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Report of the

Jefferson Lab
Program Advisory Committee

PAC 22

Meeting of July 8-11, 2002

Letter from the Director

August 9, 2002

Members of the Jefferson Lab User Group,

Jefferson Lab and its user community continue to produce outstanding science and I am gratified and proud of our productivity with 75 full and 23 partially completed experiments, 73 Phys Rev and Phys Rev Letters. We are training a whole new generation in our science with 119 PhDs and 138 more in progress. We have recently completed our annual peer review of Science and Technology with very strong recognition of our program both at 6 GeV and for the 12 GeV upgrade. While these statistics are indicators of our recent performance, I am also pleased by the continued high quality of proposals coming to the Program Advisory Committee, and the number of innovative experiments proposed by our users since this indicates a vibrant and intellectually challenging future for our laboratory and its scientific program.

PAC 22 reviewed 12 proposals and 5 Letters of Intent, with final approval for 7 and 1 conditionally approved. The Laboratory shares the concern of the users that more beam time is not available and will work on all fronts to increase running time. However, without additional funding, it is a fact of life that meritorious proposals will not be able to run due to the high demand for beam time.

We continue to work toward our 12 GeV upgrade. Representatives from our user community have gone to the Office of Science to make the case for timely start of our upgrade to access new and compelling science. This upgrade is critical to our leadership position in the field and a major component of our recently updated Institutional Plan. We are also beginning to look beyond 12 GeV, and the PAC has awarded beam time for crucial accelerator studies to help determine future capabilities. This type of activity ensures that Jefferson Lab will be well positioned to take advantage of research opportunities at the forefront where our capabilities offer unique advantages.

I would like to thank PAC 22 for their efforts reviewing and making recommendations regarding additions to our experimental program, their judicious use of the jeopardy process and their consideration of future research opportunities. As Director, I rely on the consideration and guidance of the PAC to ensure the excellence of our experimental program. I would especially like to thank those PAC members who are rotating off – Juergen Ahrens, Henk Blok, Stanley Kowalski, Gerald Miller, and Mauro Taiuti – for their service to Jefferson lab and the Nuclear Physics user community.

Sincerely,

Christoph Leemann

Letter from the PAC Chair

Introduction

The Jefferson Laboratory Program Advisory Committee held its 22nd meeting on July 8 - 11, 2002. 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 on twelve proposals and five letters of intent.

General Overview

It was a stimulating meeting in terms of discussion of the new physics results that are emerging from recent JLab measurements and the plans for new measurements proposed for the physics research program.

The overall experimental program continues to proceed well. The effective number of completed experiments has reached about 87, up from 72 at PAC 21. The user community continues to analyze and digest the data as indicated by the number of publications and talks at professional meetings. For example the number of Physical Review Letters and Physics Letters articles published was 15 in the past six months compared with 26 in the twelve months of 2001. Regarding a related issue, PAC 22 would like to recommend that increased emphasis be placed on the writing of full (archival) papers in a timely fashion. We regard this as an essential feature of the reporting of the complex measurements that characterize the JLab program. To realize their full impact, it is critical to formulate a detailed description of the data and its limitations in the context of modern calculations. The educational program at JLab continues to be very strong with 18 PhD's granted in the past six months following 25 degrees in the 12 months of 2001. This brings the total at JLab to 119 with 138 PhD projects in progress.

Turning to accelerator operations, in the first three-quarters of FY02 there were 23 weeks of operation with beam availability at 72.4%. The average availability of the three halls was 88.6% and a multiplicity of 2.4. This performance corresponds to 30.8 weeks of beam delivered to experiments on an annual basis.

The physics scope of the proposals presented at PAC 22 was very broad. They included four main themes. Several proposals addressed precision tests of the properties and wave functions of light nuclei, i.e., ^{2}H, ^{3}He, and ^{4}He. Another group addressed the mechanisms for quark propagation and measures of the color transparency of nuclear matter. The latter follows up on a related phenomenon observed at much higher energies at Fermilab. In another proposal, the quark structure of baryons was discussed in terms of three symmetric quarks versus the diquark model. This issue can be studied by measuring the kaon-hyperon decaysof baryon resonances that may be excited at JLab. Finally, perhaps the most elementary physics issue discussed at PAC 22, was the physics that determines the lifetime of the π^o meson. A recent theoretical calculation of corrections to the leading order term, can be related to the mass difference of the up and down quarks with good theoretical accuracy. All of these physics goals can be addressed at JLab but require measurements performed with high sensitivity and precision.

Recommendations

The laboratory guidelines provided for the approval of 30 days of beam time in Hall A, 73 days of beam time in Hall B, and 35 days of beam time in Hall C. These guidelines were established based on 30/45/35 days of new time to be made available in Halls A/B/C plus 50% / 100%/ 50% of the time recovered from approved experiments now required to return to the PAC due to the jeopardy process. The PAC is allowed to exceed the laboratory guidelines only if it believes the physics has sufficiently high priority, at the level of an A^{-} rating or better, but the excess would then be deducted from the allocation of the next PAC meeting.

