Jefferson Lab
Thomas Jefferson National Accelerator Facility

REPORT OF THE 45th PROGRAM ADVISORY COMMITTEE (PAC45) MEETING

July 10 – 14, 2017

The Thomas Jefferson National Accelerator Facility (Jefferson Lab) is a national physics user facility Operated by the Jefferson Science Associates, LLC, for the U.S. Department of Energy (DOE)

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From the Director

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

July 17, 2017

Dear Jefferson Lab Users,

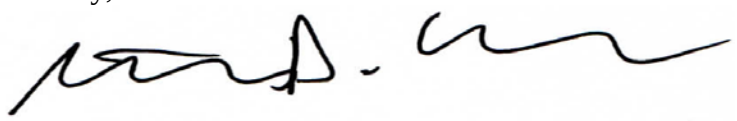
It was a real pleasure to see the new and exciting experimental proposals from our user community at last week's Program Advisory Committee (PAC45) meeting. The quality of these proposals is an indicator of the forefront scientific program that Jefferson Lab enables for its users, and this PAC was no exception.

The PAC reviewed 12 new proposals, one of which was a new run group proposal. In addition, there were two conditionally approved proposals returned for review, three Letters of Intent were submitted and three Run Group proposals, which were approved by the collaboration were submitted for comment. This review resulted in the recommendation of five experiments for approval. We had one proposal recognized as "High Impact" and another which was C1 approved, still requiring Lab approval amongst the five. We have accepted the recommendations.

The results can be viewed at: https://www.jlab.org/exp_prog/PACpage/

As in past years, the meeting was run very efficiently thanks to the efforts of the chair, Jim Napolitano. With the assistance of Susan Brown, the PAC was again able to produce its report in very short order following the meeting. I thank Jim and all the PAC members for their efforts to provide expert advice to the Lab.

Sincerely,



Stuart Henderson
Laboratory Director

From the Chair

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July 14, 2017

Robert D. McKeown Deputy Director
for Science Jefferson Lab

Dear Bob,

This letter transmits the findings and recommendations of the 45th Jefferson Laboratory Program Advisory Committee (PAC45). The Committee met July 10-14, 2017, and considered 12 individual proposals and one consolidated run group proposal for new beam time; three parallel run group additions; and three letters of intent. One proposal was dealt with in a special way, and one proposal was withdrawn before it was to be presented.

Written reports on all of the proposals and letters of intent were prepared and reviewed by the Committee before we adjourned. Four proposals were approved outright with an A^- or B^{+*} rating, and one of these (a search/confirmation for a bound, or almost bound, Λnn system) was deemed to be in the "High Impact" category. One proposal was "C1" Conditionally Approved because we felt the technology involved (the Compact Photon Source) still needs a thorough detailed design before rates can be accurately predicted; and the "Electrons for Neutrinos" proposal was "C2" Conditionally Approved because it seems some work should be done to demonstrate the concept with existing CLAS and neutrino data. Five proposals were deferred.

PAC45 continues the trend of holding proposals and presentations to a very high standard. By and large, the community is responding positively and doing a good job on their submissions. In general, we see an improvement in the impact of the physics issues identified, and in the preparation of the proposals. As always, our overriding concern is the quality of the physics that will be reached.

The JLab User BoD chair had a different role in this PAC, specifically representing the User Community as a watchdog and conduit for information about PAC operations. We also made a special effort to have increased communication between contact persons and PAC members, prior to the meeting. This led to a smoother operation during the PAC meeting, and a more transparent process for the users. We encourage the lab to continue this practice.

As you are aware, and pointed out in your opening public remarks at the meeting, proposal spokespersons need to respect deadlines and avoid unsolicited information transfer to PAC members. We are grateful that you've made the user community aware of this, and are certain that better adherence to these guidelines will only improve the functioning of the PAC and quality of the proposal submissions.

We are pleased that the concept of using Run Group Additions, rather than new formal proposals, to make use of already approved beam time, is beginning to take hold. The ALERT group, for example, prepared a well developed suite of experiments to make use of a block of time in CLAS12 with a new apparatus that they will develop. We encourage the user community to seriously consider this approach for future CLAS12 and SoLID proposals, as well as any other situations where multiple physics goals can be achieved with the same beam time.

PAC44 suggested that the time was ripe for a coherent plan to systematically attack the EMC effect, and to find a definitive solution. Since last year, there have been some workshops on this effort, and PAC45 considered some novel experiments, but the coherent plan we envisioned has still not materialized. We believe there is an opportunity for JLab to take the lead on this problem, and would be supportive of efforts in that direction.

Finally, PAC45 congratulates you and your colleagues on completion of the 12 GeV CEBAF Upgrade. Beam time at this world class facility is precious, and we are pleased and grateful to contribute to the decision making process.

The PAC is at your disposal for any other information or assistance we can give you. Best wishes,

Jim Napolitano
PAC45 Chairperson
Professor and Department Chair Temple
University Physics

Introduction

The Jefferson Lab Program Advisory Committee held its 45th meeting from July 10th through July 14th, 2017. The membership of the committee is given on pages 37-38. In response to the charge (page 37) from the JLab Science Director, Dr. Robert McKeown, the committee reviewed 2 returning C2 proposals, 10 new proposals, 1 new run group (Hall B), 3 run group additions, and 3 Letters of Intent.

Recommendations

PAC 45 SUMMARY OF RECOMMENDATIONS								
NUMBER	**CONTACT PERSON**	**TITLE**	**HALL**	**DAYS REQUESTED**	**DAYS AWARDED**	**SCIENTIFIC RATE**	**PAC DECISION**	**TOPIC***
~~C12-14-004~~ E12-12-002A	Liping Gan	Update to the (JEF) proposal	D	130	0		Approved	1
C12-16-001	Marco Battaglieri	Dark matter search in a Beam-Dump eXperiment (BDX) at Jefferson Lab an update on PR12-16-001	A	285			C2	6
PR12-17-001	Moskov Amaryan	Strange Hadron Spectroscopy with a Secondary KL Beam at GlueX	D	200			Deferred	1
PR12-17-003	Liguang Tang	Determining the Unknown Lambda-n Interaction by Investigating the Lambda-nn Resonance	A	12	12	A-	Approved **(High Impact)**	5
PR12-17-004	John Annand	Measurement of the Ratio GEn/GMn by the Double-polarized 2H(e,e'n) Reaction	A	5	5	A-	Approved	2
PR12-17-005	Douglas Higinbotham	The CaFe Experiment: Short-Range Pairing Mechanisms in Heavy Nuclei	C	7	4	B+	Approved	5
PR12-17-006	Or Hen	Electrons for Neutrinos: Addressing Critical Neutrino-Nucleus Issues	B	41			C2	5
PR12-17-007	Or Hen	Probing QCD in the nuclear medium with real photons and nuclear targets at GlueX	D	40			Deferred	5

NUMBER	CONTACT PERSON	TITLE	HALL	DAYS REQUESTED	DAYS AWARDED	SCIENTIFIC RATE	PAC DECISION	TOPIC*
PR12-17-008	David Hamilton	Polarization Observables in Wide-Angle Compton Scattering at large s, t and u	C	46	46	A-	C1	2
PR12-17-009	Ashot Gasparian	Precision Deuteron Charge Radius Measurement with Elastic Electron-Deuteron Scattering	B	39			Deferred	2
PR12-17-010	Alexander Somov	Photoproduction of vector mesons on nuclei with GlueX	D	28			Deferred	5
PR12-17-011	Mark Dalton	The Parity Violation Parton Distribution Function (PVPDF) Experiment	C	38			Deferred	3
PR12-17-012	Zein-Eddine Meziani	Partonic Structure of Light Nuclei	B	35	55	A-	Approved	5
PR12-17-012A	Raphael Dupre	Tagged EMC Measurements on Light Nuclei	B	45				5
PR12-17-012B	Whitney Armstrong	Spectator-Tagged Deeply Virtual Compton Scattering on Light Nuclei						5

