Run 13 W-Boson A_L measurement at mid-rapidity in 510GeV p+p collisions

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On behalf of the
W/Z Analysis Group

Outline

- Motivation
- W Production
- Run 13 Analysis
  - Data sample in 2013
  - Overview of planned selection cuts
  - Projection plot for A_L
  - Organization
  - Task List
  - Goals of Run 13
- Run QA
- TPC calibration status
- Summary / Outlook / Plans

Motivation

Proton's Spin Puzzle

$$\langle S_p \rangle = \frac{1}{2} = \frac{1}{2}\Delta\Sigma + L_q + \Delta G + L_g \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$
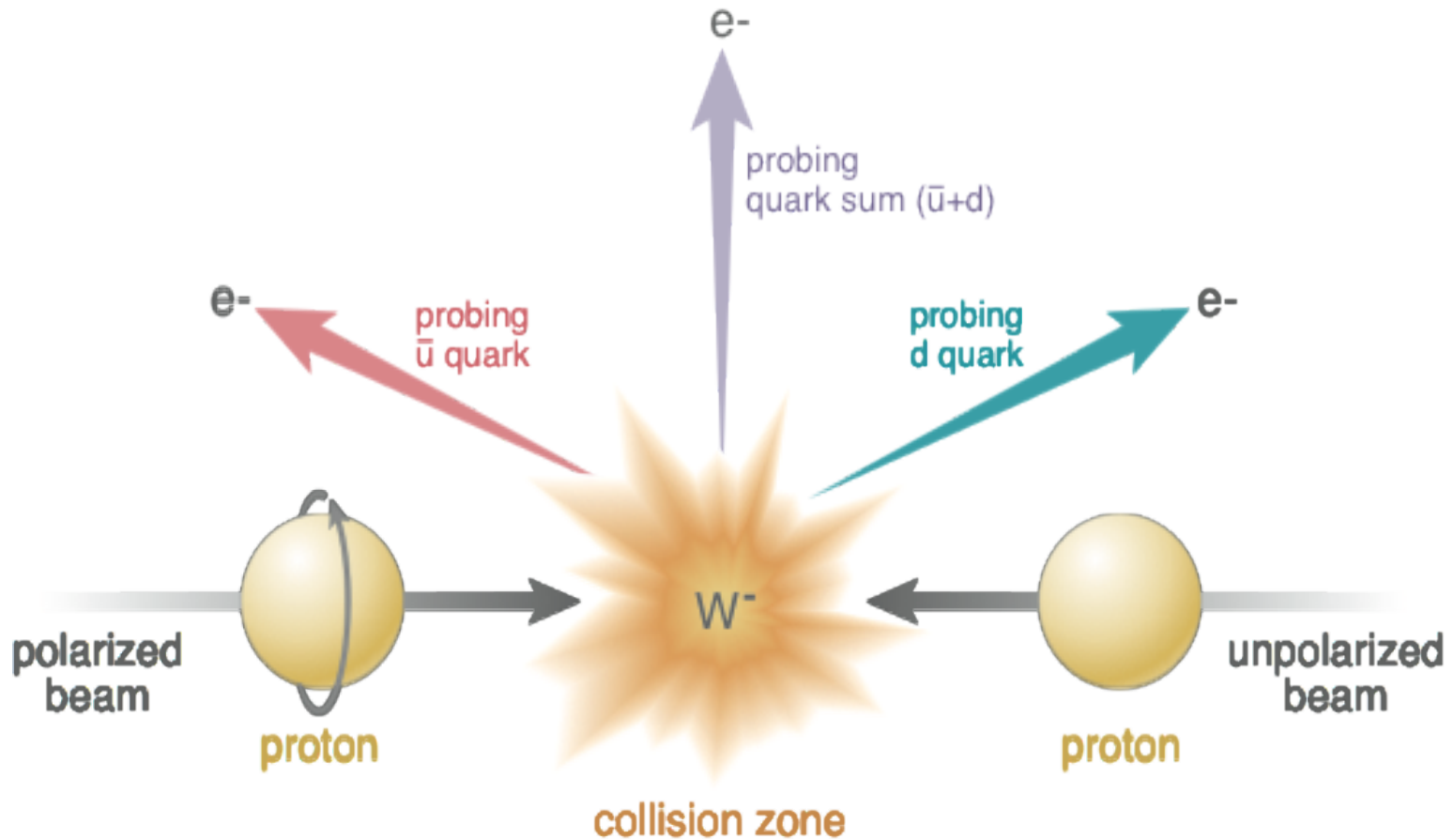
$$\Delta\Sigma \equiv \int dx(\Delta u(x) + \Delta\bar{u}(x) + \Delta d(x) + \Delta\bar{d}(x) + \Delta s(x) + \Delta\bar{s}(x))\ldots(2)$$

