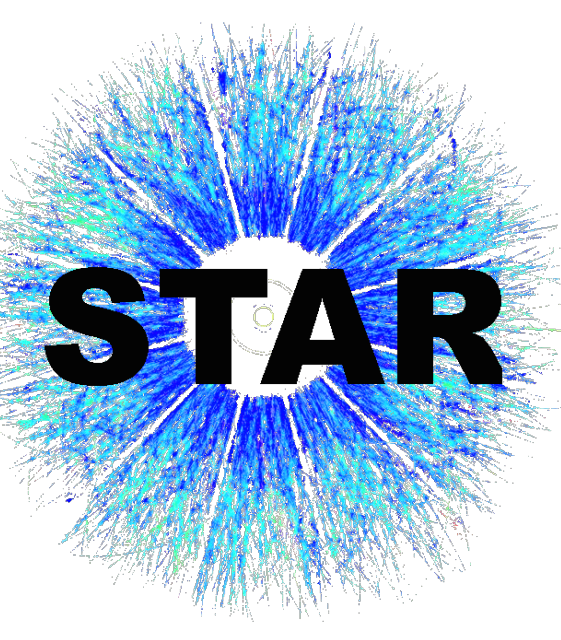




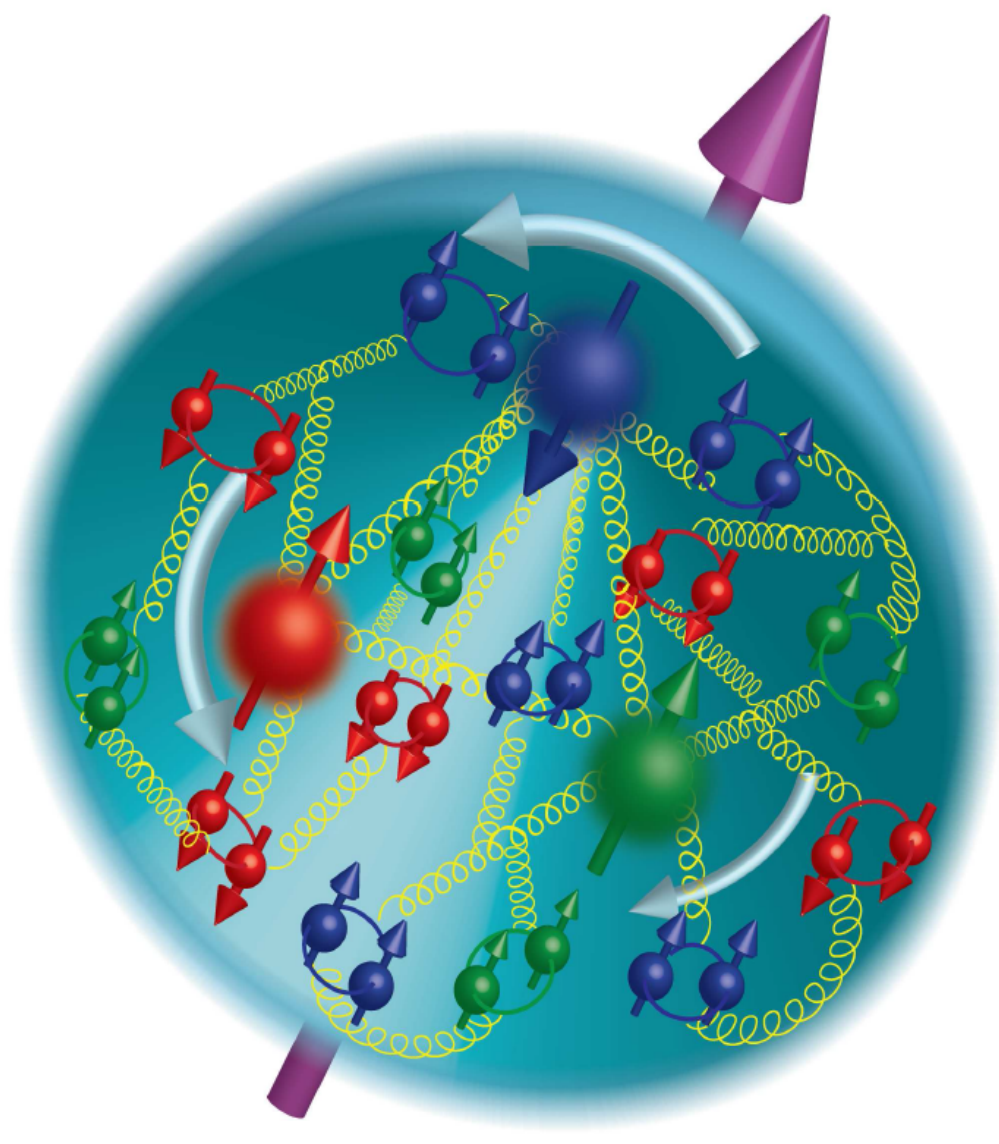
Measurement Of Longitudinal Single-Spin Asymmetry, A_L For W Boson Production In Polarized P+P Collisions At RHIC



Devika Gunarathne [Temple University, STAR collaboration]

