The STAR Transverse Spin Programme

Thomas Burton for the STAR Collaboration

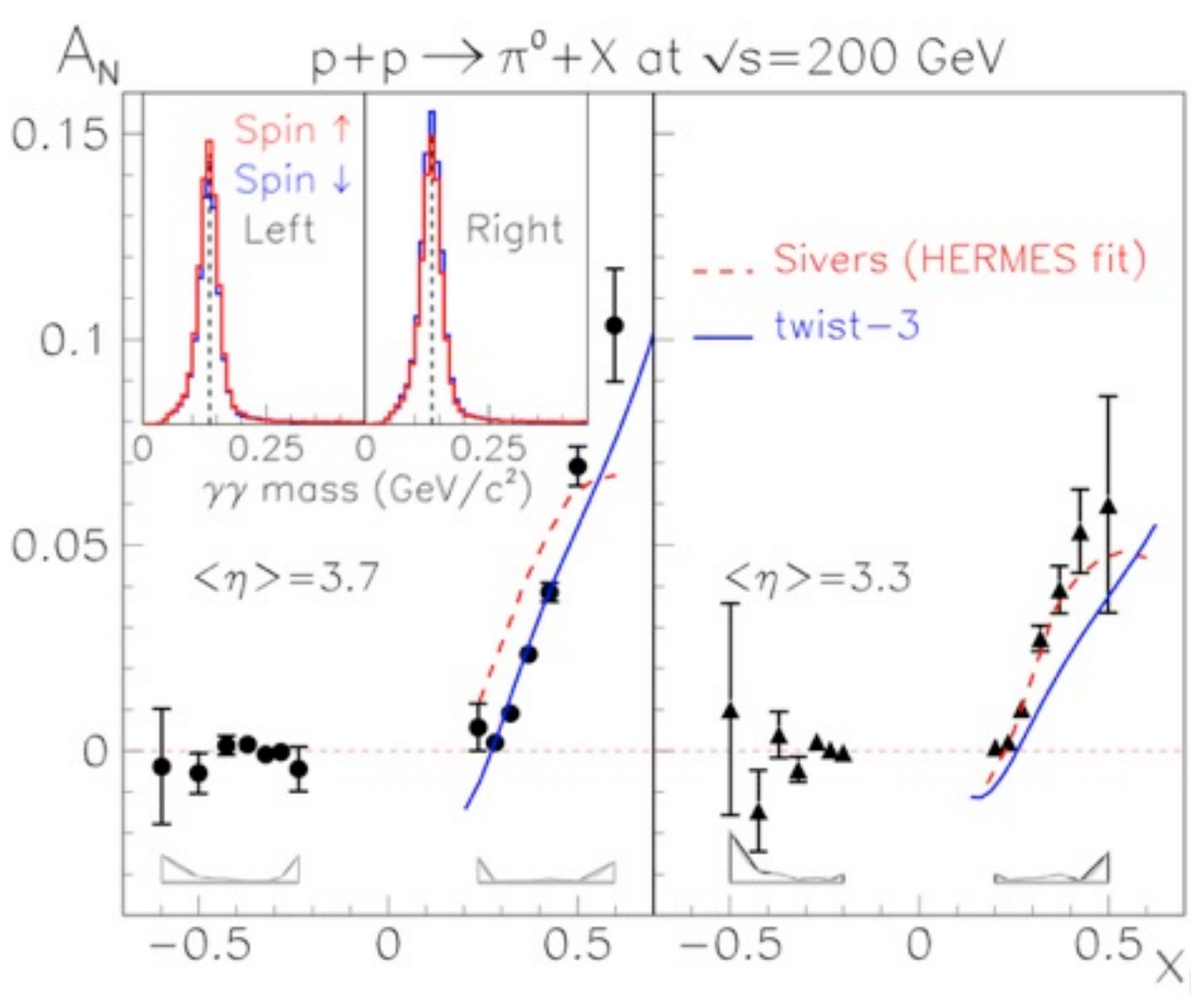
RHIC & AGS Users' Meeting

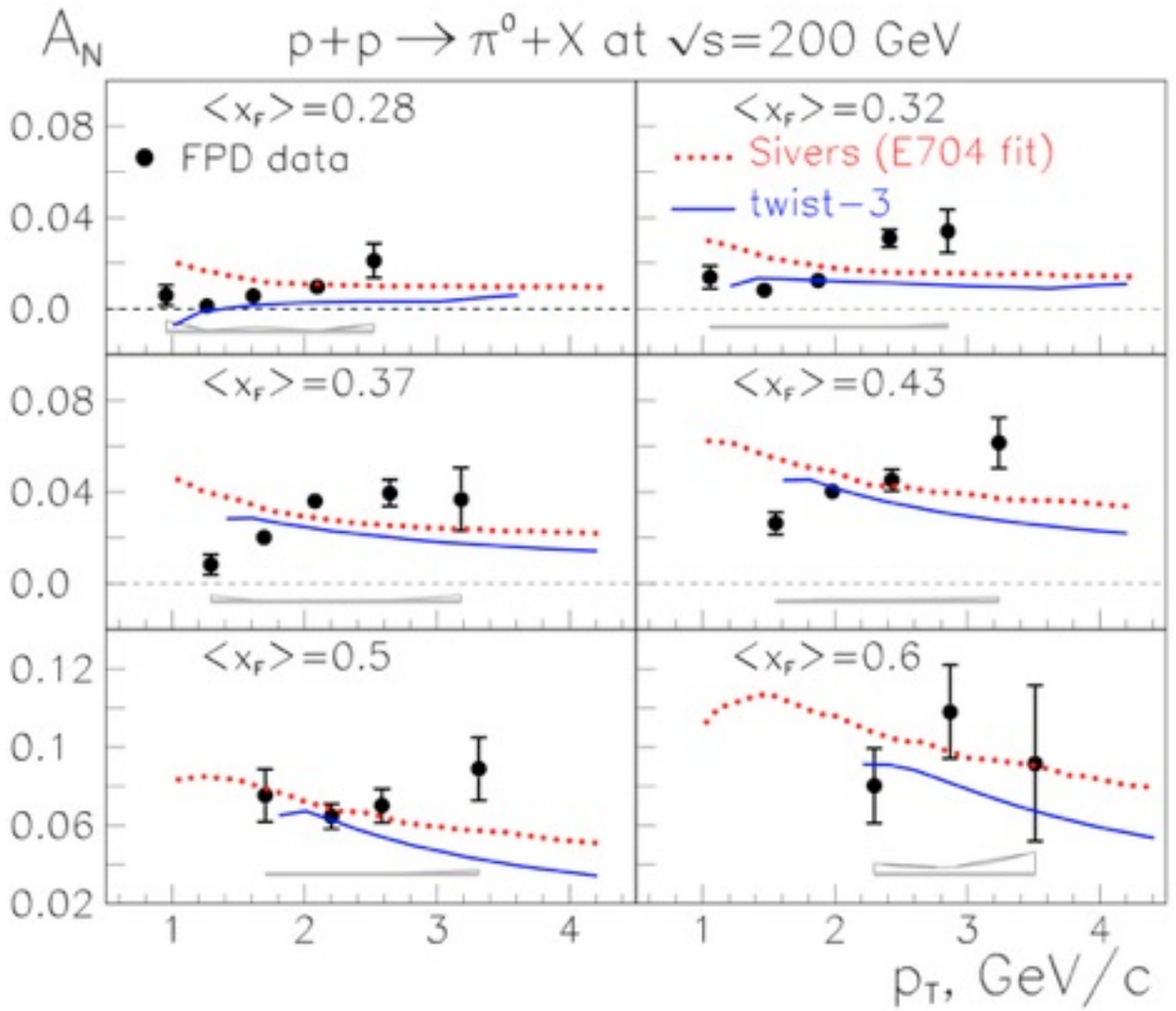
20th June 2011

Overview

- Analyses:
  - Collins asymmetry in jets-like events (forward)
  - Collins asymmetry in jets (midrapidity)
  - Forward η cross section
- The 2011 500 GeV $p^{\uparrow} + p^{\uparrow}$ run

π^0 A_N at STAR



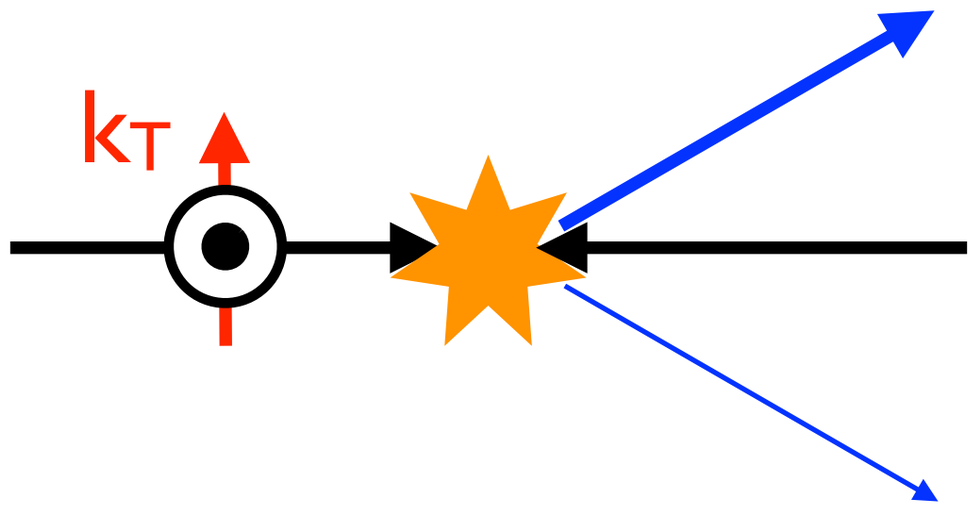


Phys. Rev. Lett. **101** (2008) 222001

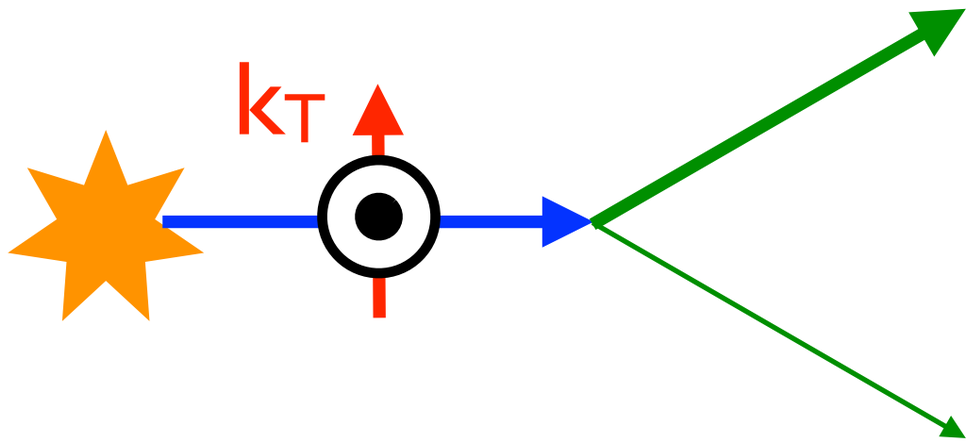
- Inclusive π^0 A_N large at forward rapidity
- p_T-dependence not described by pQCD calculations

Sivers vs. Collins mechanisms

- Inclusive π^0 A_N can include both
  - Sivers mechanism (A_N from k_T in PDF)

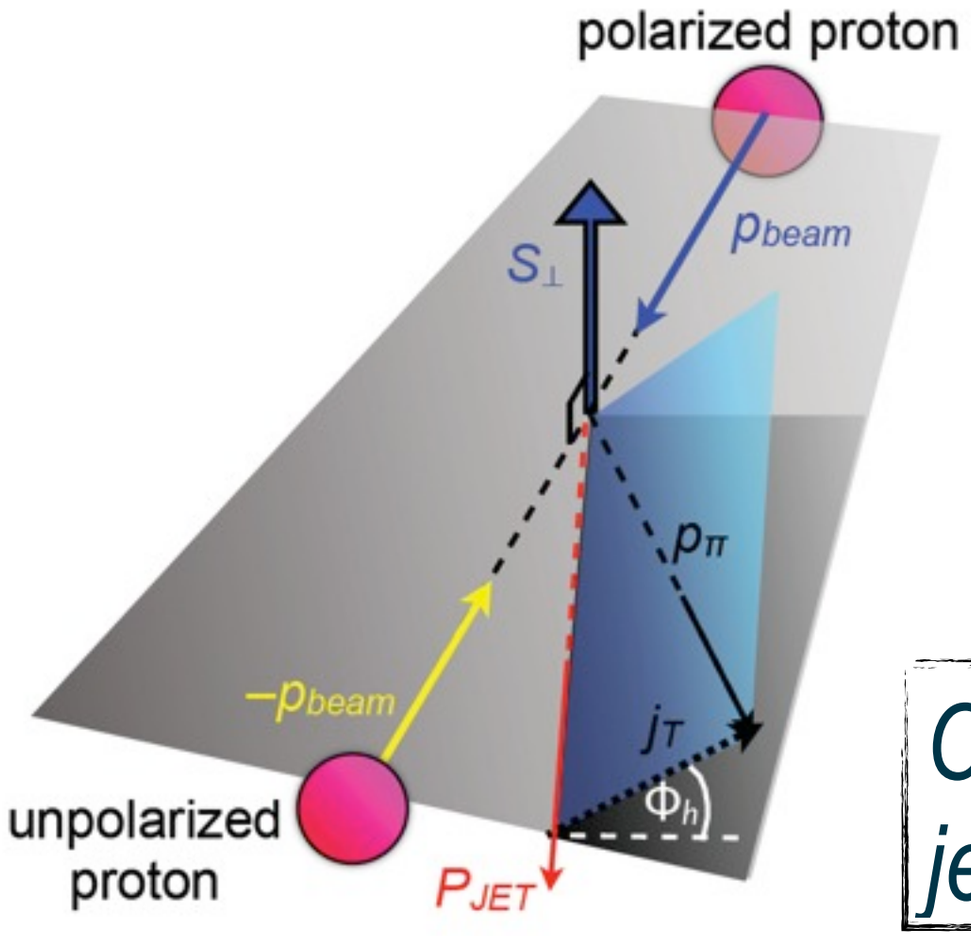


  - Collins mechanism (A_N from parton fragmentation)



