

# Systematics of $\log ft$ values for $\beta^-$ , and EC/ $\beta^+$ transitions

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## Abstract

This work is an update of the 1998 publication by B. Singh et al. [1] and reviews the  $\log ft$  values for all the known  $\beta$ -decay branches ( $\beta^-$ ,  $\beta^+$ /EC). Furthermore, an update of all  $Q$ -values (from AME2020 [2]), as well as a recalculation of all the  $\log ft$  values (through BetaShape code [3, 4]) has been conducted using relevant data in the ENSDF database, as well as in newer literature. Only those cases have been considered in this review, where the beta transitions occur between levels of firm single spin assignments (86% of the transitions), and with probable single spin assignments (14% of the transitions), but with firm parity assignments for all the transitions. Weak  $\beta$  branches of  $<1\%$  intensity in complex decay schemes have generally been omitted. Out of a total of 26 318  $\beta$  transitions extracted from the ENSDF database and current literature, data for only 4 038  $\beta$  transitions survived the filtering criteria in the present review. The  $\log ft$  values in  $\beta$  decay, spanning about 21 orders of magnitude, have been classified into allowed and forbidden categories according to the classification scheme of Konopinski [5]. All  $\log ft$  values have been deduced using the BetaShape code with new developments presented in this study. A very few number of  $\log ft$  values for very low-energy beta transitions ( $<5$  keV) survived the cut criteria and are briefly discussed in terms of atomic overlap corrections. Also tabulated and briefly discussed are seven superallowed cases with  $\Delta T=0$ ,  $T_z(\text{parent})=-2$ , while a known case for  $^{28}\text{S}$  to  $^{28}\text{P}$  has been omitted as reliable EC/ $\beta^+$  feeding to the analog state in  $^{28}\text{P}$  cannot be assigned due to lack of adequate experimental and detailed data for this decay. Centroid, width, minimum and maximum values for each category have been deduced. Uncertainties have been estimated and are also given. For literature coverage in the present review, see discussion in text.

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## 1. Introduction

Timely surveys of systematics of  $\log ft$  values in  $\beta$  decay and their distribution in terms of allowed and forbidden transitions over the entire nuclear chart based on Konopinski's classification scheme [6] remain relevant for pedagogical purposes as well as for an understanding of detailed characteristics of weak interactions. First such detailed survey was done in 1963 by C.E. Gleit et al. [7] listing about 900 beta transitions known at the time. In 1973, Raman and Gove [8] published seminal work on critical evaluation of about 160 well-known beta transitions, based

on which the authors proposed limiting values of  $\log ft$  values for allowed and forbidden transitions, the latter with different degrees of forbiddenness, and formulated rules for the assignment of spins and parities of levels populated in daughter nuclei that are used to this day in structure and decay data evaluations for the ENSDF database [9]. In 1998, more detailed review of about 3900 well-established beta transitions was published by B. Singh et al. [1], where centroids, widths, minimum and maximum values for each category were deduced from the selected values, and lower limits for first and second forbidden transitions were compared to those given in the review by Raman and Gove [8].

In addition to above mentioned compilations, there have been timely evaluations of  $0^+$  to  $0^+$ , pure Fermi superallowed beta transitions by Hardy and Towner, the most recent published in 2020 [10]. We have revisited the 1998 review with the intention of updating the Tables and Figures in the 1998 work to incorporate not only the newer decay data over the last 25 years, but also to make use of more sophisticated tools via computer codes. This enabled the selection of only the best known transitions amongst all the known  $\beta$  transitions in the ENSDF database [9] and the XUNDL compilation database [11], together with the aid of the bibliographic NSR database [12], and the NUBASE2020 [13], the last one for half-lives and spin-parity assignments of the parent activities.

Our starting point for the present study was setting up a decay data sub-library of all the  $\beta$ - and EC/ $\beta^+$  datasets by extracting from the August 2020 version of the ENSDF database [9]. This decay data library was supplemented by later updates of the ENSDF database, when beta feedings got revised significantly from newer papers, up until April 2023 version. Additionally, a large number of selected incoming publications in literature which came to our attention through retrieval of journal webpages for newer and relevant (subject to our filtering criteria) articles and those based on retrievals of the compilations in the XUNDL database [11], and through the NSR bibliographic database [12] until April 2023. **Our overall literature can be considered up to April 15, 2023, although, we can only claim that important and definite type of decay data in literature until this date have been fully covered.**

## 2. Calculation of the $\log ft$ values

The  $\log ft$  values for this review have been determined splitting the two components :  $t$ -values are from the evaluated half-lives and branching ratios;  $f$ -values have been calculated with the latest released version (v2.2) of the BetaShape code<sup>1</sup>. Uncertainties have been determined taking into account the components on both values. The theoretical modeling is summarized in this Section. Some

<sup>1</sup>Available at: <http://www.lnhb.fr/rd-activities/spectrum-processing-software/>

improvements in the  $\beta$ -decay modeling have been implemented specifically for this work and are also described.

### 2.1. Beta transitions

Beta ( $\beta$ ) decay is an isobaric three-body disintegration process. Two types can be distinguished:

$$(\beta^-): \quad \frac{A}{Z}X \longrightarrow \frac{A}{Z+1}Y + e^- + \bar{\nu}_e$$

$$(\beta^+): \quad \frac{A}{Z}X \longrightarrow \frac{A}{Z-1}Y + e^+ + \nu_e$$

The comprehensive formalism from H. Behrens and W. Bühring [14], in which both the nuclear and lepton currents are expanded in multipoles, is used in BetaShape to compute the properties of the  $\beta$  transitions. The energy spectrum of the  $\beta$  particles is normalized to the transition intensity and the spectrum shape is given assuming a massless  $\nu$  particle by:

$$\frac{dN}{dW} \propto pWq^2F_0L_0C(W)R(Z,W)A(Z,W) \quad (1)$$

where  $W = 1 + E/m_e$  is the total energy defined from the kinetic energy  $E$  of the  $\beta$  particle and its rest mass  $m_e$ ;  $p = \sqrt{W^2 - 1}$  is its momentum; and  $q = W_0 - W$  is the  $\nu$  momentum with  $W_0$  the maximum total  $\beta$  energy. The  $f$ -value is determined by integrating the spectrum shape. Its uncertainty is obtained by propagating the uncertainty on the transition energy, which depends on the uncertainties on the  $Q$ -value and on the nuclear level energies.

The relativistic wave functions of the ejected  $\beta$  particles are established by solving numerically the Dirac equation, considering the Coulomb potential generated by a static nucleus modeled as a uniformly charged sphere. The Fermi function is defined from the Coulomb amplitudes  $\alpha_k$  of these continuum states:

$$F_0L_0 = \frac{\alpha_{-1}^2 + \alpha_{+1}^2}{2p^2} \quad (2)$$

The nature of the transition is fixed by the total angular momentum change  $\Delta J = |J_i - J_f|$  and the parity change  $\pi_i\pi_f$  between the initial and final nuclear states. Spin and parity  $J^\pi$  of a given state comes directly from the ENSDF evaluation of the decay scheme. The transition nature is characterized by the value of the multipole order  $L$ : for an allowed transition,  $\Delta J = 0, 1$  and  $L = 1$ ; for any  $(L - 1)^{\text{th}}$  forbidden unique transition,  $L = \Delta J$ . For these types of transition, the nuclear matrix elements can be factored out and act as a constant factor. The energy dependency of the theoretical shape factor only comes from the lepton current:

$$C(W) = (2L - 1)! \sum_{k=1}^L \lambda_k \frac{p^{2(k-1)} q^{2(L-k)}}{(2k - 1)! [2(L - k) + 1]!} \quad (3)$$

As the Fermi function, the  $\lambda_k$  parameters are defined from the Coulomb amplitudes by:

$$\lambda_k = \frac{\alpha_{-k}^2 + \alpha_{+k}^2}{\alpha_{-1}^2 + \alpha_{+1}^2} \quad (4)$$

The shape factor (Eq. 3) is a good approximation to describe allowed and forbidden unique transitions, except in some rare cases where accidental cancellation of the nuclear matrix elements can occur. However, decoupling the lepton and nuclear currents is not possible in the case of forbidden non-unique transitions, which are very sensitive to nuclear structure. Including the latter to precisely calculate the shape factor is possible but constitutes a tremendous amount of work for the thousands of transitions present in the ENSDF database. Historically, the  $\xi$ -approximation was introduced demonstrating that first forbidden non-unique transitions can be treated as allowed if the Coulomb energy of the  $\beta$  particle at the nuclear surface is large compared to the transition energy [5, 15, 16], i.e.  $2\xi = \alpha Z/R \gg W_0$  with  $\alpha$  the fine structure constant and  $R$  the nuclear radius. Similar theoretical arguments lead to treating an  $L^{\text{th}}$  forbidden non-unique transition as  $(L - 1)^{\text{th}}$  forbidden unique. This approximation was tested against experimental shape factors in [3] and was found to be accurate only for low-energy, high- $Z$  transitions. In the context of the present review, the  $\log ft$  values of the forbidden non-unique transitions are essentially dominated by the partial half-lives. All these transitions have thus been treated according to the  $\xi$ -approximation.

**To summarize, all allowed and forbidden unique  $\beta$  transitions are calculated correctly regarding their shapes. First forbidden non-unique transitions are calculated as allowed; second forbidden non-unique transitions as first forbidden unique; third forbidden non-unique transitions as second forbidden unique; etc.**

Radiative corrections are usually split in inner corrections that renormalize the decay probability, and outer corrections that depend on the nucleus and on the  $\beta$  particle energy. The outer radiative corrections  $R(Z, W)$  in Eq. 1 include the effect of the internal bremsstrahlung process. In the first version of BetaShape (v1) [3], analytical corrections derived for allowed transitions in [17, 18] were implemented. Current version (v2.2) of the code consider more precise radiative corrections based on the work from [19] and described in detail in [20, 21]. The difference on the  $f$ -values can be higher than 1%. In Table 1, radiative corrections have been calculated for the superallowed transitions studied in minute detail by J.C. Hardy and I.S. Towner [10]. While the ones from the old version of BetaShape (v1) disagree significantly, especially for high atomic numbers, excellent agreement with the predictions from [10] is obtained in the current version (v2.2).

The last quantity  $A(Z, W)$  in Eq. 1 stands for the atomic corrections. The ones used in this work are not those implemented in BetaShape (v2.2) and are discussed below.

Finally, the  $\log ft$  value results from the  $f$ -value as the integral of the spectrum (Eq. 1)

$$f_\beta = \int_0^{W_0} pWq^2F_0L_0C(W)R(Z,W)A(Z,W)dW \quad (5)$$

and the partial half-life

$$t = T_{1/2}/P_{\beta} \quad (6)$$

deduced from the evaluated total decay half-life  $T_{1/2}$  and the evaluated transition probability  $P_{\beta}$ .

### 2.1.1. Improved atomic corrections

Recent analyses of high-precision measurements have demonstrated that the  $\beta$  spectrum shape can be significantly affected by atomic corrections at very low energy (see e.g. [22–24]). In the latest released version (v2.2) of the BetaShape code, only the atomic screening correction is included. It is based on the analytical approach from W. Bühring [25] in which the electron wave function from simplified coupled Dirac equations are radially expanded along with a screened potential. Keeping only the dominant term, formulas were established that give screened-to-unscreened ratios for the Fermi function  $F_0L_0$  and the  $\lambda_k$  parameters. This correction was adapted to the more reliable screened potentials from [26] in [27].

However, this screening correction is not able to accurately describe the ultra-low energy region of a  $\beta$  spectrum, as illustrated in Fig. 1 and 2. For the present review, improved atomic corrections have been considered, computing screened-to-unscreened ratios for the Fermi function and the  $\lambda_k$  parameters via a full numerical solving of the Dirac equation for the Coulomb potential of a spherical, uniformly charged nucleus and a screened potential from [26]. An exponential grid has been considered to ensure precision at very low energy. The Fermi function and the  $\lambda_k$  parameters up to  $\lambda_7$ , required for a sixth forbidden unique transition, have been tabulated up to 30 MeV. Such a tabulation covers more than all the transitions currently present in the ENSDF database.

In addition, the atomic exchange effect that originates in the indistinguishability of the electrons has also been taken into account in the present work. For allowed transitions, exchange is only possible with atomic electrons in  $s_{1/2}$  and  $p_{1/2}$  orbitals; the approach has already been described in [28] and references therein. Atomic orbital energies have been taken from the NIST website [29, 30] and extended by interpolation up to  $Z = 120$ . They were calculated for  $Z = 1 - 92$  in [30] with a relativistic density functional theory considering a point nucleus and electron correlations. The formalism for allowed transitions has been extended to forbidden unique ones, as briefly described in [31] for first forbidden unique transitions, and will be described in detail elsewhere. Basically, each term in the shape factor is associated with a  $\lambda_k$  parameter that is corrected by an exchange term linked to the corresponding atomic orbitals: Fermi function is influenced by  $s_{1/2}$  and  $p_{1/2}$  orbitals;  $\lambda_2$  by  $p_{3/2}$  and  $d_{3/2}$  orbitals; etc. The exchange correction factors have been tabulated on the same exponential grid as for screening. As these factors converge to unity, tabulation has been stopped when numerical precision is better than 0.001%.

Table 1  
Radiative corrections (%) on  $f$ -values of the superallowed transitions studied in [10] compared to the predictions from the former and the current versions of the BetaShape code (v1 and v2.2, respectively).

Nucleus	BetaShape (v1) [3]	BetaShape (v2.2)	Hardy and Towner [10]
$T_z = -1$			
$^{10}\text{C}$	1.679	1.678	1.679
$^{14}\text{O}$	1.583	1.539	1.543
$^{18}\text{Ne}$	1.578	1.508	1.506
$^{22}\text{Mg}$	1.606	1.465	1.466
$^{26}\text{Si}$	1.639	1.434	1.439
$^{30}\text{S}$	1.688	1.420	1.423
$^{34}\text{Ar}$	1.749	1.412	1.412
$^{38}\text{Ca}$	1.822	1.410	1.414
$^{42}\text{Ti}$	1.906	1.423	1.424
$^{46}\text{Cr}$	1.989	1.420	1.426
$^{50}\text{Fe}$	2.078	1.423	1.426
$^{54}\text{Ni}$	2.171	1.423	1.423
$T_z = 0$			
$^{26\text{m}}\text{Al}$	1.644	1.478	1.478
$^{34}\text{Cl}$	1.736	1.441	1.443
$^{38\text{m}}\text{K}$	1.803	1.437	1.440
$^{42}\text{Sc}$	1.887	1.450	1.453
$^{46}\text{V}$	1.961	1.442	1.445
$^{50}\text{Mn}$	2.045	1.440	1.444
$^{54}\text{Co}$	2.132	1.437	1.443
$^{62}\text{Ga}$	2.336	1.455	1.459
$^{66}\text{As}$	2.447	1.471	1.468
$^{70}\text{Br}$	2.565	1.487	1.486
$^{74}\text{Rb}$	2.683	1.499	1.499

Finally, it is also well-known that the atomic overlap correction, which accounts for shake-up and shake-off effects in  $\beta$  decay, decreases the emission probability close to the maximum energy [32, 33]. The most precise correction currently available in the literature is only first order and for allowed transitions [21]. It depends on the second derivative of the total electron binding energy of the atom in its ground state ( $B''$ ), determined with a fit given in [21]. The influence on the  $f$ -value is small and for the present review, this correction has been applied indifferently to allowed and forbidden unique transitions in the  $\beta$  decay calculations.

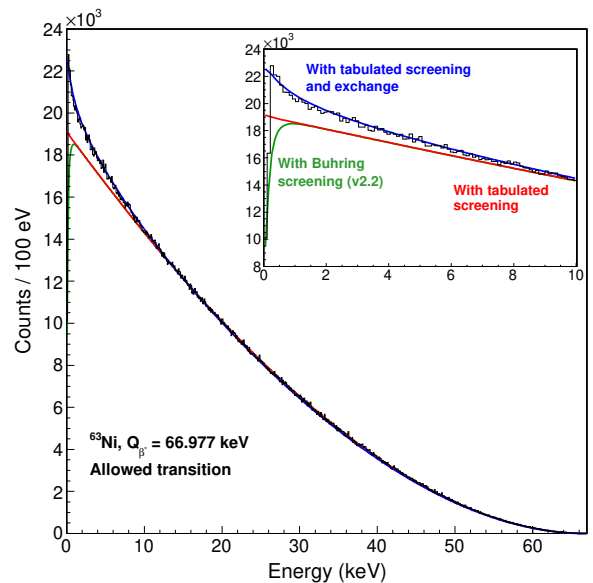
Recently, potential  $\beta$  transitions with ultra-low maximum energies have been reviewed based on up-to-date decay data [34]. In all the transitions selected in the present review, only three  $\beta^-$  decays have a maximum energy  $<5$  keV, for which the atomic overlap correction can be expected to be significant. In  $^{187}\text{Re}$  ground-state to ground-state decay, the maximum energy is 2470.9(13) eV [35]. The influence of the atomic overlap correction on the  $\log ft$  value is  $<1\%$  but significant: 11.025(7) with this correction and 11.116(7) without. However, it modifies the average spectrum energy by  $\sim 7.5\%$ : 595.01(34) eV with this correction and 642.09(33) eV without.

The second transition is from  $^{115}\text{In}$  decay with an ultra-low maximum energy of 147(10) eV determined considering the  $^{115}\text{Sn}$  first excited state energy of 497.342(3) keV from [36]. In this case,  $B'' = 226$  eV is higher than the maximum energy and the correction prevents the transition to occur. The  $f$ -value of this second forbidden unique transition has thus been determined without the atomic overlap correction. The  $\log ft$  value of 14.59(12) has been calculated with the recently measured half-life of  $5.18(6) \times 10^{14}$  y from [37]. For completeness, we also report the corresponding average spectrum energy of 42.6(27) eV. Further theoretical developments are required to improve the accuracy of this correction in the specific case of ultra-low maximum energy transitions.

The third transition appears in  $^{228}\text{Ac}$  decay from its ground-state to the 141<sup>th</sup> excited level of  $^{228}\text{Th}$  at 2123.1(3) keV. With a  $Q$ -value of 2123.8(26) keV, the maximum energy is 0.7(26) keV. No direct precision measurement of the atomic masses was found in the literature. The  $^{228}\text{Th}$  level spin is not firmly known and defines the transition as allowed. The calculated  $\log ft$  value is  $\sim 1.4$ , with or without the atomic overlap correction, which is unrealistic. This transition seems to be very unlikely and has not been considered in the present review. One can only suggest it as a potential candidate for ultra-low energy beta transition. Further high-precision measurements are required to establish a better decay scheme as well as better level energies and  $Q$ -value.

Results from this improved modeling (compared to BetaShape version 2.2) are compared in Fig. 1 and 2 to high-precision measurements of the low-energy spectra from  $^{63}\text{Ni}$  and  $^{241}\text{Pu}$  decays. The former is an allowed transition and the latter is first forbidden non-unique but can be

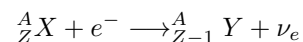
safely calculated as allowed following the  $\xi$ -approximation. Compared to the analytical screening from Bühring, the tabulated numerical screening induces a smoother energy dependency. Adding the tabulated exchange correction, excellent agreement is obtained over the entire measured energy range down to the 0.3 – 0.5 keV region in both cases. Nevertheless, accuracy of this modeling is quite uncertain below 5 keV in the general case. Strong decrease can be observed for some elements [38], such an effect having been recently questioned [39]. Prediction quality for ultra-low  $Q$ -value transitions is thus not guaranteed. High-precision measurements of different  $\beta$  decays down to the ultra-low energy region are definitely required to test and validate the theoretical models over a wide range of atomic elements.



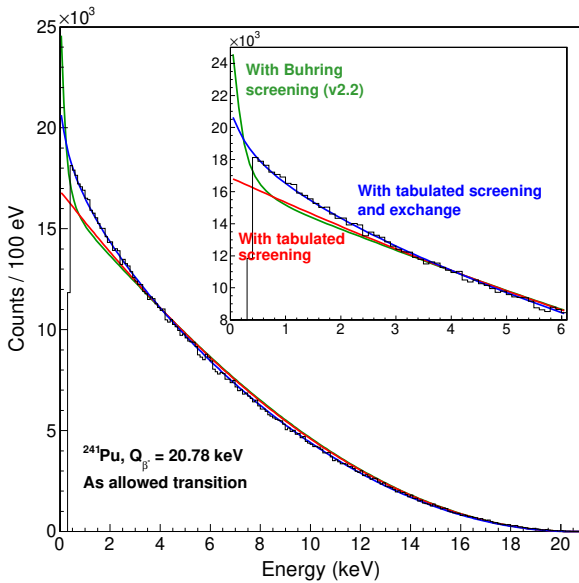
**Fig. 1:** Comparison of calculated and measured  $\beta$  spectra from  $^{63}\text{Ni}$  decay. The high-precision measurement is from [23].

## 2.2. Electron captures

Electron capture ( $\epsilon$ ) is an isobaric process that competes with  $\beta^+$  decay, the latter occurring only if the transition energy is  $\geq 2m_e$ :



These two-body transitions are classified according to the same rules as in  $\beta$  decays. The modeling implemented in the BetaShape code is also based on the formalism of Behrens and Bühring [14, 41] and has already been described in detail in [4, 42]. The total capture probability is the sum of the capture probability of each subshell, the latter being characterized by its quantum number  $\kappa$  and



**Fig. 2:** Comparison of calculated and measured  $\beta$  spectra from  $^{241}\text{Pu}$  decay. This first forbidden non-unique transition has been calculated as allowed following the  $\xi$ -approximation. The high-precision measurement is from [40].

its relative occupation number  $n_\kappa$ :

$$\lambda_\varepsilon = \frac{G_\beta^2}{2\pi^3} \sum_\kappa \frac{\pi}{2} n_\kappa C_\kappa q_\kappa^2 \beta_\kappa^2 B_\kappa S_\kappa R_\kappa \quad (7)$$

with  $G_\beta$  the Fermi coupling constant and  $q_\kappa$  the neutrino momentum.

The quantity  $C_\kappa$  is similar to the shape factor in  $\beta$  decay and couples the lepton and nuclear currents. Allowed and forbidden unique transitions can be treated without any nuclear structure input by calculating ratios of relative capture probabilities. **As in the treatment of  $\beta$  decays, all allowed and forbidden unique transitions are thus calculated correctly regarding nuclear structure, while first forbidden non-unique transitions are calculated as allowed; second forbidden non-unique transitions as first forbidden unique; etc.**

The quantity  $R_\kappa$  corresponds to the radiative corrections, which are especially important for accurate capture-to-positron ratios. In BetaShape, they are determined following [43] with a Coulomb-free theory for the capture part, and with a simplified model of the same level of accuracy for the  $\beta^+$  part. All other terms require the computation of the relativistic atomic wave functions:  $\beta_\kappa$  is the Coulomb amplitude of the bound state wave function as defined in [14];  $B_\kappa$  corrects for the overlap and exchange effects; and  $S_\kappa$  accounts for the shake-up and shake-off effects based on the description from [44].

The atomic wave functions are determined for a neutral atom, while the capture process creates a hole in the

atomic cloud. This hole slightly affects the wave functions and has to be taken into account. It is done in BetaShape using the first order, time independent perturbation approach from [45]. Accuracy of the atomic energies has also a significant influence. In this electron capture modeling, they are identical to those used for the atomic exchange effect in  $\beta$  decay [29, 30]. Two models, from J.N. Bahcall and E. Vatai, are used to estimate the overlap and exchange correction, both extended to all subshells [42]. The latter is physically more accurate and gives the central value of the capture probability. The former is used to estimate a modeling uncertainty, added to the uncertainty component from the maximum energy.

For each subshell, the relative capture probability and its contribution, the summand in Eq. 7, are calculated. The  $f$ -value of the  $\varepsilon$  transition is then simply the sum of the different contributions

$$f_\varepsilon = \sum_x \frac{\pi}{2} n_\kappa C_\kappa q_\kappa^2 \beta_\kappa^2 B_\kappa S_\kappa R_\kappa \quad (8)$$

If a  $\beta^+$  transition competes, the splitting of the branch between  $\varepsilon$  and  $\beta^+$  transitions is determined from the calculated capture-to-positron ratios. Intensities and partial half-lives are then updated accordingly. The  $f$ -value from the  $\beta^+$  transition is then added to the  $\varepsilon$  component

$$f_{\text{tot}} = f_\varepsilon + f_{\beta^+} \quad (9)$$

A comparison with different precise measurements available in the literature has highlighted good agreement and consistent results, validating this modeling [4].

