Report of the

January 26–28 Meeting

of the

Jefferson Lab

Program Advisory Committee

PAC15

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.

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Dear Members of the Jefferson Lab User Group,

The experimental nuclear physics program at Jefferson Lab is now in full swing, with all three halls taking data routinely. A total of 12 experiments requiring 327 days of 100% efficient beam delivery have been completed. Polarized beams and targets are now becoming a routine part of the landscape at the lab: Hall A has been taking data on a polarized ^{3}He target for months, and both Halls B and C have taken extensive data using dynamically polarized hydrogen and deuteron targets. The Jefferson Lab free-electron laser is setting records for beam power (550 watts, as of this writing), and preparations are underway for the first physics experiments using this important new light source.

On January 12, Secretary of Energy Bill Richardson visited the lab for the first time. His visit included a whirlwind tour of the Lab and culminated with an all-hands meeting where he talked about his vision for the DOE. He also recognized 11 staff members for their new patents and expressed enthusiasm for Jefferson Lab and its programs and collaborations.

The Jefferson Lab Program Advisory Committee (PAC15) met January 15–30, 1999 to hear details on the progress of the Accelerator and all three Halls and the run plans for all three Halls. Also discussed were new and updated proposals and letters-of-intent, the first of the jeopardy proposals, and a review of the lab's current nucleon form factors and sum rules program.

Several significant reviews were held throughout the year that re-approved the strength of our scientific and technical programs. The NSAC Medium Energy Review held August 3–5, 1998, resulted in a final report published September 30, that stated "...the highest priority be given to effective utilization of Jefferson Laboratory." NSAC accepted the report and endorses its recommendations for scientific priorities. In the report from the Science and Technology review held September 15–17, the review committee stated that the current plans to upgrade the halls and accelerator to higher energies was judged to have sound physics behind it and that the Theory Group members should be congratulated for their efforts to interact with the experimental user community. The committee members also supported efforts to increase beam polarization, reliability, and availability and felt that the potential of the accelerator machine's performance had been demonstrated. A third review, the Institutional Management Review held October 19–20, focused on strategic planning, managerial effectiveness, and organizational culture and was chaired by Bill Madia, Director of Pacific Northwest Laboratory. Jefferson Lab received an "Outstanding" evaluation from the committee members.

Another major milestone for the lab was when the U.S. Department of Energy announced that it will negotiate with the Southeastern Universities Research Association (SURA), Inc., to extend the current multi-year performance-based contract for the management and operation of Jefferson Lab. Negotiations with the department are underway.

I would like to take this opportunity to thank the members of the PAC for their efforts on behalf of Jefferson Lab and its User Community, and for the PAC's thoughtful deliberations on the physics program and the successful review of the lab's nucleon form factors and sum rules program. Particular thanks go to both the PAC and the User community for their participation in and effective use of the jeopardy process as a tool to keep the quality of the physics program high while reducing the backlog toward our jointly held goal of three to four years.

In closing, I want to express a special thank you to Brad Filippone, who has chaired PACs 11 through 15. Brad has provided strong leadership for the PAC over the last several years. His efforts have served both the lab and the User community well. Don Geeseman (ANL), the current User Group Chair and a long-time JLab experimenter, has agreed to serve as the next PAC chair. Last, but by no means least, I wish to thank you for your efforts on the proposals, updates, and letters-of-intent. I look forward to the flow of publications informing the scientific community of the exciting results coming from the Jefferson Lab experimental program. Attached is the PAC15 report.

Sincerely,

Hermann Grunder,
Director

Report of the January 26–28, 1999 Meeting of the Jefferson Lab Program Advisory Committee (PAC15)

Introduction

The Jefferson Lab Program Advisory Committee held its 15th meeting on January 26–28, in CEBAF center. PAC15 also met at the Sanderling Inn in Duck, North Carolina on January 29–30 to discuss the Lab's program in Nucleon and Meson Form Factors and Sum Rules. The PAC15 membership is given in Appendix A. In response to the charge (Appendix B) from the director, Dr. Hermann Grunder, the committee reviewed and made recommendations on 16 new proposals and 3 letters-of-intent.

Larry Cardman reported on recent accelerator developments and outlined progress in the experimental halls. Operational efficiency has remained constant since the last PAC meeting. An increase in operating funds for 1999, that was sought after by the lab in order to improve the efficiency of operations, was not provided by DOE, resulting in the December cutback of ~10% in the beam time scheduled for experiments. The DOE-recommended level of laboratory funding for FY00 is expected to allow the laboratory to maintain this constant, albeit not optimal, level of effort in terms of beam hours available for physics.

Continued progress was demonstrated in the physics programs of Halls A and B. Hall A completed a precision measurement of the proton electric form factor, whose preliminary results suggest a very interesting Q^2 dependence of the form factor. Also a polarized beam-polarized target measurement of the virtual photon analog of the Gerasimov-Drell-Hearn Sum was completed. For Hall B, the first phase of data-taking with a polarized proton target began with experiments from the g6 and eg1 run groups receiving significant data. Hall C began the polarized beam-polarized target measurement of the neutron electric form factor. Unfortunately, following a serious accident that damaged the polarized target, safety concerns related to this incident in combination with a prior agreement to transport the target to SLAC early in 1999 caused the experimental run to be terminated with only about 25% of the requested data. This issue will be discussed in more detail below.

General Comments on Operations

The PAC was pleased to see an increasing number of publications reporting on JLab experiments (> 7 Phys. Rev. Lett. were presented). Both Halls A and C are contributing to this physics output, with Hall B expected to begin physics output within the year. Clearly the complexity of the CLAS requires enormous effort to provide even a basic understanding of the data. With the evolutionary improvements in computing power and, hopefully, a considerable dose of "human power," a thorough understanding of the CLAS will be achieved.

