Beta decay of the halo nucleus ^{11}Li and its core ^{9}Li

M. Madurga[1], M.J.G. Borge[1], H.O.U. Fynbo[2], B. Jonson[3], G. Nyman[3], Y. Prezado[1], K. Riisager[2,4] and O. Tengblad[1]

[1] *Instituto de Estructura de la Materia, CSIC, E-28006 Madrid, Spain*
[2] *Inst. for Fysik og Astronomi, Aarhus Univ., DK-8000 Århus, Denmark*
[3] *Fundamental Physics, Chalmers Univ. of Technology, S-41296 Göteborg, Sweden*
[4] *PH Division, CERN, CH-1211 Geneva 23, Switzerland*

Light nuclei have been studied intensively as they are good laboratories to understand nuclear structure. In particular the halo structure have caught the interest of nuclear physicists during the last two decades and many reaction experiments have been done to highlight their structure and identify candidates. The halo structure of a state can affect the beta decay in two aspects. Firstly a reduction of overlap with the daughter state due to the extension of the halo can reduce the transition rates and 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].

We report here on the experiment carried out at the ISOLDE-PSB facility at CERN dedicated to compare the beta-strength patterns in the halo nucleus ^{11}Li and its core ^{9}Li. Considering that at the neutron drip-line, the decays are very complex, the second aim is to disentangle the multiple particle break-up channels taking advantage of the new segmented silicon detectors. The analysis presented does not include the detection of neutrons, but since the decay occurs at rest energy and momentum conservation allows to deduce both its energy and direction in three particle decays. Therefore, the complete decay kinematics can be reconstructed from coincidence events.

This new method gave recently firm values for spin and parity of the mirror levels in ^{9}Be and ^{9}B at about 12 MeV with widths around 0.4 MeV [2, 3]. In this contribution I will review the new physics that emerged from an extension of this work to the broader and overlapping lower-lying states in ^{9}Be. The study of the α-α-angular correlation data give the first experimental evidence of the $1/2^-$ character of the 2.78 MeV state as well as a firm assignment of $I^\pi = 5/2^-$ for the 7.95 MeV state. A new $3/2^-$ broad state at 5 MeV in ^{9}Be is found to be fed in the β-decay of ^{9}Li mainly decaying through the ^{5}He+α channel. The projected coincidence α-spectrum as well as the α-singles get an optimum fit when the new level is included [4]. Besides the break-up of the 2.43 MeV state in ^{9}Be, for which the partial branches are well known but the decay mode remains controversial will be revised.

Furthermore the study of the ^{11}Be states that break into two charged particles in the final state will be presented. Special attention is given to the ^{6}He+α+n channel. The coincidence spectrum and reconstructed excitation energy of this channel will be shown. Identification of the 2α+3n channel will be discussed.

References

[1] T. Nilsson, G. Nyman, K. Riisager, Hyperfine Int. 129 (2000) 67.
[2] U.C. Bergmann et al., Nucl. Phys. A692 (2001) 427.
[3] Y. Prezado et al., Phys. Lett. B 576 (2003) 55.
[4] Y. Prezado et al., Phys. Lett. B 618 (2005) 43.