Hit-Based Kalman Filter Update

Larsoft Tracking/Reconstrction Meeting
Aug. 8, 2012

H. Greenlee

Outline

- Overview.
- Recent updates.
- Tracking performance of Track3DKalmanHit module.
- Tasks.

Overview

- Classes in larsoft (TrackFinder package).
  - Algorithm class KalmanFilterAlg.
  - Producer module Track3DKalmanHit.
  - Analyzer module TrackAna (new).
    - Should work with any kind of Track objects.

Recent Updates

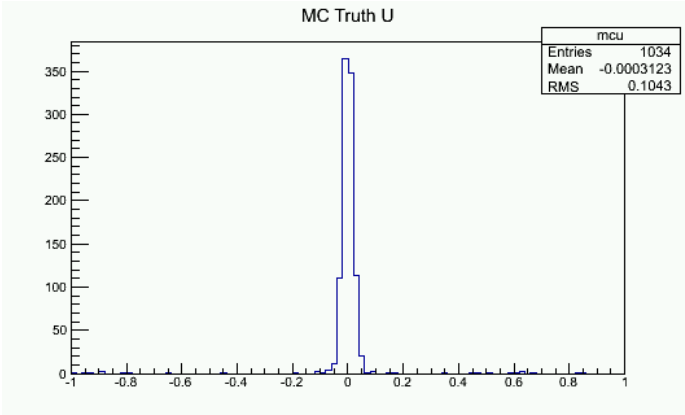
- KalmanFilterAlg.
  - No algorithm updates per se recently.
  - Updated to use new seed finder interface (SeedFinderAlgorithm).
- Track (RecoBase).
  - Add method to calculate rotation matrix between gloal (x,y,z) and local (u,v,w) coordinate systems for any given trajectory point.
- Track3DKalmanHit.
  - Now fills all Track attributes.
  - Error matrix is 5x5 in (u,v,w) coordinate system.
- TrackAna.
  - New analyzer module.

Track Performance Studies Using TrackAna

- Test sample: 1000 MicroBooNE single muons.
  - Flat momentum distribution 0.5-5.0 GeV/c.
  - Starting near upstream end of detector.
  - $\theta = 0 \pm 10°$ (both projections).
- MC particle vs. reco Track matching.
  - Start position $\Delta r_{uv} < 2$ cm.
  - Start position $\Delta w < 2$ cm.
  - Colinearity > 0.99.
  - Additionally require (reco length) > 0.5 * (mc length) for track to be considered "well reconstructed."
    - 969/1000 track pass well-reconstructed cuts (96.9%).

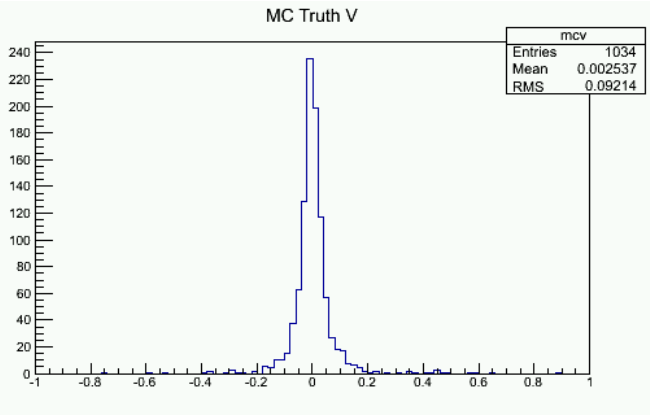
Track Start Position Resolution

U Impact Parameter



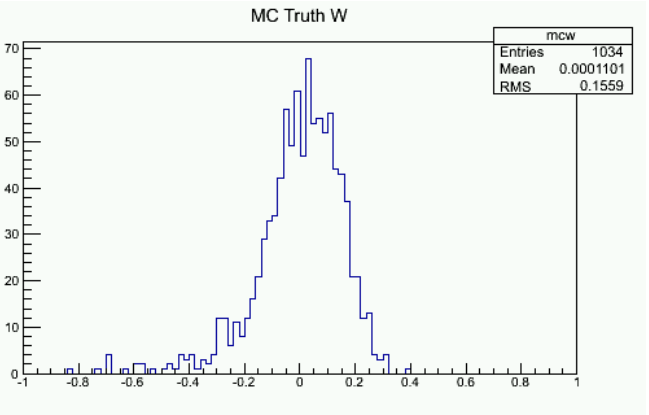
(cm)

