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For more information or copies of this report contact:
Thomas Jefferson National Accelerator Facility
User/International Liaison, 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

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

Dr. Christoph W. Leemann
Lab Director and JSA President

March 29, 2007

Dear Jefferson Lab User,

To see the strong response to our call for proposals is one of the great recurring pleasures of my job. PAC 31 was no exception, and – far from fading as we approach the 12 GeV era – you have generated exciting new ideas to explore with the current machine. Over the next few years JLab will produce some of its most important and significant results.

PAC 31 reviewed fifteen experiment proposals (and two letters of intent). The committee recommends approval of eleven of the proposed experiments (three conditional) and deferral of four. Its ratings for the eight recommended for unconditional approval were four with A, one with A-, one with B+, and two with B. I allow myself to observe that in the past eventual impact of an experiment's results and its original PAC rating were not always positively correlated, which I take to mean that we are still making discoveries, and it will be interesting to watch the trend in the future.

Included in the approved group is a definitive test of the role of two photon exchange in the extraction of elastic form factors by a comparison of e+p and e-p scattering, and a study of short-range correlations in nuclei through the (e, e´pn) reaction.

On behalf of JLab users and staff, I would like to thank the entire committee for its thorough, diligent, and dedicated work and wise counsel in shaping an exceptional scientific program. I want to express my special thanks and appreciation to Zein-Eddine Meziani, whose term on the PAC has come to an end.

Sincerely,

Christoph Leemann
Director, Jefferson Lab

Letter from the PAC Chairman

Introduction

The Jefferson Laboratory Program Advisory Committee held its 31st meeting on January 29-February 1, 2007. The membership of the Committee is given in Appendix A. In response to the charge (Appendix B) from the JLab Director, Dr. Christoph Leemann, the Committee reviewed and made recommendations concerning the fifteen proposals and two letters of intent submitted by JLab users.

General Overview

The PAC was particularly impressed to see the high level of productivity although the JLab FY06 budget was reduced by ~8% relative to that of FY05. The Laboratory management and extra effort from the staff is to be commended for maintaining a high level of operation despite a far from optimal budget. At the time of the PAC meeting there was considerable uncertainty with regard to the level of FY07 funding. The prospect of a continuing resolution at the FY06 level would mean diminished operations for the facility despite a continuing strong demand for beam time from the User Group. While I am particularly pleased to learn that the final budget was not as severe as feared at the time of the PAC meeting, I regret that there remains a 20% loss in operations for FY07. I sincerely hope that the President's budget for FY08, which will restore the Laboratory to a reasonable level of operation, becomes a reality.

The central goal of JLab is to determine the basic structure of the proton, neutron and simple nuclei. All three halls made significant progress toward this goal during the past 6 months.
Hall A completed four experiments: two experiments were aimed at elucidating the deuteron structure and two will provide high accuracy information on the ^{3,4}He form factors and the ^{4}He(e,e'p) reaction. Hall B completed the GDH sum rule experiment at low momentum transfer and began the search for new baryonic states in hyperon production. Hall B also performed important test runs for GLUEx and for positron scattering from the proton. Hall C completed the G0 experiment on the proton and began recording data for the deuteron.

The overall JLab program continued to show steady growth; prior to PAC 31 it included 173 approved experiments. To date, 133 experiments have been completed at JLab, up by 4 over the last six months. Forty-seven papers have been published or submitted to Physical Review Letters and Physics Letters over the past year, in addition to over 88 papers published (or submitted) in other refereed journals. The number of Ph.D. projects completed to date at JLab is 223 (up by 36 in the past year), with an additional 208 projects in progress.

The Hall leaders, staff and users are to be commended for keeping the physics program and technical developments apace, especially given the budget situation. Impressive progress has been made on the analysis for the G_E^n, PRIMEX, quark helicity distribution, N*, HKS and G0 experiments. Also, the FROST target is nearing the commissioning stage.

The accelerator availability has been remarkably high. The operation of the parity quality highly-polarized beam continues to be a tremendous success. The accelerator operated for nearly 7000 hours during FY06 with a beam availability of 79.3% and an average Hall availability of approximately 93%. This performance exceeded the scheduled running for the year.

The 6 GeV restoration program is making significant progress. The accelerator group developed a procedure to replace cryomodules despite the radiation damaged (leaky) valves that separate the cryomodules. CASA has developed a viable option for running with unbalanced linac energies. While a budget-forced shutdown is not expected to impede the energy restoration plans, such a shutdown should be implemented in a way to minimize damage to the ongoing excellent experimental program.

The 12 GeV upgrade has made considerable progress during the past year. The leadership for the upgrade project is now in place. Project engineering and design is underway. The recent DOE project status review indicates that the project is on track for a CD-2 approval in September. It is especially gratifying to hear that the final FY07 budget is expected to provide essentially full funding for this year's 12-GeV upgrade work.

The Laboratory received an outstanding array of very interesting proposals to be considered by the PAC. Nucleon structure studies continue to dominate the requests for beam time. Nine proposals are part of the program of nucleon form factors, inelastic scattering, exclusive or semi-inclusive experiments to study the nucleon's internal structure. Two proposals were aimed at measuring two-photon exchange effects in electron scattering, one proposal was a study of short range correlations in nuclei. One proposal was aimed at addressing issues in hadronization in nuclei, while another proposal was focused on hypernuclear studies.

Recommendations

Of the fifteen proposals received, eleven experiments were approved, three of them conditionally. The ratings for the 8 proposals were four with A, one with A^-, one with B^+ and two with B. Four experiments were deferred.

The PAC approved three experiments in Hall A for a total of 58 days: PR-07-006, Studying Short-Range Correlations in Nuclei at the Repulsive Core Limit via the Triple Coincidence (e,e'pn) Reaction, for 23 days; PR-07-007, Complete Separation of Deeply Virtual Photon and π^0 Electroproduction Observables of Unpolarized Protons, for 23 days; PR-07-012, The Angular Dependence of ^{16}O(e,e'K)Λ and H(e,e'K)Λ, for 12 days.

Two experiments were approved in Hall B for 80 days: PR-07-005, Beyond the Born Approximation: A Precision Comparison of e^+p and e^-p Elastic Scattering in CLAS, for 35 days; and PR-07-009, Meson Spectroscopy in the Coherent Production of ^{4}He with CLAS, for 45 days.

Three experiments were approved in Hall C for a total of 45 days: PR-07-002, Polarization Transfer in Wide Angle Compton Scattering, for 3 days; PR-07-003, Update to TJNAF E03-109: Spin Asymmetries on the Nucleon Experiment-SANE, for 34 days; and PR-07-011, A High Precision Measurement of the Deuteron Spin-Structure Function g_1^d/F_1^d, for 8 days.

