CAL shower study with BT data

Nicola Mazziotta

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mazziotta@ba.infn.it

EM shower profile study

- **The EM shower has been studied both in the CAL, by means of the fraction of the energy deposited in the CAL layers**
  - **Cal Layer N Ene Fraction** $= CalELayerN \Big/ \sum_{N} CalELayerN$
- **The CAL has been used as standalone detector, i.e. no geometrical cuts have been imposed**
  - **Cuts:**
    - **At least one track**
    - **Last layer in the track == Layer 0 (Tkr1LastLayer == 0)**
    - **GTCC Fifo is not full (EventGtccFifo==0)**
    - **CalRawEnergy >300 to reject pion like events in the SPS runs, since no Cherenkov counters have been used to tag electrons**
    - **a cut in CAL Total Raw Energy has been imposed to reject double particles**

EM shower profile study (cont'd)

- For each beam momentum, runs with different tilted angle, θ, (0°, 10°, 20° and 30°) have been merged to reconstruct the longitudinal shower profile
- The fraction of radiation length in each CAL layers is evaluated by taking into account the tilted angle and the TKR radiation length (RL):
- Cal Layer N RL Fraction= t =

$$\left(t_{TKR} + N * \Delta z \,/\, RL_{CsI}\right) / Cos(\theta)$$

- Where:
  - t_{TKR} = 1.4
  - Δz = 1.99 cm, CsI layer thickness
  - RLCsI = 1.86 cm, CsI radiation length

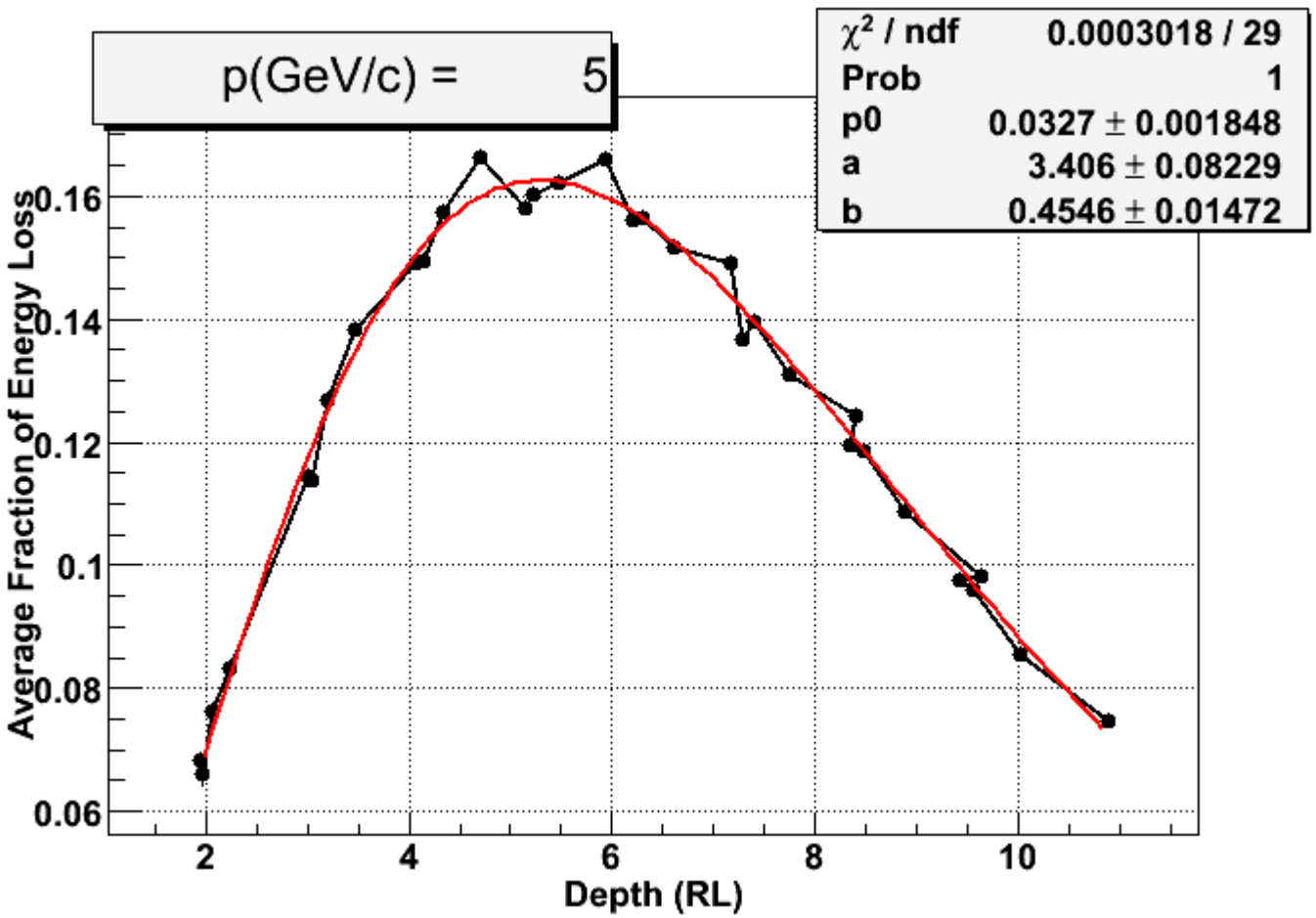
EM shower profile study (cont'd)

