Overview of the Jefferson Lab Hall A SBS form factor experiments

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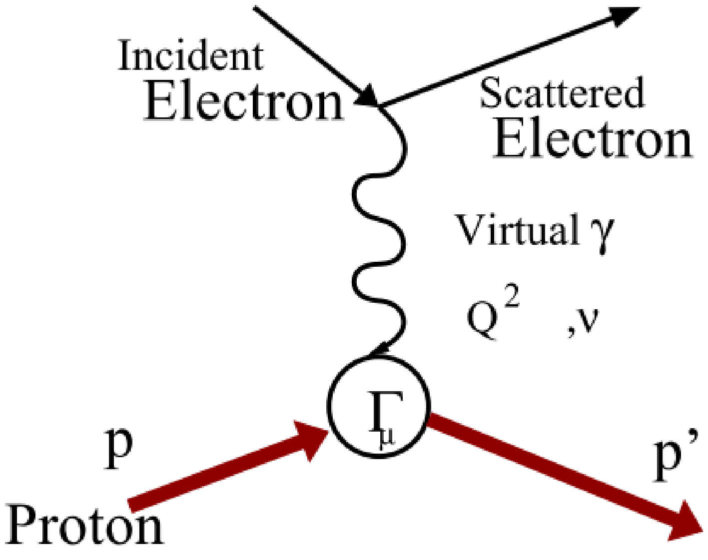
for the SBS Collaboration

The 11th biennial workshop of the APS Topical Group on Hadronic Physics (GHP2025)

Electron scattering to determine nucleon form factors

One-photon exchange (OPE)



Nucleon vertex:

$$\Gamma_\mu(p',p) = \underbrace{F_1(Q^2)}_{Dirac}\,\gamma_\mu + \frac{i\kappa_p}{2M_p}\underbrace{F_2(Q^2)}_{Pauli}\,\sigma_{\mu\nu}q^\nu$$

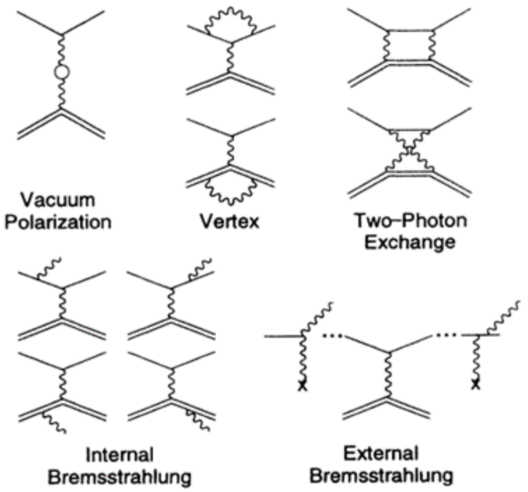
$$G_E(Q^2) = F_1(Q^2) - \kappa_N\tau\, F_2(Q^2)$$

$$G_M(Q^2) = F_1(Q^2) + \kappa_N\, F_2(Q^2)\ ,\tau = \frac{Q^2}{4M_N}$$

At $Q^2 = 0 \quad G_{Mp} = 2.79\ G_{Mn} = -1.91$

$$G_{Ep} = 1\ G_{En} = 0$$

- Need to calculate the radiative corrections to get to the OPE



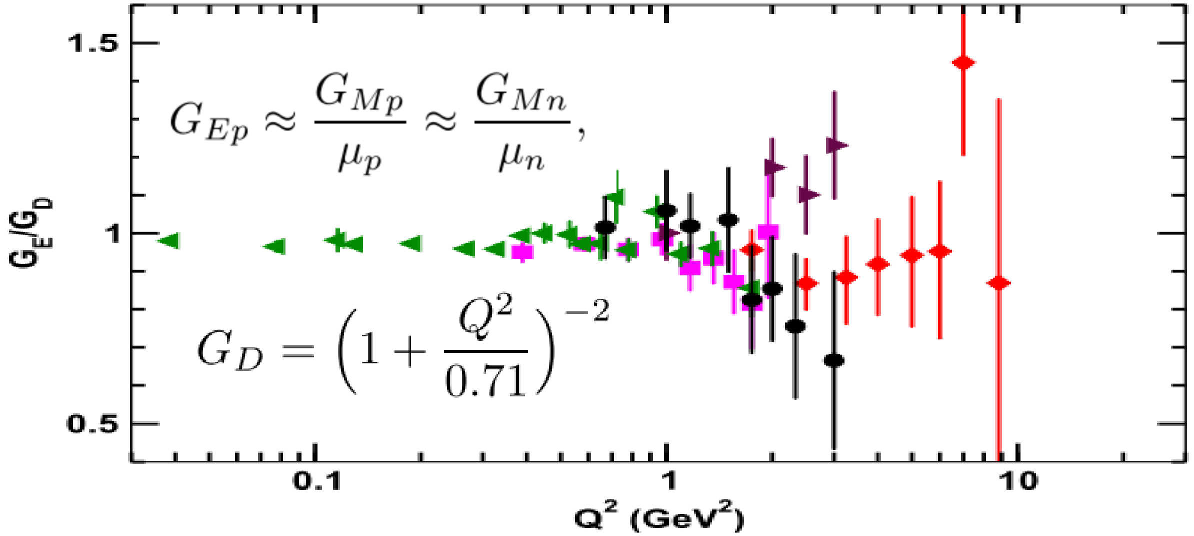
Cross-section measurements $N(e,e') \longrightarrow \frac{d\sigma}{d\Omega_e} = \left(\frac{d\sigma}{d\Omega}\right)_{Mott}\frac{E_e}{E_{beam}}\frac{1}{1+\tau}\left(G_E^2 + \frac{\tau}{\epsilon}G_M^2\right)$

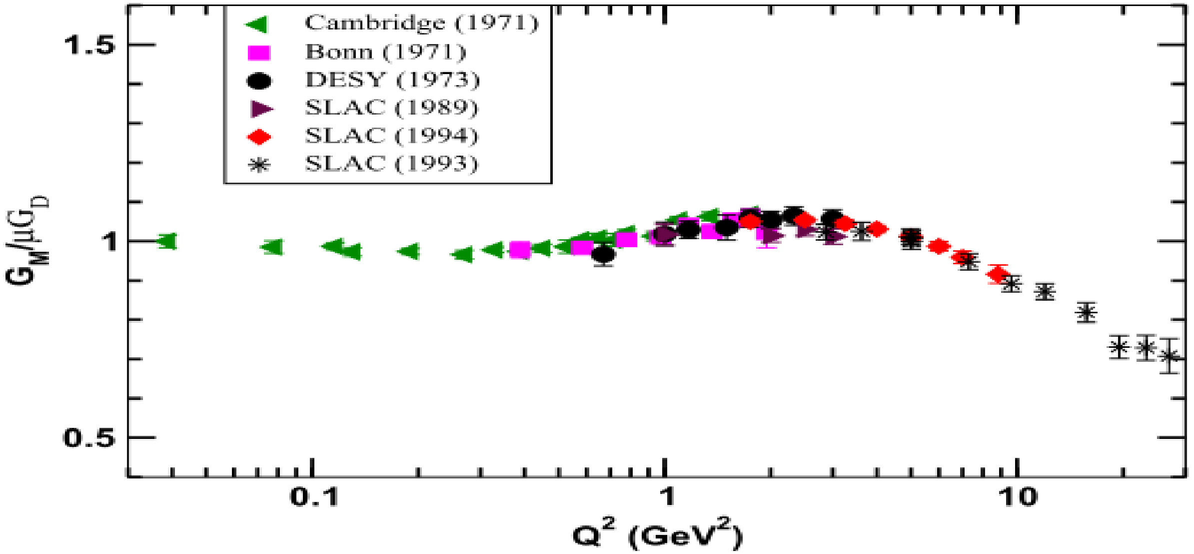
Beam-target Asymmetries $\vec{N}(\vec{e},e')N \longrightarrow A_{perp} = \frac{-2\sqrt{\tau(1+\tau)}\tan\frac{\theta_e}{2}\frac{G_E}{G_M}}{(\frac{G_E}{G_M})^2 + \frac{\tau}{\epsilon}}$

Recoil polarization $N(\vec{e},e')\vec{N} \longrightarrow \frac{G_E}{G_M} = -\frac{P_t}{P_\ell}\frac{(E_{beam}+E_e)}{2M}\tan\frac{\theta_e}{2}$

Status of proton form factor in early 1990's

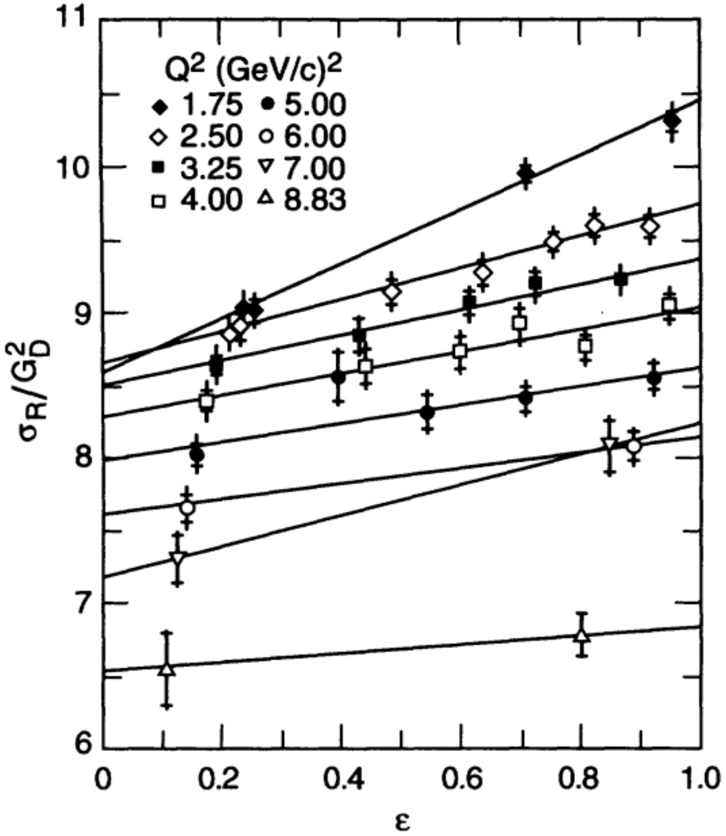
- Since 1950's there is a large body of data using cross sections
- Contribution of G_E to total cross section drops as Q^2 increases.





$$\sigma_R \equiv \frac{d\sigma}{d\Omega}\frac{(1+\tau)\epsilon}{\sigma_{ns}\tau} = \frac{\epsilon}{\tau}G^2_{E_p}(Q^2) + G^2_{M_p}(Q^2)$$

$$\frac{d\sigma}{d\Omega}_{raw} = R_{corr}\left(\frac{d\sigma}{d\Omega}\right)$$



L. Andivahis et al., Phys. Rev. D **50**, 5491 (1994)

$Q^2 = 7$

ε	R_{corr}
0.143	0.85
0.857	0.71

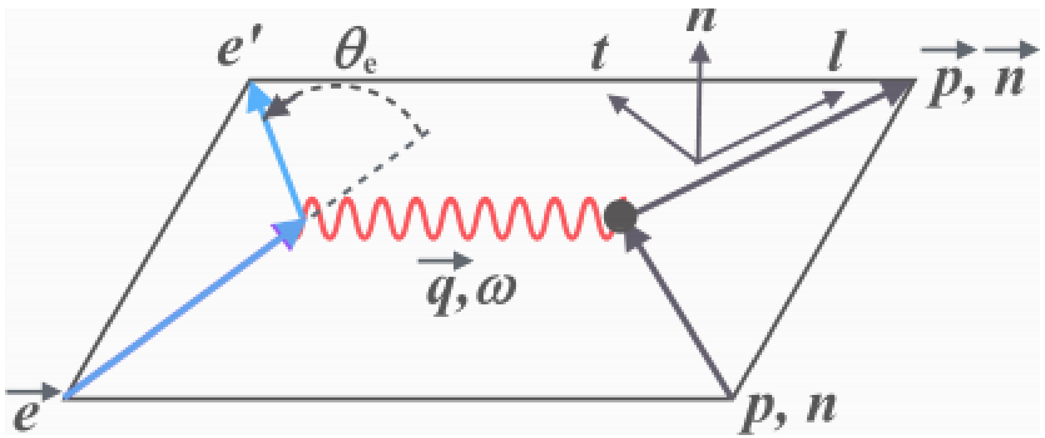
Recoil polarization to measure proton electric form factor

Theorists proposed using polarization observables

A.I. Akhiezer, M.P. Rekalo, Dokl. Akad. Nauk Ser. Fiz. 180, 1081 (1968), Sov. Phys. Dokl. 13, 572 (1968); N. Dombey, Rev. Mod. Phys. 41, 236 (1969); R. G. Arnold, C. E. Carlson, and F. Gross, Phys. Rev. C 23, 363 (1981).

