γ-ray spectroscopy of hyperfragments with stopped K^-

KEK-PS E509 collaboration

The success of high-resolution γ-ray spectroscopy of hypernuclei with germanium detectors [1, 2, 3] opened a new era of hypernuclear physics. On the other hand, it is known that stopped K^- enables us to perform systematic study of hypernuclei by producing much more hyperfragments, including neutron rich ones, than other methods such as (π^+, K^+) or (K^-, π^-), which were used in those experiment.

Such systematic study will not only give us valuable information on the ΛN two body interaction, but also enable us to discuss the effect of ΛNN three body interaction if two body interaction which consistently explains level energies of hypernuclei cannot be obtained. Furthermore, in stopped K^- method, we can study the charge symmetry breaking in the ΛN interaction as mirror hypernuclei are equally produced.

Motivated by the above discussions, we performed an experiment to measure γ rays from hyperfragments produced by stopped K^- reactions in Apr. 2002 at KEK-PS K5 beamline. Setup of the experiment was very simple, as we used several trigger counters to identify stopped K^- and a germanium detector system (Hyperball [4, 1]) to measure γ rays. We used five experimental targets (Li, Be, ^{10}B, ^{11}B, C) in order to see target dependence of γ-ray yields.

A preliminary analysis shows that a γ ray from ${}^{7}_{\Lambda}\mathrm{Li}(5/2^+ \rightarrow 1/2^+)$ was observed at 2050 keV (see Figure 1). This γ ray was clearly observed for the ^{10}B, and we determined the strength of the γ ray to be $(7.5 \pm 1.6) \times 10^{-4}$ γ's per stopped K^-. This value gives valuable information on the production mechanism of hyperfragments from stopped K^- reaction.

We also observed two more candidates for hypernuclear γ rays. One is at 1400 keV for the C target only, and the other is at 1303 keV for the ^{9}Be and ^{10}B targets. Identification of these γ rays, which is necessary to extract physics information, is not yet performed; they might be from ${}^{11}_{\Lambda}\mathrm{B}$ and ${}^{8}_{\Lambda}\mathrm{Li}$, respectively.

These preliminary results indicate that γ-ray spectroscopy of hyperfragments with stopped K^- is sufficiently feasible. We are planning to improve the experimental setups and acquire more statistics. Further experiments using heavier targets are being considered in future. γ-γ coincidence analysis is also promising in future experiments in which more efficient γ-ray detector is available.

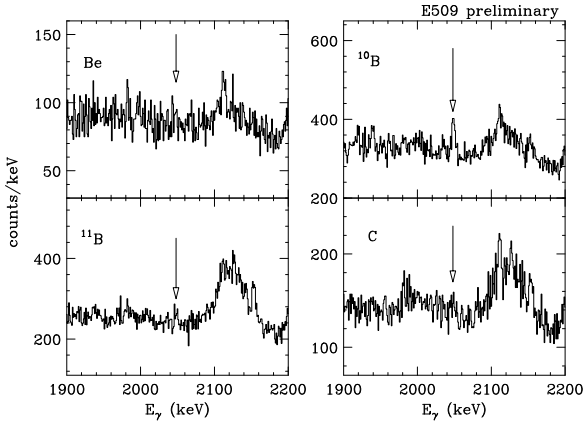

Figure 1: γ-ray energy spectrum around 2 MeV for Be, ^{10}B, ^{11}B, and C targets. The 2050 keV γ ray from the ${}^{7}_{\Lambda}$Li$(5/2^+ \rightarrow 1/2^+)$ transition was clearly observed for the ^{10}B target.

References

[1] H. Tamura *et al.*, Phys. Rev. Lett. **84** (2000) 5963.

[2] K. Tanida *et al.*, Phys. Rev. Lett. **86** (2001) 1982.

[3] H. Akikawa *et al.*, Phys. Rev. Lett. **88** (2002) 082501.

[4] H. Tamura, Nucl. Phys. A **639** (1998) 83c.