Jefferson Lab

52nd PROGRAM ADVISORY COMMITTEE (PAC 52)

July 8 – 12, 2024

U.S. DEPARTMENT OF ENERGY

JSA

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Jefferson Lab
Thomas Jefferson National Accelerator Facility
Exploring the Nature of Matter

July 24, 2024

Dear Jefferson Lab Users,

It was a pleasure to see the new and exciting experimental proposals from our user community at the recent Program Advisory Committee (PAC52) meeting, held July 8 - 12, 2024. The exceptional quality of these proposals serves as a testament to the remarkable scientific opportunities that Jefferson Lab's CEBAF brings to our scientific community.

The committee received a total of 34 submissions, which were categorized as follows: 13 new proposals, one conditionally approved proposal, three proposals for run group additions, and six jeopardy proposals. In addition, 11 letters of intent were submitted for feedback.

Of these, the PAC granted approval to eight new proposals, one proposal was approved pending review by a future PAC (C2), one proposal was approved pending a technical review by the Lab (C1), and three proposals were deferred. The two proposed run group additions were endorsed, and five experiments in jeopardy were recommended to stay active, whereas the status of one experiment was changed to "conditionally approved" (C2).

One proposal and one run group addition were withdrawn by the proponents before the PAC meeting.

The meeting was conducted efficiently and effectively, largely owing to the diligent contributions of the Chair, Markus Diehl, as well as Pamela Cole and JLab's Event Services. I extend my gratitude to Markus and all the PAC members for their dedicated efforts in offering their expert insights to the Laboratory. A special commendation is also due to Markus, as his tenure as the PAC chair has ended, for his exceptional guidance in overseeing the PAC process for the Laboratory over the past five years. Next year, we welcome Pasquale DiNezza as the PAC53 chair and his knowledge and skill.

Sincerely,

David J. Dean
Acting Laboratory Director

Markus Diehl
Theory Group
Deutsches Elektronen-Synchrotron DESY
22603 Hamburg, Germany

Hamburg, 16 July 2024

Cynthia Keppel
Associate Director of Experimental Nuclear Physics
Jefferson Lab

Dear Thia,

This letter transmits the findings and recommendations of the 52nd Jefferson Lab Program Advisory Committee (PAC52). The Committee met from July 8 to 12 and reviewed 13 new proposals, one conditionally approved proposal, 3 proposals for run group additions, and 6 experiments in Jeopardy. It also provided feedback on 11 letters of intent.

Written reports on the proposals, letters of intent and experiments in Jeopardy were prepared and reviewed by the Committee before we adjourned. 8 proposals were granted full approval, 1 proposal was approved pending review by a future PAC (C2), 1 proposal was approved pending a technical review by the Lab (C1), and 3 proposals were deferred. 2 proposed run group additions were endorsed. 5 experiments in Jeopardy were recommended to stay active, whereas the status of 1 experiment was changed to "conditionally approved (C2)". One proposal and one run group addition have been withdrawn by the proponents before the PAC meeting. PAC reports on these are not included in this document, but the PAC will send feedback directly to the spokespersons.

The chair of the Jefferson Lab Users Organization (JLUO) participates in all PAC sessions and is included in all communication between the PAC and the spokespersons of proposals. She represents the user community at all stages of the PAC review. We regard this as highly beneficial for both sides and would like to see this tradition continue. For the second time, the JLUO Chair-Elect participated in all PAC sessions as well, with the intent to further strengthen user representation and to ease the transition from one year to the next. We feel that this is a very valuable addition to the Committee and hope it will become a tradition, too.

The TAC physics and theory reports provided to the PAC were a most valuable resource for our review. We thank all those involved in their preparation, which presented a particularly heavy workload this year.

The PAC upholds its high standards for approving proposals and would like to point out several points that have come up in the review this year. *(i)* As a general rule, the PAC expects a proposal to contain estimates for both statistical and (correlated and uncorrelated) systematic uncertainties. The basis of these estimates must be clearly documented. Some measurements are statistics dominated, but even in this case sufficient information on the expected systematics should be provided, so that the committee can be convinced that it is comparatively small. *(ii)* To assess the physics reach of a proposal, it is often necessary to have a comparison with theory or model predictions, including their uncertainty or plausible range of variation. *(iii)* Showing expected error bars with central values lined up on a curve can be useful for illustration, but is generally not suitable for impact studies. A more realistic picture is obtained if

central values are randomized according to their expected statistical uncertainties. *(iv)* It is important to distinguish between observables of a measurement and quantities derived from them, such as TMDs, GPDs, or gravitational form factors. The extraction of derived quantities typically includes uncertainties from theory that an experimental proposal may or may not be able to quantify. It is inadequate to omit these uncertainties when they affect the main deliverable of the proposal. *(v)* The committee encourages proponents to provide summary tables, e.g. for beam time requests, as well as schematic drawings of the experimental setup. These provide a useful overview to reviewers and often allow for a streamlined presentation in the main text.

The committee acknowledges the diligence of proponents in replying to questions by the readers ahead of the PAC meeting. However, it should be kept in mind that the exchange between readers and proponents is meant to clarify specific questions, but not to fill in major gaps in a proposal. A proposal must contain all essential information.

One purpose of letters of intent is to establish a claim to a physics idea. This is only meaningful if the letter contains details on the physics and the measurement that are sufficient to define the envisaged experiment in terms of impact and feasibility. A mere sketch is not sufficient for this purpose.

Unfortunately, the PAC has received several documents with a large number of formal shortcomings. Examples are logical inconsistencies between different sections, undefined or inconsistent notation, untraceable references, and missing or incomplete labels in figures. This significantly increases the workload of TAC and PAC reviewers and must not proliferate, neither in proposals nor in letters of intent. The PAC urges proponents to carefully proofread their documents before submission. Co- authors, in particular the co-spokespersons, are encouraged to assume their shared responsibility in this process.

As in previous years, the PAC received several proposals aiming at studying short-range correlations in nuclei. This document the continued interest in this physics. The committee feels that it may be beneficial for the lab to organize a forum (for instance a working group or a series of meetings) that would join interested experimental groups and theorists, with the aim of developing a strategy to bring this important field forward, regarding key measurements, observables, and their theoretical interpretation.

The committee is well aware of the amount of logistics behind a PAC meeting, and would like to extend its warmest thanks to Pamela Cole, Stephanie Tysor, and Sarah Crouse for their tireless work ahead of, during, or after PAC week.

This is my last term as PAC chair. My thanks go to the Lab, especially to you and to Bob McKeown, for giving me the opportunity to serve in this position, and for the trust you have put in me. I also thank all PAC members with whom I had the pleasure to work in the last five years. I sincerely wish all the best to the Lab and to its users.

The PAC is at your disposal for any other information or assistance we can give you. Congratulations to you, Jefferson Lab, and the user community on continued success.

With best regards,

Markus Diehl
PAC52 Chair

Introduction

The Jefferson Lab Program Advisory Committee held its 52nd meeting from July 8th through July 12th, 2024. The membership of the committee is given on page 34. In response to the charge (page 35) from the Physics Director, Dr. Cynthia Keppel. The committee reviewed 13 new proposals, one conditionally approved proposal, 3 proposals for run group additions, and 6 experiments in jeopardy. It also provided feedback on 11 letters of intent.

PAC52 Recommendations

NUMBER	TITLE	HALL	DAYS REQUESTED	DAYS AWARDED	SCIENTIFIC RATING	PAC DECISION	TOPIC
New Proposals							
PR12-24-001	Measurement of the Nuclear Dependence of $R=\sigma_L/\sigma_T$ in Semi-Inclusive Deep Inelastic Scattering	C	5	7	A-	approved	5
PR12-24-002	Exploring the Transition Region of QCD with the Proton's g2 Spin Structure Function	C	26			C2	4
PR12-24-003	Studying Lambda interactions in nuclear matter with the 280Pb(e,e' K+)(208_Lambda)Tl reaction	C	42	42	A-	approved	5
PR12-24-004	Study of charge symmetry breaking in p-shell hypernuclei	C	24	24	A-	approved	5
PR12+24-005	A Dark Photon Search with a JLab positron beam	B	55	55	A-	C1	0
PR12-24-006	GlueX-III: a path to the Luminosity Frontier in Hall D	D	200	200	A	approved	1
PR12-24-007	Nuclear Dependence of Beam Normal Single Spin Asymmetry in Elastic Scattering from Nuclei	C	9	9	A	approved	0
PR12-24-008	Inclusive Studies of 3N Short-Range Correlations	C	57			deferred	5
PR12-24-009	Exclusive electro-disintegration of tensor polarized deuterium	C	86			withdrawn	5
PR12-24-010	High-precision measurement of mu_p G_E^p/G_M^p at Q^2 = 3.7 GeV^2 via Polarization Transfer	A	2	2	A-	approved	2
PR12-24-011	Study of a triaxially deformed nucleus using a Lambda particle as a probe	C	28	28	A-	approved	5
PR12-24-012	Isospin structure of 3N short-range correlations and the nucleon structure functions in 3H and 3He	C	53			deferred	5
PR12-24-013	An isospin dependence study of the Lambda-N interaction through the high precision spectroscopy of Lambda hypernuclei	C	62 (55)	55	A-	approved	5
Conditional							
C12-23-009	Nuclear Charm Production and Short-Range Correlations	D	100			deferred	5

NUMBER	TITLE	HALL	DAYS REQUESTED	DAYS AWARDED	SCIENTIFIC RATING	PAC DECISION	TOPIC
Jeopardy							
J12-24-RunGroupA	11 GeV Polarized Electrons on Liquid Hydrogen Target to Study Proton Structure, 3D Imaging, and Gluonic Excitations	B	65	65		remain active	4
J12-24-RunGroupB	CLAS12 Run-Group B: electroproduction on deuterium with CLAS12	B	51	51		remain active	4
J12-24-RunGroupC	Run Group C Jeopardy Update Document	B	40	40		remain active	5
J12-24-RunGroupH	CLAS12 Run-Group H: electroproduction on transversely polarized proton with CLAS12	B	110			change status to C2	4
E12-11-006	Heavy Photon Search Experiment	B	105	105		remain active	
E12-14-001	The EMC Effect in Spin Structure Functions	B	55	55		remain active	5
Run Group Additions							
E12-12-002A	11 GeV Polarized Electrons on Liquid Hydrogen Target to Study Proton Structure, 3D Imaging, and Gluonic Excitations	D	N/A	N/A		endorsed	
E12-20-013A/E12-15-008A	12 GeV Polarized Electrons on Liquid Hydrogen Target to Study Proton Structure, 3D Imaging, and Gluonic Excitations	C	N/A	N/A		endorsed	

Abbreviations

C1 = Conditionally Approved w/Technical Review by the Lab
C2 = Conditionally Approved w/PAC Review

Physics Topics
1 Hadron Spectra as Probes of QCD
2 Transverse Structure of the Hadrons
3 Longitudinal Structure of the Hadrons
4 3D Structure of the Hadrons
5 Hadrons and Cold Nuclear Matter
6 Low-Energy Tests of the Standard Model and Fundamental Symmetries

PR12-24-001

Scientific Rating: A-

Recommendation: Approved for 7 PAC days in Hall C

Title: Measurement of the Nuclear Dependence of $R=\sigma_L/\sigma_T$ in Semi-Inclusive Deep Inelastic Scattering

Spokespersons: D. Gaskell (contact), P. Bosted, W. Brooks, R. Ent, E. Kinney, H. Mkrtchyan

Motivation: This proposal aims to explore the nuclear dependence of the ratio $R=\sigma_L/\sigma_T$ in semi-inclusive deep inelastic scattering (SIDIS) using measurements of charged pion production taken on carbon and copper targets, analyzed in combination with proton and deuteron results from the approved experiment E12-06-104. While a possible nuclear dependence of R has been historically investigated in inclusive and exclusive DIS, this has yet to be studied in SIDIS. Such new data would provide a bridge between exclusive and inclusive scattering and, if such nuclear dependence is observed in SIDIS, could potentially aid in the interpretation of hadron attenuation measurements.

