Improvements in GFLASH fast sumulation

Igor Semeniouk
LLR, Ecole Polytechnique - CNRS/IN2P3

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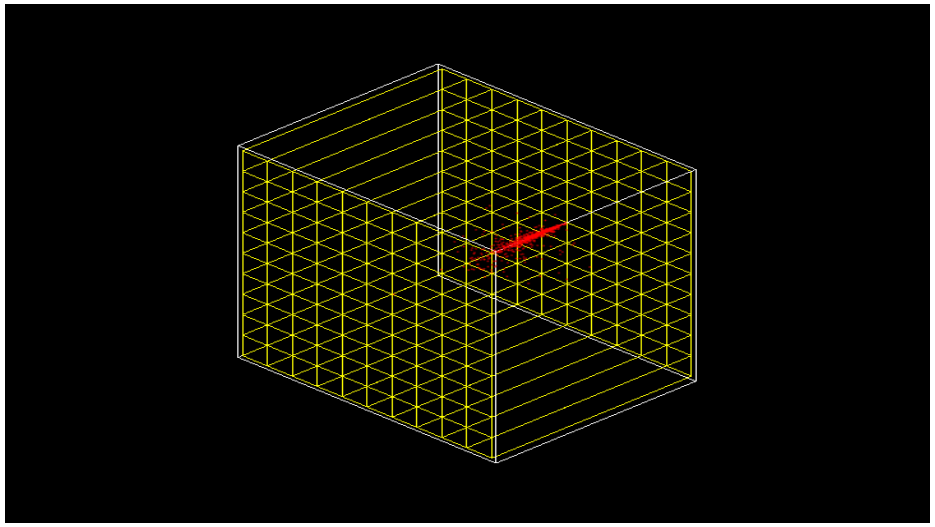
GFlasha example (old)

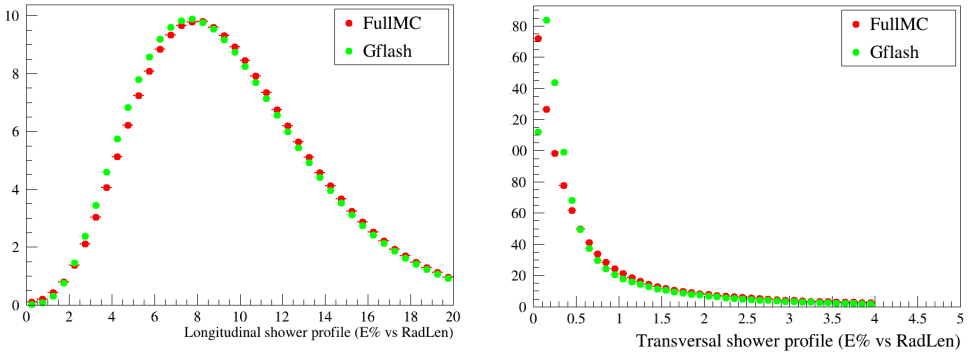
The application with allow compare and tune GFlash shower parametrization versus full Geant4 shower development.

- Example of homogeneous shower parameterization.
- All calorimeter is a single GFlash envelope
- Single crystal used as a SD volume
- In Geant4 examples since 10.06
- Good agreement with full simulation (PbWO4)

- Required fix in size and material setting commands
- Bug in Radial index calculation



