

REPORT OF THE

JEFFERSON LABORATORY
PROGRAM ADVISORY COMMITTEE

PAC 27

MEETING OF JANUARY 12-14, 2005

The Thomas Jefferson National Accelerator Facility (Jefferson Lab) is a national physics user facility managed by the Southeastern Universities Research Association (SURA), Inc., for the U.S. Department of Energy (DOE) under contract DE-AC05-84ER40150.

For more information or copies of this report contact:

Thomas Jefferson National Accelerator Facility

Physics Division, MS 12H

12000 Jefferson Avenue

Newport News, VA 23606

Phone: (757) 269-7687 / Fax: (757) 269-5800

E-mail: ewing@JLab.org

WWW: http://www.JLab.org/exp_prog/PACpage/pac.html

DISCLAIMER

This report was prepared as an account of work sponsored by the United States Government. Neither the United States, nor the United States Department of Energy, nor any of their employees makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, mark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

Report of the
Jefferson Laboratory
Program Advisory Committee

PAC 27

Meeting of January 12 – 14, 2005

Letter from Director

February 25, 2005

Members of the Jefferson Lab User Group,

Moving Jefferson Lab and its scientific program forward into the future is an important objective for both the Lab and its user community. The Program Advisory Committee plays a critical role in ensuring that we are challenging ourselves by doing the best science our capabilities can deliver and in preparing for the 12 GeV upgrade. This month, the regular meeting of the PAC included a special session to look at any significant modifications or additions to the science program proposed for inclusion in the Conceptual Design Report currently in preparation. This session and its outcome will help us prepare for the 12 GeV Upgrade, keeping Jefferson Lab at the forefront of our field with the experimental facilities needed to take advantage of the new accelerator capabilities.

This Program Advisory Committee reviewed 17 proposals and 1 letter of intent. Of these, 7 were approved, 2 were deferred with regret, 6 were deferred and 2 were rejected. Four of the accepted proposals will be carried out in Hall A, 2 in Hall C and 1 in Hall B. The PAC continues to set the bar high with regard to the Jefferson Lab science program and for that, we at the Lab are very grateful.

I want to take the opportunity to recognize the retiring Chair of our User Group Board of Directors, Paul Stoler, for his service. Paul has been an effective spokesman and advocate for Jefferson Lab's user community. I also want to recognize Alexander Donnachie of the University of Manchester and Jen-Chien Peng from the University of Illinois at Urbana Champaign who are also rotating off the PAC. Their efforts on behalf of the user community have helped to continue the strength and vitality of our scientific programs. We look forward to their continued involvement in both the experimental program and user issues at Jefferson Lab.

Sincerely,

A handwritten signature in black ink, appearing to read 'Christoph W. Leemann', written in a cursive style.

Christoph W. Leemann

Letter from the PAC Chairman

Introduction

The Jefferson Laboratory Program Advisory Committee held its 27th meeting on January 10 - 14, 2005. 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 seventeen proposals and a letter of intent submitted by JLab users.

General Overview

The agenda of the PAC27 meeting consisted of two distinct components. At the time of the meeting the Jefferson Lab management, Staff, and User community were in the middle of preparing the Conceptual Design Report (CDR). In this ongoing process the pre-Conceptual Design Report (pCDR) will be developed into a CDR which will constitute the basis for the next important step on the way to the JLab12 GeV Upgrade, namely CD-1 approval. The laboratory has asked PAC27 to review any significant modifications and/or additions to the science program that are proposed for inclusion in the CDR for the Experimental Equipment. It has been a particularly stimulating meeting thanks to the excellent presentations of the physics and experimental opportunities which the JLAB 12 GeV Upgrade will make accessible. A separate PAC27 report will address the current status of the 12 GeV Upgrade proposal. The following report addresses the part of the meeting during which the new proposals and letter of intent submitted by JLab users were considered and evaluated.

The overall JLab program continues to show solid growth; prior to PAC27 it included 155 approved experiments. To date, 110 experiments have been completed at JLab, up by 8 over the last six months. Forty papers have been published or submitted to the Physical Review, Physical Review Letters and Physics Letters over the past year, in addition to over 42 papers published elsewhere. Archival papers dealing with the construction of the experimental facilities in the three halls have been published. The number of Ph.D. projects completed to date at JLab is 192 (up by 14 in the past six months), with an additional 153 projects in progress.

Turning to accelerator operations, the second half of FY04 has gone well, and the overall performance for the fiscal year included 27 weeks of operation with beam availability of 71%. Hall availability averaged 87% and the multiplicity (the average number of halls scheduled to take data) was 2.54. The expectation of beam delivered to experiments on an annual basis is typically 30 weeks, but was reduced to 27 weeks this fiscal year due to the impact of hurricane Isabel.

The physics scope of the proposals presented to PAC27 was again very broad. They could be categorized under five main themes.

The exploration of parity-violating (PV) electron scattering continues and expands into the realm of inelastic and deep inelastic reactions. A measurement of the weak charge of the proton provides a 4% determination of this fundamental quantity and at the same time explores the possibility of new physics beyond the electroweak scale. A precise data set on poorly known electroweak coupling constants can be extracted via the asymmetry in PV deep inelastic electron scattering. Experiments in PV inelastic electron scattering covering the resonance region provide new insights into quark-hadron duality, nucleon excitations via axial-vector current and the modelling of neutrino cross sections. The PAC is especially pleased that the proposed measurements for the inelastic reactions promise to yield very interesting results with a relatively modest amount of beam time.

Six proposals address physics questions on nucleons and nuclei in the deep-inelastic region. The topics considered are as follows: tests of GPDs, d/u-ratio at large x, color transparency (CT), charge symmetry violations (CSV) for parton distribution functions, origin of the EMC effect and the investigation of long range soft and short range hard processes. Most of these topics are part of the

science program of the JLab 12 GeV Upgrade as presented in the pCDR and it is in that high-energy regime that the most significant impact on the physics issues can be expected.

Three proposals can be seen as a continuation of the extraordinary effort of JLab to find a definite answer to the question of the existence of pentaquarks. Two of them asked already PAC26 for beam time. With those experiments the mass and width of the Θ^+ pentaquark could be determined with unprecedented accuracy. The search for a hypernucleus (bound state of the Θ^+ in nuclei) is the motivation of the third proposal.

Two other proposals address, directly and indirectly, the question of the limits on the importance of two-photon exchange effects in elastic electron scattering on the nucleon. A measurement of the target single-spin asymmetry A_y should provide clean evidence for the interference of one-photon and two-photon exchange effects. A high-precision determination of the Rosenbluth decomposition in electron-proton scattering would provide new limits of the importance of two-photon effects and should help in reducing the uncertainties in the nucleon form factors G_E^p and G_M^p .

The quest for a better understanding of the excitation spectrum of the nucleon provides the motivation of two other proposals. The goal of one of the experiments is the measurement of seven polarization observables for the photoproduction of eta-mesons in a wide photon energy range which should provide an almost complete data set for a partial wave analysis. The second proposal addresses the structure of the Roper resonance. A double-polarization electroproduction experiment yields data for tests with models.

Another proposal uses and improves on the capability to measure absolute elastic electron scattering cross sections with the high resolution spectrometers in Hall A. A measurement of the differential cross section on the deuteron with a precision of better than 3% will resolve long-standing inconsistencies among different data sets and provides theory with a boost for further investigations on this elementary nuclear system.

Recommendations

Of the sixteen proposals received, seven experiments were approved. The ratings for these seven proposals were one with A, four with A-, and two with B+. Two experiments have been deferred with regret.

