Tracking and Vertex Finding: Status and Plan

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Current Status

Global Tracking Strategy :

1. Reconstruct TPC tracks (TPCRecoJP, Jon)
2. Reconstruct DC track segments (TrkRBase, Andre)
3. Connect DC to TPC tracks (SPSegAssn, Mark)
4. Fit merged and lone TPC tracks (SPTrack, Mark)

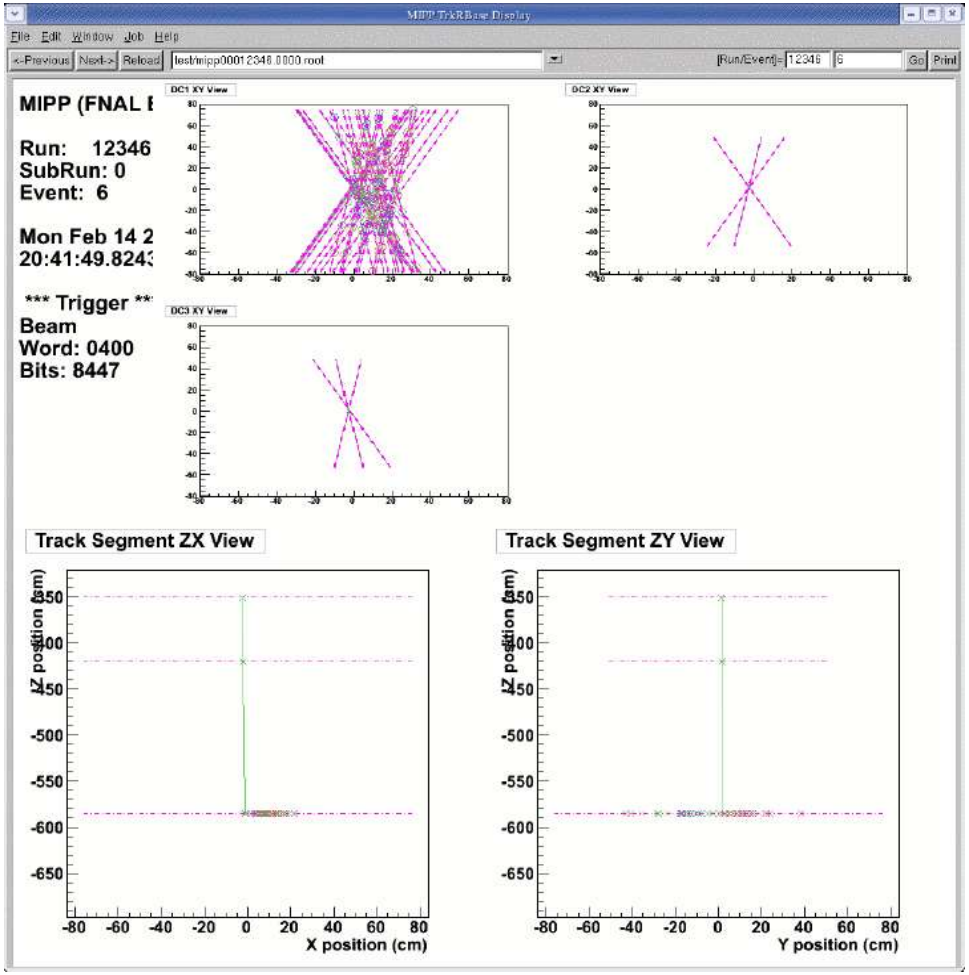
Global Vertexing :