Improvements in accelerator operations were also evident, with production running at near 80% polarization with 15-μA beam current. The lab plans to continue, at high priority, efforts to increase the current at high polarization recognizing the dramatic impact such a beam could have on the physics program. Of particular note are the impressive results obtained for polarized beam operations to date in this area — the accelerator is exceeding all reasonable expectations. Increasing the maximum energy is also progressing well with 5.1 GeV delivered for physics in December 1998, 5.5 GeV scheduled for 1999 running, and 6-GeV beam anticipated for 2000.

Hall D

A letter-of-intent was presented by a large collaboration that is interested in greatly extending the meson spectroscopy program at JLab. This letter focussed on the opportunities in this field that would be made possible with a 12-GeV beam and a hermetic detector to be located in a new Hall (Hall D) at Jlab. The PAC was asked to begin the process of evaluating the scientific opportunities and experimental feasibility of such a program. We have recommended the establishment of a PAC sub-committee that includes PAC members and outside experts in order to begin the review process of this ambitious project.

G_E^n Experiment in Hall C

The PAC discussed the modifications in procedures and policies that have been implemented at JLab in the wake of the termination of the experimental run of G_E^n in Hall C during an executive session. The focus of these discussions was on how to avoid similar problems in the future and on the importance of future measurements of G_E^n. The PAC re-emphasized the high scientific priority of precision measurements of G_E^n, and reiterated the importance of making several independent measurements. The PAC looks forward to timely precision measurements of G_E^n, including completion of the polarized beam-polarized target experiment.

Nucleon and Meson Form Factors and Sum Rules Workshop

The second PAC workshop, in what is expected to be a continuing series, addressed the status and experimental opportunities in measurements of the nucleon and meson form factors and nucleon sum rules. The workshop began with summaries of recent theoretical and experimental developments (provided by A. Radyushkin and S. Kuhn, respectively). An overview of the approved program within this sub-field was then presented by the Hall leaders. This was followed by an extensive round table discussion where key scientific questions were formulated and then matched to the approved program, in order to identify possible future experimental opportunities for the lab program. A short report and summary from this meeting are appended to this report as Appendix G. The PAC gratefully acknowledges the efforts of the laboratory staff and management in flawlessly arranging this truly off-site workshop.

Recommendations

The laboratory guidelines provided for approval of beam time of 30 days in Halls A and B, and 90 days in Hall C. These guidelines were established beginning with PAC14 in order to reduce the significant backlog of approved experiments. The larger number of days allotted for Hall C results from the first application of jeopardy for this Hall. The PAC approved experiments within these guidelines for Halls A and C and exceeded the target number by two days for Hall B. As discussed in the PAC14 report, these guidelines can be exceeded if there is a sufficiently strong physics case.

The reports and PAC recommendations for the reviewed proposals and letters-of-intent are given in Appendices D and E. The tables on the following page summarize results from PAC's 4–15.

Brad Filippone

Chair, Jefferson Lab Program Advisory Committee

APPENDICES

A. PAC15 Membership

B. Charge to PAC15

C. PAC15 Recommendations

D. Individual Reports for PAC15 Proposals

E. Individual Reports for PAC15 Letters-of-Intent

F. Approved Experiments, PACs 4—15, Grouped by Physics
Category (Appendix F can be found on line at
http://www.jlab.org/exp_prog/PACpage/.

G. Summary of PAC15 Workshop on Nucleon and Meson
Form Factors and Sum Rules (Sanderling Inn, January 30, 1999)

Totals for PACs 4–15

	Experiments Recommended for Approval	Experiments Recommended for Conditional Approval	Totals
Experiments	110	14	124
Authors	796	47	843
Institutions	140	7	147
Countries	22		22

Totals of Approved Experiments by Physics Topics for PACs 4–15

Topic	**Number**	**Hall A**	**Hall B**	**Hall C**
Nucleon & Meson Form Factors & Sum Rules	15	7	3	5
Few Body Nuclear Properties	23	12	6	5
Properties of Nuclei	18	4	8	6
N* & Meson Properties	35	6	23	6
Strange Quarks	19	4	10	5
Total	**110**	**33**	**50**	**27**

Approved Days and Conditional Approved Experiments by Hall

Hall	Approved Experiments				Conditionally Approved Experiments
	No. of Exps Completed (full/partial)	Days Run	No. of Exps in Queue	Days to be Run	
A	4 / 2×1/2 / 1×1/4	112	29	562	6
B	1 / 14×0.08 / 4×0.27 / 6×0.12 / 2×0.59	56	49	473	6
C	7 / 2×1/2 / 1×1/4	159	20	419	2
Total	**12 / ~6.6**	**327**	**98**	**1453**	**14**

Appendix A

PAC15 Membership

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Appendix B

Charge to PAC15

Jefferson Lab requests that PAC15:

A. Review proposals*, extensions, and updates and provide advice on their scientific merit, technical feasibility, and resource requirements.

B. Recommend one of four actions on each proposal, extension or update:

- approval,
- conditional approval status pending clarification of special issues,
- deferral, or
- rejection.

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

D. Provide comments on letters-of-intent.

E. Comment on the Hall running schedules.

F. Review the scientific opportunities accessible through CEBAF's capabilities in the area of "nucleon form factors and sum rules." Are the key open questions in this subfield addressed optimally by the presently approved experiments? Would extensions to or modifications of presently approved experiments provide clearer answers to these questions? Finally, are there important open questions not addressed by approved experiments that should be added to the program?