Elastic scattering of polarized electron on an unpolarized nucleon

Proposal in 1989, Charles Perdrisat and Vina Punjabi to extract proton G_E/G_M by recoil polarization using the Hall A HRS spectrometers with a polarimeter in the focal plane of the HRS.



$$I_o P_n = 0$$

$$I_o P_\ell = hP_e \frac{(E_{beam} + E_e)}{M} \sqrt{\tau(1+\tau)} \tan^2 \frac{\theta_e}{2} G_M^2$$

$$I_o P_t = -hP_e 2\sqrt{\tau(1+\tau)} \tan \frac{\theta_e}{2} G_E G_M$$

$$I_o = G_E^2 + \frac{\tau}{\epsilon} G_M^2$$

P_n P_t and P_l are normal, transverse and longitudinal components of the recoil polarization

$$\frac{G_E}{G_M} = -\frac{P_t}{P_\ell} \frac{(E_{beam} + E_e)}{2M} \tan \frac{\theta_e}{2}$$

Determine the polarization components with a focal plane polarimeter

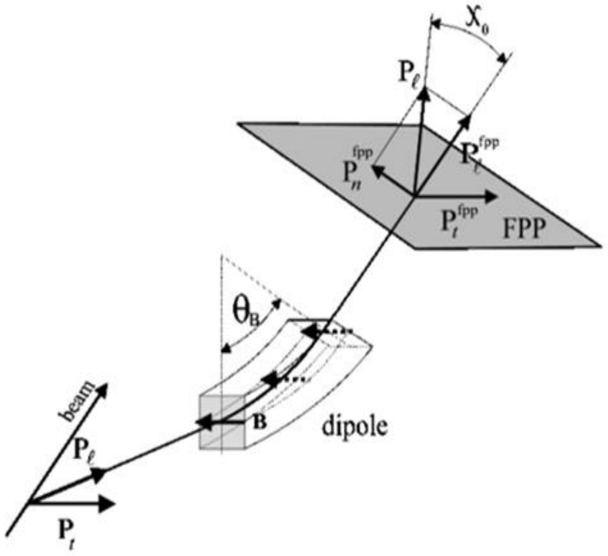


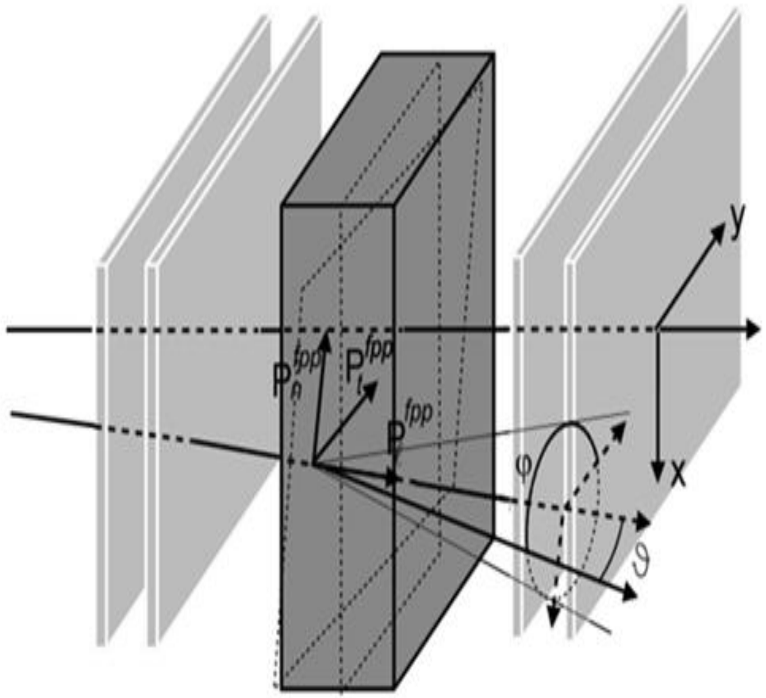
FIG. 15. Precession of the polarization component P_ℓ in the dipole of the HRS by an angle χ_θ.

$$P_t^{\mathrm{fpp}} = h P_t$$

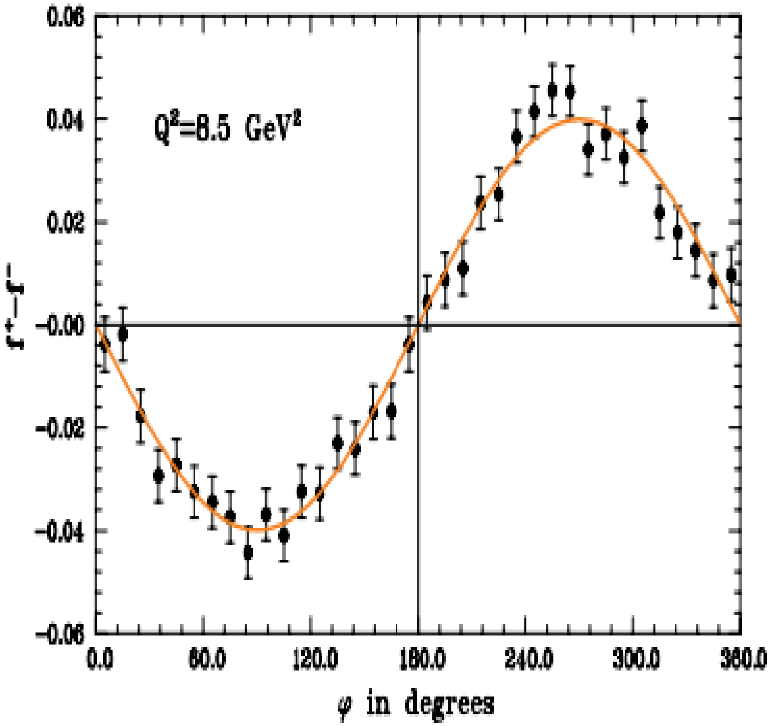
$$P_n^{\mathrm{fpp}} = h P_\ell \sin \chi_\theta$$

$$\chi = \gamma(\mu_p - 1)\Theta_{bend}$$

Scatter the protons in carbon analyzer and measure the azimuthal distributions for each beam helicity

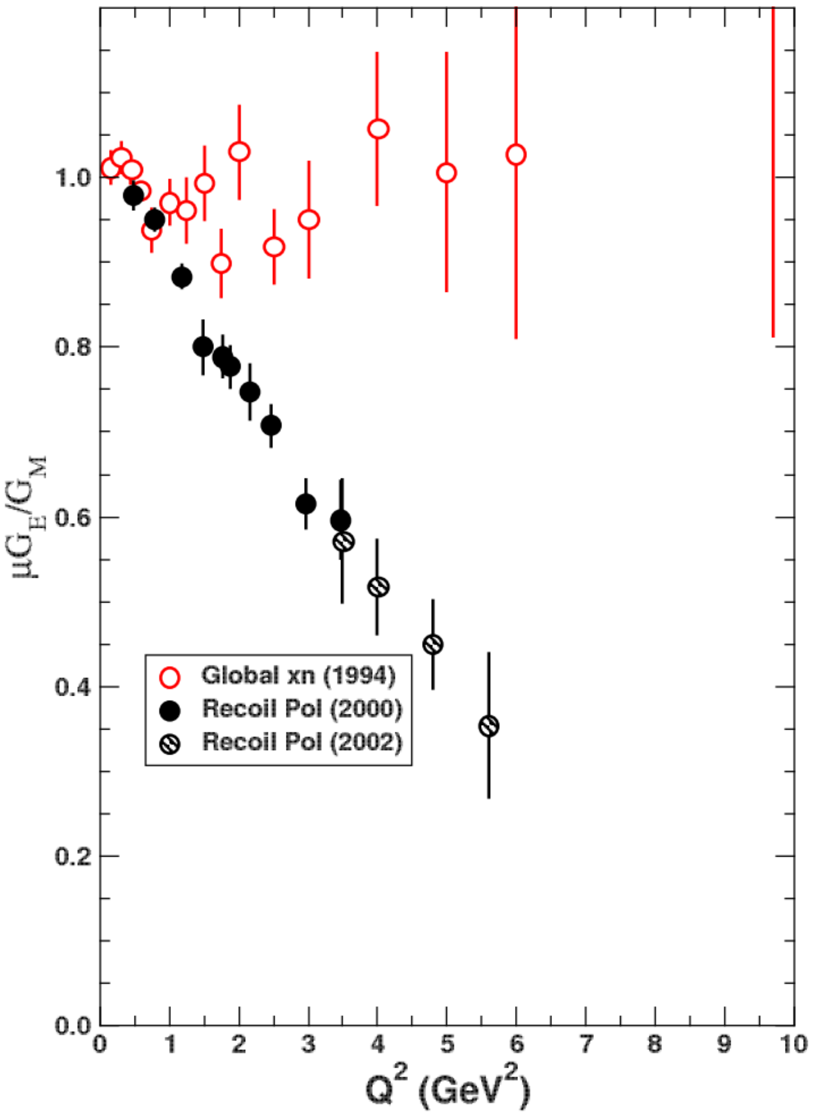


Difference of beam helicity states



$$f_+ - f_- = A_y[P_t^{\mathrm{fpp}}\cos\phi - P_n^{\mathrm{fpp}}\sin\phi]$$

Recoil polarization measurements at JLab

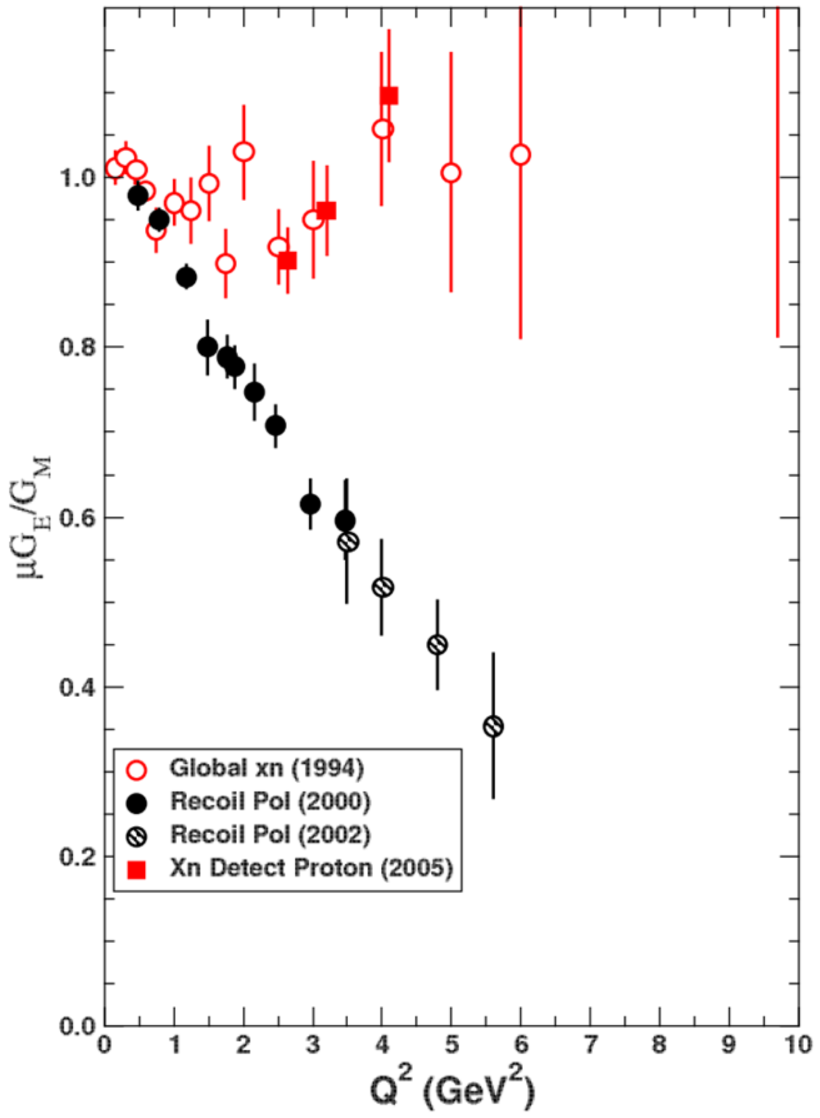


- Global cross section data analysis R.C. Walker et al., Phys. Rev. D 49, 5671 (1994)
- Recoil polarization measurements
  - Measured to Q^2 = 3.5 GeV^2 in Hall A using two HRS with FPP in RHRS
    M.K. Jones et al. Phys. Rev. Lett. 84, 1398 (2000). Long paper in V. Punjabi et al., Phys. Rev. C 71, 055202 (2005)
  - Measured to Q^2 = 5.6 GeV^2 with FPP moved to LHRS and Calorimeter.
    O. Gayou et al., Phys. Rev. Lett. 88, 092301 (2002) and A. J. R. Puckett et al., Phys. Rev. C 85:045203 (2012)

Why the difference between the two methods?

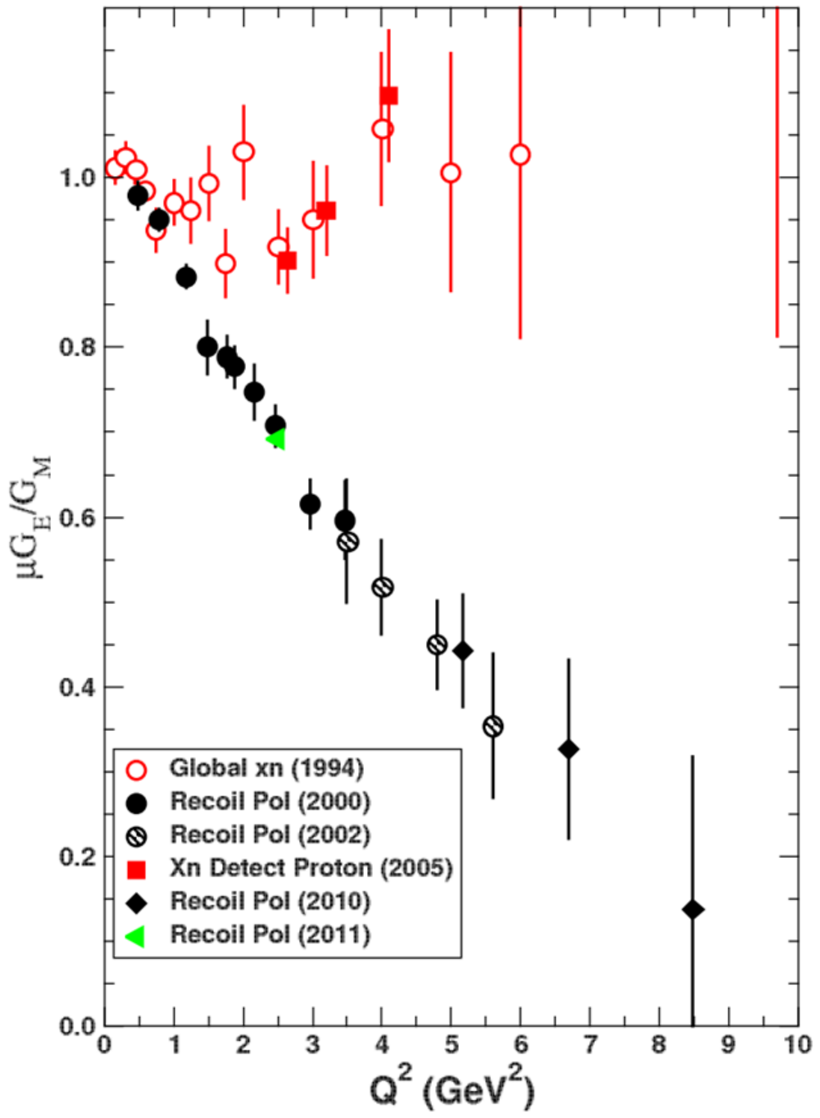
- Systematic problem with recoil polarization
  - Used different HRS. Develop "geometric" model to evaluate the error on the spin matrix through the HRS
- Cross section measurements
  - Re-evaluate the standard radiative correction.
  - Redo global analysis. New Hall C elastic data.
  - New measurement elastic p(e,p). Detecting the elastic proton.
  - Calculate hard two photon exchange contribution