### 3. Selection Criteria

The selection criteria in the review from 1998 were mainly focusing on the firm assignment of  $\pi$  values (with  $\pi$  being the corresponding parity) [1] and the exclusion of weak  $\beta$  branches (mainly transitions  $<1\%$  or  $\approx 1\%$ ). While certain well-known transitions below  $1\%$  are included within the present review, there is also a variety of more stringent selection criteria, which prevent dubious transitions from being included. By only applying the selection criteria from 1998, a total number of 4788 transitions would have been reviewed instead of the 4038 presented in this work. In direct comparison to 1998 (with 3835 reported transitions), this means an effective increase of approximately  $25\%$  within the past 25 years.

1. The intensity of the transition has to be  $\geq 1\%$ . The intensities in case of  $\beta^+/\text{EC}$  are treated as follows:
  - (a) If the total intensity is known, the corresponding value is used.
  - (b) If the total intensity is not known, but only the intensity for the  $\beta^+$ -branch is known, the corresponding value is used.
  - (c) If the total intensity is not known, but only the intensity for the EC-branch is known, the corresponding value is used.

- (d) If the total intensity is not known, but the intensity for both the  $\beta^+$ -branch, and the EC-branch are known, the sum of their respective values is used.
- 2. In addition to the selection criterion #1, transitions with intensities below 1 % are accepted, if the following conditions are fulfilled:
  - (a) The selection criteria #3 to #7 are fulfilled.
  - (b) The half-life of the parent is  $>1$  d.
- 3. The following word combinations (or the one word in case of "Pandemonium") may not be mentioned within the same line (or two consecutive lines, respectively) in the header comments of the respective ENSDF decay scheme:
  - (a) Apparent + Feeding
  - (b) Approximate + Feeding
  - (c) Incomplete + Scheme
  - (d) Pandemonium

While the majority of these decay schemes must legitimately be excluded based on their incompleteness, a manual cross check revealed some unintended exclusions. The resulting list of decay schemes, which have been exempted from this particular selection criterion is shown in section 4.

- 4. The branching ratio of the transition needs to have a well defined uncertainty. This uncertainty needs to be smaller than the third of the branching ratio. Beta branches listed as uncertain, approximate or with limits are not used. Exception: Transitions with an intensity of 100 % do not need an uncertainty.
- 5.  $J\pi$  of the parent and daughter levels needs to be known as ' $J\pi$ ' or as ' $(J)\pi$ '.
- 6. Except for the ground states, level energies of the parent and daughter need to have well-defined energies and uncertainties. Uncertain levels, or levels with energies given in the ENSDF database as ' $\dots+X$ ', ' $\dots+Y$ ', etc. are rejected.
- 7. The half-life of the parent nuclide needs to have a well defined uncertainty.

#### 4. Additional inclusions of transitions

##### 1. The decay of $^{100}\text{Sn}$

The  $Q$ -value is listed as  $Q=2720+X$ . Nevertheless,  $X$  has been estimated as  $<50$  keV. Due to its relevance as a doubly magic nucleus with extremely small  $\log ft$  value, its decay scheme has been included with  $Q=2745(25)$  keV. (Based on [46]).

##### 2. Exemptions from selection rule #3

The following decay schemes are included despite fulfilling selection criterion #3. Their respective transitions are only accepted, if they also fulfill all the other selection criteria:

- (a) **Apparent+Feeding:**  $^{22}\text{F}$  (GS),  $^{43}\text{Ti}$  (GS),  $^{71}\text{Zn}$  (1<sup>st</sup> isomere),  $^{74}\text{Rb}$  (GS),  $^{77}\text{Ge}$  (1<sup>st</sup> isomere),  $^{97}\text{Nb}$  (GS),  $^{98}\text{Ag}$  (GS),  $^{98}\text{Y}$  (2<sup>nd</sup> isomere),  $^{98}\text{Nb}$  (1<sup>st</sup> isomere),  $^{100}\text{Nb}$  (GS),  $^{100}\text{Nb}$  (1<sup>st</sup> isomere),  $^{122}\text{In}$  (2<sup>nd</sup> isomere),  $^{129}\text{In}$  (2<sup>nd</sup> isomere),  $^{129}\text{Sb}$  (GS),  $^{130}\text{In}$  (1<sup>st</sup> isomere),  $^{135}\text{Nd}$  (GS),  $^{139}\text{Cs}$  (GS),  $^{163}\text{Tm}$  (GS),  $^{165}\text{Tm}$  (GS),  $^{169}\text{Lu}$  (GS),  $^{183}\text{Os}$  (GS),  $^{184}\text{Pt}$  (GS),  $^{190}\text{Re}$  (GS),  $^{224}\text{Fr}$  (GS)
- (b) **Approximate+Feeding:**  $^{108}\text{In}$  (1<sup>st</sup> isomere),  $^{129}\text{Ba}$  (GS),  $^{146}\text{Ba}$  (GS),  $^{154}\text{Pm}$  (1<sup>st</sup> isomere)
- (c) **Incomplete+Scheme:**  $^{82}\text{Ge}$  (GS),  $^{91}\text{Tc}$  (GS),  $^{101}\text{Sr}$  (GS),  $^{116}\text{I}$  (GS),  $^{140}\text{Ba}$  (GS),  $^{151}\text{Nd}$  (GS),  $^{154}\text{Tb}$  (GS),  $^{154}\text{Tb}$  (1<sup>st</sup> isomere),  $^{154}\text{Tb}$  (2<sup>nd</sup> isomere),  $^{156}\text{Eu}$  (GS),  $^{159}\text{Er}$  (GS),  $^{169}\text{Lu}$  (GS),  $^{179}\text{Pt}$  (GS),  $^{209}\text{Rn}$  (GS)
- (d) **Pandemonium:**  $^{98}\text{Sr}$  (GS-branches into 547.87 keV, 600.30 keV and 986.39 keV),  $^{116}\text{Ag}$  (GS),  $^{116}\text{Ag}$  (1<sup>st</sup> isomere),  $^{116}\text{Ag}$  (2<sup>nd</sup> isomere)

#### 3. Other inclusions of single transitions

The following transitions have been included manually due to their appearance in a well-known decay scheme.

- (a)  $^{14}\text{O}$  -  $E_P=0.0$  keV  $\rightarrow$   $E_D=0.0$  keV
- (b)  $^{14}\text{O}$  -  $E_P=0.0$  keV  $\rightarrow$   $E_D=3948.1$  keV
- (c)  $^{28}\text{Mg}$  -  $E_P=0.0$  keV  $\rightarrow$   $E_D=972.24$  keV
- (d)  $^{66}\text{Ga}$  -  $E_P=0.0$  keV  $\rightarrow$   $E_D=2372.353$  keV
- (e)  $^{134}\text{Cs}$  -  $E_P=0.0$  keV  $\rightarrow$   $E_D=847.0$  keV

#### 5. Additional exclusions of transitions

##### 1. Exclusion of single transitions

- (a)  $^{228}\text{Ac}$  -  $E_P=0.0$  keV  $\rightarrow$   $E_D=2123.1$  keV  
This ultra-low energy  $\beta$  transition is excluded because the nuclear structure data leads to an unrealistic  $\log ft$  value of  $\approx 1.4$ . Transition nature and energy are not sufficiently well known to be credible and require further experimental investigations (cf. section 2).
- (b)  $^{28}\text{S}$  -  $E_P=0.0$  keV  $\rightarrow$   $E_D=5900$  keV  
In the current ENSDF database, for  $^{28}\text{S}$  decay to  $^{28}\text{P}$  decay, a single EC/ $\beta^+$  branch of 100% with an unrealistically low  $\log ft$  value of 2.33(9) to a proton-unbound analog  $0^+$  state at 5900 keV in  $^{28}\text{P}$  is listed, based on an experimental study by F. Pougheon et al. [47]. As the experiment in Ref. [47] was designed to measure only the beta-delayed protons, there was no information available for EC/ $\beta^+$  decays to proton-bound states in  $^{28}\text{P}$  through  $\gamma$ -ray spectroscopy. For this reason, we believe that 100% EC/ $\beta^+$  branch to the 5900 keV,  $0^+$

state assigned in the ENSDF is erroneous, thus this decay has been omitted in Table 5 of  $0^+$  to  $0^+$ ,  $\Delta T=0$ ,  $T_z(\text{parent})=-2$  transitions. Additionally, based on  $\log ft$  values for the seven transitions in Table 5, we estimate that  $EC/\beta^+$  branch to the 5900 keV,  $0^+$  level in  $^{28}\text{P}$  should be  $\sim 10\%$ , not 100% as in the ENSDF database. Until detailed experimental spectroscopic results for the decay of  $^{28}\text{S}$  decay become available,  $EC/\beta^+$  branching ratio for the superallowed beta decay to the analog state cannot be reliably assigned.

## 2. Exclusion of entire decay schemes

- (a)  $^{72}\text{Br}$  - The entire decay scheme is excluded due to uncertain beta feedings.
- (b)  $^{148\text{m}}\text{Tb}$  - Both the ground state and the excited state transitions suffer from an incomplete decay scheme. While the ground state has been filtered out by selection criterion #3, the meta stable state is filtered out manually.
- (c)  $^{146}\text{Eu}$  - This decay scheme suffers from many unplaced  $\gamma$ -rays. Hence, all transitions with beta branches below 2% have been excluded.

## 3. Exclusions from: Second Forbidden

The calculated  $\log ft$  values for these transitions are too low for a 2<sup>nd</sup> forbidden transition. It is therefore assumed, that these transitions contain incorrect experimental data.

- (a)  $^{26}\text{Ne}$  -  $E_P=0.0$  keV  $\rightarrow E_D=232.9$  keV
- (b)  $^{49}\text{K}$  -  $E_P=0.0$  keV  $\rightarrow E_D=6.69\text{E}3$  keV
- (c)  $^{49}\text{K}$  -  $E_P=0.0$  keV  $\rightarrow E_D=6.90\text{E}3$  keV
- (d)  $^{49}\text{K}$  -  $E_P=0.0$  keV  $\rightarrow E_D=7.06\text{E}3$  keV
- (e)  $^{52}\text{Mn}$  -  $E_P=0.0$  keV  $\rightarrow E_D=4627.13$  keV
- (f)  $^{56}\text{Co}$  -  $E_P=0.0$  keV  $\rightarrow E_D=2959.972$  keV
- (g)  $^{56}\text{Co}$  -  $E_P=0.0$  keV  $\rightarrow E_D=3369.95$  keV
- (h)  $^{77}\text{Rb}$  -  $E_P=0.0$  keV  $\rightarrow E_D=499.58$  keV
- (i)  $^{77}\text{Br}$  -  $E_P=0.0$  keV  $\rightarrow E_D=581.01$  keV
- (j)  $^{91}\text{Tc}$  -  $E_P=0.0$  keV  $\rightarrow E_D=1362.02$  keV
- (k)  $^{106}\text{In}$  -  $E_P=0.0$  keV  $\rightarrow E_D=2330.26$  keV
- (l)  $^{109}\text{Rh}$  -  $E_P=0.0$  keV  $\rightarrow E_D=491.589$  keV
- (m)  $^{109}\text{Sn}$  -  $E_P=0.0$  keV  $\rightarrow E_D=1171.72$  keV
- (n)  $^{109}\text{Sn}$  -  $E_P=0.0$  keV  $\rightarrow E_D=1713.27$  keV
- (o)  $^{119}\text{Cd}$  -  $E_P=0.0$  keV  $\rightarrow E_D=941.33$  keV
- (p)  $^{122}\text{Cs}$  -  $E_P=0.0$  keV  $\rightarrow E_D=1214.07$  keV
- (q)  $^{125}\text{Sb}$  -  $E_P=0.0$  keV  $\rightarrow E_D=443.554$  keV
- (r)  $^{130}\text{Sb}$  -  $E_P=5.36$  keV  $\rightarrow E_D=1815.37$  keV
- (s)  $^{145}\text{Eu}$  -  $E_P=0.0$  keV  $\rightarrow E_D=2292.82$  keV
- (t)  $^{153}\text{Tb}$  -  $E_P=0.0$  keV  $\rightarrow E_D=482.875$  keV
- (u)  $^{156}\text{Pm}$  -  $E_P=0.0$  keV  $\rightarrow E_D=517.07$  keV
- (v)  $^{160}\text{Tb}$  -  $E_P=0.0$  keV  $\rightarrow E_D=1285.59$  keV
- (w)  $^{166}\text{Ta}$  -  $E_P=0.0$  keV  $\rightarrow E_D=470.47$  keV
- (x)  $^{169}\text{Yb}$  -  $E_P=0.0$  keV  $\rightarrow E_D=570.832$  keV

- (y)  $^{172}\text{Lu}$  -  $E_P=0.0$  keV  $\rightarrow E_D=1757.56$  keV
- (z)  $^{183}\text{Ir}$  -  $E_P=0.0$  keV  $\rightarrow E_D=558.15$  keV
- (aa)  $^{183}\text{Ir}$  -  $E_P=0.0$  keV  $\rightarrow E_D=646.88$  keV
- (ab)  $^{206}\text{Po}$  -  $E_P=0.0$  keV  $\rightarrow E_D=1077.87$  keV
- (ac)  $^{206}\text{At}$  -  $E_P=0.0$  keV  $\rightarrow E_D=1564.70$  keV
- (ad)  $^{221}\text{Rn}$  -  $E_P=0.0$  keV  $\rightarrow E_D=99.88$  keV
- (ae)  $^{233}\text{Pa}$  -  $E_P=0.0$  keV  $\rightarrow E_D=320.76$  keV

## 4. Exclusions from: Second Forbidden Unique

The calculated  $\log ft$  values for these transitions are too low for a 2<sup>nd</sup> forbidden unique transition. It is therefore assumed, that these transitions contain incorrect experimental data.

- (a)  $^{99}\text{Rh}$  -  $E_P=64.3$  keV  $\rightarrow E_D=89.6$  keV
- (b)  $^{99}\text{Nb}$  -  $E_P=0.0$  keV  $\rightarrow E_D=548.7$  keV
- (c)  $^{100}\text{Nb}$  -  $E_P=0.0$  keV  $\rightarrow E_D=2970.3$  keV
- (d)  $^{105}\text{Ag}$  -  $E_P=0.0$  keV  $\rightarrow E_D=644.6$  keV
- (e)  $^{109}\text{Sn}$  -  $E_P=0.0$  keV  $\rightarrow E_D=1026.42$  keV
- (f)  $^{122}\text{In}$  -  $E_P=40$  keV  $\rightarrow E_D=2415.64$  keV
- (g)  $^{131}\text{Ba}$  -  $E_P=0.0$  keV  $\rightarrow E_D=1043.97$  keV
- (h)  $^{131}\text{Ba}$  -  $E_P=0.0$  keV  $\rightarrow E_D=1257.83$  keV
- (i)  $^{150}\text{Tb}$  -  $E_P=0.0$  keV  $\rightarrow E_D=1699.915$  keV
- (j)  $^{170}\text{Hf}$  -  $E_P=0.0$  keV  $\rightarrow E_D=114.87$  keV
- (k)  $^{187}\text{Pt}$  -  $E_P=0.0$  keV  $\rightarrow E_D=186.16$  keV

## 5. Exclusions from: Third Forbidden

The calculated  $\log ft$  values for these transitions are too low for a 3<sup>rd</sup> forbidden transition. It is therefore assumed, that these transitions contain incorrect experimental data.

- (a)  $^{105}\text{Ag}$  -  $E_P=0.0$  keV  $\rightarrow E_D=306.3$  keV
- (b)  $^{105}\text{Ag}$  -  $E_P=0.0$  keV  $\rightarrow E_D=442.3$  keV
- (c)  $^{170}\text{Lu}$  -  $E_P=0.0$  keV  $\rightarrow E_D=1397.05$  keV
- (d)  $^{183}\text{Ir}$  -  $E_P=0.0$  keV  $\rightarrow E_D=792.93$  keV

## 6. Treatment of potentially Pandemonium affected transitions

The impact of the Pandemonium effect on a nucleus of interest strongly depends on its nuclear structure and its corresponding level density. The determination of appropriate cut conditions for the exclusion of Pandemonium nuclei is therefore not straightforward. Furthermore, the enormous effort in the research topic of total absorption gamma spectrometry (TAGS) has led to reliable nuclear data sets of certain Pandemonium nuclei.

Hence, in order to ensure transparency and traceability, no nuclide has been rejected on the basis of possible Pandemonium effects. Instead, an additional flag has been added in the last column of each table, which may give an indication of potentially affected transitions. This flag has been added if the  $Q$ -value of the parent nucleus is larger than 2800 keV, and the highest known daughter level of the decay scheme has an energy less than 80 % of the  $Q$ -value. Furthermore, the following statements are applied:



1. In case of  $1^+ \leftrightarrow 0^+$  and  $0^+ \rightarrow 0^+$ , no transition has been flagged, which is evaluated with a well-known  $J\pi$  assignment for parent and daughter.
2. No transition with branching  $\geq 90\%$  has been flagged.
3. In case of parental isomeres, the level energy of the parent nucleus has been added to the  $Q$ -value in order to determine the ratio between the  $Q$ -value and the energy level of the highest known daughter.
4. There is no decay scheme where the  $Q$ -value of the parent is larger than 2800 keV, its highest known daughter level is the ground state, and which furthermore fulfills all selection criteria. Therefore, there is no need for a special treatment of these cases.
5. Despite their fulfilled conditions, the well-known decay schemes of  $^{22}\text{Na}$  and  $^{26}\text{Al}$  are not flagged. However, the suggested flagging of these low- $Z$  transitions underlines the weakness of our algorithm regarding the disregard of level densities. Furthermore, the transitions from  $^{201}\text{Bi}$  are also not flagged despite fulfilling the conditions. However, its decay scheme is well-known.

It is important to emphasize that the presented definition of the ‘‘Pandemonium flag’’ is neither sufficient to flag all transitions, which are affected by the Pandemonium effect, nor sufficient to protect any transition from being flagged, which are not affected by the Pandemonium effect.

Neither the dependency of level densities on the mass numbers is reflected by this criterion, nor the effort by TAGS measurements in order to take the Pandemonium effect into account. The additional flag in the last column of the tables must therefore be treated with caution. Nevertheless, this flag may give an indication, whether the transition could potentially be affected by the Pandemonium effect and raises the awareness of the reader.

Furthermore, it may be noticed that the authors deliberately avoided a manual decision on a possible Pandemonium effect for every transition. This manual selection would neither be flawless as well and furthermore adds a lack of transparency regarding the proceeding.

## 7. Comments on particular transitions

While the vast majority of presented data relies on the methods stated in sections 1 to 6, there are some few cases, which have been treated individually.

1.  $^{90}\text{Mo}$  ( $E_{\text{P}}=0.0 \text{ keV} \rightarrow E_{\text{D}}=2309.0 \text{ keV}$ )  
The daughter level is assigned by experiments to  $J\pi=3^+$ . This is undoubtedly incorrect as it would give an unrealistic value of  $\log ft=2.65$  for a second-forbidden transition. The only meaningful assignment is  $1^+$ . This has therefore been adapted with a new resulting value of  $\log ft=4.53$ .

2.  $^{66}\text{As}$  EC decay to  $^{66}\text{Ge}$   
Expected to be superallowed decay, with 100% decay from  $0^+$  g.s. of  $^{66}\text{As}$  to  $0^+$  g.s. of  $^{66}\text{Ge}$ ,  $\Delta T=0$ ,  $T_z(\text{parent})=0$ , with  $\log ft=3.490(2)$ . As at present, there is no known excited level of spin=0 or 1 in  $^{66}\text{Ge}$  which could be fed by the beta decay. Yet until the decay scheme of  $^{66}\text{As}$  is firmly established experimentally with possible spin=1 or 0 levels at higher excitation energy in  $^{66}\text{Ge}$ , this transition is left out of Table 4 of superallowed ( $\Delta T=0$ ,  $T_z(\text{parent})=0,1$ ), even though it seems a reliable candidate for a superallowed transition.
3.  $^{70}\text{Br}$  EC decay to  $^{70}\text{Se}$   
Expected to be superallowed decay, with 98.7(13)% decay [48] from  $0^+$  g.s. of  $^{70}\text{Br}$  to  $0^+$  g.s. of  $^{70}\text{Se}$ ,  $\Delta T=0$ ,  $T_z(\text{parent})=0$ , with  $\log ft=3.608(8)$ . As at present, except for a possible ( $0^+$ ) state at 2010 keV, there is no other known excited level of spin=0 or 1 in  $^{70}\text{Se}$  which could be fed by the beta decay. Yet until the decay scheme of  $^{70}\text{Br}$  is firmly established experimentally, with possible spin=1 or 0 levels at higher excitation energy in  $^{70}\text{Se}$ , this transition is left out of Table 4 of superallowed ( $\Delta T=0$ ,  $T_z(\text{parent})=0,1$ ). Additionally,  $\log ft$  value of 3.608 (or 3.602 if 100% feeding to the g.s. is assumed) is higher than expected  $\log ft=3.49(1)$  for  $0^+$  to  $0^+$  superallowed transitions, implying that either the half-life of  $^{70}\text{Br}$  decay or its  $Q(\beta)$  value, or both are problematic.
4.  $0^+ \rightarrow 0^+$ ,  $\Delta T=0$ ,  $T_z(\text{parent})=-2$   
From data presented in Table 5 for superallowed  $0^+$  to  $0^+$  transitions with  $\Delta T=0$ ,  $T_z(\text{parent})=-2$ , the  $\log ft$  values for seven such known transitions are listed with an expected mean value of 3.12.
5.  $^{115}\text{In}$ ,  $^{187}\text{Re}$ , and  $^{228}\text{Ac}$   
These decay schemes each contain one transition with a particular low transition energy. See discussion in section 2.1.1.

## 8. Inferences and conclusions

- 1a) **Superallowed  $0^+ \rightarrow 0^+$  transitions for  $T_z=0$  and  $T_z=-1$  parents**

Out of 24 listed cases in Table 4,  $\log ft$  values for 22 nuclei lie in the expected range [10] of 3.487(6) and 3.504(14). For two cases, the values are slightly lower: 3.472(12) for  $^{18}\text{Ne}$  and 3.465(49) for  $^{70}\text{Kr}$ , although, within the quoted uncertainties, these values almost agree with the values for  $T_z=0$  and  $T_z=-1$  parents.

- 1b) **Superallowed  $0^+ \rightarrow 0^+$  transitions for  $T_z=-2$  parents**

For all the seven cases listed in Table 5,  $\log ft$  values are in the range of 3.174(41) and 3.33(7) which

is in agreement with the expected values. As explained earlier, in case of  $^{28}\text{S}$  decay, a superallowed decay has been observed, but is omitted in our Tables and Figures due to lack of adequate data for beta branching ratio to the analog state in  $^{28}\text{P}$ . In superallowed decays, the nuclear matrix element is mostly determined by isospin coupling. Transitions with  $T_z=-2$  parents are expected to have  $ft$  values about half those with  $T_z=-1$  parents. Adding  $\log 2$  for the sake of comparison the  $\log ft$  values in Table 5 become similar to those with  $T_z=-1$  parents. It is noteworthy that all the daughter levels in Table 5 are above the proton emission threshold. Precise measurements of such  $\beta$  decays are particularly difficult and uncertainties on  $\log ft$  values have to be considered with caution.

## 2) $0^+ \rightarrow 0^+$ transitions with $\Delta T \neq 0$

In Table 6, no  $\log ft$  values were found between 3.6 and 6.4 for the 12 cases listed in this category. Lowest value among 20 cases of  $\Delta T \neq 0$  is 6.661(18) for  $^{64}\text{Ga}$  decay. This is consistent with the rule proposed [8, 49], that a  $\log ft$  between 3.6 and 6.4 indicates that it is not a  $0^+$  to  $0^+$  transition. Most likely these cases suffer from hindered transitions due to nuclear state deformation [50]. However, more investigation is needed.

## 3) $\Delta J=0$ , $\Delta\pi=\text{no}$ transitions with $\log ft < 4$

There are 41 transitions in Table 7 where  $\log ft$  values range from 2.98(9) to 3.932(17). This group of transitions is kept separate from the general allowed ( $\Delta J=0$ ) transitions since some of these are likely to fall in the category of superallowed ( $\Delta T=0$ , not  $0^+$  to  $0^+$ ) transitions, or  $\beta$  transitions for neutron decay and between mirror nuclei in odd-A nuclei from  $^3\text{H}$  to  $^{75}\text{Sr}$ , as detailed in a recent evaluation by N. Severijns et al. [51].

## 4) $0^+ \leftrightarrow 1^+$ transitions

Central  $\log ft$  value of 584 transitions is about one unit lower than for other allowed transitions.

