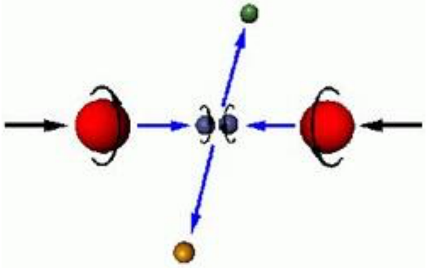
Why p+p?



- SIDIS a microscope to look into nuclear structure
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- Some new, dynamical phenomena,
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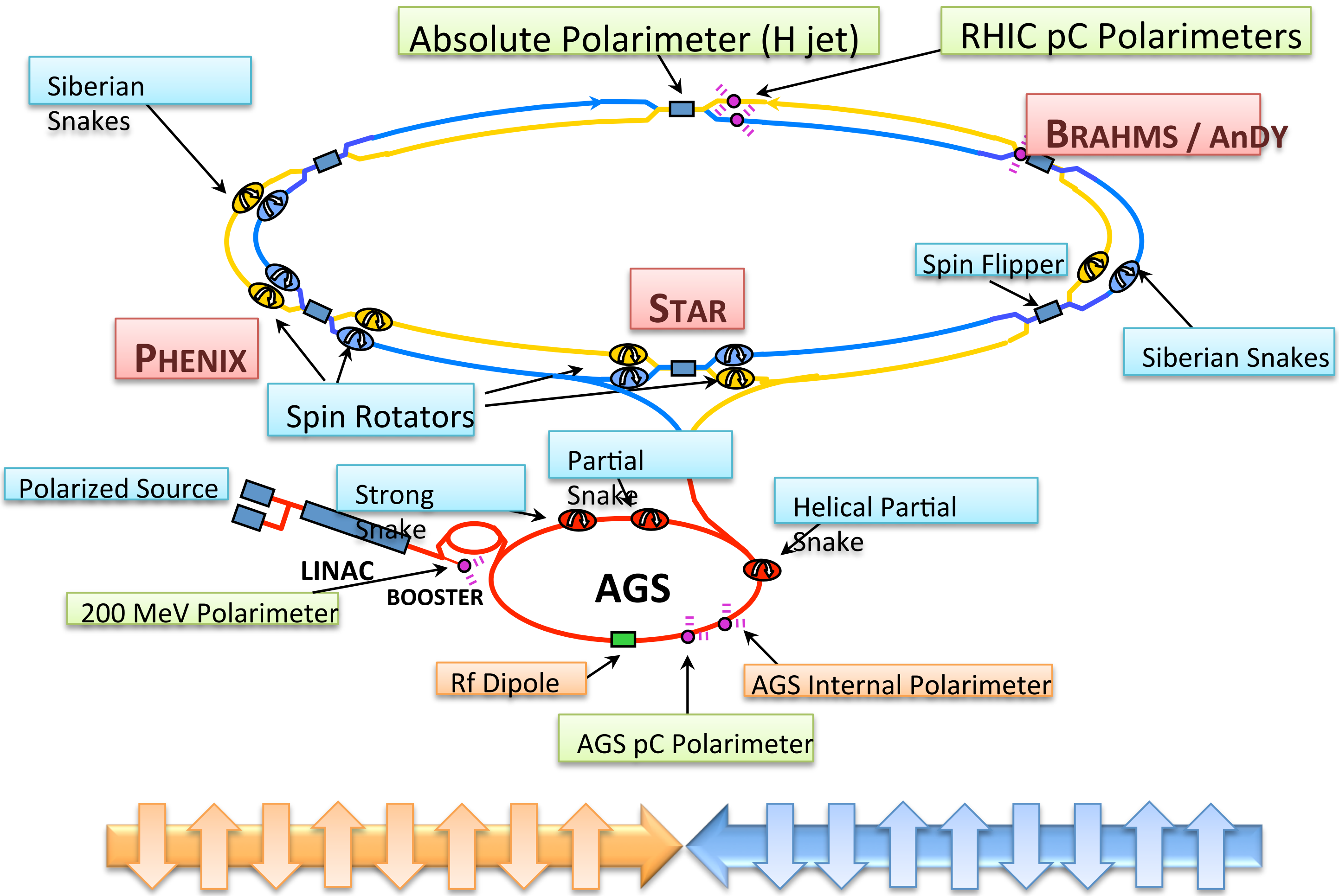
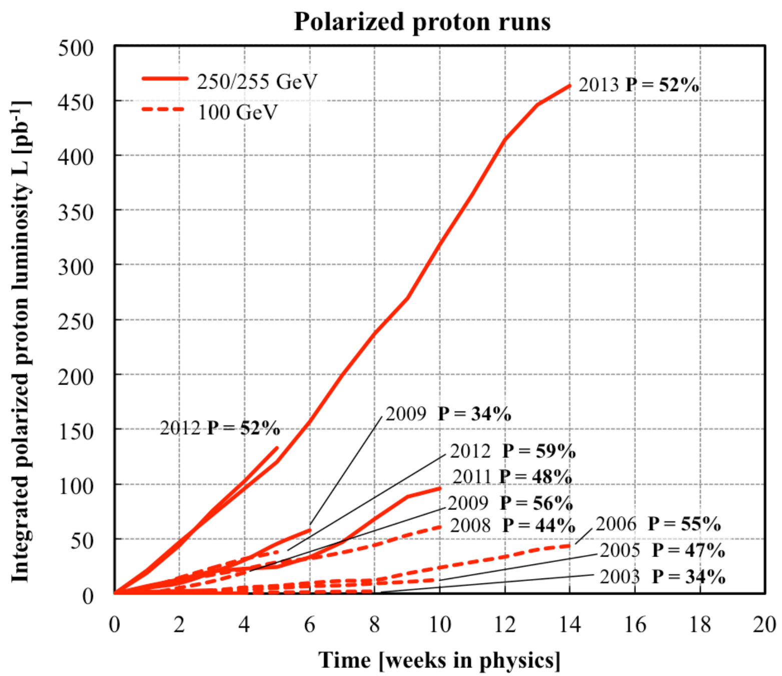
RHIC at BNL



Absolute Polarimeter (H jet)
RHIC pC Polarimeters
Siberian Snakes
BRAHMS / AnDY
Spin Flipper
STAR
Siberian Snakes
PHENIX
Spin Rotators
Partial Snake
Polarized Source
Strong Snake
Helical Partial Snake
LINAC
BOOSTER
AGS
200 MeV Polarimeter
Rf Dipole
AGS Internal Polarimeter
AGS pC Polarimeter

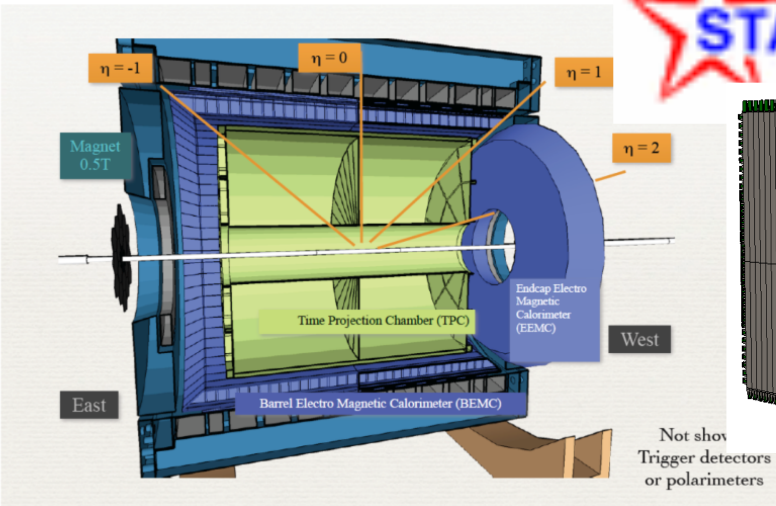
RHIC is able to collide polarized protons at sqrt{s} up to 500 GeV

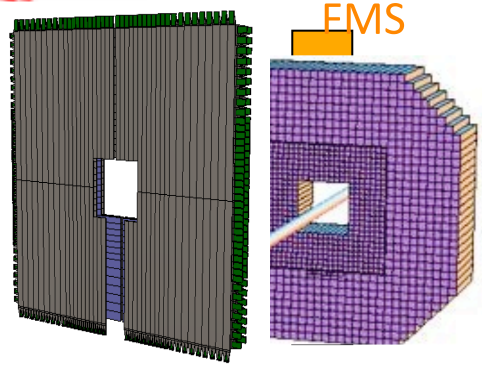


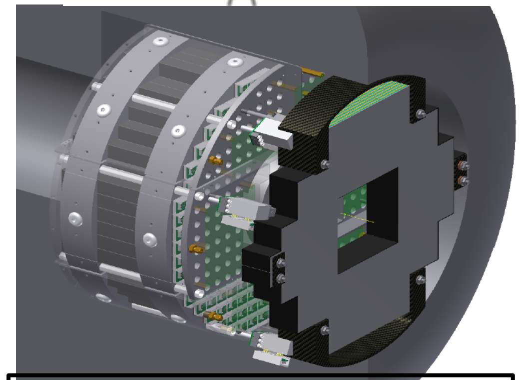
- Bonus:
  - Heavy Ion Collisions
  - d+A
  - **p↑+A !! Unique opportunity to probe saturation and fragmentation in the medium with spin**

STAR

PHENIX

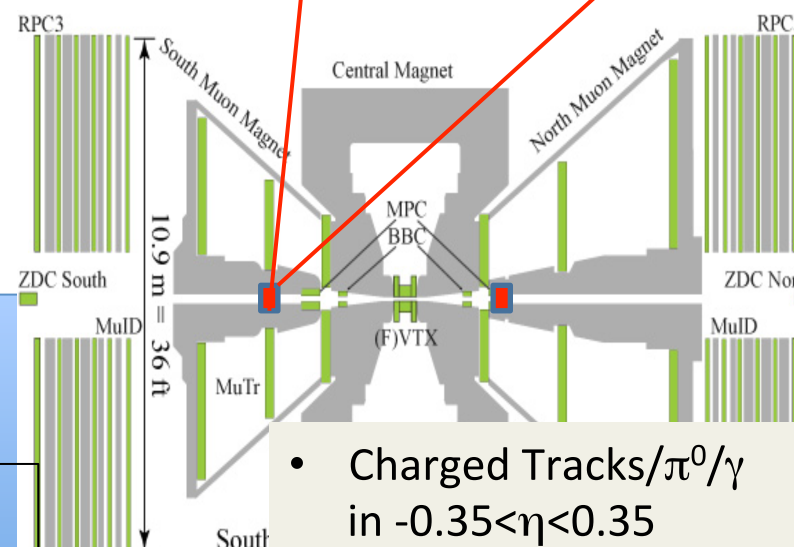


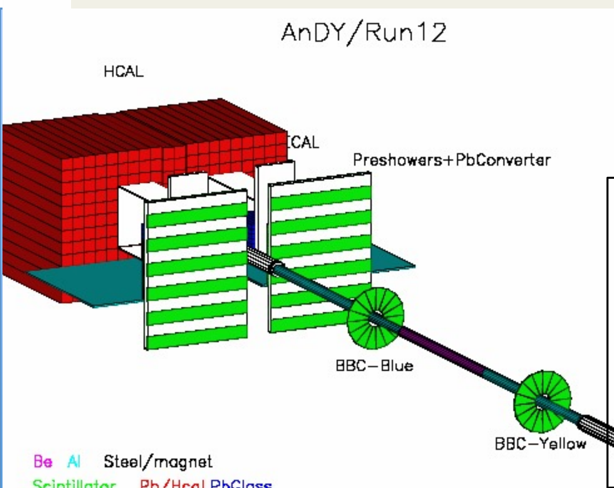




3.1<η<3.8

- PID (Barrel) with dE/dx, TOF
- Jets in -0.7<η<0.9
- EM Jets -1<η<4
- Full Azimuth
- Forward EMC with preshower



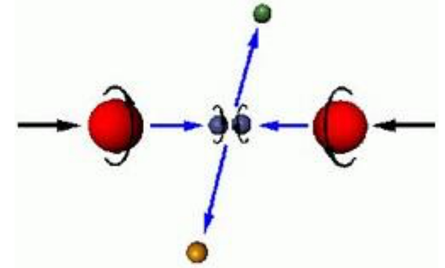


AnDY

- HCAL with preshower
- Collected data in run12 500 GeV

- Charged Tracks/π^0/γ in -0.35<η<0.35
- μ in 1<η<2
- Forward EMC with preshower

Why p+p?



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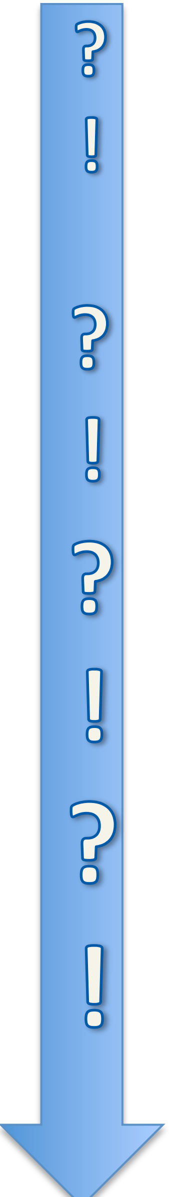
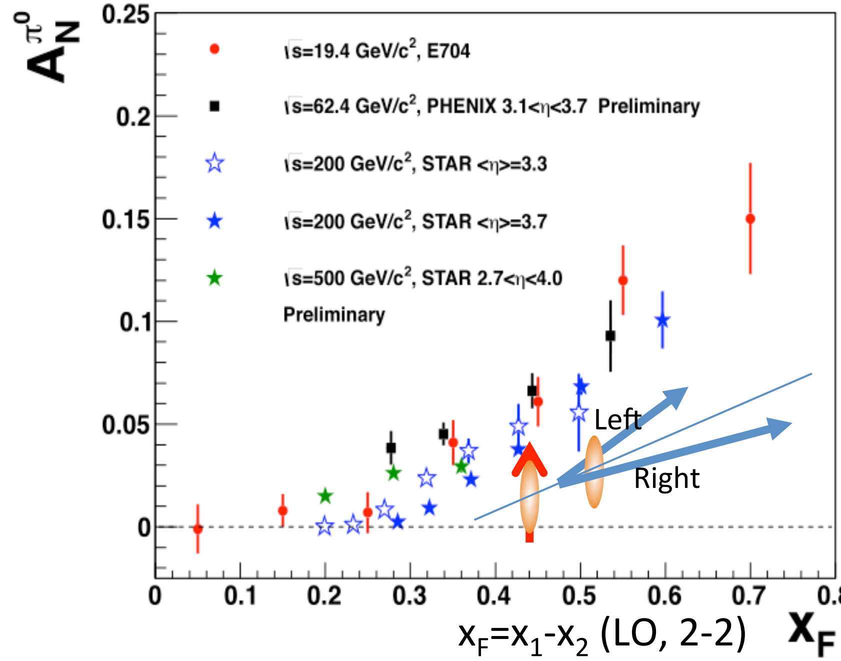
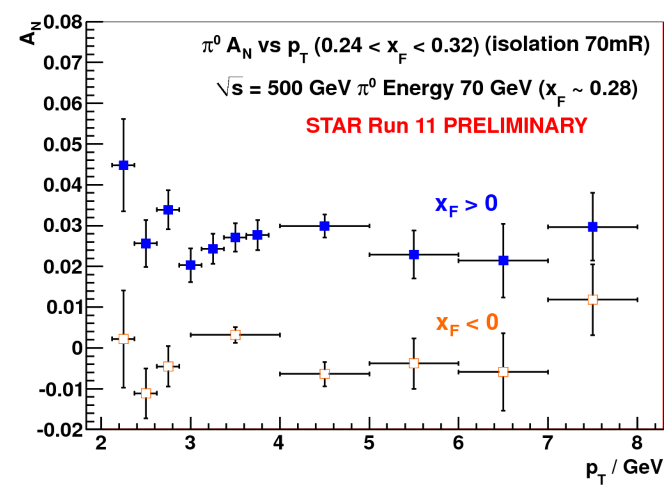
Forward large transverse single spin asymmetries: Proving ground for QCD calculations



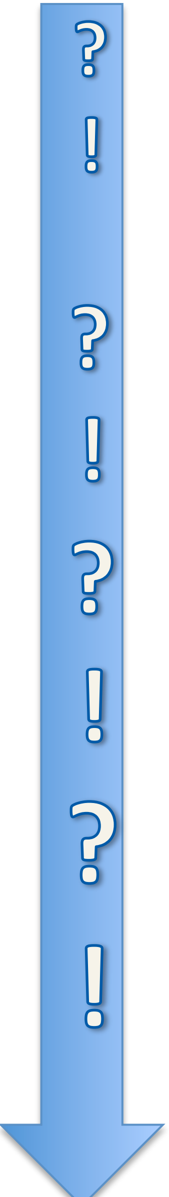
- Kane Pumplin, Repko (1978): not expected
- TMD distributions? (Sivers & Collins)
- Connection between TMD and Twist3 collinear picture: $T_F^q(x,x) = -\int d^2p_\perp \frac{\vec{p}_\perp^{\,2}}{M} f_{1T}^{\perp q}(x,\vec{p}_\perp^{\,2})|_{\mathrm{SIDIS}}$





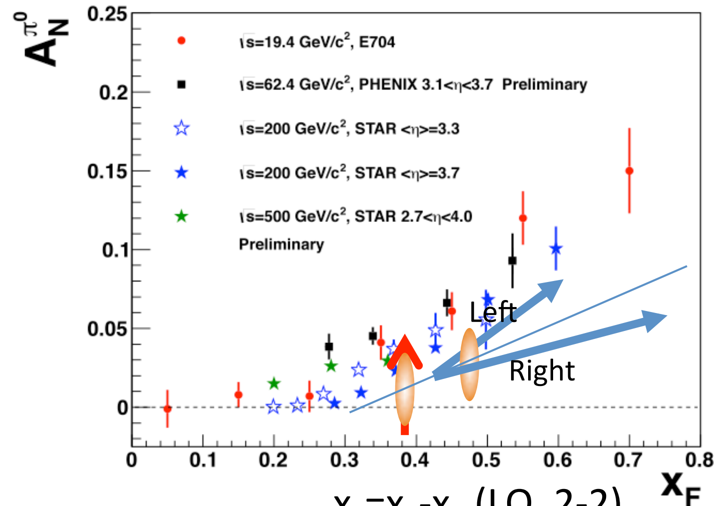
Forward large transverse single spin asymmetries: Proving ground for QCD calculations

x_F

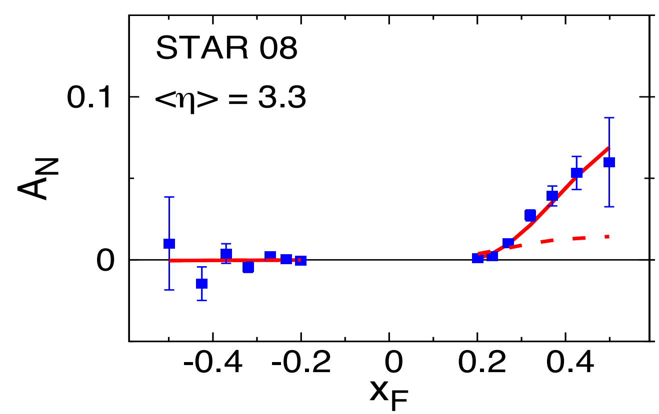


x_1

- Kane Pumplin, Repko (1978): not expected
- TMD distributions? (Sivers & Collins)
- Connection between TMD and Twist3 collinear
  - Sign problem, factorization in TMD
- Twist3 richer: Other twist3 contribution?
- FF contribution?



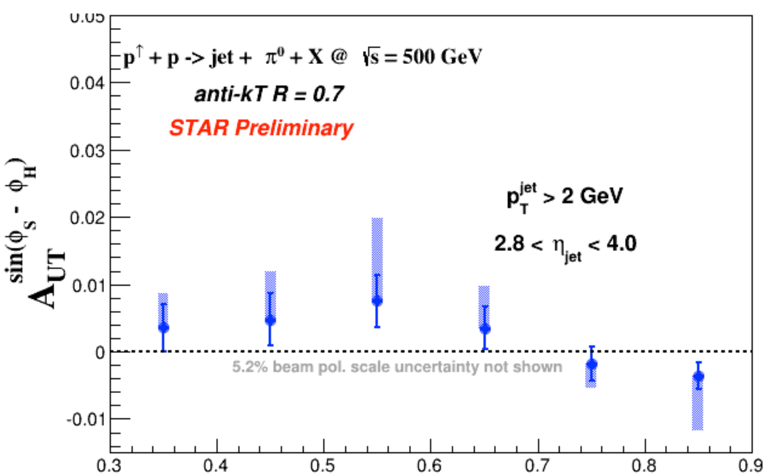
$x_F = x_1 - x_2$ (LO, 2-2)

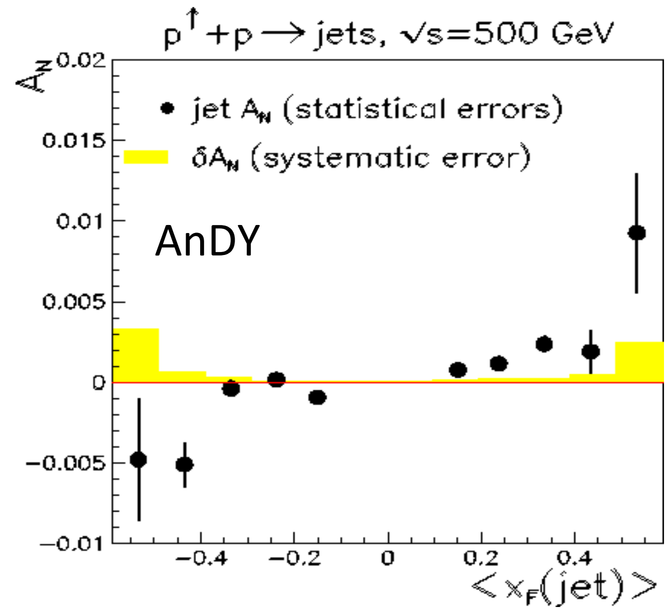


(also uses): $\hat{H}^{h/q}(z) = z^2 \int d^2\vec{k}_\perp \frac{\vec{k}_\perp^{\,2}}{2M_h^2} H_1^{\perp h/q}(z, z^2\vec{k}_\perp^{\,2})$

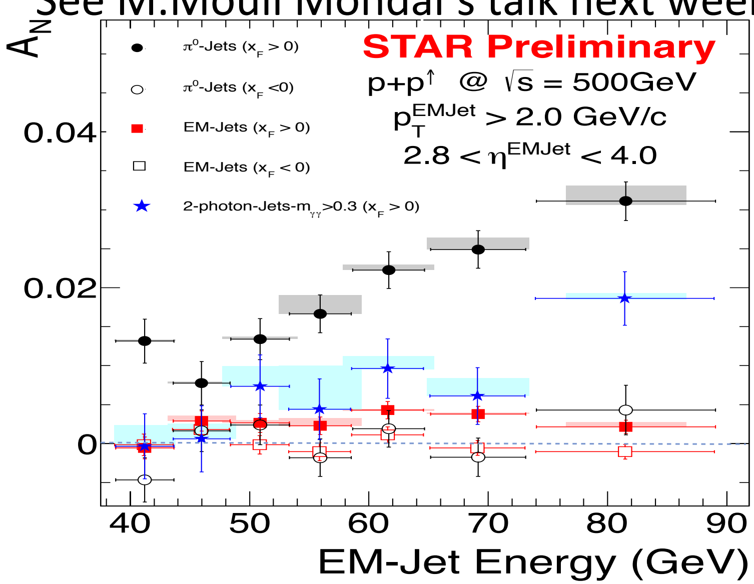
Kanazawa, Koike, Metz, Pitonyak
Phys.Rev. D89 (2014) 11, 111501

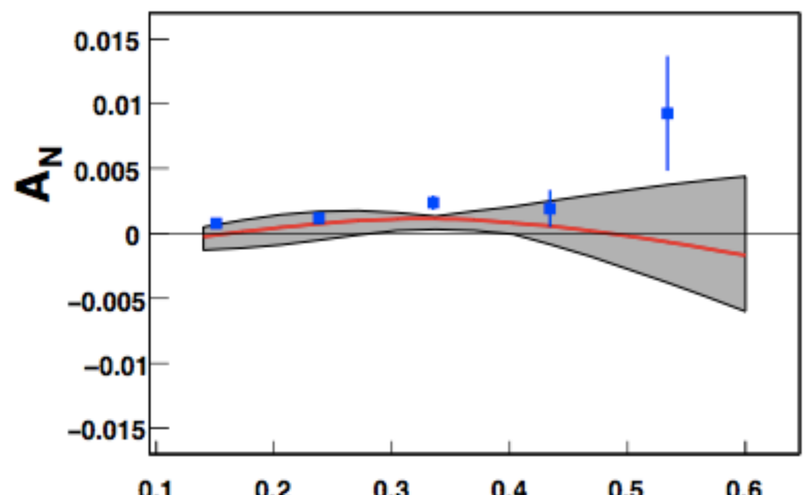
Indeed TMD (like) Contributions are small





