Perspectives of the non-mesonic weak decay in Double Hypernuclei

Felice Iazzi[(a,b)], Katarzyna Szymańska[(a,b)], Hannan Younis[(a)]

[(a)] Politecnico di Torino, Italy
[(b)] INFN Sezione di Torino, Italy

The weak decay of the Λ-hyperon inside a hypernucleus is a very important tool to investigate the hyperon-nucleon and hyperon-nucleus interaction [1]. The free Λ decay proceeds through the π -emission and strangeness suppression:

$$\Lambda \rightarrow \pi + N.$$

Inside the single hypernuclei this process undergoes to the Pauli principle and its width is considerably smaller than the free one and is decreasing with the nuclear mass, becoming practically suppressed for high mass number. An alternative weak decay is the non-mesonic decay, which is stimulated by an interacting nucleon and does not contain any meson in the final state:

$$\Lambda + N \rightarrow N + N.$$

The width of this decay goes from ≈ 0.85 up to 1.4 times the free Λ decay width, for decreasing mass number of the hypernuclei.
Considering a double-hypernuclus, instead of a single, two hyperons are present together inside the nucleus. Like in a single hypernucleus, each Λ can decay in mesonic or non-mesonic way. In additions both Λ's can interact together and the mechanism can open a new decay channel: the Λ-Λ interaction can stimulate the non-mesonic weak decay of one Λ in the reaction:

$$\Lambda + \Lambda \rightarrow \Lambda + N.$$

The energy of the final state products of the mesonic and non-mesonic (both nucleon and hyperon stimulated) decays are in quite different ranges due to their different masses in the 3 reactions.
The project of the PANDA experiment at FAIR aims, among others, to produce statistically significant amounts of double hypernuclei. They will decay in all 3 ways, allowing, in principle, an evaluation of the relative branching ratios. The PANDA set-up for hypernuclei foresees the possibility to have simultaneously different hypernuclear targets and only one detector assembly: in this way the mesonic and non-mesonic processes could be detected in the same apparatus in different nuclei with the same efficiency and acceptance. The requirements in terms of energy resolution of the detectors, in order to separate the various processes, are under study. Finally, a preliminary rough estimate of the rate of the produced decays will be given within the framework of the present design of the antiproton ring HESR at FAIR.

[1] W. Alberico and G. Garbarino, Physics Rep. 369 (2002) 1.

E-mail: katarzyna.szymanska@polito.it