Measurement and Feasibility: The proponents requested 5 days of run time, split between π^+ and π^- production data, using the HMS and the SHMS in Hall C. All of the assumed equipment is already existing, and the experimental settings are standard. The proponents proposed data taking at three kinematic points: x=0.2, 0.4, 0.5.

Issues: N/A.

Summary: This is an important add-on to the approved experiment E12-06-104, which would provide a new set of SIDIS data on carbon and copper targets and thus enable the first exploratory measurements of the nuclear dependence of $R=\sigma_L/\sigma_T$ in SIDIS. As a result of discussions between the proponents and the PAC, the PAC recommends the inclusion of 2 additional days of running for a total of 7 PAC days, so as to allow additional p_T scans to be performed. The PAC deems the p_T measurements especially important to include because they could point to or distinguish between different dynamics at work in σ_L versus σ_T. The optimal choice of kinematics enabling both multiple x points and the p_T scan should be decided by the proponents in coordination with the E12-06-104 spokespeople.

PR12-24-002

Scientific Rating: N/A

Recommendation: Conditionally approved (C2)

Title: Exploring the Transition Region of QCD with the Proton's g_2 Spin Structure Function

Spokespersons: D. Ruth (contact), K. Slifer, N. Santiesteban, J.P. Chen

Motivation: The experiment aims to make a high-precision measurement of the first x-moments of the proton structure function g_2^p in the range 0.22 GeV^2 <Q^2<3.6 GeV^2. These results will fill the gap of intermediate Q^2 values in existing measurements of polarized structure functions. It could test the Burkhardt-Cottingham sum rule and lattice predictions, as well as constrain the spin polarizability term of muonic hyperfine splitting. More generally, the results will be valuable for studying the transition between hadronic and partonic physics in the region of intermediate Q^2.

Measurement and Feasibility: The experiment will require the baseline Hall C equipment, along with the addition of the new 5T magnet for the transversely polarized target, which is already planned for approved experiments in Hall C. In addition, it needs the installation of an upstream chicane and associated support structure, and a slow raster. Polarized beams at 4.4 GeV and 8.8 GeV will be necessary. Measurements of the $g_2(x, Q^2)$ structure function have been performed previously at JLab in different kinematics. The current proposal has been resubmitted to this PAC after the previous PAC deferred it due to a lack of description of the analysis method, estimation of the systematic uncertainties, and several issues raised by the TAC. The current proposal has correctly addressed all these issues.

Issues: The installation of the chicane and the 5T magnet is well-documented, and the committee is confident that it can be carried out successfully. However, the impact of this new setup on the detector resolution and its subsequent effect on the physics results has not been thoroughly addressed. A full Monte Carlo simulation of the new setup and detector is needed.

Summary: The PAC recognizes the significant importance of measuring the fundamental proton structure function g_2 for the proton. The presented physics case and the proponents' approach to the future measurement are solid. However, a fully simulated setup is needed to ensure that any potential changes in resolution will not affect the uncertainties and, consequently, the physics output.

PR12-24-003

Scientific Rating: A-

Recommendation: Approved for 42 PAC days for physics running in Hall C.
PAC days for calibration are common for the experiments PR12-24-003, PR12-24-004, PR12-24-011 and PR12-24-013.

Title: Studying Lambda interactions in nuclear matter with the ^{208}Pb (e, e' K^{+}) $^{208}_{\Lambda}$Tl reaction

Spokespersons: F. Garibaldi (contact), L. Tang, T. Gogami, O. Benhar, P. Markowitz, S. N. Nakamura, S. Nagao, G. M. Urciuoli, J. Reinhold

Motivation: The proposal focuses on measuring the excitation spectrum of $^{208}_{\Lambda}$Tl obtained from the ^{208}Pb (e, e' K^{+}) $^{208}_{\Lambda}$Tl reaction, in order to aid the resolution of problems associated with the role of hyper-nuclear matter in determining the maximum mass of neutron stars.

Using a heavy target with large neutron excess and a rather flat density profile provides an as good as possible proxy of matter in the interior of a neutron star. State-of-the art calculations of neutron matter with modern two- and three-body hyperon-nucleon forces indicate that the three-body forces become repulsive at high density, a feature that cannot be constrained considering only lighter systems. Both the investigation with heavy nuclei and the investigation of the isospin dependence of Λ-N interactions using ^{40}Ca and ^{48}Ca targets, proposed by this collaboration as PR12-24-011, are important.

Measurement and Feasibility: The experiment intends to measure the mass of $^{208}_{\Lambda}$Tl with the ^{208}Pb (e, e'K^{+})$^{208}_{\Lambda}$Tl reaction. The goal of the precision on the Λ binding energy is 70 keV. The experiment was originally accepted to run in Hall A as E12-20-013, and then moved to Hall C according to the recommendation by the lab. As a result, the existing HES and HKS spectrometers are used for electrons and kaons, respectively. A new pair of magnets, PCS, has been built and transported to JLab, to separate particles of opposite charge. This enables independent spectrometer settings for detecting electrons and positive kaons, which benefits the acceptance of the signal and reduction of backgrounds. Expected binding energy spectra are simulated, which show the feasibility of the proposed experiment. The experiment is well prepared and feasible.

Issues: Careful considerations should be given to the design of the Pb target, including computational fluid dynamics calculations. Beam energy stability (correctable) and spread (not correctable) have to be considered by the lab.

Summary: The PAC recognizes the importance of the measurement, and the experiment is feasible. The calibration data, common to all the hypernuclear experiments, should be taken close enough in time to the physics run of this experiment.

PR12-24-004

Scientific Rating: A-

Recommendation: Approved for 24 PAC days of physics running in Hall C.
PAC days for calibration are common for the experiments PR12-24-003, PR12-24-004, PR12-24-011 and PR12-24-013.

Title: Study of charge symmetry breaking in p-shell hypernuclei

Spokespersons: T. Gogami (contact), S. N. Nakamura, S. Nagao, L. Tang, P. Markowitz, J. Reinhold, F. Garibaldi, G. M. Urciuoli

Motivation: The proposal aims to explore charge symmetry breaking (CSB) in the ΛN interaction. For that, the proponents plan to determine the ground-state energies of the p-shell hypernuclei ${}_{\Lambda}{}^{6}\mathrm{He}$, ${}_{\Lambda}{}^{9}\mathrm{Li}$, and ${}_{\Lambda}{}^{11}\mathrm{Be}$ with an uncertainty of $|\Delta B_{\Lambda}{}^{\mathrm{total}}|$=70 keV, a precision unique to Jefferson Lab and required given the magnitude of the CSB effects. These measurements ultimately would complete the binding energy systematics across the A=6, 9, and 11 hyper isospin multiplets, which then would serve as benchmarks for hypernuclear models incorporating CSB effects in different ways.

Measurement and Feasibility: The proponents aim to measure the missing mass in the ${}^{6}\mathrm{Li}(e,e'K^{+})_{\Lambda}{}^{6}\mathrm{He}$, ${}^{9}\mathrm{Be}(e,e'K^{+})_{\Lambda}{}^{9}\mathrm{Li}$, and ${}^{11}\mathrm{B}(e,e'K^{+})_{\Lambda}{}^{11}\mathrm{Be}$ reactions in Hall C, with electron detection in the HES and kaon detection in the HKS, and with standard detectors augmented by new water Cherenkov counters. Calibration time is not included in the requested PAC days as the calibrations are common for the experiments PR12-24-003, PR12-24-004, PR12-24-011 and PR12-24-013. The measurement requires an electron beam-energy stability (70 keV) and spread (70 keV) at the physical limit. The expected Λ binding energy spectra are simulated, showing the sensitivity of the proposed experiment. The experiment is well prepared and feasible.

Issues: Beam energy stability (correctable) and spread (not correctable) requirements have to be considered by the Laboratory.

Summary: This JLab-unique experiment addresses the important question of the origin of CSB effects in the ΛN interaction. This is not just of fundamental interest in the field of hypernuclei, but of relevance also for understanding the equation of state of the dense cores of neutron stars, which are thought to harbor hyperons. The calibration data, common to all the hypernuclear experiments, should be taken close enough in time to the physics run of this experiment.

PR12+24-005

Scientific Rating: A-

Recommendation: Conditionally approved (C1) for 55 PAC days in Hall B

Title: A Dark Photon Search with a JLab Positron Beam

Spokespersons: B. Wojtsekhowski (contact), P. Achenbach, A. Gasparian, B. Raydo, N. Liyanage, W. Xiong

Motivation: The proposal is to search for the A′ boson in the annihilation of a high energy positron with an atomic electron ($e^+ + e^- \rightarrow A' + \gamma$) using the missing mass method. The A' boson in this reaction would be a new particle that exists in a manner beyond the standard model (BSM) of nuclear and particle physics. Strong constraints on the light A′ boson parameters have been obtained from electron and muon anomalous magnetic moments ($g - 2$) and other particle decay modes. There are also other JLab experiments with similar physics goals that are either approved, conditionally approved, and/or deferred (PR12+23-005, E12-10-009, E12-11-006, E12-21-003), but what makes this proposal different is that it is independent of decay modes. In this way, the experiment is sensitive to invisible decay modes of the A', so it is a broader and more generic search.

Measurement and Feasibility: The observed variables are the photon energy and its angle relative to the direction of the incident beam. The projected sensitivity to the coupling constant of the A′-boson (relative to the electromagnetic coupling) is at the 2×10^{-8} level (2σ sensitivity) in the mass range of 15 to 90 MeV. The experiment will use PRAD detector components in Hall B at a luminosity of 7×10^{34} Hz/cm^2, and a positron beam with a current of 50 nA at beam energies of 2.2, 4.4 and 11.0 GeV, along with a 5-cm-long liquid hydrogen target. The request is for 55 PAC days of running.

Issues: In the future, the proponents should plot their sensitivity reach at a significance level that is consistent with the experimental limits being compared to. The TAC report has raised a number of technical issues that need to be addressed in setting up the experiment.

Summary: This proposed experiment provides an important search for dark photons that does not rely on specific decay modes of the A′, with a reach beyond existing invisible decay limits from NA64, PADME, and Belle-II. As this dark photon search experiment is within a highly competitive nuclear physics environment, its competitiveness may likely change in the period of time that will be required until a running positron beam is available at CEBAF. Future jeopardy reviews of the experiment should pay particular attention to this issue.

The PAC conditionally approves the proposal for 55 PAC days. A C1 review by the Lab should be conducted at an appropriate time and verify that positron beams will be available with the parameters required for the experiment.

PR12-24-006

Scientific Rating: A

Recommendation: Approved for 200 PAC days in Hall D

Title: GlueX-III: a path to the Luminosity Frontier in Hall D

Spokespersons: M. R. Shepherd

Motivation: This proposal seeks to continue data-taking using the GlueX spectrometer in Hall D, taking advantage of higher beam current and possibly higher beam energy (up to 12 GeV) to collect an important sample of charmonium photoproduction events. The relatively large-statistics data, including photon polarization, that will be collected by this experiment will allow examination of the photoproduction mechanism for J/ψ, which is currently not established. In addition, GlueX will continue to use data collected with a relatively open trigger to examine the light hadron spectrum, collecting sufficient statistics to be able to carry out partial-wave analysis on some currently statistics-limited light meson final states.

Measurement and Feasibility: There are no technical concerns that the GlueX collaboration will continue their successful data taking. The addition of a TRD will provide additional important capabilities in the electron-pion separation, which suppresses combinatorial backgrounds and make the data samples cleaner for a partial wave analysis.
The PAC considers the program to understand the J/ψ production mechanism critical for the community that aims to use J/ψ for studying nuclear structure.

Issues: The experiment should not be run for a significant fraction of the 200 PAC days without the TRD being fully operational. This is because this new subsystem will enhance the quality of the data significantly and might enhance the use of the collected GlueX-III dataset for future analyses not yet planned. Therefore, both JLab and the collaboration should give high priority on finalizing the TRD before GlueX-III data taking starts. The PAC also encourages the GlueX collaboration to give priority to those GlueX-II data analyses that can inform the GlueX-III running.

