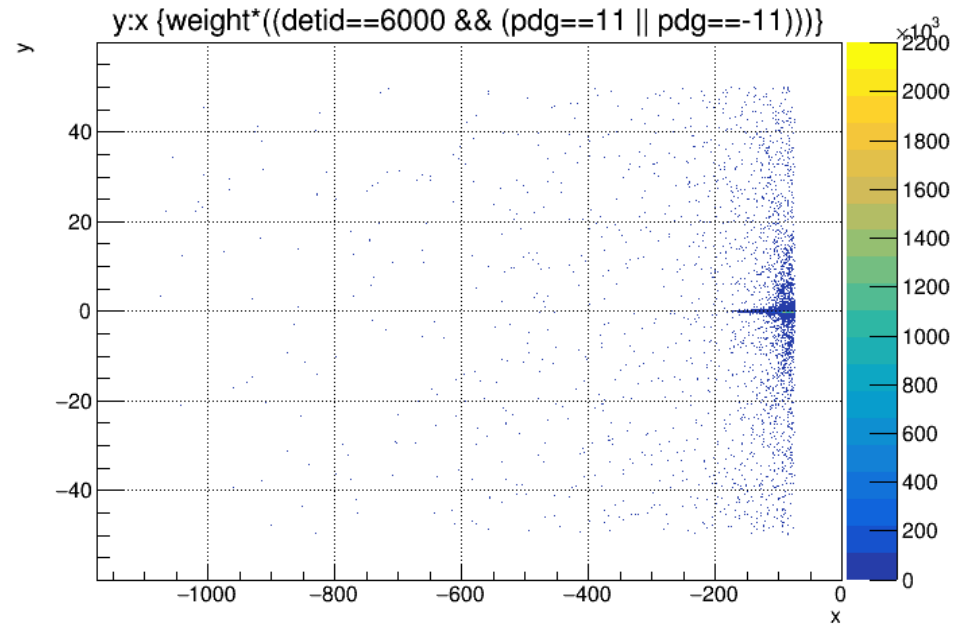| hh1 | |
|---|---|
| Entries | 520 |
| Mean | 10.15 |
| Std Dev | 1.371 |
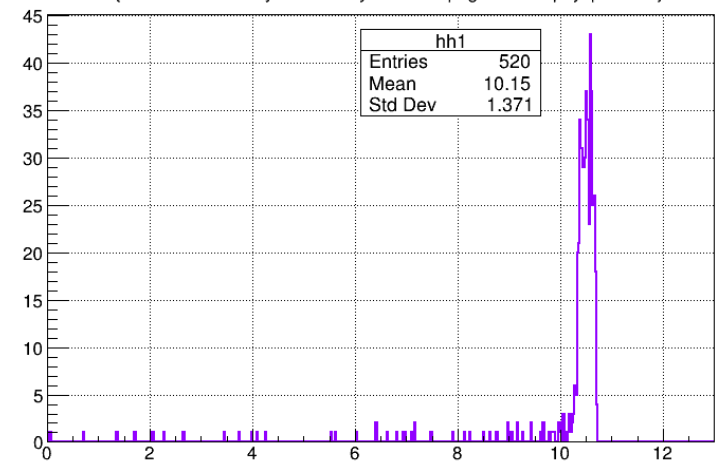
e-, 10 GeV

