Contribution ID: **75** Type: **not specified**

Study of multi-neutron emission in the beta-decay of 11Li

Thursday, 6 September 2018 14:45 (20 minutes)

Beta-decay spectroscopy is one of the most useful tools for the study of nuclear structure. In exotic nuclei beta-decay is often followed by the emission of delayed particles, a process which becomes the dominant decay channel when approaching the driplines. In the most exotic species, the emission of two or more delayed particles can also occur with a significant probability.

Whereas the spectroscopy of two delayed proton emission has been explored in a number of cases, so far no such study has been performed for the emission of two delayed neutrons. We performed an experiment at CERN-ISOLDE to detect for the first time in coincidence two delayed neutrons following the decay of 11Li and measure their energies and angles, in order to investigate the sequential or direct character of the emission and the possible correlations between the neutrons. As 11Li offers one of the largest currently known two-neutron emission probabilities and can be produced with a sufficiently high yield, it was selected as the object of this first study. In addition, the experiment is expected to provide an improved picture of the very complex 11Li single neutron emission.

Detecting two neutrons in coincidence is particularly challenging. It requires the identification and rejection of random coincidences involving ambient gamma-rays and cosmic muons, as well as cross-talk events in which a single neutron fires two detectors. To overcome these issues, we used an array of liquid scintillator modules coupled to a digital electronics and signal processing system for the detection of neutrons. The use of a liquid scintillator allows to perform neutron-gamma discrimination to reject gamma-rays and muons, while the modular character of the array allows the application of kinematical cross-talk filters.

This talk will present the aim of the experiment and will focus on the selection of the two-neutron events.

Selected session

Nuclear Structure and Dynamics

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Session Classification: Nuclear Structure and Dynamics (SALONE BOLOGNINI)