THE PARTICLE PEERS

THE SHAPE AND DEVELOPMENT OF AN ELECTROMAGNETIC SHOWER

THE PARTICLE PEERS

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THE PARTICLE PEERS

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- Theory
- Research question
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- Set-up
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- Discussion
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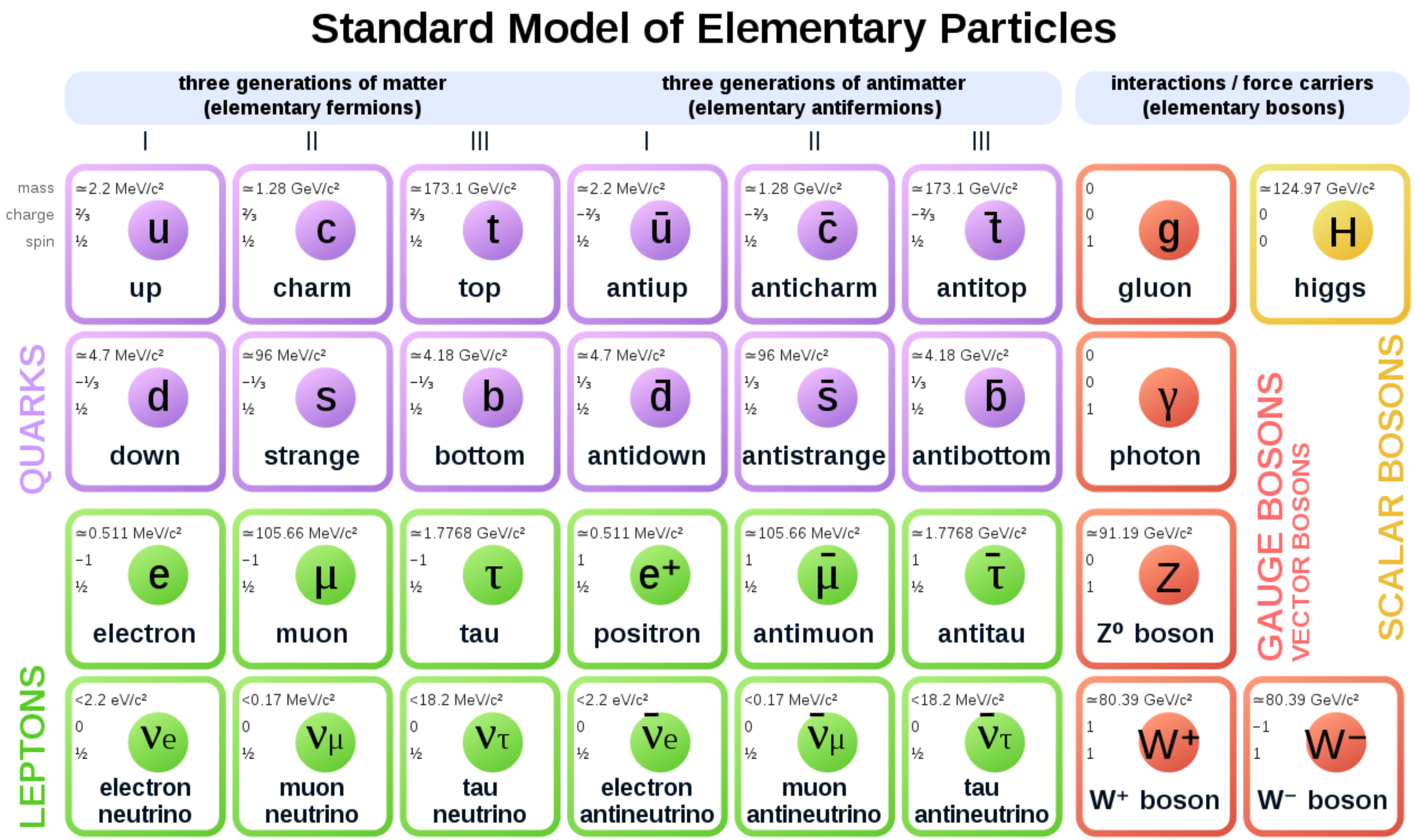
STANDARD MODEL



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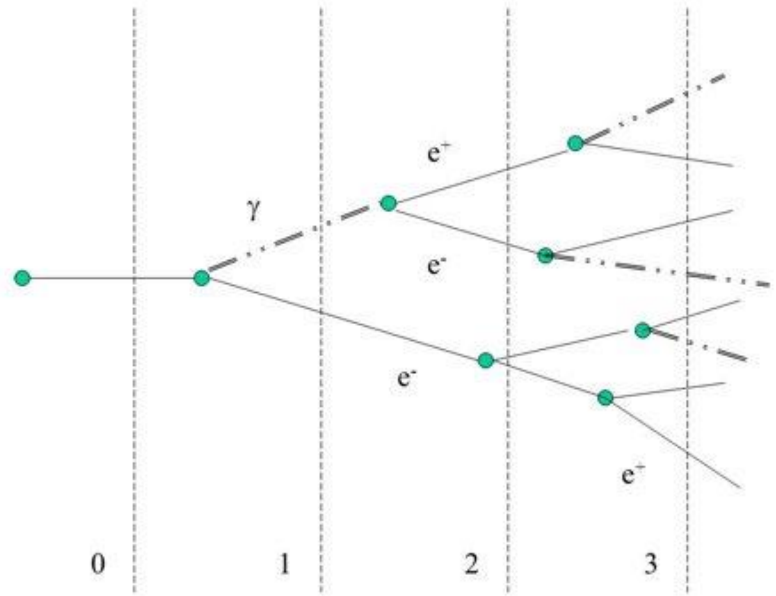
ELECTROMAGNETIC SHOWER



- 3 types of particles involved:

  Electrons e^-

  Positrons e^+

  Gamma rays (γ)

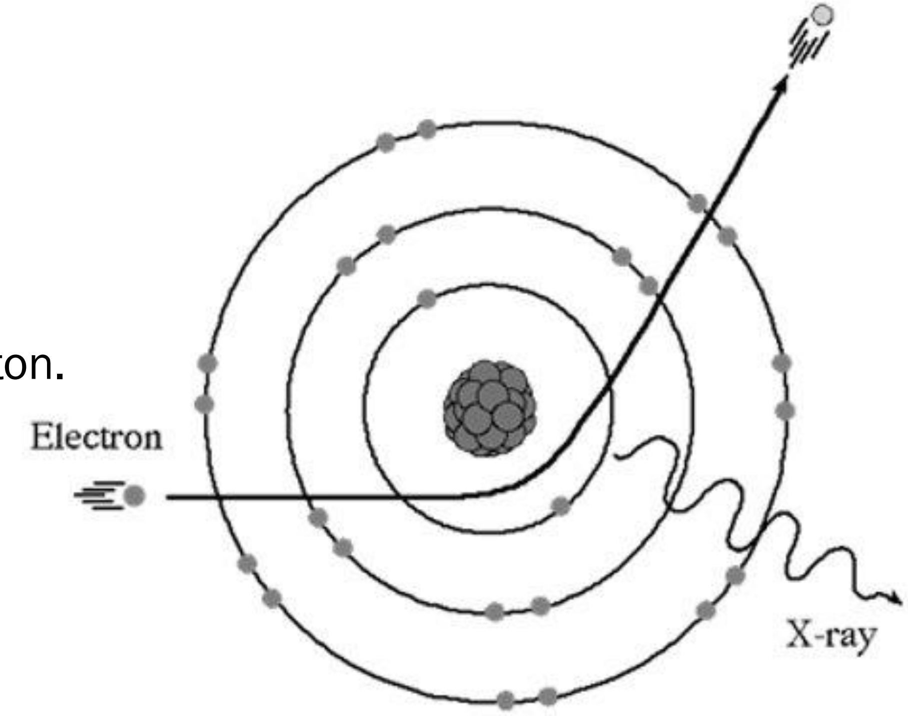
- 2 kinds of processes in the shower: bremsstrahlung & pair production

BREMSSTRAHLUNG

- Electron or positron interacting with a nucleus

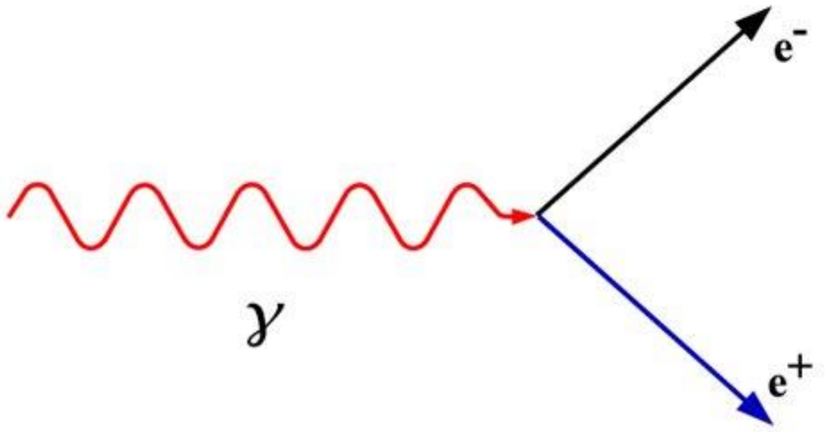
  -> emitting a photon

- When the electron or positron interacts closer with the nucleus, it will transfer more energy to the emitted photon.



