

# Hall A Status

January 2023 Winter Hall A Collaboration Meeting

Mark Jones  
Hall A/C Group Leader

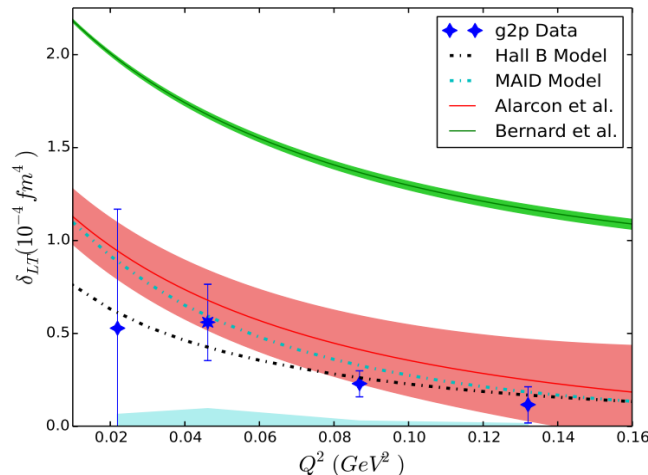
Bob Michaels  
Hall A/C Deputy Group Leader

1/26/2023

# Selection of recent Hall A publications

## E08-027 “g2p” Experiment

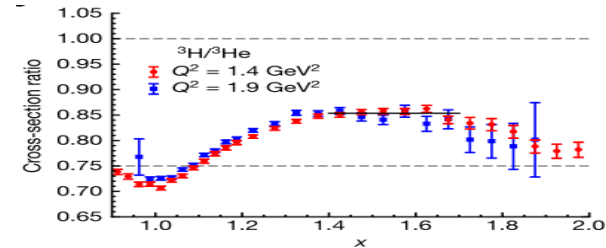
- Measured the proton spin structure functions  $g_1$  and  $g_2$  at low  $Q^2$  and extract the transverse-longitudinal spin polarizability  $\delta_{LT}$
- $$\delta_{LT}(Q^2) = \frac{16\alpha M^2}{Q^6} \int_0^{x_0} x^2 \left( g_1(x, Q^2) + g_2(x, Q^2) \right) dx$$
- Test of Chiral Perturbation Theory (CPT). Neutron data and CPT calculations disagree.
  - The CPT calculation of Alarcon et al. agrees with the data while the CPT calculation of Bernard et al. strongly disagrees with the data.
  - One known difference between the two calculations rises from the inclusion of the  $\Delta(1232)$  resonance through a perturbative expansion.
  - Published in *Nature Physics* 18, 1441–1446 (2022).



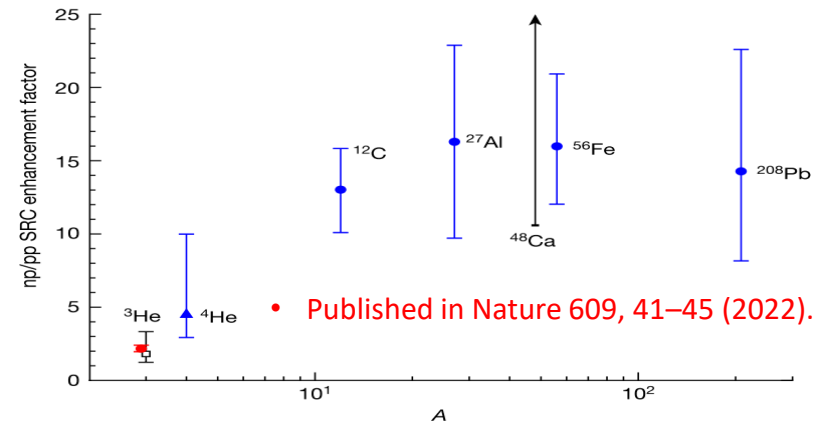
## Experiment E12-11-112 SRC in 3H and 3He

- Measured the inclusive cross-section for 3H and 3He.

$$\frac{\sigma_{3H}}{\sigma_{3He}} = \frac{1 + \sigma_{p/n} + 2R_{pp/np}}{1 + \sigma_{p/n}(1 + 2R_{pp/np})}$$



- Extract  $R_{pp/np}$  which is the ratio number of pp (nn) SRC pairs to number of np SRC pairs in 3He (3H).
- The np/pp enhancement factor is ratio of  $R_{pp/np}$  to the counting pair prediction. The result is plotted as red point. Significant decrease relative to heavier nuclei.
- The black 3He point is from 3He(eep)/3H(eep) data of the Hall A experiment, Phys. Lett. B 797, 134890 (2019)



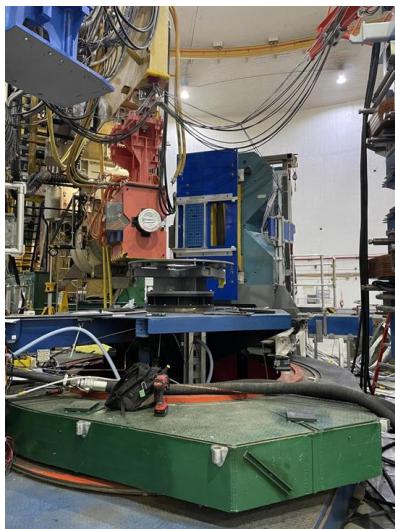
Published in *Nature* 609, 41–45 (2022).

