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Report of the
July 17-20, 2001
Meeting of the

Jefferson Lab
Program Advisory Committee

PAC 20

Letter from the Director

August 3, 2001

Members of the Jefferson Lab User Group,

Jefferson Lab and its User community are committed to maintaining a demanding and compelling scientific program. Besides executing our program we must rededicate ourselves to let the world, both scientific and in a broader sense, know about our results and their impacts. We are working tirelessly within the Agency, the Administration and in Congress to educate and inform key decision makers on the plight of the physical sciences in general and Jefferson Lab and its users in particular. The support of the user community and its home institutions are critical as we seek to make the case for a higher base funding level in the physical sciences.

These are critical times for Jefferson Lab and its users as we develop and finalize our Institutional Plan, and prepare for the annual peer review of our Science and Technology as part of our performance-based contract. PAC 20 represented another step in our effort to ensure that in times of tough choices the best physics is our first priority with the beginning of the jeopardy process in Hall B. The PAC heard 16 proposals and of these, 6 were approved and 3 conditionally approved. The ratings that these experiments received are a testament to the excellent scientific opportunities that continue to be pursued by our growing user community. These experiments represent the future of our laboratory and of our field.

I would like to thank PAC 20 and its chair, Peter Barnes, for their efforts reviewing and making recommendations regarding additions to our experimental program and their judicious use of the jeopardy process. Their thoughtful consideration and guidance are critical to the continued excellence of our program. We continue to be concerned that we are sacrificing excellent physics for lack of more operating time and we will continue to work to ensure that such trade-offs are kept to a minimum.

Sincerely,

Christoph W. Leemann

Letter from the PAC Chair

Introduction

The Jefferson Laboratory Program Advisory Committee held its 20th meeting at JLab on July 17-20, 2001. The membership of the Program Advisory Committee is given in Appendix A. In response to the charge (Appendix B) from the interim director, Dr. Christoph Leemann, the committee reviewed and made recommendations on sixteen new proposals and eight letters-of-intent.

The PAC would like to acknowledge the efforts of the laboratory staff in support of the PAC meeting, especially those of Shauna Cannella, Clara Perdue, and Lucy Collins.

General Overview

This was an outstanding meeting in terms of discussion of the new physics results that are emerging from recent JLab measurements and the introduction of new experiments proposed for the physics research program. The PAC noted that while the overall experimental program continues to proceed well, the accelerator performance during the spring, 2001, was less productive than planned. JLab management assured the PAC that they have corrected the problems and are sensitive to the impact on the physics program. The publication stream from the experimental program continues to be strong.

At our last meeting, PAC 19, the PAC advised the laboratory to give increased emphasis to concerted studies of the systematic parameters that determine the ultimate precision of the JLab experiments. As noted, significant progress has been made in understanding the energy, polarization and angle calibrations in individual halls, but much remains to be done. The ongoing discussion in PAC 20 of the comparison of the L/T separations obtained from Rosenbluth analysis and that of recoil polarization measurements, just reinforces this point. It is clear that precision measurements are a hallmark of the growing research program. We continue to encourage the laboratory to follow up on these issues.

The demand for beam time at JLab continues to be very high. PAC 20 found that the requests for beam time in Hall C at this meeting were far beyond the Hall C allocation, even after the A and A- rated experiments were identified. This is similar to a situation that existed for Hall A over the past few PAC meetings. In addition the PAC notes that in several cases it has carried out a review of a proposal which was not expected to get to the floor of the experimental hall within the three year jeopardy time constant because, for example, of the extensive construction required. Thus we potentially will be reviewing these proposals again before they can take data.

The PAC is starting to become concerned whether the proposal review system is properly matched to the scale of the experiments, size of the beam requests, and the mix of large and small projects that make up the JLab program, particularly in the case of major experiments requiring extensive construction. We note that the process is further complicated by the fact that there is a critical link between the PAC approval process and the DOE/NSF process of funding the construction of new detectors and the funding of research groups.

How well is the current process matched to the needs of the community, JLab management, and the DOE/NSF? The fact that the PAC identified some A / A- rated proposals that it ultimately

was not able to approve within the available allocations, is not taken lightly. The PAC will be evaluating all these issues over the next few meetings.

Recommendations

The laboratory guidelines provided for the approval of 30 days of beam time in Hall A, 126 days of beam time in Hall B and 51 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%/ 100% 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 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.

PAC 20 completed the first pass in the jeopardy review process of previously approved experiments in Hall B. Due to the large number of such experiments, the review will be spread over PAC 20 and 21. At this meeting, five proposals which were under jeopardy status were considered, four Hall B proposals including the E1 run group which includes 13 experiments, and one Hall C proposal.

The high demand for beam time in Hall C at this meeting made the task of the PAC extremely difficult. While 217 days were requested for Hall C, the allocation was only 51 days. Consequently the PAC found it necessary to defer some very attractive physics proposals that, in our judgement, would have been approved in more normal circumstances. Nine experiments were approved or conditionally approved. The PAC approved one experiment in Hall A for a total of 20 days, approved/conditionally approved four experiments in Hall B for 130 days of beam time and approved two experiments in Hall C for a total of 54 days. In addition, after discussions with Associate Director, Larry Cardman, the backward angle G0 measurement (E-01-116), which will follow the planned forward angle running, was conditionally approved for 60 days (with E-01-115 running in parallel) but was treated as outside the immediate Hall C allocation. Conditional approval of at least some backward angle running for G0 has been implicit in previous PAC discussions of this major research program.

The reports and PAC recommendations for the reviewed proposals and the response to the letters-of-intent are given in Appendices D and E. The tables on the following pages summarize the status of JLab commitments from PAC 4-20.

