

E02-013 Update - G_E^n at High Q^2

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for the E02-013 Collaboration

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- PRL Results
- Preliminary $Q^2 = 1.2 \text{ GeV}^2$

Nucleon Currents

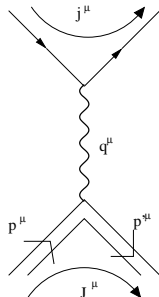
Scattering matrix element, $M \sim \frac{j_\mu J^\mu}{Q^2}$

Generalizing to spin 1/2 with arbitrary structure, one-photon exchange, using parity conservation, current conservation the current parameterized by two form factors

$$J^\mu = e\bar{u}(p') [F_1(q^2)\gamma^\nu + i\frac{\kappa}{2M}q_\nu\sigma^{\mu\nu}F_2(q^2)] u(p)$$

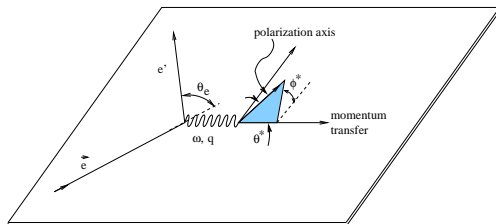
Sachs Form Factors

- $G_E = F_1 - \tau F_2$, $G_E(Q^2 = 0) = Q$
- $G_M = F_1 + F_2$, $G_M(Q^2 = 0) = \mu$



Polarized Target Measurements

Long. polarized beam/polarized target transverse to \vec{q} in scattering plane

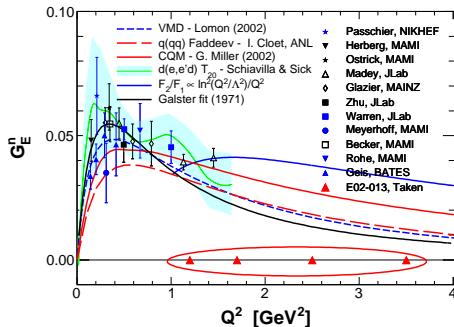


Helicity-dependent asymmetry roughly proportional to G_E/G_M

$$\frac{\sigma_+ - \sigma_-}{\sigma_+ + \sigma_-} \approx A_{\perp} = -\frac{2\sqrt{\tau(\tau+1)}\tan(\theta/2)G_E/G_M}{(G_E/G_M)^2 + (\tau + 2\tau(1 + \tau)\tan^2(\theta/2))}$$

- Highest Q^2 measurement in Hall A, E02-013 through ${}^3\text{He}(\vec{e}, e'n)pp$

Q^2 [GeV ²]	E_{beam} [GeV]	Cen. θ_e [deg]	Q_{beam} [C]
1.2	1.519	56.26	1.2
1.7	2.079	51.59	2.2
2.5	2.640	51.59	5.5
3.4	3.291	51.59	11.4



Over 100 collaborators

Spokespeople:

- Bogdan Wojtsekhowski - Jefferson Lab
- Gordon Cates - University of Virginia
- Nilanga Liyanage - University of Virginia

Analysis Coordinator:

- Seamus Riordan - Carnegie Mellon University (graduated 2008), UMass, Amherst

Ph.D. Students:

- Sergey Abrahamyan - Yerevan, Armenia
- Brandon Craver - University of Virginia
- Aidan Kelleher - College of William and Mary (graduated 2009), MIT
- Ameya Kolarkar - University of Kentucky (graduated 2007), Boston University
- Jonathan Miller - University of Maryland, College Park (graduated 2009), Uppsala

Masters Students:

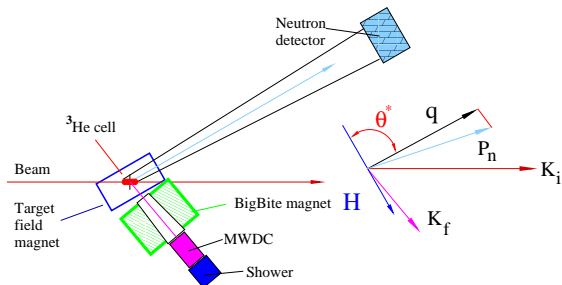
- Tim Ngo - California State University, Los Angeles (graduated 2007)

