

Report from the STAR Spin Physics Working Group

Oleg Eyser and Jim Drachenberg

May 19, 2017

STAR Collaboration Meeting

OUTLINE

- Meeting Talks
- Recent Papers
- Recent Results
- Status Reports
- Summary

From Preliminary to Publication

$\sqrt{s}$ [GeV]	Year	Channel	Analysts
200	2009	Dijet A_{LL} (EEMC)	T. Lin (IU)
200	2009	Lambda D_{LL}	J. Zhang (LBNL)
500	2011	FMS $\pi^0 A_N$	Z. Zhu (Shandong/BNL)
200	2012	Incl. jet & jet + $\pi^\pm A_{UT}$ (central)	K. Adkins (UKY)
200	2012	Lambda Polarization Transfer	J. Mei (Shandong)
510	2012	Inclusive Jet A_{LL} (central)	Z. Chang (BNL)
510	2012	Dijet A_{LL} (central)	S. Ramachandran (UKY)
510	2013	$W^\pm/Z A_L$ (BEMC + EEMC)	D. Gunarathne + A. Kraishan (Temple) + J. Zhang (LBNL)
500+510	2011 - 2013	W^+/W^- Cross Sec.	M. Posik (Temple) + S. Fazio (BNL)
510	2012 + 2013	$\pi^0 A_{LL}$ (FMS)	C. Dilks (PSU)

Toward Preliminary

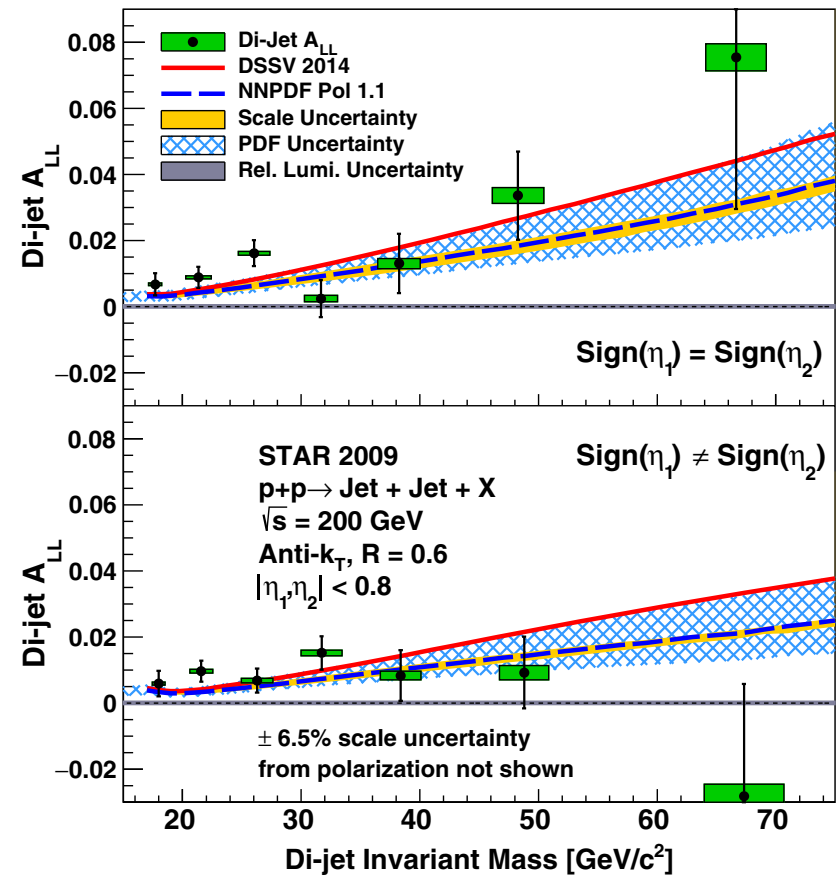
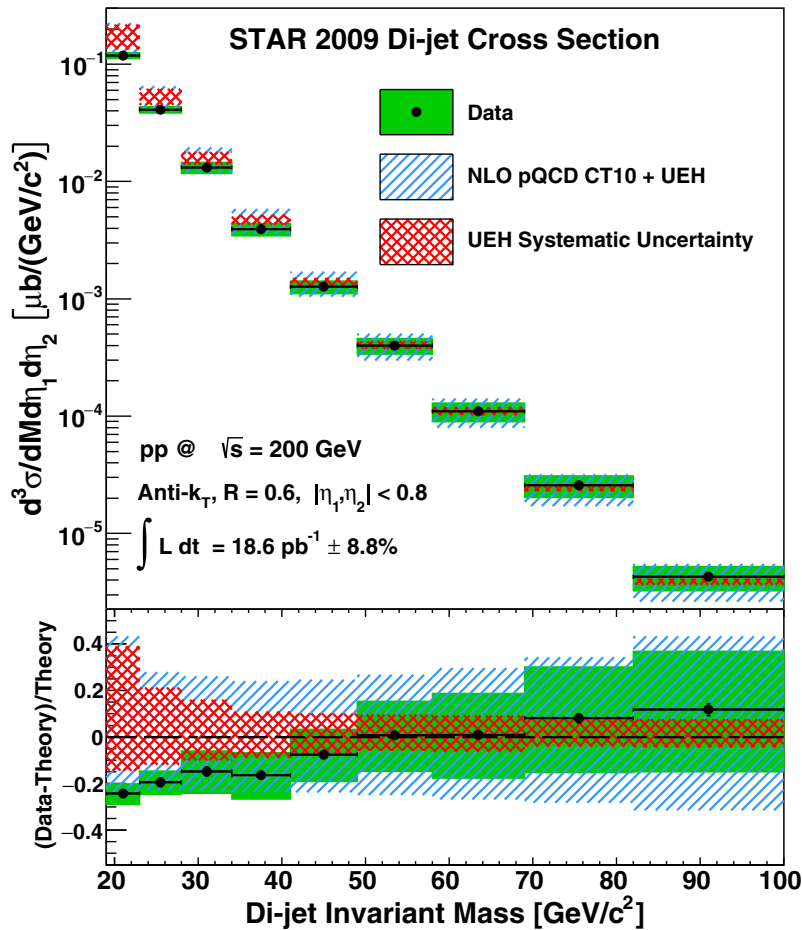
$\sqrt{s}$ [GeV]	Year	Channel	Analysts
200	2012	Dijet Sivers	H. Liu (IU)
510	2012	π^0 (EEMC) + jet (central) A_{LL}	Y. Wang (CCNU)
510	2013	Inclusive Jet A_{LL} (central)	A. Quintero (Temple)
510	2013	Dijet A_{LL} (central)	D. Olvitt (Temple)
510	2012-2013	Dijet A_{LL} (EEMC)	J. Kwasizur (IU)
510	Simu.	Endcap SMD Clustering	B. Solyst (IU)
200	2015	Direct Photons in FMS	O. Eyser (BNL)

