



# *Resonance Spin Structure*

Frank R. Wesselmann



- ▶ Overview
- ▶ Developments
- ▶ Outlook

# *E-01-006: RSS*

## Nucleon Spin Structure in the Resonance Region

- ▶ Inclusive Scattering, Polarized Beam & Target

- \* *UVa Target, HMS*

- ▶ Proton & Deuteron,

$$A_{\parallel} \ \& \ A_{\perp} \ \longleftrightarrow \ A_1 \ \& \ A_2 \ \longleftrightarrow \ g_1 \ \& \ g_2$$

- \* *consistent setup, minimal model input*

- ▶ ran January – March 2002

- ⇒ *W* Dependence

- ⇒ Polarized Local Duality

- ⇒ GDH Sum Rule

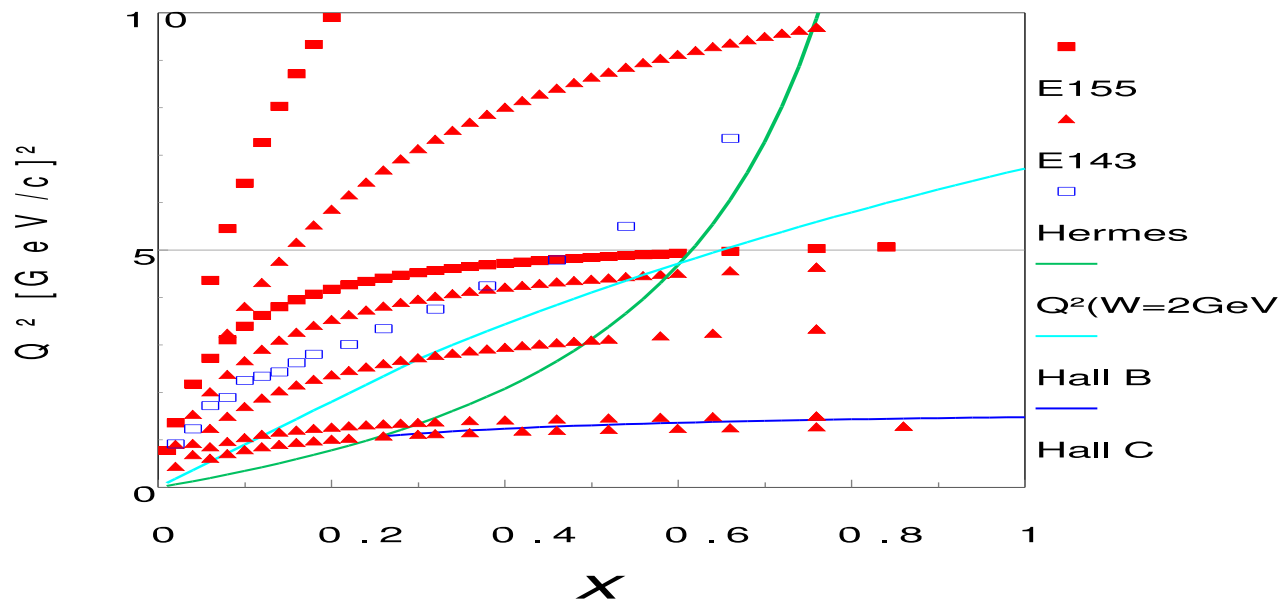
- ⇒ Higher Twist Effects

# *RSS Collaboration*

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*Florida International University, Hampton University, Mississippi State University, Norfolk State University, North Carolina A&T University, Old Dominion University, Southern University at New Orleans, Tel Aviv University, Thomas Jefferson National Accelerator Facility, Universität Basel, University of Maryland, University of Massachusetts, University of North Carolina at Wilmington, University of Virginia, Virginia Polytechnic Institute & State University, Yerevan Physics Institute*

