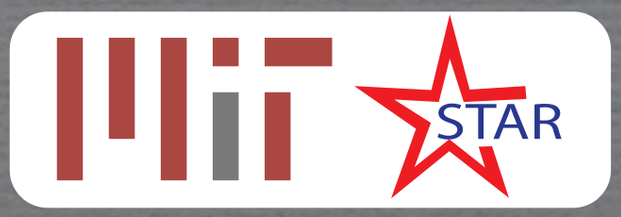
Dijet Production in Polarized Proton-Proton Collisions at 200 GeV at STAR

Matthew Walker
for the STAR Collaboration

November 4, 2010



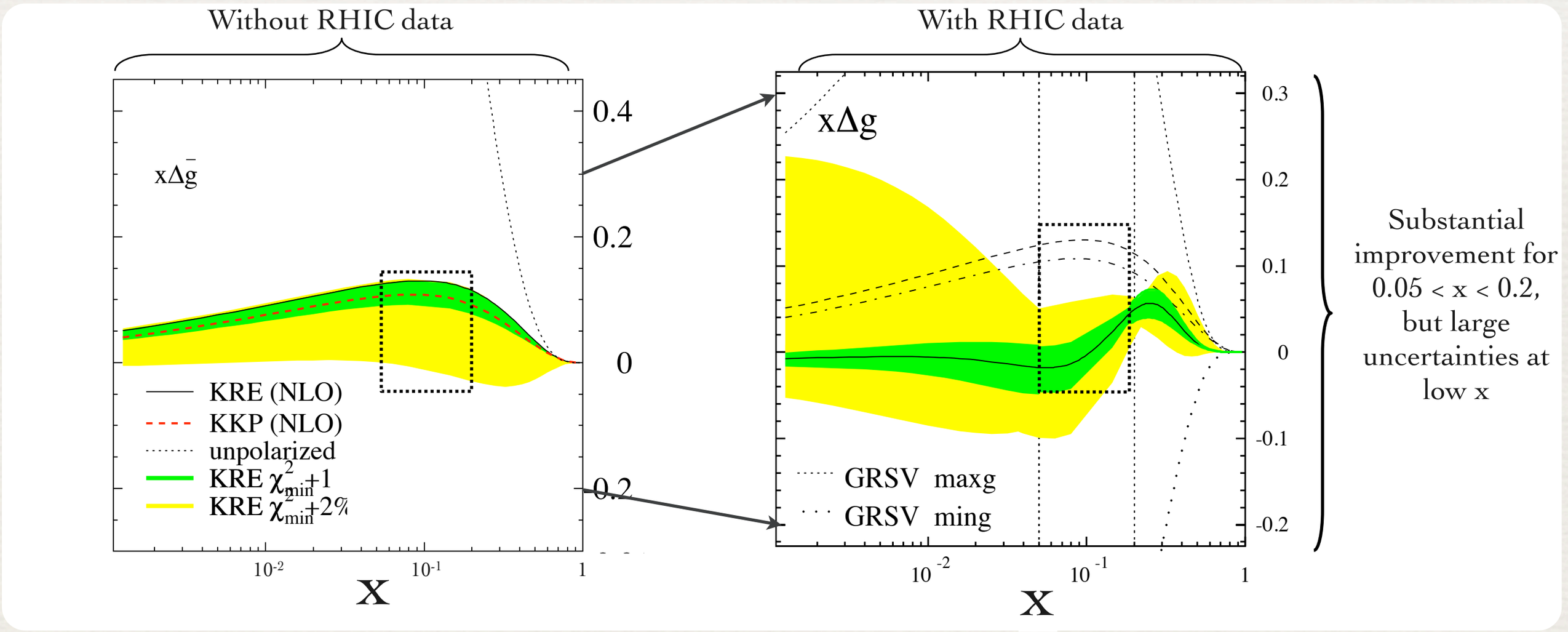
Outline

- Brief theoretical motivation
- Experimental Overview
- Cross Section Analysis
- Asymmetry Analysis
- Status of ongoing analysis

Theoretical Motivation

- Polarized DIS tells us that the spin contribution from quark spin is only ~30%.

