HiDRa Analysis

21/9/22

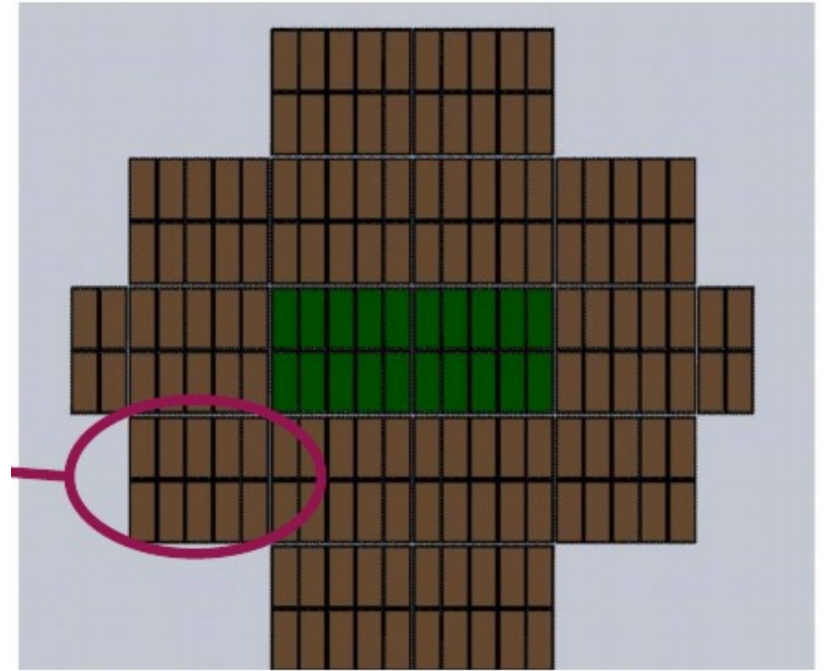# Setup & Recap

Rotation of 2.5° in both X and Y directions
1mm fiber diameter
Steel absorber material

- Studied configuration with 80 mini-modules
- Old "Standard" setup: 84 mini-modules
- Checked differences between
  2000 and 2500 mm depth
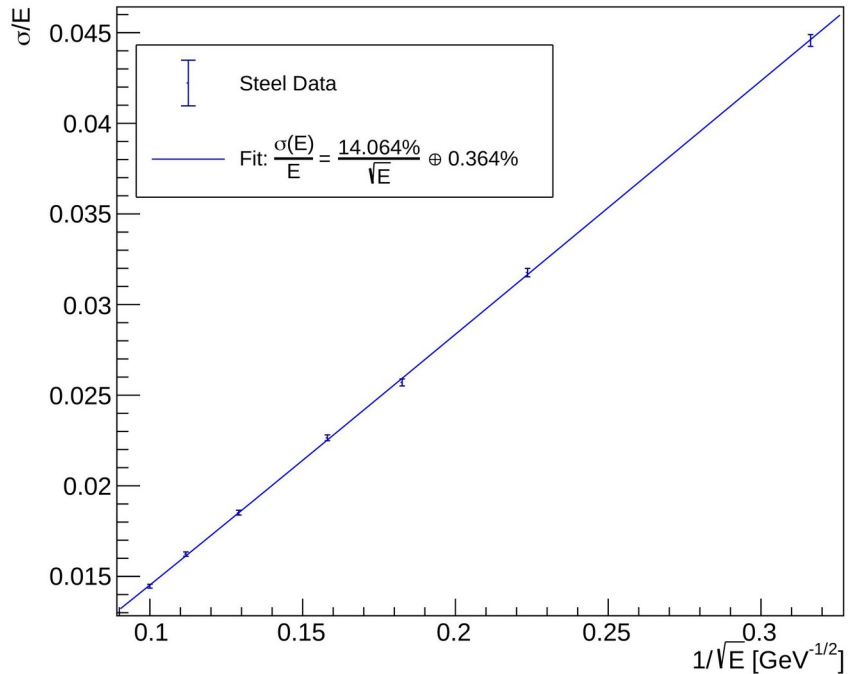- Configurations considered to increase
  containment for pions:

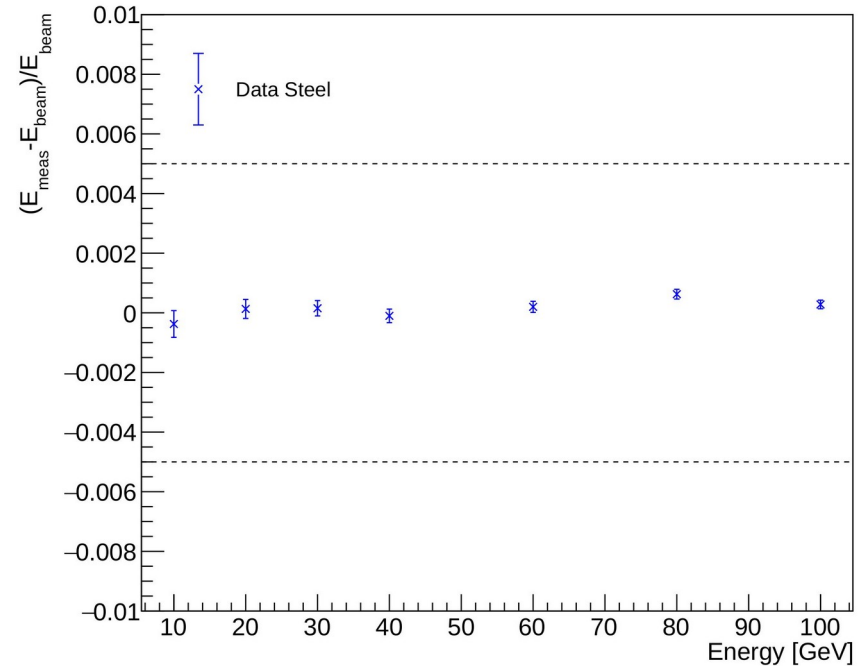"newGeo"   ⟶   104 mini-modules
"fullCont"   ⟹   480 mini-modules