Recoil polarization measurements at JLab

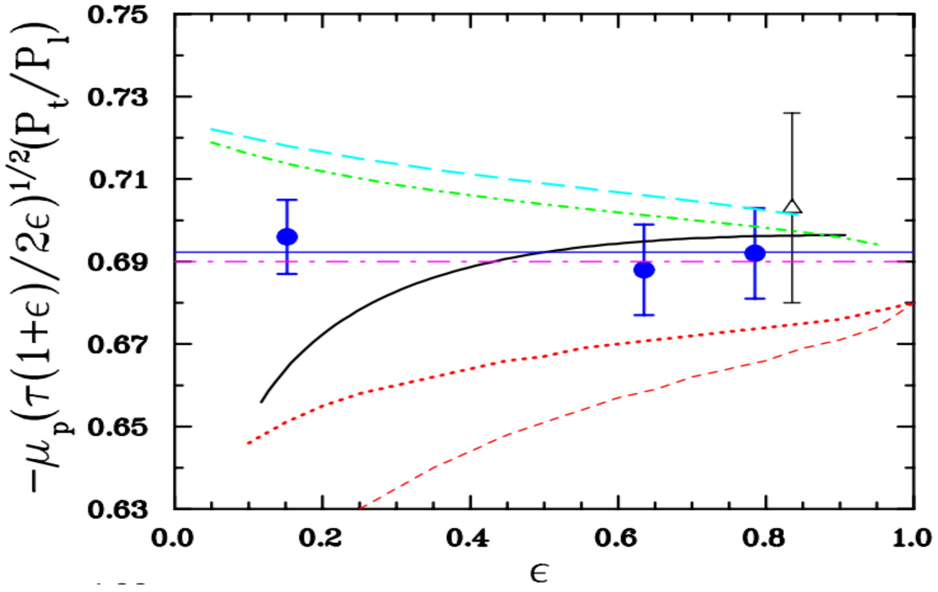


- Detect elastic proton and do Rosenbluth separation
  - Proton momentum fixed at each ε
  - Cross section is nearly constant with e
  - Reduces size of ε-dependent radiative corrections
  - Reduces systematic error from beam energy and scattering angle
  - I. Qattan et al. PRL 94, 142301 (2005)

Recoil polarization measurements at JLab

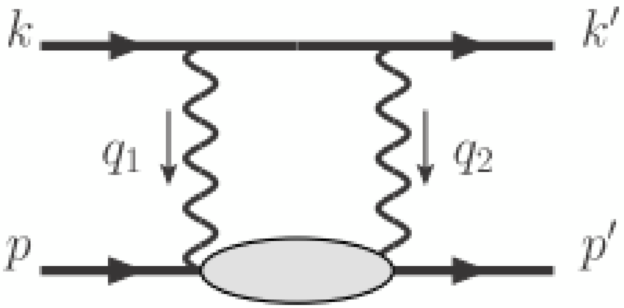


- Move to Hall C to do recoil polarization
- New FPP in HMS and larger Calorimeter
  - Measure to $Q^2 = 8.5$ GeV^2
    - *A. Puckett et al., Phys. Rev. Lett. 104, 242301 (2010)*
  - Measure to $Q^2 = 2.5$ GeV^2. Measure ε dependence
    - *M. Meziane et al. , Phys. Rev. Lett. 106, 132501 (2011)*



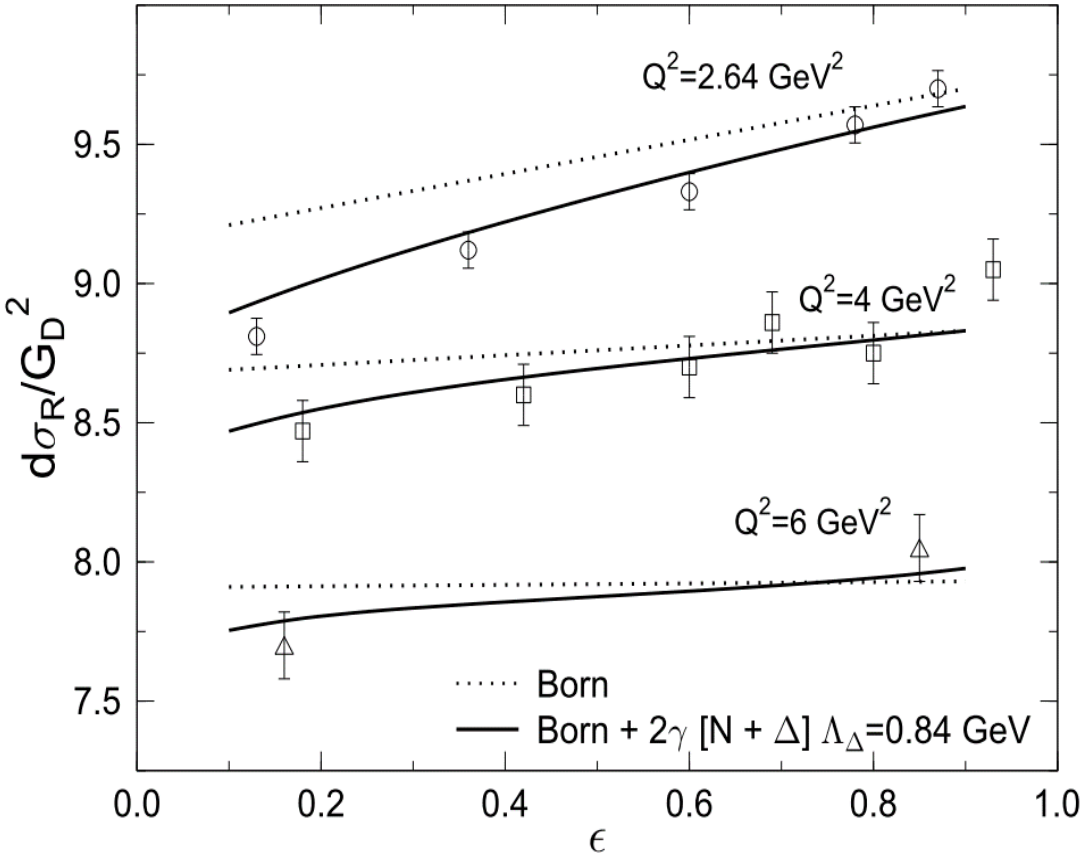
Two-photon exchange (TPE) contribution to elastic ep scattering

Two photon exchange box diagram



- Guichon and Vanderhaeghen Phys. Rev. Lett. 91, 142303 (2003) provided a generalized formalism for elastic scattering.
- Calculation of the two hard photon box diagram exchange (TPE) contribution involves knowledge of the hadronic structure
- At large Q^2 , TPE contribution of a few percent of the cross section could explain the difference and is the same order as the contribution of G_E to the cross section.

- Calculation of TPE box diagram with N and Δ by S. Kondratyuk, P. G. Blunden, W. Melnitchouk, and J. A. Tjon, Phys. Rev. Lett. 95 , 172503 (2005)
- Born calculation uses G_E/G_M from recoil polarization experiment

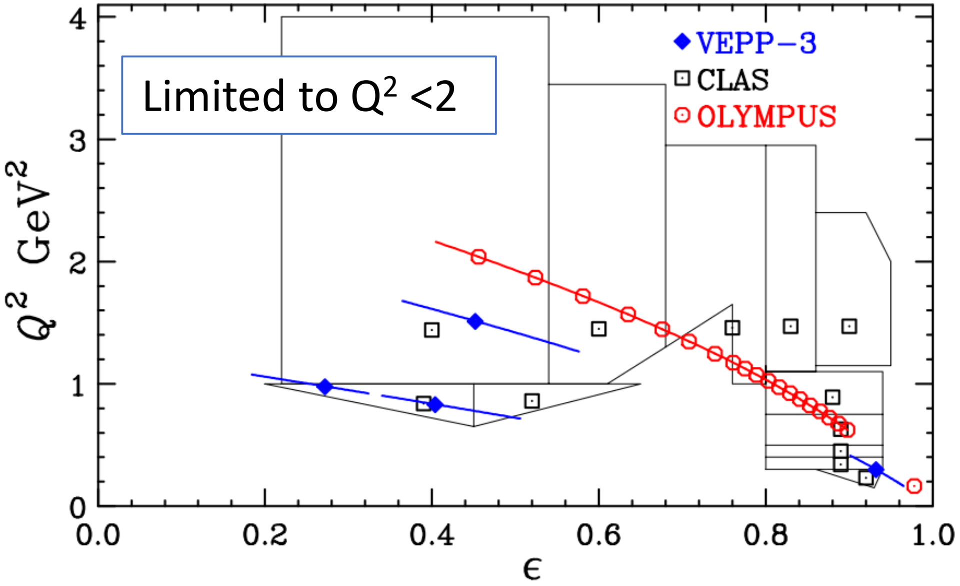


Direct measure of Two-photon exchange contribution

Measure ratio of positron+proton to electron+proton elastic cross sections

Experiments

- Using monoenergetic beams from a storage ring incident on an internal gas target.
    - The VEPP-3 experiment at Novosibirisk at 1.0 and 1.6 GeV I. A. Rachek et al. , Phys. Rev. Lett. 114 , 062005 (2015), arXiv:1411.7372.
    - The OLYMPUS experiment at DESY at 2.01 GeV B. S. Henderson et al. , Phys. Rev. Lett. 118 , 092501 (2016)
- The CLAS experiment used a mixed beam of positrons and electrons with beam energies from 0.8 to 3.3 GeV allowing for simultaneous detection of electron and positron scattering events in the CLAS D. Adikaram et al. , Phys. Rev. Lett. 114 , 062003 (2015),
- Review article: A. Afanasev, P.G. Blunden, D. Hasell, B.A. Raue, Progress in Particle and Nuclear Physics, v95, 2017

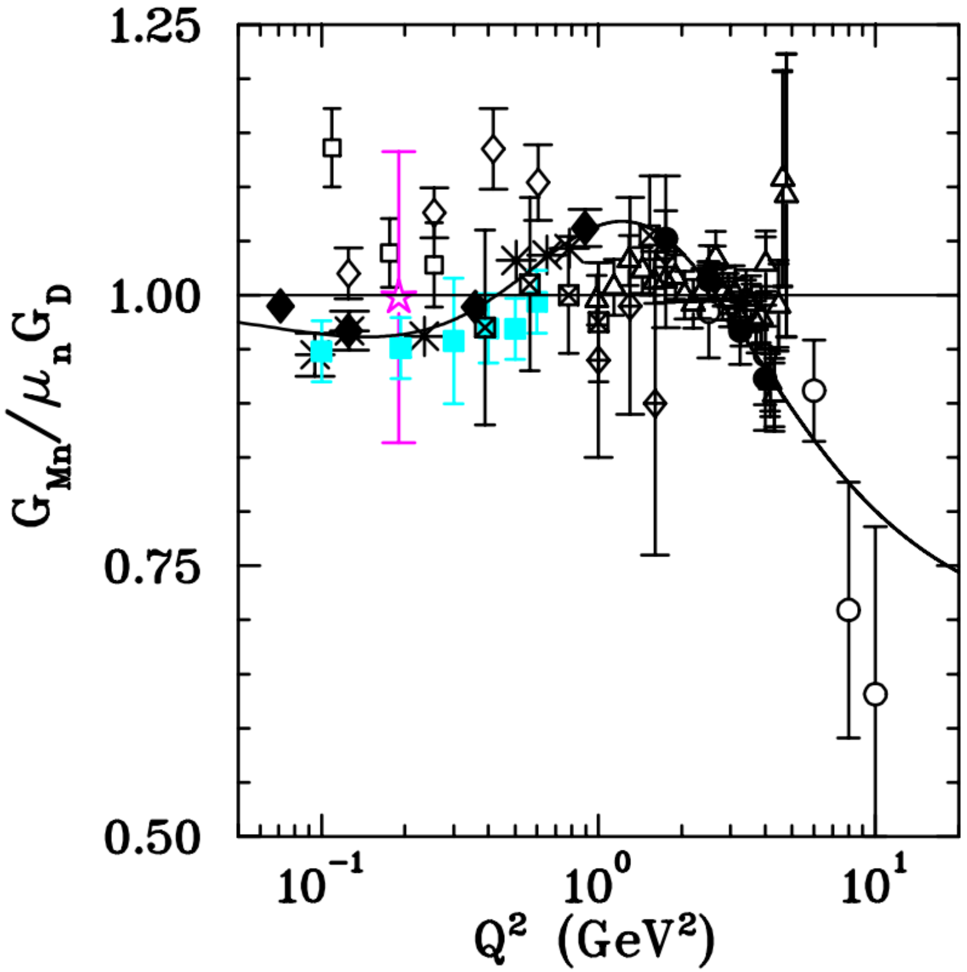


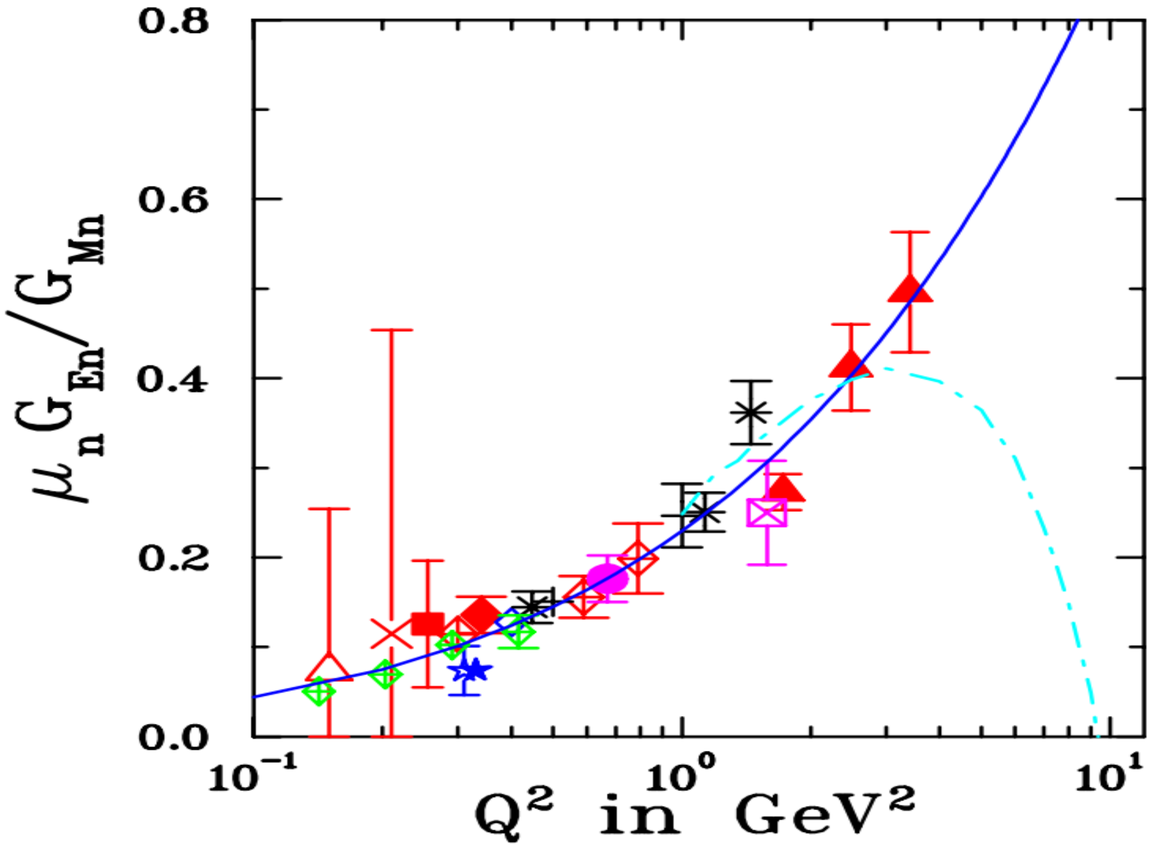
Limited to Q^2 <2

Status of Neutron Magnetic and Electric form factors around 2010

- Hall B measured neutron G_M with CLAS for Q^2 = 1 to 4.8 GeV^2
- Early SLAC measurements to Q^2 = 10 GeV^2
- Experiments at Mainz and JLab for Q^2 < 1 GeV^2