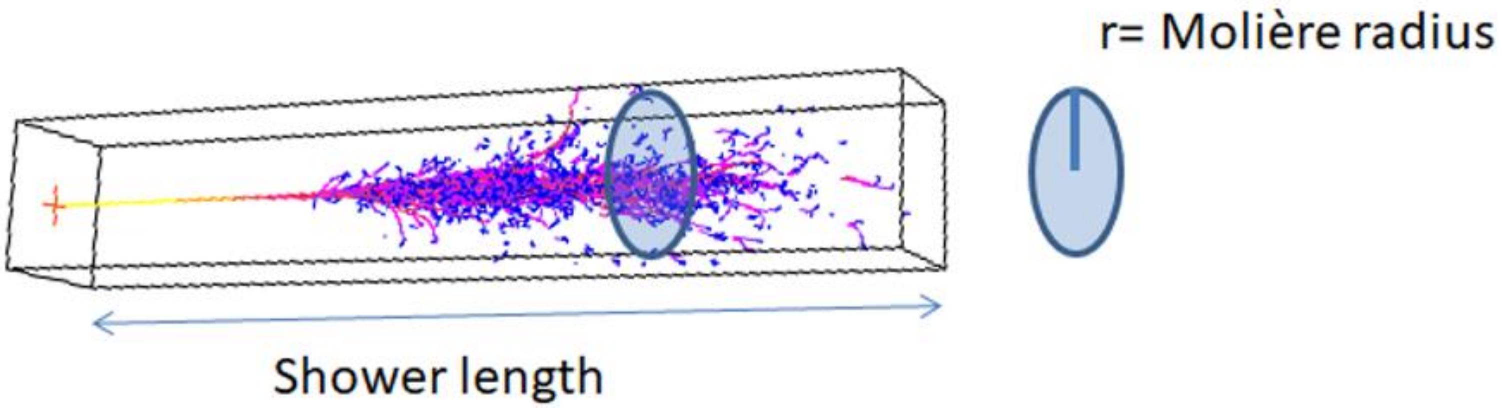
PAIR PRODUCTION

- A photon interacting with a nucleus -> creating an electron and positron pair
- The created electron and positron will have the same energy



SHOWER SHAPE

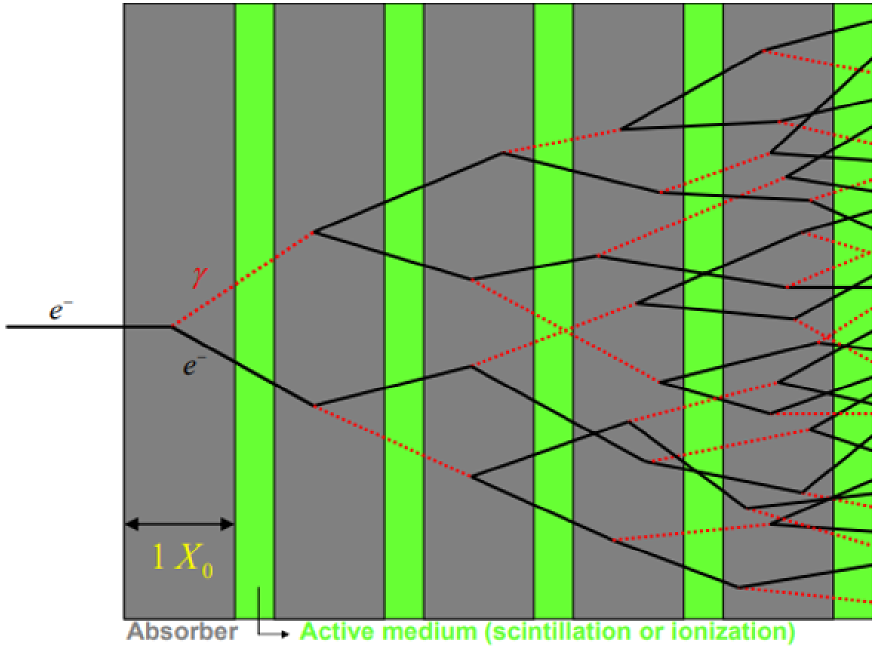
- Molière radius
- Shower length



RADIATION LENGTH -> SHOWER LENGTH

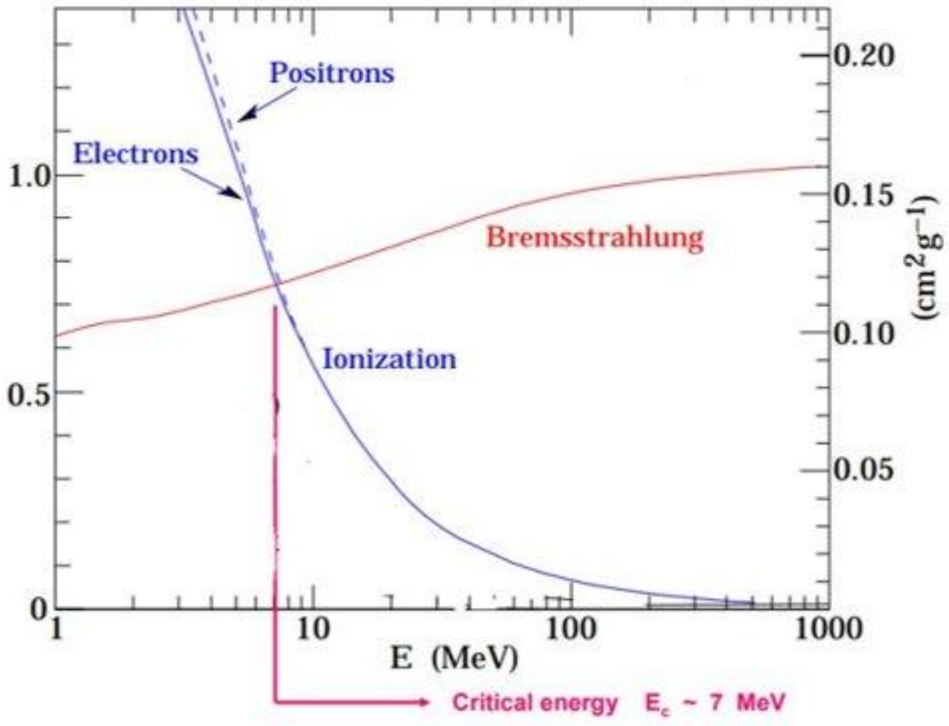
- The radiation length (X_0) is the length which is necessary for one pair production