See M.Mouli Mondal's talk next week



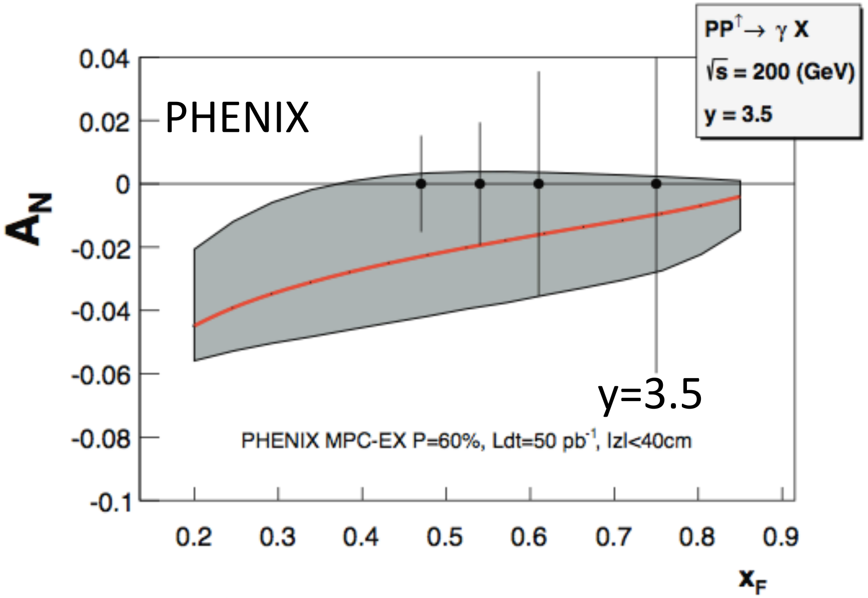


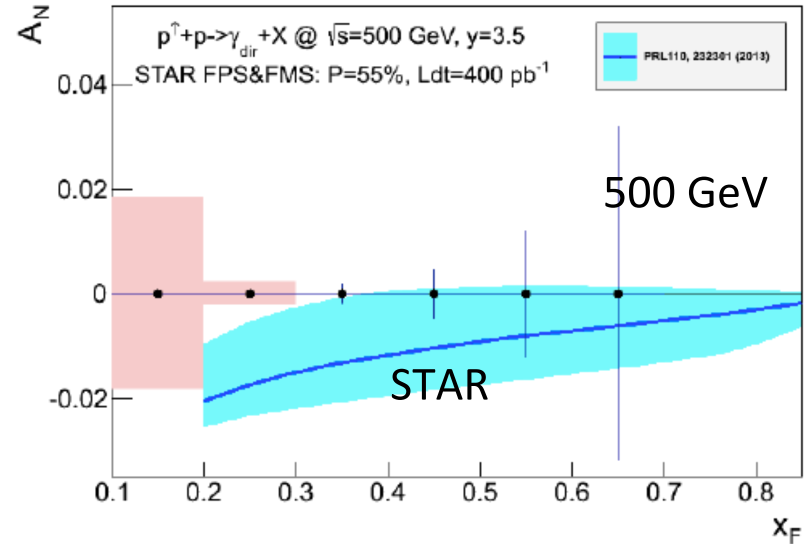
Gamberg, Kang, Prokudin,
Phys.Rev.Lett. 110 (2013) 23, 232301

Jet algorithm : anti-k_T, R = 0.7

$p_T^{EM\text{-}Jet}$ > 2.0 GeV/c, -1.0<$\eta^{EM\text{-}Jet}$<2.0

Explore origins further: Test Framework with direct Photon (only ISI)



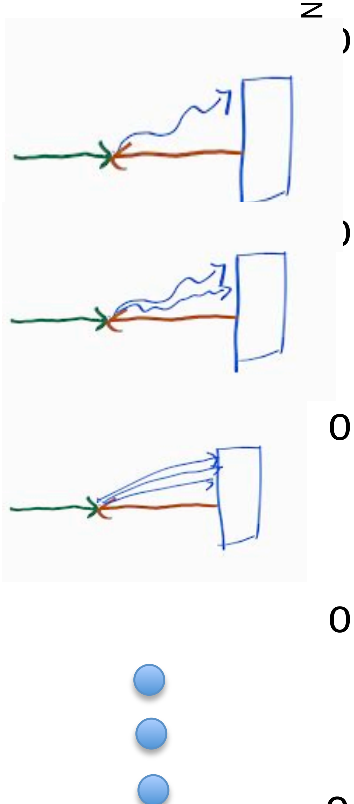


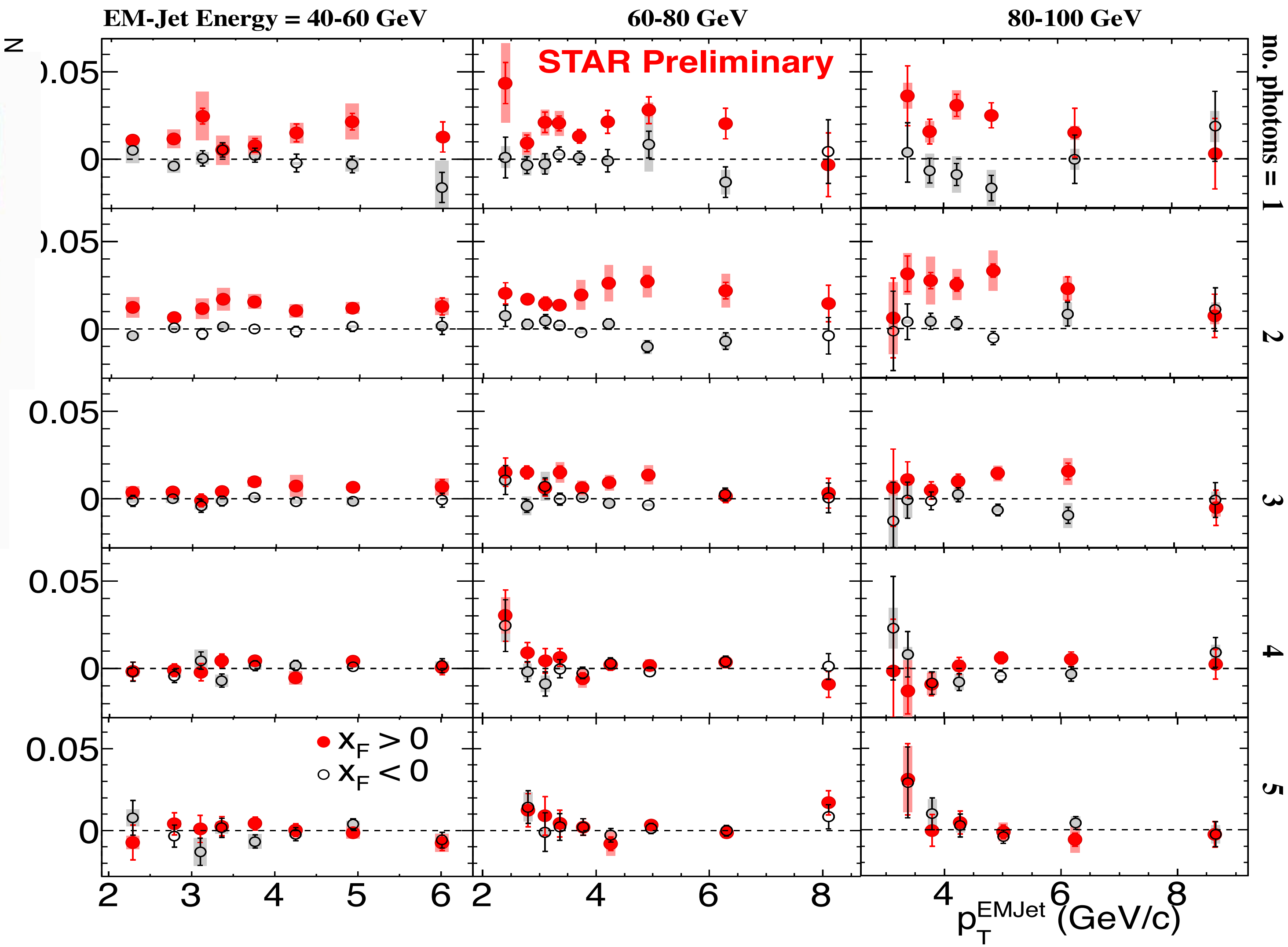
Theory curves fromGamberg, Kang, Prokudin,
Phys.Rev.Lett. 110 (2013) 23, 232301

From data already taken this year!

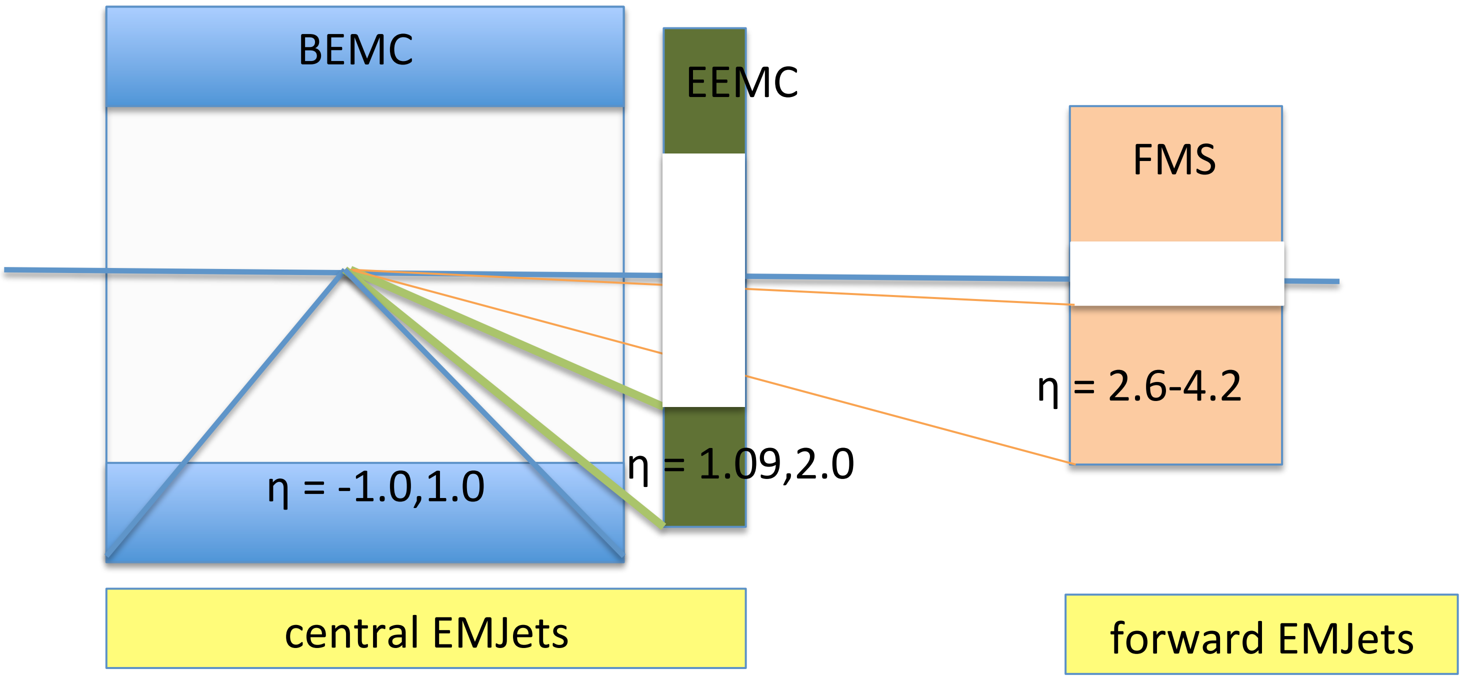
NB: Only ISI, test sign change equivalent in Twist3 framework

New: Event Topology dependence of A_N





New: A_N with midrapidity activities



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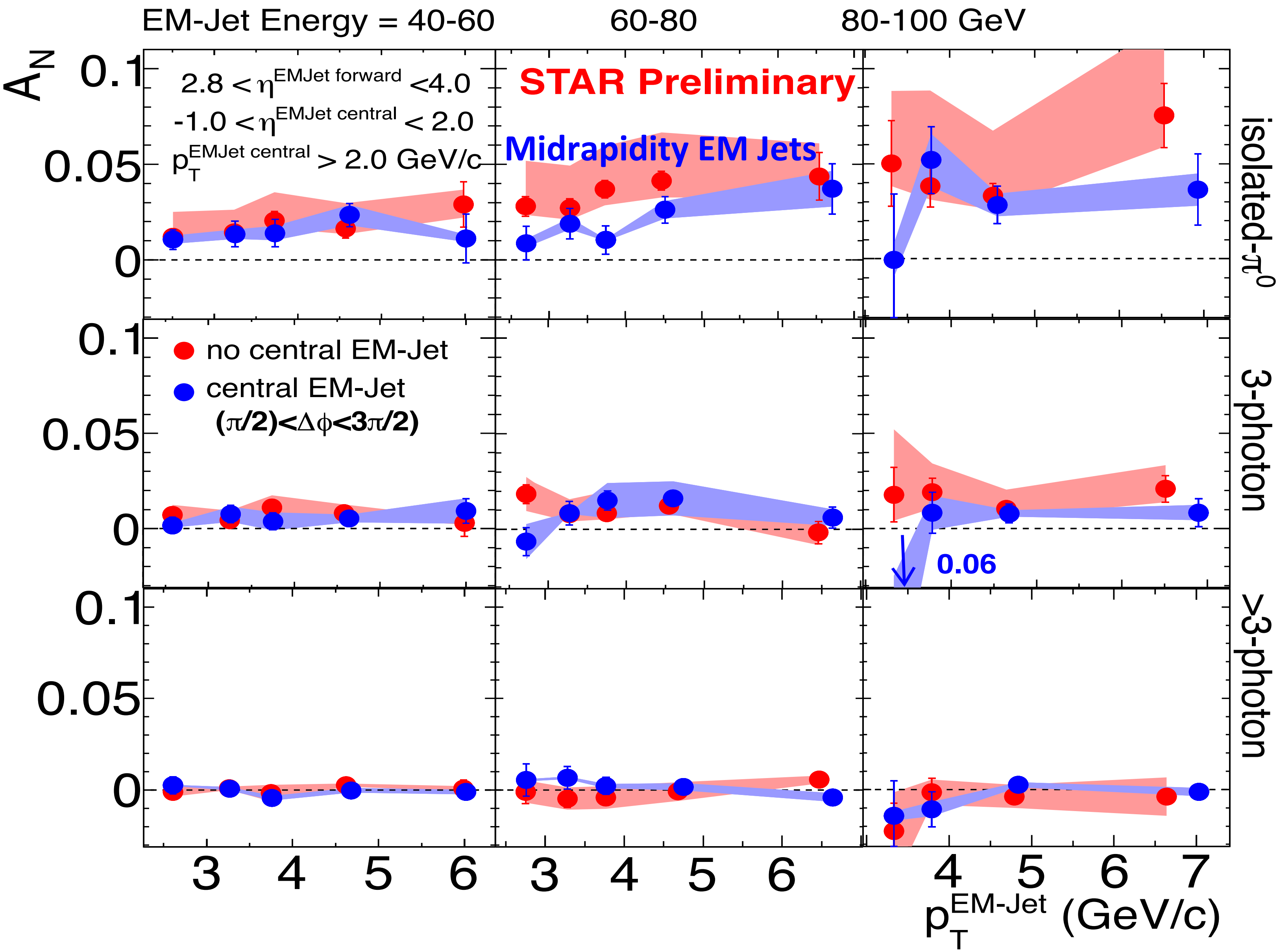

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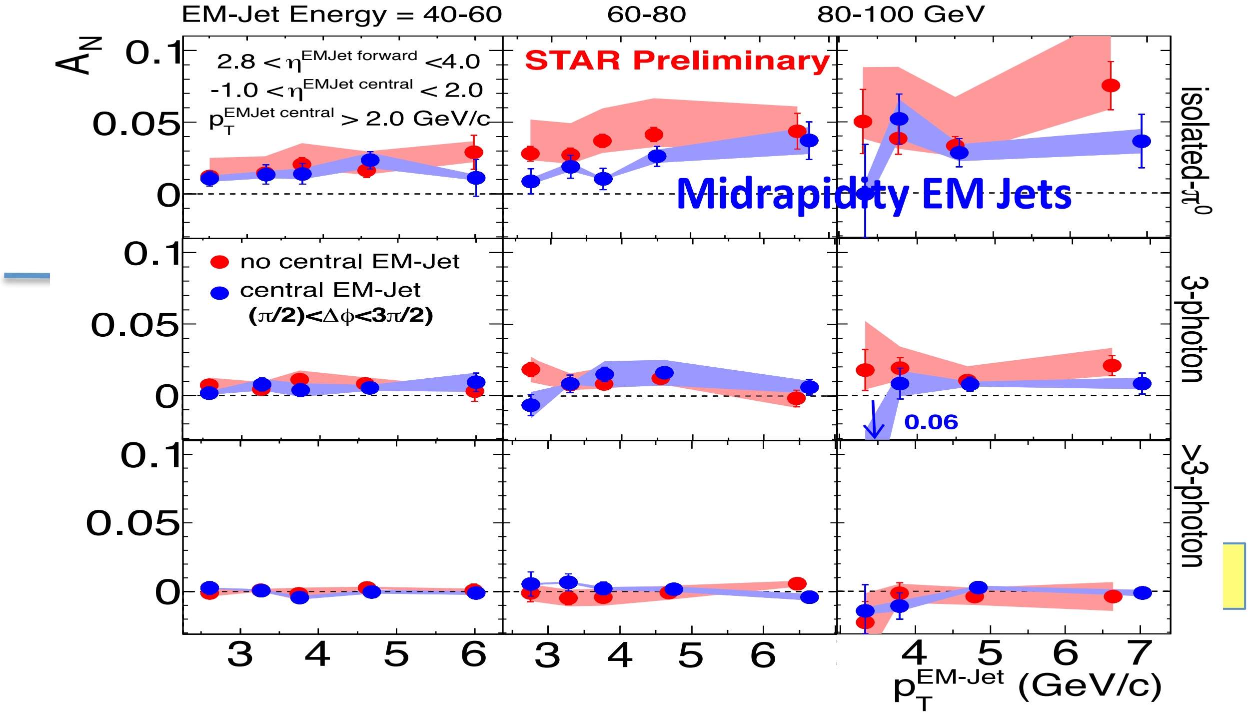
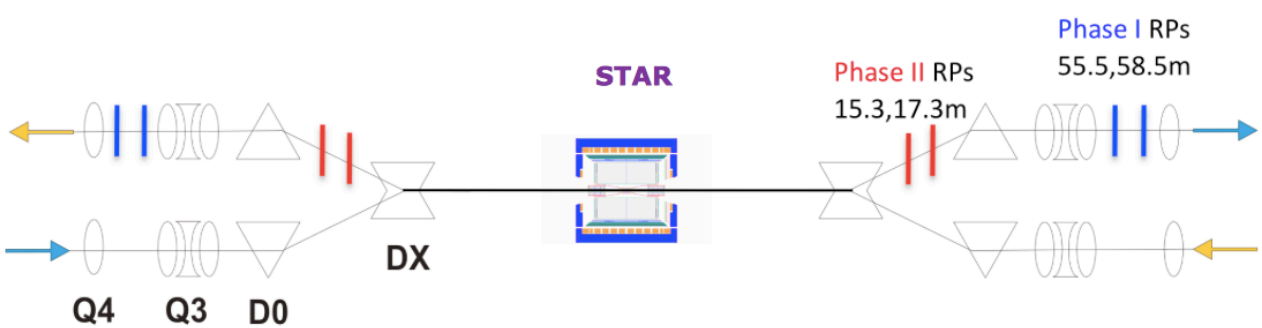
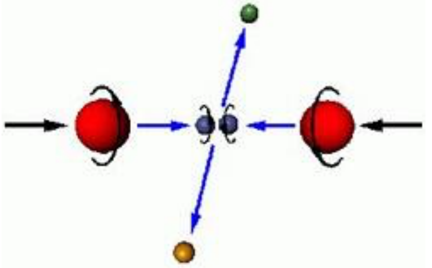


- Not 'conventional' 2-2 scattering? Explore by tagging diffractive events with Roman Pots Phase II!



Why p+p?



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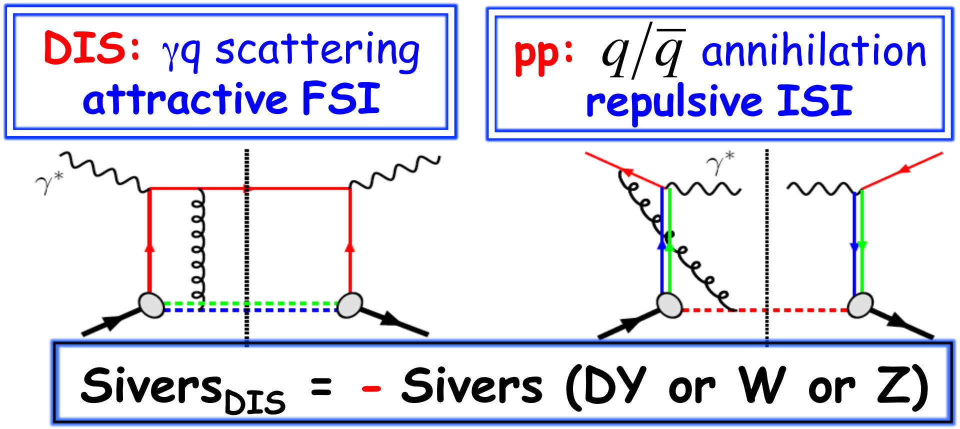
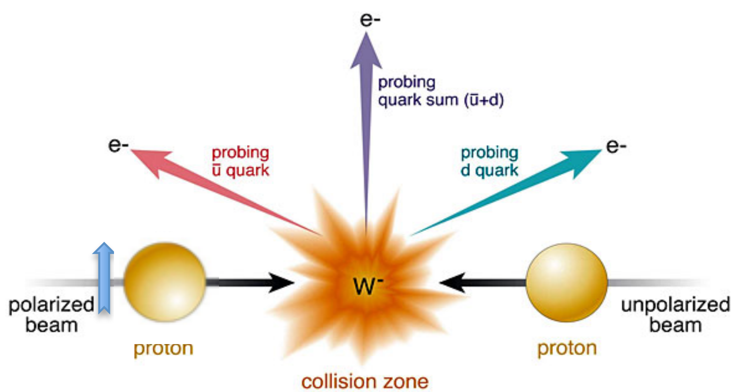
p+p perfect for "Physics of the Sign Change"



Picture by W. Vogelsang

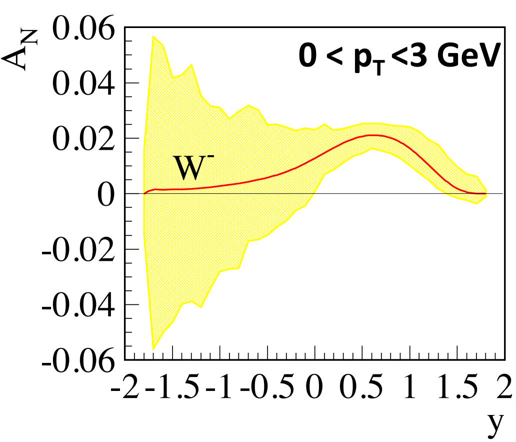


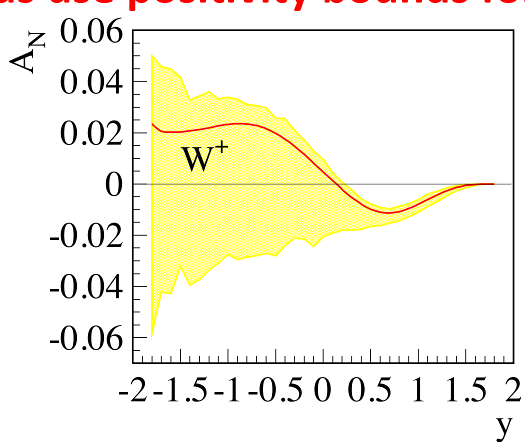
critical test for our understanding of TMD's and TMD factorization

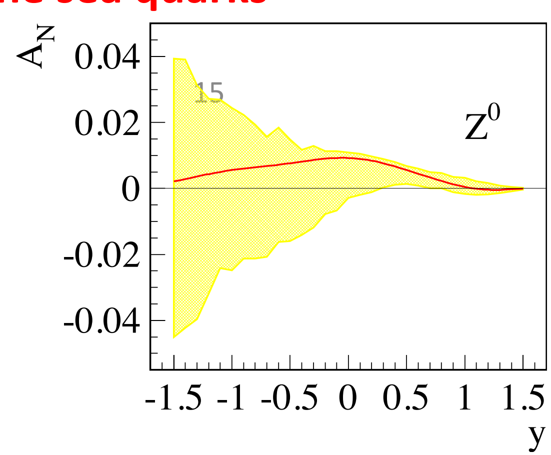
Direct γ measurement addresses sign change in Twist3 framework

M. G. Echevarria, A. Idilbi, Z-B Kang, and I. Vitev arXiv:1401.5078v1

Error bands use positivity bounds for the sea quarks







STAR: Use fully reconstructed Ws

Analysis Strategy to fully reconstruct Ws:

→ W candidate selection via high p_t lepton

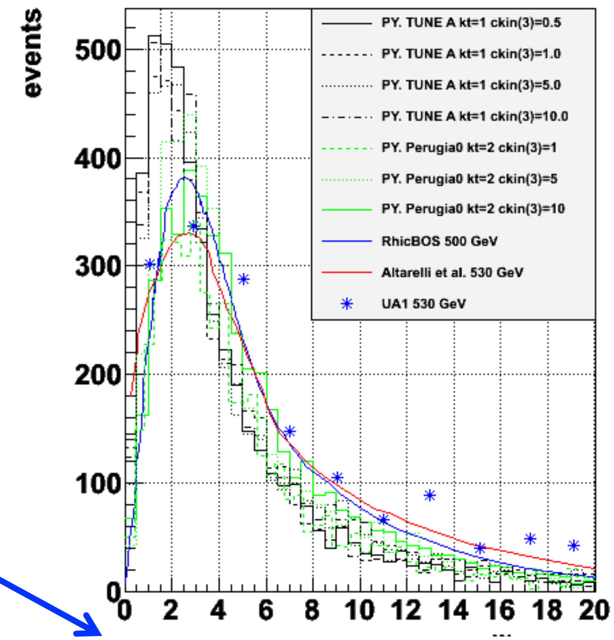
✓ In transverse plane: $$\vec{P}_T^{\,W} = \vec{P}_T^{\,e} + \vec{P}_T^{\,\nu} = \vec{P}_T^{\,recoil}$$

✓ Recoil reconstructed using tracks and towers: $$\sum_{i=tracks+trackless-clusters} \vec{P}_T^{\,i}$$

✓ Part of the recoil not within STAR acceptance

→ correction through MC (Pythia)

PYTHIA tuning



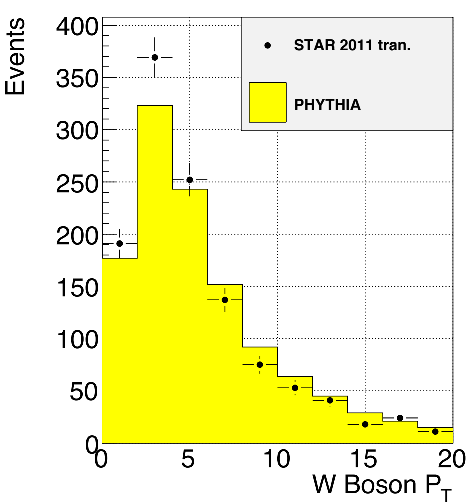
W Rapidity reconstruction:

✓ W longitudinal momentum (along z) can be calculated from the invariant mass: $$M_w^2 = (E_e + E_\nu)^2 - (\vec{p}_e + \vec{p}_\nu)^2$$

✓ Neutrino longitudinal momentum component from quadratic equation $$|\vec{p}_T^{\,e}|^2 (p_z^\nu)^2 - 2A p_z^e p_z^\nu + |\vec{p}_T^{\,\nu}|^2 |\vec{p}^{\,e}|^2 - A^2 = 0 \quad A = \frac{M_W^2}{2} + \vec{p}_T^{\,e} \vec{p}_T^{\,\nu}$$