The PAC approved four experiments in Hall A for a total of 50 days: PR-05-004, A(Q) at Low Q in ed Elastic Scattering, for 6 days, PR-05-007, Polarized e-2H Parity Violating Deep Inelastic Scattering at CEBAF 6 GeV, for 13 days, PR-05-009, High Resolution Study of the Resonance in nK+ System, PR-05-015, for 23 days, Measurement of the Target Single-Spin Asymmetry in Quasi-Elastic $^3\text{He}_{\text{polarized}}(e,e')$, for 8 days.

One experiment has been approved in Hall B for 37 days: PR-05-012, Measurement of Polarization Observables in eta-photoproduction with CLAS. Part of the experiment will be carried out concurrently with the approved experiments E02-112, E03-115, and E04-102. This experiment has been approved with the condition that on a coherent and balanced program for maximizing the physics output for all concurrently running programs should be agreed on with the Lab. Management.

Two experiments have been approved in Hall C for a total of 48 days to PR-05-008, The Q_{weak} Experiment: A Search for Physics at the TeV Scale via a Measurement of the Proton's Weak Charge, for 35 days, and PR-05-017, A Measurement of Two-Photon Exchange in Unpolarized Elastic Electron-Proton Scattering, for 13 days.

The laboratory guidelines provided for the approval of 47.5 days of beam time in Hall A, 80 days of beam time in Hall B, and 23 days of beam time in Hall C. Starting with PAC24, the formula for these guidelines has been modified, and is based on three components:

30/30/0 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 50%/50%/50% of the days under target in each hall. 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 90.5 days of approved time in four proposals were under jeopardy status, 17.5 in Hall A, 50 in Hall B and 23 in Hall C. Two of these proposals, together 29 days, were approved. The backlog in Hall A is now about 5.1 years, while the backlog in Hall B is 3.3 years and that of Hall C is 4.24 years. At this meeting the requests for beam time in Hall C far exceeded the Hall C allocation. Given so many outstanding proposals the PAC ended up by exceeding the laboratory guidelines in that hall by 13 days.

The proposal reports and the PAC recommendations for the reviewed proposals and the response to the letter of intent are given in Appendices D and E. The tables on the following pages summarise the status of the JLab commitments from PAC 4-PAC27.

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 putting the proposals in the context of ongoing theoretical work.

The enthusiastic and thoughtful contributions of Clara Perdue and Sue Ewing were especially effective in making the PAC process proceed gracefully and with high efficiency.

Berthold Schoch

Chairman, Jefferson Program Advisory Committee

Tables

Totals for PAC 4-27

	Experiments Recommended for Approval	Experiments Recommended for Conditional Approval	Totals
Experiments	159	4	163
Authors	1096	36	1132
Institutions	184	3	187
Countries	30		30

Approved Experiments Totals by Physics Topics

Topic				
	Number	Hall A	Hall B	Hall C
Nucleon and Meson Form Factors & Sum Rules	29	12	6	12
Few Body Nuclear Properties	28	17	6	5
Properties of Nuclei	28	7	11	10
N* and Meson Properties	51	10	31	10
Strange Quarks	22	4	15	3
TOTAL	159	50	69	40

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	32 3	579.1	20	345.8	2
B	53 7	516.3	16	208.5	1
C	26 2	577.5	13	270.0	1
Total	111 12	1672.9	49	824.3	4

APPENDICES

- A. PAC 27 Membership
- B. Charge to PAC 27
- C. PAC 27 Recommendations
- D. PAC 27 Individual Proposal Reports
- E. PAC 27 Individual Letters-of-Intent Reports
- F. Approved Experiments, PACs 4-27, Grouped by Physics Category

(To access Appendix F, go to http://www.JLab.org/exp_prog/PACpage/)

Appendix A
PAC 27 Membership

BERTHOLD SCHOCH (Chair)

Universitaet Bonn, Physikalisches Institut
Nussallee 12, Room 142
D 53115 Bonn, Germany
Phone/Fax: 49 228 73 2344/7869
schoch@physik.uni-bonn.de

NICOLA BIANCHI

INFN LNF, Via E. Fermi 40
00044-Frascati (Rome), Italy
Phone/Fax: 39-06-94032320/2559
nicola.bianchi@lnf.infn.it

ALEXANDER DONNACHIE

The University of Manchester
Theoretical Physics Group, Oxford Road
The Shuster Laboratory
Manchester, UK M13 9PL
Phone/Fax: 44 161 275-4190/4218
Sandy.donnachie@man.ac.uk

T. WILLIAM DONNELLY

Massachusetts Institute of Technology
Center for Theoretical Physics, 60300
77 Massachusetts Avenue
Cambridge, MA 02139
Phone/Fax: (617)253-4847/8674
Donnelly@lns.mit.edu

WILLIAM (BILL) DUNWOODIE

SLAC 2575 Sand Hill Road
Menlo Park, CA 94025
Phone/FAX: (650) 926-2729/926-4178
smd@slac.stanford.edu

EDDY JANS

NIKHEF, P.O. Box 41882
1009 DB Amsterdam
The Netherlands
Phone/Fax: 31 20 5922085/5155
eddy@nikhef.nl

SERGE KOX

Laboratoire de Physique Subatomique et
De Cosmologie (IN2P3/CNRS-UJF)
53 Avenue Des Martyrs
38026 Grenoble-Cedex, France
Phone/Fax: 33 4 76 28 41 55/4004
kox@in2p3.fr

PETER KROLL

Fachbereich Physik, Universitaet Wuppertal,
Gaustrasse 20
D-42097 Wuppertal, Germany
Phone/Fax: +49 202 439 2620/3860
kroll@physik.uni-wuppertal.de

ZEIN-EDDINE MEZIANI

Temple University, Physics Department
Barton Hall
1900 North 13th Street
Philadelphia, PA 19122-6028
Phone/Fax: (215)923-6416/(215)204-2569
meziani@temple.edu

JEN-CHIEN PENG

401B Loomis, Dept. of Physics
University of Illinois at Urbana-Champaign
1110 W. Green St.
Urbana, IL 61801-3080
Phone/Fax: (217) 244-6039/333-1215
jcpeng@uiuc.edu

ANDREW SANDORFI

Physics Dept., LEGS Group
Brookhaven National Lab, Bldg. 510A
Upton, NY 11973-5000
Phone/Fax: (516) 344-7951/2049
sandorfi@bnl.gov

PAUL STOLER

Rensselaer Polytechnic Institute
Dept. of Physics
Troy, NY 12180
Phone/Fax: (518) 2768388/6680
stoler@rpi.edu

Appendix B

Charge to PAC 27

Jefferson Lab requests that PAC 27:

- 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 27 Recommendations

Class*/Grade/Days

R	PR-05-001	Search for Exotic Pentaquark Θ^+ and Θ^{++} in Hall C at Jefferson Lab.
D	PR-05-002	The $\gamma+n \rightarrow \pi-p$ Process from 2H, 4He, 12C and the $\gamma+p \rightarrow \pi+n$ Reaction.
D/R	PR-05-003	Initial State Helicity Correlation in Wide Angle Compton Scattering.
A/B+/6	PR-05-004	$A(Q)$ at Low Q in ed Elastic Scattering.
D/R	PR-05-005	Parity Violating Electron Scattering in Resonance Region (Res-Parity).
R	PR-05-006	Measurements of Charge Symmetry Violating Quark Distributions.
A/A-/13	PR-05-007	Polarized e-2H Parity Violating Deep Inelastic Scattering at CEBAF 6 GeV.
A/A/35	PR-05-008	The QWeak Experiment: A Search for Physics at the TeV Scale via a Measurement of the Proton's Weak Charge.
A/A-/23	PR-05-009	High Resolution Study of the Resonance in nK^+ System
D	PR-05-010	Structure of the Roper Resonance from Measurement of the Double-Polarization $p(e,e'p)\pi^0$ Reaction.
D	PR-05-011	Coherent Vector Meson Production Off the Deuteron
A/A-/37	PR-05-012	Measurement of Polarization Observables in η -photoproduction with CLAS
D	PR-05-013	A Search for Bound Θ^+ Nuclei in Hall A
D	PR-05-014	Neutron Tagged Bound Proton Structure to Probe the Origin of the EMC Effect
A/B+/8	PR-05-015	Measurement of the Target Single-Spin Asymmetry in Quasi-Elastic $^3\text{He}^+(e,e')$
D	PR-05-016	Measurement of the F_2n/F_2p and d/u Ratios in Deep Inelastic Electron Scattering Off the Tritium and Helium Mirror Nuclei
A/A-/13	PR-05-017	A Measurement of Two-Photon Exchange in Unpolarized Elastic Electron-Proton Scattering.

