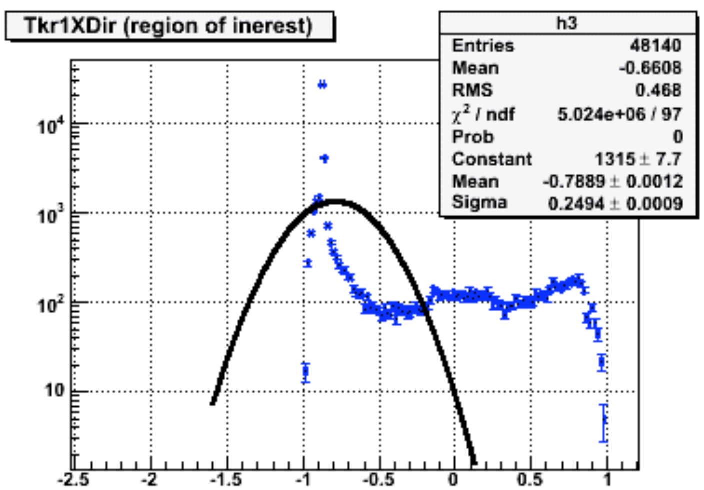
First Comparison of BackSplash: GEANT4 *(4.8.2)*- EGS5

Backsplash observed in data is larger than that of MC, specially noticeable for electrons at high energies and at large angles. See presentation May 16 2007 for details

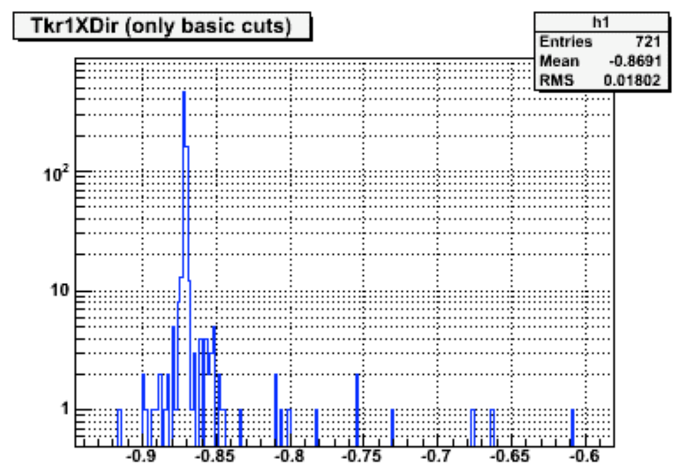
https://confluence.slac.stanford.edu/download/attachments/13893/Comp_BeamProfile_60degRuns_v3.pdf?version=1

Run 1949 (282 GeV, 60 deg)

DATA



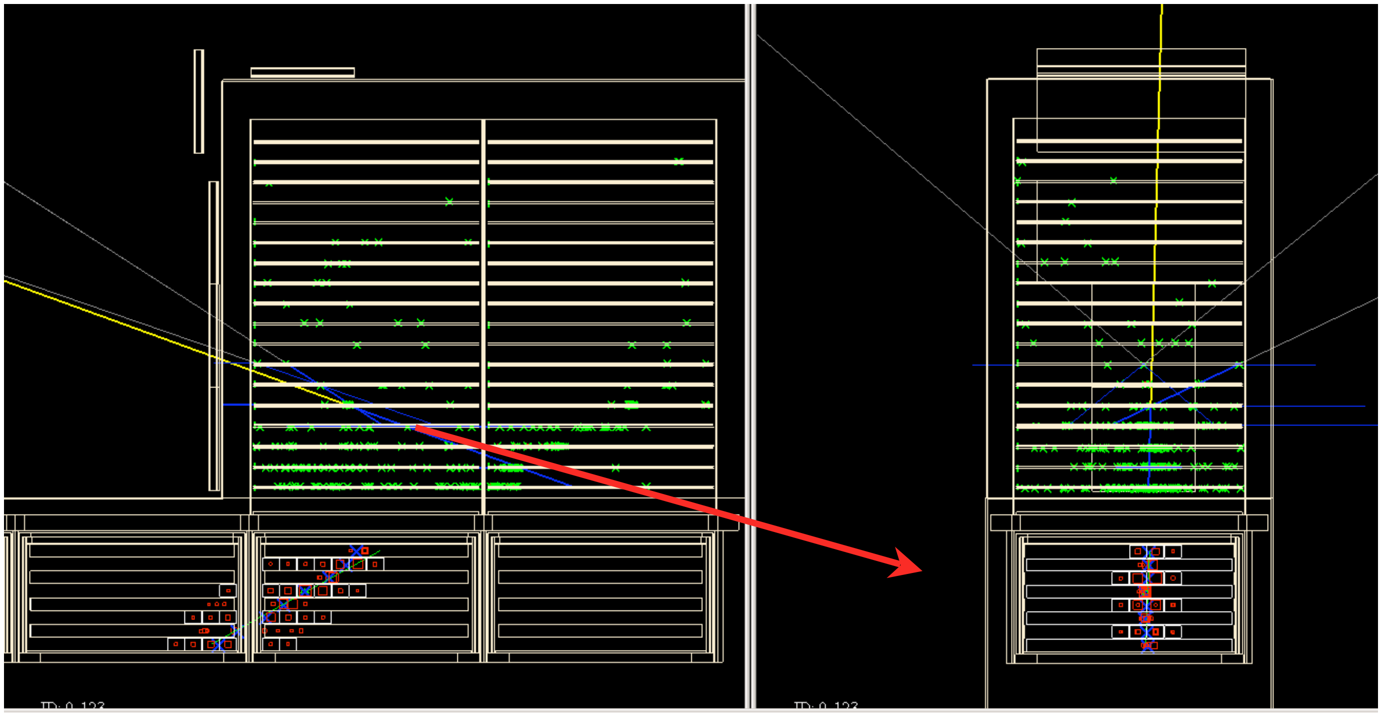
MC (Custom, low statistics)



