

Hall C Status

January 2024 Winter Hall C Collaboration Meeting

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Jan 2024

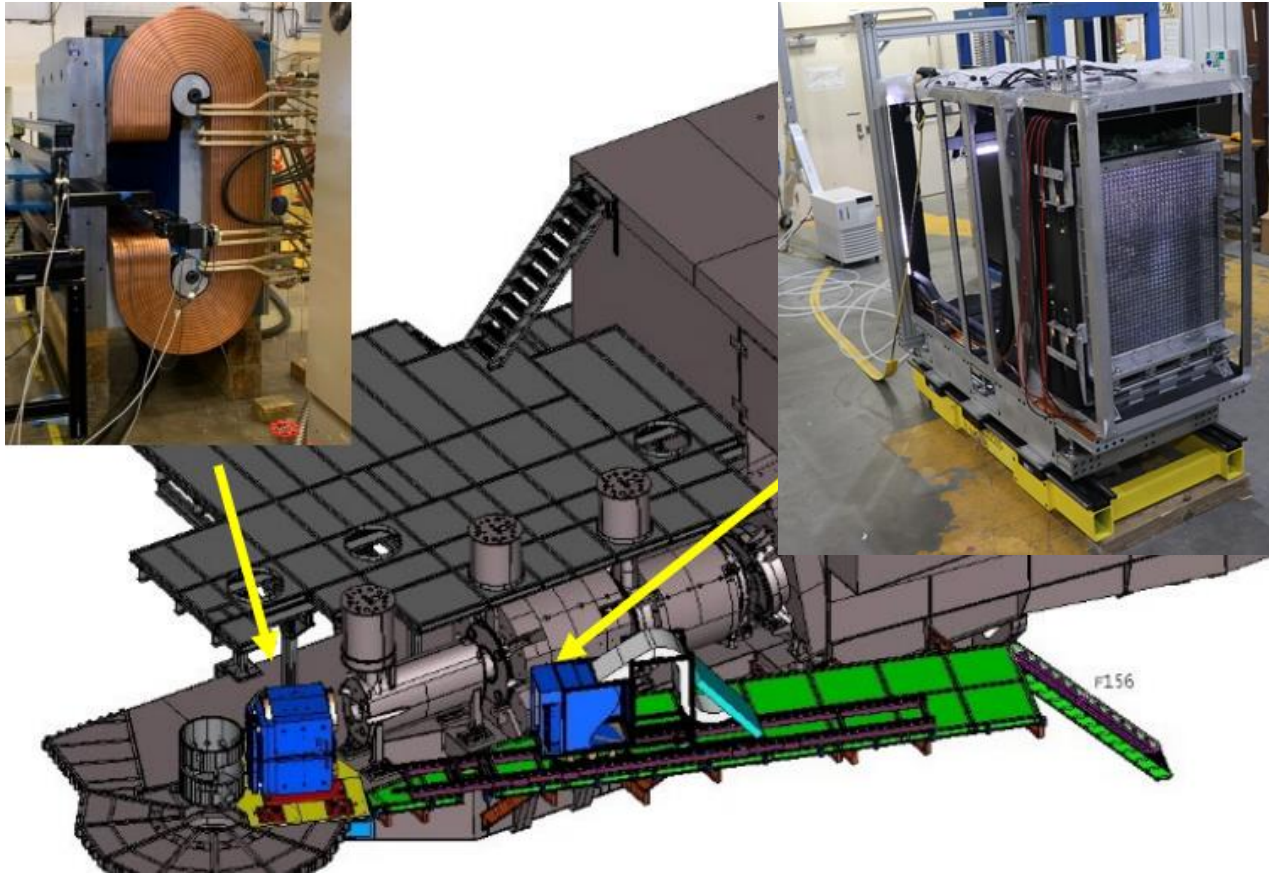
Overall Beam schedule

- Beam started in beginning of Sept 2023 due to delay caused by safety shutdown.
 - This caused a shift in the general run period scheduling back to the Sept – May schedule.
- Hall A schedule
 - GEN polarized 3He experiment ended on Oct 30, 2023. Changeover to GEN-RP / K_LL experiments
 - Run GEN-RP/K_LL in April 2024.
 - Changeover to GEp for May 2024 to Oct 2024
 - Run GEp from Nov 2024 to April 2025
 - Start MOLLER installation May 2025 to Sept 2026. MOLLER runs 3 years until 2029.
- Hall C schedule
 - Complete NPS experiment by May 2024. Changeover to LAD experiment
 - Run LAD, pion CT and R-SIDIS from Sept 2024-May 2025
 - Possible scenario
 - Run experiments using standard SHMS/HMS with emphasis on ones needing non-standard beam energies from Sept 2025-May 2026
 - Install hypernuclear setup June 2026 – Dec 2026.
 - **Target construction and installation intertwined with needs of other halls.**
 - Run hypernuclear experiments

Neutral Particle Spectrometer

Neutral Particle Spectrometer

- Sweeping Magnet with calorimeter.
 - Magnet and power supply have been tested.
- NPS attached to SHMS carriage to allow easy angle change.
 - The calorimeter is on rails.
- 1080 Lead-Tungstate blocks in calorimeter to detect γ and π^0