Topic*

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

C1=Conditionally Approve w/Technical Review
C2=Conditionally Approve w/PAC Review

PARALLEL PROPOSAL SUMMARY

NUMBER	CONTACT PERSON	TITLE	HALL	TOPIC*
E12-12-002A	Stepan Stepanyan	Near threshold J/psi photoproduction and study of LHCb pentaquarks with CLAS12	B	4
E12-10-006B	Garth Huber	Measurement of Deep Exclusive pi- Production using a Transversely Polarized 3He Target and the SoLID Spectrometer	A	4
C12-15-006A	Kijun Park	Measurement of Kaon Structure Function through Tagged Deep Inelastic Scattering (TDIS)	A	3

Proposal Reports

PR12-17-001

Scientific Rating: N/A

Recommendation: Defer

Title: Strange hadron spectroscopy with a secondary KL beam at GlueX

Spokespersons: M.J. Amaryan (Contact), M. Bashkhanov, J. Ritman, J. Stevens, I Strakovsky

Motivation: This is a proposal to study $K\pi$ resonances up to 2 GeV and Hyperon production up to W of 3.5 GeV. This high statistics experiment with the GlueX spectrometer should lead to discoveries of new states and improved properties for existing states. Progress in Lattice QCD makes revisiting this science with an improved experiment of considerable interest.

Measurement and Feasibility: A new Compact Photon Source (CPS) and KL production target and collimators would be installed in Hall D after the current approved GlueX run. This would allow higher photon fluxes that are then used to create a KL beam with rates of up to 3×10^4/sec. A variety of kaon and hyperon states can be studied with unprecedented statistics.

The KL momentum is estimated from TOF requiring 64 ns beam structure. A wider H2/D2 target is proposed but otherwise the GlueX spectrometer itself is not changed.

Issues: Mounting this experiment will transform the existing Hall D beam line, so it represents an almost irreversible change in direction for the GlueX apparatus. As such, the physics driver must be compelling, and the PAC doesn't feel that a sufficiently convincing physics case has been made. A broad program is suggested, so the PAC would welcome a larger presentation format along the lines of a run group proposal.

The CPS design is progressing but details on the KL target and shielding for the detector need to be fleshed out. The 64 ns beam structure will also require study to ensure that other halls are not adversely affected.

The beam time request is dominated by the hyperon polarimetry measurements. A simulated example of a partial wave analysis, and how it would feed into the proposed spectroscopy measurements, will be needed in a future proposal.

The LOI included doubly strange baryons but this topic was not much expanded upon in the proposal. This topic remains of considerable interest.

Summary: This experiment would introduce a new and interesting area of physics at JLAB. The PAC recommends that the collaboration work with the lattice and theoretical nuclear physics community to sharpen the physics case. In addition, more details on the KL production target and shielding will be needed before we can fully assess the feasibility of the experiment. Despite the progress made in delineating the expanded physics possibilities, the very substantial beam time request would be better motivated if more details could be provided on its impact on the proposed spectroscopic measurements.

PR12-17-003

Scientific Rating: A-, High Impact

Recommendation: Approved for 12 Days

Title: Determining the unknown Λ-n interaction by investigating the Λnn resonance

Spokesperson: Tang (contact person), Garibaldi, Markowitz, Nakamura, Reinold, Urciuoli

Motivation: The goal of the experiment is a measurement of the Λn interaction using the Λnn resonance. This resonant state can be created with sufficient precision using a ^{3}H target. The relevant reaction is ^{3}H(e,e'K^{+})(Λnn). Theoretical analysis indicates that the Λnn system should be a resonance. While the n-n reaction is precisely known, and the Λ-p interaction is known to some extent, nothing is known about the Λn interaction. One can assume that the interaction will have the same form as the Λp interaction, although its strength may vary as CSB results indicate. By treating the three-body problem through a pair-wise interaction, one can show that a small increase in strength of the Λn interaction, as compared to the Λp interaction, yields a resonance in the three-body system. Thus, a precise measurement of the resonance provides a constraint on this elusive interaction.

Measurement and Feasibility: The experiment will utilize Hall A with no additional equipment requirements. The experiment does require use of the tritium target. The requested beam time of 12 days is necessary in order to achieve the desired experimental goal.

Issues: During discussions, the PAC came to understand that the experiment could be limited by systematic effects, and we encourage the collaboration to overcome those issues as much as possible. This is particularly true of the incident beam energy uncertainty at 4.52 GeV. Reducing systematic errors will help in decreasing the error of the resonance width and energy.

Summary: The PAC viewed this experiment very favorably. It answers an important physics question and takes advantage of a tritium target that will be installed in Hall A. It also provides valuable information on the nature of hyperon-nucleon interactions. The PAC recommends the full 12 days of beam time requested.

PR12-17-004

Scientific Rating: A-

Recommendation: Approve for Five Days

Title: Measurement of the Ratio G^n_E/G^n_M by the Double-polarized ^{2}H(e,e'n) Reaction

Spokespersons: J. Annand (Contact), V. Bellini, M. Kohl, N. Psikunov, B. Sawatzky, B. Wojtsekhowski

Motivation: Measurements of the neutron electromagnetic form factors are a cornerstone of the physics program at JLab12, providing unprecedented insight into the structure of the neutron and QCD dynamics. Present data on G^n_E/G^n_M run out at Q^2=3.4GeV^2. There is much interest in extending the Q^2 regime to higher values, in order to confront theoretical calculations, to probe the possible onset of scaling behavior predicted by perturbative QCD, and to combine with existing and forthcoming proton data to obtain a quark flavor decomposition of the form factors. Given the experience with proton form factor extractions, it is crucial to employ various different methods, either based on cross section measurements with Rosenbluth separation, or on polarization. The proposed experiment will scatter a longitudinally polarized electron beam off a deuterium target, measuring the polarization of the neutron recoiling from the interaction. Compared to the previously approved experiment E12-11-009 that will use the same general technique, the present experiment uses a different method for neutron polarimetry that also provides access to the charge-exchange channel np→pn. As the latter dominates at high neutron energy and hence at higher Q^2, the proposed method would provide an avenue for future high-Q^2 measurements of the form factor ratio via recoil polarimetry.

Measurement and Feasibility: The proposed measurement will be carried out in Hall A. It will make use of all apparatus required for the already approved G^p_E/G^p_M experiment E12-09-019 (LD_2 target, BigBite spectrometer for electron detection, 48D48 dipole in hadron arm, HCAL hadron calorimeter), and operate at the same settings. It would hence prefer to run immediately following E12-09-019. A new neutron recoil polarimeter will be added, consisting mainly of a copper polarization analyzer with GEM chambers. The 48D48 dipole magnet will be used to process the spin of the recoil neutron from longitudinal to vertical direction. The form factor ratio G^n_E/G^n_M may then be obtained directly from the polarization ratio P_x/P_z. The analyzing power cancels in this ratio. The focus is on detecting forward protons from the charge-exchange process np→pn, although there is also potential for seeing large angle, low energy protons from the channel np→np, which would provide valuable information for E12-11-009.

The proposed experiment requests 5 days of running. It plans to access a single value of Q^2=4.5 GeV^2, which is sufficient for exploring and validating the new recoil polarimetry method. A precision of about 0.1 (absolute value) on the ratio G^n_E/G^n_M is anticipated.