# Hall A GEn with polarized $^3\text{He}$ target installation

Removing Cryotarget



Scattering chamber removed



Helmholtz coil installed



Frame to hold iron magnet shielding installed



Installing oven



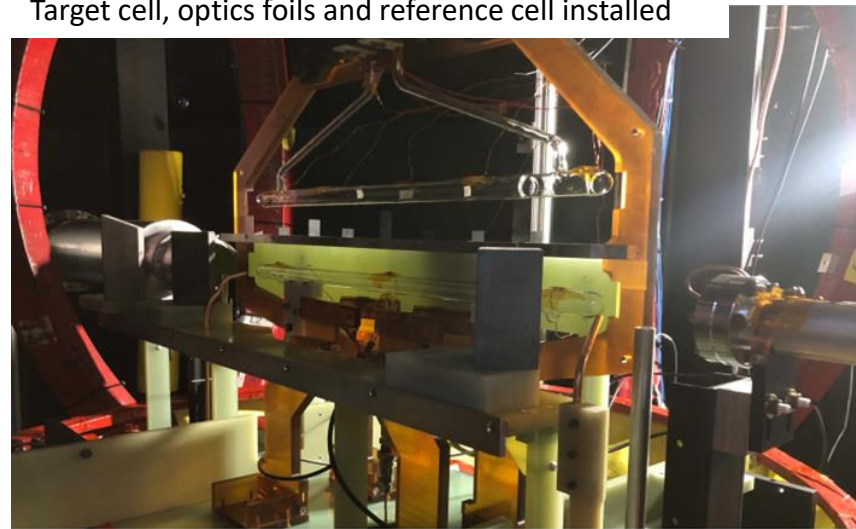
Gary Penman

Installing oven



Arun Tadepalli, Gary Penman and Bill Henry

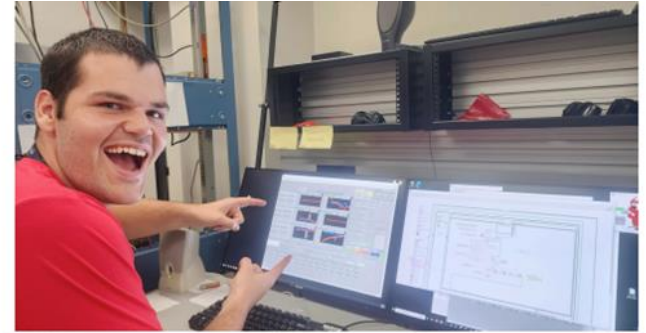
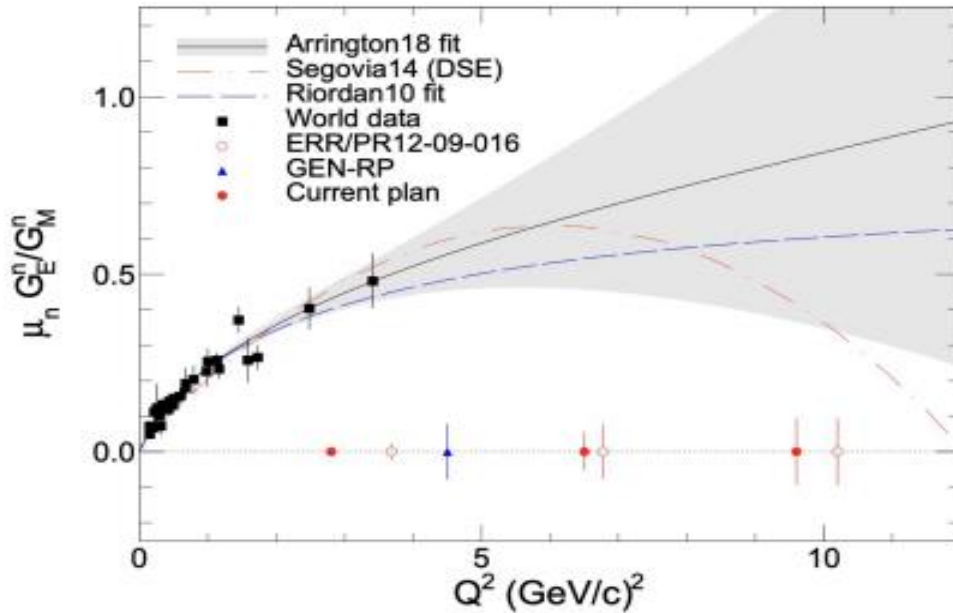
Target cell, optics foils and reference cell installed