The wrong-angle reconstruction is due to backsplash

Slide 26 of presentation May16 2007

(280 GeV, 60 incid. angle)



WRONG (random) incoming angle and impact point calculation

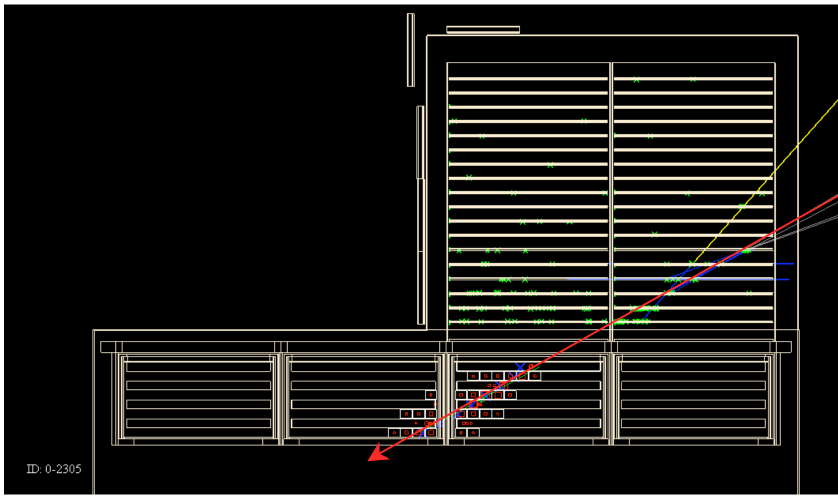
“Recognized Track 1” is missing the calorimeter

Slide 30 of presentation May16 2007

Comparison with MC data: Custom BT-1949(280GeV, 60deg)

