ANGULAR DEPENDECE OF TRACK CALORIMETRIC RECONTRUCTION?

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OUTLINE:

- Procedure for track calorimetric reconstruction.
- Analysis of R (recombination factor) as a function of track direction for:
  - T600 Data
  - 10 m^3 Data
- Possible explanations of R angular dependence in T600 Data.

Recombination Factor:

The recombination factor is the ratio between the measured most probable energy loss and the theoretical one:

$$R = \frac{(\Delta E_{mp})_{\exp}}{(\Delta E_{mp})_{theory}}$$

We can study R as a function of the track direction computing the experimental value of most probable energy loss and the corresponding theoretical value (with a procedure that we will illustrate).

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In this work we have analyzed the following events of T600:

Single muons →

- Run 893
- Run 894 external trigger
- Run 720
- Run 975 PMT trigger
- Run 781 Ext + PMT trigger

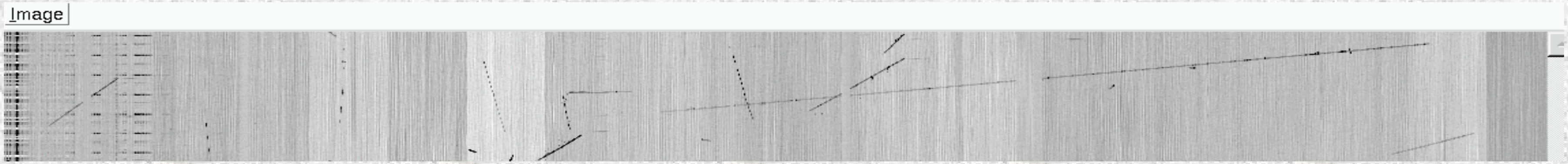
Multimuons →

- Run 959 Evt 17
- Run 699 Evt 75

Procedure for track calorimetric reconstruction

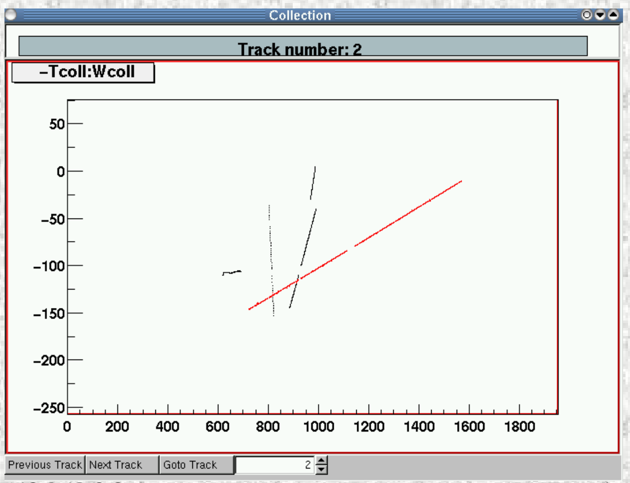
Example of Run 893 Evt 14 of **T300**

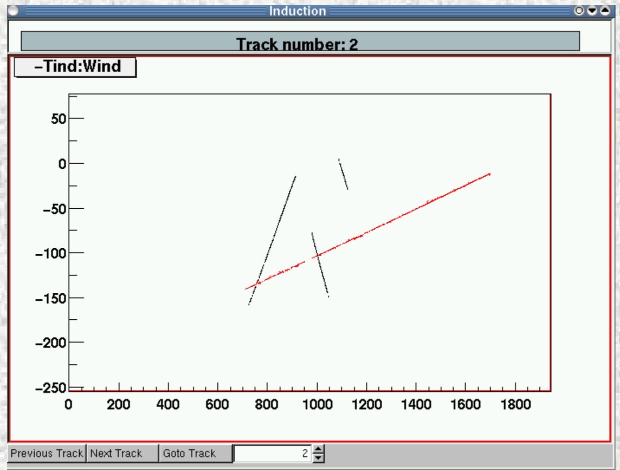
- ❑ Scanning of the event (with Qscan)
- ❑ Identification of good candidate (corresponding to geometry of trigger)



- ❑ Hit finding and 2D geometrical reconstruction of the event

(linear fit of the hits belonging to a cluster independently in the two views)





