Longitudinal shower profile update

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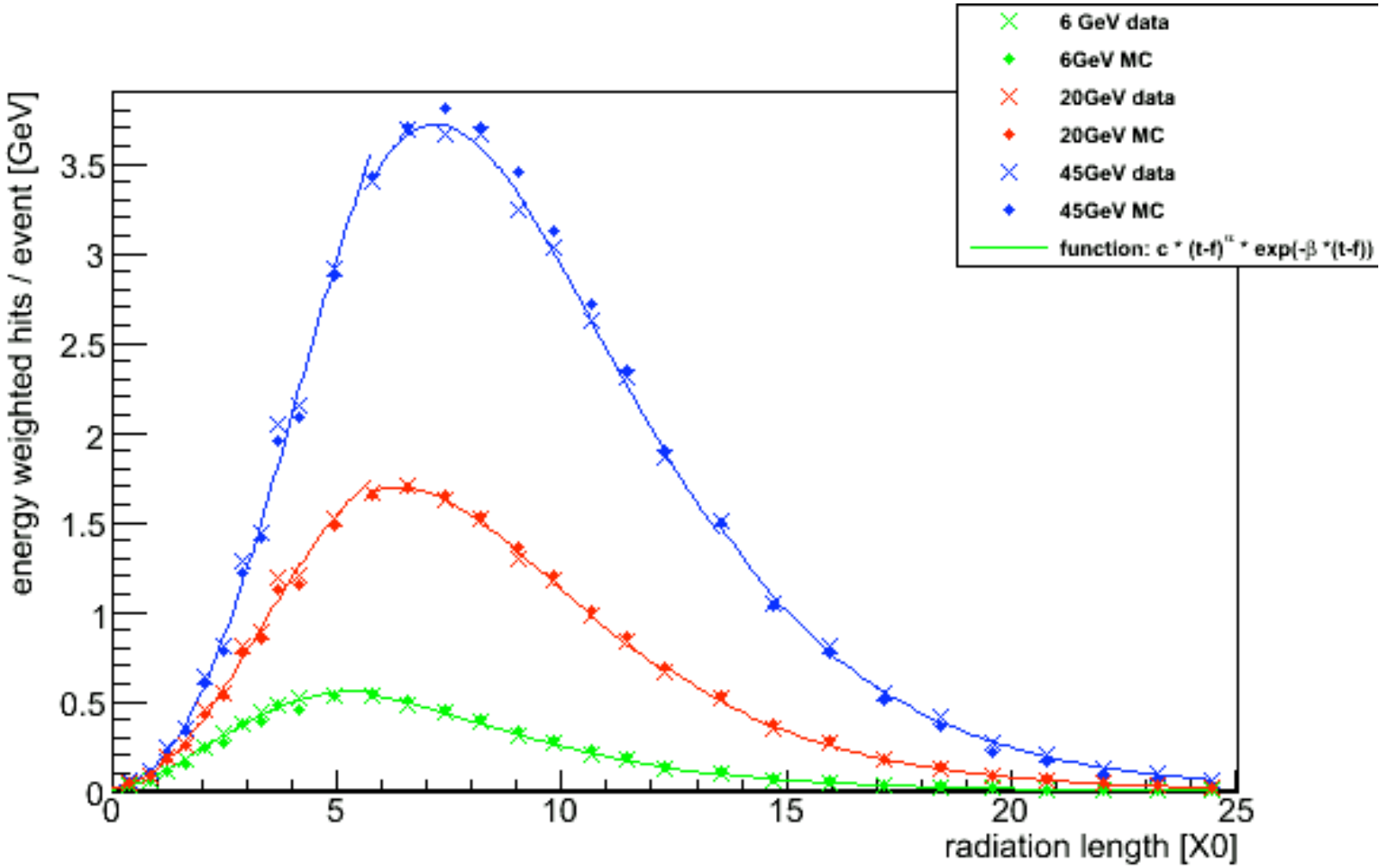
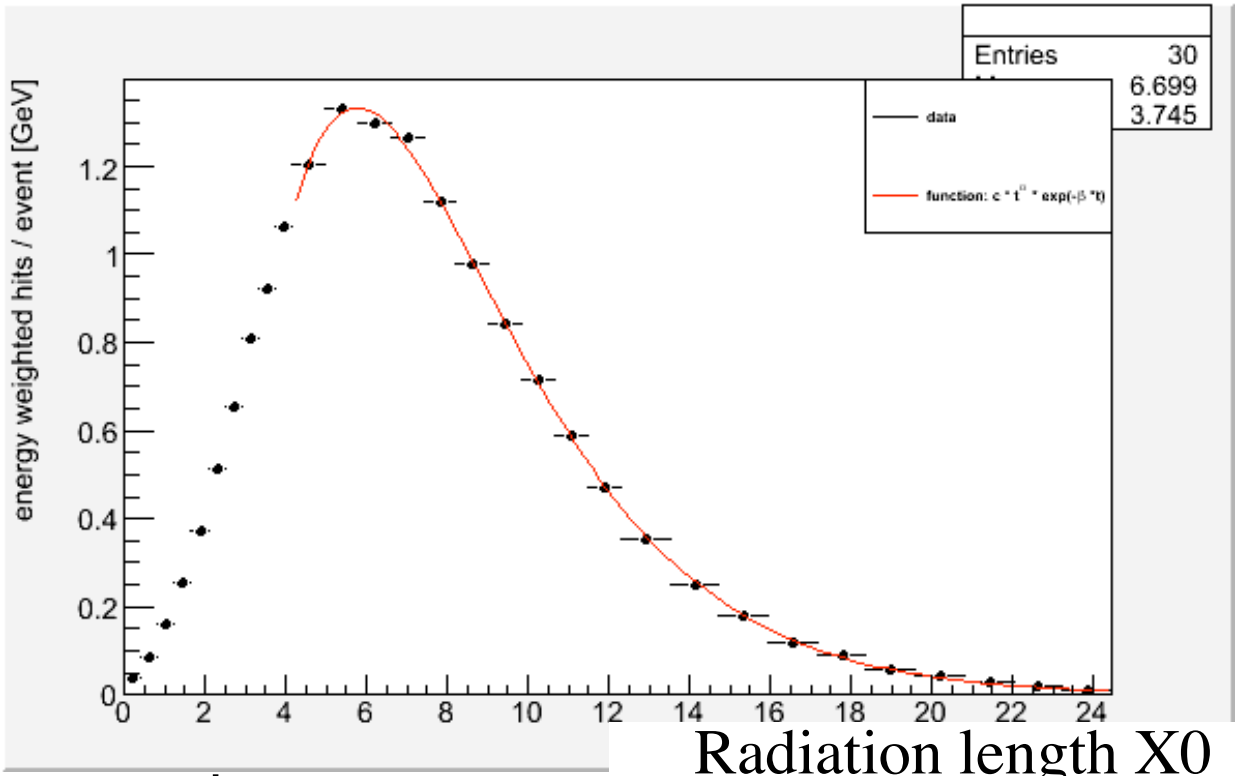
MC and data comparison