Issues: The case for polarimetry via np→pn has recently been strengthened significantly by preliminary data from JINR/Dubna showing a sizable analyzing power for n+A→p+X. Since most of the equipment is standard Hall-A equipment and the polarimeter mainly consists of a simple copper analyzer, no technical issues are foreseen. The TAC report raises the issue of a high DAQ data volume, which has been addressed by the collaboration and does not appear to be a reason for concern. Running consecutively with E12-09-019 appears to be a must.

Summary: The PAC is excited at the prospect of neutron polarimetry via the charge exchange reaction as it opens the door to measurements of the neutron form factor ratio at high momentum transfer via recoil polarimetry. We are also glad to see that there has been close interaction with E12-11-009 as shown by the fact that some members of that experiment have joined the present proposal. The PAC is optimistic that the proposed experiment will make a significant contribution to the program with recoil polarimetry at JLab.

PR12-17-005

Scientific Rating: B+

Recommendation: Approved for Four Days

Title: The CaFe Experiment: Isospin Dependence of Short-Range Nucleon Pairing in Nuclei

Spokesperson: Hen (contact person), Weinstein, Higinbotham, Cohen

Motivation: This proposal aims to measure (e,e'p) to gain a quantitative understanding of the nucleon-nucleon short range correlations in heavy nuclei, particularly in the proton-neutron channel. It is pretty well established at this point that almost all high-momentum protons in nuclei have a correlated partner, and that partner is almost always a neutron. That seems to be true for symmetric heavy nuclei, but also for asymmetric heavy nuclei (with unequal numbers of neutrons and protons). One motivation for this experiment is to precisely measure the ratio of cross sections for ^{48}Ca and ^{40}Ca (e,e'p) to understand whether there is an isospin dependence in the short range correlations. It also appears that this unlike-fermion pairing is similar to pairing in two-component ultra-cold atomic gases, which is striking considering the difference of more than 20 orders of magnitude in density.

The measurement proposed here is among a suite of measurements to gain deeper understanding of the NN short range correlations. These correlations are driven by the underlying nucleon-potential, particularly in the proton-neutron tensor part of the interaction. The proposed measurement may have implications on a number of other issues in astro, nuclear and particle physics. This would also have an impact on the 12 GeV program at JLab, by providing complementarity to other experiments outlined on the cover sheet. For example, while E12-10-108 (a "classic" EMC effect measurement) will extend understanding of EMC-SRC correlation, this proposal promises to disentangle EMC and SRC correlation by studying how the EMC effect and the SRC ratios change (separately) from 40Ca (Z=N=20) to 48Ca (8 extra neutrons). Furthermore, inclusive (e,e') measurements on 48Ca/40Ca are sensitive to both high-momentum protons and neutrons, in (e,e'p) one is sensitive to the high-momentum protons only.

Measurement and Feasibility:
The experiment could be performed in Hall C using standard equipment and targets. While only two kinematic settings of the spectrometer will be used, the wide momentum bite should give some additional information on the kinematic dependence of the results.

Issues: The PAC encourages the team to continue to examine the effects of Final State Interactions on the results from the experiment. We remain concerned that FSI could influence the interpretation of experimental results. The proponents have spent the last year working with theorists to obtain an effective field theory formulation of the 'contact' problem and other problems that short range correlations may elucidate. We encourage continuing this interaction.

Summary: The PAC recommends four days of running to determine the deviation of the 40Ca/48Ca cross section ratio from 1 (at x>1). The experimental results can be used to validate the contact formalism and isospin dependence of the np short range correlations. We believe the collaboration made a reasonable argument for pursuing the (e,e'p) measurements to investigate isospin dependence in the pn SRC as their highest priority. Comparison of 48Ca and 40Ca (e,e'p) should provide the clearest such measurement of the effect.

PR12-17-006

Scientific Rating: N/A

Recommendation: Conditional Approval C2

Title: Electrons for Neutrinos: Addressing Critical Neutrino-Nucleus Issues

Spokespersons: Or Hen, K. Mahn, E. Piasetzky, S. Stepanyan, L.B. Weinstein

Motivation: Measurements of electron scattering on targets are of great interest for neutrino experiments. The known kinematics may be used to constrain nuclear models and to test and improve neutrino event selection and energy reconstruction techniques. Quasi elastic scattering, in particular, is important for neutrino oscillation experiments as in principle one can get a clean high resolution measurement of the neutrino energy. However, the cross sections are not yet well understood and FSI, multi-nucleon effects, and undetected pions can lead to misclassification of events and errors in energy reconstruction. This experiment, with the known beam energy and CLAS12 spectrometer will provide substantial improvements of event generators used in neutrino oscillation experiments.

Measurement and Feasibility: The proposed measurements are for (e,e'p) scattering at 1, 2.2, 4.4, 6.6 and 8.8 GeV on H, ^{4}He, ^{12}C, ^{16}O, ^{40}Ar, and ^{208}Pb. The CLAS12 detector will be used to study the event topology, including detection of energetic neutrons. The total request is for 41 days of beam time (which includes one day of calibration and 3.5 days for beam energy and target changes), with a new target system.

The proposal shows a preliminary study using CLAS6 data on a limited suite of targets to study energy reconstruction methods and to evaluate the contributions of background processes. The reconstructed proton plus electron missing P_T is used to remove events with additional activity and extract a purer quasi-elastic scattering sample. This preliminary work shows promising constraints on the energy response function that should be applicable to neutrino reconstruction.

Issues: Due to the angular acceptance of the CLAS12 detector, the proposed Q^2 range is actually high relative to typical neutrino oscillation experiments. The experiment can reach lower Q^2 by changing the magnet focusing. The neutron efficiency is only 10% for low momenta so the neutron multiplicity measurements will be limited. However, measurements of the neutron kinematic distributions can still provide interesting information on neutron production.

The 8.8 GeV running is not very well motivated by neutrino physics at relevant energies and momentum transfer and occupies 40% of the running time. More traditional nuclear physics considerations may offer a stronger motivation for this beam setting. The beam request could be optimized considerably.

An overall concern is the fact that, although related and to some extent similar, electron scattering and neutrino scattering do differ. The PAC is not convinced that aiming at 1%-level measurements in electron scattering is fully warranted.

Summary: The committee overall finds the proposed physics is well motivated, but the actual measurements are in need of significant optimization. We are glad to see that neutrino and electron scattering physicists are working together on this proposal, which should lead to a better joint interpretation and use of the data. The committee was also impressed with the preliminary work done with CLAS6 data and with the plan discussed in the open session for evaluating neutrino simulation models using the proposed running. We would like to see a preliminary application of the CLAS6 data (and possibly projected CLAS12 data) to neutrino models and comparison of the improved models with one of the existing neutrino data samples (such as T2K, MINERvA, NOvA, or MiniBooNE). We believe the collaboration is more than capable of doing this before the next PAC meeting and that this would lead to a better optimized run plan. We therefore recommend C2 conditional approval.

PR12-17-007

Scientific Rating: N/A

Recommendation: Defer

Title: Probing QCD in the nuclear medium with real photons and nuclear targets at GlueX

Spokespersons: Or Hen (contact), H.Gao, A. Somov, M.Patsyuk, L.B.Weinstein, E.Piasetzky

Motivation: The proposal describes a program of measurements of photonuclear exclusive reactions A(γ, X) where X is a meson-baryon pair state. High momentum transfer exclusive processes on the nucleons will be studied in various nuclei. Three physics goals are pursued: the study of the photon structure (transition from hadronic to point like component versus hardness of the nucleon-level process in the region $1 < -t < 3$ GeV^2), the study of color transparency (CT, for $-t > 3$ GeV^2) in meson and also in baryon production, and the study of NN short range correlations (SRC) in initial state (again for $-t > 3$ GeV^2). By mapping various final states (mesons, baryons), with an appropriate choice of kinematics (wide $|t|$ range and wide angle range) and studying four different nuclei, the different effects should be separated. These photoproduction results will complement previous high Q^2 electroproduction studies.