Electron Performance

Electron resolution in [10, 100] GeV Range

Linearity

Fit: $\dfrac{\sigma(E)}{E} = \dfrac{14.064\%}{\sqrt{E}} \oplus 0.364\%$
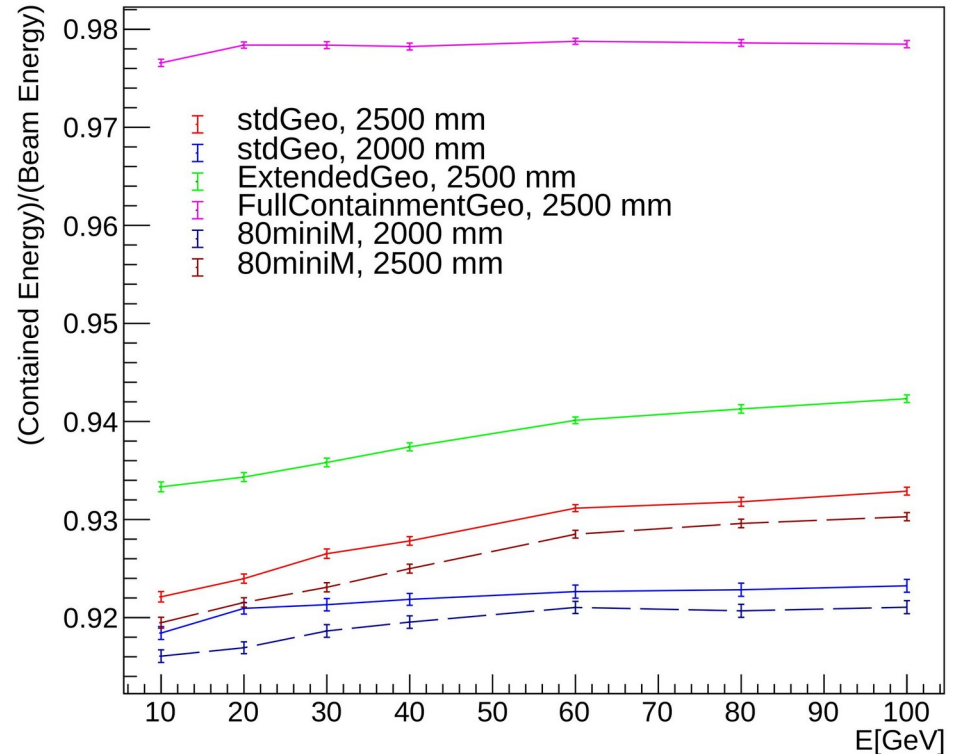
Steel Data

Data Steel

Cailbration: extracted phe/GeV ratio as the mean of the ratios obtained at energies in the range   [10, 100] GeV

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Pion Performance: Containment

$$Containment = (E_{beam} - E_{leak})/E_{beam}$$

$$E_{reco} = \frac{(1/containment) \cdot (S - \chi \cdot C)}{(1 - \chi)}$$

Pion Containment in [10, 100] GeV Range

Legend:
- stdGeo, 2500 mm
- stdGeo, 2000 mm
- ExtendedGeo, 2500 mm
- FullContainmentGeo, 2500 mm
- 80miniM, 2000 mm
- 80miniM, 2500 mm

Y-axis: (Contained Energy)/(Beam Energy)
X-axis: E[GeV]

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Pion Performance: Containment

$$Containment = (E_{beam} - E_{leak})/E_{beam}$$
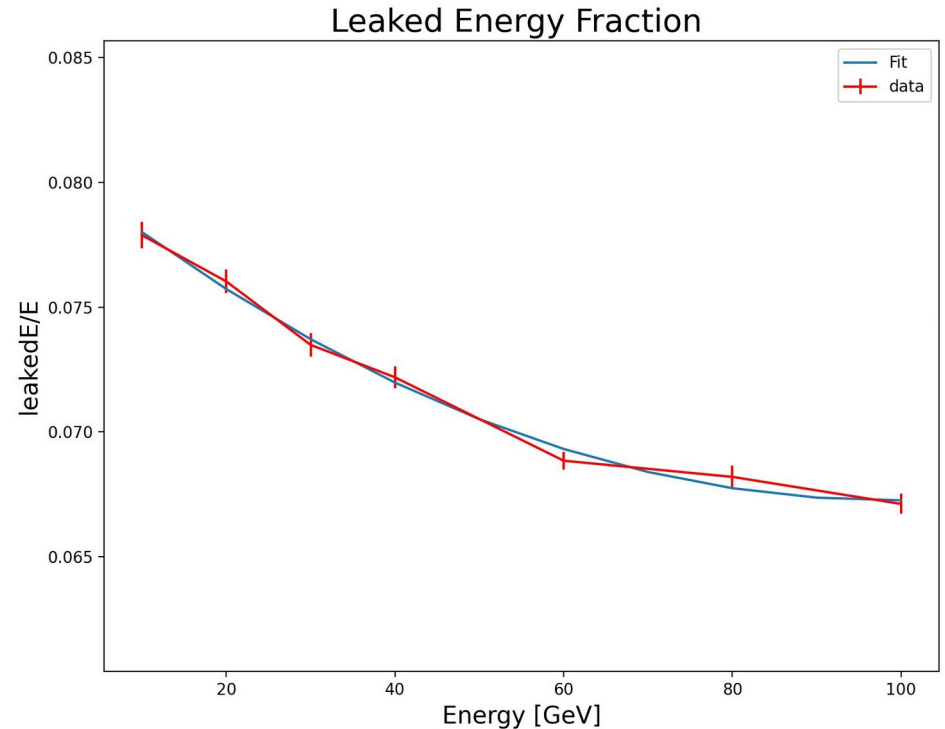
$$E_{reco} = \frac{(1/containment) \cdot (S - \chi \cdot C)}{(1-\chi)}$$