Status of the 2017 Run

$\sqrt{s}$ [GeV]	Year	Channel	Analysts
510	2017	FMS Performance in 2017	S. Trentalange (UCLA)
510	2017	FPS/FPOST Performance in 2017	D. Kapukchyan (UCR)
510	2017	2017 W Reconstruction Efficiency and Q/A	J. Zhang (LBNL)

Recent¹ STAR Spin Papers

$\sqrt{s}$ [GeV]	Year	Channel	Analysts
200	2009	Dijet A_{LL} + cross sec. (central)	B. Page (BNL)



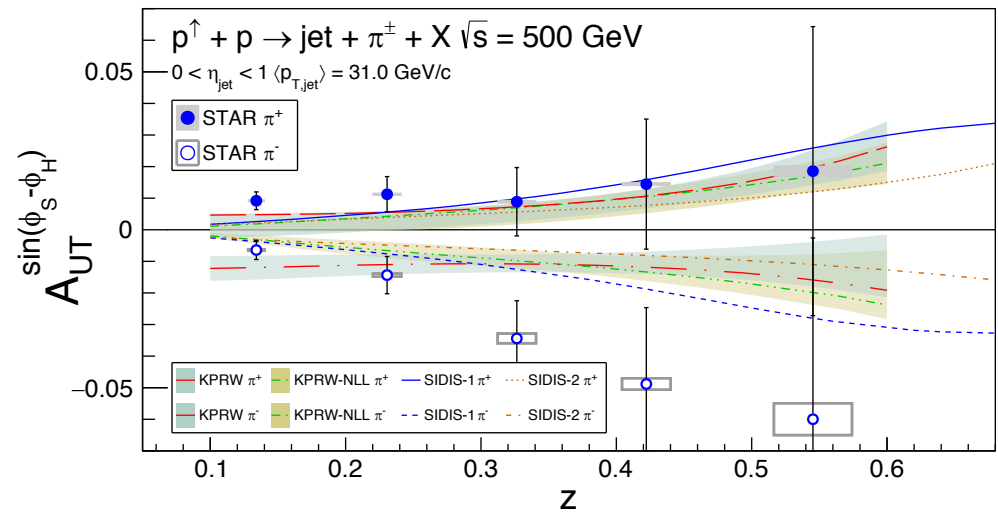
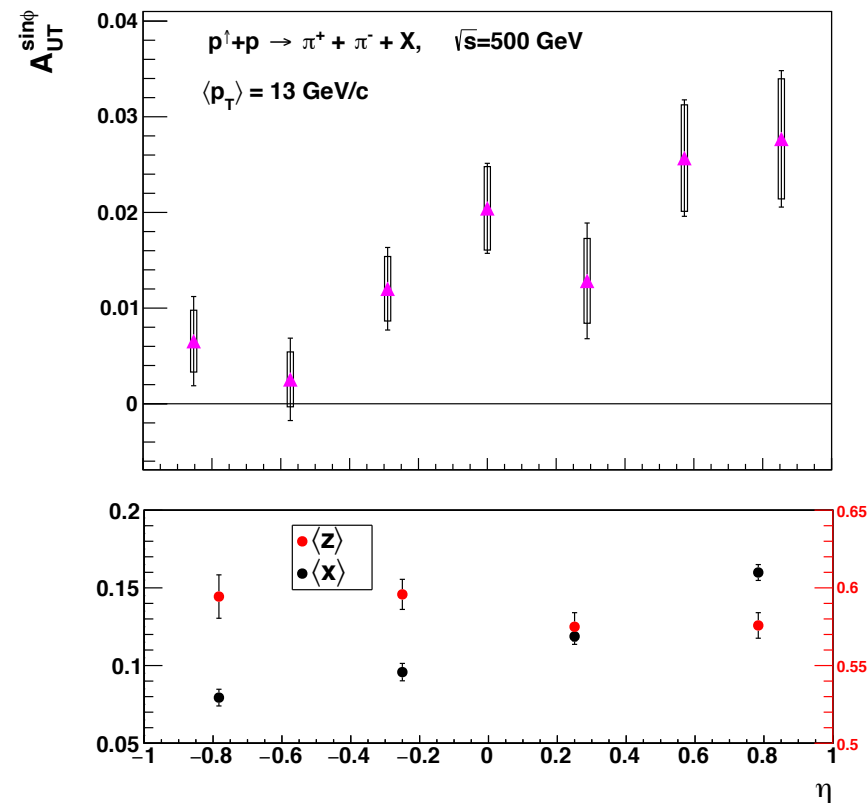
Final results published