- Sum of the quark spin contribution is well constrained.

- Relatively large uncertainty of flavor separated antiquark(sea) contribution.

- A_L of W at STAR is directly related to the antiquark helicity distribution.

W production

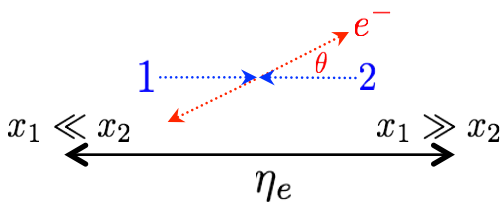Unique new way to probe the quark flavor structure using W boson production:
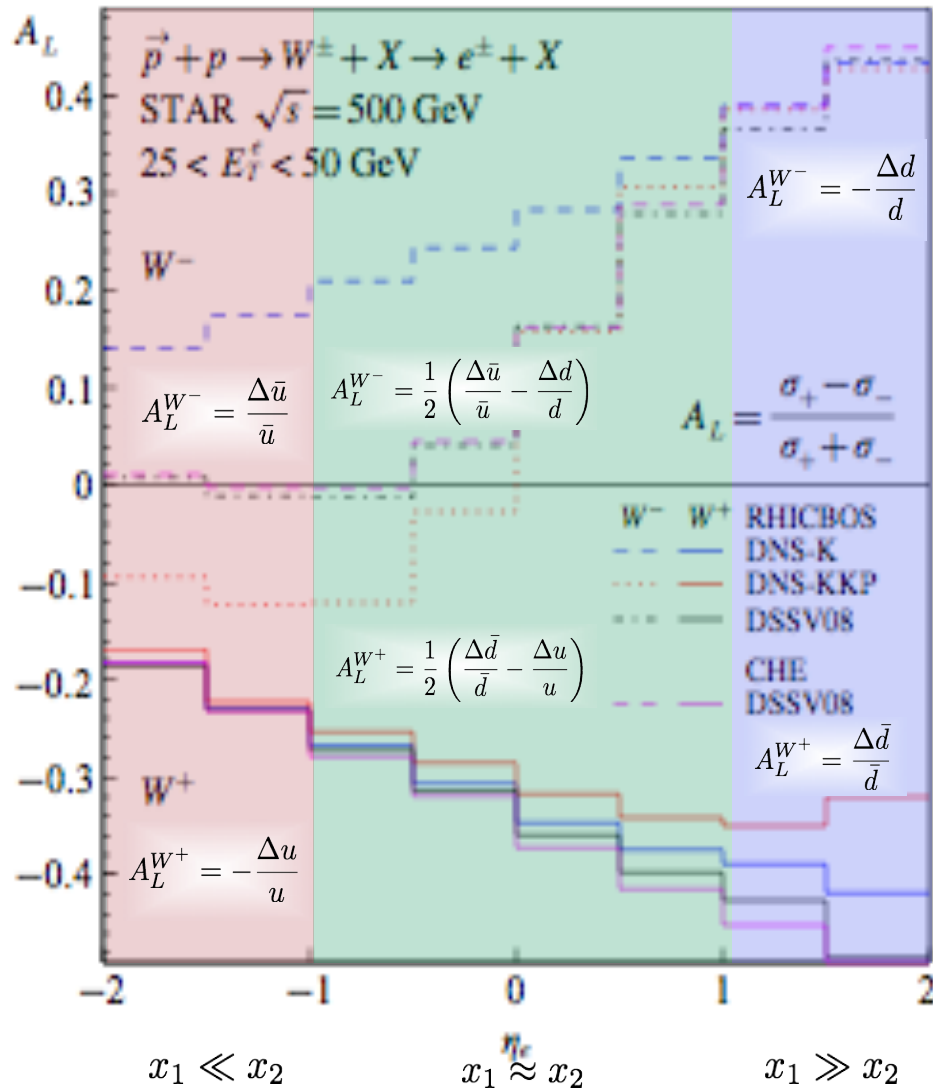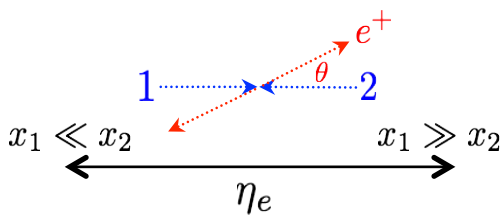
Probing the quark flavor structure