G. Begin the process of evaluating the scientific opportunities associated with a 12-GeV upgrade of CEBAF and the complement of scientific equipment needed to exploit these opportunities by forming an ad hoc subcommittee to review and provide advice on the Preliminary Design Report submitted in support of the letter of intent for the construction of a meson physics facility ("Hall D").

* Note: starting with PAC15, previously-approved proposals that have not run within 3 years of approval or 3 years of the start of physics in the relevant hall (whichever is later) are returning to the PAC for scientific review. For the purposes of this review, these "jeopardy" experiments will be treated consistently with new proposals.

Appendix C

PAC15 Recommendations

Class*/ Days		
D	PR-99-001	Medium Modification of Vector Mesons in the Subthreshold Region
R	PR-99-002	Proton Compton Scattering with Polarized Photons
B/7	E-99-003	Direct Measurement of the Lifetime of the Heavy Hypernuclei at CEBAF
D	E-99-004	Medium Modification of Neutron Electromagnetic Form Factors
B+/=	E-99-005	Meson Spectroscopy in Few-Body Decays
B/=	E-99-006	Polarization Observables in the ${}^{1}H(\vec{e},e'K^{+})\vec{\Lambda}$
B+/28	E-99-007	Measurement of G_E^p/G_M^p to $Q^2 = 5.6$ GeV^2 by the Recoil Polarization Method
B/=	E-99-008	Large Angle Two-Body Photodisintegration of the Deuteron at High Energy
R	E-99-009	Photon Asymmetry in ^{3}He $(\gamma,\pi^{+})^{3}$H
D	E-99-010	Determination of the Sum of the Electric and Magnetic Polarizabilities of the Pion using Polarized Photons
D	E-99-012	A Clean Measurement of the Neutron Skin of ^{208}Pb Through Parity-Violating Electron Scattering
B+/10	E-99-013	Photoproduction of ω Mesons off Protons with Linearly Polarized Photons
A-/22	E-99-014	A Precision Measurement of the Neutral Pion Lifetime via the Primakoff Effect
B-/25	E-99-015	Inclusive Scattering from Nuclei at x>1 and High Q^2 with a 6-GeV Beam
A/46	E-99-016	G0 Experiment
D	E-99-017	Measurement of the Spin-Dependent Asymmetry in Quasielastic Electron Scattering from Polarized Tritium

* **A=Approve, C=Conditionally Approve, D=Defer, R=Reject**

= Concurrent running with a previously approved experiment.

Appendix D

Individual Proposal Reports

Proposal: PR-99-001

Scientific Rating: n/a

Title: Medium Modification of Vector Mesons in the Subthreshold Region

Spokespersons: G. Lolos

Motivation:

This proposal requests time to study the effect of the nuclear medium on the mass and width of vector mesons.

Measurements and Feasibility:

The exclusive ^{3}He $(\gamma,\pi^+\pi^-)$ ^{3}He and the break up ^{3}He$(\gamma,\pi^+\pi^-)$pn reactions will be observed in the CLAS detector in the subthreshold region. The modification of ρ-meson properties inside the ^{3}He nucleus is expected to influence their rates. The photo production of $\pi^+\pi^-\pi^0$ on ^{3}He will be used to study the properties of ω-mesons. Data on these reactions will be accumulated during the approved g3 run with ^{3}He target. An additional 270 hours are requested for collecting more data.

Issues:

Photoproduction of $\pi^+\pi^-$ pairs can proceed via many mechanisms besides through the ρ-meson resonance. In the subthreshold region these other processes become dominant, and their yields must be well understood to extract information on the modification of the ρ-meson in ^{3}He from the $(\gamma, \pi^+\pi^-)$ reaction. For example, the non-resonant $\pi^+\pi^-$ amplitudes may interfere and distort the shape of the resonance. The PAC would want to see a convincing analysis of the data from the approved experiments in Hall B, including g3 and g1 (for data on the proton), before approval of a future proposal. This analysis should establish the extent to which vector meson properties in ^{3}He can be extracted from $\pi^+\pi^-$ photoproduction at subthreshold energies.

Recommendation:

Defer.

Individual Proposal Reports (Continued)

Proposal: PR-99-002

Scientific Rating: n/a

Title: Proton Compton Scattering with Polarized Photons

Spokespersons: B. E. Norum, K. Wang, and D. I. Sober

Motivation:

The proposal is to measure the cross section and polarization asymmetry for Compton scattering on the proton in the resonance region. The primary goal is to identify, in the context of a particular model, strength in nucleon resonances beyond the dominant delta and p-waves.

Measurement and Feasibility:

The experiment would employ the coherent bremsstrahlung source of tagged photons in Hall B to produce linearly polarized photons of 0.6-2.0 GeV. Compton events would be separated from neutral pion production primarily by photon-proton correlations.

Issues:

The PAC was not convinced that adequate Compton/pion separation could be achieved. Either a more refined simulation or, better, an analysis of existing g1 data would have been appropriate. Furthermore, Compton scattering was not seen to be the optimal means of investigating missing resonances above ω-N threshold.

Recommendation:

Reject

Individual Proposal Reports (Continued)

Proposal: E-99-003

Scientific Rating: B

Title: Direct Measurement of the Lifetime of the Heavy Hypernuclei at CEBAF

Spokesperson: L.Tang and A. Margaryan

Motivation:

This proposal is an update of the approved experiment E-95-007 that is designed to directly measure the lifetime of heavy Λ-hypernuclei to provide information on the ΛN→NN process in nuclei.

Measurements and Feasibility:

The experiment uses the SOS spectrometer in Hall C to detect K^+ produced by (e,e'K) reactions in coincidence with fission fragments observed in a low-pressure MWPC detector mounted around the target. The tagged K^+ confirms the production of the hypernucleus and identifies the beam bunch from which the reaction was initiated. By timing the fission fragment relative to the beam bunch, one obtains a direct measurement of the delayed fission and the decay time of the Λ within the nucleus. This update proposes to start with a parasitic run during the E-89-009 experiment, where no kaons will be tagged. The real experiment will be carried out after the parasitic run data is fully analyzed and understood.