Peter D. Barnes
Chairman, Jefferson Lab Program Advisory Committee

Tables

Totals for PAC 4-20

	Experiments Recommended for Approval	Experiments Recommended for Conditional Approval	Totals
Experiments	122	12	134
Authors	1000	11	1011
Institutions	158	1	159
Countries	28		28

Approved Experiments Totals by Physics Topics

Topic	**Number**	**Hall A**	**Hall B**	**Hall C**
Nucleon and Meson Form Factors & Sum Rules	19	7	4	8
Few Body Nuclear Properties	23	13	5	5
Properties of Nuclei	24	6	10	8
N* and Meson Properties	39	6	26	7
Strange Quarks	17	4	11	2
TOTAL	122	36	56	30

Approved Days and Conditionally Approved Experiments

Hall	**Approved Experiments** # Expts Completed (full/partial)	Days Run	No. Exps in Queue	Days to be Run	Conditionally Approved Experiments
A	16 / 1x.86 2x.5 1x.1 1x.54	369.2	14.60	408.7	4
B	6 / 3x.76 4x.72 3x.62 6x.61 14x.53 8x.5 3x.10	297.6	27.52	338.40	6
C	15 / 1x.5 1x.25	323.5	14.87	306.40	2
Total	37 / ~25.73	990.3	56.99	1053.50	12

APPENDICES

A. PAC 20 Membership

B. Charge to PAC 20

C. PAC 20 Recommendations

D. PAC 20 Individual Proposal Reports

E. PAC 20 Letters-of-Intent

F. Approved Experiments, PACs 4–20, Grouped by Physics Category

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

Appendix A
Program Advisory Committee, PAC 20

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Appendix B

Charge to PAC 20

Jefferson Lab requests that PAC 20:

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 20 Recommendations

Class*/Grade/Days

R	PR-01-101	Spin Polarization in Kaon Electroproduction
R	PR-01-102	Measurement of the $\Delta\Delta$ Component of the Deuteron by Exclusive Quasi-elastic Electron Scattering – Update to E-93-043
A / B$^+$/ 30	E -01-103	CLAS E1 Run Group Jeopardy Proposal.
C / B$^+$/ 22	E -01-104	Helicity Structure of Pion Photoproduction – Update to E-91-015
D	PR-01-105	G_{Ep} / G_{Mp} via Simultaneous Asymmetry Measurements of the Reaction $\vec{p}(\vec{e}, e')$
D	PR-01-106	The Electric Form Factor of the Neutron at Q^2=2.40 $(GeV/c)^2$ [and the Proton at Q^2=2.08 $(GeV/c)^2$]
A / A$^-$/ 14	E -01-107	Measurement of Pion Transparency in Nuclei
A / B$^+$/ 20	E -01-108	Detailed Study of the ^{4}He Nuclei Through Response Function Separations at High Momentum Transfers
A / A / 40	E -01-109	Measurement of G_{Ep} / G_{Mp} to Q^2= 9 $(GeV/c)^2$ via recoil polarization
D	PR-01-110	The H(e,e'n)X Reaction and the Pion Structure Function
D	PR-01-111	Measurement of the Neutron d_2^n Matrix Element: A Linear Combination of the Electric χ_E and Magnetic χ_B Color Polarizabilities
A / A$^-$/ 18	E -01-112	Photoproduction of Vector Mesons off Nuclei – Update to E-94-002
A / A / 60	E -01-113	Deeply Virtual Compton Scattering with CLAS at 6 GeV
R	PR-01-114	Update to E-91-003: A Study of Longitudinal Charged Pion Electroproduction on H, ^{2}H, ^{3}He, and ^{4}He
C / B$^+$/ 0	E -01-115	Measurement of the Parity Violating Asymmetry in the $N \rightarrow \Delta$ Transition – Update to E-97-104
C / A / 60	E -01-116	The G0 Experiment Backward Angle Measurements

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

Appendix D

Individual Proposal Reports

Experiment: PR-01-101

Spokesperson: *P. Gu'eye*

Title: Spin Polarization in Kaon Electroproduction

Motivation: The experiment proposes to study spin polarization observables in kaon electroproduction by measuring the polarization transfer and induced polarization in the reaction $\vec{e} + \vec{p} \rightarrow e' + K^+ + \Lambda$ with a longitudinally polarized electron beam. Here the self-analyzing character of Λ decay is exploited to determine the Λ polarization in the final state. It is suggested by the proponents that investigation of the polarization of the Λ can provide information on the electromagnetic form factor of the hyperon and the spin dynamics of the reaction.

Issues: This proposal was reviewed by PAC 12 and conditionally approved subject to issues addressed in this presentation. The experimental technique requires simultaneous detection of the kaon and the Λ-decay proton in the SOS. This has now been explored with a Monte Carlo simulation together with calculations of the efficiency and acceptance of the system. The PAC 20 is convinced that the measurements can be performed.

PAC 20 has serious concerns regarding the motivation of the experiment.
-The PAC is not convinced that the proposed experiment will impact our current understanding of the Λ electromagnetic form factor given uncertainties in other parameters that influence the calculated cross section.
-The measurement is made at a single choice of W, (= 1.70 GeV) and a single value of the production angle between the kaon and the Λ. It must be analyzed in a hadrodynamic model that treats multiple hyperon resonances and consequently has many parameters. This phenomenological treatment of a very limited data set where W is neither very low (few resonances) nor very large (many resonances) makes it very difficult to extract fundamental properties of the process.
-New results on Λ-production are becoming available from Hall B. In CLAS a wide choice of production angle and W can be explored. A case has not been made for how this proposed measurement, with its very restricted kinematic range, will further enhance our understanding of these spin transfer processes at this time.

It is the opinion of this PAC that while the dynamics of these spin transfer processes is of fundamental interest, the proposal has not identified a particular focus that will efficiently advance our understanding of this spin physics.

