

# Production spectra of neutron-rich hypernuclear states in the ${}^6\text{Li}(\pi^-, K^+)$ reaction at 1.2 GeV/c

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A  ${}^6_\Lambda\text{H}$  hypernucleus is one of the most interesting candidates to investigate neutron-rich  $\Lambda$  hypernuclei because a large  $\Lambda$  binding energy of  $B_\Lambda({}^6_\Lambda\text{H}) = 5.8$  MeV for the  $0^+$  ground state was suggested due to the contribution of 1.4 MeV caused by the coherent  $\Lambda$ - $\Sigma$  coupling [1]. The FINUDA collaboration reported a binding energy of  $B_\Lambda({}^6_\Lambda\text{H}) = 4.5 \pm 1.2$  MeV in the  ${}^6\text{Li}(K_{\text{stopped}}^-, \pi^+){}^6_\Lambda\text{H}$  reaction [2]. This experimental value of  $B_\Lambda({}^6_\Lambda\text{H})$  seems to be in rather good agreement with those of  $3.8 \pm 0.2$  MeV in shell-model calculations [3] and 2.47 MeV in  $t+n+n+\Lambda$  four-body cluster-model calculations [4]. Recently, the J-PARC E10 collaboration [5,6] performed the measurement of the  ${}^6\text{Li}(\pi^-, K^+){}^6_\Lambda\text{H}$  reaction at  $p_{\pi^-} = 1.2$  GeV/c; missing mass spectra from  $\Lambda$  to  $\Sigma$  regions are measured with  $K^+$  scattering angles of  $\theta_{\text{Lab}} = 2\text{--}14^\circ$ , whereas no significant peak structure is observed around the  ${}^4_\Lambda\text{H} + 2n$  threshold.

In this note, we theoretically demonstrate the inclusive spectra of the  ${}^6\text{Li}(\pi^-, K^+)$  reaction within a distorted-wave impulse approximation, using a coupled  $({}^5\text{H}-\Lambda)+({}^5\text{He}-\Sigma^-)$  model with a spreading potential, in order to study the reaction mechanism and the  $\Lambda$ - $\Sigma$  coupling. The results show that the calculated spectra by  $\pi^-p \rightarrow K^+\Sigma^-$  via  $\Sigma^-$  doorways caused by the  $\Sigma^-p \leftrightarrow \Lambda n$  coupling (one-step mechanism) can reproduce the experimental data at  $p_{\pi^-} = 1.2$  GeV/c [6], as shown in Fig. 1. We confirm that the one-step mechanism is rather favored in production of neutron-rich  $\Lambda$  hypernuclear states by nuclear  $(\pi^-, K^+)$  reactions [7]. The production cross sections of  ${}^6_\Lambda\text{H}$  are also discussed, depending on properties of the  ${}^5\text{H}-\Lambda$  potential and the  $\Lambda$ - $\Sigma$  mixing.

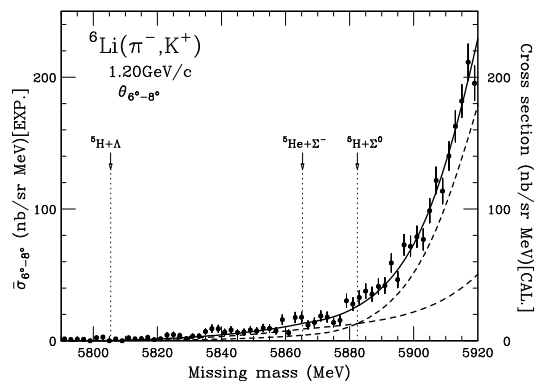


Figure 1: Comparison with the calculated inclusive spectrum in one-step mechanism and the experimental data at  $p_{\pi^-} = 1.2$  GeV/c,  $\theta_{\text{Lab}} = 7^\circ$  [6].

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