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Study of Lambda-n FSI with Lambda quasi-free productions on the 3H(e,e′Kˆ+)X reaction at JLab

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In the nucleon-nucleon (NN) interaction, realistic nuclear force models have been established with NN scattering data. On the other hand, there are relatively large uncertainties due to limited ΛN scattering data in case of the ΛN interaction. The spectroscopic studies of Λ hypernuclei have played an important role in knowledge of the effective Λn interaction.
An $nn\Lambda$ is a neutral baryon system which consists of two neutrons and a Λ. The study of the pure Λ-neutron system such as $nn\Lambda$ is expected to give us information on the Λn interaction. Although HypHI group at GSI reported measuring events which were a possibility of the bound $nn\Lambda$ [1], existence of the $nn\Lambda$ was not confirmed due to the limited significance. Since search for the $nn\Lambda$ with independent experiment is important, we measured the $^3\mathrm{H}(e,e'K^+)nn\Lambda$ reaction spectroscopy (E12-17-003) at Jefferson Lab (JLab) Hall A in 2018. In this experiment, the $nn\Lambda$ and Λ quasi-free (Λ-QF) production would be produced by a cryogenic tritium gas target with the thickness of 84.8 mg/cm^2 and a high intensity and high energy primary electron beam ($\mathrm{I_e}$ =22.5 μA, $\mathrm{E_e}$ =4.32 GeV). The missing mass was obtained by measuring momenta of K^+ (p_K =1.8 GeV/c) and scattered electrons ($p_{e'}$ =2.2 GeV/c) with two High Resolution Spectrometers (HRSs) which are the standard equipment at JLab Hall A. Validity of the missing mass was studied with the Λ and Σ^0 mass in the $\mathrm{H}(e,e'K^+)\Lambda/\Sigma^0$ reaction. However, we could not find any clear peaks on the missing mass spectrum [2].
Λ-QF events in the $^3\mathrm{H}(e,e'K^+)X$ reaction were observed in this experiment. The Λ-QF distribution has an event excess around the $nn\Lambda$ threshold region. A similar excess was already found by the previous experiment that measured Λ-QF productions with the $^3\mathrm{He}(e,e'K^+)X$ reaction and it gave important information about Λn final state interaction (FSI) [3]. Ref. [3] successfully reproduced the excess on the missing mass by using an effective range (r) and a scattering length (a) of several effective ΛN potential models. Since the measured system in this experiment is the pure neutral system, the Λ-QF distribution has important information about the Λn FSI. We fitted the Λ-QF distribution by changing the effective range and scattering length so that fitting chi-square becomes minimum.
I will present this experimental overview and the analysis result of the Λn FSI from the Λ-QF distribution.

[1] C. Rappold *et al.*, Physical Review C **88**, 041001 (2013).
[2] K.N. Suzuki *et al.*, Prog. Theor. Exp. Phys. **2022**, 013D01 (2022).
[3] F. Dohrmann *et al.*, Phys. Rev. C **76**, 054004 (2007).

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