Overall the jeopardy process is working well and continues to move toward the goal of three years of backlog in each of the three halls. At this meeting, 22 days of approved time were under jeopardy status, all in Hall B. The backlog in Hall A is now about 3.8 years, with the backlog in Halls B and C at 2.7 years and 4.9 years, respectively. Hall C is impacted by a few very large experiments approved by recent PACs.

There was a high demand for beam time at PAC 22, which, as in the recent past, made the task of the PAC very difficult. Altogether PAC 22 approved 130 days out of 266 requested days of physics running. Of the 12 proposals received, eight experiments were approved. As in the past, the PAC found it necessary to defer an attractive physics proposal that might have been approved if more beam resources had been available. The PAC approved two experiments in Hall A for a total of 31 days, four experiments in Hall B for a total of 86 days and one experiment in Hall C for 13 days. One experiment was ranked A, one A^{-}, and five B^{+}. A proposal addressing accelerator physics issues was approved for 12 days, but, because of its very different character, was not given a grade. The beam time allocated to the accelerator physics proposal will be done in a machine development cycle and will not impact physics running.

Among the newly approved proposals, the highest ranking assigned by the PAC was for Proposal 02-103, entitled “A Precision Measurement of the Neutral Pion Lifetime via the Primakoff Effect”. This experiment addresses fundamental issues in QCD. The lifetime of the neutral pion has recently been calculated to high accuracy (about 1%) using Chiral Perturbation Theory. The dominant term in the width calculation is from the axial anomaly where the correction term, dominated by the mass difference, is 4.5%. The error in the correction is estimated at 1%. This is regarded as a very resilient calculation, in which the critical input is the difference in mass of the up and down quarks. In the Primakoff method, the pion is produced by a photon in the field of a nucleus. This technique is especially well matched to the capabilities of JLab with its unique combination of a high-duty factor electron beam and the tagged photon source in Hall B. The goal of the measurement is to achieve a precision of 1.4%. Realizing this challenging goal would be a major achievement for Jlab and would have high physics impact. PAC 22 regards this measurement as an outstanding component of the JLab program and approved it as an A level experiment. Much of the equipment and resources required by this experiment are in hand. The PAC encourages JLab management to oversee and nurture the development and execution of this important measurement.

The PAC was also impressed with proposal P-02-112 for Hall B in which a search for "missing resonances" uses photoproduction from a polarized frozen spin target. PAC 22 gave it an A^- rating. The experiment takes advantage of the unique multi-particle acceptance of CLAS and the availability of both circularly and linearly polarized photons in Hall B. The PAC strongly encourages the timely development of the frozen spin target.

The PAC reports and PAC recommendations for the reviewed proposals and the PAC response to the letters-of-intent are given in Appendices D and E. Tables that summarize the status of the JLab commitments from PAC 4-22 are referenced in Appendix F at the end of this report.

The PAC is thankful for the efforts of the laboratory staff in support of the PAC 22 meeting. The enthusiastic and inventive contributions of Clara Perdue, Shauna Cannella, and Susan Ewing were especially effective in making this PAC process proceed both efficiently and effectively and are very much appreciated.

Peter D. Barnes
Chairman, Jefferson Laboratory Program Advisory Committee

Tables

Totals for PAC 4-22

	Experiments Recommended for Approval	Experiments Recommended for Conditional Approval	Totals
Experiments	134	7	141
Authors	998	61	1059
Institutions	180	3	183
Countries	29	1	30

Approved Experiments Totals by Physics Topics

Topic	**Number**	**Hall A**	**Hall B**	**Hall C**
Nucleon and Meson Form Factors & Sum Rules	21	8	4	9
Few Body Nuclear Properties	26	16	5	5
Properties of Nuclei	27	8	11	8
N* and Meson Properties	42	6	28	8
Strange Quarks	17	4	11	2
TOTAL	133	42	59	32

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	25 / 1×.67	466.0	20	321.9	3
B	35 / 3×.40 14×.53 2×.76	385.1	24	191.3	2
C	17 / 1×.5	388.5	16	296	2
Total	77 / ~11.31	1239.6	60	809.2	7

Appendices

A. PAC 22 Membership

B. Charge to PAC 22

C. PAC 22 Recommendations

D. PAC 22 Individual Proposal Reports

E. PAC 22 Response to Letters-of-Intent

F. Approved Experiments, PACs 4–22, Grouped by Physics Category

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

Appendix A

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Appendix B

Charge to PAC 22

Jefferson Lab requests that PAC 22:

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, 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 22 Recommendations

