FLUKA implementation in AliRoot

P. Christiansen, A. Ferrari, M. Kowalski, A. Morsch

1. Origin of the problem – ionzation model for the TPC
2. New features of FLUKA and TFluka
3. Fluka vs. Geant3
4. Validation with the PS data

Ionization model for the TPC

Tracking step is limited to the distance to the next primary ionization

In GEANT3 it is controlled by the STEMAX parameter, which is recalculated after each step

This was NOT a case in FLUKA. Moreover, FLUKA didn’t work properly with very short steps (studies by A. Morsch)

New features of Fluka and TFluka

Request to Alfredo to provide number of primary electrons for each step

We got more:

- number of primary electrons per step
- their positions
- their kinetic energy

Andreas implemented the substepping, so the user does not see any difference between stepping in GEANT and FLUKA.
The only difference is in secondary electrons creation.

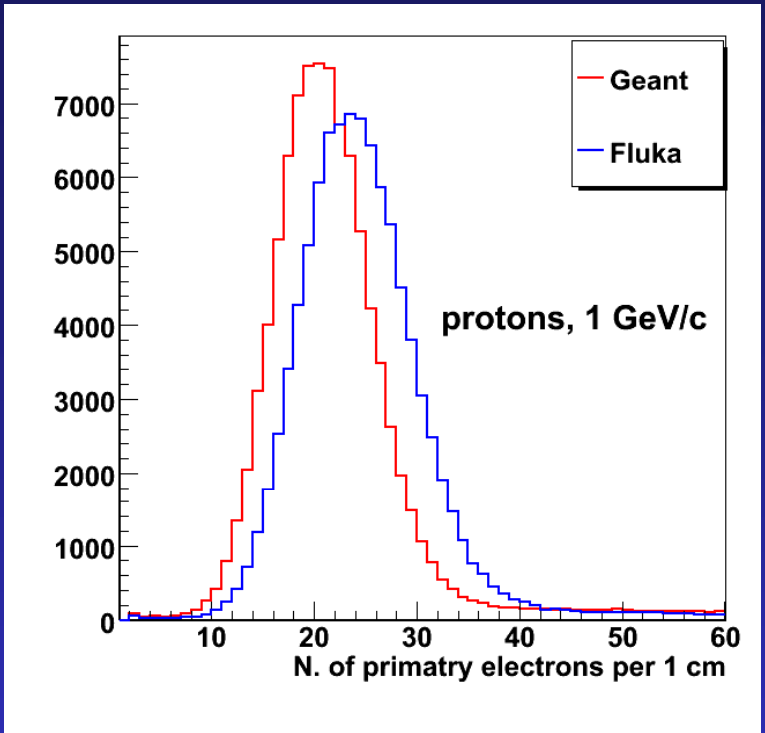
$$N_{\mathrm{sec}} = \frac{E_{dep} - I_{pot}}{w_i}$$

