REPORT OF THE

CEBAF PROGRAM ADVISORY COMMITTEE

JANUARY 1992

PAC 5

Introduction

The CEBAF Program Advisory Committee held its fifth meeting on November 18-22, 1991 at CEBAF center. In response to the formal charge (Appendix A) from Prof. J. D. Walecka (Scientific Director) the committee reviewed and made recommendations on 26 proposals, of which 8 were updates of previously submitted proposals. In addition an update on the polarized targets required for experiment PR-89-018 was also presented and reviewed by the PAC.

The proposals submitted to PAC5 have further broadened the scope of the CEBAF physics program. New areas in which the PAC approved or conditionally approved future measurements include:

- Electro- and photo- kaon production which represents one of the unique areas for CEBAF allowing the study of spectroscopy and interactions of a strange particle (Λ or Σ) embedded in a nucleus.
- Parity violation studies using longitudinally polarized electrons to test aspects of the Standard Model and provide information on the presence of strange quarks in the nucleon.
- Measurement of spin observables fully utilizing both polarized beams and targets such as $\vec{\mathrm{H}}$, $\vec{\mathrm{D}}$ and $^3\overrightarrow{\mathrm{He}}$.

The proposals are of very high quality and many involve some of the best young scientists in the field – often in leading roles. All of the proposed experiments are well matched to the projected capabilities of the accelerator and research equipment with some even pushing the limits of what may be initially possible. This combination of excellent physics and capable dedicated researchers promises to keep CEBAF at the forefront of electronuclear physics well into the next century.

The PAC was briefed by management on the status of the laboratory, the experimental equipment and the accelerator. The latter included a discussion of the plans for polarized beams as well as a possible scenario for beam delivery during the first three years of operation. We also heard brief reports from two Italian (INFN) collaborations on their plans for possible involvement in the experimental program at CEBAF.

Facility Updates

H. Grunder reported on the laboratory status. The construction project (accelerator plus experimental equipment) is essentially on cost and on schedule. At present the construction is 62% complete. Federal funds expended through FY91 total $300M and are projected to total $550M at completion. He projected that the operating budget at completion would be approximately $65M/yr in FY96$. This would allow for 35 weeks/yr of operations.

Civil construction at the site is in its final stages. All three experimental halls are nearing completion. The schedule for accelerator commissioning calls for delivery of an 800 MeV beam to Hall C by 2QFY94. A full energy beam delivered to the three halls simultaneously is promised for December 1994. The laboratory staff is approximately at its projected full complement of 375PYE.

C. Leemann reviewed the status of accelerator construction and commissioning. The performance of the superconducting accelerating cavities, delivered by industry, continues to be excellent. The average gradient for single cavities is 9.5 MV/m (5MV/m design specification) and the average $Q_0 = 8 \times 10^9$ (2.4×10^9 design specification). These are particularly positive indicators that all the design goals can be met and possibly exceeded. The critical path item remains the assembly of cryomodules. Recent problems involving vacuum integrity and higher order mode loads have been resolved. The production line has been started and is on a schedule to deliver the last cryomodule by late 1993. There is, however, no margin for any further delays if the project is to remain on the present schedule.

The 45MeV injector has been assembled in the linac vault and operated from the main control room at full design energy but reduced currents. The injector energy spread was measured to be $\Delta E/E < 4 \times 10^{-4}$ full width, which is excellent. Control, safety and interlock systems are installed and in use for around the clock operation. Helium for the accelerator is supplied from a 4800W, 2K central helium liquifier which is performing as expected.

There are some accelerator R+D projects which have recently been initiated. In collaboration with L. Cardman a recirculator setup involving the 45MeV injector has been assembled. Its goal is to explore the onset of beam breakup phenomena in the CEBAF structures. A second initiative involves the proposed implementation of a free electron laser system. This requires high peak current operation at relatively low duty factor which can be carried out essentially simultaneously with beam delivery to the three experimental halls. The FEL facility will require additional funding of approximately $27M which is expected to be shared by industry, the State of Virginia and the Federal Government. Management assures the PAC that the FEL will not be allowed to affect beam quality nor impact the resources available to the nuclear physics community as a result of such operations.

J. Domingo presented an update on the status of the experimental equipment. The basic experimental plan was endorsed by NSAC and approved by DOE. Contracts have been placed for most of the major components in all halls and the associated detector systems are proceeding on schedule.

In Hall A the design and construction of the pair of high resolution spectrometers is well advanced. The dipoles including the Fe assembly and the coil-cryostat system as well as the large $\cos 2\theta$ quadrupoles will be constructed under fixed price contracts. The contracts for the small $\cos 2\theta$ quadrupoles are expected to be let by spring 1992. Final design of the support carriage is essentially complete. Prototype efforts on detector elements (drift chambers and Cerenkov detectors) are underway at MIT and Regina. Cryotarget design and prototyping is being carried out at California State University. The schedule calls for the electron spectrometer to be operational by January 1995, with the hadron spectrometer following approximately six months later. Physics with the pair of spectrometers is projected to start by 4QFY95.

The contract for the CLAS magnet was awarded in February 1991. Design and prototyping efforts for the drift chambers and electromagnetic calorimeter are well advanced. A contract for approximately one-third of the required time-of-flight photomultipliers and calorimeter scintillators has been signed. Prototype efforts are also underway on the trigger processor and the data acquisition system. The contract for the photon tagger magnet was awarded in September 1991. The schedule calls for the CLAS detector to be operational by mid-1995.

The first experiments are expected to be carried out in Hall C. Contract for the HMS dipole was awarded in July 1991. The cold Fe quadrupole contract is awaiting Oak Ridge approval. Support structure fabrication is essentially complete and the drift chambers are under construction at CEBAF. The construction of the second-arm spectrometer, SOS, is being managed by ANL. Cu and Fe contracts have been awarded; the machining and coil fabrication contracts are now out for bids. Specifications for the remaining systems are being developed. The schedule calls for both the HMS and SOS spectrometers to be completed and operational by March 1994 in time for the initial beam.

The laboratory is at present unable to fund some essential experimental hardware. The requirement to maintain a 25% contingency on items not under contract and 10% on items with a fixed price contract together with a budget cap has forced some equipment to be descoped.

In Hall A the focal plane polarimeter for the hadron spectrometer, the 1kW cryotarget and the laser beam polarimeter were descoped. Items delayed in Hall B include a Moller beam polarimeter, the low energy half of the photon tagger, the large angle calorimeter segment and the level-3 trigger system. Items descoped in Hall C include the 150W cryotarget, laser beam polarimeter and Enge split-pole hypernuclear spectrometer.

Many of the descoped items are absolutely crucial for carrying out the approved physics program. It is the intent of laboratory management to restore as many of these items as funding will allow. Once contracts are in place for the major equipment the contingency picture will be further clarified. However, since many of the major components are now under contract it is difficult to envision that all of the descoped items would be restored by turn-on.

A significant fraction of the most important experiments proposed for CEBAF require polarized beams. Existing source technology can deliver 200μA beams with 40% polarization and acceptable lifetime. Such a source has been constructed for CEBAF by L. Cardman (University of Illinois). It will be delivered to CEBAF (December 1991) and is planned to be installed on the accelerator by April 1993. It is very desirable to develop sources with much higher polarization–approaching 100%. Recent progress shows a lot of promise. At present these alternative technologies, with polarizations $\sim 80\%$ have much lower quantum efficiencies which could limit beam currents to some tens of μA. It is not clear that the figure-of-merit in this case would be better for the highest luminosity experiments.

