Jefferson Lab
Thomas Jefferson National Accelerator Facility

REPORT OF THE
42nd
PROGRAM ADVISORY COMMITTEE (PAC42) MEETING

July 28 – 31st, 2014

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)

For more information or copies of this report contact:
Thomas Jefferson National Accelerator Facility
User Liaison Office, MS 12H5
12000 Jefferson Avenue
Newport News, VA 23606
Phone: (757) 269-6388 / Fax: (757) 269-6134
E-mail: users@JLab.org
WWW: http://www.JLab.org/exp_prog/PACpage/pac.html

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

September 2, 2014
Phone: (757) 269-7552
Email: mont@jlab.org

Dear Jefferson Lab Users,

One of the great pleasures that I have as Director is seeing the new and exciting experimental proposals that come from our user community. 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 Program Advisory Committee (PAC42) reviewed 12 new proposals, 1 conditional proposal, 6 letters of intent, and 5 parallel or run group proposals. This review resulted in 9 approvals, 3 deferrals and 1 conditionally approved proposal. The results can be viewed at http://www.jlab.org/exp_prog/PACpage/PAC42/PAC42_Results_VGr.pdf.

The Chair of the PAC42 was again Naomi Makins, whose intense concentration on the issues brings to a forefront the important issues. We are incredibly impressed by the continued efforts of our diverse committee.

Sincerely,

Hugh Montgomery
Laboratory Director

Introduction

The Jefferson Lab Program Advisory Committee held its 42nd meeting from July 28th through July 31st, 2014. The membership of the committee is given in Appendix A. In response to the charge (Appendix B) from the JLab Director, Dr. Hugh Montgomery, the committee reviewed 13 potential experiments: 12 new proposals, 6 Letters of Intent and 1 conditionally approved.

In addition the PAC held discussions regarding reassessment of scientific priorities prior to the beginning of full 12 GeV production running.

Recommendations

PAC 42 SUMMARY OF RECOMMENDATIONS								
NUMBER	CONTACT PERSON	TITLE	HALL	DAYS REQUESTED	DAYS AWARDED	SCIENTIFIC RATE	PAC DECISION	TOPIC*
12-14-004	L. Gan	Eta Decays with Emphasis on Rare Neutral Modes: The JLab Eta Factory (JEF) Experiment	D	130			C2	1
C12-12-002	C. Meyer	A study of meson and baryon decays to strange final states with GlueX in Hall D (C12-12-002)	D	220	220	A	Approved	1
12-14-009	L. Myers	Ratio of the electric form factor in the mirror nuclei 3He and 3H	A	1.5	1.5	A	Approved	2
12-14-008	Xi. Jiang	Measurements of Semi-Inclusive DIS Double-Spin Asymmetries on a Longitudinally Polarized 3He Target	A	33			Deferred	3
12-14-010	C. Keppel	Measurement of Tagged Deep Inelastic Scattering (TDIS)	A	23			Deferred	3
12-14-001	W. Brooks	The EMC Effect in Spin Structure Functions	B	55	55	B+	Approved	3/5
12-14-002	S. Malace	Precision Measurements and Studies of a Possible Nuclear Dependence of R	C	22	22	B	Approved	3/5
12-14-007	S. Riordan	The EMC PVDIS Experiment: A Constraint on Isovector Dependent Nuclear Modification Effects Using Parity-Violating Deep Inelastic Scattering	A	71			Deferred	3/5
12-14-003	B. Wojtsekhowski	Wide-angle Compton Scattering at 8 and 10 GeV Photon Energies	C	18	18	A-	Approved	4G
12-14-005	D. Dutta	Wide Angle Exclusive Photoproduction of pi-zero Mesons	C	20	18	B	Approved	4G

12-14-006	D. Keller	Initial State Helicity Correlation in Wide Angle Compton Scattering	C	31	15	B	Approved	4G
12-14-011	L. Weinstein	Proton and Neutron Momentum Distributions in A = 3 Asymmetric Nuclei	A	10	12	B+	Approved	5
12-14-012	C. Mariani	Measurement of the Spectral Function of 40Ar through the (e,e2p) reaction	A	9	9	A-	Approved	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

Proposal Reports

PR12-14-001

Scientific Rating: B+

Recommendation: Approve

Title: **The EMC Effect in Spin Structure Functions**

Spokespersons: W. Brooks, S. Kuhn

Motivation: PR12-14-001 is a proposal to measure the Bjorken-x dependence of the double spin asymmetry on the polarized proton in ^{7}Li relative to a free polarized proton using the CLAS12 detector. The goal is to look for modification in the spin-dependent PDFs in nuclei — the spin analog of the traditional EMC effect.

Measurement and Feasibility: The measurement is performed on a ^{7}LiD target, correcting for the D contribution, dilution, etc… to isolate the polarized proton contribution in ^{7}Li. A very similar ^{6}LiH target is used at the same time to provide the free proton information with similar systematics.

Two observables will be measured: R1, the ratio of the spin-dependent cross sections of ^{7}Li and the free proton, and R2, the ratio of the longitudinal asymmetries, scaled by the sum of the proton and neutron unpolarized cross section to account for the 'dilution' of the signal from the polarized proton. R1 is sensitive to both the unpolarized EMC effect and the spin-dependent contribution, while R2 is chosen to isolate the spin-dependent modification.

R1 and R2 are sensitive to different sources of systematic uncertainties, but both end up with total point-to-point uncertainties of 3-4% and scale uncertainties of ~4%. Conventional models predict R1 and R2 values near 0.9 with little x-dependence, while most of the models of spin-dependent EMC effects predict changes in R2 of order 5-10%, with significant changes in the x-dependence.

Issues: The TAC report indicated skepticism about the 3% control of the target polarization. The proponents do plan a measurement of the beam*target polarization using (quasi)-elastic scattering as a cross check.

If it can be measured with sufficient precision, this measurement provides a unique and valuable independent test of models of the EMC effect. However, while the proposed measurement is sensitive enough to see an effect for many of the models shown, the precision of the measurement is not sufficient to precisely map out a nuclear modification. In addition, it is not clear to what extent the results can be interpreted and used to help understand the EMC effect at this time.

Recommendation: Approved for 55 days.

PR12-14-002

Scientific Rating: B

Recommendation: Approve

Title: **Precision measurements and studies of a possible nuclear dependence of R**

Spokespersons: S. Malace, D. Gaskell, E. Christy, C. Keppel, P. Solvignon

Motivation: The proposal aims to measure both $R=\sigma_L/\sigma_T$ and the differences R_d-R_p and R_A-R_d over a range in x and Q^2. Extractions of the nuclear structure function from inclusive cross sections rely on knowing R, and it is typically assumed that R is identical for the proton, deuteron, and nuclei in the DIS regime. A precise measurement of R for a range of nuclei and kinematics will significantly improve tests of this assumption. In addition, there are clear deviations of the assumption of A-independence in the resonance region (as well as somewhat above W^2=4 GeV^2), and some hints in the DIS region.

Measurement and Feasibility: Such measurements are difficult and require careful control of systematics. The proponents have a long history of making such measurements; the stated precision goal will require close attention to details but should present no major problem. The experiment will make direct L/T separations, avoiding much of the model dependence of previous extractions, and the comparison of R between different nuclei will be extracted through the 8' dependence of the target ratios, allowing for significant cancellation between many of the experimental uncertainties.

Issues: The current proposal has been cut back compared to the version presented to PAC40, yielding a more focused measurement. The kinematics have been chosen to minimize concern about issues with Coulomb corrections, and some data will be taken to test the models used to apply these corrections.

Recommendation: Approved to run 22 days.
While the PAC was not convinced that the experiment is likely to see a significant nuclear dependence of R in the DIS region, it was considered worthwhile to do a survey for such effects and, in the absence of any such indication, to improve limits on possible nuclear dependence.