Containment extracted from fit at fixed energy
Instead of the beam energy I should use

$$containment(E) = containment(\frac{S - \chi \cdot C}{1-\chi})$$

... To be corrected soon

Leaked Energy Fraction

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Pion Performance: Chi factor

Considering geometries already used last weeks:
- "Calibration" with 40 GeV pion beam
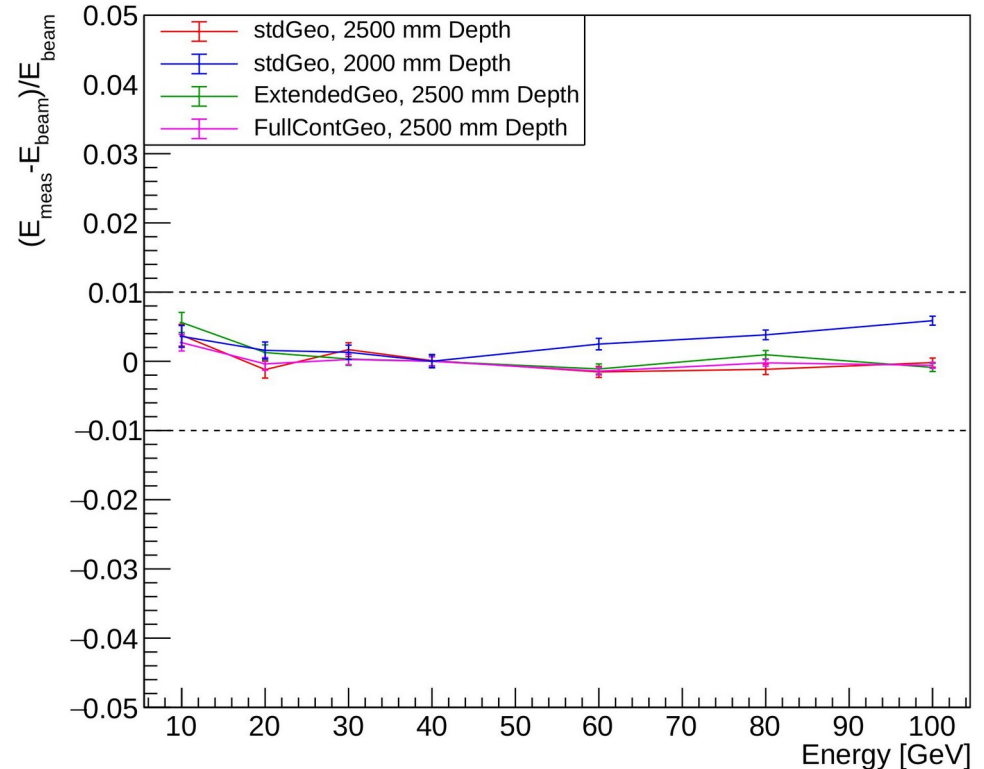- Find χ such that E_{reco} is exactly 40 GeV

Problem:
Just like in the last presentations, for each geometry a different χ value is found

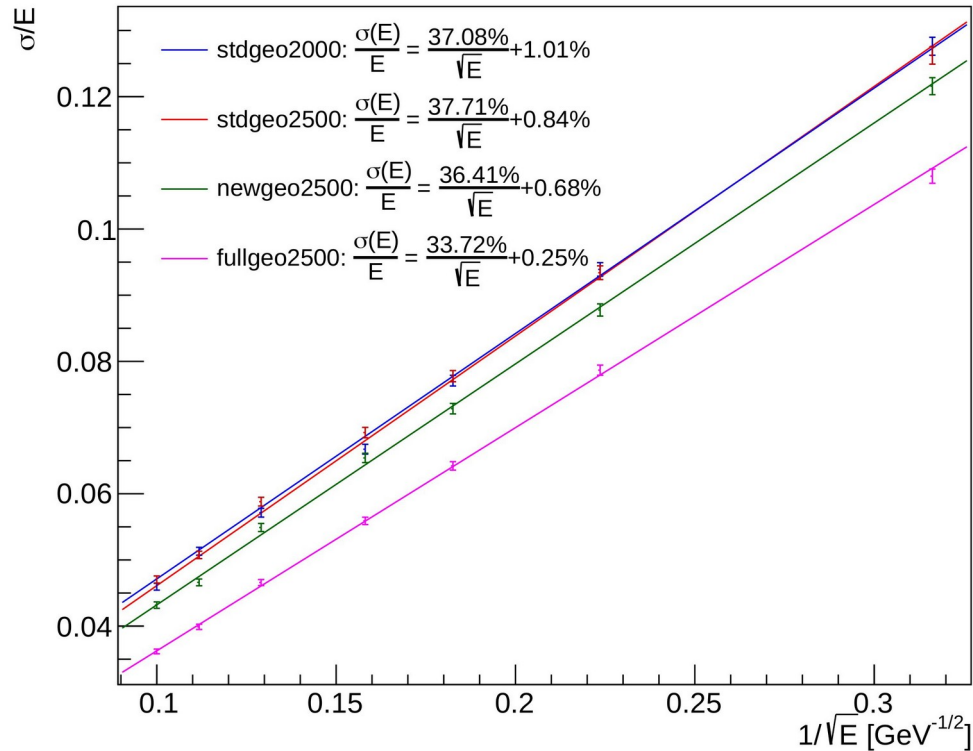New χ are a little smaller than the old ones
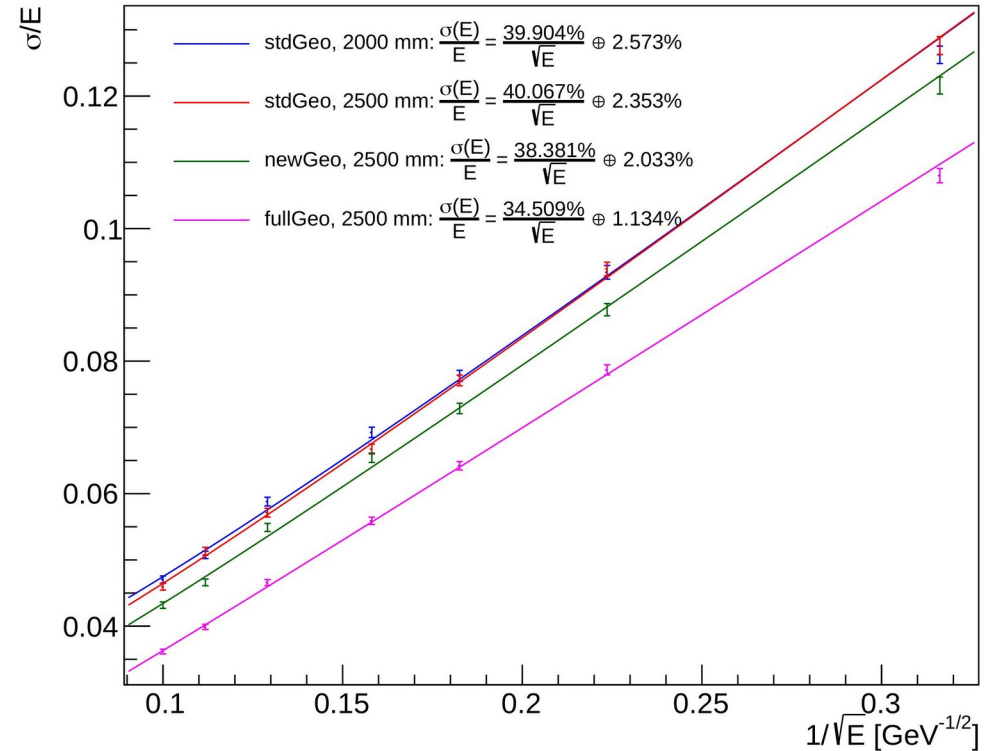⟹ Slightly better resolutions

