Asymmetry of Nonmesonic Weak Decay of Polarized ${}^{13}_{\Lambda}$C

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Weak hyperon nucleon interaction can be studied in the weak nonmesonic decay of Λ hypernuclei. The nonmesonic decay ($\Lambda n \to nn$, $\Lambda p \to np$; $\Delta q = 400\mathrm{MeV/c}$) is strangeness changing hyperon nucleon weak process. The process has momentum transfer larger than the Fermi momentum. It thus makes the Pauli blocking effect of little importance and the process can be taken as almost two body reaction.

Recently E462 experiment measured the nonmesonic weak decay of ${}^{5}_{\Lambda}$He hypernuclei with high statistics.[1, 2] The result shows that the branching ratio, $\Gamma(\Lambda n \to nn)/\Gamma(\Lambda p \to np)$, becomes compatible with the theoretical estimation.[3] The ratio constrains the magnitude of decay amplitudes in terms of isospin. On the other hand, the asymmetry of the decay with respect to the polarization of Λ is due to the interference between parity-conserving and parity-violating amplitudes. For full understanding of the nonmesonic weak decay, precise measurement of the asymmetry is necessary as well as the branching ratio.

So far the asymmetry of the nonmesonic weak decay of polarized hypernuclei has been measured for ${}^{12}_{\Lambda}$C(${}^{11}_{\Lambda}$B) and ${}^{5}_{\Lambda}$He hypernuclei. In KEK-PS E160 experiment, which is pioneering experiment to measure the asymmetry, quite large asymmetry parameter (-1.3 ± 0.4) was observed for the nonmesonic decay of the polarized ${}^{12}_{\Lambda}$C hypernuclei.[4] However recent experiments, E278[5] and E462[1], show that the asymmetric parameter obtained by measuring ${}^{5}_{\Lambda}$He is small and consistent with zero.

Theory estimates the asymmetry parameter to be around -0.7 which is consistent with E160 results but E278/E462, and could not explain the discrepancy between these experiments. The discrepancy may be due to the p-wave contribution in the decay of ${}^{12}_{\Lambda}$C. New experiment on p-shell hypernuclei under better condition than E160 is vital to study the nonmesonic weak decay. We propose to measure the nonmesonic weak decay of polarized 13_{Λ}C hypernuclei. The physics motivation and the feasibility of the experiment will be presented.

References

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