Report of the June 13-17, 1994 Meeting of the CEBAF Program Advisory Committee

– PAC8 –

CEBAF

The Continuous Electron Beam Accelerator Facility

The Continuous Electron Beam Accelerator Facility (CEBAF) is a national physics user facility managed by the Southeastern Universities Research Association (SURA), Inc., for the U.S. Department of Energy (DOE) under contract DE-AC05-84ER40150.

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July 25, 1994

Dear Members of the CEBAF User Group,

Accelerator commissioning is underway and first beam was delivered to a target in Hall C on July 24, 1994! The CEBAF scientific program of experiments will begin this year. As a critical part of this process and to ensure an excellent physics program, the June 13-17, 1994 Program Advisory Committee (PAC8) considered new proposals, letters-of-intent and experiment updates and gave scientific ratings for the Hall A and C experiments.

Attached is the *Report of the June 13-17, 1994 Meeting of the CEBAF Program Advisory Committee*. I want to thank John Cameron and the members of the PAC for their thoughtful deliberations and care and consideration in the preparation of this report.

At the suggestion of the PAC, the PAC's scientific ratings for the Hall A experiments recommended for approval are included in the PAC8 report. As all of the update information on the Hall A experiments was available to PAC8, I concurred with the PAC that there was no need to delay presenting these ratings. Spokespersons should note that they are free to submit updates for their experiments at any time to the PAC if they feel that there is new information available which could change the present scientific rating of their experiment.

I wish to thank you the Users for your efforts on the proposals and implementation of the experimental equipment. It is satisfying to see so many well functioning collaborations for the experiments and experimental halls.

Sincerely,

Hermann Grunder
Director

Report of the June 13-17, 1994 Meeting of the CEBAF Program Advisory Committee

Introduction

The CEBAF Program Advisory Committee held its eighth meeting on June 13-17, 1994, in CEBAF Center. In response to a formal charge (Appendix A) from the Director, Dr. Hermann Grunder, the committee reviewed and made recommendations on 22 new proposals and 5 letters-of-intent. Two updates on experiments to measure G_E^n were also received. The PAC also reviewed progress reports and updates and original proposals for all experiments which had previously been accepted for Hall A and assigned scientific priorities to these. New experiments accepted for Halls A and C were also assigned a scientific priority rating using a system where A corresponds to highest priority and C to lowest priority. The rating for each experiment came from combining the individual ratings of all of the PAC members.

The PAC membership is given in Appendix B. New members for this meeting were Peter de Witts Huberts (NIKHEF-K) and Doug Beck (U Illinois).

This PAC meeting took place at a particularly exciting time at CEBAF, marking the transition from construction to the delivery of beam to the Hall C experimental area. The PAC heard reports from Hermann Grunder on the status of the project, including progress on Accelerator developments, in the experimental halls, and on budget projections for FY95. Proposals in the FY95 budget allocation process lend hope that there may yet be funds to operate as originally proposed for 18 weeks of physics running in FY95. Clearly it is imperative that the Hall C commissioning and experimental program start as soon as possible. John Domingo gave a report on the experimental facilities. Hall C is almost complete and is ready to accept first beam. The news that the HMS spectrometer is working satisfactorily was most encouraging. A brief report was presented to PAC for development of polarized beam. This included a set of what capabilities could be available during the initial years of operation starting in summer 1995. A list of resources needed to meet these goals was also discussed. Appendix I gives the information presented to the PAC on the availability of polarized beams.

General Comment on Proposals and Presentations

The quality of the new proposals presented to the PAC was judged to be high. However, in a few cases, proposals did lack some basic information needed by PAC evaluators. These included sufficient information to allow count rate estimates to be verified and a clear evaluation of both systematic as well as statistical error. When Monte Carlo simulations are presented, it is important that the input parameters and assumptions be clearly presented so that a degree of reliability can be assessed.

The spokespersons who made presentations are commended on adhering well to the tight schedule for presentations. The PAC did find it very useful to have a representative available for some time after the presentation in several cases to help clear up some uncertainties.

Concerns and General Recommendations

During PAC discussions the following questions, concerns, and recommendations surfaced. These are mostly of a general nature and perhaps, in some cases, may fall outside the PAC charge.

1. As part of its charge, PAC reviewed proposals and updates for Hall A which had been accepted some time ago. From this experience it was felt that a regular system of upgrades and associated jeopardy categories should eventually be instated for each hall. A reasonable time to start such reviews might be after one or two years of operation in the hall.

2. With the broad array of proposals now accepted, there is an associated large commitment of personnel. At some point it may be advisable to look at the overall commitment of individuals and groups to see if this continues to be reasonable.

3. The PAC received updates on two proposals to measure G_E^n . It was felt that the material presented would be most valuable to the technical advisory panel (TAP) which was previously recommended by PAC. The TAP would look in detail into the feasibility of these experiments for early running in Hall C.

4. The PAC was presented with one proposal which would use a proposed laser backscattering facility for polarized photons. While the physics of the proposal was judged favorably, the PAC believes that the eventual uniqueness of such a facility at CEBAF is most likely to involve the use of higher energy photons and the full capabilities of the CLAS detector.

5. The PAC looks forward to hearing details of how an initial physics program will be integrated with the commissioning of Hall A.

6. Of the 11 experiments that have A or A– scientific ratings, 7 require polarized beam. Obviously, polarized beam will play an important role in the CEBAF program and its development must be pursued aggressively. The resources identified as being needed to complete this task expediently seemed minimal to some PAC members when placed in the context of what is being committed at other facilities. The PAC strongly encourages the lab management to review these needs immediately and to commit to ensuring that the polarized beams required to do high priority experiments in Halls A and C not be the limiting factor in pursuing the physics.

Summary of Proposal Recommendations

The following tables summarize the results for this PAC and also provide some summary information from all of the PACs:

PAC 8 Summary by Hall

Hall	A	B	C
Proposals Recommended for Approval	3	4	2
Proposals Recommended for Conditional Approval	3	2	1
Days Recommended for Approval	63	18*	57

* Hall B experiments recommended for approval by PAC8 have 131 additional days which will be run simultaneously with previously approved experiments.

The reports and PAC recommendations for each of the proposals reviewed are given in Appendix E.

Totals for PACs 4 -8

	Experiments Recommended for Approval	Additional Experiments Recommended for Conditional Approval	Total
Experiments	69	10	79
Authors	503	37	540
Institutions	112	5	117
Countries	18		18

Totals of Approved Experiments by Physics Topic for PACs 4-8

Topic	Number	Hall A	Hall B	Hall C
Nucleon and Meson Form Factors and Sum Rules	10	3	3	4
Few Body Nuclear Properties	13	7	3	3
Properties of Nuclei	14	3	8	3
N* and Meson Properties	21	3	16	2
Strange Quarks	11	2	6	3
Total	69	18	36	15

A detailed listing of the experiments by physics topic for PACs 4-7 is available from the User Liaison Office in the report: *CEBAF Experiment Summaries, January 1994*. A new version of the summaries which will include PAC8 results will be available in the Autumn of 1994.

Scientific Ratings Summary of Experiments Recommended for Approval by PACs 4-8

Rating	A	A–	B+	B	B–	C
Hall A	2	3	5	3	4	1
Hall C	3	3	4	3	2	
Total*	5	6	9	6	6	1

* Hall B experiments have not yet been given scientific ratings.

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John Cameron

Chair, CEBAF Program Advisory Committee

Date:______________________________

Appendices

A. Charge to PAC8

B. PAC8 Membership

C. PAC8 Recommendations

D. Scientific Ratings for Hall A and C Experiments

E. Individual Reports for PAC8 Proposals

F. Hall A Scientific Rating Reports

G. Hall C Scientific Rating Reports

H. Individual Reports for PAC8 Letters-of-Intent

I. Guidance to PAC8 on Polarized Beams

Appendix A
Charge to PAC8

The following charge was given to the PAC by the CEBAF Director, Hermann Grunder:

Charge to the June 13-17, 1994 Program Advisory Committee (PAC8):

CEBAF requests PAC8 to:

1) review proposals and provide advice on,

   A) the scientific merit, technical feasibility, and manpower requirements of the proposals,

   B) a recommendation for the proposal to be placed into one of four classes:
      a) approval of the proposal,
      b) conditional approval status pending clarification of special issues,
      c) deferral, or
      d) rejection,

2) provide comments on letters-of-intent and updates,

3) provide scientific ratings for all of the Hall C experiments, and

4) provide preliminary scientific ratings for all of the Hall A experiments and those Hall B experiments submitted to PAC8. (Note, the ratings for the Hall A experiments are presented in this report as final at the request of the PAC and concurrence of Hermann Grunder.)