INTRODUCTION

SPIN STRUCTURE OF THE PROTON



spin sum rule

$$\langle S_p \rangle = \frac{1}{2} = \frac{1}{2} \Delta\Sigma + \Delta G + L$$

Quark / antiquark Contribution

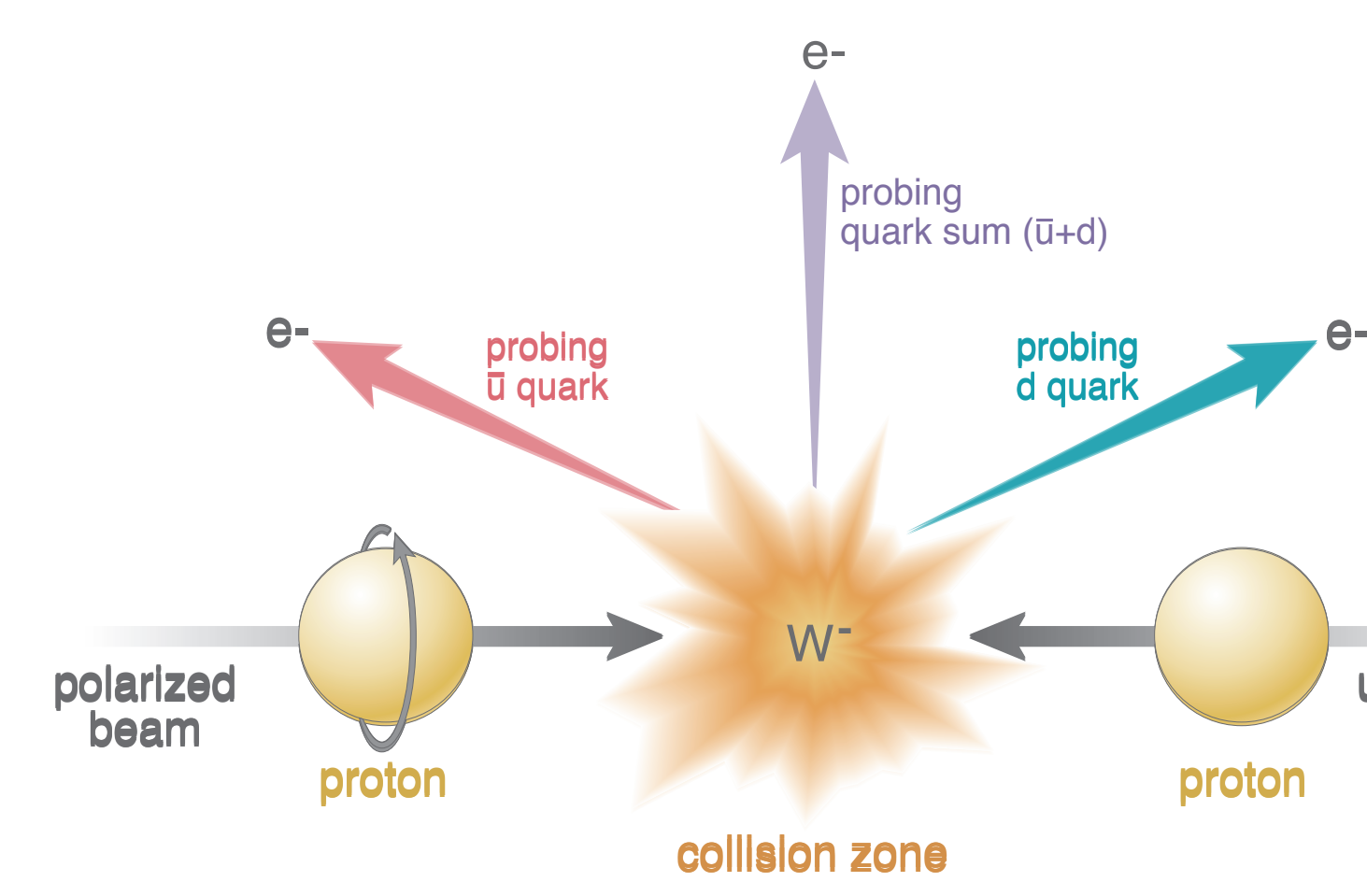
$$\Delta\Sigma = \int (\Delta u + \Delta d + \Delta s + \Delta\bar{u} + \Delta\bar{d} + \Delta\bar{s}) dx \sim 30\%$$

DSSV global analysis of helicity PDF

- Large uncertainty for sea quark polarization

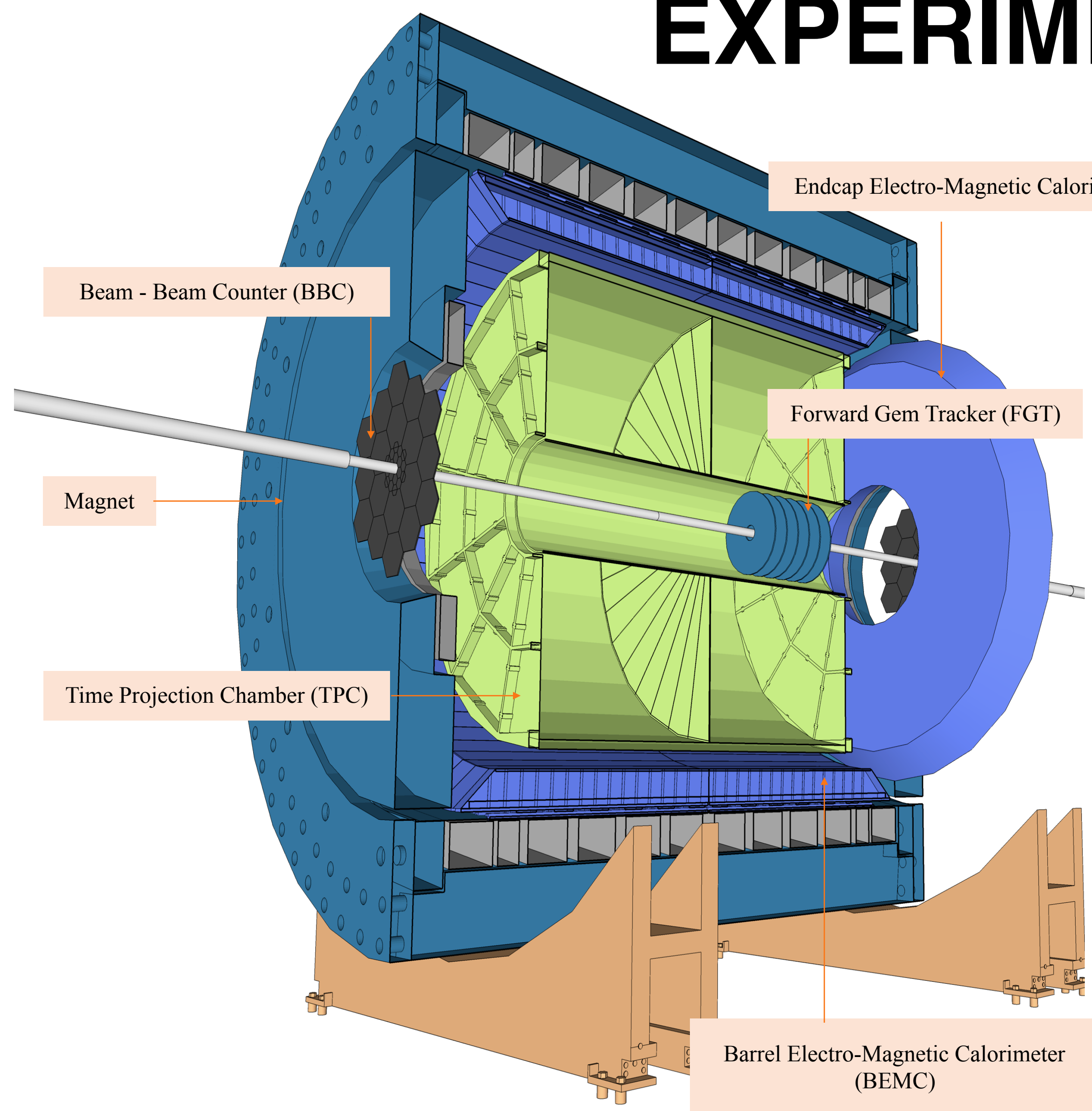
W Boson Production in polarized p+p collisions

- Direct access to $\Delta q / \Delta\bar{q}$
- Easy detection



- No fragmentation involve.
- Maximum parity violation

EXPERIMENT



STAR Detector

TPC : $-1.3 < \eta < +1.3$,
Tracking and Particle ID

BEMC : $-1.0 < \eta < +1.0$

EEMC : $+1.1 < \eta < +2.0$

Barrel and Endcap 2π calorimetry

BBC / ZDC :

