Recent Progress of Studying Nucleon Structure at Jefferson Lab

Selected Highlights in 2025-2026

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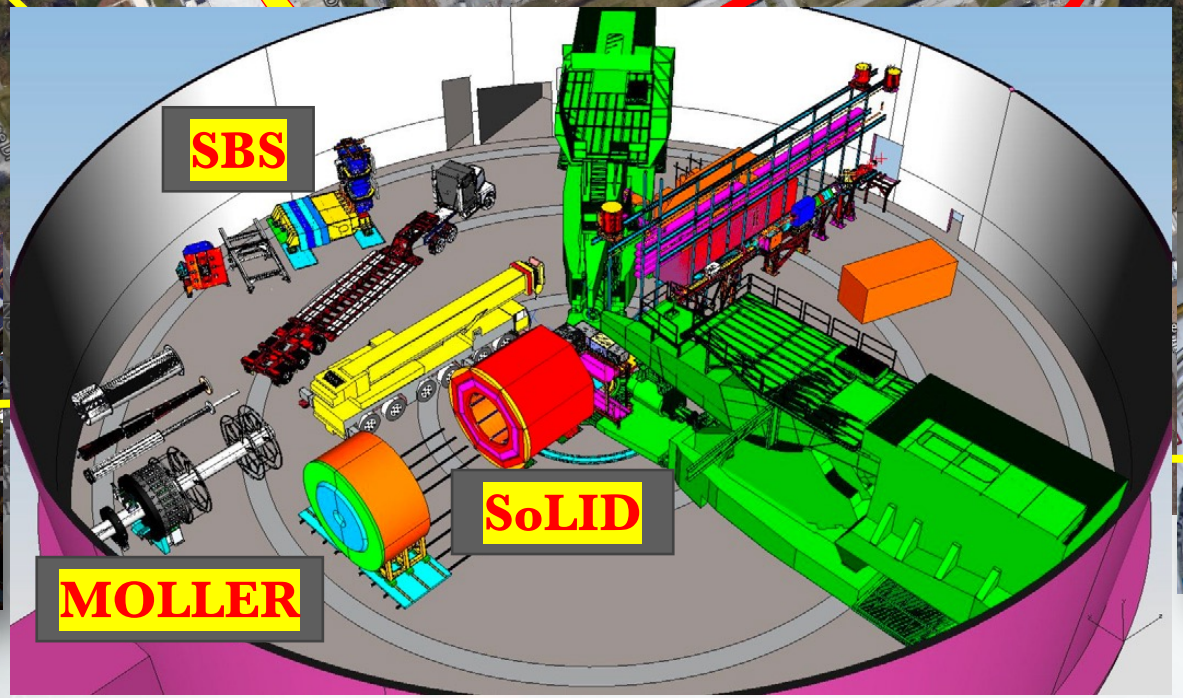
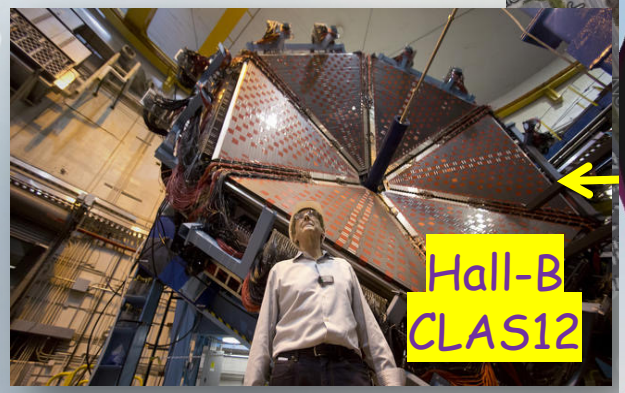
EIC-Asia Workshop on QCD and Hadron Structure
04/29-05/01,2026, Academia Sinica, Taipei

Tsinghua University

Jefferson Lab Overview

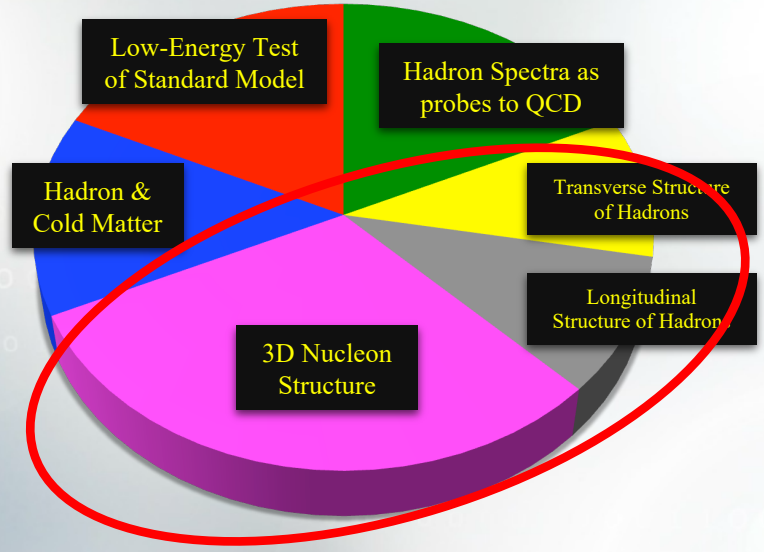
CEBAF



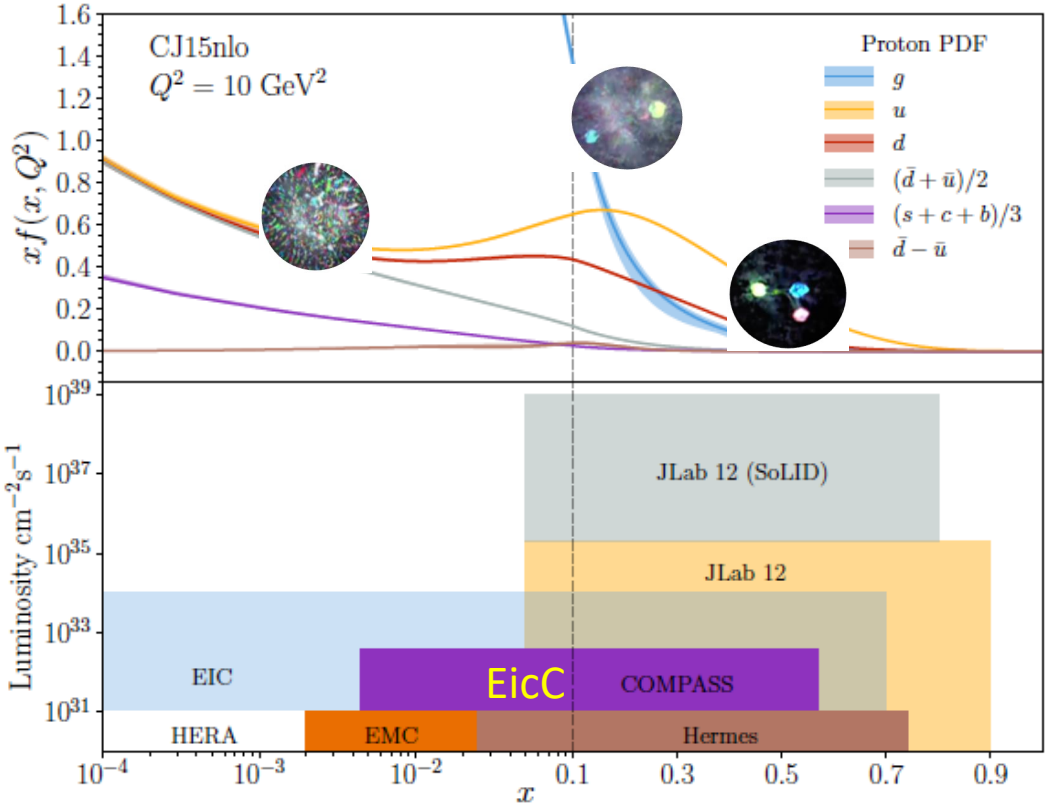


Jefferson Lab Overview

- **Features**: High luminosity (10^{39} $cm^{-2}s^{-1}$); polarized beam & targets; high-precision detectors; four halls operation simultaneously; 10.6GeV/c for Hall A&B&C, 12GeV/c (to ~8GeV photons) for Hall-D
- **Top Missions**:
  - ✓ Explore hadronic structure and interactions in nuclei (EMC, SRC, Hypernuclei, etc.)
  - ✓ Discover evidence for physics BSM (PVDIS, beam-dump experiments)
  - ✓ Explore the fundamental nature of confined states quarks and gluons (from 1D to 3D, Exotic Hadrons)



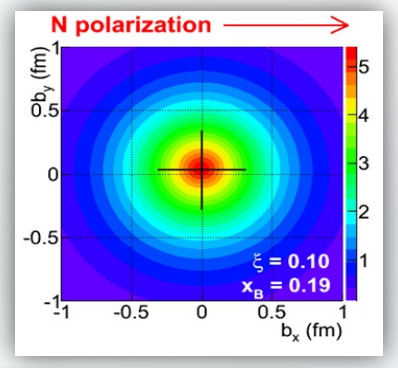
- JLab kinematic probe partonic structure in valance quark region (non-pQCD)

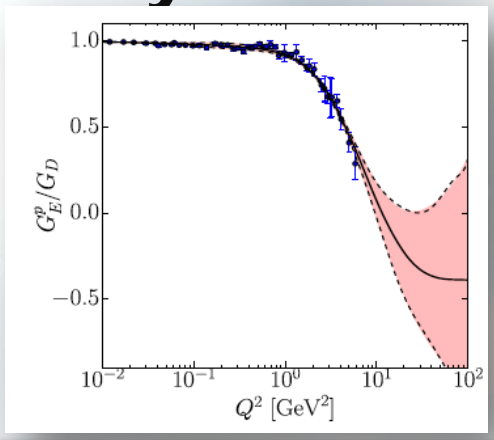


*Prog. Part. Nucl. Phys.*127 (2022) 103985

Overview of Nucleon Structure Study

Nucleon Polarization	Quark Polarization: Unpolarized (U)	Longitudinally Polarized (L)	Transversely Polarized (T)
U	H		$2\widetilde{H}_T + E_T$
L		$\widetilde{H}$	$\widetilde{E}_T$
T	E	$\widetilde{E}$	$H_T, \widetilde{H}_T$





High-Energy Probes

5D

$\psi(\vec{x}, \vec{k}, t)$

$W_p^u(x, k_\perp, r_T)$ Wigner distributions

$d^2 k_\perp$

$d^2 r_\perp$

Generalized Parton Distribution (GPD)

Form Factors $G_E(Q^2)$, $G_M(Q^2)$

3D

$d^2 r_\perp$

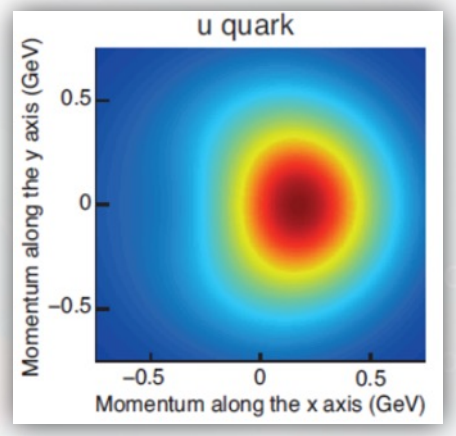
1D

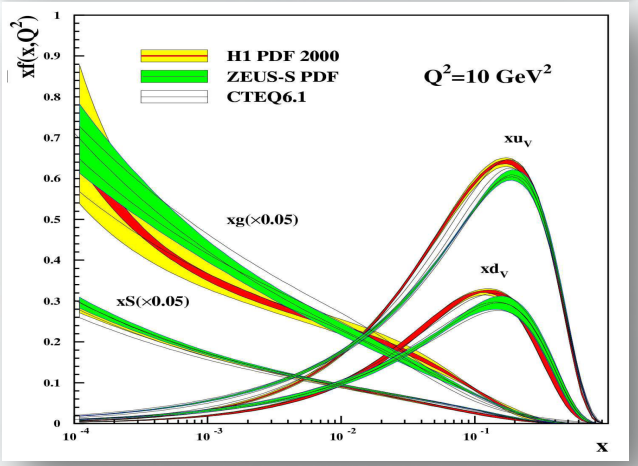
Transverse Momentum Distribution (TMD)

$d^2 k_\perp$

Parton Distribution Functions, $f_1^u(x)$, $g_1^u(x)$, $h_1^u(x)$

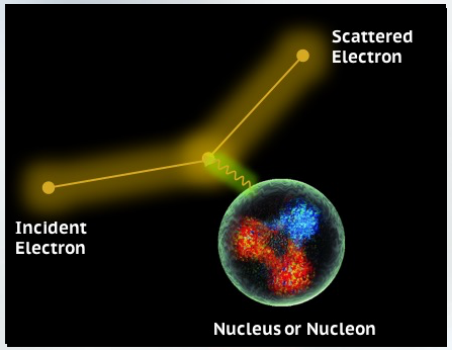
Leading Twist TMDs	Nucleon Polarization	Quark Polarization: Unpolarized (U)	Longitudinally Polarized (L)	Transversely Polarized (T)
	U	$f_1(x,k_T^2)$ Unpolarized		$h_1^\perp(x,k_T^2)$ Boer-Mulders
	L		$g_1(x,k_T^2)$ Helicity	$h_{1L}^\perp(x,k_T^2)$ Long-Transversity
	T	$f_{1T}^\perp(x,k_T^2)$ Sivers	$g_{1T}(x,k_T^2)$ Trans-Helicity	$h_1(x,k_T^2)$ Transversity; $h_{1T}^\perp(x,k_T^2)$ Pretzelosity



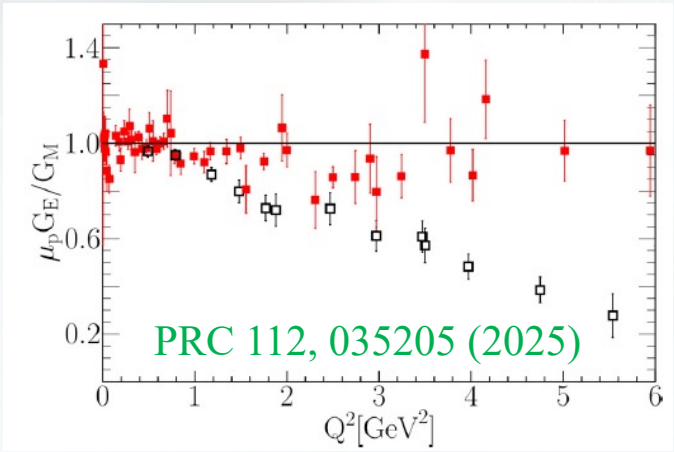


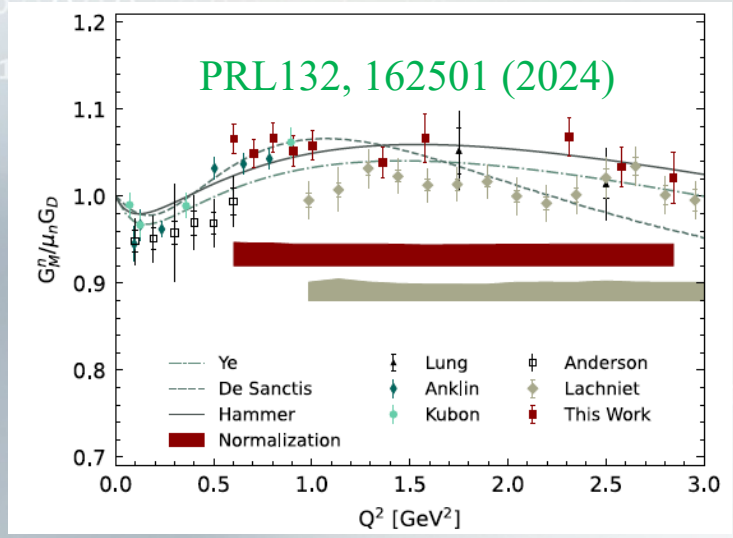
Form-Factors

- e/p & e/n elastic scattering cross-sections: $\frac{d\sigma}{d\Omega} = \left(\frac{d\sigma}{d\Omega}\right)_{\text{Mott}} \frac{1}{1+\tau}\left[(G_E^p(Q^2))^2 + \frac{\tau}{\epsilon}(G_M^p(Q^2))^2\right]$
- Form-factors link to charged distributions: $G_{E,M}^p(Q^2) = \int \left(1 + i\vec{q}\cdot\vec{x} - \frac{(\vec{q}\cdot\vec{x})^2}{2} + \ldots\right)\rho_{E,M}^p(\vec{x})d^3x$
- Precisely measured since 1950s
  - ✓ Most recent global analysis: PLB777, 8-15 (2018)

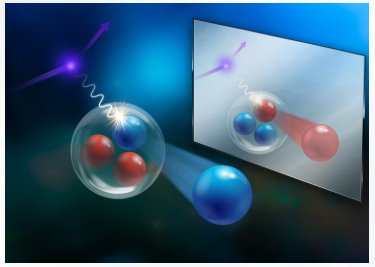


- **Focus now**: protons FFs at very high-Q2 &low-Q2 (radii), neutron-FFs
- Newly extracted proton FFs up to 4.1GeV^2 from old Hall-C data
- Newest neutron FF results from Tritium@Hall-A



