REPORT OF THE CEBAF PROGRAM ADVISORY COMMITTEE 4

APRIL 1990

At its fourth meeting, the CEBAF Program Advisory Committee responded to the charge (Appendix A) to review and assess the first set of experimental proposals to CEBAF and to comment on the final drafts of the Conceptual Design Reports (CDR-s) for experimental equipment in the three Halls. The Committee met for two separate weeks, the first in December 1989 and again in March 1990 to hear presentations on 47 proposals and on the status of plans for equipment in the experimental areas (Appendix B).

The Committee is pleased to see the emergence of the outlines of a real CEBAF experimental program, scheduled to start in 1994. It notes the wide participation of the user community and the considerable thought and hard work that had gone into the preparation of the proposals. This augurs well for the future of CEBAF. "Approval" of 221 days of beam time is recommended among the three experimental areas.

The Committee notes a good match between the anticipated physics program and the equipment described in the CDR-s. It urges that the CDR-s be submitted to the Department of Energy without further delay in order that their review and funding may proceed expeditiously.

EXPERIMENTAL PROPOSALS

The proposals submitted in this first round cover a wide range of physics accessible to CEBAF. Many thoughtful projects were described. The degree of completeness of the proposals is variable, which is not surprising five years in advance of anticipated operation. While PAC4 has reacted to these proposals to the best of its ability, there is considerable room for future PAC-s to review the milestones set for these proposals, to recommend additional experiments, and to make recommendations regarding the relative priorities of approved proposals.

Also, it should be noted that several of the proposals approved will require the ultimate in performance for particular experimental systems. It may turn out that the collaborations will find that the tune up of the apparatus may best be carried out with less demanding 'bread-and-butter' experiments. Such issues are best left for subsequent PAC meetings. Detailed reactions to the specific proposals are in Appendix C; these are intended for CEBAF management and may be transmitted to the proposers of the experiments as deemed appropriate.

Approval Ratings.

The PAC was asked to make recommendations on proposals in four categories, and while the dividing lines are not sharp, some operational definitions of these classifications emerged in the course of deliberations.

> APPROVAL implies that the proposal is recommended for approval for the number of days of beam time stated, provided specific milestones are met; the operation of the accelerator and the experimental equipment described in the CDR-s, at the requisite levels of performance, are assumed implicitly to constitute some of these milestones. Progress will be reviewed by the PAC at future meetings. Frequently, less than the full time requested in the proposal was recommended for 'approval'. In these cases, requests for additional time will have to be the subject of new proposals submitted for future meetings of the PAC; in most cases this will be appropriate after initial data have been obtained.
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> CONDITIONAL APPROVAL implies that the recommendation of full approval is contingent on answering questions raised by the PAC. The number of hours to be approved will be determined at future PAC meetings, when these questions have been answered satisfactorily.
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> DEFERRAL (without prejudice for the future) implies that con-

cerns by the PAC will have to be addressed in revised proposals to future PAC meetings.

REJECTION implies that the PAC did not see much future potential in the specific proposal.

Units

Because of the length of running time involved in most CEBAF experiments the PAC requests that the standard unit in which experiments are requested be *days,* rather than the more traditional hours that have been the currency for beam time at some smaller facilities. (N.B. A "day" is a calendar day of beam time.)

Summary of Proposal Recommendations at PAC4

Of the 47 proposals, approval was recommended for 16 (for a total of 221 days of beam time), conditional approval for 13, deferral for 15, and rejection for 2. These recommendations are summarized in the Table.

Priorities

At the time of the PAC4 meeting, the anticipated first operation of CEBAF is five years in the future. While the recommended approval of beam time is intended to reflect a firm commitment (subject to satisfying requisite milestones), the *priority* of approved experiments will have to be the subject of PAC deliberations in the future. In addition, practical considerations will naturally play a role in the scheduling of experiments.

Simultaneous Running of Experiments at CLAS

Because of the nature of the device, experiments at CLAS must be treated somewhat differently from others, and in a way that has not been usual in nuclear physics. With a relatively open trigger, the data from a particular measurement can bear on several, sometimes rather disparate, physics issues. In such cases it is still best to distinguish between a primary high-priority experiment, which will

Table: PAC4 Recommendations on Proposals

Proposal	Contact Person	Keyword	Hall	Recommendation	Time (in days)
89-001	B. M. Preedom	Vector Mesons	B	Deferral	
89-002	D. I. Sober	Shadowing	B	Deferral	
89-003	R. Lourie	$^{16}O(e,e'p)$	A	Approval	20
89-004	R. Schumacher	Hyperon	B	Approval	$30^{(1)}$
89-005	R. Madey	G_E^n	A/C	Conditional	
89-006	J. Jourdan	Deformation of N	C	Deferral	
89-007	R. Mckeown	Polarized ^{3}He	B	Deferral	
89-008	B. Filippone	$x > 1$	C	Approval	8
89-009	E. V. Hungerford	Hypernuclear	C	Approval	25
89-010	R. Milner	A & Q Dependence	C	Deferral	
89-011	H. E. Jackson	$(e,e'\pi)$	C	Conditional	
89-012	R. J. Holt	$\gamma d \to np$	C	Approval	10
89-013	B. Zeidman	$d(e,e'K)$	C	Deferral	
89-014	C. F. Perdrisat	G_E^p	A	Conditional	
89-015	H. Baghaei	Multihadron	B	Conditional$^{(3)}$	
89-016	Z.-E. Meziani	Quasielastic (e,e')	A	Deferral	
89-017	R. Sealock	Multihadron	B	Conditional$^{(3)}$	
89-018	D. Day	G_E^n	A/C	Deferral	
89-019	R. Gilman	$\gamma d \to n\vec{p}$	A/C	Conditional	
89-020	D. A. Jenkins	$\gamma d \to pn$	B	Deferral	
89-021	G. G. Petratos	^{3}He elastic	A	Approval	30
89-022	D. F. Geesaman	$A(e,e'p)$	C	Conditional	
89-023	R. Carlini	Parity	C		
89-024	G. S. Mutchler	Hyperon rad. decay	B	Approval	$30^{(1)}$
89-025	J. R. Comfort	Vector Mesons	B	Deferral	
89-026	J. M. Finn	$D(e,e'p)$ separations	A	Deferral	
89-027	L. B. Weistein	Multihadron	B	Conditional$^{(3)}$	
89-028	J. M. Finn	$D(e,e'\vec{p})$	A	Approval	8
89-029	H. P. Blok	$He(e,e'd)$	A	Deferral	
89-030	R. A. Lindgren	$He(e,e'2N)$	A	Deferral	
89-031	R. A. Miskimen	Multihadron	B	Conditional$^{(3)}$	
89-032	G. A. Leksin	Multihadron	B	Conditional$^{(3)}$	
89-033	C. Glashausser	$^{16}O(e,e'\vec{p})$	A	Approval	20
89-034	P. Boberg	$(e,e'p)$	A	Rejection	
89-035	C. C. Chang	$(e,e'\pi)$	A	Deferral	
89-036	K. S. Egiyan	Multihadron	B	Conditional$^{(3)}$	
89-037	V. Burkert	(N^*) Δ	B	Approval	$20^{(2)}$
89-038	R. Minehart	(N^*) Δ'	B	Approval	$20^{(2)}$
89-039	S. Dytman	(N^*) η	B	Approval	$20^{(2)}$
89-040	P. Stoler	(N^*) High q	B	Deferral	
89-041	K. Giovanetti	(N^*) L/T	B	Rejection	
89-042	V. Burkert	(N^*) $\vec{e}\Delta$	B	Approval	$20^{(2)}$
89-043	L. Dennis	(N^*) $K, ..., f_0$	B	Approval	$20^{(2)}$
89-044	J. Mougey	$He(e,e'p)$	A	Approval	30
89-045	B. Mecking	$\gamma d \to KX$	B	Approval	20
89-046	C. N. Papanicolas	$^{208}Pb(e,e'p)$	A	Conditional	
89-047	J. Jourdan	Threshold $d(e,e'p)$	A	Conditional	

$^{(1)}$ Measurements to be carried out concurrently.
$^{(2)}$ Measurements to be carried out concurrently.
$^{(3)}$ Measurements to be carried out concurrently.

control the experimental running conditions (beam energy, etc.), and other lower-priority experiments, which could be approved as well, when they can utilize a different aspect of the data from the same running conditions. In other cases, where the priority of different measurements is similar, the PAC suggests that the conditions for the approved run be arrived at by agreement between the various components. These distinctions form a continuum and in the language of our recommendations we attempt to address these issues.

Conceptual Design Reports

The Committee finds that the match between the equipment described in the Conceptual Design Reports and the anticipated research program at CEBAF is a good one. Halls A and B are to be equipped with two highly refined instruments. The pair of high-resolution spectrometers in Hall A, when fully developed, well understood and tested, will permit high-resolution coincidence experiments with continuous, high-intensity beams that will explore electromagnetic response functions at high momentum transfer far better than has been possible hitherto. The large-acceptance detector in Hall B, when fully implemented, will permit measurements of electromagnetic reactions on nuclei with multiple particles in the final state, and should provide a new generation of precision data on the low-lying spectrum of baryons. At the same time, the moderate-resolution, high-momentum spectrometer and ancillary equipment in Hall C will allow for a variety of experiments to be carried out that either do not require the high resolution and solid angle of Halls A and B, need a short-orbit spectrometer for short-lived particles, or may require special equipment that will be more readily accommodated here than in those Halls.

Following the initial approval by NSAC in 1983, the CEBAF accelerator is on a schedule to deliver beam to experiments in early 1994. At the updates presented in March for each of the three experimental Halls, the PAC was shown projected schedules for construction of the experimental equipment. It is of serious concern to the PAC that even this optimistic schedule shows that the completion of high-quality coincidence capability fully matching the excellent beam qualities of the CEBAF accelerator may not occur until two years after beam availability.* The PAC recommends that CEBAF management take the necessary steps, such as setting priorities and allocating resources, to ensure that some of the important coincidence experiments that have been proposed can be started as soon as beam is available. These priorities should reflect the funding profiles for equipment to which DoE is committed.

The specific reactions of the PAC to the CDR-s in the three Halls is in Appendix D. More general issues addressed are

High-Resolution Spectrometer for Hypernuclear Physics.

The Committee is concerned about the state of equipment development for the hypernuclear program. Even though this area of physics had been identified in PAC 1 as one having very high overall scientific priority (second highest of all the sub-areas considered) in the CEBAF experimental program, the management at CEBAF has not succeeded in adding even a single scientist to its staff in this field, while other areas have been strengthened substantially with addition of new staff. As a consequence, there is no in-house effort dedicated to this task, nor are there strong in-house advocates of this potentially rich and novel area for nuclear structure research. This is a field where CEBAF has the potential for making a truly unique and important contribution. Some interest from the user community has been demonstrated by proposals, and this is likely to increase substantially when it becomes clear that equipment will be available for such studies and that it has the full support of CEBAF management and staff.