$$\frac{1}{2} = \frac{1}{2}\Delta\Sigma + L_q + \Delta G + L_g$$



D. de Florian et al., Phys. Rev. D71, 094018 (2005).

D. de Florian et al., Phys. Rev. Lett. 101 (2008) 072001

Correlation Measurements

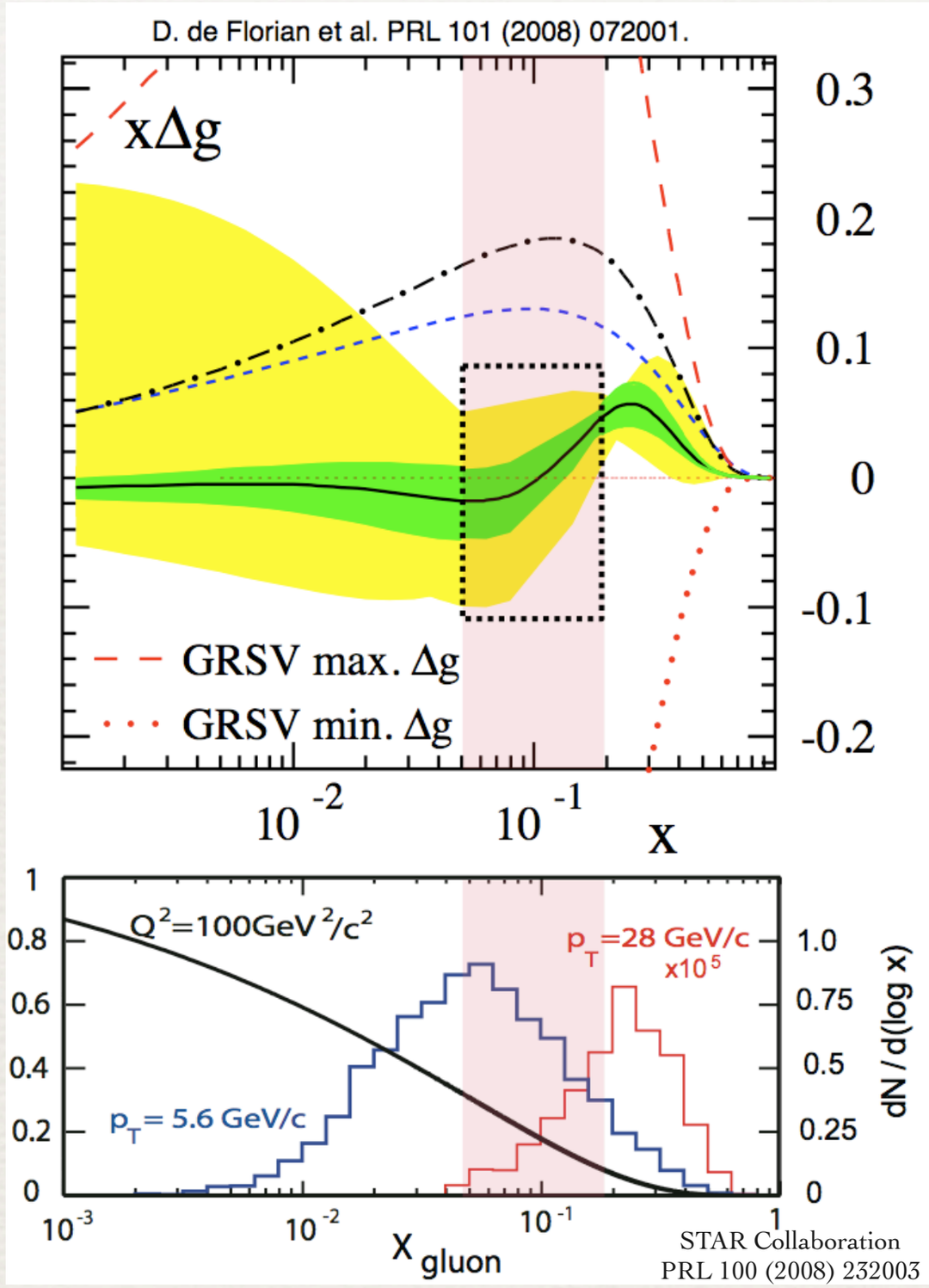
- Reconstructing multiple physics objects (di-jets, photon/jet) provides information about initial parton kinematics
- STAR well suited for correlation measurements with its large acceptance