GOOD data/MC agreement after P_T correction

W+ sample



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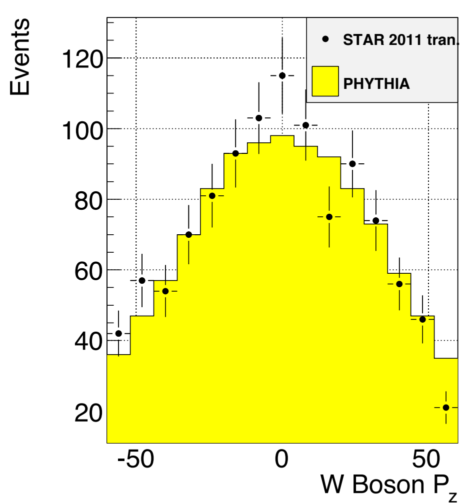
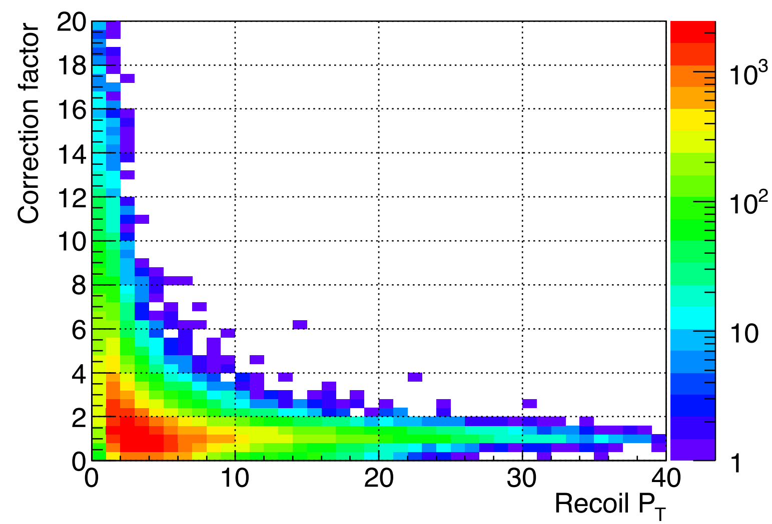
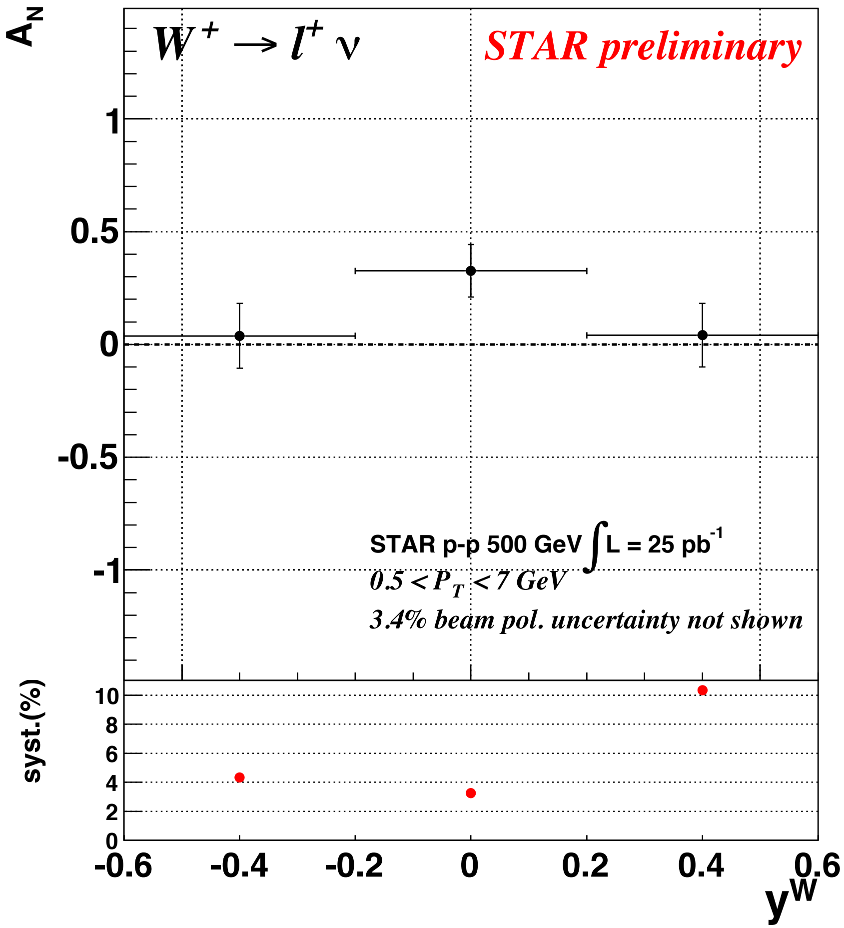
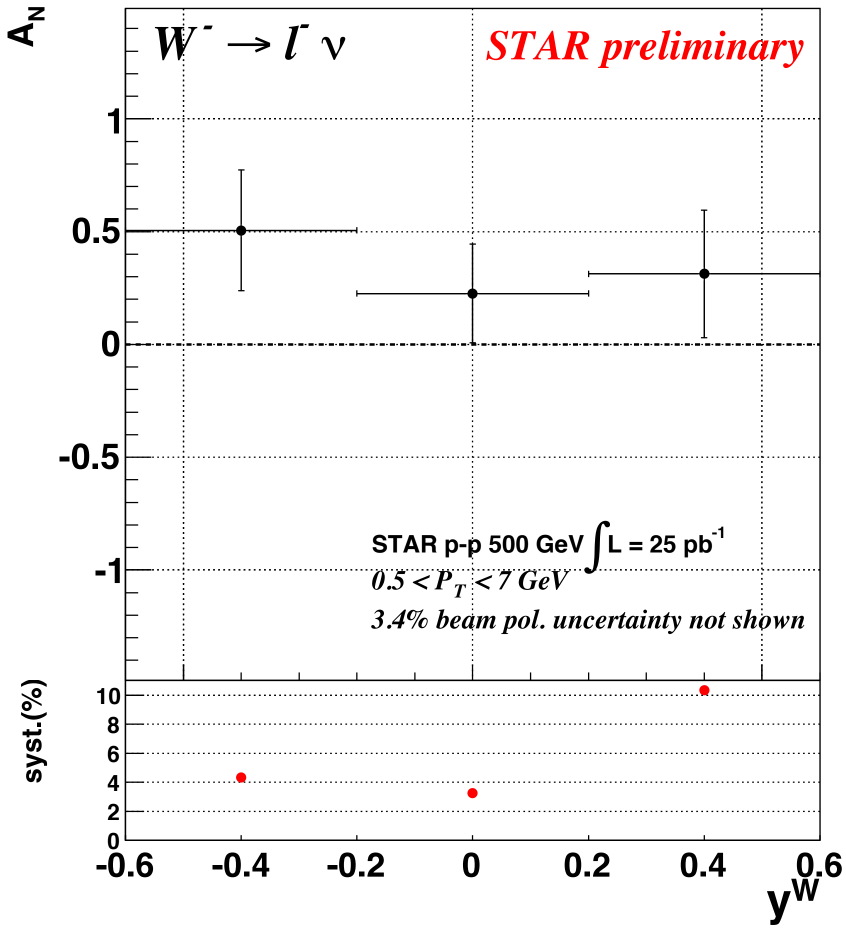




A_N vs W-rapidity

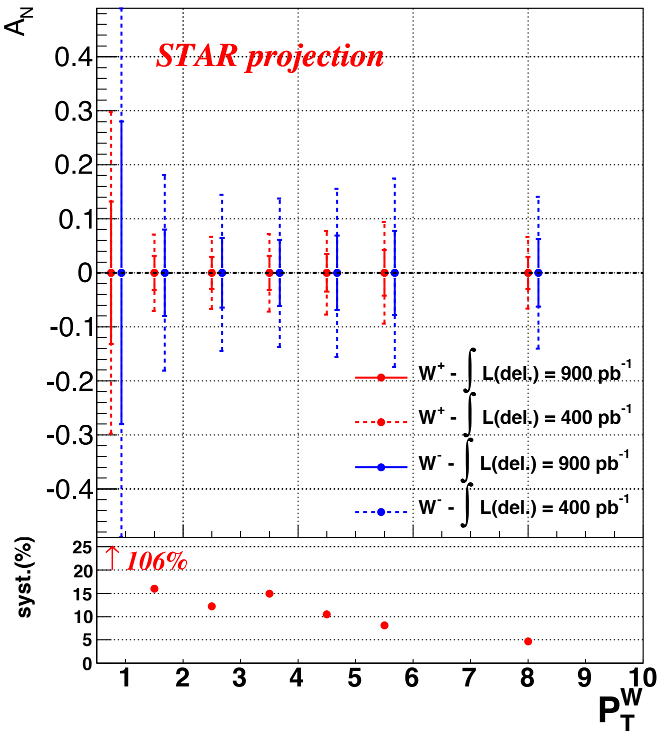
S. Fazio, DIS 2014

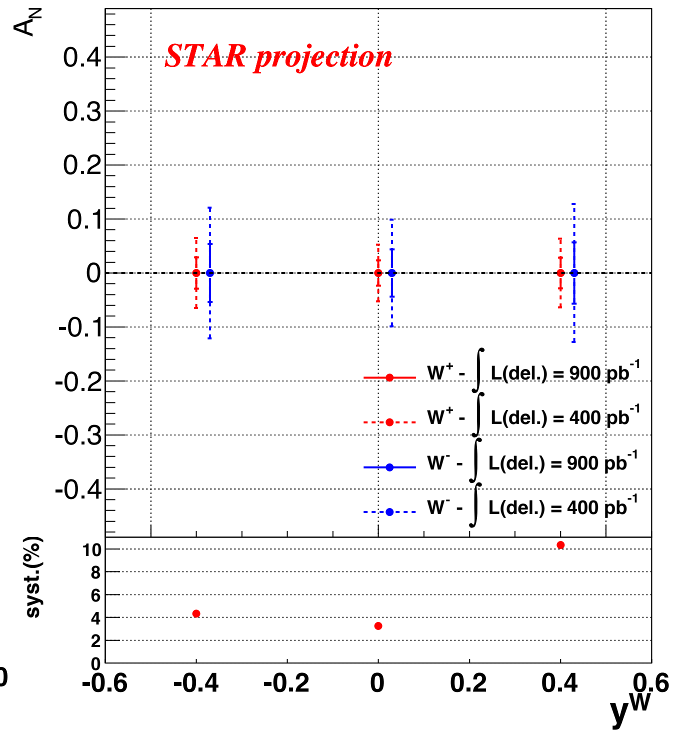


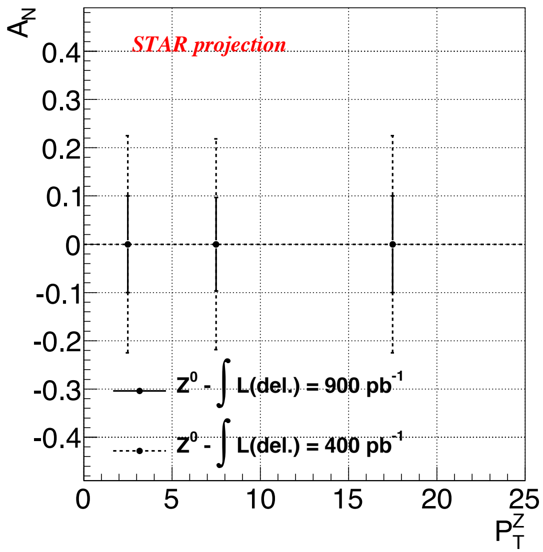


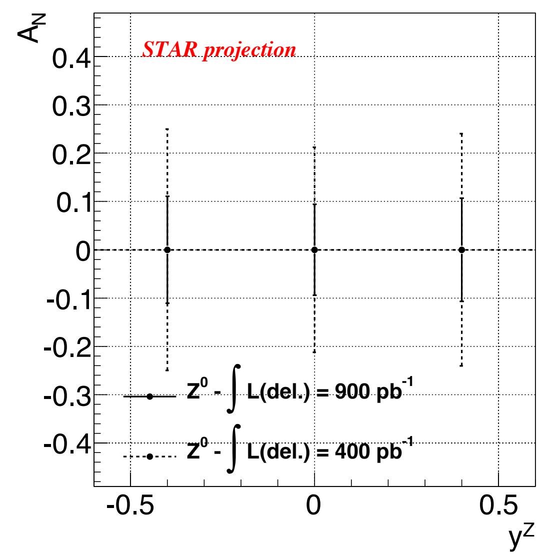
$A_N(W^{+/-},Z^0)$ from Run 2016 (or 17?)

2016: possible recorded lumi as big as 900 pb^{-1}









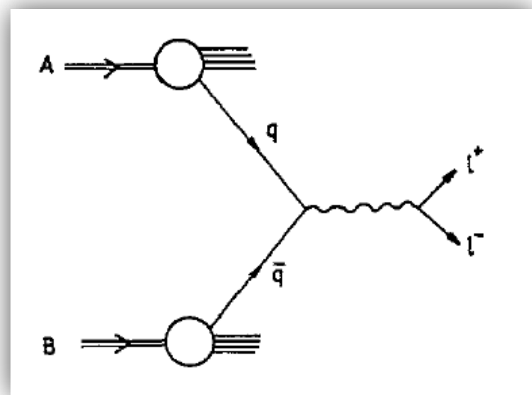
$A_N(W^{+/-},Z^0)$:

will be able to constrain sea quark Sivers

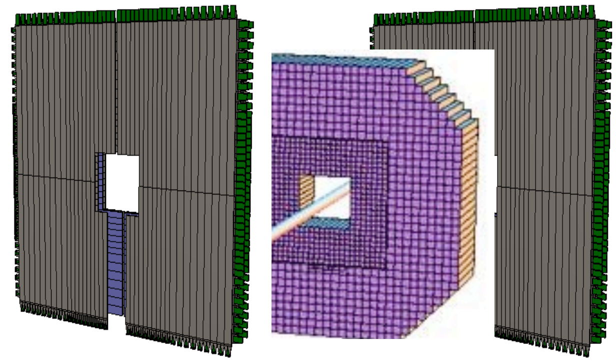
and

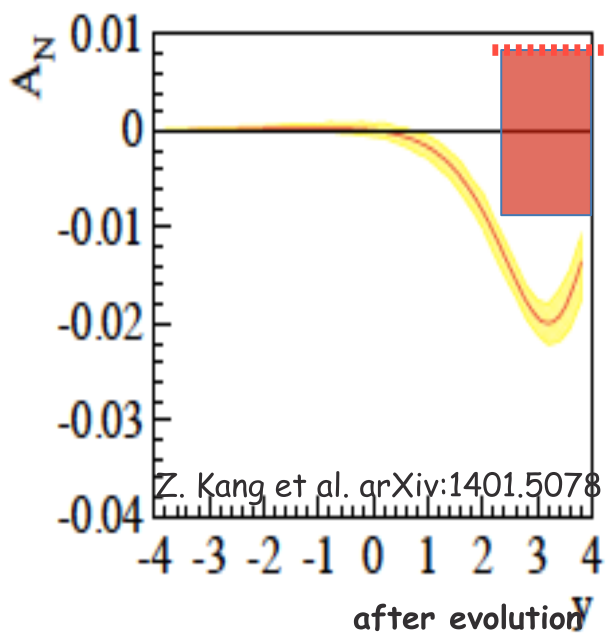
make a statement on the sign change

Drell-Yan in 16/17with STAR postshower



STAR Pre+Postshower

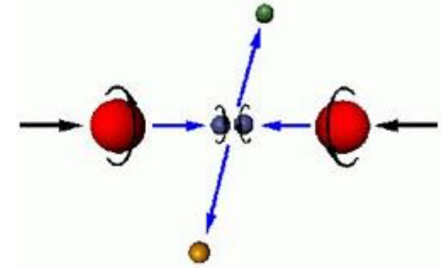




with polarization of 55% and k = 77 ¯pb / 400 ¯pb

Simulation by S. Heppelmann (BNL)

Why p+p?



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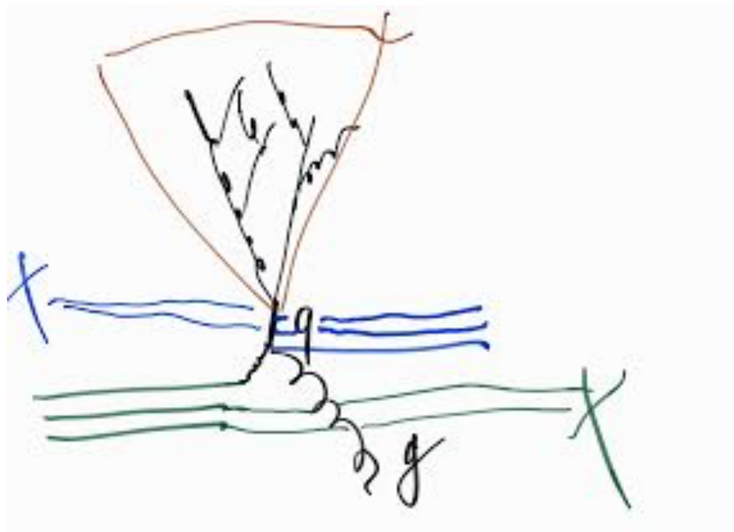
Jet Physics

- Reconstruction of partonic kinematics

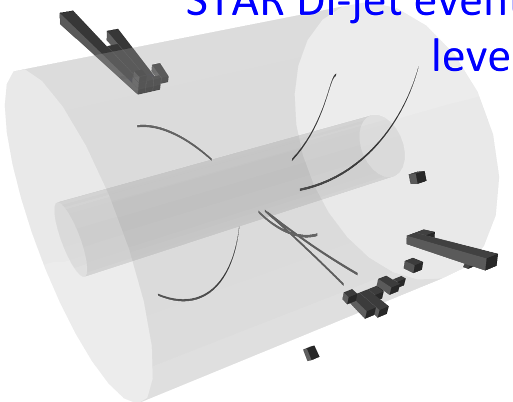


→"SIDIS like" physics in correlations of jets and hadrons (in jets)

Jet Physics in STAR

Data jets

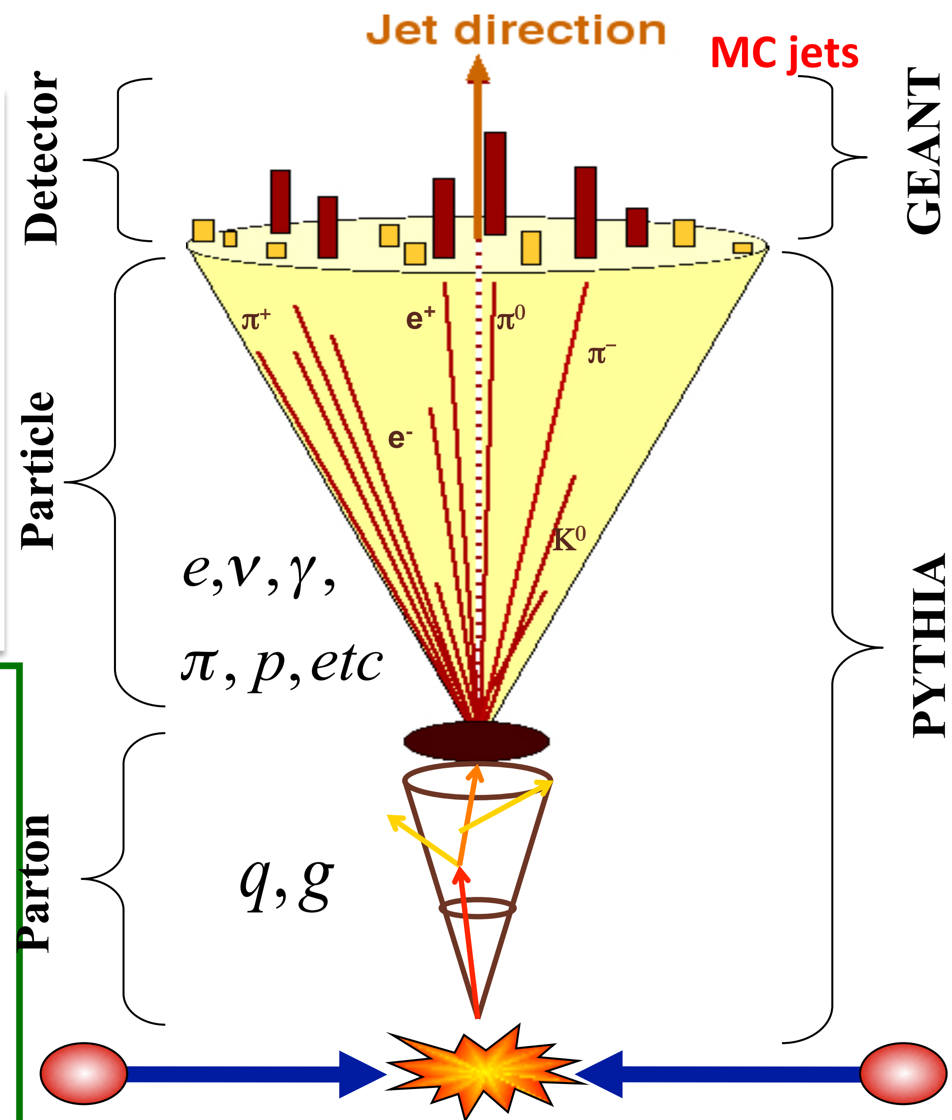
STAR Di-jet event at detector-level



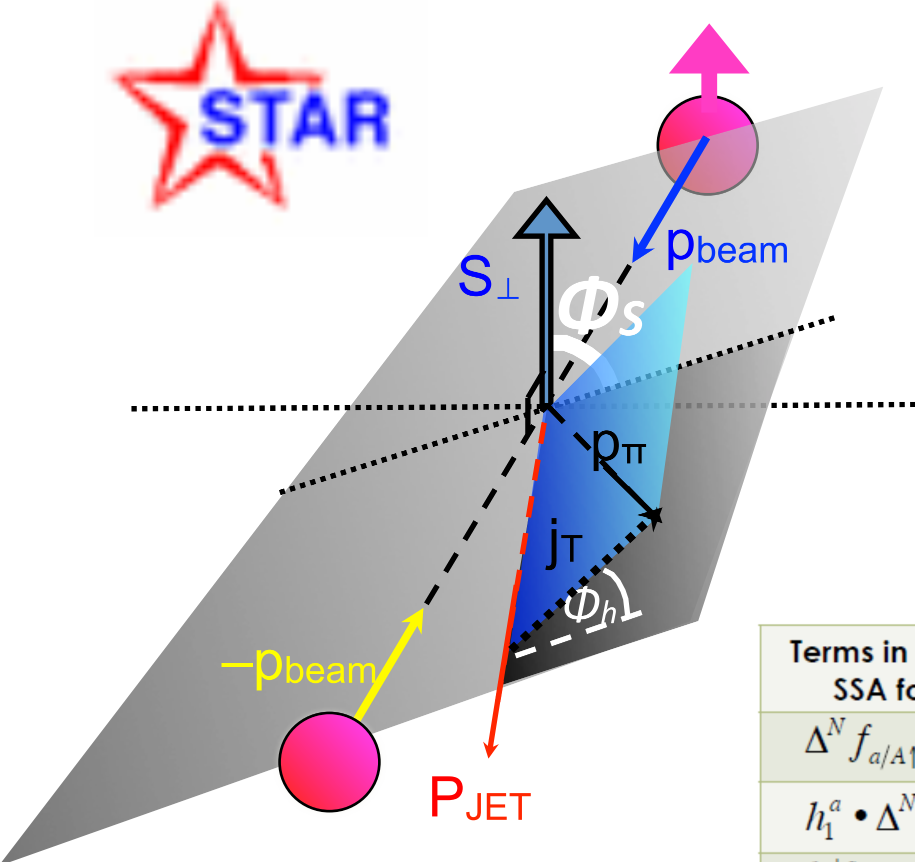
e.g. Anti-k_T algorithm (2011 results)
JHEP 0804, 063 (2008)

Use **PYTHIA** + **GEANT** to quantify detector response

- Trigger Bias
- Reconstruction smearing/bias (unfolding)
- Reconstruction of partonic variables, parton matching
- Underlying event/pileup effects



Naively: Collins asymmetries, $A^{\sin(\phi S-\phi h)} \propto h_1 \otimes H_1$



Terms in Numerator of TMD SSA for qq scattering	English Names	Modulate
$\Delta^N f_{a/A\uparrow} \bullet f_{b/B} \bullet D_{\pi/q}$	Sivers • PDF • FF	$\sin(\varphi_{S_A})$
$h_1^a \bullet \Delta^N f_{b\uparrow/B} \bullet D_{\pi/q}$	Transversity•Boer-Mulder•FF	$\sin(\varphi_{S_A})$
$h_{1T}^{\perp a} \bullet \Delta^N f_{b\uparrow/B} \bullet D_{\pi/q}$	Pretzelocity•Boer-Mulder•FF	$\sin(\varphi_{S_A})$
$h_1^a \bullet f_{b/B} \bullet \Delta D_{\pi/q\uparrow}$	Transversity•PDF •Collins	$\sin(\varphi_{S_A} - \varphi_\pi)$
$\Delta f_{a/A\uparrow}^N \bullet \Delta^N f_{b\uparrow/B} \bullet \Delta D_{\pi/q\uparrow}$	Sivers•Boer-Mulder•Collins	$\sin(\varphi_{S_A} - \varphi_\pi)$
$h_{1T}^{\perp a} \bullet f_{b/B} \bullet \Delta D_{\pi/q\uparrow}$	Pretzelocity•PDF•Collins	$\sin(\varphi_{S_A} + \varphi_\pi)$
$\Delta f_{a/A\uparrow}^N \bullet \Delta^N f_{b\uparrow/B} \bullet \Delta D_{\pi/q\uparrow}$	Sivers•Boer-Mulders•Collins	$\sin(\varphi_{S_A} + \varphi_\pi)$

Based on work by F.Yuan (*Phys.Rev.Lett.100:032003*) and D'Alesio et al. (*Phys.Rev. D83, 034021*)

