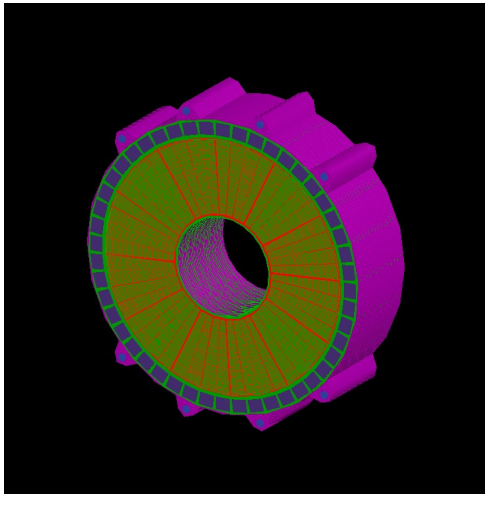
Comparison of LumiCal Response in Geant3 and Geant4

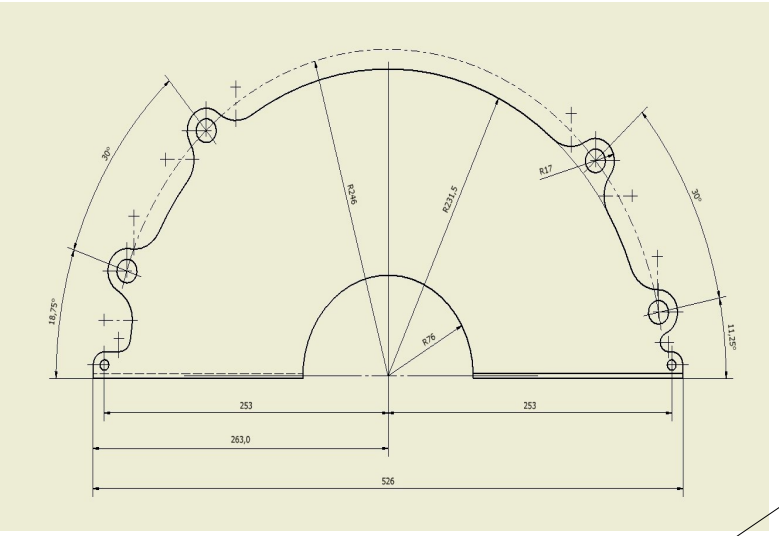
J. Aguilar, B. Pawlik, L. Zawiejski

