

PseudoTrack Tool

**Reid Mumford, Satyajit Behari, Petar Maksimovic
Johns Hopkins University**

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Motivation for PseudoTrack

Want something that looks like a real track without detector hits.

A PseudoTrack w/

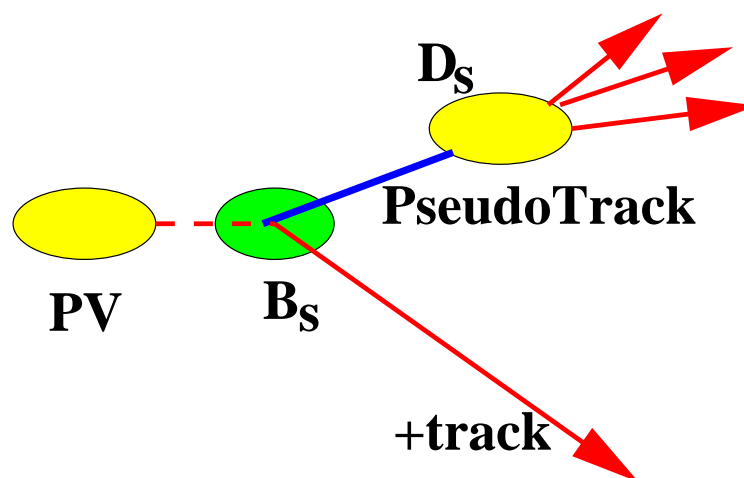
5 track parameters and full 5x5 track covariance matrix.

The tool is useful for an inclusive analysis such as

$$B_s^0 \rightarrow D_s X$$

Only the tertiary vertex is reconstructed and the secondary vertex is still unknown.

PseudoTrack can be used in B_s^0 vertex fitting.



PseudoTrack History

This idea is not new.

Joe Boudreau implemented PseudoTracks years ago in TrackingUtils/PseudoTrack.

However

- The code has not been maintained.
- SpacePointProgressiveFitter to fit tracks into a ProductionVertex.
- PseudoTracks are derived from ProductionVertex.
- Non-trivial initialization incantations.

Much of this functionality is already provided by Sin2BetaMods framework.

We want to simply create a “track” starting from a CTVMFT vertex.

Calculating PseudoTracks

New PseudoTrack functionality added to Sin2BetaMods, Universal Finder framework

1. Start w/ a fitted vertex (\vec{x} , \vec{p} , and 6x6 error matrix, $\Sigma(\vec{x}, \vec{p})$).
2. Calculate track parameters using [Trajectory/Helix](#)
3. Calculate partial derivatives (track parameter expressions from CDFNote 1790).

$$V_{ij} = \frac{\delta(f_j)}{\delta x_i}$$

where $f_j = \{cot(\theta), Curv, z_0, d_0, \phi_0\}$ and $x_i = \{x, y, z, p_x, p_y, p_z\}$.

- derivatives computed using Mathematica.

4. Similarity transform from 6x6 \vec{x} and \vec{p} errors to 5x5 Track Parameter errors

$$\Sigma'(cot\theta, C, z_0, \phi_0, d_0) = V^T \Sigma(\vec{x}, \vec{p}) V$$

Testing Performance

First tests done on a $D_s^+ \rightarrow \phi\pi^+$ Pythia msel=5 sample.

