The Thomas Jefferson National Accelerator Facility (Jefferson Lab) is a national physics user facility Operated by the Jefferson Science Associates, LLC, for the U.S. Department of Energy (DOE)

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Jefferson Lab
Thomas Jefferson National Accelerator Facility
Exploring the Nature of Matter

October 18, 2007

Members of the Jefferson Lab User Group,

This has been a successful year for Jefferson Lab and its users with outstanding experimental results, steady progress on the 12 GeV Upgrade, and excellent reviews from our sponsors at the Department of Energy.

This Program Advisory Committee, chaired(acting) by Michael Pennington, reviewed 9 proposals and 3 letters of intent. The quality of these submissions were again impressive, a measure of the exciting science that the Jefferson Lab accelerator enables. PAC 32 completed a thorough assessment and five proposals were approved, three were conditionally approved, and one proposal was deferred.

I have enjoyed working with the Program Advisory Committee during my tenure and value their role in helping to assure a dynamic and challenging scientific program delivering high impact, high profile experimental results from Jefferson Lab's unique research capabilities. I thank them for their dedication to Jefferson Lab and to excellent science.

Sincerely,

Christoph W. Leemann
JSA President
Director, Jefferson Lab

Letter from the Acting PAC Chair
Introduction

Introduction

The Jefferson Laboratory Program Advisory Committee held its 32nd meeting from August 6th to 8th, 2007. The membership of the Committee is given in Appendix A. In response to the charge (Appendix B) from the JLab Director, Dr Christoph Leeman, the Committee reviewed and made recommendations for the 9 proposals and 3 Letters of Intent for experiments that will use the base equipment currently planned for the 12 GeV upgrade.

12 GeV upgrade:

The PAC applauds the way in which the Laboratory has weathered the recent storm of funding uncertainties and has made steady progress towards bringing the 12 GeV upgrade to reality. The PAC was highly impressed with the key steps made in the decision-making process with DoE leading to CD-2, and with the presentation it received for the first time on the exciting development of the new Hall D.

All 12 experiments considered at this PAC are part of the central mission of JLab physics to illuminate the properties of nucleons and how these are reflected by the flavor, momentum and angular momentum carried by their constituent quarks and gluons. A key issue for this PAC was which of these experiments are critical to the first 5 years of experiments with the 12 GeV upgrade.

Proposals recommended for Approval:

Proposal PR12-07-104 is a measurement of the neutron magnetic form-factor G^n_M in Hall B using a deuterium target. The method proposed is elegant and its physics essential to the program. The results of this experiment, if successful, will provide neutron data, which when combined with proton results determine the isovector form-factor, that is more readily computable on the lattice, having no disconnected quark contributions. This essential measurement will thus have the added benefit of providing a valuable test of the efficacy of lattice calculations.

Proposal PR12-07-105 is the measurement of the longitudinal-transverse separated pion electroproduction cross-section in Hall C. This will provide essential constraints on Generalized Parton Distributions (GPDs) central to the 12 GeV program. The experiment uses techniques already implemented for measuring the pion form-factor in Hall C and previously approved for 12 GeV (PR12-06-101). Discussion of this proposal clarified the theoretical basis for GPD studies and emphasised that even if σ_T is found not to be small, interpreted in terms of sizeable higher twist effects, the separation of σ_L may be sufficient for investigating GPDs.

Proposal PR12-07-107 is the study of spin-orbit correlations with a longitudinally polarized target in Hall B. This experiment measuring single and double-spin asymmetries would provide unique coverage of the multi-dimensional space of kinematics in semi-inclusive deep inelastic scattering. This complements GPD studies and would provide key information about the spin and orbital angular momentum carried by the internal structure of the proton.

Proposal PR12-07-108 is a precision measurement of the elastic electron-proton cross-section in Hall A, which will allow the determination of the electric and magnetic form-factors G^p_E and G^p_M, when combined with measurement of their ratio in PR12-07-109. It is clear the measurement of the elastic cross-section is essential. The PAC recommended that the collaboration should consider a short extension to include measurements at low Q^2 for several values of ε to allow a Rosenbluth separation. When these are combined with polarization transfer measurements they can then pin down the key two photon contribution directly from data. Even though this is not within the portfolio of base equipment, the PAC supported the use of a third vertical drift chamber to improve the track-reconstruction efficiency as proposed.

Proposal PR12-07-109 is the measurement of the large acceptance proton form-factor ratio at 13 and 15 GeV/c^2 using the recoil polarization method in Hall A. This experiment would use a challenging technique including GEMs for defining the kinematics. Though it is number five in a line of measurements of the key proton form-factors $G^p_{E,M}$, the technique proposed may significantly improve their precision. The PAC praised the novel proposal and believed the promised improvements in technology warranted the investment, some of which would come from non-DOE sources.