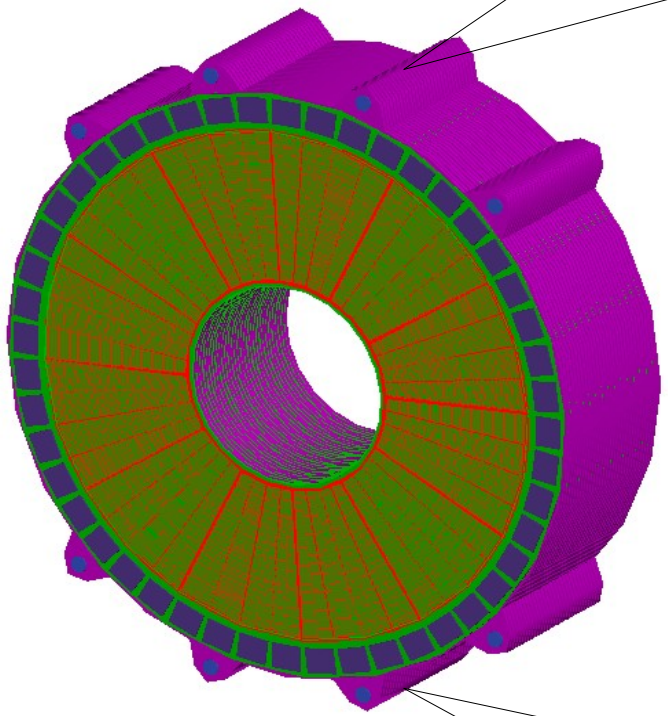
IFJ-PAN, Krakow

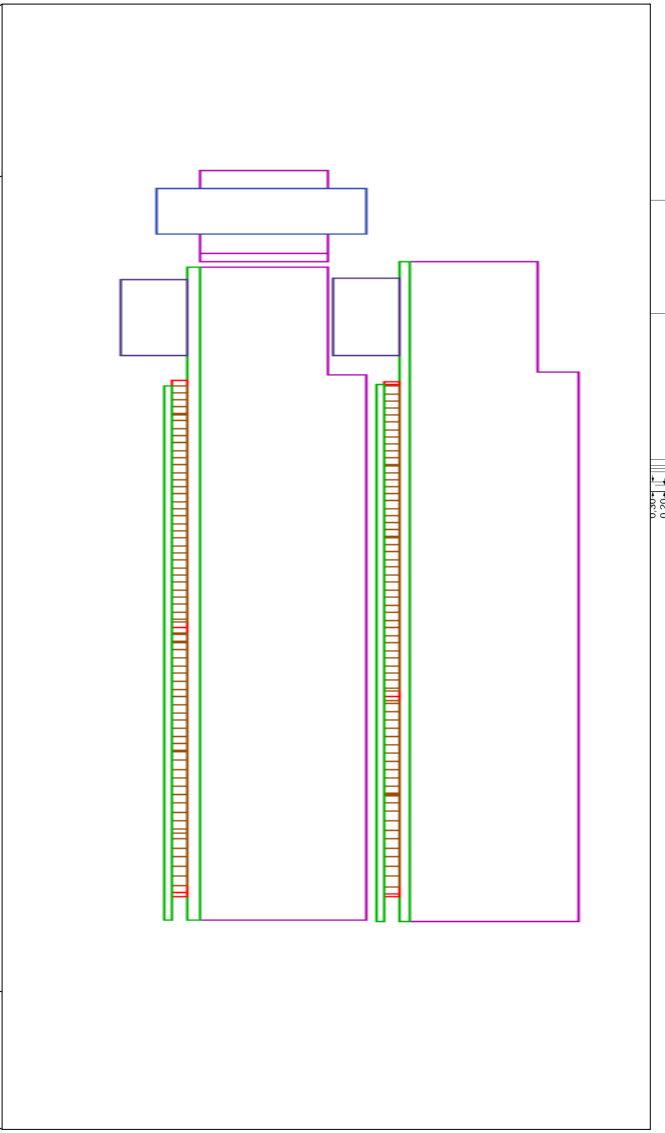
- Maximum charge deposition
- Moliere radius
- Reconstructing primary particle energy