- still need to fit the whole curve in one plot, instead of regions
- used error estimate of TProfile to get a correct error handling

Fit to data

Shift calculated from fit to data and MC:
Const * (x-shift)^alpha * exp(-beta(x-shift)); beta=0.5



3 fits were done:

- 1 to fit all layers,
- 1 to fit the leakage energy correctly (shown above),
- 1 for the first layers

Error estimate

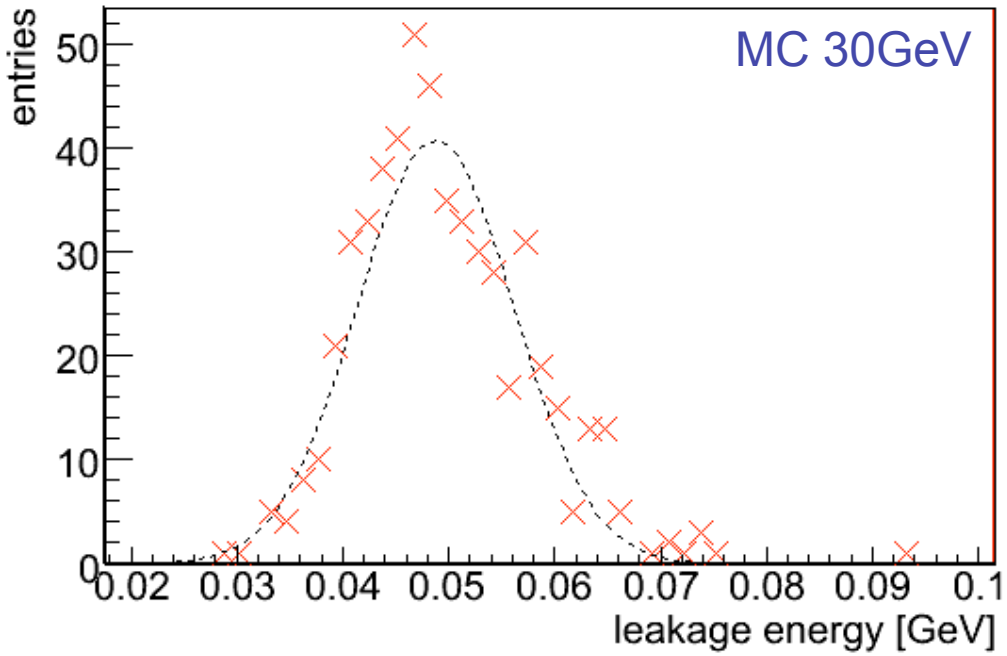
Method:

- split the sample into subsamples,
- fit each subsample,
- extract the interesting parameters like shower max, leakage energy,
- calculate the RMS for the parameters,
- get the error by dividing the RMS by the square root of the number of subsamples

Check:

- the method should be independent on the number of subsamples used within limits