- A=Approve, C=Conditionally Approve, D=Defer, DR= Defer with Regret, R=Reject

Appendix D

Individual Proposal Reports

Proposal: PR 05-001

Scientific Rating: N/A

Title: Search for Exotic Pentaquark Θ^+ and Θ^{++} in Hall C

Spokespersons: H. Gao, W. Xu, S.N. Nakamura

Motivation: Several experiments have reported observations of the exotic baryon state denoted as the $\Theta^+(1540)$. The observed mass positions vary from 1525 to 1555 MeV with widths consistent with detector resolution. The proposed experiment would confirm the existence of this state, and measure the mass and width to high precision. In addition, a search would be performed for the doubly-positive-charged pentaquark states expected in certain theoretical models, while investigating the possibility that the $\Theta^+(1540)$ might be isovector rather than isoscalar.

Measurement and Feasibility: The experiment requests 20 days of beam time in Hall C. For the doubly-positive-charged measurement [measurement A: 8 days], untagged bremsstrahlung end-point-spectrum photons from a 50 μ A, 3.825 GeV electron beam interact in a 4 cm LH₂ target to produce a forward K^- , which is detected in the Short-Orbit Spectrometer (SOS) in coincidence with a proton [or K^+] in the High Momentum Spectrometer (HMS). The energy of the incident photon and the momentum vector of the missing K^+ [or proton] can be calculated under the assumption that only the latter is produced in addition. The K^+p mass scale is well known ($\delta M = \pm 1.0$ MeV), and the mass resolution is 9.1 [or 6.6] MeV full-width-half-maximum (FWHM). The mass and width of the $\Theta^+(1540)$ would be measured using the interactions of the bremsstrahlung photon end-point spectrum from a 25 μ A, 3.475 GeV electron beam in a 4 cm LD₂ target [measurement B: 12 days]. A forward K^- is detected in the SOS in coincidence with a K^+ in the High resolution Kaon Spectrometer (HKS) and a neutron in a dedicated neutron counter, so that the energy of the incident photon and the momentum vector of the spectator proton can be calculated uniquely, assuming the latter to be the only undetected final state particle. The invariant mass of the $n K^+$ system is measured with a mass scale uncertainty $\delta M = \pm 0.5$ MeV and a mass resolution of 3.7 MeV (FWHM). The forward K^- is detected in a momentum-transfer-squared range from 0.6-1.3 (GeV/c)². The HKS and beam splitter from the HN E01-011 experiment, and the Bremsstrahlung radiator are required for this experiment, as is a neutron detector which has yet to be built. The HKS and neutron detector are located out of plane at angles (-32, -11) and (-23, +14) deg., resp., and the SOS spectrometer is positioned at +20 deg. A prototype neutron counter has been tested, but the experiment would benefit from direct confirmation of expected background levels, accidental rates and neutron efficiency; such tests are to be performed during the requested time allocation. Direct experimental checks of mass resolution and precision of mass scale are also planned during the running period requested; these will make use of the reaction $\gamma n \rightarrow K^+\Sigma^-$ with $\Sigma^- \rightarrow \pi^- n$ and also of elastic e-p scattering. The experiment seems feasible as proposed, although the accidental rates in the neutron detector are of concern.

Issues: The change in experimental configuration with respect to the original proposal [PR-04-004] has addressed many of the issues raised previously by the TAC with respect to measurement B. Shielding of the neutron counter has been increased, and in addition the counter will be positioned 10 m from the target. Background simulations indicate that the levels in the neutron counter will be

low, but despite repetitive TAC and PAC requests for detailed information on this, the concerns remain that the stated signal-to-background estimate may be overly optimistic. The TAC has also expressed concerns about the probability of accidentals as a result of the large [30 ns] timing window of the neutron counter. The readiness of the HKS (out of plane setting) and the neutron counter is essential to the experiment. At the present time the existence of the Θ^+ has not been established with certainty, although high statistics data should be forthcoming soon from the tagged photon experiments on LH₂ and LD₂ in the CLAS detector. In this regard, it should be recalled that, at the behest of PAC 25, an extensive effort has been undertaken to calibrate the tagger precisely, and to establish carefully the mass scale for CLAS event reconstruction.

In light of present knowledge and previous searches for the doubly-charged state, and the availability of high statistics data on the same reaction from the CLAS LH₂ experiment in the near future, it appears difficult to justify the need for measurement A.

For measurement B, this proposal does not compare favorably to that for a similar high resolution search in Hall A. The present proposal suffers from serious uncertainties, even after two iterations, in terms of the counting rates in the neutron detector. In addition the most recent estimate of the mass resolution which can be achieved (3.7 MeV FWHM) is significantly worse than that for the Hall A measurement (2.1 MeV). Finally, a major installation effort is required in Hall C (related to installation of the HKS in an out-of- plane configuration, work in the downstream region, etc.). Overall the PAC favors the Hall A experiment and does not regard scheduling two measurements to be appropriate.

Recommendation: A: Reject

B: Reject

Proposal: PR-05-002

Scientific Rating: N/A

Title: The $\gamma + n \rightarrow \pi^- + p$ process from ${}^2\text{H}$, ${}^4\text{He}$, ${}^{12}\text{C}$ and the $\gamma + p \rightarrow \pi^+ + n$ reaction.

Spokespersons: Dipankar Dutta, Haiyan Gao, Roy Holt

Motivation: This proposal has three distinct parts:

- I. The measurement of charged pion photo-production from nucleons as a function of \sqrt{s} above the resonance region at fixed θ_{cm} to study the interplay of dimensional scaling and possible superimposed oscillatory modulation.
- II. If these oscillations are verified, the measurement of the cross section in ${}^{12}\text{C}$ to try to observe nuclear filtering.
- III. To study the possibility of color transparency by observing the t dependence of pion photo-production in ${}^4\text{He}$.

Measurement and Feasibility: The measurement would utilize bremsstrahlung photons and the two HRS spectrometers in Hall A. Each experimental point requires a different beam energy. Thus, 7 beam energies are required. The TAC points out that it would be difficult to run other experiments while this experiment runs, because of the required specialized beam energies. However, it appears there is some flexibility in the exact required values of \sqrt{s} so that the collaboration could possibly run *opportunistically* whenever conditions are such that other experiments are run at or near the required energies. The number of proposed beam energies has been reduced from the previous experiment in order to lessen this impact. However, this results in a reduced density of \sqrt{s} points (see below).

