Hyperon–Nucleon Bound States and Electroproduction of Strangeness on Light Nuclei*

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The $A(e,e'K^+)YX$ reaction has been investigated in Hall C at Jefferson Lab. Data were taken for $Q^2 \approx 0.35$ and 0.5 GeV^2 at a beam energy of 3.245 GeV for ^1H,^2H,^3He,^4He, C and Al targets. The missing mass spectra are fitted with Monte Carlo simulations including Λ, Σ^0, Σ^- hyperon production. Models for quasifree production are compared to the data, excess yields close to threshold are attributed to FSI. Evidence for Λ-hypernuclear bound states is seen for $^{3,4}He$ targets.

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1. Introduction

The high intensity CW electron beams at the Jefferson Lab provide the possibility to study with high precision the electroproduction of strangeness. Experiment E91016 measured the $A(e,e'K^+)YX$ for $^1H,^2H,^3He,^4He$, C and Al targets. Angular distributions of K^+ were measured at forward angles with respect to the virtual photon, γ^*. This paper focuses on preliminary results on data from Helium targets.

The experiment was performed in 1996 and 1999 in Hall C of Jefferson Lab. For a description of experimental method see [1] and references therein. The spectrometer angle for detecting the e' was kept fixed; the K^+ arm was varied. Three different angles between the γ^* and the K^+ were studied, $\theta^{lab}_{\gamma^* K} = 0^o$, $\simeq 6^o$, and $\simeq 12^o$.

2. Results and Discussion

The missing mass distribution for $^1H(e,e'K^+)Y$ shows two peaks corresponding to the Λ and Σ^0 hyperons[1]. The acceptance as well as radia-

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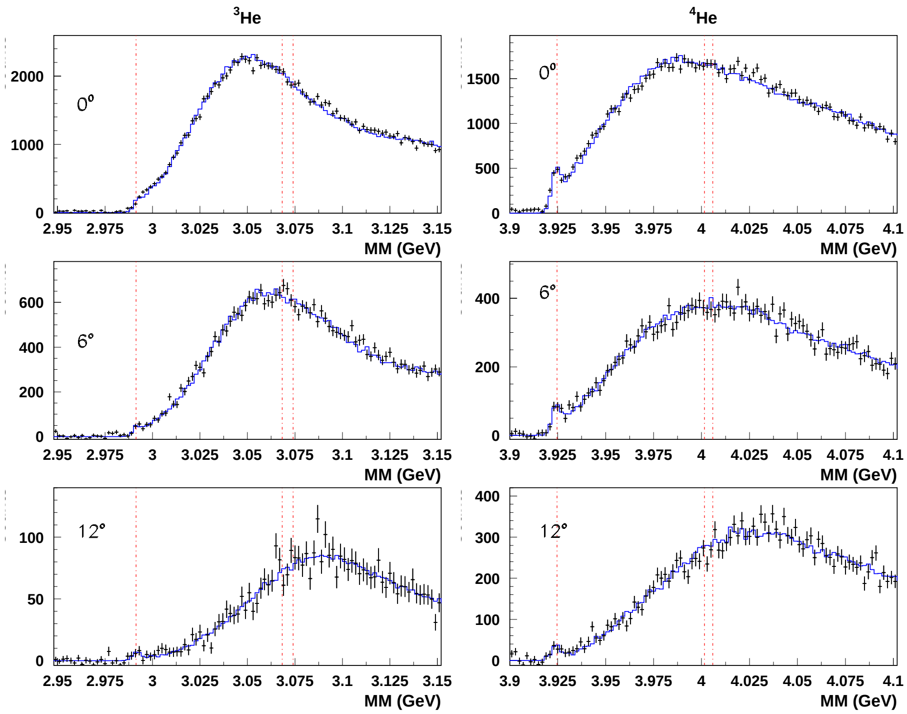

Fig. 1. Missing mass distributions for $^{3,4}He(e,e'K^+)$ at $\theta^{lab}_{\gamma^*,K} = 0^o, 6^o, 12^o$. The solid line represents a Monte Carlo simulation of the quasifree contributions for Λ, Σ^0, Σ^- production for $^{3,4}He$. FSI corrections are applied and the simulation of $^{3,4}He(e,e'K^+)^{3,4}_{\Lambda}H$ are added. The dot-dashed lines show the threshold for quasifree Λ, Σ^0, Σ^- production for $A = 3, 4$.

tive processes are computed by Monte Carlo simulations. A parametrization of the γ^*N cross section has been derived by fitting the kinematic dependences of the $^1H(e,e'K^+)Y$ cross section over the acceptance [1]; this parametrization has been used for $A \geq 2$ [2]. For $A \geq 2$, the momentum and in-medium energy of the struck nucleon in the target is taken from full spectral functions[3]. Excess yields close to the Λn and ΣN thresholds are attributed to FSI, described in an effective range model[4]. For $A = 3, 4$ the agreement between simulation and data is shown in Fig. 1. Near the quasifree Λ-thresholds for $A = 3, 4$, Fig. 1 exhibits narrow structures which are attributed to the $^3_\Lambda H$ and $^4_\Lambda H$ bound states. The structures are independent of the angle and centered at the correct binding energy. While barely discernible for ^3He at $\theta^{lab}_{\gamma^*,K} = 0^o$, it becomes evident for $\theta^{lab}_{\gamma^*,K} = 6^o, 12^o$. It is clearly visible for all measured angles for ^4He. Further quantitative statements are expected after completing the analysis of the data.

3. Summary

The measurements on $^{1}H(e,e'K^{+})Y$ established the basic high precision data to extend the experiments on associated hyperon production to nuclear targets. For $A \geq 2$ a full spectral function is used to describe the struck nucleon in the nucleus. In each case the kinematic model derived from hydrogen is used in impulse approximation to describe the quasifree production of hyperons off nuclear targets. Moreover, for $A = 3, 4$, we observe clear evidence for the $^{3}_{\Lambda}H$, $^{4}_{\Lambda}H$ bound states produced in electroproduction.

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