Summary: The PAC agrees that the experiment is very well motivated, and the experimental realization is sound. The addition of the TRD will provide important additional performance enhancement of the GlueX detector and significantly improve the signal to background ratio in general. The PAC therefore recommends approval of the requested 200 PAC days.

PR12-24-007

Scientific Rating: A

Recommendation: Approved for 9 PAC days in Hall C

Title: Nuclear Dependence of Beam Normal Single Spin Asymmetry in Elastic Scattering

Spokespersons: C. Gal (contact), C. Ghosh, S. Park

Motivation: The goal of this proposal is to resolve the so-called PREX A_n puzzle, where the measured asymmetry for ^{208}Pb shows a striking disagreement from the theoretical prediction and from the results for $Z \leq 20$ nuclei. The asymmetry arises from two photon exchange (TPE), because the single-photon exchange contribution vanishes due to time-reversal symmetry. The high-precision measurement from this proposal will help to resolve the above-mentioned puzzle and may lead to a new discovery.

Measurement and Feasibility: The proponents aim to measure the asymmetry using targets with a broad range for Z (from Z = 6 to Z = 90) at $Q^2 = 0.0092$ GeV^2. They request 9 PAC days of beam time in Hall C using the SHMS spectrometer. The TPE predictions for all the nuclei in the proposal sit at approximately 6 ppm. The precision of the collected data is expected to reach 0.5 ppm for each nucleus.

This experiment will leverage the procedures and techniques developed at the lab for previous parity-violation experiments. The estimated total systematic uncertainty budget would be smaller than 0.2 ppm, which is less than half of the statistical uncertainty for each target.

Issues: A concern has been raised in the TAC report about the estimation of inelastic background contributions and the position scans that will serve this purpose for C, Sn, Au, Pb targets. This issue has been adequately addressed by the proponents.

Summary: The PAC recognizes the significant importance of the proposed measurements and approves the experiment.

PR12-24-008

Scientific Rating: N/A

Recommendation: Deferred

Title: Inclusive Studies of 3N Short-Range Correlations

Spokespersons: B. Duran (contact), N. Fomin, J. Arrington, S. Li

Motivation: The proposal aims to confirm the onset of the 3N-SRC plateau by accessing the high x ($2.4 < x < 2.9$) and high Q^2 domain in inclusive electron scattering from nuclei. It also aims to study the Q^2 dependence and proposes to test the nuclear scaling of the SRC ratios with $a_3(A) \propto [a_2(A)]^2$, where $a_2(A)$ and $a_3(A)$ can be defined in terms of nuclear cross section ratios relative to ^{2}H and ^{3}He, respectively. This proposal is an extension of the experiment E12-06-105, which has a limited statistical accuracy at high x.

Measurement and Feasibility: The proposal requires an electron beam energy of 10.6 GeV or higher and ^{3}He, ^{4}He, ^{9}Be, ^{12}C, ^{40}Ca, and ^{197}Au targets. It uses the SHMS in Hall C at 10, 11 or 12 degrees and 9.2 GeV central momentum. One setting (10 degrees) is common with E12-06-105. The experiment will use 20 cm long helium targets and foil targets. In total, 47 PAC days were originally requested for measurements, calibration, trigger tests and other purposes.

The statistics goal is driven by the prediction that $a_3 \propto (a_2)^2$. With the expected statistical (1.6-5%) and systematic (2%) uncertainties in the region of interest, the experiment aims to distinguish between a plateau and a linear increase in x for the double ratio of ^{4}He/^{3}He or A/^{4}He.

Issues: The 60 μA electron beam heat load on a 20 cm long helium target is too high according to recent discussions with the target group. The proponents will use 35 μ A instead. In addition, the TAC report requested 1 additional day for target changeover. These changes resulted in an increase of the total requested running time to 57 PAC days.

As pointed out in the Theory TAC report, effects that are known to be negligible in 2N-SRC (FSI and Δ isobar) or effects from the 3N-SRC geometry could be sizeable and complicate the data interpretation. The PAC recommends close collaboration with theorists to estimate such effects and to obtain more theoretical guidance on establishing the presence of 3N correlations, given that there may not be a plateau but a more complex dependence on x.

Summary: The PAC defers the proposal, given the lack of a strategy to firmly establish the existence of 3N-SRCs from the proposed data. A future proposal would benefit significantly from having the data and physics lessons from E12-06-105 published. The PAC encourages the proponents to get theoretical support in order to devise a clear strategy to quantify 3N-SRCs and their A-dependence. Alternatively, they may consider focusing on a measurement with fewer targets, to map the region of the expected onset of the 3N-SRCs and to provide a first experimental characterization of the critical region.

PR12-24-010

Scientific Rating: A-

Recommendation: Approved for 2 PAC days in Hall A

Title: High-precision measurement of $\mu_p G^E_p / G^M_p$ at $Q^2 = 3.7$ GeV^2 via Polarization Transfer

Spokespersons: A. Puckett (contact), A. Schmidt, J. Bernauer

Motivation: The experiment aims to measure the $\mu_p G^E_p / G^M_p$ ratio of proton electromagnetic form factors at a single kinematic point $Q^2 = 3.7$ GeV^2 via the polarization transfer method. This measurement seeks to decrease the uncertainties of previous measurements in this region by a factor of four, in anticipation of a future measurement of the same observable using a positron beam. These combined measurements are expected to shed light on the discrepancy between determinations of this ratio via the polarization transfer and the Rosenbluth methods, by testing the hypothesis that the main reason for the discrepancy is hard two-photon exchange (TPE). They could constrain the additional form factors that appear beyond the one-photon approximation.

Measurement and Feasibility: The measurement is proposed to be made in conjunction with the approved high-precision measurement E12-07-109 of $\mu_p G^E_p / G^M_p$ via polarization transfer up to $Q^2 = 12$ GeV^2, which is to take place in Hall A. Electrons with an energy of 4.3 GeV and 85% longitudinal polarization will be scattered from the 30 cm liquid hydrogen target, with the SBS detecting the recoil proton and the ECAL detecting the scattered electron.

E12-07-109 is approved for 45 PAC days, using three different beam energies, while the proposed measurement would add 2 more days, enough for high-statistics data taking at lower Q^2. The measurement is feasible and would additionally provide help for controlling the systematics of E12-07-109.

Issues: There are no major technical issues. The main motivation for the proposed measurement is a comparison with the future positron beam experiment that is not yet approved (although the physics case of the corresponding LOI12+23-008 was viewed favorably by PAC51).

Summary: The proposed high-precision measurement (in combination with future analogous positron beam measurements) could provide important information on the hard TPE contribution to proton electromagnetic form factors. The PAC recommends the approval of the requested 2 PAC days.

PR12-24-011

Scientific Rating: A-

Recommendation: Approved for 28 PAC days of physics running in Hall C.
PAC days for calibration are common for the experiments PR12-24-003, PR12-24-004, PR12-24-011 and PR12-24-013.

The physics run of the present experiment can serve as the common ^{27}Al-target calibration.

Title: Study of a triaxially deformed nucleus using a Lambda particle as a probe

Spokespersons: S. N. Nakamura (contact). T. Gogami, S. Nagao, L. Tang, F. Garibaldi, G. M. Urciuoli, J. Reinhold, P. Markowitz

Motivation: The proposal aims to study triaxial deformation in nuclei with the Λ as a probe. Specifically, $_{\Lambda}{}^{27}$Mg is used as a test case to demonstrate the approach, with the triaxial nucleus ^{26}Mg being probed via the Λ in a *p* orbital. A Λ particle in the *p* orbital of a hypernucleus is predicted to produce shifts in the energy levels, depending on which axis of the triaxial nucleus (long, short, intermediate) the *p*-shell Λ wave function is aligned with. The emerging extra peaks would be detected in missing mass spectroscopy, and their mere existence would demonstrate the effect.

Measurement and Feasibility: The proponents aim to measure the missing mass spectrum in the ^{27}Al(e,e'K^{+})$_{\Lambda}{}^{27}$Mg reaction in Hall C, with electron detection in the HES and kaon detection in the HKS, using standard detectors. Calibration time is not included in the requested PAC days as the calibrations are common for the experiments PR12-24-003, PR12-24-004, PR12-24-011 and PR12-24-013. In turn, the present measurement can serve as the ^{27}Al-target calibration for the campaign. The 7 days for ^{27}Al calibration requested in the proposal PR12-24-013 will be subtracted correspondingly.

The measurement desires an electron beam-energy stability (70 keV) and spread (70 keV) at the physical limit set by synchrotron radiation, but it may be able to tolerate 100 keV in energy spread. The expected Λ binding energy spectra are simulated, showing the sensitivity of the proposed experiment. The experiment is well prepared and feasible.

Issues: Beam energy stability (correctable) and spread (not correctable) requirements have to be considered by the Laboratory.

Summary: This JLab-unique experiment would establish a novel approach to sense triaxial deformation in nuclei. The PAC appreciates the novel idea, which might enable possible other types of deformation or cluster structures to be probed. The committee commends the proponents for taking into account the PAC comments on last year's LOI12-23-016 when writing this proposal. The calibration data, common to all the hypernuclear experiments, should be taken close enough in time to the physics run of this experiment.

PR12-24-012

Scientific Rating: N/A

Recommendation: Deferred

Title: Isospin structure of 3N short-range correlations and the nucleon structure functions in ^{3}H and ^{3}He

Spokespersons: S. Li (contact), J. Arrington, B. Duran, N. Fomin, T. Hague, D. Higinbotham, D. Meekins

Motivation: The proposal aims to find evidence of 3N SRCs in the ratio of inclusive electron scattering cross sections of tritium to ^{3}He (^{3}H/^{3}He) in the kinematic domain away from the excitation of *N* resonances and between the *N* quasi-elastic peak and the elastic peak of A=3 nuclei, i.e. for $2 < x < 3$ and relatively large Q^2.
Previous experiments at JLab found some hints of the onset of 2N SRCs as an (x, Q^2)-independent plateau in the ratio of cross sections of various nuclei to the one of Deuterium at $1 < x < 2$. A similar search for the onset of 3N SRCs from the ratio to the ^{3}He cross section at $x > 2$ was inconclusive. However, the Hall A experiment E12-11-112 found a possible indication of a plateau at $x \sim 2.5$ in the ^{3}H/^{3}He ratio, where scaling-violation effects are expected to cancel in the ratio.
This proposal aims to extend the E12-11-112 kinematic coverage to larger Q^2 in order to verify whether this trend of the ratio is confirmed, which would have implications on the possible isospin configurations of 3N SRC.
As a byproduct, the proposal wants to measure the ^{3}H/^{3}He ratio in the DIS regime to access the ratio of neutron-to-proton F_2 structure functions at large x, confirming and modestly improving on the precision reached by the E12-10-103 (MARATHON) experiment.

Measurement and Feasibility: The proposed experiment wants to take data for inclusive electron scattering on ^{3}H and ^{3}He, using the Hall C SHMS and 11 and 8.8 GeV beams, reaching $Q^2 = 2.8$ and 1.8 GeV^2 at $x = 2.5$. The plan is to use the same low-density tritium gas target as previously used in Hall A. Tungsten collimators are proposed to shield the SHMS from scattering on the target walls. Event rates are estimated assuming the same luminosity achieved in Hall A, with a maximum current of 22.5 μA for tritium safety. The statistics of 5k and 10k events for the two explored kinematics amount to 53 PAC days (including calibration and installation/configuration changes).

Issues:

- Based on naïve expectations, a confirmation of the plateau in the ^{3}H/^{3}He ratio would indicate that an isospin-symmetric star-like configuration of the three nucleons is preferred. However, a theoretical calculation predicts that the observed ratio in E12-11-112 could be due to two sequential 2N SRCs in an anti-aligned asymmetric configuration. The possibility of having different configurations either competing or dominating at different x, suggests that the trend of the cross-section ratio could not necessarily be a plateau, and that the absence of a plateau would not necessarily imply absence of 3N SRC. Hence, a cross section ratio scaling in (x, Q^2) seems not best suited to exploit the onset of 3N SRCs, also because the onset of 2N SRCs (which is the underlying motivation of this proposal) is not unambiguously proven in all tested nuclei.
- There is no comparison between the projected uncertainties and theoretical predictions, including their respective uncertainties, for different isospin configurations of the 3N system, in order to assess whether the former can discriminate among the latter.