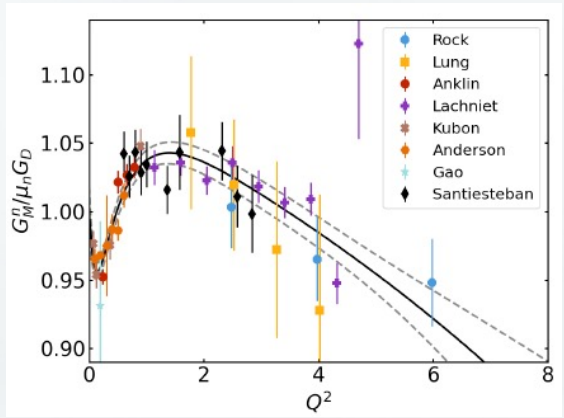


$$R = \sigma_{^3\text{H}}/\sigma_{^3\text{He}} \approx R_{\text{Free}} = (\sigma_{ep} + 2\sigma_{en})/(2\sigma_{ep} + \sigma_{en})$$



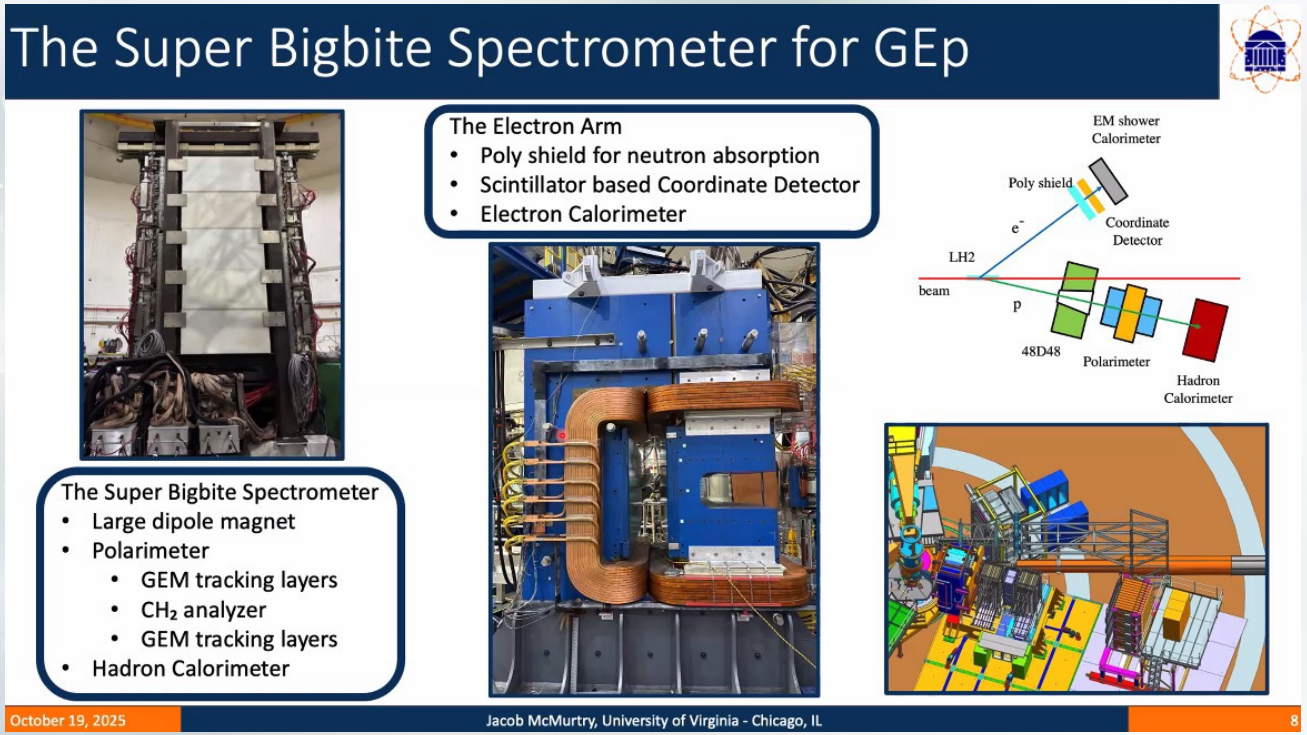
- Updated global fits underway

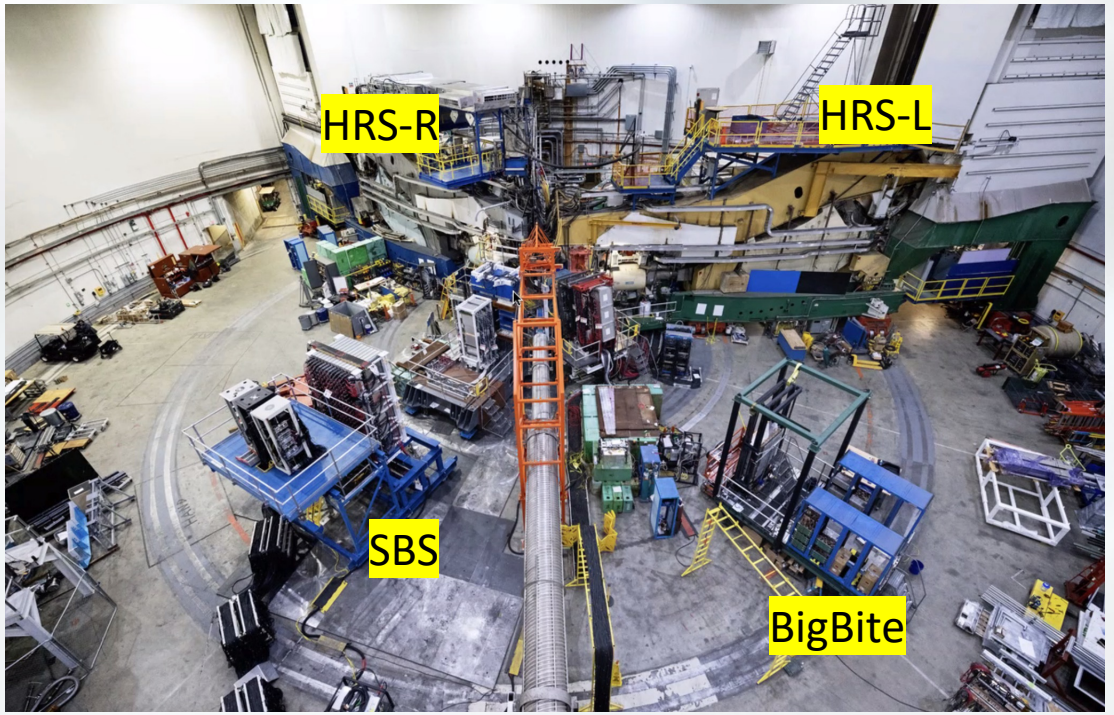
arXiv:2501.18443



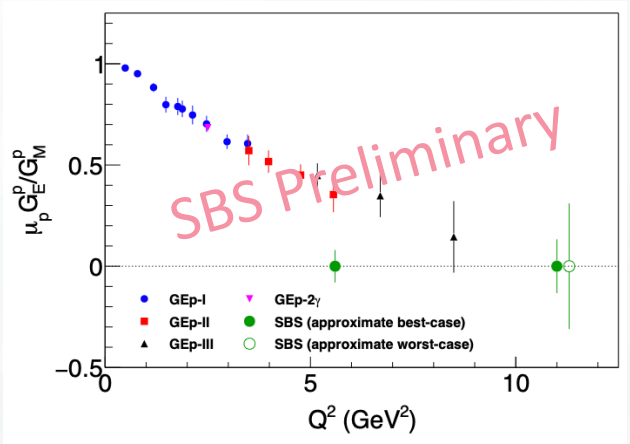
Form-Factors

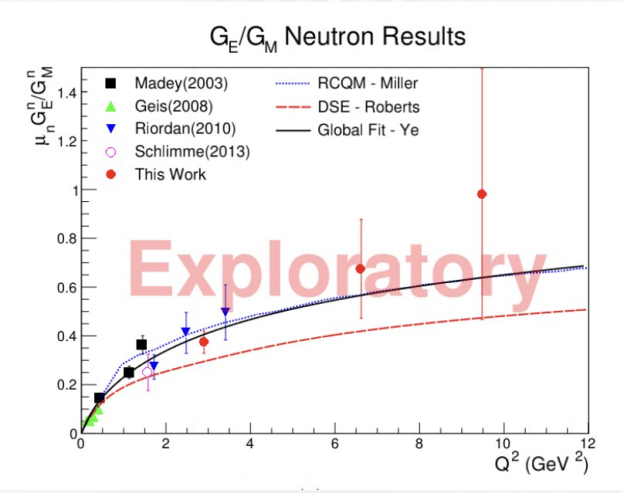
- Hall-A SBS aim to measure FF at high-Q2





- Data partially taken (Aug 2025);
- New FF data to be taken in 2028



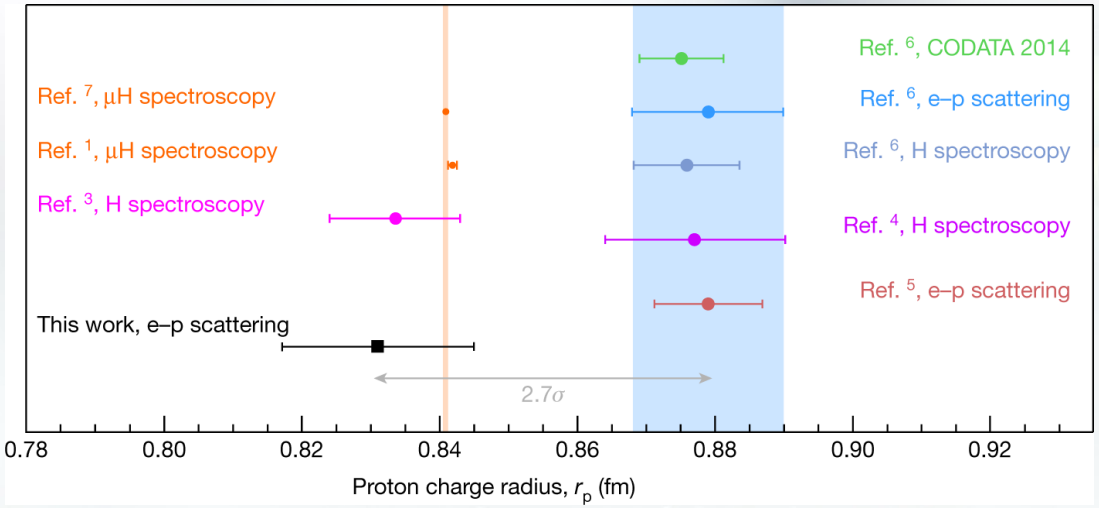


Proton Charged Radius

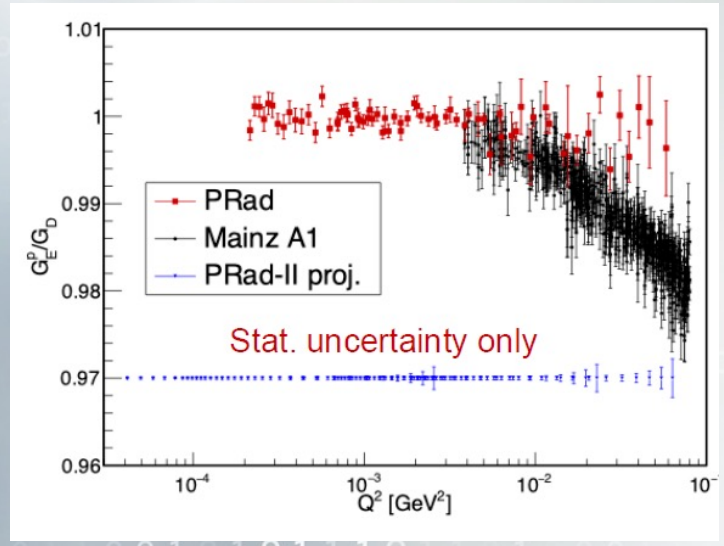
- Proton charged radius can be extrapolated via low-Q2 FF data

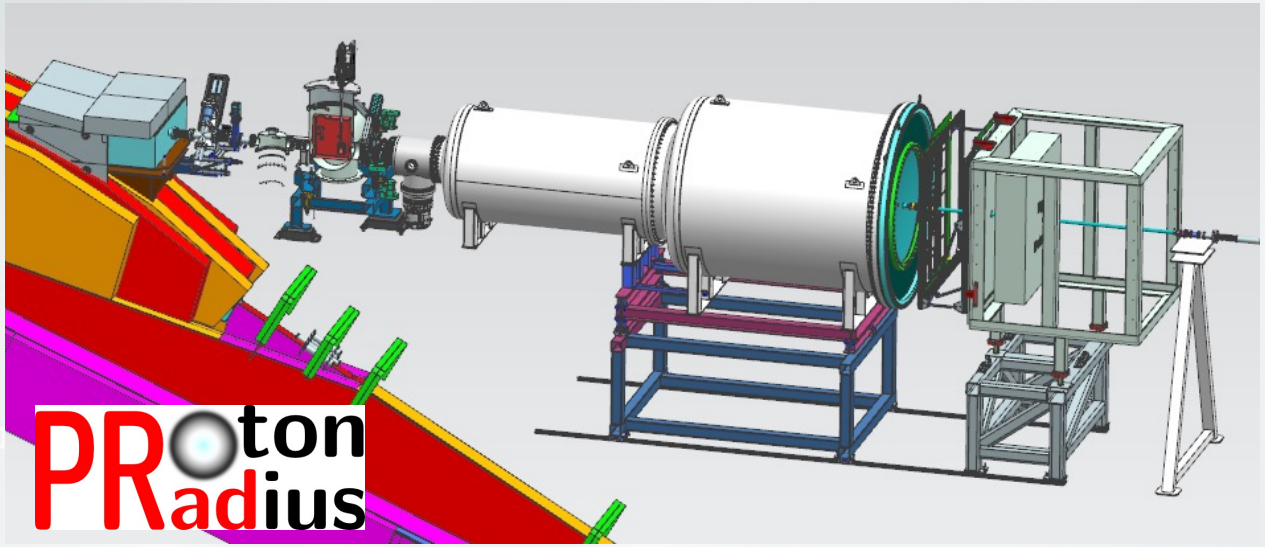
$$r_p \equiv \left(-6 \left. \frac{dG_E(Q^2)}{dQ^2} \right|_{Q^2=0} \right)^{1/2}$$

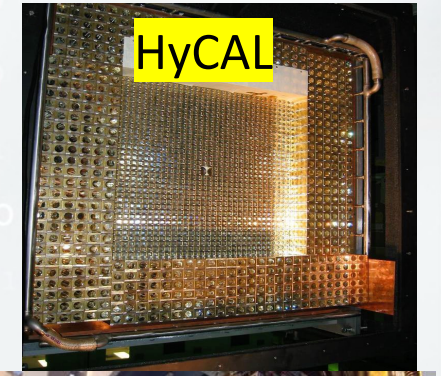
Xiong, et. al. *Nature* **575**, 47–150 (2019) [JLab]



- PRAD-I result conformed a smaller radius
- PRAD-II aims for completely resolving proton radius puzzle (running now!)





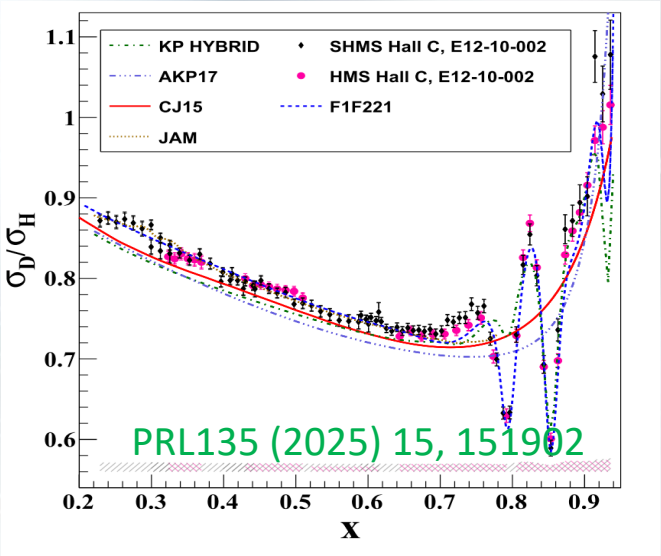


Parton Distribution Function (PDFs)

❑ DIS cross-section to F2, hence to PDF sum:

$$\frac{d^2\sigma}{d\Omega dE'} = \sigma_{\text{Mott}} \frac{2MxF_2}{Q^2\varepsilon}\left(\frac{1+\varepsilon R}{1+R}\right) \qquad F_2(x) = x\Sigma_i e_i^2 f_i(x)$$

✓ $R = \sigma_L/\sigma_T$, link to mass/high-twist/P_T-motion; Rosenbluth separation needed; Small at Q2>10GeV^2 or x>0.5

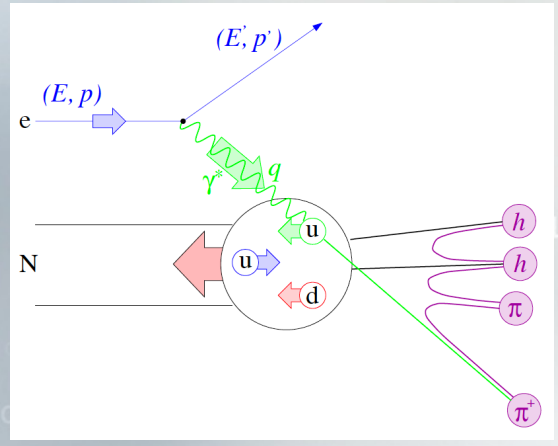


❑ Hall-C E12-10-002 experiment recently extract σ_D/σ_H at large x

✓ ^{2}D (effective "n") need high-precision data for nuclear-correction (incl. R)

❑ Measure *R* in SIDIS **π** cross-section (E12-06-104/E12-24-001):

