Proton energy spectra in the nonmesonic weak decay of medium-heavy Λ hypernuclei

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Nonmesonic weak decay ($\Lambda N \rightarrow NN$), which takes place in Λ hypernuclei, provides a unique opportunity to investigate the short range nature of baryon-baryon weak interaction, which is related to meson and/or quark current exchanges. The ratio of decay rates of neutron- to proton- nonmesonic weak decay (Γ_n/Γ_p) has been a long standing puzzle since there has been large discrepancy between theoretical calculations and experimental data[1][2], which contains 50-100% errors. Theoretical calculations based on conventional pion exchange give very small Γ_n/Γ_p ratios (0.1-0.3) due to tensor dominance of the pion exchange potential. Recent theoretical progresses show that models on heavy meson exchange (K, ρ and ω) and direct quark exchange can provide larger Γ_n/Γ_p ratios [3][4], and also the two-nucleon induced nonmesonic decay might be important[5]. Therefore, more precise data are seriously awaited in order to understand the whole mechanism of nonmesonic weak decay and its short range nature. We had carried out an experiment which aimed at the precise measurement of lifetimes and branching ratios of medium-heavy Λ hypernuclei. Observed proton energy spectra[6], shown in Figure 1, are carefully compared with those of a theoretical calculation including the collision process of the outgoing nucleons in the final state[7]. Evaluated Γ_n/Γ_p ratios of $^{12}_{\Lambda}$C , $^{28}_{\Lambda}$Si and $_{\Lambda}$Fe are close to 1 or larger. Available theoretical calculations have difficulty in reproducing the present large Γ_n/Γ_p ratios.

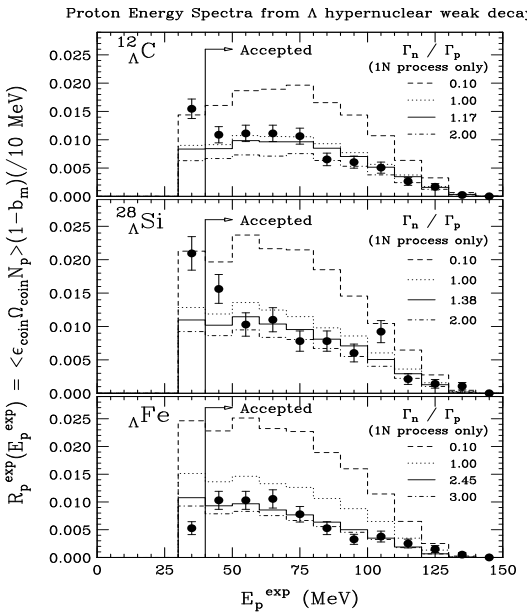

Figure 1: Proton energy spectra in the nonmesonic decay of $^{12}_{\Lambda}$C , $^{28}_{\Lambda}$Si and $_{\Lambda}$Fe

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