STAR

The Committee was asked to assess a Letter of Intent from the STAR collaboration for the construction of an out-of-plane spectrometer system in Hall C. It heard a presentation that outlined an experimental program encompassing many

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* According to the present schedule, both spectrometers will be operational in April 1995

components. The Committee did not have sufficient time needed for a detailed examination of this project and appointed a subcommittee to study this Letter of Intent in greater depth.

Parity

Because of the special demands placed on the Laboratory by ultra-high precision parity experiments, the PAC did not treat Proposal PR-89-023 in the standard way. This is an important area of physics, and with the very high stability expected for the beam at CEBAF, the facility could play an important role, though specific experiments remain to be defined. Such measurements are very difficult, and not suitable for early experiments at CEBAF. The Committee urges that, to the extent that the development of the accelerator can be guided by decisions now, the Laboratory not do anything that would preclude delivering polarized electron beams with the needed precision. Specific research in this area is very sensitive to CEBAF performing optimally and stably. The Committee had some questions both about the feasibility of the measurement proposed in PR-89-023 and about the equipment in the CDR included for this developmental task. The Committee notes that early feasibility tests to explore the approaches put forward in this proposal could perhaps be undertaken in a timely way at the Bates Laboratory. The Committee recommends that major commitments of equipment or effort in this area should await the demonstrated operation of CEBAF at the anticipated high levels of stability, and be made after the beginning of CEBAF's important nuclear physics research program.

Common features that need to be addressed in more detail than is apparent in the CDR-s still are the need for precision current measurements and absolute energy measurements in all Halls, the need for high-power cryogenic and polarized targets in Halls A and C (and the special issues involving polarized targets in Hall B).

Appendix A

Charge to PAC 4

Introduction

CEBAF has received 47 proposals for the initial experimental program. These prposals are based on two rounds of Letters of Intent.

CEBAF has a draft Conceptual Design Report (CDR) for the experimental equipment. This CDR builds on workshops, summer studies, and user collaborations, as well as a Preliminary Conceptual Design Report (PCDR), which was completed December 31, 1988. The CDR will contain Memoranda of Understanding from collaboration groups committing effort to the experimental program. The draft CDR was reviewed by the Department of Energy at the Semi-Annual Review, which took place September 19-21, 1989. At that review, the DOE Review Committee supported the scope of the proposed equipment and recommended that a phased approach be developed to try to accomplish this program.

The CEBAF Laboratory management is currently in discussions with the DOE/DNP concerning the implementation of the funding of the equipment described in the CDR. This funding will be based on a phasing of the initial experimental equipment, beginning at turn-on and extending approximately two years.

Due to the large number of proposals, it has been decided that two PAC meetings are necessary. Approximately half of the occurring as early as possible in 1990. CEBAF has also received three updated LOIs, including a progress report on the STAR Detector, which will be presented to the PAC for comments at PAC4b.

FORMAL CHARGE

CEBAF requests PAC4 to review the proposals and provide advice on:

(1) The scientific merit, technical feasibility, and relative ranking of the proposals.

(2) An assignment of the proposal into one of four classes:

(a) Approval of the proposal,

(b) Conditional approval pending equipment or beam tests for special requirements, these conditional proposals being reviewed by the PAC at an appropriate time in the future,

(c) Deferral for consideration at a later date pending clarification of physical or technical questions,

(d) Rejection.

(It should be noted that category (a) would imply approval for approximately the requested total beam time unless specifically noted otherwise. The allocation of this beam time must await scheduling decisions which can only be made much closer to machine turn on.)

CEBAF requests that PAC4 review the draft CDR for the experimental equipment and provide advice on the following:

(1) Does the CDR adequately address the scientific requirments in the proposals,

(2) Is the CDR consistent with the scientific opportunities envisioned by the PAC at its previous three meetings?

GUIDELINE:

As a guideline, it can be anticipated that approximately 6,000 hours of useful beam time from the accelerator will be awarded by PAC4 through the approved proposals.

(This number of hours is projected to be approximately two-thirds of the useful beam time that will be delivered by the accelerator in the first three years of CEBAF operations. A firmer projection will become available as we get closer to turn on.)

Appendix C

Report on Proposals

Proposal: PR-89-001

Spokespersons: B. Preedom and G. Blanpied

Nuclear Mass Dependence of Vector Meson Interactions Using The Photoproduction of Lepton Pairs

MOTIVATION

The production of neutral vector mesons in nucleons and nuclei and the subsequent measurement of their decay into lepton pairs has the potential to provide interesting new information. In addition, the photon energy range proposed is in a region where shadowing is still an open question and precise data can contribute to our understanding of this problem. With considerably more simulation and theoretical analysis this experiment may provide information on the production, decay, and possibly the propagation of vector mesons in the nuclear medium.

ISSUES

The question of the impact of inherent asymmetries of CLAS for e^+-e^- measurements needs to be examined and modeled. The experiment should continue to be optimized, both as to the target position, with more accurate modeling of the production rate into this weak decay branch and by more thorough consideration of other background channels that may be present.

The proponents are encouraged to pursue theoretical support in the analysis of the production amplitudes, including the details of the interference of the decay leptons with the Bethe-Heitler pairs. The effect of the Coulomb field on the expected asymmetry of the pairs should be investigated.

The large amount of beam time required for a precise measurement and the non-standard experimental arrangement require careful optimization before a final decision can be made. In any case, the Committee recommends that the measurements on heavy targets await the analysis of the light target data.

The experiment is difficult and the proposal should be re-examined after some operating experience with the CLAS is available.

MANPOWER

Adequate.

RECOMMENDATION

Deferral.

Proposal: PR-89-002

Spokesperson: D. Sober

Shadowing

MOTIVATION

The aim of this experiment is to measure the energy and A dependence of the total hadronic cross section for absorption of real photons in the energy range between 0.5 and 3.0 GeV. This covers the region populated by nucleon resonances above the delta and extending into the continuum.

Measurements on heavy nuclei will be compared to measurements on hydrogen (deuterium) to look for shadowing of the photons that would appear as a reduced total cross section per nucleon in heavy nuclei. Previous data in this region with errors $\sim 5\%$ and fluctuations up to 10% indicate a shadowing effect ranging from about 10% in carbon to 20% in lead.

The physics of shadowing is not well understood, and the PAC considers this an interesting question. The previous data in this energy region are not good enough to explore possible effects of higher nucleon resonances in nuclei.

MEASUREMENT

The proposed measurement would use CLAS with tagged photons in Hall B to measure the total hadronic cross sections. This would be done by measuring all charged particles and a sample of the neutral particles (π^0,neutrons). Corrections would have to be made for inefficiencies and undetected particles.

ISSUES

The main difficulty with this experiment stems from the need to make accurate measurements of the total cross sections, with errors less than 5%, in order to improve upon previous data. This will require precise knowledge of the photon flux, detector efficiencies, and corrections for undetected events. Here the primary problem is with the low multiplicity channels and with events dominated by π^0 and neutron emission. The CLAS detector is not well suited to measuring neutral particles. The proponents suggest sampling 5% of the data using the scintillator trigger counters. This is a dubious technique considering the low efficiency of these detectors and their susceptibility to room background. The proponents suggest inserting lead sheets into the CLAS to detect photons. This method will have low efficiency and would interfere with the performance of the detector for charged particles. The feasibility of this technique needs to be demonstrated by more modeling.

The proponents mentioned the need for external neutron detectors. These detectors, if they are required, need to be specified in detail.

Some of the demands for absolute precision will be reduced in comparing the ratios of cross sections from heavier nuclei to that from hydrogen (deuterium). The proponents need to refine their understanding of the total error on the ratio of cross sections that must be achieved in order to observe shadowing.

MANPOWER

Adequate.

RECOMMENDATION

Deferral.

Proposal: PR-89-003

Spokespersons: W. Bertozzi, R. Lourie, A. Saha and L. Weinstein

Study of the quasielastic $(e, e'p)$ reaction in ^{16}O at high recoil momentum.

MOTIVATION

The goal of this proposal is to determine the high momentum components of proton wave functions in ^{16}O by studying the $(e, e'p)$ reaction. The experimental program will allow a separation of $R_L + (v_{TT}/v_L)R_{TT}$, R_T and R_{LT}. In addition to studying knockout from specific valence shells, this experiment will be the first exploration of the continuum to very large missing energies $E_m \sim 300MeV$.

The broad kinematic range available at CEBAF will allow a significant increase in our understanding of the momentum distribution in nuclei. This experiment requires only a modest missing energy resolution.

ISSUES

The Committee recognizes the fundamental role of CEBAF in understanding the nuclear interaction at short distances. Therefore it is important to develop rapidly an understanding of the $(e, e'p)$ reaction on medium and heavy nuclei at CEBAF energies. The separation of longitudinal and transverse response functions will require *accurate measurements* of cross sections in well determined kinematic conditions. The incident beam energy, the integrated charge, the spectrometer acceptances and focal plane efficiencies must be accurately known. To achieve *1% accuracy will require a large amount of work* from the collaboration over a long period of time.

At future meetings, the Committee would like to see a more detailed discussion of the *accuracy* with which such measurements can be performed at CEBAF and encourages the collaboration to develop experimental methods to increase the accuracy of this measurement as much as possible.

MANPOWER

Adequate.

RECOMMENDATION

Approval for 20 days of running.

Proposal: PR-89-004

Spokesperson: R. Schumacher

Electromagnetic Production of Hyperons

MOTIVATION

The electromagnetic production of hyperons from nucleons is very poorly determined experimentally. Such measurements have considerable intrinsic interest, and are also an essential element of electromagnetic hypernuclear studies.

We support the doubts expressed in the proposal regarding the validity of the diagrammatic analyses of $\gamma N \to K\Lambda, K\Sigma$. We see the main impact of these measurements as being complementary to ordinary non-strange photoproduction, and suggest a similar approach based on a partial wave decomposition of amplitudes including Born terms, backgrounds, and s-channel nucleon resonances. This will require a physics analysis package similar to that of the CLAS $\gamma N \to \pi N$ program, and this group should participate in the development of that package.

All known Y^*'s have been established via $\bar{K}N$ scattering measurements, but a *very* large fraction of the expected states are unknown. If this is because their $\bar{K}N$ couplings are weak, they might be seen in associated production. The proponents should consider whether the CLAS acceptance is sufficient to carry out an isobar analysis of any non-$\bar{K}N$ decays of Y^*'s. If so, the proposed KY^* program could have great impact.

FEASIBILITY

No serious difficulties are foreseen.

RECOMMENDATION

Approval for 30 days of running, with the understanding that the proponents of experiment PR-89-024 be participants and have access to the data relevant to their proposed measurements. Modifications to accommodate PR-89-024 are encouraged as long as they do not compromise this measurement. The PAC will review progress at a future meeting.