Pion Linearity

stdGeo, 2500 mm Depth
stdGeo, 2000 mm Depth
ExtendedGeo, 2500 mm Depth
FullContGeo, 2500 mm Depth

Resolution: how to present results?

Pion resolution in [10, 100] GeV Range

σ/E

stdgeo2000: $\frac{\sigma(E)}{E} = \frac{37.08\%}{\sqrt{E}} + 1.01\%$

stdgeo2500: $\frac{\sigma(E)}{E} = \frac{37.71\%}{\sqrt{E}} + 0.84\%$

newgeo2500: $\frac{\sigma(E)}{E} = \frac{36.41\%}{\sqrt{E}} + 0.68\%$

fullgeo2500: $\frac{\sigma(E)}{E} = \frac{33.72\%}{\sqrt{E}} + 0.25\%$

$1/\sqrt{E}$ [GeV$^{-1/2}$]

Pion resolution in [10, 100] GeV Range

σ/E

stdGeo, 2000 mm: $\frac{\sigma(E)}{E} = \frac{39.904\%}{\sqrt{E}} \oplus 2.573\%$

stdGeo, 2500 mm: $\frac{\sigma(E)}{E} = \frac{40.067\%}{\sqrt{E}} \oplus 2.353\%$

newGeo, 2500 mm: $\frac{\sigma(E)}{E} = \frac{38.381\%}{\sqrt{E}} \oplus 2.033\%$

fullGeo, 2500 mm: $\frac{\sigma(E)}{E} = \frac{34.509\%}{\sqrt{E}} \oplus 1.134\%$