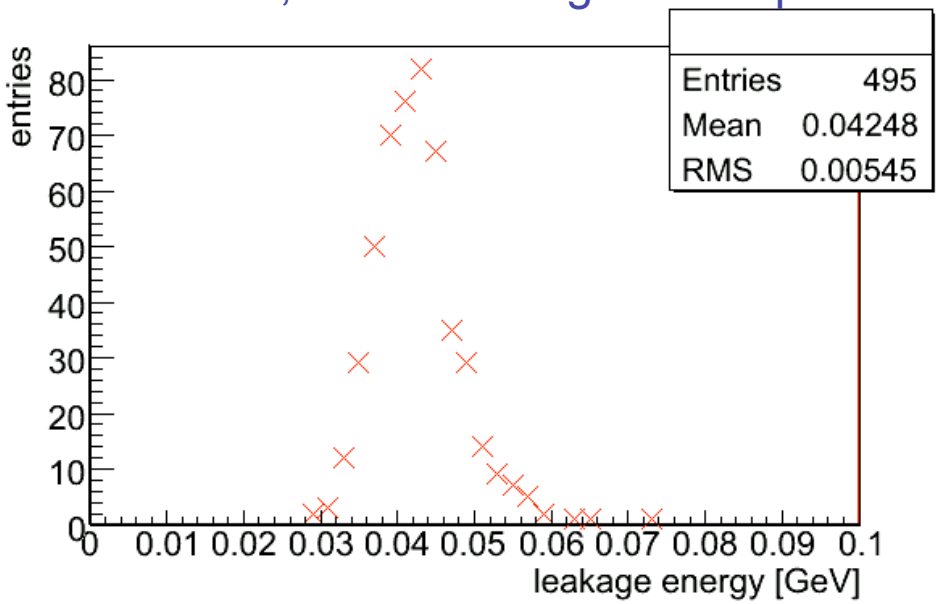
Error estimate



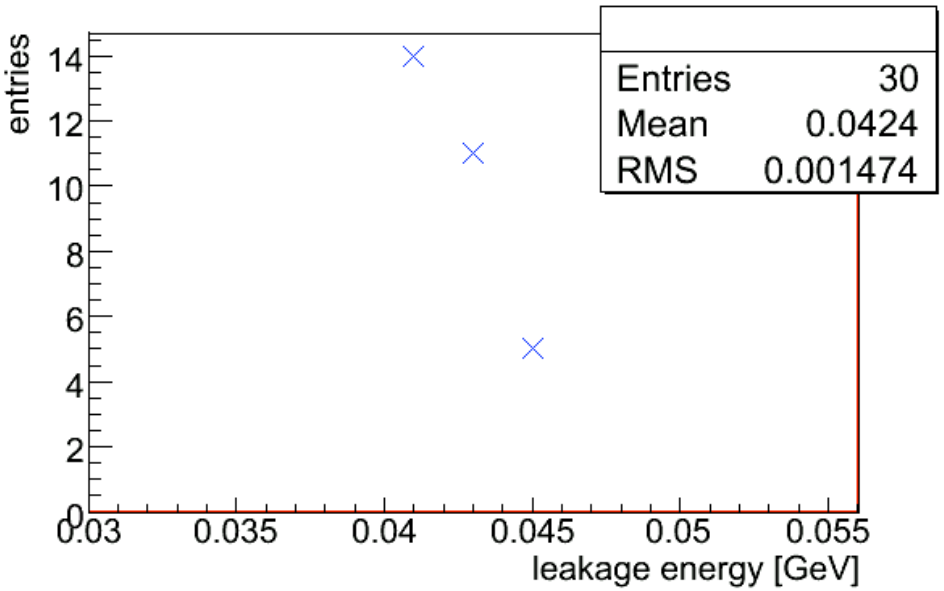
Leakage energy, shower max and X0 in front of Calo nearly gaussian