## 5) Allowed transitions (not $0^+ \leftrightarrow 1^+$ )

From a database of 1899 transitions, the central  $\log ft$  value is lower for  $\Delta J=1$  transitions than for  $\Delta J=0$  transitions. In each category of  $\Delta J=0$  and  $\Delta J=1$  transitions, the central  $\log ft$  value and the width of the distribution for odd-A nuclides are less than those for even-A nuclides.

## 6) First-forbidden non-unique transitions

From a database of 1254 transitions, the central  $\log ft$  value is lower for  $\Delta J=0$  transitions than for  $\Delta J=1$  transitions, which is reverse of that for allowed transitions. In each category of  $\Delta J=0$  and  $\Delta J=1$  transitions, the central  $\log ft$  value and the width

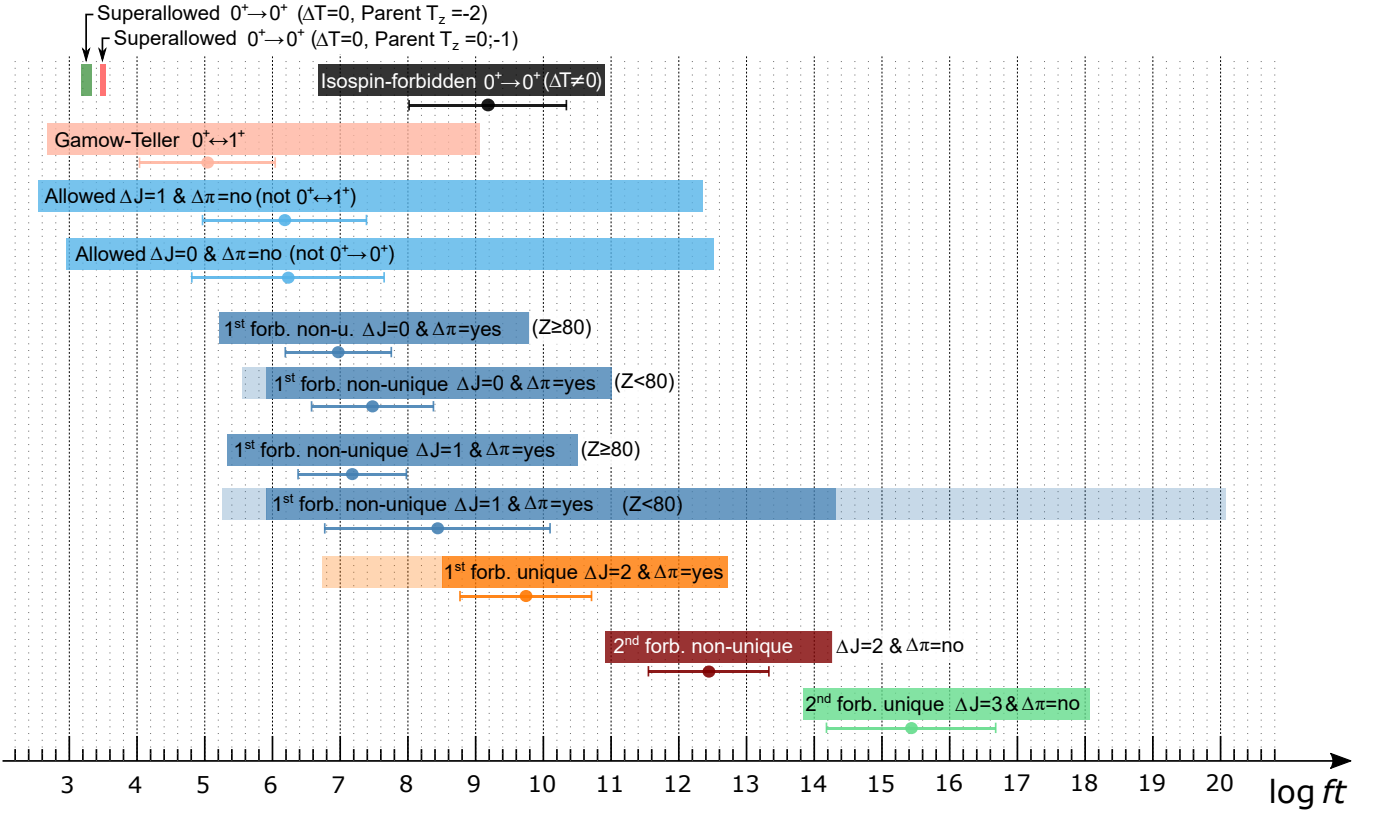
of the distribution for odd-A nuclides are less than those for even-A nuclides, similar to that for allowed transitions. A lower limit of  $\log ft=5.9$  for the first forbidden transitions for  $Z<80$  and 5.1 for  $Z>80$  is proposed [8, 49]. From a total of about 1100 transitions considered in this review, we find that there are only two real cases in the  $Z<80$  region, where  $\log ft$  value is  $<5.9$ . These are from well-known decays of  $^{96}\text{Y}$  ( $0^-$  to  $0^+$  transition) with  $\log ft=5.616(7)$ , and  $^{142}\text{Cs}$  ( $0^-$  to  $0^+$ ) with  $\log ft=5.78(4)$  (based on TAGS data in [52]). The data for the decay of  $^{96}\text{Y}$  to  $^{96}\text{Zr}$  were not available at the time of publication of [8]. For  $^{33}\text{Mg}$ ,  $^{96}\text{Rb}$ ,  $^{97}\text{Rb}$ ,  $^{98}\text{Y}$ ,  $^{177}\text{W}$ , and  $^{203}\text{Au}$  decays,  $\log ft$  values are somewhat lower than 5.9, which could be explained by Pandemonium effect in most cases. Other 18 cases of low  $\log ft$  values are for  $Z\geq 80$ , lowest being  $\log ft$  of 5.202(6) for  $^{207}\text{Tl}$  decay ( $1/2^+$  to  $1/2^-$  transition), consistent with the findings in Ref. [8]. The policy in Nuclear Data Sheets [49] regarding nuclides with  $Z$  around 82 ( $\log ft$  limit is lowered to 5.1) should apply for  $Z\geq 80$  as intended in Ref. [8].

## 7) First-forbidden unique transitions

A lower limit of  $\log f^{1u}t=8.5$  was proposed in Ref. [8]. We find that from a total of 213 transitions in Table 13, there are 12 transitions which show  $\log f^{1u}t < 8.5$ , within the quoted uncertainties, being in the range of 6.7 to 8.317. Eight of these transitions correspond to weak feedings (1.7-3.9%) where data problems, such as Pandemonium effect for at least three of the above eight transitions, or other decay scheme issues, could give rise to low  $\log f^{1u}t$  values. These are:

$^{78}\text{As}$ :	$\beta$ branch = 3.5(5)%	$\log f^{1u}t = 6.72(7)$
$^{97}\text{Tc}$ :	$\beta$ branch = 3.94(18)%	$\log f^{1u}t = 7.451(31)$
$^{98}\text{Y}$ :	$\beta$ branch = 3.0(4)%	$\log f^{1u}t = 8.28(6)$
$^{103}\text{Cd}$ :	$\beta$ branch = 3.4(9)%	$\log f^{1u}t = 7.99(12)$
$^{106}\text{In}$ :	$\beta$ branch = 2.50(23)%	$\log f^{1u}t = 7.964(42)$
$^{108}\text{In}$ :	$\beta$ branch = 3.0(7)%	$\log f^{1u}t = 7.73(10)$
$^{108}\text{In}$ :	$\beta$ branch = 2.4(7)%	$\log f^{1u}t = 7.73(13)$
$^{110}\text{In}$ :	$\beta$ branch = 1.74(15)%	$\log f^{1u}t = 7.307(49)$

For exceptionally low  $\log f^{1u}t$  values of 6.72(7) and 7.30(5) for  $2^-$  to  $4^+$   $\beta$  transitions to the 2682.09 and 3294.73 keV levels in  $^{78}\text{Se}$ , perusal of spin-parity assignment arguments for these levels in the ENSDF database shows that  $4^+$  assignments for both the levels are based only on L-transfer equal to 4 in (p,p') and (t,p) reactions, further e.g. called "L(p,p')=4". However, the quoted precision for observed level energies is rather low. According to data in the ENSDF database, in (t,p), three levels are reported: 2677(11) keV with L(t,p)=4; 3288(9) keV with L(t,p)=1 and 3295(10) keV with L=4, while in



**Fig. 3:** Distribution of  $\log ft$  values for different transition types based on all listed transitions within this review. The entire range of listed  $\log ft$  values is shown with horizontal bars for each transition type. Below these bars, both the centroid and the width of each distribution are indicated by an additional data point and its error bars, respectively. In case of first forbidden non-unique transitions with  $\Delta J=1$  and  $\Delta\pi=\text{yes}$  with  $Z<80$ , there are only two cases with a comparatively large  $\log ft$  of approximately 20, that occur in  $^{176}\text{Lu}$  decay, well known to be affected by nucleus deformation [53]. Otherwise, the maximum is 14.334. This fact is indicated by a transparent bar on the right side of the filled bar. As discussed later in the conclusions section of the paper, unexpected low  $\log ft$  values are subject to revision due either to pandemonium effect, or low experimental  $\beta$  feedings known with less precision. Realistically, we consider that minimum  $\log ft$  values for first-forbidden non-unique transitions for  $Z<80$  region are not  $<5.9$ , and those for the first-forbidden unique transitions not  $<8.5$ , as proposed by Raman and Gove [8]. This fact is indicated by transparent regions left to the corresponding filled bar. The overall color assignment is identical to Figures 4 - 7.

(p,p'), two levels are reported: 2680.7(20) keV with  $L(p,p')=4$  and 3288.4(20) keV doublet with  $L=4$ . While it is plausible that the 2682.09(9) keV and 3294.73(13) keV levels populated in  $^{78}\text{As}$  decay correspond to  $L=4$  levels in (p,t) and (p,p'), yet correspondence of levels in  $^{78}\text{As}$  decay and particle-transfer studies is not absolutely established due to high level density in this energy range.

Two other cases, with significant  $\beta$  feedings, and well-established decay schemes, where  $\log f^{1ut}$  values are marginally lower than 8.5 are:  $^{146}\text{Gd}$  ( $0^+$  to  $2^-$ ),  $\beta$  branch = 26.5(16)%,  $\log f^{1ut} = 8.268(33)$ ; and  $^{182}\text{Re}$  ( $7^+$  to  $5^-$ ),  $\beta$  feeding=7.1(23)%,  $\log f^{1ut} = 8.33(26)$ . Low  $\log f^{1ut}$  value for  $^{146}\text{Gd}$  decay could possibly be related to semi-closed shell ( $N=82$ ) of this nuclide. The distribution shown for the first-forbidden unique transitions in the third panel of Figure 11 is quite likely skewed on the right side due to lack of experimental data for a large number

of possible but as yet unobserved weak  $\beta$  branches which could give  $\log f^{1ut}$  values much larger than the central value of 9.5. We conclude that lower limit of  $\log f^{1ut}=8.5$  is valid for first-forbidden transitions.

#### 8) Second-forbidden non-unique transitions

A lower limit of  $\log ft=11.0$  was proposed in Ref. [8]. We find that from a total of 27 transitions, there is one weak transition from  $5^-$  to  $7^-$  in the decay of  $^{148}\text{Eu}$ , with intensity of 0.106(25)% and  $\log ft=10.92(10)$ . All the other transitions have  $\log ft > 11.1$ .

#### 9) Second-forbidden unique transitions

A lower limit of  $\log ft=12.8$ , based on  $^{22}\text{Na}$  decay, was proposed in Ref. [8]. There are only 12 transitions known in this category, based on which, we propose a limit of  $\log f^{2ut}=13.83$  (value for  $0^+$  to  $3^+$  (100%) transition in  $^{10}\text{Be}$   $\beta^-$  decay). This value is

consistent with that proposed in Ref. [8], but our value is based on the strong  $\beta^-$  transition from  $^{10}\text{Be}$  decay, rather than on the very weak one (0.056%) from  $^{22}\text{Na}$  B+/EC decay in Ref. [8].

10) **Third forbidden non-unique transition**

Since only one transition is known:  $3/2^-$  to  $9/2^+$  in  $^{87}\text{Rb}$   $\beta^-$  decay with  $\log ft=17.0724(25)$ , no lower limit for  $\log ft$  can be proposed for such transitions.

11) **Third forbidden unique transitions**

Only two transitions, both  $4^-$  to  $0^+$  are known, both in  $^{40}\text{K}$   $\beta^-$  and  $\beta^+$ /EC decay, with  $\log ft$  values of 20.5932(10) and 21.64(11), respectively, which do not provide adequate data for proposing lower limit for  $\log ft$  in this category.

12) **Fourth forbidden non-unique transitions**

Only three transitions are known:  $6^+$  to  $2^+$  in  $^{50}\text{V}$  EC decay, with  $\log ft=24.338(37)$  (highest  $\log ft$  value in the present survey),  $1/2^+$  to  $9/2^+$  in  $^{113}\text{Cd}$   $\beta^-$  decay with  $\log ft$  values of 22.8060(38), and  $9/2^+$  to  $1/2^+$  in  $^{115}\text{In}$   $\beta^-$  decay with  $\log ft$  value of 22.991(25), based on which, one can perhaps set a lower limit of  $\log ft=22$  for such transitions.

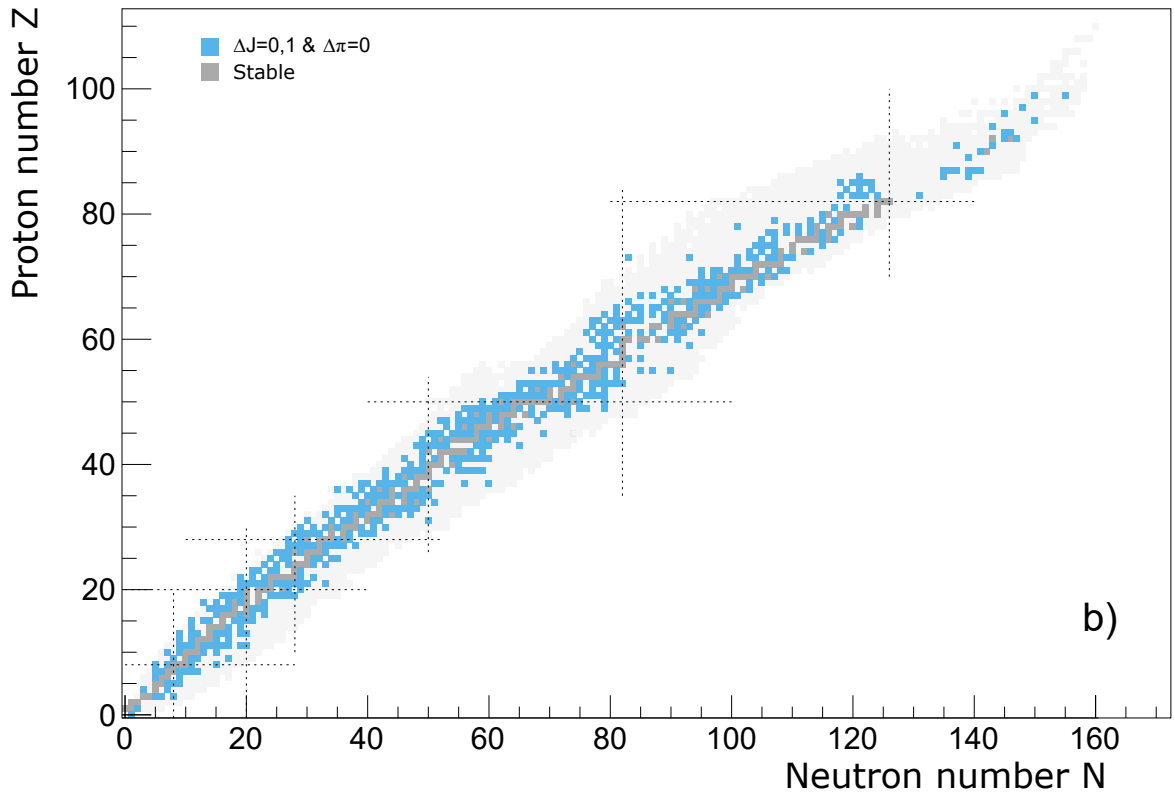
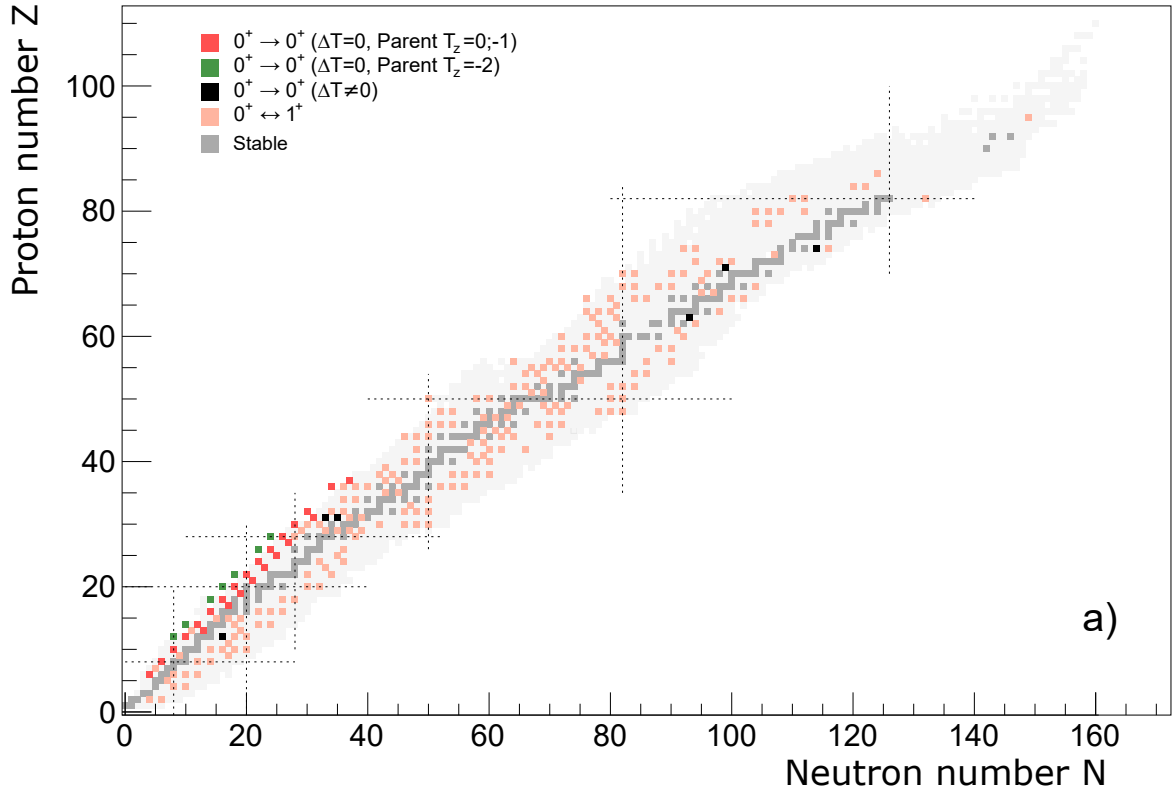
While we recognize that  $\log ft$  values can depend on nuclear structure properties of the parent and daughter levels, especially in the deformed regions of the nuclear chart, where  $\beta$  transitions can be allowed unhindered or forbidden by the K-quantum numbers involved, such issues fall outside the scope of our present work, albeit, we point out two prominent cases: 1.  $^{176}\text{Lu}$   $\beta^-$  decay, where the two known first-forbidden beta transitions occur between  $J\pi=7^-$  g.s. of  $^{176}\text{Lu}$  and  $J\pi=0^+$ ,  $6^+$  and  $8^+$  members of the ground-state band in  $^{176}\text{Hf}$ , resulting in exceptionally large  $\log ft$  values of 19.2 and 20.1, respectively [53]; 2.  $^{100}\text{Sn}$  EC/ $\beta^+$  decay investigated by C.B. Hinke et al. [46] and D. Lubos et al. [54], where  $0^+$  to  $1^+$  Gamow-teller transition has almost the lowest  $\log ft$  value of 2.66(14) in our Tables, which is likely due to decay of a doubly-closed ( $Z=N=50$ ) nucleus. This topic may get taken up in detail at a later date when BetaShape code undergoes further development to possibly include nuclear structure model calculations. We note that beta decays and  $\log ft$  values for neutron decay and between the mirror nuclei in odd-A region ( $^3\text{H}$  to  $^{75}\text{Sr}$ ) have recently been analyzed and evaluated in detail by N. Severijns et al. [51]. Extensive theoretical calculations have been performed for beta-transition matrix elements, half-lives, and  $\log ft$  values by the theory group at the University of Jyvaskyla [55–57] and by D.-L. Fang et al. [58], yet at present, it appears impractical to make detailed comparison of experimental and available theoretical results.

## Acknowledgments

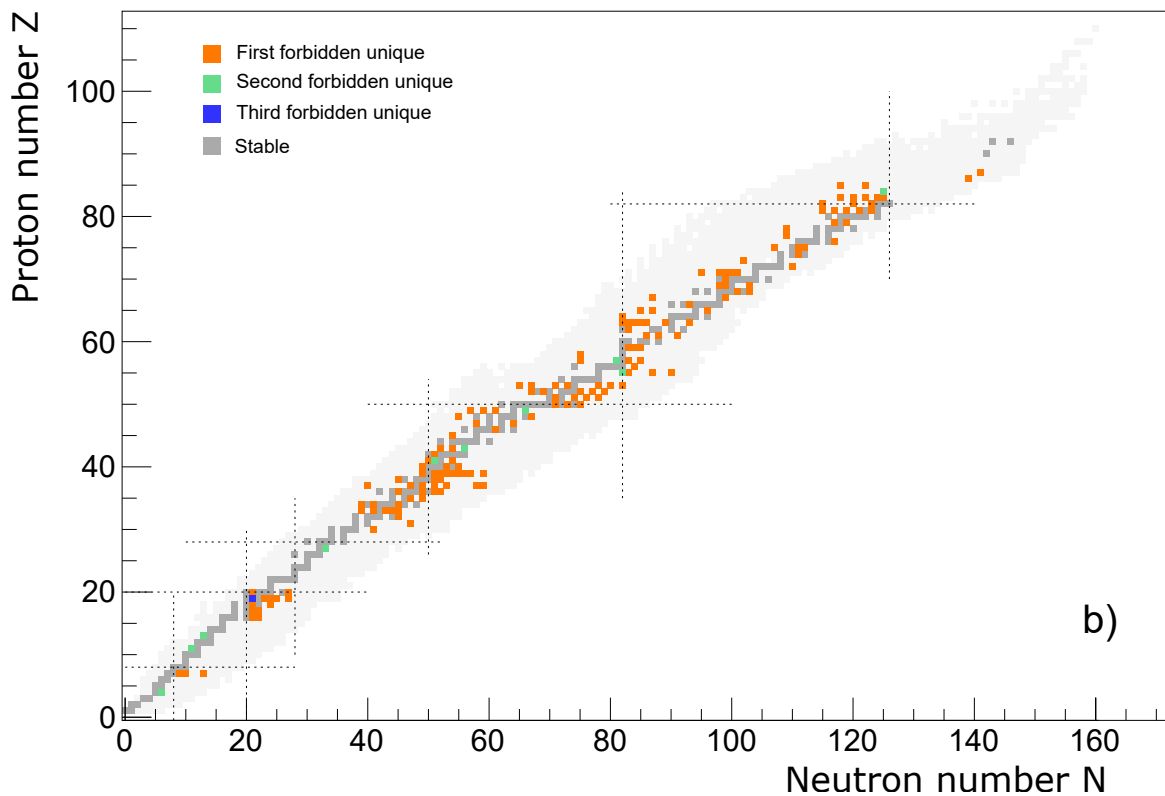
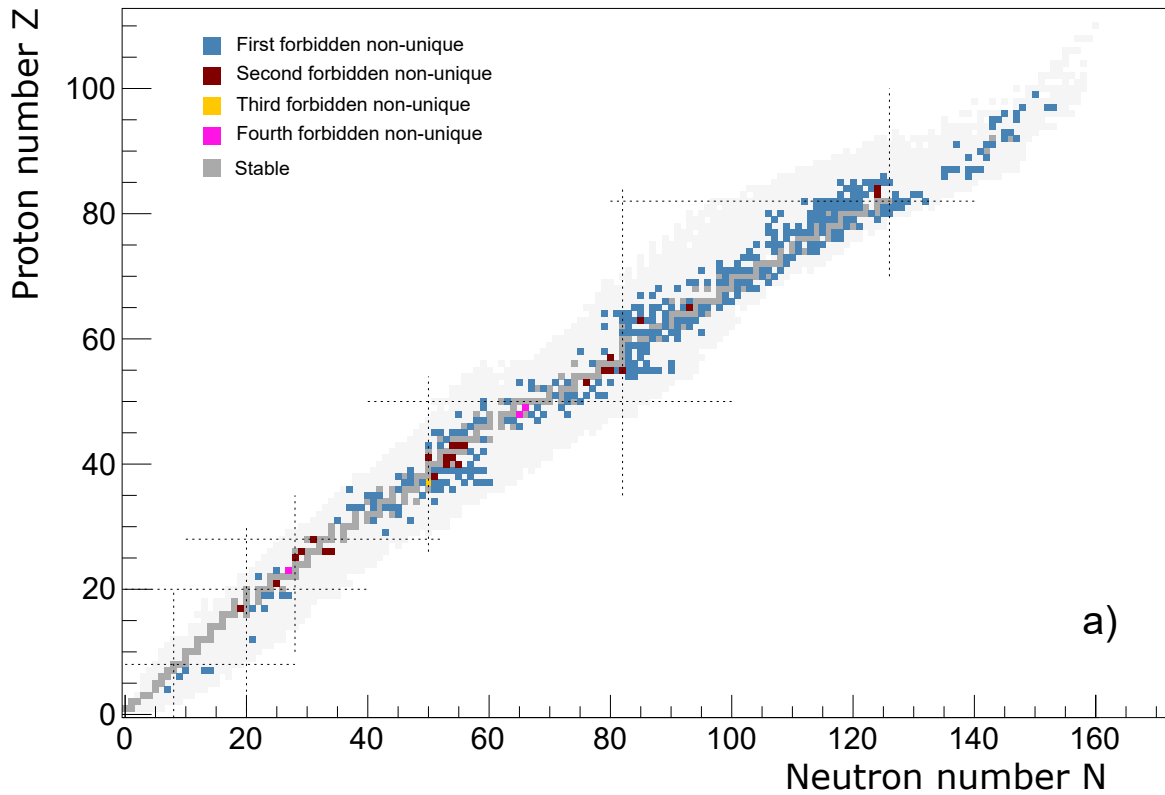
The authors are grateful to Prof. J. C. Hardy (Texas A&M University) for valuable consultations about the treatment of transitions, which are potentially affected by the Pandemonium effect, and an insight into super-allowed  $\beta$  transitions. The theoretical developments were performed as part of the EMPIR Project 20FUN04 PrimA-LTD, which has received funding from the EMPIR program co-financed by the Participating States and from the European Union’s Horizon 2020 research and innovation program. The support by the Konrad Adenauer Stiftung is gratefully acknowledged.