Phys. Rev. D 95, 071103(R) (2017)

¹ Since August collaboration meeting spin report

STAR Spin Papers Currently in GPC

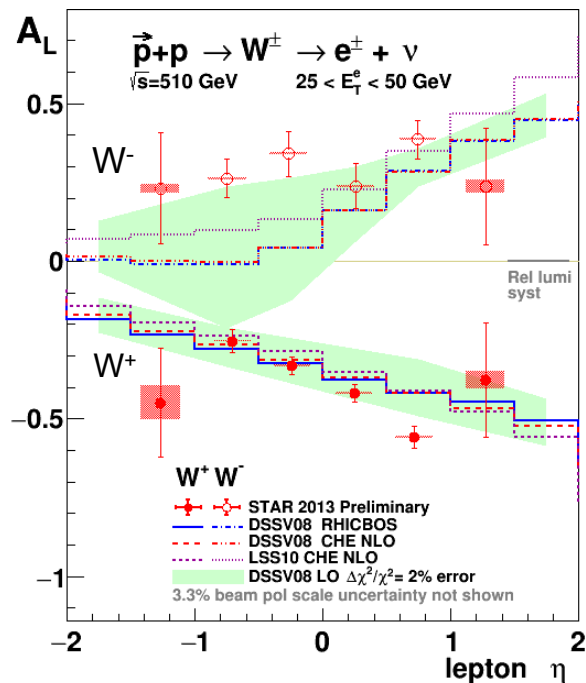
$\sqrt{s}$ [GeV]	Year	Channel	Analysts
500	2011	$\pi^+ \pi^-$ IFF A_{UT} (central)	M. Skoby (Mich.) + A. Vossen (CEEM)
500	2011	Incl. jet & jet + $\pi^\pm$ A_{UT} (central)	J. Drachenberg (Lamar)



Lead analysts actively working on both drafts
Expect both papers to release within a few weeks

