VERY PRELIMINARY RESULTS FOR THE SPIN STRUCTURE FUNCTION g_2 FROM SLAC E155X

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REPRESENTING THE E155X COLLABORATION

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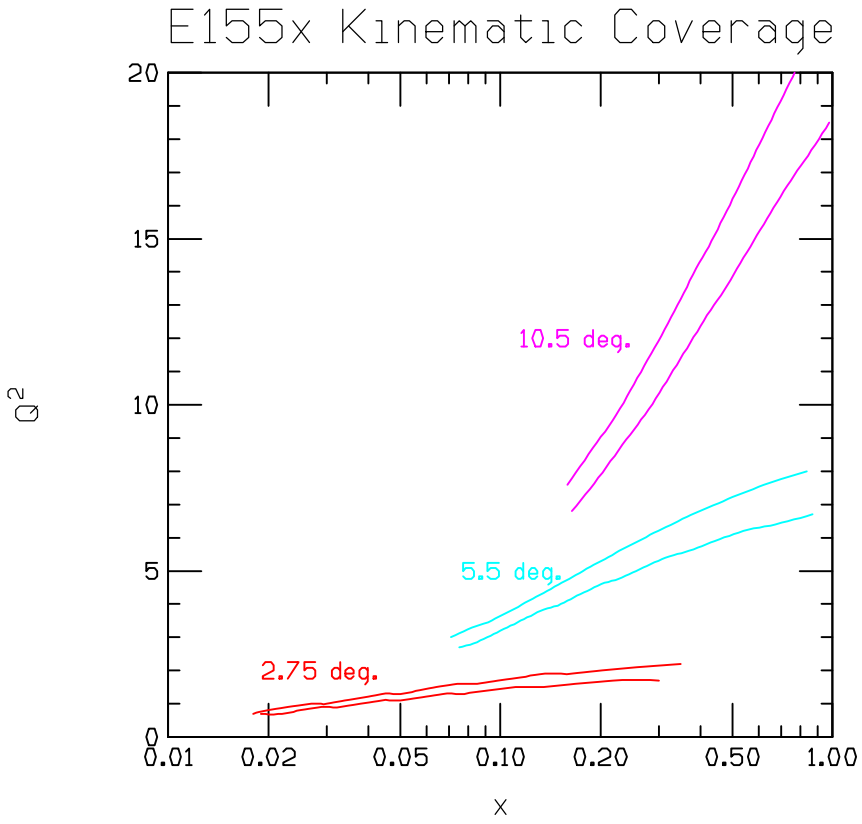
- EXPERIMENT
- g_2 AND A_2 FOR PROTON
- OUTLOOK FOR DEUTERON/NEUTRON
- OUTLOOK FOR d_2

EXPERIMENTAL OVERVIEW

- SLAC ELECTRON BEAM:
  - LONGITUDINAL POLARIZATION $P_b = 0.83$
  - ENERGY $E = 29.1$ or $E = 32.3$
  - 120 HZ, 400 nsec SPILLS, 25 nA CURRENT.
- TRANSVERSELY POLARIZED TARGETS:
  - 1 K, 5 T, D.N.P
  - NH3 FOR PROTONS (AVERAGE $P_t = 0.75$).
  - LiD FOR DEUTERONS ($< P_t >= 0.22$).
- SCATTERED ELECTRONS DETECTED:
  - AT 2.75, 5.5, AND 10.5 DEGREES
  - CHERENKOV AND LEAD GLASS FOR I.D.
  - HODOSCOPES FOR TRACKS ($dP/P \approx 0.03$)
- PHOTOPRODUCED INCLUSIVE PIONS ALSO DETECTED (ANALYSIS IN PROGRESS)

- NOTE: 10.5 DEG. SPECTROMETER HAD NEW DETECTORS: ANALYSIS STILL IN PROGRESS. WHEN COMPLETE, WILL ALLOW STUDY OF Q^2-DEPENDENCE OF g_2.



