

IX International Conference  
on Calorimetry in High Energy Physics

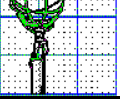
Annecy, France, October 2000

# GEANT4 Simulation of the Hadronic End-cap Calorimeter ( HEC ) of ATLAS

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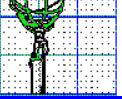
## Contents:

- Test beam GEANT3 & GEANT4 ( v.2.0 R2 ) geometry description
- Simulation of muons
- Simulation of electrons
- Conclusions



## GEANT3 (G3) & GEANT4 (G4) geometry description:

- full description of beam line  
( MWPC, scintillators, cryostat )
- geometry of HEC in the same manner in  
G3 & G4
- output: TTree in ROOT file

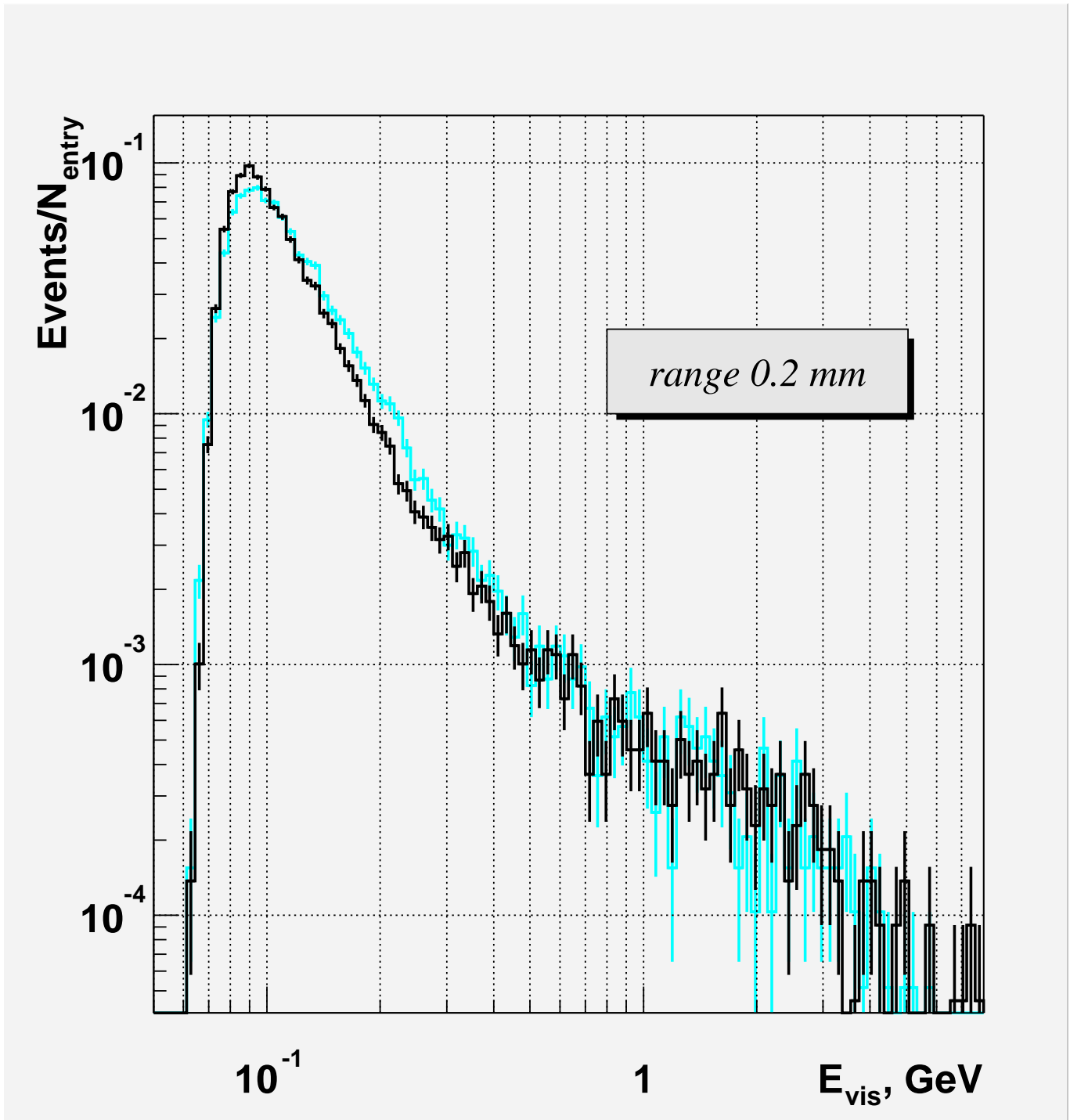


## Simulation of muons:

- only one energy  $E_\mu = 180 \text{ GeV}$
- ATLAS cuts for G3
  - particles transportation - 100 keV
  - $\delta$ -rays & bremsstrahlung - 1 MeV
- in G4 different cut ranges  
{ 0.2, 0.5, 1, 2, 4 } mm
- statistics:
  - ~ 20 000 events - G3
  - ~ 30 000 events - G4

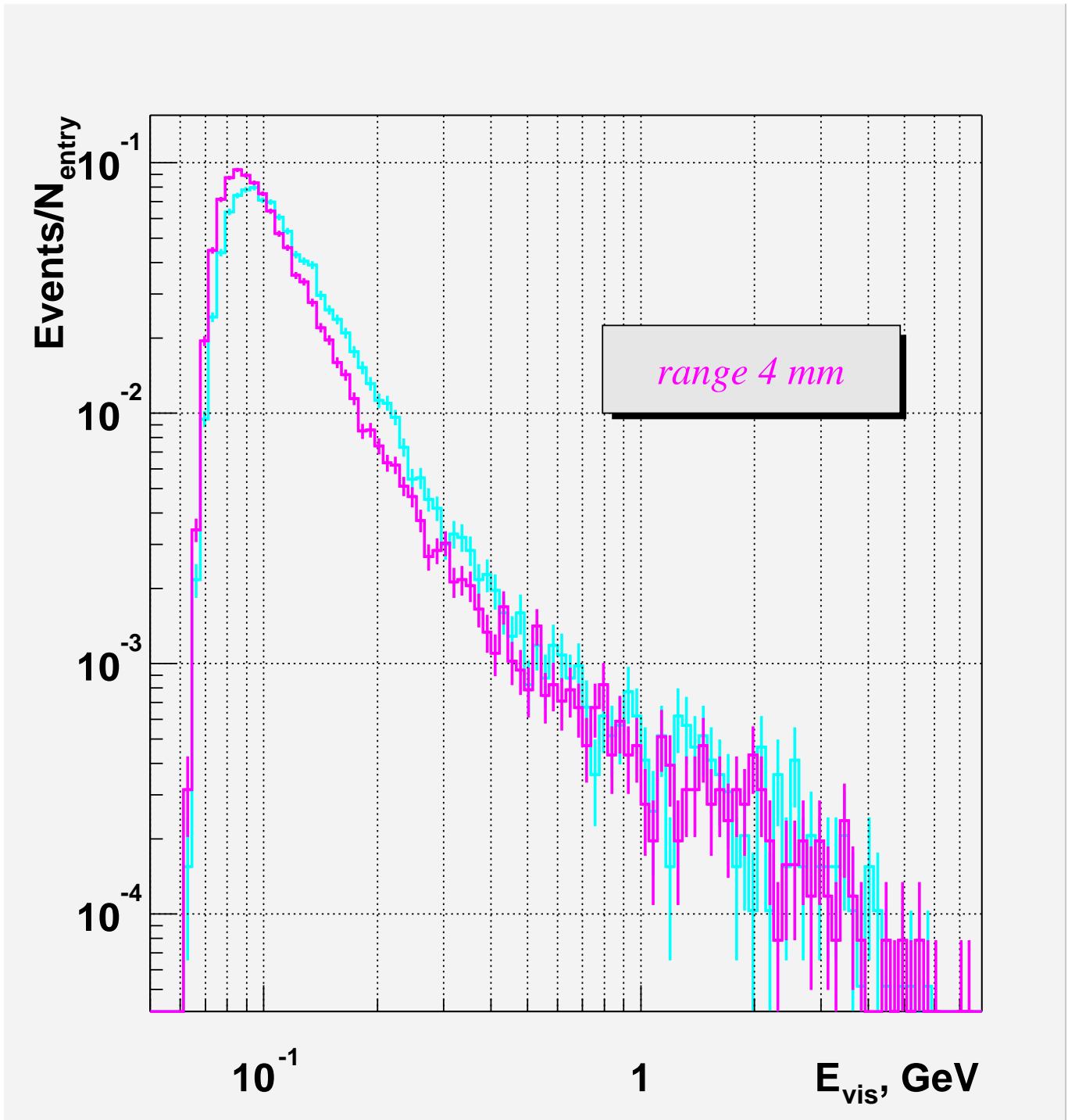


Muon energy distribution for G3 ( blue ) and G4 - 0.2 mm:



