Geant4 Electromagnetic Physics Meeting
January 19, 2012, CERN

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Study of simplified model of ATLAS tilecal

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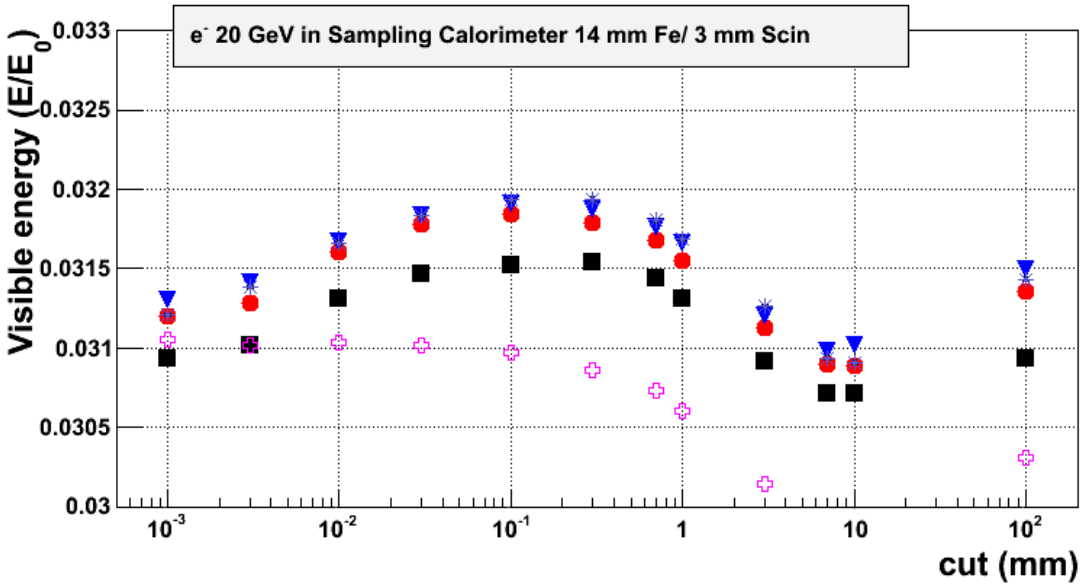
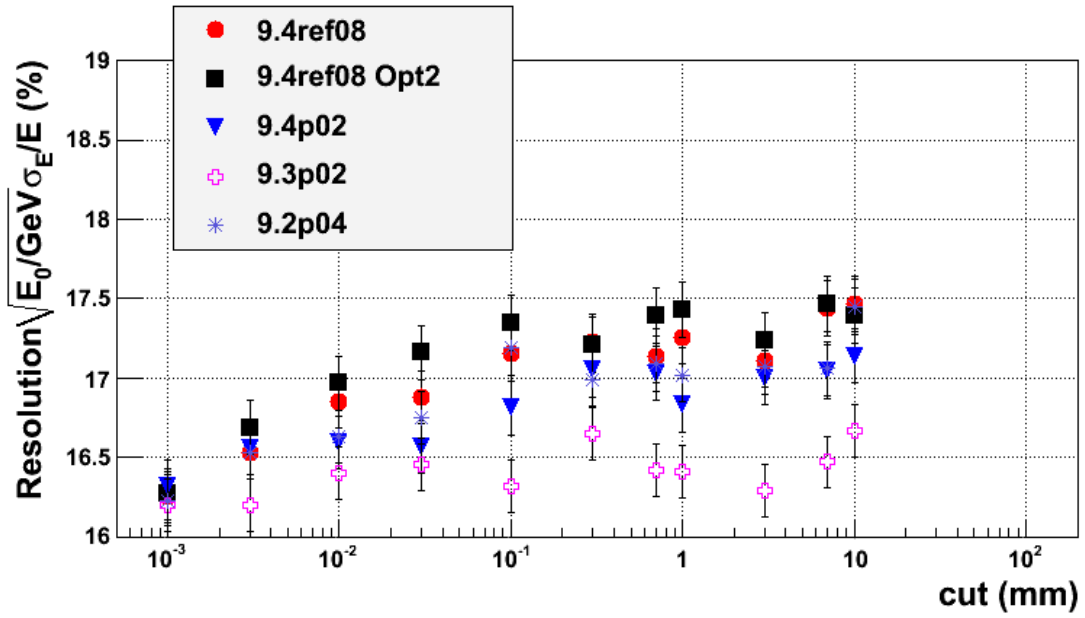




Motivation:

It is observed a cut dependence of ATLAS TILECAL response including effect of sampling ionisation for small steps of particles