- The average longitudinal profile has been fitted with the gamma distribution (p0, a and b are the fitted parameters)

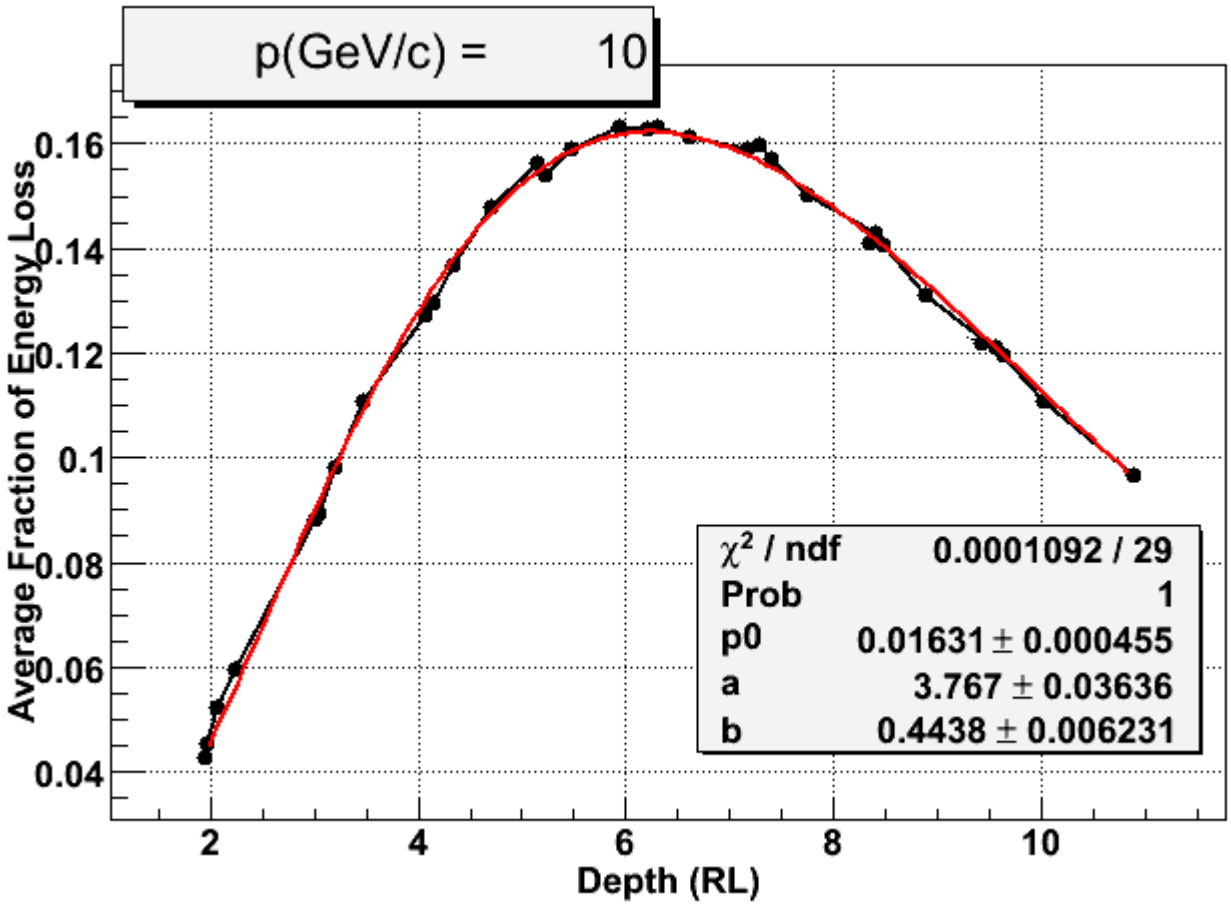
$$f(t) = p_0 t^{a-1} exp(-bt)$$

- The maximum of the shower tmax and the critical energy Ec have been evaluated

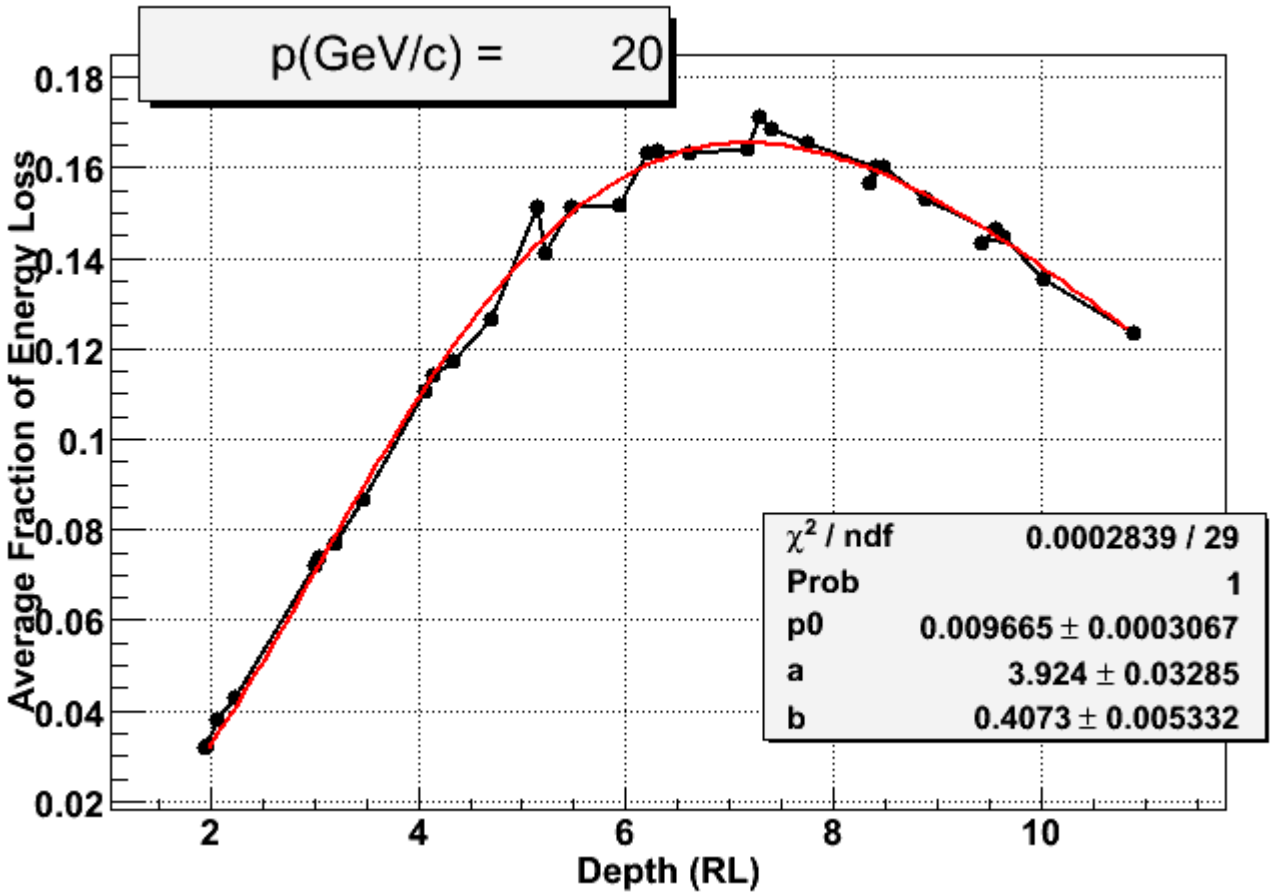
p = 5 GeV/c


p(GeV/c) = 5
χ^2 / ndf 0.0003018 / 29
Prob 1
p0 0.0327 ± 0.001848
a 3.406 ± 0.08229
b 0.4546 ± 0.01472
Average Fraction of Energy Loss
0.16
0.14
0.12
0.1
0.08
0.06
2
4
6
8
10
Depth (RL)