Appendix B
PAC8 Membership

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Appendix C

PAC 8 Recommendations

Rating†-Days*			
D	**PR-94-001**	Hall B	Polarization Measurements of Neutral Pion Photoproduction: A test of Chiral Dynamics
D	**PR-94-002**	Hall B	Photoproduction of Vector Mesons Off Nuclei
C	**PR-94-003**	Hall B	Study of the Δ(1232) Using Double Polarization Asymmetries
A-29	**PR-94-004**	Hall A	In-plane Separations and High Momentum Structure in $d(e,e'p)$
A-3	**PR-94-005**	Hall B	Determination of the $N\Delta$ Axial Vector Transitions Form Factor $G_A^{N\Delta}$ from the $ep \rightarrow e'\Delta^{++}\pi^-$ Reaction
R	**PR-94-006**	Hall A	High Q^2 Measurement of the ratio of the electric and magnetic form factors of the neutron with polarized ^3He using the HRS spectrometers
R	**PR-94-007**	Hall C	Measurement of Transverse Polarization Observables in the $d(\vec{e}, e'\vec{n})p$ Reaction
A	**PR-94-008**	Hall B	Photoproduction of η and η' Mesons from Deuterium
D	**PR-94-009**	Hall C	Longitudinal and Transverse Cross Sections in the $d(e,e'K^+)YN$ Reactions at $Q^2 = 0.5$ to 2 (GeV/c)^2
A-31	**PR-94-010**	Hall A	Measurement of the Neutron (^3He) Spin Structure Function at Low Q^2; a Connection between the Bjorken and Drell-Hearn-Gerasimov Sum Rules
C	**PR-94-011**	Hall A	A Study of Off-Shell Effects in Electromagnetic Reactions
A-3	**PR-94-012**	Hall A	Measurement of Photoproton Polarization in the $H(\gamma, \vec{p})\pi^o$ Reaction

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

* Days for Hall B represents days in addition to already approved days from previously approved experiments.

Appendix C

PAC 8 Recommendations

Rating†-Days*			
C	**PR-94-013**	Hall C	A Measurement of t_{11} in Elastic e - D Scattering
A-10	**PR-94-014**	Hall C	The Δ(1232) Form Factor at High Momentum Transfer
A	**PR-94-015**	Hall B	Study of the Axial Anomaly using the $\gamma\pi^+ \rightarrow \pi^+\pi^o$ Reaction Near Threshold
C	**PR-94-016**	Hall B	Measurement of Rare Radiative Decays of the ϕ Meson
A-15	**PR-94-017**	Hall B	The Neutron Magnetic Form Factor from Precision Measurements of the Ratio of Quasielastic Electron-Neutron to Electron-Proton Scattering in Deuterium
A-47	**PR-94-018**	Hall C	Measurement of the Deuteron Tensor Polarization at Large Momentum Transfers in D $(e, e'\vec{d})$ Scattering
D	**PR-94-019**	Hall B	Measuring Nuclear Transparency in Double Rescattering Processes
D	**PR-94-020**	Hall A	Investigation of the ^{3}He Wave Function using the $^3\vec{\mathrm{He}}(\vec{e}, e'p)\,d$ and the $^3\vec{\mathrm{He}}(\vec{e}, e'p)\,pn$ Reactions
C	**PR-94-021**	Hall A	The Electric Form Factor of the Neutron Extracted from the $^3\vec{\mathrm{He}}(\vec{e}, e'n)\,pp$ Reaction
D	**PR-94-023**	Hall A	Measurement of small components of the ^{3}He wave function using $^3\vec{\mathrm{He}}(\vec{e}, e'p)$ in Hall A
138*	**Total Days**		

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

* Days for Hall B represents days in addition to already approved days from previously approved experiments.

Appendix D

Scientific Ratings for Hall A Experiments

Experiment	Experiment Title	Rating
E-89-003	Study of the Quasielastic $(e,e'p)$ Reaction in ^{16}O at High Recoil Momenta	B–
E-89-019	Measurement of Proton Polarization in the $d(\gamma,p)n$ Reaction	B
E-89-021	Elastic Electron ^{3}He - ^{4}He Scattering at Large Momentum Transfers	B
E-89-028	Polarization Transfer Measurements in the D $(\vec{e}, e'p)\,\vec{n}$ Reaction	B–
E-89-033	Measurement of Recoil Polarization in the ^{16}O $(\vec{e}, e'\vec{p})$ Reaction with 4 GeV Electrons	B–
E-89-044	Selected Studies of the ^{3}He and ^{4}He Nuclei Through Electrodisintegration at High Momentum Transfer	B+
E-91-004	Measurement of Strange Quark Effects Using Parity-Violating Elastic Scattering from ^{4}He at Q^2=0.6 (GeV)^2	A
E-91-006	Study of Nuclear Medium Effects by Recoil Polarization up to High Momentum Transfers	C
E-91-010	Parity Violation in Elastic Scattering from the Proton: Plans for the First Run	A
E-91-011	High-Precision Separation of Polarized Structure Functions in Electroproduction of the Δ and Roper Resonances	A–
E-91-026	Measurement of the Electric and Magnetic Structure Functions of the Deuteron at Large Momentum Transfers	B+
E-93-024	Measurement of the Magnetic Form Factor of the Neutron at Large Momentum Transfers	B+
E-93-027	The Electric Form Factor of the Proton by Recoil Polarization	B+
E-93-049	Polarization Transfer in the Reaction ^{4}He $(\vec{e}, e'\vec{p})\,^{3}$H in the Quasi-elastic Scattering Region	B+
E-93-050	Nucleon Structure Study by Virtual Compton Scattering	A–
E-94-004	In-plane Separations and High Momentum Structure in $d(e,e'p)$	B
E-94-010	Measurement of the Neutron (^{3}He) Spin Structure Function at Low Q^2; a Connection between the Bjorken and Drell-Hearn-Gerasimov Sum Rules	A–
E-94-012	Measurement of Photoproton Polarization in the H $(\gamma, \vec{p})\,\pi^{o}$ Reaction	B–

Appendix D

Scientific Ratings for Hall C Experiments

Experiment	Experiment Title	Rating
E-89-008	Inclusive Scattering from Nuclei at $x > 1$ and High Q^2	B
E-89-009	Investigation of the Spin Dependence of the ΛN Effective Interaction in the P Shell	B+
E-89-012	Two Body Photodisintegration of the Deuteron at Forward Angles and Photon Energies Between 1.5 and 4.0 GeV	A–
E-91-003	A Study of Longitudinal Charged Pion Electroproduction in ^{2}D, ^{3}He, and ^{4}He	B+
E-91-007	Measurement of the Nuclear Dependence and Momentum Transfer Dependence of Quasi-elastic $(e,e'p)$ Scattering at Large Momentum Transfer	B–
E-91-013	The Energy Dependence of Nucleon Propagation in Nuclei as Measured in the $(e,e'p)$ Reaction	B–
E-91-016	Electroproduction of Kaons and Light Hypernuclei	A–
E-91-017	"G^0": Measurement of the Flavor Singlet Form Factors of the Proton	A
E-93-018	Longitudinal/Transverse Cross Section Separation in $p(e,e'K^+)\Lambda$ (Σ) for $0.5 \leq Q^2 \leq 2.0$ $(\text{GeV}/c)^2$, $W \geq 1.7$ GeV, and $t_{\text{min}} \geq 0.1$ $(\text{GeV}/c)^2$	B+
E-93-021	The Charged Pion Form Factor	B+
E-93-026	The Charge Form Factor of the Neutron	A
E-93-028	Deformation of the Nucleon	B
E-93-038	The Electric and Magnetic Form Factors of the Neutron from the $d(\vec{e}, e'\vec{n})p$ Reaction	A
E-94-014	The $\Delta(1232)$ Form Factor at High Momentum Transfer	B
E-94-018	Measurement of the Deuteron Tensor Polarization at Large Momentum Transfers in D $(e, e'\vec{\vec{d}})$ Scattering	A–

Appendix E

Proposal: PR-94-001, Hall B

Spokespersons: A. Bernstein, B. E. Norum, P. Welch

Title: Polarization Measurement of Neutral Pion Photoproduction: A Test of Chiral Dynamics

Motivation:

This experiment proposes to measure near-threshold π^o photoproduction from hydrogen as a test of chiral dynamics. The experiment would use a new laser backscattering facility to produce linearly polarized photons.

