Study of energy shower profile and 1m3 energy resolution

Jan Blaha

Laboratoire d'Annecy-le-Vieux
de Physique des Particules

MicroMegas Physics Meeting
LAPP, 22 Avril 2009

PART 1

Study of energy shower profile

Calorimeter configuration

Properties of the absorber materials:

absorber	Z	ρ [g.cm^{-3}]	λ [g.cm^{-2}]	λ [cm]	1 abs. [cm]	80 planes [cm]
Fe	26	7.87	132.1	16.78	1.9	200
W	74	19.30	191.9	9.97	1.127	170.16
Pb	82	11.35	199.6	17.6	1.993	239.44

Calorimeter with Fe absorber:

Passive layer: 9 λ (including 4 mm thick steel cover)

Active layer: 6 mm (3 mm of gas)

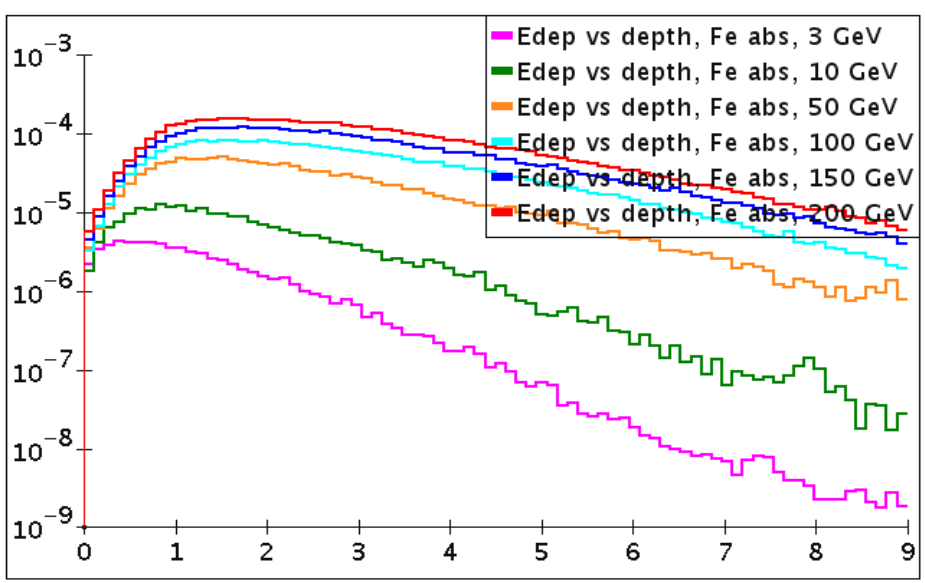
Calorimeter with W and Pb absorbers:

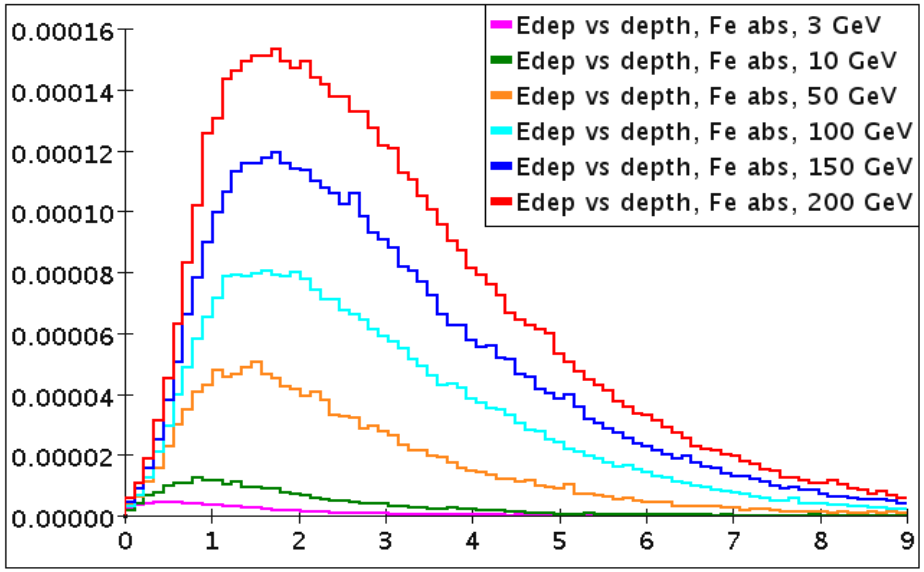
Passive layer: 9 λ

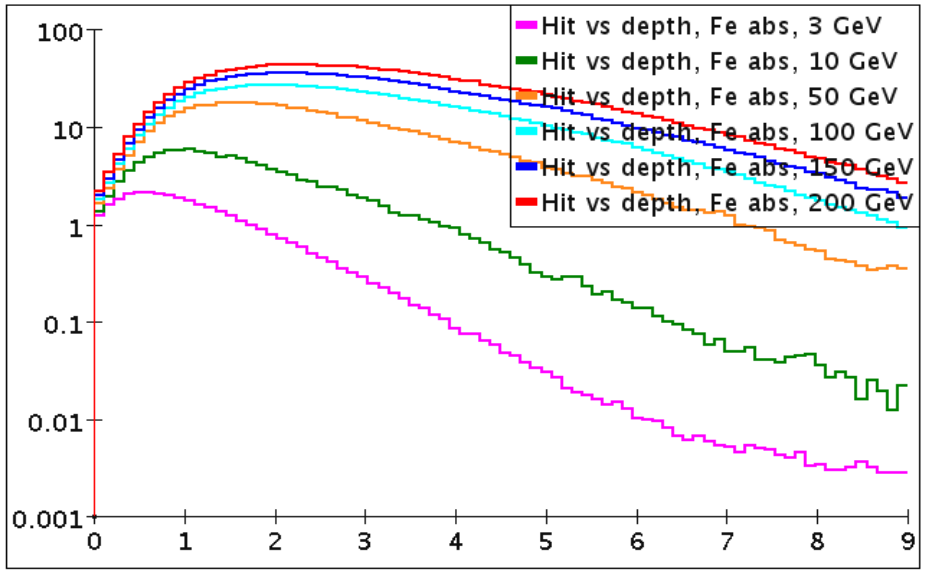
Active layer: 6 mm (3 mm of gas) + 4 mm of Al (32 cm in total (0.8λ))

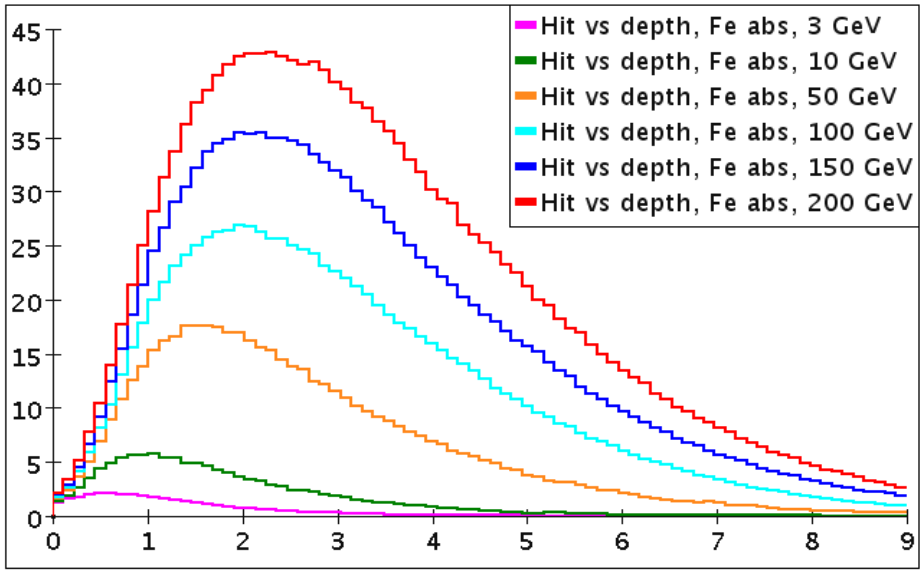
Longitudinal profile – Fe Abs

Longitudinal energy and hit profile (Fe abs, 9 λ)