The present plan calls for two polarized sources to be installed on the accelerator together with a thermionic gun. The pair of sources is designed to provide backup for maintaining throughput in case crystal lifetime is a problem. There is a possibility for one of the sources to be a high polarization version which would be most suitable for experiments with a polarized liquid target and/or CLAS, both of which necessarily operate at much reduced luminosities.

At present the accelerator is engineered to operate using only a single source at a time. A bunch-by-bunch switching scenario is a possible future option.

Many of the proposed CEBAF experiments require current measurements at the 1% level or better. The technology for achieving this in CW operation at 4GeV and 200μA is not presently in hand. It was clear in the discussions with the PAC that up to now there has been essentially no focused effort on precise absolute current measurements. Unless this problem is solved soon it will not be possible to carry out some of the most important experiments which CEBAF was designed to do. The PAC recommends that management address this issue in time to effect a solution *before* beam is delivered to experiments.

M. Taiuti (INFN) reported to the PAC on recent negotiations for the involvement of his collaboration with Hall B physics. The group is very interested in many of the experiments proposed for CLAS and has explicitly joined in several of the proposals being considered by this PAC. As part of their contribution to the development of the CLAS detector they have proposed to construct additional elements for the electromagnetic calorimeter to extend its coverage from 45° to 90°. This would be a particularly worthwhile improvement for CLAS and would significantly enhance its capabilities for physics. Funds for the first module have already been made available. No decision has been made on the funding for the other five modules which would be required for full coverage. INFN is making a long-term commitment to nuclear physics at CEBAF. The PAC endorses these developments as being in the best interests of CEBAF and the nuclear physics community.

S. Frullani discussed briefly the plans of a second INFN collaboration that is interested in pursuing physics in Hall A. They have developed a proposal to construct a multi- purpose spectrometer (MPS) which is relatively small and short, allowing for the detection of kaons and low energy pions, as well as having the capability for being used at up to 30° angles out-of-plane. In combination with the pair of HRS spectrometers it would also allow for some high resolution triple coincidence experiments in which there is a lot of interest. The instrument is estimated to cost approximately $8M. The group is presently in the process of setting up an international collaboration (with participants from some of the following countries: Italy, US, France, Netherlands, Japan, China, etc) which could provide the necessary manpower to effect such a project. It is expected that up to 10 Italian physicists would be part of these efforts. It is hoped that such a collaboration would be set up in approximately six months. The PAC endorses these efforts to put together a strong collaboration. We believe that such a versatile third spectrometer would significantly enhance the Hall A physics program.

Proposal Ratings

The PAC was charged with providing recommendations on individual proposals in four categories and, while the dividing lines are not sharp, some operational definitions of these categories emerged in the course of our deliberations. For consistency we have tried to follow in spirit and practice the definitions as developed and applied in PAC4 for the first round of experimental proposals.

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 requested levels of performance, are assumed implicitly to constitute some of these milestones. Progress will be reviewed by the PAC at future meetings as required. Frequently, less than the full time requested in the proposal was recommended for "approval". In some instances the PAC decided to limit the scope of the proposed measurements. In all cases the recommended time was deemed adequate to achieve useful and publishable first results. 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.

CONDITIONAL APPROVAL implies that the recommendation of full approval is contingent on answering specific questions raised by the PAC. The number of days to be approved is left to be determined at a future PAC meeting, when these questions have been answered satisfactorily.

DEFERRAL (without prejudice for the future) implies that more serious concerns by the PAC will have to be addressed before approval or conditional approval can be recommended. These issues should be addressed in a new proposal for consideration at a future PAC meeting.

REJECTION implies that the PAC concluded that a compelling case had not been made at this time for performing the experiment as proposed.

There are many reasons which lead to proposals receiving either **DEFERRED** or **REJECTED** ratings. Considerations which enter include scientific merit, technical feasibility, adequacy of manpower, impact on resources and competing experiments. As a practical matter, only a fixed number of beam hours can be allocated at any given time. As a result only the "best" experiments, in an overall sense, can be recommended for approval. One should also note that in making its evaluations and recommendations the PAC is for the most part limited to the material before it as written and presented.

First experiments are now expected to start in approximately 2 1/2 years. While the recommended approval of beamtime is intended to reflect a firm commitment (subject to satisfying requisite milestones), the "priority" to run approved experiments will have to be the subject of future PAC deliberations. In addition, practical considerations will naturally play a role in the scheduling of experiments.

Because of the length of running time involved in most CEBAF experiments the PAC again requests that the standard unit in which most experiments are requested be days, rather than the more traditional hours which has been the norm. We note that this request which was first made by PAC4 was almost universally ignored in the latest round of proposals.

Summary of Proposal Recommendations

Of the 27 proposals reviewed by this PAC, approval is recommended for 13, conditional approval for 6, deferral for 1, and rejection for 7. These recommendations are summarized in Table 1. The recommended days of beam time for approved experiments are summarized by Halls in Table 2. Data is presented for both <u>accelerator days</u> and <u>proposal days</u>.

As noted in PAC4, some of the experiments at CLAS are treated differently than those in Halls A and C. With a relatively open trigger, the data from a particular measurement can simultaneously contribute to different physics issues. In such cases we try to distinguish between a primary high-priority experiment, which will control the experimental running conditions (beam energy, field, luminosity, etc), and other lower-priority experiments, which may be approved at the same time, when they can utilize a different aspect of the data from the same running conditions. In those cases, where the priority of the different measurements is similar, the PAC recommends that the conditions for the approved run be arrived at by agreement between the principals involved. In practice these various distinctions form a continuum and in the language of our recommendations we attempt to indicate our intent.

The approval of an initial experimental program at CEBAF is closely coupled with the anticipated useful accelerator beam hours during the first few years of operation. It is planned that during FY94 approximately 1,000 beam hours will be delivered to experiments possibly at relatively low energies. During FY95 and FY96 the schedule calls for 5,000 hours each year. By FY96 it is anticipated that delivery of beams with correlated energies and independent intensities to all three halls simultaneously will be possible.

The individual reports and our recommendations for each of the proposals reviewed is presented in Appendix C.

TABLE 1 PAC5 Recommendations on Proposals					
Proposal	Contact	Keyword	Hall	Recommendation	Time(d)
91–001	J. Napolitano	$H(e,e'K^+)Y$	C	Deferred	
91–002	P. Stoler	(N^*) high-Q^2	B	Approved	21*
91–003	H. E. Jackson	$A(e,e'\pi)$	C	Approved	21
91–004	E. Beise	Parity: ^{4}He	A	Conditional	
91–005	D. Jenkins	^{2}H(γ,pn)	B	Rejected	
91–006	A. Saha	$A(e,e'\vec{p})$, FSI	A	Approved	8
91–007	R. G. Milner	$A(e,e'p)$	C	Approved	5
91–008	B. G. Ritchie	η photoproduction	B	Approved	26*
91–009	W. Hersman	Multihadron	B	Approved	33†
91–010	P. Souder	Parity: H, ^{4}He	A	Conditional	
91–011	R. W. Lourie	Δ, Roper	A	Conditional	
91–012	V. B. Ganenko	^{2}H$(\vec{\gamma},pn)$	A	Rejected	
91–013	G. Geesaman	$A(e,e'p)$	C	Approved	24
91–014	C. E. Hyde–Wright	Strangeness production	B	Approved	19
91–015	D. I. Sober	$\gamma p \to \pi N$, helicity	B	Approved	18
91–016	B. Zeidman	$A(e,e')_\Lambda A$	C	Approved	21
91–017	D. H. Beck	Parity, $G_E^0/^1$H	C	Rejected	
91–018	S. A. Wood	^{3}He$(\gamma,d)p$	C	Rejected	
91–019	D. Mack	A_e	C	Rejected	
91–020	R. D. McKeown	$^3\vec{H}e$	B	Conditional	
91–021	Z.-E. Meziani	Pb(e,e')	A	Rejected	
91–022	O. K. Baker	^{1}H$(e,e'K^+)$	C	Conditional	
91–023	V. Burkert	Pol. Str. Function	B	Approved	42
91–024	H. Funsten	ω production	B	Approved	21*
91–025	W. Bertozzi	$A(e,e'X)$	A	Rejected	
91–026	G. G. Petratos	^{2}H$(e,e'd)$	A	Approved	24
89–018	D. Day	G_E^n	A/C	Conditional	

*Measurements to be carried out concurrently.

