CC1π^+ Fitter

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fiTQun Workshop

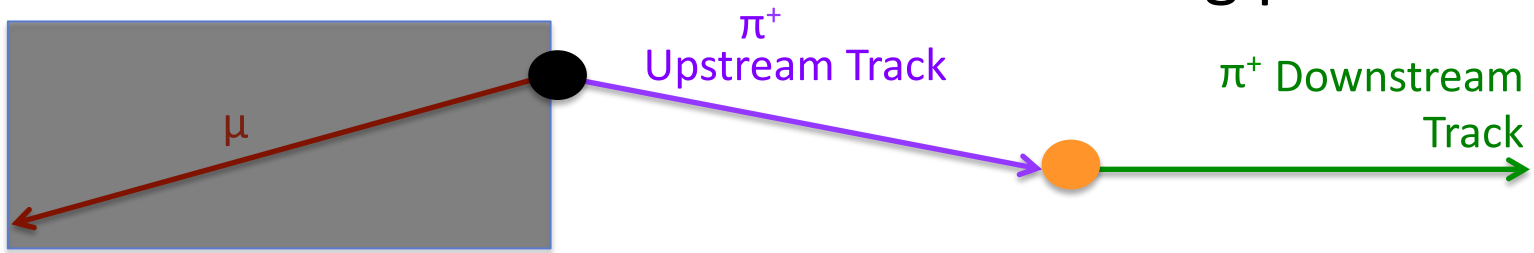
August 20, 2015

Outline

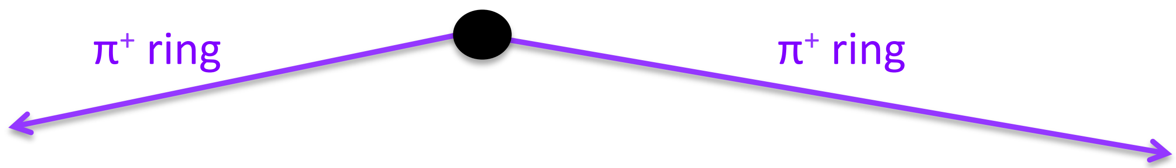
- Review of $\pi+$ fit performance on $\pi+$ particle gun
- Work in Progress:
  - Re-incorporating the μ
  - Fit performance/selection efficiency on T2K MC

