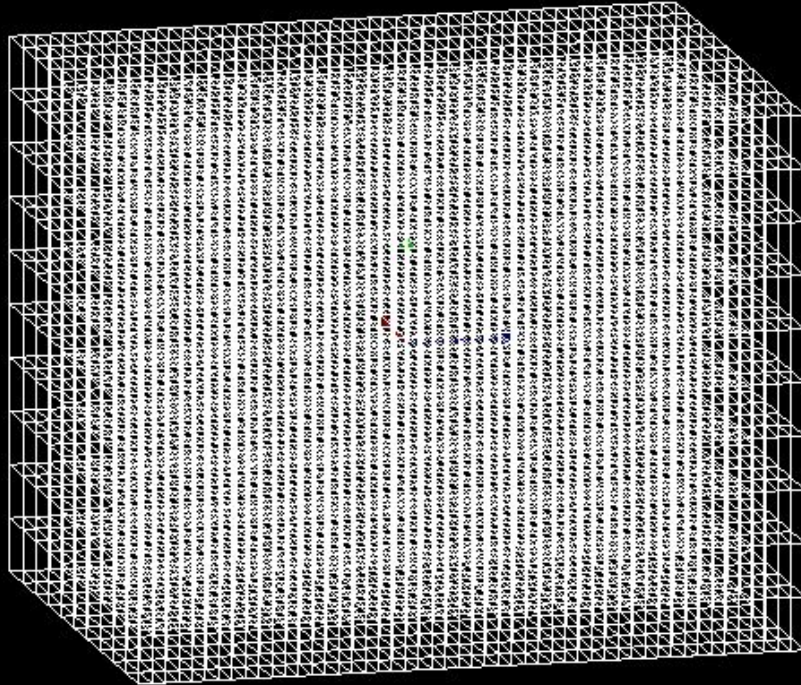


MPGD-HCAL simulation G4

18/03/2022

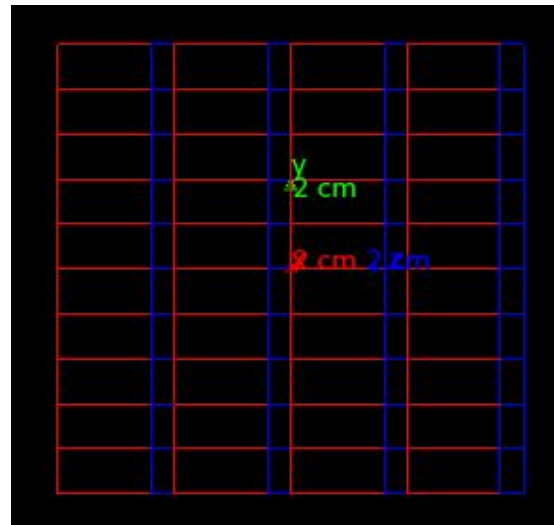
NEW GEOMETRY: Cells implemented



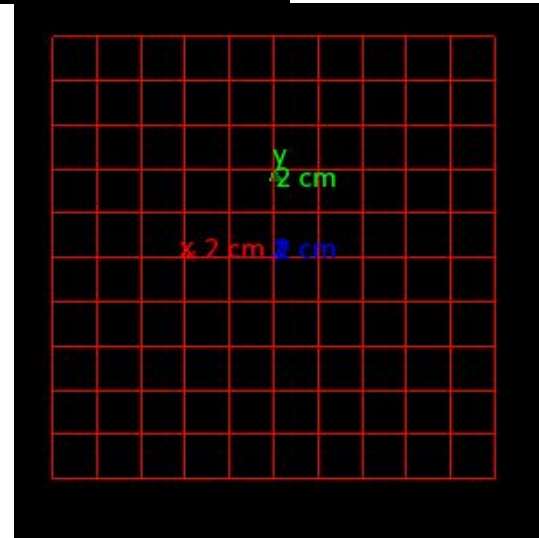
i.e. 50 layers; 10x10 cells da 10 cm

Geometry description

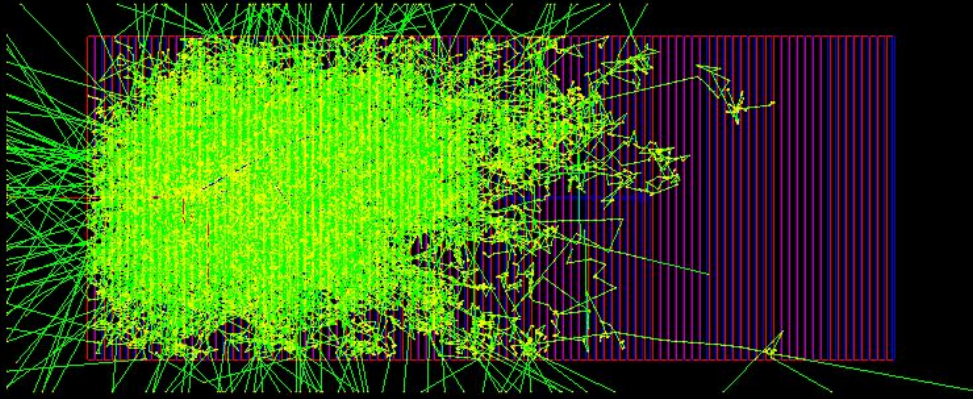
Layers along the beam axis (z axis)
each layer made of 2 cm of Fe and 5 mm of Ar