Proposal: PR-89-005

Spokesperson: R. Madey

The Electric Form Factor of the Neutron from the $d(\vec{e}, e'\vec{n}\,)p$ Reaction

MOTIVATION

The neutron charge form factor is a fundamental and interesting quantity. The measurement of this form factor at even a few points should provide stringent constraints on theoretical models. For example, in the most naive quark models the neutron form factor should vanish. Presently, information on the form factor itself must be inferred from the elastic charge form factor of the deuteron, or from unpolarized quasi-elastic scattering from the deuteron. The results are highly model dependent and are little more than loose upper limits constrained by the charge radius.

MEASUREMENT AND FEASIBILITY

This collaboration proposes to measure the electric form factor G_E^n of the neutron by scattering longitudinally-polarized electrons from deuterium quasi-elastically and by measuring the transverse polarization component, p_s, of the recoil neutron. The measurement will be performed in Halls A or C with a liquid-deuterium target. The neutron is to be detected in coincidence with the scattered electron in a neutron polarimeter to be provided by Kent State University.

It is proposed to measure G_E^n with an uncertainty δG_E^n in the range ±0.010 to ±0.016 in the Q^2 range 0.15 to 2.0 $(\mathrm{GeV/c})^2$. Calculations by Arenhovel indicate that this recoil polarization technique has almost no dependence on the deuteron wave function, and is insensitive to the influence of final-state interactions, meson-exchange currents, and isobar configurations.

ISSUES

Several features of the experiment gave the PAC some concern:

1. The ratio of true to accidental events is reported to be about two to one. This estimated value is not large and one has to be concerned that it may become worse in the, as yet unknown, environment in the experimental area with beam on. What can be done to improve it?

2. Can the magnitude of background processes be modeled or measured? For example, what is the background of neutrons originating from the target, and can one clearly distinguish quasi-free neutrons from those associated with pion production?

3. What is the pion to electron ratio at large angles and can pions be properly rejected? What is the impact on the analysis of making a mistake in the pion rejection?

MANPOWER

Adequate.

RECOMMENDATION

Conditional approval.

Proposal: PR-89-006

Spokesperson: J. Jourdan

The Deformation of the Nucleon

MOTIVATION

The basic idea behind this proposal – to use polarization degrees of freedom in an inclusive (e, e') experiment to measure a possible deformation of the nucleon – is an interesting one. The physics is of high importance.

MEASUREMENT

The measurement will be done in Hall C using an electron beam with 50% polarization and a cryogenic NH_3 target whose effective H polarization will be 14%. The Q^2 ranges from 0.2-1.4 $(GeV/c)^2$.

FEASIBILITY AND OTHER ISSUES

Interpretation of the data is likely to be highly model-dependent, as it requires understanding and separating out the underlying non-resonant background. At the very least, full use of the data will require a very significant associated theoretical effort. We would like to see a more complete discussion of the problems of interpretability and the associated statistical and systematic errors.

On the experimental side, the following issues need further study: (1) the polarized NH_3 target will exhibit a contamination of the measurement due to the nitrogen polarization; (2) there is also the problem of contamination from the beam halo and the target-vessel end caps; (3) an upstream chicane will be necessary to correct for the beam divergence. Who will build this device?

MANPOWER

Clear identification is needed of the people who will develop, build and test the polarized target and operate it for this experiment .

RECOMMENDATION

Deferral.

Proposal: PR-89-007

Spokesperson: R. McKeown

Experiments with a Polarized ^3He target and the CEBAF large acceptance spectrometer

MOTIVATION

Recent progress in the development of polarized ^3He targets offers the opportunity to measure the neutron form factors, small amplitudes for the delta electroproduction and small components of the ^3He ground-state wave function. This is a proposal to measure the charge form factor of the neutron using a polarized electron beam and the polarized neutron provided by the polarized ^3He. An independent measurement of the neutron charge form factor using polarized ^3He rather than a deuteron target would be useful. Particularly interesting would be studies of small components of the ^3He ground state wave function made possible by the polarization.

MEASUREMENT AND FEASIBILITY

The polarized gas target would be installed in the field-free central region of the CLAS detector after removal of the small solenoid and the region one superlayer. While the physics program with a polarized ^3He target at CLAS is potentially very attractive, this proposal is written more in the style of a Letter of Intent. In order to evaluate its feasibility, it needs to be fleshed out with more details. This should include Monte Carlo studies of the target/detector performance and acceptance.

ISSUES

Several features of the experimental program outlined in the proposal gave the PAC some concern.

1. Five different physics projects have been identified in this proposal. What

are the running times requested for each and how will they be accommodated in the 30 days requested?

2. The measurement of G_E^n is fundamental and important. With the ^3He target in place, do the small solenoid and the region-one tracking chamber have to be removed? How does this impact the operation of the drift chambers and the tracking? What is the acceptance of the spectrometer with the target in place? What are the systematic errors that might contribute to the total error in this measurement? How might the presence of the two protons in the target compromise this measurement?
3. Polarized ^3He targets will not work in the presence of even rather small magnetic field gradients. Are these gradients sufficiently small in the target region of CLAS for the operation of the polarized target?

MANPOWER

The present group appears too small.

RECOMMENDATION

Deferral.

Proposal: PR-89-008

Spokespersons: D. Day and B.Filippone

Inclusive Scattering from Nuclei at $x > 1$ and High Q^2

MOTIVATION

The primary motivation for this measurement is to scatter electrons from nuclear targets in the kinematic regime x> 1, below the quasielastic peak and forbidden for scattering on free nucleons. Measurements at high x and high Q^2 will probe the region of high internal momentum in the nucleus, and explore the transition from y-scaling given by scattering from nucleons, to x-scaling given by scattering from quarks. It is not clear whether it will be possible unambiguously to identify the constituents struck by the virtual photon from such inclusive data. However, the PAC recognizes that the proposed measurements will probe a previously unexplored region where high momentum components are important.

MEASUREMENT AND FEASIBILITY

This is a single-arm experiment. It requires beam energies in the range of 4 to 6 GeV and one spectrometer equipped to detect electrons.

The primary limitation will be from low counting rates. Therefore, large beam currents, large acceptance (but only modest resolution) and reasonably thick targets and long running times will be required. There do not appear to be any technical issues which would prevent this experiment from achieving its goals as soon as a 4-GeV (6-GeV) high-current beam is available and one spectrometer equipped to detect electrons is working in Hall A or Hall C.

ISSUES

A major fraction (25% to 30%) of the kinematic space occurs at the highest values of x and Q^2, where the physics is most interesting, and requires a beam energy of 6 GeV which will probably not be available in the early stages of CEBAF.

MANPOWER

The manpower listed in the proposal is adequate, but more people will be required for a long run ($\sim$40 days).

RECOMMENDATION

Approval for 8 days to be run when 4 GeV electrons are available.

Proposal: PR-89-009

Spokespersons: R. Chrien, and E. V. Hungerford

Investigation of the Spin Dependence of the ΛN Effective Interaction in the P Shell

MOTIVATION

The program presented in this proposal aims at high-resolution studies of hypernuclear states. The PAC sees this as a very important area of physics. With the potential gain of an order of magnitude in resolution (from 1 MeV to 0.1 MeV) a wide range of physics opens up, and there is potential for major surprises.

MEASUREMENT AND FEASIBILITY

The studies of count rates and backgrounds have shown that $(e, e'K)$ experiments with optimized apparatus (short kaon spectrometer and 0° electron detection) will be possible, although with count rates that are small. To achieve the optimal energy resolution, a simple version of an energy–loss system will be needed.

ISSUES

The proposal presents a two–step approach, employing first SOS as a low–resolution K–spectrometer (see also PR-89-013) and then later installing a dedicated high–resolution device. This approach may be justified given some of the remaining uncertainties on real and accidental counting rates. However, waiting to start the high–resolution spectrometer (until the first low–resolution results are available) would lead to a significant delay for a full high–resolution hypernuclear program. The PAC wonders whether an immediate push on the development of a high–resolution spectrometer system would not be more appropriate.

The present proposal has not yet developed firm ideas on the scheme of dispersion matching that would ultimately be needed. The entire system should be designed such as to allow for an easy integration of dispersion matching at the appropriate time.

MANPOWER

The group proposing the hypernuclear program at present does not seem to have the critical mass needed to carry through the design and construction of the "ultimate" high–resolution system. Strengthening of the group, together with *urgently needed* dedicated manpower from CEBAF for design and engineering of the high–resolution spectrometer, is highly desirable.

RECOMMENDATION

The PAC approves this experiment for 25 days of running. This approval is conditional on the milestone that the group come up with appropriate manpower to carry out the experiment in an effective way. Progress on understanding accidental rates and other technical matters should be reviewed at future PAC meetings.

Proposal: PR-89-010

Spokesperson: R. Milner

Measurement of the Nuclear Dependence and Momentum Transfer Dependence of Quasielastic $(e, e'p)$ Scattering at Large Momentum Transfers

MOTIVATION

In QCD, large $-q^2$ electron-nucleon scattering can be viewed as scattering from Fock-states that have all quarks within a short inter-quark distance, of order q^{-1}. The proposal aims at a measurement of the reduction of the final state interaction of the proton at large Q^2, linked to the occurrence of these spacially small Fock states. This is a topical and interesting idea and should be tested.

ISSUES

The interpretation of the results obtained in this experiment will depend very much on conventional calculations of FSI and multistep processes at large q^2. Studies in terms of approximations valid at large nucleon momenta (e.g. Glauber calculations) could give a better idea of the signal one is looking for.

The performance of SOS at very high luminosity needs closer scrutiny given the potential sensitivity to low-energy particles making their way through the shallow bend. The experiment depends, at large q^2, on a very high π/e rejection ratio of $\sim 10^4$. It needs to be shown that the detector package to be developed for SOS is capable of achieving this. Such experiments would benefit from the extended dynamic range provided by the availability of 6-GeV electrons

RECOMMENDATION

Deferral, with encouragement to resubmit the proposal with adequate response to the above issues.

Proposal: PR-89-011

Spokesperson: H. Jackson

A Study of Longitudinal Charged Pion Electroproduction in D, ^3He, and ^4He

MOTIVATION

The PAC found this to be a new and interesting experimental concept with the possibility of providing information on the short-range part of the N-N pion exchange.

MEASUREMENT AND FEASIBILITY

The experiment does not require technically difficult regimes of the proposed spectrometers for Hall C, the HMS and SOS. The decision to study pion production in quasi-free kinematics and at lower momentum transfer is considered important for interpreting the data. The ability to separate the longitudinal and transverse cross sections is crucial for the interpretation of the data.

ISSUES

The experiment is designed to maintain the final-state nucleon pairs in the T=1 state, where absorption is suppressed. The Committee recommends consideration also of different kinematic regimes, particularly those that maintain the quasi-free nature, but with a pion energy higher than the delta isobar. Information on charged pion production from the proton would be useful in understanding our present knowledge of the reaction, and consideration should be given to improving and extending the range of parameters in the experiment. Some concern was expressed about the interpretability of the measurements, given that the struck pion will be significantly off-shell.

RECOMMENDATION

Conditional approval.