Error estimate

MC 30GeV, 100 event big subsamples

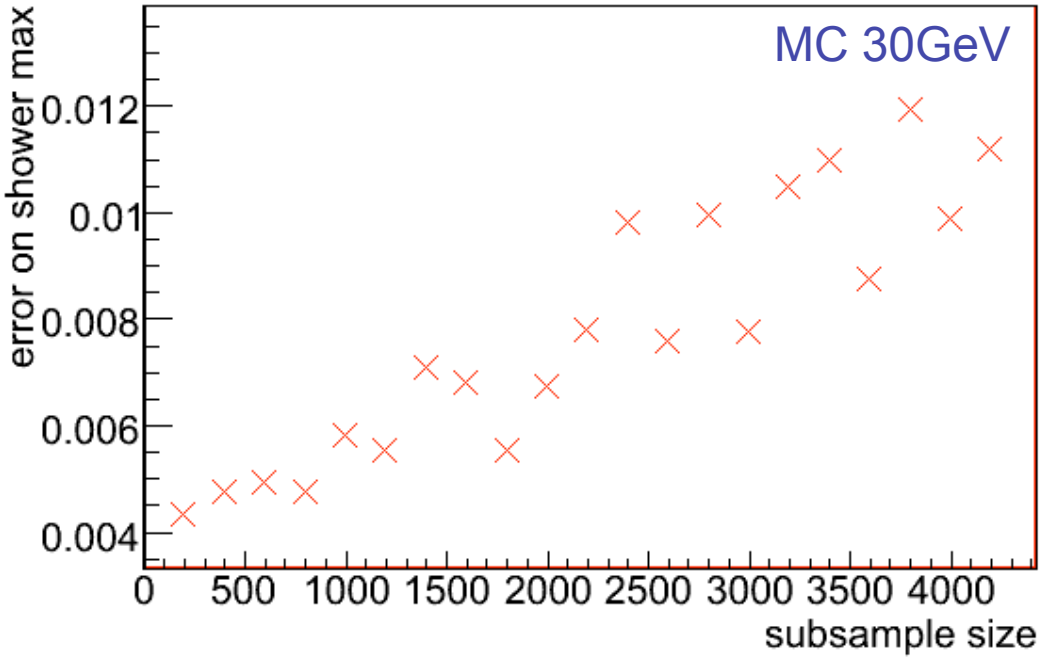


MC 30GeV, 4000 event big subsamples



Leakage energy, shower max and X0 in front of Calo nearly gaussian

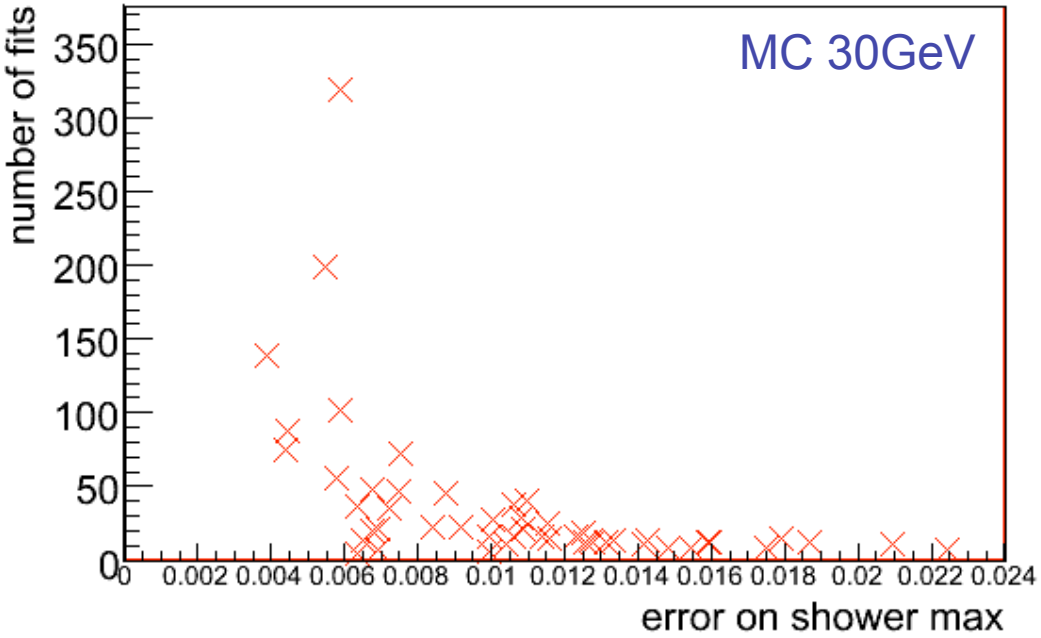
Error estimate



Problem: errors are not independent of subsample size

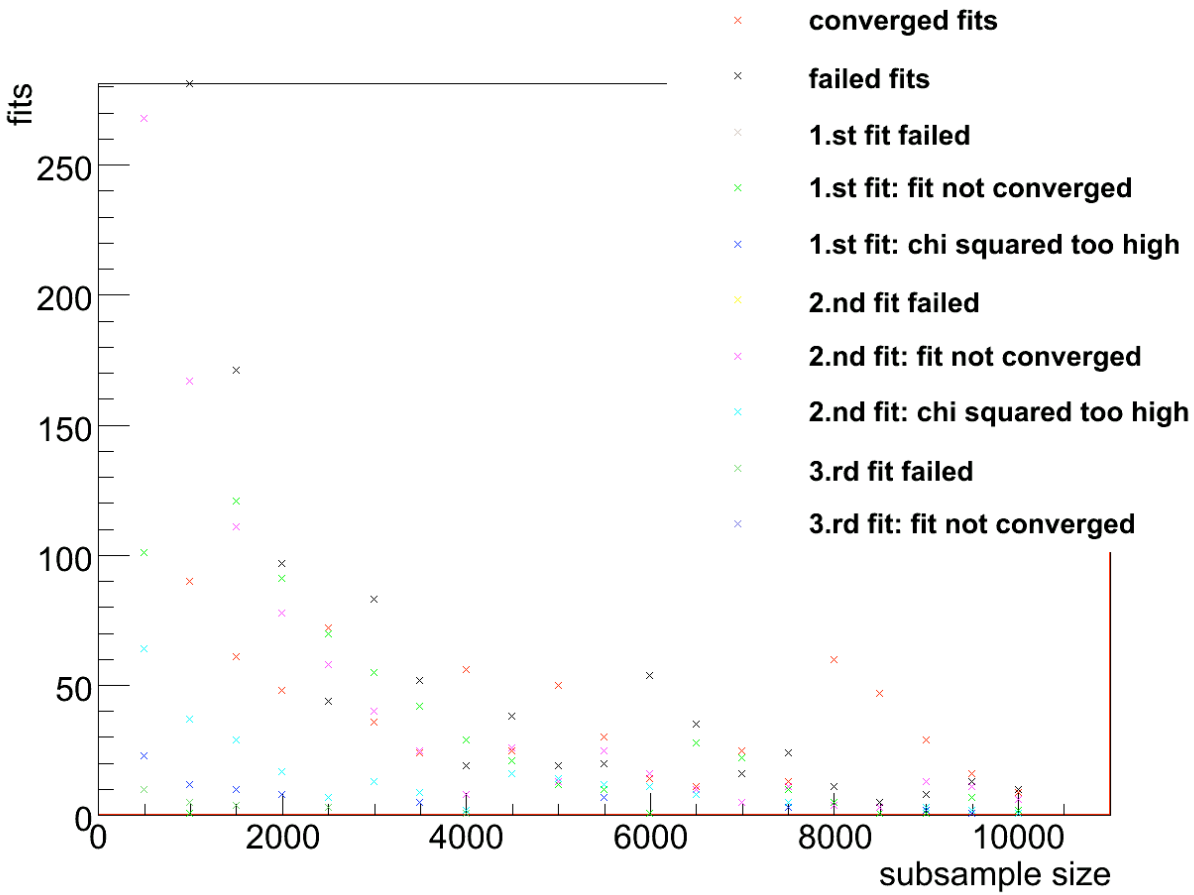
⇒Check if there is a dependency on the number of subsamples and the error estimate