$$A_L^{e^-} \approx \frac{\int_{\otimes(x1,x2)} [\Delta\bar{u}(x_1)d(x_2)(1-\cos\theta)^2 - \Delta d(x_1)\bar{u}(x_2)(1+\cos\theta)^2]}{\int_{\otimes(x1,x2)} [\bar{u}(x_1)d(x_2)(1-\cos\theta)^2 + d(x_1)\bar{u}(x_2)(1+\cos\theta)^2]}$$

$x_1 \ll x_2 \qquad x_1 \gg x_2$

η_e

$$A_L^{e^+} \approx \frac{\int_{\otimes(x1,x2)} [\Delta\bar{d}(x_1)u(x_2)(1+\cos\theta)^2 - \Delta u(x_1)\bar{d}(x_2)(1-\cos\theta)^2]}{\int_{\otimes(x1,x2)} [\bar{d}(x_1)u(x_2)(1+\cos\theta)^2 + u(x_1)\bar{d}(x_2)(1-\cos\theta)^2]}$$
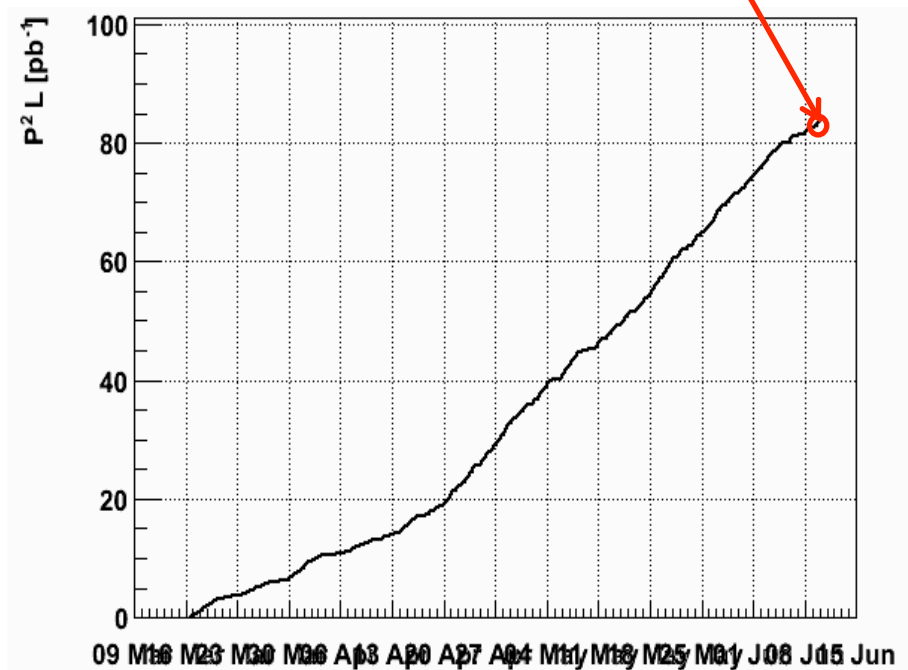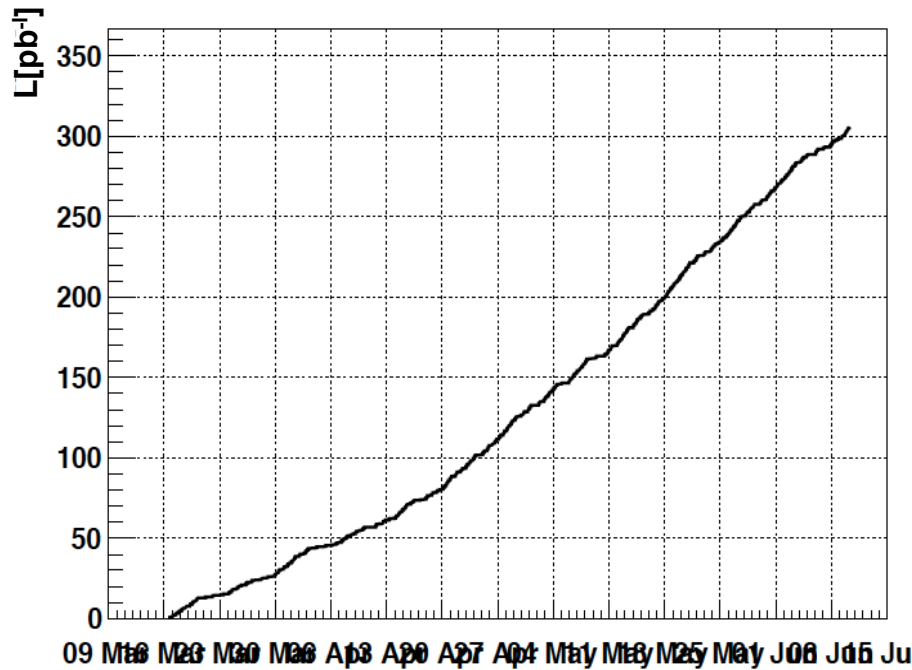
$x_1 \ll x_2 \qquad x_1 \gg x_2$