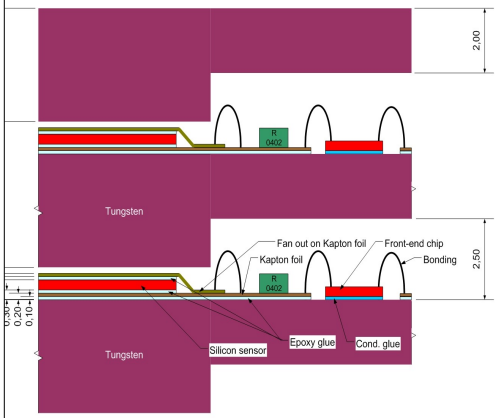


Geometry


30°
R246
R231.5
R17
30°
18.75°
R76
11.25°
253
253
263,0
526

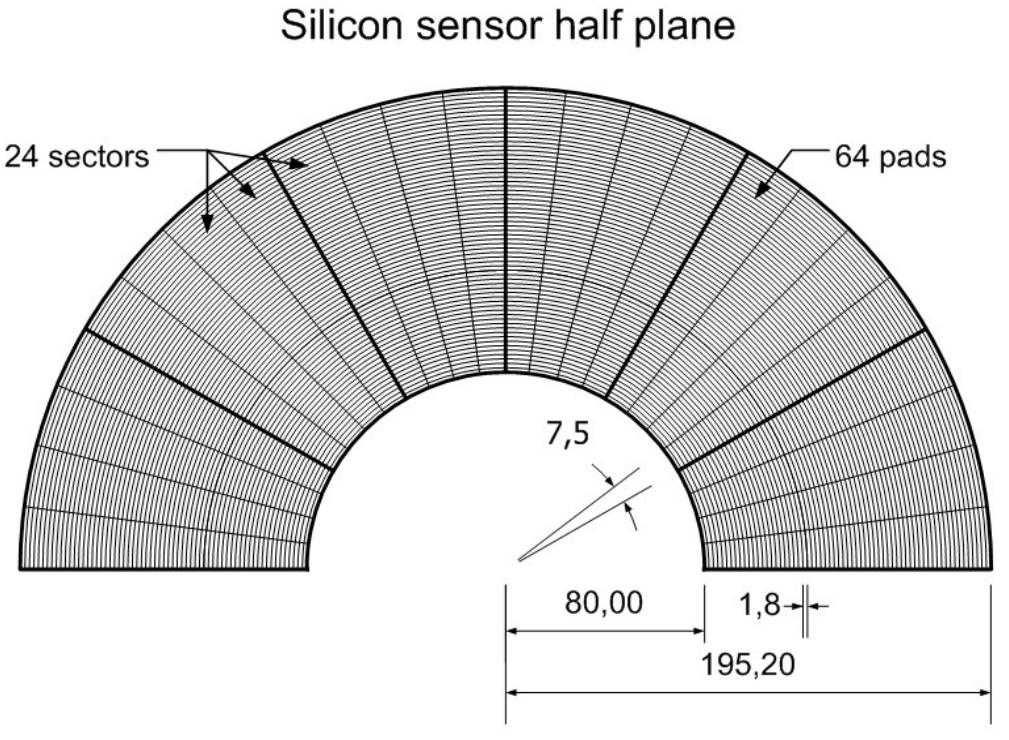





2,00
R
0402
Tungsten
Fan out on Kapton foil
Front-end chip
Kapton foil
Bonding
2,50
R
0402
0,30
0,20
0,10
Silicon sensor
Epoxy glue
Cond. glue
Tungsten

Geometry

- Sensitive radius:
  80-195.2mm
- Volumes
  - 2 modules
  - 30 layers/sector
  - 12 tiles/layer
  - 4 sectors/layer
  - 64 cells/sector
- Non-sensitive space only between tiles



Run parameters

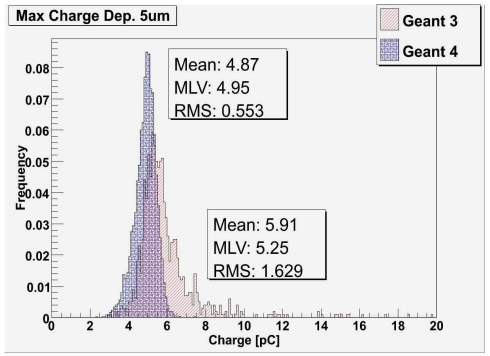
- Particle: e-
- Energy: 250 GeV
- Position: 2.500m before LumiCal
- Theta: 55mrad
- Smearing: 0
- Events: 10,000
- Range cuts: 0.005mm, 0.050mm, 0.500mm, 1.000mm