†Proposal represents unified run plan for 6 experiments.

TABLE 2 **Beam Time Summary** **Approved Experiments**				
Accelerator Days	Halls A	B	C	Total
PAC4	108	71	44	223
PAC5	32	111	71	214
TOTAL	140	182	115	437
Proposal Days	Halls A	B	C	Total
PAC4	108	183	44	335
PAC5	32	345	71	448
TOTAL	140	528	115	783

Appendix A
Charge to PAC5

Introduction

CEBAF has 16 approved proposals and 13 conditionally approved proposals from the first round (PAC4). 5340 accelerator beam hours (8040 proposal hours) have been awarded.

CEBAF has an approved Experimental Equipment Plan and the major equipment items are now under procurement. Occupancy of the end stations will occur in early 1992.

CEBAF has received 26 proposals in the second round, 18 of which are new and 8 of which are resubmissions.

CEBAF's goal is to start physics operation in Hall C by March, 1994.

Since we are further into the project CEBAF has a better conception of what the accelerator operations scenario is likely to be from 1994-1996.

Formal Charge

CEBAF requests PAC5 to review the proposals and provide advice on:

(1) The scientific merit, technical feasibility, and manpower requirements of the proposals.

(2) An assignment of the proposal into one of the 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 (or by CEBAF management) 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.)

Specifics

PAC5 should take into account the operations scenario for the experimental halls presented by the Accelerator Division for the first three years of CEBAF operation.

At this time, PAC5 should recommend the specific award of no more than a total of 2/3 of the anticipated useful accelerator beam hours from CEBAF during its first three years of operation, allowing flexibility for new proposals and new ideas.

PAC5 should also review and provide appropriate advice on the

- status of the polarized target development (Proposal 89-018)

- proposed Italian (INFN) participation at CEBAF.

Appendix B

Agenda and Schedule of Meetings

Appendix C

Reports on Proposals

Proposal: PR-91-001
Spokesperson: J. Napolitano

Measurement of the Differential Cross Sections for $p(\gamma, K^+)\Lambda$ and $p(\gamma, K^+)\Sigma^0$ at $\theta_{cm} = 90°$ and $1.4 \leq E_\gamma \leq 3.4$ GeV

Motivation

It is proposed to measure associated photoproduction of K^+ with $\Lambda°$ and $\Sigma°$ hyperons from the proton for photon energies between 1.4 and 3.4 GeV. These measurements would provide the first differential cross section data between 1.5 and 4 GeV and test the predicted s^{-7} scaling dependence of this cross section. Given the evidence against simple scaling in the related $\gamma N \rightarrow \pi N$ reactions, the PAC concluded that such a measurement without an angular distribution would be of limited interest.

Measurement and Feasibility

Measurements would be done with the bremsstrahlung endpoint technique with K^+ detection in the SOS spectrometer.

Issues

The PAC is concerned that the ten accelerator energy changes required for this measurement would place an undue burden and complication on operations during the first few years of useful beam. Furthermore, the availability of angular distribution information (which may be essential) would require a much more ambitious experimental program, suggesting that the goals of this measurement be re- examined.

Recommendation

The PAC recommends that this proposal be deferred.

Proposal: PR-91-002
Spokesperson: P. Stoler, V. Burkert

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

Motivation

The experiment will study the high Q^2 behavior of several important baryon resonances. It is a natural extension of PR-89-037, -038, and -039 which were recommended for approval by PAC4.

Measurement and Feasibility

The measurements should be feasible with the CLAS spectrometer.

Issues

Measurements at the highest Q^2 discussed in the proposal (> 4 GeV^2) will require either a longer running time than that presently approved or a dedicated trigger. This part of the proposal is seen to be a second generation program for CLAS and the PAC does not believe that either of these strategies is appropriate at this time. Nor would we wish the run plan of the approved lower Q^2 measurements to be strongly influenced by this proposal. However, we note that if CLAS is able to take data at the planned luminosity and rate, then there will be a substantial number of events in the 3-4 GeV^2 range. The PAC strongly encourages the proponents to analyze these events, which will provide new information on the high Q^2 behavior of the baryon resonances and allow planning of second generation experiments in the future.

Manpower

The manpower is judged to be adequate.

Recommendation

The PAC recommends approval for parasitic running together with experiments PR-89-037, -038, and -039 for 21 days in Hall B.

Proposal: PR-91-003
Spokesperson: H.E. Jackson

A Study of Longitudinal Charged Pion Electroproduction in ^{2}D, ^{3}He, and ^{4}He

Motivation

The proposed experiment will measure the longitudinal cross section of charged pion electroproduction in parallel kinematics. Model calculations of the cross-section predict that the longitudinal response will be suppressed at virtual pion momenta below $k = 1fm^{-1}$ and enhanced for larger k. In order to control multinucleon processes driven by the delta isobar, the measurements are proposed at W = 1.16 and 1.33 GeV and for two values of Q^2. These kinematics will allow one to study virtual pion momenta in the pion quenching and excess regions, respectively, and should reduce the dependence of the analysis on the reaction mechanism.

Measurement and Feasibility

A first experiment of this type has been performed by members of this group at Saclay. Given this experience, the planned experiment using the SOS and HMS spectrometers in Hall C should not pose major difficulties. The ability to separate the longitudinal and transverse cross sections with good accuracy is crucial for this experiment.

Issues

The request of PAC4 to improve the choice of kinematics has been met. Given the limitations of beam time, the collaboration has proposed to make the initial measurements for only two of the four envisaged choices of kinematics. This provides the option for studying either the reaction mechanism or the dependence on virtual pion momentum. Both choices will be useful as a first step, but the interpretability of the data may eventually require a more general study.

Manpower

The manpower is judged to be adequate.

Recommendation

The PAC recommends that this experiment be approved for 21 days in Hall-C.

Proposal: PR-91-004
Spokesperson: E. Beise

Measurement of Strange Quark Effects using Parity-Violating Elastic Scattering From ^{4}He at $Q^2 = 0.6$ (GeV)^2

and

Proposal: PR-91-010
Spokesperson: P. Souder

Parity Violation in Elastic Scattering From the Proton and ^{4}He

The PAC recommends the conditional approval of parity-violating electron scattering measurements using the pair of HRS spectrometers in Hall A to determine the strangeness electric form factor G_E^s. The PAC feels that considerable progress has been made by the parity community, resulting in the three strong proposals which were presented at PAC5. However, several open questions remain, both on the specific physics to be explored and on the way the experiments will be carried out. In particular, the initial choice of target (^{4}He or ^{1}H) and the optimal kinematics (e.g. momentum transfer) remain to be defined. The PAC would like to see further refinement of the physics arguments which lead to these choices before arriving at a specific recommendation for a first measurement of parity–violating electron scattering at CEBAF.

