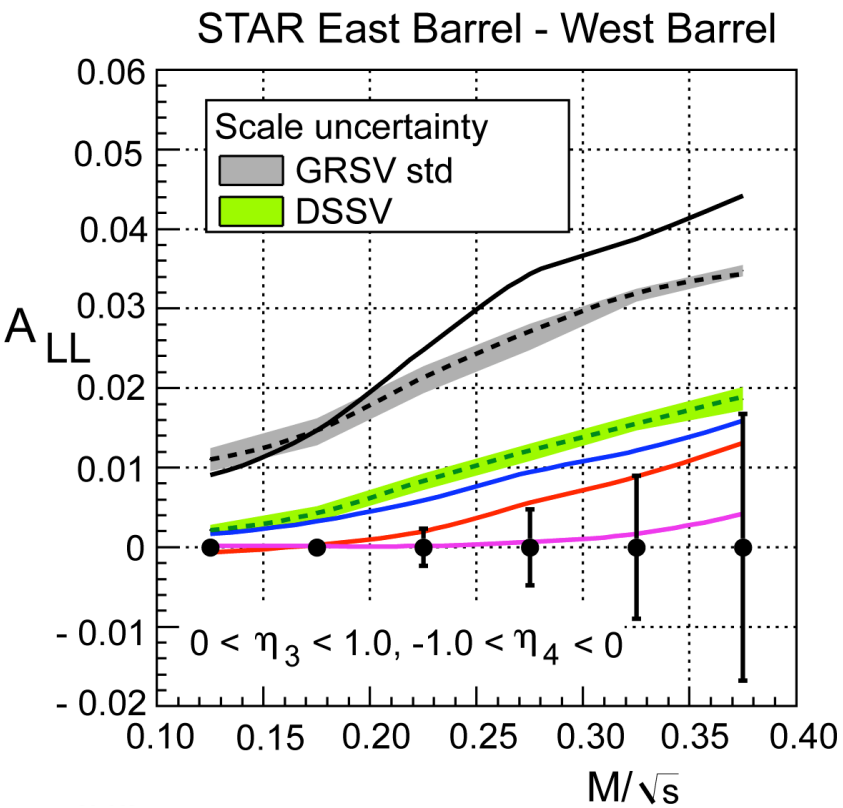
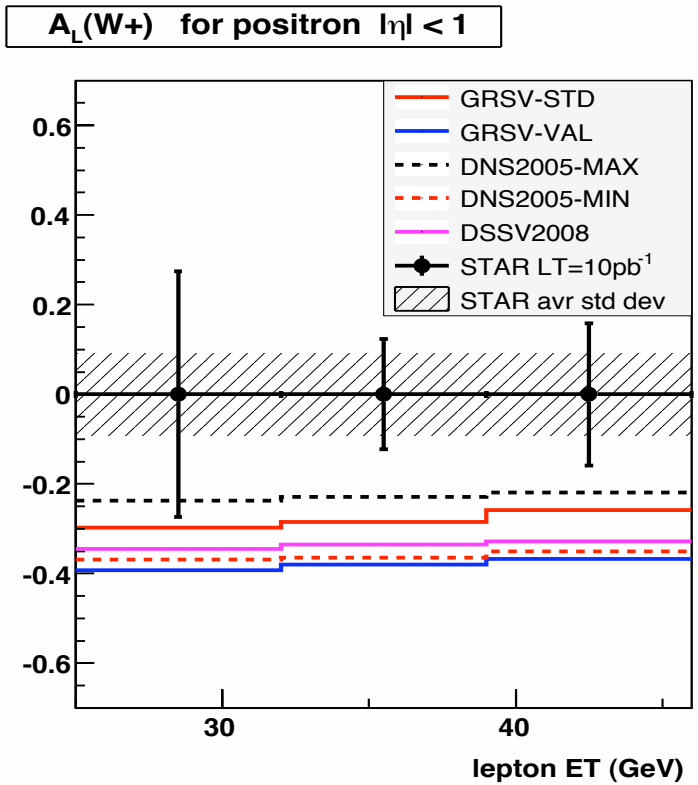
STAR Plans
- RUN 9 -

