PR12-07-101: *Hadronization in Nuclei by Deep Inelastic Electron Scattering*

I. Balitsky, F. Gross

The proposed experiment is devoted to the study of mechanism of confinement by analysing the space-time structure of hadron production and formation in semi-inclusive deep inelastic electron scattering (SIDIS) on various nuclei. A primary objective of the study is the development of a quantitative understanding of confinement and the differentiation of an array of existing model predictions. The theoretical studies of SIDIS are based on the factorization assumption, i.e. that the amplitude is a product of the parton density (depending on Bjorken x) and the fragmentation function depending on z - the fraction of the quark momentum carried by the hadron. This assumption will be checked by comparing the amplitudes at the same energy but different Q^2. The main goal of the experiment is to determine whether the hadron is formed inside or outside the nucleus and distinguish between different quantitative theoretical models of the hadronization process. The two recent models discussed in the proposal are the Wang model based on multiple parton scattering, and the Kopeliovich two-stage model where during the "production time" the quark picks up an antiquark and forms a colorless dipole and then during the formation time this dipole converts into a hadron. By choosing different targets and different various final state hadrons (pions or kaons) one can get sufficient information to distinguish between these as well as other models.

The proposed experiment would hopefully stimulate further studies of the problem of the mechanisms of quark confinement in QCD. In addition, comparison of RHIC experiments on the propagation of partons through hot nuclear media and this suggested experiment (studying the propagation of quarks/gluons in cold nuclear matter) will bring new information about the quark-gluon plasma in QCD.

This experiment is complementary to the approved Hall B experiment E12-06-117. It will focus on the events with high Q^2 and z where E12-06-117 will obtain limited data.

PR12-07-102: *Precision Measurement of the Parity-Violating Asymmetry in DIS...*

D.G. Richards, M. Vanderhaeghen

This experiment aims to determine the combination of low-energy constants $2C_{2u} - C_{2d}$, through the measurement of the parity-violating asymmetry in DIS off deuterium, and hence obtain a low-energy determination of $\sin^2\theta_W$, the weak mixing angle. This angle is very precisely determined at the Z-pole, and the running of the angle to low energies, such as that of this proposal, can be computed within the Standard Model of particle physics. Any discrepancy between the low-energy determination and the value obtained by running from the Z-pole might be indicative of beyond-the-standard-model (BSM) physics affecting the running of the angle. Thus this experiment affords a exciting opportunity for low-energy experiments to constrain new physics at the TeV scale.

The proposers note that the asymmetry in this case is relatively large, around 280ppm, and they propose determining this asymmetry to about 0.5% accuracy. The proposal outlines the range of BSM extensions to which the asymmetry is sensitive. There is some confusion in the description, in that SUSY theories, for example, typically unify the coupling constants at a unification scale that is far below the Planck scale. However, this does not diminish the significance of the proposal.

The proposal describes in considerable detail both the (electroweak) radiative corrections such as the $\gamma - Z$ box diagram, and hadronic effects, notably charge-symmetry-violations (CSV) and higher-twist contributions. These latter in particular might mask any possible BSM physics. This experiment is at a single x and Q^2; as the authors note, this proposal has to be viewed as an element of a broad program to study PV scattering since it is by exploring different kinematics that the BSM and hadronic effects can be delineated.

PR12-07-103: *The Nuclear Transparency of Pion-photoproduction from ^{4}He at 12 GeV*

M. Vanderhaeghen, J. Dudek

This experiment proposes to measure the nuclear transparency in the quasi-free $\gamma n \to \pi^- p$ reaction on deuterium and ^{4}He up to a momentum transfer $-t$ of 9 GeV^2, extending a previous JLab experiment (E94104) which was performed up to about $-t = 3.5$ GeV^2.

The measurement of nuclear transparency is interesting quantity to explore as a rise with momentum transfer can be interpreted as a signal of color transparency (CT). One weak point in the present proposal however is that the authors only show the effect within one model calculation (Gent group, figure 7). It is already obvious from the existing data points (green) that the model with CT effect included overestimates the data points. The proposers should seek comparison with other theory calculations to get a better estimate of the variations of the model predictions.