Issues: Regarding Part I above, the PAC believes that pion photo-production remains one of the fundamental processes in nuclear physics, and as such a detailed measurement of the differential cross section as a function of \sqrt{s} at constant θ_{cm} is motivationally sound. In analogy with other exclusive reactions, one would like to know whether dimensional scaling-like behavior is observed with increasing \sqrt{s} . Although previous data indicate some suggestions of scaling with superimposed undulations, they also suggest a remarkable amount of structure in the interface between the resonance and continuum regions. The PAC is convinced that detailed mapping of the \sqrt{s} dependence of the cross section with sufficient density of data points, including the entire range of \sqrt{s} from about 2 GeV where the particularly strong variations are observed, and continuing through the region where possible undulations are observed will be of significant interest. The PAC does not believe that the proposed number and density of points in \sqrt{s} are nearly enough to carry this out.

The proposal speculates that such undulations, if they exist, may be due to interference between sub leading long range and short range hard processes. However, the PAC expects that at these energies soft processes may be dominant, and such structures may not be explicable in terms of simple processes. Still, there is a considerable literature on this subject and having detailed cross sections over this \sqrt{s} interval would be very useful.

Regarding Part II, the PAC considers Part II to be moot in light of our recommendations for Part I. Even if the undulations of part I were established, the density of points would be too low to be able to map out the possible structure in Part II.

Regarding Part III, the evidence obtained in the analysis of the ${}^4\text{He}$ does not show any significant evidence of color transparency given the size of the systematic and statistical errors, coupled with uncertainties inherent in the basic Glauber type approximation used.

The PAC is not convinced that extending the measurements to $t = -5 \text{ (GeV/c)}^2$ will clarify the situation.

Recommendation: Defer.

Proposal: PR-05-003

Scientific Rating: N/A

Title: Initial State Helicity Correlation in Wide Angle Compton Scattering

Spokespersons: Donald Day, Bogdan Wojtsekhowski

Motivation: The aim of this experiment is a measurement of the initial-state helicity correlation A_{LL} for real Compton scattering off protons (RCS), thus to allow for a further test of the dynamical interpretation of RCS at intermediate energies. Comparison of data on A_{LL} to the polarization transfer variable, K_{LL} , already measured at $s=7 \text{ GeV}^2$ and at a scattering angle of 120° (E99-114) and planned to be measured at the same energy but different angles (E03-003), will provide valuable information on the dynamics of RCS. In current dynamical approaches to RCS differences between both observables can be traced back to quark helicity flip, and hence to quark masses.

Measurement and Feasibility: The proposed experiment uses circularly polarized bremsstrahlung photons at an energy of 4.3 GeV, generated by a longitudinally polarized electron beam. The photons will be scattered off a polarized NH_3 target. The scattered photons will be detected in the BigCal calorimeter and the recoil protons in the HMS spectrometer. The experiment uses standard equipment, thus can be judged feasible. The large background from π^0 photoproduction seems to be under control. Also the Moeller electron background will be limited by the magnetic field in the target region. The A_{LL} parameter will be measured at $s = 9 \text{ GeV}^2$ and two c.m.s. scattering angles (70° and 140°) with an overall error less than ± 0.10 . As a by-product, A_{LL} will be measured also for the photoproduction of neutral pions.

Recommendation: Defer with regret

Proposal: PR-05-004

Scientific Rating: B⁺

Title: $A(Q)$ at low Q in ed Elastic Scattering

Spokespersons: Ronald Gilman, Doug Higinbotham, Xiaodong Jiang

Motivation: Discrepancies of the order of 10% between two high-precision data sets of the elastic deuteron electromagnetic form factor $A(Q^2)$ in the range $0.2 < Q < 0.5$ GeV/c prevent us from reaching definite conclusions on the role of relativity in the description of the deuteron and testing conclusively different calculations. Furthermore, Chiral perturbation calculations are becoming available to test our understanding of this simple nuclear system using symmetries of the basic theory of strong interaction namely QCD.

Measurement and Feasibility: The measurement requires an improved knowledge of the HRS spectrometers, reduced uncertainties in the scattering angle and acceptance, as well as a more precise determination of the beam intensity at all beam currents. Satisfactory progress has been made by the proponents to achieve the required level of uncertainties for this measurement. The stated goal of a total systematic uncertainty of 3% or better appears feasible. The beam current monitor (silver calorimeter) design and construction, needed for the measurements of the absolute current below $1 \mu\text{A}$, is well in progress.

Issues: The experiment is in principle feasible at other accelerators like MAMI (Mainz). At Jefferson Lab, the effort of this group will bring a timely answer to the physics issues and will also improve the performance of the HRS.

Recommendation: Approve for 6 days in Hall A

Proposal: PR-05-005

Scientific Rating: N/A

Title: Parity-Violating Electron Scattering in the Resonance Region

Spokespersons: P. Bosted, V. Dharmawadane, H. Mkrtchyan

Motivation: The objective of the experiment is to measure the parity-violating (PV) asymmetries of ^1H and ^2H , namely A_p and A_d , at $Q^2 = 0.4$ and 1.0 $(\text{GeV}/c)^2$ in the resonance region ($1.1 < W < 2.2$ GeV). A search for resonance structures in A_p and A_d as a function of the Nachtmann scaling variable ξ will be performed. Applicability of the concept of local and global quark-hadron duality in the weak neutral current sector can be investigated. The results will be sensitive to down/strange quark contributions and to the axial-vector current. Calculations predict relatively large asymmetries of between 40 and 80 ppm for ^2H at $Q^2 = 0.4$ and 1.0 $(\text{GeV}/c)^2$, respectively. Additionally, the PV asymmetries can provide very valuable information for modeling of neutrino interaction cross sections, which is important for neutrino oscillation experiments, and will serve in modeling of the background in the SLAC E158 measurement of PV in Møller scattering.

Measurement and Feasibility: A longitudinally polarized electron beam of $80 \mu\text{A}$ will impinge on 25 cm long LH2 and LD2 targets. The scattered electrons will be detected at 11° in the lead glass array of the HMS, which will be operated in flux-integrating mode. The anticipated statistical uncertainty per W-bin of 0.15 GeV amounts to $\approx 7\%$.

Issues: The contribution to the asymmetry of electrons that are scattered from the polarized iron of the dipole of HMS is at present unknown. GEANT simulations and analysis of either existing or newly collected data should be pursued to determine this background contribution. The PAC has doubts about the possibility to test local duality with the projected data due to the coarse resolution in W. However, the interpretation of neutrino experiments would greatly benefit from these asymmetry data, since they would eliminate the need to extrapolate from higher Q^2 using theoretical models and fits. This would be especially the case if the measurements would involve not only hydrogen and deuterium, but also a nuclear target of relevance for neutrino oscillation studies, such as carbon or oxygen.

Recommendation: Defer with regret.

Individual Proposal Reports

Proposal: PR-05-006

Scientific Rating: N/A

Title: Measurements of Charge Symmetry Violating Quark Distributions

Spokespersons: Kawtar Hafidi, Brahim Mustapha

Motivation: The goal of the experiment is to detect charge symmetry violation (CSV) in the nucleon's valence quark distributions through a measurement of charged pions in semi-inclusive deep-inelastic electron-deuteron scattering. While charge symmetry (CS) is generally assumed for the parton distribution functions (PDF), no direct search for CSV effects in PDF has ever been made. Current PDF parameterizations allow CSV effects up to the 10% level, and the CSV effect has been proposed as a possible explanation for the NuTeV anomaly. The proposed experiment aims at a determination of the CSV effect of the proton's valence quark distribution at ~3% sensitivity level.