In the transverse plane (XY plane) 100x100 cm²
divided into cells of 1x1 cm²

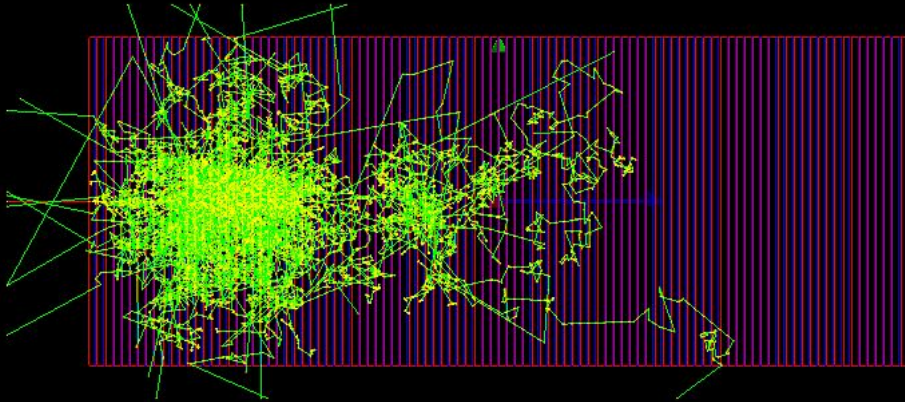


100 layers; 1 pi- 60 GeV

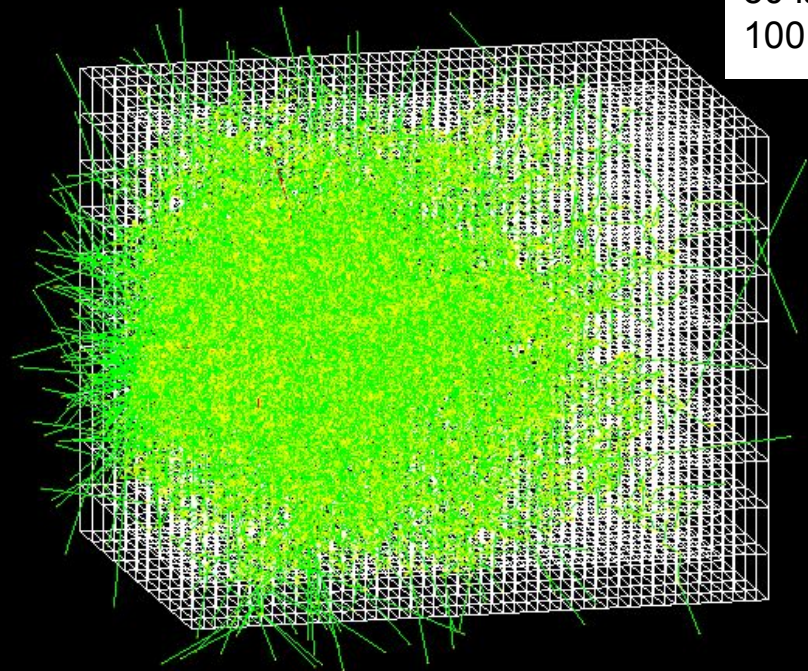


Simulating 100 layers detector
with 100x100 1cm² cells is time
consuming

100 layers; 1 pi- 10 GeV

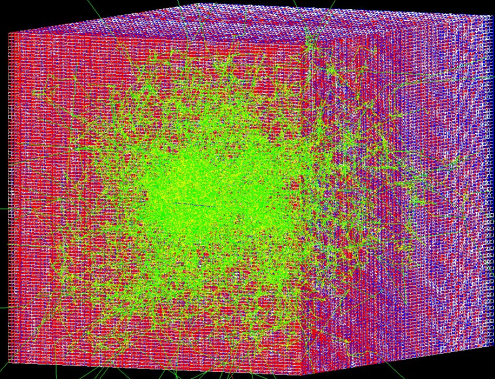
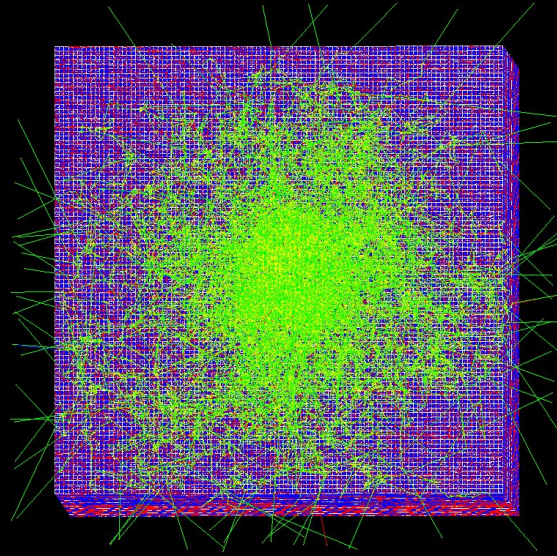
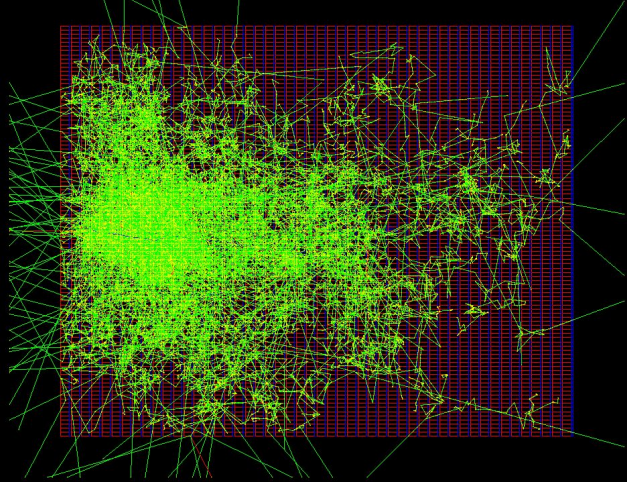


Final Geometry for results presented today:
50 layers (2 cm Fe + 5 mm Ar)
100 x 100 1cm² cells