Class*/Grade/Days		
C/B^+/16	PR-02-101	Exclusive Study of Deuteron Electrodisintegration Near Threshold
A/NR/12	PR-02-102	CEBAF Energy Recovery Experiment
A/A/22	PR-02-103	A Precision Measurement of the Neutral Pion Lifetime via the Primakoff Effect
A/B^+/20	PR-02-104	Quark Propagation Through Cold QCD Matter
R	PR-02-105	Study of Color Transparency in Two-Body Break-up Processes
D	PR-02-106	Probing the Limits of the Standard Model of Nuclear Physics with the $^4He(\vec{e},e'\vec{p})^3H$ Reaction
R	PR-02-107	Measurement of Charge Pion Production Ratios in Semi-Inclusive Deep-Inelastic Scattering at 6 GeV
A/B^+/15	PR-02-108	Measurement of A_X and A_Z Asymmetries in the Quasi-Elastic $^3\overrightarrow{He}(\vec{e},e'd)$ Reaction
A/B^+/13	PR-02-109	Measurement of $R=\sigma_L/\sigma_T$ on Deuterium in the Nucleon Resonance Region
A/B^+/24	PR-02-110	Q^2 Dependence of Nuclear Transparency for Incoherent ρ^0 Electroproduction
D	PR-02-111	g3 Experiment - Jeopardy Proposal
A/A-/20	PR-02-112	Search for Missing Nucleon Resonances in the Photo-production of Hyperons using a Polarized Photon Beam and a Polarized Target

* A=Approve, C=Conditionally Approve, D=Defer, R=Reject, NR=Not Rated

Appendix D

Individual Proposal Report

Proposal: PR-02-101

Scientific Rating: B^+

Title: Exclusive Study of Deuteron Electrodisintegration Near Threshold

Spokespersons: K. Wang, B. E. Norum, W. Bertozzi and T. Tamae

Motivation: The aim of this experiment is a detailed study of deuteron electro-disintegration at threshold at an intermediate four-momentum transfer $Q^2 = 12\ fm^{-2}$. The five structure functions would be extracted with high resolution at the final-state energy, E_{np} and with sufficient statistics to provide a stringent test of modern nuclear two-body models. Close to threshold, the n-p pair is predominantly in the singlet $^1S_0$ state. For this transition and for the chosen value of Q^2, the contributions of meson exchange currents are dominant, and the individual structure functions have different sensitivities to relativistic corrections and final-state interactions.

Measurement and Feasibility: In this D(e,e′p)n experiment, electrons would be detected in the HRS and protons in BigBite, with full acceptance up to $E_{np} \sim 4$ MeV. Measurements at two different beam energies would allow a separate determination of the longitudinal and transverse structure functions f_L and f_T , while f_{LT}, f_{TT} and f'_{LT} would be extracted from the azimuthal distribution of the protons (using also the beam-polarization asymmetry). Calibration data would be obtained simultaneously using elastic electron-deuteron scattering.

Issues: The PAC believes that a sufficiently precise determination of all five structure functions could provide a benchmark data set against which to test and refine the two-body calculations. In order to achieve the necessary statistical precision, it is essential that this experiment attains the counting rates as proposed. In that respect, the PAC was not fully convinced that the BigBite detection system could operate efficiently with single rates of several MHz. Tracking efficiencies, for example, could be an issue. The experimenters should demonstrate that this experiment can be run within a factor of two of the stated luminosity.

Recommendation: Conditionally approve for 16 days in Hall A

Individual Proposal Report

Proposal: PR-02-102

Scientific Rating: Not Rated

Title: CEBAF Energy Recovery Experiment

Spokespersons: A. Bogacz and A. Hutton

Motivation: The goals of this proposal are to carry out accelerator physics studies using CEBAF beams. There are two main objectives. The first is to demonstrate energy recovery from a high-energy beam. The second goal is to demonstrate operation in a current-doubling mode.

Measurement and Feasibility: Multi-GeV, high current CW Energy Recovery Linacs (ERL's) are seen as important elements for planned future facilities such as the Electron-Ion Collider (RHIC), High Energy Electron Cooling (RHIC), Electron Light- Ion Collider (JLab), and a third-generation Light Source (Cornell). The JLab FEL (75 MeV) is the highest power ERL currently operational using superconducting cavities. Demonstration of this technology with multiple cavities at GeV energies is highly desirable.

There are three phases to the proposed experiment. In the first phase the beam would be accelerated in the North linac to 445 MeV and decelerated in the South linac to 45 MeV and dumped. This requires no new hardware. In the second phase the beam would be accelerated in the North and South linacs to 845 MeV and then decelerated in the North and South linacs and dumped. This experiment requires a new $\lambda/2$ magnetic chicane at the end of the South linac. The last phase is part of the current doubling experiment. The beam would be accelerated in the North and South linacs, it would then pass through a $\lambda/4$ magnetic chicane, drift through the North and South linacs with no energy change, pass throughout the $\lambda/4$ chicane a second time, and be decelerated in the North and South linacs and dumped. The effective gun current would be doubled.

The experiments will involve careful measurements of all beam properties: energy, current, emittance, and beam halo. These are important parameters which will help to characterize the quality of the energy recovery and current doubling experiments. The only hardware required to carry out these experiments is a magnetic chicane for phase adjustment. This is a straightforward design and construction project and is relatively inexpensive (~$100k).

Issues: The PAC believes that these experiments would provide very valuable data and experience in the operation of high-energy, high-current ERL's. This information will be essential in advancing the planning and design of future facilities by JLab and the Nuclear Physics community. This effort would also lead to better understanding and control of machine parameters for the nuclear physics program.