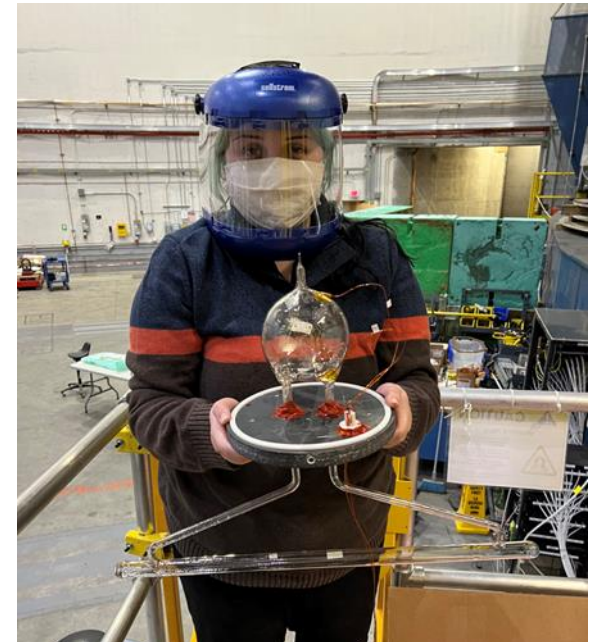


# GEn using polarized helium target

- Started running the experiment at beginning of Oct 2022
- First time running with 60cm long  $^3\text{He}$  cell
  - 45-50% polarization in beam!
- Completed the  $Q^2 = 3.0$  and  $6.8$  kinematics
- Presently running the  $Q^2 = 9.9$  kinematics
- Talks by Gordon Cates, Arun Tadepalli and Sean Jeffas



Hunter Presley excited about the first NMR measurement



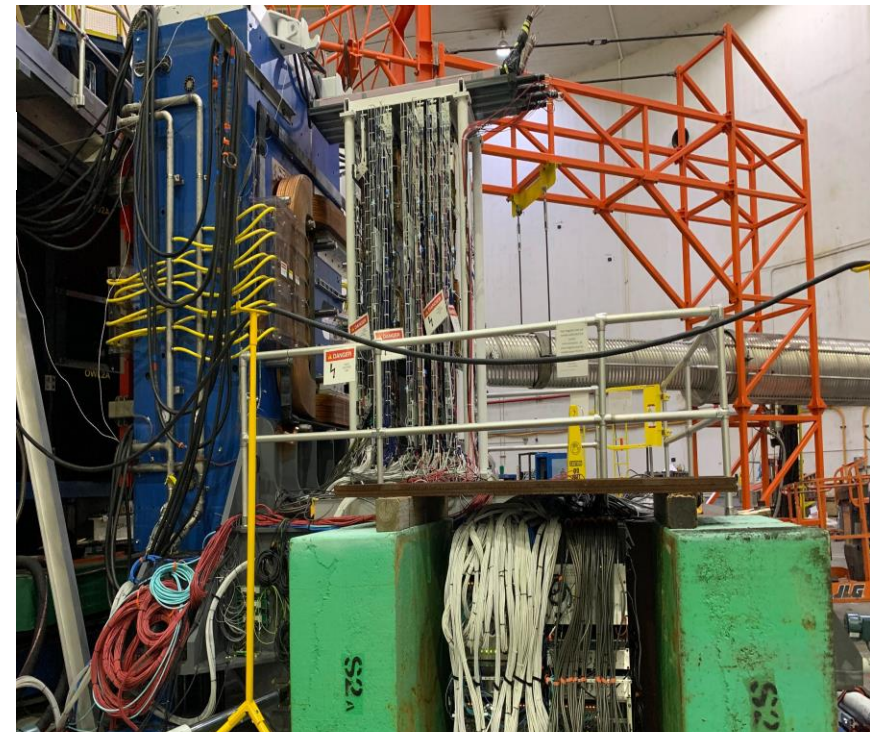
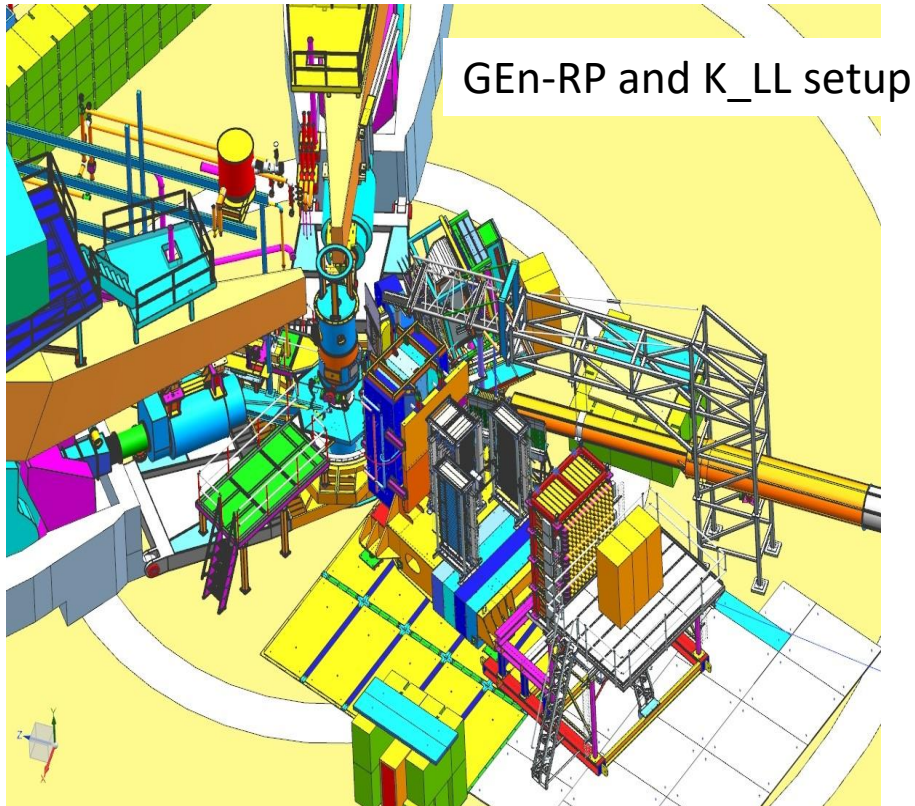
Kate Evans with the  $^3\text{He}$  target cell