ppLong @ 200 GeV



ppLong @ 500 GeV



- Assumptions on luminosity projections
- STAR physics goals
- STAR readiness

Jan Balewski

MIT

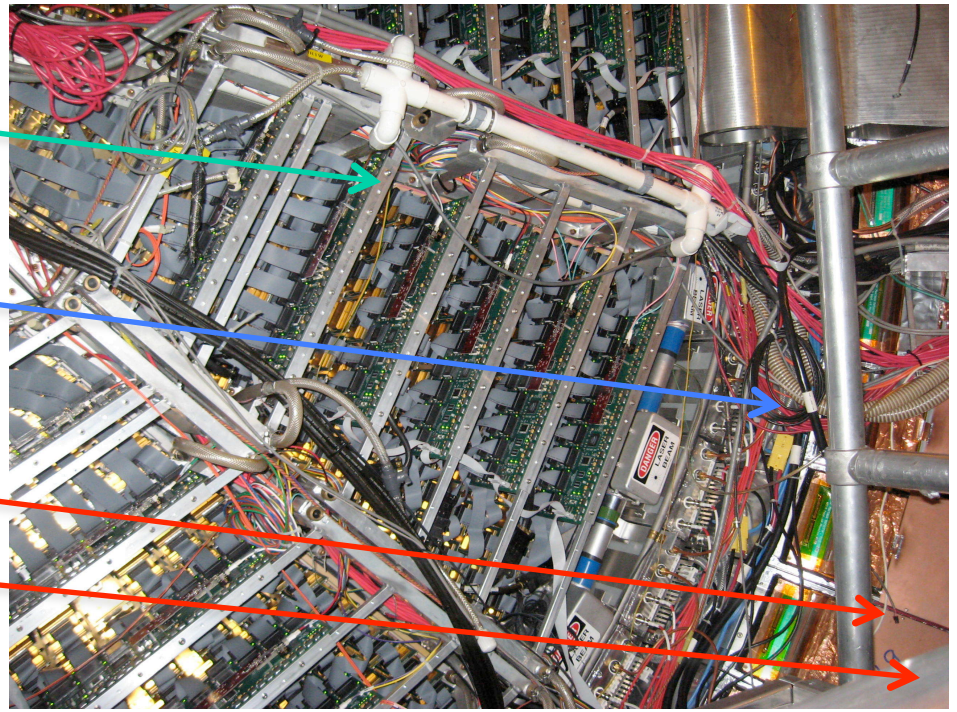
First things first: Commissioning

- **Major** changes in the detector: will need to be commissioned

Time Projection Chamber DAQ1000:
replacement of entire electronics chain
(one sector run routinely in 2008)

Time of Flight: 75% of trays in place
First run with more than ~few trays

Electromagnetic Calorimeter:
Shower Max: modification of electronics to decrease deadtime
Towers: rewire trigger to increase jet efficiency



Trigger: New electronics (QT boards) for basic detector systems (BBC, ZDC, etc.)
New Trigger Control Unit for greater flexibility

Overall goal: increase sampled/delivered ratio by lowering deadtime

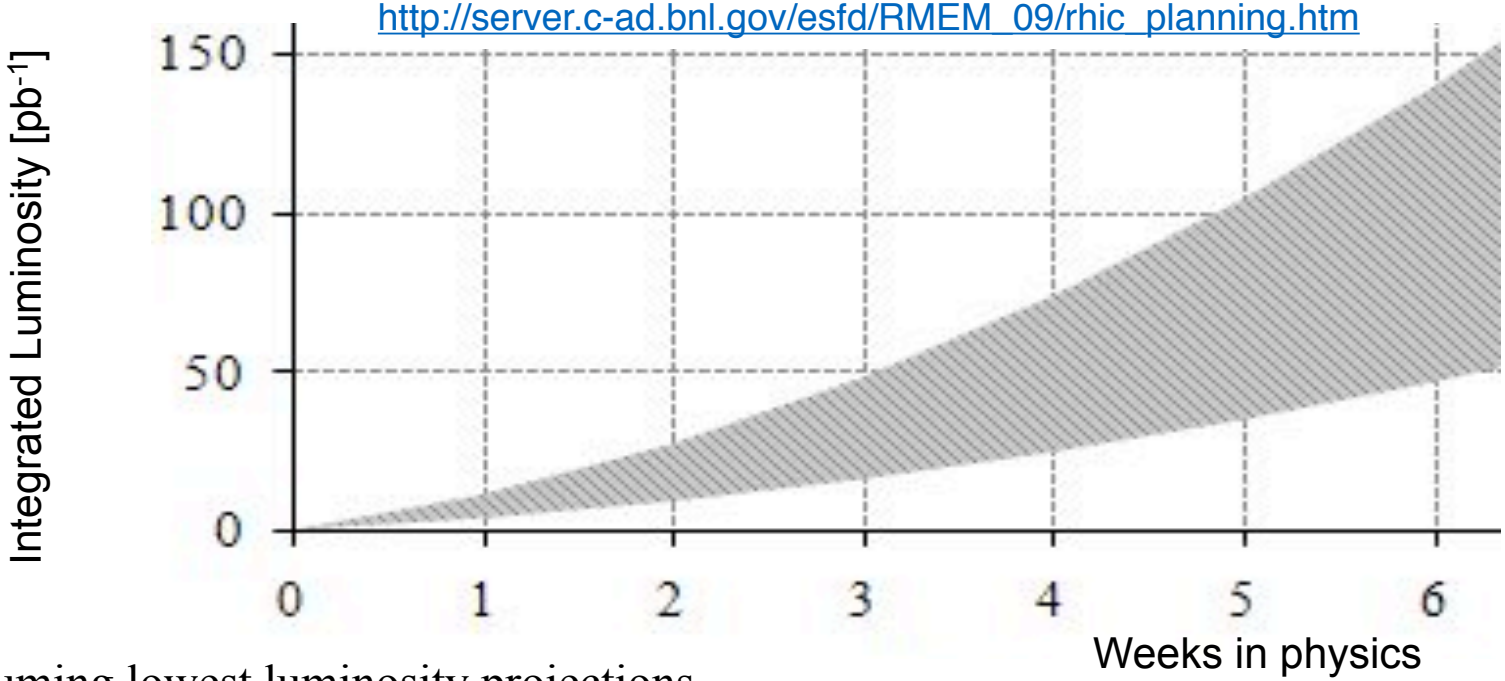
While there have been prototypes, and some commissioning can be done w/o beam, need 1-2 weeks to shake down with stable beam

Executive Summary of STAR Goals for Run 9

- Commission major detector upgrades
- Physics and preparation for the future at 500 GeV
  - Establish local polarimetry of transverse components
  - W cross-section
  - W A_L: 10 pb^{-1} sampled, longitudinal polarization 50%
  - ★ FOM $P^2L=2.5pb^{-1}$
- If goals achieved switch to 200 GeV
  - pp2pp, transverse pol, 3.5 days, special beam conditions
- If the run is extended
  - **highest priority 200 GeV p+p (STAR BUR)**
  - BUR: 50 pb-1 sampled, 60% Longitudinal Polarization
  - ★ FOM P^4L = 6.5 pb-1
- If above goal reached: A_N at forward rapidity
  - switch to transverse beam polarization

Run 9 Beam Use Request @ 500 GeV

http://server.c-ad.bnl.gov/esfd/RMEM_09/rhic_planning.htm



Assuming lowest luminosity projections

Goals for 500 GeV running

(1) Establish local polarimetry at 500 GeV. Needs: HIGH POLARIZATION, CLEAN BEAM!
(2) Benchmark the backgrounds in the W region relative to expectations
(3) Identify a W signal in the BEMC
(4) First A_L measurement for W+ in the BEMC