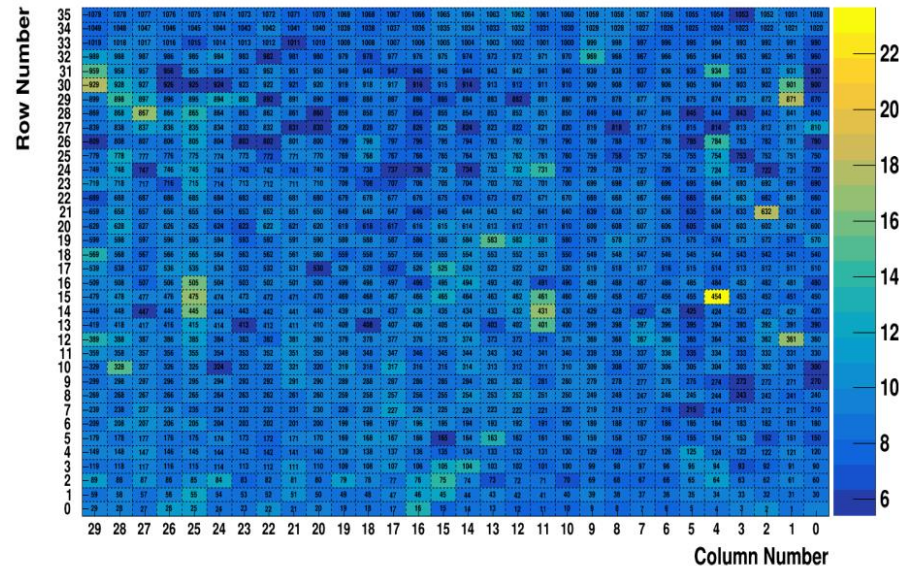


NPS experiments are running well

- Big effort to get all 1080 NPS blocks ready.
 - Large group installed the DAQ hardware, cabling, NPS hardware
 - Needed modification to all HV/LV/signal distribution boards
- Commissioning went well.
 - Software and calibration tools were ready.
 - First time using CODA3 with FADC trigger for NPS in coincidence with HMS

