Report of the February 3–4, 1997 Meeting of the Jefferson Lab Program Advisory Committee

– PAC11 –

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March 31, 1997

Dear Members of the Jefferson Lab User Group,

Over a year of running has been completed in Hall C providing the data for five experiments. Halls A and B are both in their commissioning phases and plan to begin physics running this Spring and Summer respectively. This progress represents a significant accomplishment on the part of the User Community, staff and supporting agencies.

The Jefferson Lab Program Advisory Committee (PAC11) met February 3–4, 1997 to hear details on the progress of the Accelerator and all three Halls, the run plans for all three Halls, and new and updated proposals and letters-of-intent. Attached is the *Report of the February 3–4, 1997 Meeting of the Jefferson Lab Program Advisory Committee*. I want to thank Brad Filippone and the members of the PAC for their efforts on behalf of Jefferson Lab and its User Community, and for the PAC's thoughtful deliberations on the physics program.

As construction and commissioning of the experimental equipment is nearly complete and the physics program will shortly be in full operation, we are planning to have two PAC meetings per year. The next PAC meeting (PAC12) will be early August 1997. The call for proposals will be announced in April 1997.

I wish to thank you, the Users, for your efforts on the proposals, updates and letters-of-intent, and for your hard work in getting the experimental programs underway. The flow of science from Jefferson Lab has now begun in ernest and we can look forward to many exciting new results for nuclear physics.

Sincerely,

Hermann Grunder
Director

Report of the February 3-4, 1997 Meeting of the
Jefferson Lab Program Advisory Committee

INTRODUCTION

The Jefferson Lab Program Advisory Committee held its 11th meeting on Feb. 3–4, 1997, in CEBAF Center. The PAC11 membership is provided in Appendix A. In response to the charge (See Appendix B.) from the Director, Dr. Hermann Grunder, the committee reviewed and made recommendations on three new proposals, two proposals that previously had been conditionally approved, and one extension of a previously approved experiment. The PAC also heard an update on a previously approved experiment and provided comments on four letters-of-intent.

The PAC also discussed the scientific merit and priority of the G_E^n program of experiments, the treatment of experiments in "jeopardy," and the treatment of rejected proposals. A clarification of the possible recommendations of the PAC regarding proposals was discussed and is presented below. Lastly, an update of the three experimental Halls was provided and a report on the status of polarized beam was presented.

SPECIFIC CHARGES

The PAC was requested to comment on three specific areas in the charge. These areas are addressed below:

1. G_E^n Program

The PAC confirmed the importance for Jefferson Lab of providing the best possible data on G_E^n in the intermediate Q^2 range. This includes running multiple experiments with different techniques in order to reduce possible systematic uncertainties. The scheduling of the different experiments should be driven by the need to produce a result with minimum uncertainty in a timely fashion consistent with other high priority experiments in the laboratory.

2. Jeopardy Category

The present policy for experiments that are not run within three years after approval (or within three years after commissioning of the Hall if they were approved before Hall operations began) is that an update must be presented to the PAC in order to remain on the list of approved experiments. PAC11 discussed the possibility of reducing this time period in order to limit a possible significant backlog of "unscheduled" experiments. It was decided that the present three year period should be maintained until sufficient operational experience is obtained for all three experimental Halls.

3. Rejected Proposals

The PAC was asked to help clarify what criteria must be met in order for a previously rejected proposal to be resubmitted to the PAC. The essential criteria is that the re-submittal must address the comments and concerns of the original PAC in a substantive way as determined by laboratory management.

CLARIFICATION OF PAC RECOMMENDATIONS

The laboratory management presented to the PAC revised wording for the recommendations that can be made for new proposals. These modifications were discussed by the PAC and, with some minor changes, approved. The revised recommendations are:

APPROVAL: the proposal is recommended for approval for a recommended number of days of beam-time, provided specific milestones are met.

CONDITIONAL APPROVAL: the recommendation of full approval is contingent on addressing issues raised by the PAC. Two categories of Conditional Approval are possible:

1. The proposal will have to be updated to address the issues raised and the updated proposal will be reviewed by the PAC at a future meeting before being given a scientific rating and a recommendation for beam-time.

2. The PAC has provided a scientific rating and a recommended beam-time, with resolution of the issues raised left for review by Laboratory management. (This category will generally be used only when the issues raised are technical in nature.)