Atlas TILECAL tests

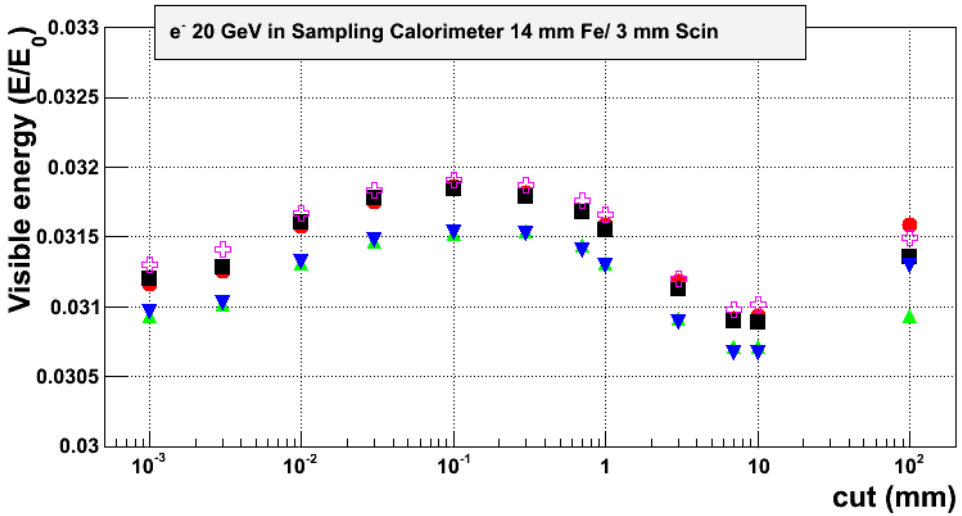
(on the base of TestEm3 example)

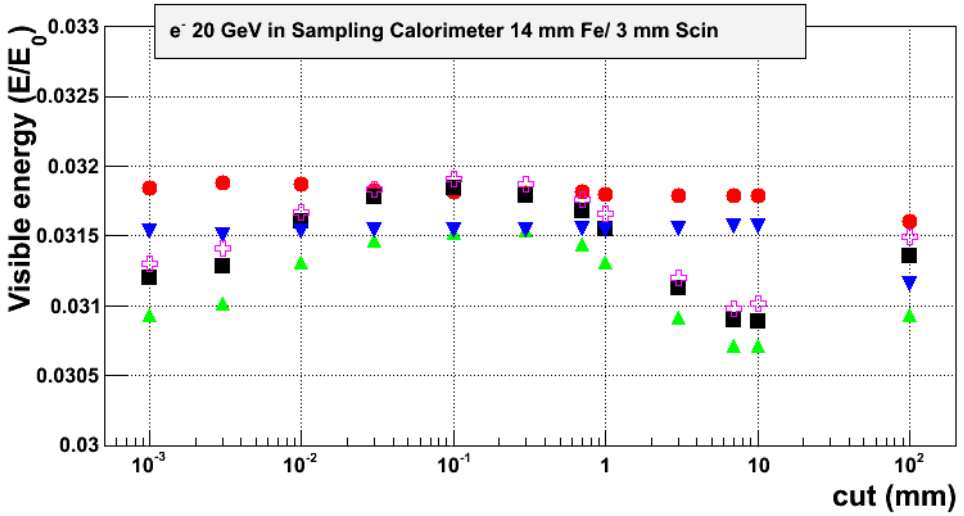
- Study of cut dependence of ATLAS TILECAL response for different components of EM shower
- Study of an influence of multiple scattering on ATLAS TILECAL response