Issues:

Since E-95-007 was approved, two new hypernuclear lifetime measurements were carried out elsewhere. However, the data in the heavy-mass region do not allow a definite conclusion on the lifetime dependence on the mass number.

The collaboration has been joined by major collaborators of the new experiments that measured lifetimes of medium-A nuclei with similar timing resolution.

Recommendation:

Approval for seven days running on Bi.

Individual Proposal Reports (Continued)

Proposal: PR-99-004

Scientific Rating: n/a

Title: Medium Modification of Neutron Electromagnetic Form Factors

Spokespersons: J.J. Kelly, R. Madey, P.E. Ulmer

Motivation:

The issue of possible changes in the structure of the nucleon in the nuclear medium continues to be of high interest. While arguments based on *y*-scaling, for example, suggest that these changes cannot be large, high precision measurements of the nucleon form factors in nuclei by entirely different techniques can be important.

Measurements and Feasibility:

The same apparatus that will be used to measure the ratio of G_E^n/G_M^n for the neutron in deuterium in E-93-038 will be used to measure this ratio for a neutron in ^{4}He at a Q^2 of 1 GeV^2. The recoil polarization technique promises small systematic experimental errors. A statistical accuracy of 5% is expected for the polarization ratio P_T/P_L in 14 days. A new ^{4}He target must be designed, constructed, tested, and installed.

Issues:

A comparable experiment to measure the ratio of form factors for the proton in ^{4}He, E93-049, is scheduled for this fall. This experiment is expected to achieve errors of 3 to 5% over the Q^2 range from 1 to 3 GeV^2. The theoretical errors in interpreting the ratio of polarizations in terms of the ratios of form factors are likely to be somewhat smaller for protons than for neutrons. While there are good reasons to carry out measurements for both the neutron and the proton if the medium effects are large, a small effect for the proton is likely to signal a small (and hard to measure) effect for the neutron as well. This experiment should be deferred until initial proton results are available. If the effects seem substantial, rapid resubmission of this proposal is encouraged.

Recommendation:

Defer

Individual Proposal Reports (Continued)

Proposal: E-99-005

Scientific Rating: B+

Title: Meson Spectroscopy in Few-Body Decays

Spokespersons: G. Adams, C. Salgado, D. Weygand

Motivation:

This proposal requests time to identify new mesons with masses up to 2 GeV, with special emphasis on exotic mesons and strangeonium states.

Measurements and Feasibility:

The experiment will study the photoproduction of mesons that decay to three-meson final states, and reconstruct π^0 and η from their $\gamma\gamma$ decays. It will thereby sample the $\rho\pi$, $\eta\phi$ and K^*K meson decay channels and potentially the $\pi\ f_0$ also. These channels are expected to be important modes for hybrid states that have been predicted to exist in the kinematic reach of the experiment.

Issues:

Tantalizing signals have been seen in some of these channels in older, low statistics experiments and the proposed experiment plans to clarify these issues. The qualitative increase in data in these photon induced processes, and the potential for discovery of new physics provide a compelling case, though the PAC has some concerns as to whether the full realization of a partial wave analysis can unambiguously isolate exotic J^{PC} resonances in this experiment.

Recommendation:

Approved for zero additional time.

Appendix D

Individual Proposal Reports (Continued)

Proposal: E-99-006

Scientific Rating: B

Title: Polarization Observables in the ${}^{1}H(\vec{e}, e' K^{+})\vec{\Lambda}$

Spokespersons: D. Carman, K. Joo, l. Kramer, B. Raue

Motivation:

This proposal requests time to study the basic reaction mechanism for Lambda electroproduction on the nucleon, by measuring spin observables for the proton, and to explore their implications for models of kaon formation through intermediate $q\overline{q}$ states.

Measurements and Feasibility:
The polarization of Λ's produced by polarized electrons on unpolarized hydrogen will be measured at 2.4 and 4.0 GeV. By using polarized electrons and the analyzing power of the Lambda decay, it will be possible to measure double-polarization observables for this reaction. The large angular acceptance of the CLAS spectrometer provides an important advantage for measuring the Λ polarization. In this respect the proposal is complementary to the previously approved experiment E98-101 in Hall C. Data will be accumulated during the current e1 run. Data quality will be improved by running with the highest beam polarization available. An analysis of the limited unpolarized data sample available provides a convincing basis for estimates of attainable experimental precision.

Issues:

On general grounds the reaction is of interest as a source of information on the interplay between the baryon resonance amplitudes and the underlying QCD structure. However, in the kinematics of this experiment, the dominance of resonance production will, most probably, obscure any direct polarization signature for the spin structure of intermediate $q\overline{q}$ pairs. High quality data will be of greatest value in carrying out a detailed partial wave analysis of the production cross section.

Recommendation:

Approval for zero additional time

Individual Proposal Reports (Continued)

Proposal: E-99-007

Scientific Rating: B+

Title: Measurement of G_E^p/G_M^p to $Q^2 = 5.6\ GeV^2$ by the Recoil Polarization Method

Spokespersons: C. Perdrisat, M. Jones, V. Punjabi, E. Brash

Motivation:

Precise measurements of the elastic electric form factor of the proton (G_E^p) are a useful probe of the internal structure of the proton. In addition they provide important inputs into few-body and many-body nuclear structure calculations where the structure of the proton may play a role. This experiment would extend the precision measurements of G_E^p to $Q^2 = 5.6\ GeV^2$. There are some theoretical suggestions that QCD-motivated models of the proton structure may begin to be applicable in the Q^2 range ~ 5 – 10 GeV^2.