The laboratory guidelines provided for the approval of 60 days of beam time in Hall A, 45 days of beam time in Hall B, and 62 days of beam time in Hall C. Starting with PAC 24, the formula for these guidelines has been modified, and is based on three components: 30/45/25 days of new time to be made available in Halls A/B/C, plus 100%/100%/100% of the time recovered from approved experiments now required to return to the PAC due to the jeopardy process, and 0%/0%/50% of the days under target in the halls. The PAC is allowed to exceed the laboratory guidelines if it believes the physics has sufficiently high priority, that is at a rating of A^- or better, but the excess would then be deducted from the allocation of the next PAC meeting.

The jeopardy process continues to evolve at JLab. At this meeting 42 days of approved time in two proposals were under jeopardy status, 15 in Hall A and 27 in Hall C. Including the recommendations of PAC31, the backlog[†] in Hall A is now about 3.7 years, while the backlog in Hall B is 3.7 years and that of Hall C 3.6 years, assuming the operations for FY07 would be at the FY06 funding level. The requests at this meeting for beam time in Hall A and Hall B were beyond the allocation. Given the outstanding proposals, the PAC exceeded the laboratory guidelines in Hall B by 35 days.

The proposal reports and the PAC recommendations for the reviewed proposals and the responses to the letter of intents are given in Appendices D and E. The tables on the following pages summarize the status of the JLab commitments from PAC 4 through PAC 31.

The PAC is very appreciative of the efforts of the Hall leaders and the Laboratory staff in support of the PAC meeting and review process. The TAC reports continue to be a very important ingredient in the process of evaluation of proposals. The comments provided by the theory group help greatly by placing the proposals in the context of ongoing theoretical work.

The proponents are to be commended for presenting an impressive array of very interesting physics proposals and for carefully answering the PAC's questions. Finally, the enthusiastic and thoughtful contributions of Rachel Harris were essential in making the PAC process proceed gracefully and efficiently.

Roy J. Holt
Chairman, Jefferson Program Advisory Committee

[†] Note added in proof: the backlog numbers quoted are for the level of operation that was routine prior to FY06. With budgets now anticipated, together with the need to redirect funding to the 12 GeV Upgrade, these estimates should be increased by about 25%.

Tables

Totals for PAC 4-31

	Experiments Recommended for Approval	Experiments Recommended for Conditional Approval	Totals
Experiments	181	3	184
Authors	1193	36	1229
Institutions	209	3	212
Countries	30		30

Approved Experiments Totals by Physics Topics

Topic	**Number Total**	**Hall A**	**Hall B**	**Hall C**
Nucleon and Meson Form Factors & Sum Rules	36	12	7	17
Few Body Nuclear Properties	29	18	6	5
Properties of Nuclei	34	12	11	11
N* and Meson Properties	58	12	35	11
Strange Quarks	24	5	16	3
TOTAL	181	59	75	47

Approved Days and Conditionally Approved Experiments

Hall	**Approved Experiments**				Conditionally Approved Experiments
	# Expts Completed (full/partial)	Days Run	No. Exps in Queue	Days to be Run	
A	38 1	743.0	22	340.9	1
B	60 5	656.8	15	332.0	2
C	28 7	694.2	16	266.6	0
Total	126 13	2094.0	53	939.5	3

APPENDICES

A. PAC 31 Membership

B. Charge to PAC 31

C. PAC 31 Recommendations

D. PAC 31 Individual Proposal Reports

E. PAC 31 Individual Letters-of-Intent Reports

F. Approved Experiments, PAC 31, Grouped by Physics Category

(To access Appendix F, go to http://www.jlab.org/exp_prog/proposals/07prop.html.

APPENDIX A

PAC 31 Membership

ROY HOLT (Chair)
Argonne National Lab
Physics Division
Argonne, ILL 60439
Urbana, IL 61801-3080
Phone: (708) 252-4012
holt@anl.gov

BARBARA BADELEK
Institute of Experimental Physics
Warsaw University
Hoza 69
PL 00681 Warsaw, Poland
Phone/Fax: 48 22 62 14771/94309
badelek@fuw.edu.pl

RON GILMAN
Rutgers University
Department of Physics and Astronomy
P.O. Box 849
Piscataway, NJ 08855-0849
Email: gilman@jlab.org
Phone: (757) 269-7011

XIANGDONG JI
University of Maryland
Physics Department
2204A Physics Building
College Park, MD 20742
Phone/Fax: 301-405-7277
xji@physics.umd.edu

ED KINNEY
University of Colorado
Nuclear Physics Laboratory
Campus Box 446
Boulder, CO 80309-0446
Phone: (303)492-3662
edward.kinney@COLORADO.EDU

NAOMI MAKINS
Department of Physics
University of Illinois at Urbana-Champaign
1110 West Green Street
Urbana, IL 61801-3080
Phone: 217-333-7291
makins@uiuc.edu

ZEIN-EDDINE MEZIANI
Temple University, Physics Department
Barton Hall
1900 North 13th Street
Philadelphia, PA 19122-6028
Phone/Fax: (215)204-5971/(215)204-2569
meziani@temple.edu

MICHAEL PENNINGTON
University of Durham
Science Laboratories
South Rd
Durham DH1 3LE
United Kingdom
Phone/Fax: 44-(0)191-334-3668/3658
m.r.pennington@durham.ac.uk

MARCO RIPANI
INFN
Via Dodecaneso 33
16146 Genova
Italy
Phone/Fax: 39-010-353-6458/313358
ripani@ge.infn.it

HANS STROHER
Forschungszentrum Jülich
Institut für Kernphysik
D-52425 Jülich
Email: h.stroeher@fz-juelich.de
Phone: +49-2461-61-3093
Fax: +49-2461-61-3930

WITOLD NAZAREWICZ
Department of Physics
The University of Tennessee
226m Ayres Hal
1403 Circle Drive
Knoxville, TN 37996-1200
Email: witek@utk.edu
Phone: (865) 574-4580
Fax: (865)-576-8746

PIERRE GUICHON
DAPNIA/SPhN, Bat. 703
CEA-Saclay
F91191 Gif-sur-Yvette Cedex, France
Phone/Fax: 33-1-69-08-7207/7584
pierre.guichon@cea.fr

Deleted: O

APPENDIX B

Charge to PAC 31

Jefferson Lab requests that PAC 31:

1. Review both new proposals* and extensions† or updates‡ to previously-approved proposals, and provide advice on their scientific merit, technical feasibility and resource requirements.