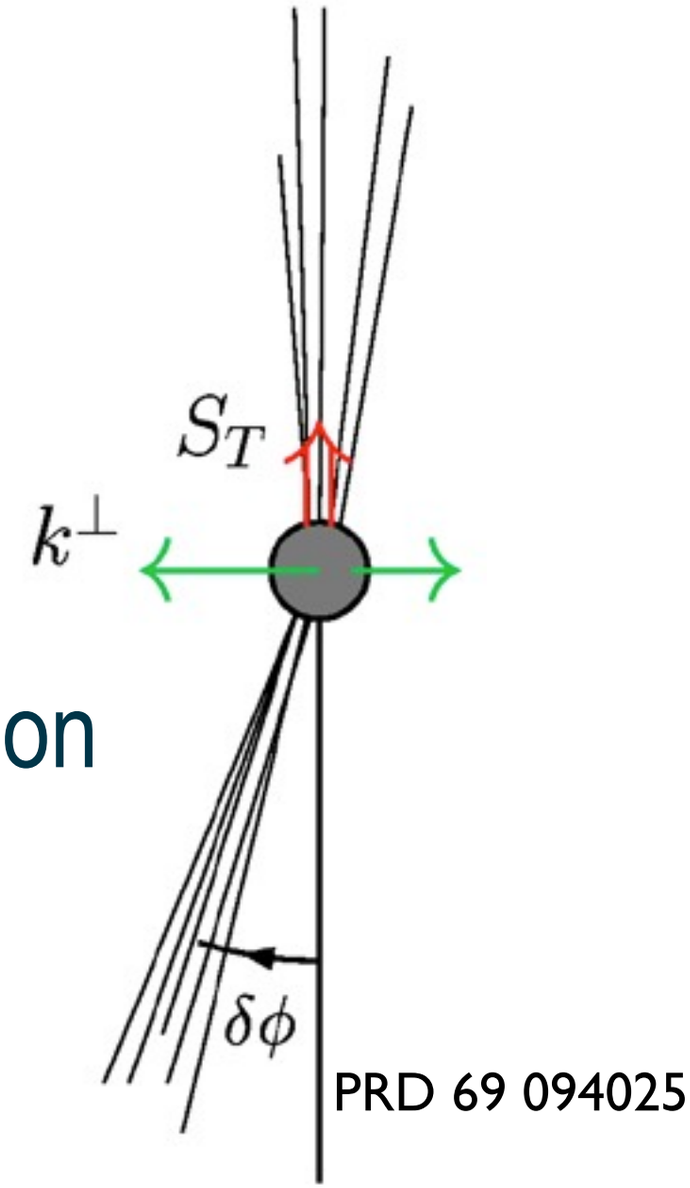
➡Go beyond inclusive hadron measurements

Sivers vs. Collins mechanisms



Collins - modulation of hadrons around jet axis

Can disentangle via jet measurements



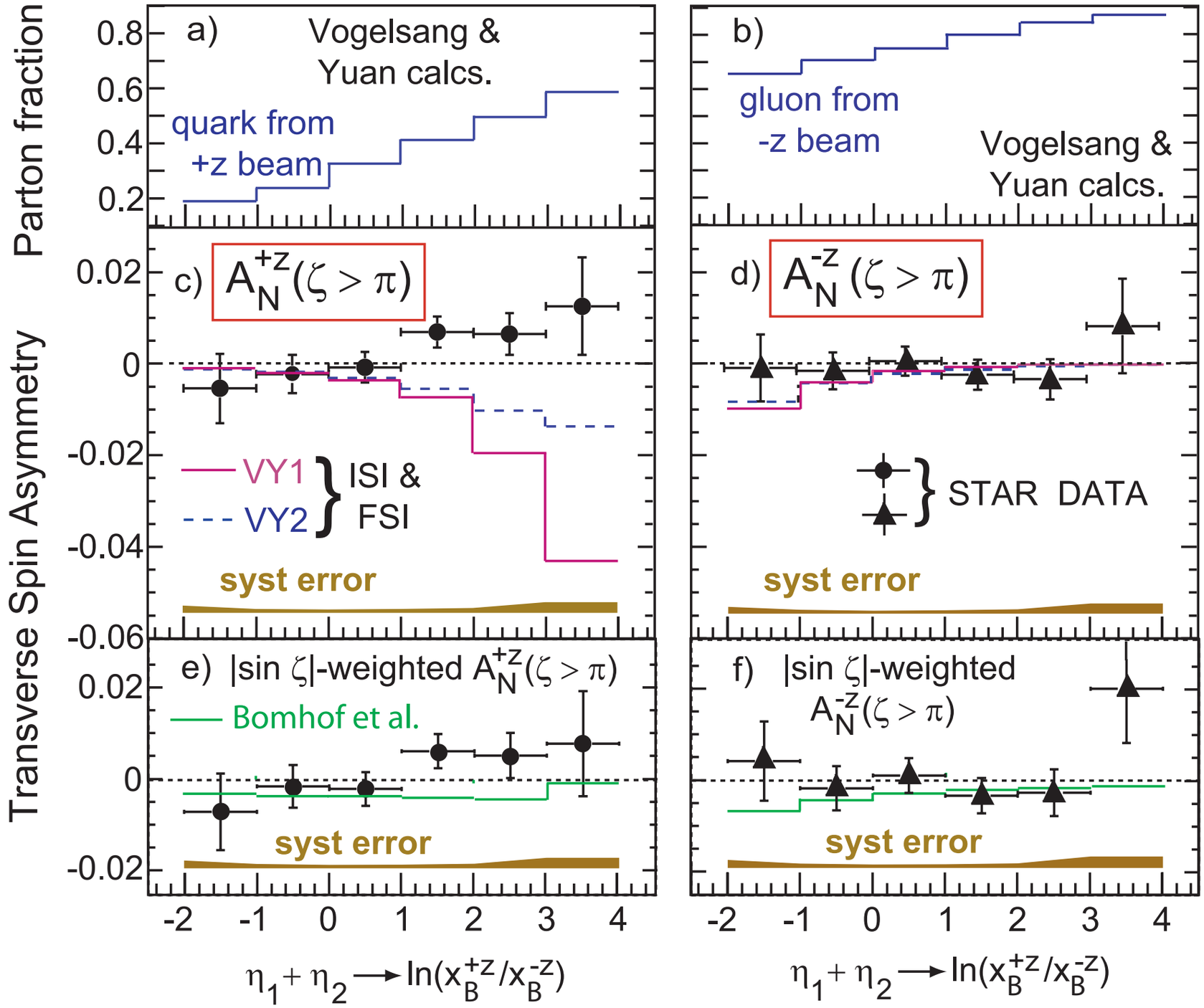
Sivers - modulation of jet direction.

e.g. STAR di-jet

PRL 99 142003

PRD 69 094025

Sivers in di-jets



Phys. Rev. Lett. **99** (2007) 142003

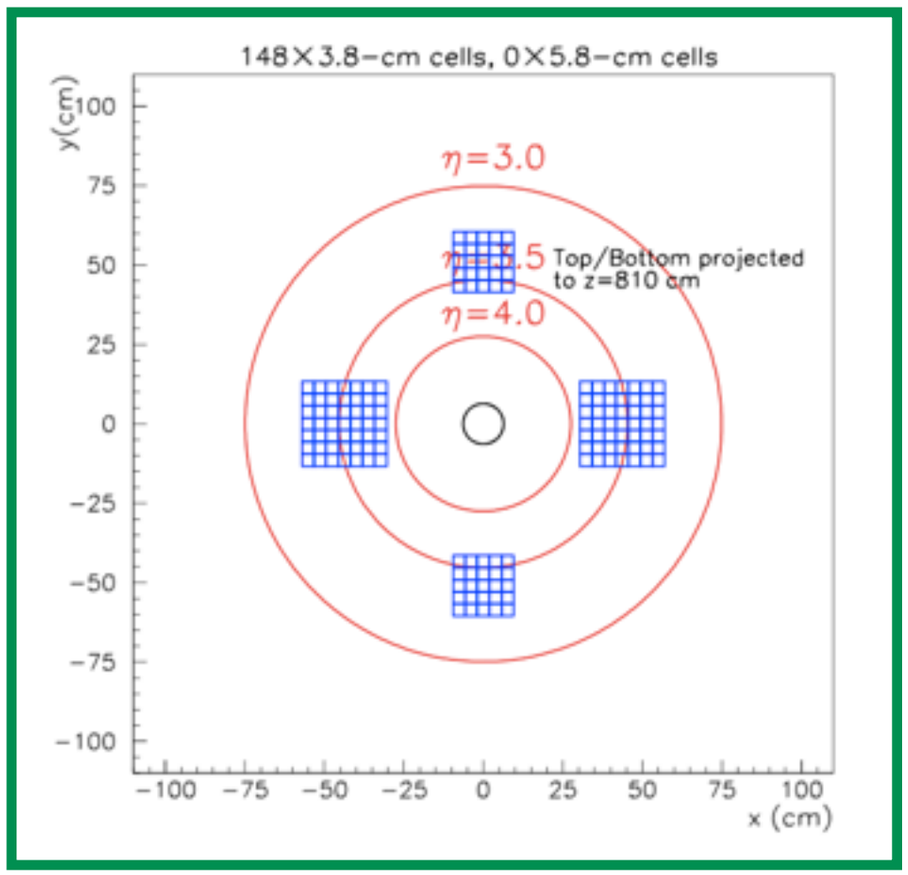
Forward Collins Asymmetry

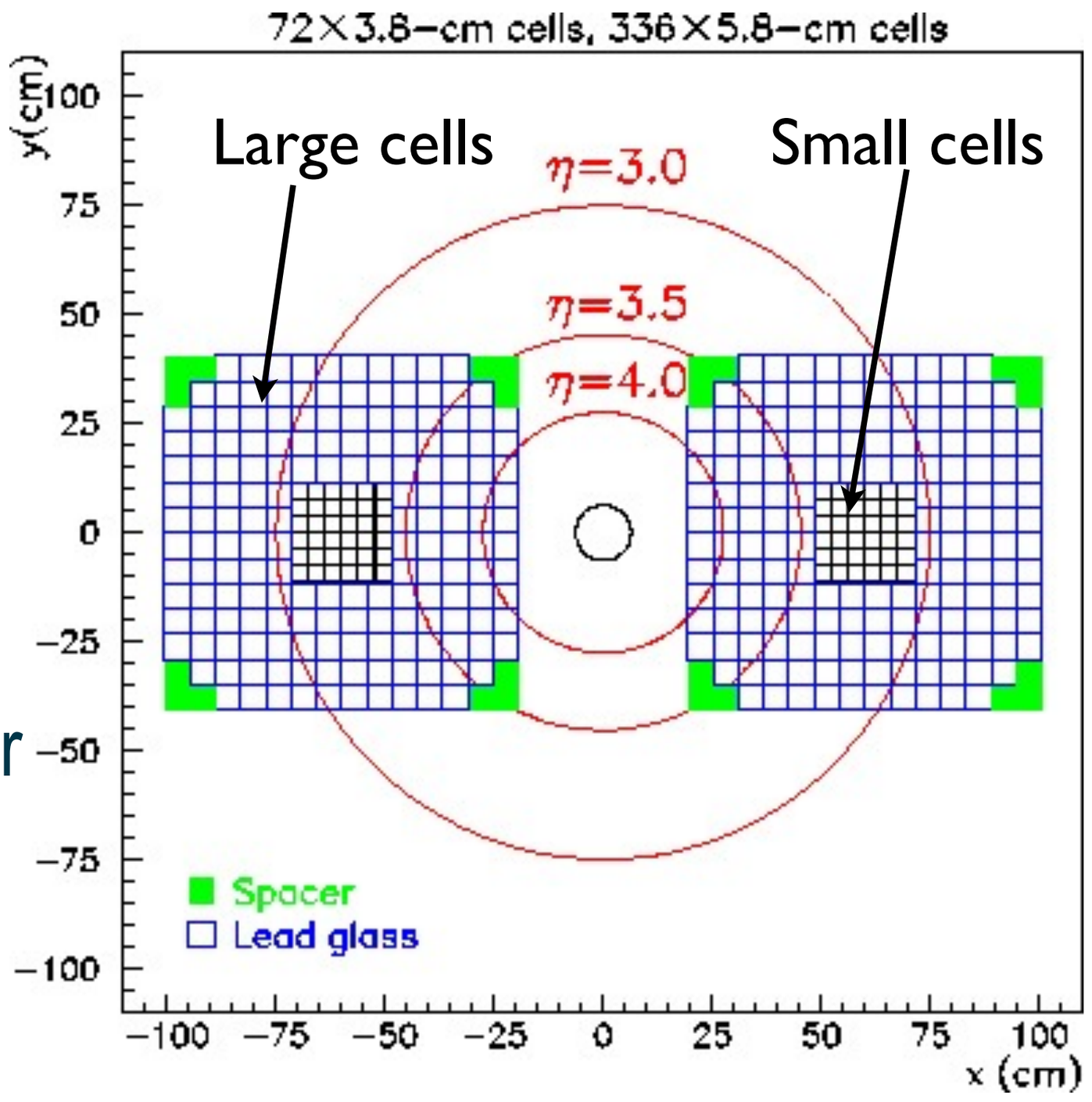
- Unable to do full forward jet reconstruction

  ➡ use “jet-like” events: “cluster” of cells with E > threshold

- Use upgraded Forward Pion Detector: “**FPD++**”
  - 2006 data
  - 6.8 pb^{-1}
  - <P> = 60%.