- Hall A measured neutron G_E/G_M to Q^2 = 3.4 GeV^2 with beam-target asymmetries
- JLab and Mainz various experiments use quasi-free scattering on deuteron in recoil polarization and beam-target asymmetry to G_E/G_M to Q^2 < 2 GeV^2





Extending the Q^2 range of form factor measurements

- JLab 12 GeV upgrade meant the opportunity to measure the form factors to $Q^2 = 18$ GeV^2
- Challenges for the experiments
  - Need large acceptance spectrometers
  - Need detectors that can handle the large background rate.
  - High luminosity cryogenic targets
  - High luminosity, high polarization polarized helium targets
  - Isolate elastic or quasi-elastic electron-nucleon events from large inelastic background
  - Identify elastic or quasi-elastic proton and neutrons
- Approved experiments using upgraded BigBite spectrometer and new Super BigBite spectrometer
  - E12-07-109 (GEp): Measure Proton G_E/G_M by recoil polarization to $Q^2 = 12$ GeV^2
  - E12-09-016 (GEN2): Measure Neutron G_E/G_M by beam-target asymmetry to $Q^2 = 10$ GeV^2
  - E12-09-019 (GMN) : Measure Neutron G_M to $Q^2 = 13.5$ GeV^2
  - E12-17-004 (GEN-RP) : Measure Neutron G_E/G_M by recoil polarization at $Q^2 = 4.5$ GeV^2
  - E12-20-010 (nTPE) : Measure TPE in elastic scattering on neutron at $Q^2 = 4.5$ GeV^2
  - Bogdan Wojtsekhowski at Jlab is main driver of SBS form factor program. Recruiting collaborators to be co-spokesperson on experiments.

BigBite Spectrometer

- Upgraded BigBite Spectrometer
- Used to detect electrons
  - GEMs for tracking
    (INFN-Rome,INFN-Catania, U of Virginia, JLab)
  - Scintillator hodoscope segments in 90 paddles
    (U of Glasgow)
  - GRINCH Gas Cerenkov with 510 PMTs
    (NC A&T, College of W&M)
  - Shower and preshower used for trigger, e/pi PID
    (JLab, U of Connecticut)
- Used in the GMN, GEN2 and GEN-RP experiments
- BigBite performance
  - 1-1.5% momentum resolution
  - 1-2 mrad in-plane and out-of-plane angular resolution
  - 2-6mm vertex resolution

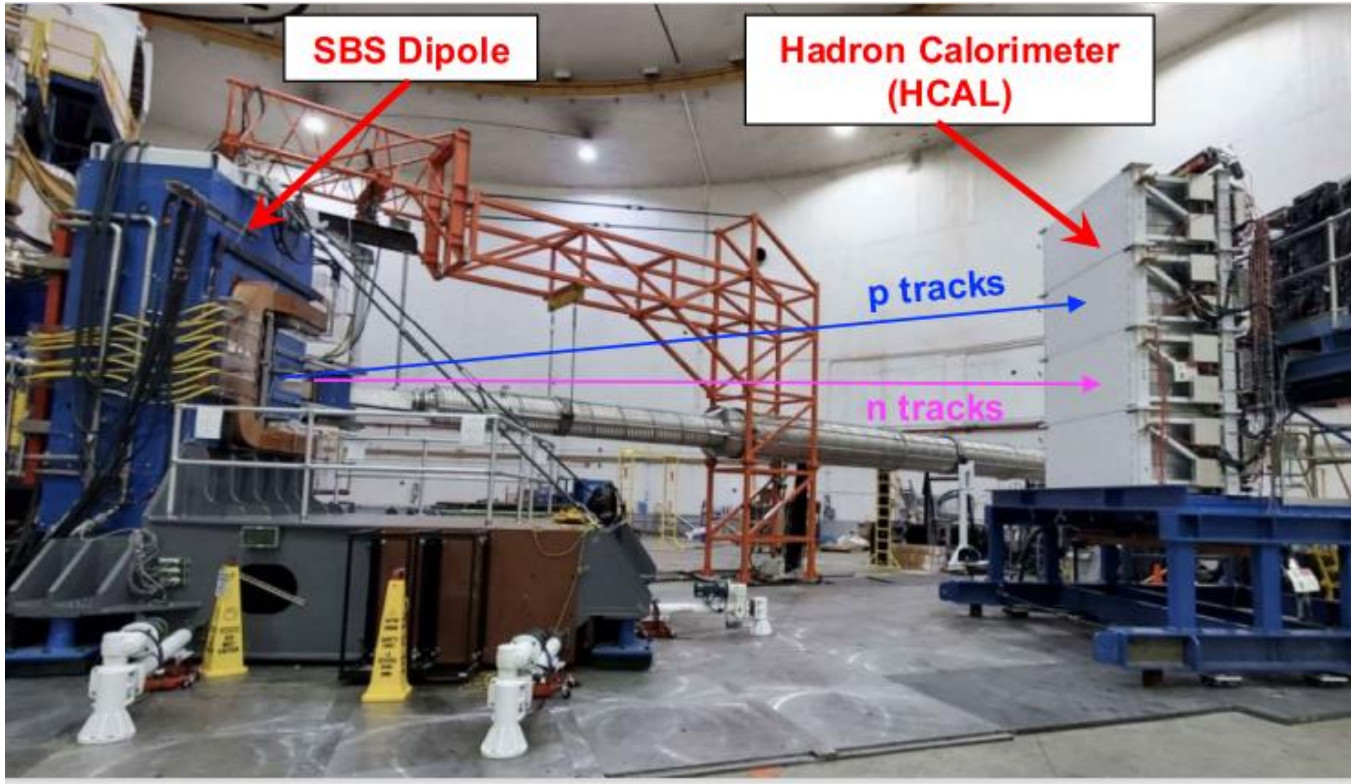
Super BigBite Spectrometer

Super BigBite Magnet

- Modified the BNL D48D48 magnet
  - Cut-out for beam line
  - New coils
  - Max Integral Bdl = 1.6 Tm
  - Separate protons and neutrons
  - 50msr acceptance at 15 deg

Hadron Calorimeter

- 12x24 array of interleaved iron/scintillator blocks
- Cover area
- High efficiency for neutron and proton detection
- Carnegie Mellon, INFN-Catania

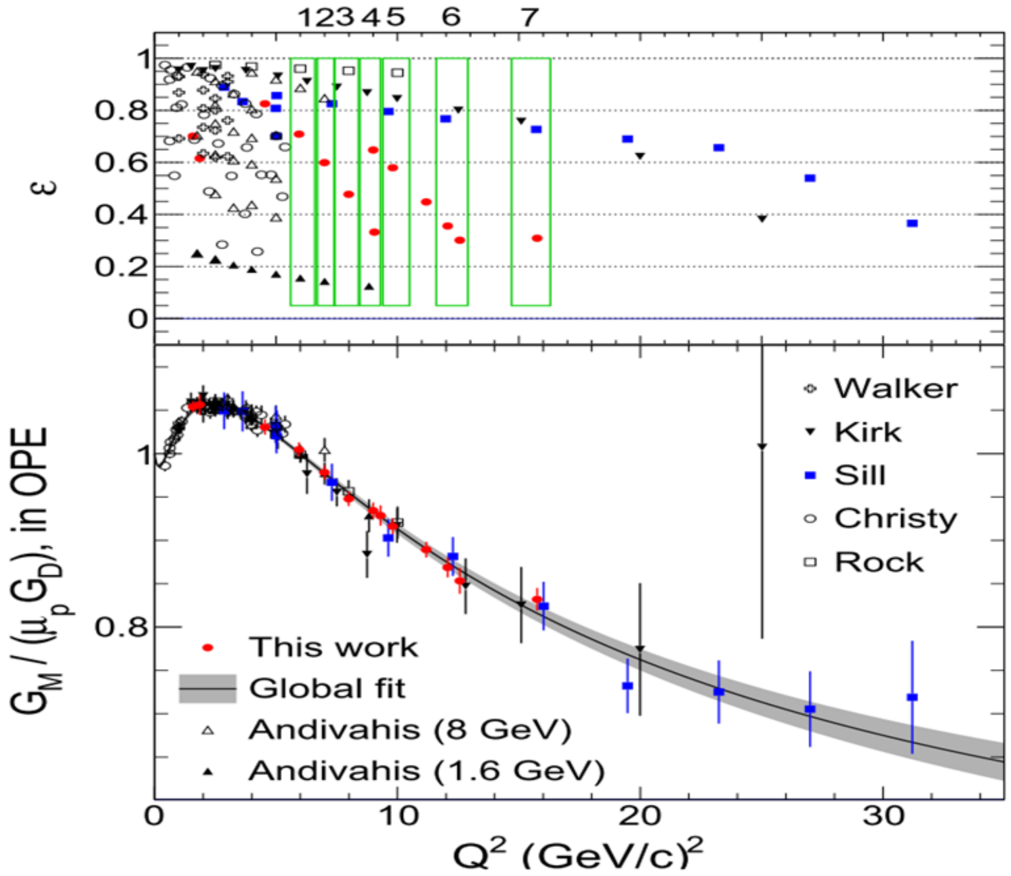


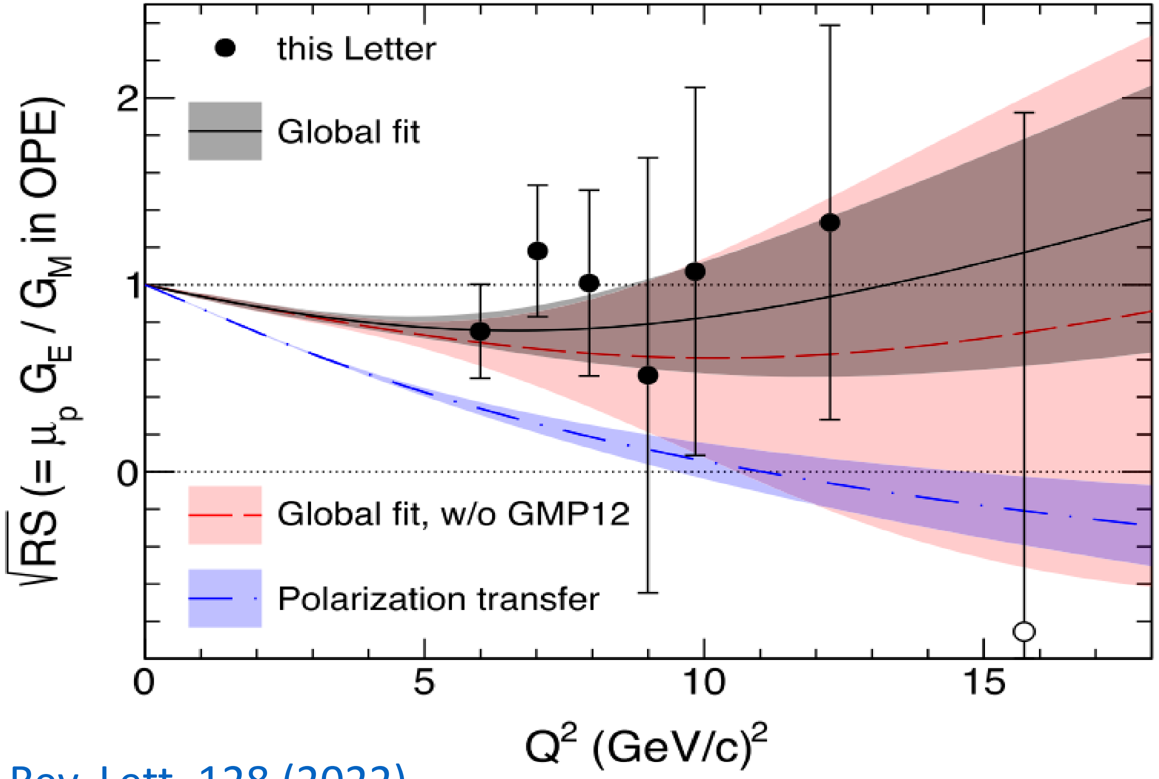
Hall A: Proton magnetic form factor, G_M, at $Q^2 = 15.75$

- High luminosity needed to do longitudinal-transverse separation.
- Use the Left and Right HRS in Hall A to measure cross sections at different epsilon to extract G_M and G_E/G_M.
- Hard two-photon exchange contributions at 4% to explain difference

$$\sigma_R = \tau\, G_M^2(Q^2) + \varepsilon\, G_E^2(Q^2) = \sigma_T + \varepsilon\, \sigma_L$$
$$= G_M^2(Q^2)(\tau + \varepsilon\, RS(Q^2)/\mu_p^2),$$

$$G_M = \mu_p(1 + a_1\tau)/(1 + b_1\tau + b_2\tau^2 + b_3\tau^3),$$
$$RS = 1 + c_1\tau + c_2\tau^2.$$