2. Recommend one of four actions on each proposal, extension or update:
   - approval,
   - conditional approval status pending clarification of special issues,
   - deferral with regret,
   - deferral, or
   - rejection.

   (There are two types of conditional approval: conditional pending PAC review of open scientific questions; and conditional pending Jefferson Lab management review of open technical issues. In the later case, the PAC should recommend a beam time allocation.)

3. Provide a scientific rating and recommended beam-time allocation for all proposals recommended for approval.

4. Provide comments on letters-of-intent.

5. Comment on the Hall running schedules.

* Previously-approved proposals that have not, within 3 years of PAC approval, been scheduled to run to completion are returned to the PAC for a fresh scientific review. For the purposes of these reviews, the "jeopardy" experiments are to be treated consistently with new proposals.

† Extension proposals are treated as new proposals, and the merits and status of the original proposal are considered only to the extent that they may bear on the relevance and merit of the extension proposal.

‡ In reviewing an experiment update, the PAC will treat the original proposal and any request for changes taken together as a single new proposal and treat the combination in a manner analogous to a previously-approved proposal undergoing a jeopardy review.

APPENDIX C

PAC 31 Recommendations

Recommendation/ Rating / Days	Proposal		Description
A/A-/23	PR-07-006		Studying Short-Range Correlations in Nuclei at the Repulsive Core Limit via the Triple Coincidence (e,e'pn) Reaction
A/A/23	PR-07-007		Complete Separation of Deeply Virtual Photon and π^o Electroproduction Observables of Unpolarized Protons
A/B+/12	PR-07-012		The Angular Dependence of $^{16}O(e,eK)$ and $H(e,e'K)\ \Lambda$
A/A/35	PR-07-005		Beyond the Born Approximation: A Precision Comparison of e^+p and e^-p Elastic Scattering in CLAS
A/A/45	PR-07-009		Meson Spectroscopy in the Coherent Production of ^4He with CLAS
	PR-07-002		Polarization Transfer in Wide Angle Compton Scattering (Part1, Hall A)
A/B/3	PR-07-002		Polarization Transfer in Wide Angle Compton Scattering (Part 2, Hall C)
A/A/34	PR-07-003		Update to TJNAF E03-109: Spin Asymmetries on the Nucleon Experiment-SANE
A/A/8	PR-07-011		A High Precision Measurement of the Deuteron Spin-Structure Function $g_1/F_1{}^d$
C2	PR-07-001		The δ_{LT} Puzzle: Testing Chiral Perturbation Theory in the Generalized Longitudinal-Transverse Spin Polarizability
C1/B	PR-07-013		Target Normal Single-Spin Asymmetry in Inclusive DIS $n\uparrow(e,e')$ with a Polarized ^3He Target
D	PR-07-015		Measurement of double-spin asymmetries on a transversely polarized proton target in semi-inclusive DIS reaction
C2	PR-07-004		Measurement of the Proton Elastic Form Factor Ration at low Q^2
D	PR-07-008		Hadronization in Nuclei by Deep Inelastic Electron Scattering
D	PR-07-010		RES-Parity: Parity Violating Electron Scattering in the Resonance Region
D	PR-07-014		Measurement of non-pole backgrounds in the extraction of the charged pion form factor

A=Approve,
C1=Conditionally Approve w/Technical Review
C2=Conditionally Approve w/PAC Review
D=Defer

APPENDIX D

Individual Proposal Report

Proposal: PR-07-001

Scientific Rating: B+

Title: The δ_{LT} Puzzle: Testing Chiral Perturbation Theory in the Generalized Longitudinal-Transverse Spin Polarizability

Spokespersons: A. Camsonne, J.-P. Chen, K. Slifer

Motivation: This experiment measures the inclusive spin-structure function $g_2(x)$ on the proton in the low-Q^2 kinematic range $0.04 < Q^2 < 0.2$ GeV^2. The principal goal presented is to combine these data with $g_1(x)$ measurements from the CLAS EG4 experiment in the same Q^2 range to form the generalized longitudinal-transverse polarizability $\delta_{LT}(Q^2)$ by taking the 2nd moment over x of the sum of g_1 and g_2. The physics interest in this quantity at low Q^2 is to compare it with Chiral Perturbation Theory (XPT), where calculations fail for δ_{LT} on the neutron in the $Q^2 \geq 0.1$ range (the δ_{LT} " puzzle") while succeeding to describe the similar polarizability γ_0. In addition, the $g_2(x)$ data will assist in reducing the systematic errors on the EG4 $g_1(x)$ measurement, and will permit the testing of the Burkardt-Cottingham Sum Rule (BCSR) in this unexplored kinematic range.

Measurement and Feasibility: The proposed experiment constitutes a major installation in Hall A requiring significant technical resources. However, none are felt to be insurmountable, and no particular technical obstacles were identified.

Issues: The PAC feels that to justify the resources and time requested, the physics case should be more solidly established. The proposal presently provides little support for the data points at $Q^2 > 0.1$ GeV^2 which account for much of the requested beam time, and where XPT calculations (at modest order) may be expected to break down. The PAC finds these kinematic points of importance, but that their value lies elsewhere. One example is the precise BCSR measurements, particularly as SLAC data at higher Q^2 suggest a violation of this sum rule. A second important motivation is the systematic-error reduction the proposed data can provide for the generalized GDH measurements at CLAS. This error reduction is mentioned in the proposal, but the influence of g_2 is not quantified. Further, one PAC member pointed out the importance of precise g_2 data on the proton, especially at low Q^2, to ongoing calculations of the hyperfine structure of hydrogen – a physics case which should be explored.