Recommendation: Reject

Scientific Rating: N/A

Individual Proposal Report

Proposal: PR-01-102

Title: Measurement of the Δ-Δ Component of the Deuteron by Exclusive Quasi-elastic Electron Scattering, Update to E-93-043

Spokesperson: B. Quinn

Motivation: This is an update of accepted Hall B proposal E-93-043. Its goal is to measure the Δ-Δ component in the deuteron ground-state wave function by quasi-free knockout of a Δ^- leading to the detection of the charged particles from exclusive Δ^{++} Δ^- final states in the CLAS spectrometer.

Measurements and Feasibility: Measurements of quasi-elastic scattering from the Δ^- with detection of the scattered electron and the decay products of the spectator Δ^{++} would be performed in Hall B using a 4 GeV unpolarized electron beam and a deuterium target. Spectator Δ^{++} s from the Δ-Δ component in the deuteron ground state would be reconstructed from their p-π^+ decay products. Events would be selected corresponding to the missing mass in the Δ-region. A subset of events that include the π^- from the decay of the Δ^- would be used to reconstruct the unobserved neutron mass in order to check backgrounds. This experiment was incorporated into the e1 run group even though its simultaneous requirements of a deuterium target and reversed field make it incompatible with the requirements of other experiments in that group. Two short runs were performed parasitically in order to check background rates. These results are not yet fully analyzed, although preliminary back-angle Δ^{++} distributions were presented.

Issues: The PAC believes that the small $\Delta\,\Delta$ probability cannot be reliably extracted, given the uncertainties in the reaction mechanism and the competing backgrounds.

Recommendation: Reject

Scientific Rating: N/A

Individual Proposal Report

Proposal: E-01-103

Title: CLAS E1 Run Group Jeopardy Proposal

Contact Person : V. Burkert

Motivation: Experiments in this run group are aimed at studying the known baryons, and to seek the "missing resonances" of the quark model.

Measurement and Feasibility: CLAS is used with polarized electron beams at a range of energies, and with proton and deuterium targets.

Issues: The variety of channels explored, the range of kinematics, and the use of spin observables are part of the multi-pronged attack needed if progress is to be made in the N* investigations. The anticipated data on the $N \rightarrow \Delta$ transition will yield important information on the slope of the multipole ratios R_{EM} and R_{SM} at low Q^2 and will provide a check on the existing data. The single-pion polarization data on ^1H and ^2H targets will be important for a full Partial-Wave Analysis. On the issue of missing resonances: even if a PWA is unable to extract resonances in a range of partial waves, definite proof of even a few missing resonances would be very significant. Using polarized electrons would add to the sensitivity of these studies. Based on the existing data there seems to be a discovery potential in the $K^* \Sigma$ channel, which can access resonances predicted above 2 GeV.

Recommendation: Approve for 30 days in Hall B

Scientific Rating: B^+

Individual Proposal Report

Proposal: E-01-104

Title: Helicity Structure of Pion Photoproduction, update to E-91-015

Spokespersons: D. Sober, M. Khandaker, and D. Crabb,

Motivation: The experiment is an update to E-91-015, which was placed in jeopardy due to the unavailability of a suitable polarized target. The aim is to test predictions of partial-wave analyses for helicity asymmetry in single-pion photoproduction on the proton; to evaluate the single- and double-pion contributions to the GDH sum rule; and to use the helicity asymmetry as a tool in searching for missing resonances.

Measurement and Feasibility: The experiment utilizes a polarized electron beam, the Hall B photon tagger, and the CLAS detector to measure the helicity dependence of exclusive pion photoproduction channels on the proton. The experiment requires construction and installation of a new frozen-spin target. The measurements described in the proposal are feasible, although it might be difficult to guarantee exclusivity at the higher energies.

Issues: The PAC believes that the proposed experiment will give insight into the contribution of exclusive channels to the GDH integral; it will also add significantly to the data base of partial-wave photo-pion amplitudes; and it will serve as the $Q^2=0$ limit for much of the N* data. Further, it believes that the construction of the frozen-spin target is a good investment which will make possible new experiments at JLab

Recommendation: Conditional approval for 22 days in Hall B, subject to the availability of the frozen-spin target.

Scientific rating: B^+

Individual Proposal Report

Proposal: PR-01-105

Title: G_{Ep} / G_{Mp} via Simultaneous Asymmetry Measurements of the Reaction $\vec{p}(\vec{e},e')$

Spokesperson: G. Warren

Motivation: The ratio G_{Ep} / G_{Mp} is vital to our understanding of the structure of the proton. Results from Hall A experiments using electron-proton polarization transfer have shown that this ratio clearly decreases with increasing Q^2. An experiment based on the Rosenbluth separation method (E-01-001) has been approved to check on these findings. The proposed experiment aims at providing another check with different systematic uncertainties and high statistical precision.

Measurement and Feasibility: The polarized beam polarized target asymmetry is to be measured simultaneously, using two spectrometers at the same Q^2, for different orientations of the proton polarization. The ratio of both cross sections is a function of G_{Ep} / G_{Mp} . In this ratio the degrees of polarization and the dilution factor of the target drop out to first order, thus minimizing systematic uncertainties. It is proposed to measure G_{Ep} / G_{Mp} at Q^2=1.1 and 2.1 $(GeV/c)^2$.

Issues: The proposal is clearly written and the underlying idea is very good. However, given the existing data and the approved experiment to check on them, the PAC does not find a compelling reason to approve this proposal at the present time.