Recent¹ STAR Spin Results

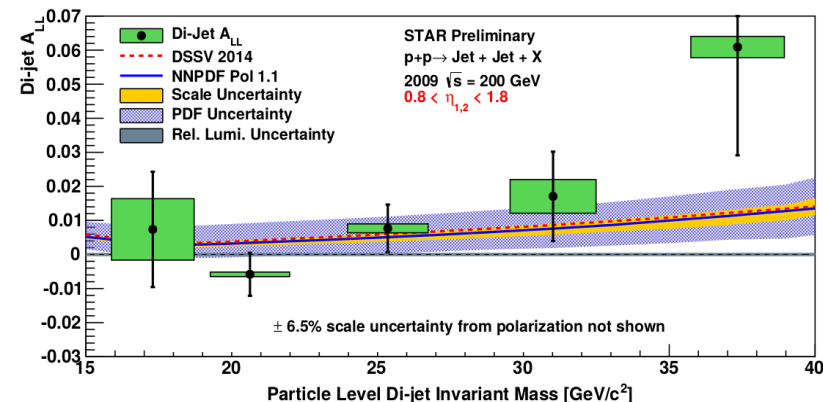
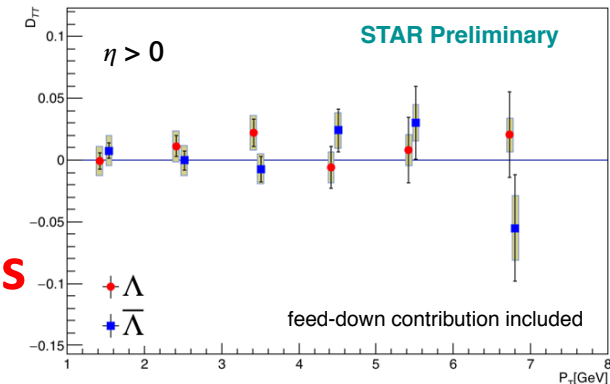
$\sqrt{s}$ [GeV]	Year	Channel	Analysts
200	2009	Dijet A_{LL} (EEMC)	T. Lin (IU)
510	2013	$W^\pm/Z$ A_L (BEMC + EEMC)	D. Gunarathne + A. Kraishan (Temple) + J. Zhang (LBNL)
200	2012	Lambda Polarization Transfer	J. Mei (Shandong)



*Released for SPIN 2016 at UIUC,
DNP 2016 in Vancouver,
and DIS 2017 in Birmingham*

Conference Presentations

- DIFFRACTION (1)
- INPC (2)
- Spin (8)
- DNP (6)
- DIS (4)
- APS (5)

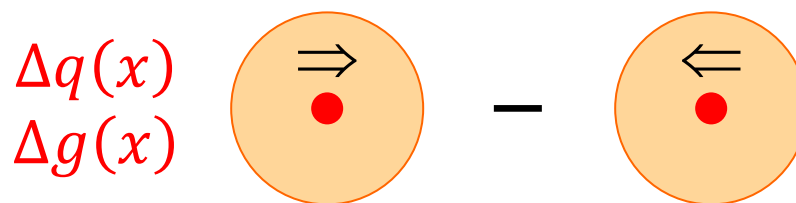


¹ Since August collaboration meeting spin report

STAR Gluon Helicity Measurements

Consider proton moving right

Proton spin-polarization $\Rightarrow$



$$A_{LL}^{jet} = \frac{N^{++} - N^{+-}}{N^{++} + N^{+-}} \sim \frac{\Delta f(x_1)\Delta f(x_2)}{f(x_1)f(x_2)} \hat{a}_{LL}$$

e.g. for jet production

STAR Gluon Helicity Measurements

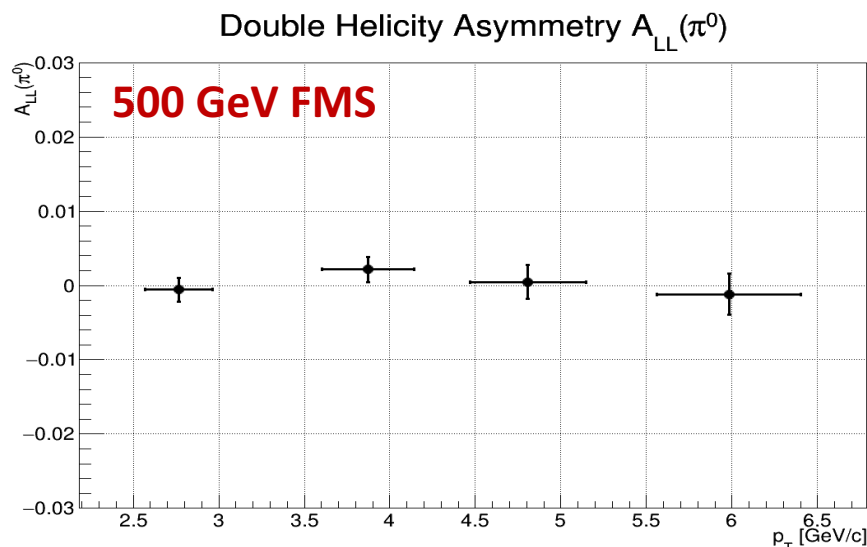
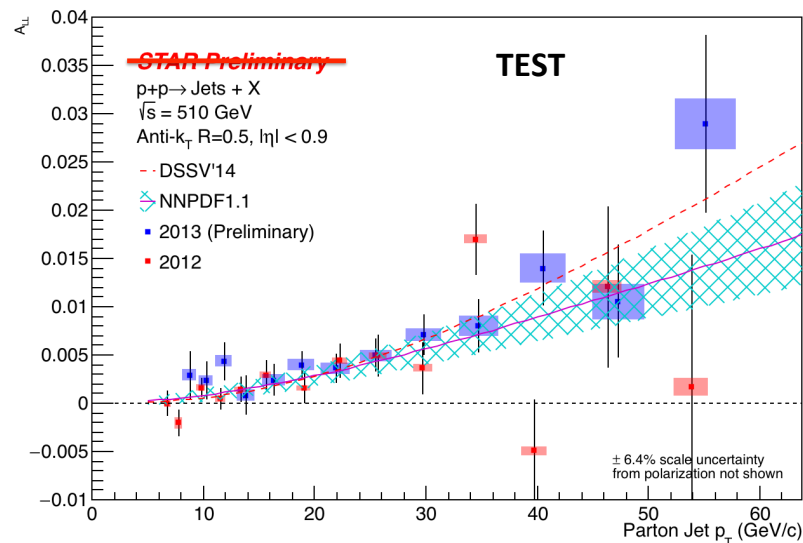
Inclusive Probes