DEFERRAL: while a strong case to perform the experiment may exist, serious concerns or issues raised by the PAC will have to be addressed in a new proposal at a future PAC meeting.

REJECTION: the PAC concludes that a compelling case has not been made for performing the experiment as proposed.

GENERAL COMMENTS AND RECOMMENDATIONS

The PAC is pleased to see the enormous progress made since PAC10. Hall C has begun its physics program with five experiments completed and the first large scale experiment (t_{20}) being installed. Halls A and B have both received first beam and appear ready to begin full commissioning.

Progress on the polarized source and injector has been steady, with first polarized beam having been delivered to Hall C and its polarization measured with a Møller polarimeter. Some concern was expressed that the progress towards high polarization and high current was not as obvious. The PAC re-emphasized the importance of achieving both very soon since much of the Lab's high-priority physics program relies on high polarization/high current.

The reports and PAC recommendations for proposals and letters-of-intent reviewed are given in Appendices D and E. The following tables summarize results from PACs 4-11.

________________________________ Date:________________

Brad Filippone
Chair, Jefferson Lab Program Advisory Committee

Totals for PACs 4-11

	Experiments Recommended for Approval	Additional Experiments Recommended for Conditional Approval	Total
Experiments	86	13	99
Authors	629	34	663
Institutions	120	4	124
Countries	20		20

Totals of Approved Experiments by Physics Topic for PACs 4-11

Topic	Number	Hall A	Hall B	Hall C
Nucleon and Meson Form Factors and Sum Rules	11	4	3	4
Few Body Nuclear Properties	18	9	5	4
Properties of Nuclei	14	3	8	3
*N** and Meson Properties	28	4	20	4
Strange Quarks	15	3	8	4
Total	86	23	44	19

As of PAC 11, five experiments in Hall C have completed taking data, see Appendix F.

Approved Days and Conditional Approved Experiments by Hall

Hall	Approved Experiments			Conditionally Approved Experiments
	# of Expts	Days to be Run	Days Run	
A	23	538		6
B	44	447		5
C	19	370	74	2
Total	86	1,355	74	13

Appendix A
PAC11 Membership

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Appendix B

Charge to PAC11 from Jefferson Lab Director, Hermann Grunder

Jefferson Lab requests that PAC11:

1) Review proposals, extensions and updates and provide advice on their scientific merit, technical feasibility and resource requirements.
2) Recommend one of four actions on each proposal, extension or update:
   - Approval,
   - Conditional approval status pending clarification of special issues,
   - Deferral, or
   - Rejection.
3) Provide a scientific rating and recommended beam-time allocation for all proposals recommended for beam-time.
4) Provide comments on letters-of-intent.
5) Comment on:
   - The scientific merit and beam-time priority for running all of the approved G_E^n experiments as proposed;
   - The treatment of experiments that have not received beam-time within three years ("jeopardy"); and
   - Minimum requirements for resubmission of previously rejected proposals.

Appendix C
PAC11 Recommendations

Class† -Days	Experiment	Rating	Title
A–13	E-93-021	B+	Extension to E-93-021: The Charged Pion Form Factor
A–60‡	E-93-038	A	The Electric Form Factor of the Neutron from the $d(\vec{e}, e'\vec{n})p$ Reaction and The Magnetic Form Factor of the Neutron from the $d(\vec{e}, e'\vec{n})p$ Reaction
A–14	E-94-021	B+	The Electric Form Factor of the Neutron Extracted from the $^3\vec{\mathrm{He}}(\vec{e}, e'n)pp$ Reaction
A–9	E-94-110	B+	Measurement of $R = \sigma_L/\sigma_T$ in the Nucleon Resonance Region
A–26	PR-96-001	B+	Recoil Polarization in η Electroproduction
A–21	PR-96-002	B	Precision Measurement of the Nucleon Spin Structure Functions in the Region of the Nucleon Resonances
A–18	PR-96-003	A–	Two-Body Photodisintegration of the Deuteron at High Energy

† **A = Approve, C = Conditionally Approve, D = Defer, R = Reject**
‡ See discussion.