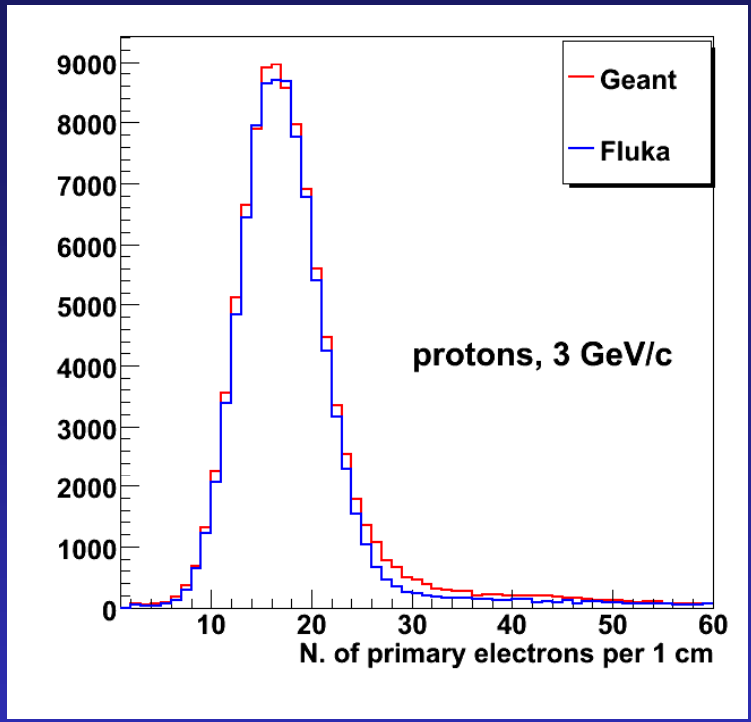
Geant

$$N_{\mathrm{sec}} = \frac{E_{kin}}{\tilde{w}_i}$$

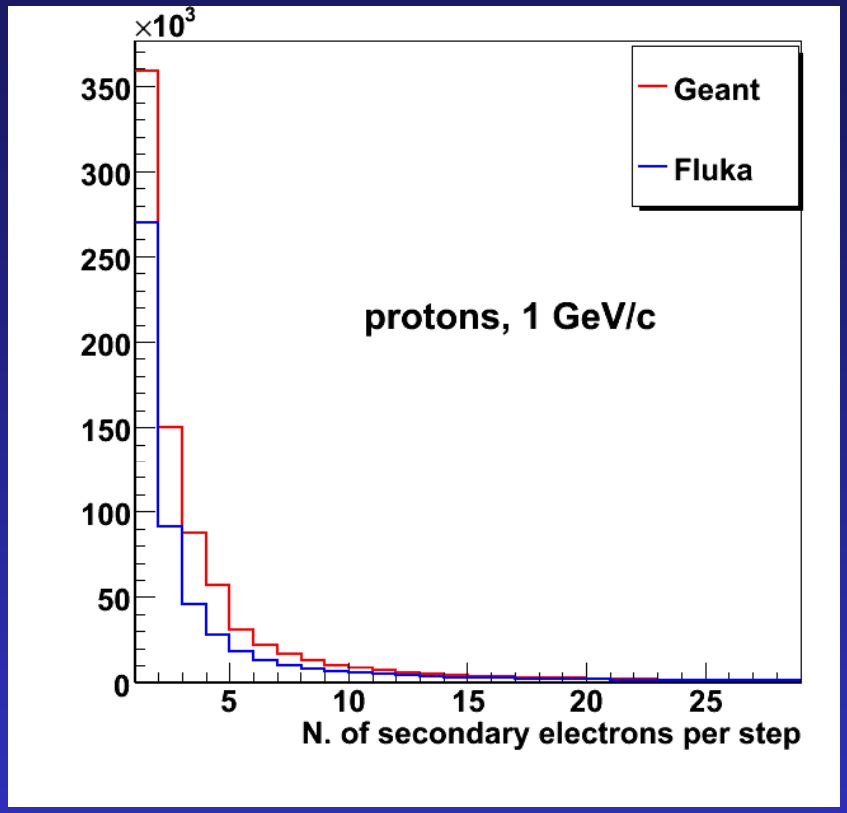
$$\tilde{w}_i > I_{pot}$$

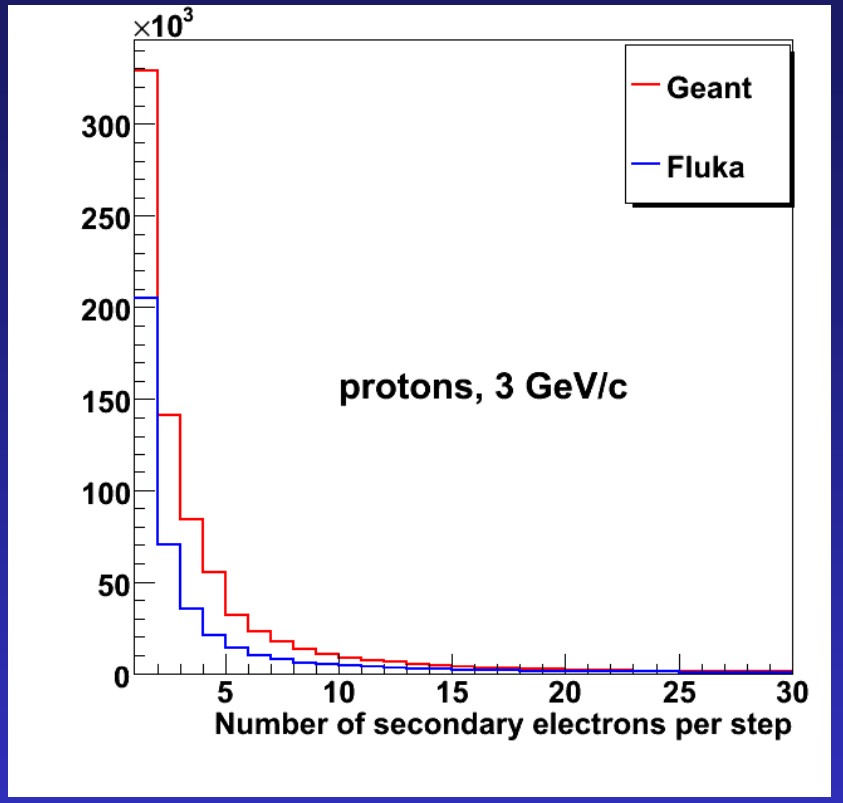
Fluka

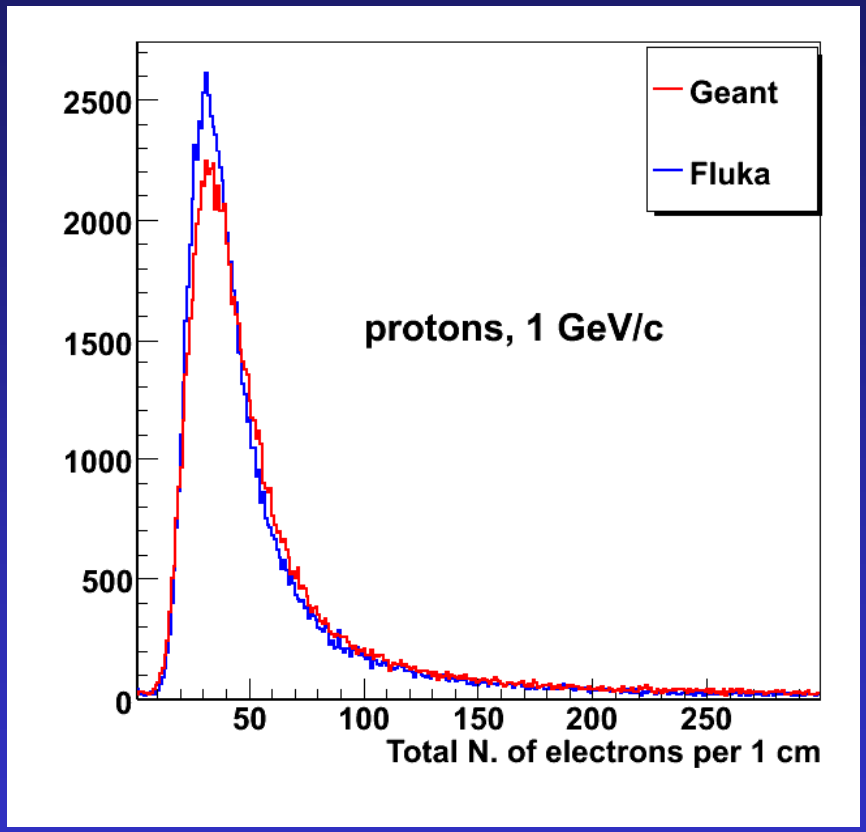


