Local Muon Tracks and Beyond
F. Déliot, 25 April 01

- the new *muo_trackreco*
- results of the fit algorithm:

→ efficiencies, resolutions for local track finding

→ preliminary studies of the new muo_trackreco performances

→ errors

- association with central tracks (global fit):

→ algorithm

→ status and plans

What's new in muo_trackreco?

- major changes:

  → use *SegmentChunk* (LinkedList segment algorithm) instead of *MuoSegmentChunk* (Combinatorial segment algorithm)

  → adapt the algorithm to use the benefits from this chunk (segment errors, keeping several segments: not only the one with the best χ^2)

  → new output Chunk more adapted to fit algorithm (*TrackChunk* instead of *MuoTrackChunk*)

  → new RCP parameters (propagation step, maximum number of iterations)

  → magnetic field: mapping and simple field (constant field in the toroid) driven by the new *mag_field* framework package

Algorithm

- segment association and track finding:

  → make all possible segment pairs (in same or adjacent octants)

  → cuts on segment pairs (keep only compatible segments)

  → create tracks for not combined A segment (Pt = 1.99 GeV)

  → perform first geometrical momentum estimation

  → perform fit (if failed return first estimation)

  → loose cut on track χ^2

  → check if extrapolated tracks meet vertex domain (straight line in the calorimeter)

  → if several tracks have close z position, keep the one with the best χ^2

Muon::Track

- new output for track finding:
  - → region, octant, segment indices
  - → nber of wire hits in A and BC layers
  - → nber of scintillator hits in A and BC layers
  - → position and momentum (3-vectors) at A and BC layers
  - → charge, χ^2 , nber of iterations
  - → error matrix of the fit parameters (BC layer)
  - → error matrix in position and momentum at A layer

<u>fake tracks</u>?

- → fit failed: $\chi^2 = -1$, itnber $\neq 0$
- → single segment tracks: χ^2 = segment quality, itnber = 0
- → fit not performed: $\chi^2 = -1$, itnber = 0 (all events)

Efficiencies and Resolutions

- samples used: single muons: Pt from 5 to 50 or 100 GeV
- t42 with head version of muo_trackreco

  → with *LL* or *Combi* segment algorithm

  → fixed segment errors

→ nb of fitted events (which can be fitted): more than 85%

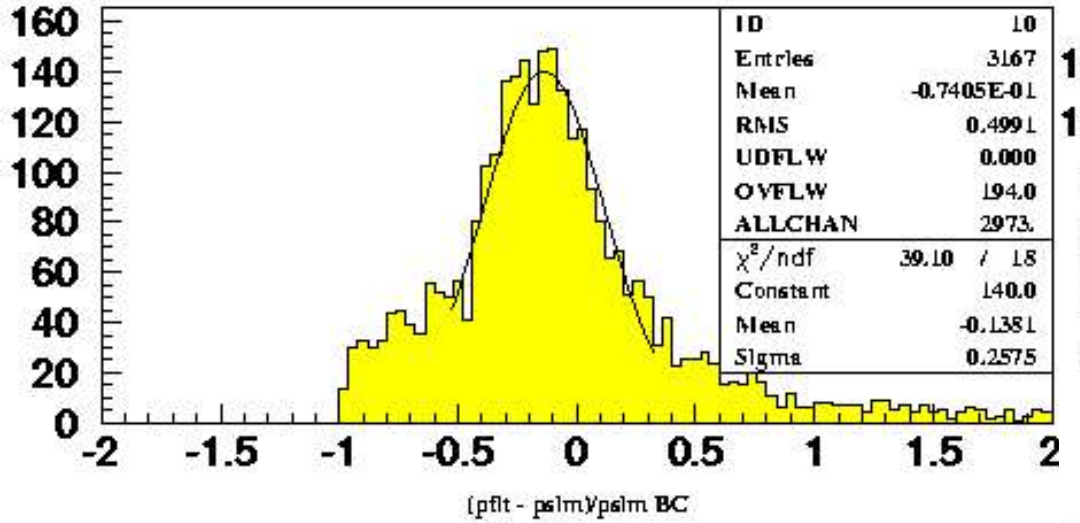
→ nb of fitted events with $\chi^2 < 5$: ~ 75%

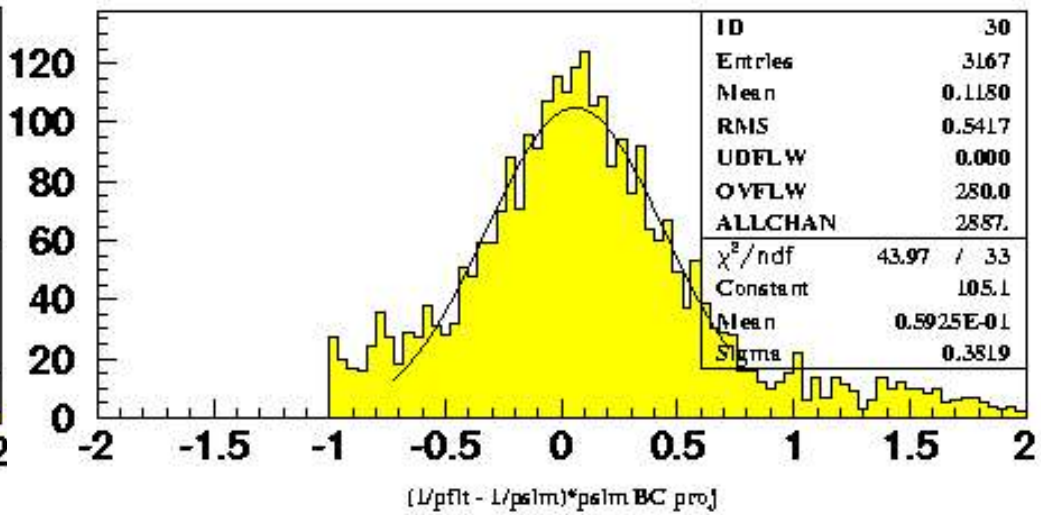
→ momentum resolution: $(P_{fit} - P_{MC})/P_{MC} \sim 25\%$

