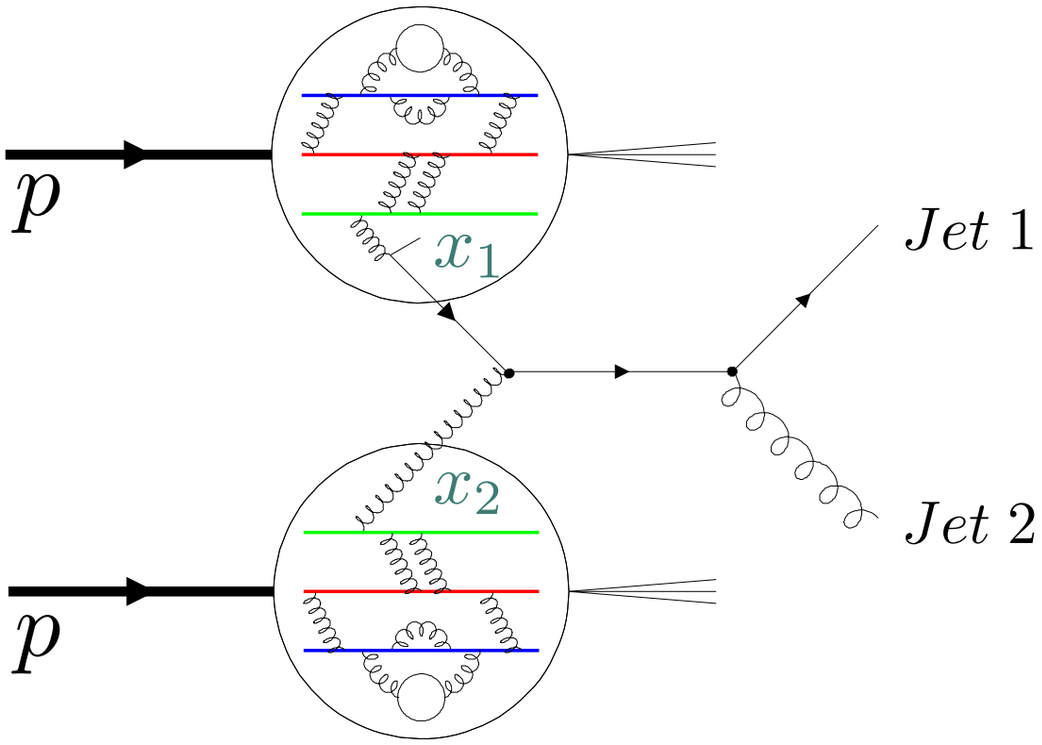
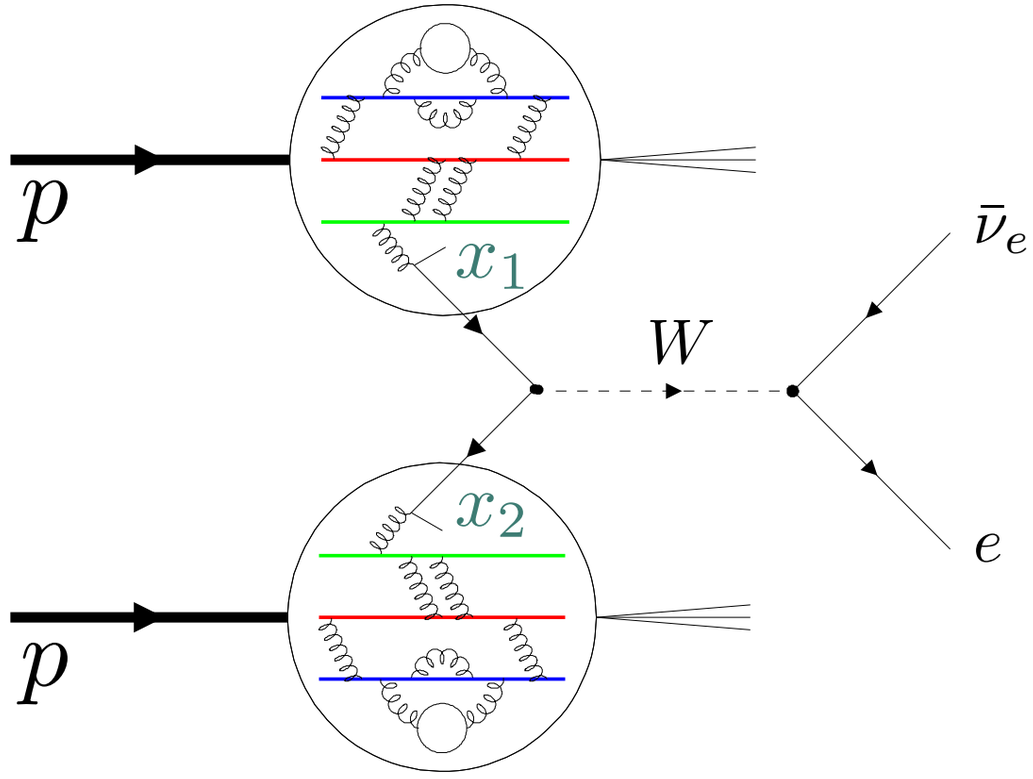
STAR Spin Plan for Run 11

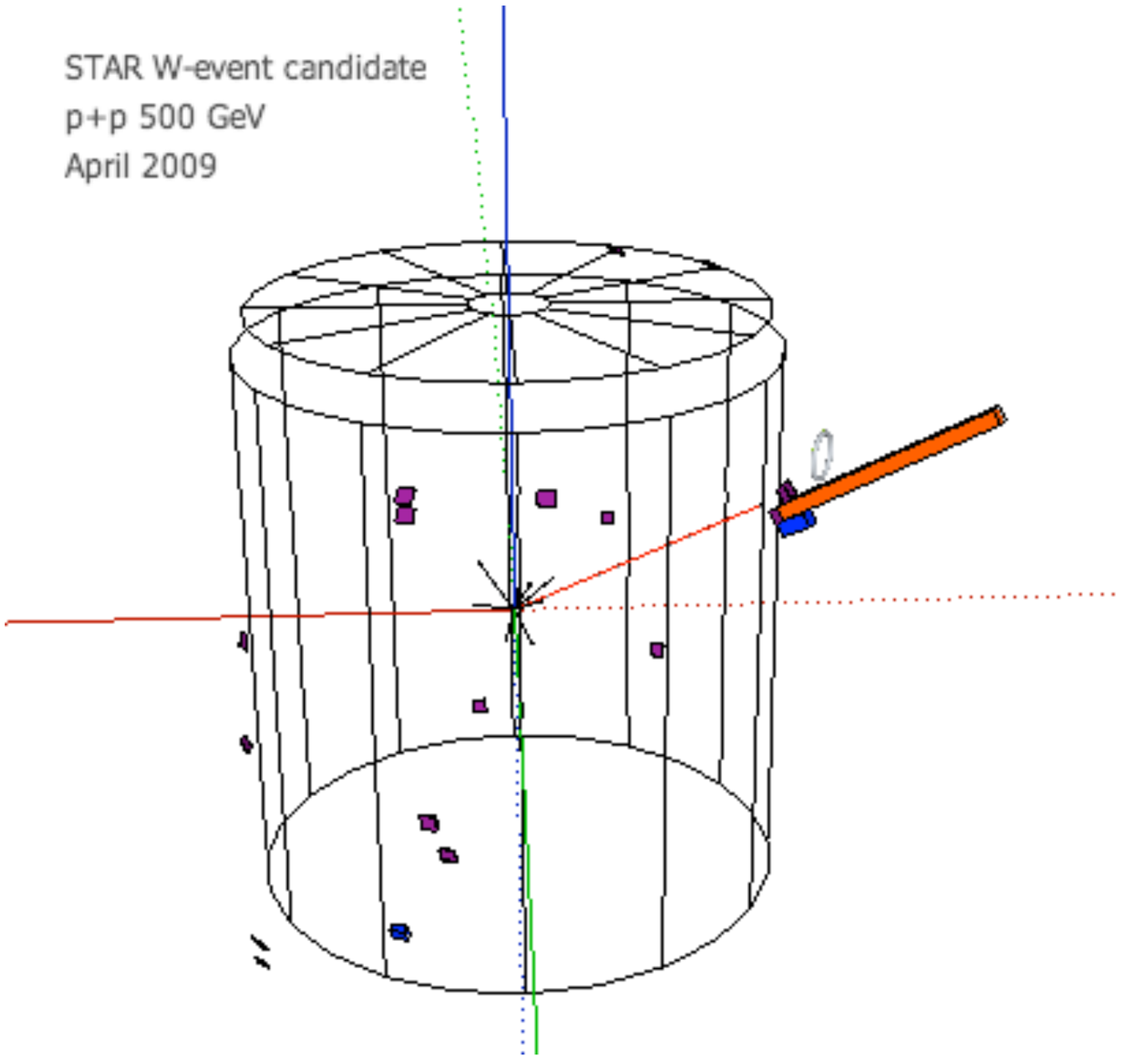


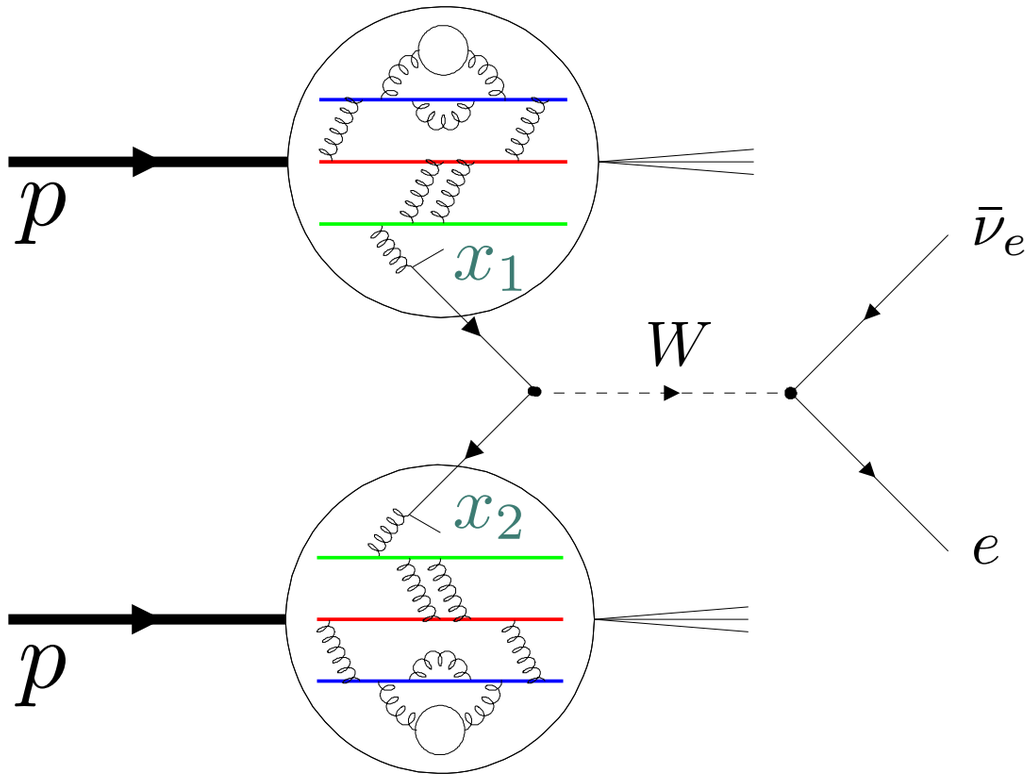


RSC Meeting, BNL
November 16, 2011

Jan Balewski (MIT)
for STAR Collaboration

STAR Spin Plan for Run 11





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STAR Physics Goals for Run 11