The PAC feels that precise parity violation measurements for several targets with a broad range of kinematic conditions can be successfully carried out with the HRS spectrometers in Hall A. However, there are a number of open technical questions, including the selection of the mode of data acquisition (integration or digital counting), the determination of possible backgrounds, the development of electron source and beam diagnostics (polarimetry, position monitoring, feedback systems) and target geometry optimization. We would like to see a detailed evaluation of all technical difficulties associated with the operation of the HRS spectrometers at the highest luminosities in their most forward positions. The potential impact of such a difficult experiment in the first few years of CEBAF operation must be more thoroughly evaluated with the Hall A collaboration and laboratory management to ensure mutual understanding of possible scheduling priorities and conflicts.

Whereas the individual experimental groups bring considerable technical expertise to bear on the difficult task of undertaking parity experiments, it is the PAC's perception that the manpower in either of the collaborations alone may not be completely adequate. We strongly encourage the groups interested in measuring G_E^s to combine their intellectual resources and proceed as a unified collaboration. Moreover, we encourage them to strengthen this collaboration by including others who have also expressed interest in parity studies at CEBAF and are not presently a part of the Hall A efforts. Common technical problems should be addressed jointly so that the most effective parity program can be implemented. This will require close cooperation in the collaboration, on the one hand, and management and accelerator groups responsible for polarized electron sources and beamlines, on the other.

The PAC recommends that a PAC/TAP panel be formed which would review in detail all of the technical issues associated with performing parity measurements in Hall A as proposed in PR-91-004 and PR-91-010. The PAC expects that regular progress reports will be made at future meetings and, in particular, following the PAC/TAP technical review a unified plan for an initial G_E^s measurement in Hall A would be presented to the next PAC meeting. It is preferable that the collaboration arrive at a jointly agreed upon choice of target, kinematics and technique (including a common detector package) for the initial experiment. However, if the groups involved cannot arrive at such a plan for presentation to the PAC, then the PAC may have to recommend the assignment of initial priority based on the present proposals.

Recommendation

The PAC recommends that this experiment be conditionally approved for Hall A.

Proposal: PR-91-005
Spokesperson: D. Jenkins

Deuteron Photodisintegration

Motivation

The proposed experiment would measure the cross sections for deuteron photo disintegration over a range of angles for energies between 0.5 and 1.5 GeV. It would be performed in CLAS using a tagged photon beam and would run concurrently with PR-89-045 measuring kaon photoproduction from the deuteron.

The motivation is to measure an angular distribution over a wide range in CM angles and with greater precision than previous experiments in order to explore more precisely the reaction in a region sensitive to short range deuteron structure and nucleon resonances above the Δ.

Measurement and Feasibility

The measurement could be easily carried out parasitically with PR-89-045 as long as the hardware trigger is not restricted to suppress triggering on single charged particles.

Issues

While such systematic studies would be of some interest, the PAC was not persuaded that having data of the type proposed would be sufficiently important to recommend approval of the measurement. The new data would be in a range where some results already exist and where neither the conventional nuclear physics model nor the model based on scaling ideas are expected to work. The PAC was also not persuaded that the data would be of such sufficient importance to justify that additional trigger restrictions be imposed upon PR-89- 095 if they were to run concurrently.

Manpower

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

Recommendation

The recommendation of the PAC is that this proposal be rejected. The collaboration is encouraged to participate in experiment PR-89-045 and extract whatever data can be accumulated in a non-interfering parasitic mode, i.e., without imposing the specific hardware trigger proposed.

Proposal: PR-91-006
Spokesperson: A. Saha

Study of Nuclear Medium Effects by Recoil Polarization up to High Momentum Transfers

Motivation

The proposed measurements of the recoil proton polarization in quasifree (e,e′$\vec{p}$) reactions will provide new information which is expected to be important in understanding the reaction mechanism and for studying nuclear structure at momentum transfers up to about 4 GeV^2. The good resolution proposed will help to determine the final state of the nucleus and facilitate understanding of the change in the response functions as one moves from one side to the other of the quasifree peak.

Measurement and Feasibility

This experiment will use an unpolarized beam and the focal plane polarimeter with the HRS spectrometer in Hall A. The incident beam energy will be fixed at 4 GeV. The proposed targets are H, D, ^{4}He, ^{12}C and ^{16}O.

Issues

The polarimeter feasibility has not been clearly documented for recoil energies much above 2 GeV where the analyzing power is expected to be low and systematic effects will become increasingly important.

It will be necessary to develop hadron based models which can be used to understand data taken at values of Q^2 $\lesssim$ 4 GeV^2 where perturbative QCD is likely not applicable.

Manpower

The manpower is judged to be adequate.

Recommendation

The PAC recommends that this experiment be approved for 8 days in Hall A with unpolarized beam at 4 GeV for measurements up to $Q^2 = 4$ GeV^2.

Proposal: PR-91-007
Spokesperson: R.G. Milner

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

Motivation

If the reaction mechanism in $(e, e'p)$ produces a small color singlet state (as would be the case if perturbative QCD were applicable to the scattering), then QCD predicts that each final–state channel will experience a diminished final–state interaction on its way out of the nucleus. This phenomenon of "color transparency" is interesting since it is in sharp contrast to the behavior expected in effective hadron pictures at low energies.

Measurement and Feasibility

The proposal requests time to do $(e, e'p)$ measurements using the Hall C HMS as the proton arm and the SOS as the electron arm. The measurements are proposed as a function of A for the Q^2 range from 1 to 6.2 GeV^2.

Issues

The PAC felt that the case made for these measurements was marginal: the maximum Q^2 will be low, and SLAC experiment NE-18 seems likely to provide cross sections at a level of precision commensurate with uncertainties in theory (which is required to define "normal" behavior). The potentially relevant improvement over NE-18 is in energy resolution, although the argument that this would be critical was not compelling.

Manpower

The available manpower and experience was deemed adequate.

Recommendation

The PAC recommends approval for 5 days to allow measurement of the $Q^2 = 6.2\ GeV^2$ points proposed. It further recommends that this time be scheduled so as to be contiguous with the running of PR-91-013 so that the two experiments can share setup time.

Proposal: PR-91-008
Spokesperson: B. G. Ritchie

Photoproduction of η and η' Mesons

Motivation

A number of measurements of η photoproduction between threshold and 2.5 GeV exist, but data are sparse, angular distributions are essentially nonexistent above 1 GeV, and the statistical precision is limited. For η' photoproduction the situation is much worse: only one indication of a signal exists in the resonance region. This experiment can produce complete and precise ($\sim 5\%$) angular distributions for η photoproduction over the entire resonance region. A complete survey of η' photoproduction will also be produced, if this cross section is the same order of magnitude as that for η photoproduction. Measurement of the η photoproduction angular distributions can make significant contributions to the understanding of $I = 1/2$ (N^*) nucleon resonances.

Measurement and Feasibility

The CLAS spectrometer and the missing-mass technique are well-adapted for observing η and η' photoproduction. The proposers have demonstrated that the proton momentum resolution anticipated for CLAS and the photon energy resolution of the photon tagging system are adequate for detection of ηp and $\eta' p$ final states. The diameter of the hydrogen target determines the low-momentum cutoff for the observed protons; this diameter must be carefully chosen in consultation with the rest of the CLAS collaboration. The principal experimental uncertainty is the ability of the DAQ system to survive with the low-multiplicity trigger (tagged photon and a single charged particle) required for the missing-mass technique. This uncertainty will only be resolved by running the experiment.

Manpower

The group of physicists involved in the proposal is adequate for deriving the proposed physics once the Data Summary Tapes are available. The proposers are members of the

CLAS Collaboration which is responsible for developing the detector, collecting the data and reducing them to the DST level.

Recommendation

The PAC recommends that this experiment be approved for 26 days in Hall B to be run concurrent with PR-89-004.

