Crossing angle study at EIC (IP6)

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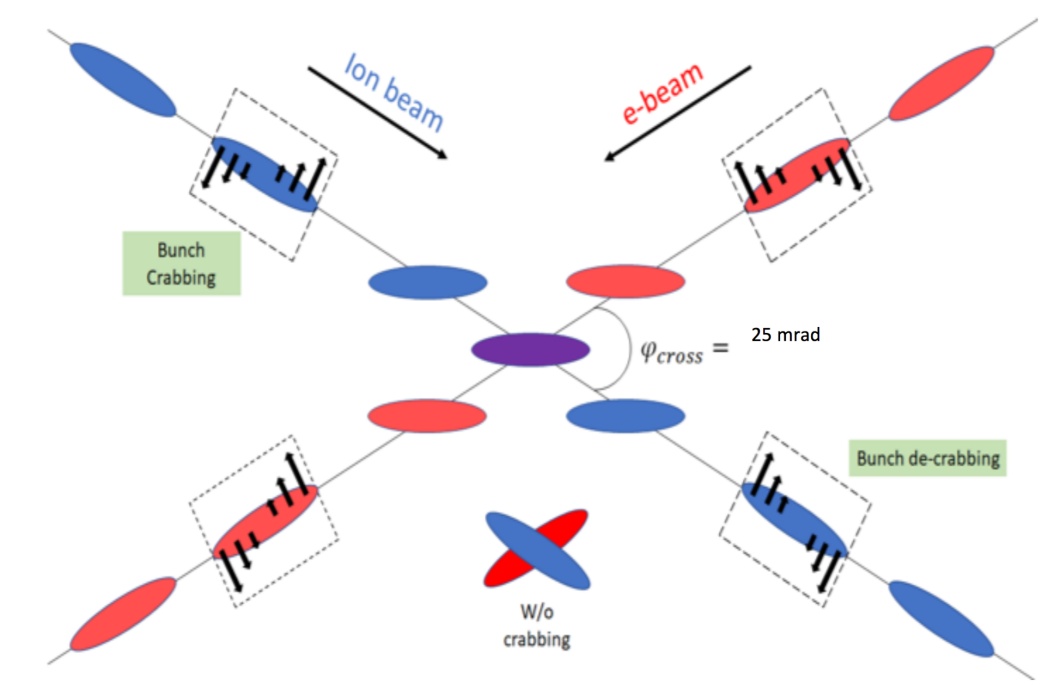
with lots of help & inputs from Jin Huang (BNL) and Barak Schmookler (SBU)

Crossing angle @ EIC

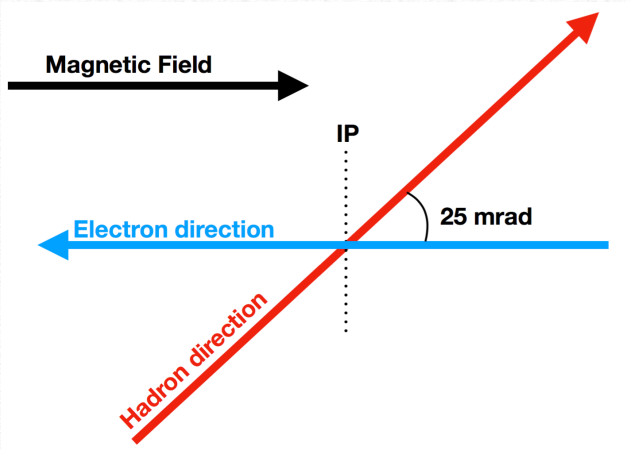
- At EIC IP6, the electron-hadron beam is not head-on along z axis like in HERA

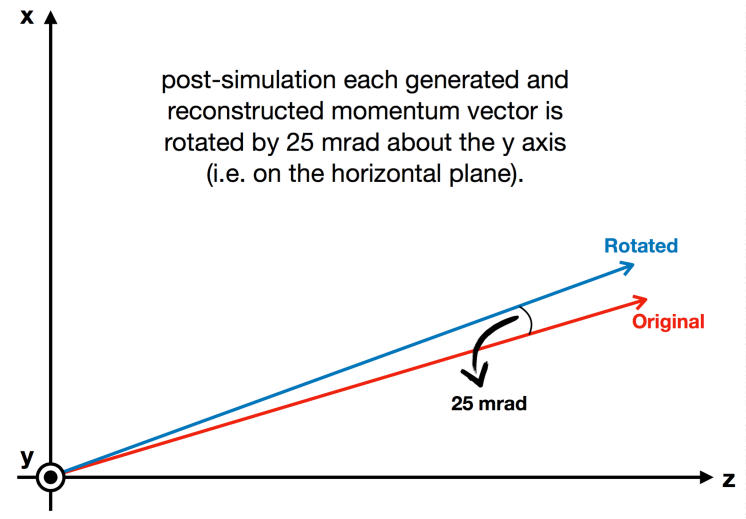


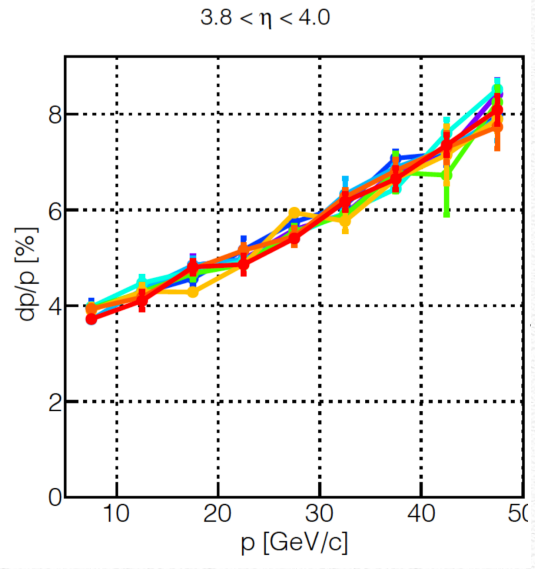
- Already some studies done
  - Crossing angle and its implications for the central detector design: https://indico.bnl.gov/event/9887/timetable/
  - Including a nice study from Rey