FPD++

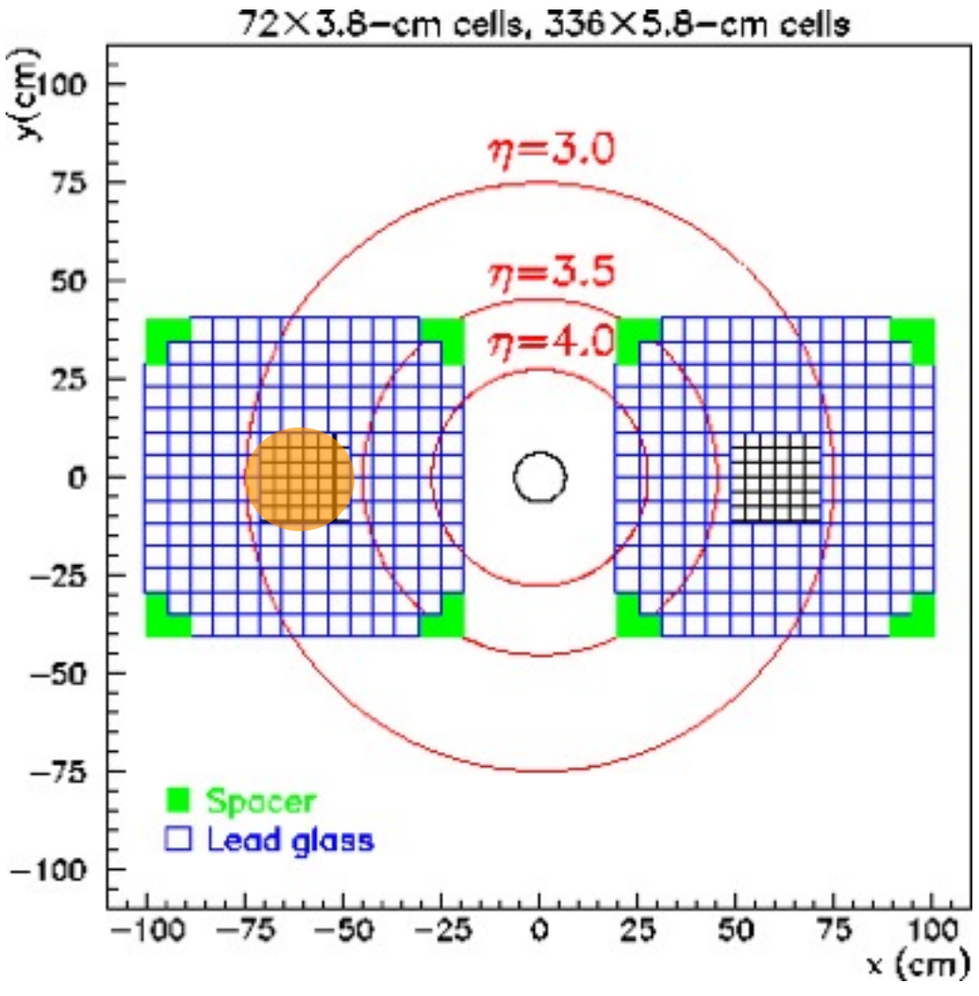


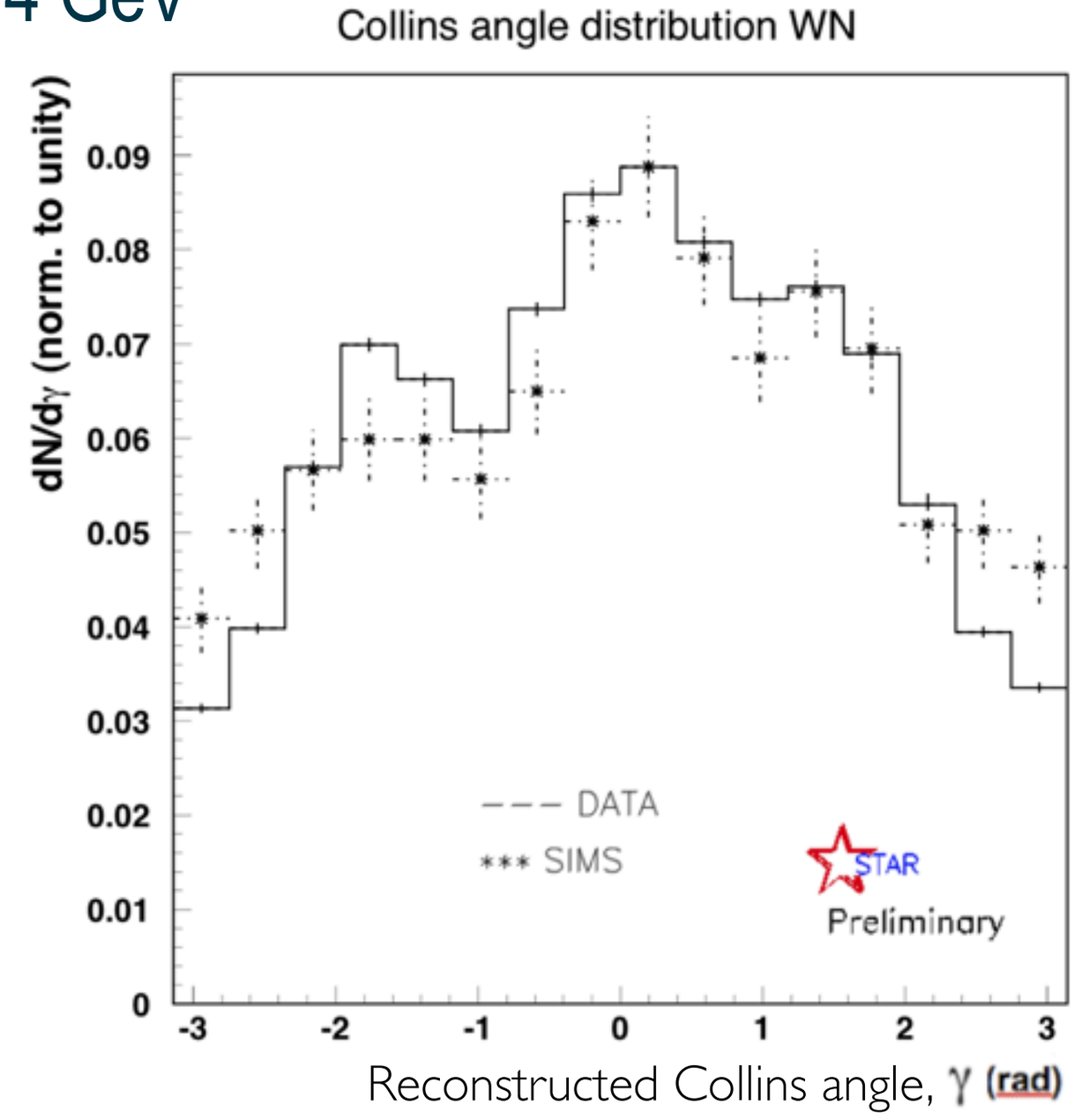


- Pb-glass EM calorimeter
- Upgrade of FPD
  - ~8 times acceptance
- 7.4 m from interaction point

Forward Collins Asymmetry

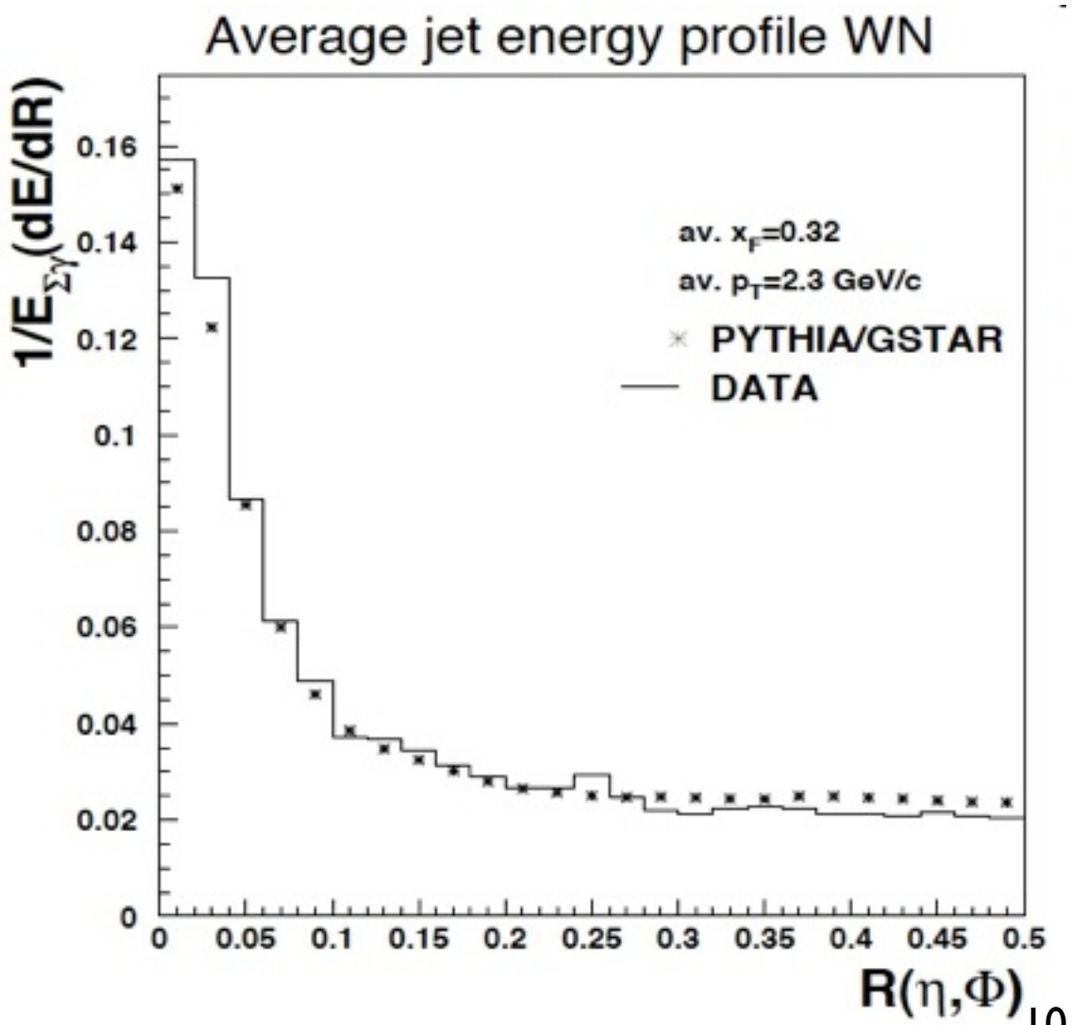
- Find events with π & “jet-like” object
  - cluster with 10+ cells with > 0.4 GeV
  - p_T > 1.5 GeV, x_F > 0.23

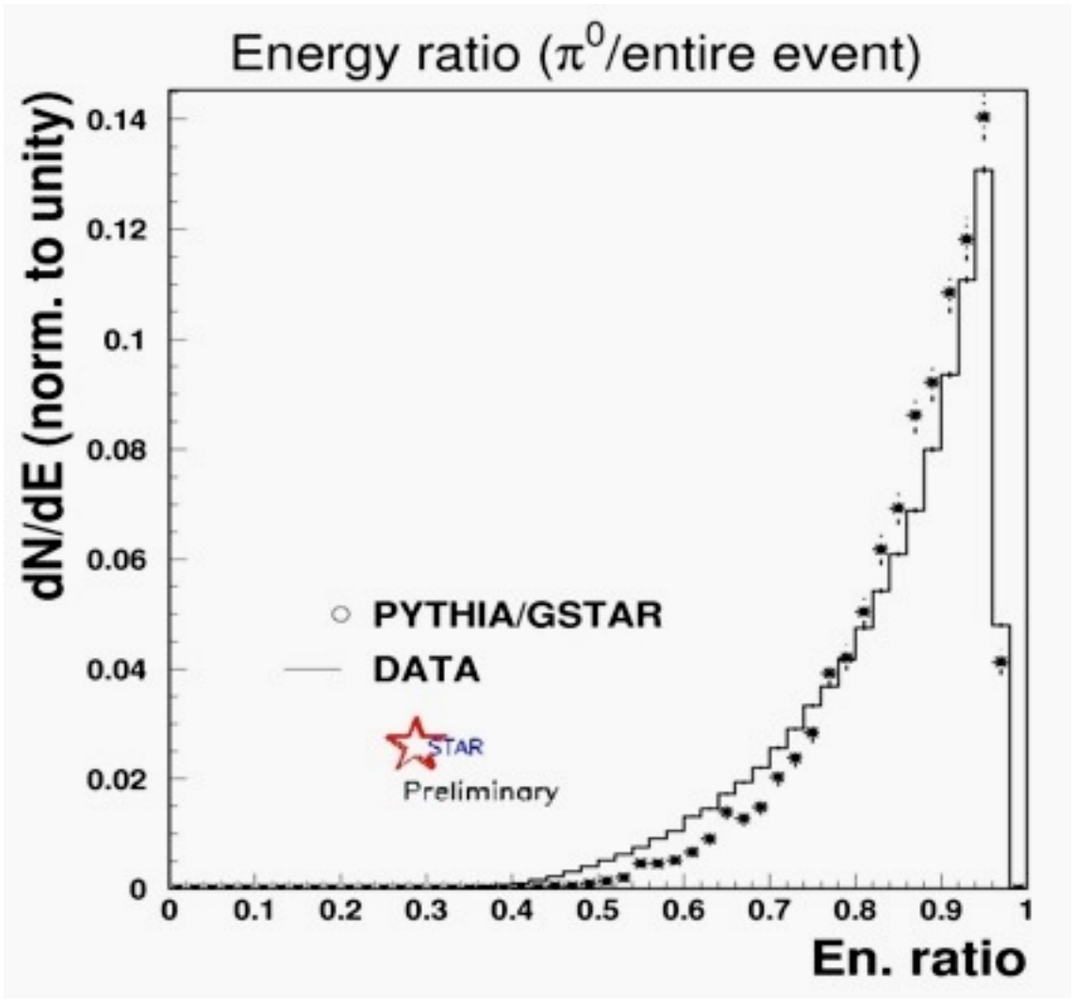




Forward Collins asymmetry

- Trigger: sum of E in small cells > threshold
- Calibrate each cell so $M_{\gamma\gamma}$ peak at M_{π^0}
- Described well by physics + detector simulation



