Simple HCAL model

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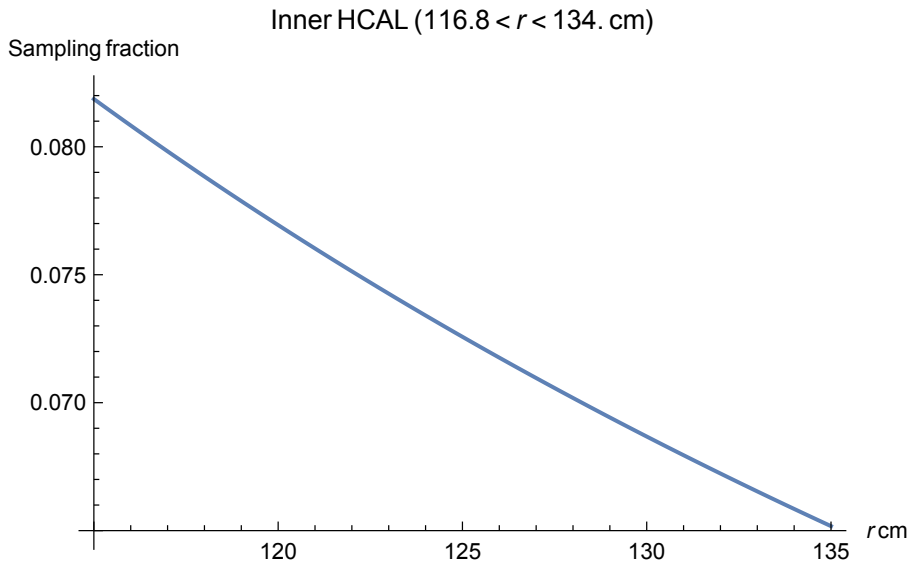
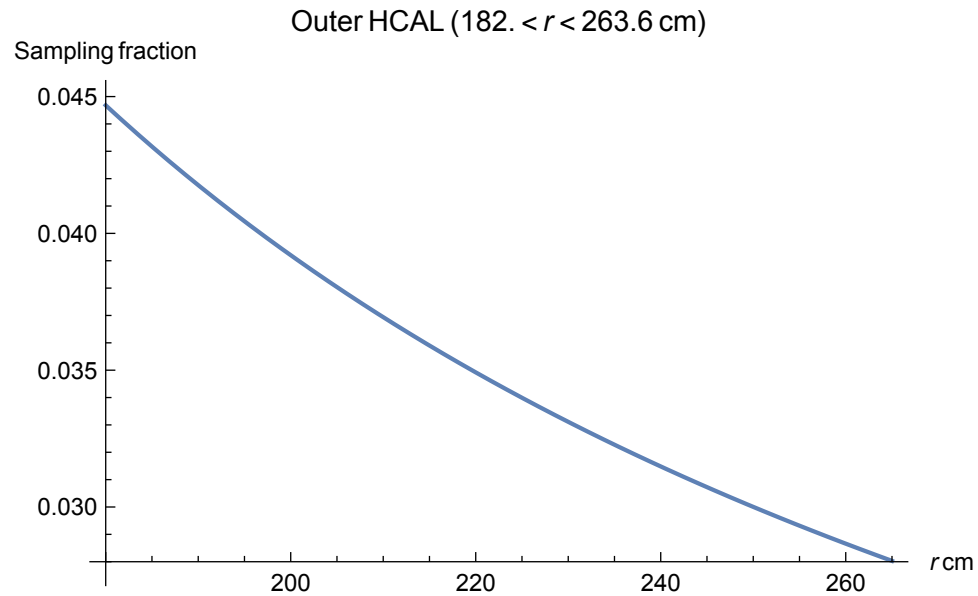
An uncomplicated HCAL

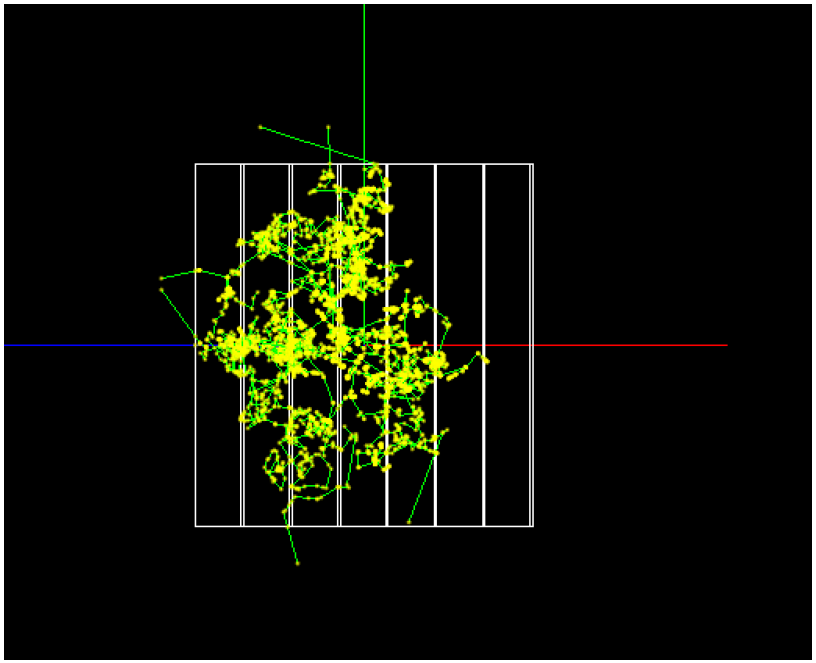
- An idealized model of the HCAL
  - Steel absorber plates (G4_Fe)
  - 7 mm polystyrene scintillator
  - Aim for total length $5.5\lambda_I$
  - FTFP_BERT 2.0
  - Just energy deposition, no light production or whatnot
  - No magnetic field
- Explore sampling fractions in the ballpark of the HCAL