Measurement and Feasibility: The proposed experiment would measure the ratios of the π^- to π^+ production yields on deuterium for $x=0.35$ and 0.45 and $0.5 < z < 0.65$ using a 6 GeV electron beam in Hall C. The SOS spectrometer would be used to detect the scattered electrons and the charged pions would be detected by the HMS spectrometer. A similar experiment (E00-108) using a lower energy electron beam was successfully carried out. The proposed measurement is technically feasible.

Issues: The PAC recognizes the importance and timeliness of an experiment dedicated to a sensitive search for CSV effects in PDF. A clear observation of the CSV effect would have tremendous impact on our understanding of the parton distributions in the nucleon, as well as on fundamental symmetries. While the proposed measurement is feasible, the PAC is not convinced that the CSV effect could be extracted reliably from the data. In particular, the extraction of CSV relies on a leading-order expression assuming the validity of factorization. For the proposed kinematics, many potentially important and undetermined corrections to this simplified picture could arise. These include the contamination of pions from vector meson decay and from target fragmentation, final state interactions, and power corrections. The PAC believes that the leading-order expression used in the proposal could not be justified at 6 GeV, making it extremely difficult to reach the ambitious goal of this experiment.

Recommendation: Reject

Proposal: PR-05-007

Scientific Rating: A⁻

Title: Polarized e⁻H Parity Violating Deep Inelastic Scattering at CEBAF 6 GeV

Spokespersons: Xiaochao Zheng, Paul E. Reimer

Motivation: A measurement of the parity-violating deep inelastic asymmetry of longitudinally-polarized electron scattering off deuterium is proposed. From the asymmetry measurement, precise information on a combination of the poorly known weak vector Z-electron times axial Z-quark couplings will be extracted. These couplings might be sensitive to physics beyond the Standard Model. Hadronic higher twist effects should also be considered, although they are expected to be small.

Measurement and Feasibility: The two Hall A HRS spectrometers will be used to detect the electrons scattered from a 25 cm long liquid deuterium target. The deuteron is chosen as target due to the isospin symmetry that relates u and d quark distributions in the proton and neutron. Two different angular and momentum settings will allow a measurement at Q^2 values of 1.1 and 1.9 (GeV/c)², at x=0.25 and 0.3, respectively.

A Compton polarimeter upgrade for a 1% precision measurement of the beam polarization and a fast DAQ to handle rates of about 1 MHz are specifically foreseen for this measurement.

The experiment appears feasible and the running time can be divided readily into two phases as described in the proposal.

Issues: The PAC recognizes the importance of the proposed measurement of the vector-axial (VA) couplings for which accurate Standard Model predictions are available. The precise evaluation of higher twist effects in the Q^2 range of the measurement is also relevant.

A careful investigation of the possible background from rescattering of polarized electrons inside the spectrometer should be performed.

The PAC recommends the approval of the first phase, which already results in a significant improvement in this field. It will also allow extremely useful preparation for a second phase of the experiment which can be presented in the future.

Recommendation: Approve for 13 days in Hall A

Proposal: PR-05-008

Scientific Rating: A

Title: The Q_{Weak}^p Experiment: A Search for Physics at the TeV Scale via a Measurement of the Proton's Weak Charge

Spokespersons: Roger Carlini, David Bowman, Mike Finn, Shelly Page, Stan Kowalski

Motivation: The goal of this very low Q^2 ep-scattering parity-violation (PV) experiment is to extract the so-called weak charge of the proton, $Q_w^p = 1 - 4\sin^2\theta_w$, and hence the weak mixing angle θ_w . The Standard Model predicts how the latter runs from its value at the Z^0 pole, where it is determined very precisely, to low Q^2 . From the complete Q_{Weak}^p experiment a determination of Q_w^p at $Q^2=0.03$ (GeV/c)² with an uncertainty of 4% is anticipated, permitting verification of the predicted running of $\sin^2\theta_w$. Deviation from the expected value of $\sin^2\theta_w$ would require extensions to the Standard Model and, when used in concert with the purely leptonic PV measurement E158, help constrain which classes of extensions are viable. Run I, which requires 14 days of data-taking would result in an 8% measurement of Q_w^p , while after the additional 92 days of production foreseen for Run II the total error would have been halved.

Measurement and Feasibility: This low Q^2 asymmetry contains two contributions, Q_w^p , which is the desired SM quantity, and effects from hadronic form factors. The latter decrease in importance as $Q^2 \rightarrow 0$; however, at $Q^2 = 0.03$ (GeV/c)² these are predicted to amount to $\approx 1/3$ of the asymmetry. The world data on PV electron scattering will be used to constrain these contributions and accordingly they are predicted to be responsible for about half of the total uncertainty in Q_w^p at the end of Run II.

The Q_{Weak}^p detector has matured considerably since its first presentation to PAC21 in January 2002. A tracking system, consisting of sets of triple-GEM detectors as well as horizontal and vertical drift chambers, has been added to enable the precise determination of the acceptance-weighted Q^2 distribution. Detailed GEANT simulations have resulted in a V-shaped design of the quartz bars in which the scattered electrons will be detected. A half-length prototype fused silica bar has been tested successfully with beam in the detector hut of the SOS spectrometer.

Issues: The problem of the 2.5 kW cooling power of the LH2 target is solved, albeit by exhausting practically all of the cryogenic cooling power available for other experiments. Ongoing R&D activities to increase the polarization of the beam via super lattice photocathodes are yielding encouraging results. Precise beam polarimetry in Hall C, which is crucial for the Q_{Weak}^p experiment, involves two projects: upgrade of the Møller polarimeter to higher currents and design of a Compton polarimeter. Both projects are making good progress, although the latter continues to be on the critical path. The collaboration is strongly encouraged to test new and critical components of the setup, such as the GEMs, beforehand under realistic beam conditions to permit commissioning of the complete Q_{Weak}^p detector in a timely fashion. Funding from DOE/NSF/NSERC is in place for Q_{Weak}^p ; however, limitations in cash flow also appear to be a critical path issue and could have an impact on timely running of the experiment.

Q_{Weak}^p ; however, limitations in cash flow also appear to be a critical path issue and could have an impact on timely running of the experiment.

The allocation of beam time for Run II should be considered by the PAC and JLab management only once sufficient details are known about the performance of the numerous critical technical aspects of the Q_{Weak}^p experiment.

Recommendation: Approve for 35 days in Hall C.

Proposal: PR 05-009

Scientific Rating: A⁻

Title: High Resolution Study of the Resonance in the $n K^+$ System

Spokespersons: B. Wojtsekhowski, P. Reimer, G. Cates, V. Nelyubin

Motivation: Several experiments have reported observations of the exotic baryon state denoted as the $\Theta^+(1540)$. The observed mass positions vary from 1525 to 1555 MeV with widths consistent with detector resolution. The proposed experiment would confirm the existence of this state, and measure the mass and width to high precision.

Measurement and Feasibility: The experiment requests 20 days of 5.0 GeV electron beam time in Hall A at a current of 30 μ A, plus 3 days for set-up, testing and calibration studies. The mass and width of the $\Theta^+(1540)$ would be measured using a deuterium target. A forward K^- would be detected in the HRSL spectrometer equipped with a septum magnet, a low-momentum K^+ would be measured in BigBite, and a neutron counter would detect the final state neutron. The invariant mass of the $n K^+$ system would be measured with a mass scale uncertainty of $\delta M = \pm 0.5$ MeV and a mass resolution of 2.1 MeV full-width-half-maximum. The neutron counter is under construction, and a prototype has been tested, while commissioning of the BigBite Spectrometer is under way. Expected background levels, accidental rates, mass resolution and precision of mass scale and resolution have been extensively checked by the proponents in the course of E04-012, and the results are in excellent agreement with the estimates contained in the present proposal. As described, the experiment appears to be feasible.