$1/\sqrt{E}$ [GeV$^{-1/2}$]
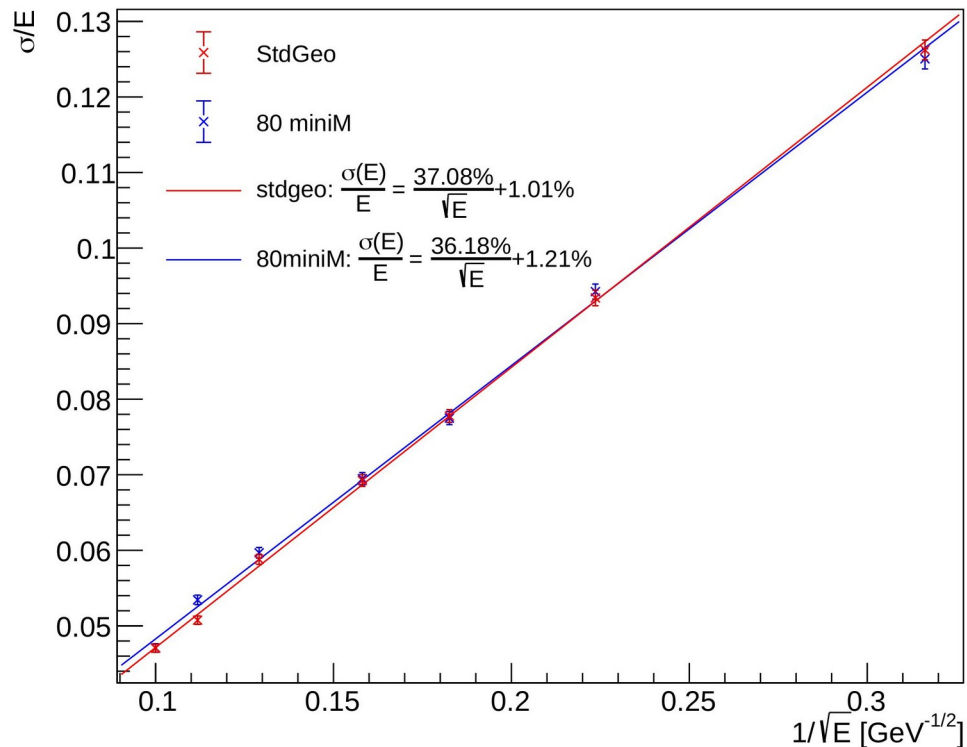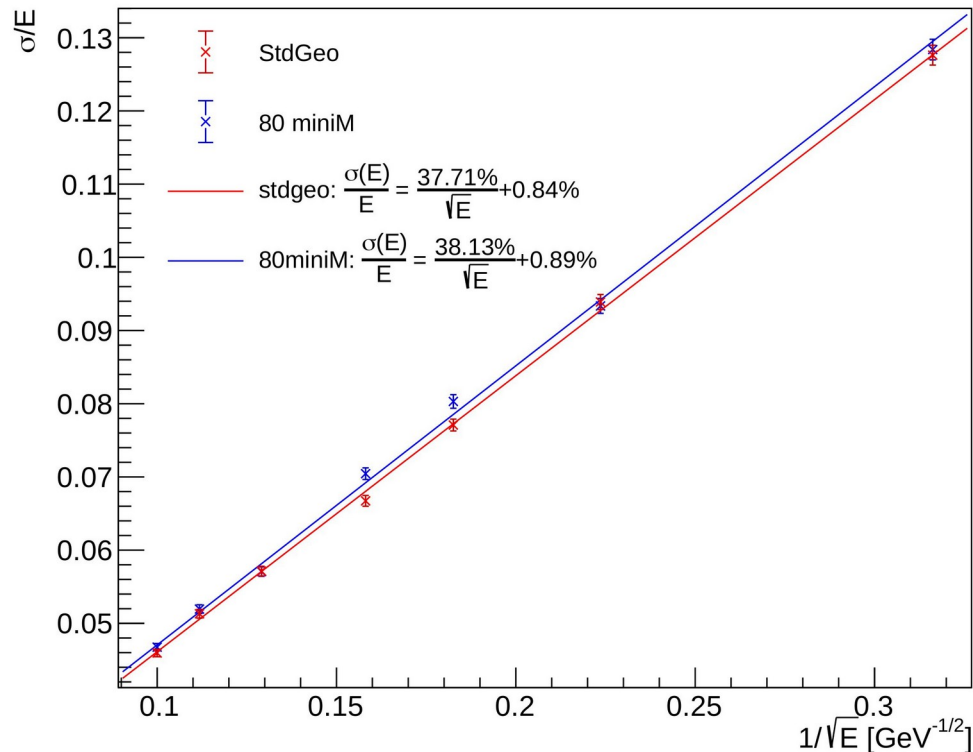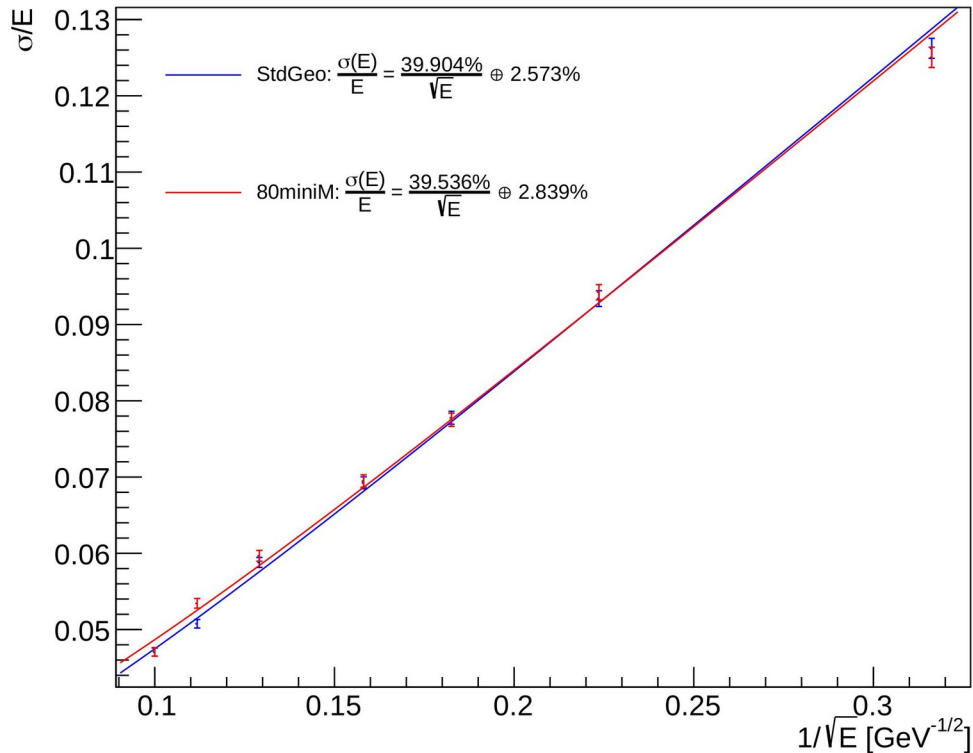
Pion Resolution