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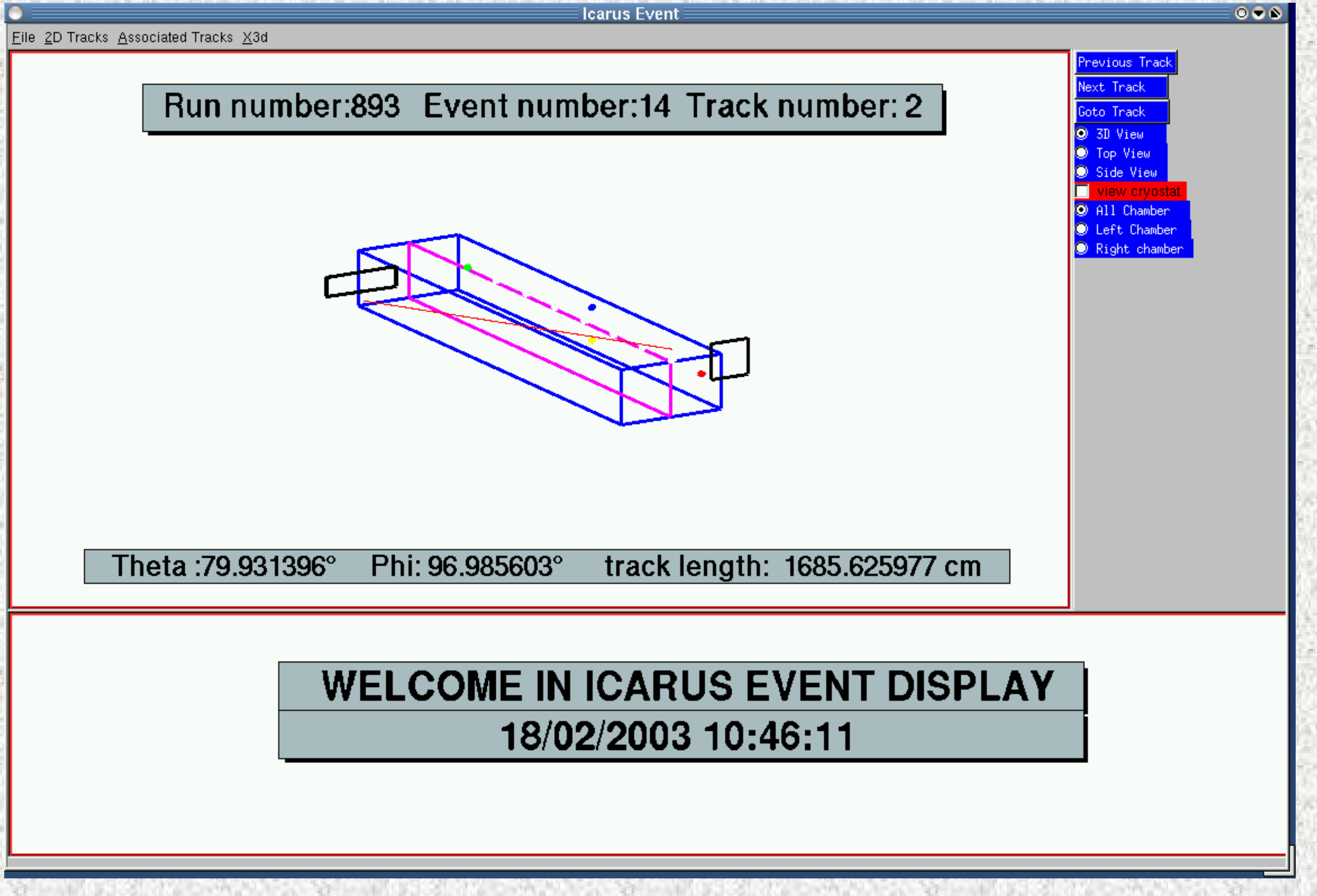
- 3D geometrical reconstruction with association of 2D tracks.

  (determination of θ ,ϕ of the track)



New version of visual program QPMT with new facility!!!!

❑ Measurement of energy released per unit track lenght

• knowing the values of θ ,ϕ we compute the track pitch lenght dx (the effective portion of the track exposed to the wire) and we compute the distribution of values of ADC/dx , corrected for the life-time, for each track.

•We fit the distribution of ADC/dx with a convolution of a Landau function and Gaussian function.The fit gives the most probable value of Landau distribution

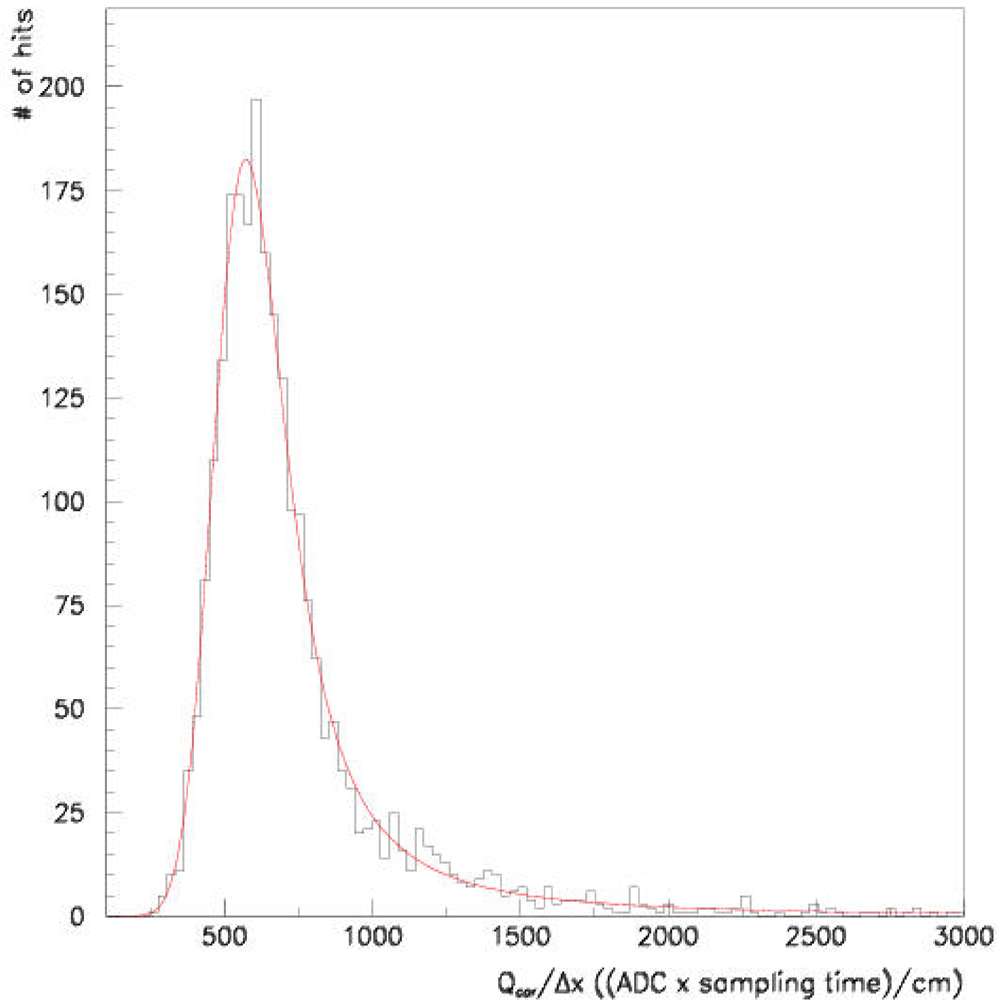
• We convert the most probable value of ADC/dx to charge with our conversion factor (computed using our algorithm of hit finding)

ADC → CHARGE (f_c=84.6 ± 3% e^- /units)