Events with worse mis-reconstructed angle

Evt 2905

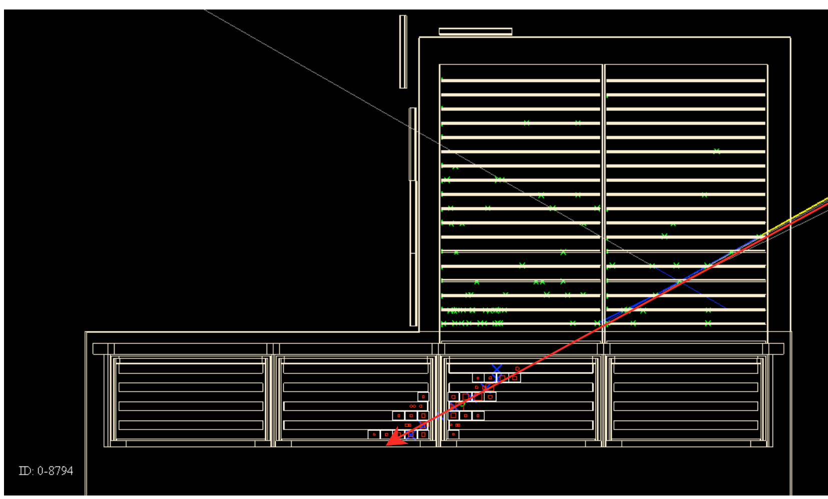


$\Delta\Theta$

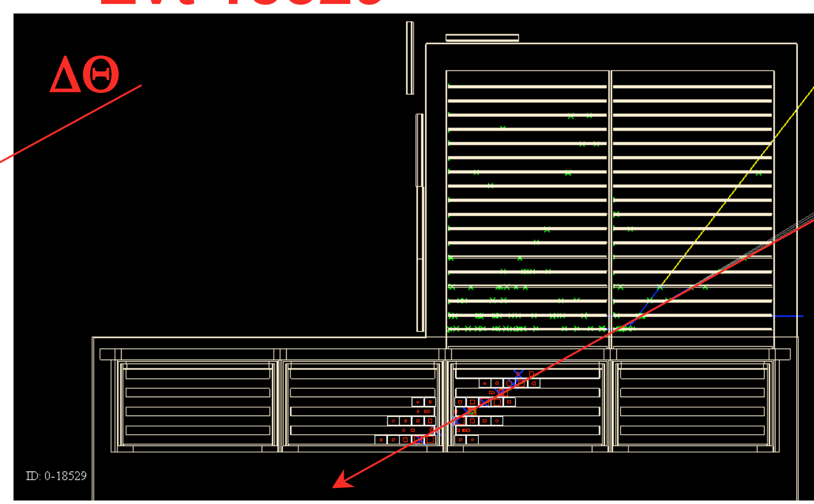
Amount of backsplash in MC seems to be smaller than in real data

Tracker reconstruction is most of the times correct

Evt 8794 (see next slide)



Evt 18529



$\Delta\Theta$

First Comparison of BackSplash: GEANT4 *(4.8.2)*- EGS5

Goal of this work:

Find out whether the data-MC disagreement is due to not accurate physics in the MC simulations

Methodology:

Compare **Geant 4** predictions with a well tested MC code to simulate Electromagnetic showers, **EGS5**

First Comparison of BackSplash: GEANT4 *(4.8.2)*- EGS5

Simple CsI calorimeter + Simple Tracker:

8 layers (1.99cm) along -Z direction

8.6 radiation lengths (1.85 cm)

24 columns (2.67 cm) along +Y direction

1 piece (34.4 cm) along X direction

Gaps of 2 mm in Z and Y direction (vacuum)

36 Si layers of 0.04 cm thickness

4 W alloy (92.5% W, 5% Ni, 2.5% Fe) layers of 0.0720 cm

12 W layers of 0.0097 cm thickness

Location of Si layers with respect to CAL is the same as in reality (Z pos. extracted from GlastRelease-v13r5p2)

Some details of the simulation

1 - Production thresholds

GEANT4 Dist cut = 1mm

Energy thresholds (MeV): gamma 0.038 e- 0.692 e+ 0.658

EGS5

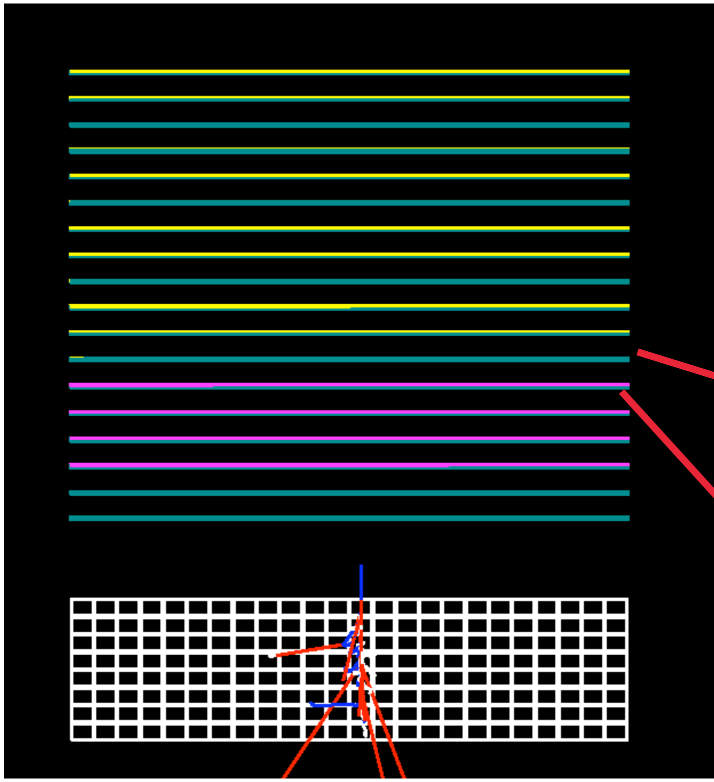
Energy thresholds (MeV): gamma 0.04 e-/e+ 0.70

2 - Location of W planes is right on the top of the first Si layer of a tray. This could be updated to be more realistic, but I do not think it will have a significant impact.

3 - The space between Si layers or Si layers and W layers is vacuum. We could update that… but I do not think it will modify the outcome of this comparison.