1) Spin Physics (500 GeV p+p, 9-10 weeks)

- $W^{\pm}$ A_L at mid-y ($P^2*L= 20\ pb^{-1}$)
- Light meson A_N at forward-y ($P^2*L= 4\ pb^{-1}$)
- Δg measurements at 500 GeV
- DPE and hadronic spin-flip amplitude**

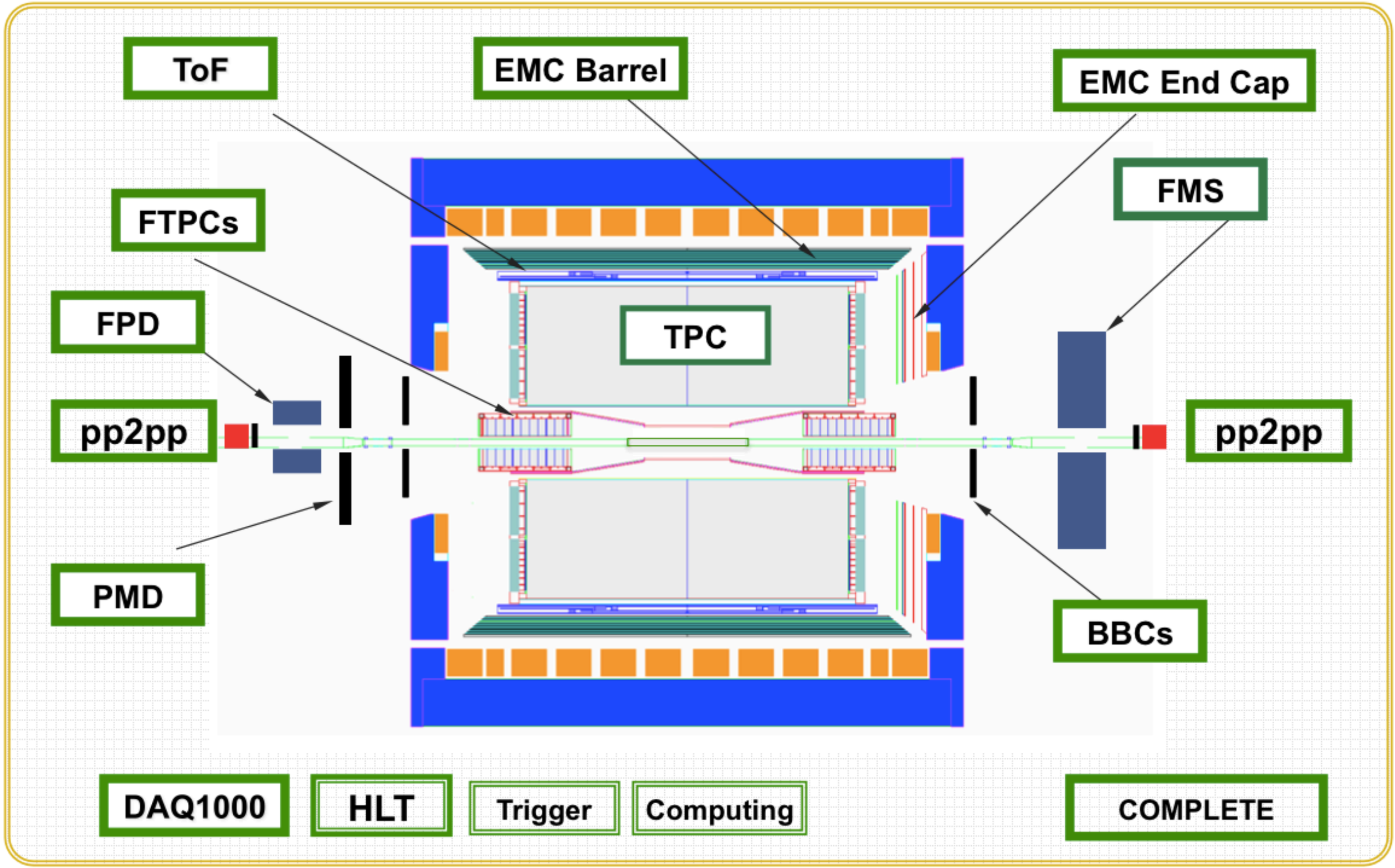
2) Heavy Ion Physics*

- High luminosity, low material 200 GeV AuAu collisions
  di-electron, J/psi, Y, rare particle search, …
- Complete phase-I BES at 18 and 27 GeV
- 193 GeV U+U collisions
  hydro limit, LPV, path length dependence

* Request a CA-D test to determine the lowest possible collision energy at RHIC

** Request complete the Run 9 spin physics goals at $\sqrt{s}$ = 200 GeV

STAR Detector in Run 11



STAR BUR for Run 11

Run	Beam Energy	Time	System	Goal
11	$\sqrt{s_{NN}}$ = 18, 27 GeV*	2 weeks	Au + Au	100, 150M minbias
	$\sqrt{s_{NN}}$ = 200 GeV	4 weeks	U + U	200M minbias 200M central
18 weeks	$\sqrt{s}$ = 500 GeV	5 weeks 6 weeks	$p_\uparrow p_\uparrow$ $p_\rightarrow p_\rightarrow$	trans. P^2*L= 4 pb^{-1} long. P^2*L= 20 pb^{-1}
		1 week	$p_\uparrow p_\uparrow$	pp2pp at high β*

Tentative Run Plan:

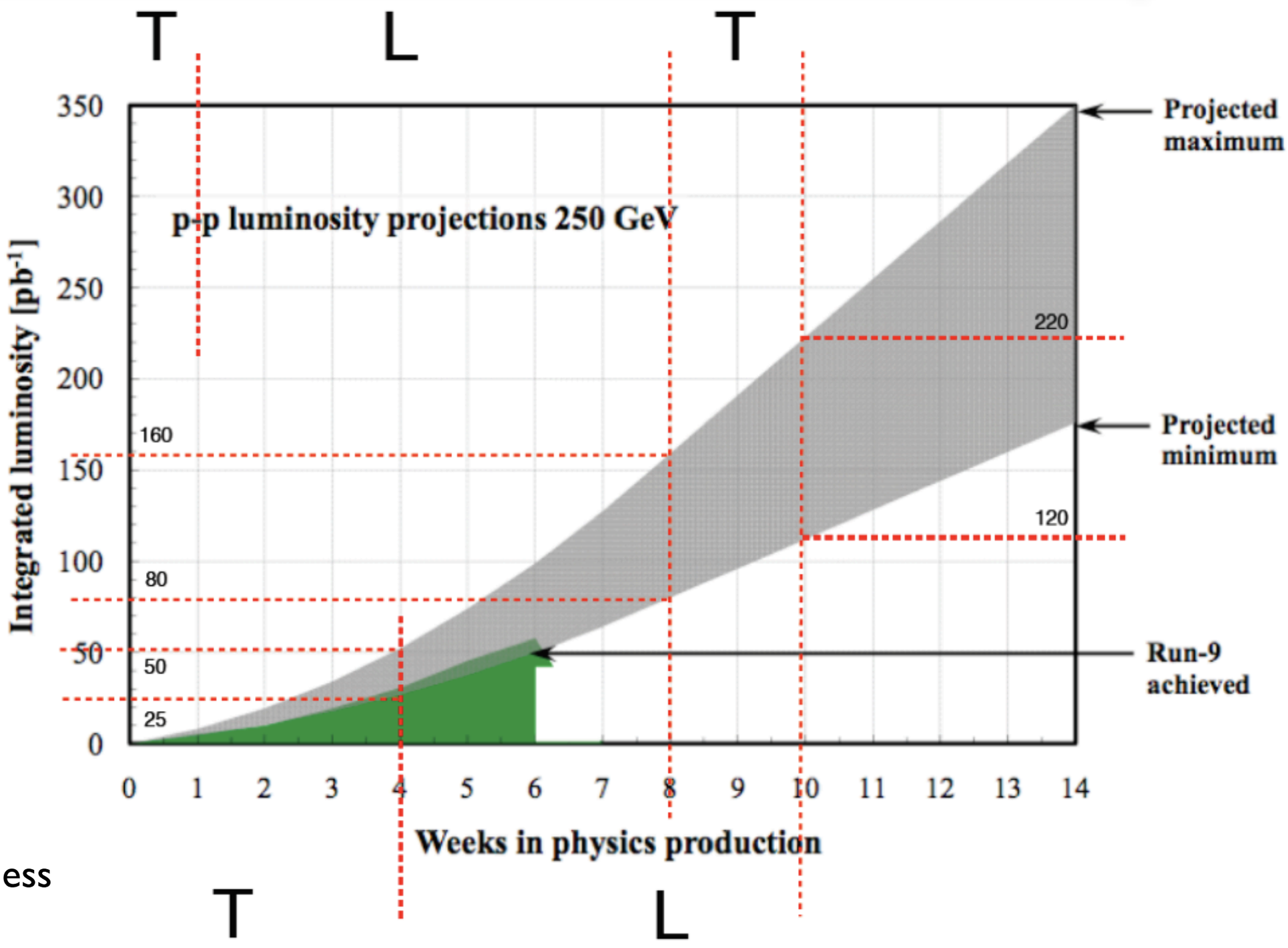
from Steve Vigdor

- 1.5 weeks cooldown/ warmup
- 3.5 weeks pp commissioning
- 10 weeks 500 GeV pp (includes 1-2 days with IP2 collisions)

