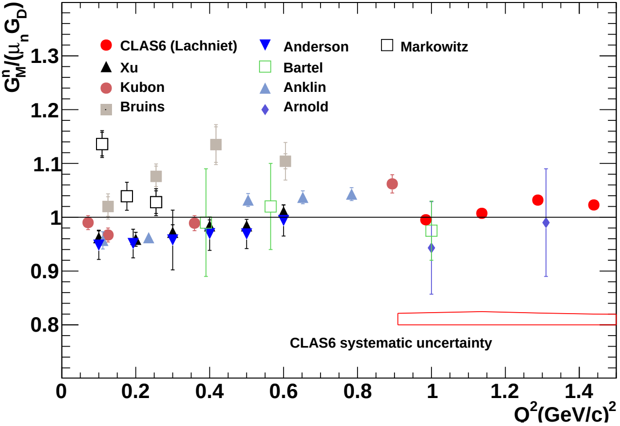
Tension in Low-Q^2 G_M^n measurements



Experiments used ratio method unless noted otherwise.

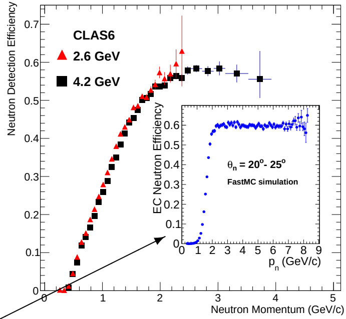
Author	Reference	NDE Method	Author	Reference	NDE Method
Lachniet	PRL 102, 192001 (2009)	$^1H(e,e'\pi^+n)$	Anderson[1]	PRC 75, 034003 (2007)	NA
Xu[1]	PRC 67, 012201 (2003)	NA	Bartel	NP B58, 429 (1973)	$^1H(\gamma,\pi^+n)$
Kubon	PLB 524, 26 (2002)	$^1H(n,p)n$	Anklin	PLB 336, 313 (1998)	$^1H(n,p)n$
Arnold[2]	PRL 61, 806 (1988)	NA	Anklin	PLB 426, 248 (1998)	$^1H(n,p)n$
Bruins	PRL 75, 21 (1995)	$^1H(\gamma,\pi^+)n$	Markowitz[3]	PRC 48, R5, (1993)	$^2H(\gamma,np)$

1 - $^3\vec{He}(\vec{e},e')$ 2 - $^2H(e,e')$ 3 - $^2H(e,e'n)$

Neutron Detection Efficiency Method

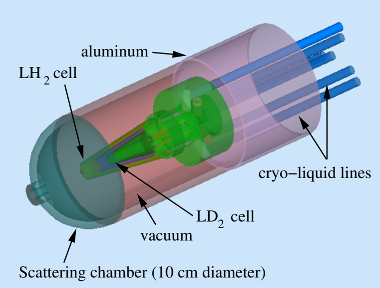
1. Use the $ep \rightarrow e'\pi^+ n$ reaction from the hydrogen target as a source of tagged photons in the FTOF and the ECAL.
2. For electrons use CLAS12 tracking. For π^+, use positive tracks, cut on the difference between β measured from tracking and from the time-of-flight to reduce photon background.
3. For neutrons, use $ep \rightarrow e'\pi^+ X$ for $0.9 < m_X < 0.95\ GeV/c^2$.
4. Use the predicted neutron momentum $\vec{p}_n$ to determine the location of a hit in the fiducial region and search for that neutron.
5. The CLAS6 G_M^n results.
6. GSIM12 simulation results for CLAS12 are shown in the inset. Proposed measurement will extend to higher momentum where the efficiency is stable.

Calorimeter efficiency

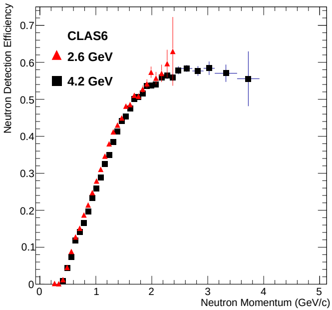


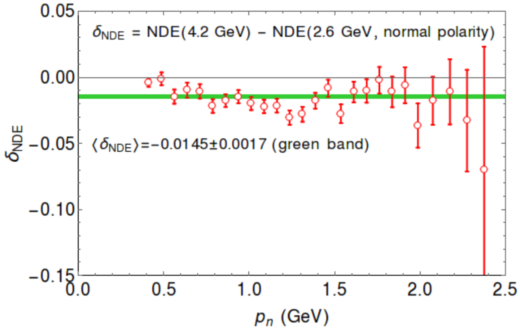
Conceptual Target Design

1. Modeled after E5 target used in CLAS6 G_M^n measurement.
2. Dual target cell with two, 2-cm cells containing liquid hydrogen and deuterium.
3. The hydrogen cell is downstream and separated from the deuterium target by 1.0-cm gap.
4. Enables us to perform in situ calibrations during data collection.



