

Hall A/C Status

JLab Open House on June 8, 2024



Josh Crafts, CUA grad, and the NPS calo



Whit Seay, Hall A engineer, explaining about the CLEO magnet to be used in SoLID



Sanghwa Park, Hall A/C staff, demonstrating principles of a spectrometer



Bill Henry, Hall A/C staff, and the ^3He target poster



Chandan Ghosh, Hall A/C staff, demonstrating scintillators

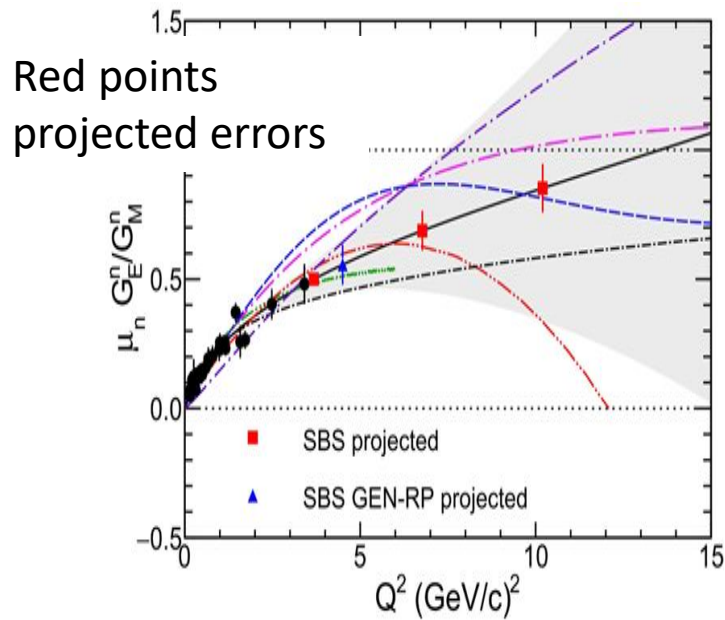


Ciprian Gal, Hall A/C staff, discussing the MOLLER experiment.

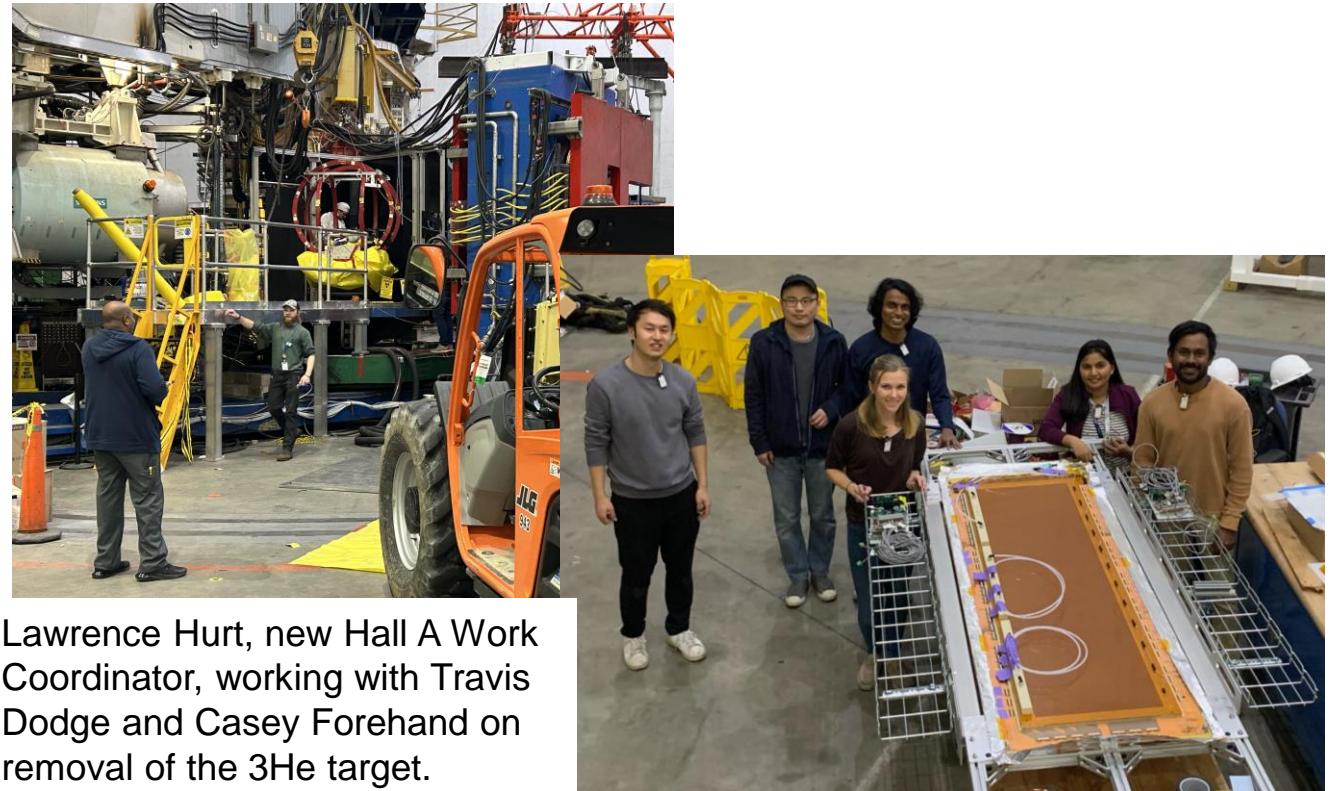
Mark Jones, Hall A/C Group Leader, PAC52 meeting , July 2024
Bob Michaels, Hall A/C Deputy Group Leader

Hall A: Completed Neutron G_E/G_M by Beam-target Asymmetry on polarized ^3He experiment

- Started in Oct 2022
 - Fall 22, Completed $Q^2= 2.9$ and 6.6 GeV^2
 - Started $Q^2 = 9.9 \text{ GeV}^2$ in Jan-Mar 2023
 - Sept/Oct 2023 Completed $Q^2 = 9.9 \text{ GeV}^2$
- Polarized ^3He target
 - First time running with 60cm long ^3He cell
 - 50-55% polarization in beam!