$$x_1 = \frac{1}{\sqrt{s}}(p_{T3}e^{\eta_3} + p_{T4}e^{\eta_4})$$

$$x_2 = \frac{1}{\sqrt{s}}(p_{T3}e^{-\eta_3} + p_{T4}e^{-\eta_4})$$

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

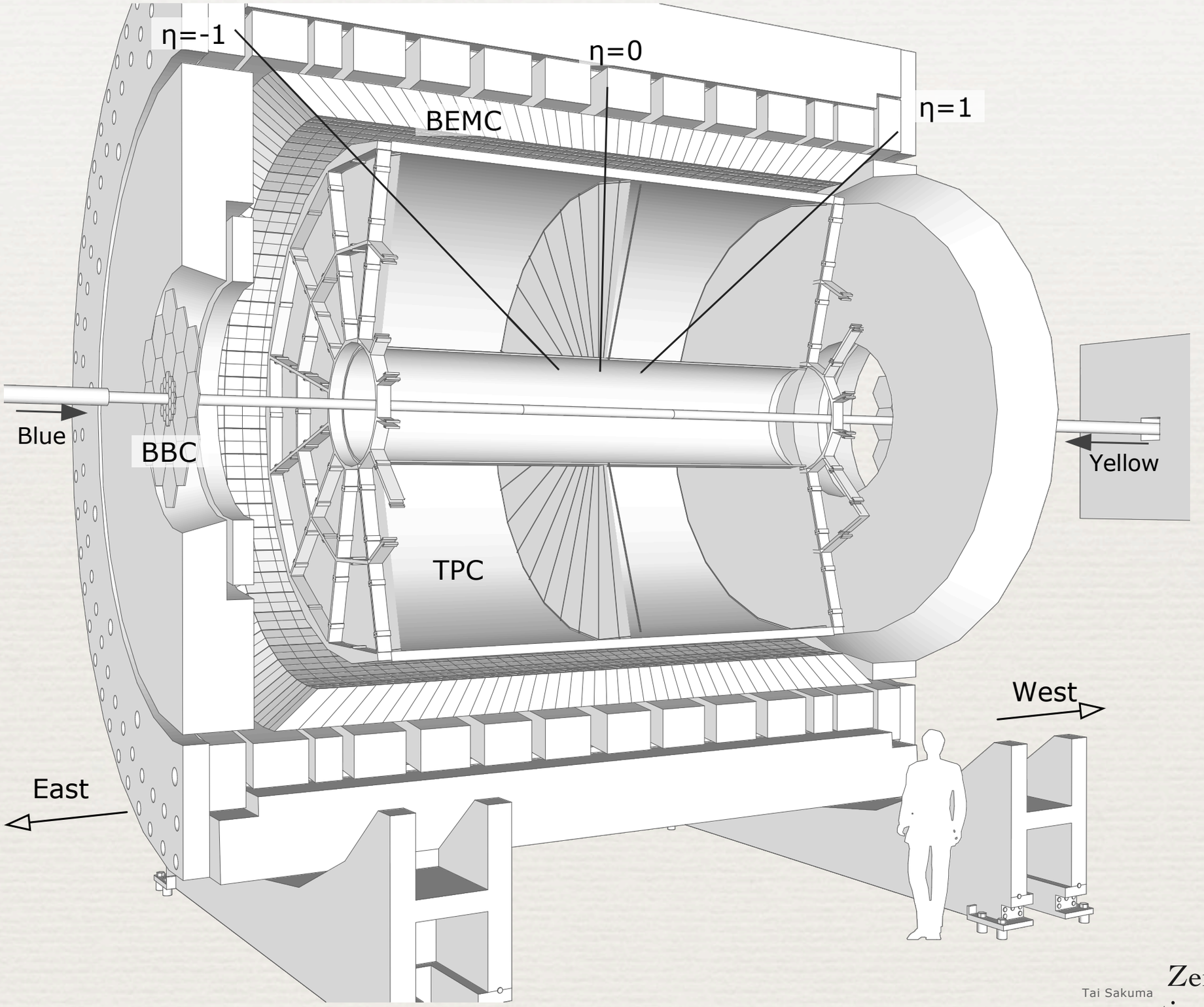
$$\eta_3 + \eta_4 = \ln \frac{x_1}{x_2}$$



Experimental Setup

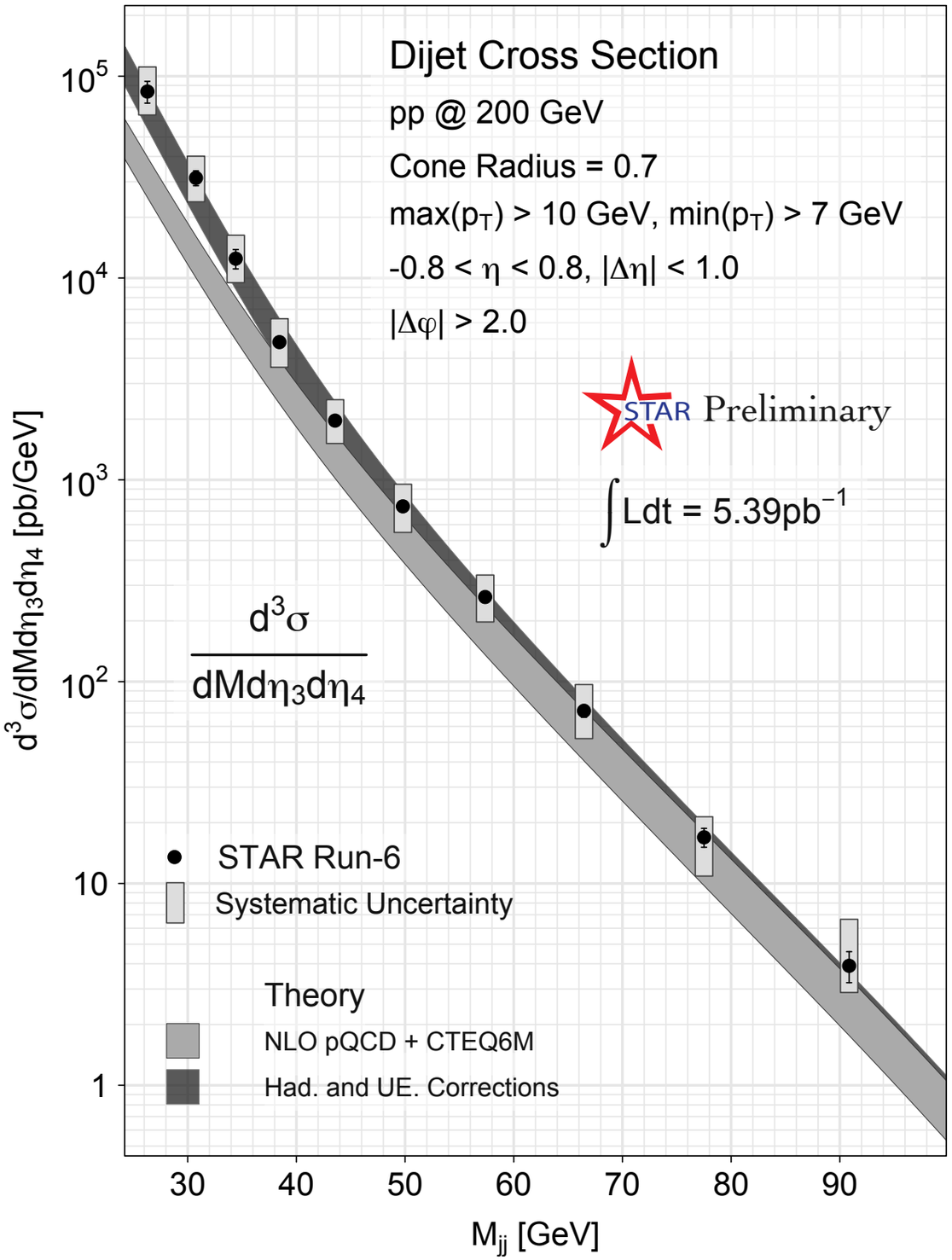
- RHIC produces polarized proton beams up to 250 GeV in energy
- Siberian snake magnets in the AGS and RHIC help protect beam from depolarized resonances