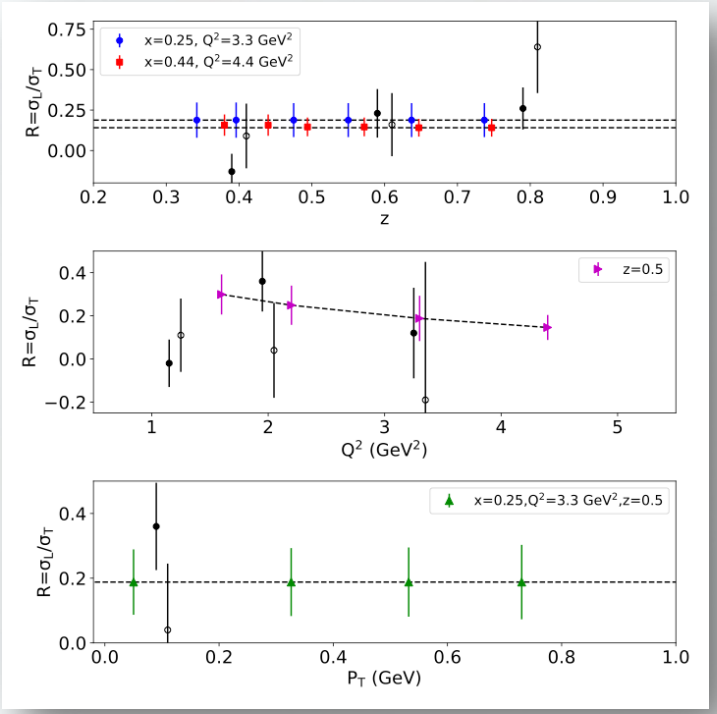
$$d\sigma_{SIDIS} \propto F_{UU,T}(x, Q^2, z, P_{hT}) + \epsilon F_{UU,L}(x, Q^2, z, P_{hT}) \qquad R_{SIDIS} = \frac{F_{UU,L}}{F_{UU,T}}$$



- Diff. from DIS
- Could be big and flavor-dep.
- Difficult in Rosenbluth separation

✓ completed run in 2025-2026@ Hall-C

✓ More R measurements in 2026/2027



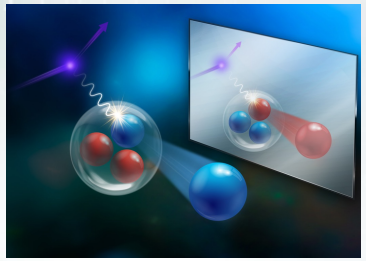
Quark PDFs at High-x

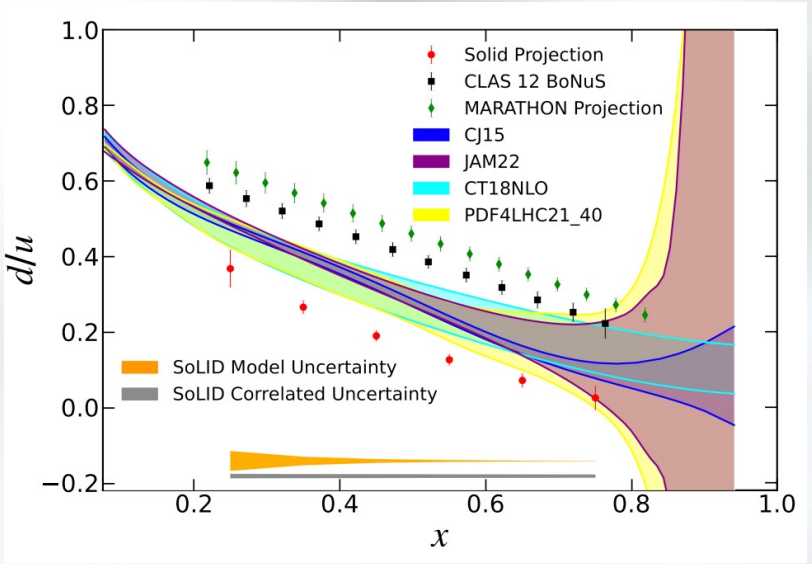
- Precision measurements of the F2n/F2p ratios to extract d/u at x→1;
  - ✓ Test QCD models!

- Hall-A MARATHON utilized mirror 3H and 3He targets (done in 2017)

$$\frac{F_2^n}{F_2^p} = \frac{2\mathcal{R} - F_2^{^3\mathrm{He}}/F_2^{^3\mathrm{H}}}{2F_2^{^3\mathrm{He}}/F_2^{^3\mathrm{H}} - \mathcal{R}}$$

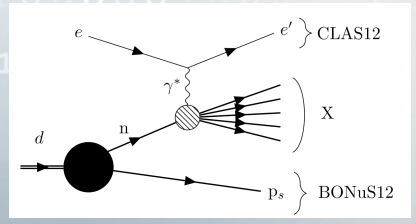
MARATHON, PRL**128**, 132003 (2022)

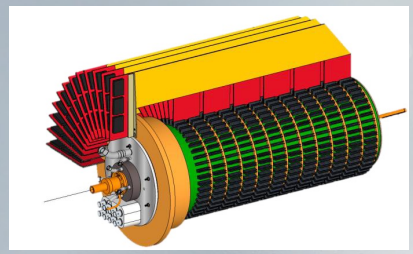


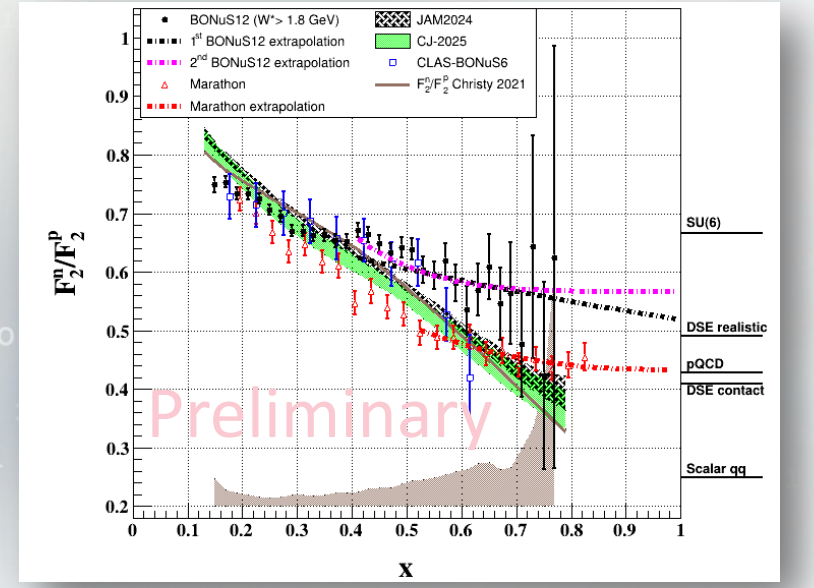


- Hall-B detector recoil proton from eD scattering (BoNUS+CLAS);

- New data in 2020 w/ BoNUS12 + CLAS12 →published soon



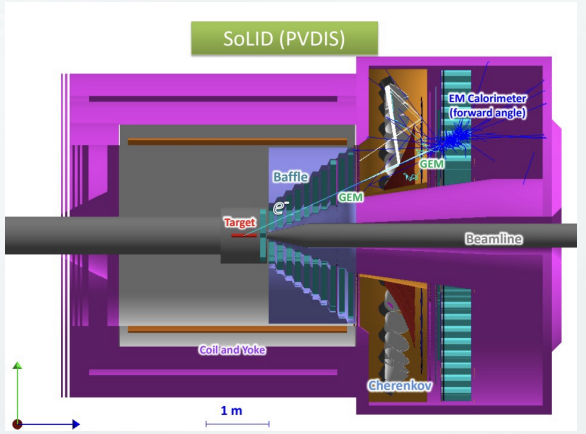




- Future: PVDIS w/ SoLID (only proton target needed!)

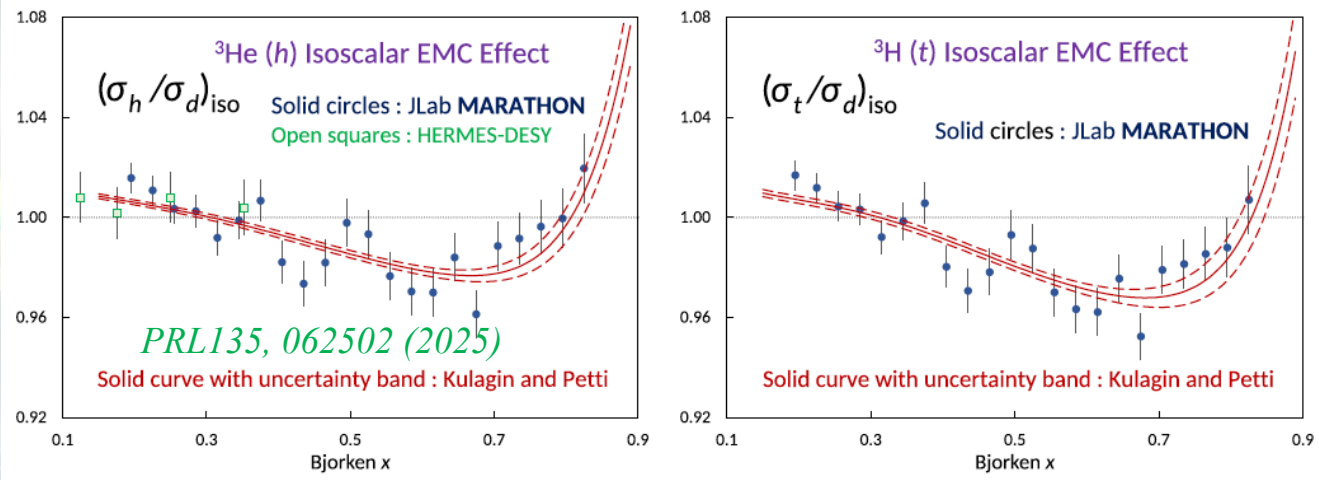
$$a_1^p(x) = \left[\frac{12C_{1u}u(x) - 6C_{1d}d(x)}{4u(x) + d(x)}\right]$$

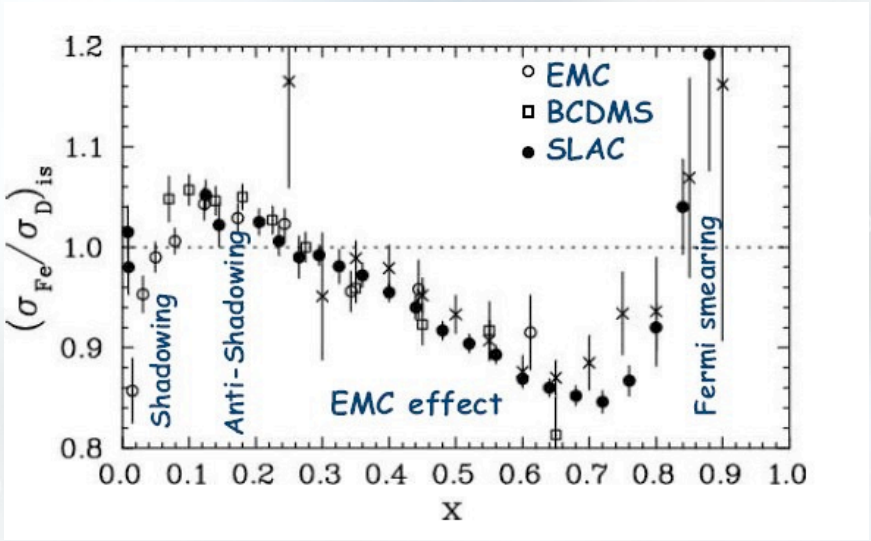
$$\sim \left[\frac{u(x) + 0.912d(x)}{u(x) + 0.25d(x)}\right]$$



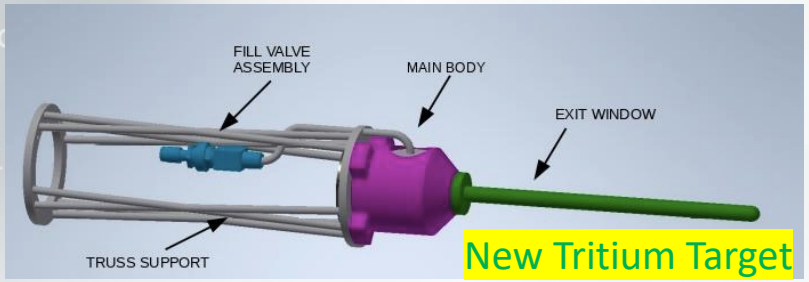
PDFs in Nuclei

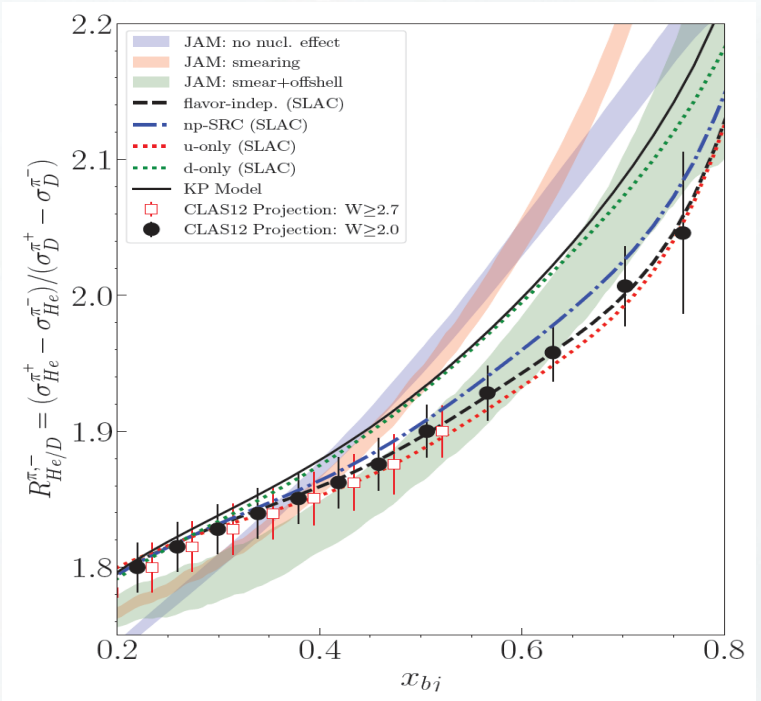
- 1D Partonic Structure in heavy nuclei shows EMC effect
  - 40 years of puzzle waiting to be answer
- Quark PDFs in light nuclei (A=3) is also likely to be modified





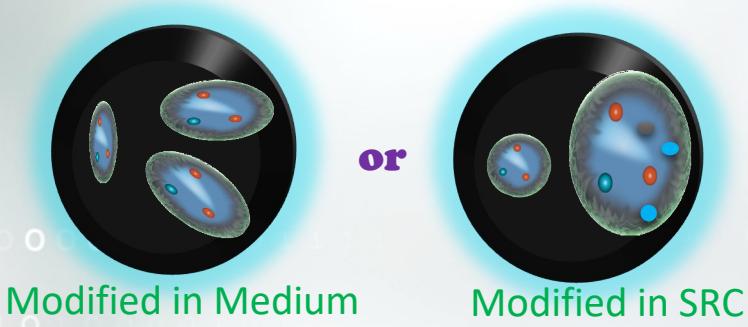
- Flavor-dependent EMC effect: which quark is modified more?
  - ✓ Second generation Tritium experiment: SIDIS w/ CLAS12
  - ✓ C12-21-004, updated proposal submitted to 2026 PAC



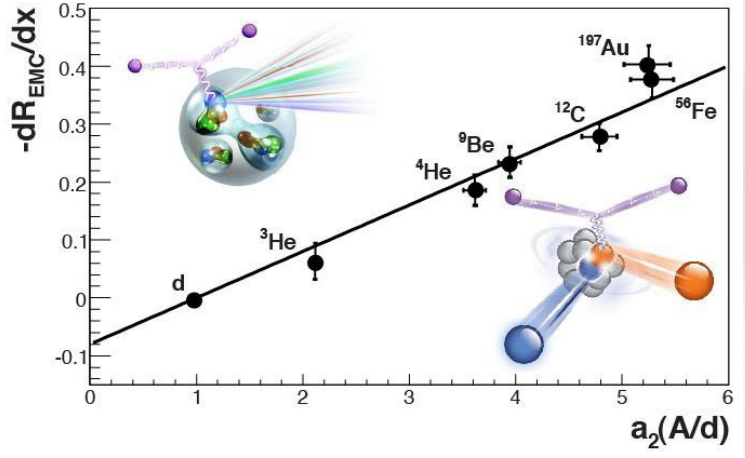


PDFs in Nuclei

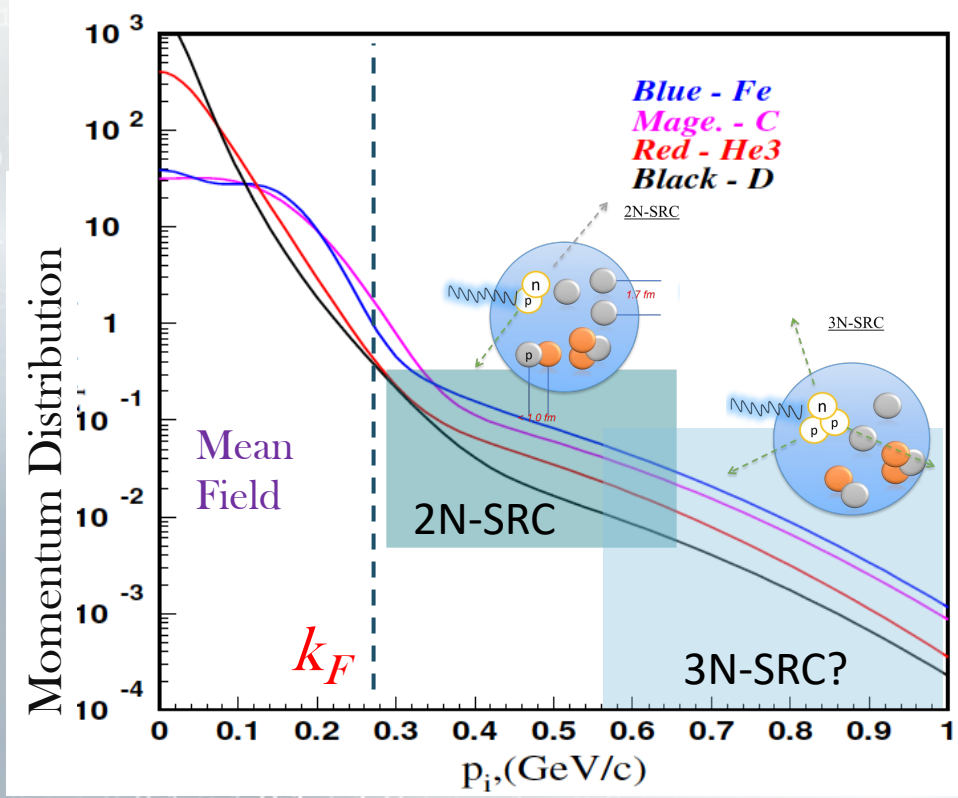
❑ EMC link to the SRC?