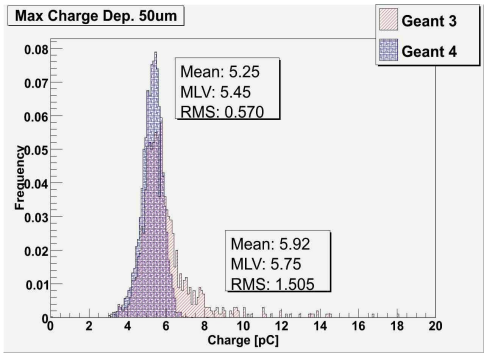
Range cuts in Geant 4

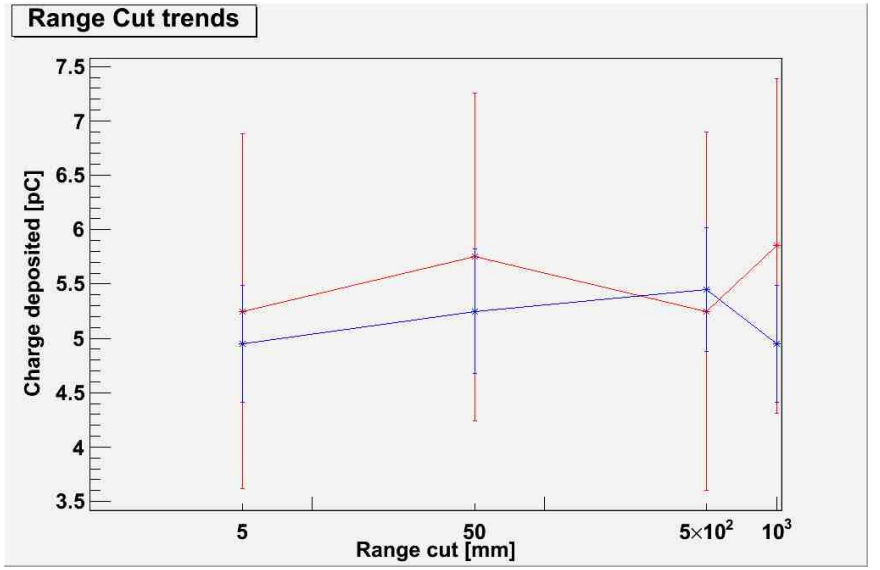
- Not really a range as much as a threshold in production energy.
- Particles lose energy through secondary production down to an energy corresponding to the cut range.
- Depends on the material
- Particle is STILL tracked down to zero range – the track is not killed, but the range cut-off does affect the accuracy of the stopping position.
- Geant 4 puts a “please” after your range cuts: they are a suggestion.
- Geant 3 sets a hard limit – particles are not tracked below their production threshold. Floor of 10 KeV.

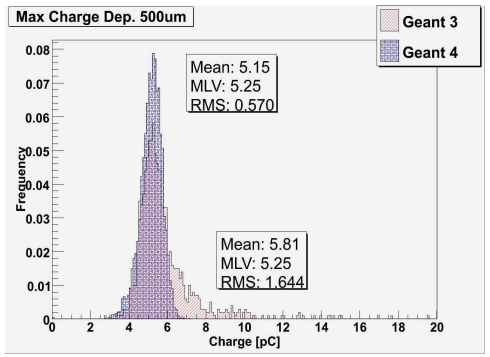
Thanks for the explanation to Dennis Wright:
http://conferences.fnal.gov/g4tutorial/g4cd/Slides/Fermilab/PhysicsTutor.pdf

