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For more information or copies of this report contact:
Thomas Jefferson National Accelerator Facility
User/International Liaison, MS 12B
12000 Jefferson Avenue
Newport News, VA 23606
Phone: (757) 269-6388 / Fax: (757) 269-7003
E-mail: users@JLab.org
WWW: http://www.JLab.org/exp_prog/PACpage/pac.html

Report of the
January 14-16, 2003
Meeting of the

Jefferson Lab
Program Advisory Committee

PAC 23

Letter from Director

February 11, 2003

Members of the Jefferson Lab User Group

The ongoing quality of the Jefferson Lab experimental program is of paramount concern as we move forward and realize the scientific potential of the unique tool that resides at Jefferson Lab. We are pleased and gratified that the quality of our scientific program has been recognized by the S&T Review Committee, the Institutional Management Panel and also the Science Policy Advisory Group, who feel that "we know no planned facility that could seriously challenge CEBAF's world-class status for at least a decade."

The work done by our Program Advisory Committee is key to putting the best science first. PAC 23 has again done an excellent job examining 12 proposals with 5 approved, 1 conditionally approved and 5 deferred.

In addition to their work in reviewing these proposed experiments, the PAC also had a special session to look ahead at the 12 GeV program. This was an intense and grueling experience as they examined both science and pCDR proposals for the four experimental halls. I want to thank the PAC Chair, Dr. Peter Barnes, and the PAC for their dedication to excellent science and a dynamic scientific program for the future. Through efforts like theirs, JLab will enjoy decades of leadership in our field.

Sincerely,

Christoph W. Leemann
Director

Letter from the PAC Chair

Introduction

The Jefferson Laboratory Program Advisory Committee held its 23rd meeting on January 14 - 16, 2003. The membership of the Committee is given in Appendix A. In response to the charge (Appendix B) from the JLab Director, Dr. Christoph Leemann, the Committee reviewed and made recommendations for twelve proposals and provided comments on four letters of intent.

General Overview

The PAC 23 meeting was especially productive in view of its broad scope and extended program. The agenda consisted of two distinct components. The first involved an evaluation of the twelve Proposals and four Letters of Intent submitted for possible inclusion in the JLab 6 GeV physics program. The following report addresses that part of the meeting. The second component involved an assessment by the extended PAC of the physics driving the proposed 12 GeV Upgrade of JLab. A separate PAC 23 report will address the physics impact of the 12 GeV Upgrade.

The overall JLab experimental program continues to show solid growth; it now consists of 133 approved experiments. To date, 90.9 experiments (equivalent) have been completed at JLab, up by 4 over the past six months. About 24 papers have been published or submitted to the Physical Review and Physical Review Letters over the past year, in addition to papers published elsewhere. A number of archival papers, dealing with the construction of the experimental facilities in the three halls, have also been submitted for publication. The number of Ph.D. projects completed to date is 130 (up by eleven in the past six months), with an additional 129 in progress. All of this is indicative of a very strong and healthy physics research program at JLab.

The accelerator performance during FY02 was equally impressive. There were 32.4 weeks (equivalent) of physics delivered, based on 25.6 weeks of accelerator operation with 73% beam availability. The three hall availabilities ranged from 78 to 93 %. The hall multiplicity in FY02 was 2.28.

At PAC 23, the new projects added to the JLab research program were very diverse in character. They included detailed nuclear physics issues, such as an attempt to measure the neutron distribution radius of ^{208}Pb through parity violating electron scattering. Several experiments addressed the structure of the nucleon, for example, by measuring the generalized Gerasimov-Drell-Hearn integral down to very low Q^2 where Chiral Perturbation Theory applies, measurement of single spin asymmetries on ^{3}He to obtain unmeasured partonic distribution functions including the first measurement of neutron transversity at JLab, and a test of the handbag mechanism in photon scattering by a proton. The structure of the free neutron extracted from nuclear scattering, is also addressed in a new technique requiring construction of a radial time projection chamber

capable of detecting low-momentum recoiling spectator protons in the backward hemisphere at CLAS. In an exploratory measurement, the sub-threshold photo-production of J/ψs on Be will be studied for the first time at JLab. The intent is to test models of charm production based on intrinsic charm, hidden color, quasi-free smearing, or gluon exchange mechanisms in the nuclear system. Several of these measurements, which require incident energies of 6 GeV, may be viewed as precursors of the future JLab program to be performed at 12 GeV.

Recommendations

The high demand for beam time at this meeting made the task of the PAC extremely difficult, as discussed below. Of the twelve proposals received, only six experiments were approved. Because of the high backlog in Hall A, the PAC found it necessary to defer several attractive physics proposals that might have been approved in more normal circumstances. The PAC approved three experiments in Hall A for a total of 61 days, two experiments in Hall B for 45 days, and one experiment in Hall C for 7 days. The ratings for these six proposals were one with A, two with A^-, and three B^+.

The laboratory guidelines provided for the approval of 60 days of beam time in Hall A, 45 days of beam time in Hall B, and 25 days of beam time in Hall C. These guidelines were established based on 30/45/25 days of new time to be made available in Halls A/B/C plus 100% / 100%/ 100% of the time recovered from approved experiments now required to return to the PAC due to the jeopardy process. The PAC is allowed to exceed the laboratory guidelines if it believes the physics has sufficiently high priority, that is at the level of an A^- rating or better, but the excess would then be deducted from the allocation of the next PAC meeting.