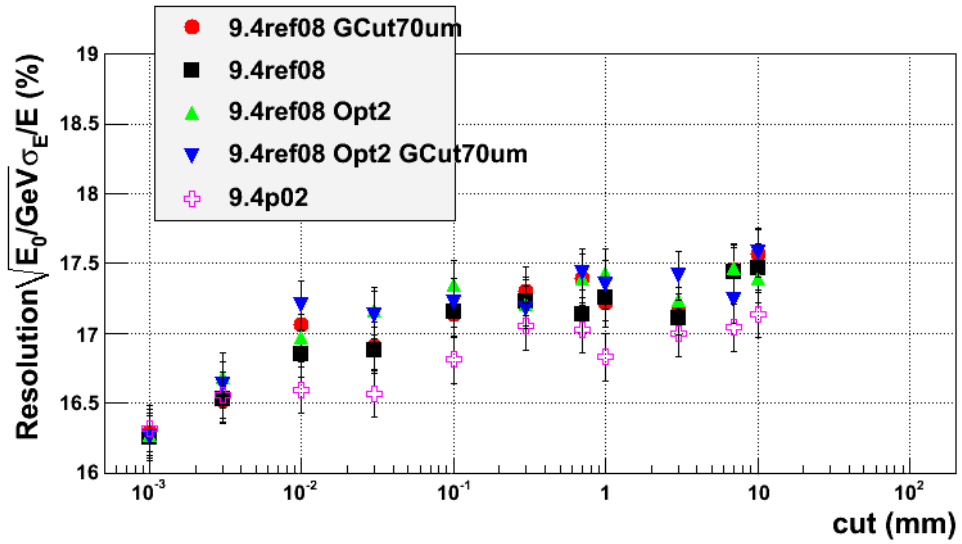
Atlas TILECAL tests

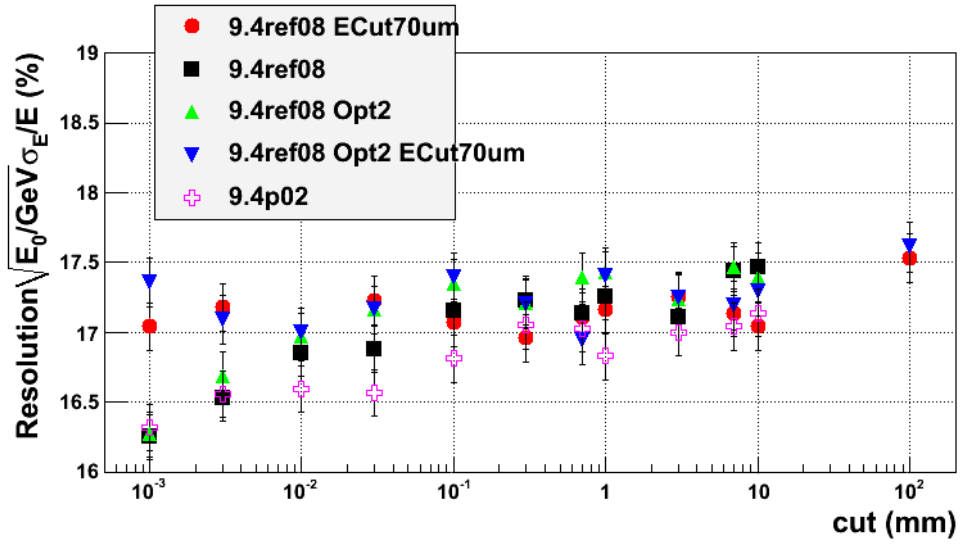
Variable parameters:

fix cut value of gamma (0.07 mm) and change cut value of electron from 1 um up to 100 mm (on the left plot) and vice versa (on the right plot)