GFLASH Hits in homogeneous calorimeter



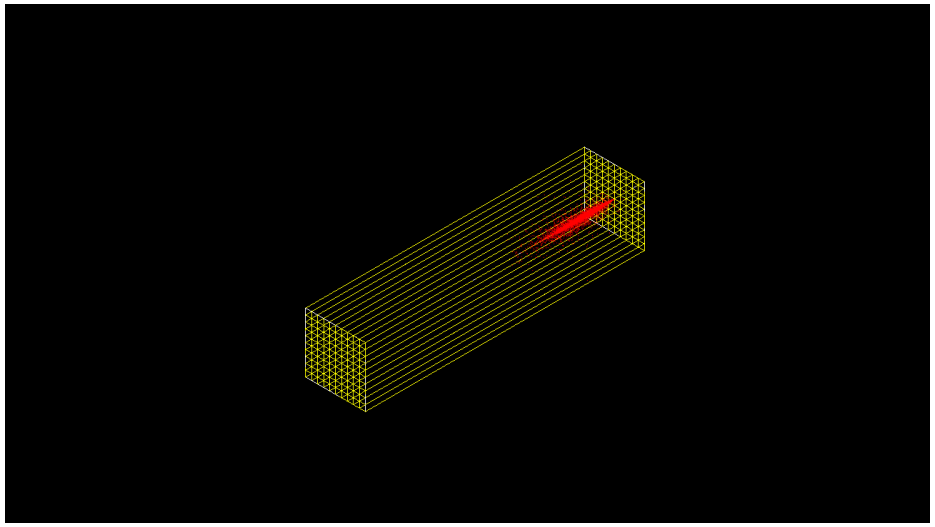
Shower profiles in homogeneous calorimeter (PbWO4)

GFlasha example (updated)

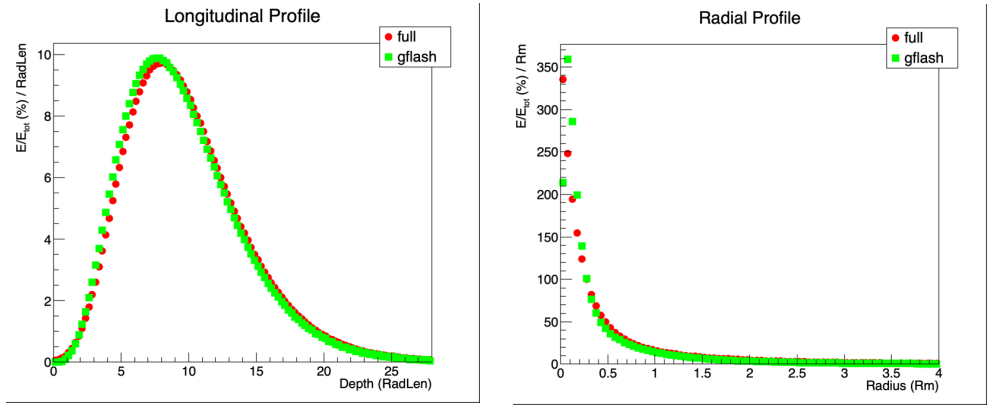
- Larger calorimeter length
- Radial histograms in fraction of radius Moliere
- Fixed bug in radial index calculation

- Good agreement with full simulation (PbWO4)

- Command for size and material setting not work correctly
- Existing workaround pass the size and material name via application arguments