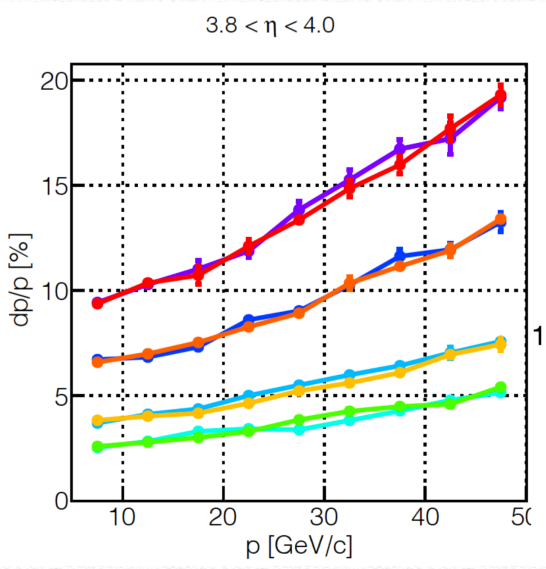
Rey's study

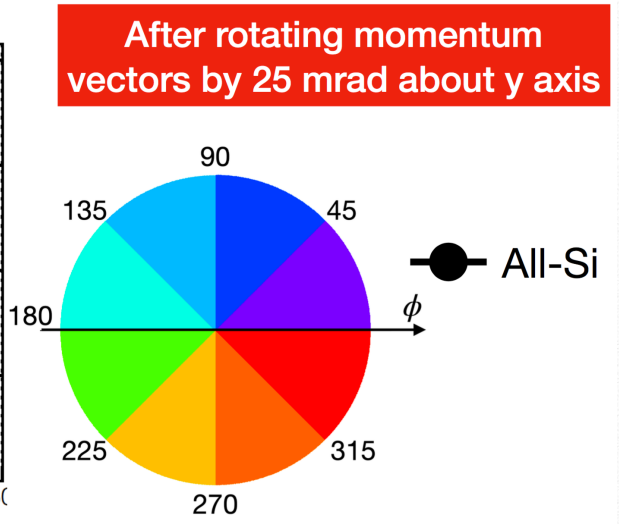
- Rey looked at the tracker performance if rotaing tracks by 25mrad







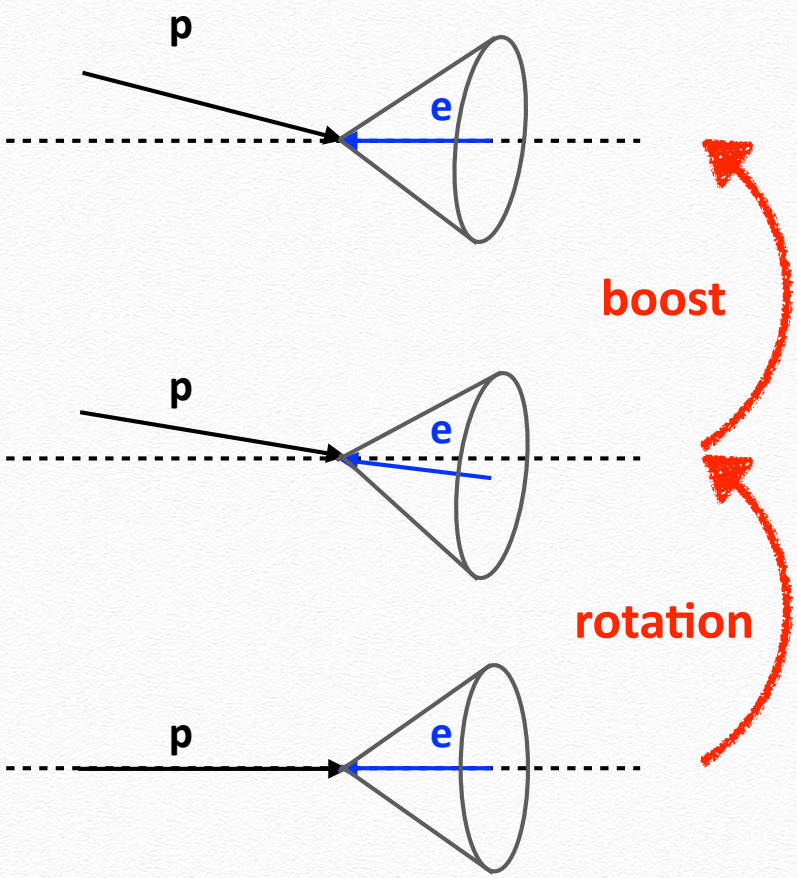




Steps to implement Xing angle

- Scenario: hadron beam has 25 mrad angle from z axis and electron beam along z
  - Detectors' centroid aligned with z (magnetic field along aligned with z)