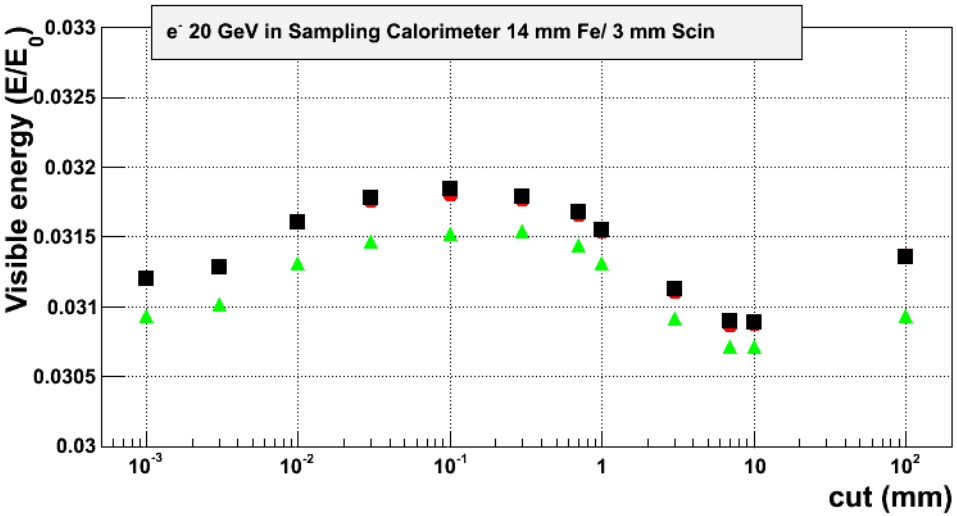


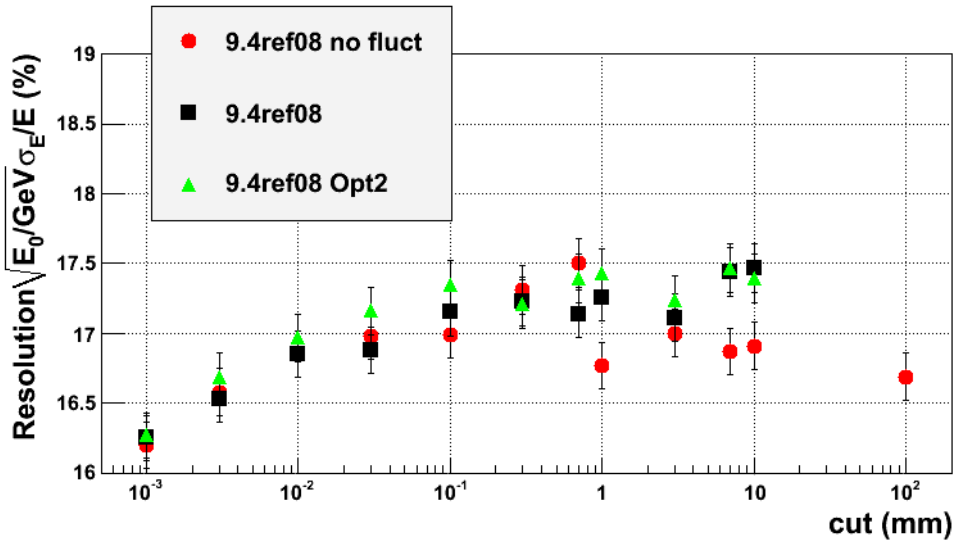
Atlas TILECAL tests

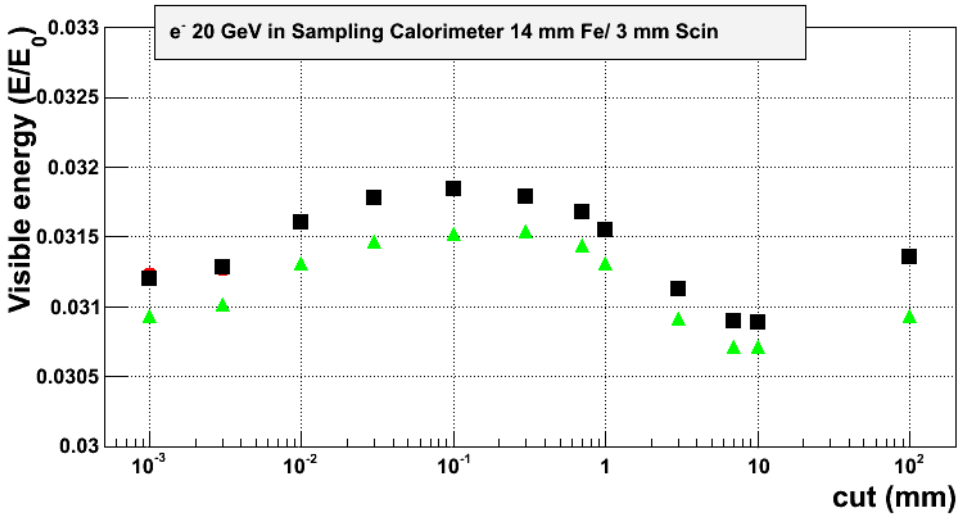
Variable parameters: switching off fluctuation and voxelization

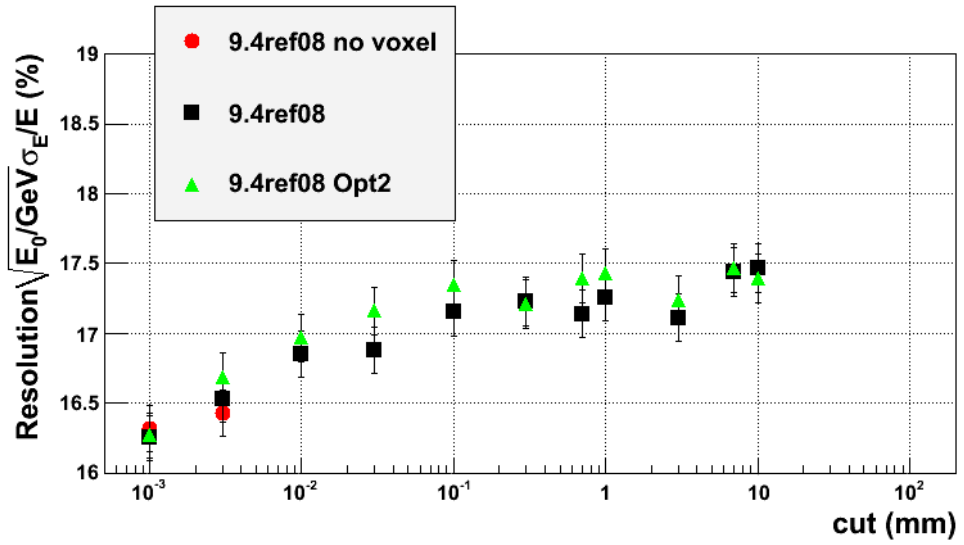
/process/eLoss/fluctuation false

/run/optimizeGeometry false









Atlas TILECAL tests (multiple scattering)