Appendix D

Proposal: E-93-021, Hall C
Spokespersons: H. Blok, G. M. Huber, D. Mack
Title: Extension to E-93-021: The Charged Pion Form Factor
Scientific Rating: B+

Motivation:

Measurement of $F_\pi(Q^2)$ from $Q^2 = 0$ - 5 (GeV/c)^2 would provide one of the simplest challenging tests of QCD-based models of hadron structure. Pion electroproduction is a complex process but it is currently the best known physical process for providing information on $F_\pi(Q^2)$ for $Q^2 > 0.5$ (GeV/c)^2.

Measurements, Feasibility and Issues:

This experiment consists of measuring the differential cross-sections for $p(e,e'\pi^+)n$, $d(e,e'\pi^\pm)NN$, and $p(e,e'p)\pi^o$ at two values of Q^2 [2.4 and 3.2 (GeV/c)^2] and at two values of epsilon for each Q^2. Extraction of $F_\pi(Q^2)$ at each Q^2 is a model-dependent procedure. Comparison of π^o production with π^+ production tests the dominance of the pion pole term in the longitudinal cross section. Measurements with proton and deuteron targets provide a useful test of isospin dependence.

Care must be taken to isolate the longitudinal term from the other components of the cross section with attention to minimizing systematic errors. Presently only two values of virtual photon polarization are being used at each Q^2. It is suggested that an additional value of epsilon be considered at one of the lower Q^2 points to check for linearity of the cross section.

Recommendation:

Approval of extension for 13 days at 5 GeV.

Appendix D

Proposal: E-93-038, Hall C

Spokespersons: B. D. Anderson, D. Madey

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

Scientific Rating: A (No change from previous scientific rating, see PAC8 Report.)

Motivation:

The electric form factor of the neutron, G_E^n, is a key to an understanding of the structure of nuclei. The value of G_E^n can become comparable in magnitude to that of G_E^p at high Q^2, meaning that the present large uncertainty in the value of G_E^n carries over directly to our knowledge of the structure of nuclei at high Q^2. Knowledge of G_E^n is also needed for testing theories of nucleon structure and for extraction of strangeness form factors from parity violating (e,e') experiments.

Measurement, Feasibility and Issues:

This experiment will determine the electric form factor of the neutron, G_E^n, over a range of Q^2 from 0.5 to 1.7 $(\mathrm{GeV}/c)^2$ by measuring polarization transfer in disintegration of the deuteron by polarized electrons. A new neutron polarimeter will measure the up/down scattering asymmetry of the sideways polarization component of the final-state neutron. A dipole magnet will be used to precess the longitudinal component of the neutron polarization to the sideways direction to enable its measurement also. Using the same polarimeter for both measurements removes the uncertainty in the value of G_E^n due to the analyzing power of the polarimeter. Carrying out both measurements in quick succession also minimizes errors due to drifts of the beam polarization. Measurements with a neutron detector array will be made to determine G_M^n in the same kinematics. A similar polarimeter has been operated in an earlier experiment at Bates (E85-05). Measurements with an LH_2 target, with shadow shields, and with a dummy target are included for control of systematic errors.

The PAC notes its continuing interest in seeing this experiment carried out. The PAC agrees with the need to determine G_E^n with relative errors of 10% or less, both for the intrinsic interest of the measurement and to remove G_E^n as a significant source of errors for the parity-violating asymmetry program already approved. The PAC supports the collaboration's revised proposal to take data at three values of Q^2, noting the improvements made to the experimental method since the original proposal.

Recommendation:

Approval for 60 days. (No change from previous recommendation, see PAC6 Report.)

Appendix D

Proposal: E-94-021, Hall A

Spokespersons: W. Korsch, R. McKeown

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

Scientific Rating: B+

Motivation:

The goal of this experiment is the determination of the neutron electric form factor, G_E^n, at Q^2 of 1.0, 1.5 and 2.0 (GeV/c)^2 by scattering polarized electrons from polarized ^{3}He and detecting the coincident neutron.

Measurements, Feasibility and Issues:

This measurement would occur in Hall A using a polarized ^{3}He target already approved for use in other experiments. Previous PAC concerns regarding backgrounds from the lead wall, inelastic reactions and the target cell have been adequately addressed. The experiment appears feasible.