Error estimate



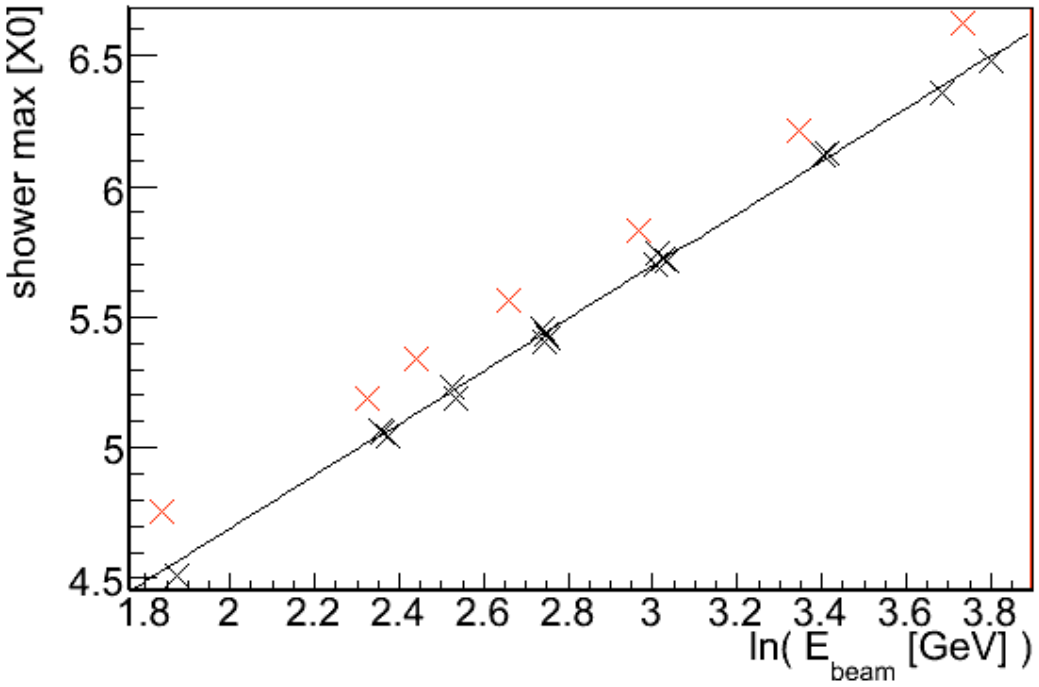
The error gets smaller the higher the number of fits considered until a constant error is reached
=> make sure to have at least 100 fits considered

Error estimate



some statistics on how many fits are failing and why, basically 50% of the fits are failing => too much, needs more work

Shower maximum

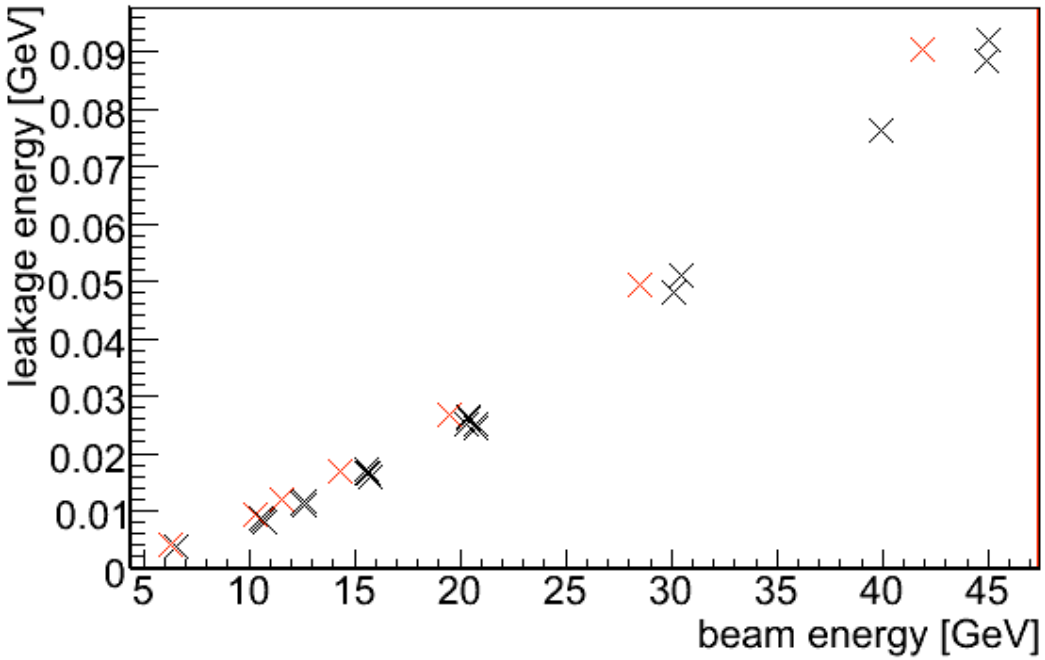


MC: red
data: black

Redo these
Plots, they
Are a bug

- red MC, black data
- well modelled, slight difference between MC and data

Leakage Energy



MC: red

data: black

Well behaved, but …

Leakage Energy, continued

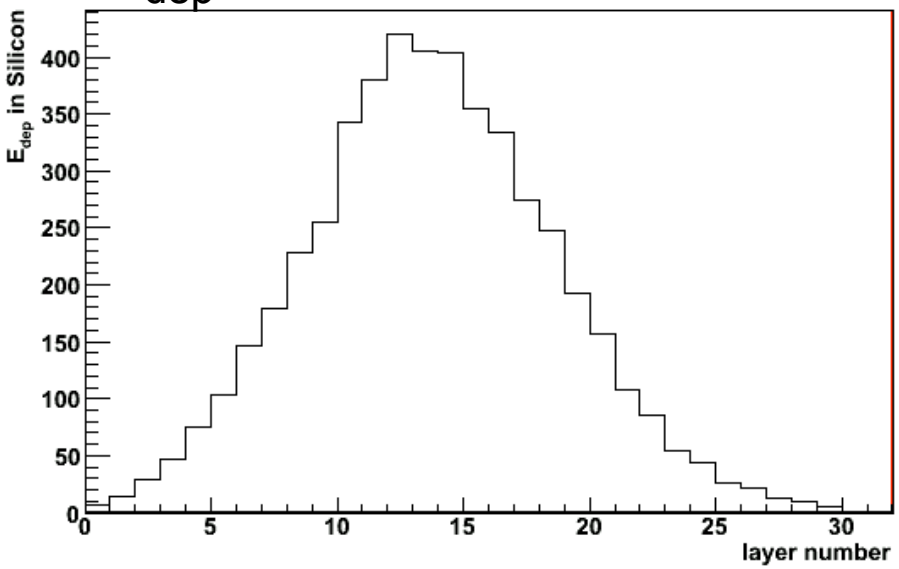
as e.g. described in Wigman's Calorimeter book
and in G. Graziani, ATL=LARG-2004-001, Linearity of the response for EM Barrel module P13