Recommendation: C1=Conditionally Approve w/Technical Review

Individual Proposal Report

Proposal: PR-07-002

Scientific Rating: N/A for the Hall A part, B for the Hall C part

Title: Polarization transfer in Wide Angle Compton Scattering

Spokespersons: B. Wojtsekhowski, A. M. Nathan, R. Gilman

Motivation: This proposal was presented at PAC 29 (PR-06-001) as a jeopardy update of E03-003 and at that time it was deferred with regret due to lack of beam time. The experiment's goal is a measurement of three spin-dependent observables, K_{LL}, K_{LS}, and P_N, in Real Compton Scattering (RCS) off protons at three kinematic points with s = 8.9 GeV^2 and θ^{cm}_p = 70º, 90º, and 110º. The proposed measurement is motivated by theoretical work indicating that the RCS reaction, at values of s, $|t|$, and $|u|$ significantly larger than the nucleon mass squared, may be dominated by a "handbag mechanism" involving one current quark in the proton, in which case it could be described within the framework of the Generalized Parton Distributions (GPDs). Specifically, in the GPD framework, each of the three RCS response functions is sensitive to the $1/x$-weighted integral over x of one of the GPD's (summed over flavor): $R_V(t)$, $R_A(t)$, and $R_T(t)$ are related to the moments of $H^q(x,\xi=0,t)$, $\hat{H}^q(x,\xi=0,t)$ and $E^q(x,\xi=0,t)$ respectively. The measurement of the spin-transfer observables K_{LL} and K_{LS}, when combined with the existing measurements from experiment E99-114, would permit the independent determination of the three RCS response functions, and so of the aforementioned GPD moments. Experiment E05-101 was approved for a similar measurement at θ^{cm}_p = 130º. Before the handbag picture was proposed, there was the expectation that exclusive reactions at high momentum transfer like this could be described in the pQCD framework, where the proton is represented by three current valence quarks exchanging gluons, and the photon is absorbed/emitted by any of such quarks. Other models describe instead RCS in terms of different physics ingredients ranging from constituent quarks to Regge exchanges.

Measurement and Feasibility: The proposed experiment was deemed feasible, and no experimental problems were identified. The proposal creatively optimized the resources of experimental Halls A & C in recognizing that the best plan would be to measure the two backward kinematic points in Hall A and the forward point in Hall C (requiring 3 rather than 15 days of data-taking). Considerable installation work is required: 1 month in Hall A, followed by 17 days of running. In Hall C, careful scheduling of the experiment would reduce the installation time to only a few of days, followed by 3 days of running. The comments by the TAC about backgrounds in Hall C have been satisfactorily addressed by the proponents.

Issues: There is consensus in the PAC that the previously published polarization measurements have clearly shown a contradiction with the pQCD predictions. Although this looks quite evident also from measurements of other reactions and observables (e.g. the ratio of the electric to magnetic elastic proton form factors), having some more evidence from the RCS polarization observables may be beneficial. On the other hand, the PAC felt that, given the absence of a rigorous proof of a factorization theorem, the assumption that the reaction proceeds via a handbag diagram involving a current quark seems only weakly justified. The agreement of the data with this particular approach does not seem to be sufficient to conclude that the physics is indeed driven by the GPDs. For instance, an alternative approach based on constituent quarks may equally explain the data. Although in the latter case there would be also an interesting insight into the reaction mechanism, the connection with the GPDs would be lost and so would be much of the exciting physics presented in the proposal.

Therefore, given the large effort involved in measuring the polarization observables in RCS at all the proposed angles, but considering the interest in having some additional information on the behavior of these observables in a fundamental exclusive reaction, to be compared with model predictions, the PAC decided to approve only the Hall C measurement, as it has the minimum overhead and beam time impact. For the Hall A part of the proposal instead, the PAC decides for deferral.

Recommendation: Defer in Hall A, Approve for 3 days in Hall C

Individual Proposal Report

Proposal: PR-07-003

Scientific Rating: A

Title: Spin Asymmetries on the Nucleon Experiment - SANE

Spokespersons: S. Choi, Z.-E. Meziani, O.A. Rondon

Deleted: , G. Huber

Motivation:
The proposal aims at a simultaneous measurement of the longitudinal spin asymmetry A_1 and the spin structure function g_2 of the proton over a broad range of *x*: from 0.3 to 0.8 and Q^2: from 2.5 GeV^2 to 6.5 GeV^2. This kinematic region extends over and beyond the resonance region. Extraction of A_1^p will be limited by systematic errors while that of g_2^p - by the statistics. The latter extraction will be done in a model-independent way, from the measurement of two asymmetries for two different orientations of the target magnetic field relative to the direction of the beam. While there is practically no information about the spin structure of the proton at high *x*, in particular outside the resonance region, the knowledge of g_2 will not only address very interesting physics related to the twist-2 and twist-2/twist-3 parts of g_2 (e.g. stimulate lattice calculations), but also it will substantially decrease systematic errors on many A_1 measurements resulting from the lack of knowledge of g_2.

Measurement and Feasibility:
The proposal is an update of the TJNAF E-03-109, conditionally approved in June 2003 by PAC24 for 27 days of beam in Hall C. Since then the Collaboration has been working hard on the target and detector elements to be ready for data taking and installation in the first half of 2008. Meanwhile changes in the CEBAF capabilities induced necessary changes in the planned measurements. Polarised electrons will be scattered on polarised protons using beams of 6 GeV and 4.8 GeV and the UVA solid polarised NH3 target. Two beam and target spin configurations will be used: parallel and the target spin at 80 degrees relative to the beam. Scattered electrons will be detected in the large acceptance non-magnetic detector BETA consisting of a forward tracking hodoscope, a threshold Cherenkov counter, a tracking hodoscope and the BigCal electromagnetic calorimeter. Several detector elements were added or redesigned since the original proposal.

Issues:. The proposed experiment requires a large installation. Questions and comments raised in this context by TAC were satisfactorily answered by the Collaboration. The PAC estimates that the status of preparations should guarantee a successful running of the experiment

Recommendation: Approve with A priority for 34 days

Individual Proposal Report

Proposal: PR-07-004

Scientific Rating:

Title: Measurement of the Proton Elastic Form Factor Ratio at low Q^2

Spokespersons: R. Gilman, D.W. Higinbotham, G. Ron

Motivation:
The aim is the precision measurement of the proton elastic form-factor ratio $\mu G_E / G_M$ in the range of $Q^2 = 0.25 - 0.7$ GeV^2. A point-to-point systematic uncertainty of better than 1% is sufficient to map out any changes in shape of the ratio in this Q^2 region. The measurement will use the recoil polarization method which determines the form-factor ratio more directly than the Rosenbluth separation. An important by-product of precise knowledge of the electric to magnetic ratio is that, when combined with other high statistics measurements of the cross-sections, this will reduce uncertainties in the Zemach radius, which is the key parameter in fixing the hyperfine corrections to the Hydrogen atom. The ratio of form-factors is a fundamental measurement. Determination of the precise Q^2 dependence will eliminate speculative parametrizations and motivate further theoretical work.

Measurement and Feasibility:
The group has shown with the limited LEDEX running that this experiment is feasible to the precision proposed.

Issues:
Since Mainz is presently running an experiment which using Rosenbluth separation can determine the same ratio in the same region of Q^2, consideration should be given to these results and especially their level of uncertainties before approval to proceed with this proposal is given.

