Spin Structure Measurements in Hall A

Vincent Sulkosky

Jefferson Lab

Users Group Workshop and Annual Meeting

June 20^{th}, 2007

Outline

- Inclusive Electron Scattering and Structure Functions
- Quark-Hadron Duality: E01-012
- Gerasimov-Drell-Hearn (GDH) Sum Rule: E97-110
- Future Hall A Spin Structure Measurements

Inclusive Electron Scattering

Energy transfer:

$$\nu = E - E^{'}$$

4-momentum transfer squared:

$$\vec{q} = \vec{k} - \vec{k'}$$

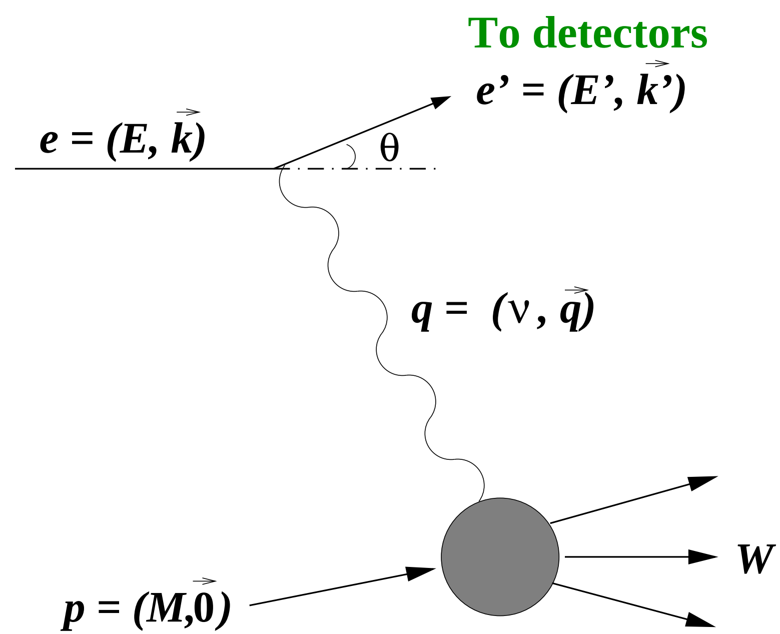
$$Q^2 = -q^2 = 4EE^{'} \sin^2 \frac{\theta}{2}$$

Invariant Mass:

$$W^2 = M^2 + 2M\nu - Q^2$$

Bjorken variable:

$$x = \frac{Q^2}{2M\nu}$$



Inclusive Cross Sections

- Unpolarized cross sections

$$\frac{d^2\sigma}{dE'd\Omega} = \sigma_{\mathrm{Mott}} \left[\frac{1}{\nu} F_2(x,Q^2) + \frac{2}{M} F_1(x,Q^2) \tan^2\frac{\theta}{2}\right]$$

- Polarized cross sections

$$\Delta\sigma_{\parallel} = \frac{d^2\sigma^{\downarrow\Uparrow}}{dE'd\Omega} - \frac{d^2\sigma^{\uparrow\Uparrow}}{dE'd\Omega} = K\left[(E + E'\cos\theta)\, g_1(x,Q^2) - \left(\frac{Q^2}{\nu}\right) g_2(x,Q^2)\right]$$

$$\Delta\sigma_{\perp} = \frac{d^2\sigma^{\downarrow\Rightarrow}}{dE'd\Omega} - \frac{d^2\sigma^{\uparrow\Rightarrow}}{dE'd\Omega} = K E' \sin\theta \left[g_1(x,Q^2) + \frac{2E}{\nu} g_2(x,Q^2)\right]$$

$$K = \frac{4\alpha^2}{M\nu Q^2}\frac{E'}{E}$$

$\downarrow$, $\uparrow$ are for electron spin

$\Uparrow$, $\Rightarrow$ are for target spin direction

F_1, F_2, g_1, g_2: structure functions

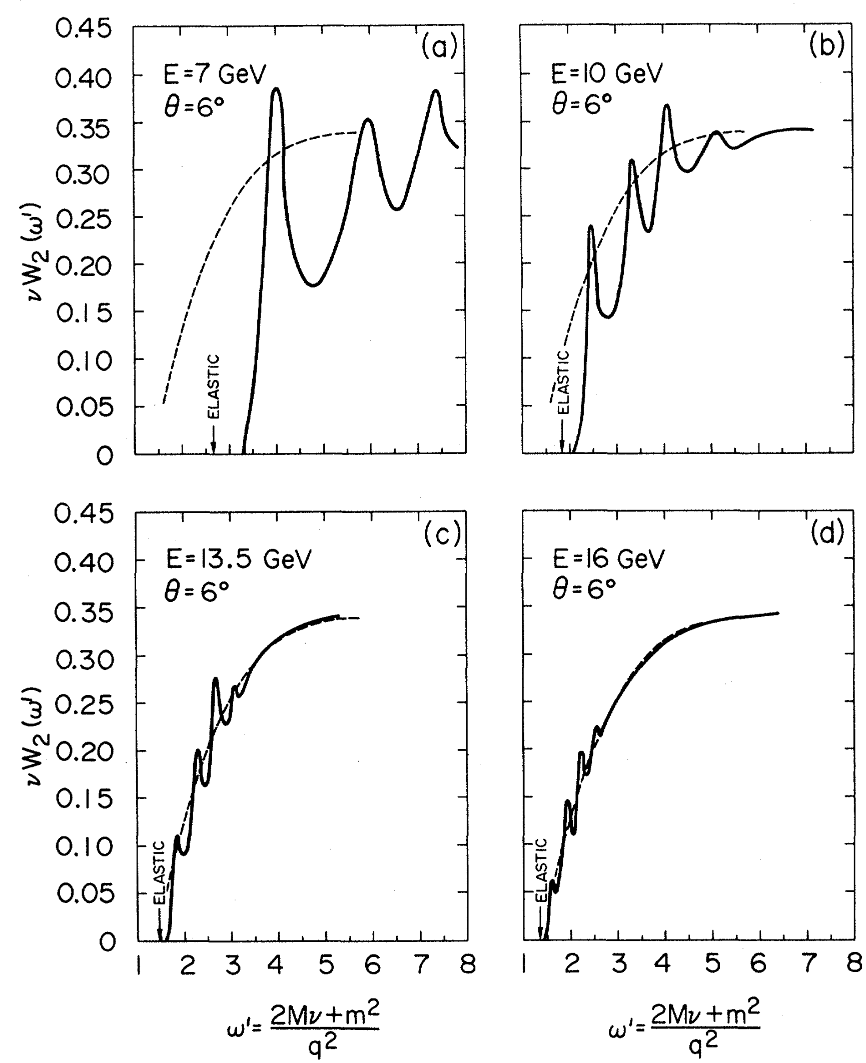
Quark-hadron Duality

- First observed by Bloom and Gilman in the 1970's on F_2.
- Scaling curve at high Q^2 is an accurate average over the resoance region at lower Q^2.
- Global and local duality are observed for F_2.

  I. Niculescu et al., PRL 85 (2000) 1182.
- Recent Hall B data for g_1^p:

  P.E. Bosted et al., PRC 75 (2007) 035203.

E. D. Bloom and F. J. Gilman, PRL **25** (1970) 1140



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E01-012

Spokespersons: J.P. Chen, S. Choi and N. Liyanage; PhD student: P. Solvignon

Test of spin duality on the neutron (^{3}He)

- Ran in Jan.-Feb. 2003
- Inclusive experiment: $^3\overrightarrow{\mathrm{He}}(\vec{e},e')X$

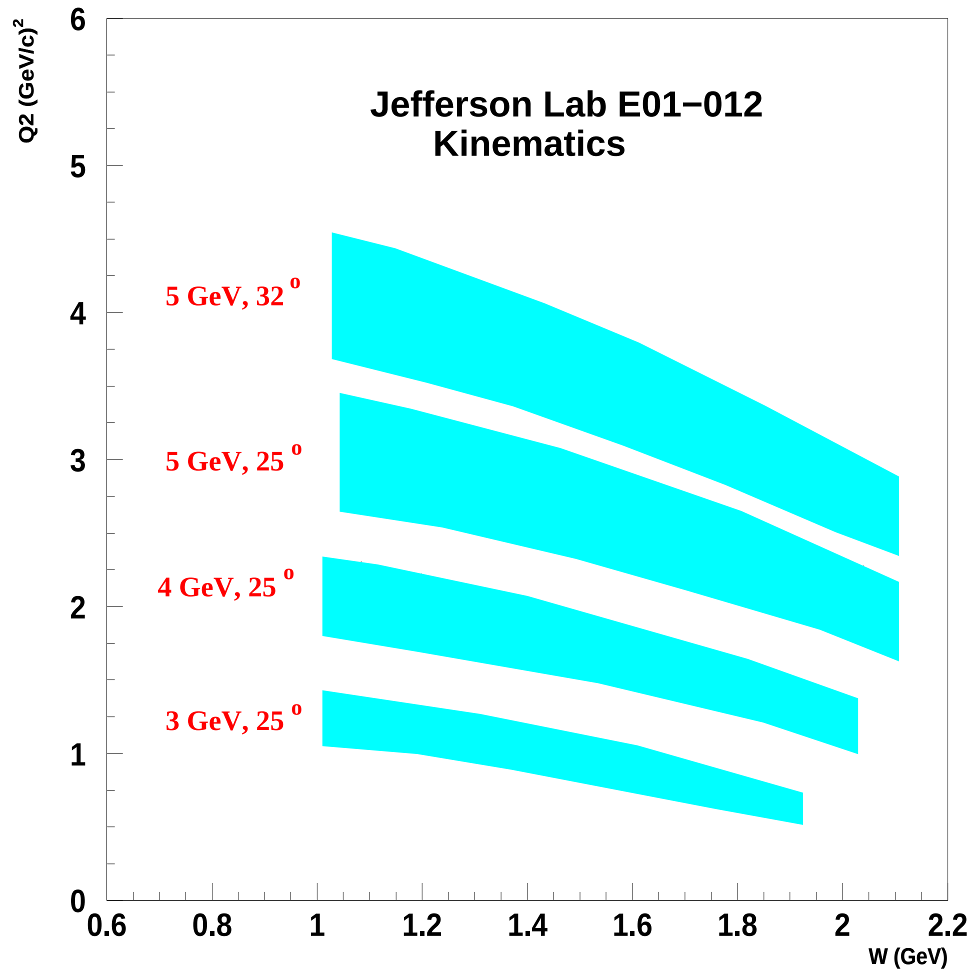
  ⇒ Polarized electron beam:

  70% $< P_{\mathrm{beam}} <$ 85%

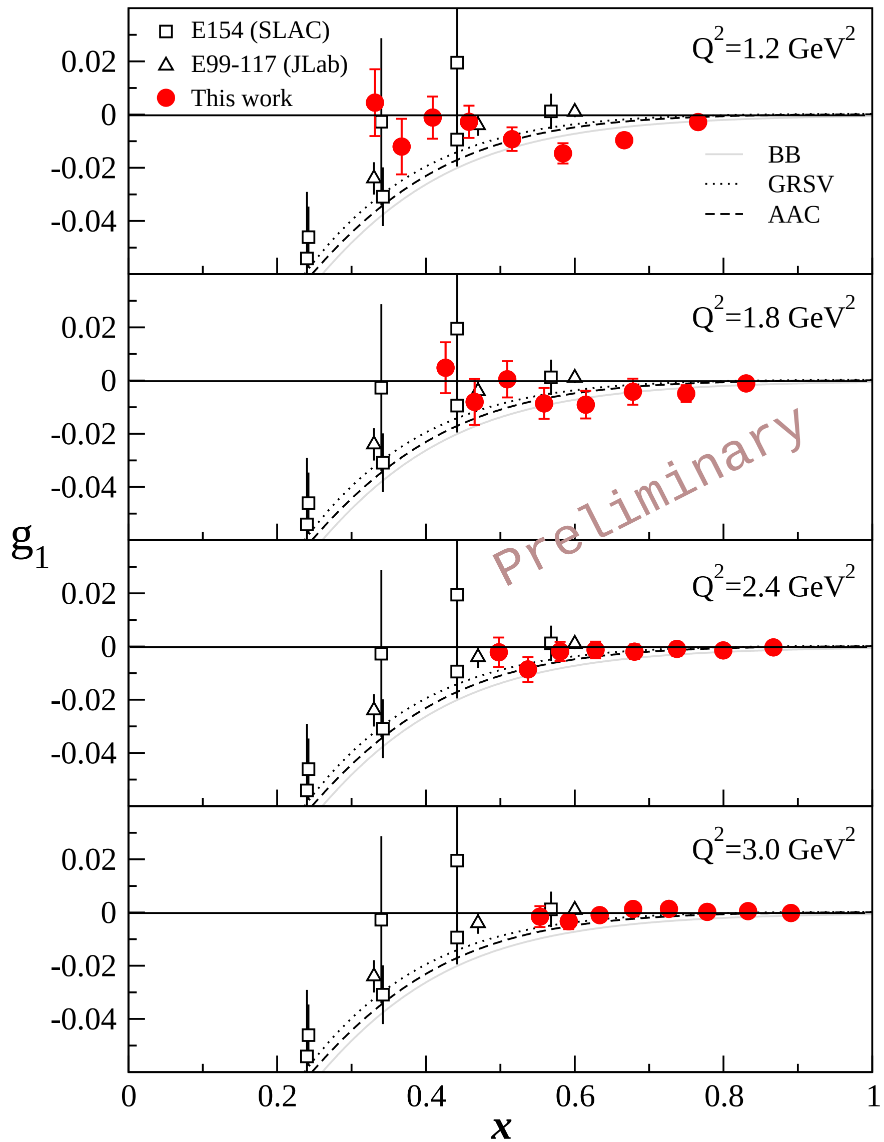
  ⇒ Standard Hall A equipment

  ⇒ Pol. ^{3}He target (para & perp):

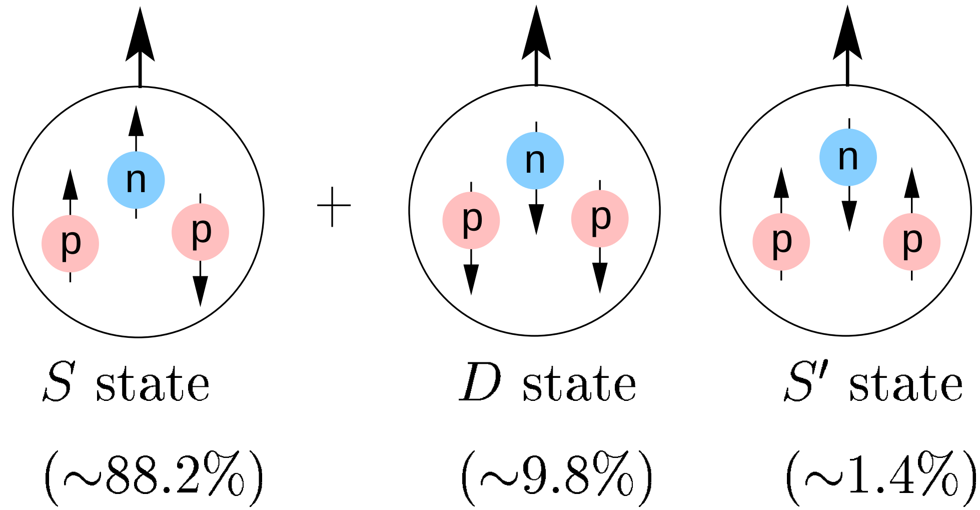
  $\langle P_{\mathrm{targ}} \rangle$ = 37%
- Measured polarized cross-section differences
- Form g_1 and g_2 for ^{3}He



$g_1^{^3\mathrm{He}}$ *at Constant* Q^2



^{3}He as an Effective Polarized Neutron Target



P_n = 86% and P_p = -2.8%

J.L. Friar *et al.*, PRC **42**, (1990) 2310

Extraction of Neutron Results

$$\Gamma_1^\mathrm{n}(Q^2) = \frac{1}{P_\mathrm{n}}\left[\Gamma_1^{^3\mathrm{He}}(Q^2) - 2P_\mathrm{p}\Gamma_1^\mathrm{p}(Q^2)\right]$$

C. Ciofi degli Atti & S. Scopetta, PLB **404**, (1997) 223

Test of Duality on the Neutron and ^{3}He

- Define integration range as a function of W in the resonance region
- Integrate $g_1^{\rm res}$ and $g_1^{\rm DIS}$ over that same x range at constant Q^2
- Target mass correction applied.

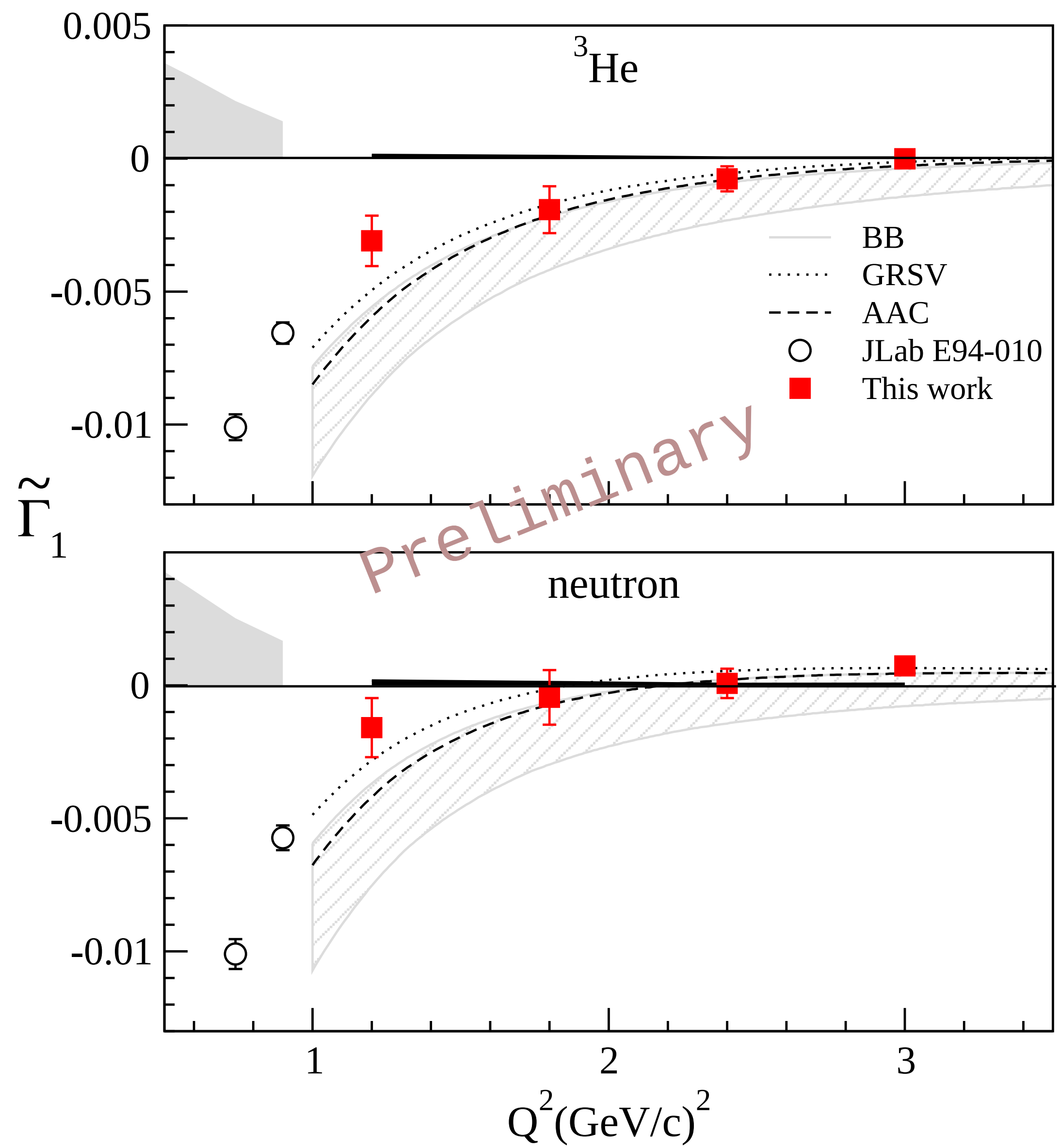
$$\tilde{\Gamma}_1^{\rm res} = \int_{x_{\rm min}}^{x_{\rm max}} g_1^{\rm res}(x, Q^2)dx \qquad \tilde{\Gamma}_1^{\rm DIS} = \int_{x_{\rm min}}^{x_{\rm max}} g_1^{\rm DIS}(x, Q^2)dx$$

If $\tilde{\Gamma}_1^{\rm res} = \tilde{\Gamma}_1^{\rm DIS} \Rightarrow$ duality is verified.

