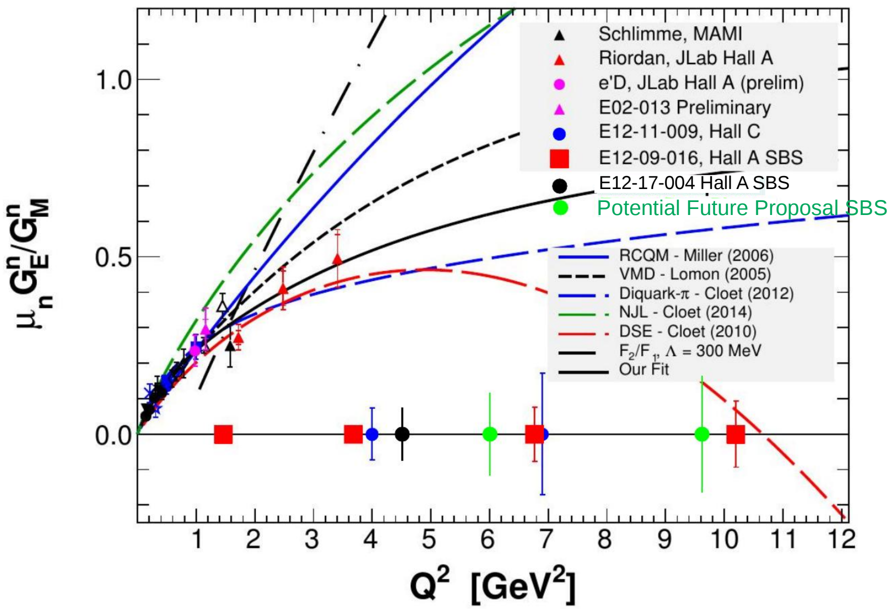
The 1st SBS Experiments:
G_M^n/G_M^p by the cross-section ratio method
Experiment E12-09-019
G_E^n/G_M^n by double polarized $^2H(\vec{e},e'\vec{n})$
Experiment E12-17-004

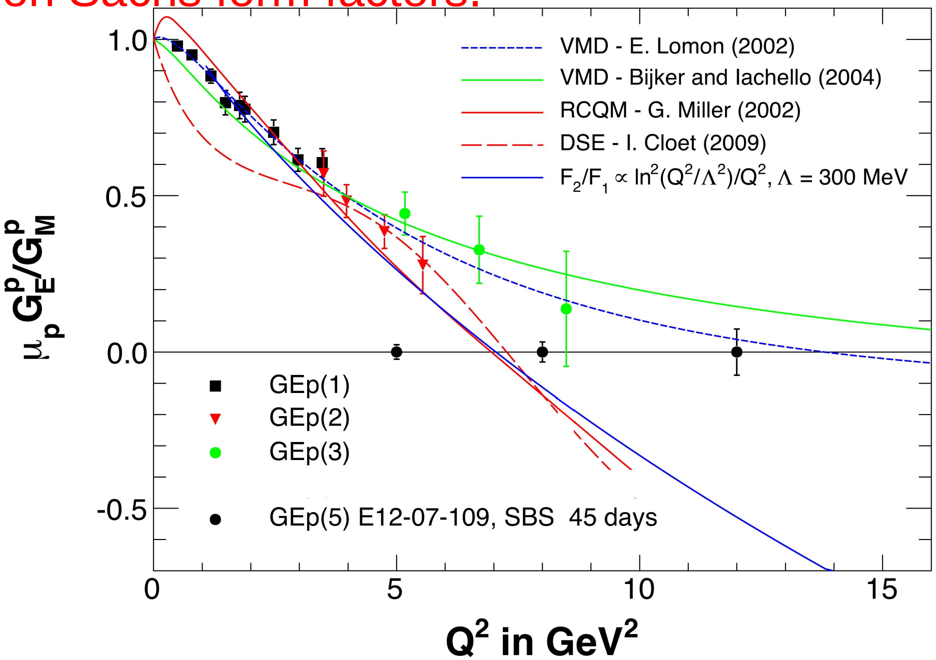
John Annand
School of Physics and Astronomy
University of Glasgow

for the
SBS Collaboration

New EMFF Experiments in JLab Hall A
Super BigBite Spectrometer (SBS)

Hall A all 4 Nucleon Sachs form factors.





Cross Section

$$\sigma_{ep} \propto \frac{E^2}{Q^{12}}$$

Polarimetry

$$A_y \propto \frac{1}{p_p} \sim \frac{M}{Q^2}$$

$$FOM \propto N A_y^2 \sim \frac{E^2}{Q^{16}}$$

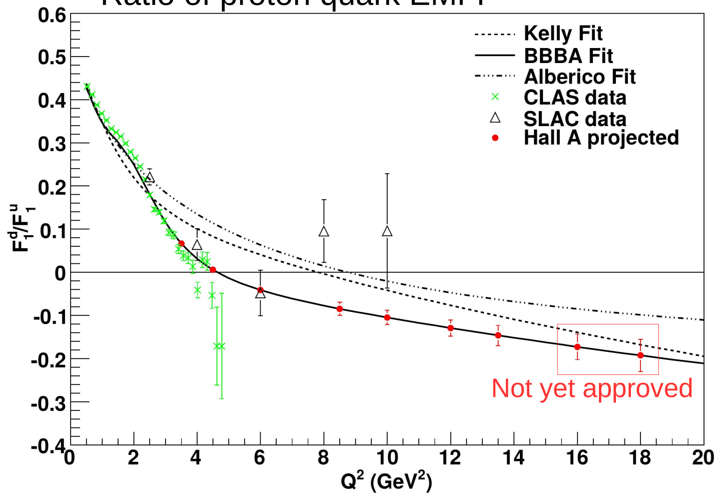
E12-07-108 G_{Mp} elastic *p(e,e')p* using HRS
max Q^2 = 16 (GeV/c)^2 see yesterdays talk L.Ou

SBS programme of nucleon EMFF measurements

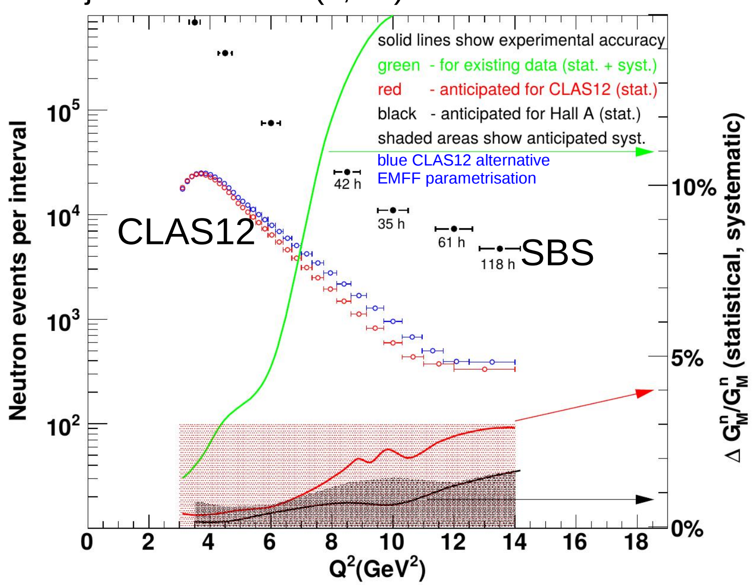
- E12-09-019 G_{Mn}/G_{Mp} (by ratio *d(e,e'n)/d(e,e'p)* method)
- E12-09-016 G_{En}/G_{Mn} (with polarized beam & target)
- E12-07-109 G_{Ep}/G_{Mp} (with polarized beam & recoil polarimetry)
- E12-17-004 G_{En}/G_{Mn} (with polarized beam & recoil polarimetry)

E12-09-019 G_{Mn}/G_{Mp} Motivation

Ratio of proton quark EMFF



Projected numbers (e,e'n) events & uncertainties



- Assuming very small nucleon strange content ... G_{Mn} (+ the other 3 Sachs FF) enables iso-spin analysis of EMFF, ie $F_{1(2)}^{u(d)}$
- Also gives info on neutron transverse charge density down to scale ~0.05 fm
- Approved experiment will measure at Q^2 = 3.5 – 13.5 (GeV/c)^2
- Smaller statistical and systematic uncertainties at each Q^2 bin than CLAS12 experiment E12-07-104 CLAS12 experiment has finer Q^2 granularity
- SBS could measure up to Q^2 = 18 (GeV/c)^2 but not approved.

Approved kinematic points
BigBite e' spectrometer...
Min. $\theta_{e'}$ ~ 30 deg   Max. $E_{e'}$ ~ 3.8 GeV

Beam and Spectrometer Configurations for "Golden" Settings

Kin	Q^2 [GeV²]	E_{beam} [GeV]	θ_{bb} [°]	θ_{sbs} [°]	d_{bb} [m]	d_{mag} [m]	d_{hcal} [m]	∫Bdl [Tm]	$P_{e'}$ [GeV/c]	$P_{h'}$ [GeV/c]
1	3.5	4.40	32.50	31.10	1.80	2.00	7.20	1.71†	2.54	2.64
2	4.5	4.40	41.90	24.70	1.55	2.25	8.50	1.71†	2.00	3.20
3	5.7	4.40	58.40	17.50	1.55	2.25	11.00	1.71†	1.36	3.86
4	8.1	6.60	43.00	17.50	1.55	2.25	11.00	1.65	2.28	5.17
5	10.2	8.80	34.00	17.50	1.75	2.25	11.00	1.60	3.38	6.29
6	12.0	8.80	44.20	13.30	1.55	2.25	14.00	1.50	2.41	7.27
7	13.5	11.00	33.00	14.80	1.55	3.10	17.00	0.97	3.80	8.08

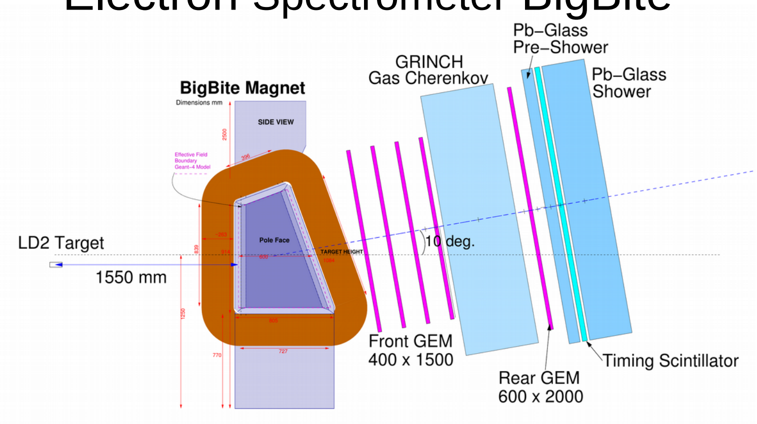
†SBS Field integral is at maximum.

Experimental Apparatus for E12-09-019

E12-09-019 Readiness Review June 2017

E12-17-004 uses all of these components (and some extra)