PR12-14-003

Scientific Rating: A–

Recommendation: Approve

Title: **Wide-angle Compton scattering at 8 and 10 GeV photon energies**

Spokespersons: D.J. Hamilton, S. Sirca, B. Wojtsekhowski

Motivation: This proposal aims to measure the cross section for real Compton scattering from the proton at an incident photon energy of 8 GeV and 10 GeV (corresponding to values of s = 15.9 and 19.6 $(GeV/c)^2$, respectively) at wide c.m. scattering angles (in the range between 50^o and 105^o). Previous 6 GeV JLab polarization-transfer data have shown a clear indication for a partonic mechanism in the wide-angle Compton Scattering (WACS) process. These data have shown the WACS process to take place on a single quark, in stark contrast with the perturbative QCD picture, which involves three active quarks exchanging two hard gluons. How such a quark is embedded in the nucleon and if a factorization between the partonic subprocess and its embedding in the nucleon can be formulated in a more systematic way are still open questions, motivating cross section measurements at large s and t. The present experiment aims to extend the kinematic range of previous JLab WACS experiments by a factor of 2.

Measurement and Feasibility: This experiment will be performed in Hall C, using an untagged bremsstrahlung photon beam incident on a liquid hydrogen target. The scattered photon will be detected in a newly proposed neutral particle detector (NPS) for Hall C. The scattered electrons from the electron beam will pass through a liquid hydrogen target, with the scattered electron deflected by a sweeping magnet to allow discrimination between Compton and elastic electron-scattering processes. To ensure the exclusivity of the reaction, the recoil proton will be detected in the Hall C magnetic spectrometer HMS. The experimenters request 425 hours (18 days) of beam time.

Issues: The proposal is a resubmission of PR12-13-009, which was deferred by PAC40. The PAC had two main issues: 1) it wanted to see a realistic π^0 background subtraction for each kinematic setting; 2) it was not convinced on the choice of kinematic points to make the strongest physics case. The proponents have done a good job addressing both questions. They refocused the experiment and chose 4 fixed intermediate values of –t for which a scan in s will permit a test of the factorization of the WACS process into a perturbatively calculable s-dependent part and a non-perturbative Compton Form Factor that only depends on t. Furthermore, they proposed two more measurements at –t = 9 and 11 $(GeV/c)^2$ to extend the range over which the Compton Form Factor is extracted. They dropped several data points at larger momentum transfers, reducing the beam time by about a factor of 2. In the new proposal, the proponents also made a detailed π^0 background subtraction. For the intermediate values of t considered in the present experiment, the π^0 background subtraction is under good control.

Recommendation: Approve
The PAC considers WACS to be the process of choice to explore factorization in a whole class of wide-angle processes. The PAC recommends approval with the full allocation of the requested 18 days.

PR12-14-004

Scientific Rating:

Recommendation: Conditionally Approve (C2)

Title: **Eta Decays with Emphasis on Rare Neutral Modes: The JLab Eta Factory (JEF) Experiment**

Spokespersons: Liping Gan, D. Mack, A. Somov, S. Taylor, X. Chen

Motivation: The main goals of the proposed experiment are to perform (i) a search for a hypothetical light gauge boson coupling to baryon number with mass between the pion and eta masses; (ii) a search for the C violating and P conserving $\eta \rightarrow 3\gamma$ decay with an order of magnitude improvement over current bounds; (iii) a determination of two low energy constants entering chiral perturbation theory at order p^6 from $\eta \rightarrow \pi^0 2\gamma$ decay; and (iv) a clean determination of the light quark mass ratio Q from $\eta \rightarrow 3\pi$ decays.

Measurement and Feasibility: The experiment is proposed to run in Hall D using the high-energy tagged photon facility with its planned 30 cm LH_2 target, the GlueX detector, and a new high-granularity, high-resolution $PbWO_4$ forward calorimeter with flash ADC readout on every channel (FCAL-II). The desired performances in terms of reduced backgrounds and enhanced invariant mass resolutions will be achieved thanks to the new FCAL-II and to the fact that η mesons are produced significantly boosted. This offers exquisite background rejection capabilities compared to other facilities with comparable η production rates. The proposed measurements appear to be feasible and the experiment is well suited for the tagged Hall D photon beam.

Issues: The proposal was considered by PAC 39 (as PR12-12-003) and PAC 40 (as PR12-13-004) and deferred in both cases. The PAC understands the very strong scientific interest of performing new measurements of rare η decays with improved sensitivity to test the SM. In particular, the PAC sees the determination (iv) of Q from the $\eta \rightarrow 3\pi$ decay ratio and the Dalitz distribution as the most compelling physics result and recommends to perform this measurement as a run group with GlueX and experiment PR12-10-011 (which is approved to measure the $\eta \rightarrow 2\gamma$ decay width via the Primakoff effect). This part of the proposal can be performed with the existing calorimeter (FCAL) used by GlueX.

The other three physics goals (i)-(iii) will need the FCAL-II, which will mean a major investment in various kinds of resources. The PAC recognizes that (as was requested) compatibilities and synergies with GlueX were addressed in the resubmitted proposal and that the physics case was further refined. However, the physics of FCAL-II was considered too speculative to displace the GlueX program. Of course, the impact of a discovery in the proposed channels would be enormous; so as not to prevent these studies from running in the near future, we therefore ask that FCAL-II and the associated JEF physics program be fully incorporated to run in parallel with GlueX. We have thus given the experiment a C2 rating: approval of the physics case with the condition that JEF return to a later PAC with a convincing demonstration of their capabilities for running concurrently with GlueX. We ask that the experimenters include all approved phases of GlueX in their simulations, including JEF compatibility with the newly approved DIRC detector. In this way, the opportunities presented by the much higher-resolution FCAL-II for the wider GlueX program including the Primakoff-η experiment can be quantified and run times optimized.

It was also pointed out in the proposal that there is ongoing theory work on both the SM test parts (i) and (ii) and the physics regarding chiral perturbation theory (iii). We approve these parts of the proposal under the conditions that (i) it is demonstrated that they can run simultaneously with the approved GlueX program (this should in particular include an estimate of the background due to the higher coincidence rate) even when the expected DIRC bars will be installed, and (ii) that the theory motivation is sharpened further. The PAC would also like to see more details on the envisioned program on η' decays.

Recommendation: **C2 conditional approval**

The proposed experiment exploits the unique capabilities provided by Hall D to improve on the measurements of dominant and rare η decay modes. However, in order to optimize the impact of the FCAL-II, an evolved proposal should be formulated that demonstrates the physics reach of the new device when operated in parallel with the approved GlueX program.

PR12-14-005

Scientific Rating: B

Recommendation: Approve

Title: **Wide angle exclusive photo production of π0 mesons**

Spokespersons: D. Dutta, H. Gao, S. Sirca, M. Amaryan, M. Kunkel, I. Strakovsky

Motivation: This proposal aims to measure the differential cross-section of the γ p —> π^0 p process in the energy range 10 GeV^2 < s < 20 GeV^2 at large pion center of mass angles between 55° and 105°. The measurement will be carried out in Hall C using an electron beam impinging on a 6% copper radiator and a liquid hydrogen target. The recoil proton will be detected in the HMS spectrometer and photons from the π^0 —> γ γ decay will be detected in the Neutral Particle Spectrometer, which is under construction.

Measurement and Feasibility: The energy range and the scattering angles are large enough to allow the description of the process in terms of partonic interactions and the exploration of the elementary mechanism at work. The data will extend studies of the scaling behavior of the cross-section and allow for comparisons to handbag calculations — which severely under-predict existing cross sections — at higher energies than previously measured. The expected results could spur further theoretical development and test the limits of the Generalized Parton Distribution formalism for exclusive reactions. The case was also made that a reliable measurement could be made detecting either single photons from the π^0 decay or reconstructing the pion by detecting both photons.

Issues: There are no major technical issues. Theoretically, the interpretation of hard-exclusive meson production in terms of the handbag diagram and GPD formalism is inevitably more complicated than for hard-exclusive photon production. The PAC applauds the experimenters for designing their π^0 experiment to run in concert with the WACS proposal PR12-14-003, but must assign higher priority to the latter experiment.

Recommendation: **Approved for 18 days** to run in parallel with PR12-14-003
While the proposed measurements are of modest physics impact, most of the data can be taken in parallel with PR12-14-003. The PAC recommends that this experiment run entirely in parallel with PR12-14-003 and thus approves 18 days out of the requested 20.