If VTX ready for productive ops:
- *2 weeks Au+Au commissioning*

If VTX not ready for productive ops:
- *2 more weeks 500 GeV pp*

Spin Polarization Sequence: TL or TLT



Criteria
* FMS trigger readiness
* is P large enough

Transverse Spin: **$L*p^2=4\ pb^{-1}$**
FMS , π^0 and jets
First 4 weeks

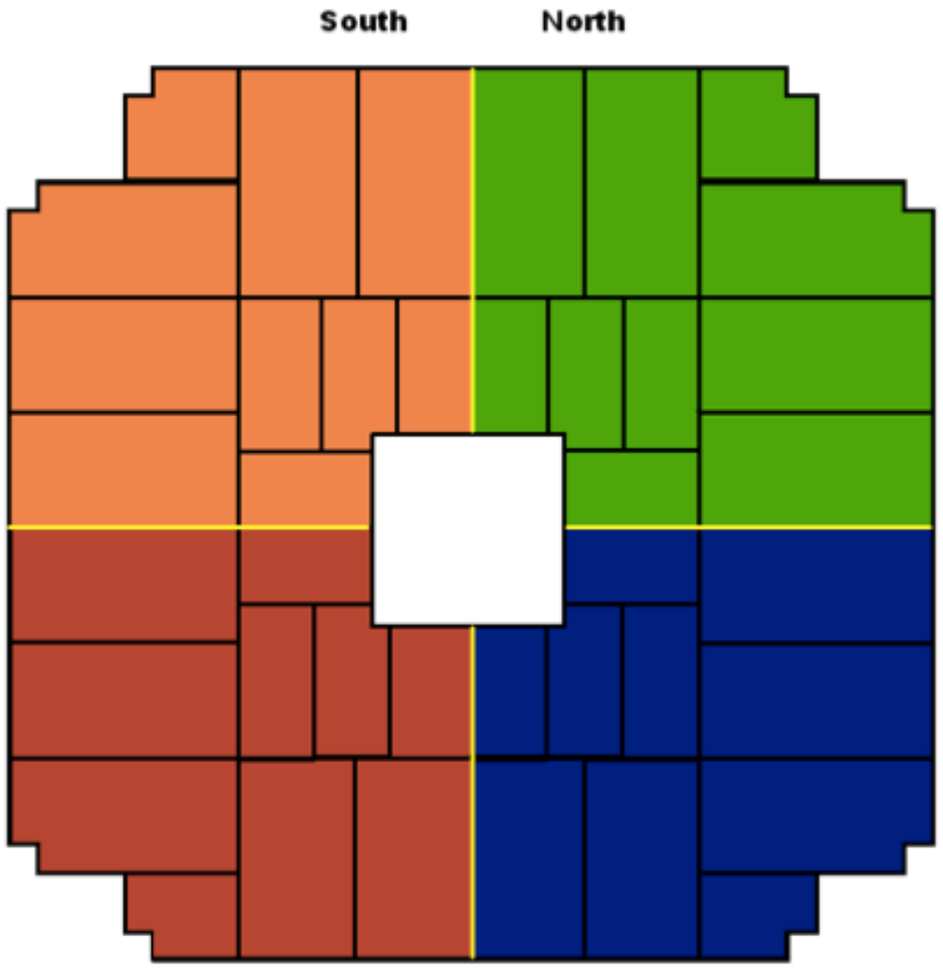
Long. Spin: **$L*p^2 = 20\ pb^{-1}$**
$W^{\pm}$, jets at midrapidity
last 6 weeks

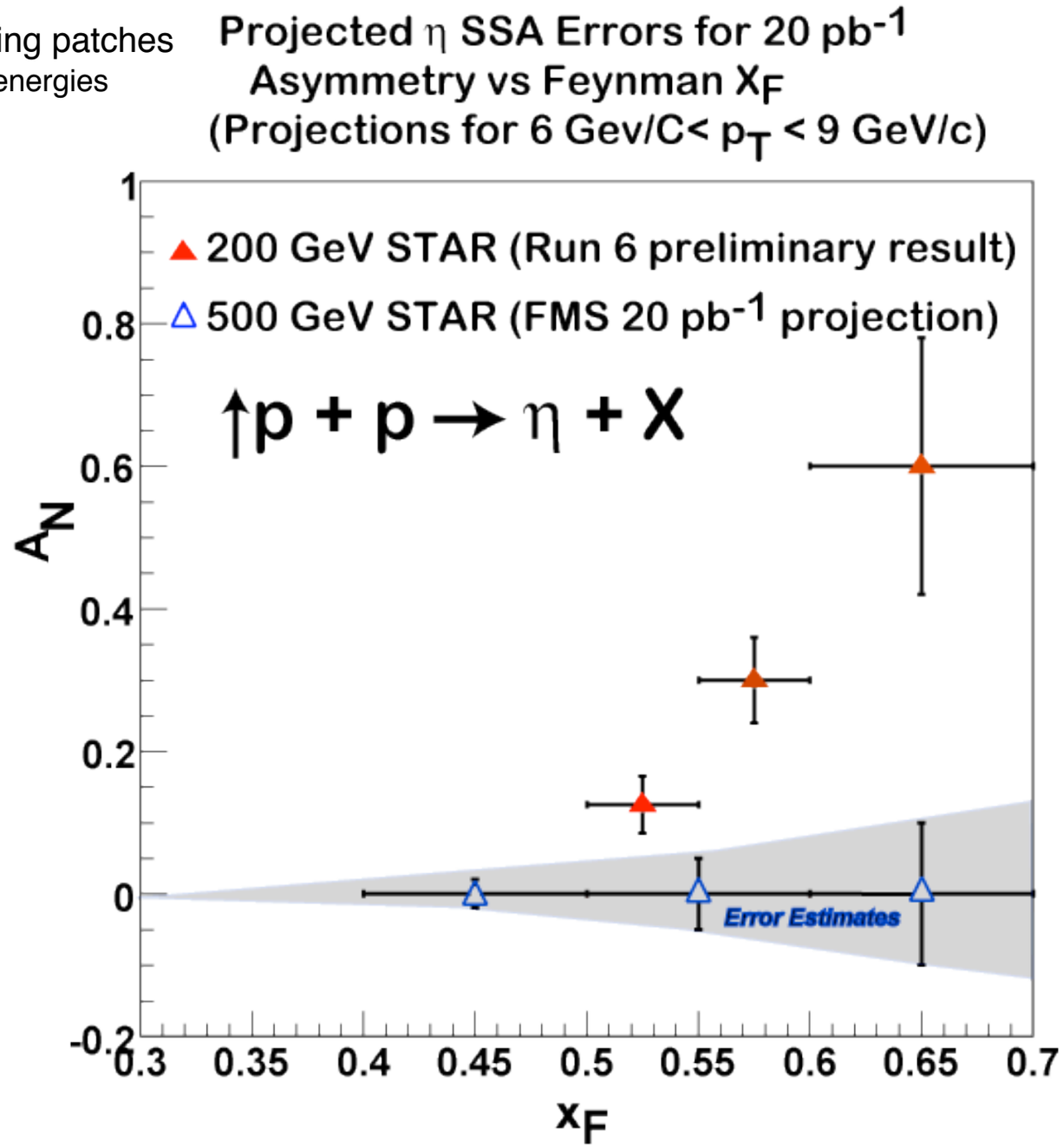
$\Rightarrow L*p^4=4\ pb^{-1}$

Forward Meson Spectrometer

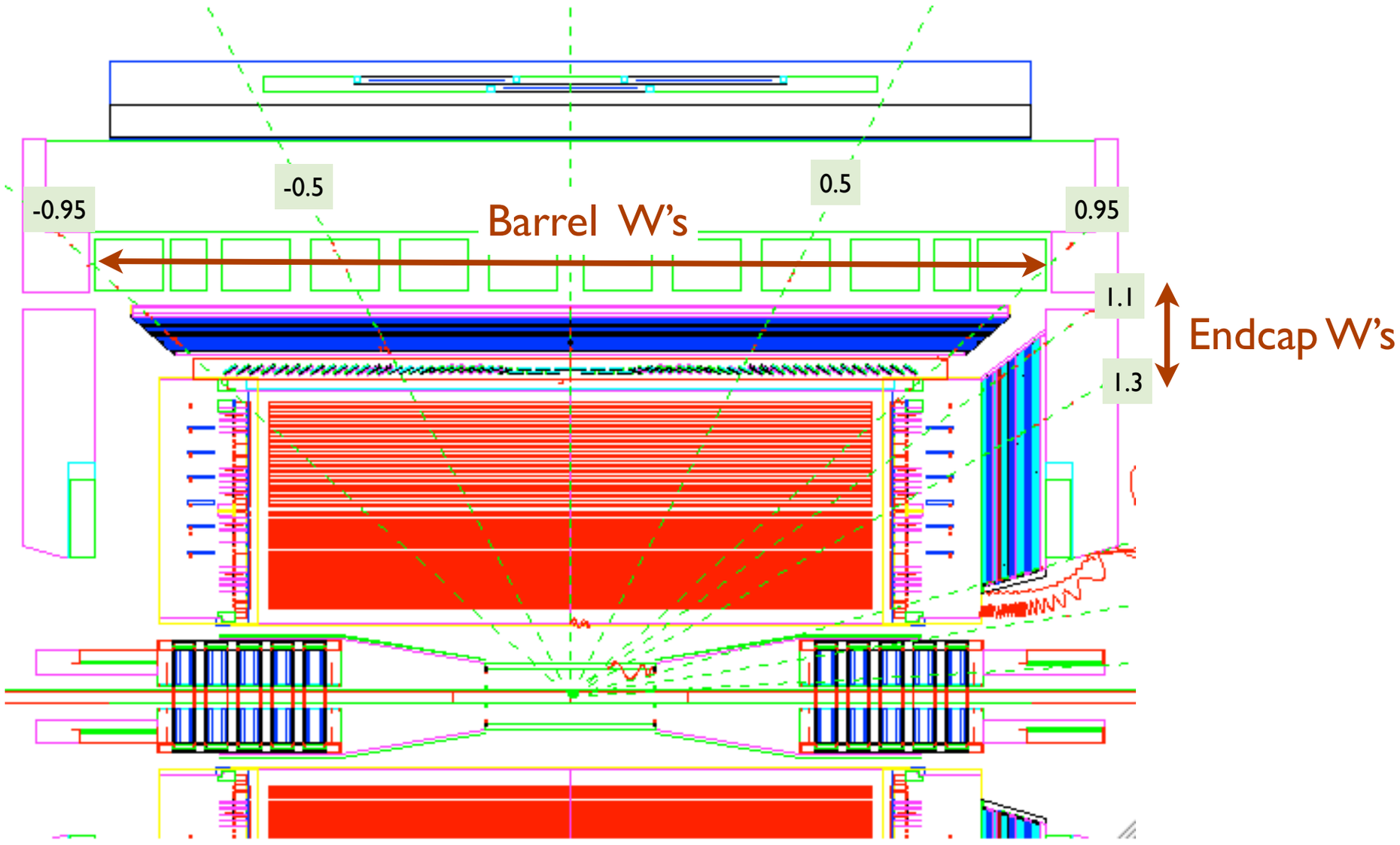
Origin of large A_N for forward mesons
- Collins vs. Sivers
- sensitivity to quark angular momentum?