HCAL sampling fraction by arithmetic

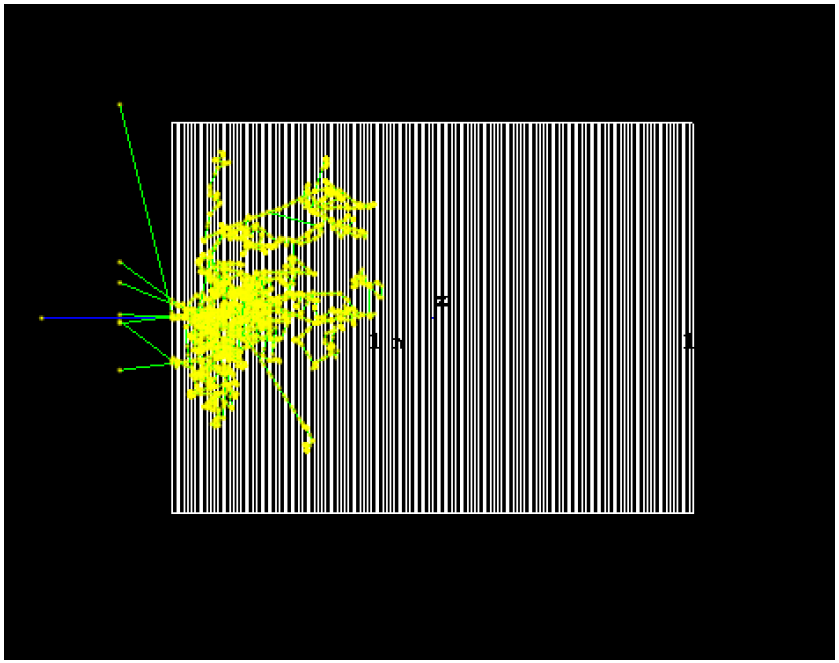




Events

