Coincidence Measurement of the Weak Decay of ${}^{12}_{\Lambda}$C (E508)

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The experiment is to measure the exclusive decay observables in the weak decay of ${}^{12}_{\Lambda}$C. The aim of the experiment is to obtain the mass dependent information of the observables by adding p-shell hypernuclei, ${}^{12}_{\Lambda}$C, in the data set, in addition to that of s-shell ${}^{5}_{\Lambda}$He of E462. The data set of ${}^{5}_{\Lambda}$He and ${}^{12}_{\Lambda}$C will give the mass dependence of 1N-, 2N-NMWD and FSI whose information will help to sort out the 2N-NMWD and FSI. There has been intriguing inconsistency of the asymmetry parameter of NMWD among those of the s-, p-shell hypernuclei and theoretical predictions of baryonic weak interaction. To shed light on the situation of the asymmetry parameter of NMWD is another important purpose of the experiment.

We have measured the decay product particle spectra from the Λ hypernucleus ${}^{12}_{\Lambda}$C by detecting both neutral (n and γ) and charged particles (p and π^-) in coincidence for the total $\sim$2000 Gπ^+ beam. The experiment was carried out at K6 beam line of KEK 12 GeV-PS with 1.05 GeV/c π^+ beams via ${}^{12}C(\pi^+, K^+)$ reaction using the large acceptance SKS spectrometer for the detection of the outgoing kaons. The decay product particles, neutrons, protons, pions and gammas were detected by three decay coincidence counter systems placed around the target. Top and bottom counter systems are symmetrically placed and the third side arm counter was installed for the angular correlation measurement of two nucleons from NMWD process. Top and bottom counters covered $\sim$ 9 percent of solid angles and the side one $\sim$7 percent. Each counter system consisted of a decay product start timing counter, a drift chamber, stop timing counter and neutron counters of 6 layers of 5 cm thick plastic sintillation counters.

The analysis has been going on smoothly and now actively progressing. The neutral particle identification was made from the time of flight spectrum as shown in Fig.1. The separation of n and γ is good. A preliminary result on the neutron spectrum shown in Fig.2, though the normalization is still changing, but not drastically, confirmed the strong neutron deficiency observed in E369 which showed the proton channel dominance in NMWD of Λ hypernuclei finally resolving the long standing Γ_n/Γ_p puzzle [1, 2]. The charged particle identification was made combining the ΔE-E method and TOF-E methods and a typical PID for charged particles is shown in Fig.1. In order to show a comparison with that of neutron, a typical proton number spectrum, though very preliminary, also is shown in Fig.2.

An important discovery has been made in the analysis of decay asymmetry parameter, α_{NM}, in the NMWD of ${}^{12}_{\Lambda}$C with much improved statistics over that of E160. We have obtained α_{NM} close to zero, with one sigma level of about 10 percent, which is contradicting the previous result of large negative value and establishing a new result consistent with that of E278.

Another important result has been obtained, though preliminary again, for Γ_{π^0} with a much reduced error bar which has been the largest error source in the study of NMWD due to the large uncertainty of the previous Γ_{π^0} measurement.

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[1] O. Hashimoto *et al.*, Phys. Rev. Lett. **88**, 042503 (2002).
[2] J. Kim *et al.* Submitted to Phys. Rev. Lett.

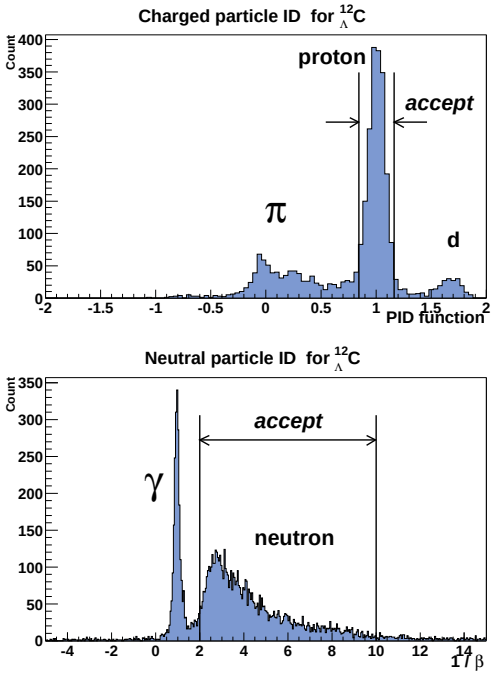

FIG. 1: The above one shows the particle identification of the detected charged particles and the below that of the neutral particles.

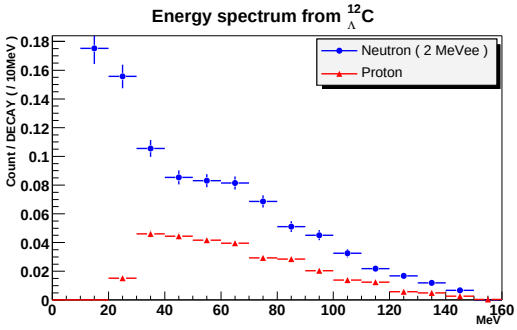

FIG. 2: Preliminary spectra of the neutron and proton number per hypernuclear decay.