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# Article / Book Information

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# 論 文 要 旨

THESIS SUMMARY

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| 専攻：<br>Department of | 基礎物理学　専攻 | 申請学位（専攻分野）：<br>Academic Degree Requested | 博士　（　理学　）<br>Doctor of |
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要旨（英文 800 語程度）
Thesis Summary（approx.800 English Words ）


In this thesis, we have studied the following two subjects: (1) We have studied the production reaction of the Λ(1405) and the strange dibaryon resonances, by solving the $\bar{K}NN$-$\pi YN$ coupled channel AGS equations. (2) We have investigated the possibility to have a bound state in neutron-rich light hypernuclei, the ${}^{3}_{\Lambda}n$ and the ${}^{6}_{\Lambda}$H, by using the GEM.

In the investigation of the Λ(1405) resonance production reactions, we have employed the two types of meson-baryon interactions: an energy-dependent (E-dep.) interaction and an energy-independent (E-indep.) one, both derived from the leading term of the chiral effective field theory. For the $K^- d \to \pi\Sigma n$ reaction, we have found peak and bump structures in the differential cross sections at the resonance energy of the Λ(1405) for each of E-dep. model and E-indep. interaction model. Therefore it is possible to observe the signal of the Λ(1405) resonance in the physical cross sections. Since the magnitude and the interference patterns with backgrounds of the cross section are significantly different between E-dep. model and E-indep. model, the $K^- d \to \pi\Sigma n$ reactions are useful to obtain the information on the dynamical origin of the $\bar{K}N$-$\pi\Sigma$ coupled systems with the Λ(1405). Furthermore, we have also shown that the channel dependence of the cross section is quite large in the forward neutron scattering, so that we may also obtain the crucial information on the $I=1$ $\bar{K}N$-$\pi\Sigma$ interactions.

For the strange dibaryons production reactions, we have found clear bump structures appear in the quasi-two-body scattering amplitudes and the transition probabilities for the $Y_{K(I=0)}N \to \pi\Sigma N$ reaction. We have also shown that the amplitudes and the transition probabilities for the E-dep. and E-indep. models have quite different energy dependencies. Because this difference is closely related to the different nature of Λ(1405) between these two models, the strange dibaryon resonance production reaction could be useful for study of the dynamical models of the Λ(1405). We have also estimated the transition probability of the $\Lambda N$ final state, and found the signature of the strange dibaryon resonances in the $\Lambda N$ mass spectrum was less significant than that of the $\pi\Sigma N$ final state due to the strong contribution of the background amplitudes.

Motivated by observed data for the ${}^{3}_{\Lambda}n$, we have performed the calculation of the $\Lambda NN$-$\Sigma NN$ three-body coupled systems by employing the simulated NSC97f $YN$ interactions. These interactions reproduce the observed binding energies of the ${}^{3}_{\Lambda}$H, ${}^{4}_{\Lambda}$H and ${}^{4}_{\Lambda}$He. However, we have not found any bound state in the ${}^{3}_{\Lambda}n$ system by using these interactions. We have also investigated the possibility to produce such a bound state in ${}^{3}_{\Lambda}n$ by tuning the strength of these potentials. As a result, we have not found any possibility to have a bound state in ${}^{3}_{\Lambda}n$, while maintaining consistency with the observed data.

For the ${}^{6}_{\Lambda}$H, we have studied the structure within the framework of a $tnn\Lambda$ four-body model. In the calculation of the ${}^{6}_{\Lambda}$H binding energy, it is important to reproduce the binding energy of the core nucleus ${}^{5}$H. To reproduce the binding energy of core nucleus ${}^{5}$H, we have employed the $tnn$ three-body force as well as the $tn$ two-body interaction. When the $tnn$ three-body force has been tuned to reproduce the central value of the observed ${}^{5}$H resonance energy, we have obtained the ${}^{6}_{\Lambda}$H ground state as a resonance at $(E,\ \Gamma)=(-0.87,\ 0.23)$ MeV with respect to the $tnn\Lambda$ threshold, which means $B_\Lambda$=2.47 MeV. This value is inconsistent with the observed data $B_\Lambda=4.0\pm1.1$ MeV by FINUDA Collaboration. The observed ${}^{5}$H resonance energy has the error bar. Next, we have tuned the strength of $tnn$ three-body force so as to reproduce the lowest bound based on the error of the observed ${}^{5}$H resonance energy. However, we have not found any bound state for ${}^{6}_{\Lambda}$H below the ${}^{4}_{\Lambda}$H$nn$ threshold. We have generated a shallow bound state of ${}^{6}_{\Lambda}$H at $E$=-2.07 MeV (by 0.07 MeV below the lowest ${}^{4}_{\Lambda}$H$nn$ threshold) when the $tnn$ three-body force has been adjusted to have the ${}^{5}$H at resonance energy $(E,\ \Gamma)=(1.17, 0.91)$ MeV which is, however, 0.23 MeV below the lower bound of the error on the observed energy. In this case, the separation energy is $B_\Lambda$=3.24 MeV, which is consistent with the FINUDA data within the error.


備考 ： 論文要旨は、和文 2000 字と英文 300 語を 1 部ずつ提出するか、もしくは英文 800 語を 1 部提出してください。
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