Meson exchange in the weak decay of Λ hypernuclei and the Γ_n/Γ_p ratio

D. Jido[a], E. Oset[b] and J. E. Palomar[b]

[a] *Research Center for Nuclear Physics (RCNP), Osaka University, Ibaraki, Osaka 567-0047, Japan*

[b] *Departamento de Física Teórica e IFIC, Centro Mixto Universidad de Valencia-CSIC, 46100 Burjassot (Valencia), Spain*

In this talk, we discuss the Λ nonmesonic weak decay in nuclei based on the meson exchange model under the guidelines of chiral Lagrangians. The one-pion and one-kaon exchange are considered, together with the exchange of two pions, either correlated, leading to an scalar-isoscalar exchange (σ-like exchange), or uncorrelated (box diagrams), and extra effects of the omega exchange are also considered.

The problem of the Γ_n/Γ_p ratio is the most persistent and serious problem related to the nonmesonic decay of Λ hypernuclei. The problem lies in the large discrepancy between the theoretical ratio provided by the one-pion exchange model (OPE) and the experiment. The OPE model, using exclusively the parity conserving part of the weak Λ decay vertex, leads to a Γ_n/Γ_p ratio of 1/14 in nuclear matter. On the other hand, experimentally the ratio has been observed with the order of unity in light nuclei with large errors.

We take a unified approach including all the relevant elements within the context of the one- and two-meson exchange. Thus, we include pion exchange, kaon exchange, the exchange of two pions, uncorrelated or interacting in the scalar-isoscalar channel (the σ channel) and ω exchange. The correlated two-pion exchange is calculated using the Bethe-Salpeter equation and the chiral Lagrangians. Short range correlations via the Landau-Migdal interaction are also considered, which serves to estimate the effects of the rho meson or K^* exchange. The present calculations are done using nuclear matter and the local density approximation to go to finite nuclei.

The results obtained here lead to ratios of Γ_n/Γ_p of the order of 0.54 and simultaneously one can obtain values for the absolute decay rates of different hypernuclei that are compatible with the experimental ones. These high values obtained for Γ_n/Γ_p are compatible with all present experiments within errors. We have found that the contribution of K exchange is essential to reduce the total decay rate from the OPE results and simultaneously increase the value of the Γ_n/Γ_p ratio. We have also found some cancellations between correlated and uncorrelated two-pion exchanges, such that the total contribution of the two-pion exchange to the total rate and the Γ_n/Γ_p ratio is small. Finally we conclude that our study of the long and intermediate distances has shown that one can obtain values for Γ_n/Γ_p considerably larger than those given by the OPE model while still having total rates in fair agreement with experiment.

References

[1] D. Jido, E. Oset, J.E. Palomar, Nucl. Phys. **A695**, 525-555 (2001).