- The shower length is the length of the entire particle shower



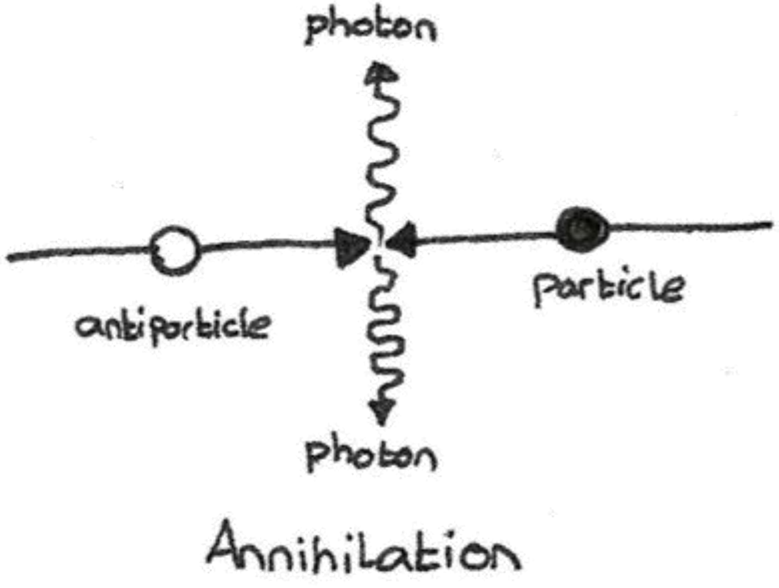
CRITICAL ENERGY

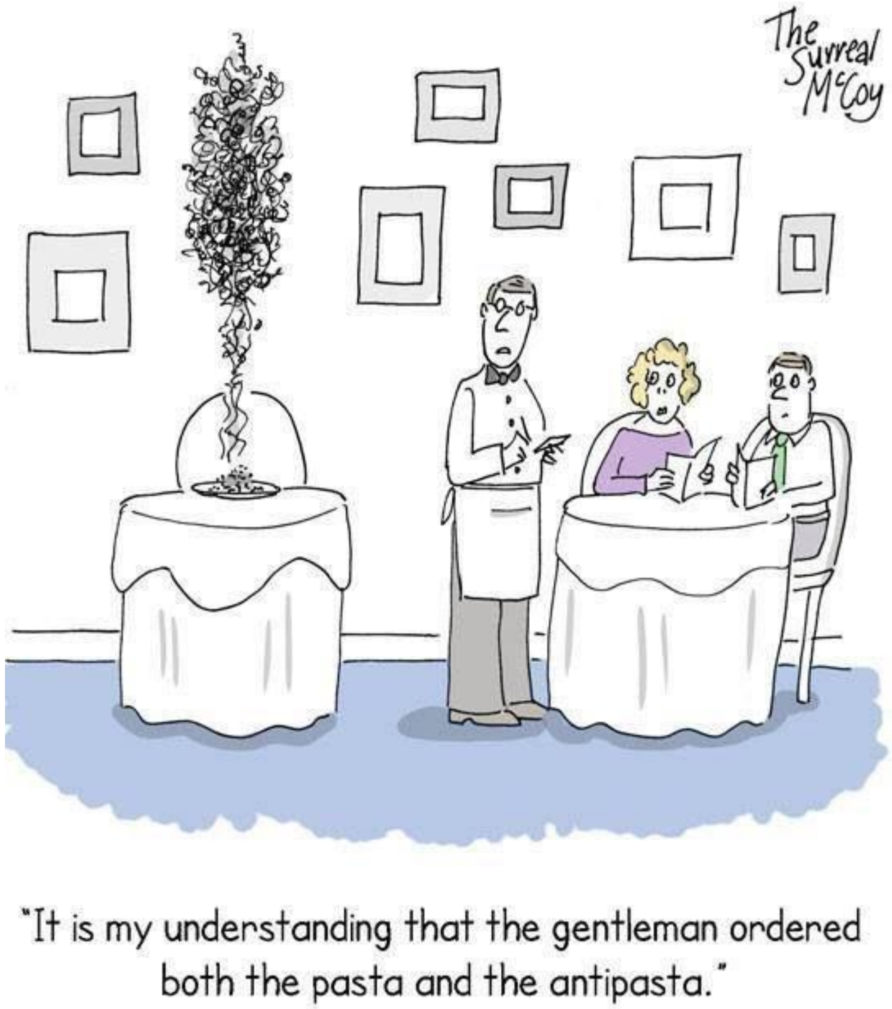
- The critical energy (E_{crit}) is the energy at which the chance of bremsstrahlung (thus pair production) is equal to ionization.



ANNIHILATION

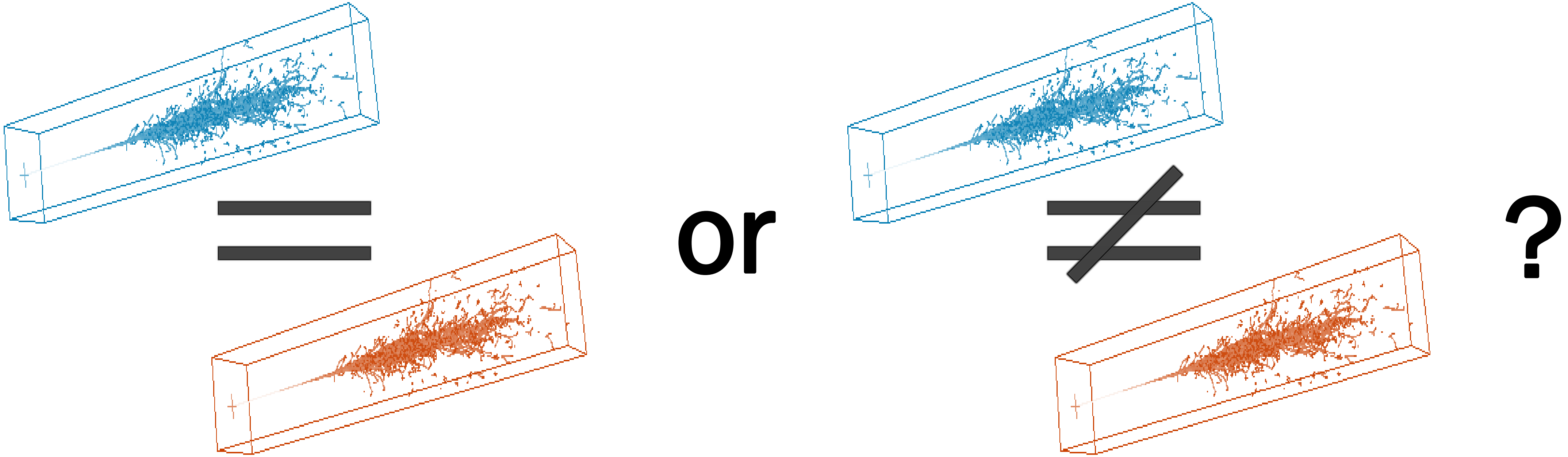
- Electron + positron -> two photons
- Might cause difference between the showers



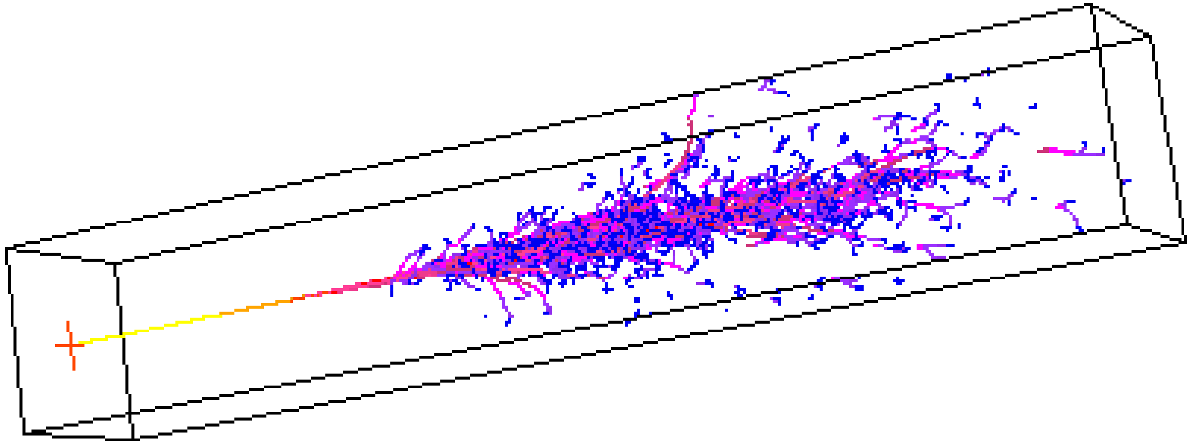


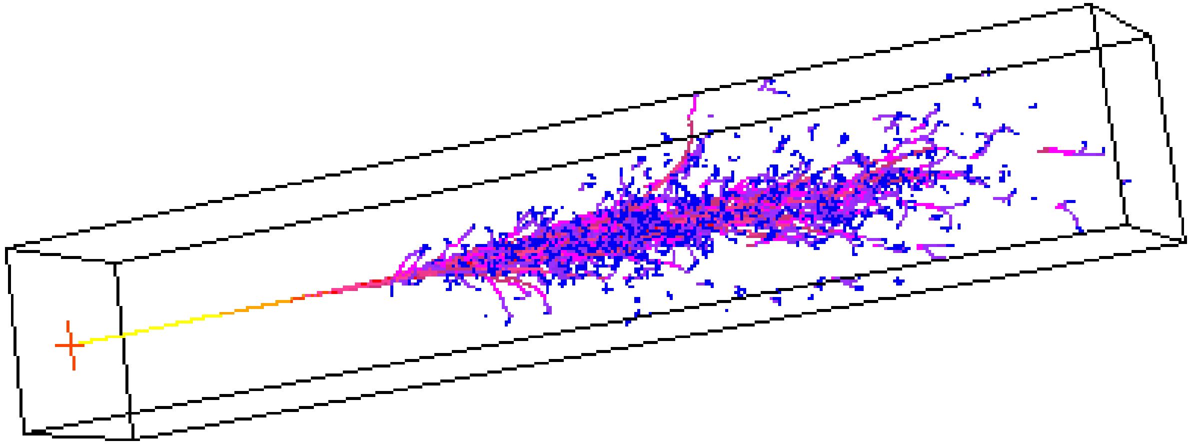
RESEARCH QUESTION

- Is there a difference in the shape and development of an electromagnetic shower created by electrons and an electromagnetic shower created by positrons?