V Impact Parameter



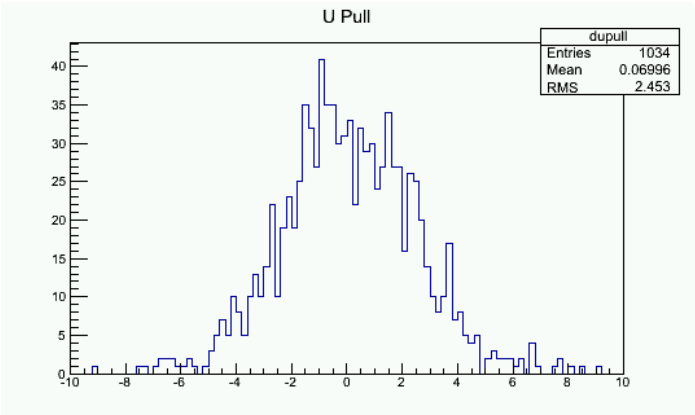
(cm)

W Impact Parameter

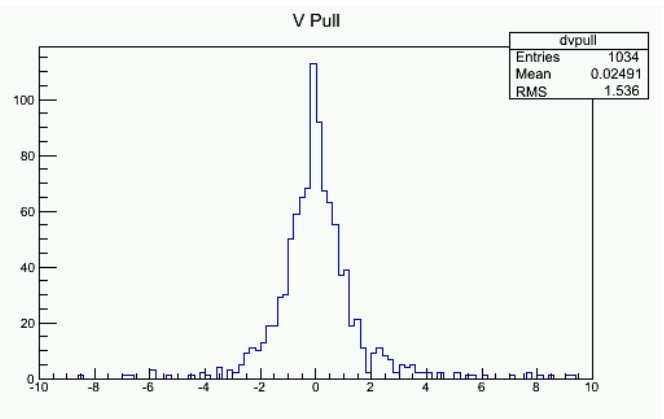


(cm)