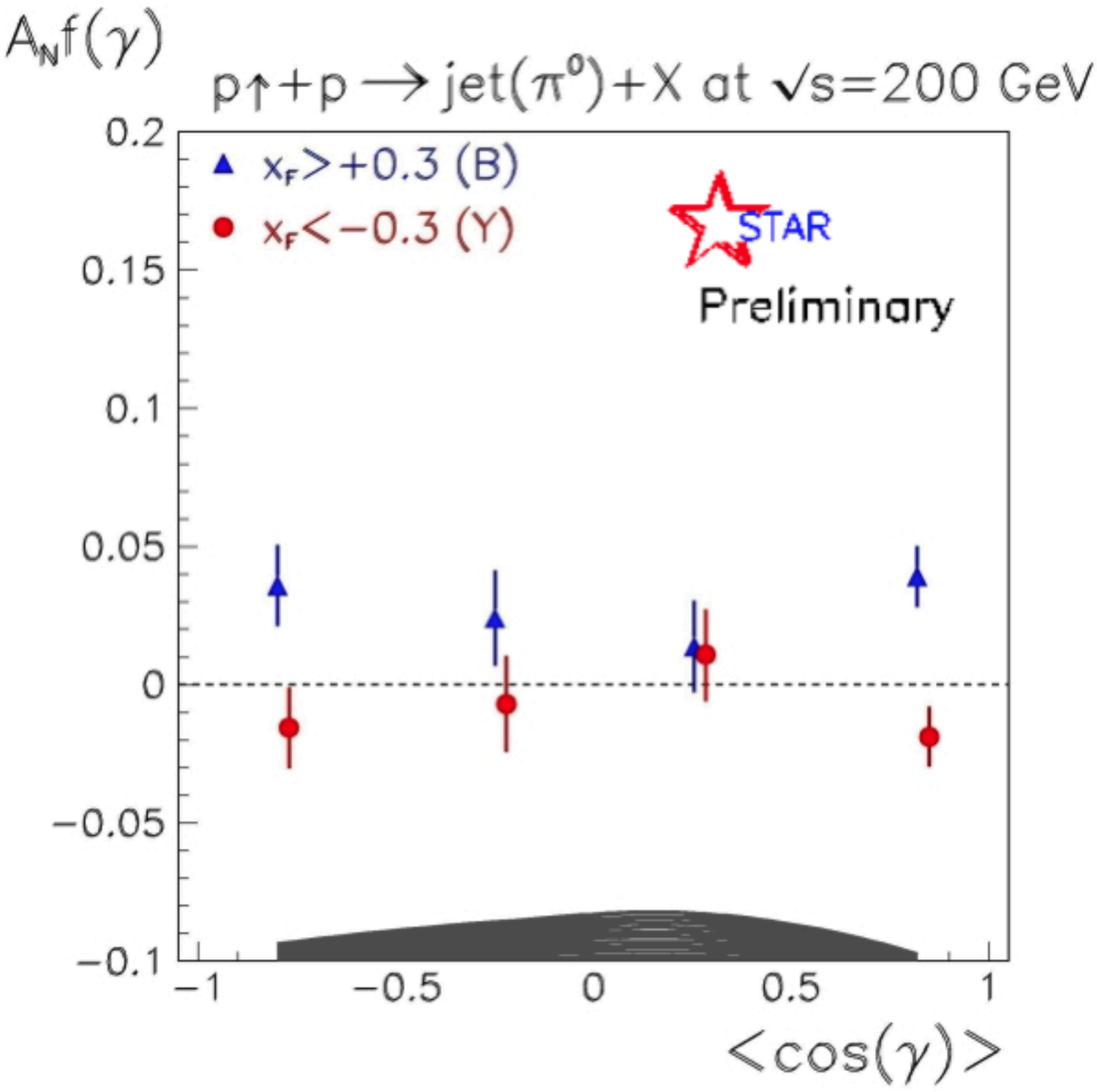


Forward Collins asymmetry

- Collins ⇒

  Gradient of $A_N(\gamma)$

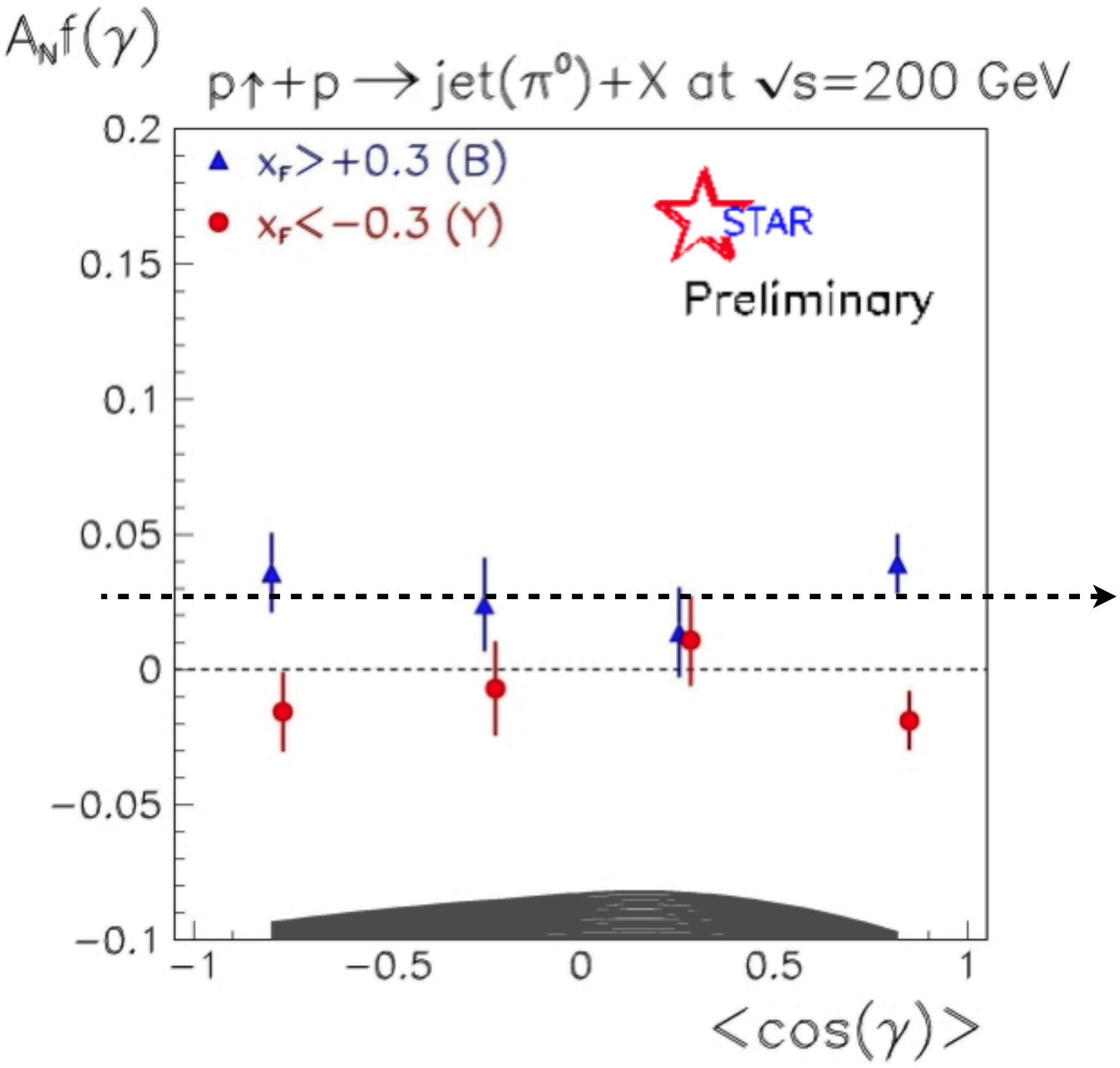
Forward Collins asymmetry



- Collins ⇒

  Gradient of $A_N(\gamma)$

Forward Collins asymmetry

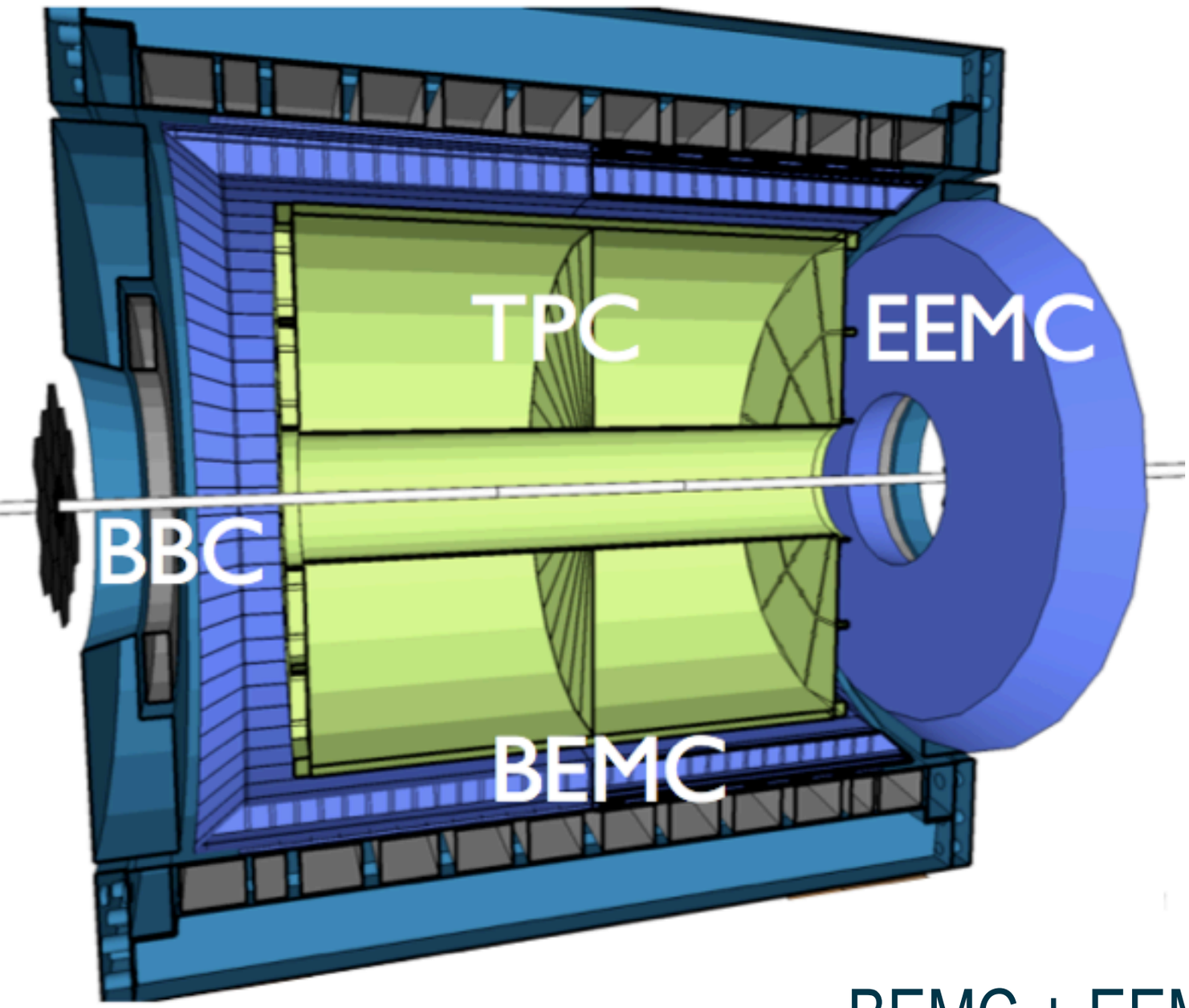


- Collins ⇒

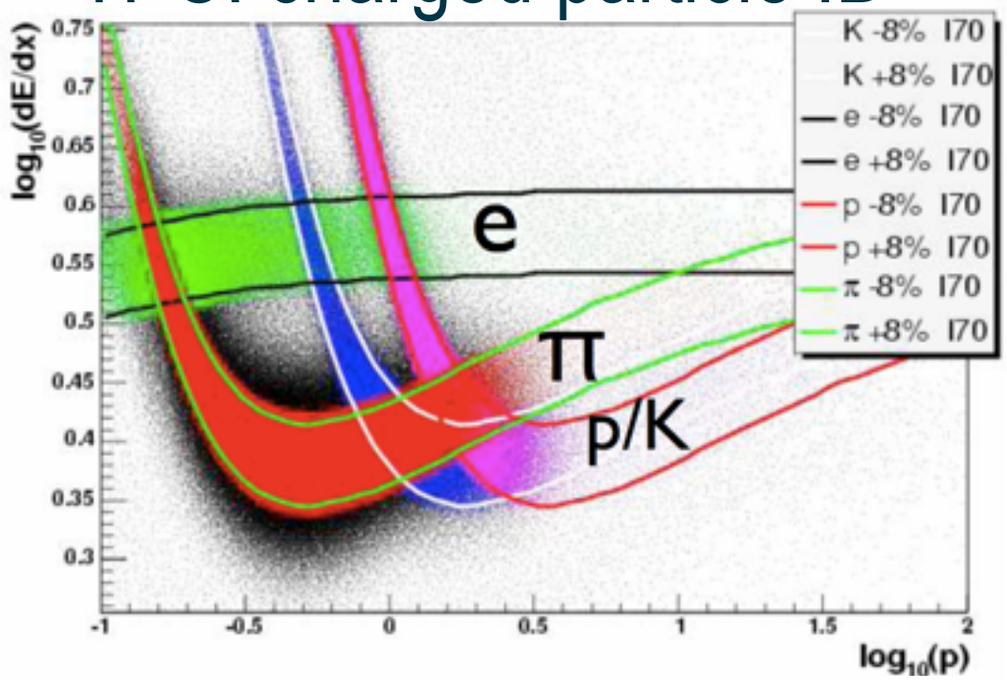
  Gradient of $A_N(\gamma)$

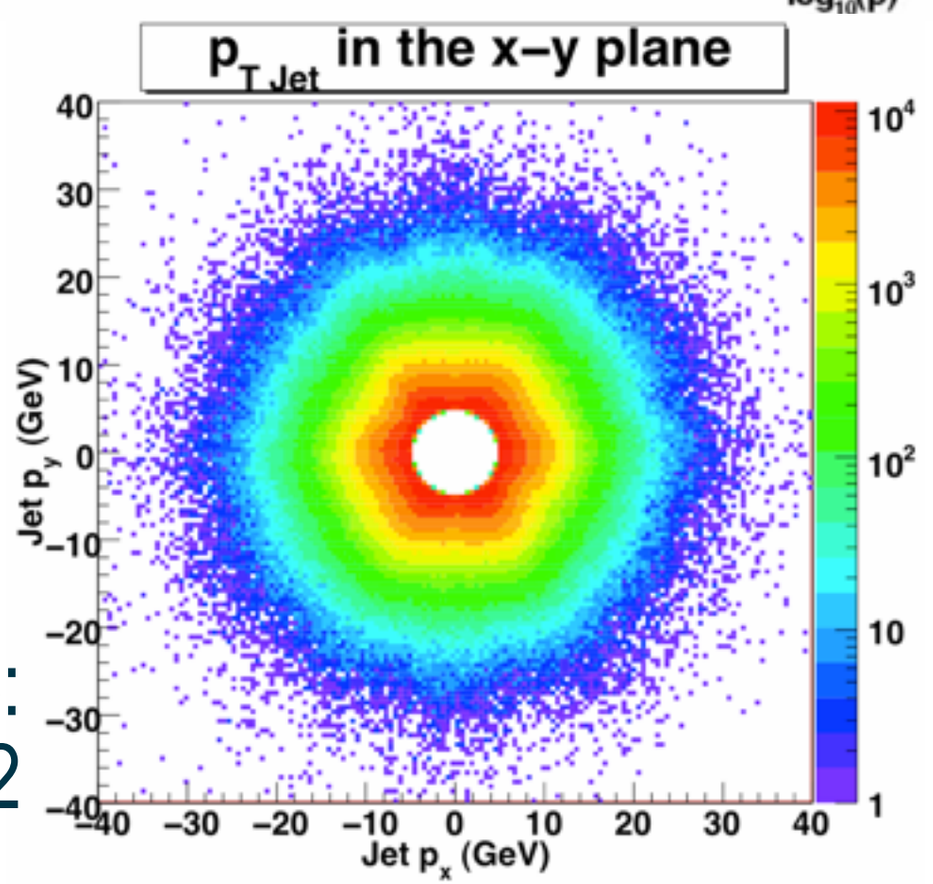
- No indication of a Collins-like contribution