Recommendation: Defer

Scientific Rating: N/A

Individual Proposal Report

Proposal: PR-01-106

Title: The Electric Form Factor of the Neutron at $Q^2 = 2.4$ $(GeV/c)^2$ [and the Proton at $Q^2 = 2.08$ $(GeV/c)^2$]

Spokespersons: R. Madey and S. Kowalski

Motivation: This is an extension to higher momentum transfer [$Q^2 = 2.4$ $(GeV/c)^2$] of completed Hall C experiment E-93-038, which determined the neutron charge form factor at $Q^2 = 0.45$, 1.13, and 1.47 $(GeV/c)^2$. In addition to its intrinsic interest, the neutron electric form factor is also required in few-body calculations of nuclear charge form factors. For the proton, a measurement of the ratio G_{Ep} / G_{Mp} at $Q^2 = 2.08$ $(GeV/c)^2$ using an independent technique, would also check the corresponding JLab and SLAC measurements.

Measurements and Feasibility: Polarized electron beams of 3.4 and 4.2 GeV and a liquid deuterium target would be used in Hall C to measure the recoil-neutron sideways polarization in quasi-elastic breakup of the deuteron. This measurement has been shown to be sensitive to the neutron form factor ratio, G_{En} / G_{Mn} while being largely insensitive to nuclear effects such as final-state interactions, meson-exchange currents, isobar configurations, and details of nuclear potential models. Measurements would be made in the neutron polarimeter of the ratio of asymmetries of neutron spins oppositely processed in the Charybdis dipole magnet; this ratio is largely independent of the beam polarization and the analyzing power of the polarimeter.

An incidental measurement of the proton form factor ratio G_{Ep} / G_{Mp} at $Q^2 = 2.08$ $(GeV/c)^2$ could be performed at a modest cost in beam time (3.6) days with a stand-alone proton polarimeter and a dipole precession magnet. This measurement would be an independent check of previous measurements at JLab (with a focal-plane polarimeter) and at SLAC (using a Rosenbluth separation).

Issues: Measurement of the neutron electric form factor at higher momentum transfers was viewed as timely, interesting, and an important part of the JLab program. The incidental measurement of the proton form factor was not viewed as competitive or timely. The PAC strongly endorses this experiment, but is forced to defer it due to lack of beam time in Hall C at this time.

Recommendation: Defer

Scientific Rating: N/A

Individual Proposal Report

Proposal: E-01-107

Title: Measurement of Pion Transparency in Nuclei.

Spokespersons: K.R. Garrow and R. Ent

Motivation: The experiment aims to search for color transparency by measuring the A and Q^2 dependences of pion electroproduction in nuclei. Color transparency has been predicted to exist due to decreasing final-state interactions for compact color-neutral quark-gluon systems, but experiments to date have not yielded an unambiguous result. This proposal would take advantage of the expected earlier onset of color transparency for mesons compared to nucleons, along with the cleanliness of exclusive electroproduction to make a definitive measurement.

Measurement and Feasibility: The experiment uses the Hall C spectrometers and the aerogel detector currently under construction for the HMS. Pion production will be measured for 6 targets at 5 values of Q^2. An L-T separation will be made for $Q^2 = 2$ $(GeV/c)^2$. Quasi-elastic kinematics are used to ensure production from a single nucleon. The excellent kinematic resolution offers better precision than previous experiments, with better knowledge of the final state. The measurements are feasible, though the proposed statistics appear to be better than required, given the systematic uncertainties.

Issues: The interpretation of color transparency experiments remains rather model dependent. The PAC was concerned that nuclear effects other than color transparency could influence the pion production process and confuse the interpretation. The choice of kinematics to simplify the pion production, to enhance the formation length, and to measure the Q^2 dependence largely address these concerns. In view of the dominance of the systematic uncertainties it was concluded that the experiment could be completed adequately with a slightly reduced running time.

Recommendation: Approve for 14 days in Hall C.

Scientific rating: A -

Individual Proposal Report

Proposal: E-01-108

Title: Detailed Study of the ^{4}He Nuclei through Response Function Separations at High Momentum Transfers.

Spokespersons: K. Aniol, S. Gilad, D. Higinbotham, and A. Saha

Motivation: The aim is to provide a large and precise data set for testing and constraining theoretical models of ^{4}He, and in particular to study the short-range structure, nucleon-nucleon correlations, and possible limits to the hadronic description of this nucleus. This measurement augments the existing program of (e,e'p) studies of light nuclei.

Measurement and Feasibility: The experiment uses standard Hall A spectrometers and targets to measure the (e,e'p) reaction on ^{4}He at a variety of kinematic settings. Response function separations will be made up to p_m=0.5 GeV/c, and cross sections will be measured up to p_m =1.2 GeV/c. There do not appear to be any major feasibility issues.

Issues: Very careful control of systematic errors will be needed to perform precise Rosenbluth separations. It is important to devote sufficient time to calibration runs to minimize these systematic errors, for example using a hydrogen target. The experimenters should consider optimizing the kinematics to avoid regions where the errors on the longitudinal response will be too large to be meaningful (for example at the highest Q^2 value proposed, and in the breakup region).

Recommendation: Approve for 20 days in Hall A.

Scientific Rating: B $^+$

Individual Proposal Report

Proposal: E-01-109

Title: Measurement of G_{Ep} / G_{Mp} to $Q^2 = 9$ $(GeV/c)^2$ Via recoil polarization

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

Motivation: This proposal aims to extend measurements of G_{Ep} / G_{Mp} to $Q^2 = 9$ $(GeV/c)^2$, which is the highest momentum transfer practically accessible with a 6 GeV beam at CEBAF. The results of previous high precision measurements taken by this collaboration via the recoil polarization technique in Hall A have shown that the ratio of G_{Ep} / G_{Mp} falls steadily with increasing Q^2. This very clear and startling discovery is a highlight of the recent JLab scientific program and has stimulated new theoretical attempts to describe the nucleon form factors. It is important to pursue these measurements to higher momentum transfers to see if the trend continues.