## 9. List of Tables and Figures

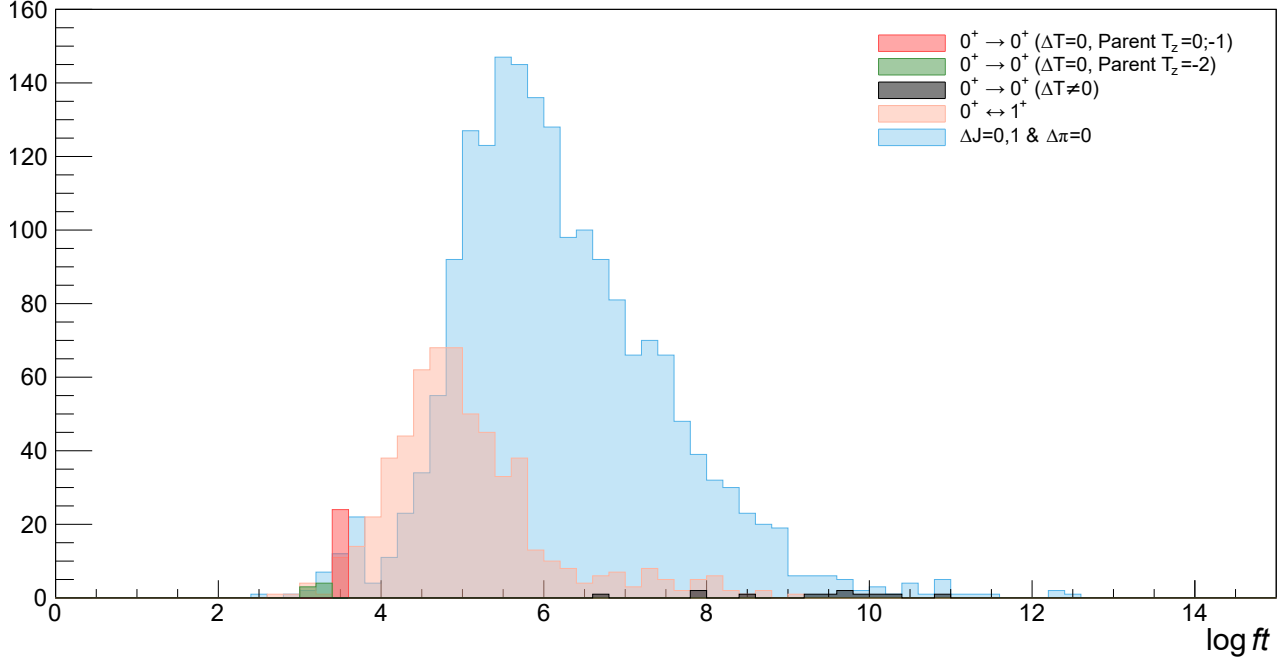
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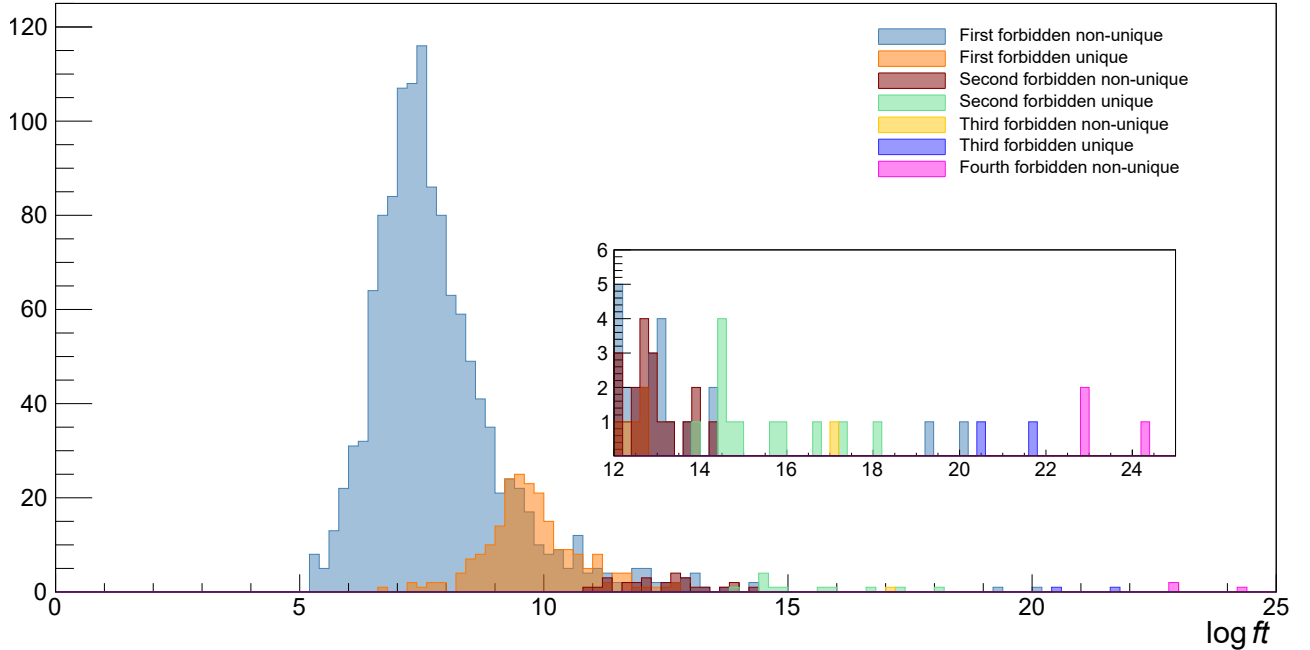
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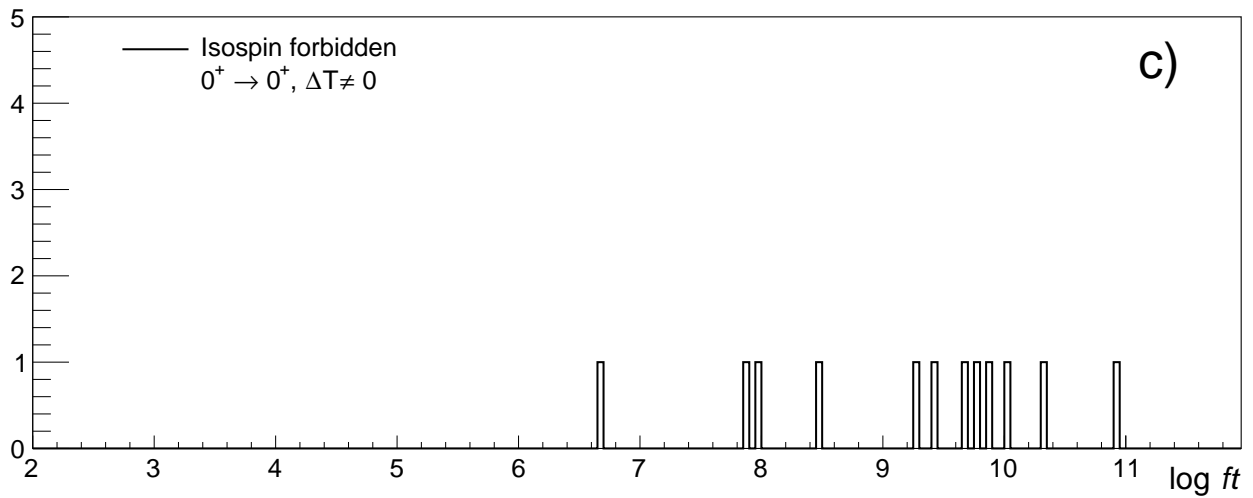
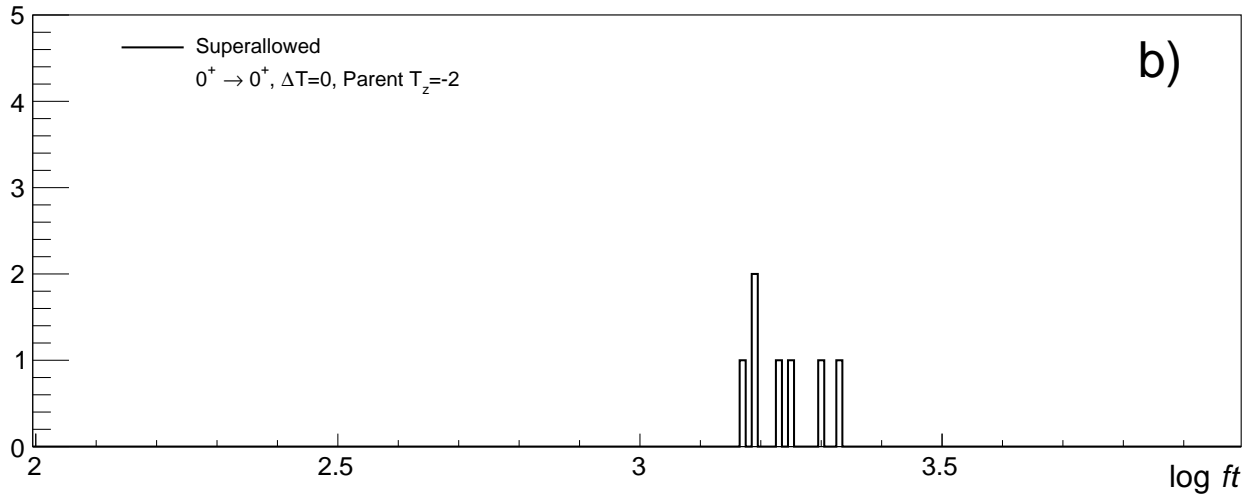
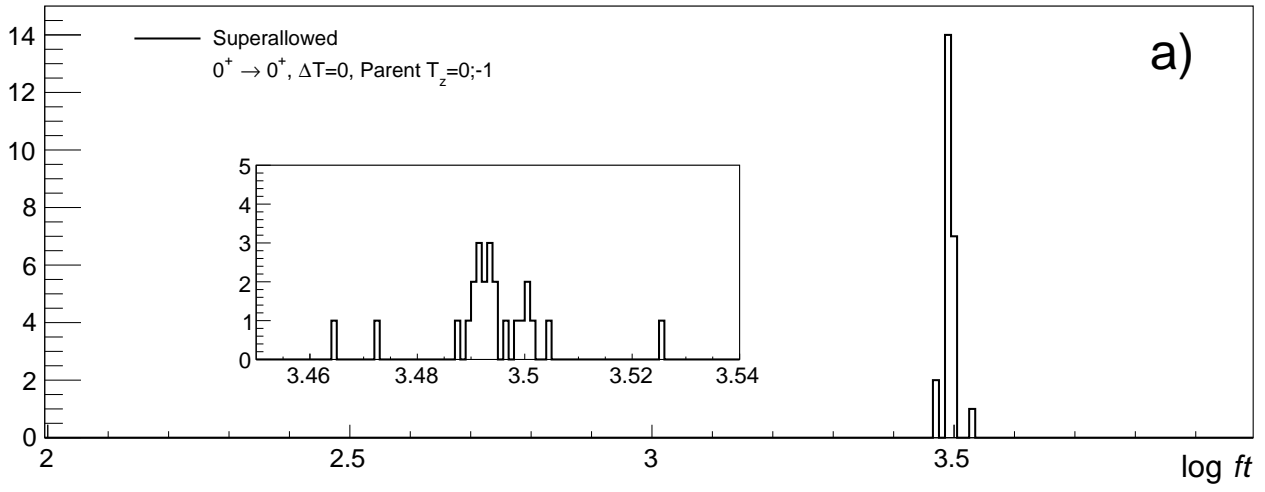


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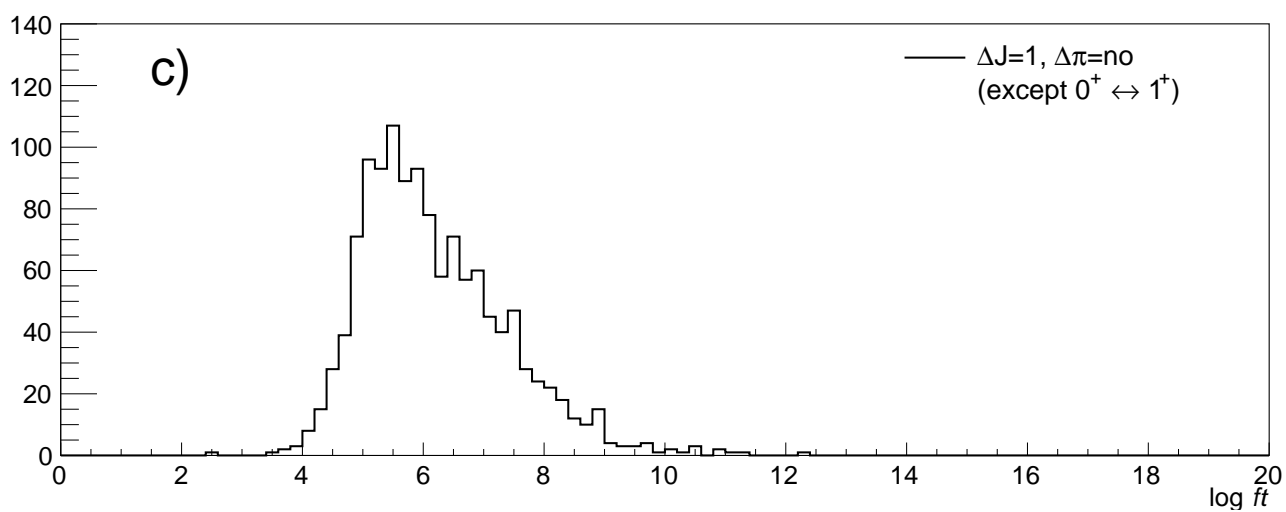
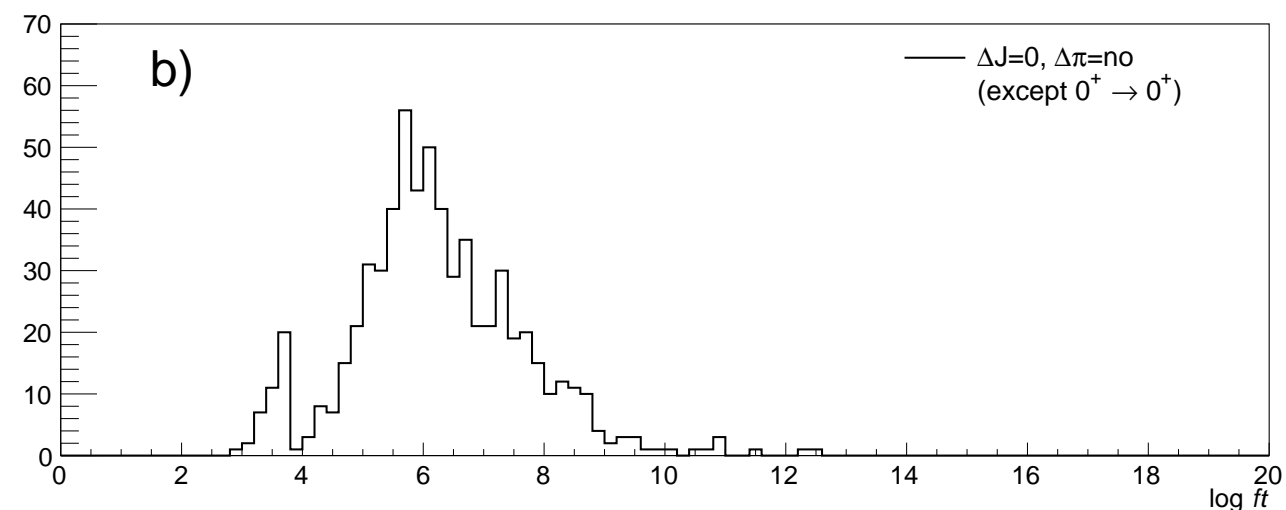
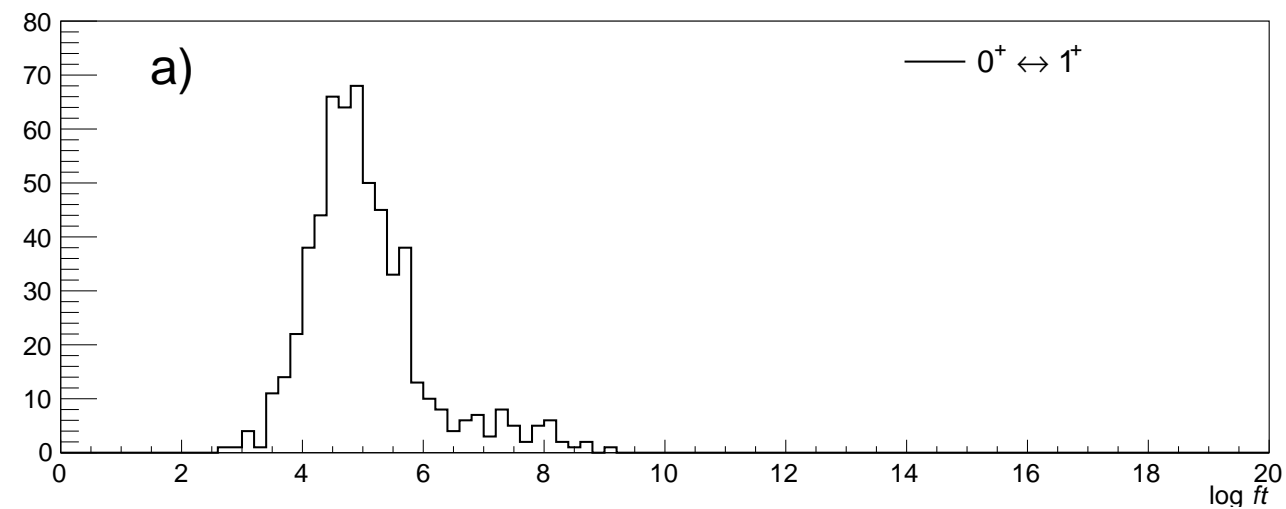


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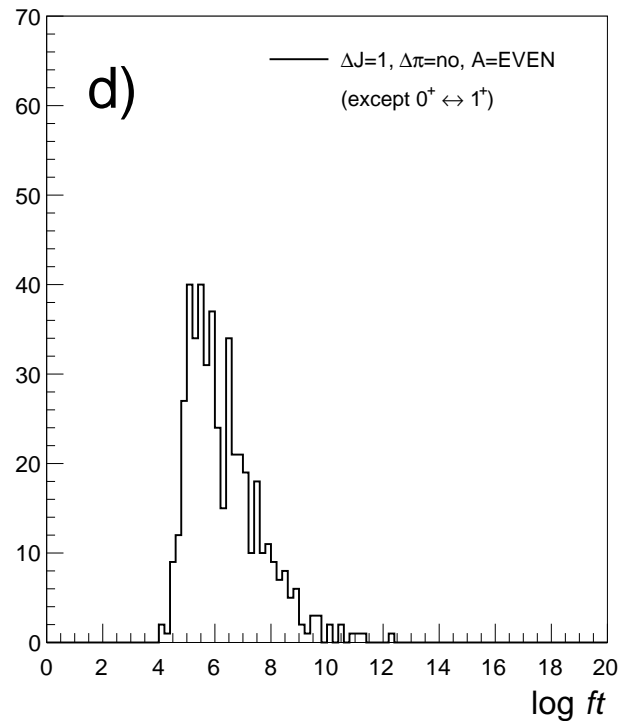
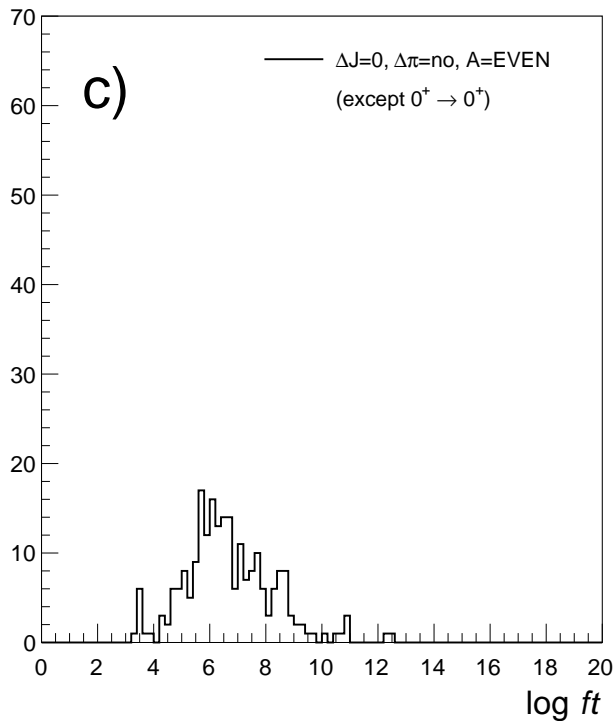
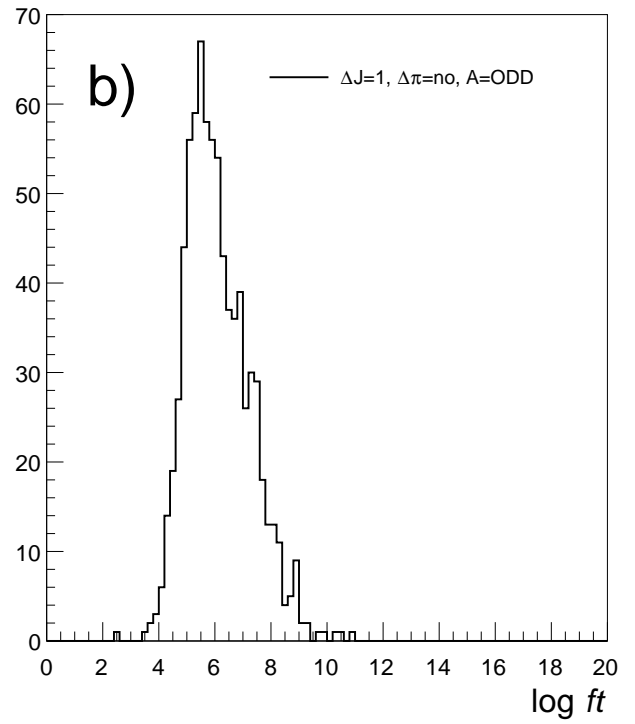
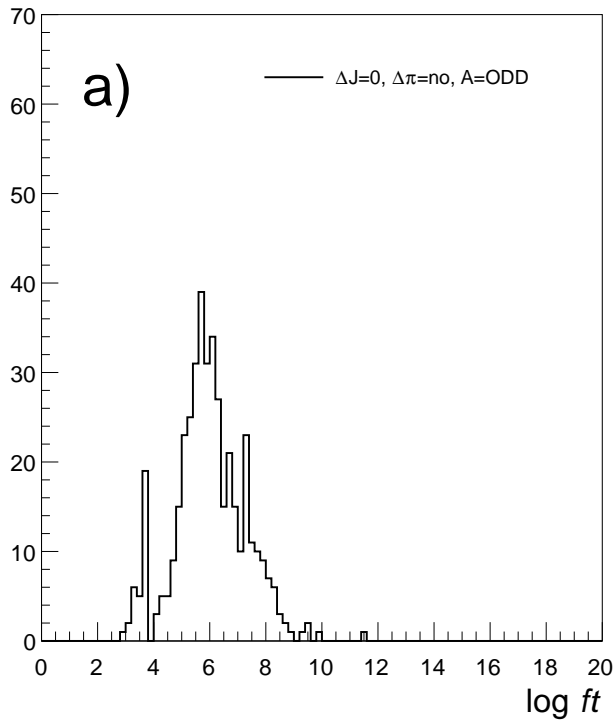