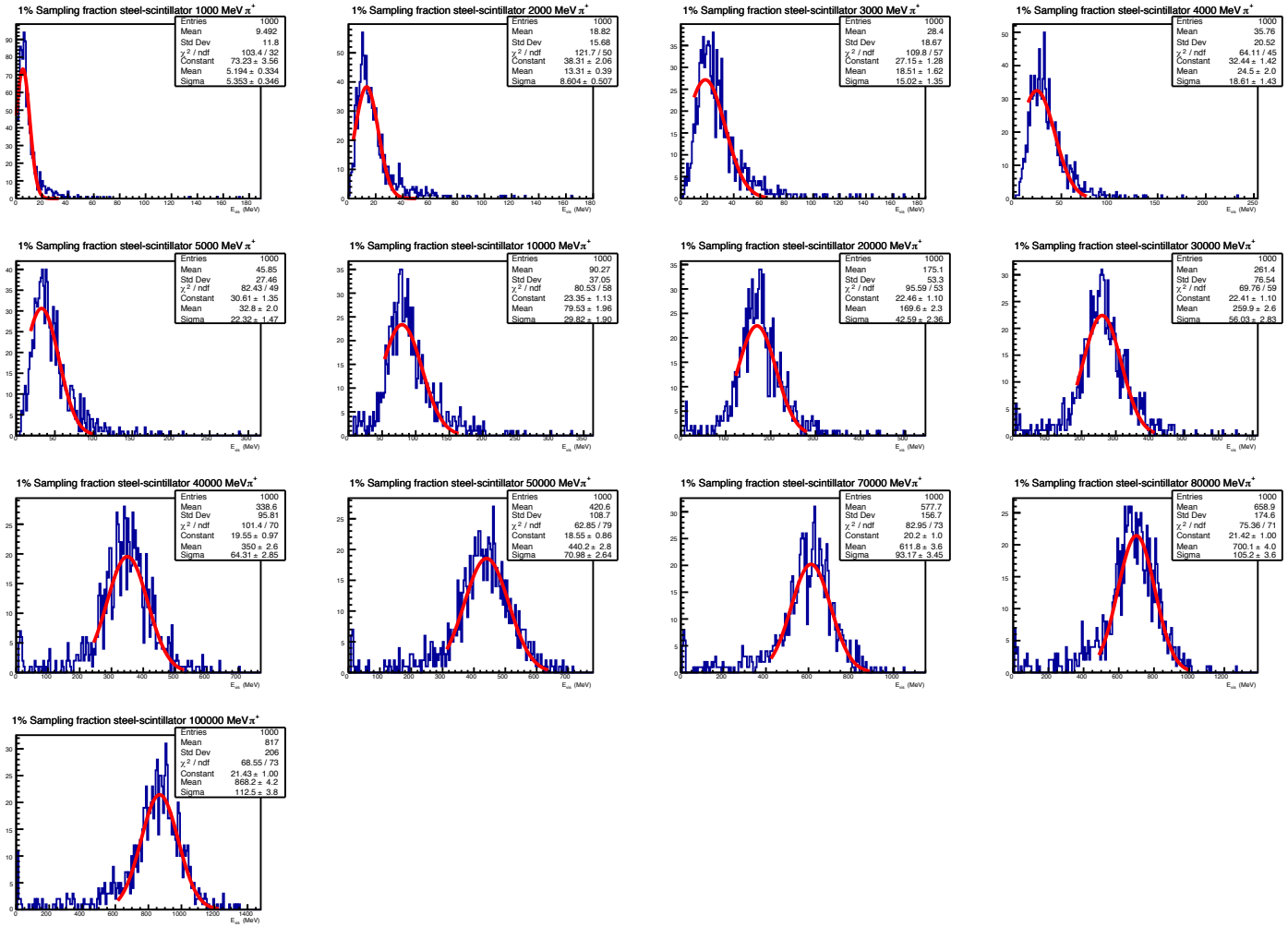


1% sampling fraction

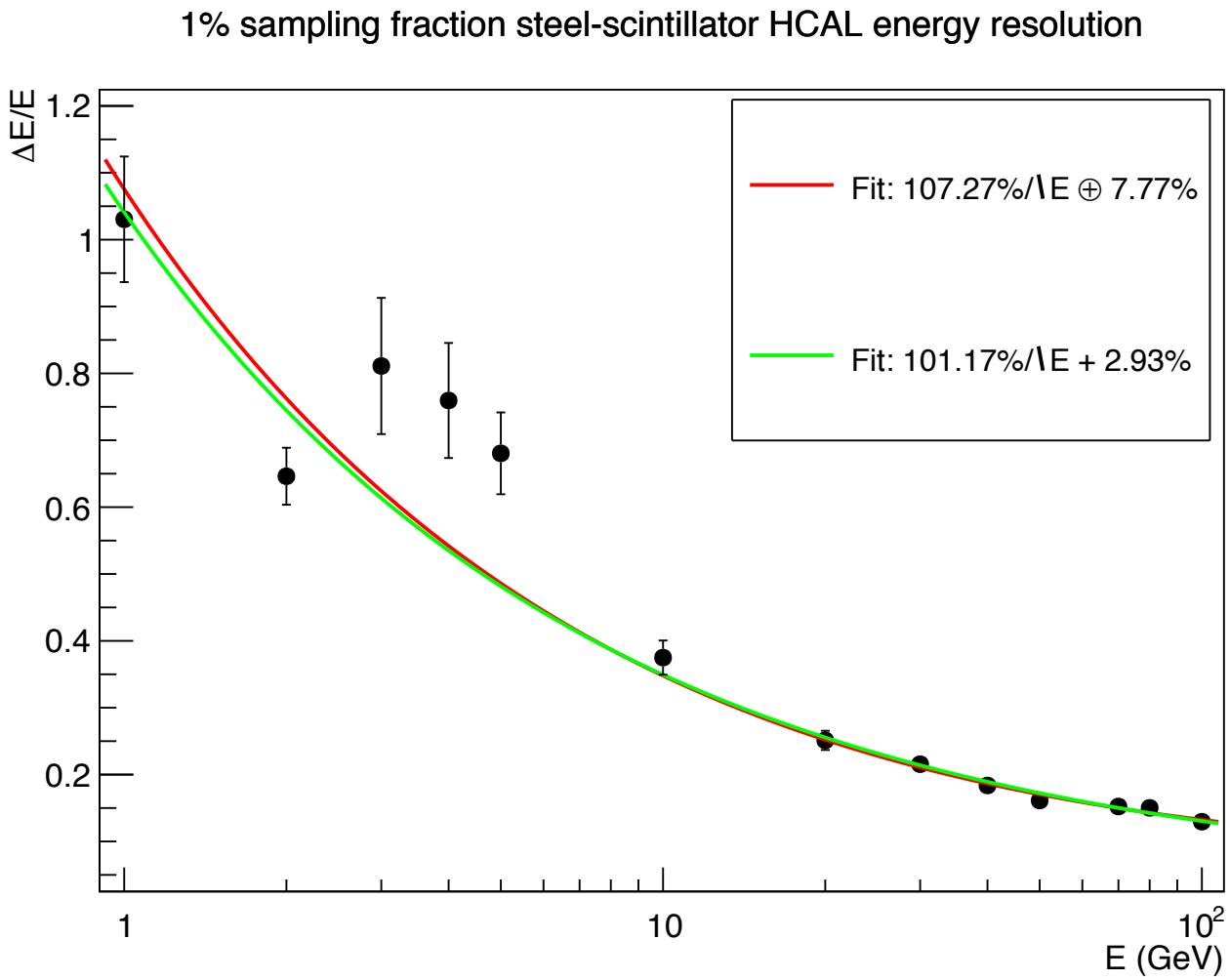


10% sampling fraction