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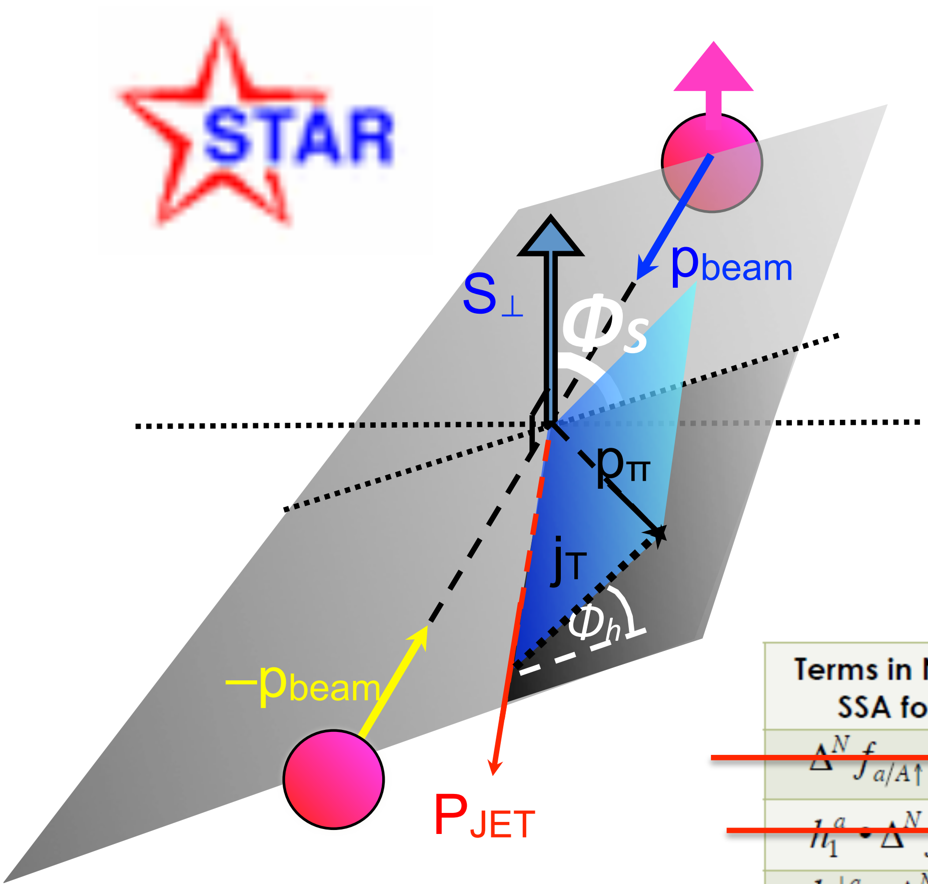

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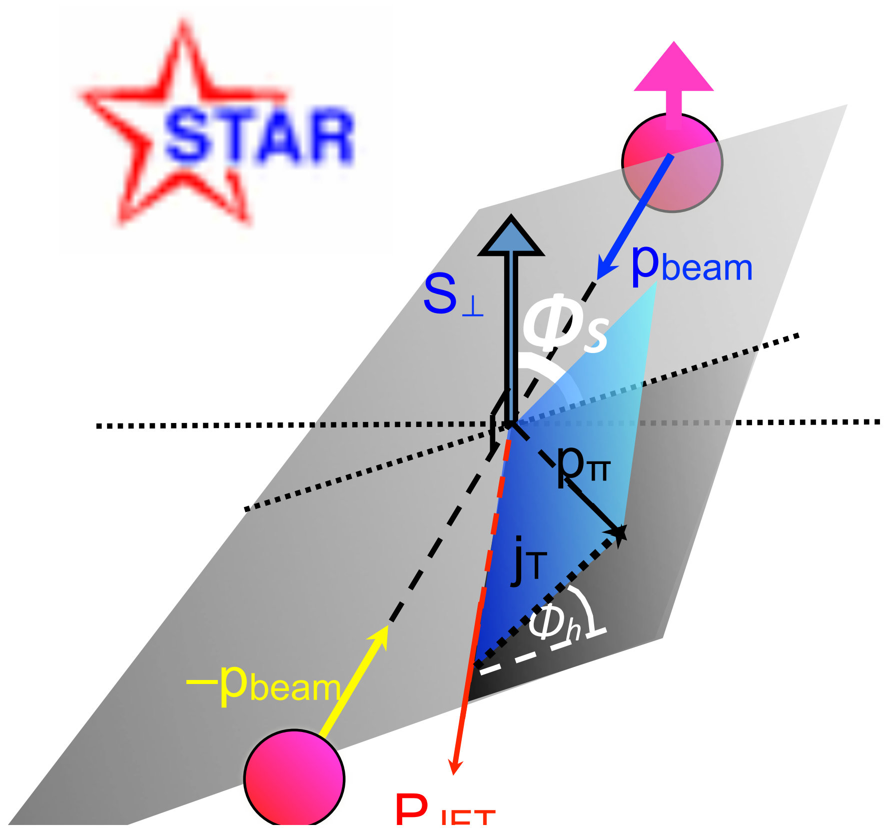
~~$\Delta^N f_{a/A\uparrow} \bullet f_{b/B} \bullet D_{\pi/q}$~~	~~Sivers • PDF • FF~~	~~$\sin(\varphi_{S_A})$~~
~~$h_1^a \bullet \Delta^N f_{b\uparrow/B} \bullet D_{\pi/q}$~~	~~Transversity•Boer-Mulder•FF~~	~~$\sin(\varphi_{S_A})$~~
~~$h_{1T}^{\perp a} \bullet \Delta^N f_{b\uparrow/B} \bullet D_{\pi/q}$~~	~~Pretzelocity•Boer-Mulder•FF~~	~~$\sin(\varphi_{S_A})$~~
$h_1^a \bullet f_{b/B} \bullet \Delta D_{\pi/q\uparrow}$	Transversity•PDF •Collins	$\sin(\varphi_{S_A} - \varphi_\pi)$
~~$\Delta f_{a/A\uparrow}^N \bullet \Delta^N f_{b\uparrow/B} \bullet \Delta D_{\pi/q\uparrow}$~~	~~Sivers•Boer-Mulder•Collins~~	~~$\sin(\varphi_{S_A} - \varphi_\pi)$~~
~~$h_{1T}^{\perp a} \bullet f_{b/B} \bullet \Delta D_{\pi/q\uparrow}$~~	~~Pretzelocity•PDF•Collins~~	~~$\sin(\varphi_{S_A} + \varphi_\pi)$~~
~~$\Delta f_{a/A\uparrow}^N \bullet \Delta^N f_{b\uparrow/B} \bullet \Delta D_{\pi/q\uparrow}$~~	~~Sivers•Boer-Mulders•Collins~~	~~$\sin(\varphi_{S_A} + \varphi_\pi)$~~

Based on work by F.Yuan (*Phys.Rev.Lett.100:032003*) and D'Alesio et al. (*Phys.Rev. D83, 034021*)

Naively: Collins asymmetries, $A^{\sin(\phi_S-\phi_h)} \propto h_1 \otimes H_1$



Terms in Numerator of TMD SSA for qq scattering	English Names	Modulate
$\Delta^N f_{a/A\uparrow} \bullet f_{b/B} \bullet D_{\pi/q}$	Sivers • PDF • FF	$\sin(\varphi_{S_A})$
$h_1^a \bullet \Delta^N f_{b\uparrow/B} \bullet D_{\pi/q}$	Transversity•Boer Mulder•FF	$\sin(\varphi_{S_A})$
$h_{1T}^{\perp a} \bullet \Delta^N f_{b\uparrow/B} \bullet D_{\pi/q}$	Pretzelocity•Boer-Mulder•FF	$\sin(\varphi_{S_A})$
$h_1^a \bullet f_{b/B} \bullet \Delta D_{\pi/q\uparrow}$	Transversity•PDF •Collins	$\sin(\varphi_{S_A} - \varphi_\pi)$
$\Delta f^N_{a/A\uparrow} \bullet \Delta^N f_{b\uparrow/B} \bullet \Delta D_{\pi/q\uparrow}$	Sivers•Boer-Mulder•Collins	$\sin(\varphi_{S_A} - \varphi_\pi)$
$h_{1T}^{\perp a} \bullet f_{b/B} \bullet \Delta D_{\pi/q\uparrow}$	Pretzelocity•PDF•Collins	$\sin(\varphi_{S_A} + \varphi_\pi)$
$\Delta f^N_{a/A\uparrow} \bullet \Delta^N f_{b\uparrow/B} \bullet \Delta D_{\pi/q\uparrow}$	Sivers•Boer-Mulders•Collins	$\sin(\varphi_{S_A} + \varphi_\pi)$

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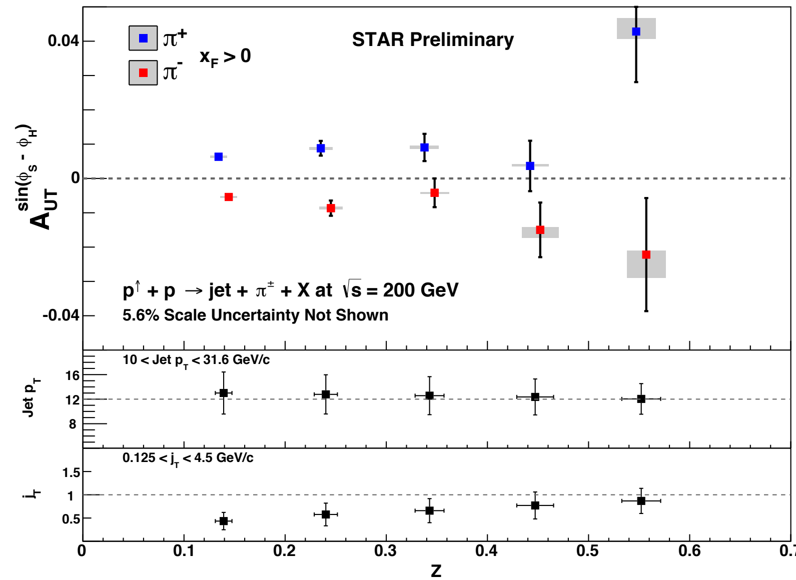
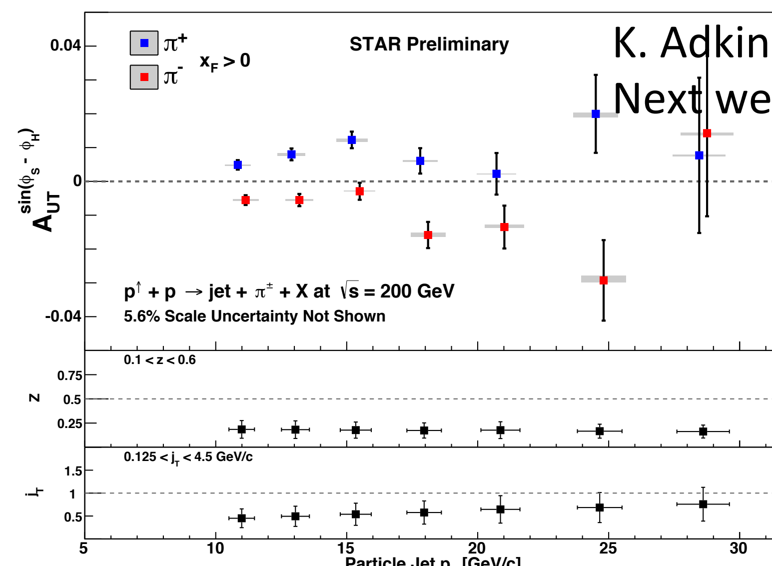


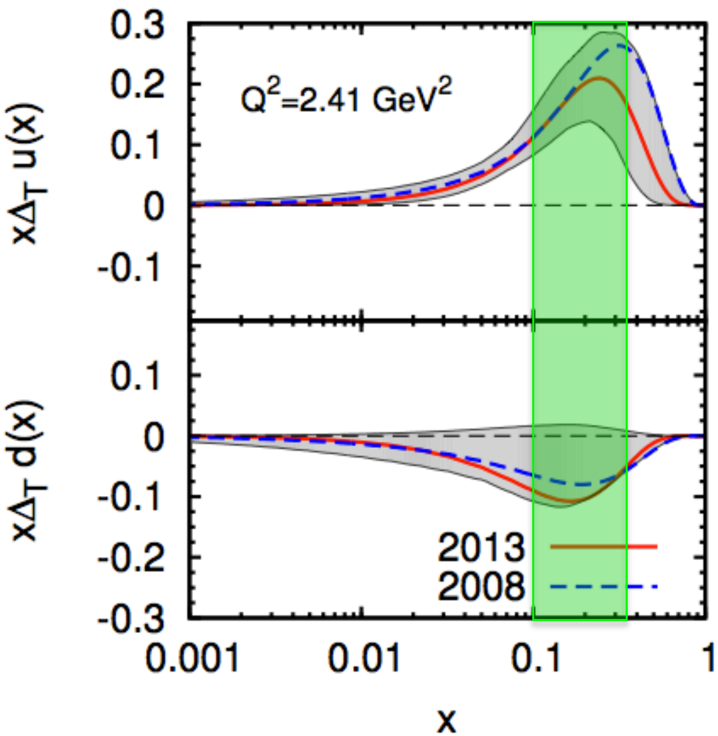


K. Adkins
Next week

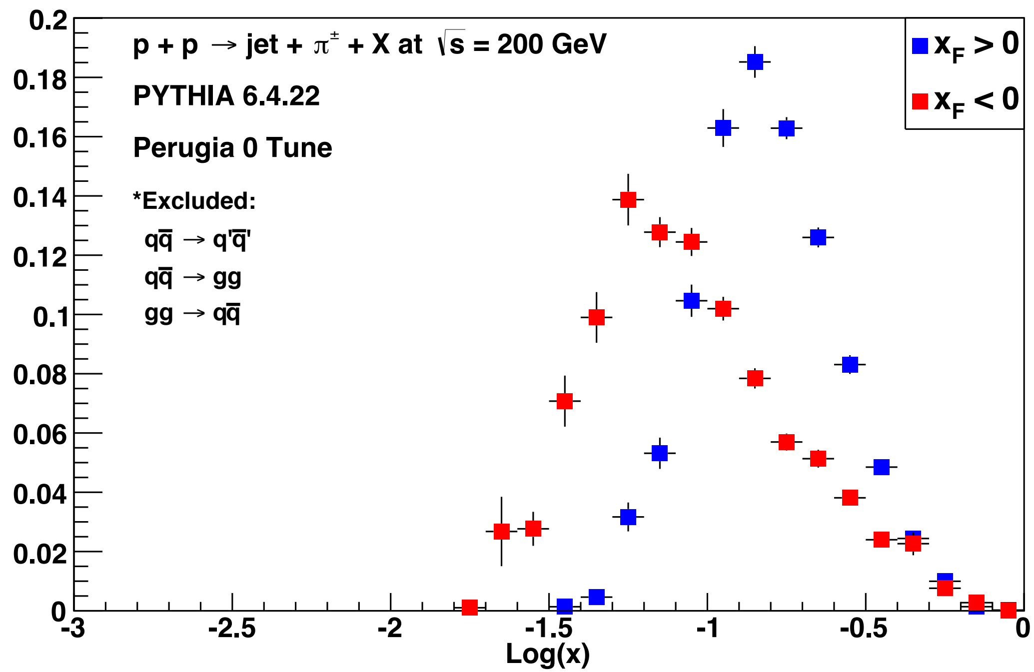
$$d\sigma \approx d\sigma^{UU}\left[1 + A_N \sin(\phi_h - \phi_s)\right]$$

STAR Kinematic Coverage

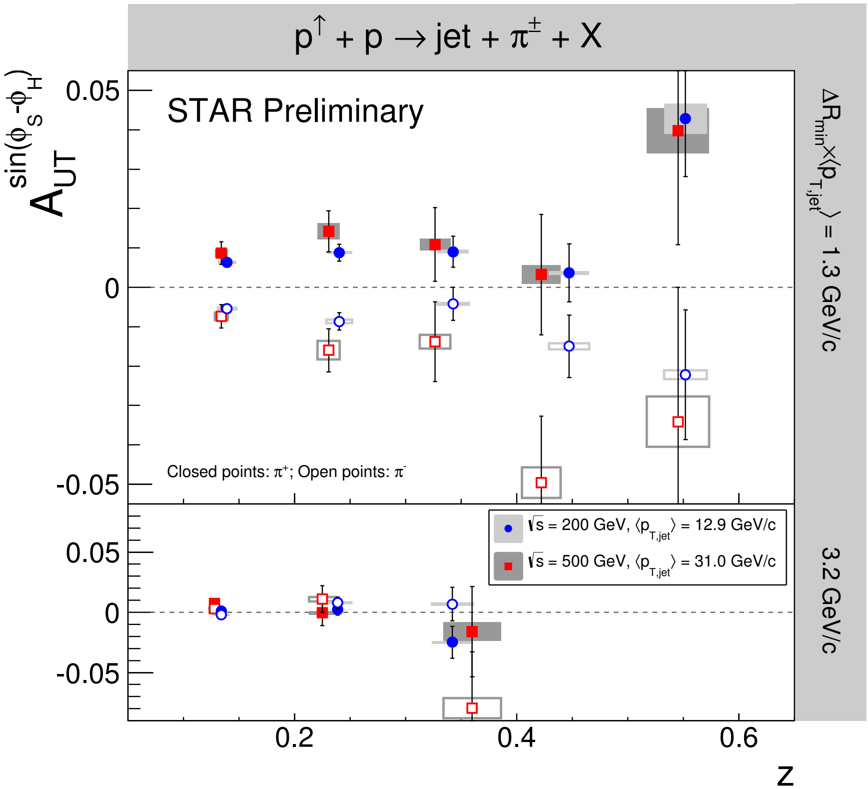
- Analysis of forward and backward scattered jets yields access to a broad range of momentum fractions
- Distribution of sampled x values is consistent between √s = 200 GeV and 500 GeV analyses
- This x range samples the unconstrained portion of $h_1(x)$



Phys. Rev. D **87** 094019 (2013)

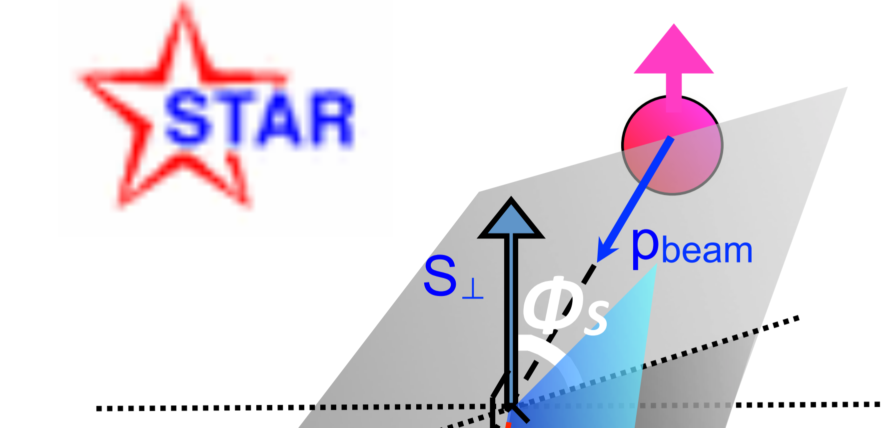


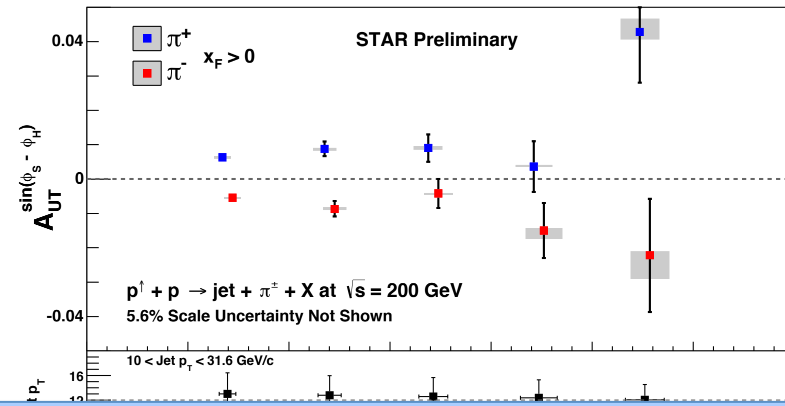
200 vs. 500 GeV Comparison

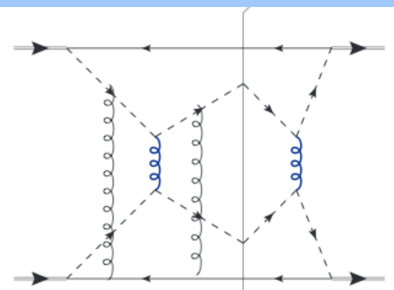


- Matching kinematics to sample lower <j_T> (top) shows that the two energies have asymmetries which are extremely similar in shape and magnitude
- The higher <j_T> asymmetries (bottom) both go away
- Resulting asymmetries are quite sensitive to the sampled $\pi^{\pm}$ kinematics

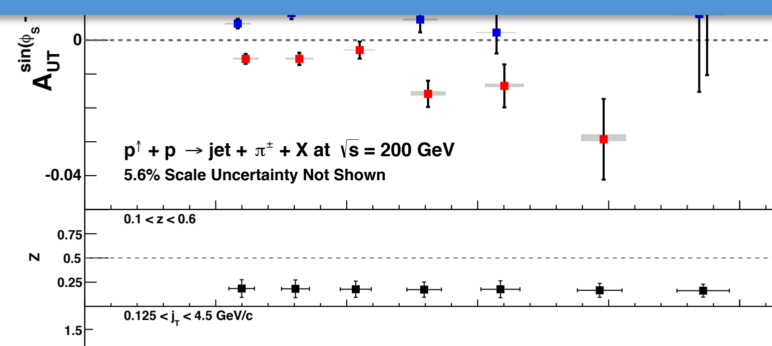
Naively: Collins asymmetries, $A^{\sin(\phi_S-\phi_h)} \propto h_1 \otimes H_1$







Unknown "Color Entanglement" Effects
(AKA Factorization Breaking)



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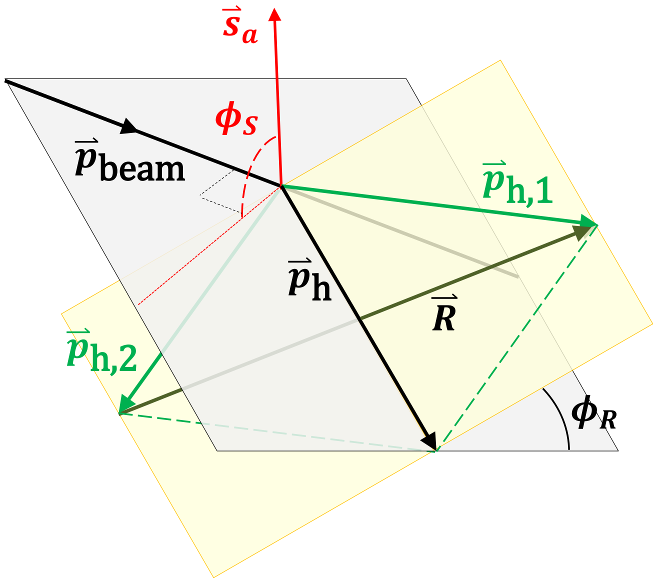
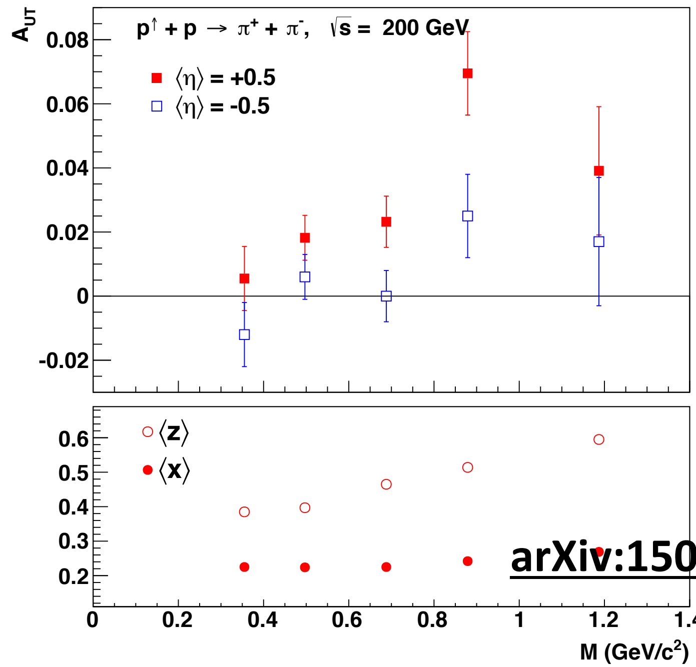
$h_1^a \bullet f_{b/B} \bullet \Delta D_{\pi/q\uparrow}$	Transversity•PDF •Collins	$\sin(\varphi_{S_A} - \varphi_\pi)$
$\Delta f_{a/A\uparrow}^N \bullet \Delta^N f_{b\uparrow/B} \bullet \Delta D_{\pi/q\uparrow}$	Sivers•Boer-Mulder•Collins	$\sin(\varphi_{S_A} - \varphi_\pi)$
$h_{1T}^{\perp a} \bullet f_{b/B} \bullet \Delta D_{\pi/q\uparrow}$	Pretzelocity•PDF•Collins	$\sin(\varphi_{S_A} + \varphi_\pi)$
$\Delta f_{a/A\uparrow}^N \bullet \Delta^N f_{b\uparrow/B} \bullet \Delta D_{\pi/q\uparrow}$	Sivers•Boer-Mulders•Collins	$\sin(\varphi_{S_A} + \varphi_\pi)$

Based on work by F.Yuan (Phys.Rev.Lett.100:032003) and D'Alesio et al. (Phys.Rev. D83, 034021)

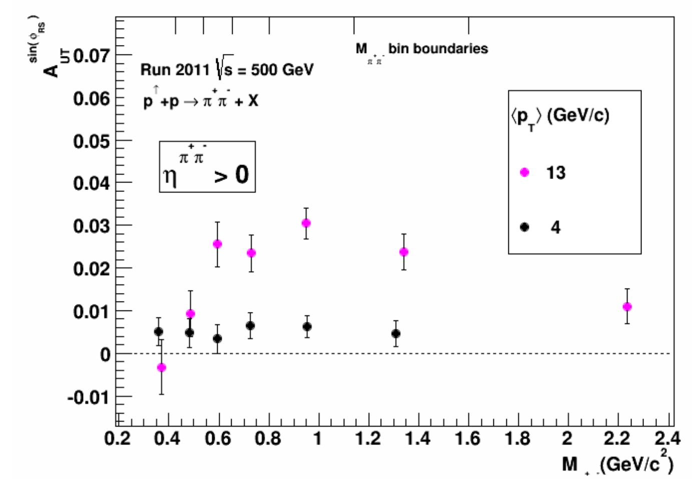
$$d\sigma \approx d\sigma^{UU}\left[1 + A_N \sin(\phi_h - \phi_s)\right]$$