Needs FOM = $P^2*L = 2.5$ pb^{-1} sampled

For example, 20 pb^{-1} delivered / 10 pb^{-1} sampled at P = 50%

500 GeV longitudinal running

Goal 1: establish W signal reco STAR (using mid-rapidity e)

W reco algorithm work in progress (Joe Seele, MIT)

Pythia events. generated

- partonic pT>10 GeV/c
- thrown LT~5pb^{-1} (QCD-eve), LT=170pb^{-1} (W-eve)
- realistic vertex distribution sigZ=25 cm

Full STAR response simu & reco framework

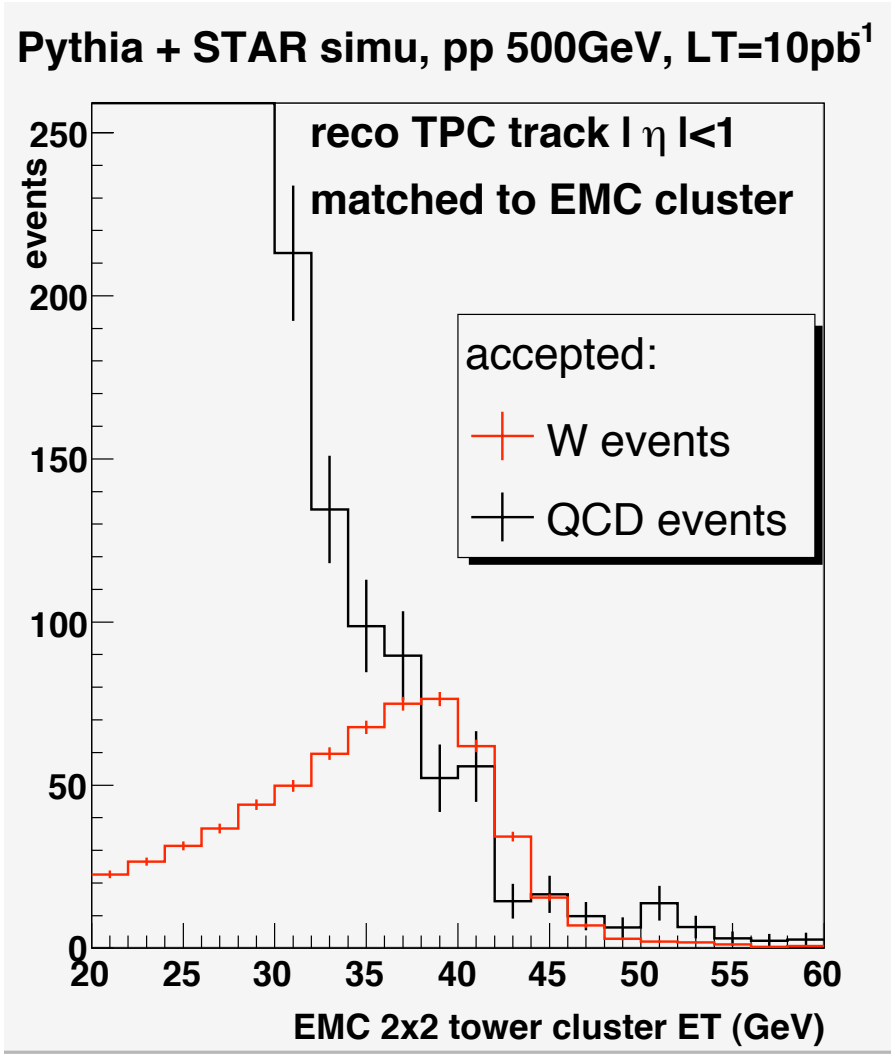
W-algo, implemented

- vertex |z| <60 cm
- highest 2x2 tower BEMC cluster w/ ET>15 GeV
- highest pT reco primary TPC track , |eta|<1
- match track to CG of EMC cluster:
  - delta eta <0.03
  - delta phi <0.03

(EMC & TPC have full coverage in phi, use log(ET) for cluster CG, EMC tower size: eta*phi=0.05*0.05)

W-algo NOT implemented

- EMC transverse, longitudinal shower profile
- isolation cone around reco electron
- veto if large ET in phi opposite to electron