# Scintillator screen
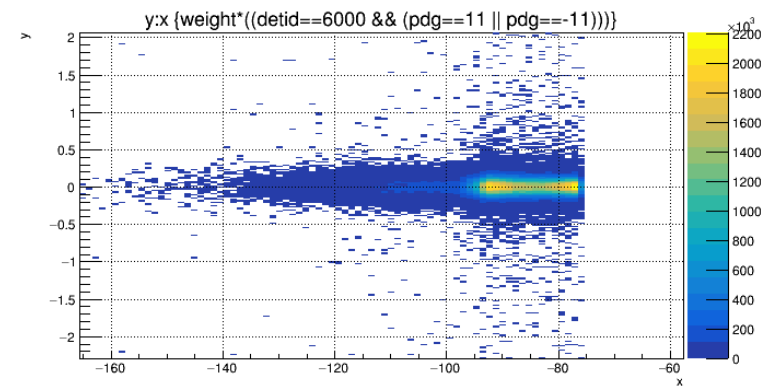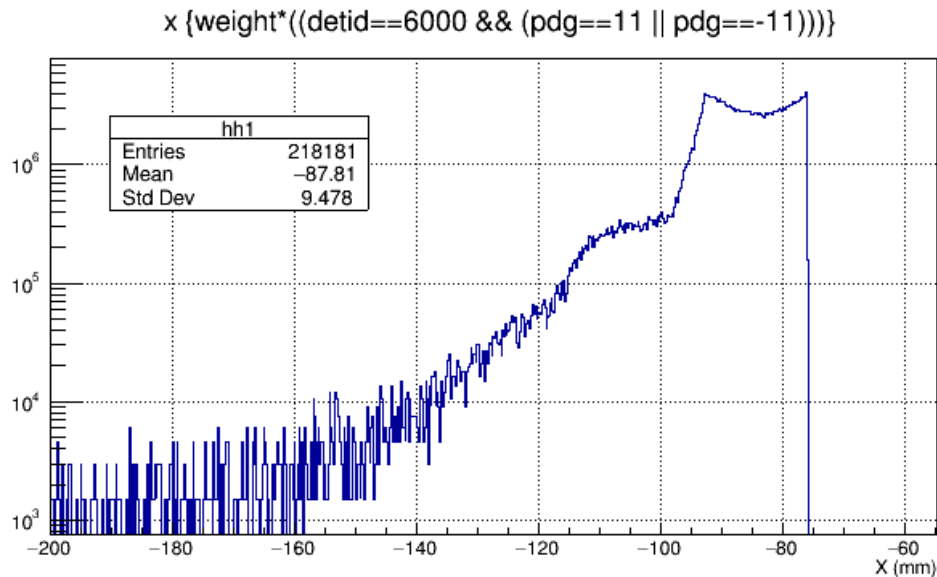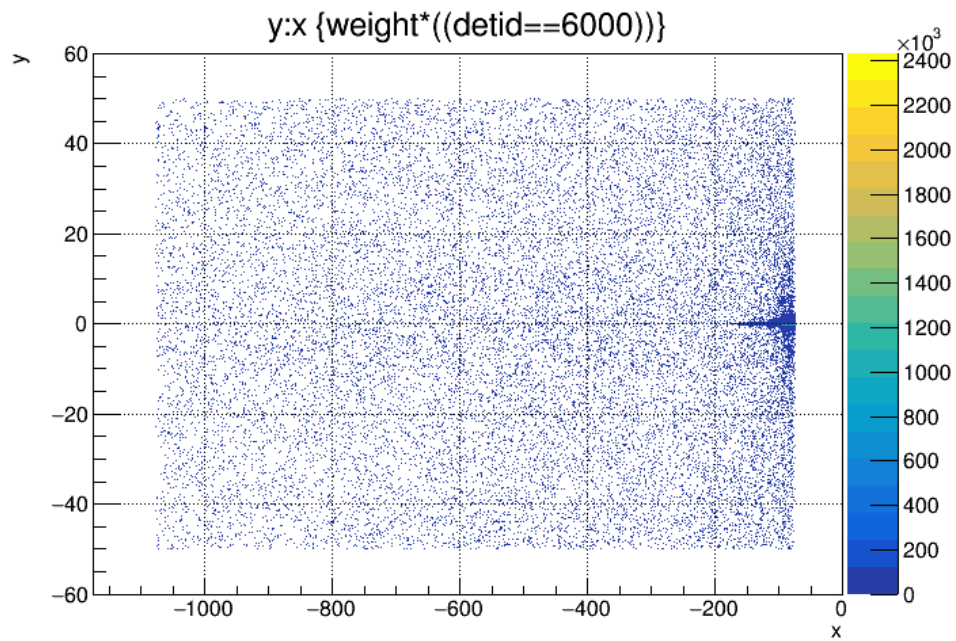
# Gamma spectrometer

- Converting target is 10 um tungsten;

- It is ~0.3% X0;

- 5 BX not enough statistics;

- Roughly with 65k photons per BX, the number of e+(e-):  65k * 5 * 0.003  =  975



x {weight*(detid==3001 || detid==3000)}

# Summary

- Switched to FLASH magnet model in all three places of LUXE geometry.

- The distribution of the By component of the field is approximated by function fitted to the measurements in xz plane and constant in y. Bx=Bz=0.

- Field values are tuned to roughly optimize the acceptance of the detectors.

- Processed ptarmigan MC for low $\xi$.

- The performance of electron detectors looks reasonable.

- Jobs for higher $\xi$ completed, checking them.