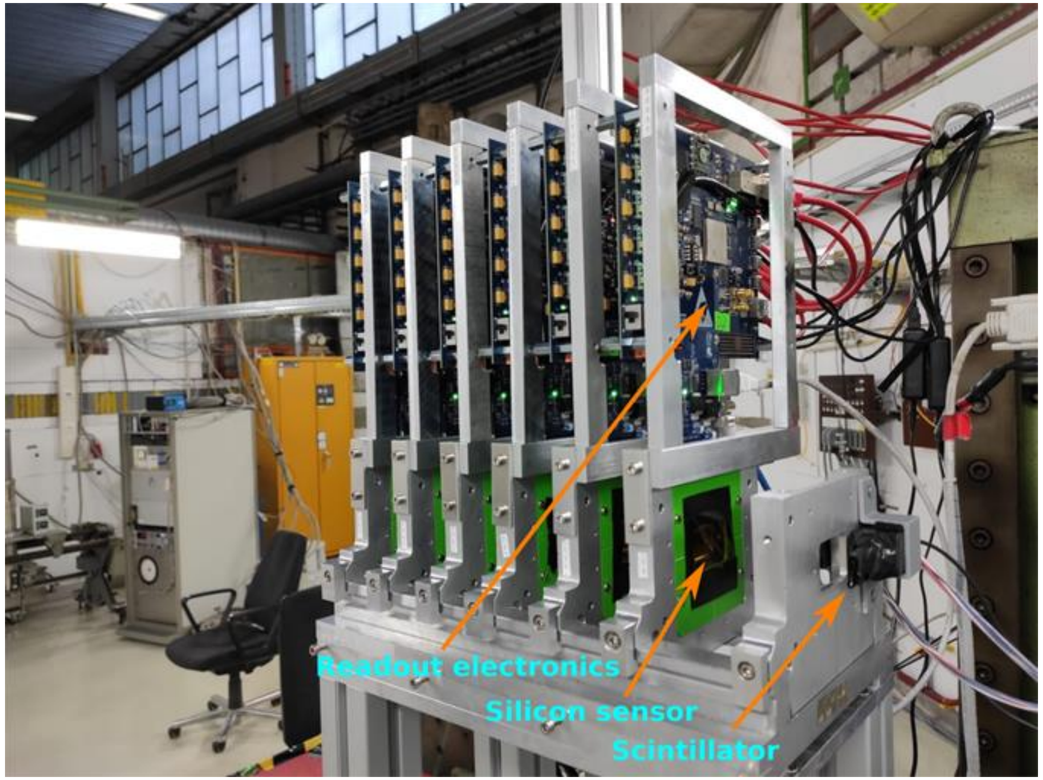
EXPECTATIONS

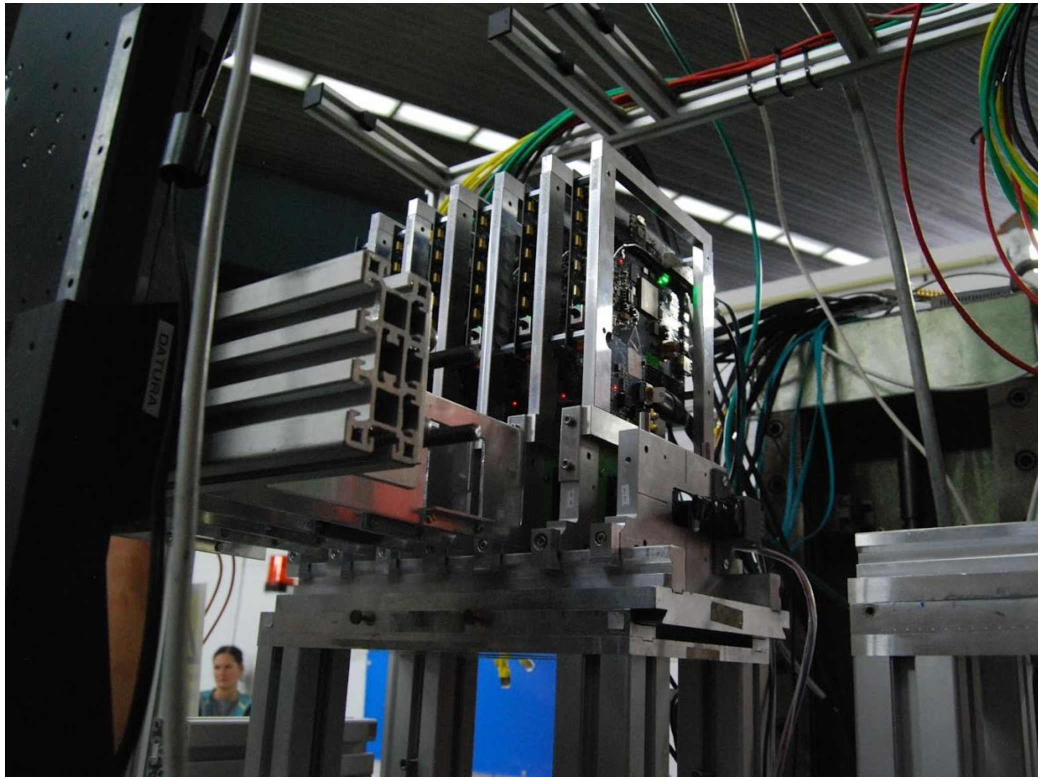




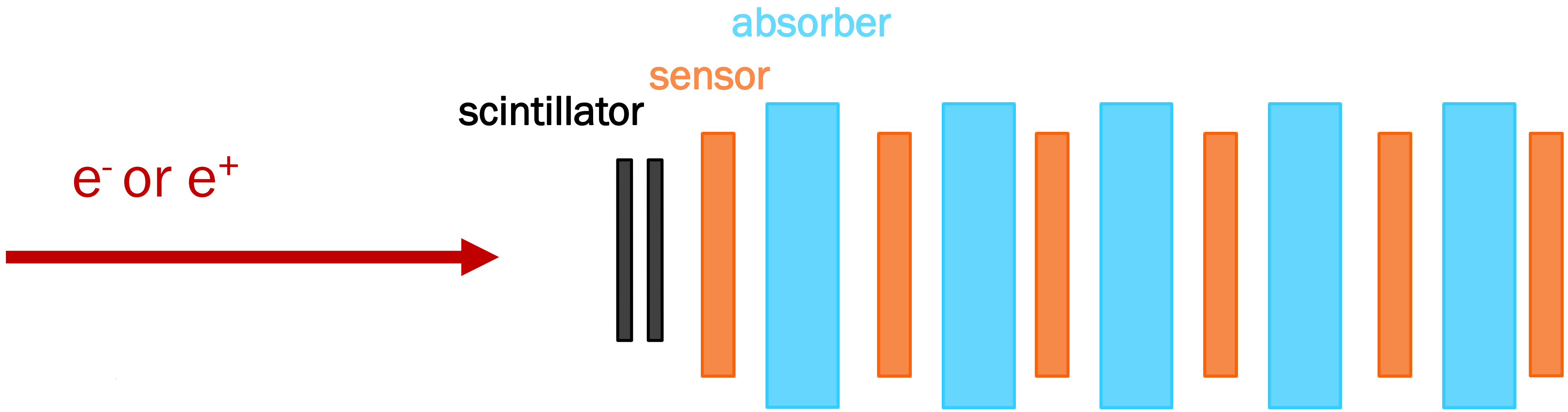
SET-UP

Beam telescope





THE SET-UP



TUNGSTEN

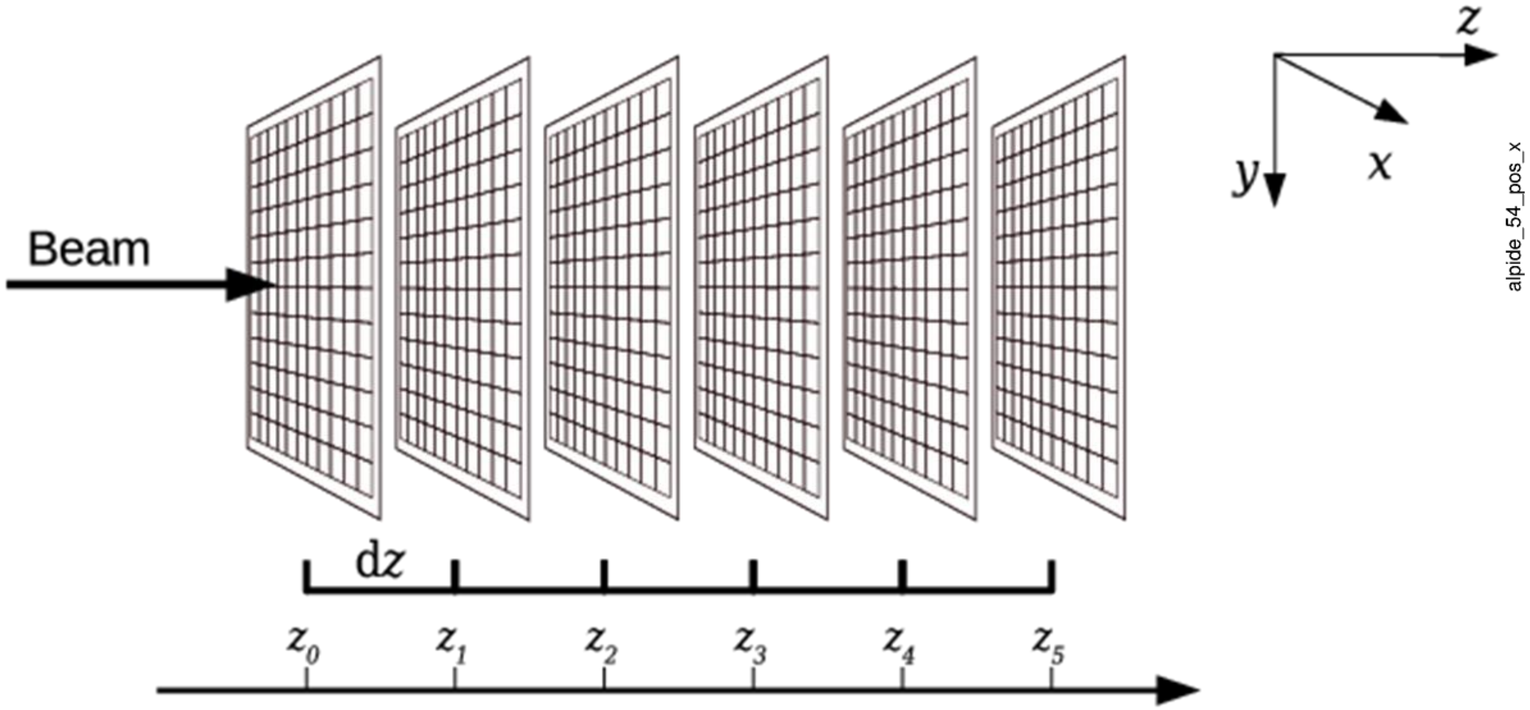
- High density of 19.28 g/cm³
- Molière radius = 0,9327 cm
- Radiation length = 0,3534 cm
- Shower length

1 GeV = ca. 2,45 cm	6,3 GeV = ca. 3,38 cm

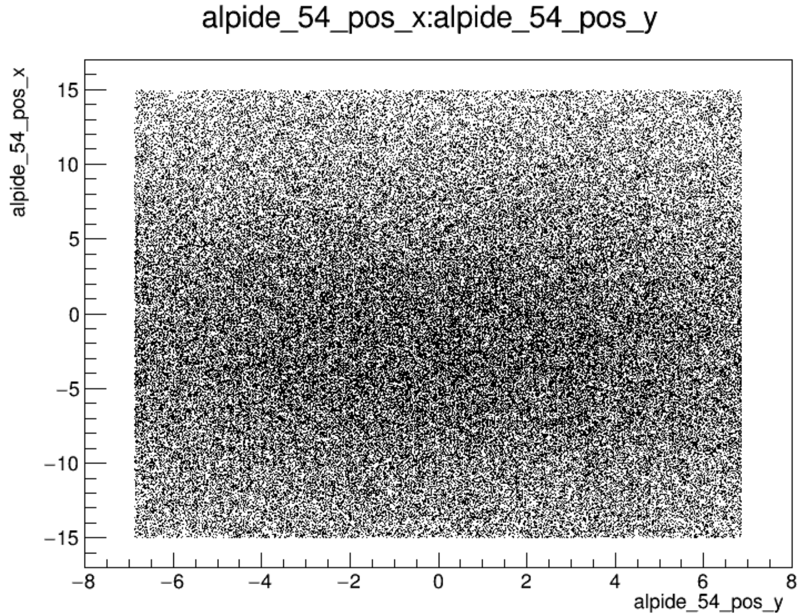
COPPER