Boost and rotation worked out by Jin and Barak

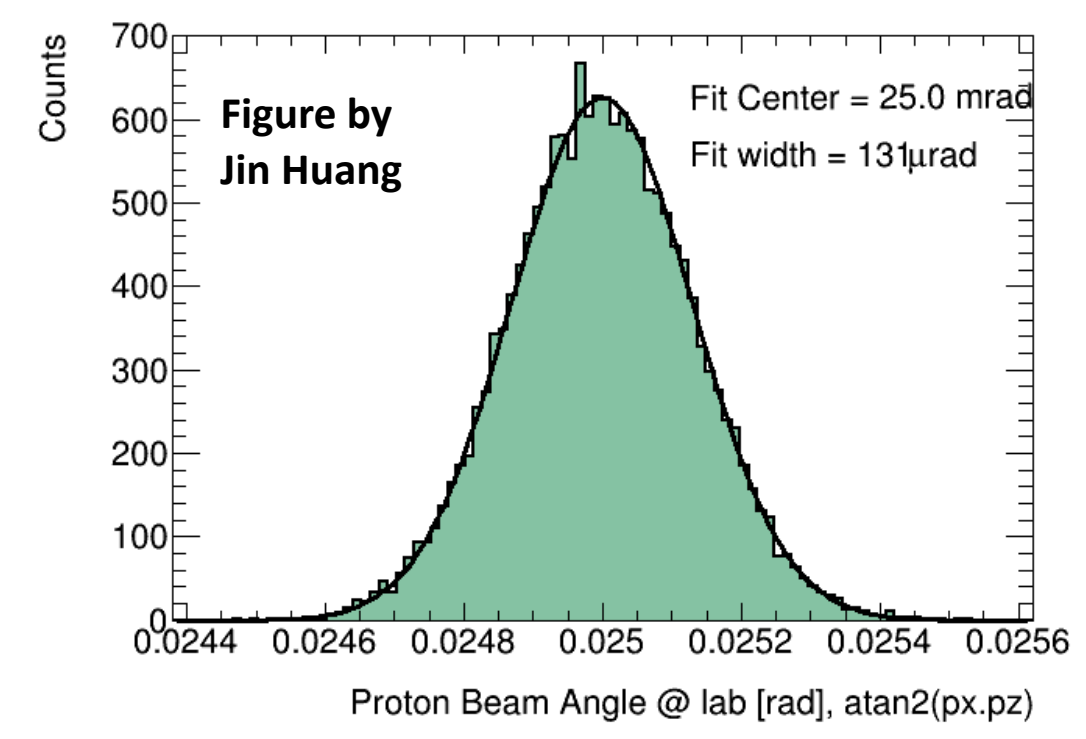


Real collisoin geometry

Pythia head-on e+p event

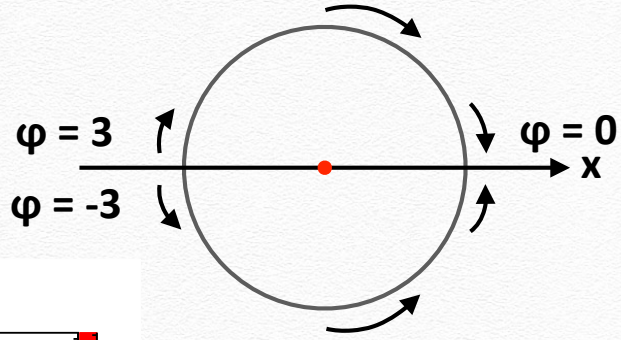
Crossing angle study in Fun4All

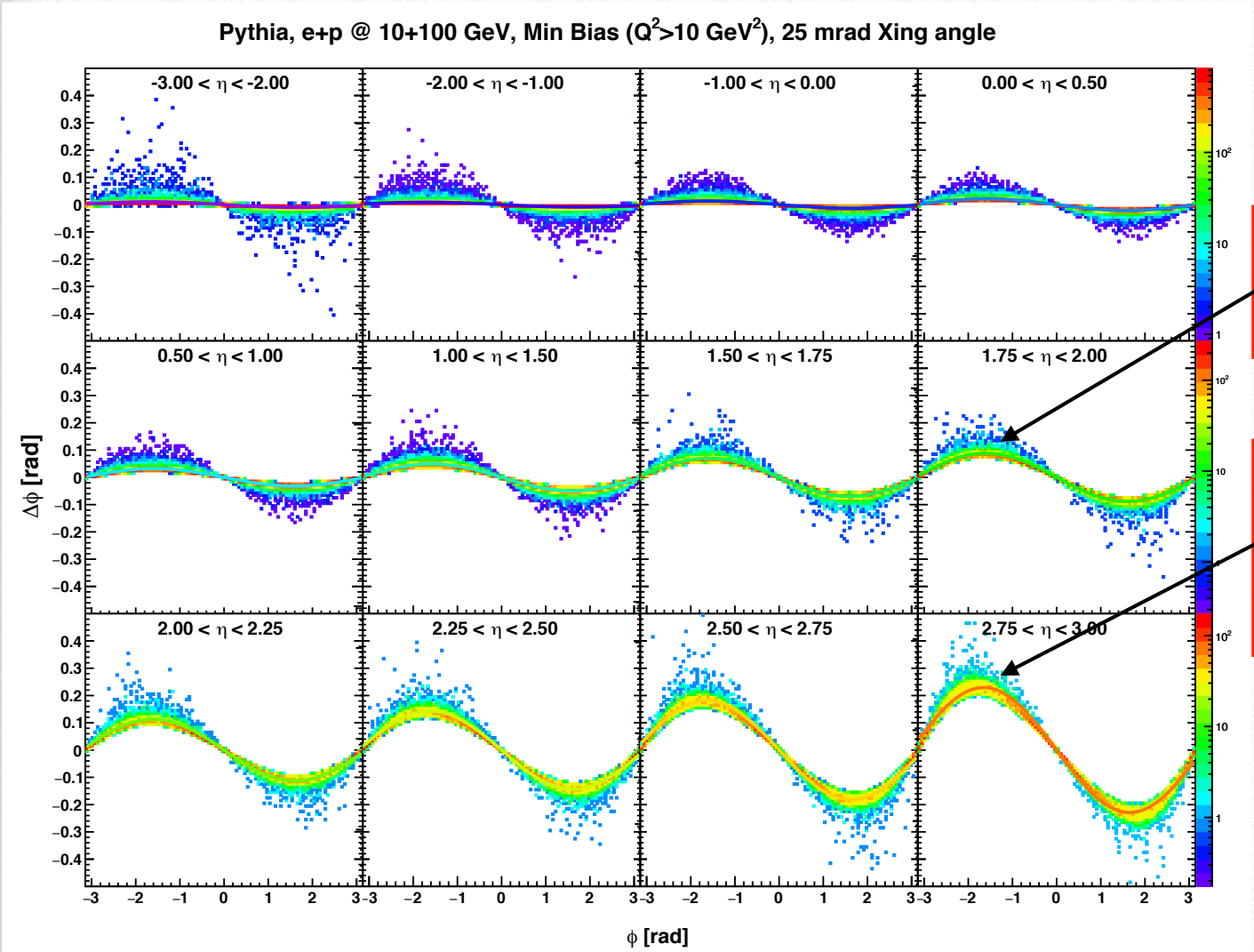
- The crossing angle now implemented in Fun4All by Jin
  - Xing angle + beam divergence: https://github.com/sPHENIX-Collaboration/coresoftware/pull/1087
  - Crab cavity kick: https://github.com/sPHENIX-Collaboration/coresoftware/pull/1113



