

Study of ΛN interaction via the γ -ray spectroscopy of ${}^4_{\Lambda}\text{He}$ and ${}^{19}_{\Lambda}\text{F}$ (E13-1st)

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An investigation of the ΛN interaction plays an important role in understanding baryon-baryon interactions by introducing the strangeness quantum number. γ -ray spectroscopy using germanium (Ge) detector is a powerful tool to study the spin-dependent ΛN interactions through precise measurements of level structures of hypernuclei. Their energy spacing is sometimes several tens of keV due to small spin-dependent ΛN interactions. By using Ge detectors with an energy resolution of ~ 3 keV, these fine structures can be measured. Using this method, the structures of p -shell hypernuclei were previously measured at KEK and BNL, and the strengths of spin-dependent terms in the ΛN effective interaction in p -shell region were determined. We plan to extend our knowledge of the interactions to s - and sd -shell region in E13 using a newly developed Ge detector array, Hyperball-J, and high intensity K^- beam at the J-PARC facility. In the first phase of E13, ${}^4_{\Lambda}\text{He}$ and ${}^{19}_{\Lambda}\text{F}$ will be studied at the K1.8 beam line [1]. By measuring the ${}^4_{\Lambda}\text{He}$ ($1^+ \rightarrow 0^+$) γ ray, we will examine the existence of charge symmetry breaking in the ΛN interaction by comparing to the ${}^4_{\Lambda}\text{H}$ data. ${}^{19}_{\Lambda}\text{F}$ will be the first hypernucleus in sd -shell to be studied by the γ -ray spectroscopy method. In particular, a radial dependence of the spin-dependent ΛN interactions can be investigated from the interaction strength between the s -shell, p -shell and sd -shell hypernuclei.

Hypernuclei will be produced by the (K^-, π^-) reaction. K^- beams and scattered π^- mesons are particle-identified and momentum-analyzed by the beam line spectrometer and the SksMinus spectrometer, respectively. On the other hand, γ rays are detected by Hyperball-J, placed around the target. Through the coincidence measurement between these spectrometer systems and Hyperball-J, γ rays from produced hypernuclei can be measured. The whole detector system was installed at the beam line and tested with a beam in 2013. We confirmed full operation of the system. In this talk, an outline and the preparation status of E13-1st will be presented.

References

- [1] H. Tamura, M. Ukai, T.O. Yamamoto, T. Koike, Nucl. Phys. A 881 (2012) 310-321.