Measurement, Feasibility and Issues:

This measurement requires the development of a new Compton backscattering device to be placed upstream of the CLAS detector in Hall B. In addition a special π^o spectrometer would have to be added either before or after the CLAS. The physics presented in this proposal is clearly important, and is being addressed presently at several lower energy electron facilities. Before final approval of this proposal, it would be necessary to present a detailed comparison of the possible results from CEBF and those of the other facilities. While the physics proposed here is both interesting and topical, it alone would not constitute a sufficient case for developing a laser backscattering facility at CEBAF. However, the PAC considers such a facility with photons in the 1 GeV range coupled with the CLAS detector to have high physics potential. Thus this proposal is deferred until presentation of a larger physics program at higher energy is made and the technical feasibility is studied by a separate technical advisory panel.

Manpower:

Adequate

Recommendation:

Defer

Appendix E

Proposal: PR-94-002, Hall B
Spokespersons: P.-Y. Bertin, M. Kossov, B.M. Preedom
Title: Photoproduction of Vector Mesons Off Nuclei

Motivation:
The proposed experiment seeks to measure a reduction in the vector meson mass in the nuclear medium.

Measurement, Feasibility, and Issues:
PAC likes the motivation for this measurement and believes that an unambiguous demonstration of a reduction in the vector meson mass would be an important result. However, the proposed experiment is not convincing and the projected sensitivity marginal. PAC was not convinced that the detector acceptance, the background and the effect of multiple targets on the background were optimal for the proposed measurement. PAC urges the proposers to work on developing an experiment which can provide a significantly increased sensitivity to a vector mass reduction. This sensitivity should be quantified in terms of the uncertainty in the appropriate experimental observables.

Manpower:
Adequate

Recommendation:
Defer

Appendix E

Proposal: PR-94-003, Hall B

Spokespersons: V. Burkert, R. Minehart, P. Stoler

Title: Study of the Δ(1232) Using Double Polarization Asymmetries

Motivation:

The proposed measurements would use the CLAS to study the double polarization asymmetry in $\vec{p}\,(\vec{e}, e'p)\,\pi^{o}$ and $\vec{p}\,(\vec{e}, e'n)\,\pi^{+}$ in the Delta region, obtaining a 4π angular distribution at values of Q^2 between 0.5 and 4 (GeV/c)^2 in order to determine the E_{1+}/M_{1+} ratio and its Q^2 variation.

Measurement, Feasibility and Issues:

The experiment would use a polarized electron beam and a polarized NH_3 target with detection of the final state electron and one of the hadrons by CLAS. The PAC believes that this physics is interesting and important. However, measurement of asymmetries at the level of precision needed in order to be sensitive to plausible values of E_{1+}/M_{1+} requires detailed understanding both of the spectrometer and of the systematic errors associated with this measurement. Particular attention should be given to extraction of asymmetries with a polarized target in a large magnetic field and to other contributing partial waves. Before approving this experiment, PAC requests a detailed study to address these critical issues.

Manpower:

Adequate

Recommendation:

Conditional approval is recommended. However, a decision on the additional 12 days of beam being requested is deferred until such time as results from the initial run become available.

Appendix E

Proposal: PR-94-004, Hall A
Spokesperson: P. Ulmer
Title: In-Plane Separation and High Momentum Structure in $d(e,e'p)$
Scientific Rating: B

Motivation:

The proposed experiment has three goals:

- Q^2 dependence of the separation of R_L and R_T for the $d(e,e'p)$ response in the range 0.2 -3.4 $(\mathrm{GeV}/c)^2$ for $p_r = 0$.
- Separation of R_L R_{TT}, R_T and R_{LT} for a range of p_r up to 0.5 GeV/c for quasielastic electron kinematics at $|\vec{q}| = 1\mathrm{GeV}/c$
- Determination of R_L at $|\vec{q}| = 1.9\mathrm{GeV}/c$ for p_r up to 0.3 GeV/c.

Measurement, Feasibility and Issues:

This experiment has been previously deferred on two previous occasions based on technical grounds. The PAC accepts the collaboration's assessments of the impacts of target density and luminosity uncertainties. The PAC encourages continued work on the measurement of the beam energy.

To the extent possible the collaboration should choose the kinematics to complement those of E-89-028.

Manpower:

Adequate

Recommendation:

Approve for 29 days.

Proposal: PR-94-005, Hall B

Spokespersons: L. Elouadrhiri, D. Heddle, R. Hicks and Zh. Li

Title: Determination of the $N\Delta$ Axial Vector Transitions Form Factor $G_A^{N\Delta}$ from the $ep \rightarrow e'\Delta^{++}\pi^-$ Reaction

Motivation:

This is a proposal to extract the axial-vector $N\Delta$ transition form factor from a measurement of the $ep \rightarrow e'\Delta^{++}\pi^-$ reaction. The form factor is extracted from the *s*-wave amplitude near the $\Delta^{++}\pi^-$ threshold using the low energy theorem.

Measurement, Feasibility and Issues:

The PAC finds the physics interesting and the cross section measurements with the CLAS to be feasible. The PAC, however, stresses that a careful theoretical analysis will be required to extract information about the Q^2 dependence of the transition form factor and ultimately of the helicity amplitudes.

Manpower:

Adequate

Recommendation:

Approve for running for 50 days concurrently with the N^* experiments. An extra three days are recommended for target empty measurements.

Appendix E

Proposal: PR-94-006, Hall A

Spokesperson: F. W. Hersman

Title: High Q^2 Measurement of the ratio of the electric and magnetic form factors of the neutron with polarized ^{3}He using the HRS spectrometers

Motivation:

This experiment aims at determining the electric form factor of the neutron, G_E^n, by measuring the asymmetry in the reaction $^3\vec{\mathrm{He}}(\vec{e}, e'n)pp$ in Hall A. The electron would be detected in one of the magnetic spectrometers and the neutron would be detected by an array of neutron counters provided by the collaboration.

The experiment would make measurements at an angle of the target polarization for which the measured asymmetry nearly vanishes. This method is expected to provide a determination of the ratio G_E^n/G_M^n with smaller systematical uncertainties than other methods. The use of a polarized ^{3}He target is expected to reduce significantly the contribution of the proton to the measured asymmetry.

Measurement, Feasibility and Issues:

The Committee is concerned with the following technical issues:

- The geometry of the neutron counter is not optimized.
- The shielding of the neutron counter has not been studied in sufficient detail to demonstrate that the background (in a high luminosity environment) can be understood.
- The "zero method" would be more appropriate to a large acceptance detector.
- Absence of any information on the neutron energy.
- The effects of averaging the asymmetry over a large range of values of the initial momentum of the target neutron is a major concern.

In summary, the PAC is not convinced that this experiment is feasible as proposed.

Manpower:

Adequate

Recommendation:

Reject

Proposal: PR-94-007, Hall C

Spokespersons: B. D. Anderson, R. Madey, W. Zhang

Title: Measurement of Transverse Polarization Observables in the $d(\vec{e}, e'\vec{n})p$ Reaction

Motivation:

This proposal is to measure several polarization response functions for the deuteron using polarization transfer to the neutron. These measurements are seen to be complementary to similar measurements using the proton polarimeter to be carried out in Hall A. Possible interesting effects would be due to final state interactions, meson exchange current, isobar configurations and relativistic corrections, but there was not a clear picture of what important additional information would be obtained from measurements of the neutron polarization as compared to the more easily measured proton polarization.

Measurement and Feasibility:

Measurements of four spin transfer coefficients would be made at one value of momentum transfer at symmetric points relative to the virtual photon momentum direction. These symmetric kinematics would be used to extract the polarization observables $A^t_{\pm}$ and structure functions $R^t_{LT'}$ and $R^t_{TT'}$.

Issues:

The measurement would require accurate and reproducible determination of all quantities which define the kinematics (beam energy, angles of electron and neutron and momentum determination). Insufficient detail was presented on how these can be constrained. As the cross section is dropping rapidly, one may also be very sensitive to finite geometry effects.

Manpower:

Adequate.

Recommendation:

Reject

Proposal: PR-94-008, Hall B

Spokesperson: B. G. Ritchie

Title: Photoproduction of η and η' Mesons from Deuterium

Motivation

The proposed experiment is aimed at providing a reliable data set for η and η' photoproduction from deuterium. Currently data are either non-existent (η') or sparse with low statistics and limited to energies near threshold (η). Both the coherent channel involving detection of the recoil deuteron and the break-up channel involving detection of one of the nucleons are proposed in order to complement the CEBAF electroproduction measurements under consideration by the *N** collaboration. It is also aimed at providing a foundation for subsequent studies of the photoproduction of these mesons by heavier targets and with polarized photons and/or polarized targets.