Compare with IFF





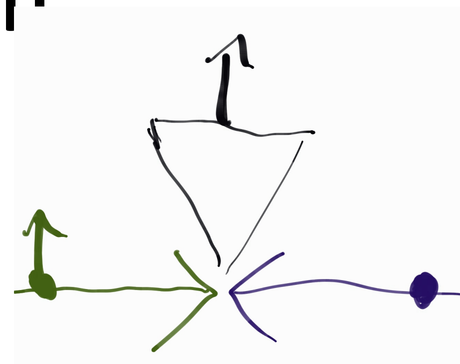
arXiv:1504.00415

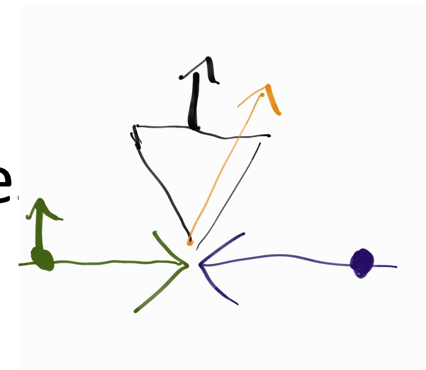


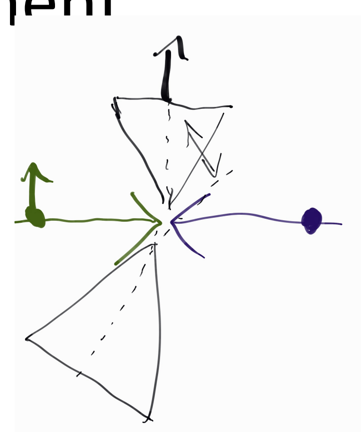
New IFF result at 200 GeV (10x statistics) will be shown at this APS spring meeting

K. Landry
Next week

More Jet Measurement







- Jet A_N: Related to quark/gluon Sivers
- Collins Like": $A^{\sin(\phi S-2\phi h)} \propto h_1^{\perp,g} \otimes H_1$
  - Access linear gluon polarization
  - 500 GeV, low p_T: g-g scattering dominate
- Dijet-Imbalance Asymmetries
  - "Real"-TMD framework Sivers measurement
  - Allows to probe kT dependence

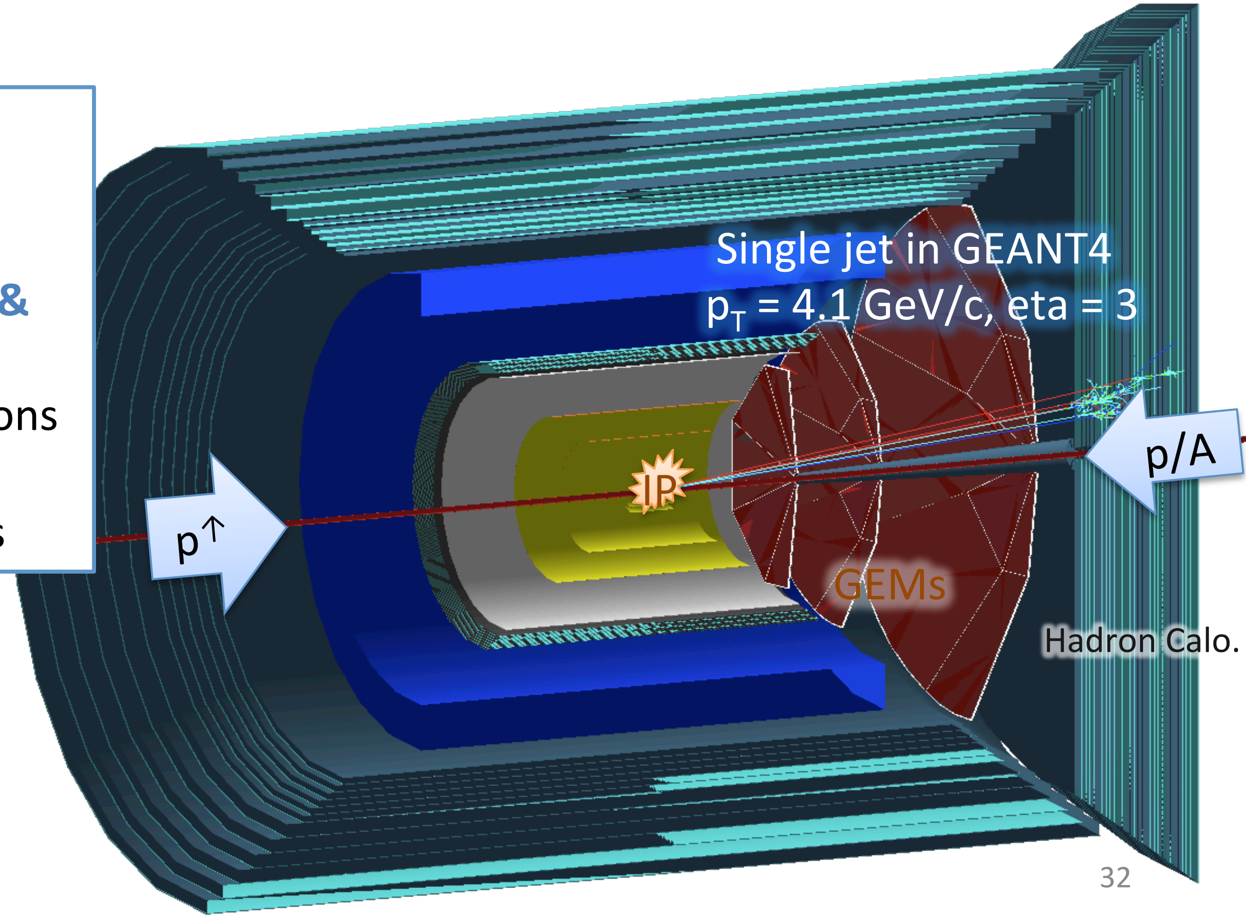
Were are we going

- Now: 200 GeV p↑+p and p↑+A with forward upgrades at Phenix and STAR
  - Direct γ
  - Mid rapidity jets (2x FOM run 12)
  - polarized pA
- Near Term: (Run 16/17)
  - 500 GeV transverse:
  - Direct photon
  - W asymmetries
  - DY
- Mid-Term: Detector Upgrades
  - sPHENIX + fsPHENIX
  - Forward Upgrade at STAR
- Long Term: eRHIC with eSTAR, ePHENIX and dedicated EIC detector

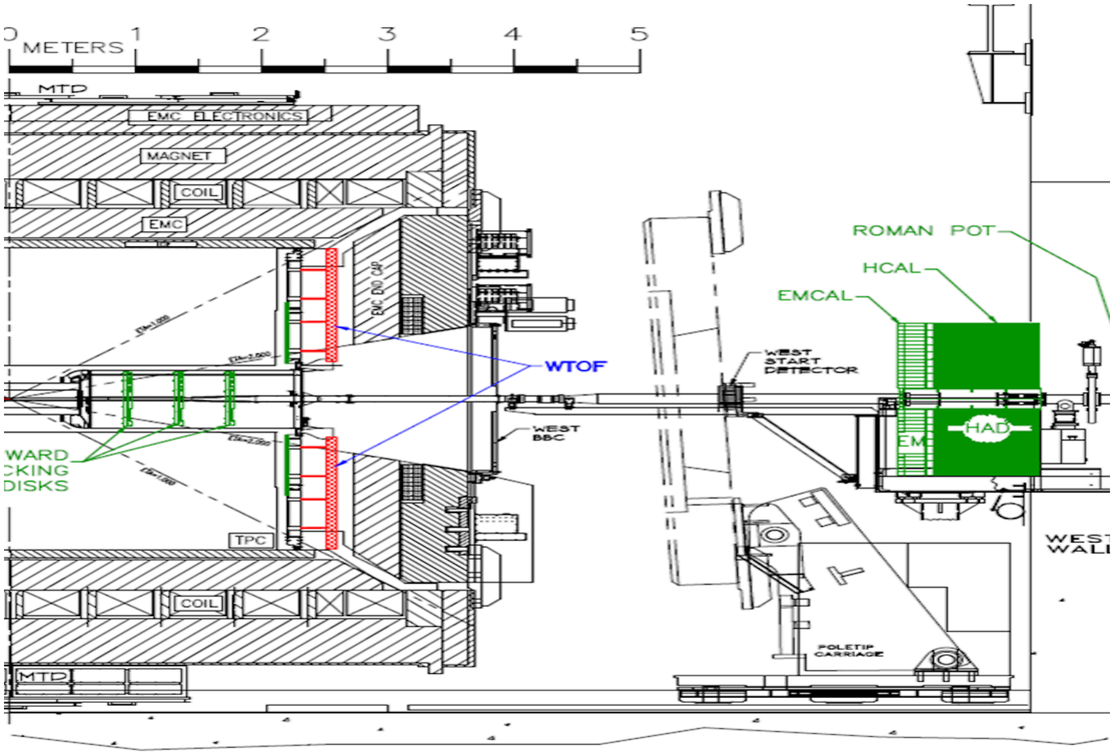
sPHENIX with *fs*PHENIX

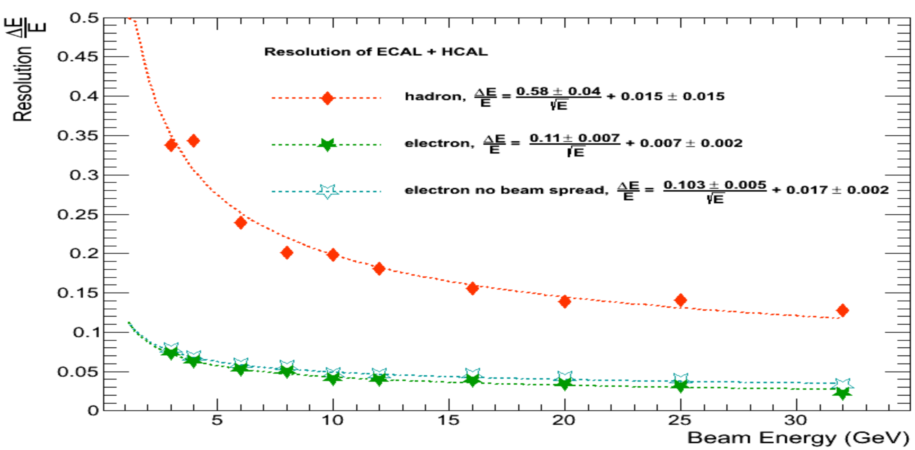
- Shared detector with future eRHIC program
- See white paper http://www.phenix.bnl.gov/plans.html

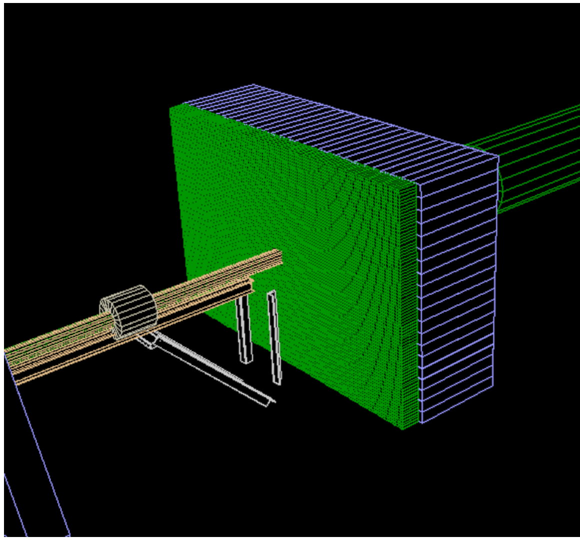
EIC detector GEM + H-Cal
→ Forward jet with charge sign tagging
+ reuse current silicon tracker & Muon ID detector
→ polarized Drell-Yan with muons
+ central detector (sPHENIX)
→ Forward-central correlations



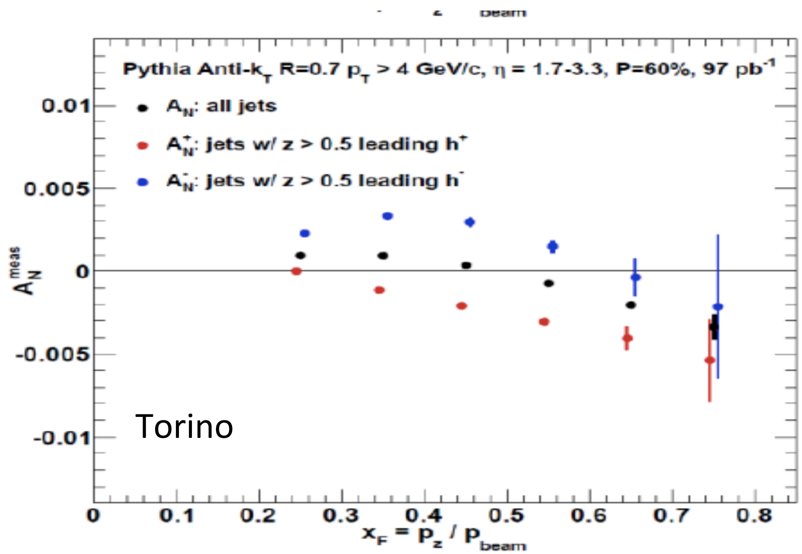
Forward ECAL/HCAL (FCS) at STAR ~2020

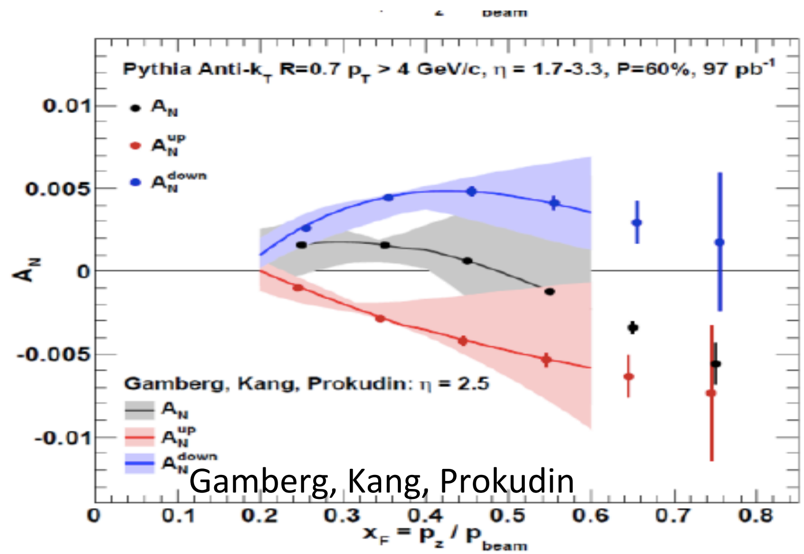




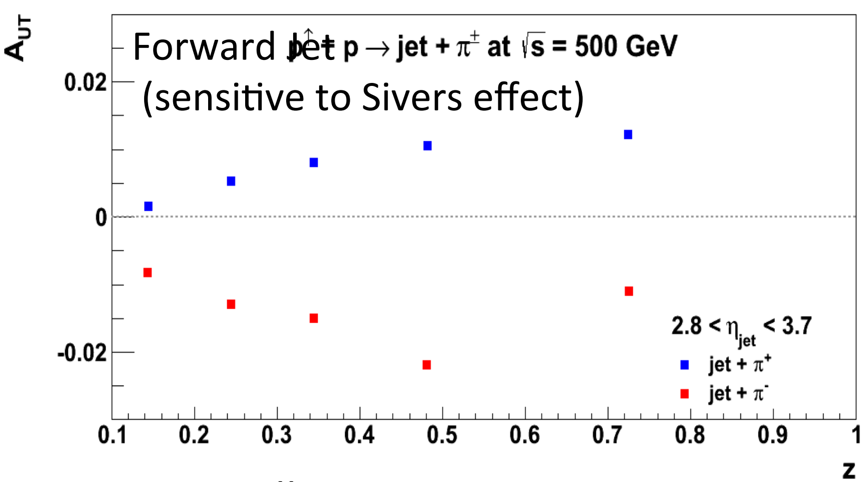


Investigate Forward TSSAs

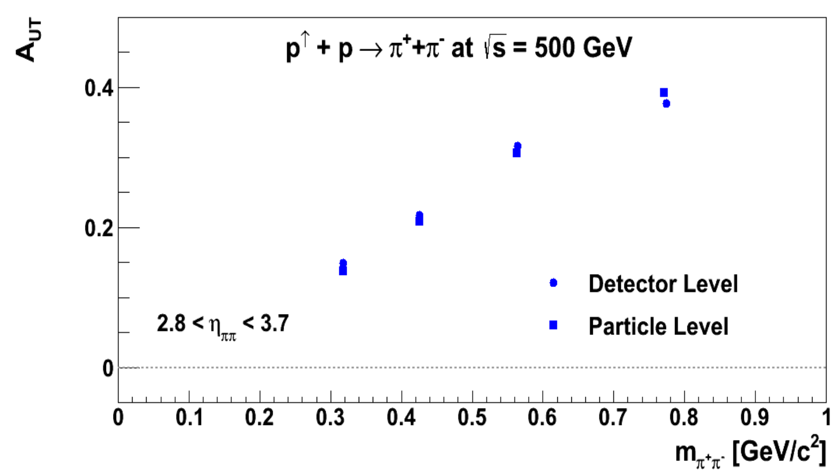




Torino Parametrization for Sivers/Collins ($1fb^{-1}$)

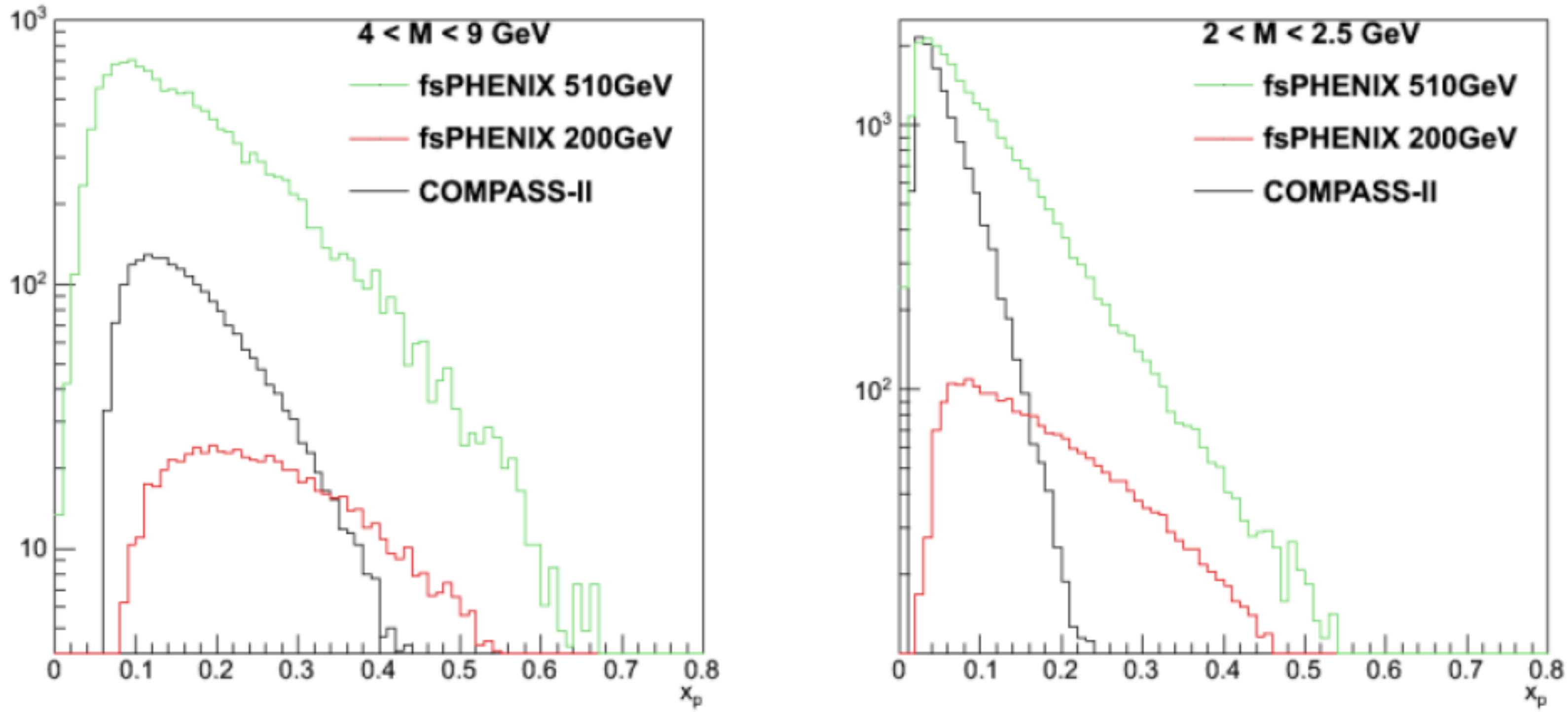


Collins Asymmetries



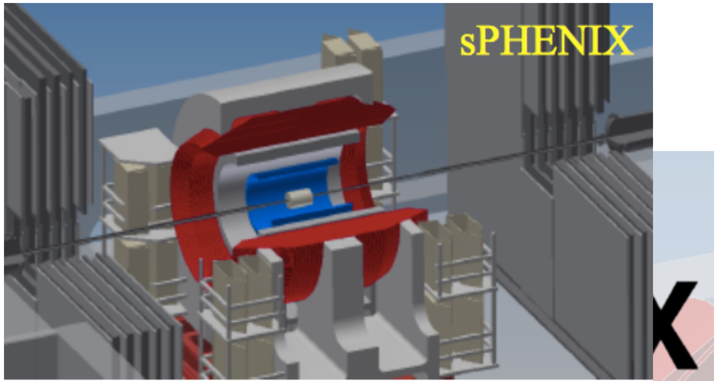
IFF Detector smearing effect

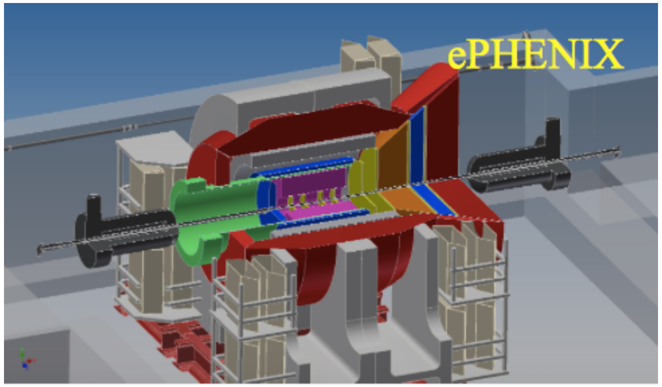
DY at fsPHENIX's muon system



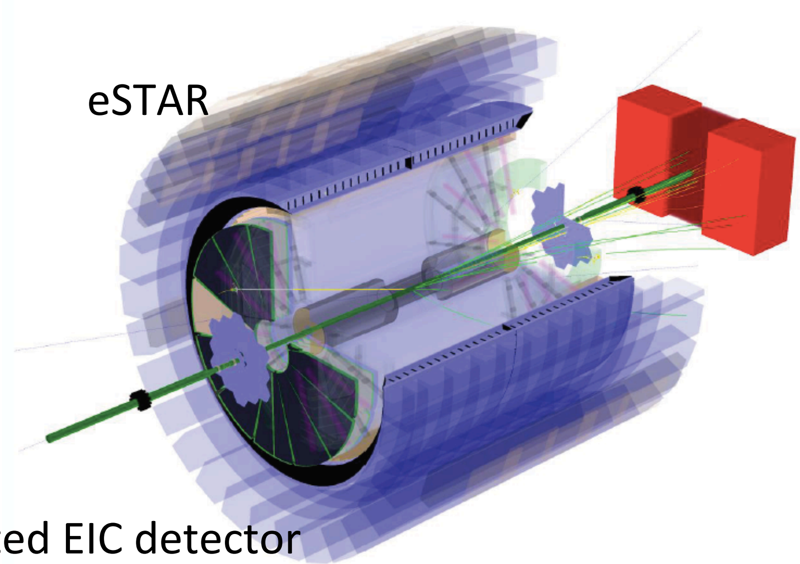
- FoM for high mass pairs comparable at 200 GeV, better at 500
- Low mass comparable at 500

Far Future

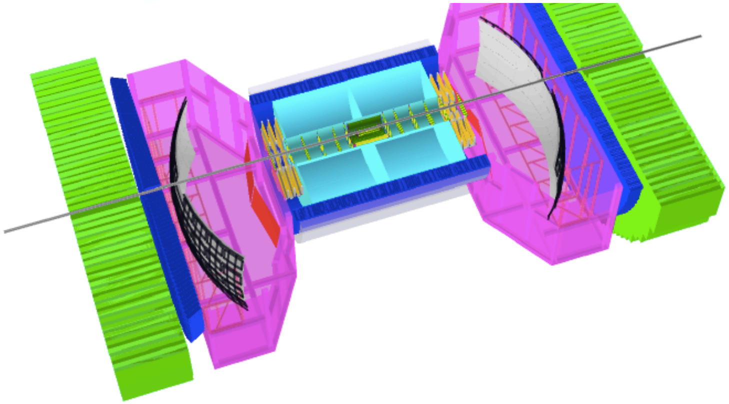




eSTAR



Dedicated EIC detector

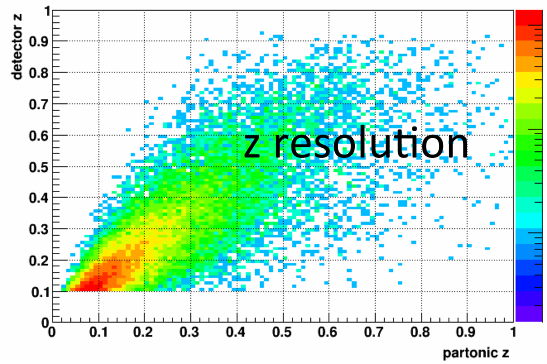


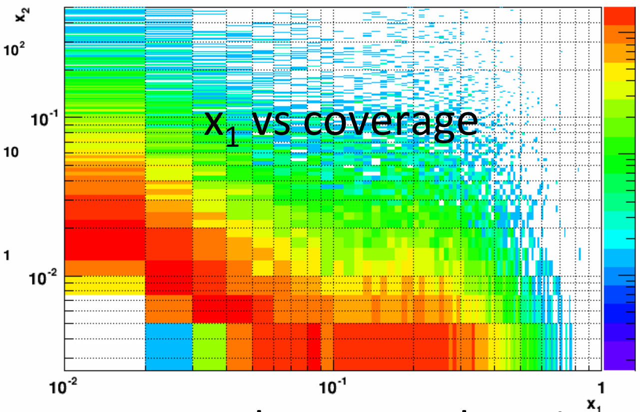
Summary/Outlook

- p+p offers exciting opportunities to explore dynamics of QCD
- Luminosities at RHIC have made many exciting new measurements feasible and theory progress has been impressive
  - Origin of A_N
  - Sign Change in W production, A_N and direct γ
  - Correlation measurements with jets and hadrons
- The present RHIC run explores new offers new opportunities in polarized pp
- We have a great machine, the next step is make use of this with appropriate instrumentation upgrades in the forward direction! →fsPHENIX, STAR forward upgrade

