Electromagnetic logitidinal shower development

Depth (in X_o)at which the shower has the maximum number of particles:

(e.g.: http://rkb.home.cern.ch/rkb/PH14pp/node58.html)

$t_{max} \approx \ln(E/\varepsilon) - c$ (with: $\varepsilon \cong 550$ MeV/Z $c \cong 1$ for electrons ($Z_{Pb} = 82$))

Shower depth for 95% lognitudinal containment:

$T_{95}[X_o] \approx t_{max} + 0.08 \cdot Z + 9.6$

Parametrization for average differential longitudinal energy deposit:

$DE = k \cdot t^{(a-1)} \cdot e^{-bt} \cdot dt$ (with: $k = E\, b^a / \Gamma(a)$)

Integrate this up to some depth t' :

$$E_{t'} = E \int_0^{\tau'} \frac{\tau^{a-1} e^{-\tau}}{\Gamma(a)} d\tau = E \cdot GAMDIS(\tau', a) \quad (\text{with: } \tau = bt)$$

CERN Library function

Differentiate DE and set to zero (for shower maximum):

$\Rightarrow t_{max} = (a-1) / b$

Looked at ntuples of different energies and additional X_0 in front.

Fit for a and b and see whether they follow a logarithmic energy dependence

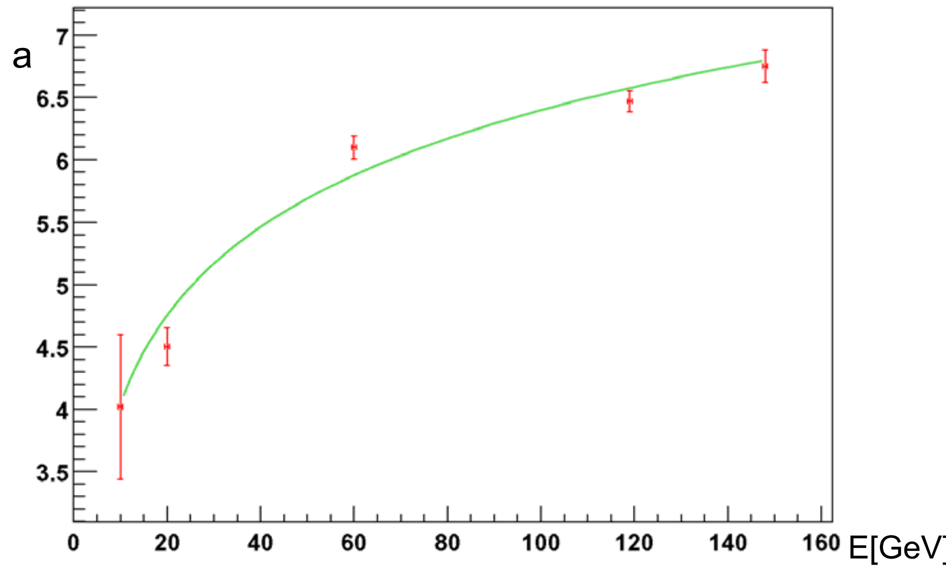
Compare : $tmax = (a-1)/b$ with tmax theory : $tmax \approx \ln (E / \varepsilon) - c$

Fit for a,b : All energies, all X_0,
for 5 possibilities of x0junk: (1.8, 1.9, 2.0, 2.1, 2.2)
and then form the average over the results for a and b.

a vs E

$a = a_1 + a_2 \ln E$

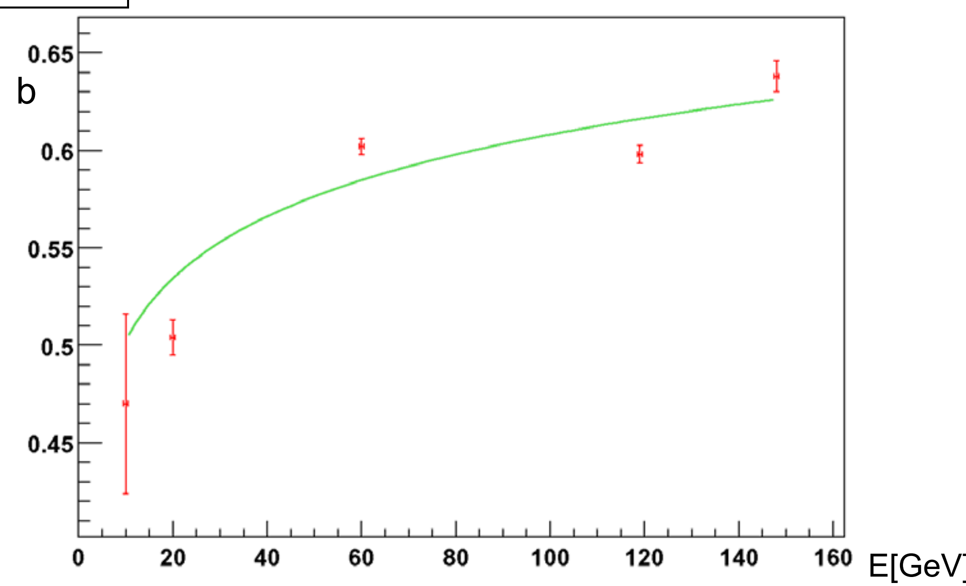
$a_1 = 1.68 \pm 0.36$
$a_2 = 1.02 \pm 0.08$