Pion resolution in [10, 100] GeV Range, 2000mm Depth

Pion resolution in [10, 100] GeV Range, 2500mm Depth

Pion Resolution

Pion resolution in [10, 100] GeV Range, 2000mm Depth

StdGeo: $\frac{\sigma(E)}{E} = \frac{39.904\%}{\sqrt{E}} \oplus 2.573\%$

80miniM: $\frac{\sigma(E)}{E} = \frac{39.536\%}{\sqrt{E}} \oplus 2.839\%$

Pion resolution in [10, 100] GeV Range, 2500mm Depth

StdGeo: $\frac{\sigma(E)}{E} = \frac{40.067\%}{\sqrt{E}} \oplus 2.353\%$

80miniM: $\frac{\sigma(E)}{E} = \frac{40.693\%}{\sqrt{E}} \oplus 2.414\%$
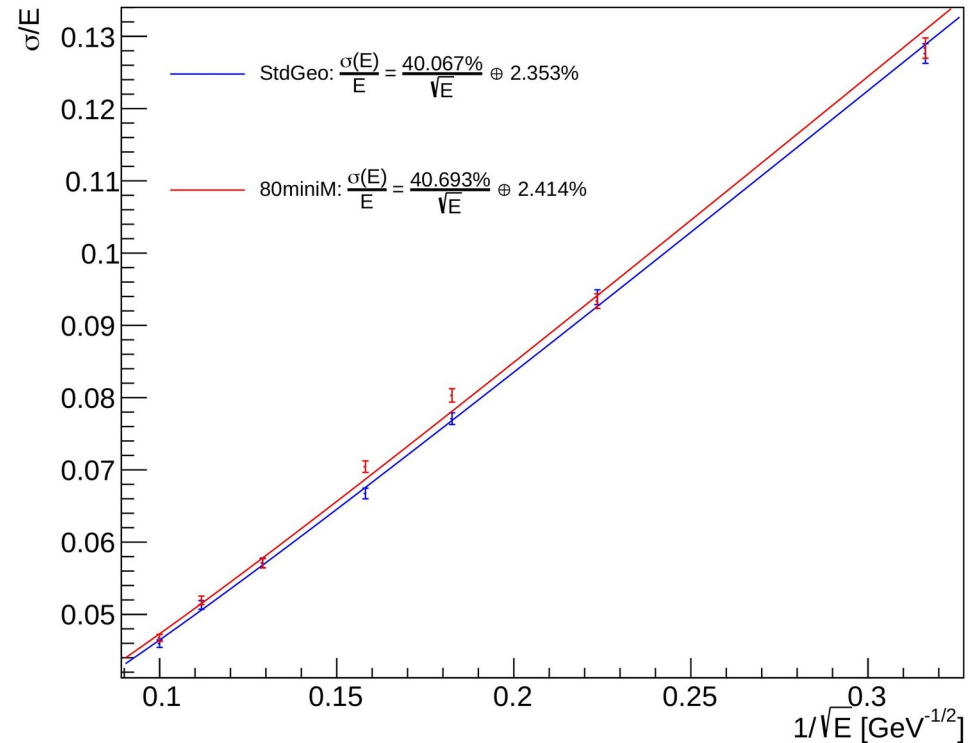
Fixing one chi factor