Relative Luminosity

RESULTS

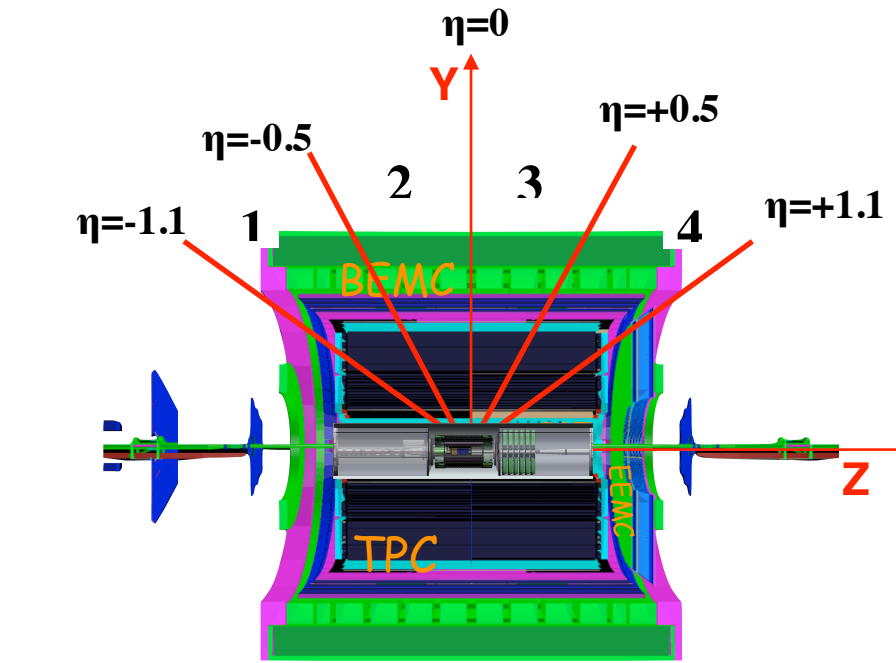
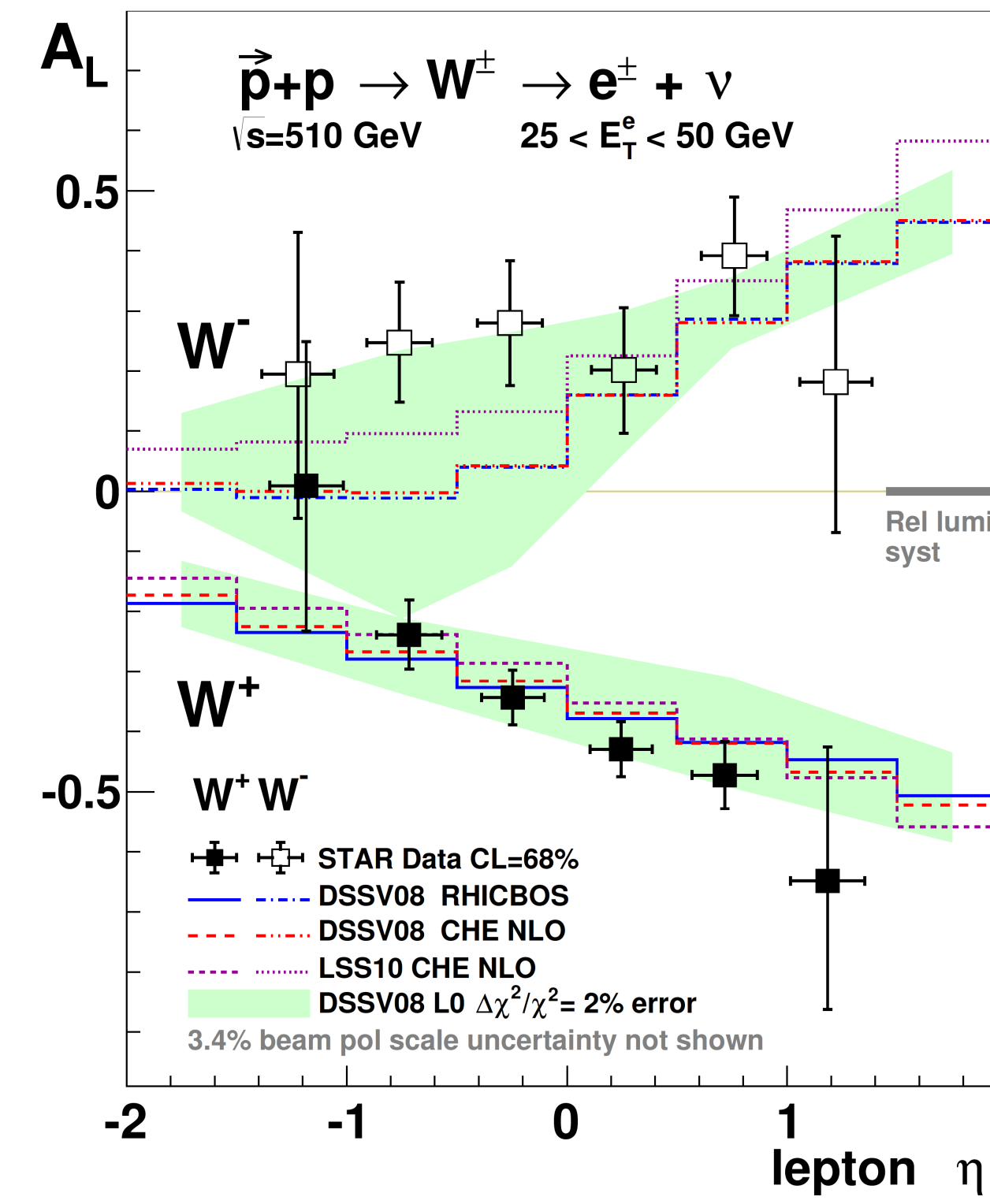
STAR Run 2012 W AL Published Results