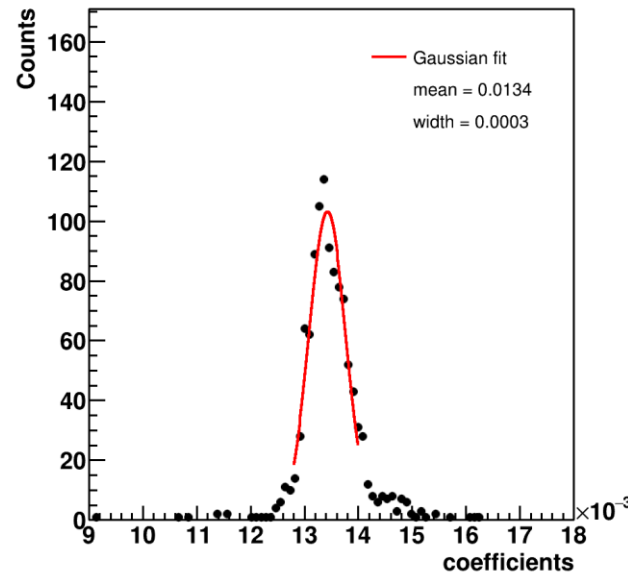
Attend NPS session

Cosmic run: mean amplitude per channel (mV)
All 1080 channels operational

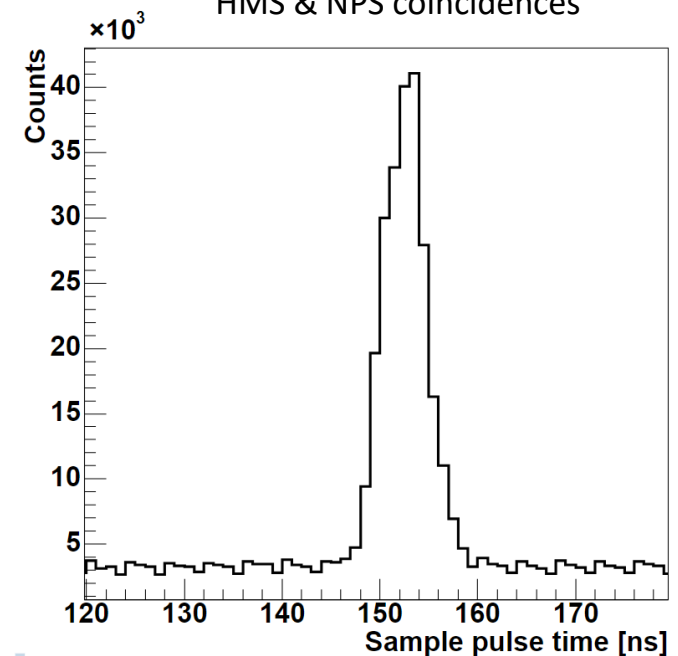


Initial calibration using elastics

Calibration coefficients



FADC time distribution:
HMS & NPS coincidences



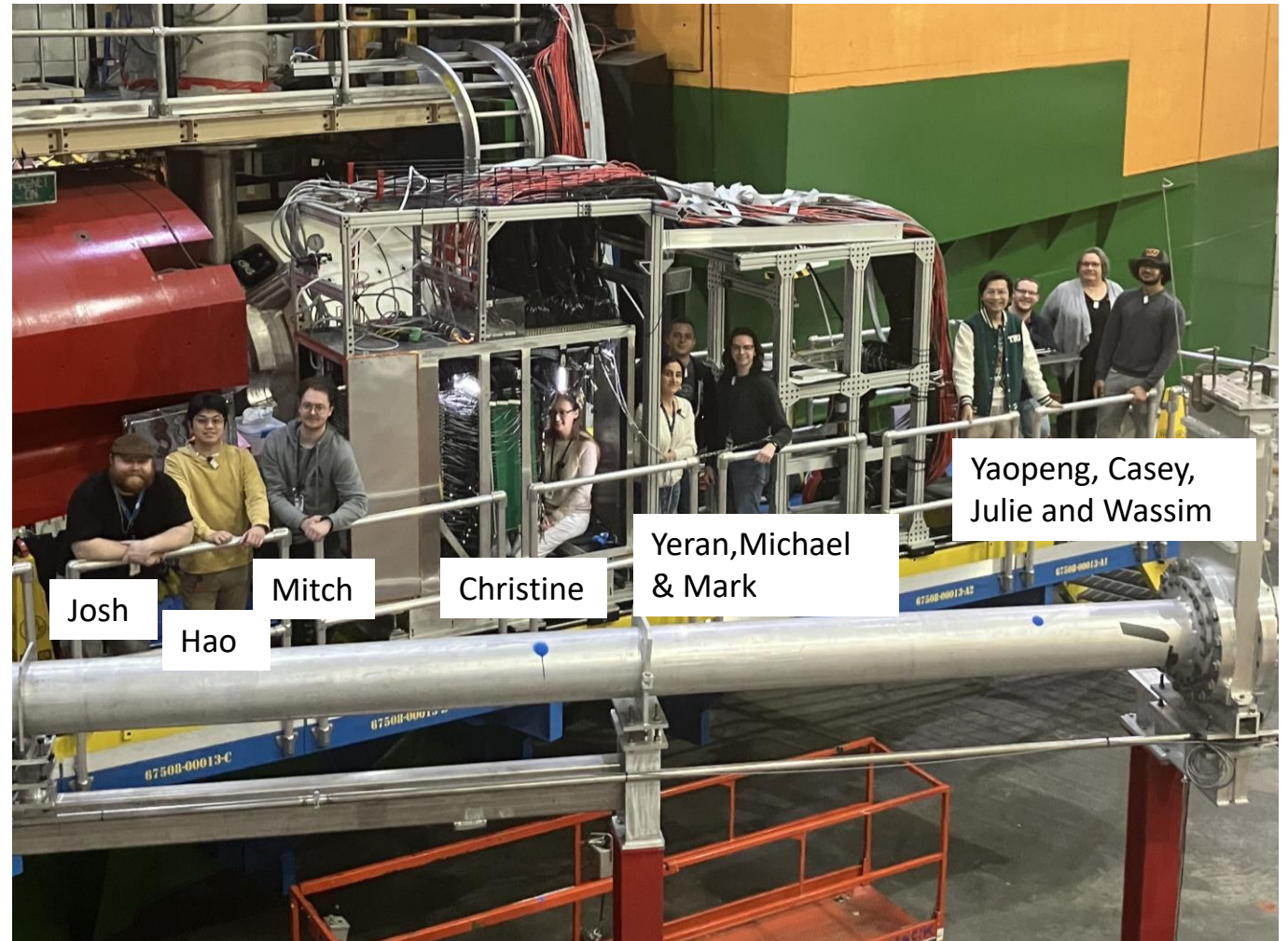
Ongoing Hall C experiments using NPS

- [E12-13-010](#) and [E12-22-006](#)

- Exclusive Deeply Virtual Compton on proton and neutron
- The exclusive π^0 electroproduction cross section and a longitudinal/transverse separation.