- PythiaeRHIC
  - Peal out $D^0 \rightarrow K\pi$
  - Feed to Fun4All
  - Apply beam parameters
  - Only turn on trackers (using Hybrid for this study)
  - Look at the new $D^0 \rightarrow K\pi$ (both reco and true) from track evaluator

D^0 ϕ shift with Xing angle

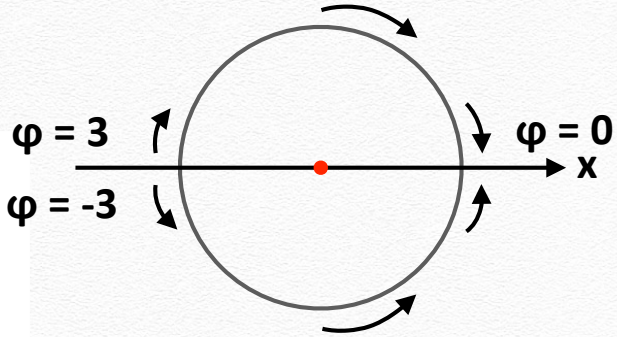


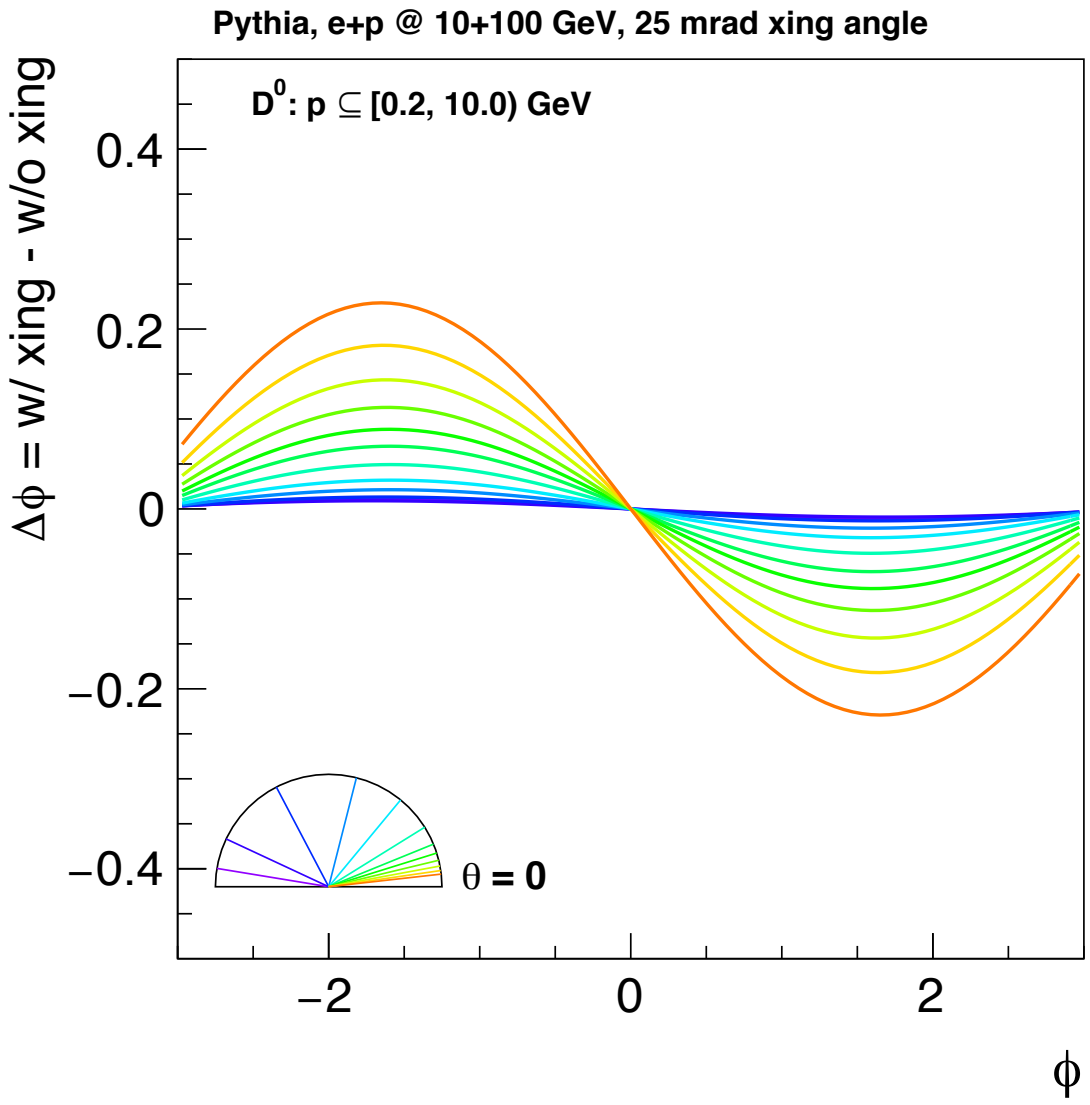


Stronger Δφ shift along y axis

Stronger Δφ shift at forawrd rapidity (around θ~0)