Electron Spectrometer BigBite



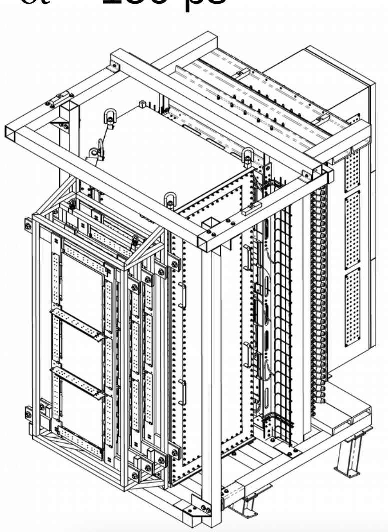
Ω ~ 55 msr

$\delta p/p$ ~ 0.5%

$\delta\theta$ ~ 1 mr

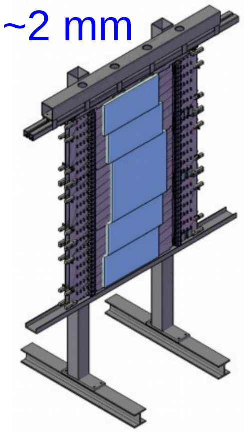
δz ~ 2 mm @ target

δt ~ 150 ps



Coordinate Detector CDet

δx, δy ~2 mm

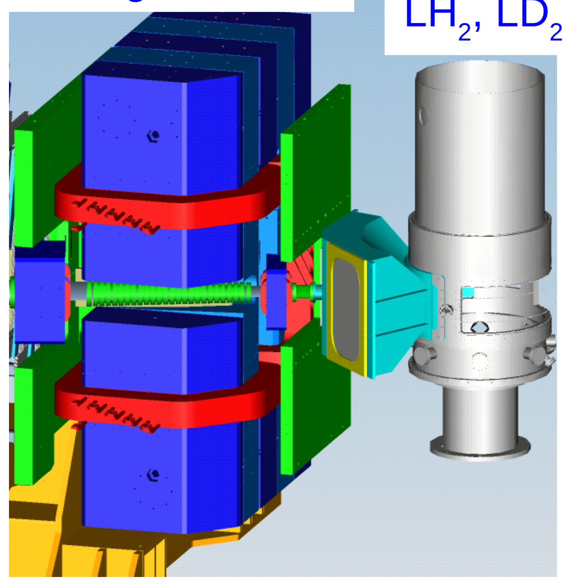


48D48 Dipole

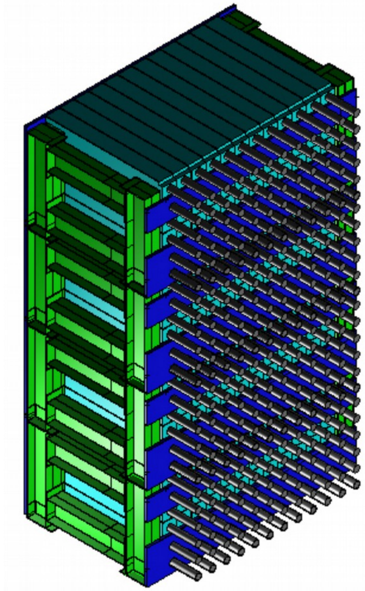
~2 Tm integrated field

Hall-A Target

LH_2, LD_2, C-foil



Hadron Calorimeter HCAL

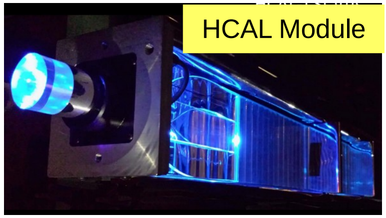


80 – 90% efficiency

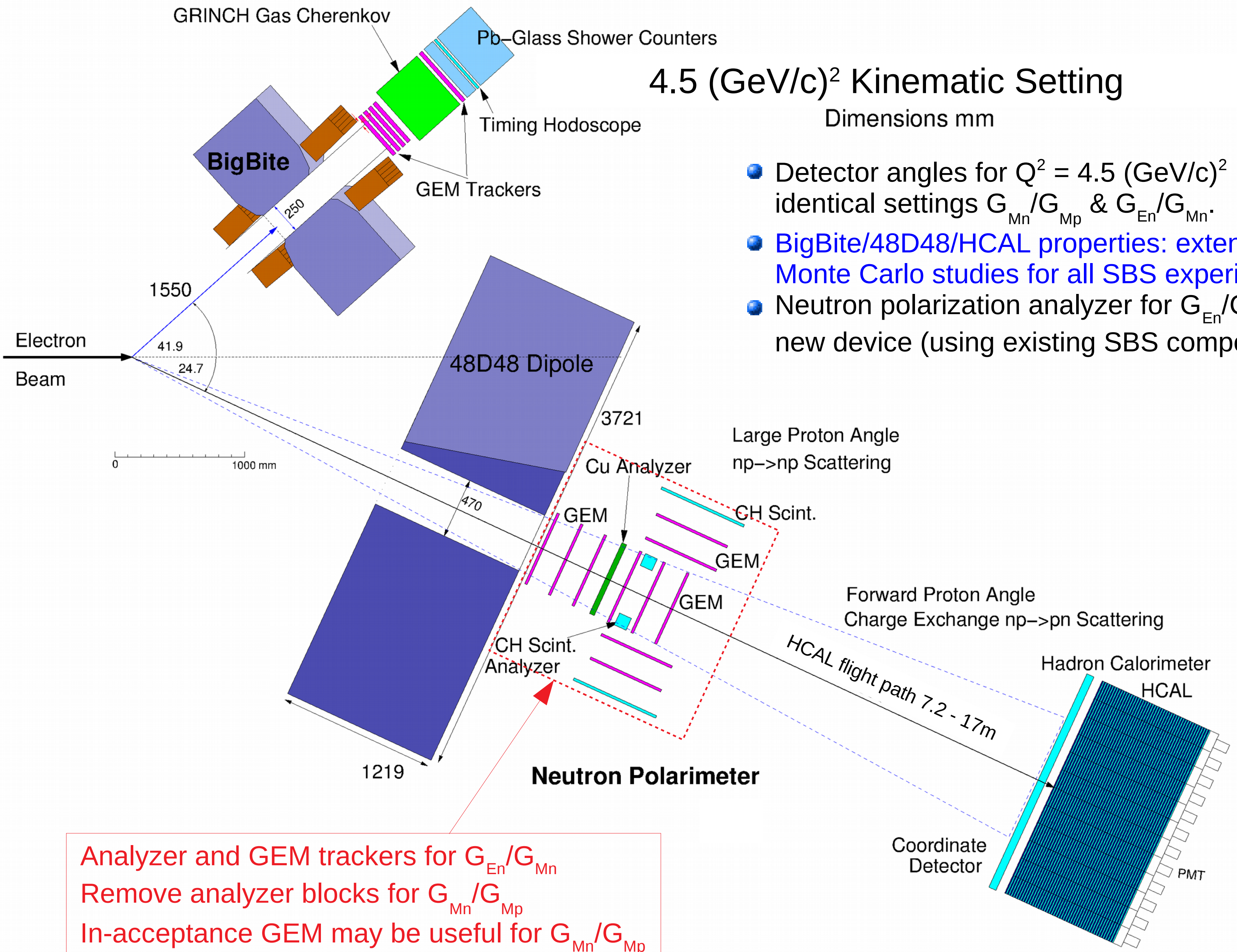
multi-GeV p and n

Effective suppression of soft background

~0.5 ns timing resolution



Schematic Experiment Layout



4.5 $(GeV/c)^2$ Kinematic Setting

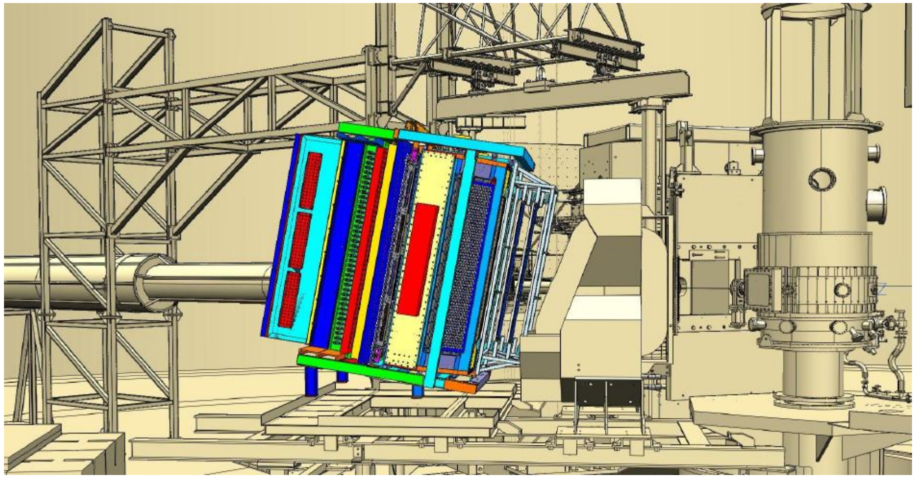
Dimensions mm

- Detector angles for $Q^2 = 4.5\ (GeV/c)^2$ identical settings G_{Mn}/G_{Mp} & G_{En}/G_{Mn}.
- BigBite/48D48/HCAL properties: extensive Monte Carlo studies for all SBS experiments
- Neutron polarization analyzer for G_{En}/G_{Mn} new device (using existing SBS components)

Analyzer and GEM trackers for G_{En}/G_{Mn}
Remove analyzer blocks for G_{Mn}/G_{Mp}
In-acceptance GEM may be useful for G_{Mn}/G_{Mp}

BigBite Status

- BB upgrade: collaborative effort JLab, W&M, INFN Rome, UVa, Glasgow ...
  Dipole & Pb-Glass shower counters: unchanged from 6-GeV JLab experiments
  New GEM trackers, GRINCH Gas Cherenkov, Timing hodoscope
- Detector mounting frame modification: design complete, welding to start Spring 2018
  … then install Pb-Glass shower counters and Timing Hodoscope
- Summer 2018 start full integration of BigBite detectors
  GRINCH Cherenkov & GEMs to upgraded weld-ment
  GRINCH status … see T. Averett's talk
- When detector assembly complete: move to Experimental Staging Building
  to commission and test electronic systems, trigger, DAQ
- Move from ESB directly to Hall A when ready for experiment.
- $^{3}H/^{3}He$ experiments likely to run through 2018, APEX, $PREX_2$, CREX in 2019
  possible BB move to Hall A is ~2020 … still uncertain

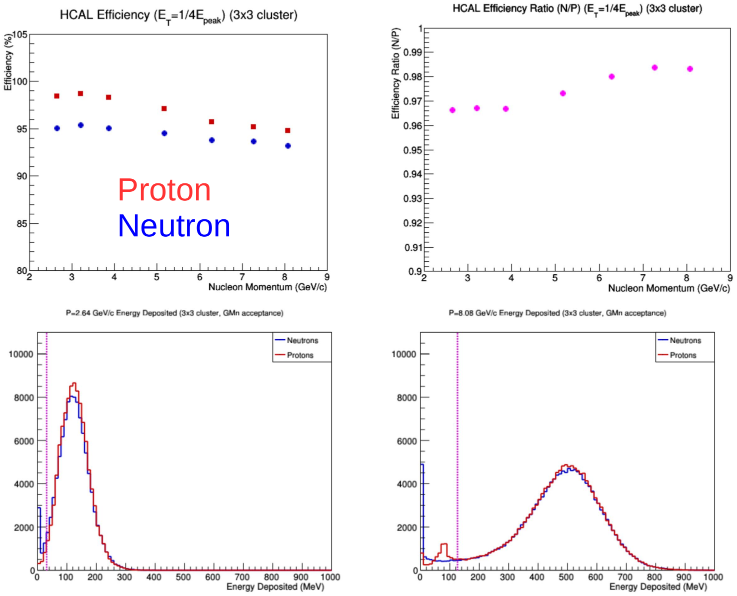


Timing Hodoscope

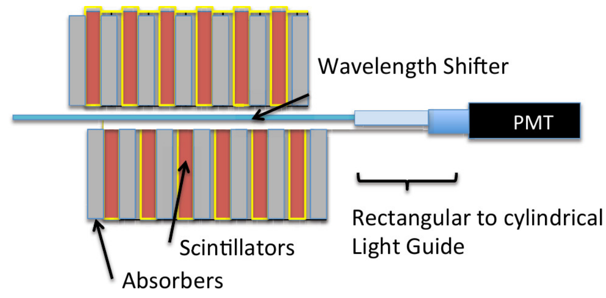
(Pre-)Shower Pb-Glass Elements

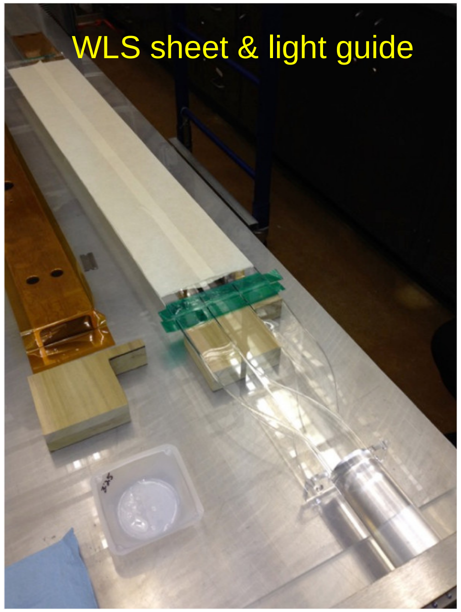
Hadron Calorimeter HCAL-J Status

CMU, INFN Catania, JLab



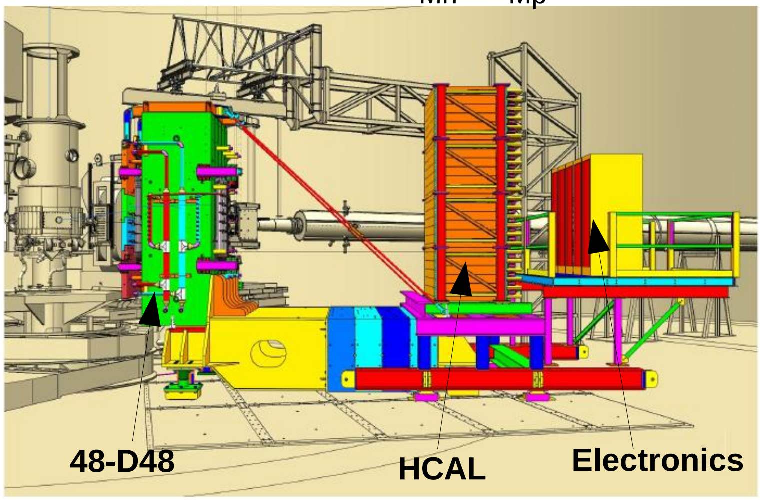
Alternating plates plastic scint and Fe. Central WLS sheet collects scintillation





- 288 Calorimeter modules
  4 10-ton sub-assembly (crane capacity)
- Proton and neutron response very similar … cross-section ratio d(e,e'n)/d(e,e'p)
- High detection efficiency
- Effective soft background suppression
- 0.5 ns time resolution
- Module fabrication complete
- Assembly of sub-assemblies in progress
- Design of rear stand, layout of power supplies, electronics, cabling … in progress
- Projected completion date → 2019