Postdocs:

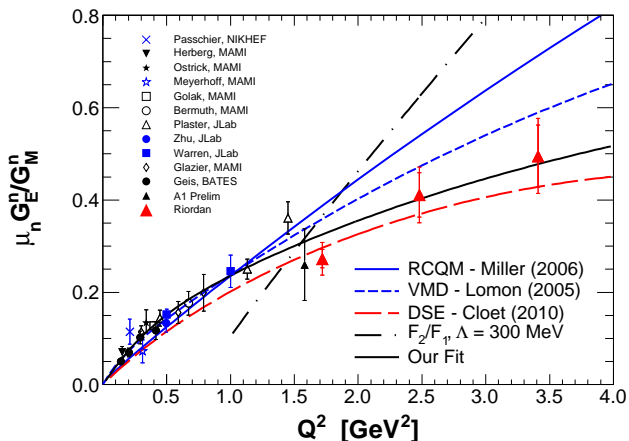
- Rob Feuerbach - JLab, College of William and Mary (-2007)

Experimental Setup

- Polarized ^3He target acts as effective free neutron source
- Two arms to measure coincidence e' and n , allow for cuts on $p_{\text{miss},\perp}$ to suppress FSI



- BigBite - large acceptance spectrometer, reconstructs \vec{e}'
- Neutron arm - matches BB acceptance, measures neutron momentum through ToF, performs nucleon charge ID



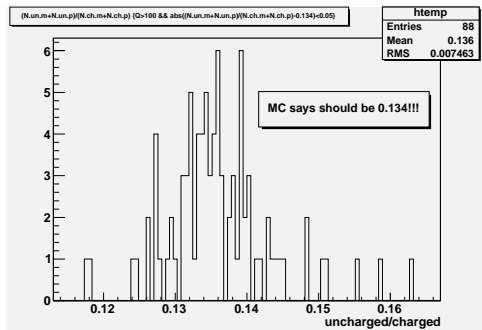
- $\sim 3\%$ rel. change in target polarization in Sept.
- Accepted to PRL last week, on arXiv:1008:1738
- A1 Preliminary from P. Grabmayr, private communication

- Data was taken in first few days of experiment
- Triggers were not fully optimized and thresholds were changed
- Using 0.8 mC of data (70-80%) of full run
- Optics not complete for full BigBite acceptance, but of good quality (loss of $\sim 30\%$ stat)

- Cannot do proton dilution from data (no N_2), must rely on MC
- Neutron arm threshold was changed - must consider for proton dilution
- Inelastic contribution should be negligible
- FSI/proton polarization from Misak's code needs more work
 - Full FSI not calculated, look at estimate based on previous kinematics and no correction

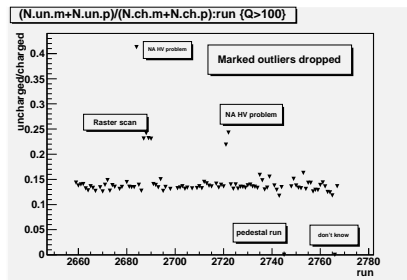
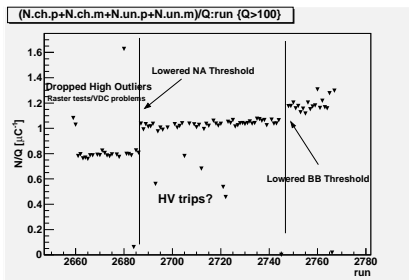
Proton Correction from MC

- Monte Carlo says proton dilution factor is 0.84 (was ~ 0.8 for other kinematics)
- Uncharged to charged ratio agrees quite well with MC