- Nov 3, Ready to start Wide-Angle Charged Pion Photoproduction (A_LL) on ^3He
 - Leak found in the Hall A dump pump station. Cancelled A_LL experiment
 - Leaks fixed in Jan 2024
- Changeover for GEN-RP. Remove the ^3He target, install cryo target, setup SBS

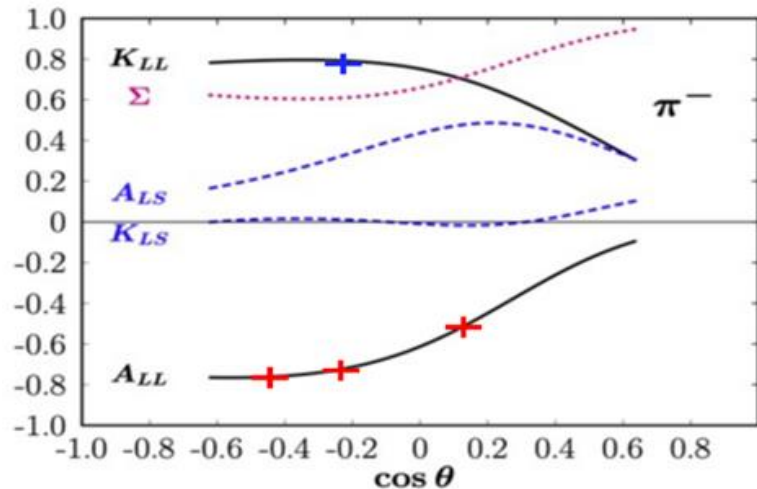
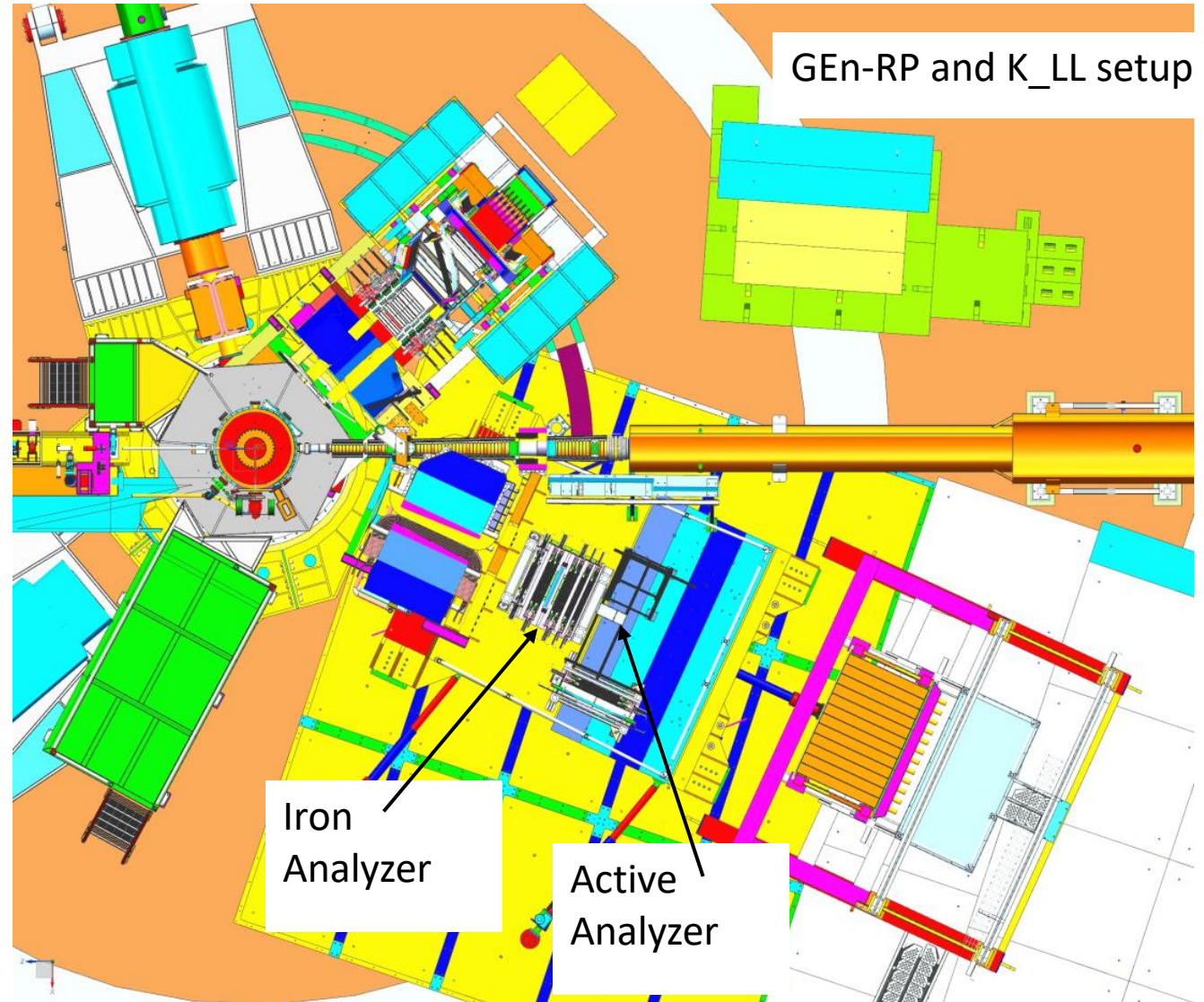


- Lawrence Hurt, new Hall A Work Coordinator, working with Travis Dodge and Casey Forehand on removal of the ^3He target.