- Large anti u quark polarization than theoretical prediction

single spin asymmetry

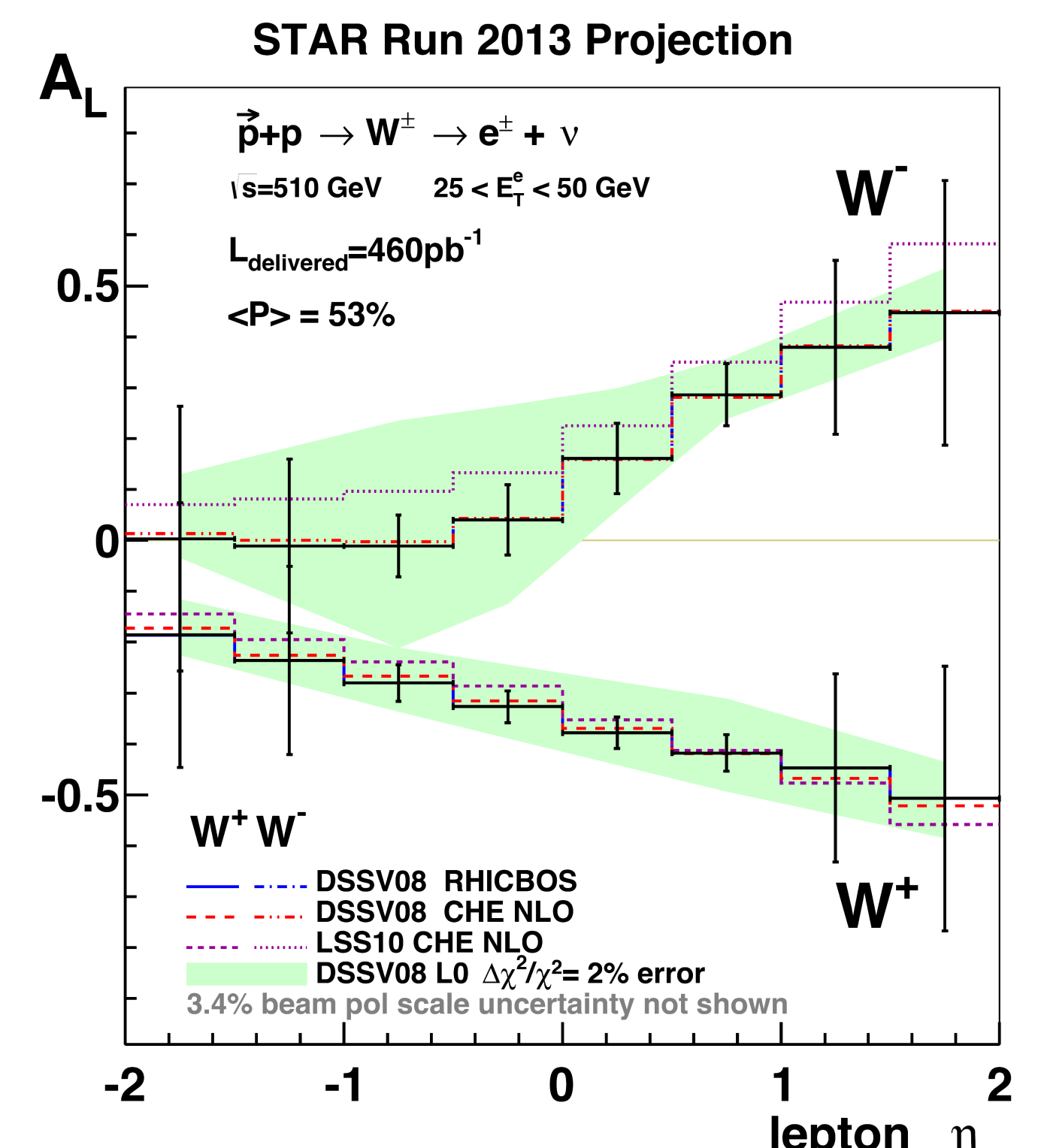
$$A_L = \frac{\sigma^+ - \sigma^-}{\sigma^+ + \sigma^-}$$

$$A_L = \frac{1}{P_1} \frac{N_{++} + N_{+-} - N_{-+} - N_{--}}{N_{++} + N_{+-} + N_{-+} + N_{--}}$$



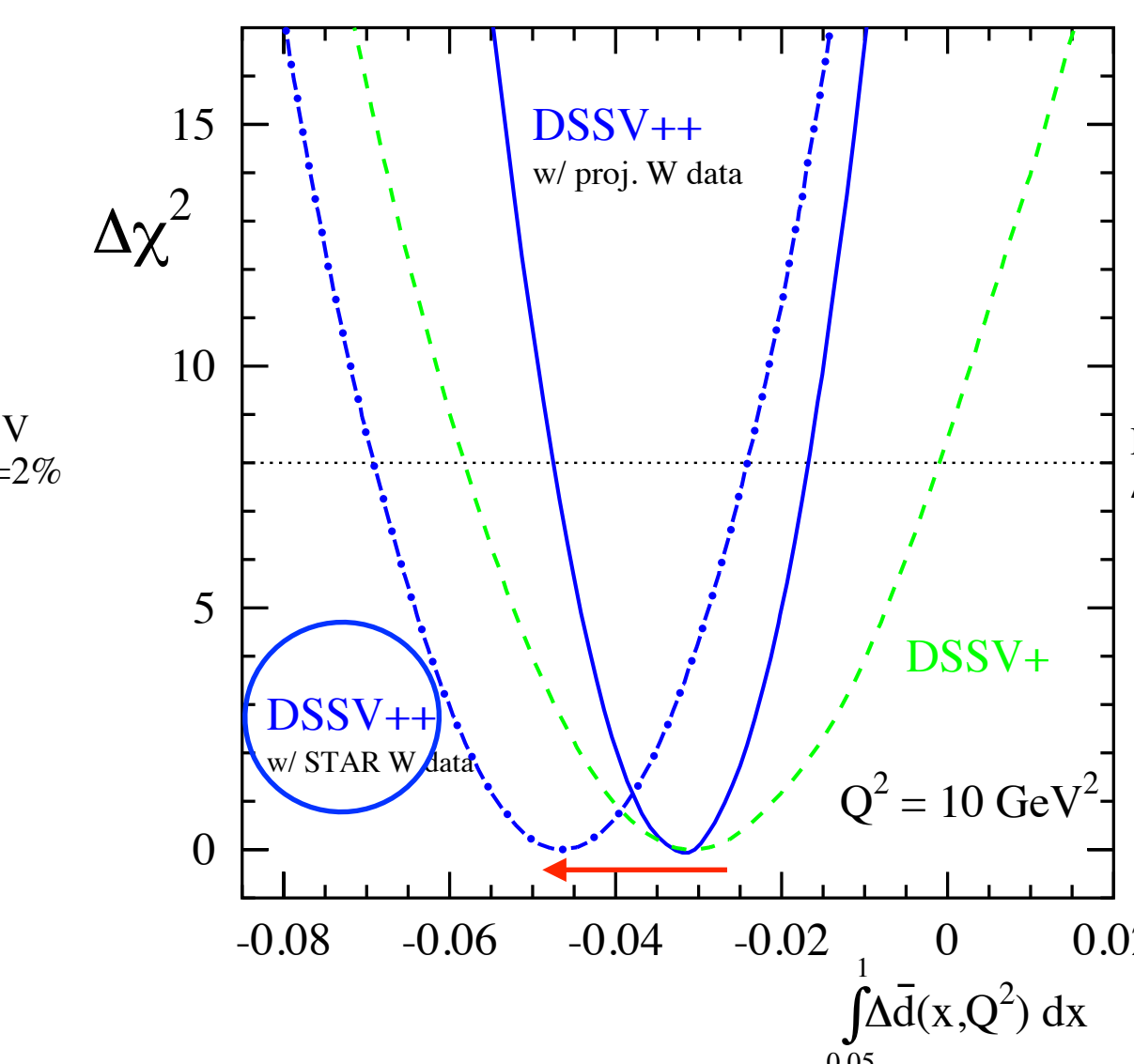
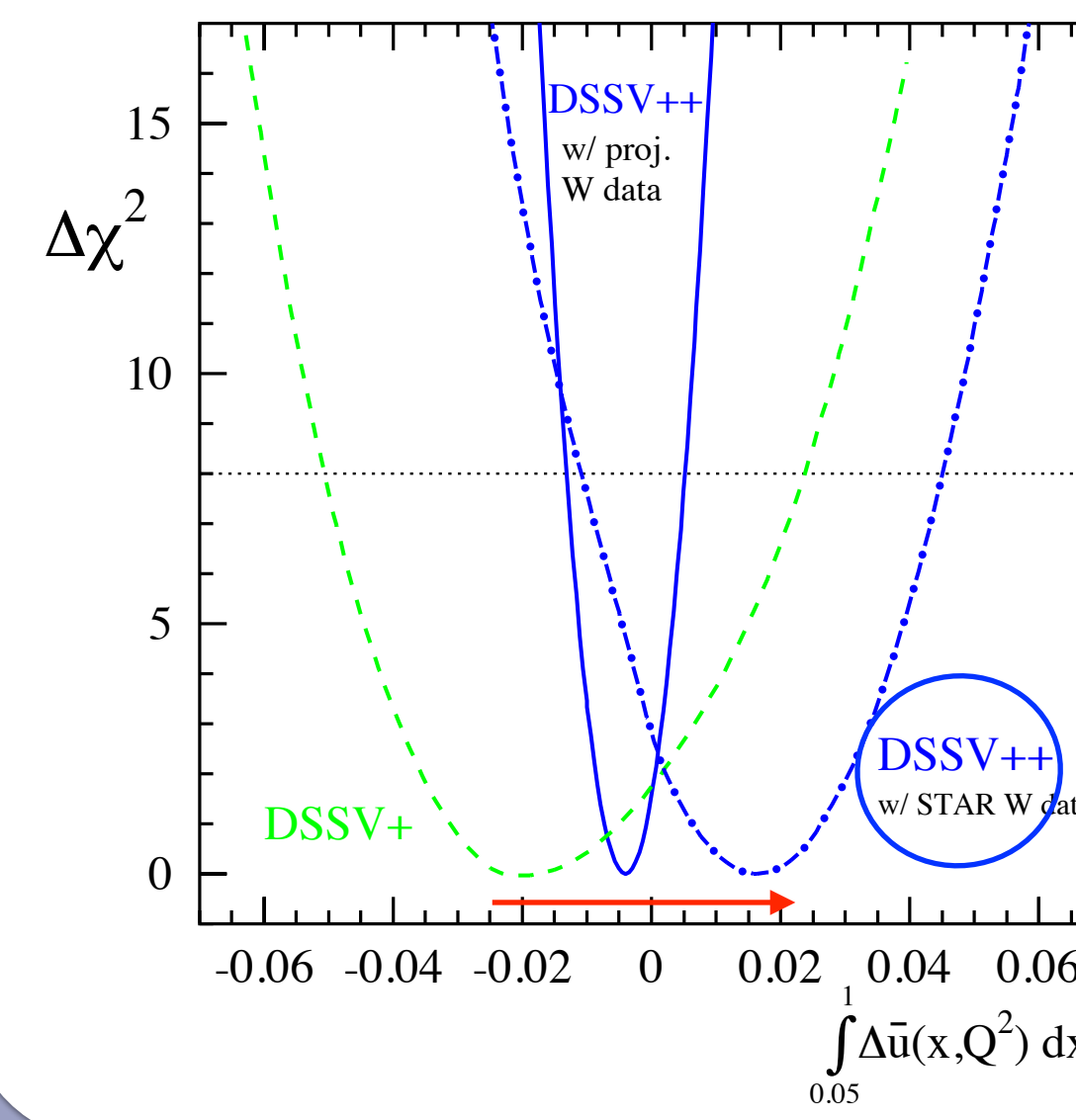
STAR Run 2013 W AL Projections

