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### **Hypernuclear physics via $\gamma$ -ray spectroscopy**

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A series of hypernuclear  $\gamma$ -ray spectroscopy experiments performed at KEK-PS and BNL-AGS using a germanium detector array, Hyperball, have accumulated precise data on various p-shell  $\Lambda$  hypernuclei. We observed “hypernuclear fine structure” in various hypernuclei and extracted the strengths of all the spin-dependent parts (spin-spin, spin-orbit, and tensor terms) of the  $\Lambda$ - $N$  interaction. The obtained strengths reproduced structure of most of the p-shell  $\Lambda$  hypernuclei quite well, and also played important roles in testing and improving baryon-baryon interaction models. We also measured a B(E2) value of  ${}^7_{\Lambda}\text{Li}$  and confirmed “shrinking effect” of a  $\Lambda$  hyperon. In the J-PARC facility, further experiments of hypernuclear  $\gamma$ -ray spectroscopy are planned to be performed. In the first experiment (E13), we will extend our study to s-shell and sd-shell hypernuclei and investigate the  $\Lambda$ - $N$  interaction more in detail. We also plan to study the g factor of a  $\Lambda$  hyperon in a nucleus by measuring a B(M1) value of  $\Lambda$ -spin-flip transitions in hypernuclei in order to study possible modification of baryon properties in nuclear matter. In future, we will also investigate “impurity effect” of nuclear structure induced by a  $\Lambda$ , such as the shrinking effect and a possible change of nuclear deformation.