Midrapidity Collins asymmetry



TPC: charged particle ID

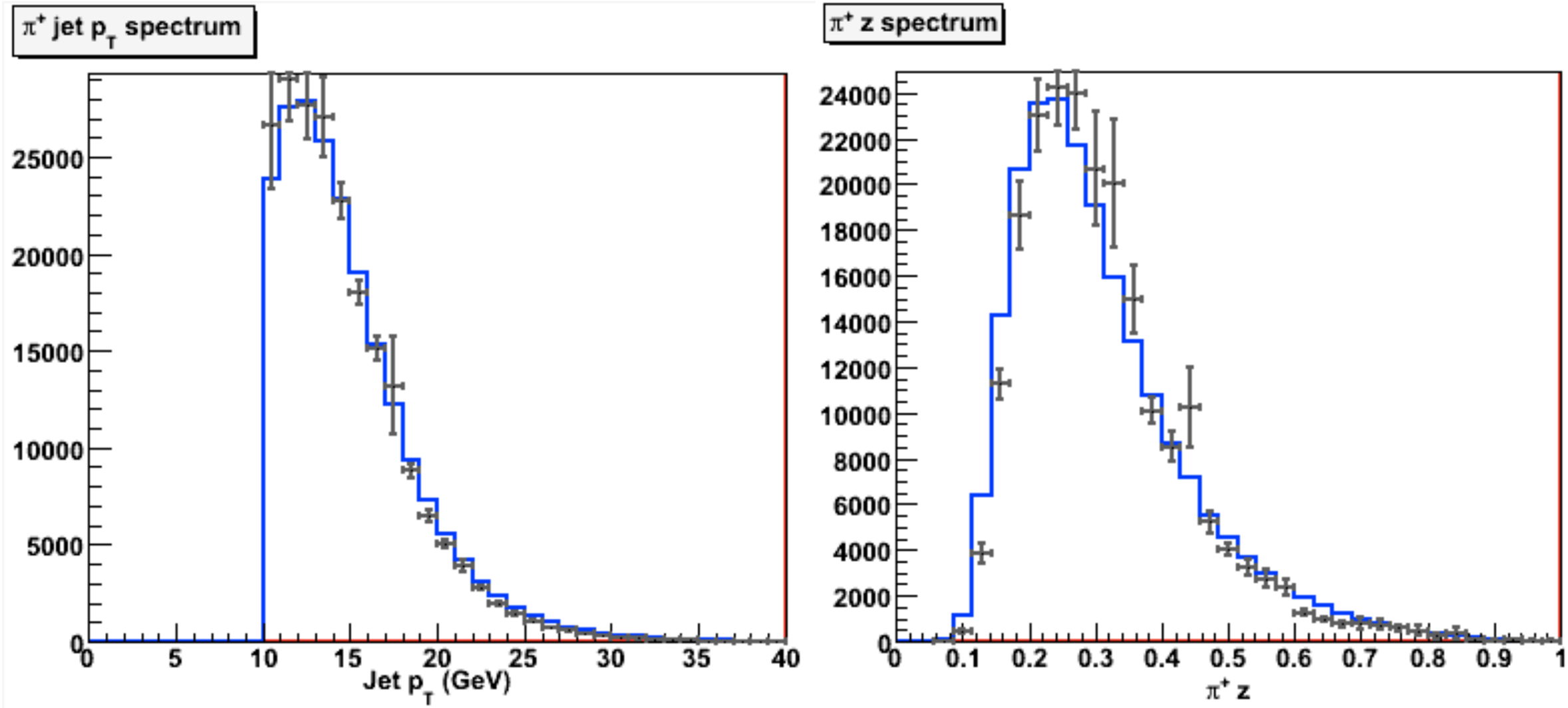




BEMC + EEMC: Reconstruct jets $-1 < \eta < 2$

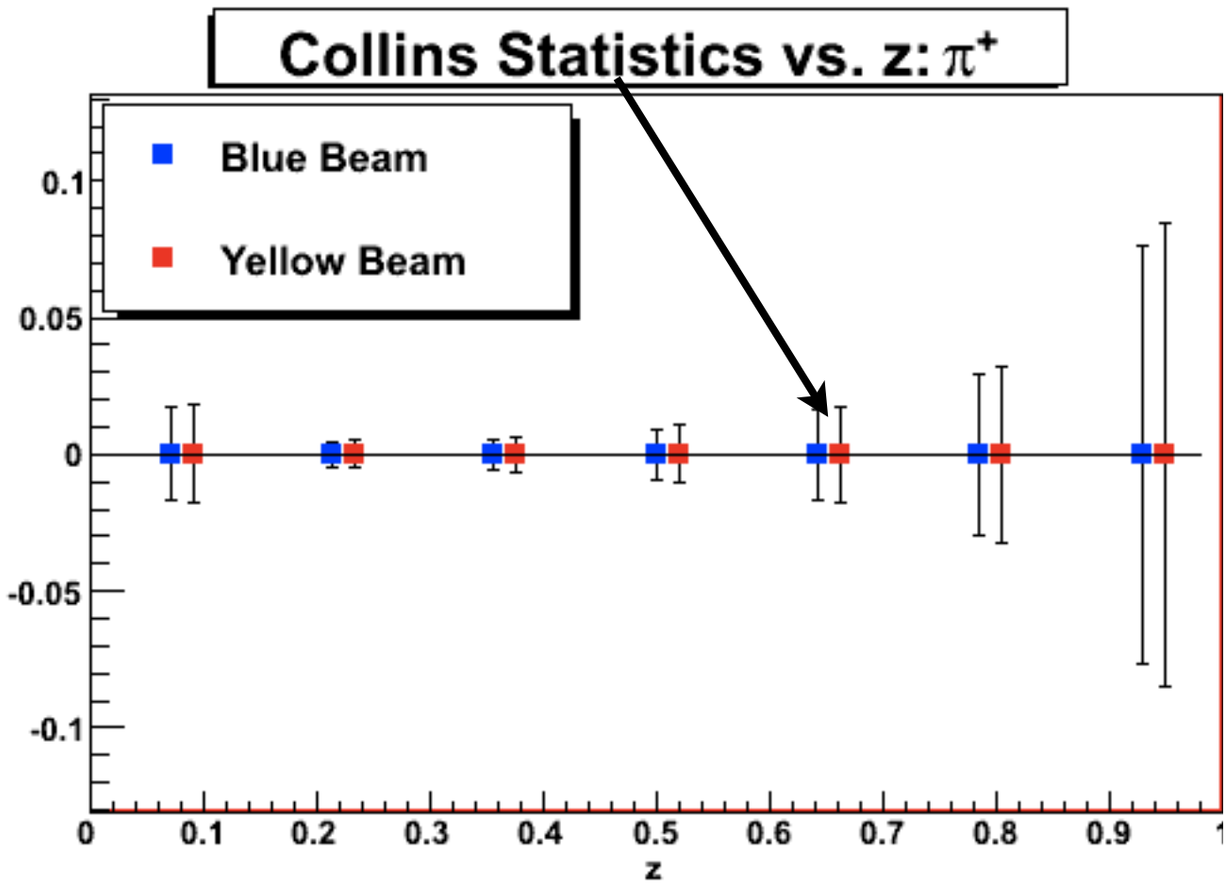
Midrapidity Collins asymmetry

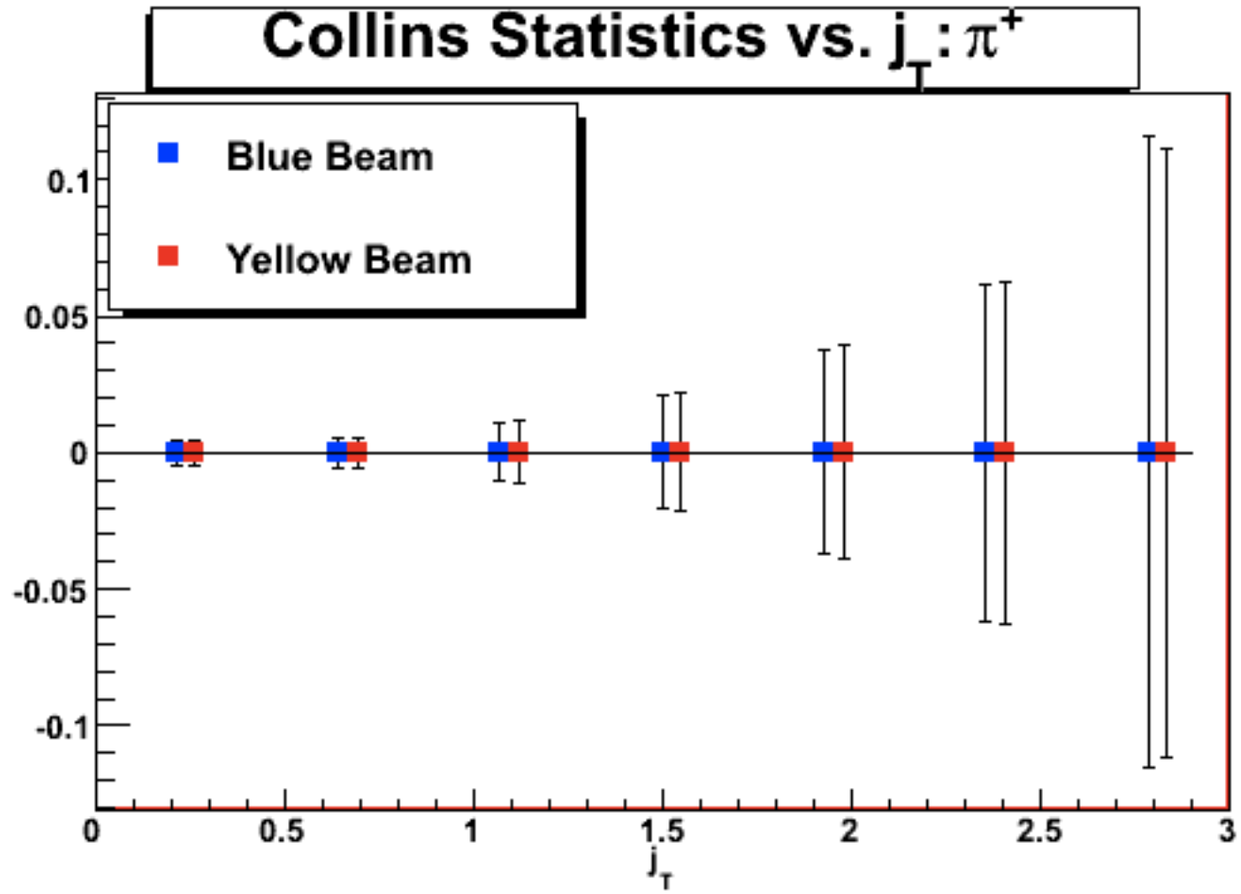
- Simulations match jet & π data well



Midrapidity Collins asymmetry

- Preliminary measurement is expected soon
- Current δq + Collins FFs ⇒ expect A_N ≈ few %