Variable parameters:

Range Factor

parameter of MSC step limitation algorithm developed in order to achieve optimal balance between simulation precision and CPU performance of simulation. At the start of a track or after entering in a new volume, the algorithm restricts the step size to a value $f_r \cdot \{r, \lambda_1\}$, where λ_1 the transport mean free path, r is the range of the particle, f_r is a parameter (RANGE FACTOR) $\in [0, 1]$, taking the max of r and λ_1 is an empirical choice. By default $f_r = 0.04$.

Lateral Displacement

The G4MultipleScattering class simulates the multiple scattering of charged particles after a given step, computes the mean path length correction and the mean lateral displacement.

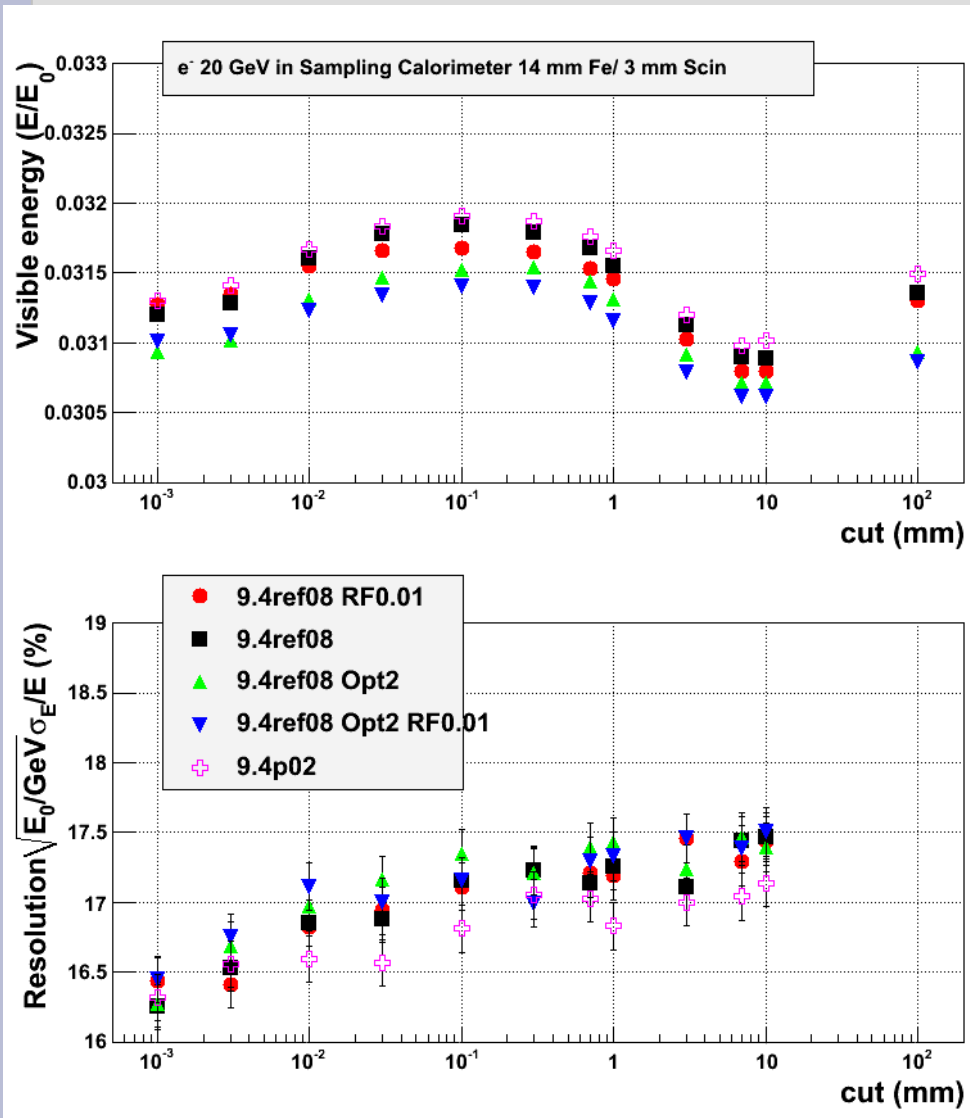
Atlas TILECAL tests (multiple scattering)