Recommendation: C2=Conditionally Approve w/PAC Review

Individual Proposal Report

Proposal: 07-005

Scientific Rating: A

Title: Beyond the Born Approximation: A Precise Comparison of e+p and e-p Elastic Scattering in CLAS

Spokespersons: A. Afanasev, J. Arrington, W. Brooks, K. Joo, B. Raue, L. Weinstein

Motivation: The measurements of the electric to magnetic form factor ratio G_E/G_M of the proton have revealed a strong discrepancy between the results of the Rosenbluth and the polarization method. Theoretical calculations and phenomenological analysis suggest that the discrepancy is due to the failure of the one photon, or Born, approximation. The authors propose to test directly this hypothesis by measuring the charge asymmetry $[\sigma(e^+)-\sigma(e^-)]/[\sigma(e^+)+\sigma(e^-)]$. Since this quantity is exactly zero in the Born approximation, any deviation can be attributed to multi-photon exchanges. A previous experiment at SLAC reported a result consistent with zero but the kinematics corresponded to large values of the virtual photon polarization. The phenomenological analysis indicates that the asymmetry depends linearly on epsilon and therefore the vanishing of the asymmetry at large epsilon might just be an accident. The only way out is clearly to make a measurement in a large domain of epsilon.

Measurement and Feasibility: In a short test run the collaboration has been able to run with about 4% of the proposed luminosity. Data taken during the run in combination with Monte Carlo studies indicate that a combination of larger apertures, better shielding, and better collimation in various beam line and target components will likely result in being able to run at the full proposed luminosity. The proposal describes a number of methods being used to ensure that the electron and positron beam properties are sufficiently identical and well characterized that the quality of the measured asymmetries is not compromised. These issues appear to be under control.

Issues: The authors have redone the phenomenological analysis using the Rosenbluth and polarization data, moreover imposing that the asymmetry be zero at epsilon=1. This determines (to some extent) the 2gamma amplitude and they use it to estimate the asymmetry they can expect in their experimental set up. Running at the proposed luminosity should give a definitive measurement of whether two-photon exchange reconciles the Rosenbluth and polarization transfer data in a region in which the two techniques clearly disagree. It is important that the measurement be done close to the proposed luminosity.

Given the role of the Born approximation in the analysis of essentially all electron scattering experiments, it is vital, in particular for JLab, that the validity of this approximation be carefully delineated and that any deviation be under control. The direct detection of multi-photon effects through the charge asymmetry experiment appears as the best tool to achieve this goal. The experiment should be strongly supported.

Recommendation: Approve with A priority for 35 days

Individual Proposal Report

Proposal: PR-07-006

Scientific Rating: A^-

Title: Studying Short-Range Correlations in Nuclei at the Repulsive Core Limit via the Triple Coincidence (e, e'pN) Reaction

Spokespersons: E. Piasetzky, S. Gilad, B. Moffit, J. Watson, D. Higinbotham

Motivation: The collaboration proposes to study two-nucleon knock-out reactions (e,e'pp) and (e,e'pn) on ^{4}He normalized to the (e,e'p) reaction in the missing momentum range from 400 to 875 MeV/c in order to study the short-range repulsive part of the NN interaction and investigate the transition from a tensor-force-dominated region at energies around 500 MeV/c. JLab is uniquely positioned to answer this compelling question.

Measurement and Feasibility: The ^{4}He(e,e'p) reaction will use the Hall A cryotarget and the two standard high resolution spectrometers. The (e,e'pp) and (e,e'pn) reactions will be measured simultaneously using the BigBite spectrometer and an array of scintillation counters that will detect the recoiling protons and neutrons. The previous JLab experiment by this group demonstrated the dominance of correlated np pairs over pp pairs in the range of relative momenta (275–550) MeV/c on ^{12}C; this can be explained in terms of deuteron-correlations due to the tensor force. This tantalizing result constitutes a unique contribution of JLab program to our understanding of the nucleus. The Technical Advisory Committee did not raise any questions. The PAC believes that the physics objectives can be accomplished by performing measurements at four values of missing momenta.

Issues: None

Recommendation: Approve with A- priority for 23 days

Individual Proposal Report

Proposal: PR-07-007

Scientific Rating: A

Title: Complete Separation of Deeply Virtual Photon and π^0 Electroproduction Observables of Unpolarized Protons

Spokespersons: C. Munoz Camacho, J. Roche, C.E. Hyde-Wright, P.-Y. Bertin

Motivation: The ultimate goal of this experimental program is the determination of the Generalized Parton Distributions. These quantities are well defined from the point of view of QCD. There exist strong factorization theorems that allow the electro-production amplitude to be expressed in terms of GPDs and hard perturbative kernels, and the evolution of the GPDs with respect to the factorization scale is well understood.

This collaboration's first experiment, E00-110, successfully tested the scaling behavior of the imaginary part of the DVCS amplitude, a compulsory condition for the factorization theorem. The authors now propose to apply their experimental technique to disentangle the three terms in the (e, $e'\gamma$) cross section: Bethe-Heitler (which corresponds to the radiation by the electron and is calculable), DVCS, and the interference between the BH and DVCS processes. In the analysis of the previous experiment, E00-110, the DVCS term in the cross section was neglected, as suggested by early theoretical calculations. After a careful examination of their data, the authors have come to the conclusion that this approximation is questionable, and this is the principal point they wish to address with this proposal. To this end, they will separate the DVCS cross section from the other terms using two values of the incident beam energy, with the kinematic invariants Q^2, s, and t held fixed. This separation will allow the first scaling test for the real part of the amplitude. A successful demonstration of scaling would be a decisive step forward in the long route toward the determination of the GPDs.

As the experiment is based on the detection of the high energy photon, the authors are also able to measure the (e,$e'\pi^0$) cross section through the two-photon decay of the π^0. This is more than a by-product as the exclusive electro-production of mesons is a rich source of information on the GPDs. Here they will measure separately the longitudinal and transverse π^0 cross sections for the first time, which is a key point as we know that the factorization theorem for π^0 production applies only to the longitudinal cross section. The proposed experiment will be able to test this factorization theorem for the first time by measuring its Q^2 dependence at fixed values of x and comparing the result with the predictions of the GPD formalism.

Measurement and Feasibility: This experiment is a major technical undertaking, requiring the installation of a larger calorimeter in Hall A and modifications to the Hall A beam pipe. The TAC has requested further detail on these modifications, but is confident that they can be accomplished given the collaboration's experience and success with E00-110.