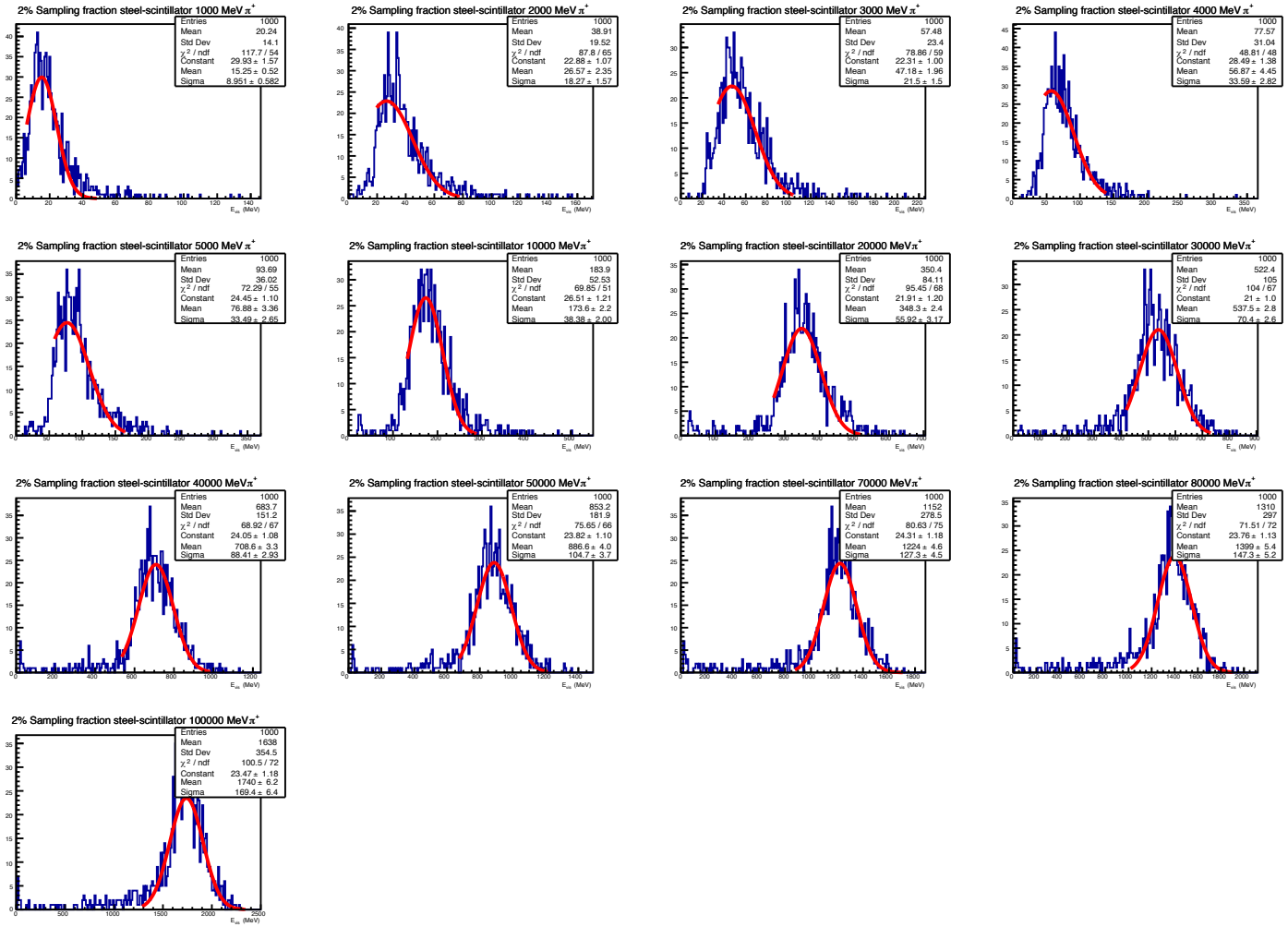
1% sampling fraction



1% sampling fraction