- A full Geant4 simulation of the whole setup, including the shielding tungsten collimators, is required, in order to estimate backgrounds and construct a detailed analysis of the systematic errors.
- Moving the MARATHON tritium target from Hall A to Hall C will require substantial work to implement modifications inside and outside Hall C, as well as new operational procedures to conduct the experiment.
- The estimate of the statistical uncertainties in the neutron-to-proton ratio of F_2 structure functions should be done more appropriately, using Monte Carlo techniques to randomize the data points, which will probably lead to uncertainties larger than those plotted in the proposal. In any case, the displayed results would confirm the MARATHON results at best, which would be a good outcome but not a significant improvement.
- A detailed analysis of all the experimental systematics should be presented both for the SRC and the F_2 structure function analysis.
- The collaboration should work with the theoretical community to obtain - if possible different - predictions for SRCs, to better assess whether the current projected uncertainties can indeed provide access to 3N SRCs.

Summary: The PAC thinks that a robust and comprehensive theoretical analysis is needed to interpret the outcome of the proposed measurement in any scenario (onset of a plateau or of a different trend in the cross-section ratio), so as to unambiguously establish the onset of 3N SRCs. Without such a theoretical guidance, the envisaged physics output seems too poor with respect to the requested beam time and the amount of work implied by the required setup. Therefore, the PAC defers this proposal, recommending the proponents to work closely with theorists, in order to develop a theoretical framework and an analysis strategy that will allow for a quantitative interpretation of the experimental outcome, beyond assumptions based on simple models.

PR12-24-013

Scientific Rating: A-

Recommendation: Approved for 42 PAC days for physics running and 13 PAC days for calibration in Hall C. The calibration is common for the experiments PR12-24-003, PR12-24-004, PR12-24-011 and PR12-24-013.

Note that another 7 PAC days for calibration with a ^{27}Al target should be added if PR12-24-011, which will use a ^{27}Al target for physics, were carried significantly later.

Title: An isospin dependence study of the Lambda-N interaction through the high precision spectroscopy of Lambda hypernuclei with electron beam

Spokespersons: S. N. Nakamura (contact), L. Tang, G. M. Urciuoli, J. Reinhold, P. Markowitz, T. Gogami, S. Nagao, F. Garibaldi

Motivation: The collaboration seeks to explore the isospin dependence of the three-body ΛNN interaction in ^{40}Ca ($^{40}_{\Lambda}$K) and ^{48}Ca ($^{48}_{\Lambda}$K). The experiment will measure the binding energy of both hypernuclei. This investigation should give insight into the ΛN-ΣN coupling in the ΛN interaction and into the ΛNN three-body interaction. The investigation of the Λ-N interaction in heavy nuclei (PR12-24-003) and the investigation of its isospin dependence in the present proposal are both important.

Measurement and Feasibility: The experiment intends to measure the mass of $^{40}_{\Lambda}$K and $^{48}_{\Lambda}$K with ^{40}Ca (e, e'K^{+})$^{40}_{\Lambda}$K and ^{48}Ca (e, e'K^{+})$^{48}_{\Lambda}$K reactions, respectively. The goal of the precision on the Λ binding energy is 70 keV. The experiment was originally planned in Hall A as E12-15-008, and then moved to Hall C according to the recommendation by the lab. As a result, the existing HES and HKS spectrometers are used for electrons and kaons, respectively. A new pair of magnets, PCS, has been built and transported to JLab, to separate particles of opposite charge. This enables independent spectrometer settings for detecting electrons and positive kaons, which benefits the acceptance of the signal and reduction of backgrounds. Expected binding energy spectra are simulated, which show the feasibility of the proposed experiment. The experiment is well prepared and feasible.

Issues: In order to achieve the desired precision, close communication with the lab on the beam energy precision/spread is required.

Summary: The PAC recognizes the importance of the measurement, and the experiment is feasible. The calibration data, common to all the hypernuclear experiments, should be taken close enough in time to the physics run of this experiment.

C12-23-009

Scientific Rating: N/A

Recommendation: Deferred

Title: Nuclear Charm Production and Short-Range Correlations

Spokespersons: O. Hen (contact), J. Pybus

Motivation: The proposed experiment aims to measure the |t|-dependence of the 2N-SRC process in ^{4}He(γ, ρ^0 pp) and ^{4}He(γ, ρ^- pp), to search for exclusive 3N-SRC breakup with ^{4}He(γ, ρ^0 ppp) and ^{4}He(γ, ρ^- ppp), and to measure semi-inclusive J/ψ production on ^{4}He (γ ^{4}He$\rightarrow$ J/ψ p X) as a function of E_γ, |t|, and a light-cone variable α_{miss} in and above the subthreshold regime.

Measurement and Feasibility: The experiment is an extension of the first SRC-CT experiment E12-19-003 that took place in 2021 using ^{2}H, ^{4}He and ^{12}C targets for 19 PAC days with the standard GlueX configuration. The new proposal requests 95 PAC days with a ^{4}He target (about 10 times more statistics than E12-19-003) and 5 PAC days with a ^{2}H target, the latter mainly for calibration purposes. The highest possible electron beam energy E_{beam} (12 GeV) and a coherent photon peak energy of 8 GeV are required. The J/ψ measurements would benefit from the GEM-TRD installation planned by GlueX.

Issues: The proposal was conditionally approved in 2023. For a resubmitted proposal, the PAC51 expected "the collaboration to finalize and publish the results of E12-19-003, in order to estimate the systematic uncertainties with sufficient accuracy."

A 2N-SRC ρ data analysis note is however not yet ready, and a publication of these results would give confidence in the measured systematic uncertainties. The J/ψ analysis was finalized, and an imminent publication is planned. The |t| and α_{miss} dependences of the J/ψ cross section measured by E12-19-003 are consistent within uncertainties with the unmodified plane-wave impulse approximation (PWIA) model (which is presented without uncertainty). From the new projections of differential kinematic distributions provided to this PAC, it is not clear if the proposed experiment will have the sensitivity to measure variations with respect to this model. A variation would mean the presence of either SRC nucleons or more exotic contributions. The J/ψ would profit from the GEM-TRD installation, and the PAC expects a full simulation with the GEM-TRD for a future proposal.

Summary: The PAC defers the proposal given that the issues from the previous PAC were not fully addressed, and because with the present information it is not clear whether the J/ψ measurements would have sufficient physics impact. The PAC encourages the proponents to work on a more robust projection of the precision of the J/ψ analysis and on its comparison to theory predictions. This should show the sensitivity of the proposed experiment to measure variations in the |t| and α_{miss} dependences of the J/ψ cross section with respect to PWIA models. If the forthcoming studies on J/ψ are not conclusive, the proponents may consider optimizing the running time for the 2N-SRC ρ meson measurements.

J12-24-RunGroupA

Title: 11 GeV Polarized Electrons on Liquid Hydrogen Target to Study Proton Structure, 3D Imaging, and Gluonic Excitations

Spokespersons: L. Elouadrhiri (contact), H. Avakian, D. Carman, D. Glazier, R. R. Paremuzyan, F.X. Girod, E. Pasyuk

Motivation: Accurately measure exclusive and semi-inclusive processes, reconstructing final states in all details and angular distributions, in order to build 3D maps of the internal dynamics of elementary constituents of hadrons and their resonances. The Run Group A (RG A) includes 13 experiments organized in the following 6 subclasses:

- **Exclusive processes**: measure the DVCS cross section and Beam Spin Asymmetry (BSA) to extract the Compton Form Factor (CFF) for unpolarized quarks in the proton and in the pion; measure the Deeply Virtual Meson Production (DVMP) cross section and BSA for M=π^0, η, φ, ρ, to extract quark CFF for chiral-odd and gluon GPDs
- **SIDIS**: measure the fully differential cross section and BSA for single-pion production to extract the twist-2 and twist-3 structure functions for unpolarized proton targets; measure the fully differential cross section and BSA for two-pion production to extract the twist-3 collinear parton distribution e(x) and the Di-hadron Fragmentation Function $G_1^{\perp}$
- **Quasi-photoproduction**: measure the TCS cross section to extract both real and imaginary parts of the unpolarized quark CFF; measure photoproduction of J/ψ to extract the nucleon gravitational form factors
- **N* structure**: measure inclusive and exclusive electron-proton cross section and BSA to various final states to extract the γ*pN* electro-couplings and the N$\rightarrow$N* transition GPD
- **MesonEx:** the E12-11-005 experiment aims to study light-quark hybrids in complementarity to Hall D, as well as to find possible evidence of glueballs
- **VeryStrange:** the E12-11-005A experiment is to study electro- and photo-production of baryons with S=-2, -3 strangeness number, in particular the resonances Ξ* and Ω^-

1) Is there any new information that would affect the scientific importance or impact of the Experiment since it was originally proposed?

The very broad physics program of RG A is central to the physics agenda of JLab12. The scientific motivation remains strong, although the physics outcome would largely benefit from comparison with theoretical predictions based on the state-of-the-art frameworks and analysis tools. Thus, the PAC encourages the proponents to form collaborative working groups with theorists that are experts in the various fields touched by the RG A physics program.

2) If the experiment has already received a portion of its allocated beam time, the spokespersons should present the status of the analysis of the existing data and the projected result for the final complete data set. The goal is to show the physics impact of the beam time requested in the jeopardy update.

The RG A collected data in 2018 and 2019 for 74 of the total assigned 139 PAC days. Some

experiments have already published their results in journals, whereas other ones are finalizing the analysis. During the PAC presentation, the proponents have discussed the projected impact on various observables from the statistics that would be accumulated in the remaining 65 PAC days, demonstrating the potential to discriminate among different theoretical models, when available, or showing in other cases how crucial the remainder of the RG A beam time is to realize the experimental goals.

3) What is the status of the collaboration in terms of institutes, committed staff, and prospective students?

During the presentation, the proponents have satisfactorily described how the subgroups of the various RG A experiments form a larger and well-coordinated group committed to the efficient functioning of the Hall B setup. The RG A subgroups are also active in involving new students and post-docs for a natural turn-over.

4) Should the remaining beam time allocation and experiment grade be reconsidered?

No.

Summary: The motivation to complete the very broad physics program remains very strong, in particular about the experiments on DVCS, SIDIS, and N* structure. The PAC recommends the RG A to stay active with the scientific grade A. The PAC also recommends to maintain the remaining beam time allocation of 65 PAC days.

J12-24-RunGroupB

Title: CLAS12 Run-Group B: electroproduction on deuterium with CLAS12

Spokespersons: S. Niccolai (contact)

Motivation: The motivation of this run group has not changed:

1. Comprehensive study of GPD and TMDs using deuterium as a neutron target and measuring exclusive and semi-inclusive reactions. Main goals: access to the GPD E, leading to the contribution of quark angular momentum to the nucleon spin; flavor separation of GPDs and TMDs via combination of proton and deuteron observables; accurate measurement of the neutron magnetic form factor at high Q^2
2. Exclusive, near-threshold coherent and incoherent J/ψ quasi-real photoproduction on the deuteron, to study the gluonic structure of bound nucleons and of the deuteron, and to search for isospin partners of the LHCb pentaquark
3. In-medium structure functions, Short Range Correlations, and the EMC effect, studied via proton-DIS with neutron-spectator tagging, to be compared to free-proton DIS results
4. Quasi-real proton-antiproton (p pbar) photoproduction to look for p pbar resonances and to study the coherent production mechanism on deuterium

1) Is there any new information that would affect the scientific importance or impact of the Experiment since it was originally proposed?

Preliminary analysis of the experimental data taken so far demonstrates good progress and confirms the promises of the proposed experiments, including the DVCS measurements, in- medium structure functions and the EMC effect. Neutron DVCS plays a unique role to constrain the flavor structure of the GPDs. Recent GlueX and E12-16-007 results on near-threshold J/ψ photoproduction have motivated a measurement of the isospin-dependence of this process from this run group.