Test of Duality on the Neutron and ^{3}He

- Integration range:

  1.08 GeV < W < 1.93 GeV



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Virtual Photon-nucleon Asymmetry: $A_1^{^3\mathrm{He}}$

Parton Model:

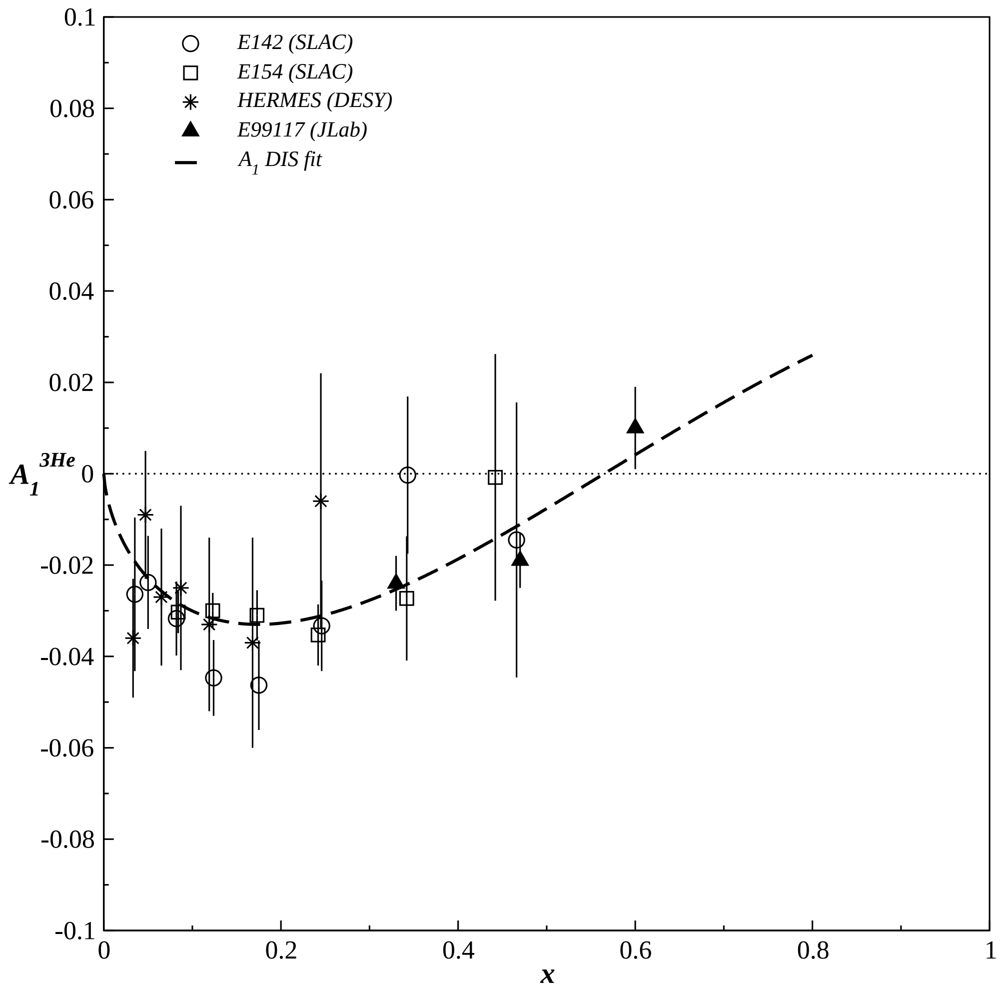
$$A_1(x, Q^2) \approx \frac{g_1(x,Q^2)}{F_1(x,Q^2)}$$

If Q^2-dependence for g_1 and F_1 are similar $\Rightarrow$ weak Q^2-dependence for A_1.

Resonance Region:

If local duality is observed for g_1 and F_1 $\Rightarrow$ $A_1^{\mathrm{res}} = A_1^{\mathrm{DIS}}$.

Virtual Photon-nucleon Asymmetry: $A_1^{^3\mathrm{He}}$



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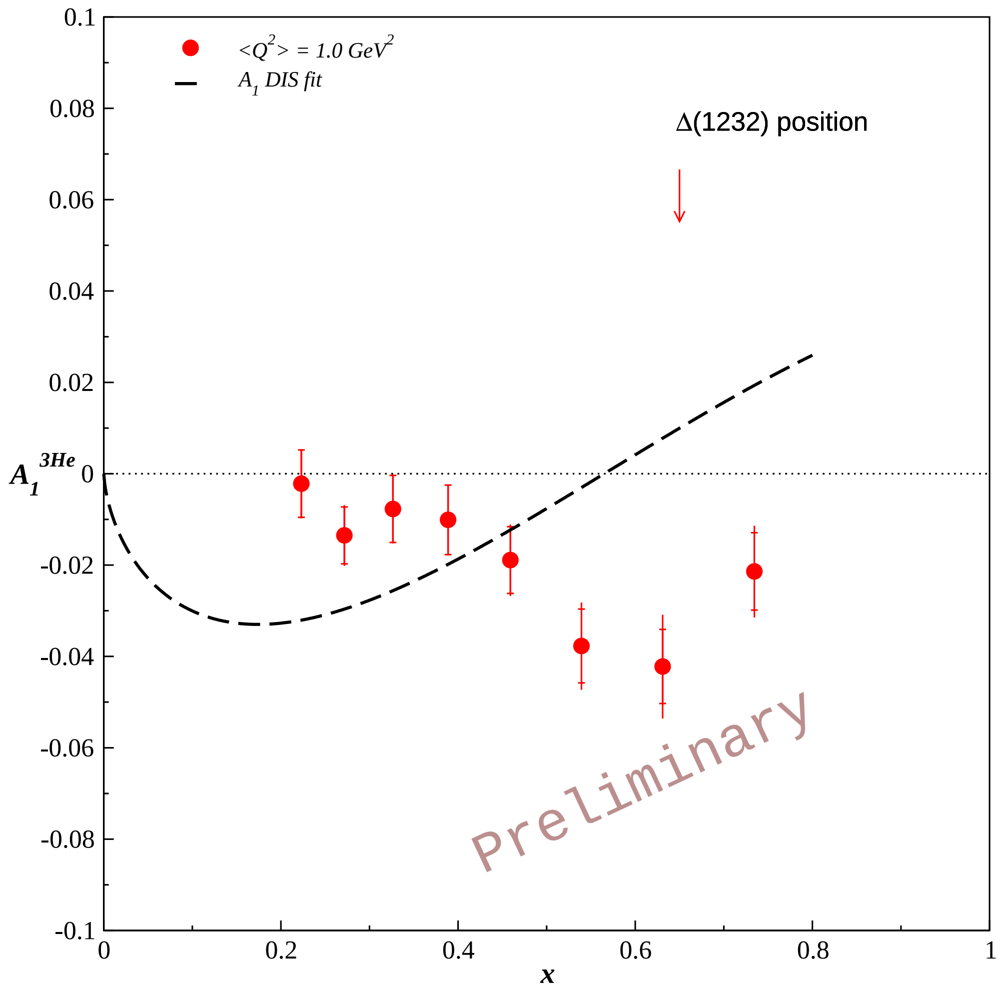

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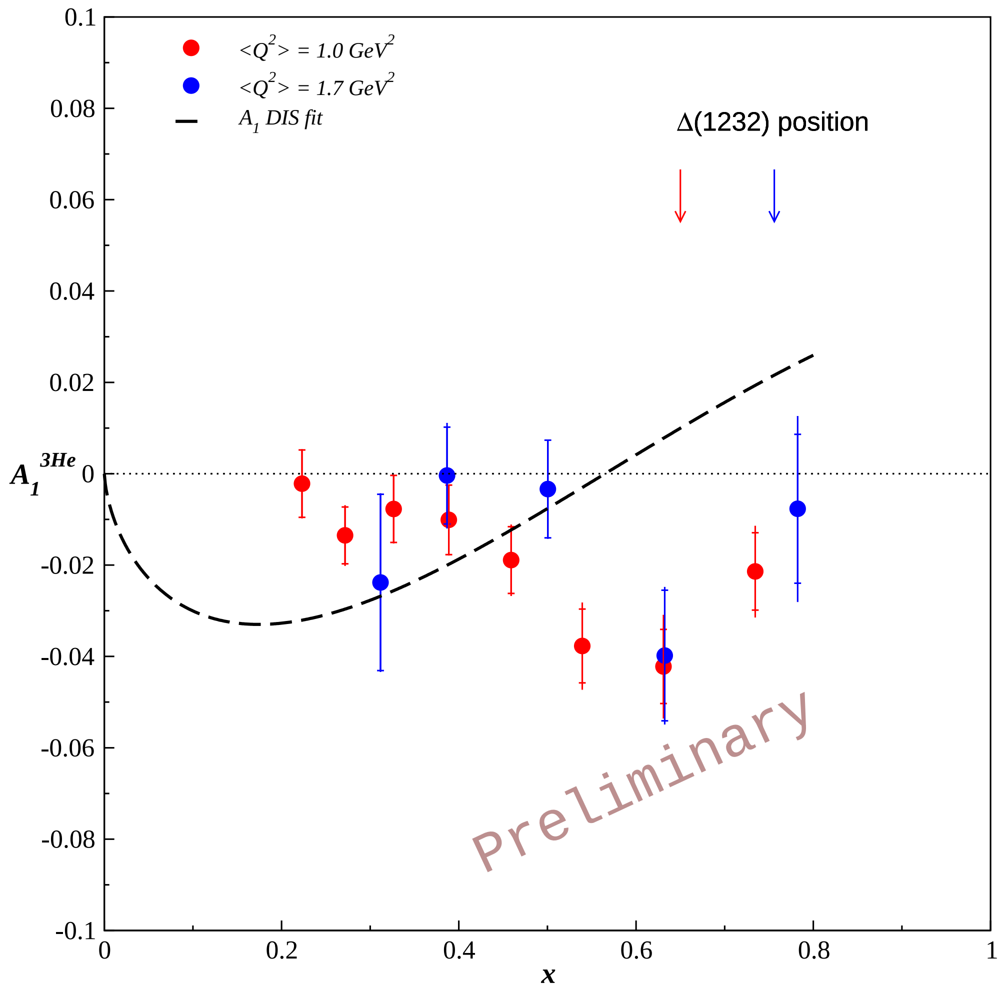

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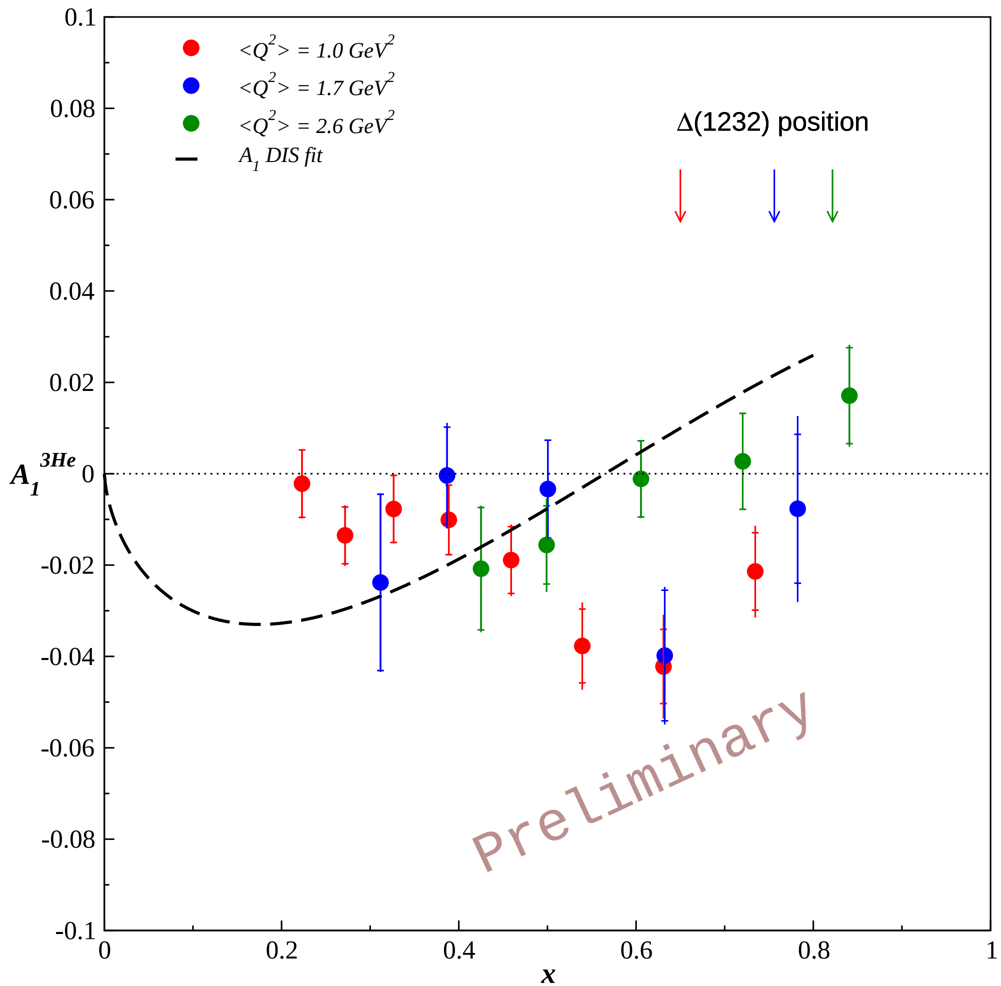

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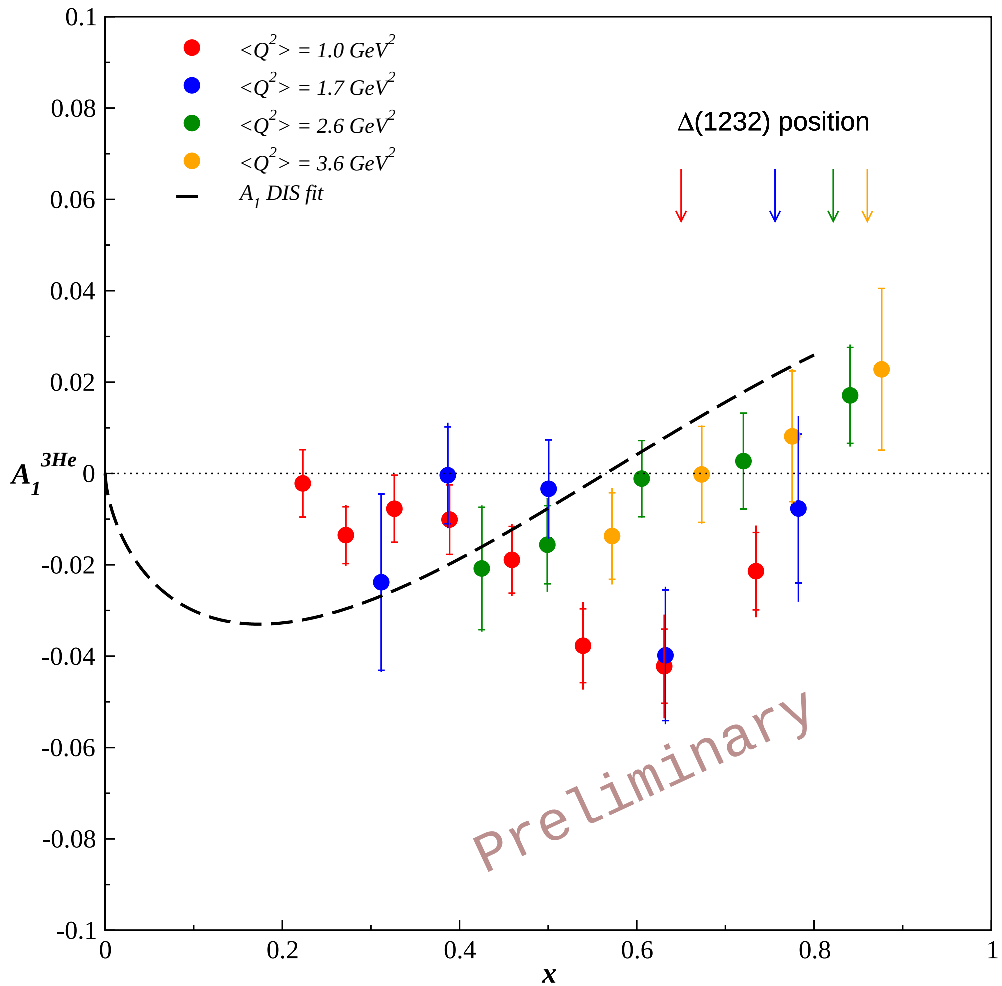
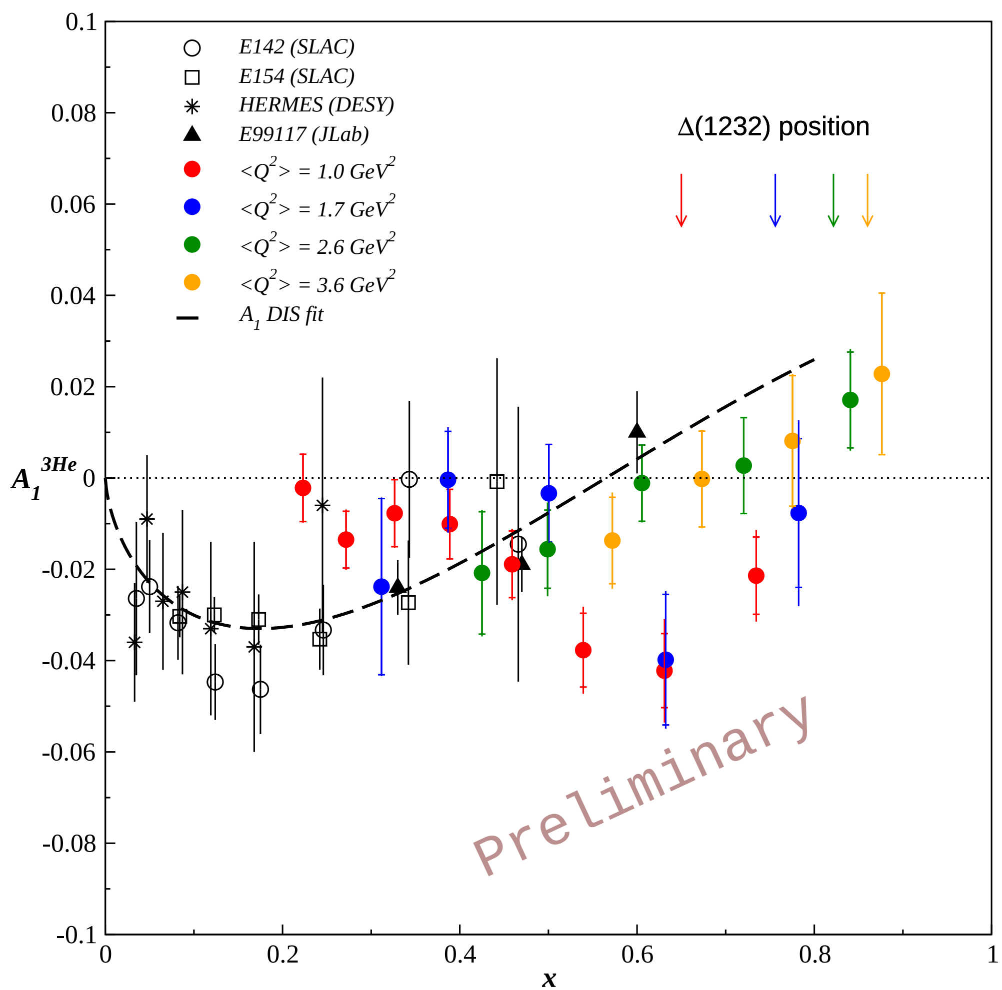


Virtual Photon-nucleon Asymmetry: $A_1^{^3\mathrm{He}}$



In Progress

- The ^{3}He results are final but work is ongoing for the neutron extraction.
- First paper in preparation:
  - ^{3}He: g_1, $\tilde{\Gamma}_1$, and A_1
  - Neutron: $\tilde{\Gamma}_1$
- Future papers: $d_2^{\rm n}$, BC sum rule, $A_1^{\rm n}$ and $A_2^{\rm n}$

Gerasimov-Drell-Hearn (GDH) Sum Rule ($Q^2 = 0$)

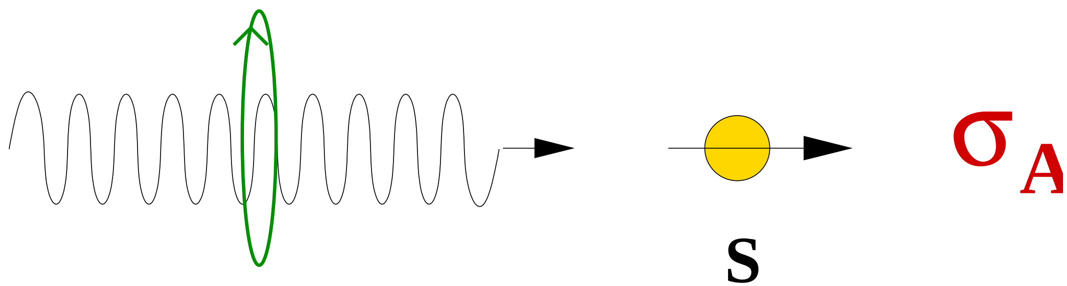
$$I_{\mathrm{GDH}} = \int_{\nu_{\mathrm{th}}}^{\infty} \frac{\sigma_{\mathrm{P}}(\nu) - \sigma_{\mathrm{A}}(\nu)}{\nu} d\nu \quad = -4\pi^2 S\alpha \left(\frac{\kappa}{M}\right)^2$$

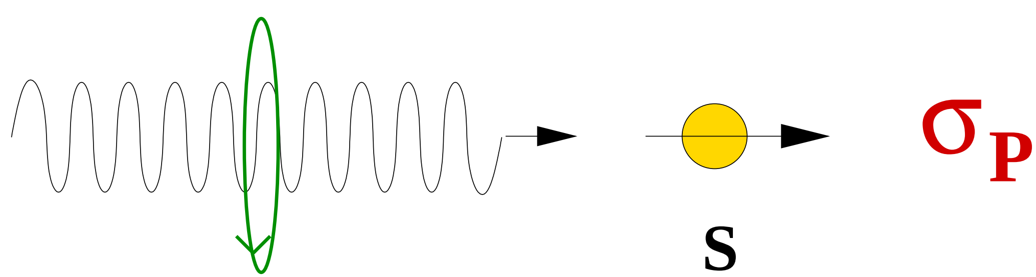
- Circularly polarized photons incident on a longitudinally polarized spin-S target.

Gerasimov-Drell-Hearn (GDH) Sum Rule ($Q^2 = 0$)

$$I_{\rm GDH} = \int_{\nu_{\rm th}}^{\infty} \frac{\sigma_{\rm P}(\nu) - \sigma_{\rm A}(\nu)}{\nu} d\nu \;\; = -4\pi^2 S\alpha \left(\frac{\kappa}{M}\right)^2$$

- $\sigma_{\rm P}$ ($\sigma_{\rm A}$) photoabsorption cross section with photon helicity parallel (anti-parallel) to the target spin.