# Updated Hall A Run Schedule

- GEn experiment runs until March 20<sup>th</sup> 2023
- April-May 2023: Installation for GEn-RP and K\_LL experiments
  - Use mobile crane
  - Deinstallation of polarized target
  - Reconfigure beamline
  - Install side detectors. Move BigBite and HCAL
- June-July 2023: **Overhead Hall A Crane finally repaired.**
- Aug 2023 : Install cryotargets
- Aug 28<sup>th</sup> to Sept 18<sup>th</sup> 2023: Run GEn-RP E12-17-004
- Sept 18<sup>th</sup> to Sept 25<sup>th</sup> 2023: Run K\_LL E12-20-008
- Sept 26<sup>th</sup> 2023 to July 19<sup>th</sup> 2024 :
  - Remove BigBite and DAQ
  - Install GEp ECAL and Coordinate Detector and its DAQ.
  - Rearrange the SBS and Bigbite GEMS for GEP GEM configuration
  - Planning on MOLLER phase-1 beamline work
- July 19<sup>th</sup> 2024 to Nov 7 2024: Run GEp
- Nov 7 2024: Start GEp deinstallation and MOLLER installation

# Upcoming 2023 experiments

- Measurement of the Ratio GEn/GMn by the Double-polarized  $^2\text{H}(\vec{e}, e' \vec{n})$  Reaction
  - Outgoing neutron polarization measured by charge exchange
  - Additional polarization measurement using the side detectors
- Polarization Transfer in Wide-Angle Charged Pion Photoproduction (K\_LL)