Measurement, Feasibility and Issues:

Using an incident beam of 1.6 GeV electrons, a tagged photon flux of 10^7 photons/sec in the energy range from 0.6 to 1.52 GeV will be used. The running conditions are compatible with the previously approved experiments (E-89-045 and E-93-017) so that no additional beam or set-up time is required. The PAC recommends that emphasis be given to the analysis of break-up measurements with optimal kinematics to reduce rescattering corrections so that elementary amplitudes (such as $\gamma+n \rightarrow \eta+n$) might be extracted. The case presented for the physics content of coherent production was not adequately focused or compelling.

Manpower:

Adequate

Recommendation:

Approve to run for 23 days simultaneously with previously approved CLAS experiments E-89-045 and E-93-017.

Proposal: PR-94-009, Hall C

Spokespersons: S.Y. Beedoe, P. Markowitz

Title: Longitudinal and Transverse Cross Sections in the $d(e,e'K^+)YN$ Reactions at $Q^2 = 0.5$ to 2 (GeV/c)^2

Motivation:

The purpose of the proposal is to make an *L/T* separation in the $d(e,e'K^+)$ reaction. Although the proponents did not present a clearly focused physics motivation for the experiment, the PAC believes that $(e,e'K^+)$ studies will be an important part of the CEBAF program.

Measurement, Feasibility and Issues:

The collaboration should present assessment of the impact of the proposed measurements on 1) the extraction of the Kaon form factor, 2) the determination of the neutron cross section and 3) the extraction of the ΛN interactions. Charge exchange reactions in the final state must be taken into account to extract quantitative information from the data. Finally, a full simulation of the experiment should be performed in order to fully assess the systematic errors. The collaboration should explore the possibility of performing this experiment in conjunction with E-93-018 in order to minimize the systematic errors and beam time.

Manpower:

Adequate

Recommendation:

Defer

Proposal: PR-94-010, Hall A
Spokesperson: G. Cates, Z.-E. Meziani
Title: Measurement of the Neutron (^{3}He) Spin Structure Function at Low Q^2; a Connection between the Bjorken and Drell-Hearn-Gerasimov Sum Rules
Scientific Rating: A–

Motivation:

The goal of the proposal is the study of the Q^2 evolution of the extended DHG sum rule for the neutron by inclusive scattering of polarized electrons on a polarized ^{3}He target. The longitudinal and transverse spin structure functions are determined, across the resonance and deep inelastic region, from the measured asymmetries with target and beam spins parallel and perpendicular. Data in the momentum transfer range between 0.14 (GeV/c)^2 and 3 (GeV/c)^2 provide an interesting connection between the deep inelastic and the low momentum transfer regions.

Measurement, Feasibility and Issues:

The PAC finds the physics of considerable interest and notes that a similar program has been endorsed by a previous PAC in the case of experiment E-93-004 using CLAS and a polarized ND_3 target. The PAC believes that these two experiments are complementary, and that the differences in experimental techniques and associated corrections together with the considerable interest on DHG sum rules in few body systems make this an interesting addition.

Manpower

The collaboration is adequate with extensive experience in polarization measurements.

Recommendation:

Approve for 31 days.

Proposal: PR-94-011, Hall A
Spokespersons: R. Ent, H. J. Bulten, J. van den Brand
Title: A Study of Off-Shell Effects in Electromagnetic Reactions

Motivation:

This experiment will provide cross section and polarization transfer coefficients for virtual Compton scattering off the proton in the four-momentum-transfer-range Q^2 = 0.28-1.0 (GeV/c)^2. The proposal emphasized the relevance of the experiment to models of off-shell couplings to the nucleon.

Measurement and Feasibility:

The measurements will be carried out using the Hall A spectrometers and focal-plane polarimeter. The scattered electron and proton are observed in coincidence. The incident beam energy will be in the range 2.5 - 4.0 GeV.

Issues:

The PAC feels that the emphasis on the off-shell behavior of the electromagnetic vertex, rather than on observables, is misplaced. We would like to see a discussion that places these measurements in the context of the low-energy expansion, and the higher Q^2 measurements planned at CEBAF. The PAC also recommends that high quality unpolarized cross sections should be the first priority, with polarization measurements following later.

Manpower:

Adequate

Recommendation:

Conditional approval

Appendix E

Proposal: PR-94-012, Hall A
Spokesperson: R. Gilman, R. J. Holt
Title: Measurement of Photoproton Polarization in the $H(\gamma, \vec{p})\pi^{o}$ Reaction
Scientific Rating: B–

Motivation:

The experimenters propose measuring cross section and polarization in the reaction $H(\gamma, \vec{p})\pi^{o}$ for photon energies from 0.8 to 4.0 GeV and center-of-mass angles between 45° and 90°. It is argued that these measurements could test whether asymptotic scaling sets in at about 2 GeV, as one interpretation of data for $H(\gamma, \pi^{+})n$ suggests. The experiment will yield new data on a fundamental photopion reaction that is presently poorly constrained.

Measurement, Feasibility and Issues:

The experiments will use the focal plane polarimeter in the Hall A HRS hadron spectrometer to perform the measurement. The bremsstrahlung photon beam will be produced from a copper radiator.

The PAC has technical concern about backgrounds generated from scattering off the aluminum endcap of the target and, particularly, about the calibration requirements for the polarimeter. The experimental goal of < 2.5% false asymmetry will be difficult to achieve.

The structure apparent in the existing $H(\gamma, \vec{p})\pi^{o}$ data at 90° makes it very unlikely that these measurements will reveal asymptotic scaling.

Manpower:

Adequate

Recommendation:

Approve for 3 days.

Appendix E

Proposal: PR-94-013, Hall C
Spokesperson: J. H. Mitchell
Title: A Measurement of t_{11} in Elastic e - D Scattering

Motivation:

A precise measurement of the charge form factor of the deuteron at relatively high momentum transfer continues to be of great interest. This proposal is aimed at extracting the charge form factor of the deuteron from a measurement of t_{11} at momentum transfers of 3.2 and 3.8 fm^{-1}.

Measurement, Feasibility and Issues:

The PAC believes this measurement to be worthwhile but was concerned that the analysis of systematic errors was incomplete. The collaboration should give a detailed account of the systematic errors in the proposed method.

Manpower:

Adequate

Recommendation:

Conditional approval

Proposal: PR-94-014, Hall C
Spokespersons: J. Napolitano, P. Stoler
Title: The Δ(1232) Form Factor at High Momentum Transfer
Scientific Rating: B

Motivation:

The goal of this proposal is to extract the E_{1+}/M_{1+} ratio for the Δ resonance at a single momentum transfer of 4 $(\mathrm{GeV}/c)^2$. This ratio is potentially sensitive to the role of perturbative QCD in moderate momentum transfer processes, as it is equal to 1 in the limit of perturbative QCD and small in the quark models.

Measurement, Feasibility and Issues:

This measurement can provide some early, useful information of high statistical precision on the structure of the Δ, that may help guide the more extensive polarization programs in both Hall A and B. The measurement is fairly straightforward, as it uses the SOS and HMS spectrometers operating in a standard configuration. However, the PAC has reservations that unambiguous information on the E_{1+}/M_{1+} ratio could be extracted from this measurement.

Manpower:

Adequate

Recommendation:

Approve for 10 days.

Appendix E

Proposal: PR-94-015, Hall B

Spokespersons: R. A. Miskimen

Title: Study of the Axial Anomaly using the $\gamma\pi^+ \rightarrow \pi^+\pi^o$ Reaction Near Threshold

Motivation:

It is proposed to measure the $\gamma\pi^+ \rightarrow \pi^+\pi^o$ reaction near threshold using tagged photons in the CLAS detector. The $\gamma \rightarrow 3\pi$ structure function $F^{3\pi}$ would be extracted and compared to the prediction of the anomaly.

Measurement, Feasibility and Issues:

The PAC finds the possibility of extracting new information on the axial anomaly to be of considerable interest. This anomaly is fundamental and is important in other processes. π^+ and π^o particles will be detected as a function of s, t and angle and an extrapolation to the pole performed. However, the proposed measurements may suffer from the presence of background processes which will make the extraction of the desired information difficult. The interpretation of the results should be aided by calculations presently underway.

Manpower:

Adequate

Recommendation:

Approve for 58 days of CLAS operation, concurrent with experiments E-89-004, E89-024, E-91-008 and E-93-033.

Proposal: PR-94-016, Hall B

Spokespersons: A. R. Dzierba, J. Napolitano

Title: Measurement of Rare Radiative Decays of the ϕ Meson

Motivation:

The goal of this experiment is to measure rare (B.R. $\leq 10^{-4}$) radiative decays of the $\phi(1020)$ in order to study the structure of daughter states as well as to probe possible symmetry violations. Sensitivity to branching ratios at this level would permit significantly improved charge conjugation tests for modes such as $\phi \rightarrow \omega\gamma$ as well as provide important information about the structure of the heretofore poorly understood scalar states a_o and f_o.