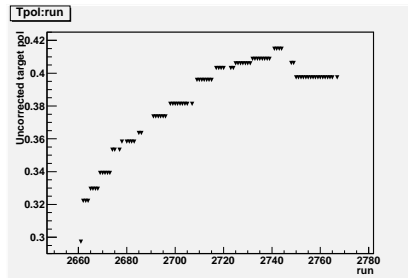
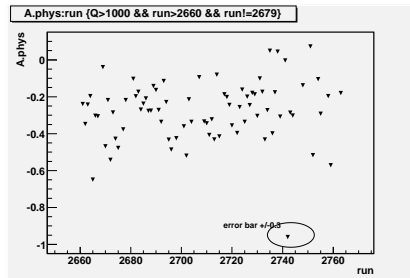
Run Selection

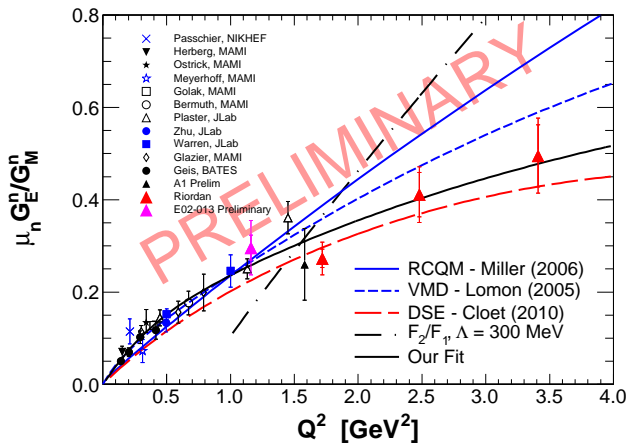
- Runs are very stable in yield of total quasielastics per charge
- Uncharged/charged looks very stable for runs
- Cut out suspicious deviations



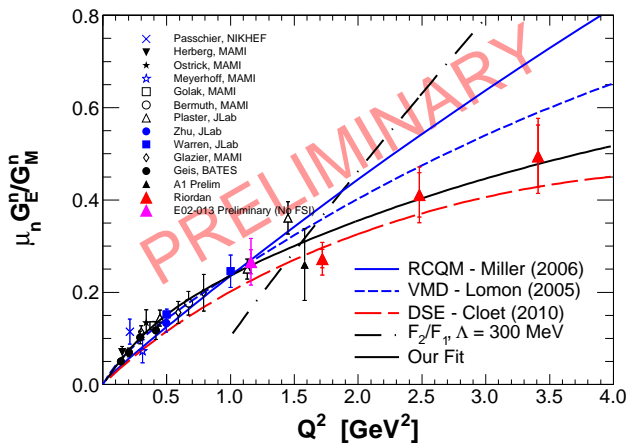
Run Selection

- Asymmetry is pretty stable considering large changes in target polarization over the run





- $A_{||}$ is about 1/3 of the asymmetry. Larger contribution from systematics

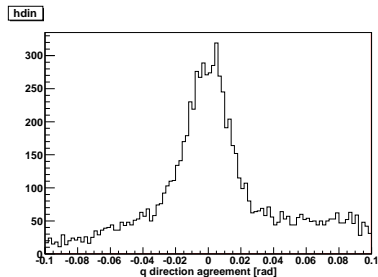
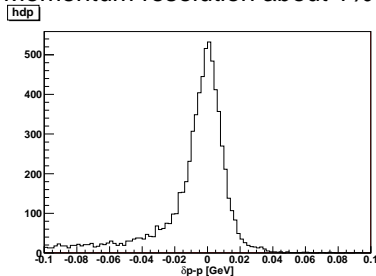


- Highest three Q^2 points accepted by PRL
- Preliminary $Q^2 = 1.2 \text{ GeV}^2$ point consistent with previous data
- Full analysis will continue into next year

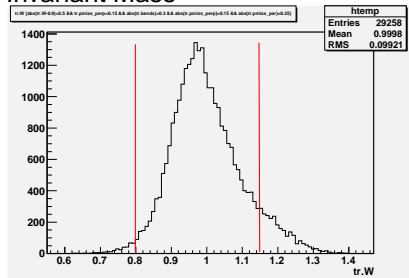
BACKUP SLIDES

- Only minor adjustments were necessary from existing optics for bulk of acceptance
- Optics only done for central part of BigBite - loss of $\sim 30\%$ statistics

Momentum resolution about 1%



Invariant Mass



Missing parallel momentum