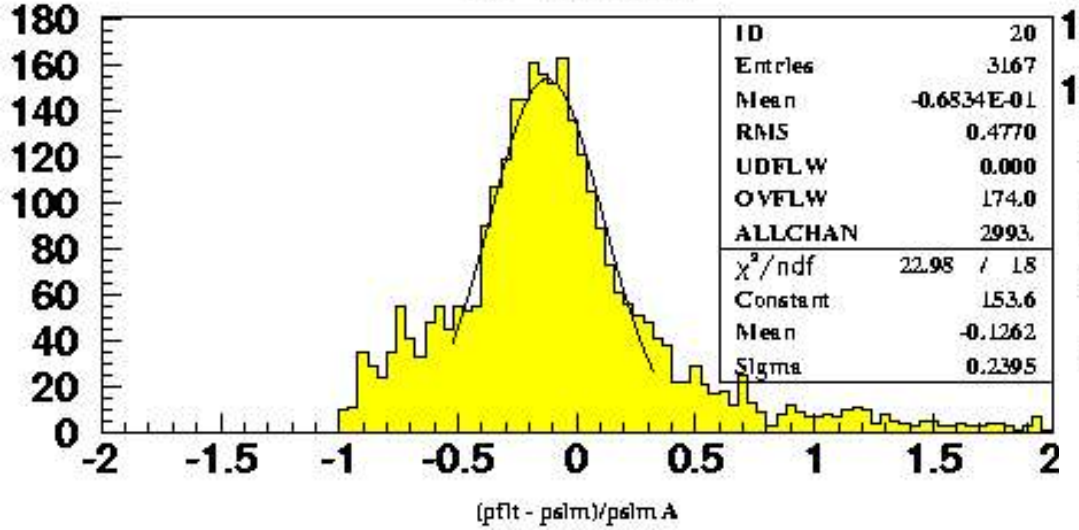
but tails

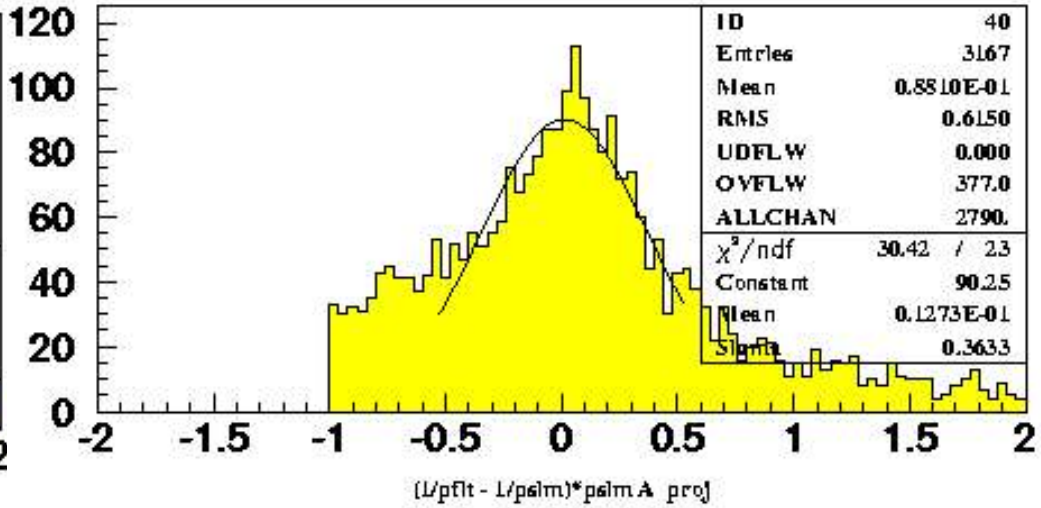
in the deviation plane: $(1/P_{fit} - 1/P_{MC}) \times P_{MC} \sim 37\%$

Momentum Resolution







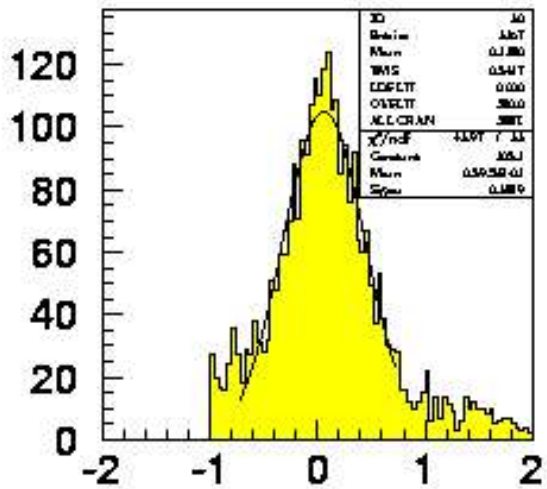


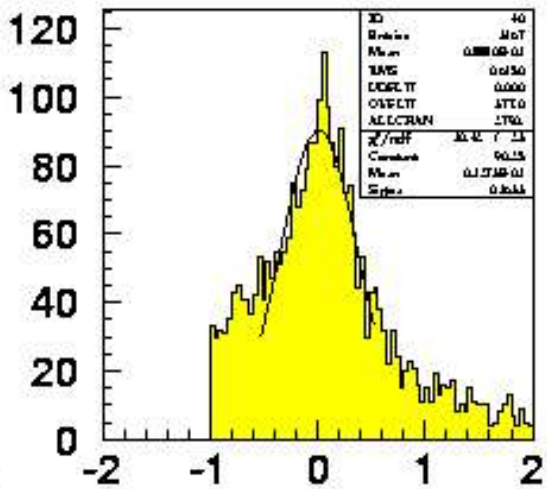
$(P_{fit} - P_{MC})/P_{MC} \sim 25\%$

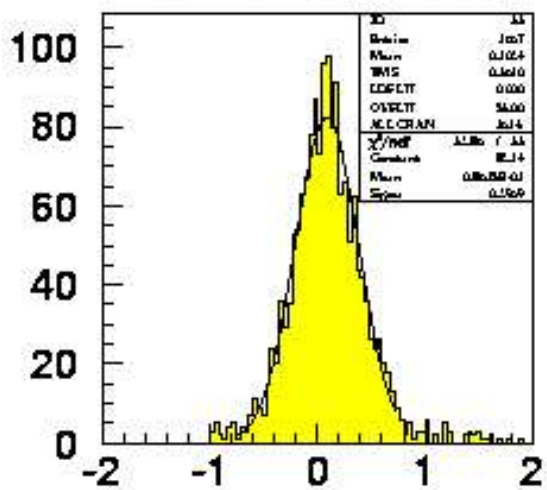
$(1/P_{fit} - 1/P_{MC}) \times P_{MC} \sim 37\%$