Measurement, Feasibility and Issues:

The measurement would be carried out using a lead glass array and the Hall B tagged photon beam. The use of a 1 inch thick Be target together with a downstream charged particle veto should allow B.R. ~ 10^{-5} sensitivity to the neutral radiative modes in a month of running time. While enthusiastic about the physics goals, the PAC was concerned that the possible backgrounds associated with this measurement had not been adequately examined by the proposers. The PAC recommends that final approval be contingent upon presentation of a convincing Monte Carlo simulation showing that electromagnetic and hadronic backgrounds associated with Hall B operation are not a problem.

Manpower:

The manpower is considered to be adequate.

Recommendation:

Conditional approval

Proposal: PR-94-017, Hall B

Spokesperson: W. Brooks, M. F. Vineyard

Title: The Neutron Magnetic Form Factor from Precision Measurements of the Ratio of Quasielastic Electron-Neutron to Electron-Proton Scattering in Deuterium

Motivation:

This proposal is to use CLAS in Hall B to make precise measurements of the ratio of quasielastic electron-neutron to electron-proton scattering in deuterium over a Q^2 range from 0.3 to 5.1 $(\mathrm{GeV}/c)^2$. The neutron magnetic form factor would then be extracted from the ratio using the existing knowledge of the proton form factor. The high precision data expected for G_M^n would add to the data set of both the neutron form factors from CEBAF which will provide tests of our understanding of nucleon structure.

Measurement:

The experiment would use a dual target system in CLAS. This would allow the needed neutron detection efficiency of the CLAS electromagnetic calorimeters to be determined simultaneously with the quasielastic scattering. The proton and neutron solid angles would be measured using different methods. It is expected that the neutron angle error would be the limiting factor in the uncertainty.

Feasibility and Issues:

The dual target proposed together with the ability to do accurate ray tracing in CLAS would seem to provide many advantages for the experiment. The “on-line” calibration of the neutron efficiency to the stated accuracy of better than 1% is a critical component. While PAC is generally impressed by the novel features in the proposal, there remain concerns that several of the goals may not be as easily obtained as expected. The PAC concerns include:

- The exact knowledge of neutron and proton solid angles will be governed by very different quantities in the analysis. In particular, effects of the magnetic field in correlating proton angle and momentum cuts are not present for the neutron. For the latter, momentum selection is given only by time-of-flight. How are the momentum cuts matched?
- There will be background due to the delta which has to be separated.
- How large an effect does one expect due to proton charge-exchange or rescattering in the final state. Given the importance of this effect it would be essential to have more than one theoretical estimate.

Manpower:

Adequate

Recommendation:

Approve for 15 days.

Proposal: PR-94-018, Hall C

Spokespersons: E. J. Beise, S. Kox

Title: Measurement of the Deuteron Tensor Polarization at Large Momentum Transfers in D $(e, e'\vec{d})$ Scattering

Scientific Rating: A–

Motivation:

The primary goal of the proposed experiment is to separate the charge and quadrupole form factors of the deuteron in the momentum transfer range of 4.0 to 6.8 fm^{-1}. In this range of momentum transfer the charge form factor has a node whose precise position is sensitive to the deuteron wave function, isoscalar meson exchange currents and relativistic effects. Six points are proposed to be measured.

Measurement and Feasibility:

This proposal is an upgrade of proposal PR-93-004 and makes use of electron scattering from a high-power liquid deuterium target The PAC6 report called for the optimization of the deuteron channel and full simulation of background rates. This committee finds that the present proposal has responded to both concerns in a convincing manner. In particular, the highest energy proposed now is 4 GeV resulting in an improved figure of merit. Background rejection in the polarimeter now appears to be adequate.

Issues:

There remains a strong physics interest in the proposed measurements. The committee suggests that a measurement at a lower momentum transfer of about 3.5 fm^{-1} be included as a means of calibrating the data set.

Manpower:

Adequate

Recommendation:

Approve for 47 days.

Proposal: PR-94-019, Hall B
Spokesperson: K. Sh. Euiyan, Yu. G. Sharabian, M. Strikman
Title: Measuring Nuclear Transparency in Double Rescattering Processes

Motivation:

The proposal aims to observe color transparency effects in ^{3}He and ^{4}He at intermediate momentum transfer $Q^2 \leq 4$ (GeV/c)^2. The approach is the direct measurement of quasielastic $(e,e'p)$ scattering leading to final states with a high momentum proton in the q direction and a low momentum proton in rescattering kinematics. The interaction probability, measured as the ratio of $(e,e'pp)$ to $(e,e'p)$ cross sections is argued to be sensitive to color transparency effects. Data at $Q^2 = 1$ (GeV/c)^2 could provide a benchmark of conventional models and of competing effects.

Measurement, Feasibility and Issues:

PAC believes that the observation of color transparency in this momentum transfer range would be a result of great interest, once an unambiguous identification procedure for the effect is established. The proposed technique could be a signature of these phenomena but the complexity of two nucleon reaction channels, requires much more extensive calculations. Evaluation of competing MEC and correlation effects as well as analysis of sensitivity to the model parameters, two body potentials, relativistic effects and related approximations should be presented. It is important to test the sensitivity to two-body correlations resulting from realistic potentials such as those from Bonn and Paris.

Manpower:

Adequate

Recommendation:

Defer

Appendix E

Proposal: PR-94-020, Hall A

Spokespersons: W. Korsch, R. McKeown, Z.-E. Meziani

Title: Investigation of the ^{3}He Wave Function using the $^3\vec{\mathrm{He}}\,(\vec{e}, e'p)\,d$ and the $^3\vec{\mathrm{He}}\,(\vec{e}, e'p)\,pn$ Reactions

(Note: The discussions and recommendations for PR-94-020 and PR-94-023 are identical.)

Motivation:

These two proposals aim at determining the small components (*D* and *S′*) of the ^{3}He wave function, by means of the $^3\vec{\mathrm{He}}\,(\vec{e}, e'p)\,d$ and $^3\vec{\mathrm{He}}\,(\vec{e}, e'p)\,pn$ reactions, in a kinematic range where the contribution of FSI and MEC are relatively small.

The Committee emphasizes that such a study should be one of the important experiments to be performed at CEBAF. It takes full advantage of the polarized beam and of the large momentum transfer achievable. The Committee recognizes also that the Hall A spectrometers are well suited to such an experiment, in which the deuteron and the *pn* continuum must be disentangled.

Measurement, Feasibility and Issues:

To extract the *S′*- and *D*-state components in the wave function of ^{3}He requires an optimal choice of kinematics. The highest value of Q^2 compatible with a reasonable counting rate and minimal statistical errors should be chosen to minimize the corrections to quasifree scattering. Neither of the two present proposals, PR-94-020 and PR-94-023, satisfy this requirement. In PR-94-020 the choice of kinematics is closer, but the error in the asymmetry at P_m = 270 MeV/*c* is too large to allow a meaningful determination of the *D/S* and *S′*/S ratios. On the other hand, the kinematics chosen by PR-94-023 lead to small errors at P_m =400 MeV/*c*, but the low value $\vec{k} = 600\,\mathrm{MeV}/c$ of the momentum transfer will likely give rise to sizable FSI + MEC contributions. PAC recommends that in order to optimize the use of resources a single, more optimal proposal be submitted.

Recommendation:

Defer

Appendix E

Proposal: PR94-021, Hall A

Spokesperson: W. Korsch, R. McKeown

Title: The Electric Form Factor of the Neutron Extracted from the $^3\vec{He}$ $(\vec{e}, e'n)\,pp$ Reaction

Motivation:

The goal of this experiment is to determine in the range of Q^2 = (1-2) $(\mathrm{GeV}/c)^2$ the ratio of electric to magnetic form factors of a neutron bound in ^{3}He. If the wave function of ^{3}He and reaction mechanism processes are sufficiently well understood, then the result will be an accurate determination of the ratio of electric to magnetic form factor of the neutron, quantities of fundamental interest. The proposed experiment would extend the database of G_E^n obtained with different techniques (and systematic errors) on the deuteron.

Measurement, Feasibility and Issues:

The PAC recognizes the interest of an independent determination of the neutron form factor with a polarized ^{3}He target. However, the following issues should be clarified.

i) The segmentation and the timing resolution of the neutron detector should be optimized and the effect of charge exchange reactions occurring in the shielding of the detector on detector performance evaluated.

ii) Are the proposed luminosities realistic given the total rates in the neutron counters from the beam interacting with the cell walls and the helium?

iii) A detailed assessment of uncertainties due to the range of initial momentum accepted.