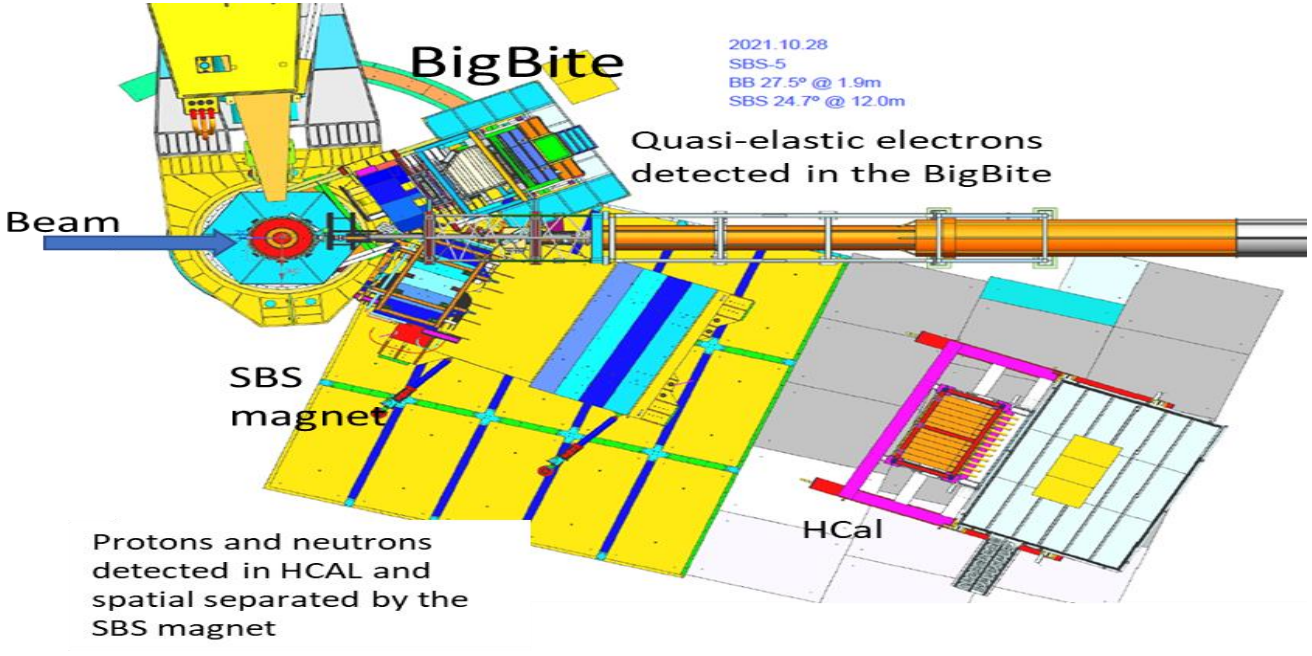




Plots from Phys. Rev. Lett. 128 (2022)

Measurement of neutron magnetic form factor

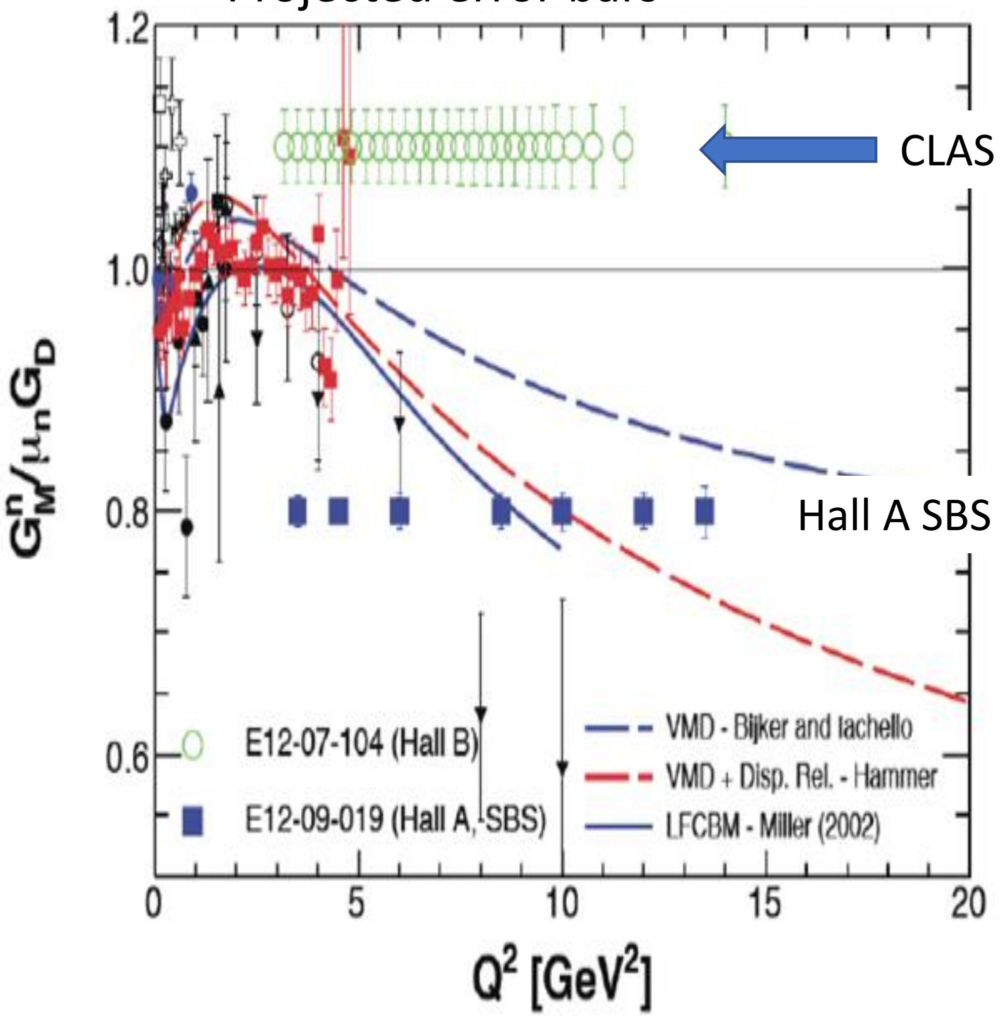
- Measured GMn from the ratio of cross section in quasi-elastic D(e,e’n) to D(e,e’p)
- Measured at Q^2 = 3, 4.5, 7.4 , 9.9 and 13.5 GeV^2
- Ran from Sept 2021 to March 2022
- Experiment E12-20-010 (nTPE)
  - At Q^2 = 4.5 GeV^2 measured an additional point at ε= 0.80
  - Rosenbluth separation to determine neutron TPE.
- Hall B has completed the same type of measurement using CLAS



Quasi-elastic electrons detected in the BigBite

Protons and neutrons detected in HCAL and spatial separated by the SBS magnet

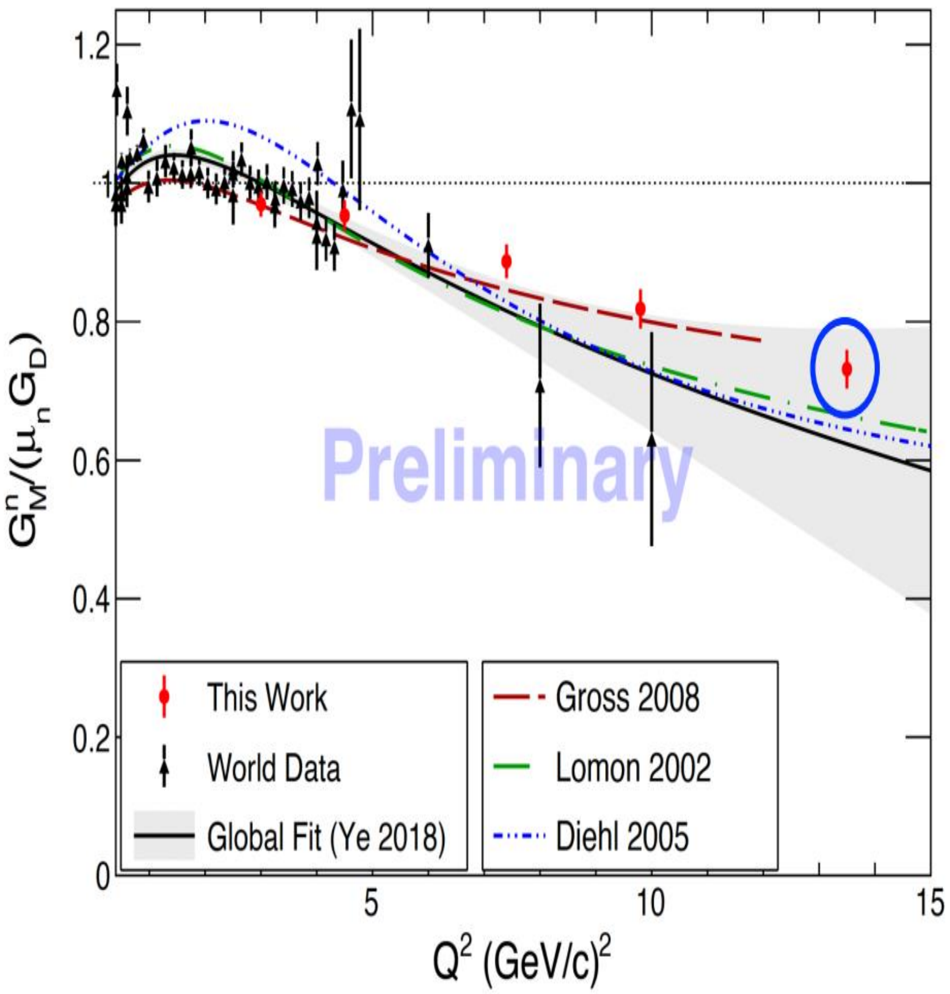
Projected error bars



Measurement of neutron magnetic form factor

$$\begin{aligned} R_{np} \equiv \frac{\sigma_{d(e,e'n)p}}{\sigma_{d(e,e'p)n}} &\approx \frac{\sigma_{en\to en}}{\sigma_{ep\to ep}} \\ &\approx \frac{\epsilon {G_E^n}^2 + \tau {G_M^n}^2}{\epsilon {G_E^p}^2 + \tau {G_M^p}^2} \\ \implies G_M^n &\approx \sqrt{\frac{R_{np}\sigma_R^p - \epsilon {G_E^n}^2}{\tau}} \end{aligned}$$

- Preliminary data shown by Provakar Datta at his earlier talk at GHP
- Thanks to hard work of the graduate students involved in the SBS GMn experiment: Vanessa Brio (Catania University), John Boyd (University of Virginia), Provakar Datta (University of Connecticut), Nathaniel Lashley-Colthirst (Hampton University), Ralph Marinaro (University of Glasgow), Anuruddha Rathnayake (University of Virginia) , Maria Satnik (William & Mary), Sebastian Seeds (University of Connecticut), Ezekiel Wertz (College of William and Mary)

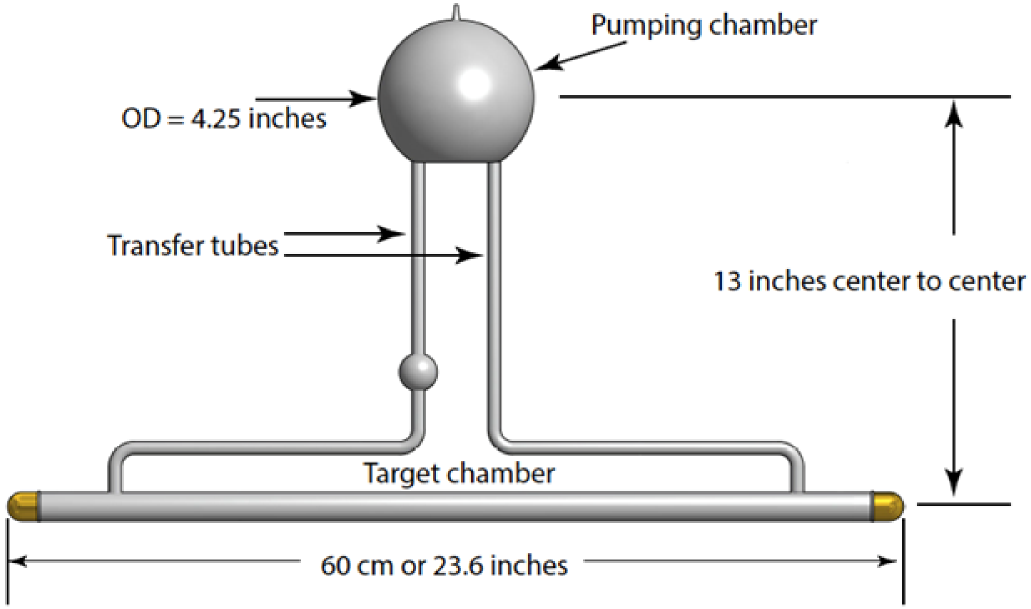


Neutron electric form factor by beam-target asymmetry

- Used polarized 3He target as an effective polarized neutron target. U of Virginia led effort with College of W&M and JLab support.
- Measured asymmetry in scattering of polarized electron beam on polarized neutron
- Achieved peak performance of 55% neutron polarization at 50uA beam current with 60cm long cell

$$A = \frac{\sigma_+ - \sigma_-}{\sigma_+ + \sigma_-}$$

$$A = -\frac{2\sqrt{\tau(1+\tau)}\tan\frac{\theta_e}{2}}{G_E^2 + \frac{\tau}{\epsilon}G_M^2}\Big[\sin\theta^*\cos\phi^* G_E G_M + \sqrt{\tau\left[1+(1+\tau)\tan^2\frac{\theta_e}{2}\right]}\cos\theta^* G_M^2\Big].$$