Proposals recommended for Conditional Approval:

Proposal PR12-07-101 studies hadronization in nuclei by deep inelastic electron scattering in Hall C. The space-time evolution of hadronization from the formation of a quark-antiquark pair to an embryonic colorless state to fully formed hadrons is fundamental and interesting. However, the PAC was not convinced that this experiment would provide a modelling for hadronization transportable from one process to another. The PAC believed the proponents should demonstrate (i) the relevance of its results to RHIC experiments, (ii) why the approved CLAS12 experiment cannot do this, (iii) why identifying kaons is useful in testing models. Moreover, they should reassess the proposed kinematics, (*i.e.* values of ν and Q^2), in the light of the analysis of recent results from CLAS and HERMES.

Proposal PR12-07-102 is the precision measurement of parity-violating asymmetry in deep inelastic scattering in Hall C. The size of such effects may signal physics beyond the Standard Model. The separation of genuine parity-violation contributions from effects generated by higher twist components and by charge symmetry violation was not demonstrated. This may require dedicated theoretical effort. It is unclear whether the polarimetry really can be done to an accuracy of 0.3%, when Q_{weak} plans only 1%. If the experiment succeeds it may uniquely provide information about the difference between the momentum distribution of *up* quarks in a proton and *down* quarks in a neutron (*i.e.* charge symmetry violation), in addition to separating effects attributable to physics beyond the Standard Model. However, the proposal presented no simulations and gave little more information than the Letter of Intent.

Proposal PR12-07-106 is a measurement of the *A*-dependence of J/ψ photoproduction near threshold. This was measured thirty years ago at SLAC with roughly 30% uncertainties. The proposal will improve this by a factor of three. This is a clever experiment with a good team, who can doubtless make this measurement to the accuracy planned, but the PAC was unconvinced about why this had to be done in the first five years of 12 GeV running. It has long been claimed that the behavior of J/ψ production in media is a key signature of the development of a quark-gluon plasma. Knowledge of this production in cold matter is critical for such interpretation. The

PAC requests answers to (i) why greater accuracy in this knowledge would improve this understanding? (ii) what would be the impact of increased precision on the nuclear physics calculation of the J/ψ*N* absorption cross-section? (iii) would this improved measurement of the cross-section near threshold motivate a lattice calculation of the scattering length?

Proposal Defered

Proposal PR12-07-103 is a study of nuclear transparency in π-photoproduction from deuterium and ^{4}He in Hall C. The study of nuclear transparency as a function of momentum transfer may signal the onset of *color transparency*. This would be of great interest. However, the PAC was unconvinced that this experiment would add significantly to the exploration of an approved electroproduction experiment (PR12-06-107) to merit its inclusion in the first five years of 12 GeV experiments.

Letters of Intent

LOI12-07-101 is a measurement of the Λ-polarization in the target fragmentation region to determine the polarization of the strange quark sea in the proton. However, this experiment needs to take account of results of the precursor HERMES and COMPASS measurements.

LOI12-07-102 is the measurement of the tagged neutron structure function on a deuterium target. This experiment would elucidate the EMC effect in a deuteron, using the backward detection of a proton to enhance deep inelastic events on a neutron. It would complement the BONUS experiment. However, there remain many issues to be resolved, not least whether there would be sufficient statistics in the proposed running to really probe the EMC effect.

LOI12-07-103 is a detailed study of semi-inclusive deep inelastic π-production on unpolarized proton and deuteron targets in CLAS12. Data on π-production would be taken with other commissioning CLAS12 experiments and map out the landscape of fragmentation as a function of x, z, p_T, and Q^2. This would provide key inputs to global analyses at next-to-leading-order in perturbative QCD to constrain the fragmentation functions of quarks.

All three Letters of Intent require significant work before they can be brought to proposal stage. All were encouraged to do this.

Acknowledgements

The PAC is very appreciative of the support of Hall Leaders and JLab staff in elucidating details of the key laboratory infrastructure and in preparing TAC and theory reports. We are most grateful too to Rachel Harris and her colleagues for essential help in bringing the committee together, and preparing, and keeping track of, all its paperwork. All this was essential to the committee's deliberations. Lastly, and most importantly, we thank all the scientists involved in developing these proposals – proposals that have the potential to illuminate the heart of matter.