2) If the experiment has already received a portion of its allocated beam time, the spokespersons should present the status of the analysis of the existing data and the projected result for the final complete data set. The goal is to show the physics impact of the beam time requested in the jeopardy update.

The experiment has taken 39 days of total 90 awarded PAC days.

Progress has been made on the analysis of the data from the previous run for all experiments in this run group. In particular, the result from neutron DVCS (submitted for publication) has demonstrated its significant impact on the global fit of the flavor dependent Compton Form Factors. Analyses and publications for most of other channels are also well underway.

3) What is the status of the collaboration in terms of institutes, committed staff, and prospective students?

During the presentation, the proponents have satisfactorily described how the subgroups of the various RG B experiments form a larger and well-coordinated group committed to the efficient functioning of the Hall B setup. The RG B subgroups are also active in involving new students and

post-docs for a natural turn-over.

4) Should the remaining beam time allocation and experiment grade be reconsidered?

No.

Summary: The motivation to complete the neutron DVCS measurements is very strong. The efforts of the collaboration to measure additional DVCS channels are commended by the PAC. The PAC also recognizes the motivation for the measurement of the iso-spin dependence in near-threshold J/ψ photoproduction. The PAC recommends to maintain the remaining beam time allocation of 51 days and the scientific rating A.

J12-24-RunGroupC

Title: CLAS12 Run Group C

Spokespersons: S. Kuhn (contact), H. Avakian, M. Defurne, C. Dilks, T. Hayward, S. Niccolai

Motivation: Run Group C (RG C) comprises five approved experiments and three run group additions with the CLAS12 spectrometer in Hall B, each scattering polarized electrons from longitudinally polarized protons or deuterons to determine the various structure functions of nucleons. This includes polarized PDFs at high x, TMDs and GPDs. Experiments are
E12-06-109: Longitudinal spin structure of the nucleon
E12-06-109a: DVCS on the neutron with a polarized deuterium target
E12-06-119b: DVCS on a longitudinally polarized proton target
E12-07-107: Spin-orbit correlations with a longitudinally polarized target
E12-09-009: Spin-orbit correlations in kaon electroproduction in DIS
E12-09-007b: Study of partonic distributions using SIDIS kaon production
E12-09-007a: Dihadron electroproduction in DIS with longitudinally polarized targets
E12-07-107a: Baryon production in target fragmentation region with polarized targets

1) Is there any new information that would affect the scientific importance or impact of the Experiment since it was originally proposed?

There have been no other directly competing experiments with longitudinally polarized targets. Other recently published JLab measurements with unpolarized targets in the same kinematic region could be better utilized in global phenomenological analyses if also the complementary polarized target data becomes available.

2) If the experiment has already received a portion of its allocated beam time, the spokespersons should present the status of the analysis of the existing data and the projected result for the final complete data set. The goal is to show the physics impact of the beam time requested in the jeopardy update.

Since the last Jeopardy update of RG C, the experiments have received 80 out of 120 PAC days of allocated beam time, with three run periods in 2022 and 2023. Preliminary results have been shown for proton DVCS, neutron DVCS, timelike Compton scattering, SIDIS and inclusive spin structure functions. For selected experiments also projections for the complete data set have been presented, demonstrating the impact of the remaining beam time.

3) What is the status of the collaboration in terms of institutes, committed staff, and prospective students?

According to the spokesperson's statement, all spokespersons and other senior personnel are committed to setting up and taking data for the anticipated additional run of RG C, and to analyze the complete data set including these new data. While some students working on the first run of RG C will graduate (or have already done so) before RG C can run again, the collaboration is actively and successfully recruiting new students (and postdocs) to work on the present analysis and to also help with the next run.

4) Should the remaining beam time allocation and experiment grade be reconsidered?

No. The collaboration has convincingly argued that the new target sample irradiation procedure and other advancements will significantly improve the figure of merit for the remaining data taking with respect to what was possible during 2022-2023.

Summary: The PAC recommends Run Group C to stay active with scientific grade A, and it confirms the remaining 40 PAC days. Scheduling this in conjunction with Run Group G (E12-14-001) would be beneficial by reducing the total overhead time.

J12-24-RunGroupH

Title: CLAS12 Run-Group H: electroproduction on transversely polarized proton with CLAS12

Spokespersons: M. Contalbrigo (contact)

Motivation: This run group contains a set of measurements for GPD and TMD studies with a transversely polarized target in Hall B.

1) Is there any new information that would affect the scientific importance or impact of the Experiment since it was originally proposed?

Yes, as pointed out in several PACs in the past and in the PAC 48 theory report, theoretical work in recent years has sharpened the requirements for interpreting SIDIS measurements in 12 GeV kinematics in terms of parton distributions (PDFs or TMDs). The proponents of this proposal should work with the theory community on impact studies detailing the impact of these data on our understanding of PDFs, TMDs and GPDs, especially because significant beam time and investments in building new equipment are requested. It is also noted that since the original proposal was presented to PAC 39 several new data sets have become available, which constrain the observables under discussion not necessarily in the same kinematic region. This should be considered when assessing the global impact of this Run Group H data. It is noted that both the LHCb polarized target running and the STAR forward upgrade can reach x above 0.4 at higher Q^2 than JLab.

2) If the experiment has already received a portion of its allocated beam time, the spokespersons should present the status of the analysis of the existing data and the projected result for the final complete data set. The goal is to show the physics impact of the beam time requested in the jeopardy update.

N/A

3) What is the status of the collaboration in terms of institutes, committed staff, and prospective students?

The proposal is run as part of the CLAS Collaboration, such it can be assumed that enough work force is available to carry out the experiment.

4) Should the remaining beam time allocation and experiment grade be reconsidered?

Yes.

The PAC commends the collaboration and JLab that a technical solution for a transversely polarized target was found. The scientific motivation for the different measurements in the run group remain strong. But the new solution to realize a transverse polarized target leads to a significant change of the experimental setup. Therefore, the PAC asks the collaboration to perform the following studies to understand the impact of the new experimental setup on the different measurements.

- Perform a full GEANT simulation of the entire beamline leading up to the target, to get a good estimate of the background and synchrotron radiation.
- Perform a full GEANT simulation of the different physics measurement to understand the impact of the new acceptance on the different measurements, i.e. SIDIS and DVCS.
- Based on the new simulations, the systematic uncertainties for the different measurements should be evaluated.

- Based on the new simulations, impact studies of the measurements on the physics observables, in particular TMDs and Compton Form Factors, should be determined.

For these reasons the PAC has revised the status of the experiment to C2 (conditionally approved with return to a future PAC).

Summary: The scientific motivation of the run group remains strong. Finding a technical solution for a transverse target has been crucial to make the different measurements possible. But due the large changes in the experimental setup compared to the original proposal, the PAC encourages the collaboration to submit a new proposal that details the scientific reach of run group H with the new setup, assessing the statistical and systematic uncertainties as well as the kinematic coverage. The PAC status of the run group is therefore changed to **C2**.

E12-11-006

Title: Heavy Photon Search Experiment
(also denoted as CLAS12 Run Group I)

Spokespersons: T. Nelson (contact), S. Stepanyan, M. Holtrop

Motivation: Establishing the nature of dark matter is one of the major open challenges of modern physics. Well-motivated scenarios involving light hidden-sector dark matter with mediators in the MeV-GeV range are relatively unexplored and remain one of the simplest mechanisms by which dark matter can interact with ordinary matter, which allows the dark matter to be produced from Standard Model particles in the hot thermal plasma present in the early Universe.

1) Is there any new information that would affect the scientific importance or impact of the Experiment since it was originally proposed?

Models with a broken hidden-sector U(1) gauge symmetry, giving rise to a "dark" or "hidden sector" photon, are currently regarded as particularly attractive and can be tested experimentally. Such hidden-sector gauge symmetries are common in theories beyond the Standard Model, and have long been recognized as giving rise to a simple and appealing portal from the Standard Model sector to this hidden sector.

2) If the experiment has already received a portion of its allocated beam time, the spokespersons should present the status of the analysis of the existing data and the projected result for the final complete data set. The goal is to show the physics impact of the beam time requested in the jeopardy update.

Since the last jeopardy update to PAC48 in 2020, the HPS Experiment has used 30 of the originally given 135 PAC days. The current request is for 105 PAC days of beam time. The HPS collaboration continues the analysis and calibration of the already taken data. The published results of the A′ searches use the resonance and displaced vertex signatures from engineering run data sets.
The collaboration is engaged in ongoing detector maintenance and repair work in preparation for further running to complete HPS data-taking, while continuing to improve the calibration and analysis of the 2019 and 2021 data sets. The experimental sensitivity remains approximately linear with the available statistics, so that the remaining beam time will have a significant impact.

3) What is the status of the collaboration in terms of institutes, committed staff, and prospective students?

The collaboration consists of 50 scientists from 17 institutions in five different countries. There is an influx of students that have been and are helping to run the experiment and analyze the data.

4) Should the remaining beam time allocation and experiment grade be reconsidered?

No.

Summary: The PAC recommends the experiment to stay active, with the remaining 105 PAC days and with the previous scientific grade A. This Heavy Photon Search experiment is part of a highly competitive nuclear and particle physics environment. It would benefit from running as early as compatible with experimental readiness and scheduling constraints. In the same spirit, the PAC encourages the collaboration to publish the results of all the past runs in a timely manner.

E12-14-001

Title: The EMC Effect in Spin Structure Functions (also denoted as CLAS12 Run Group G)

Spokespersons: W. Brooks (contact), S. Kuhn, M. Arratia

Motivation: The proponents aim to perform the first experimental study of spin-dependent nuclear effects in DIS. This can be achieved by comparing DIS cross sections from polarized ^{6}LiH and ^{7}LiD targets. Model calculations indicate that the EMC effect can be sensitive to differences in the spin-dependent DIS cross sections, sufficiently large to be detected in the proposed experiment. The anticipated results of the measurement have the potential to distinguish between the theoretical pictures in which the modifications are primarily caused either by mean-field-type interactions or by nucleons at momenta of a few hundred MeV (short-range correlations).

1) Is there any new information that would affect the scientific importance or impact of the Experiment since it was originally proposed?

The experiment was approved in 2014 (PAC42, rated B+) and went to a re-approval in 2020 (PAC48, rated A-) after a jeopardy review. Since the initial approval, the community's interest in measuring the EMC effect in polarized structure functions has grown, and the physics case remains compelling. No comparable data have been collected anywhere, nor are likely to be available in the foreseeable future. New model calculations of spin-dependent effects support the ability of the proposed measurements to discriminate between several of the theoretical explanations.

2) If the experiment has already received a portion of its allocated beam time, the spokespersons should present the status of the analysis of the existing data and the projected result for the final complete data set. The goal is to show the physics impact of the beam time requested in the jeopardy update.

N/A

3) What is the status of the collaboration in terms of institutes, committed staff, and prospective students?

The experiment has the backup of the CLAS collaboration. Several proponents are from institutions that are able to recruit students.

4) Should the remaining beam time allocation and experiment grade be reconsidered?

The PAC confirms the importance of the physics measurement, together with the previously assigned grade.

Summary: The committee reaffirms the solidity of the proposal and recognizes its significant potential impact on the theoretical understanding of the EMC effect. The preparation of the LiD target remains a crucial aspect of the experiment. Collaboration with the Spin-Polarized Fusion project at JLab facilitates further development in this area.
The PAC reaffirms the allocated beam time of 55 PAC days and the previous scientific A- grade.

E12-12-002A

Title: Measurement of α_- for $\Lambda \rightarrow$ proton π^-

Spokespersons: P. Hurck (contact), D. I. Glazier, D. G. Ireland, K. Livingston, F. Afzal, A. Thiel, Y. Wunderlich, V. Crede, M. M. Dalton

Motivation: The main goal of the experiment is to measure the asymmetry parameter of the weak decay of the Lambda hyperon $\Lambda \rightarrow p\pi^-$. This measurement requires a both circularly and linearly polarized photon beam, and it uses the GlueX spectrometer in Hall D. The longitudinal polarization can be achieved by providing a longitudinally polarized electron beam to the Hall D tagger.