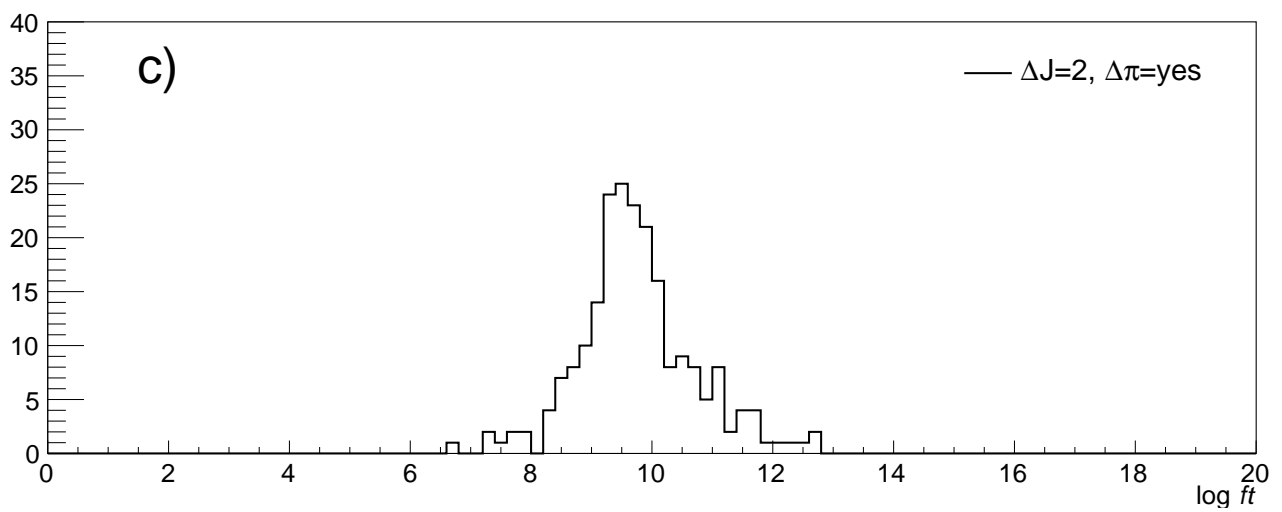
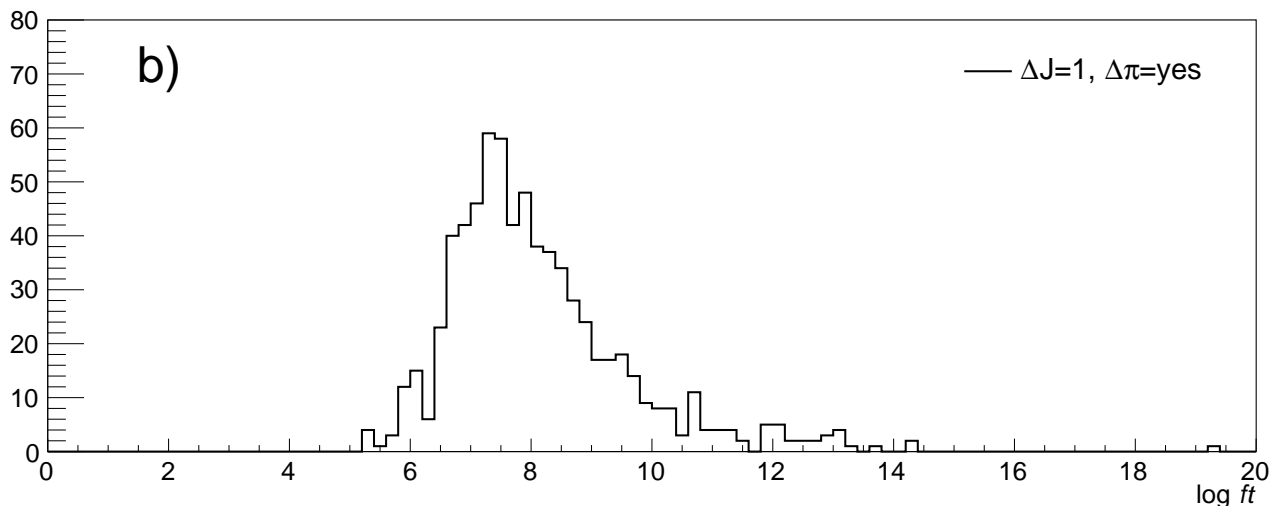
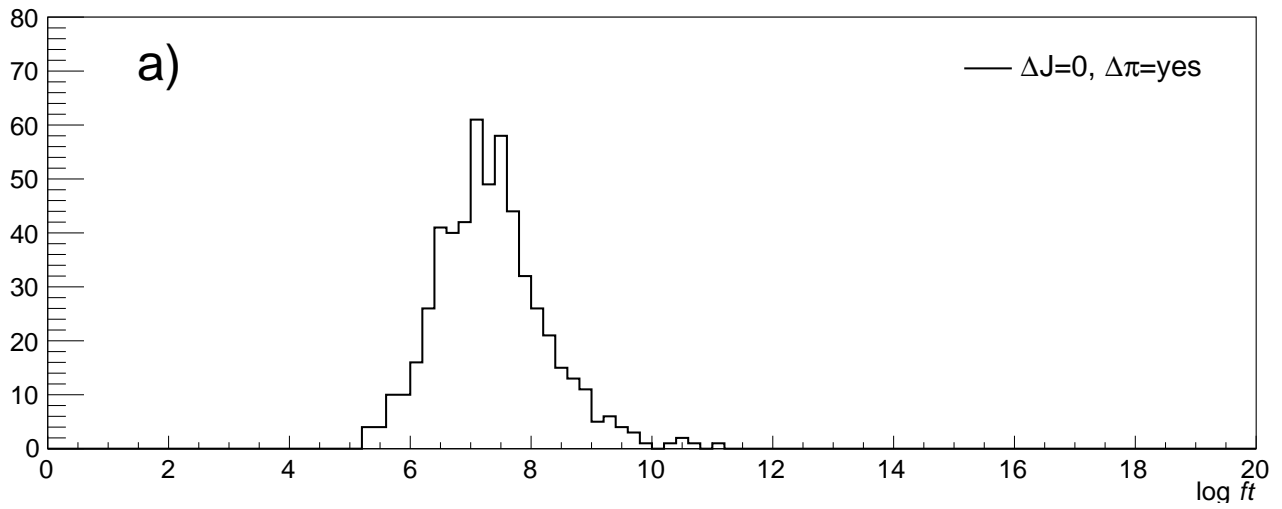
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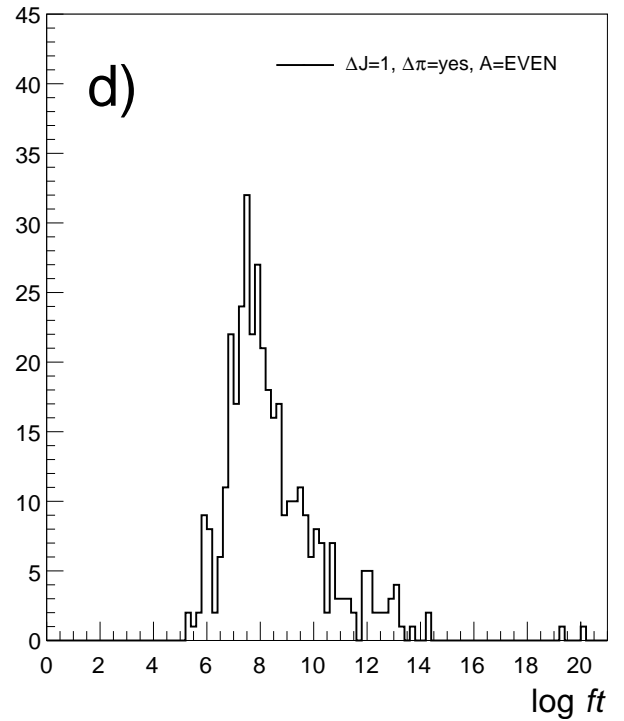
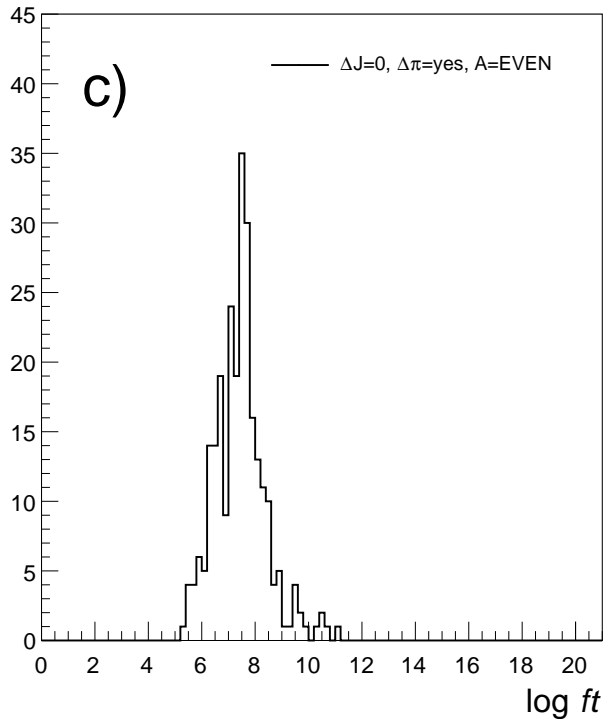
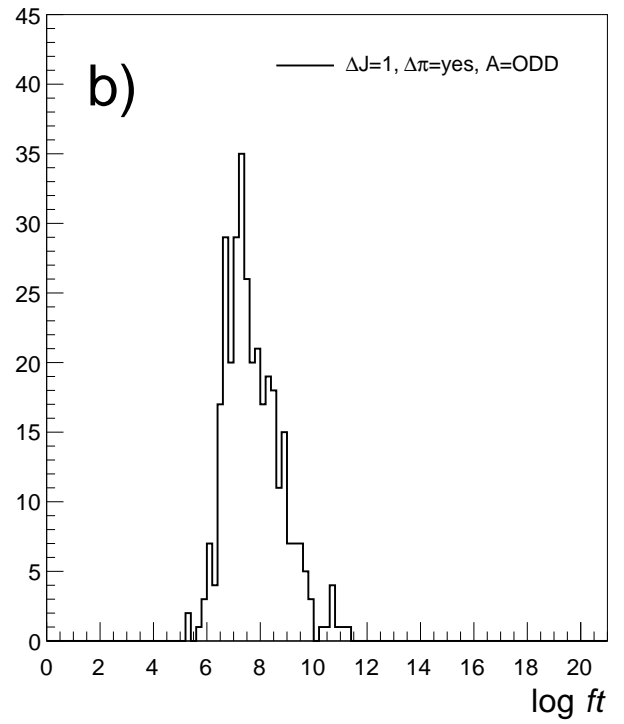
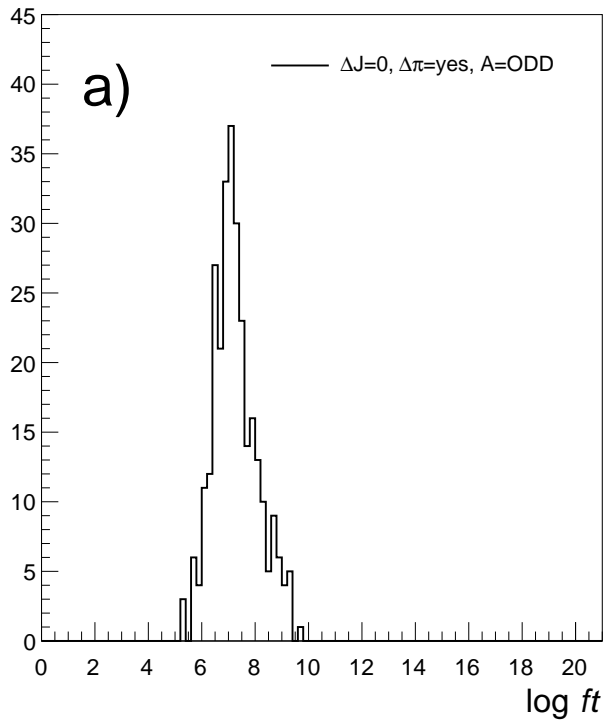
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**Fig. 11:** Log  $ft$  distributions of first forbidden transitions. a) First forbidden non-unique transitions with  $\Delta J=0$  and  $\Delta\pi=\text{yes}$  (top). b) First forbidden non-unique transitions with  $\Delta J=1$  and  $\Delta\pi=\text{yes}$  (middle). c) First forbidden unique transitions with  $\Delta J=2$  and  $\Delta\pi=\text{yes}$  (bottom).



**Fig. 12:** Log  $ft$  distributions of first forbidden non-unique transitions, which are separated for even and odd mass numbers. a) First forbidden non-unique transitions with  $\Delta J=0$ ,  $\Delta\pi=\text{yes}$ , and odd mass numbers (top left). b) First forbidden non-unique transitions with  $\Delta J=1$ ,  $\Delta\pi=\text{yes}$ , and odd mass numbers (top right). c) First forbidden non-unique transitions with  $\Delta J=0$ ,  $\Delta\pi=\text{yes}$ , and even mass numbers (bottom left). d) First forbidden non-unique transitions with  $\Delta J=1$ ,  $\Delta\pi=\text{yes}$ , and even mass numbers (bottom right).

## References

- [1] B. Singh, J. Rodriguez, S. Wong, J. Tuli, Review of  $\log ft$  values in  $\beta$  decay, *Nuclear Data Sheets* 84 (3) (1998) 487–563.
- [2] M. Wang, W. Huang, F. G. Kondev, G. Audi, S. Naimi, The AME 2020 atomic mass evaluation (II). tables, graphs and references, *Chinese Physics C* 45 (3) (2021) 030003.
- [3] X. Mougeot, Reliability of usual assumptions in the calculation of  $\beta$  and  $\nu$  spectra, *Phys. Rev. C* 91 (2015) 055504. doi:10.1103/PhysRevC.91.055504.
- [4] X. Mougeot, Towards high-precision calculation of electron capture decays, *Applied Radiation and Isotopes* 154 (2019) 108884. doi:10.1016/j.apradiso.2019.108884.
- [5] E. J. Konopinski, G. E. Uhlenbeck, On the Fermi Theory of  $\beta$ -Radioactivity. II. The “Forbidden” Spectra, *Phys. Rev.* 60 (1941) 308–320. doi:10.1103/PhysRev.60.308.
- [6] E. J. Konopinski, Beta-decay, *Reviews of Modern Physics* 15 (4) (1943) 209.
- [7] C. Gleit, C. Tang, C. Coryell, Beta-decay transition probabilities, *Nuclear Data Sheets* 5 (1963) 5.
- [8] S. Raman, N. Gove, Rules for spin and parity assignments based on  $\log ft$  values, *Phys. Rev. C* 7 (5) (1973) 1995.
- [9] T. W. Burrows, The evaluated nuclear structure data file: Philosophy, content, and uses, *Nuclear Instruments and Methods in Physics Research Section A* 286 (3) (1990) 595–600, <http://www.nndc.bnl.gov/ensdf/>.
- [10] J. C. Hardy, I. S. Towner, Superaligned  $0^+ \rightarrow 0^+$  nuclear  $\beta$  decays: 2020 critical survey, with implications for  $V_{ud}$  and CKM unitarity, *Phys. Rev. C* 102 (2020) 045501. doi:10.1103/PhysRevC.102.045501.
- [11] XUNDL database, <http://www.nndc.bnl.gov/ensdf/ensdf/xundl.jsp>.
- [12] B. Pritychenko, E. Běták, M. Kellett, B. Singh, J. Totans, The nuclear science references (NSR) database and web retrieval system, *Nuclear Instruments and Methods in Physics Research Section A* 640 (1) (2011) 213–218, Nuclear Structure Reference File, <http://www.nndc.bnl.gov/nsr/>.
- [13] F. Kondev, M. Wang, W. Huang, S. Naimi, G. Audi, The NUBASE2020 evaluation of nuclear physics properties, *Chinese Physics C* 45 (3) (2021) 030001.
- [14] H. Behrens, W. Bühring, *Electron Radial Wave Functions and Nuclear Beta Decay*, Clarendon, Oxford, 1982.
- [15] H. M. Mahmoud, E. J. Konopinski, The evidence of the once-forbidden spectra for the law of  $\beta$ -decay, *Phys. Rev.* 88 (1952) 1266–1275. doi:10.1103/PhysRev.88.1266.
- [16] T. Kotani, Deviation from the  $\xi$  approximation in first forbidden  $\beta$  decay, *Phys. Rev.* 114 (1959) 795–806. doi:10.1103/PhysRev.114.795.
- [17] A. Sirlin, General properties of the electromagnetic corrections to the beta decay of a physical nucleon, *Phys. Rev.* 164 (1967) 1767. doi:10.1103/PhysRev.164.1767.
- [18] W. Jaus, Electromagnetic corrections of order  $Z\alpha^2$  and  $Z^2\alpha^3$  to fermi beta decays, *Phys. Lett. B* 40 (1972) 616. doi:10.1016/0370-2693(72)90610-7.
- [19] A. Czarnecki, W. J. Marciano, A. Sirlin, Precision measurements and CKM unitarity, *Phys. Rev. D* 70 (2004) 093006. doi:10.1103/PhysRevD.70.093006.
- [20] I. S. Towner, J. C. Hardy, Improved calculation of the isospin-symmetry-breaking corrections to super-allowed fermi  $\beta$  decay, *Phys. Rev. C* 77 (2008) 025501. doi:10.1103/PhysRevC.77.025501.
- [21] L. Hayen, N. Severijns, K. Bodek, D. Rozpedzik, X. Mougeot, High precision analytical description of the allowed  $\beta$  spectrum shape, *Rev. Mod. Phys.* 90 (2018) 015008. doi:10.1103/RevModPhys.90.015008.
- [22] X. Mougeot, M.-M. Bé, C. Bisch, M. Loidl, Evidence for the exchange effect in the  $\beta$  decay of  $^{241}\text{Pu}$ , *Phys. Rev. A* 86 (2012) 042506. doi:10.1103/PhysRevA.86.042506.
- [23] M. Loidl, M. Rodrigues, C. Le-Bret, X. Mougeot, Beta spectrometry with metallic magnetic calorimeters, *Applied Radiation and Isotopes* 87 (2014) 302–305. doi:10.1016/j.apradiso.2013.11.024.
- [24] X. Mougeot, C. Bisch, Consistent calculation of the screening and exchange effects in allowed  $\beta^-$  transitions, *Phys. Rev. A* 90 (2014) 012501. doi:10.1103/PhysRevA.90.012501.
- [25] W. Bühring, The screening correction to the fermi function of nuclear  $\beta$ -decay and its model dependence, *Nucl. Phys. A* 430 (1) (1984) 1–20. doi:10.1016/0375-9474(84)90190-8.
- [26] F. Salvat, J. D. Martinez, R. Mayol, J. Parellada, Analytical Dirac-Hartree-Fock-Slater screening function for atoms ( $Z=1-92$ ), *Phys. Rev. A* 36 (1987) 467–474. doi:10.1103/PhysRevA.36.467.
- [27] X. Mougeot, Systematic comparison of beta spectra calculations using improved analytical screening correction with experimental shape factors, *Applied Radiation and Isotopes* 109 (2016) 177 – 182. doi:10.1016/j.apradiso.2015.11.030.
- [28] E. Aprile, J. Aalbers, F. Agostini, M. Alfonsi, L. Althueser, F. D. Amaro, V. C. Antochi, E. Angelino, J. R. Angevaere, F. Arneodo, D. Barge, L. Baudis,

- B. Bauermeister, L. Bellagamba, M. L. Benabderrahmane, T. Berger, A. Brown, E. Brown, S. Bruenner, G. Bruno, R. Budnik, C. Capelli, J. M. R. Cardoso, D. Cichon, B. Cimmino, M. Clark, D. Coderre, A. P. Colijn, J. Conrad, J. P. Cussonneau, M. P. Decowski, A. Depoian, P. Di Gangi, A. Di Giovanni, R. Di Stefano, S. Diglio, A. Elykov, G. Eurin, A. D. Ferella, W. Fulgione, P. Gaemers, R. Gaior, M. Galloway, F. Gao, L. Grandi, C. Hasterok, C. Hils, K. Hiraide, L. Hoetzsch, J. Howlett, M. Iacovacci, Y. Itow, F. Joerg, N. Kato, S. Kazama, M. Kobayashi, G. Koltman, A. Kopec, H. Landsman, R. F. Lang, L. Levinson, Q. Lin, S. Lindemann, M. Lindner, F. Lombardi, J. Long, J. A. M. Lopes, E. López Fune, C. Macolino, J. Mahlstedt, A. Mancuso, L. Manenti, A. Manfredini, F. Marignetti, T. Marrodán Undagoitia, K. Martens, J. Masbou, D. Masson, S. Mastroianni, M. Messina, K. Miuchi, K. Mizukoshi, A. Molinaro, K. Morã, S. Moriyama, Y. Mosbacher, M. Murra, J. Naganoma, K. Ni, U. Oberlack, K. Odgers, J. Palacio, B. Pelssers, R. Peres, J. Pienaar, V. Pizzella, G. Plante, J. Qin, H. Qiu, D. Ramírez García, S. Reichard, A. Rocchetti, N. Rupp, J. M. F. dos Santos, G. Sartorelli, N. Šarčević, M. Scheibelhut, J. Schreiner, D. Schulte, M. Schumann, L. Scotto Lavina, M. Selvi, F. Semeria, P. Shagin, E. Shockley, M. Silva, H. Simgen, A. Takeda, C. Therreau, D. Thers, F. Toschi, G. Trincherro, C. Tunnell, M. Vargas, G. Volta, H. Wang, Y. Wei, C. Weinheimer, M. Weiss, D. Wenz, C. Wittweg, Z. Xu, M. Yamashita, J. Ye, G. Zavattini, Y. Zhang, T. Zhu, J. P. Zopounidis, X. Mougeot, Excess electronic recoil events in XENON1T, *Phys. Rev. D* 102 (2020) 072004. doi:10.1103/PhysRevD.102.072004.
- [29] NIST, Atomic reference data for electronic structure calculation, NIST Stand. Ref. Database 141, 2009. doi:10.18434/T4ZP4F.
- [30] S. Kotochigova, Z. H. Levine, E. L. Shirley, M. D. Stiles, C. W. Clark, Local-density-functional calculations of the energy of atoms, *Phys. Rev. A* 55 (1997) 191–199. doi:10.1103/PhysRevA.55.191.
- [31] S. J. Haselschwardt, J. Kostensalo, X. Mougeot, J. Suhonen, Improved calculations of  $\beta$  decay backgrounds to new physics in liquid xenon detectors, *Phys. Rev. C* 102 (2020) 065501. doi:10.1103/PhysRevC.102.065501.
- [32] J. N. Bahcall, Overlap and exchange effects in beta decay, *Phys. Rev.* 129 (1963) 2683–2694. doi:10.1103/PhysRev.129.2683.
- [33] J. C. Hardy, I. S. Towner, Superallowed  $0^+ \rightarrow 0^+$  nuclear  $\beta$  decays: A new survey with precision tests of the conserved vector current hypothesis and the standard model, *Phys. Rev. C* 79 (2009) 055502. doi:10.1103/PhysRevC.79.055502.
- [34] D. K. Keblbeck, R. Bhandari, N. D. Gamage, M. Hovana Gamage, K. G. Leach, X. Mougeot, M. Redshaw, Updated evaluation of potential ultralow  $Q$ -value  $\beta$ -decay candidates, *Phys. Rev. C* 107 (2023) 015504. doi:10.1103/PhysRevC.107.015504.
- [35] P. Filianin, C. Lyu, M. Door, K. Blaum, W. J. Huang, M. Haverkort, P. Indelicato, C. H. Keitel, K. Kromer, D. Lange, Y. N. Novikov, A. Rischka, R. X. Schüssler, C. Schweiger, S. Sturm, S. Ulmer, Z. Harman, S. Eliseev, Direct  $Q$ -value determination of the  $\beta^-$  decay of  $^{187}\text{Re}$ , *Phys. Rev. Lett.* 127 (2021) 072502. doi:10.1103/PhysRevLett.127.072502.
- [36] V. A. Zheltonozhsky, A. M. Savrasov, N. V. Strilchuk, V. I. Tretyak, Precise measurement of energy of the first excited state of  $^{115}\text{Sn}$  ( $E_{\text{exc}} \simeq 497.3$  keV), *Europhysics Letters* 121 (1) (2018) 12001. doi:10.1209/0295-5075/121/12001.
- [37] A. F. Leder, D. Mayer, J. L. Ouellet, F. A. Danevich, L. Dumoulin, A. Giuliani, J. Kostensalo, J. Kotila, P. de Marcillac, C. Nones, V. Novati, E. Olivieri, D. Poda, J. Suhonen, V. I. Tretyak, L. Winslow, A. Zolotarova, Determining  $g_A/g_V$  with high-resolution spectral measurements using a  $\text{LiInSe}_2$  bolometer, *Phys. Rev. Lett.* 129 (2022) 232502. doi:10.1103/PhysRevLett.129.232502.
- [38] K. Kossert, M. Loidl, X. Mougeot, M. Paulsen, P. Ranitzsch, M. Rodrigues, High precision measurement of the  $^{151}\text{Sm}$  beta decay by means of a metallic magnetic calorimeter, *Applied Radiation and Isotopes* 185 (2022) 110237. doi:10.1016/j.apradiso.2022.110237.
- [39] O. Nitescu, S. Stoica, F. Simkovic, Exchange correction for allowed  $\beta$ -decay, arXiv:2206.13513 [physics.atom-ph] (2022). doi:10.48550/ARXIV.2206.13513.
- [40] M. Loidl, M. Rodrigues, B. Censier, S. Kowalski, X. Mougeot, P. Cassette, T. Branger, D. Lacour, First measurement of the beta spectrum of  $^{241}\text{Pu}$  with a cryogenic detector, *Applied Radiation and Isotopes* 68 (7) (2010) 1454–1458. doi:10.1016/j.apradiso.2009.11.054.
- [41] W. Bambynek, H. Behrens, M. H. Chen, B. Crasemann, M. L. Fitzpatrick, K. W. D. Ledingham, H. Genz, M. Mutterer, R. L. Intemann, Orbital electron capture by the nucleus, *Rev. Mod. Phys.* 49 (1977) 77–221. doi:10.1103/RevModPhys.49.77.
- [42] X. Mougeot, Improved calculations of electron capture transitions for decay data and radionuclide metrology, *Applied Radiation and Isotopes* 134 (2018) 225–232. doi:10.1016/j.apradiso.2017.07.027.
- [43] B. R. Holstein, Electromagnetic corrections to  $\varepsilon/\beta^+$  ratios, *Phys. Rev. C* 20 (1) (1979) 387 – 388. doi:10.1103/PhysRevC.20.387.
- [44] B. Crasemann, M. H. Chen, J. P. Briand, P. Cheval-