Gerasimov-Drell-Hearn (GDH) Sum Rule (Q^2 = 0)

$$I_{\rm GDH} = \int_{\nu_{\rm th}}^{\infty} \frac{\sigma_{\rm P}(\nu) - \sigma_{\rm A}(\nu)}{\nu} d\nu \;\; = -4\pi^2 S\alpha \left(\frac{\kappa}{M}\right)^2$$

- Circularly polarized photons incident on a longitudinally polarized spin-S target.
- $\sigma_{\rm P}$ ($\sigma_{\rm A}$) photoabsorption cross section with photon helicity parallel (anti-parallel) to the target spin.
- The sum rule is related to the target's mass M and anomalous part of the magnetic moment κ.

Spin-$\frac{1}{2}$ Targets

$$I_{\rm GDH} = \int_{\nu_{\rm th}}^{\infty} \frac{\sigma_{\frac{1}{2}}(\nu) - \sigma_{\frac{3}{2}}(\nu)}{\nu} d\nu = -2\pi^2\alpha(\frac{\kappa}{M})^2$$

The sum rule is valid for any target.

	M[GeV]	Spin	κ	$I_{\rm GDH}[\mu$ b]
Proton	0.938	$\frac{1}{2}$	1.79	–204.8
Neutron	0.940	$\frac{1}{2}$	-1.91	–233.2
Deuteron	1.876	1	-0.14	–0.65
Helium-3	2.809	$\frac{1}{2}$	-8.38	–498.0

1 μb = 10^{-34} m^2

- Proton sum rule was verified to $\sim$ 10%, Mainz and Bonn.
- Measurements for the neutron are in progress.

Generalized GDH Integral ($Q^2 > 0$)

$$I(Q^2) = \int_{\nu_{\rm th}}^{\infty} \left[\sigma_{\frac{1}{2}}(\nu, Q^2) - \sigma_{\frac{3}{2}}(\nu, Q^2)\right] \frac{d\nu}{\nu}$$

$$\sigma_{1/2} - \sigma_{3/2} = \frac{8\pi^2\alpha}{MK} \left[g_1(\nu, Q^2) - \left(\frac{Q^2}{\nu^2}\right) g_2(\nu, Q^2)\right]$$

- Replace photoproduction cross sections with the corresponding electroproduction cross sections.
- The integral is related to the Compton scattering amplitudes: $S_1(Q^2)$ and $S_2(Q^2)$.

$$S_1(Q^2) = \frac{8}{Q^2} \int_0^1 g_1(x, Q^2) dx = \frac{8}{Q^2} \Gamma_1(Q^2)$$

X.-D. Ji and J. Osborne, J. Phys. **G27**, 127 (2001)

At $Q^2 = 0$, the GDH sum rule is recovered.

Importance of the Generalized GDH Sum Rule

χPT Lattice QCD pQCD

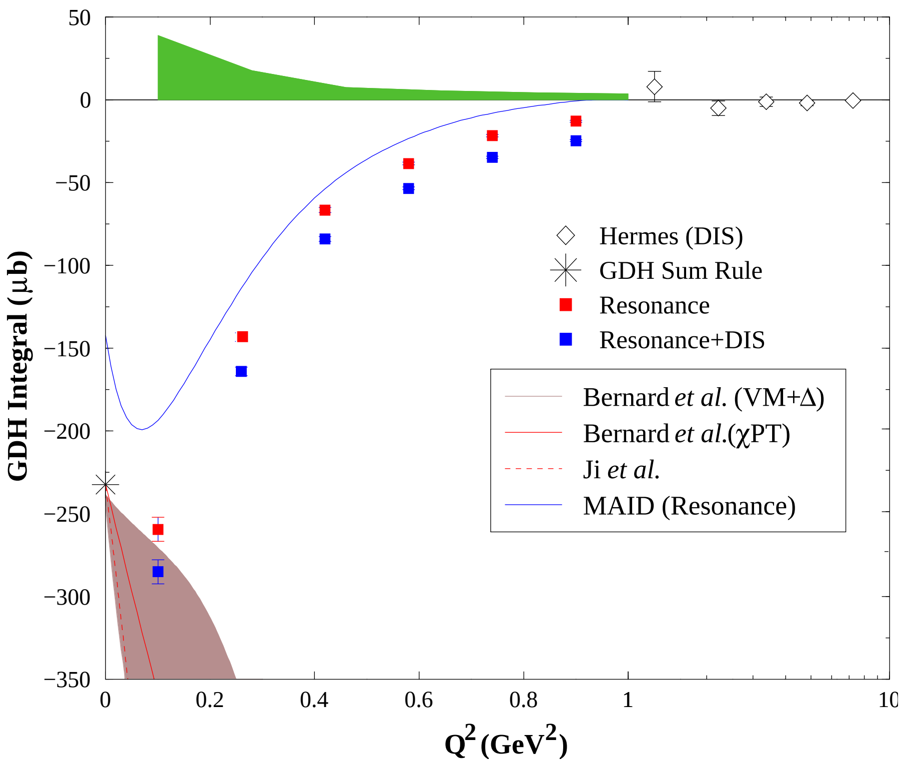
$Q^2 = 0$ $Q^2 = \infty$

Hadronic Partonic

- Constrained at the two ends of the Q^2 spectrum by known sum rules.
- S_1 and S_2 are calculable at any Q^2.
- Compare theoretical predictions to experimental measurements over the entire Q^2 range.
- Provides a bridge from the non-perturbative region to the perturbative region of QCD.

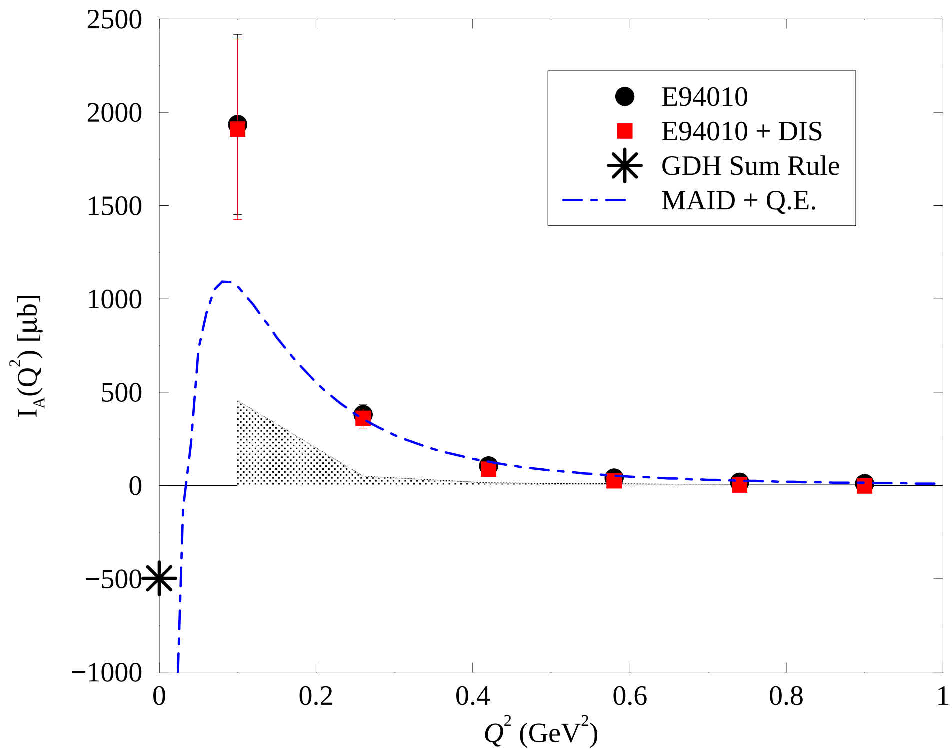
Hall A GDH Results

Neutron



M. Amarian *et al.*, PRL **89**, (2002) 242301

Helium-3



Preliminary results from K. Slifer

Experiment E97-110

Precise measurement of generalized GDH integral at low Q^2, 0.02 to 0.3 GeV^2

- Ran in spring and summer 2003
- Inclusive experiment: $^3\vec{\mathrm{He}}(\vec{e},e')X$

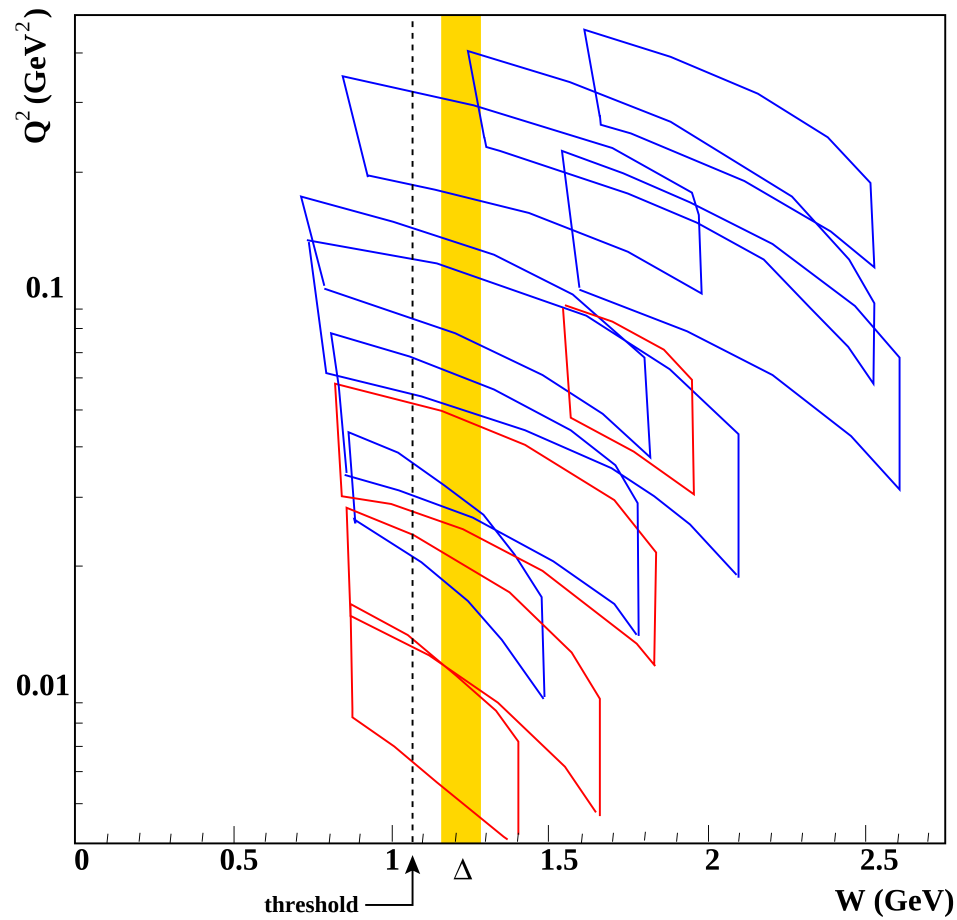
  $\Rightarrow$ Scattering angles of 6° and 9°

  $\Rightarrow$ Polarized electron beam:

  65% $< P_{\mathrm{beam}} <$ 78%

  $\Rightarrow$ Pol. ^{3}He target (para & perp):

  $\langle P_{\mathrm{targ}} \rangle$ = 40%
- Measured polarized cross-section differences



Spokespersons: J.P. Chen, A. Deur, and F. Garibaldi

Students: J. Singh, V. Sulkosky, and J. Yuan

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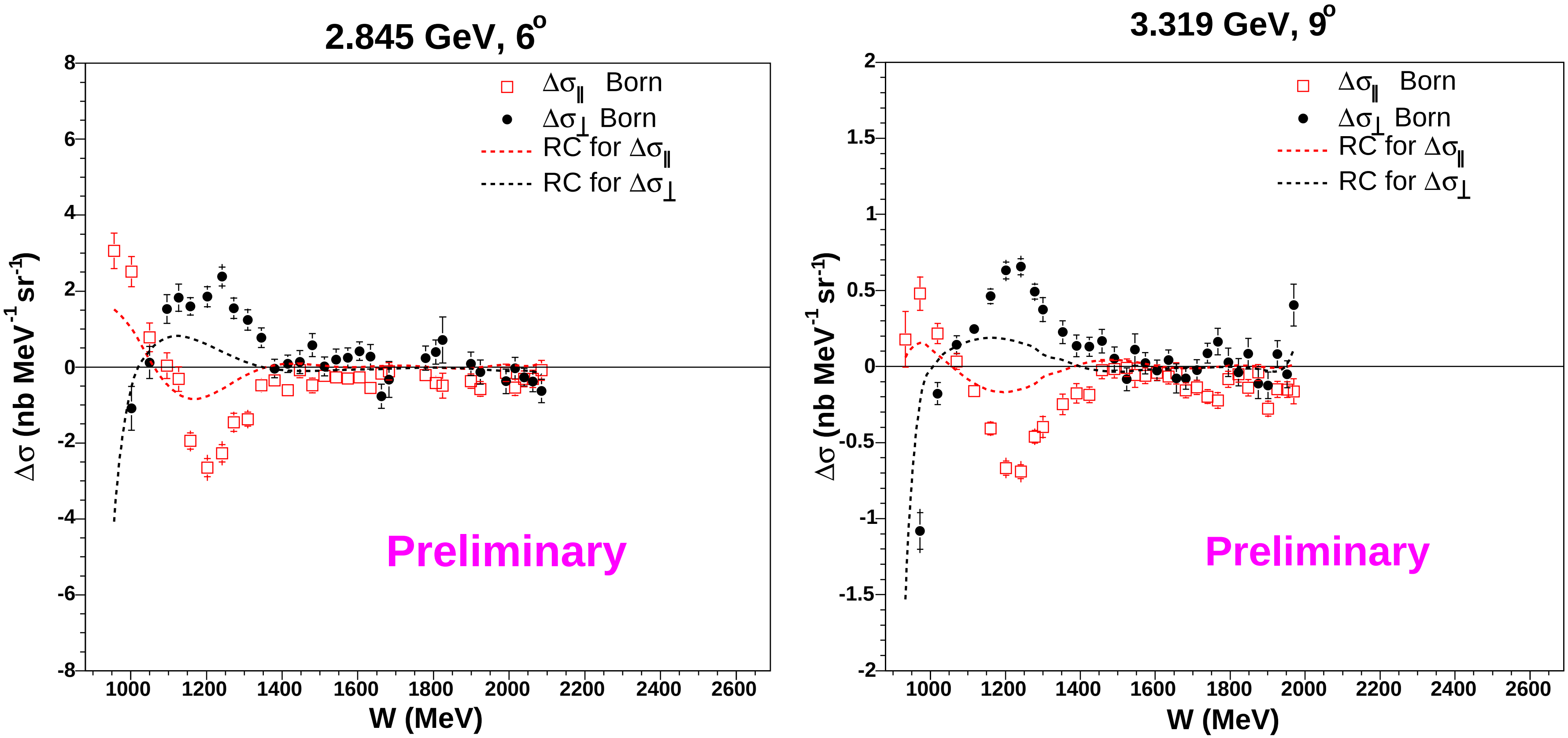
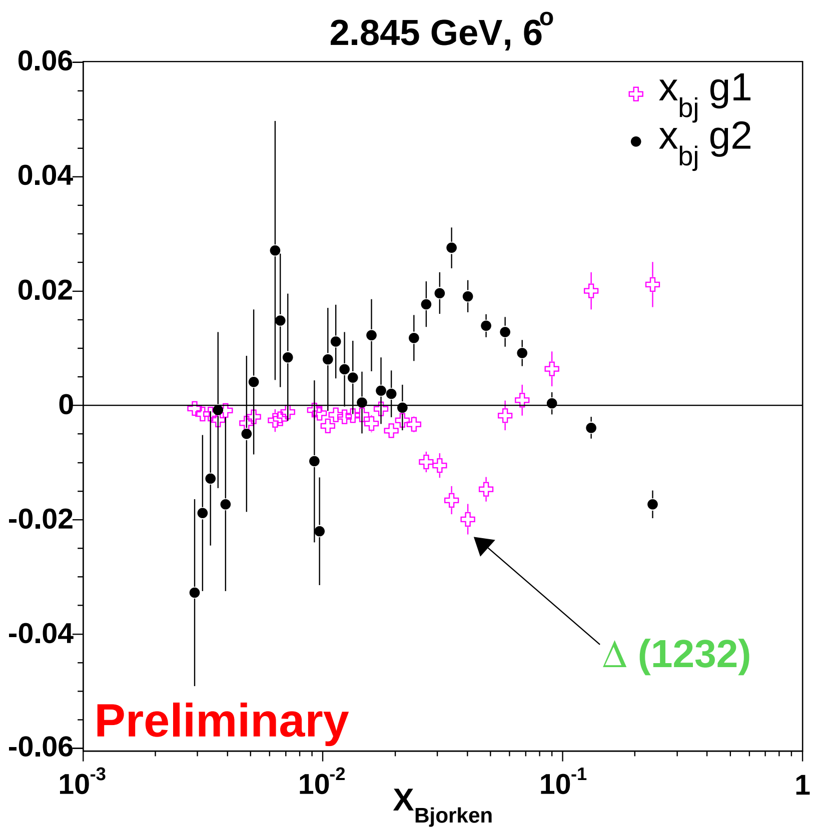
The Septum Magnet

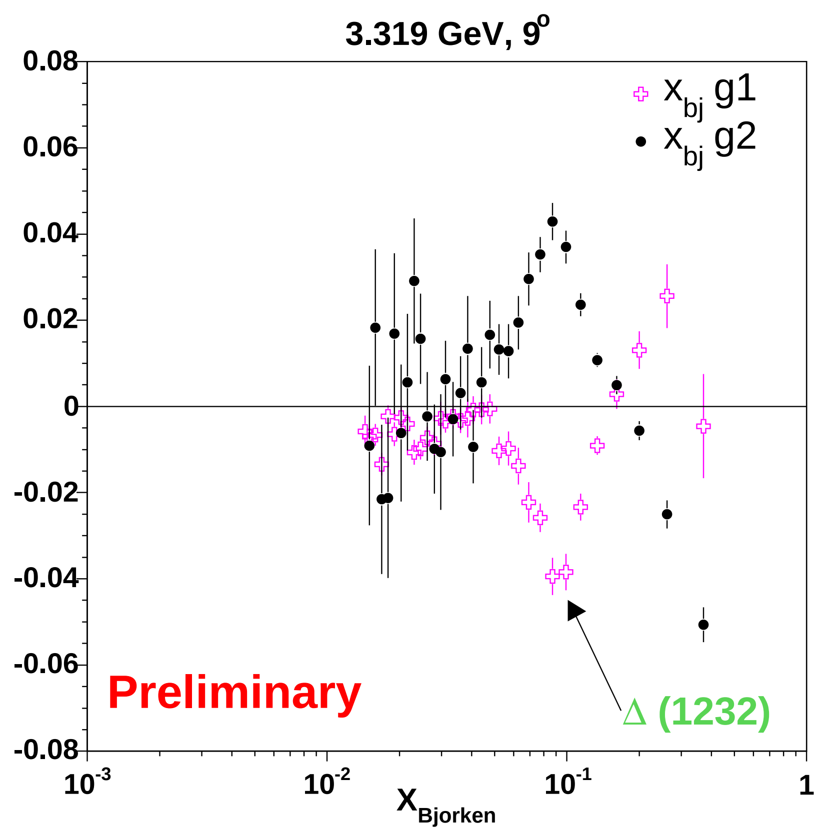
- Low Q^2 requires forward angles.
- Minimum spectrometer angle is 12.5°.
- The septum magnet allows detection of electrons with scattering angles of 6° and 9°.
- Designed for the spectrometers to retain their resolution.