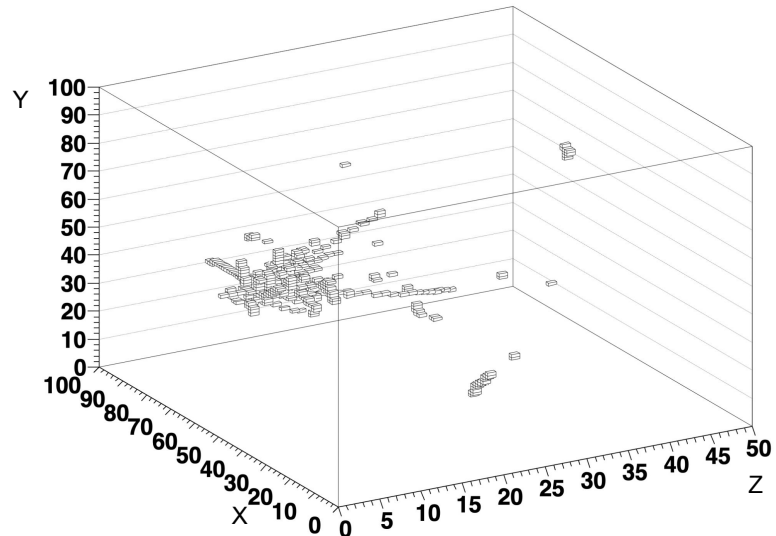
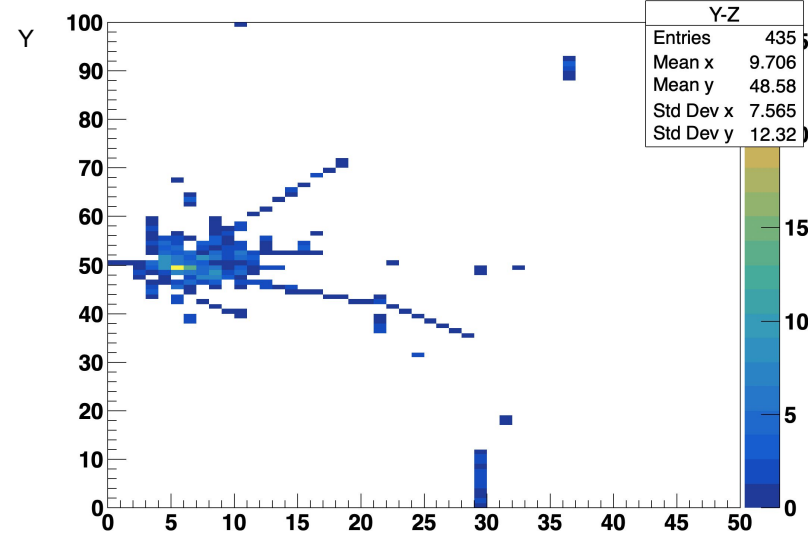
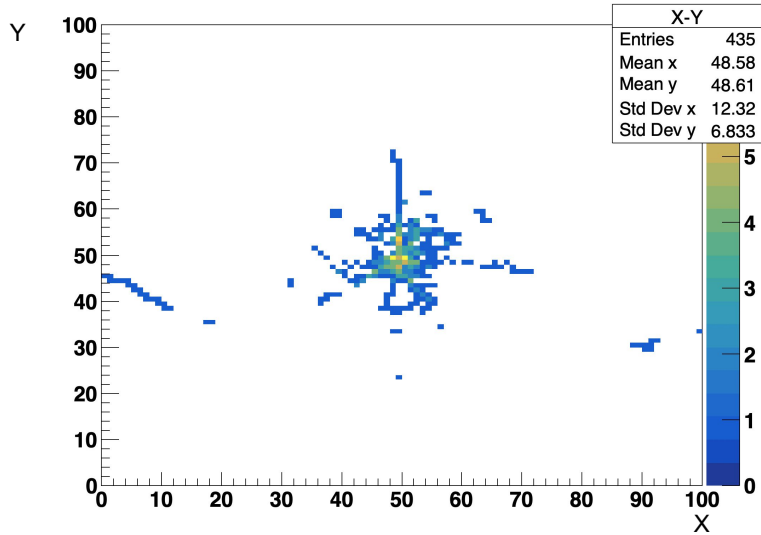
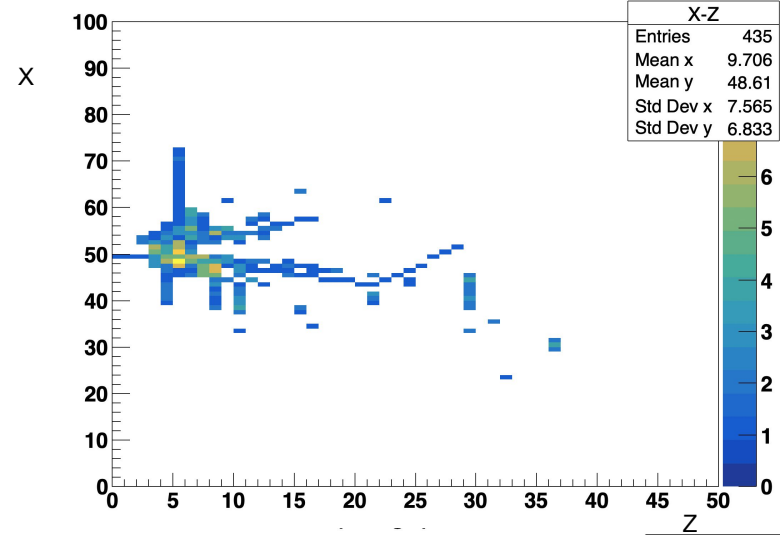
50 layers; voxelled detector; 1 pi- 60 GeV

1 pi- 20 GeV

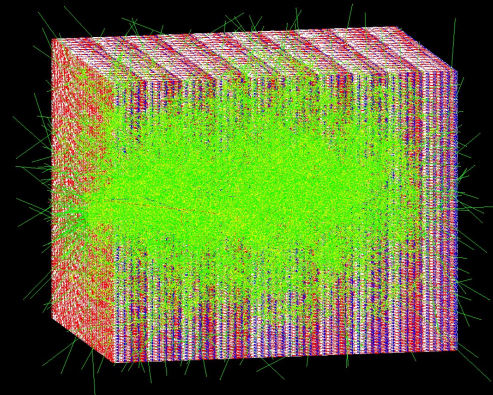
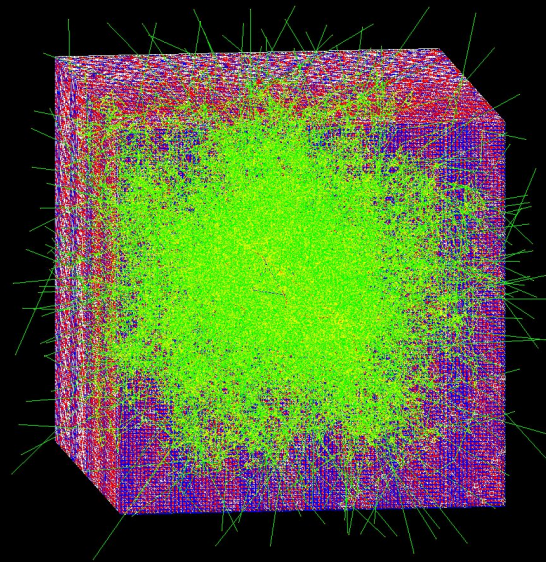
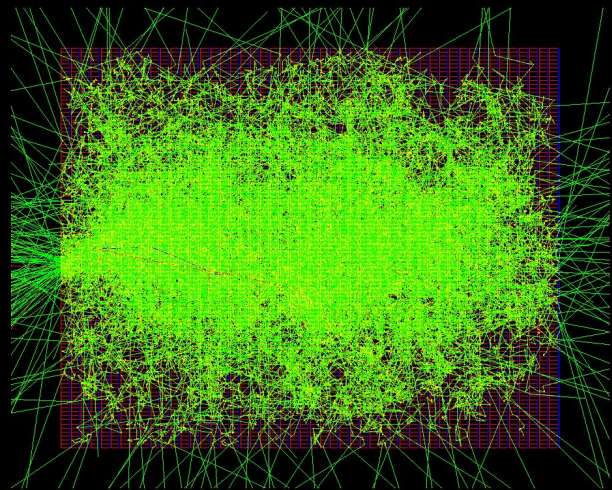