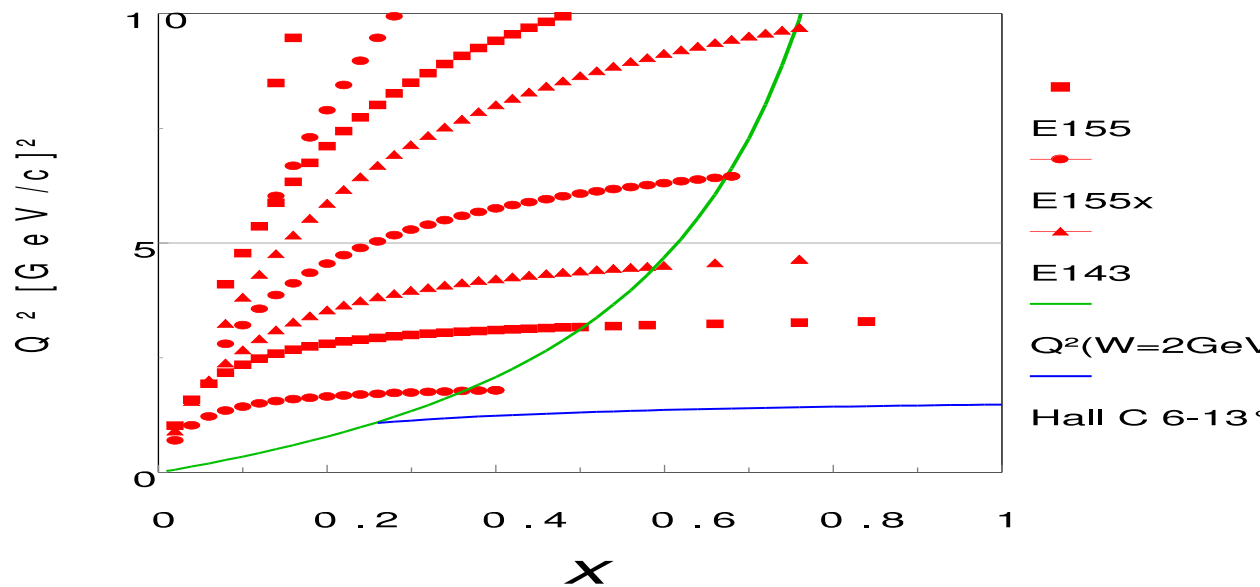
# World Kinematics



$Q^2$  vs.  $x$

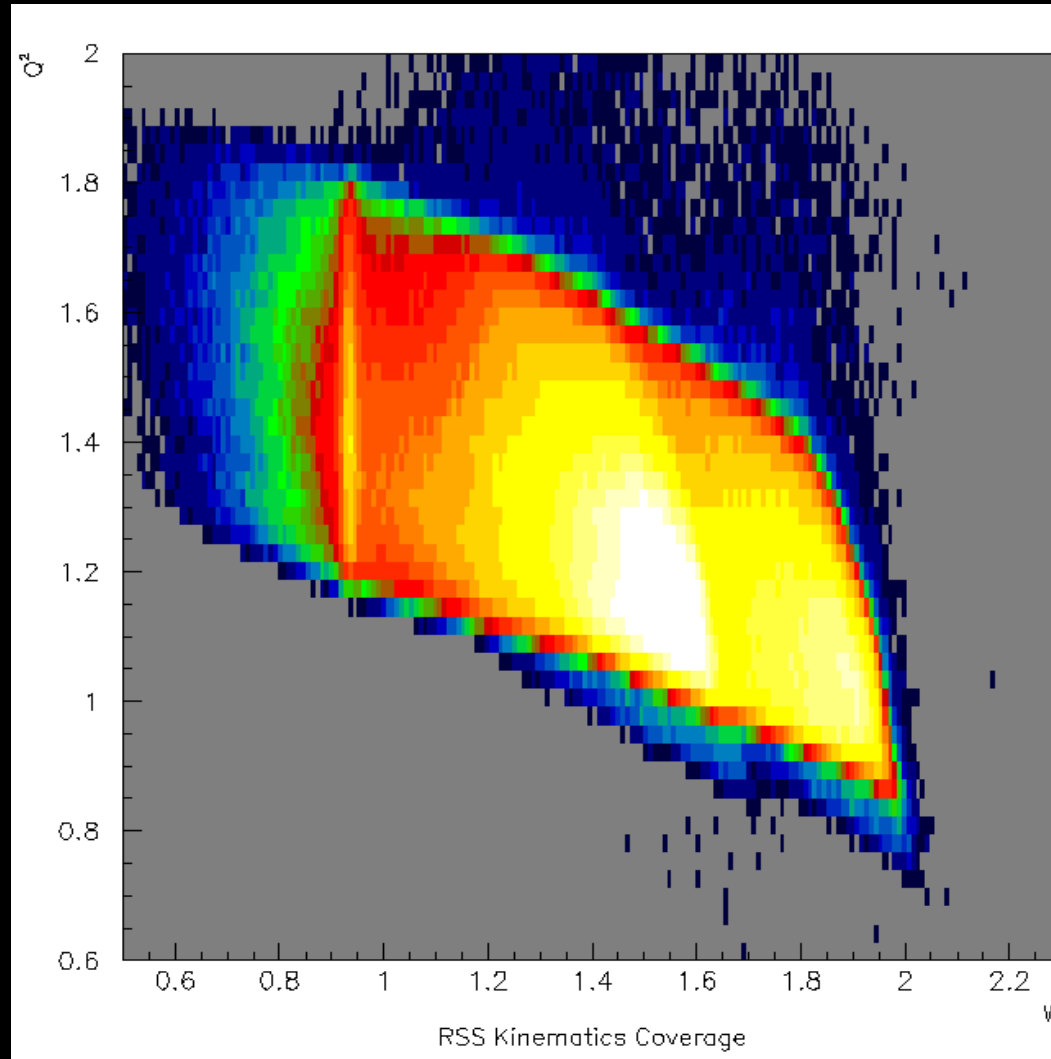
$0 < Q^2 < 10 \text{ GeV}^2$

$0 < x < 1$



# *RSS Kinematics*

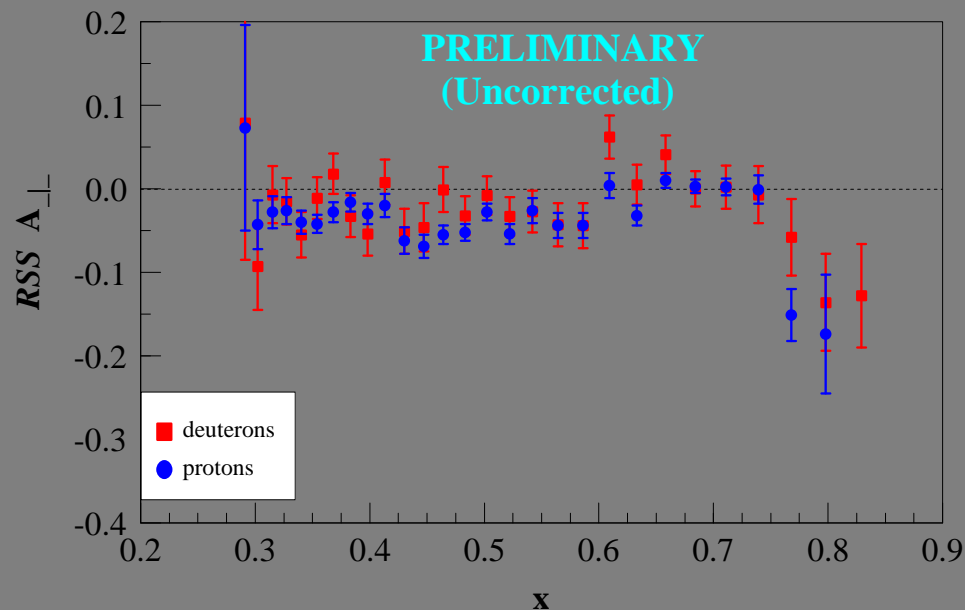
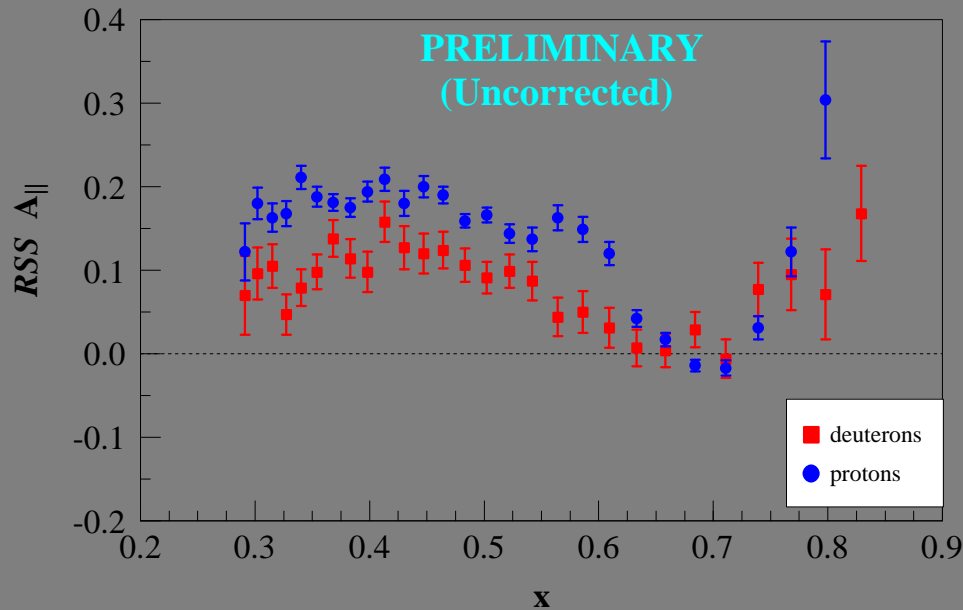
- ▶ Beam Energy  
 $E_0 = 5.755 \text{ GeV}$
- ▶ HMS Settings:  
 $\theta_0 = 13.15^\circ$   
 $p_0 = 4.08, 4.7 \text{ GeV}/c$
- ▶  $0.8 < W < 2.0 \text{ GeV}$
- ▶  $\langle Q^2 \rangle = 1.3 \text{ GeV}^2$