Proposal: PR-89-012

Spokesperson: R. Holt

Two-Body Photodisintegration of the Deuteron at Forward Angles and Photon Energies Between 1.5 and 4.0 GeV

MOTIVATION

The main aim of this experiment is to extend the measurement of two-body photodisintegration of deuterium to higher energy to test for the onset of power-law scaling of the cross sections. It offers an opportunity to extend the measurement on deuterium into the regime beyond the range of traditional meson-nucleon models and perhaps it will reveal further evidence for scattering on the quark constituents. The PAC considers this physics to have very high scientific priority.

MEASUREMENT

The measurement is a straightforward extension of a recent experiment by this group at SLAC. It uses photons near the bremsstrahlung end point produced in a radiator just upstream of the target. The electron beam passes through the target, and contributions from electroproduction are measured with the radiator removed and subtracted. The two-body disintegration is measured by detecting protons below pion threshold in a single arm spectrometer. This single arm experiment makes only modest demands on the performance of the beam and spectrometer. It could be run as soon as a 4 GeV beam and one spectrometer equipped to detect protons are available in either Hall A or Hall C.

ISSUES

There are no major issues affecting the evaluation of this as a CEBAF experiment.

MANPOWER

The manpower listed on the proposal is adequate in number; many have recent experience with a similar measurement.

RECOMMENDATION

Approval for 10 days of beam time.

Proposal: PR-89-013

Spokesperson: B. Zeidman

Electroproduction of Kaons and Light Hypernuclei

MOTIVATION

The primary focus of this proposal is on studies of kaon electroproduction from deuterium, with some preliminary measurements on ^{3,4}He as well as on the proton. This is an important starting point for future studies of hypernuclei using kaon electroproduction and as such is supported by the PAC. The measurements on the deuteron are also interesting in their own right as they should yield information concerning electroproduction on the neutron, final–state YN interactions, $\Sigma - \Lambda$ mixing (cusp effects) and the possible existence of $S = -1$ dibaryons.

MEASUREMENT AND FEASIBILITY

This appears to be a good candidate experiment for initial coincidence measurements in Hall C using the HMS and the SOS. The PAC was again disappointed that sufficiently detailed studies of how the SOS would be implemented have not been forthcoming and would like to see a more detailed design for the experiment. Specifically, a full design for the detector package in the spectrometer should be made available for evaluation.

ISSUES

The approach taken here using the HMS/SOS pair appears to be well suited to modest resolution studies, beginning with the deuteron and perhaps extending later to the light hypernuclei. However, for systems heavier than the helium hypernuclei, it will be necessary to have high resolution capability (see PR-89-009). The groups involved here are encouraged to explore the possibility of combining their efforts with that of the proponents of the high resolution studies.

MANPOWER

Adequate.

RECOMMENDATION

Deferral.

Proposal: PR-89-014

Spokespersons: C. F. Perdrisat and V. Punjabi

Electric Form Factor of the Proton by Recoil Polarization

MOTIVATION

A complete description of the internal structure of the nucleon requires determination of the electric and magnetic form factors G_E^p and G_M^p at all values of four momentum transfers. At the present time the form factors of the proton are not well separated beyond $Q^2 = 1(GeV/c)^2$. At high momentum transfer, magnetic scattering dominates and the charge scattering becomes increasingly difficult to extract from the incoherent (unpolarized) scattering.

MEASUREMENT AND FEASIBILITY

It is proposed to measure G_E^p by the recoil polarization method which determines the interference of the charge and magnetic form factors directly. The anticipated error bars of the extracted G_E^p (statistical plus systematic) are 4.5% at 4.5 $(GeV/c)^2$ and significantly less at smaller Q^2. A major contributor to this error is the uncertainty in G_M^p which will be decreased by experiments at SLAC.

ISSUES

The technique used for making this important measurement is well established. The main concern of the PAC relates to the response of the proton polarimeter. What is the impact on the results of any instrumental asymmetry in the polarimeter and how would it be detected or calibrated? What is the impact on the results of pions generated in the carbon analyzer? Finally we note that the goal here is a factor of two or three improvement over the results projected for SLAC/NPAS Experiment NE-11. Is this worth the effort? Can the proposed measurement be improved further?

MANPOWER

Adequate.

RECOMMENDATION

Conditional approval.

Proposal: PR-89-015

Spokesperson: H. Baghaei

Study of Coincidence Reactions in The Dip and the Delta Resonance Regions

MOTIVATION

The motivation of this experiment is to study the ω and q dependence of (e,e'), $(e,e'NN)$ and $(e,e'N\pi)$ in the dip and Δ resonance regions as well as the $\Delta(1232)$ production and its interaction with nucleons in the hadronic medium. Recent experiments have shown that there is substantial multiparticle strength in these regions and therefore exclusive measurements are going to be most interesting for a detailed understanding of such strength. Anomalous strength in the dip region has been a long-standing issue. Moreover, multinucleon strength at energies higher than the quasi-elastic peak could resolve the Coulomb sum rule problem. Experiments PR-89-015, -017, -027, -031, -032, and -036 address this and related problems.

FEASIBILITY AND ISSUES

The above proposed experiments would utilize the CLAS detector in Hall B and would study several nuclei ranging from ^{3}He to ^{208}Pb. Much of the data for these experiments could be taken simultaneously. Generally, a non-restrictive trigger is proposed for the scattered electrons, and any neutral particles are detected by means of their decay products or in the shower counters. Data acquisition is a major problem, which needs attention by the proponents. The PAC believes that the capabilities of CLAS are ideal for survey experiments of this type.

Longitudinal/transverse separations may not be possible for all processes, but would facilitate interpretation of some aspects of the data. A more detailed analysis, on the feasibility of such separation and to guide the choice of energies and the data reconstruction, would be useful.

Neutral-particle detection may be a serious problem, especially in early configurations of CLAS, which will have more restricted shower-counter coverage.

MANPOWER

Adequate.

RECOMMENDATION

Conditional approval. The overlap of proposals PR-89-015, -017, -027, -031, -032, and -036 is high but not complete. The proponents should attempt to coordinate beam energies, targets, and data acquisition, so that the six experiments can run simultaneously. The present feeling of the PAC is that the initial measurements should be limited to ^3He and one heavy nucleus, ^3He having priority, and that the optimal beam energies and kinematics are close to those in PR-89-031.

Proposal: PR-89-016

Spokesperson: Z.-E.Meziani

The Transverse and Longitudinal Response Functions for Quasi Elastic Electron Scattering in the Momentum Transfer Region $0.3 \leq Q^2 \leq 1.5(GeV/c)^2$

MOTIVATION

One of the most tantalizing problems in nuclear physics is the apparent lack of saturation of the Coulomb (longitudinal) sum rule. Experimentally, the sum rule works well for the few-nucleon systems, but is low by up to a factor of two in heavier elements. The PAC attributes high scientific priority to this experiment.

ISSUES

The crucial element in the determination of the experimental sum rule is the ability to construct the sum over its entire range of energy loss ω and to do so at large q^2 where some of the theoretical assumptions may be more valid. This requires an experiment that is much more precise than the ones performed up to now, given the larger transverse contribution at high q^2 and ω. To achieve this accuracy, systematical errors have to be reduced to a level significantly below the ones achieved by previous experiments. This requires a careful study of ways to minimize systematic errors in the measurement of charge, detector efficiency and acceptance as a function of energy.

Given the fact that high accuracy can only be achieved after some experience has been gained with the apparatus, followed by a detailed study of the contributing factors, this experiment will only be feasible after such systematic experimental studies have been performed.

RECOMMENDATION

Deferral.

Proposal: PR-89-017

Spokesperson: R. Sealock

Electroexcitation of the $\Delta(1232)$ in nuclei

MOTIVATION

The motivation of this experiment is to study the A and Q^2 dependence of $\Delta(1232)$ with the emphasis on the Δ-nucleon potential and the Δ-decay modes. Recent experiments have shown that there is substantial multiparticle strength in these regions, and therefore exclusive measurements are going to be most interesting for a detailed understanding of such strength. Anomalous strength in the dip region has been a long-standing issue. Experiments PR-89-015, -017, -027, -031, -032, and -036 address this and related problems.

FEASIBILITY AND ISSUES

The above proposed experiments would utilize the CLAS detector in Hall B and would study several nuclei ranging from ^3He to ^{208}Pb. Much of the data for these experiments could be taken simultaneously. Generally, a non-restrictive trigger is proposed for the scattered electrons, and any neutral particles are detected by means of their decay products or in the shower counters. Data acquisition is a major problem, which needs attention by the proponents. The PAC believes that the capabilities of CLAS are ideal for survey experiments of this type.

Longitudinal/transverse separations may not be possible for all processes, but would facilitate interpretation of some aspects of the data. A more detailed analysis, on the feasibility of such separation and to guide the choice of energies and the data reconstruction, would be useful.

Neutral-particle detection may be a serious problem, especially in early configurations of CLAS, which will have more restricted shower-counter coverage.

MANPOWER

Adequate.

RECOMMENDATION

Conditional approval. The overlap of proposals PR-89-015, -017, -027, -031, -032, and -036 is high but not complete. The proponents should attempt to coordinate beam energies, targets, and data acquisition, so that the six experiments can run simultaneously. The present feeling of the PAC is that the initial measurements should be limited to ^3He and one heavy nucleus, ^3He having priority, and that the optimal beam energies and kinematics are close to those in PR-89-031.

Proposal: PR-89-018

Spokesperson: D. Day

An Experiment to Measure the Charge Form Factor of the Neutron

MOTIVATION

The charge form factors of the proton and the neutron determine the isoscalar and isovector nucleon charge distribution. Therefore, understanding the neutron form factor is of fundamental importance, since at present only the charge radius of the neutron is known with good accuracy. The additional information on the charge form factor of the neutron is inferred from the charge form factor of the deuteron and the results are highly model dependent. The measurement of this form factor at even a few points could provide stringent constraints on theoretical models.

MEASUREMENT AND FEASIBILITY

It is proposed to determine the form factor G_E^n by measuring the spin-dependent part of the elastic electron-neutron cross-section. A longitudinally polarized electron beam will be quasi-elastically scattered from polarized deuterium nuclei in a deuterated ammonia (ND_3) target.

ISSUES

The PAC concluded that this is an important but difficult measurement. It depends heavily on the properties of the polarized ND_3 target. Further, the Committee would like to know the impact that the polarized nitrogen in the target has on the measurement.

MANPOWER

Clear identification is needed of the people who will develop, build and test the polarized target and operate it for this experiment.

RECOMMENDATION

Deferral, pending clarification of the performance of the proposed target. It is hoped that the requisite effort will be devoted to the development of the polarized target needed for this and other experiments.

Proposal: PR-89-019

Spokespersons: R. Gilman, R. Holt, Z.-E. Meziani

Measurement of Proton Polarization in the $d(\gamma,\vec{p})n$ Reaction

MOTIVATION

This proposal bears a strong connection with PR-89-012 where unpolarized photodisintegration cross sections at 90° are to be measured to 4 GeV. This proposal addresses issues related to the polarization of the outgoing proton following photodisintegration to an energy of 1.5 GeV. Perturbative QCD predicts that the polarization observable P_n will be zero. The measurement proposed would cover the range for which interesting behavior in the unpolarized cross section has already been reported (SLAC experiment NE8).