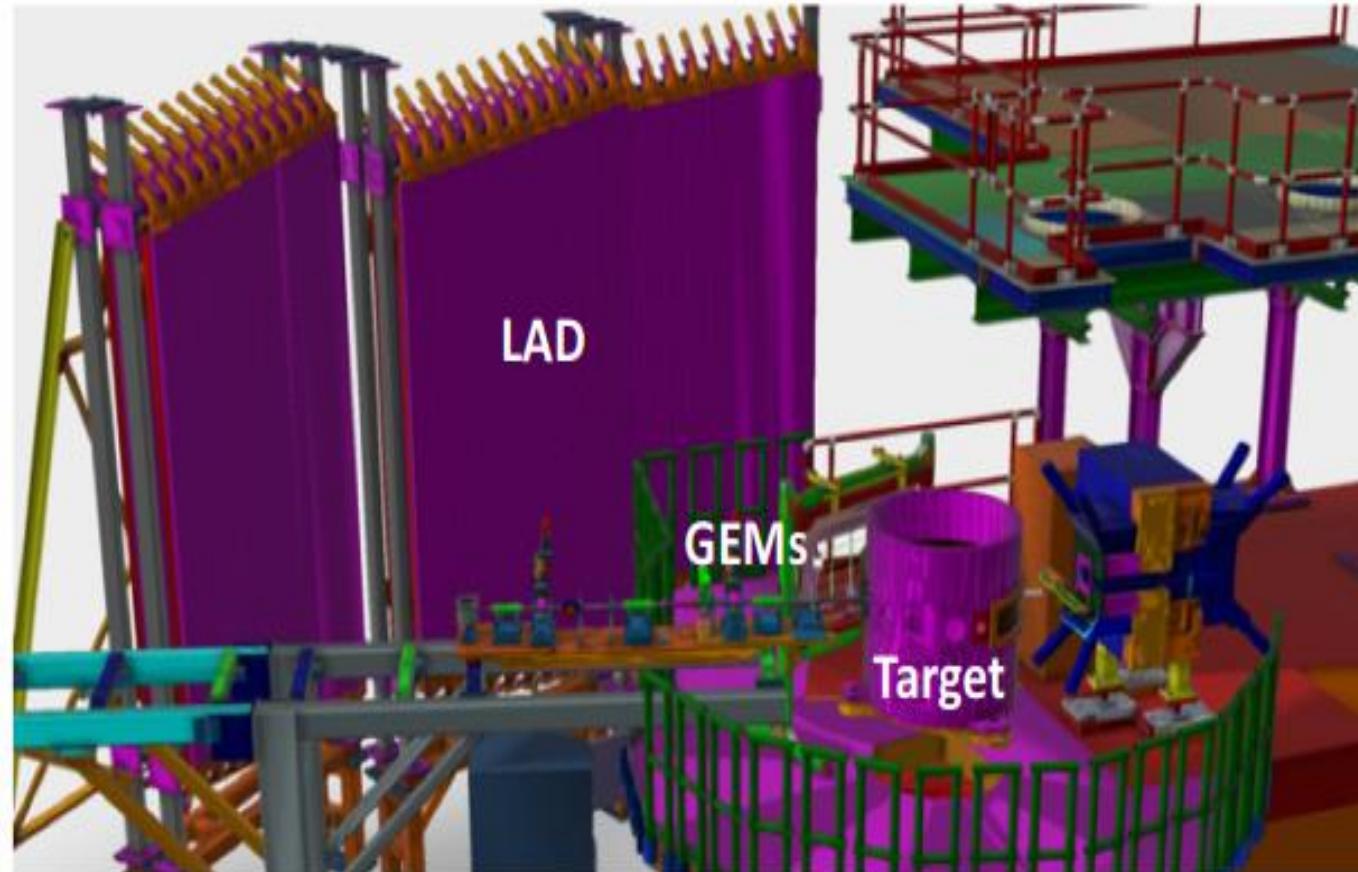
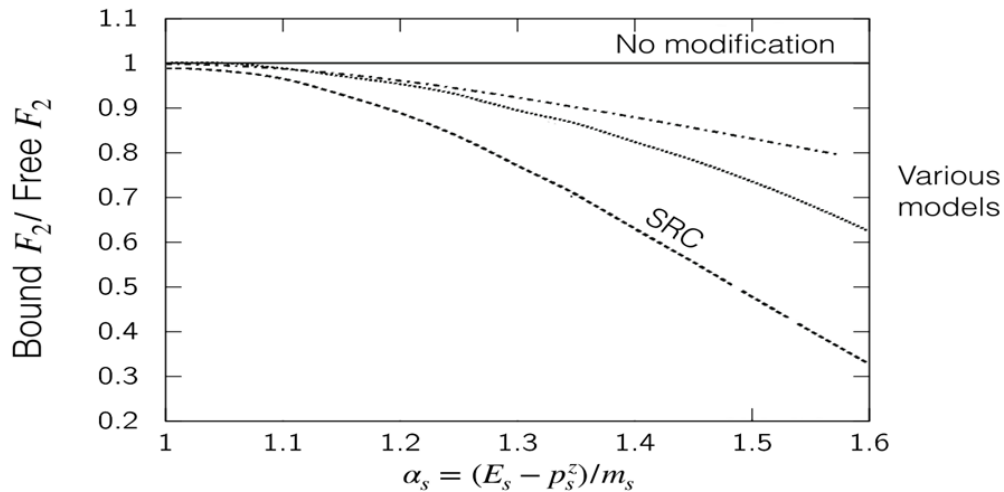
- [E12-13-007](#) and [E12-23-014](#)

- SIDIS $p(e,e',\pi^0)$ cross section. Map the transverse momentum dependence and test of factorization.
- Measure $R=\sigma_L/\sigma_T$ in SIDIS $p(e,e',\pi^0)$ cross section.