Proposal: PR-91-009
Spokesperson: W. Hersman

Multihadron Physics with CLAS: Update on CEBAF Proposals PR-89-015, -017, -027, -031, -032, and - 036

Motivation

Following the recommendations of PAC4 the proponents of the Proposals PR-89-015, -017, -027, -031, -032, and -036 have developed a unified run plan for these experiments, which recognizes the particular interest in the ^{3}He measurements. The motivation of these experiments is to study the ω and q dependence of the multihadron reactions to obtain detailed information on three-body forces, the multiparticle strengths in (e, e') reactions, the role of meson exchange currents, the Δ- interaction in the medium, short range correlations and production of cumulative hadrons from heavy cluster fragments.

Measurement and Feasibility

The proposed experiments would employ the CLAS detector in Hall B and would use four target nuclei: ^{3}He, ^{4}He, ^{12}C and ^{56}Fe. The data for the various experiments will be taken simultaneously. The PAC believes that the capabilities of CLAS are ideally suited for survey experiments of this type.

Issues

Data acquisition and neutral-particle detection need particular attention by the proponents. The PAC believes that L/T separations would be very useful in interpreting some of the data and encourages the proponents to study the feasibility of performing them. At a future meeting the PAC would like to see a detailed discussion of these issues.

Manpower

The manpower is judged to be adequate.

Recommendation

The PAC recommends approval for 33 days in Hall B. The time should be apportioned approximately 20% at 0.8 GeV, 30% at 2.0 GeV and 50% at 4.0 GeV.

Proposal: PR-91-010
Spokesperson: P. Souder

Parity Violation in Elastic Scattering From the Proton and ^{4}He

and

Proposal: PR-91-004
Spokesperson: E. Beise

Measurement of Strange Quark Effects using Parity-Violating Elastic Scattering From ^{4}He at $Q^2 = 0.6$ (GeV)^2

The PAC recommends the conditional approval of parity-violating electron scattering measurements using the pair of HRS spectrometers in Hall A to determine the strangeness electric form factor G_E^s. The PAC feels that considerable progress has been made by the parity community, resulting in the three strong proposals which were presented at PAC5. However, several open questions remain, both on the specific physics to be explored and on the way the experiments will be carried out. In particular, the initial choice of target (^{4}He or ^{1}H) and the optimal kinematics (e.g. momentum transfer) remain to be defined. The PAC would like to see further refinement of the physics arguments which lead to these choices before arriving at a specific recommendation for a first measurement of parity–violating electron scattering at CEBAF.

The PAC feels that precise parity violation measurements for several targets with a broad range of kinematic conditions can be successfully carried out with the HRS spectrometers in Hall A. However, there are a number of open technical questions, including the selection of the mode of data acquisition (integration or digital counting), the determination of possible backgrounds, the development of electron source and beam diagnostics (polarimetry, position monitoring, feedback systems) and target geometry optimization. We would like to see a detailed evaluation of all technical difficulties associated with the operation of the HRS spectrometers at the highest luminosities in their most forward positions. The potential impact of such a difficult experiment in the first few years of CEBAF operation must be more thoroughly evaluated with the Hall A collaboration and laboratory management to ensure mutual understanding of possible scheduling priorities and conflicts.

Whereas the individual experimental groups bring considerable technical expertise to bear on the difficult task of undertaking parity experiments, it is the PAC's perception that the manpower in either of the collaborations alone may not be completely adequate. We strongly encourage the groups interested in measuring G_E^s to combine their intellectual resources and proceed as a unified collaboration. Moreover, we encourage them to strengthen this collaboration by including others who have also expressed interest in parity studies at CEBAF and are not presently a part of the Hall A efforts. Common technical problems should be addressed jointly so that the most effective parity program can be implemented. This will require close cooperation in the collaboration, on the one hand, and management and accelerator groups responsible for polarized electron sources and beamlines, on the other.

The PAC recommends that a PAC/TAP panel be formed which would review in detail all of the technical issues associated with performing parity measurements in Hall A as proposed in PR-91-004 and PR-91-010. The PAC expects that regular progress reports will be made at future meetings and, in particular, following the PAC/TAP technical review a unified plan for an initial G_E^s measurement in Hall A would be presented to the next PAC meeting. It is preferable that the collaboration arrive at a jointly agreed upon choice of target, kinematics and technique (including a common detector package) for the initial experiment. However, if the groups involved cannot arrive at such a plan for presentation to the PAC, then the PAC may have to recommend the assignment of initial priority based on the present proposals.

Recommendation

The PAC recommends that this experiment be conditionally approved for Hall A.

Proposal: PR-91-011
Spokesperson: R.W. Lourie

High-Precision Separation of Polarized Structure Functions in Electroproduction of the Δ and Roper Resonances

Motivation

The proposed measurements will be an important component in a programmatic study at CEBAF using spin observables in (e,e$'\vec{p}$) reactions to perform multipole decompositions of the Δ and Roper resonances.

Measurement and Feasibility

The experiment will use the focal plane polarimeter in Hall A in parallel kinematics using a polarized beam of 100 μA. The scattered electrons will be detected in coincidence in the second spectrometer. Measurements will be made on each side of $\vec{q}$.

Issues

The following issues should be addressed and a response is expected at a future meeting:

(1) Measurements for a range in W will be important in developing confidence that the multipole decomposition is reasonable.

(2) A multipole analysis should be carried out using existing data plus a representative set of the quasi-data expected to be obtained to ensure that resonance effects can be separated from non-resonant contributions. A variation of the systematic error should be tried to see if it might not be better at this early stage to take data at more values of Q^2 with somewhat lower statistical accuracy.

(3) A plan should be presented to ensure that the expected data will be taken at kinematics which overlap those taken in the N^* experiments on CLAS.

Manpower

It is judged to be adequate.

Recommendation

The PAC recommends that this experiment be conditionally approved for Hall A.

Proposal: PR-91-012
Spokesperson: V.B. Ganenko

$\vec{\gamma}d \rightarrow pn$ Reaction Asymmetry Cross-Section Measurements

Motivation

The goal of this proposal is to measure the angular distribution of the polarized photon asymmetry in the d($\vec{\gamma}$,pn) reaction at energies between 0.6 and 2.0 GeV.

Measurement and Feasibility

In the proposed technique, an electron beam impinges on an aligned diamond crystal radiator to produce linearly polarized photons which irradiate a liquid deuterium target. The photo-protons are detected in the HRS, while the recoil neutrons are detected in coincidence in a neutron detector. The incident electron beam also passes through the deuterium target. Thus, radiator in and out measurements as well as radiator alignment differences must be recorded.

Issues

Given the existing data up to 1.0 GeV and the lack of theoretical calculations of the asymmetry above 1 GeV, the PAC did not see the importance of such measurements at this time. In addition, the PAC has serious concerns about the feasibility of the proposed technique. Generally, previous data using this technique have not been of high quality. It appears that the background expected in the neutron counter was not estimated for a 50 μA beam impinging on a 5% radiator.

Manpower

The Kharkov group has extensive experience in operating the diamond crystal radiator. However, there is no clear indication of which group would be responsible for developing the neutron counter.

Recommendation

The PAC recommends that this experiment be rejected.

Proposal: PR-91-013
Spokesperson: D.Geesaman

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

Motivation

This is an update of proposal PR-89-022 which was conditionally approved by PAC4. It aims to study the A- dependence of the spectral function at very high momentum transfer where the background part of the spectral function, which is due to many-body processes, may provide information on N-N correlations. One also expects to clarify the fundamental problem of the propagation of nucleons in nuclear matter.

Measurement and Feasibility

This experiment proposes to measure the quasi-free $(e, e'p)$ cross section on ^{12}C, ^{28}Si, ^{58}Ni,^{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 demands envisioned make this a feasible experiment, given the expected properties of the electron and hadron spectrometers.