Cross Section Differences

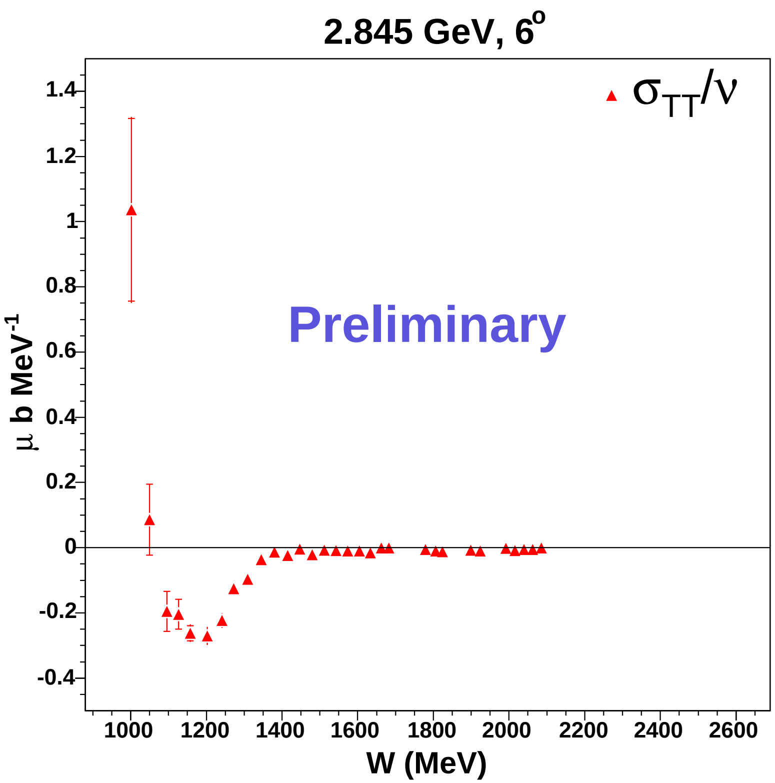


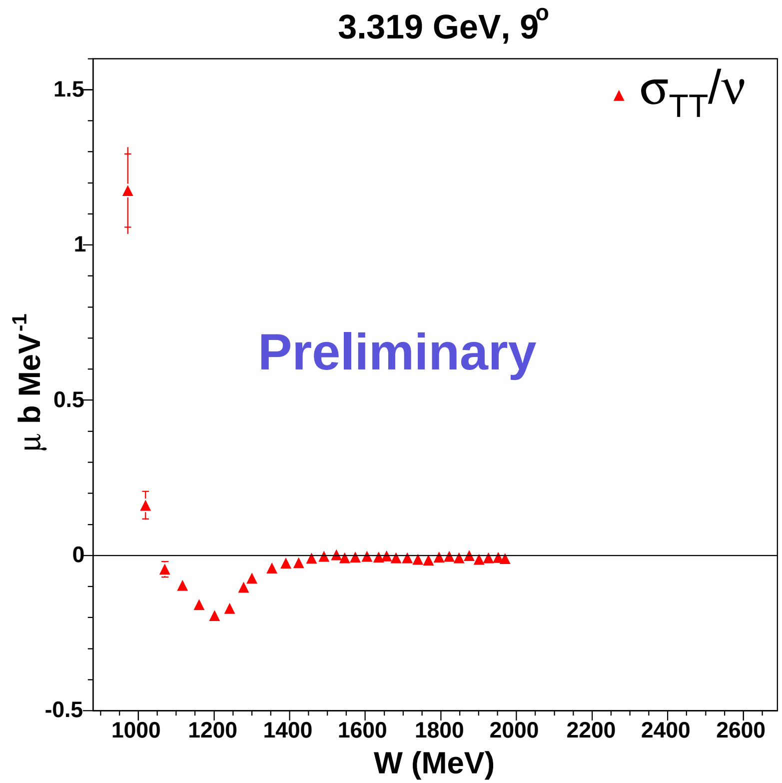
^{3}He Spin Structure Functions





The GDH Integrand: σ_{TT}

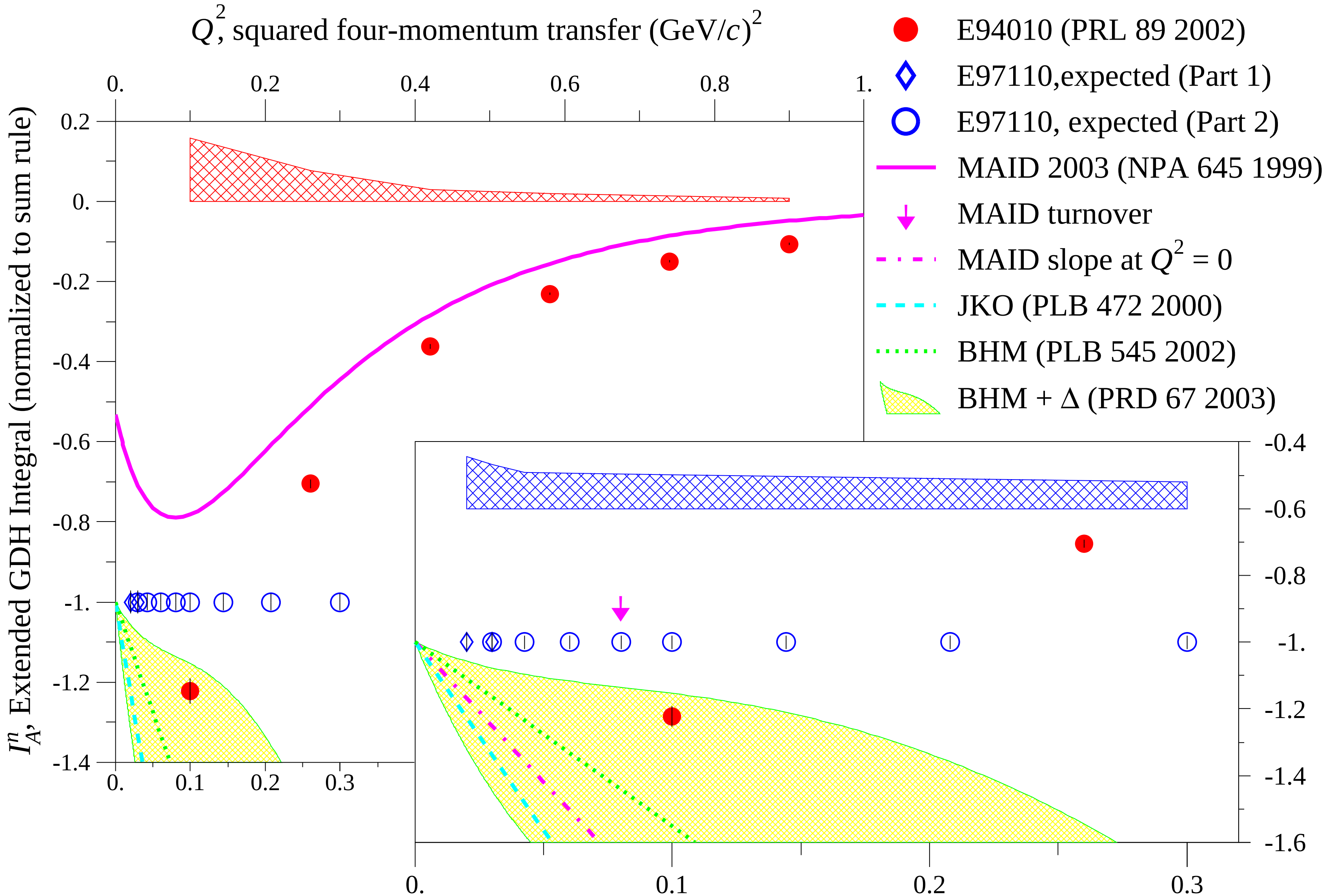




$$I(Q^2) = \int_{\nu_{\mathrm{th}}}^{\infty} \frac{2\sigma_{\mathrm{TT}}}{\nu} d\nu; \quad 2\sigma_{\mathrm{TT}} = \sigma_{1/2}(\nu, Q^2) - \sigma_{3/2}(\nu, Q^2)$$

$$\sigma_{\mathrm{TT}} = \frac{4\pi^2\alpha}{MK}\left[g_1(\nu, Q^2) - \left(\frac{Q^2}{\nu^2}\right) g_2(\nu, Q^2)\right]$$

Expected Neutron Results



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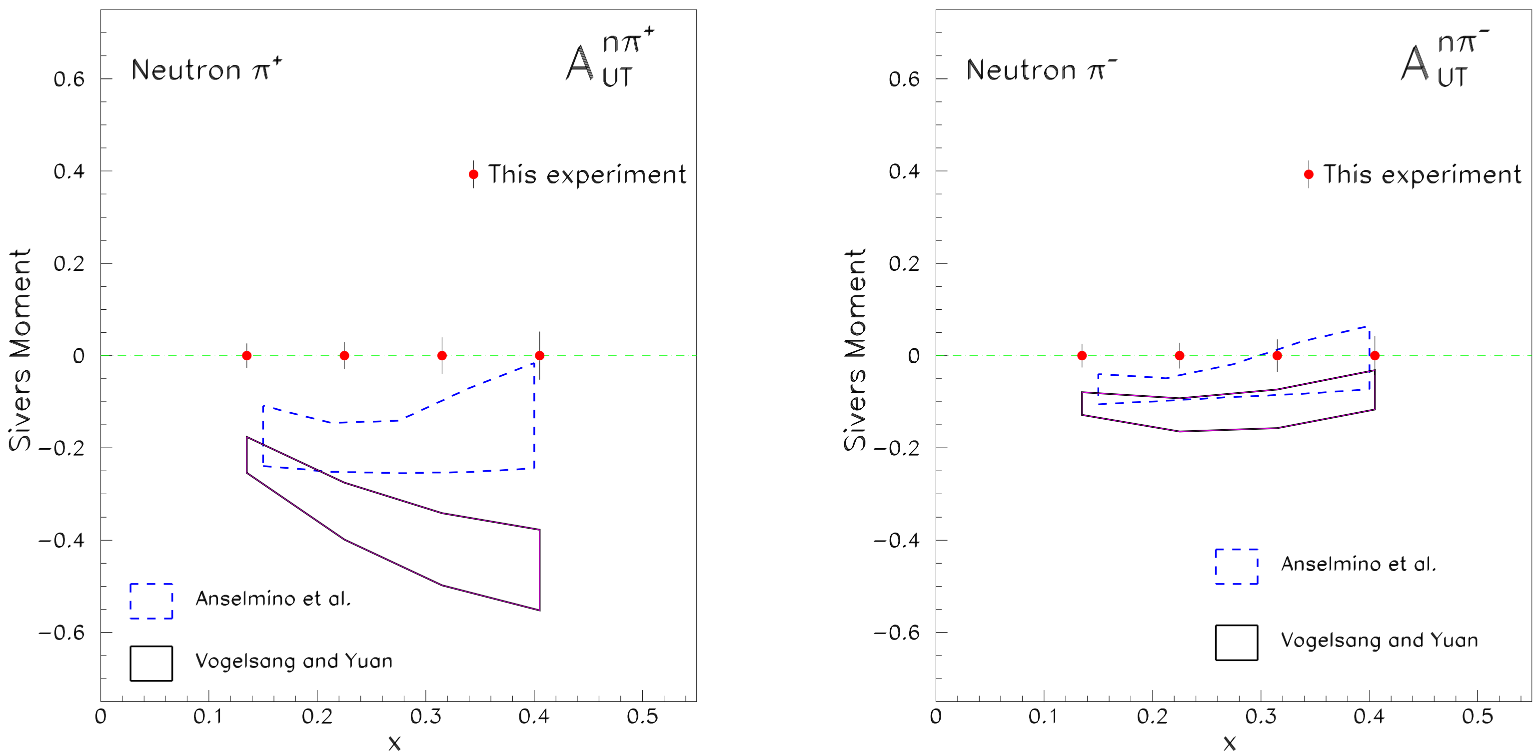
Future Hall A Experiments

- E06-010/E06-011: Transversity
- E06-014: d_2^{n}
- E12-06-122: A_1^{n} (12 GeV approved proposal)

E06-010/E06-011: Transversity

Spokespersons: X. Jiang, J.-P. Chen, E. Cisbani, H. Gao and J.-C. Peng

Requires two Chiral-odd objects to measure: Drell-Yan or Semi-Inclusive DIS



$$A_{UT}(\phi_h, \phi_s) = A_{UT}^{Collins} \sin(\phi_h + \phi_s) + A_{UT}^{Sivers} \sin(\phi_h - \phi_s)$$

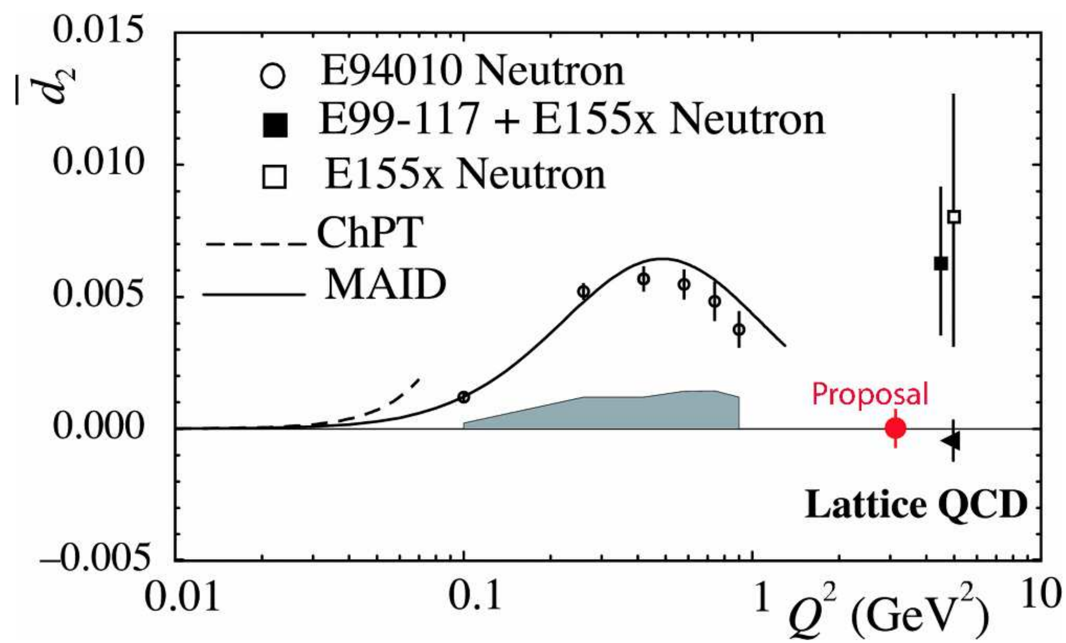
See Jen-Chieh Peng's talk.

E06-014: $d_2^{\rm n}$

Spokespersons: B. Sawatzky, S. Choi, X. Jiang and Z.-E. Mezianni

$$d_2^{\rm n} = \int_0^1 x^2\left(2g_1^{\rm n} + 3g_2^{\rm n}\right)dx$$

- OPE: d_2 a twist-3 matrix element
- Arising from quark-gluon interactions
- Clean indicator of HT effects in nucleons
- E06-014:
  - ⇒ BigBite and HRS spectrometers
  - ⇒ $0.2 < x < 0.65$
  - ⇒ 2 GeV$^2 < Q^2 <$ 5 GeV^2
  - ⇒ Polarized electron beam
  - ⇒ Pol. ^{3}He target
- Reduce statistical uncertainty by a factor of 4
- Benchmark test of Lattice QCD

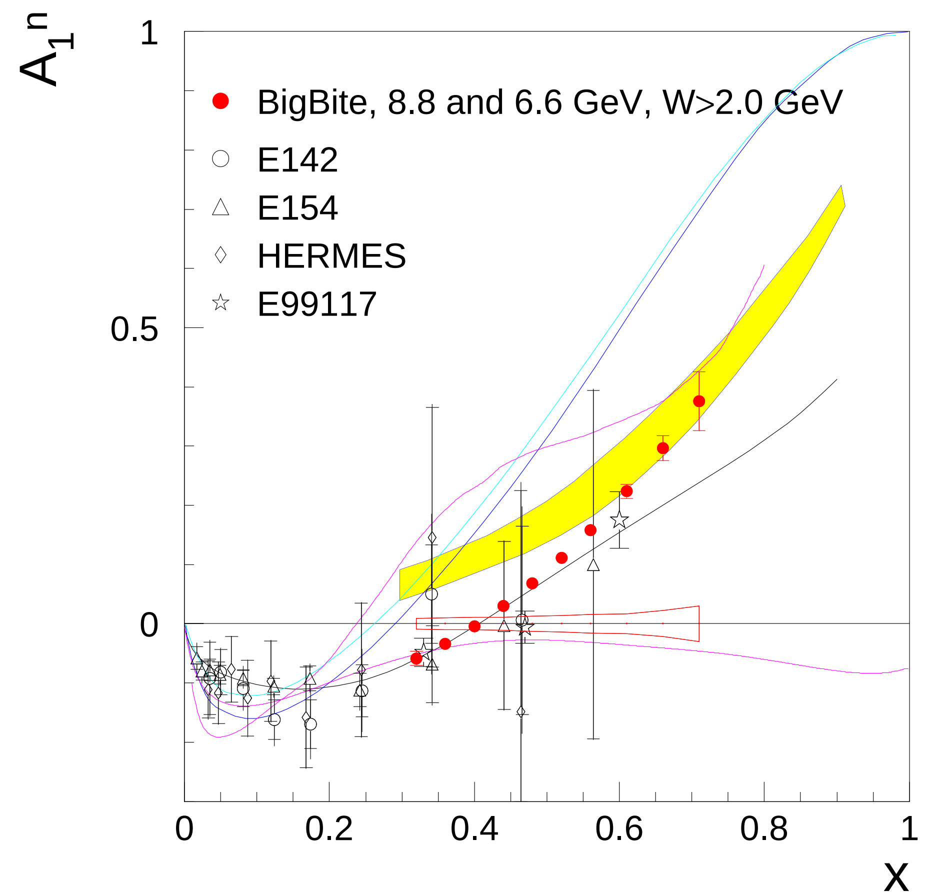


E12-06-122: A_1^n

Spokespersons: B. Wojtsekhowski, N. Liyanage, X.-C. Zheng, G. D. Cates,
Z.-E. Mezianni and G. Rosner

A_1^n using 6.6 GeV and 8.8 GeV beam with BigBite, approved by PAC30.

- Beam time: 90 hours at 6.6 GeV and 460 hours at 8.8 GeV.
  - $\Rightarrow$ Beam Current: 10 μA.
  - $\Rightarrow$ Polarized electron beam:
    - P_{beam} = 80%
  - $\Rightarrow$ 40 cm Pol. ^{3}He target:
    - P_{targ} = 50%
- Resonance data collected simultaneously.
- Similar proposal conditionally approved using 11 GeV beam and baseline equipment in Hall C: x up to 0.77.



Summary and Conclusion

Duality:

- E01-012 provides fi rst data of neutron(^{3}He) spin Structure functions in the resonance region for Q^2 between 1.0 GeV^2 and 4.0 GeV^2.
- Dedicated test of Quark-hadron duality for neutron and ^{3}He SSFs.
- Global duality demonstrated for the neutron and ^{3}He SSF g_1.
- Observed DIS-like behavior in $A_1^{^3\mathrm{He}}$ measured in the resonance region.

Summary and Conclusion

Generalized GDH:

- The GDH integral is an important tool used to study the nucleon over the full Q^2 range.
- E97-110 provides precision data for the generalized GDH integral at low Q^2, 0.02 to 0.3 GeV^2
- Extraction of the ^{3}He structure functions and the GDH integrand has been performed.
- Moments of the spin structure functions and the GDH integral extraction are in progress.
- These data allow us to check χPT at very low Q^2.

Summary and Conclusion

Future Hall A Spin Program:

- E06-010/E06-011: Transversity (2008)
- E06-014: d_2^{n} (2008)
- E12-06-122: A_1^{n} (12 GeV)

Extra Slides

Target Mass Corrections

$$g_1(x,Q^2) = g_1(x,Q^2;M=0) + \frac{M^2}{Q^2} g_1^{(1)\mathrm{TMC}}(x,Q^2) + \frac{h(x,Q^2)}{Q^2} + O(\frac{1}{Q^4})$$

- Kinematic effect: finite value of $\frac{4M^2x^2}{Q^2}$.
- Need to apply before calculating higher twist effects.
- TMCs are expressed by higher moments of $g_1(x,Q^2;M=0)$.

E12-06-122: A_1^n

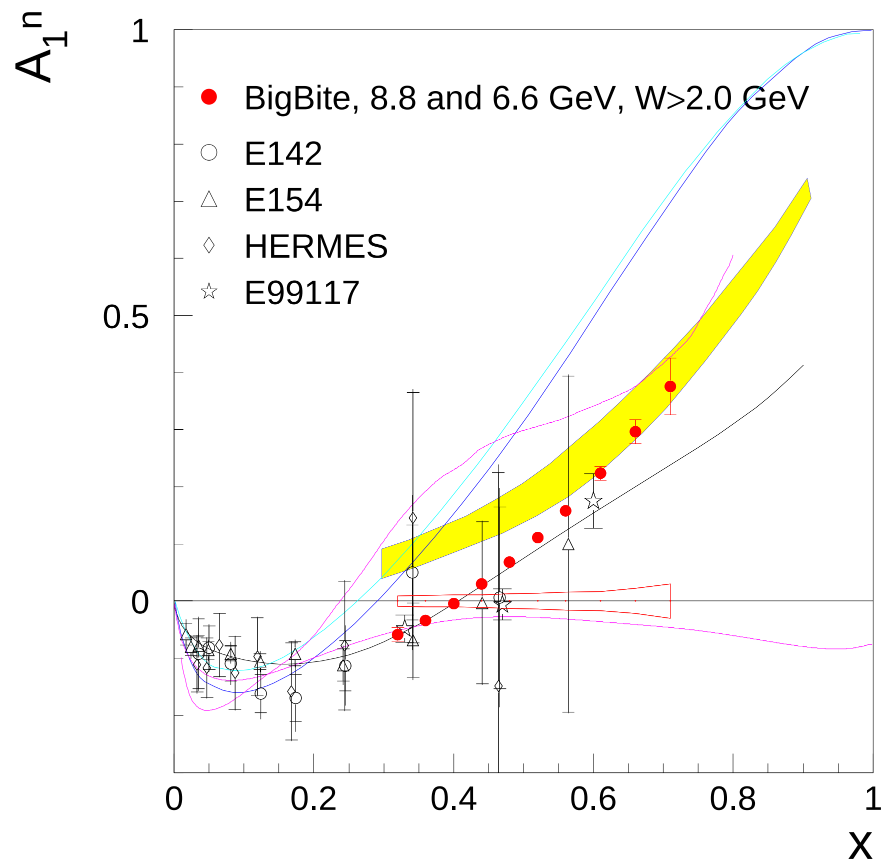
Spokespersons: B. Wojtsekhowski, N. Liyanage, X.-C. Zheng, G. D. Cates, Z.-E. Mezianni and G. Rosner

A_1^n using 6.6 GeV and 8.8 GeV beam with BigBite, approved by PAC30.