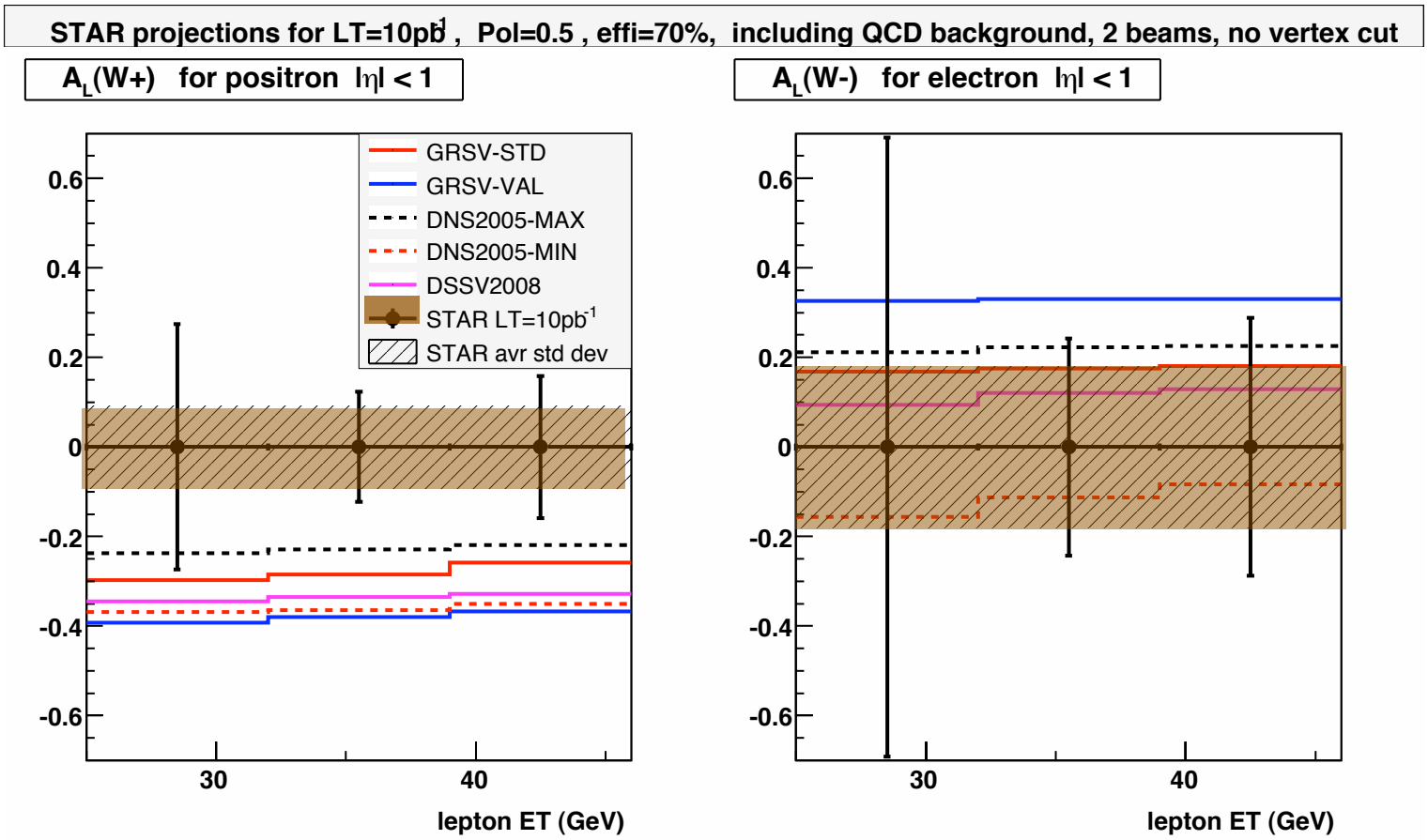


500 GeV longitudinal running

Goal 2: First measurement of A_L for W

Effective signal ~250 (W^+) ~60 (W^-) with 10 pb^{-1}

- FOM = 2.5pb^{-1}
- Polarization = 50%
- Longitudinal
- Luminosity: 10pb^{-1}



(assuming W-reco algo at mid rapidity yields S/B >1 for lepton ET>30 GeV)

Other opportunities at 500 GeV

- Jets and dijets: Δg(x) to lower x, different parton subprocesses

  With projected integrated luminosity and polarization: new constraints for $0.05<x_T<0.1$

- First measurement of A_N at 500 GeV with Forward Pion Detector and Forward Meson Spectrometer for mesons heavier than pi0

- Heavy flavor

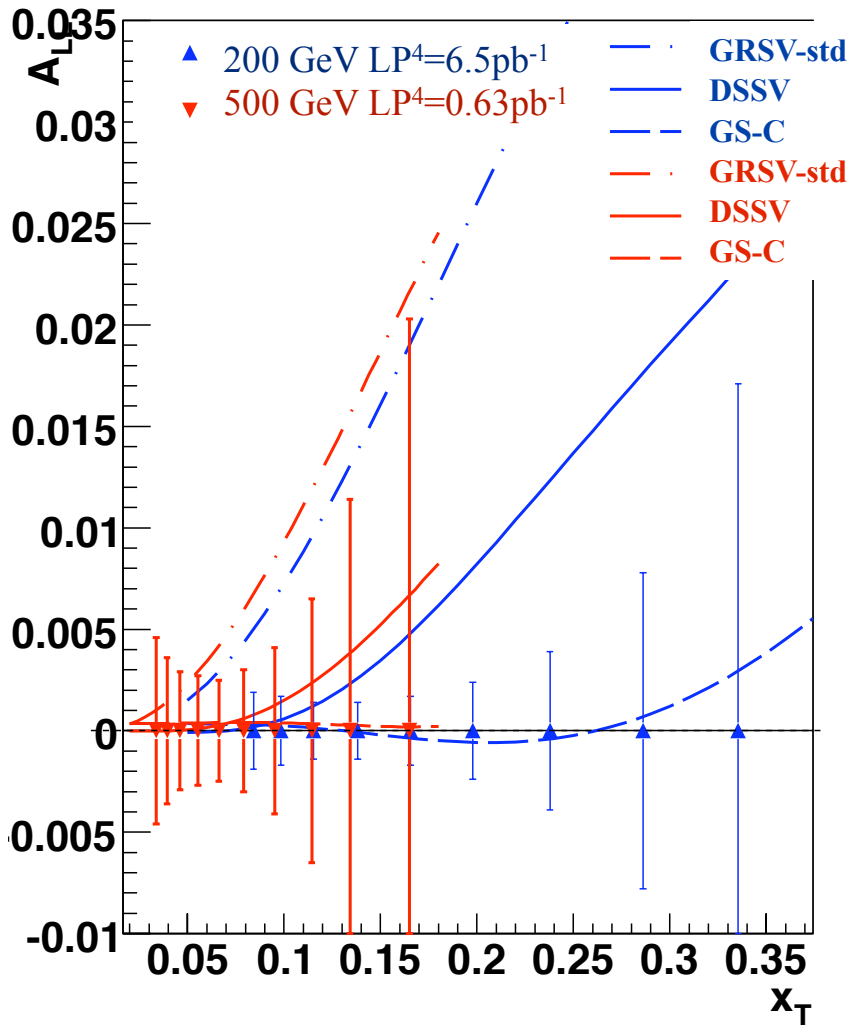
  Use the TOF, EMC, and reduced material to measure charm, non-photonic electrons, J/Ψ and Upsilon