Issues: The readiness and availability of BigBite and the neutron counter are essential to the experiment, and both should be available by early 2006. The PAC feels positive about the high precision offered by the proposed measurement. Although at the present time the existence of the Θ^+ has not been established with certainty and cross section estimates are highly model-dependent, high statistics data should be available soon from the tagged photon experiments on LH_2 and LD_2 in CLAS. If these experiments confirm the existence of the Θ^+ , the proposed experiment should improve greatly the precision of the mass and width measurements while providing information on the differential cross section for the momentum transfer squared region accessible. If no conclusive signal is observed, a highly-restrictive upper limit on the differential cross section for the acceptance region of the experiment should be established.

Recommendation: Approve for 23 days in Hall A

Proposal: PR-05-010

Scientific Rating: N/A

Title: Structure of the Roper resonance from measurements of the double-polarization
 $p(\vec{e}, e'\vec{p})\pi^0$ reaction

Spokespersons: S. Sirca, O. Gayou, A. Sarty and S. Gilad

Motivation: The Roper is the lowest lying positive parity N^* resonance with a structure that remains shrouded in mystery despite its *four star* PDG status. While a range of models with very different excitation mechanisms has been proposed, key discriminating characteristics such as the Q^2 dependence of its multipole amplitudes are very poorly determined. For example, a *breathing mode* excitation to a $(1s)^2(2s)^1$ three-quark configuration would be expected to lead to sizeable S_{1-} strength, while the excitation of a hybrid with a (q^3g) configuration should be dominated by the M_{1-} multipole with very little accompanying S_{1-} strength. An accurate multipole decomposition is the most information an experiment can offer to theory and in this case its impact would clearly be very high. This is badly needed in the region of the Roper.

Measurement and Feasibility: It is proposed to use a standard hydrogen target and the two HRS spectrometers in Hall A, one equipped with a focal plane polarimeter. Data would be taken at a single angle corresponding to $\theta_{\pi q} = 180^\circ$ with the proton recoiling along the virtual photon momentum (*anti-parallel* kinematics). Scans in W would be carried out at two values of Q^2 and one scan in Q^2 would be made at the peak of the Roper, $W = 1440$ MeV. The collaboration has used this apparatus successfully in studies of the $N \rightarrow \Delta$ transition and there is little doubt that the proposed measurements in the region of the Roper could be completed successfully.

Issues: The collaboration has chosen the goal of testing models, rather than obtaining the data necessary for an independent multipole analysis which could address the structure of the Roper. However, a failure of a particular model, whose parameters have not been constrained properly due to a serious paucity of data, would not be terribly surprising and would have little real impact. A complete multipole analysis requires measurements of many different observables and, as such, may even require several proposals. Recoil polarization asymmetries can certainly play a vital role. However, it is essential that each measurement be part of a coordinated plan. In the absence of such an overall plan we are likely to end up some years from now with a collection of data sets, all at different Q^2 values, that cannot be analyzed as a unit. This is extremely undesirable.

A full Roper *campaign* very likely will be limited to a few values of Q^2 . The spokesmen have argued that an exploratory experiment involving a scan in Q^2 is necessary to avoid measuring at a zero crossing in one of the major Roper multipoles ($A_{1/2}$ or $S_{1/2}$). While this is a valid point, the present experiment will not serve that function. The proposed data would yield information on a single observable at a single angle, which is insufficient for even the most limited multipole analysis. We suggest the collaboration begins the task of coordinating experiments in the different Halls so as to mount a serious joint effort aimed at determining the π -production multipoles in the very interesting region of the Roper resonance. Coordination by a *Roper Working Group*, or some equivalent structure, could maximize the scientific impact of what will likely be a challenging but important set of experiments.

Recommendation: Defer

Proposal: PR-05-011

Scientific Rating: N/A

Title: Coherent Vector Meson Production off the Deuteron

Spokespersons: Laird Kramer, Franz Klein, Stepan Stepanyan

Motivation: A reduced interaction probability for a compact colorless object in hadronic matter is a basic consequence of QCD. However, a non-ambiguous signal for *Color-Transparency* (CT) requires both the verification of small point-like configurations as well as an associated reduction in the reaction cross section. Despite several campaigns at BNL, SLAC, FNAL, DESY and JLab, a definitive signal for CT remains elusive. This is likely due to the rapid expansion of point-like configurations which increases their interaction probability and so masks CT.

This experiment is motivated by theoretical calculations which suggest that expansion effects can be controlled in reactions with deuteron targets under special kinematics in which rescattering contributions are large. The proposed *signal* for CT appears in a ratio of cross sections at high $-t$, where rescattering is expected to be significant, to low $-t$, where single nucleon reactions should dominate. Meson production is chosen, instead of nucleon knockout, since small $q\bar{q}$ configurations should be formed more readily than small qqq baryons.

Measurement and Feasibility: This is a resubmission of proposal E-02-012 under jeopardy review. Approximately 10% of the desired data have been collected during the E6 running period and an additional 50 days is requested.

The proposed experiment would measure the fully-exclusive reaction $D(e, e'VD)$, where $V = \rho, \omega$ and ϕ mesons would be reconstructed from their decay products in the CLAS. Vector meson production with longitudinal photons is predicted to have substantially smaller higher-twist corrections and so smaller theoretical uncertainties. The associated cross sections are planned to be extracted from vector-meson decay angular distributions assuming s -channel helicity conservation. A standard deuterium cryo-target would be positioned 60 cm upstream to increase the CLAS forward angle acceptance. A new solenoid, built at Saclay for a DVCS experiment, would be used instead of the standard mini-torus to reduce Møller electrons in the expectation of running at a high luminosity of $2 \times 10^{34} \text{ cm}^{-2} \text{ s}^{-1}$.

Issues: Past CT experiments have been plagued by ambiguities in the interpretation of data. It is not clear at the outset that this experiment is free of such problems. All calculations of CT effects presented in the proposal were carried out within a single model. It is not clear that the 20-30% effects predicted in the cross section ratio could not be generated by traditional nuclear many-body contributions.

Preliminary data from the E6 run with 10% of the desired statistics were presented, without separation of the longitudinal component, and compared to calculations. Given the theoretical uncertainty band, reducing these errors by a factor of three would certainly be inconclusive. While the predicted theoretical uncertainty shrinks substantially for the ratio of longitudinal cross sections, extracting this component requires s -channel helicity conservation. This is expected to be valid to the 95% level for ρ -production, seriously violated for ω -production and somewhere in between for ϕ -production. Even for ρ -production, the shape of the ρ signal will be distorted by interference with the *Drell-Söding* amplitude (2π production followed by recombination as a ρ). This effect is t -dependent and will alter the CT ratio *signal*. Data presented from the E6 run suggest that *Drell-Söding* interference may already be affecting the results at $-t = 0.4 \text{ (GeV/c)}^2$. It has not been demonstrated that corrections associated either with this effect, with ρ - ω interference or with violation of s -channel helicity conservation are not magnified in the ratio *signal*. The very technique that has amplified the apparent sensitivity in the CT *signal*, taking the ratio of two rapidly falling cross sections, can also amplify the uncertainties from t -dependent effects. The collaboration should undertake a more thorough modeling of the data extraction and investigate possible variations in the calculations due to conventional nuclear effects. Assuming the corrections can be adequately

handled, it may prove useful to consider forming the ratio of integrals over broader ranges in $-t$, such as $-t < 0.4$ and $-t > 0.8$. This could potentially increase the statistics and substantially reduce the required running time.