Michael Pennington
Acting Chair, Jefferson Program Advisory Committee

Tables

	Experiments Recommended for Approval	Experiments Recommended for Conditional Approval	Totals
Experiments	196	3	184
Authors	1165	36	1229
Institutions	191	3	212
Countries	28		30

(1) Approved Experiments Totals by Physics Topics

Topic	**Number Total**	**Hall A**	**Hall B**	**Hall C**
Nucleon and Meson Form Factors & Sum Rules	36	12	7	17
Few Body Nuclear Properties	29	18	6	5
Properties of Nuclei	35	11	11	11
N* and Meson Properties	56	10	35	11
Strange Quarks	26	7	16	3
TOTAL	180	58	75	47

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	43 0	787.9	15	281.0	0
B	61 4	691.8	14	298.0	2
C	34 3	738.8	10	222.0	0

Total	138	7	2218.5	39	801.0	2

APPENDIXES

A. PAC 31 Membership

B. Charge to PAC 31

C. PAC 31 Recommendations

D. PAC 31 Individual Proposal Reports

E. PAC 31 Individual Letters-of-Intent Reports

F. Approved Experiments, PAC 31, Grouped by Physics Category

(To access Appendix F, go to http://www.jlab.org/exp_prog/proposals/07prop.html

APPENDIX A

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Appendix B
Charge to PAC32

Jefferson Lab requests that PAC 32:

1. Review both proposals* and letters of intent† for experiments that will use the base equipment currently planned for the
12 GeV Upgrade and provide advice on their scientific merit, technical feasibility and resource requirements.
2. Identify high-quality physics that, based on what we know today, is highly likely to be of sufficient scientific merit that it will be included in the priority list to be established for the first 5 years of 12 GeV Operations
3. Identify other physics that has the potential for falling into this category pending clarification of scientific and/or technical
4. Provide comments on technical and scientific issues that should be addressed by the proponents prior to a second review and the assignment of scientific priority at a future PAC.

***** Proposals and letters of intent will be considered ONLY if the proponents clearly state their intent to participate in and contribute to the construction of the base equipment.

† Letters of intent for 12 GeV at PAC30 will be given the same "rights" to their scientific ideas as are currently afforded to deferred experiments

APPENDIX C
PAC 32 Recommendations

A	PR12-07-109		Large Acceptance Proton Form Factor Ratio Measurements at 13 and 15 (GeV/c)2 Using REcoil Polarization Method
A	PR12-07-107		Studies of Spin-Orbit Correlations with Longitudinally Polarized Target
A	PR12-07-104		Measurement of the Neutron Magnetic Form Factor at High Q2 Using the Ratio Method on Deuterium
A	PR12-07-108		Precision Measurement of the Proton Elastic Cross Section at High Q^2
A	PR12-07-105		Scaling Study of the L-T Separated Pion Electroproduction Cross Section at 11 GeV
CA	PR12-07-101		Hadronization in Nuclei by Deep Inelastic Electron Scattering
CA	PR12-07-106		The A-dependence of J/Psi Photoproduction near Threshold
CA	PR12-07-102		Precision Measurement of the Parity-Violating Asymmetry in Deep Inelastic Scattering off Deuterium using Baseline 12 GeV Equipment in Hall C
D	PR12-07-103		The Nuclear Transparency of Pion-photoproduction from 4He at 12 GeV

- A=Accept,
- C1=Conditionally Approve w/Technical Review,
- C2=Conditionally Approve w/PAC Review,
- D=Defer

APPENDIX D

Individual Proposal Report

Proposal: PR12-07-109

Title: Large Acceptance Proton Form Factor Ratio Measurements at 13 and 15 (GeV/c)^2 Using Recoil Polarization Method

Spokespersons: C.F. Perdrisat, L.P. Pentchev, E. Cisbani, V. Punjabi and B.Wojtsekhowski

Motivation: This collaboration proposes to extract G_{Ep}/G_{Mp} at Q^2 =12.9 and 14.8 (GeV/c)^2 through a measurement of the polarization transfer in elastic $\vec{e}\,\vec{p}$ scattering. The estimated absolute statistical accuracy, $\Delta[\mu_p\ G_{Ep}/G_{Mp}\ ]$, will be about 0.1. This accuracy would match the precision achieved in lower momentum transfer recoil measurements at JLab. Knowledge of the proton form factors is crucial for the understanding of the structure of the nucleon, and their measurements belong to the mainstream of the scientific program of the Laboratory. The form-factors challenge phenomenological models and may be directly compared to lattice QCD calculations.

Measurement and Feasibility: The experiment will run in Hall A. BigCal will be used to detect electrons scattered off a 40 cm cryogenic target; the latter requires a special, dedicated design. A customized setup for detecting the recoil proton will include a dipole magnet, three new fast trackers (GEMs) for the determination of its momentum, interaction point and polarization, as well as a hadron calorimeter to control the trigger rate. The dipole is available from BNL, the polarimeter can be developed from the existing new polarimeter built in Hall C, and several options exit for the hadron calorimeter (e.g. using parts recovered from calorimeters existing at the collaborating institutions). A new and key part of the detector is the set of GEMs. Construction, implementation and installation of those devices will require a large, strongly coordinated organizational and financial effort. The proposal would be strengthened if the new recoil proton detector could be used by the future Hall A experiments, *e.g.* SIDIS from different polarized targets, GEN measurements, J/ψ photo-production, etc.