U Pull

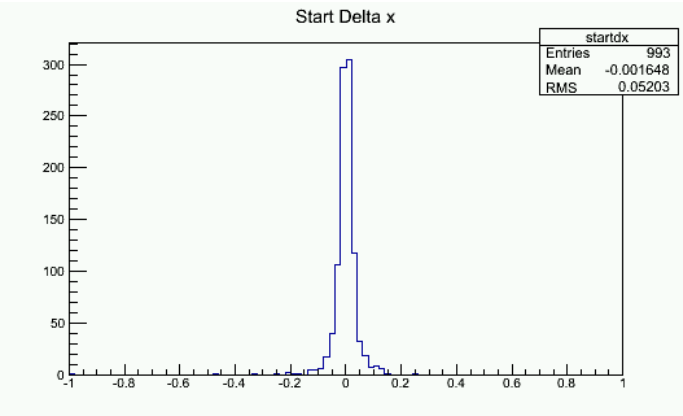


V Pull



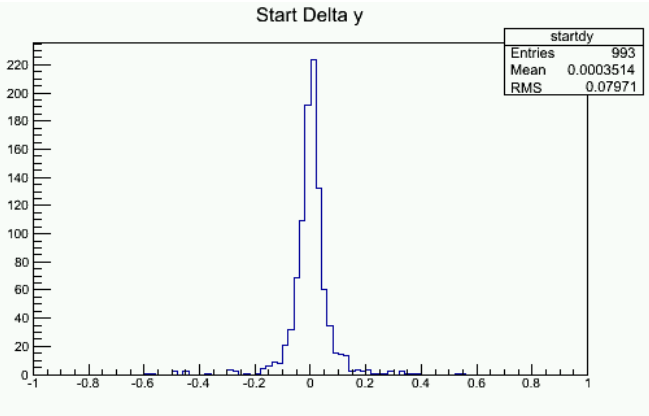
Track Start Position Resolution

X Resolution



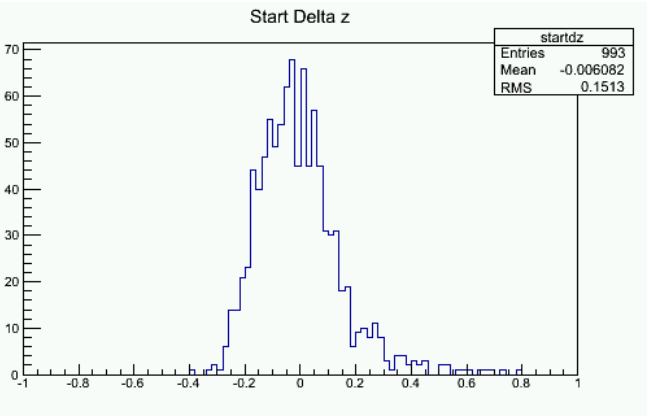
(cm)

Y Resolution



(cm)

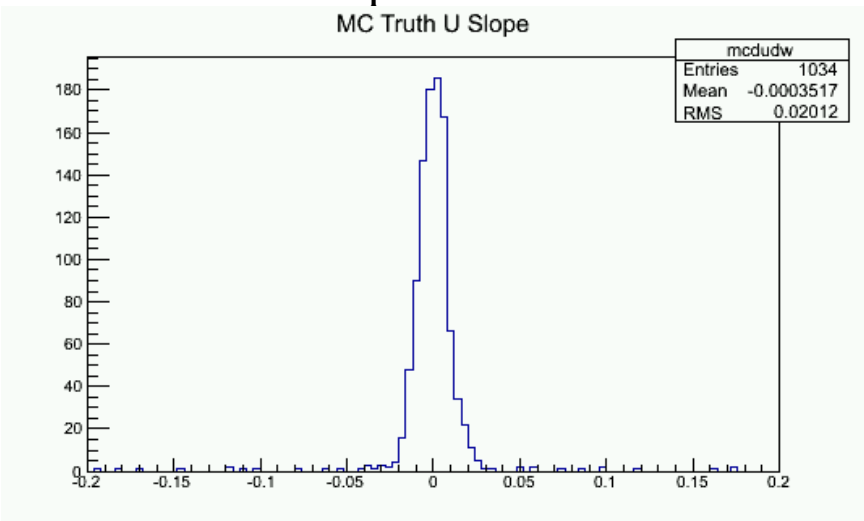
Z Resolution



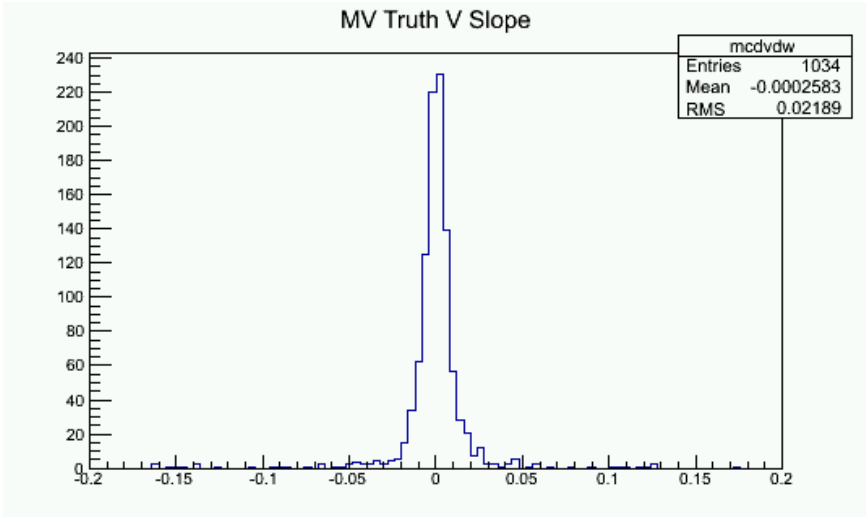
(cm)