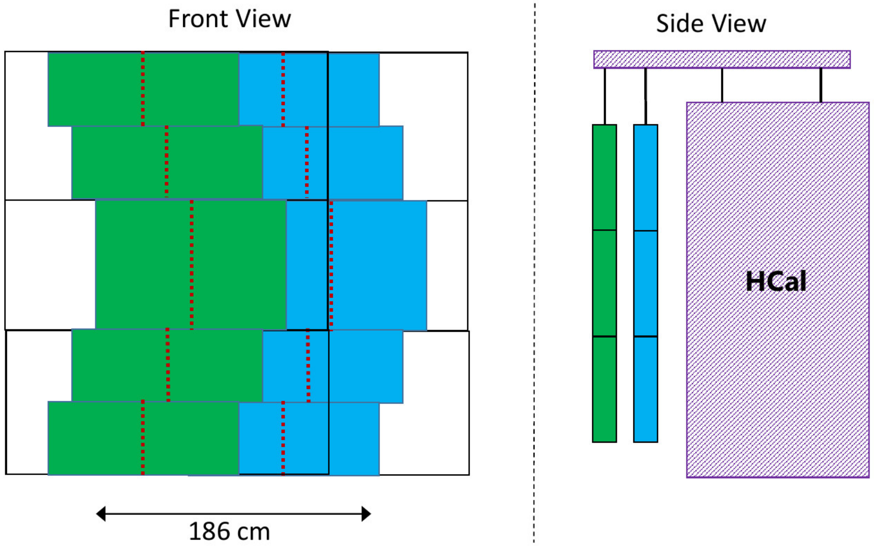
HCAL-J for G_{Mn}/G_{Mp}



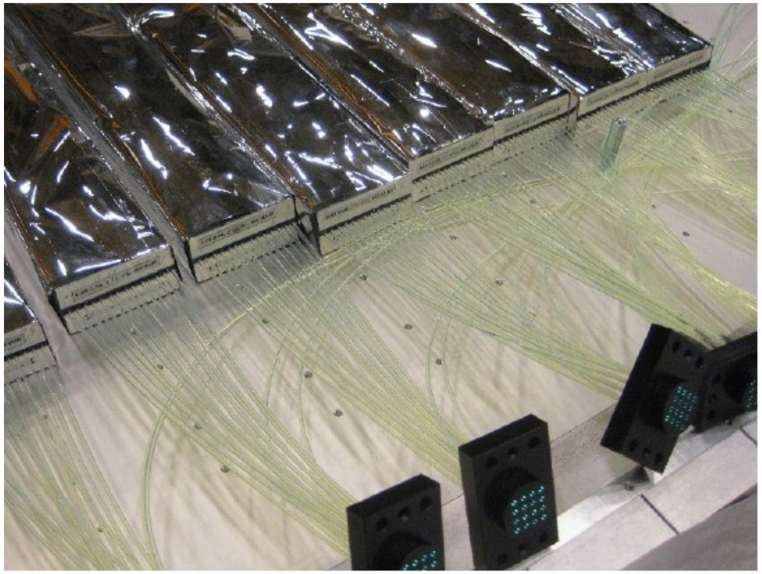
Coordinate Detector Cdet

CNU, JLab, Glasgow

Offset planes to cover HCal acceptance

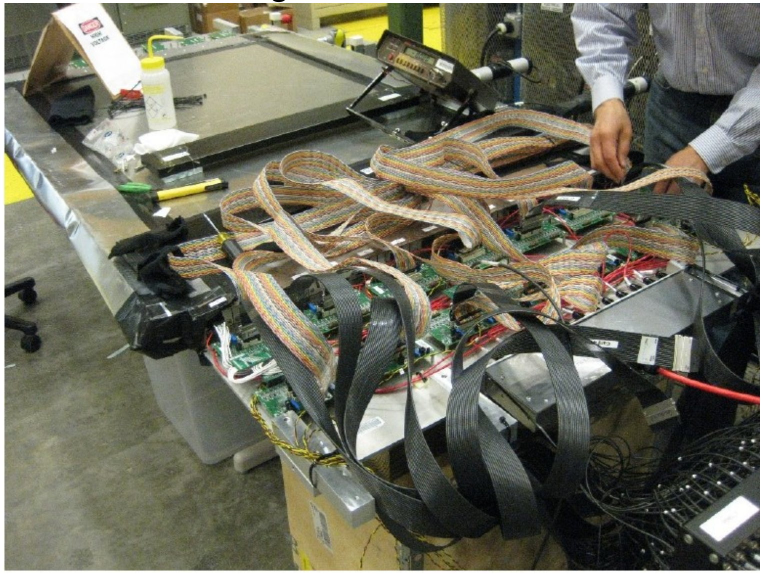


WLS + MaPMT readout of plastic scint.



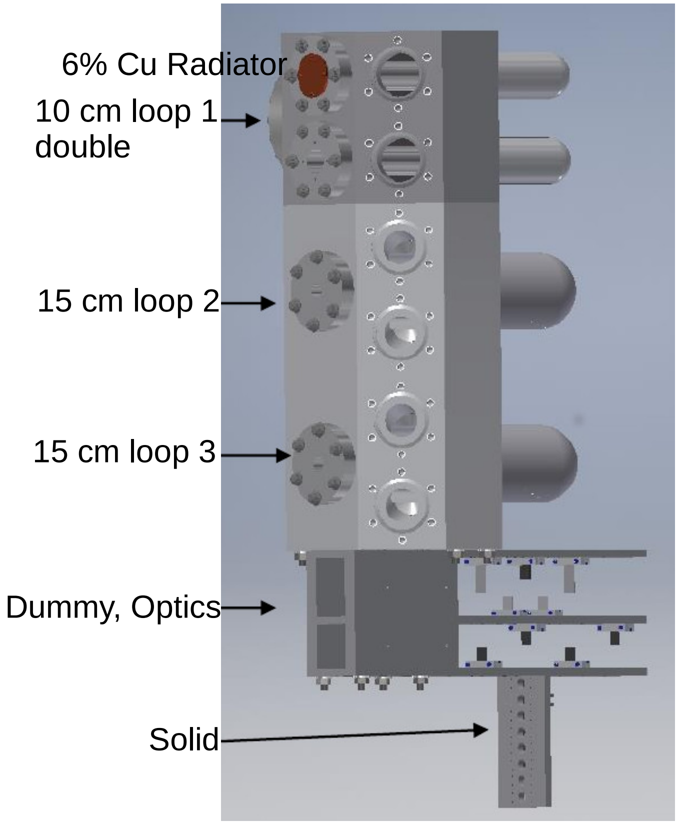
- Originally designed for e' arm of G_{Ep}/G_{Mp} experiment
- G_{Mn}/G_{Mp} CDet aids differentiation of p and n incident on HCAL.
- Angled plastic rods (groups of 14) with WLS + MA-PMT readout
- 6 Plastic scintillator modules (total 2352 channels) are assembled.
- CNU currently cosmic-ray testing module 1 + NINO front-end electronics + DAQ readout

NINO amplifier/discriminator cards and cabling, module 1 in Test Lab.

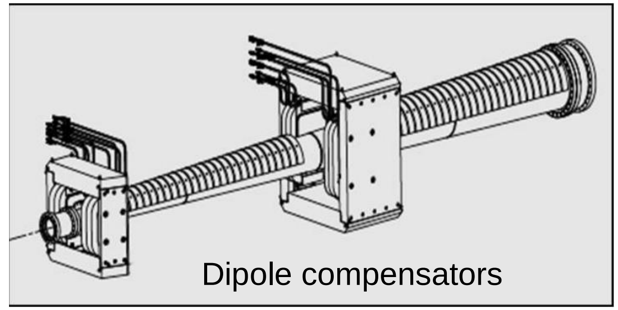


Target and Exit Beamline

Hall-A Target (JLab)



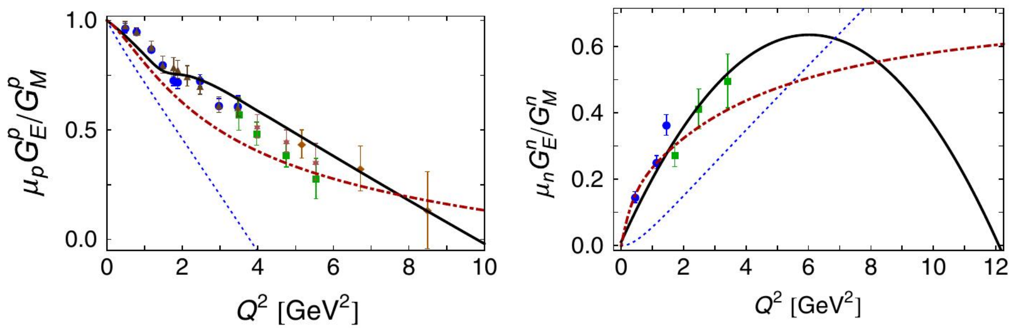
Exit beamline shielding (JLab)



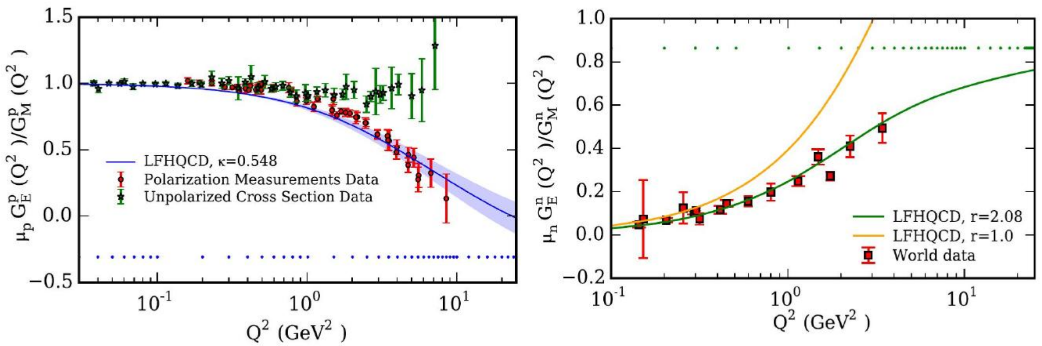
- Target more-or-less standard Hall-A LH_2, LD_2, Optics, Solid
- Running 40+ µA beam on 10 cm LD_2 target
- Detector calibrations LH_2 and spectrometer optics C foil
- Large Q^2...SBS placed at small polar angles, not too far from target
- Exit beamline passes thro' slot in 48D48 dipole yoke. Require active compensation and shielding for “stray” 48D48 B field

E12-17-004 G_{En}/G_{Mn} Motivation

J. Segovia et al., Few-Body Syst. 55 (2014), 1185.
DSE common framework N-elastic and Δ-transition form factors



R. S. Sufian et al., Phys. Rev. D95(2017),014011.
Light Front Holographic QCD



Different theoretical frameworks...

Very different predictions for $\mu_n G_{En}/G_{Mn}$

Up to now no recoil polarimetry measurement at $Q^2 > 1.5$ (GeV/c)^2 (Hall C)

Hall A ^{3}He(e,e'n) $Q^2 \leq 3.4$ (GeV/c)^2

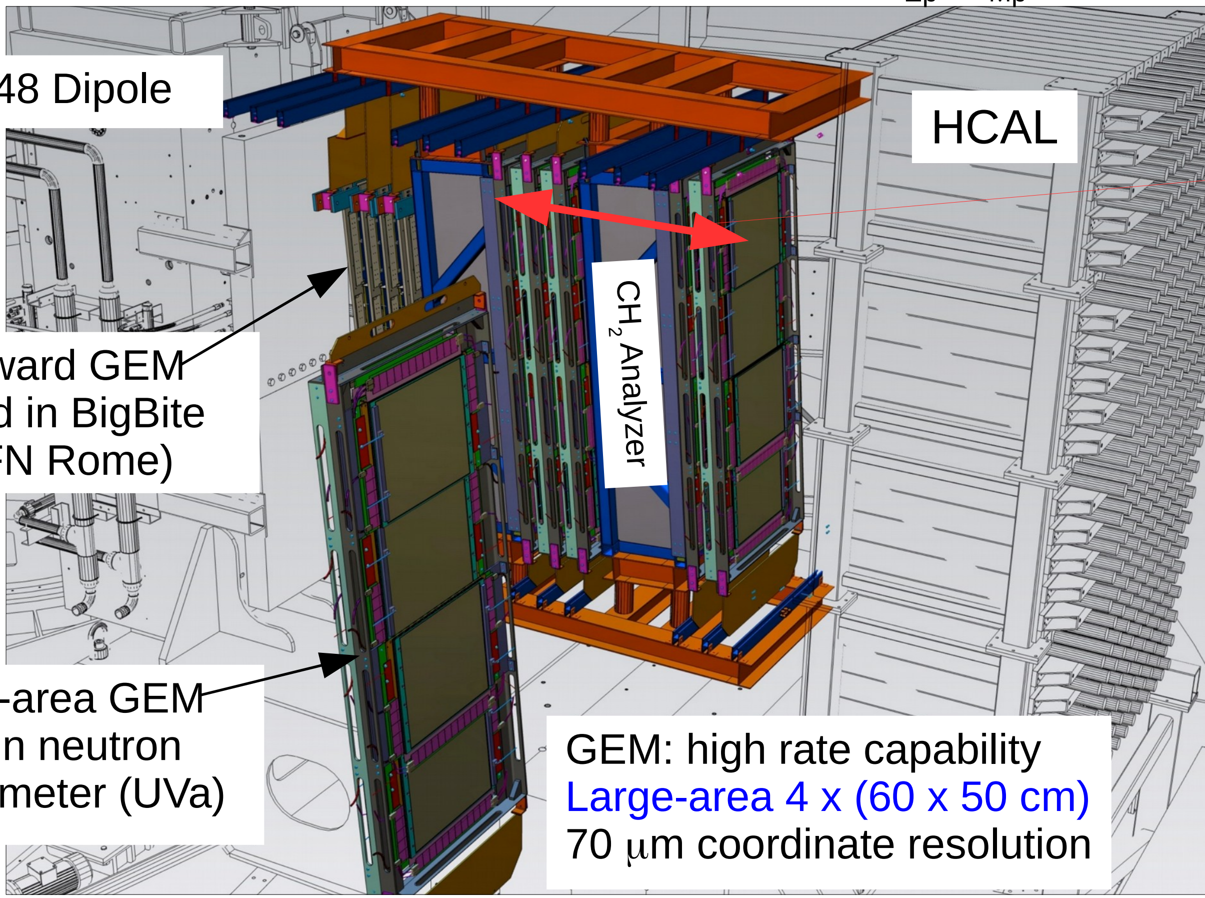
S. Riordan et al., PRL 105(2010), 262302.