η_e

A_L

$\vec{p} + p \rightarrow W^{\pm} + X \rightarrow e^{\pm} + X$

STAR $\sqrt{s} = 500$ GeV

$25 < E_T^e < 50$ GeV

W^-

$A_L^{W^-} = -\dfrac{\Delta d}{d}$

$A_L^{W^-} = \dfrac{\Delta\bar{u}}{\bar{u}}$

$A_L^{W^-} = \dfrac{1}{2}\left(\dfrac{\Delta\bar{u}}{\bar{u}} - \dfrac{\Delta d}{d}\right)$

$A_L = \dfrac{\sigma_+ - \sigma_-}{\sigma_+ + \sigma_-}$

	W^-	W^+	RHICBOS
	-- --	——	DNS-K
	······	——	DNS-KKP
	-·-·	——	DSSV08
	-- --	——	CHE DSSV08

$A_L^{W^+} = \dfrac{1}{2}\left(\dfrac{\Delta\bar{d}}{\bar{d}} - \dfrac{\Delta u}{u}\right)$

$A_L^{W^+} = \dfrac{\Delta\bar{d}}{\bar{d}}$

W^+

$A_L^{W^+} = -\dfrac{\Delta u}{u}$

η_e

$x_1 \ll x_2 \qquad\qquad x_1 \approx x_2 \qquad\qquad x_1 \gg x_2$

Run-13 Data sample

	L (pb⁻¹)	P	P²L (pb⁻¹)
Run 9	12	0.40	1.9
Run 12	72	0.56	22.6

FOM Run 13 (Mid-rapidity W trigger BHT3): ~ 85pb⁻¹
Goal for Run 13: ~50pb⁻¹

Run-13 Analysis

❑Overview of planned selection cuts

- Trigger
  - BHT3 level-0 , $E_T > 7.3$GeV
  - L2W seed tower $E_T > 5$Gev
  - L2W E_T sum>13GeV

- TPC vertex ranking > 0

- Identifying $e^{+/-}$ candidates – Planned cuts:
  - Track quality cuts
    - minimum of 15 TPC points
    - more than 51% of the maximum number of TPC points
    - the radius of the track hit nearest to the beam line < 90 cm
    - the radius of the track hit farthest from the beam line > 160 cm
    - primary track have pT > 10 GeV/c
  - Track and Cluster Matching cuts
    - cluster $E^e_T > 15$ GeV
    - distance between extrapolated track and centroid of tower cluster $|\Delta r| < 7$ cm

