Contribution ID: **32** Type: **Poster (In person)**

Improving the precision of β spectrum shape measurements at WISArD

Wednesday 29 November 2023 17:56 (1 minute)

Measurements of the shape of the β energy spectrum are interesting to study, e.g., nuclear structure [1] and, when high precision is reached, allow to test for exotic scalar and/or tensor currents in the weak interaction [2].

However, the experimental precision reached is limited by the incomplete energy deposition caused by backscattering. In the WISArD set-up, this problem is alleviated using two detectors placed in a high magnetic field. This configuration ensures a 4π solid angle and guides backscattered β particles towards the opposite detector. In December 2020 the InESS@WISArD [3] proof-of-principle experiment measured the β spectrum shape of $^{114}_{49}$In using two plastic scintillators, which led to the first determination of weak magnetism in the fission fragment region. While these results are very promising, the data analysis showed several opportunities for further improvement.

For subsequent experiments, we are investigating the possibility of replacing the scintillators with lithium doped silicon (Si(Li)) detectors. These have a superior energy resolution, i.e., an improvement of about a factor of 50 [3,4], and a significantly lower energy threshold, i.e., around 1.5 keV [4], compared to 65 keV [3]. Such detector characteristics can drastically improve the situation for of the systematic effects encountered with the scintillators, thus making the installation of these Si(Li) detectors a promising path for further advances in β spectrum shape studies.

References:

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Session Classification: Poster Session