TRIGGER:
4 jet patches (JP), each covering ~90^0 in azimuth
Board sum (BSum) triggers - compensates absence of overlapping patches
Provide efficiency for "inclusive … meson" measurements at lower energies
Possible di-jet and J/ψ trigger (two non-adjacent JP0 patches)
High tower - diagnostic/calibration





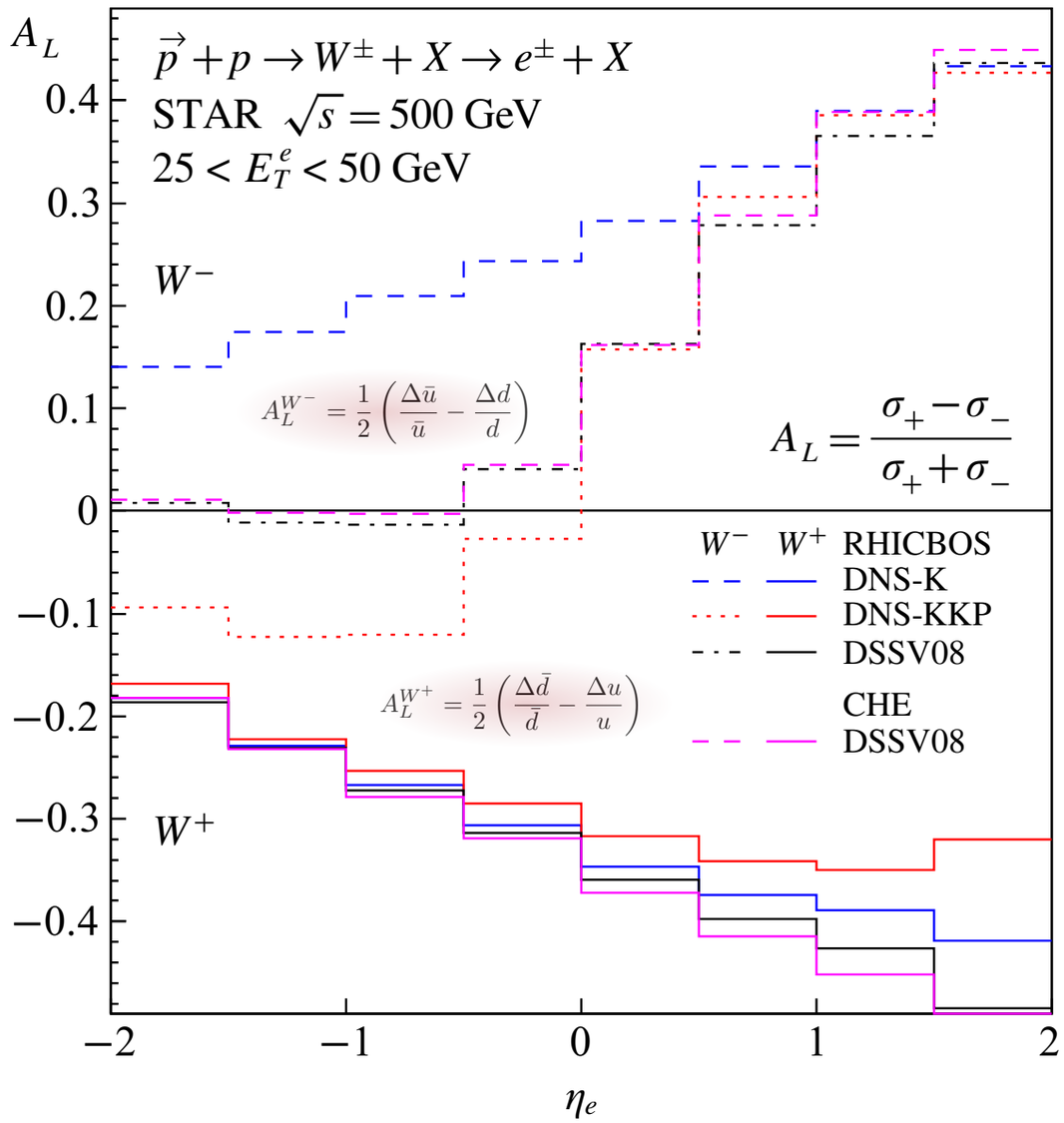
W's in Run 11 : more LT and wider η



pp500	W+	W-
Pythia x-sect (pb)	93	29
ET>25	68	21
ET & $\|\eta\|$ <0.5	36	6.6
ET & $\|\eta\| \in [0.5,1]$	20	3.2
ET & $\eta \in [1.1,1.3]$	1.5	0.98

W A_L

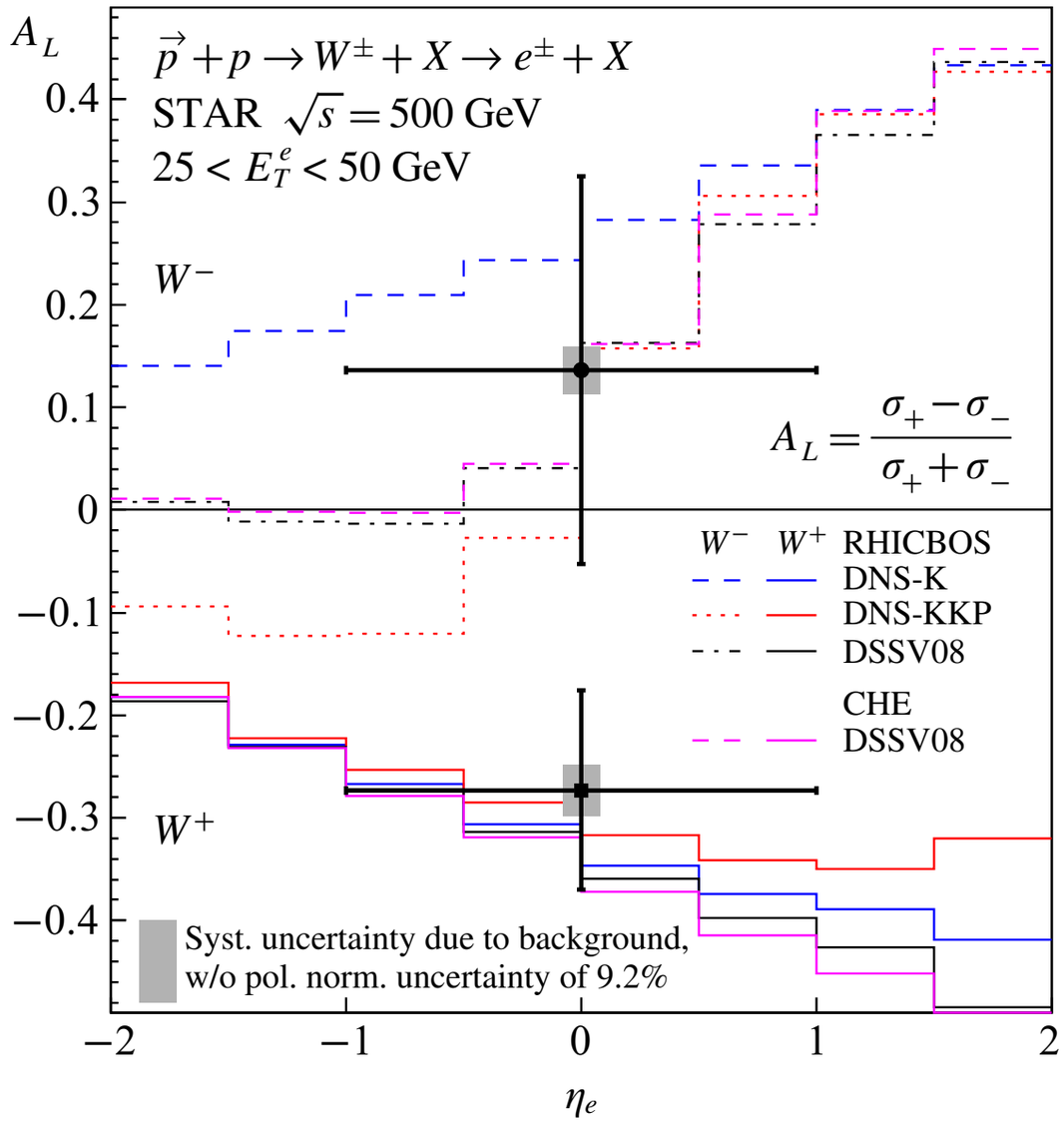
pre Run 9



lepton |η|<1: 2 beams, eff=0.65 w/ 9MHz RF, Run9 QCD bckg, rhicbos σW⁺,W⁻=82, 19 pb

W A_L

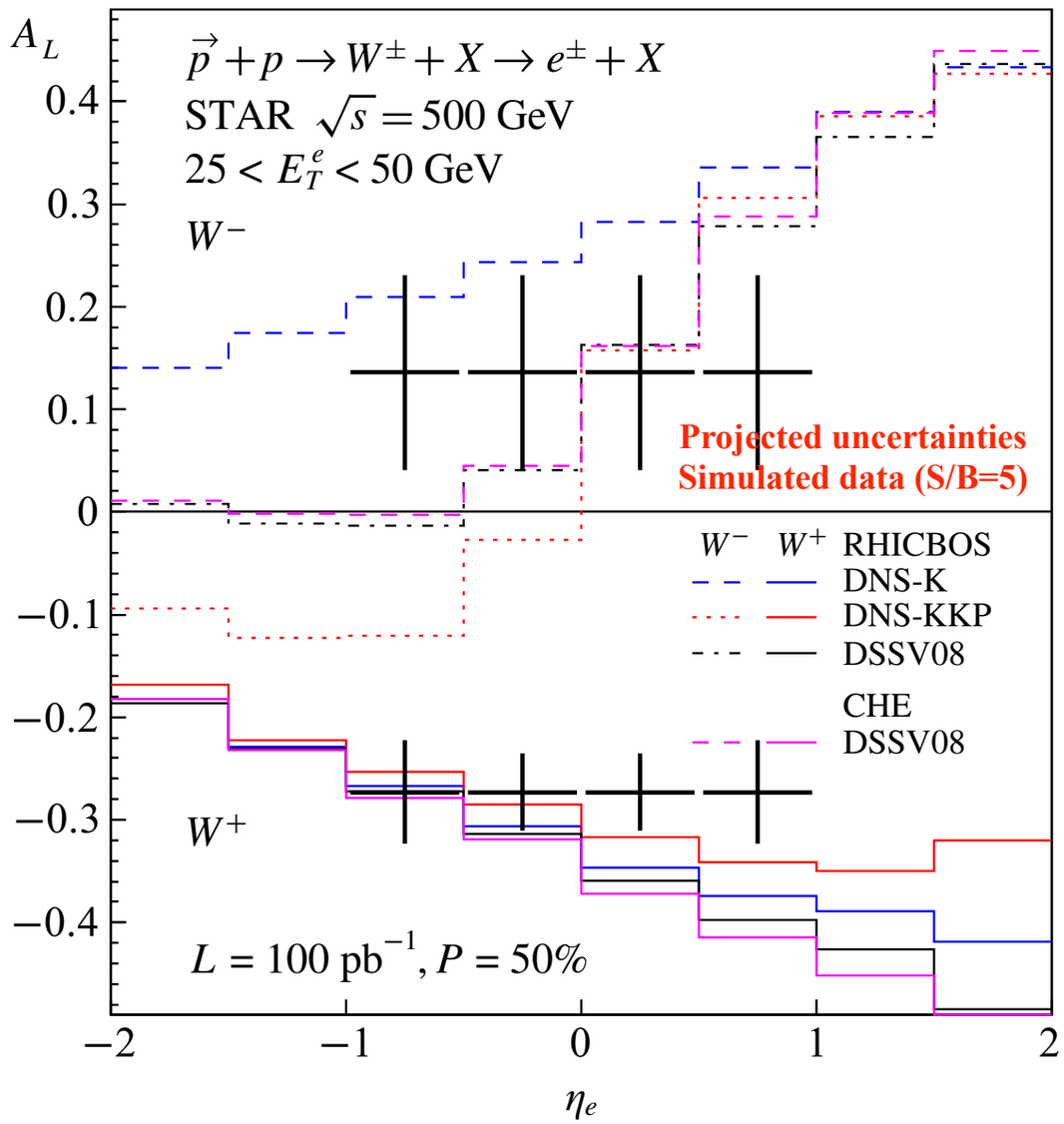
STAR Run 9 achieved



lepton $|\eta|<1$: 2 beams, eff=0.65 w/ 9MHz RF, Run9 QCD bckg, rhicbos $\sigma W^+, W^-$=82, 19 pb