Inclusive jets

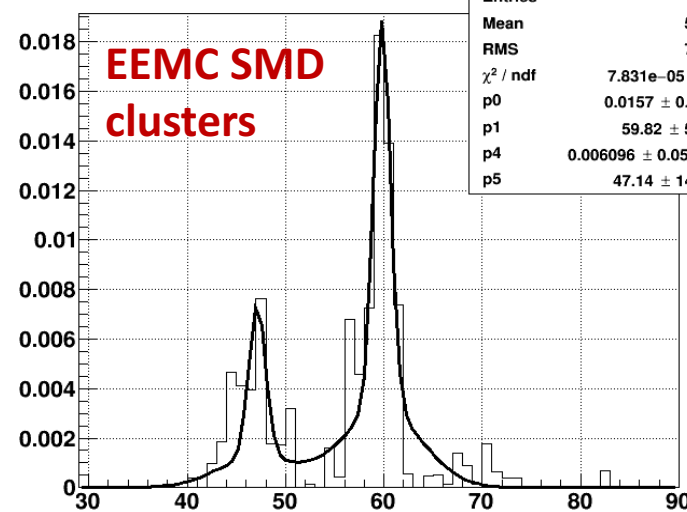
- 2012 near-final w/ draft analysis note posted
- 2012 cross section to follow in future
- 2013 near preliminary; last systematics to wrap in ~2 weeks (target EPS meeting)

Inclusive pions

- 2012-13 FMS finalizing resolution systematics and B.G. corrections for paper (updating analysis note)
- EEMC: new SMD shower fitting procedure



Re-Fit Photons



Thr-U I4	
Entries	31
Mean	56.18
RMS	7.317
χ^2 / ndf	7.831e-05 / 284
p0	0.0157 $\pm$ 0.0912
p1	59.82 $\pm$ 59.60
p4	0.006096 $\pm$ 0.053002
p5	47.14 $\pm$ 147.27