The jeopardy process continues to evolve at JLab. At this meeting 30 days of approved time were under jeopardy status, all of them in Hall A. The backlog in Hall A is now about 4.8 years, while the backlog in Hall B is 3.3 years and that of Hall C, 4.9 years.

The backlog in Hall A was a serious constraint on the PAC 23 proposal evaluation and recommendation process. Two proposals (P-03-005 and P-03-007) were judged worthy of approval by the PAC but were ultimately recommended for deferral. They could not be fit into the beam time allocation for Hall A. In addition two very similar proposals (P-03-006 and P-03-009) for Halls B and A, addressed measurements of the GDH integral at very low Q^2 and required rather low beam current. The PAC could not distinguish these two projects on intellectual grounds. Because of the program pressure for high current experiments in Hall A, it was decided to approve the Hall B proposal, P-03-006, since it was a better match to the low current operation and small backlog of Hall B. This proposed measurement of the generalized GDH integral, will extend the CLAS program of these measurements on the proton down to the Q^2 range of 0.01 to 0.5 $(GeV/c)^2$. This is vital for testing Chiral Perturbation Theory calculations; different approaches give very different predictions. This was the highest ranked proposal at PAC 23 and was given an over all rating of A.

The reports and PAC recommendations for the reviewed proposals and the response to the letters-of-intent are given in Appendices D and E. The tables on the following pages summarize the status of the JLab commitments from PAC 4-23.

The PAC is very appreciative of the efforts of the laboratory staff in support of the PAC meeting. The enthusiastic and thoughtful contributions of Clara Perdue and Shauna Cannella were especially effective in making the PAC process proceed at maximum efficiency.

Peter D. Barnes
Chairman, Jefferson Laboratory Program Advisory Committee

Tables

Totals for PAC 4-23

	Experiments Recommended for Approval	Experiments Recommended for Conditional Approval	Totals
Experiments	138	7	145
Authors	1028	70	1098
Institutions	182	3	185
Countries	30		30

Approved Experiments Totals by Physics Topics

Topic	**Number**	**Hall A**	**Hall B**	**Hall C**
Nucleon and Meson Form Factors & Sum Rules	22	8	4	10
Few Body Nuclear Properties	27	17	5	5
Properties of Nuclei	27	8	11	8
N* and Meson Properties	45	7	30	8
Strange Quarks	17	4	11	2
TOTAL	138	44	61	33

Approved Days and Conditionally Approved Experiments

Hall	**Approved Experiments**				Conditionally Approved Experiments
	# Expts Completed (full/partial)	Days Run	No. Exps in Queue	Days to be Run	
A	27 / 0	482.9	17	336	3
B	35 / 2×.76 14x.62 3x .4	394.4	15.2	253.44	2
C	17 / 1×.5 1x.33	411.6	14.67	279.9	2
Total	79 / ~12.23	1256.5	46.87	869.34	7

APPENDICES

A. PAC 23 Membership

B. Charge to PAC 23

C. PAC 23 Recommendations

D. PAC 23 Individual Proposal Reports

E. PAC 23 Letters-of-Intent

F. Approved Experiments, PACs 4-23, Grouped by Physics Category

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

Appendix A

PETER D. BARNES (Chair)
Los Alamos National Laboratory
MS H846 P-25: Subatomic Physics
Los Alamos, New Mexico 87545
Phone/Fax: (505) 667-2000/665-7920
pdbarnes@lanl.gov

NICOLA BIANCHI
INFN LNF
Via E. Fermi 40
00044-Frascati (Rome), Italy
Phone/Fax: 39-06-94032320/2559
nicola.bianchi@lnf.infn.it

PETER BOSTED
S.L.A.C. MS 44
2575 Sand Hill Road
Menlo Park, CA 94025
Phone: (650) 926-2319
bosted@slac.stanford.edu

ALEXANDER DONNACHIE
Theoretical Physics Group
Shuster Laboratory
University of Manchester
Oxford Road
Manchester, UK M13 9PL
Phone: 44-161-275-4190
sandy.donnachie@man.ac.uk

T. WILLIAM DONNELLY
Massachusetts Institute of Technology
Center for Theoretical Physics, 26-403
77 Massachusetts Ave.
Cambridge, MA 02139
Phone/Fax: (617) 253-4847/8674
donnelly@lns.mit.edu

MICHEL GARÇON
DAPNIA/SPhN, Bat. 703
CEA Saclay
91191 Gif-sur-Yvette, Cedex, France
Phone/Fax: 33-1-69-08-8623/7584
mgarcon@cea.fr

EDDY JANS
NIKHEF
P.O. Box 41882
1009 DB Amsterdam
The Netherlands
Phone/Fax: 31-20-5922085/5155
eddy@nikhef.nl

FRITZ KLEIN
Physikalisches Institut
Universitaet Bonn
Nussallee 12
53115 Bonn, Germany
Phone/Fax: 49-228-73-2341/3518
klein@physik.uni-bonn.de

PETER KROLL
Fachbereich Physik
Universitaet Wuppertal
Gaussstrasse 20
D-42097 Wuppertal, Germany
Phone/Fax: 49-202-439-2620/3860
kroll@physik.uni-uppertal.de

JEN-CHIEH PENG
401B Loomis, Dept. of Physics
University of Illinois at Urbana-Champaign
1110 W. Green St.
Urbana, Il 61801-3080
Phone/Fax: (217) 244-6039/333-1215
jcpeng@npl.uiuc.edu

ANDREW SANDORFI
Physics Dept.
LEGS Group
Brookhaven National Laboratory Bldg. 510A
Upton, NY 11973-5000
Phone/Fax: (631) 344-7951/2049
sandorfi@bnl.gov