W A_L

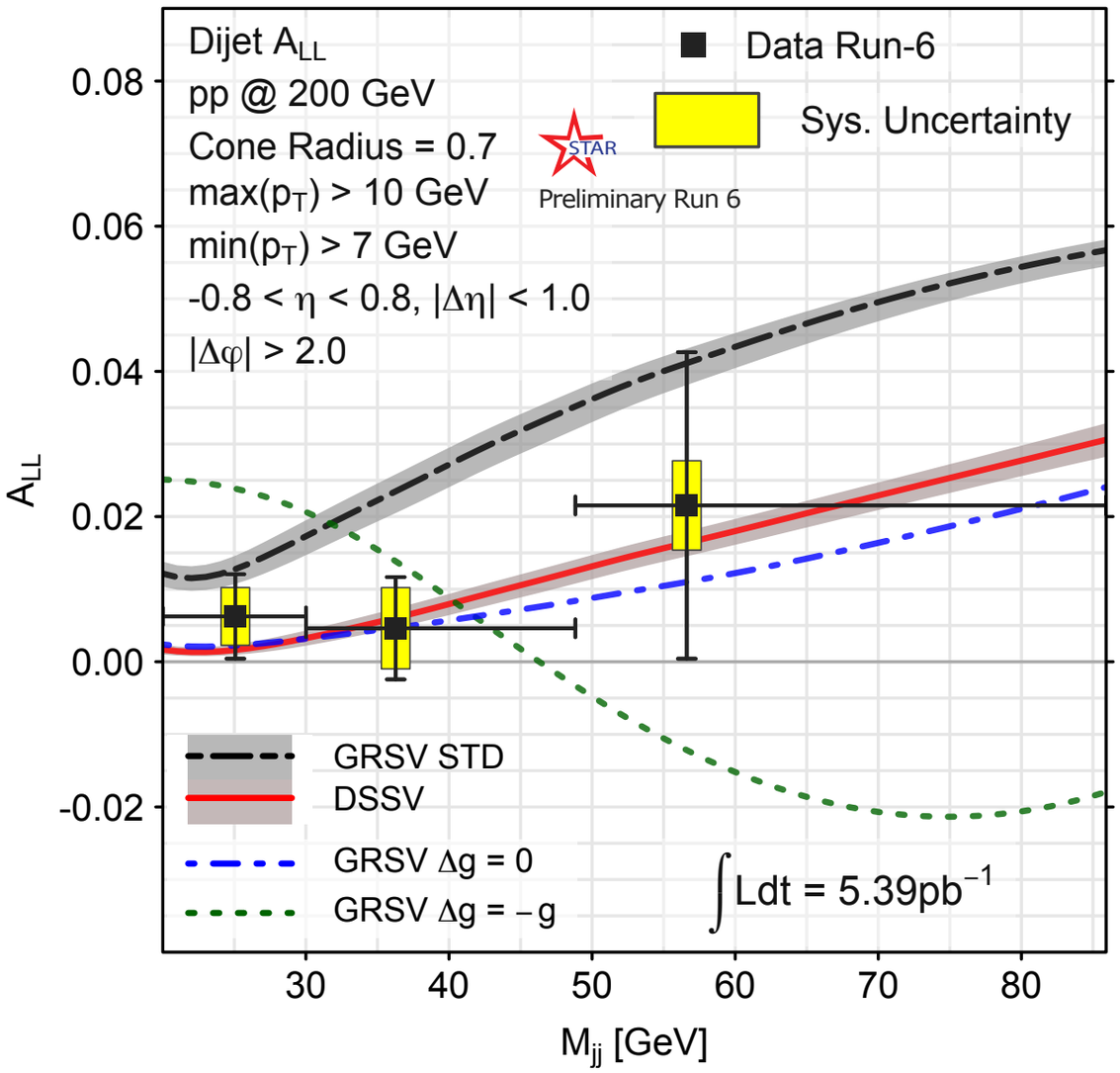
STAR Run 11 projections

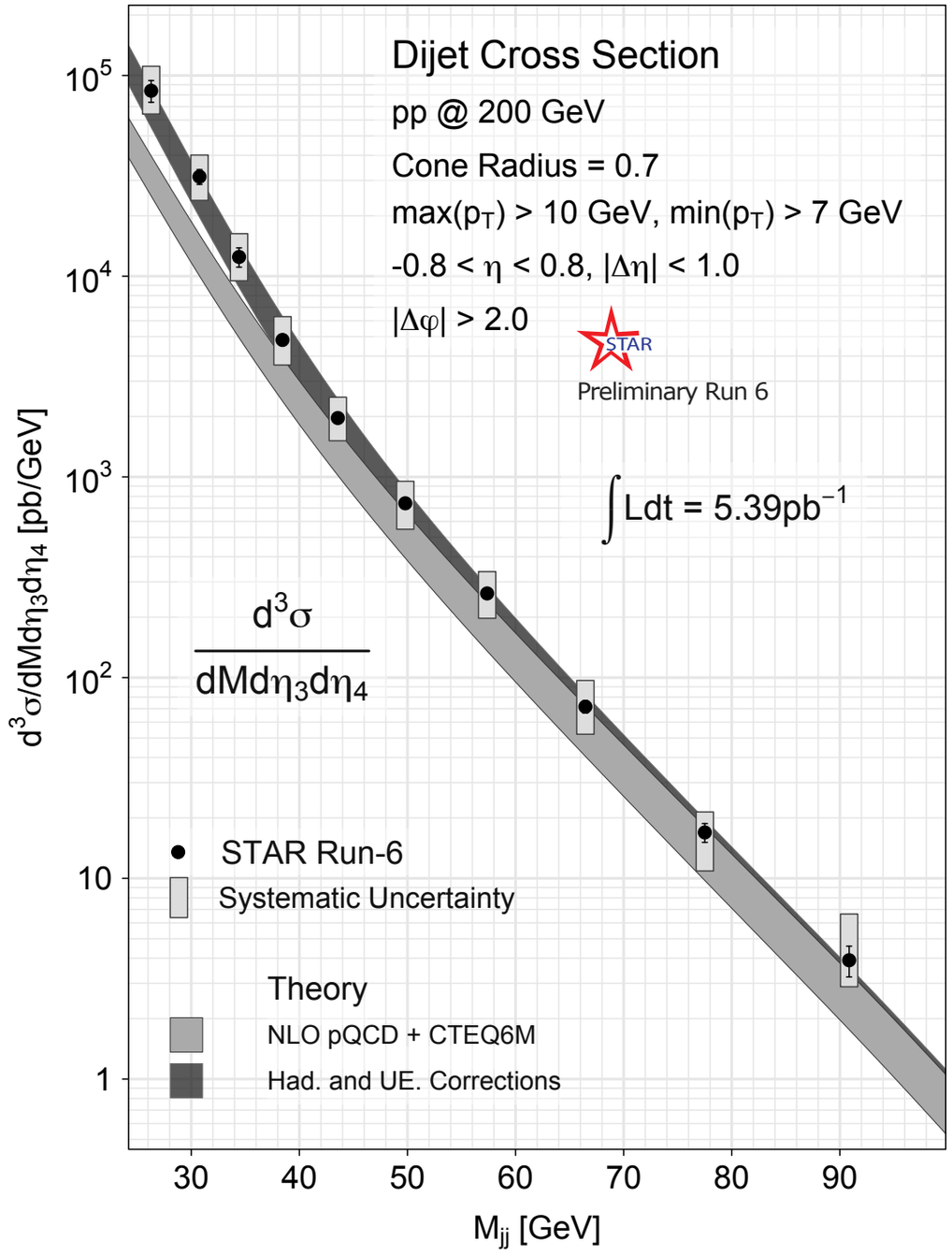


lepton |η|<1: 2 beams, eff=0.65 w/ 9MHz RF, Run9 QCD bckg, rhicbos $\sigma W^+, W^-$=82, 19 pb

Di-Jets A_{LL} from Run 6

- Data are well described by NLO pQCD plus hadronization and underlying event corrections