Run-13 Analysis

- Isolation cuts

$$E_T^e / E_T^{4x4} > 0.95$$
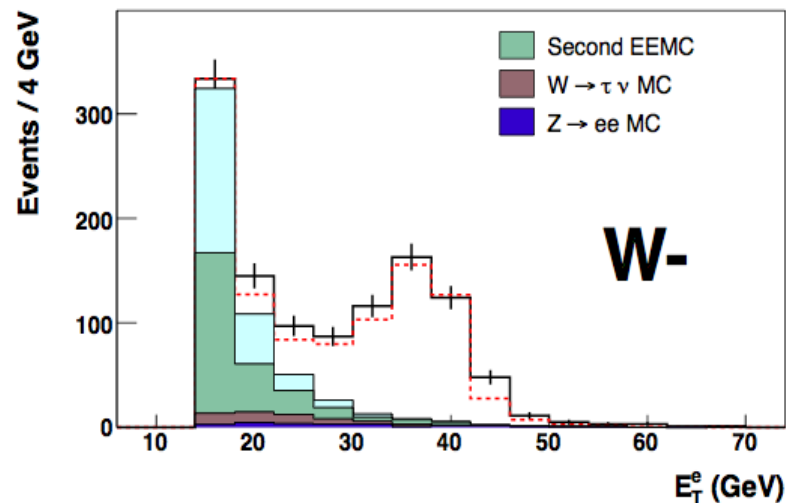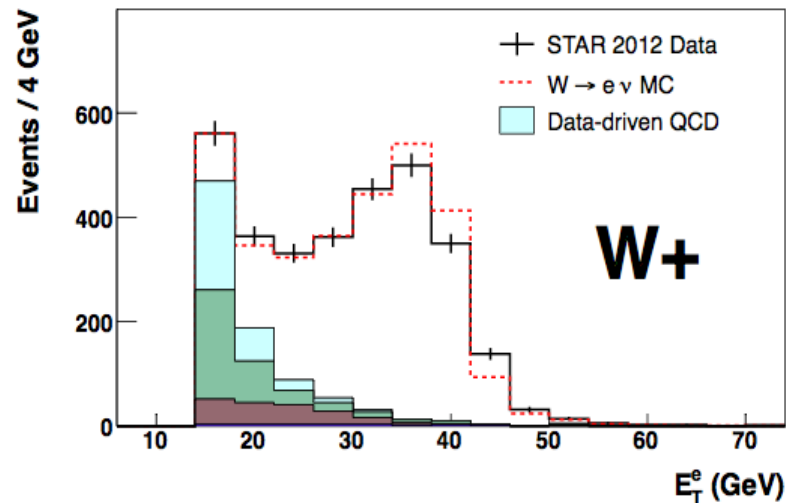
$$E_T^e / E_T^{\Delta R < 0.7} > 0.88$$