- Large data set in run 2013 expect to reduce uncertainty further

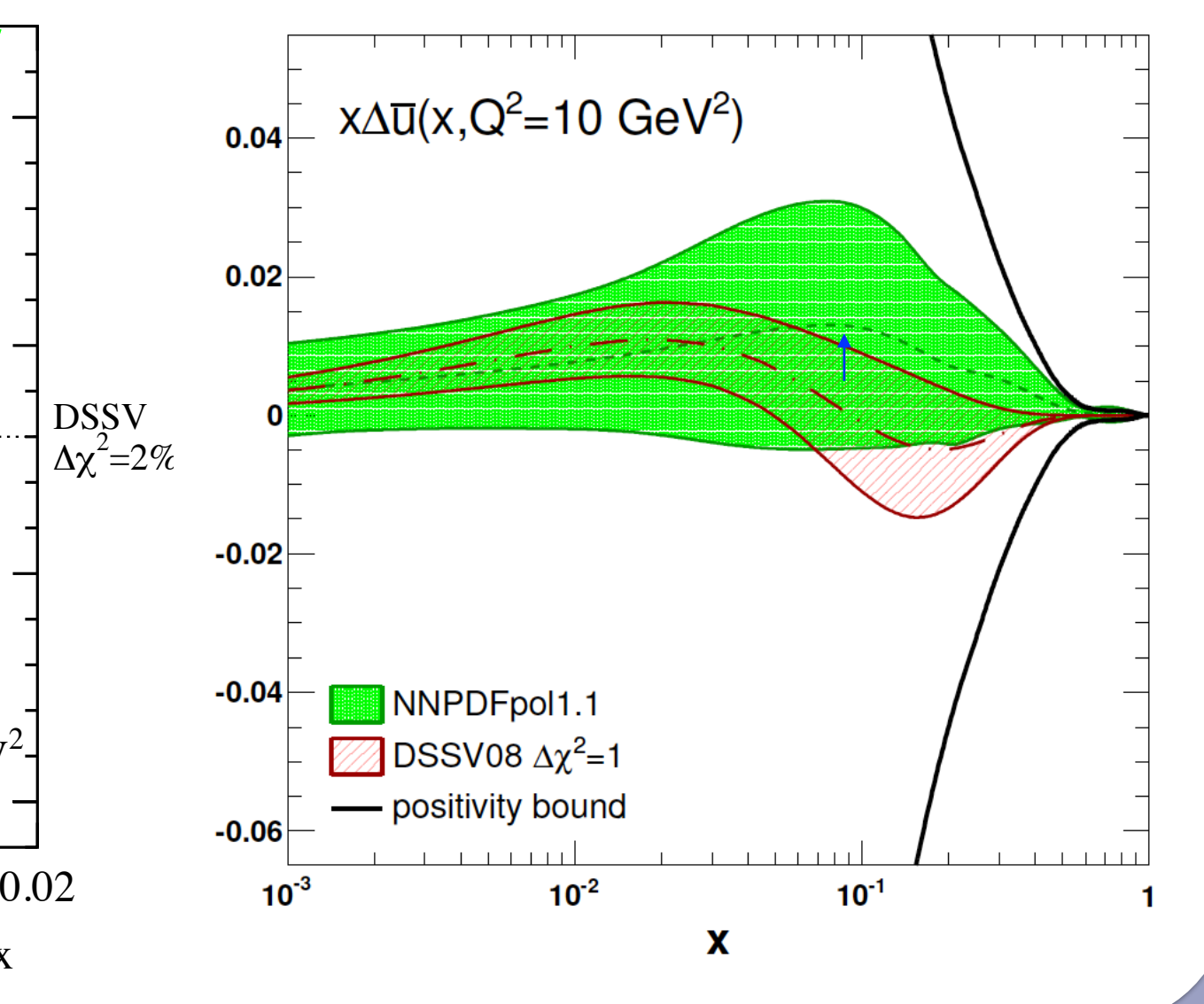


Impact of Recent STAR W AL Results on Recent Global Analyses and Predictions for future STAR Results

DSSV++ Global Analysis includes published STAR W AL Results



NNPDF analysis of anti U quark polarization.