$Q^2$  vs.  $W$

$0.6 < Q^2 < 2.0 \text{ GeV}^2$      $0.5 < W < 2.3 \text{ GeV}$

# Measured Asymmetries



- ▶ Preliminary Results
- ▶ Approximate Dilution Factor
- ▶ No Other Corrections
- ▶  $1.08 < W < 1.9 \text{ GeV}$

# Physics from Data

$$A^{raw} = \frac{N^{\downarrow\uparrow} - N^{\uparrow\uparrow}}{N^{\downarrow\uparrow} + N^{\uparrow\uparrow}} \quad \text{or} \quad \frac{N^{\downarrow\Rightarrow} - N^{\uparrow\Rightarrow}}{N^{\downarrow\Rightarrow} + N^{\uparrow\Rightarrow}}$$

charge, deadtime normalized:  $N^i \rightarrow N^i/Q_i$

$$A = \frac{1}{C_N f_{RC}} \times \left( \frac{A^{raw}}{f \mathcal{P}_{beam} \mathcal{P}_{target}} - C_D \right) + A_{RC}$$

$\mathcal{P}_{beam}$  Beam Polarization

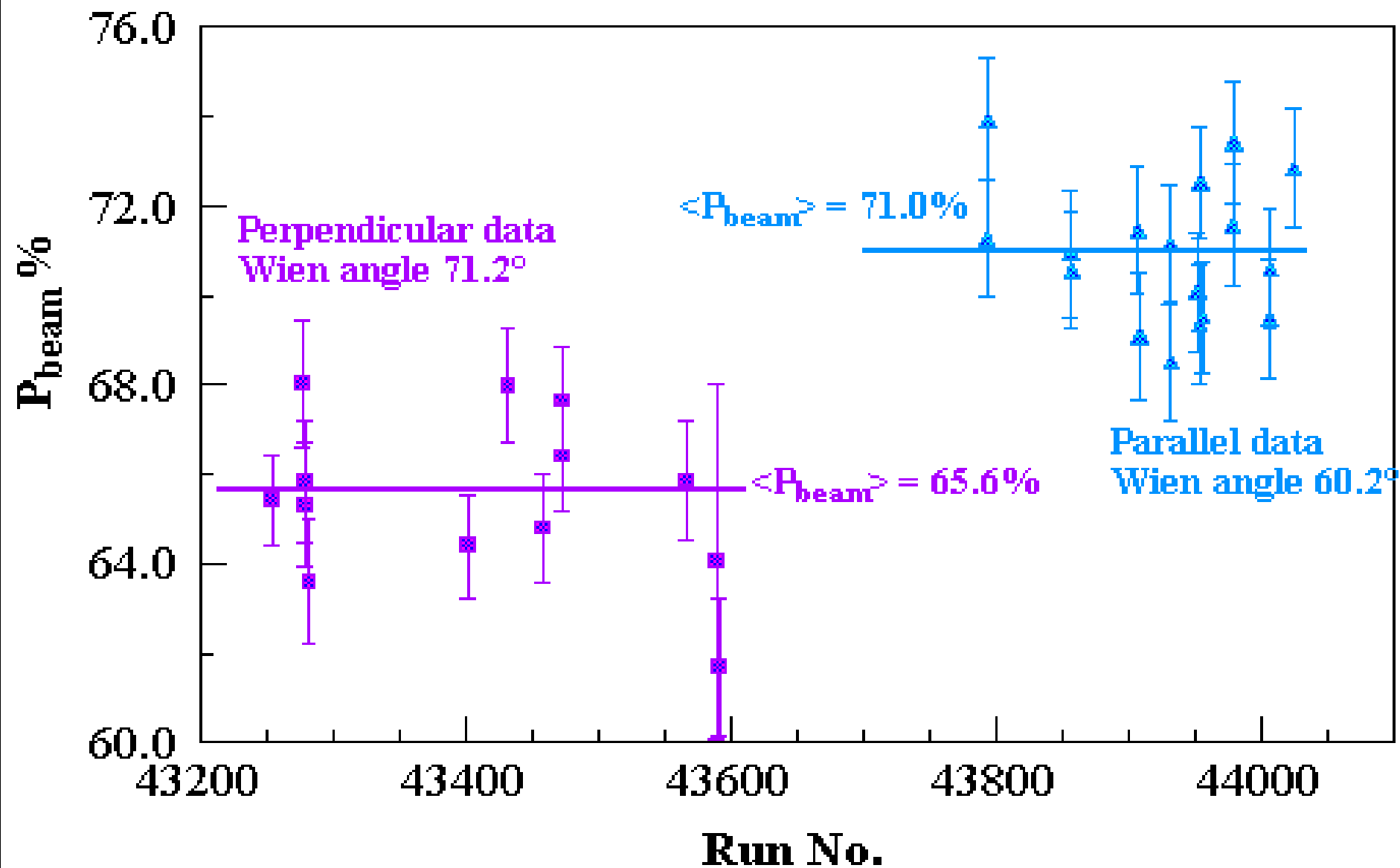
$\mathcal{P}_{target}$  Target Polarization