π^+ Fitter

- Understand π^+ fit before move on to fitting $\mu + \pi^+$



- Existing 2 ring π fit assumes both rings come from one vertex

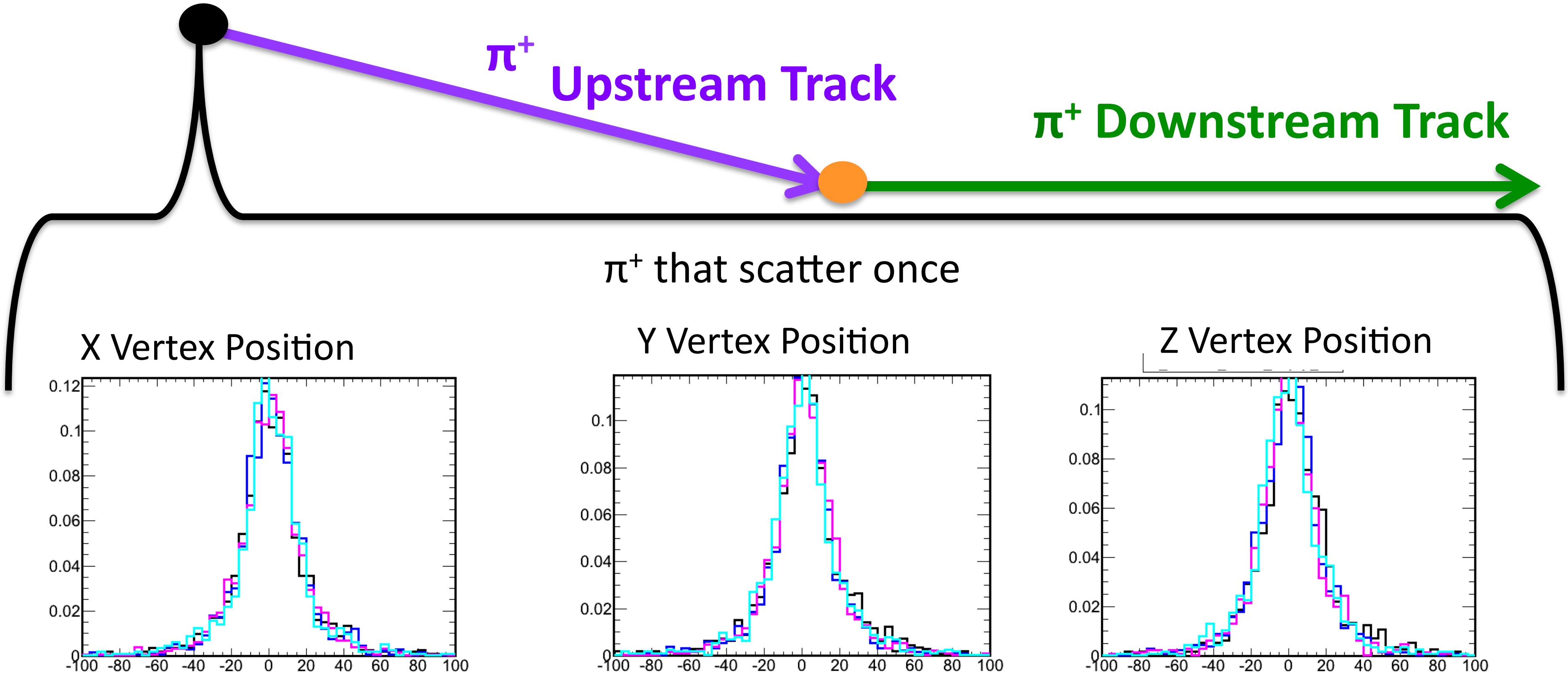


- Run on π^+ particle gun with momentum from 0-1 GeV.
- Cuts: FCFV, remove in-gate decay electrons, evis>30.
- All plots shown are area normalized

π^+ Fitter Configurations

- Seed with truth information, 'theoretical limit' on how well fit can perform
- Best previous fit with reconstructed seed: Seed upstream ring with the higher momentum ring of 2R π fit and downstream ring with a grid search
- Seed with both combinations of 2R π fit. Do the fit in both combinations and select the one with the better likelihood.
- Seed with each ring of the 2R π fit as the US rings, and do a grid search on both for the DS rings. Do the fit in both combinations and select the one with the better likelihood