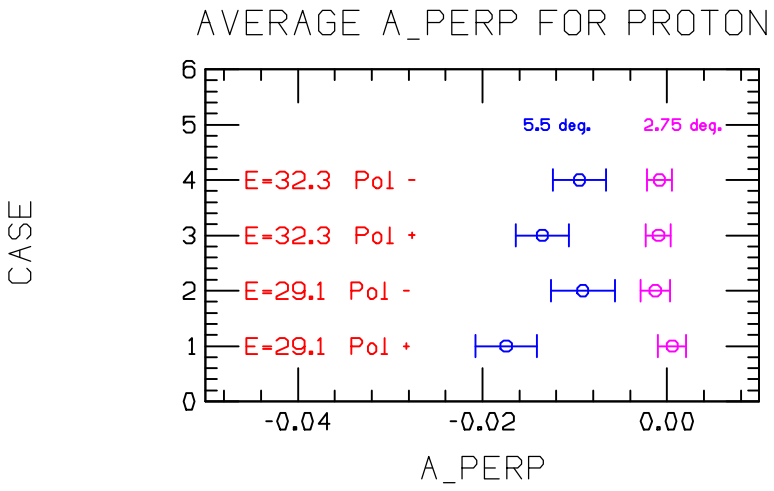
THE $A_\perp$ ASYMMETRY

$$A_\perp = \frac{C_1}{f P_t f_{RC} \cos(\phi)} \left(\left(\frac{N_L - N_R}{N_L + N_R} \right) \frac{1}{P_b} + A_{EW} \right) + A_{RC}$$

- N_L AND N_R ARE RATES FOR L AND R BEAM HELICITY, CORRECTED FOR PAIR-SYMMETRIC CONTRIBUTIONS (FEW PERCENT) AND PIONS MIS-IDENTIFIED AS ELECTRONS (FEW PERCENT)
- $C_1 \approx 1$ CORRECTS FOR POLARIZED ^{15}N
- $\cos(\phi)$ IS THE ANGLE BETWEEN PLANE OF ELECTRON/PROTON SPINS AND PLANE OF ELECTRON SCATTERING.
- f IS DILUTION FACTOR (≈ 0.16 PROTON)
- A_{EW}: ELECTROWEAK ASYMMETRY ($\approx 8 \times 10^{-5} Q^2$)
- f_{RC} AND A_{RC} ARE FOR RADIATIVE CORRECTIONS, PRESENTLY MADE USING g_2^{ww} MODEL AND E155 FIT TO g_1. THIS WILL BE REFINED IN FUTURE, LIKELY RESULTING IN REDUCTION OF STATISTICAL ERRORS AT LOWEST x OF EACH SPECTROMETER.

SYSTEMATIC CHECKS

- TARGET POLARIZATION ALIGNED (+) OR ANTI-ALIGNED (-) WITH B FIELD
- BEAM ENERGY CHANGED BY 3.2 GeV TO PRECESS SPIN BY π IN TRANSPORT LINE.
- CORRECT FOR EW ASYMMETRY (DEPENDS ONLY ON BEAM HELICITY)
- ANY REMAINING FALSE ASYMMETRIES (I.E. HELICITY-DEPENDENT BEAM POSITION) WOULD SHOW UP AS A DIFFERENCE IN AVERAGE $A_\perp$. NONE SEEN.



DETERMINATION OF g_2 and A_2

- WE USE MEASURED $A_\perp$ and E155 FIT TO g_1 TO OBTAIN g_2 USING

$$A_\perp = \frac{\sigma^{\downarrow\leftarrow} - \sigma^{\uparrow\leftarrow}}{\sigma^{\downarrow\leftarrow} + \sigma^{\uparrow\leftarrow}} = f_k E' \sin(\theta)\Big[g_1(x,Q^2) + \frac{2E}{\nu} g_2(x,Q^2)\Big]$$