- Light Blue: LSS(BBS)

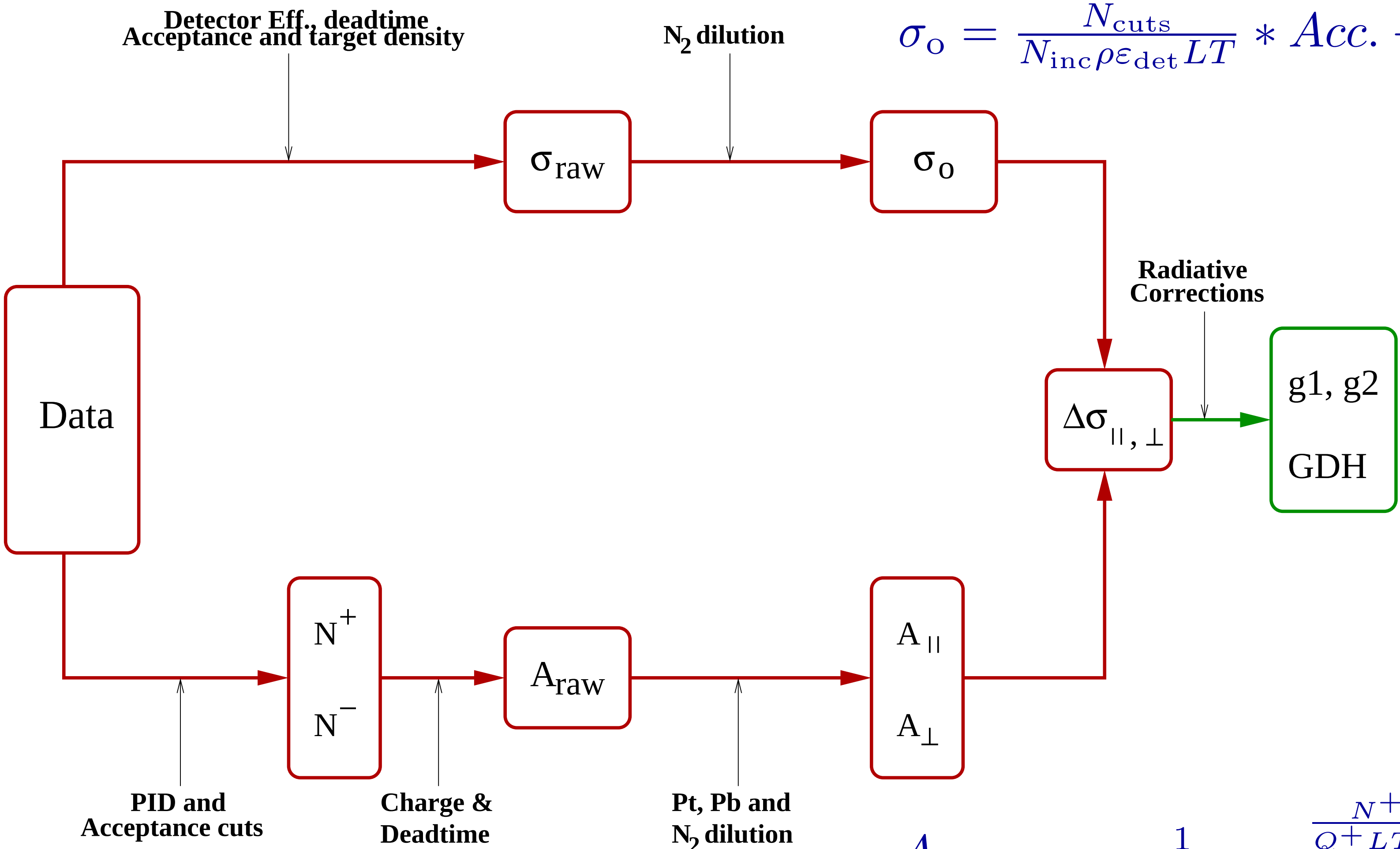
  - using HHC with fi t to data.
- Blue: BBS - using HHC.
- magenta (above yellow band):

  bag model.
- yellow band: RCQM.
- black: LSS2001.
- magenta (< 0): soliton model.



Analysis Procedure

$$\sigma_0 = \frac{N_{\rm cuts}}{N_{\rm inc}\rho\varepsilon_{\rm det}LT} * Acc. - \frac{2\rho_{\rm N_2}}{\rho + \rho_{\rm N_2}}\sigma_{\rm N_2}$$



$$A_{\parallel,\perp} = \frac{1}{f_{\rm N_2}P_{\rm tg}P_{\rm beam}} \frac{\frac{N^+}{Q^+LT^+} - \frac{N^-}{Q^-LT^-}}{\frac{N^+}{Q^+LT^+} + \frac{N^-}{Q^-LT^-}}$$

The E97-110 Collaboration

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Y. Qiang, R. Ransome, B. Reitz, R. Roche, A. Saha, A. Shabetai,
J. Singh, S. Sirca, K. Slifer, R. Snyder, P. Solvignon, R. Stringer,
R. Subedi, **V. Sulkosky**, W.A. Tobias, P. Ulmer, G. Urciuoli,
A. Vacheret, E. Voutier, K. Wang, L. Wan, B. Wojtsekhowski,
S. Woo, H. Yao, **J. Yuan**, X. Zheng, L. Zhu

and the Jefferson Lab Hall A Collaboration

Systematic Uncertainties

Source	Systematic Uncertainty
Target density	2.0%
Acceptance/Effects	7.5%
VDC efficiency	2.5% (6°) 2.0% (9°)
Charge	1.0%
PID Detector and Cut effs.	$<$ 1.0%
$\delta\sigma_{\mathrm{raw}}$	8.4% (6°) 8.2% (9°)
Nitrogen dilution	0.2–0.5%
$\delta\sigma_{\mathrm{exp}}$	8.5% (6°) 8.3% (9°)
Beam polarization	3.5%
Target polarization	7.5%
$\delta\left(\Delta\sigma_{\parallel,\perp}\right)$	11.9% (6°) 11.7% (9°)

Chiral Symmetry

$$\mathcal{L}_{\rm QCD} = -\frac{1}{4g^2} G^{\alpha}_{\mu\nu} G^{\mu\nu}_{\alpha} + \bar{q} i \gamma^{\mu} D_{\mu} q - \bar{q} \mathcal{M} q$$
$$\mathcal{L}_{\rm QCD} = \mathcal{L}_0 + \mathcal{L}_{sb}$$

- Consider the limit where the light quark masses vanish.
- For massless fermions, chirality (handedness) is identical to a particle's helicity.
- Extra symmetry to the Lagrangian and obtain left and right handed quark fields.

$$q_{L,R} = \frac{1}{2}(1 \mp \gamma_5) q \,,$$

GDH Derivation

Based on fundamental physical arguments

- Lorentz and gauge invariance: low energy theorem, Phys. Rev. **96**, 1428 (1954).
- Unitarity of the S-matrix: optical theorem.
- Causality: dispersion relations for forward compton scattering.

The Quark-Parton Model

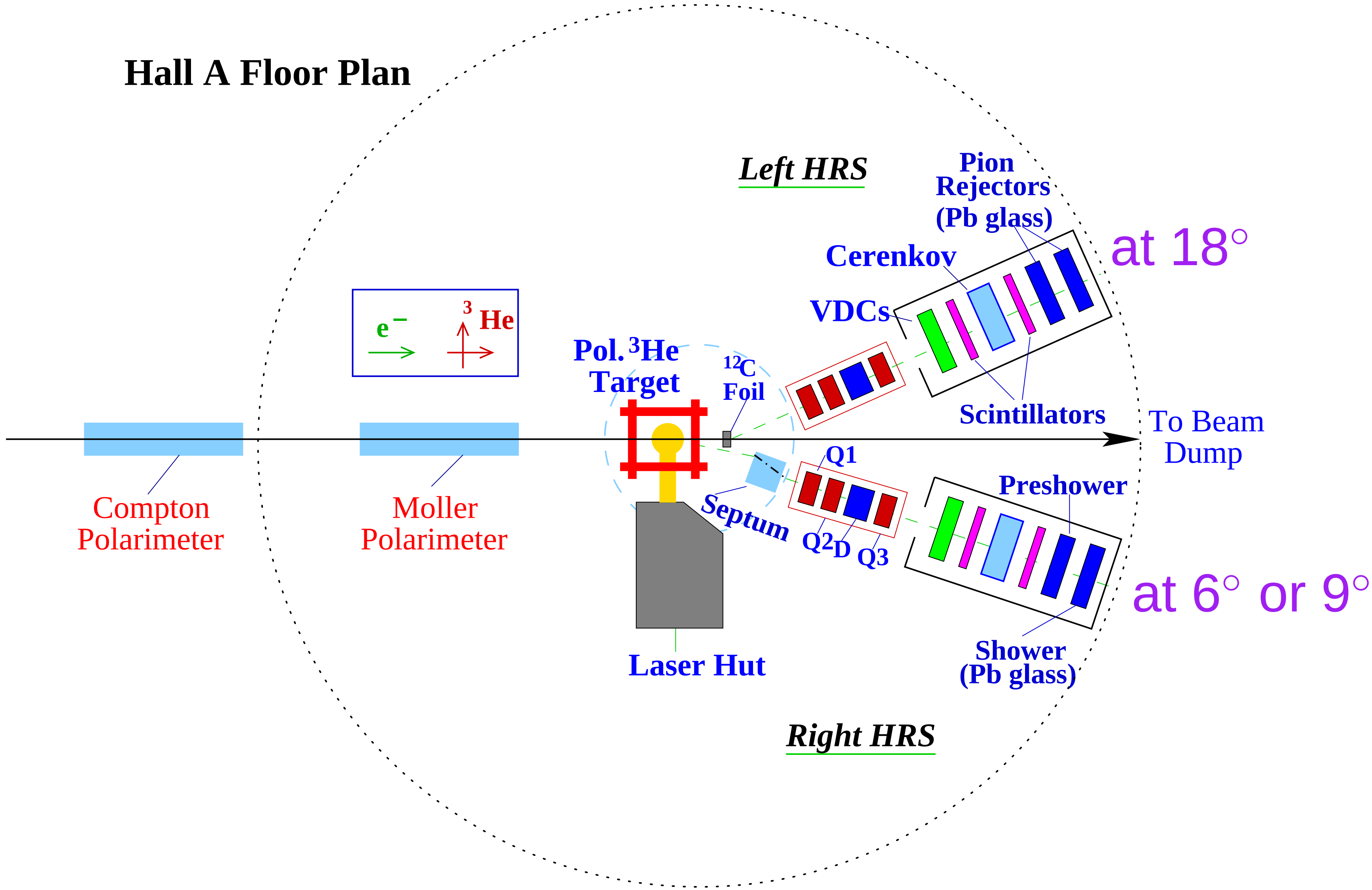
Infinite-momentum frame

- Partons: quarks and gluons (point-like).
- With no quark-quark or quark-gluon interactions.
- x: fraction of nucleon's momentum carried by the struck quark
- $q_i(x)$ and $\Delta q_i(x)$ are quark momentum distribution functions.

$$F_1(x) = \frac{1}{2} \sum_i e_i^2 q_i(x)$$

$$g_1(x) = \frac{1}{2} \sum_i e_i^2 \Delta q_i(x)$$

Experimental Setup



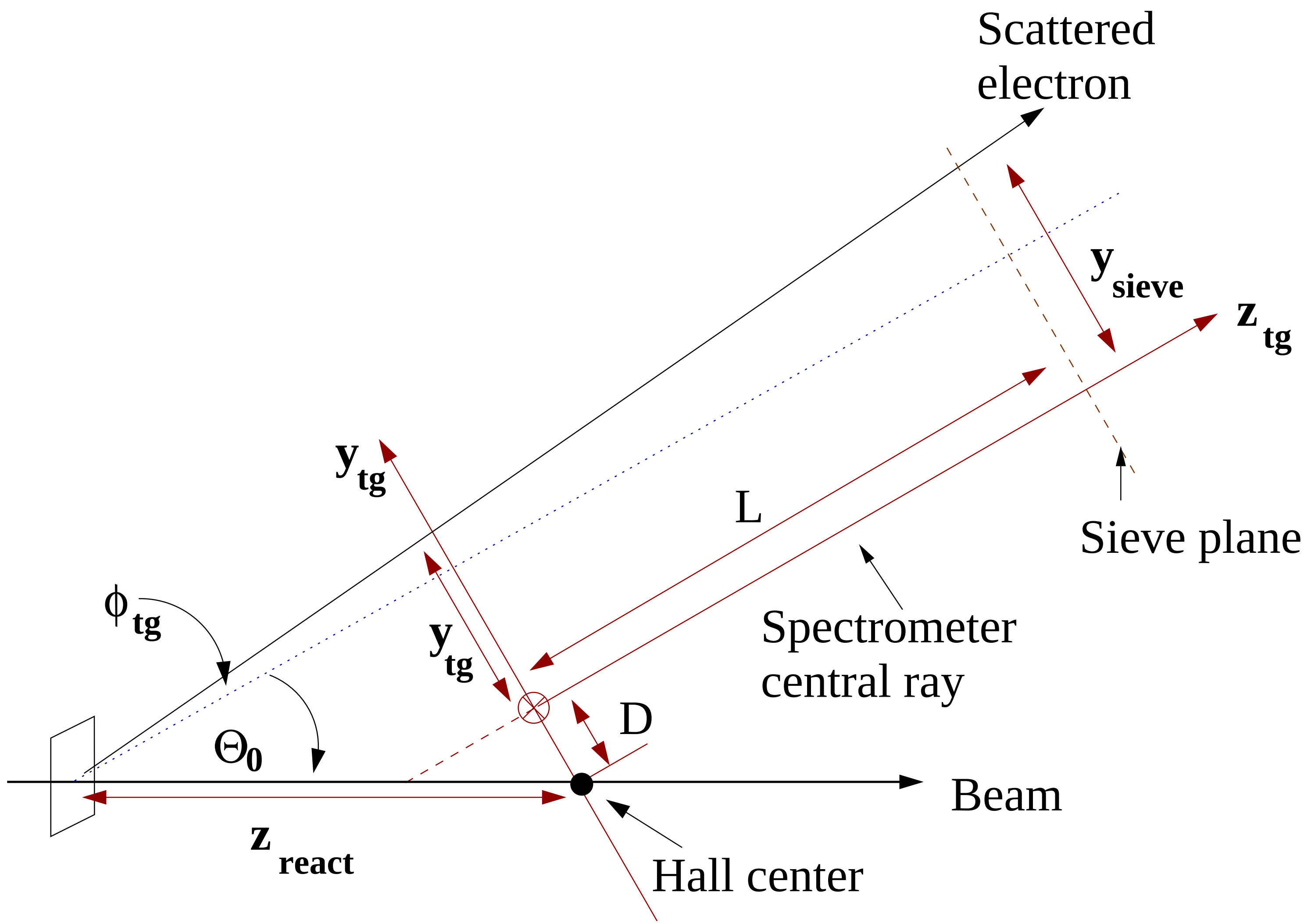
Spectrometer Optics

Optics transformation matrix

- The target coordinates are related to coordinates measured at the focal plane.
- The matrix is well know for the standard HRS.
- The addition of the septum magnet required a new determination of the matrix.
- Experiment E97-110 was the commissioning experiment for the septum.

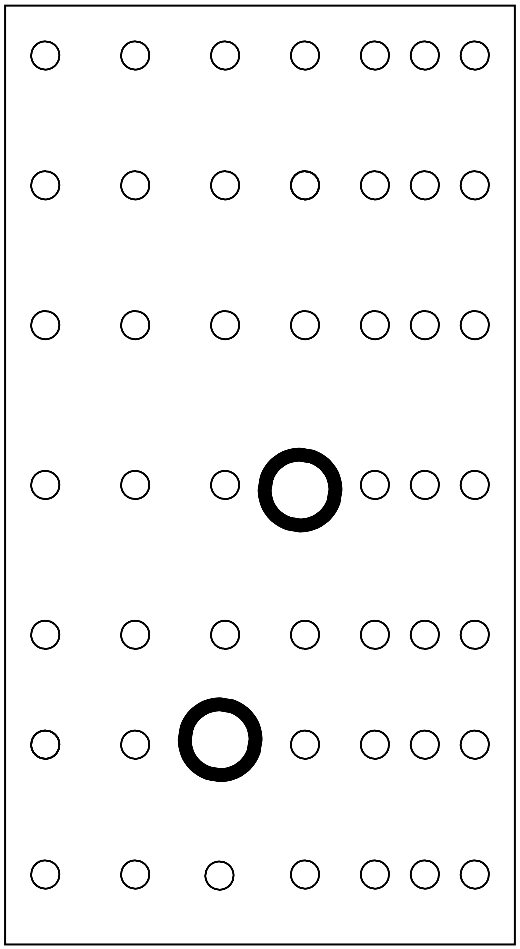
$$\begin{bmatrix} \delta \\ \theta \\ y \\ \phi \end{bmatrix}_{\rm tg} = \begin{bmatrix} \langle\delta|x\rangle & \langle\delta|\theta\rangle & \langle\delta|y\rangle & \langle\delta|\phi\rangle \\ \langle\theta|x\rangle & \langle\theta|\theta\rangle & \langle\theta|y\rangle & \langle\theta|\phi\rangle \\ \langle y|x\rangle & \langle y|\theta\rangle & \langle y|y\rangle & \langle y|\phi\rangle \\ \langle\phi|x\rangle & \langle\phi|\theta\rangle & \langle\phi|y\rangle & \langle\phi|\phi\rangle \end{bmatrix} \begin{bmatrix} x \\ \theta \\ y \\ \phi \end{bmatrix}_{\rm fp}$$