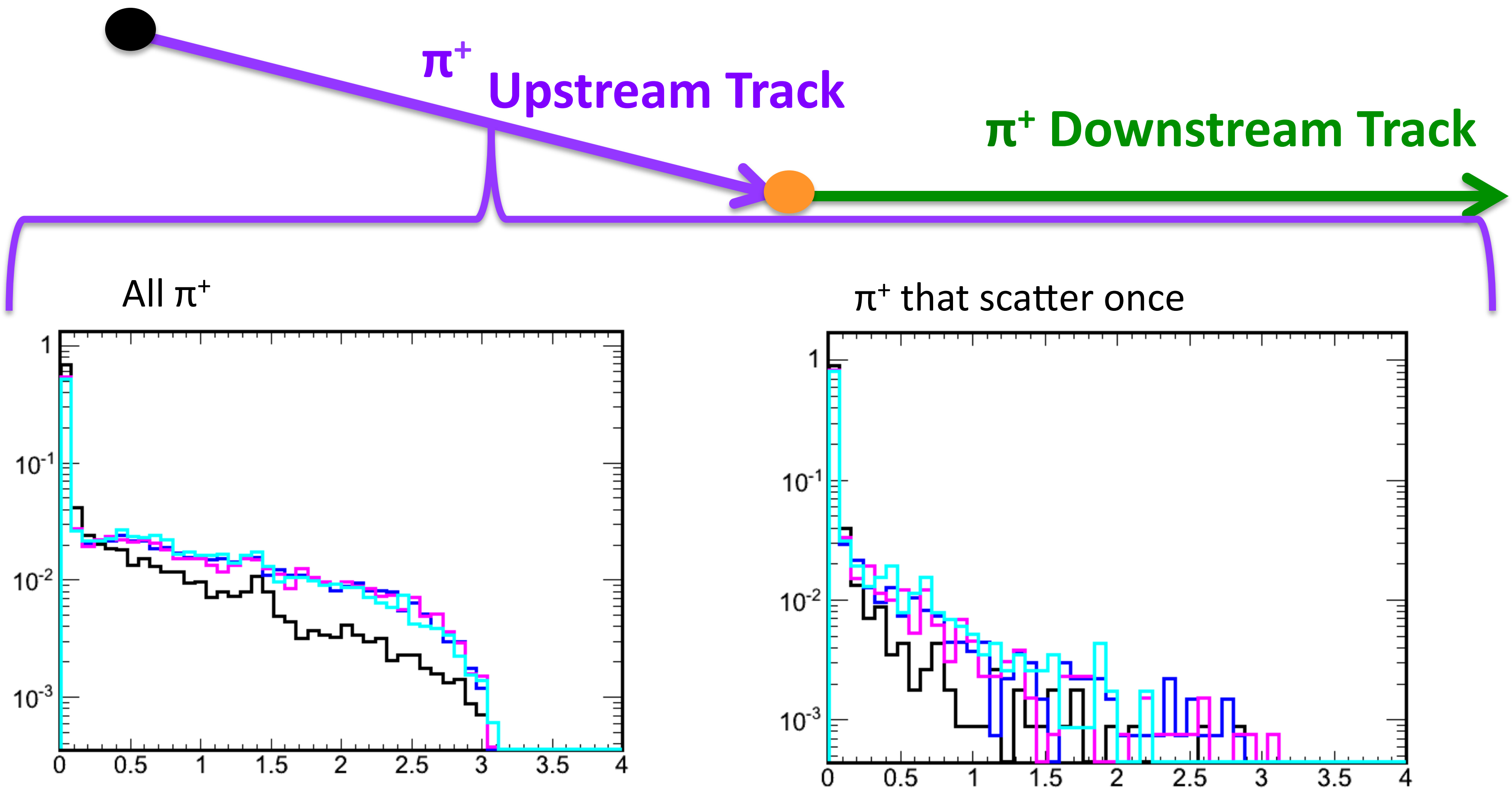
Upstream Vertex Resolution



vtx_{fit}-vtx_{true} (cm)

- Vertex resolution is about the same for all configurations

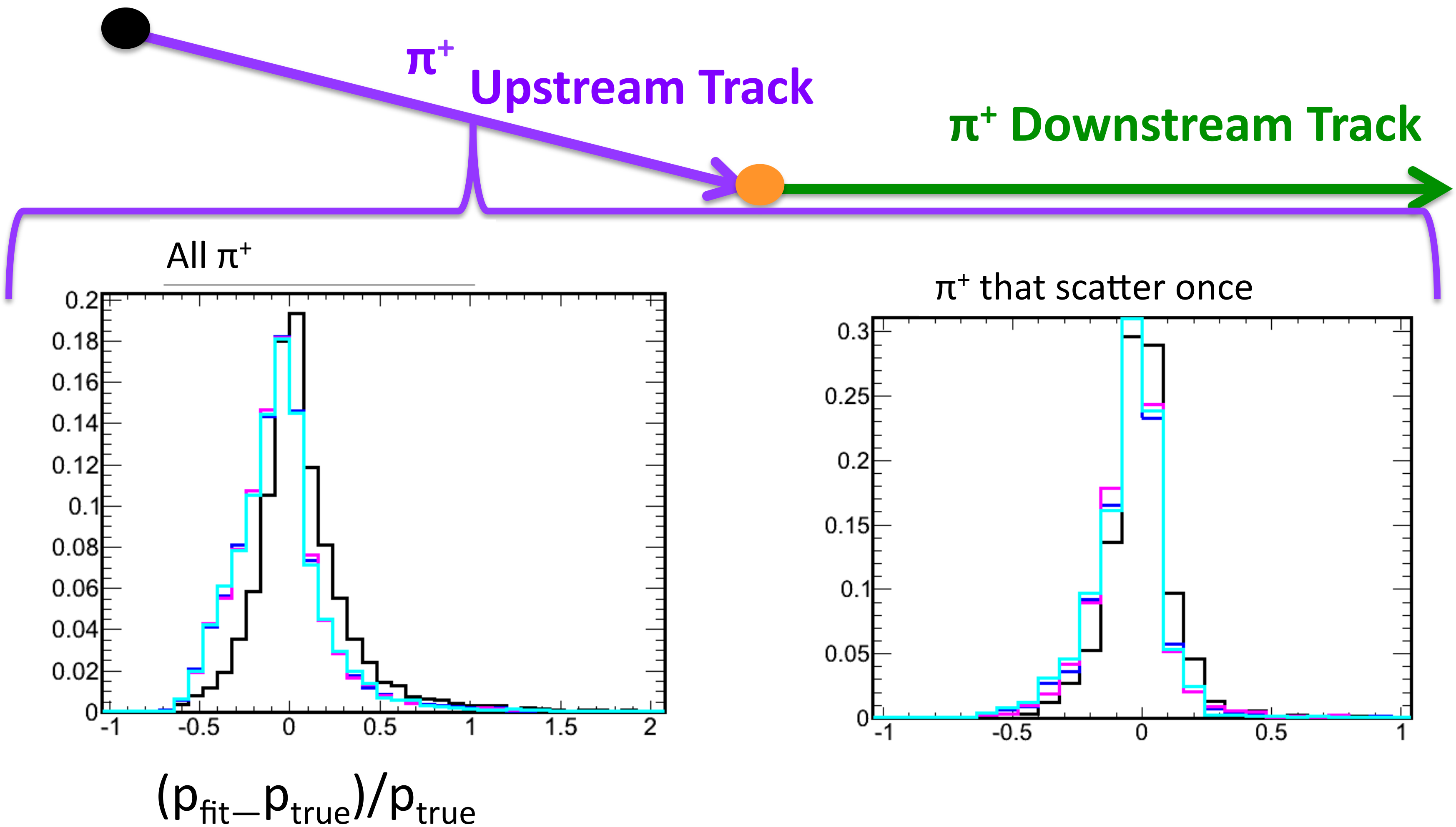
Upstream Angle Between True & Reconstructed