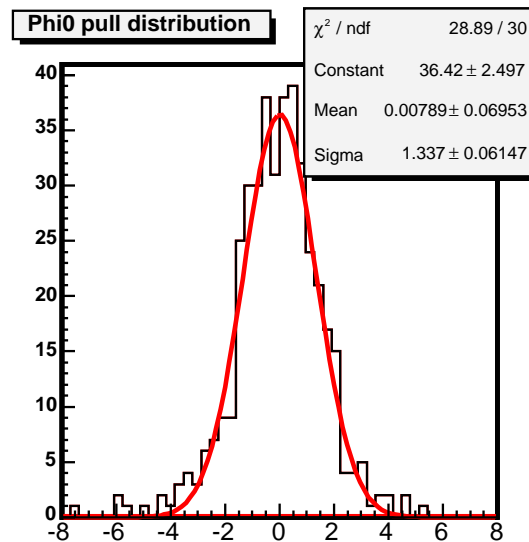
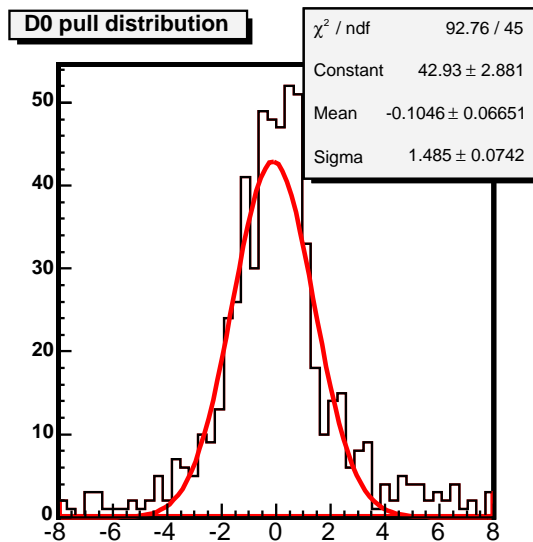
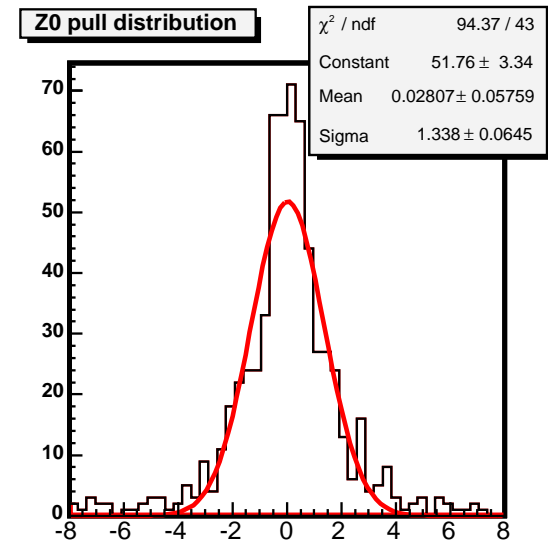
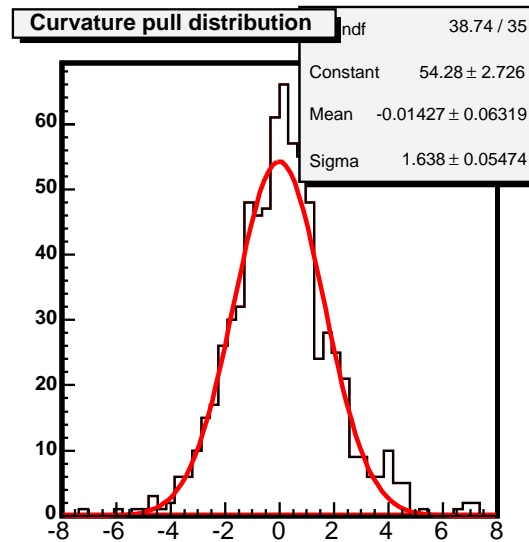
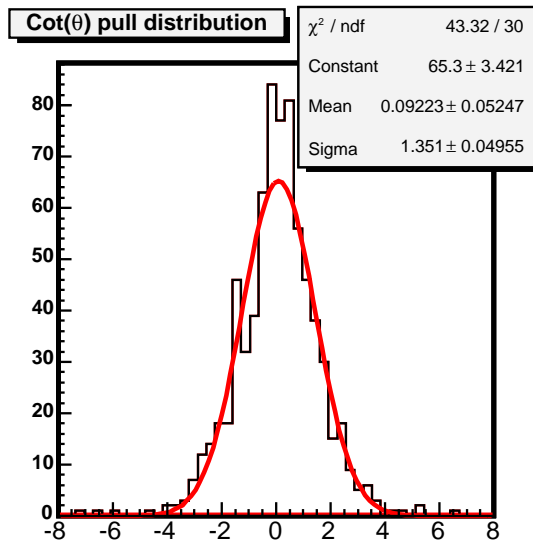
- Check performance on charged tracks.
- Compare **PseudoTrack** calculated from reconstructed D_s to track calculated from **HEPG & OBSV truth** information.
- Compute pulls for all track parameters, i .