Jefferson Lab experiment E02-013,

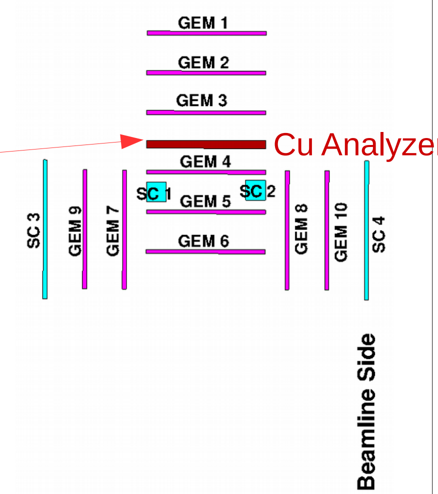
- In terms of Q^2 range and precision, neutron measurements lag way behind proton measurements
- For measurements in space-like domain at medium-high Q^2 JLab is the only viable lab. Use double-polarized, Quasi-elastic ^{2}H(e,e'n), ^{3}He(e,e'n)
- JLab: E12-09-016 G_{En}/G_{Mn} with polarized electron beam & ^{3}He target up to Q^2 of ~10 (GeV/c)^2
- Independent verification of results … alternative method with polarized electron beam, unpolarized ^{2}H target and polarimeter to measure polarisation transfer to recoiling neutron.
- QE signal much cleaner with ^{2}H target compared to ^{3}He
- ^{2}H recoil polarimetry experiment: neutron polarimeter FoM will limit the maximum Q^2 achievable
- New polarimetry technique, enable access to Q^2 ~ 10 (GeV/c)^2 ??

Neutron Polarimeter (GEM) Chambers

Proton polarimeter for E12-07-109 G_{Ep}/G_{Mp}



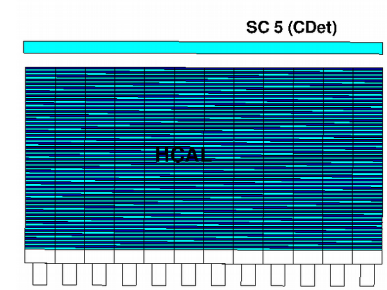
Plan view of neutron polarimeter



Analyzer block(s) removed for G_{Mn}/G_{Mp} cross-section run

Separate run for G_{En}/G_{Mn}

GEMs can be slid in/out of detector acceptance...possibly useful for G_{Mn}/G_{Mp}



Neutron polarimeter employs charge exchange n-p scattering

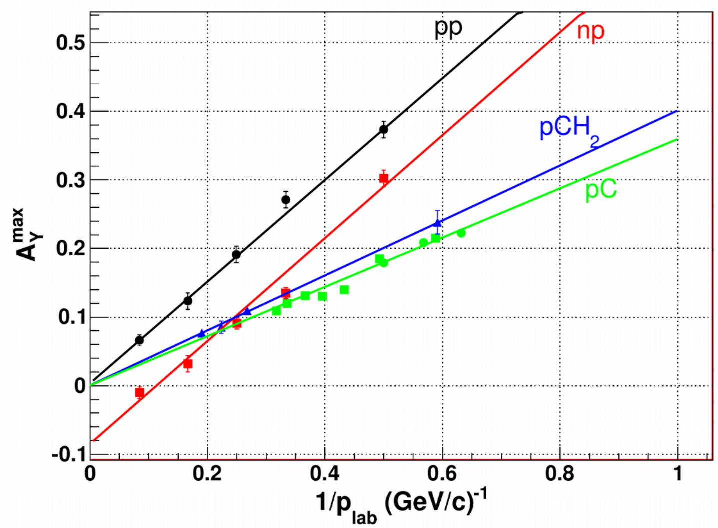
Cu analyzer, compact longitudinally, high A_y

Use same GEM and HCAL as E12-07-109 (G_{Ep}/G_{Mp})

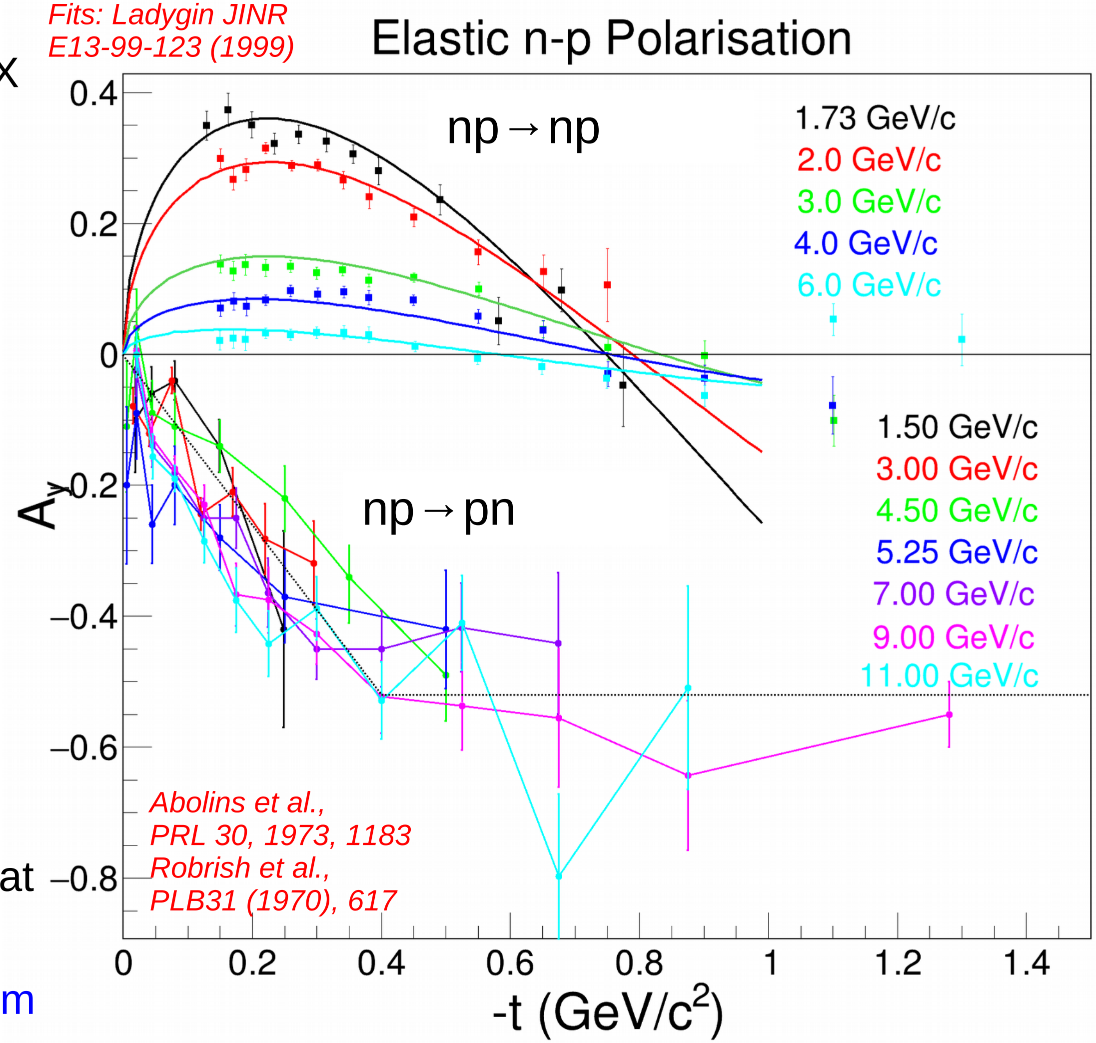
Geometry will be somewhat different to E12-07-109

n-p Elastic: Forward Neutron vs. Forward Proton

- A_y for pp→pp scales as $1/p_{lab}$
  np→np similar slope negative offset
- Until recently no data on n+C→n+p+X p_{lab}~several GeV/c (nor any nucleus)



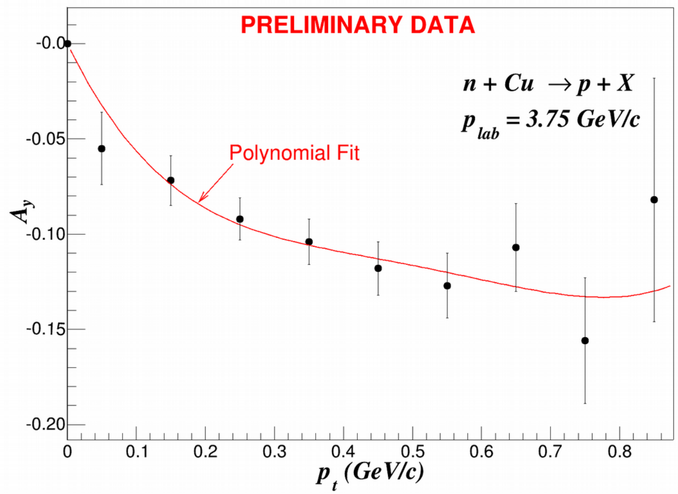
Diebold et al., PRL 35,(1975),632
Fits: Ladygin JINR E13-99-123 (1999)



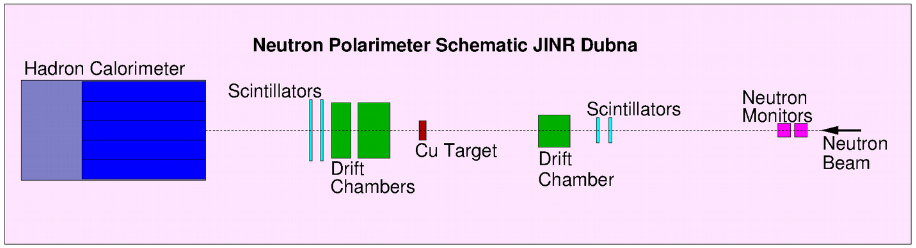
- A_y for np→np falling rapidly with increasing neutron momentum
- A_y for charge-exchange np→pn large at sufficiently large t (θ_p ~ few deg.)
- No apparent strong incident momentum dependence for charge-exchange A_y
- $\sigma_{np\to np}$ factor ~10 higher than $\sigma_{np\to pn}$

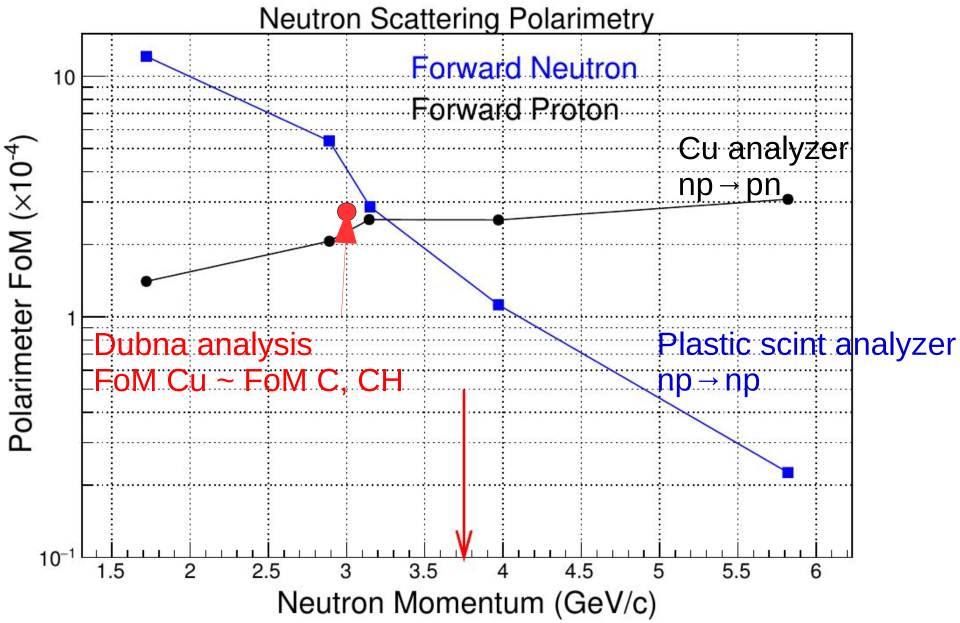
Polarized Charge-Exchange n-p on Nuclei Measured JINR Dubna 2016-7

