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THE JUPITER ELECTRON SCATTERING PROGRAM AT JEFFERSON LAB

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JUPITER (Jlab Unified Program to Investigate nuclear Targets and Electroproduction of Resonances) is a new collaboration between the Nuclear Physics electron scattering and High EnergyPhysics neutrino scattering communities to investigate the structure of nucleons and nuclei with electron and neutrino Beams. The first phase of JUPITER is Hall C experiment E04-001 on Inclusive Electron Scattering from Nuclear Targets. First data run of E04-001 is currently scheduled for January of 2005.

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Experiments E02-109 and E04-001 at Jefferson Laboratory have been approved to measure the longitudinal-transverse (L-T) separated structure functions F_2 and $R = \sigma_L/\sigma_T$ from Deuterium and nuclear targets in the resonance region. It is the first stage of an overal JUPITER program to investigate quark-hadron duality and electromagnetic and weak structure of nucleons and nuclei [1,2]. The targets proposed include Carbon, Quartz, Aluminum, Calcium, Steel and Copper in conjunction with baseline data on Hydrogen and Deuterium. The targets proposed are (or closely resemble) nuclear targets commonly used in neutrino experiments such as the low statistics bubble chamber experiments on Hydrogen, Deuterium, Neon, and Argon and high statistics neutrino experiments on Scintillator (MINERvA, MiniBONNE, K2K and JPARC), Water (SuperK, JPARC), Steel (MINOS) and Argon (CNGS). In addition to performing studies of quark-hadron duality in electron scattering on nuclear targets for the separated structure functions, these data will used as input vector form factors in a future analysis of neutrino data in order to investigate quark hadron-duality in the axial structure function of nucleons and nuclei. This will be done in collaboration with the MINERvA neutrino experiment [2] to be run in the NUMI [3] low energy neutrino beam at Fermilab.

An immediate impact of these new measurements with nuclear targets will be the reduction in uncertainties in neutrino oscillation parameters for current and near term neutrino oscillations experiments such as K2K and MINOS. The data are even more important for the more precise next generation neutrino oscillations experiments such as JPARC and NUMI Off-axis.

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Measurements will be made in the quasielastic and nucleon resonance region ($1 < W^2 < 4$ GeV^2) spanning the four-momentum transfer range $0.1 < Q^2 < 4.0$ (GeV/c)^2. The decomposition of the inclusive electroproduction cross sections into longitudinal and transverse strengths will accomplished by performing Rosenbluth separations to extract the transverse structure function $F_1(x, Q^2)$, the longitudinal structure function $F_L(x, Q^2)$, and the ratio $R = \sigma_L/\sigma_T$.

The analysis of the separated resonance region proton data from experiment E94-110 [4], which was also performed in Hall C, has recently been completed. Figures 1 and 2 show preliminary results of analysis of data from Jlab experiment E94-110 [4] on hydrogen in the resonance region. Similar data with deuterium and with nuclear targets will be taken by JUPITER.

The extension of the proton measurements to deuterium and nuclear targets is approved and will done in a simultaneous run by E02-109 [5], and E04-001 The JUPITER program represents the first global survey of these fundamental separated quantities in the resonance region for nucleons bound in nuclei. Data from all of the previous experiments will be also incorporated into the analysis.

The analysis machinery which was developed for E94-110 can be used with only very little modification. The great care and time invested in developing the experimental requirements, systematic uncertainty measurements, and analysis machinery will be of immediate benefit to the program. The program also builds upon the experience from previous lower statistics studies with (electrons) of the nuclear-dependence of the separated structure functions in the DIS region that were done by SLAC experiment E140 [6], as well as the very low Q^2 high W^2 studies (to test the HERMES effect) that are done by JLab experiment E99-118 [7]. In parallel, a group of experimenters led by Steve Manly (Rochester) and Will Brooks (Jlab) will investigate final states on nuclear targets in Hall B.