Manpower:

Adequate

Recommendation:

Conditional approval

Proposal: PR-94-023, Hall A

Spokespersons: F. W. Hersman

Title: Measurement of small components of the ^{3}He wave function using $^3\vec{\mathrm{He}}(\vec{e}, e'p)$ in Hall A

(Note: The discussions and recommendations for PR-94-020 and PR-94-023 are identical.)

Motivation:

These two proposals aim at determining the small components (D and S') of the ^{3}He wave function, by means of the $^3\vec{\mathrm{He}}(\vec{e}, e'p)\,d$ and $^3\vec{\mathrm{He}}(\vec{e}, e'p)\,pn$ reactions, in a kinematic range where the contribution of FSI and MEC are relatively small.

The Committee emphasizes that such a study should be one of the important experiments to be performed at CEBAF. It takes full advantage of the polarized beam and of the large momentum transfer achievable. The Committee recognizes also that the Hall A spectrometers are well suited to such an experiment, in which the deuteron and the *pn* continuum must be disentangled.

Measurement, Feasibility and Issues:

To extract the S'- and D-state components in the wave function of ^{3}He requires an optimal choice of kinematics. The highest value of Q^2 compatible with a reasonable counting rate and minimal statistical errors should be chosen to minimize the corrections to quasifree scattering. Neither of the two present proposals, PR-94-020 and PR-94-023, satisfy this requirement. In PR-94-020 the choice of kinematics is closer, but the error in the asymmetry at $P_m = 270$ MeV/c is too large to allow a meaningful determination of the D/S and S'/S ratios. On the other hand, the kinematics chosen by PR-94-023 lead to small errors at P_m =400 MeV/c, but the low value $\vec{k} = 600\,\mathrm{MeV}/c$ of the momentum transfer will likely give rise to sizable FSI + MEC contributions. PAC recommends that in order to optimize the use of resources a single, more optimal proposal be submitted.

Recommendation:

Defer

Appendix F: Hall A Scientific Rating Reports

Experiment: E-89-003, Hall A
Spokesperson: W. Bertozzi, R. Lourie, A. Saha, L. Weinstein
Title: Study of the Quasielastic $(e,e'p)$ Reaction in ^{16}O at High Recoil Momenta
Scientific Rating: B–
Days of Beam: 20

The study of $^{16}\mathrm{O}(e,e'p)$ is an important example of the investigation of the short range structure of the nuclear many-body system. The proposed experiments involving separation of longitudinal, transverse and interference structure functions will be important provided sufficient accuracy can be achieved at high missing momenta. To date this has not been done. Measurement of the recoil proton polarization is useful to help understand the reaction mechanism in this process. Therefore the kinematics should be jointly optimized with E-89-033. Continued progress in the development of nuclear many-body theories would enhance the physics which could be extracted from these measurements.

Experiment: E-89-019, Hall A
Spokespersons: R. Gilman, R. Holt and Z.-E. Meziani
Title: Measurement of Proton Polarization in the $d(\gamma,p)n$ Reaction
Scientific Rating: B
Days of Beam: 19

See PAC7 report for comments.

Experiment: E-89-021, Hall A
Spokesperson: G. G. Petratos
Title: Elastic Electron ^{3}He - ^{4}He Scattering at Large Momentum Transfers
Scientific Rating: B
Days of Beam: 30

Precision measurements of charge and magnetic form factors of few-body nuclei should be a part of the CEBAF program. These form factors provide tests of few-body wave function, exchange current corrections, and relativistic effects. We concur with the early PAC approval of this proposal and the allocation of 30 days of beam. We regard the proposed ^{3}He magnetic form factor measurement as the more important physics, and recommend that priority be given to them.

Experiment: E-89-028, Hall A

Spokespersons: J. M. Finn, P. E. Ulmer

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

Scientific Rating: B–

Days of Beam: 8

The polarized electron beam and focal plane polarimeter make it possible to measure the polarization transfer coefficients as well as the induced transverse polarization for the D $(\vec{e}, e'p)\,\vec{n}$ reaction. These quantities are sensitive to meson exchange currents, isobar currents, final state interactions, and relativistic effects, but this sensitivity depends on the specific kinematics. To the extent possible the collaboration should choose the kinematics to complement that of proposal PR-94-004.

Experiment: E-89-033, Hall A

Spokesperson: C. Chang, C. Glashausser, S. Nanda, W. Van Orden

Title: Measurement of Recoil Polarization in the ^{16}O $(\vec{e}, e'\vec{p})$ Reaction with 4 GeV Electrons

Scientific Rating: B–

Days of Beam: 20

The study of ^{16}O$(e,e'p)$ is an important example of the investigation of the short range structure of the nuclear many-body system. The proposed experiments involving separation of longitudinal, transverse and interference structure functions will be important provided sufficient accuracy can be achieved at high missing momenta. To date this has not been done. Measurement of the recoil proton polarization is useful to help understand the reaction mechanism in this process. Therefore the kinematics should be jointly optimized with E89-003. Continued progress in the development of nuclear many-body theories would enhance the physics which could be extracted from these measurements.

Experiment: E-89-044, Hall A

Spokesperson: M. Epstein, R. Lourie, J. Mougey, A. Saha

Title: Selected Studies of the ^{3}He and ^{4}He Nuclei Through Electrodisintegration at High Momentum Transfer

Scientific Rating: B+

Days of Beam: 30

This experiment aims at determining the cross section of the ^{3}He$(e,e'p)$ and ^{4}He$(e,e'p)$ reactions at high missing momentum (up to $P_m = 680$ MeV/c) and large momentum transfer ($Q^2 = 4$(GeV/$c)^2$). It is perfectly suited to the Hall A capability, and will be a benchmark experiment in the field.

The Committee reaffirms its previous recommendation that priority be given to measurements on ^{3}He.

Appendix F: Hall A Scientific Rating Reports

Experiment: E-91-004, Hall A
Spokesperson: E. Beise
Title: Measurement of Strange Quark Effects Using Parity-Violating Elastic Scattering from ^{4}He at Q^2=0.6 (GeV)^2
Scientific Rating: A
Days of Beam: 85

See PAC7 report for comments.

Experiment: E-91-006, Hall A
Spokesperson: A. Saha
Title: Study of Nuclear Medium Effects by Recoil Polarization up to High Momentum Transfers
Scientific Rating: C
Days of Beam: 8

The proposed measurements of the recoil polarization in quasifree A $(e, e'\vec{p})$ reactions may provide new information relevant to the reaction mechanism at momentum transfers up to 4 (GeV/c)^2. The PAC believes it is necessary to develop conventional models which could be used to understand data taken at values of $Q^2 \leq 4$ (GeV/c)^2.

Experiment: E-91-010, Hall A
Spokespersons: M. Finn and P. Souder
Title: Parity Violation in Elastic Scattering from the Proton: Plans for the First Run
Scientific Rating: A
Days of Beam: 42

See PAC7 report for comments.

Experiment: E-91-011, Hall A
Spokespersons: R. Lourie
Title: High-Precision Separation of Polarized Structure Functions in Electroproduction of the Δ and Roper Resonances
Scientific Rating: A–
Days of Beam: 45

See PAC7 report for comments.

Appendix F: Hall A Scientific Rating Reports

Experiment: E-91-026, Hall A
Spokespersons: G. G. Petratos
Title: Measurement of the Electric and Magnetic Structure Functions of the Deuteron at Large Momentum Transfers
Scientific Rating: B+
Days of Beam: 24

This experiment will measure the deuteron electric form factor $A(Q^2)$ up to $Q^2 = 6$ (GeV/c)^2. In addition the experiment will improve the information on the magnetic form factor $B(Q^2)$ up to $Q^2 = 1.4$ (GeV/c)^2. The PAC believes these are important data for understanding the structure of the deuteron, and that the measurement is certainly feasible with the initial complement of equipment in Hall A.

Experiment: E-93-024, Hall A
Spokespersons: J. Gomez, G. G. Petratos
Title: Measurement of the Magnetic Form Factor of the Neutron at Large Momentum Transfers
Scientific Rating: B+
Days of Beam: 10

This experiment will provide a measure of the neutron magnetic form factor up to $Q^2 = 6.5$ (GeV/c)^2 by inclusive quasielastic electron deuteron scattering. It will complement other determinations of this quantity and should contribute to a precise knowledge of the structure of the nucleon.

Experiment: E-93-027, Hall A
Spokespersons: C. F. Perdrisat, V. Punjabi
Title: The Electric Form Factor of the Proton by Recoil Polarization
Scientific Rating: B+
Days of Beam: 16

The determination of the ratio of the electric to magnetic form factors of the proton in the momentum transfer range between 0.5 (GeV/c)^2 and 3.5 (GeV/c)^2 with few percent accuracy is of substantial scientific interest. The recoil polarization is sensitive to the interference term between the magnetic and electric form factors and provides a measurement of G_E^p rather independent from absolute beam polarization and polarimeter analyzing power. A simultaneous calibration of the polarimeter with uncertainty in the 1-2% range is also a result of interest.