E12-11-107 LAD experiment

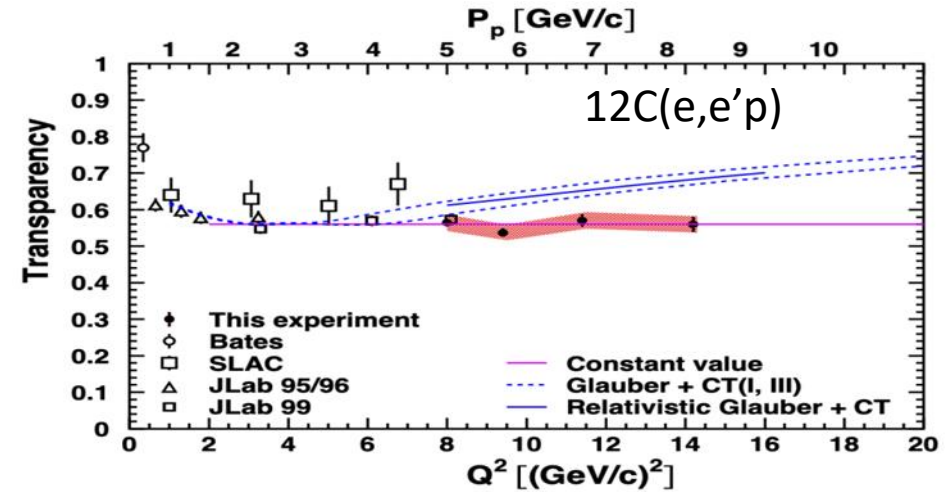
- Spectator tagged DIS $d(e, e'p)$
 - Install Large Angle Detector
 - HMS/SHMS detect electron
- Does the EMC Effect depend on nucleon virtuality?
- Measure Bound F_2 by tagging the SRC proton in $D(ee'p)$ DIS and look for nuclear effects
- Will provide crucial information needed for identifying the origin of the EMC Effect



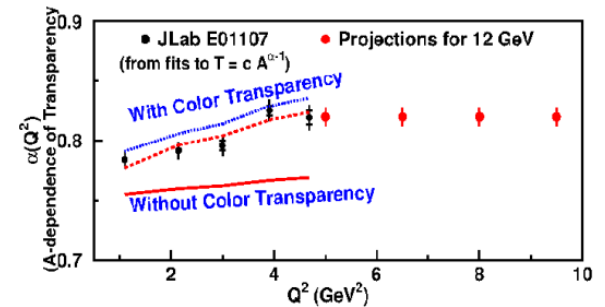
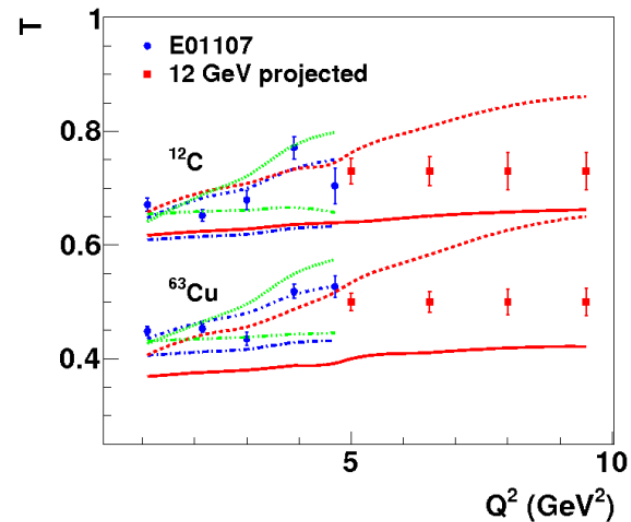
E12-06-107 Complete CT experiment

No Sign of Color Transparency for Protons Traversing Nuclei

- Unique prediction of QCD is that hadrons can be produced as a point like configurations in nuclei.
- CT is seen in other reactions.
- [Phys. Rev. Lett. 126, 082301 \(2021\)](#).

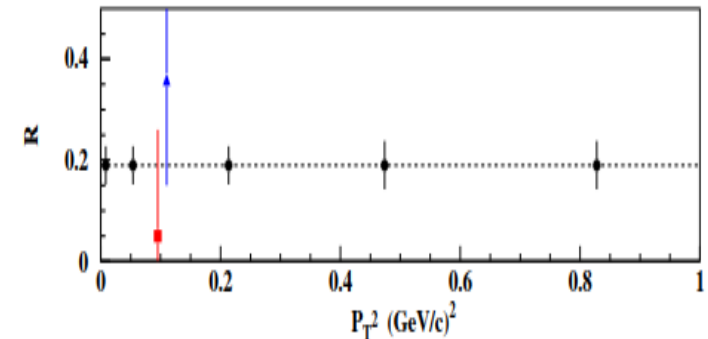
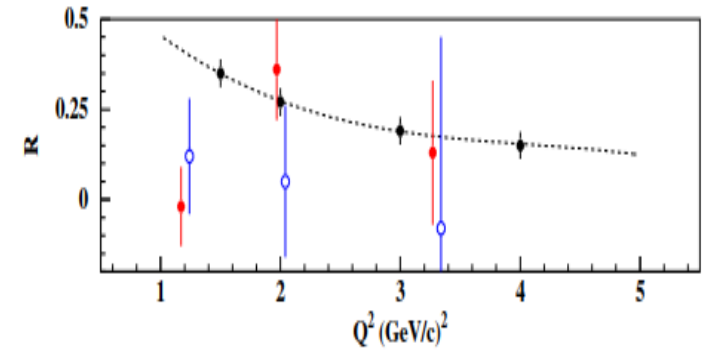
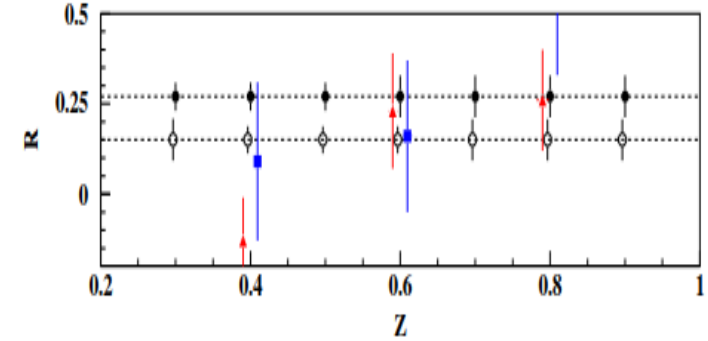


- Complete the experiment
- Measure Color Transparency in $A(e, e \pi)$
- Will the trend from earlier data continue?