- High density of 8,96 g/cm³
- Molière radius = 1,598 cm
- Radiation length = 1,436 cm

DATA TAKING



Beam
dz
z_0
z_1
z_2
z_3
z_4
z_5
z
y
x



alpide_54_pos_x:alpide_54_pos_y
alpide_54_pos_x
alpide_54_pos_y

DATA TAKING

- Set-up 1:

  - 14 mm of Tungsten

- Set-up 2:

  - 4 mm of Tungsten

- Set-up 3:

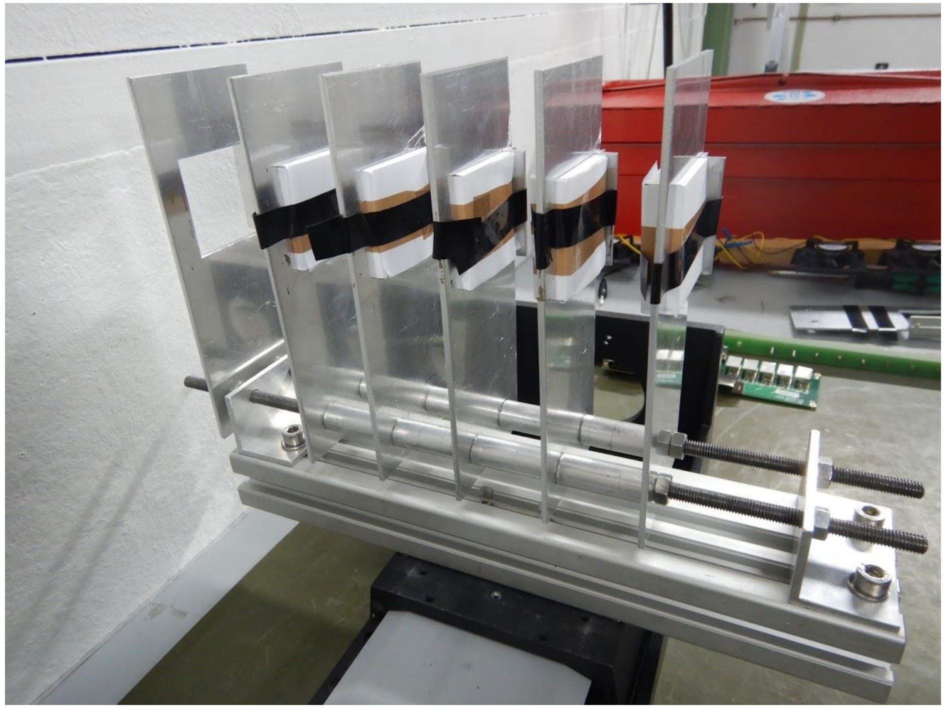
  - 2 mm of Tungsten

- Set-up 4:

  - 9 mm of Tungsten

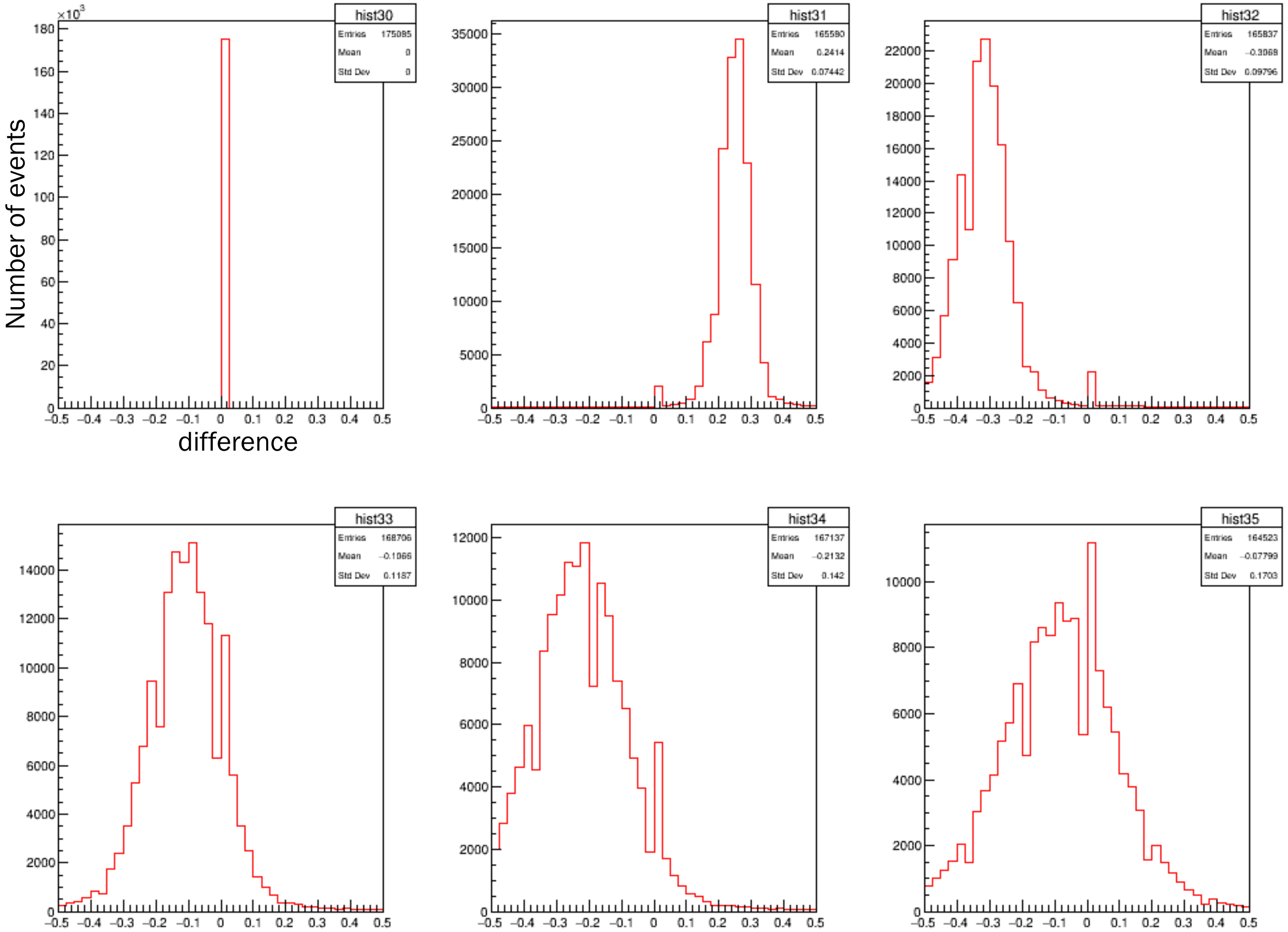
- Set-up 5:

  - 40 mm of Copper



ANALYSIS

- **Alignment**
- Clusters
- Molière radius
- Number of clusters
- 3D model



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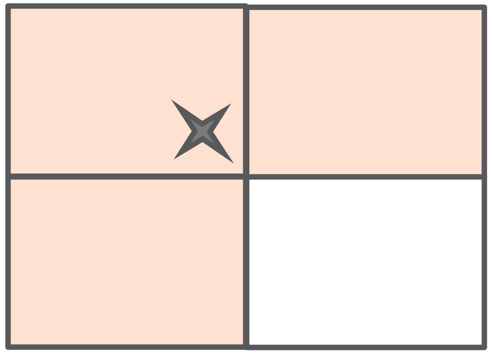

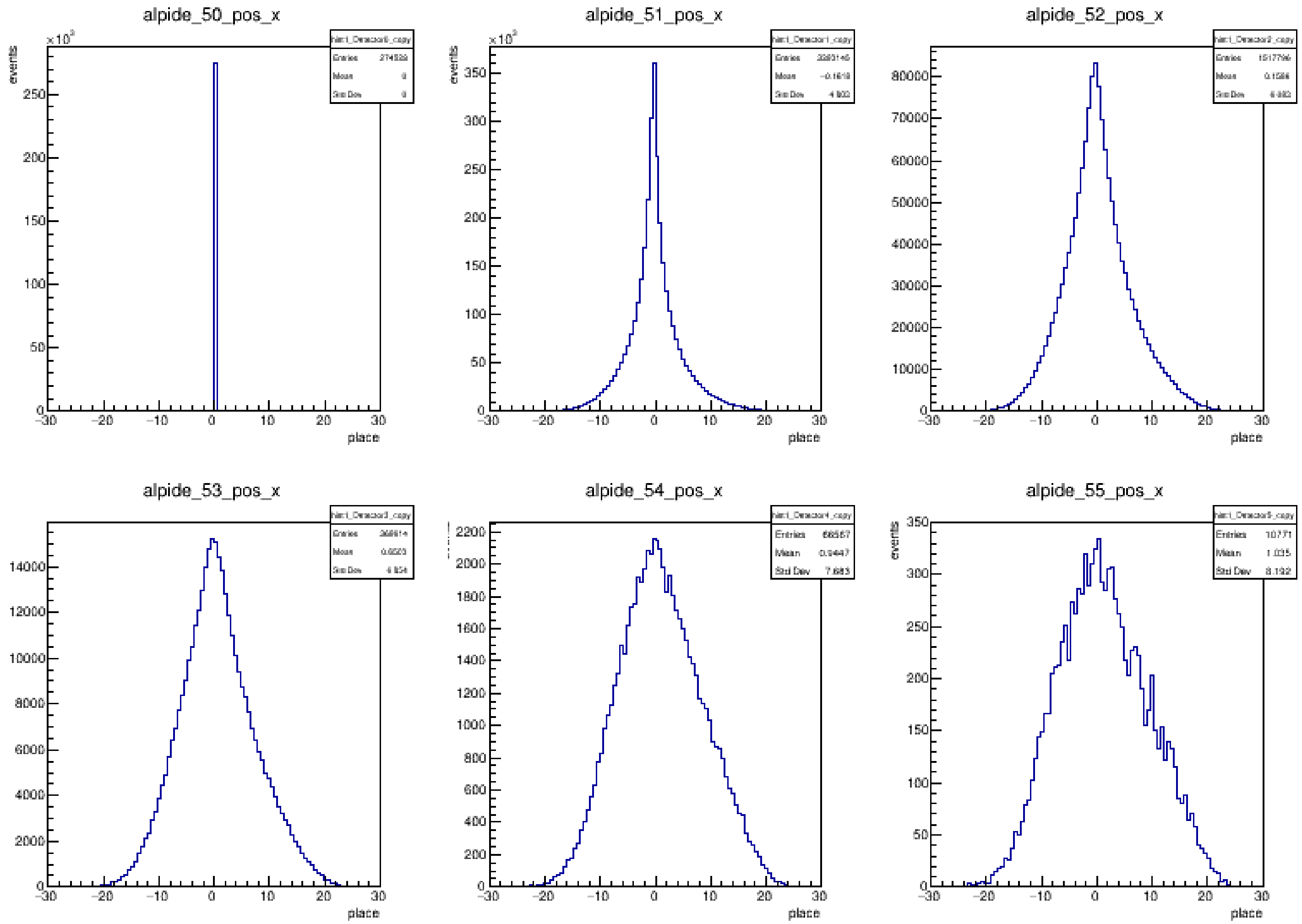

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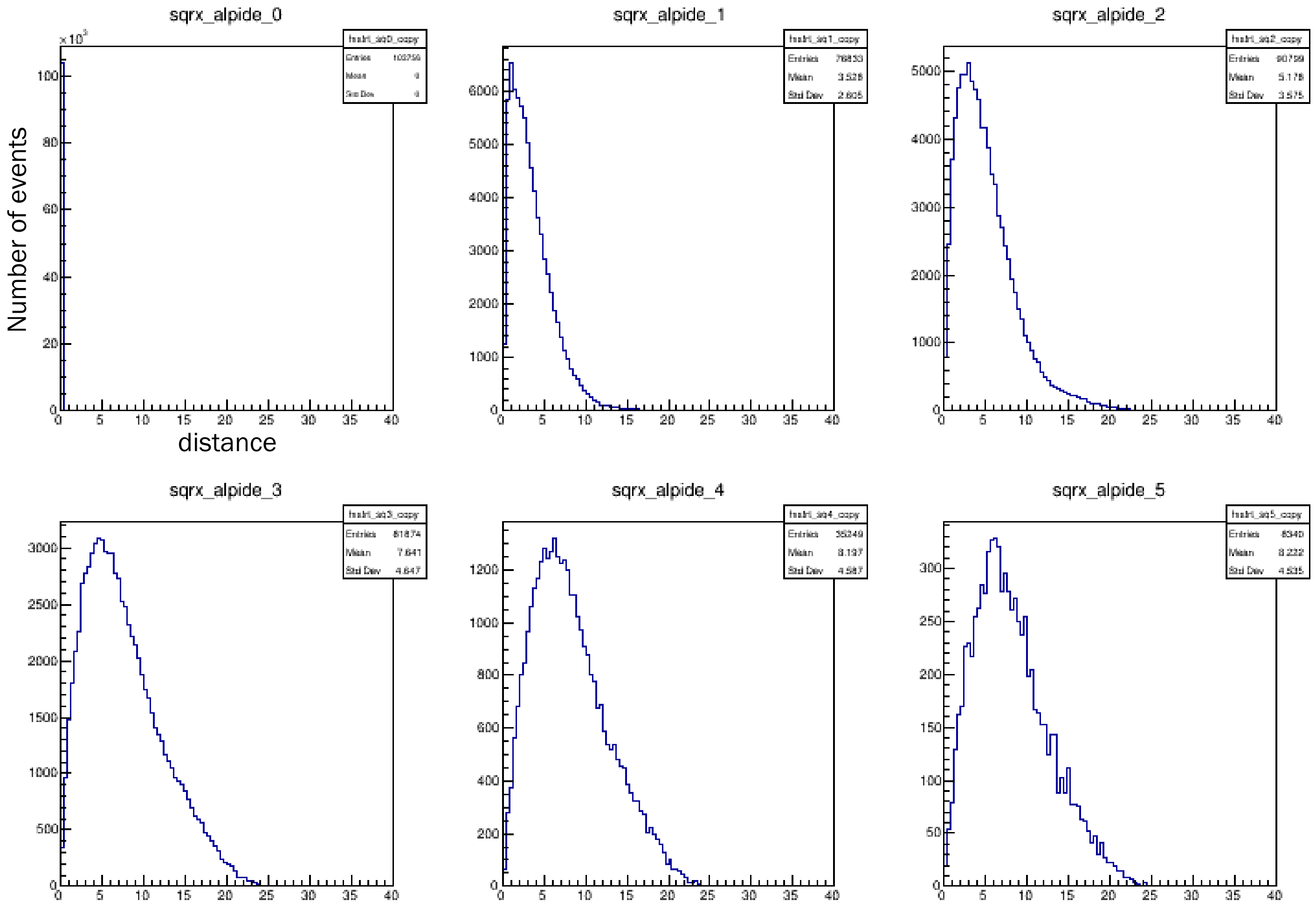