PAUL STOLER (for ALAN NATHAN)
Rensselaer Polytechnic Institute
Dept. of Physics
Troy, NY 12181
Phone/Fax: (518) 276-8388/6680
stolep@rpi.edu

MAURO TAIUTI
Dipartimento di Fisica
Universita' di Genova
Via Dodecanneso, 33
l-16146 Genova, Italy
Phone/Fax: 39-010-353-6458
taiuti@genova.infn.it

Appendix B

Charge to PAC 23

Jefferson Lab requests that PAC 23:

1) Review both new proposals* and extensions† or updates‡ to previously approved proposals, and provide advice on their scientific merit, technical feasibility and resource requirements.
2) Recommend one of four actions on each proposal, extension or update:
   - Approve,
   - Conditionally approve, status pending clarification of special issues,
   - Defer, or
   - Reject.

   (There are two types of conditional approval: conditional pending PAC review of open scientific questions; and conditional pending Jefferson Lab management review of open technical issues. In the later case, the PAC should recommend a beam time allocation.)
3) Provide a scientific rating and recommended beam-time allocation for all proposals recommended for approval.
4) Provide comments on letters-of-intent.
5) Comment on the Hall running schedules.

* Previously approved proposals that have not, within 3 years of PAC approval, been scheduled to run to completion are returned to the PAC for a fresh scientific review. For the purposes of these reviews, the "jeopardy" experiments are to be treated consistently with new proposals.

† Extension proposals are treated as new proposals, and the merits and status of the original proposal are considered only to the extent that they may bear on the relevance and merit of the extension proposal.

‡ In reviewing an experiment update, the PAC will treat the original proposal and any request for changes taken together as a single new proposal and treat the combination in a manner analogous to a previously approved proposal undergoing a jeopardy review.

APPENDIX C

PAC 23 Recommendations

Class*/Grade/Days		
D	03 -001	A Search for Evidence of Soft-Hard Factorization in Charged Pion Electroproduction
D	03 -002	Spin Asymmetries on the Nucleon Experiment (SANE)
A/B+/7	03 -003	Polarization Transfer in Wide Angle Compton Scattering
A/B+/24	03 -004	Measurement of Single Target-Spin Asymmetry in Semi-Inclusive Pion Electroproduction on a Transversely Polarized ^{3}He Target
D	03 -005	Hard Photodisintegration of a Proton Pair
A/A/20	03 -006	The GDH Sum Rule with Nearly-Real Photons and the Proton g_1 Structure Function at Low Momentum Transfer
D	03 -007	Probing the Limits of the Standard Model of Nuclear Physics with the ^{4}He(e,e'p)^{3}H Reaction
A/B+/7	03 -008	Sub-threshold J/ψ Photoproduction
R	03 -009	Measurement of the Proton Gerasimov-Drell-Hearn Integral at Low Q^2
D	03 -010	Virtual Compton Scattering and the Generalized Polarizabilities of the Proton at Q^2 up to 4.0 $(GeV/c)^2$
C/A-/30	03 -011	Update of E-00-003: Neutron Skin of ^{208}Pb Through Parity Violating Electron Scattering
A/A-/25	03 -012	The Structure of the Free Neutron Via Spectator Tagging

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

Appendix D

Individual Proposal Report

Proposal: PR-03-001

Scientific Rating: N/A

Title: A Search for Evidence of Soft-Hard Factorization in Charged Pion Electroproduction

Spokespersons: D. Gaskell and D. Mack

Motivation: The primary goal of this proposal is to search for evidence of QCD factorization in exclusive charged pion production by longitudinal virtual photons. At sufficiently high Q^2 where QCD factorization is valid, two Generalized Parton Distribution functions (GPDs) can be studied in this process. To test the onset of factorization, this experiment proposes to determine the Q^2 dependence of the longitudinal cross sections over the range $3 < Q^2 < 4$ $(GeV/c)^2$. A secondary goal of the experiment is to determine L/T ratios for pion electroproduction off neutrons.

Measurement and Feasibility: This experiment proposes to measure $p(e, e'\pi^+)n$ and $d(e, e'\pi^-)$ at $Q^2 = 3.0, 3.5, 4.0$ $(GeV/c)^2$ with $x = 0.5$ and $-t = 0.38$ $(GeV/c)^2$ using the Hall C SOS and HMS spectrometers for electron and pion detection. An L-T separation will be performed for data taken at two values of ε at each Q^2. Similar measurements at lower values of Q^2 and $-t$ were carried out successfully in previous Hall C experiments. The proposed measurement is technically feasible.

Issues: The PAC recognizes the importance of the investigation of the feasibility of an active GPD program at JLab on hard exclusive meson production. An accurate L-T separation for charged pion electroproduction at the highest Q^2 and the appropriate range of $-t$ is clearly of interest. However, the PAC is not convinced that a meaningful test of factorization can be achieved as proposed. First, the limited Q^2 coverage ($3 < Q^2 < 4$ $(GeV/c)^2$) makes an accurate determination of the Q^2 dependence difficult, especially if the cross sections and L/T ratios turn out to be less favorable than predicted by the Regge model. Second, even if an accurate determination of the Q^2 dependence is obtained, it remains difficult to draw a meaningful conclusion concerning the onset of factorization. The physics motivation for this proposal could be considerably strengthened with GPD calculations for the longitudinal cross sections at the proposed kinematics, possibly including a quantitative discussion of next-to-leading order and/or higher twist corrections. Cross section estimates could be obtained from CLAS data already taken at 5.75 GeV incident energy.