Target Coordinates

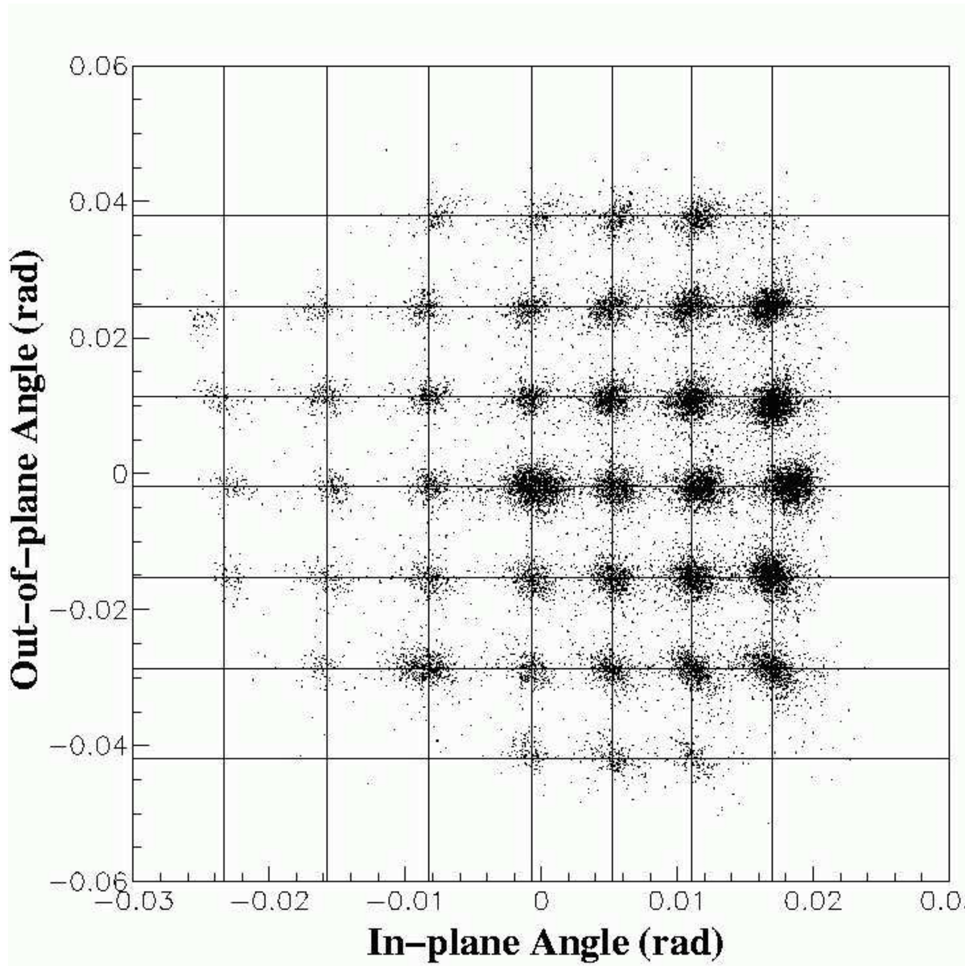


Optics Calibration Results

Sieve Slit

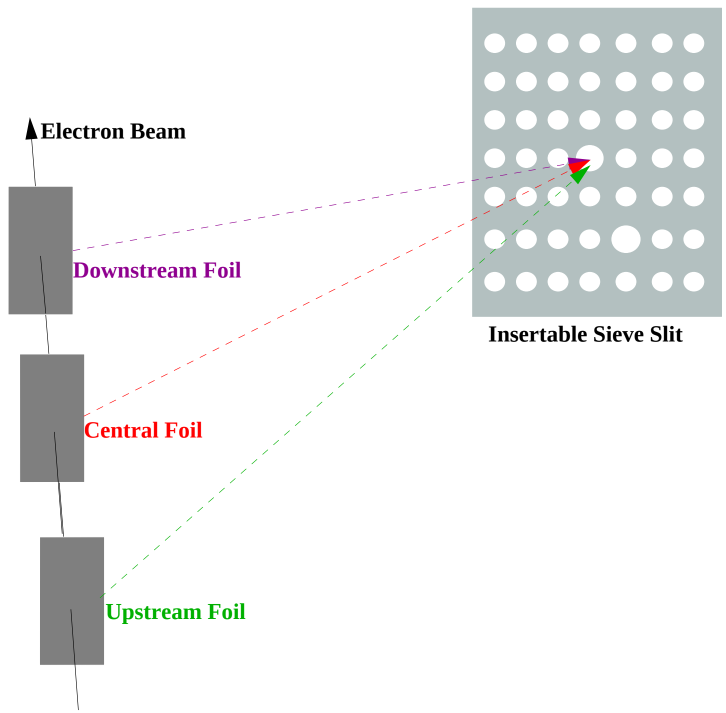


Angular Reconstruction

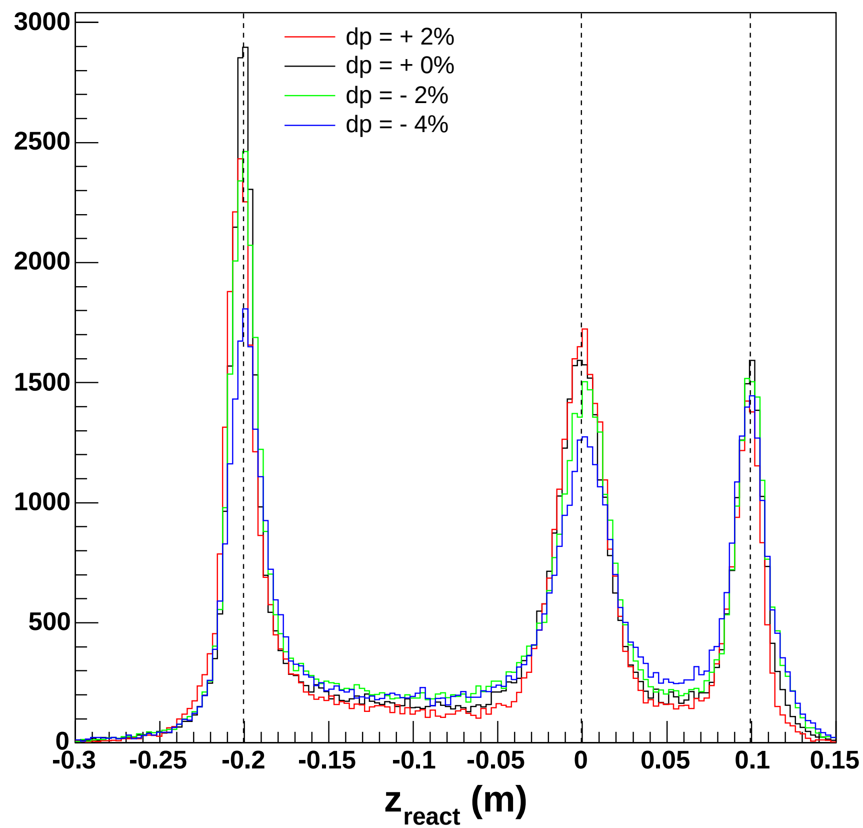


Optics Calibration Results

Configuration



Position Reconstruction



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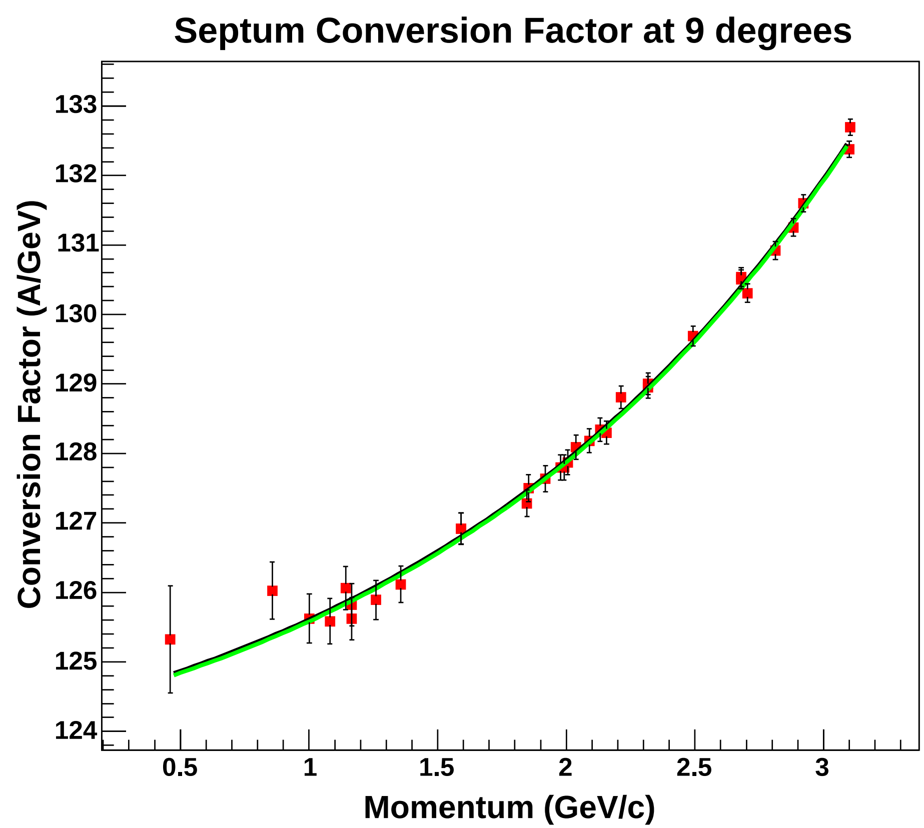
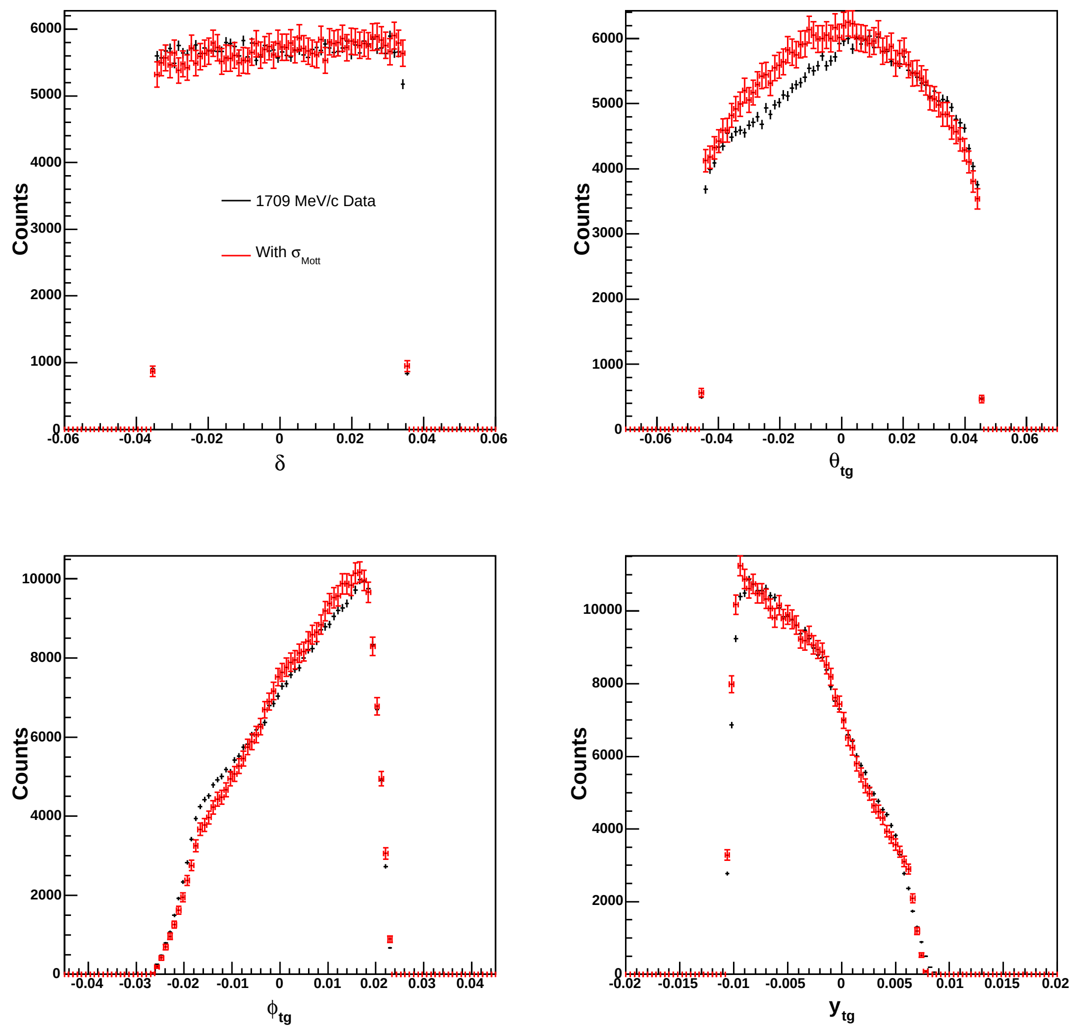
Hysteresis of the Septum Magnet

- The septum shows signs of hysteresis at higher currents.
- An interpolation between optimized settings was used to correct shifts seen in the target quantities.



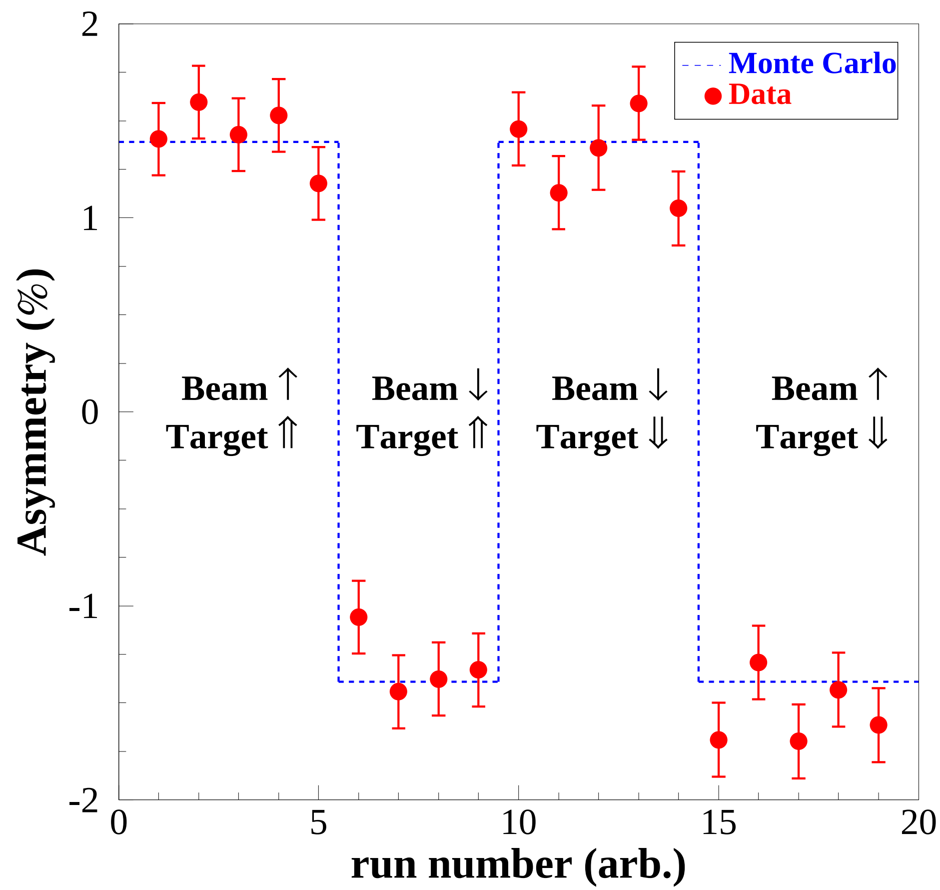
Acceptance for ^{3}He Data

Black: Data, Red: Simulation

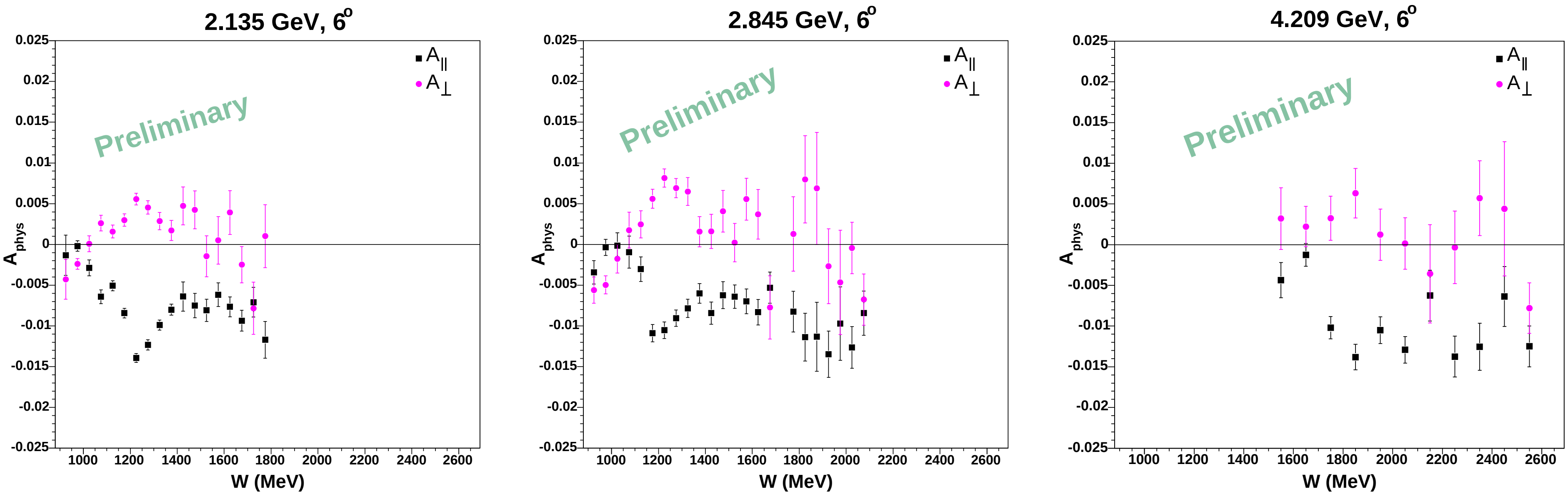


^{3}He Elastic Asymmetry

- Monte Carlo prediction: 1.390%
- Preliminary data analysis: (1.403 $\pm$ 0.044)% (stat. only) $\chi^2/\mathrm{N_{dof}}$ = 1.08.
- Four target and beam confi gurations
- For seven out of the twelve beam energies, elastic data were acquired.

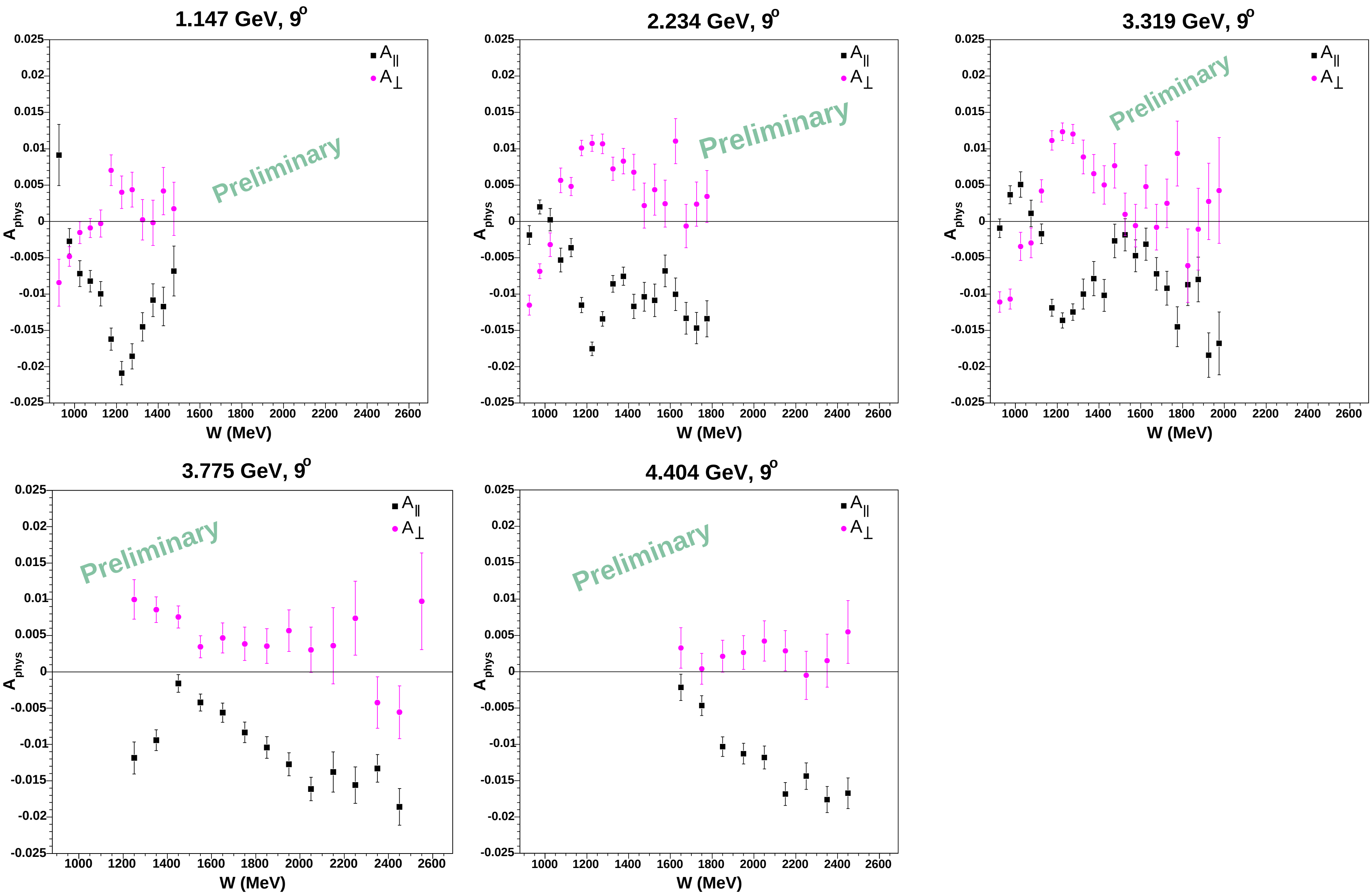


^{3}He Inelastic Asymmetries

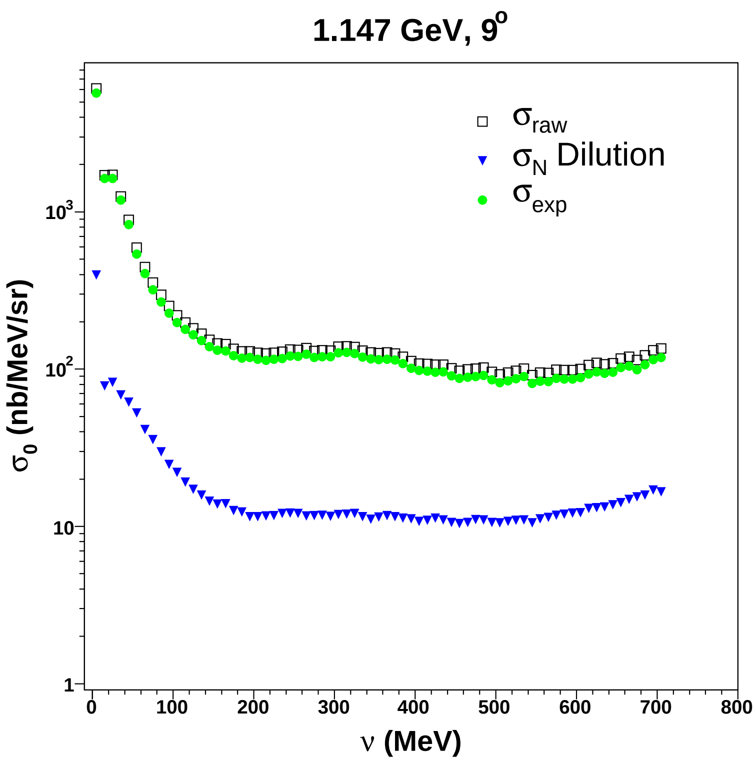


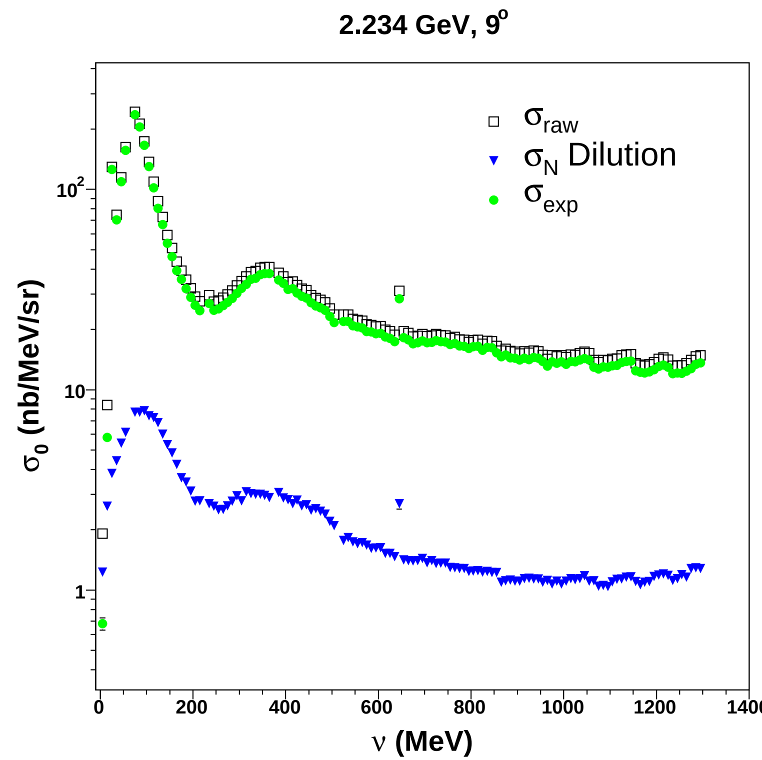
No Radiative Corrections!