Angle Between True and Reconstructed Directions (radians)

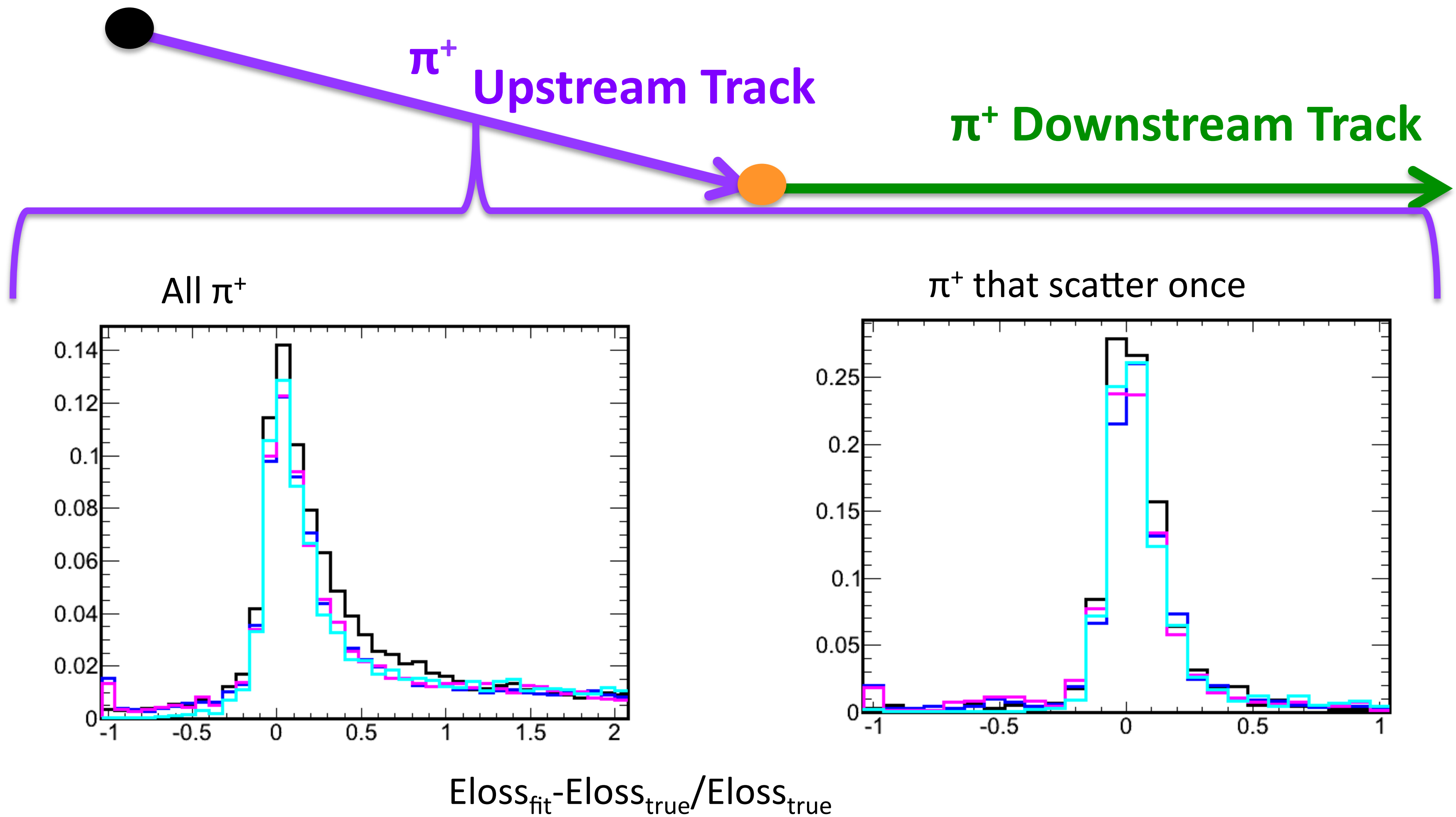
- About the same for all fitter configurations