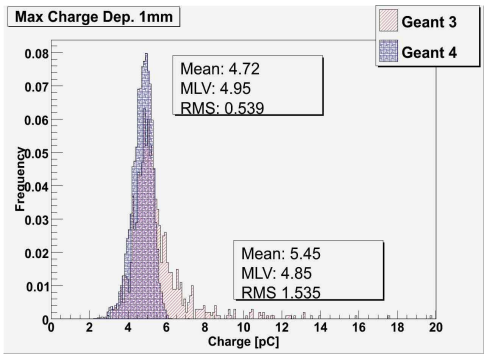
Charge Deposited



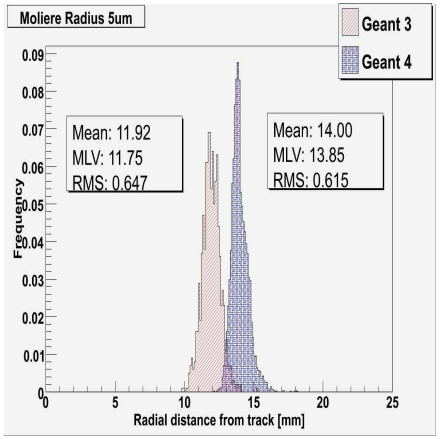


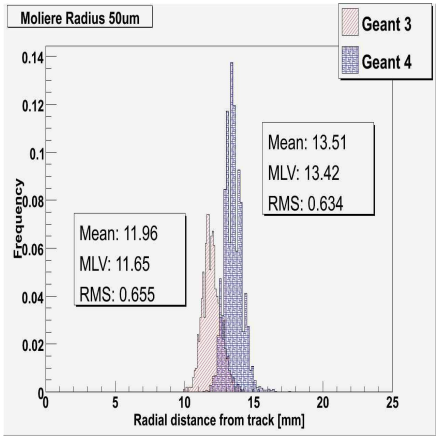


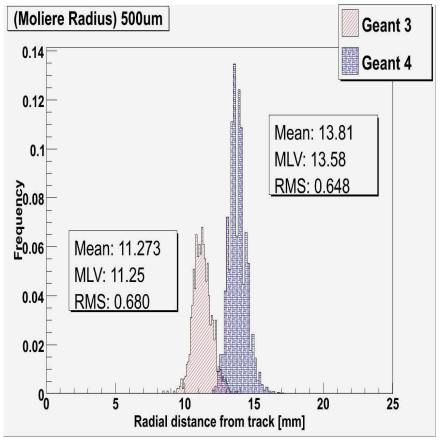


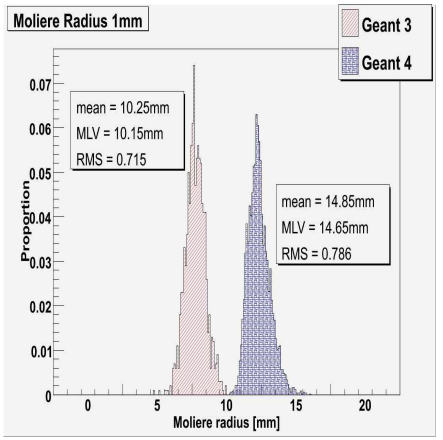


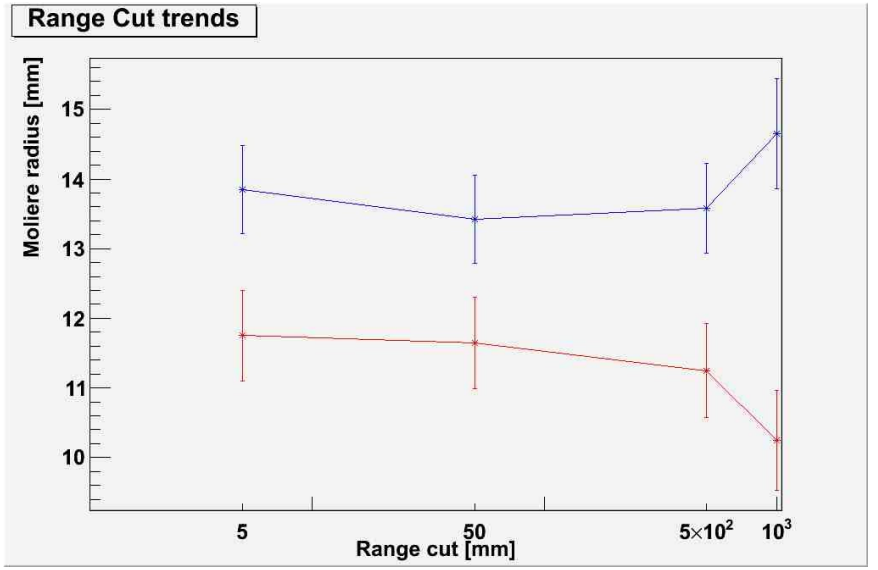