D^0 ϕ shift with Xing angle

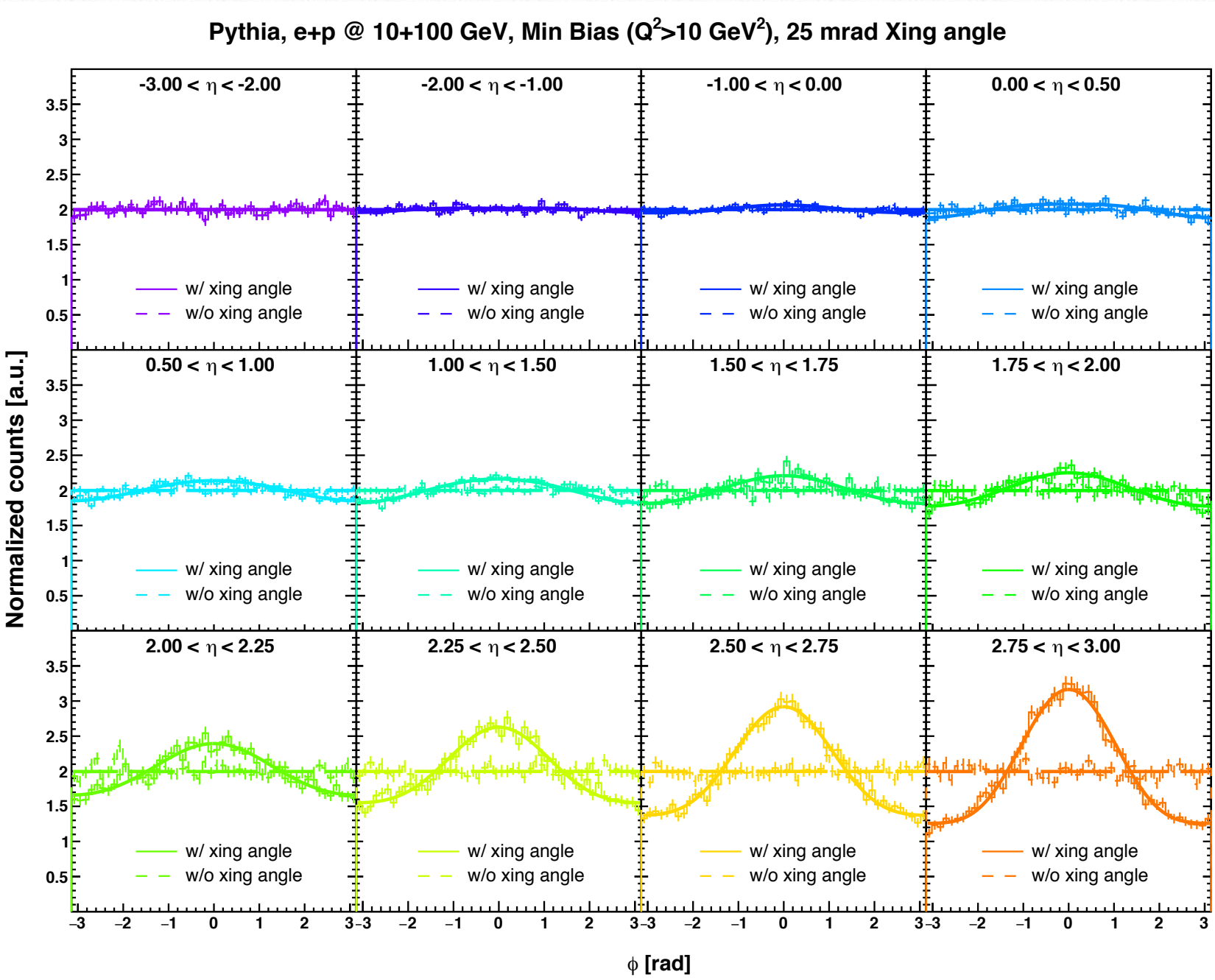




Such shift will create an "artificial" azimuthal anisotropy of the outgoing particles

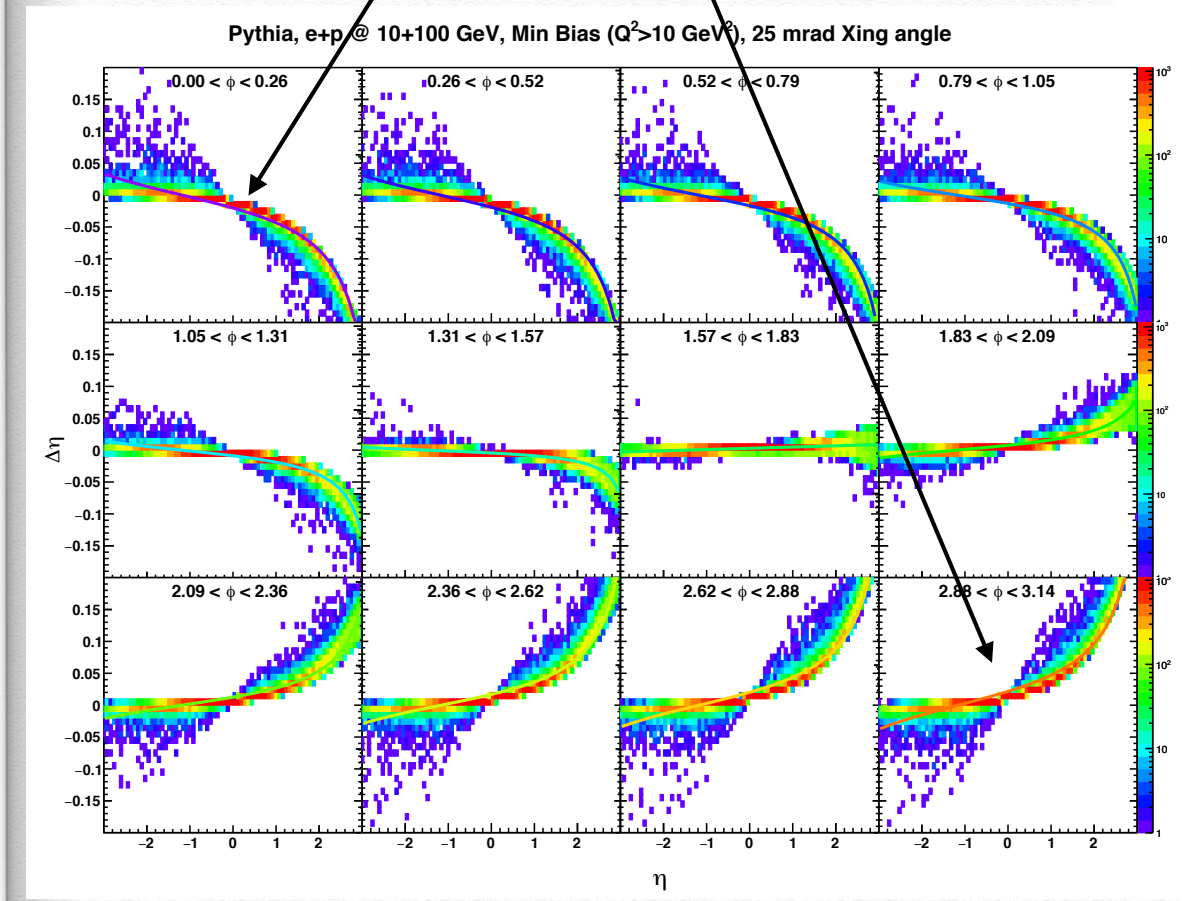
Correctable as long as one boost back to head on event by event