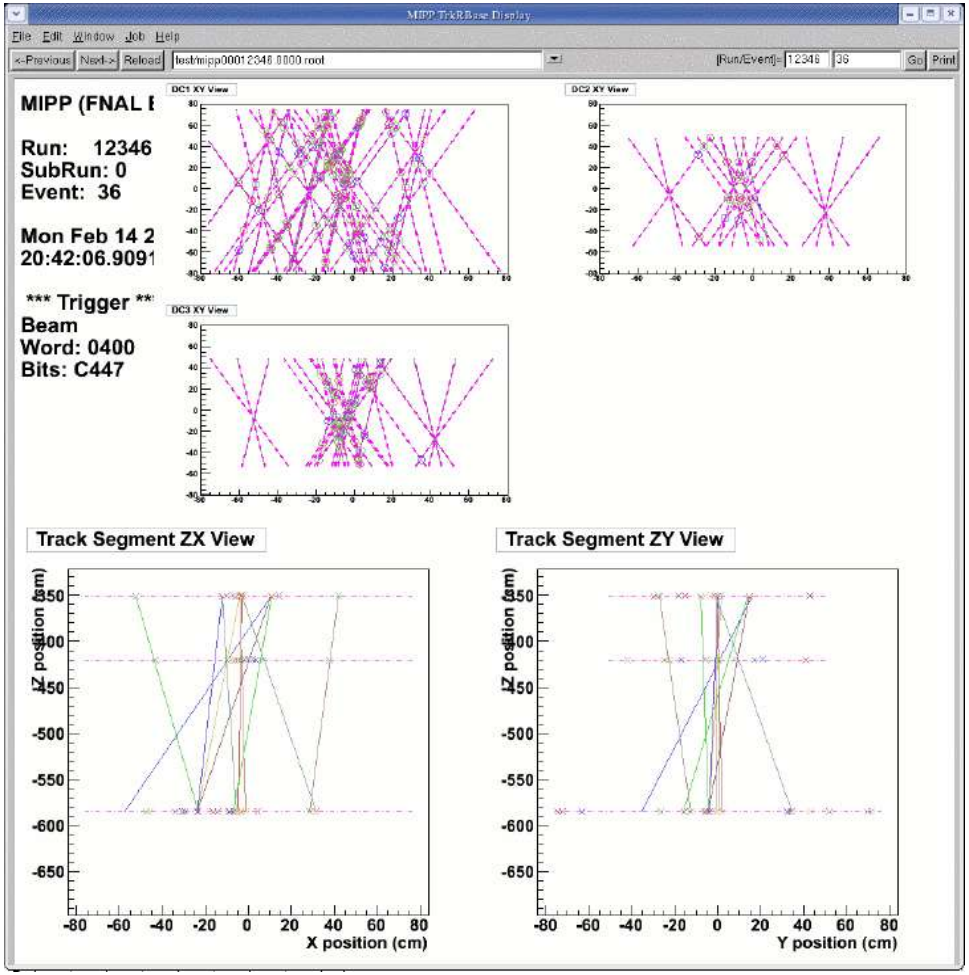
- NA

Existing Base Classes:

- RBTrackPoint :
  reconstructed:
  - $(x(z), y(z), p_x(z), p_y(z), q/p(z))$
  - dE/dx
  - uncertainties
- RBTrack :
  - vector of RBTrackPoints
  - reconstructed g.o.f.
- RBVertex :
  - vector of pointers to RBTracks
  - reconstructed (x,y,z) & uncertainties