Taiga, Xinzhan, Vimukthi, Holly, Saru and Bhasitha getting ready to prepare new GEM chamber from UVA for the GEN-RP experiment

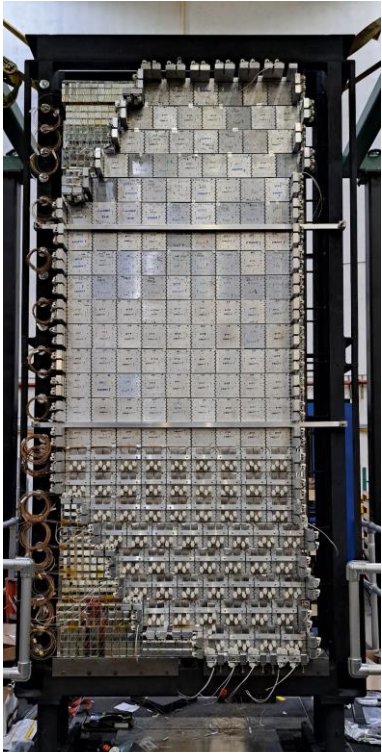
Hall A: GEn-RP and K_LL ran in April/May 2024

- Measurement of the Ratio GEn/GMn at $Q^2 = 4.5$ by the Double-polarized d(een) Reaction
 - Outgoing neutron polarization measured by charge exchange with iron analyzer
 - Additional polarization measurement using the side detectors and 32 channel active analyzer
- Polarization Transfer in Wide-Angle Charged Pion Photoproduction (K_LL)

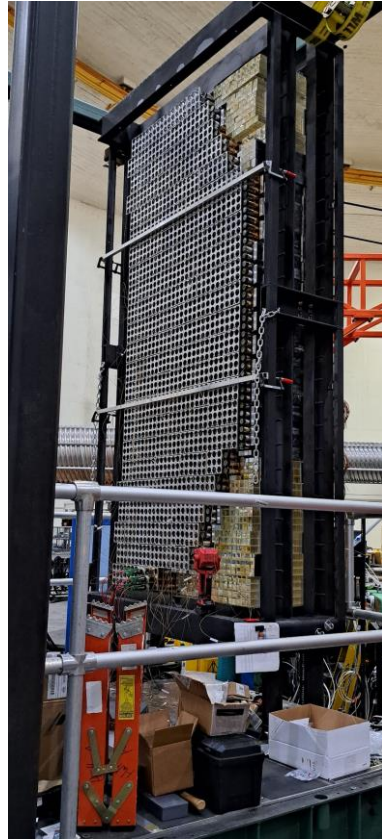


Hall A Next Run period: Proton electric form factor

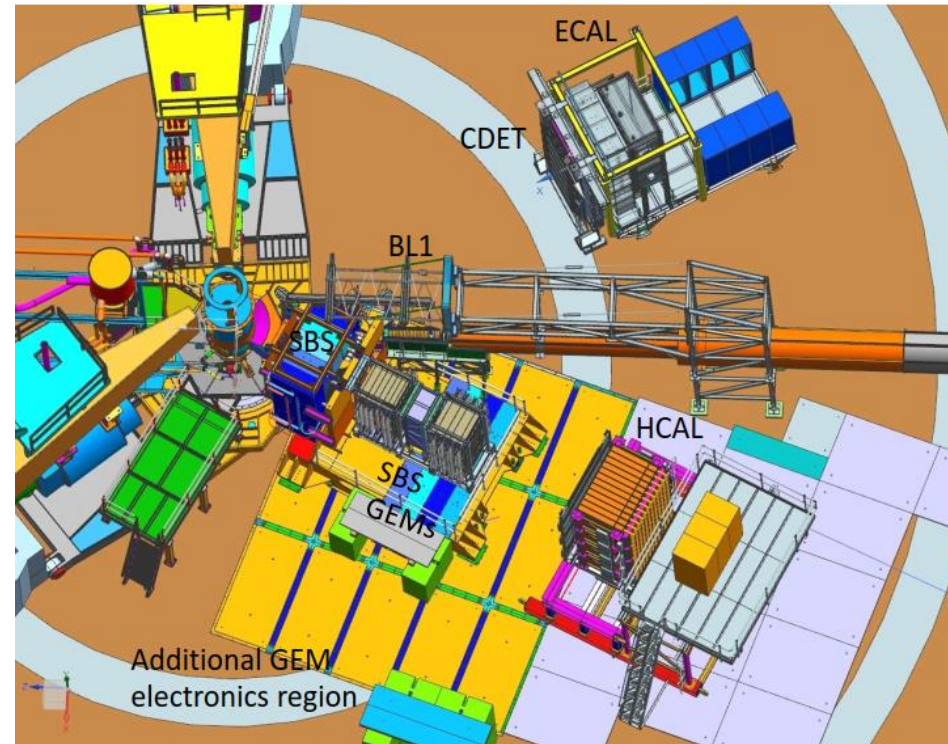
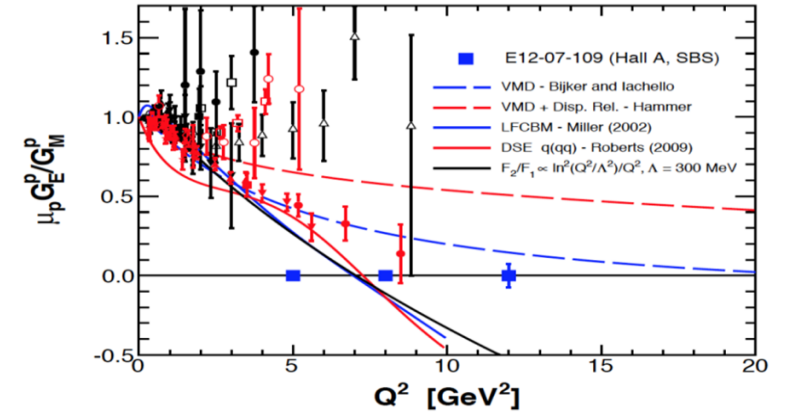
- Measure G_E^p by measuring recoil proton polarization in elastic scattering
- Currently deinstalling BigBite, installing ECAL and SBS GEMs
- Measure to $Q^2 = 12 \text{ GeV}^2$