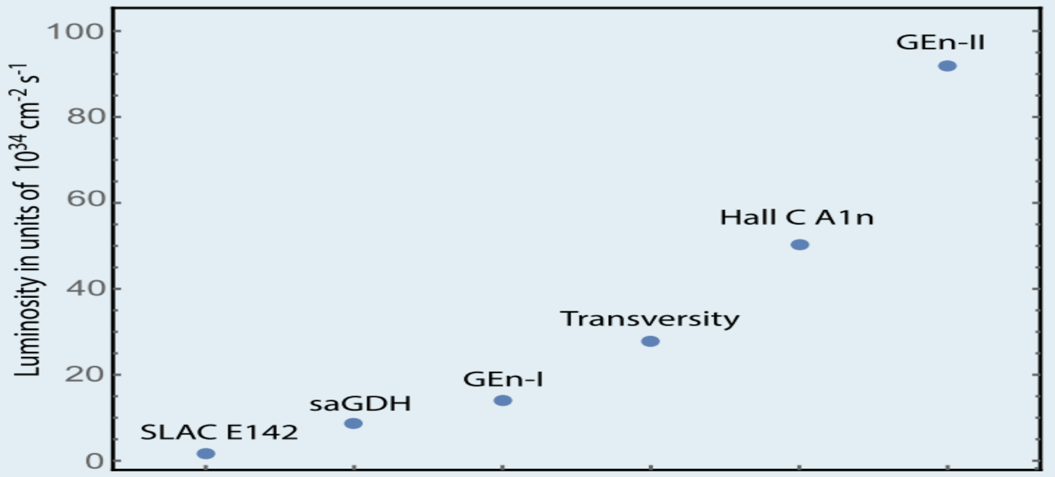
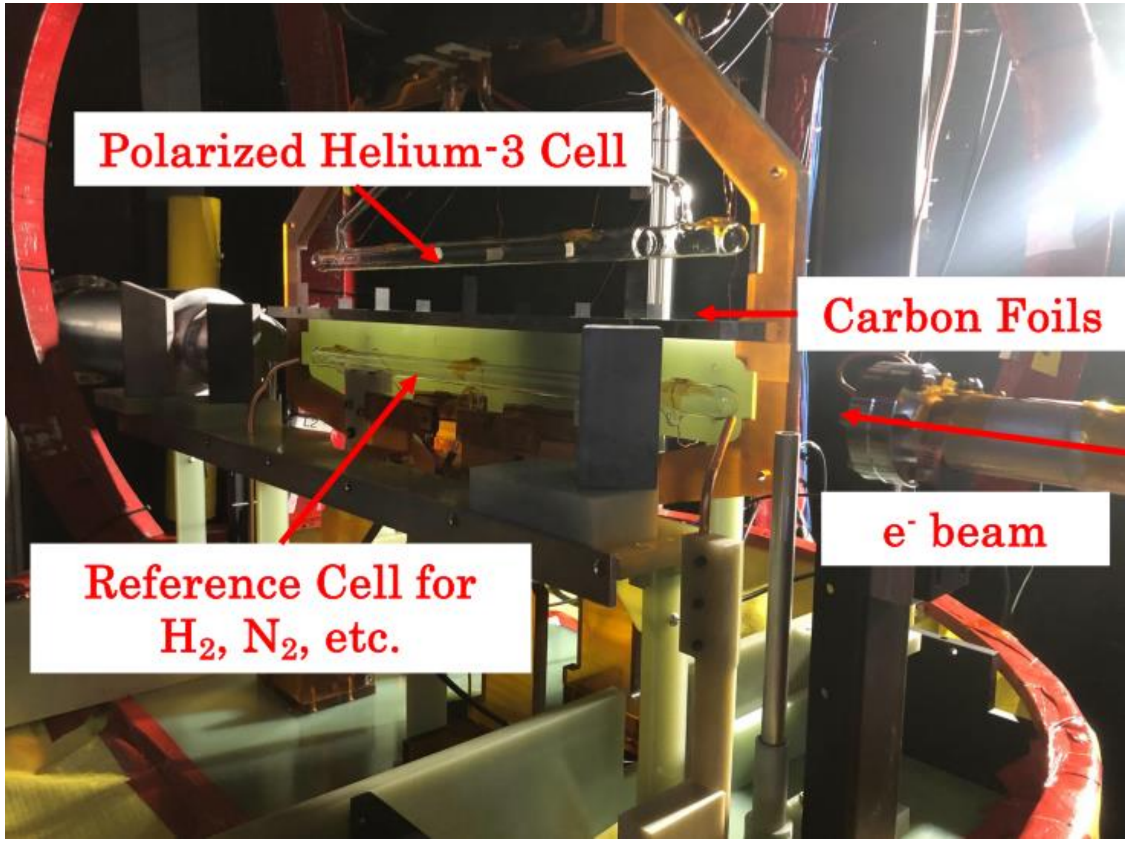


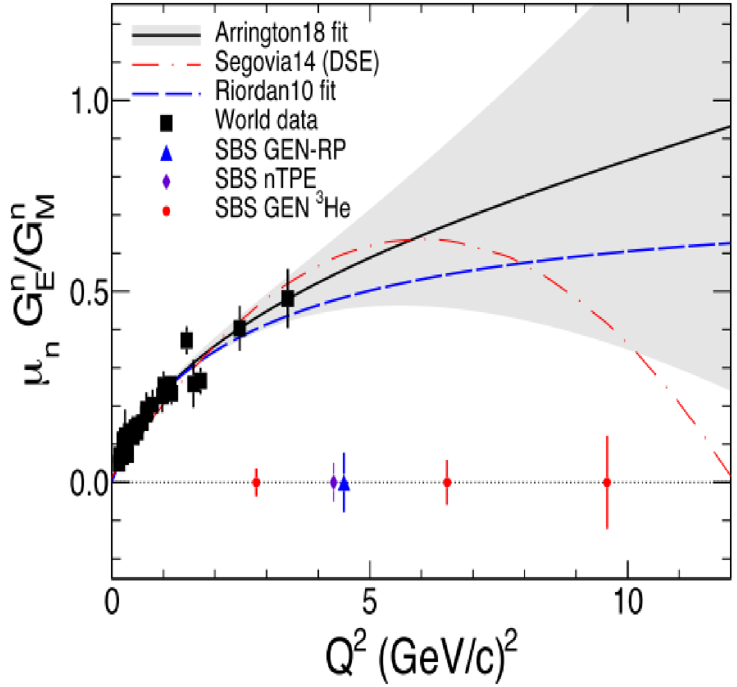
Figure 3. Luminosity, weighted by the square of polarization, is shown for the polarized ^{3}He targets used in various experiments dating back to SLAC E142 (published in 1991).

GEN2: Neutron electric form factor by beam-target asymmetry

- Use same BigBite and Super BigBite Spectrometer as GMN
- Measured at Q^2 = 3, 6.8 and 9.9 GeV^2
  - Increased Q^2 range by approximately 3x
- Experiment ran from Oct 2022 to Oct 2023.



Projected error bars



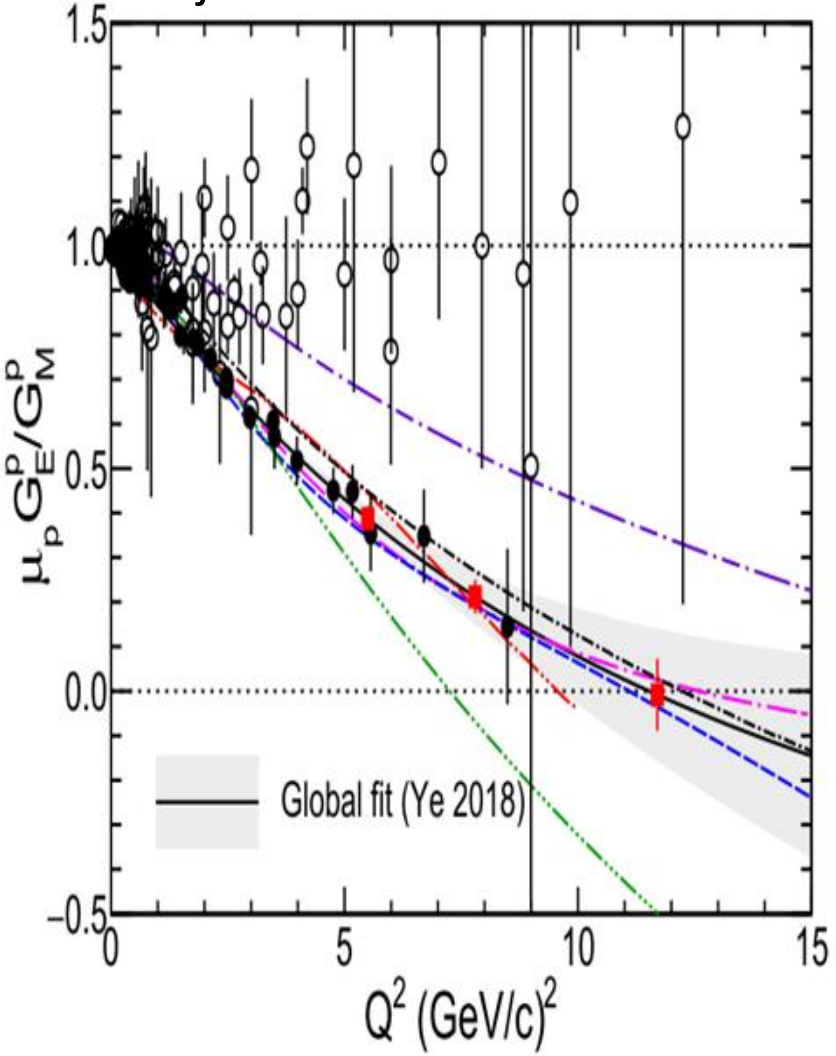
Graduate students on GEN2:
Faraz Chahili (Syracuse University), Kate Evans (William & Mary), Vimukthi Gamage (University of Virginia), Jack Jackson (William & Mary), Sean Jeffas (University of Virginia), Jacob Koenemann (University of Virginia), Gary Penman (University of Glasgow), Braian Mederos (University of Virginia), Hunter Presley (University of Virginia)

GEP Experiment measure proton G_E/G_M to Q^2 = 12 GeV^2

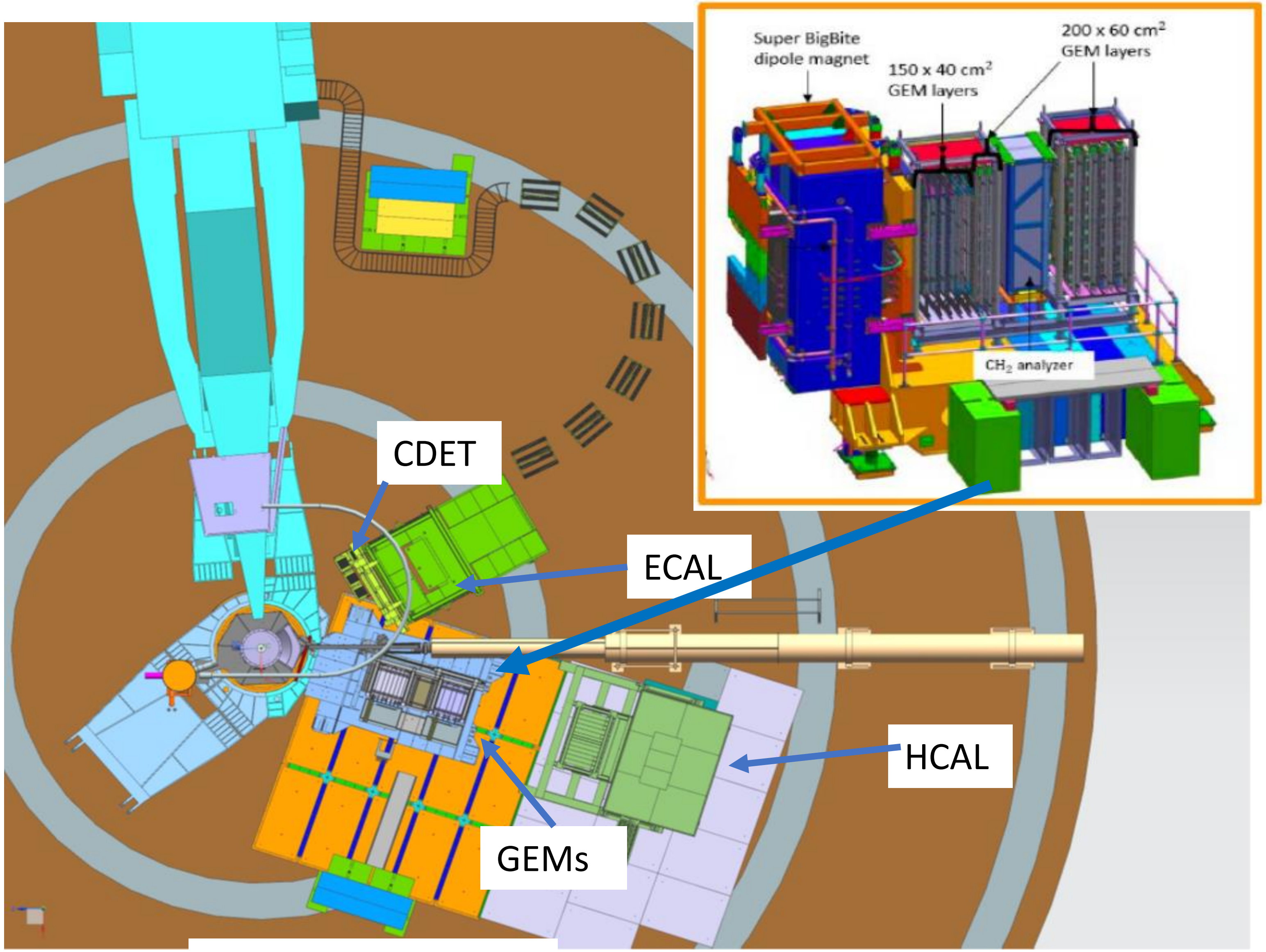
- New detectors for electron detection
  - Large 1656 lead glass blocks in Electron Calorimeter (ECAL)
    - Enclosure by Yerevan AANL and NCCU.
    - New PMT base design and testing over 2000 PMTs by JMU.
    - Installation done and overseen by Jlab staff with support from Virginia Tech, UTK, MSU, AANL and other universities.
  - Coordinate Detector
    - Two planes, each with 1176 scintillator bars.
    - Covers active area of 104 x 294 cm2
    - U. of Idaho and CNU lead effort.
- SBS spectrometer for proton detection
  - Magnet used to precess spin.
    - Insert pole shims to increase integral Bdl to 2.1 Tm
  - Focal plane polarimeter: front tracker with 8 GEM planes, 50cm thick plastic analyzer followed by rear tracker with 8 GEM planes
  - GEM chambers constructed by U. of Virginia.
  - Hadron Calorimeter

Graduate students on GEP working on the installation and preparation: Mahmoud Gomina (Virginia Tech), Nikolas Hunt (U of Connecticut), Jacob McMurtry (U of Virginia), Leonard Giuseppe Re (Catania University), Ben Spaude (William & Mary), Jhih-Ying Su (U of Massachusetts Amherst), Vidura Vishvanath (U of Virginia)

Projected error bars



GEP : Proton GE/GM by recoil polarization



Electron Detection

- Electron Calorimeter (ECAL)
  - 1656 Lead glass blocks
  - Trigger formed in FADC from clusters
  - Need good energy calibration at FADC
  - Tight cut on elastic to reduce accidentals
  - Measure angle and energy
- Coordinate Detector (CDET)
  - 2352 scintillator bars
  - Measures vertical angle
  - Aids track finding in front GEMs
  - Reduce the photon background