Recommendation: Defer

Individual Proposal Report

Proposal: PR-03-002

Scientific Rating: N/A

Title: Spin Asymmetries on the Nucleon Experiment (SANE)

Spokespersons: G. Warren and O. Rondon

Motivation: The goal of this proposal is to provide a measurement of the inclusive spin asymmetries A_1^p and A_2^p in the high-x region where present DIS data suffer from large statistical uncertainties. At high x, the present data for A_1^p seem to exceed the SU(6) symmetry prediction but their convergence to the SU(6) broken symmetry limit and the pQCD expectation of unity at x=1 is still not completely established. Few measurements are available for A_2^p at high x.

Measurement and Feasibility: The experiment is proposed to run in Hall C with 4.8 and 6.0 GeV electron beams on an existing NH_3 polarized target. Contrary to the well-established technique of using magnetic spectrometers, a new total absorption electron telescope is proposed to detect the scattered electrons. This new BETA detector will require the construction of a gas Cherenkov counter, a Lucite Cerenkov counter, and the implementation of a Pb-glass calorimeter already planned for the G_E^p/G_M^p measurement. Installation times and technical support will be important. In comparison with the magnetic spectrometer technique, the expected energy, angular and vertex resolution will be worse. Since the magnetic field of the target will sweep off charged particles below 0.18 GeV/c, charged particles of higher momenta and all neutral particles will go through the detector. Therefore the background rate is expected to be high and its uncertainty may have a big impact on the projected systematic error. The latter is currently estimated to be not better than that for available DIS data and for the already collected CLAS data at 5.7 GeV. Therefore the large improvement of the statistical accuracy and the benefit of the possible separation of A_1 and A_2 asymmetries may be spoiled by the possible large uncertainty in the systematic error. When considering the measurement above the resonance region, the x-range will still be far from x=1 and the Q^2-range quite limited. Both of these limitations could be ameliorated by combining data above and within the resonance region. However this may raise additional issues with respect to the interpretation of the data.

Issues: Due to the novel technique proposed for the measurement, the PAC recommends that a better investigation of the systematic errors be performed and a more convincing comparison made with the accuracy of the data available at CLAS. The measurement of the inclusive asymmetry, A_2, and the consequent determination of g_2 may also deserve more consideration as a major aspect of the proposal. In addition the PAC suggests that the Collaboration explores measurements where the utilization of BETA is critical, beyond the present capability of CLAS.

Recommendation: Defer

Individual Proposal Report

Proposal: PR-03-003

Scientific Rating: B+

Title: Polarization Transfer in Wide Angle Compton Scattering

Spokespersons: B. Wojtsekhowski and A. M. Nathan

Motivation: The handbag mechanism where the photons interact with a single quark, and the leading-twist mechanism, which involves three active quarks, provide drastically different predictions for the polarization transfer parameters. The experiment will attempt to clarify which, if either of the two mechanisms, is the dominant one for the given kinematical situation. Provided the experimental results support the handbag mechanism, an extraction of the Compton form factors may be attempted.

Measurement and Feasibility: The experiment utilizes an untagged bremsstrahlung beam and the Hall A target. The scattered photon and the recoil proton are detected and the polarization of the latter is measured. The recent E99-114 measurement demonstrated the feasibility of this experiment.

Issues: At a beam energy of 3.2 GeV, target mass corrections are probably large and may lead to uncertainties in the form factors. The PAC 23 concludes that a measurement at a scattering angle of 160 degrees is not compelling. It is doubtful that the two dynamical mechanisms mentioned in the motivation are applicable and thus a separate measurement configuration is not justified.

Recommendation: Approve for 7 days in Hall A

Individual Proposal Report

Proposal: PR-03-004

Scientific Rating: B+

Title: Measurement of Single Target-Spin Asymmetry in Semi-Inclusive Pion Electroproduction on a Transversely Polarized ^{3}He Target

Spokespersons: X. Jiang, J. P. Chen, and J-C. Peng

Motivation: Measurements of Single Spin Asymmetries (SSA) have been shown to be a powerful tool, with the potential to access new and unmeasured partonic distribution functions, including transversity. The first promising results are becoming available. A worldwide program is currently running or planned, using proton and deuteron targets, several probes, and various choices of kinematics. This proposal aims to perform the first measurement of SSA using electrons on a neutron target, the latter provided by polarized ^{3}He.

Measurement and Feasibility: It is proposed to measure the azimuthal distribution of π^- in the reaction ^{3}He(e, e′π^-)X with a polarized helium target in Hall A. A 6 GeV beam will be used together with the BigBite spectrometer to detect electrons and an HRS spectrometer to detect the pions close to the virtual photon direction. The Hall A polarized helium target, which has already been successfully used in other experiments, will be modified to allow complete freedom in choosing the polarization direction and to permit frequent flipping of the spin. The measurement appears to be feasible, if the effects that acceptance cuts have on the extracted pion distributions are kept under control. The overall systematic uncertainty of the planned measurement may be larger than projected, but still would be less than the statistical uncertainties and therefore would be acceptable for a first measurement.

Issues: Since factorization may be questionable at 6 GeV, the interpretation of the measured asymmetry in terms of the convolution of distribution and fragmentation functions may be problematical. To improve the likelihood of a successful simplified analysis, the PAC recommends that the measurement be undertaken at larger values of z, namely $z \cong 0.5$ and 0.6, instead of the proposed values of $z \cong 0.4$ and 0.5. It is also noted that additional contributions can enter into the asymmetry. They may come from interferences between transverse and longitudinal projection of the current matrix elements in the reaction. While these are usually assumed to be negligible when compared with the purely transverse response, at the lowest values of Q^2 proposed, they may play some role. The analysis should be done in a way that allows for the different azimuthal angle dependences these contributions imply.