Track Slope Resolution

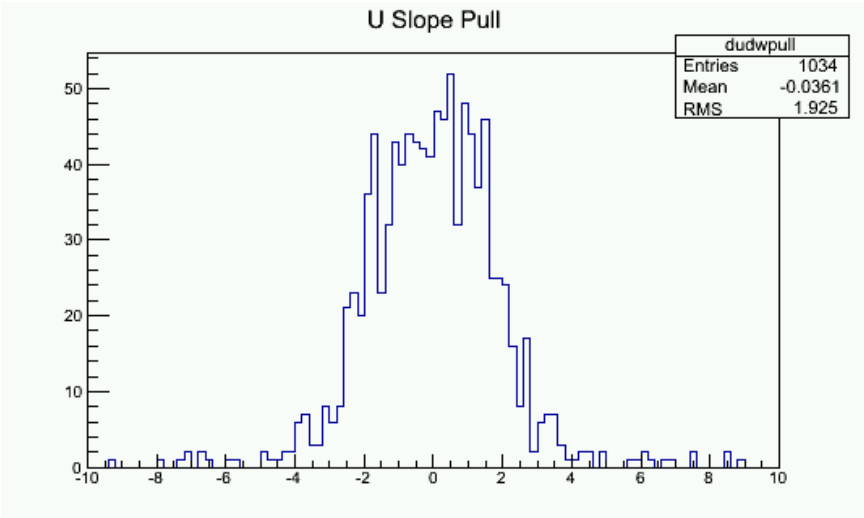
U Slope Resolution



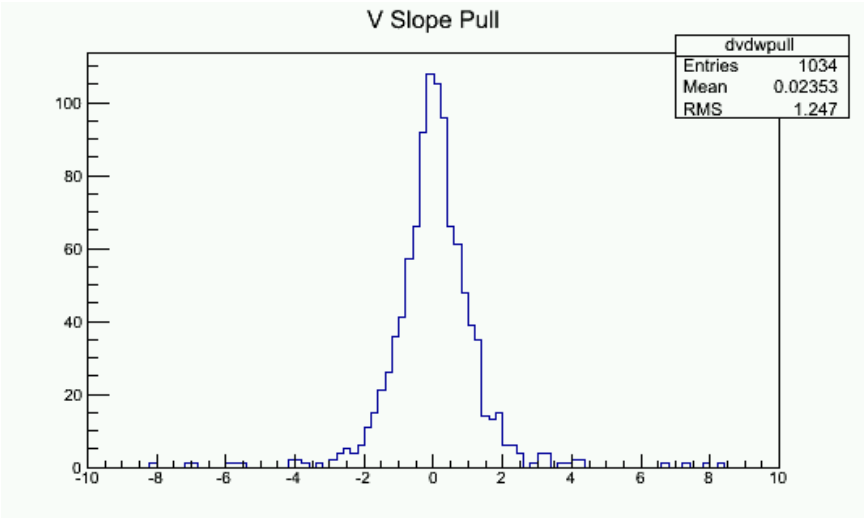
V Slope Resolution



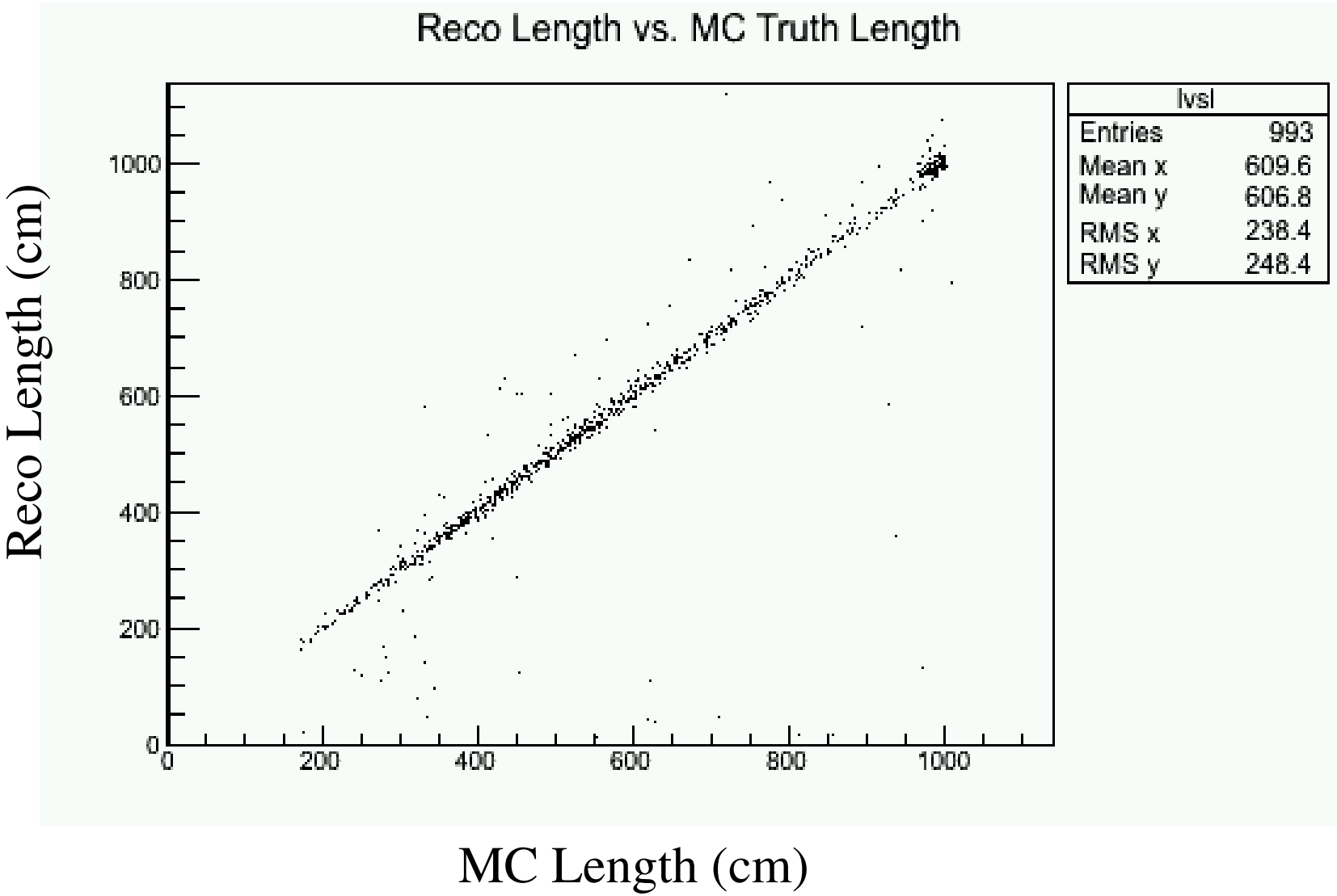
U Slope Pull