ECAL Front view.
All Supermodules
(1700 blocks) installed.
Installing heaters

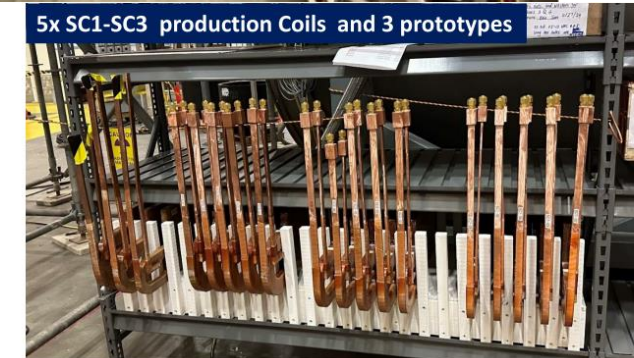
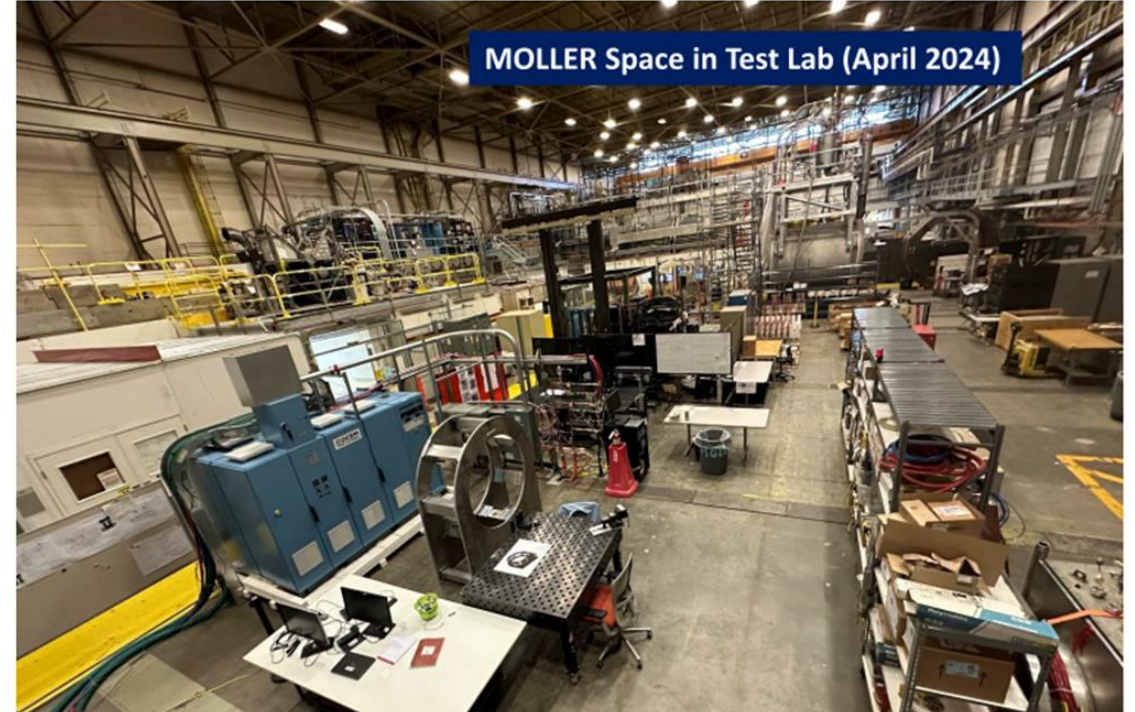
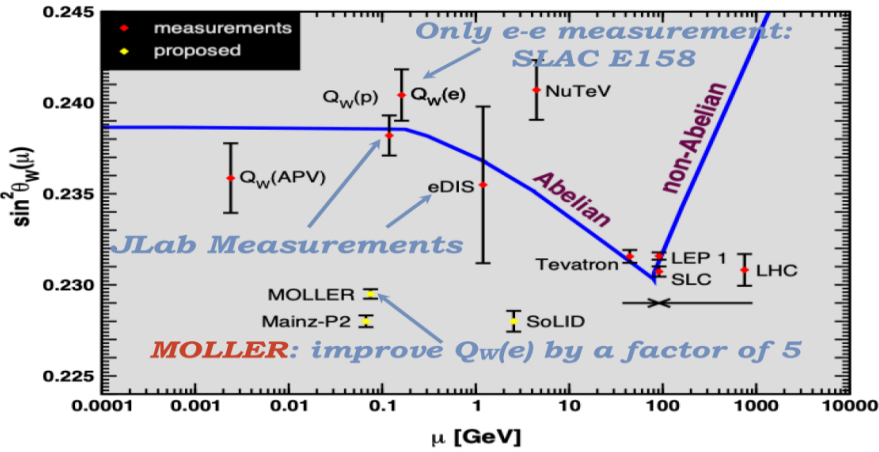


ECAL Rear view.