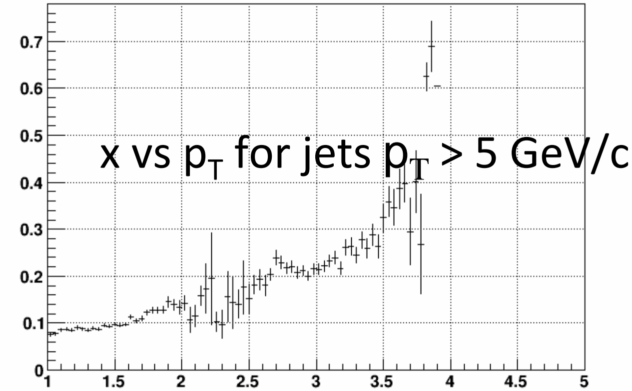
BACKUP

Kinematics covered by Forward Upgrade in p+p (from simulation)





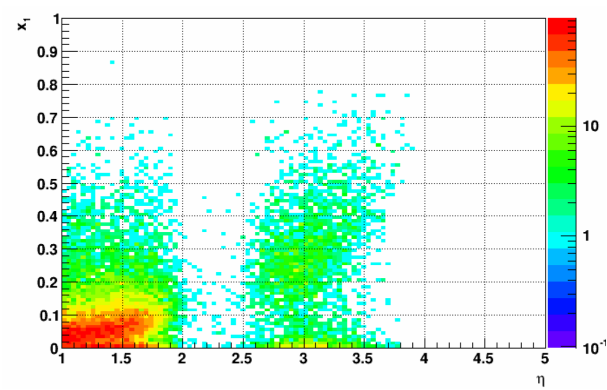
Valence quark region

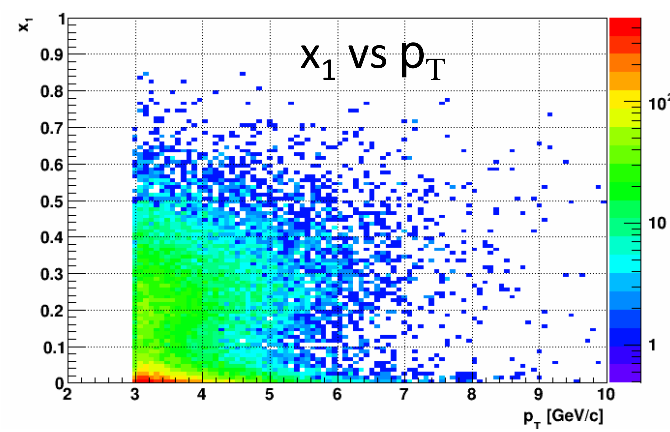


Select x with p_T/η

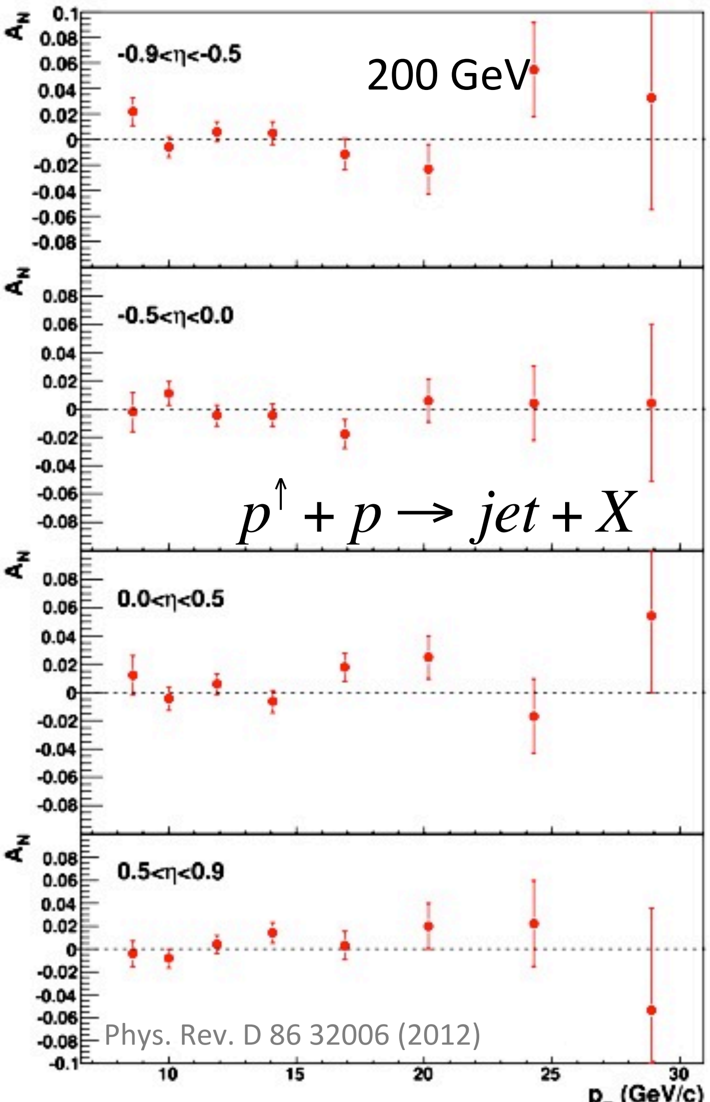
Good z resolution

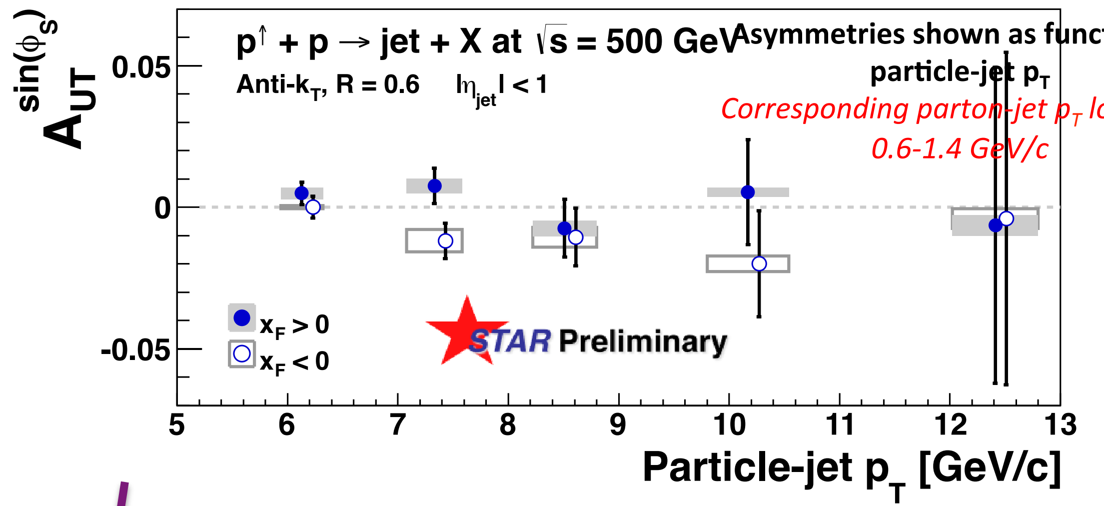
x_1 vs η

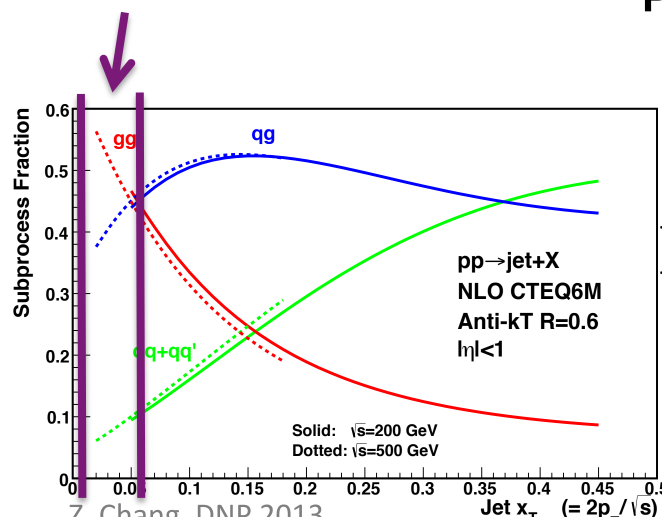




STAR Jet A_N, $A^{\sin(\phi S)}$ related to $f_1^{\perp}$





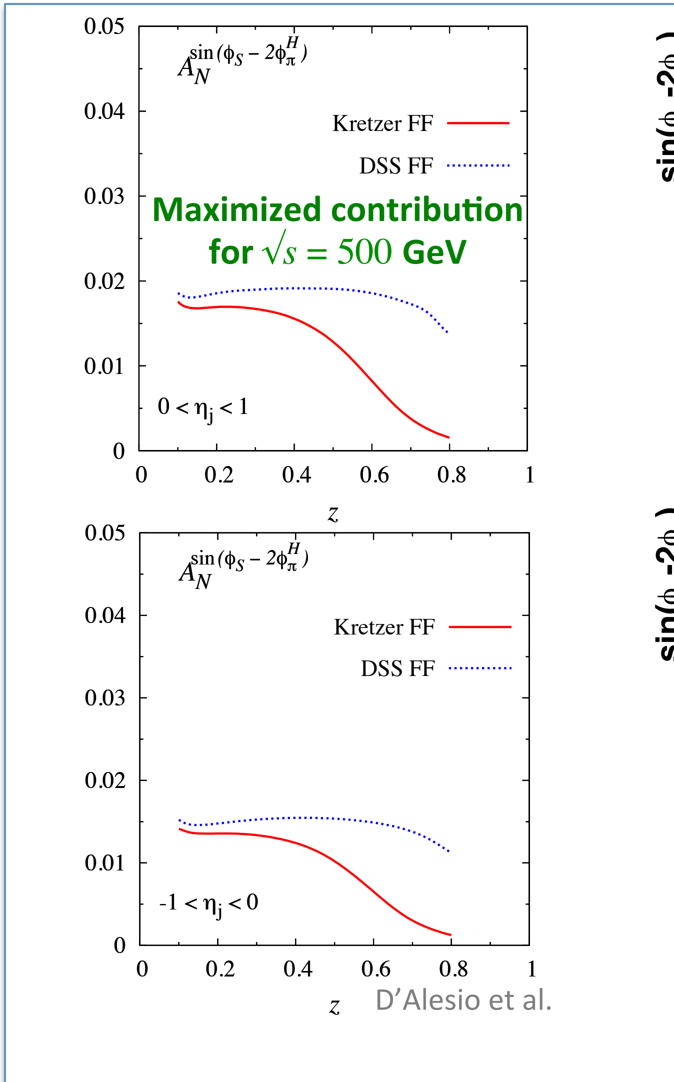


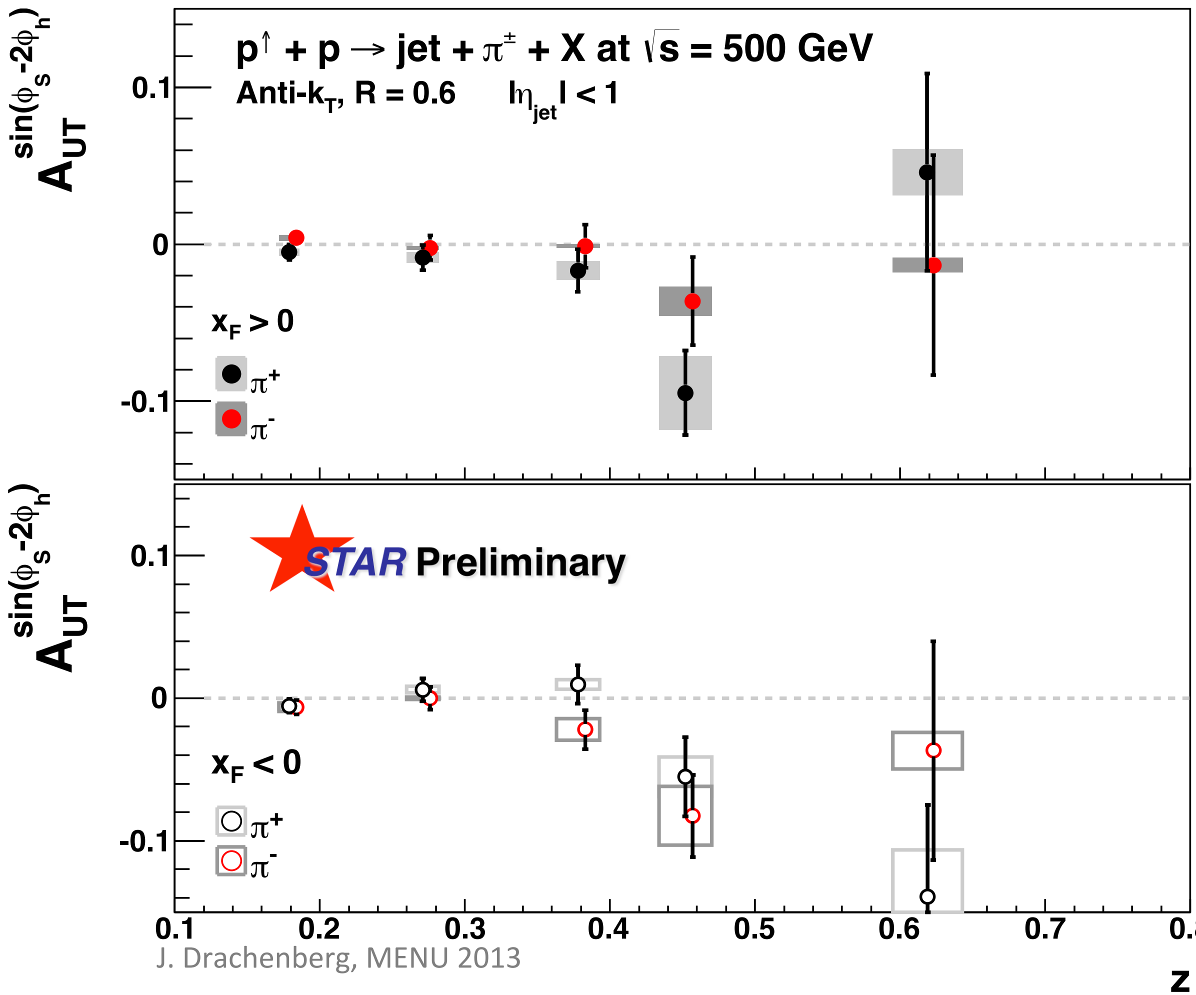
Z. Chang, DNP 2013

Leading sys.. Error from parton matchin, no sig. trigger bias due to min bias trigger

Similarly, di-jet at central psuedorapidity and 200 GeV consistent with zero PRL 99, 142003

"Collins Like": $A^{\sin(\phi S-2\phi h)} \propto h_1^{\perp,g} \otimes H_1$



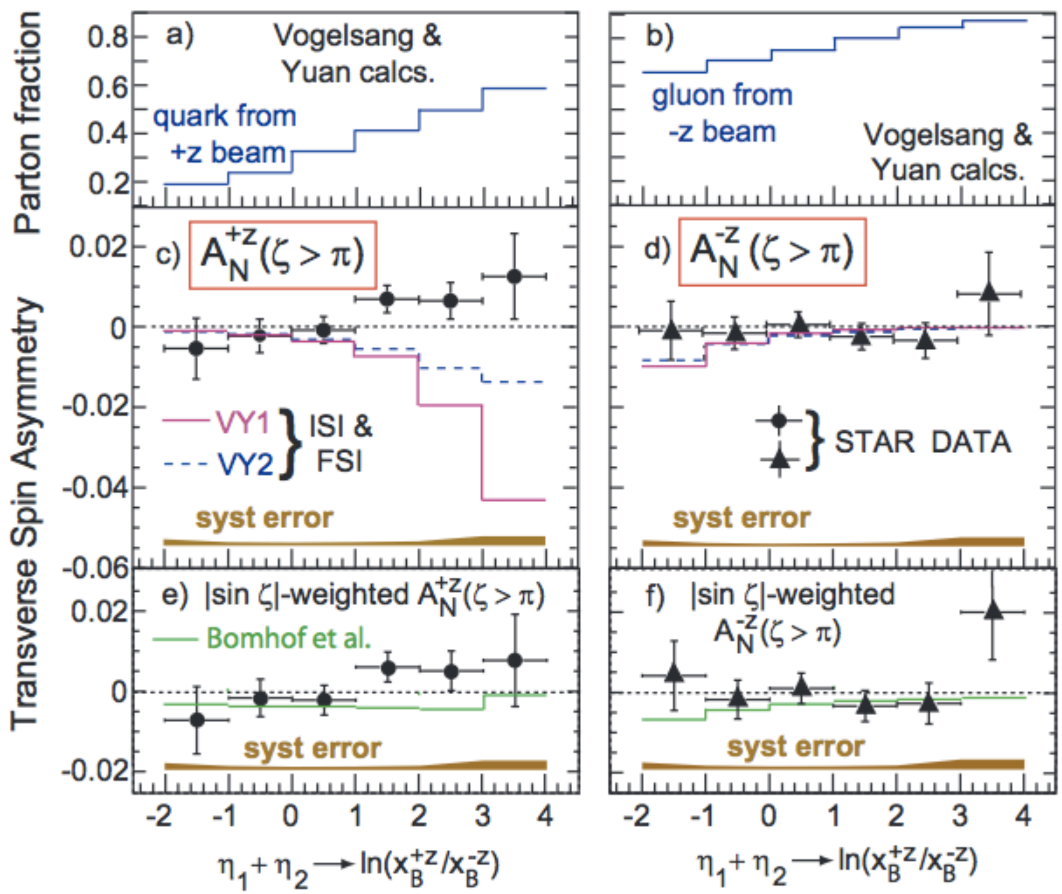


Model predictions shown for "maximized" effect, saturated to positivity bound

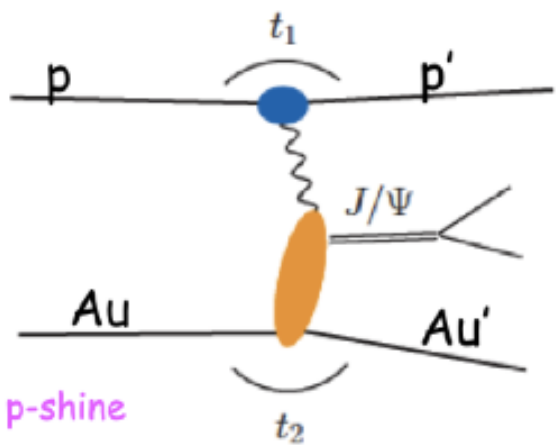
Until now, Collins-like asymmetries completely unconstrained

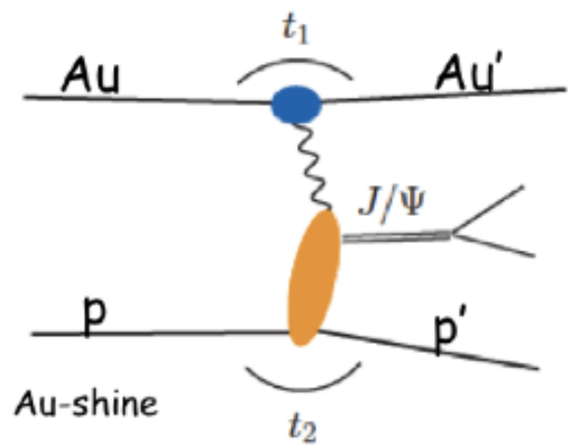
→ ***Sensitive to linearly polarized gluons***

Collins/"real" Sivers and IFF: Entanglement

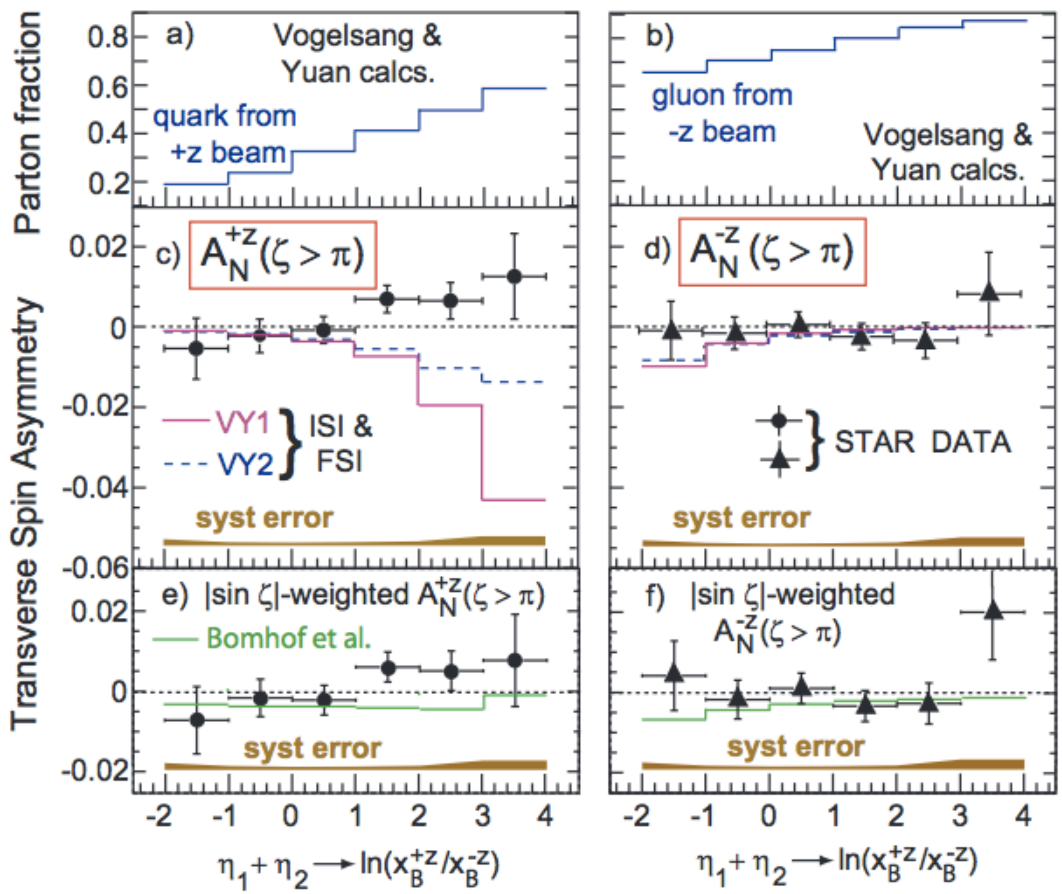


GPD E in p+Au

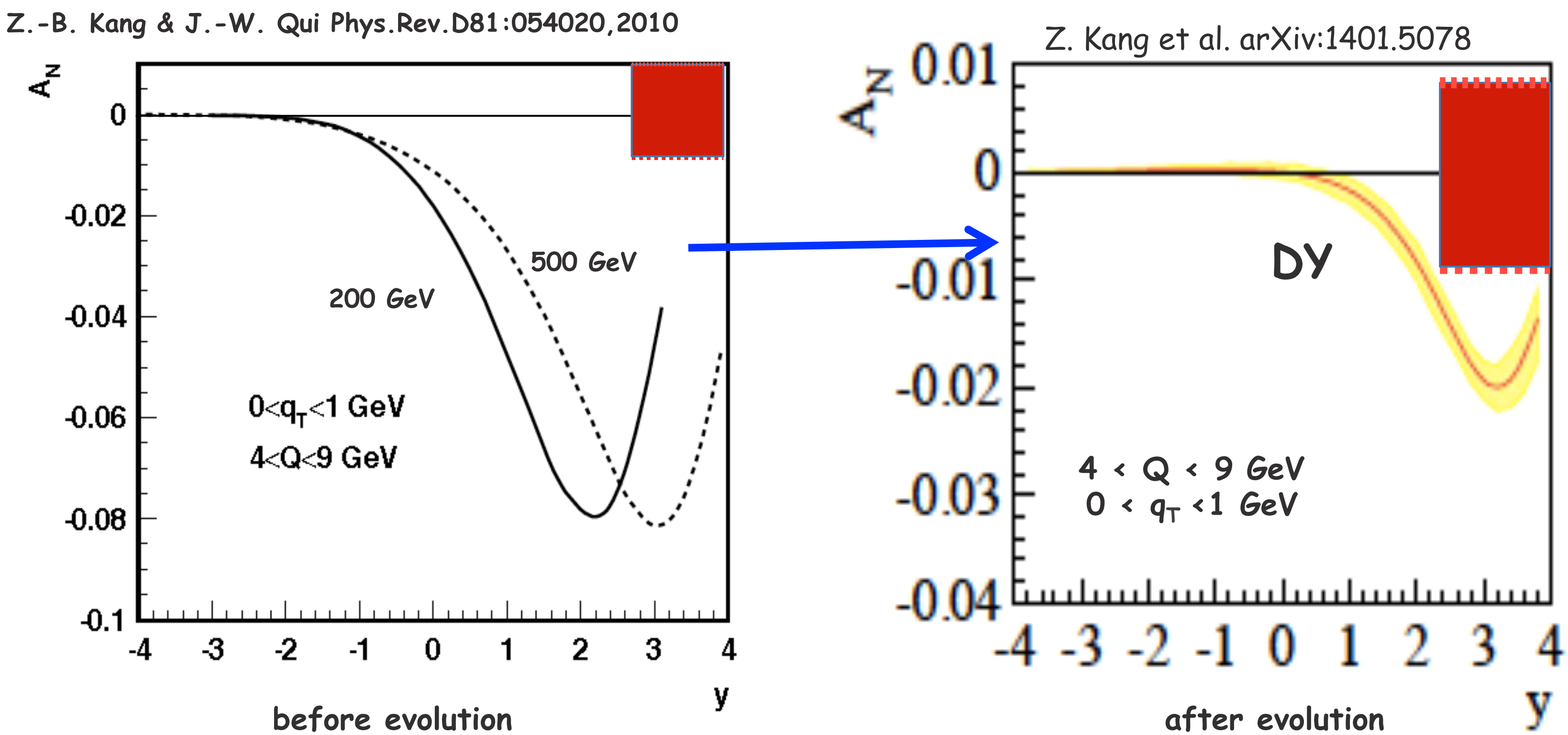




Collins/"real" Sivers and IFF: Entanglement



Drell-Yan: TMD Evolution



Error plotted along x-axis of 0.012 with polarization of 55% and k = 77 ¯pb / 400 ¯pb

A_N

δA_N =

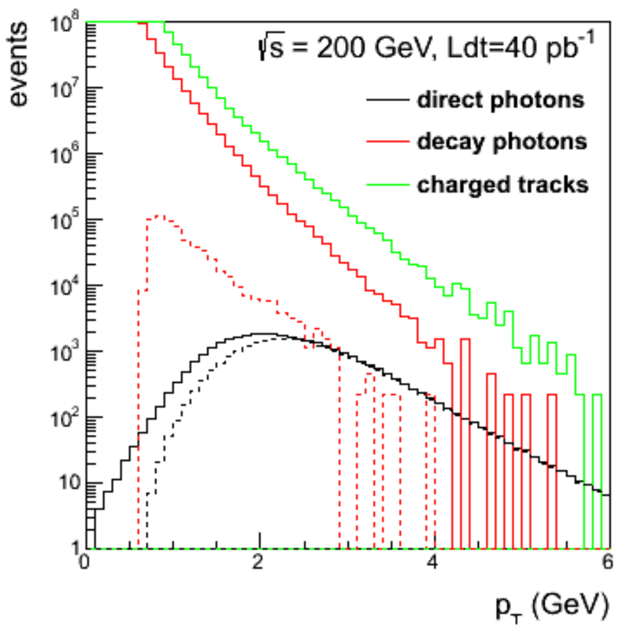
2015-2015:
Direct γ with the FMS Preshower and evaluation of DY

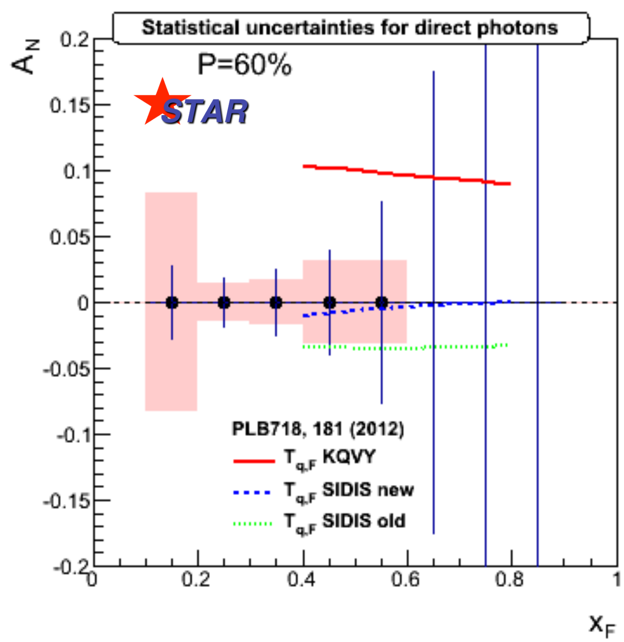
STAR Beam Use Request calls for transverse p+p/A @200GeV (2015) and p+p @510GeV
Direct γ measurement:

3 layer preshower in front of the FMS,
→ distinguish photons, electrons/positrons
and charged hadrons.