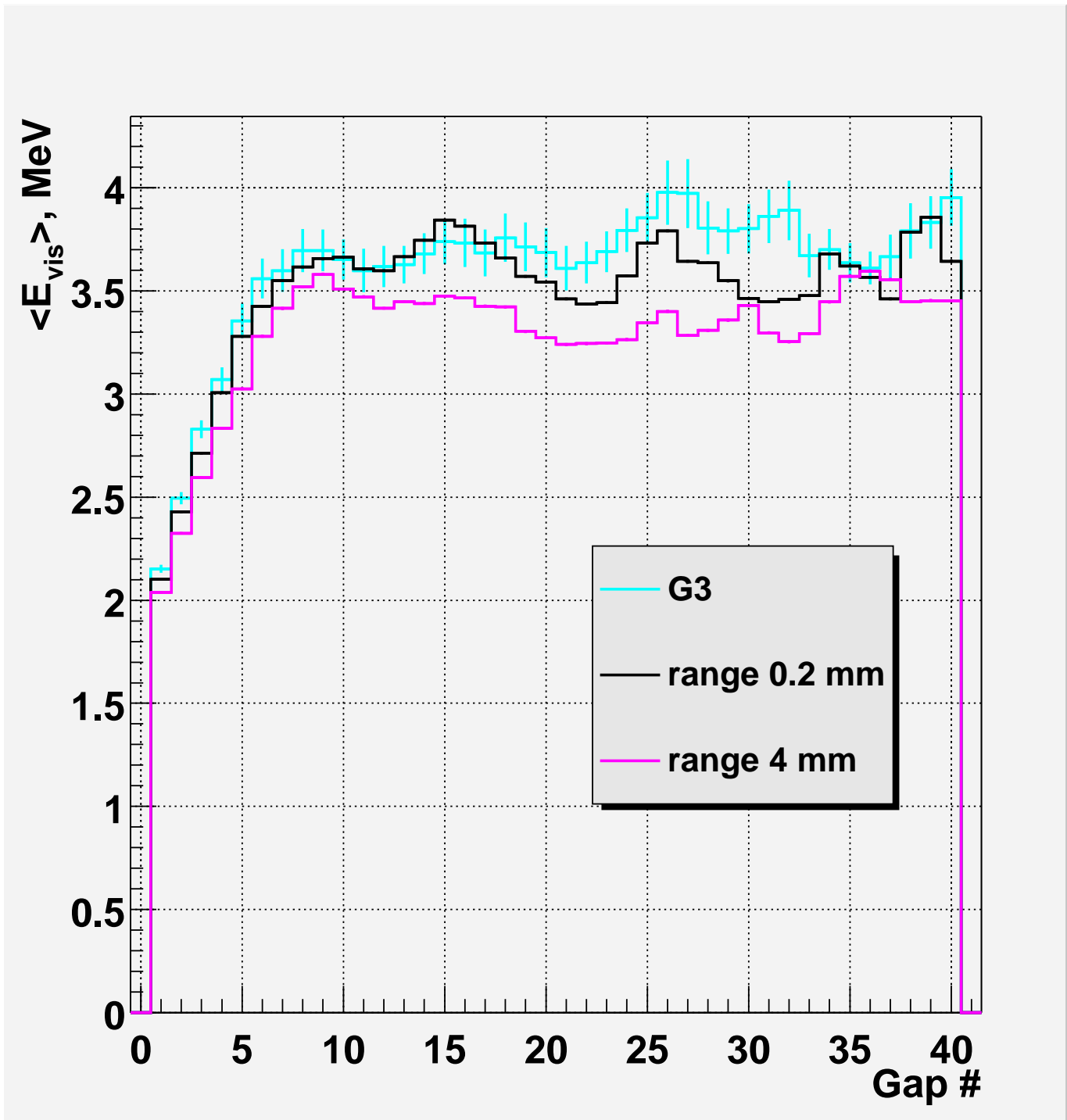


Muon energy distribution for G3 ( blue ) and G4 - 4 mm:



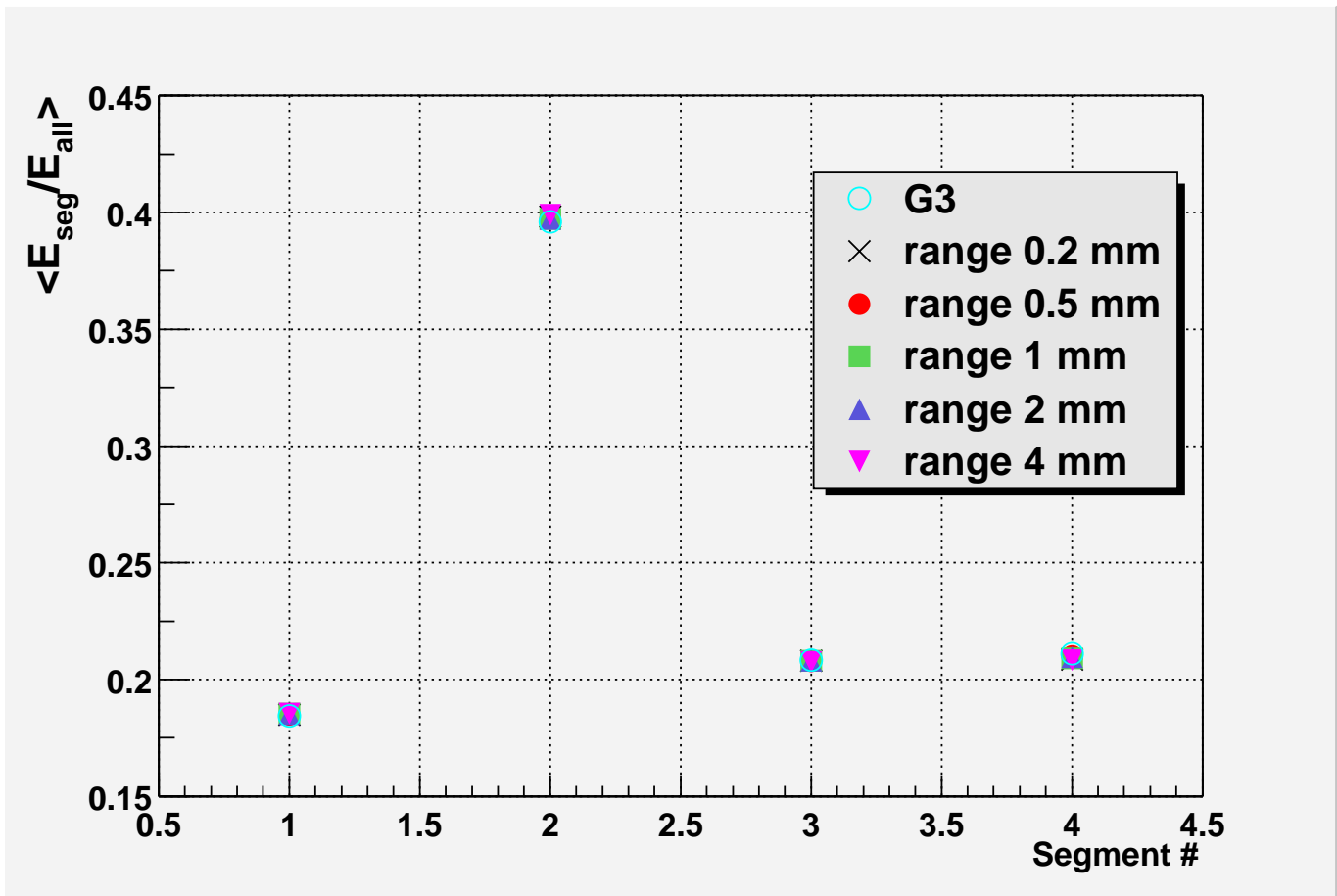


## Muon longitudinal shower profile:





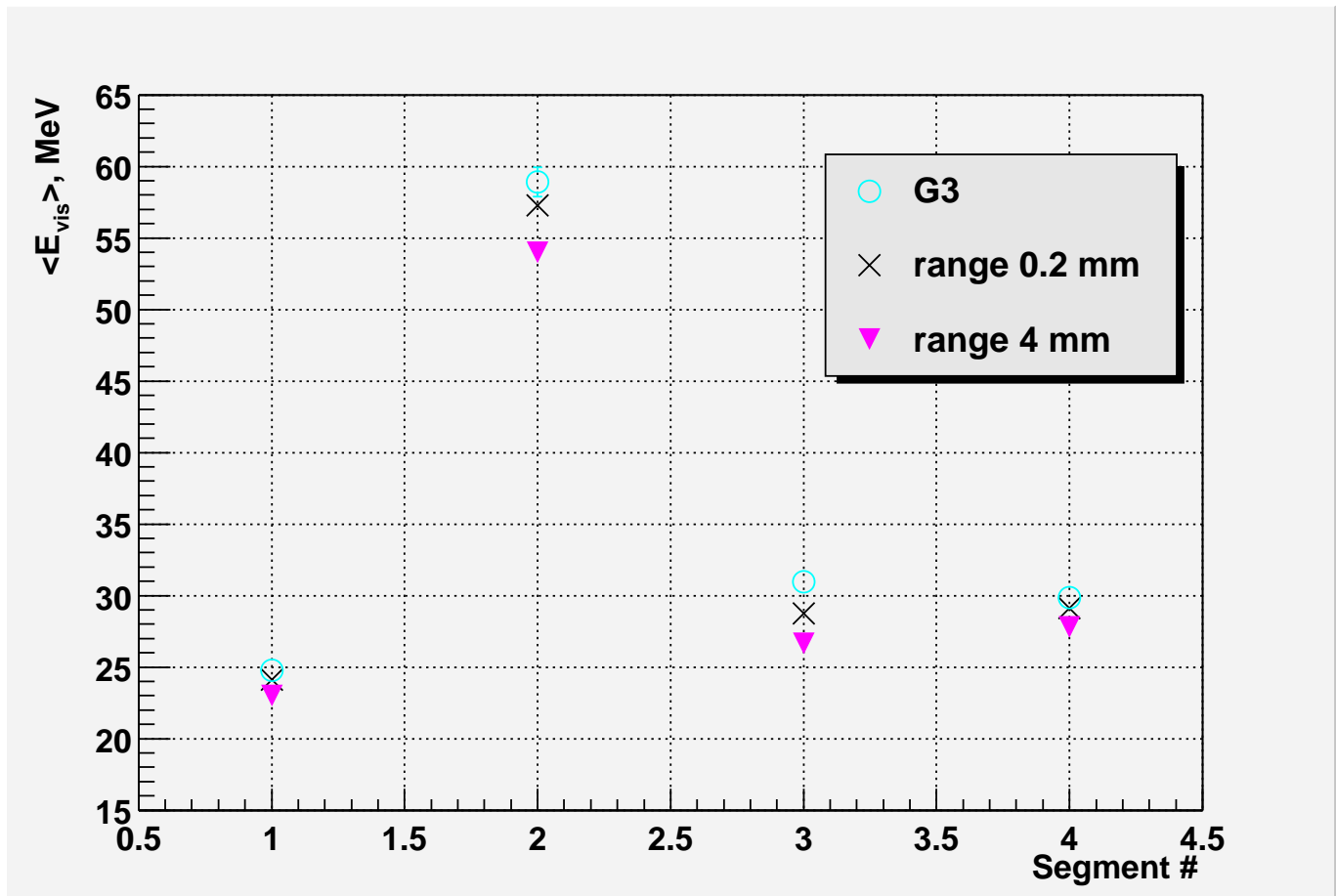
Muon longitudinal profile from segments ( readout 8+16+8+8 gaps):

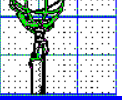






Mean visible energy in segments:



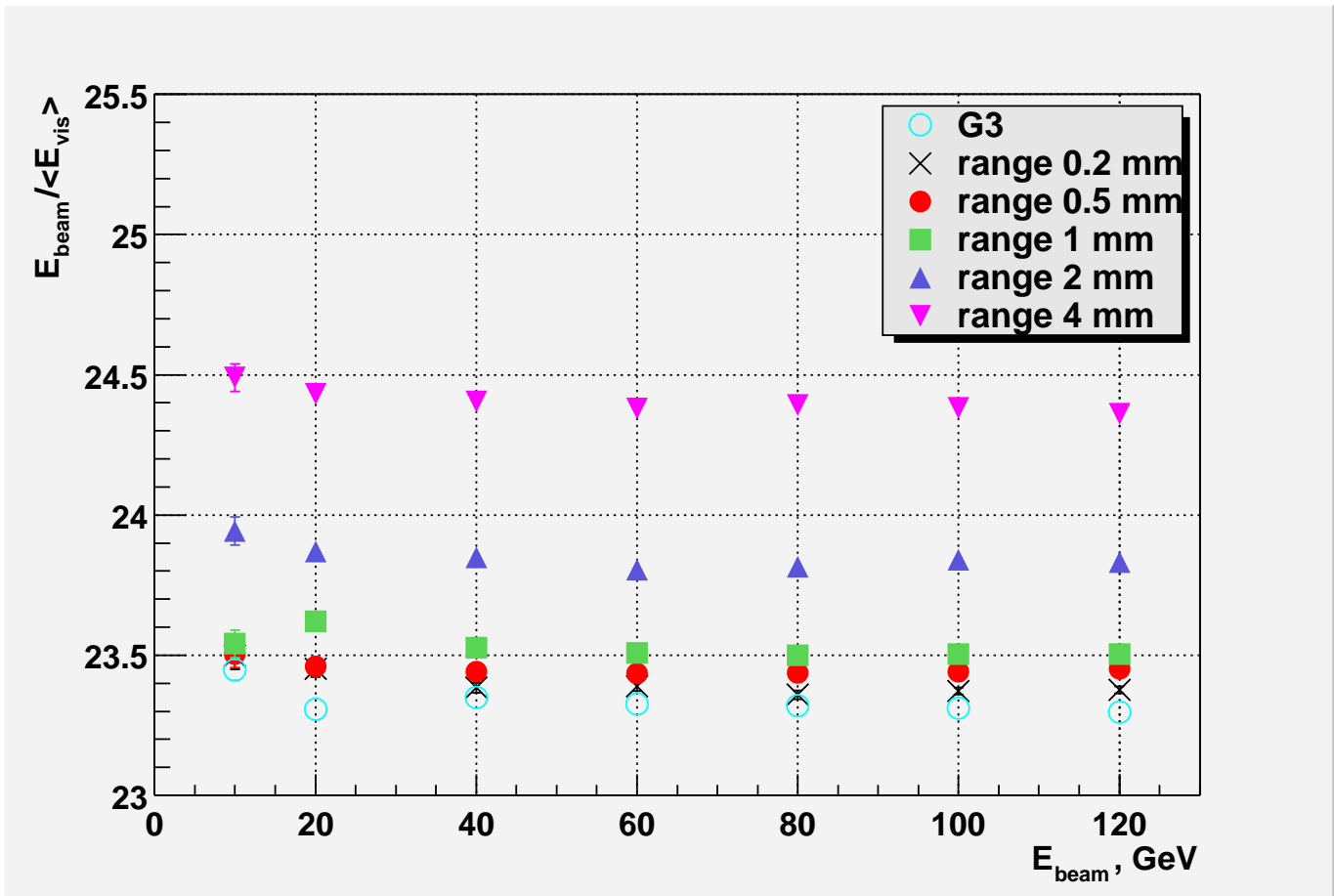


## Simulation of electrons:

- diff. energies  
 $E_e = \{ 10, 20, 40, 60, 80, 100, 120 \}$  GeV
- ATLAS cuts for G3
- in G4 diff. cut ranges  $\{ 0.2, 0.5, 1, 2, 4 \}$  mm
- statistics:  $\sim 2000$  events for each energy and cut