Issues: This experiment, together with the previous work, is laying the foundation of a long-term experimental program based on the GPD concept. The authors are now at the point

where they will make the crucial test of the theoretical construction, namely the scaling properties of the real part of the DVCS amplitude. At the same time, they will perform the first measurement of the π^0 longitudinal cross section, testing factorization in the exclusive meson production sector for the first time and hopefully clearing the path to another rich source of information on the GPDs. The PAC strongly supports the proposal.

Recommendation: Approve with A priority for 23 days

Individual Proposal Report

Proposal: PR-07-008

Scientific Rating: N/A

Title: Hadronization in Nuclei by Deep Inelastic Electron Scattering

Spokespersons: B.E. Norum, K. Wang, J.P. Chen

Motivation: This collaboration proposes to use the high luminosity capabilities of Hall A to study the hadronization of pions and kaons from deep inelastic scattering in nuclei. The experimental plan is to study the high z and p_T behavior of the hadron attenuation at fixed ν and Q^2 with high statistical precision. Such data could help discriminate among different models of hadronization.

Measurement and Feasibility: The measurement as planned uses standard Hall A spectrometers, including the expected upgraded and refurbished RICH detector, and unpolarized targets. No significant technical problems are foreseen.

Issues: This program would be complementary to that in Hall B (at similar kinematics) due to its ability to use high luminosity to focus on a particular kinematic dependence with much higher precision. In addition, the kaon identification capabilities would be very useful. Unfortunately, the kinematics proposed (especially at high z) are in the range where the fragmentation is no longer independent of the parton distributions, which would likely make the interpretation of these data in terms of the available models difficult, if not impossible. This is particularly true for the kaons, which barely satisfy the Berger criterion in any case (rapidity separation to ensure current/target fragment separation). Finally, the proposal does not take into account new HERMES data on hadron attenuation that may have sufficient precision to resolve the main physics questions. Specifically, is there any question this experiment can address that the available HERMES data cannot? We note that many of the kinematic problems would be absent at 11 GeV, which makes the proposal more suitable for the future physics program at the upgraded CEBAF. We strongly encourage the collaboration to develop Hall A studies to address specific, quantitative hadronization questions with high precision.

Recommendation: Defer

Individual Proposal Report

Proposal: PR-07-009

Scientific Rating: A

Title: Meson Spectroscopy in the Coherent Production on ^{4}He with CLAS

Spokespersons: I. Aznauryan, H. Fenker, S. Stepanyan, C. Salgado, P. Eugenio

Motivation: The experiment aims to study the production of $\pi^\circ\eta$ and $\pi^\circ\eta'$ meson pairs in coherent quasi-real photoproduction off ^{4}He. The goal of the experiment is to search for meson states with exotic (i.e. non-qq_bar) quantum numbers, in particular $I^GJ^{PC} = 1^-1^{-+}$, and more specifically the hybrid candidate states $\pi_1(1400)$ and $\pi_1(1600)$ as well as possible other states with masses up to 2 GeV/c^2. $\pi^\circ\eta$ and $\pi^\circ\eta'$ meson pairs will have exotic quantum numbers, provided they are produced in p-waves (L=1) – this will be determined *via* the decay angular distribution in a Partial Wave Analysis (PWA). Coherent production from ^{4}He will simplify the PWA, e.g. since it suppresses the background from the production of s-channel baryon resonances. Unambiguous identification of any state beyond the quark model would be a significant milestone for hadron spectroscopy and constitute a major progress in our understanding of QCD. Identifying and studying hadronic states with gluonic degrees-of-freedom is one of the major issues of the 12 GeV JLab-upgrade ("GlueX").

Measurement and Feasibility: The experiment will be performed with an electron beam of up to 6 GeV, which is converted into a flux of quasi-real photons upstream of the production target either detected via the small-angle (<0.5°) scattered electrons or reconstructed from kinematics. The quasi-real photons are incident on a 20 cm long 7 atm He gas-cell as production target. The expected luminosity is $L = 3 \times 10^{33}$ cm^{-2} s^{-1}. The recoiling ^{4}He nucleus will be detected in a radial TPC ("BONUS"), and the meson final states will be identified via their photon and pion decays in a lead-tungstate forward calorimeter as well as the CLAS detector systems (including the DVCS solenoid, providing the magnetic field for helium tracking). It is essential to keep the momentum transfer sufficiently small, as the production cross section scales with the square of the He-form factor. The trigger will be 3 or 4 photons in the calorimeters (IC, ECs). An excellent understanding of the CLAS detector and its acceptances is needed to ensure an unambiguous partial wave analysis.

Issues: The PAC was convinced that this is an outstanding experiment and should be pursued as soon as possible.

Recommendation: Approve with A priority for 45 days

Individual Proposal Report

Proposal: PR-07-010

Scientific Rating: N/A

Title: RES-Parity: Parity Violating Electron Scattering in the Resonance Region

Spokespersons: J. Arrington, P.E. Bosted, H. Mkrtchyan, X. Zheng

Motivation: The proposal is aimed at measuring Parity-Violating (PV) asymmetries on three different targets (H, D, ^{12}C), over the full resonance region (up to a missing mass W = 2.1 GeV) in the Q^2 domain 0.5 - 1.0 $(GeV/c)^2$. This is an exploratory measurement that might have an impact on many areas of hadronic physics and on the weak interaction sector. Examples mentioned are: isospin decomposition of the nucleon resonances; quark-hadron duality; flavor dependence of the EMC effect; parameterizations of hadronic background, higher twists and radiative corrections for other planned (E-05-007, DIS-Parity) and future (12 GeV) PV experiments; and finally neutrino cross sections, necessary for the interpretation of neutrino oscillation experiments.

Measurement and Feasibility: The experiment is proposed to run in Hall A, using the same equipment as E05-007 (DIS-Parity experiment). The DIS- and Res-Parity collaborations would be closely working together on the necessary developments (upgraded Compton polarimeter and fast DAQ). The key elements of the experimental set-up are the 2 HRS spectrometers, liquid cryogenic targets (H and D), a polarized electron beam with PV quality and a fast acquisition system allowing for a counting method to reject pion background. Concerning the beam, the size of the asymmetry to be measured is large (50-100 ppm) and the beam performances achieved in Hall A routinely exceed in quality the requirements of this proposal. The beam energy and spectrometer settings have been optimized leading to the choice of a 4.8 GeV beam and a 12.5° detection angle for the scattered electrons.