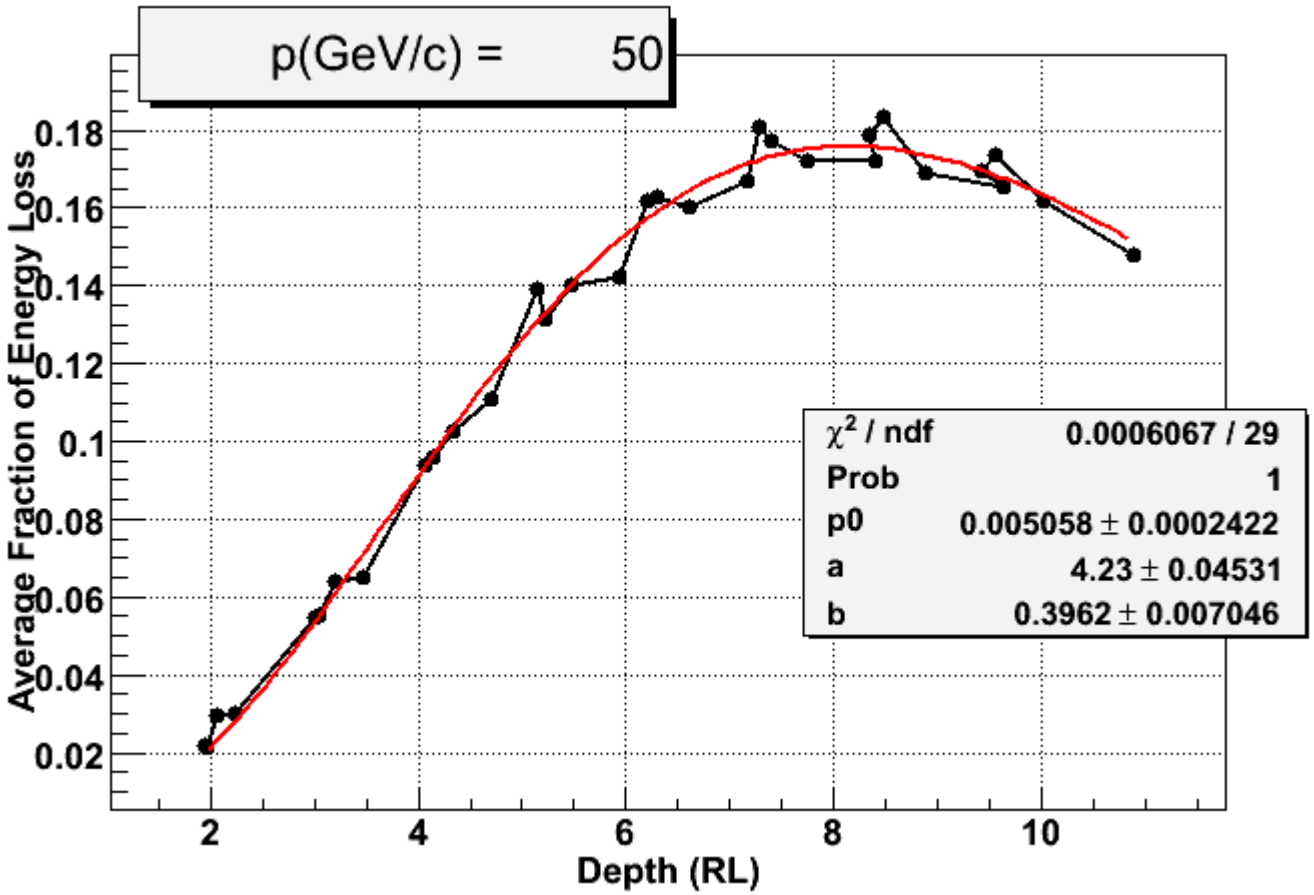
p = 10 GeV/c


p(GeV/c) = 10
Average Fraction of Energy Loss
0.16
0.14
0.12
0.1
0.08
0.06
0.04
2
4
6
8
10
Depth (RL)
χ² / ndf 0.0001092 / 29
Prob 1
p0 0.01631 ± 0.000455
a 3.767 ± 0.03636
b 0.4438 ± 0.006231