$R = \sigma_L / \sigma_T$ in SIDIS charge pions

- 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)



PAC results

| | NUMBER | CONTACT PERSON | TITLE | HALL | DAYS REQ'D | DAYS AWARDED | SCIENTIFIC RATING | PAC DECISION | TOPIC |
|-----------------------|-------------|----------------------|---|------|------------|--------------|-------------------|--------------|-------|
| Standard SHMS/HMS }] | PR12-23-001 | Nikos Sparveris | Measurement of the Generalized Polarizabilities of the Proton in Virtual Compton Scattering | C | 62 | 62 | A- | Approved | 2 |
| | PR12+23-002 | Eric Voutier | Beam Charge Asymmetries for Deeply Virtual Compton Scattering on the Proton at CLAS12 | B | 100 | 100 | A- | C1 | 4 |
| Positron beam }] | PR12+23-003 | Dave Gaskell | Measurement of Deep Inelastic Scattering from Nuclei with Electron and Positron Beams to Constrain the Impact of Coulomb Corrections in DIS | C | 9.3 | 9.3 | A- | C1 | 5 |
| Large installation }] | PR12-23-004 | Bogdan Wojtsekhowski | A Search for a Nonzero Strange Form Factor of the Proton at 2.5 (GeV/c)^2 | C | 45 | 45 | A- | Approved | 2 |
| | PR12+23-005 | Bogdan Wojtsekhowski | A Dark Photon Search with a JLab positron beam | B | 60 | | | Deferred | 6 |
| Positron beam }] | PR12+23-006 | Carlos Munoz Camacho | Deeply Virtual Compton Scattering using a positron beam in Hall C | C | 137 | 137 | A- | C1 | 4 |
| | PR12-23-007 | David Ruth | A Measurement of the Proton g2 Structure Function at Intermediate Q2 | C | 33 | | | Deferred | 2 |
| | PR12+23-008 | Axel Schmidt | A Direct Measurement of Hard Two-Photon Exchange with Electrons and Positrons at CLAS12 | B | 55 | 55 | A | C1 | 2 |
| | PR12-23-009 | Or Hen | Nuclear Charm Production and Short-Range Correlations in Hall D | D | 100 | | | C2 | 5 |
| Standard SHMS/HMS }] | PR12-23-010 | Holly Szumila- Vance | Color Transparency in Maximal Rescattering Kinematics | C | 95 | 40 | B+ | Approved | 5 |
| | PR12-23-011 | Dipangkar Dutta | Precision Deuteron Charge Radius Measurement with Elastic Electron-Deuteron Scattering | B | 40 | | | Deferred | 3 |
| Positron beam }] | PR12+23-012 | Michael Nycz | A measurement of two-photon exchange in unpolarized elastic positron-proton and electron-proton scattering | C | 56 | 56 | A- | C1 | 2 |

PAC : Jeopardy

| | NUMBER | CONTACT PERSON | TITLE | HALL | DAYS REQ'D | DAYS AWARDED | SCIENTIFIC RATING | PAC DECISION | TOPIC |
|--|------------|---------------------|--|------|------------|--------------|-------------------|------------------------------|-------|
| Large installation } Polarized deuteron } Standard SHMS/HMS } Polarized deuteron } Hypernuclear } Large installation } Compact Photon Source } Polarized target } | C12-15-006 | Dipangkar Dutta | Measurement of Tagged Deep Inelastic Scattering | A,C | 60 | 27 | A- | Remain active with C1 status | 3 |
| | E12-13-011 | Karl Slifer | The Deuteron Tensor Structure Function b1 | C | 47.4 | 41 | A- | Remain active | 3 |
| | E12-14-002 | William Henry | Precision Measurements and Studies of a Possible Nuclear Dependence of R | C | 22 | 22 | A- | Change rating from B to A- | 5 |
| | E12-15-005 | Elena Long | Measurements of the Quasi-Elastic and Elastic Deuteron Tensor Asymmetries | C | 52.8 | 45 | A- | Remain active | 5 |
| | E12-15-008 | Satoshi N. Nakamura | An isospin dependence study of the Lambda-N interaction through the high precision spectroscopy of Lambda hypernuclei with electron beam | C | 61 | 28 | A | Remain active | 5 |
| | E12-16-001 | Marco Battaglieri | Dark Matter search in a Beam Dump eXperiment (BDX) | A | N/A | N/A | A | Remain active | 6 |
| | E12-17-008 | David Hamilton | Polarization Observables in Wide-Angle Compton Scattering at large s, t and u | C | 46 | 46 | A- | Remain active | 2 |