Display of a 1 GeV electron shower in this Detector

Geant 4 simulation, visualized with HepRapp browser

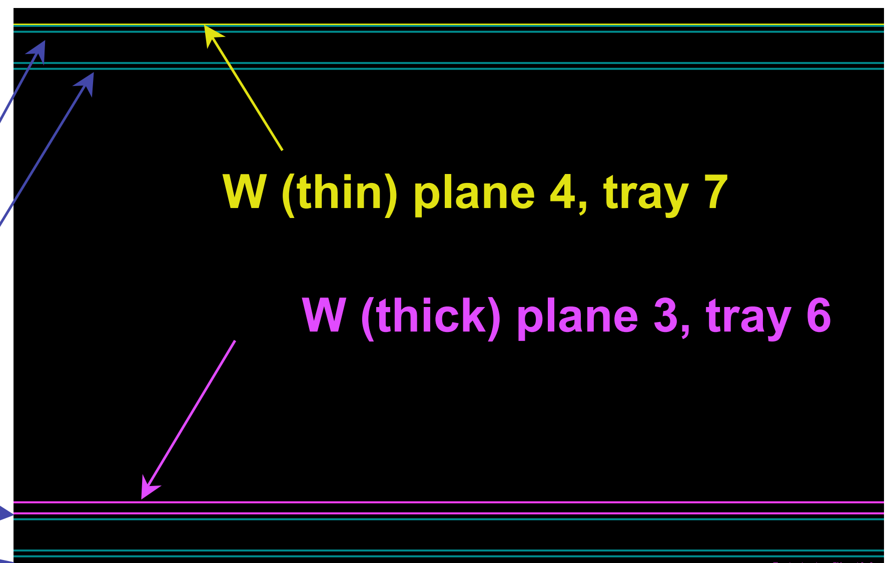


Blue - Si planes

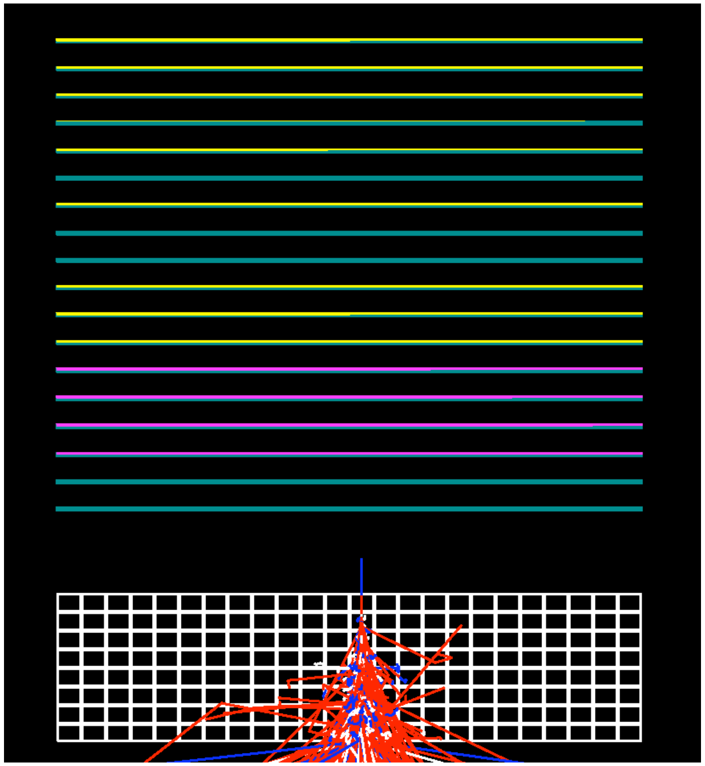
Magenta - Thick W

Yellow - Thin W

White - CsI



Display of a 100 GeV electron shower in this Detector



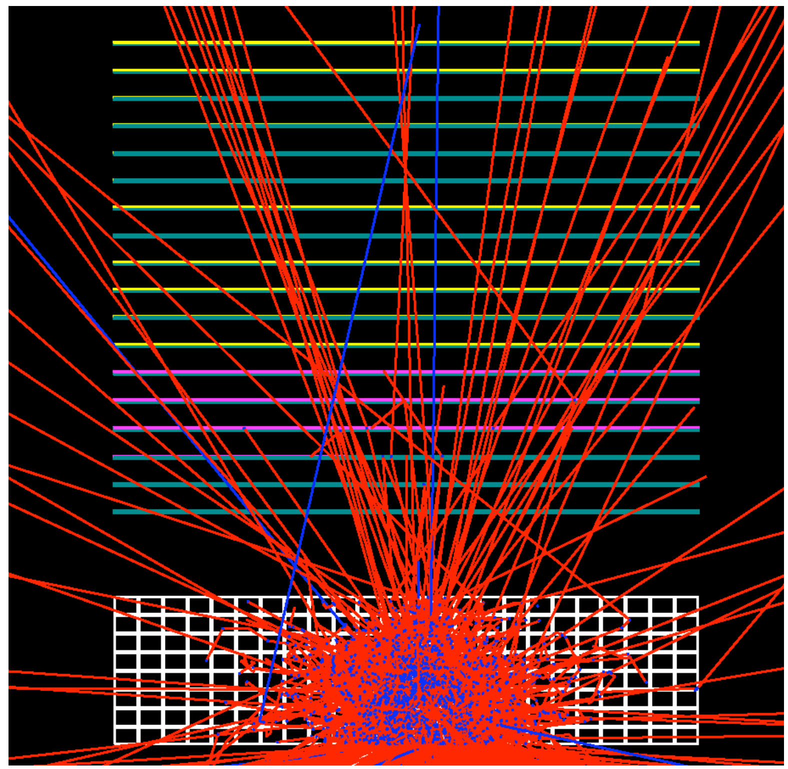
Only particles with P > 10 MeV/c are displayed

