Contribution ID: **197** Type: **Oral Presentation**

Evaluation of target non-uniformity and dispersion effects on energy measurement resolution in NUMEN experiment

Monday, 26 August 2019 16:30 (30 minutes)

In the NUMEN Experiment, a number of double Exchange reactions will be studied in order to get very precise measurements of their cross sections and final state levels. The interest for these reactions lies in the possibility for some nuclides, to have DCE with initial and final states identical to those of the Neutrino-less Double Beta Decay [1]. To reach a good precision in the energy measurements, high statistics is needed and severe constraints about the target thickness must be satisfied. The main sources of error are the straggling of projectiles and products and the dispersion effect inside the target. Both are related to the target thickness, which must be of the order of few hundreds nanometre. Moreover, the thickness uniformity plays a crucial role in the spread of the energy. The solution to these problems has been found by designing a target as a target isotope deposition on a substrate of special graphite (HOPG) [2], whose thermodynamic properties fit the cooling requirements [3]. The results of the chosen deposition technique (Electron Beam) for 116Sn, 130Te, 76Ge isotopes will be illustrated in terms of electron microscopy (FESEM) images. A more precise quantitative evaluation of the thickness distribution has been performed by Rutherford Back Scattering (RBS) and alpha-transmission measurements. The latter one allows to estimate also the thickness uniformity. In addition, a Montecarlo code has been implemented, aiming to estimate the precision of the measurements of the final states nuclear levels. The Montecarlo results will be reported in the talk for all the targets, together with the results of the tests of thickness and thickness uniformity, obtained with the above mentioned techniques.

[1] Cappuzzello F. et al., Eur. Phys. J. A, 54 (2018) 72, https://doi.org/10.1140/epja/i2018-12509-3
[2] F. Pinna et al., Design and test of an innovative static thin target for intense ion beams, Il Nuovo Cimento (2018), in press.
[3] V. Capirossi et al., Nucl. Instr, and Meth. in Phys. Res. A, (2018), in press. 2 https://doi.org/10.1016/j.nima.2018.08.081

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Session Classification: Workshop on Heavy Ion Physics