Measurements and Feasibility: The recoil polarization technique has a number of advantages over the traditional Rosenbluth separation method for determining G_{Ep} / G_{Mp}. The results do not depend on a precise knowledge of the beam polarization and the polarimeter analyzing power, since a ratio of polarization components are measured simultaneously with the same device. On the other hand, the results are dependent on correctly accounting for spin precession of the outgoing polarized protons in the spectrometer, which rely on detailed simulations of the magnetic field.

The new measurements will be carried out in Hall C using the HMS, a new focal plane polarimeter, and a lead glass array to detect the scattered electrons. The feasibility of using the lead glass calorimeter for electron detection was tested already, with a small array, in Hall A at moderate momentum transfers, and the results agreed with the two-spectrometer data taken previously. The collaboration now proposes a low Q^2 point at 4.2 $(GeV/c)^2$ to overlap earlier data taken with different apparatus in Hall A, plus two new data points at 7.5 and 9 $(GeV/c)^2$.

Issues: The sensitivity of the experiment relies on the analyzing power for the polarimeter (2 x 60 cm CH_2), being significantly nonzero in the appropriate momentum range. At the time of writing the proposal, there were no analyzing power data available that would validate extrapolations that were made to design the new experiment. The collaboration has undertaken to measure this analyzing power at Dubna, and the committee is pleased to note that preliminary results obtained this summer are in reasonable agreement with extrapolations made in the proposal. A second issue is that of radiative corrections involving the proton at these high momentum transfers. Work in progress, for example by Afanasev et al., addresses this issue and it will be important to evaluate the radiative corrections carefully before the experiment is carried out. Finally, the committee agrees that the low Q^2 point will provide a very important cross check in comparison with earlier results taken with a completely different spectrometer and polarimeter system.

This proposal was submitted to PAC18 and deferred pending results of E-99-007 to a momentum of 5.6 $(GeV/c)^2$. The committee was pleased to see the preliminary results of E-99-007, which show a consistent trend with earlier measurements at lower Q^2, and also to learn

that the new apparatus could be used up to 12 $(GeV/c)^2$ in the longer term, as limited by the highest momentum accessible to the HMS. This experiment will not be ready to run until 2004 at the earliest, since construction and testing of the new equipment will take approximately 3 years to complete. However the committee acknowledges the importance and urgency of the proposed measurements.

Recommendation: Approve for 40 days in Hall C.

Scientific Rating: A

Individual Proposal Report

Proposal: PR-01-110

Title: The H(e,e'n)X Reaction and the Pion Structure Function

Spokespersons: R. Holt, P. Reimer, and K. Wijesooriya

Motivation: The aim of this experiment is two-fold: a) to test the Sullivan process (coupling of the virtual photon to a charged pion from the proton pion cloud) in the region of intermediate x_π where the experiment could provide a test of a recent puzzling result from ZEUS. (b) to perform a measurement of the pion structure function at large values of x_π, in the region where the Drell-Yan results for the pion structure function could be questioned.

Measurement and Feasibility: The momentum transfer is between 1 and 2 (GeV/c)^2. The Big Bite spectrometer and two separate neutron detectors would be used for 15 days in Hall A, and the experiment seems to be feasible.

Issues: The PAC is concerned about the interpretation of the data. The momentum transfer is low as well as the value of W for the pion. The interpretation in terms of deep inelastic scattering from the pion might not be valid. For example, there could be transitions such as $\gamma\pi \rightarrow \rho$ (or a_1). Another concern that should be addressed is the possibility of target fragmentation leading to a low momentum neutron in the final state. In addition, one would like to know the Q^2 -dependence of the structure function.

Recommendation: Defer

Scientific Rating: N/A

Individual Proposal Report

Proposal: PR-01-111

Title: Measurement of the Neutron d^n_2 Matrix Element: a Linear Combination of the Electric χ_E and Magnetic χ_B Color Polarizabilities.

Spokespersons: X. Jiang and Z.-E. Meziani

Motivation: The motivation is to test model calculations (in particular, lattice models) of the d^n_2 matrix element, which in the framework of the Operator Product Expansion is sensitive to twist-three quark-gluon correlations, and to electric and magnetic color polarizabilities.

Measurement and Feasibility: The measurement uses longitudinally polarized electron scattering from polarized ^{3}He to measure the spin structure functions $g_1(x)$ and $g_2(x)$ at fixed $Q^2=2$ $(GeV/c)^2$. The spin asymmetry for inclusive electron scattering is measured in the standard Hall A spectrometers. The d^n_2 matrix element is evaluated by integrating $x^2(2g_1+3g_2)$ over the measured region, with extrapolations to x=0 and x=1 to cover the unmeasured regions. Models are used to correct for the difference between a polarized ^{3}He nucleus and a free polarized neutron. The experiment appears to be feasible, building on a foundation of several similar experiments in Hall A. The experiment could provide a factor-of-four smaller error than existing data for the neutron d^n_2 matrix element.

Issues: The principal issue is that the integral will be strongly affected by contributions in the resonance region, which may introduce significant higher-twist contributions, clouding the interpretation in terms of quark-gluon correlations. A secondary concern is the reliability of the extraction of the value of d^n_2 of the neutron from the data on ^{3}He. Since the nuclear effects are largest at high x, it is not obvious that these are negligible in an integral that is weighted by x^2.

Recommendation: Defer

Scientific Rating: N/A

Individual Proposal Report

Proposal: E-01-112

Title: Photoproduction of Vector Mesons Off Nuclei, update to E-94-002

Spokespersons: D.P.Weygand, M.V.Kossov, and C.Djalali

Motivation: This experiment aims at studying the properties of vector mesons propagating in nuclei. In-medium effects are predicted to modify the invariant mass distribution of e^+e^- pairs that originate from the vector meson decay.

