Status of track based vertexing at L3

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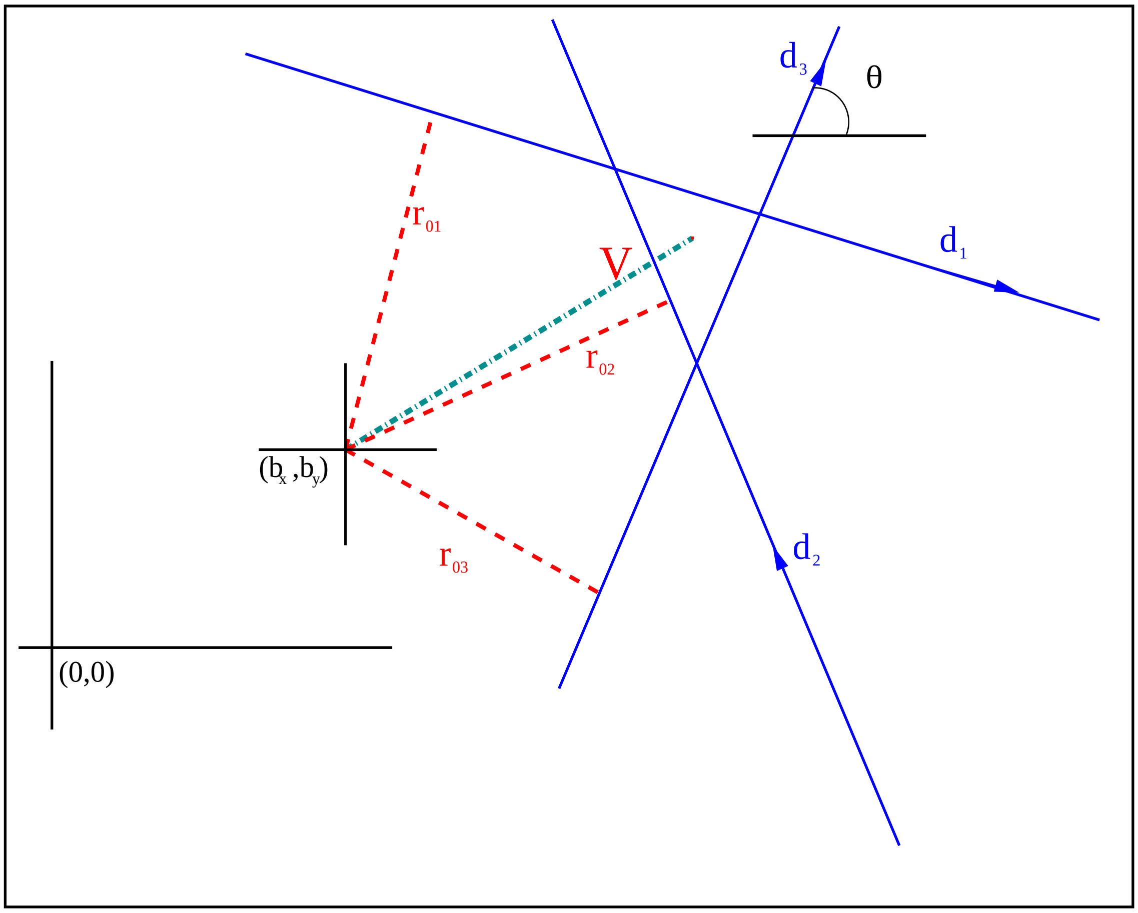
Introduction

- tools are called L3TCFTVertex and L3TXYVertex
- use tracks from the level 3 tracking tools
- L3TCFTVertex run first to find Z postion
- L3TXYVertex uses Z information to find XY position
- requires average beamspot position

XY Method

- place following cuts on the tracks
  1. $N_{SMThitsxy} \geq 3$
  2. $N_{hitsZ} \geq 10$
  3. DCA significance < 3
- require
  $Z_0 - Z_{vertex} <$ 1cm
- recalculate track parameters wrt mean beamspot position, linearise tracks at DCA
- perform a χ^2 minimisation

Impact parameter minimisation



Each track is parameterised by

$$\vec{r_{0i}} + t\hat{d}_i$$

where t is a scalar. At the impact parameter point,

$$t = \vec{V}.\hat{d}_i$$

The method minimises the χ^2,

$$\chi^2 = \sum_{i=1}^{numtracks} \frac{\vec{r_{0i}} + \hat{d}_i.[\vec{V}.\hat{d}_i] - \vec{V}}{{\sigma_i}^2}$$