Issues: The PAC believes that the experiment could address a number of important issues. However, no single issue has been sufficiently investigated and quantitatively discussed such as to produce a compelling and convincing case, as already clearly requested in previous PAC reviews. The PAC strongly suggests to the proponents to concentrate on a single topic and work out the details as extensively as possible. In particular, the PAC suggests that extensive simulations even based on “toy models” under different assumptions would be very helpful to show how the data would impact each observable in other sectors. The proponents should also engage theorists and experimentalists in this field in order to determine what is needed for the various goals. Particularly important would be to clarify the importance of the proposed measurements for the neutrino oscillation program, much in line with what has been done for F_2 and R in nuclei.

Recommendation: Defer

Individual Proposal Report

Proposal: PR-07-011

Scientific Rating: A

Title: A High Precision Measurement of the Deuteron Spin-Structure Function g_1^d/F_1^d

Spokespersons: P. Bosted, F.R. Wesselmann, X. Jiang

Motivation: The proposal aims at definitive measurements of the deuteron structure function g_1^d/F_1^d in the deep-inelastic kinematics ($0.15 < x < 0.6$, $1 < Q^2 < 6$ GeV^2) accessible with a 6 GeV beam. The principal goal is to provide the low Q^2 anchor points for the NLO QCD fits of the spin-dependent observables. World data in this moderate range of *x* are imprecise and the new measurements will considerably reduce the resulting spin-dependent parton density distributions.

Measurement and Feasibility: The experiment will use two longitudinally polarized deuteron targets, ^{6}LiD and ND_3. Scattered electrons will be detected in the detector assembly BETA, planned for the upcoming experiments, e.g. SANE. Additional measurements will be done with the HMS detector.

Issues: Apart of a high impact the planned measurements will have on the spin-dependent distributions, usage of two polarized targets will also constrain the nuclear effects in ^{6}LiD, the most commonly used polarised deuteron target. Poor knowledge of these effects severely biases the present measurements of the cross section asymmetries.

The experiment requires a large installation but no serious issues were raised by the TAC.

Recommendation: Approve with A priority for 8 days

Individual Proposal Report

Proposal: 07-012

Scientific Rating: B+

Title: The Angular Dependence of $^{16}O(e,e'K)^{16}N_{\Lambda}$ and H(e,e'K) Λ

Spokespersons: F. Garibaldi, P. Markowitz, M. Iodice, J. LeRose

Motivation: The cross section for electroproduction of light hypernuclei is not well understood. While $^{12}C(e,e'K^{+})$12B_lambda is well predicted, $^{16}O(e,e'K^{+})^{16}N_{\Lambda}$ predictions are off by a factor of 2. A measurement of kaon electroproduction on a waterfall target at two additional angles will provide information on the elementary process and the validity of various reaction models, which are largely unconstrained in the forward angle region and predict qualitatively different behaviors. The ratio of $^{16}O(e,e'K^{+})$ to the elementary process is nearly model independent. One can also attempt to infer from the data the photo-production section, which can then be compared to existing larger angle data from Hall B and other facilities.

Measurement and Feasibility: This measurement is a larger-angle version of E94-107, which has already run successfully in Hall A. If the cross sections drop rapidly with angle, the signal might become difficult to see, but given the range of models this appears to still provide a sufficient result.

Issues: The PAC was convinced that the measurement of the elementary $p(e,e'K^{+})\Lambda$ process is of sufficient interest to warrant measurement at both angles. The PAC did not find the argument for the measurement of $^{16}O(e,e'K^{+})^{16}N_{\Lambda}$ at all angles equally compelling.

Recommendation: Approve with B+ priority for 12 days

Individual Proposal Report

Proposal: PR-07-013

Scientific Rating: B

Title: Target Normal Single-Spin Asymmetry in Inclusive DIS $n^{\uparrow}(e,e')$ with a Polarized ^{3}He Target

Spokespersons: X. Jiang, T. Holmstrom, R. Gilman, T. Averett

Motivation: This experiment aims to measure the inclusive single-spin asymmetry A_N from a transversely polarized ^{3}He target in the kinematic range $2 < W < 3$ GeV and $1 < Q^2 < 3$ GeV^2, and thereby to explore the contribution of two-photon exchange to single-spin asymmetries (SSAs) in the DIS regime. Two-photon exchange effects have recently been revealed to be of great importance in the accurate extraction of nucleon form factors, particularly from data employing the Rosenbluth-separation technique. In the area of SSA observables, it is known that two-photon effects contribute at the few-percent level in quasielastic scattering. However, no data exist on the size of these effects in the DIS regime. Recent calculations indicate that two-photon effects in inclusive SSAs should drop with increasing W to the level of 10^{-4}. However, these calculations are model-dependent and it is important to establish (or at least constrain) the size of the two-photon effects as they may influence the interpretation of the mounting body of semi-inclusive DIS data in terms of transverse-momentum dependent parton distribution functions.

Measurement and Feasibility: This experiment requests zero beam time as it proposes to run parasitically with the approved transversity experiments E-06-010 and E-06-011. As the transversity experiments are semi-inclusive coincidence measurements, a new trigger for BigBite must be designed for this inclusive measurement, and must be able to deal with the high rate. In addition, to reduce systematic uncertainties to the experiment's goal of an asymmetry measurement at the 10^{-4} level, this experiment imposes requirements on beam quality, target density uniformity, and fast target-flipping rate well beyond those needed by transversity.

Issues: The PAC has two concerns. The first involves theoretical interpretation. The PAC applauds the collaboration's efforts in recruiting theorists to address the concerns of PAC29: the Christ-Leigh theorem clearly shows that a non-zero value of A_N *requires* two-photon exchange in the absence of T and P violations in the electromagnetic and strong interactions. (The small violations in the standard model give negligible asymmetries of the order of 10^{-7}.) However, one of the main motivations of this experiment is to help constrain two-photon effects in *semi-inclusive* SSAs in the DIS regime, and the connection between these and the inclusive SSAs to be measured here. Essentially, the goal of the experiment should not be simply the observation of another signature of two-photon exchange (whose existence is unquestioned) but to add to our present understanding of these effects. The PAC's second concern is that the technical requirements of this experiment, as listed in the previous paragraph, have only been addressed qualitatively by the collaboration to date. The PAC requests that a technical review be performed of the specific requirements of this proposal on the accelerator and experimental apparatus (e.g. the feasibility of the newly-proposed trigger), and that approval of the proposal be conditional on demonstration of its negligible impact on the transversity experiments.

Recommendation: C1=Conditionally Approve w/Technical Review

Individual Proposal Report

Proposal: PR-07-014

Scientific Rating: N/A

Title: Measurement of non-pole backgrounds in the extraction of the charged pion form factor.

