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Spectroscopy of Λ Hypernuclei: Recent Progress and Future Prospects

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Recently, great progress has been made in spectroscopic studies of Λ hypernuclei. In this talk, the present status and future plans of Λ hypernuclear spectroscopy are presented, particularly on precision γ -ray spectroscopy. We have been investigating detailed structure of Λ hypernuclei by means of the precision γ -ray spectroscopy technique with a large germanium detector array, Hyperball. We have studied γ transitions in various p-shell Λ hypernuclei (${}^7_{\Lambda}\text{Li}$, ${}^9_{\Lambda}\text{Be}$, ${}^{10}_{\Lambda}\text{B}$, ${}^{11}_{\Lambda}\text{B}$, ${}^{15}_{\Lambda}\text{N}$, and ${}^{16}_{\Lambda}\text{O}$) via the $(\pi^+, K^+\gamma)$ reaction at KEK and the $(K^-, \pi^-\gamma)$ reaction at BNL. The precise level structure data of these hypernuclei allowed us to determine all the spin-dependent (spin-spin, spin-orbit, and tensor) ΛN interaction strengths, which give stringent constraints to baryon-baryon interaction models. The upgraded apparatus (Hyperball2) is now ready for further studies, where one of the most important subjects is the study of magnetic moment of a Λ in a nucleus through measurement of $B(M1)$ values for Λ -spin-flip $M1$ transitions in hypernuclei. In near future, hypernuclear γ spectroscopy will be greatly developed by using strong beams from the 50 GeV proton synchrotron at J-PARC. In addition, recent progress and future plans are summarized for high-resolution Λ hypernuclear spectroscopy via the $(e, e'K^+)$ reaction at Jlab and spectroscopy of neutron-rich Λ hypernuclei via the (π^-, K^+) reaction at KEK.