Using the further parameterisation

$$\hat{d}_i = (cos\theta_i, sin\theta_i)$$

the vertex position can be expressed via the relation

$$V_k = (C_{jk})^{-1} B_j$$

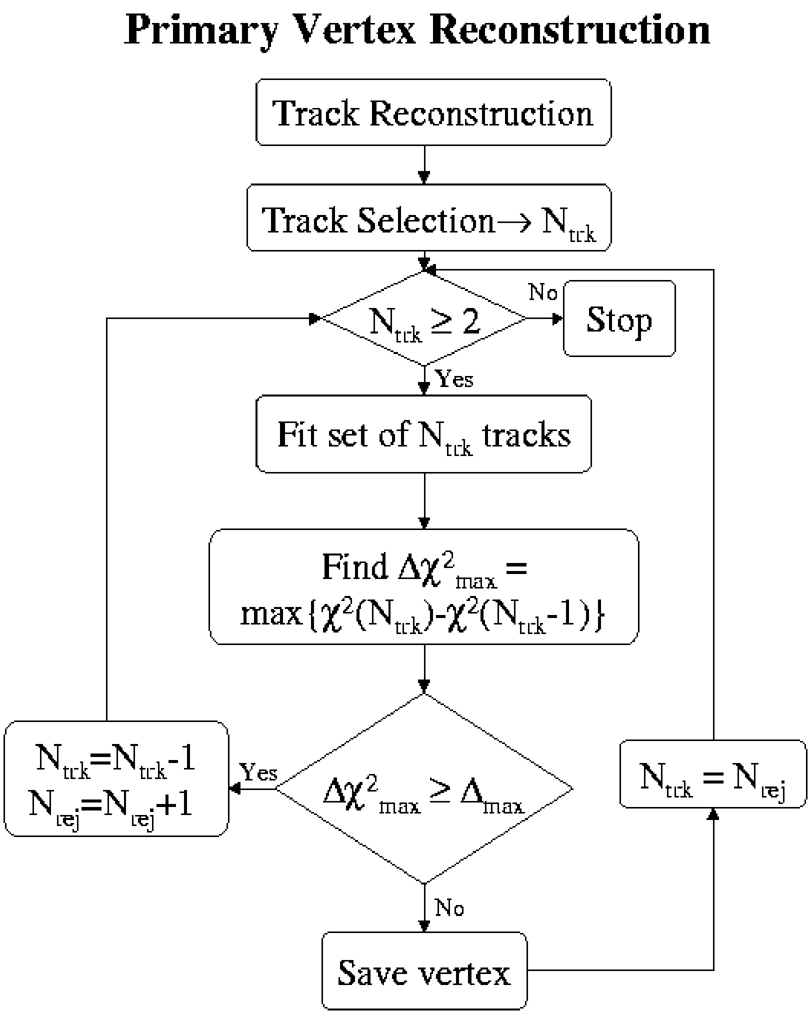
where

$$C_{jk} = \begin{pmatrix} \sum sin^2\theta_i/\sigma_i^2 & -1/2\sum sin2\theta_i/\sigma_i^2 \\ -1/2\sum sin2\theta_i/\sigma_i^2 & \sum cos^2\theta_i/\sigma_i^2 \end{pmatrix}$$

and

$$B_j = \sum_{i=1} \vec{r_{0i}}/\sigma_i^2$$

Primary vertexing algorithm



DCA error description

- previously parameterised error with number SMT hits and P_t
- expect multiple scattering to be dominant at low P_t
- now use