STAR Detector



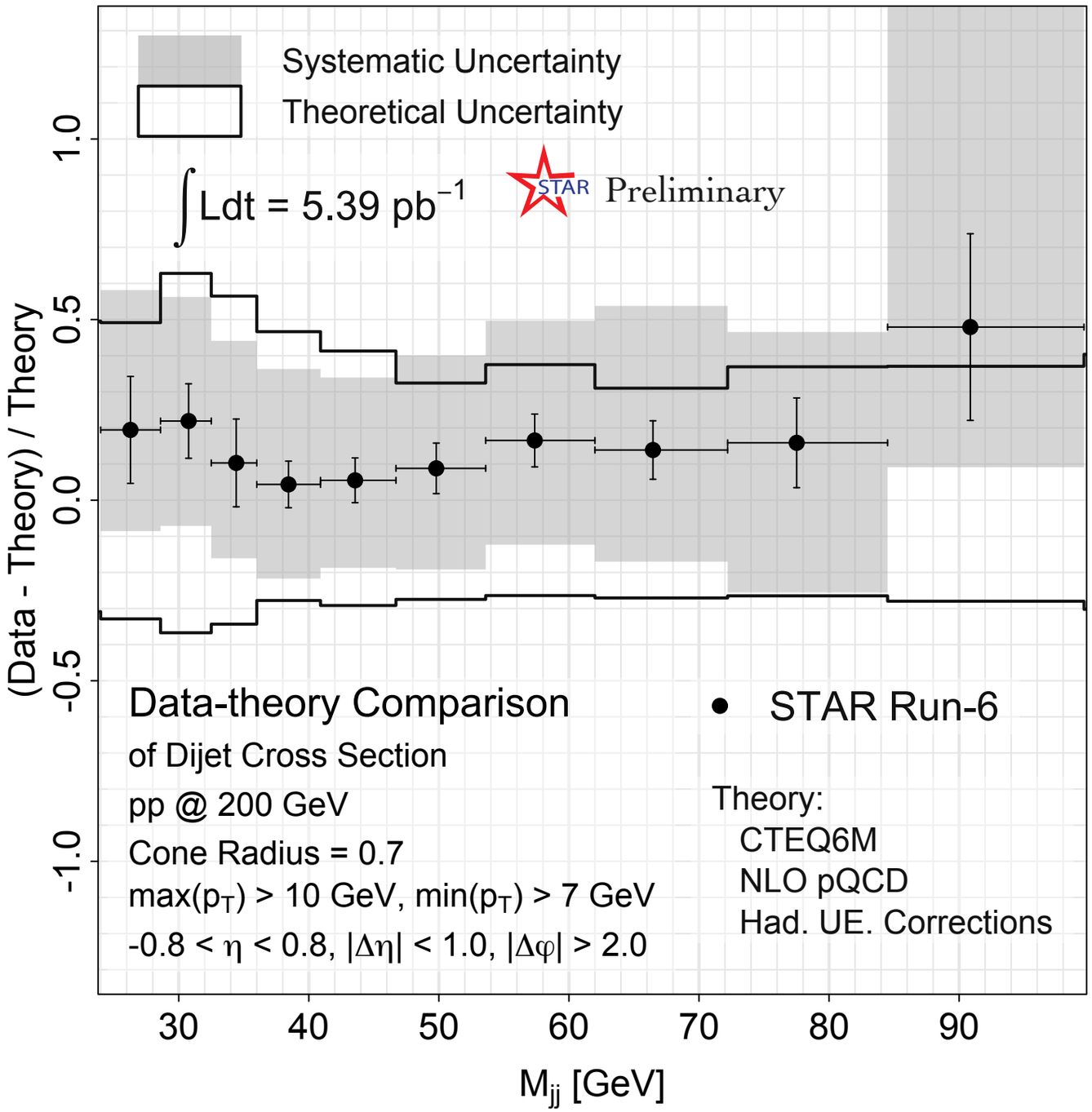
Not shown:
Zero-degree calorimeters,
time-of-flight, polarimeters

