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CHARGED PION ELECTROPRODUCTION ON H,^2H, and ^3He

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A series of measurements of single pion electroproduction on the proton, deuteron, and ^3He was completed recently at Jefferson Laboratory by the NucPi Collaboration. The goal was a determination of the longitudinal cross section in parallel kinematics by means of a Rosenbluth separation, and a search for target-mass dependent effects. Longitudinal pion electroproduction should be sensitive to nuclear pion currents because of the dominance of the pion-pole process for charged-pion emission in the direction of the virtual photon. Data have been obtained at $Q^2 = 0.4\ GeV^2$, for $W = 1.15$ and $W = 1.6\ GeV$. from H,^2H, and ^3He, and for a range of values of Q^2 on H and ^2H at $W = 1.9\ GeV$.

1 Measurements

Measurements of single charged pion electroproduction on light nuclei were carried out at Jefferson Lab in Feb-April 1998 using the Hall C facility. 0.845 to 3.245 GeV electrons were scattered from high-density cryo-targets. The scattered electrons were observed in the High Momentum Spectrometer in coincidence with pions observed in a short orbit spectrometer. The kinematic conditions, shown in table 1, correspond to momentum transfers for which, in one case, the electroproduction is expected to be quenched ($p_{recoil} \approx 0.200\ GeV/c$), and a second, in which according to the standard pion-exchange model of nuclear forces, one expects a substantial enhancement ($p_{recoil} \approx 0.400\ GeV/c$). Measurements were made at kinematics corresponding to two virtual photon polarizations for each momentum transfer in order to use the data to carry out a Rosenbluth separation of the transverse and longitudinal cross sections. To date, measurements have been made for the proton, deuterium, and ^3He.

2 Results

The physics quantity of basic interest is the longitudinal charged pion electroproduction cross section for the proton bound in the deuteron and ^3He measured relative to the cross section for the free proton. To extract this quantity, the experimental measured coincidence yield is simulated in a Monte Carlo calculation(SIMC) using a realistic model of the experiment. The effects of spectrometer response, radiation, nucleon Fermi motion, and kinematic variation of the primary nucleon cross section are included in the simulation. To avoid corrections for the coherent contributions, $^3He(e,e'\pi^+)T/Dn$, to the π^+

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Table 1: Kinematic Conditions for JLAB experiment E91-003.

E	ω	Θ_e	Θ_q	W	Q^2	p_π	ϵ	p_{recoil}
GeV	GeV	deg	deg	GeV	GeV/c^2	GeV/c		GeV/c
0.845	0.46	66.87	27.11	1.150	0.396	0.327	0.43	0.451
1.645	0.46	26.04	41.94	1.150	0.396	0.327	0.86	0.451
1.645	1.108	39.33	15.46	1.600	0.400	1.079	0.49	0.197
3.245	1.108	13.79	23.54	1.600	0.400	1.079	0.89	0.197
2.446	1.879	38.40	10.01	1.950	0.600	1.856	0.37	0.180
3.549	1.879	18.31	14.87	1.950	0.600	1.856	0.74	0.180
2.669	1.957	36.60	11.45	1.950	0.750	1.929	0.43	0.210
3.549	1.957	21.00	15.47	1.950	0.750	1.929	0.70	0.210
3.007	2.410	56.33	10.50	1.950	1.600	2.326	0.27	0.400
4.045	2.410	28.49	16.63	1.950	1.600	2.326	0.63	0.400

spectrum measured for ^3He, the π^- spectrum corrected by the measured π^+ to π^- ratio measured for σ_l in the deuteron is used to estimate quasifree π^+ production in ^3He. The resulting extracted cross section ratios are shown in Fig. 1. Within the precision of the measurements, there is no indication of

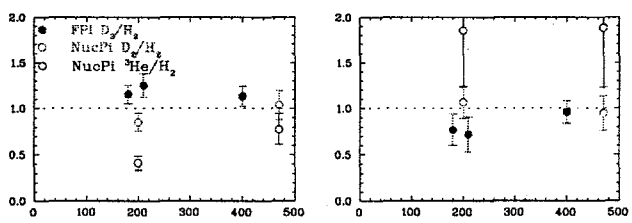

Figure 1: The measured ratios of $d\sigma_l/d\Omega_\pi$, left, and $d\sigma_t/d\Omega_\pi$, right, for single $\pi+$ electroproduction on the deuteron and ^3He to the free proton cross section.

multinucleon contributions. The measured values of the $d\sigma_l/d\Omega_\pi$ ratios cluster around one, with the exception of the point for ^3He at 0.197 GeV. There is no evidence in these data for a measurable enhancement of $d\sigma_l/d\Omega_\pi$ in either target.

Acknowledgments

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