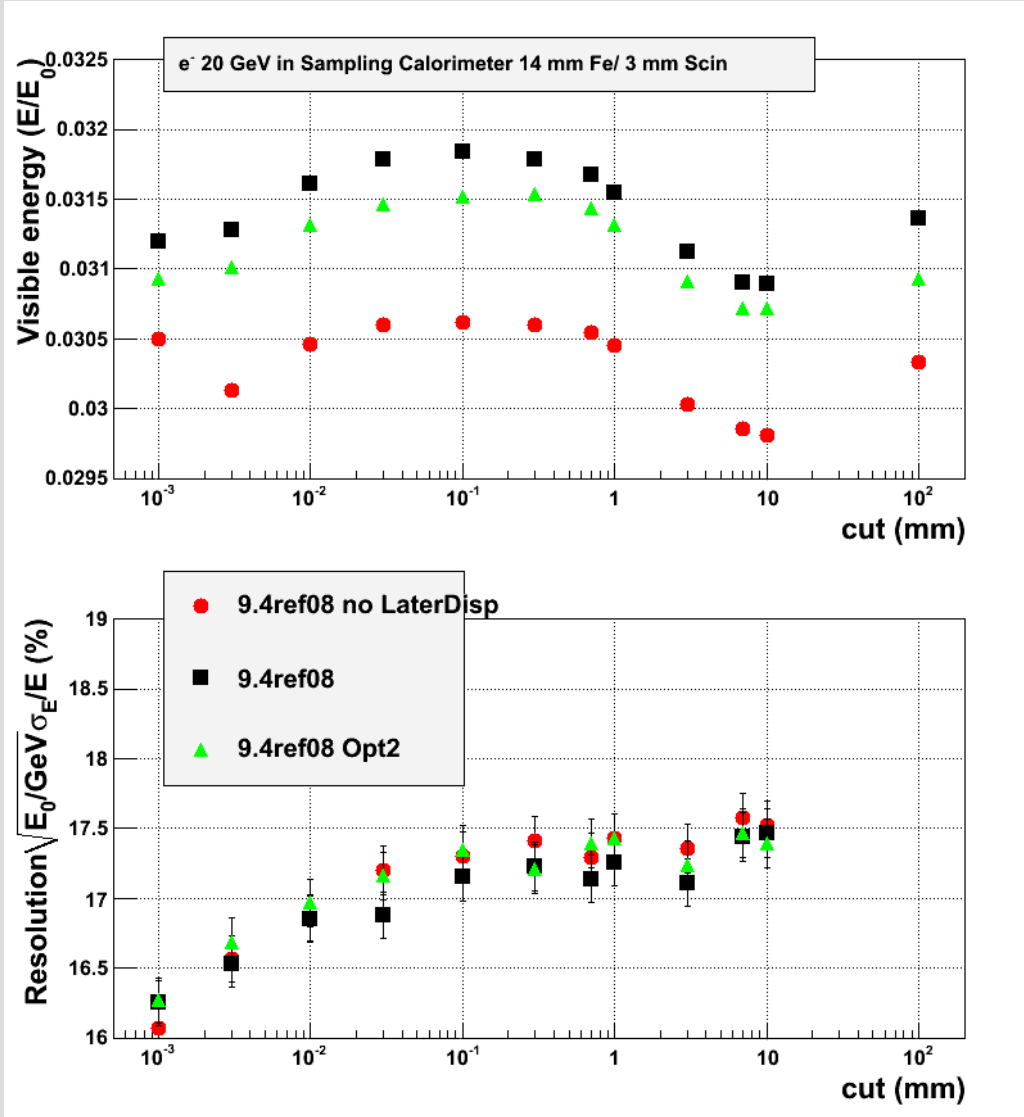
Variable parameters: Range Factor, Lateral Displacement

Range Factor has been changed from 0.04 (default) to 0.01 (left plot).