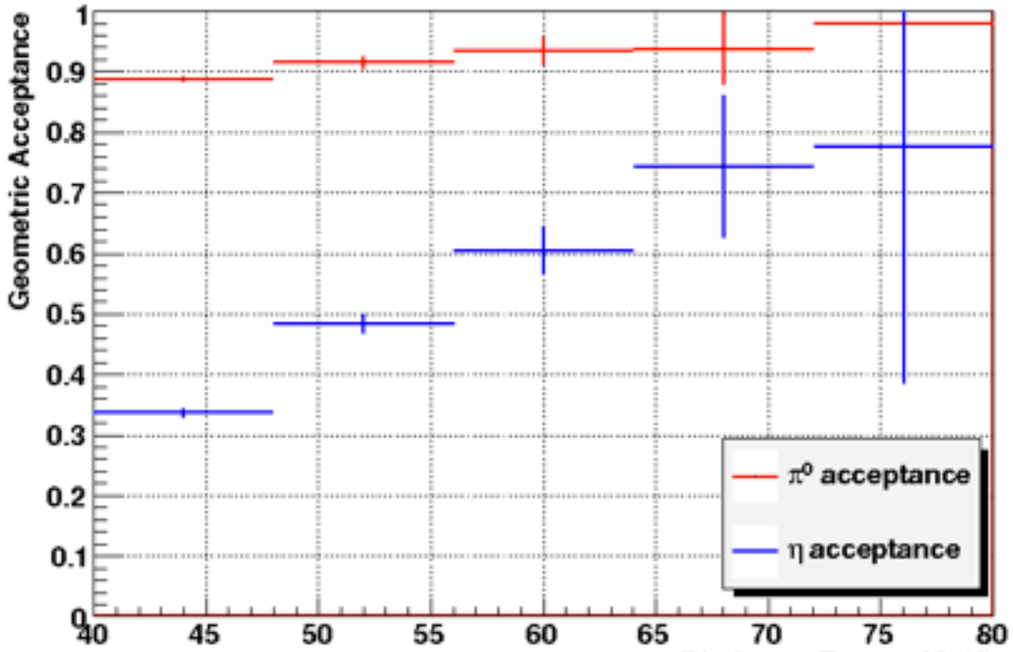
- Similar precision for π^-

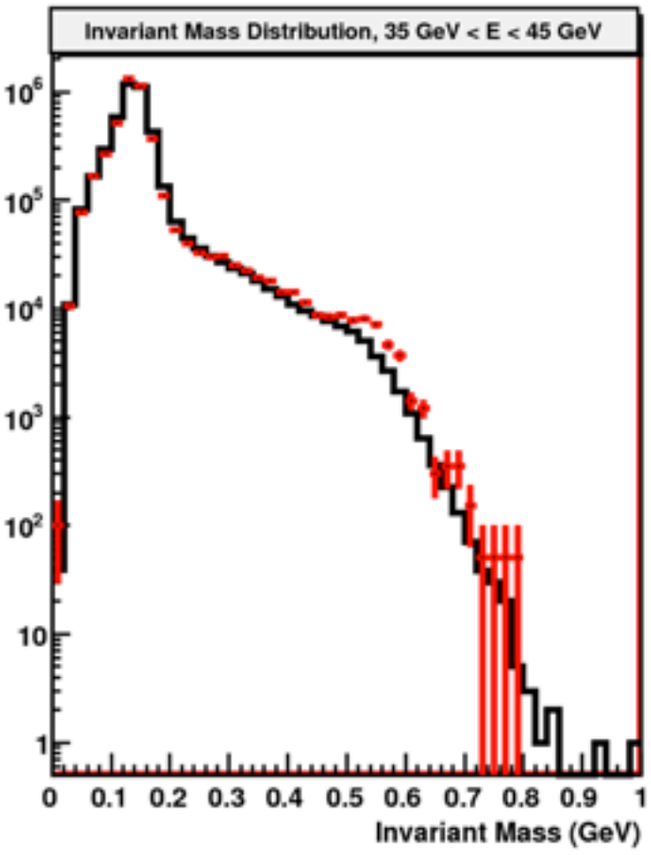
z: energy fraction carried by π

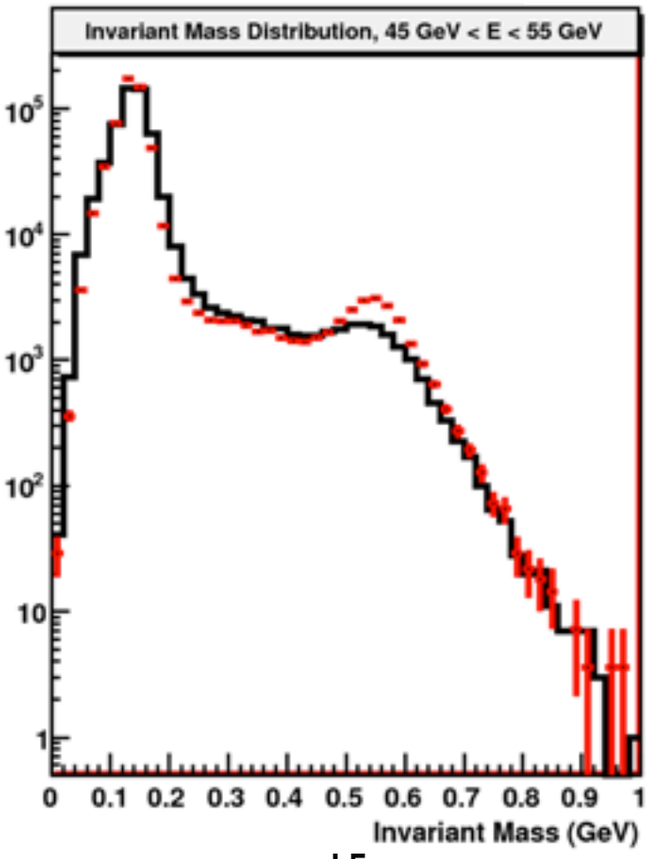
j_T: π p_T w.r.t. jet axis

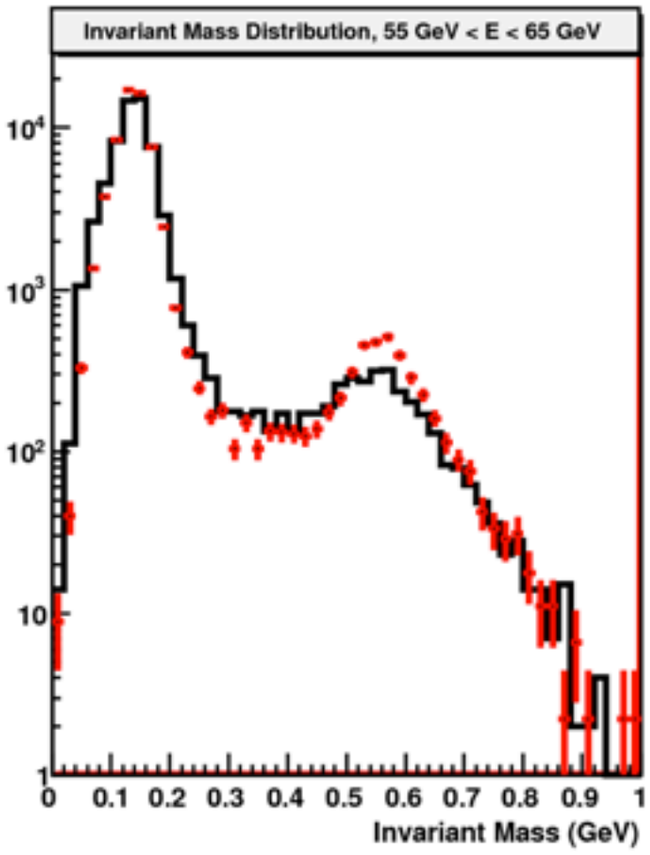
Forward η

- Extend forward A_N to higher mass
- η acceptance: mostly $x_F > 0.5$, improves greatly with E

