

Shower studies with Geant4

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Outline

- 1 Introduction
- 2 G4 variables
- 3 Analogue vs Digital
- 4 Counting MIPS

Introduction

- Geant4.9.1,
- Mokka with private sensitive detector definition and detector geometry,
- very simple detector: 30 layers Si+W.
- SiBulk 299 μm , SiEpi 1 μm .
- 20 layers W 2.1 mm + 10 layers W 4.2 mm.
- Shower development: tracks, countaining one or more steps.
- Whatever the number of steps/track : count the number of tracks recorded in the epi.
- Count the total energy deposited in the bulk per event.
- Compare the resolution for 1,5,10,20,30,40,50,75,100 GeV.
- 150,200 GeV still running ...

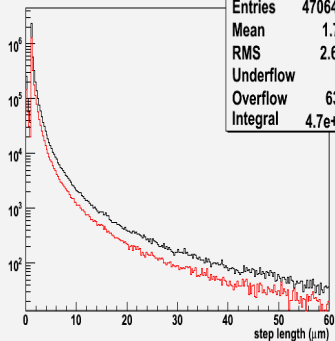
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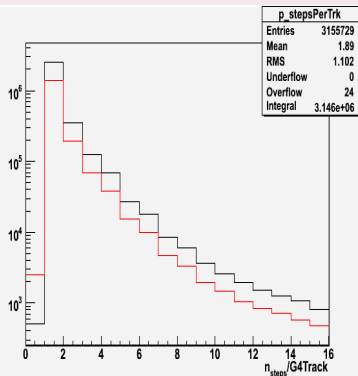
G4 tracks and steps

Step length

Red: 10 GeV, black: 100 GeV



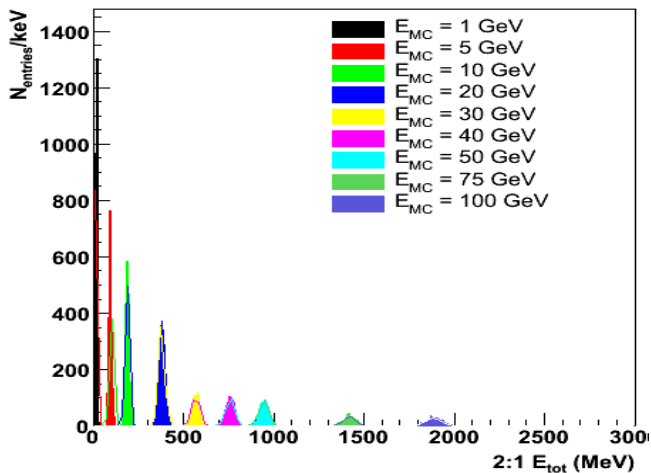
Number of steps per tracks



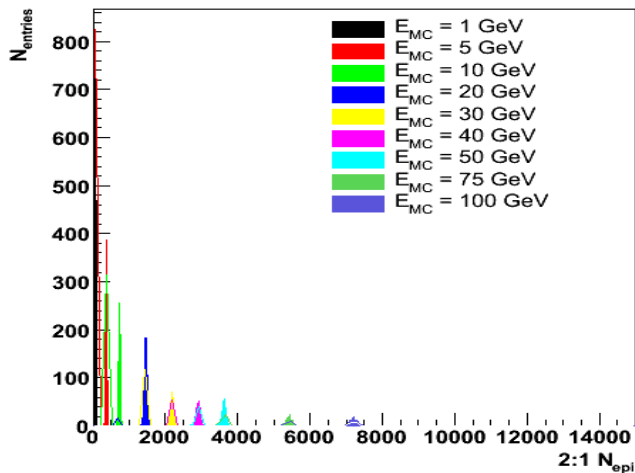
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Fit of the energy in the bulk