PR12-14-006

Scientific Rating: B

Recommendation: Approve

Title: Initial State Helicity Correlation in Wide-angle Compton scattering

Spokespersons: D. Day, D. Keller, J. Zhang

Motivation: The aim of this experiment is a study of the reaction mechanism of the simple exclusive wide-angle Compton Scattering (WACS) reaction. Previous JLab polarization transfer data have shown a clear indication for a partonic mechanism in the WACS process. The target polarization observable A_{LL} proposed would complement the pioneering measurement of the recoil observable K_{LL}. In the simplest picture where the Compton process takes place on a single massless quark, both observables are equal. The difference between the observables is indicative of the scale at which one approaches the leading order partonic mechanism for WACS. Any difference between the polarization observables K_{LL} and A_{LL} will allow to study the size of power-suppressed corrections to WACS, e.g. due to quark mass effects in a constituent quark model framework for such power corrections.

Measurement and Feasibility: The proposed measurement is located in Hall C and uses an untagged polarized bremsstrahlung photon beam from the 4.4 GeV e- beam. It requires the polarized NH3 target, the NPS (in a non-standard mounting) for the photon detection and the HMS spectrometer for the recoil proton detection. Three angle settings are proposed for the measurement of the A_{LL} helicity correlation in the exclusive WACS reaction. Although this experiment is complementary to the cross section measurement of the WACS reaction (PR-12-14-003 using 11 GeV e beam), it is proposed to run using a 4.4 GeV e- beam. Indeed in presence of the polarized target, the maximum acceptable luminosity is ~ 10^{-3} times smaller, preventing a measurement at the maximum beam energy of 11 GeV, where counting rates drop.

Issues: Substantial rework of the target area is needed. Further measurement at higher energy would be more valuable but cannot be achieved with the present setup.

Recommendation: Approve for 15 days
The PAC feels that a measurement at two angles (instead of three) is enough to achieve the physics goal. Both angles should be chosen to be as close as possible to both existing K_{LL} measurements (the published result from E99-114 and the upcoming result from E07-002) in order to make the best possible comparison between A_{LL} and K_{LL}. As this essentially amounts to removing the 90º central angle from the proposed set of data points, the PAC recommends 15 days of beam time.

PR12-14-007

Scientific Rating:

Recommendation: Defer

Title: **The EMC PVDIS Experiment: A Constraint on Isovector Dependent Nuclear Modification Effects Using Parity-Violating Deep Inelastic Scattering**

Spokesperson: Seamus Riordan, Rakitha Beminiwattha

Motivation: The proposed experiment would measure parity violating deep inelastic scattering (PVDIS) on ^{48}Ca using SoLID in HallA, using 69 days of beam time at 11 GeV (and two days at 4.4 GeV). The primary scientific goal is to identify nuclear medium modifications to the difference between u(x) in the proton and d(x) in the neutron. Small "charge symmetry violating" effects should be present (and may be discovered using PVDIS on deuterium in a separate experiment) but larger induced charge symmetry violation effects may arise in the nuclear medium. Furthermore, the proposed measurement will inform potential explanations of the NuTeV anomaly.

Measurement and Feasibility: SoLID would be used in a configuration "practically identical" (as written on a presentation slide) to that in the approved deuterium PVDIS experiment E12-10-007, with the LD2 target replaced with a 12% R.L. ^{48}Ca target encased in an evacuated tube. The range $0.2 \leq x \leq 0.8$ will be covered (for $Q^2 > 2\text{GeV}^2$) including ≈1% statistical uncertainty for $x \leq 0.7$. Per-bin systematic uncertainties are expected to be smaller than this. The parity violating asymmetries are orders of magnitude larger than those already measured by other PV experiments at JLab. The proposed measurement will be sufficient to distinguish between various models that would give rise to the medium modifications under investigation. A modified version of the plot on slide 15, using data points from Figure 31 in the proposal, was provided to us, to clarify the sensitivity relative to one representative model calculation.

The collaboration is well prepared to proceed with this experiment, along with the rest of the experimental program in SoLID. The encased ^{48}Ca target technology is well known to these collaborators. The target will experience significant heating in the 80μA beam, and the TAC questioned the calculations that give a 100°C temperature rise, but the collaboration has since demonstrated how those calculations were in fact conservative. The TAC also asked about background calculations, including neutron flux and its effect on the superconducting magnet, and these also seem to be well under control.

There is considerable theoretical support for this proposal, and the collaboration is essentially the same group of people who have developed SoLID for Parity Violation experiments. Finally, the spokespersons of E12-10-008, "A series of measurements of the EMC effect on a range of light nuclei" (including ^{40}Ca and ^{48}Ca), commented on the complementarity of these two independent measurements of nuclear medium modifications of the fundamental quark distributions.

Issues: Instantaneous and yearly-integrated radiation limits might both be reached with a 12% R.L., high Z target. It is not clear to what extent the solenoid itself would provide the necessary shielding to avoid this, or if other measures would need to be taken. It will have to be demonstrated to the laboratory that these critical levels would not be reached before the experiment could be scheduled.

Sensitivity to induced charged symmetry breaking, however, is not unique to this proposal within the JLab program. The spokespersons of experiment E12-10-008 commented that "assuming no flavor dependence, the difference between ^{40}Ca and ^{48}Ca should be less than the percent level if one assumes the SLAC E139 A-dependent parameterization for the EMC effect. However, the CBT model predicts up to a 4% effect on ^{48}Ca compared to ^{40}Ca for x_{Bj} below 0.7. E12-10-008 will be able test this prediction with approximately 60 hours of production data on both ^{40}Ca and ^{48}Ca targets (without counting overheads) with a proposed 1% statistical and random systematic uncertainty along with the ~1.4% relative

normalization uncertainty between the targets." In other words, effects the size of CBT might in fact be observable with this far less challenging experiment, although not at the same level of precision as proposed by the SoLID collaboration. The PAC concluded that if the E12-10-008 collaboration focused on a high statistics measurement of the $^{48}Ca/^{40}Ca$ ratio, including taking advantage of the x-dependence, then it could be possible to test the Cloet (and similar) models with reasonable precision.

Recommendation: **Defer**
The PAC commends the PR12-14-007 collaboration for a novel and well-developed proposal. However, E12-10-008 will likely be able to access the same physics, albeit with somewhat less precision, on an earlier time scale and with fewer resources. The PAC thus felt that the proposal should be deferred at this time.

PR12-14-008

Scientific Rating:

Recommendation: Defer

Title: **Measurements of Semi-Inclusive DIS Double-Spin Asymmetries on a Longitudinally Polarized 3He Target**

Spokespersons: X. Jiang, A. J. R. Puckett, N. Liyanage

Motivation: The main goal of this proposal is to study the longitudinal spin structure of the neutron by measuring the longitudinal double-spin asymmetry A_1^h for identified pions and kaons produced from a polarized ^{3}He target. The measurements would allow the extraction of helicity PDFs and, in particular, Δd and $\Delta \bar{d}$ with small statistical uncertainties in a three dimensional grid (x,Q^2,z) in the range $0.2 < x < 0.7$, $3 < Q^2 < 11$ GeV^2, $0.2 < z < 0.8$, with $W > 2$ GeV. The measurements of identified hadron yields in the same kinematical range with the same acceptance for positive and negative hadrons will allow high precision multiplicity measurements, which are needed to test the factorized, QCD-based description of semi-inclusive hadron production at intermediate energies.

Measurement and Feasibility: The experiment proposes to use the same experimental apparatus (BigBite and Super BigBite spectrometers in Hall A, and the high luminosity ^{3}He polarized target) that is under construction for experiment E12-09-018 (approved by PAC38 with rating A-) to measure transverse spin asymmetries. The proponents are members of that collaboration. The proposed technique is similar, using 8.8 and 11 GeV beams to enlarge the Q^2 range and spectrometer positions optimized for the largest Q^2 values. The magnet current in the SBS will be reversed regularly to assure the same acceptance for positive and negative hadrons. "Calibration" data with unpolarized targets will also be collected to measure multiplicities. The technical issues that require R&D — the novel detector performance, background and trigger rates, as well as operation of the new ^{3}He high luminosity target — are the same as for experiment E12-09-018.