b vs E

$b = b_1 + b_2 \ln E$

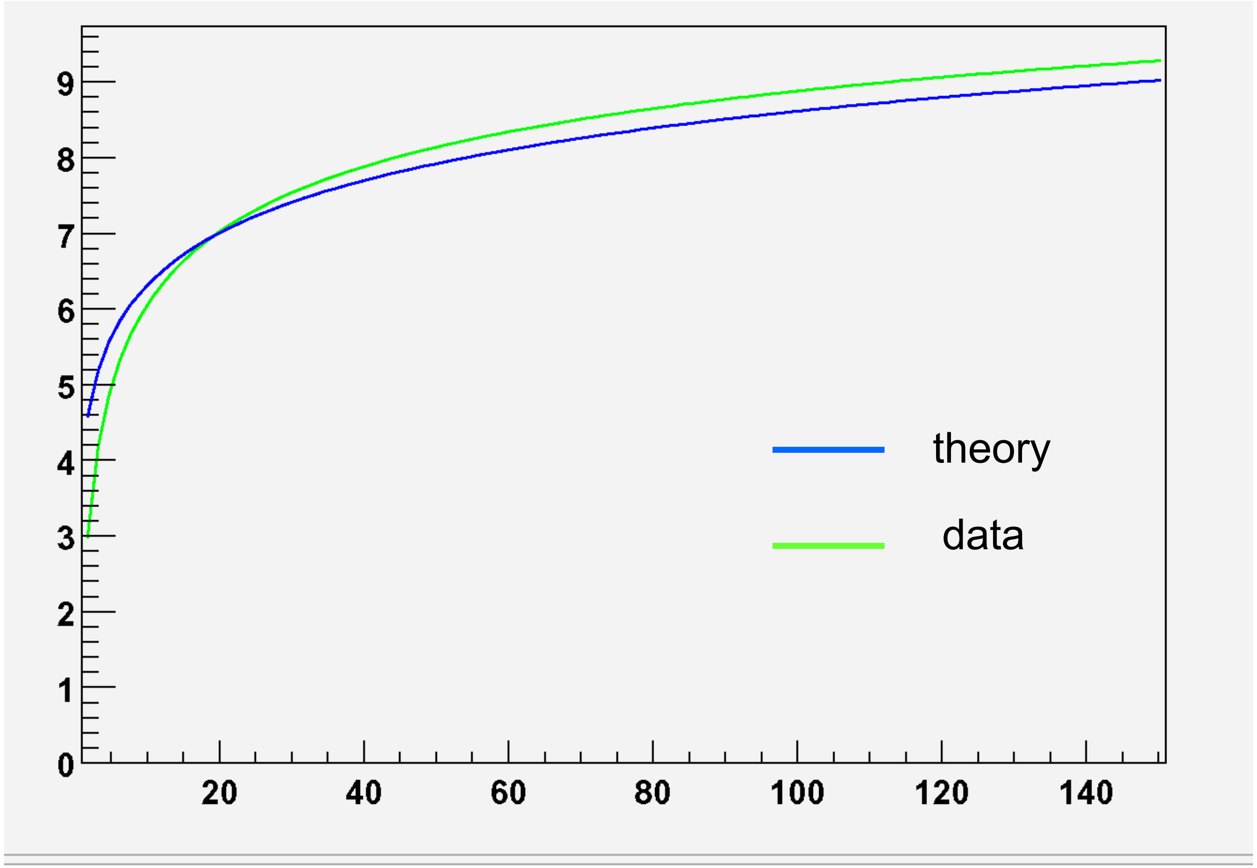
$b_1 = 0.397 \pm 0.46$
$b_2 = 0.002 \pm 0.05$



Depth of shower maximum

Data : tmax = (a-1)/b with a and b from fits as a function of energy

Theory : tmax ≈ ln (E / ε) - c



Next on the list:

Working on making better use of the PS now

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