$$P_{scat} = P sin(\theta)^{3/2}$$

- total error given by

$$\sigma_{tot}{}^2 = \sigma_{SMThits}{}^2 F(P_{scat})^2$$

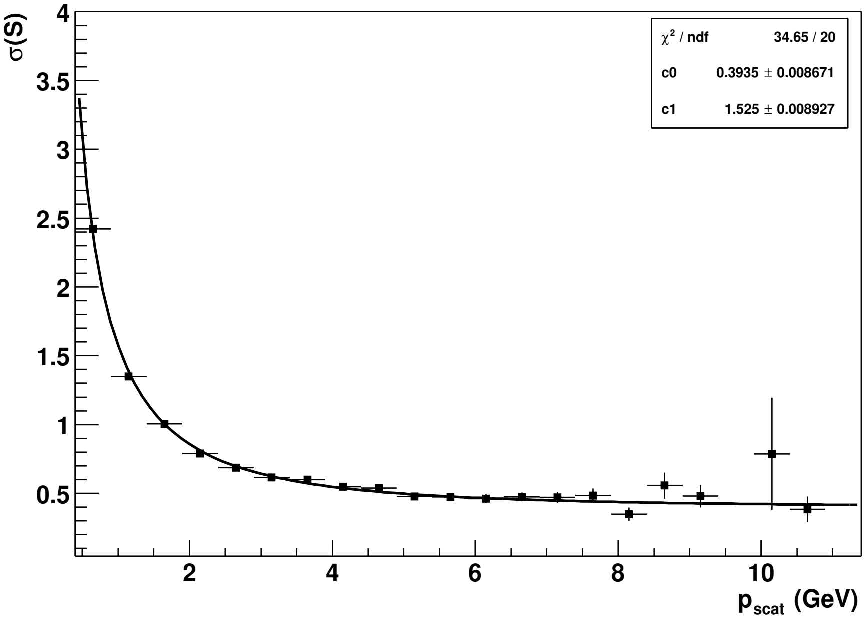
- where

$$F(P_{scat}) = p_0 + \frac{p_1}{P_{scat}{}^2}$$

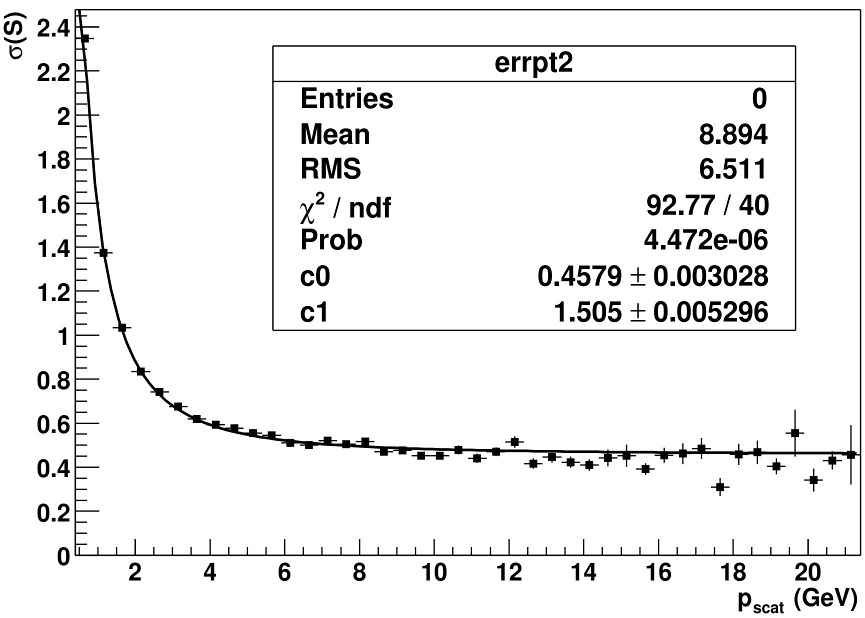
Method

- using QCD Monte Carlo, bin track significance
- fit gaussian to each bin and plot sigma
- fit resulting plot with above function

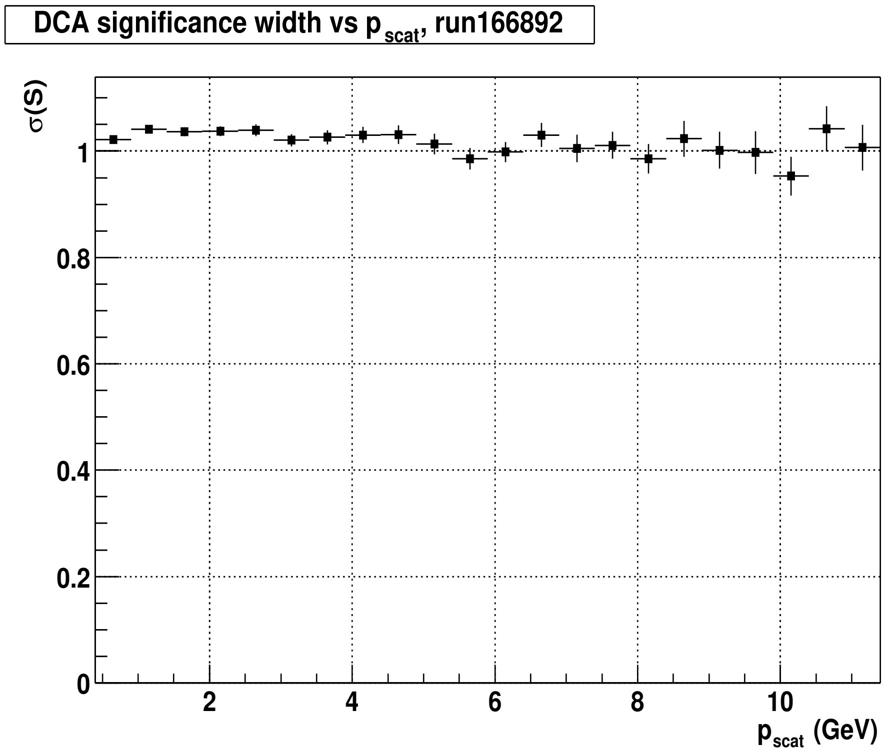
DCA significance width vs p_{scat}, QCD + 0.5 mb, p_T > 10 GeV