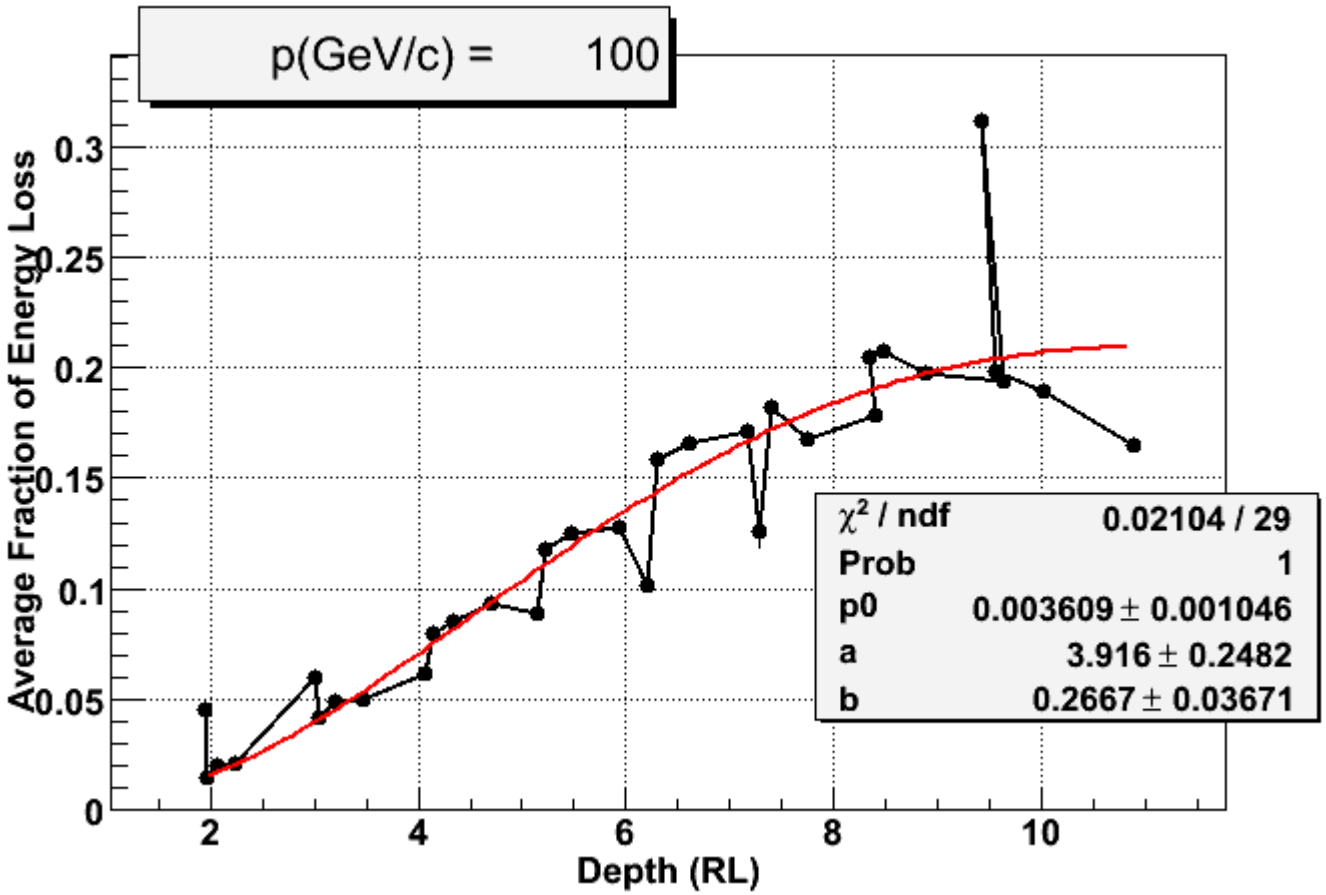
p = 20 GeV/c


p(GeV/c) = 20
Average Fraction of Energy Loss
Depth (RL)
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
2
4
6
8
10
χ² / ndf 0.0002839 / 29
Prob 1
p0 0.009665 ± 0.0003067
a 3.924 ± 0.03285
b 0.4073 ± 0.005332