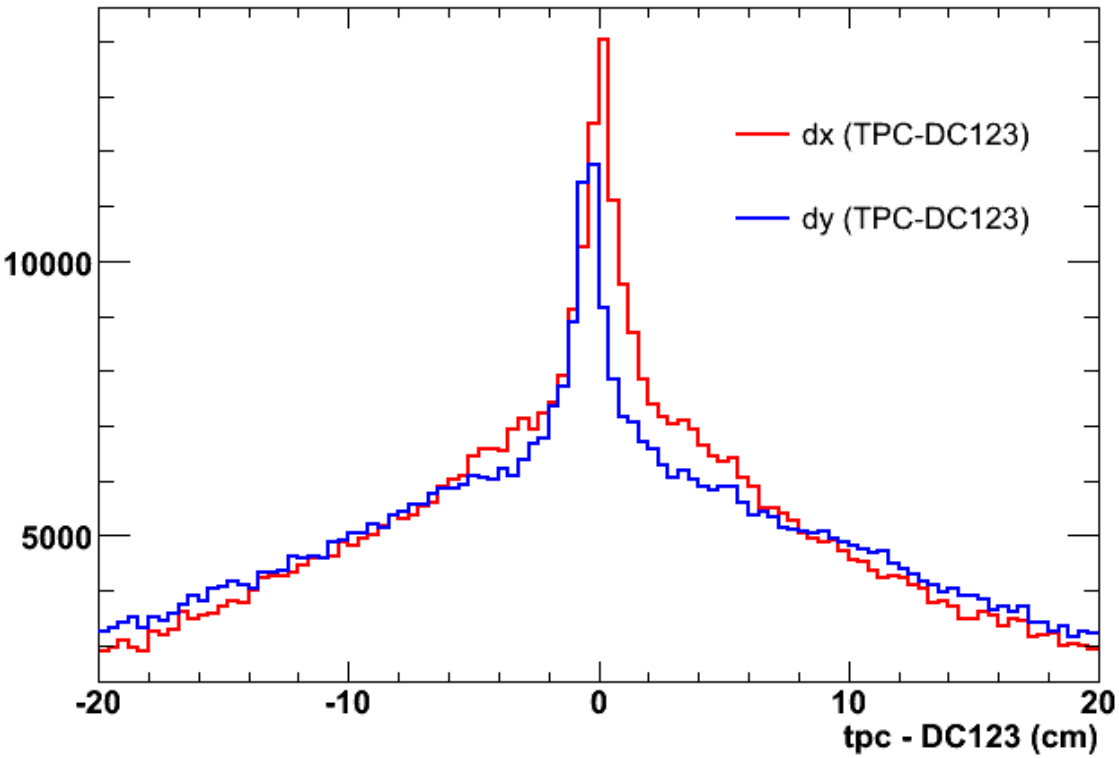
DC Track Segments

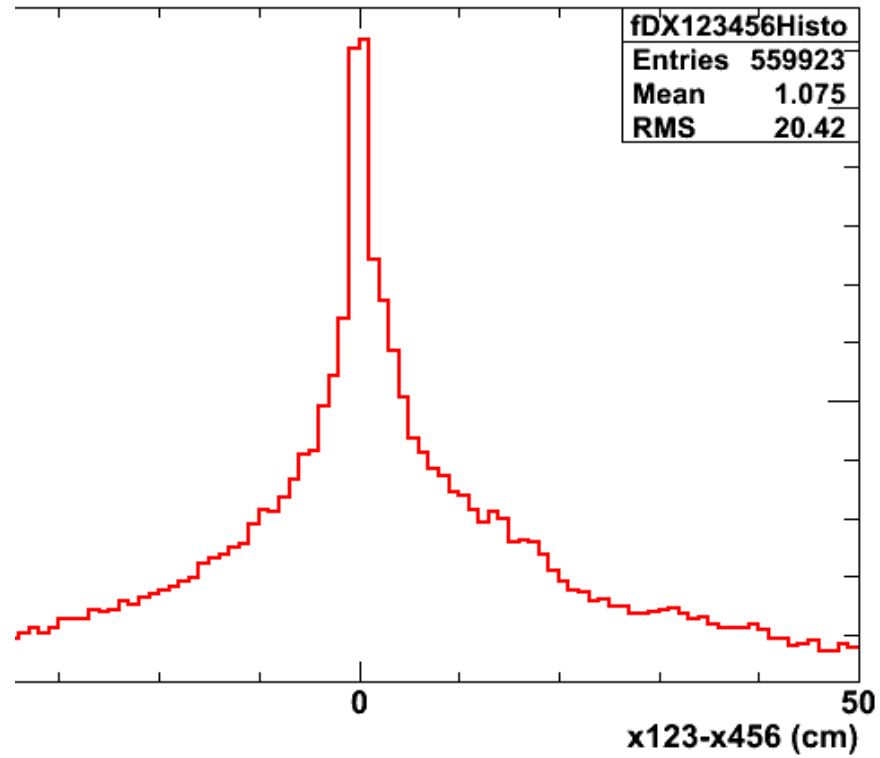




1. Form groups of contiguous wires into clusters
2. Form wire crossings from clusters
3. Form tracks from crossings (and clusters if they match well ...)

SPSegAssn





1. Matches DC123 segments upstream to TPC tracks
2. Matches DC123 segments downstream to DC456 segments
3. All TPC tracks are “saved” regardless of success in matching

Global Tracking: SPFit

Using hits collected by SPSegAssn, SPFit calculates:

$$\vec{\alpha} = \vec{\alpha}_0 + (A^T V^{-1} A)^{-1} A^T V^{-1} (\vec{m} - \vec{f}(\vec{\alpha}_0))$$

where

$$\vec{\alpha} = (x, y, \frac{dx}{dz}, \frac{dy}{dz}, \frac{q}{p}),\ \vec{\alpha}_0 = \vec{\alpha}(z_0)$$

$$\vec{m} = \text{vector of 'n' measurements}$$

$$\vec{f} = \text{predicted values of } (x, y)$$

$$A = \frac{\partial \vec{f}}{\partial \vec{\alpha}}$$

$$V = \text{covariance matrix of } \vec{m} \text{ (weights)}$$

Global Tracking: SPFit

Pros:

- simple
- straightforward
- it works

Cons:

- does not pick hits up on outer regions of drift chambers
- inversion of possibly very large $n \times n$ matrix
- costly numerical evaluation of $\partial \vec{f} / \partial \vec{\alpha}$
- only accurately predicts (x, y) at z_0
- ignores multiple scattering

Where I'd like to go from here...

- Simplify RBTrackPoint so that it holds <u>only</u>:
  - reconstructed (x, y) and $(\Delta x, \Delta y)$ values
  - fit values of $(x, y, dx/dz, dy/dz, q/p)$
  - other fundamental quantities (ie: dE/dx)

- Modify RBTrack to contain generic vector matrices

- Add new track fitting package with the goal of dealing with all “cons” of SPFit; hopefully this will later be easily transformed to a Kalman fitter.

- Finally, refit all tracks with a vertex constraint!