• knowing the values of ionization energy for LAr (I=23.6 eV) we convert the charge to energy

CHARGE → **ENERGY**

For this track we obtain :



$(ADC/dx)_{m.p.}$ = 553 ± 4

[(ADC x sampling time) /cm]

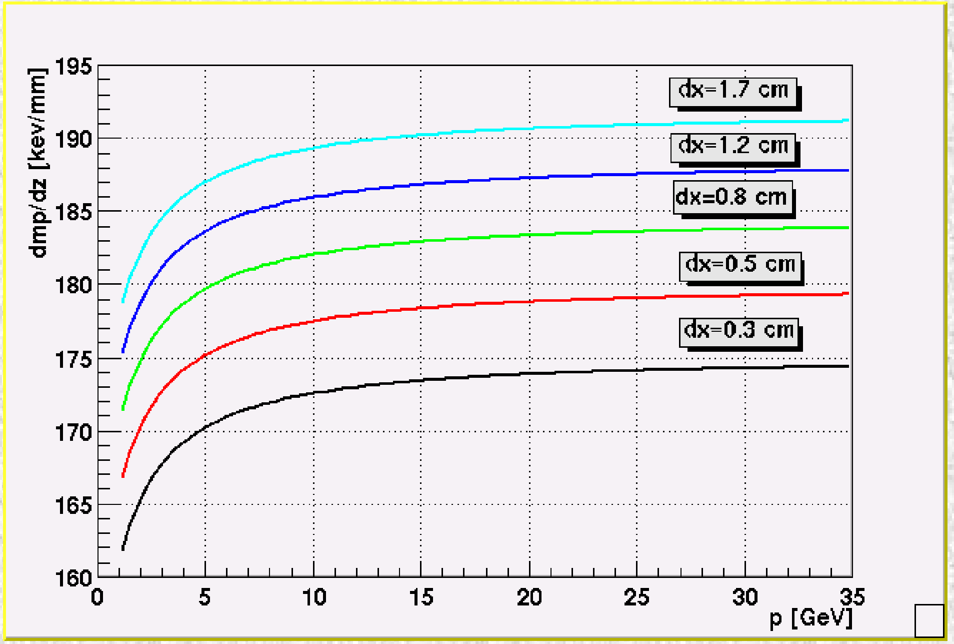
$(dQ/dx)_{m.p.}$ = 46800 ± 400

[e^-/cm]

$(dE/dx)_{m.p.}$ = 110.5 ± 0.1

[KeV /mm]

The theorical behavior of most probable value of the energy loss is the following:



- The m.p. increases as a function of dx (track pitch lenght)
- The m.p. increase as a function of muon momentum. It reaches a plateau at about 30 GeV.

- single muons.

Track lenght > 10 m → Energy > 2 GeV

In this case we considered

2 GeV < Eμ<35 Gev (value of plateau)

- multimuons.