Measurement and Feasibility: The equipment to read out the helicity phase of the electron beam has already been installed and verified. The electron beam longitudinal polarization will be evaluated using the measurements in other halls, as well as from the analysis of exclusive ρ production. The run group addition will use the remainder of the GlueX-II beam time, about 118 PAC days. The measurement can be performed alongside GlueX-II running and requires no new hardware or new beam time.
The measurement is possible because uses both linear and circular photon beam polarization, which results in an over-constrained set of amplitudes. These can be fitted to data and used to extract α_-, which will be left as a free parameter in the fit. It is expected that the determination of α_- will achieve statistical uncertainties comparable to existing measurements and independent systematic uncertainties. This is a collaboration-approved proposal.

Issues: The linear polarization of the photon beam needs to be measured precisely for this measurement. This will be done in Hall D using a triplet polarimeter. By comparison, the expected uncertainty on the circular photon polarization on the measurement is negligible.

Summary: The experiment proposal aims to measure the weak decay constant α_- for the Lambda hyperon decay, using the GlueX spectrometer in Hall D. The necessary tools to measure the $\gamma p \rightarrow K\Lambda$ process have been developed within the standard GlueX run conditions. The proponents have the support of the GlueX collaboration, as documented by the letter from the Collaboration Board. This is a well-motivated proposal to measure a quantity of theoretical interest, using verified tools within an established experiment.

The PAC endorses the Run Group addition.

E12-20-013A / E12-15-008A

Title: High-resolution spectroscopy of light hypernuclei with the decay-pion spectroscopy

Spokespersons: S. Nagao (contact), T. Gogami, S. N. Nakamura, L. Tang, G. M. Urciuoli, F. Garibaldi, J. Reinhold, P. Markowitz

Motivation: The goal of the experiment is to measure the Λ binding energies of the ground states of s- and p-shell hypernuclei ($^{3,4}_{\Lambda}$H, $^{7}_{\Lambda}$He, $^{8}_{\Lambda}$Li, $^{9,10,11}_{\Lambda}$Be, $^{10,11,12}_{\Lambda}$B) with the best precision ever taken, namely at the 10-keV level. This measurement can lead to a better understanding of the Λ-N interaction, especially of Charge Symmetry Breaking and of ΛN-ΣN mixing, which are actively discussed in the community.

Measurement and Feasibility: The momenta of the pions emitted from a hyper-fragment with 2-body weak decay will be measured by adding the Enge spectrometer to the PCS+HES+HKS spectrometers at Hall C, which are used for the PR12-24-003, PR12-24-004, PR12-24-011, and PR12-24-013 experiments. Data from the targets ^{6,7}Li, ^{9}Be and ^{12}C of these experiments will be used. Although the proposal requests 21 additional PAC days for the ^{12}C target ,which cannot be approved as a run group addition, the proponents have shown that the Λ binding energies can be measured with the already approved beam time at the level of 10 keV, except for $^{10}_{\Lambda}$Be and $^{10}_{\Lambda}$B. Even without these hypernuclei, the physics goal of the proposed run group addition is still sound.

Issues: 21 additional PAC days cannot be approved as a run group addition and would require a separate proposal.

Summary: The PAC finds that the proposed run group addition to a set of hypernuclear experiments, PR12-24-003, PR12-24-004, PR12-24-011, and PR12-24-013, will lead to an important physics outcome. The Enge spectrometer has to be added to the spectrometers for these experiments.

The PAC endorses this run group addition.

LOI12-24-001

Title: Hadron spectroscopy with a polarized target at GlueX in Hall D - From the strange to the charm sector

Spokespersons: F. Afzal (contact), M. M. Dalton, P. Hurck, A. Thiel, Y. Wunderlich, K. Livingston

Motivation: The main research goal of this LOI is to provide new insights towards understanding QCD confinement, testing quark model and lattice QCD predictions. To this end, it is proposed to perform a measurement with an elliptically (both circularly and linearly) polarized photon beam and a longitudinally polarized target at GlueX in Hall D. Thus, one will be able to measure a large set of polarization observables and can expect to make a significant contribution towards accomplishing a complete experiment and towards mapping out the hyperon spectra. The measurement will provide much needed data, which will be complementary to the data planned to be taken with the K_{Long} Facility in Hall D (C12-19-001). The second part of the LOI describes the use of double polarization observables to search for potential pentaquark resonances and open-charm threshold contributions in J/ψ photoproduction.

Measurement and Feasibility: To conduct this proposed measurement, a longitudinally polarized butanol target, as well as a carbon foam target for background measurements, will be needed in Hall D. This request for a polarized target for GlueX in Hall D is in line with a previously accepted proposal from GlueX (E12-20-011). In addition, the GlueX-III setup is assumed. Technically there are no concerns, given that the GlueX experiment is well understood and that the planned upgrades integrating a TRD will enhance its performance.

Issues: The LoI estimates that 100 PAC days are needed to complete the outlined measurements. A proposal should address in detail the following points:

- a more complete analysis of the GlueX-I and II datasets should be presented, to show that the experiment can achieve a statistical and systematic precision needed to meet its different goals.
- a description of how the running conditions have been chosen to optimize degree of electron beam polarization vs. beam energy to get the optimal circular and linear photon polarization.
- The collaboration should perform a MC challenge to show they can extract the observables with the statistical and systematic precision needed to gain insight in the missing hyperon states. This will help to determine optimal running conditions.
- The collaboration should also provide a MC challenge for the second part of the proposal, related to the sensitivity in searching for potential pentaquark resonances and open-charm threshold contributions in J/ψ photoproduction. Again, this will help to determine optimal running conditions.
- The collaboration should address in detail the points raised in the Theory TAC report, which are repeated here for completeness:

  "Given the somewhat subtle logic surrounding zero-trajectories and the lack of discrete ambiguities in this case, it might help to add a visual illustration of the breakdown of uniqueness of solution at the level of amplitudes upon absence of target polarization, e.g. a Monte-Carlo input/output failure within some simple resonance model. This would be a natural part of a more detailed study of sensitivity to the degree of polarization. A simple illustration of how the photon beam polarization impacts the partial-wave analysis of the meson-baryon system at the lower

vertex in Figure 4 would be of value. Presumably it helps to restrict which Reggeons appear in the t-channel exchange, and this provides some constraint, but how this will be used practically isn't clear within the LOI."

Summary: Only after careful consideration of the issues raised above and in the Theory report should the proponents progress to a full proposal. A proposal should include a detailed study of anticipated systematic and statistical uncertainties and the anticipated sensitivity for finding the missing hyperons, new pentaquarks and open-charm threshold contributions in J/ψ photoproduction.

LOI12-24-002

Title: Spin-1 TMDs and Structure Functions of the Deuteron

Spokespersons: D. Ruth (contact), N. Santiesteban, K. Slifer, E. Long, J. Poudel, D. Keller, I. Fernando, J.P. Chen

Motivation: This LOI proposes to measure tensor structure functions related to the spin-1 TMDs. By using a spin-1 (deuterium) tensor-polarized nucleus, it is possible to study ten new leading-twist TMDs, which have never been investigated before.

Measurement and Feasibility: The measurement relies on SIDIS processes, where the TMD functions can be extracted by combining the scattered lepton and produced hadron kinematics with modulation angles defined by the leptonic, hadronic, and target spin vectors. The working group appears to be well-structured, but the complexity of the measurement suggests expanding the collaboration and strengthening the connection with theoreticians. The proponents, with enough experience to successfully conduct the measurement, have correctly identified a list of items to develop for the final proposal. For example:

1. Conduct an exploratory measurement using deuteron data recently collected in Hall-B by the CLAS12 Run Group C .
2. Refine the projections for the structure function $F_{U(LL),T}$, which represents the angular independent contribution from transverse photon and tensor deuteron polarization.
3. Provide a detailed description of the ssRF+AFP method mentioned in the LOI, including the associated systematic uncertainties.

Issues: The proposal relies on the assumption that $F_{U(LL),T}$ is 10% of the unpolarized $F_{UU,T}$, which must be clearly justified, including the dependence on kinematical variables. A plausible range for the size of the ratio $F_{U(LL),T}$ / $F_{UU,T}$ and its implication on the observables should also be discussed. The required experimental equipment is based on the standard Hall C package, expanded by the SBS. The proposal needs a detailed description of the complete setup and its usage, including PID, resolution, optimization of kinematics, background subtraction, and target dilution factor. The feasibility of the polarized deuterium target is a crucial part of the experiment and must be described properly.

Summary: The proposed measurement has the potential to unlock a new set of unmeasured TMDs. The existing data from CLAS must be considered to steer the future proposal. The committee also suggests identifying measurements that can yield physics insights without a complete extraction of TMDs from the data. The proponents are encouraged to work toward a full proposal, which must include a thorough discussion of all the hardware and analysis aspects mentioned in the present LOI and address the requests outlined in this report.

LOI12-24-003

Title: Studying the Strangeness D-term via Exclusive Electroproduction of Phi Mesons

Spokespersons: H. Klest (contact), S. Joosten. H. Szumila-Vance

Motivation: The proposed measurement investigates the exclusive electroproduction of φ mesons near threshold. Its main goals are to measure the |t|-dependence of the differential cross section and to extract the strangeness D-term, which is one of the form factors of the energy-momentum tensor in the nucleon. The contribution of strangeness to the total quark D-term is presently unknown. The proposed experiment could add information on the quark and gluon distributions in JLab kinematics and potentially impact our understanding of the strangeness contribution to the gravitational form factors of the nucleon.

Measurement and Feasibility: The proponents foresee 30 days of beam to measure the cross section for near-threshold deep exclusive φ production as a function of momentum transfer |t| via the missing mass of the H(e, e′p) reaction using the spectrometers in Hall C. They plan to use the SHMS at 13° to detect electrons with a central momentum of 6.7 GeV and the HMS at 32° to detect protons with central momenta of 1.1 GeV and 1.8 GeV. The electron kinematics correspond to an average Q^2 of 3.4 GeV^2 and an average W of 2.2 GeV. They plan to measure for 16.5 days with the HMS set to detect protons at 1.1 GeV for |t| close to t_{min}. They also plan to measure for 11.5 days at higher |t| to pin down the normalization of the cross section and to provide a larger lever arm for extracting the functional form of the |t|-distribution.

This measurement will use the standard Hall C equipment and utilize a 10 cm liquid hydrogen target with an unpolarized electron beam at an energy of 10.6 GeV and a beam current of 75 μA.

Issues: There are a number of concerns related to the interpretation of the proposed measurements: (1) Unlike the J/ψ, the φ meson can have a significant final state interaction with the nucleon in near-threshold kinematics. A detailed study/simulation needs to be included to estimate the final state interaction effects near the threshold. (2) As for the J/ψ, a gluonic contribution can play an important role for φ meson electroproduction. The presented impact study of the proposed measurement depends on the assumption that the strangeness D-term is the sole contribution. This needs a rigorous justification, or gluonic contributions should be taken into account. The mere statement that the gluonic contribution is suppressed by a factor of α_s is insufficient, because other prefactors might not be small and because the gluonic D-term may be larger than the one for strangeness.

Summary: The PAC recommends the proponents to proceed to a full proposal only after the issues raised are carefully considered.

LOI12-24-004

Title: Studies of Inclusive Structure with A=3 Targets in CLAS

Spokespersons: T. J. Hague (contact), S. Li, D. Biswas, M. Nycz, D. Meekins

Motivation: The proposed experiment aims to study nucleon structure by means of inclusive electron scattering on the proton and on nuclei, in the nucleon resonance and DIS regions. First, a study on duality in the neutron and in A=3 targets is proposed, which would allow one to improve the extraction of F_2^n/F_2^p at high *x*. Second, the proponents aim to study the Q^2 scaling in the two-nucleon (2N) SRC region. Third, the nuclear dependence of the ratio $R = \sigma_L/\sigma_T$, if any, could be measured thanks to the extraction of $\Delta R = R_{A1} - R_{A2}$, with two different nuclear targets A1 and A2, for several target types and with a Rosenbluth separation using 4.4 and 10.6 GeV beam energies.