STAR Gluon Helicity Measurements

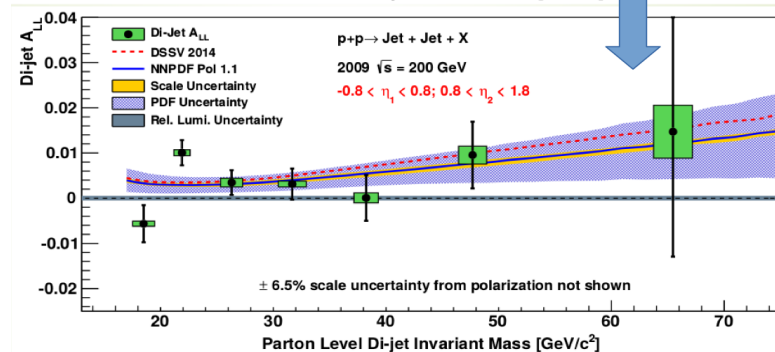
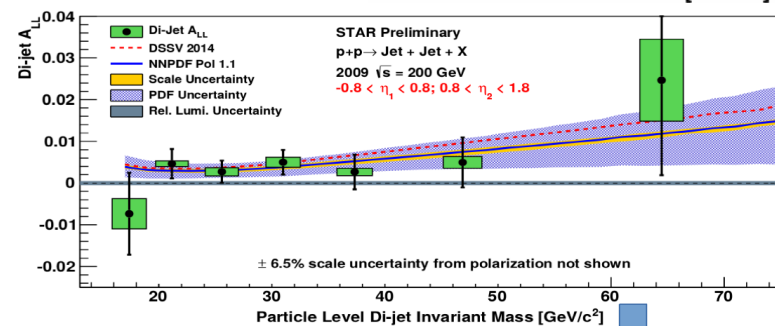
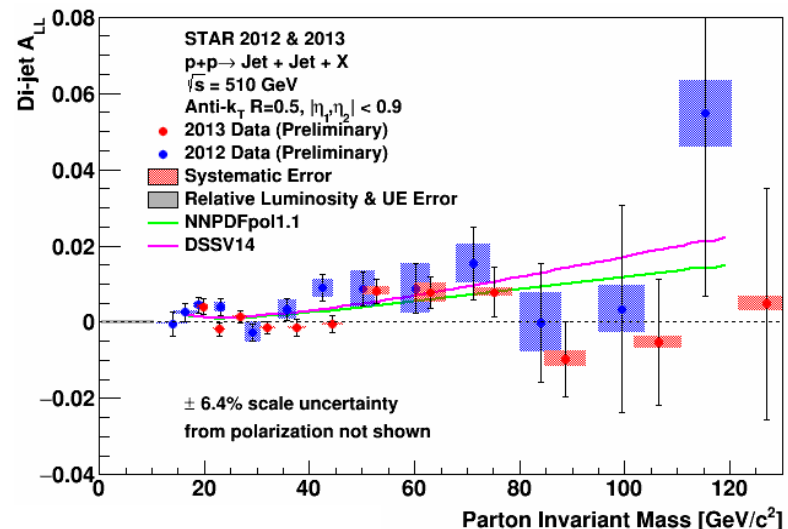
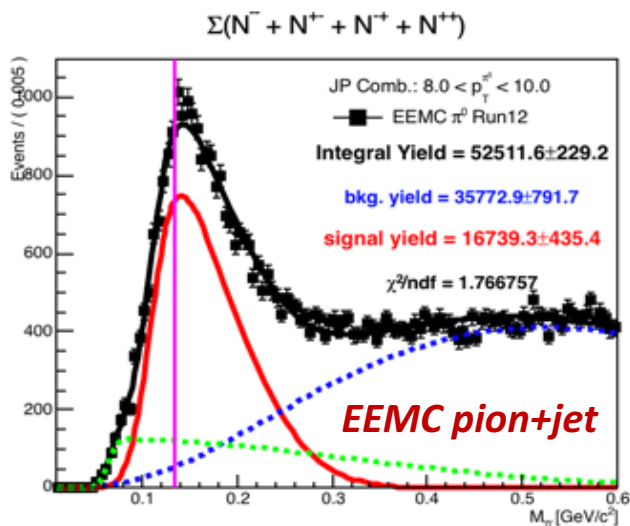
Correlation Probes

Dijets

- 2012 finalizing corrections/syst. wi/ full M.C.; trigger bias study underway; final this summer
- 2013 near preliminary; wrapping up systematics and note for release (target Users' Mtg & EPS)
- 2009 EEMC trig/reco bias + U.E. complete; final results, soon

EEMC Pion-jet

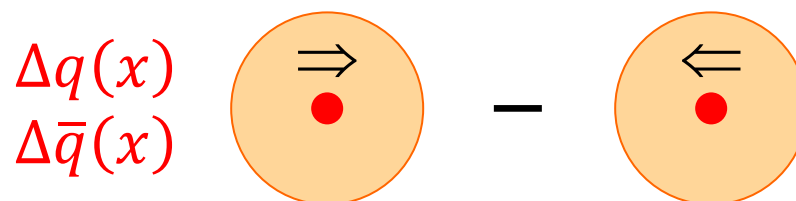
- 2012 trees reproduced; major task is the B.G. correction; target results by end of summer



STAR Sea-quark Helicity Measurements

Consider proton moving right

Proton spin-polarization $\Rightarrow$



$$A_L^{W^-} = \frac{N^+ - N^-}{N^+ + N^-} \propto \frac{-\Delta d(x_1)\bar{u}(x_2) + \Delta \bar{u}(x_1)d(x_2)}{d(x_1)\bar{u}(x_2) + \bar{u}(x_1)d(x_2)}$$