  Useful as check on theory

- Dileptons: first from STAR

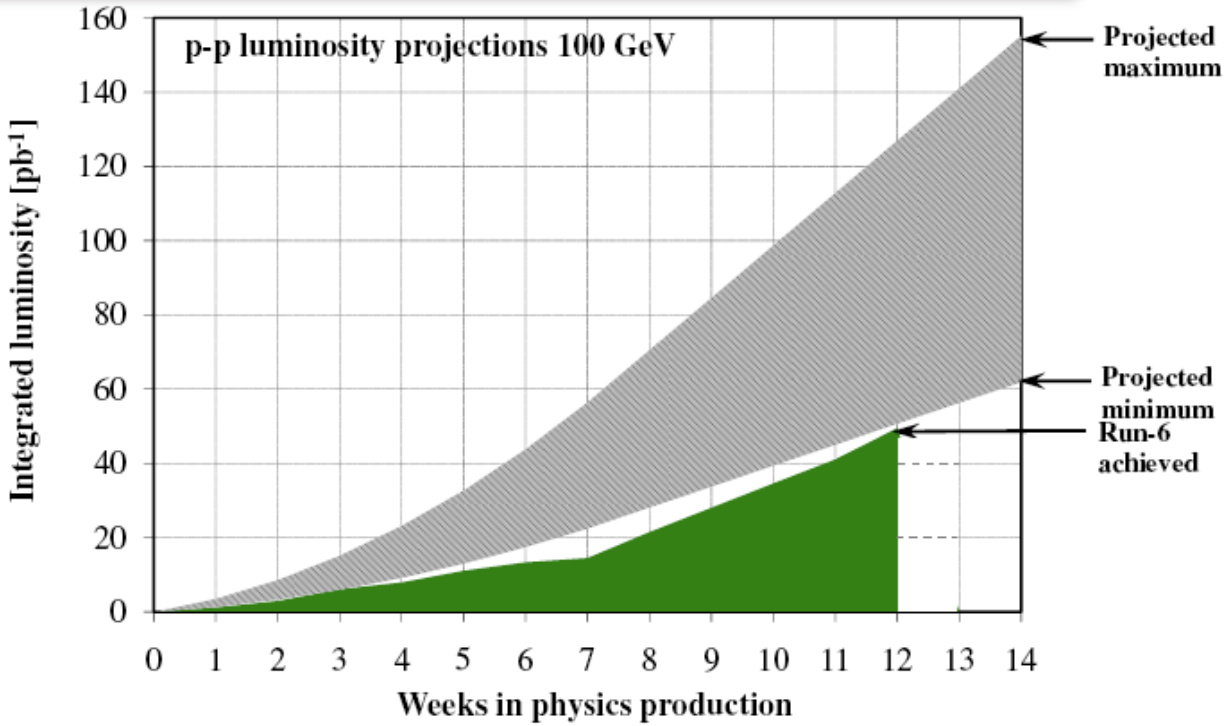
  Expect significant φ➔ee signal with ~100M minbias events

Projected sensitivity STAR pp→jet+X



Run 9 Beam Use Request @ 200 GeV

Assumed Run 9 projected performance for STAR BUR



Essential for STAR: high polarization (FOM ~LP^4)

Goal is challenging but hoping that prior 500 GeV run will lead to high lumi on day 1

Projections following RHIC retreat: P = 0.60 - 0.65 / L_{ave} = $40 \cdot 10^{30}$ $cm^{-2}s^{-1}$

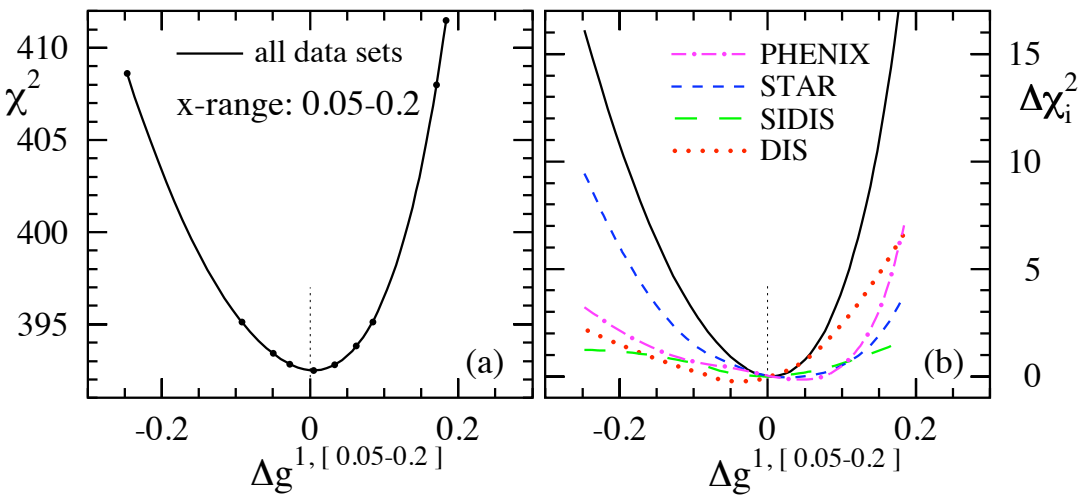
STAR BUR is based on: P = 0.6 / ~100pb^{-1} => 50pb^{-1} recorded