JINR, Glasgow, IPN Orsay, CEA Saclay, W&M, NSU



Dubna polarimeter similar to SBS device





- JINR Dubna Nov 16 – Feb 17.
- Measure asymmetries polarized np→pn C, CH, CH_2, Cu Target
- p_{lab}: 3.0 – 4.2 GeV/c
- Extract A_y as a function of $p_t = p_{lab} \sin\theta$
- Cu asymmetry similar to C
- Use polynomial fit to Cu data to calculate FoM of SBS neutron polarimeter by MC

$$\mathcal{F}^2(p_n) = \int \varepsilon(p_n, \theta_n') \, A_y^2(p_n, \theta_n') d\theta_n'$$

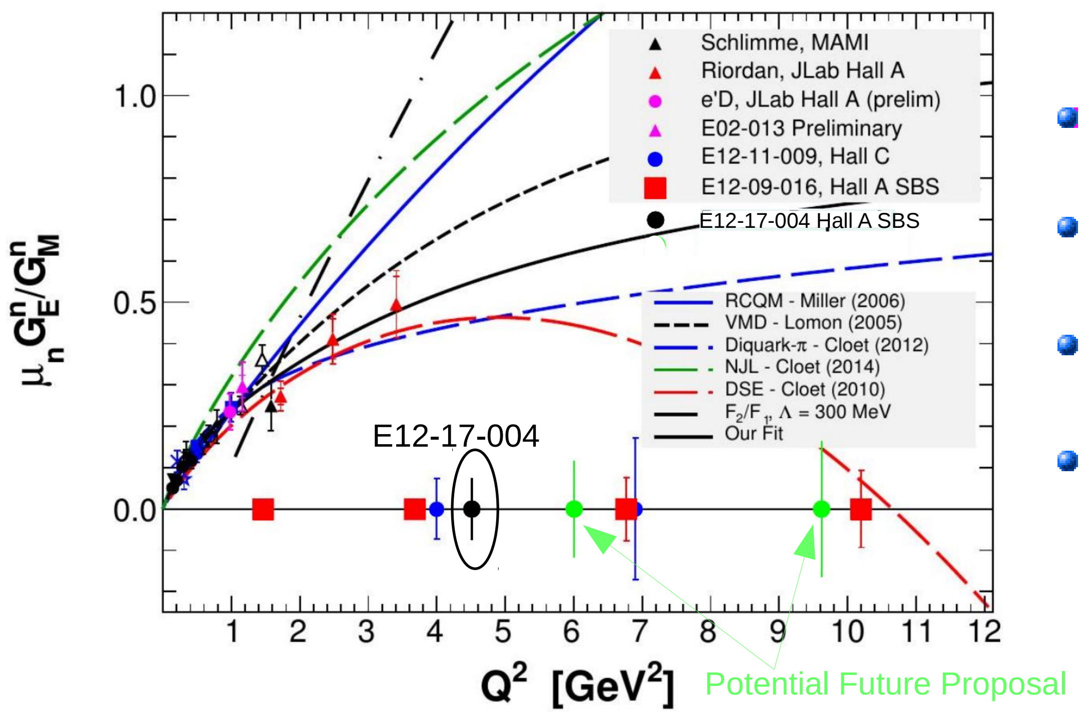
- Monte Carlo uses
- A_y free np→np: JINR fit to $\boldsymbol{p_n}$ and $\boldsymbol{t}$ dependence.Scale A_y by 0.5 for ^{12}C scattering (as in p+^{12}C case)
- A_y for np→pn on Cu: New measurement from JINR Assume A_y depends on p_t only, vis free np→pn scattering

E12-17-004 Precision @ L = 1.26 × 10^{38} $cm^{-2}s^{-1}$

Charge exchange np→pn on Cu Analyzer

$$\delta P = \sqrt{\frac{2}{N_{inc}\mathcal{F}^2}} \qquad R = \mu_n G_E^n / G_M^n$$

E_{beam} (GeV)	Q^2 $(GeV/c)^2$	p_n (GeV/c)	Rate (Hz)	FoM × 10^{-4}	Time (hr)	δP	δR
4.4	**4.5**	**3.15**	**48.8**	**2.53**	**100**	**0.019**	**0.078**
6.6	6.0	3.97	26.0	2.53	150	0.024	0.12
8.8	9.3	5.82	2.9	3.08	750	0.029	0.17



- Approved kinematic point PAC45, 2017 $Q^2 = 4.5\ (GeV/c)^2$
- Estimates from Geant-4 Monte Carlo model + Dubna measurement
- δR based on Glaster G_{En} and Kelly G_{Mn} EMFF parametrisation
- Expect overall systematic error in asymmetry measurement to be ~3.0%

Time Lines for Preparation of 1st SBS Experiments

- E12-09-019 Readiness Review (June 2017):
  Identified ~140 tasks towards putting SBS E12-09-019 on the floor in Hall A
  That does not include tasks to include neutron polarimetry apparatus
  for E12-017-004
- We now have 2018 and 2019 to finish construction, commissioning and testing … installation time on Hall A floor remains uncertain
- Much of the detector construction is complete
- Much of the design of support structures is complete
  but fabrication is on going
- General detail of power-supply & front-end electronics layout, cabling etc.
  quite a bit remains to be fully worked out and documented
- Slow control systems … need full documentation of power supply, HV etc.
- DAQ much work already on sub systems, but these will need to be tied together
- Commissioning and testing the sub systems to an acceptable performance level will be time consuming … the devil is in the detail
- Desireable to have a detailed schedule with milestones etc.
  Necessary effort requires to be further quantified...how much is available
  from the SBS collaboration and when ? (1st attempt B. Quinn 2017)

Summary

- E12-09-019 G_{Mn}/G_{Mp} will be the 1st SBS experiment to run in Hall A

  Underwent readiness review June 2017. Earliest start is 2020

  Approved for 31 days of beam
- E12-17-004 G_{En}/G_{Mn} by recoil polarimetry approved by 2017 PAC with A- rating.

  It will "piggy back" on a single E12-09-019 kinematic setting $Q^2 = 4.5$ (GeV/c)^2.

  It measurement successful return to PAC to request time for higher Q^2 .

  Currently approved for 5 days of beam.
- Good progress in constructing and testing the new SBS detector components, most of which are common to E12-09-019 and E12-17-004.
- **But still a great deal to do before 2020**

Thanks for your attention

Backup

Summary of Experimental Method

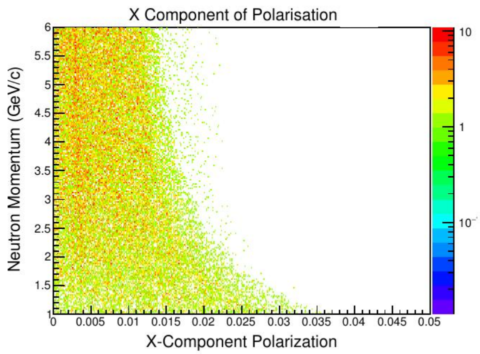
Obtain G_{En}/G_{Mn} for Q^2 of 4.5…..eventually up to ~ 9 $(GeV/c)^2$

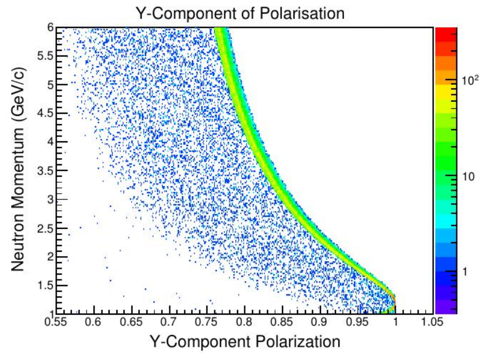
Measure double-polarised $^2H(\vec{e},e'\vec{n})p$

As opposed to E12-09-016 $\overrightarrow{^3He}(\vec{e},e'n)pp$

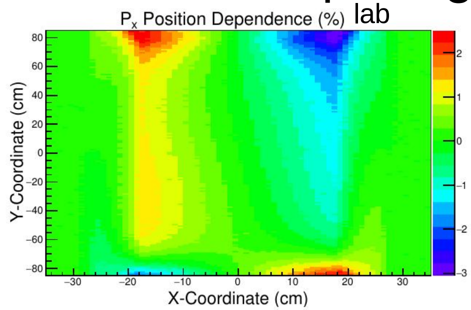
- Polarization ratio of final-state neutron $P_x/P_z \rightarrow G_{En}/G_{Mn}$ (precess $P_z \rightarrow P_y$ in dipole magnetic field)
- Cryogenic D_2 Target 10 cm long
- 40 μA 80% polarized electron beam, L = 1.26 x 10^{38} $cm^{-2}s^{-1}$
- BigBite e' detector (same configuration as E12-09-019 G_{Mn}/G_{Mp})
- SBS Neutron polarimeter: acceptance well matched to electron arm
  Polarimeter detects high-momentum, small angle protons
  produced by np→pn **AND** low-momentum large-angle protons produced by np→np
  scattering
- **Apart from polarimeter very similar to G_{Mn}/G_{Mp} E12-09-019 setup**