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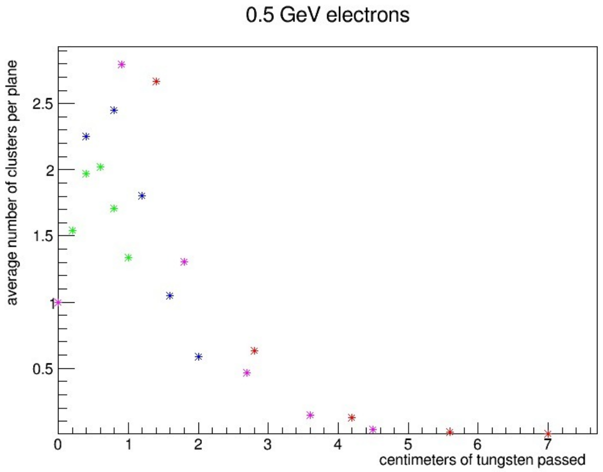
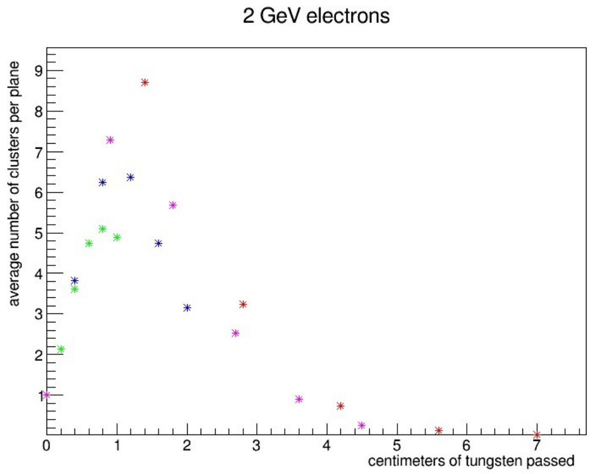
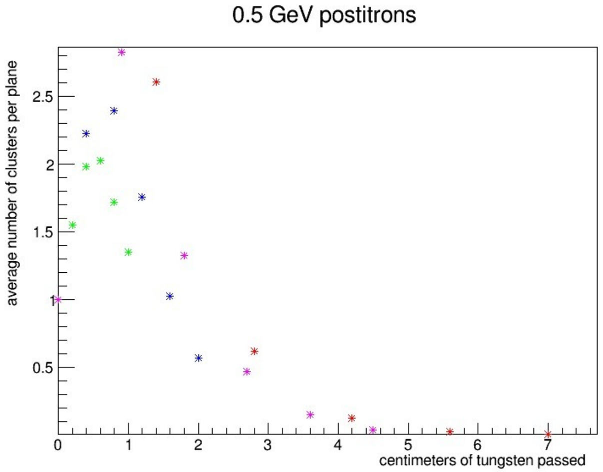
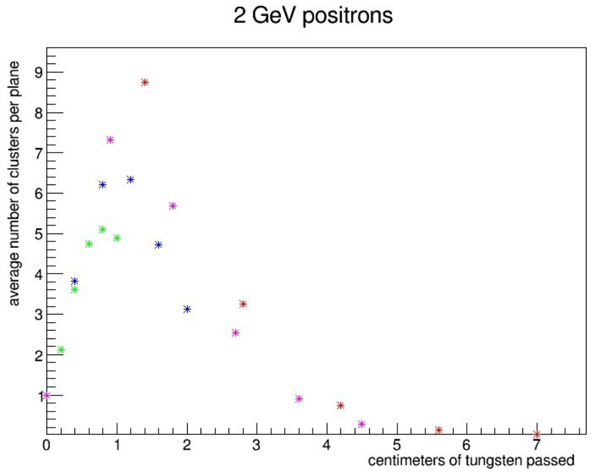
Green	2mm
Blue	4mm
Pink	9mm
Red	14mm









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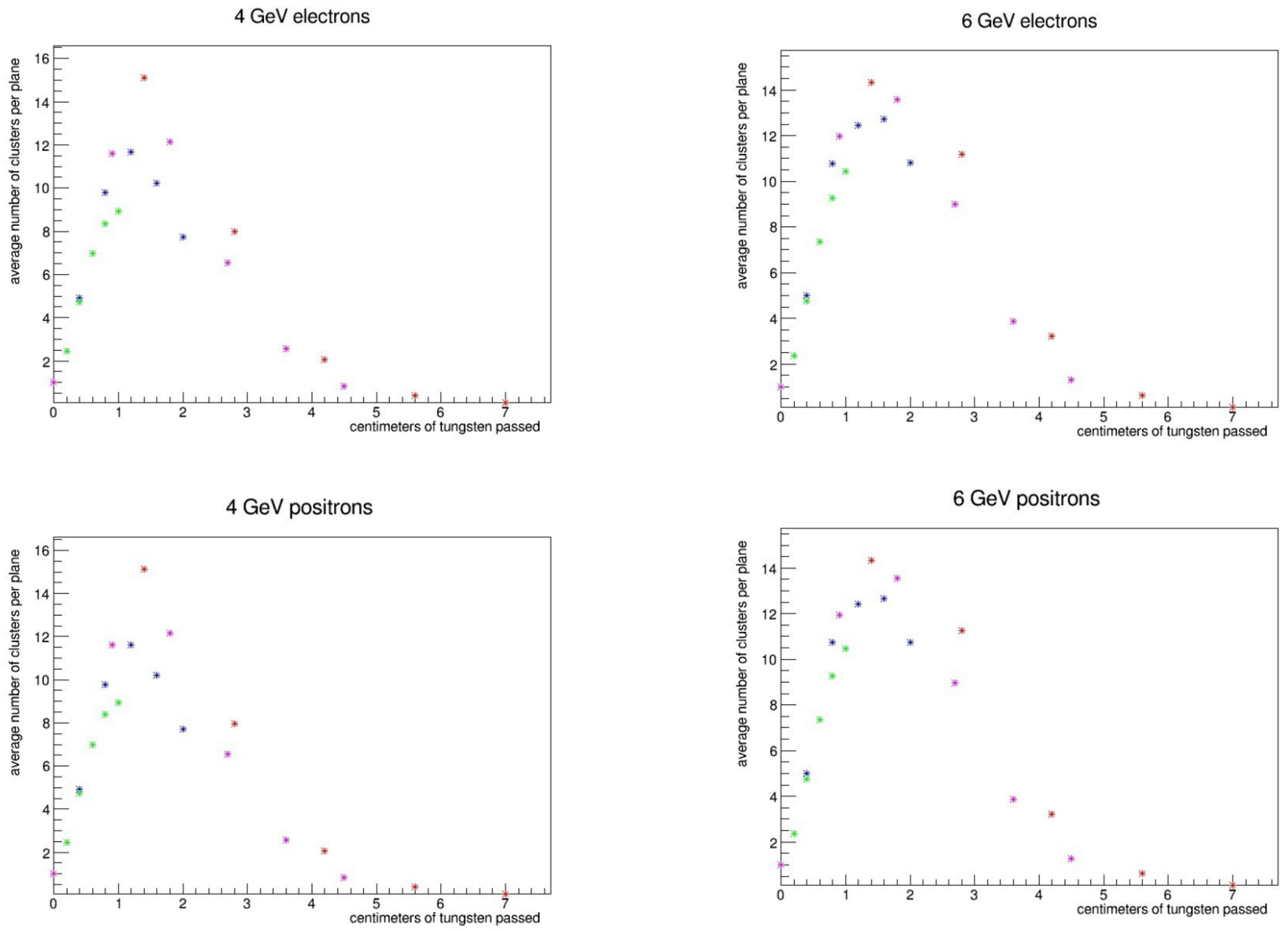