$f$  Dilution Factor

$A_{RC}, f_{RC}$  Radiative Corrections

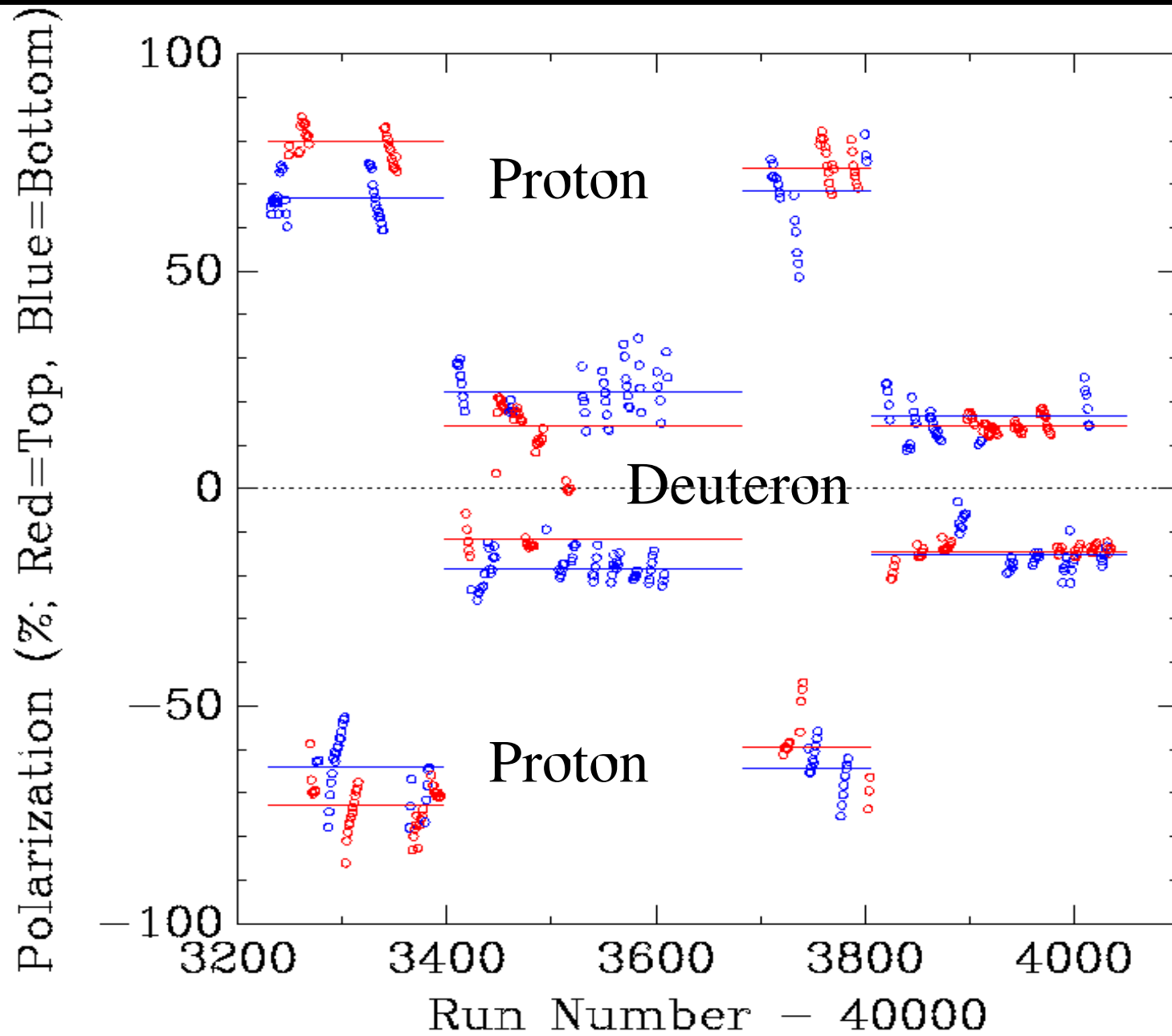
$C_N, C_D$  Nitrogen Corrections

# Beam Polarization



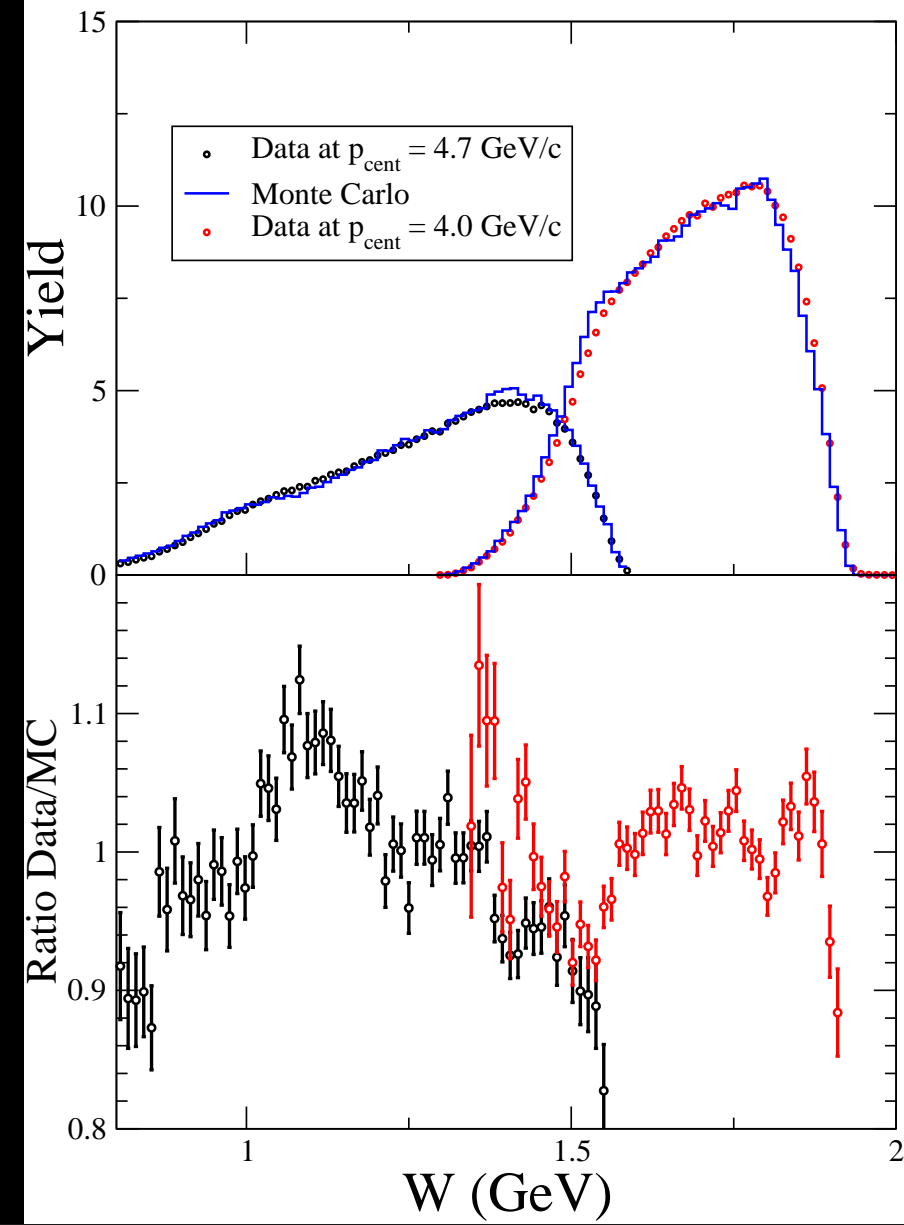