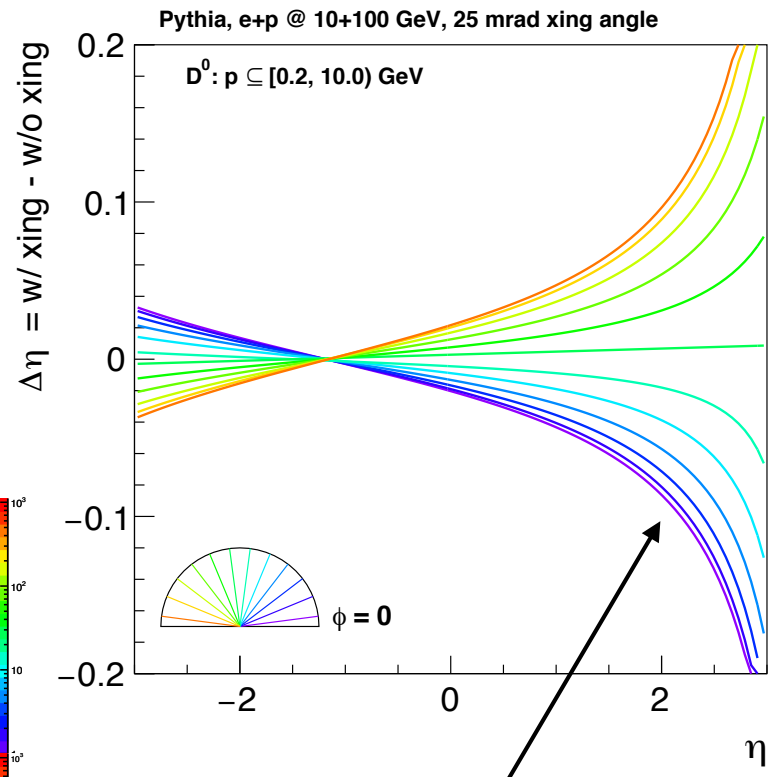
D^0 ϕ distribution w & w/o Xing angle



D^0 η shift with Xing angle

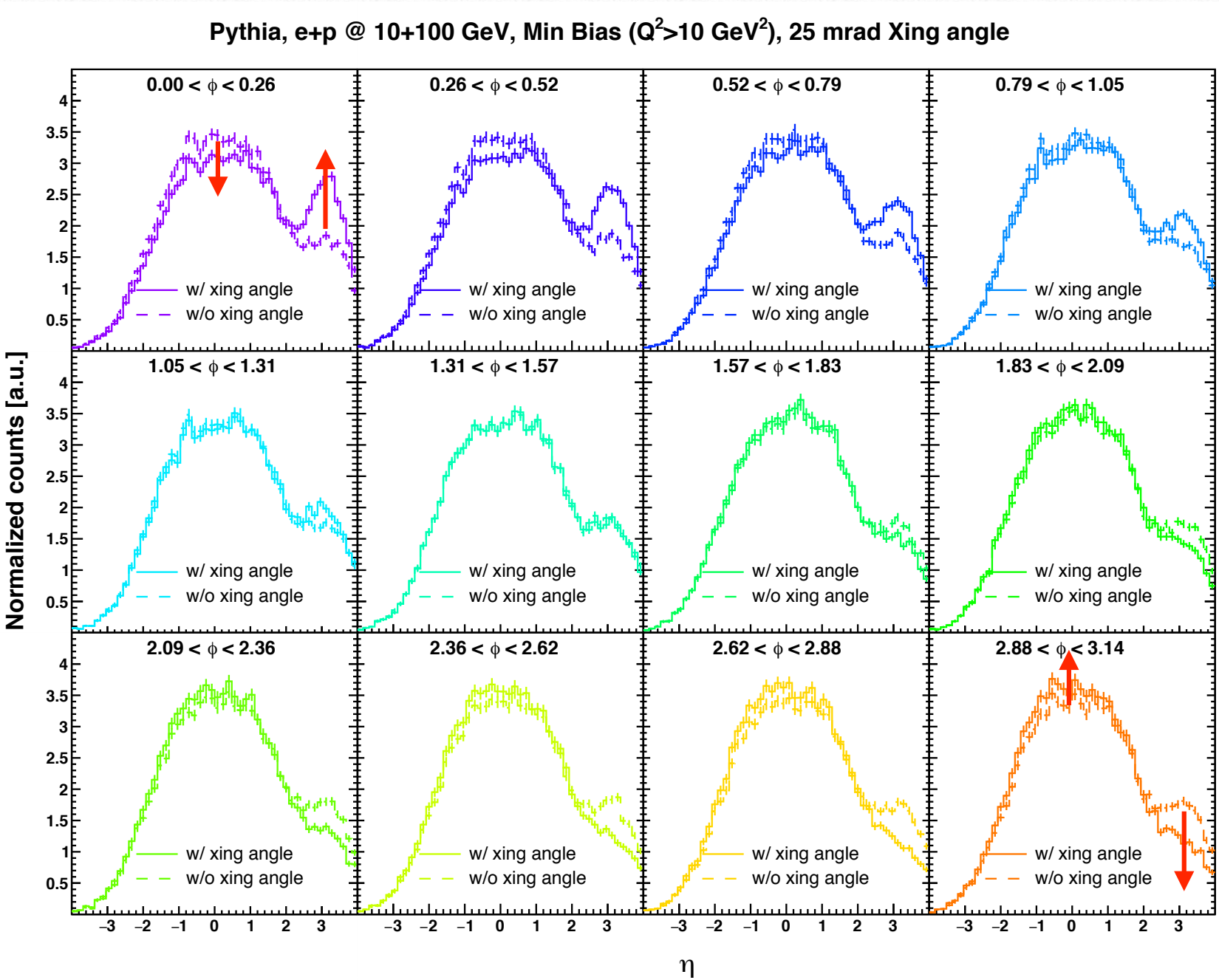
Larger effect along x axis