Moliere Radius



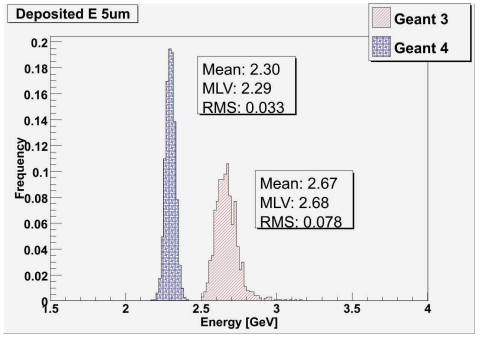


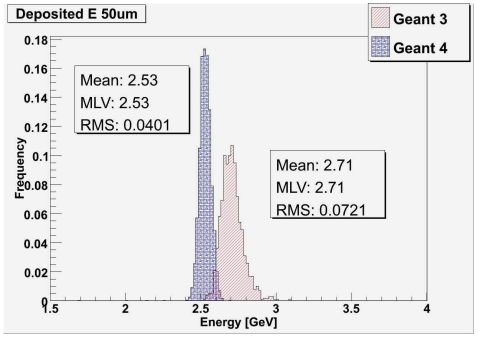


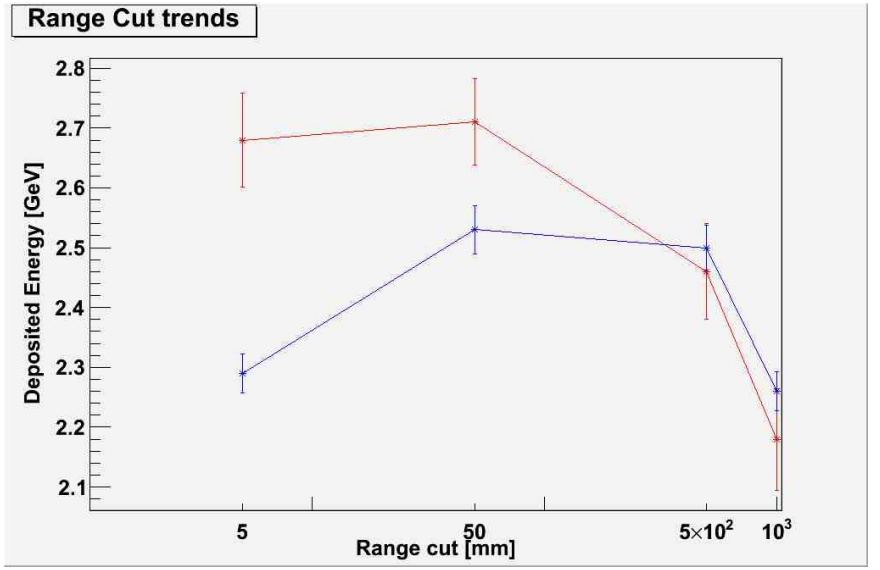


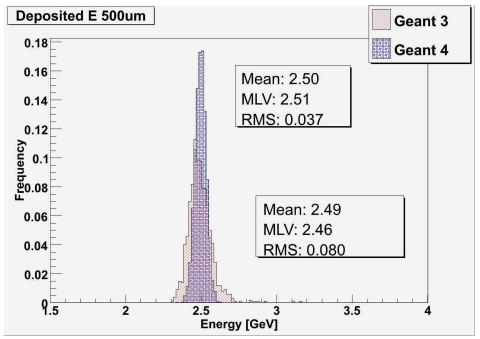


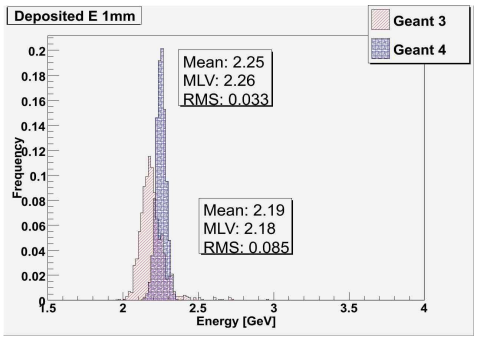
Reconstructing Energy:
Raw Energy Deposit