- lier, A. Chetoui, M. Tavernier, Atomic electron excitation probabilities during orbital electron capture by the nucleus, *Phys. Rev. C* 19 (1979) 1042–1046. doi:10.1103/PhysRevC.19.1042.
- [45] E. Vatai, On the exchange and overlap corrections in electron capture, *Nuclear Physics A* 156 (3) (1970) 541–552. doi:10.1016/0375-9474(70)90250-2.
- [46] C. Hinke, M. Böhmer, P. Boutachkov, T. Faestermann, H. Geissel, J. Gerl, R. Gernhäuser, M. Górka, A. Gottardo, H. Grawe, et al., Superallowed Gamow-Teller decay of the doubly magic nucleus  $^{100}\text{Sn}$ , *Nature* 486 (7403) (2012) 341–345.
- [47] F. Pougheon, V. Borrel, J. Jacmar, R. Anne, C. Détraz, D. Guillemaud-Mueller, A. Mueller, D. Bazin, R. Del Moral, J. Dufour, et al., Beta-delayed proton decay of 28, *Nuclear Physics A* 500 (2) (1989) 287–300.
- [48] A. Morales, A. Algora, B. Rubio, K. Kaneko, S. Nishimura, P. Aguilera, S. Orrigo, F. Molina, G. De Angelis, F. Recchia, et al., Simultaneous investigation of the  $T=1$  ( $J\pi=0^+$ ) and  $T=0$  ( $J\pi=9^+$ )  $\beta$  decays in  $^{70}\text{Br}$ , *Phys. Rev. C* 95 (6) (2017) 064327.
- [49] General Policies, *Nuclear Data Sheets* 185 (2022) iii–x. doi:https://doi.org/10.1016/j.nds.2022.10.004.
- [50] F. Kondev, G. Dracoulis, T. Kibédi, Configurations and hindered decays of k isomers in deformed nuclei with  $A>100$ , *Atomic Data and Nuclear Data Tables* 103-104 (2015) 50–105. doi:https://doi.org/10.1016/j.adt.2015.01.001.
- [51] N. Severijns, L. Hayen, V. De Leebeeck, S. Vanlangendonck, K. Bodek, D. Rozpedzik, I. S. Towner,  $\mathcal{F}t$  values of the mirror  $\beta$  transitions and the weak-magnetism-induced current in allowed nuclear  $\beta$  decay, *Phys. Rev. C* 107 (2023) 015502. doi:10.1103/PhysRevC.107.015502.
- [52] M. Wolińska-Cichočka, B. C. Rasco, K. P. Rykaczewski, N. T. Brewer, A. Fijałkowska, M. Karny, R. K. Grzywacz, K. Goetz, C. J. Gross, D. W. Stracener, et al., Complete  $\beta$ -decay patterns of  $^{142}\text{Cs}$ ,  $^{142}\text{Ba}$ , and  $^{142}\text{La}$  determined using total absorption spectroscopy, *Physical Review C* 107 (3) (2023) 034303. doi:10.1103/PhysRevC.107.034303.
- [53] F. G. A. Quarati, G. Bollen, P. Dorenbos, M. Eibach, K. Gulyuz, A. Hamaker, C. Izzo, D. K. Keblbeck, X. Mougeot, D. Puentes, M. Redshaw, R. Ringle, R. Sandler, J. Surbrook, I. Yandow, Measurements and computational analysis of the natural decay of  $^{176}\text{Lu}$ , *Phys. Rev. C* 107 (2023) 024313. doi:10.1103/PhysRevC.107.024313.
- [54] D. Lubos, J. Park, T. Faestermann, R. Gernhäuser, R. Kruecken, M. Lewitowicz, S. Nishimura, H. Sakurai, D. Ahn, H. Baba, et al., Improved Value for the Gamow-Teller Strength of the  $^{100}\text{Sn}$  Beta Decay, *Phys. Rev. Lett.* 122 (22) (2019) 222502.
- [55] P. Pirinen, J. Suhonen, Systematic approach to  $\beta$  and  $2\nu\beta\beta$  decays of mass  $A=100$ –136 nuclei, *Phys. Rev. C* 91 (5) (2015) 054309.
- [56] F. F. Deppisch, J. Suhonen, Statistical analysis of  $\beta$  decays and the effective value of  $g_A$  in the proton-neutron quasiparticle random-phase approximation framework, *Phys. Rev. C* 94 (5) (2016) 055501.
- [57] J. Kostensalo, J. Suhonen, Spin-multipole nuclear matrix elements in the  $pn$  quasiparticle random-phase approximation: Implications for  $\beta$  and  $\beta\beta$  half-lives, *Phys. Rev. C* 95 (1) (2017) 014322.
- [58] D.-L. Fang, B. A. Brown, T. Suzuki, Investigating  $\beta$ -decay properties of spherical nuclei along the possible r-process path, *Phys. Rev. C* 88 (3) (2013) 034304.



## 10. Explanation of Tables

All the level energies, half-lives of parent nuclei, spins and parities, and beta branches are from the ENSDF database, augmented by selected data from newer literature. Our overall literature can be considered up to April 15, 2023. See section 1 for details. The  $Q$ -values were updated to values in the AME2020 database [2]. All the  $\log ft$  values, as well as their uncertainties are deduced by us using the BetaShape code [3, 4]. As detailed in section 2, uncertainties in the case of  $\beta$  decays arise from those in evaluated branching ratios,  $Q$ -values, half-lives and level energies. In the case of  $\varepsilon$  decays, a theoretical component is also estimated from the difference between two models of the overlap and exchange correction, and is included in the  $\log ft$  uncertainty. For the most precise  $\log ft$  values quoted in the present review, uncertainties from theory could be much higher than the listed ones.

We applied the ENSDF policies of strong rules for spin-parity assignment [49]. Some of the parent/daughter level  $J\pi$  have been determined through the application of  $\log ft$  rules in the Nuclear Data Sheets. These have not been excluded from the present work.

Nuclide	Parent nucleus for the respective transition.
Decay	Decay mode for the respective transition.
$Q$	$Q$ -value of the parent nucleus for the given decay mode.
$E_P$	Energy level of the parent nucleus.
$J\pi$	Assignment of both spin and parity of the parent/daughter.
$E_D$	Energy level of the daughter nucleus.
Branch	Branching ratio of the parent state to undergo this particular transition.
Unc.	Uncertainty for a value is in the last digit(s) of the value.
Pand.	Flag for a potentially Pandemonium affected transition.

## 11. Statistics on $\log ft$ distributions

Table 2

Statistical summary for all  $\log ft$  distributions. The number of transitions, which fulfill all selection criteria are shown, as well as the mean value, and the width of the respective distributions. Furthermore, the minimal and maximal  $\log ft$  value is listed respectively.

Name	Transitions	Number	Centroid	Width	Min	Max
Superallowed	$0^+ \rightarrow 0^+$ ( $\Delta T=0$ , Parent $T_z=0;-1$ )	24	3.494	0.016	3.465	3.525
Superallowed	$0^+ \rightarrow 0^+$ ( $\Delta T=0$ , Parent $T_z=-2$ )	7	3.24	0.06	3.174	3.33
Isospin forbidden	$0^+ \rightarrow 0^+$ ( $\Delta T \neq 0$ )	12	9.19	1.16	6.661	10.92
Gamow-Teller	$0^+ \leftrightarrow 1^+$	584	5.04	0.99	2.66	9.046
Allowed	$\Delta J=0$ , $\Delta \pi=\text{no}$ , not $0^+ \rightarrow 0^+$	642	6.24	1.42	2.98	12.532
	$\Delta J=0$ , $\Delta \pi=\text{no}$ , even A	224	6.68	1.57	3.317	12.532
	$\Delta J=0$ , $\Delta \pi=\text{no}$ , odd A	418	6.00	1.26	2.98	11.594
Allowed	$\Delta J=1$ , $\Delta \pi=\text{no}$ , not $0^+ \leftrightarrow 1^+$	1257	6.19	1.21	2.574	12.367
	$\Delta J=1$ , $\Delta \pi=\text{no}$ , even A	468	6.33	1.30	4.129	12.367
	$\Delta J=1$ , $\Delta \pi=\text{no}$ , odd A	789	6.11	1.14	2.574	10.89
First-forbidden non-unique	$\Delta J=0$ , $\Delta \pi=\text{yes}$	546	7.35	0.90	5.202	11.03
	$\Delta J=0$ , $\Delta \pi=\text{yes}$ , even A	256	7.45	0.96	5.2711	11.03
	$\Delta J=0$ , $\Delta \pi=\text{yes}$ , odd A	290	7.25	0.83	5.202	9.795
	$\Delta J=0$ , $\Delta \pi=\text{yes}$ , $Z < 80$	412	7.47	0.90	5.568 <sup>2</sup>	11.03
First-forbidden non-unique	$\Delta J=0$ , $\Delta \pi=\text{yes}$ , $Z \geq 80$	134	6.97	0.79	5.202	9.795
	$\Delta J=1$ , $\Delta \pi=\text{yes}$	708	8.14	1.60	5.23 <sup>2</sup>	20.082
	$\Delta J=1$ , $\Delta \pi=\text{yes}$ , even A	376	8.50	1.89	5.33	20.082
	$\Delta J=1$ , $\Delta \pi=\text{yes}$ , odd A	332	7.74	1.04	5.23	11.22
	$\Delta J=1$ , $\Delta \pi=\text{yes}$ , $Z < 80$	544	8.43	1.66	5.23	20.082
First-forbidden unique	$\Delta J=1$ , $\Delta \pi=\text{yes}$ , $Z \geq 80$	164	7.18	0.80	5.33	10.51
	$\Delta J=2$ , $\Delta \pi=\text{yes}$	213	9.75	0.97	6.72 <sup>2</sup>	12.78
Second-forbidden non-unique	$\Delta J=2$ , $\Delta \pi=\text{no}$	27	12.45	0.89	10.92	14.23
Second-forbidden unique	$\Delta J=3$ , $\Delta \pi=\text{no}$	12	15.44	1.25	13.8383	18.081
Third-forbidden non-unique	$\Delta J=3$ , $\Delta \pi=\text{yes}$	1				
Third-forbidden unique	$\Delta J=4$ , $\Delta \pi=\text{yes}$	2				
Fourth-forbidden non-unique	$\Delta J=4$ , $\Delta \pi=\text{no}$	3				

<sup>2</sup>As discussed later in the conclusions section of the paper, unexpected low  $\log ft$  values are subject to revision due either to pandemonium effect, or low experimental  $\beta$  feedings known with less precision. Realistically, we consider that minimum  $\log ft$  values for first-forbidden non-unique transitions for  $Z < 80$  region are not  $< 5.9$ , and those for the first-forbidden unique transitions not  $< 8.5$ , as proposed by Raman and Gove [8].

## 12. Summary of $\log ft$ values

**Table 3**

Distribution of all  $\log ft$  transitions, which fulfill the selection criteria. The first line shows the sum of all entries from the respective column. The first column represents the mid point of the respective interval. For example, '2.1' means:  $2.0 \leq \log ft < 2.2$ . The value for  $T_z$  in this table refers to the parent state.. The letters 'n' and 'y' regarding parity changes in the header correspond to 'no' and 'yes', respectively.

Log $ft$	$0^+ \rightarrow 0^+$ $\Delta T=0$ $T_z=0;-1$	$0^+ \rightarrow 0^+$ $\Delta T=0$ $T_z=-2$	$0^+ \rightarrow 0^+$ $\Delta T \neq 0$	Allowed $0^+ \leftrightarrow 1^+$	Allowed $\Delta J=0$ $\Delta \pi=n$ no $0^+ \rightarrow 0^+$	Allowed $\Delta J=1$ $\Delta \pi=n$ no $0^+ \leftrightarrow 1^+$	1 <sup>st</sup> f. $\Delta J=0$ $\Delta \pi=y$	1 <sup>st</sup> f. $\Delta J=1$ $\Delta \pi=y$	1 <sup>st</sup> f.u. $\Delta J=2$ $\Delta \pi=y$	2 <sup>nd</sup> f. $\Delta J=2$ $\Delta \pi=n$	2 <sup>nd</sup> f.u. $\Delta J=3$ $\Delta \pi=n$	3 <sup>rd</sup> f. $\Delta J=3$ $\Delta \pi=y$	3 <sup>rd</sup> f.u. $\Delta J=4$ $\Delta \pi=y$	4 <sup>th</sup> f. $\Delta J=4$ $\Delta \pi=n$
	24	7	12	584	642	1257	546	708	213	27	12	1	2	3
2.1														
2.3														
2.5						1								
2.7				1										
2.9				1	1									
3.1		3		4	2									
3.3		4		1	7									
3.5	24			11	11	1								
3.7				14	20	2								
3.9				22	1	3								
4.1				38	3	8								
4.3				44	8	15								
4.5				62	6	28								
4.7				68	16	39								
4.9				68	21	71								
5.1				50	31	96								
5.3				46	30	93	4	4						
5.5				33	40	107	4	1						
5.7				38	56	89	10	3						
5.9				13	43	93	10	12						
6.1				10	50	78	16	15						
6.3				8	40	58	26	6						
6.5				4	29	71	40	23						
6.7			1	6	35	57	40	40	1					
6.9				7	21	60	42	42						
7.1				3	21	45	61	46						
7.3				8	30	40	49	59	2					
7.5				5	19	47	58	58	1					
7.7				2	20	28	44	42	2					
7.9			2	5	15	24	32	48	2					
8.1				6	10	22	26	37						
8.3				2	12	18	21	38	4					
8.5			1	1	11	12	15	34	6					
8.7				2	10	10	13	28	8					
8.9					4	15	11	24	10					
9.1				1	2	4	5	16	15					
9.3			1		3	3	6	18	24					
9.5			1		3	3	4	18	24					
9.7			2		1	4	3	14	23					
9.9			1		1	1	1	9	21					
10.1			1		1	2		8	15					
10.3			1			1	1	8	9					
10.5					1	3	2	3	9					
10.7					1		1	11	8					
10.9			1		3	2		4	5	1				
11.1						1	1	4	8	1				
11.3						1		4	2	3				
11.5					1			2	4					
11.7									4	2				
11.9								5	1	2				
12.1								5	1	3				
12.3					1	1		2	1					
12.5					1			2	1	2				
12.7								2	2	4				
12.9								3		3				
13.1								4		1				
13.3								1		1				
13.5														
13.7								1		1				

**Table 3**  
(continued)

Log $ft$	$0^+ \rightarrow 0^+$	$0^+ \rightarrow 0^+$	$0^+ \rightarrow 0^+$	Allowed $0^+ \leftrightarrow 1^+$	Allowed $\Delta J=0$ $\Delta\pi=n$ no $0^+ \rightarrow 0^+$	Allowed $\Delta J=1$ $\Delta\pi=n$ no $0^+ \leftrightarrow 1^+$	1 <sup>st</sup> f.	1 <sup>st</sup> f.	1 <sup>st</sup> f.u.	2 <sup>nd</sup> f.	2 <sup>nd</sup> f.u.	3 <sup>rd</sup> f.	3 <sup>rd</sup> f.u.	4 <sup>th</sup> f.
	$\Delta T=0$ $T_z=0;-1$	$\Delta T=0$ $T_z=-2$	$\Delta T \neq 0$				$\Delta J=0$ $\Delta\pi=y$	$\Delta J=1$ $\Delta\pi=y$	$\Delta J=2$ $\Delta\pi=y$	$\Delta J=2$ $\Delta\pi=n$	$\Delta J=3$ $\Delta\pi=n$	$\Delta J=3$ $\Delta\pi=y$	$\Delta J=4$ $\Delta\pi=y$	$\Delta J=4$ $\Delta\pi=n$
13.9										2	1			
14.1														
14.3								2		1				
14.5											4			
14.7											1			
14.9											1			
15.1														
15.3														
15.5														
15.7											1			
15.9											1			
16.1														
16.3														
16.5														
16.7											1			
16.9														
17.1												1		
17.3												1		
17.5														
17.7														
17.9														
18.1											1			
18.3														
18.5														
18.7														
18.9														
19.1														
19.3								1						
19.5														
19.7														
19.9														
20.1								1						
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20.5													1	
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20.9														
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21.7													1	
21.9														
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22.7														
22.9														2
23.1														
23.3														
23.5														
23.7														
23.9														
24.1														
24.3														1
24.5														
24.7														
24.9														

### 13. Superallowed Transitions

#### 13.1. Superallowed (Parent $T_z=0; -1$ )

**Table 4**

List of superallowed transitions with  $0^+ \rightarrow 0^+$ ,  $\Delta T=0$ , and parent  $T_z=0; -1$ . The upper nine transitions are assigned with parent  $T_z=0$ , and the lower 14 transitions are assigned with parent  $T_z=-1$ .

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	$\text{Log } ft$	Unc.	Pand.
<sup>26</sup> Al	$\beta+/\varepsilon$	4004.40	228.305	0+	0.0	0+	100.		3.48971	6	
<sup>34</sup> Cl	$\beta+/\varepsilon$	5491.604	0.0	0+	0.0	0+	100.		3.49173	13	
<sup>38</sup> K	$\beta+/\varepsilon$	5914.067	130.22	0+	0.0	0+	99.9670	44	3.49235	15	
<sup>42</sup> Sc	$\beta+/\varepsilon$	6426.290	0.0	0+	0.0	0+	99.9941	14	3.49249	17	
<sup>46</sup> V	$\beta+/\varepsilon$	7052.37	0.0	0+	0.0	0+	99.985	10	3.49318	7	
<sup>50</sup> Mn	$\beta+/\varepsilon$	7634.48	0.0	0+	0.0	0+	99.9423	30	3.49326	17	
<sup>54</sup> Co	$\beta+/\varepsilon$	8244.55	0.0	0+	0.0	0+	99.9955	6	3.49408	14	
<sup>62</sup> Ga	$\beta+/\varepsilon$	9181.07	0.0	0+	0.0	0+	99.8577	26	3.49827	13	
<sup>74</sup> Rb	$\beta+/\varepsilon$	1.04158E4	0.0	0+	0.0	0+	99.545	31	3.5015	8	
<sup>10</sup> C	$\beta+/\varepsilon$	3648.06	0.0	0+	1740.05	0+	1.4646	19	3.4906	6	
<sup>14</sup> O	$\beta+/\varepsilon$	5144.364	0.0	0+	2312.798	0+	99.446	13	3.49020	7	
<sup>18</sup> Ne	$\beta+/\varepsilon$	4444.5	0.0	0+	1041.55	0+	7.70	21	3.472	12	
<sup>22</sup> Mg	$\beta+/\varepsilon$	4781.41	0.0	0+	657.00	0+	53.16	12	3.4915	10	
<sup>26</sup> Si	$\beta+/\varepsilon$	5069.14	0.0	0+	228.305	0+	75.67	14	3.4917	8	
<sup>30</sup> S	$\beta+/\varepsilon$	6141.60	0.0	0+	677.01	0+	77.4	10	3.487	6	
<sup>34</sup> Ar	$\beta+/\varepsilon$	6061.79	0.0	0+	0.0	0+	94.48	8	3.49309	41	
<sup>38</sup> Ca	$\beta+/\varepsilon$	6742.26	0.0	0+	130.2	0+	77.26	15	3.4940	9	
<sup>42</sup> Ti	$\beta+/\varepsilon$	7016.65	0.0	0+	0.0	0+	48.1	14	3.499	13	
<sup>46</sup> Cr	$\beta+/\varepsilon$	7604	0.0	0+	0.0	0+	76.7	23	3.504	14	
<sup>50</sup> Fe	$\beta+/\varepsilon$	8150	0.0	0+	0.0	0+	73.9	17	3.501	10	
<sup>54</sup> Ni	$\beta+/\varepsilon$	8731.8	0.0	0+	0.0	0+	78.9	12	3.496	7	
<sup>58</sup> Zn	$\beta+/\varepsilon$	9.37E3	0.0	0+	203	0+	74	9	3.50	6	
<sup>62</sup> Ge	$\beta+/\varepsilon$	9.85E3	0.0	0+	0.0	0+	85.30	33	3.525	34	
<sup>70</sup> Kr	$\beta+/\varepsilon$	1.033E4	0.0	0+	0.0	0+	73	3	3.465	49	

#### 13.2. Superallowed (Parent $T_z=-2$ )

**Table 5**

List of superallowed transitions with  $0^+ \rightarrow 0^+$ ,  $\Delta T=0$ , and Parent  $T_z=-2$ .

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	$\text{Log } ft$	Unc.	Pand.
<sup>20</sup> Mg	$\beta+/\varepsilon$	1.06272E4	0.0	0+	6496	0+	2.20	20	3.247	40	
<sup>24</sup> Si	$\beta+/\varepsilon$	1.0794E4	0.0	0+	5953	0+	9.9	9	3.174	41	
<sup>32</sup> Ar	$\beta+/\varepsilon$	1.11344E4	0.0	0+	5046.3	0+	22.71	16	3.186	9	
<sup>36</sup> Ca	$\beta+/\varepsilon$	1.0966E4	0.0	0+	4281.9	0+	38.0	10	3.186	20	
<sup>40</sup> Ti	$\beta+/\varepsilon$	1.153E4	0.0	0+	4359	0+	25.6	8	3.225	27	
<sup>48</sup> Fe	$\beta+/\varepsilon$	1.129E4	0.0	0+	3036.8	0+	35	5	3.33	7	
<sup>52</sup> Ni	$\beta+/\varepsilon$	1.178E4	0.0	0+	2931	0+	49	5	3.30	5	

## 14. Isospin Forbidden Transitions

**Table 6**

List of isospin forbidden transitions with  $0^+ \rightarrow 0^+$  and  $\Delta T \neq 0$ .