2006 Cross Section



- Unpolarized differential cross section between 24 and 100 (GeV/c^2)
- NLO theory predictions using CTEQ6M provided by de Florian with and without corrections for hadronization and underlying event from PYTHIA
- Statistical Uncertainties as lines, systematics as rectangles

2006 Cross Section

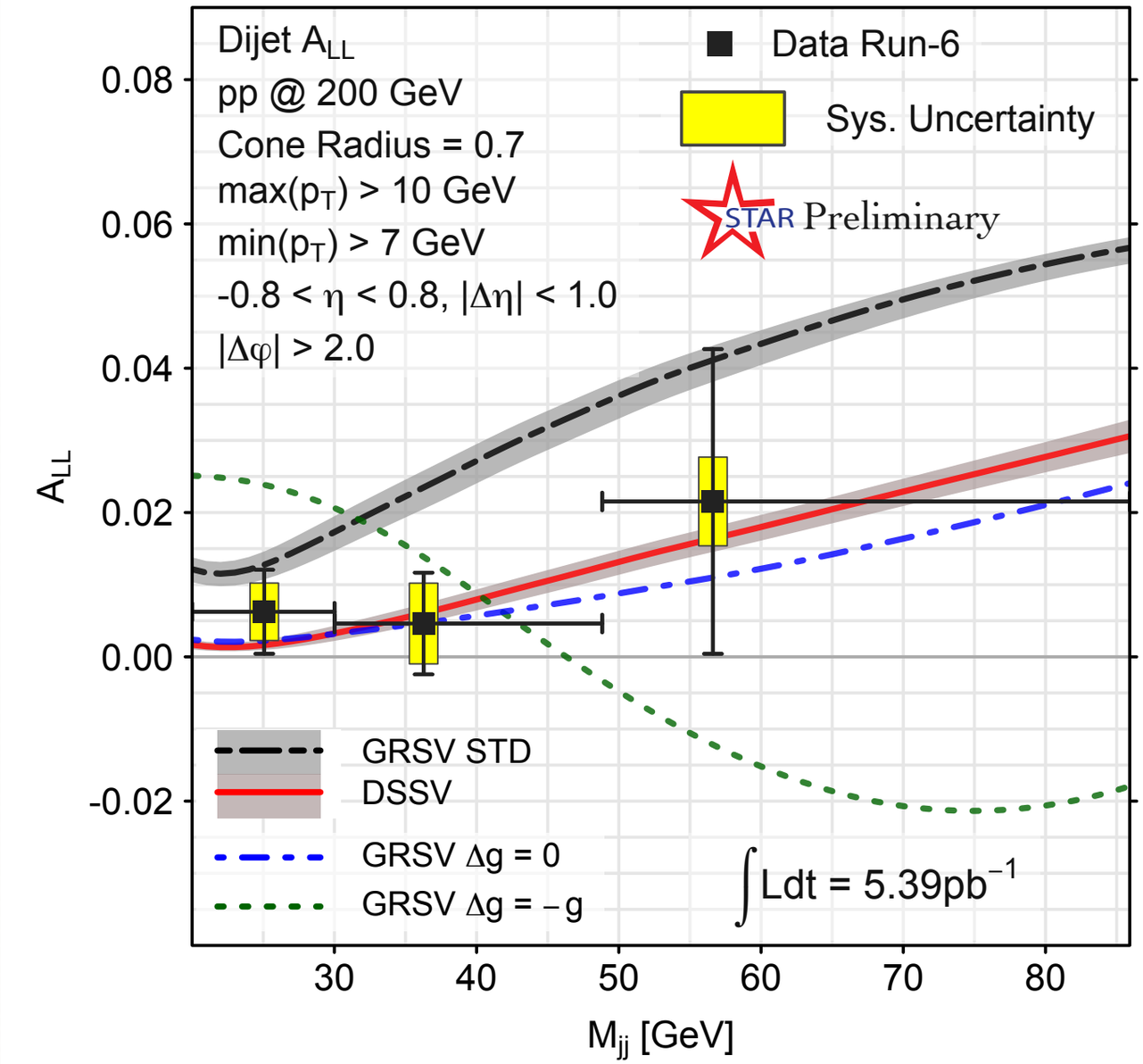


- Comparison to theory (including hadronization and underlying event correction) shows good agreement within systematic uncertainties