Recommendation: Approve for 24 days in Hall A

Individual Proposal Report

Proposal: PR-03-005

Scientific Rating: N/A

Title: Hard Photodisintegration of a Proton Pair

Spokespersons: R. Gilman and E. Piasetzky

Motivation: It is proposed to measure in Hall A the high energy photodisintegration of ^{3}He into pp-pairs emitted back-to-back, with the neutron left as a spectator. In particular, it is proposed to measure the energy dependence of the cross section between 2.4 and 5.0 GeV. At 3.2 GeV the angular distribution around 90^o would be mapped out. While several data sets exist on np-emission from the deuteron, which suggest an s^{-11} scaling at 90^o, the proposed data would be the first for pp. They would allow one to study the reaction dynamics and to investigate the validity of the impulse approximation. In the approximation that the photodisintegration amplitude factorizes, it can be related to the NN scattering amplitude. Then, the data could be compared with measurements on high energy pp-scattering in which a significant oscillation around scaling behavior was observed at BNL, pointing to interference effects between long and short range phenomena.

Measurement and Feasibility: To obtain sufficient luminosity, a beam of untagged bremsstrahlung photons would be directed at a ^{3}He cryogenic gas target. Near 90^o the outgoing protons would be detected in coincidence by two magnetic spectrometers set at the kinematical endpoint of the bremsstrahlung spectrum. The estimated counting rates fall strongly with the photon energy, towards 10^{-4} per second for the highest photon energy of 5 GeV. The required background suppression in this configuration is based on existing experience and appears feasible. The experiment requires no new equipment or development time, and could run at almost any time the cryo-target is installed in Hall A.

Issues: The PAC concludes that in view of the existing data for the np (deuteron) system, a first measurement on hard pp-photodisintegration is appropriate for clarification of the dominating contributions in the reaction dynamics. Although the count rates are uncertain and the applicability of the impulse approximation is presently not obvious, a study of the energy dependence and angular distributions has exploratory potential and justifies the investment.

The PAC would like to see this experiment performed, but due to limitations in the available beam time, the proposal cannot be accepted at this time.

Recommendation: Defer

Individual Proposal Report

Proposal: PR-03-006

Scientific Rating: A

Title: The GDH Sum Rule with Nearly-Real Photons and the Proton g_1 Structure Function at Low Momentum Transfer

Spokespersons: M. Ripani, M. Battaglieri and R. DeVita

Motivation: The GDH sum rule is a basic physical concept, which has generated widespread interest. The proposed measurements of the generalized GDH integral, will extend the CLAS program of these measurements on the proton, down to the Q^2 range of 0.01 to 0.5 $(GeV/c)^2$. This is vital for testing Chiral Perturbation Theory calculations; different approaches give very different predictions. Extraction of the moments of g_1 at fixed values of Q^2 will be valuable for comparison with lattice gauge calculations.

Measurement and Feasibility: The Collaboration will use the same NH_3 polarized target as in the previous CLAS measurements. Four beam energies will be required to cover the proposed range of x and Q^2. Unlike the previous CLAS asymmetry measurements, this experiment will obtain cross section differences, whose normalizations will be checked by simultaneous measurements of elastic scattering. A special Cerenkov detector will be constructed which will replace the current CLAS Cerenkov detector in one sector. This new detector is designed to enable CLAS to detect electrons at angles as small as 5 degrees. The relatively conservative optical design of the proposed Cerenkov detector appears adequate for the task.

Issues: It had been suggested that combining these data with the neutron results from Hall A would reduce ambiguities in the calculations arising from the $\Delta(1232)$ resonance. However, it appears that the result of such a subtraction is greatly affected by the uncertainties in the unmeasured high-energy part of the integral, which is required in order to compare with the Chiral model calculations.

Recommendation: Approve for 20 days in Hall B

Individual Proposal Report

Proposal: PR-03-007

Scientific Rating: N/A

Title: Probing the Limits of the Standard Model of Nuclear Physics with the $^{4}He(e, e'p)^{3}H$ Reaction

Spokespersons: S. Strauch, R. Ent, R. D. Ransome and P. E. Ulmer

Motivation: This proposal is a continuation of the previous experiment E93-049. The polarization transfer parameters in $e + {}^{4}He \rightarrow e' + p + {}^{3}H$ would be measured at $Q^2 = 0.8$ and 1.3 $(GeV/c)^2$ with appreciably smaller errors than in the previous experiment. The goal is to establish the deviations of the present data from the predictions obtained from theoretical models.

Forming the double ratio of polarization transfer parameters for this process over those for elastic e p scattering may shed light on in-medium modification of the electromagnetic form factors of the proton. Predictions from current theoretical models can be better tested with the help of the new data.

Measurement and Feasibility: As a continuation of a previous experiment, this measurement is clearly feasible. The standard equipment of Hall A would be used. The advantage of studying the double ratio of polarization transfer parameters is that many experimental errors cancel. The choice of the Q^2 values (0.8 and 1.3 $(GeV/c)^2$) appears reasonable given the current theoretical predictions and the present data.

Issues: The PAC 23 regards this as an important measurement, which would shed light on nuclear effects. The double ratio of polarization parameters is known to be very robust against uncertainties in the theoretical models.