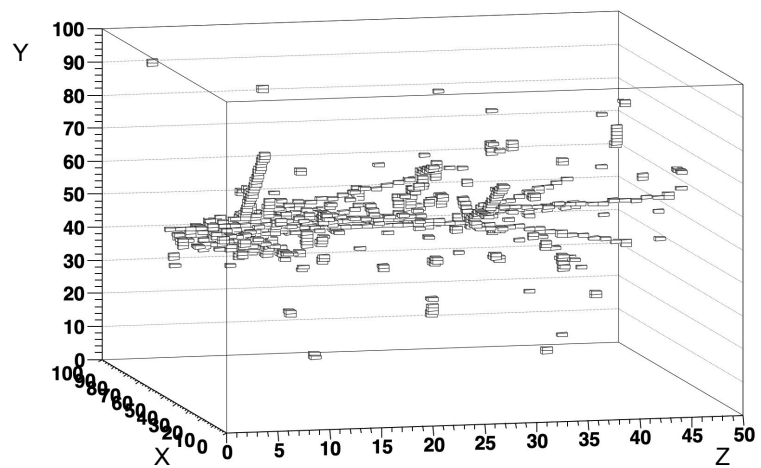
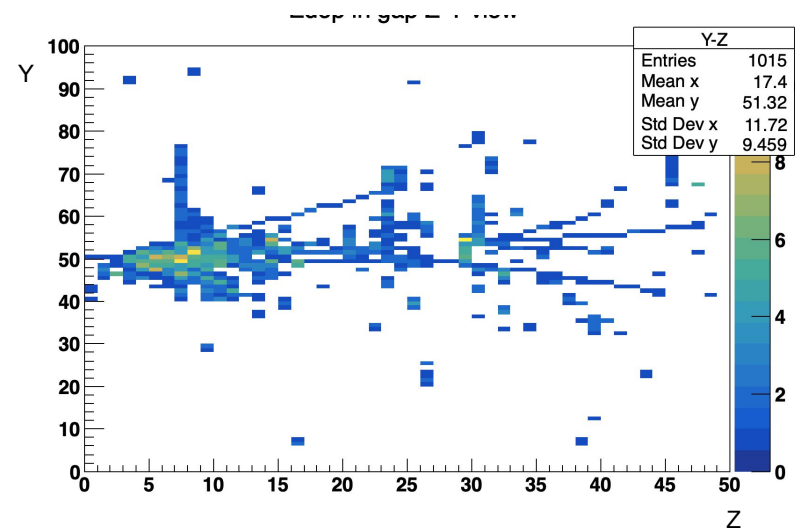
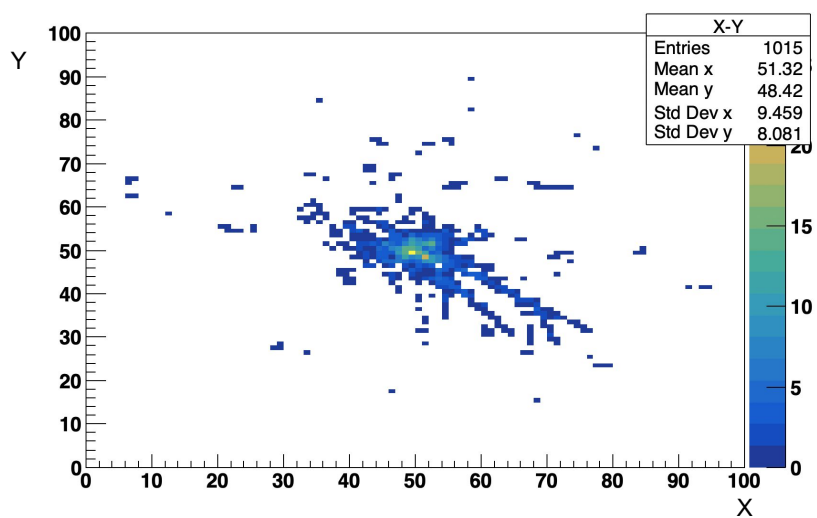
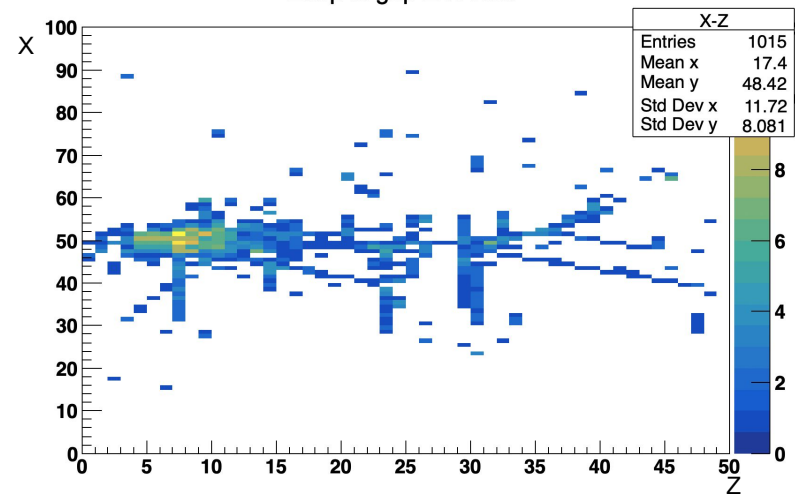
Digital Readout

1 Hit = 1 cell with energy deposition in the gas > 30 eV
no time window implemented for multiple hits in the same cell

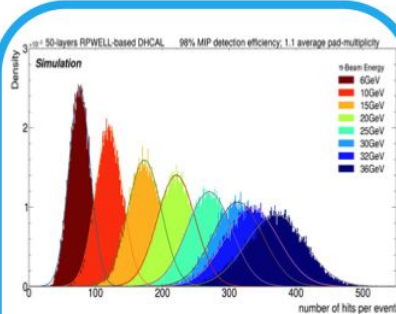


1 pi- 60 GeV



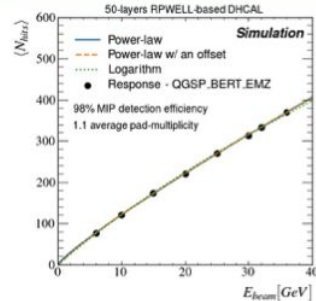


Energy Reconstruction and Resolution



Extract $\langle N_{hits} \rangle$ per E_{beam}

D. Shaked Renous



Fit a response function to the described data

$$[1] \langle N_{hits} \rangle = a \cdot E_{beam}^b$$

$$[2] \langle N_{hits} \rangle = a \cdot E_{beam}^b - c$$

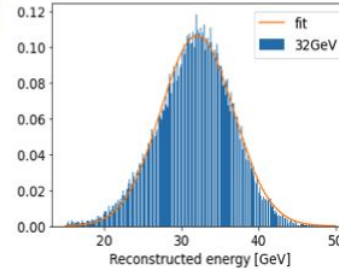
$$[3] \langle N_{hits} \rangle = \frac{a}{b} \log(1 + bE_{beam})$$