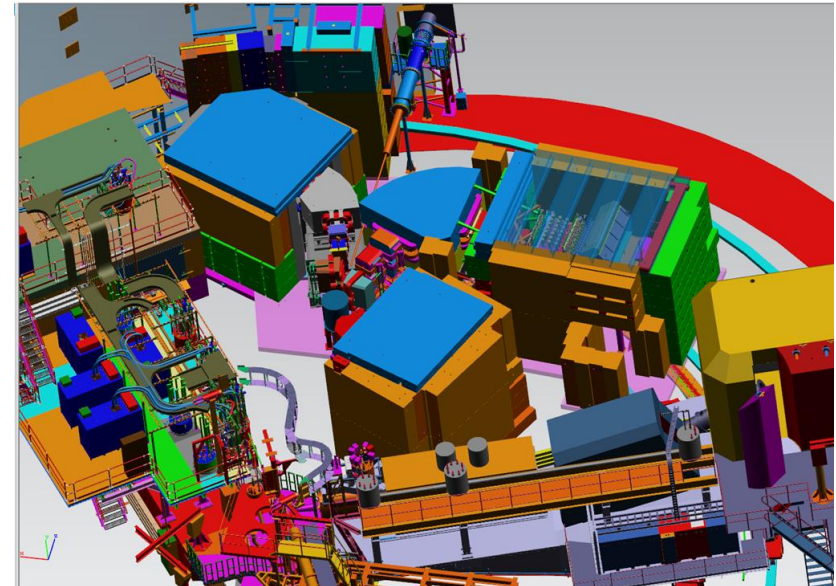
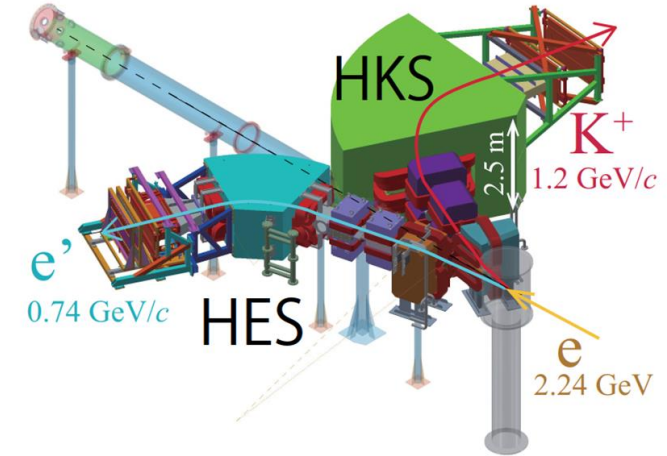
Approved standard SHMS/HMS experiments

- List of possible experiments in no particular order for possible running in Fall 2025
- Typically around 90 -100 PAC days in run period

| Number | Title | Days | Rating |
|---------------------------|---|------|--------|
| 12-23-001 | Measurement of the Generalized Polarizabilities of the Proton in Virtual Compton Scattering | 62 | A- |
| 12-23-010 | Color Transparency in Maximal Rescattering Kinematics | 40 | B+ |
| 12-14-002 | Precision Measurements and Studies of a Possible Nuclear Dependence of R | 22 | A- |
| 12-20-007 | Backward-angle Exclusive π^0 Production above the Resonance Region | 29 | B |
| 12-22-001 | Measurement of the N to Delta Transition Form Factors at low four momentum transfers | 11 | A- |

Hypernuclear experiments

- E12-15-008 , “An isospin dependence study of the Lambda-N interaction ...”
 - Jeopardy approved by PAC51 for the original 28 days with A rating
 - Need to come back to the PAC52 for the requested 61 days need to run in Hall C.
 - ^{40}Ca and ^{48}Ca targets
- E12-20-013 , “Studying Lambda interactions in nuclear matter with the $^{208}\text{Pb}(e, e'K^+)$ ”
 - Although not in Jeopardy need to present at PAC52 for Hall C running
 - 20days at 25uA .
- LOI12-23-011, “High-resolution spectroscopy of light hypernuclei with the decay-pion spectroscopy”
 - 14 PAC days. Need ENGE magnet and PS.
- LOI12-23-013, “Study of charge symmetry breaking in p-shell hypernuclei”
 - 21.5 PAC days.
- LOI12-23-016, “Study of a triaxially deformed nucleus using a Lambda particle as a probe”
 - 28 PAC days