The PAC 23 would like to see this experiment performed, but due to limitations in the available beam time, the proposal cannot be accepted at this time.

Recommendation: Defer

Individual Proposal Report

Proposal: PR-03-008

Scientific Rating: B+

Title: Sub-threshold J/ψ Photoproduction

Spokespersons: P. Bosted and J. Dunne

Motivation: It is proposed to measure the cross section for sub-threshold photo-production of J/ψs with a 6.0 GeV (60 μA) electron beam on a Be target. In this sub-threshold production process, one is sensitive to short-distance configurations in the nucleus. The intent is to test models of charm production based on intrinsic charm, hidden color, quasi-free smearing, or gluon exchange mechanisms.

Measurement and Feasibility: The measurement requires an untagged bremsstrahlung photon beam and a thick Be foil that is used as both the radiator and the production target. In Hall C the SOS and HMS will be used to detect the di-lepton decay modes of the J/ψ. The different models of the production mechanism predict a cross section of 0.01 to 10 pb/nucleon leading to 1 to 1000 J/ψs per 3 day run near 5 GeV and at less than 5 degrees. Two runs at different values of *t* are planned. It is estimated that the background rejection will be very high, with background levels of ≤ 1 count/ 3 days.

Issues: The PAC regards this experiment as an exploratory measurement to determine the yield and backgrounds for this sub-threshold production process with 6 GeV electrons. The model dependence of the extrapolation of the measurement, required to extract an integrated cross section, should be investigated. The PAC encourages a more thorough investigation of the nuclear effects in the production rate estimates. A simulation of the muon background rate and the optimization of the rejection technique should also be attempted. The PAC encourages this measurement, as a necessary step needed to ascertain whether or not a study of the physics of sub-threshold J/ψ production is feasible at JLab.

Recommendation: Approve for 7 days in Hall C

Individual Proposal Report

Proposal: PR-03-009

Scientific Rating: N/A

Title: Measurement of the Proton Gerasimov-Drell-Hearn Integral at Low Q^2

Spokespersons: A. Deur, J. P. Chen and D. Crabb

Motivation: The proposed experiment of inclusive scattering would measure the proton GDH_p integral from 0.006 to 0.4 $(GeV/c)^2$, and in so doing would provide the missing low Q^2 points required to create a nearly complete map of the evolution of the GDH integral for the proton from the photon point to the DIS regime. The results up to about $Q^2 \approx 0.05$ $(GeV/c)^2$ are particularly interesting in that they could be directly compared with calculations from χPT for the generalized GDH (Q^2) integral. Such calculations, carried to sufficiently high order that their impact becomes manifest, would provide solid theoretical predictions for such GDH (Q^2) experiments.

Measurement and Feasibility: The proposed p(e, e′) measurements with 100 nA electrons would be carried out in Hall A with the two HRS spectrometers. Longitudinally polarized electrons would be used with a well understood NH_3 polarized target. The Collaboration assembled for this proposal has an accomplished track record. Many of the members are associated with E97-110, a very similar experiment on the neutron, which is about to run in Hall A with the same set of spectrometers. Systematic uncertainties for the proposed proton measurements are likely to be very similar. The PAC has no doubt that this Collaboration would be successful in carrying out this very interesting experiment.

Issues: The two low-Q^2 proton GDH proposals being reviewed PAC 23, PR-03-006 and PR-03-009, both have the same goals, very similar kinematical coverage, and reliable methodology. In fact, while the PAC decided that the demand for beam time at JLab precluded the scheduling of both experiments, it found it nearly impossible to choose between the two on purely intellectual grounds. In the final analysis, the choice in favor of PR-03-006 was made on the basis of the significant backlog of approved high current experiments in Hall A. The PAC concluded that it would be inappropriate to compound this problem further with a low current experiment whose goals could be realized in Hall B, which is not so oversubscribed.

The PAC evaluated the opportunity for obtaining the difference of the neutron GDH and proton GDH integrals under similar conditions from the combination of experiments. E-97-110 and PR-03-009. However, both measurements would cover only the resonance region and the PAC was concerned that the errors on this difference would be dominated by the necessary extrapolations into the higher energy regime, about which there is no solid information.

Recommendation: Reject

Individual Proposal Report

Proposal: PR-03-010

Scientific Rating: N/A

Title: Virtual Compton Scattering and the Generalized Polarizabilities of the Proton at Q^2 up to 4.0 $(GeV/c)^2$

Spokespersons: C. E. Hyde-Wright and G. Laveissière

Motivation: It is proposed to measure virtual Compton scattering ($ep \rightarrow e'p\gamma$) cross sections for four values of Q^2 between 0.65 and 4.0 $(GeV/c)^2$ and for three values of W below the two-pion threshold. The results would be used to extract the generalized polarizabilities of the proton at the corresponding Q^2.

Measurement and Feasibility: This measurement would be an extension of the successful E93-050 experiment above the one-pion threshold into the Δ region. The experiment is feasible at the proposed kinematics with the existing equipment. While E93-050 used a low energy expansion to extract the generalized polarizabilities, much of the interpretation of the proposed measurements hinges on a dispersion relation formalism. The present experiment benefits from higher cross sections at the higher center-of-mass energies.

Issues: The PAC recognizes that generalized polarizabilities provide important information on the structure of the proton. However, the physical interpretation of these quantities, especially at high Q^2, was not convincingly presented. In addition, systematic uncertainties arising from the use of dispersion relations should be evaluated. Finally, the complete results of E93-050 and a discussion of their interpretation would make possible a better evaluation of the impact of this proposal.