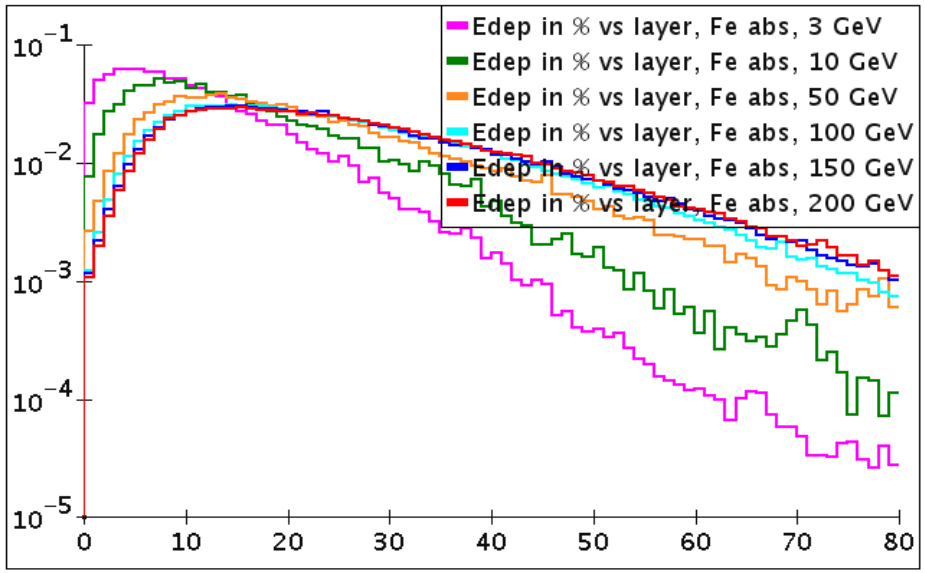


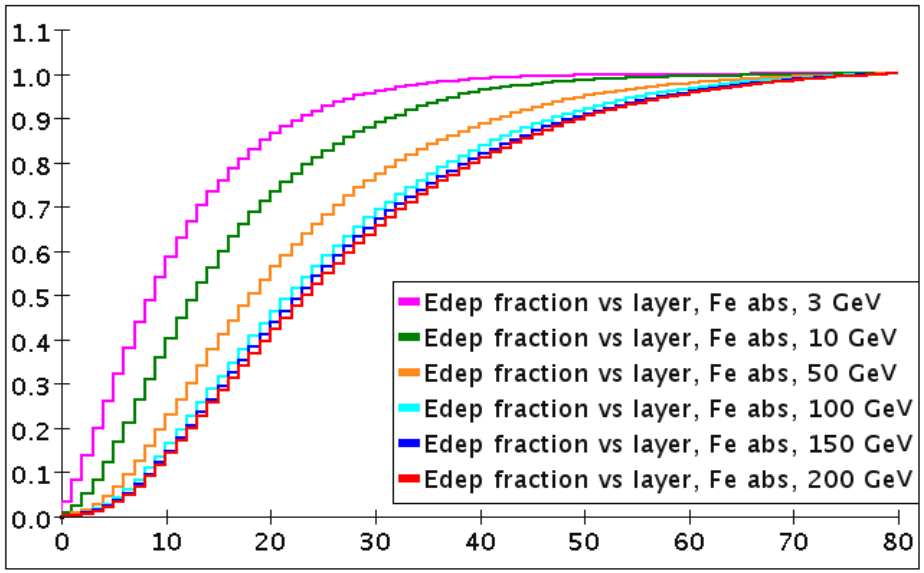


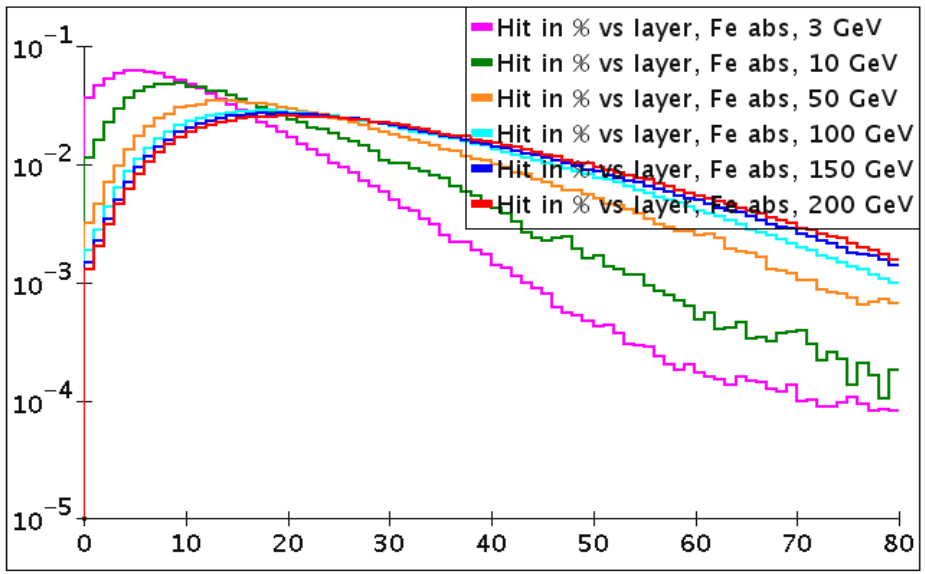


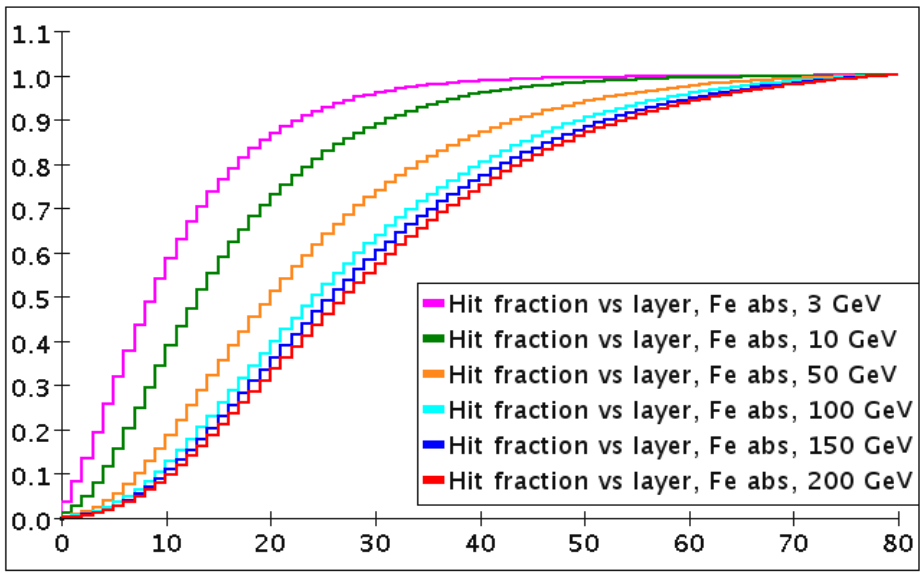
Longitudinal profile – Fe Abs

Longitudinal energy (hit) profile and energy fraction in shower



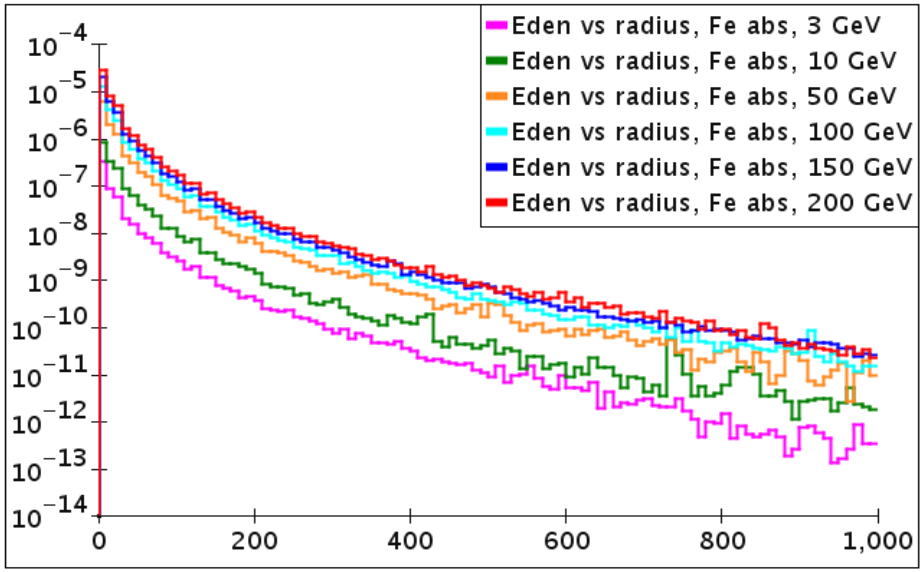


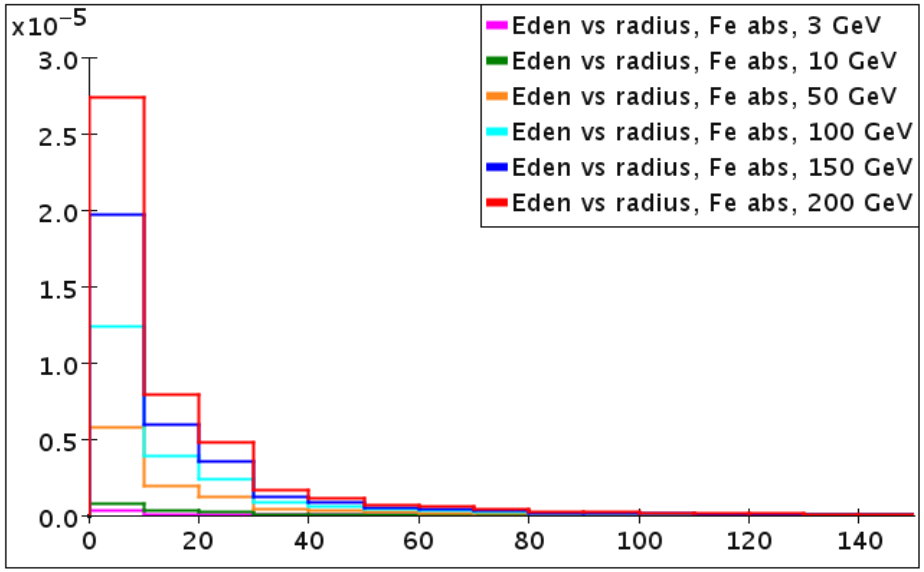


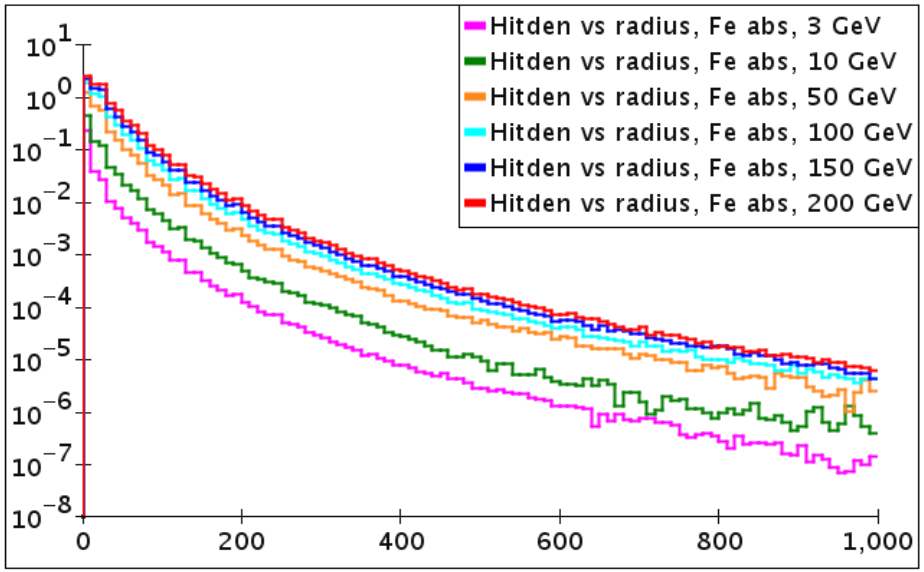


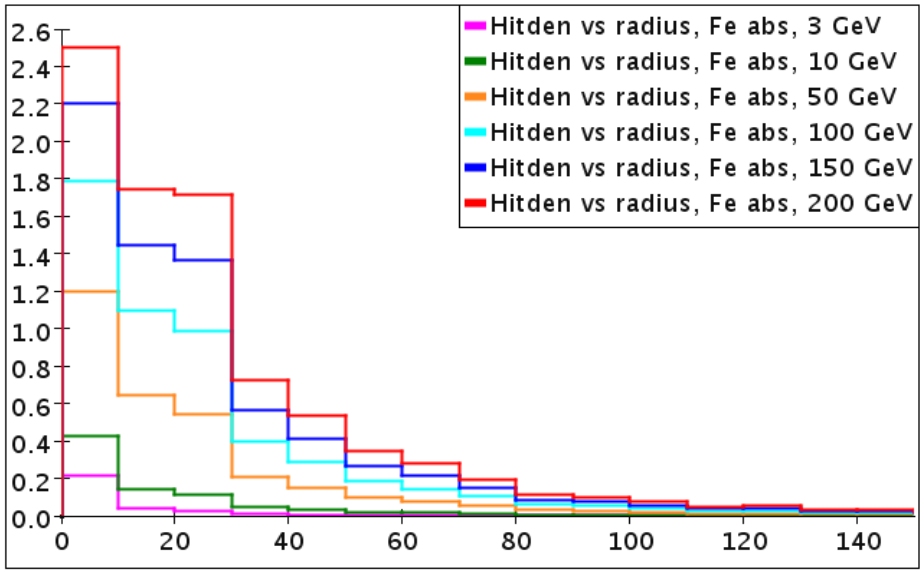
Lateral profile – Fe Abs

Lateral energy (hit) profile as an energy (hit) density vs radius



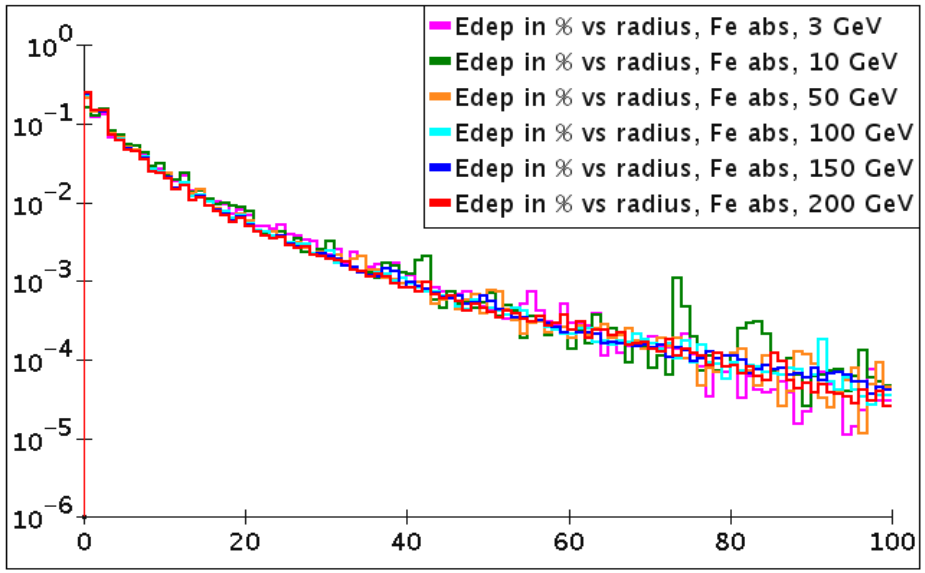