Upstream Momentum Resolution



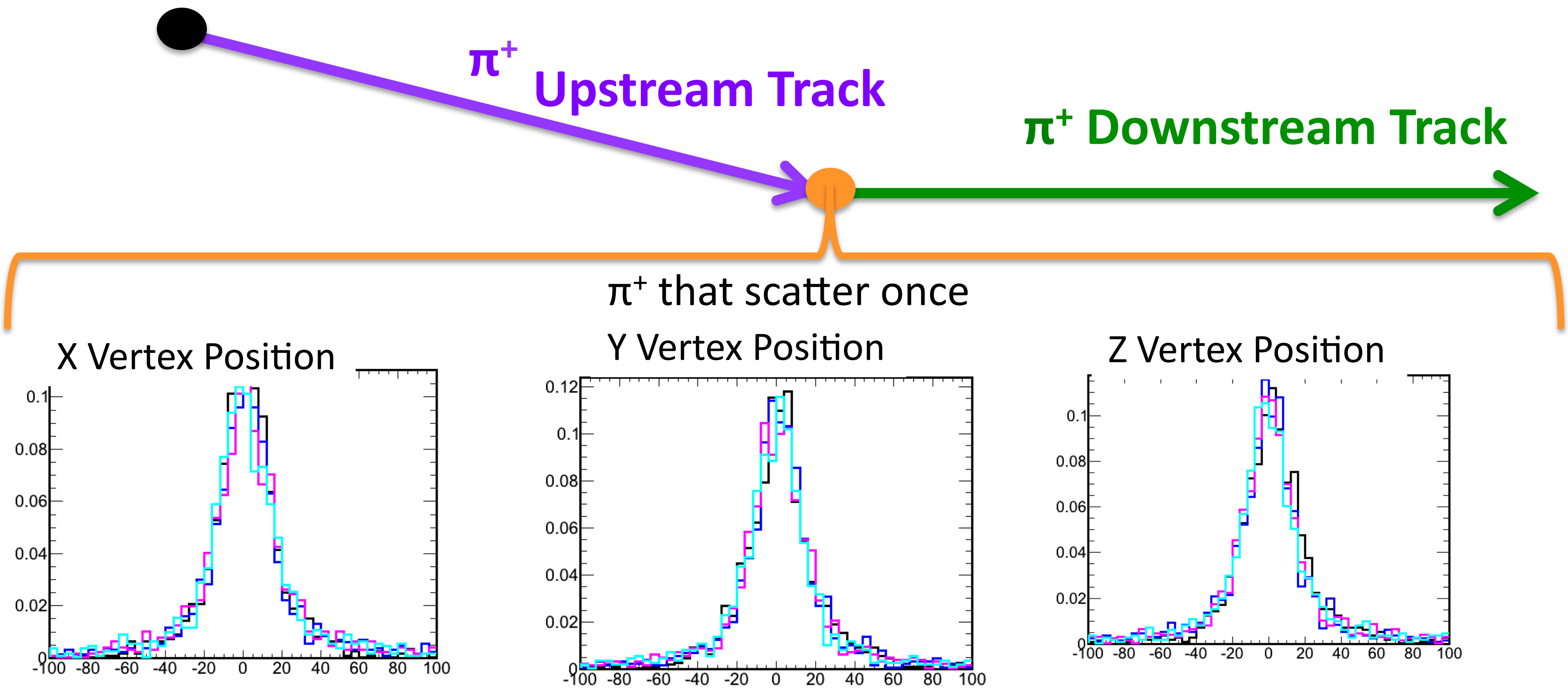
- About the same for all fitter configurations.
- Bias relative to truth seeding