[1] CALICE, 2019

[2] Repond, CHEF 2013

[3] Chefdeville, CHEF 2013

GDD group meeting - CERN, 16.3.2022



Reconstructed energy using the inverse response function

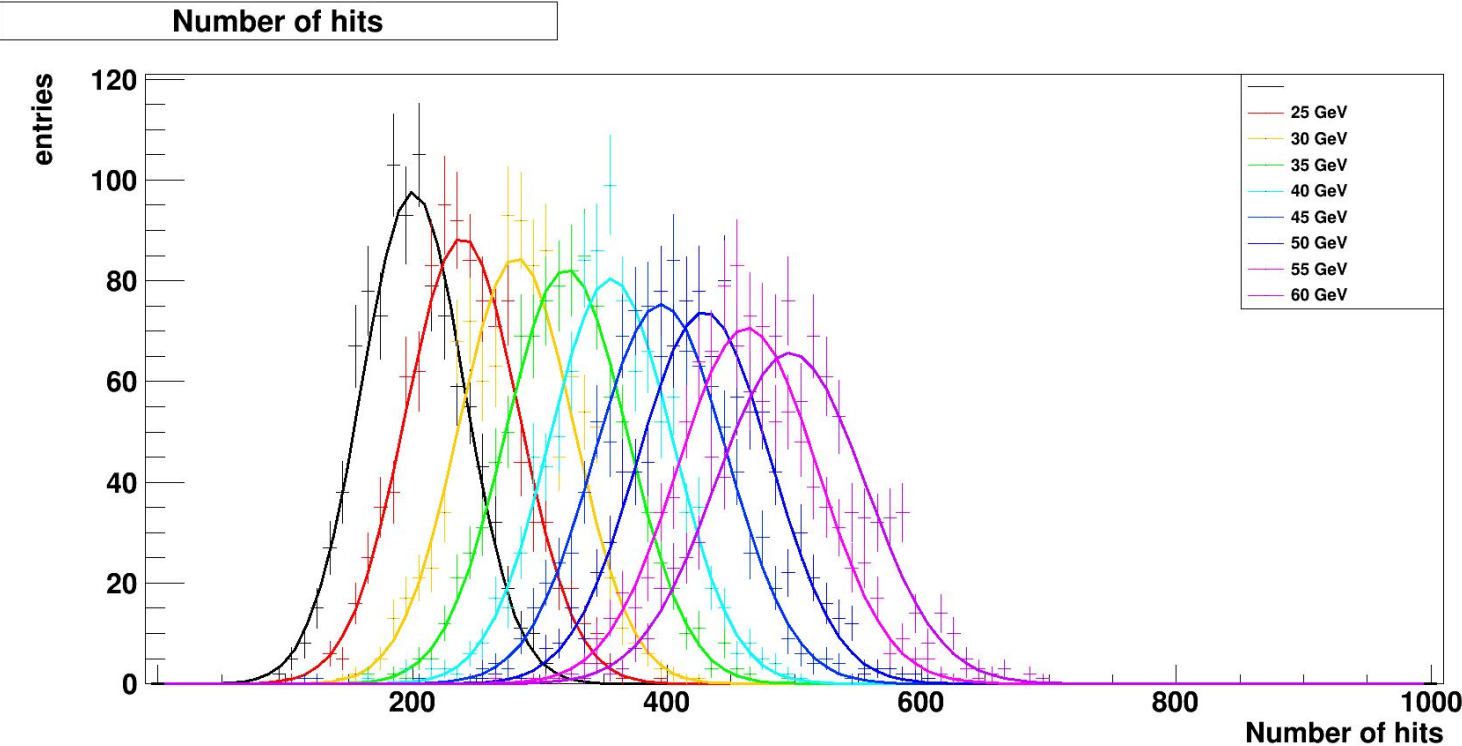
Fit the energy resolution

$$\frac{\sigma}{E[GeV]} = \frac{S}{\sqrt{E[GeV]}} \oplus C$$

to the relation $\frac{\sigma_{rec}}{\langle E_{rec} \rangle}$ as a function of E_{beam}

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Hit : energy deposited in the gas in one cell > 30 eV