V Slope Pull



Track Length Comparison

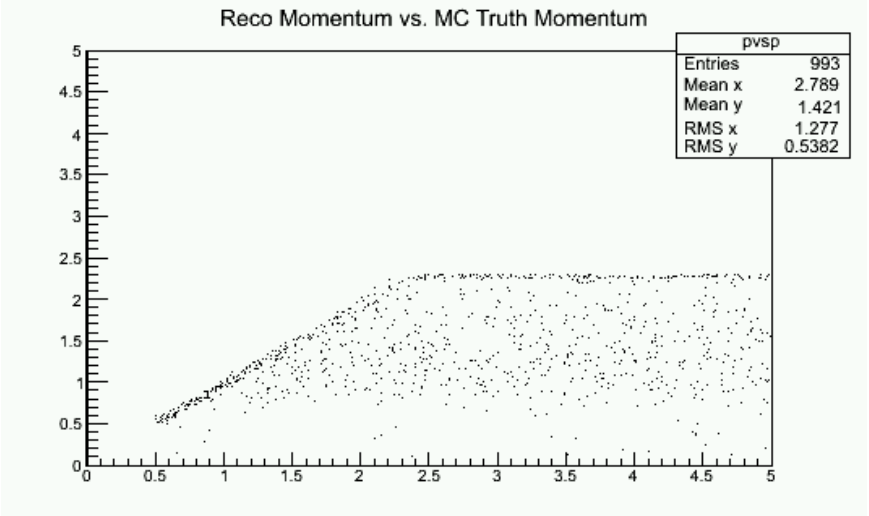


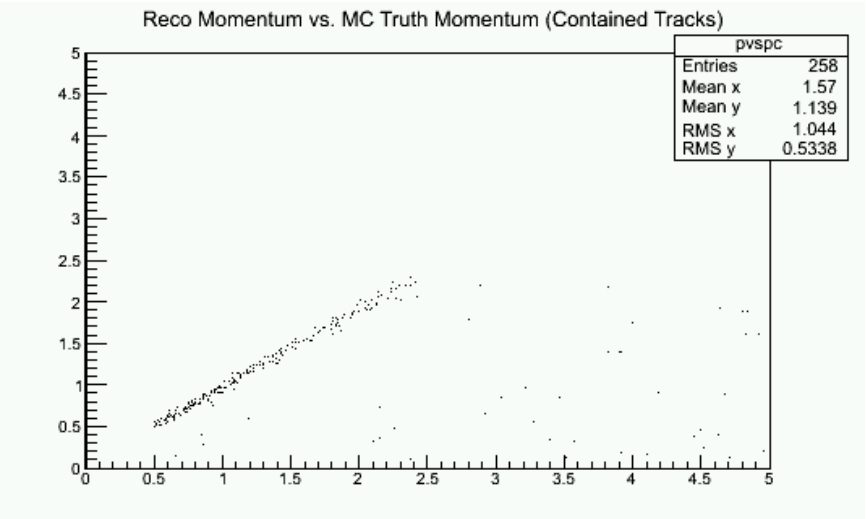
Range Momentum Comparison

All Tracks

Contained Tracks

Reco Momentum (GeV/c)