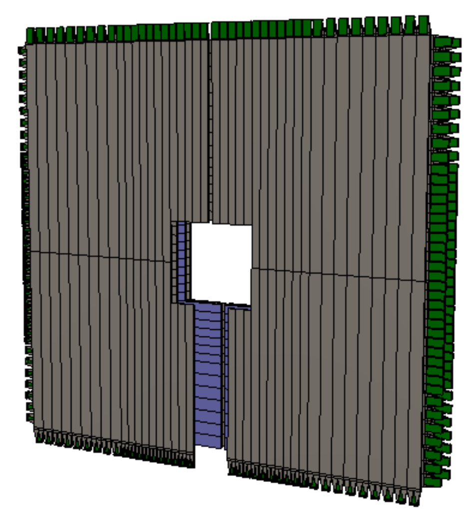
→J/Ψ

→for p+p @510GeV in run16 currently evaluating the most cost
Effective approach in forward calorimeter and possible tracking option
to do DY measurement

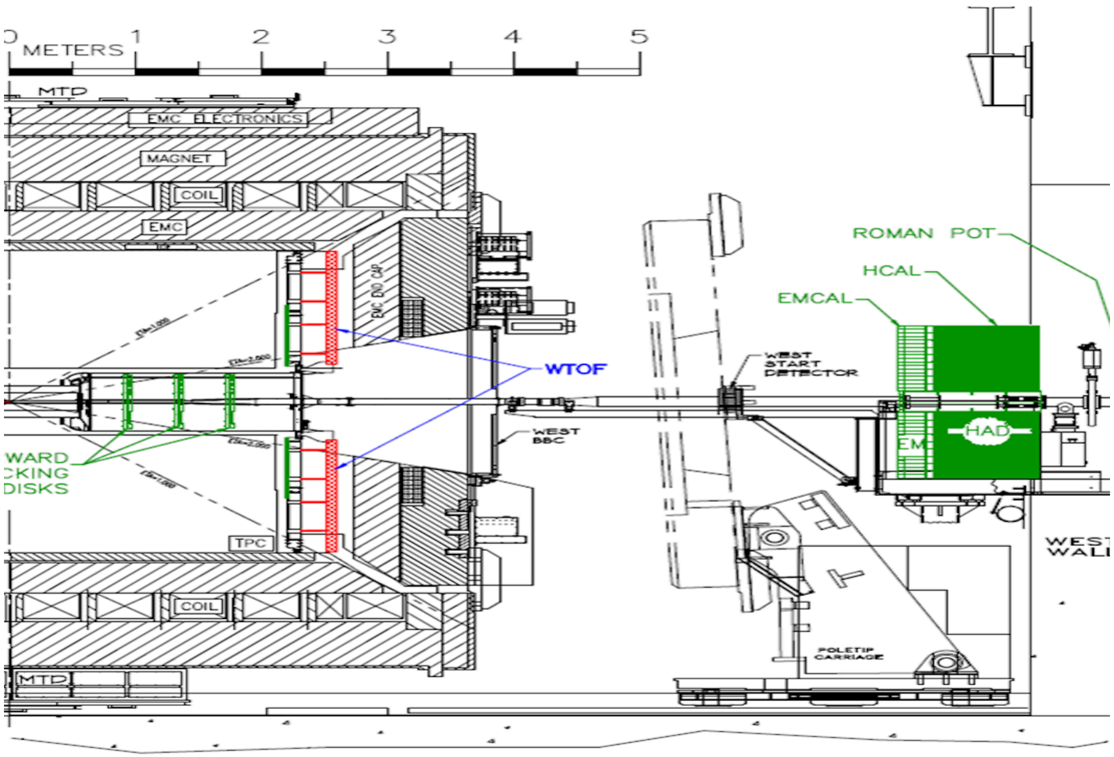


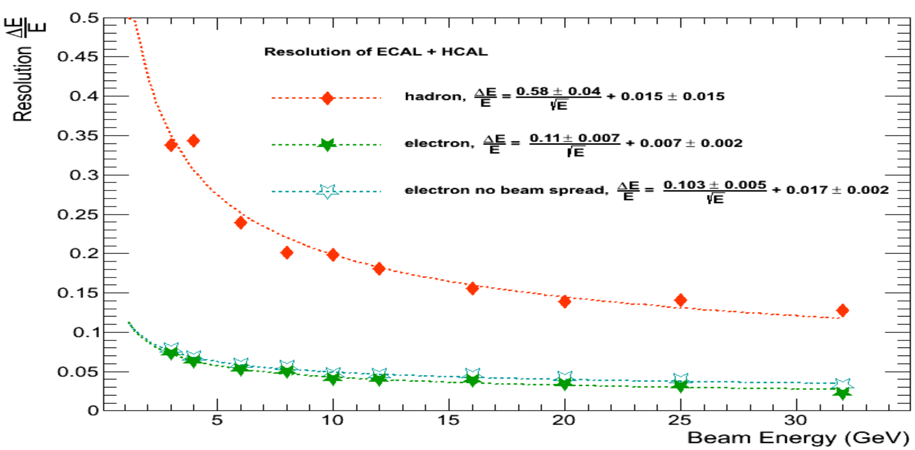


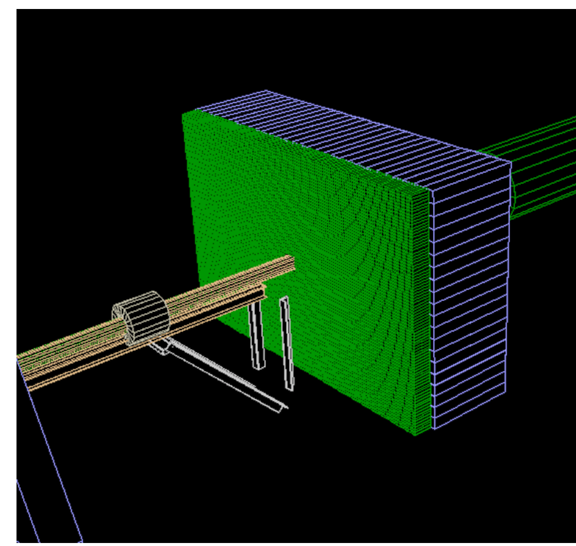
STAR FMS-PreShower:



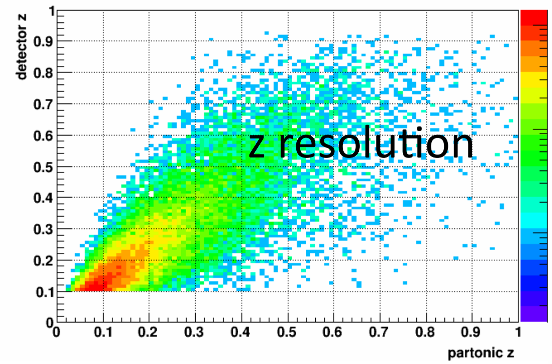
Forward ECAL/HCAL (FCS) ~2020



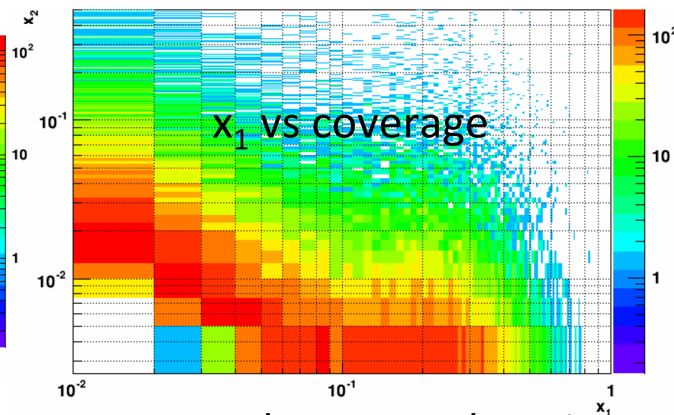




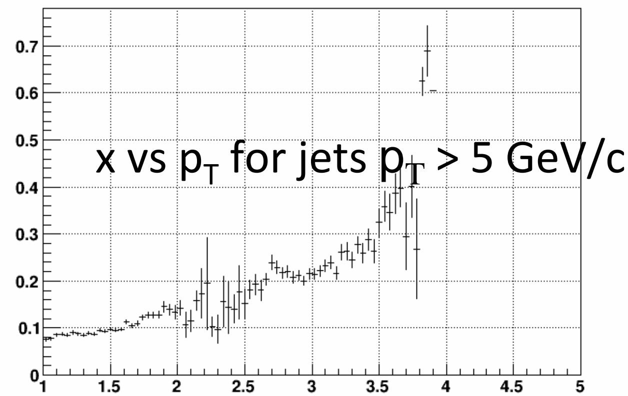
Kinematics covered by Forward Upgrade in p+p (from simulation)



Good z resolution

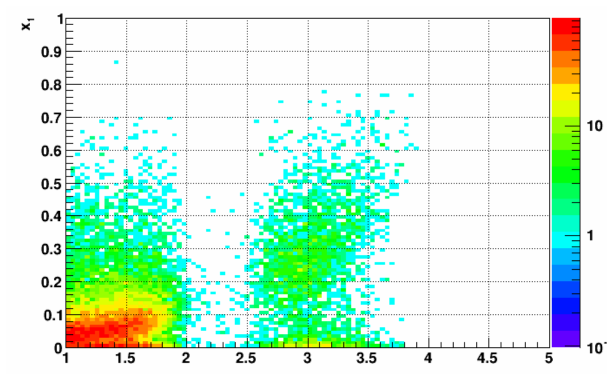


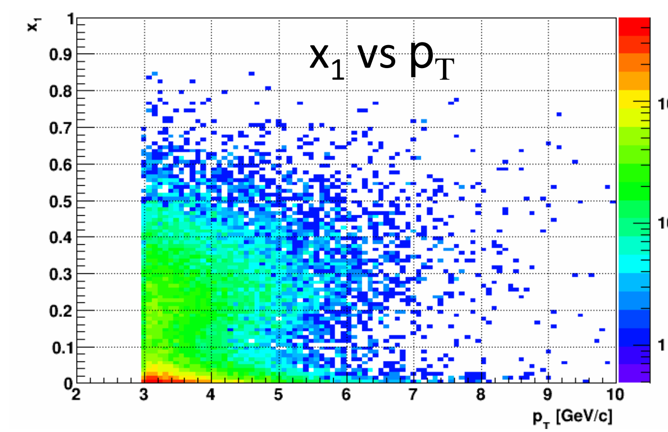
Valence quark region



Select x with p_T/η

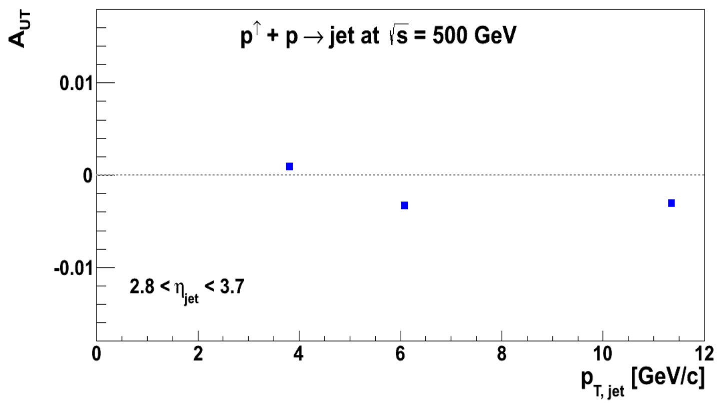
x_1 vs η



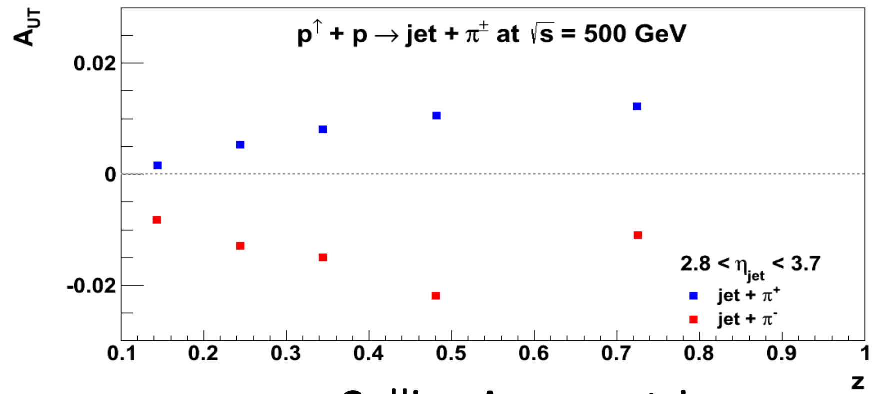


Significant Forward TSSAs Expected

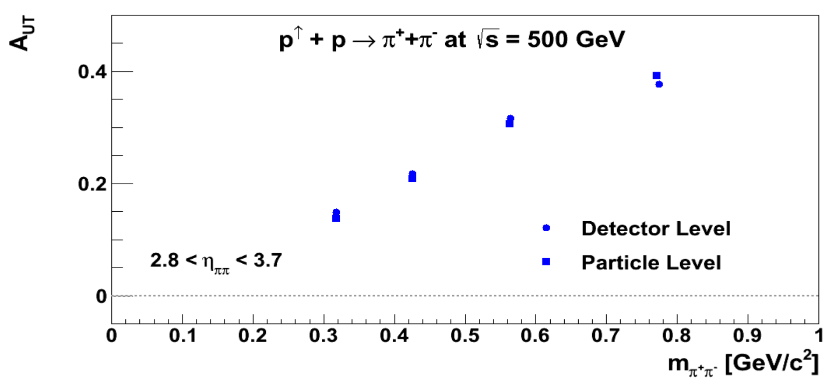
- Torino Parametrization for Sivers/Collins



Forward Jet
(sensitive to Sivers effect)



Collins Asymmetries



IFF Detector smearing effect

Outlook

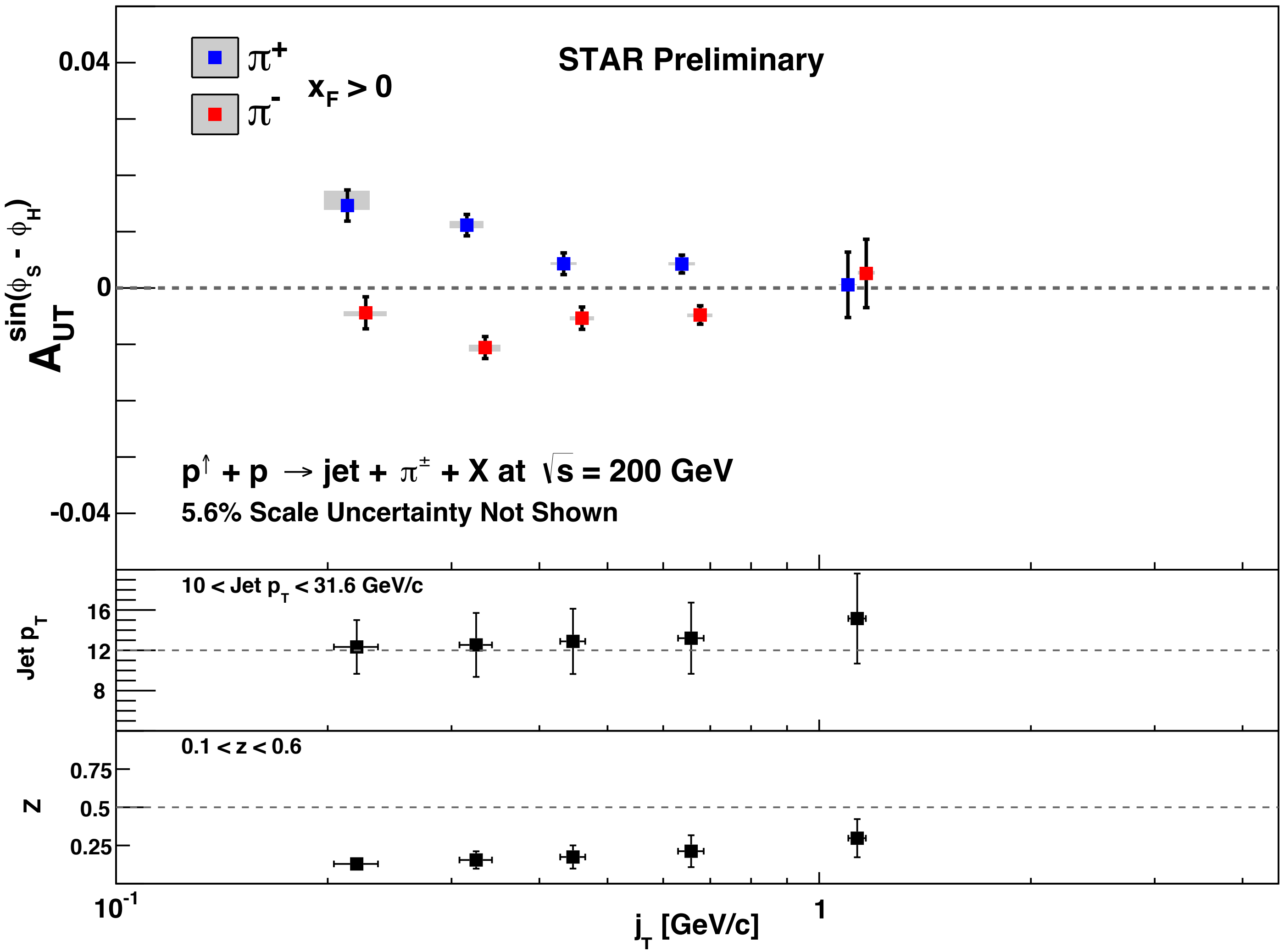
- 3. Physics of the sign change (gauge link)
  - -….
- 4. Entanglement (one step more complicated than sign change →leptonic final state
- 5. Future: Fermi lab, eStar? Even LHC with multi-parton-interactions

Signchange

- Physics of the sign change
  - (werners pic… etc)

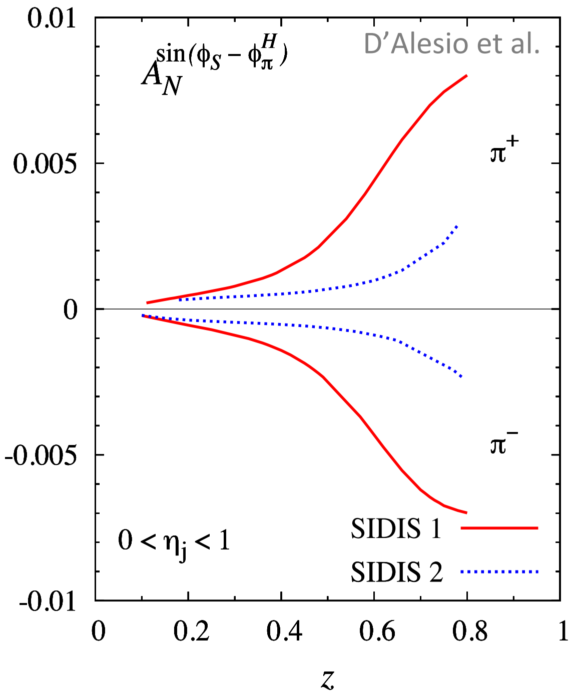
√s = 200 GeV

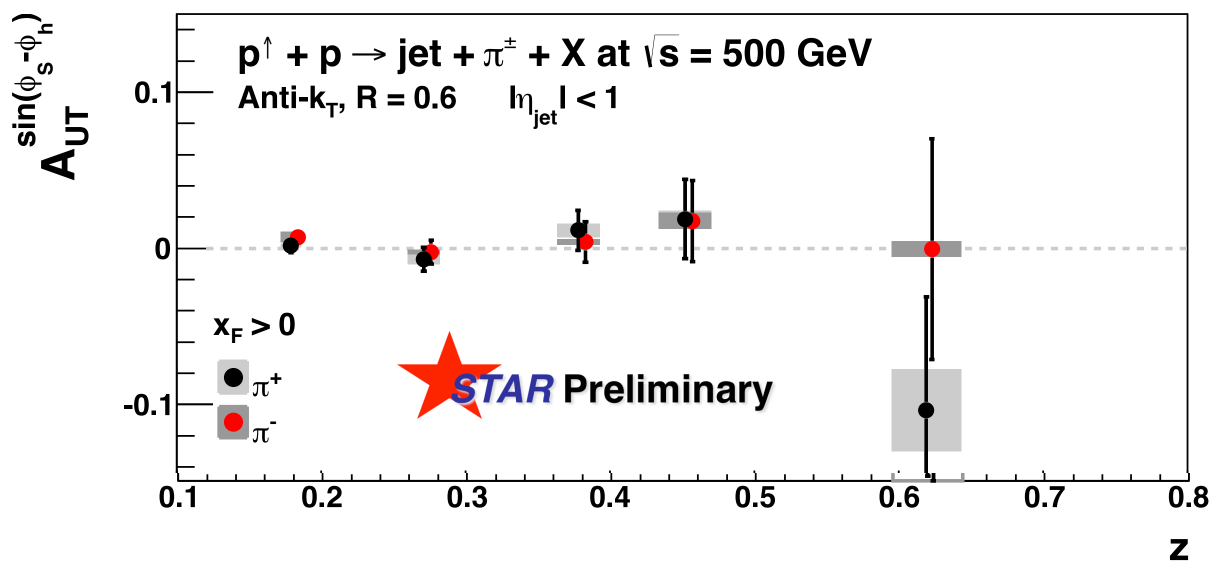
A_{UT} vs. j_T for $x_F > 0$

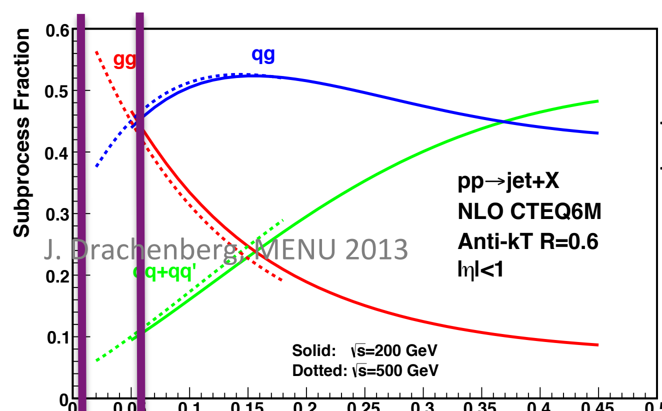


Collins Asymmetry at 500 GeV

Increased gluonic subprocesses at $\sqrt{s}$ = 500 GeV lead to expectation of ***small Collins asymmetry*** until larger z