Issues

The response to the comments of PAC 4 were found satisfactory. The discussion of the L/T separation at the largest Q^2 shows that, although this would be interesting, it is extremely time consuming. New theoretical calculations taking into account many body effects were presented. Charge exchange effects have been estimated to be less than 5%.

Manpower

It is judged to be adequate to carry out the proposed measurements.

Recommendation

The PAC recommends that this experiment be approved for 24 days in Hall C.

Proposal: PR-91-014
Spokesperson: C.E. Hyde-Wright

Quasi-Free Strangeness Production in Nuclei

Motivation

Measurements of quasifree photoproduction of K^+ and K^o in nuclei, using tagged photons, are proposed as a means to understand potential medium effects on the elementary N(γ,K) vertex. Differences and similarities between this process and quasifree $(e, e'p)$ scattering may also prove useful in furthering our understanding of the latter. The information obtained could be important in applications to hypernuclei production processes and further our knowledge about the kaon–nucleus interaction.

Measurement and Feasibility

No major technical problems are foreseen.

Issues

The PAC is not fully convinced that the connections between quasi-free strangeness production and $(e, e'p)$ scattering will be simple to obtain, however, the measurements should be interesting in their own right and for their connection to hypernuclei production mechanisms.

Manpower

It is judged to be adequate.

Recommendation

The PAC recommends approval for 19 days in Hall B.

Proposal: PR-91-015
Spokesperson: D.I. Sober

Helicity Structure of Pion Photoproduction

Motivation

The question of the spin structure of the nucleon is currently of great interest. Precise data on single pion photoproduction might play an important role in separating the contributions of the different reaction channels to the Drell-Hearn-Gerasimov sum rule.

A measurement of the asymmetry in combination with the differential cross sections would constitute the basis for a more refined multipole analysis at photon energies around 1 GeV.

Measurement and Feasibility

With a polarized electron beam, a tagging spectrometer covering the lower part of the electron energy in the focal plane, and a polarized target positioned in CLAS, this second generation experiment would be feasible.

Issues

The possibility of using a frozen spin target should be seriously explored, especially as an investment for future experiments.

Recommendation

The PAC recommends that this experiment be approved for 18 days of beam time in Hall B.

Proposal: PR-91-016
Spokesperson: B. Zeidman

Electroproduction of Kaons and Light Hypernuclei

Motivation

It is proposed to study the interactions between nucleons, lambdas, and sigmas in few-body systems. This measurement provides an opportunity to measure the absolute cross section for electroproduction of kaons in light nuclei and to determine the level structure of ${}^{3}_{\mathrm{Y}}\mathrm{He}$ and ${}^{4}_{\mathrm{Y}}\mathrm{He}$, where Y= Λ^0 or Σ^0. While studies of final–state interactions in the $D\,(e, e'K^+)\,\Lambda n$ reaction may provide some information on the ΛN interaction, the PAC felt that the studies of the cusp in the production cross section near the ΣN production threshold might be less informative.

Measurement and Feasibility

The HMS and SOS spectrometers in Hall C will be used to study the electroproduction of kaons in targets of deuterium, ^{3}He, and ^{4}He. Some of the measurements will be hampered, however, by the moderate momentum resolution of the SOS.

Issues

The PAC judged the SOS detector package to be adequate to provide the particle identification and tracking required for these measurements. The mass resolution achievable in the SOS is judged to be an important limit on the impact of the ^{3}He and ^{4}He measurements.

Manpower

It is judged to be adequate.

Recommendation

The PAC recommends approval for 21 days in Hall C.

Proposal: PR-91-017
Spokesperson: D. H. Beck

Measurement of the Flavor Singlet Charge Form Factor of the Proton: G_E^0

Motivation

The goal of this experiment is to obtain information on G_E^0, the flavor singlet "charge" form factor of the proton in the Q^2 range $0.1 < Q^2 < 0.3\,\mathrm{GeV}^2$ by means of parity-violating elastic e-p scattering. Results from the Bates–SAMPLE experiment, at essentially the same Q^2, will allow for the separation of G_M^0, the flavor singlet magnetic form factor, and G_E^0. In addition, using knowledge of G_E^p and G_E^n, the weak neutral current can be separated into the different quark flavor distributions in the proton in the low-Q^2 regime, and provide a determination of G_E^s. Information on the strange quark content of the nucleon is, at present, of very great interest and is ultimately the basic goal of all three parity experiments proposed for CEBAF.

Measurement and Feasibility

The proposed technique involves tagging 2.5 GeV elastically scattered electrons at scattering angles $\sim$ 7–13° by detecting recoil protons and thereby limiting large contributions from inelastic channels. This unique approach utilizes an azimuthally symmetric, iron-free toroidal spectrometer, with a solid angle acceptance of $\sim$ 0.5sr, to momentum analyze and detect the recoil protons. The high detector segmentation makes direct particle counting possible. Time-of-flight measurements will be used to eliminate backgrounds due to positrons and pions ($\beta = 1$). At the proposed luminosity, $\mathcal{L} \sim 2 \times 10^{38}\mathrm{cm}^{-2}\mathrm{s}^{-1}$, the target requirements are nominal ($P \sim 200$ W) and would present no problems.

The proposal estimates that 1,500 hours would be required to shake down the apparatus and carry out the measurements. The predicted asymmetry is $\sim 5 \times 10^{-6}$ with an expected uncertainty of 5%. This would determine G_E^0 to about 3%.

Issues

The PAC had several serious concerns with the proposal as presented. The proposed technique would allow parity measurements only on ^{1}H; experiments on ^{4}He, ^{12}C, *etc.*, would have to be done using some other device, *e.g.* in Hall A. The PAC was not convinced that building a device limited to a ^{1}H target is the best way to proceed with the first parity violation measurements at CEBAF. The equipment would essentially be limited to a maximum $Q^2 = 0.3\,\mathrm{GeV}^2$ — which leaves very little flexibility in terms of future possibilities. Furthermore, this experiment involves the measurement of much smaller asymmetries than either of the Hall A proposals. As an initial parity experiment it thus presents some additional risk. All such measurements are very likely ultimately to be limited by systematic effects. The prospects for follow-on parity experiments with the same device have not been documented and were only alluded to in response to questions.

The proposed technique of single-event counting and time-of-flight measurements presents possible complications and potential problems. In contrast to detecting elastically scattered electrons with a high resolution magnetic spectrometer there are many sources of background contributing to the region of the recoil proton momenta. There are also potential dead-time effects which must be identified, simulated, evaluated, and controlled. Charge integration techniques on electron accelerators, for asymmetries even smaller than those involved here, have been demonstrated to work. This would be the first experiment with electron beams utilizing digital counting techniques.

The polarized source would need to be operated in a non-standard manner for this experiment. The duty factor is substantially decreased (a factor of 16) for purposes of making the time-of-flight measurements and the peak currents must be correspondingly increased to maintain luminosity. It will make more problematic the possibility of a much higher polarization source — at least in the near future. Such devices currently suffer between one and two orders of magnitude reduced quantum efficiency. It would require added expense and resource commitment to re-engineer the source to allow for operation in such a non-standard mode.

The estimated cost ($\sim$\$6M) of the spectrometer is not insignificant at a time of severe budgetary constraints for all funding agencies. Cost-benefit considerations cannot be ignored. It will require additional resources and manpower to build the proposed instrument. Such a significant commitment and investment requires that the device should be able to do a measurement *substantially better* than existing devices to justify its development. The PAC was not convinced that such a compelling case had been made.