BUR Goal: FOM ~ 6.5pb^{-1}

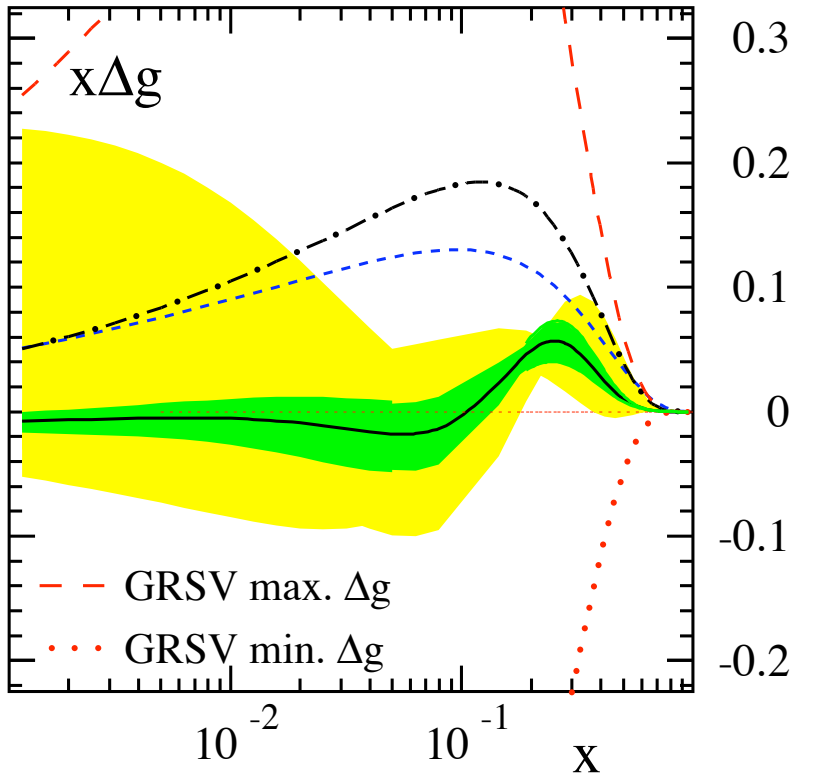
Will switch to transverse if achieve goal before end of run

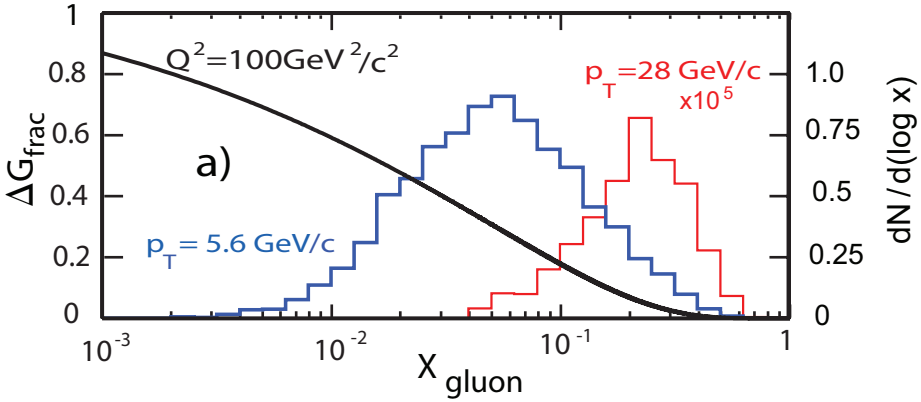
Highlights of recent results - Gluon polarization

- Global analysis incl. RHIC pp data



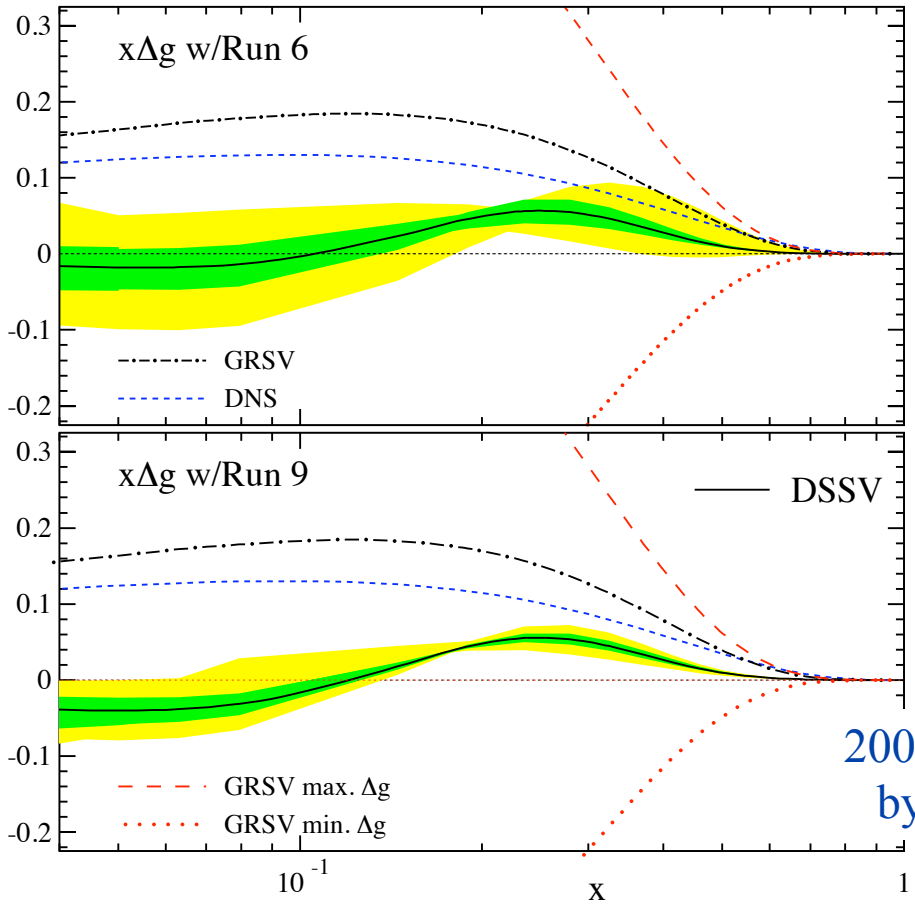
- Strong constraint on the size of Δg from RHIC data for $0.05<x<0.2$
- Evidence for a small gluon polarization over a limited region of momentum fraction
- Important: Mapping x-dependence and extension of x-coverage needed!