Measurements and Feasibility:

Based on preliminary results from 93-027 where the recoil polarization was used to measure G_E^p at lower Q^2 with a carbon analyzer, the technique appears straightforward. For the present proposal the carbon analyzer will be replaced by CH_2, which has a significantly larger analyzing power at higher Q^2. In addition the focal plane polarimeter must be moved to the electron arm due to the lower maximum field for the HRSH compared to HRSE. This experiment would measure at four values of Q^2 including one overlap point with E-93-027 and up to the highest Q^2 possible with the present spectrometer pair in Hall A.

Issues:

The PAC looks forward to the timely publication of the results from E-93-027.

Recommendation:

Approved for 28 days

Individual Proposal Reports (Continued)

Proposal E-99-008

Scientific Rating: B

Title: Large Angle Two-Body Photodisintegration of the Deuteron at High Energy

Spokesperson: R. Gilman. R.J. Holt, and Z.E. Meziani

Motivation:

This experiment proposes to extend the existing differential cross section measurements for the D(γ,p)n reaction to center-of-mass angles of 115, 130, and 145^o in the energy range 1.2 to 3.2 GeV.

Measurements and Feasibility:

The measurement is a straightforward extension to large angles of the E-89-012 and E-96-003 experiments done by many members of the collaboration in Hall C. It uses real photons produced in the Hall A radiator just upstream of the deuteron target. The photoproduced protons are detected in the HRS electron spectrometer, set for positively charged particles. The experiment is compatible with approved experiment E-89-019 and much of it (all energies but 3.2 GeV) can run parasitically with E-89-019.

Issues:

The proposal bears a strong connection with Hall B E-97-017 experiment, which proposes measurements of angular distributions of the process for photon energies from 0.8 to 1.5 GeV with the same motivation. The PAC considers it very important to measure a complete angular distribution for the D(γ,p)n reaction at energies above 1.5 GeV in order to provide a stringent test of the models. A convincing case for the measurement at 3.2 GeV was not made.

Recommendation:

Approval for zero additional beam time.

Appendix D

Individual Proposal Reports (Continued)

Proposal: PR-99-009

Scientific Rating: n/a

Title: Photon Asymmetry in ^{3}He $(\gamma,\pi^+)^3$H

Spokespersons: B. Norum, J. Calarco, K. Wang

Motivation:

The aim of the experiment is to obtain data to study possible modifications of the properties of the Delta in the nucleus and to measure the D-state component of the 3-body wave functions.

Measurements and Feasibility:

The observables are differential cross sections and photon asymmetries. The differential cross sections, as a function of *t*, are sensitive to many body contributions of the nuclear response. The photon asymmetries have an increased sensitivity to the E^{1+}-amplitude and to admixtures of the D-state in ^{3}He. In principle, the CLAS detector in combination with the coherent tagged Bremsstrahlung source provides, by its large acceptance, the possibility to investigate such reactions, provided the two-body kinematics of this process can be reconstructed.

Issues:

The PAC is not convinced that the overall resolution for the pion singles data is sufficient to isolate the isoelastic channel from the background processes, especially for the higher photon energies.

The PAC notes that a careful study of the accidental background rates was missing in the proposal in order to clarify at what luminosity the experiment can run considering the expected nb cross sections.

The model dependence in extracting both the E^{1+} amplitude and the D-state admixture from the data were not stated quantitatively.

Recommendation:

Reject.

Appendix D

Individual Proposal Reports (Continued)

Proposal: PR-99-010

Scientific Rating: n/a

Title: Determination of the Sum of the Electric and Magnetic Polarizabilities of the Pion Using Polarized Photons

Spokespersons: B. Norum, K. Wang, R. Hicks

Motivation:

This proposal requests time to measure the sum of the electric and magnetic polarizabilities of the positively charged pion.

Measurements and Feasibility:

This measurement of the $\vec{g}\pi \to gp^{+} + n$ reaction aims at extracting the $gp \to gp$ Compton amplitude. From the energy dependence of this process one extracts the sum of the electric and magnetic polarizabilities of the pion. Testing the clear chiral perturbation theory prediction of this quantity is an important step in confirming the low energy limit of QCD. The experiment uses a polarized, Compton back-scattered, photon beam and the CLAS to detect the neutron and π^{+}.

Issues:

The PAC is concerned about the contributions of the amplitudes of competing processes. The signal appears in the energy and *t*-dependence of the process and the collaboration should provide more convincing evidence that the extraction is under control. The extrapolation to the pion pole also remains a concern. The collaboration did not make the case that polarized photons are required. Technical concerns on the feasibility of such an intense back-scattering photon source remain.

Recommendation:

Defer

Individual Proposal Reports (Continued)

Proposal: PR-99-012

Scientific Rating: n/a

Title: A Clean Measurement of the Neutron Skin of ^{208}Pb Through Parity-Violating Electron Scattering

Spokesperson: R. Michaels and P.A. Souder

Motivation:

The proposed experiment would determine the radius parameter R_n of the neutron distribution in ^{208}Pb to a precision of ±1%, and thereby test the existence of a "neutron skin" in heavy nuclei. A precise calibration of R_n for heavy nuclei is needed to achieve improved precision in the interpretation of atomic parity violation experiments.

Measurements and Feasibility:

The radius of the neutron distribution will be determined by measuring the parity-violating helicity asymmetry for elastic electron scattering from ^{208}Pb to a precision of $\pm 1.5 \times 10^{-8}$, i.e., to ±3% of the predicted asymmetry. The measurement exploits the dominant coupling of Z^0 bosons to neutrons in the nucleus. R_n can be extracted from a measurement at a single low Q^2-value, under the assumption that the neutron and proton distributions are essentially identical in shape, except for a small radius difference.