Experiment: E-93-049, Hall A

Spokespersons: R. Ent, P. E. Ulmer, J. F. J. van den Brand

Title: Polarization Transfer in the Reaction $^4\mathrm{He}\,(\vec{e}, e'\vec{p})\,^3\mathrm{H}$ in the Quasi-elastic Scattering Region

Scientific Rating: B+

Days of Beam: 12

This experiment will study possible modification of the nucleon within the nuclear medium by measurement of the *LL* and *LT* polarization transfer coefficients in the reaction $^4\mathrm{He}\,(\vec{e}, e'\vec{p})\,^3\mathrm{H}$. Theoretical calculations indicate that in the kinematic range explored in this measurement, $0 < Q^2 < 4$ $(\mathrm{GeV}/c)^2$ and missing momentum less than 250 MeV/*c,* the ratio of D_{LL} and D_{LT} could well be insensitive to FSI and MEC effects, allowing extraction of G_M/G_E in the nuclear medium. These results should be helpful in understanding $(e,e'p)$ data from light and medium nuclei.

Experiment: E-93-050, Hall A

Spokespersons: P. Bertin

Title: Nucleon Structure Study by Virtual Compton Scattering

Scientific Rating: A–

Days of Beam: 10

See PAC7 report for comments.

Appendix G: Hall C Scientific Rating Reports

Experiment: E-89-008, Hall C

Spokespersons: D. Day and B. Filippone

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

Scientific Rating: B

Days of Beam: 8

The transition from *y*-scaling to *x*-scaling as well as the problem of high momentum components of the nuclear wave function are of fundamental interest. The proposed experiment addresses this issue by measuring inclusive cross sections in complex nuclei at high x and high Q^2. The PAC recognizes the feasibility of the experiment and that the proposed measurements with the 4 GeV energy beam substantially extend the range of existing data. While the measurements will be at higher Q^2 than previous data, a clear understanding of the physics may still require an accurate evaluation of final state interactions.

Experiment: E-89-009, Hall C

Spokespersons: R. Chrien, E. Hungerford and L. G. Tang

Title: Investigation of the Spin Dependence of the ΛN Effective Interaction in the *P* Shell

Scientific Rating: B+

Days of Beam: 25

CEBAF offers the potential for high resolution hypernuclear physics. For example, electroproduction studied with very high resolution (0.1 MeV) would allow the observation of the spin orbit splitting of hypernuclear states. PAC7 concurs with the high priority given by previous PACs to the development of such a program. However, there are technical questions concerning the feasibility of making such measurements at very low momentum transfer which should be addressed before construction of a high resolution spectrometer can begin. While this experiment by itself is unlikely to provide much new insight into hypernuclear states because of the low resolution of the spectrometers, it will provide answers to the technical questions and should be given high priority for this reason.

Experiment: E-89-012, Hall C

Spokesperson: R. J. Holt

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

Scientific Rating: A–

Days of Beam: 10

The aim of this experiment is to study the two-body photodisintegration of the deuteron to test for the onset of power-law scaling. It offers the opportunity to extend previous measurements of this group at SLAC to higher energies and larger transverse momenta. The analysis of scaling as a function of both kinematical variables has the potential to test perturbative QCD. The experiment uses photons near the bremsstrahlung end point. As a single arm experiment, it makes only modest demands on the performance of the beam and spectrometer. It can be run as soon as the beam, target and the HMS spectrometer are available in Hall C.

Appendix G: Hall C Scientific Rating Reports

Experiment: E-91-003, Hall C

Spokesperson: H. E. Jackson

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

Scientific Rating: B+

Days of Beam: 21

The proposed experiment will measure the longitudinal cross section of charged pion electroproduction in parallel kinematics. Model calculations predict that the longitudinal response in a nucleus will be suppressed at virtual pion momenta below $k = 1$ fm^{-1} and enhanced for larger k. A first experiment of this type has been performed by members of this group at Saclay. It showed a quenching of the cross section of about 20% for small k in the deuteron. Since such effects are easily masked by correlations and final state interaction, a systematic investigation over a larger kinematical range in energy and momentum transfer will be necessary. In particular, it is crucial for this experiment to separate the longitudinal and transverse cross sections and to choose kinematical situations close to the pion pole. In order to identify multi-nucleon processes driven by the delta isobar, the measurements are proposed at W = 1.16 GeV and 1.33 GeV. The planned experiment using the SOS and HMS spectrometers in Hall C should not pose major difficulties. Depending on the results of this first measurement, the interpretation of the data may eventually require a more general study.

Experiment: E-91-007, Hall C

Spokesperson: R. G. Milner

Title: Measurement of the Nuclear Dependence and Momentum Transfer Dependence of Quasi-elastic $(e,e'p)$ Scattering at Large Momentum Transfer

Scientific Rating: B–

Days of Beam: 5

The physics motivation for the proposed measurements is color transparency, the possibility that a highly localized color singlet state (i.e., the high momentum configurations) will experience diminished final state interactions. The proposal requests time in Hall C for measurements with the HMS as the proton arm and the SOS as the electron arm. A range of targets and Q^2 (1 to 6.2 (GeV/c)^2) is proposed. The concerns expressed previously by the PAC, that SLAC NE-18 diminishes the urgency and impact of the experiment, remain. NE-18 provided data up to proton momenta of 4.5 GeV/c and revealed no anomalous behavior.

Appendix G: Hall C Scientific Rating Reports

Experiment: E-91-013, Hall C
Spokesperson: D. Geesaman
Title: The Energy Dependence of Nucleon Propagation in Nuclei as Measured in the $(e,e'p)$ Reaction
Scientific Rating: B–
Days of Beam: 24

This experiment studies the propagation of protons in nuclear matter at energies from T_p = 400-2000 MeV, a region over which the nucleon-nucleon T-matrix for elastic scattering, T_{NN}, varies by more than a factor of two and strong final state interactions are expected for the proton. The experiment builds on an existing Bates measurement for T_p = 180 MeV and will perform the first *L-T* separation for T_p = 400 MeV and 1000 MeV.
The experiment requires modest spectrometer resolution and particle ID performance and uses targets of C, Si, Ni, Pb, making it well suited for early running as experience with Hall C spectrometers is being acquired. The utility of the results concerning FSI for the broader CEBAF program was recognized.

Experiment: E-91-016, Hall C
Spokesperson: B. Zeidman
Title: Electroproduction of Kaons and Light Hypernuclei
Scientific Rating: A–
Days of Beam: 21

This experiment takes advantage of the unique capability of CEBAF to study electroproduction of kaons from light nuclei. The study of electroproduction on few body systems is a step towards a more extensive program aimed at studying hypernuclei.
These experiments on light nuclei will give new information on the ΛN and ΣN interaction.

Experiment: E-91-017, Hall C
Spokespersons: D. Beck
Title: "G^0": Measurement of the Flavor Singlet Form Factors of the Proton
Scientific Rating: A
Days of Beam: 46

See PAC7 report for comments.

Experiment: E-93-018, Hall C

Spokesperson: O. K. Baker

Title: Longitudinal/Transverse Cross Section Separation in $p(e,e'K^+)\Lambda$ (Σ) for $0.5 \leq Q^2 \leq 2.0$ (GeV/c)^2, $W \geq 1.7$ GeV, and $t_{\min} \geq 0.1$ (GeV/c)^2

Scientific Rating: B+

Days of Beam: 15

The group proposes to study kaon electroproduction in the momentum transfer range $0.5 \leq Q^2 \leq 2.0$ (GeV/c)^2. The four structure functions will be separated and, if the kaon pole is shown to dominate the longitudinal term, it may be possible to extract the kaon electromagnetic form factor. In any case, final state Λ, Σ^o hyperons will be identified and the associated structure functions will be studied over a wide range of Q^2. This type of information will be important to future CEBAF plans involving strangeness production.

Experiment: E-93-021, Hall C

Spokesperson: D. J. Mack

Title: The Charged Pion Form Factor

Scientific Rating: B+

Days of Beam: 9

This proposal is to perform a *L/T* separation using pion electroproduction from the proton to extract the pion electromagnetic form factor. Approval has been given for the first phase of this experiment (9 days) to measure the form factor for momentum transfer < 1.6 (GeV/c)^2. This measurement will demonstrate the capability of Hall C to perform such separations and provide form factor information at a level competitive with previous data. The PAC views the second phase measurements, which will provide the first precision form factor information at high Q^2, (1.5 - 5 (GeV/c)^2), as having high priority. These measurements will require a 6 GeV beam.