Measurement and Feasibility: The proponents propose to measure precise inclusive ratios of ^{1}H, ^{2}H, ^{3}H, ^{3}He nuclei with three electron beam energies of 2.2, 4.4 and 10.6 GeV and in a broad interval of x. Runs with A=3 targets are already planned in CLAS12 and this proposal is mostly, but not entirely, related to experiments E12-20-005 and C12-21-004.

Issues: The proposal aims at searching for the onset of duality, in order to use the resonance region for extracting information on PDFs. As reported in the Theory TAC report, the latter is challenging because of the systematic uncertainties that would arise from the resonance-averaging procedure. The proponents are encouraged to contact a global PDF analysis group, to precisely define a possible resonance averaging procedure and to quantify its accuracy and uncertainty. Also, the identification of the duality onset relies on PDF extrapolations into unmeasured regions at high *x,* and the measurements at high *x* are then in turn used to extract PDFs at high *x*. This will lead to model dependent extraction. Well-defined tests of the extraction procedure would need to be identified in a full proposal, as well as an estimation of the associated uncertainties.
Experimental details are not discussed in the LOI, and these need to be given in a full proposal where the expected uncertainties on all the proposed observables, obtained from realistic simulations, or extrapolated from existing data, are presented. Finally, parts of the proposed measurements are unique to this LOI and cannot be considered as a run group addition. The proponents should carefully lay out which part needs one or several separate proposals.

Summary: The proposal addresses several questions on Q^2 and isospin dependence in inclusive electron scattering in the nucleon resonance and DIS regions for the proton and light nuclei. The PAC encourages the proponents to proceed to a full proposal once the above issue.

LOI12-24-005

Title: Final-State Interactions Studies in Deuterium at Very High Missing Momenta

Spokespersons: C. Yero (contact), W. Boeglin, M. Sargsian, M. Jones

Motivation: This LOI wants to explore the short-range repulsive part of the NN interaction by measuring exclusive unpolarized electro-disintegration of the deuteron, d(e, e'p) in kinematic conditions where other effects like meson-exchange currents, isobar configurations, and final-state interactions (FSI) can be minimized. In particular, the angular distribution of the backward recoiling neutron will be considered to explore where the persisting FSI are minimal, based on the finding of a previous Hall A experiment (Phys. Rev. Lett. 107, 262501 (2011)). The focus will be on the critical range of large missing momenta (~ 800 MeV/c) where none of the deuteron theoretical models is able to reproduce the current data, as shown in the previous E12-10-003 experiment in Hall C.

Measurement and Feasibility: The LOI proposes to measure the exclusive unpolarized electro-disintegration of the deuteron in Hall C with a 10.55-GeV electron beam incident on a 10-cm long liquid deuteron target. The scattered electron will be measured in the SHMS in coincidence with the knocked-out proton detected in the HMS, with the recoiling neutron being reconstructed from momentum conservation.
The unpolarized cross section will be measured at three central recoil angles $\theta_{nq} = 49^o, 60^o, 72^o$ at momentum transfer $Q^2 = 4.5$ GeV^2. Then, it will be divided by the theoretically calculated cross section in plane-wave impulse approximation (PWIA), which describes the quasi-elastic knock-out of the proton. Ratios close to one will be the signal of minimal FSI effects.
The run time request is for 548 hours (~23 PAC days), including 8 hours of overhead for spectrometer momentum/angle changes among the three different angular settings. Given the similarity with the E12-10-003 experiment, the overall systematic uncertainty (coming from normalization and kinematics) is estimated to be below 10%.

Issues: The LOI wants to focus on missing momenta as large as ~ 800 MeV/c, because these correspond to the inelastic threshold for the proton-neutron channel and hence to a possible onset of non-nucleonic degrees of freedom in the deuteron. However, all the theoretical ingredients of the presented analysis are non-relativistic, and largely depend on the choice of the optical potential. An upgrade of the theoretical framework to include relativistic effects is thus necessary before presenting a proposal, as acknowledged by the proponents themselves.

Summary: The LOI proposes to measure the angular distribution of the ratio of the exclusive unpolarized cross section for electro-disintegration of the deuteron to the corresponding calculated cross section in PWIA at large missing momenta and momentum transfer, in order to find the best kinematic conditions for minimizing FSI and emphasizing the short-range features of the NN interaction, and in order to explore the regime of possible non-nucleonic degrees of freedom in the deuteron. The PAC encourages the proponents to work towards a full proposal only after the above issues are fully addressed. Specifically, the theoretical framework should be revisited by fully including relativistic effects before repeating the simulations and studies in preparation of the proposal.

LOI12-24-006

Title: Generalized Parton Distributions from Double Deeply Virtual Compton Scattering at Jefferson Lab Hall C

Spokespersons: M. Boër

Motivation: The proposed experiment aims to make the first measurement of double DVCS (DDVCS) i.e. photon-proton scattering where both the initial and final photons are virtual. This offers a uniquely direct access to the GPDs $F(x,\xi,t)$ in the "ERBL" kinematical region $|x|<\xi$. Since standard DVCS observables are sensitive only to the integral of GPDs over this region, the proposed measurement would make GPD extractions much more reliable and less model-dependent.

Measurement and Feasibility: The process to be observed is $ep \rightarrow ep\gamma^* \rightarrow ep\mu^+\mu^-$. The measurement relies on a dedicated setup in Hall C and involves developing a spectrometer with a "four quadrants" geometry and a dead zone around the beam. All four final-state fermions are detected using GEMs, scintillator hodoscopes and electromagnetic calorimeters (to be developed for the timelike Compton scattering experiment C12-18-005) and muon detectors to be developed for the present experiment. Additionally, scattered particles would be deflected by a 2.4 T magnet presently used in the SBS spectrometer of Hall A. Due to the small cross section (with an extra α_{em} in comparison to DVCS), the measurement is difficult but may be feasible at high enough luminosity, which might be available at Hall C.

Issues: The claim that this measurement would enable "tomographic" extrapolation to $\xi=0$ appears rather strong considering that, for tomography, one needs x dependence for zero ξ, which is outside the ERBL region and outside the kinematic region of the proposed experiment. The TAC report expresses concerns about using the proposed strong magnet with an electron beam and about showers of low-energy electrons into the calorimeter.

Summary: PAC recognizes the significant benefits for the GPD program if a DDVCS measurement can be accomplished using a realistic amount of beam time. The proponents are encouraged to determine the amount of beam time required under optimal conditions to perform the measurement and extract the corresponding Compton form factors from pseudo-data. The full proposal should include a description of the methods to identify each particle, measure its energy or momentum, and specify the resolution of these measurements. Additionally, expected signal rates, accidental coincidence rates, and singles rates for all detectors should be detailed. Optimization of muon detection, potentially using calorimetry, might be considered. Given that the required measurement time is likely to be substantial, special consideration should be given to the relation between the present initiative with existing DDVCS efforts in other halls.

LOI12-24-007

Title: Deeply Virtual Compton Scattering using the Tagged Deeply Inelastic Scattering Experimental Setup

Spokespersons: E. Fuchey (contact), A. Camsonne, R. Montgomery, Z. Ye

Motivation: The LOI proposes the measurement of DVCS off the neutron using electron scattering off a deuteron with tagging of the spectator proton. Neutron DVCS is complementary to proton DVCS due to the different GPD flavor combinations involved and due to different electromagnetic form factors in the interference with the Bethe-Heitler process. It is an effective method to access the important GPD E. Tagging the spectator proton enables a clean identification of the initial state neutron, and possibly also its Fermi momentum, thus controlling two significant sources of systematic uncertainties that affect other neutron DVCS measurements.

Measurement and Feasibility: The experiment would perform the measurement in Hall A, partly together with the 11 GeV TDIS measurement (C12-15-006) where the Super BigBite Spectrometer (SBS) detects the scattered electron. In this proposal, an additional calorimeter for photon detection is envisioned. Additionally, an 8.8 GeV run is considered, which would not be parasitic to TDIS but would require additional beam time. This should enable a Rosenbluth-type separation between $DVCS^2$ and DVCS/Bethe-Heitler interference terms in the main signal process, as well as a σ_L/σ_T separation for π^0 production. Proton tagging using the TDIS TPC would enable the identification of neutron events, while the missing-mass technique would be used to select exclusive events.

Issues: Conducting Rosenbluth separation for DVCS with just two beam energies might be problematic and prone to systematic uncertainties (in the sense that one can always draw a straight line through two points).

As noted in the TAC report, a correction must be made to account for the inefficiency due to the significant fraction of recoil protons below the TPC threshold. Also, the large proton track multiplicity in the TPC will likely make the proton reconstruction challenging. Finally, the measurement will likely have a low ratio of real to accidental events.
The PAC must note that submitted LOI contains some unclear or conflicting statements, which made it difficult to review.

Summary: The proponents should progress towards a proposal only after careful consideration of the issues raised above, with a clearly defined measurement and method of analysis, which should include a detailed study of anticipated systematic and statistical uncertainties.

LOI12+24-008

Title: Measurement of the Two-Photon Exchange Contribution to the Positron-Neutron Elastic Scattering Cross Section

Spokespersons: E. Fuchey (contact), S. Alsalmi

Motivation: This LOI proposes to measure the two-photon exchange (TPE) contribution in elastic positron-neutron scattering at two different momentum transfers (Q^2=3.0 and 4.5 GeV^2) using two beam energies (3.3 and 4.4 GeV for Q^2=3.0 GeV^2 and 4.4 and 6.6 GeV for Q^2=4.5 GeV^2). The measurement of the Rosenbluth slope in positron-neutron scattering can then be compared to electron-neutron results expected from experiment E12-20-010. Such a comparison is interesting, because a significant two-photon exchange current would lead to a difference in the respective Rosenbluth slopes between e^+-N and e^--N elastic scattering.

Measurement and Feasibility: This work is benefitting from the experience and on-going analysis of E12-20-010. The LOI proposes to use the same experimental setup as E12-20-010, namely the BigBite (BB) spectrometer to detect scattered positrons and the Super BigBite Spectrometer (SBS) to detect protons and neutrons. The measurement will use the planned CEBAF unpolarized positron beam at the maximum proposed intensity of 1 μA on a cryogenic deuterium target. The run time request is for a total of 12 days, including time for calibration/efficiency measurements and kinematic changes.

Issues: In a full proposal, it will be important to directly address whether the proton two-photon exchange contributions in the relevant kinematics will be sufficiently well known, as commented on in the TAC report. Secondly (this is more of a consideration than an issue), the proponents are encouraged to consider additional dedicated running on hydrogen to further reduce systematics.

Summary: The proposed experiment would provide a measurement of the Rosenbluth slope in elastic e^+-N scattering that can be directly compared with the measurement in the e^-N channel from E12-20-10, thus elucidating whether or not the discrepancy between the electric and magnetic form factor ratios extracted via Rosenbluth separation vs. polarization transfer is indeed due to the two-photon exchange contribution. The PAC encourages the proponents to work toward a full proposal after the above issues are considered. The collaboration should also explore if there is anything to be gained by adding dedicated hydrogen running to further aid in control of systematics, as suggested in the TAC report.

LOI12-24-009

Title: Measurement of the Nucleon Axial Vector Form Factor at $Q^2 = 1$ $(GeV/c)^2$

Spokespersons: B. Wojtsekhowski (contact)

Motivation: This LOI proposes to measure the axial-vector form factor of the nucleon using the reaction $H(e^-, n)\nu_e$. Most of the existing experimental measurements of this form factor come from neutrino scattering experiments with wide-band beams and often with nuclear targets. In contrast, the uniqueness of the proposed measurement is that it will use a mono-chromatic (known) beam and a nucleon target. Knowledge of the axial-vector form factor is becoming increasingly important for precision accelerator-based neutrino oscillation experiments, especially for those that compare neutrinos and antineutrinos.

Measurement and Feasibility: The request is for 25 days of electron data-taking at 2.2 GeV on a liquid hydrogen target in Hall C. For the detector, the proposal is to use the electron/pion arm from the existing SBS magnet, the SBS GEM chambers, and the lead-glass electromagnetic calorimeter that is currently under construction for the Gep experiment E12-07-109, which will run in 2025. The rest of the experimental needs will require new investment.