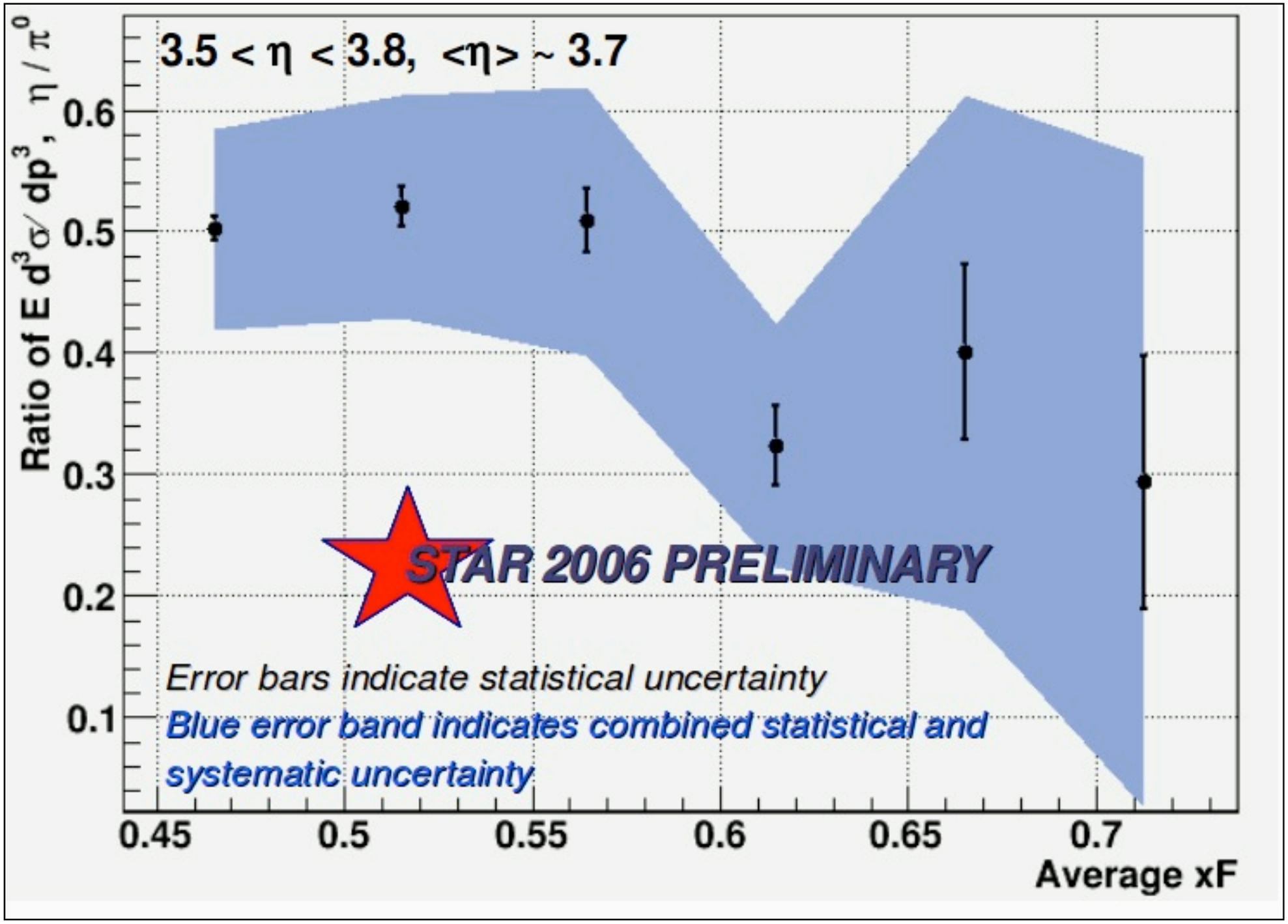








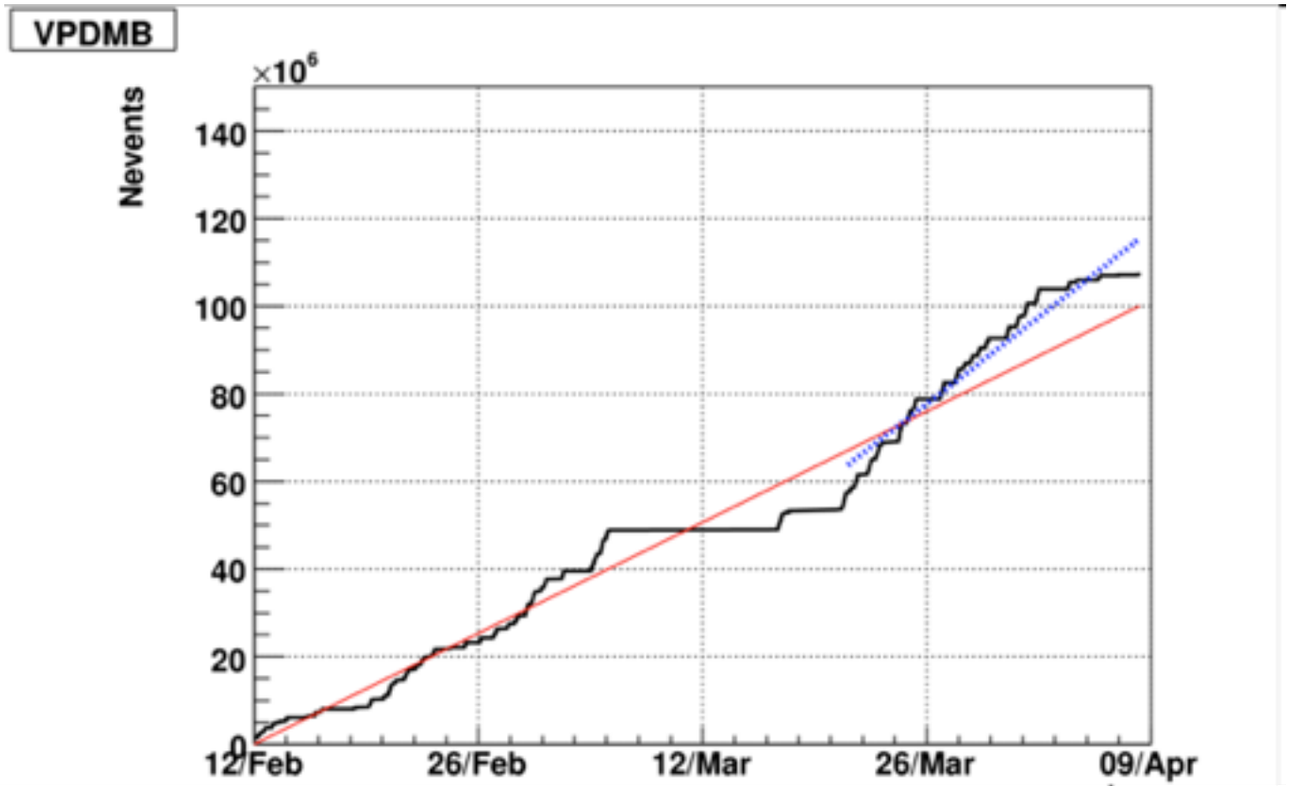
η/π^0 cross section ratio

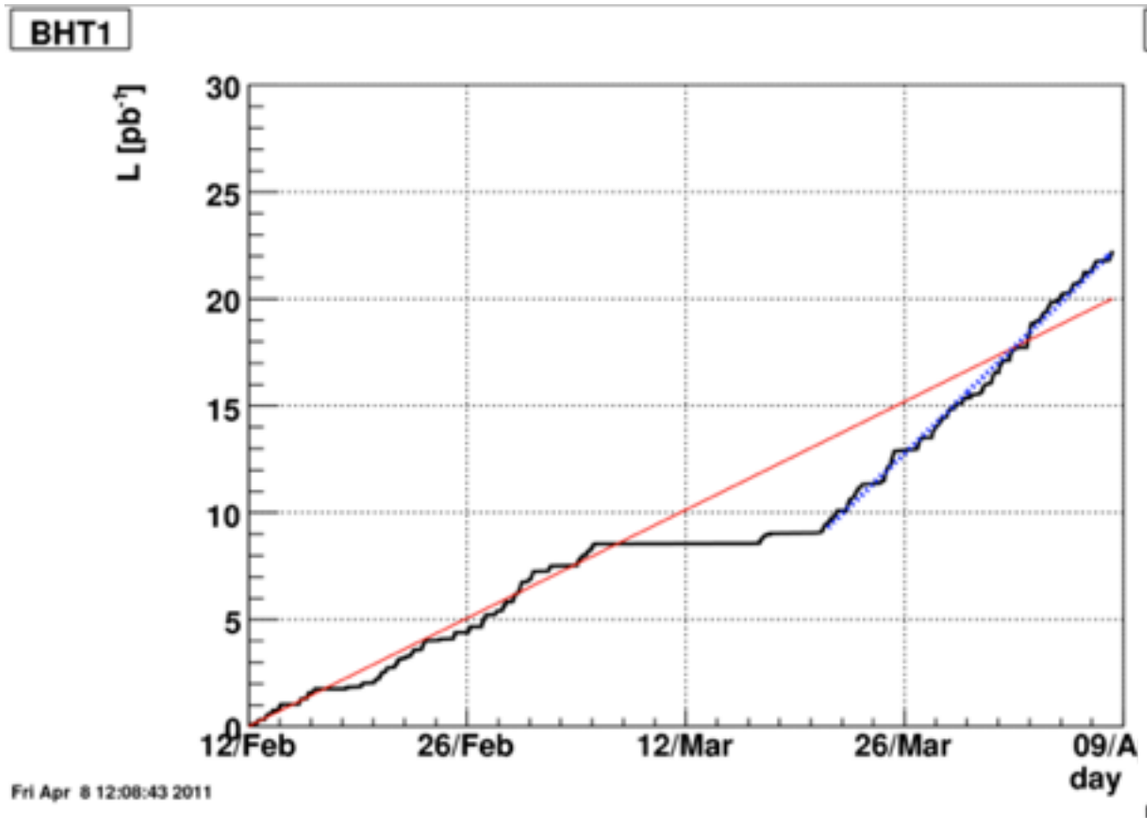


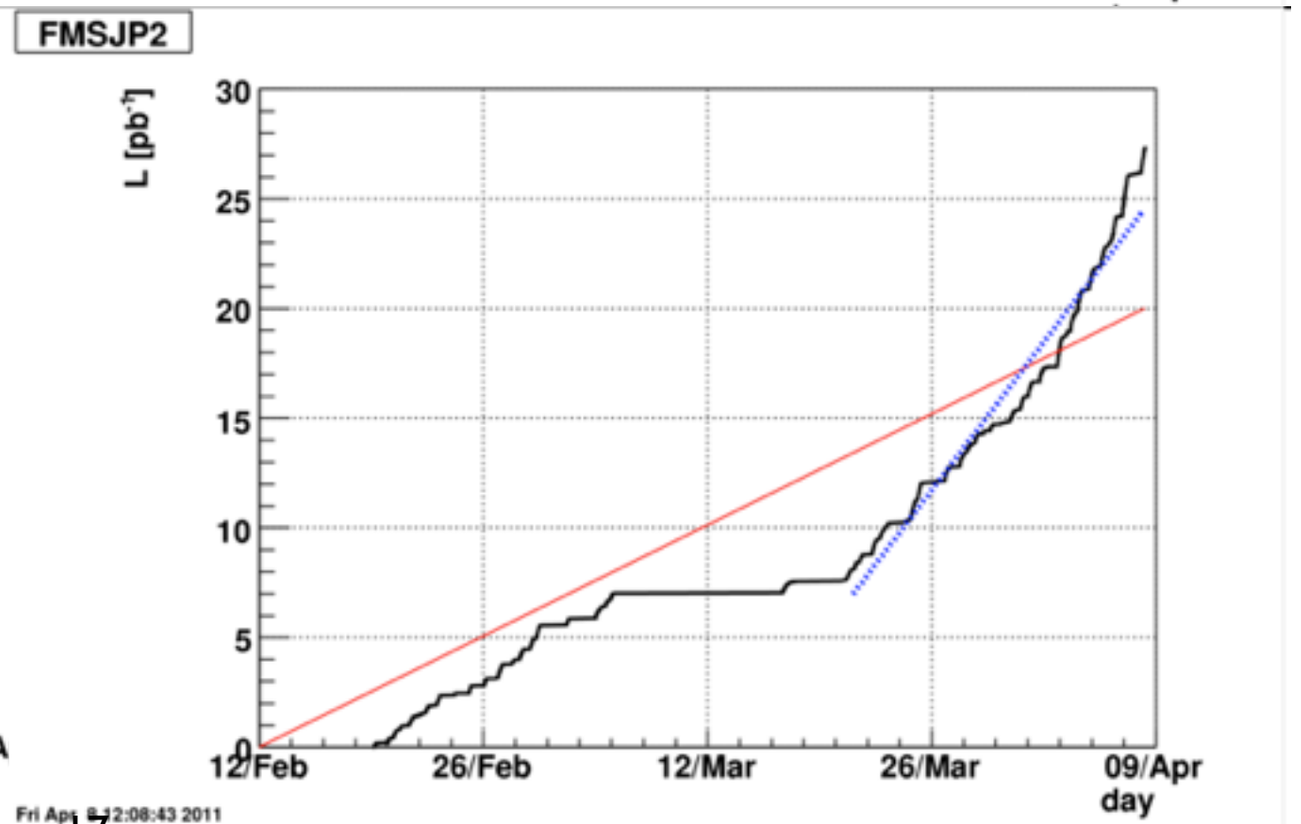
- Points at Average xF of each bin

2011 500 GeV

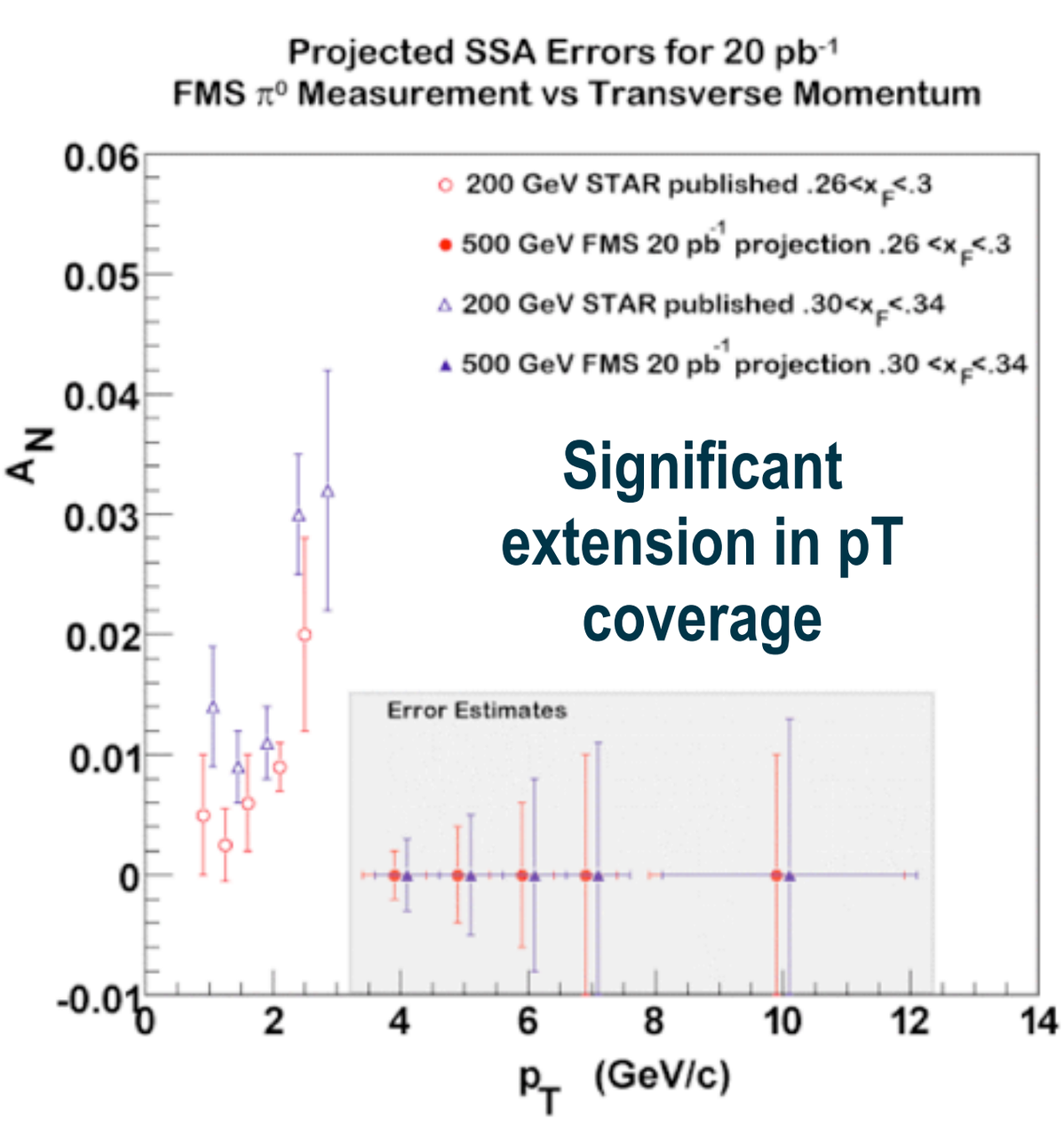
- 8 weeks of transverse running
- Exceeded goals for transverse data-taking