A precise determination of G_E^n is of high scientific interest. This experiment offers a complementary technique to the two approved experiments on the deuteron. However, interpretation may be problematic as the experiment would be conducted outside the kinematic regime where full Faddeev or other “exact” calculations are available. Establishing consistency between results obtained with deuterium and ^{3}He targets, given the lower Q^2 data now becoming available, argues for only a single Q^2 point at 1.0 (GeV/c)^2. Additional data may be motivated as a result of the 1.0 (GeV/c)^2 measurement.

Recommendation:

Approval for 14 days in Hall A.

Appendix D

Proposal: E-94-110, Hall C
Spokesperson: C. Keppel
Title: Measurement of $R = \sigma_L/\sigma_T$ in the Nucleon Resonance Region
Scientific Rating: B+

Motivation:

The proposed experiment aims to obtain a data set of improved accuracy on $R = \sigma_L/\sigma_T$ for inclusive scattering in the range of momentum transfer $0.75 < Q^2 < 4.9$ (GeV/c)^2 as a phase I measurement, with an extension to higher momentum transfer in phase II. The physics motivation is to test with better accuracy duality in the separated responses in the region of the nucleon resonances.

Measurements, Feasibility, and Issues:

This proposal was submitted to PAC9, where the physics was strongly endorsed. However, PAC9 raised several questions about the claimed accuracy, asked that a subset of the originally proposed measurements be selected to demonstrate the required accuracy, and suggested that data be included which would kinematically connect to the existing SLAC deep-inelastic measurements of $R(Q^2)$.

The PAC is convinced that each of these issues has been reasonably addressed. The experiment has been improved substantially by adding a third photon polarization to each Q^2 data set and by performing each photon polarization point with the same spectrometer. There is still some concern that the desired accuracy may not be achievable, but it is likely that this experiment will improve the existing data base significantly. Particular attention should be paid to the expected high pion rates, and to the determination of the beam energy. The PAC suggests that substantial progress be made toward achieving the desired 10^{-4} accuracy in beam energy determination before phase II is approved.

Recommendation:

Approval for phase I for 9 days at 5 GeV.

Conditional approval for phase II contingent on a review of phase I by the PAC.

Proposal: PR-96-001, Hall A
Spokespersons: W. Bertozzi, J. J. Kelley, A Sarty
Title: Recoil Polarization in η Electroproduction,
Scientific Rating: B+

Motivation:

Measurement of the R_L, R_T and R'^{S}_{TT} response functions, using spin observables, in the S_{11} resonance region.

Measurement, Feasibility and Issues:

The proposed measurements have two significant aspects: (i) to separate the transverse and longitudinal response functions using polarization observables and (ii) to measure the R'^{S}_{TT} response function and extract the $|E^{+}_{o}|$ amplitude for exciting the S_{11} resonance. Both measurements are important and the PAC recommends an award of the requested time. The main concern of the PAC is that the assumed beam parameters, 75 μA current with 75% polarization, may not be available in the near future, and suggests that if the experiment is carried out with lower beam current, the total beam time awarded remains at 26 days and the *L*/*T* separation requiring data at 0º and 180º be given preference.

Recommendation:

Approved for 26 days.

Appendix D

Proposal: PR-96-002, Hall C

Spokesperson: O. A. Rondon-Aramayo

Title: Precision Measurement of the Nucleon Spin Structure Functions in the Region of the Nucleon Resonances

Scientific Rating: B

Motivation:

This proposal seeks to measure the spin structure of the proton and deuteron in a region of moderate Q^2 and W that encompasses the nucleon resonances. The projected experimental precision substantially improves on existing data in that kinematic range and is somewhat better than the approved Hall B experiments. The precision measurements are useful for a test of local duality (Bloom-Gilman) for the spin structure functions, and will contribute in general to the body of data on the nucleon. The data also will be used to test the prediction that A_{TT} approaches -1 at high Q^2 for the $\Delta(1232)$.

Measurements, Feasibility and Issues:

The separation of the physics asymmetries A_1 and A_2 uses the traditional technique of measurement of asymmetries for parallel and perpendicular target spin orientation. This experimental technique has been successful in previous experiments, and the group is quite capable of repeating these results in the Hall C HMS. While there is significant overlap with two Hall B experiments, E-91-023 and E-93-009, this proposal provides more precise data on A_1 and A_2 at a single Q^2 using a somewhat complementary technique and observables.