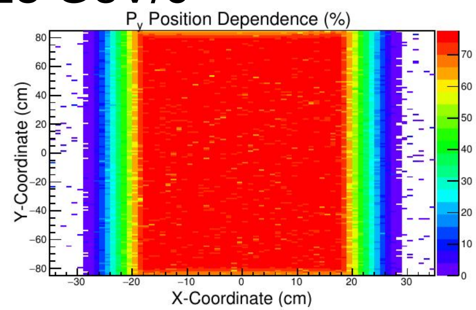
Spin Precession in 48D48 Dipole

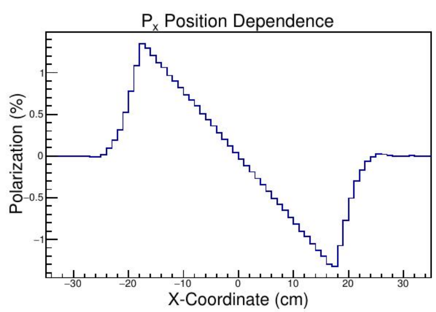


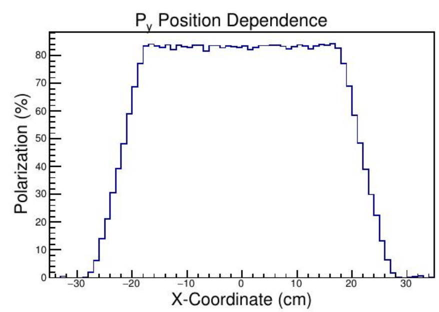


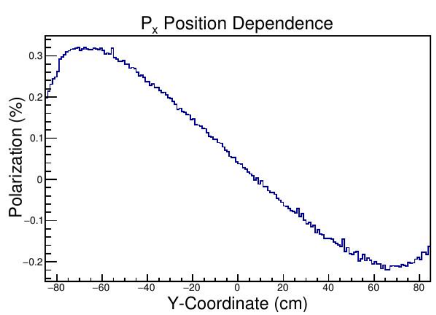
P_{lab} = 3.15 GeV/c

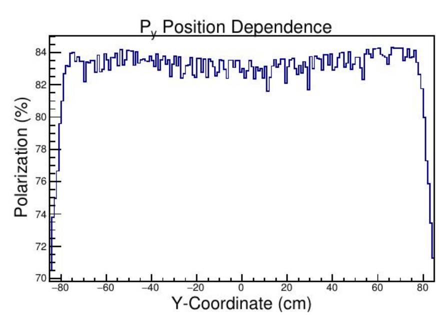








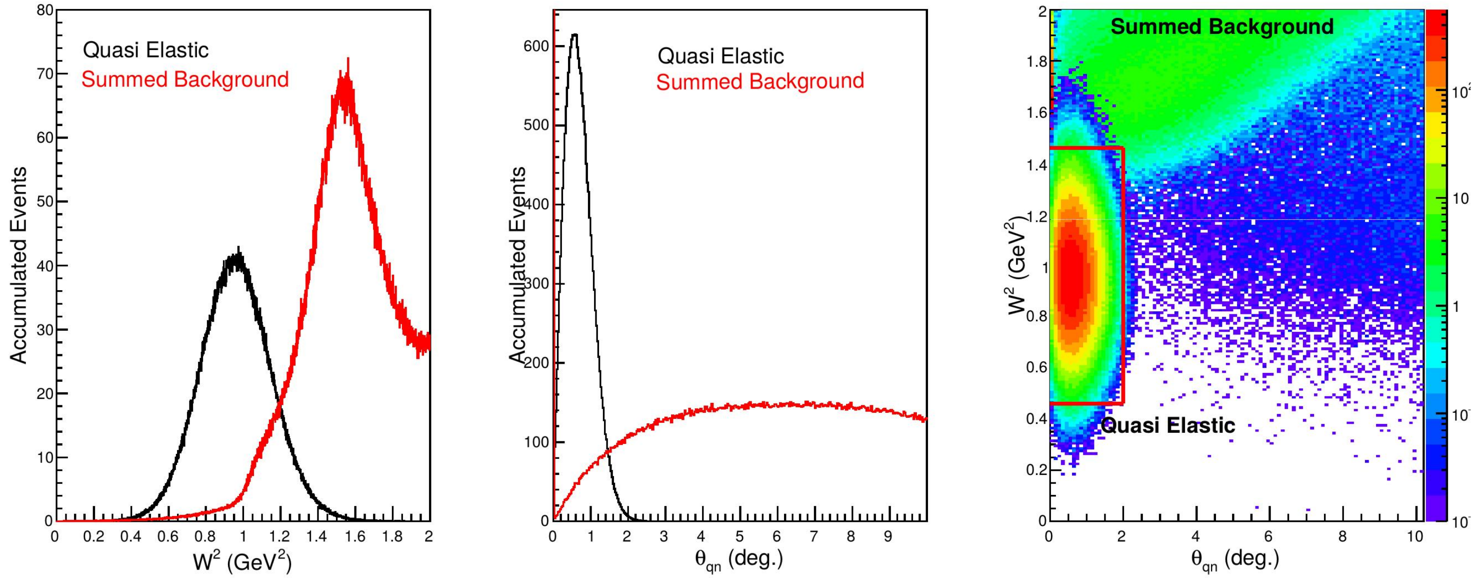




- Nucleon spin precession calculated in Geant-4.10 Earlier G4 have problems with neutron spin precession
- TOSCA field map, no field clamps fitted
- Start neutrons with spin (0,0,1) at target, track through dipole field, record spin components at analyser
- Max spin transfer z→ x ~3%
- Smoothly varying, can be corrected, polarimeter has good position resolution
- Max sys. error to P_x/P_z ~ 1%

$d(e,e'n)$ QE Signal Separation

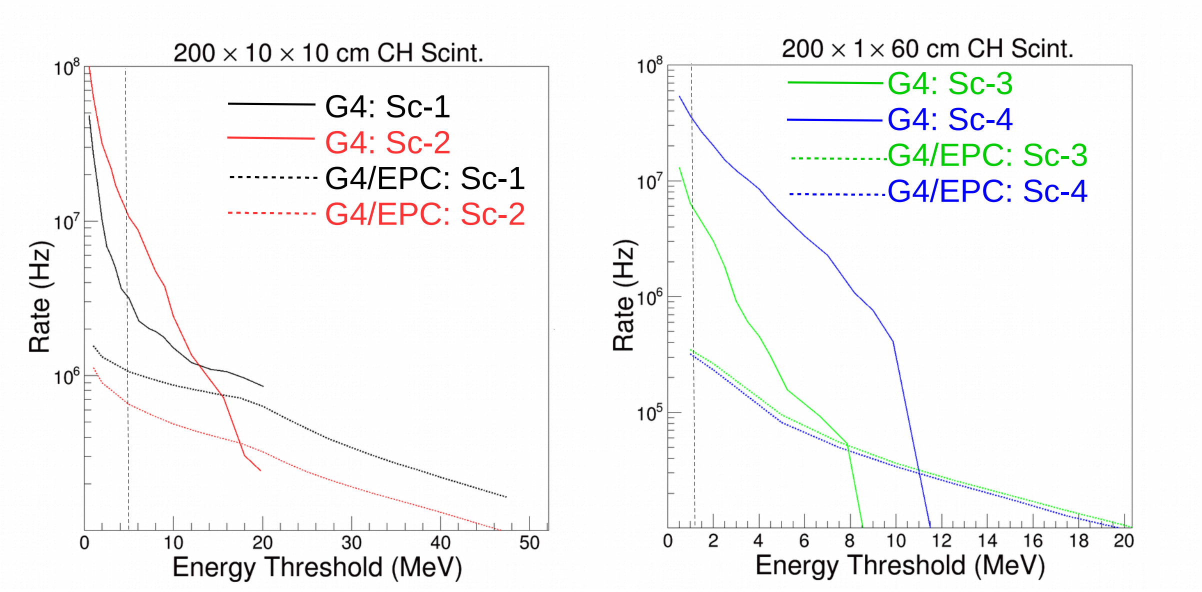
QFS: J. W. Lightbody and J. S. O'Connell, Computers in Physics 2(1988),57



- BigBite: clean separation of electrons from π^- (GRINCH and Preshower/Shower)
- Polarimeter: clean separation of d(e,e'n) from d(e,e'p) (front GEM)
- $d(e,e'n)$ QE signal has some contamination, mainly from pion electroproduction
- Use QFS code to calculate QE and non-elastic cross sections
  MC procedure folds in detector resolution effects
- Combination of W^2 and θ_{qn} to separate QE from non-elastic
- "Red-box" cut: 98.5% QE events accepted, non-elastic background 1.5% of QE strength
- Cleaner separation of QE for $d(e,e'n)$ compared to $^3He(e,e'n)$ (polarized target G_{En}/G_{Mn})

Preliminary: Large Angle Polarimeter Rates

Polarimeter: Large-Angle Scintillators



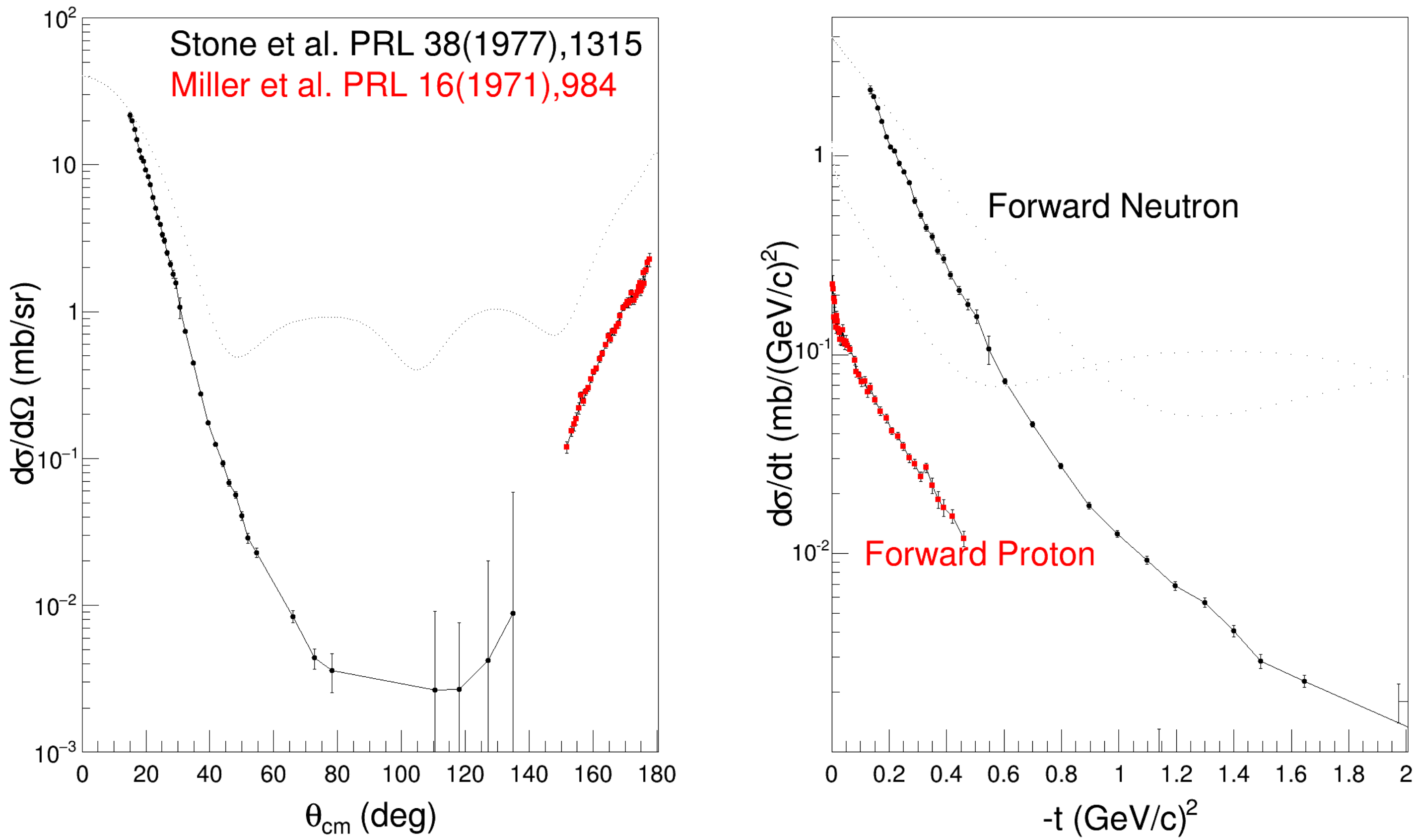
Scintillators will require to be segmented

- Calculations made with Geant-4
- 4.4 GeV electrons on 10 cm D_2, use G4 electromagnetic and hadronic physics models to sample produced particle types and 4-momenta
  Need huge number of events to obtain reasonable hadron sample
- Use code EPC to calculate differential cross section $\sigma(p,\theta)$ for p,n,π^0,π^-,π^+ electro production
  In G4 use these to generate particles at the target position and then track through BB/SBS

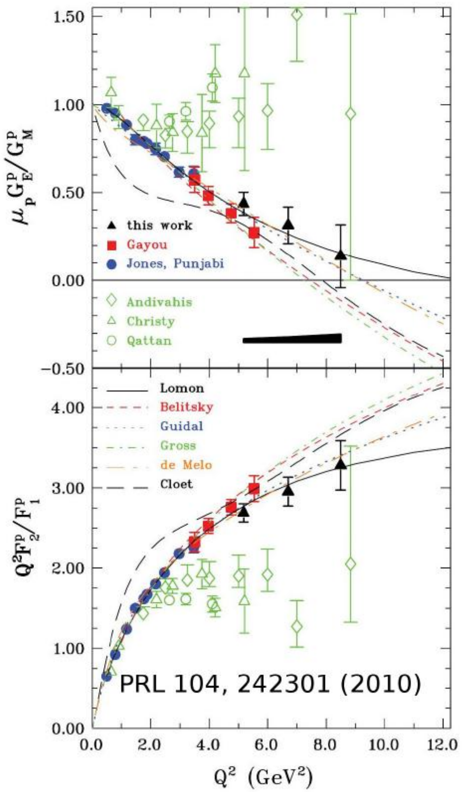
EPC: J. W. Lightbody and J. S. O'Connell, Computers in Physics 2(1988),57