Possible running scenario

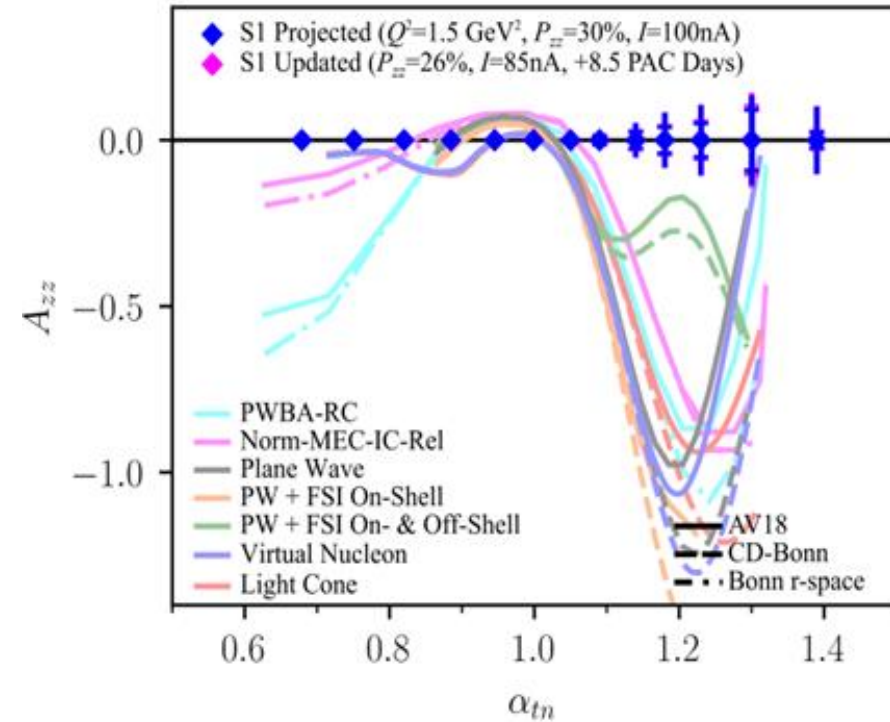
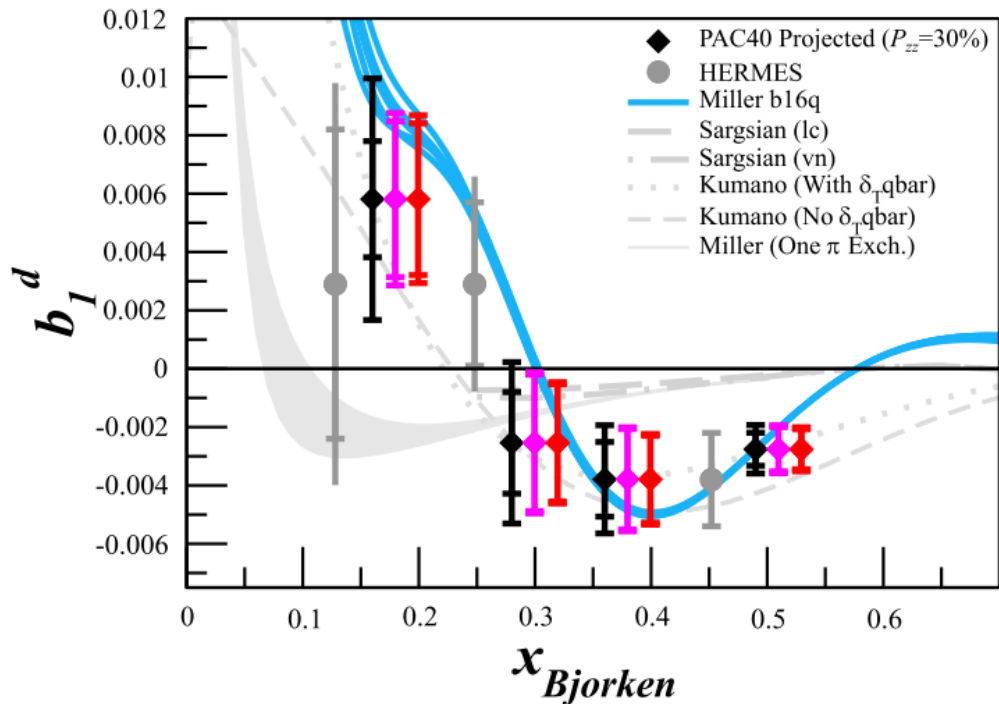
- Experiment PAC days.

| E12-15-008 | E12-20-013 | L12-23-011 | L12-23-013 | L12-23-016 | Total PAC days |
|------------|------------|------------|------------|------------|----------------|
| 61 | 20 (40?) | 14 | 21.5 | 28 | 144.5 (165.5) |

- One possible scenario
 - Installation from June 2026 to Dec 2026.
 - Run Jan 2027 to May 2027. Roughly 75 PAC days (5 months running)
 - Down June, July and August
 - Run Sept 2027- March 2028. Roughly 90 PAC days (6 months running)
 - April 2028 start changeover to next experiments.
- Back to reality
 - Need to have approved experiment go back to PAC52 to get more time
 - Need to coordinate with resources from Target Group.
 - LOI to PAC52 to get approved
 - Scheduled ERR for Nov 2024

Experiments Using a Novel Tensor Polarized Deuteron Target

- Approval from PAC Jeopardy
- Lots of R&D to reach deuteron tensor polarization = 26-30% (previously 10%)
- Two experiments
 - Inclusive b_1 probes the gluonic part of tensor structure – not present in free nucleons
 - First measurement of A_{zz} in quasifree $D(ee'p)$ is sensitive to tensor part of SRC



Summary

- Exciting physics program using NPS is underway
 - Massive effort over the Winter down to replace 20 columns of rad damage PMT bases
 - **Running into May. Please sign up for shifts**
- This meeting has talks on large variety of past experiments.
- Session on planning future experiments including with positron beam
- Starting in Fall 2025
 - Standard SHMS/HMS experiments.
 - Experiments with non-standard beam energies
- Running during MOLLER and after:
 - During MOLLER, limits on total target power and beam current in the two halls
 - Hypernuclear experiments in 2026-2028
 - Polarized deuteron experiments
 - WACS and other experiments using the NPS
 - Strange form factor experiment
 - Experiments using the Compact Photon Source
 - Capital project is ongoing
 - SBS/BB experiments that did not run in Hall A
 - Exciting new letters of intent
- **Future plans have to work with needs of the other halls and target group resources.**