Upstream Energy Loss Resolution



- Energy loss resolution is about the same for all fitter configurations

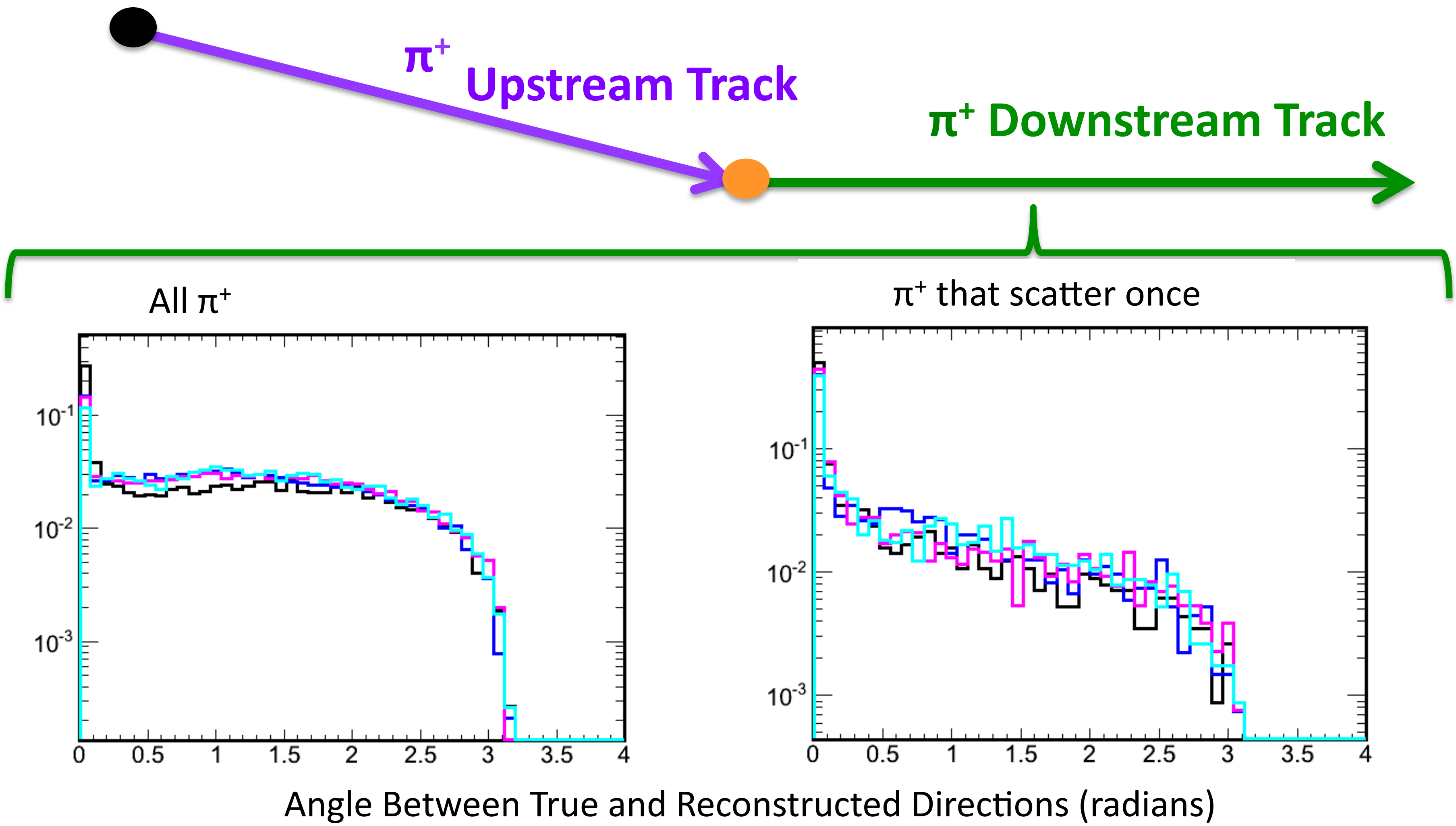
Downstream Vertex Resolution



vtx_{fit}-vtx_{true} (cm)