n-p Elastic Cross Section

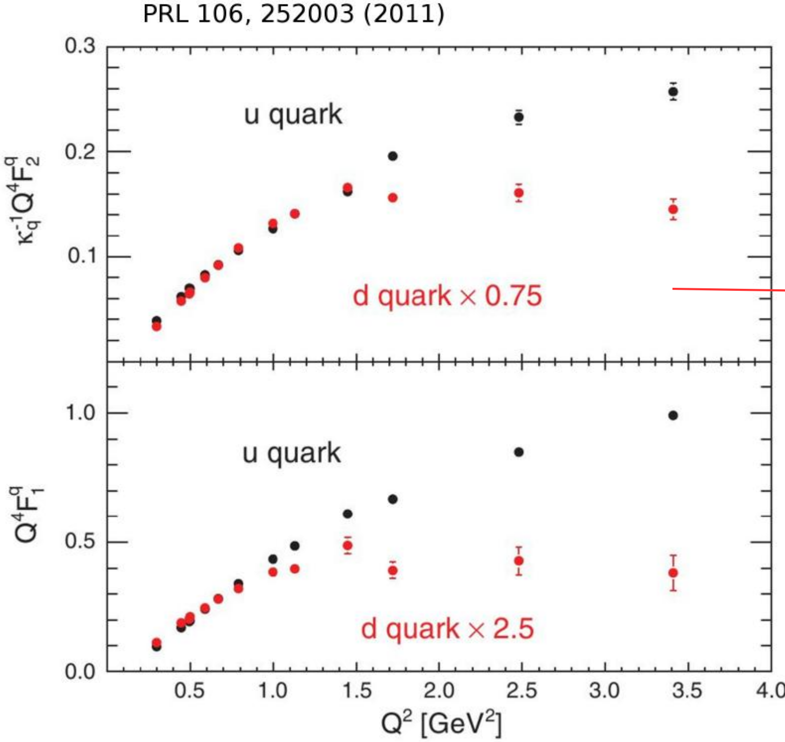
p_{lab} = 5 GeV/c



Scaling of EM Form Factors



Flavor-separated
u/d distributions



Present measurement will extend separation to $Q^2 = 4.5 (\mathrm{GeV}/c)^2$

No RP data with ^{2}H target
$Q^2 > 1.5$ (GeV/c)^2

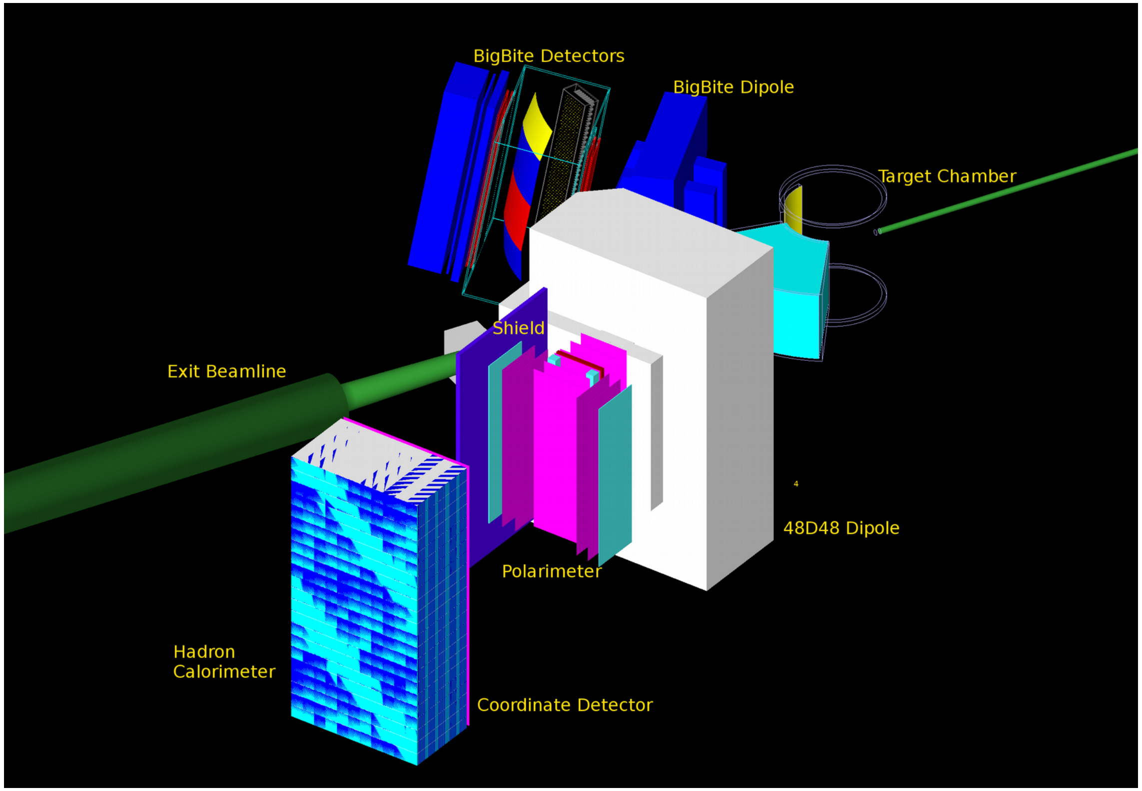
$$G_E = F_1 - \tau F_2 \qquad G_M = F_1 + F_2 \qquad F^u_{1,2}(Q^2) = F^n_{1,2} + 2F^p_{1,2} \qquad F^d_{1,2}(Q^2) = 2F^n_{1,2} + F^p_{1,2}$$

Most cited JLab publication: M.Jones et al., PRL 84(2000),1398

Double polarized experiments show that $\mu_p G_{Ep} \neq G_{Mp}$

u/d flavour separation….quite different u,d dependence on Q^2

diquark configuration?



The Geant-4 Model

- Geant4.10.03: add ϕ dependence polarised nucleon elastic and QE scattering
- Record signal amplitude and time from each detector element.
- Analyse simulated data as in real experiment.
- Calculate element rates 4.4, 6.6, 8.8 GeV, 40 μA on 10 cm LD_2
  ($\mathfrak{L}$ = 1.26 x 10^{38} $cm^{-2}s^{-1}$)
- Simulate n-p scattering processes in polarimeter….angle resolution, acceptance efficiency
- Reconstruct polar, asimuthal angles….ϕ distributions give effective analyzing power of polarimeter

G_E/G_M using Recoil Polarimetry

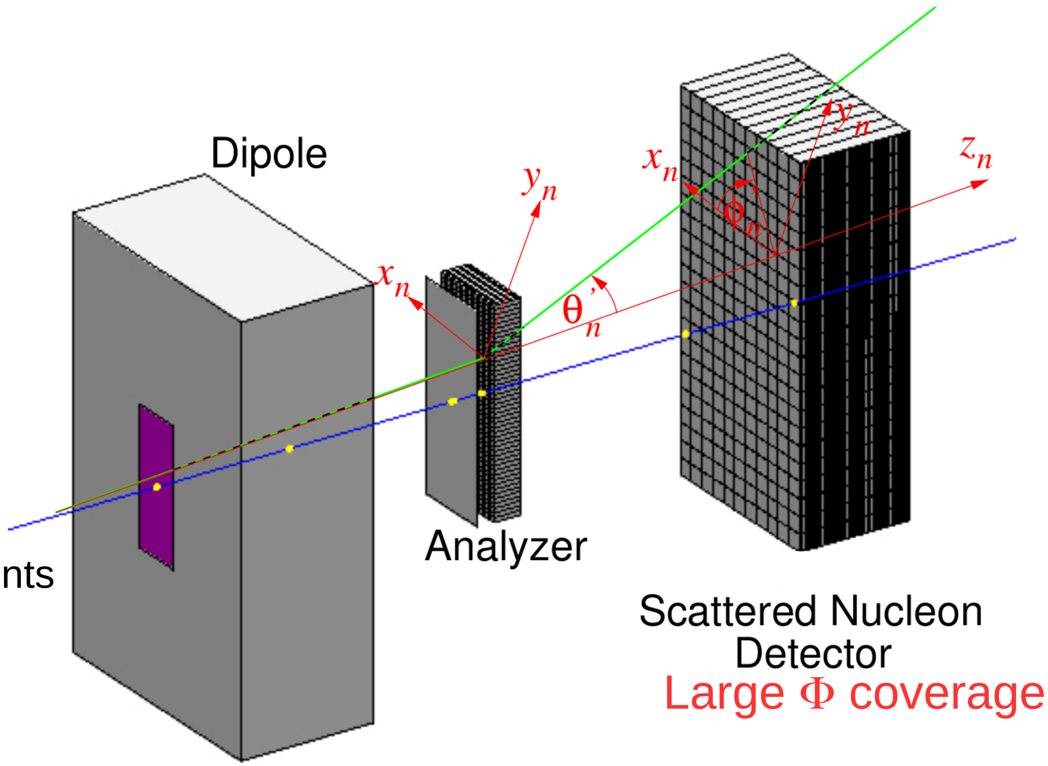
A.I.Akhiezer et al., JEPT 33 (1957),765
R.G.Arnold, C.E.Carlson and F.Gross, Phys.Rev. C23(1981),363

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

$$P_y = 0$$

$$P_z = hP_e \frac{2\tau\sqrt{1+\tau+(1+\tau)^2\tan^2\frac{\theta_e}{2}}\tan\frac{\theta_e}{2} G_M^2}{G_E^2 + \tau G_M^2 (1 + 2(1+\tau)\tan^2\frac{\theta_e}{2})}$$

$$\frac{P_x}{P_z} = \frac{1}{\sqrt{\tau + \tau(1+\tau)\tan^2\frac{\theta_e}{2}}} \cdot \frac{G_E}{G_M}$$



Recoil Polarimetry...

N-N scattering $V_{so}(\boldsymbol{l.s})$ →

ϕ dependence → transverse polarisation components

$$\sigma(\theta'_n, \phi'_n) = \sigma_\circ \left(1 + P_e \alpha_{eff} \left[P_x^n \sin\phi'_n + P_y^n \cos\phi'_n\right]\right)$$

Precession angle of nucleon P_z through dipole

$$\chi = \frac{2\mu_N}{\hbar c \beta_N} \int_L B.dl$$

Integrated Field ~2 Tm: $\chi \rightarrow 70°$ as $\beta_n \rightarrow 1$

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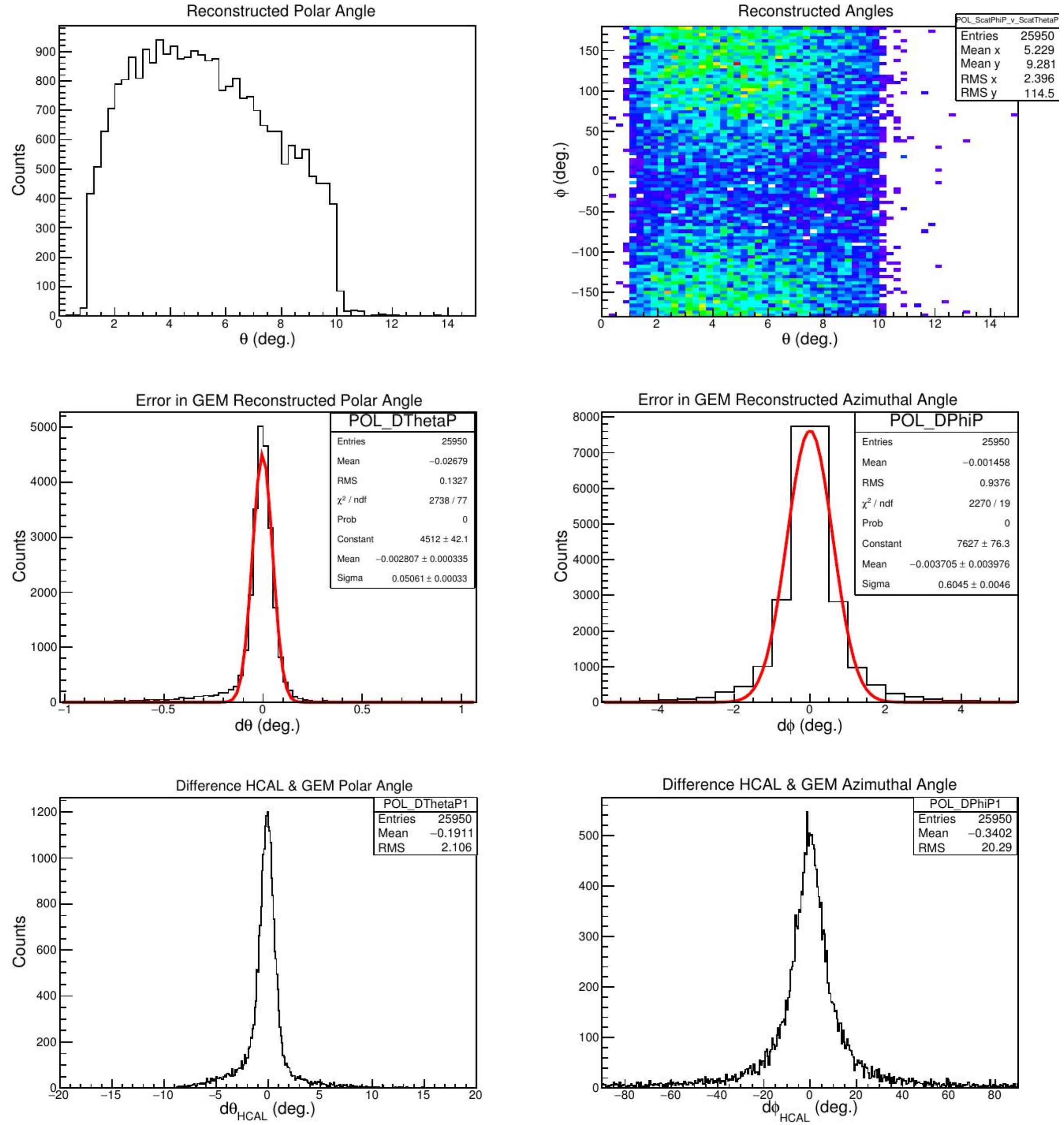
Forward Proton Angle Reconstruction by GEM

- Reconstruct analyzer hit position and proton angle using GEM position info.
  σ_θ ~ 0.05 deg.
  σ_ϕ ~ 0.6 deg.
- Select polar scattering angle... optimum range depends on p_{lab}
- Select calorimeter energy deposit > ½ peak channel
- Polarimeter detection efficiency ~3%
- Polarimeter similar to Dubna setup...expect similar effective analyzing power



