Gamma-ray spectroscopy with strangeness and a new Ge array at J-PARC

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A series of γ-ray spectroscopy experiments at the BNL-AGS in U.S.A. and the KEK-PS facilities in Japan in the past decade has identified energy levels of Λ hypernuclei for the first time with a high precision. A Λ hypenucleus has a Λ hyperon with a strangeness quantum number, S=-1. The nucleus can be produced following the n(π^+, K^+)Λ and n(K^-,π^-)Λ reactions. A use of high energy hadron beams such as π^+ and K^- with their momenta $\sim$GeV/c means a huge background and has made the γ-ray spectroscopy of hypernuclei extremely difficult. The hypernuclear γ-ray spectroscopy was pioneered by Tamura et. al. at Tohoku with an advent of the Ge detector array Hyperball in 1998, in conjunction with a hypernuclear production tagging by the large acceptance magnetic spectrometer system, Superconducting Kaon Spectrometer (SKS).

So far the p-shell hypernuclei have been systematically studied. These data have laid a foundation for investigating spin dependent terms in the ΛN interaction. In addition to identifications of energy levels, the lifetime measurement of an excited level in ${}^{7}_{\Lambda}$Li via DSAM has enabled extraction of B(E2) which indicated that an inclusion of Λ resulted in the size shrinkage of a nucleus. The hypernuclear spectroscopy will be continued at Japan Proton Accelerator Research Complex (J-PARC) that has just begun operation. Due to its much higher beam intensity, a new Germanium detector array dedicated to the hypernuclear γ-ray spectroscopy has been developed and being constructed. The new Ge array, Hyperball-J has several new features such as a total mechanical cooling of Ge detectors and very fast Compton and background suppressors using PWO crystals replacing the conventional BGO shields.

In this contributions a brief summary of the hypernuclear γ-ray spectroscopy will be given followed by the present status of the Hyperball-J array and of preparation for an experiment at J-PARC which is scheduled this year.