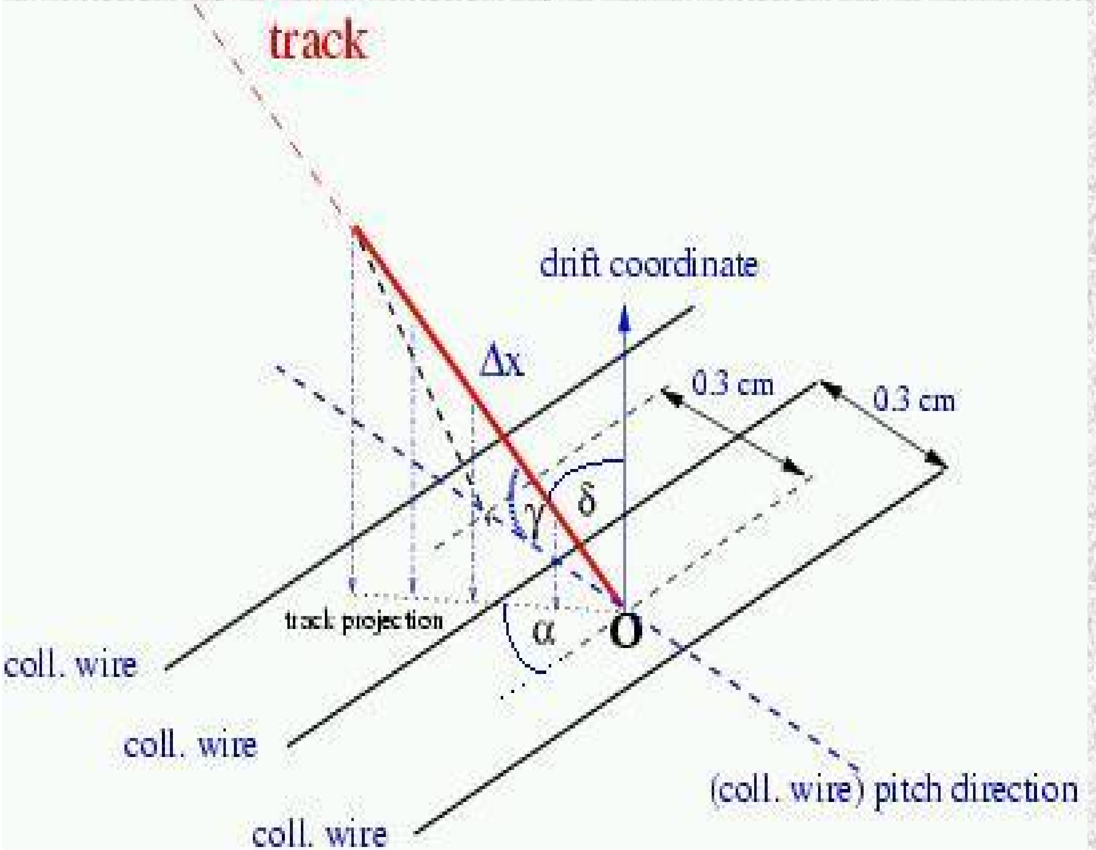
Track lenght > 5 m →Energy > 1 GeV

In this case we considered

1 GeV < Eμ<35 Gev (value of plateau)

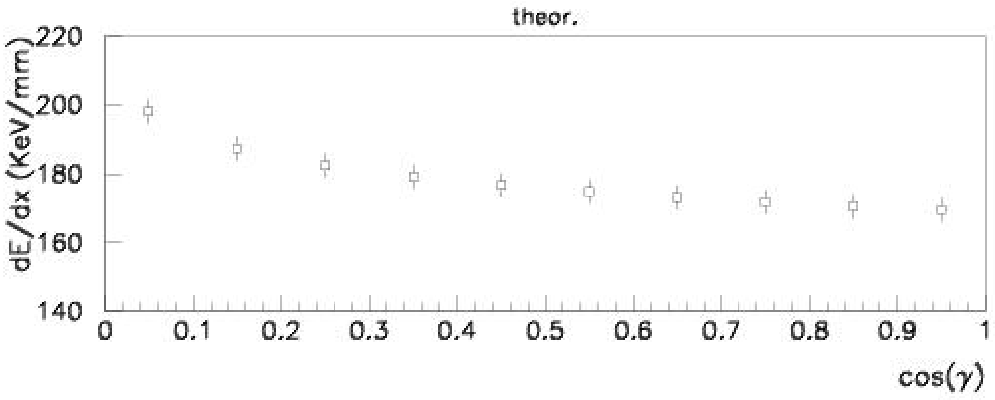
For each experimental reconstructed track we calculate the theoretical value of most probable energy loss corresponding to the dx of the track and to the central value of energy interval, and we consider the error due to the indetermination of muon momentun .

Some definitions



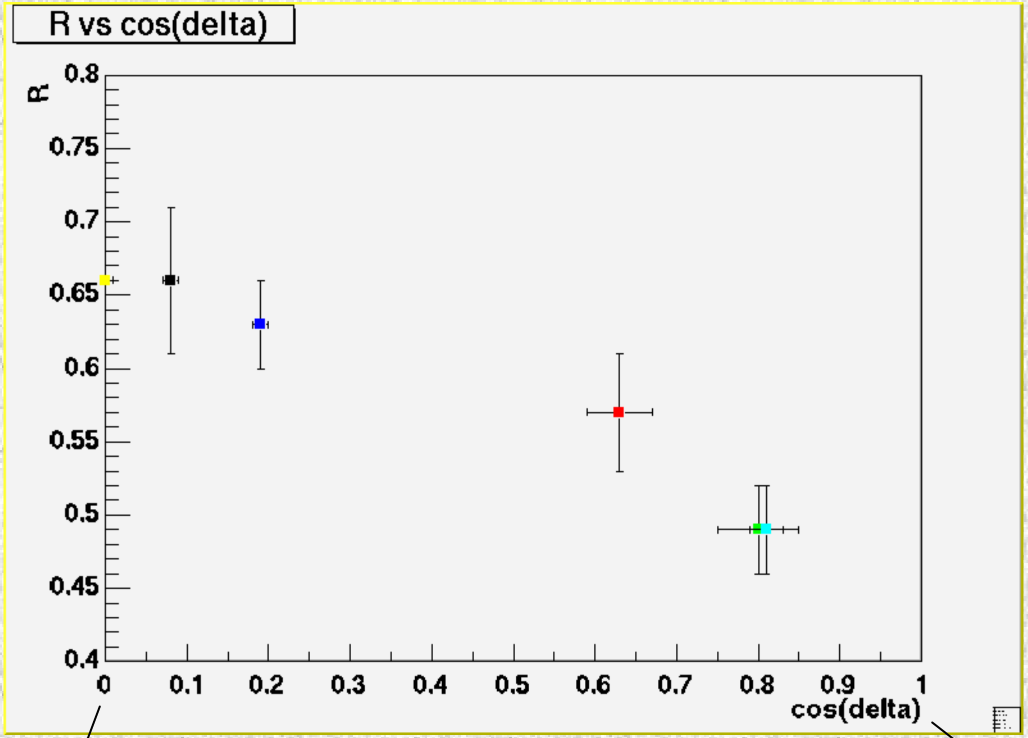
- γ is the angle between the track direction and the direction of the collection wire pitch.
- α is the angle between the track projection on the collection plane and the collection wires.
- δ is the angle between the track direction and the direction of electric field (drift).

The theoretical behavior of most probable value of energy loss as a function of cos(γ) is expected to be:



We don't expect any dependence of R on γ or on α. Possibly we expect a dependence only on δ, in case of angular dependence of the recombination effect.