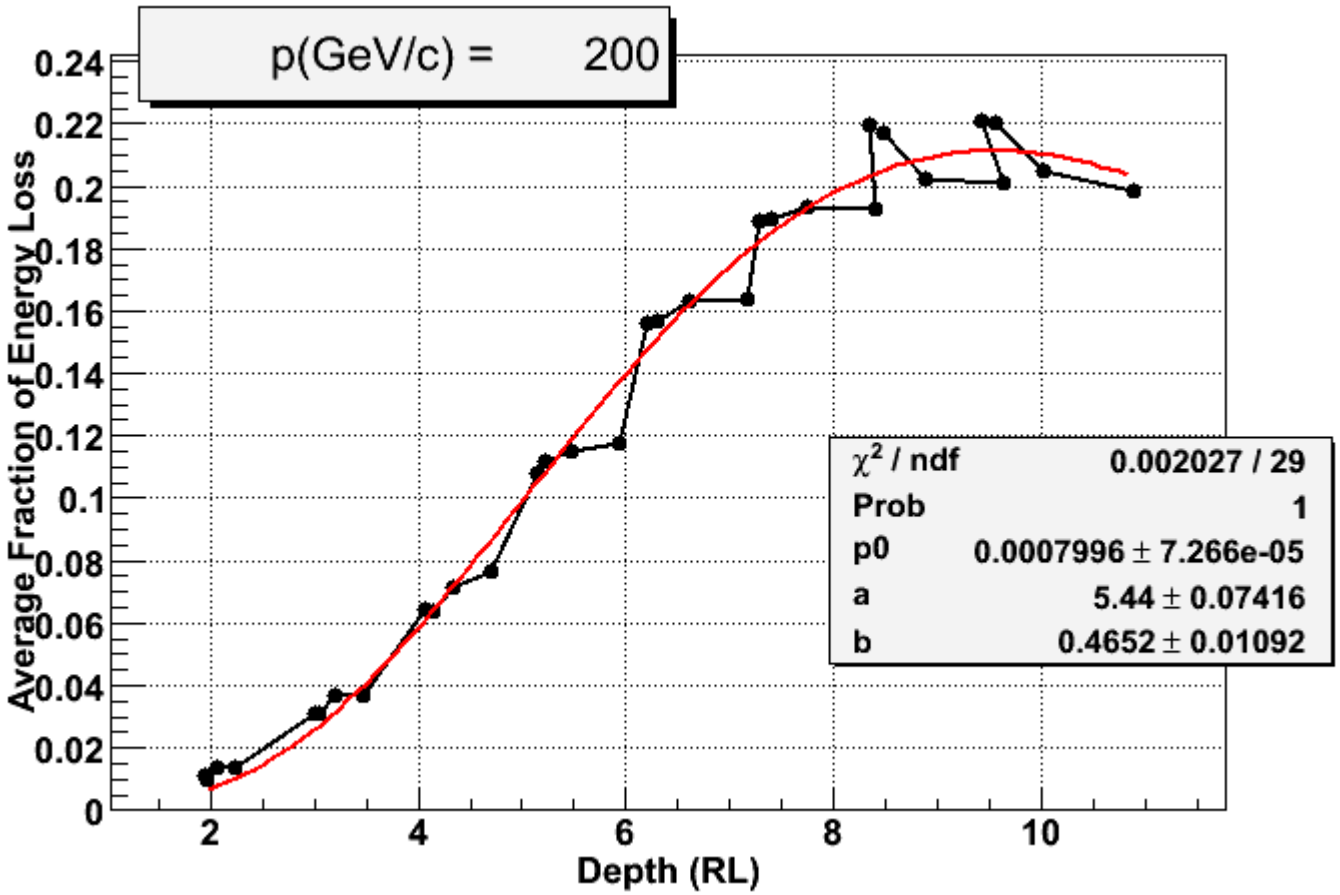
p = 50 GeV/c


p(GeV/c) = 50
Average Fraction of Energy Loss
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
2
4
6
8
10
Depth (RL)
χ² / ndf 0.0006067 / 29
Prob 1
p0 0.005058 ± 0.0002422
a 4.23 ± 0.04531
b 0.3962 ± 0.007046