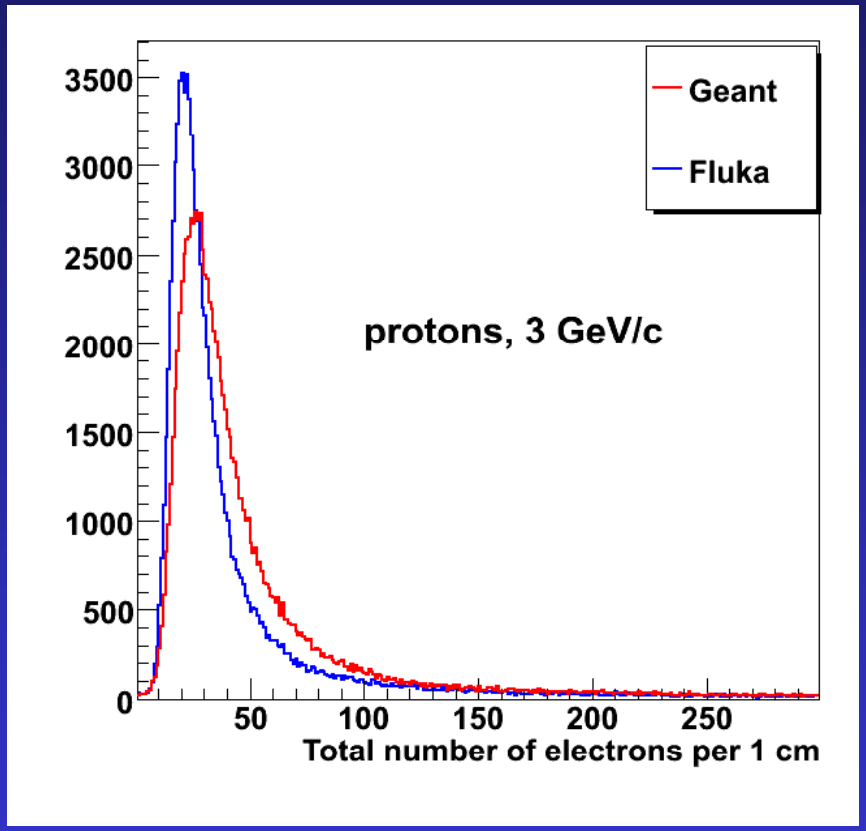


Alfredo improved the cross section at the relativistic rise, previously Fluka was always lower than Geant


×10^3
350
300
250
200
150
100
50
0
5
10
15
20
25
Geant
Fluka
protons, 1 GeV/c
N. of secondary electrons per step