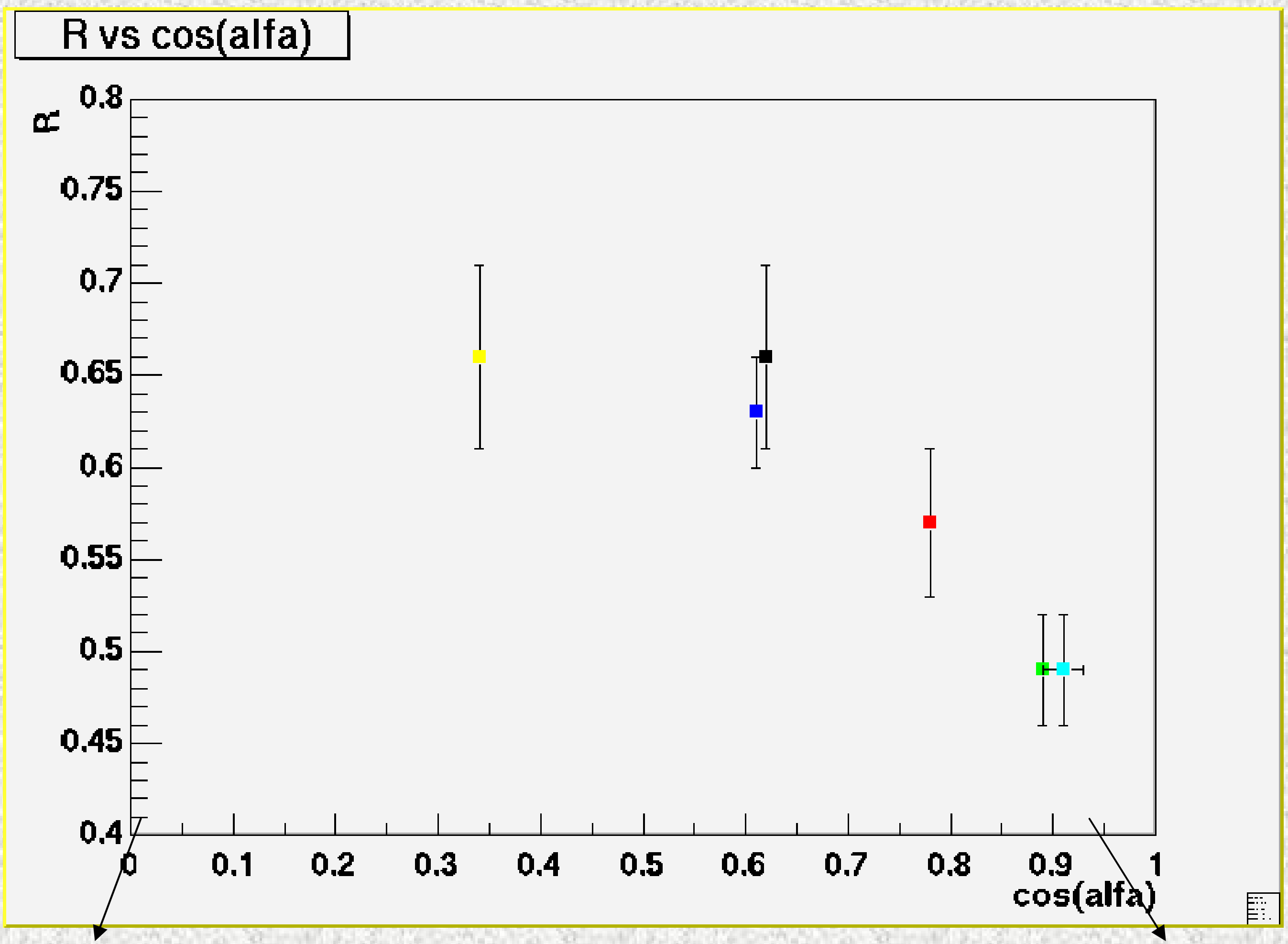
If we plot R as a function as cos(δ), R doesn't appear constant. In this case R decreases as a function of cos(δ).



Tracks orthogonal to the E. field

Tracks parallel to the E. field

The same effect for cos(α).



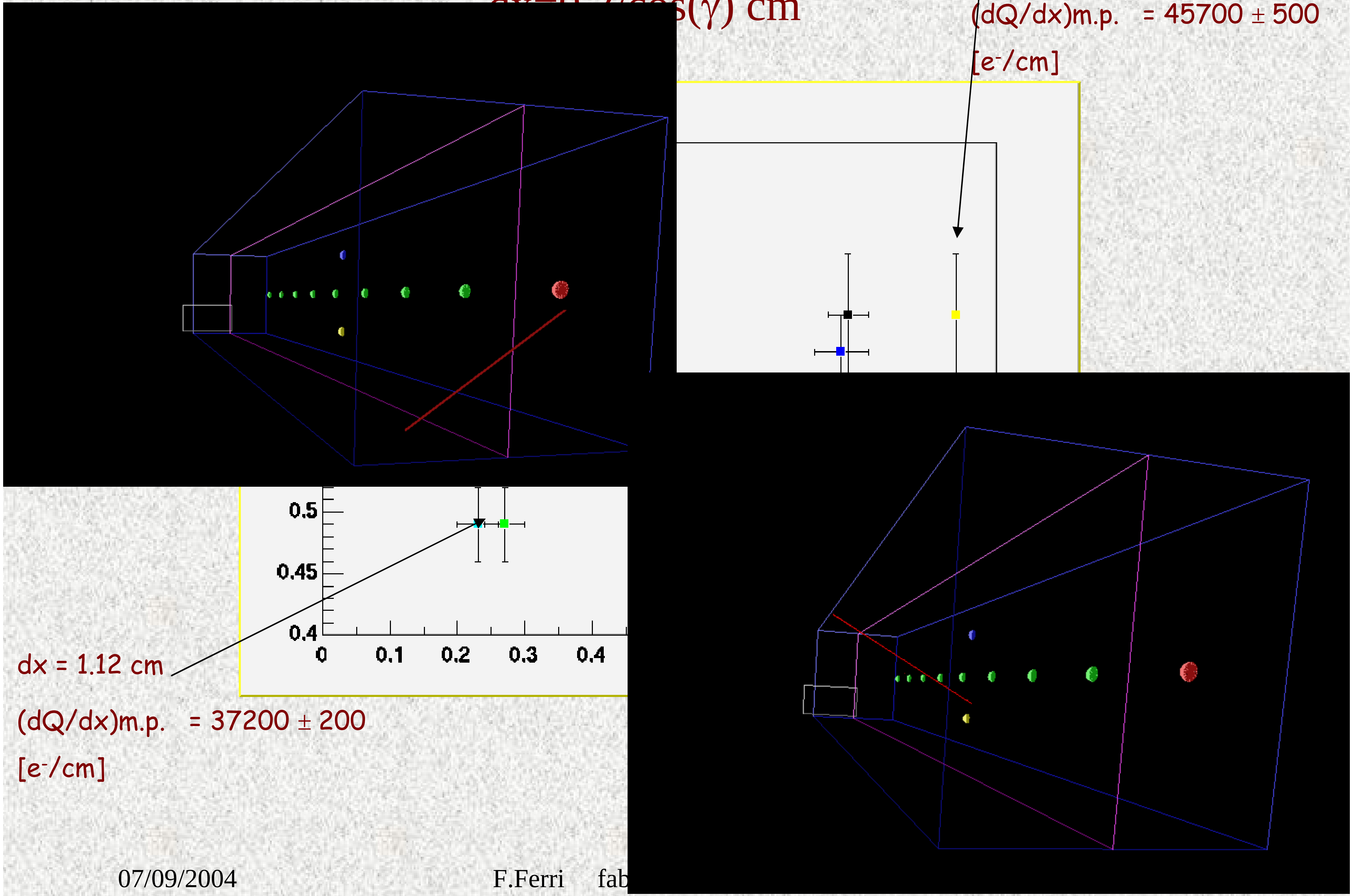
Track with projection on the collection plane perpendicular to the wires

