Contribution ID: **110** Type: **Oral**

Total Absorption Spectroscopy of isotopes with medical interest

Tuesday, 18 July 2023 16:25 (15 minutes)

Nuclear beta decay is often the first source of experimental information on nuclear structure when we are not too close to the drip lines. However, one of the main physical quantities relevant to this process, the beta-intensity distribution, is not easy to measure in medium-mass or heavy nuclei where high density of states is at reach within the Q-beta window. In these cases, the Total Absorption Spectroscopy (TAS) technique, based on high-efficiency scintillators, has proven to be far more sensible than the high-resolution technique, based on HPGe detectors. In the former one detects entire gamma cascades rather than individual gamma rays and infers the beta intensity applying some unfolding techniques to the whole spectrum. In the latter, one infers the beta-intensity distribution from gamma-intensity balance obtained from the analysis of individual gamma peaks.

The advantage of the TAS technique over the high-resolution one, lies in the high sensitivity of the former, since it allows the measurement of weak beta decay branches to levels at high excitation energy in the daughter nucleus, where HPGe-detector arrays tend to have lower sensitivity. Despite the low sensitivity of high-resolution experiments to high-lying beta strength, they are the primary source of information on the beta-decay scheme and daughter nuclear structure.

The therapeutic and diagnostic use of radionuclides is well known and widely applied in different techniques and pathologies. The efficacy of the treatments, as well as the off-target dose minimisation in both treatment and diagnosis depend, among other things, on the decay characteristics of the radionuclide in use. In particular, the different particles and radiation emitted, the emission energies and the emission probabilities, are of paramount importance in the calculations of the dose administered to the patient in medical imaging or therapeutic treatment with radioisotopes.

In this contribution we will present a series of TAS measurements carried out at ISOLDE (CERN) since July-2022 aimed at the detection of all the beta strength missing in previous studies of some nuclei of medical interest. A proper determination of the beta-intensity distribution within the Q window is essential to calculate the distribution of energy per decay that goes as gamma rays or as kinetic energy of emitted particles, which is necessary to calculate the dose administered to a patient subject to a PET scan or theragnostic treatment. We will show results on 66Ga and comparisons of recent TAS data vs evaluated ENSDF data on 128Ba/128Cs, 76Br and others.

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Session Classification: Session 7B

Track Classification: Applications