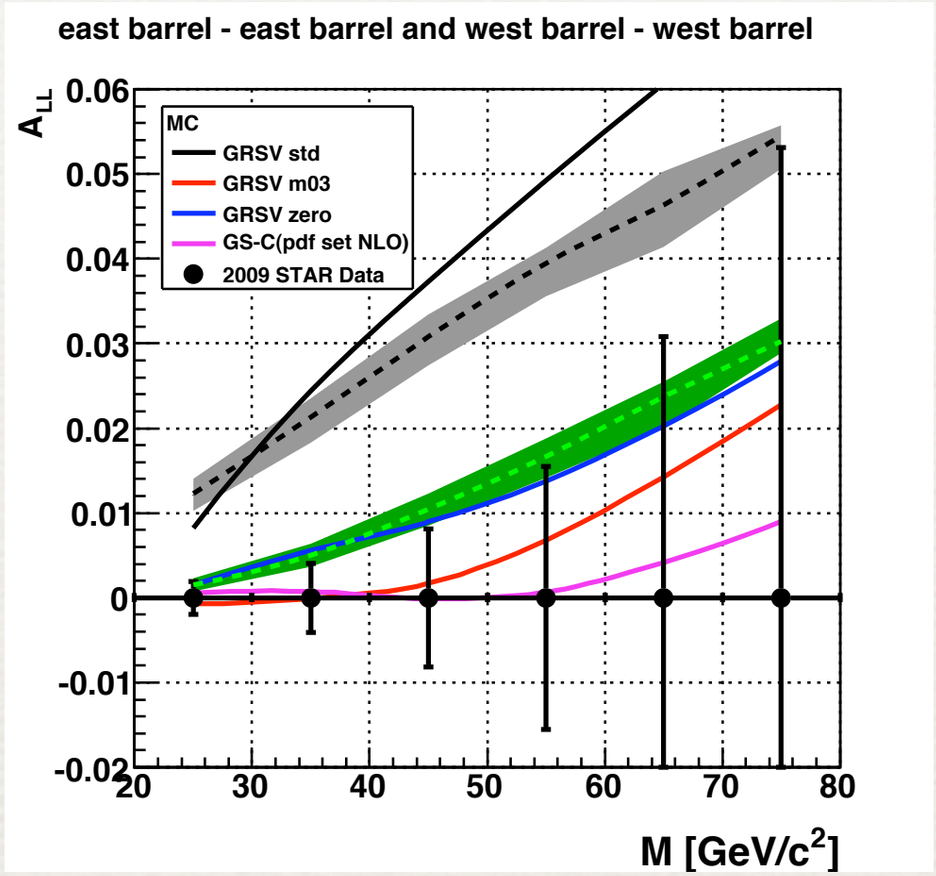
2006 Asymmetry

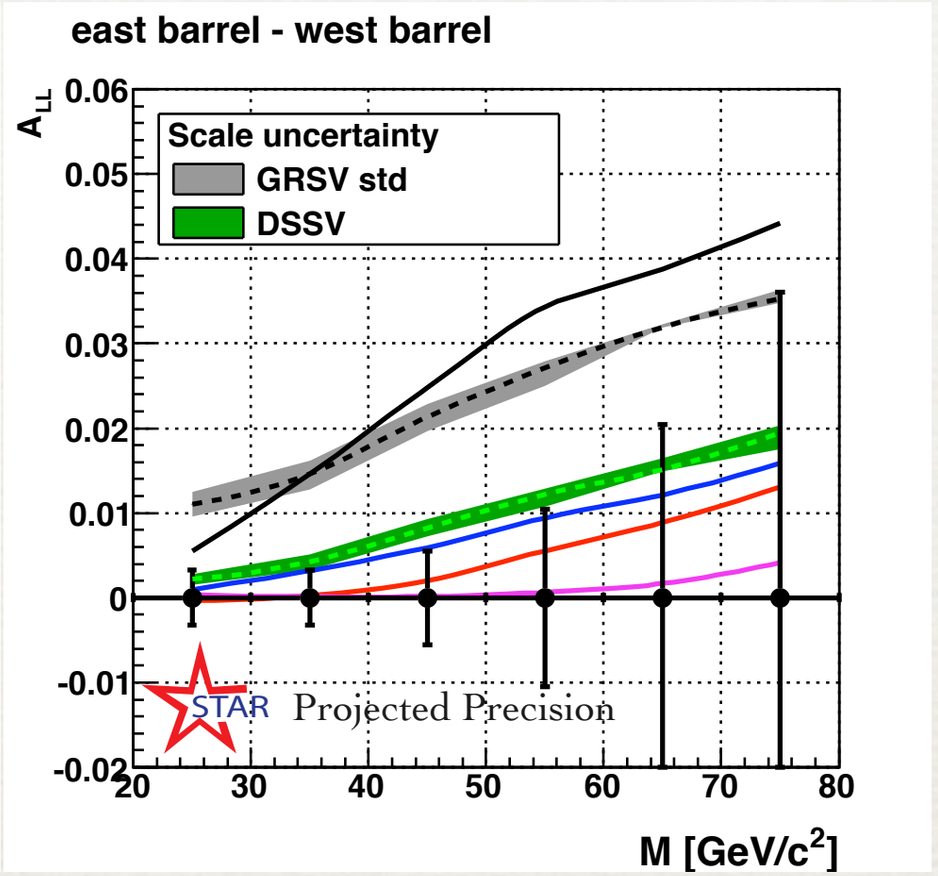
$$A_{LL} = \frac{1}{P_B P_Y} \frac{N^{++} - RN^{+-}}{N^{++} + RN^{+-}}$$