Measurement and Feasibility: The simultaneous measurement in CLAS, of the e^+e^- photoproduction from different nuclear targets (^{2}H, C, Fe, Pb) is proposed. The detection of e^+e^- pairs would permit the determination of the mass of vector mesons, with small distortion from final-state interactions. Tagged photons from a 2.4 GeV electron beam would allow the study of the process above the ρ threshold to include ω and ϕ photoproduction. The invariant-mass distribution of the e^+e^- pairs will be measured to search for possible modifications of the vector meson properties. A recent phenomenological estimate showed both that the background could be one order of magnitude smaller compared to the meson contribution and that the Bethe-Heitler incoherent e^+e^- background could be further reduced with appropriate kinematical cuts. To minimize systematic errors, the solid targets are divided into several parts and the separation between adjacent targets is matched to the CLAS vertex reconstruction resolution. The energy resolution and the statistical precision would provide invariant-mass resolution adequate to detect the effect.

Issues: Several theories differ in their predictions of vector meson properties in nuclear matter. However the PAC believes that these properties are measurable. Furthermore, the PAC considers that the knowledge of possible nuclear medium modifications is of high importance as a reference for experiments at RHIC and LHC. The PAC is also convinced that this experiment would provide a clear measurement of this effect, if present. Systematic errors could be further reduced by permuting the solid target positions during the run. The PAC also encourages measurement of the ratio of the absolute cross sections in different nuclei.

Recommendation: Approve for 18 days in Hall B.

Scientific Rating: A $^-$

Individual Proposal Report

Proposal: E-01-113

Title: Deeply Virtual Compton Scattering with CLAS at 6 GeV

Spokespersons: L. Elouadrhiri, S. Stepanyan, V. Burkert, and M. Garçon

Motivation: To measure the Q^2, x_B, and t dependences of Generalized Parton Distributions by means of Deeply Virtual Compton Scattering.

Measurement and Feasibility: The main focus is the measurement of the beam spin asymmetry in the reaction $\vec{e}\, p \to e\, p\, \gamma$, which is directly proportional to the imaginary part of the DVCS amplitude. A longitudinally polarized electron beam at 6 GeV elastically scattering from a proton, enables the determination of the interference with the Bethe-Heitler process through the helicity-dependent asymmetry. These measurements will map out the DVCS amplitude in the range of Q^2 from 1 to 4 $(GeV/c)^2$ and x_B from 0.15 to 0.55.

Issues: DVCS is a topic that is attracting much theoretical interest and is one of the cornerstones of the proposed 12 GeV upgrade. Measurements of the Q^2 dependence in particular can help elucidate whether the kinematic region appropriate to scaling, is reached at these energies. This can be an essential first step in determining the generalized parton distributions of the proton. The experiment requires various changes to the standard CLAS setup, the most substantive of which are the construction of a forward lead tungstate calorimeter and the replacement of the mini-torus with a superconducting solenoid. The PAC strongly endorses these upgrades, as they serve as prototypes for an eventual
12 GeV upgrade.

Recommendation: Approve for 60 days in Hall B.

Scientific Rating: A

Individual Proposal Report

Proposal: PR-01-114

Title: A Study of Longitudinal Charged Pion Electroproduction on H, ^{2}H, ^{3}He and ^{4}He, Update to Experiment E-91-003

Spokesperson: H.E. Jackson

Motivation: The aim is to determine the longitudinal cross section for quasi-free pion production on nuclear targets in parallel kinematics using the Rosenbluth separation, in order to search for signatures of excess pions resulting from nuclear exchange currents.

Measurement and Feasibility: The intent is to improve upon existing data by going to larger values of the invariant mass, which will allow for a better handling of the Fermi broadening, and by extending the study to the high missing-mass tail, where it has been speculated that previously unobserved strength may reside. Furthermore, ^{4}He will be studied, where the density approaches that of nuclear matter. The collaboration has the experience required to perform the experiment within the specified accuracy.

Issues: Modified pion production on a nucleus is in principle an interesting issue. However, the interpretation of the measured cross sections in terms of a pion excess is still disputed. It is also not clear how large or small the effect may be in the chosen kinematics. Consequently, the PAC did not find this a compelling case for granting scarce beam time.

Recommendation: Reject

Scientific rating: N/A

Individual Proposal Report

Proposal: E-01-115

Title: Measurement of the Parity Violating Asymmetry in the $N \rightarrow \Delta$ Transition, (Originally E-97-104)

Spokespersons: S.P. Wells, N. Simicevic

Motivation: It is proposed to use parity violation in inclusive pion electroproduction to extract the axial vector transition form factor $G^A_{N\Delta}$ for Q^2 = 0.1 to 0.6 $(GeV/c)^2$. The experiment would yield the first determination of this transition form factor in the neutral-current sector and aims at an improved precision over another determination in the charged current sector, using neutrino scattering. New theoretical developments concerning the anapole contribution to the $N \rightarrow \Delta$ transition might also be tested.

Measurement and Feasibility: The experiment is to run concurrently with the G0 experiment in the LH_2 backward-angles configuration. The same equipment and beam conditions as G0 will be used (see report on P-01-116)). The experiment needs to use the Cherenkov counters, which are currently being designed for installation in the G0 apparatus.

Issues: The incomplete coverage of the Δ peak and the poor missing-mass resolution will complicate the data analysis and the extraction of the pure $N \rightarrow \Delta$ parity-violating asymmetry.

Recommendation: Conditional Approval for concurrent running with experiment E-01-116 (G0) in Hall C.