×10^3
300
250
200
150
100
50
0
5
10
15
20
25
30
Geant
Fluka
protons, 3 GeV/c
Number of secondary electrons per step

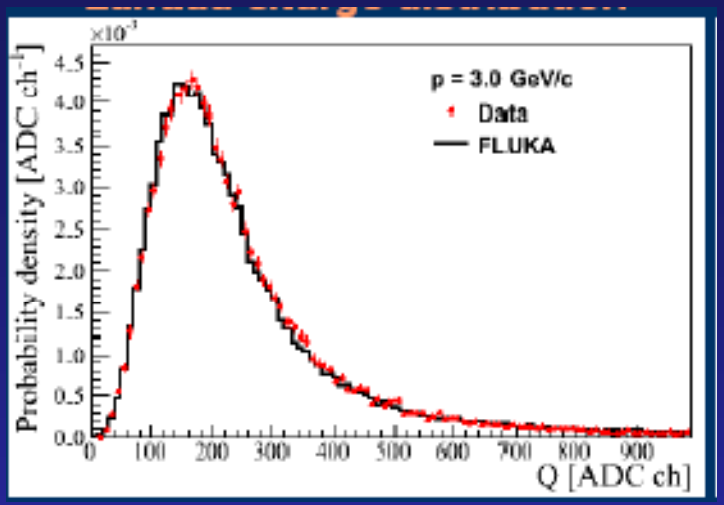

Geant
Fluka
protons, 1 GeV/c
2500
2000
1500
1000
500
0
50
100
150
200
250
Total N. of electrons per 1 cm