CONCLUSION

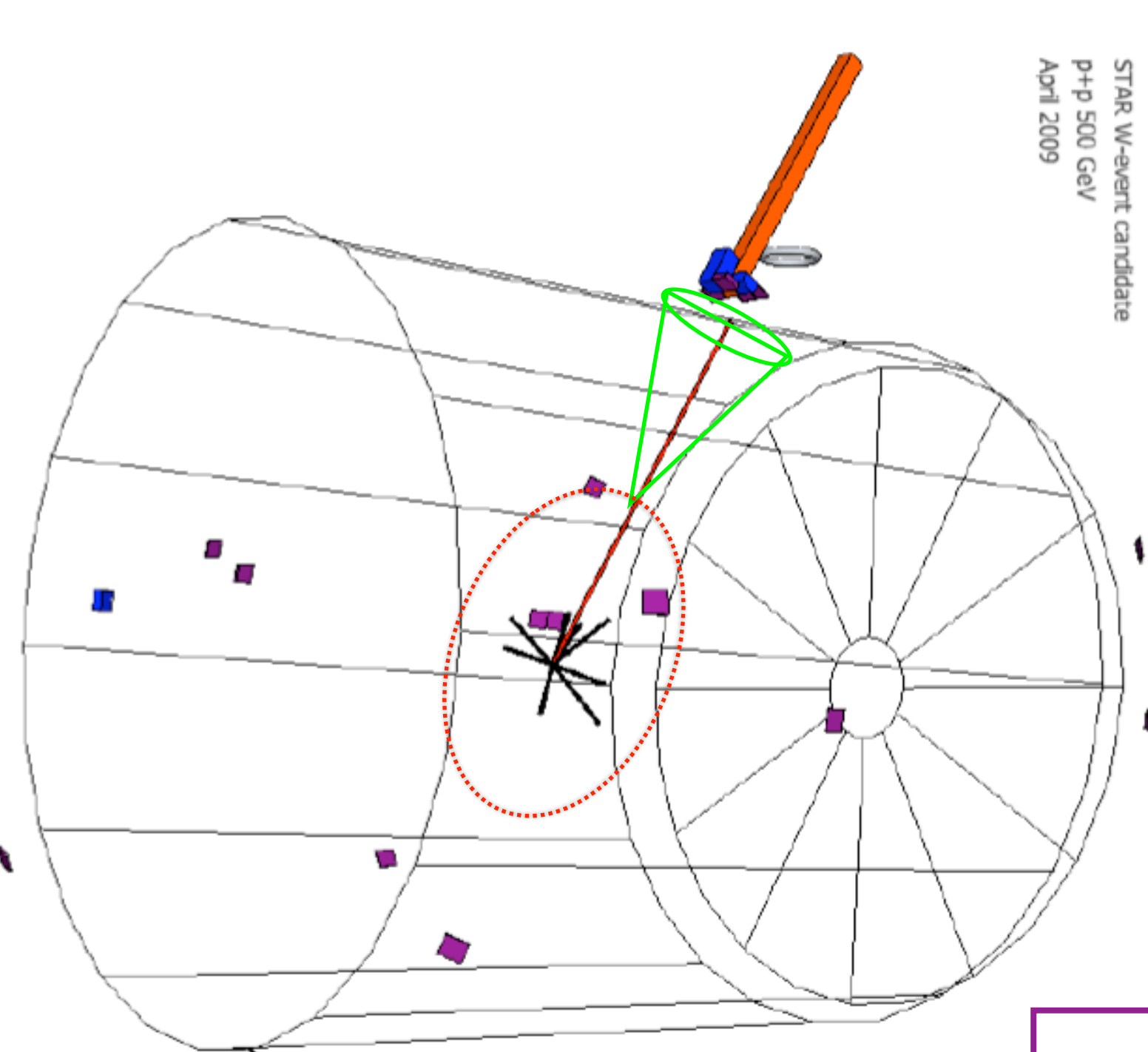
- The production of W bosons in polarized P+P collisions provides an excellent way to study the spin and flavor asymmetries of the proton quark and antiquark distributions.
- STAR has measured the parity violating single spin asymmetry A_L for pseudo-rapidity between -1.4 and +1.4 from STAR 2012 and 2011 data providing the first detailed look at the asymmetries η dependence.
- STAR 2012 W A_L results provide significant constraints on anti u and anti d quark polarizations.
- Large data set of STAR 2013 is being analyzed currently in mid rapidity region (pseudo-rapidity between -1.0 and +1.0) and expects results reduce uncertainty further.
- High precision results from STAR 2013 data will improve the constraints on the anti u and anti d quark polarizations.