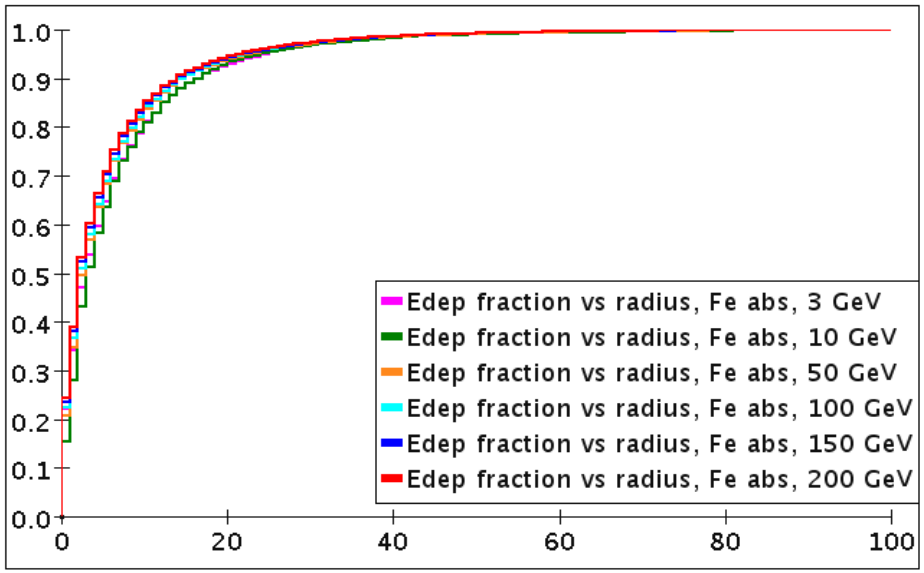


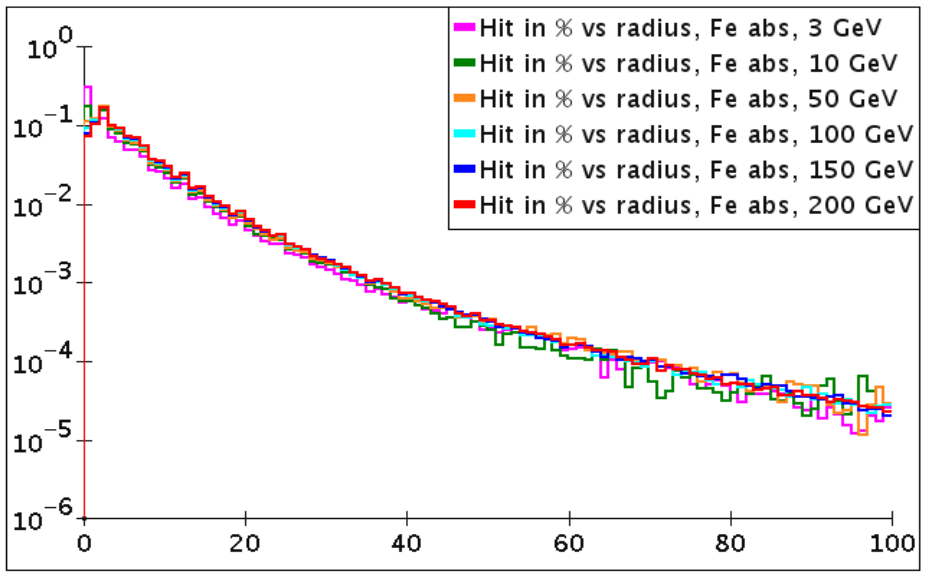


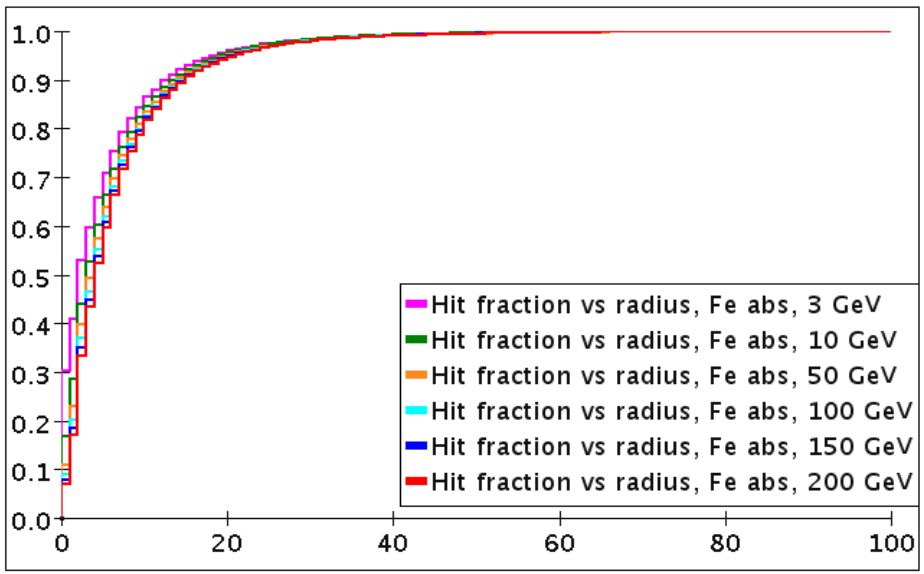
Lateral profile – Fe Abs

Lateral energy (hit) profile and energy fraction in shower



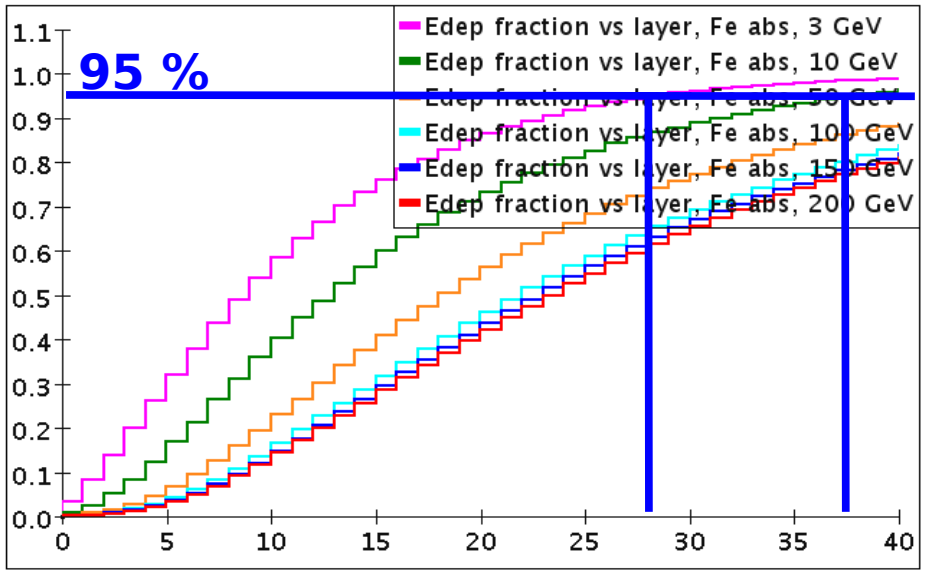


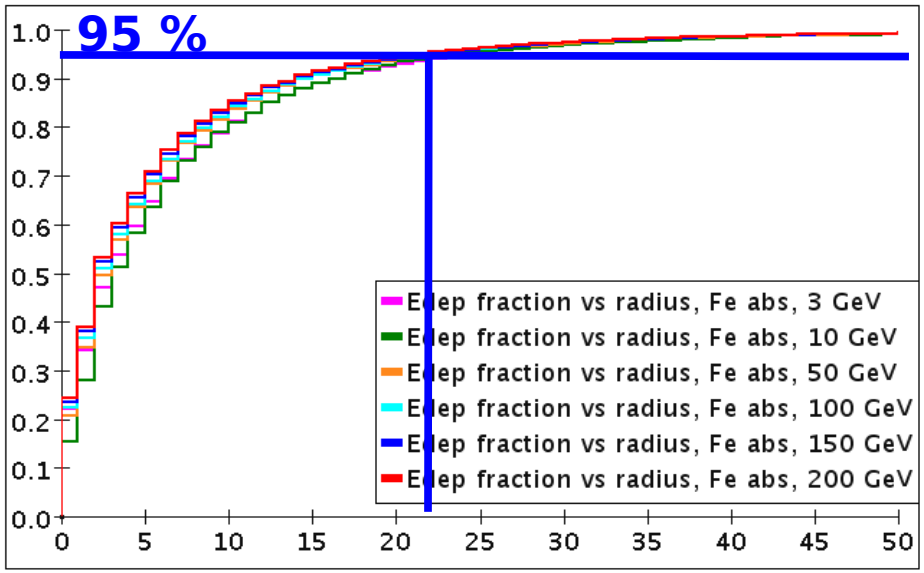


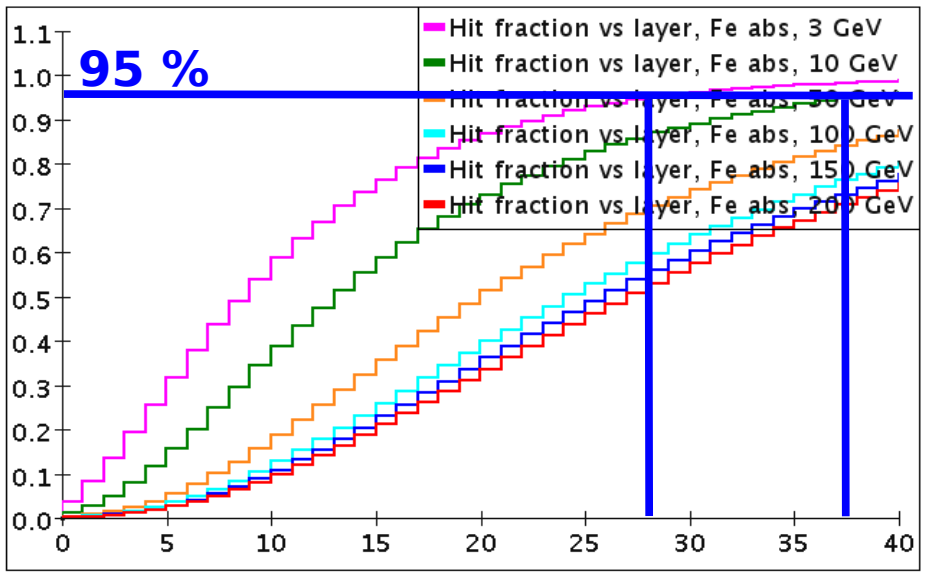


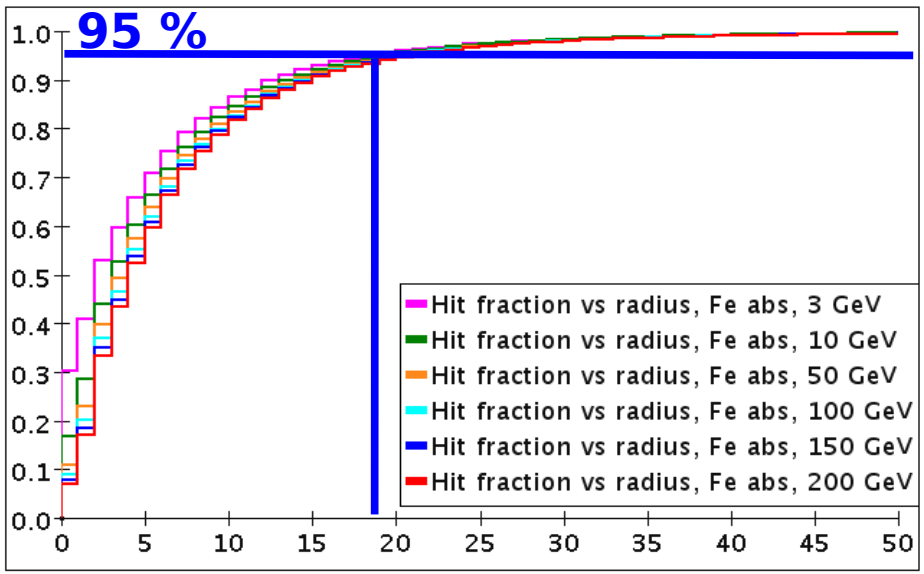
Long. and lateral profile – Fe Abs

Comparison of the long and lateral profiles for 1m3



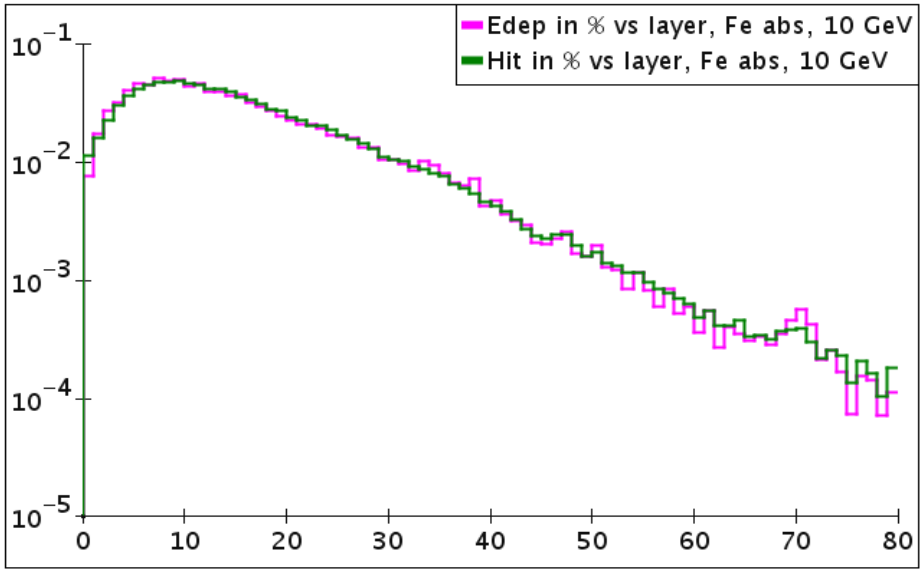


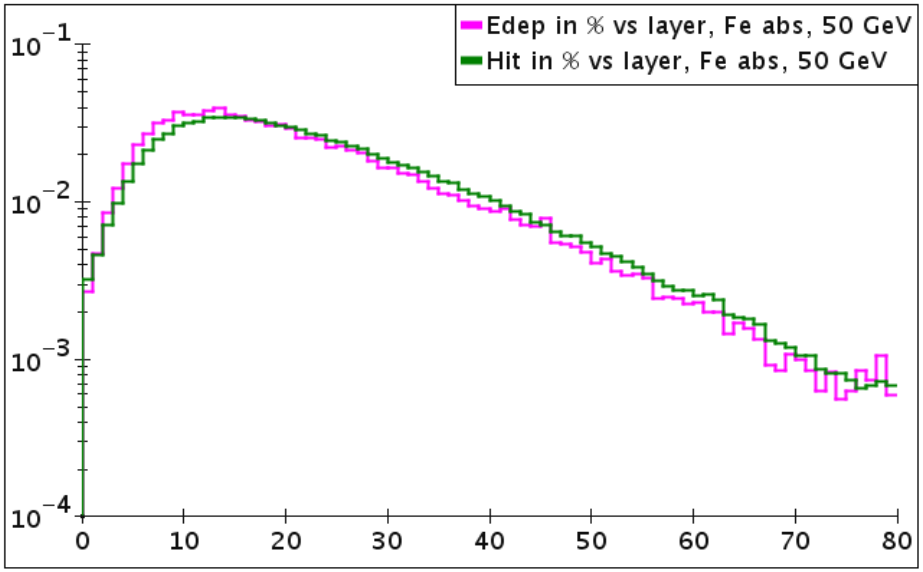