Measurement and Feasibility: The measurements would be performed in Hall D using a tagged photon beam (8-9 GeV) at 20% of the high intensity of GlueX, several nuclear targets (2H, 4He, 12C, 40Ca) and the GlueX spectrometer in its standard configuration. 40 days are required in total including 3 days for calibration and commissioning.

Issues: The TAC report mentions issues needing more study. For example, neutron backgrounds in Hall D and GlueX need to be considered more thoroughly.

Summary: Three different physics cases (photon structure, CT and SRC) are addressed, associated possibly to different -t ranges, and measured through various reactions on four nuclei. However, with regard to photon structure, the proposal fails in describing the perspective relative to previous understanding. Reference to actual knowledge on the photon structure is missing and improvement not properly quantified. The included theoretical curves regarding CT and SRC should be better motivated and explained. Several other approved JLab experiments will address CT. In addition, combining photon structure and CT studies seems to be a complication.

The experimental similarities with the proposal PR12-17-010 must be studied in detail to hopefully overcome their differences and settle on a common beam time request.

PR12-17-008

Scientific Rating: A-

Recommendation: C1 (Conditional Approval) for 46 days

Title: Polarization Observables in Wide-Angle Compton Scattering at large s, t and u

Spokespersons: D. Day, D. Hamilton (Contact), D. Keller, G. Niculescu, B. Wojtsekhowski, J. Zhang

Motivation: Real Compton Scattering (RCS) off a proton is a fundamental and basic process which, at high energies, should be explained in terms of photon-quark interactions. The mechanism behind RCS in the regime of $\sqrt{s}$ = 5-10 GeV remains not well understood. Measurements have shown that these data cannot be described by pQCD calculations involving the scattering of three valence quarks, but the dominant mechanism could be the handbag model with the photon scattering of a single quark. The proposed measurements aim at disentangling the existing handbag mechanisms (CQM, SCET and GPD) that have been proposed to describe asymmetries previously measured in Wide Angle Compton Scattering (WACS). In particular the double longitudinal spin asymmetry K_{LL}, related to the helicity transfer from the photon to the scattered proton, is surprisingly large and stable with respect to the photon center-of-mass scattering angle. In the GPD and SCET formalisms, K_{LL} equals the spin asymmetry A_{LL} relative to the helicity of the photon and the initial photon, while in CQM the difference between these two quantities grows with the center-of-mass scattering angle.

Measurement and Feasibility: This proposal requests 46 days to measure the initial state correlation asymmetries A_{LL} and A_{LS} in WACS on a polarized proton target at photon energies of 8.8 GeV at Θ_{CM}=70, 90, 110 degrees and 11 GeV at Θ_{CM}=70 degrees. These kinematic points optimize statistical precision while also maintaining sufficiently high Mandelstam variables to facilitate interpretation within the handbag formalism.

Issues: The PR12-17-008 collaborators have done substantial work to show that the novel design of the Compact Photon Source (CPS) is feasible and that radiation levels in the hall are acceptable. The PAC recommends the collaboration continue to work closely with the lab while finalizing the design and price estimate for the CPS, and clearly establishing the expected maximum photon intensity.

Summary: Investigations into the mechanisms behind WACS will provide valuable insight into the nature of exclusive reactions and proton structure and are ideally suited for the facilities provided by the Jefferson Lab 12 GeV upgrade. The PAC commends the PR12-17-008 collaborators on successfully unifying the strongest aspects of the PR12-15-003 and PR12-16-009 proposals. Pending the successful review of the CPS, and subsequent approval of PR12-17-008, the PAC recommends the running time for the approved experiment E12-14-006 be subsumed into the running time for this proposal.

PR12-17-009

Scientific Rating: N/A

Recommendation: Deferred

Title: Precision Deuteron Charge Radius Measurement with Elastic Electron-Deuteron Scattering

Spokesperson: A. Gasparian (contact person), H. Gao, D. Dutta, N. Liyanage, E. Pasyuk

Motivation: The goal of the experiment is a measurement of the differential cross section of elastic electron deuteron scattering in the very low Q^2-range from $2x10^{-4}$ to $5x10^{-2}$ $(GeV/c)^2$. From this the determination of the deuteron charge radius r_d with an accuracy of $\delta r_d/r_d = 0.5\%$ is possible. The recent "deuteron radius puzzle" is a $\delta r_d/r_d=0.8\%$ deviation (corresponding to 6.5σ) of an r_d extraction from the atomic spectroscopy of muonic deuterium as compared to the CODATA value for r_d. This "deuteron radius puzzle" is a possible third observation in addition to the muon g-2 factor and the proton radius puzzle which is related to a possible violation of electron-muon universality. Possible explanations for these "puzzles" come from new physics beyond the standard model.

Measurement and Feasibility: The experiment intends to reinstall an updated version of the PRad Experiment (E12-11-106) with a windowless deuterium gas target. A new silicon strip recoil detector and its readout electronics as well as an additional, new GEM tracking layer with its read out electronics will complement the existing PRad apparatus. The requested beam time is necessary in order to achieve the $\delta r_d/r_d = 0.5\%$ accuracy goal.

Issues: The precise understanding of the systematic error is a prerequisite for the experiment proposed here. A complete assessment of the systematic corrections and associated systematic errors in $\delta r_d/r_d$ is at present very difficult and will only be possible after the analysis of the PRad experiment has finished. The new recoil silicon strip detector for the detection of the scattered deuteron is instrumental to discriminate elastic e-d scattering from background in the important, unexplored low-Q^2-region. It is not clear how the efficiency of this detector for the lowest energy deuterons can be determined and calibrated. Extrapolation from protons or higher energy deuterons leads to systematic errors which cannot be quantified. The target experiment error $\delta r_d/r_d = 0.5\%$ is too large to give a definitive answer to the primary question.

Summary: While the present target accuracy of this proposal is large as compared to the effect, the PAC finds the proposal potentially interesting and encourages the authors to scrutinize the final error in $\delta r_d/r_d$ once the PRad analysis is finished. A possibility to substantially reduce the experimental error on $\delta r_d/r_d$ seems to be very attractive but needs to be worked out in detail. A method to calibrate the efficiency of the silicon strip detector for low energy deuterons with energies as expected in this proposal for the low q^2 intervals needs to be thoroughly worked out. The systematic error while extrapolating from measurements with protons from elastic scattering or from higher energy deuterons needs to be quantitatively understood.

PR12-17-010

Scientific Rating: N/A

Recommendation: deferred

Title: Photoproduction of vector mesons on nuclei with GlueX

Spokespersons: Liping Gan, Ashot Gasparian, Ilya Larin, Alexander Somov (Contact), Sergey Gevorkyan

Motivation: The proposed measurements aim to study the photoproduction of light vector mesons on nuclear targets with photon beam energies between 6 and 12 GeV using the GlueX detector. The primary focus is on the first extraction of the cross-section of longitudinally polarized ω on nucleons $\sigma_L(\omega N)$ from incoherent photoproduction off nuclear targets (C, Si, Sn and Pb). Two methods to access the $\sigma_L(\omega N)$ are proposed: the measurement of nuclear transparency $A_{eff}=\sigma_A/A\sigma_N$ and the spin density matrix element ρ_{00}. The measurements of the nuclear absorption in different nuclei are useful for extracting meson-nucleon cross sections while the use of different beam energies will shed light on the disagreement between earlier experimental results and existing theory predictions and provide additional information on color transparency. The proposed measurements provide a unique opportunity to access $\sigma_L(\omega N)$ and when combined with the already known cross section for transverse polarization $\sigma_T(\omega N)$ would give important information on the dependence of the vector meson – nucleon interaction on the polarization.