ANALYSIS

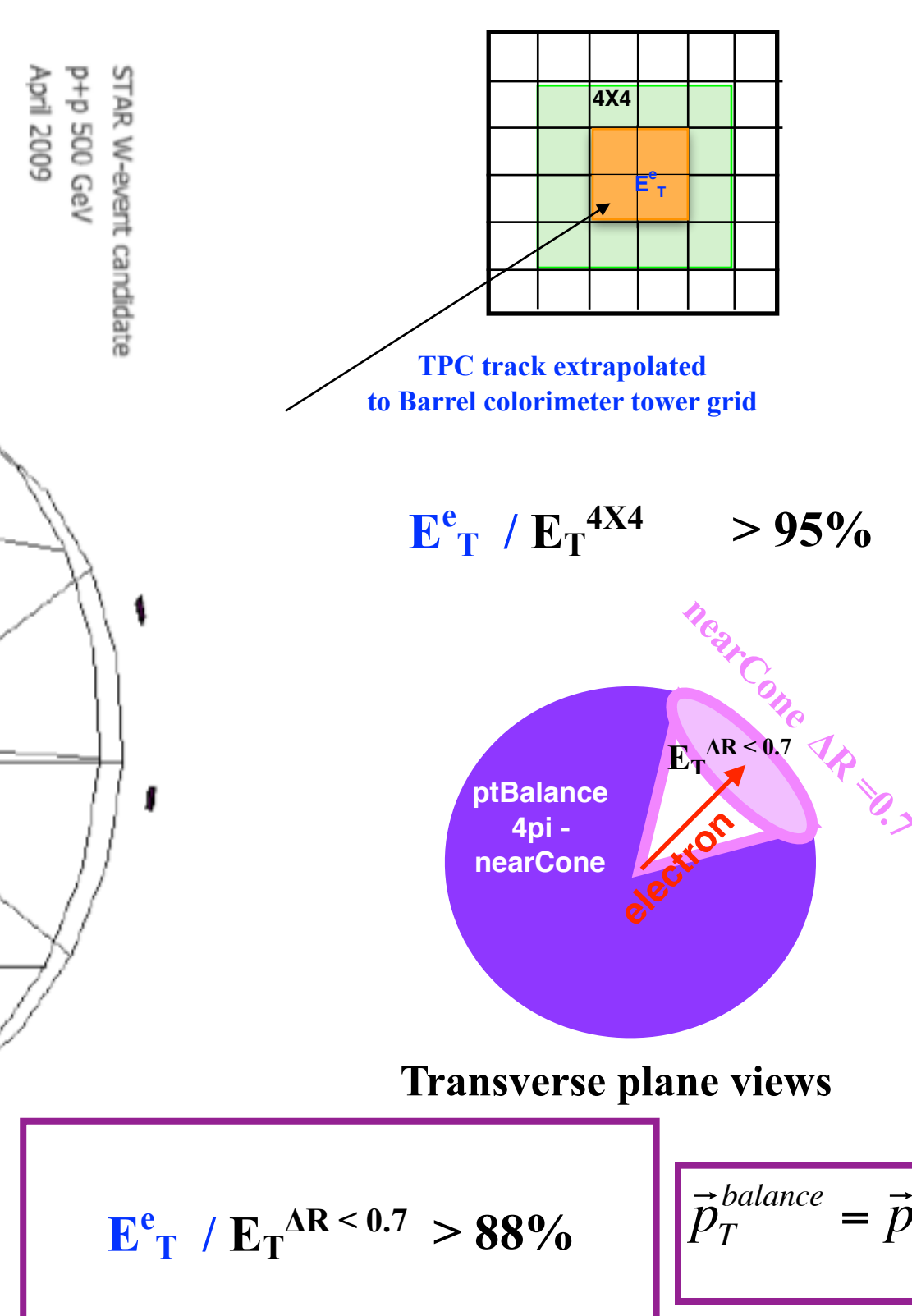
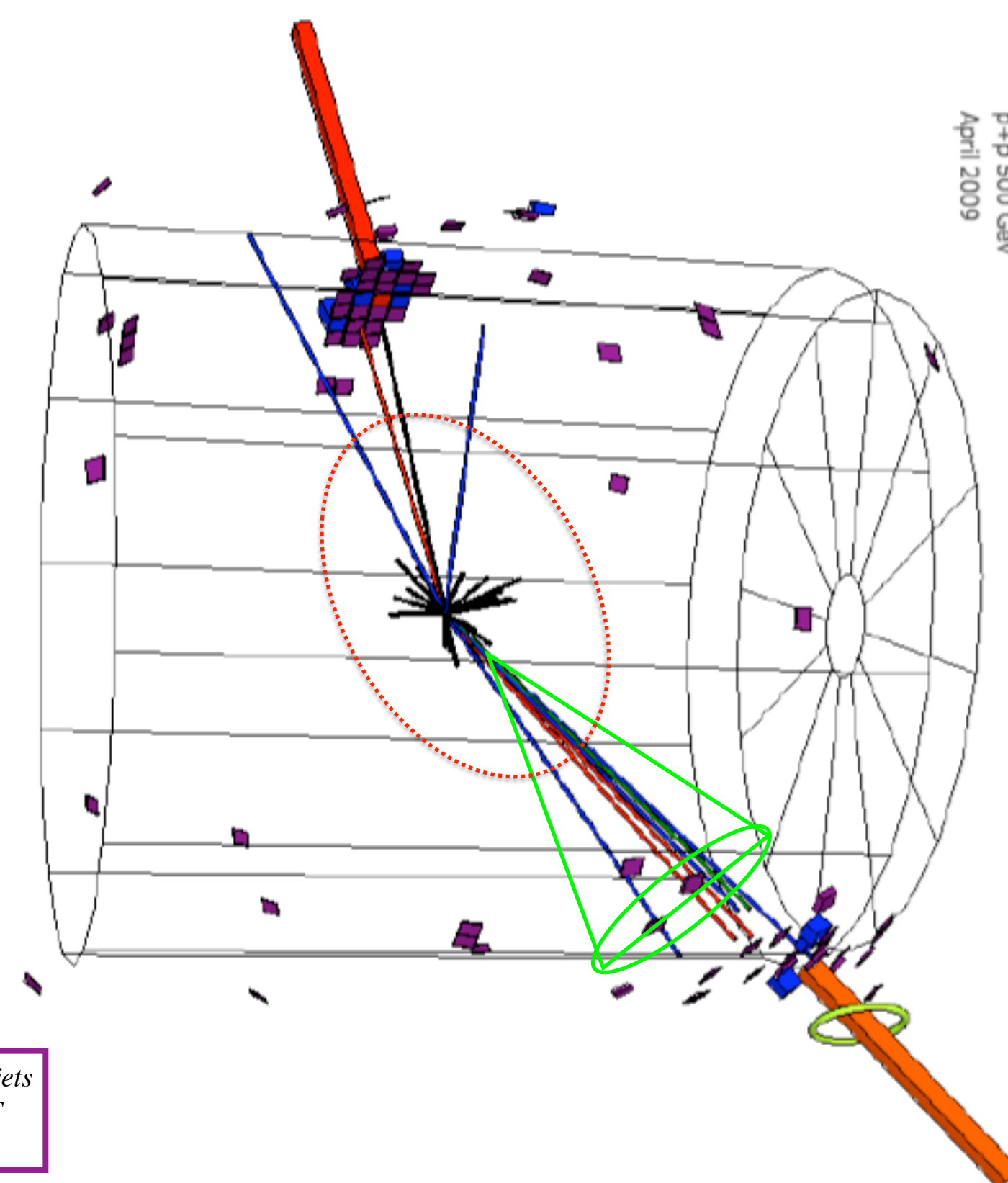
Reconstruction of W bosons from decay electron and positrons

- Isolated high energetic TPC tracks pointing to calorimeter tower. Energy from the maximum 2x2 cluster.
- Undetected neutrino leads to large opposite missing energy, large imbalance in the transverse momentum.
- Cuts designed to take the advantage of topological difference between W and QCD type BG event