Besides the motivation to test the onset of CT, the authors also mention that the experiment would "validate the strict applicability of factorization theorems for meson electroproduction experiments" and they make the link with the formalism of GPDs. This whole part is very weakly founded as the GPD formalism applies to the longitudinal meson electroproduction cross section at large Q^2 and small $-t$, whereas the authors address the photoproduction cross section at large $-t$ (wide angle scattering). The factorization for that process is not even proven theoretically. It is not clear what the authors want to test here. Unless the authors can make a stronger point, they should omit the whole discussion of factorization and GPDs.

PR12-07-104: *Measurement of* G_M^n *at high* Q^2 ...

R. Schiavilla, R. Edwards

The proposed experiment will expand our experimental knowledge of the neutron magnetic form factor by about a factor of 3 in Q^2, from 4.8 $(\mathrm{GeV/c})^2$—the current upper limit—to roughly 14 $(\mathrm{GeV/c})^2$. Its intrinsic scientific merits are very high, and need not be elaborated on here, since they are discussed in the proposal. It suffices to say that the neutron (and proton) electromagnetic form factors are among the most basic properties of hadrons, and a crucial testing ground for lattice QCD and QCD-inspired models of nucleonic structure. The proton magnetic form factor is known for Q^2 beyond 30 $(\mathrm{GeV/c})^2$.

The experiment, which is planned to run in the upgraded CEBAF and CLAS12 detector, will measure the ratio of $d(e,e'n)p$ to $d(e,e'p)n$ cross sections in quasielastic kinematics. Deuteron structure and other conventional effects (such as FSI and MEC) should be negligible at these kinematics (and rather large momentum transfers), and so this ratio corresponds essentially to the ratio of free neutron to proton cross sections. It is then possible to "solve" for G_M^n in terms of a reduced proton cross section, G_E^n, and kinematical factors. This technique has been successfully used in an earlier JLab experiment by the CLAS E5 group, members of which are among the proponents of the present experiment, to determine G_M^n in the Q^2-range (0.5–4.8) $(\mathrm{GeV/c})^2$.

The experiment aims at a 3% measurement of G_M^n and, in order to achieve this goal, several issues, in particular having to do with the selection of quasielastic events and the kinematical cuts needed to minimize inelastic contributions, and neutron detection efficiencies, are addressed in the proposal. Of course, one also needs to know the proton cross section and G_E^n. However, measurements of G_E^n are only available up to 3.4 $(\mathrm{GeV/c})^2$ (once the analysis of the experiment E02-13 data in Hall A is finalized), and the JLab 12 GeV program will extend these only up to 7.5 $(\mathrm{GeV/c})^2$. In the proposal, it is argued that the fractional error on G_M^n due to G_E^n will not exceed 0.5%. But it is important to keep in mind that such an upper limit is derived from extrapolations of available parameterizations of G_E^n, the reliability of which is unknown.

PR12-07-105: *Scaling study of the L-T separated pion electroproduction cross section at 11 GeV*

W. Melnitchouk, H.-W. Lin

This well-written proposal aims to measure LT-separated pion electroproduction cross sections, with the goal of providing a high-quality data set of separated longitudinal and transverse π^+ cross sections. This data set will help to determine the suitability of the GPD formalism in describing hard exclusive pion production. One of the glaring problems with the application of the GPD formalism to current pion production data is the relatively large transverse cross section compared to the longitudinal. For hard-soft factorization to be realized, one would need $\sigma_L \gg \sigma_T$, a condition which is not yet realized in the existing data. Obtaining high-quality separated L and T cross sections at higher energies is therefore crucial to unraveling this problem, and providing guidance to theory.

The authors mention possible alternative interpretations [16] of hard exclusive reactions (specifically for DVCS, but also applicable for pion electroproduction) in terms of Regge exchange. Recent theoretical work (Szczepaniak et al., arXiv:0707.1239v1 [hep-ph]) has suggested that the Regge framework may in fact be more applicable for describing hard exclusive reactions at low $-t$, and the proposal may benefit from an expanded discussion of this possible interpretation of the data.

In any event, the case for making this set of measurements seems very clear, and the theoretical understanding of hard exclusive reactions should benefit from the proposed data.

A minor point: although we could eventually work it out, it wouldn't hurt to label what the curves in Fig. 3 are.