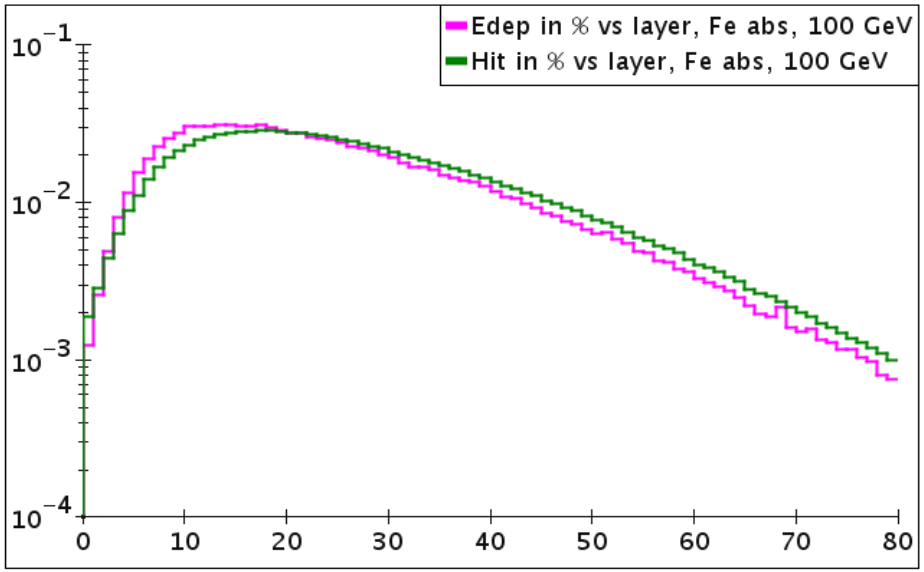


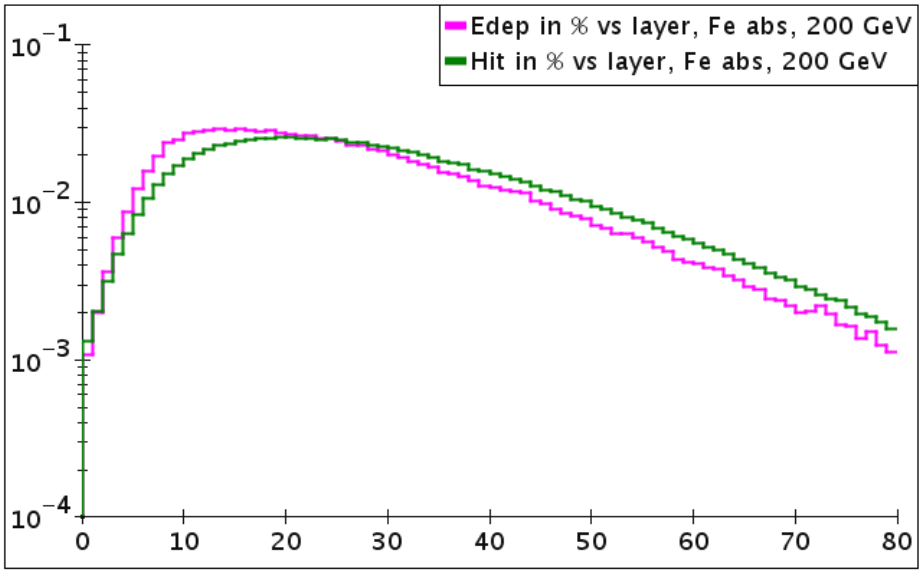
Analog vs Digital – Fe Abs

Comparison of the longitudinal energy (hit) profiles for different energies



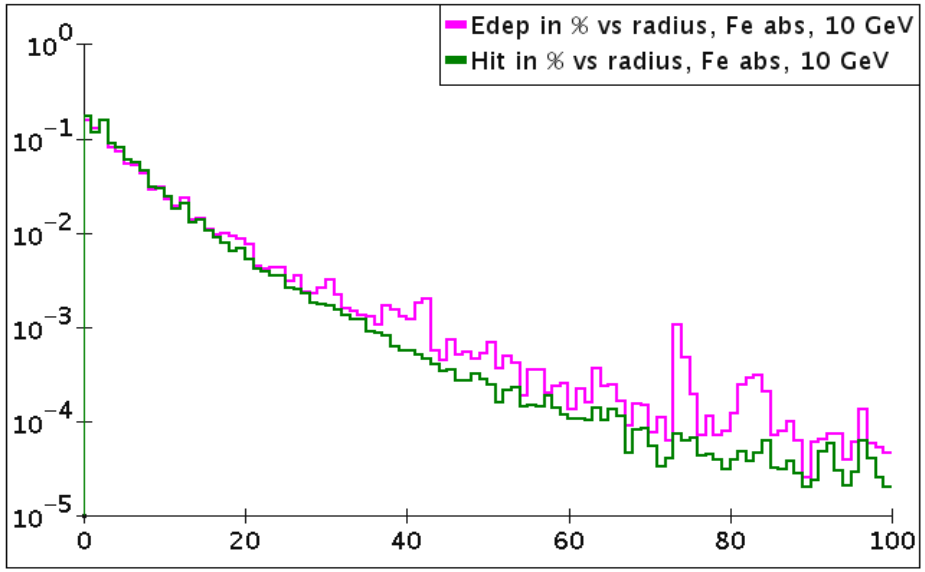


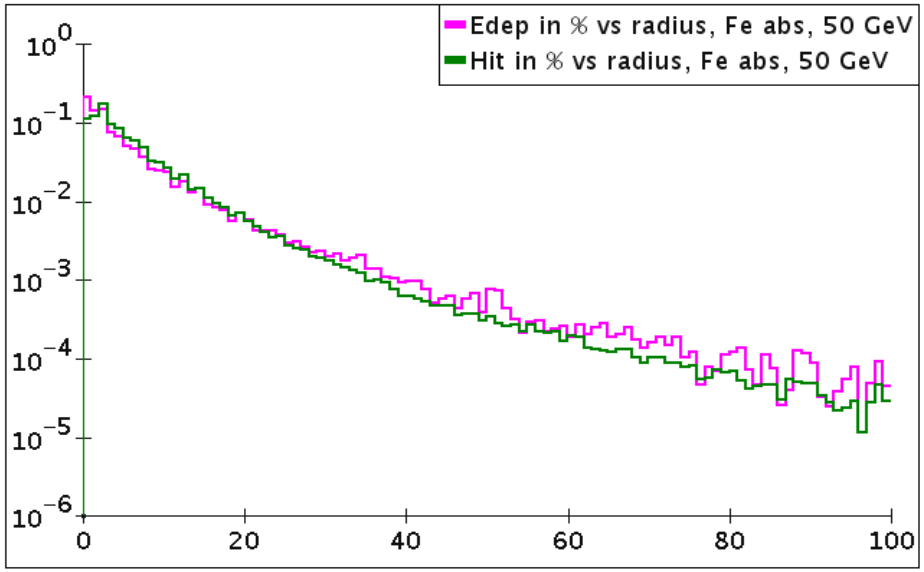


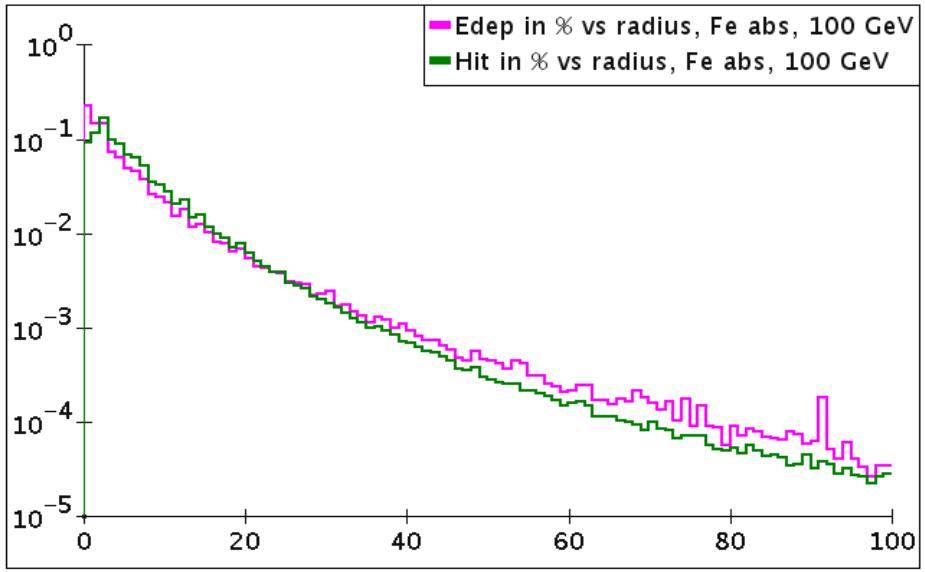


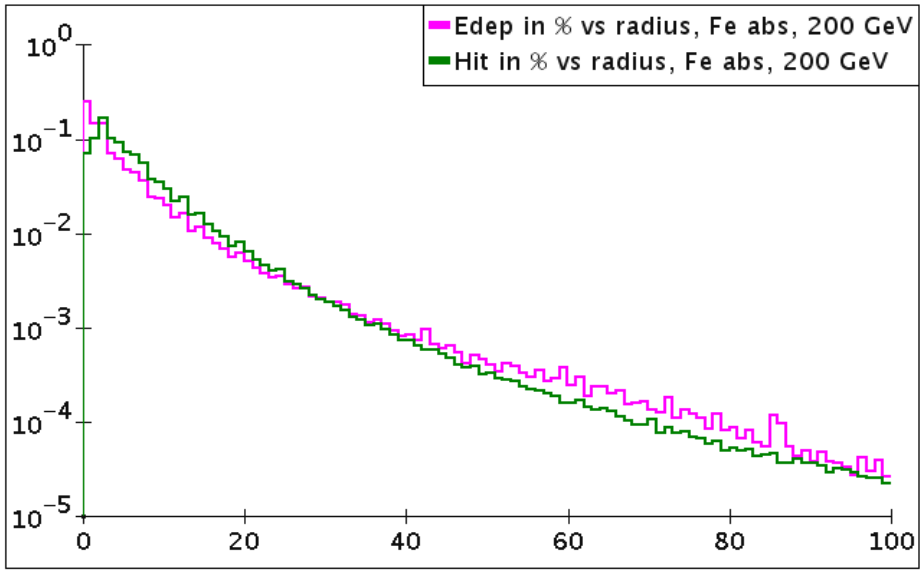
Analog vs Digital – Fe Abs

Comparison of the lateral energy (hit) profiles for different energies



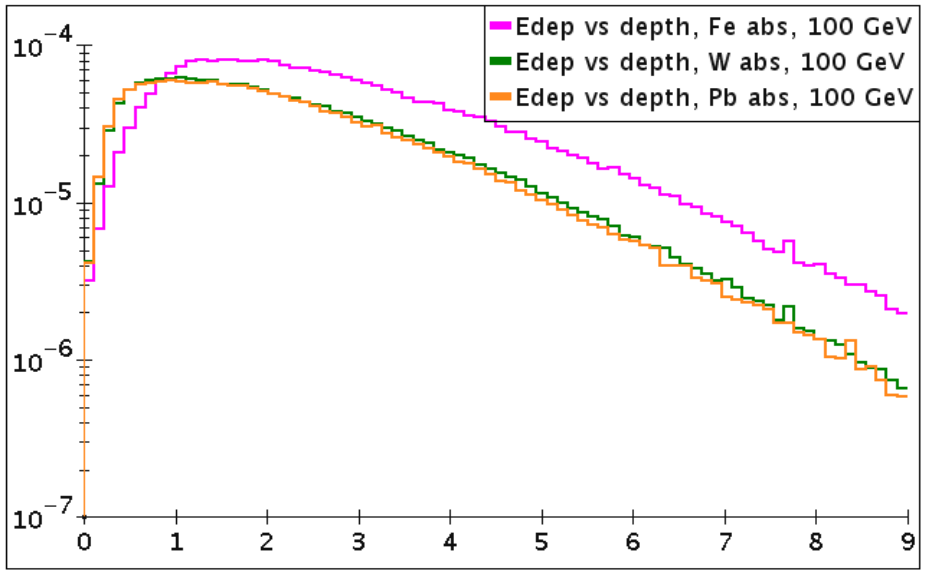


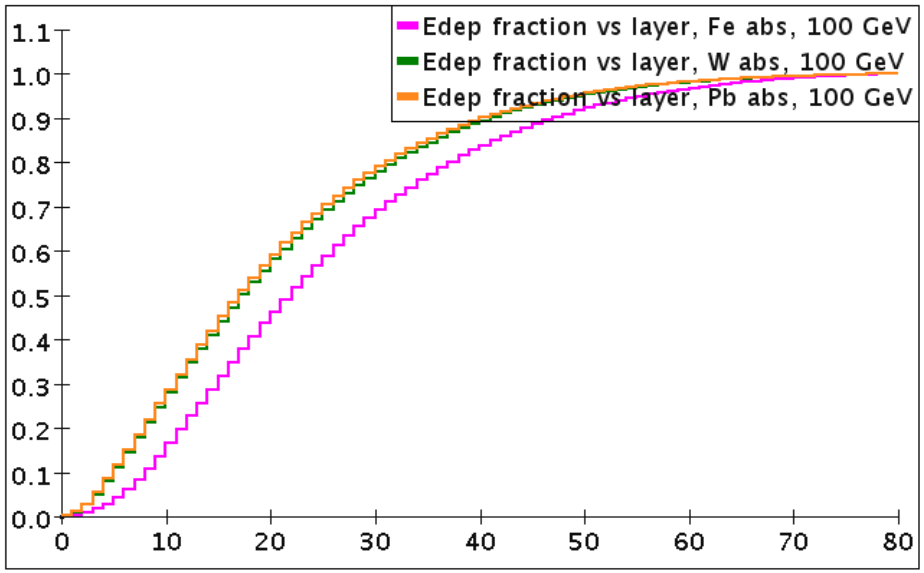


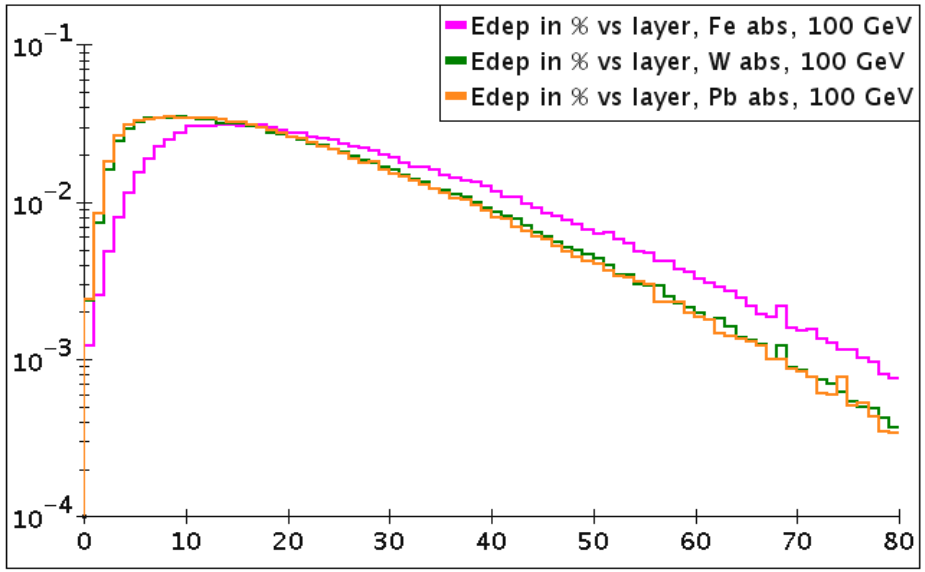