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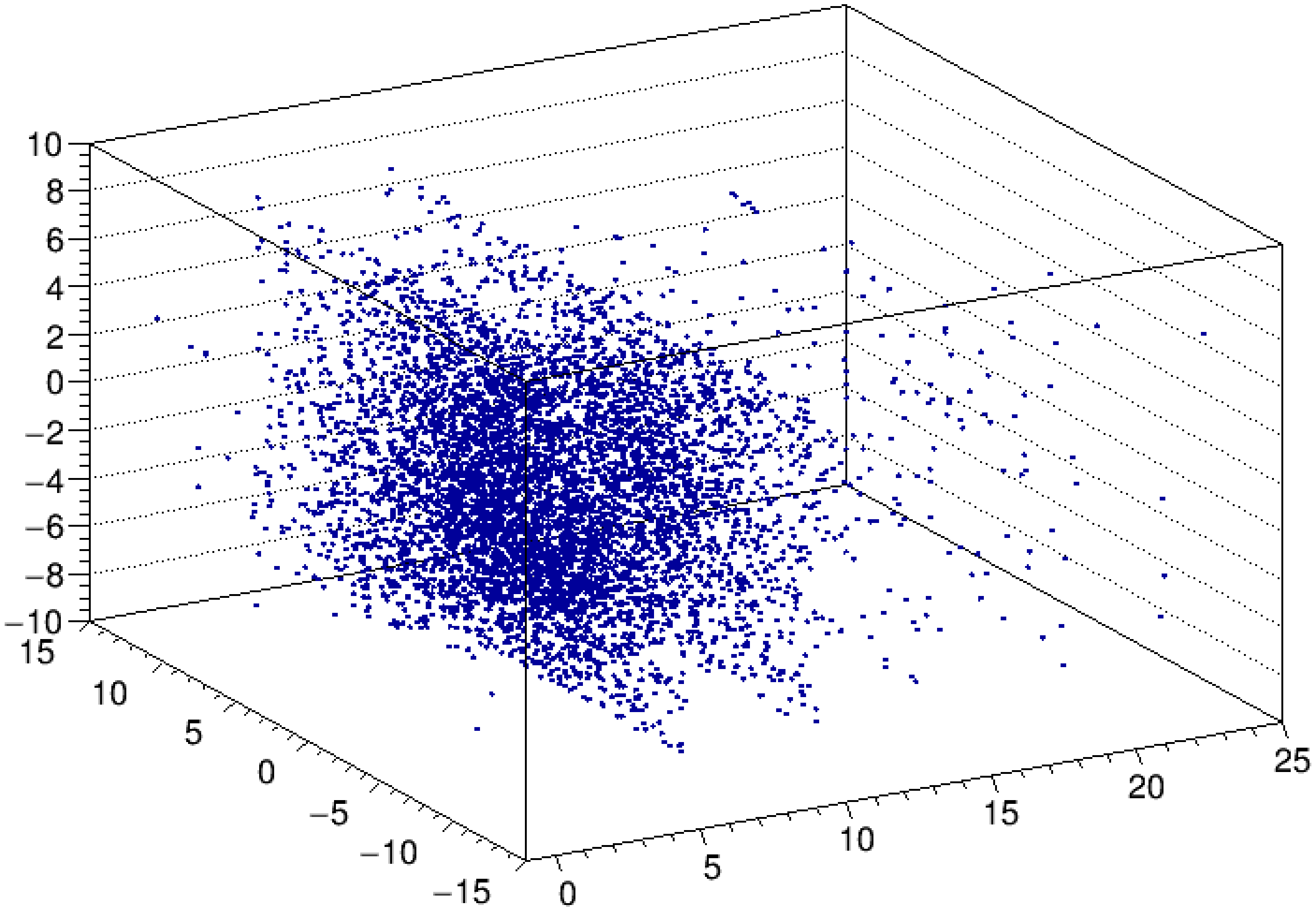
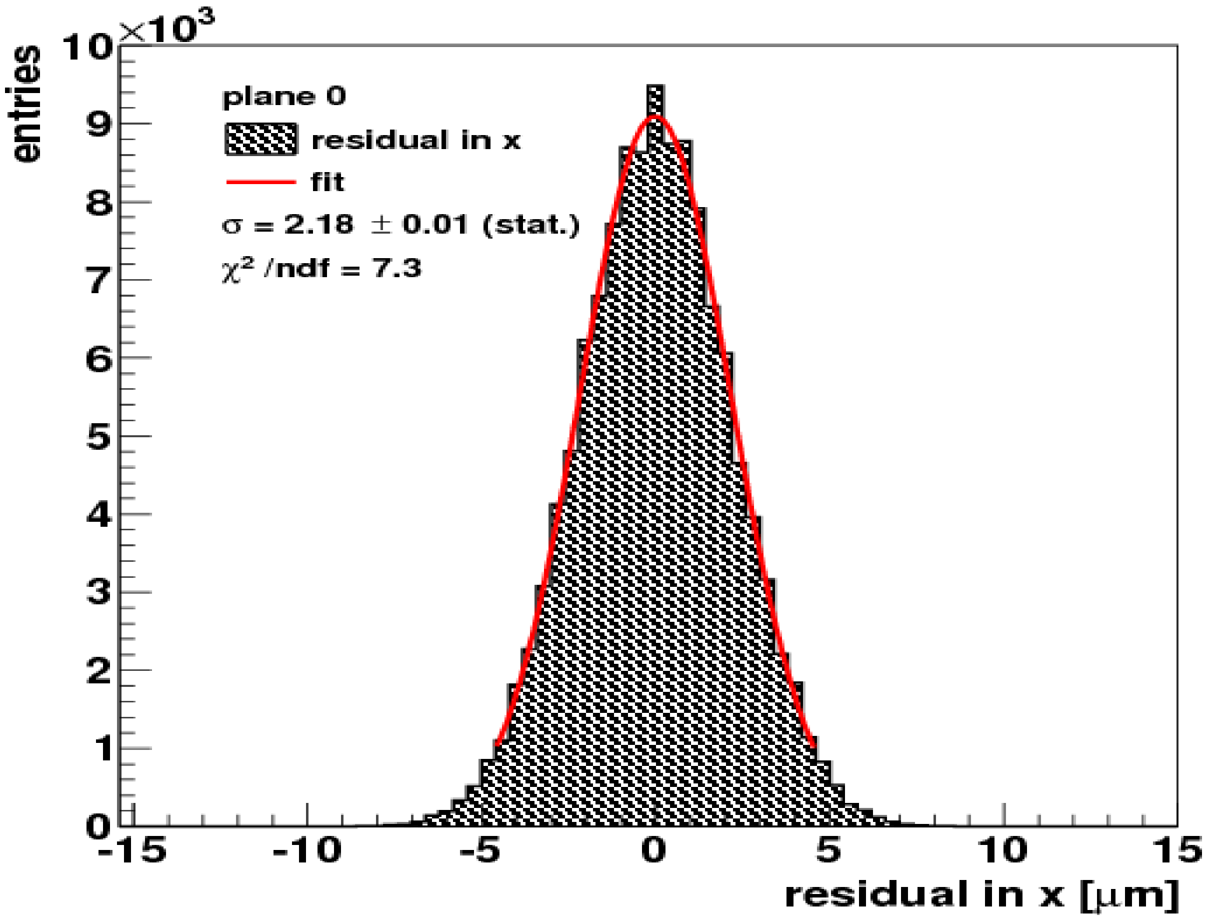


DISCUSSION

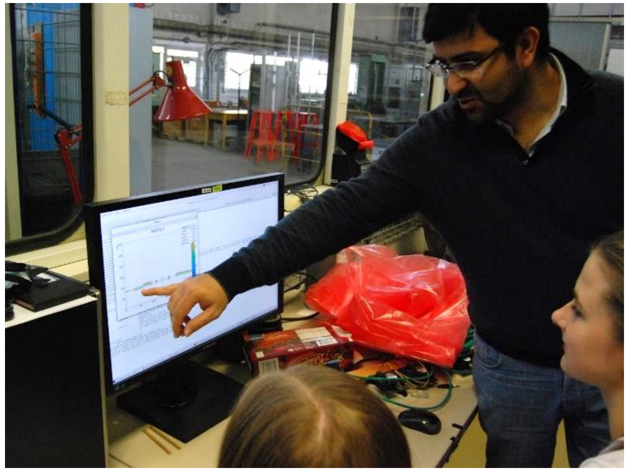
- Detector size
- Scattering
- Amount of events
- Antimatter as absorber

NEXT STEP

- Further analysing of our data
- Fitting
- Tracking
- Comparing
- Conclusion



QUESTIONS?



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