Proton Detection

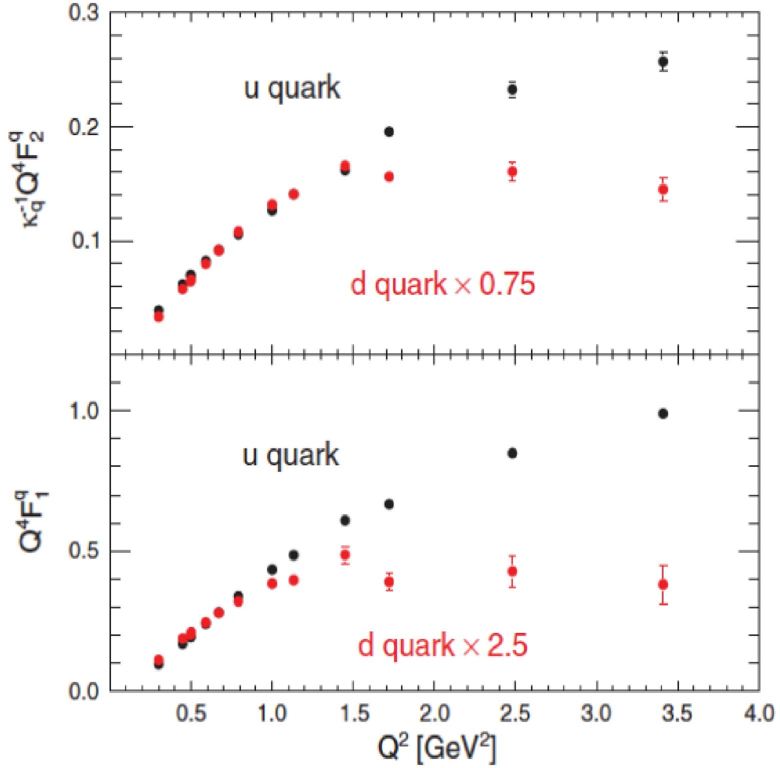
- FPP is GEMS Front and rear tracker
  - Each 8 layers of GEMs
  - Measure momentum, z-target, angles
  - Plastic analyzer for rescattering protons
  - Measure the recoil polarization of protons
- Hadron Calorimeter (HCAL)
  - 288 iron/scintillator blocks
  - Trigger formed in FADC from clusters
  - Aids track finding in rear trackers

Flavor decomposition of the form factors

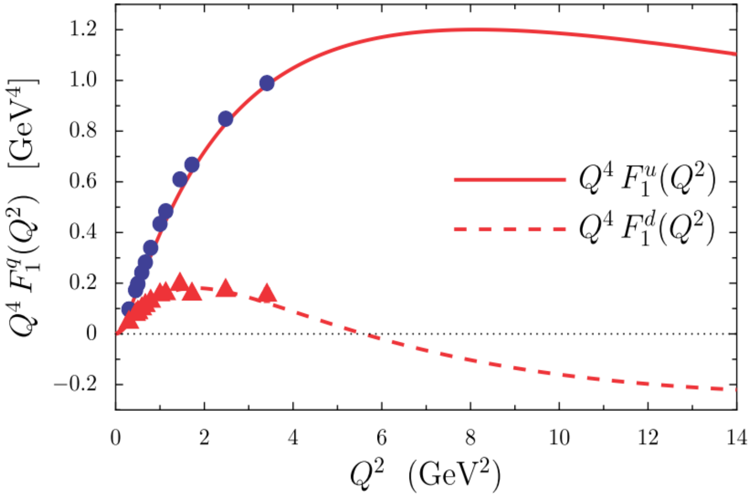
Charge symmetry and assume contribution to nucleon is only from the up and down quarks

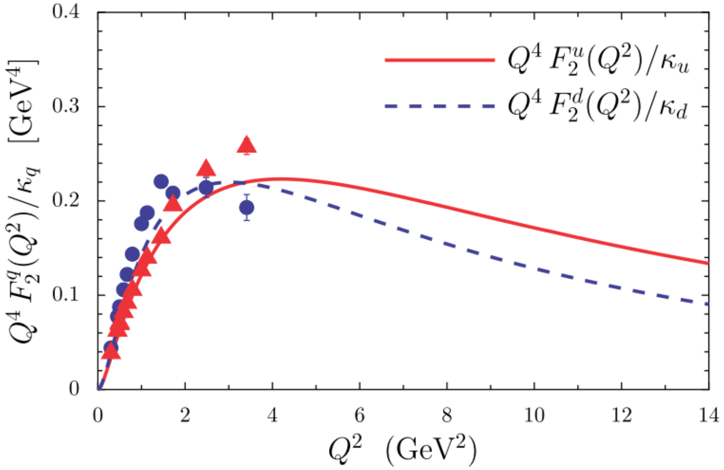
$$G_{(E,M)p} = \frac{2}{3}G_{(E,M)u} - \frac{1}{3}G_{(E,M)d}$$
$$G_{(E,M)n} = \frac{2}{3}G_{(E,M)d} - \frac{1}{3}G_{(E,M)u}$$

$$F_{(1,2)u} = 2F_{(1,2)p} + F_{(1,2)n}$$
$$F_{(1,2)d} = F_{(1,2)p} + 2F_{(1,2)n}$$



I. Cloët and G. A. Miller Phys. Rev. C **86**, 015208 demonstrated that in a constituent quark model with the valence quarks, represented by quark-diquark combinations and immersed in a cloud of pions can reproduce the data.





G. Cates, C. de Jager, S. Riordan, B. Wojtsekhowski
Phys. Rev. Lett. 106 (2011) 252003

Form factors and Generalize Parton Distributions

M. Diehl and P. Kroll Eur.Phys.J. C73 (2013) 4, 2397
Fitted form factor data by assuming a form for the valence GPD

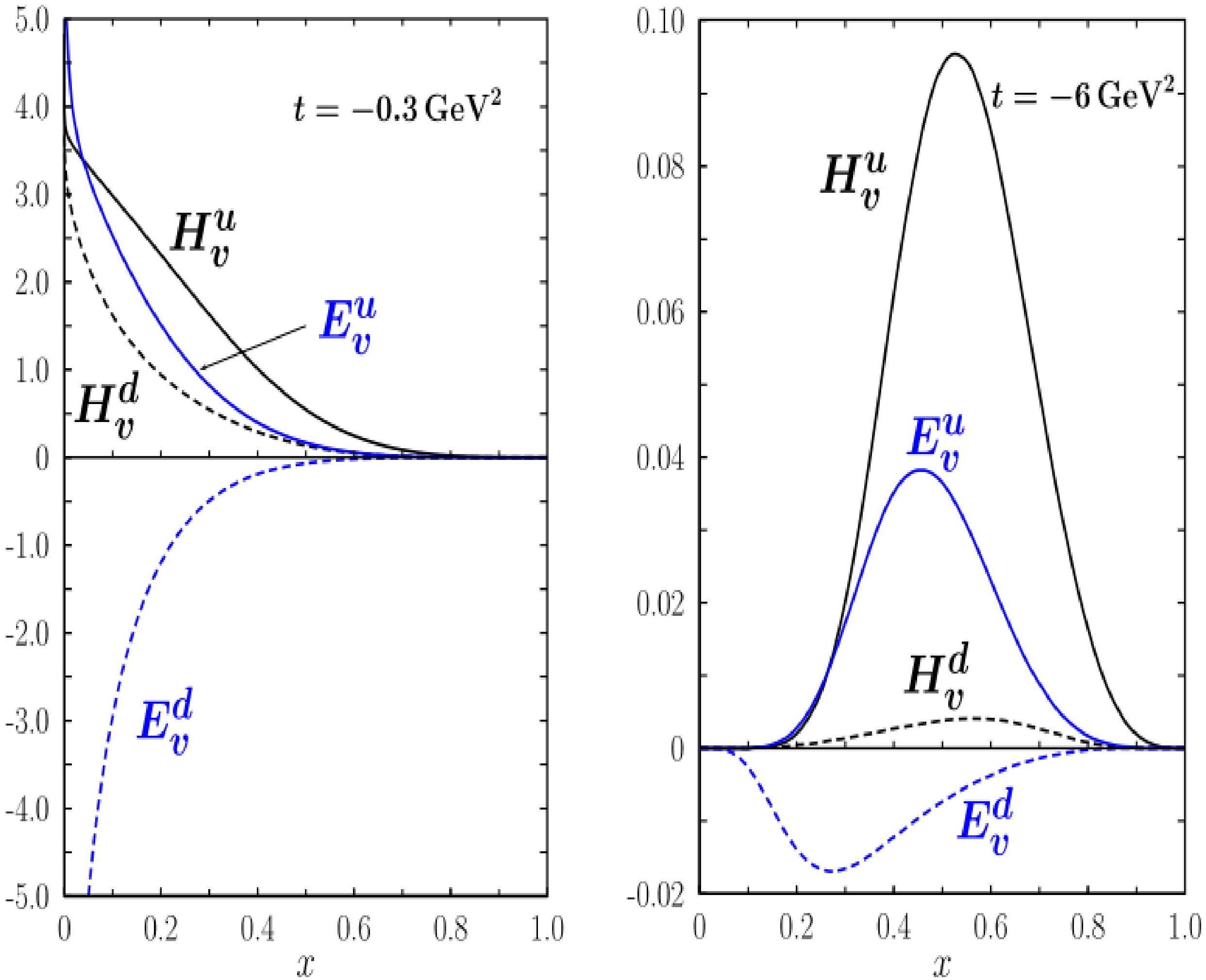
$$F_1^q(t) = \int_0^1 \mathrm{d}x\, H_v^q(x,t)$$

$$F_2^q(t) = \int_0^1 \mathrm{d}x\, E_v^q(x,t)$$

Large Q^2 form factor data determines the large x behavior of the valence GPD

Use Ji's sum rule to determine total angular momentum of up and down quarks

$$J_v^u = 0.230^{+0.009}_{-0.024}\,, \qquad J_v^d = -0.004^{+0.010}_{-0.016}$$



Calculation using continuum Schwinger function methods

Plot from talk by Craig Roberts at the QCHSC24 (arXiv:2503.05984)
Summarizes recent papers by his group.

Parameter free Faddeev equation predictions by Z.-Q. Yao, D. Binosi, Z.-F. Cui, C. D. Roberts, arXiv:2403.08088.

The Schlessinger point method (SPM) to objectively assess the likelihood that the data support the existence of a zero in G_E/G_M by P. Cheng, Z.-Q. Yao, D. Binosi, C. D. Roberts, Phys. Lett. B 862 (2025) 139323.

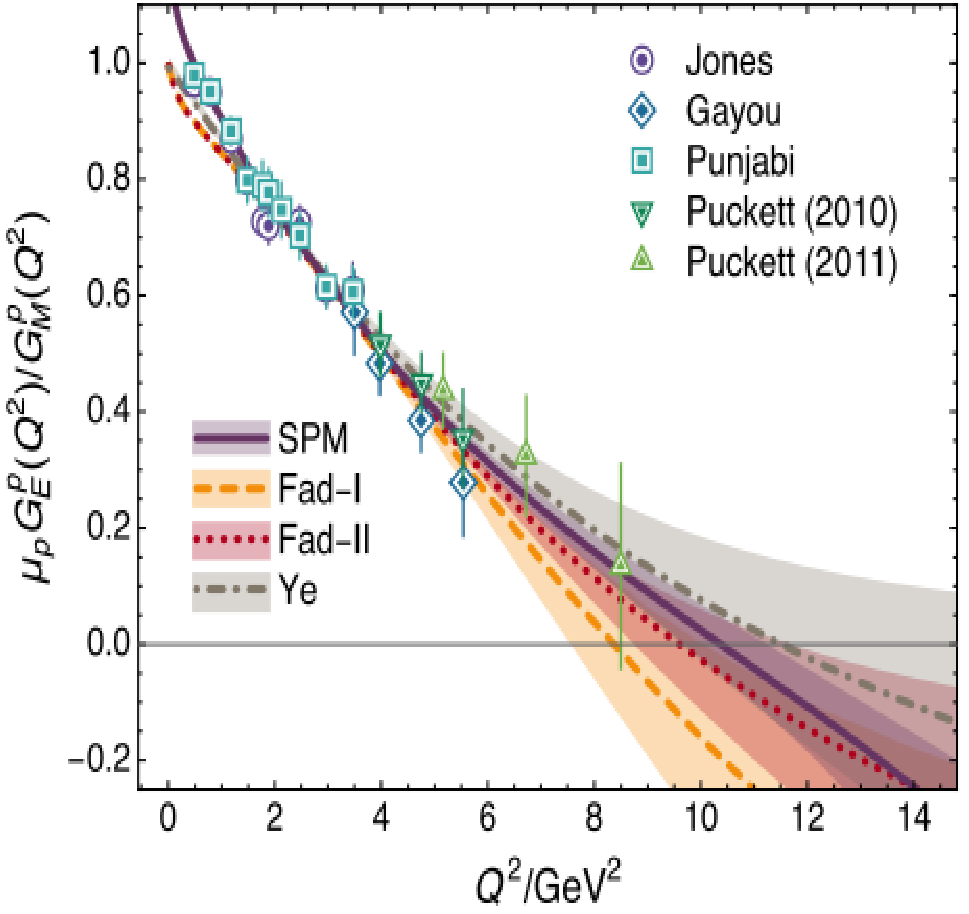


Figure 3: Prediction for the ratio $\mu_p G_E^p(Q^2)/G_M^p(Q^2)$ obtained in the objective SPM analysis of available data [60–64] that is described in Ref. [65]. For comparison, the figure also depicts the parameter-free Faddeev equation predictions [57, Fad-I, Fad-II] and the curve obtained via a subjective phenomenological fit to the world's electron + nucleon scattering data [66, Ye]. Both theory and phenomenology deliver a zero crossing at a location that is compatible with the SPM prediction.