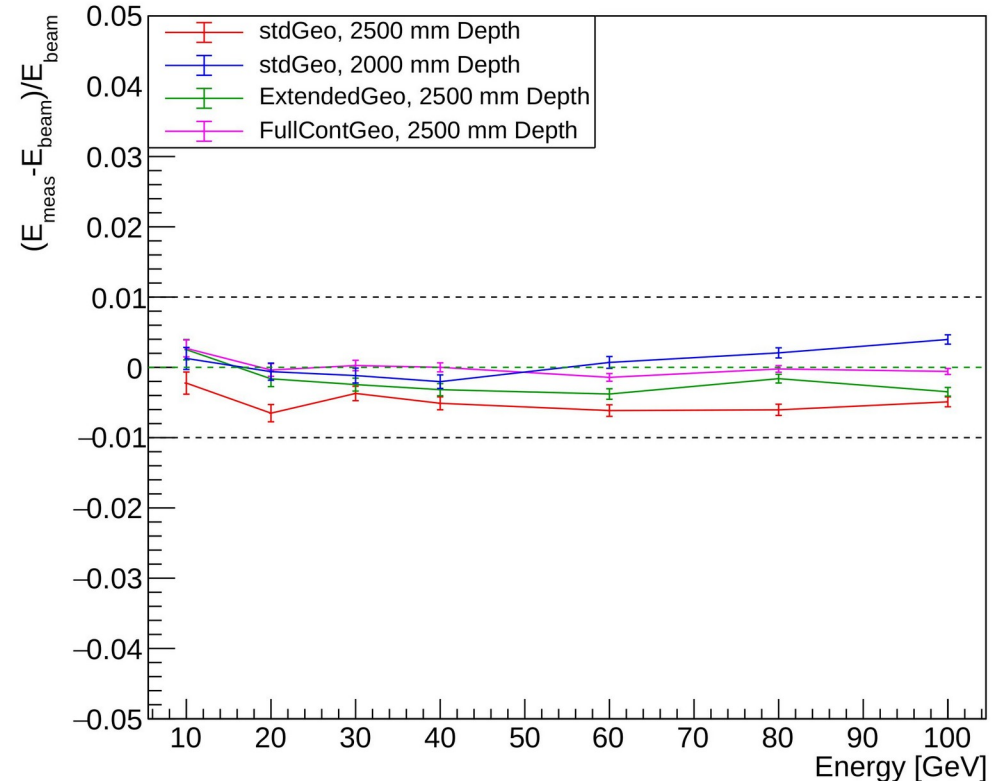χ should depend only by the response of the calorimeter, and not by the geometry
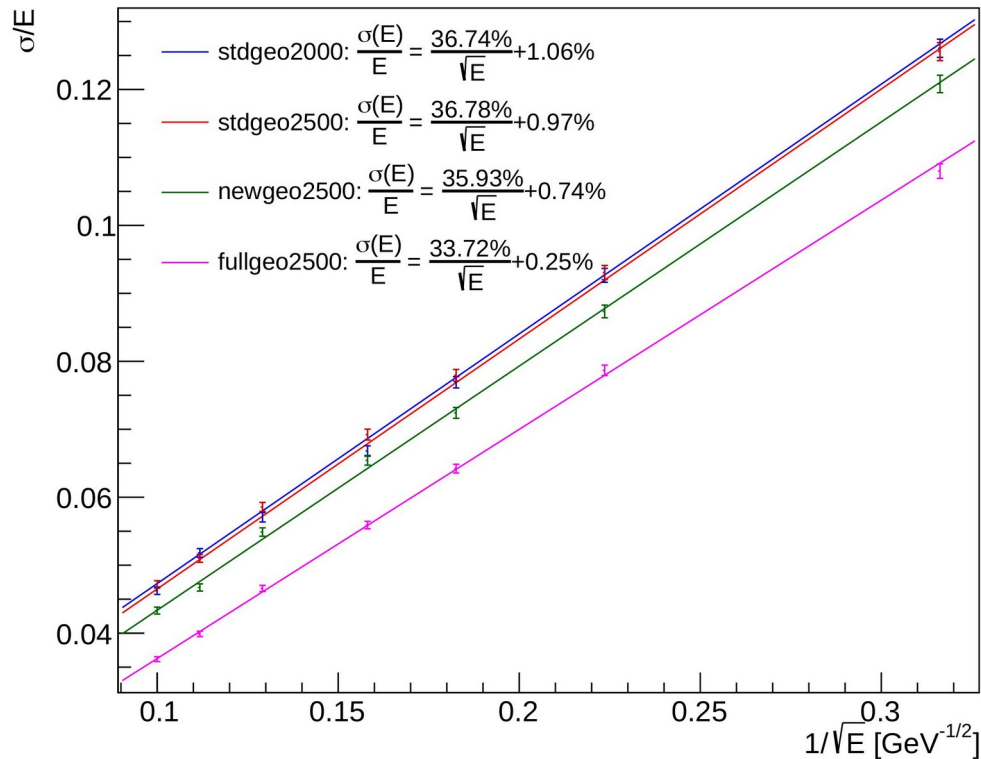
Tried to fix the value obtained with the "FullContainment" configuration (480 mini-modules) at 40 GeV, and using it for all other geometries
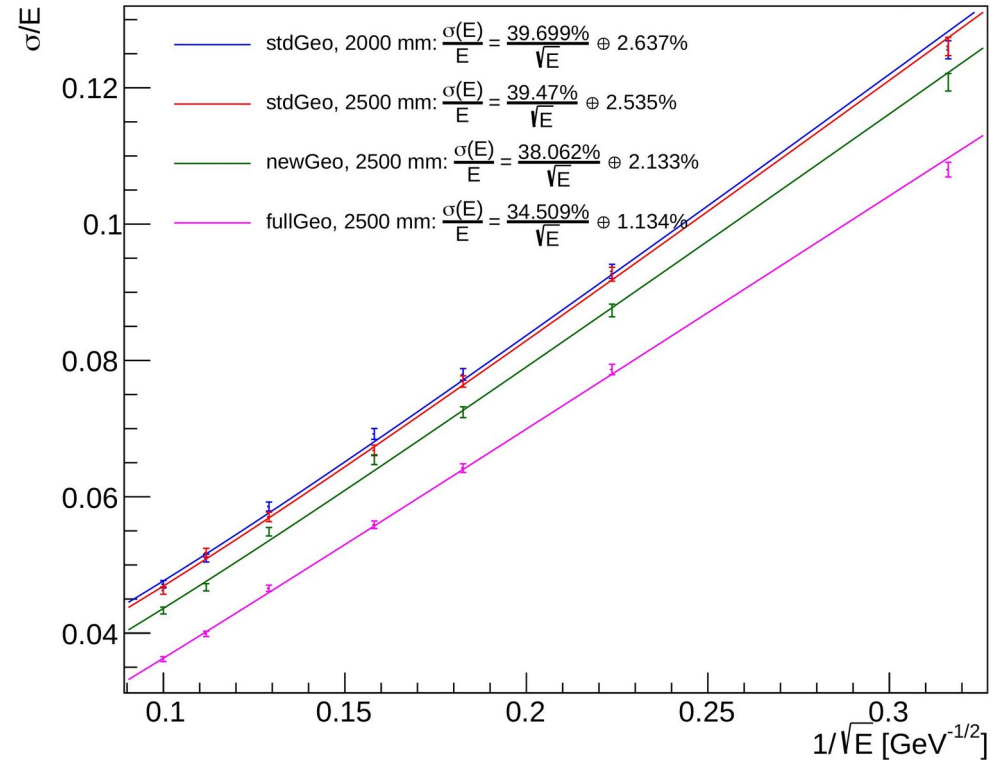

Pion Linearity

Legend:
- stdGeo, 2500 mm Depth
- stdGeo, 2000 mm Depth
- ExtendedGeo, 2500 mm Depth
- FullContGeo, 2500 mm Depth

y-axis: $(E_{meas} - E_{beam})/E_{beam}$
x-axis: Energy [GeV]

Pion Resolution

Pion resolution in [10, 100] GeV Range

stdgeo2000: $\frac{\sigma(E)}{E} = \frac{36.74\%}{\sqrt{E}} + 1.06\%$

stdgeo2500: $\frac{\sigma(E)}{E} = \frac{36.78\%}{\sqrt{E}} + 0.97\%$

newgeo2500: $\frac{\sigma(E)}{E} = \frac{35.93\%}{\sqrt{E}} + 0.74\%$

fullgeo2500: $\frac{\sigma(E)}{E} = \frac{33.72\%}{\sqrt{E}} + 0.25\%$

Pion resolution in [10, 100] GeV Range

stdGeo, 2000 mm: $\frac{\sigma(E)}{E} = \frac{39.699\%}{\sqrt{E}} \oplus 2.637\%$

stdGeo, 2500 mm: $\frac{\sigma(E)}{E} = \frac{39.47\%}{\sqrt{E}} \oplus 2.535\%$

newGeo, 2500 mm: $\frac{\sigma(E)}{E} = \frac{38.062\%}{\sqrt{E}} \oplus 2.133\%$