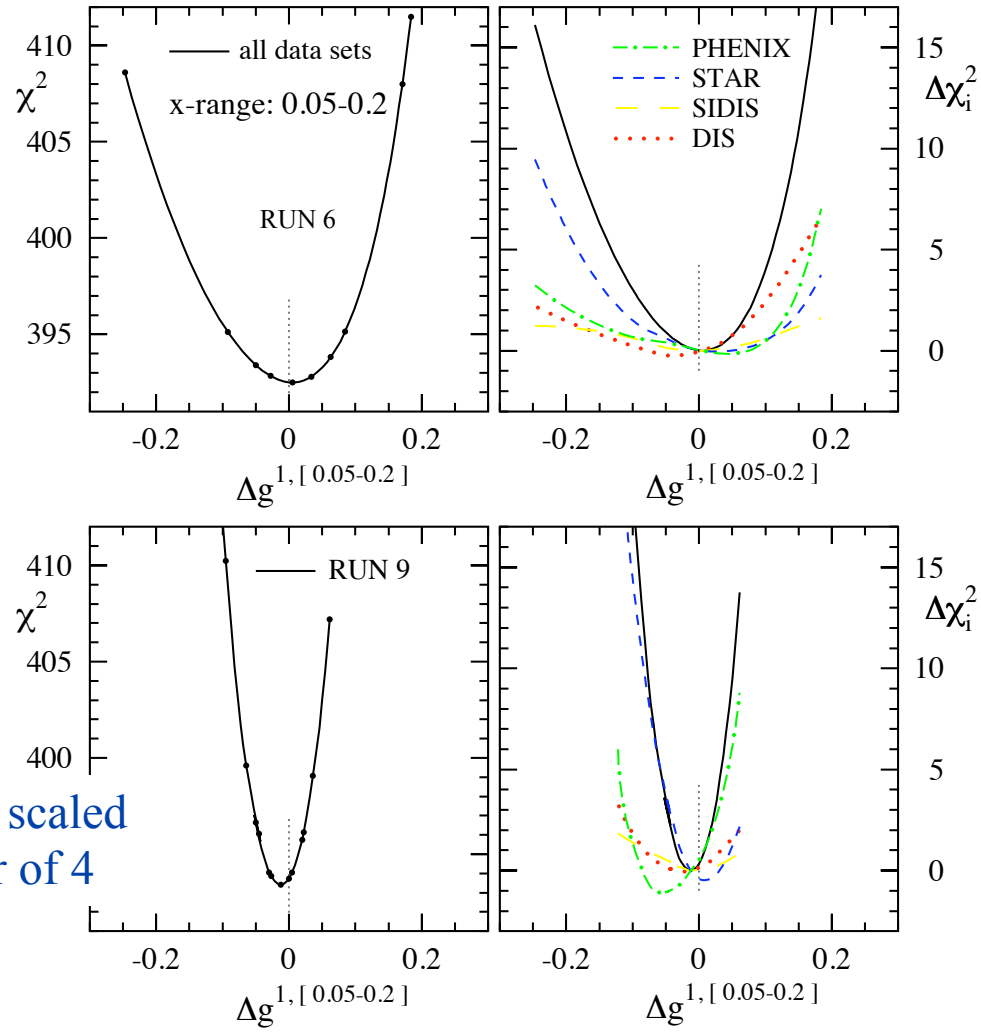




Run 9 projections - Gluon polarization

- Gluon polarization - Projection Run 9



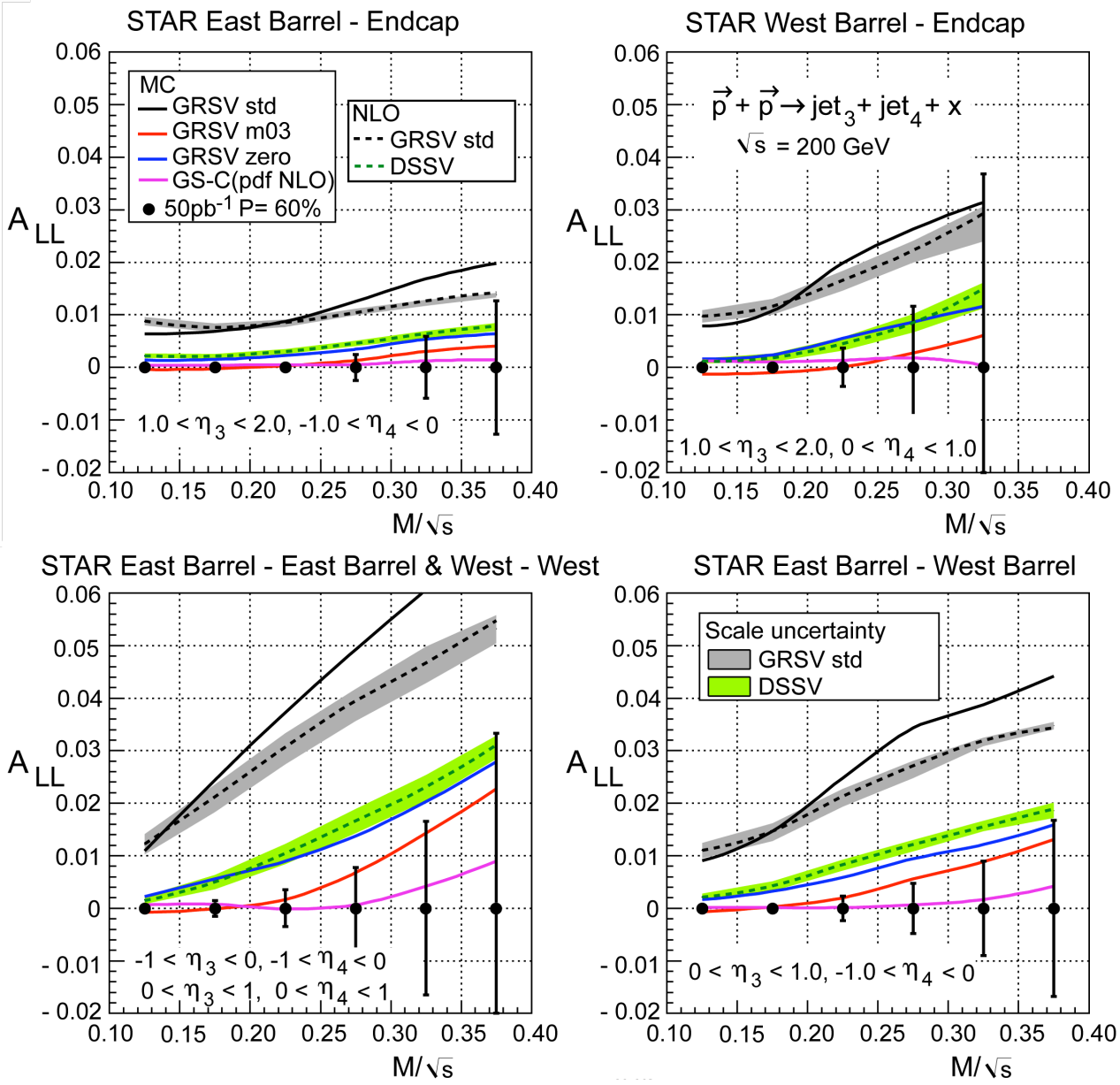


2006 stats scaled by factor of 4

- Substantial improvement on gluon polarization from inclusive measurements
- Complementary information from STAR and PHENIX (inclusive jets & pi0)

BUR Di-Jet production: 50pb^{-1} / 60% (FOM=6.5)

- Gluon polarization - Di-Jets
  - Substantial improvement in Run 9 from Di-Jet production
  - Good agreement between LO MC evaluation and full NLO calculations



$$M = \sqrt{x_1 x_2 s}$$

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

Run 9 goals summary

- Higher sensitivity : Luminosity / DAQ 1000
- Sensitivity to shape of $x\Delta g(x)$: Correlation measurements
- Sensitivity to low x : Forward calorimetry
- **Large impact for: FOM=6.5pb^{-1} at 200GeV**