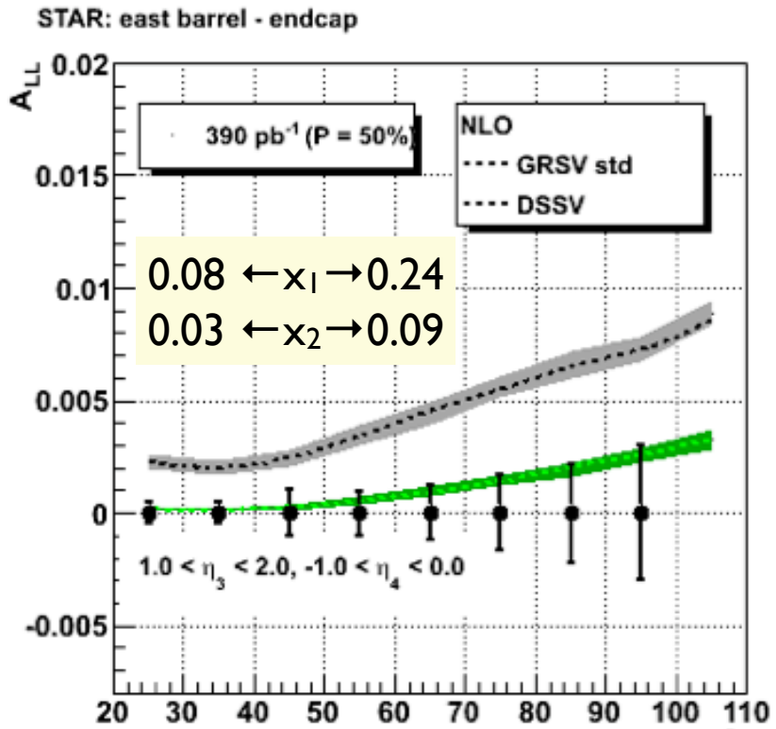


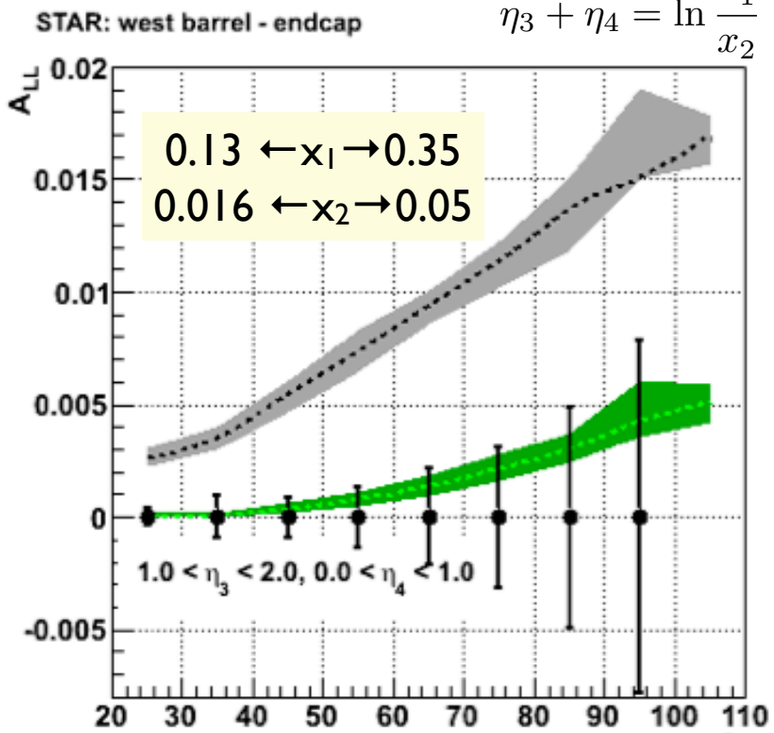
- First Di-Jet A_{LL} measurement in agreement with Δg constrained by previous inclusive jet result, i.e. small gluon polarization preferred!
- Run 9 data: Improved stat. precision ⇒ Constrain x dependence - Crucial input to Global QCD analysis!

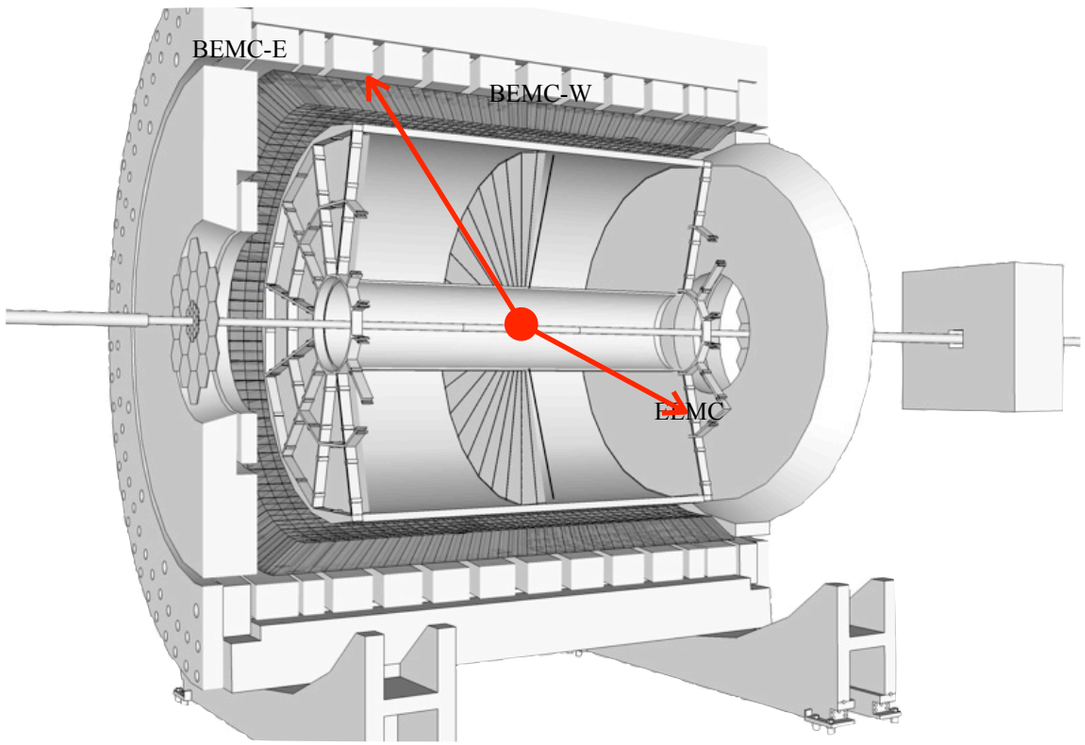
Di-Jet A_{LL} Projections

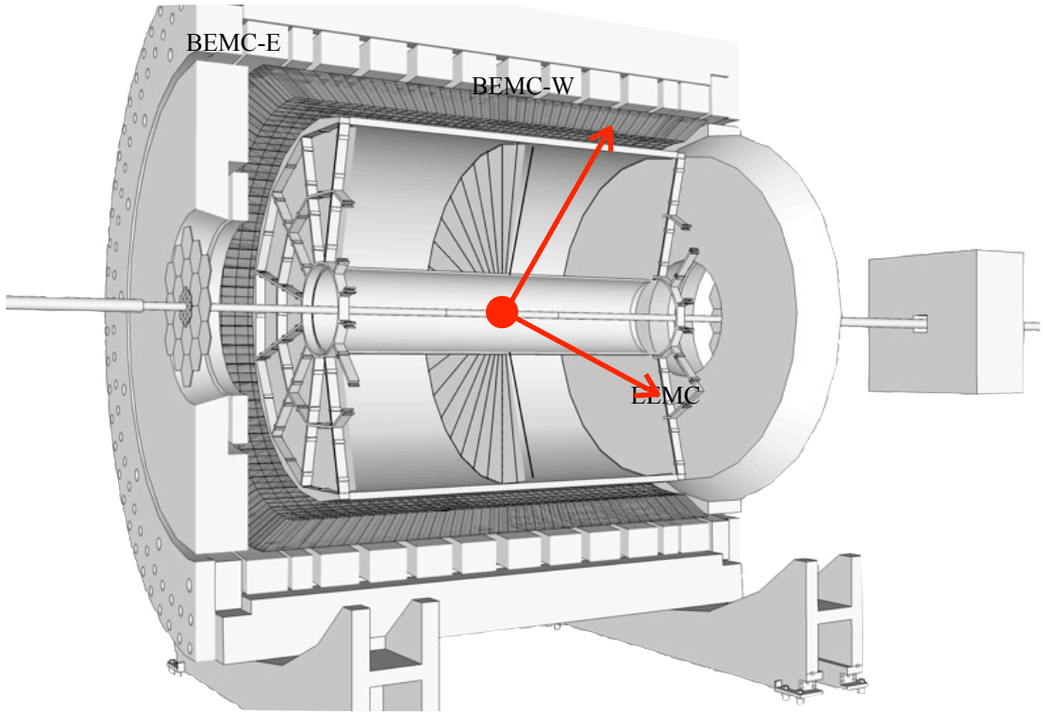
$$x_{1\,(2)} = \frac{1}{\sqrt{s}}\left(p_{T_3}e^{\eta_3(-\eta_3)} + p_{T_4}e^{\eta_4(-\eta_4)}\right)$$