Track with projection on the collection plane parallel to the wires

dx=0.2/cos(γ) cm

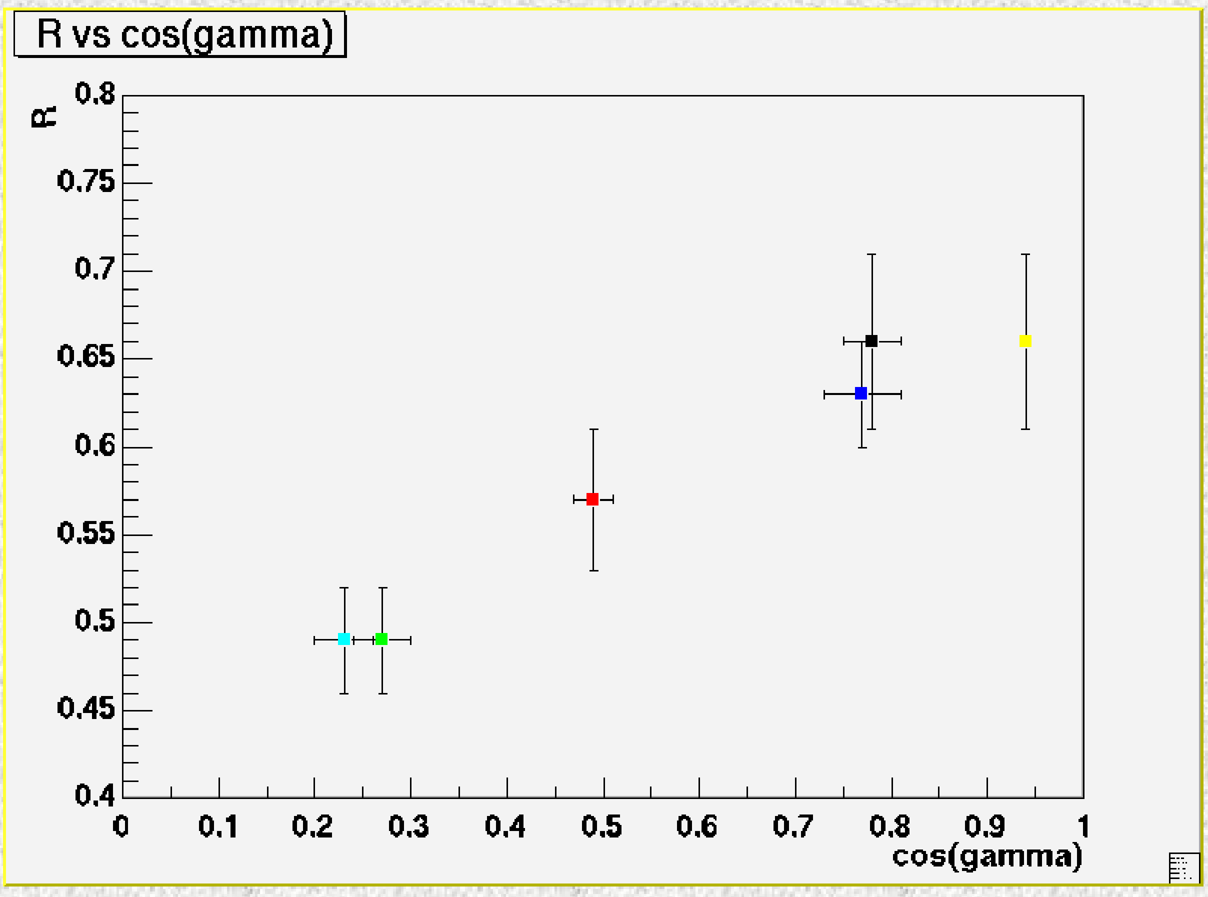
dx = 0.38 cm

(dQ/dx)m.p. = 45700 ± 500 [e^-/cm]