L. Weinstein et al, PRL 106, 052301 (2011)



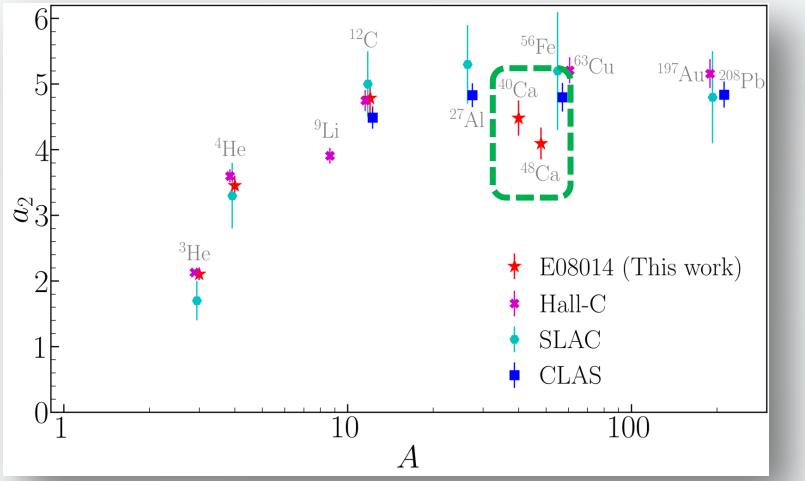
❑ Short Range Correlations (SRC):

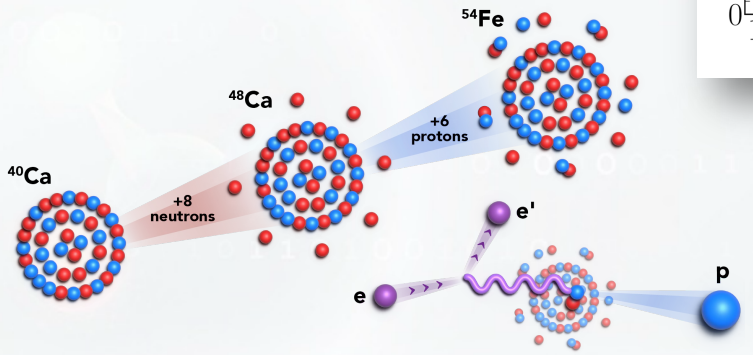


✓ Probability of 2N-SRC vs A (E08-014, Hall-A):

$$a_2(A,D) = \frac{2}{A}\frac{\sigma_A(x,Q^2)}{\sigma_D(x,Q^2)},$$

Y.P. Zhang et.al.,PLB 872 (2026) 140087

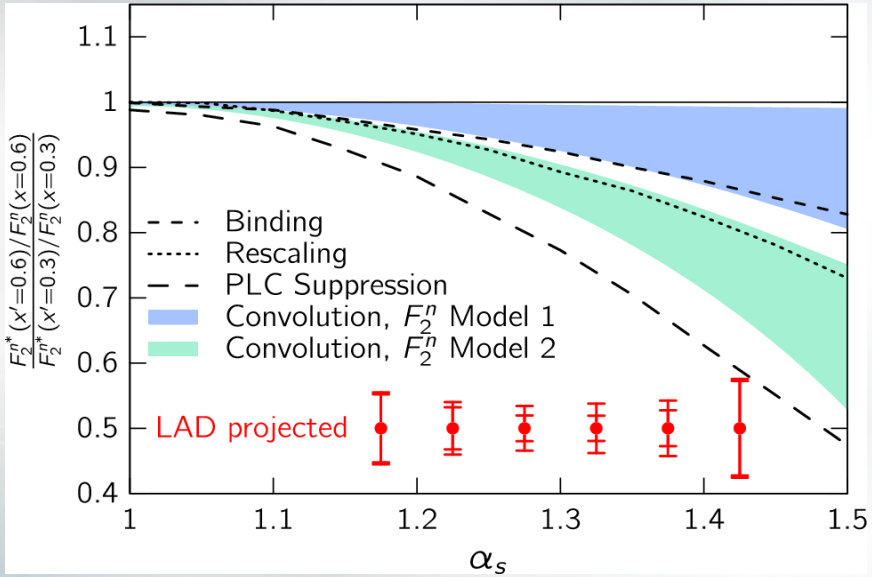


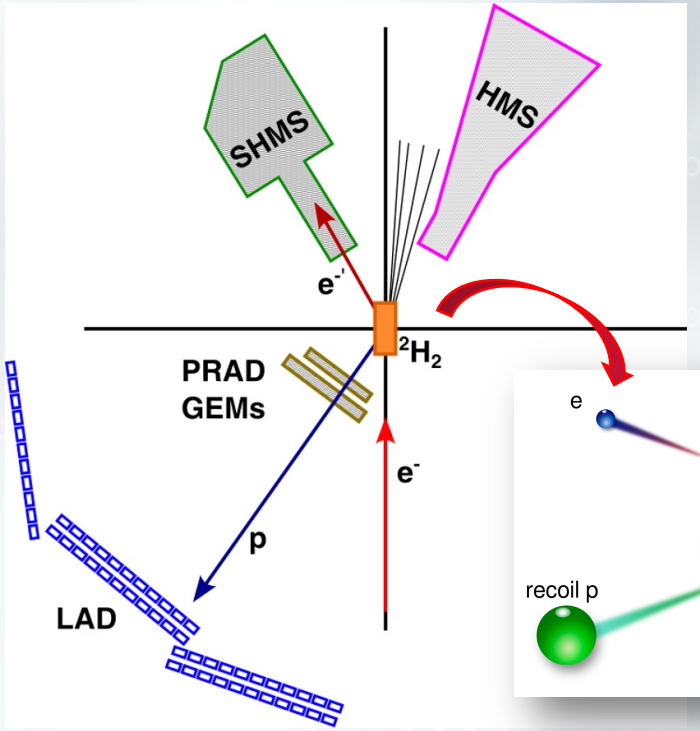


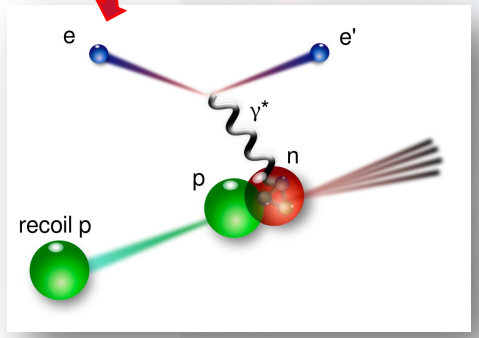
✓ CaFe in Hall-C (accepted by Nature)

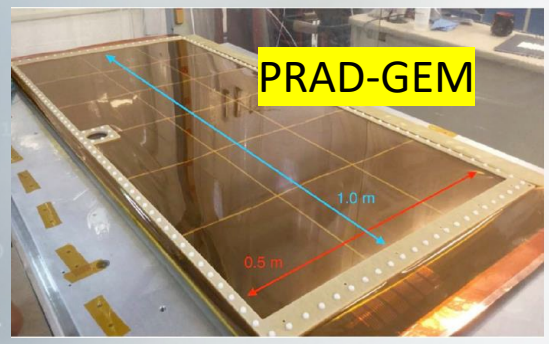
PDFs in Nuclei

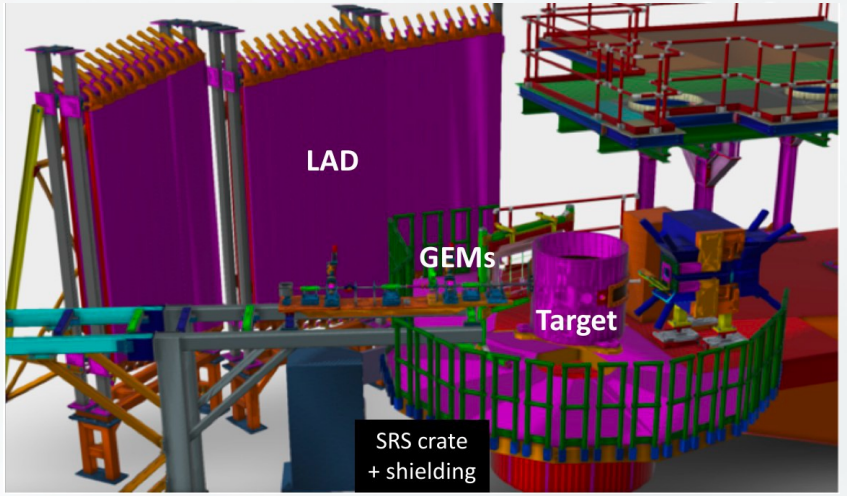
- Tagged DIS w/ D2 using LAD @ Hall-C
  - ✓ LAD to detect high-P spectator proton
  - ✓ Completed in mid 2025; Analyzing data now





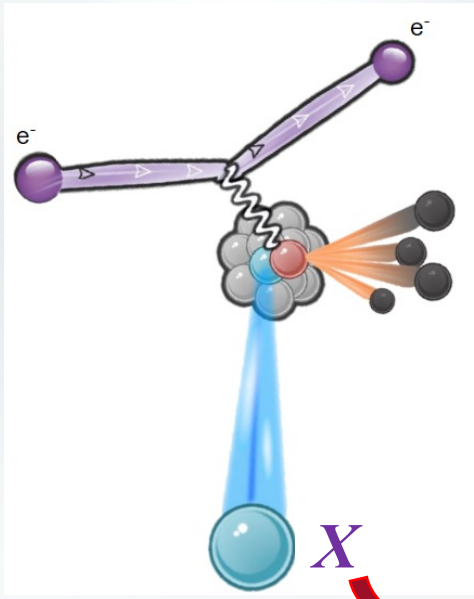


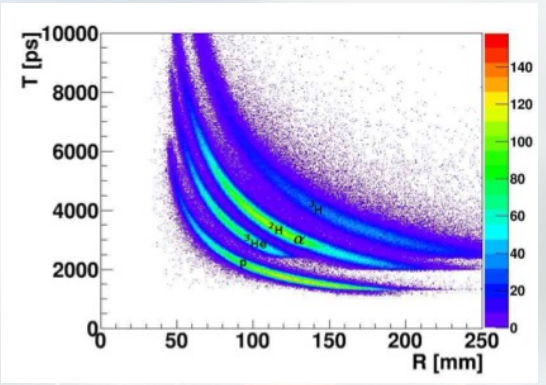




PDFs in Nuclei

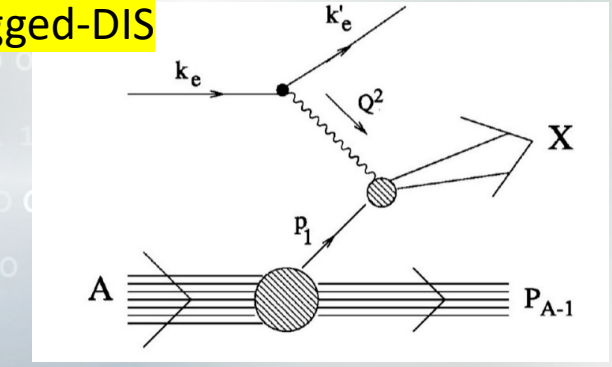
- Tagged DIS & SRC w/ He4 using ALERT@CLAS12,Hall-B
  - ✓ ALERT to detect low-P spectator proton
  - ✓ Measure EMC @10.6GeV (+ DVCS)
  - ✓ Measure SRC @6.6GeV
  - ✓ Completed in late 2025; Analyzing data now



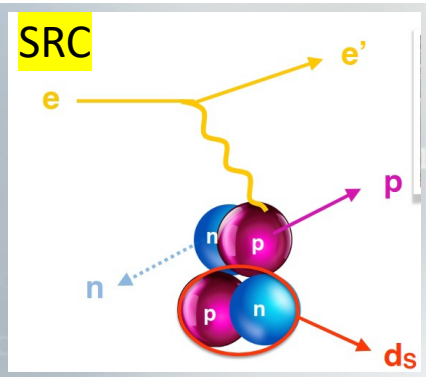


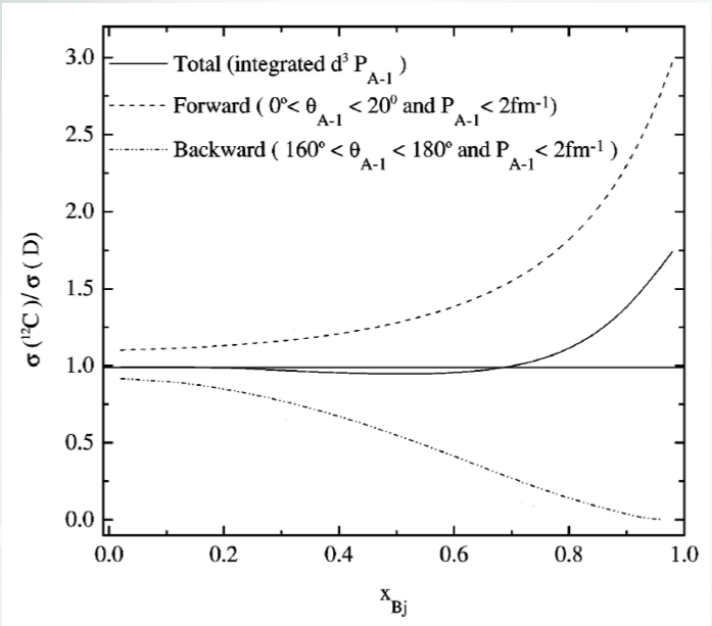
ALERT Recoil Detector

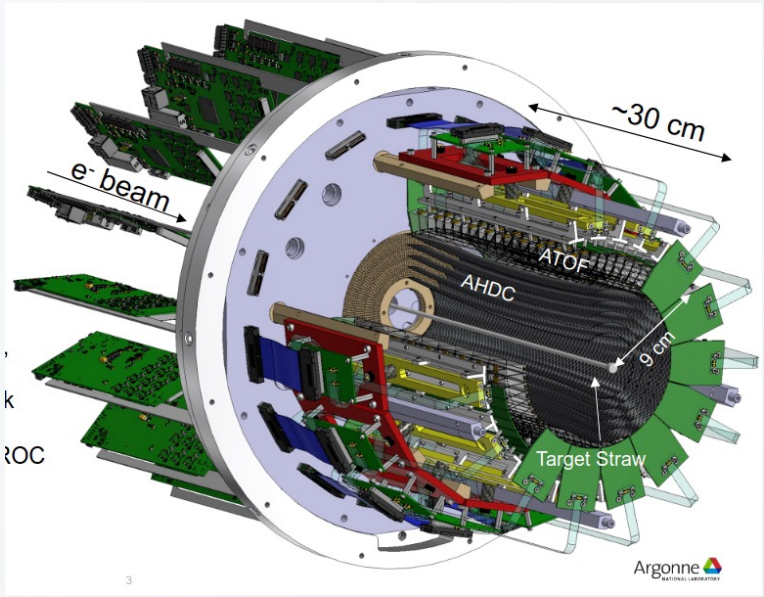
Tagged-DIS



SRC







TMDs

❑ Transverse Momentum Distribution Functions (TMDs)

- ✓ 3D parton distribution in spatial space in momentum space
- ✓ Link to spin and orbital angular momenta
- ✓ 8 Leading Twist TMD, many more high-twist

❑ Semi-Inclusive Deep Inelastic Scattering (SIDIS)

- ✓ Beam &/ Target spin asymmetries link to TMD modules
- ✓ TMD & Fragmentation Function needed to decoupled

$$A_{UT}(\varphi_h^l,\varphi_S^l)=\frac{1}{P}\frac{N^{\uparrow}-N^{\downarrow}}{N^{\uparrow}+N^{\downarrow}}$$
$$=A_{UT}^{Collins}\sin(\phi_h+\phi_S)+A_{UT}^{Sivers}\sin(\phi_h-\phi_S)$$
$$+A_{UT}^{Pretzelosity}\sin(3\phi_h-\phi_S)$$