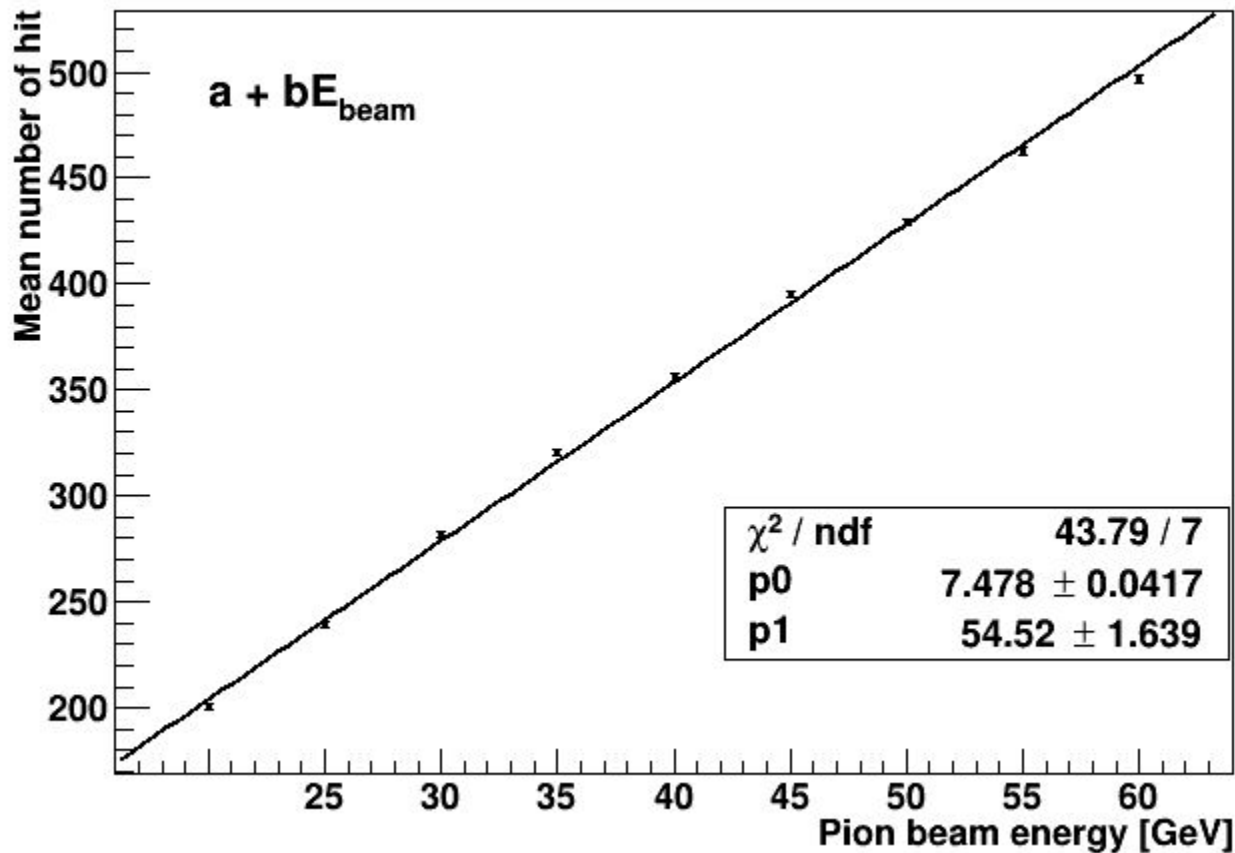


Graph

Mean number of hit
extracted from the
gaussian fit of the
hit distribution

Data fitted with
linear function

$$\langle N_{hits} \rangle = a \cdot E_{beam}^b - c$$



BACKUP

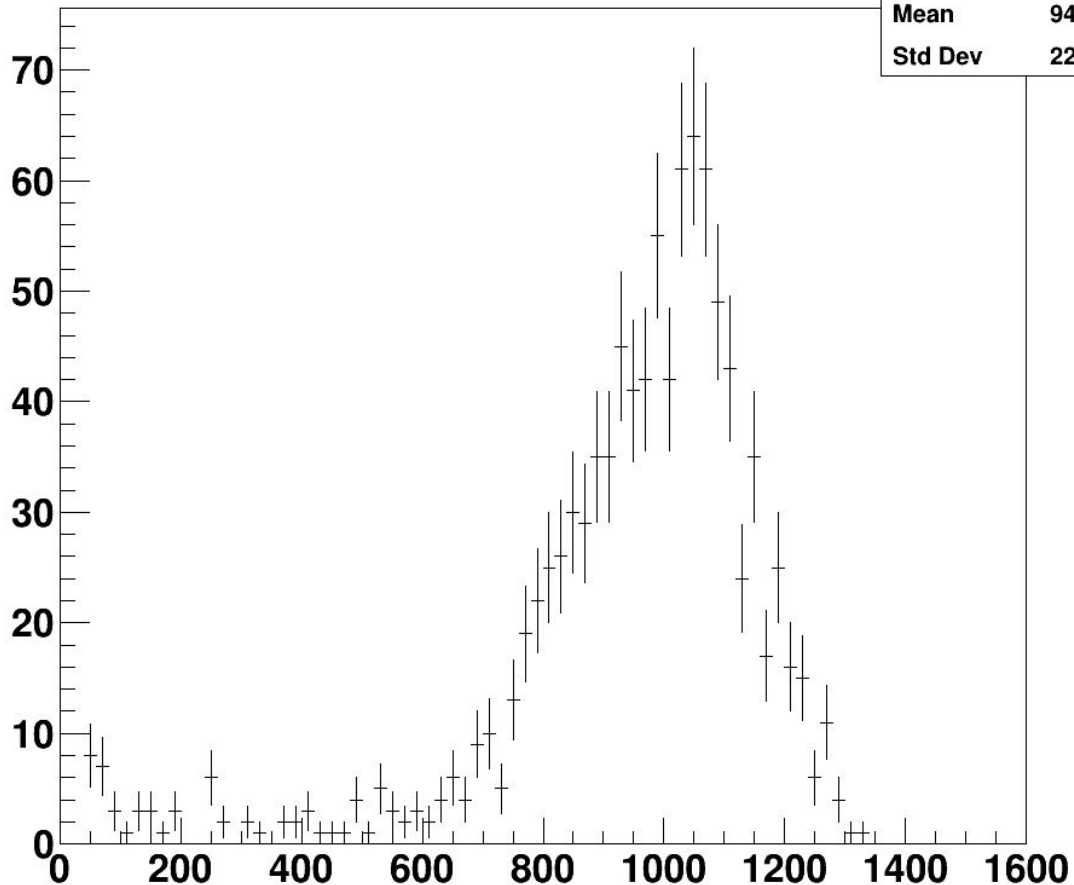
Number of hits

nHits

Entries	1000
Mean	943.2
Std Dev	227.2

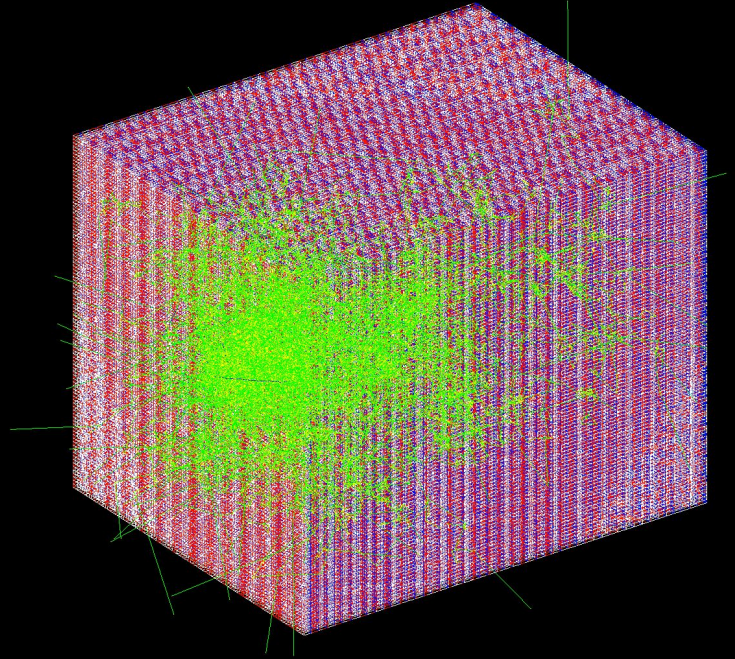
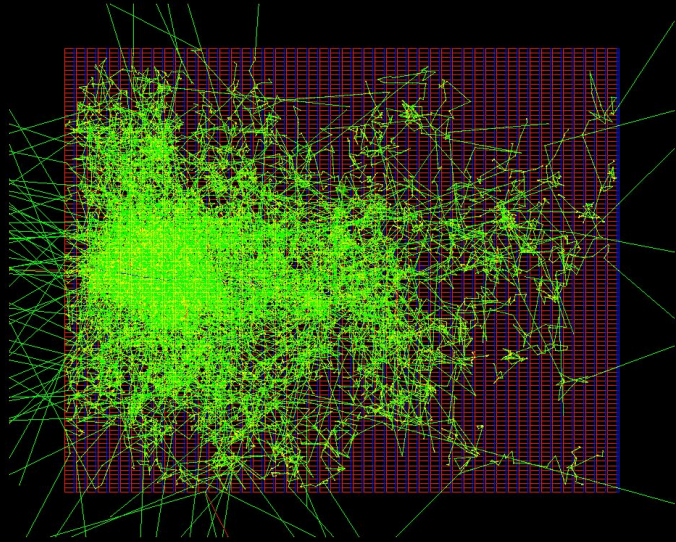
XY 1x1 m²
50 layers
60 GeV Pion beam