Recommendation: Defer

Individual Proposal Report

Proposal: PR-03-011

Scientific Rating: A-

Title: Update of E-00-003: Neutron Skin of ^{208}Pb Through Parity Violating Electron Scattering

Spokespersons: R. Michaels, P. A. Souder and G. M. Urciuoli

Motivation: This experiment aims to make a precise (1%) measurement of the neutron-charge radius of a heavy neutron-rich nucleus through parity violating electron scattering. This will constrain models of nuclear structure, and will have implications for subjects ranging from neutron stars to Standard Model tests using atomic parity violation.

Measurement and Feasibility: The experiment will measure the parity-violating asymmetry in elastic electron scattering from ^{208}Pb at a single value of momentum transfer. Polarized electrons, with an energy of 850 MeV, will scatter from a lead foil sandwiched between two diamond foils and be detected in both HRS spectrometers in Hall A. The septum magnets will be used to allow a scattering angle of 6 degrees. A set of lead-quartz calorimeters will be used in flux integrating mode to cover the elastic peak region in the HRS focal planes. The theoretical framework for determining the neutron-distribution radius from the parity-violating asymmetry seems to be reasonably well under control.

The experiment is extremely challenging, as it aims to measure a parity-violating asymmetry with a statistical error of 15 ppb, and an even smaller systematic error. The experience gained from the ongoing E158 experiment at SLAC and the HAPPEX-2 runs at JLab will be essential in making the present proposal feasible.

Issues: Conditional approval rests on successful demonstration that the following technical challenges have been met:

1. Tests of radiation damage to the diamond foils in the target.
2. Implementation of a plan to measure the beam polarization with two independent polarimeters, each with systematic errors of 2% or better.
3. Success in meeting the beam and detector requirements of HAPPEX-2 (i.e. accuracy in Q^2 measurement, detector noise and linearity, electronics noise level, helicity-correlated beam parameters, charge asymmetry, etc.).
4. Successful commissioning of the new luminosity monitor.
5. Demonstration of source stability, feedback systems, and betatron matching in the accelerator to control helicity-correlated beam parameters to the proposal levels.

Recommendation: Conditionally approve for 30 days in Hall A

Individual Proposal Report

Proposal: PR-03-012

Scientific Rating: A-

Title: The Structure of the Free Neutron Via Spectator Tagging

Spokespersons: S. Kuhn, C. Keppel and W. Melnitchouk

Motivation: Nuclear corrections, sometimes with substantial theoretical uncertainty, have to be applied in order to extract neutron properties from electron scattering data on nuclear targets. Up to now this has hampered precise experimental determination of important quantities such as transition form factors of neutron resonances and the study of duality for F^n_2, as well as F^n_2 at large x from deep-inelastic scattering. To minimize the effects of nuclear corrections it is proposed to construct a radial time projection chamber (RTPC), capable of detecting recoiling spectator protons down to 70 MeV/c in the backward hemisphere of CLAS. This would permit the extraction of almost on-shell neutron properties from electrodisintegration data on deuterium.

Measurement and Feasibility: It is proposed to measure the $^2H(e, e'p_s)$ reaction at 4 and 6 GeV, thus covering the kinematical range $W<2.5$ GeV and $1.2<Q^2< 5$ $(GeV/c)^2$. These data will permit the extraction of the Q^2-dependence of transition form factors of the Δ and higher resonances. The question of whether or not the neutron will show local duality from resonance to resonance, similar to that observed recently for the proton, will be addressed. Moreover, F^n_2 / F^p_2 can be determined up to x=0.62 (0.74) for W>2 (1.5) GeV with diminutive corrections for nuclear binding effects. The nuclear corrections that have to be applied are small and under control. These data are of fundamental importance for the understanding of nucleon structure. The PAC strongly supports the development of an RTPC for detection of low-momentum spectator protons, which can also be used for the study of semi-inclusive and exclusive reactions in the future.

Issues: The construction and performance of the RTPC and associated electronics are crucial to the successful accomplishment of this proposal. Substantial laboratory involvement will likely be needed to ensure a successful development and commissioning program prior to installation in CLAS. It does not appear that this experiment will suffer unduly from a somewhat reduced allocation of beam time.

Recommendation: Approve for 25 days in Hall B

Appendix E

Individual Letter of Intent Report

Letter of Intent: LOI-03-001

Title: Determination of the Sum of the Electric and Magnetic Polarizabilities of the Pion Using Polarized Quasi-Real Photons

Contact Person: K. Wang

This LOI describes a measurement of $\gamma^* p \rightarrow \gamma \pi^+ n$ to be made with quasi-real photons of about 0.7 GeV, generated from 3.2 GeV electrons and tagged at ~1° in a new detector proposed for CLAS.

The goal of the experiment is to isolate *t*-channel γ-π scattering from a proton and thereby extract the dipole polarizabilities of the pion. Potentially, this is an extremely interesting experiment. The electric and magnetic polarizabilities of an elementary particle are characteristic fundamental parameters measuring the strength of the dipole moment induced by the electromagnetic fields of a photon. The pion is a particularly interesting particle, a $q\bar{q}$ state to 0^{th} order but with large multiple $q\bar{q}$ $q\bar{q}$ components, and so its polarizabilities can be expected to reveal very interesting physics. The pion is also one of the Goldstone bosons of QCD, and expansions in the pion mass are expected to converge rapidly. The properties of the pion offer an important arena for testing Chiral Perturbation Theory. This experiment would require a great deal of preparation but may well be worth the effort, provided that polarizabilities can indeed be deduced from measured cross sections.