Recommendation: Approve for 12 days

Individual Proposal Report

Proposal: PR-02-103

Scientific Rating: A

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

Spokespersons: A. Gasparian, S. Danagoulian, R. Miskimen, and D. Dale

Motivation: This is a jeopardy review of the PRIMEX experiment which aims at the measurement of the neutral-pion lifetime to a high level of precision, 1.4%, via the Primakoff process. The experiment addresses fundamental issues in QCD. The lifetime of the neutral pion recently has been calculated to high accuracy using Chiral Perturbation Theory. A correction of 4.5% to the leading-order term has been obtained. The coming together of high precision in theory and experiment gives important relevance to PRIMEX.

Measurement and Feasibility: The goal of the measurement, to determine the lifetime of the neutral pion with a precision of 1.4%, is very demanding. The Hall B tagging system, a pair spectrometer to measure the luminosity, and a high granularity calorimeter, HYCAL, will be used. Since the first proposal, efforts have been made to improve on the equipment.

The HYCAL will now have higher granularity by using more $PbWO_4$ crystals, the pair spectrometer has been carefully mapped and tested, and the number of pair detectors will be increased. The main source of the systematic error stems from the luminosity measurement, i.e., from the photon flux and the target thickness.

Issues: The value of this experiment depends on the precision to be achieved. Therefore, every effort has to be made to guarantee the projected systematic accuracy. Since the main source of error stems from the determination of the luminosity, special efforts are needed to improve on this systematic error. It is therefore recommended that a check be made of the merits of using HYCAL instead of a lead-glass block to measure the tagging efficiency, and to use the pair spectrometer for an absolute luminosity measurement.

The PAC is concerned about the model dependence in the determination of the unknown phase appearing in the interference term and about subtraction of the incoherent and the coherent nuclear background. It recommends developing a convincing demonstration that the resulting contribution to the errors, is sufficiently small to not impact the result, at the proposed precision.

Recommendation: Approve for 22 days in Hall B

Individual Proposal Report

Proposal: PR-02-104

Scientific Rating: B^+

Title: Quark Propagation Through Cold QCD Matter

Spokesperson: W. Brooks

Motivation: This proposal plans to study the propagation and hadronization of quarks in a nuclear medium through a detailed measurement of the A-dependence of leading-hadron production in deep-inelastic scattering. Evidence for partonic energy loss in a nuclear medium has been reported in a variety of processes, including Drell-Yan in p-A collisions and hadron production in e-A and A-A collisions. In particular, a recent HERMES measurement showed a striking reduction of the pion multiplicity ratios at low ν and at high z. The HERMES data have been used to extract information on partonic energy loss and on hadronization time. The proposed JLab experiment would extend the HERMES measurement to a different kinematic region with much improved statistical accuracy. These new data would provide crucial new insight into the issue of partonic energy loss in nuclear medium, as well as on the space-time structure of the hadronization process.

Measurement and Feasibility: The proposed experiment would use CLAS to measure hadrons produced with a 5.7 GeV electron beam on targets of N, Ar, Kr, and Au. These data will be compared with the existing e6 data on deuterium to evaluate the multiplicity ratios, which will be studied as a function of Q^2, ν, z, p_T, ϕ and A. A short test run was taken using a 1 mm Pb target to check the single hits due to X-rays, the occupancy in the inner drift chambers, and the trigger rate. The results suggest that the proposed measurements are feasible.

Issues: The PAC believes that an excellent measurement could be performed with a reduced amount of beam time. The PAC suggests that the two proposals 02-104 and 02-110, with minor adjustments in the selection of targets, could partly share beam time. It is left to the proponents together with the Hall B management to find the best solution.

Recommendation: Approve for 20 days in Hall B

Individual Proposal Report

Proposal: PR-02-105

Scientific Rating: N/A

Title: Study of Color Transparency in Two-Body Break-up Processes

Spokespersons: A. Saha and E. Voutier

Motivation: Color transparency is based on the hypothesis that a high momentum transfer exclusive reaction proceeds by the formation of a small-sized wave packet. The intent of this experiment is to determine if the failure to observe color transparency in (e,e´p) reactions (up to $Q^2 = 8$ (GeV/c)^2) is caused by a rapid expansion of a small-sized wave packet, or if the wave packet was never small in size. This would be done by studying cross sections for two-body break-up reactions as a function of missing momentum, p_m. Conventional calculations of the effect of final state interactions find that these decrease the cross section for small values of p_m, but increase it for larger values. This effect (approximately a factor of five for deuterium) would completely vanish at large enough values of Q^2, providing an interesting signal for the effects of color transparency.

Measurement and Feasibility: The cross sections for D(e,e´p)n, ^{3}He(e,e´p)d and ^{4}He(e,e´p)^{3}H would be measured as a function of missing momentum, and ratios of cross sections for high and low values of p_m, would be studied as a function of Q^2. Standard equipment in Hall A would be used, thus presenting no special experimental difficulties.