The HAPPEX results provide some evidence that a measurement of such high precision is feasible. However it requires very careful attention to beam polarization monitoring and stability, beam helicity correlations with a strained cathode source, and the design of a target that can withstand sufficient power to attain the necessary statistics in a reasonable run time.

Proposal: PR-99-012 (Continued)

Issues:

The PAC is enthusiastic about the prospect of turning parity violation measurements into a quantitative tool for nuclear structure. The neutron skin problem is a suitable application, where a measurement can have a substantial impact if it is made with no worse than the stated precision goal. The Committee feels that the present proposal does not yet adequately address several experimental and theoretical interpretation issues at the relevant 1% level. It looks forward to a revised proposal that addresses in more detail the requirements for polarization monitoring and other systematic error crosschecks, the power limits of various target designs, and the detector design. On the theoretical side, a revised proposal should consider whether other contributions to the asymmetry, e.g., arising from strangeness in the nucleus or parity admixtures in the nuclear wave functions, might complicate the interpretation in terms of R_n at the 1% level.

Recommendation:

Defer

Appendix D

Individual Proposal Reports (Continued)

Proposal: E-99-013

Scientific Rating: B+

Title: Photoproduction of ω Mesons off Protons with Linearly Polarized Photons

Spokespersons: F.J. Klein, P.L. Cole

Motivation:

The proposers intend to study isospin-_ resonances and *t*-channel processes in photoproduction of ω mesons. A primary goal is to search for resonances that do not couple strongly to the pion-nucleon channel.

Measurement and Feasibility:

The experiment will employ the coherent bremsstrahlung Facility in Hall B to produce linearly polarized photons from 4 and 6 GeV electrons. The setup is essentially identical to that intended for the related approved experiments on ρ and ϕ production. Polarization observables more than double the number of spin density matrix elements that can be determined. The PAC was pleased that the collaboration has already demonstrated the ability to reconstruct ω's from existing g1 data.

Issues:

While the experiment should provide valuable information on the ω production mechanism, the quark model calculation in the proposal doesn't allow the potential sensitivity to missing resonances to be estimated. The complex helicity structure of the reaction likely necessitates a complicated partial wave analysis. Toward this end, high quality data, especially near threshold, are essential.

Recommendation:

Approval for 10 days in Hall B at 4 GeV.

Appendix D

Individual Proposal Reports (Continued)

Proposal: E-99-014

Scientific Rating: A-

Title: A Precision Measurement of the Neutral Pion Lifetime via the Primakoff Effect

Spokesperson: A. Gasparian, R. Miskimen, S. Danagoulian, D. Dale

Motivation:

A measurement of the neutral pion lifetime with uncertainty of 1.4% is proposed. The measurement would use Primakoff production from C, Sn and Pb, tagged photons in Hall B and a hybrid Pb glass-$PbWO_4$ calorimeter.

Measurements and Feasibility:

One goal of the measurement is to test the 2% corrections to the pion lifetime that are expected in the chiral limit. A tagged photon beam and a highly-segmented calorimeter are important elements in limiting systematic errors. The measurement requires knowledge of the absolute beam energy to 0.1% and the luminosity to 1%. There are also distortion corrections that add to the systematic error.

Issues:

The PAC has emphasized previously that a measurement as demanding as that proposed will require careful attention to detail and an uncompromising approach to all elements of the experiment. In particular, the collaboration had been asked to address in more detail the following issues: background rate created upstream of the target, collimation of the photon beam, photon flux control, calorimeter design, choice of target materials and a careful study of final state interactions.

The PAC believes that these questions have been addressed satisfactorily and notes that several decisive improvements have been included in the present proposal.

Recommendation:

Approval for 22 days

Individual Proposal Reports (Continued)

Proposal: E-99-015

Scientific Rating: B-

Title: Inclusive Scattering from Nuclei at x>1 and High Q^2 with a 6 GeV Beam

Spokespersons: D. Day, B. Filippone, A. Lung

Motivation:

Measurements of inclusive electron nucleus cross sections at large x and Q^2 provide a rich set of elementary data. Several types of scaling behavior can be explored. Confrontation with theory may yield information on high momentum components in nuclear wave functions, short-range correlations, and the transition to scattering from quarks.

Measurements and Feasibility:

The success of E-89-008, which studied the same reaction with a lower energy beam, suggests that these measurements should be relatively straightforward. No unusual problems are expected at the higher energy. The targets include D, C, Fe, Au, and ^{3}He (which was not included in 89-008). The range in x will be similar, but Q^2 will be extended to greater than 10 $(GeV/c)^2$.

Issues:

It is difficult to define crisply and quantitatively the information contained in such data, even if scaling behavior is confirmed. The appearance of inclusive data at high Q^2 is expected to attract the attention of theorists and lead to a new generation of calculations.

Recommendation:

Approval for 25 days.

Individual Proposal Reports (Continued)

Proposal: E-99-016

Scientific Rating: A

Title: G0 Experiment

Spokesperson: D. Beck

Motivation:

The experiment seeks to determine the contribution of strange quarks and antiquarks in the proton to its electric and magnetic form factors, with a Q^2-dependent sensitivity (over the range 0.1-1.0 $(GeV/c)^2$) to contributions at the level of 1-5% of the form factor values. This proposal requests time for commissioning the experiment.