Measurement and Feasibility: The proposed experiment would utilize the standard GlueX detector package. The collaboration's extensive experience in reconstructing multi-particle π^0 and photon final states should make reconstruction of the vector mesons straightforward. However, the proposal lacks critical details about the methods that will be used to measure the nuclear transparency and to extract the meson-nucleon cross section. As a result it is not possible to verify the stated systematic errors and confirm the beam time estimates.

Issues: While a first measurement of $\sigma_L(\omega N)$ is compelling, the connection to theoretical models needs to be strengthened. It is not clear from the proposal how the measurement of $\sigma_L(\omega N)$ will aid in the "interpretation of color transparency effects in the electroproduction of vector mesons".

Summary: The PAC considers the proposed measurements and in particular the extraction of $\sigma_L(\omega N)$ interesting and encourages the collaboration to better spell out the experimental technique to be used.

The experimental similarities with the proposal PR12-17-007 must be studied in detail to hopefully overcome their differences and settle on a common beam time request.

PR12-17-011

Scientific Rating: N/A

Recommendation: Deferred

Title: The Parity Violation Parton Distribution Function (PVPDF) Experiment: A new experimental constraint on PDFs

Spokesperson: M. Dalton (contact person), C. Keppel, K. Paschke

Motivation: The goal of the experiment is a measurement of the parity violating cross section asymmetry A_{PV} in inclusive deep inelastic scattering (DIS) from a proton target with 1 $(GeV/c)^2 < Q^2 < 3.5$ $(GeV/c)^2$ and $0.1 < x < 0.5$. The asymmetry is sensitive to the neutral current interference structure function $F_2^{\gamma Z}$. The data will provide a new and complementary experimental constraint on the parton distribution functions at low Q^2 and could potentially constrain the strangeness PDF.

Measurement and Feasibility: The measurement will require 38 days of 11 GeV polarized beam at 70 μA on a 20 cm liquid hydrogen target in Hall C. The parity violating asymmetry A_{PV} is of order 130 ppm. Data will be taken with the spectrometers and detectors constituting the base equipment in Hall C, with the SHMS fixed at 8.5 degrees and 6.5 GeV and the HMS fixed at the minimum angle (10.5 degrees) and 6.4 GeV. Both of the existing Polarimeters in Hall C will be used to obtain polarimetry at level of the Q_{weak} experiment (0.6% polarization accuracy). Commissioning data will be taken with full tracking to precisely determine the kinematics of the scattering. The asymmetry measurement itself will include only the lead glass calorimeters and Heavy Gas Cherenkov detectors.

Issues: The proposal has put an emphasis on constraining the strange parton distribution by the determination of the neutral current interference structure function $F_2^{\gamma Z}$. In the x-range $0.1 < x < 0.5$, the valence u- and d-quark distributions are about an order of magnitude larger than the strangeness contribution and have an error band of their own. This will deteriorate the sensitivity for strangeness PDFs and it is not clear to what extent. Furthermore, higher order corrections need to be evaluated and included. For the measurement of the asymmetry, the tracking system of the spectrometers will not be used, so that the single event resolution will be given by the lateral shower fluctuations in the lead glass calorimeter. It is not clear to what extent the binning in Q^2 and x that has been presented in the proposal matches the resolution in Q^2 and x.

Summary: The PAC finds the proposal potentially interesting but finds the presented impact on the strange PDFs optimistic in view of the large uncertainties in the much larger u- and d-quark and antiquark distributions. The authors did not make clear whether the shown binning in x really matches the resolution in x. The PAC encourages the authors to quantitatively work out the impact of the proposed measurement on constraining the strange PDF including all other sources of uncertainty such as the light quark and antiquark distributions, unknown higher twist corrections, x-resolution and input from PDF-determinations from LHC. The SoLID experiment aims for a measurement of the same asymmetry in a similar, reduced x-, and an enlarged Q^2-range on a deuterium target. The PAC encourages the authors to make a quantitative comparison concerning the impact on PDF-constraints between the SoLID measurements at higher precision but smaller x-range and the proposed measurement with reduced accuracy but enlarged x-range.

PR12-17-012

Scientific Rating: A-

Recommendation: Approve for 55 days

Title: **ALERT Run group**: Nuclear Exclusive and Semi-inclusive Measurements with a New CLAS12 Low Energy Recoil Tracker
12-17-012: Partonic Structure of Light Nuclei
12-17-012A: Tagged EMC measurements on light nuclei
12-17-012B: Spectator tagged Deeply Virtual Compton Scattering On Light Nuclei
12-16-011C: Other Physics Opportunities with the ALERT Run Group

Spokespersons: N. Baltzell, Z.-E. Meziani (Contact), K. Hafidi, M. Hattawy, R. Dupré, M. Paulone, G. Charles, W. Armstrong

Motivation: This run group will enhance CLAS12 with a large acceptance drift chamber and a scintillator hodoscope capable of distinguishing light recoil nuclei (ALERT). This will allow measurements of Deeply Virtual Compton Scattering (DVCS) and Meson Production (DVMP) on a ^{4}He target, as well as Deep Inelastic Scattering (DIS) and DVCS on a nucleon extracted from light nuclei (^{4}He and ^{2}H), whose remnants are tagged. Thus, the group proposes a comprehensive physics program to investigate the fundamental partonic structure of the ^{4}He nucleus.

Measurement and Feasibility: The proposal is to replace the central detector around the CLAS12 target with a low energy recoil detector consisting of a drift chamber and a scintillator hodoscope located inside the drift chamber volume. The combination of time-of-flight and low density tracker will have the ability to distinguish light recoil nuclei and, unlike a TPC, would allow triggering to substantially reduce data rates. The group is composed of four experiments, performing measurements all related to the study of the partonic structure of ^{4}He and light nuclei. A total of 55 days are requested under various running conditions.

Proposal PR12-17-012. This proposal focuses on the extraction of the ^{4}He GPD, via DVCS, e ^{4}He → e ^{4}He γ and DVMP, e ^{4}He → e ^{4}He Φ, processes. The final outgoing ^{4}He is detected and tagged. It is a particularly clean case, as the ^{4}He is a spin 0 state and it has only one complex GPD, H_A . Both its real and imaginary part can be extracted by measuring the longitudinal beam spin asymmetry, A_{LU}. Such a measurement has already been performed at JLab, with only a few experimental points and large uncertainties on the extracted Re(H_A) and Im(H_A). The comparison with similar information obtained on a proton, although not so straightforward, might give important information on nuclear structure. In addition, the ^{4}He gluon GPD can be accessed in DVMP via Φ production. This experiment requires 10 days of 1000nA beam and 20 days of 500 nA beam and 5 days for commissioning.

Proposal PR12-17-012A This proposal measures the EMC effect as a function of recoil momentum and x for the tagged processes: ^{2}H(e, e'p)X, ^{4}He(e, e' ^{3}H)X and ^{4}He(e, e' ^{3}He)X . The ALERT drift chamber and TOF allow ^{3}He and ^{3}H to be separated, enabling tagged measurements of F_{2n} and F_{2p} for bound n and p. The data should be able to distinguish models for the EMC effect such as binding (x-scaling), nucleon swelling (Q^2-scaling) and suppressions due to short-range correlations by studying distributions vs the recoil momentum at fixed DIS kinematics. They request 20 days of running time on deuterium at 500nA and share 20 days on ^{4}He with the coherent ^{4}He measurements (polarization required by nuclear GPD) and use the same 5 days of commissioning as coherent ^{4}He.