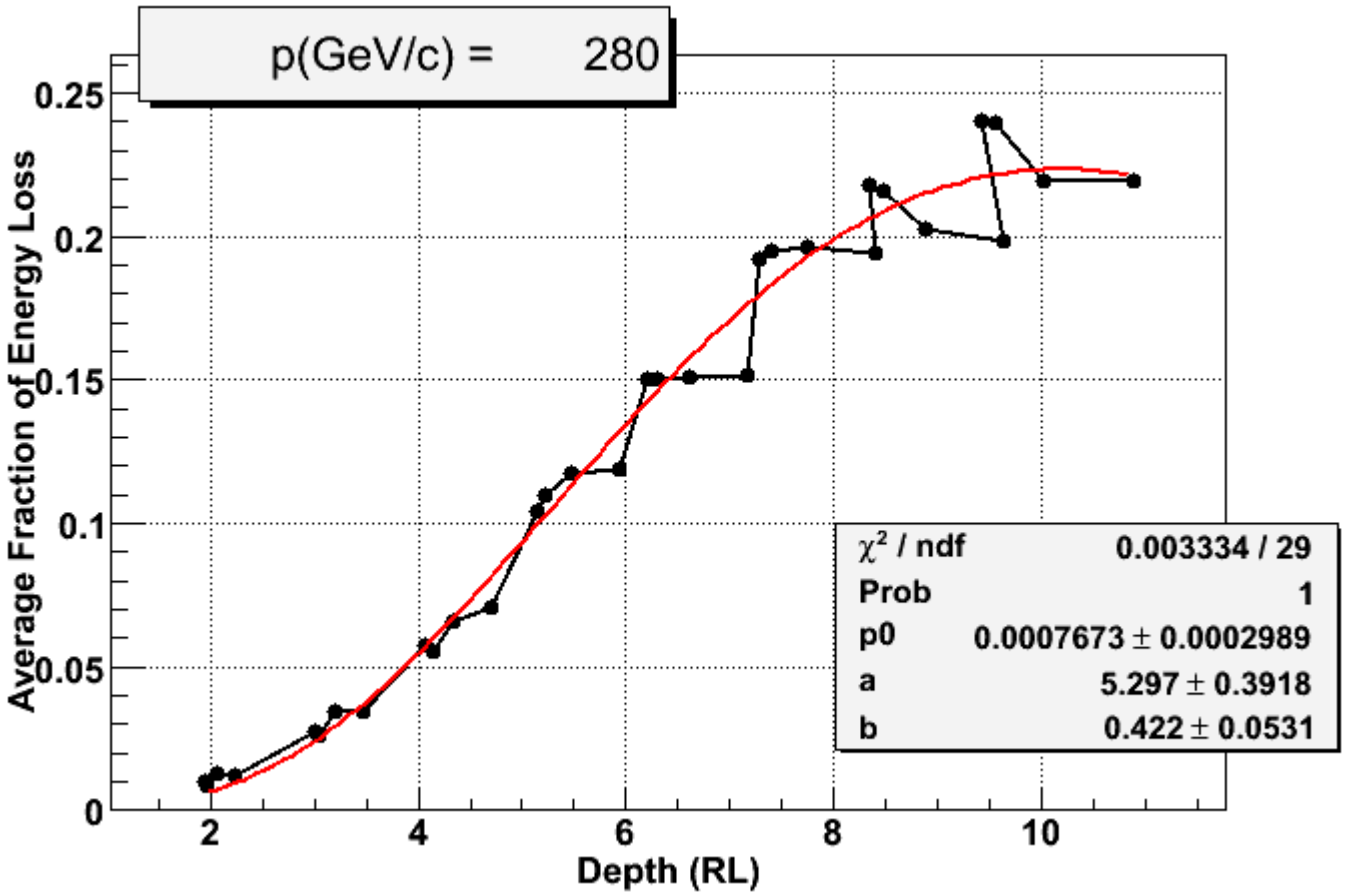
p = 100 GeV/c


p(GeV/c) = 100
Average Fraction of Energy Loss
0
0.05
0.1
0.15
0.2
0.25
0.3
2
4
6
8
10
Depth (RL)
χ² / ndf 0.02104 / 29
Prob 1
p0 0.003609 ± 0.001046
a 3.916 ± 0.2482
b 0.2667 ± 0.03671