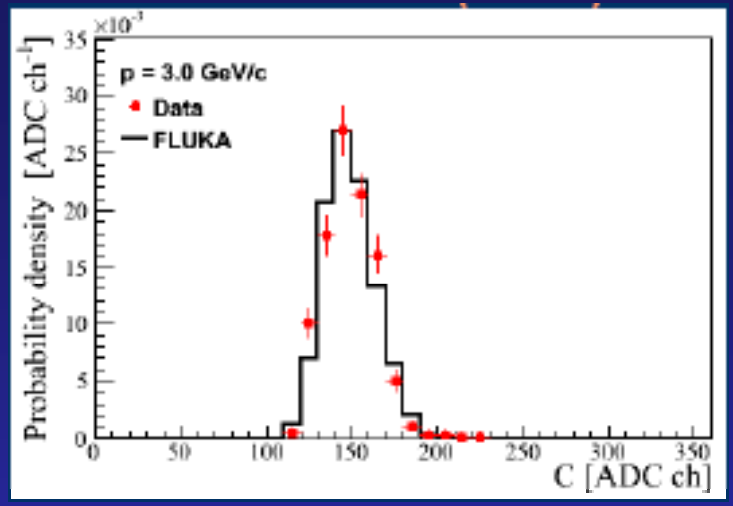

Geant
Fluka
protons, 3 GeV/c
3500
3000
2500
2000
1500
1000
500
0
50
100
150
200
250
Total number of electrons per 1 cm

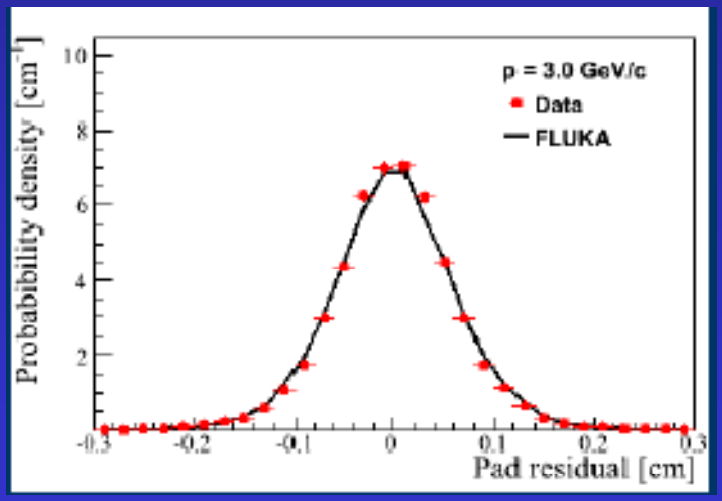
FLUKA vs. PS data

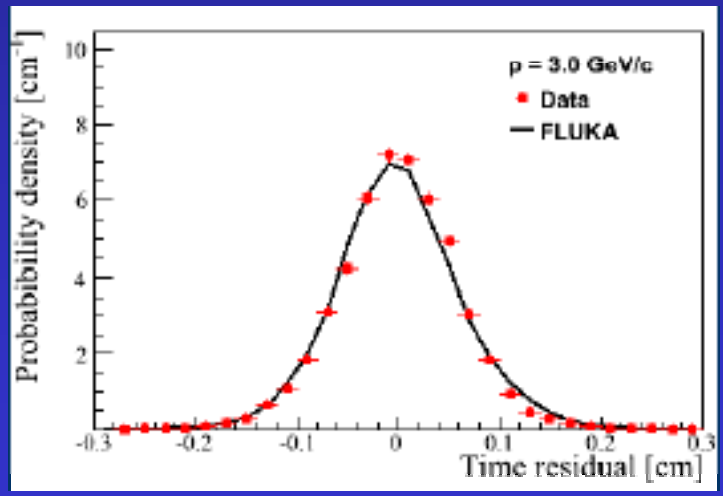
- TPC test beam data from 2004
  - 1 and 3 GeV/c protons, IROC only (63 rows)
  - Simple repetitive beam geometry (Very Important)
  - 90 cm drift length & no magnetic field