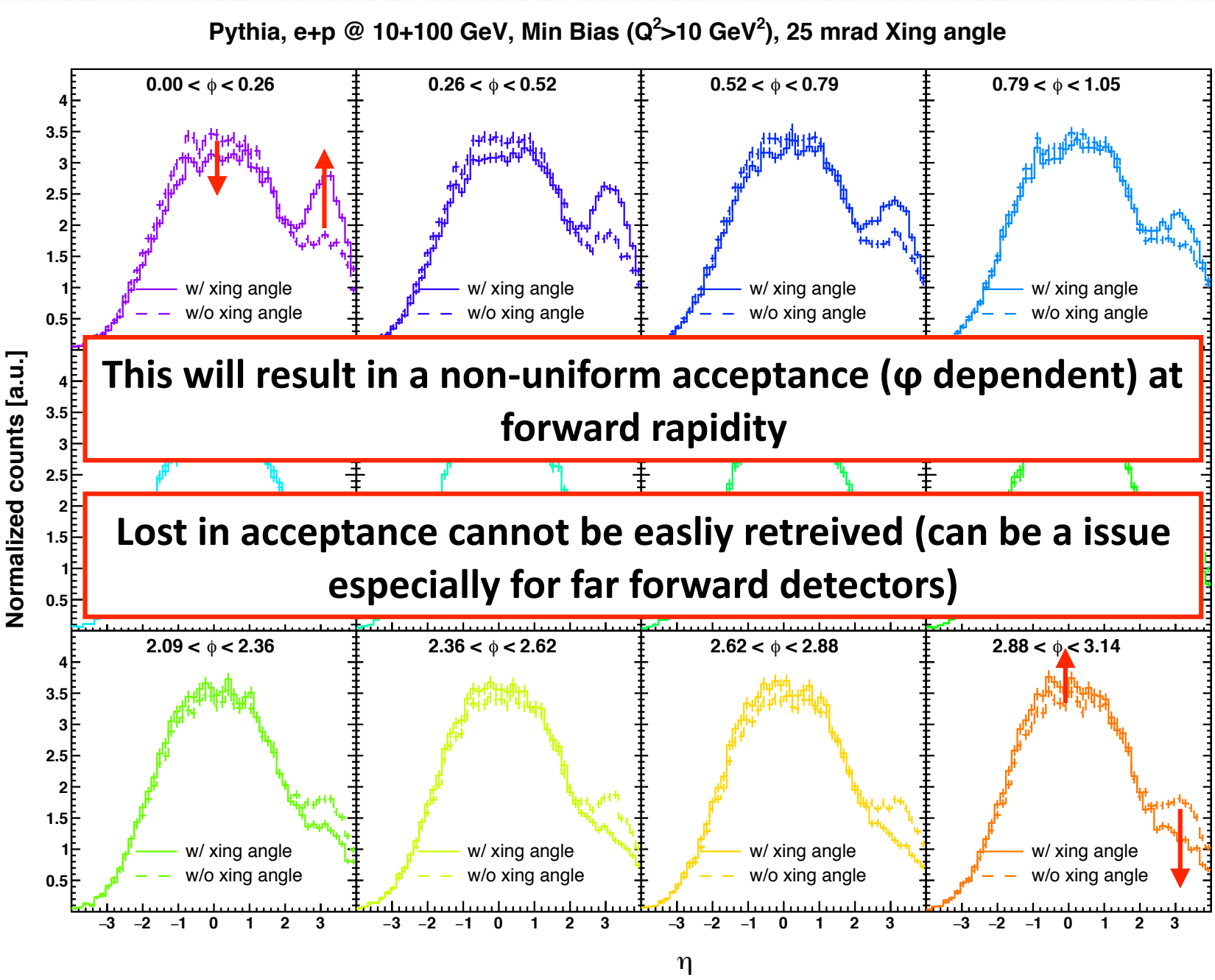


Larger effect at very forward rapidity

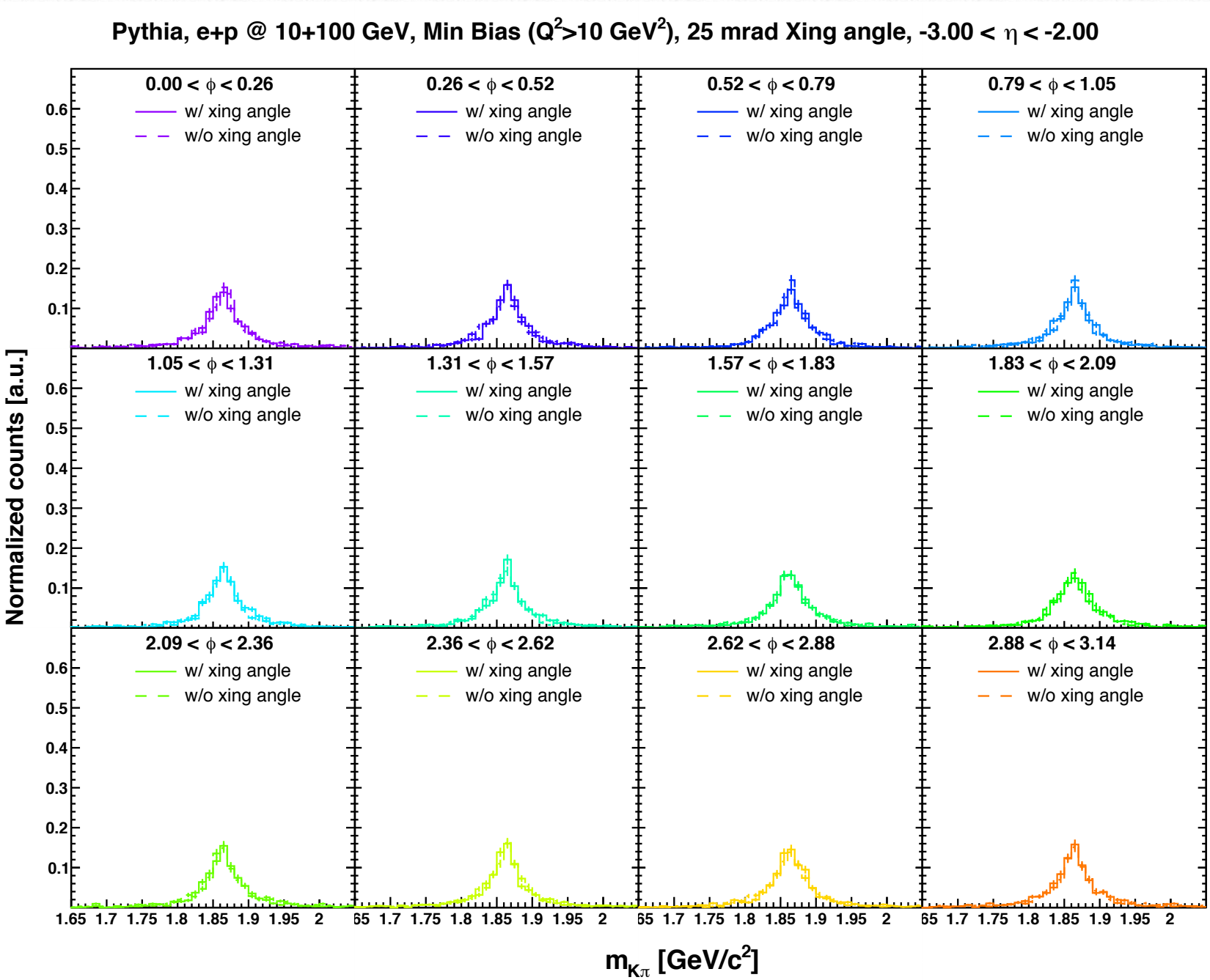
D^0 η distribution w & w/o Xing angle