Sampling Fraction depends on X0
⇒Leakage energy estimate depends on correct modelling of the sampling fraction
⇒ created a MC sample with energy depositions in Si & W (thanks for G. Musat)
(still small errors in MOKKA, e.g. total energy deposited < beam energy)

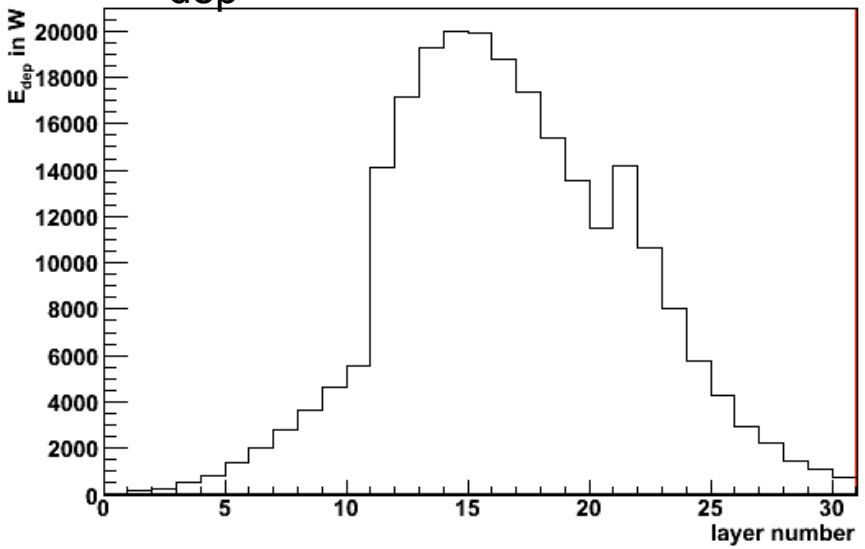
Effect is also seen for CALICE prototype

Leakage Energy, continued

E_{dep} in Si



E_{dep} in W

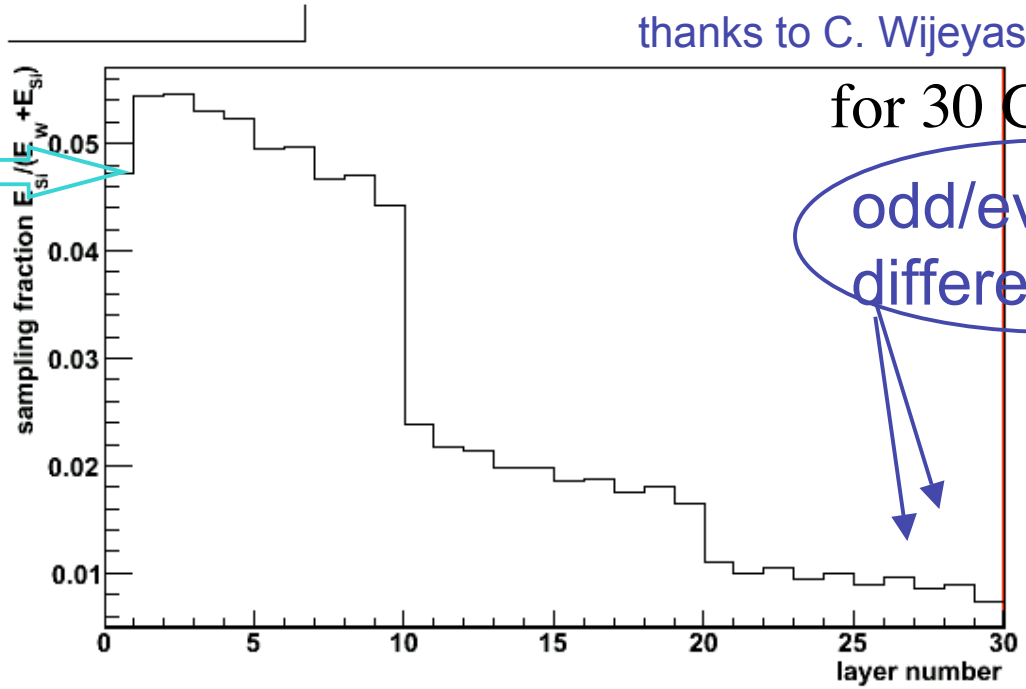


read out energy in silicon and tungsten from a MC sample to build the sampling fraction

Leakage energy, continued

Not clear what goes wrong in first layer

thanks to C. Wijeyasinghe



⇒ needs to be taken into account for leakage energy (difference for 30 GeV: 0.05GeV -> 0.03GeV)