Proposal PR12-17-012B aims at a clean extraction of the neutron DVCS beam spin asymmetry in a bound and a quasi-free configuration to provide an unambiguous answer to the question whether nucleons are modified in medium at the parton level. To do so, measurements on ^{4}He and deuterium targets are proposed investigating the exclusive processes: 1. e + ^{4}He → e' + γ + p + ^{3}H, 2. e + ^{4}He → e' + γ + (n) + ^{3}He, 3. e + ^{2}H → e' + γ + (n) + p. For all these reactions the ALERT detector enables spectator recoil tagging. The electron, photon and, for the first reaction also the proton, will in addition be measured in CLAS12. In all cases the detection of the spectator nucleus/proton provides valuable additional information. The first process provides a measurement of bound proton DVCS. Moreover, by also detecting the final state proton, over-determined kinematics are provided, which are needed to systematically probe the size of FSIs. It will share running days with **PR12-17-012A.**

Proposal 12-17-012C highlights several other interesting physics topics which are complementary to the other run group proposals. Exclusive π^0 production, coherent exclusive DVCS from the deuteron and DVCS in three-body break up reactions are highlighted in the proposal. No additional run time is requested for these studies.
Issues: The relevance of the final state interactions (FSI) in tagged DVCS on ^{4}He is still an open issue. The PAC appreciates the work done by the collaboration in order to clarify the point and takes note of the proposed strategy, consisting in measuring process 1 and comparing the results with models in order to study FSI and access their relevance in the region of interest for processes 2 and 3. The data, which will be collected in parallel with the other Run Group measurements will hopefully give the expected results and relevant information.

Summary: The committee was generally enthusiastic about the diverse and logically structured science program presented in this proposal. In particular, the tagged EMC studies and the unique study of coherent GPD's on the ^{4}He nucleus appear to be exciting new areas of investigation. Despite lingering concerns about the method of handling FSI, these investigations do not require dedicated running time and are worth pursuing within the allotted days. Additional theoretical input is warranted.

~~C12-14-004~~

E12-12-002A

Scientific Rating: N/A

Recommendation: Approve as a parallel run group addition to E12-12-002

Title: Update to the JEF proposal

Spokespersons: Liping Gan (Contact), Zisis Papandreou, Alex Somov, Simon Taylor

Motivation: This proposal is an update to the C2 conditionally-approved JLab Eta Factory (JEF) Experiment. The JEF program will make precision measurements of various η(') decays with emphasis on rare neutral modes. The physics goal is to use those rare decays to probe the isospin-violating sector of low energy QCD and search for physics beyond the Standard Model, in particular, a leptophobic dark boson B^0.

Measurement and Feasibility: The JEF program will use the existing beam line and detector array of the current GlueX experiment with a modification to the forward calorimeter (FCAL). This proposal addressed issues raised by the PAC42 "that FCAL-II and the associated JEF physics program be fully incorporated to run in parallel with GlueX". A detailed simulation of the key signal channel $\eta \rightarrow \pi^0\gamma\gamma$ is performed along with various background channels. The results suggest that the JEF experiment has full capability to take data concurrently with GlueX or any other experiments using a LH_2 target in Hall D.

Issues: The estimated cost of the total FCAL-II is about $4.5M, along with additional $1M for the infrastructure and mounting. The projected date for FCAL-II installation is 2023. 130 PAC day plus 12 days for commission is requested, which could overlap with the run time allocated to GlueX.

The budget estimate and hence the anticipated start date of the experiment appear to be on the conservative side. With the possible recycling of the PrimEx calorimeter (HyCal) crystals, as well as additional crystals that JLab plans to purchase, the cost and preparation time of the experiment could be greatly reduced.

Summary: The PAC endorses the physics of the JEF program. The simulation of the key channel suggests that the proposed measurements are feasible. The PAC recommends approval of this proposal, as a run group addition to approved GlueX running with the DIRC. The PAC encourages the collaboration to further develop and optimize the technical design of the FCAL-II utilizing existing resources, and to make a credible plan to build a sufficient FCAL-II to carry out the measurements. No new beam time will be allocated, so the PAC encourages the collaboration to develop a concurrent run plan.

C12-16-001 (BDX)

Scientific Rating: N/A

Recommendation: Proceed with the planned tests

Title: Dark Matter Search in a Beam Dump Experiment (BDX)

Spokespersons: Marco Battaglieri (contact) Gordan Krnjaic, Eder Izaguirre, Elton Smith, Marzio De Napoli, Raffaella De Vita, Andrea Celentano

Motivation: The experiment would search for a leptophilic dark matter particle χ coming from the decay of a ``heavy photon" A′ produced in the beam dump for a high energy electron beam. The χ would be detected via elastic scattering with atomic electrons (or potentially other processes) tens of meters downstream of the dump, following a column of heavy shielding. The plan is to parasitically use 11 GeV beam in Hall A at JLab. The theoretical motivation is sound, and the recent FLUKA simulations done by the collaboration provide additional confidence in the background calculations.

Measurement and Feasibility: This is a special submission. The PAC is charged with considering the collaboration's plans for upcoming measurements of backgrounds downstream of the Hall A dump, using a sampling detector "BDX-Hodo" to be inserted into vertical wells drilled at three locations. The idea is to measure the muon flux (without the heavy shielding that would eventually be installed) as a benchmark for the simulations. Neutrons are of interest to the RadCon group, and they plan to be included in the measurements. The plans are well motivated, and the detector is appropriately designed.

Issues: (1) The neutrino flux from the beam dump is discussed in Sec.3.1.3 of this submission, and the background rate is estimated. The PAC encourages the planned work to in fact simulate potential neutral current interactions that would appear to be dark matter candidates, and demonstrate cuts to remove them. **(2)** It is well known by the collaboration that this is a competitive field. The PAC finds this opportunity to be exciting, and encourages the collaboration and laboratory to move forward with all deliberate speed. Furthermore, the collaborators needs to ensure that, as the field evolves, this experiment remains vital and competitive.

Summary: The collaboration should continue working with JLab to carry out the proposed tests, towards achieving full approval at a subsequent PAC.

Run Group Additions

C12-15-006A

Scientific Rating: N/A

Recommendation: Note taken as a run group addition

Title: "*Measurement of Kaon Structure Function through Tagged Deep Inelastic Scattering (TDIS)"*

Spokespersons: Kijun Park (Contact), Tanja Horn, Rachel Montgomery

Motivation: The proposal aims at measuring the currently unknown kaon structure function through Tagged Deep Inelastic Scattering (TDIS), e p → e' Λ X, in which the initial proton turns into a Λ hyperon by emitting a K (the so-called Sullivan process). It is a similar mechanism to the one exploited by the conditionally approved C12-15-006 proposal for studying the pion structure function. This proposal is a natural extension of C12-15-006, although with more uncertainties.

Measurement and Feasibility: The proposed measurement does not require additional beam time or detector to the approved running conditions of C12-15-006, and can run as part of the pion-TDIS Run Group SBS.

Issues: None

Summary: The PAC endorses the addition of this effort to the approved proposal.