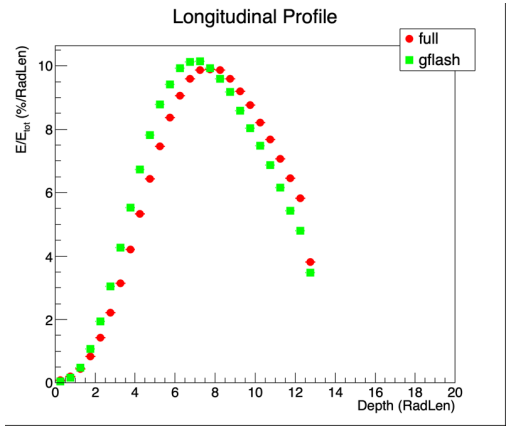


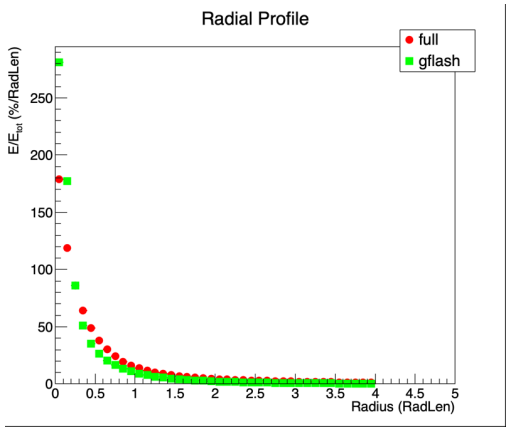
GFLASH Hits in homogeneous calorimeter



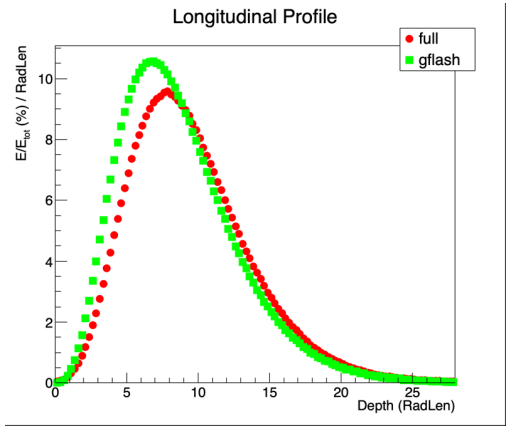
Shower profiles in homogeneous calorimeter

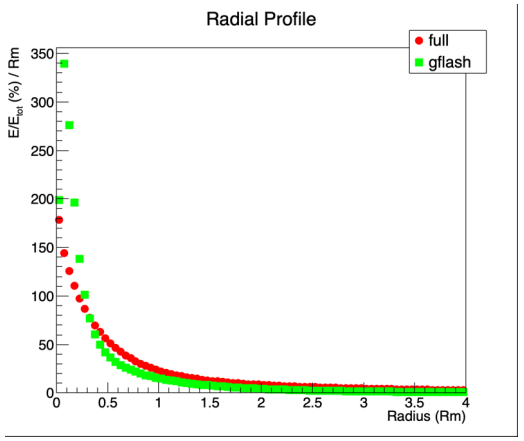
Gflasha example
CsI Material





Old



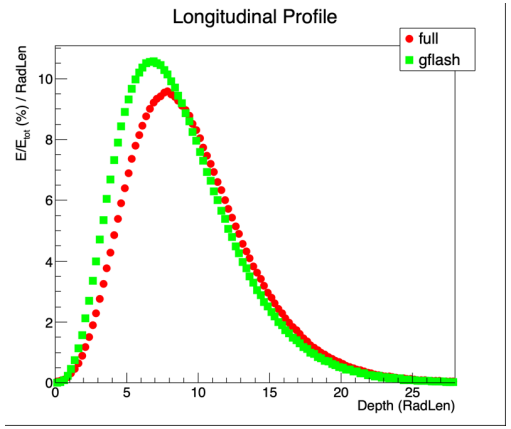


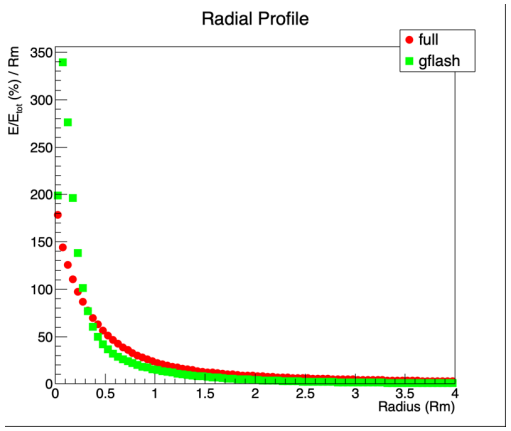
Updated

Better Histograms for CsI

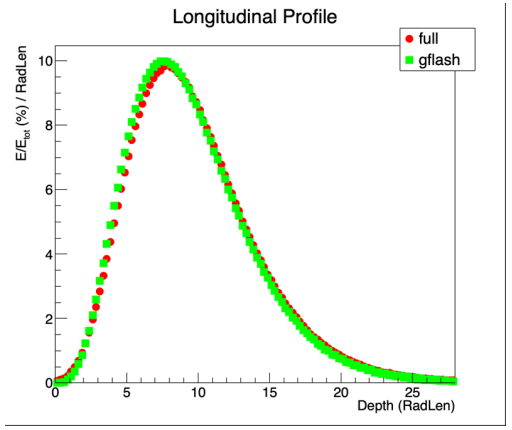
But shower maximum shifted !