Given that the neutrino signal being probed is ~7-8 orders of magnitude smaller than the elastic electron scattering and pion photo-production reactions, the proposed measurement requires significant strategies for background rejection (~ x 10^4 rejection for the e-p process). While the precision of the measurement will depend strongly on the success of such background rejection, even an initial measurement of $G_A(Q^2)$ at twice the quoted precision would be valuable, given the dearth of existing experimental data.

Issues: The LOI is short on detail and lacking in physics plots. Overall, the proposal needs a more detailed description of the measurement itself, the associated theory, and the detector setup that will be used. A full simulation and description detailing the strategy for background rejection will be critical content for a full proposal. A plot of the planned accuracy of the axial-form factor measurement compared to existing measurements should be produced. It will also be important to tabulate to what extent existing vs. new experimental equipment will be required to carry out the planned measurement.

Summary: This LOI offers a unique opportunity to measure the axial-vector form factor (the least well-known nucleon form factor) in a very different manner than is commonly probed in neutrino scattering. Such a measurement is of considerable importance for accelerator-based neutrino oscillation experiments. The PAC encourages the proponents to proceed to a full proposal after the above issues are addressed. The PAC encourages the use of a full Monte Carlo simulation to assess detector performance, background levels, and systematic uncertainties. If this method of extracting the axial-vector form factor proves successful, the PAC notes that this could become part of a larger measurement campaign. In particular, a measurement of the Q^2 dependence of the axial-vector form factor would be of great interest to the neutrino scattering community.

LOI12-24-010

Title: Open Charm at JLab with the sPHENIX MAPS tracker

Spokespersons: M. Arratia (contact), S. Paul

Motivation: The proposed experiment aims to search for exclusive open charm photoproduction ($\gamma A \rightarrow D^{0bar} \Lambda^{+}_{c}$ and $\gamma A \rightarrow D^{*bar} \Lambda^{+}_{c}$) by integrating the sPHENIX MAPS vertex tracker (MVTX) from RHIC with CLAS12. By measuring such channels, the proponents will test a theoretical assumption that has been proposed to understand the intriguing trends that have been observed in J/ψ photoproduction ($\gamma p \rightarrow J/\psi p$) near threshold. This assumption states that the final state in $\gamma p \rightarrow J/\psi p$ is in part produced from rescattering of intermediate charmed states and therefore cannot be factorized and interpreted in terms of the gluonic structure of the nucleon. The proponents aim to constrain open charm production on a proton target from measurements on a Be target, and to study cold nuclear matter effect with a heavy nucleus.

Measurement and Feasibility: The proponents request 50 PAC days with an electron beam energy of 10.6 GeV on light (Be) and heavy (such as Pb or UO_2) solid targets, in order to measure the photoproduction cross section of $\gamma A \rightarrow D^{0bar} \Lambda^{+}_{c}$ and $\gamma A \rightarrow D^{*bar} \Lambda^{+}_{c}$.

The scattered electrons will be triggered and detected with the CLAS12 forward tagger corresponding to a small Q^2 interval ($0.01 < Q^2 < 0.1$ GeV^2). The D mesons ($D \rightarrow K\pi$) or Λ_c ($\Lambda_c \rightarrow K\pi p$) will be reconstructed with the MVTX and the CLAS12 detectors, and a selection will be performed on the hadron displaced vertex. The exclusive process will be identified using the missing-mass technique. Sizeable yields are estimated with a Be target. The background rates are not estimated yet since this requires a full simulation of the detectors. No radiation damage is expected on the MVTX, and no impact on the CLAS12 Central Vertex Tracker performance is expected from the MVTX material budget.

Issues: The integration of the MVTX within CLAS12 might be challenging. A new target design with solid target is needed. The current CLAS12 SVT would remain in place. Studies should determine the vacuum chamber size that fits with the MVTX. The background rates and the related uncertainties on the measured Be cross section are not estimated in this LOI. An accurate estimate of the cross-section uncertainties with a Be target should be provided by using a realistic simulation of CLAS12 with MVTX. The rate estimate should be done with an up-to-date theory and different theoretical models. Finally, the motivations for a heavier target should be presented in more detail in a full proposal.

Summary: The proposal aims to search and measure open charm photoproduction cross section with Be and a heavier target. These measurements will shed light on the J/ψ photoproduction near threshold. The PAC encourages the proponents to proceed toward a proposal including full simulations of CLAS12 and MVTX, once the above issues are addressed.

LOI12-24-011

Title: Measurement of the Coherent J/Psi Electroproduction off ^{4}He

Spokespersons: W. Armstrong (contact), S. Lee

Motivation: This proposal aims to measure the exclusive differential cross section for coherent J/ψ electroproduction off ^{4}He with two goals: (1) locate the diffraction minimum in the J/ψ production cross section off a ^{4}He target and compare the corresponding |t| distribution to that from the electromagnetic form factor, with the aim to get insight into the distribution of matter relative to the quark charge; (2) hope to extract the gluon gravitational form factors of ^{4}He as a first step towards determining the mass radius of ^{4}He.

Measurement and Feasibility: Measurement of coherent J/ψ electroproduction off ^{4}He will be conducted with a gaseous ^{4}He target and the ALERT detector at Hall B. The experiment will require 100 days of total beam time, consisting of 97 days of production data and 3 days for calibration of the detector and beam blocker. The cross section at an effective photon energy of $k_\gamma > 7.6$ GeV will be extracted for $0.2\ \text{GeV}^2 < |t| < 0.95\ \text{GeV}^2$.

Recoil ^{4}He detection is crucial for running at the nominal CLAS12 luminosity with efficient DAQ trigger rates. Therefore, the proponents intend to employ ALERT as the recoil detector while detecting other final state particles with CLAS12. The experiment will use a 10.6 GeV electron beam with currents up to 1.3 μA incident on a 5 atm gaseous ^{4}He target.

Issues: The diffraction minimum for light nuclei target is an interesting subject, as it can be compared to the relevant charge form factor measurements. However, the extraction of the gluon gravitational form factors from the measurements is much more challenging. In this LOI, different models have been used to motivate the measurement. From the QCD factorization point of view, i.e., the exclusive meson production in the GPD framework, large skewness is needed to expand the differential cross section in terms of various gravitational form factors. A major issue of the proposed experiment is that in near-threshold kinematics the skewness is actually smaller compared to that for the nucleon target. Therefore, the interpretation of the measurement in terms of form factors will become harder. A detailed simulation and study are needed to justify this physics goal.

Summary: The PAC recommends the proponents to proceed to a full proposal only after the issues raised are carefully considered.

PAC 52 MEMBERS

ELKE CAROLINE ASCHENAUER
Physics Department
Bldg. 510D, Room 2-195
P.O. Box 5000
Upton, NY 11973-5000
(631) 344-4769
elke@bnl.gov

KEITH (OLIVER) BAKER
Professor of Physics Yale University
Yale High Energy Physics
217 Prospect Street
New Haven, CT 06511-4712
oliver.baker@yale.edu

MARKUS DIEHL, CHAIR
Theory Group
Deutsches Elektronen-Synchroton
DESY 22603
Hamburg, Germany
Phone: 49-(0)40-8998-3447
markus.diehl@desy.de

PASQUALE DI NEZZA
Laboratori Nazionali di Frascati Istituto
Nazionale di Fisica Nucleare Via E.
Fermi, 54
00044 Frascati (Roma) - Italia
Tel + 39-06-9403-2284
pasquale.dinezza@lnf.infn.it

ALEXANDRA GADE
Professor of Physics
Facility for Rare Isotope Beams
and Michigan State University
640 South Shaw Lane
East Lansing, MI 48824
(517) 908-7441
gade@frib.msu.edu

CYNTHIA HADJIDAKIS
IJCLab, CNRS/Université Paris-Saclay Bât. 100
15 Rue Georges Clémenceau 91405
Orsay, France
Phone: +33-1691-55181
cynthia.hadjidakis@ijclab.in2p3.fr

YORDANKA ILIEVA, JLUO CHAIR
Professor
712 Main St.
Columbia, SC 29208
(803) 777-2887
ilieva@sc.edu

KRESIMIR KUMERICKI
University of Zagreb
Bijenicka Cesta 32
Zagreb, Croatia, HR-10000
00385-91-5399-549
kkumer.phy@pmf.hr

CURTIS A. MEYER
The Otto Stern Professor of Physics
Professor by Courtesy
Pittsburgh Supercomputing Center
Carnegie Mellon University
5000 Forbes Ave.
Pittsburgh, PA 15213
(412) 260-6290
cmeyer@cmu.edu

MARCO RADICI
INFN - Sezione di Pavia
Via Bassi 6, I27100 Pavia - Italy
Phone: +39-0382-987451
marco.radici@unipv.it

SHIN'YA SAWADA
KEK, High Energy Accelerator
Research Organization
Tsukuba, Ibaraki 305-0801
Japan
shinya.sawada@ke

CONCETTINA SFIENTI
Institute for Nuclear Physics
Johannes Gutenberg-Universität
Mainz Johann-Joachim-Becher
Weg 45, D-55099
Mainz, Germany
sfienti@kph.uni-mainz.de

PAC 52 MEMBERS – continued

MATTHEW SHEPHERD, JLUO CHAIR - ELECT
Professor
Department of Physics
Indiana University
Swain West 265
727 East Third Street
Bloomington, IN 47405
Office Phone: (812) 856-5808
mashephe@indiana.edu

FENG YUAN
Lawrence Berkeley National Laboratory
Nuclear Science Division
1 Cyclotron Road
Mailstop 70R0319
Berkeley, CA 94720-8153
Phone: (510) 486-5626
fyuan@lbl.gov

GERALYN (SAM) ZELLER
Fermi National Accelerator Laboratory Kirk and Pine Streets
Mailstop 123
Batavia, IL 60510-5011
Phone: (630) 840-6879
gzeller@fnal.gov

Charge to PAC52

Review new proposals, previously conditionally approved proposals, jeopardy proposals, and letters of intent for experiments that will utilize the 12 GeV upgrade of CEBAF and provide advice on their scientific merit, technical feasibility and resource requirements.

Identify proposals with high-quality physics that, represent high quality physics within the range of scientific importance represented by the previously approved 12 GeV proposals and recommend for approval.

Also provide a recommendation on scientific rating and beam time allocation for jeopardy proposals (if revision is sought) and those newly recommended for approval.

Identify other proposals with physics that have the potential for falling into this category pending clarification of scientific and/or technical issues and recommend for conditional approval. Provide comments on technical and scientific issues that should be addressed by the proponents prior to review at a future PAC.

List of common acronyms

ADC	Analog-to-digital converter
CDR	Conceptual Design Report
DAQ	Data Acquisition
DIS	Deep inelastic scattering
DVCS	Deeply virtual Compton scattering
ECAL	Electromagnetic Calorimeter
EMC	European Muon Collaboration
GEM	Gas electron multiplier (detector)
GPD	Generalized parton distribution
HES	High-resolution Electron Spectrometer (in Hall C)
HKS	High-resolution Kaon Spectrometer (in Hall C)
HMS	High Momentum Spectrometer (in Hall C)
NLO	Next-to-leading order (in perturbation theory)
NPS	Neutral Particle Spectrometer (in Hall C)
PAC	Program Advisory Committee
PDF	Parton distribution function/parton density
PMT	Photomultiplier tube
PVDIS	Parity violating DIS
SBS	Super BigBite Spectrometer (in Hall A)
SHMS	Super High Momentum Spectrometer (in Hall C)
SIDIS	Semi-inclusive DIS
SoLID	Solenoidal Large Intensity Device (planned detector in Hall A)
SRC	Short-range correlation (between nucleons in a nucleus)
TAC	Technical advisory committee (for the PAC)
TCS	Timelike Compton scattering
TFF	Transition form factor
TMD	Transverse-momentum dependent (PDF or fragmentation function)
TPE	Two-photon exchange
TRD	Transition radiation detector