Issues: The predictions of the size of color transparency effects depend on a parameter, the expansion time, which is constrained by current (e,e´p) experiments. When currently allowed values of this parameter are used, the effect of color transparency is predicted to be small for deuterium, even at the highest values of momentum transfer. The theory for ^{4}He is not sufficiently developed. This makes it difficult to believe that a strong case for observing color transparency could be made. An experiment of this type, performed with a higher beam energy to access higher Q^2, would be very interesting.

Recommendation: Reject

Individual Proposal Report

Proposal: PR-02-106

Scientific Rating: N/A

Title: Probing the Limits of the Standard Model of Nuclear Physics with the $^{4}He(\vec{e},e'\vec{p})^{3}H$ Reaction

Spokespersons: S. Strauch, R. Ransome, R. Ent and P. Ulmer

Motivation: This proposal is for a continuation of a previous study using polarization transfer observables in the $^{4}He(\vec{e},e'\vec{p})^{3}H$ reaction, which indicated that nucleon electromagnetic form factors are modified in the nuclear medium from their free values. Additional data would be obtained with smaller uncertainties at Q^2 = 0.8 and 1.3 $(GeV/c)^2$ to verify the trends seen in the previous measurement.

Measurement and Feasibility: As this is a continuation of a previous measurement by the same group, the experiment is clearly feasible. The spectrometers in Hall A will be used, including the focal plane polarimeter for the hadron arm. By determining a specific polarization “super-ratio”, many experimental uncertainties cancel. Furthermore, the acceptance of the hadron spectrometer will be scanned with the $^{1}H(e,e'p)$ reaction. The measured value will be compared to the best available calculations, which include relativistic effects, various relativistic potentials and current operators, and many-body currents.

Issues: The main issues identified for experiments of this type center around the level of the nuclear-model uncertainty. Before one can claim to have identified any modification of the nucleon’s form factors in the nuclear medium, it is necessary to be sure that the nuclear modeling is under control: specifically, the initial and final nuclear states and the electromagnetic current operator are all subject to some level of uncertainty. While such uncertainties are inevitable, they tend to cancel with this choice of observables in the form of a specific “super-ratio”. Furthermore, the choice of the target nucleus is also optimal for reducing model uncertainties. Accordingly this provides one of the best opportunities for uncovering nucleon modifications. It is important to continue to explore all possible sources of nuclear model uncertainty through close collaboration with the relevant theorists.

The PAC wishes to compliment the proposers on the thoroughness of their responses to the questions posed.

The PAC would like to see this experiment performed, but due to limitations in the available beam time, the proposal cannot be accepted at this time.

Recommendation: Defer

Individual Proposal Report

Proposal: PR-02-107

Scientific Rating: N/A

Title: Measurement of Charged Pion Production Ratios in Semi-Inclusive Deep-Inelastic Scattering at 6 GeV

Spokespersons: X. Jiang, R. Ransome, J.-P. Chen

Motivation: Semi-inclusive deep-inelastic scattering (SIDIS) has great potential for the study the flavor structure of the nucleon. Interpretation of the data requires the applicability of factorization in the process. This proposal aims to study the factorization hypothesis at the highest values of Q^2, W and W' accessible at JLab.

Measurement and Feasibility: Electroproduction cross sections for positive and negative pions from proton, deuteron, and ^{3}He targets, would be measured at the highest W and W' values possible at JLab. The septum magnet in Hall A would allow pions to be measured at angles as small as 6 degrees. The BigBite spectrometer would be used to detect electrons and to provide a large coincidence rate. This would allow the experiment to be done quickly and efficiently. Neutron cross sections would be determined from both the deuteron and ^{3}He cross sections. Ratios of proton to neutron yields would be formed of the sums and differences of positive and negative pion yields. The z-dependence of these ratios, in bins of fixed x and Q^2, would be examined to determine if they are independent of z, which would be a necessary but not sufficient condition to test the factorization hypothesis. Another test of factorization would be to compare the absolute values of the ratios, which are sensitive to the u and d valence and sea quark distributions, to values which have been determined from other experiments. The present proposal does not present any unusual difficulties in terms of rates, backgrounds, or particle identification.

Issues: There is an approved experiment in Hall C (E-00-108) that will address the same physics goals as the present experiment, although at somewhat smaller W' values. Also, existing data from Hall B have significant overlap with the present proposal. The PAC would like to wait until these results have been analyzed and studied before deciding on the best way to extend this type of study. Ultimately, tests of factorization in SIDIS are important for the future program at JLab, but the PAC does not believe that it is urgent and compelling to approve the present proposal at this time.

Recommendation: Reject

Individual Proposal Report

Proposal: PR-02-108

Scientific Rating: B^{+}

Title: Measurement of A_x and A_z Asymmetries in the Quasi-Elastic $^{3}\overrightarrow{He}(\vec{e}, e'd)$ Reaction

Spokespersons: Z.-L. Zhou, W. Bertozzi, D. Higinbotham, S. Širca, and B. Norum

Motivation: The proposal aims at testing modern Faddeev calculations with emphasis on the S' and D states of ^{3}He. Such calculations are needed for the interpretation of experiments such as Deep-Inelastic Scattering and neutron form-factor measurements that use polarized ^{3}He as a polarized neutron target.