ISSUES

While viewing this as an interesting experiment, the PAC is concerned that, in the absence of a successful theory for photodisintegration experiments in the 1-2 GeV region, the precision required to provide a sufficiently stringent test of the underlying physics is uncertain, at this time. A more convincing case might be made if there existed a (hadronic) calculation of the polarization and differential cross section which agreed with available data and also predicted large polarizations at the energies proposed here, that is, in contrast to the quark–based approach which predicts zero polarization.

Polarization observables are sensitive to delicate interferences and so relating a non-zero result to specific underlying physics may not be straightforward. Finding zero polarization at high energies, on the other hand, would be quite interesting.

MANPOWER

Adequate.

RECOMMENDATION

Conditional approval. A convincing case should be made that the experiment can be done with sufficient accuracy to distinguish between hadronic predictions and a possible smooth approach to asymptotia.

Proposal: PR-89-020

Spokesperson: D. A. Jenkins

Deuteron Photodisintegration

MOTIVATION

This proposal is to initiate an extensive program of measurements of deuteron photodisintegration observables using the CLAS detector with a first phase aimed at a determination of the unpolarized cross section for a wide range of momentum transfers and scattering angles. Later phases would focus on measurements of polarization observables.

MEASUREMENT AND FEASIBILITY

While such systematic studies are of general interest, the PAC is not convinced that the initial phase (which involves rather significant beam time) is well suited to addressing the high-Q^2 region. With much less time such measurements with large angular coverage could be undertaken in the lower-Q^2 region. The PAC recommends that such initial analysis of the data that will be accumulated in the approved proposal PR-89-045 be undertaken for this purpose.

MANPOWER

The manpower may have to be supplemented to undertake this experiment in an effective way.

RECOMMENDATION

Deferral.

Proposal: PR-89-021

Spokesperson: G. Petratos

^3He, ^4He Form Factors

The goal of this proposal is to measure the form factors of the ground state of ^3He and ^4He at very high momentum transfer. This experiment will provide fundamental information on the role of non-nucleonic components in nuclei. The determination of the second diffraction minimum predicted by theory in the ^3He magnetic form factor is of special interest. This experiment will be an ideal early use of the high energy, high current, and large solid angles available at CEBAF.

This experiment is feasible with the present design of the Hall A detection system. It should be noted, however, that the target proposed by the collaboration needs 1 kW refrigeration instead of the 200 W currently planned for in the CDR.

The separation of the charge and magnetic form factors should be optimized. The Committee believes that the number of incident beam energies should be decreased in order to accommodate other users.

RECOMMENDATION

Approval for 30 days of beam time, provided satisfactory progress is made on the development of a high-power cryogenic target.

Proposal: PR-89-022

Spokesperson: D. F. Geesman

The Energy dependence of Nucleon Propagation in Nuclei as measured in the $(e, e'p)$ Reaction

MOTIVATIONS

The proposal aims to study the A-dependence of the spectral function at very high momentum transfer. This is a particularly interesting issue since the background part of the spectral function, which is due to three- and more-body break-up processes, provides important information on the N-N correlations. Also one expects to clarify the fundamental problem of measuring the dynamics of nucleons in hadronic matter, as characterized by the mean free path, by means of a combined analysis of such experimental data and realistic theoretical calculations of the final state interactions.

MEASUREMENTS AND FEASIBILITY

This experiment proposes to measure the quasifree $(e, e'p)$ cross section on ^{12}C, ^{28}Si, ^{58}Ni and ^{208}Pb for proton energies $T_p = 400$, 700, 1000 and 2000 MeV, with a Rosenbluth separation at the lowest T_p. The modest resolution required and the particle identification are feasible, given the expected properties of the electron and hadron spectrometers.

ISSUES

The PAC would like to see (i) a discussion about doing L/T separations at the largest Q^2 where the difficulties with the reaction mechanism (MEC) are largest; (ii) a Glauber calculation to estimate the conventional absorption effect; and (iii) an analysis of the effects due to charge exchange processes.

MANPOWER

Adequate.

RECOMMENDATION

Conditional approval.

Proposal: PR-89-024

Spokesperson: G.S. Mutchler

Radiative Decays of the Low-Lying Hyperons

MOTIVATION

This experiment would provide important information about the quark-model wave functions of the low-lying Λ and Σ hyperons. This is especially true for the $\Lambda(1405)$, which cannot be directly observed in K^-p reactions. Radiative decay measurements can be expected to provide very stringent tests of these models, and would help resolve a number of long-standing issues regarding these states.

MEASUREMENT

The experiment would be done on the CLAS using the tagged photon beam. In order to detect the decay gammas, the shower counter array is required. The magnetic field in the CLAS will be reduced in order to avoid limiting the forward acceptance.

FEASIBILITY AND OTHER ISSUES

The acceptance should be as large as possible, and will be limited by the shower counter. Present plans call for it to extend back to 45 degrees; extending it further would help this and other measurements significantly. The resolution assumed for the shower counter seems pessimistic at $10\%/\sqrt{E}$; counters with significantly better resolution have been built. In order to resolve the low-energy gammas present in some of the decays, we urge that the feasibility of constructing a small gamma detection array in the backward hemisphere be investigated. Finally, the backgrounds present from the LH_2 target should be studied.

RECOMMENDATION

The $\Lambda\gamma$ measurement may be carried out to the extent feasible in conjunction with the approved running of PR-89-004, the latter experiment being the primary determinant of running conditions. For the $\Sigma\gamma$ work deferral is recommended.

Proposal: PR-89-025

Spokesperson: J. Comfort

Vector-Meson Decay of High-Lying Nucleon Resonances

MOTIVATION

The goal of this proposal is to study the photoproduction of high-lying N^* and Δ resonances as a test of quark models of the nucleon. The idea is to search for those resonances which decay via emission of the vector mesons ρ, ω, and ϕ. These unusual decay modes may allow a separation of these resonances from others nearby and from the underlying background.

MEASUREMENT

The experiment will be done using the CLAS with an incident electron energy of 2.4 GeV. Photons will be tagged over the range from 0.7 to 2.1 GeV. The ϕ decays with a 50% branch to K^+K^- pairs; to identify them requires good K/π separation which should be available up to 1.5 GeV kinetic energy. Neutrals will be detected by inserting Pb converters between drift chamber layers 1 and 2.

FEASIBILITY AND OTHER ISSUES

As with the N^* program in general, the issue of separating resonances from each other and from the background is one requiring a great deal of theoretical study and practical modeling of the CLAS and its acceptance. This has not yet been done in any thorough way; in fact, this proposal did not discuss the important issue of the signal-to-noise ratio. This clearly requires more effort and will be essential to the success of this project.

There is some concern about the method of using Pb converters to detect gammas in the CLAS; the idea needs to be modeled now and studied in the CLAS itself when it is available.

RECOMMENDATION

Deferred. Some of the measurements proposed here may be extracted from the information obtained when experiments PR-89-004 and PR-89-024 are run. We suggest arrangements be made to gain access to those data. The work requiring Pb converters in the CLAS should be deferred until experiments PR-89-004 and PR-89-024 are run and it has been shown that the technique will work well enough to do this experiment.

Proposal: PR-89-026

Spokespersons: J.M. Finn and P. Ulmer

In-Plane Separations and High Momentum Structure in $D(e, e'p)$

MOTIVATION

This proposal is aimed at a study of the high-momentum components of the deuteron and the separation of the $T, L + TT$ and TL response functions for coplanar kinematics. High precision measurements of this type for the deuteron constitute significant goals for CEBAF.

MEASUREMENT AND FEASIBILITY

This is a technically challenging experiment which will demand the most of the capabilities of the Hall A spectrometer system. The PAC felt that the proposed range of measurements could potentially yield valuable and fundamental information and provide a firmer foundation for further work — although it was not clear from the presentation that the precision which can be reached will really be able to provide definitive tests of deuteron structure and/or of the reaction process. In particular, some concern was felt that the various existing theoretical predictions differed by about the same amount as the projected experimental error bars. Additional theoretical work will likely be required to bring these issues into sharper focus.

MANPOWER

Adequate.

RECOMMENDATION

Deferral until initial experiments in Hall A have allowed the capabilities of the system to be refined.

Proposal: PR-89-027

Spokespersons: W. Bertozzi, W. Boeglin, L. Weinstein

Coincidence Reaction Studies with LAS

MOTIVATION

The motivation of this experiment is to study the contribution of multinucleon processes in the quasielastic, dip and Δ resonance regions. Recent experiments have shown that there is substantial multiparticle strength in these regions and therefore exclusive measurements are going to be required for a detailed understanding of the strength. Anomalous strength in the dip region has been a long-standing issue. Moreover multinucleon strength at energies higher than the quasi-elastic peak could help resolve the Coulomb sum rule problem. Experiments PR-89-015, -017, -027, -031, -032, and -036 address this and related problems.

FEASIBILITY AND ISSUES

The above proposed experiments would utilize the CLAS detector in Hall B and would study several nuclei ranging from ^{3}He to ^{208}Pb. Much of the data for these experiments could be taken simultaneously. Generally, a non-restrictive trigger is proposed for the scattered electrons, and any neutral particles are detected by means of their decay products or in the shower counters. Data acquisition is a major problem, which needs attention by the proponents. The PAC believes that the capabilities of CLAS are ideal for survey experiments of this type.

Longitudinal/transverse separations may not be possible for all processes, but would facilitate interpretation of some aspects of the data. A more detailed analysis, on the feasibility of such separation and to guide the choice of energies and the data reconstruction, would be useful.

Neutral-particle detection may be a serious problem, especially in early configurations of CLAS, which will have more restricted shower-counter coverage.

MANPOWER

Adequate.

RECOMMENDATION

Conditional approval. The overlap of proposals PR-89-015, -017, -027, -031, -032, and -036 is high but not complete. The proponents should attempt to coordinate beam energies, targets, and data acquisition, so that the six experiments can run simultaneously. The present feeling of the PAC is that the initial measurements should be limited to ^3He and one heavy nucleus, ^3He having priority, and that the optimal beam energies and kinematics are close to those in PR-89-031.

Proposal: PR-89-028

Spokespersons: J. M. Finn and P. Ulmer

Polarization Transfer Measurements in the $D(\vec{e}, e'\vec{p})$ Reaction

MOTIVATION

The experiment is designed to measure the polarization observables in $(\vec{e}, e'\vec{p})$ on the deuteron. In one set of measurements the polarization asymmetries about q= 1.26 GeV/c would be measured. A second measurement involves studying the Q^2 dependence at zero recoil momentum.

MEASUREMENT AND FEASIBILITY

The PAC felt that the proposed range of measurements is interesting but not likely to strain our understanding of deuteron structure. It would provide a direct measurement of the spin-dependent amplitudes as a function of momentum. Small changes in the wave function amplitudes and phases could show up significantly in the spin observables.