Lattice QCD calculations of proton and neutron form factor

In proceedings of LATTICE2024 by S. Syritsyn, M. Engelhardt, S. Krieg, J. Negele and A. Pochinsky arXiv:2502.17283

Calculate connected and disconnected diagrams

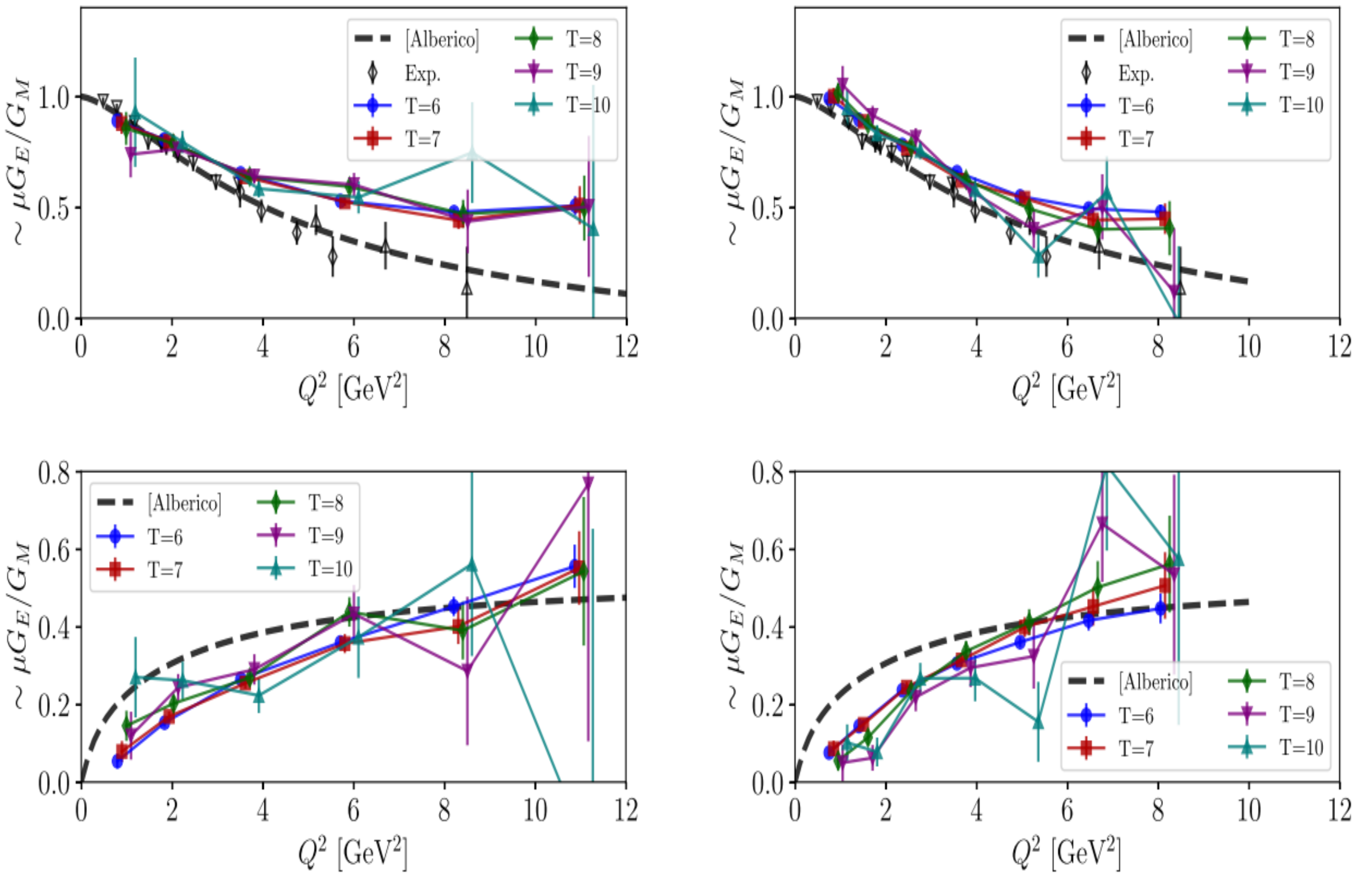
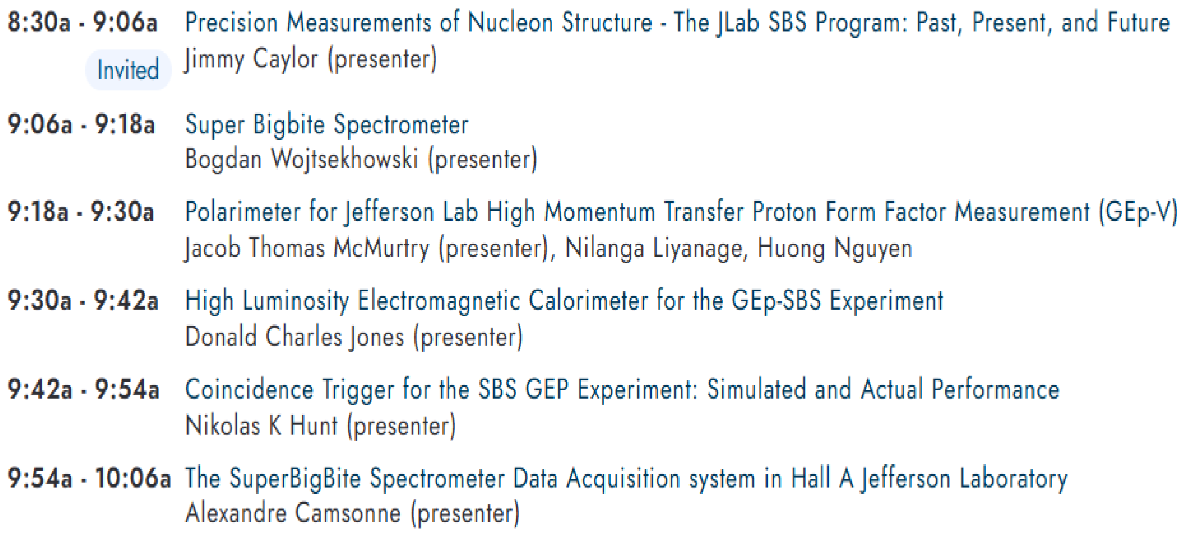


Figure 5: Ratio of the form factors G_E/G_M of the proton (top) and neutron (bottom) on the D5 ($m_\pi \approx$ 280 MeV, left) and D6 ($m_\pi \approx$ 170 MeV, right) ensembles. Both connected and disconnected contributions are included. The black data points are experimental values and the dashed lines are phenomenological fits [17]

Conclusion

- The JLab Hall A SBS form factor program is nearing completion
  - At GHP, Provakar Datta presented preliminary results for the neutron G_M to Q^2 = 13.5 GeV^2
  - Completed measurements of the neutron G_E/G_M to Q^2 = 10 GeV^2 using beam-target asymmetries
    - 60cm long polarized 3He cell. Factor of two larger FOM than previous targets.
  - Completed measurements of the neutron G_E/G_M at Q^2 = 4.5 GeV^2 using recoil polarization
    - Measure recoil polarization using charge exchange.
  - Completed installation of equipment for measurement of proton G_E/G_M to Q^2 = 12 GeV^2
    - Experiment is scheduled to start at the end of March.
- At the APS meeting on Tuesday March 18th

Mini-Symposium: Early Results from Nucleon Form Factor Campaign with SBS at JLab



8:30a - 9:06a Precision Measurements of Nucleon Structure - The JLab SBS Program: Past, Present, and Future
Invited Jimmy Caylor (presenter)

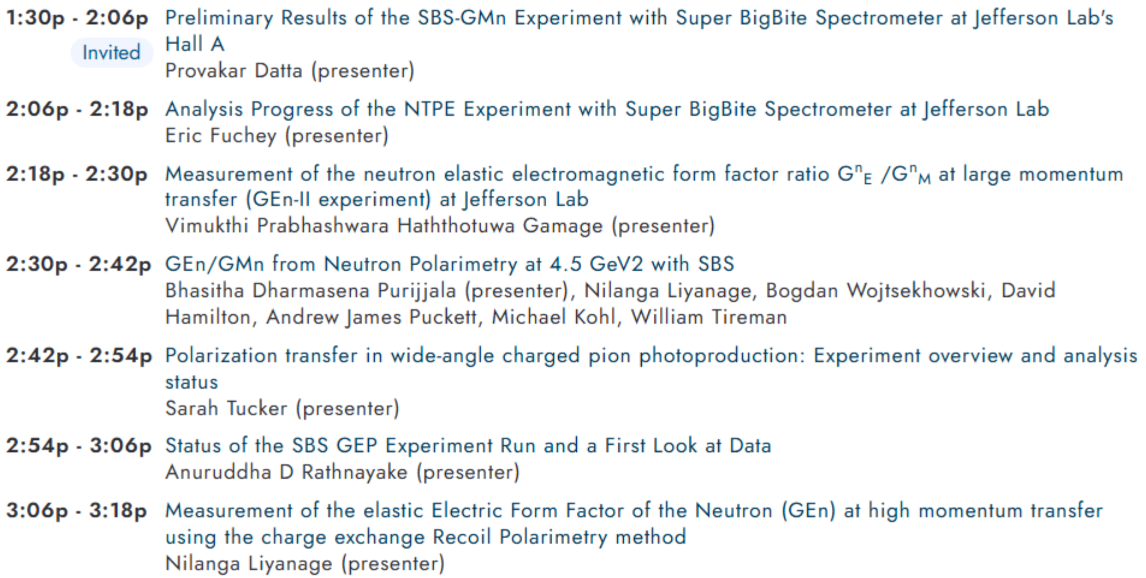
9:06a - 9:18a Super Bigbite Spectrometer
Bogdan Wojtsekhowski (presenter)

9:18a - 9:30a Polarimeter for Jefferson Lab High Momentum Transfer Proton Form Factor Measurement (GEp-V)
Jacob Thomas McMurtry (presenter), Nilanga Liyanage, Huong Nguyen

9:30a - 9:42a High Luminosity Electromagnetic Calorimeter for the GEp-SBS Experiment
Donald Charles Jones (presenter)

9:42a - 9:54a Coincidence Trigger for the SBS GEP Experiment: Simulated and Actual Performance
Nikolas K Hunt (presenter)

9:54a - 10:06a The SuperBigBite Spectrometer Data Acquisition system in Hall A Jefferson Laboratory
Alexandre Camsonne (presenter)



1:30p - 2:06p Preliminary Results of the SBS-GMn Experiment with Super BigBite Spectrometer at Jefferson Lab's Hall A
Invited Provakar Datta (presenter)

2:06p - 2:18p Analysis Progress of the NTPE Experiment with Super BigBite Spectrometer at Jefferson Lab
Eric Fuchey (presenter)

2:18p - 2:30p Measurement of the neutron elastic electromagnetic form factor ratio G^n_E /G^n_M at large momentum transfer (GEn-II experiment) at Jefferson Lab
Vimukthi Prabhashwara Haththotuwa Gamage (presenter)

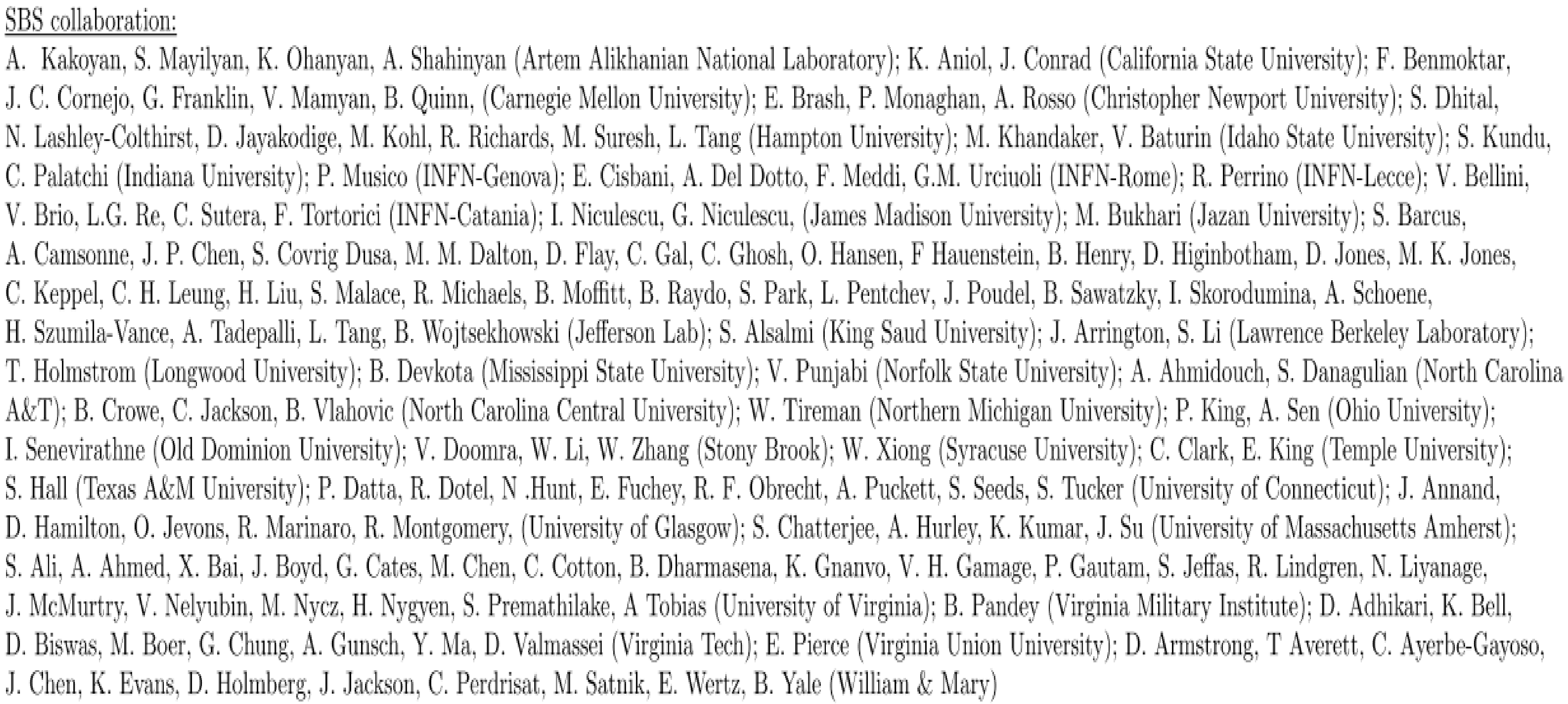
2:30p - 2:42p GEn/GMn from Neutron Polarimetry at 4.5 GeV2 with SBS
Bhasitha Dharmasena Purijjala (presenter), Nilanga Liyanage, Bogdan Wojtsekhowski, David Hamilton, Andrew James Puckett, Michael Kohl, William Tireman

2:42p - 2:54p Polarization transfer in wide-angle charged pion photoproduction: Experiment overview and analysis status
Sarah Tucker (presenter)

2:54p - 3:06p Status of the SBS GEP Experiment Run and a First Look at Data
Anuruddha D Rathnayake (presenter)

3:06p - 3:18p Measurement of the elastic Electric Form Factor of the Neutron (GEn) at high momentum transfer using the charge exchange Recoil Polarimetry method
Nilanga Liyanage (presenter)

Thanks to the SBS Collaboration



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