CLAS6 G_M^n E5 results for the EC





CLAS6 EC Energy Stability (Nathan Baltzell)

Run-Dependent EC Sampling Fraction

- During data quality checks, we found systematic drops in detectors' energy response
  - EC, SC, IC in coincidence
- ~10% of data affected, but only significant effect is on energy

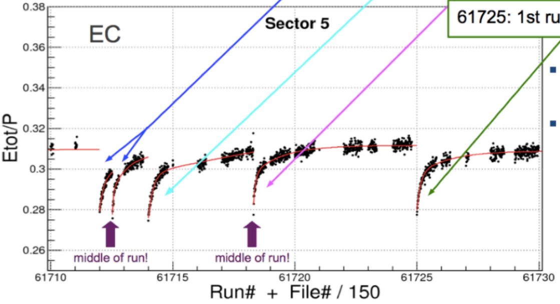
$$E_0 - A\left[e^{-\alpha(t-t_0)} + e^{-\beta(t-t_0)}\right]$$

61712: "beam went crazy . . . dying. Stopped run [61711]. . . . Started new run. . . ." No beam for a few minutes ~1 hour before end of run.

61714: First run after beam down for over 8 hours.

61718: Dips at file #45, which happens to be when HV trips in logbook and MCC performs beam checks.

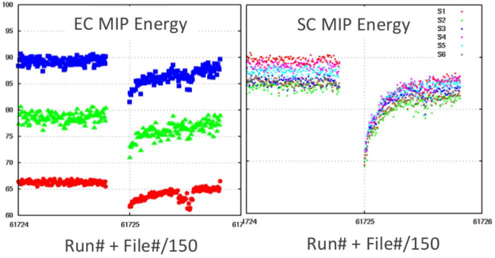
61725: 1st run after beam down for ~1.5 hours.

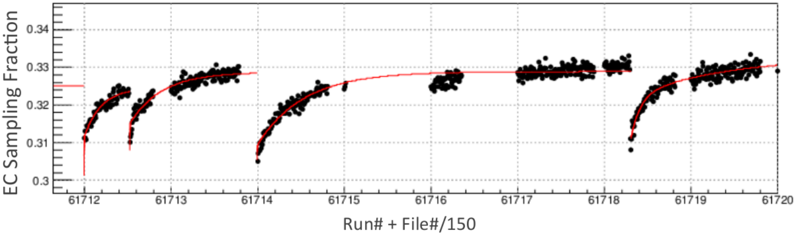


- Correlated with online logbook entries regard beam down/bad
- Saturation, corroborated by correlation with PMT type
  - The more EMI tubes in each sector, the stronger the effect
  - Philips XP show small effect

CLAS Energy Run-Dependence

- During data quality checks, we found systematic drops in detectors' energy response
  - EC, SC, IC in coincidence
- ~10% of data affected, but only significant effect is on energy





Neutron Detection Efficiency Systematic Uncertainties

Systematic Uncertainties - Summary

Quantity	$\delta G_M^n / G_M^n \times 100$	Quantity	$\delta G_M^n / G_M^n \times 100$
Neutron efficiency parameterization	< 0.7(1.5)	θ_{pq} cut	< 1.0(1.7)
proton σ	< 1.5(1.5)	G_E^n	< 0.7(0.5)
neutron accidentals	< 0.3	Neutron MM cut	< 0.5
neutron proximity cut	< 0.2	proton efficiency	< 0.4
Fermi loss correction	< 0.9	Radiative corrections	< 0.06
Nuclear Corrections	< 0.2		

Summary of expected systematic uncertainties for CLAS12 G_M^n measurement ($\Delta G_M^n / G_M^n = 2.4\%$(2.7)). Red numbers represent the previous upper limits from the CLAS measurement.

CLAS6 G_M^n E5 results for the EC