Hall A : MOLLER

- Inflation Reduction Act provided full funding.
- In Jan 2023, passed CD-3A review and spending CD-3A funds.
- CD2 /CD3 review in October 2023.
- In May 2024, ESAAB Approval: MOLLER Project CD-2/3
- Installation after GEp run ends
- Reuben Fair is PM, Klaus Dehmelt is Deputy PM.

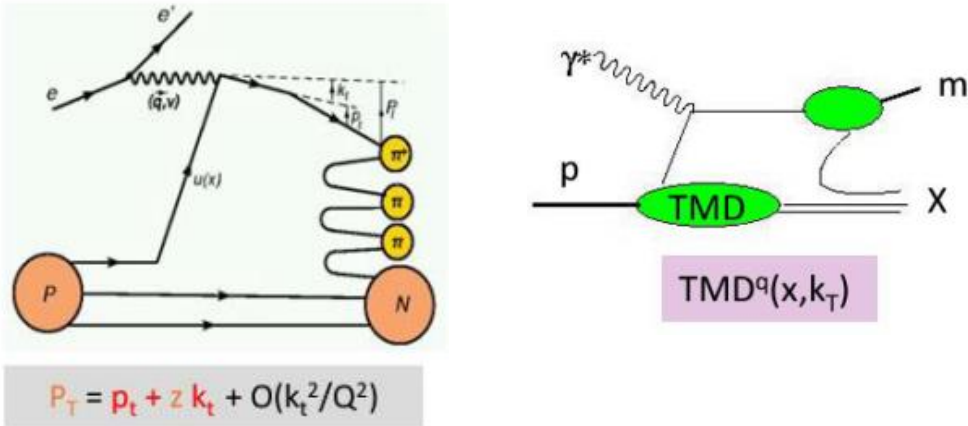


Hall C : Completed 4 NPS experiments from Sept 2023-May 2024

E12-13-007 & E12-23-014

E12-13-007 goal: Measure the basic SIDIS cross sections of π^0 production off the proton, including a map of the P_T dependence ($P_T \sim \Lambda < 0.5$ GeV), to validate (*) flavor decomposition and the k_T dependence of (unpolarized) up and down quarks

Linked to framework of *Transverse Momentum Dependent Parton Distributions*
 Transverse momentum widths of quarks with different flavor (and polarization) can be different



PR12-23-014 expands on 12-13-007 (24 days) to include

- All three beam energies (not just 10.6 GeV)
- Both proton and deuteron targets

What it adds to JLAB12 SIDIS program:

- Precision measurement of R_{SIDIS} on π^0
- Precision proton/deuteron π^0 multiplicity ratios
- Larger Q^2 compared to CLAS12 for beam asymmetries, etc.

E12-13-010 (LH2) & E12-22-006 (LD2)

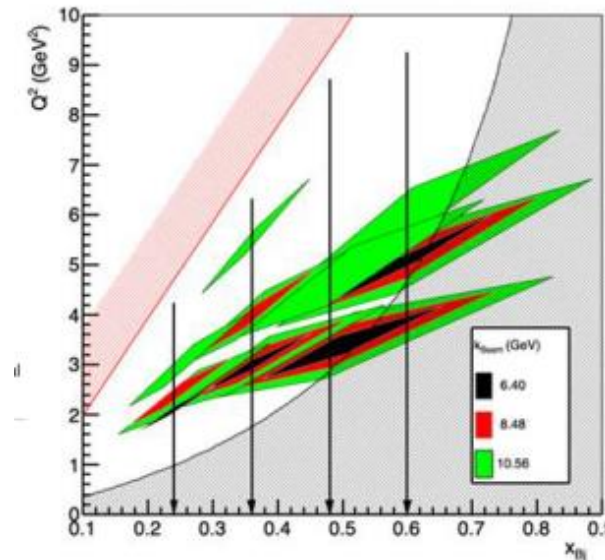
Simplest process: $e + p \rightarrow e' + p + \gamma$ (DVCS)

E12-13-010 DVCS measurements follow up on measurements in Hall A:

- Scaling of the Compton Form Factor
- Rosenbluth-like separation of DVCS:

$$\sigma = |BH|^2 + \text{Re}[DVCS^* BH] + |DVCS|^2$$
 $\sim E_{beam}^2$ $\sim E_{beam}^3$
- L/T separation of π^0 production

DVCS NPS/HallC/JLab 2023-2024



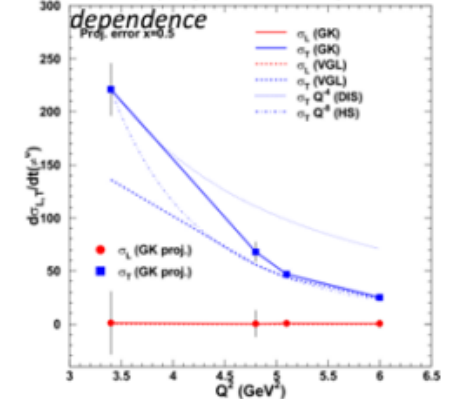
Projected Impact on flavor dependence of CFFs