Lateral Displacement has been switched off

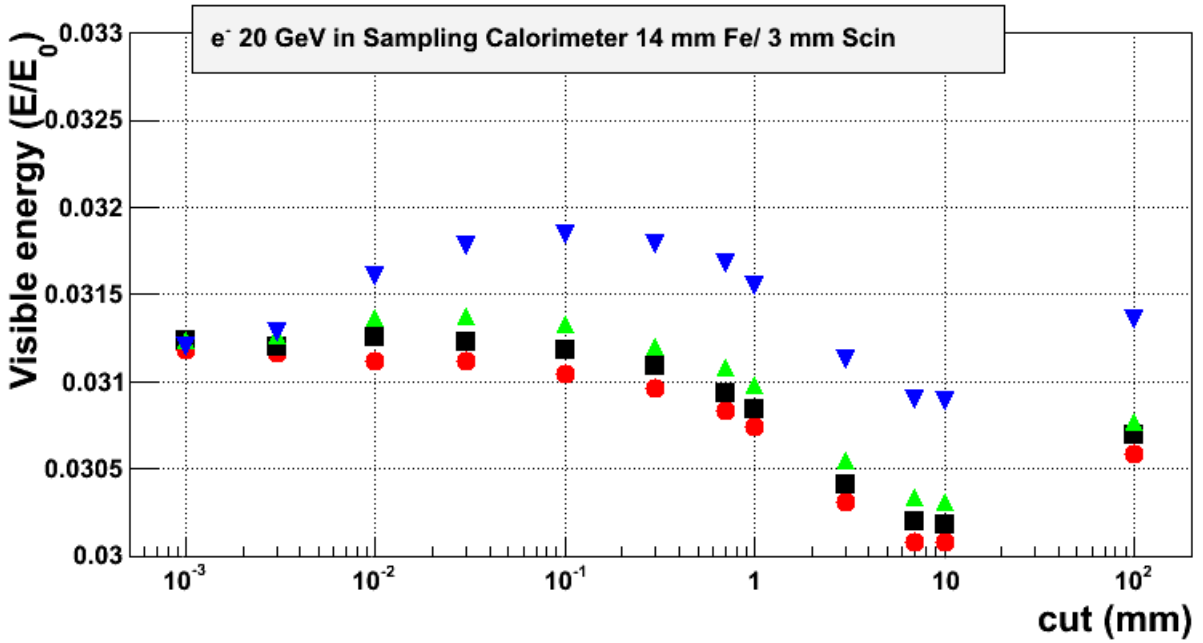
(/process/msc/LateralDisplacement false)

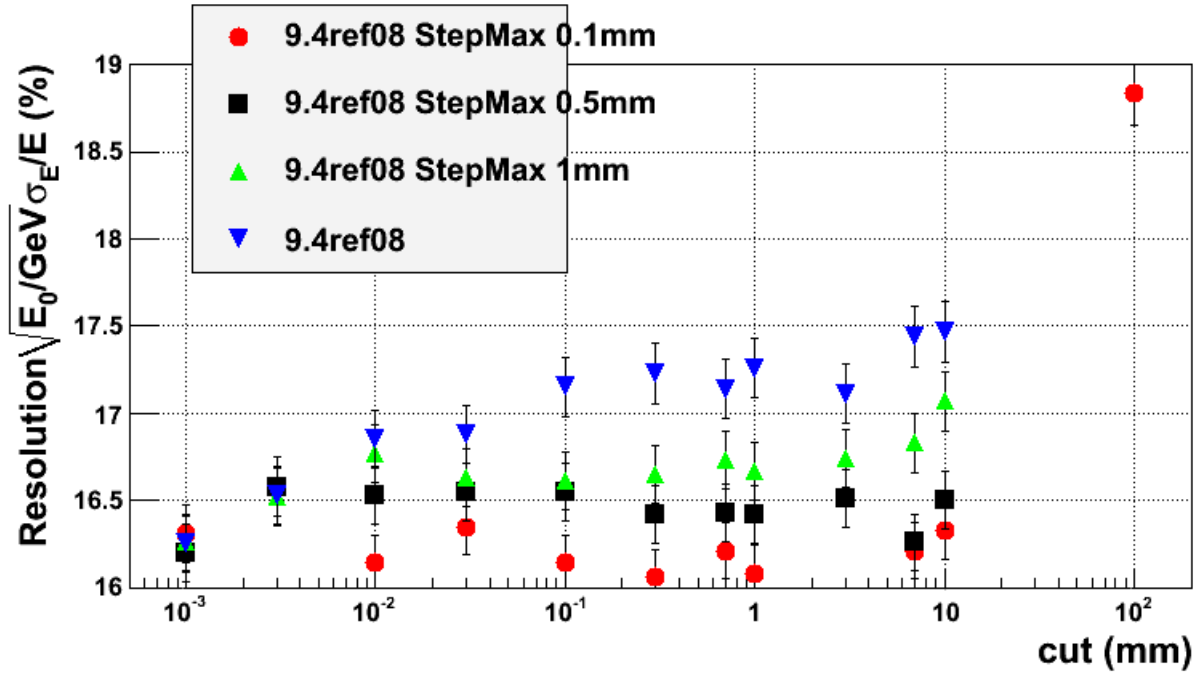




Atlas TILECAL tests (Step Limit)