Blue - electron

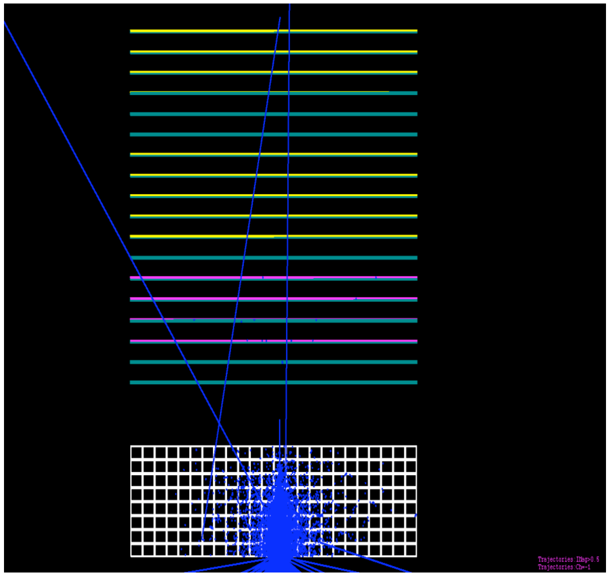
White - positron

Red - photon

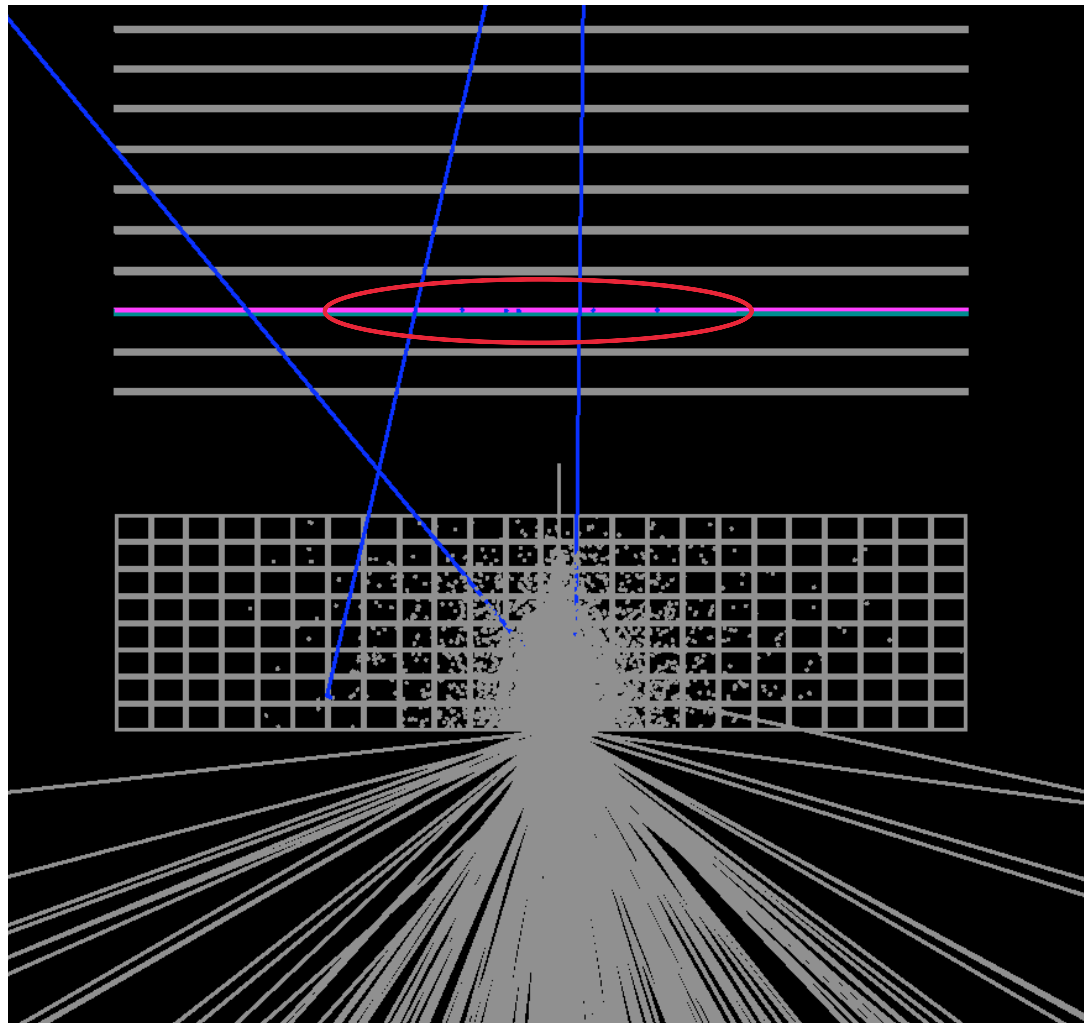
Particles with P > 0.5 MeV/c are displayed



