Decay Data Evaluation Project: Updating the evaluations of nuclear decay data and their importance in radionuclide metrology

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Reliable and precise nuclear decay data are essential in many applications. In radionuclide metrology, decay data are input parameters in calculations related to radioactivity measurements, when absolute or relative standardisation methods are used. This is why the metrology community, especially in Europe, has carefully evaluated decay schemes and atomic and nuclear data for the last 50 years.

This paper presents the results obtained recently concerning the update of the nuclear decay data evaluations of a number of radionuclides of interest for nuclear medicine: ^{52}Mn, ^{52m}Mn and ^{226}Th. The initial evaluations were produced in the framework of the IAEA CRP F41029 "Nuclear Data for Charged-particle Monitor Reactions and Medical Isotope Production" (2012-2018) [1], [2], [3]. The work was undertaken using the procedures and tools of the Decay Data Evaluation Project (DDEP), an international co-operation officially founded 25 years ago [4].

New developments in this field have recently become available. For example, the new Atomic Mass Evaluation (AME 2020) [5] has enabled updated decay energies (*Q-values*) to be included, which influence the beta endpoint energies in the decay schemes, having a particular importance for these evaluations. Furthermore, a new version (2.2/2021) of the BetaShape code [6], [7] for β transitions and electron captures (EC) has been released and provides improved calculations for single transition and total β spectra, EC probabilities and their ratios for all subshells, mean energies, log *ft* values, EC/β+ ratios and branch splitting. The new *Q values* from AME 2020 are included in this new version of the code as an external file, and a simple option allows for an automatic update of this parameter.

These developments can lead to important improvements in the recommended data resulting from the evaluation procedure, beyond possible new published measurements. The nuclear decay data update for the two manganese radionuclides ^{52}Mn and ^{52m}Mn, decaying by EC/β+ transitions, is a good example of what improved theoretical predictions can provide. The updates to the alpha-particle emitter ^{226}Th will be briefly discussed.

The authors have also considered the question "How often should nuclear decay data evaluations be updated?". Several criteria to support the decision of undertaking data evaluation updates are proposed and discussed, along with recent examples relevant for radionuclide metrology.

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