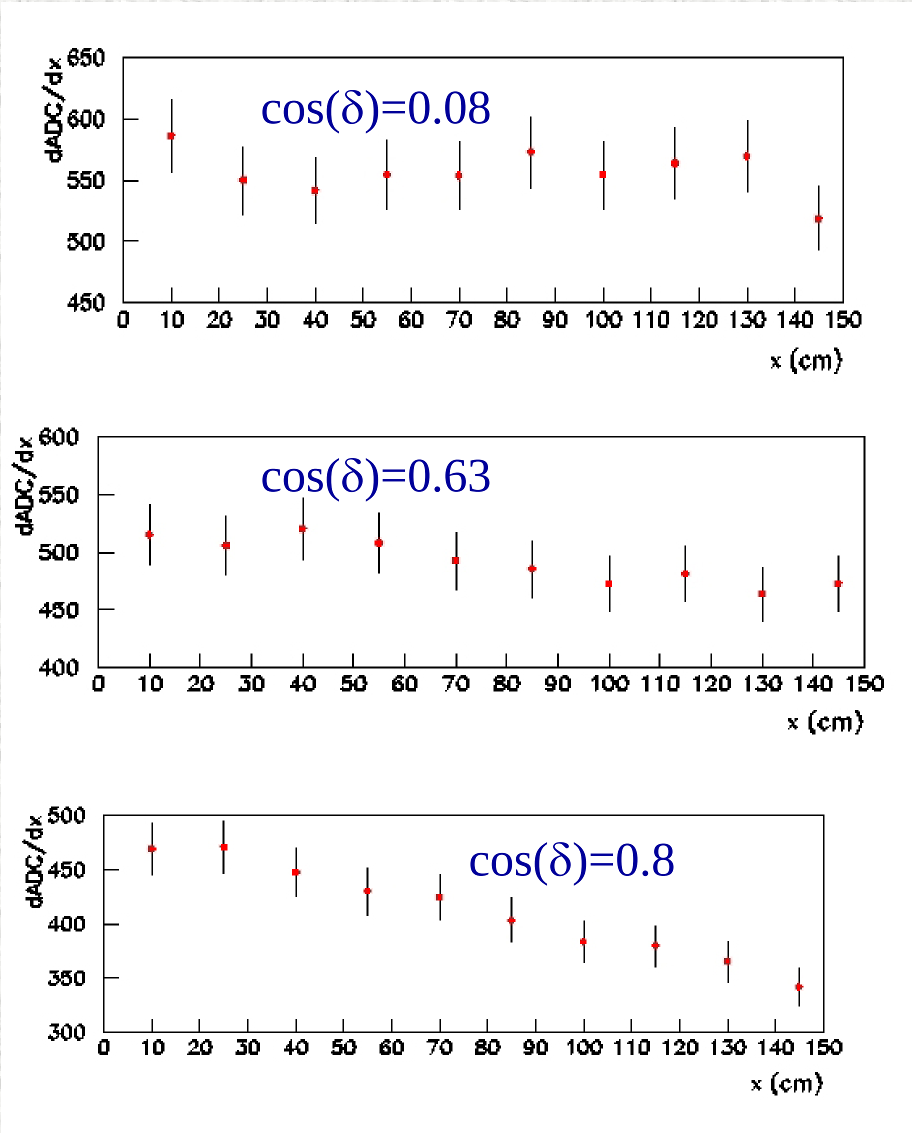
dx = 1.12 cm

(dQ/dx)m.p. = 37200 ± 200 [e^-/cm]



We observe that R depends on (increases with) cos(γ).

Dependence of the charge on the drift coordinates



If we plot the charge, corrected for the life-time, as a function of drift coodinates, we observe a dependence.

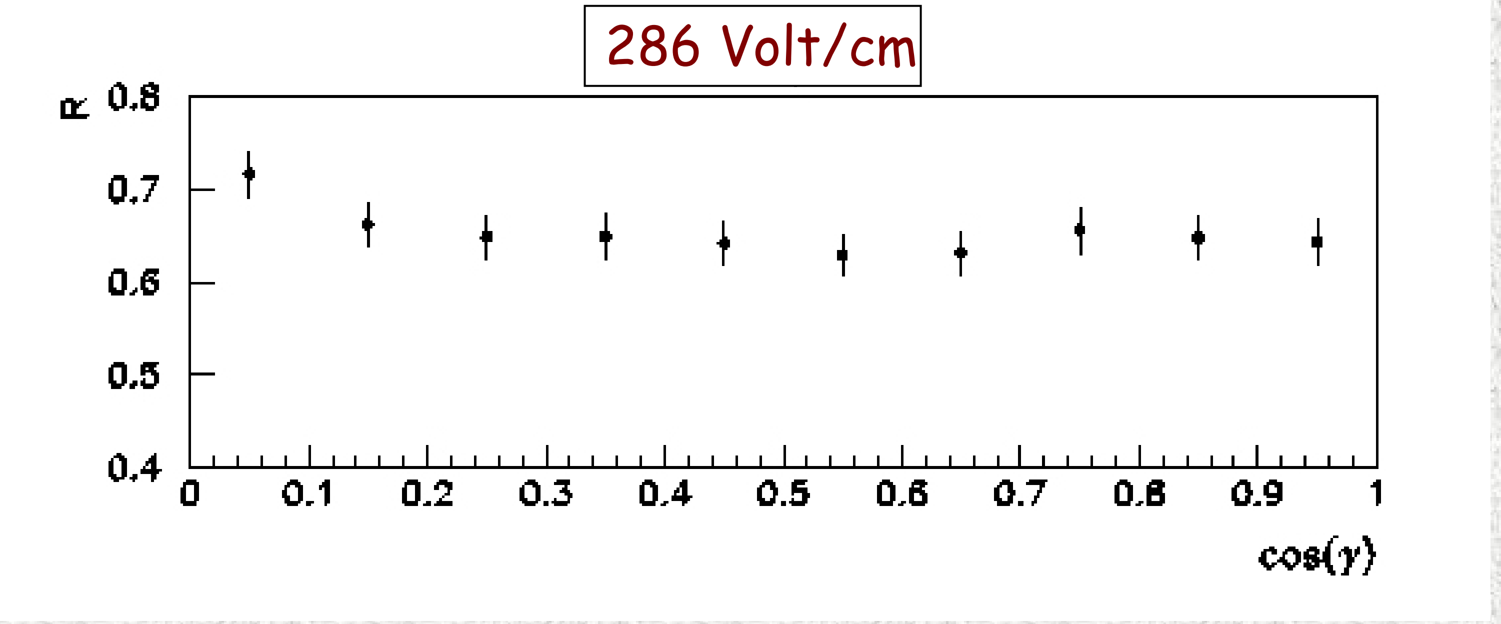
This dependence is stronger when cos(δ) becomes bigger.

We measure less charge for bigger values of drift.

In particular , for cos(δ)=0.8, we measure ~470 ADCxtime sampling for x=0 cm, and ~350 ADCxtime sampling for x=150 cm.

$10m^3$ Data (sample of NIM paper)

We did the same analysis for the data of $10m^3$



We don't observe the same dependence of R on cos(γ), cos(δ), cos(α)

(dQ/dx)m.p. = 50200 ± 300 [e^-/cm] > (dQ/dx)m.p. T600
(@ 286 V/cm) (@ 500 V/cm)!!!