Scientific rating: B^+

Individual Proposal Report

Proposal: E-01-116

Title: G0 Backward Angle Measurements

Spokesperson: D. H. Beck

Motivation: This experiment will measure the parity-violating asymmetry using proton and deuteron targets. The aim is to determine the electric and magnetic strangeness form factors of the proton as well as the electron-nucleon axial form factor. The backward angle data is needed to separate the electric and magnetic form factors and the deuteron is needed mainly to determine the axial form factor.

Measurement and Feasibility: The present request is for 70 days at $Q^2 = 0.8$ $(GeV/c)^2$. The G0 collaboration has prepared a detailed management plan. Forward angle measurements are planned to be run in a year or so. The collaboration needs to construct an aerogel Cherenkov detector to reject pions, a need arising mainly from the use of the deuteron target.

Issues: This request is for a sizeable amount of time, which would follow the forward angle measurement. The choice of $Q^2 = 0.8$ $(GeV/c)^2$, would minimize the impact on other experimental Halls and is higher than the planned 0.45 $(GeV/c)^2$ experiment at Mainz. The impact of possible complications in the interpretation of the deuteron target measurement needs to be better understood. Nevertheless the physics motivation for this experiment is compelling. In the judgment of the PAC, the experiment could be adequately performed with a 60 day allocation of beam time.

Recommendation: Conditional approval for 60 days in Hall C, depending on demonstrated performance of the necessary components.

Scientific Rating: A

Appendix E

Individual Letter of Intent Report

Letter of Intent: LOI-01-101

Contact person: R. Carlini

Title: Search for New Physics at the TeV Scale Via a Measurement of the Proton's Weak Charge.

The proponents intend to measure the weak charge of the proton via parity violating elastic scattering at very small Q^2 (0.03 $(GeV/c)^2$). The asymmetry is expected to be very small (0.3 ppm) and is proportional to $Q_{weak} = (1 - 4 \sin^2\theta_w)$: a 4% measurement of Q_{weak} would yield a 0.2% measurement of $\sin^2\theta_w$ assuming that hadronic corrections associated with nucleon weak form factors would be adequately known from experiments already underway or planned at JLab and elsewhere (HAPPEX, G0, SAMPLE, etc.). The physics motivation is to provide a very precise measurement of $\sin^2\theta_w$ to check the predicted running of the weak interaction coupling constant with Q^2. A significant deviation from the expected behavior would signal new physics beyond the Standard Model, hints of which may already have been seen elsewhere, such as the recent muon (g-2) result from Brookhaven.

The PAC agrees that this is a very exciting possibility and encourages the group to develop a proposal. However, it is noted that the measurements will pose perhaps the greatest technical challenges of any experiment yet proposed at this laboratory. In addition to requiring excellent control of helicity correlated beam properties, the experiment would require polarized beam at very high intensity (180 μA). A proposal should discuss predictions based on various non-Standard-Model approaches and should demonstrate that the measurements could clearly rule out at least some classes of alternative theories.

A number of technical challenges should be met in developing a full proposal, as noted in the Letter of Intent. The PAC agrees that monitoring of the beam polarization may well require an on-line Compton Polarimeter in Hall C. The G0 spectrometer has been taken as a model for simulation purposes; a definite plan for the instrumentation needs to be worked out. Strong support from the laboratory, the source group, and significant theoretical effort will need to be in place to ensure the success of this initiative.

Individual Letter of Intent Report

Letter of Intent: LOI-01-102

Title: Nucleon-Antinucleon Photoproduction with CLAS

Contact Persons : R. Baldini, M. Battaglieri, V. Koubarovsky, M. Ripani

Photoproduction of nucleon-antinucleon pairs is a good tool to investigate threshold production. CLAS data have been analyzed for the reaction

$$\gamma p \rightarrow p\bar{p}p,$$

$$\gamma \ p \rightarrow p \ \bar{p} \ p \quad ,$$

for which previous experiments could not rely on full particle identification. An invariant mass spectrum for the proton-antiproton system has been extracted. Two motivations for the measurement are presented in this letter:

(1) determination of time-like form factors,
(2) search for structures in the nucleon-antinucleon system.

Indications for structures can be seen in the invariant mass spectrum, but need to be on a better footing before it warrants in a full proposal.

CLAS can provide full particle identification for the process of interest. In order to increase the acceptance for forward angles, the target could be translated upstream, a possibility that has been extensively studied for other experiments and which will be used in forthcoming measurements.

The PAC does not see how time-like form factors could be extracted from CLAS data in a gauge-independent basis. Given that data are scarce and not very precise for the proton and that no data exist for the neutron it is certainly worthwhile to measure them.

The PAC recommends further evaluation of existing data and the impact of future measurements at CLAS.

Individual Letter of Intent Report

Letter of Intent: LOI-01-103

Title: Measurement of A_x and A_z asymmetries in the quasi-elastic $^3\vec{He}(\vec{e}, e' d)$ reaction

Contact person: Z. Zhou

The motivation of the experiment is two-fold: (1) a determination of the effect of the S' component of the ^{3}He wave function, and (2) the isolation of the isovector interaction current contributions. The measurements would utilize a longitudinally polarized electron beam and a ^{3}He target polarized either longitudinally (z) or sideways (x) relative to the q axis. The scattered electron is detected in an HRS and the ejected deuteron is detected in the Big Bite spectrometer. The claim is that for recoil momenta less than 50 MeV/c, the D-state will be highly suppressed so that the asymmetries will be sensitive to the interference between S and S' states. Also, the isovector component of the interaction current will be disentangled in measurements at a recoil momentum of 100 MeV/c, where the asymmetries are expected to be independent of the wave function.