Issues: The committee took note of the complementarity in the Q^2 range and experimental technique with the SOLID experiment, as well as the advantage of using a ^{3}He target versus the ND_3 target that will be used in CLAS12. However, the collaboration did not make the case that it could do substantially better than these already approved experiments. The PAC notes in particular that the proposal focuses on a comparison with SOLID and did not provide an accurate comparison with CLAS. The CLAS longitudinal-spin program is likely to run either concurrently with or before this proposal and provides very similar advantages: sensitivity to the neutron (with its ND_3 and NH_3 targets), kaon identification, and a similar phase space that also extends to high Q^2. CLAS' open geometry also offers the additional advantage of larger coverage in azimuthal angle, and its larger acceptance largely (if not entirely) offsets the higher luminosity of this proposal. The PAC also stresses that the collaboration should follow the agreement within the JLab SIDIS community to refrain from presenting 1D projections of extracted $\Delta q(x)$ results. First, without new data in the challenging W-range of JLAB12, no reasonable systematic error can be estimated on these extractions. Second, such plots provide a grossly misleading measure of an experiment's capabilities, both because of their inevitable lack of systematic errors and because of the absence of such plots in competing proposals. One such plot did appear in an update document submitted to PAC38 by CLAS E12-09-007, and as expected, it displays the same minuscule statistical uncertainties (with more bins) as the projections shown in this proposal.

Recommendation: Defer

PR12-14-009

Scientific Rating: A

Recommendation: Approve

Title: Ratio of the electric form factor in the mirror nuclei ^{3}He and ^{3}H

Spokespersons: L.S. Myers, D.W. Higinbotham, J.R. Arrington

Motivation: This proposal intends to measure the ratio of electric form factors of ^{3}He and ^{3}H at low Q^2 (0.05 to 0.09 GeV^2) and extract the difference of their charge radii. This will give valuable input for comparison with recent chiral effective theory (χEFT) calculations and Green's Function Monte Carlo (GFMC) simulations, which are about an order of magnitude more precise than the existing data.

Measurement and Feasibility: The collaboration proposes to carry out this experiment in Hall A, taking advantage of the unique one-time availability of the ^{3}H target at JLab. The experiment will use the left HRS spectrometer at two forward scattering angles (12.5^o and 15^o) and a 1.1 GeV electron beam of 5 μA. Only minor modifications compared to the approved MARATHON setup are required. From the cross section ratio measured with a total uncertainty of 2% the difference of the charge radii can be extracted with a factor of about 5 smaller uncertainty than the existing data. The experiment is feasible and only requires 1.5 PAC days.

Issues: Apart from the radii difference it is highly desirable to measure the absolute individual radii as precisely as possible: this could provide an important normalization for atomic isotope shift measurements and also resolve the difference between the experimental results from Bates and Saclay. (Both the ^{3}H and ^{3}He radii obtained from the Bates experiment are about 0.1 fm smaller than the Saclay results.) This goal, however, is hampered by the limited Q^2 range of the proposed measurement, with the lower value of 0.05 GeV^2 constrained by the smallest possible spectrometer angle. The PAC therefore suggests that the proponents investigate the possibility that a calorimeter at smaller angles might enlarge the Q^2 coverage and lead to improved absolute individual radii.

Recommendation: Approve
The proposed measurement only needs 1.5 PAC days for data taking on H, D, ^{3}H, ^{3}He, C, and empty target. The PAC feels that this is an important experiment which has to be done and recommends approval.

PR12-14-010

Scientific Rating:

Recommendation: Defer

Title: **Measurement of Tagged Deep Inelastic Scattering (TDIS)**

Spokespersons: C. Keppel, P. King, D. Dutta, J. Annand, B. Wojtsekhowski, J. Zhang

Motivation: This proposal aims to investigate tagged deep inelastic scattering by measuring electron scattering at high W^2 and high Q^2 from hydrogen and deuterium targets in coincidence with low momentum recoiling protons. The main goal is to measure hadron production in the target fragmentation region, and thus gain information on so-called fracture functions. By extrapolating the measurements to low values of t, this proposal aims to access the pion structure function via the Sullivan process.

Measurement and Feasibility: The measurement is proposed for Hall A. It will use a nitrogen cooled hydrogen gas target at 1 atm in a 40 cm long, 10 mm diameter aluminum tube, which is technically challenging. A new radial TPC will need to be developed that is similar to that used in BONUS. The experimenters request a total of 23 days at 11 GeV and 4.4 GeV.

Issues: The TAC report voiced several technical concerns. The main concern is the high rate of accidental coincidence background, and wonders whether the pion rejection is sufficient in the RICH. There were several concerns regarding the radial TCP and it is pointed out that the very thin-wall target is technically challenging. While no show-stoppers were identified by the PAC, substantial progress with regards to RTCP and target development needs to be made to move forward.

The committee expresses enthusiasm towards the possibility of measuring the pion structure function, but is not persuaded by the fracture function physics presented. First, the universality of these objects is highly unclear. As they include PDF, fragmentation, *and* target-remnant effects in their very definition, they can only be applied to processes with the same target and beam; any experiment that needs information about target-remnant effects will measure the needed multiplicities itself. Second, this experiment focuses on a very special semi-inclusive channel – final-state nucleon detection – that is specific to this experiment. The committee feels that the importance of this aspect of experiment to the JLab SIDIS program is overstated and finds no support for the claim that this experiment may prove critical to a large number of approved JLab experiments.

Recommendation: Defer
The committee recommends that the proponents build a stronger physics case that is focused on the pion structure function measurement. The PAC particularly urges the proponents to clarify if a clear signature of the Sullivan process can be identified. This task is challenging indeed. At the H1 and ZEUS experiments cited in the proposal, the only support that scattering from pions was dominant within cuts came from model-dependent simulations and from the measurement of Regge-trajectory slopes via t- and z-dependences. (The lower JLab energies might provide an advantage: e.g. the highest-z region above 0.95 had to be excluded at HERA to avoid the dominant Pomeron-exchange channel, a concern that is likely irrelevant at JLab.) A resubmission of this proposal should address this challenge and clarify the strategy that the experiment will use to interpret its results in terms of the pion form factor.

PR12-14-011

Scientific Rating: B+

Recommendation: Approve

Title: **Proton and Neutron Momentum Distributions in A = 3 Asymmetric Nuclei**

Spokespersons: Lawrence Weinstein, Or Hen, Shalev Gilad, Werner Boeglin

Motivation: The goal is to use the MARATHON tritium target to measure the quasi-elastic reaction ^{3}H(e,e'p) along with the corresponding reaction with the mirror nucleus ^{3}He(e,e'p) at Q^2 = 2 GeV^2 and x = 1.2 Forming the cross-section ratio (to cancel final-state interaction effects) as a function of missing momentum will inform about the proton momentum distributions in the two nuclei, and by charge symmetry one obtains the proton and neutron momentum distributions in either nucleus. This will be the first measurement of any nuclear momentum distribution at the few % level and will provide the first direct test of the theory calculations.

Measurement and Feasibility: The experiment is proposed to run in Hall A using standard equipment. It will be performed at relatively low luminosity, implying that backgrounds and other rate-related effects are deemed negligible. There do not appear to be any experimental issues that cannot be dealt with in a straightforward way.

The proposal was considered by PAC 40 (as PR12-13-012) and deferred. The PAC recommended to refocus the proposal and to strengthen the physics case. The resubmission removed the deuteron part of the proposal and emphasizes the inversion of the momentum distribution from the majority to the minority nucleon. After recent results by CLAS (submitted to Science) confirmed the importance of short-range correlations (SRC) also in asymmetric nuclei, the focus is now to develop a better understanding of the SRC. In this context this is an important measurement that will form the basis for the understanding of other data and for model comparisons, since A = 3 nuclei are calculable in many models based on fundamental two- and three-nucleon interactions. In the longer term the successful models may help for the understanding of the NuTeV anomaly, may inform about the density-dependence of the nuclear symmetry-energy up to supra-nuclear densities (neutron stars), and may serve in facilitating the precision requirements of the next generation of neutrino-oscillation experiments.