The experiment also has particular value as a calibration for the theory, apparently more sensitive in this respect, than PR-89-026 and thus could also stimulate other theoretical efforts. It can provide auxiliary information which would be particularly useful for the G_E^n measurements which have been proposed using deuterium as the neutron target.

The proposed accuracy will demand a precise understanding of the polarimeter properties. On the other hand, it might be an easier experiment than the proposed precision measurements of R_L and R_T (PR-89-026).

MANPOWER

Adequate.

RECOMMENDATION

The PAC recommends that this experiment be approved for 8 days. The emphasis should be on a measurement which would reduce the theoretical uncertainty in the interpretation of the $d(\vec{e}, e'\vec{n})p$ experiment for G_E^n.

Proposal: PR-89-029

Spokesperson: H. P. Blok

Study of the (e,e$'$d) reaction on ^{3,4}He

MOTIVATION

The proposal is motivated by experiments performed at NIKHEF, in which it was observed that the q-dependence of the measured cross sections was quite different in the case of ^{4}He than for ^{6}Li, which followed the free deuteron values. Attempts to fit the ^{4}He data with DWIA calculations have not been successful. This experiment proposes to extend the NIKHEF measurements to higher q^2.

MEASUREMENT AND FEASIBILITY

The measurements will be made as a function of energy and momentum using the Hall A spectrometers. The experiments are straightforward and feasible when the two Hall A spectrometers have been commissioned.

ISSUES

The committee was concerned that the case for extending the NIKHEF measurements to larger q^2 was not made by the theoretical calculations presented.

The Committee believes that the general problem of studying two nucleon correlations at CEBAF should have high priority. However, there is some concern that the specificity of the reaction, restricting the neutron and proton to the deuteron bound state, will greatly complicate the interpretation and reduce its value. More theoretical input is needed.

MANPOWER

The manpower is adequate to perform these measurements.

RECOMMENDATION

Deferral

Proposal: PR-89-030

Spokespersons: R. Lindgren, M. Epstein, G. Lolos, Z.-E. Meziani

Two-Nucleon Knockout Reactions on ^{3,4}He

MOTIVATION

Two-nucleon knockout reactions may offer the opportunity to measure important features of the two-nucleon correlation function. By choosing the kinematics properly, sensitivity to these correlations and the interpretability of the data can be enhanced. This is a proposal to measure in symmetric kinematics p-p final states resulting from the electrodisintegration of ^3He. This final configuration minimizes the sensitivity to meson-exchange currents. Future plans include the measurement of n-p final states, which are sensitive to these currents.

MEASUREMENT AND FEASIBILITY

Two-proton events from a cooled high-pressure ^3He gas cell would be detected in Hall A using the pair of High Resolution Spectrometers to detect the scattered electron and one of the protons. The second proton would be detected using a plastic scintillator hodoscope. Kinematic regions were chosen that emphasize the longitudinal structure function over the transverse one. Counting rates are fairly large.

ISSUES

Several features of the proposed experiment gave the PAC some concern.

(1). The final state interactions of the outgoing protons are expected to be large. This will severely hamper the interpretability of the data.

(2). Operating plastic scintillators at luminosities approaching 10^{37} may be extremely difficult.

(3). It may be more appropriate for this experiment to await a survey of ^3He knockout reactions performed in Hall B.

MANPOWER

Adequate.

RECOMMENDATION

Deferral.

Proposal: PR-89-031

Spokespersons: W. Hersman, J. Lightbody and R. A. Miskimen

Study of Multi-Nucleon Knock-out with CLAS

MOTIVATION

The motivation of this experiment is to study the multi-nucleon knockout reactions on several nuclei, with particular attention to ^{3}He. Recent experiments have shown that there is substantial multiparticle strength in these regions and therefore exclusive measurements are going to be most interesting for a detailed understanding of such strength. Anomalous strength in the dip region has been a long-standing issue. Moreover, multinucleon strength at energies higher than the quasi-elastic peak could resolve the Coulomb sum rule problem. Experiments PR-89-015, -017, -027, -031, -032, and -036 address this and related problems.

FEASIBILITY AND ISSUES

The above proposed experiments would utilize the CLAS detector in Hall B and would study several nuclei ranging from ^{3}He to ^{208}Pb. Much of the data for these experiments could be taken simultaneously. Generally, a non-restrictive trigger is proposed for the scattered electrons, and any neutral particles are detected by means of their decay products or in the shower counters. Data acquisition is a major problem, which needs attention by the proponents. The PAC believes that the capabilities of CLAS are ideal for survey experiments of this type.

Longitudinal/transverse separations may not be possible for all processes, but would facilitate interpretation of some aspects of the data. A more detailed analysis, on the feasibility of such separation and to guide the choice of energies and the data reconstruction, would be useful.

Neutral-particle detection may be a serious problem, especially in early configurations of CLAS, which will have more restricted shower-counter coverage.

MANPOWER

Adequate.

RECOMMENDATION

Conditional approval. The overlap of proposals PR-89-015, -017, -027, -031, -032, and -036 is high but not complete. The proponents should attempt to coordinate beam energies, targets, and data acquisition, so that the six experiments can run simultaneously. The present feeling of the PAC is that the initial measurements should be limited to ^3He and one heavy nucleus, ^3He having priority, and that the optimal beam energies and kinematics are close to those in PR-89-031.

Proposal: PR-89-032

Spokespersons: G. A. Leksin, V. Gavrilov

Study of Local Properties of Nuclear Matter in Electron-Nucleus and Photon-Nucleus Interactions with Backward Particle Production Using the CLAS Detector

This experiment proposes to study the space-time picture of backward hadron production. Like-particle correlations for small relative momenta would yield information on the source size as a function of Q^2, ν and A. The kinematics are designed to test the idea of hadron emission from a single localized source.

The measurements require the high acceptance of the CLAS detector and would push its capabilities for close 2-track reconstruction. At $Q^2 \sim 1GeV^2$ for an inclusive electron trigger, it would require a π/e rejection ratio greater than 10^3. This appears to be close to what may actually be feasible. The experiment would also benefit if higher (>4 GeV) beams become available.

The PAC felt that this was a very novel and potentially quite interesting measurement. The proposal was not very well organized or developed although the oral presentation cleared up many of the questions. Experiments PR-89-015, -017, -027, -031, -032, and -036 address this and related problems.

FEASIBILITY AND ISSUES

The above proposed experiments would utilize the CLAS detector in Hall B and would study several nuclei ranging from ^3He to ^{208}Pb. Much of the data for these experiments could be taken simultaneously. Generally, a non-restrictive trigger is proposed for the scattered electrons, and any neutral particles are detected by means of their decay products or in the shower counters. Data acquisition is a major problem, which needs attention by the proponents. The PAC believes that the capabilities of CLAS are ideal for survey experiments of this type.

Longitudinal/transverse separations may not be possible for all processes, but would facilitate interpretation of some aspects of the data. A more detailed analysis, on the feasibility of such separation and to guide the choice of energies and the data reconstruction, would be useful.

Neutral-particle detection may be a serious problem, especially in early configurations of CLAS, which will have more restricted shower-counter coverage.

MANPOWER

Adequate.

RECOMMENDATION

Conditional approval. The overlap of proposals PR-89-015, -017, -027, -031, -032, and -036 is high but not complete. The proponents should attempt to coordinate beam energies, targets, and data acquisition, so that the six experiments can run simultaneously. The present feeling of the PAC is that the initial measurements should be limited to ^3He and one heavy nucleus, ^3He having priority, and that the optimal beam energies and kinematics are close to those in PR-89-031.

Proposal: PR-89-033

Spokespersons: C. Glashausser, C. C. Chang, S. Nanda, J. W. Van Orden

Measurement of Recoil Polarization in the $^{16}O(\vec{e}, e'\vec{p})$ reaction with 4 GeV electrons

MOTIVATIONS

The main emphasis of the proposal is for studying of the reaction mechanism in the lightest real nucleus. At the same time it will provide fundamental information on the spin-isospin dependence of the N-N correlations in a complex nucleus and on the relativistic dynamics in hadronic systems. It is the first recoil polarization experiment.

MEASUREMENT AND FEASIBILITY

The experiment proposes to measure the recoil polarization of the outgoing proton in the $(\vec{e}, e'\vec{p})$ reaction on ^{16}O at 4 GeV in the focal plane of the HRS of Hall A. The experiment requires the development of a focal plane polarimeter. The measurement of the polarization is expected to lead to substantial results. The theoretical work on the reaction mechanism will need to be extended and completed in order to fully interpret the measurements.

ISSUES

At a future meeting the PAC would like to see: (i) a discussion of the feasibility of using H_2O instead of cryogenic O_2 and (ii) a discussion about the possibility to coordinate the kinematics with proposal PR-89-003 (Lourie) to optimize the information to be gained on the reaction mechanism.

MANPOWER

Adequate

RECOMMENDATION

Approval for 20 days, subject to future review on the development of the polarimeter and other issues.

Proposal: PR-89-034

Spokespersons: P. Boberg and C. Chang

Medium Effects of the $(e, e'p)$ Nucleon Knockout Reaction

MOTIVATION

The experiment proposes to measure the A-dependence of the longitudinal and transverse response functions using the $(e, e'p)$ reaction. This is a topic of considerable interest and appropriate to CEBAF.

MEASUREMENT AND FEASIBILITY

The measurements would be made using the the Hall A Spectrometers. However, there is essentially no discussion of the feasibility of obtaining R_L and R_T at the stated accuracy of a few percent.

ISSUES

- The discussion of scientific goals is too brief.

- The technical discussion of the feasibility of making the measurement to the proposed accuracy needs to be developed.

- The Committee was not convinced that the choice of ^{12}C and ^{63}Cu targets is optimal.

MANPOWER

Adequate.

RECOMMENDATION

Rejection.

Proposal: PR-89-035

Spokesperson: C. C. Chang, R. Gilman, J. O'Connell

Measuring the Number of Pions in the Nucleus

MOTIVATION

The experiment proposes to deduce the number of pions in the nucleus by measuring the cross section for pion production by inelastic scattering of electrons. The Committee believes that the electroproduction of pions is a topic of high scientific merit that should be addressed at an early stage at CEBAF. However, the Committee notes that the relationship of this measurement to the density of pions in the nucleus is controversial.

MEASUREMENT AND FEASIBILITY

The experiment would be carried out using the Hall A apparatus and would be feasible for early running since it does not push the capabilities of the apparatus as far as some others.

ISSUES

- The Committee is concerned that the unambiguous interpretation of the results will be difficult. While it is desirable to measure above the Δ resonance and separate the longitudinal and transverse terms, the Committee does not understand the choice of very low momentum transfer and is concerned that under these conditions, the initial pion is too far away from the mass shell for interpretation in the way discussed.

- A more detailed discussion of the problem of pion decay in the spectrometer is necessary.

- The Committee feels that the measurements on heavy targets may be premature and should await analysis of the light target data.

MANPOWER

Adequate.