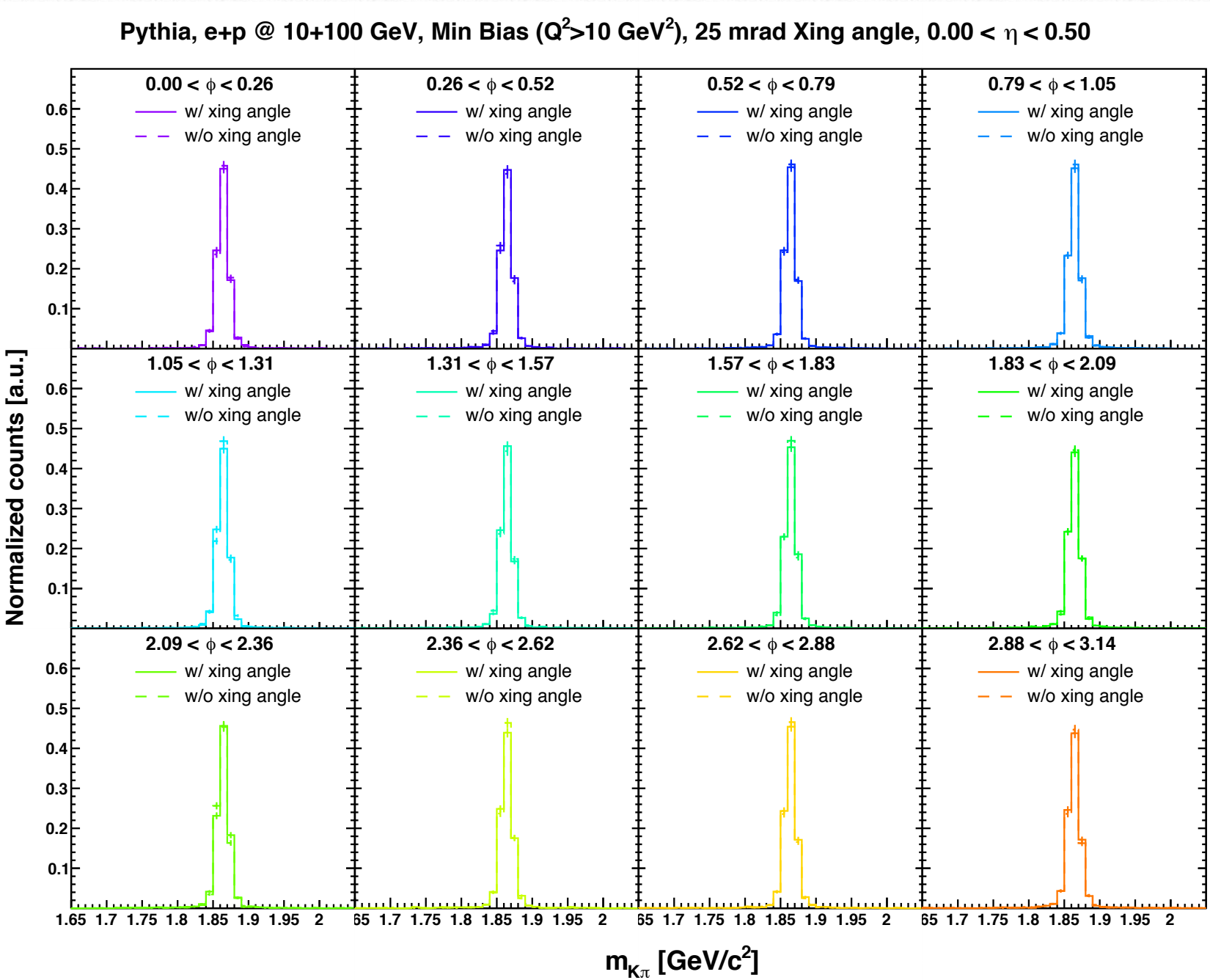
D^0 η distribution w & w/o Xing angle



D^0 mass resolution w & w/o Xing angle



D^0 mass resolution w & w/o Xing angle



D^0 mass resolution w & w/o Xing angle