Main differences :

• Current "C" type board on the T600 collection plane (charge=integral of the signal)

Charge "Q" type board on the $10m^3$ collection plane (charge=maximum of the signal)

• 1500 cm drift in the T600

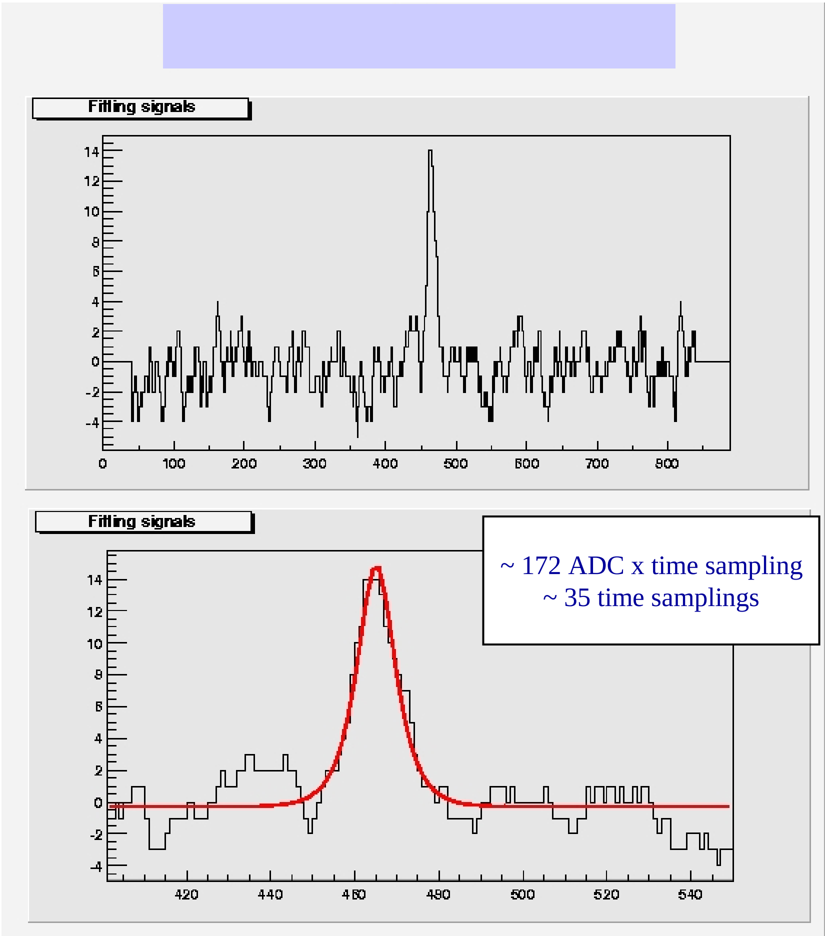
35 cm drift in the $10m^3$

Possible explanations of R angular dependence in T600 data:

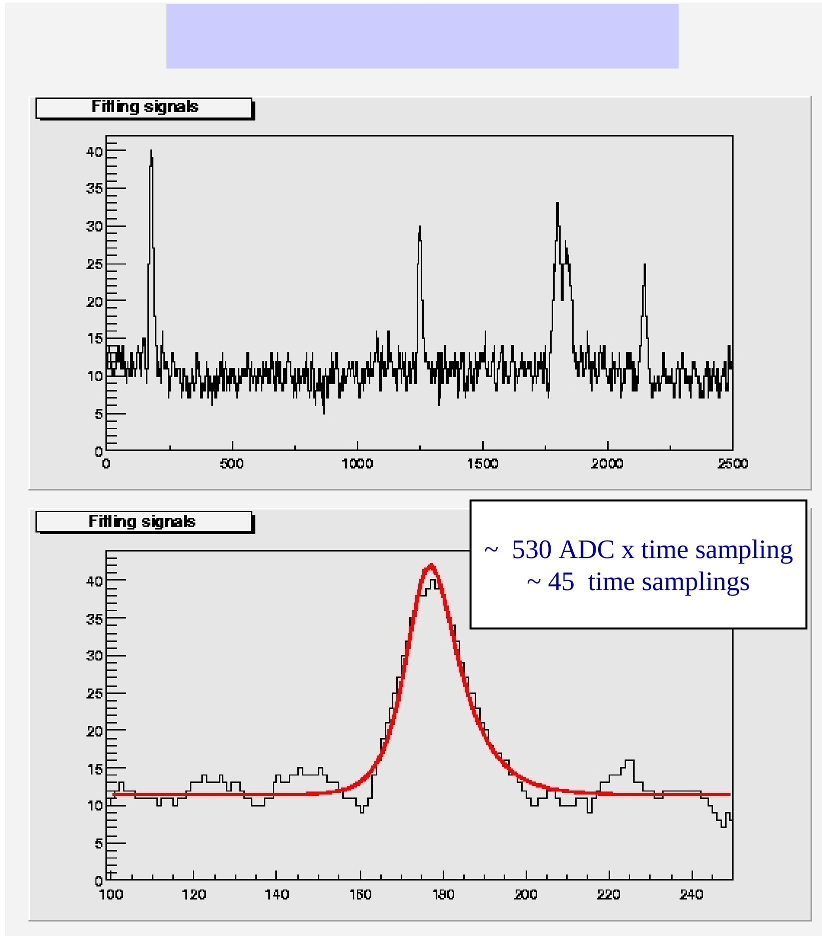
- ➢ Anomalous behavior of current "C" type board?
- ➢ Possible failures of the hit finding algorithm for "C" type board ?
- ➢ Physical effect: recombination effect dependent on track direction?

Example of signals in the T600 collection plane
current "C" type board

Track with dx=0.31 cm, ~ parallel to the E. field



Track with dx=1.1 cm, ~ orthogonal to the E. field



The observed R angular dependence prevent from doing the calorimetric reconstruction of the tracks

To be done:

- Analysis of other T600 muon tracks
- Analysis of the test data with c.r. muon tracks (at different angles) with the 50 l with "C" type and "Q" type boards

Example of signal in the 10m^3 collection plane

Charge "Q" type board

Track with dx=1.1 cm