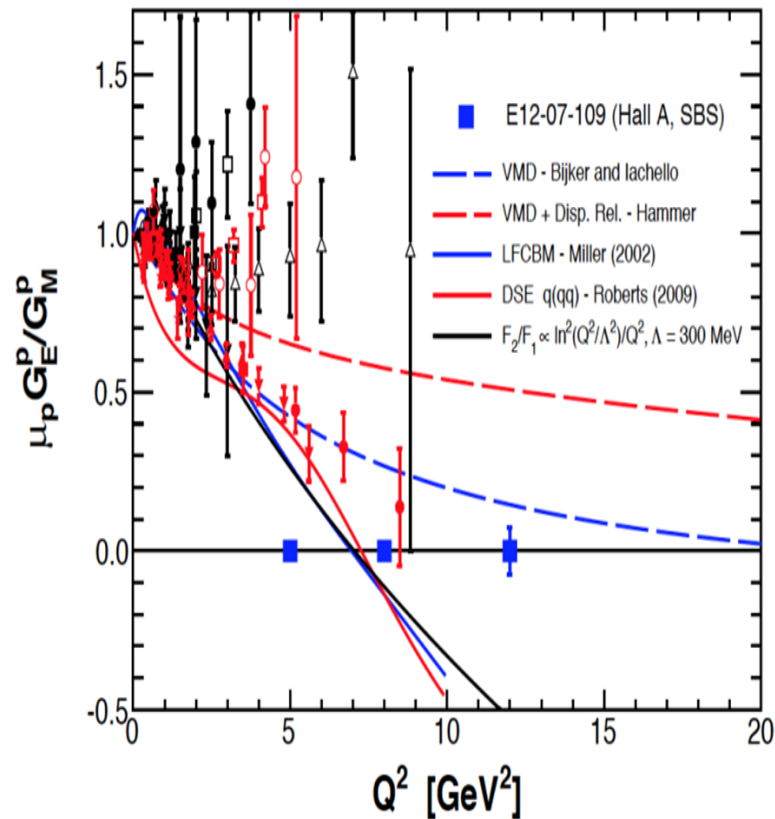


Inline SBS GEMs installed and used in GEn.  
Talk by Holly Szumila-Vance



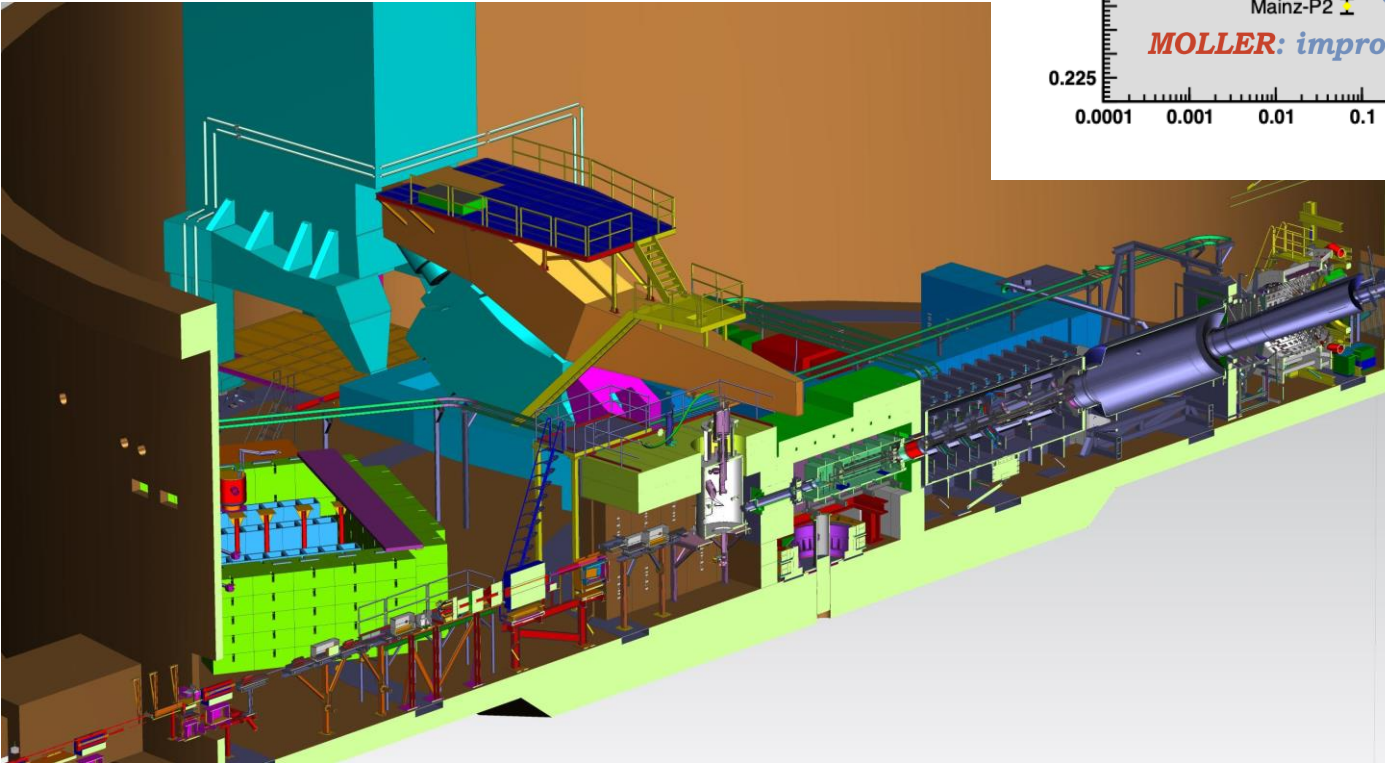
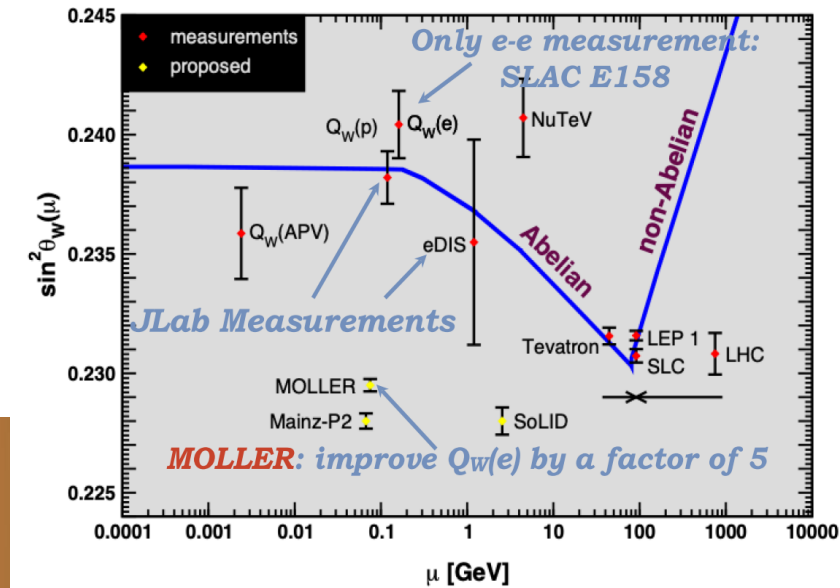
# GEP experiment

- Installation begins in Oct 2023 and ends July 2024
- Experiment runs from July 2024 to Nov 2024
- Measure to  $Q^2 = 12$



# MOLLER Project

- Inflation Reduction Act provided full funding.
- Positive Independent Final Design Review on Dec 5-8<sup>th</sup>.
- Positive DOE/SC CD-3A/Status Review on Jan 12-13<sup>th</sup>.
- MOLLER session on Friday afternoon.