PR12-07-106: ***The A-dependence of*** J/ψ ***photoproduction near threshold***

J. Dudek, R. Schiavilla

The quantity of interest here is the J/ψ cross section on nucleons, which is interesting in that it is supposed to sample only the gluonic field of the nucleon. The authors propose extraction of this quantity through modeling of the photoproduction reaction on various nuclei and of the s and t dependence on a proton target.

It is mentioned that the color transparency is minimized. Presumably this is required to ensure that it is really the J/ψ that is scattering. A heuristic argument is made to justify this - it is not indicated whether detailed calculations exist that render reliable extraction of the ψN cross section possible. One specific proposal made is that measurements in the region $0.4 < -t < 1.6$ will distinguish between dependencies e^{bt} and $(1 - at)^{-4}$. Plotting these functions over this range one finds that by suitable manipulation of a and b one can get the two curves to agree very well. Thus it is unclear that the experiment will really distinguish between them.

PR12-07-107: *Studies of Spin-Orbit Correlations with Longitudinally Polarized Target*

K. Orginos, W. Melnitchouk

This is a proposal that aims to measure the single and double spin azimuthal asymmetries in semi-inclusive electro-production of pions using the 11 GeV polarized electron beam and the CLAS12 detector, with longitudinally polarized proton and deuteron targets. The objectives include the study of correlations of the transverse spin of quarks with their transverse momentum through the resulting spin asymmetries. In addition, the flavor decomposition and the transverse momentum dependence of the quark helicity distributions will be studied.

The 12 GeV Upgrade will provide the essential improvements needed to study these processes, and will significantly improve experimental results for quark helicity and transverse quark spin distributions, including their dependence on transverse momentum. Hence this is an experiment suitable for the 12 GeV runs.

One point that the authors should address in more detail is how the series of assumptions and simplifications made in the extraction of the underlying transverse momentum distribution functions from the experimental data affect their results. For example, how does inclusion of the "soft factor" in Eq. (3) modify the extraction of the distributions?

Also, as a minor correction, in Eqs. (10) and (11) the parameter μ_D should be defined.

PR12-07-108: *Precision Measurement of the Proton Elastic Cross Section at High* Q^2

R. Edwards, I. Balitsky

This Hall A experiment proposes to measure the proton elastic cross section at beam energies up to 11 GeV and Q^2 to 17 GeV^2. In this Q^2 range, the expected cross-section error expected is less than 2%, compared to the 5 to 10% today. Since the ϵ is low for this process, i.e. $p(e,p)e'$, $G_M^p(Q^2)$ can be measured with little contamination from G_E^p. These high accuracy cross section data are important quantities needed for further form-factor measurements via L-T separation. This cross-section measurement is, of itself, an excellent justification for running this experiment since it will yield the kind of paradigm data that appear in text books. Given that these data are also needed for further experiments, it seems clear that the proposers know that this is the first kind of experiment to run in the 12 GeV program.

The first stated physics goal of this experiment is to make a stringent test of pQCD scaling of F_1 in the 7 to 8 GeV^2 range. The second goal is the measurement of G_M^p. This prioritization seems a little out of place for this experiment since all the discussion is devoted to G_E and G_M. The first goal should be a clean measurement of G_M^p. Scientists will argue about pQCD scaling for a while, but the data are needed first.

PR12-07-109: *Large Acceptance Proton Form Factor Ratio Measurements at 13 and 15 (GeV/c)^2 Using Recoil Polarization Method*

F. Gross, N. Mathur

This proposal would extend the measurements of the ratio G_{Ep}/G_{Mp} to two higher Q^2 points using a novel single dipole detector system setup in Hall A. The expected experimental accuracy is of the order of 10%. It complements three sets of measurements of this quantity out to 9 (GeV)^2, the limit that can be achieved with a 6 GeV beam.

Measurement of the ratio G_{Ep}/G_{Mp} through polarization transfer continues to be of great theoretical interest. The proton charge form factor is a fundamental quantity that can only be measured (in this Q^2 range) at JLab, and an accurate measurement of it is of lasting fundamental importance, regardless of the state of the theory. The only theoretical uncertainty of importance in this experiment is the role of the two photon exchange correction. We now know that the polarization transfer method is less sensitive to this correction than is the Rosenbluth method, so that G_{Ep} is best measured in this way. The two photon corrections have been estimated and are small.