# Target Polarization

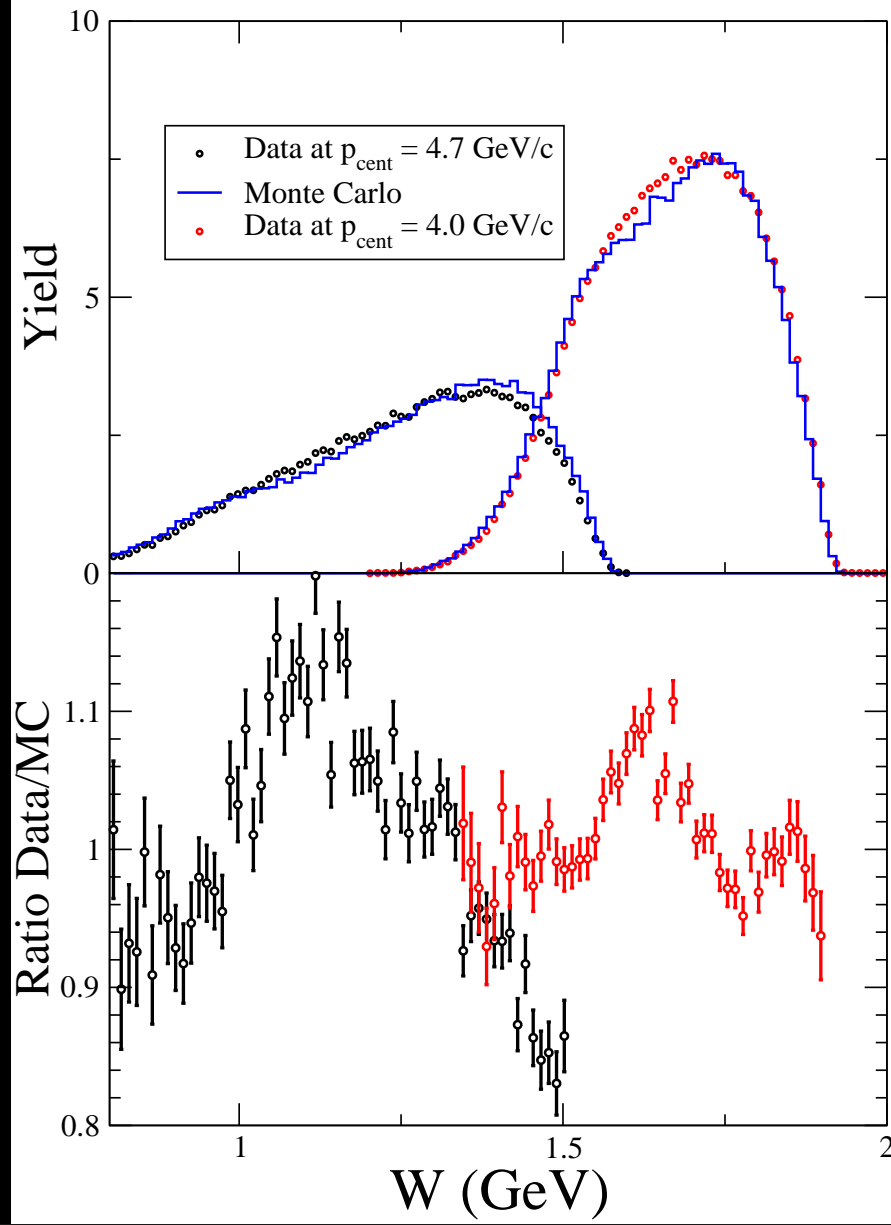


# Monte Carlo Simulation

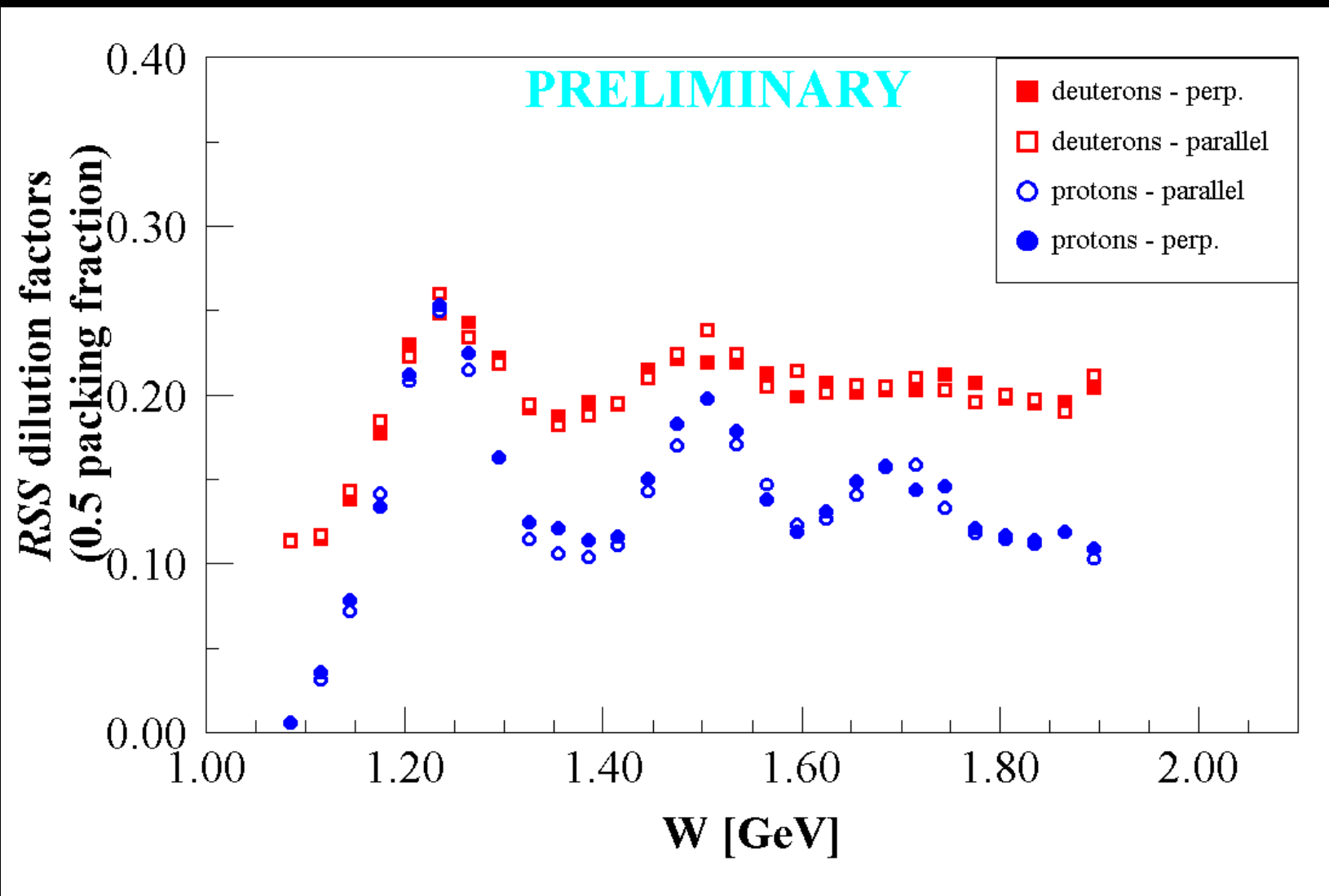
## Parallel field



## Perpendicular field

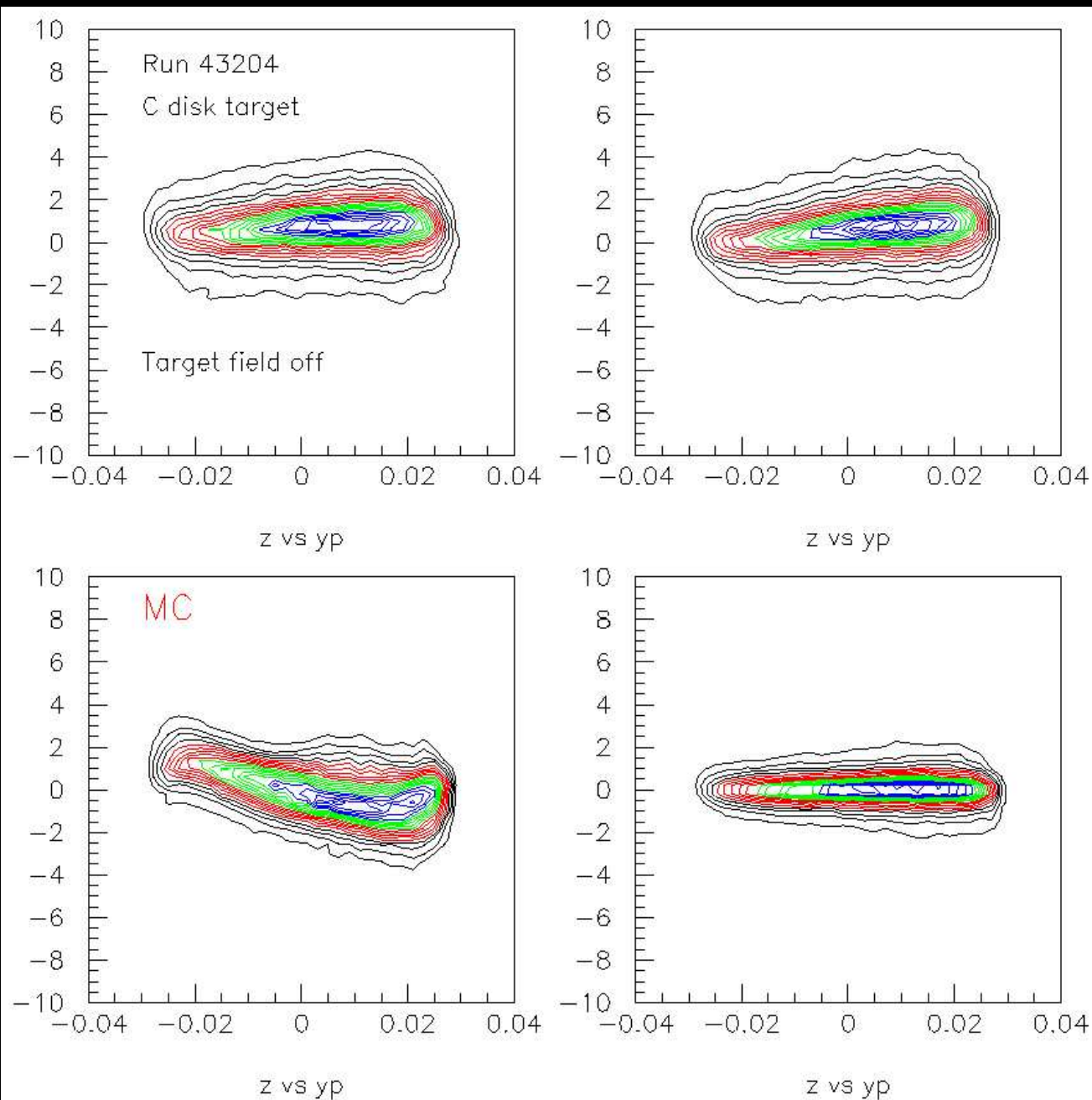