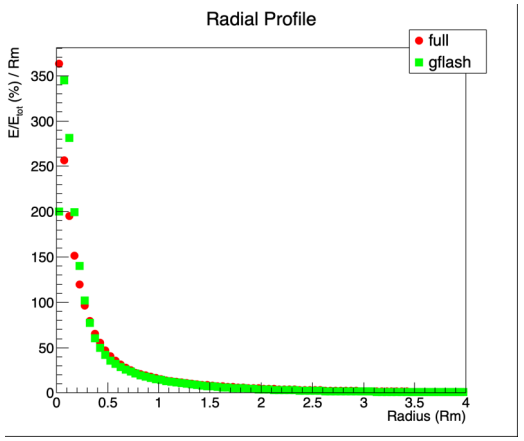
Gflasha example
Es and Ec calculation in GFlashHomoShowerParameterisation





CsI Original





CsI Updated

Scale Energy:

$$Es = 21.0\ MeV$$

Critical Energy:

O. I. Dovzhenko and A. A. Pommanskii formula:

$$Ec = 2.66(X_0 \frac{A}{Z})^{1.1}$$

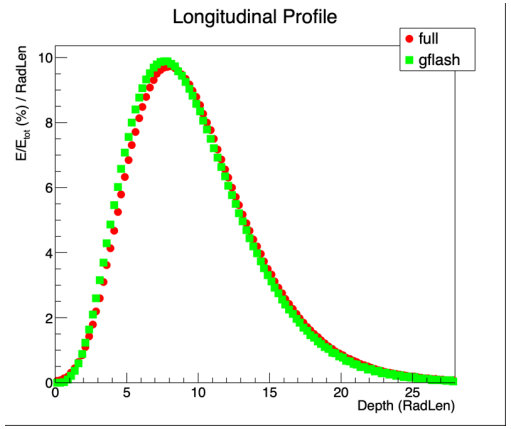
Updated:

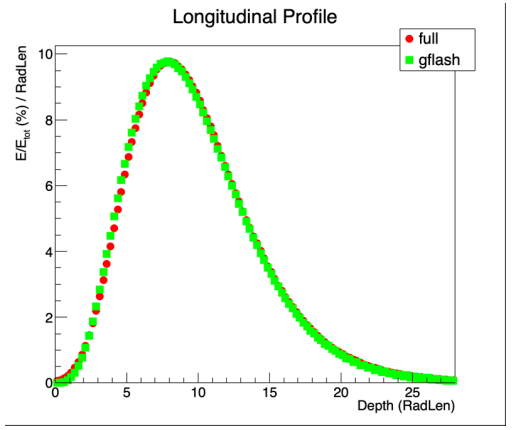
$$Es = 21.2\ MeV$$

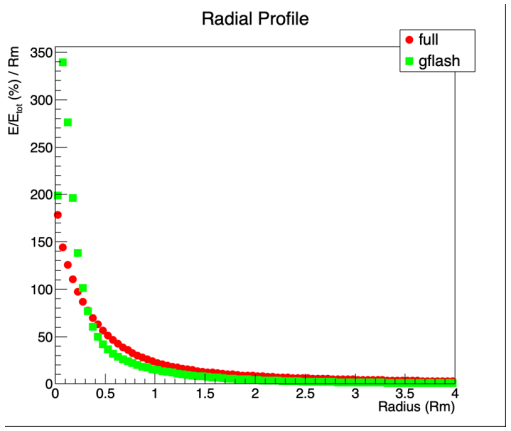
$$Ec = \frac{610\ MeV}{Z + 1.24}$$

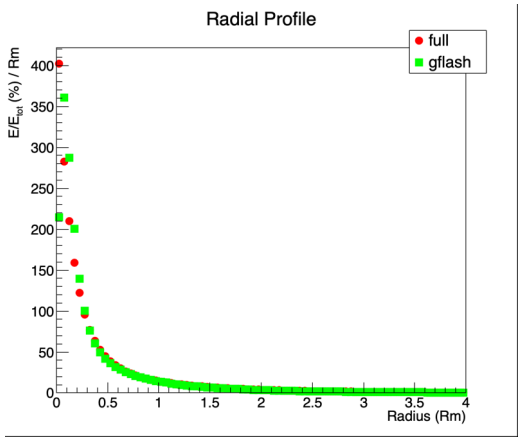
Rossi approximation for solids and liquids