Longitudinal profile

Longitudinal energy profile for different absorbers (Fe, W, Pb)



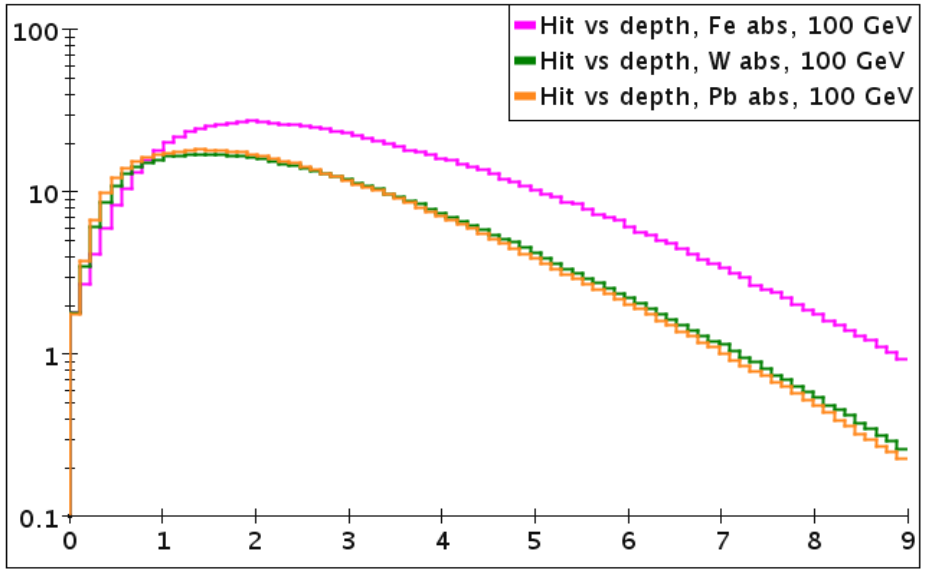


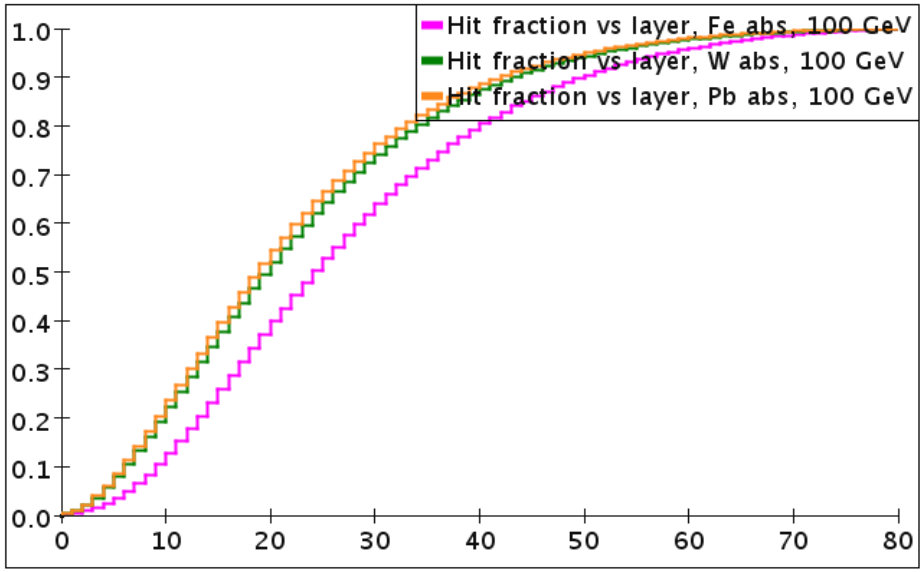


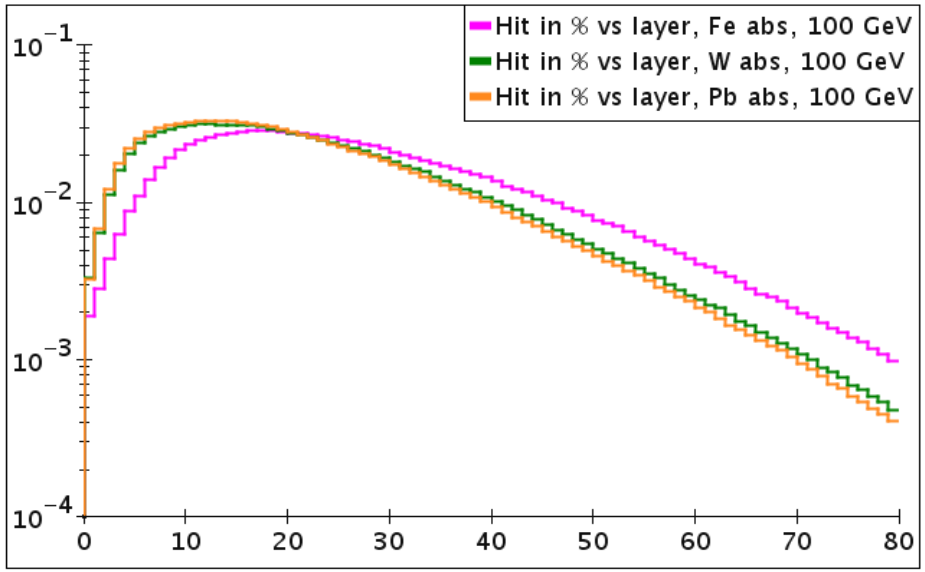
100 GeV pions

Longitudinal profile

Longitudinal hit profile for different absorbers (Fe, W, Pb)



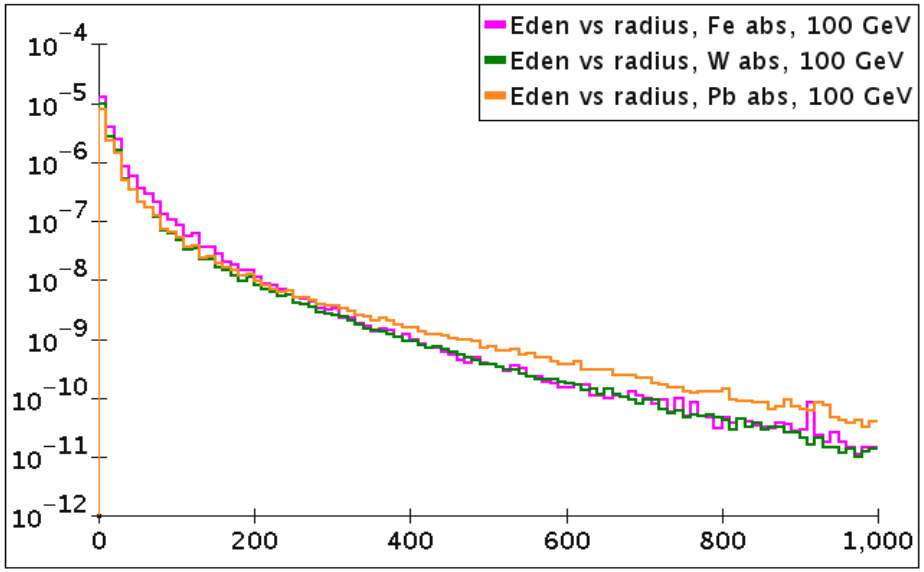


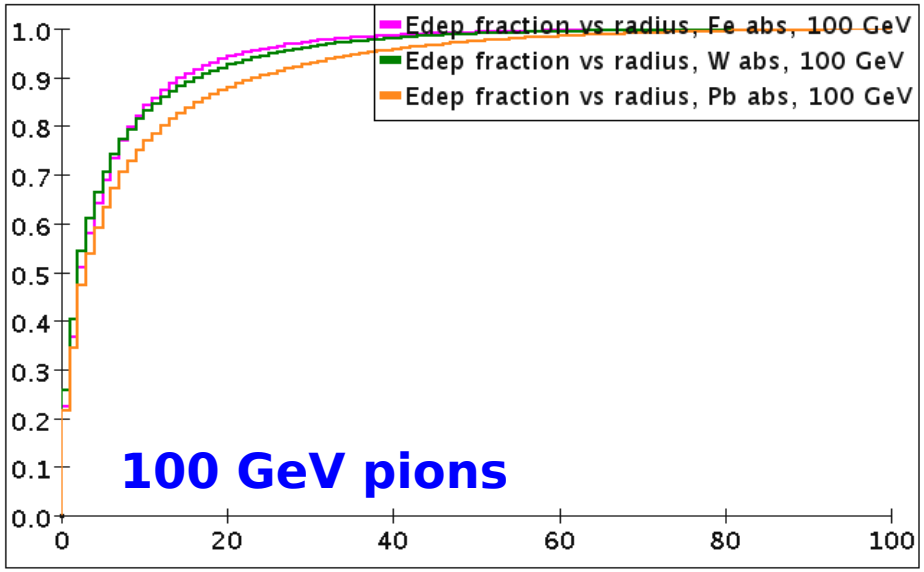


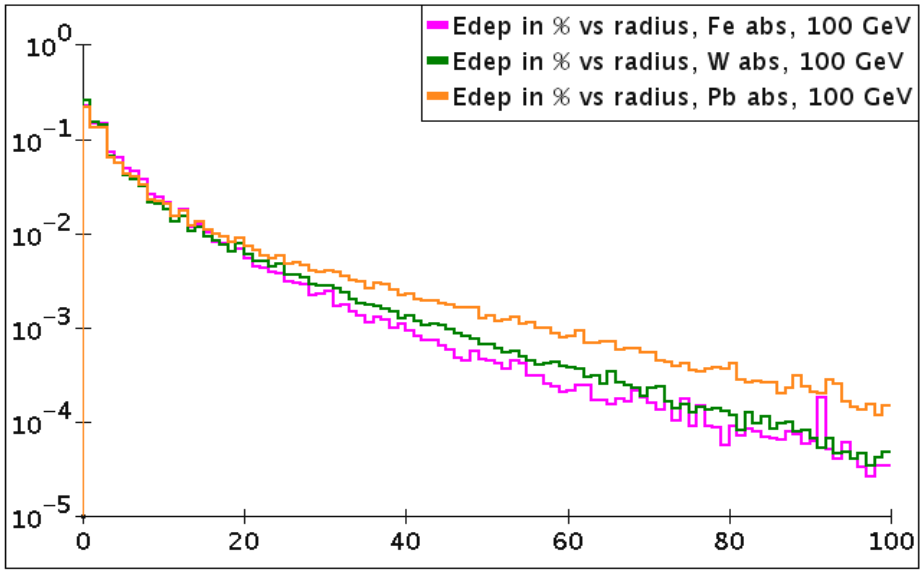
100 GeV pions

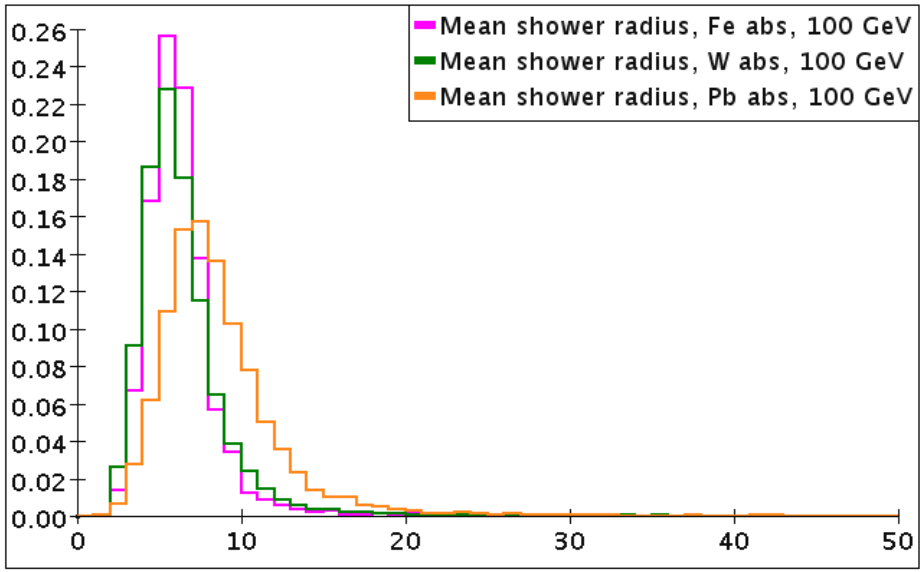
Lateral profile

Lateral energy profile for different absorbers (Fe, W, Pb)