Measurements and Feasibility:

A custom superconducting toroidal spectrometer is being constructed to enable (in separate runs) forward- and backward-angle measurements of the parity-violating helicity asymmetry in e-p elastic scattering. Attainment of the sensitivity goal requires reaching a typical statistical precision of ±5% of the measured asymmetry value (-3 to -35×10^{-6}) and keeping systematic errors below 2.5×10^{-7}. The statistical precision goal necessitates a high-power, long liquid hydrogen target, for which the spectrometer is designed. Although the demands on polarized source average current (~40 μA), beam polarization (≥50%), and helicity correlations are within standard performance ranges, the source must operate in a new "pulsed" mode at a 32 MHz repetition rate. Delivering this beam will require the development of a special 32 MHz drive laser for the photocathode source; this will require significant effort that should begin soon if G0 is to meet its tentative schedule. A unique feature among high-precision parity experiments is operation in a single-event counting mode, rather than an integration mode, allowing flight time cuts to be applied after acquisition to suppress backgrounds.

Proposal: PR-99-016 (Continued)

Issues:

The PAC feels that G0 addresses an important question in nucleon structure at a suitably ambitious sensitivity level. In particular, recent results from the related SAMPLE and HAPPEX experiments whet the appetite for a separation of electric and magnetic strange form factors over a range of Q^2-values. The PAC was pleased to hear about the enlargement of the collaboration and the substantial progress on design, funding and management of the project. The envisioned annual technical reviews by the laboratory are important to keep the experiment on track.

Recommendation:

Approve 46 days.

Appendix D

Individual Proposal Reports (Continued)

Proposal: PR-99-017

Scientific Rating: n/a

Title: Measurement of the Spin-dependent Asymmetry in Quasielastic Electron Scattering from Polarized Tritium

Spokesperson: C.E. Jones

Motivation:

This proposal requests time to provide an experimental benchmark for theoretical calculations of spin observables in the three-body system and to study medium modification of the proton electromagnetic form-factor.

Measurement and Feasibility:

The $A_{T'}$ and $A_{TL'}$ inclusive quasi-elastic asymmetries will be measured by polarized electron scattering on polarized tritium: three kinematics set-ups are proposed, amounting to 47 days of beam time. Scattered electrons are detected independently in the SOS and HMS of Hall C. A polarization of 50% is assumed for beam and target, and an intensity of 190 μA is requested. The polarized tritium target is an optically-pumped spin-exchange low density target.

Issues:

To justify the considerable resources (manpower, total beam time, fraction of available beam current, etc.) needed by this experiment, a stronger physics case has to be made to better underline the connection with the present A=3 open questions. The possibility of absolute separation of $R_{T'}$ and $R_{TL'}$ should be strengthened. The PAC does not feel that the medium modification arguments are, by themselves, strong enough. The PAC acknowledges the progress made on the laser pumped H target, but no clear progress has been reported on the specific tritium target. Recommendation is made to also study possible alternative technology for the tritium target. The high beam intensity requested will provide severe constraints on the JLab scheduling, and has to be taken into account by the collaboration. The PAC strongly supports the general physics motivations for a tritium program at JLab, and considers that a future proposal along these lines would be a good start.

Recommendation:

Defer

Appendix E

Individual Letter-of-Intent Reports

Letter of Intent: LOI-99-001

Title: Photoproduction of Gluonic Excitations

Spokespersons: A. Dzierba

This letter of intent represents one of the key physics motivations of the energy upgrade of CEBAF. The existence and nature of gluonic excitations in low energy spectroscopy is one of the most important open questions in the standard model. The collaboration proposes to use linearly polarized photons to study the production of mesonic states with masses in the 1-3 GeV region with unparalleled statistical precision. Photon beams have unique properties that complement meson beams, and the existing data are quite limited. Meson spectroscopy is one sector that is not optimally addressed with the existing experimental equipment.

The proposed approach is extremely promising. The collaboration has made an impressive start in assembling a talented team of physicists, exploring the required detector capabilities and developing concepts of how this program can be carried out at JLab. The PAC is quite encouraged by the parallel efforts of members of this group in E-99-005 to begin mining JLab data for this physics.

This program sets much of the scale for the energy upgrade, both in the choice of the target energy and in proposing to consume the largest single fraction of resources for new experimental equipment. It appears likely that the physics justifies this focus. It is essential that the collaboration present a concise statement of the physics impact that the physics community can support enthusiastically. At the same time, we encourage the collaboration to seek out other physics opportunities to broaden the scientific case.

The PAC enthusiastically supports this effort. Given its significance to the future of the laboratory, we believe it is appropriate to appoint a PAC subcommittee to more carefully assess this initiative.

Appendix E

Individual Letter-of-Intent Reports (Continued)

Letter –of-Intent: LOI-99-002

Title: Exclusive Kaon Electroproduction at 6 GeV in Hall B

Spokespersons: D. Carman

This letter-of-intent discusses an extension to beam energies of 6 GeV of the present Hall B program to measure cross sections and polarization observables in Λ electro-production on the proton. The increased energy will bring the experiment closer to the kinematic region in which quark-gluon degrees of freedom become significant. The PAC feels that it is likely that interesting new physics will emerge. The results from E-99-006 at 4 GeV, which was approved by this PAC, may also point the way toward new physics accessible at higher energies. If a proposal with a well-focused motivation based on the 4 GeV data is developed, it could be an important part of a program of an e1 run with CLAS at 6 GeV.