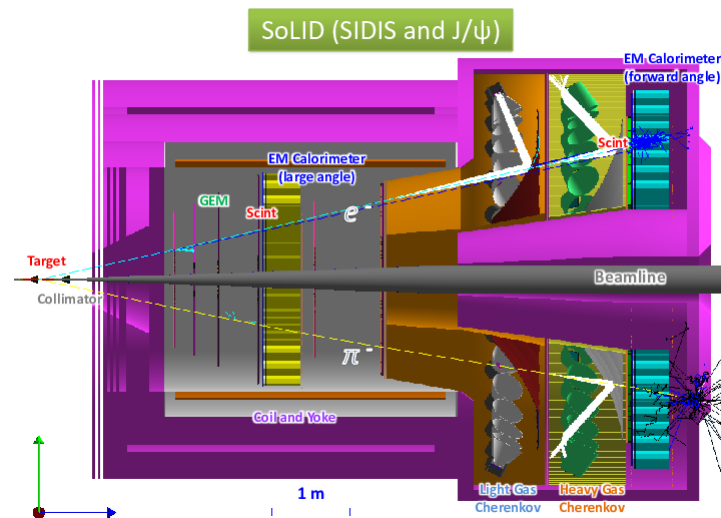
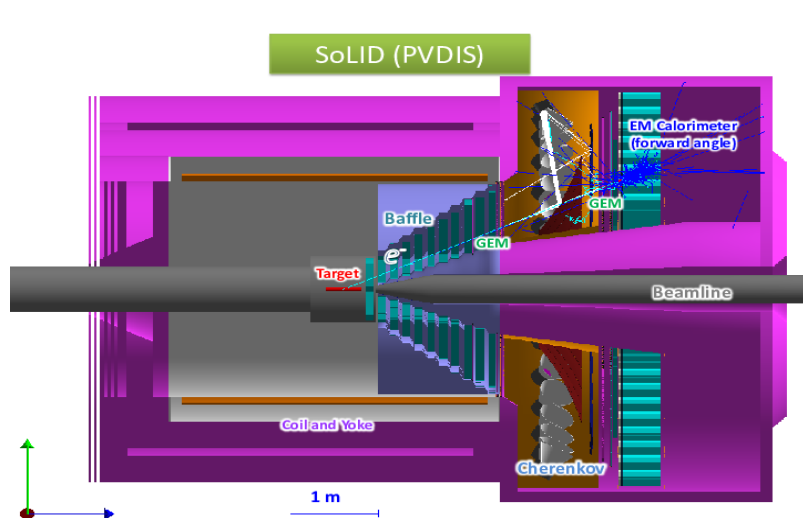




# SoLID : Solenoidal Large Intensity Device

- A series of SIDIS experiments will probe the confined motions (3-D imaging) of partons inside protons and neutrons including orbital motion, and uncover the rich QCD dynamics such as spin-orbital correlations.
- Parity Violating Deep Inelastic Scattering (PVDIS) to search for new interactions beyond the Standard Model.
- $J/\psi$  production near threshold will provide information on the pure gluonic component of QCD

pCDR R&D is being carried out with tests in Hall C. See talk by Xinzhan Bai



Unique Capability:

- ✓ High luminosity ( $10^{37-39}$ )
- ✓ Large acceptance detector with full  $\phi$  coverage
- ✓ State-of-the-Art Technology

# SoLID : Solenoidal Large Intensity Device at the PAC

Five experiments went through PAC jeopardy.

4 retained A rating and one went from A- to A rating

1. *Target Single Spin Asymmetry in Semi-Inclusive Deep-Inelastic Electro Pion Production on a Transversely Polarized  $^3\text{He}$  Target at 8.8 and 11 GeV*
2. *Target Single Spin Asymmetry in Semi-Inclusive Deep-Inelastic ( $e, e' \pi^\pm$ ) Reaction on a Transversely Polarized Proton Target*
3. *Precision Measurement of Parity-Violation in Deep Inelastic Scattering over a Broad Kinematic Range*
4. *Asymmetries in Semi-Inclusive Deep-Inelastic Electro-Production of Charged Pion on a Longitudinally Polarized He-3 Target at 8.8 and 11 GeV*
5. *Near-Threshold Electroproduction of  $J/\psi$  at 11 GeV*

Two additional SoLID proposals presented

1. *First Measurement of the Flavor Dependence of Nuclear PDF Modification Using Parity Violating Deep Inelastic Scattering.* Conditionally approved (C2 , need review by PAC)
2. *Measurement of the Beam Normal Single Spin Asymmetry in Deep Inelastic Scattering using the SOLID Detector.* Approved with A- rating