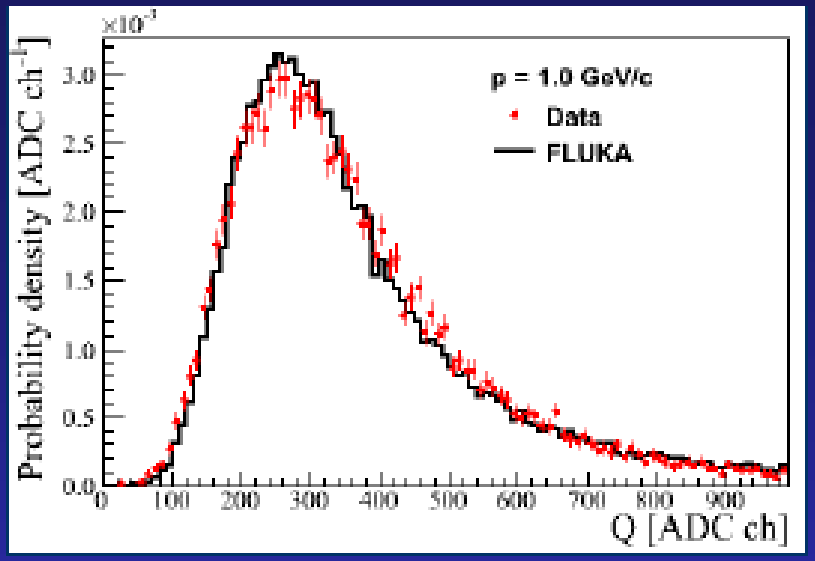
- AliROOT modifications
  - Increase gain by factor 3 to decrease threshold effects
  - Remove symmetrization part of clustering
    - Probably not necessary with the gain increase

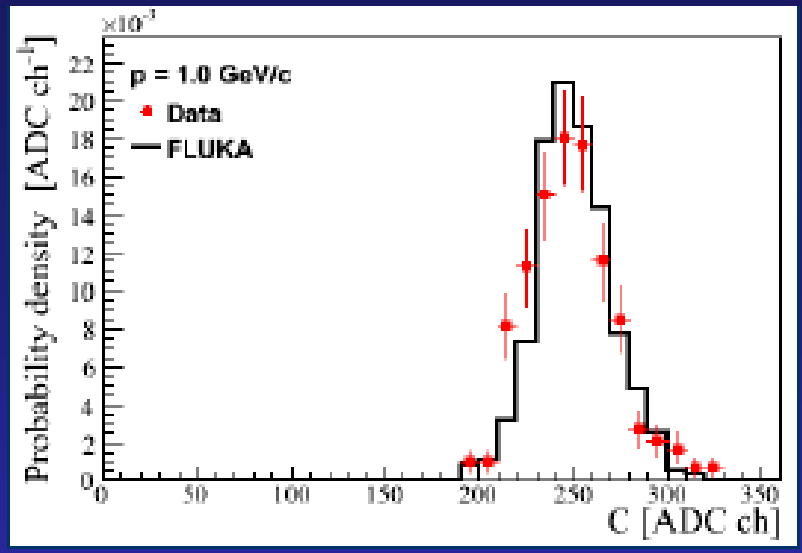

p = 3.0 GeV/c
Data
FLUKA
Probability density [ADC ch^{-1}]
Q [ADC ch]