^{3}He Inelastic Asymmetries

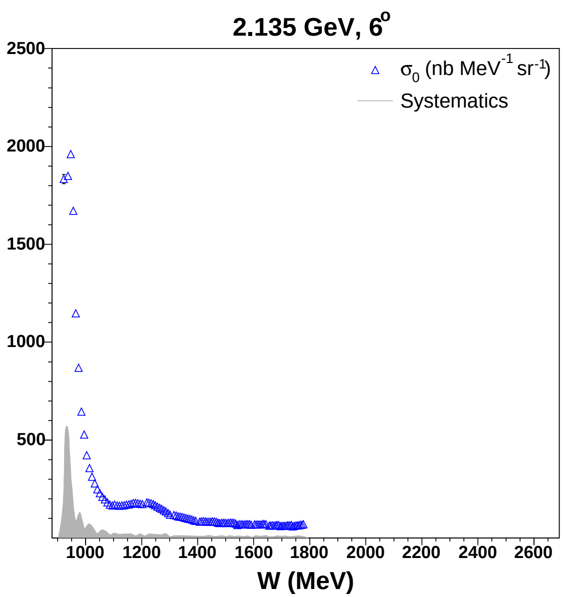


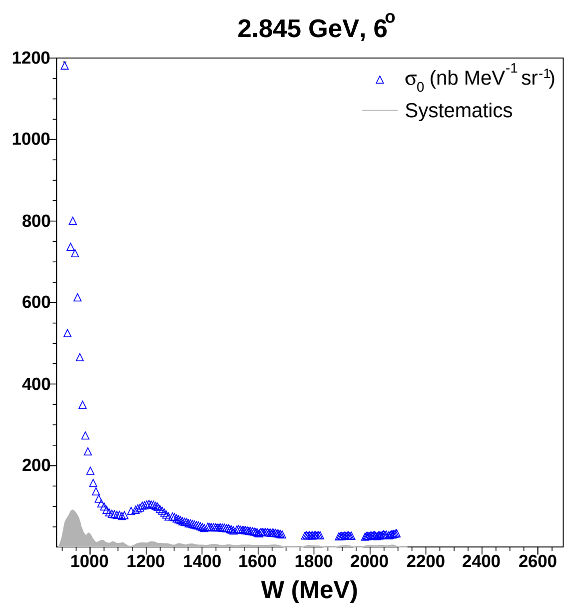
Nitrogen Subtraction

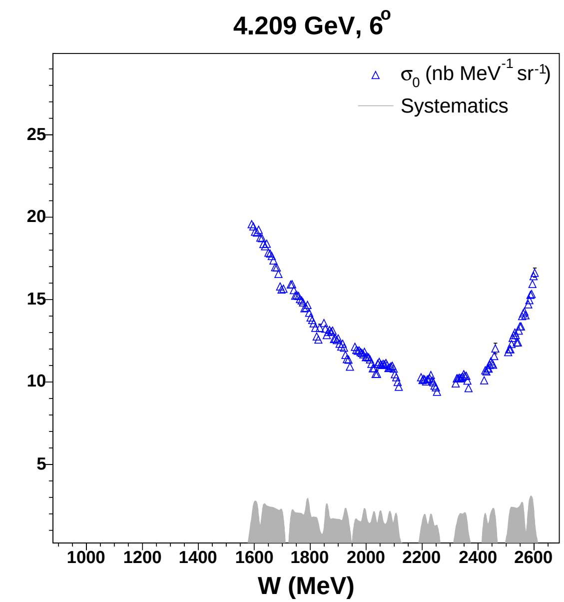




Preliminary ^{3}He Cross Sections







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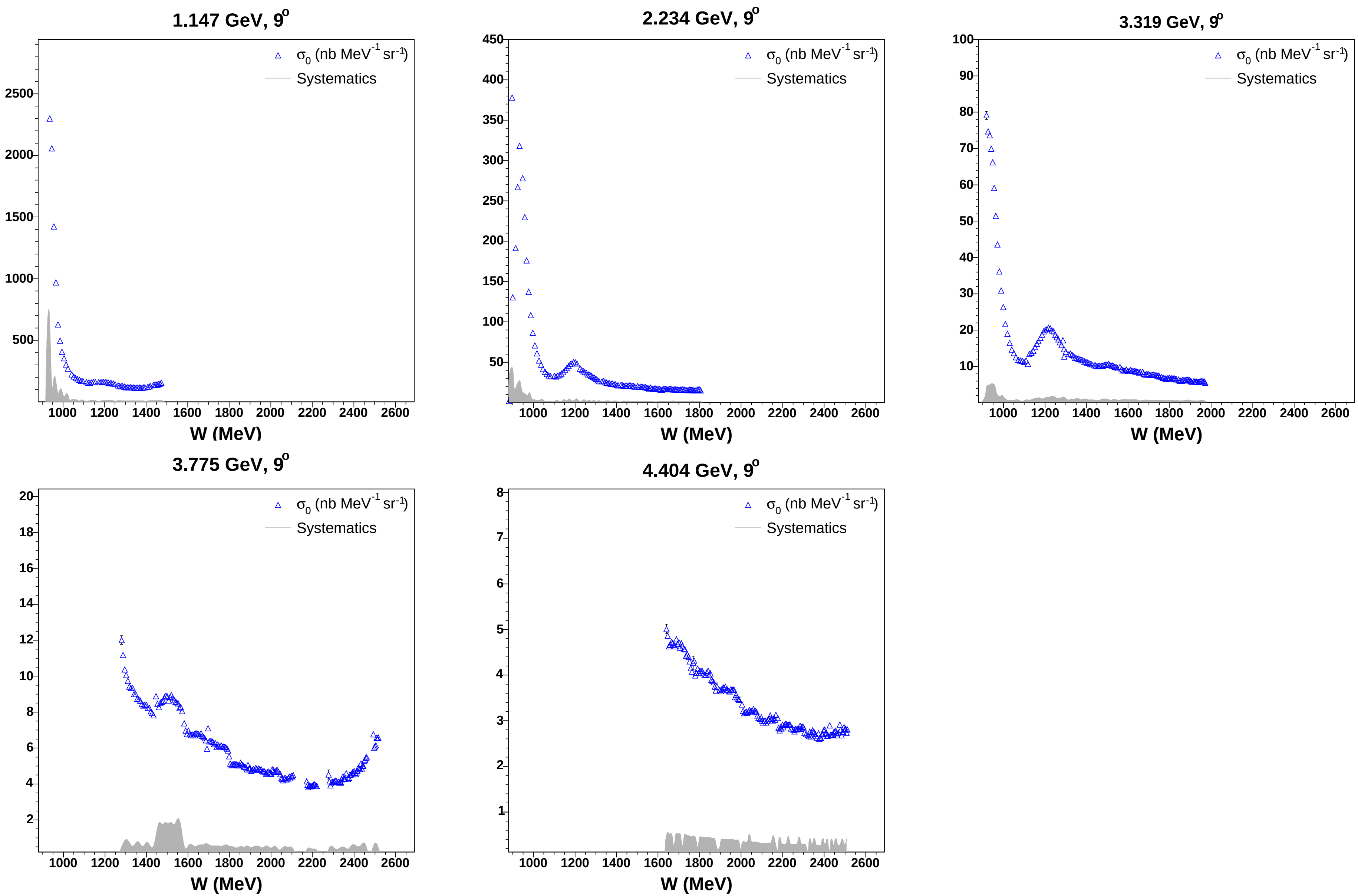
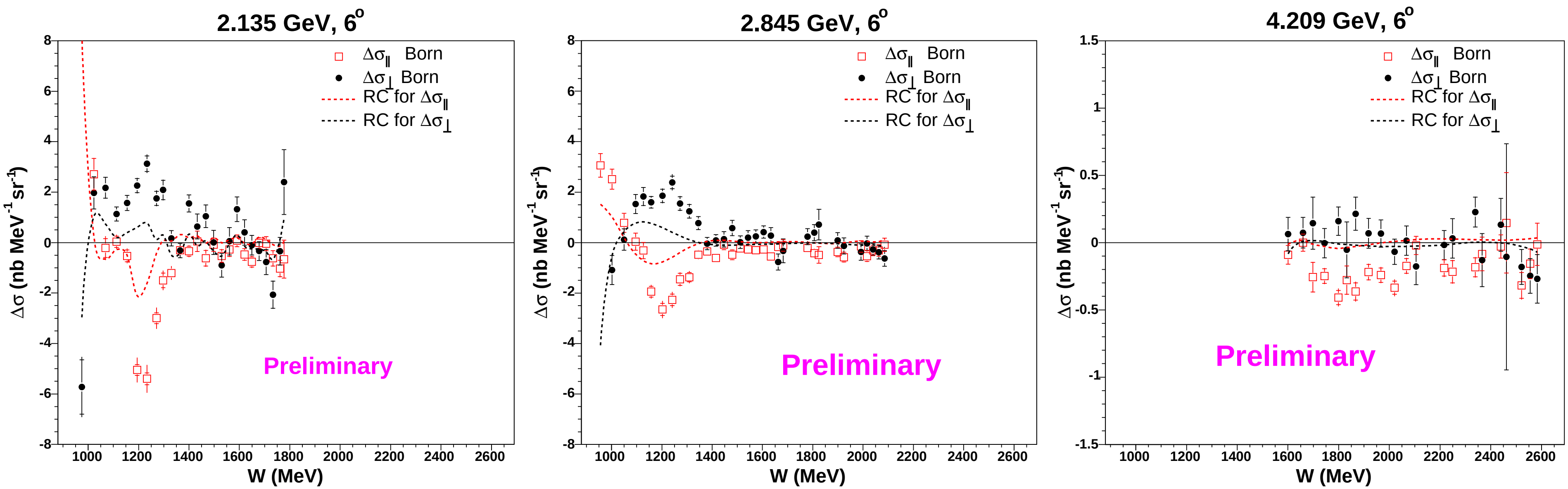
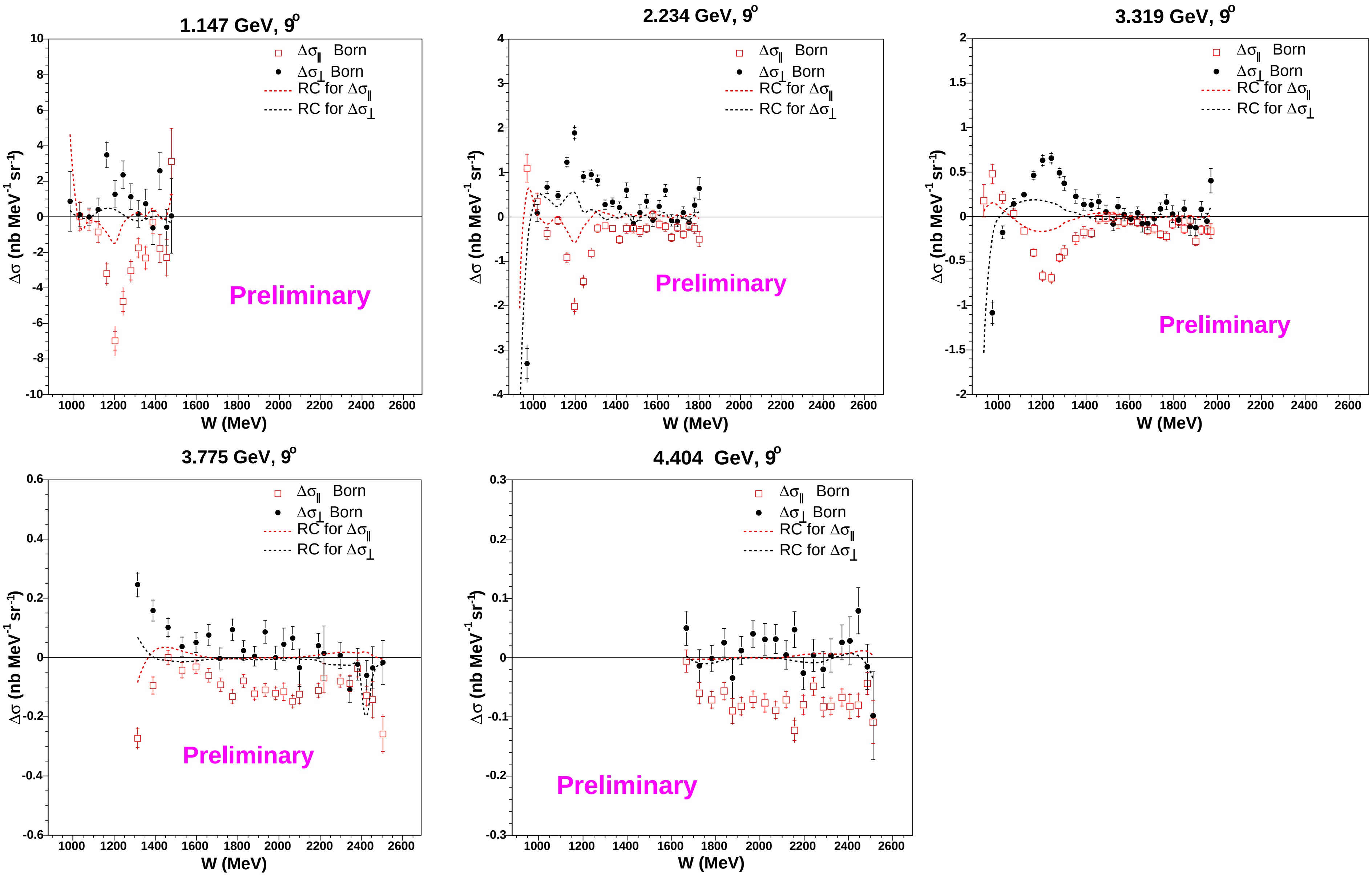
Preliminary ^{3}He Cross Sections



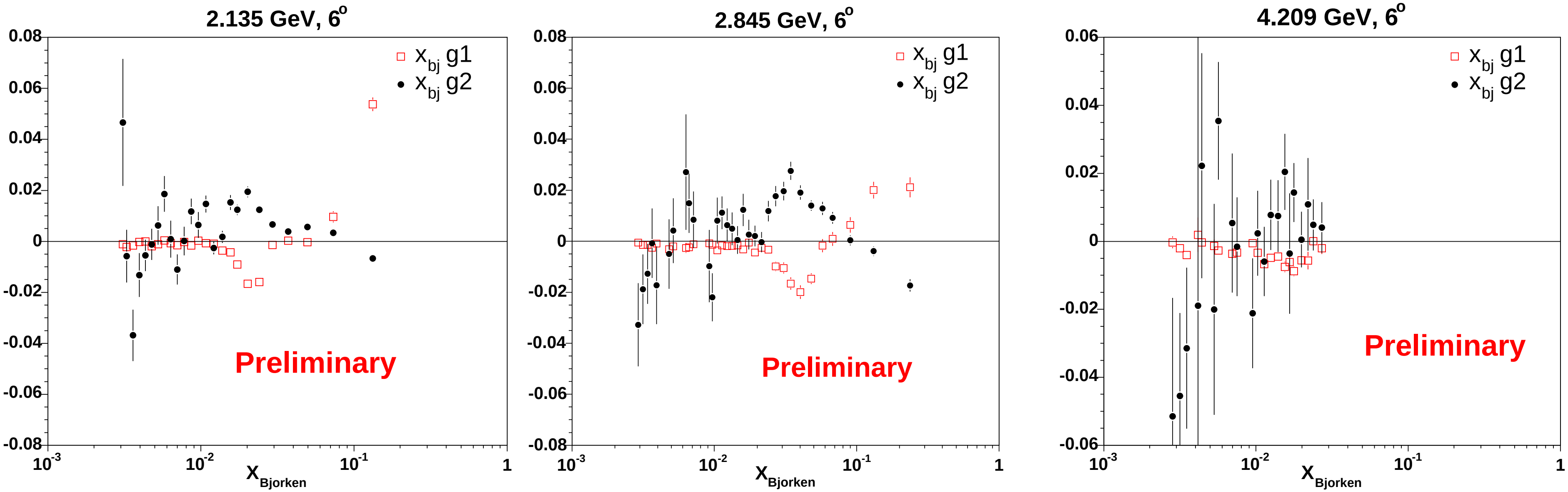
Cross Section Differences



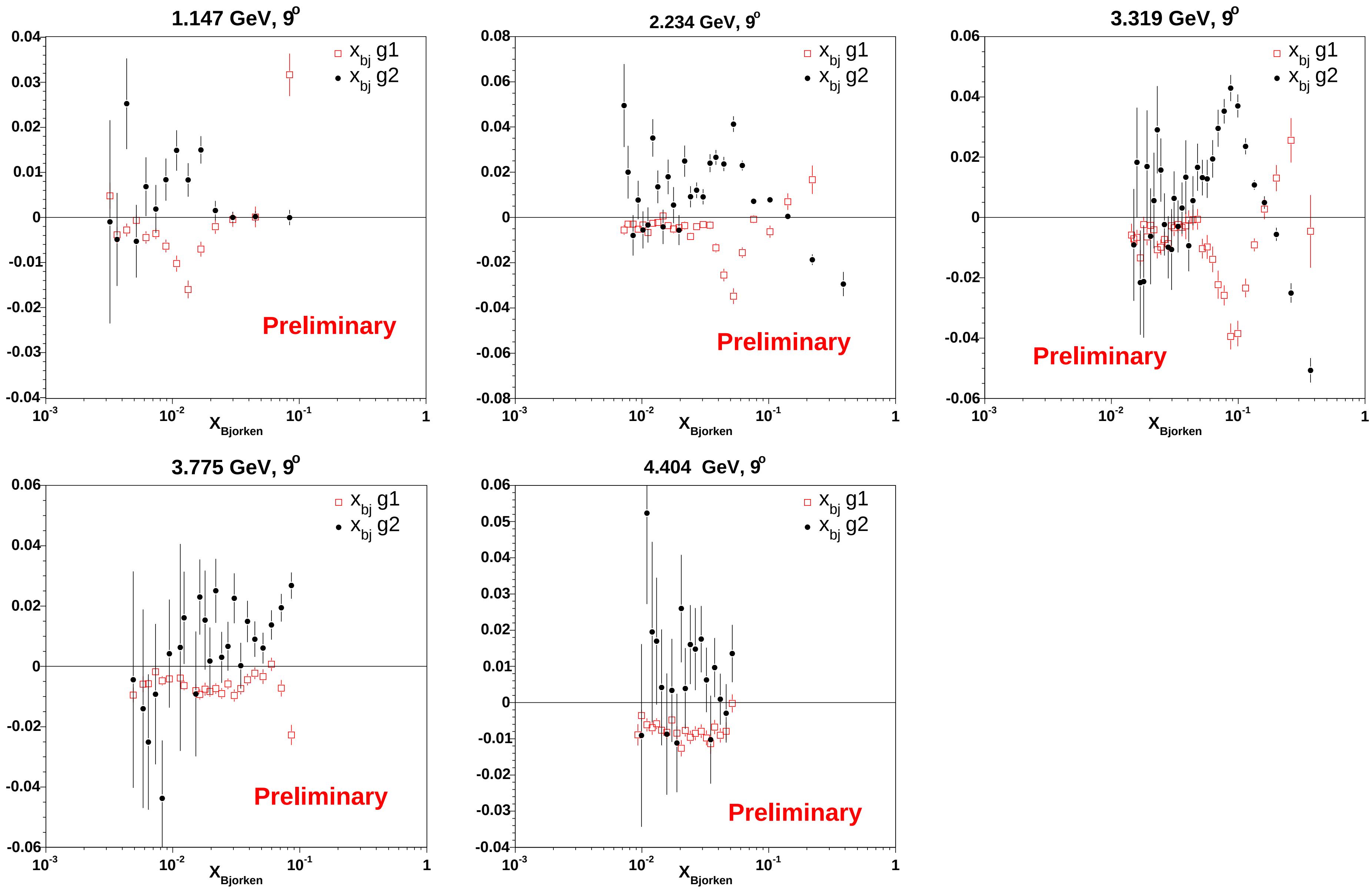
Cross Section Differences



^{3}He Spin Structure Functions



^{3}He Spin Structure Functions



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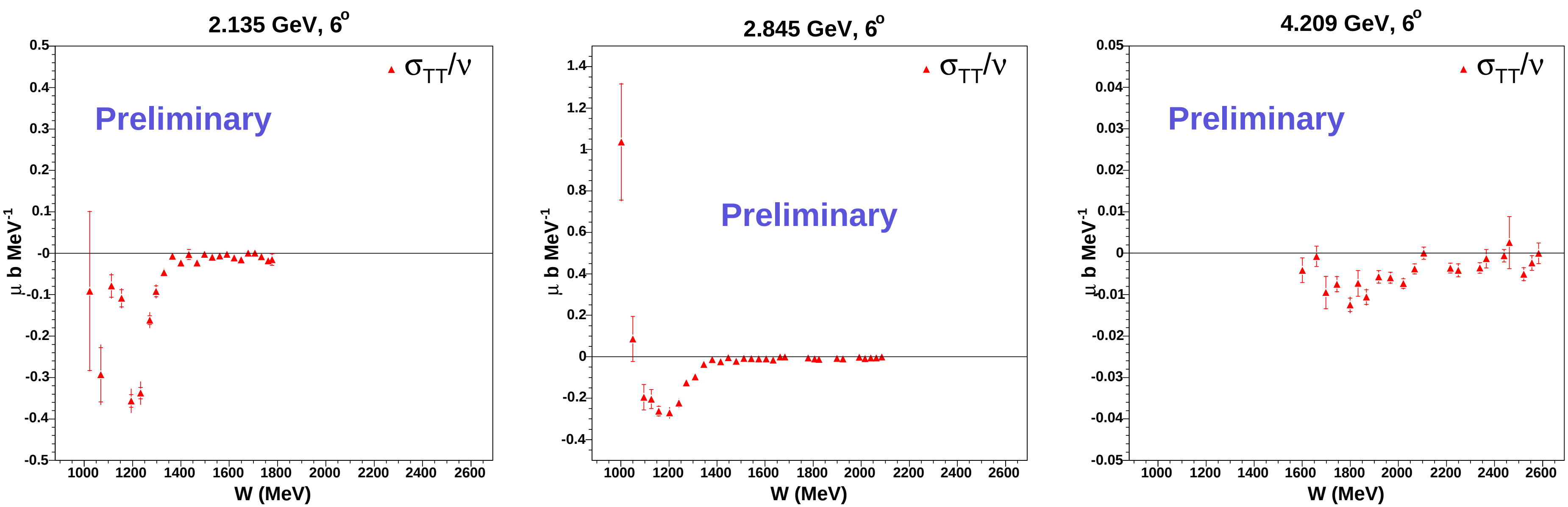
The GDH Integrand: σ_{TT}



$$2\sigma_{\mathrm{TT}} = \sigma_{1/2}(\nu, Q^2) - \sigma_{3/2}(\nu, Q^2)$$

$$\sigma_{\mathrm{TT}} = \frac{4\pi^2\alpha}{MK}\left[g_1(\nu, Q^2) - \left(\frac{Q^2}{\nu^2}\right) g_2(\nu, Q^2)\right]$$