Issues: High Q^2 measurements at 11 GeV incident energy result in 1/15 of the FOM at 6 GeV. To get statistical errors similar at both energies at the same beam time, detectors with acceptance an order of magnitude larger than classical ones are needed. The idea proposed by the collaboration is novel and challenging, albeit costly. The collaboration will thus also apply for funds to agencies other than NSF/DOE. While the committee is presently convinced that the experiment should run, it also reminds the proponents that all the approved 12 GeV proposals will be subject to (at least) one more examination, just before the upgraded Laboratory program will actually start running. In particular, at that time the proponents are expected to deliver an update of the two-photon exchange correction, based on the newest data and calculations.

Recommendation: Approval

Individual Proposal Report

Proposal: PR12-07-107

Title: Studies of Spin-Orbit Correlations with Longitudinally Polarized Target

Spokespersons: H. Avakian, P. Bosted, K. Hafidi, K. Griffioen, P. Rossi

Motivation: This proposal aims to measure single and double spin asymmetries in semi-inclusive electroproduction of pions using a longitudinally polarized electron beam and longitudinally polarized proton and deuteron targets. The objectives include the study of correlations of the transverse spin of quarks with their transverse momentum through measurement of the single spin azimuthal asymmetry, which is sensitive to the $h_{1L}^{\perp}(x,k_T)$ distribution function. In addition, the transverse momentum dependence of the quark helicity distributions, $\Delta u(x,k_T)$ & $\Delta d(x,k_T)$, will be studied through measurement of the double spin asymmetry for pion production. This is especially important in the large-x region where these distributions are poorly known.

Measurement and Feasibility: The experiment requests 103 days total of beam time, most of which will be parasitic with the approved Hall B experiment E12-06-109. Thanks to the high luminosity, it features a unique coverage of kinematics, with data taken as a function of x, Q^2 and P_T independently, for two values of z.

Issues:
This experiment is well motivated and constitutes an essential part of the JLab 12 GeV program. The theory underpinning single spin asymmetries in semi-inclusive DIS is rapidly developing, as evidenced, for example, by the discussions of the "soft factor" in the formal factorization of the cross-section, and the PAC looks forward to seeing a more rigorous foundation for the simple factorized expressions that are used in terms of the distribution and fragmentation functions. We also stress the importance of determining the extent to which the data may suffer from higher twist contamination, and so a comprehensive study of the Q^2 dependence of the asymmetries is essential. (The rapid evolution of this field is also evidenced by the proliferation of names for the various distribution functions that have recently arisen, and we hope that a more intuitive nomenclature will eventually develop.)

Recommendation: Approval

Individual Proposal Report

Proposal: PR-12-07-104

Title: Measurement of the Neutron Magnetic Form-Factor at High Q^2 Using the Ratio Method on Deuterium

Spokespersons: G.P. Gilfoyle

Motivation: The goal of this experiment is to measure the neutron magnetic form-factor in the range Q^2=2-14GeV^2. The physics case is clear as the nucleon form factors are essential observables for understanding strongly interacting systems. It is crucial to have both the neutron and proton form factors, because the isoscalar and isovector combinations are sensitive to different physical effects. For instance, the isovector combination is free of the disconnected contributions which are notoriously difficult to compute on the lattice.

Measurement and Feasibility: This experiment uses the ratio method which reduces experimental and theoretical uncertainties and has already been successfully employed by the collaboration at 6 GeV. The ratio of the quasi-elastic cross sections D(e,e'n) to D(e,e'p) allows the neutron magnetic form-factor to be determined assuming that:

i) the elastic proton cross section is known, which is true and will improve in the future.
ii) the neutron electric form factor is known. This is not a critical issue because at large Q^2 its contribution is quite small. As shown in the proposal, the final uncertainty due to this incomplete knowledge is about 1.5%.

Due to Fermi motion the inelastic cross section is a strong background under the quasi-elastic peak. This background will be suppressed by imposing cuts on the angle between the momentum transfer and the direction of the emitted particle. The problem of proton and neutron detector efficiency calibration is elegantly solved by using a dual Hydrogen/Deuterium target. Elastic scattering on Hydrogen will provide tagged protons and π^+ electroproduction will provide tagged neutrons.

Issues: No objections have been raised about the experimental technique.

Recommendation: Approval for Hall B

Individual Proposal Report

Proposal: PR12-07-108

Title: Precision Measurement of the Proton Elastic Cross-section at High Q^2

Spokespersons: J. Arrington, B. Moffit, S. Gilad, B. Wojtsekhowski

Motivation: This experiment aims to measure the elastic electron-proton cross-section in the Q^2 range from 7 to 17.5 GeV^2 with an unprecedented precision of less than 2%. The principal purpose of the measurement is twofold. First, the experiment will determine with new precision the proton magnetic form-factor G^p_M at high Q^2. This will be accomplished by removing the contribution of G^p_E from the measured cross-section using the results on G^p_E/G^p_M determined via polarization transfer by the proposed experiment PR12-07-109. Knowledge of G^p_M and other form-factors is essential to our understanding of the nucleon, providing in particular important new constraints on the GPDs. Second, a precise measurement of the proton elastic cross-section at the kinematics of the 12 GeV JLab facility is essential for the accurate normalization of numerous other experiments, notably the measurements of the form-factors G^p_E, G^n_E, and G^n_M, and of nuclear transparency in $A(e,e'p)$ quasielastic scattering.