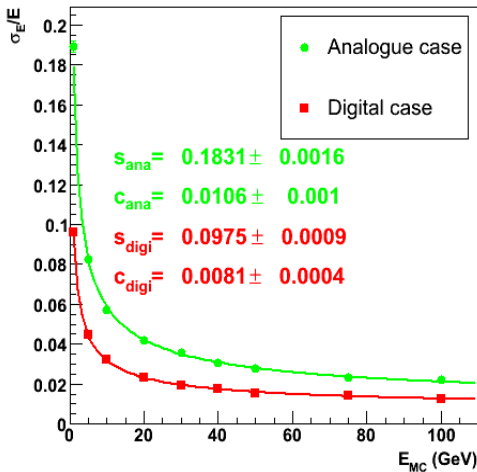


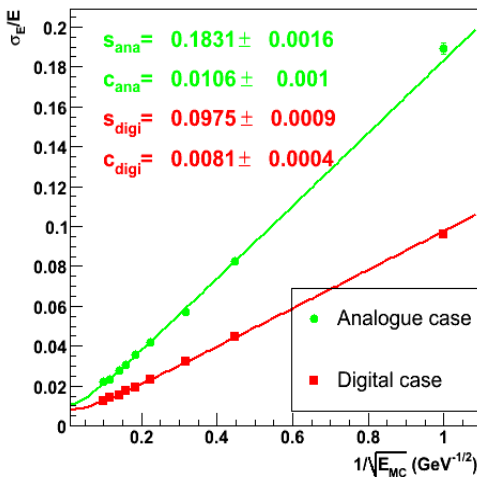
Fit of the number of hits in the epi



Resolution vs E: analogue vs digital

$$\text{Fit function: } \sigma_E/E = \sqrt{(s/\sqrt{E})^2 + c^2}$$



Resolution vs $1/\sqrt{E}$: analogue vs digitalFit function: $\sqrt{(sx)^2 + c^2}$ 

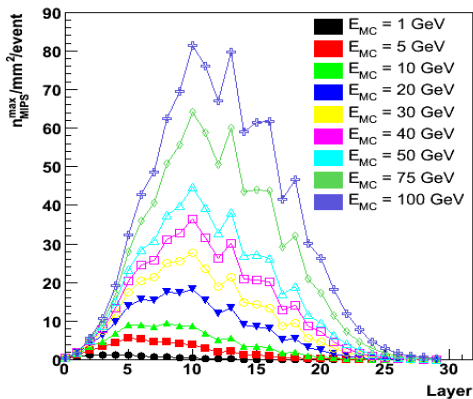
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Counting MIPS ... vs layer

Assuming a MIP is a hit in $5 \times 5 \times 1 \mu\text{m}^3$ cell...

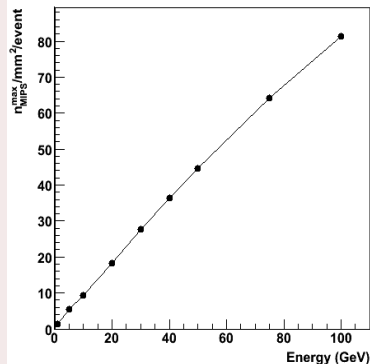
Max vs layer for several energies



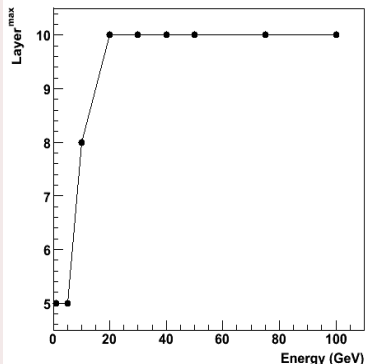
Counting MIPS ... max vs E

Assuming a MIP is a hit in $5 \times 5 \times 1 \mu\text{m}^3$ cell...

Max vs E



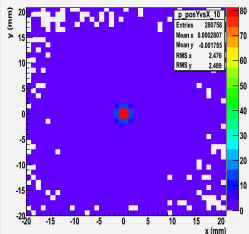
max layer vs E



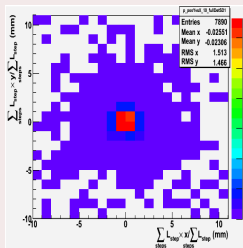
Counting MIPS ... More correctly ...

Assuming a G4 track is a MIP ...

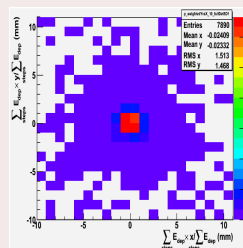
Previous method:
hits in $5 \times 5 \times 1 \mu\text{m}^3$



With G4 tracks:
position weighted
by the step length

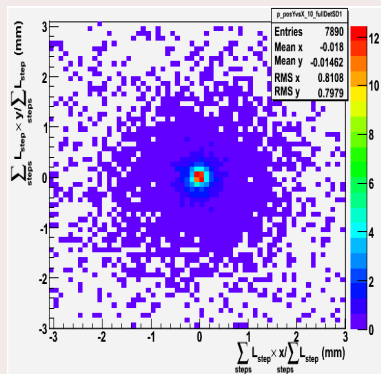


With G4 tracks:
position weighted
by the step E_{dep}

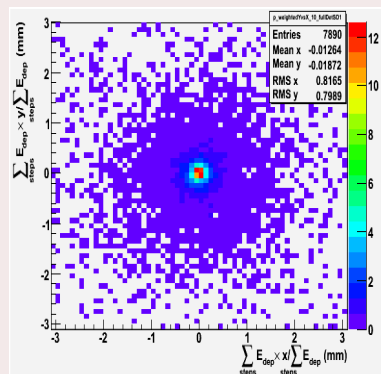


Assuming a G4 track is a MIP

Position weighted by the step length



Position weighted by the step E_{dep}



Counting MIPS ... More correctly ... vs layer

Assuming a G4 track is a MIP ...

Max vs layer for 20 events at 100 GeV