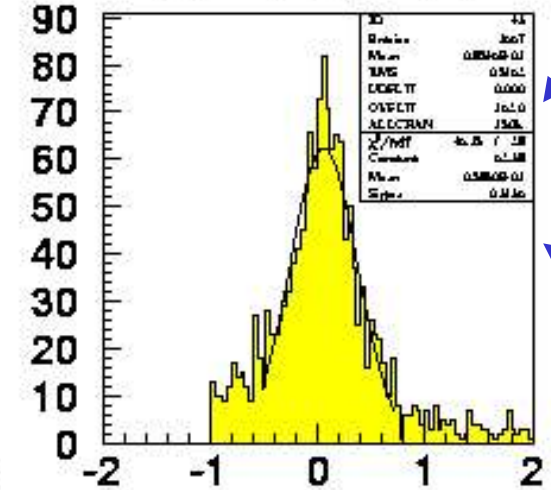
Momentum Resolution

with cuts on segments



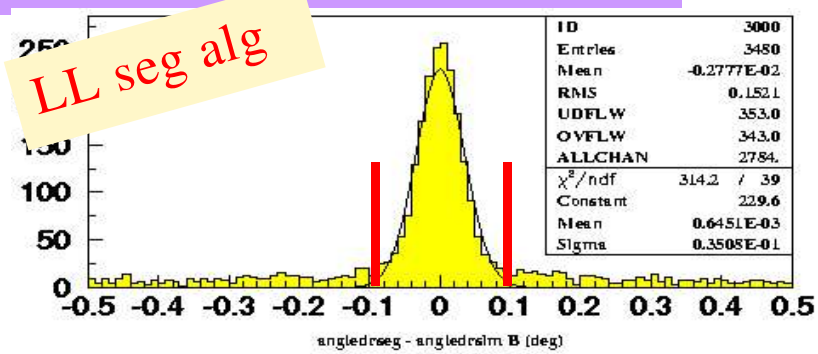


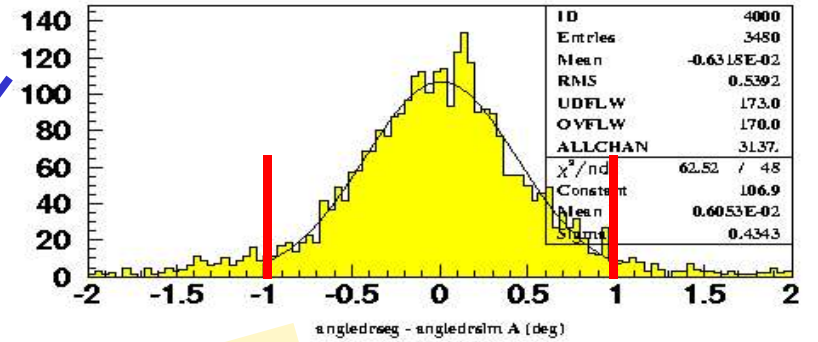




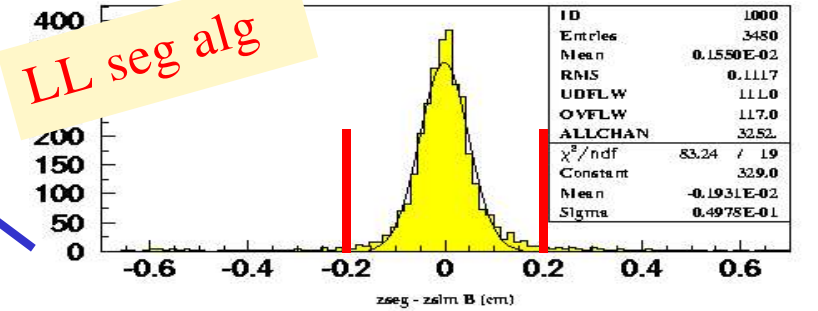
$$(1/P_{fit} - 1/P_{MC}) \times P_{MC} \sim 30\%$$