e.g. for W^- production

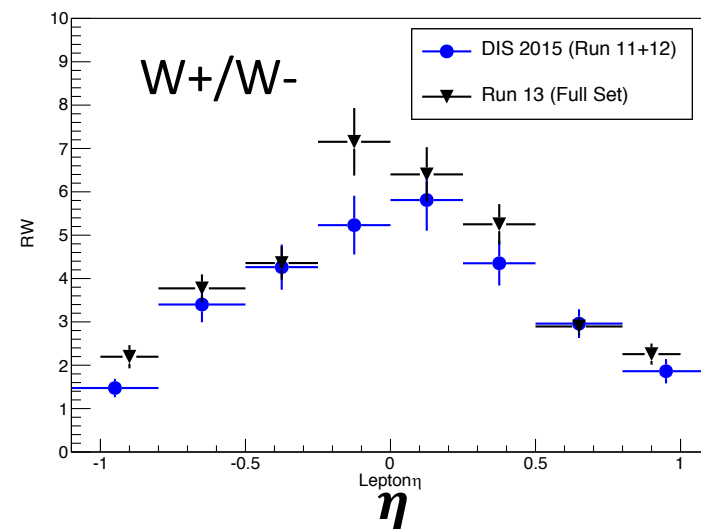
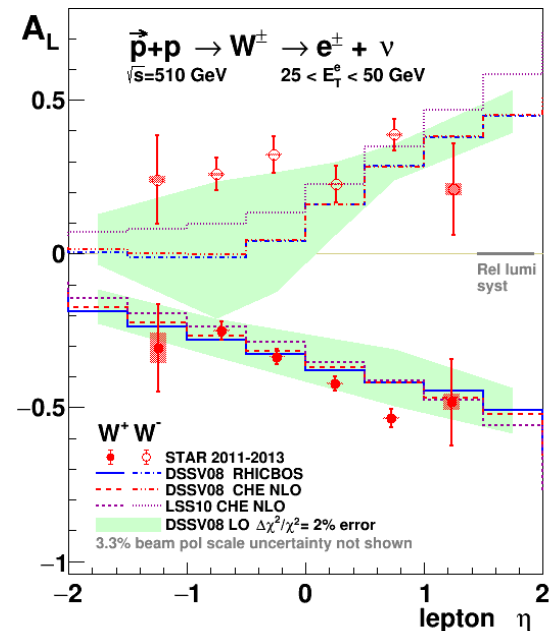
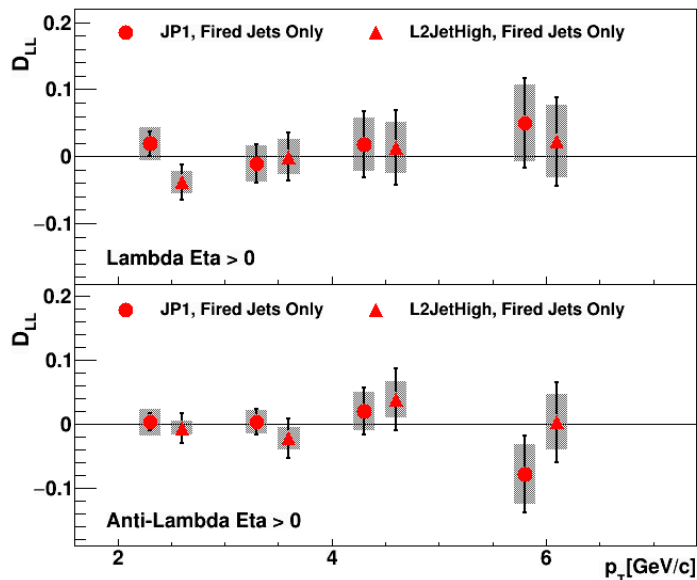
STAR Sea-quark Helicity Measurements

u-bar/d-bar

- 2013 A_L updated cuts and corrections, e.g. wrong charge-sign correction; preparing paper proposal
- 2013 x-sec ratio updating analyses wi/ new production (e.g. StiCA and new geometry); new BEMC gains; updating systematics studies

strange

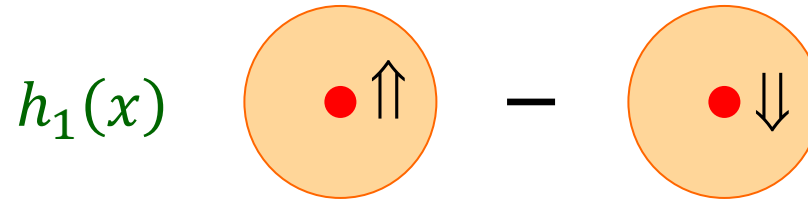
- 2009 Lambda D_{LL} : new M.C. analysis; updated trigger bias, propagating to updated systematics; preparing documentation for final results/paper



STAR Transverse Measurements

Consider proton moving right

Proton spin-polarization $\Uparrow$



$$A_{UT}^{\pi^+\pi^-} \sin(\phi_{RS}) = \frac{N^\uparrow(\phi_{RS}) - N^\downarrow(\phi_{RS})}{N^\uparrow(\phi_{RS}) + N^\downarrow(\phi_{RS})} \propto \frac{h_1(x_1)f(x_2)H^\times(z)}{f(x_1)f(x_2)D(z)} \hat{d}_{TT}$$

e.g. charged-pion IFF

STAR Transverse Measurements

Transversity

Collins (jet+pion)