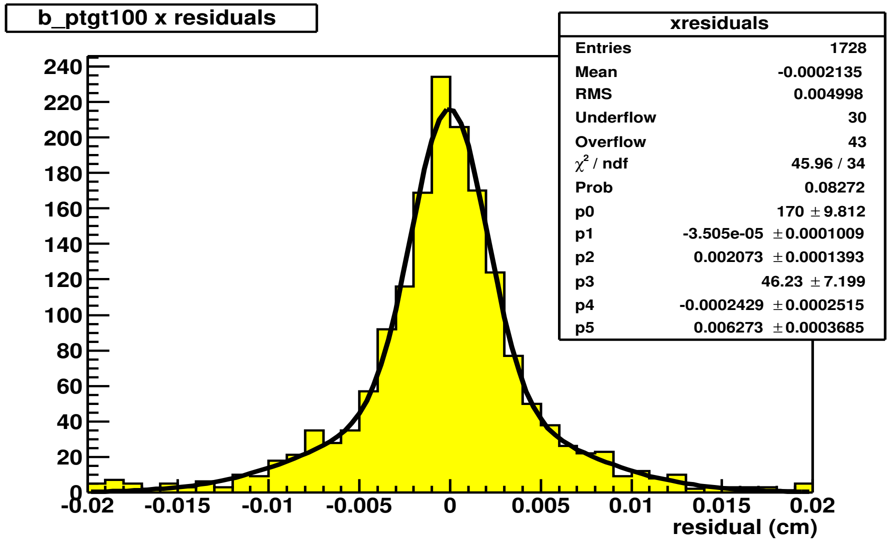


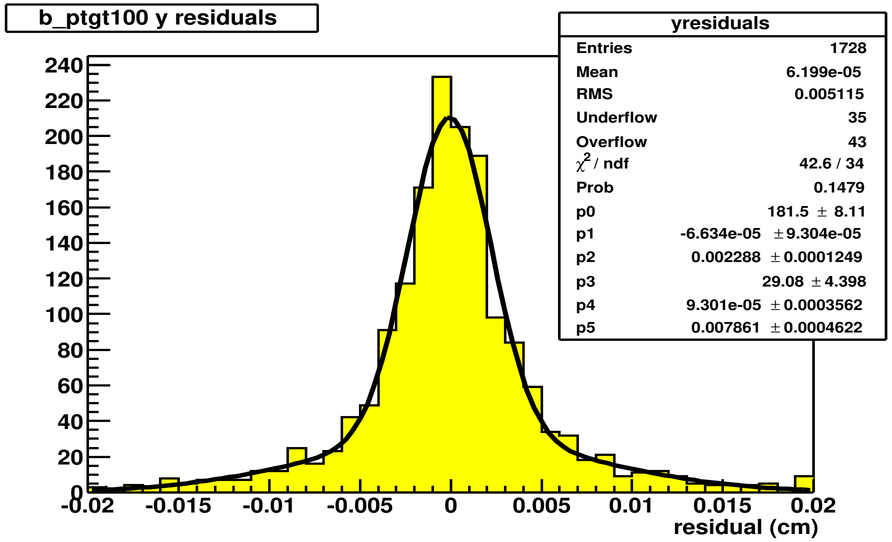
DCA significance width vs p_{scat}, QCD + 0.5 mb, p_T > 40 GeV