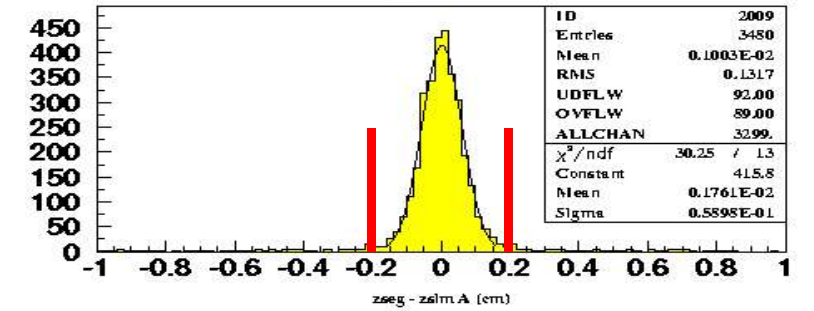
LL seg alg



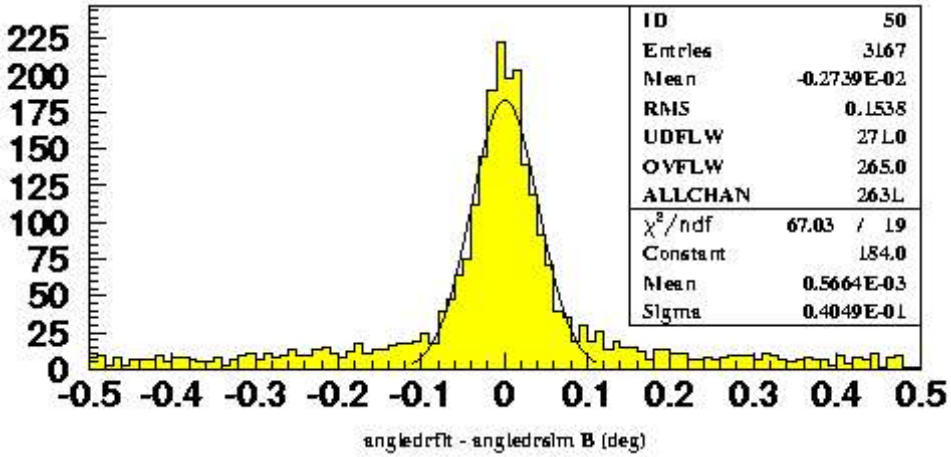


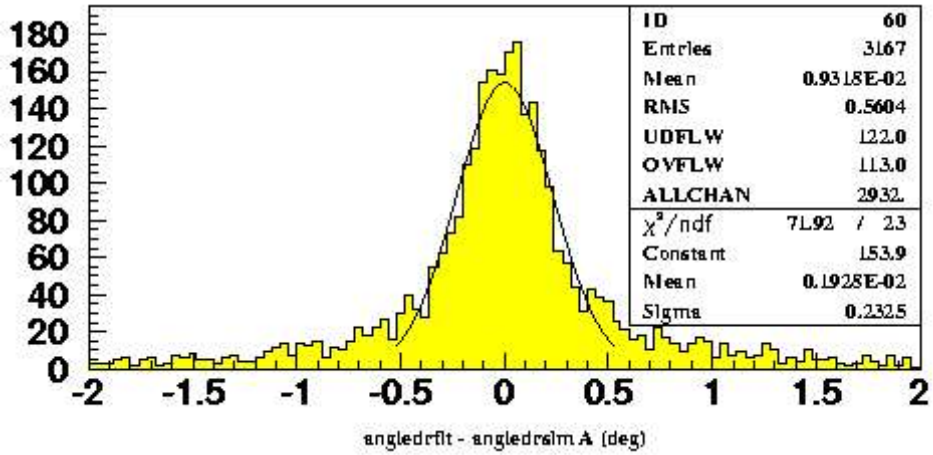
LL seg alg



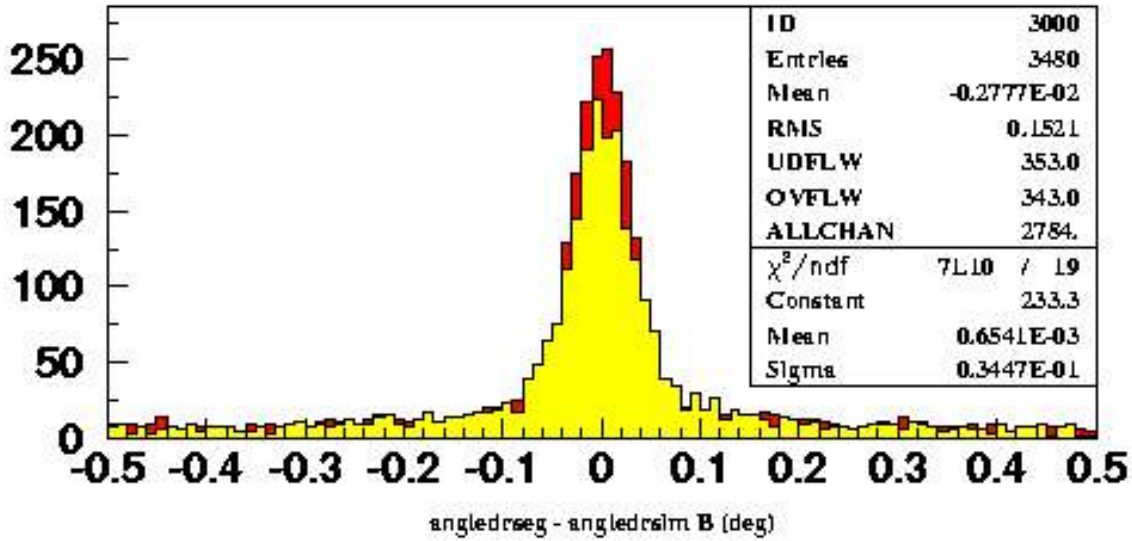


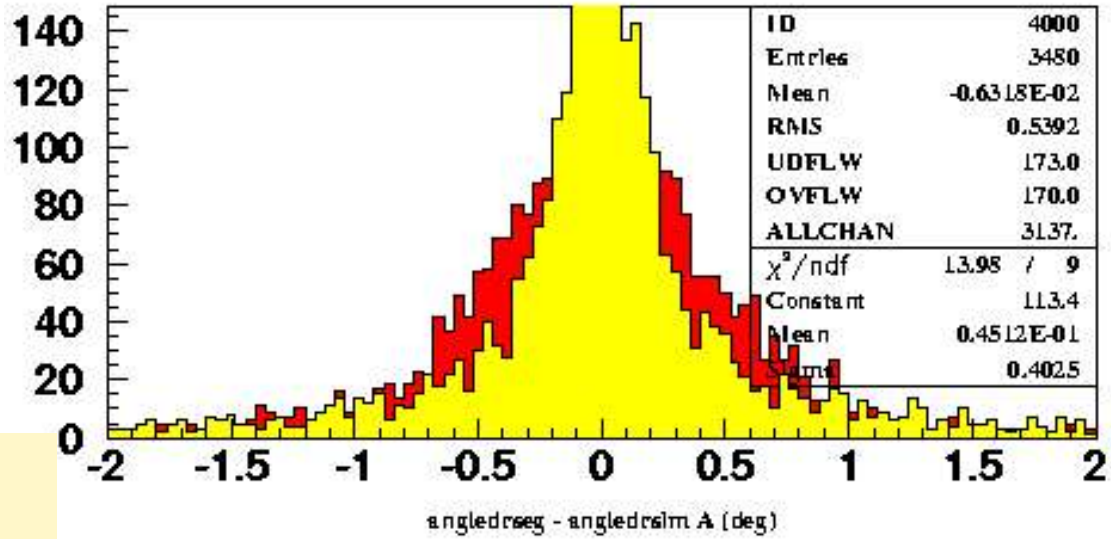
Angular Resolution





red: seg, yellow: fit



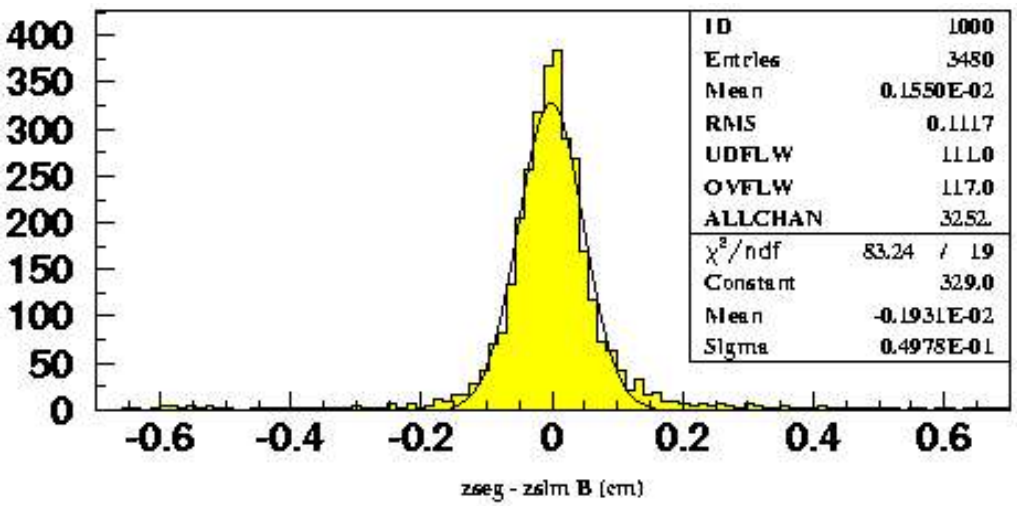


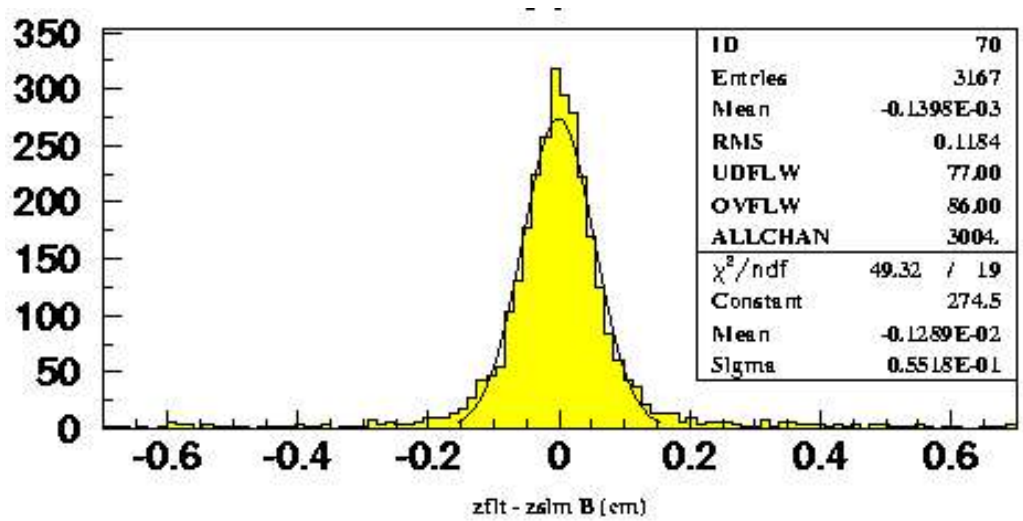
in the drift plane, at layer A:

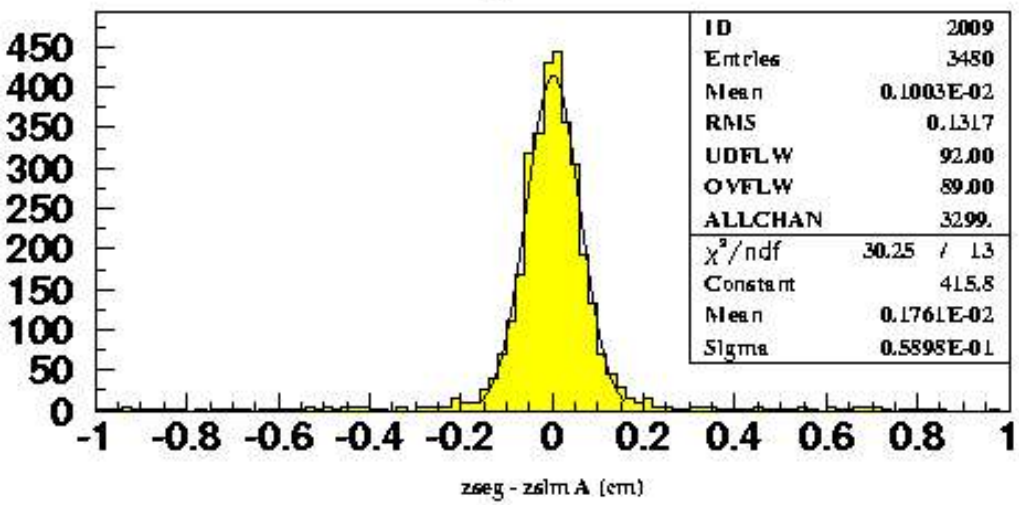
Segment (LL): $\theta_{seg} - \theta_{MC} \sim 0.43$ deg

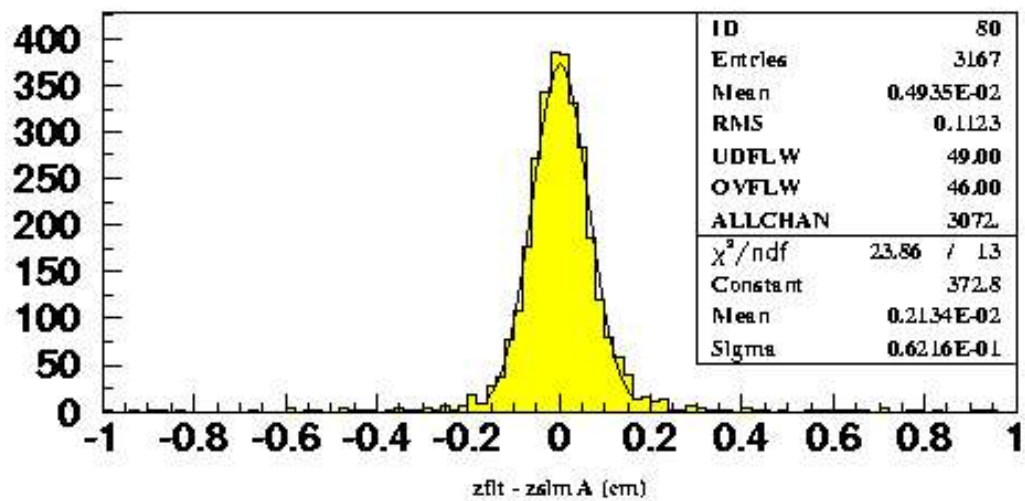
Fit: $\theta_{fit} - \theta_{MC} \sim 0.23$ deg

Position Resolution









Same resolution for segment and fit:

BC: $z_{fit} - z_{MC} \sim 0.05$ cm

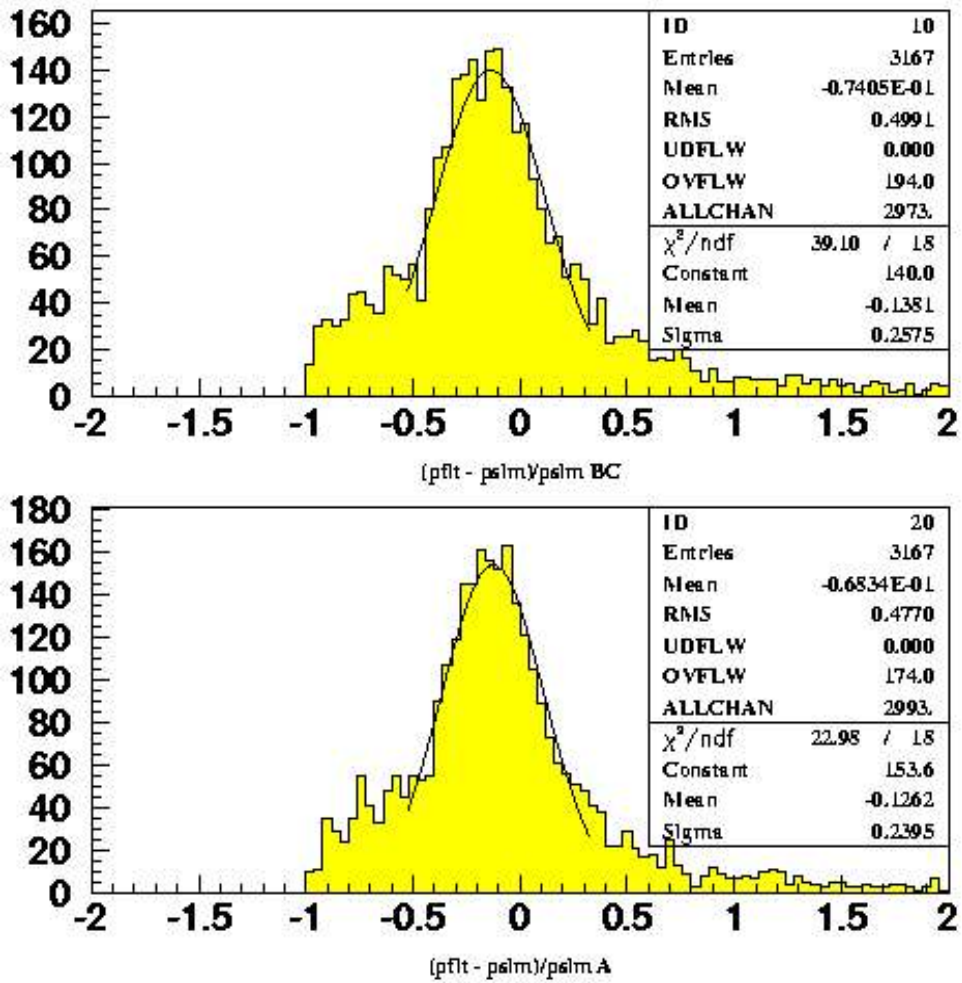
A: $z_{fit} - z_{MC} \sim 0.06$ cm

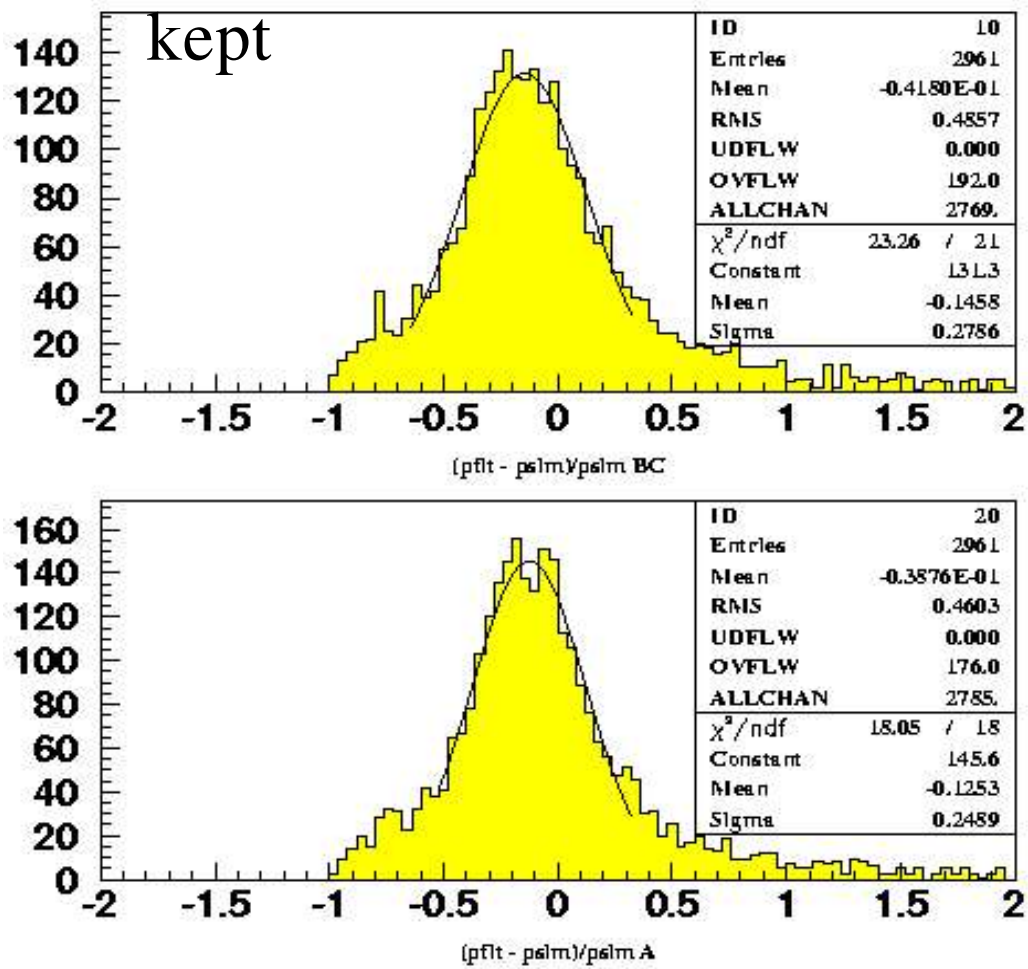
More Than One Segment Kept

preliminary

segment with best χ^2 kept

2 segments with lower χ^2 kept





Same resolution, timing increased, less tails?

More Results

preliminary

- different value for the propagation step:

  → default: 1 cm (~ 100 steps)

  → tests with: 5 cm, 10 cm ⇒ do not affect the momentum resolution

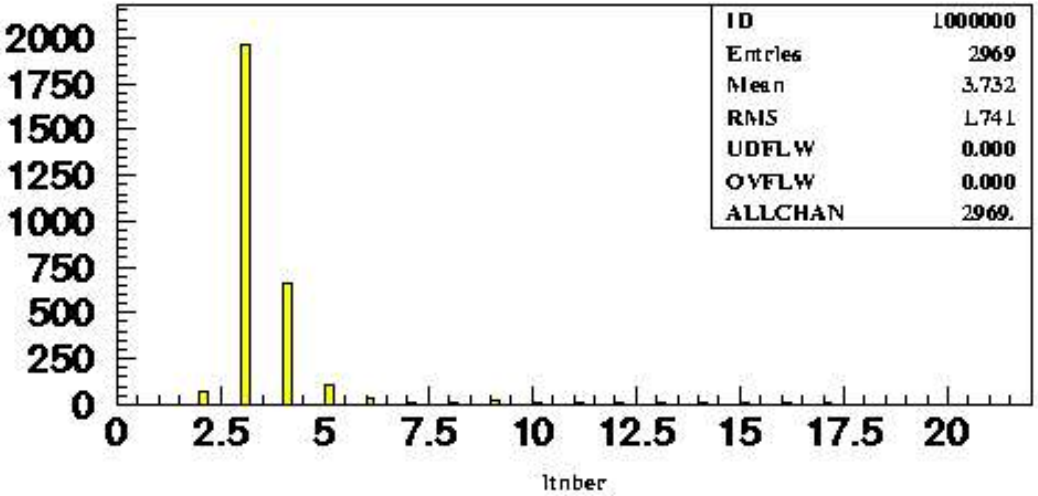
  → timing: total reconstruction time on d0mino (10000 evts):

  LL, step = 1cm: 5024.38 s

  LL, step = 10cm: 2442.17 s

  → affect errors ??