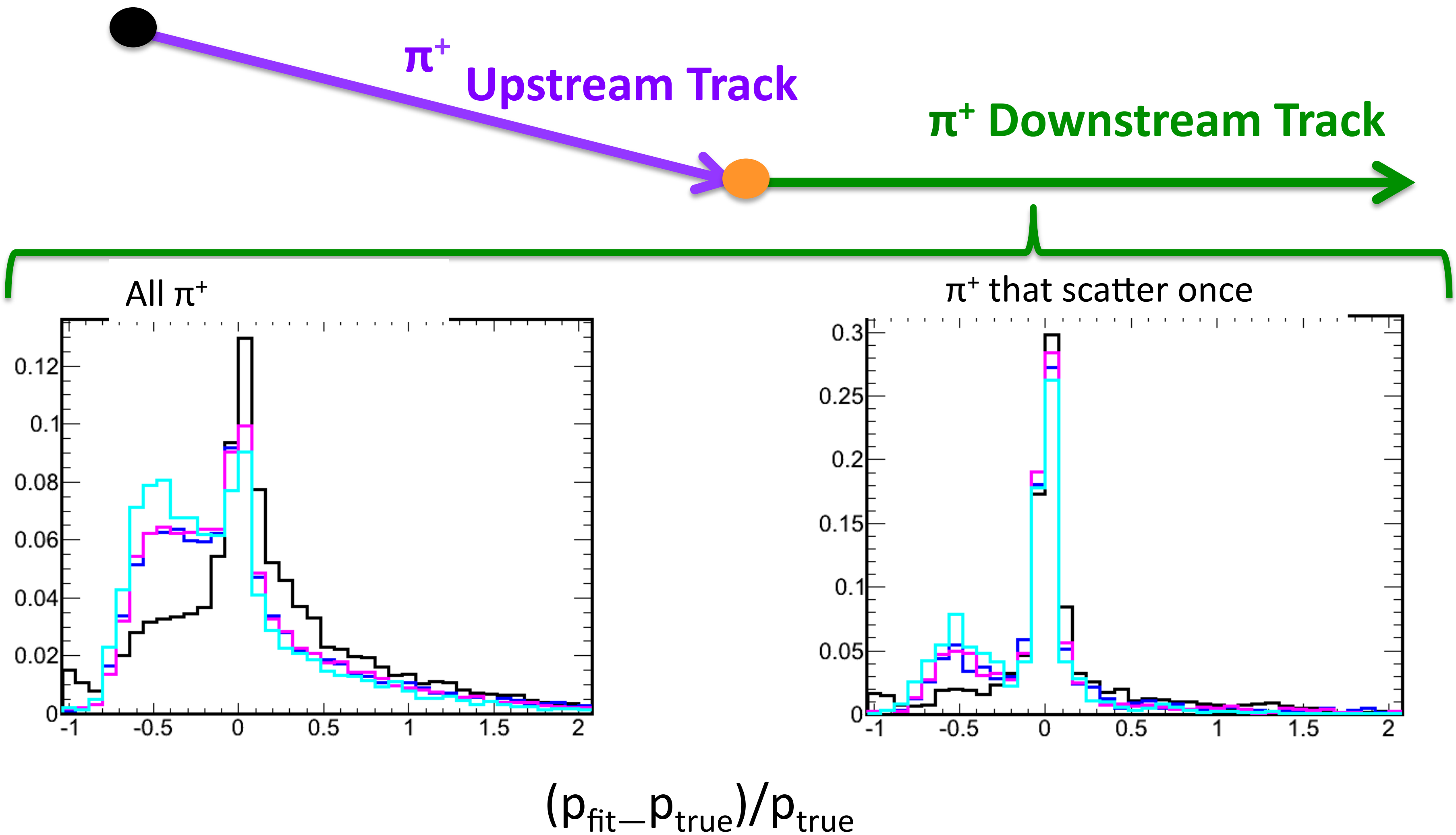
- Vertex resolution is about the same for all configurations