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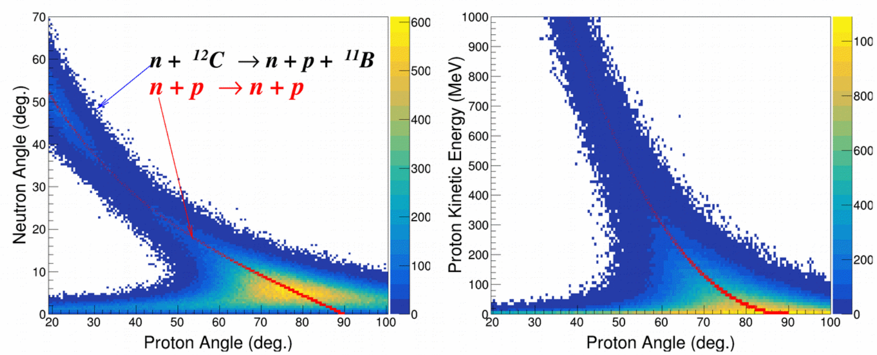
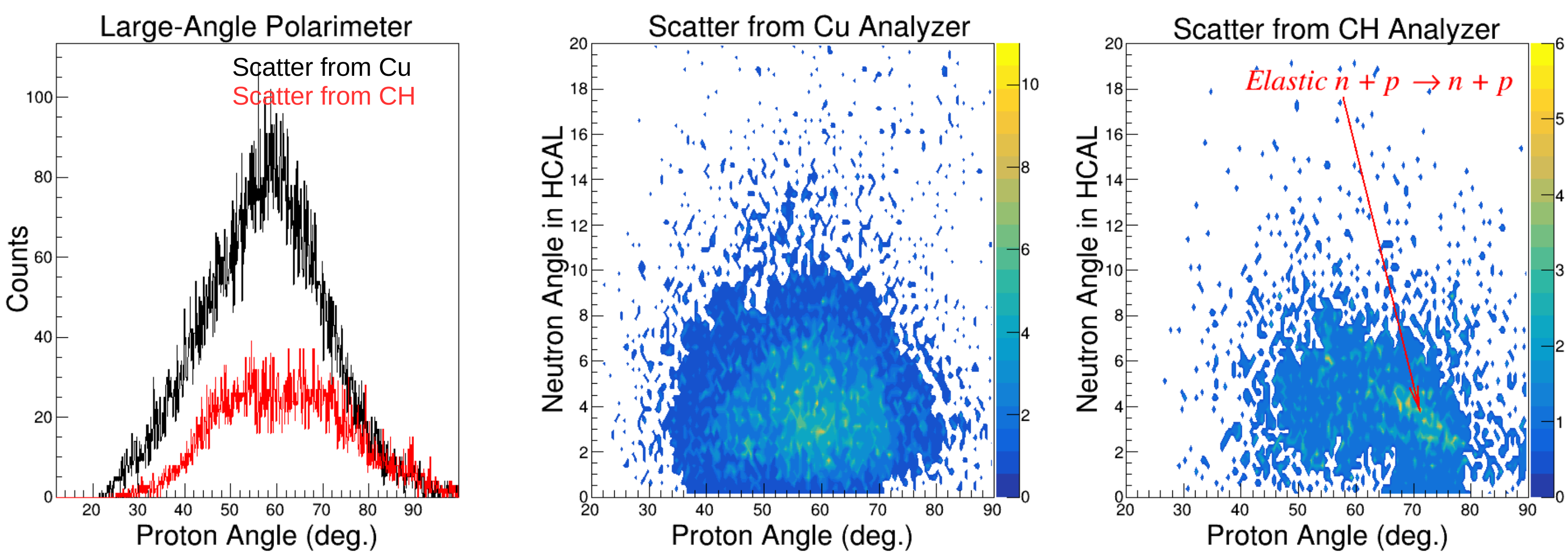
Large-Angle-Proton Polarimetry

Incident Neutron Momentum 3.15 GeV/c
Fermi smearing of proton angle



- QE n-p scattering from ^{12}C or ^{57}Cu
  Fermi smearing of large-angle recoiling proton
- ~1% incident neutrons scatter in Cu making detected large angle proton track
- ~0.4% neutrons scatter in CH making detected large angle proton track
- ~25% of detected large-angle protons have coincident energetic neutron in HCAL

Geant-4 Calculation 3.15 GeV/c Incident Neutrons



Hadron Arm Tracking Detector Rates

4.4 GeV electrons 10 cm D_2 target

Detector	Rate kHz/cm^2
GEM 1	62
GEM 2	63
GEM 3	62
GEM 4	11
GEM 5	11
GEM 6	14
GEM 7	9
GEM 8	27
GEM 9	5
GEM 10	19
CDet 5	30

- GEM rates mainly from soft photons
  Rates factor ~10 lower than G_{ep}/G_{mp}
- Beamline shield reduces rates in side detectors
- Well defined ***q*** vector from BigBite
  Fermi-smeared QE nucleon "spot" @ analyzer area ~ 100 cm^2 →
  GEM rate within spot ~1.5 MHz
- ~5% chance GEM accidental hit
  if Δt ~ 35 ns (GEM σ_t ~ 6 ns)
- Clean track reconstruction expected

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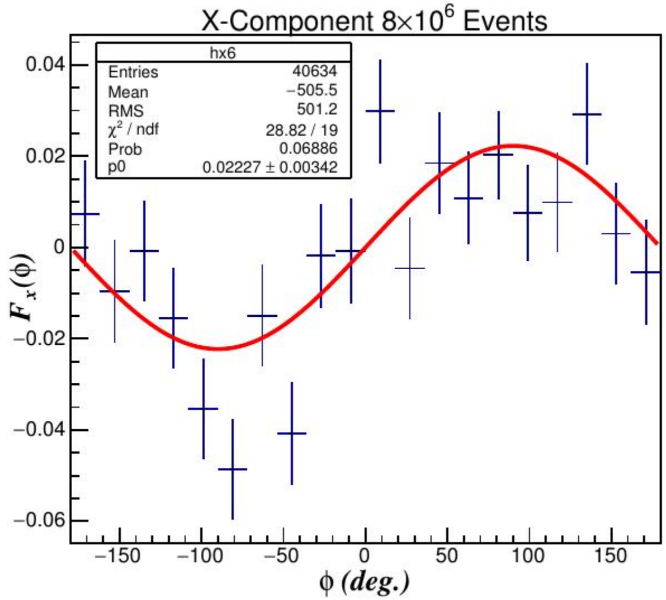
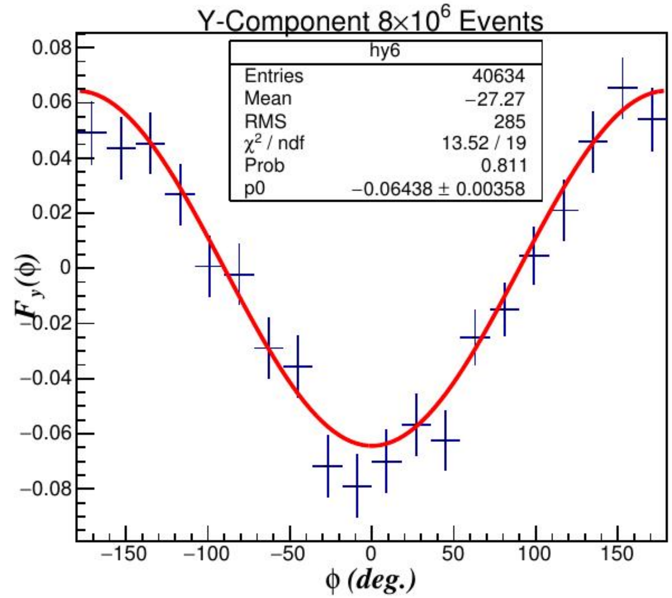
Obtaining Polarisation Components $P_x P_y$

$$\sigma(\theta_n, \phi_n) = \sigma(\theta_n)\left\{1 + P_e A_y^{eff}(P_x \sin\phi_n + P_y \cos\phi_n)\right\}$$

8×10^6 simulated events, p_{lab} = 3.15 GeV/c

Proposed data point: 18×10^6 incident neutrons





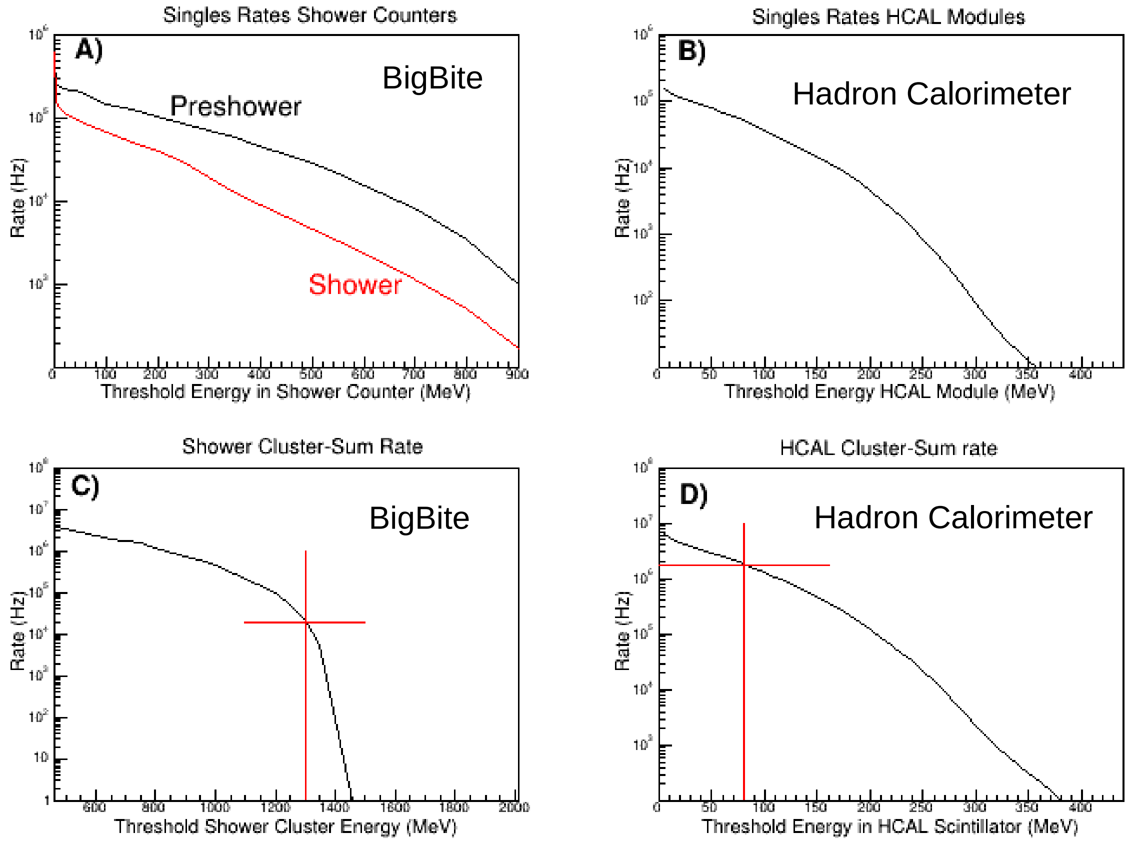
- 4 Comb. beam helicity, SBS dipole polarity —— $F(\phi_n) = C\{1 \pm |P_x^*| \sin\phi_n \pm |P_y^*| \cos\phi_n\}$
- Unpolarized Distribution —— $C = F_{++} + F_{--} + F_{+-} + F_{-+}$
- Polarized Distributions —— $F_x = (F_{++} - F_{-+} + F_{+-} - F_{--})/C$

  $F_y = (F_{++} - F_{+-} + F_{-+} - F_{--})/C$

- Effective analyzing power of polarimeter ~$0.9 \times A_y$ for $np \rightarrow pn$ scattering
- Its the same for x and y polarisation components
- Dilution: no significant dependence on p_{lab}

Trigger Rates @ 40 μA on 10 cm D_2

Applies both to E12-09-019 and E12-17-004



- Cluster-sum rate in BigBite Pb-Glass
  ~ 20 kHz at threshold of 1.3 GeV (65% $E_{e'}$)
- Cluster-sum rate in HCAL
  ~ 1.7 MHz at threshold of 0.5 E_{peak} for 3 GeV/c nucleons
- BigBite-HCAL coincidence rate for Δt ~ 50 ns: **1.7 kHz**
- DAQ should handle 5 kHz comfortably

PAC Response to LOI12-15-003
(the precursor to PR12-17-004)

Issues: The TAC raised a number of issues including high rate for the DAQ and backgrounds in the neutron arm. The proposed method in general is the same as what is proposed in the already approved E12-11-009, and the proposed improvement in the FOM of the recoil neutron polarimeter if demonstrated will benefit E12-11-009. There is also an approved Experiment E12-09-016 using a polarized 3He target which allows for an extraction of the neutron electric form factor in excess of Q2=10 (GeV/c)2 . While the PAC believes in the importance of extending the GnE determination from the deuteron to a Q2 value comparable to that of E12-09-016, the PAC does not believe there should be parallel efforts in pursuing the same experimental technique.

Recommendation: The proponents are encouraged to work with the lab management and the E12-11-009 collaboration to improve the FOM of the recoil neutron polarimeter in order to optimize the measurements using the already approved beam time of E12-11-009.

- Discussions with CGEN group who proposed E12-11-009
  B. Sawatzky and M. Kohl have joined PR12-17-004 as co-spokespersons
  W. Tireman has joined PR12-17-004 as collaborator
- Request 100 hr for 1 data point @ Q^2 = 4.5 $(GeV/c)^2$
  Identical kinematics to Q^2 = 4.5 $(GeV/c)^2$ G_{Mn}/G_{Mp} point (SBS experiment E12-09-019)
- Configure SBS neutron polarimeter to measure both np→pn and np→np scattering channels...include detectors for large-angle, low-momentum protons, additional to small-angle, high-momentum proton detector
- Compare polarimetry FoM np→np and np→pn
  Use results to optimize polarimetry at higher Q^2 (up to 9.3 $(GeV/c)^2$)