E12-10-006B

Title: Measurement of Deep Exclusive π^- Production using a Transversely Polarized ^{3}He Target and the SoLID Spectrometer

Spokespersons: Z. Ahmed, G. Huber (Contact), Z. Ye

Motivation: Exclusive production of pseudoscalar mesons provides an avenue for obtaining information on the elusive generalized parton distribution E-tilde. This proposed run group addition plans to measure A_{UT} spin asymmetries on ^{3}He. Such a measurement with SoLID would be complementary to PR12-12-005 in Hall C, but could become available on a shorter time scale. Its main limitation is that a Rosenbluth separation of longitudinal and transverse photon contributions is not available, resulting in dilution of the asymmetry and a less clear-cut connection to E-tilde (which contributes to the longitudinal part). Nevertheless, given that relatively high Q^2 can be reached, dominance of the longitudinal part is expected. In any case, the proposed measurements would provide valuable information. A significant reach in t (7 bins) is possible.

Measurement and Feasibility: The experiment will run in parallel with the already approved SIDIS experiment E12-10-006 at SoLID. No new equipment is required. Proton detection from en—>eπp is well understood. An offline analysis of the SoLID triple coincidence events will be performed.

Issues: We do not see any issues. The proponents have addressed all points raised in a recent SoLID review. The experiment has been vetted with SoLiID and fully endorsed by the collaboration which in fact sees potential for this to become a flagship measurement at SoLID.

Recommendation: The PAC takes note of this run group addition.

E12-12-001A

Scientific Rating: N/A

Recommendation: The PAC takes note of this run group addition.

Title: Near threshold J/ψ photoproduction and study of LHCb pentaquarks with CLAS12

Spokespersons: S. Stepanyan (contact), M. Battaglieri, A. Celentano, R. de Vita, V. Kubarovski

Motivation: The goal is to study gluonic contributions to the nucleon form factor and hidden charm pentaquark states seen by LHCb, Pc(4380) and Pc(4450) in the J/ψ p interaction. J/ψ photoproduction, already foreseen in approved experiments of CLAS12 Run Group A, has regained much interest with the LHCb discovery. Data close to threshold production are not currently available. This measurement is sensitive to the nucleon form factor, and thus to the non-perturbative gluon fields in the nucleon.

Measurement and Feasibility: The experiment would run as part of CLAS12 (RG-A), using the same settings as the approved experiments E12-12-001 (untagged) and E12-11-005 (tagged) with additional triggers like the μ+μ- decay mode of J/ψ for the untagged part. Tagged and untagged exclusive photoproduction of J/ψ near threshold will be studied. No additional beam time is required. With this measurement and the approved measurements in Hall A (E12-12-006, SoLid) and Hall C (12-16-007, 11 days high impact) JLab should produce a significant contribution to the subject.

Issues: Assumptions on pentaquark cross-section and branching ratios used to evaluate the count rates may be optimistic, as for the concurrent experiments. However even a negative result is interesting.

Summary: The PAC takes note of this run group addition.

Letters of Intent

LOI 12-17-001

Scientific Rating: N/A

Recommendation: N/A

Title: Study of J/ψ Photoproduction off deuteron

Spokespersons: Y. Ilieva

Motivation: Measurements of exclusive photoproduction of J/ψ near threshold off a deuteron target are proposed as an addition to CLAS RG B. The LoI is an extension of the approved E12-12-001 RG A experiment on the proton. By the interaction with the target through two-gluon exchange, the process probes gluonic observables and gluonic structure in the nucleon. The three main physics topics proposed are: An independent access to the magnitude of the J/ψ N elastic cross-section (via FSI in incoherent photoproduction), two-gluon form factor of deuteron (coherent photoproduction γd J/ψ d) and J/ψ photoproduction off the neutron. The measurements will be used in conjunction with the data obtained with a proton target in E12-12-001.

Measurement and Feasibility: The measurements, to be added to CLAS12 Run Group B, do not require any additional beam time nor modification to the detectors. Exclusive photoproduction of J/ψ (coherent and incoherent) near threshold will be measured off the deuteron. Various detection scenarios are explored in the LOI to assess the ability to discriminate between the different mechanisms involved.

Issues: An LOI was not needed since the measurements will be proposed as a Run-Group addition. The PAC nevertheless concurs with the Theory TAC report which contains various suggestions regarding theoretical motivation.

Summary: This LOI should be submitted to the CLAS12 collaboration as a run group addition.

LOI12-17-002

Title: Search for a φ-N Bound State at Hall B

Spokespersons: H. Gao

Motivation: Recent data from LHCb show evidence for hidden-charm pentaquark states. This motivates the search for further multi-quark states, containing, for instance, an s-sbar pair. The present LOI proposes to look for a φN bound state in Hall B. φ mesons are particularly promising in this context thanks to the fact that they are almost purely ssbar. Relatively little theoretical work has been done, but one model calculation predicts the existence of such a φN bound state with mass 1950 MeV (about 7 MeV below the open φN threshold) and width 4 MeV. There are also indications for a ^{4}He-φ bound state from the lattice, albeit with large quark masses.

Measurement and Feasibility: The idea for this experiment is to scatter a 4.4-GeV electron beam off a gold target. Scattering of the virtual photon and a nucleon produces a φ-meson which interacts with a second nucleon to form the bound state. The theoretical model predicts that the main decay mode (46.5% branching ratio) of the bound state would be to pK^+K^-. It is proposed to use the CLAS12 forward detector, the Forward Tagger (for the scattered electron), and the BONUS12 detector in Hall B for the measurement. This is expected to allow for seeing the bound state decay products. Fairly detailed studies of kinematics and backgrounds have been performed. They show that protons and kaons with energies below 500 MeV and down to 50 MeV will need to be detected, which appears to be feasible with BONUS12. It is found that some of the main backgrounds (for example from Λ decay) can be suppressed quite well.

Issues: Given the LHCb results, we find the idea for such a search well motivated. We do think that prior to formulating a full proposal the proponents should reach out to other theory groups to see whether the case for a φN bound state can be further strengthened, for example, by other model calculations. This applies especially to the production mechanism in a nuclear environment that is being considered here. It needs to be investigated better whether interactions within the nucleus may destroy the bound state prematurely or inhibit its formation. In addition, further background studies are needed, especially of the pion background at energies below 250 MeV.

Recommendation: The PAC encourages preparation of a full proposal that addresses the points raised above.

LOI12-17-003

Title: Studying Λ interactions in nuclear matter with the 208Pb(e,e'K^+)208Tl reaction

Spokespersons: **F. Garibaldi**

Motivation: The LOI describes a study of the ^{208}Pb(e,e'K^+) reaction which will provide information on the properties of a bound hyperon in a larger nucleus. This group has previously been approved to investigate the isospin dependence of hyperon dynamics. The use of kaons as a probe of spectroscopy should enable a substantial increase in accuracy as compared to previous spectroscopic measurements using pions. Indeed, with kaons, hypernuclear mass centroids should be measured to an FWHM accuracy of 100 keV, as compared to 2 MeV in previous pion measurements. A large body of theoretical calculations have been performed in 208Pb that should enable one to disentangle experimental information and provide a sound model of the lambda interaction in uniform nuclear matter. Because of the 100 keV FWHM capability of kaons, one should be able to precisely determine single particle states within the ^{208}Pb hypernucleus. The experiment will also make it possible to see deeply bound single particle hole states within the Pb nucleus.

Measurement and Feasibility: The measurements will take place in Hall A. The proponents have begun to develop an analysis of their target design, although extensive CFD and heat analysis should be performed in the full proposal to demonstrate target viability. Before the experiment runs, these calculations should be supported either by beam tests or by tests with a thermal test stand similar to what is being set up by Silviu Covrig and collaborators to check the APEX and the PREX-II solid target designs. The collaboration has demonstrated a good understanding of the kinematics of the experiment and counting rates to be expected. The proposal does assume that C12-15-008, utilized in for the 40Ca and 48Ca has been set up.