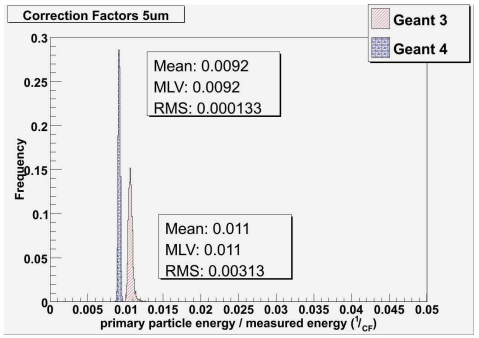


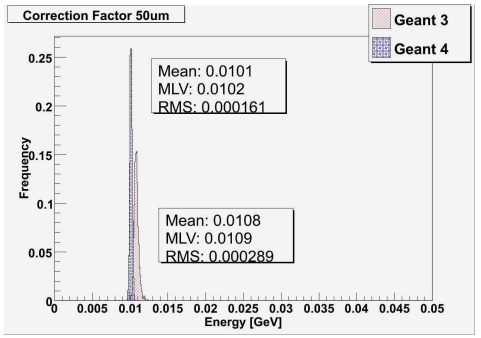


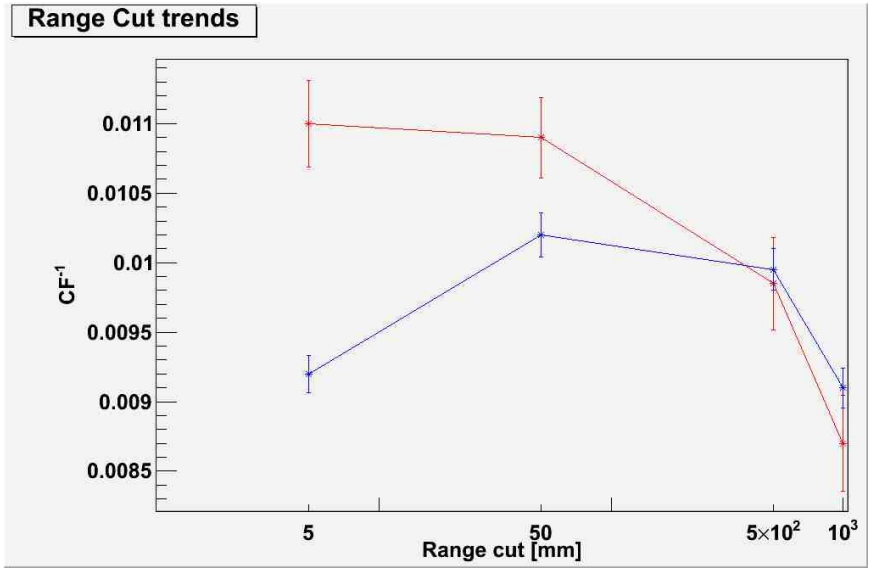


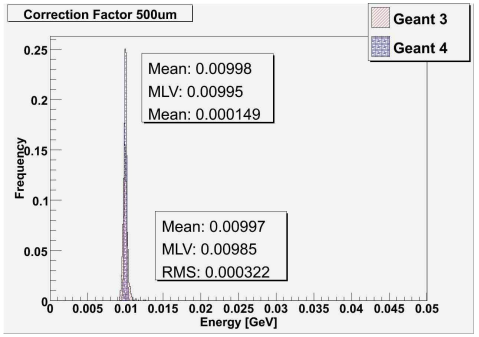
Reconstructing Energy:

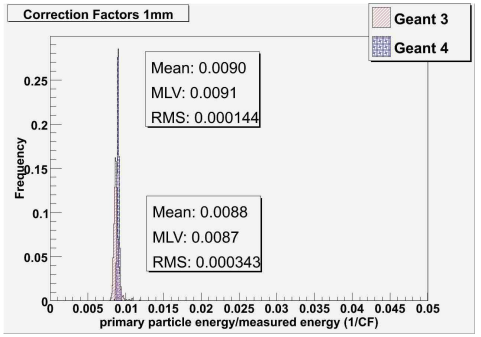
$$Correction\ Factor = \frac{E_{Input}}{E_{Dep}}$$





