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Determination of the experimental upper limit of the rare β-proton branch of 8B

Thursday, 26 November 2020 16:00 (5 minutes)

In this workshop, we present the latest results coming out of the data analysis of the IS633 experiment carried out at the IDS on 2017, related with the rare β-delayed proton branch present in the decay of 8B. This branch is supposed to be enhanced by the proton-halo configuration of the 8B, however, there is a lack of experimental results.

This rare decay proceeds through electron capture (EC) to the 17.6 MeV state of 8Be which, instead of breaking up into two α-particles, emits a low-energy proton of 337 keV, known from reaction studies [1]. Assuming a proton-halo configuration of 8B, an extremely low branching ratio has been estimated considering it as a 7Be core plus an orbiting proton [2]. The EC would occur on the 7Be-core and therefore the transition matrix element can be estimated to be the same as for the decay of 7Be g.s. to 7Li g.s. Scaling by the half-live, an upper limit of the branching ratio is set to 2.3·10-8 [3].

This very low branching ratio in combination with the low energy of the proton oblige us to realize a specific and compact set-up in order to enhance the sensitivity to the proton branch. The main decay of 8B is always accompanied by an α-α coincidence in two opposite detectors, we thus aim for an improved anticoincidence efficiency to exclude all events accompanied by a β- or an α-particle.

To determine the experimental upper limit, an accurate knowledge of the set-up and the electronics used in the experiment has been crucial. By comparing the experimental results with accurate Geant4 simulations of the set-up has allowed us to determine the upper limit of the branching ratio to the 17.6 MeV state, reducing by two orders of magnitude the previous experimental estimation [3] with a confidence level of 99.99% (3).

[1] J.A. Wheeler. The alpha-particle model and the properties of the nucleus Be-8. Physical Review, 59(1):27, 1941.

[2] T. Nilsson et al. Halo-nuclei at ISOLDE. Hyperfine Interactions 129, 67-81, 2000.

[3] M.J.G. Borge et al. Rare βp decays in light nuclei. Journal of physics G: nuclear and particle physics, 40(035109), 2013.

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