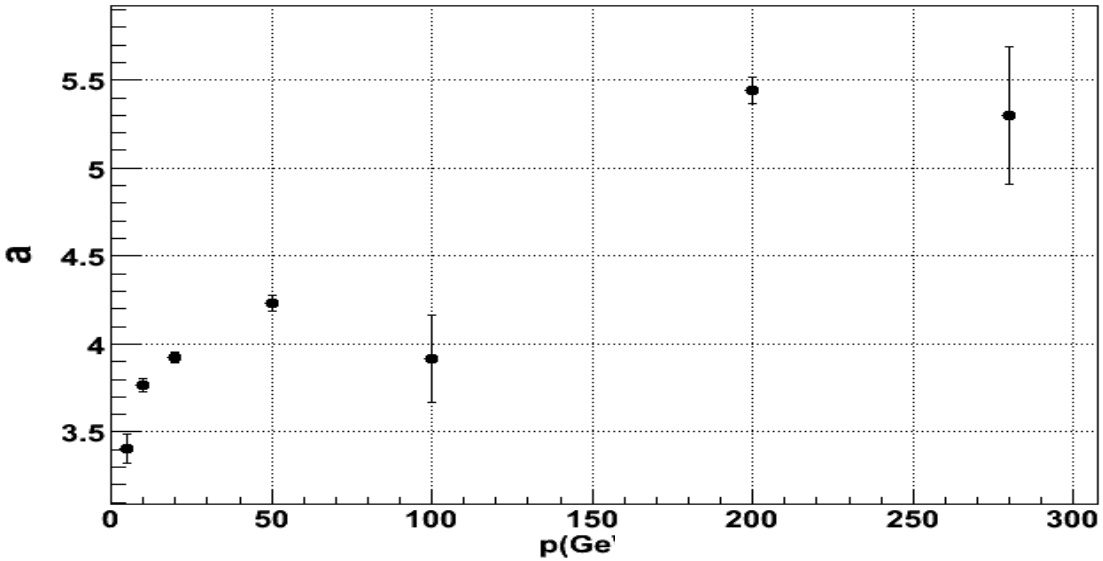
p = 200 GeV/c

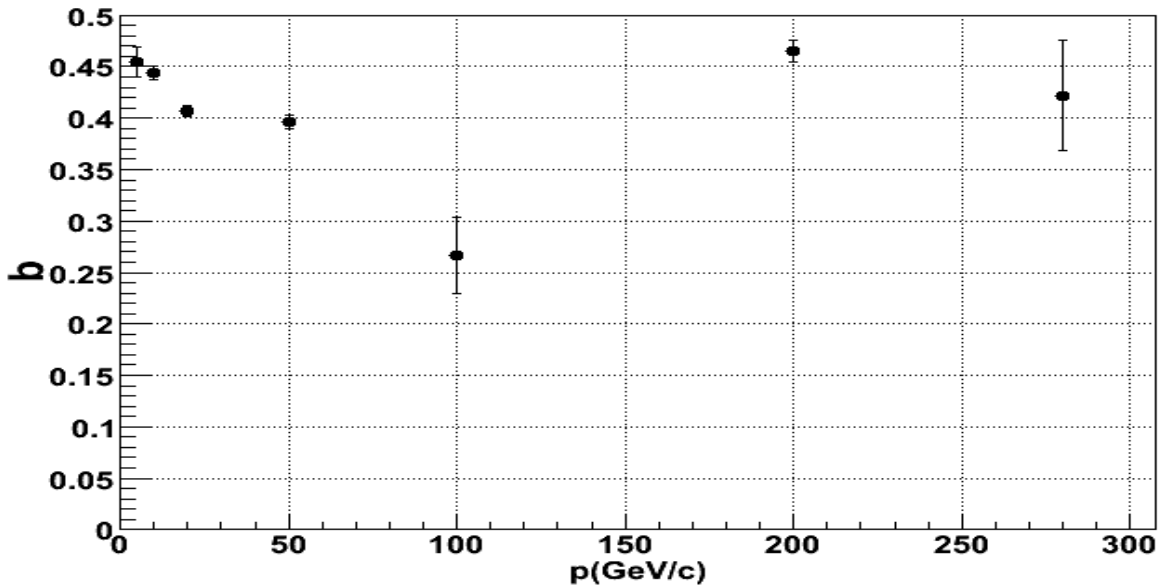

p(GeV/c) = 200
Average Fraction of Energy Loss
Depth (RL)
0.24
0.22
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
2
4
6
8
10
χ² / ndf 0.002027 / 29
Prob 1
p0 0.0007996 ± 7.266e-05
a 5.44 ± 0.07416
b 0.4652 ± 0.01092

p = 280 GeV/c

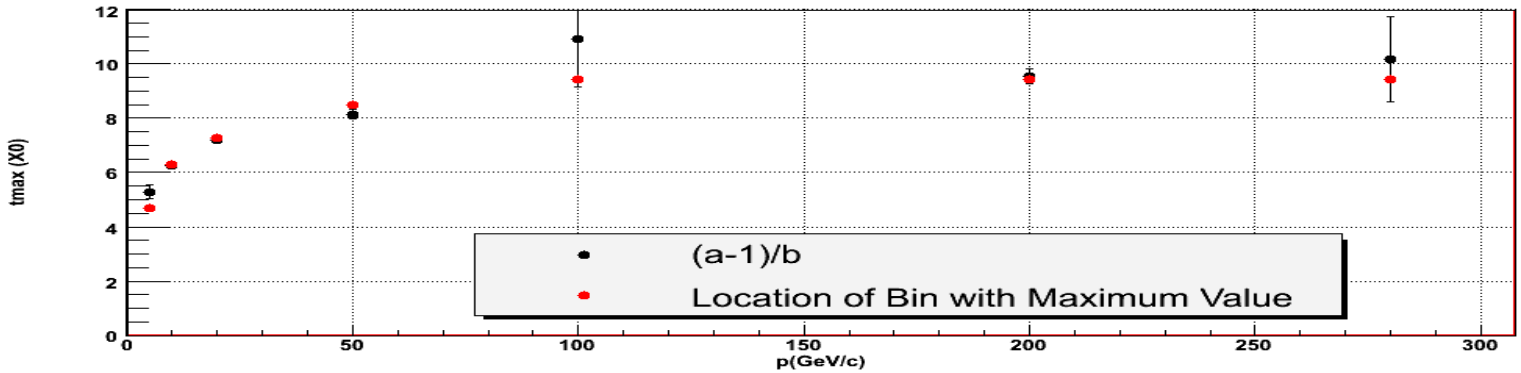

p(GeV/c) = 280
Average Fraction of Energy Loss
Depth (RL)
0
0.05
0.1
0.15
0.2
0.25
2
4
6
8
10
χ² / ndf 0.003334 / 29
Prob 1
p0 0.0007673 ± 0.0002989
a 5.297 ± 0.3918
b 0.422 ± 0.0531