Measurement and Feasibility: The double-polarization asymmetries A_x and A_z in the $^{3}\overrightarrow{He}(\vec{e}, e'd)$ reaction would be determined in both parallel and perpendicular kinematics for a range of recoil momentum. A value of 620 MeV/c is chosen for the three-momentum transfer, which is large enough that the produced deuterons incur only a small energy loss in the target, and which is within the range where relativistic effects in the Faddeev calculations are not too large. The experiment would use the Hall A polarized target, one of the HRS spectrometers for the detection of the scattered electron, the other one for monitoring the product of target and beam polarization, and the BigBite spectrometer for the detection of the deuteron. Due to the relatively high luminosity of this set-up in combination with a large virtual photon flux, the count rates would be large enough to determine the small asymmetries with good accuracy. The A_x and A_z asymmetries in the two kinematics show a different sensitivity to ingredients of the calculations such as the S' and D states, meson-exchange currents, and Delta-isobar currents.

Issues: The experiment is feasible. These measurements can provide important benchmark data for testing the Faddeev calculations. It was noted that a large fraction of the data in perpendicular kinematics will be ‘out-of-plane'. Close collaboration with the relevant theoretical groups is needed to gauge the sensitivity to different ingredients of the calculations.

Recommendation: Approve for 15 days in Hall A

Individual Proposal Report

Proposal: PR-02-109

Scientific Rating: B^+

Title: Measurement of $R=\sigma_L/\sigma_T$ on Deuterium in the Nucleon Resonance Region

Spokespersons: M.E. Christy and C. Keppel

Motivation: The proposal aims to use the Rosenbluth technique to measure the longitudinal-transverse (L-T) separated structure functions from deuterium throughout the nucleon resonance region ($1<W^2<4$ GeV^2) and spanning the Q^2 range $0.5<Q^2<4.0$ (GeV/c)^2. This would allow the extraction of the transverse structure function $F_1(x,Q^2)$, the longitudinal structure function $F_L(x,Q^2)$, and the ratio $R=\sigma_L/\sigma_T$. Besides the intrinsic interest in obtaining these for the deuteron, the same quantities for the neutron could be obtained by subtracting the proton data. This would allow the first precision test of parton-hadron duality for the neutron. In addition, a precision measurement of R in this kinematic regime would reduce the uncertainties on the spin structure functions g_1 and g_2 from spin-asymmetry measurements in the resonance region. Finally, the longitudinal structure function from the aluminum target walls would automatically be obtained as part of the background studies, which may provide a measure of the pion excess in nuclei.

Measurement and Feasibility: The experiment would be performed in Hall C using the HMS to detect the scattered electron. The experiment and the analysis would follow the techniques of experiment E94-110, for which L-T separated structure functions were successfully measured on the proton. Therefore, the experiment has already been demonstrated to be feasible, the analysis procedure is well developed by the proposers and the expected systematic errors on R are realistic. To help minimize systematic errors due to uncertainties in the kinematics, proton elastic data would be taken at all possible beam energies and HMS angle settings. For some of the kinematic settings, simultaneous single-arm positron yields would be measured with the SOS in order to ascertain the charge symmetric background.

Issues: The broadening of the nucleon resonances in deuterium must be considered in order to interpret the quantities extracted from a deuteron-proton subtraction as neutron properties.

Recommendation: Approve for 13 days in Hall C

Individual Proposal Report

Proposal: PR-02-110

Scientific Rating: B^+

Title: Q^2 Dependence of Nuclear Transparency for Incoherent ρ^0 Electroproduction

Spokespersons: K. Hafidi, M. Holtrop, and B. Mustapha

Motivation: Several experiments have searched for evidence of nuclear transparency, but only one was able to see a strong effect. Here the measurement of the exclusive incoherent electroproduction of the ρ^0(770) meson in nuclei is proposed. The increase of the ratio $T_A=\sigma_A/A\sigma_N$ at large Q^2 would be the signal for the onset of color transparency. Theoretical calculations predict a significant signal at the JLab energies.

Measurement and Feasibility: The exclusive incoherent electroproduction of the ρ^0 meson will be measured in D, C and Cu and the ratio, T_A, will be evaluated. To avoid the effects of competitive processes that could mimic the signal, the study of the Q^2 dependence of the ratio T_A, will be performed keeping constant the coherence length (l_c=0.4 and 0.5 fm). To cover a large Q^2 interval up to 4 (GeV/c)^2, the measurement will be performed at two different beam energy values (E_0= 4 and 6 GeV). A run with real photons is proposed in order to obtain the Q^2=0 point. The ρ^0 will be detected by measuring with CLAS, the $\pi^+\pi^-$ pair that originates from the vector meson decay. In order to improve the detection efficiency, the CLAS magnetic field will be set at 50% of its maximum value. Kinematical cuts have to be applied to select the reaction of interest.