Measurement and Feasibility: The proposal requests 31 days of running in Hall A (a third of which might be shared with PR12-07-109) using only the standard 12 GeV equipment. The quoted systematic uncertainty is ambitious. The principal challenge is the determination of the acceptance correction: given the use of an extended 20 cm target, this will require a knowledge of the Hall A spectrometer optics which considerably exceeds that currently achieved. The PAC recognizes the amount of work involved, but feels that the goal is within reach. The proposal also calls for the addition of a third VDC to the standard HRS configuration, a modification that the TAC felt was insufficiently justified. Given the existence of a spare VDC already and the resulting improvements in track-reconstruction efficiency, the PAC feels that this upgrade is well worthwhile.

Issues: (1) The PAC suggests that the planned list of kinematic points be expanded so that two or three ε values are measured at each Q^2 point in order to constrain 2γ-exchange (TPE) corrections as accurately as possible. As these additional measurements are only possible at the lower Q^2 values, the influence on the total run time will be modest.

(2) A future version of this proposal should include a complete evaluation of the uncertainties on the G^p_M measurement: the plotted uncertainties do not presently account for TPE corrections or the subtraction of G^p_E. The treatment of radiative corrections should also be more consistent: the total error budget for the cross-section includes the standard radiative corrections, but excludes the much larger 2% uncertainty on the TPE corrections. The proposal explains that this TPE uncertainty will not influence the use of the cross-section measurement for normalization purposes, as they will share the same correction, but this is (partly) true also for standard radiative corrections. Moreover, a

measurement of the Born-level elastic cross-section will require complete radiative corrections, including TPE.

Recommendation: Approval

Individual Proposal Report

Proposal: PR-12-07-105

Title: Scaling Study of the L-T Separated Pion Electroproduction Cross-Section at 11 GeV

Spokespersons: T. Horn and G. Huber

Motivation: This experiment measures pion electroproduction to determine the separated longitudinal, transverse, and LT and TT interference responses. Measurements are proposed at three values of x_B, 0.3, 0.4, and 0.55, as a function of Q^2. It is anticipated that at higher Q^2, the longitudinal cross section will become much larger than the transverse cross section, and will fall as Q^{-6}. In this case, the longitudinal response can be interpreted in terms of Generalized Parton Distributions (GPDs).

Measurement and Feasibility: The proposed experiment uses standard Hall C equipment, the HMS and SHMS spectrometers in coincidence. It uses the same techniques as the pion form-factor experiments already run in Hall C, as well as the higher Q^2 F_π -experiment already approved for 12 GeV.

Issues: A detailed study to determine whether or not meson electroproduction can provide information on GPDs is important. The PAC believes that the kinematics might not be fully optimized. The experiment could better overlap the F_π-experiment. The collaboration should consider whether the highest x / Q^2 point fully justifies the large time required.

Recommendation: Approved for Hall C

Individual Proposal Report

Proposal: PR12-07-101

Title: Hadronization in Nuclei by Deep Inelastic Electron Scattering

Spokespersons: B.E. Norum, K. Wang, J.P. Chen, H.J. Lu

Motivation: This collaboration proposes to use the high luminosity capabilities of Hall C to study the hadronization of quarks into pions and kaons in deep inelastic scattering on nuclei. The experimental plan is to study the z ($0.2 < z < 0.85$) and p_T ($0 < p_T < 0.8$ GeV/c) dependences of hadron attenuation at a fixed ν of 6 GeV and Q^2 values of 2.82, 4.26, and 5.99 $(\text{GeV/c})^2$, with high statistical precision. Such data are claimed to help discriminate between different models of hadronization. Beyond its intrinsic interest as a basic phenomenon of quark-hadron dynamics, a better understanding of hadronization would be especially useful in refining the interpretation of recent results from RHIC. Targets of C, Cu, and W are proposed, in addition to LH_2 and LD_2.

Measurement and Feasibility: The measurement as planned uses the capabilities of the future Hall C spectrometers and unpolarized targets. No significant technical problems are foreseen.