Recommendation

The PAC recommends that this experiment be rejected. In addition to being severely limited in the scope of the physics that could be addressed, the expected accuracy was not significantly improved over the experiments proposed for Hall A to warrant such a major investment in resources at this time. The PAC believes that a good case has been made for parity experiments using the spectrometers being constructed in Hall A (Proposals PR-91-004 and PR-91-010) and has recommended the conditional approval of an initial experiment in Hall A. Of course, there are technical issues which must be addressed as well as milestones which must be met in that case (or in many of the approved or conditionally approved experiments) before the first parity measurements at CEBAF can be performed. In light of this, the PAC feels that the Hall A option is better suited for parity studies at CEBAF in the short term. It is highly likely that after the first parity experiments at CEBAF have been carried out, using equipment which will exist in Hall A, there will be more information available to define the equipment appropriate for further measurements.

The collaboration is encouraged to continue its interest and involvement in parity experiments by joining other efforts for example, and/or by developing much more powerful schemes for future experiments.

Proposal: PR-91-018
Spokesperson: S.A. Wood

A Test of Reduced Nuclear Amplitudes in the Two-Body Photodisintegration of ^{3}He for $E_\gamma \leq 2.0$ GeV

Motivation

At sufficiently high momentum transfer, perturbative QCD predicts an s^{-17} scaling of the differential cross section from constituent counting rules, and an even faster drop with energy is found from the "reduced nuclear amplitudes" approach. This experiment is similar to the proposed measurements of deuteron photodisintegration. It would extend the maximum energy of existing data by a factor of four.

Measurement and Feasibility

The photon beam would be provided by the conventional bremsstrahlung endpoint technique, and the deuterons would be detected in the HMS spectrometer. The group has carried out related experiments on deuteron disintegration and plan to extend these measurements up to energies of 4 GeV (approved proposal PR-89-012).

Issues

This measurement is not compelling, since in the energy range covered by the experiment neither conventional three-body calculations nor perturbative QCD are expected to give reliable predictions. The PAC recommends that the collaboration concentrate its efforts on the approved deuteron photodisintegration measurements, where scaling is expected to set in at lower energies and cross sections can be followed out to higher energies.

Manpower

The manpower is judged to be adequate.

Recommendation

The PAC recommends that this experiment be rejected.

Proposal: PR-91-019
Spokesperson: D. Mack

A Precision Measurement of A_e in $p(\vec{e}, e'p)\pi^0$

Motivation

The basic idea in this proposal is to make a precision measurement of A_e in the reaction $p(\vec{e}, e', p)\pi^\circ$ over the Δ resonance. The observable A_e is interesting because it is sensitive to the charge form factor (G_C) in the $N \to \Delta$ transition and a non-zero value for this form factor would suggest nucleon or Δ deformation. While this is important nucleon physics, the PAC notes that there are already numerous proposals to measure G_C and G_E at CEBAF, Bates, Mainz and other laboratories.

Measurement and Feasibility

The measurement is proposed for Hall C using polarized electrons. The large acceptance of the HMS-SOS spectrometer pair make this out-of-plane measurement feasible.

Issues

The PAC feels that such small asymmetry measurements will initially be very difficult. Systematic errors must be controlled and the small signal demands very high precision. This level of precision is not likely to be available early in CEBAF's running schedule. The PAC also believes that the quantity G_C will be more directly addressed in measurements of A_{LT} in proposal PR-89-006. Furthermore, the Committee believes that a measurement of A_e at only two values of Q^2 does not justify the significant effort involved in this experiment.

Manpower

The manpower is judged to be adequate.

Recommendation

The PAC recommends that this experiment be rejected.

Proposal: PR-91-020
Spokesperson: R.D. McKeown

Experiments with a polarized ^{3}He target and the CEBAF Large Acceptance Spectrometer

Motivation

The collaboration proposes to study polarized electron scattering from a polarized ^{3}He target in CLAS to test models of the structure of ^{3}He as well as to use this target as a "polarized neutron" in the measurement of G_E^n. The PAC feels that both of these goals are very interesting and important.

Measurement and Feasibility

The scattering of longitudinally polarized electrons off polarized ^3He in CLAS will allow the simultaneous measurement of inclusive quasielastic scattering as well as the exclusive quasielastic reactions $(e, e'p)$ and $(e, e'n)$.

Issues

Extracting the physics of this experiment requires high luminosity running, which may be difficult to achieve with the combination of high currents in Hall B together with the required target thickness. There may also be difficulties associated with the use of polarized targets in the early stages of CLAS operation.

Manpower

The PAC judged the manpower available to be adequate for the proposed measurements.

Recommendation

The PAC recommends that this experiment be conditionally approved. The collaboration must demonstrate the feasibility of running at the required luminosity with CLAS shielded from the backgrounds produced in the thick target end windows. In addition the collaboration should make a compelling case demonstrating the superiority of the proposed target over alternative techniques for producing polarized ^{3}He.

Proposal: PR-91-021
Spokesperson: Z.-E. Meziani

Identification of Structures in the Δ(1232) Resonance Region in ^{208}Pb

Motivation

The primary goal of the proposed experiment is to confirm or disprove the presence of structures, "glitches", in the momentum spectrum of scattered electrons suggested by existing data.

Measurement and Feasibility

This single-arm inclusive measurement concentrates on the existence of a possible fine structure in the Δ resonance region. Very high statistics are needed as well as good energy resolution.

Issues

The proponents speculate that heavy nuclei lose their smooth excitation energy dependence as the momentum transfer increases. A set of earlier data was presented which exhibited several possible non-statistical oscillations; however, these could also be due to uncontrolled systematic errors, for example. It is noted that such effects have never been observed in a large body of hadronic data. The PAC does not believe that, lacking a statistical analysis, a convincing case has been made for associating such fluctuations with any new physics.

Manpower

The manpower is judged to be adequate.

Recommendation

The PAC recommends that this experiment be rejected.

Proposal: PR-91-022
Spokesperson: O.K. Baker

Measurement of the Kaon Form Factor for 1.0 $GeV^2 \leq Q^2 \leq 2.0$ GeV^2

Motivation

This experiment proposes to measure kaon electroproduction up to a momentum transfer of 2 GeV^2 to extract the electromagnetic form factor of the kaon. Any information that can be obtained on the kaon form factor at large Q^2 would be of very fundamental interest.

Measurement and Feasibility

In evaluating the feasibility of this proposal, the PAC considers that the measurement of kaon electroproduction and the extraction of the kaon form factor should be treated separately. The combination of the CEBAF CW beam and the Hall C spectrometers is uniquely well suited to carry out such measurements. A Rosenbluth separation would allow the extraction of the longitudinal part of the electroproduction cross section. Information which is obtained in the 1-2 GeV^2 range would be new and interesting.

Issues

However, the Committee is concerned that the proposers have underestimated the difficulty of extracting the kaon form factor from these measurements. There are many technical issues, such as the uniformity of the spectrometer acceptance, which will influence the feasibility of making the measurements at the required few percent level. There are also considerable theoretical uncertainties associated with the form factor extraction. In light of the long history connected with the extraction of the pion form factor from electroproduction data, the Committee considers this to be a long term program which is unlikely to produce an early result.

Manpower

Given the difficulty of the kaon form factor measurement, the Committee believes that additional manpower would be beneficial.

Recommendation

The PAC recommends that this experiment be conditionally approved. A more detailed discussion of the experimental and theoretical issues connected with the kaon form factor measurement should be presented to a future PAC.

Proposal: PR-91-023
Spokesperson: V. Burkert

Measurement of Polarized Structure Functions in Inelastic Electron Proton Scattering using CLAS

Motivation

The goal of this experiment is to study inclusive electron scattering with a polarized beam and a polarized $^{15}NH_3$ target in CLAS. The polarized structure functions A_1 and A_2 would be measured in the range $0.2 < Q^2 < 1.5$ GeV^2 and $1.1 < W < 1.8$ GeV. The main interest of this experiment is to establish the Q^2 evolution of the Gerasimov-Drell-Hearn sum rule.