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
<sup>28</sup> Mg	$\beta^-$	1830.77	0.0	0+	972.24	0+	0.31	4	7.96	6	
<sup>64</sup> Ga	$\beta^+/\epsilon$	7171.2	0.0	0+	0.0	0+	24.7	10	6.661	18	
<sup>66</sup> Ga	$\beta^+/\epsilon$	5175.5	0.0	0+	0.0	0+	51.0	40	7.889	34	
<sup>66</sup> Ga	$\beta^+/\epsilon$	5175.5	0.0	0+	2372.353	0+	0.340	30	8.465	38	
<sup>156</sup> Eu	$\beta^-$	2452.5	0.0	0+	0.0	0+	32	3	9.882	41	
<sup>156</sup> Eu	$\beta^-$	2452.5	0.0	0+	1049.41	0+	1.28	12	10.330	41	
<sup>156</sup> Eu	$\beta^-$	2452.5	0.0	0+	1168.14	0+	4.1	4	9.680	43	
<sup>156</sup> Eu	$\beta^-$	2452.5	0.0	0+	1715.16	0+	0.032	10	10.92	14	
<sup>170</sup> Lu	$\beta^+/\epsilon$	3458	0.0	0+	0.0	0+	0.80	13	9.77	7	
<sup>170</sup> Lu	$\beta^+/\epsilon$	3458	0.0	0+	1228.84	0+	0.73	12	9.28	7	
<sup>170</sup> Lu	$\beta^+/\epsilon$	3458	0.0	0+	1566.38	0+	0.35	5	9.44	6	
<sup>188</sup> W	$\beta^-$	349.0	0.0	0+	207.8478	0+	0.0105	12	10.00	6	

## 15. Allowed Transitions

15.1.  $\Delta J=0$ ,  $\Delta\pi=no$ ,  $\log ft < 4$ , not  $0^+ \rightarrow 0^+$

**Table 7**

List of allowed transitions with  $\Delta J=0$  and  $\Delta\pi=no$ , but also  $\log ft < 4$ , and not  $0^+ \rightarrow 0^+$ .

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	$\log ft$	Unc.	Pand.
$^1_0n$	$\beta^-$	782.34700	0.0	1/2+	0.0	1/2+	100		3.01944	25	
$^3_1H$	$\beta^-$	18.59202	0.0	1/2+	0.0	1/2+	100.0		3.0547	7	
$^7_4Be$	$\varepsilon$	861.89	0.0	3/2-	0.0	3/2-	89.56	4	3.25	6	
$^{11}_6C$	$\beta^+/\varepsilon$	1981.69	0.0	3/2-	0.0	3/2-	100.		3.59759	16	
$^{13}_7N$	$\beta^+/\varepsilon$	2220.47	0.0	1/2-	0.0	1/2-	100.		3.67200	44	
$^{15}_8O$	$\beta^+/\varepsilon$	2754.18	0.0	1/2-	0.0	1/2-	100.		3.6448	8	
$^{17}_9F$	$\beta^+/\varepsilon$	2760.47	0.0	5/2+	0.0	5/2+	100.		3.36336	43	
$^{19}_{10}Ne$	$\beta^+/\varepsilon$	3239.50	0.0	1/2+	0.0	1/2+	99.9878	7	3.23870	15	
$^{20}_{11}Na$	$\beta^+/\varepsilon$	1.38924E4	0.0	2+	10274	2+	2.877	42	3.486	7	
$^{21}_{11}Na$	$\beta^+/\varepsilon$	3546.919	0.0	3/2+	0.0	3/2+	94.93	13	3.6146	10	
$^{23}_{12}Mg$	$\beta^+/\varepsilon$	4056.179	0.0	3/2+	0.0	3/2+	92.14	9	3.67440	46	
$^{24}_{13}Al$	$\beta^+/\varepsilon$	1.388477E4	0.0	4+	8439.36	4+	50.0	20	3.932	17	
$^{24}_{13}Al$	$\beta^+/\varepsilon$	1.388477E4	0.0	4+	9516.28	4+	37.0	15	3.512	18	
$^{24}_{13}Al$	$\beta^+/\varepsilon$	1.388477E4	425.8	1+	9965.3	1+	1.83	19	3.60	4	
$^{25}_{13}Al$	$\beta^+/\varepsilon$	4276.808	0.0	5/2+	0.0	5/2+	99.11	8	3.5740	8	
$^{28}_{15}P$	$\beta^+/\varepsilon$	1.43449E4	0.0	3+	9315.78	3+	11.30	40	3.485	15	
$^{29}_{15}P$	$\beta^+/\varepsilon$	4942.23	0.0	1/2+	0.0	1/2+	98.290	30	3.6878	16	
$^{31}_{16}S$	$\beta^+/\varepsilon$	5398.01	0.0	1/2+	0.0	1/2+	98.860	40	3.68566	37	
$^{31}_{17}Cl$	$\beta^+/\varepsilon$	1.20080E4	0.0	3/2+	6278.89	3/2+	18.7	7	3.418	18	P
$^{31}_{18}Ar$	$\beta^+/\varepsilon$	1.836E4	0.0	5/2+	12282	5/2+	5.30	30	2.98	9	P
$^{32}_{17}Cl$	$\beta^+/\varepsilon$	1.26808E4	0.0	1+	7001.0	1+	22.47	20	3.5130	42	
$^{33}_{17}Cl$	$\beta^+/\varepsilon$	5582.52	0.0	3/2+	0.0	3/2+	98.58	19	3.7530	9	
$^{33}_{18}Ar$	$\beta^+/\varepsilon$	1.16190E4	0.0	1/2+	5548	1/2+	31.0	14	3.291	20	
$^{35}_{18}Ar$	$\beta^+/\varepsilon$	5966.2	0.0	3/2+	0.0	3/2+	98.23	5	3.75945	44	
$^{35}_{19}K$	$\beta^+/\varepsilon$	1.18744E4	0.0	3/2+	5572.66	3/2+	36.0	30	3.321	41	P
$^{36}_{19}K$	$\beta^+/\varepsilon$	1.281436E4	0.0	2+	6612.12	2+	42.0	40	3.498	42	
$^{37}_{19}K$	$\beta^+/\varepsilon$	6147.48	0.0	3/2+	0.0	3/2+	97.89	11	3.6687	6	
$^{39}_{20}Ca$	$\beta^+/\varepsilon$	6524.5	0.0	3/2+	0.0	3/2+	99.9975	27	3.6376	6	
$^{40}_{21}Sc$	$\beta^+/\varepsilon$	1.43230E4	0.0	4-	7658.3	4-	49.0	40	3.317	36	
$^{41}_{21}Sc$	$\beta^+/\varepsilon$	6495.55	0.0	7/2-	0.0	7/2-	99.9630	30	3.4608	12	
$^{41}_{22}Ti$	$\beta^+/\varepsilon$	1.2945E4	0.0	3/2+	5940	3/2+	25.0	6	3.374	14	P
$^{43}_{22}Ti$	$\beta^+/\varepsilon$	6873	0.0	7/2-	0.0	7/2-	90.3	14	3.564	8	
$^{44}_{23}V$	$\beta^+/\varepsilon$	1.3741E4	0.0	(2)+	6606.4	2+	30	5	3.46	8	P
$^{45}_{23}V$	$\beta^+/\varepsilon$	7123.82	0.0	7/2-	0.0	7/2-	95.7	15	3.648	8	
$^{47}_{24}Cr$	$\beta^+/\varepsilon$	7444	0.0	3/2-	0.0	3/2-	96.2	13	3.704	14	
$^{49}_{25}Mn$	$\beta^+/\varepsilon$	7712.43	0.0	5/2-	0.0	5/2-	91.9	28	3.684	15	
$^{51}_{26}Fe$	$\beta^+/\varepsilon$	8054.0	0.0	5/2-	0.0	5/2-	93.8	13	3.672	7	
$^{55}_{28}Ni$	$\beta^+/\varepsilon$	8694.0	0.0	7/2-	0.0	7/2-	100.		3.6362	36	
$^{57}_{29}Cu$	$\beta^+/\varepsilon$	8774.95	0.0	3/2-	0.0	3/2-	89.9	8	3.6797	42	P
$^{59}_{30}Zn$	$\beta^+/\varepsilon$	9142.8	0.0	3/2-	0.0	3/2-	94.1	30	3.707	15	
$^{61}_{31}Ga$	$\beta^+/\varepsilon$	9214	0.0	3/2-	0.0	3/2-	94.0	10	3.691	13	
$^{71}_{36}Kr$	$\beta^+/\varepsilon$	1018E1	0.0	(5/2)-	0.0	(5/2)-	91.5	9	3.658	30	

15.2. Gamow-Teller,  $0^+ \leftrightarrow 1^+$

**Table 8**

List of allowed Gamow-Teller transitions with  $0^+ \leftrightarrow 1^+$ .

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	$\text{Log } ft$	Unc.	Pand.
$^6\text{He}$	$\beta^-$	3505.21	0.0	0+	0.0	1+	100		2.90924	8	
$^8\text{He}$	$\beta^-$	1.066388E4	0.	0+	980.	1+	84	1	4.202	7	
$^{10}\text{C}$	$\beta^+/\varepsilon$	3648.06	0.0	0+	718.380	1+	98.530	20	3.04935	12	
$^{12}\text{Be}$	$\beta^-$	1.17084E4	0.0	0+	0.0	1+	99.50	3	3.7991	11	
$^{12}\text{B}$	$\beta^-$	1.33694E4	0.0	1+	0.0	0+	98.216	28	4.06593	49	
$^{12}\text{N}$	$\beta^+/\varepsilon$	1.73381E4	0.0	1+	0.0	0+	96.17	5	4.1145	7	
$^{12}\text{N}$	$\beta^+$	1.73381E4	0.0	1+	7654.07	0+	1.410	30	4.626	9	
$^{14}\text{Be}$	$\beta^-$	1.629E4	0.0	0+	1280	1+	91	9	3.66	5	
$^{14}\text{C}$	$\beta^-$	156.4765	0.0	0+	0.0	1+	100		9.0460	22	
$^{14}\text{O}$	$\beta^+/\varepsilon$	5144.364	0.0	0+	0.0	1+	0.500	13	7.372	11	
$^{14}\text{O}$	$\beta^+/\varepsilon$	5144.364	0.0	0+	3948.10	1+	0.0545	19	3.133	16	
$^{16}\text{C}$	$\beta^-$	8010.2	0.0	0+	4320	1+	15.6	17	3.827	48	
$^{18}\text{C}$	$\beta^-$	1.1806E4	0.0	0+	2614.35	1+	61	5	4.163	38	
$^{18}\text{F}$	$\beta^+/\varepsilon$	1655.93	0.0	1+	0.0	0+	100.		3.5795	12	
$^{18}\text{Ne}$	$\beta^+/\varepsilon$	4444.5	0.0	0+	0.0	1+	92.11	21	3.0946	11	
$^{20}\text{O}$	$\beta^-$	3813.6	0.0	0+	1056.848	1+	99.973	3	3.7391	17	
$^{20}\text{Mg}$	$\beta^+/\varepsilon$	1.06272E4	0.0	0+	984.10	1+	72.0	25	3.780	15	
$^{20}\text{Mg}$	$\beta^+/\varepsilon$	1.06272E4	0.0	0+	2970	1+	10.90	30	4.063	13	
$^{20}\text{Mg}$	$\beta^+/\varepsilon$	1.06272E4	0.0	0+	4094	1+	2.20	30	4.38	6	
$^{20}\text{Mg}$	$\beta^+/\varepsilon$	1.06272E4	0.0	0+	4760	1+	3.30	30	3.947	40	
$^{20}\text{Mg}$	$\beta^+/\varepsilon$	1.06272E4	0.0	0+	5507	1+	1.00	11	4.132	48	
$^{20}\text{Mg}$	$\beta^+/\varepsilon$	1.06272E4	0.0	0+	6273	1+	2.10	40	3.40	8	
$^{22}\text{O}$	$\beta^-$	6.49E3	0.0	0+	1627.0	1+	31	5	4.57	8	
$^{22}\text{O}$	$\beta^-$	6.49E3	0.0	0+	2571.5	1+	68	8	3.81	6	
$^{22}\text{Mg}$	$\beta^+/\varepsilon$	4781.41	0.0	0+	583.05	1+	41.33	20	3.6466	21	
$^{22}\text{Mg}$	$\beta^+/\varepsilon$	4781.41	0.0	0+	1936.9	1+	5.45	7	3.466	6	
$^{24}\text{Ne}$	$\beta^-$	2466.3	0.0	0+	472.2074	1+	92.1	2	4.3697	28	
$^{24}\text{Ne}$	$\beta^-$	2466.3	0.0	0+	1346.63	1+	7.9	2	4.406	11	
$^{24}\text{Al}$	$\beta^+/\varepsilon$	1.388477E4	425.8	1+	0.0	0+	24.3	11	5.08	1	
$^{24}\text{Si}$	$\beta^+$	1.0794E4	0.0	0+	425.8	1+	41.0	44	4.369	47	
$^{24}\text{Si}$	$\beta^+$	1.0794E4	0.0	0+	1088.3	1+	23.9	5	4.452	28	
$^{24}\text{Si}$	$\beta^+/\varepsilon$	1.0794E4	0.0	0+	2991	1+	5.8	7	4.56	5	
$^{24}\text{Si}$	$\beta^+/\varepsilon$	1.0794E4	0.0	0+	3364	1+	11.0	10	4.166	40	
$^{24}\text{Si}$	$\beta^+/\varepsilon$	1.0794E4	0.0	0+	4400	1+	1.00	23	4.85	10	
$^{24}\text{Si}$	$\beta^+$	1.0794E4	0.0	0+	4670	1+	1.39	23	4.60	8	
$^{24}\text{Si}$	$\beta^+$	1.0794E4	0.0	0+	4970	1+	1.31	23	4.50	8	
$^{24}\text{Si}$	$\beta^+/\varepsilon$	1.0794E4	0.0	0+	6243	1+	2.20	20	3.672	42	
$^{26}\text{F}$	$\beta^-$	1.819E4	0.0	1+	0.0	0+	36.5	60	4.79	9	
$^{26}\text{F}$	$\beta^-$	1.819E4	0.0	1+	0.0	0+	36.5	60	4.79	9	
$^{26}\text{Ne}$	$\beta^-$	7342	0.0	0+	82.0	1+	91.6	2	3.877	7	
$^{26}\text{Si}$	$\beta^+/\varepsilon$	5069.14	0.0	0+	1057.739	1+	21.4	5	3.561	10	
$^{26}\text{Si}$	$\beta^+/\varepsilon$	5069.14	0.0	0+	1850.62	1+	2.73	7	3.864	11	
$^{28}\text{Ne}$	$\beta^-$	1.229E4	0.0	0+	0.0	1+	55	5	4.19	5	
$^{28}\text{Na}$	$\beta^-$	1.4032E4	0.0	1+	0.0	0+	60	5	4.622	37	
$^{28}\text{Na}$	$\beta^-$	1.4032E4	0.0	1+	3862.15	0+	20.1	19	4.428	41	
$^{28}\text{Mg}$	$\beta^-$	1830.77	0.0	0+	1372.85	1+	94.8	10	4.4567	47	
$^{28}\text{Mg}$	$\beta^-$	1830.77	0.0	0+	1620.1	1+	4.9	10	4.57	9	
$^{30}\text{Ne}$	$\beta^-$	1.481E4	0.0	0+	150.62	1+	63	11	4.05	9	
$^{30}\text{Ne}$	$\beta^-$	1.481E4	0.0	0+	926.0	1+	7.7	12	4.85	8	
$^{30}\text{Ne}$	$\beta^-$	1.481E4	0.0	0+	2113.6	1+	14.0	18	4.41	7	
$^{30}\text{Mg}$	$\beta^-$	6982.7	0.0	0+	688.0	1+	68	20	3.94	13	



**Table 8**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
<sup>30</sup> Mg	$\beta^-$	6982.7	0.0	0+	2413.5	1+	7	1	4.29	6	
<sup>30</sup> P	$\beta^+/\epsilon$	4232.11	0.0	1+	0.0	0+	99.9390	30	4.8466	7	
<sup>30</sup> S	$\beta^+/\epsilon$	6141.60	0.0	0+	0.0	1+	20.0	10	4.358	22	
<sup>30</sup> S	$\beta^+/\epsilon$	6141.60	0.0	0+	3019.2	1+	2.28	5	3.562	10	
<sup>32</sup> Mg	$\beta^-$	1.0270E4	0.0	0+	2765.3	1+	24.6	8	4.178	29	
<sup>32</sup> Mg	$\beta^-$	1.0270E4	0.0	0+	3202.2	1+	10.7	10	4.417	48	
<sup>32</sup> Al	$\beta^-$	1.2978E4	0.0	1+	0.0	0+	85	5	4.364	26	
<sup>32</sup> Al	$\beta^-$	1.2978E4	0.0	1+	4983.9	0+	4.3	11	4.66	11	
<sup>32</sup> Si	$\beta^-$	227.19	0.0	0+	0.0	1+	100		8.22	5	
<sup>32</sup> P	$\beta^-$	1710.661	0.0	1+	0.0	0+	100		7.90654	16	
<sup>32</sup> Ar	$\beta^+/\epsilon$	1.11344E4	0.0	0+	1168.55	1+	57.0	30	3.945	25	
<sup>32</sup> Ar	$\beta^+/\epsilon$	1.11344E4	0.0	0+	3772	1+	3.68	11	4.430	16	
<sup>34</sup> P	$\beta^-$	5383.0	0.0	1+	0.0	0+	84.8	21	5.165	11	
<sup>34</sup> Ar	$\beta^+/\epsilon$	6061.79	0.0	0+	665.8	1+	2.520	40	4.784	7	
<sup>34</sup> Ar	$\beta^+/\epsilon$	6061.79	0.0	0+	3129.2	1+	1.280	30	3.475	10	
<sup>36</sup> Si	$\beta^-$	7.81E3	0.0	0+	1303.1	1+	37	4	4.45	8	
<sup>36</sup> Si	$\beta^-$	7.81E3	0.0	0+	2281.0	1+	48	6	4.01	8	
<sup>36</sup> Ca	$\beta^+/\epsilon$	1.0966E4	0.0	0+	1112.4	1+	14.3	6	4.519	22	
<sup>36</sup> Ca	$\beta^+/\epsilon$	1.0966E4	0.0	0+	1618.6	1+	31.0	17	4.061	27	
<sup>36</sup> Ca	$\beta^+/\epsilon$	1.0966E4	0.0	0+	3357	1+	10.3	10	4.060	45	
<sup>36</sup> Ca	$\beta^+/\epsilon$	1.0966E4	0.0	0+	4658	1+	1.20	20	4.55	8	
<sup>36</sup> Ca	$\beta^+/\epsilon$	1.0966E4	0.0	0+	5926	1+	2.20	40	3.74	8	
<sup>38</sup> Si	$\beta^-$	1.045E4	0.0	0+	1694	1+	17	5	4.54	14	
<sup>38</sup> Si	$\beta^-$	1.045E4	0.0	0+	1874	1+	51	8	4.02	9	
<sup>38</sup> S	$\beta^-$	2937	0	0+	1941.998	1+	86.6	19	4.957	15	
<sup>38</sup> S	$\beta^-$	2937	0	0+	2751.09	1+	1.44	6	4.14	6	
<sup>38</sup> Ca	$\beta^+/\epsilon$	6742.26	0.0	0+	458.5	1+	2.84	6	4.807	9	
<sup>38</sup> Ca	$\beta^+/\epsilon$	6742.26	0.0	0+	1697.7	1+	19.48	13	3.4341	29	
<sup>40</sup> S	$\beta^-$	4720	0.0	0+	889.02	1+	35	5	4.74	13	
<sup>40</sup> S	$\beta^-$	4720	0.0	0+	2306.23	1+	46	4	3.74	12	
<sup>40</sup> Ti	$\beta^+/\epsilon$	1.153E4	0.0	0+	2276	1+	23.2	6	3.863	21	
<sup>40</sup> Ti	$\beta^+/\epsilon$	1.153E4	0.0	0+	2746	1+	29.1	10	3.644	24	
<sup>40</sup> Ti	$\beta^+/\epsilon$	1.153E4	0.0	0+	2933	1+	1.90	40	4.78	9	
<sup>40</sup> Ti	$\beta^+/\epsilon$	1.153E4	0.0	0+	3221	1+	2.4	6	4.60	11	
<sup>40</sup> Ti	$\beta^+/\epsilon$	1.153E4	0.0	0+	3648	1+	1.71	20	4.62	6	
<sup>40</sup> Ti	$\beta^+/\epsilon$	1.153E4	0.0	0+	3780	1+	2.65	29	4.39	5	
<sup>40</sup> Ti	$\beta^+/\epsilon$	1.153E4	0.0	0+	4264	1+	2.05	22	4.35	5	
<sup>40</sup> Ti	$\beta^+/\epsilon$	1.153E4	0.0	0+	4518	1+	2.60	40	4.16	7	
<sup>40</sup> Ti	$\beta^+/\epsilon$	1.153E4	0.0	0+	4649	1+	1.98	29	4.24	7	
<sup>40</sup> Ti	$\beta^+/\epsilon$	1.153E4	0.0	0+	5014	1+	1.50	30	4.23	9	
<sup>40</sup> Ti	$\beta^+/\epsilon$	1.153E4	0.0	0+	5080	1+	1.03	25	4.37	11	
<sup>42</sup> S	$\beta^-$	7.19E3	0.0	0+	1267.48	1+	17.6	11	4.966	35	
<sup>42</sup> S	$\beta^-$	7.19E3	0.0	0+	2123.28	1+	63	3	4.099	32	
<sup>42</sup> S	$\beta^-$	7.19E3	0.0	0+	3029.76	1+	16.2	9	4.299	38	
<sup>42</sup> Ti	$\beta^+/\epsilon$	7016.65	0.0	0+	611.0	1+	51.5	13	3.252	11	
<sup>44</sup> Ar	$\beta^-$	3108.2	0.0	0+	1886.13	1+	93.0	6	4.1511	40	
<sup>44</sup> Ar	$\beta^-$	3108.2	0.0	0+	2325.94	1+	3.2	2	4.866	27	
<sup>44</sup> Ar	$\beta^-$	3108.2	0.0	0+	2574.28	1+	2.2	1	4.418	20	
<sup>46</sup> Ar	$\beta^-$	5642.7	0.0	0+	1944.30	1+	95.6	25	4.242	31	
<sup>46</sup> Cr	$\beta^+/\epsilon$	7604	0.0	0+	993.21	1+	14.2	14	3.905	43	
<sup>46</sup> Cr	$\beta^+/\epsilon$	7604	0.0	0+	1432.52	1+	3.36	23	4.367	30	
<sup>46</sup> Cr	$\beta^+/\epsilon$	7604	0.0	0+	2459.80	1+	1.52	11	4.267	32	
<sup>46</sup> Cr	$\beta^+/\epsilon$	7604	0.0	0+	2977.88	1+	2.50	17	3.786	30	