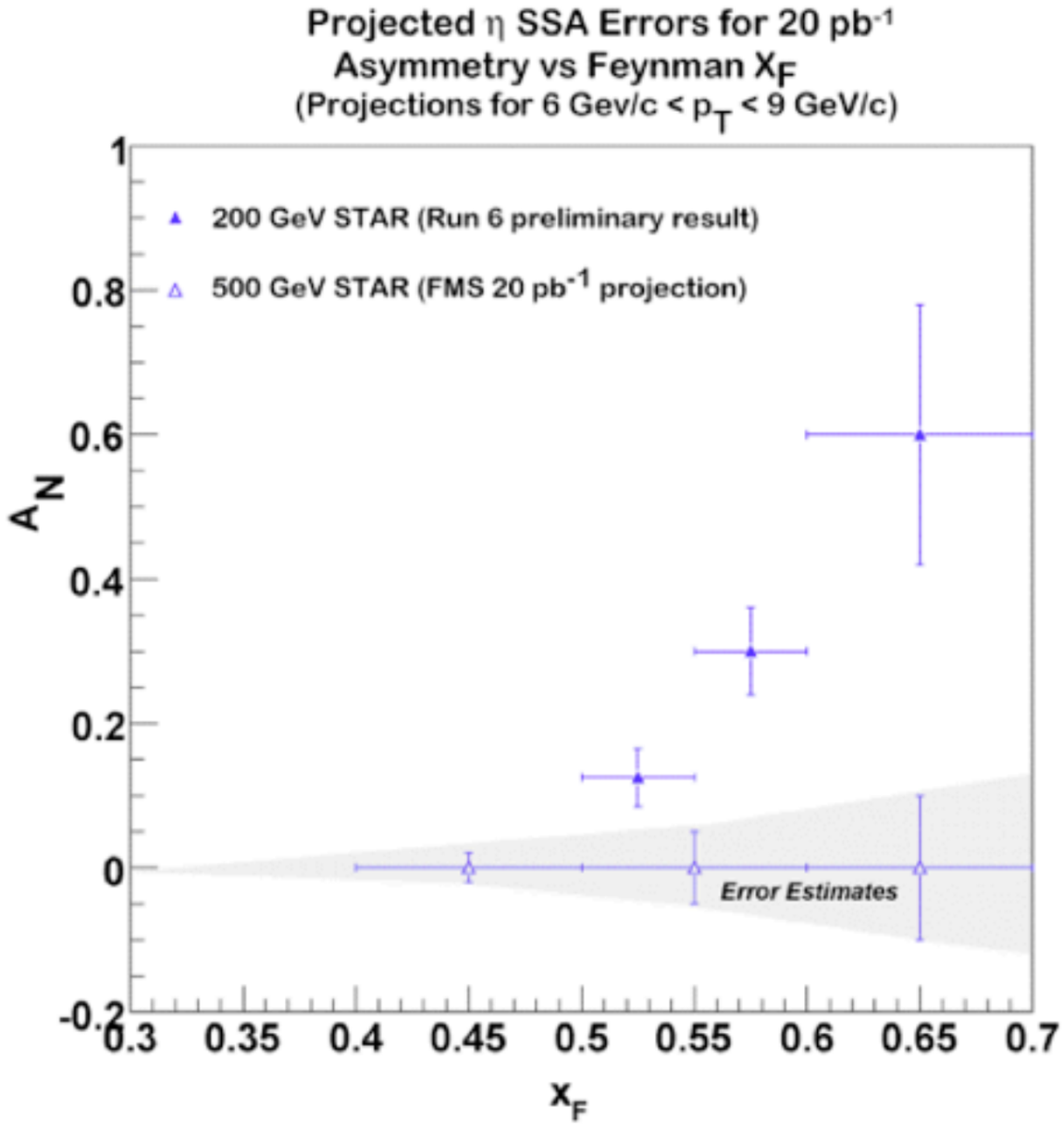






Plans

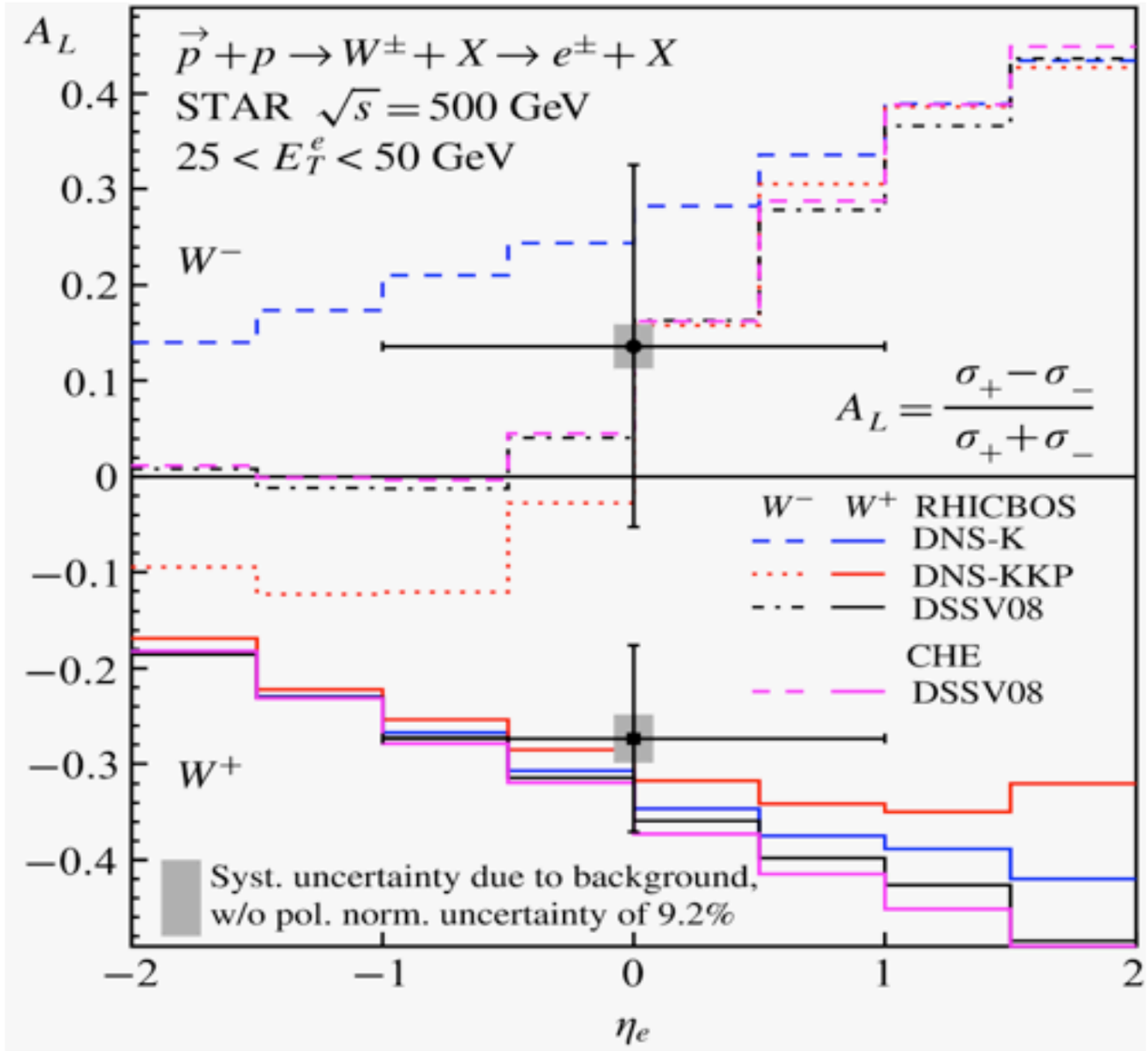




- 27.4 pb^{-1} acquired exceeds 20 pb^{-1} goal

A_N^W

- W measurements a major part of the 500 GeV programme
- Significant efforts in measuring A_L^W
- Plan first measurements of A_N^W



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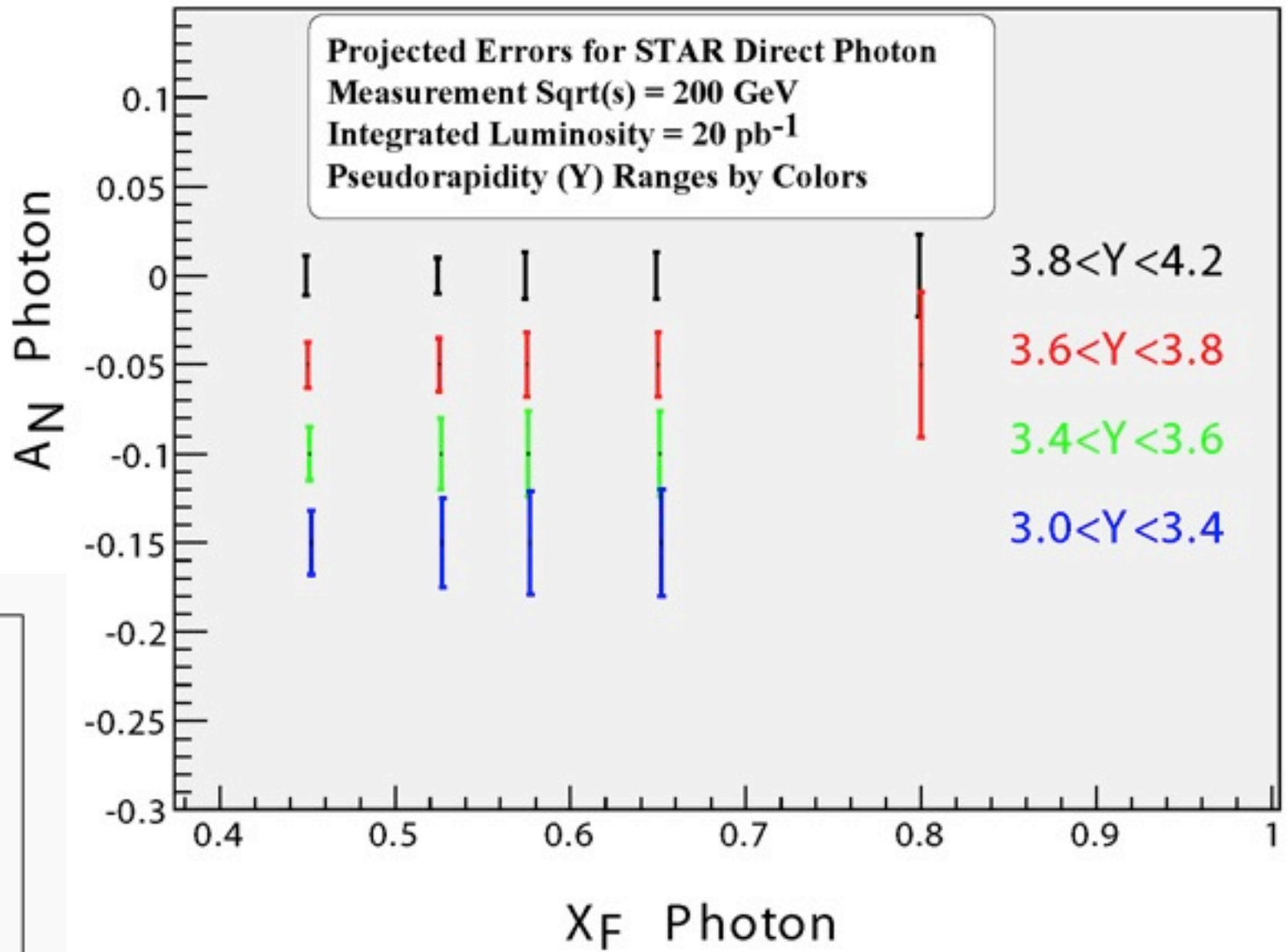
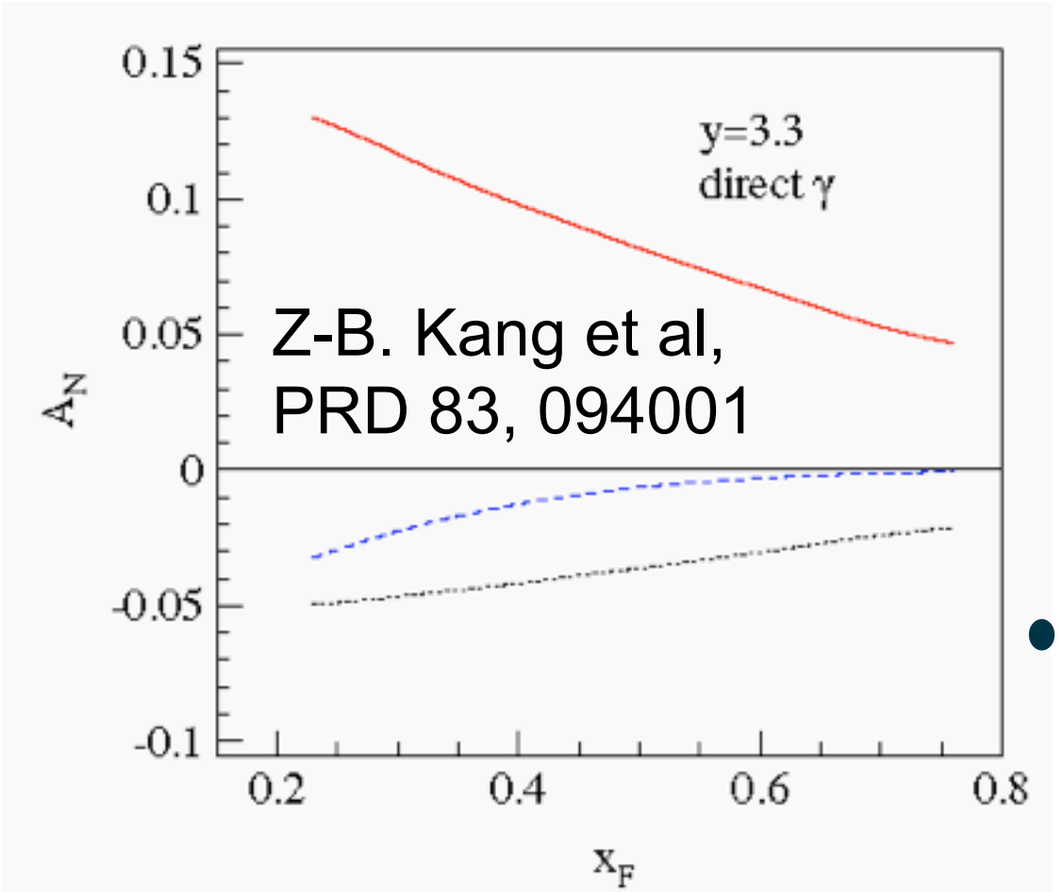
Beyond - A_N of direct photons

- 200 GeV requested in BUR for run 13
- Significant precision achievable





- Important for testing model predictions

Conclusion

- Numerous analyses in progress & near completion
  - Collins asymmetry @ mid- & forward rapidity
  - Forward η
- Successful transverse run this year

➡Exceeded data goals, allows

  - extensions of past/current analysis
  - new analyses e.g. A_N^W