Recommendation:

Approval for 21 days.

Proposal: PR-96-003, Hall C
Spokesperson: R. J. Holt
Title: Two-Body Photodisintegration of the Deuteron at High Energy
Scientific Rating: A–

Motivation:

The experiment proposes to extend the deuteron photodisintegration data to higher energies and test whether the cross section adheres to the quark counting rules or exhibits some new features at high energies.

Measurement, Feasibility and Issues:

The measurement represents the natural extension of the work begun at SLAC by the NE8 and NE17 experiments and continued at Jefferson Lab by the E-89-012 experiment. It uses virtual and real photons near the bremsstrahlung endpoint produced in a radiator just upstream of the deuteron target. To better discriminate between the simple quark counting rule and other theoretical models, the cross section will be measured for photon energies of 4.0, 4.4, and 5.0 GeV at center of mass angles of 37º, 53º, 70º and 90º and for a photon energy of 5.5 GeV at 37º and 53º. The PAC considers it very important to extend the measurement of the deuteron differential cross section to this unexplored region to better discriminate among different models.

Recommendation:

Approval for 18 days at 5.5 GeV.

Appendix E

Letter-of-Intent: LOI-96-001
Spokespersons: D. Jenkins
Title: Spin Observables in Pion Photoproduction

The $p\,(\gamma, \pi^{\pm})$, $p\,(\gamma, \pi^{\circ})$ reactions provide important information about the structure of the nucleon. In order to obtain a model-independent determination of the complex multipole amplitudes, differential cross section measurements as well as single and double polarization experiments have to be performed. This is a demanding task requiring substantial manpower and equipment.

The PAC encourages the collaboration to work out a strategy for the implementation of the different experiments. Future proposals should be part of this program.

Letter-of-Intent: LOI-96-002
Spokespersons: D. Dale, A. Gasparian
Title: Measurement of $F_{\gamma^{*}\gamma\pi^{\circ}}$ at Low Q^2 via the Virtual Primakoff Effect

The PAC finds this LOI to be of significant interest. The proposed measurements, if performed with high accuracy, would significantly improve the data on the slope of the form factor $F_{\gamma^{*}\gamma\pi^{\circ}}$ at low Q^2. We encourage the proposers to work with Jefferson Lab in exploring options other than the use of the Møller polarimeter for doing this experiment. Although we understand the group's arguments for exploiting the polarimeter, the emphasis should be on optimizing the equipment design for a significant measurement.

Appendix E

Letter-of-Intent: LOI-96-003
Spokespersons: J. R. Calarco
Title: A Study of a Possible 6-quark Dibaryon Structure Using the $ed \rightarrow pp\pi^-$ Reaction

The PAC does not feel that the existing data on pion double charge exchange and the $pp \rightarrow pp\pi^+\pi^-$ reaction convincingly establish the existence of a narrow state near 2060 MeV. Ongoing experiments at Uppsala, COSY, and MAMI all aim to confirm or refute its existence. At the present time, a proposal to map out the transition form factor for this state thus appears premature. If the ongoing experiments were to confirm the existence of such a state, then a proposal for a carefully designed experiment to study its structure at Jefferson Lab would be welcome.

Letter-of-Intent: LOI-96-004
Spokespersons: O. K. Baker
Title: Polarization Transfer in Kaon Electroproduction

This letter describes a proposed study of polarization transfer in hyperon electroproduction on the proton. The experiment would be performed in Hall C, and the kaon and lambda decay would be measured simultaneously in the short-orbit spectrometer, taking advantage of the self-analyzing properties of the hyperon decay to measure the Lambda polarization along the momentum transfer. The physics objective is a determination of the electric form factor, G_E^{Λ} , of the Lambda and the polarization transfer to the Lambda. Some inconsistencies in the treatment of the production cross sections in terms of spin dependent response functions should be resolved. Effects of finite acceptance and varying source position on the measurement of Lambda polarization should be addressed in a careful exposition of the planned measurement. Given the present status of our understanding of the *u*-channel amplitudes in hyperon production, it appears unlikely that information on G_E^{Λ} will be accessible. Nevertheless, the polarization transfer data will be of wide interest, and preparation of a complete proposal is strongly encouraged.