Experiment: E-93-026, Hall C

Spokesperson: D. Day

Title: The Charge Form Factor of the Neutron

Scientific Rating: A

Days of Beam: 60

Measurement of the neutron electric form factor to a precision of order 0.01 in the momentum transfer range 0.2 - 3 (GeV/c)^2 is a high priority for nuclear physics. It is a fundamental quantity needed for the understanding of both nucleon and nuclear structure. PAC7 notes the successful utilization of the target technology at SLAC. It also recognizes that other facilities may produce data comparable to that of the proposed experiment in the lower momentum transfer range on a similar time scale.

Experiment: E- 93-028, Hall C

Spokesperson: J. Jourdan

Title: Deformation of the Nucleon

Scientific Rating: B

Days of Beam: 15

The quadrupole strength in the N-Δ transition is a fundamental quantity for the understanding of the structure of the nucleon and delta wave function. The proposal is to measure the asymmetry in the inclusive scattering of polarized electrons on polarized protons.
The PAC recognizes the feasibility of the experiment and the importance of the physics. However, the interpretation of the data will require an accurate evaluation of the non-resonant background, which relies on model calculations.

Experiment: E- 93-038, Hall C

Spokesperson: R. Madey

Title: The Electric and Magnetic Form Factors of the Neutron from the $d\,(\vec{e}, e'\vec{n})\,p$ Reaction

Scientific Rating: A

Days of Beam: 60

Measurement of the neutron electric form factor to a precision of order 0.01 in the momentum transfer range 0.2 - 3 (GeV/c)^2 is a high priority for nuclear physics. It is a fundamental quantity needed for the understanding of both nucleon and nuclear structure. This experiment was judged to be technically feasible based on a measurement carried out by this collaboration at Bates. PAC7 notes the work done on increasing the figure of merit of the experiment but is not convinced that the optimization is complete. We note that other facilities may produce data comparable to that of the proposed experiment at a lower momentum transfer range on a similar time scale.

Appendix H: Individual Reports for PAC8 Letters-of-Intent

Letter-of-Intent: LOI-94-001, Hall B

Spokespersons: M. Ripani, M Taiuti

Title: Baryon Resonances Investigation by Two-Pion Electroproduction with a Polarized Electron Beam

The proposed experiment would search for baryon resonances at ~ 2 GeV that have been predicted by the quark model but are as yet unseen. The hope is that polarization asymmetries will prove particularly sensitive to certain resonance states, thereby allowing them to be picked out of a complicated background.

The proposers calculated the decay asymmetry A_d, obtained from the two electron beam helicities $\grave{e}$ and $\acute{e}$, for $\Delta\pi$ production. A_d was defined for a fixed direction $(\Theta_\Delta,\phi_\Delta)$ of the Δ in the hadronic center-of-mass system and evaluated as a function of the angle of the emitted pion in the subsequent $\Delta \rightarrow N\pi$ decay. This asymmetry was markedly changed with the introduction of a P_{11} resonance with a postulated mass of 2 GeV and couplings equal to that of the Roper $P_{11}(1440)$.

The experimenters are encouraged to do more realistic modeling of the $\Delta\pi$ production and to complete the ρ study now in progress. This could provide motivation for a future program with CLAS. If the results continue to be interesting, the PAC would like to see an experimental proposal.

Letter-of-Intent: LOI-94-002, Hall B

Spokespersons: G.P. Gilfoyle, L. Dennis

Title: Electroproduction of the $f_0(975)$ Scalar Meson

It is proposed to use CLAS in order to examine electroproduction of the $f_0(975)$from various nuclear targets through study of its $\pi^+ \pi^-$ decay channel. In particular, it is suggested that the A–dependence of the cross section may serve as a means of distinguishing between a relatively compact $q\bar{q}$ state and the much larger $k\bar{k}$ molecule picture of f_0 structure. While this geometrical approach appears in principle plausible, a much more convincing case concerning extraction of the structure information needs to be developed before this LOI is submitted as a proposal.

Letter-of-Intent: LOI-94-003, Hall B

Spokespersons: H. Funsten, P. Rubin, E. S. Smith

Title: Production of Vector Mesons by Longitudinal Photons

The letter aims to measure the ratio between the longitudinal and transverse cross sections in the electroproduction of vector mesons from the proton. Vector mesons would be detected in CLAS by their decay products, performing L/T separation by the usual Rosenbluth procedure. The Q dependence of the L/T ratio is shown to be sensitive to the mechanism of vector meson production. In contrast the existing data are not yet sufficiently accurate to afford a systematic analysis. The PAC recognizes the interest of the physics program, but is concerned with the degree of reliability and precision obtainable in a L/T separation measurement with CLAS. The PAC believes that future work should be focused on accurate simulations to achieve a realistic evaluation of systematic and statistical errors.

Letter-of-Intent: LOI-94-004, Hall B

Spokespersons: B. Wojtsekhowski, D. Crabb

Title: Monopole Deuteron Form Factor at 0.5 - 1 (GeV/c)^2

The purpose of the experiment is to extract the monopole form factor of the deuteron from a measurement of t_{11} for the momentum transfer region of 0.5 to 1.0 (GeV/c)^2. The monopole form factor in this momentum transfer region is interesting as a test of recent models of the deuteron and the isoscalar meson exchange current.

The CLAS detector would be used to detect scattered electrons and recoil deuterons from a polarized ND_3 target. This measurement is similar, in principle, to PR-94-013 proposed for Hall C. While the solid angle for CLAS is much larger than the Hall C spectrometer, the luminosity is limited in CLAS to 1×10^{34}. The figure of merit per Q^2 bin is similar to that of PR-94-013. In addition, the figure of merit of PR-94-018 greatly exceeds the method discussed here. Thus, it is not clear that this experiment will add much useful information when it is likely to be performed.

Letter-of-Intent: LOI-94-005, Hall A

Spokespersons: A. Afanasev, J. Gomez, S. Nanda

Title: Form Factors of the Transitions $\gamma\pi^o \rightarrow \gamma$ and $\gamma^*\eta \rightarrow \gamma$

It is proposed to study the $\gamma\pi^o \rightarrow \gamma$ and $\gamma^*\eta \rightarrow \gamma$ transition form factors by measurement of virtual Compton scattering on the proton and nuclear targets. Determination of these quantities would constrain our understanding of mesons.

The proposed experiment would measure the t dependence of the cross section to distinguish π^o and η processes and extrapolate to low t. The PAC finds the proposed experiment interesting but several details remains to be addressed in any future proposal. At low t diffractive process may be significant and it is unclear how this may affect the ability to extract the transition form factors. In addition, it would be instructive to see a realistic simulation of the proposed measurement where the extrapolation to the meson pole can be studied.

Appendix I: Guidance to PAC8 on Polarized Beams

NOTE TO PROGRAM ADVISORY COMMITTEE 8 ON POLARIZED BEAMS

CEBAF polarized beam capabilities will increase with time as the technologies advance and the injector system is enhanced to include components such as mode locked lasers and concurrent operation of multiple injectors. What follows is what the combined Accelerator and Physics Divisions believe they will be able to provide during the **initial** years of operation.

- Only **one injector** will be in operation at a time.
- **Only one experimental hall** will receive longitudinally polarized beam at a time. If multiple beam operation is involved, the other halls will receive non-longitudinally polarized beams.
- With multiple beam operation from a single injector, the **range of currents** available at any one time is limited. The lowest current being delivered to any one hall can be at most a factor of 100 below the maximum current being delivered to any other hall.
- **Currents ≤ 36 μA** will be available with polarizations up to **~80%** starting late summer 1995.
  - ∗ If this 36 μA goes to more than one hall, the maximum current available to any one hall is 12 μA.
- **Currents ≤ 200 μA** will be available with polarizations up to **~45%** starting late summer 1995.
  - ∗ Initially the maximum current going to any one hall is 100 μA. If the 200 μA available at the injector goes to more than one hall, the maximum current available to any one hall is 67 μA.
- **Currents in the 10 ➔ 100 nanoA** range at **~80%** polarization will only be available to a single hall at a time. The earliest they will be available is the Spring of 1996.
  - ∗ Note, the beam current and position monitors and methods of Accelerator operations for beam currents in the tens of nano-amp range are yet to be worked out.

Given time, these restrictions will be removed. For example, the mode locked laser will facilitate a very low current tens of nano-amp beam running to one hall while high current beams run to the other halls. There is a mode locked laser development project which will hopefully produce the desired laser on the time scale of a year or two. Coupling the laser to an injector will also take some time. Similarly, there is a year or two of development work required to be able to run two injectors simultaneously. Most of this development work will not begin until after the Accelerator commissioning activities are complete.