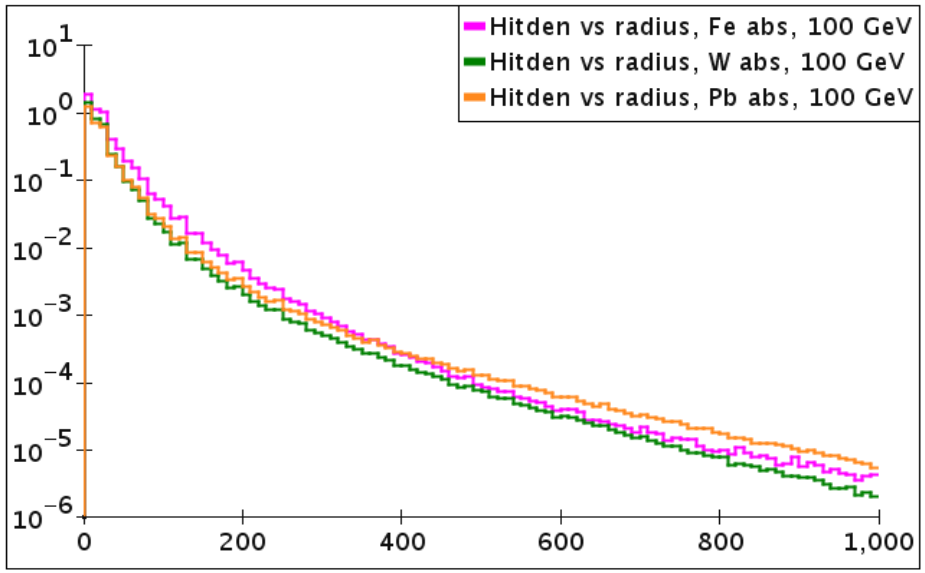


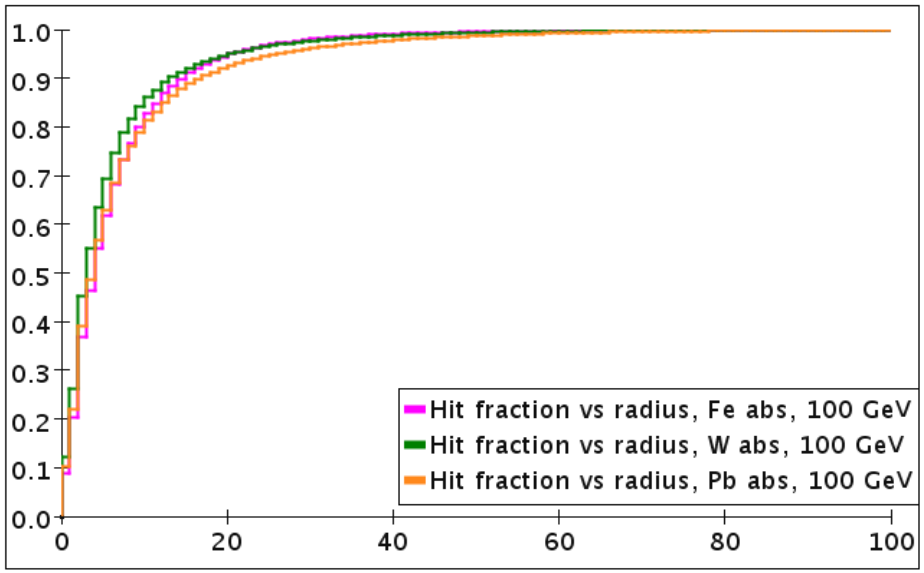


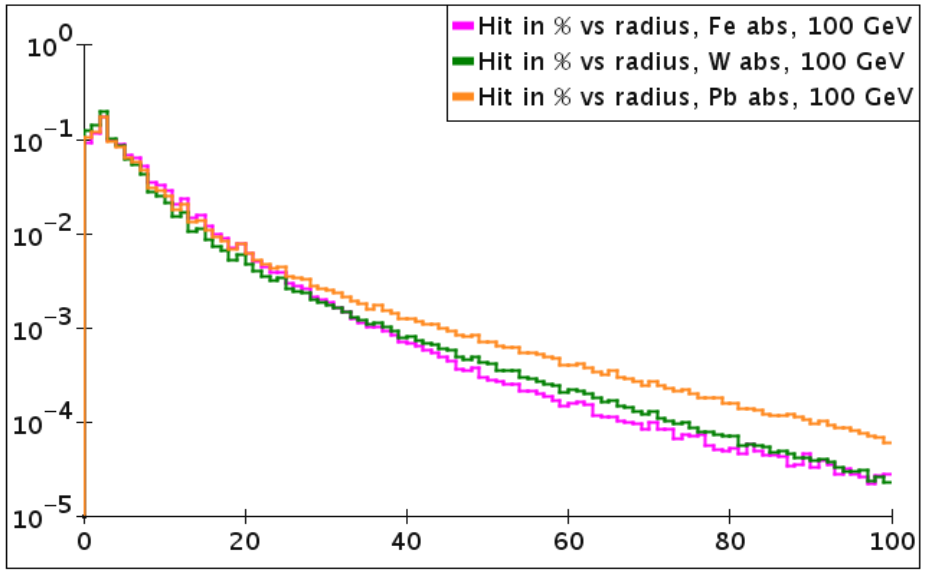


Lateral profile

Lateral energy profile for different absorbers (Fe, W, Pb)