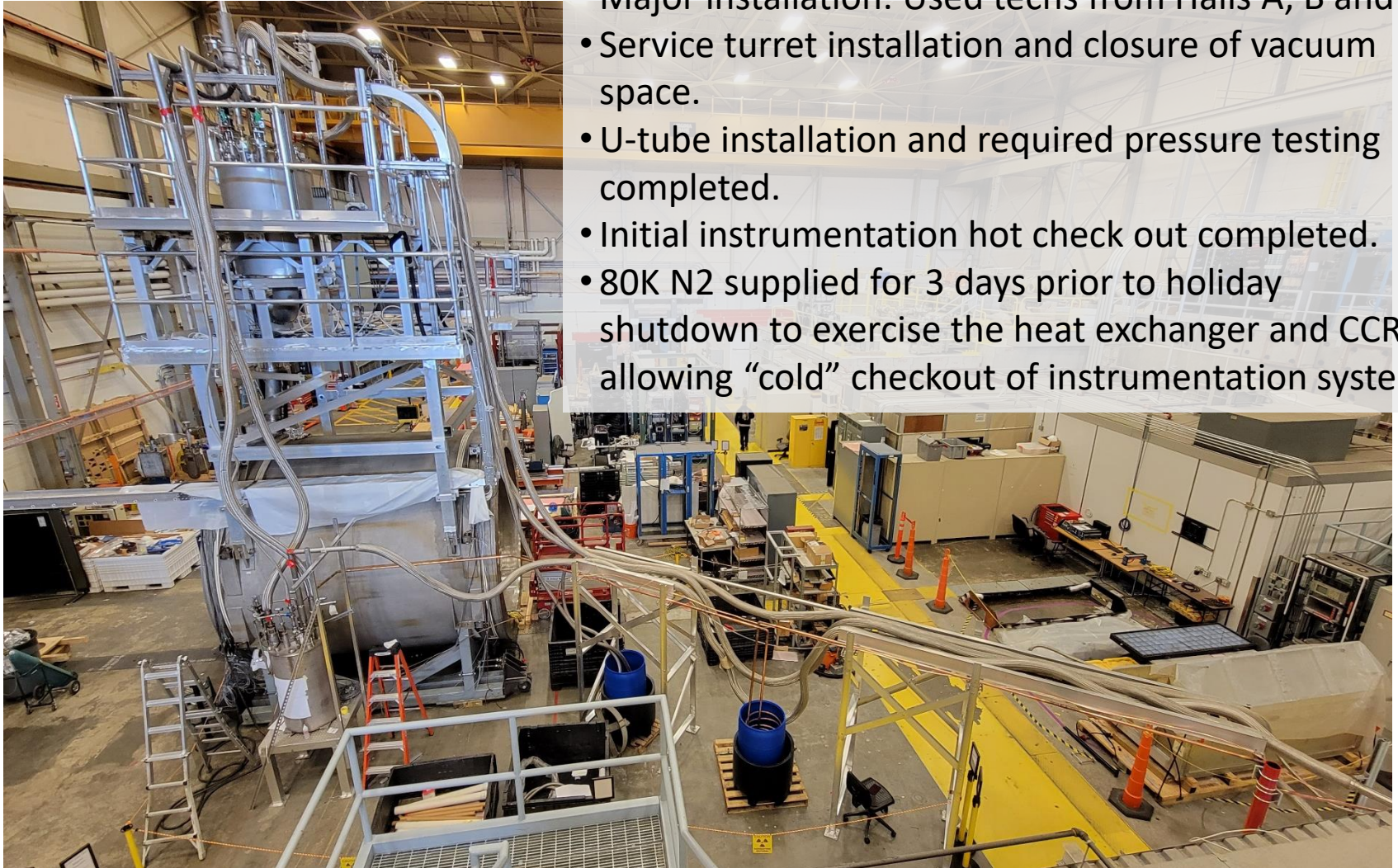
Six Run Group experiments

Session on SoLID physics and detectors on Friday afternoon

# CLEO Magnet Cold Test for SoLID

Installation completed in early December with:

- Major installation: Used techs from Halls A, B and C
- Service turret installation and closure of vacuum space.
- U-tube installation and required pressure testing completed.
- Initial instrumentation hot check out completed.
- 80K N2 supplied for 3 days prior to holiday shutdown to exercise the heat exchanger and CCR allowing “cold” checkout of instrumentation system.