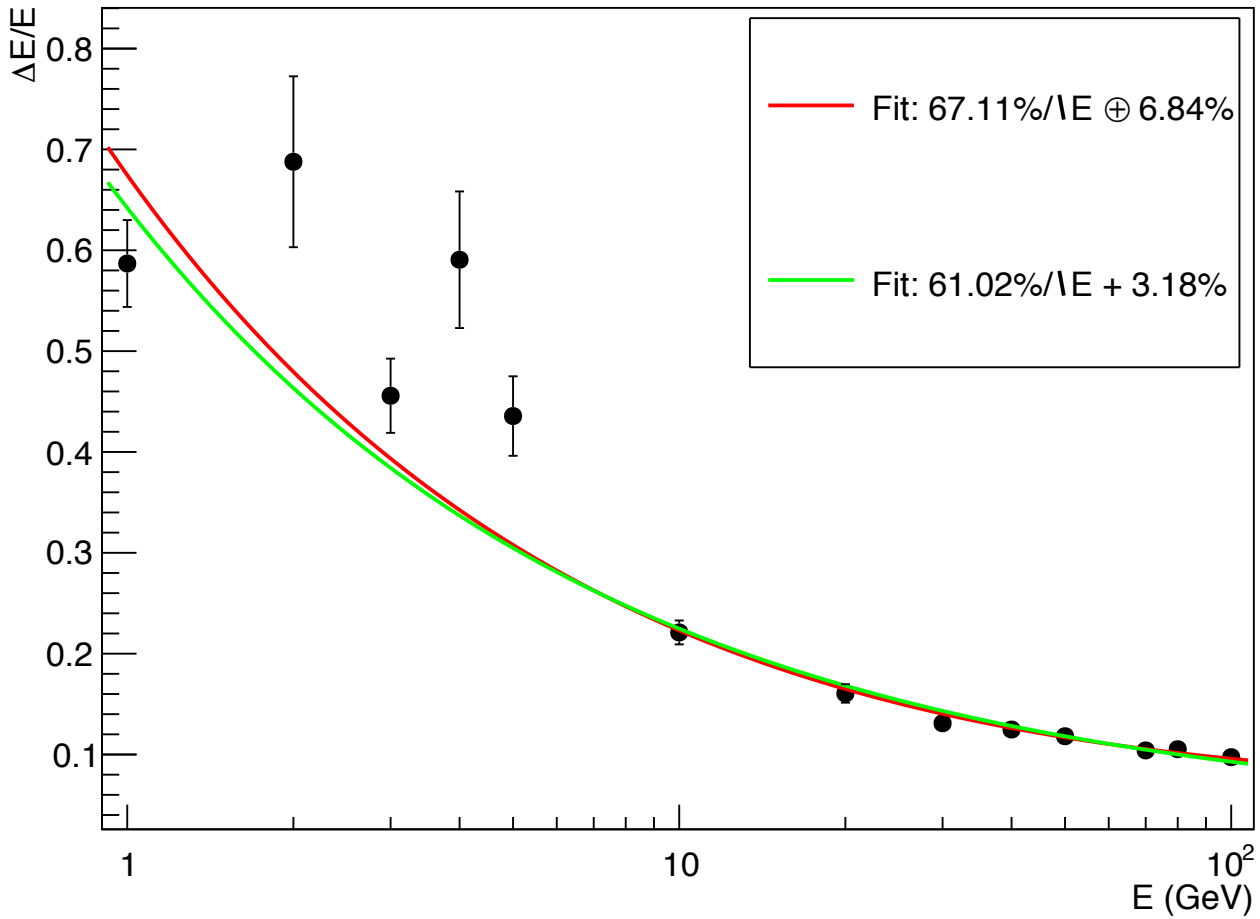


2% sampling fraction

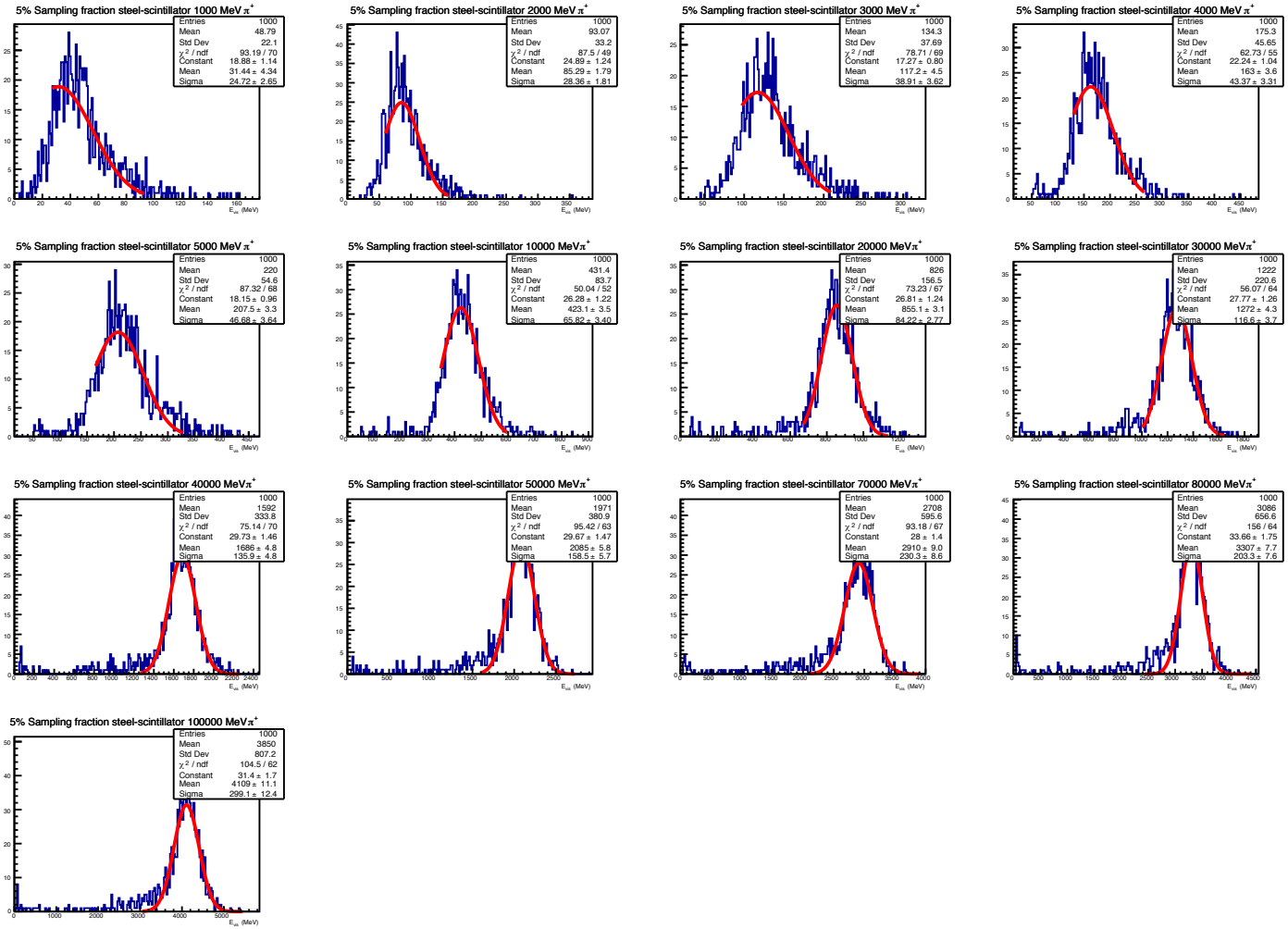


2% sampling fraction