Gflasha example
Es and Ec calculation in GFlashHomoShowerParameterisation









PbWO4 Original

PbWO4 Updated

Material : PbWO4

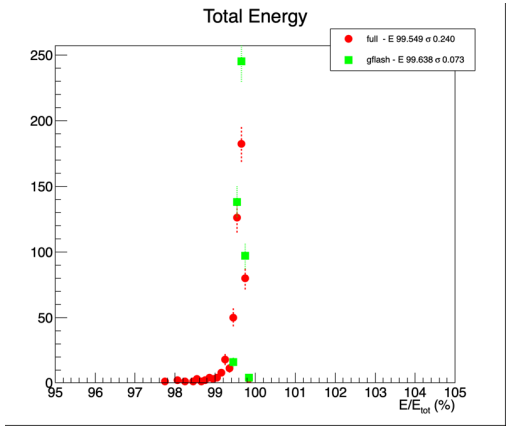
The better argument also !

The updates in class GFlashHomoShowerParameterisation ready to publish.

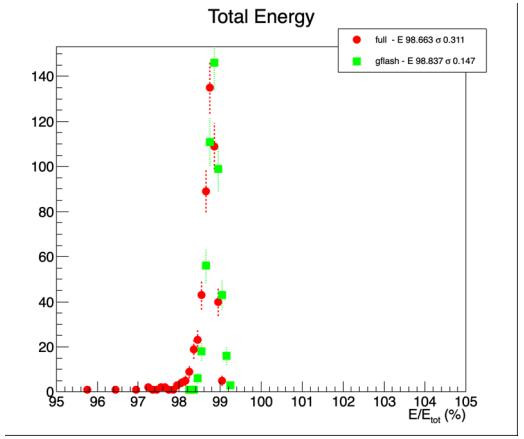
Gflasha example
Unresolved Issues

- Material changes stopped to work
- Workaround exist send material name via application parameter

- The energy resolution, narrow distribution when use GFLASH v.s. full MC
- The correlation parameters must be tuned according calorimeter length and material