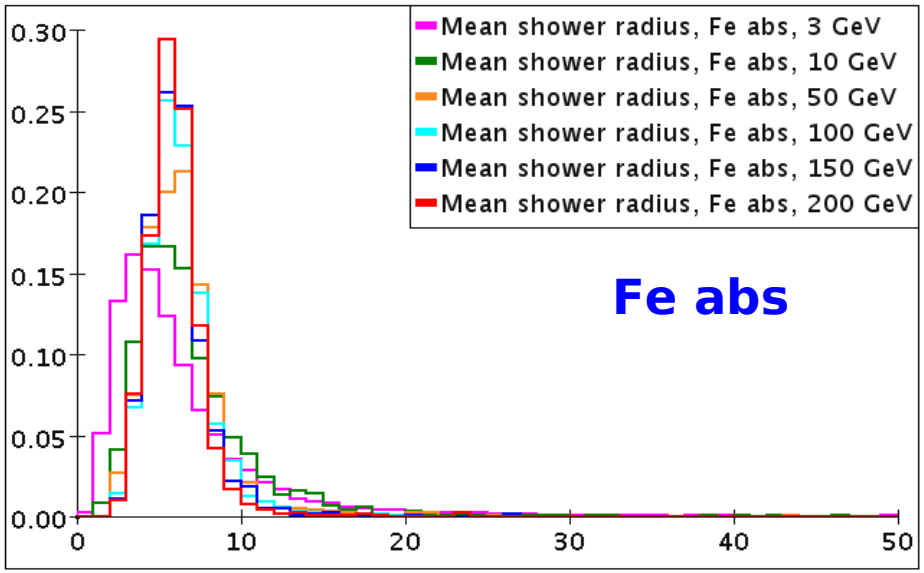


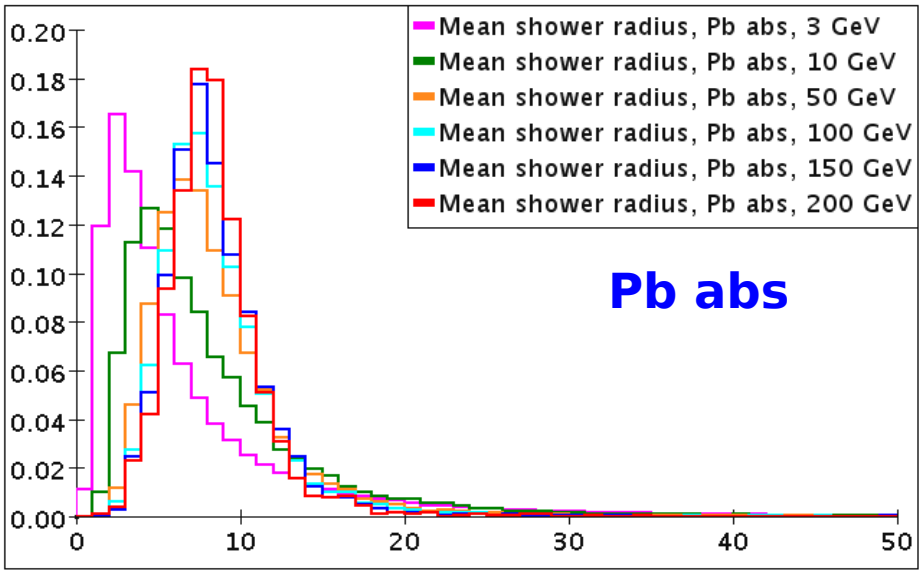


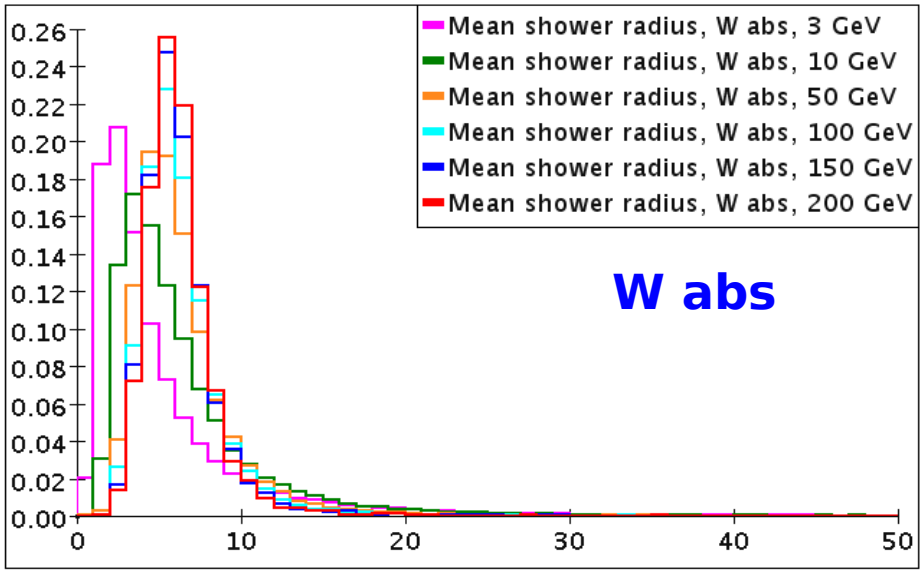


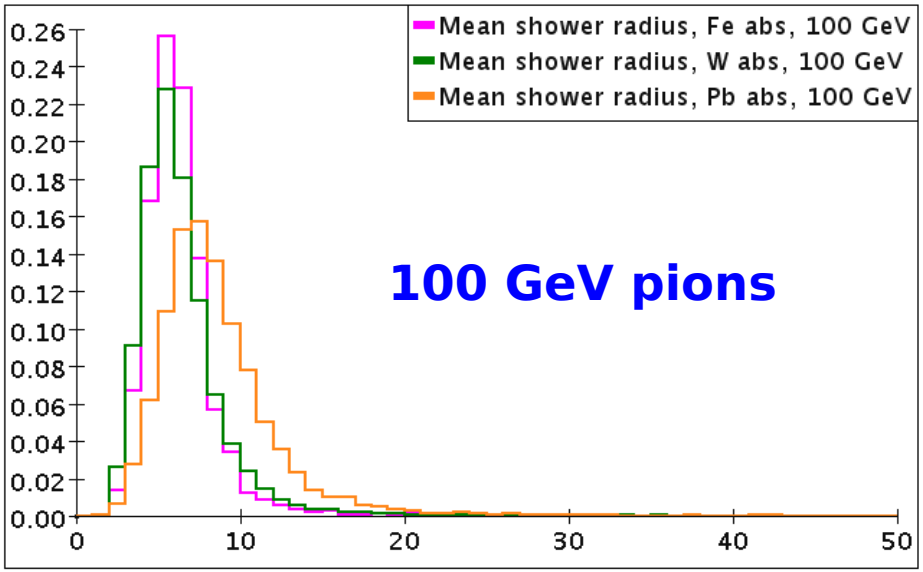
100 GeV pions

Mean shower radius









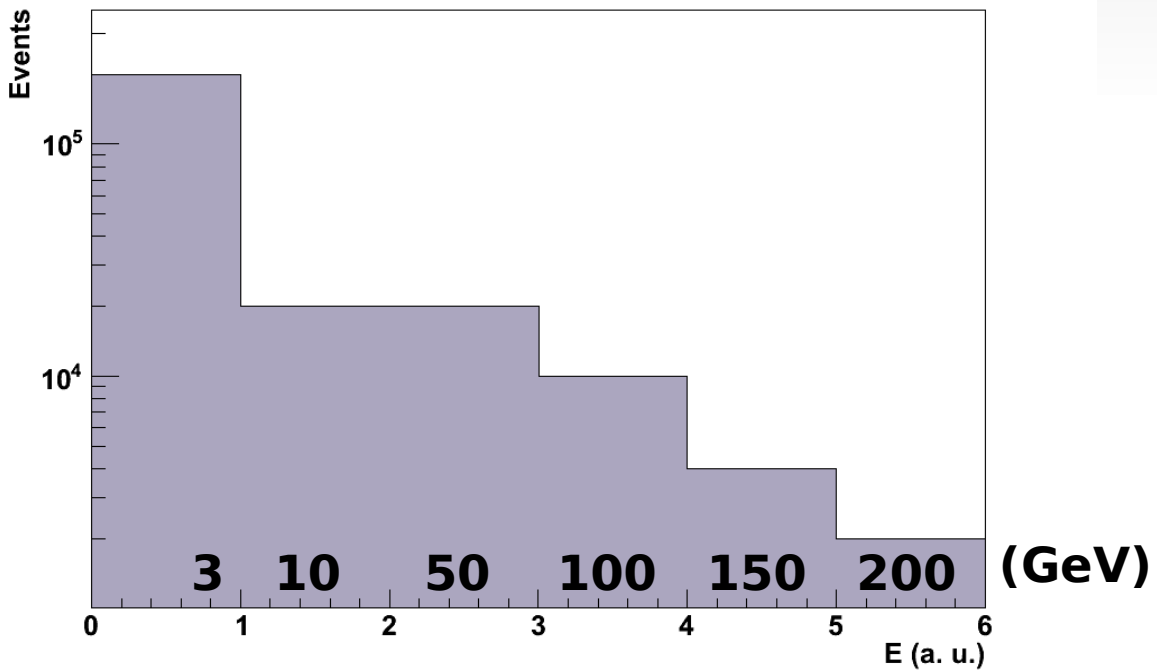
PART 2

Study of 1m3 energy resolution (preliminary results)

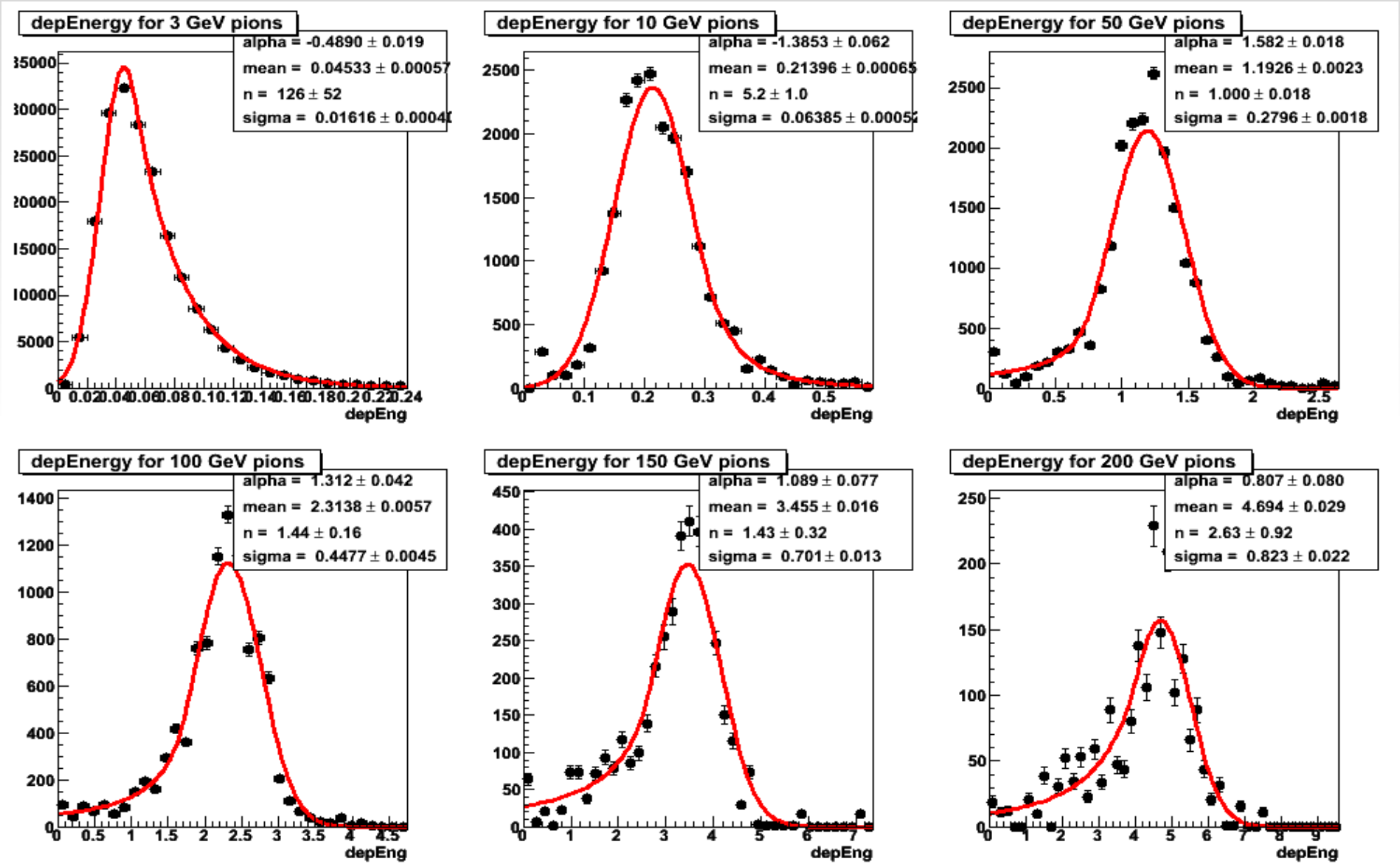
Configuration

- **1m3 calorimeter**
- **Fe absorber, 40 planes (4.5 λ)**
- **No threshold for digital mode**