RECOMMENDATION

Deferral

Proposal: PR-89-036

Spokesperson: K. S. Egiyan

Study of short-range Properties of Nuclear Matter in Electron-Nucleus and Photon-Nucleus Interactions with Backward Particle Production using CLAS

MOTIVATION

The determination of the effects due to two-nucleon or two baryon ($N-\Delta$ or $\Delta-\Delta$) correlations in heavy nuclei is an important challenge for the field which is addressed in this proposal. Reactions involving nucleons ejected in the backward direction with momentum greater than the Fermi momentum cannot take place if $N-N$ correlations are absent. This regime therefore should be sensitive to such correlations which involve large virtual momenta of the pairs. Preliminary investigations have taken place at Yerevan. Experiments PR-89-015, -017, -027, -031, -032, and -036 address this and related problems.

FEASIBILITY AND ISSUES

The above proposed experiments would utilize the CLAS detector in Hall B and would study several nuclei ranging from ^{3}He to ^{208}Pb. Much of the data for these experiments could be taken simultaneously. Generally, a non-restrictive trigger is proposed for the scattered electrons, and any neutral particles are detected by means of their decay products or in the shower counters. Data acquisition is a major problem, which needs attention by the proponents. The PAC believes that the capabilities of CLAS are ideal for survey experiments of this type.

Longitudinal/transverse separations may not be possible for all processes, but would facilitate interpretation of some aspects of the data. A more detailed analysis, on the feasibility of such separation and to guide the choice of energies and the data reconstruction, would be useful.

Neutral-particle detection may be a serious problem, especially in early configurations of CLAS, which will have more restricted shower-counter coverage.

MANPOWER

Adequate.

RECOMMENDATION

Conditional approval. The overlap of proposals PR-89-015, -017, -027, -031, -032, and -036 is high but not complete. The proponents should attempt to coordinate beam energies, targets, and data acquisition, so that the six experiments can run simultaneously. The present feeling of the PAC is that the initial measurements should be limited to ^3He and one heavy nucleus, ^3He having priority, and that the optimal beam energies and kinematics are close to those in PR-89-031.

The CLAS N* Program: Proposals PR-89-037, -038, -039, -040, -041, -042, -043

Since the running conditions for the eight proposals PR-89-037, -038, -039, -040, -041, -042, and -043 are similar, the PAC has considered them as a coherent package, while evaluating the proposals on their individual merits.

MOTIVATION

This group using the CLAS detector can make a substantial contribution to our understanding of baryon structure. 1) The Q^2-dependent electroproduction form factors will provide information on the internal composition (orbital and spin wave functions) of the baryons, and 2) the partial wave decomposition of electroproduction provides information on the resonant structure of the baryon spectrum.

Given the expected quality of their data, the N* group should not plan to rely on existing πN analyses for resonance parameters, but prepare for a self-standing analysis. A joint comprehensive analysis is needed for all final states: $\pi N, \eta N, \rho N, \omega N, (\pi\pi)_S$, and $(\pi\eta)_S$. These channels should approximately saturate the widths of the baryon resonances below 2 GeV. The analysis package should anticipate polarized electron running. The PAC encourages the N* group to continue to involve theorists in supporting the project.

MEASUREMENT AND FEASIBILITY

Considerable effort will have to go into understanding the detector response. The PAC notes that there is an immediate need for more realistic detector simulations and analysis programs. Some form of coherent coupled-channel amplitude with background and resonances should be used to Monte Carlo the detector response and then assess the ability of the analysis package to reproduce the input amplitude. There is also a need for more work on the trigger: it is not too early to begin the job of classifying events in the trigger by physics interest (final-state channel, Q^2, etc.). The group's computing needs will very likely saturate any level of computing power available, and it is important to continue to address issues related to how open or specific a trigger to use, given the expected enormous event rates.

MANPOWER

Adequate.

RECOMMENDATION

Approval for 20 days of beam time to be split between 2 and 4 GeV incident energy, and between hydrogen and deuterium targets for PR-89-037, -038, -039, -042, and -043. Subject to reports of progress with CLAS and plans for specific experimental strategies to be reviewed at future PAC meetings.

Proposal: PR-89-037

Spokesperson: V. Burkert

Electroproduction of the Delta Resonance

This experiment will provide a large increase in the quality and quantity of data on this process which could allow investigation of important scientific questions such as the deformation of the Δ. However, extraction of the physics will require a careful determination of the E/M ratio, with phase, as a function of Q^2. This, in turn, requires extensive knowledge and control of systematic errors and the CLAS acceptance function over the full kinematic range of the experiment.

Proposal: PR-89-038

Spokesperson: R. Minehart

Measurement of p(e,e$'\pi$) in the 2nd and 3rd Resonance Regions.

This experiment will provide new information on nucleon resonances in this mass region. Because of the quality and quantity of information anticipated, this experiment is an important part of the CLAS N* program, and is a natural extension of PR-89-037 on the Δ. Information on $\gamma N^* N$ and $N^* N\pi$ couplings and their behavior as a function of Q^2 will be forthcoming for existing, and possibly new, resonances in this mass region.

Proposal: PR-89-039

Spokesperson: S. Dytman

Amplitudes for the $S_{11}(1535)$ and $P_{11}(1710)$ Resonances from p(e e$'$p) η Experiment

The η decay focuses on the $S_{11}(1535)$ and $P_{11}(1710)$ resonances. Since this channel has isospin 1/2, the group should attempt a complete partial wave analysis. This may be possible given that the experiment will cover a significantly larger kinematic range with a great improvement in errors over existing data.

Proposal PR89-040

Spokesperson: P. Stoler

The Study of Excited Baryons at High Momentum Transfer with the CLAS

This experiment could provide important information about the high Q^2 behavior of the form factors of several important baryon resonances. It is a natural extension of the studies at low Q^2 discussed in proposals PR-89-037, -038, and -039. In fact, some of these data will be accumulated in parallel with those experiments, as discussed above. However, because of the small cross sections involved, the experiment may require additional dedicated running with higher currents and special triggering arrangements in the CLAS. Those runs may be a second-generation experiment for the device. The PAC recommends that data obtained from the other experiments in the N^* program be made available for the purposes of this proposal and that the high-Q^2 measurements be *deferred.*

Proposal: PR-89-041

Spokespersons: S. Dytman and K. Giovanetti

A Longitudinal Transverse Separation of the Amplitudes for the $S_{11}(1535)$ Resonance

Unfortunately, this experiment seems to provide only a small subset of what will be available from PR-89-037, -038, -039, and -040. The CLAS will already provide excellent out-of-plane coverage for all these reactions and related studies, making possible a full amplitude analysis rather than a more restricted L/T separation. We do not see the need for restricted in-plane L/T separation measurements, which would be extremely difficult to carry out successfully. The PAC recommends *rejection.*

Proposal PR-89-042

Spokesperson: V. Burkert

Measurement of the Electron Asymmetry in p(e,e′p)π^0 and p(e,e′π^+)n Reaction in the Mass Region of the Delta for $Q^2 < 2(GeV/c)^2$

This experiment will provide additional information necessary to decompose and understand the amplitude structure, especially in the hadronic continuum. Spin degrees of freedom should be exploited in all aspects of the N* program, and we recommend that polarized electrons be a part of CLAS from its first operations. This measurement requires polarized running, which is compatible with all other N^* experiments.

Proposal: PR-89-043

Spokespersons: L. Dennis and H. Funsten

Measurements of the Electroproduction of $\Lambda(1115)$, $\Lambda^*(1520)$ and $f_o(975)$ via the $K^+ K^- p$ and $K^+ \pi^- p$ Final States

The $f_o(975)$ may be the only molecule made of mesons, and understanding its structure is certainly of interest. The second goal of the experiment is to understand better the mechanisms which are most important in ΛK production, including the extraction of the N^* contributions.

The experiment requires good K/π separation, which should be available.

The experiment should be done such as to take full advantage of the ϕ meson production that will occur. So far, it appears that the proposers have looked only at the missing mass spectra that are expected in the experiment. We suggest strongly that they also look at the Dalitz plots in order to survey the entire phase space for the purposes of doing a full amplitude analysis. This will allow a clear separation of the ϕ meson bands from the f_o meson bands, and of each from "contamination" by $K\Lambda^*$ production.

On the experimental side, we recommend that a study be made of the feasibility of studying the $\pi^+\pi^-$ decay mode of the f_o meson to allow a coupled channel analysis of the $K\overline{K}$ threshold region.

Proposal: PR-89-044

Spokespersons: M. Epstein, R. Lourie, J. Mougey and A. Saha

Selected Studies of the ^3He and ^4He nuclei through electrodisintegration at high momentum transfer

MOTIVATION

The A=3,4 systems are prime candidates for study of nuclear structure, since detailed microscopic calculations are available for the ground states. At the same time, these systems represent good cases for a study of reaction mechanisms, as there is hope that it may be possible to model the contributions of final state interactions and meson exchange currents in a more microscopic way than for A$>$ 4.

MEASUREMENT AND FEASIBILITY

The experiment is well tuned to the capabilities of the set of spectrometers available in Hall A. The full set of kinematics proposed represents a rather long-range program of which specific parts are to be carried out with higher priority. As the reaction mechanism (FSI, MEC, charge exchange) needs to be understood before nuclear structure information can be extracted, a study of this aspect should come first. For these studies of the reaction mechanism, the ^3He target is the preferred.

ISSUES

For a successful separation of the longitudinal and transverse structure functions, the systematic errors that can be achieved in Hall A need closer study.

A high-power target at 10°K seems to be a nonoptimal compromise, as the effort to cool from 20°K to 10°K is out of proportion with the gain in density.

The high luminosity envisaged plus the small beam spot require attention, to avoid unacceptable target density fluctuations.

RECOMMENDATION

Approval for 30 days, for running on ^3He. L/T separations should only be started once the milestone of the 1% accuracy needed for L/T separations has been demonstrated.

Proposal: PR-89-045

Spokesperson: B. Mecking

Study of Kaon Photoproduction on Deuterium

The goal of this proposal is to study the photoproduction of hyperons from deuterium using monochromatic photons. Kaons and other particles emitted in the decay of the hyperon-nucleon system will be detected in the CLAS. The experiment will be performed with a missing-mass resolution of 4.5 MeV.

The K^+ identification will be ensured by measuring:

1) the time of flight between a hodoscope close to the target and the outer scintillation counters, and

2) the energy deposition in the drift chambers and scintillation counters.

The Committee believes that this is an important experiment in particular for the determination of the kaon production amplitudes from the neutron. The measurement of possible narrow structures is also of significant interest. Informations on the $\Lambda-N$ interaction would be very valuable, although it may be difficult to extract because of the large uncertainties in the high-momentum components of the deuteron wave function.

RECOMMENDATION

Approval for 20 days of running.

Proposal: PR-89-046

Spokespersons: B. Frois, L. Lapikas, J. Mougey and C. Papanicolas

Study of quasi-particle orbits in closed shell nuclei with $(e, e'p)$

MOTIVATION

The proposed experiment aims to measure via $(e, e'p)$ the high–momentum components of heavy nuclei. The momentum distribution can provide information on properties of the nuclear wave function that are beyond those described by mean–field theories.