The PAC endorses the first motivation, since knowledge of the effect of small components of the ^{3}He wave function is essential in making the transition from a polarized ^{3}He target to a polarized neutron. We encourage the proponents to develop a full proposal and to enlist the support of few-body theory groups (such as the Bochum group) to obtain full Faddeev calculations of the reaction as a guide in selecting the kinematics and interpreting the results. We call to their attention the report of PAC 18 on PR-00-106, which had similar goals and which was deferred due to lack of theoretical guidance. The PAC is less interested in the second motivation, since it believes that the isovector part of the interaction current has already been well studied in experiments at NIKHEF and Bates.

Individual Letter of Intent Report

Letter of Intent: LOI-01-104

Title: Double Polarization Observables in ϕ Photoproduction using a Polarized Target

Contact person: D. Tedeschi

The intent is to measure the spin correlation between a polarized photon and a polarized proton in the $\vec{\gamma}\,\vec{p} \to \phi\ p$ reaction. This polarization observable would extend the study of the spin-averaged process. Within the context of a particular model, it is sensitive to the $s\bar{s}$ content of the proton. The ϕ may be produced by diffractive processes (modeled by the exchange of a Pomeron), by π-exchange, or by direct knock-out from the proton. All of these will interfere to produce the measured spin correlation.

The PAC has serious reservations about the interpretation of such an experiment. The dominance of the usual diffractive process is not as well established for spin-dependent processes. Also, the knock-out process is based on a particular cluster model, which is not unique. A previous proposal (see PR-98-103) was deferred on these grounds.

The experiment necessitates the construction for Hall B, of a new polarized target of the frozen spin type, well suited for use with photon beams. The PAC is dubious that the small yield of the ϕ production, resulting from this polarized proton target reaction, could be cleanly identified, because of the dilution with C and O nuclei in the target.

Individual Letter of Intent Report

Letter of Intent: LOI-01-105

Title: Polarization Observables in the Photoproduction of Hyperons using a Polarized Photon Beam and a Polarized Target

Contact Person : L. Todor

The polarization observables in hyperon photoproduction using a longitudinally polarized target and circularly and linearly polarized photon beams appear to be of significant value in the overall problem of fully understanding N* properties. These observables may have particularly good sensitivity to the " missing resonances" and could check model predictions for resonances such as the $D_{13}(1960)$. A prime motivation for this experiment is to provide input to partial-wave analyses of N* intermediate states. The experiment seems well matched to the capabilities of CLAS with a frozen-spin polarized target, and the proponents are encouraged to submit a full proposal.

Individual Letter of Intent Report

Letter of Intent: LOI-01-106

Title: Search for Missing Resonances in Photoproduction of Vector Mesons using a Polarized Photon Beam and a Polarized Target

Contact Person : F. Klein

This letter of intent is to study vector meson photoproduction with CLAS, using the proposed frozen spin polarized target (see E-01-104) to search for missing baryon resonances. The measurement of polarization observables in the reactions $e\ p \rightarrow e'\ \omega\ p$ and $e\ p \rightarrow e'\ \rho\ N$ would take advantage of CLAS to study the angular dependence. The proponents showed how the missing resonance $F_{15}(2000)$ would strongly affect the angular dependence of the polarization observables. However, their estimate is based on an incomplete model.

The PAC considers this experiment to be a natural extension of the experimental program to search for missing resonances currently in progress in Hall B. However the proponents should provide a better estimate of the contribution of competing effects, such as $\Delta\pi$ and non-resonant $N\pi\pi$ production.

The PAC also suggests that extending the measurement to high t would add valuable physics to the proposal.

We encourage a full proposal on this subject.

Individual Letter of Intent Report

Letter of Intent: LOI-01-107

Title: Weak Production Of Strangeness

Contact Person : O. K. Baker

The intent is to measure the cross section for polarized electrons interacting with protons, to produce a Lambda-neutrino final state. This weak process is stated to be of importance in understanding stellar dynamics. This process has never been observed, and the cross section is proportional to the square of a weak matrix element. This would lead to about 10 counts per day at a beam intensity of 25 microamperes. The use of polarized electrons would help in reducing and measuring the background. Nevertheless, the cross section is extremely small and could be dwarfed by background processes. A successful proposal would have to convince the PAC that the backgrounds could be overcome. It would also be necessary for the PAC to understand how knowing the cross section would impact these astrophysical calculations. In addition the PAC was puzzled by the use of the CH_2 target, which may introduce background to the measurement.

Individual Letter of Intent Report

Letter of Intent: LOI-01-108

Title: Quark Propagation Through Cold QCD Matter

Contact Person: Will Brooks

This experiment will study quark propagation through cold nuclear matter by semi-exclusive high energy electron scattering from nuclei. QCD calculations of quark energy loss in dense matter indicate a coherent effect for gluon radiation, greatly increasing the rate of energy loss. A clean measurement of the energy loss at normal nuclear matter density will constrain theory, and strengthen the case for using the quark energy-loss as a probe in relativistic heavy ion collisions.

The experiment will use CLAS with nuclear targets. The choice of deep inelastic kinematics selects interactions of the virtual photon with an isolated quark, and $0.3 < x < 0.6$ ensures that the quark structure functions are not affected by nuclear shadowing. Hadron formation-times in these kinematics should be comparable to, or larger than, the corresponding nuclear radius. Measuring the energies of the virtual photon and the outgoing hadrons should provide a cleaner energy loss result than is possible in hadron-induced reactions.

The cleanliness of the production process could be problematic, especially at lower Q^2. The PAC feels that the proposed study of the Q^2 dependence will help to address this issue. We encourage further development of the expected signals; figure 1 in the proposal is a good start. The collaborating theorists can and should provide specific predictions for this measurement.

The PAC found this letter of intent very interesting; the likely impact of the result is high. We concur with the author that this is best done with a 12 GeV beam, but encourage evaluation of what could be started already at 6 GeV.

Appendix F

Jefferson Lab Experiments, PAC 4-20, Grouped By Category

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