# Dilution Factor



Packing Fraction,  $\sim 0.5 - 0.6$ , from Ratio of  $NH_3$  to  $C$  Rates

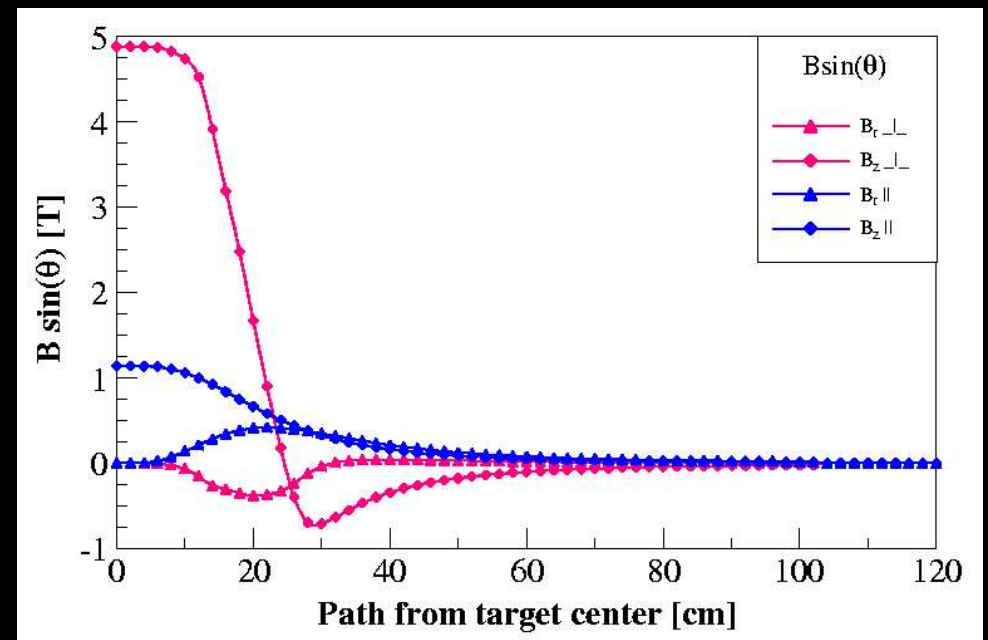
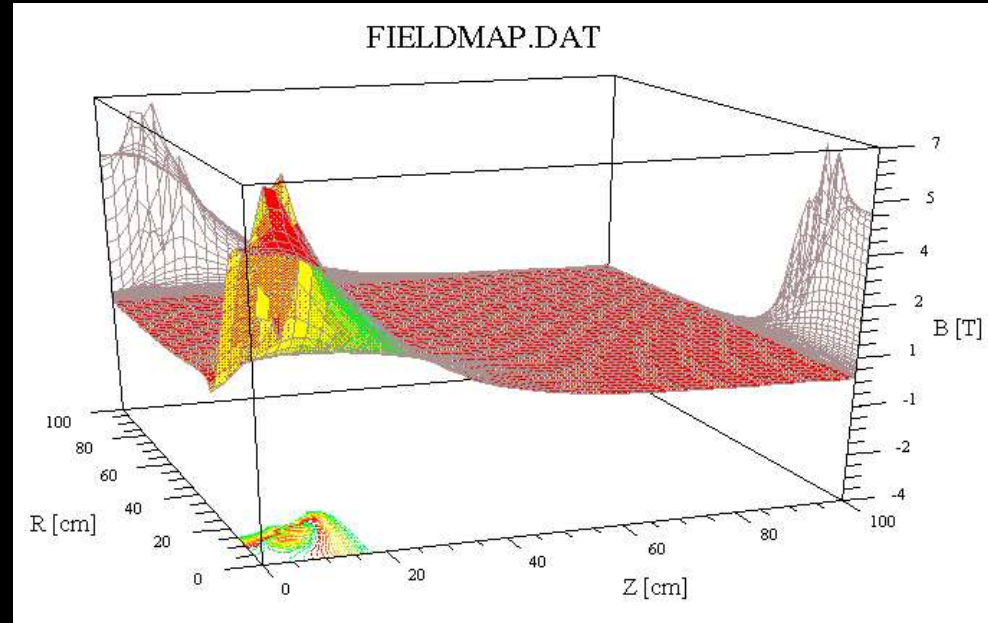
# Beam Raster