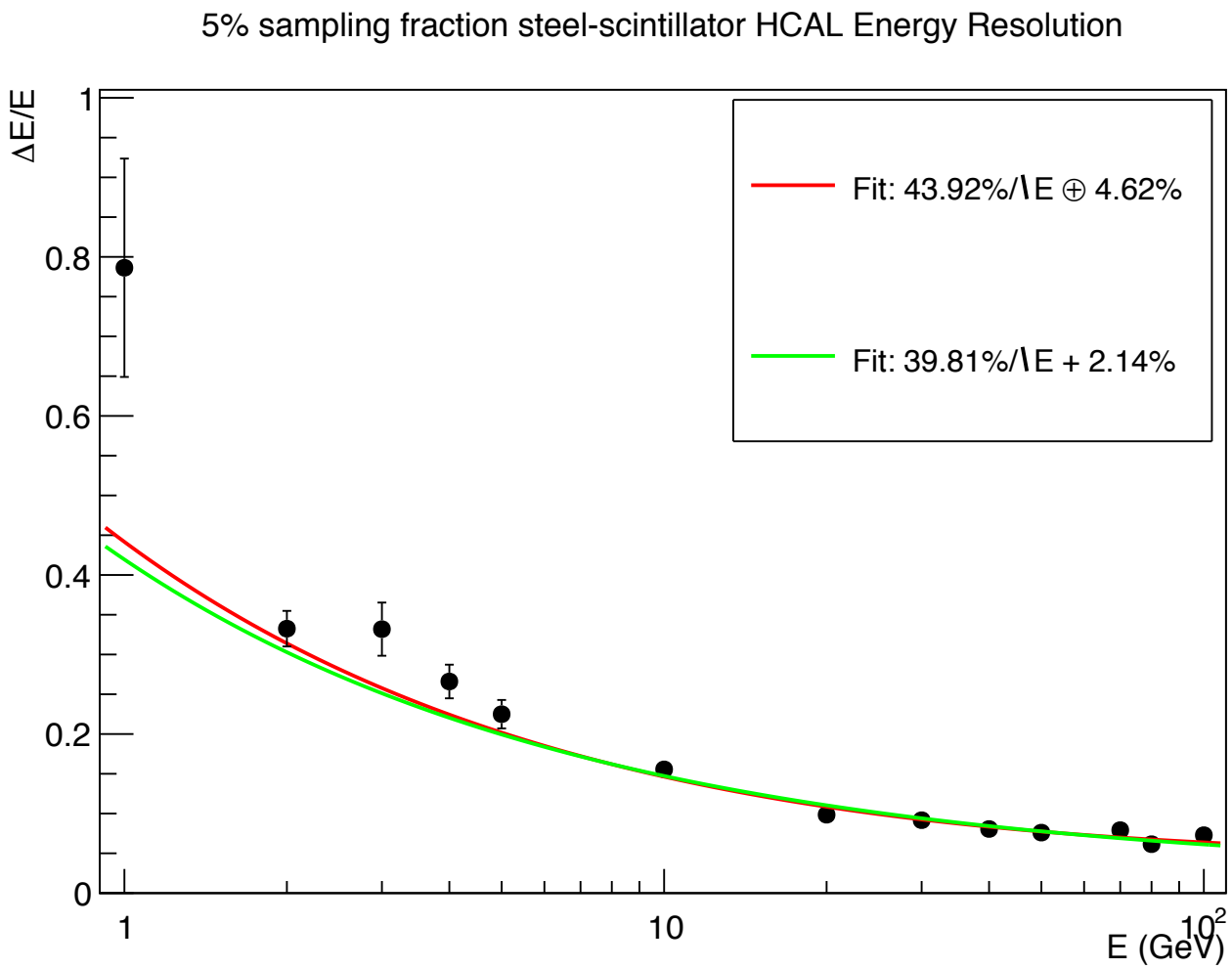
2% sampling fraction steel-scintillator HCAL energy resolution