- WE CAN COMPARE g_2 TO THE SIMPLE TWIST-2 MODEL OF WANDZURA-WILCZEK

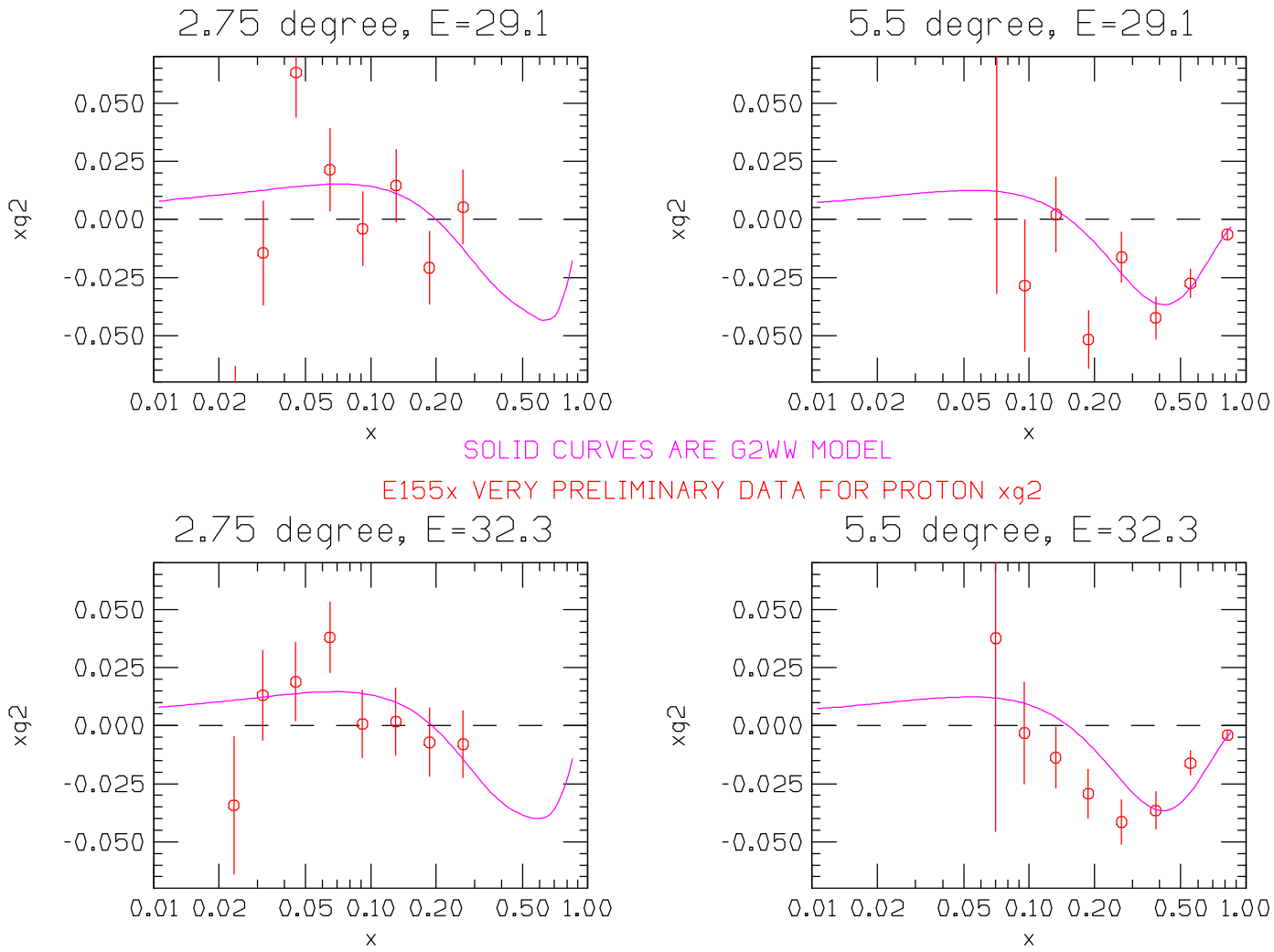
$$g_2^{WW}(x,Q^2) = -g_1(x,Q^2) + \int_x^1 \frac{dy}{y} g_1(y,Q^2)$$