- ▶ Distribution of Events,  $z$  vs.  $dy/dz$
- ▶ Data (top) cfg. MC (bottom)
- ▶ Initial (left) and Improved (right)

# Target Field

- ▶ Strong Target Field
  - \* *affects particle trajectories*
  - \* *complex*
- ▶ Perpendicular
  - \* *unique to RSS*
  - \* *field more significant:*  
 $\sin(103^\circ) / \sin(13^\circ)$
- ▶ Actual Field *not* Identical to Field Map

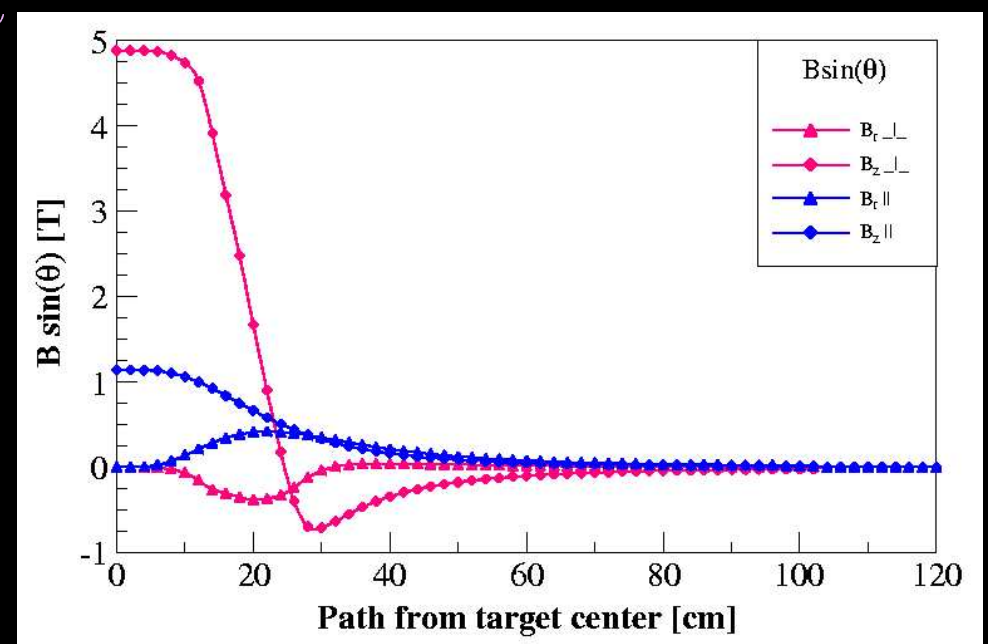
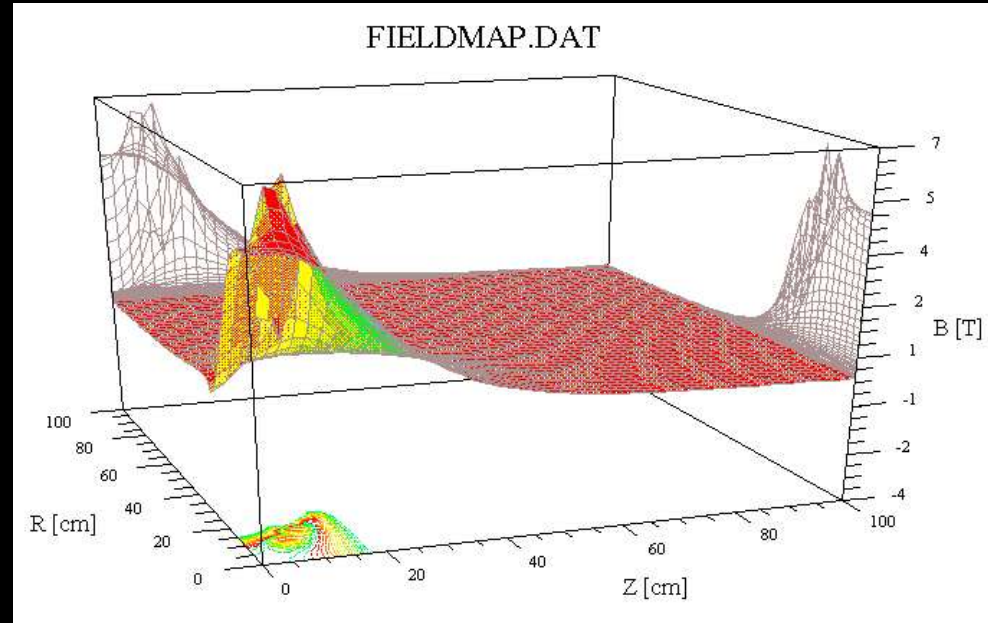