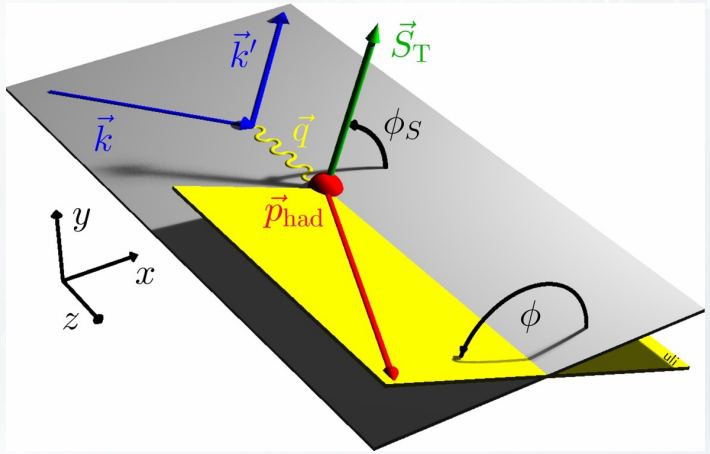
UT: **U**npolarized beam
+ **T**ransversely polarized target

- Transversity $A_{UT}^{Collins}\propto\langle\sin(\phi_h+\phi_S)\rangle_{UT}\propto h_1\otimes H_1^{\perp}$
- Sivers $A_{UT}^{Sivers}\propto\langle\sin(\phi_h-\phi_S)\rangle_{UT}\propto f_{1T}^{\perp}\otimes D_1$
- Prezelosity $A_{UT}^{Pretzelosity}\propto\langle\sin(3\phi_h-\phi_S)\rangle_{UT}\propto h_{1T}^{\perp}\otimes H_1^{\perp}$
- Worm-Gear $A_{LT}^{Worm-Gear}\propto\langle\cos(\phi_h-\phi_s)\rangle_{LT}\propto g_{1T}\otimes D_1$

8 Quark-TMDs (leading twist)

Leading Twist TMDs		Quark Polarization: Unpolarized (U)	Longitudinally Polarized (L)	Transversely Polarized (T)
Nucleon Polarization	U	$f_1(x,k_T^2)$ Unpolarized		$h_1^{\perp}(x,k_T^2)$ Boer-Mulders
	L		$g_1(x,k_T^2)$ Helicity	$h_{1L}^{\perp}(x,k_T^2)$ Long-Transversity
	T	$f_{1T}^{\perp}(x,k_T^2)$ Sivers	$g_{1T}(x,k_T^2)$ Trans-Helicity	$h_1(x,k_T^2)$ Transversity; $h_{1T}^{\perp}(x,k_T^2)$ Pretzelosity

$$f_1(x)=\int d^2\boldsymbol{k}_{\perp}\, f_1(x,k_{\perp})$$
$$g_1(x)=\int d^2\boldsymbol{k}_{\perp}\, g_{1L}(x,k_{\perp})$$
$$h_1(x)=\int d^2\boldsymbol{k}_{\perp}\,[h_{1T}(x,k_{\perp})+\tfrac{k_{\perp}^2}{2M^2}h_{1T}^{\perp}(x,k_{\perp})]$$



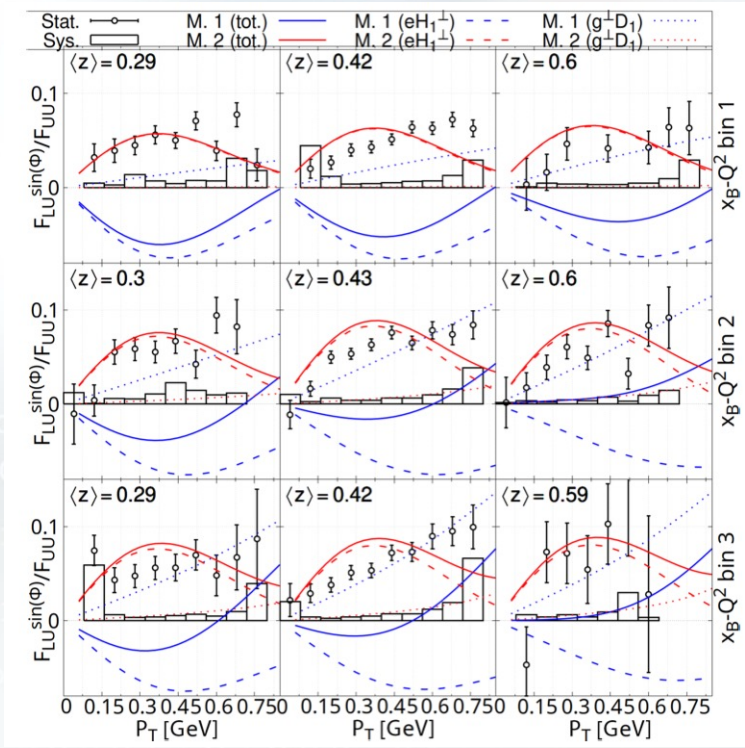
TMDs w/ CLAS12

- 10.6 GeV SIDIS in kaon production w/ polarized beam @CLAS12
  - ✓ Map out z and PT dependent in $F_{LU}^{sin\phi}$ PRC, 112, 055202 (2025)

$$A_{LU}(z, P_T, x_B, Q^2, \phi) = \frac{d\sigma^+ - d\sigma^-}{d\sigma^+ + d\sigma^-} = \frac{A_{LU}^{\sin\phi} \sin\phi}{1 + A_{UU}^{\cos\phi} \cos\phi + A_{UU}^{\cos 2\phi} \cos 2\phi},$$

$$F_{LU}^{\sin\phi} = \frac{2M}{Q}\kappa\left[-\frac{\hat{\boldsymbol{h}}\boldsymbol{k}_T}{M_h}\left(xeH_1^\perp + \frac{M_h}{M} f_1 \frac{\tilde{G}^\perp}{z}\right) + \frac{\hat{\boldsymbol{h}}\boldsymbol{p}_T}{M}\left(xg^\perp D_1 + \frac{M_h}{M} h_1^\perp \frac{\tilde{E}}{z}\right)\right].$$

Twist-3 Boer-Mulder



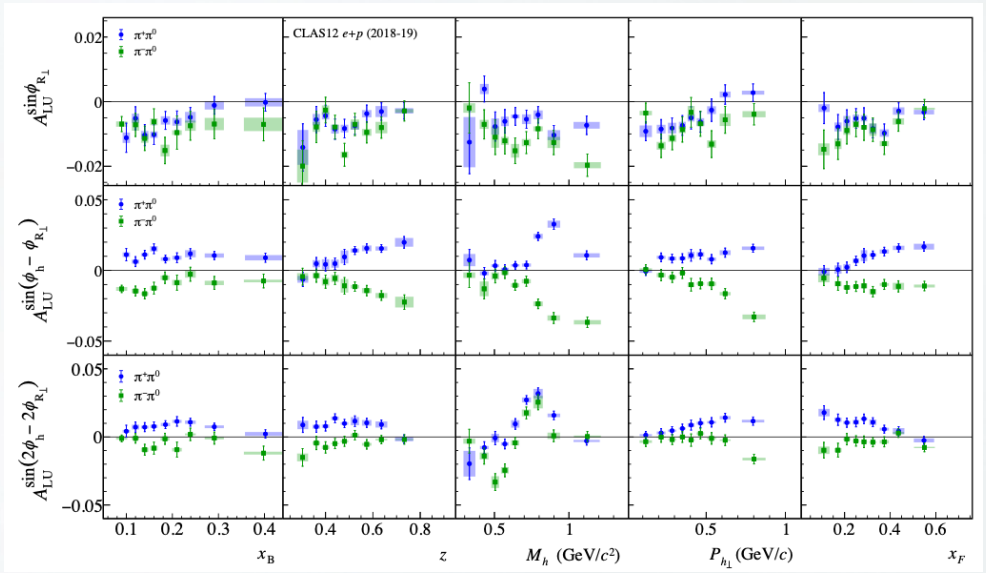
- 10.6 GeV SIDIS in di-pion production w/ polarized beam @CLAS12
  - ✓ extract di-hadron fragmentation function & twist-PDF

$$A_{LU}^{\sin(m(\phi_h - \phi_{R_\perp}))} \propto f_1 \otimes G_1^\perp$$ DiFF

arXiv:2602.1471

$$A_{LU}^{\sin(\phi_{R_\perp})} \propto \left[x\, e(x) H_1^\sphericalangle(z, M_h) + \frac{1}{z} f_1(x) \tilde{G}^\sphericalangle(z, M_h)\right]$$

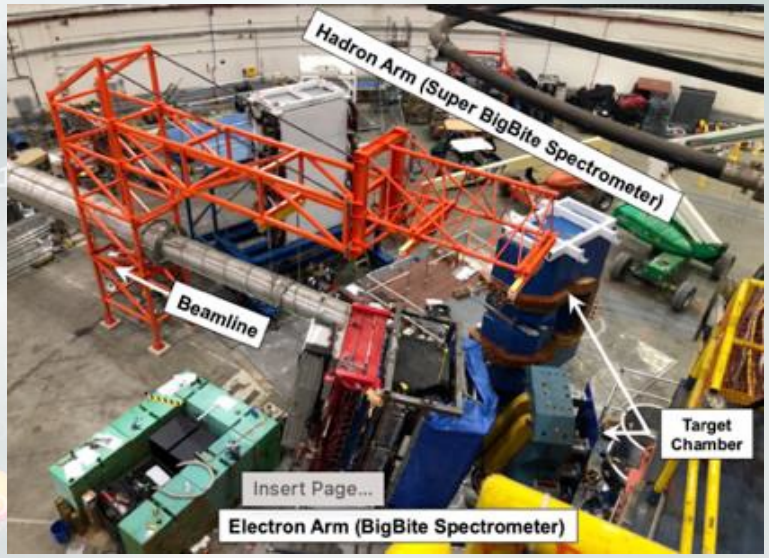
Twist-3

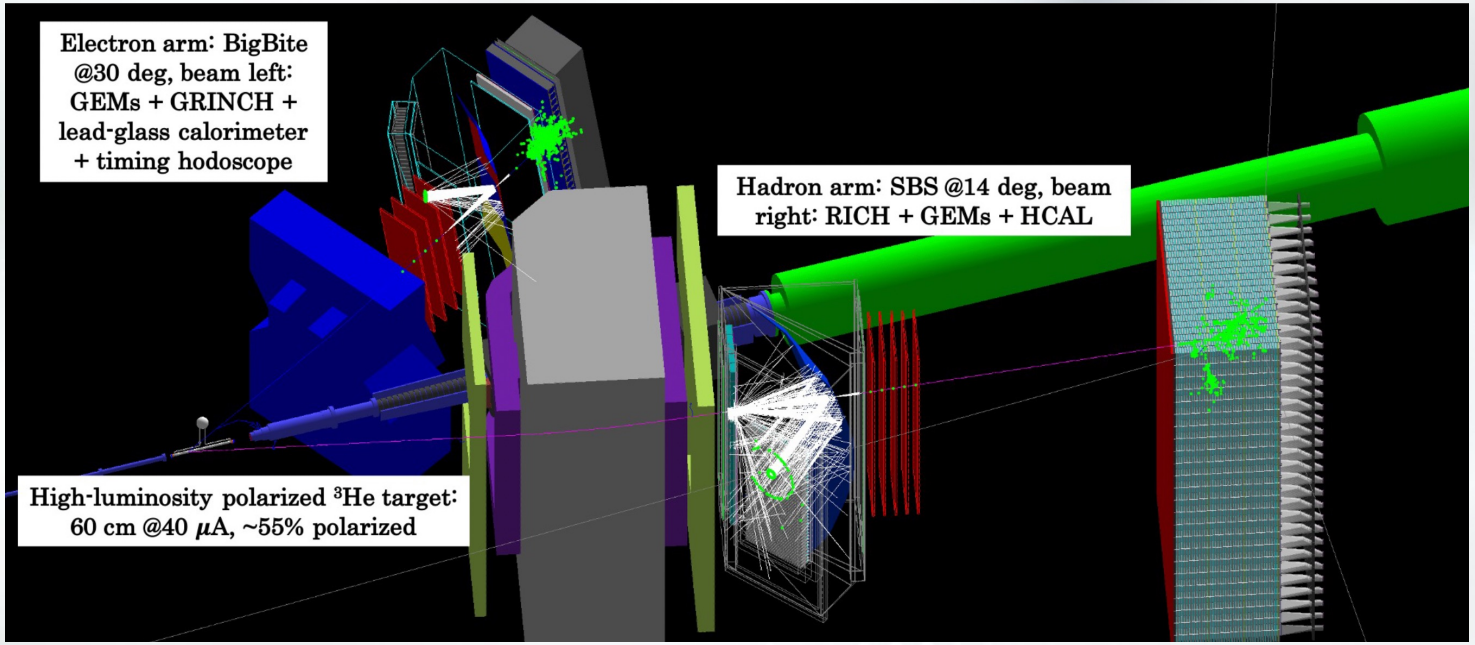


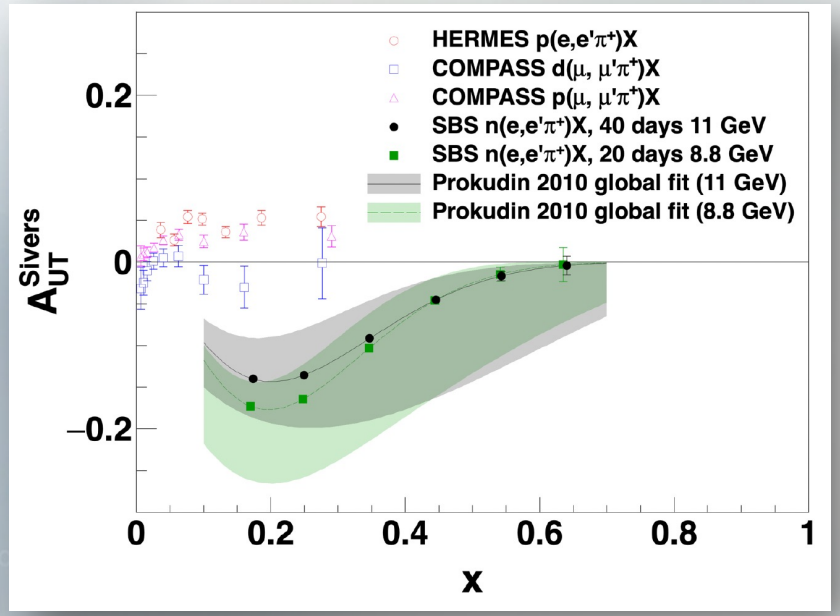
- SIDIS w/ polarized H&D in 2027 (RG-C & D)
- Future SIDIS w/ high-power polarized He3

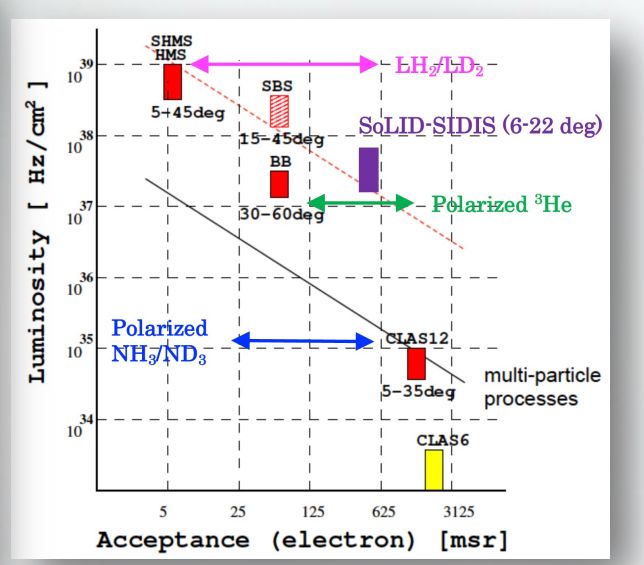
TMDs w/ SBS@Hall-A

- Future SBS SIDIS E12-09-018 w/ polarized He3 & new RICH

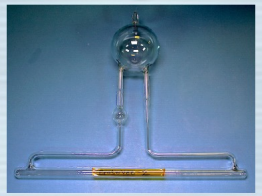


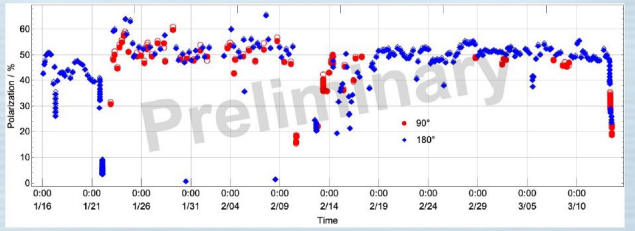






Shown is Mike Souza, our inceton glassblower, holding

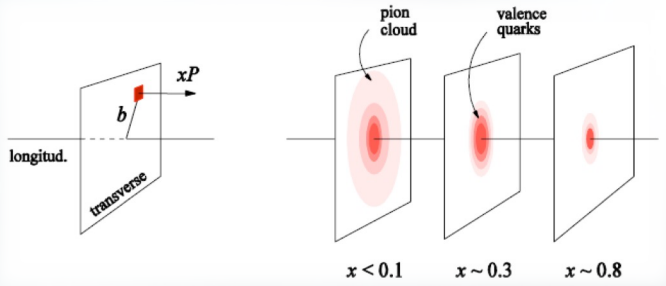




GPDs

❑ **Generalized Parton Distributions** (GPDs)

- ✓ 3D parton distribution in spatial space
- ✓ 8 leading-twist GPDs



8 Quark-GPDs (leading twist)

		Quark Polarization		
		Unpolarized (U)	Longitudinally Polarized (L)	Transversely Polarized (T)
Nucleon Polarization	U	H		$2\tilde{H}_T + E_T$
	L		$\tilde{H}$	$\tilde{E}_T$
	T	E	$\tilde{E}$	$H_T, \tilde{H}_T$