⇒ the effect is energy dependent

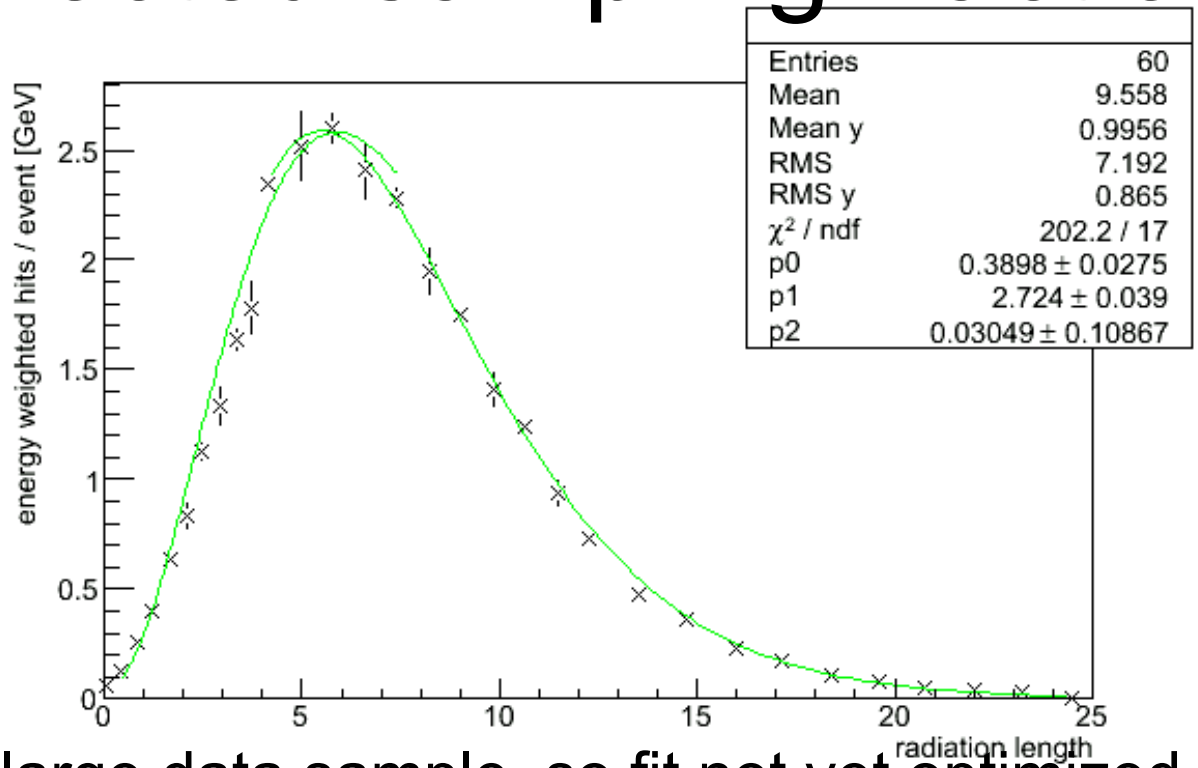
Leakage energy, continued

Energy accounted for:

- 30.00 GeV electrons simulated
- 26.63 GeV in tungsten
- 00.55 GeV in silicon
- 01.00 GeV in the other passive material
- ~0.10 GeV longitudinal leakage

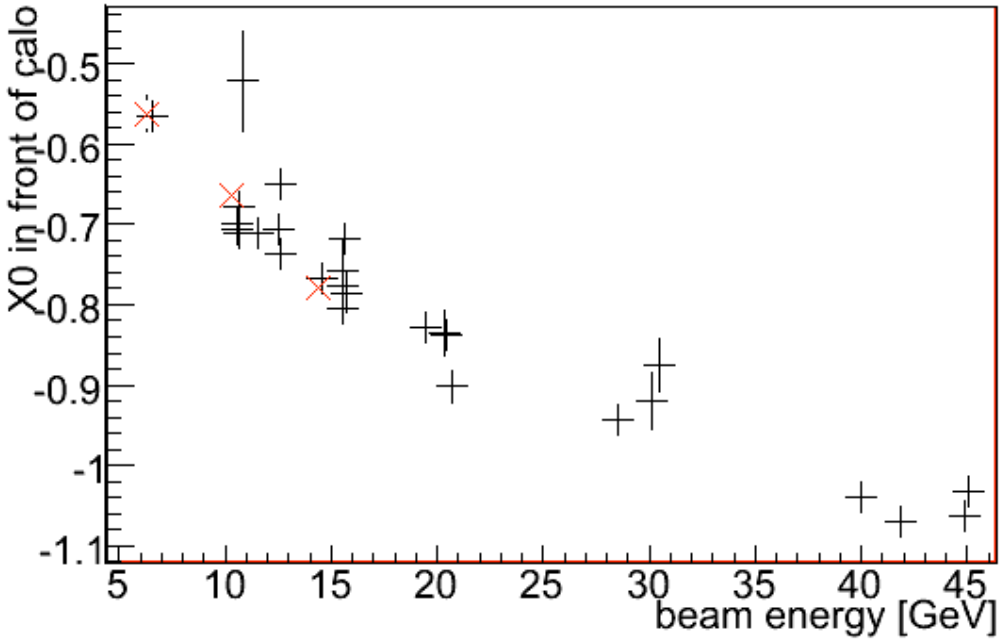
$\Rightarrow$ 28.28 GeV altogether deposited in the ECAL, where does the rest of the energy going to?

Leakage energy: corrected sampling fractions



- needed large data sample, so fit not yet optimized (done last minute)
- chi squared has improved a lot: 202/17 and 53/13
- odd / even layer correction not sufficient for long. profile

Open problem: “shift”