$$Pull_i = \frac{PST_i - TRUE_i}{\sigma_{PST_i}}$$

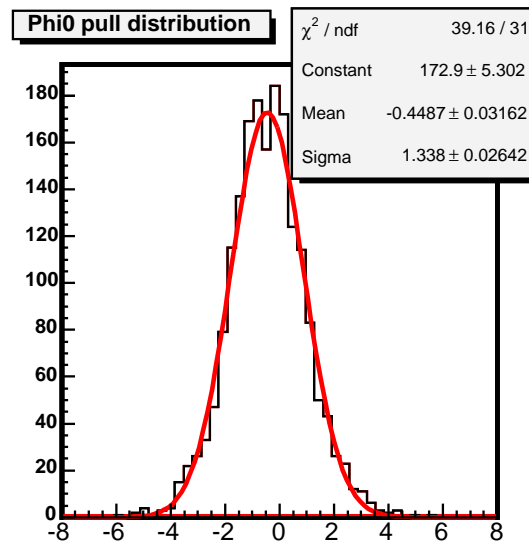
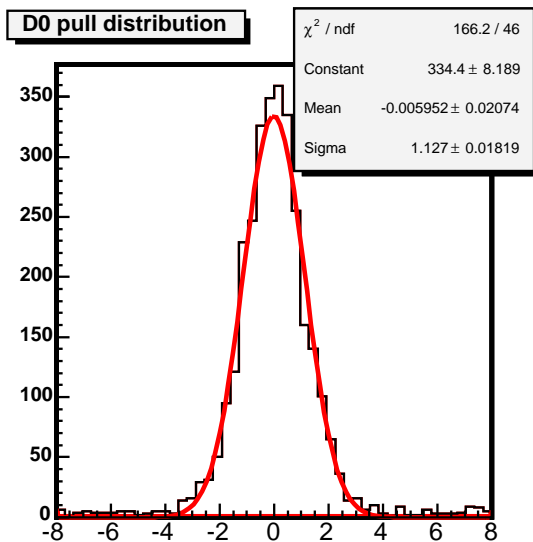
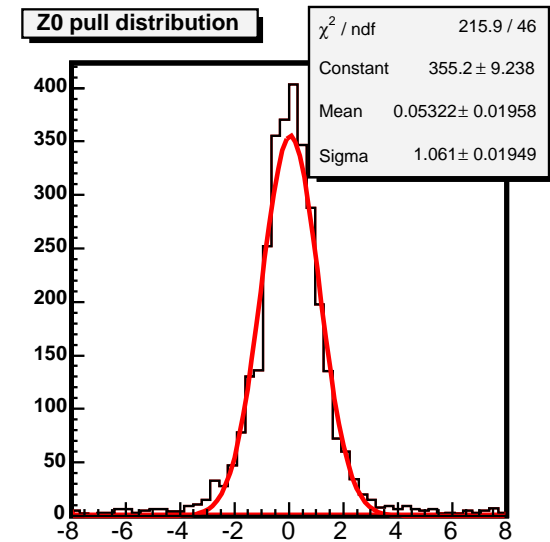
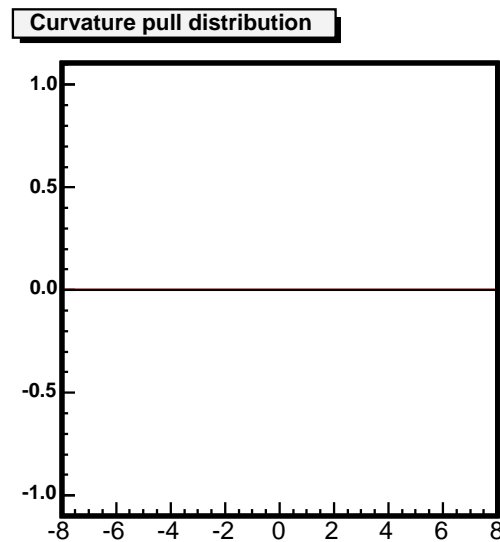
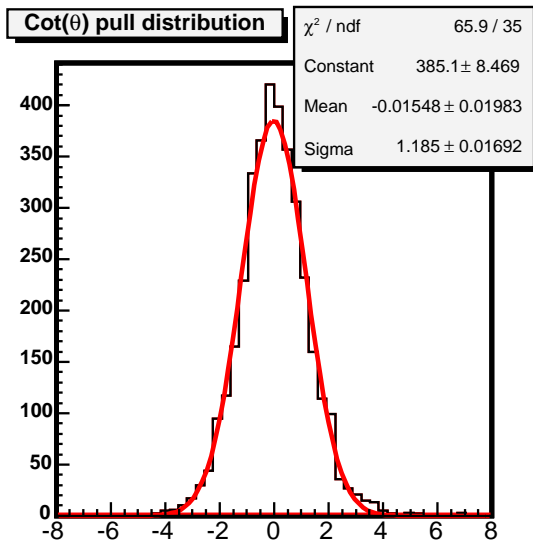
Second tests done on a $B^+ \rightarrow D^0\pi$ msel=1 MC sample.

- Check performance on neutral tracks.
- Compare **PseudoTrack** calculated from reconstructed D^0 to track calculated from **HEPG & OBSV truth** information.

Pull Distributions: D_s^+ Charged PseudoTrack



Pull Distributions: D^0 Neutral PseudoTrack



Summary and Outlook

Summary

Pull distributions are okay with reasonable fits and widths ($\sigma \sim 1.1 - 1.6$).
New PseudoTrack is working as expected.

Future plans

- Use PseudoTracks with Topological Vertexing tool to pin down secondary vertex in inclusive reconstruction.
- PseudoTracks give us flexibility to use other vertexing tools (ie SecVtx) to find secondary vertices.
- More to come