Due to limited CLAS acceptance at 6 GeV, the coherence length for this study was fixed at $l_c = 0.5$ fm. This is substantially smaller than the inter-nucleon distance in deuterium and from calculations with $l_c = 0.7$ fm it is clear that the CT signal grows rapidly with l_c . The collaboration is urged to consider planning an experiment with the upgraded machine at 11 GeV where a search at larger l_c is compatible with the CLAS acceptance.

Recommendation: Defer

Proposal: PR-05-012

Scientific Rating: A

Title: Measurement of Polarization Observables in eta-photoproduction with CLAS

Spokespersons: Eugene Pasyuk, Michael Dugger

Motivation: It is proposed to measure the observables Σ , T , P , E , F , G and H in η photoproduction with a polarized beam and polarized frozen-spin target in the CLAS, for photon energies in the range 0.75 – 2.0 GeV. This represents an “almost complete” set of variables for this channel. Taken together with approved experiments E02-112, E03-115 and E04-102, this will provide the data required for a multipole analysis with minimal ambiguities and will yield valuable information on the N^* resonances.

Measurement and Feasibility: The recoil proton will be detected and the missing mass technique used to identify η photoproduction. Energy bins will be 25 MeV wide below 1.4 GeV and 50 MeV wide above 1.4 GeV. The data will be subdivided into 10 angular bins in the $\cos \theta$ range from -0.9 to 0.9 at each energy. The Hall B tagger covers a range in photon energies from 20% to 95% of the incident electron beam energy. Unpolarized, circularly polarized and linearly polarized tagged photon beams are presently available. The design and construction of the Hall B frozen spin target is well underway and the current plan is to have the target operational for experiments by the end of 2005. The CLAS detector will be used in its standard configuration and will be compatible with the approved experiments using the frozen spin target. Some data-taking in parallel will be possible. Projected uncertainties in the polarization observables are of the order of ± 0.1 for most of the asymmetries, but may be larger for some such as G .

Issues: It is necessary to see how this proposal integrates with the approved experiments E02-112, E03-115 and E04-102 using the frozen spin target as part of a coherent approach to understanding the baryon spectrum. A coherent and balanced program for maximizing the physics output from the suite of experiments on K , π and η photoproduction should be agreed upon with the Lab management.

Recommendation: Conditional approval for 37 days in Hall B.

Proposal: PR 05-013

Scientific Rating: N/A

Title: A Search for Bound Θ^+ Nuclei in Hall A

Spokespersons: R. Feuerbach

Motivation: The proposal is aimed at searching for a hypernucleus (that is, a bound state of the θ^+ in a nucleus) by means of the reaction $\gamma A \rightarrow K^-(\theta^+A)$. The information obtained from the measured levels observed could help in determining the properties of the binding potential and possibly the parity of the θ^+ .

Measurement and Feasibility: The experiment is proposed for 8 days in Hall A, using the experimental design used successfully for the Hypernuclear experiment E94-107. Septum magnets are used to select small momentum transfers at very small polar angles, allowing large ϕ coverage. The two HRS spectrometers will detect the scattered electron and the produced K^- , which allows the mass of the θ^+ hypernucleus to be determined by a missing mass technique. With this set-up, very good resolution can be achieved (about 1 MeV) and measuring the spectroscopy of the various bound states is possible. The experiment will require high luminosity ($10^{38} \text{ cm}^{-2} \text{ s}^{-1}$) and will use a set of 7 ^{12}C target foils spaced by 3 cm, giving a total of 700 mg/cm^2 , and a $40 \mu\text{A}$ electron beam of 5.75 GeV. Estimates of the rates are given for the θ^+ production cross section and for the sticking factor, but are necessarily based on several assumptions, due to theoretical uncertainties and the lack of appropriate data.

Issues: One motivation for the LoI discussed at PAC26 was the expectation, based on a theoretical calculation, that the observation of θ^+ bound states would be enough to determine the parity of the θ^+ . This is now contradicted by subsequent calculations. The observation of the bound states and their spectroscopy would then most likely be used to characterize the properties of the binding potential and the θ^+ -nucleon interaction. Nonetheless, the possibility of bound states of the θ^+ in nuclei is potentially very interesting. Since the LoI, the experimental details have been investigated in more detail following the recommendations of PAC 26 and have come to the quality required for a proposal. However, despite further developments in the theoretical models since the submission of the LoI, strong uncertainties remain, such as the forward cross section for θ^+ photoproduction on free nucleons and the sticking factor. The experiment is seen as “second generation”, to be reconsidered once the reality of the θ^+ is confirmed and appropriate theoretical calculations have been done.

Recommendation: Defer

Proposal: PR-05-014

Scientific Rating: N/A

Title: Neutron Tagged Bound Proton Structure to Probe the Origin of the EMC Effect

Spokespersons: Nilanga Liyanage, Bogdan Wojtsekhowski

Motivation: The determination of the ratio F_2^n/F_2^p and the d/u quark momentum distributions at large x in the proton suffer from uncertainties due to our lack of understanding of the EMC effect in the deuteron. Different classes of models lead to very different results at large x making the extraction of the neutron structure function from the deuteron ambiguous. The proposed experiment aims to probe the EMC effect from a barely bound to a strongly bound proton by means of deep inelastic scattering off the proton in the deuteron and by tagging the spectator neutron. This would allow discrimination between different models of the EMC effect.

Measurement and Feasibility: In the proposed experiment the ratio $\sigma[D(e,e'N)X]_{(x',\alpha^{sp},p_t,Q^2)}/\sigma[p(e,e')X]_{(x',Q^2)}$ is measured at values of x' from 0.11 up to 0.6 and spectator momentum fraction $1.04 \leq \alpha^{sp} \leq 4$ where $\sigma[D(e,e'N)X]_{(x',\alpha^{sp},p_t,Q^2)}$ is normalized to the inclusive $D(e,e')$ cross section. An absolute measurement of this ratio is performed at each of the proposed α^{sp} by using the reaction $D(e,e'pn)$ to calibrate the neutron detector efficiency to about 3%. Furthermore, to improve on the relative uncertainty in the determination of this ratio as a function of α^{sp} , it is normalized at each value of x' by its measured value at $x'=0.2$ leading to the determination of the ratio $G = \sigma[D(e,e'N)X]_{(x',\alpha^{sp},p_t,Q_1^2)}/\sigma[D(e,e'N)X]_{(x'=0.2,\alpha^{sp},p_t,Q_2^2)}$. The experiment makes use of the BigBite spectrometer to detect electrons. The spectator neutrons are detected by using the neutron detector of the G_E^n experiment (E02-013) for the largest momenta and a new specially designed low energy neutron detector. The method takes advantage of the beam time structure as used in the G0 experiment in order to reduce the electromagnetic background and determine the shape of the neutron background with precision.

Issues: While the PAC is in principle very positive about this method, some issues remain to be addressed. The sensitivity of this experiment is at the 4σ level, which is marginal. The rate of accidental coincidences in the neutron detectors needs to be investigated by a test measurement, as already considered by the proponents, in order to optimize the luminosity of the experiment. A more complete estimate of the resulting systematic errors must be performed and must include the effect of $R = \sigma_L/\sigma_T$, as well as the possible uncertainty resulting from the normalization of the deuteron coincidence cross section to the inclusive one when the spectator is far off-shell.