# Target Field

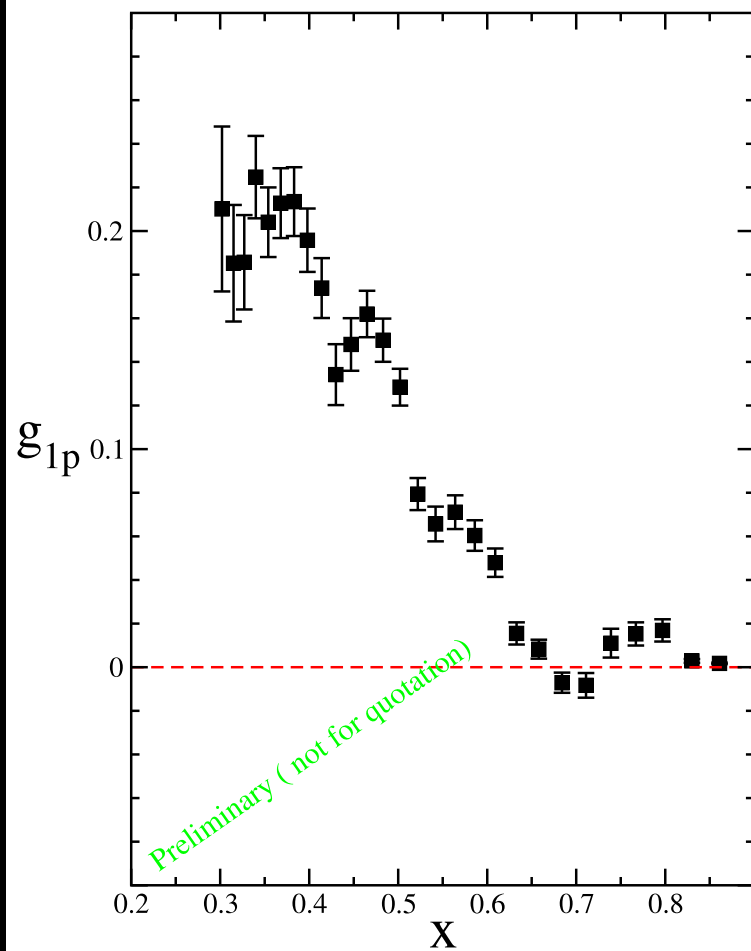
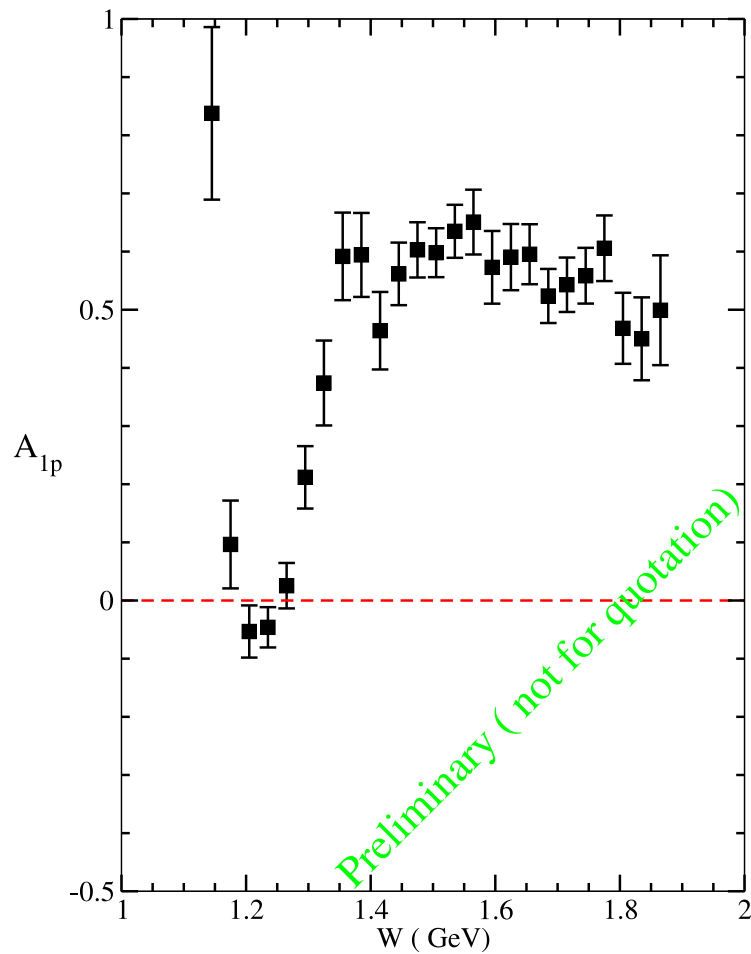
▶ Large Effects in Short Path Lengths

\* 3 mm path length error  
⇒ 2% of  $\int B dl = 0.76 Tm$

▶ MC now Reproduces Data Features



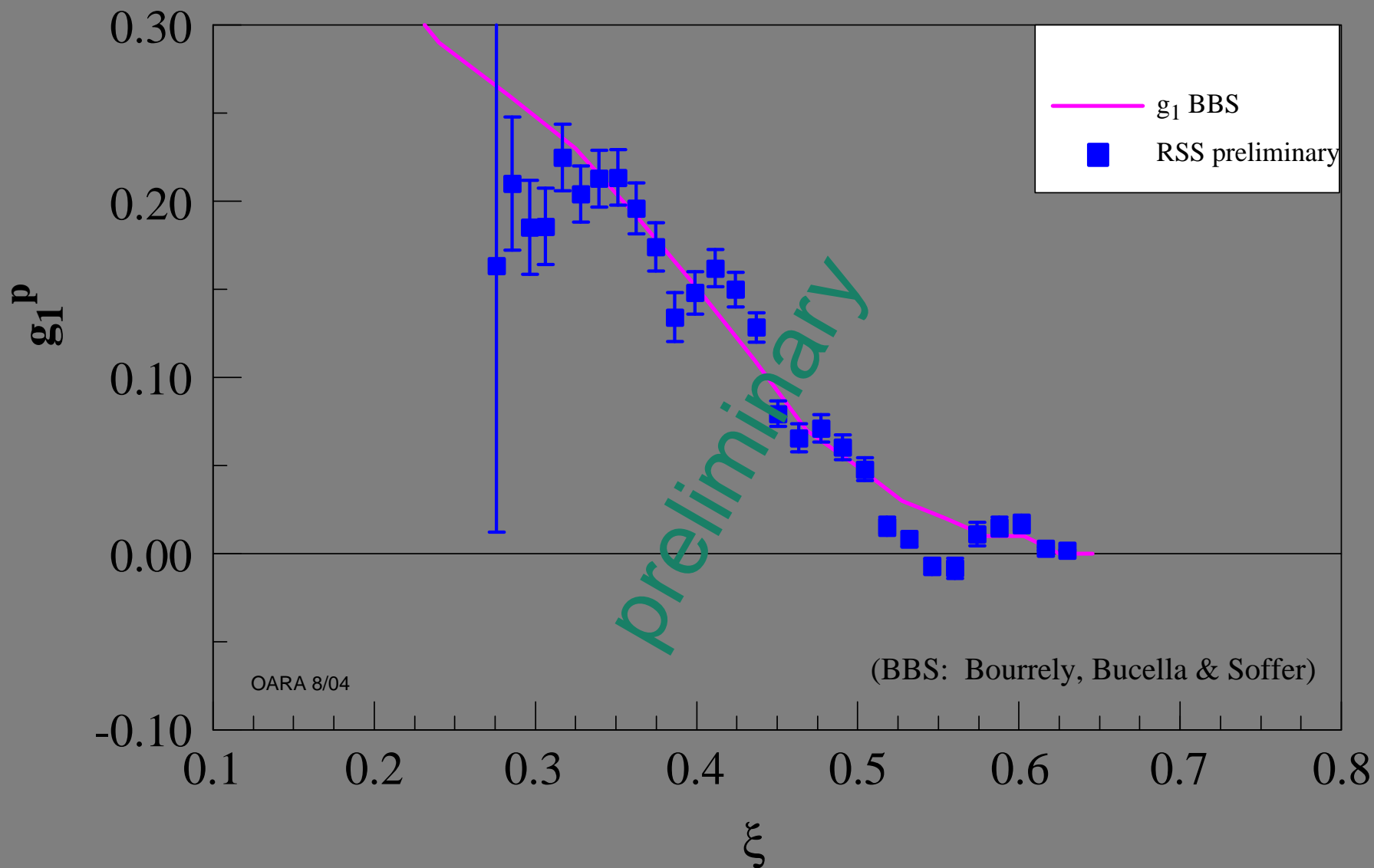
# RSS – Results



based on Hall C fits for  $R$  and  $F_2$

Not Fully Corrected

# RSS – Results



Not Fully Corrected



# Status & Outlook

- ▶ Individual Cell Packing Fractions, Dilution Factors ongoing
- ▶ Count Asymmetries, Pass 2 final preparations
- ▶ Final Off-Line Target Polarizations ongoing
- ▶ Nitrogen and Radiative Corrections preliminary

## By End of 2004:

- ▶ Spin Asymmetries
- ▶  $g_1$  &  $g_2$
- ▶ Neutron SSF's
- ▶ Systematic Errors
- ▶ Polarized Local Duality
- ▶ p Elastic Asymmetry