- At 500GeV: Observe first W signal / First inclusive jet/hadron and di-jet measurements (Longitudinal beam polarization) / First A_N measurement (Transverse beam polarization)

Backup

Goals from p+p 200 GeV for heavy ion physics

Goal in the BUR: $\mathcal{L} = 50\ \mathrm{pb}^{-1}$

- Reference for Au in RHIC II era: last chance for a few years

Factor 5x increase in $\mathcal{L}$ for rare probes vs. run 6

Non-photonic electrons: extend correlation signatures for B vs. D

J/Ψ: use TOF and EMC for precision

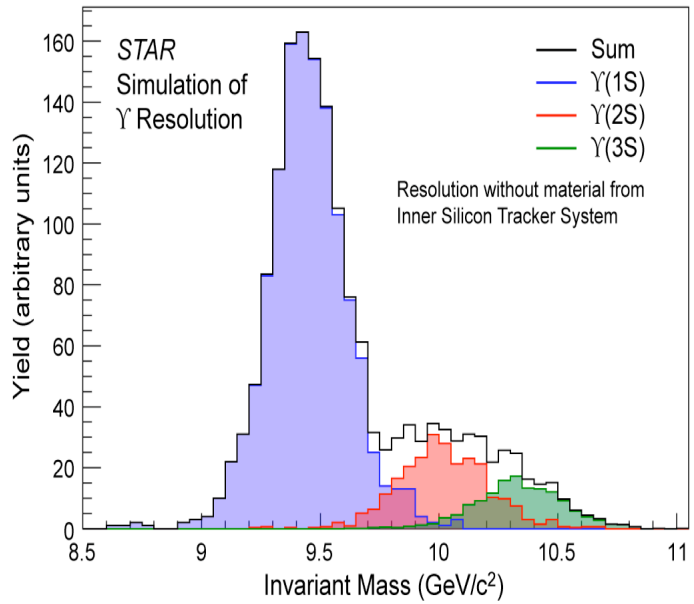
Upsilon: 1st attempt to separate higher states

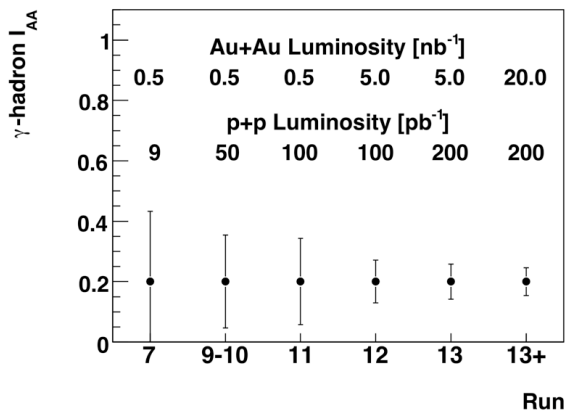
γ-hadron: currently p+p is limit on I_{AA}

Large minbias dataset with DAQ1000: 300 M

Has not been possible in previous years, due to DAQ limitations

Fundamental baseline for untriggerable probes: D, dileptons, hadrons





http://www.c-ad.bnl.gov/esfd/CAD_operation_fy09.pdf