PbWO4



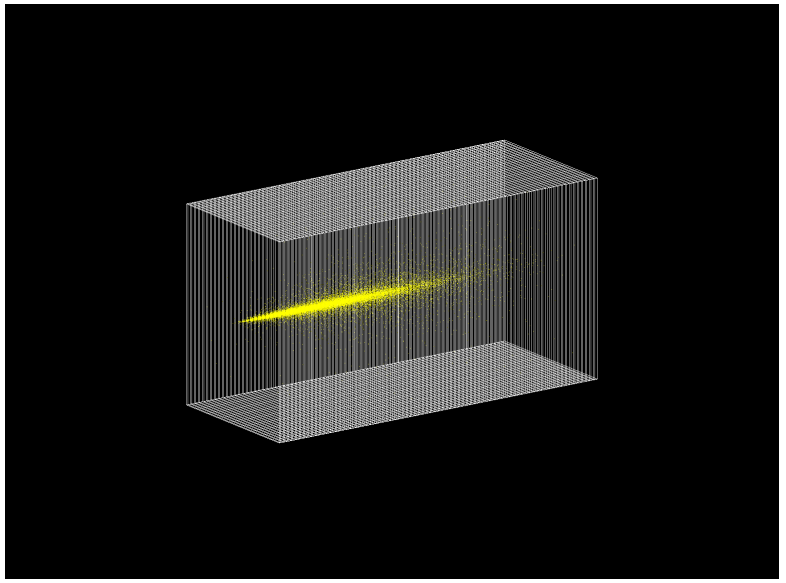
CsI

GFlashb example

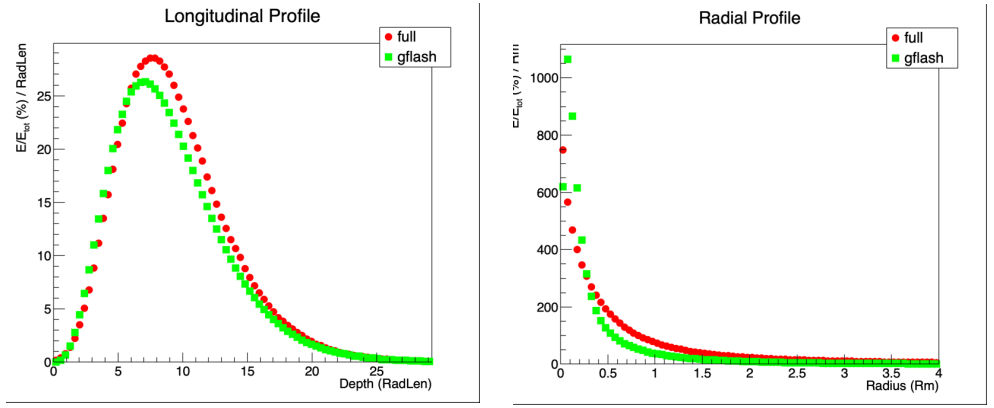
The application to make studies of Sampling GFlash shower parametrization versus full Geant4 shower development.

- Simple “shashlik” like geometry, with several layers of two volumes: “scintillator” and “absorber”.
- Possibility to redefine size and materials
- All calorimeter is a single Gflash envelope
- SD associated with scintillators volumes.
- The longitudinal bins chosen as fraction of cell