Recommendation: Defer

Proposal: PR-05-015

Scientific Rating: B+

Title: Measurement of the Target Single-Spin Asymmetry in Quasi-Elastic $^3\text{He}_{\text{polarized}}$ (e, e')

Spokespersons: Todd Averett, Jian-ping Chen, Xiaodong Jiang

Motivation: The goal of the experiment is to measure the target single-spin asymmetry, A_y , for electron scattering off a vertically polarized ^3He target. An observation of a non-zero A_y would provide unambiguous evidence for the interference of one-photon and two-photon exchange amplitudes. New constraints on the Generalized Parton Distribution (GPD) could also be obtained from a measurement of A_y on the neutron.

Measurement and Feasibility: The proposed experiment would measure the single-spin asymmetry of quasi-elastic scattering of electrons off a vertically polarized ^3He target. The scattered electrons will be measured with the HRS spectrometers in Hall A at $Q^2 = 0.5, 1.0, \text{ and } 2.26$ (GeV/c)². The ^3He target being constructed for the E03-004 experiment would be utilized. The proposed measurement appears feasible, provided that sufficient care is exercised to control the various systematic errors, including luminosity monitoring and the inelastic background subtraction.

Issues: The PAC recognizes that this proposal has a physics goal to similar those of several previously deferred proposals which aimed at measurements of A_y (and P_N) in e-p scattering. The concern expressed by the previous PACs regarding the lack of direct connection between A_y and the G_E/G_M discrepancy is shared by the present PAC. However, the fact that this experiment could be carried out using existing equipment represents a significant advantage. The physics case for the study of the GPDs through the measurement of A_y on the neutron is well articulated in the proposal. The PAC believes the proposed approach has sufficient merit to warrant a test run for the two lower Q^2 values (0.5 and 1.0 (GeV/c)²), which in itself would produce valuable results.

Recommendation: Approve for 8 days in Hall A

Proposal: PR-05-016

Scientific Rating: N/A

Title: Measurement of the F_2^n/F_2^p and d/u Ratios in Deep Inelastic Electron Scattering Off the Tritium and Helium Mirror Nuclei

Spokespersons: G. G. Petratos, J. Gomez, R.D. Ransome

Motivation: Nucleon structure functions and valence quark distributions are presently quite well determined with the relevant exception of the large x region where these quantities are small. In particular, the ratios of the neutron to proton structure functions F_2^n/F_2^p and the down to up quark distribution d/u are difficult to access for lack of a free neutron target. It has been shown that the simple extraction of F_2^n from the deuteron F_2^D fails when x exceeds values of about 0.6, due to nuclear corrections which suffer from substantial theoretical uncertainties. A novel and powerful technique consists in the comparison of deep inelastic scattering off Tritium and Helium3 targets.

Measurement and Feasibility: It is proposed to perform deep inelastic scattering with the 6 GeV beam. The experiment will use either the Hall A HRS or the Hall C HMS system in almost standard configuration. Three ^2H , ^3H and ^3He 12 cm long gas targets are foreseen. These will operate at room temperature and at 11 atm pressure. The Tritium target density will result in an activity of 190 Ci. The chosen kinematics will allow access to x values up to 0.69 in the DIS region and up to 0.77 in the resonance region, where duality may be advocated. The extraction of F_2^n/F_2^p and of d/u from the Tritium to Helium3 ratio will only marginally suffer from nuclear corrections which are expected to be small and under control. In addition, the studies of the relative EMC effect on the two mirror nuclei ^3H and ^3He and of the elastic tritium form factors will be performed.

Issues: The PAC recognizes the importance of the proposed measurement. It will improve the accuracy and the x -range for the F_2 ratio of the approved BoNuS experiment. Concerning the EMC effect, the experiment will provide complementary information to that from E-03-113 which collected data on ^3He and ^4He .

However, a definitive step in the direction of large x inclusive physics will be better performed after the 12 GeV upgrade. Therefore the PAC recommends the development of a full program with higher luminosity and a better-defined tritium target which will possibly allow the start of such a program with the present machine.

Recommendation: Defer

Proposal: PR-05-017

Scientific Rating: A⁻

Title: A Measurement of Two-Photon Exchange in Unpolarized Elastic Electron-Proton Scattering.

Spokespersons: John Arrington

Motivation: The aim of this experiment is to make a high-precision determination of the Rosenbluth decomposition in ep scattering for a wide range of momentum transfers, $Q^2 = 0.9-6.6$ (GeV/c)², and to map out the ε -dependence especially well for a wide range of ε for $Q^2 = 1.12$ and 2.56 (GeV/c)². Any non-linearities in ε , which stem from two-photon exchange (TPE) corrections, will be better defined by these measurements than in previous studies. When used in concert with the recoil polarization measurements the results of the Rosenbluth separation should help in reducing the uncertainties in the nucleon form factors G_E^p and G_M^p and in limiting the size of the TPE contributions, at least via intercomparisons with modeling of the ε - and Q^2 -dependence of the TPE effects.

Measurement and Feasibility: The measurements proposed are similar to those already performed in Hall A in E01-001 and appear to be feasible at the desired precision. As demonstrated by E01-001, proton detection will be used to reduce the ε -dependent uncertainties.

Issues: While it is very unlikely that these measurements will fully answer all of the issues involved in arriving at a “final” determination of the proton form factors and the TPE contribution, they nevertheless should help to narrow the spectrum of possibilities for the size, ε - and Q^2 -dependence of the TPE contributions and accordingly shrink the uncertainties on G_E^p and G_M^p .

An observation of a deviation from linearity would be significant. Any improvement is very desirable, given the enormous effort that has already gone into determinations of the proton and other form factors using the Rosenbluth method and, as the proposers indicated in their presentation to the PAC, given the potential impact that this improvement may have for other experiments.

Recommendation: Approve for 13 days in Hall C

Proposal: LOI-05-001

Scientific Rating: N/A

Title: Measurement of Meson Cloud in the Nucleon

Spokespersons: Paul M. King

Motivation: It is proposed to measure DIS scattering off hydrogen and deuterium targets in coincidence with low-momentum protons (on hydrogen) or pairs of protons (on deuterium).

The primary goal of the experiment is to measure the pion structure function in the valence-quark region through pion exchange. The measurements should also give information on the pion cloud in the nucleon which is important for extracting accurately the neutron structure function in the forthcoming BONUS tagged-proton DIS experiment. Specifically the reactions are $\gamma p \rightarrow X p$ or $X\Delta$ and $\gamma n \rightarrow X p$ or $X\Delta$.

Measurement and Feasibility: The experiment will use a 6 GeV unpolarized electron beam, scattered electrons will be detected using the CLAS spectrometer and the recoiling protons will be measured using the BONUS detector which is currently under construction. Technically the experiment appears feasible.

Issues: It is assumed that pion exchange can be identified by the recoiling proton. However, there will be a significant background under the pion-exchange peak, particularly for π^0 exchange, for example from $\gamma p \rightarrow \rho p$ and $\gamma p \rightarrow \rho N^*$. It is less serious for π^+ exchange. Further the kinematics limit the mass of the system X to be less than 1.25 GeV, so it will be dominated by a few resonances, and the maximum value of t is -0.025 GeV^2 so excludes most of the pion peak. Also this contribution is restricted to rather small x , while BONUS focuses more on larger x . The limitation on the mass of the system X reduces the relevance for the pion structure function (extreme duality arguments need to be invoked), determining the pion exchange contribution will be difficult and the connection with BONUS is tenuous.

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

Appendix F

Jefferson Lab Experiments, PAC 4-27, Grouped by Category

(To access Appendix F, go to http://www/exp_prog/PACpage/PAC27/ExpSum.pdf)