Issues: This program would be complementary to that approved in Hall B (at similar kinematics) due to its ability to use high luminosity to focus on particular kinematic dependences with much higher precision, and its ability to identify kaons at high momenta (a capability which is absent from the planned CLAS12 spectrometer). The proposed range of measurements is too limited in hadron p_T, and should be extended to p_T greater than 1 GeV/c where it is most difficult for large acceptance spectrometers to obtain sufficient statistics. Given the HERMES data on Xe, the W target should be replaced with a higher-A target, such as Pb. An explicit demonstration of the connection of the specifically proposed measurements to RHIC physics issues would strengthen the motivation. The committee felt that the present choice of kinematics was not shown to address specific theoretical questions to which the high-precision and kaon capabilities would provide a direct answer *and* which could not be answered by the CLAS12 experiment. In fact, despite the opinions expressed above, it is probably premature to choose new kinematics for the measurement until the theory community has had sufficient time to understand the implications of the recent large sets of CLAS and HERMES hadron attenuation data.

Recommendation: Conditional approval

Conditions to be addressed:

1) Identify kinematic choices which address specific hadronization physics questions that cannot be adequately addressed by the approved CLAS12 experiment (or previous data).
2) Provide a detailed demonstration of the impact of the proposed measurement on RHIC physics.
3) Investigate the extension of the measurements to higher values of p_T, several ν values, and a heavier target.

Individual Proposal Report

Proposal: PR12-07-106

Title: The A-dependence of J/ψ photoproduction near threshold

Spokespersons: P. Bosted, E. Chudakov, J.A. Dunne

Motivation: This experiment proposes to measure J/ψ photoproduction on a range of nuclear targets from Be to Au. From the A-dependence the cross-section for J/ψ nucleon interaction just above threshold will be determined to a factor of 3 better precision than at SLAC thirty years ago. Knowledge of this cross-section for J/ψ production on cold matter may serve as key input to the interpretation of J/ψ production results in heavy ion collisions.

Measurement and Feasibility: The method of this experiment is elegant and should undoubtedly lead to differential cross-section results as a function of s and t with the precision claimed. The experimental design is well thought out. Thick radiators are used to produce the bremsstrahlung, while segmented solid targets are employed to help control systematic errors. The J/ψ's are identified through their significant dilepton decay modes, both electron and muon. The HMS is used at relatively large angles to detect the negatively charged leptons in coincidence with the SHMS at forward angles to detect the positive leptons. This arrangement optimizes real rate, reduces background and gives excellent mass resolution for the J/ψ.

Issues: The key issues are the motivation for these measurements and why it is critical that these take place in the first 5 years of running of the 12 GeV upgrade. In particular:

(1) how will a more precise value of the near threshold cross-section impact on the interpretation of RHIC results on J/ψ production?

(2) what impact will a more precise measurement of the absorption cross-section have on conventional nuclear physics description of such a process?

(3) will such a measurement motivate a lattice calculation of the J/ψ scattering length of corresponding precision on a similar time scale. A quenched calculation appears feasible.

Recommendation: Conditionally approved.

Individual Proposal Report

Proposal: PR12-07-102

Title: Precision Measurement of the Parity-Violating Asymmetry in Deep Inelastic Scattering off Deuterium Using Baseline 12 GeV Equipment in Hall C

Spokespersons: Paul Reimer, Kent Paschke, and Xiaochao Zheng

Motivation:
It is proposed to measure the large helicity asymmetry in the scattering of 12 GeV longitudinally polarized electrons on deuterium in the deep-inelastic regime with a statistical uncertainty of 0.5%.

Measurement and Feasibility:
The experiment will use both Hall C 12 GeV spectrometers and a 40-cm liquid ^{2}H target. The kinematical range of the experiment is centered on Q^2=3.3 GeV^2, x=.34, and W^2=7.3 GeV^2, well within the deep inelastic electron scattering regime. The Parity-Violating (PV) asymmetry is large and can be measured with a statistical uncertainty of less than 0.5% using counting techniques. The large asymmetry arises from the lepton-quark couplings $2C_{2u}$-C_{2d} and is modified, at the few percent level, by charge-symmetry-violating effects and higher-twist effects. All three effects are interesting and their determination has a high scientific priority. If $2C_{2u}$-C_{2d} can be measured with 0.5% uncertainty, the Standard Model would be tested with precision comparable to the best contemporary experiments. It may be possible to determine separately these three sources of PV asymmetry as these have different kinematical signatures (see below). However, such a separation is beyond the scope of the proposal. Nevertheless, the group proposing the experiment has a strong record of accomplishment in the physics and techniques of parity violation in electron scattering.

Issues: The physics issues contained in this proposal, testing the Standard Model by measuring lepton-quark weak couplings, observing charge-symmetry violation, and observing higher twist effects, are very interesting and important provided that they can be disentangled. The proposed measurement determines a linear combination of $2C_{1u}$-C_{1d} and $2C_{2u}$-C_{2d}**.** The size of the uncertainty in this correction should be quantified. The asymmetry from photon-Z interference is ~Q^2. The proposal argues that the asymmetries from higher-twist decrease with Q^2, while asymmetries from charge symmetry breaking increase with x. The Q^2-x acceptance (shown in Figure 5.) indicates that the variation of Q^2 and x are highly correlated. It is therefore not possible to separate the three effects from their kinematical signatures. The proponents should investigate the possibility of using multiple spectrometer settings and/or energies in order to achieve a kinematical separation.