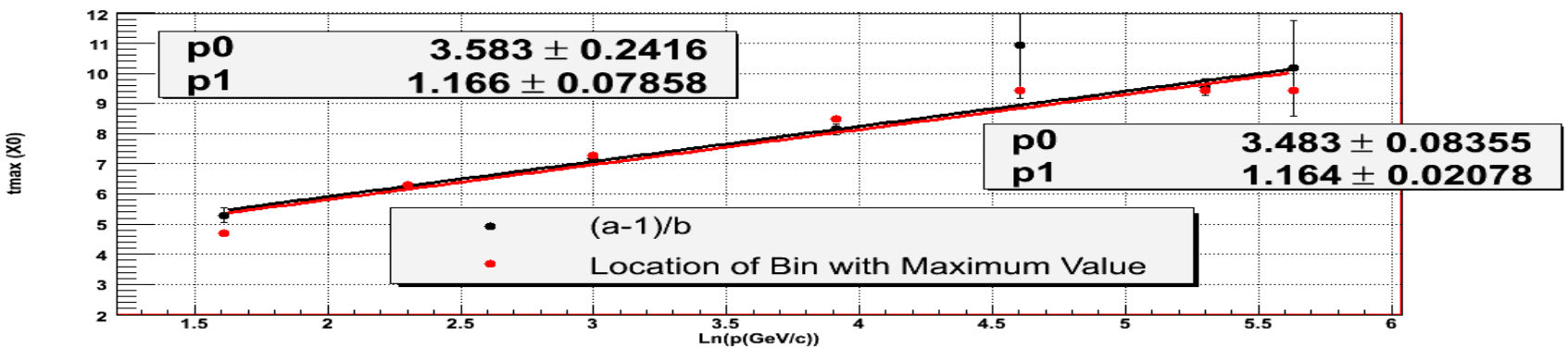
a and b value from best-fit





T max



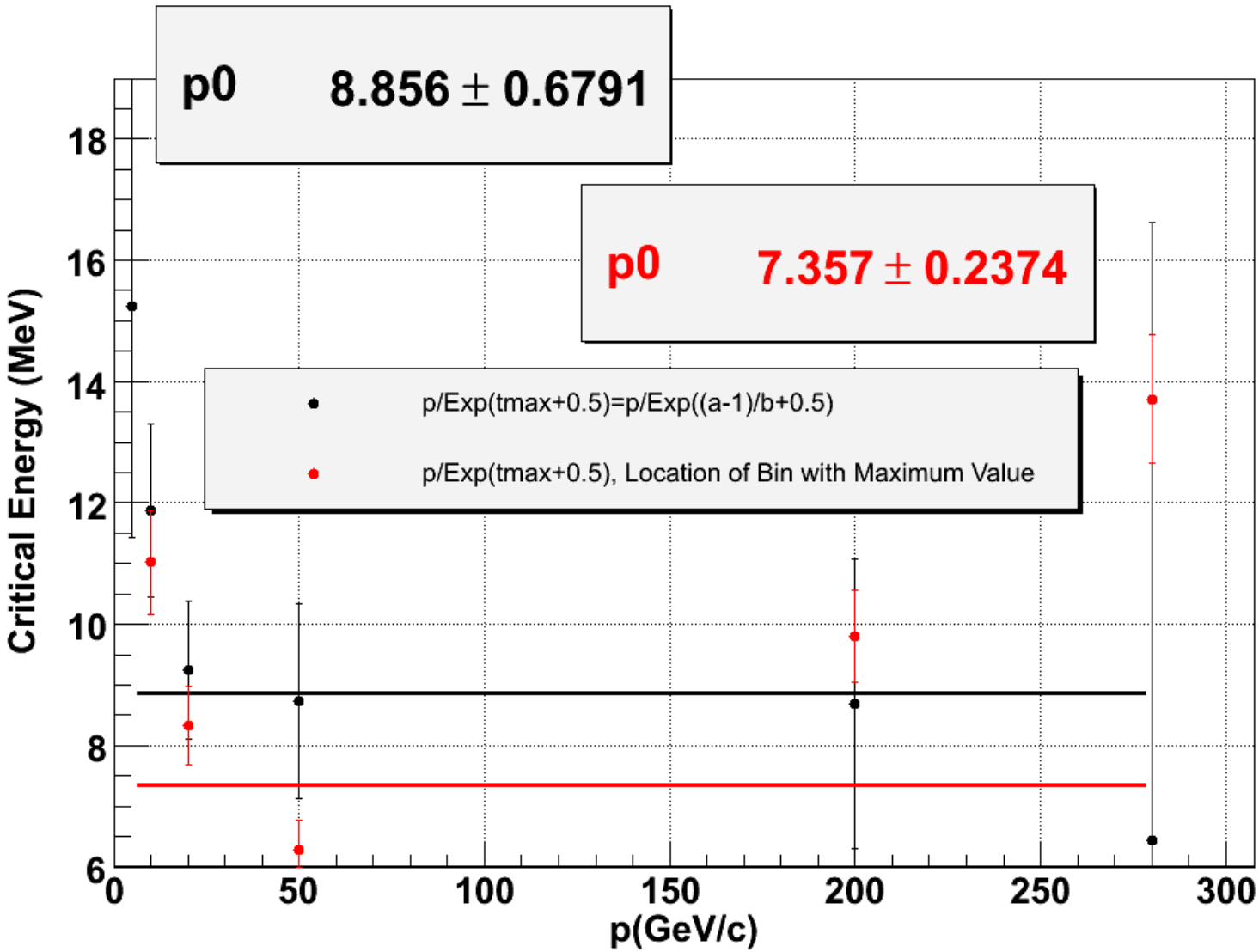


Tmax increases with ln(E), tmax=p0+p1*ln(E)

Tmax = ln(E/Ec)+Ce, where Ce=-0.5

Ec=exp(Ce-p0) ➔ Ec=16.85 MeV (18.63 MeV)

Critical energy



Conclusions

- The analysis is still in progress
- The evaluation of the CaI depth in radiation length needs to be reviewed by using the real geometry
- A method to merge the TKR hits in the shower profile is being to be completed