Gamma-Ray Spectroscopy of Hypernuclei with ^{10}B Target

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Investigation of hypernuclear γ rays using ^{10}B target is related to two important subjects. One is to determine a small spacing between the ground-state doublet states. The measurement of the ground-state double spacing gives an information on the strength of ΛN spin-spin interaction (Δ). The other subject is to study structure of verious hypernuclei which may be produced as hyperfragments from unbound excited states of $^{10}_{\Lambda}$B.
Previously, Chrien *et al.* searched for the M1 transition between the ground-state doublet ($2^- \to 1^-$), but did not observe this transition below 1 MeV. Because of an expected large cross section for $^{10}_{\Lambda}$B(2^-), they concluded that the doublet spacing is smaller than 80 keV which corresponds to $\Delta < 0.22$ MeV [1]. On the other hand, M1 transition of $^{7}_{\Lambda}$Li ($3/2^+ \to 1/2^+$) was measured at KEK (E419) in 1998, which indicates $\Delta \sim 0.5$ MeV[2]. In this situation, to repeat the $^{10}_{\Lambda}$B experiment with higher statistics is recommended.
In 2001, we carried out an experiment of γ ray spectroscopy of hypernuclei with (K^-,π^-) reaction using 0.93 GeV/c incident K^- beam at BNL-AGS D6 beamline (E930). We employed an array of 14 germanium detectors (Hyperball) for γ ray detection. The bound region and the excited region of the $^{10}_{\Lambda}$B mass spectrum were selected with D6 spectrometer.
In a preliminary analysis at present, we have not observed any γ rays which is ascribed to the transition between the ground-state doublet. If the small doublet spacing is established after further analysis, it will require a new theoretical treatment which, for example, includes the three-body ΛNN interaction.
When we gated the excited region of the $^{10}_{\Lambda}$B mass spectrum, we observed several noticeable γray peaks from $^{7}_{\Lambda}$Li, $^{9}_{\Lambda}$Be, and some unidentified hypernuclei. In particular, we will be able to assign the spins of the excited states of $^{9}_{\Lambda}$Be($5/2^+$ and $3/2^+$) from relative intensities of the E2 transitions ($5/2^+ \to 1/2^+$ and $3/2^+ \to 1/2^+$) observed in our spectrum. It suggests that γ spectroscpy of hyperfragments produced from (K^-,π^-) reaction is also a promising method to study hyerpnuclei.

Reference

[1] R.E.Chrien *et al.*, Phys.Rev. C **41** (1990) 1062.
[2] H.Tamura *et al.*, Phys. Rev. Lett. **86** (2001) 1982.