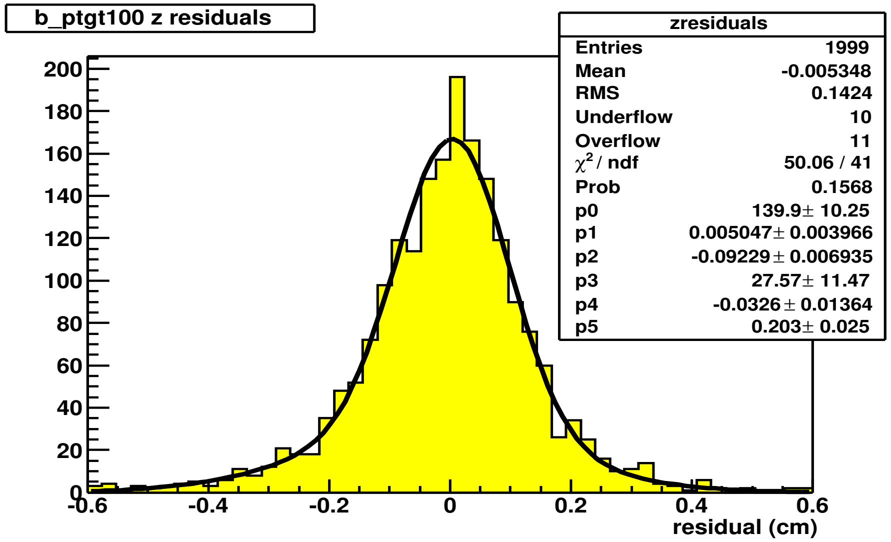


Data with error correction









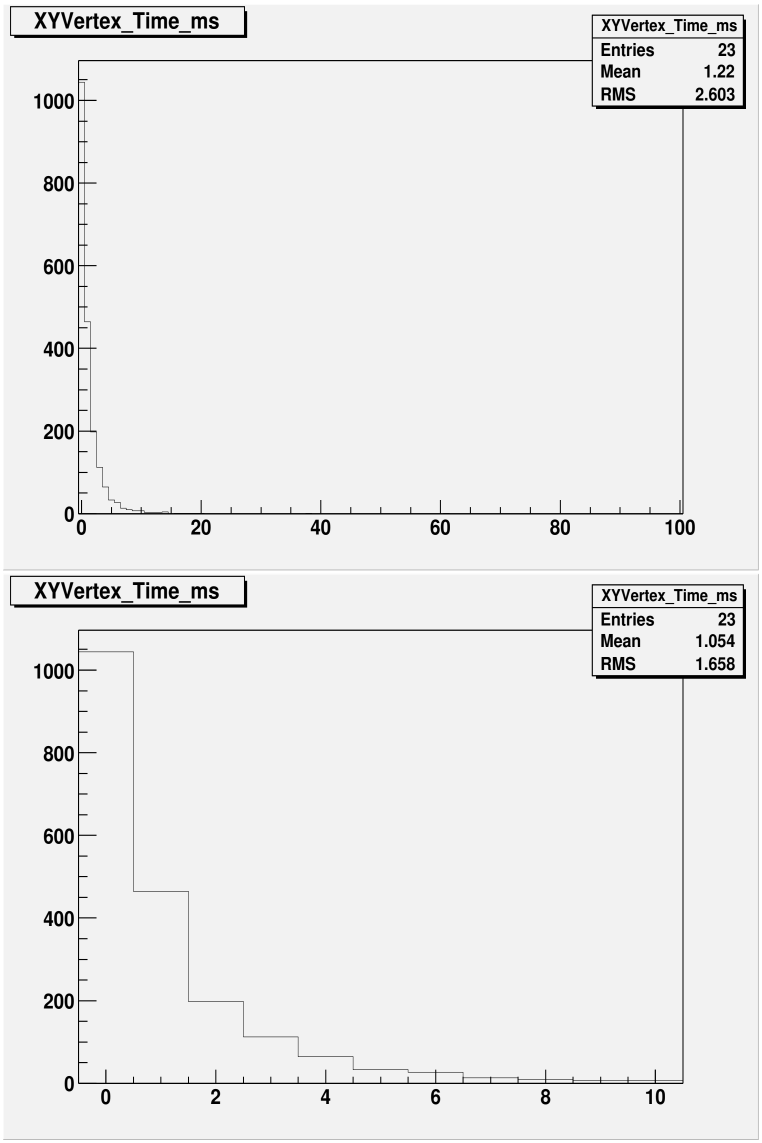
Efficiency in Z = 0.995

Purity in Z = 0.995498

Efficiency in XY = 0.707035

Purity in XY = 0.814236

Timing


XYVertex_Time_ms
XYVertex_Time_ms
Entries 23
Mean 1.22
RMS 2.603
1000
800
600
400
200
0
0
20
40
60
80
100
XYVertex_Time_ms
XYVertex_Time_ms
Entries 23
Mean 1.054
RMS 1.658
1000
800
600
400
200
0
0
2
4
6
8
10

Summary

In p15:

- we have 3D vertex information for p15
- all code is implemented
- can interface with beamspot

Further work:

- tune the algorithm χ^2 cut
- retune track selection parameters
- certification soon!