Issues: The PAC is concerned that nuclear effects other than color transparency could influence the ρ^0 production process and confuse the interpretation. The choice to perform the measurement in two nuclei at constant coherent length could control most of the competitive mechanisms. To improve the interpretation, the PAC strongly suggests extracting from the data all possible information on the spin density matrix of the detected vector meson. Because, for D and C targets, CLAS has demonstrated running at a luminosity a factor of two larger than that assumed in this proposal, this measurement can be accomplished with less beam time.

The PAC suggests that the two proposals 02-104 and 02-110, with minor adjustments in the selection of targets, could partly share beam time. It is left to the proponents together with the Hall B management to find the best solution.

Recommendation: Approve for 24 days in Hall B

Individual Proposal Report

Proposal: PR-02-111

Scientific Rating: N/A

Title: Jeopardy Proposal for the Remaining Six Days of the g3 Experiment -

Spokespersons: B. L. Berman, Y. Y. Ilieva, M. F. Vineyard, and I. Niculescu

Motivation: As formulated in this proposal, the objective is to use the nucleus in order to study, for many processes, the modification of the elementary amplitudes by the strongly-interacting nuclear medium. To explore the density dependence of the nuclear medium modifications, measurements in CLAS have been completed for targets of ^{3}He and ^{4}He. It is proposed to extend these measurements into the large nuclear-radius regime with targets of C and Pb. In both the proposed and the completed measurements, attention is focused on quasi-free strangeness production (K^+ + hyperon) to study modification of the hyperon-nucleon interaction, on inclusive η production to explore medium modification of the $S_{11}(1535)$ resonance, on Δ^{++} knockout from ^{3}He and ^{4}He and determination of the isobar component of the ground-state wave function of ^{3}He, together with a number of other topics.

Measurement and Feasibility: The measurements in ^{3}He and ^{4}He were made in December 1999; a small percentage of the data has now been analyzed. This preliminary analysis demonstrates the power of the CLAS system to detect multi-particle final states. The extension of the technique to carbon and lead appears to be well within the capability of the CLAS system. The sample of data analyzed so far is, however, still too small to demonstrate the nuclear modification phenomena discussed above.

Issues: The measurements made to date offer many intriguing physics possibilities. However, the PAC found that the physics case, as presented, lacked clarity and focus. Furthermore, the data sample that has been analyzed is too limited to permit an assessment of the impact of the initial measurements. The PAC concluded that the case has not yet been made for extending these measurements to heavier nuclei. We recommend deferral of this proposal pending more complete analysis of the ^{3}He and ^{4}He data. A successful demonstration of medium-modification phenomena in the light targets could justify extension of the measurements to heavier targets. However, such a new proposal would be better served by focusing on a few physics topics with well-formulated objectives.

Recommendation: Defer

Individual Proposal Report

Proposal: PR-02-112

Scientific Rating: A^-

Title: Search for Missing Nucleon Resonances in the Photoproduction of Hyperons Using a Polarized Photon Beam and a Polarized Target

Spokespersons: F. Klein, L. Tudor, and P. Eugenio

Motivation: The standard SU(6)xO(3) symmetric quark model of baryons predicts many states that have not been observed. These "missing resonances" are also predicted to decay weakly, or not at all, to π-N and so would not have been observed in pion-beam experiments or pion photoproduction, which have been the predominant reactions used in the study of baryon resonances. An alternative explanation is to invoke the diquark model of the nucleon which automatically excludes the unobserved resonances predicted by the symmetric quark model. The symmetric quark model predicts that several of the "missing resonances" couple strongly to γp and to KΛ or KΣ, so photoproduction of hyperons provides an obvious reaction in which to search for these states. Also, exclusive pseudoscalar-meson photoproduction permits a complete set of measurements, that is, permits determination of the magnitude and relative phases of the invariant amplitudes, through appropriate combinations of polarized beam, polarized target and recoil polarization The latter can be measured in this case due to the weak decay of the Λ and Σ^+. This provides the maximum amount of information possible for partial-wave analysis.

Measurement and Feasibility: The proposal is to measure KΛ, KΣ^0 and KΣ^+ photoproduction from W = 1.705 GeV to W = 2.34 GeV and covering almost the full angular range, using the CLAS detector with a polarized frozen-spin target. The combinations of longitudinally-polarized target with circularly-polarized beam and transversely-polarized target with linearly-polarized beam will be used and the polarization of the Λ and Σ^+ determined. The CLAS magnetic field will be set to 50% of its maximum value. The target length is set to 25 mm and diameter to 15 mm to reduce energy loss and multiple scattering. To determine the effective dilution factor it is proposed to collect data simultaneously at 50% event rate on a carbon target at a slightly downstream position. CLAS-g1, g8 have demonstrated the feasibility of hyperon photoproduction. Twelve days of beam time can be shared with E01-104.

Issues: It is essential to perform a sample partial-wave analysis on Monte Carlo data to establish the required statistics and so determine the appropriate beam time. It is important to establish that the data will permit a model-independent partial-wave analysis. A new polarized target is required. A transverse-polarization capability is essential. The PAC sees this experiment as an important part of the laboratory's program.