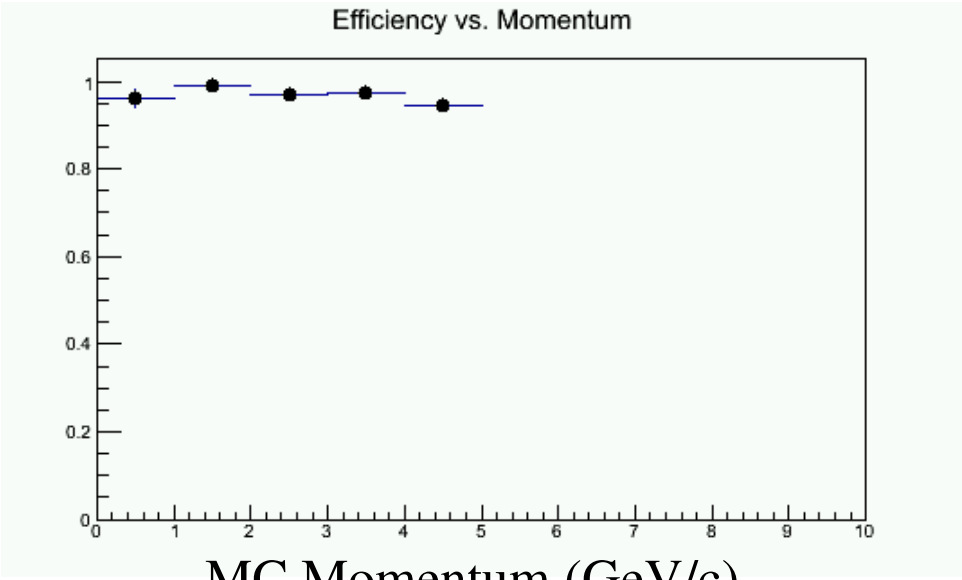




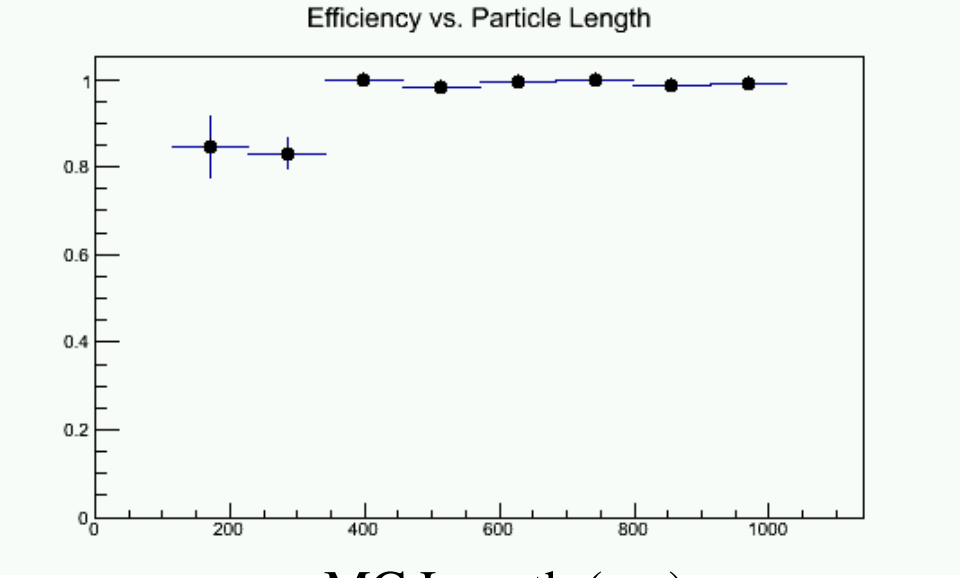
MC Momentum (GeV/c)

MC Momentum (GeV/c)

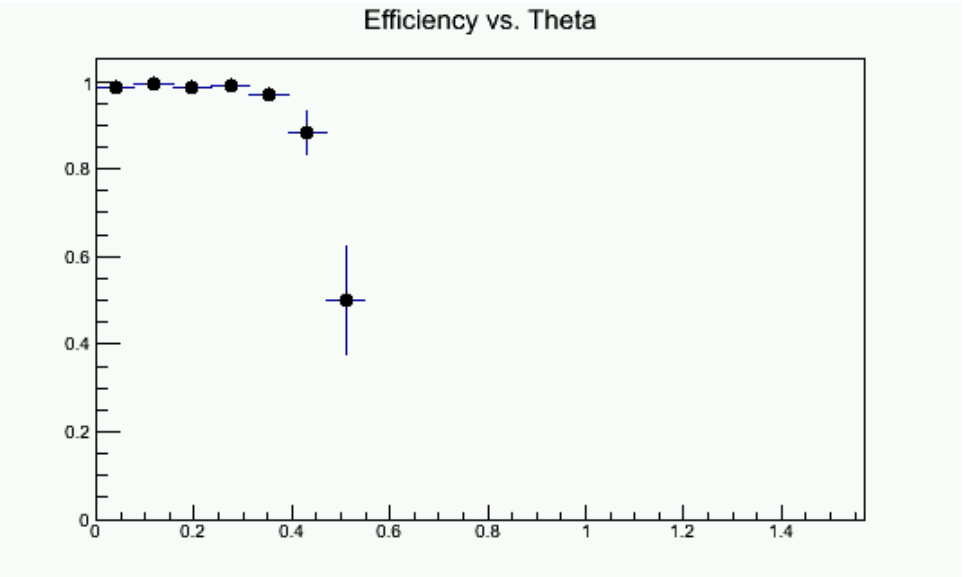
Track Efficiency



MC Momentum (GeV/c)



MC Length (cm)



MC θ

Tasks

- Add refinements and additional histograms in TrackAna.
- Measure track performance with additional kinds of events.
  - Other particle types.
  - Physics-type (genie) events.
- Track algorithm improvements.
  - Better momentum determination for non-contained tracks (i.e. MS momentum).
  - Study track reconstruction misbehaviors (e.g. large-θ inefficiency) with a view to improving performance.