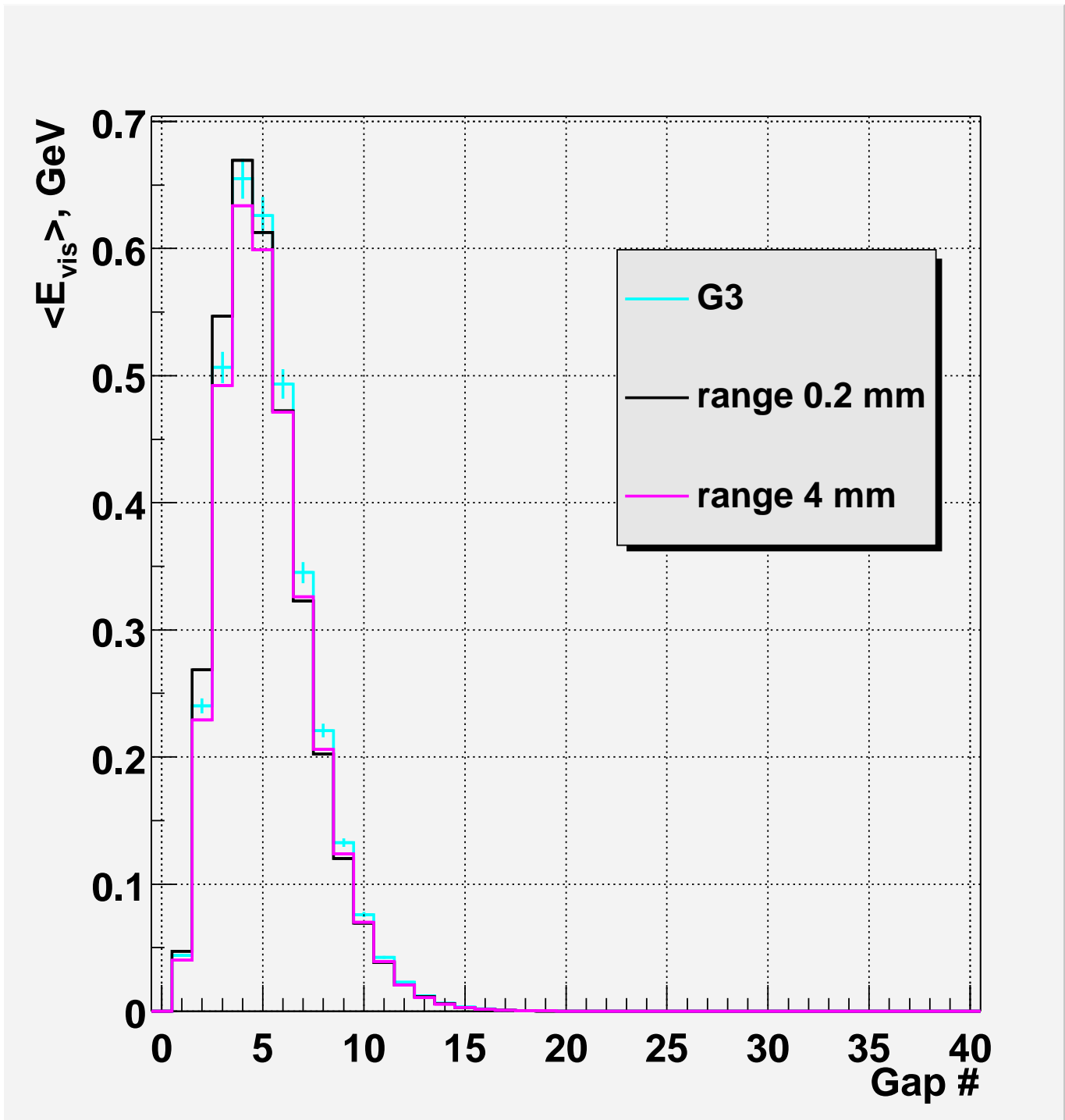


”Calibration” constant for G3 & G4:





## Electron longitudinal shower profile:



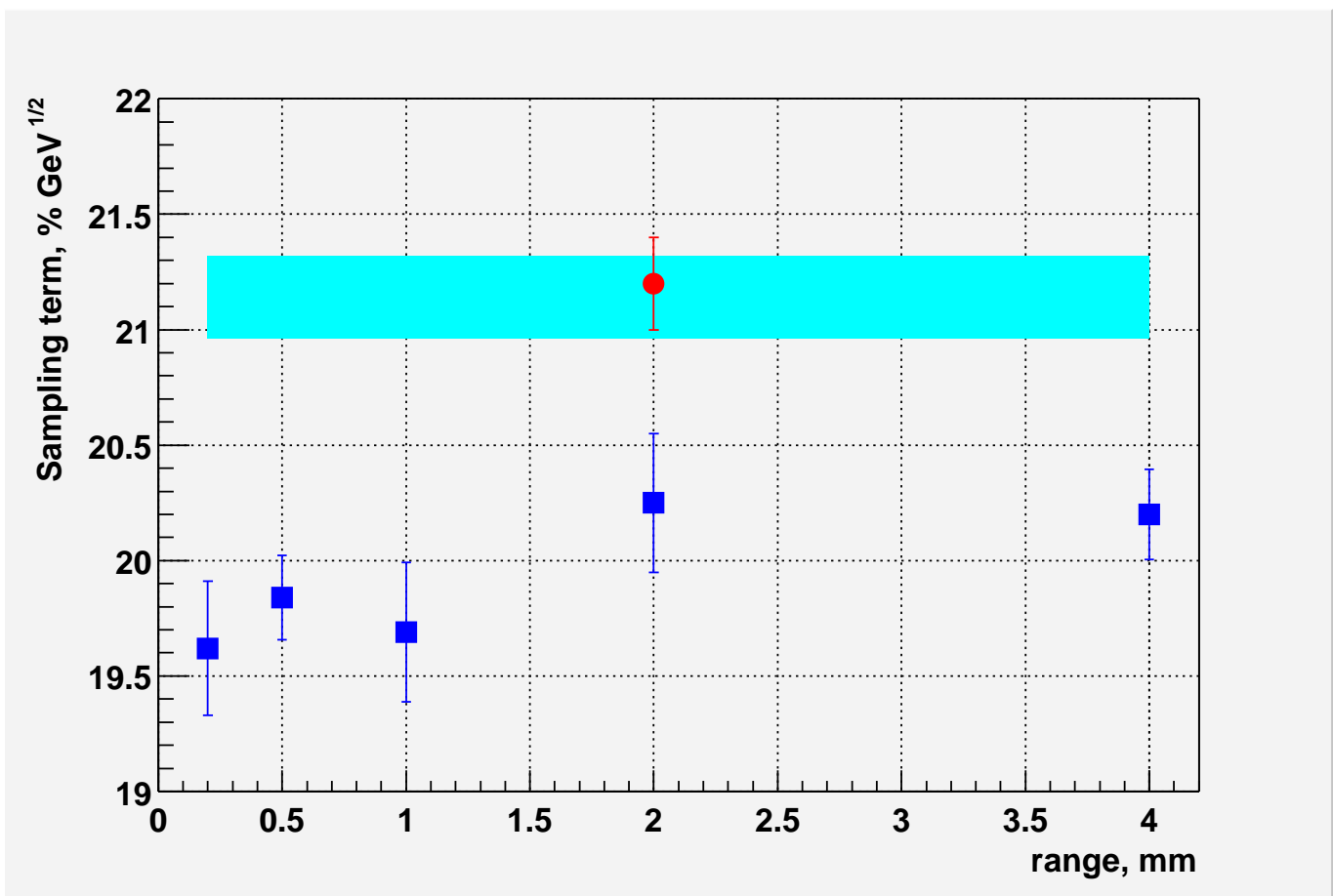


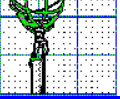
Energy resolution of electrons:

$$\sigma(E)/E = a/\sqrt{E} \oplus b$$

- Constant term  $b$  is compatible (within errors) with zero for TB/G3/G4.
- Sampling term  $a$  for:
  - G3 ( blue corridor )
  - Test Beam (red point) - thanks A. Minaenko
  - G4 ( blue points )

versus cut ( for G4 ):





## Conclusions:

- mean visible energy in different segments for muons show that in G3 we have more visible energy than in G4 for all ranges
- energy distributions of muons for different cuts prove previous conclusion
- "calibration" constant for electrons in G4 is systematically bigger than in G3, which means that as for muons, we observe less visible energy in G4
- constant term of energy resolution is compatible ( within errors ) with zero for G3, G4 and Test Beam
- sampling term of energy resolution for G3 and Test Beam are compatible
- sampling term from G4 are systematically lower than in G3 or Test Beam