References

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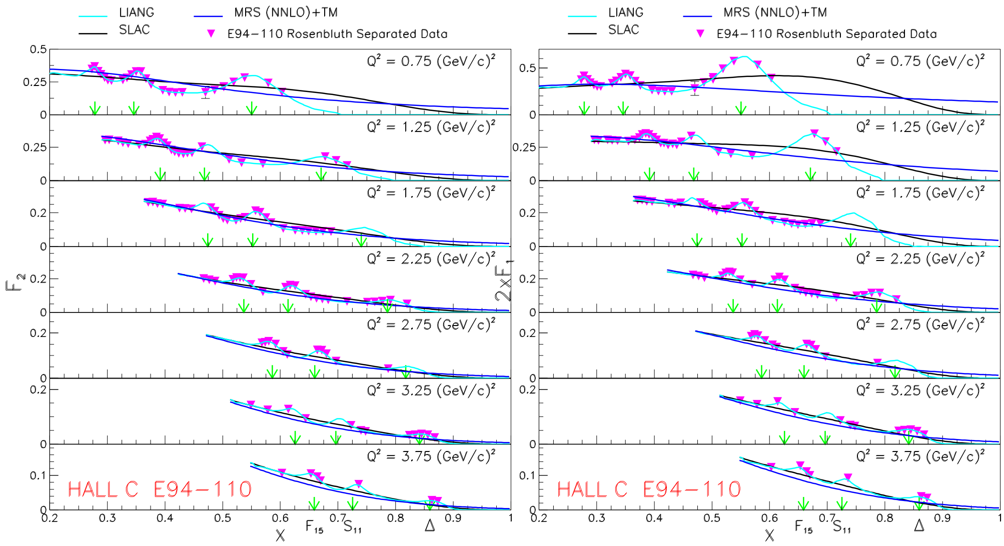

Fig. 1. Recent data from Jlab experiment E94-110 (on Hydrogen) for $2xF_1$ (left) and F_2 (right) in the resonance region. JJUPITER Data with deuterium and nuclear targets ill be taken at the same time in a January 2005 run of E02-109/ E04-001.

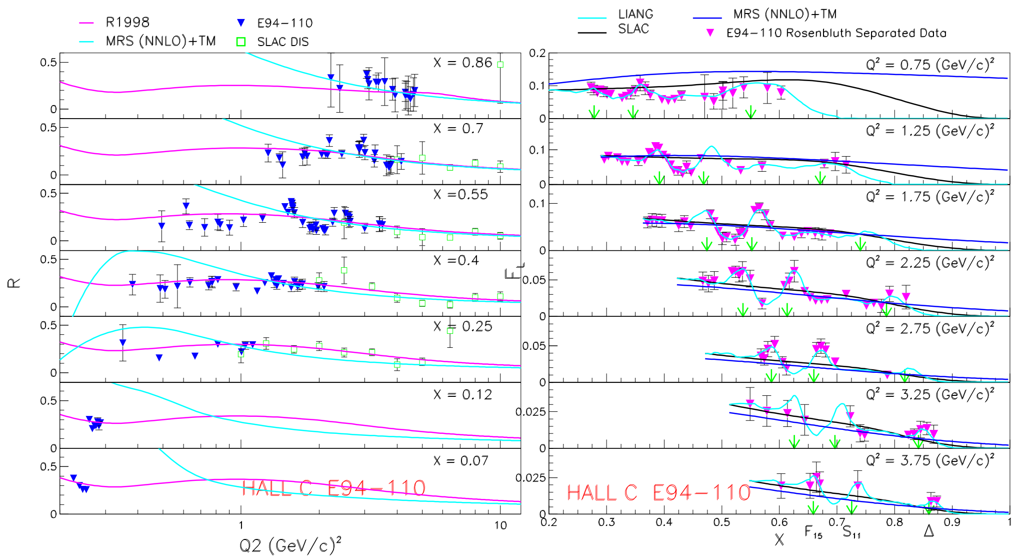

Fig. 2. Recent data from Jlab experiment E94-110 (on hydrogen) for R (left) and F_L (right) in the resonance region. JUPITER Data with deuterium and nuclear targets ill be taken at the same time in a January 2005 run of E02-109/ E04-001.