- W Candidate event selection
  - signed PT-balance >15 GeV/c

- Reduction of background by Cuts

  - Second EEMC
  - Data-driven QCD

  - $W \rightarrow \tau \nu$

  - $Z \rightarrow e^+ e^-$
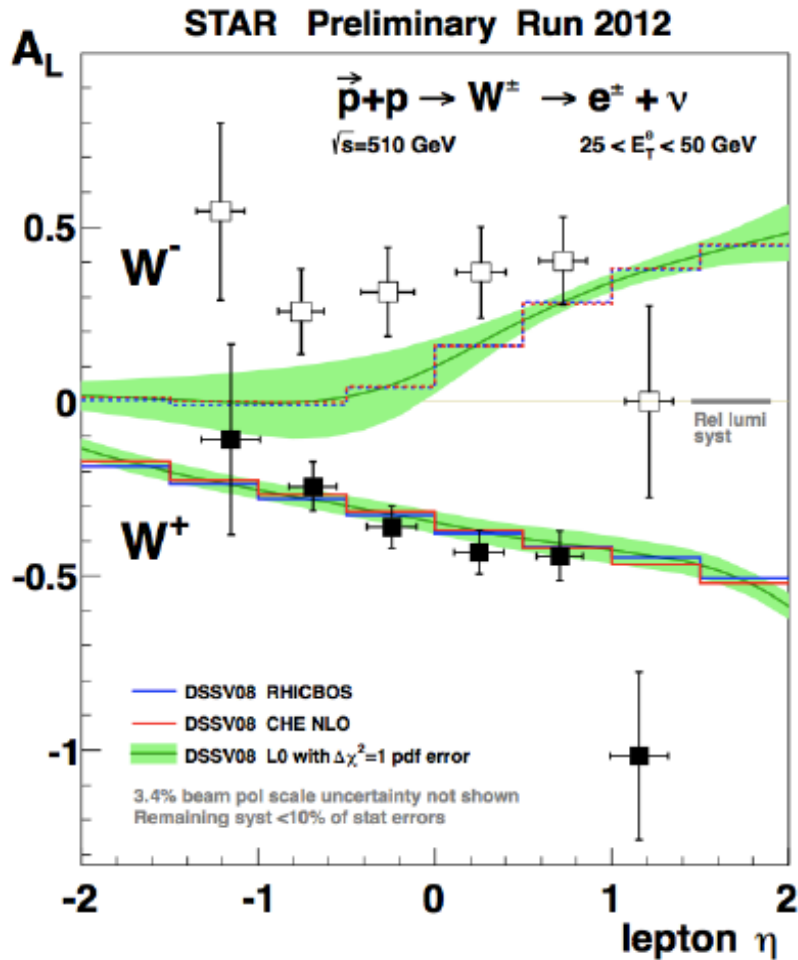
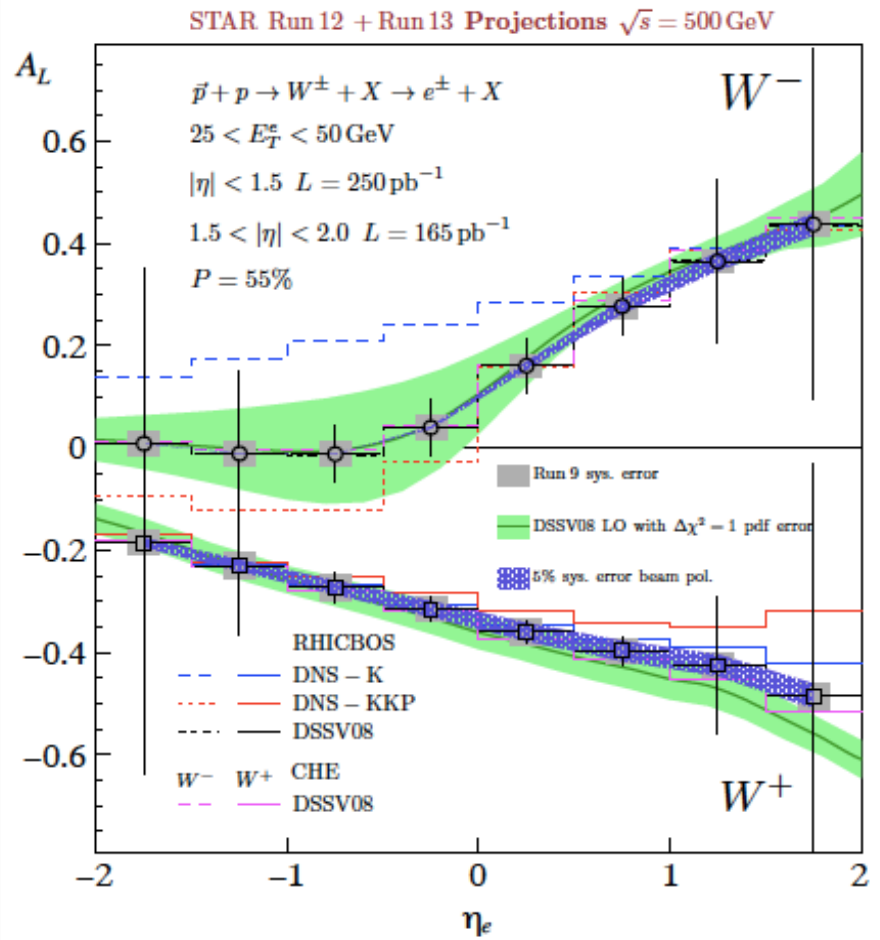*Mid-rapidity: STAR Background treatment / Signal distribution (Run 12)*