- WE CAN ALSO EXTRACT VIRTUAL PHOTON-NUCLEON ASYMMETRY

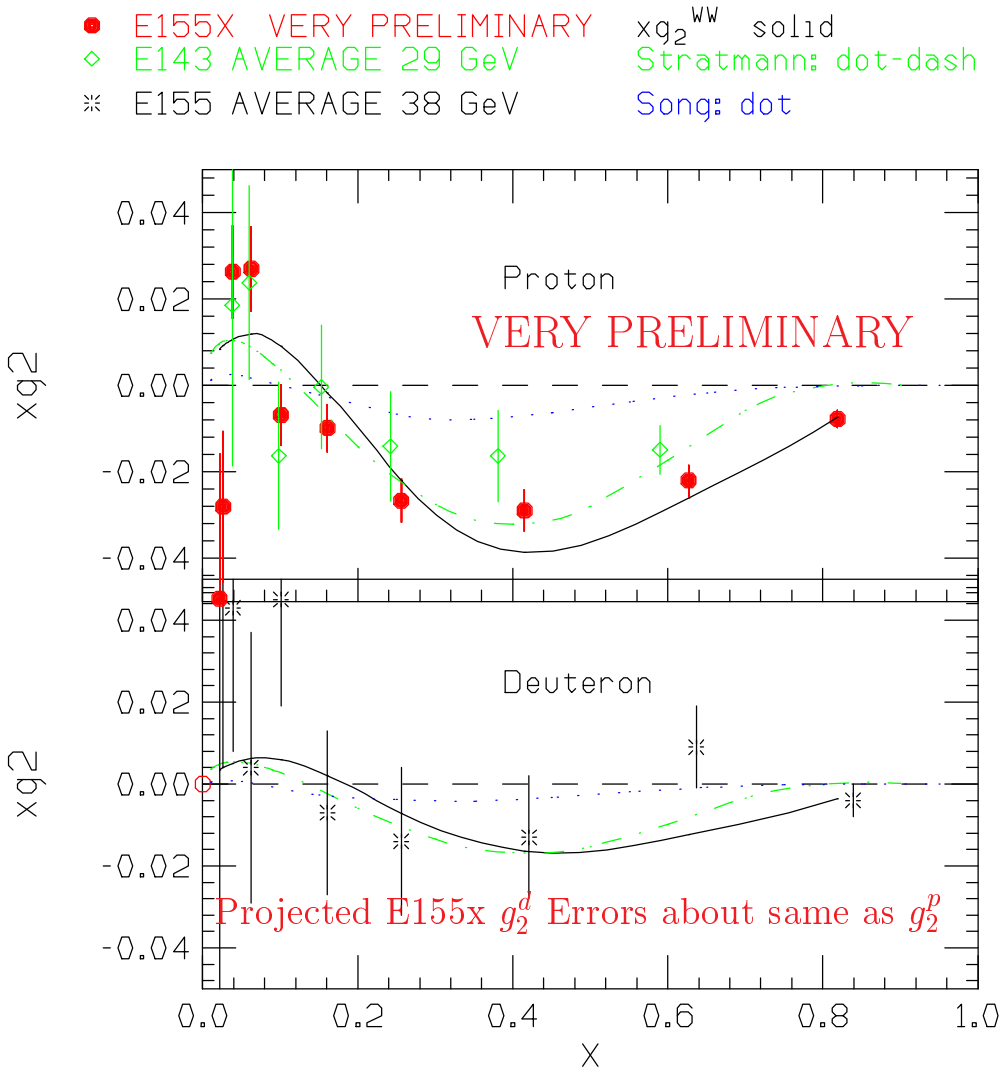
$$A_2(x,Q^2) = \frac{2\sigma_{TL}}{\sigma_T^{1/2} + \sigma_T^{3/2}} = \gamma \frac{g_1(x,Q^2) + g_2(x,Q^2)}{F_1(x,Q^2)}$$