Display of a 100 GeV electron shower in this Detector



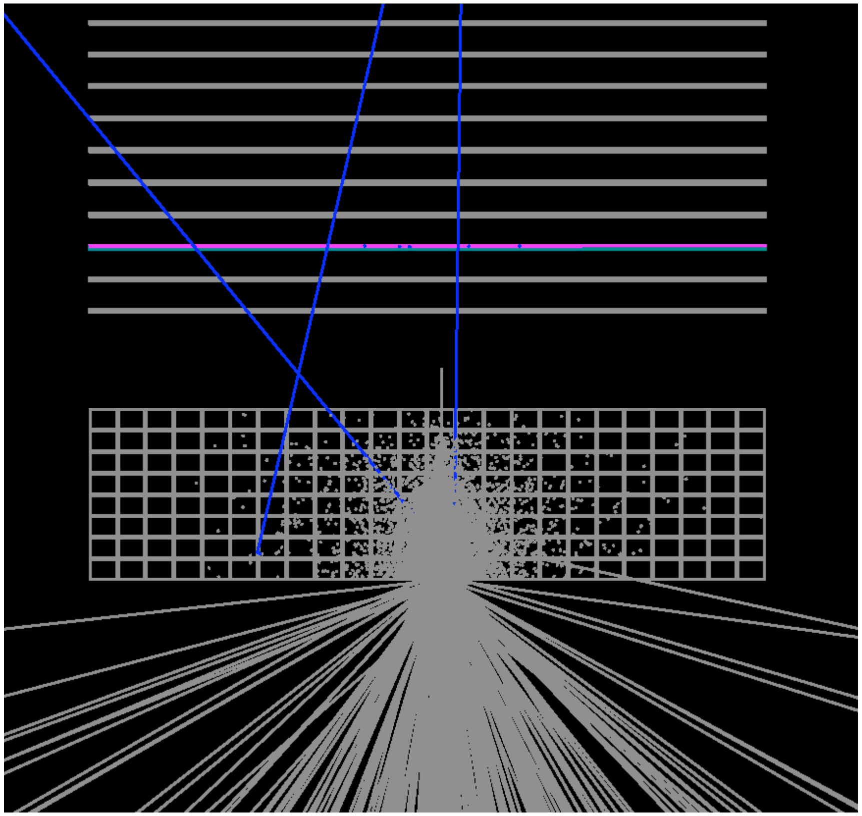
ONLY ELECTRONS with P > 0.5 MeV/c are displayed

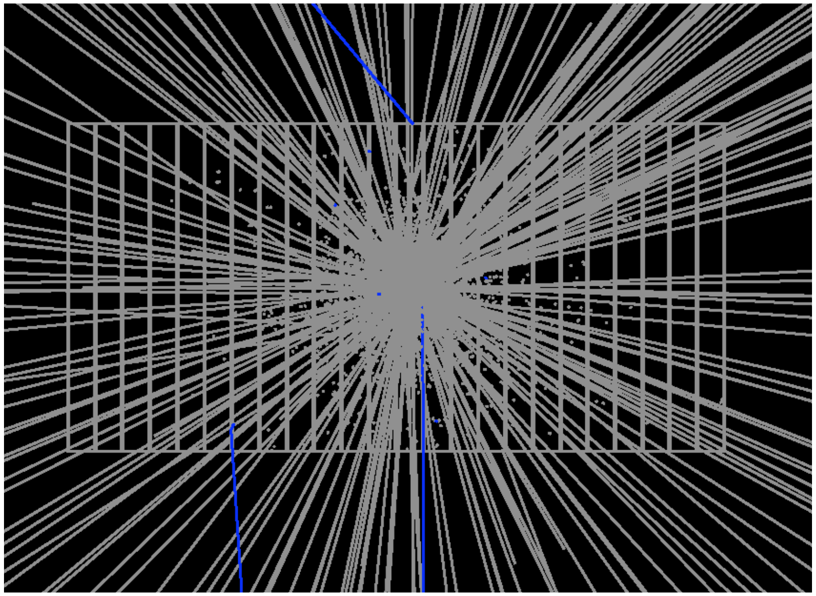


Photons (mostly in E range 0.5-5 MeV) produce electrons in the W and Si planes (Photoelectric or Compton) which can deposit energy in the Si planes (also W planes, of course…)