Recommendation: Approve for 20 days in addition to the 12 days of parallel data-taking

Appendix E

PAC 22 Response to Individual Letters of Intent

Letter of Intent: LOI-02-101

Title: Pion Photoproduction from a Polarized Target

Contact Persons: S. Strauch, N. Benmouna, and G. O'Rielly

This LOI is a natural complement to PR 02-112. The intention is to provide the maximum experimental information possible on this reaction apart from recoil nucleon polarization. The principal aims of the experiment are to resolve ambiguities in present partial-wave analyses and to provide better determination of the γN couplings of the baryon resonances. Much of the data (above 1.7 GeV) can be taken in parallel with PR 02-112.

The collaboration is encouraged to return with a full proposal, addressing the following:

1. The optimum CLAS settings for both independent and combined studies of KY and πN.

2. A demonstration of the utility of the proposed data by performing a sample partial-wave analysis on Monte Carlo data.

Individual Letter of Intent Report

Letter of Intent: LOI-02-102

Title: Forward Electron Compton Scattering and Absolute Energy Calibration of the Tagged Photon Beam in Hall B

Contact Persons: L. Gan and A. Gasparian

It is proposed to use the HYCAL from the PRIMEX experiment to improve on the absolute calibration of the Hall B tagger from 1% to 0.1%. This would be done by measuring the minimum opening angle between the photon and the electron after the Compton process.

According to the list of systematic errors contributing to the final result of PRIMEX, it is not of primary importance to reduce this source of uncertainty.

Obtaining a better calibration for the tagger is certainly an important commissioning task for Hall B. For this purpose all possible reactions to achieve the calibration should be discussed, of which the proposed procedure is one. For example, the PAC encourages the collaboration to investigate whether a measurement of the neutral-pion energy (via the minimum opening angle between the decay photons) could be used as an energy calibration of the tagger.

A second issue is to measure the absolute cross section of high-energy electron Compton scattering in order to learn about radiative corrections. The PAC wonders whether the corrections are known well enough that the Compton process could serve as a cross-section standard against which the accuracy of the PRIMEX experiment could be checked.

Individual Letter of Intent Report

Letter of Intent: LOI-02-103

Title: A Test of Factorization in $N(e,e'\pi^{\pm})N$ with a 6 GeV Beam

Contact Person: D. Mack

The intent is to measure the Q^2 dependence of the longitudinal cross section in the $p(e,e'\pi^+)n$ reaction above the resonance region, at fixed values of the Bjorken variable x_B and the four-momentum transfer, t, from the virtual photon to the pion. In the deeply virtual regime, the process is described at leading order by the handbag diagram amplitude. This amplitude factorizes into a hard scattering and a nonperturbative part described by the generalized parton distributions (GPD) in the nucleon. This factorization leads to a Q^{-6} dependence of σ_L, which would be tested here. Such an experiment would be a natural, and even necessary, complement to the on-going or approved measurements of exclusive deeply virtual production of vector mesons and of photons at Jefferson Lab. It necessitates a Rosenbluth separation.

The authors are encouraged to proceed with a proposal. The choice of kinematics, the estimation of counting rates and the sensitivity of the observables to the two relevant GPDs and to higher-twist terms should be investigated using model calculations.

Individual Letter of Intent Report

Letter of Intent: LOI-02-104

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

Contact Person: E. Pasyuk

The physics addressed is a natural complement to PR-02-112. The intention is to provide the maximum experimental information possible on this reaction apart from recoil nucleon polarization. There are two principal aims: to determine the η-nucleon widths of established resonances and to look for the "missing resonances" predicted by the symmetric quark model, some of which are believed to decay strongly to η-nucleon. Most of the data (from 1.7 to 2.0 GeV) can be taken in parallel with PR 02-112.

The collaboration is encouraged to return with a full proposal, addressing the following:

1. The lowest energy of W = 1.5 GeV to address the discrepancy on the γN couplings of the $D_{13}(1520)$.

2. The optimum CLAS settings for both independent and combined studies of KY and ηN.

3. A demonstration of the utility of the proposed data by performing a sample partial-wave analysis on Monte Carlo data.

Individual Letter of Intent Report

Letter of Intent: LOI-02-105

Title: Measurement of Tagged Neutron Structure Functions Using CLAS

Contact Person: S. Kuhn

This LOI proposes to build a novel apparatus consisting of a gas target and Gas Electron Multiplier microstrip detectors for measuring slow recoiling charged particles in CLAS. A major physics motivation for constructing such a detector system is to have a precise determination of neutron structure functions at large x. Using a gas deuterium target and tagging of neutrons via backward-going protons with momentum down to 70 MeV/c, one can minimize the Final-State-Interaction and correct for Fermi-motion and off-shell effects.

The PAC believes the physics and the techniques of this LOI are very important and encourages submission of a full proposal.

Appendix F

(To access Appendix F, view the Experiment Summary at
http://www.jlab.org/exp_prog/PACpage/)