Downstream Angle Between True & Reconstructed



- Results similar for all fit configurations

Downstream Momentum Resolution

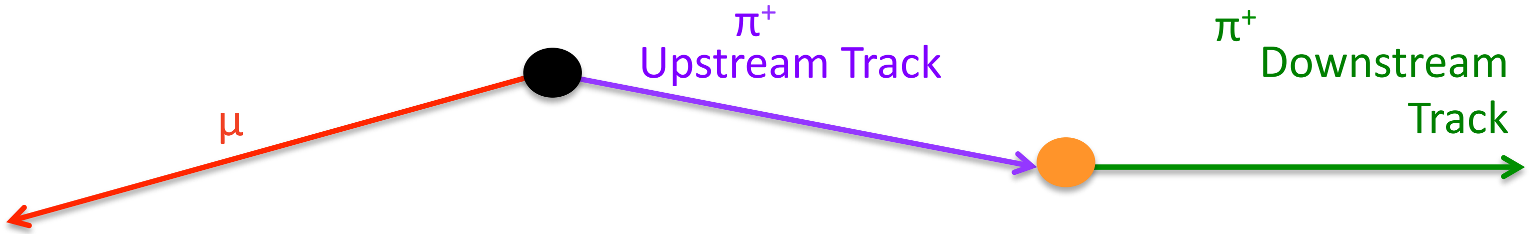


- Small improvement over the previous best fit configuration
- Double peaked structure persists

Work in Progress

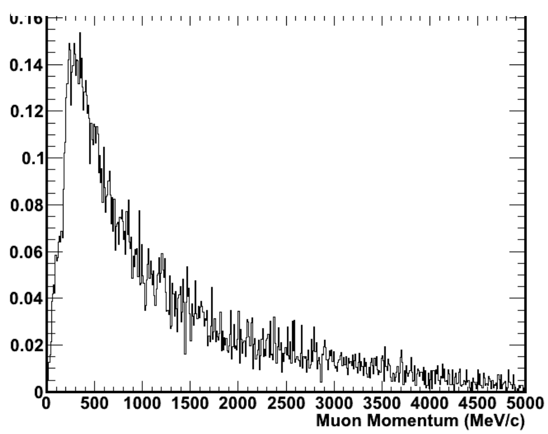
Fitting for Full CC1π Topology

- Float μ + π rings simultaneously

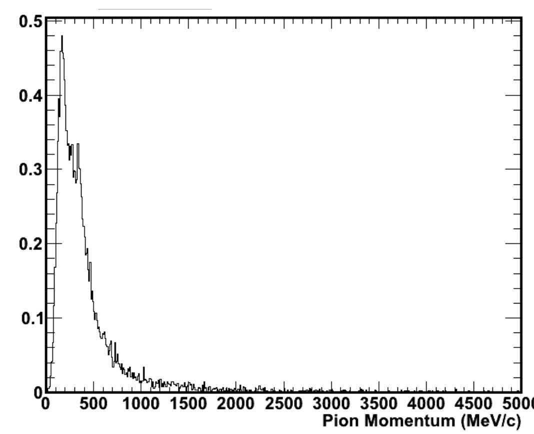


- Making μ+π ‘particle gun’ sample using momentum and angular distributions of μ and π for NEUT CC1π events

π^+ Momentum Distribution



μ Momentum Distribution



Seeding CC1π+ Fit

- Seed with 2R π fit. Expect one of 2R π fit rings to be μ, other to be π:
  - How does π^+ fit perform in the presence of a μ ring?
    - Seed μ with truth. Seed US π^+ with 2R π fit and DS with a grid search. Do both combinations and pick the one with the better likelihood.
  - Seed μ and US π with the 2R π fit in both configurations. Do a grid search on whichever ring is designated 'US π'. Pick the fit with the better likelihood.

- Seed with 3R π fit:
  1. Seed μ, US π and DS π in all kinematically allowed configurations (Mike's strategy)
  2. Try all combinations of seeding μ and US π with two of the three 3R π rings. Do a grid search on whichever is called the 'US π ring'. Select the fit with the best likelihood.
     - May be ways to simplify this later on? Only try combinations of the two highest energy rings?

- How do we decide what strategy is best? Need to understand reconstruction performance and efficiency.

Running π^+ fit on MC

- Fit performance validation
- Make NC1π^+ selection, evaluate selection efficiency.
- This work will lead in to systematic error studies to look at how selection efficiency changes with with varying π^+ interaction cross sections.

Conclusions

- π^+ fitter performs well.

- Currently working towards:
  - Adding μ back in to the fit
  - Begin work on systematic errors. Use NC1π as a π-only sample at SK to use for systematic error evaluation. Start looking at π^+ fitter on T2K-SK/ATMPD MC.