The energy spectra of the emitted neutrons and protons in Λ hypernuclear weak decay and the Γ_n/Γ_p ratio.

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Even though it has been 50 years since the discovery of Λ hypernuclei and their decay in 1952, a consistent understanding of their decay process is yet to be achieved.

A Λ hypernucleus decays through either a mesonic ($\Lambda \rightarrow p\pi^-$, $n\pi^0$) or a non-mesonic weak decay (NMWD; Λ+p$\rightarrow$n+p, Λ+n$\rightarrow$n+n). Both modes are comparable in light Λ hypernuclei, but NMWD is dominant in heavy Λ hypernuclei (A $\geq$ 12). The NMWD of Λ hypernuclei provides a practical means of investigating the four fermion strangeness changing baryon-baryon weak interaction. In this talk the focus will be on the NMWD of Λ hypernucleus.

The total decay rates of the heavy Λ hypernuclei, which is essentially Γ_{nm}, have recently been measured accurately and were found to saturate to a value about 20 percent increased from that of a free Λ[1]. It is the partial decay rates of the two decay branches of the NMWD, the n-induced and the p-induced weak decay, which have not been determined accurately yet. In fact the relative ratio of the two has been a long standing puzzle in that the experimental ratios including the most recent KEK data[2] indicate the dominance of the neutron induced channel while the theoretical predictions, so far mostly based on the boson exchange model, show the dominance of the proton induced channel.

However, the uncertainties of the current experimental data of NMWD are still so big that it fails to give a clear guide for the theoretical models. The big uncertainties are largely due to that from the treatment of the final state interaction (FSI) on the emitted nucleons. Although the recent intranuclear cascade (INC) calculation for the FSI[3] has shown some success to reproduce the emitted proton spectra from NMWD of ${}^{12}_{\Lambda}$C with $\Gamma_n/\Gamma_p{\sim}1.17$, it seems to have a difficulty for its neutron counterpart[4]. The recently measured energy spectrum of the emitted neutron in the decay of Λ hypernucleus, ${}^{12}_{\Lambda}$C, showed the yield significantly reduced from that predicted with the FSI calculation for $\Gamma_n/\Gamma_p \sim 1.17$. A preliminary analysis for the proton and neutron spectra with an experimentally determined FSI which is stronger than the previously used one indicates for the first time that the experimental Γ_n/Γ_p ratio in ${}^{12}_{\Lambda}$C might be significantly smaller than one. However, in order to accurately detrmine how much of FSI to be increased, it is necessary to understand the contribution from the two nucleon induced NMWD, which has been predicted to be important. In order to resolve these issues, the exclusive coincidence measurements of the Λ hypernuclei, ${}^{5}_{\Lambda}$He and ${}^{12}_{\Lambda}$C(KEK-PS E462 and E508), have been approved and are now in progress at KEK.

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