Recommendation: **Approve for 12 days with a beam current of 20 μA** (rather than the requested 10 days at 25 μA indicated in the written proposal).

PR12-14-012

Scientific Rating: A-

Recommendation: Approve

Title: **Measurement of the Spectral Function of ^{40}Ar through the (e,e′p) reaction**

Spokespersons: O. Benhar, C. Mariani, C.-M. Jen, D.B. Day, D. Higinbotham

Motivation: This experiment is motivated by the need to model the response of liquid Argon detectors to neutrino beams. This information is important for the LBNF program (and other oscillation experiments) that use liquid Ar. The critical issue is that reconstruction of the neutrino energy depends on the spectral functions of neutrons and protons in ^{40}Ar. The neutrino beam has an energy spread and hence the neutrino flux as a function of energy has to be extracted by simulations that include the correct nuclear physics. A challenge is that the next generation of neutrino oscillation experiments aim at a precision of 1% and hence ensuring that the nuclear corrections are properly addressed is critical. This data will provide experimental input to construct the argon spectral function, thus allowing the most reliable estimate of the neutrino cross sections. In addition, the analysis of the (e,e′p) data will help a number of theoretical developments, such as the description of final-state interactions needed to isolate the initial-state contributions to the observed single-particle peaks, that is also needed for the interpretation of the signal detected in neutrino experiments.

This experiment has significant support from the neutrino community. Letters of support for this proposal were received from the Fermilab management, and spokespeople from LBNE, ArgoNeuT, Captain, LArIAT, and MicroBooNE. The analysis and simulation groups of these experiments will use these data.

Measurement and Feasibility: The experimenters propose a measurement of the (e, e′p) cross section on argon. Kinematics will be chosen to scan the missing energy domain extending from $E_m \sim 8$ MeV to $E_m \sim 60$ MeV, using the Hall A HRS spectrometers. Similar (e,e'p) experiments have been performed at JLAB and hence this measurement should be straightforward. Kinematical conditions corresponding to interactions with protons moving parallel to the incoming electron beam will be selected to minimize the final state interactions. To test the final-state interaction corrections, and inform such corrections needed for neutrino interactions, the experimenters also propose to measure two days in anti-parallel kinematics where final state interactions should be largest.

Issues: The proposal did not describe how the precision of the proposed experiment would translate into a precision in neutrino oscillation experiments. Given the uncertainty in correction for final-state interactions, it is likely that the systematic errors will be larger than the quoted 3%. However we anticipate that larger errors are likely to be acceptable. The energy resolution will also be larger than the quoted value, but again this appears to be acceptable. The PAC also noted that for anti-neutrino experiments the spectral functions of the neutrons are also important, but this experiment will only determine the proton spectral functions. An appropriate model will be needed to infer neutron spectral functions from the proton data taken in this experiment.

Recommendation: Approve for the requested 9 days of beam time.

C12-12-002

Scientific Rating: A

Recommendation: Approve

Title: **A study of decays to strange final states with GlueX in Hall D using components of the BaBar DIRC**

Spokesperson: Curtis Meyer

Motivation: This proposal is an extension of the already approved GlueX experiments on meson spectroscopy. For the proposed running, the detector system will be crucially extended by adding a forward Cherenkov particle identification system to enable especially kaon identification at high momenta (3σ K/π separation up to ~ 4 GeV/c). Without such a system the GlueX program cannot be successfully pursued without severe restrictions. Therefore, PAC 40 strongly encouraged the GlueX collaboration to move forward with the design of such a system and aim at an early installation. The mapping of the spectrum of conventional and exotic hadrons will ultimately require the implementation of a dedicated particle ID system in the forward direction. Kaon identification is essential for resolving the flavor composition of meson states and is needed to allow for a systematic (coupled channel) amplitude analysis of many different hadronic final states to be really able to map out the spectrum of hybrid as well as of conventional mesons (addressing e.g. whole exotic multiplets and not only a single state). The planned investigation of cascade baryons will also profit from the new detector capabilities. The proposal was already given conditional approval in PAC39, conditional on the final design of the particle ID system.

Measurement and Feasibility:
The second stage (named stage IV) of the experiment was approved by PAC40 as E12-13-003 (200 days at an average intensity of 5×10^7 tagged photons/s on target), including the implementation of a level-three trigger based on a new computing farm. This running will provide an increase in statistics by a factor 10 over the initial GlueX running. The collaboration showed that this increase in statistics, coupled with a sophisticated multivariate analysis, allows the production of 10^4 events per 10 MeV/c^2 mass bin while keeping the background contamination within 10%. The PAC40 proposal was based on the baseline GlueX setup only.

With the present proposal, a design of a Cherenkov PID detector for Hall D is put forward, as requested by PAC39 and again strongly encouraged by PAC40. The design is based on the BaBar DIRC bars, which are available to the collaboration. Including the independent DIRC information into the multivariate analysis provides a high discrimination power and significantly improves the purity of the data samples, and therefore their sensitivity on the contributing amplitudes. Purities of 90% reached in simulations without the DIRC can now be pushed to 99% for several final states and to better than 95% in nearly every case. The latter increase would lead to a sensitivity increase of a factor of 2, the former to a factor of 9, which is a large step forward toward a better understanding of the hadron spectrum.

Issues: The design is viable but R&D is still required. It needs to be decided whether the DIRC can be mounted vertically and whether the new technology of micro-channel plates is usable for light detection or whether the more conservative and more expensive solution of multi-anode PMTs needs to be chosen.

The PAC strongly encourages the GlueX-collaboration to work with the JLab Physics Division for an optimization of the FDIRC-readout and the time schedule.

Recommendation: **Approve**
GlueX is the flagship experiment in Hall D; the physics motivation for the proposed running is very sound. The motivation for the hardware extension is very obvious to reach the physics goals of the experiment and is strongly supported by the PAC.

The PAC recommends approval with the full allocation of the requested 220 days and urges the laboratory and the collaboration to maximize the overlap of these 220 days with the already approved beam time of experiment E12-13-003.

Letters of Intent

LOI-12-14-001

Title: **Search for Exotic Gluonic States in the Nucleus**

Spokespersons: J.Maxwell

Motivation: 25 years ago the existence of a double helicity flip structure function $\Delta(x,Q^2)$ was predicted. The structure function is expected to be sensitive to the gluonic components in the target and vanishes for a bound state just of protons and neutrons ("nuclear gluonometry"). The interest of this LOI is to understand to what extent a nucleus is more than a collection of nucleons and whether there might be even some novel gluonic components in nuclei not found in individual nucleons.

Measurement and Feasibility: Δ can be accessed with an unpolarized electron beam and a transversely polarized nuclear target with spin ≥ 1, measuring a tensor asymmetry. The experiment is planned for Hall C in the low x-regime (<0.3).

Issues: The question of how large Δ is and how sensitive an according measurement might be is a crucial open question. At the level of the LOI, how well one will be able to measure this quantity remains an open question. Detailed calculations of Δ e.g. from lattice calculations are needed.

In addition to gluonic components in the nucleus, also rho and Δ-components (and two or more nucleon correlations with spin ≥ 1) would lead to a non-zero-Δ. How can those contributions be separated from a possible gluonic component? The sensitivity of an according experiment to gluonic components in the nucleus needs to be demonstrated in a full proposal.

The target is a further challenge: Even though successful experiments at JLab and SLAC have shown that the JLab/UVa solid targets provide a dependable solution, further R&D is needed to provide high values for the tensor polarization (of nitrogen) and to be able to measure the polarization during the experiment.

Of course many additional experimental issues need to be addressed and discussed in detail in a full proposal. One of those is how the systematics will be controlled (changes in the detector efficiencies over time, unmeasured drifts in luminosity) since one is aiming at a measurement of a presumably quite small asymmetry. Another issue is the study of possible background sources to the asymmetry.

Recommendation: This LOI presents an interesting idea. For a full proposal the issues above need to be addressed in detail. To do so requires not only significant work on the experimental side but also on the theory side.