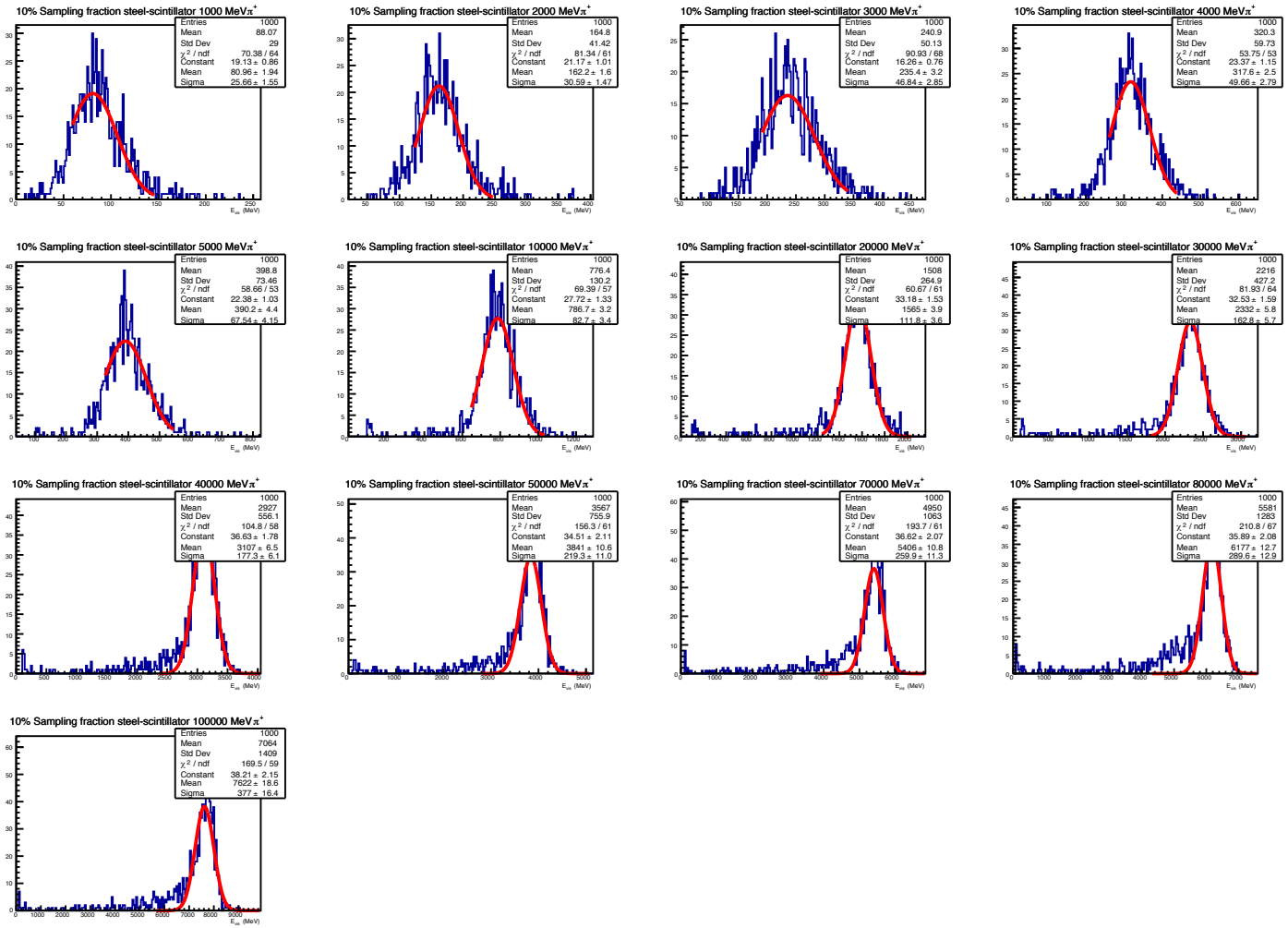
5% sampling fraction



5% sampling fraction

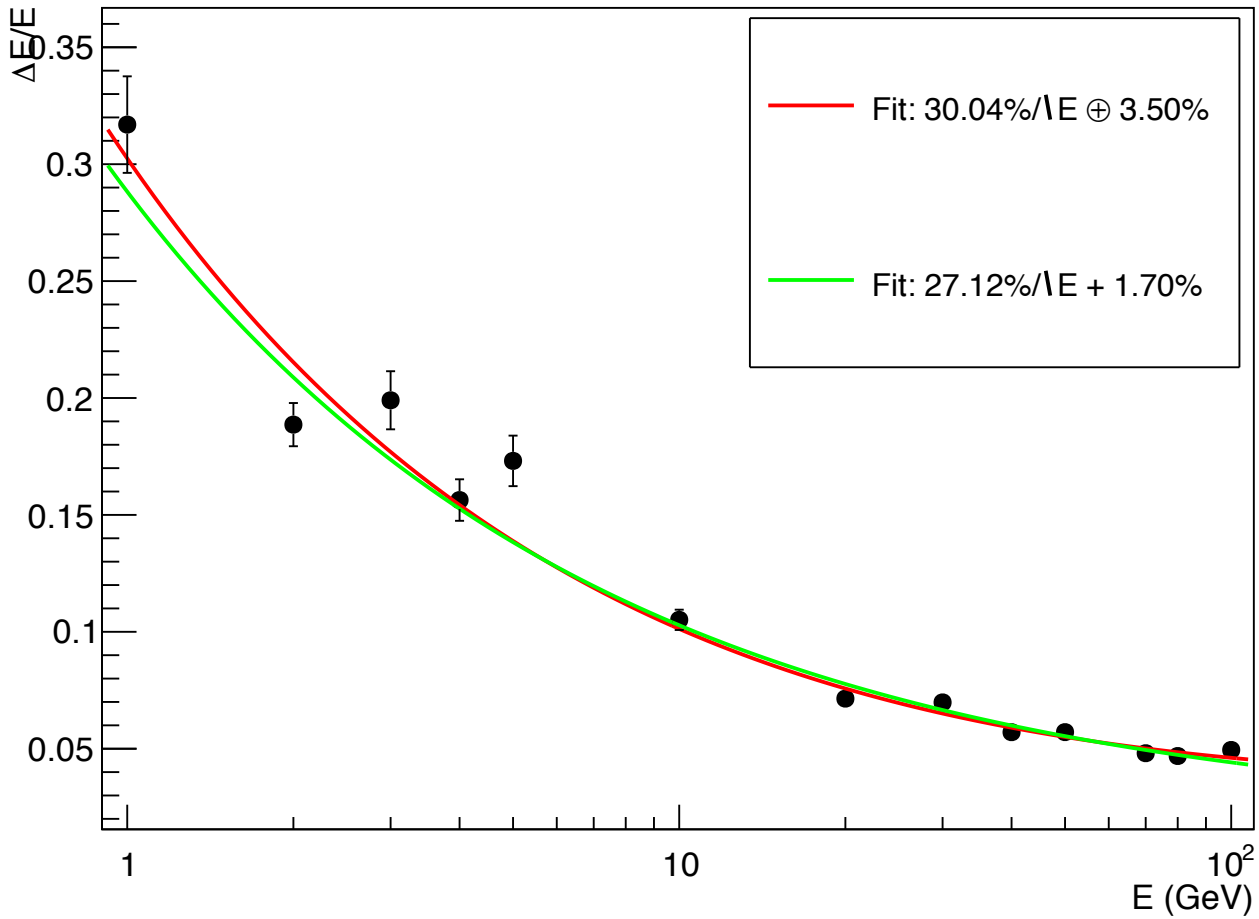


10% sampling fraction



10% sampling fraction

10% sampling fraction steel-scintillator HCAL energy resolution



What they're saying about hadronic calorimetry

Energy resolution of hadron showers

Hadronic energy resolution of non-compensating calorimeters does not scale with $1/\sqrt{E}$

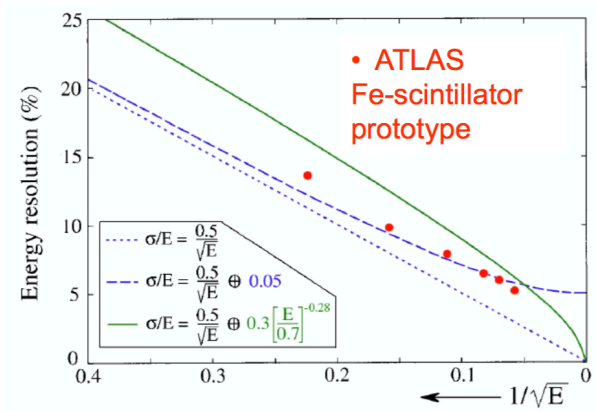
➔ $\sigma / E = a/\sqrt{E} \oplus b$ does not describe the data

Effects of non-compensation on σ/E is are better described by an energy dependent term:

$$\sigma / E = a/\sqrt{E} \oplus b\,(E/E_0)^{L-1}$$

In practice a good approximation is:

$$\boxed{\sigma / E = a/\sqrt{E} + b}$$



70

Sampling fraction	Stochastic term	Constant term
1%	101%	3%
2%	61%	3%
5%	40%	2%
10%	27%	2%

What I'd conclude (feel free to differ)

- The weird behavior of resolution below 10 GeV is intrinsic to the GEANT model (maybe there are pulleys and levers to fix this)
- High sampling fraction seems to predict unnaturally good resolution
- We need to look at e/h and be open to adjusting the sampling fraction to make the calorimeter more compensating (e/h ~ 1)