- COMPARE TO POSITIVITY LIMIT $A_2 < \sqrt{R(x,Q^2)}$

RESULTS FOR PROTON g_2



RESULTS FOR Q^2-AVERAGED g_2^p



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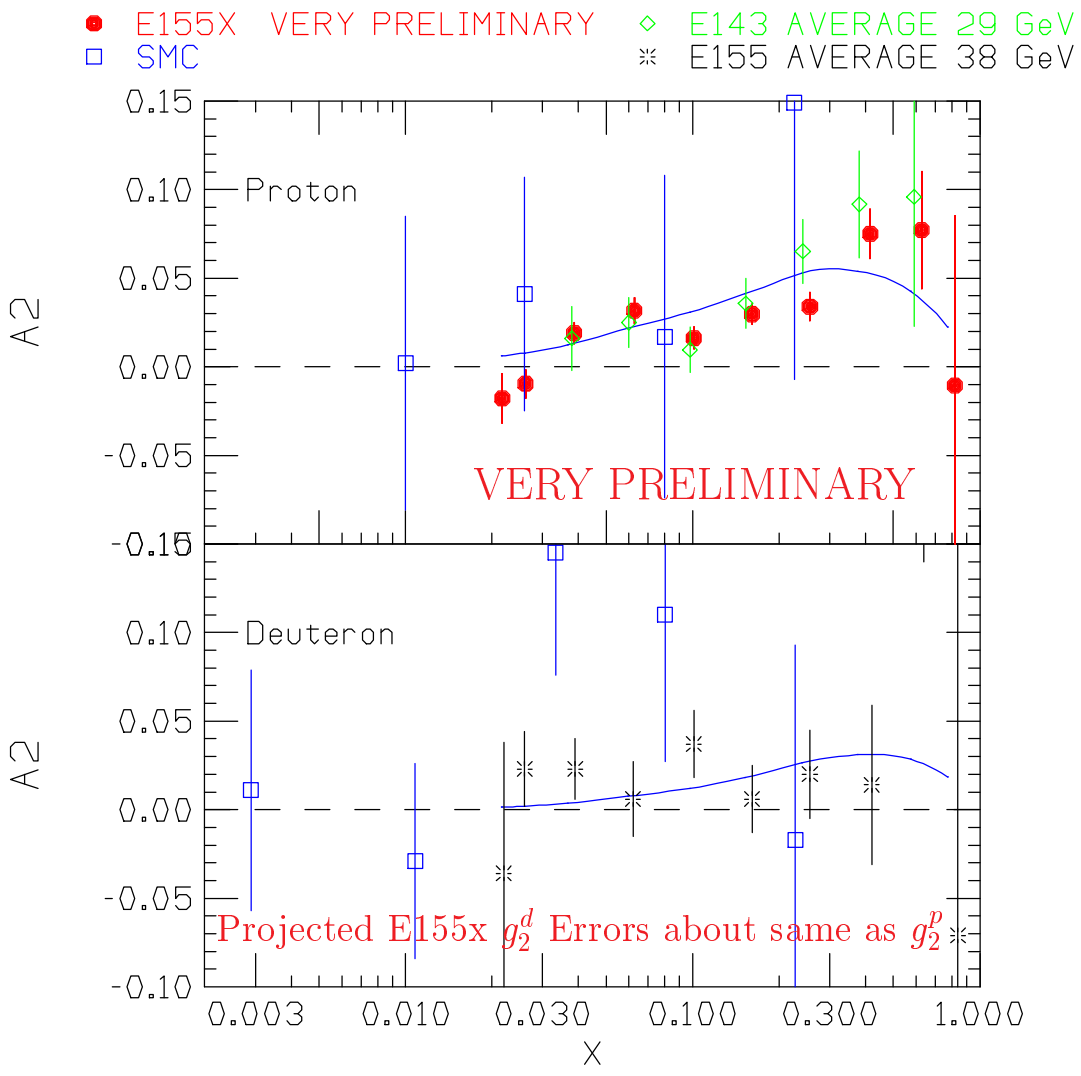