Display of a 100 GeV electron shower in this Detector

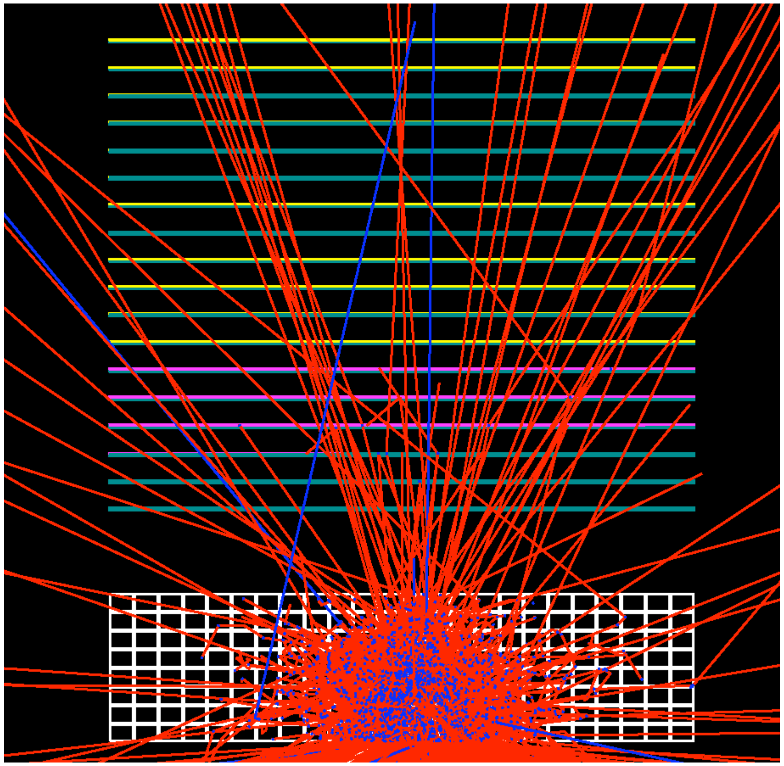
The 3 electrons exiting the calorimeter ("backwards") have large angles and do not go much over the tracker





Display of a 100 GeV electron shower in this Detector

Particles with P > 0.5 MeV/c are displayed



Backsplash can be quantified by computing the energy deposited in the Si and W planes.

This is the quantity that will be used in the G4-EGS5 comparison

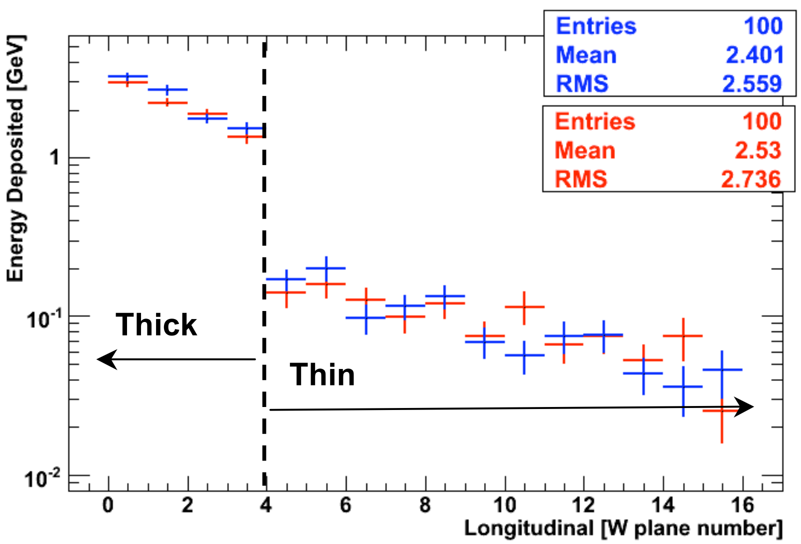
Yesterday, I got the EGS5 simulation working… EGS5 might be very reliable… but defining geometries is painfully tedious, and easy to make mistakes…