Summary: The study of the 208Pb(e,e'K^+) 208_{Λ}Tl reaction together with the other reactions proposed by this collaboration will eventually "complete" the systematic study of Λ hypernuclear bound states over the wide mass range. The PAC recommends moving forward toward a full proposal.

Program Status

12 GeV Approved Experiments by Physics Topics

Topic	Hall A	Hall B	Hall C	Hall D	Other	Total
The Hadron spectra as probes of QCD	0	3	1	3	0	**7**
The transverse structure of the hadrons	6	4	3	1	0	**14**
The longitudinal structure of the hadrons	2	3	6	0	0	**11**
The 3D structure of the hadrons	5	9	6	0	0	**20**
Hadrons and cold nuclear matter	8	4	7	0	1	**20**
Low-energy tests of the Standard Model and Fundamental Symmetries	3	1	0	1	1	**6**
Total	**24**	**24**	**23**	**5**	**2**	**78**
Total Experiments Completed	**2.5**	**1.1**	**0**	**0.4**	**0**	**4.0**
Total Experiments Remaining	**21.5**	**22.9**	**23.0**	**4.6**	**2.0**	**74.0**

12 GeV Approved Experiments by PAC Days

Topic	Hall A	Hall B	Hall C	Hall D	Other	Total
The Hadron spectra as probes of QCD	**0**	**319**	**11**	**540**	**0**	**870**
The transverse structure of the hadrons	**150.5**	**185**	**110**	**25**	**0**	**470.5**
The longitudinal structure of the hadrons	**65**	**230**	**165**	**0**	**0**	**460**
The 3D structure of the hadrons	**409**	**872**	**197**	**0**	**0**	**1478**
Hadrons and cold nuclear matter	**220**	**230**	**205**	**0**	**14**	**669**
Low-energy tests of the Standard Model and Fundamental Symmetries	**547**	**180**	**0**	**79**	**60**	**866**
Total Days	**1391.5**	**2016**	**688**	**644**	**74**	**4813.5**
Total Approved Run Group Days (includes MIE)	**1391.5**	**981**	**645**	**444**	**74**	**3535.5**
Total Approved Run Group Days (without MIE)	**573.5**	**981**	**645**	**444**	**28**	**2671.5**
Total Days Completed	**83**	**30**	**0**	**48**	**0**	**161**
Total Days Remaining	**491**	**951**	**645**	**396**	**28**	**2511**

PAC Days
Boldface = days designated High Impact
Parentheses = days not counting toward High Impact total

PAC "High Impact" Selection

Row Color
Yellow = High Impact
Green = backup expt

Exp#	Exp Name	Hall	Run Group/Days	PAC Days	PAC Grade	Comments
			TOPIC 1: SPECTROSCOPY			
E12-06-102	GlueX: Mapping the Spectrum of Light Quark Mesons and Gluonic Excitations with Linearly Polarized Photons	D		(120) approved ★90	A	GlueX - assumed half commissioning/half physics ★plus (30) commissioning days
E12-16-007	A Search for the LHCb Charmed "Pentaquark" using Photoproduction of J/Psi at Threshold in Hall C at Jefferson Lab	C		11	A	
			TOPIC 2: FORM FACTORS			
E12-06-101	Measurement of the Charged Pion Form Factor to High Q2	C		52	A	Requires fully commissioned SHMS
E12-07-109	GEp/GMp: Large Acceptance Proton Form Factor Ratio Meas's at 13 and 15 (GeV/c)2 Using Recoil Polarization Method	A		45	A-	Requires SBS and high power cryo target
E12-11-106	High Precision Measurement of the Proton Charge Radius	B		15	A	Non-CLAS12 experiment, Prad
			TOPIC 3: PDFs			
E12-06-113	BONuS: The Structure of the Free Neutron at Large x-Bjorken	B	F/40	(40) approved ★21 ↓	A	Requires BONuS Radial TPC upgrade ★42 days High Impact for the experiment
E12-10-103	MARATHON: Measurement of the F2n/F2p, d/u Ratios and A=3 EMC Effect in DIS off the Tritium and Helium Mirror Nuclei	A	Tritium target group/61	↑ ★21 (42) approved	A	**that runs first; experiments are equally important & both are essential**
E12-06-110	A1n HallC–3He: Meas of Neutron Spin Asymmetry A1n in the Valence Quark Region Using an 11 GeV Beam and a Polarized 3He Target in Hall C	C		36	A	Requires high luminosity 3He
			TOPIC 4T: TMDs			
C12-11-111	TMD CLAS–HDIce: SIDIS on Transverse polarized target	B	G/110	110 concurrent	A	Requires transversely polarized HDIce with electron beam
C12-12-009	Dihadron CLAS-HDIce: Measurement of transversity with dihadron production in SIDIS with transversely polarized target	B	G/110	(110) concurrent	A	Requires transversely polarized HDIce with electron beam C1 Proposal
E12-06-112	TMD CLAS-H(Unpol): Probing the Proton's Quark Dynamics in Semi-Inclusive Pion Production at 12 GeV	B	A/139	(60) approved ★10	A	Hall B commissioning + 10 days ★plus (50) commissioning days
			TOPIC 4G: GPDs			

E12-06-114	DVCS HallA–H(UU,LU): Measurements of Electron-Helicity Dependent Cross Sections of DVCS with CEBAF at 12 GeV	A	Early: DVCS & GMp/62	(100) approved ★70	A	Hall A commissioning
C12-12-010	DVCS CLAS–HDIce: DVCS at 11 GeV with transversely polarized target using the CLAS12 Detector	B	G/110	(110) concurrent	A	Requires transversely polarized HDIce with electron beam C1 Proposal
E12-11-003	DVCS CLAS–D(UU,LU): DVCS on the Neutron with CLAS12 at 11 GeV	B	B/90	(90) approved	A	Requires D target; central neutron detector ready in 2016 ★Backup GPD-E meas if HDIce delayed

TOPIC 5: NUCLEAR

E12-13-005	Bubble Chamber: Measurement of 16O(^{3},±)12C with a bubblechamber and a bremsstrahlung beam	INJ		14	A-	Our guess: 2017
E12-11-101	PREx-II: Precision Parity-Violating Measurement of the Neutron Skin of Lead	A		35	A	Requires septum, Pb target, 1% Moller polarimetry
E12-06-105	SRC–hiX: Inclusive Scattering from Nuclei at $x > 1$ in the quasielastic and deeply inelastic regimes	C		32	A-	
E12-11-112	SRC–Tritium: Precision measurement of the isospin dependence in the 2N and 3N short range correlation region	A	Tritium target group/61	19	A-	
E12-17-003	Determining the Unknown Lambda-n Interaction by Investigating the Lambda-nn Resonance	A		12	A-	

TOPIC 6: FUNDAMENTAL SYMMETRIES

E12-11-006	HPS: Status of the Heavy Photon Search Experiment at Jefferson Laboratory (Update on PR12_11_006)	B	H/180	(155) approved ★39	A	Non-CLAS12 experiment, HPS ★25 pre-CLAS engr + 14 physics @ 4.4 GeV
E12-10-009	APEX: Search for new Vector Boson A1 Decaying to e+e-	A		34	A	

<<<SUMMARY of "HIGH IMPACT" DAYS>>>

by Topic	1	2	3	4GT	5	6	total post - commissioning
	101	112	78	190	112	73	666
Days Complete	20	15		50		15	
	81	97	78	140	112	58	566

by Hall	A	B	C	D	INJ	
	236	195	131	90	14	666
Days Complete	50	30		20		
	18					
	6	**165**	**131**	**70**	**14**	**566**

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Charge to PAC45

Review new proposals, previously conditionally approved 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 proposals 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.