- Simultaneous fit of E12-13-010 (p) and E12-22-006 (n)
- Real and imaginary parts of CFFs H and \tilde{H} and E (u & d) as free parameters (nDVCS not sensitive to \tilde{E})

π^0 Exclusive Cross Sections

- Relative L/T contribution to π^0 cross section important in probing transversity
- Results from Hall A at 6 GeV Jlab suggest that the longitudinal cross section in π^0 production is non-zero up to $Q^2=2$ GeV²

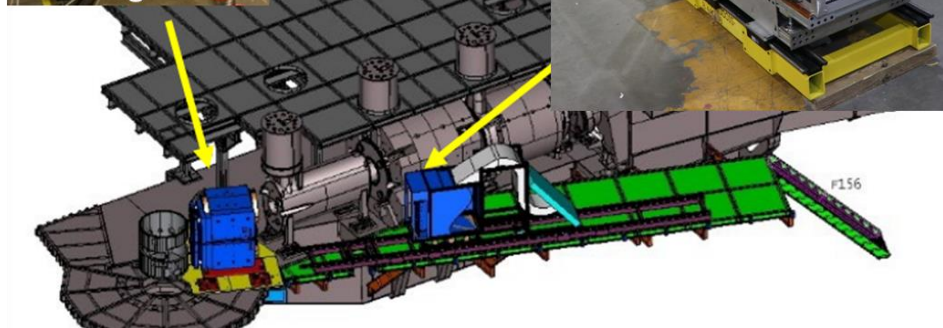
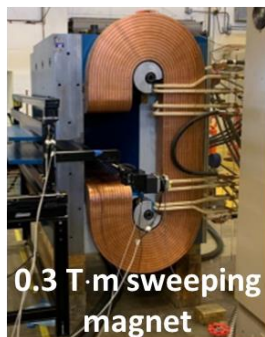
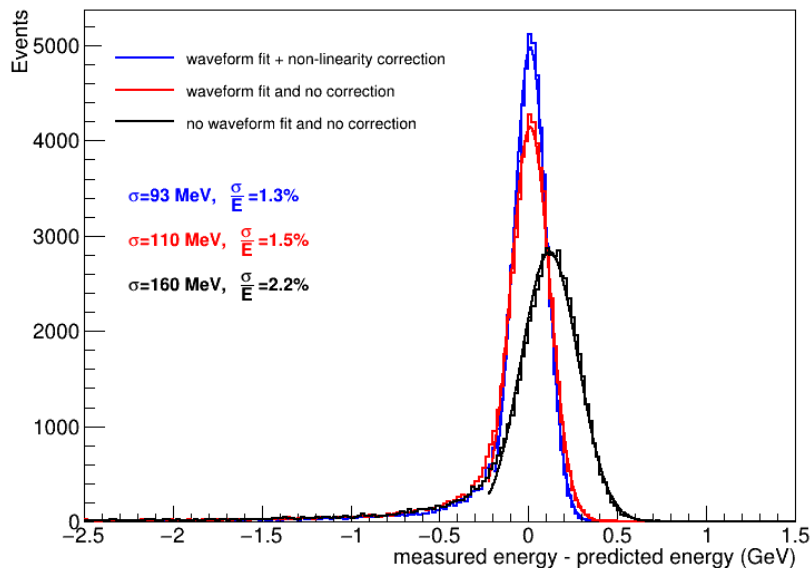
12 GeV projections: confirm Q^2/t



