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Indium Energy Spectrum Shape (InESS) at WISArD

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The Standard Model of Particle Physics (SM) has been a great success describing three of the four fundamental interactions. At the same time, it does not resolve mysteries such as the matter-antimatter asymmetry observed in the Universe, the occurrence of dark matter and dark energy, nor the origin of CP symmetry breaking. Furthermore, the theory includes a large number of free parameters. Possible extensions referred to as Beyond Standard Model (BSM) physics are experimentally accessible through particle collisions, i.e., at LHC, or through high-precision experiments. The latter are indirect searches and the goal of the WISArD collaboration at ISOLDE.

During LS2 we benefited from the availability of the WISArD solenoid, providing a strong magnetic field, to perform a beta spectrum shape measurement. These electron energy measurements are typically impacted by the backscattering effect from the detector, which de-forms the observed energy. We built a detector set-up with two plastic scintillators coupled to SiPMs installed face-to-face. In this configuration, the high magnetic field provides a closed system and a 4π solid angle. Thus, adding both detector signals within an integration time window allows the reconstruction of the full electron energy for backscattered events.

The isotope of choice was ^{114}In motivated by scientific and practical reasons. The ground state decays through a pure Gamow-Teller beta transition that is theoretically well-described [1]. Practically, its relatively long-living isomeric state ($T_{1/2} \approx 50$ d) and commercial availability were essential to our measurement during LS2 and the absence of radioactive beam delivery at ISOLDE. One drawback when interested in BSM physics is the lack of independent information on the nuclear structure contributions for ^{114}In. This necessitates their inclusion into the spectrum fit.

At the end of 2020, the detector set-up was characterized, using converted electron sources (^{137}Cs and ^{207}Bi) as well as a continuous beta source (^{90}Sr). For ^{114}In two different source activities, i.e. 1 kBq and 5kBq, were used to cross-check pile-up effects.
The talk will present details on the detector set-up, the performed measurements and the status of the analysis.
[1] L. Hayen et al., Reviews of Modern Physics 90(1),15008 (2018).

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