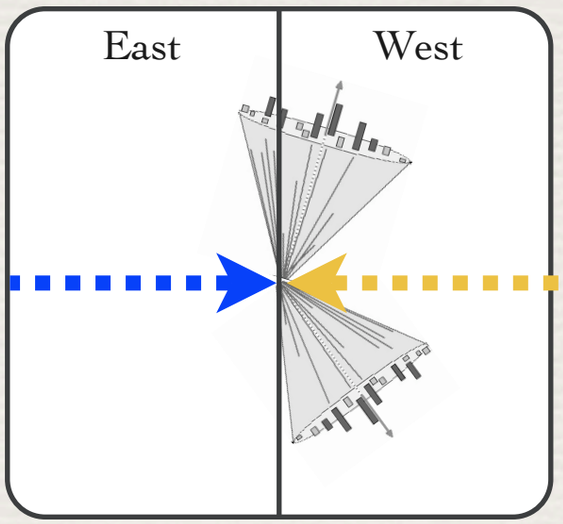
- Run 6 Longitudinal double helicity asymmetry
- Systematic uncertainties show effects on trigger efficiency from different theory scenarios
- Scale uncertainty (8.3%) from polarization uncertainty not shown

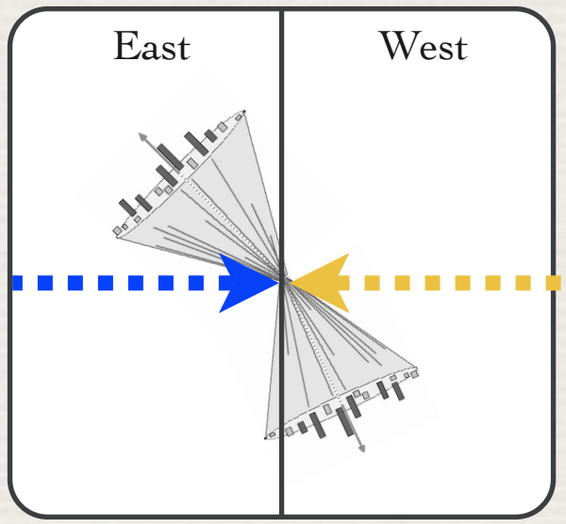


2009 Projections







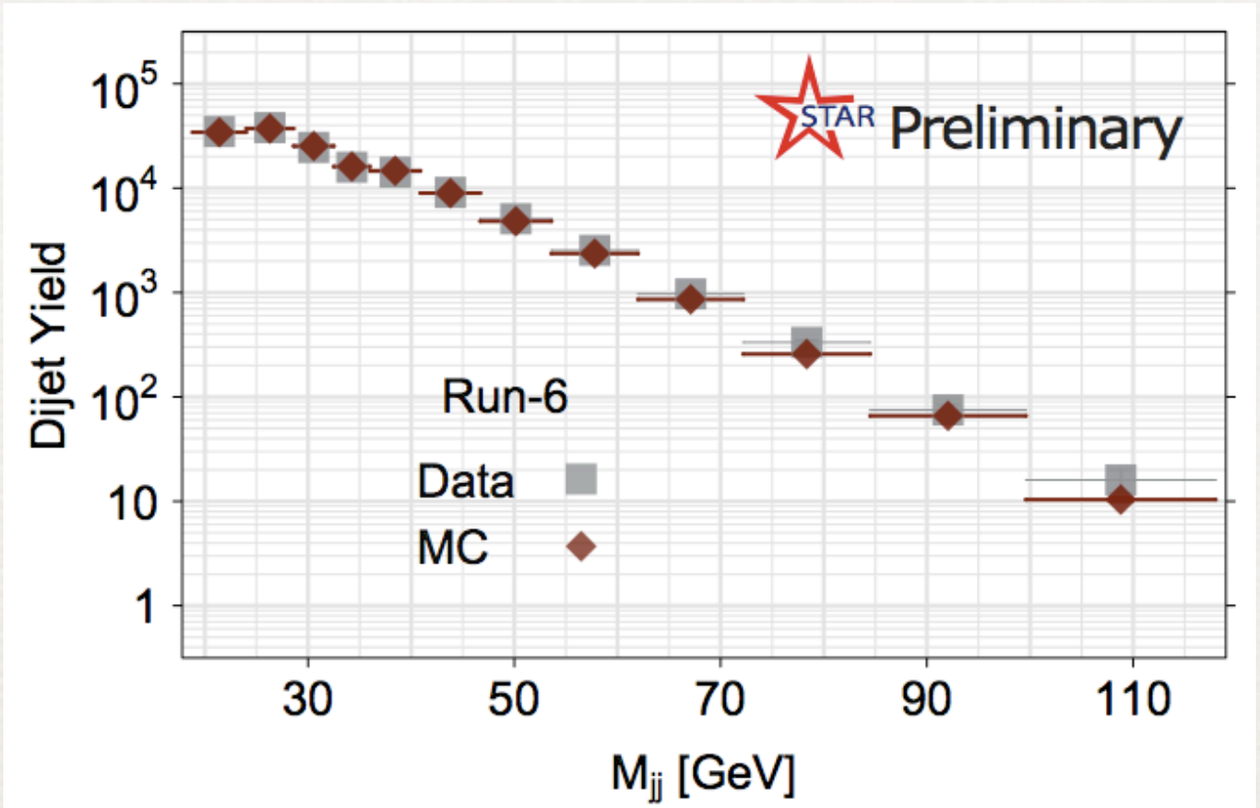


Summary

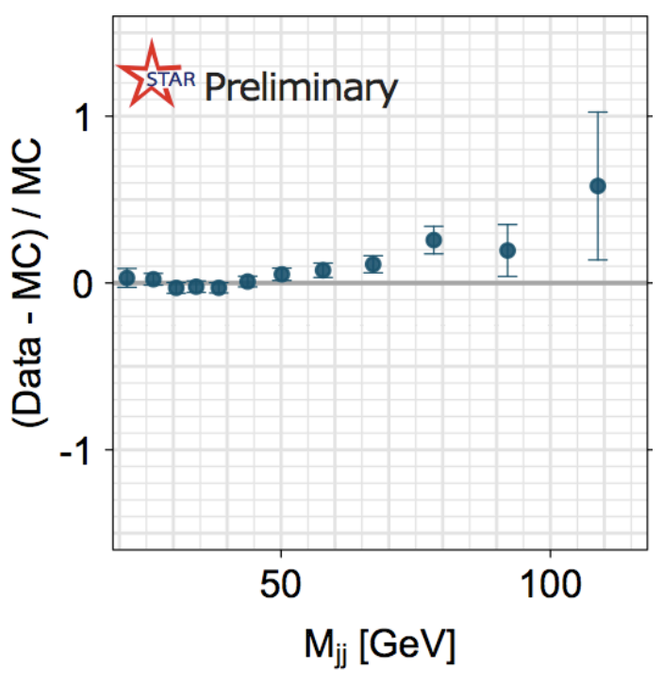
- Correlations measurements provide constraints on parton kinematics, which helps constrain the shape of $\Delta g(x)$
- 2006 Dijet cross section (5.39 pb^{-1}) shows good agreement with NLO calculations