LOI-12-14-002

Title: Tensor Asymmetry Azz in the x>1 Region

Spokespersons: E. Long, K. Slifer, P. Solvignon, D. Day, D. Keller, D. Higinbotham,

Motivation: This Letter of Intent is to express interest in measurement of the tensor asymmetry A_{zz} in electron scattering on tensor-polarized deuterium in the quasi-elastic region for $0.8 < x_b < 1.75$. The tensor asymmetry A_{zz} is sensitive to the short-range part of the NN interaction and the deuteron wave function. The combination of the selected kinematic range and sensitivity to tensor interactions will explore the short-range nature of the NN interaction. One of the specific aims is to determine the S/D-wave ratio in the deuteron wave function at large relative momenta k > 300 MeV. In addition, the tensor asymmetries at large recoil momenta will serve as a sensitive test of "relativistic effects" in the treatment of deuteron structure, which are an important aspect of the overall theoretical framework. The letter cites recent calculations by M. Sargsian for A_{zz} in the $x > 1$ range using virtual-nucleon and light-cone methods. These approaches show significant differences that can be discriminated experimentally at the $3 – 6\ \sigma$ level. The letter also describes interest from several theoretical groups with interest on making tests of short-range NN interactions.

Measurement and Feasibility: Electron scattering off tensor-polarized deuterium would be measured in the quasi-elastic region using the Hall C HMS and SHMS spectrometers. This proposal would use the same setup as the C1-approved experiment E12-13-011, which is to measure the deuteron tensor structure function b1. The C1-approval is subject to demonstration that 35% tensor polarization is possible. The expected asymmetry is larger in the case of this measurement, but we anticipate that a similar requirement would apply. It is anticipated that a full proposal would be for 39 days, which would include 30 days for three different Q^2 values and 9.1 additional days of overhead.

I**ssues:** A significant amount of beam time will be required for this measurement. A full proposal will need a detail discussion of expected systematic and statistical errors similar to what is in the letter that carefully justifies the requested time. The proposal should also demonstrate what sensitivity they will have to NN interaction models, such as the 6-quark model, final state interaction models, and NN interaction models, mentioned in the proposal. It will also be important to discuss how the results will distinguish between effects from the NN-interaction, the treatment of these interactions at high virtuality, and the intrinsic deuteron wave function.

Recommendation: Proceed to proposal addressing the issues noted above.

LOI-12-14-003

Title: **Studies of Chiral-Odd GPDs in Hard Exclusive Pseudoscalar Meson Production Using the CLAS12 Detector**

Spokespersons: Andrey Kim

Motivation: The primary aim of this Letter of Intent is to study the reaction mechanism in hard exclusive production of π^0, η, $K^+\Lambda$, $K^+\Sigma^0$ on a proton.

Measurement and Feasibility: The experiment will use an 11 GeV highly polarized electron beam, unpolarized hydrogen and polarized NH_3 targets, and the CLAS12 detector including the RICH. As the CLAS12 resolution is not good enough to separate $K^+\Lambda$ and $K^+\Sigma^0$ channels, it is proposed to completely identify the Λ by detecting the p and π^- decay products, using both inbounding and out bounding field configurations of CLAS. The proponents request no extra beam time but can run concurrently within the unpolarized and longitudinally polarized run groups in Hall B/ CLAS12.

Issues: The interpretation of the channels presented in this LOI is performed within the handbag model, involving chiral-odd generalized parton distributions. As a factorization theorem for meson production only exists for the longitudinal photon cross section, this is therefore an interesting exploratory study how to interpret the large transverse photon cross section in a partonic framework. Prior to a factorization demonstration in meson production, the interpretation of these results will necessarily involve model dependence. It will however be interesting to see – in particular in the strangeness sector – how the partonic matrix elements involving nucleons and hyperons are related using SU(3) relations.

Recommendation: As this LOI proposes an analysis that can be done concurrently with the unpolarized and longitudinally polarized run groups in Hall B/ CLAS12, the PAC identifies this experiment as a clear candidate for a CLAS12 run group proposal. The authors should therefore submit this proposal to the CLAS12 collaboration.

LOI-12-14-004

Title: Medium modification of hadronic distributions in SIDIS

Spokespersons: H. Avakian

Motivation: The goal of the LOI is to explore nuclear modifications in spin-dependent and spin-independent SIDIS.

Measurement and Feasibility: LOI-12-14-004 is a proposal to measure the SIDIS hadron distributions in tandem with the unpolarized approved experiment E12-06-117 on a series of nuclear targets and to potentially perform spin-dependent studies concurrently with the EMC effect proposal (PR12-14-001) where the targets would be polarized ^{6}LiH and ^{7}LiD.

The proposed measurements are the A-dependent ratio of the single spin azimuthal asymmetries $\langle \sin \phi \rangle$, the hadron multiplicities and the double-spin asymmetries as a function of x_{Bj}, z and p_T.

The spin-independent ratios are already proposed in E12-06-117 although with a somewhat less well developed formalism. The spin azimuthal asymmetry measurement is new but can run as part of the existing run group.

Issues: The polarized target measurements will suffer from very significant dilution. Given the 2-4% statistical and systematic uncertainties projected for the cross section ratio as a function of x_{Bj} alone, it is not obvious without detailed simulation that significant effects can be measured in multiple kinematic dimensions. The PAC is also concerned about the interpretation of the proposed data, as it would appear very difficult to disentangle nuclear-modification effects in final-state hadron production from those in the initial-state PDFs or TMDs.

Recommendation: This proposal would be more appropriately reviewed as a member of the existing and proposed run groups.

LOI-12-14-005

Title: **Investigating neutral meson-nuclei bound states with coherent electroproduction of η and Φ mesons off 4He in Hall-C**

Spokespersons: M. Paolone, Z.-E. Meziani

Motivation: The purpose of the LOI is to explore the possible existence of η- and ϕ-^{4}He-nucleus bound states. Since neutral mesons are considered they must be bound via the strong interaction. While a previous JLab-experiment investigating ϕ-D bound states was inconclusive, an experiment performed at MAMI searching for η-^{3}He bound states gave first hints that such states might exist. Such bound states have been predicted by theory. The theoretical mechanisms however leading to such states are very different; nuclear scattering potentials with mesonic degrees of freedom are e.g. used on the one hand, QCD van der Waals type potentials with purely gluonic (pomeron or multi-gluon) exchanges on the other hand.

Measurement and Feasibility: The experiment will use an electron beam to coherently produce the mesons of the ^{4}He-target. To maximize any potential binding the kinematics of the experiment (measuring the electron and the ^{4}He in coincidence) is set such that within acceptance the produced meson and the recoiling nuclei travel in the same direction with about the same velocity. This is an interesting idea, and overcomes the problem of mesons being too fast in the nuclei to really produce a bound state.

The experiment is intended to take place in Hall C. Three reactions will be investigated using an electron beam at specifically chosen kinematics: the coherent production of eta-, and phi-mesons and electron-^{4}He-elastic scattering (to understand the systematic uncertainties).

Issues: The experiment will run at rather high rates. At the present stage of the LOI, it remains unclear how far background can be suppressed (accidental coincidence rates) and what influence existing background in general will have on the extraction of the signal.

To deal with the high rates (high tracking inefficiencies) a possible upgrade - replacing the SHMS drift chambers by GEM planes - is mentioned in the LOI. A full proposal must either propose a concrete hardware configuration or clarify how this problem will be solved.

It remains unclear whether – if yes, how – physical quantities like the binding energy and the width of the possible bound state can be extracted from the experimental information. Can these quantities be extracted independently? What sensitivity to different theoretical approaches will be achieved?

Recommendation: The LOI includes the quite interesting proposal to electro-produce η and ϕ mesons of ^{4}He at kinematics where the meson and the ^{4}He are moving in the same direction with small relative velocity. This maximizes the chances for producing a bound state. The PAC encourages the preparation of an according proposal. The proposal needs to address the issues raised above.