Measurement and Feasibility

This experiment also involves the use of a polarized beam– polarized target in CLAS. The PAC believes that the measurements would have significant impact on our theoretical understanding of nuclear structure. Data on the Q^2 evolution of the DHG sum rule will help us to understand the connection between the quark model at low energy and the EMC spin structure functions in the deep inelastic regime. Furthermore, this experiment will provide new information on the Roper resonance which will allow its structure to be disentangled from that of the other nucleon resonances.

Issues

The operation of the CLAS detector in the presence of the high target magnetic field should be established before embarking on a long range program involving high field polarized targets.

Manpower

The manpower is judged to be adequate.

Recommendation

The PAC recommends that this experiment be approved for 42 days in Hall B.

Proposal: PR-91-024
Spokesperson: H. Funsten

Search for "Missing" Resonances in the Electroproduction of ω Mesons

Motivation

A number of nucleon resonances predicted by the non- relativistic quark model have not been observed in πN phase shifts. Weak πN couplings may be the explanation for the fact that they have not been seen. One reasonably successful model predicts that some of these "missing" resonances, particularly $N^*(1955)$, may, however, have a large ωN coupling. This motivates the search for these resonances in ω photoproduction. In addition, the narrow width of the ω enhances the ability to detect these final states in an experiment. Finally, since $I_\omega = 0$, the signal-to-noise ratio is substantially improved compared to ρN final states because backgrounds from $I = 3/2$ (Δ) resonances are eliminated.

Measurement and Feasibility

The CLAS spectrometer and the missing-mass technique are well-adapted to the search for these "missing" nucleon resonances. The proposers have demonstrated that the resolution anticipated for the CLAS detector is quite adequate for the measurement. The $N^*(1955)$ resonance should be observed in this experiment if it is produced in photoproduction and with strong decay amplitudes comparable to the theoretical estimates. The principal experimental uncertainty is the ability of the DAQ system to survive with the low-multiplicity trigger (electron and one charged particle) required for the missing-mass technique. This uncertainty will only be resolved by running the experiment.

Manpower

The group of physicists included in the proposal is adequate for extracting the proposed physics once Data Summary Tapes are available. The proposers are members of the CLAS Collaboration which is responsible for developing the detector, accumulating the data and reducing them to the DST level.

Recommendation

The PAC recommends that this proposal be approved for 21 days in Hall B for concurrent running with the CLAS N^* program.

Proposal: PR-91-025
Spokesperson: W. Bertozzi

An Investigation of Multi-Nucleon Processes at High Q

Motivation

The proposal aims to study the nature of knockout reactions $(e, e'X)$ as a function of the momentum transfer and missing energy. The goal is to understand the nature and the mechanism underlying the missing energy distribution in the $(e, e'p)$ reactions. The PAC does not believe that the proposed measurements will be particularly helpful in understanding the short range correlations responsible for the large energy spreading of the $(e, e'p)$ reactions. Although the proposed experiment might be useful to further our understanding of the reaction mechanisms and their longitudinal/transverse nature, the PAC was not convinced about the importance of such studies in complex nuclei at this time.

Measurement and Feasibility

The measurements would use the Hall A spectrometers with Cerenkov and shower counters in the electron arm and standard focal plane instrumentation in the hadron arm, optimized for pion rejection and cluster identification. Except for the L/T separation and the $^{12}\mathrm{C}(e, e'd)$ measurements at low-Q^2 there are no stringent requirements on either the energy or the angular resolution.

Issues

There are no significant issues associated with performing these rather straightforward measurements.

Manpower

The manpower listed in the proposal would be adequate. Many of the proponents have been associated recently with similar measurements.

Recommendation

The PAC recommends that this experiment be rejected. It is felt that, for cluster knockout studies, survey experiments of a similar type may be better undertaken using the CLAS detector before embarking on any major program for specifically chosen kinematics using the Hall A spectrometers.

Proposal: PR-91-026
Spokesperson: G.G. Petratos

Measurement of the Electric and Magnetic Structure Functions of the Deuteron at Large Momentum Transfers

Motivation

The goal of this proposal is to provide further constraints on the theoretical models describing the electromagnetic properties of the deuteron. The objective is to provide high precision data for $A(Q^2)$ and $B(Q^2)$ to high momentum transfers.

Measurement and Feasibility

The high beam currents, large solid angle spectrometers and high power deuterium target planned for CEBAF should permit the data for $A(Q^2)$ to be extended to 6 GeV^2 and higher accuracy for $B(Q^2)$ to 1.4 GeV^2.

Issues

The PAC recognizes the important role that CEBAF will have in understanding nuclear interactions at short distances. It is essential to understand the simplest nuclear systems at high momentum transfer. The measurements of $B(Q^2)$ at low Q^2 and $A(Q^2)$ appear to be straightforward with the HRS spectrometers in Hall A. The experiment to measure $B(Q^2)$ at 180 degrees in Hall C requires a complicated setup and substantial laboratory resources. Thus, the collaboration is encouraged to explore alternative simpler schemes more fully for these measurements.

Manpower

The PAC feels that the 180° measurements as proposed would require substantially more manpower resources.

Recommendation

The PAC recommends approval for 24 days for the measurement of $A(Q^2)$ up to 6 GeV^2 and $B(Q^2)$ up to 1.4 GeV^2 in Hall A. We recommend that the measurement of $B(Q^2)$ at 180° not be approved at this time.

Proposal: PR-89-018
Spokesperson: D. Day

An Experiment to Measure the Charge Form Factor of the Neutron

Update

This experimental proposal to measure $\mathrm{G_E^n}$ was first reviewed by PAC4. At that time the PAC concluded that it was a very important but difficult measurement. It depends heavily on the properties of the proposed polarized ND_3 target. D. Day and D. Crabb reviewed the progress to date on the developments in constructing the target which are presently underway at the University of Virginia.

The construction of the polarized H and D target is reported to be well-advanced. The design of the liquid target is based on operation in a 5T magnetic field with 140GHz microwaves and cooled using a 1K high cooling power (1W) ^{4}He evaporation refrigerator. It is expected that proton polarizations $> 95\%$ and deuteron polarizations $\sim 45\%$ will be obtained using radiation- doped frozen ammonia. It is projected that a useful luminosity $\sim 1.5 \times 10^{34}$ can be achieved for the proposed G_E^n measurements.

The high field magnet is under construction at Oxford Industries in England and the refrigerator has been ordered. Both are expected to be at UVa by Spring 1992. Vacuum pumps are on-hand and the microwave generator is being assembled. An NMR system, for measuring target polarization, is also being developed. It is projected that the target would be operational by October 1992.

The PAC endorses the efforts the collaboration has committed towards the development of polarized targets for use at CEBAF.

Recommendation

The PAC recommends that this proposal be conditionally approved.

Appendix D

Program Advisory Committee

S. Kowalski	(MIT, Chairman)
R. Arnold	(SLAC)
P. Barnes	(LAMPF)
E. Bilpuch	(Duke University)
J. Cameron	(Indiana University)
D. Cassel	(Cornell University)
T. W. Donnelly	(MIT)
D. Dreshsel	(University of Mainz)
S. Fantoni	(Inst. of Adv. Studies/Trieste)
B. Frois	(Saclay)
R. Holt	(ANL)
N. Isgur	(CEBAF)
A. B. McDonald*	(Queens University)
B. Schoch*	(University of Bonn)
J. Symons	(LBL)

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