The 40cm ^{2}H target will produce a large neutron background. A strategy for reducing this background should be developed and modeled. The experiment requests 85 μA which is larger than the 80 μA specified in the upgrade. The time allocated to spectrometer calibrations may be too short to study rate effects and the reproducibility of acceptance measurements. The asymmetries will be large, but some time should be allocated for the measurement of helicity-correlated modulations. While the HMS has been well characterized, there may be surprises in early running of the SHMS. The best projected measurement of beam polarization has an uncertainty of 1.0 %. The proposal assumes an uncertainty of less than 0.5% in the goal of an overall statistical uncertainty of 0.5%. A plan leading to a polarization uncertainty of < 0.5% should be developed or the overall uncertainty should be relaxed. Experimental backgrounds such as scattering from the spectrometer walls should be modeled.

Recommendation: Conditional approval subject to satisfactorily addressing the above issues.

Proposal: PR12-07-103

Title: The Nuclear Transparency of Pion-photoproduction from ^{4}He at 12 GeV

Spokesperson: Dipangkar Dutta, Haiyan Gao

Motivation: This proposal intends to measure π^- photoproduction on the neutron at θ_{cm} = 90° for five incident photon energies between 3.3 GeV and 11 GeV, using the quasifree γ n $\rightarrow$ π p reaction on deuteron and ^{4}He targets. The objective of the experiment is to measure nuclear transparency (NT) by comparing the production cross-sections obtained for the two target nuclei. A rise of NT as a function of $|t|$ (momentum transfer squared) would be an indication for the onset of *color transparency* (CT), the vanishing of hadron interactions in the nuclear medium at high momentum transfers. At lower energies, a previous experiment (E94-104) has obtained hints for a CT-like behavior, and the new proposal would extend the CT measurement to higher $|t|$. Other issues are (i) to investigate the charm threshold region to confirm or disprove the existence of a novel resonance, which has been discussed as a possible explanation for the transparency result obtained in an A(p,2p) measurement, and (ii) to establish possible connections with QCD factorization in deeply-virtual meson production (DVMP), which is claimed to rigorously require the onset of CT.

Measurement and Feasibility: It is proposed to conduct the experiment in Hall C with a 20 – 50 μA electron beam on to a 6% RL copper radiator for bremsstrahlung production, using the HMS (π) and the SHMS (p) for coincident detection. The dominant background will be quasielastic (e,e´p), which will be reduced by the use of gas and aerogel Cherenkov detectors. Within a beamtime of 14.5 days the cross-section will be obtained to a total accuracy of better than 5% over the $|t|$-range of 3 – 9 GeV^2.

Issues: CT has been observed in dijet production at high energy, electroproduction of ρ^0s in nuclei, and more recently in pion electroproduction A(e,e´π); a CT signal for A(e,e´p) has not been observed for momentum transfers up to about 8 (GeV/c)^2. There are already two approved 12 GeV proposals (E12-06-106 and E12-06-107) aiming to investigate CT in electroproduction. While no concern has been raised that the experiment will not be feasible, there is consensus in the PAC that the proposed photoproduction measurement will not be able to add significant new information beyond one possible basic observation: namely, a possible further increase of transparency for larger $|t|$ which might be interpreted as an additional indication for CT by a comparison with model calculations. The connection of the observation of CT in the photoproduction experiment to other observations of CT with pions was not clear. Up to now only qualitative ideas have been presented to indicate that electro- and photo-production might probe different regions in the formation-length vs. effective-size parameter space – this would have to be substantiated by more detailed calculations. The charm-threshold region is not scanned in small enough steps to observe a possible resonance or its impact on transparency, which

in any case needs to be quantified. While the PAC remains interested in the exploration of CT phenomenon, it feels that the proposed measurement is not clearly one that should be included in the first set of experiments. Finally, the physics motivation based on the relationship with the GPD program ("factorization [in exclusive meson production] is rigorously not possible without the onset of CT") is misleading (or irrelevant) in the context of this experiment: the factorization theorem of the GPD program is for meson production by a highly virtual photon together with a moderate momentum transfer to the target while this experiment deals with meson production by a real photon with high momentum transfer to the target. Thus the respective kinematical domains where QCD factorization holds in each case are totally different.