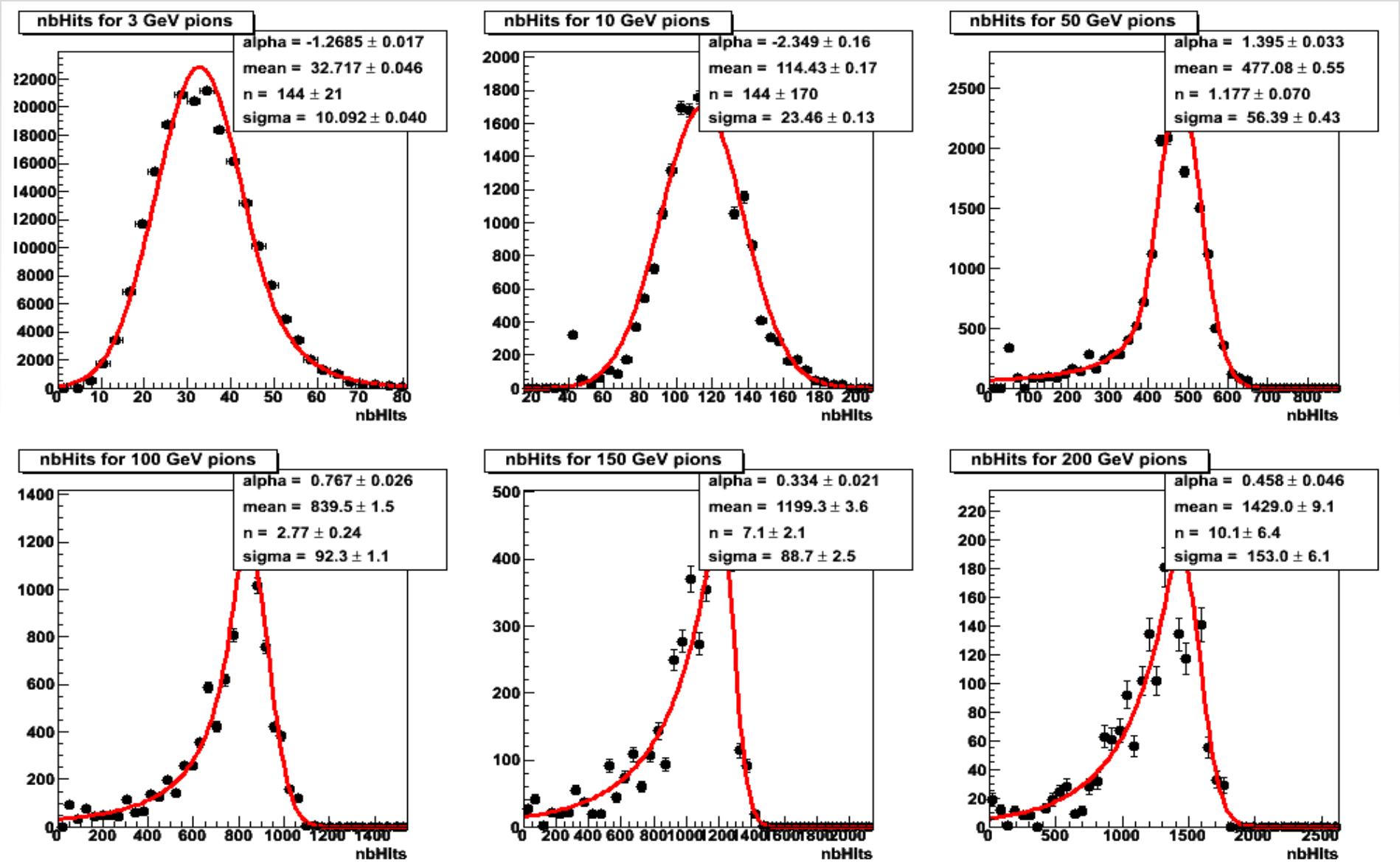
Statistics



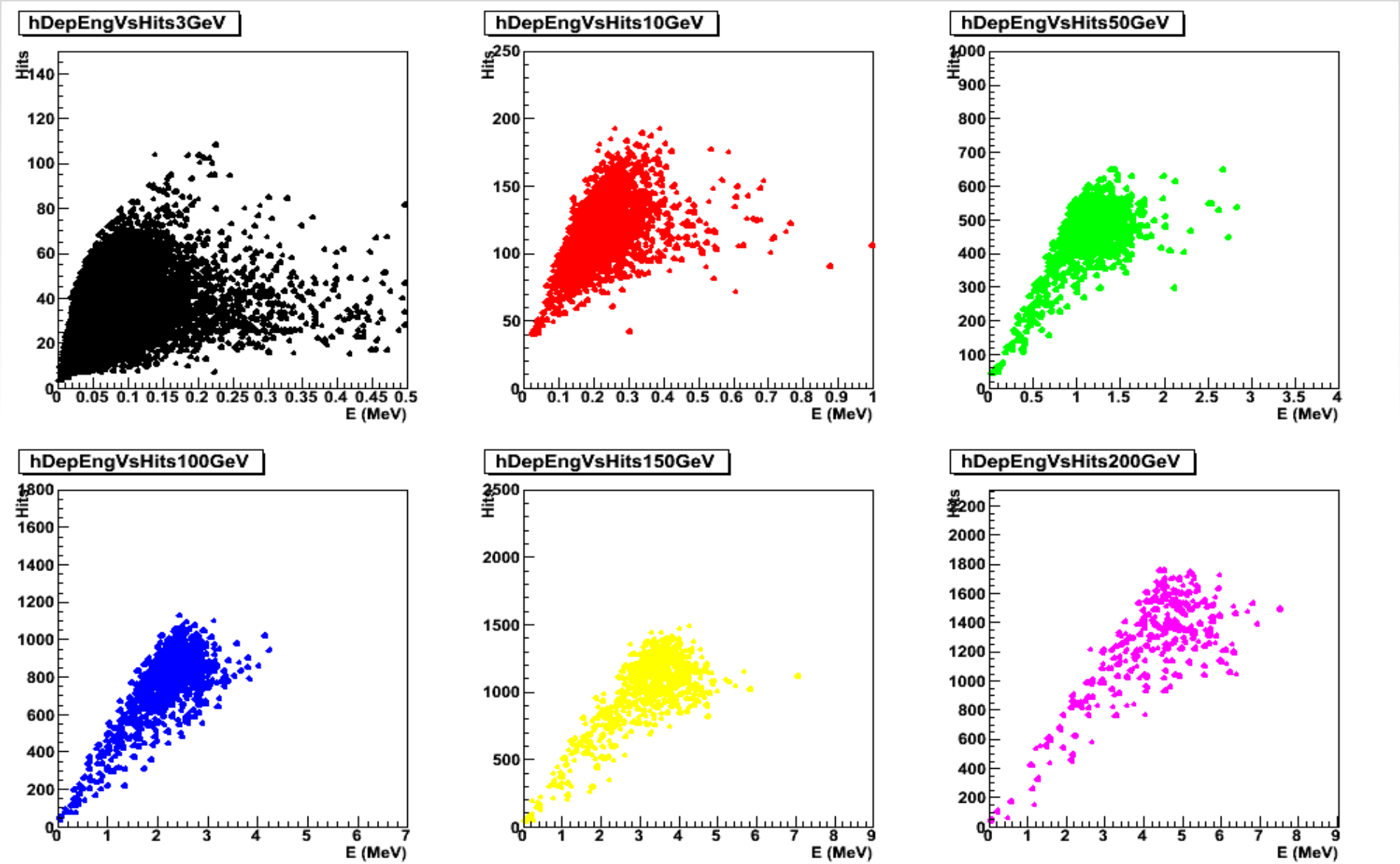
Dep. energy distributions



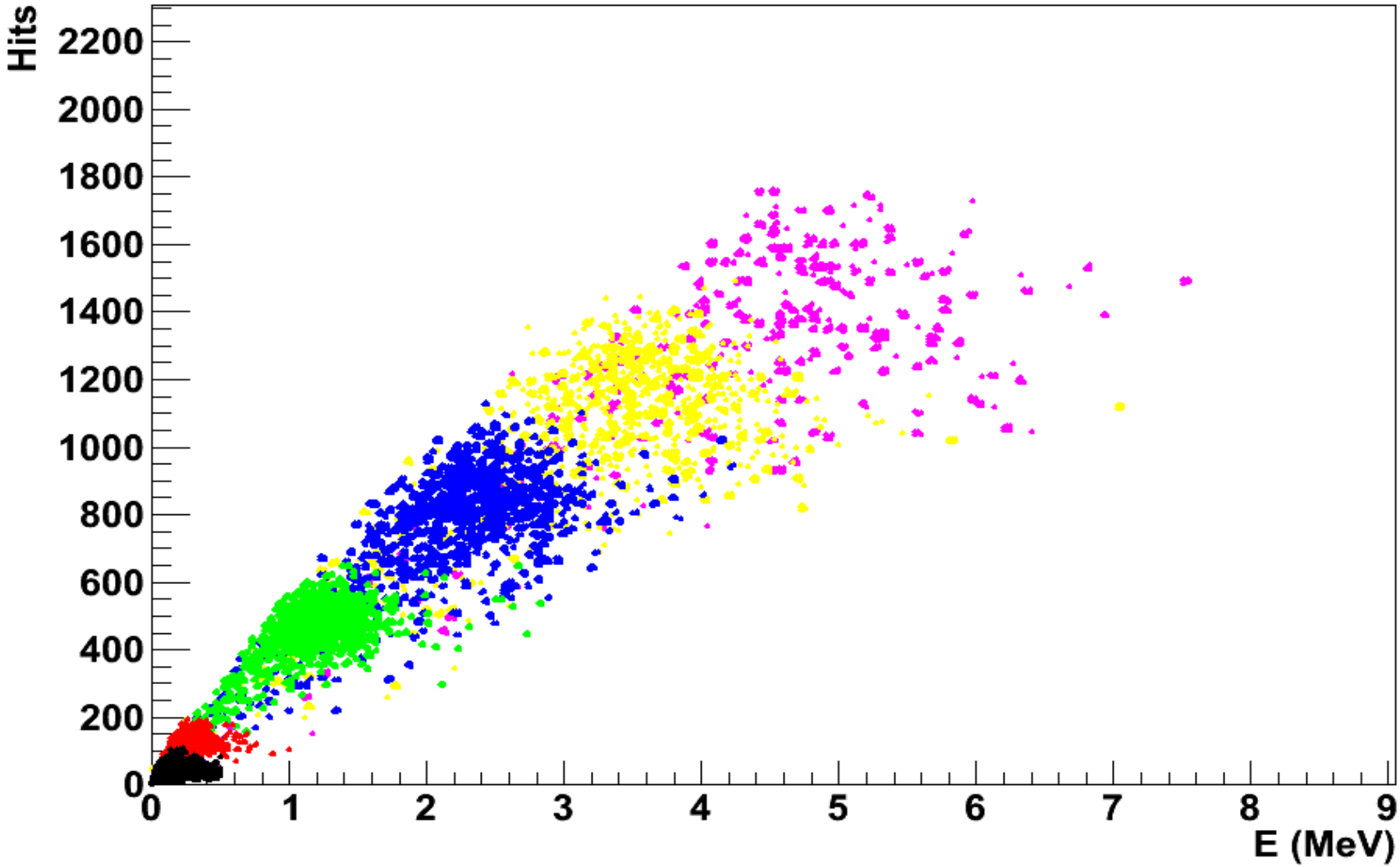
Hit distributions



Nb. of Hits vs dep. energy

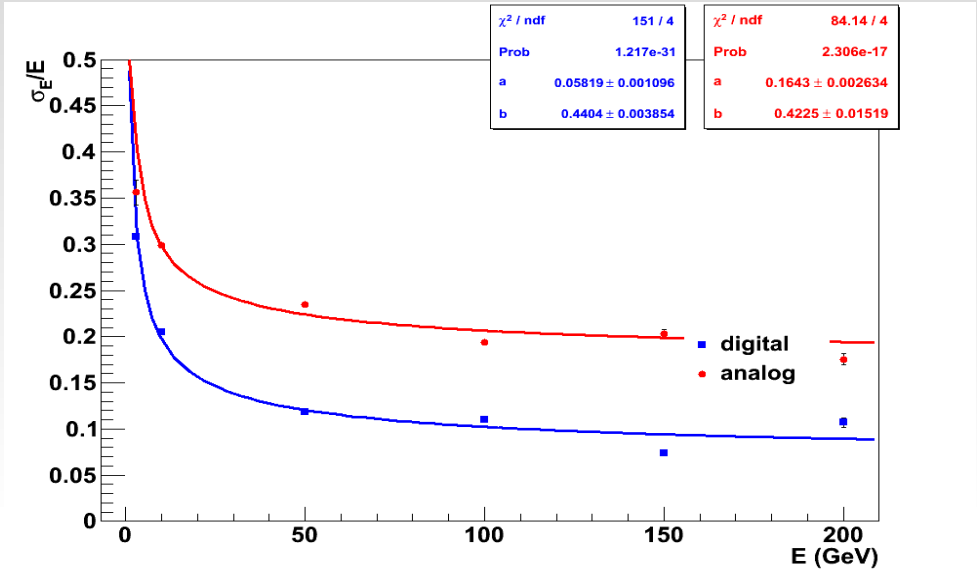


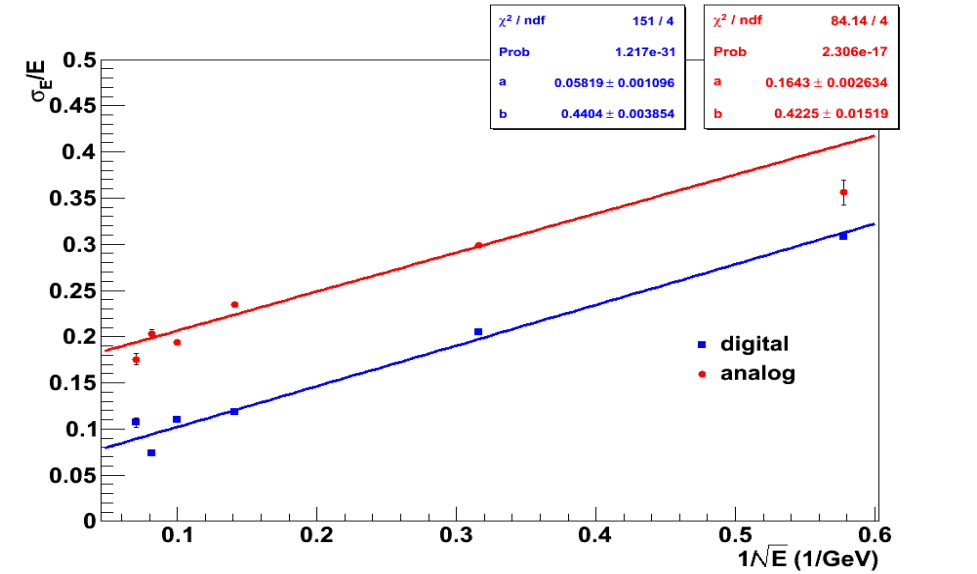
Nb. of Hits vs dep. energy



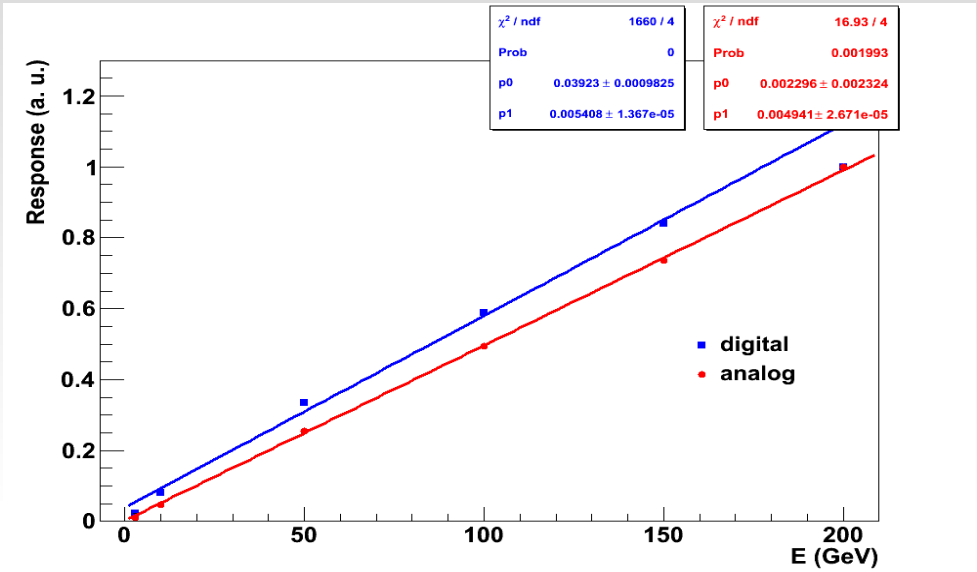
Energy resolution and linearity

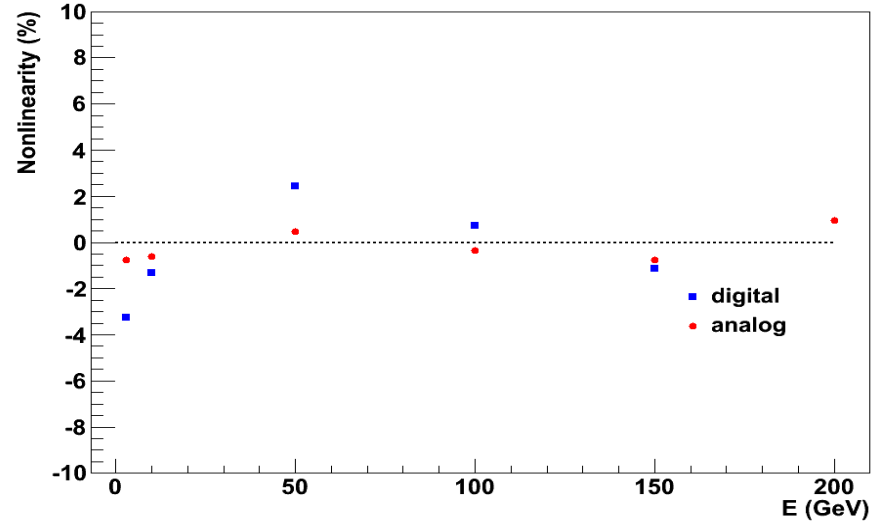
Energy resolution





Linearity





Summary and prospectives

Energy shower profile:

- Longitudinal shower profile behaves as expected: similar profile for W and Pb (high Z materials) in comparison with Fe
- Lateral shower profile shows surprisingly similar behavior for Fe and W and slightly worsen behavior for Pb – this need to be explained
- Different shower profile behavior for higher energy in case of analog and digital mode has been found – this could be due to the saturation effect and need to be verified with in threshold study

1m3 energy resolution:

- Digital energy resolution has been found superior to analog contrary to the linearity which is better in analogue mode (comparable results were found for 8m3)
- Energy leakage plays important role and need to be take into account (leakage corrections?)
- Up to which energy we are interested?
- As in previous case, an optimal threshold(s) need to be found with respect to energy resolution and linearity performance

Next work:

- Threshold study!