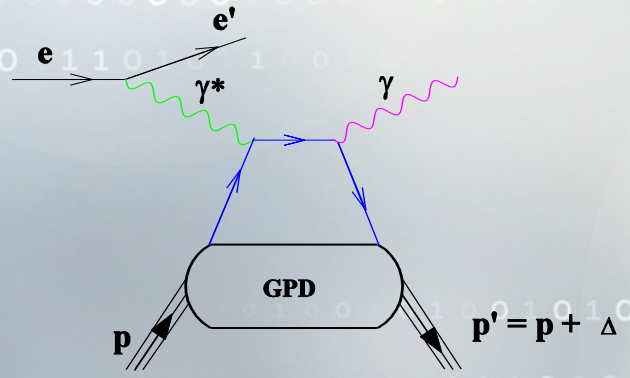
❑ Ji's Sum-Rule link GPD to nucleon spin:

$$J_{q/g} = \frac{1}{2}\int_{-1}^{+1} dx \cdot x[H^{q/g}(x,\xi,0) + E^{q/g}(x,\xi,0)]$$

(X. Ji, PRL 78, 610 (1997)

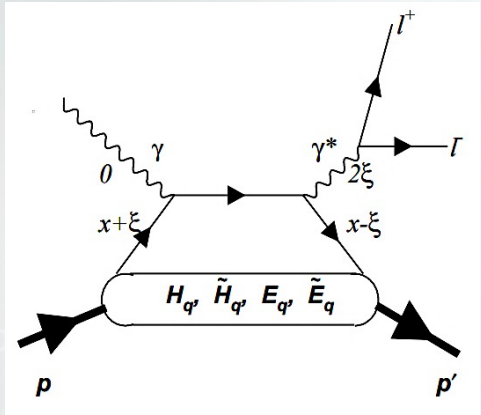
❑ GPDs (in fact, Compton form-factors) are measured by exclusive processes:

$e + N \to e' + N + \gamma$



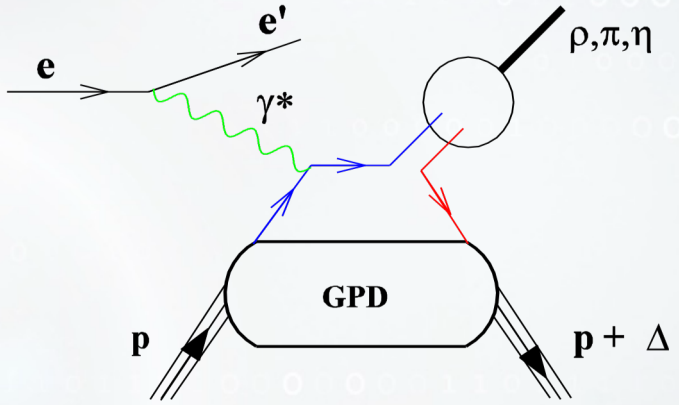
Deeply Virtual Compton Scattering (DVCS)

$\gamma + N \to N + l^+ + l^-$



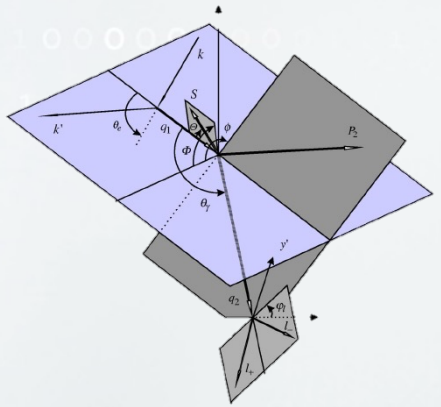
Timelike Compton Scattering (TCS)

$e + N \to e' + N' + Meson$



Deep Virtual Meson Production (DVMP)

$e + N \to e' + N + l^+ + l^-$

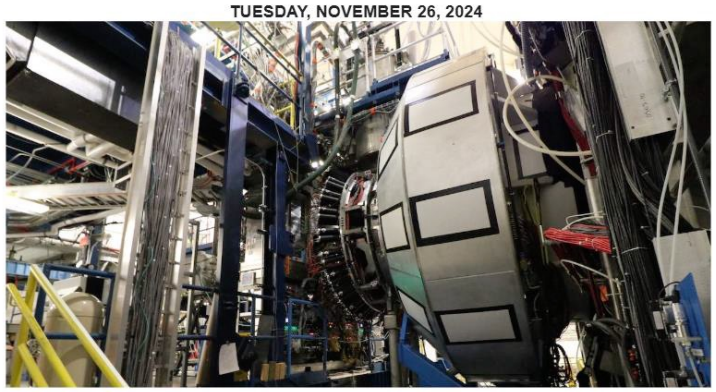


Double-DVCS (DDVCS)

GPDs /CLAS12

- First Neutron DVCS with CLAS12 central neutron detector

  Phys. Rev. Lett.133, 211903 (Nov. 2024),

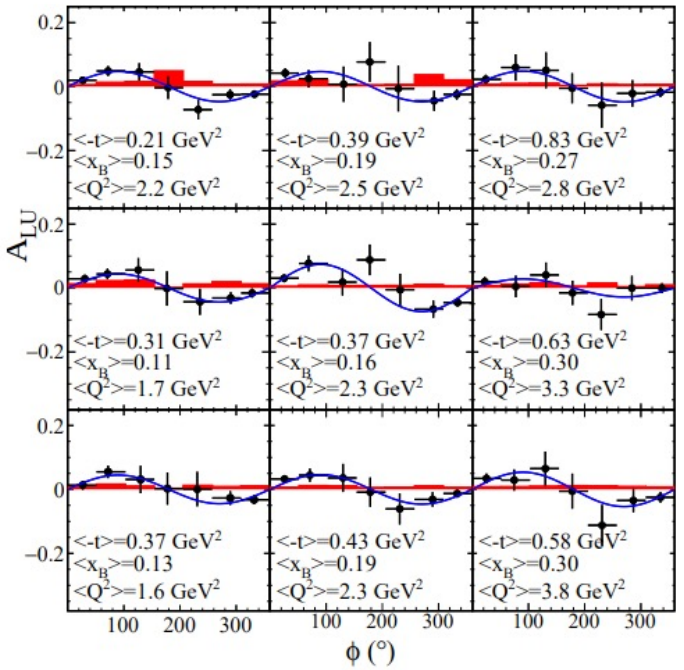


TUESDAY, NOVEMBER 26, 2024

A view of the Central Neutron Detector in Hall B's CEBAF Large Acceptance Spectrometer for 12 GeV (CLAS12).

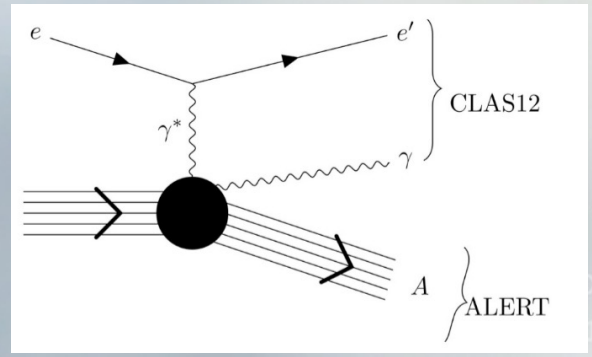
Accessing the Lesser-Known Nucleon

Protons and neutrons – known collectively as nucleons – are the building blocks of matter, but protons have received more attention in certain types of nuclear physics experiments. Until now. New results published in Physical Review Letters describe a first-time glimpse of the internal structure of the neutron thanks to the development of the Central Neutron Detector installed in Experimental Hall B's CLAS12 detector. To read the full story, click here.

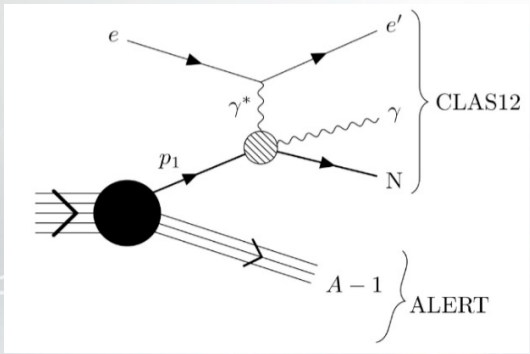


- ALERT measured DVCS/DVMP in He4
  - RG-L (w/ tagged DIS & SRC)
  - Completed in 2025, analyzing now

✓ 1 GPD in He4 (coherence DVCS)
✓ Nuclear-GPD in He4 (incoherence)



Coherent-DVCS



Incoherent-DVCS

- Global GPD analysis to extract proton property

Eur. Phys. J. C manuscript No.
(will be inserted by the editor)

arXiv:2503.18152

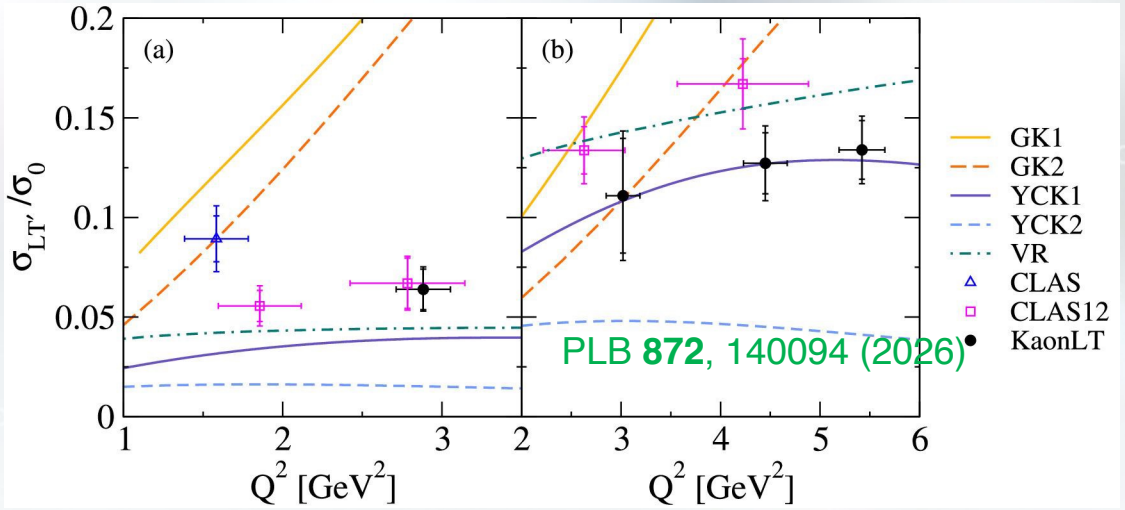
Open database for GPD analyses

V.D. Burkert[1], A. Camsonne[1], P. Chatagnon[1,2], K. Cichy[3], M. Constantinou[4], H. Dutrieux[5], I. M. Higuera-Angulo[1], C. Mezrag[2], D. Richards[1] P. Sznajder[6]

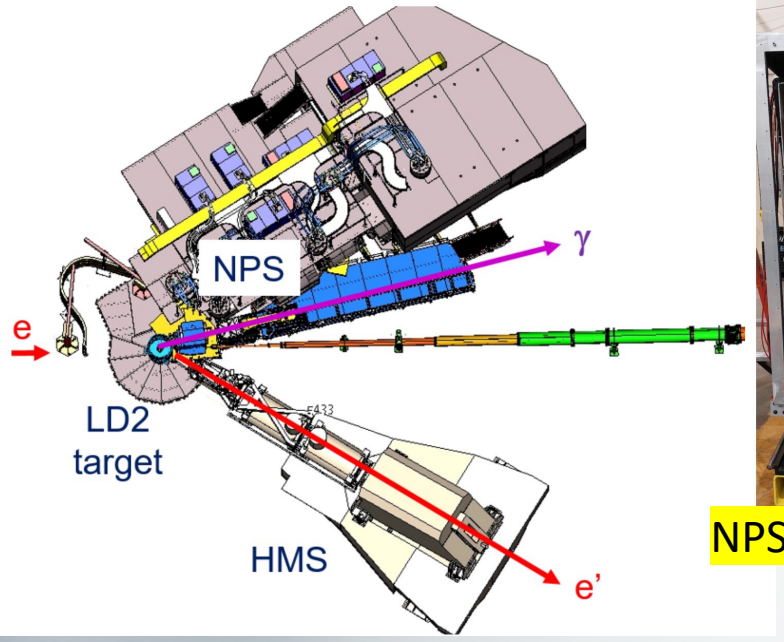
GPDs w/ in Hall-C

- PionLT/KaonLT Experiment in Hall C (completed in 2018):
  - ✓ DVMP w/ $\pi^+/K^+$to improve GPD models
    $(e + p \rightarrow e' + \pi^+/K^+ + n/\Lambda)$
  - ✓ First extract of Q2-depdt of σ_{LT}/σ_0 in asymmetries

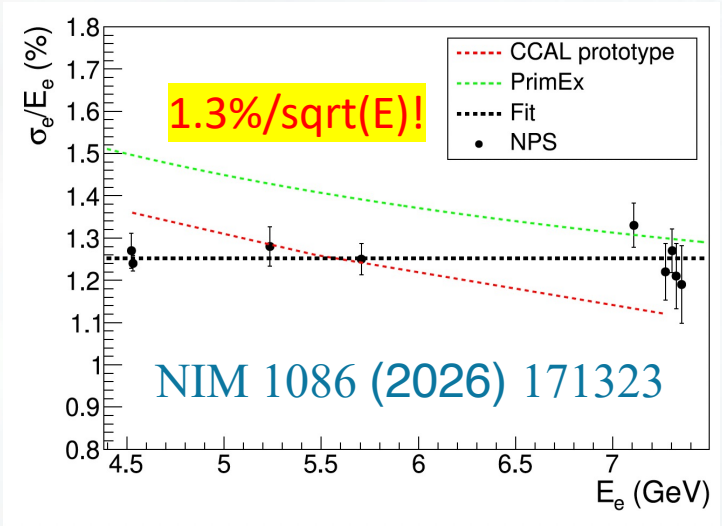
$$A_{LU}(Q^2, x_B, t, \phi) = \frac{\sqrt{2\epsilon(1-\epsilon)}\frac{\sigma_{LT'}}{\sigma_0}\sin\phi}{1+\sqrt{2\epsilon(1+\epsilon)}\frac{\sigma_{LT}}{\sigma_0}\cos\phi+\epsilon\frac{\sigma_{TT}}{\sigma_0}\cos 2\phi},$$

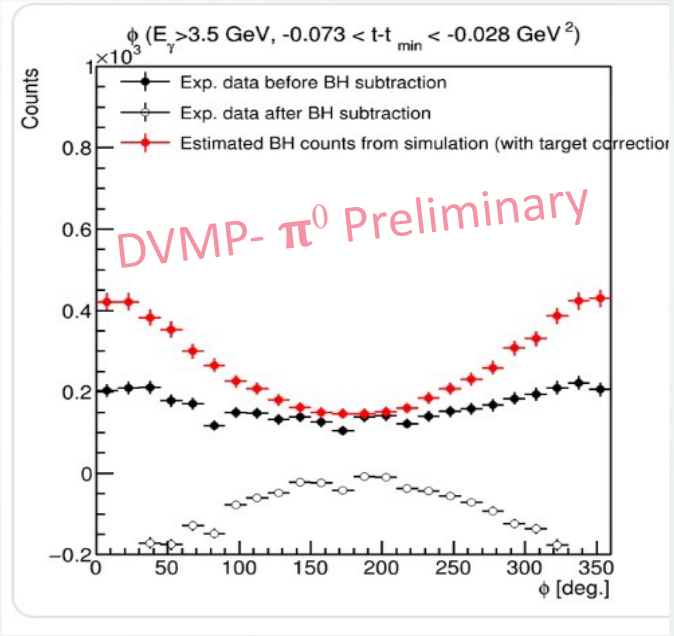


- NPS Experiments (1st part completed in 2024):