- Projection plot for A_L

(a)

(b)

Run-13 Analysis

- Organization

  - Weekly W/Z analysis meetings started, Monday, 02:00PM

  - Mailing list: (Same as previous W analysis meeting list)

  - WWW-page:
    https://drupal.star.bnl.gov/STAR/event/2013/07/15/w-2013-analysis-meeting

Run-13 Analysis

- ## Task list

  - Run QA 2013 (QA Team)
  - Pre-production (Gene)
  - Production and oversight (Gene / Devika)
  - Spin bits in 2013 DB (After muDST production) (?)
  - PPV vertex finding (Jinlong)
  - W/Z analysis code (Jinlong, Devika using existing code)
  - BEMC calibration (Alice / Danny)
  - EEMC calibration (Mike)
  - TPC calibration / Beam line constrain (Gene / Maxence)
  - Relative luminosity (?)
  - MC simulation (Devika)
  - Background treatment (Devika / Jinlong / Bernd)
  - Polarization (Bernd)
  - Theory (Bernd)
  - FGT tracking (Akio)

Run-13 Analysis

- Goals

  – $W^{+/-}$ A_L from Run 13 : Publication
    - Mid-rapidity (Run 12 type)
    - Forward rapidity (Incl. FGT)
  – $W^{+/-}$ cross-section ratio from Run 13 : Publication
    - Mid-rapidity
  – Combination of Run 12 / Run 13 W+/-

Run QA

- The run13 W analysis group plans to do a "standard runQA", similar to that described by Jim Sowinski. This is expected to begin shortly so a pre-production run can be requested soon for the run13 data.

- Some people involved with runQA are:

  - Danny O.   Devika G.   Jinlong Z.
  - Maxence V.   Xuan Li   Steven T.
  - Zilong C.   Qinghua Xu   Bernd S.
  - Hal S.

  - 10 people for ~14 weeks of running

Run QA

❑Task list

- Categorize all runs according to priority condition

  - – First priority runs
    - trgSetup:pp500_production_2013
    - detectors in: TPX, BTOW, BSMD, ETOW, ESMD,TOF
    - runs marked as "Successful" in the shift log
  - – Second priority runs
    - trgSetup: pp500_production_2013_noendcap
    - detectors in: TPX, BTOW, BSMD, TOF
    - runs marked as "Successful" in the shift log
  - – Third priority runs
    - All remaining pp500_production_2013 runs

- Use the script "loopMainAll.tcl" from Jim+Jan to produce above priority lists.(Already produced the First Priority Runs.: #s ~1840 with cutoff -3 min.)

Run QA

❑Task list cont..

- Use several sources to do QA(Clear instructions on how /what to use in following sources will document by Hal+Davika by next analysis meeting)

    - Shift log (check comments from shift crew and others)
    - Monitoring plots at http://online.star.bnl.gov/
    - runLog browser to check daq, trigger rates
    - J-Plots
    - Fgt info(FGT qa spraed sheets)

- Produce separate spread sheets for each person and start QA by the end of next week.

- Record results in the run list spreadsheet with comments (use status codes to fill "status")

TPC Calibration Status

- T0 & Twist (Time scale: Couple of days)

- Space Charge & Grid Leak (Time scale: Couple of weeks)

  - charge measured in the TPC as a function of luminosity

    - reduce variance in Q/p_T measure of $e^{+/-}$ candidates due to disconnect between luminosity measured and TPC distortions

  - GMT to help confirm the SC&GL calibration

    - SC&GL model to remove luminosity dependencies in Q/p_T reconstruction

  - after T0 & Twist are done start calibration

  - potential change of track reconstruction software for Run 13: **Sti** (current) => **Stv** (future)

Gene/Maxence

Summary/Outlook/Plans

- Start Run QA and prepare a golden list for pre production

- Test Justin's W reconstruction code for the preproduction and for the MC sample

- Measure W^+ and W^- asymmetries as a function of pseudorapidity.

- Develop FGT tracking algorithm and extend A_L measurements for backward / forward regions.

Thank you!