MEASUREMENT AND FEASIBILITY

This experiment is the only one proposed that makes full use of the high-resolution capabilities of the Hall A spectrometers. It is not clear, however, whether the measurement of closely–spaced levels corresponding to different shells with very different momentum distributions (strengths) actually requires the use of dispersion matching.

ISSUES

The kinematics of the proposed measurements are strongly constrained by the requirement of constant outgoing proton energy. This leads to kinematical situations where the interpretation of $(e, e'p)$ in terms of DWBA becomes more questionable (due to the small value of q). Dropping this requirement, at the expense of having to understand the energy dependence of the FSI, may represent a better strategy.

The proposal considers a number of nuclei. Concentration on the heaviest nucleus– ^{208}Pb – may initially be advisable given the better validity of mean–field calculations for this nucleus.

The PAC notes the large differences between the written proposal and the oral presentation.

MANPOWER

The experiment requires excellent resolution performance in Hall A, and a corresponding effort from the Hall-A group. The question of the integration of this experiment into the overall program of the Hall-A collaboration needs clarification.

RECOMMENDATION

Conditional approval for ^{208}Pb. The proponents should show at a future PAC meeting that they can indeed, with the resolution envisaged, separate levels spaced as closely as 350 keV with relative strengths that differ by more than a factor of 10.

Proposal: PR-89-047

Spokespersons: J. Jourdan, J. Mougey and G. Petratos

Deuteron Electrodisintegration at Threshold at Large Momentum Transfers

MOTIVATION

The proposed single-arm d(e,e$'$)np experiment is of fundamental importance and would extend the data for electrodisintegration of the deuteron to the highest practical momentum transfer, limited only by the projected cross-section sensitivity of approximately 5×10^{-42}.

MEASUREMENT AND FEASIBILITY

The experiment requires a scattering angle of 160° and is designed for Hall A. The resolution (limited by target thickness) is 1 MeV in the (n-p) system. This is an order of magnitude better than the SLAC experiment over a similar kinematic range and comparable to the proposed Bates experiment at lower momenta. The projected errors are small ($< 20\%$ at the highest momentum transfer).

At the highest momentum transfer, the small cross sections will present a challenge for the detector system. Spectrometer background will have to be controlled and understood before the maximum sensitivity can be projected.

ISSUES

The PAC felt that the proposal was not very well developed. We were not presented with a very clear understanding of how well the continuum contribution could be interpreted to allow for a measurement of the singlet state transition. The PAC would like to see a more complete discussion of theoretical considerations showing the contribution of various amplitudes as well as what particular aspects of the theory would be tested by these measurements.

MANPOWER

The manpower resources appear to be adequate for carrying out the proposed measurements.

RECOMMENDATION

Conditional approval, subject to review of overall progress, and specifically with respect to the above issues.

Appendix D

Comments on the CDRs

HALL A CDR

The Hall A CDR is essentially completed. The principal physics goal is an instrument for high-resolution charged-particle coincidence studies, matching the capabilities of the accelerator. A pair of identical high-resolution (1×10^{-4}) magnetic spectrometers with maximum momentum capabilities of 4 GeV/c has been designed and costed. The design appears to address the needs of the physics program and the most recent recommendations of the PAC. Requirements for momentum and angular resolution, solid angle, momentum acceptance, extended targets and basic configuration essentially meet the physics goals.

A TAP had evaluated in detail the proposed design and plan (including costs and schedule) for constructing these instruments. The panel raised several concerns and made suggestions for improving the design. Some of these have been addressed by the collaboration while others remain to be resolved.

Of serious concern to the TAP and this PAC is the compromise forced on the design by the decrease in the size of Hall A due to budget limitations. The committee feels that the proposed spectrometer layout is too constrained with no room for fully optimizing the detector layout and certainly no room for future development. The PAC recommends that options be examined for reducing the overall spectrometer length. Possible options include a reduction of the inter-element drift space, the detector profile, and possibly a change in the overall scale of the instrument. To provide an extra (1-2)m would not seriously affect the physics capabilities of the spectrometer system. Some fine tuning of the optical layout during the last few months, has resulted in some additional flexibility for the detector layout. The PAC encourages further efforts in this direction.

Many of the proposed experiments require precise knowledge of the beam intensity ($< 1\%$) over a broad range of current, and also of the absolute energy (1×10^{-4}). A design for the instrumentation needed to meet these requirements is not in hand. The Committee urges the collaboration to address this important problem soon. Precise intensity measurements are also important in the other two experimental halls.

A focal-plane polarimeter will be part of the detector package for the hadron spectrometer. The proposed precision experiments demand that its acceptance and calibration be fully understood to the required accuracy. A plan must be developed which would achieve this.

Much of the Hall A program will clearly require high-power cryogenic targets. The CDR does not appear to allow, in the costing, for the spectrum of targets that have been proposed. It is important that CEBAF carry out an evaluation and develop a plan for a basic complement of targets that will eventually be needed. This evaluation should incorporate the targeting needs of Halls B and C.

The PAC notes the importance of polarized targets such as H, D and ^3He for some of the most fundamental measurements at CEBAF. It strongly supports the development of polarized targets suitable for the high-intensity beams of CEBAF, such as the polarized NH_3 and ND_3 targets.

The PAC feels that a very effective collaboration has evolved around the Hall A program. There appears to be adequate manpower to develop all of the required subsystems. Users have played a very important role in the design of these systems. They are also committed to the construction of major elements of the spectrometer system. A cohesive well-focused management structure is now in place.

HALL B CDR

The Large Acceptance Spectrometer (CLAS) is unique at CEBAF in providing multiparticle detection capability with good energy resolution and particle identification, large acceptance, and adequate rate capability. This permits a broad class of electro- and photo-induced reactions to be studied. This detector is well matched to the high duty factor of the accelerator and is well suited for the investigations of important areas of research which were not previously feasible. The conceptual design of this complex system is now well developed and has been reviewed twice by TAPs. The project is well organized, the design is well advanced, and many of the crucial components are being prototyped.

A large number of the proposals submitted to PAC 4 require utilization of CLAS, and a large group of outside users is committed to contributing to this project. The design appears to address the needs of the physics program. There are, however, a number of aspects of the spectrometer not yet fully worked out, and about which the PAC has questions.

Specific items of concern are the following:

a) The drift chambers are organized into three separate superlayers. A detailed design of the central (target) region and the region I chamber is not yet available. Because widely dissimilar targets are discussed in the CEBAF proposals, the PAC urges that the compatibility of these targets with the proposed system and with the expected performance be confirmed.

b) The design of a gas Cherenkov detector is in progress. Its performance is still uncertain and needs to be evaluated more fully.

c) Two versions of the Shower Counters are being explored. The cost of a lead scintillator sandwich design is being compared with the advantages of a lead-scintillator fiber design. For some experiments this is a crucial detector. Opportunities for lowering the cost should be evaluated in order to provide a detector with as large an acceptance as possible.

$d)$ Provision has been made for polarized targets in the field-free region of the toroid as required by several proposals. The PAC is concerned that this may require removal of the region I drift chambers in some cases and have impact on the performance of tracking in CLAS. Furthermore, the Committee would like clarification as to whether the specification for maximum field gradient ($\sim$ 100 milli-Gauss/cm), as required by optically pumped polarized gas targets, can be achieved over the required volume.

The large user involvement in CLAS is necessary, as a great deal of work will be needed to bring the entire detector system into operation, and a reasonable start has been made in this direction. However, with so many off- site users involved in the construction, careful coordination and monitoring of progress will be needed during the design and construction of CLAS in order to bring the full system into operation on schedule.

The full cost breakdown of CLAS is presented in the CDR. It is reassuring that an outside cost estimate of the superconducting coil construction was in agreement with the internal CEBAF estimate.

Hall C CDR

Hall C is a general-purpose experimental hall, designed to serve a variety of experiments of different types in a flexible way. It incorporates a medium-resolution 6-GeV spectrometer (HMS), used mainly to define the momentum transfer. This spectrometer is supplemented by a variety of auxiliary detection systems for coincidence experiments, such as a short-orbit spectrometer (SOS) for decaying particles (e.g. pions and kaons), neutron detectors and polarimeters, and others such as out-of-plane detectors. Also, a separate high-resolution coincidence spectrometer system for hypernuclear spectroscopy is proposed.

The focal plane instrumentation and other detection systems are designed and developed by user groups.

HMS

Given the constraints of designing a spectrometer with modest resolution, large solid angle, high momentum ($p > 4GeV/c$) and reasonable cost, the proposed design seems a good choice. The design has been reviewed by a TAP and has been judged to be a good one. The PAC finds that the HMS is a good match to the proposed physics program.

SOS

The spectrometer as an optical instrument is well suited to measuring pions and kaons with large acceptance and short flight path at modest resolution. The TAP has found that this type of spectrometer is a good compromise in the conflicting performance requirements, and its magnetic design is fully understood. The PAC finds that the stated capabilities of SOS are matched to the relevant parts of the physics program.

Several problems were noted.

1) Will the spectrometer operate satisfactorily at a luminosity of 10^{38}? Given the relatively shallow bend and the 40problems from high singles rates or high background from low energy particles bouncing inside the acceptance?

2) The PAC is concerned that insufficient detail on the detector package was presented. Some experiments propose to use the SOS for electron detection at far backward angles where pion/electron ratios will be large (10^4). An adequate detector package to meet these conditions needs to be developed.

Hypernuclear Spectroscopy

Hypernuclear spectroscopy at high resolution was given high physics priority by the PAC. No specific device to carry out such a program is included in the CDR. Although low-resolution hypernuclear studies may be carried out with the SOS, a dedicated high-resolution kaon spectrometer is required for high-precision studies together with a zero-degree, small-solid-angle, electron spectrometer. The PAC urges a greater CEBAF role in the design of such a system to be pursued in collaboration with interested outside groups.

Cryogenic Targets

Much of the Hall C program will clearly require high-power cryogenic targets. The CDR does not appear to allow, in the costing, for the spectrum of targets that have been proposed. It is important that CEBAF carry out an evaluation and develop a plan for a basic complement of targets that will eventually be needed. This evaluation should incorporate the targeting needs of Halls A and B.

Polarized Targets

The PAC notes the importance of polarized targets such as H, D and ^3He for some of the most fundamental measurements at CEBAF. It strongly supports the development of polarized targets suitable for the high-intensity beams of CEBAF, such as the polarized NH_3 and ND_3 targets.

Current measurements

Some of the proposed experiments will need an accurate determination of the beam intensity. A design for the instrumentation needed to meet this requirement is not in hand, and should be addressed soon.

Parity

The proposed PAVEX detector for parity-violation studies is not sufficiently developed to be included in the CDR.

Future Options

Hall C has the potential for several interesting areas of investigation. Among these is the hypernuclear spectrometer, STAR, and parity violation studies.