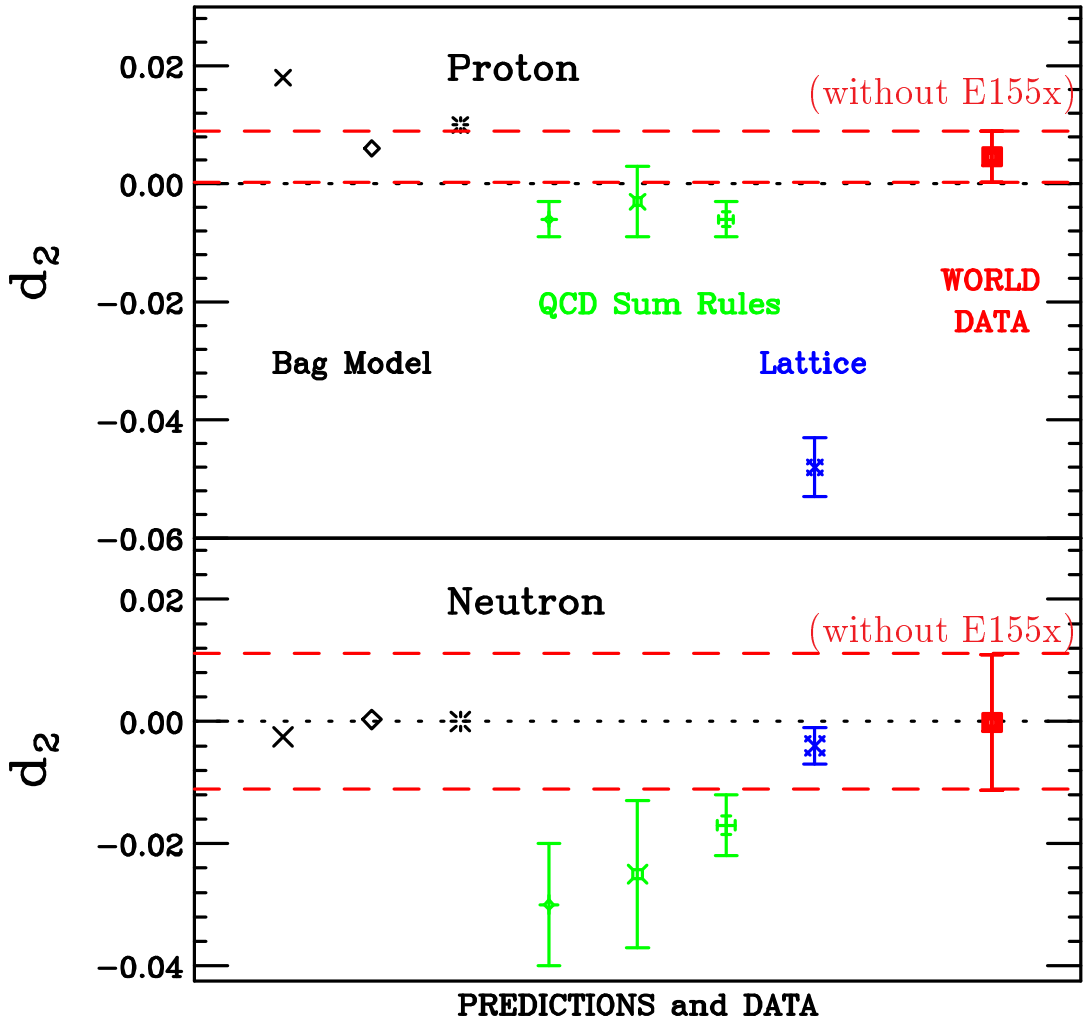
OUTLOOK FOR DEUTERON/NEUTRON

- ANALYSIS IN PROGRESS
- KINEMATIC COVERAGE IDENTICAL TO PROTON
- STATISTICAL ERRORS ON DEUTERON ABOUT SAME AS FOR PROTON
- FIRST INDICATIONS ARE THAT g_2^d IS MUCH CLOSER TO ZERO THAN g_2^p, AS WOULD BE EXPECTED FROM g_2^{ww} MODEL.
- STATISTICAL ERRORS ON NEUTRON ABOUT TWICE THAT OF PROTON

THE TWIST-3 d_2 MATRIX ELEMENT

$$d_2 = 3\int_0^1 x^2[g_2(x,Q^2) - g_2^{WW}(x,Q^2)]dx$$

ADDITION OF E155X RESULTS TO WORLD DATA WILL REDUCE PRESENT ERRORS (SHOWN BELOW) BY APPROXIMATELY FACTOR OF THREE FOR BOTH PROTON AND NEUTRON, ALLOWING GOOD DISCRIMINATION BETWEEN MODELS.



SUMMARY

- E155x ERRORS $\approx$ 3x SMALLER THAN PREVIOUS RESULTS, WITH ABOUT 80% OF 2.75 AND 5.5 DEGREE PROTON DATA ANALYZED.
- NORMALIZATION SYSTEMATIC ERROR SMALL COMPARED TO STATISTICAL ERRORS.
- RADIATIVE CORRECTIONS AND RESOLUTION SMEARING CORRECTIONS STILL NEED STUDY: DATA SHOULD BE CONSIDERED "VERY PRELIMINARY".
- PROTON g_2 IS POSITIVE FOR $x < 0.1$, NEGATIVE FOR $x > 0.2$.
- ROUGH AGREEMENT SEEN WITH g_2^{ww} MODEL AND BAG MODEL OF STRATMANN ET AL.
- PROTON A_2 IS POSITIVE FOR ALL x.
- ANALYSIS OF DEUTERON AND 10.5 DEGREE DATA WILL ALLOW STUDY OF NEUTRON g_2 AND Q^2-DEPENDENCE