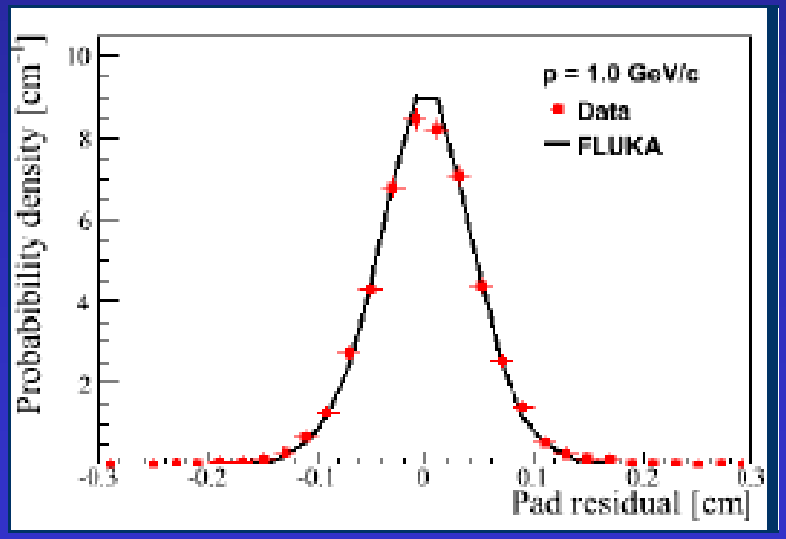

p = 3.0 GeV/c
Data
FLUKA
Probability density [ADC ch^{-1}]
C [ADC ch]

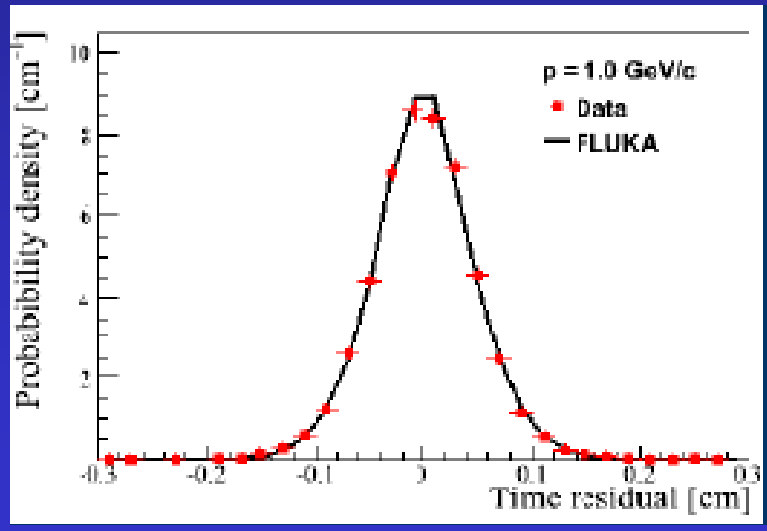

p = 3.0 GeV/c
Data
FLUKA
Probability density [cm^{-1}]
Pad residual [cm]


p = 3.0 GeV/c
Data
FLUKA
Probability density [cm^{-1}]
Time residual [cm]


p = 1.0 GeV/c
Data
FLUKA
Probability density [ADC ch^{-1}]
Q [ADC ch]


p = 1.0 GeV/c
Data
FLUKA
Probability density [ADC ch^{-1}]
C [ADC ch]


p = 1.0 GeV/c
Data
FLUKA
Probability density [cm^{-1}]
Pad residual [cm]


p = 1.0 GeV/c
Data
FLUKA
Probability density [cm^{-1}]
Time residual [cm]

Conclusions

1. Predictions of FLUKA and GEANT are slightly different
2. Fluka describes existing data quite well
3. Final tuning of FLUKA is more difficult that for GEANT
4. FLUKA based AliRoot ready for production
5. Main problem with FLUKA is the CPU consumption
6. The production-ready version is in SVN