β-delayed particle studies of the halo nucleus ^{11}Li and its core ^{9}Li

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Light nuclei have been studied intensively as they are good laboratories to understand nuclear structure. In particular the halo structure has attracted the attention of nuclear physicists during the last two decades and many reaction experiments has been done to highlight their structure and identify candidates. The halo structure of a state can affect beta decay in two aspects. Firstly the transition rates can be diminished as the extension of the halo state can reduce the overlap with the daughter states. Secondly the halo particle can decay more or less independently from the core, giving equivalent decay pattern for both the halo nucleus and the core [1].

With this aim we have revisited the ^{11}Li and ^{9}Li decays with special emphasis in the study of the particle emission. We report here on the experiment carried out at the ISOLDE-PSB facility at CERN dedicated to compare the β-strength patterns of the halo nucleus ^{11}Li and its core ^{9}Li. Both charged particles and neutrons were detected by the use of a cubic system of 6 telescopes with DSSSD detectors in front for the charged particles and surrounded by 16 pads of the TONNERRE neutron time of flight array [2] covering 20 % of 4π. Considering that at the drip-line the decays are very complex, in order to correctly assign the feeding to the high excited states from the measured spectra it is necessary to disentangle the multiple particle break-up channels. The analysis presented here concentrates in the channels involving particle emission. If the state of interest breaks up in three particles the detection of two of them in coincidence allows to reconstruct the energy of the missing particle. Therefore the properties of the state in question as well as the decay mechanism can be derived. This method allowed recently to characterize the mirror levels in ^{9}Be and ^{9}B at about 12 MeV [3,4].

In the present work it was found that the β-delayed charged particle emission from the 10.6 and 18.5 MeV states in ^{11}Be seem to need more channels than previously considered [5]. New decay channels involving ^{5}He and ^{7}He are needed to describe the correlated particle energy spectrum. The contribution of other excited states as suggested in different publications has been considered, but no experimental evidence has been found to include them. The decay of the core nucleus, ^{9}Li, and in particular the breakup of the 2.43 MeV state will also be discussed together with the comparison of the decay patterns.

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