LOI-12-14-006

Title: **Dark matter search in a Beam-Dump eXperiment (BDX) at Jefferson Lab**

Spokespersons: M. Battaglieri, A. Celentano, R. De Vita, E. Izguirre, G. Krnjaic, E. Smith, S. Stepanyan

Comments: The experimental sensitivity is based on models where a "dark photon" A′ couples to e^+e^- and to "dark fermions" $\chi^-\chi$. Unlike searches for A′ → e^+e^-, BDX involves only one "anomalous" coupling of A′ to e^+e^-. This collaboration would search for χ or χ^- directly, however, which implies another "anomalous" coupling of the χ to ordinary matter. Sensitivities depend on the various couplings involved, as well as the masses of A′ and χ.

BDX searches for χ signals downstream of a CEBAF beam dump. A design criterion is that the detector be sensitive to signals both from χ-e^- scattering (giving GeV scale electrons) or χ-nucleon scattering (MeV scale protons). This is an ambitious goal, and it is important that sensitivity in one mode not be compromised in order to meet the other.

Potential detector design options should be laid out in a full proposal, along with the selection criteria that lead to the proposed design. At the moment, the collaboration is leaning towards a segmented plastic scintillator volume similar to the prototype CORMORINO detector, as described in NIM A696 (2012) 110. Given some way to detect directionality, GeV electron signals should be clear, but proton recoil signals will be more difficult. Pulse shape discrimination might be considered, if liquid scintillators are an option, although this only makes sense if cosmic ray and beam-related neutrons are negligible.

The collaboration needs to gather data from CORMORINO before proceeding with a full proposal, in order to demonstrate background sensitivity in a detector based on that concept. This should probably include plans to use CORMORINO in a shielding environment similar to what would be encountered at JLab. Results should be compared to simulations.

Other helpful components of a full proposal would include some explicit listing of what makes this experiment superior to previous beam dump experiments, and by how much. Examples might include anticipated integrated luminosity, modern data acquisition and analysis techniques, and options for changing directional shielding to demonstrate that a beam-related signal is not from neutrons produced at the beam dump.

The site should be determined soon, working closely with the Laboratory management. Hall A is probably the optimum site from the point of view of the physics, since it affords the highest luminosity at high energy over several years. Although Hall D was originally considered, it seems that the integrated luminosity there, over a long run, would be at least an order of magnitude smaller. On the other hand, mounting the experiment behind Hall A entails much higher infrastructure costs, requiring that a pit be dug and services brought to it. Mounting the experiment behind Hall C appears impractical because of the site boundary.

Summary and Recommendation: BDX could become the definitive beam dump experiment at electron accelerators. Sited at Jefferson Lab, it would use the CEBAF high intensity beam and modern technologies for detector design, trigger, and data acquisition, to achieve the most stringent limits (or to make the first discovery) of a class of dark matter particles.

The collaboration is encouraged to proceed with a full proposal to the laboratory, but the PAC emphasizes that the collaboration needs to meet a high standard in order to be eventually approved. Experimentally, a fully fleshed-out detector design needs to be presented, including both simulations and measurements (with CORMORINO or otherwise) that demonstrate its sensitivity to both detection channels as well as its ability to reject cosmic ray backgrounds with whatever necessary overburden. Theoretically, it must be made clear what models and attendant assumptions motivate this particular measurement, as well as the extent to which these models are (or are not) addressed in other experiments at other laboratories. Finally, the PAC realizes that the infrastructure costs to build and instrument a pit that would house this experiment will be extensive, and recommends that the laboratory require an approved proposal before scheduling onsite tests with beam as part of the design process.

Finally, we comment that BDX would obviously benefit from a low duty factor beam, as opposed to that provided by CEBAF, if a suitable high energy, high intensity accelerator could be identified.

Run Group Proposals

E12-06-108A

Title: **Exclusive N* → KY Studies with CLAS12**

Spokespersons: Daniel Carman, Ralf Gothe, and Victor Mokeev

Motivation: This proposal aims to extract the p(e,e'K)Λ and p(e,e'K)Σ cross sections for $1.6 \leq W \leq 3$ GeV and for $4 \leq Q^2 \leq 12$ GeV^2. The primary goal is to extract information on N* states that decay to KY final states, suitable for inclusion into analyses of excited baryons. New information will be gained on the electro-coupling parameters for known states, and possible evidence for previously unknown or poorly known excited nucleons.

Measurement and Feasibility: CLAS12 is well suited to these measurements, and the data will be extracted concurrently with running of the already approved experimental program in Hall B.

Issues: none

Summary: This analysis constitutes an important "must-do" part of the CLAS12 N* program, adding the use of the CLAS12 RICH to the already approved program.

E12-06-112A / E12-09-008A

Title: Semi-Inclusive Lambda Electroproduction in the Target Fragmentation Region

Spokespersons: M. Mirazita, J. Phillips, H. Avakian

Motivation: This proposal aims to use data taken with the CLAS12 detector in Hall B on an unpolarized target to measure Lambda production, with emphasis on the target-fragmentation region and on spin-transfer to the Lambda from the beam (the observable D_{LL}).

Measurement and Feasibility: This proposal runs in parallel with the approved E12-06-112 and E12-09-008 experiments and does not require additional hardware or beam time. It builds on earlier measurements made with CLAS at 6 GeV but will have substantially higher statistics and a somewhat better kinematic regime for separating the target and fragmentation regions.

The Lambda polarization should be measurable with significant precision, allowing much better measurements of possible longitudinal spin-transfer than presently exist. In addition, the differential Lambda production rate as a function of x_{Bj}, Q^2 and z can be measured with good statistical power and from these measurements a Lambda fracture function can be derived.

Issues: As with all near-term measurements in the poorly explored target-fragmentation region, this analysis will be exploratory in nature. The proposed interpretation of D_{LL} in terms of Δs in the nucleon will be subject to considerable systematic uncertainties: first from the Lambda production mechanism (e.g. contributions from the decay of the $\Sigma+$, whose up quarks are strongly polarized), and second from the spin structure of the Lambda itself. As noted in prior analyses of D_{LL}-to-Λ (e.g. at OPAL and HERMES), the approximation that the strange quark carries all of the Λ's spin is only true in the naïve constituent quark model. Other models, such as SU(3)-flavor rotation of the proton's spin content, indicate significant polarization of the u quarks in the Λ, and so any participation of struck u quarks from the target will also contribute to D_{LL}. However, the target fragmentation region does appear to offer the best opportunity to suppress the usual u-quark dominance in DIS.

The PAC also urges caution in the use of the "fracture function" as a generic motivation for all $x_F < 0$ measurements, as the universality, implications, or practical utility of these theoretical objects are far from clear. (The usefulness of $x_F < 0$ data can be more simply motivated as important input to Monte Carlo tuning.) We refer the proponents to our report on proposal PR12-14-010 where further remarks are included on this issue.

Summary: The PAC finds that this measurement is a well motivated exploration of the target-fragmentation region, and that the focus on D_{LL} is appropriate as $x_F < 0$ is the most likely regime for obtaining a clean interpretation of this quantity.

E12-06-112B / E12-09-008B

Title: **Higher-twist collinear structure of the nucleon through di-hadron SIDIS on unpolarized hydrogen and deuterium**

Spokespersons: A. Courtoy, S. Pisano

Motivation: The goal is measurement of the higher-twist collinear PDF e(x), coupled to a di-hadron fragmentation function, the so-called Interference Fragmentation Function analyzed from Belle data. In addition, new information on the unpolarized di-hadron fragmentation function can be obtained.

Measurement and Feasibility: The experiment will run in parallel with the approved experiment E12-09-008, with polarized beam and unpolarized liquid hydrogen and deuterium targets, dedicated to studies of the Boer-Mulders asymmetry in kaon electro-production. The new aspect, with respect to the parallel E12-09-008 proposal, is the observation of a hadron pair in the current fragmentation region; this allows the measurement of the higher-twist collinear PDF e(x), coupled to a di-hadron fragmentation function.

Issues: The extraction of information on e(x), so far essentially unknown, is difficult, as it appears in measured quantities combined with other unknown higher-twist di-hadron fragmentation functions. Further, the study of e(x) requires some model-based assumptions, or must rely on future available information.