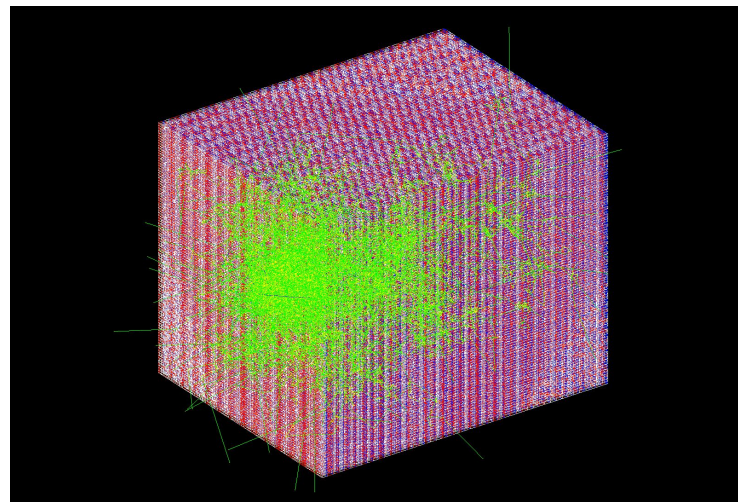
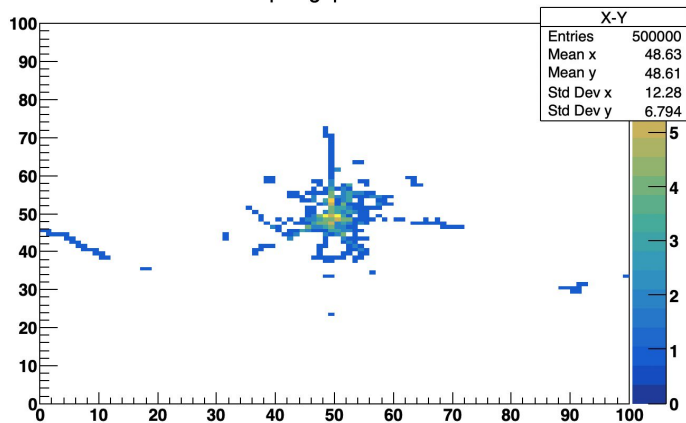
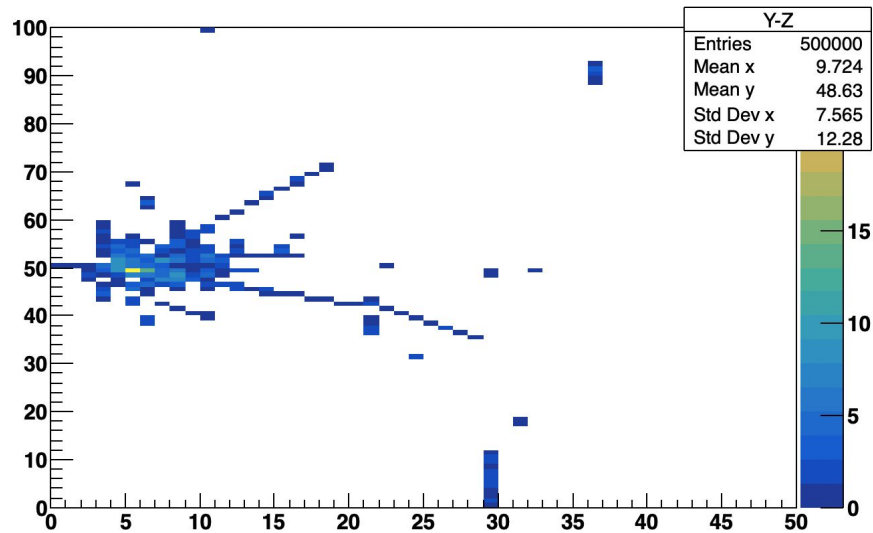
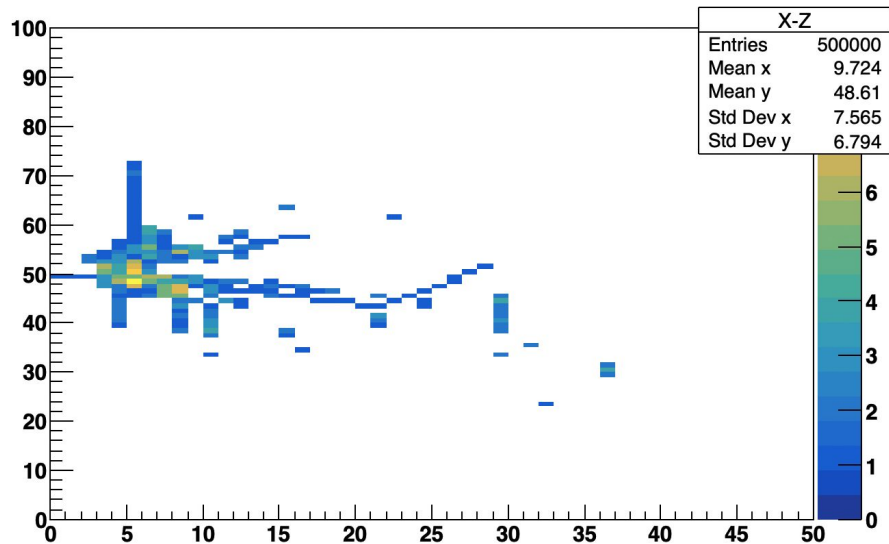
Physics list: QGSP_BERT