- 2012 background correction, kinematic shifts, trigger bias updated; approaching final Lambda D_{TT}
- 2012 new M.C. analysis; updated trigger bias, propagating to updated systematics; preparing documentation for final results/paper

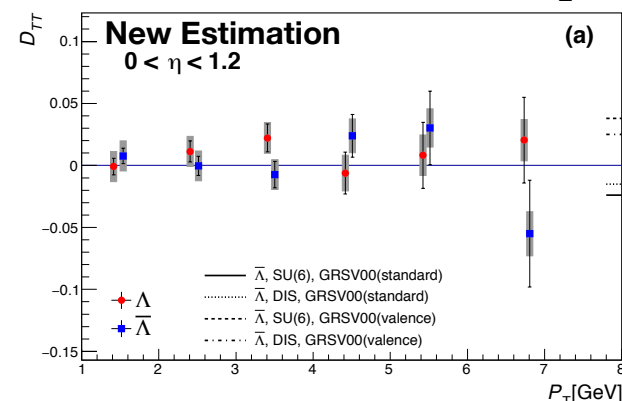
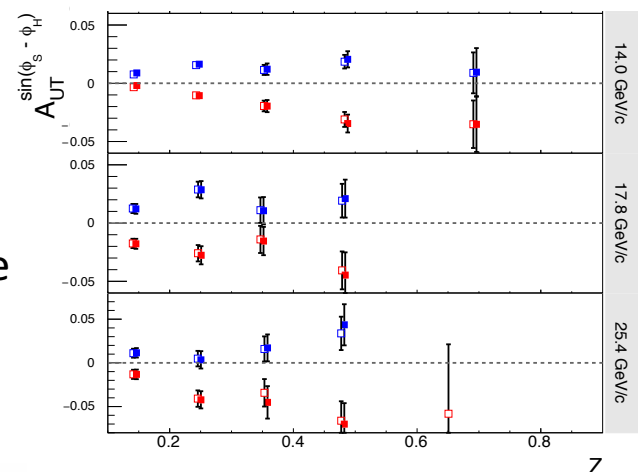
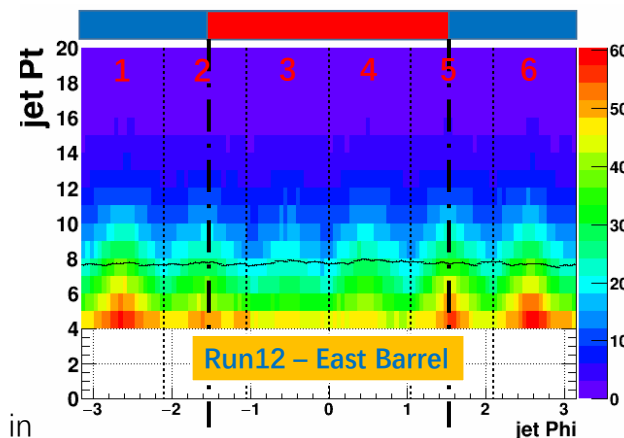
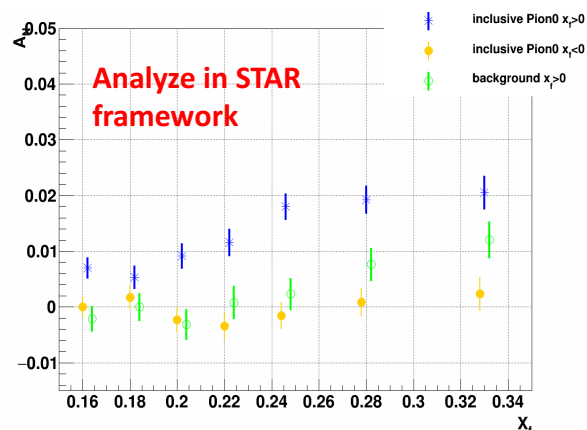
Sivers

Dijet

- 2012 analysis uses p_T imbalance technique; investigating measurement options, e.g. cross-ratio to cancel acceptance

Forward

- 2011 A_N reproduced; integrated into STAR framework; new photon shower shape; further work on M.C. and Collins



Summary

- **Papers published since August 2016 meeting (1)**
 - 2009 Dijet A_{LL} [PRD 95, 071103(R) (2017)]
- **Papers in GPC (2)**
 - 2011 500 GeV Charged Pion IFF
 - 2011 500 GeV inclusive jet & jet + $\pi^\pm$ A_{UT}
- **Preliminary results since August 2016 meeting (4)**
 - 2013 510 GeV BEMC $W^\pm$ A_L
 - 2013 510 GeV EEMC $W^\pm$ A_L
 - 2009 200 GeV EEMC Dijet A_{LL}
 - 2012 200 GeV Lambda Polarization Transfer
- **Updates presented, this week (20 talks + EMC workshop)**