The PAC encourages the Collaboration to pursue the work needed for a full proposal. However, given the very large effort that is anticipated, the scope should be expanded to include the kinematical regions needed to extract both the electric and magnetic polarizabilities. The LOI has discussed two ways to attempt an extraction of polarizabilities: through a Chew-Low extrapolation of data in the physical region ($t < 0$) to the pole at $t = m_\pi^2$ and by fitting the data in the physical region to a theoretical calculation. The first relies on the strict linearity of a function at low $-t$ which may be spoiled by a variety of other contributions which will not vanish even at $t = 0$. The second relies on the accurate modeling of the interferences between the *t*-channel diagram of interest and diagrams involving resonances whose parameters may not be known to sufficient accuracy. Such a major effort will require a committed collaboration with the breadth of diverse talents needed to tackle this challenging experiment.

Individual Letter of Intent Report

Letter of Intent: LOI-03-002

Title: Transverse Polarization Effects in Hard Scattering at CLAS

Contact Person: H. Avakian

This LOI proposes to study exclusive and semi-inclusive electron scattering in Hall B with a transversely polarized hydrogen target and CLAS. With this experimental set-up it would be possible to measure simultaneously the following reactions:

- Single spin asymmetry in semi-inclusive pion electro-production above the resonance region to access the distribution and fragmentation functions such as transversity and the Collins and Sivers functions,
- Transverse target asymmetry in deeply virtual Compton scattering and hard exclusive pion electro-production to provide complementary data to investigate GPDs.

A preliminary estimate of the background and the count rate for the semi-inclusive pion electro-production suggests that these reactions could be measured.

The physics of the proposed reactions is an extension to the experimental programs currently running at JLab. The transversely polarized target would improve the CLAS capabilities giving access to other observables, particularly g_2. In order to prepare the submission of a full proposal the following issues have to be considered by the proponents:

- The interpretation of the data, as it is proposed, is based on rather simplified assumptions. A full proposal should elaborate on the interpretability of the experiment in view of effects such as higher-twist contributions and competitive mechanisms that could mask or imitate those of interest.
- The effort and manpower required to build the transversely polarized target and the new beam line has to be estimated.
- A detailed study of the background and the detector acceptance in the new configuration with a strong transverse magnetic field in the central region of CLAS is also required.
- Including other measurements such as g_2 would definitely strengthen the scientific case.

Individual Letter of Intent Report

Letter of Intent: LOI-03-003

Title: Search for Exotic Hybrids in the Coherent Production off ^{4}He

Contact Person: S. Stepanyan

The LOI proposes to search for mesons with exotic quantum numbers, the $\pi_1(1400)$ and the $\pi_1(1600)$, in the $\pi^0\eta$ and $\pi^0\eta'$ channels using coherent production with quasi-real photons on ^{4}He. Additionally the C(1480) will be studied in the $\phi\pi$ channel. Coherent production has several advantages, including no background from baryon resonances and, at $t = t_{min,}$ no helicity flip so that the helicity of the $\pi^0\eta$ and $\pi^0\eta'$ will be the same as that of the initial photon. It is assumed that this latter condition will hold for $|t| > |t_{min}|$ thus simplifying the partial wave analysis of the final state. It is also assumed that the reactions are dominated by natural parity exchange. The use of an electron beam instead of a tagged photon beam has several advantages but does require the construction of a forward electron tagger.

The Collaboration is encouraged to return with a full proposal addressing the following issues.

1. It should be demonstrated that the assumptions of no helicity flip and natural parity exchange are not necessary for the partial wave analysis.

2. The estimate of cross sections should be clarified and the assumptions going into that estimate justified.

3. Separate rate estimates should be made for the $\pi_1(1400)$ and the $\pi_1(1600)$.

4. The technical feasibility of the forward electron tagger and ^{4}He tagging should be established.

5. The viability of the experiment without tagging the electron should be evaluated.

Individual Letter of Intent Report

Letter of Intent: LOI-03-004

Title: Meson Spectroscopy Using Electron Scattering at Very Small Q^2 in CLAS

Contact Person: C. Salgado

This LOI proposes to study the exotic $\pi_1(1600)$ in the $\pi^+\pi^+\pi^-$ and $\pi^+\eta'$ channels and to explore the spectrum of the radial and orbital excitations of the $\phi(1020)$, via their decays to K^+K^- and KK^*, using quasi-real photons on a hydrogen target. The use of an electron beam instead of a tagged photon beam has several advantages but does require the construction of a forward electron tagger.

The Collaboration is encouraged to return with a full proposal addressing the following issues.

1. As the $\rho(1450)$ and $\rho(1700)$ can decay to KK and KK^* it is essential to have isospin separation. How will this be achieved?

2. A comparison of the strangeonia part of the program should be made with FOCUS and with ISR at BABAR.

3. The production of baryon resonances gives a potentially serious background. A convincing analysis of the Collaboration's present data should be available before a proposal is submitted.

4. The technical feasibility of the forward electron detector should be established.

5. The viability of the experiment without tagging the electron should be evaluated.

Appendix F

Jefferson Lab Experiments, PAC 4-23, Grouped By Category

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

★ Completed Experiment

☆ Partially Completed

★/ Original experiment partially completed but considered complete by the Collaboration as the major goals were achieved (no additional running planned)

☆̄ Partially complete (continuation halted by PAC during a jeopardy review)

* Contact Person for Experiments with Multiple Spokespersons