MC: red

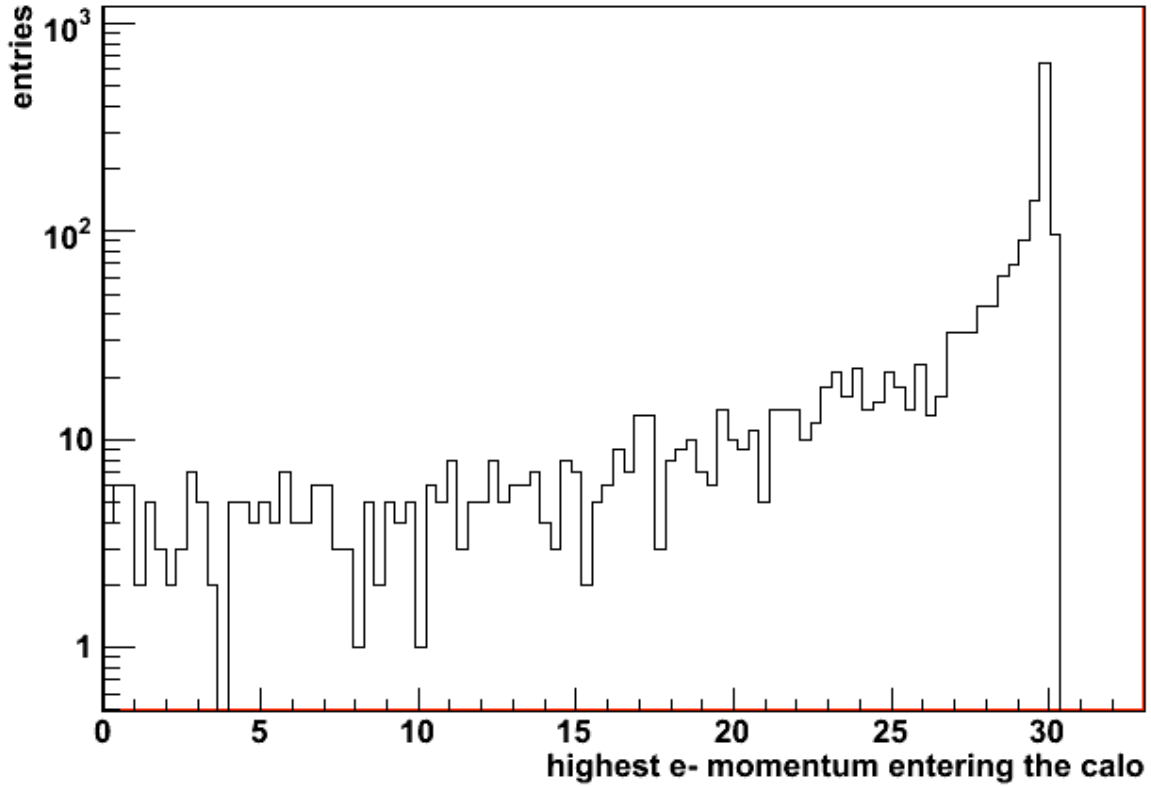
data: black

⇒ is the parameter “shift” depending on the momentum with which the electrons enter the calo?

“shift” parameter

• readout momentum of electron when entering the calorimeter
• can be done in the “fake layer” introduced in the testbeam simulation
• however needed to generate my private samples (official samples have not simulated the fake layer)

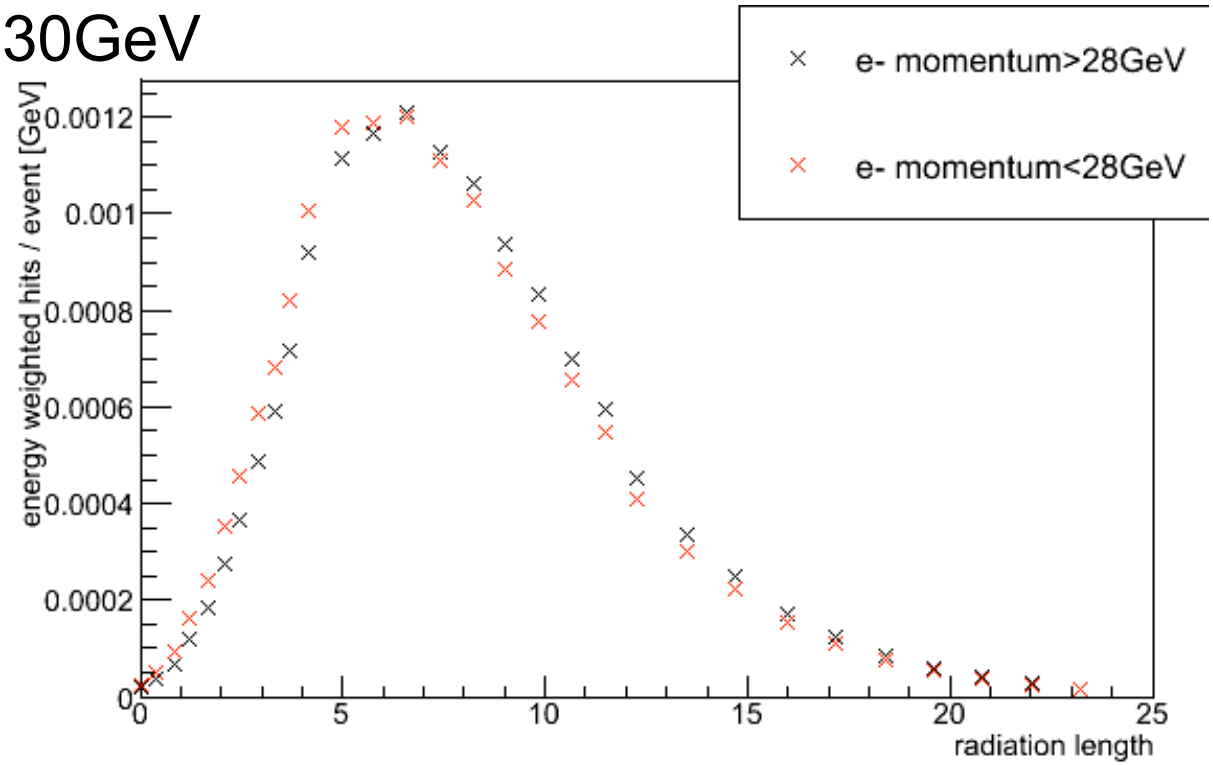
“shift” parameter



Energy distribution of electrons entering the ECAL
(only the electron with the highest momentum
has been considered)

“shift” parameter

energy: 30GeV



Shift parameter is depending on the momentum of the electron when entering the calorimeter

“shift” parameter

However:

- 30GeV MC sample:
  - (e-) > 28 GeV: shift = -1.14
  - (e-) < 28 GeV: shift = -0.87
- 6GeV MC sample:
  - (e-) > 5.5 GeV: shift = -0.61
  - (e-) < 5.5 GeV: shift = -0.45

$\Rightarrow$ Problem not solved by this study

MC production needed for my analysis

- readout of all material in the ECAL for 6 GeV, 10GeV, 15GeV, 20GeV, 30GeV, 45GeV
(can provide my drivers to do this)