# CLEO Cold Test - Update

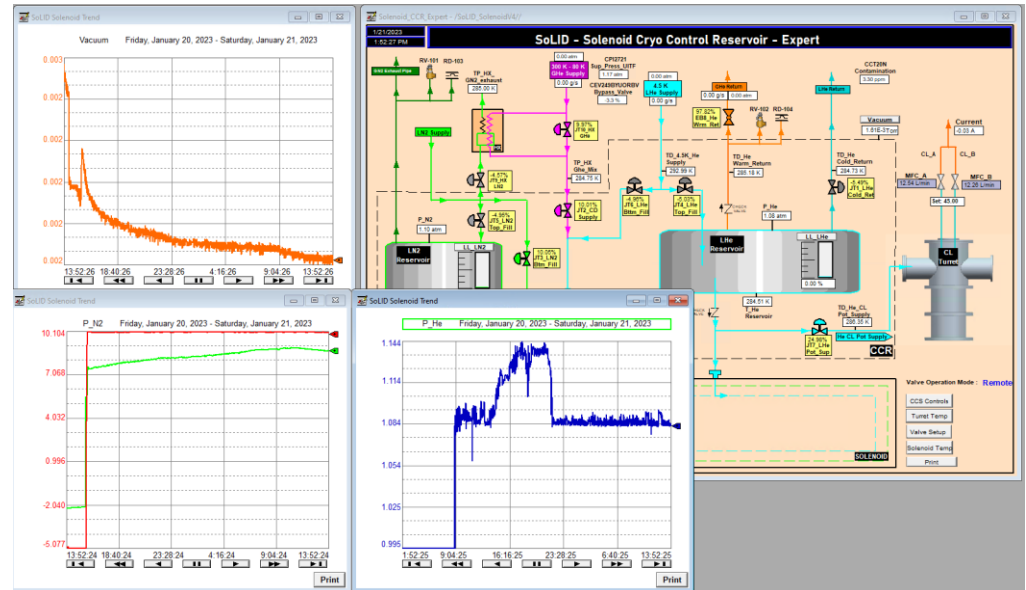
Planned maintenance down of the CTF Dec 21<sup>st</sup> to Jan 23<sup>rd</sup>.

Added heater controllers to the He warm return and N2 vent lines to control ice build up.

Continue to work on vacuum system to improve vacuum quality.

Worked on the instrumentation and controls system to adjust noisy signals and increase the number of signals that are archived.

Added check valve in the nitrogen vent line to prevent cross talk between the heat exchanger and the CCR vent lines.



# CLEO Cold Test - Update

- CTF maintenance down ended Jan 23<sup>rd</sup>
- Cryo line purging started with warm GHe and N2 Jan 20<sup>th</sup>
- Cool down to 80K to start Jan 23<sup>rd</sup> using heat exchanger
- Cool down from 80K to 4K to commence around Feb 5<sup>th</sup> after cryomodule testing is complete.
- 1 to 2 days of power on testing at 100 A
- Warmup to begin no later than Feb 25<sup>th</sup>



# Summary

- Exciting results from experiments: **Attend afternoon session**
  - CREX, APEX, MARATHON,
  - Tritium hypernuclei, Tritium inclusive, DVCS, Coulomb Sum Rule
- SBS form factor experiments are running full steam ahead : **Attend Friday morning session**
  - Neutron Magnetic FF experiment successfully completed. Up to  $Q^2 = 13.5$  w/ 1% error
  - First measurement of Neutron Two Photon Exchange completed
  - Neutron Electric FF using polarized helium target
    - Completed the  $Q^2 = 3.0$  and  $6.8$  kinematics
    - Presently running the  $Q^2 = 9.9$  kinematics
  - **Updated Beam Schedule**
    - April-May 2023 : Install GEn-RP
    - June-July 2023 : Hall A Crane repair
    - August 2023 : Install Cryotarget
    - Sept 2023 : Run GEn-RP and Pion photoproduction  $K_{LL}$
    - Oct 2023 – July 2024 : Install GEp
    - July – Nov 2024 : Run GEp
    - Nov 2024 : Start GEp deinstallation and MOLLER install



# Summary

- MOLLER : **Attend Friday afternoon session**
  - Strong project leadership and strong user collaboration
  - Exciting new physics discovery potential
  - Successful recent set of reviews.
  - Nathan Rider from EES Instrumentation & Controls Systems (EESICS) will give a talk at this meeting.
- SoLID : **Attend Friday afternoon session**
  - A rated experiments covering a range of physics topics
  - Full support of JLab management and working hard to be part of LRP
  - Recommendation form the QCD Town Hall Meeting

## **Recommendation 1: Capitalizing on past investments**

**The highest priority for QCD research is to maintain U.S. world leadership in nuclear science for the next decade by capitalizing on past investments. Maintaining this leadership requires recruitment and retention of a diverse and equitable workforce. We recommend support for a healthy base theory program, full operation of the CEBAF 12-GeV and RHIC facilities, and maintaining U.S. leadership within the LHC heavy-ion program, along with other running facilities, including the valuable university-based laboratories, and the scientists involved in all these efforts.**

This includes the following, unordered, programs:

- The 12-GeV CEBAF hosts a forefront program of using electrons to unfold the quark and gluon structure of visible matter and probe the Standard Model. We recommend executing the CEBAF 12-GeV program at full capability and capitalizing on the full intensity potential of CEBAF by the construction and deployment of the Solenoidal Large Intensity Device (SoLID).

Looking for some fun?

# TABLE TENNIS, ANYONE?

## JOIN US!



Open to the JLab community,  
Monday – Friday, in CEBAF Center rm. F117

Contact Andrew Seitz at [seitz@jlab.org](mailto:seitz@jlab.org)  
for equipment and coordination.