FIRST comparisons are shown in the next slides

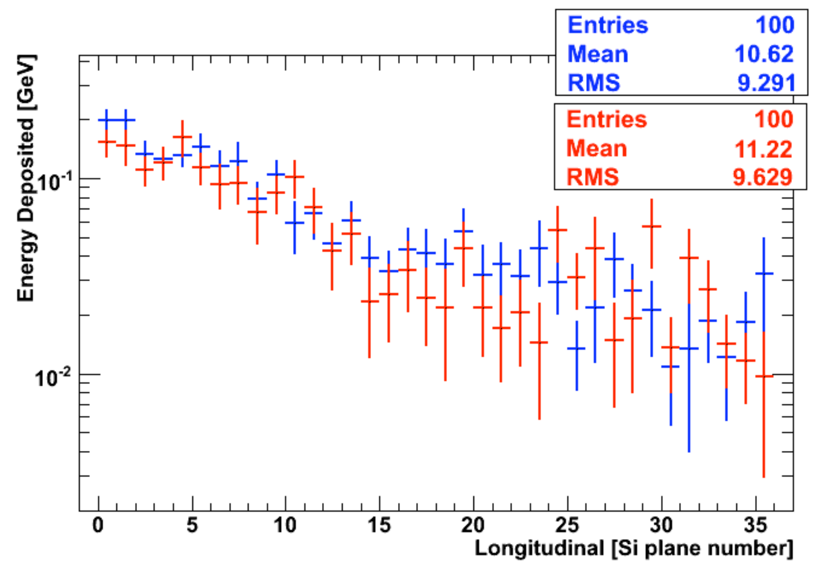
Electrons 100 GeV

Energy deposited in Tracker **GEANT 4** **EGS 5**

W planes



Si planes

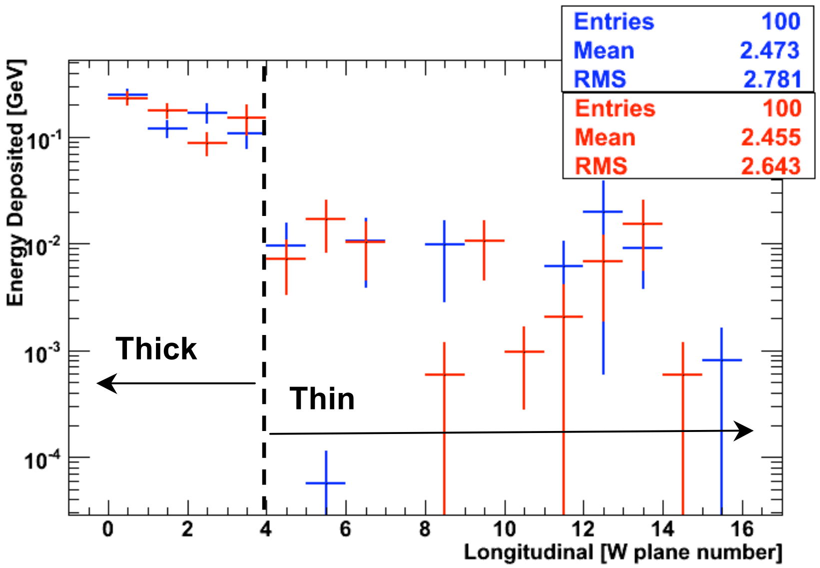


It seems a very good agreement in energy deposited in both W and Si planes

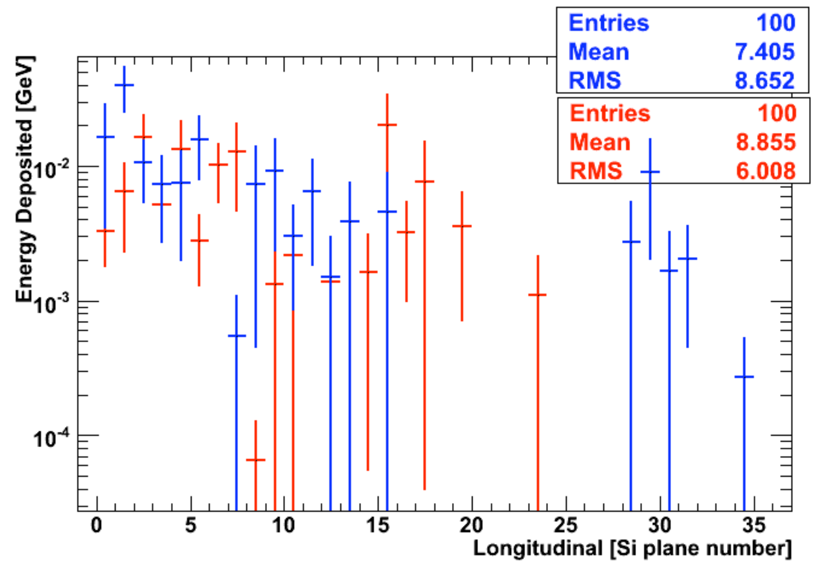
Electrons 1 GeV

Energy deposited in Tracker **GEANT 4** **EGS 5**

W planes



Si planes



It seems a very good agreement in energy deposited in both W and Si planes

REMARK: Bin errors come from the profiles; RMS/sqrt(N) of the distribution of energy deposited in that layer by the 100 events. That distribution MIGHT NOT be gaussian for these few event, hence meaning NOT trustable errors

I should increase statistics for a better comparison

Conclusions

Setup to compare backsplash in G4 and EGS5 is ready

First comparisons show good agreement
(1, 100 GeV; 0 deg. Incidence angle)

Outlook

- Increase number of simulated events
- Perform the comparison at several energies and angles:
E =1,100, 280, 500 (GeV)   Angles : 0, 30, 60, 80 (deg)