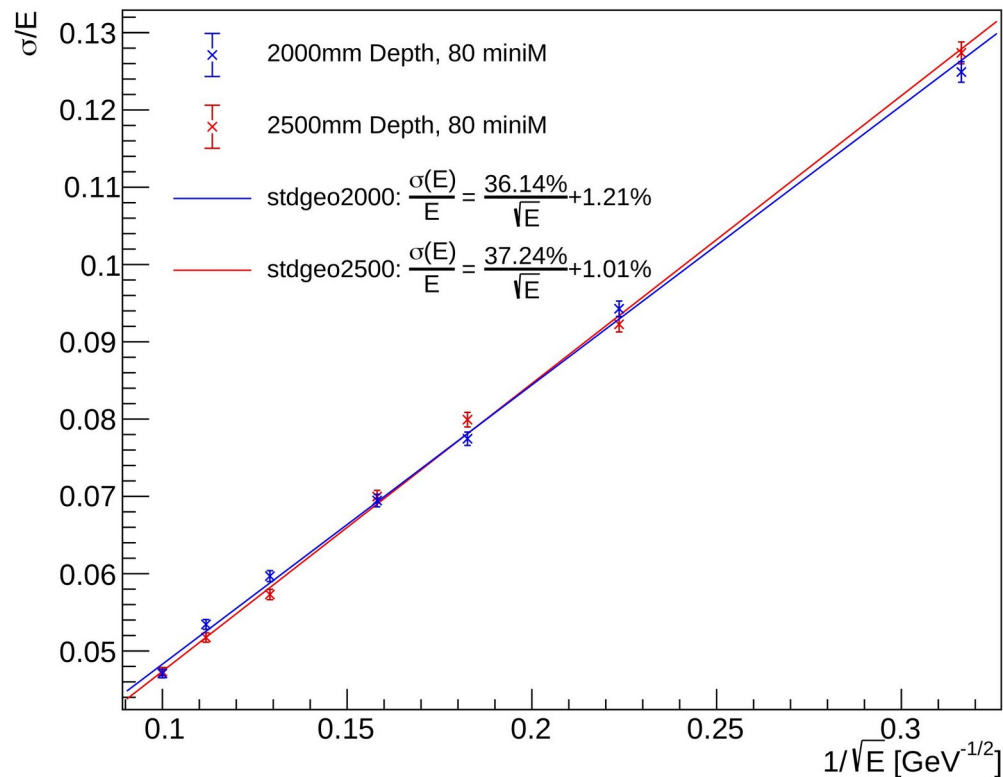fullGeo, 2500 mm: $\frac{\sigma(E)}{E} = \frac{34.509\%}{\sqrt{E}} \oplus 1.134\%$

Pion Resolution

Pion Linearity, 80miniM
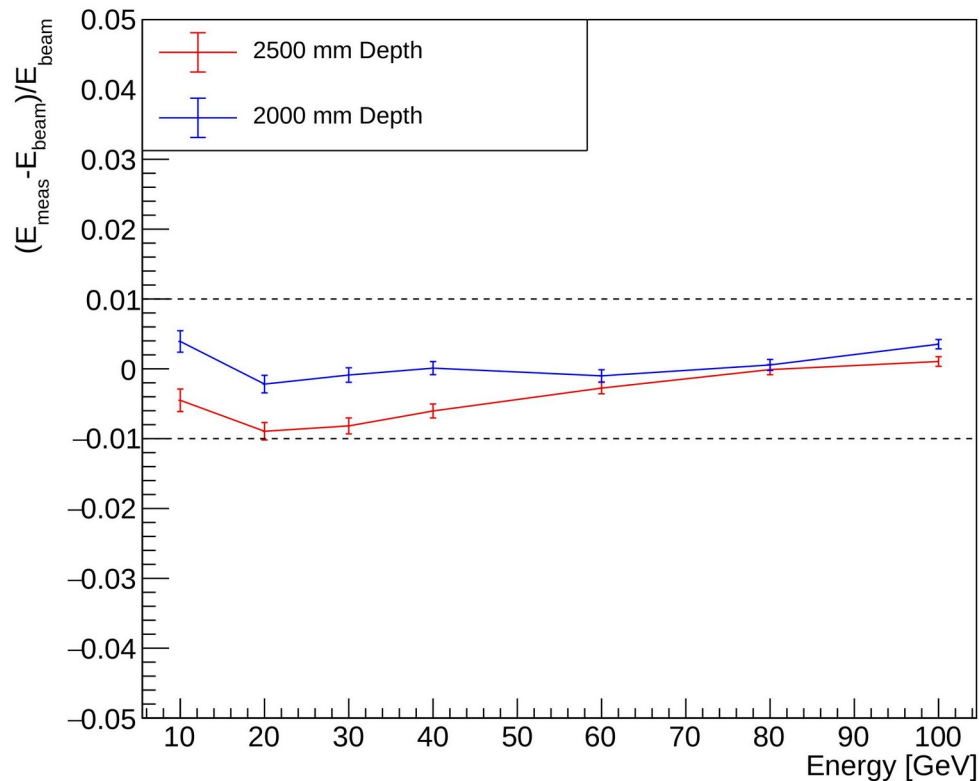
Pion resolution in [10, 100] GeV Range

Pion Resolution

Pion resolution in [10, 100] GeV Range, 80miniM

2000 mm: $\dfrac{\sigma(E)}{E} = \dfrac{39.506\%}{\sqrt{E}} \oplus 2.845\%$

2500 mm: $\dfrac{\sigma(E)}{E} = \dfrac{40.092\%}{\sqrt{E}} \oplus 2.585\%$

σ/E

$1/\sqrt{E}$ [GeV$^{-1/2}$]