Variable parameters: Step Limit 0.1, 0.5, 1 mm

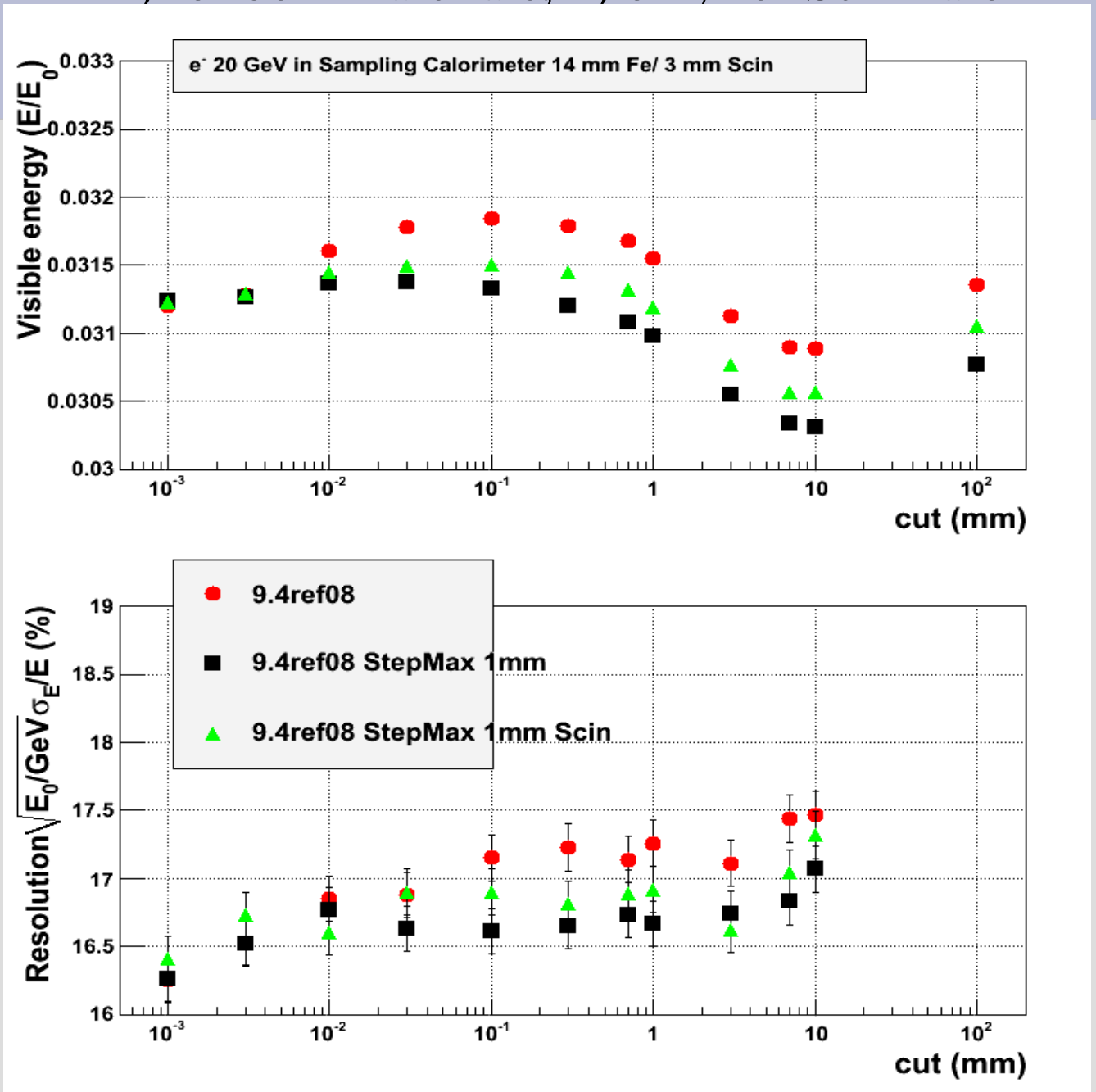




Atlas TILECAL tests (Step Limit)

Variable parameters: Step Limit 1 mm

1) for both materials; 2) only for Scintilator



Summary

— ATLAS TILECAL response depends on cut value of electron and doesn't depend on cut value of gamma. -> ~~Bremsstrahlung~~

— ~~optimizeGeometry factor~~

— MSC. A decreasing of response due to a change of Range Factor is ~0.5%. Switching off Lateral Displacement results in 3% decreasing of the calorimeter response

— A sensitive dependence of the response on StepLimit parameter

— Possible explanation: different work of the fluctuation model for electrons and hadrons

— Recommendation: Parameters of the calorimeter are not optimal. To improve results it is necessary to tune parameters of the simulation