Not published

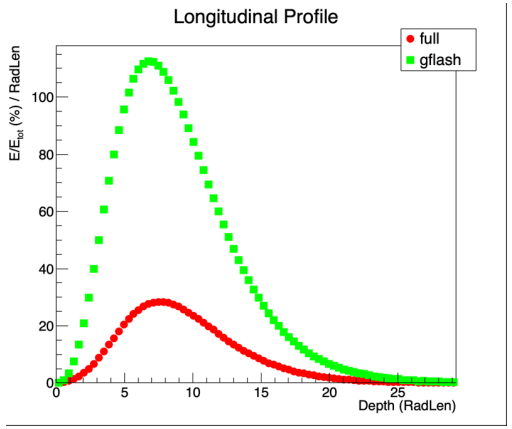


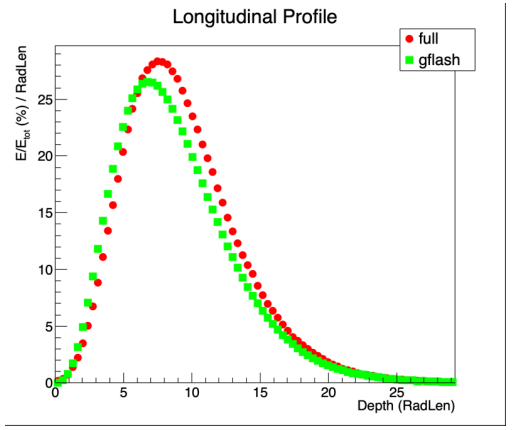
Hits in sampling calorimeter

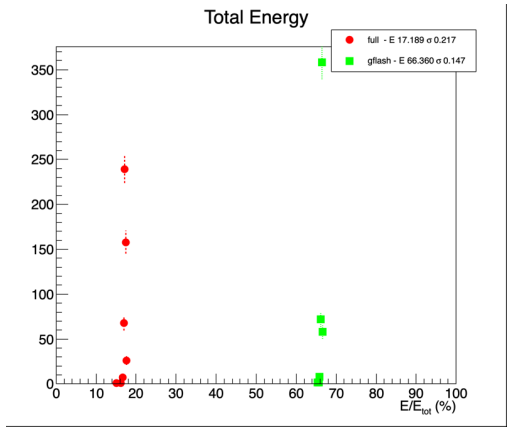


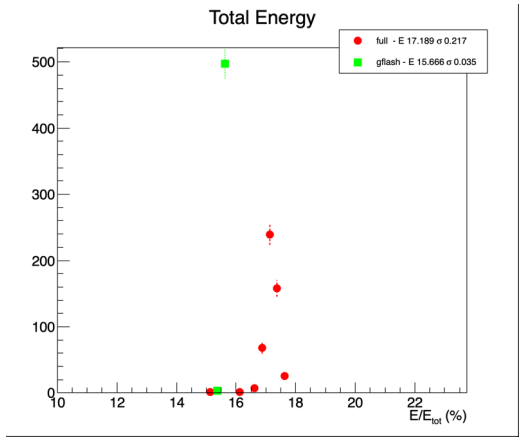
Shower profiles in sampling calorimeter

Gflashb example
The energy deposition









Without correction

dE = dE * pho_{sc} / pho_{eff}

Material : Pb 2mm + Sc 6 mm

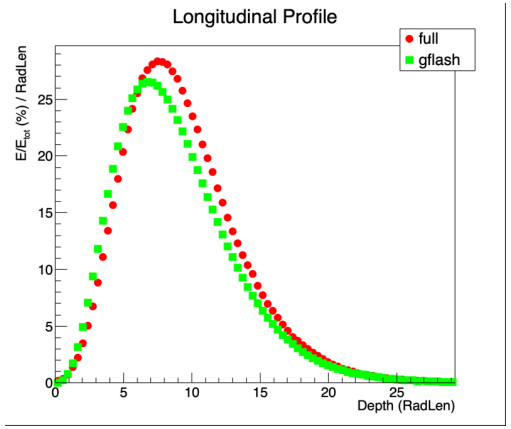
The energy deposition in SD was corrected by factor:

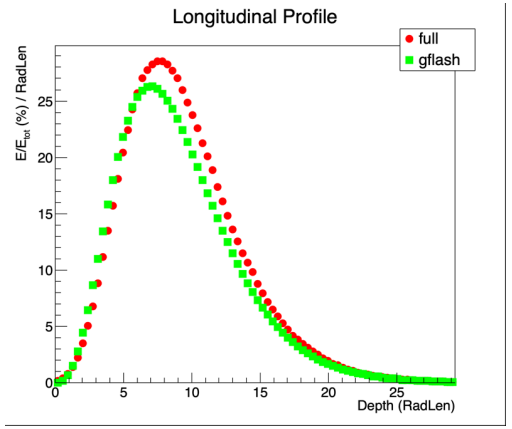
$$Density_{Material2} / Density_{Mixure}$$

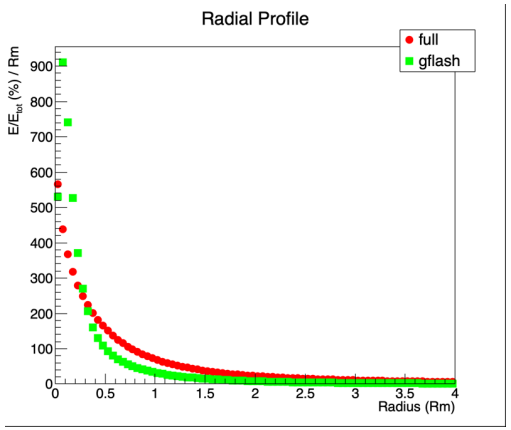
The ration between Sc density and Efficial material mixure densiry used in parametrization.

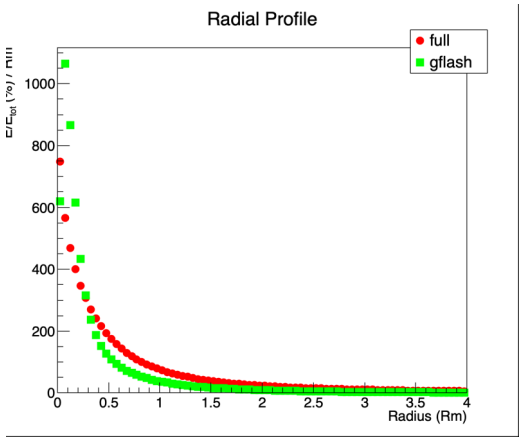
The new function ***GetEffDensity*** added to GFlashSamplingShowerParameterisation

Gflasha example
Es and Ec and sampling fluctuation
GFlashSamplingShowerParameterisation