$$\eta_3 + \eta_4 = \ln\frac{x_1}{x_2} \qquad M = \sqrt{x_1 x_2 s}$$



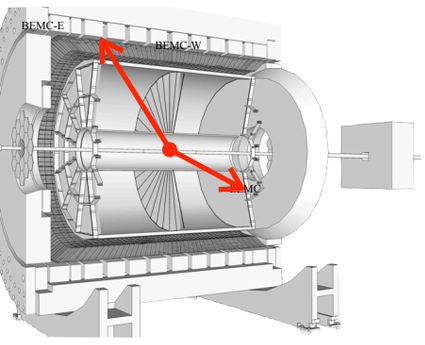


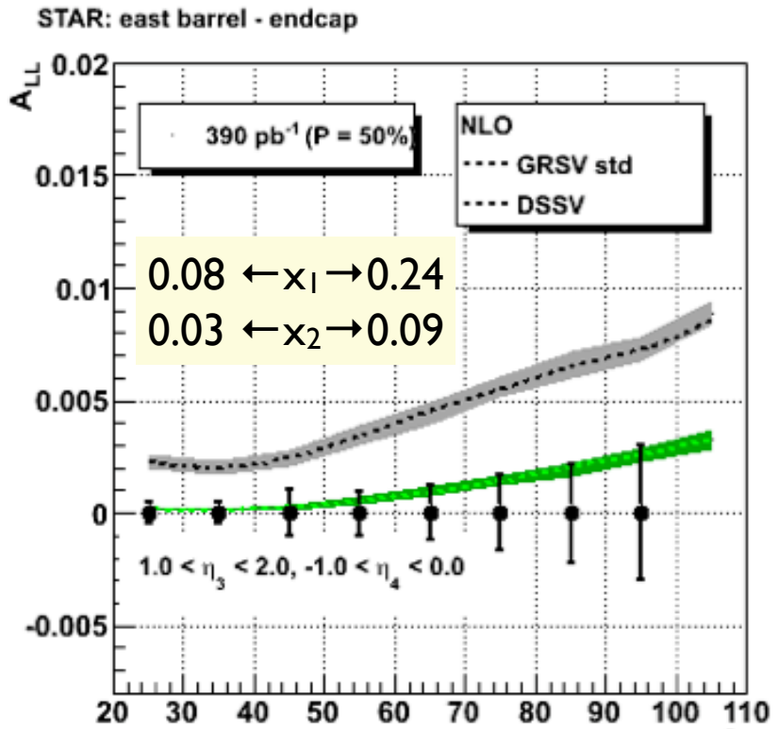


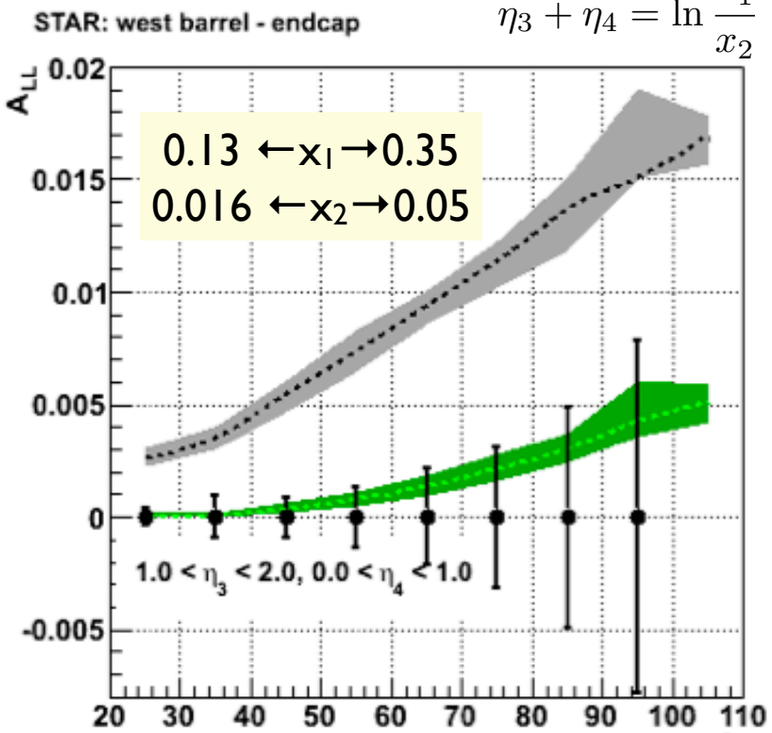


Di-Jet A_{LL} Projections

Shown LP^4=24 pb^{-1}
in Run 11 expected ~4 pb^{-1}

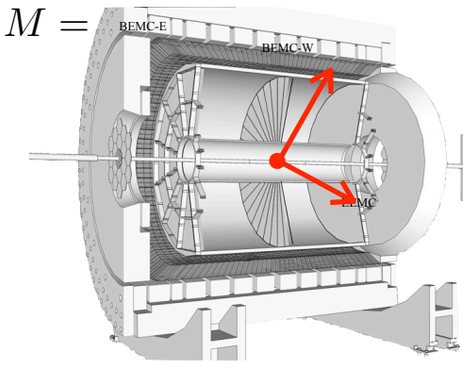


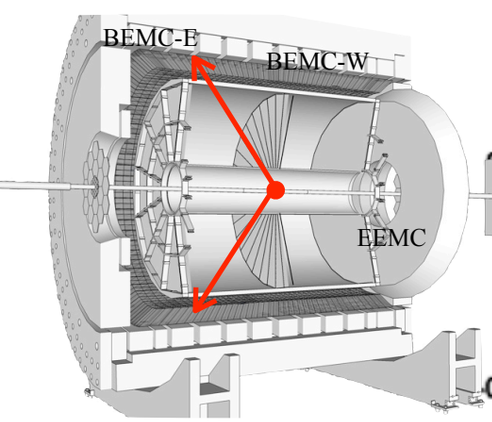


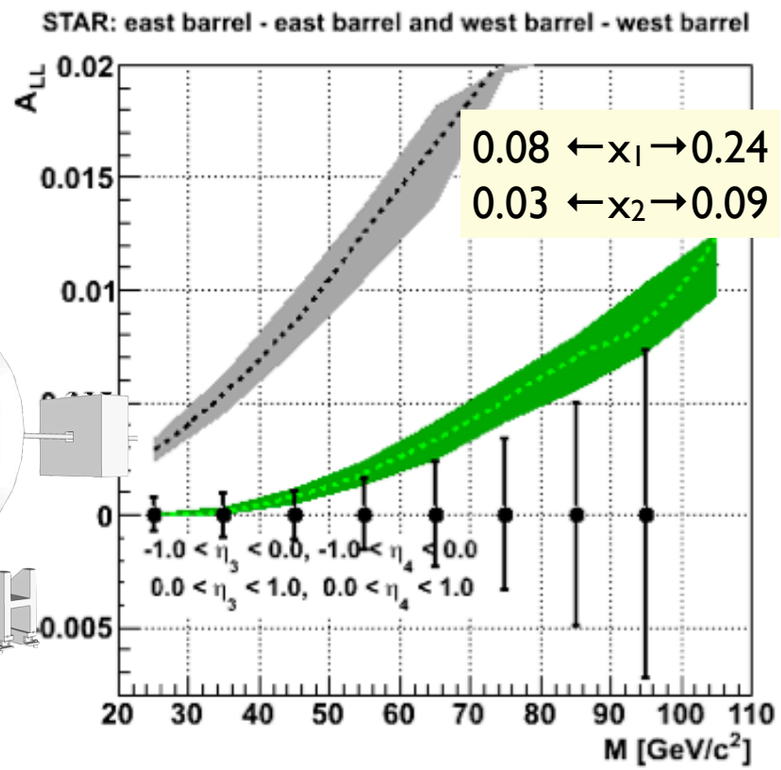


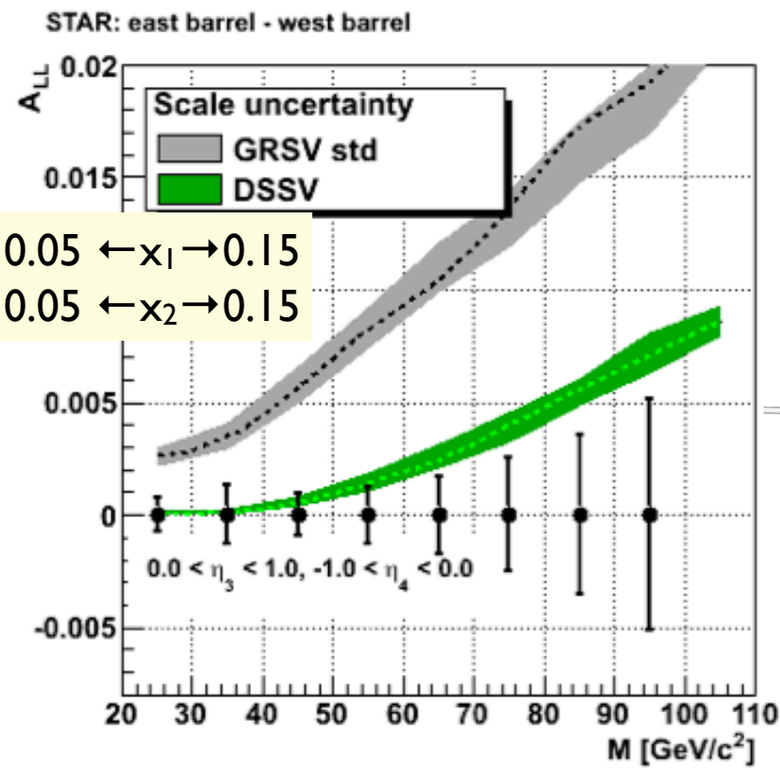
$$\eta_3 + \eta_4 = \ln \frac{x_1}{x_2}$$

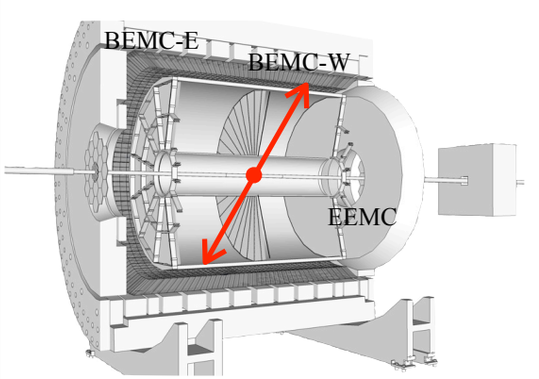
$M =$











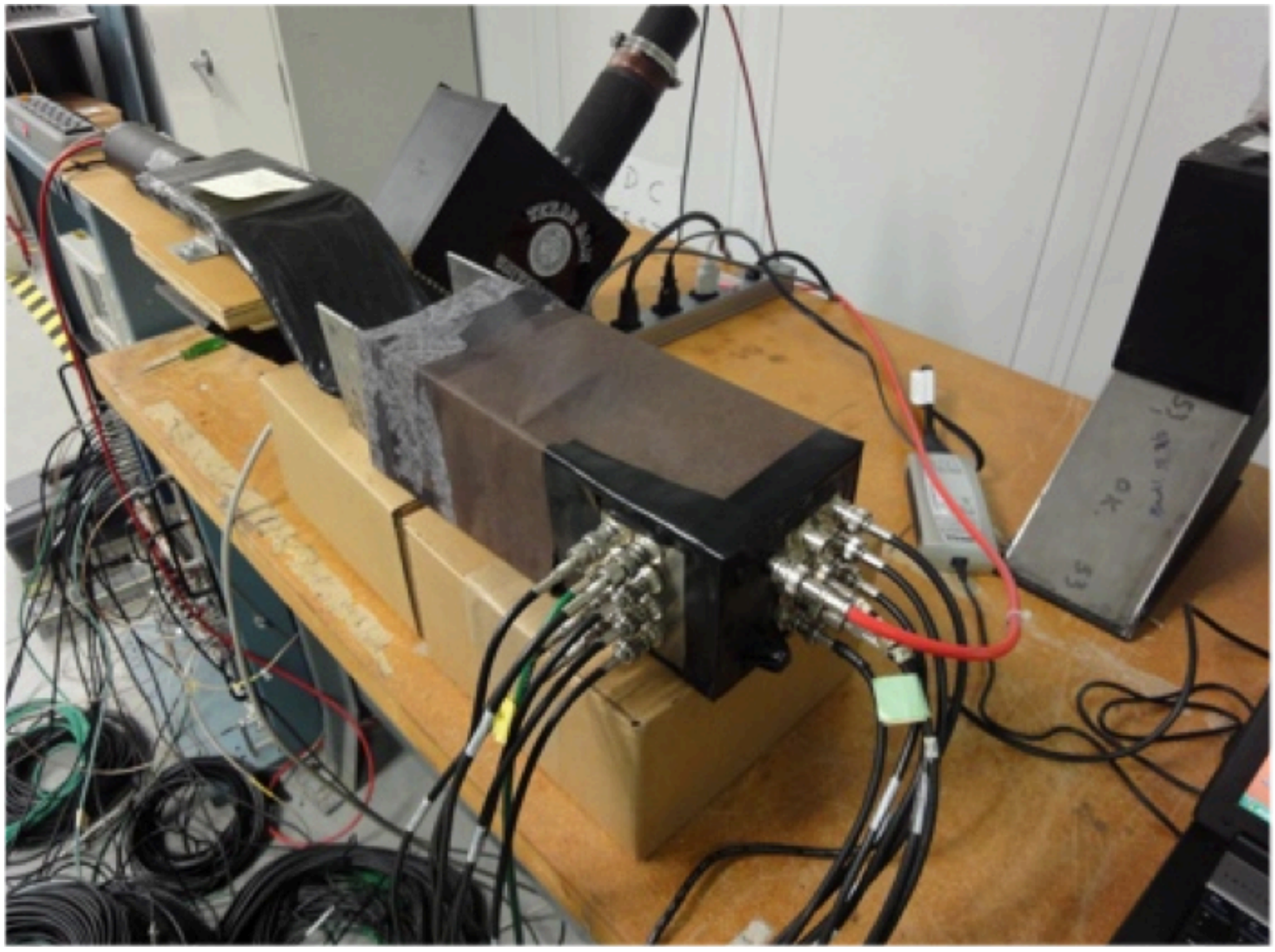
New ZDC SMD polarimetry

Purpose:

- improve relative lumi for jet A_{LL}
- study large A_N at forward angles

Setup:

6 towers from BRAHMS and 2 existing STAR SMD modules



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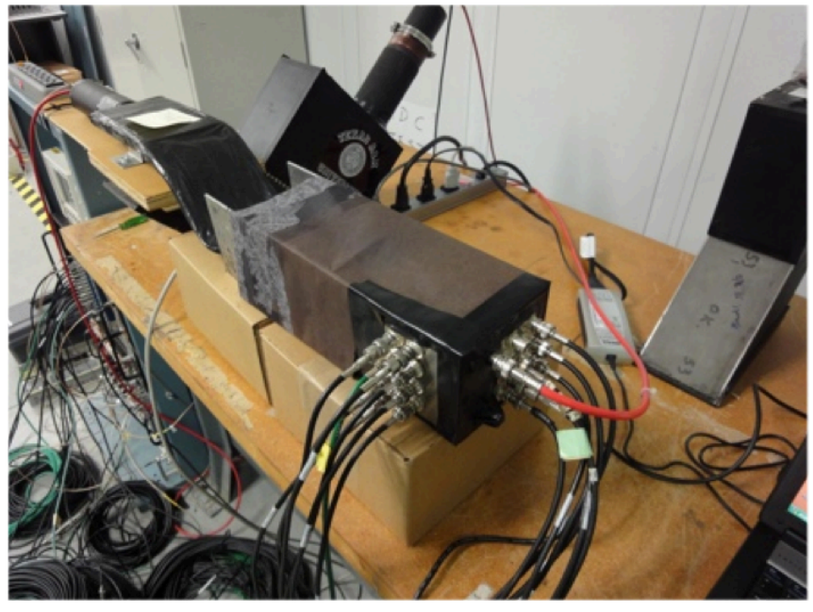

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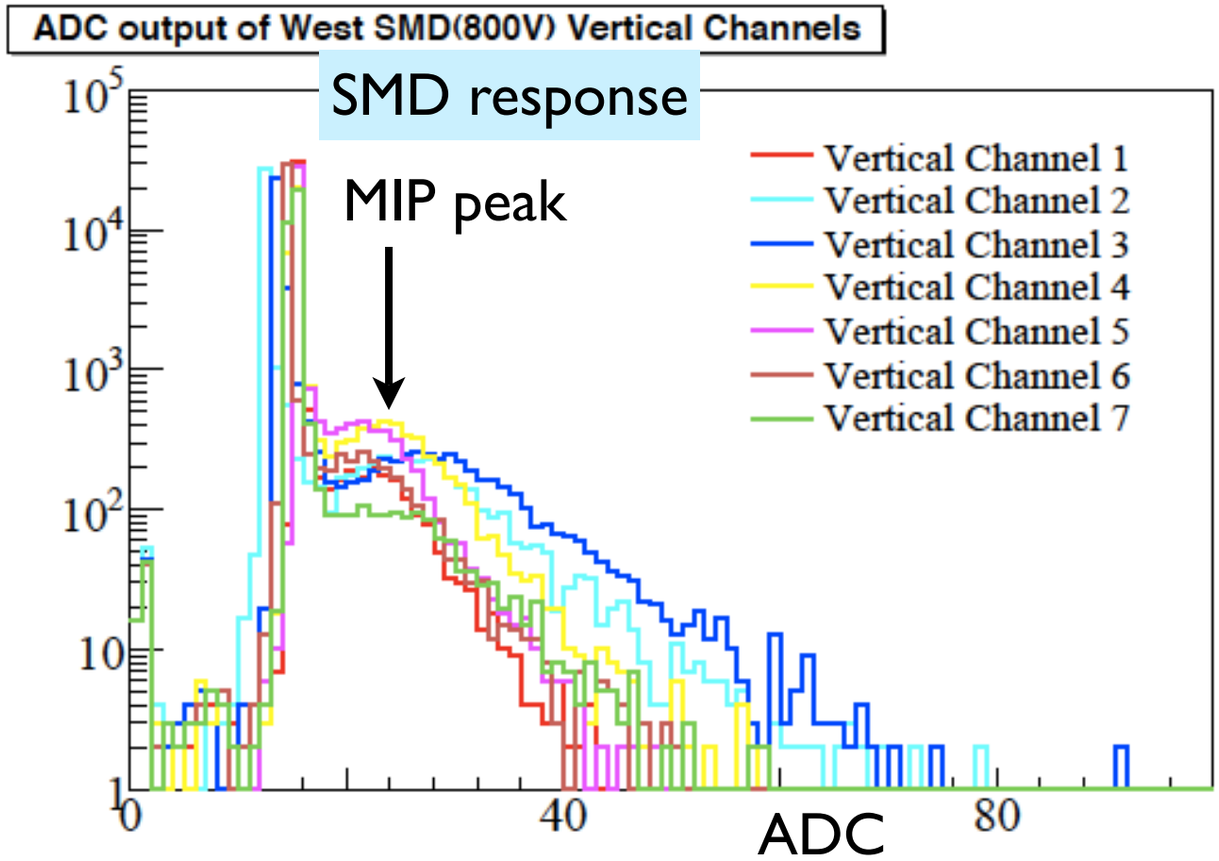
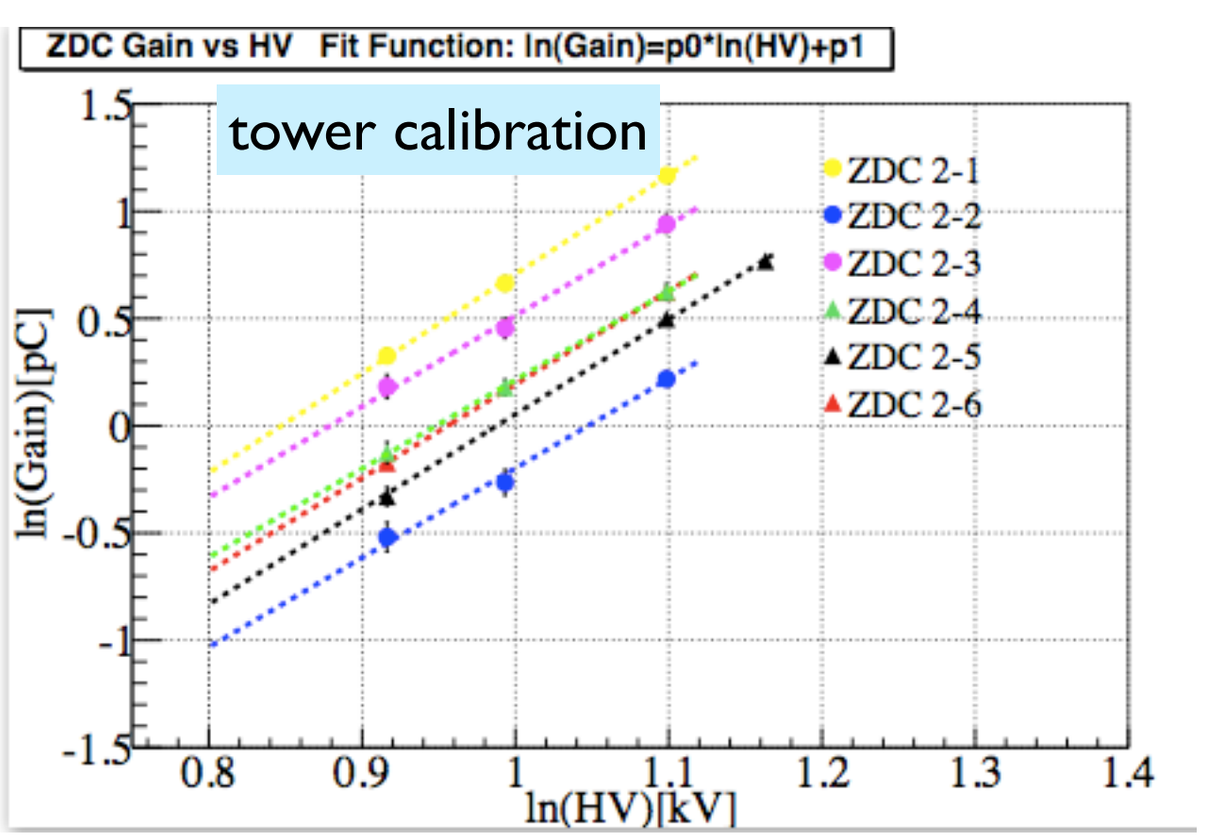
- Rest of the system unchanged: trigger on Front-Back module





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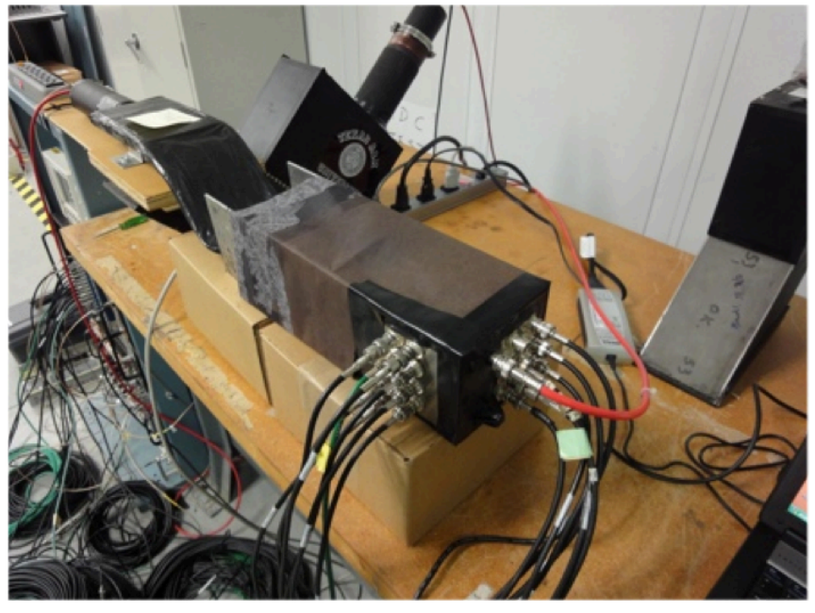

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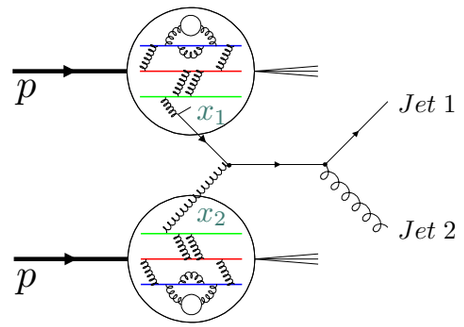
Next steps:

- read out ZDC SMD with scalers boards, one for each side.
- pass tower energy to scalers to study an x_F dependence.

Summary



- 10 weeks of polarized pp 500 GeV
- long/transverse split 3/2
- transverse: forward A_N for π^0, η
  → Sivers/Collins
- longitudinal :
  - W A_L → see quark polarization
  - di-jet A_{LL} → gluon polarization
- improved relative luminosity w/ ZDC
- 10x more events vs. Run 9

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