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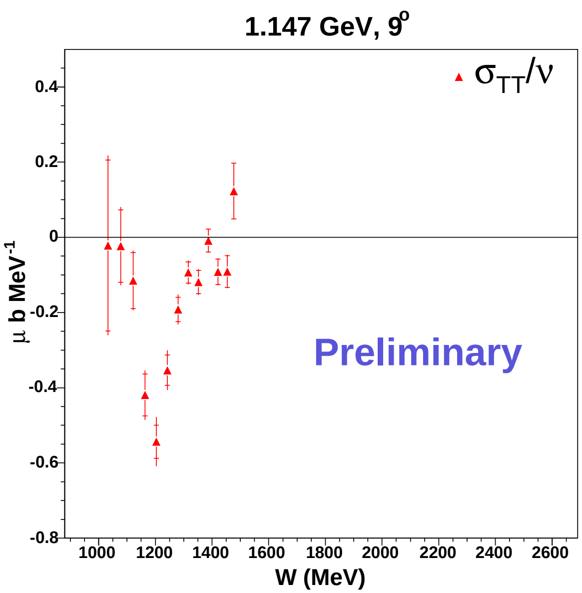
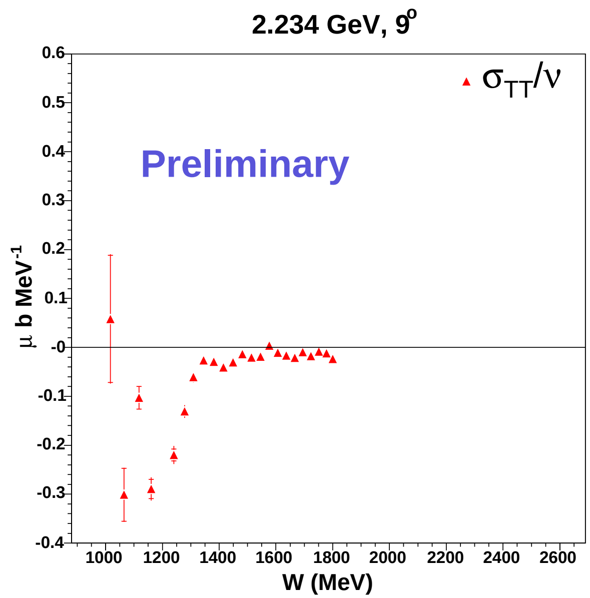
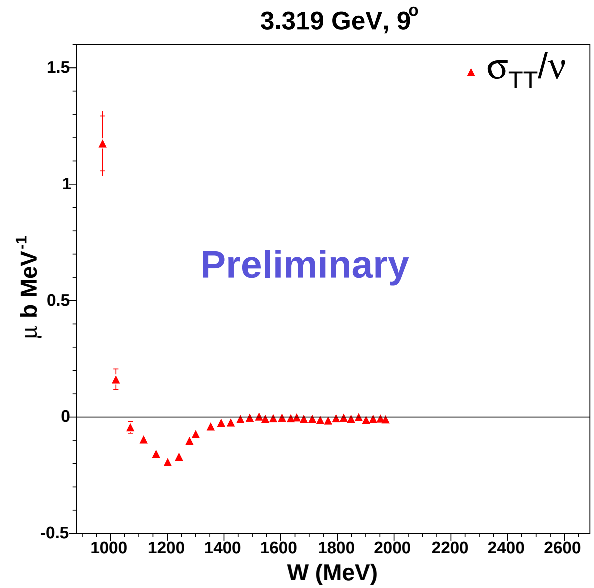
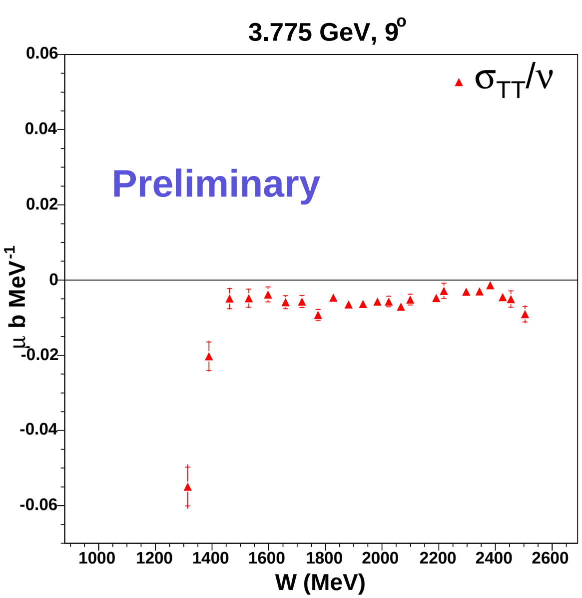
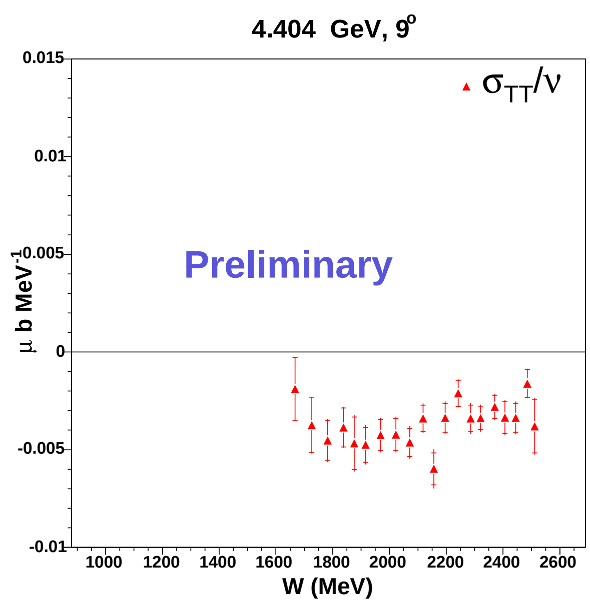
The GDH Integrand: σ_{TT}









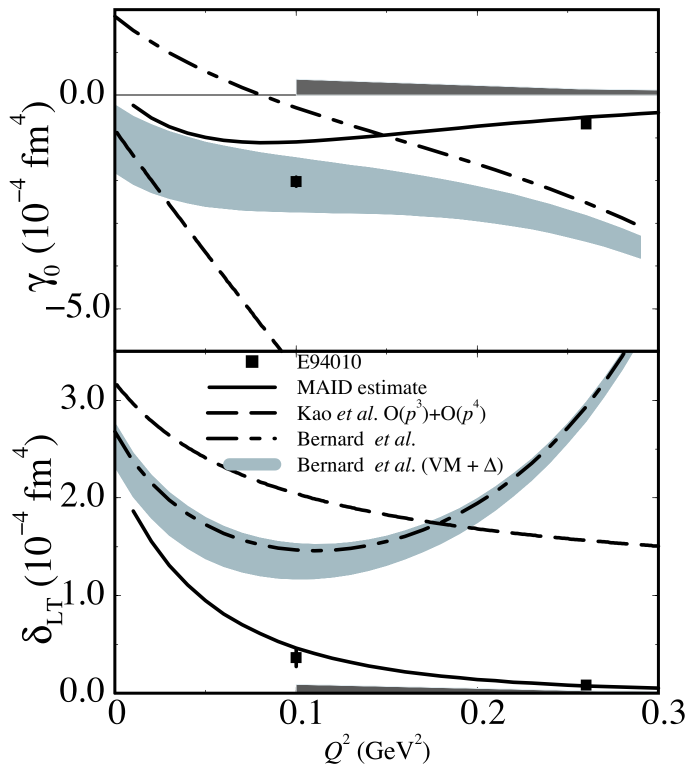


$$I(Q^2) = \int_{\nu_{\mathrm{th}}}^{\infty} \frac{2\sigma_{\mathrm{TT}}}{\nu} d\nu$$

Spin Polarizabilities

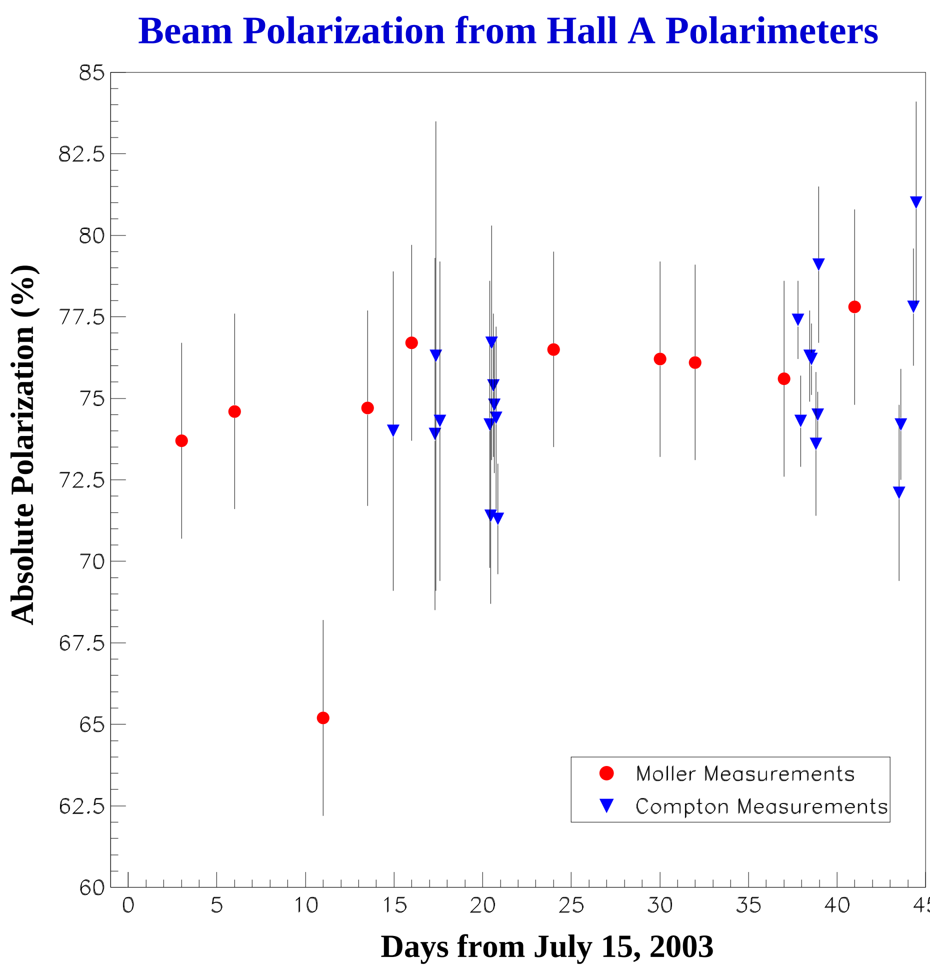
$$\gamma_0 = \frac{4e^2M^2}{\pi Q^6}\int_0^{x_0} x^2\left(g_1 - \frac{4M^2}{Q^2}x^2 g_2\right)dx$$

$$\delta_{LT} = \frac{4e^2M^2}{\pi Q^6}\int_0^{x_0} x^2\,(g_1 + g_2)\,dx$$



M. Amarian *et al.* , PRL **93**, 152301 (2004)

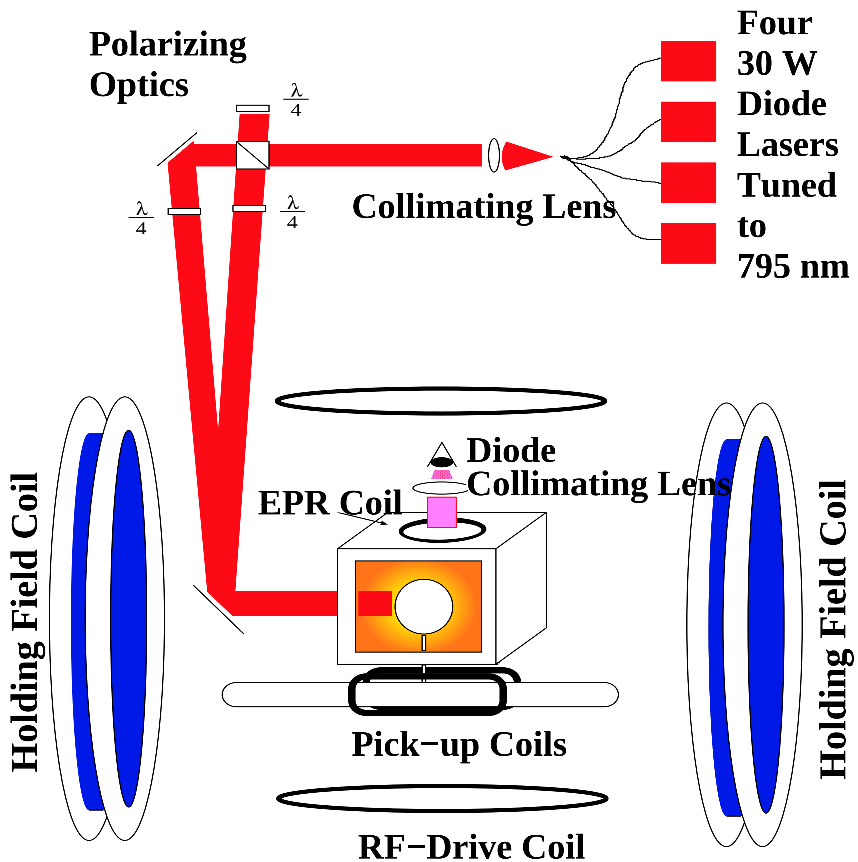
Electron Beam Polarization



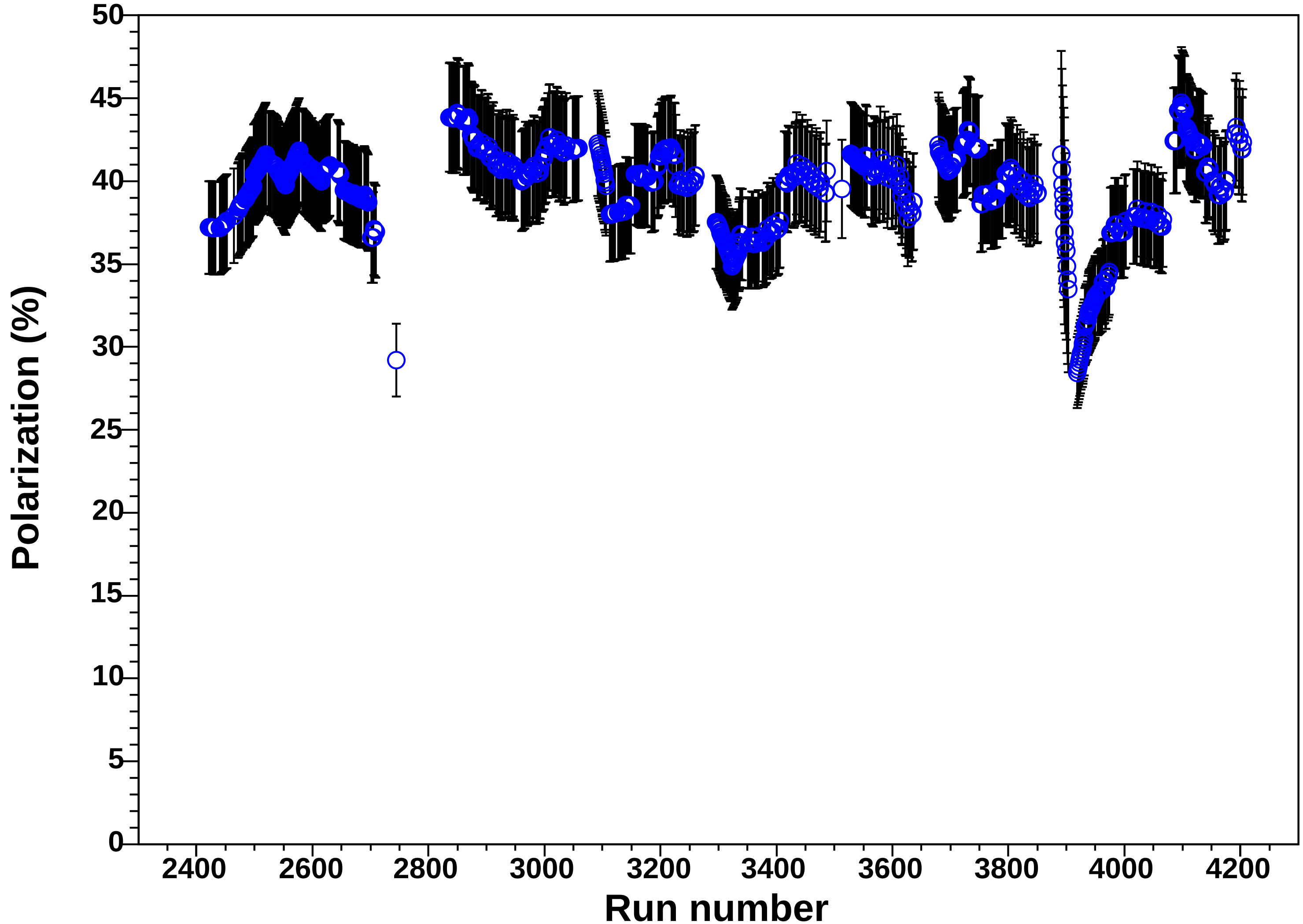
$\langle P_{\mathrm{beam}} \rangle$ was 74.7% from Møller and 74.9% from Compton.

Polarized ^{3}He System

- Both longitudinal and transverse configurations.
- Two independent polarimetries: NMR and EPR.



Preliminary Target Polarization



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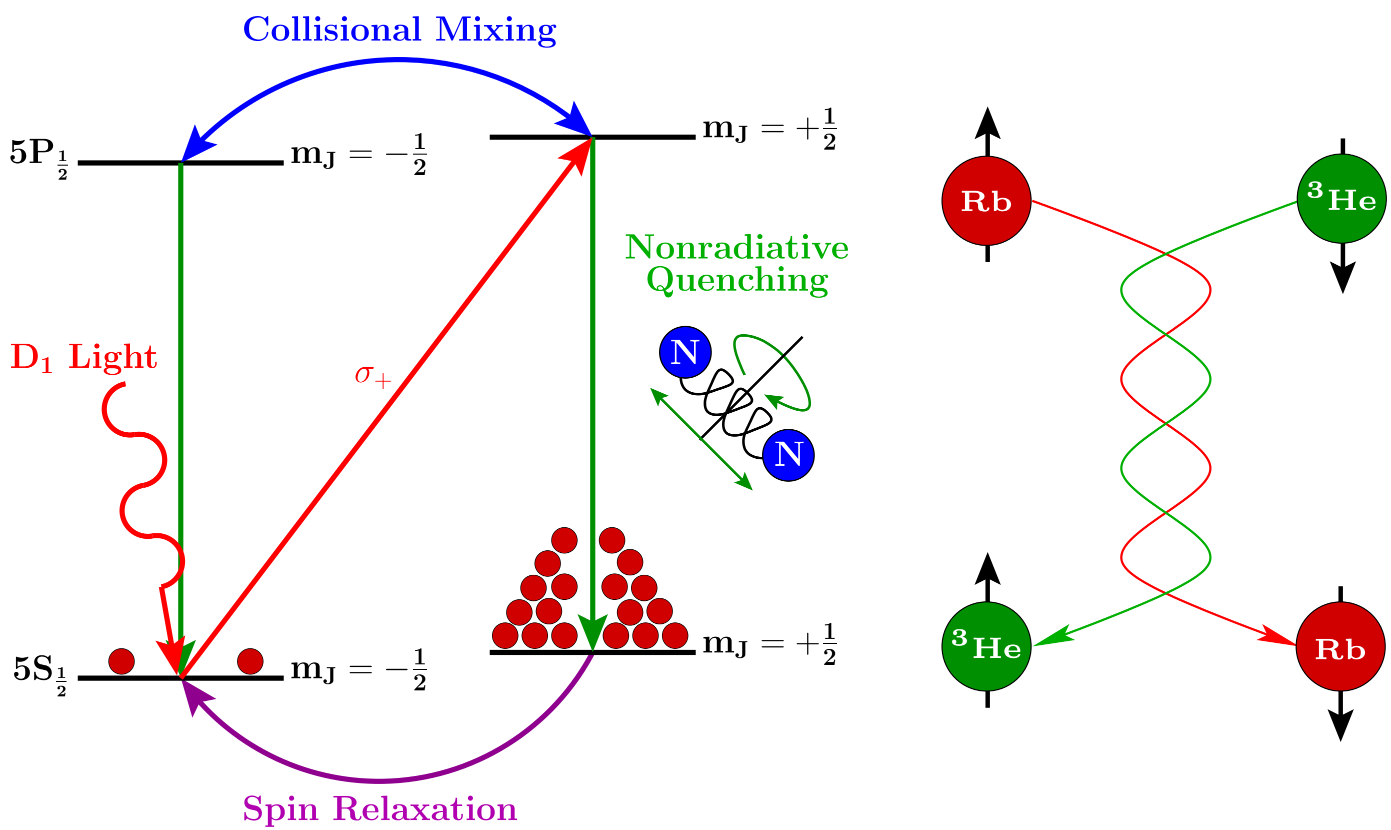
Spin Exchange Optical Pumping



^{3}He nucleus is polarized via spin-exchange with optically pumped Rb atoms.