Without modification

With correction in parametrisation

Material : Pb 2mm + Sc 6 mm

$$Es = 21.2\ MeV$$

$$Ec = \frac{610\ MeV}{Z + 1.24}$$

Sampling fluctuation shutting gamma(a,b)

$$\mathrm{a} = dE(t)/c^2$$

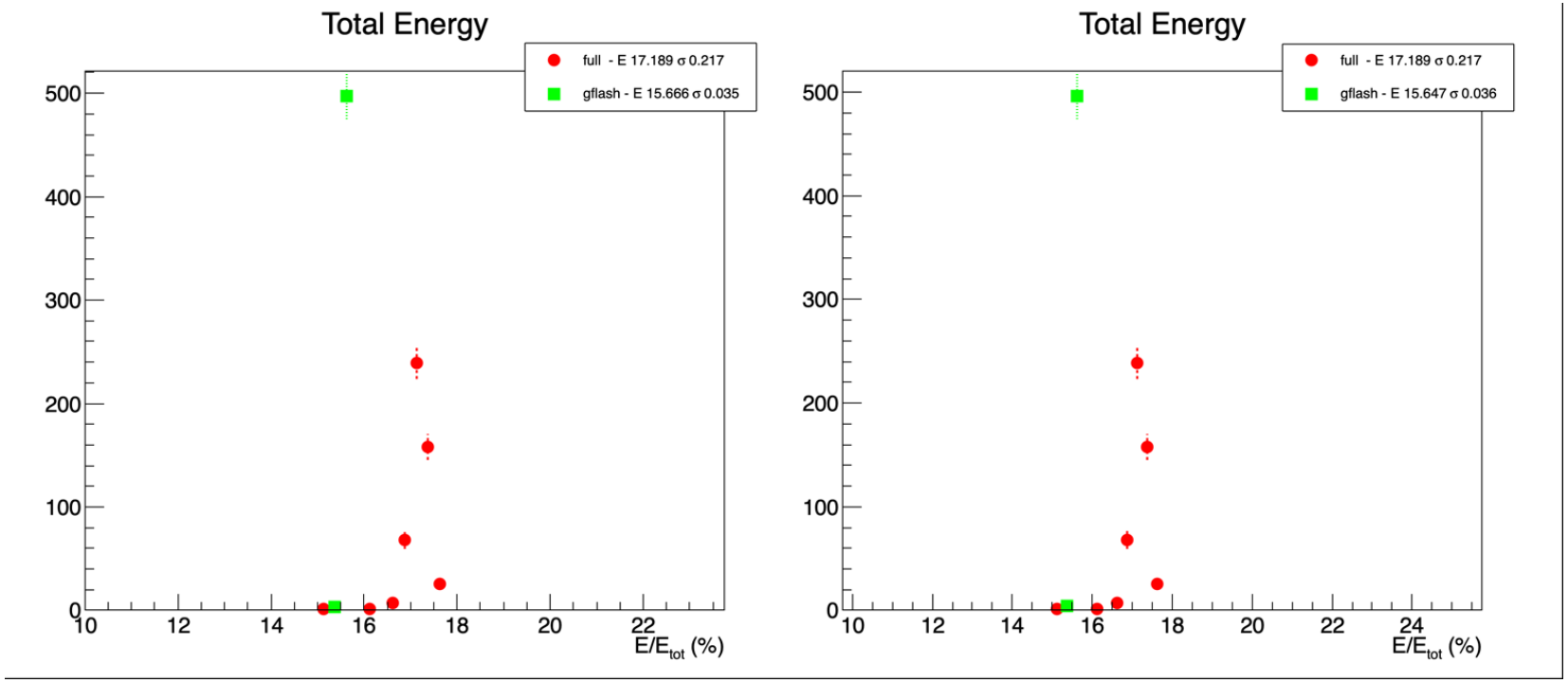
$$\mathrm{b} = 1.0\ /c^2$$

Where c =0.11

The better but neeed more tests !

The updates in class GFlashSumplingShowerParameterisation ready to publish.

GFlashb
The energy deposition in scintillator



Old

New

No difference after correction of sampling fluctuation function

Summary

- The both examples need updates in geometry to allow changes of calorimeters sizes and material via detector commands in macro
- The some tuning can be necessarily to better results depending on calorimeter size and material
- The GFLASH parametrization give narrow energy distribution in comparison with full MC
- For sampling calorimeter, the longitudinal step must be adjusted to fit underlined sampling calorimetry structure.
- The updates for GFlashHomeShowerParameterisationand GFlashSamplingShowerParameterisation classes was ready.

Thank You !