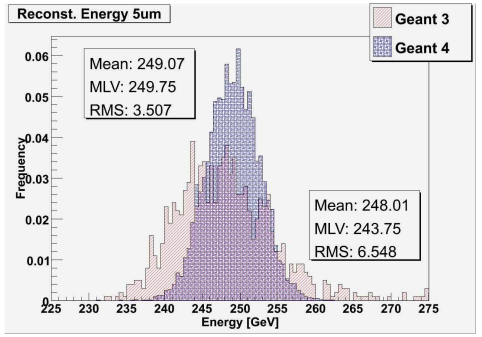


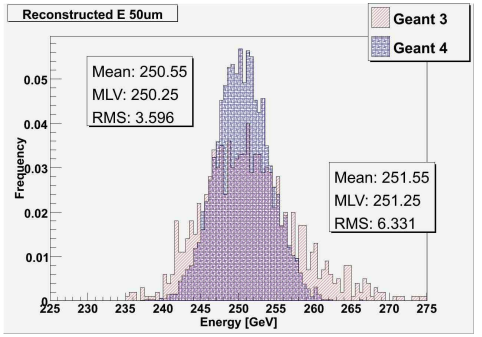


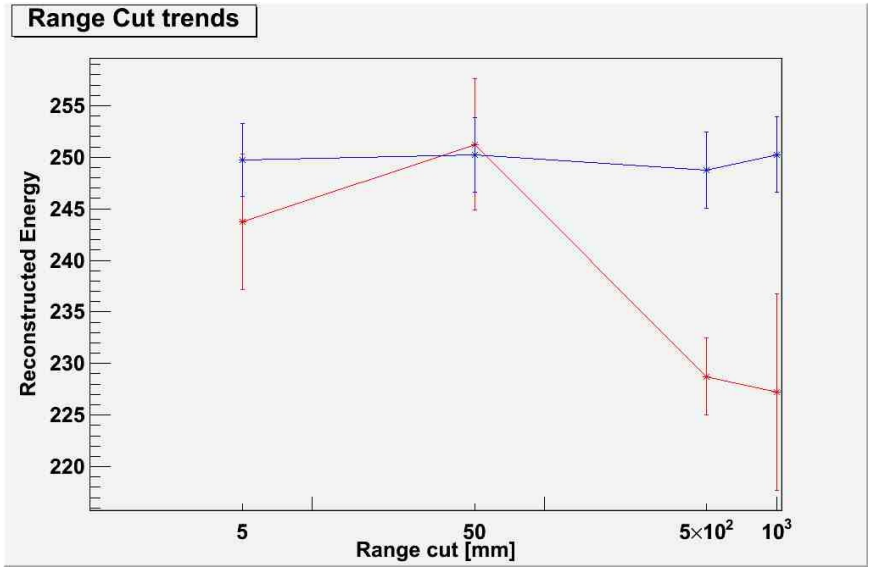


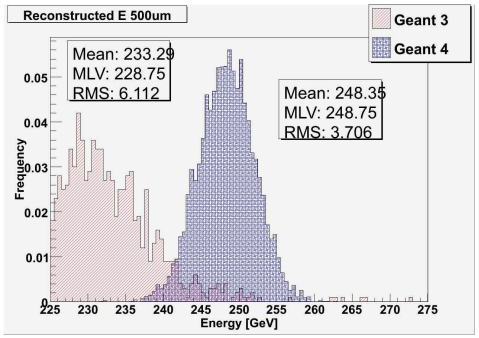
Reconstructing Energy:

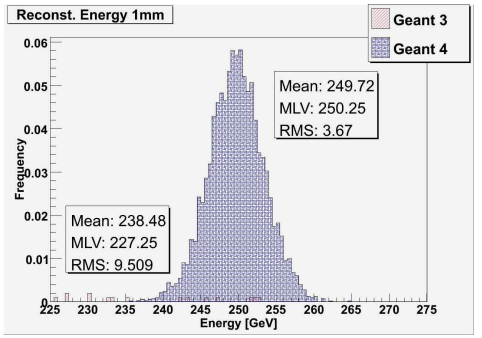
$$\overline{CF} \cdot E_{Dep}$$

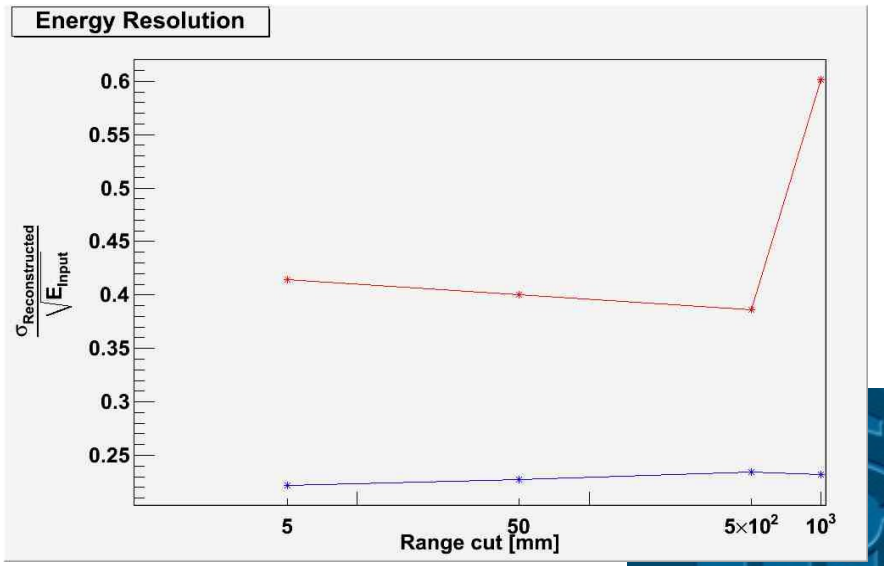












Summary

- Geant 3 and Geant 4 don't always agree, and they disagree in different ways:
  - Energy resolution: very different values
  - Charge deposition: different shapes
- Perhaps this can be entirely accounted for by the difference in treating range cuts, nevertheless:
- We need to be aware of how well the simulation approximates reality!
- Unfortunately, the only time we will know for sure which parameters give the best results is when the detectors are already in the test beams.