Novel calculation of nucleon spectra in the non–mesonic weak decay of hypernuclei and implications on the Γ_n/Γ_p puzzle

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We have incorporated the One–Meson–Exchange model of Ref. [1] in an intranuclear cascade calculation for the evaluation of the decay nucleon spectra for s- and p-shell hypernuclei. The two–nucleon induced decay mechanism of Ref. [2] has been taken into account as well [1]. The effects of the strong interaction on the primary nucleons in their way out of the nucleus have been estimated through a Monte Carlo simulation that improves the one of Ref. [3], used in previous nuclear matter calculations.

Neutron and proton kinetic spectra, normalized per non–mesonic weak decay, have been calculated for the experimentally interesting cases of ${}^{5}_{\Lambda}$He and ${}^{12}_{\Lambda}$C and compared with the data of Refs. [4,5]. Preliminary calculations for ${}^{12}_{\Lambda}$C show that the neutron spectra of Ref. [4] is reproduced very well with a Γ_n/Γ_p ratio of 0.34, which is the value predicted by the OME model. Instead, the proton spectra of Ref. [5] is overestimated, indicating a possible underestimation of the number of protons observed in this experiment.

References

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[1] We recall here the predictions of Ref. [1] for the one–nucleon–induced decay rate and the neutron–to–proton ratio: $\Gamma_{\rm nm}({}^{5}_{\Lambda}{\rm He}) = 0.32\,\Gamma_\Lambda$, $\Gamma_{\rm nm}({}^{12}_{\Lambda}{\rm C}) = 0.55\,\Gamma_\Lambda$, $\frac{\Gamma_n}{\Gamma_p}({}^{5}_{\Lambda}{\rm He}) = 0.46$ and $\frac{\Gamma_n}{\Gamma_p}({}^{12}_{\Lambda}{\rm C}) = 0.34$. For the two–nucleon–induced process, Ref. [2] obtained: $\Gamma_2({}^{5}_{\Lambda}{\rm He}) = 0.04\,\Gamma_\Lambda$ and $\Gamma_2({}^{12}_{\Lambda}{\rm C}) = 0.16\,\Gamma_\Lambda$.