Contribution ID: **206** Type: **Oral Presentation**

Study of exotic nuclei of interest for applied and fundamental nuclear physics with Total Absorption Gamma-ray Spectroscopy (TAGS)

The study of beta decay of neutron rich nuclei is particularly important for many fields in fundamental and applied physics [1]. In nuclear reactors, fission products, through their decays, produce an additional energy called decay heat [2]. The assesment of this energy is essential for nuclear safety since it represents around 7% of the power in an operating reactor and these decays continue after reactor shutdown. Beta decay also leads to antineutrino emmission and is thus a good tool for exploring fundamental neutrino physics [3] such as reactor antineutrino anomalies (RAA). This flux anomaly is a deviation of ~6% in the measured number of antineutrino compared to the predicted one. The shape anomaly is an excess of events in the 5 MeV region observed by short baseline and
high precision reactor experiments [4]. In nuclear astrophysics, the r-process is a nucleo-synthesis process [5] at the origin of half of the nuclei heavier than iron. It takes place in hot (T~10^{9}K) and highly neutron-dense environments. This process is based on the competition between neutron capture (n,ɣ), photo-dissociation (ɣ,n) and beta decay. A
precise knowledge of beta strength functions S B (E) can constrain the theoretical models used to understand this nucleo-synthesis process. Some of the existing data of the beta decay properties of fission products involved in these fields of nuclear physics are affected by the pandemonium effect [6]: due to the low efficiency at high energy of
high-resolution detectors, such as Germanium (HPGe), some gamma-rays and the corresponding high energy levels can be missed in the decay data leading to a distortion of the beta decay feeding calculation.
New measurements of relevant nuclei for the above mentioned topics have been performed at the IGISOL facility (Jyväskylä, Finland) in September 2022, using the Total Absorption Gamma-ray Spectroscopy (TAGS) technique [7]. TAGS is complementary to high resolution gamma-ray spectroscopy and employs a calorimeter to measure the gamma cascades de-exciting each level of the daughter nucleus providing a direct measurement of the beta feeding I B . The deduced beta feeding is then used to calculate the beta strength used in the fields of research mentioned above.
In the proposed talk, we will present the TAGS technique and preliminary results of the analysis of the 85 Se and 136 I, two nuclei interesting for their contributions in the calculation of the reactor decay heat. The 136 I and its isomeric state 136m I are also involved in the r-process calculations.

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Session Classification: Parallel session

Track Classification: Nuclear Structure, Spectroscopy and Dynamics