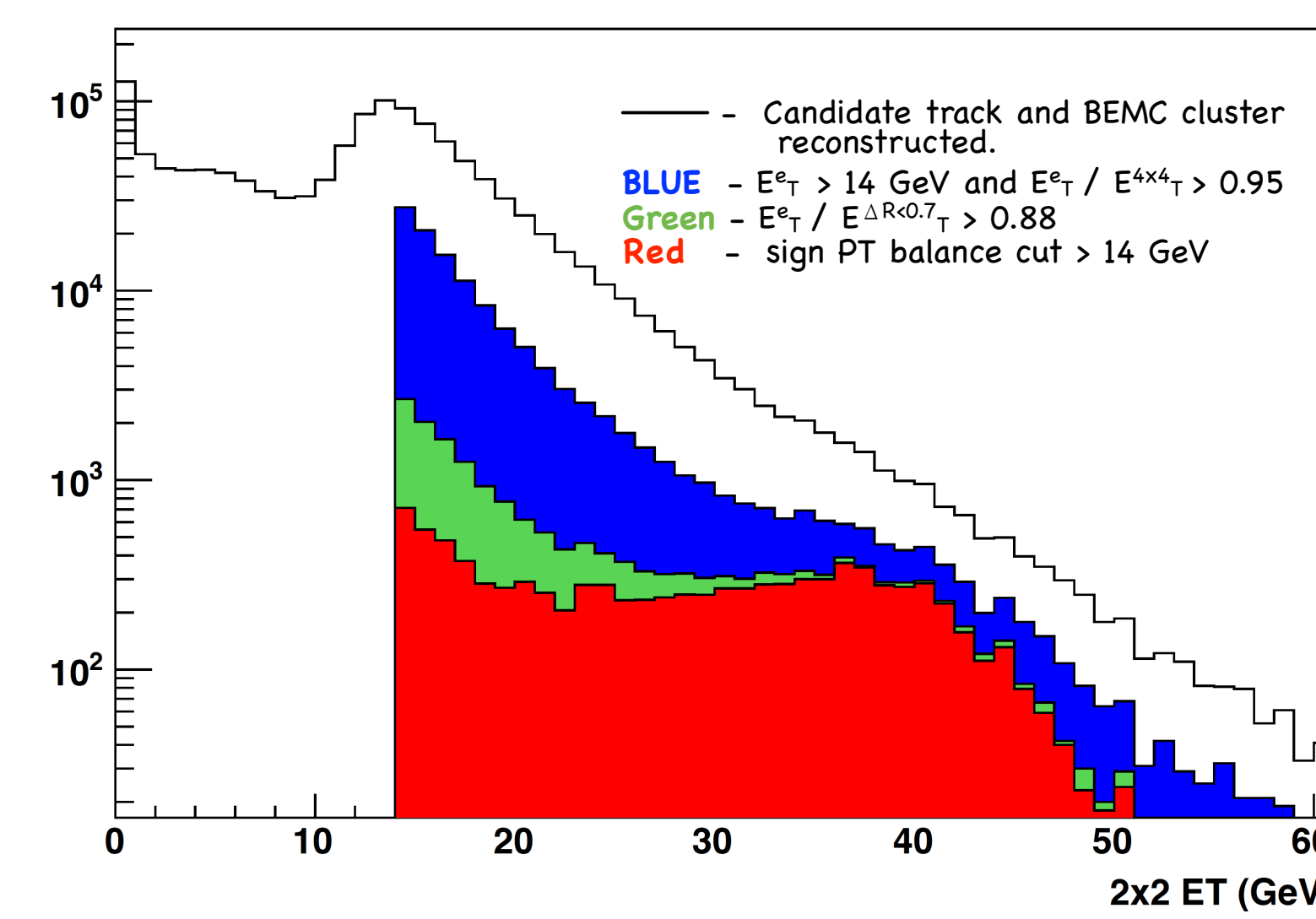
Calorimeter response from a simulated W event



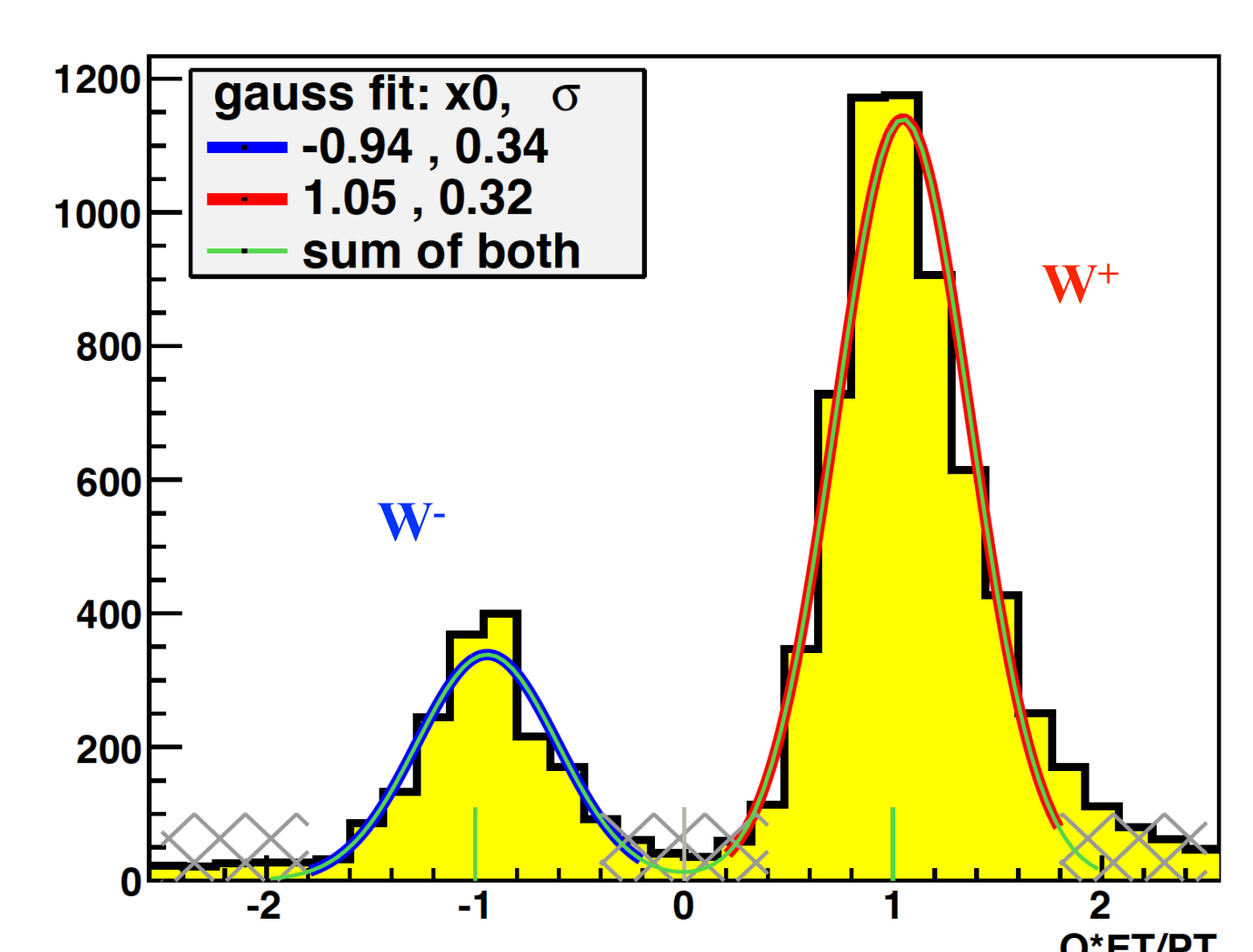
Calorimeter response from a simulated QCD type di-jet background event



W candidate tracks as a function of transverse Energy



TPC Charge sign separation



Background Estimation

- QCD BG using data driven procedure
- Electroweak BG (W->tau, Z->e+e-) using MC simulation