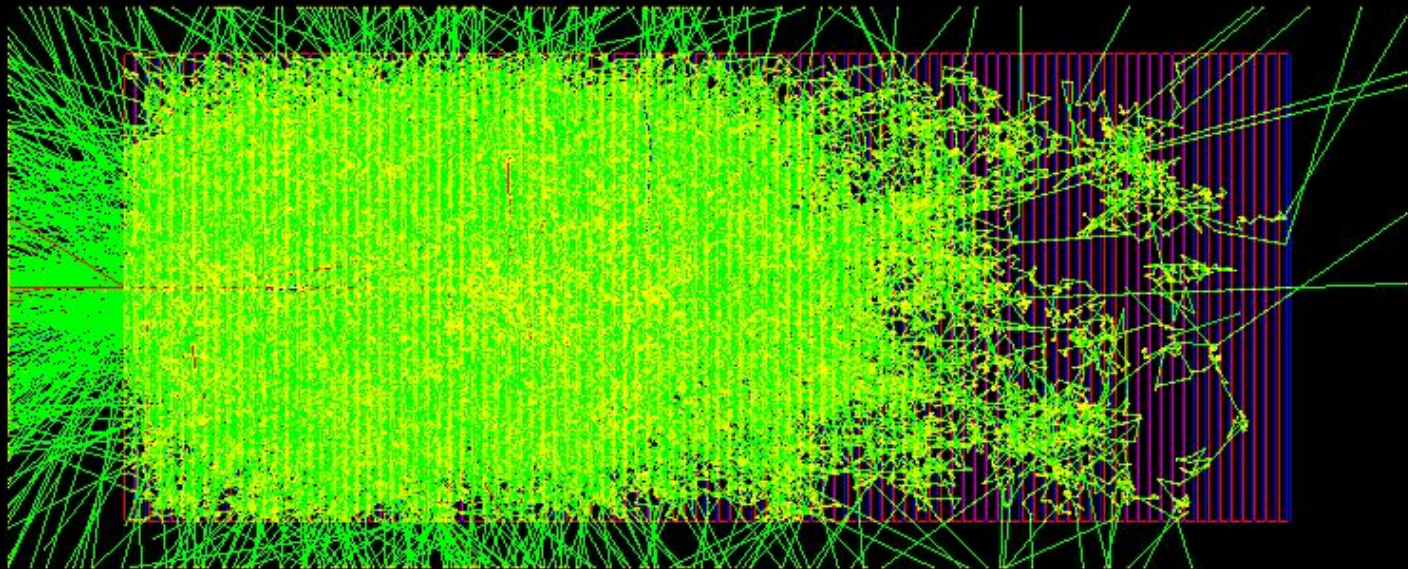
G4WT0 > number of Hits: 125
G4WT0 > Event 10 Hit n. 0 Row: -1 Column: -1 Layer: -1 Position: 0 0 0 fm Global Time: 0 ps E. dep. : 0 eV
G4WT0 > Event 10 Hit n. 1 Row: -1 Column: -1 Layer: -1 Position: 0 0 0 fm Global Time: 0 ps E. dep. : 0 eV
G4WT0 > Event 10 Hit n. 2 Row: 0 Column: 0 Layer: 2 Position: -20 -20 10 cm Global Time: 3.82566 ns E. dep. : 7.11117 keV
G4WT0 > Event 10 Hit n. 3 Row: -1 Column: -1 Layer: -1 Position: 0 0 0 fm Global Time: 0 ps E. dep. : 0 eV
G4WT0 > Event 10 Hit n. 4 Row: -1 Column: -1 Layer: -1 Position: 0 0 0 fm Global Time: 0 ps E. dep. : 0 eV
G4WT0 > Event 10 Hit n. 5 Row: -1 Column: -1 Layer: -1 Position: 0 0 0 fm Global Time: 0 ps E. dep. : 0 eV
G4WT0 > Event 10 Hit n. 6 Row: -1 Column: -1 Layer: -1 Position: 0 0 0 fm Global Time: 0 ps E. dep. : 0 eV
G4WT0 > Event 10 Hit n. 7 Row: 0 Column: 1 Layer: 2 Position: -10 -20 10 cm Global Time: 3.7672 ns E. dep. : 1.77672 keV
G4WT0 > Event 10 Hit n. 8 Row: -1 Column: -1 Layer: -1 Position: 0 0 0 fm Global Time: 0 ps E. dep. : 0 eV
G4WT0 > Event 10 Hit n. 9 Row: -1 Column: -1 Layer: -1 Position: 0 0 0 fm Global Time: 0 ps E. dep. : 0 eV
G4WT0 > Event 10 Hit n. 10 Row: -1 Column: -1 Layer: -1 Position: 0 0 0 fm Global Time: 0 ps E. dep. : 0 eV
G4WT0 > Event 10 Hit n. 11 Row: 0 Column: 2 Layer: 1 Position: -0 -20 -15 cm Global Time: 2.68084 ns E. dep. : 3.04253 keV
G4WT0 > Event 10 Hit n. 12 Row: -1 Column: -1 Layer: -1 Position: 0 0 0 fm Global Time: 0 ps E. dep. : 0 eV
G4WT0 > Event 10 Hit n. 13 Row: -1 Column: -1 Layer: -1 Position: 0 0 0 fm Global Time: 0 ps E. dep. : 0 eV
G4WT0 > Event 10 Hit n. 14 Row: -1 Column: -1 Layer: -1 Position: 0 0 0 fm Global Time: 0 ps E. dep. : 0 eV
G4WT0 > Event 10 Hit n. 15 Row: -1 Column: -1 Layer: -1 Position: 0 0 0 fm Global Time: 0 ps E. dep. : 0 eV
G4WT0 > Event 10 Hit n. 16 Row: 0 Column: 3 Layer: 1 Position: 10 -20 -15 cm Global Time: 2.74176 ns E. dep. : 20.3576 keV
G4WT0 > Event 10 Hit n. 17 Row: 0 Column: 3 Layer: 2 Position: 10 -20 10 cm Global Time: 3.48743 ns E. dep. : 21.709 keV
G4WT0 > Event 10 Hit n. 18 Row: -1 Column: -1 Layer: -1 Position: 0 0 0 fm Global Time: 0 ps E. dep. : 0 eV
G4WT0 > Event 10 Hit n. 19 Row: -1 Column: -1 Layer: -1 Position: 0 0 0 fm Global Time: 0 ps E. dep. : 0 eV
G4WT0 > Event 10 Hit n. 20 Row: -1 Column: -1 Layer: -1 Position: 0 0 0 fm Global Time: 0 ps E. dep. : 0 eV
G4WT0 > Event 10 Hit n. 21 Row: -1 Column: -1 Layer: -1 Position: 0 0 0 fm Global Time: 0 ps E. dep. : 0 eV
G4WT0 > Event 10 Hit n. 22 Row: -1 Column: -1 Layer: -1 Position: 0 0 0 fm Global Time: 0 ps E. dep. : 0 eV
G4WT0 > Event 10 Hit n. 23 Row: -1 Column: -1 Layer: -1 Position: 0 0 0 fm Global Time: 0 ps E. dep. : 0 eV
G4WT0 > Event 10 Hit n. 24 Row: -1 Column: -1 Layer: -1 Position: 0 0 0 fm Global Time: 0 ps E. dep. : 0 eV
G4WT0 > Event 10 Hit n. 25 Row: -1 Column: -1 Layer: -1 Position: 0 0 0 fm Global Time: 0 ps E. dep. : 0 eV
G4WT0 > Event 10 Hit n. 26 Row: 1 Column: 0 Layer: 1 Position: -20 -10 -15 cm Global Time: 2.83198 ns E. dep. : 15.6671 keV

1 pi- 20 GeV





100 layers;
5 pi- 60 GeV



50 layers; 10x10 celle da 10 cm
5 pi- 60 GeV

