Study of Double-Λ Hypernuclei and Perspective

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Study of Λ-Λ interaction is one of the most challenging work in nuclear physics. It may provide us of an opportunity to verify various ideas on baryon-baryon interaction such as the SU(3)$_{\text{flavor}}$ symmetry. Besides, the information about Λ-Λ force is useful to investigate multi-strangeness system such as "strange matter". The study of hyperon-hyperon interaction could also provide us the solution for the problem of non-existence of the $H$ particle.

Experimentally, we have carried out the E373 experiment, where we could expect one thousand events of $\Xi^-$ hyperon capture at rest in nuclear emulsion. Among them, there are found several double-hypernucleus events and two events with twin single-hypernuclei. The interaction energies, $\Delta B_{\Lambda\Lambda}$, between two Λ hyperons are obtained by the mass measurement of double-Λ hypernuclei. The scanning in the experiment is almost done, then it will be important that the results have to be summarized.

In nuclear physics, it has been progressed by newly-discovered nuclei. We are preparing a next-generation hybrid-emulsion experiment, AGS-E964 at BNL. More than ten thousands of $\Xi^-$ hyperons capture at rest shall be detected in nuclear emulsion. We could make nuclear chart with $S=-2$ using several tens' double-Λ hypernuclei. It will be carried out the measurements of A-dependence of $B_{\Lambda\Lambda}$, binding energy of two Λ hyperons in nucleus, and X-ray emitted from the capture process of $\Xi^-$ hyperons. The development of Double-sided Silicon Strip Detector and a fast scanning system shall also be introduced.

At J-PARC, we will challenge to analyze one hundred thousands of events showing $\Xi^-$-stopping in nuclear emulsion. In this experiment, all of interactions in the emulsion could be scanned. It is necessary to develop a fully automated and quite fast scanning system, and also new type of nuclear emulsion with very fine-sized crystal which can be treated even in daylight after cutting UV-light. We will discuss an outline of the experiment.