Appendix E

Individual Letter-of-Intent Reports (Continued)

Letter –of-Intent: LOI-99-003

Title: A Precision Measurement of $G^E{}_p/G^M{}_p$ at $Q^2 = 2.0$ and $4.0\ GeV^2$

Spokespersons: B. Wojtsekhowski, W. Bertozzi, K. Fissum, D. Rowntree

Precision measurements of $G^E{}_p$ are of great interest for providing information on the proton's substructure. New precision measurements using recoil polarization from Hall A experiment 93-027 indicate a decreasing ratio of $G^E{}_p/G^M{}_p$ with Q^2, contradicting some of the previous measurements using a Rosenbluth separation. This LOI discusses a new precision measurement in Hall A using the Rosenbluth technique. It would require control and understanding of systematic effects at the level of 1% in measurements of relative cross sections. The PAC acknowledges the interesting suggestions for limiting potential systematic errors presented in this letter but is not convinced that this 1% level can be achieved. In addition, as a cross-check on the recoil polarization technique a polarized beam-polarized target measurement would be more straightforward than the extremely challenging high-precision Rosenbluth separation discussed here. Also, while the PAC appreciates the importance of demonstrating the potential for doing high-precision Rosenbluth measurements with regard to future possible measurements (e.g. Coulomb Sum Rule), the PAC is not convinced that the physics motivation discussed in the present letter warrants the significant effort required to carry out such a difficult experiment.

Appendix F

PACs 4–15 Grouped by Physics Category

To access Appendix F (Experiment Summary),
type http://www.jlab.org/exp_prog/PACpage/
in your web browser

Appendix F includes a list of experiments organized by physics category including rating, hall, spokesperson(s), etc.

Appendix G

Summary of PAC15 Workshop on Nucleon and Meson Form Factors and Sum Rules (Sanderling Inn, January 30, 1999)

INTRODUCTION:

This was the second workshop focusing on one of the five scientific topics that characterize the Jefferson Lab physics program. It should be noted that the motivation for these workshops is to review the approved physics program at JLab in the context of recent scientific developments and to match the existing program with recent key questions in the sub-field in order to identify opportunities for future experimental work.

The workshop began with a summary of key theoretical questions and recent developments, presented by A. Radyushkin, followed by a summary of recent experimental developments both at Jefferson Lab and elsewhere by S. Kuhn. An overview of the approved program in each Hall covering the topic of nucleon and meson form factors and sum rules was then presented by the Hall leaders. This was followed by an extensive discussion where key scientific questions were formulated and then matched to the approved program in order to identify possible future experimental opportunities for the Lab. These discussions are summarized below.

SCIENTIFIC QUESTIONS

Hadronic form factors are fundamental functions describing the internal structure of hadrons. It is difficult to identify broad themes associated with this sub-field that go beyond this basic statement. Of course, there are a variety of issues that pervade this topic. Some questions that were discussed at the workshop include:

- What is the role of perturbative QCD in understanding nucleon form factors at high Q^2?
- Can we understand form factors as manifestations of parton correlations?
- Can we understand the nucleon as a strongly interacting few-body system?
- Can form factor ratios be calculated in believable QCD-motivated models?
- Can non-forward distributions provide a link between form factors and structure functions?

The key element that emerged in the discussion on form factors was that JLab will likely play an important role in elucidating the link between perturbative (PQCD) and non-perturbative QCD (NPQCD). For nucleon form factors, PQCD is not expected to make dominant contributions until at least $Q^2 = 10$ GeV^2. Thus, JLab at 6 GeV and later at 12 GeV will provide precision data from the purely NPQCD region of $Q^2 < 3 - 5$ GeV^2, to, hopefully, the edge of the PQCD regime.

Other scientific aspects of form factor studies include the important role they play in understanding nuclear structure. When nuclei are probed at length scales < 1 fm, the structure of the nucleon must be accurately included to interpret the data.

There is always some ambiguity in how certain experiments are identified with certain sub-fields. A flavor decomposition of the nucleon form factors will require information on the proton and neutron from both virtual photon exchange and Z^0 exchange (via parity violation). An interesting complement to elastic form factors are non-forward distributions. It remains uncertain if Jlab's energies will be sufficient to allow comprehensive study of these distributions.

Discussion of sum rules focussed on the Gerasimov-Drell-Hearn (GDH) sum rule for photon-nucleon scattering. This sum rule follows from general principles (eg. causality, unitarity, ...) and assumes the applicability of certain dispersion relations within QCD and Regge phenomenology. A clear distinction was made between this sum rule and the Bjorken (BJ) sum rule in deep-inelastic polarized lepton scattering. What occurs between the $Q^2 = 0$ GDH sum rule prediction and the high Q^2 BJ prediction is not a testable sum rule. Rather it is an interesting regime where the Q^2 dependence of the helicity response of the nucleon resonances must dominate. Approved measurements at JLab will provide direct information on the level of saturation of the GDH sum rule and explore the Q^2 dependence of the resonance contributions to virtual photon scattering.

EXPERIMENTAL OPPORTUNITIES FOR THE FUTURE

The approved JLab program has identified many of the important scientific questions that exist in this sub-field. PAC members were asked in an "around-the-table" format to discuss potentially important measurements that are presently part of the approved program. The following ideas were discussed:

- Nucleon $G_A(Q^2)$ and $G_{PS}(Q^2)$ determined from near threshold pion electroproduction .
- G_E^n to $Q^2 > 2$ GeV^2: It was generally felt that a significant effort in this regard should wait until the first precision data are available from the approved experiments at lower Q^2.
- Precision measurement of $G_M^p(Q^2)$: this form factor does not appear to be explicitly part of the approved program.
- Precision measurement of $G_E^p(Q^2)$ using polarized beam and polarized target to complement recoil polarization measurements.
- Performing a global reanalysis of nucleon form factor data including JLab data: perhaps a form factor sub-group would be useful for coordinating such global re-analyses.

CONCLUSIONS

The approved program for this sub-field includes many highly rated proposals. JLab is poised to make important contributions to our understanding of nucleon and meson structure through form factor measurements. Many of these measurements (including those at higher beam energies) will explore this structure at scales corresponding to the transition between non-perturbative and perturbative QCD.