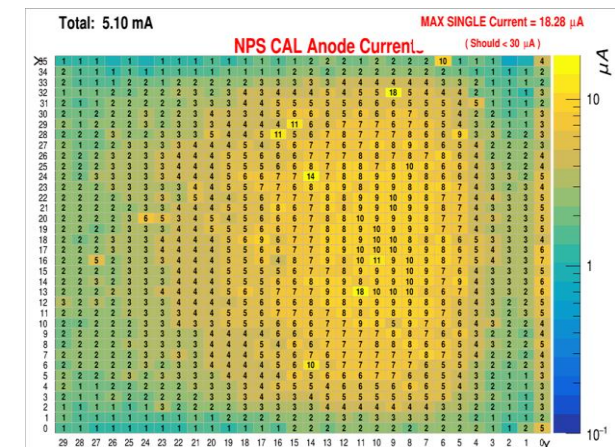
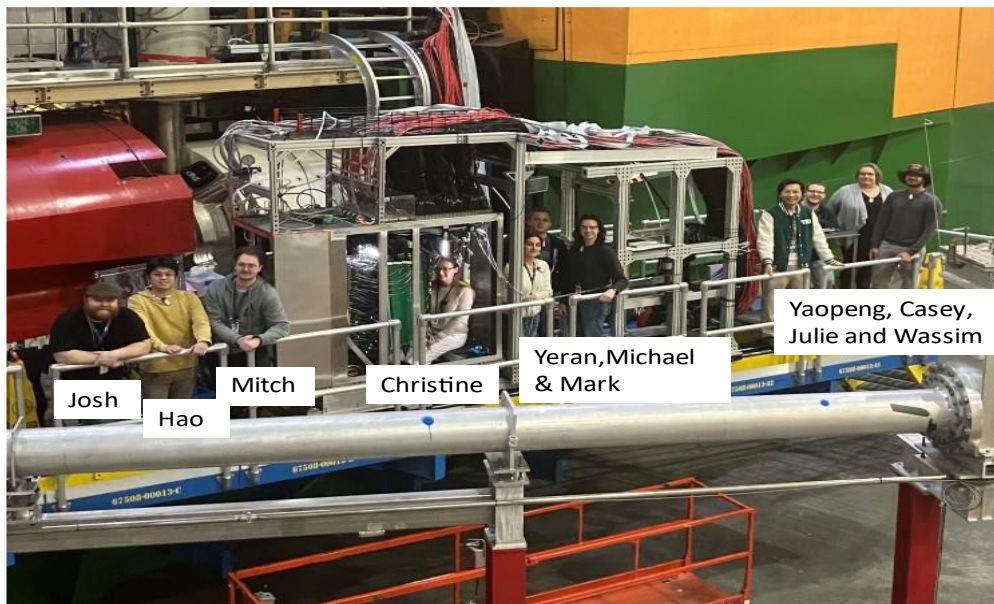
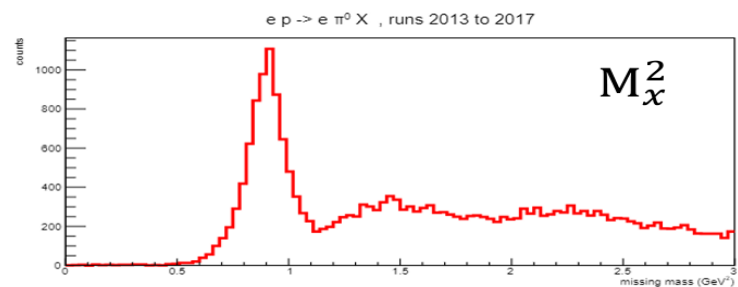
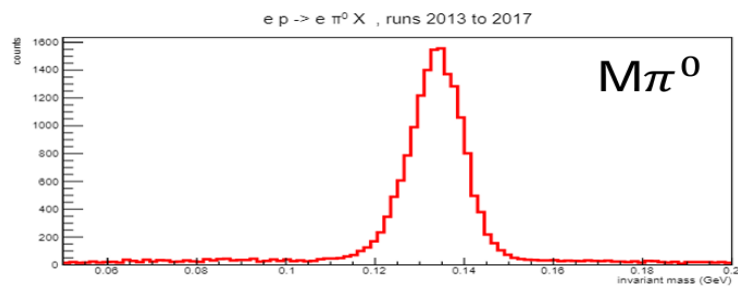
E12-13-010 provides also data on σ_T and σ_L at higher Q^2 for reliable interpretation of 12 GeV GPD data

NPS calorimeter operation

➤ 1.3% Energy resolution at 7.3 GeV



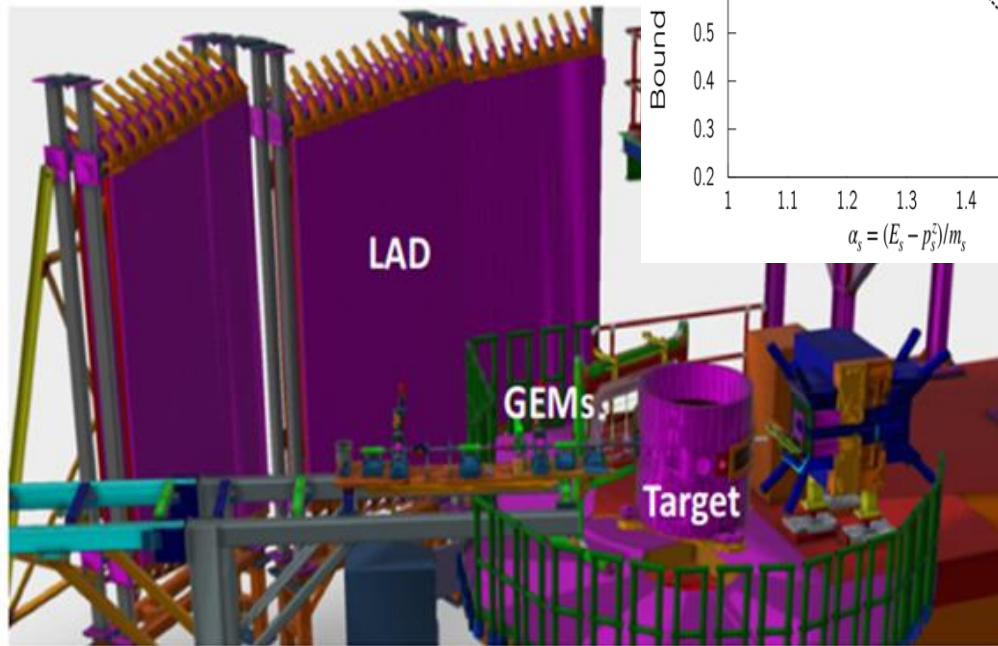
- 1080 PbWO₄ crystals
- 0.6 Tm sweeping magnet
- F250ADC sampling electronics
- Large opening angle beam pipe
- SHMS as carriage for rotation
- Luminosity ($\approx 7.5 \times 10^{37} \text{ cm}^2/\text{s}$)