Spokespersons: T. Horn, D. Gaskell and G. Huber

Motivation: To reliably extract the charged pion form factor $F_\pi(Q^2)$ it is proposed to constrain the size of the non-pole contributions in π^+ electroproduction by measuring the π^0 longitudinal electroproduction cross section above the resonance region at Q^2 = 2.45 GeV^2, 3.1 GeV^2 and 3.8 GeV^2 in a region of $t_{min} >$ 0.3. Simultaneous measurement of the π^0 / η ratio to test various factorization theorems is also proposed.

Measurement and Feasibility: The measurement uses the polarization transfer technique in the exclusive reaction $H(\vec{e},e'\vec{p})\pi^0$ to determine longitudinal over transverse ratio $R = \sigma_L / \sigma_T$ and extract the longitudinal cross section σ_L. The experiment would be performed in Hall A using the HRS-R to measure the scattered electrons and the HRS-L to measure the recoiling protons and their polarization using the focal plane polarimeter. The experimental technique is sound and was previously used in Hall A in the N-Δ transition study.

Issues: The PAC is concerned that a measurement of the π^0 channel in the proposed range of t and Q^2, cannot be related to the π^+ channel in a reliable way without establishing that factorization occurs in this process. This situation might change given results from the newly approved DVCS experiment, in which as a by-product, the longitudinal cross section is extracted using the Rosenbluth method.

Concerns about the final systematic uncertainties are noted. For example, in the listed uncertainties, the impact of the hard photon background subtraction on the polarization measurement could be large but was not included. This uncertainty also depends on the relative contribution of hard photons to that of pions and thus is model dependent since there are clear differences between the VGL and VGG models in the cross section predictions.

Recommendation: Defer

Individual Proposal Report

Proposal: PR-07-015

Scientific Rating:

Title: Measurement of double-spin asymmetries on a transversely polarized proton target in semi-inclusive DIS reaction

Spokespersons: X. Jiang

Motivation: Transverse momentum dependent (TMD) parton distribution functions, which necessarily depend on dynamics beyond the collinear approximation, provide information on correlations between parton spin and transverse motion and the spin of the nucleon. In particular, they could possibly arise from orbital motion. Recent observations of asymmetries at other experiments (e.g., HERMES) prove that these distribution functions can be accessed experimentally. The proposed experiment seeks to measure the double spin asymmetry in π^+ semi-inclusive deep inelastic scattering from a longitudinally polarized beam on a transversely polarized hydrogen target. A non-zero asymmetry arises from the TMD g_{1T} structure function which is the helicity (longitudinal) distribution of partons in a transversely polarized nucleon.

Measurement and Feasibility: The semi-inclusive asymmetry measurement is proposed in Hall C using the BETA spectrometer to detect the scattered electron in coincidence with positive pion detection in the HMS. It is proposed that the experiment could be run parasitically with the SANE experiment (E-07-003), however the SANE collaboration has stated that the HMS will be in use for calibration throughout SANE running, and hence is not available for a parasitic measurement. As a stand-alone experiment, the asymmetry measurement appears feasible given an experienced and large enough collaboration. Charge symmetric background at the lower scattered electron energies could be problematic.

Issues: While the exploration of TMD structure functions and fragmentation functions is exciting and topical, the present experiment can probably not relate the asymmetry to be measured, to the ratio of the g_{1T} and f_1 structure functions, as proposed. Assumptions are required including u-quark dominance and cancellation of the fragmentation function effects in the numerator and denominator. The limited range and relatively low values of pion transverse momentum possible in the present experiment would require extensive modeling of the momentum dependence in both fragmentation and structure function, which given that these dependences are not well known, would likely give the extracted g_{1T} large model-dependent systematic uncertainties. These uncertainties would undermine the theoretical tests that are motivating the experiment. Additionally, earlier experiments suggest that it is important to measure both signs of charged pions (and kaons if possible) in order to understand sea quark effects. We further note that experiments of this type could be performed at 12 GeV.

Recommendation: Defer

APPENDIX E

Individual Letter of Intent Report

Letter of Intent: LOI-07-001

Title: Study of Hypernuclei by Pionic Decay at JLab

Spokespersons: A. Margaryan, O. Hashimoto, S. Majewski, L. Tang

Motivation: This Letter of Intent describes a potential program of systematic studies of light hypernuclei at JLab using pionic decay. The Project aims at determination of structural properties, such as binding energies, lifetimes, production mechanism, and in-medium effects on electric and magnetic properties. The highlights of the proposed program include (i) precision measurements of binding energies of hypernuclei (100 keV resolution; to be compared with a current resolution ~700 keV); (ii) Studies of exotic, extremely rich halo hypernuclei such as $^{8}H_{\Lambda}$; (iii) Measurements of electromagnetic rates (and moments) using a "tagged-weak pi-method." If successful, the program described in the LOI has a potential to move JLab into the field of precision hypernuclear spectroscopy that is essential for making an impact on modern shell-model- and ab-initio calculations. To this end, the group intends to utilize the high-resolution kaon spectrometer (HKS) in Hall C, develop a high-resolution magnetic spectrometer for hypernuclear decayed pions (HπS), and develop a Cherenkov picosecond timing technique based on the recently proposed RF picosecond phototubes.

Measurement and Feasibility: As suggested by the TAC report, there are a number of potentially serious experimental issues with rates, resolutions, and backgrounds that need to be addressed by comprehensive simulations.

Issues: The above issues will need to be adequately addressed if this letter of intent is to proceed to a full proposal.

Recommendation: The physics motivations of this Letter of Intent are strong and the PAC encourages the proponents to develop this into a full proposal.

Individual Letter of Intent Report

Letter of Intent:: LOI-07-002

Scientific Rating: N/A

Title: RF Cerenkov picosecond Timing Technique for JLab 12 GeV Physics Program

Spokespersons: S. Majewski, L. Tang, O. Hashimoto

Motivation: The hypernuclear program proposed in LOI-07-001 requires the development of a new fast Cerenkov detector to provide a trigger to measure low momentum pions, so that the binding energy and lifetime of hypernuclear states can be measured.

Measurement and Feasibility: The proposed detector, with about 20 ps resolution, appears feasible.

Issues: The PAC finds the case for the timing technique would be compelling if it can be shown to have broad applicability, for example to particle identification improvements in CLAS or to improving signal to noise ratios in coincidence timing measurements. However, the PAC is not a technical advisory committee, and should only receive technical proposals such as this one as part of a physics proposal. TAC comments should be considered.

Recommendation: The PAC does not recommend proceeding to a full proposal.

APPENDIX F

Jefferson Lab Experiments, PAC 30,
Grouped by Category

(To access Appendix F, go to http://www.jlab.org/exp_prog/proposals/07prop.html.