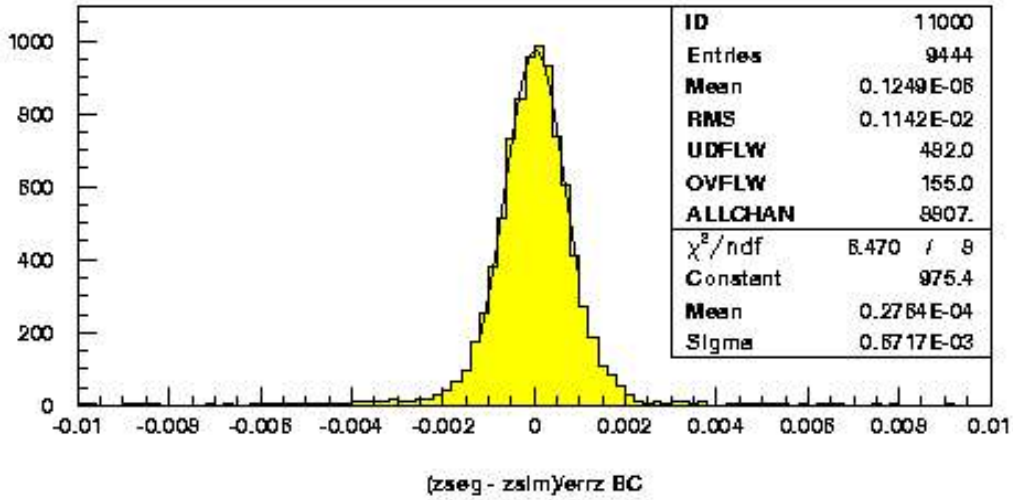
- number of iterations:

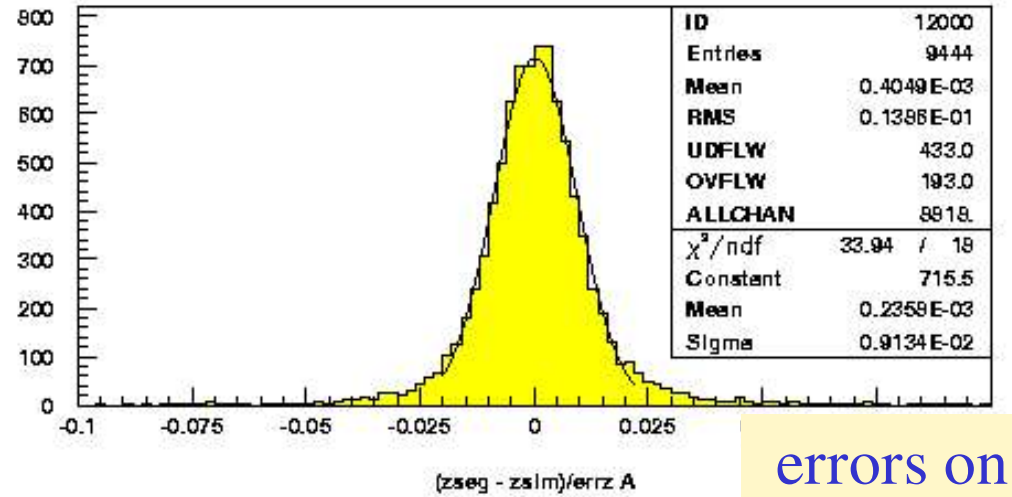


Segment Errors

- sample used: single muons: Pt = 50 GeV, η= 0.55 , φ = 10°

position pull plots:

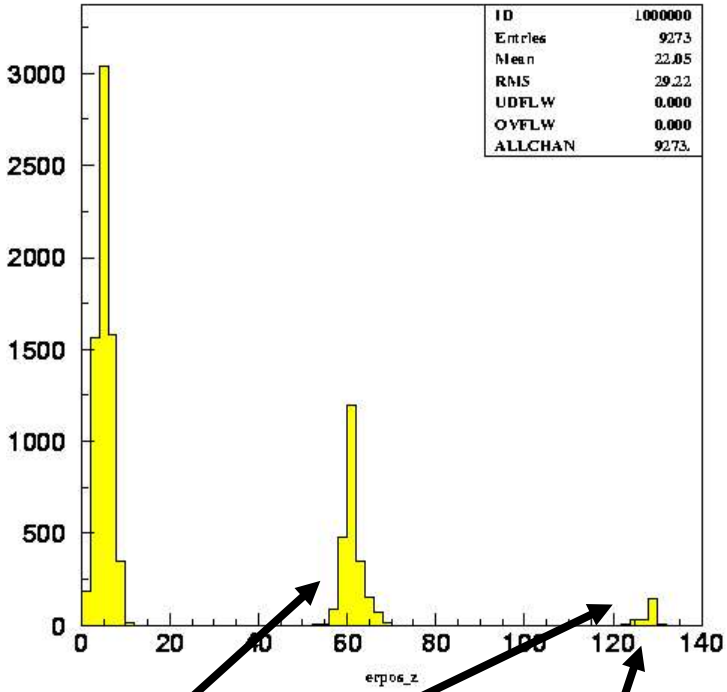




errors on position too large

errors on angle not correct

z position error

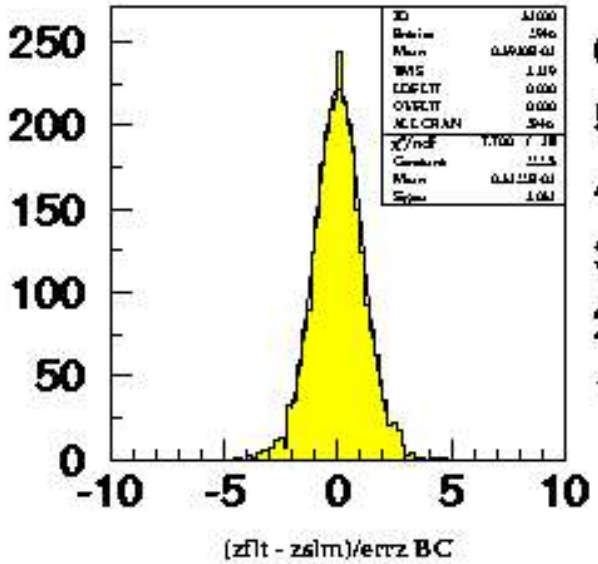


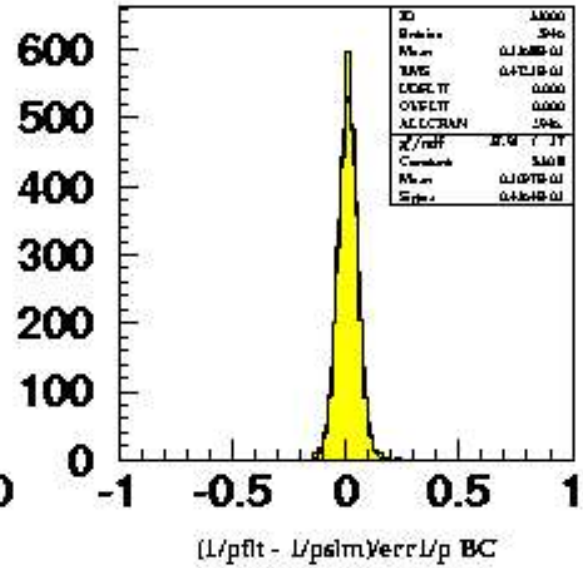
layer B

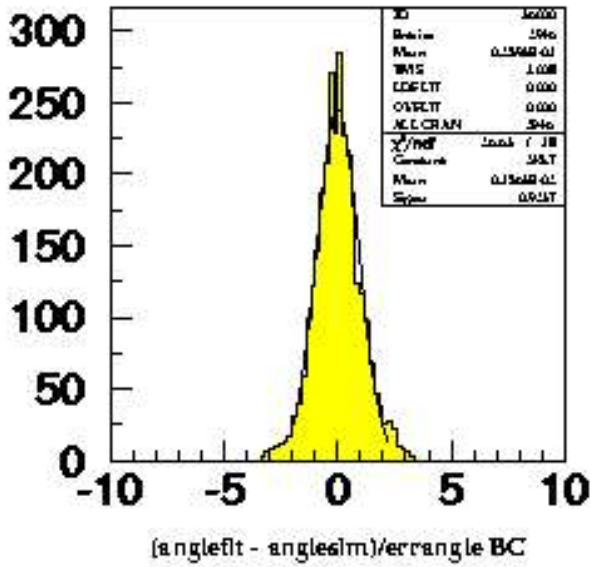
octants 5,6

Fit Errors

fit pull plots with fixed segment errors:

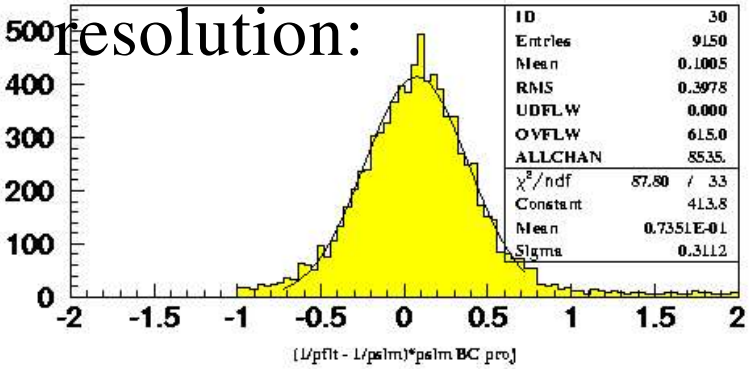


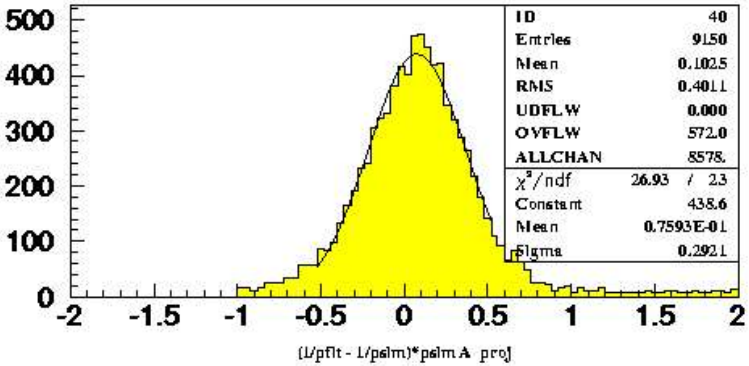




error on 1/p
too large

momentum
resolution:





$(1/P_{fit} - 1/P_{MC}) \times P_{MC} = 30\%$

good gaussian shape

Global Fit

- goal:

  → associate muon tracks in the local muon system with central tracker track

  → provide a χ^2 in order to choose the relevant central track

  → improve the central track resolution (special regions of the detector, high momentum particule)

- need to propagate through the calorimeter taking into account:

  → the inhomogenous magnetic field

  → multiple scattering

muo_centralmatch

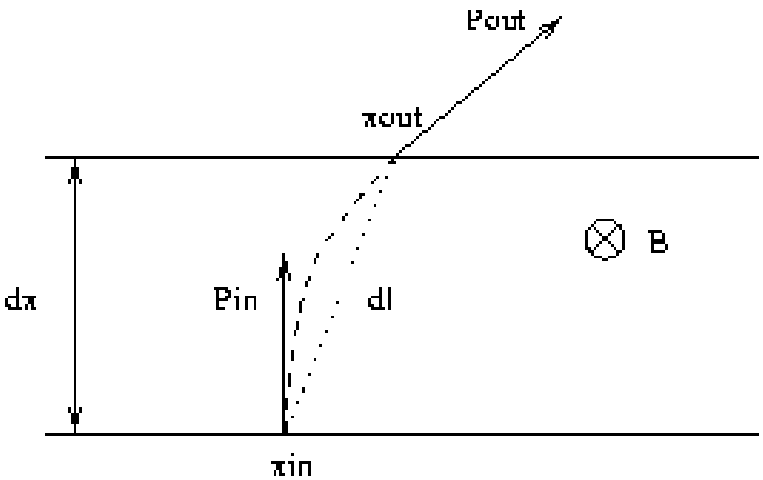
Algorithm

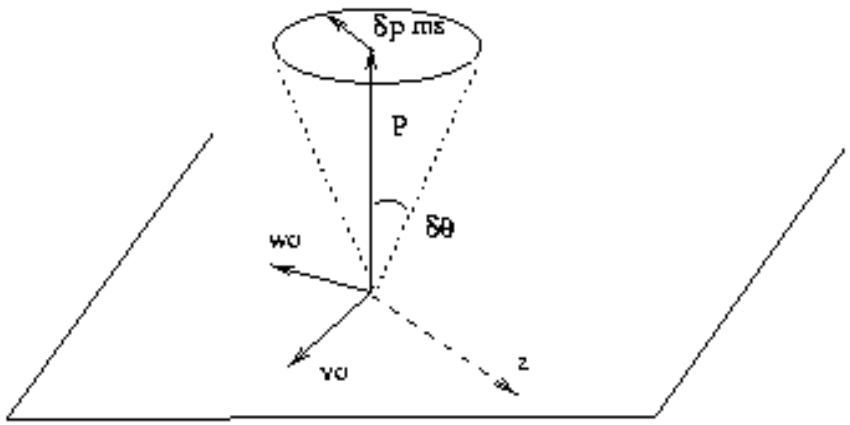
- take the error matrix of the local muon track result of the fit:

  → the error matrix propagation through the toroid from BC layer to A layer is now performed in muo_trackreco

- propagation through the calorimeter:

  → propagate the (6×6) error matrix in position and momentum variables by infinitesimal step through a given materiel with a given magnetic field





Algorithm (2) - Plans

• combine the two tracks and the two error matrices and provide the final ones with the χ^2 of the combination:

$$P^F = \left(\sum_{i=1}^{2} E_i^{-1} \right)^{-1} \cdot \left(\sum_{i=1}^{2} E_i^{-1} P_i \right) \qquad E^F = \left(\sum_{i=1}^{2} E_i^{-1} \right)^{-1}$$

status:

→ code written and compared successfully with standalone statistical propagation

→ tests of error matrix result from the fit

plans:

→ debug pull plot in 1/p

→ check the result of the combination

need good segment errors

Conclusion

- local muon track:

→ good efficiency

→ reasonable resolution but very correlated to segment quality

→ need more studies for optimization (timing, RCP cuts, …)

→ need to check error on 1/p

- association with central tracks:

→ need good segment errors

→ need to check if χ^2 gives the possibility to choose the right central tracker track associated with the muon one.