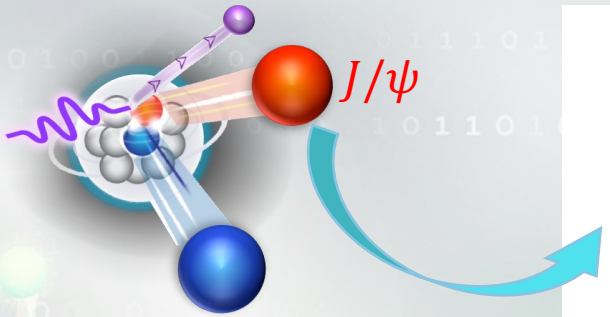
NPS Calorimeter





GlueX in Hall-D

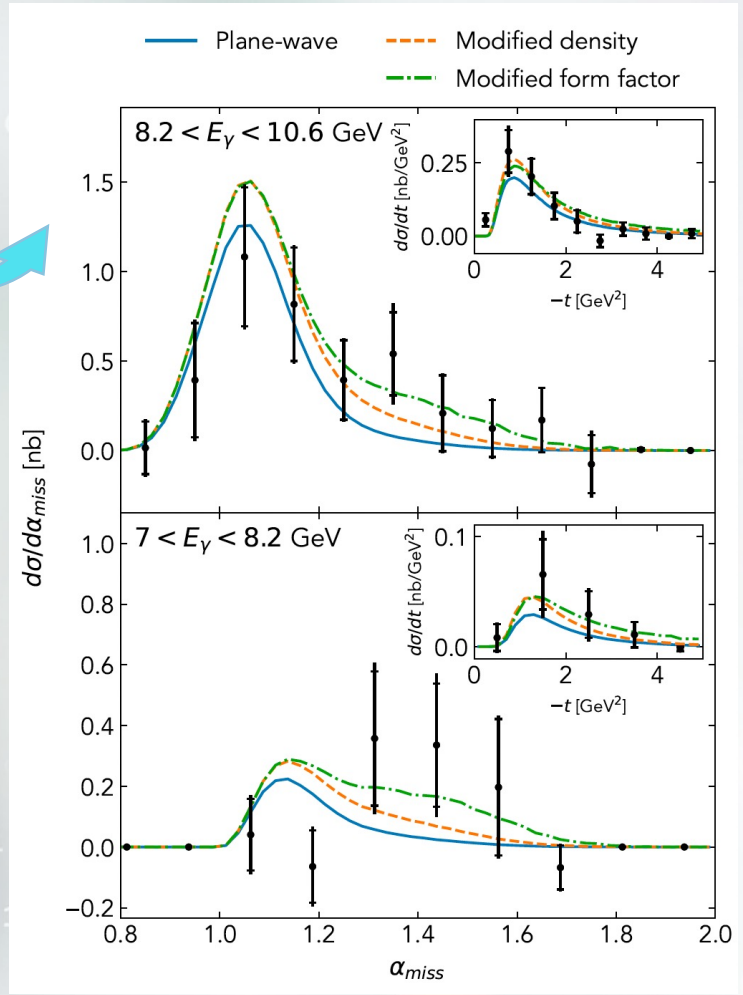
- A(γ, J/ψ p)X reaction below threshold
  - ✓ ~8GeV photons scatter on He4&C12 near threshold J/ψ ~ (8.2GeV)

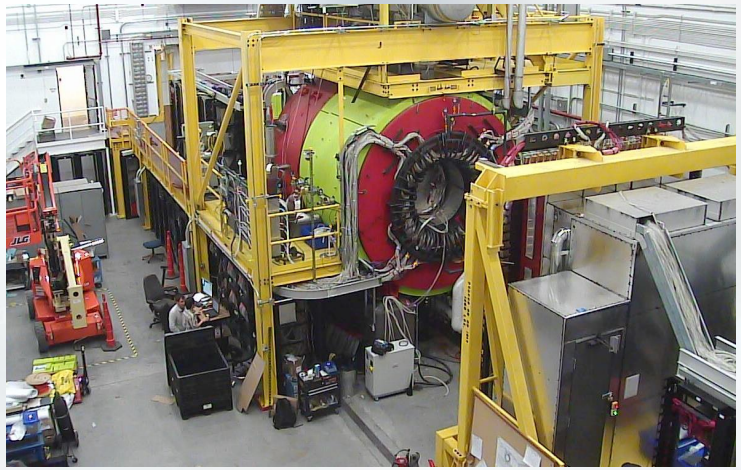


$$\vec{P}_{p-recoil} = -\vec{P}_{p\to J/\psi}$$

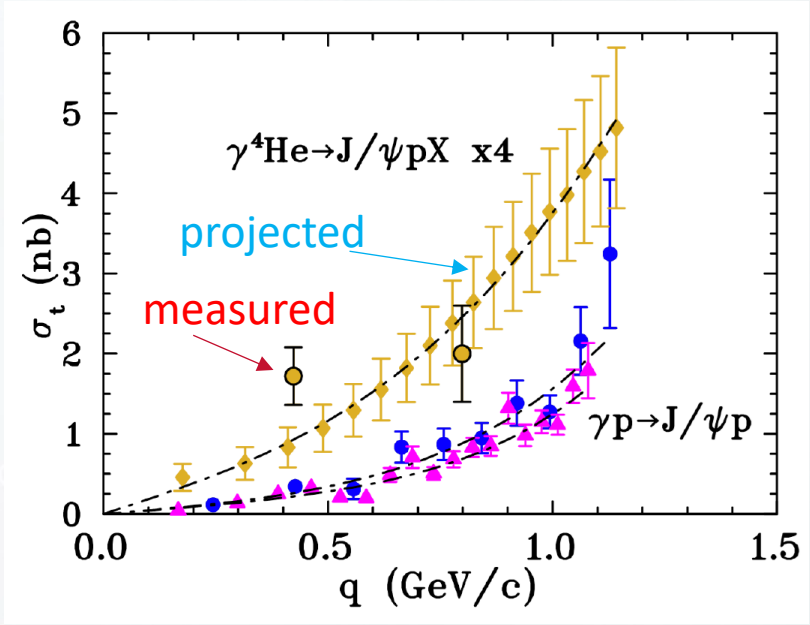
$$\alpha_{\mathrm{miss}} = \frac{E_{\mathrm{miss}} - p_{z,\mathrm{miss}}}{m_A/A}$$

PRL 134 (2025) 201903,
w/ editor suggest.



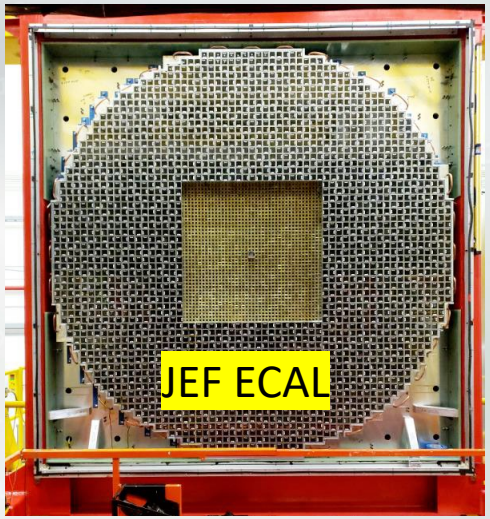


- ✓ New approved SRC experiment in 2025



GlueX in Hall-D

- Next:
  - ✓ JEF & PrimeX-eta

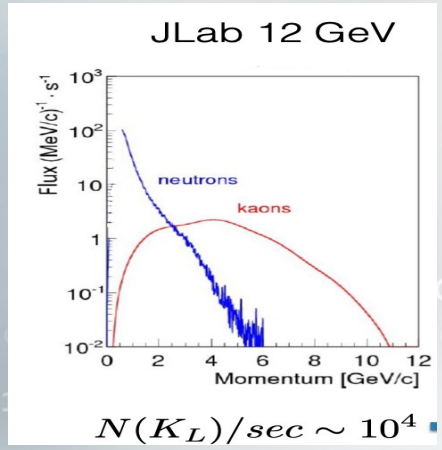


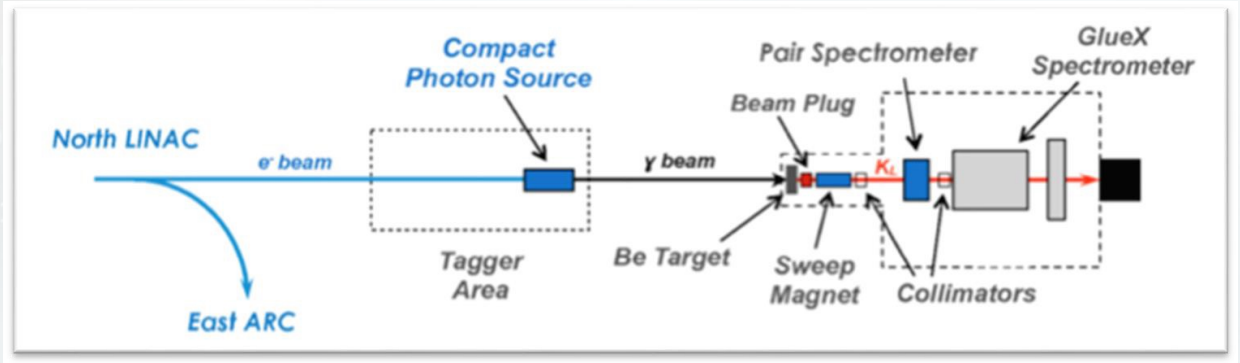
Experiment	name	Title	PAC rating	PAC days	data taken
E12-06-102	GlueX-I	Mapping the Spectrum of Light Quark Mesons and Gluonic Excitations with Linearly Polarized Photons	A	120	100%
E12-12-002	GlueX-II	A study of meson and baryon decays to strange final states with GlueX in Hall D	A	220	46%
A	JEF	Eta Decays with Emphasis on Rare Neutral Modes: The JLab Eta Factory(JEF) Experiment	Grp	100	0%
E12-10-011	PrimeX-η	A Precision Measurement of the eta Radiative Decay Width via the Primakoff Effect	A-	79	100%
E12-13-008	CPP/NPP	Measuring the Pion Polarizability in the $\gamma\gamma \to \pi\pi$ Reaction	A-	25	100%
E12-19-003	SRC/CT	Studying Short-Range Correlations with Real Photon Beams at GlueX	B+	15	100%
		Not yet scheduled			
E12-19-001	KLF	Strange Hadron Spectroscopy with Secondary KL Beam in Hall D	A-	200	
E12-20-011	REGGE	Measurement of the high-energy contribution to the Gerasimov-Drell-Hearn sum rule	A-	33	

- considerable installation / new equipment required
- finished data taking

- JEF: fully budgeted, installation in progress
- KLF: partly budgeted, design in progress
- REGGE: not yet budgeted

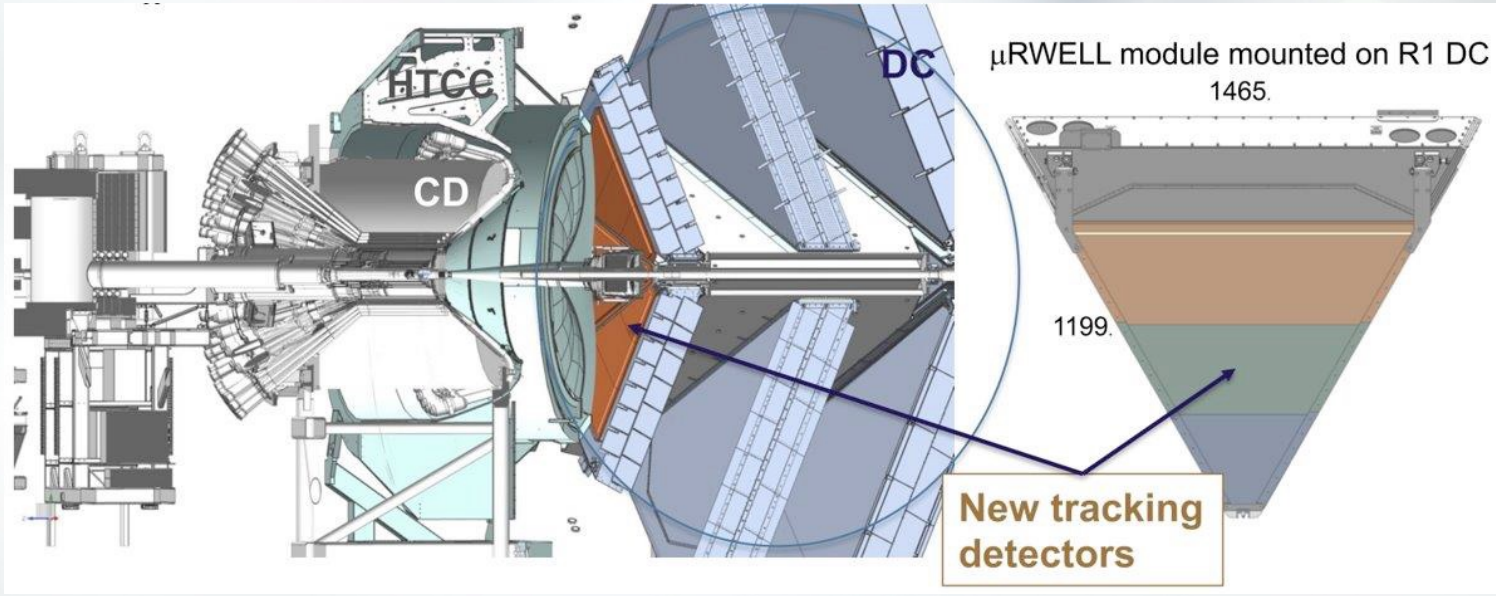
- ✓ KLONG Facility:



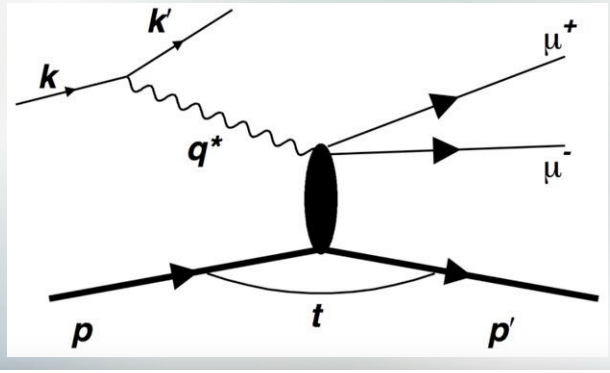


Future Upgrade-muCLAS12

- CLAS12 luminosity to be upgraded to 10^{37} $cm^{-2}s^{-1}$.
  - DC to muRWELL trackers
  - Add forward trackers

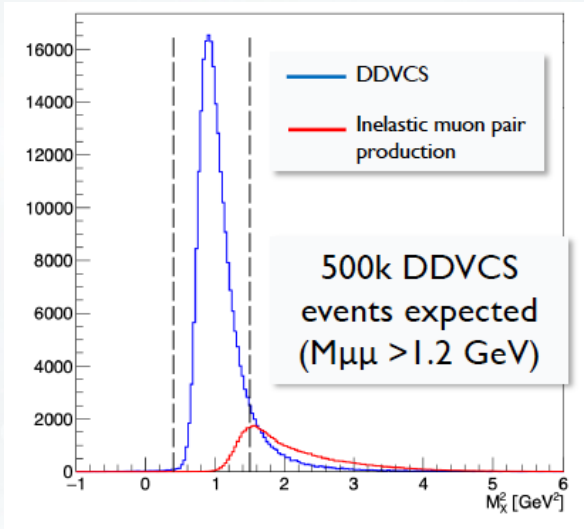


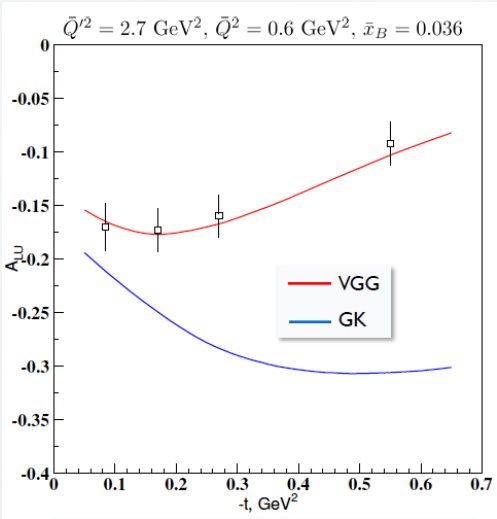
- Enable the Doubly-DVCS measurements



Electro- and photo-production of muon pairs with μCLAS12: Double Deeply Virtual Compton Scattering, Timelike Compton Scattering, and J/ψ production

A Proposal to PAC 53

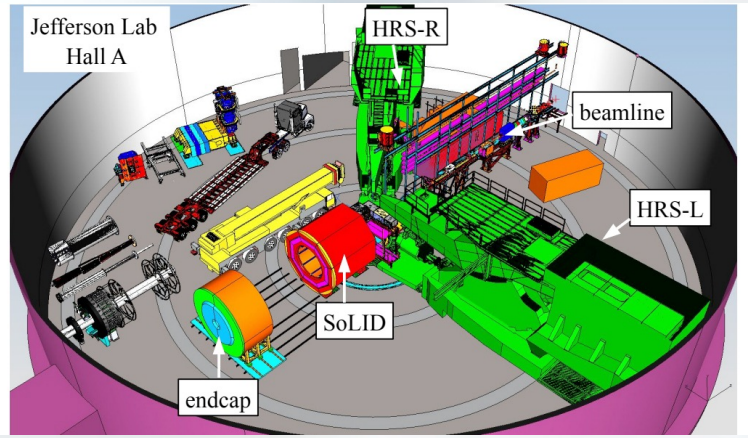


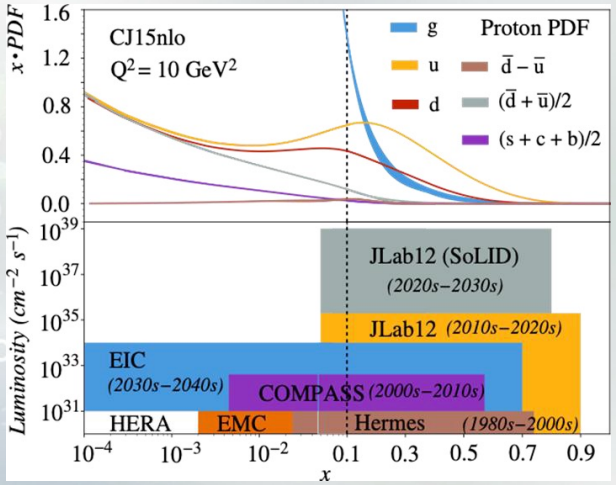


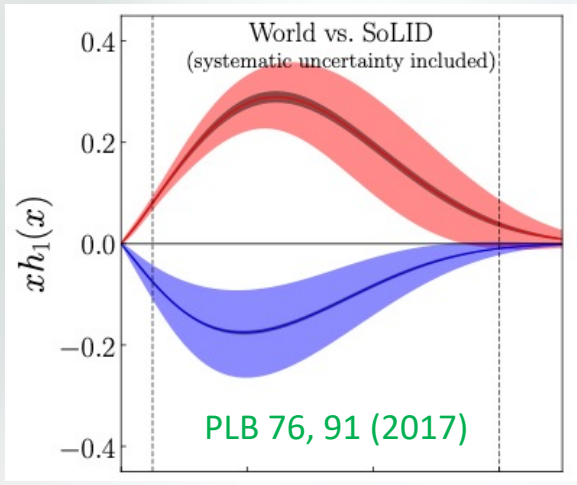
200 days to distinguish models at small-t region