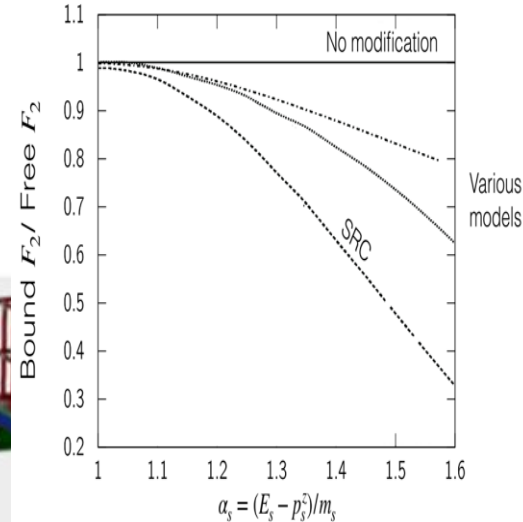
Hall C: Next run period

E12-11-107 Spectator tagged DIS $d(e, e' p_s)$

- Install Large Angle Detector
- HMS/SHMS detect electron

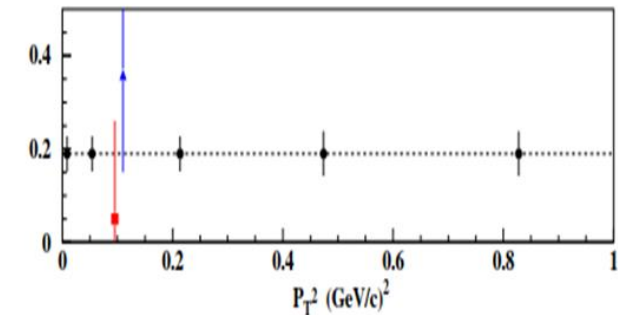
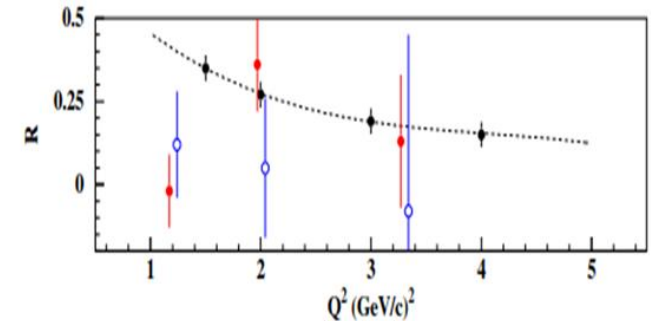
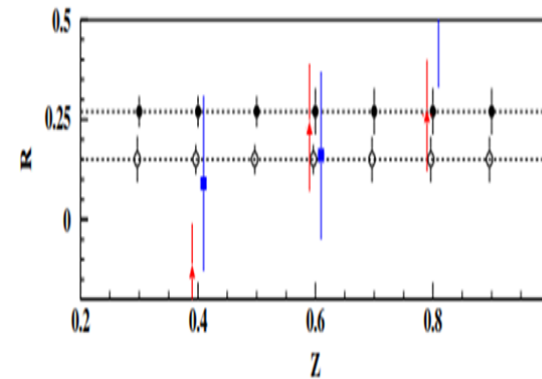


- Does the EMC Effect depend on nucleon virtuality?
- Measure Bound F_2 by tagging the SRC proton in $D(ee' p)$ DIS and look for nuclear effects
- Will provide crucial information needed for identifying the origin of the EMC Effect



E12-06-104 $R = \sigma_L / \sigma_T$ in SIDIS on 1H and 2H

- Verify whether $R_{SIDIS} = R_{DIS}$.
- Check the z -dependence of R from the semi-inclusive to the exclusive region.
- Verify that R_{SIDIS} anneals to R_{DIS} at large p_T .
- Verify if R_{SIDIS} follows the Q^2 dependence of R_{DIS} , at two values of x .
- Verify that $R_{SIDIS}^{\pi^+} = R_{SIDIS}^{\pi^-}$ and $R_{SIDIS}^H = R_{SIDIS}^D$.
- With a factor of ten reduced statistics: map $R_{SIDIS}^{K^+}$ and $R_{SIDIS}^{K^-}$.



- Map $R_{SIDIS}^H + R_{SIDIS}^D$ as function of z at $x = 0.2$ and $Q^2 = 2.0 \text{ GeV}^2$ (168 Hours)
- Map R_{SIDIS}^H as a function of z at $x = 0.4$ and $Q^2 = 4.0 \text{ GeV}^2$ (319 Hours)
- Map R_{SIDIS}^H as a function of p_T^2 at $x = 0.3$ and $Q^2 = 3.0 \text{ GeV}^2$ (311 Hours)
- Add kinematics to map R_{SIDIS}^H for $Q^2 = 1.5\text{-}5.0 \text{ GeV}^2$ (88 Hours)

Hall C outlook

- Successfully completed 4 NPS experiments
- Next run period expected to be 24 weeks
 - Run LAD and R-SIDIS
 - Had to move Pion CT experiment to Fall 2025
- Current LOTO safety pause means uncertain date for start of physics (Late Jan/Feb 2025???)
- Future running
 - Following run period standard HMS/SHMS with non-standard beam energies (188 PAC days)
 - Hypernuclear experiments
 - Polarized deuteron target experiments
 - NPS Calo experiments
 - Strange Form Factor
 - SBS SIDIS polarized ^3He and TDIS.

Hall A outlook

- Successfully completed GMn, GEn, GEn-RP and K_LL
- Next run period will complete GEp
- MOLLER
 - Early procurements from CD3A are arriving
 - CD2/CD3 ESAAB Approval in May 2024
 - NSF and Canadian detector work progressing
- SoLID
 - Part of recommendation #4 in the NSAC LRP
 - Dec 2023, redid the cost estimate of the SoLID project
 - Lab is looking at ways to “redirect” money from Jlab’s OPS and capitol to share cost of project.