Recommendation: Defer

APPENDIX E

Individual Proposal Report

Proposal: LOI-12-07-101

Scientific Rating: N/A

Title: Lambda Polarization in the Target Fragmentation Region

Spokespersons: H. Avakian

Motivation: This experiment measures both exclusive and inclusive final states at the same time in the p(e,e'Λ)X reaction. There are a number of motivations, as the physics is different for the inclusive and exclusive processes. For inclusive production, the reaction can reflect generally the production process, and more specifically physics such as fracture functions and the polarization of the strange quark sea in the proton. For exclusive production, the data might be used to constrain the generalized parton distributions (GPDs).

Measurement and Feasibility: The proposed experiment uses standard CLAS12 equipment. A 6-GeV version of this experiment has already run in Hall B, with some preliminary results presented in the LOI. Since the Λ decay is self-analyzing, determining the Λ polarization is straightforward.

Issues: While the data will significantly improve on existing measurements, it is not clear what will be learned from them beyond input to reaction mechanism phenomenology. In particular, it is not clear how much can actually be learned about the strange quark polarization. The physics results would be considerably richer if a polarized target were used, and the PAC encourages the collaboration to consider this possibility. When proceeding to a proposal, what is being learned from HERMES and COMPASS data should be taken into account. There is no discussion of backgrounds in the LOI, in particular possible contamination of the Λ channel from production of higher mass hyperons that decay into Λ's. Finally, as GPDs only apply to the longitudinal cross section, the interpretation of unseparated cross sections in terms of GPDs might be mistaken and misleading.

Recommendation: The collaboration is encouraged to develop a proposal.

Individual Proposal Report

Proposal: LOI-12-07-102

Title: Tagged Neutron Structure Function in Deuterium

Spokespersons: S. Kuhn, S. Bultmann, K. Griffioen

Motivation: The central purpose of this proposal is to study the deuteron under special kinematic conditions aimed at enhancing the EMC effect. In particular, the reaction D(e,e'p)X is measured where the proton is detected in the backward direction and deep inelastic scattering on the neutron is emphasized. These particular kinematics are believed to minimize final state interactions. In addition, the outgoing proton momentum is relatively large in order to emphasize the N-N interaction at short range, where the EMC effect is expected to be enhanced. A better understanding of the EMC effect may be possible in a simple nucleus where precise nuclear calculations can be performed. These data could help with the extraction of the neutron structure function from the BONUS experiments.

Measurement and Feasibility: Although the experiment is feasible at some level, it is not clear from the LOI that sufficient statistics can be accumulated to observe the EMC effect in the deuteron, particularly if the effect is as small as some models predict.

Issues:

(2) Provide a convincing interpretation of the existing data, shown in Fig. 2 of the LOI, before proceeding to a full proposal.
(3) Develop a fully quantitative strategy for unraveling short range correlations in the deuteron and the final state interaction from a possible exotic EMC effect.
(4) Ensure that there is sufficient statistical precision and systematic accuracy to pin down a reasonable prediction for the EMC effect.
(5) Discuss in a quantitative way, possibly from existing data, whether there is a real background of backward going protons from secondary hadronic processes in the interaction that could contaminate the desired data.
(6) Discuss whether a possible D(e,e'n)X companion experiment could help in the interpretation of the proposed data.

Recommendation: A full proposal is encouraged provided the issues listed above can be addressed adequately.

Individual Proposal Report

Proposal: LOI12-07-103

Title: A Detailed Study of Semi-Inclusive Deep-Inelastic Pion Productions on Unpolarized Proton and Deuteron Targets with the CLAS12 Detector.

Spokespersons: X. Jiang and H. Lu

Motivation: The authors propose a detailed study of event multiplicity, azimuthal angle and transverse momentum dependence of semi-inclusive pion production with 11 GeV (and 8.8, 6.6 GeV) electron beam scattering off unpolarized proton and deuteron targets using the large acceptance CLAS12 detector. Measurements will span a dense three-dimensional grid of x, Q^2 and z and a wide p_T range. These survey data will be inputs to the next generation NLO global analysis of the polarized and unpolarized SIDIS as well as e^+e^- and pp data, to constrain the parton fragmentation functions, densities and helicity distributions. The proposed study will thus be of great importance for understanding the (deep) inelastic electroproduction and will belong to the mainstream of the scientific program of the Laboratory.

Measurement and Feasibility: This experiment will be entirely parasitic to any physics program involving CLAS12. However extracting the interesting events from the collected data as well as their analysis will be a major effort for which a large group with clearly defined commitments will be necessary.

Issues: The submitted document does not meet the criteria of a standard letter-of-intent. It lacks details of the experiment and simulation, data analysis, expected uncertainties as well as discussion of the relation of this experiment to other experiments and detailed information concerning the analysis commitments of the group.

Recommendation: In spite of the drawbacks listed above, the committee recognizes the fundamental value of the proposed study and encourages the proponents to submit a full proposal.

APPENDIX F

Jefferson Lab Experiments, PAC 32,
Grouped by Category

(To access Appendix F, go to http://www.jlab.org/exp_prog/proposals/07prop.html