Summary: The PAC considers such a proposal as a possible addition to the physics explored by E12-09-008.

E12-10-006A

Title: **Dihadron Electroproduction in DIS with Transversely Polarized 3He Target at 11 & 8.8 GeV**

Spokespersons: J.-P. Chen, A. Courtoy, H. Gao, A.W. Thomas, Z. Xiao, J. Zhang

Motivation: This analysis will study Single Target Spin Asymmetries for di-hadron production in deep inelastic scattering off a transversely polarized ^{3}He target. The main asymmetries result from the combined effect of the transversity and the Sivers function coupled, respectively, to polarized and unpolarized di-hadron fragmentation functions. These have been, or will soon be, measured in Belle experiments. The neutron transversity distribution and the Sivers function can then be obtained.

Measurement and Feasibility: This proposed experiment would run in parallel with the approved experiment E12-10-006, which will measure the transversity distribution h_1 and the Sivers function in deep inelastic scattering off a transversely polarized ^{3}He target. The new feature, with respect to the original E12-10-006 proposal, is the use of di-hadron, rather than single-hadron, production.

Issues: the PAC recommends studying possible interesting correlations between asymmetries measured in single and double hadron production. The complementarity with the conditionally approved Hall B experiment C12-11-111, using proton and deuterium targets, should also be considered.

Summary: The PAC considers such a proposal a valid addition to the physics explored by E12-10-006, adding an alternative way of measuring the same important quantities.

E12-11-108A / E12-10-006A

Title: **Target Single Spin Asymmetry Measurements in the Inclusive Deep-Inelastic N(e,e') reaction on Transversely Proton and Neutron (^{3}He) Targets using the SoLID Spectrometer**

Spokespersons: T. Averett, H. Yao, A. Camsone, X. Jiang, N. Liyanage

Motivation: The measured asymmetry A_{UT}, which is zero at Born level, can be non-zero when two-photon exchange is included. A recent measurement at 5.9 GeV in Hall A gave a negative value different from zero at the 2.9 sigma level. The present experiment will provide new precise measurements both on the proton and neutron, covering $1.5 < Q^2 < 7.5$ GeV^2 and $0.05 < x < 0.65$. The goal is to discriminate between various parton model predictions for the nucleon intermediate state in two-photon exchange

Measurement and Feasibility: The proposed experiment would run in parallel with the approved experiments E12-11-108 and E12-10-006, which will measure the transversity distribution h_1 and the Sivers function in deep inelastic scattering off transversely polarized H and ^{3}He targets respectively in Hall A using the SoLID spectrometer. The new aspect, with respect to the original proposals, is the recording of fully inclusive DIS events in addition to single hadron production.

Issues: A dedicated trigger on single particles will have to be optimised in order to collect sufficiently high statistics for the measurement of A_y, which is predicted to be very small ($\sim 10^{-4} - 10^{-5}$). Also the systematics will have to be kept very low.

Summary: The PAC considers such a proposal a valid addition to the physics explored by E12-10-006.

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 (GluEx and heavy baryon and meson spectroscopy)		1		3		4
The transverse structure of the hadrons (Elastic and transition Form Factors)	5	3	2	1		**11**
The longitudinal structure of the hadrons (Unpolarized and polarized parton distribution functions)	2	3	6			**11**
The 3D structure of the hadrons (Generalized Parton Distributions and Transverse Momentum Distributions)	5	9	7			**21**
Hadrons and cold nuclear matter (Medium modification of the nucleons, quark hadronization, N-N correlations, hypernuclear spectroscopy, few-body experiments)	6	3	7		1	**17**
Low-energy tests of the Standard Model and Fundamental Symmetries	3	1		1	1	**6**
TOTAL	**21**	**20**	**22**	**5**	**2**	**70**

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 (GluEx and heavy baryon and meson spectroscopy)		119		540		**659**
The transverse structure of the hadrons (Elastic and transition Form Factors)	145.5	85	102	25		**357.5**
The longitudinal structure of the hadrons (Unpolarized and polarized parton distribution functions)	65	230	165			**460**
The 3D structure of the hadrons (Generalized Parton Distributions and Transverse Momentum Distributions)	409	872	212			**1493**
Hadrons and cold nuclear matter (Medium modification of the nucleons, quark hadronization, N-N correlations, hypernuclear spectroscopy, few-body experiments)	180	175	201		14	**570**
Low-energy tests of the Standard Model and Fundamental Symmetries	547	205		79	60	**891**
TOTAL	**1346.5**	**1686**	**680**	**644**	**74**	**4430.5**

PAC42 Members

NAOMI MAKINS (Chair) University of Illinois 401 B Ioomis, MC 704 1110 W. Green Street Urbana, IL 61801 Phone: 217-333-7291 Fax: 217-333-1215 gnome@jlab.org	**HEIDI SCHELLMAN** Northwestern University Department of Physics & Astronomy 2145 Sheridan Road Evanston, IL 60208 Phone: 847-491-3685 Fax: 847-467-6857 schellma@fnal.gov
MAURO ANSELMINO Dipartimento di Fisica Teorica Via P. Giuria 1 -10125 Torino Tel. 011-670.7227 Fax 011-670.7214 anselmino@to.infn.it Ubicazione ufficio: EN-27	**ULRIKE THOMA** Arbeitsgruppe Thoma Raum Nr. 207 Helmholtz-Institut für Strahlen- und Kernphysik Nussallee 14-16 53115 Bonn Deutschland Telephone: +49 228 732202 Fax: +49 228 732505 thoma(a)hiskp.uni-bonn.de
WOLFGANG LORENZON University of Michigan 1440 Randall Lab 450 Church Street Ann Arbor, MI 48109-1040 Phone: 734-647-6825 Fax: 734-936-6529 lorenzon@umich.edu	**JOHN ARRINGTON** Argonne National Laboratory 9700 S. Cass Ave, Building #203 Argonne, IL 60439 630-252-3619 (office) 630-252-3903 (fax) johna@anl.gov
FABIENNE KUNNE IRFU / SPhN Bat 703 CEA Saclay F-91191 Gif/Yvette cedex Phone: +33 1 69084345 Fax: +33 1 69087584 fabienne.kunne@cea.fr	**JENS ERLER** Universidad Nacional Autónoma de Mexico Departamento de Física Teórica Cubículo 227 Ed. Principal A. P. 20-364, C. P. 01000 México, D. F. MEXICO Phone: (52)(55)5622-5166 Fax: (55)5622-5015 erler@fisica.unam.mx

ANNA MARTIN Dipartimento di Fisica Universita degli Studi di Trieste Via A. Valerio 2 I-34127 Trieste Phone: +39-040-558-3363 Fax: +39-040-558-3350 Anna.Martin@ts.infn.it	**MARC VANDERHAEGHEN** Institut für Kernphysik Johannes Gutenberg-Universität Mainz Johann-Joachim-Becherweg 45 D-55099 Mainz Phone: +1-49 (0)6131 3923696 Fax: +1-49 (0)6131 3925474 marcvdh@kph.uni-mainz.de
JIM NAPOLITANO Department of Physics College of Science and Technology Temple University Barton Hall Room A327 1900 N. 13th Street Philadelphia, PA 19122-6082 Phone: 215-204-7827 Fax: 215-204-5652 napolj@temple.edu	**BRADLEY SHERRILL** Facility for Rare Isotope Beams Michigan State University East Lansing, MI 48824 Phone: 517-908-7322 sherrill@frib.msu.edu
HANS-JÜRGEN ARENDS Institut für Kernphysik Johannes Gutenberg-Universität Mainz Johann-Joachim Becherweg 45 D 55099 Mainz Phone: 06131-3925194 Fax: 06131-3922964 arends@kph.uni-mainz.de	

Charge to PAC42

1. 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.

    a. 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.
    b. Also provide a recommendation on scientific rating and beam time allocation for proposals newly recommended for approval.

2. 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.

3. For newly approved Stage II PAC42 proposals , PAC should consider if any of these should be included in the "High Impact" category to receive priority for scheduling in the early (first 3-5 years) running

† Letters of intent will be given the same "rights" to their scientific ideas as are currently afforded to deferred experiments