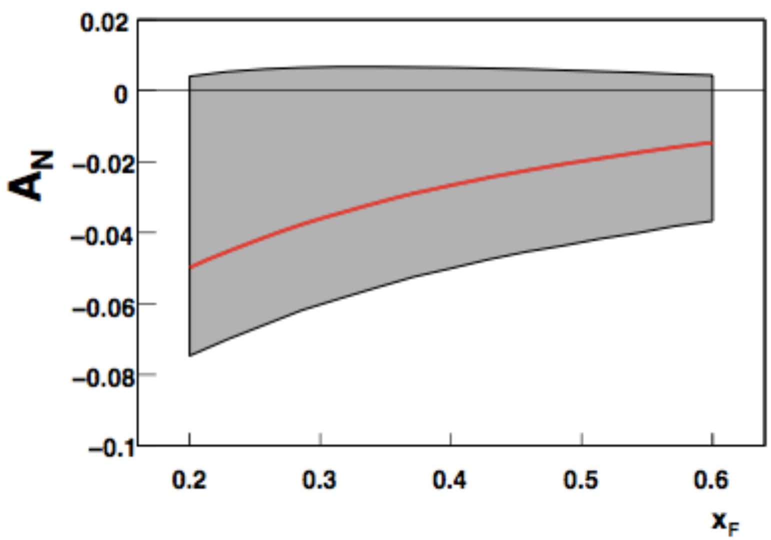


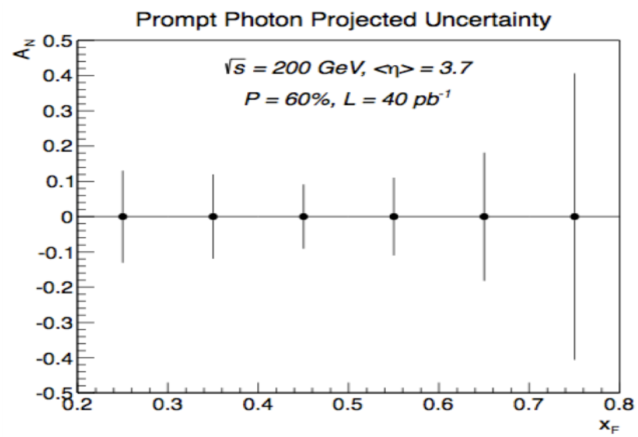


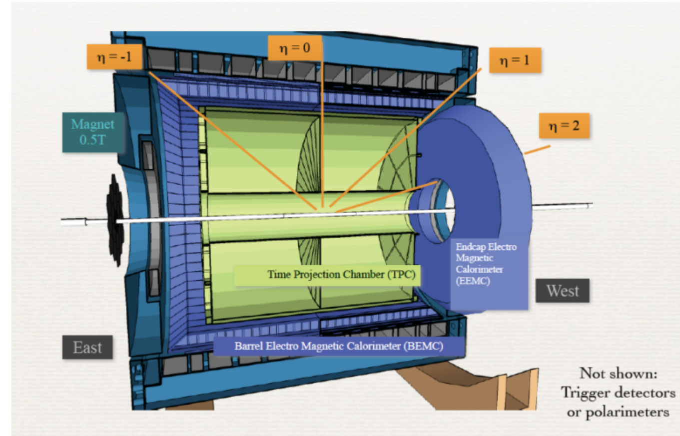


Z. Chang, DNP 2013

Leading sys.. Error from parton matchin, no sig. trigger bias due to min bias trigger

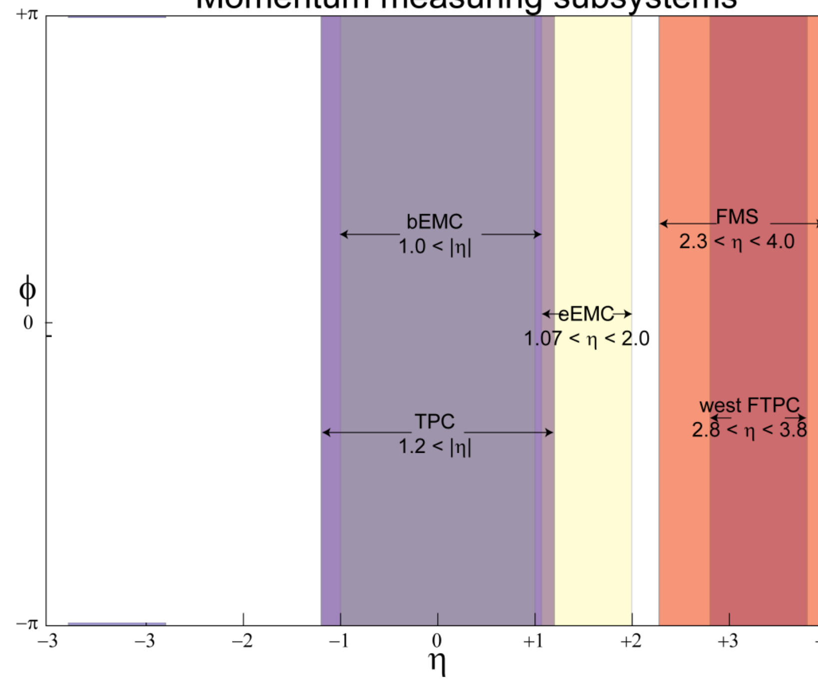

0.02
0
-0.02
-0.04
-0.06
-0.08
-0.1
A_N
0.2
0.3
0.4
0.5
0.6
x_F

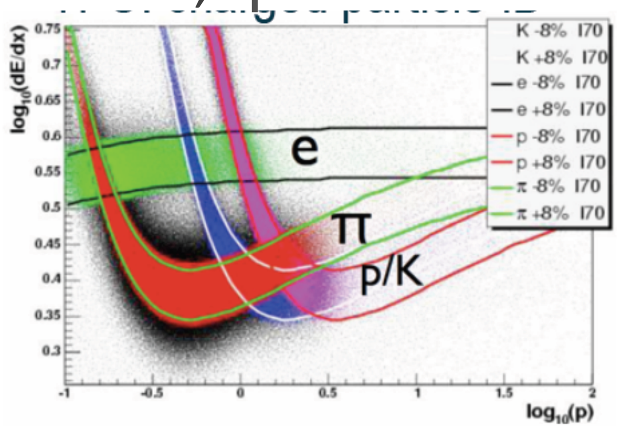

Prompt Photon Projected Uncertainty
$\sqrt{s}$ = 200 GeV, <η> = 3.7
P = 60%, L = 40 pb^{-1}
A_N
x_F



FMS

- Central Region (-1<η<1)
  - Identified Pions, η
  - Jets
- Endcap (1<η<2)
  - π^0, η, (some) jets
- FMS (2<η<4)
  - π^0, η





Full azimuth spanned with nearly contiguous electromagnetic calorimetry from -1<η<4

⇒ approaching full acceptance detector

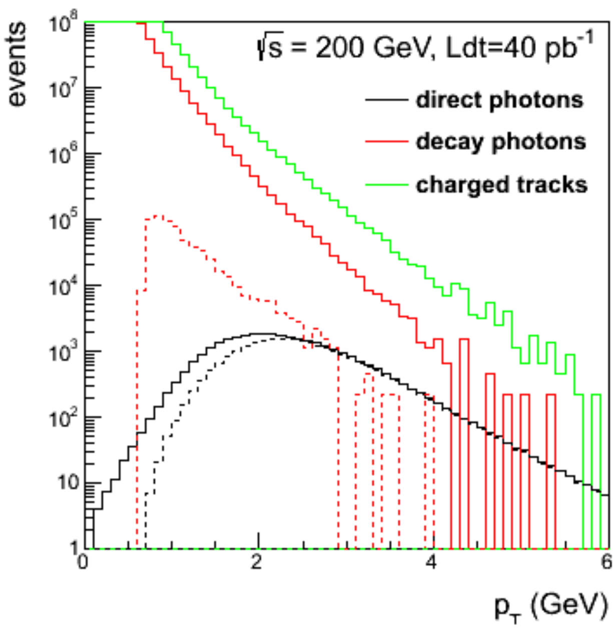
PID (Barrel) with dE/dx, in the future: ToF pi/K separation up to 1.9 GeV

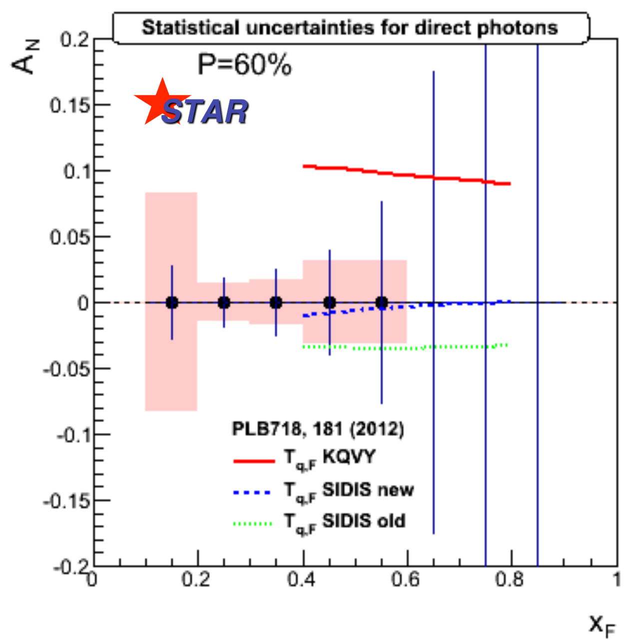
Direct γ with the FMS Preshower in 2015

8 layer Silicon minipad Tungsten sandwich pre-shower in front of lead-tungstate MPC electromagnetic calorimeter ($3.1<|\eta|<3.8$)

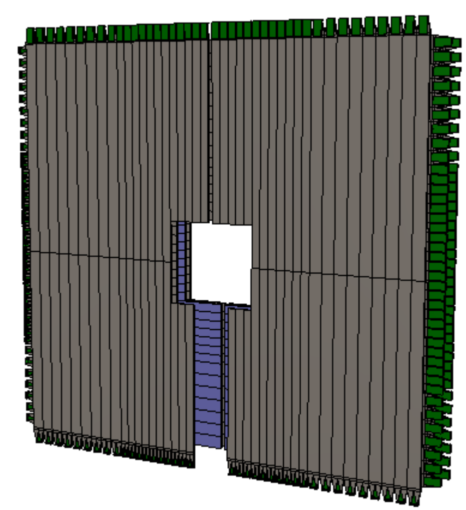
→ Reconstruct and reject π^0 mesons

⇒ enhances π^0/γ separation (up to >80GeV)



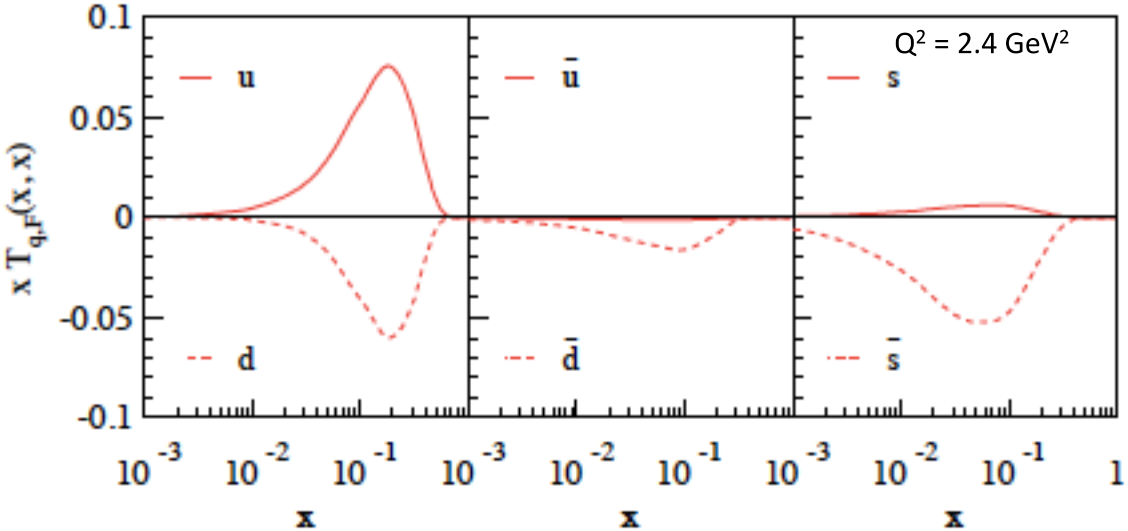


STAR FMS-PreShower:



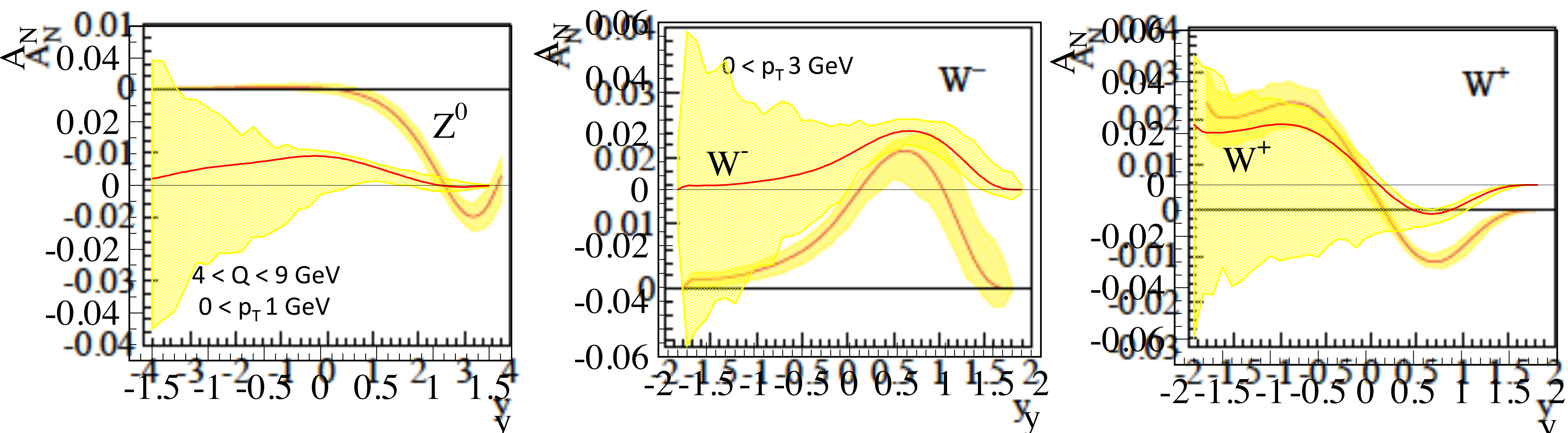
New Theory predictions

Z. Kang et al. arXiv:1401.5078v1

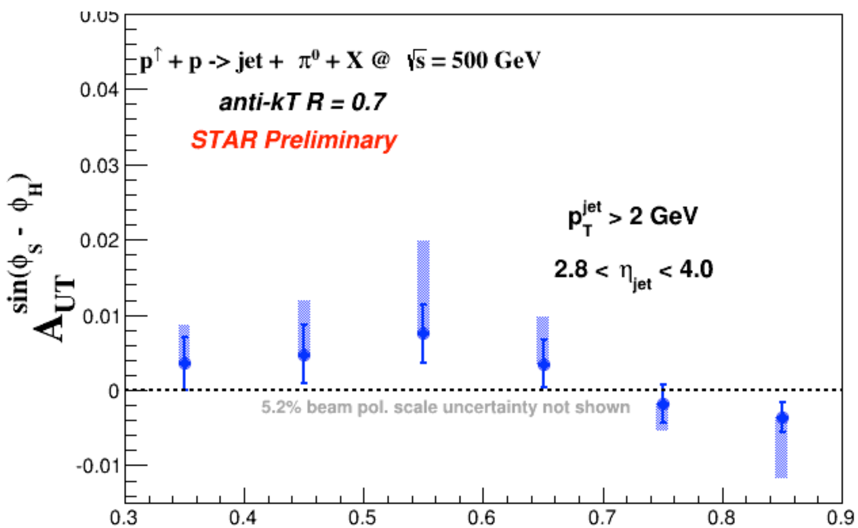


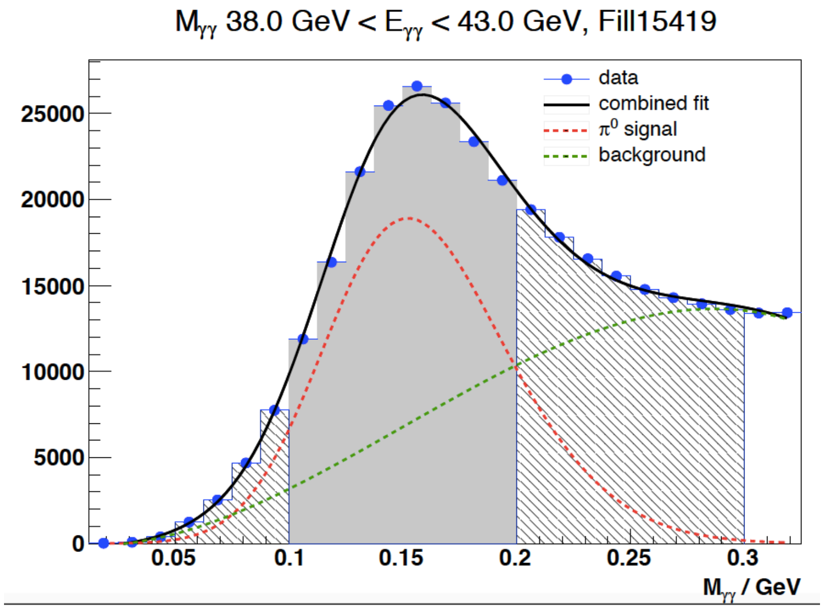
despite fitted,
sea quarks unconstrained

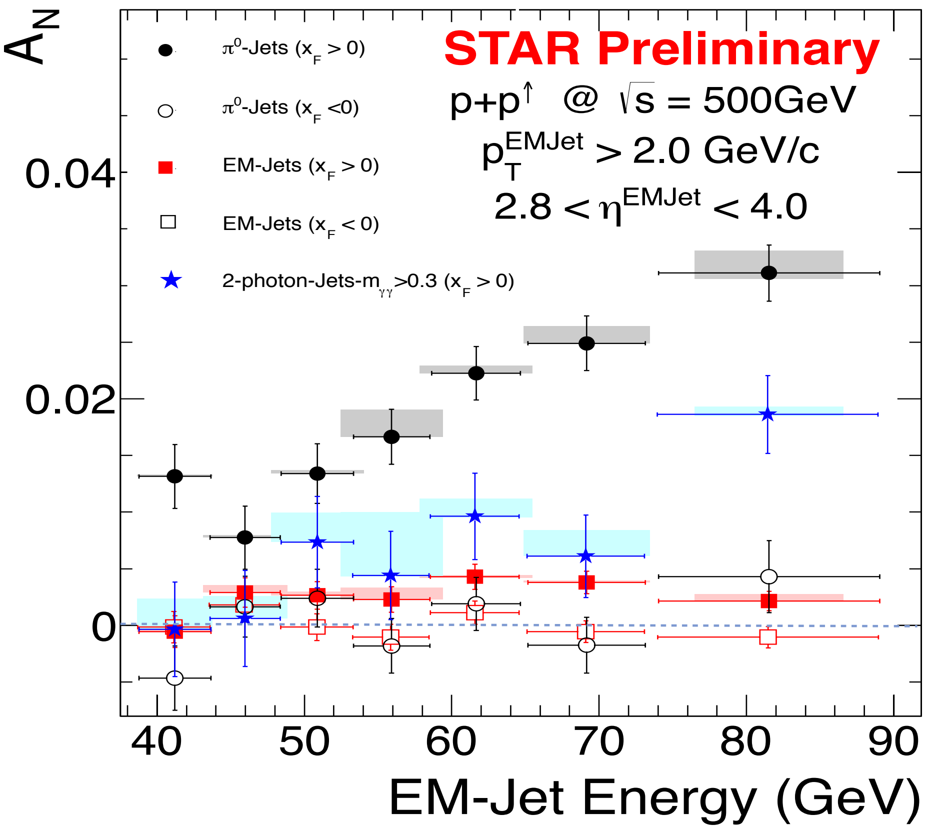
impacts $A_N(W^{\pm,} Z^0)$
new calculations for
$A_N(\gamma)$ coming
and $A_N(W^{\pm,} Z^0)$
maximized sea-quarks



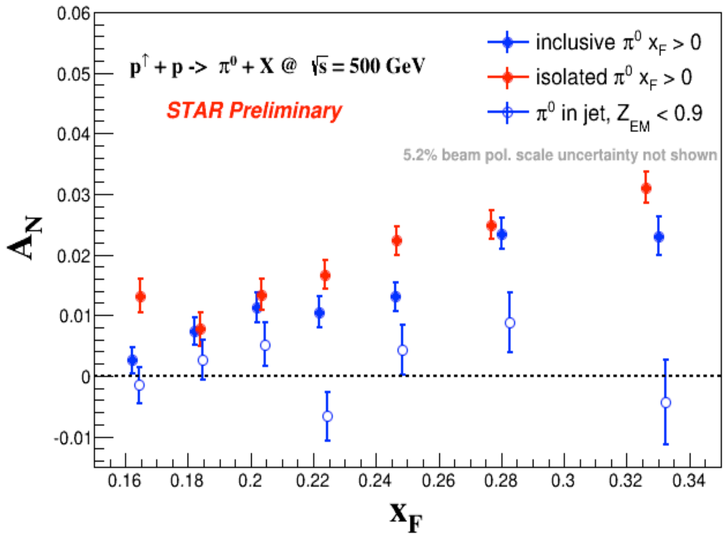
Z. Kang A_N ($W^{+/-}$,Z^0) accounting for sea quark uncertainties using positivity bound as limit


p↑ + p -> jet + π0 + X @ √s = 500 GeV
anti-kT R = 0.7
STAR Preliminary
pT jet > 2 GeV
2.8 < ηjet < 4.0
5.2% beam pol. scale uncertainty not shown
AUT sin(φS - φH)


Mγγ 38.0 GeV < Eγγ < 43.0 GeV, Fill15419
data
combined fit
π0 signal
background
Mγγ / GeV



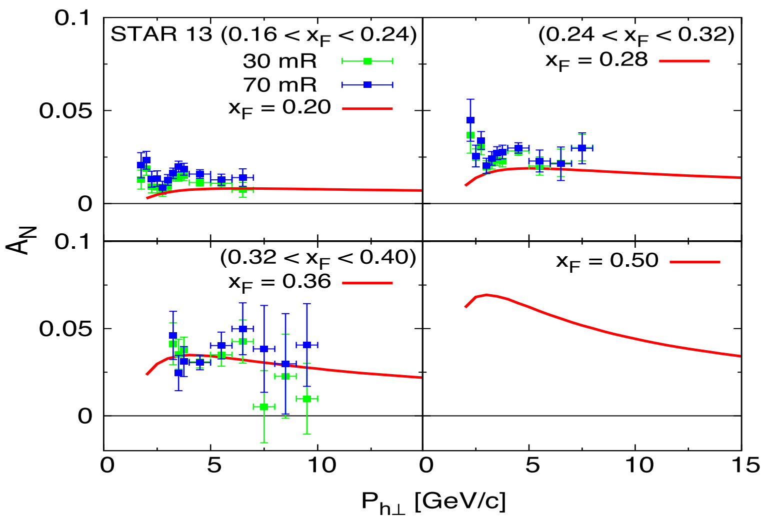
STAR Preliminary
p+p↑ @ √s = 500GeV
p_T^{EMJet} > 2.0 GeV/c
2.8 < η^{EMJet} < 4.0
π^0-Jets (x_F > 0)
π^0-Jets (x_F <0)
EM-Jets (x_F > 0)
EM-Jets (x_F < 0)
2-photon-Jets-$m_{\gamma\gamma}$>0.3 (x_F > 0)
A_N
EM-Jet Energy (GeV)

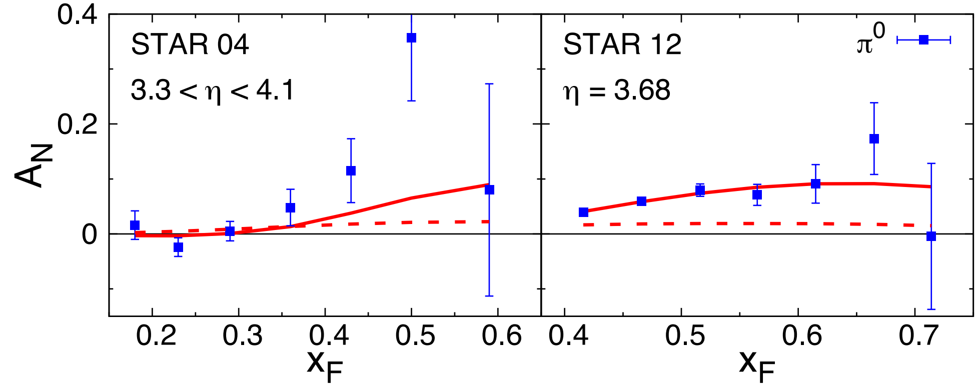


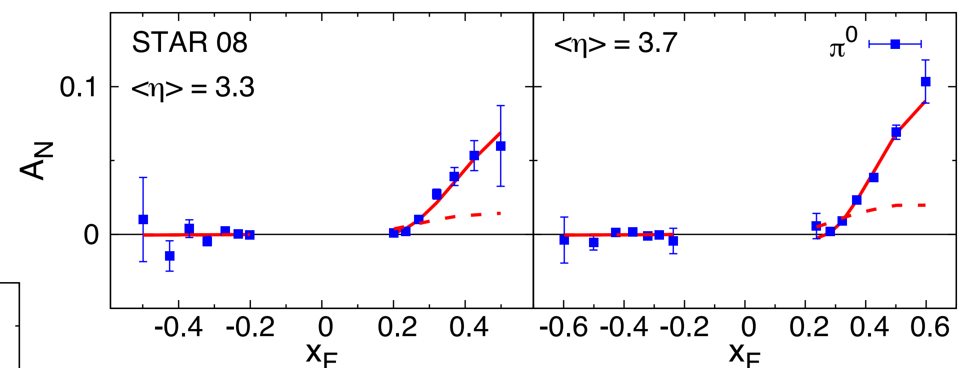
$p^\uparrow + p \to \pi^0 + X$ @ √s = 500 GeV
STAR Preliminary
inclusive π^0 x_F > 0
isolated π^0 x_F > 0
π^0 in jet, Z_{EM} < 0.9
5.2% beam pol. scale uncertainty not shown
A_N
x_F

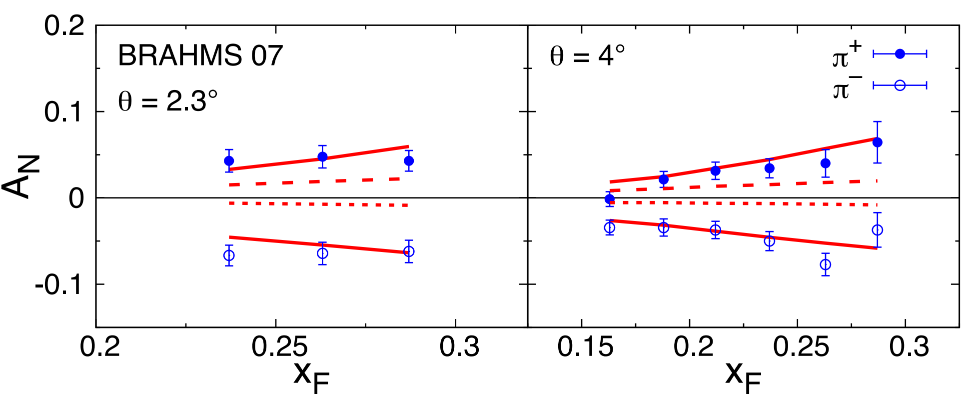
Accounting for all Twist3 parts

- ISR/FSR contributions









Kanazawa, Koike, Metz, Pitonyak
Phys.Rev. D89 (2014) 11, 111501