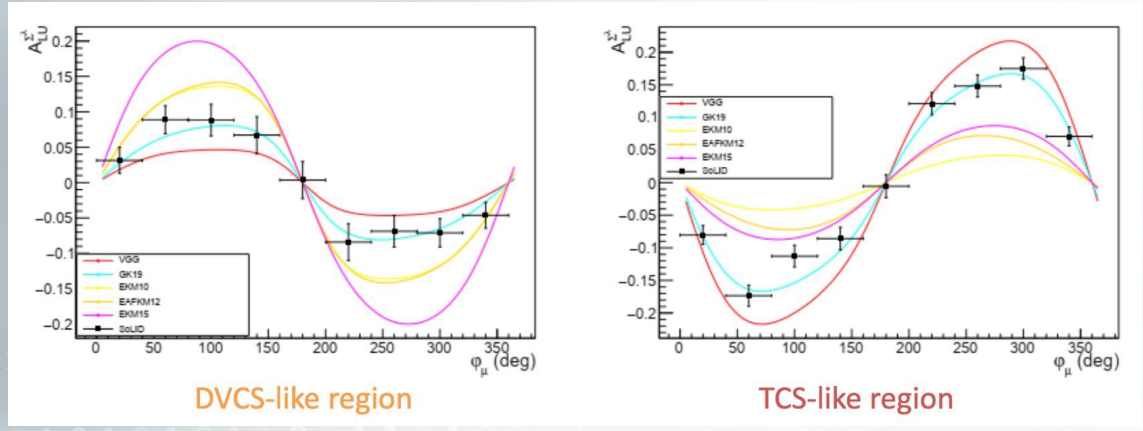
Future Upgrade-SoLID

- The Solenoidal Large Intensity Device SoLID):
  - ✓handle 10^{37}-10^{39} cm^{-2} s^{-1} luminosities
  - ✓full 2π azimuthal acceptance;
  - ✓Polarized p&n targets.
- Provide 4D/5D mappings of TMD & GPD; PVDIS for d/u & BSM

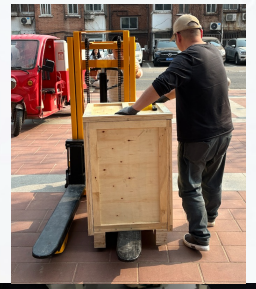


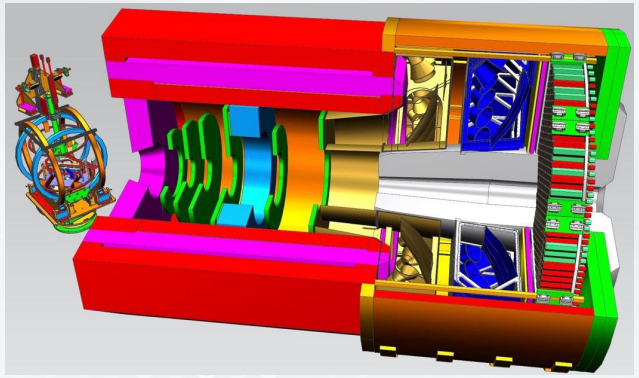


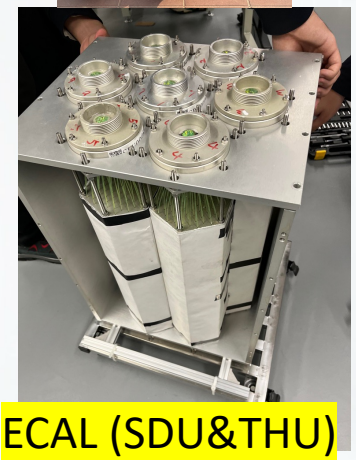




Arrived at Norfolk







ECAL (SDU&THU)

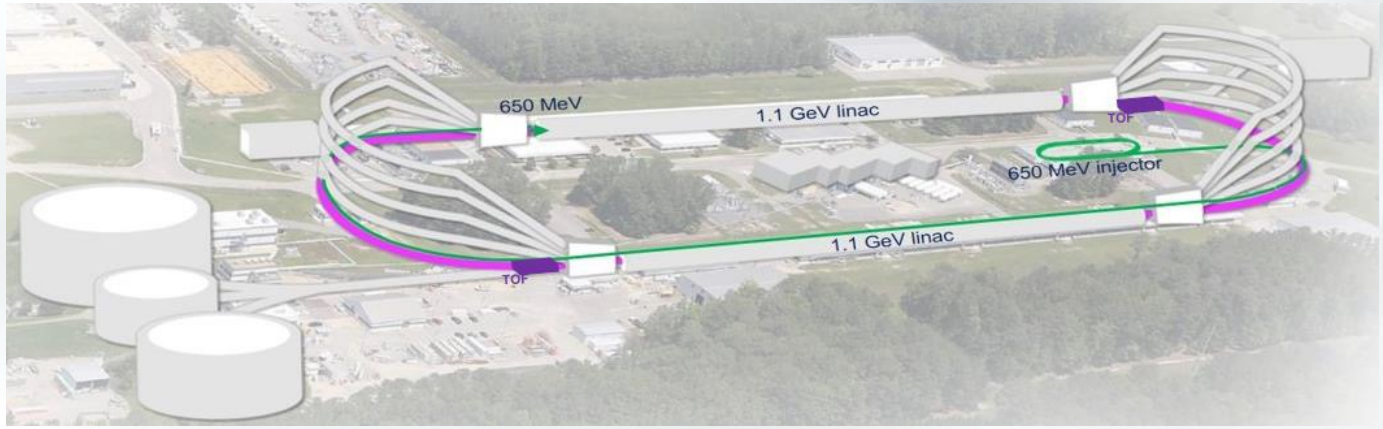
CLEO Magnet @ JLab

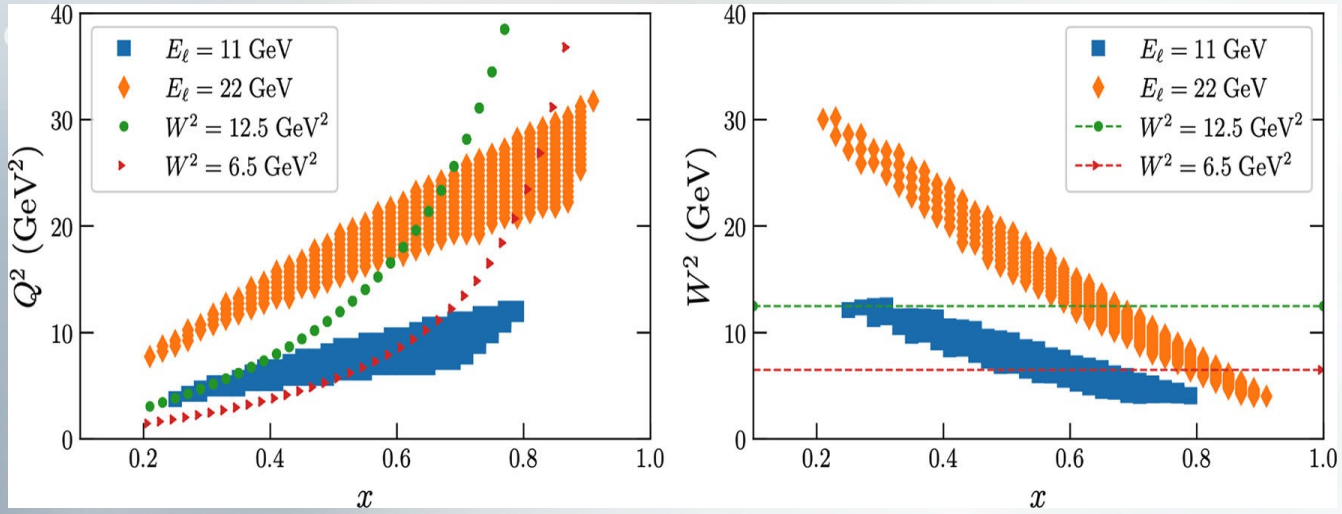
Future Upgrade-22GeV

- Fixed Field Alternating (FFA) gradient arcs to increase energy to 22 GeV

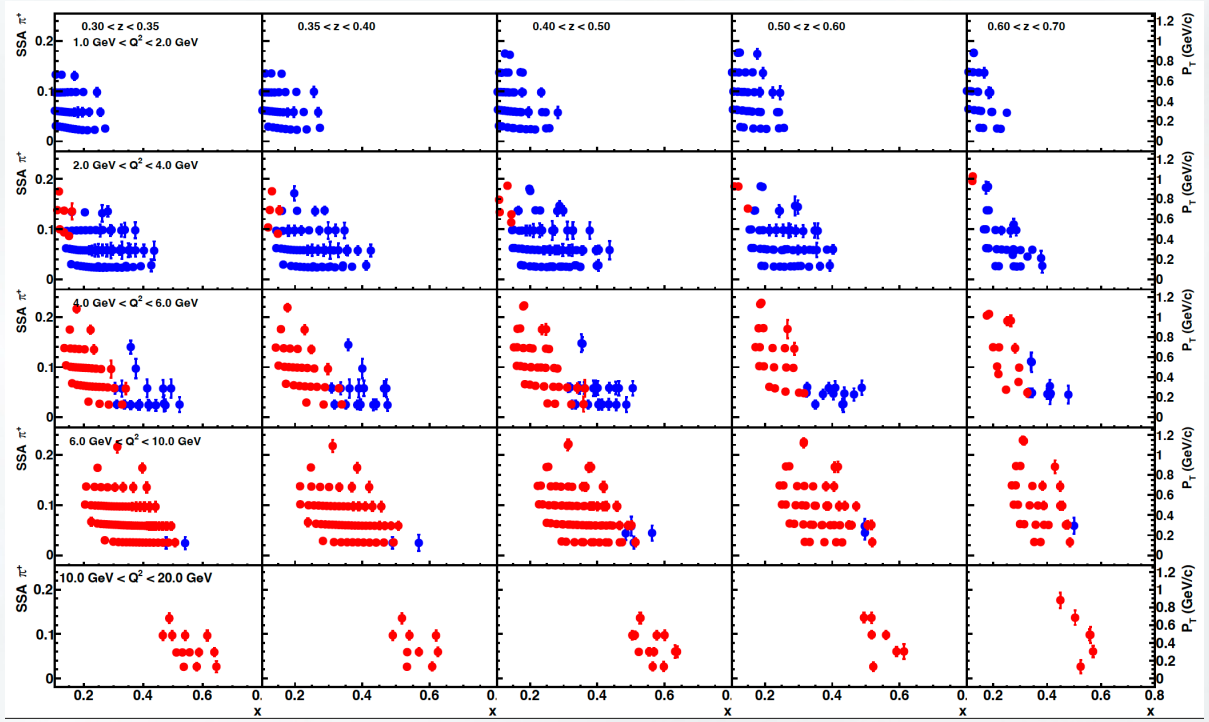
  Eur. Phys. J. A (2024) 60:173 arXiv:2601.05773

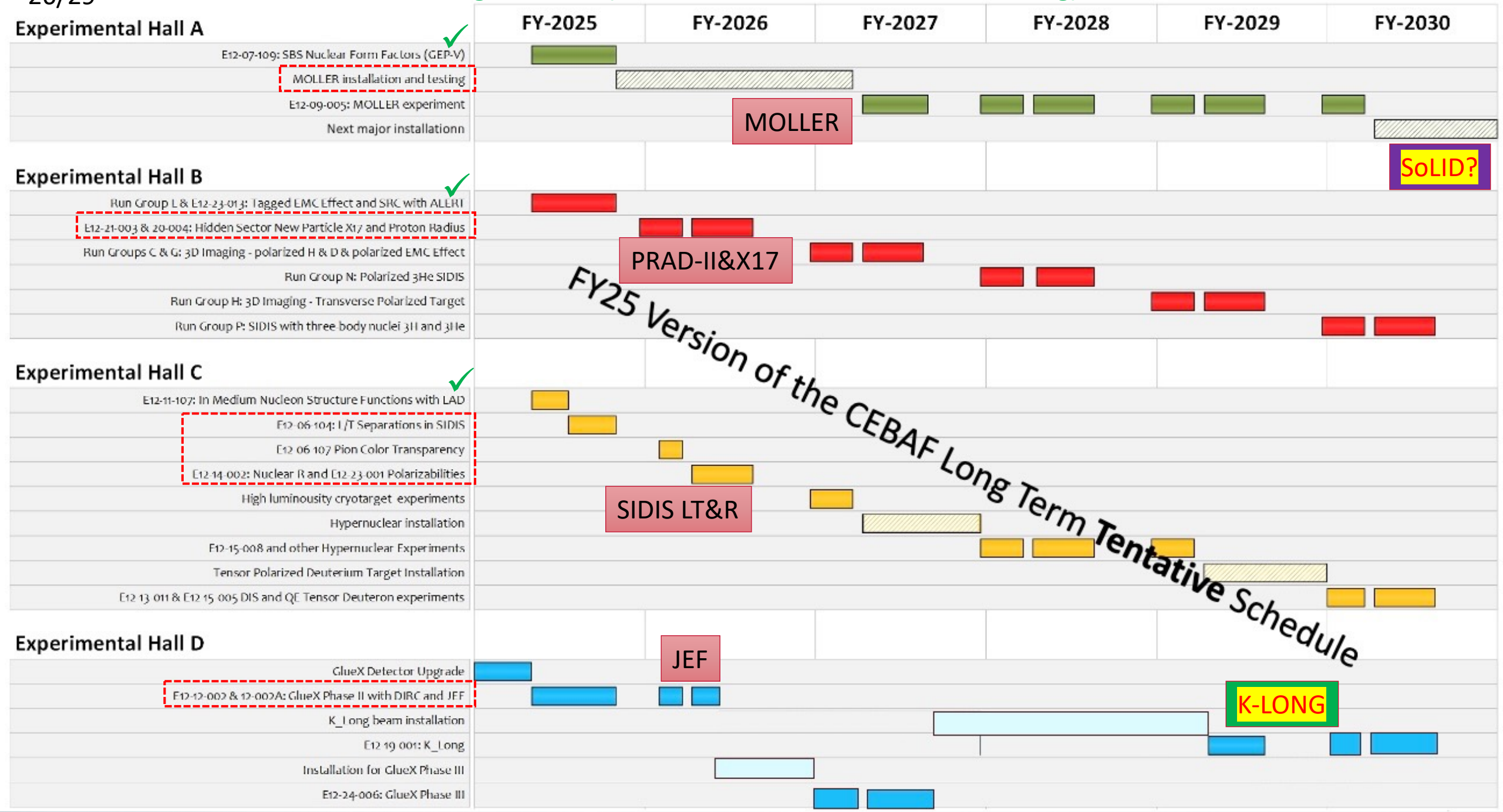
- Impact on Nucleon Structure:
  - ✓ Expands DIS to higher Q2
  - ✓ Enlarge phase-space for TMD/GPD
  - ✓ From valance quarks to sea
  - ✓ Crosses charm threshold, gluonic GFFs and XYZ states
  - ✓ EIC Synergy





Collins SSA (SoLID@22GeV)




FY-2025
FY-2026
FY-2027
FY-2028
FY-2029
FY-2030
Experimental Hall A
E12-07-109: SBS Nuclear Form Factors (GEP-V)
MOLLER installation and testing
E12-09-005: MOLLER experiment
Next major installationn
MOLLER
SoLID?
Experimental Hall B
Run Group L & E12-23-013: Tagged EMC Effect and SRC with ALERT
E12-21-003 & 20-004: Hidden Sector New Particle X17 and Proton Radius
Run Groups C & G: 3D Imaging - polarized H & D & polarized EMC Effect
Run Group N: Polarized 3He SIDIS
Run Group H: 3D Imaging - Transverse Polarized Target
Run Group P: SIDIS with three body nuclei 3H and 3He
PRAD-II&X17
FY25 Version of the CEBAF Long Term Tentative Schedule
Experimental Hall C
E12-11-107: In Medium Nucleon Structure Functions with LAD
E12-06-104: L/T Separations in SIDIS
E12-06-107 Pion Color Transparency
E12-14-002: Nuclear R and E12-23-001 Polarizabilities
High luminousity cryotarget experiments
Hypernuclear installation
E12-15-008 and other Hypernuclear Experiments
Tensor Polarized Deuterium Target Installation
E12-13-011 & E12-15-005 DIS and QE Tensor Deuteron experiments
SIDIS LT&R
Experimental Hall D
GlueX Detector Upgrade
E12-12-002 & 12-002A: GlueX Phase II with DIRC and JEF
K_Long beam installation
E12-19-001: K_Long
Installation for GlueX Phase III
E12-24-006: GlueX Phase III
JEF
K-LONG

Summary

- Current Status: Jefferson Lab retains its preeminence at the intensity frontier, successfully navigating the transition from 1D collinear densities to precision 3D tomographic measurements.
- The Science Pipeline: Emergent data from Hall-A (MARATHON, SBS), Hall-B CLAS12 (ALERT), and Hall-C (KaonLT, NPS, LAD) are resolving fundamental inquiries regarding the d&u PDF , the origins of the EMC effect, and explore TMD & GPD.
- The Future Outlook: muCLAS12, SoLID, and 22 GeV upgrade before EIC.