- First Dijet double-spin asymmetry (FOM = 0.59 pb^{-1}) from 2006 data suggests preference away from GRSV-std scenario
- 2009 Dijet asymmetry analysis underway with FOM = 0.96 pb^{-1} analyzed to date, and more to come

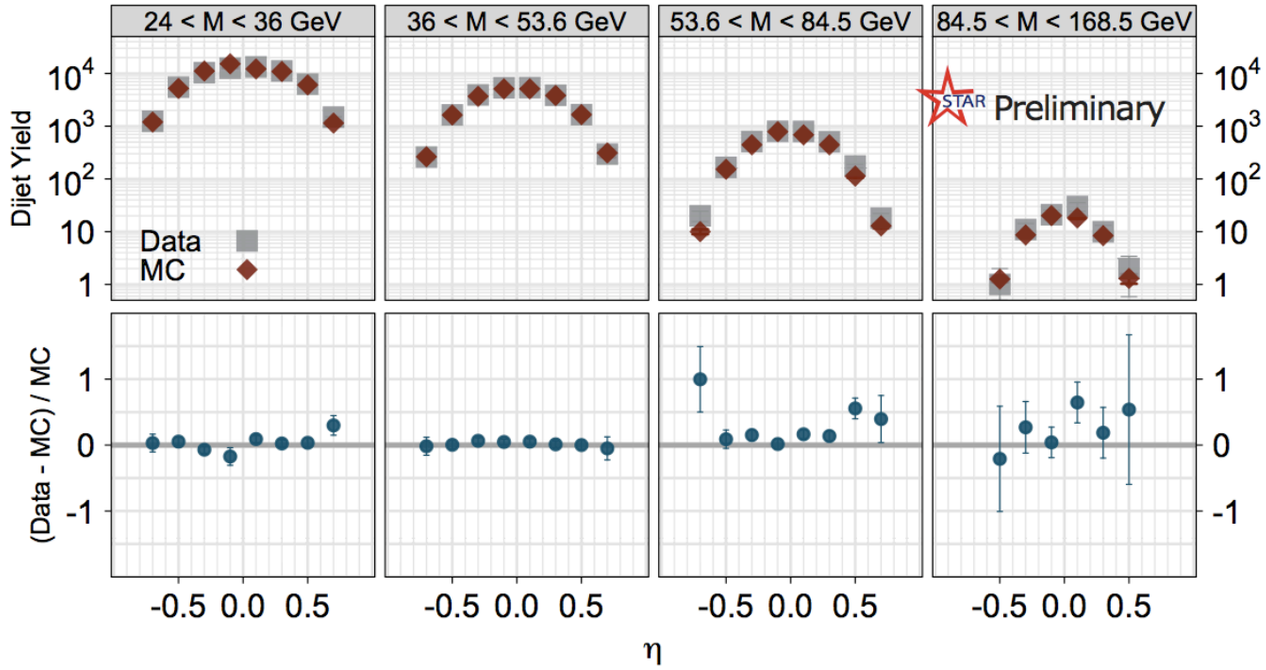
Backup

Data/Simulation Run 6



- 2006 Simulation:
  - 11 STAR MC productions producing 4M events with partonic pT between 3 GeV and 65 GeV
  - PYTHIA 6.410, CDF Tune A
- Run 6 data and simulation agreement is good





Data/Simulation Run 9

- Run 9 data simulation agreement is good