**Table 8**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
<sup>48</sup> Fe	$\beta+\epsilon$	1.129E4	0.0	0+	3204	1+	1.00	30	4.83	13	
<sup>48</sup> Fe	$\beta+\epsilon$	1.129E4	0.0	0+	3495	1+	1.80	30	4.49	8	
<sup>48</sup> Fe	$\beta+\epsilon$	1.129E4	0.0	0+	3713	1+	1.30	20	4.56	7	
<sup>50</sup> Fe	$\beta+\epsilon$	8150	0.0	0+	2403.84	1+	1.47	10	4.371	30	
<sup>50</sup> Ca	$\beta-$	4947.9	0.0	0+	1847.772	1+	99	1	4.118	5	
<sup>52</sup> Ca	$\beta-$	6257.3	0.0	0+	1636.43	1+	86.8	13	4.482	29	
<sup>52</sup> Ca	$\beta-$	6257.3	0.0	0+	2745.7	1+	11.2	12	4.84	5	
<sup>52</sup> Ca	$\beta-$	6257.3	0.0	0+	4265.7	1+	1.4	4	4.68	13	
<sup>52</sup> Ti	$\beta-$	1965.3	0.0	0+	141.606	1+	100		4.040	26	
<sup>54</sup> Ni	$\beta+\epsilon$	8731.8	0.0	0+	936.7	1+	19.9	12	3.830	26	
<sup>56</sup> Ti	$\beta-$	6.76E3	0.0	0+	0.0	1+	94	3	3.87	6	
<sup>56</sup> V	$\beta-$	9.10E3	0.0	1+	0.0	0+	70	2	4.646	44	
<sup>56</sup> Cr	$\beta-$	1626.5	0.0	0+	110	1+	100		4.286	7	
<sup>56</sup> Ni	$\epsilon$	2132.87	0.0	0+	1720.19	1+	100		4.3933	30	
<sup>58</sup> Zn	$\beta+\epsilon$	9.37E3	0.0	0+	1051	1+	6.0	10	4.37	7	
<sup>58</sup> Cu	$\beta+\epsilon$	8561.02	0.0	1+	0.0	0+	81.2	5	4.8791	28	
<sup>58</sup> Cu	$\beta+\epsilon$	8561.02	0.0	1+	2943.3	0+	10.2	14	4.78	6	
<sup>60</sup> Zn	$\beta+\epsilon$	4170.8	0.0	0+	62.0	1+	20	5	5.35	11	
<sup>60</sup> Zn	$\beta+\epsilon$	4170.8	0.0	0+	670.1	1+	73	6	4.370	37	
<sup>60</sup> Cr	$\beta-$	6059.4	0.0	0+	0.0	1+	88.6	6	4.090	9	
<sup>60</sup> Mn	$\beta-$	8445.2	0.0	1+	0.0	0+	88	2	4.532	33	
<sup>60</sup> Mn	$\beta-$	8445.2	0.0	1+	1974	0+	5.0	6	5.24	6	
<sup>60</sup> Mn	$\beta-$	8445.2	0.0	1+	2356	0+	3.0	5	5.34	8	
<sup>62</sup> Ge	$\beta+\epsilon$	9.85E3	0.0	0+	571.3	1+	3.40	10	4.784	38	
<sup>62</sup> Ge	$\beta+\epsilon$	9.85E3	0.0	0+	978.3	1+	1.80	10	4.959	45	
<sup>62</sup> Ge	$\beta+\epsilon$	9.85E3	0.0	0+	1017.1	1+	2.60	10	4.789	41	
<sup>62</sup> Ge	$\beta+\epsilon$	9.85E3	0.0	0+	2164.1	1+	2.60	20	4.46	6	
<sup>62</sup> Fe	$\beta-$	2546	0.0	0+	506.1	1+	100		4.126	21	
<sup>62</sup> Cu	$\beta+\epsilon$	3958.90	0.0	1+	0.0	0+	99.608	24	5.1708	14	
<sup>62</sup> Zn	$\beta+\epsilon$	1619.5	0.0	0+	0.0	1+	40	5	4.99	5	
<sup>62</sup> Zn	$\beta+\epsilon$	1619.5	0.0	0+	548.29	1+	31.0	30	4.637	43	
<sup>62</sup> Zn	$\epsilon$	1619.5	0.0	0+	637.45	1+	28.6	22	4.596	34	
<sup>64</sup> Cu	$\beta+\epsilon$	1674.62	0.0	1+	0.0	0+	61.05	30	4.9785	40	
<sup>64</sup> Cu	$\beta-$	579.6	0.0	1+	0.0	0+	38.48	26	5.3151	33	
<sup>64</sup> Ga	$\beta+\epsilon$	7171.2	0.0	0+	3186.77	1+	30.6	7	5.125	10	
<sup>64</sup> Ga	$\beta+\epsilon$	7171.2	0.0	0+	3366.00	1+	29.1	7	5.027	11	
<sup>64</sup> Ga	$\beta+\epsilon$	7171.2	0.0	0+	3425.14	1+	6.80	30	5.618	19	
<sup>64</sup> Ga	$\beta+\epsilon$	7171.2	0.0	0+	3795.00	1+	4.03	17	5.570	18	
<sup>64</sup> Ga	$\beta+\epsilon$	7171.2	0.0	0+	4454.70	1+	1.33	8	5.459	26	
<sup>66</sup> Ni	$\beta-$	252.0	0.0	0+	0.0	1+	100		4.283	9	
<sup>66</sup> Cu	$\beta-$	2640.9	0.0	1+	0.0	0+	90.77	9	5.3424	14	
<sup>66</sup> Ga	$\beta+\epsilon$	5175.5	0.0	0+	3228.885	1+	7.4	6	6.147	36	
<sup>66</sup> Ga	$\beta+\epsilon$	5175.5	0.0	0+	3791.123	1+	26.9	22	5.000	38	
<sup>66</sup> Ga	$\beta+\epsilon$	5175.5	0.0	0+	4085.983	1+	1.67	14	5.981	39	
<sup>66</sup> Ga	$\epsilon$	5175.5	0.0	0+	4295.339	1+	6.2	5	5.224	37	
<sup>66</sup> Ga	$\epsilon$	5175.5	0.0	0+	4461.409	1+	1.96	17	5.541	40	
<sup>66</sup> Ga	$\epsilon$	5175.5	0.0	0+	4806.199	1+	2.30	19	4.889	39	
<sup>66</sup> Ge	$\beta+\epsilon$	2116.7	0.0	0+	43.81	1+	12.9	20	5.46	7	
<sup>66</sup> Ge	$\beta+\epsilon$	2116.7	0.0	0+	381.859	1+	48.3	19	4.494	20	
<sup>66</sup> Ge	$\beta+\epsilon$	2116.7	0.0	0+	536.62	1+	22.2	8	4.675	19	
<sup>66</sup> Ge	$\beta+\epsilon$	2116.7	0.0	0+	705.990	1+	9.3	5	4.908	26	
<sup>66</sup> Ge	$\epsilon$	2116.7	0.0	0+	1456.09	1+	1.30	10	5.078	35	
<sup>66</sup> Ge	$\epsilon$	2116.7	0.0	0+	1556.66	1+	1.41	11	4.897	36	

**Table 8**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
$^{68}\text{Cu}$	$\beta^-$	4440.1	0.0	1+	0.0	0+	33	4	5.77	5	
$^{68}\text{Ga}$	$\beta^+/\varepsilon$	2921.1	0.0	1+	0.0	0+	96.640	30	5.2097	16	
$^{68}\text{Ge}$	$\varepsilon$	107.3	0.0	0+	0.0	1+	100		5.007	24	
$^{70}\text{Ga}$	$\beta^-$	1651.9	0.0	1+	0.0	0+	98.91	6	5.1050	19	
$^{70}\text{Se}$	$\beta^+/\varepsilon$	2404.1	0.0	0+	81.56	1+	40.4	22	4.767	24	
$^{70}\text{Se}$	$\beta^+/\varepsilon$	2404.1	0.0	0+	234.78	1+	4.65	25	5.537	24	
$^{70}\text{Se}$	$\beta^+/\varepsilon$	2404.1	0.0	0+	458.21	1+	44.9	22	4.305	22	
$^{70}\text{Se}$	$\beta^+/\varepsilon$	2404.1	0.0	0+	581.58	1+	5.50	40	5.087	32	
$^{70}\text{Kr}$	$\beta^+/\varepsilon$	1.033E4	0.0	0+	1119.8	1+	7.80	40	4.17	6	
$^{70}\text{Kr}$	$\beta^+/\varepsilon$	1.033E4	0.0	0+	2305.5	1+	5.20	30	4.03	7	
$^{72}\text{Zn}$	$\beta^-$	442.8	0.0	0+	161.1	1+	85.1	2	4.484	12	
$^{72}\text{Zn}$	$\beta^-$	442.8	0.0	0+	207.9	1+	14.7	3	4.989	17	
$^{72}\text{Se}$	$\varepsilon$	361.6	0.0	0+	46.025	1+	100	6	4.598	31	
$^{72}\text{Kr}$	$\beta^+/\varepsilon$	5121	0.0	0+	0.0	1+	35.0	10	4.713	14	
$^{72}\text{Kr}$	$\beta^+/\varepsilon$	5121	0.0	0+	309.92	1+	16.8	6	4.878	17	
$^{72}\text{Kr}$	$\beta^+/\varepsilon$	5121	0.0	0+	415.15	1+	16.2	9	4.839	25	
$^{72}\text{Kr}$	$\beta^+/\varepsilon$	5121	0.0	0+	575.83	1+	1.48	19	5.79	6	
$^{72}\text{Kr}$	$\beta^+/\varepsilon$	5121	0.0	0+	576.79	1+	13.4	8	4.834	27	
$^{72}\text{Kr}$	$\beta^+/\varepsilon$	5121	0.0	0+	755.57	1+	1.55	12	5.671	34	
$^{72}\text{Kr}$	$\beta^+/\varepsilon$	5121	0.0	0+	939.27	1+	1.08	5	5.719	21	
$^{72}\text{Kr}$	$\beta^+/\varepsilon$	5121	0.0	0+	1027.80	1+	1.67	14	5.476	37	
$^{72}\text{Kr}$	$\beta^+/\varepsilon$	5121	0.0	0+	1386.08	1+	1.98	16	5.168	36	
$^{72}\text{Kr}$	$\beta^+/\varepsilon$	5121	0.0	0+	1772.05	1+	2.89	12	4.722	20	
$^{74}\text{Kr}$	$\beta^+/\varepsilon$	2956	0.0	0+	212.86	1+	31	6	4.77	8	
$^{74}\text{Kr}$	$\beta^+/\varepsilon$	2956	0.0	0+	306.55	1+	41	7	4.56	7	
$^{76}\text{Kr}$	$\varepsilon$	1275	0.0	0+	315.68	1+	53	6	4.82	5	
$^{76}\text{Kr}$	$\varepsilon$	1275	0.0	0+	355.28	1+	9.9	11	5.51	5	
$^{76}\text{Kr}$	$\varepsilon$	1275	0.0	0+	451.96	1+	25.3	23	5.003	42	
$^{76}\text{Kr}$	$\varepsilon$	1275	0.0	0+	868.16	1+	2.1	3	5.46	7	
$^{76}\text{Kr}$	$\varepsilon$	1275	0.0	0+	898.36	1+	2.1	3	5.39	7	
$^{76}\text{Zn}$	$\beta^-$	3993.6	0.0	0+	199.50	1+	33	6	4.75	8	
$^{76}\text{Zn}$	$\beta^-$	3993.6	0.0	0+	275.28	1+	29	5	4.77	8	
$^{76}\text{Zn}$	$\beta^-$	3993.6	0.0	0+	565.53	1+	11.0	6	5.032	33	
$^{76}\text{Zn}$	$\beta^-$	3993.6	0.0	0+	1030.30	1+	10.7	5	4.768	31	
$^{76}\text{Zn}$	$\beta^-$	3993.6	0.0	0+	1545.44	1+	4.1	3	4.830	39	
$^{76}\text{Zn}$	$\beta^-$	3993.6	0.0	0+	1750.14	1+	2.00	11	4.982	33	
$^{76}\text{Zn}$	$\beta^-$	3993.6	0.0	0+	2091.02	1+	2.1	2	4.664	47	
$^{78}\text{Zn}$	$\beta^-$	6220.8	0.0	0+	860.37	1+	38	3	4.77	6	
$^{78}\text{Zn}$	$\beta^-$	6220.8	0.0	0+	979.72	1+	15.9	17	5.11	6	
$^{78}\text{Zn}$	$\beta^-$	6220.8	0.0	0+	1031.08	1+	6.6	16	5.47	11	
$^{78}\text{Zn}$	$\beta^-$	6220.8	0.0	0+	1866.61	1+	12.2	10	4.86	6	
$^{78}\text{Zn}$	$\beta^-$	6220.8	0.0	0+	2205.68	1+	17.6	17	4.54	6	
$^{78}\text{Zn}$	$\beta^-$	6220.8	0.0	0+	2654.89	1+	3.6	6	5.00	8	
$^{78}\text{Ge}$	$\beta^-$	955	0.0	0+	277.3	1+	96	1	4.279	24	
$^{78}\text{Ge}$	$\beta^-$	955	0.0	0+	293.9	1+	4	1	5.62	11	
$^{78}\text{Br}$	$\beta^+/\varepsilon$	3573.8	0.0	1+	0.0	0+	86.40	40	4.7687	42	
$^{80}\text{Zn}$	$\beta^-$	7575.1	0.0	0+	1449.92	1+	34	4	4.67	5	
$^{80}\text{Zn}$	$\beta^-$	7575.1	0.0	0+	2092.21	1+	21.6	18	4.643	36	
$^{80}\text{Zn}$	$\beta^-$	7575.1	0.0	0+	2560.40	1+	7.4	7	4.933	41	
$^{80}\text{Zn}$	$\beta^-$	7575.1	0.0	0+	2676.94	1+	13.6	12	4.622	38	
$^{80}\text{Ge}$	$\beta^-$	2679.3	0.0	0+	0.0	1+	65	7	4.541	47	
$^{80}\text{Ge}$	$\beta^-$	2679.3	0.0	0+	265.35	1+	27	6	4.73	10	
$^{80}\text{Ge}$	$\beta^-$	2679.3	0.0	0+	680.26	1+	3.6	7	5.26	8	

**Table 8**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
$^{80}\text{Ge}$	$\beta^-$	2679.3	0.0	0+	937.05	1+	5.3	10	4.85	8	
$^{80}\text{As}$	$\beta^-$	5544.9	0.0	1+	0.0	0+	56	6	5.726	47	
$^{80}\text{As}$	$\beta^-$	5544.9	0.0	1+	1873.3	(0)+	4.2	4	6.051	42	
$^{80}\text{Br}$	$\beta+/\varepsilon$	1870.46	0.0	1+	0.0	0+	7.10	20	4.688	13	
$^{80}\text{Br}$	$\beta^-$	2004.4	0.0	1+	0.0	0+	85.0	7	5.5012	37	
$^{80}\text{Rb}$	$\beta+/\varepsilon$	5718.0	0.0	1+	0.0	0+	74.4	30	4.937	20	
$^{80}\text{Rb}$	$\beta+/\varepsilon$	5718.0	0.0	1+	1321.1	0+	1.90	30	5.89	7	
$^{80}\text{Sr}$	$\beta+/\varepsilon$	1864.0	0.0	0+	0.0	1+	40	7	4.78	8	
$^{80}\text{Sr}$	$\beta+/\varepsilon$	1864.0	0.0	0+	553.5	1+	12.1	13	4.87	6	
$^{80}\text{Sr}$	$\beta+/\varepsilon$	1864.0	0.0	0+	589.0	1+	42	5	4.30	7	
$^{82}\text{Sr}$	$\varepsilon$	178	0.0	0+	0.0	1+	100		4.69	8	
$^{82}\text{Y}$	$\beta+/\varepsilon$	7946	0.0	1+	0.0	0+	75	7	5.098	42	
$^{82}\text{Y}$	$\beta+/\varepsilon$	7946	0.0	1+	1310.8	0+	2.1	6	6.23	12	
$^{82}\text{Ge}$	$\beta^-$	4690.4	0.0	0+	1092.05	1+	80	8	4.19	5	
$^{82}\text{Rb}$	$\beta+/\varepsilon$	4404.0	0.0	1+	0.0	0+	84.80	40	4.5986	27	
$^{84}\text{Se}$	$\beta^-$	1835	0.0	0+	408.2	1+	100		4.085	35	
$^{86}\text{Zr}$	$\varepsilon$	1314	0.0	0+	271.90	1+	95	8	4.857	40	
$^{86}\text{Zr}$	$\varepsilon$	1314	0.0	0+	883.90	1+	5.7	3	5.292	43	
$^{88}\text{Kr}$	$\beta^-$	2917.7	0.0	0+	2231.761	1+	9.1	5	5.681	25	
$^{88}\text{Kr}$	$\beta^-$	2917.7	0.0	0+	2392.147	1+	67	4	4.406	27	
$^{88}\text{Kr}$	$\beta^-$	2917.7	0.0	0+	2548.420	1+	2.65	16	5.287	28	
$^{88}\text{Zr}$	$\varepsilon$	670	0.0	0+	392.86	1+	100		5.733	24	
$^{90}\text{Ru}$	$\beta+/\varepsilon$	5840.9	0.0	0+	144.1	1+	49	11	4.63	10	
$^{90}\text{Kr}$	$\beta^-$	4406	0.0	0+	1780.01	1+	65	6	4.607	40	
$^{90}\text{Kr}$	$\beta^-$	4406	0.0	0+	2127.58	1+	2.29	19	5.801	36	
$^{90}\text{Kr}$	$\beta^-$	4406	0.0	0+	3083.07	1+	2.07	19	4.891	41	
$^{90}\text{Mo}$	$\beta+/\varepsilon$	2489.0	0.0	0+	382.0	1+	81	5	5.322	28	
$^{90}\text{Mo}$	$\varepsilon$	2489.0	0.0	0+	1769.1	1+	8.0	8	5.219	44	
$^{90}\text{Mo}$	$\varepsilon$	2489.0	0.0	0+	2125.6	1+	4.1	5	4.89	5	
$^{90}\text{Mo}$	$\varepsilon$	2489.0	0.0	0+	2309.0	1+	2.1	6	4.53	13	3
$^{92}\text{Kr}$	$\beta^-$	6003	0.0	0+	1360.91	1+	88	5	4.308	25	
$^{92}\text{Sr}$	$\beta^-$	1949	0.0	0+	1383.90	1+	97	6	4.361	37	
$^{92}\text{Ru}$	$\beta+/\varepsilon$	4624.5	0.0	0+	711.36	1+	50.0	40	4.984	35	
$^{92}\text{Ru}$	$\beta+/\varepsilon$	4624.5	0.0	0+	1443.89	1+	8.7	8	5.241	40	
$^{92}\text{Ru}$	$\beta+/\varepsilon$	4624.5	0.0	0+	1796.57	1+	5.4	5	5.175	41	
$^{92}\text{Ru}$	$\beta+/\varepsilon$	4624.5	0.0	0+	2106.9	1+	2.70	40	5.22	6	
$^{92}\text{Ru}$	$\beta+/\varepsilon$	4624.5	0.0	0+	2316.06	1+	4.00	30	4.882	33	
$^{92}\text{Ru}$	$\beta+/\varepsilon$	4624.5	0.0	0+	2390.95	1+	18.4	11	4.159	27	
$^{92}\text{Ru}$	$\beta+/\varepsilon$	4624.5	0.0	0+	2770.99	1+	4.60	40	4.474	39	
$^{92}\text{Ru}$	$\beta+/\varepsilon$	4624.5	0.0	0+	3004.7	1+	2.60	18	4.563	31	
$^{92}\text{Ru}$	$\beta+/\varepsilon$	4624.5	0.0	0+	3048.1	1+	1.28	15	4.84	5	
$^{94}\text{Ru}$	$\beta+/\varepsilon$	1575	0.0	0+	442.5	1+	73	10	3.93	6	
$^{94}\text{Ru}$	$\varepsilon$	1575	0.0	0+	966.9	1+	27	6	3.81	10	
$^{94}\text{Sr}$	$\beta^-$	3506	0.0	0+	1427.71	1+	98.1	9	4.403	7	
$^{96}\text{Pd}$	$\beta+/\varepsilon$	3504	0.0	0+	939.1	1+	50.9	24	3.768	23	
$^{96}\text{Pd}$	$\beta+/\varepsilon$	3504	0.0	0+	1275.3	1+	39.6	13	3.620	17	
$^{96}\text{Pd}$	$\beta+/\varepsilon$	3504	0.0	0+	1564.6	1+	5.40	40	4.278	34	
$^{96}\text{Pd}$	$\beta+/\varepsilon$	3504	0.0	0+	1802.1	1+	4.8	5	4.172	46	
$^{96}\text{Sr}$	$\beta^-$	5412	0.0	0+	931.70	1+	92	3	4.014	15	
$^{96}\text{Sr}$	$\beta^-$	5412	0.0	0+	1983.58	1+	3.4	4	4.94	5	
$^{98}\text{Sr}$	$\beta^-$	5866	0.0	0+	547.87	1+	14	3	4.95	9	

<sup>3</sup>For further information, see 7.

**Table 8**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
$^{98}\text{Sr}$	$\beta^-$	5866	0.0	0+	600.30	1+	49	8	4.39	7	
$^{98}\text{Sr}$	$\beta^-$	5866	0.0	0+	986.39	1+	6.9	5	5.090	32	
$^{98}\text{Zr}$	$\beta^-$	2243	0.0	0+	0.0	1+	100		4.176	10	
$^{98}\text{Nb}$	$\beta^-$	4591	0.0	1+	0.0	0+	61	3	4.713	23	
$^{98}\text{Nb}$	$\beta^-$	4591	0.0	1+	734.61	0+	20	2	4.864	44	
$^{98}\text{Pd}$	$\beta^+/\varepsilon$	1854	0.0	0+	112.06	1+	66	5	3.999	35	
$^{98}\text{Pd}$	$\varepsilon$	1854	0.0	0+	837.0	1+	23.5	15	3.942	32	
$^{98}\text{Pd}$	$\varepsilon$	1854	0.0	0+	1007.5	1+	5.9	5	4.379	41	
$^{98}\text{Pd}$	$\varepsilon$	1854	0.0	0+	1262.3	1+	2.4	3	4.45	6	
$^{100}\text{Pd}$	$\varepsilon$	378	0.0	0+	151.86	(1)+	0.66	6	6.60	12	
$^{100}\text{Pd}$	$\varepsilon$	378	0.0	0+	158.80	1+	92	8	4.42	12	
$^{100}\text{Cd}$	$\beta^+/\varepsilon$	3943	0.0	0+	952.05	1+	69	5	3.590	32	
$^{100}\text{Cd}$	$\beta^+/\varepsilon$	3943	0.0	0+	1156.39	1+	2.30	20	4.918	38	
$^{100}\text{Cd}$	$\beta^+/\varepsilon$	3943	0.0	0+	1212.69	1+	3.70	30	4.670	36	
$^{100}\text{Cd}$	$\beta^+/\varepsilon$	3943	0.0	0+	1393.15	1+	15.8	14	3.907	39	
$^{100}\text{Cd}$	$\beta^+/\varepsilon$	3943	0.0	0+	1574.30	1+	5.5	5	4.234	40	
$^{100}\text{Cd}$	$\beta^+/\varepsilon$	3943	0.0	0+	1892.95	1+	1.90	20	4.474	47	
$^{100}\text{Sn}$	$\beta^+/\varepsilon$	7.03E3	0.0	0+	2745	1+	100.		2.66	14	
$^{100}\text{Zr}$	$\beta^-$	3419	0.0	0+	0.0	1+	46	5	4.65	5	
$^{100}\text{Zr}$	$\beta^-$	3419	0.0	0+	400.52	1+	17.9	9	4.830	33	
$^{100}\text{Zr}$	$\beta^-$	3419	0.0	0+	504.29	1+	33	4	4.50	6	
$^{100}\text{Nb}$	$\beta^-$	6402	0.0	1+	0.0	0+	50	7	5.14	9	
$^{100}\text{Nb}$	$\beta^-$	6402	0.0	1+	695.21	0+	8.5	14	5.68	9	
$^{100}\text{Nb}$	$\beta^-$	6402	0.0	1+	1504.79	0+	3.7	6	5.74	9	
$^{100}\text{Nb}$	$\beta^-$	6402	0.0	1+	2037.55	0+	4.7	7	5.42	9	
$^{100}\text{Nb}$	$\beta^-$	6402	0.0	1+	2086.38	0+	7.0	12	5.22	10	
$^{100}\text{Tc}$	$\beta^-$	3206.4	0.0	1+	0.0	0+	93.29	3	4.6189	34	
$^{100}\text{Tc}$	$\beta^-$	3206.4	0.0	1+	1130.25	0+	5.38	13	5.067	11	
$^{102}\text{Cd}$	$\beta^+/\varepsilon$	2587	0.0	0+	490.44	1+	63.9	18	3.806	43	
$^{102}\text{Cd}$	$\beta^+/\varepsilon$	2587	0.0	0+	1045.59	1+	25.7	8	3.846	44	
$^{102}\text{Cd}$	$\beta^+/\varepsilon$	2587	0.0	0+	1368.6	1+	6.3	6	4.24	6	
$^{102}\text{Mo}$	$\beta^-$	1012	0.0	0+	0.0	1+	94.1	6	4.222	21	
$^{102}\text{Mo}$	$\beta^-$	1012	0.0	0+	359.86	1+	4.8	7	4.82	7	
$^{102}\text{Tc}$	$\beta^-$	4534	0.0	1+	0.0	0+	92.9	6	4.804	13	
$^{104}\text{Mo}$	$\beta^-$	2155	0.0	0+	174.8	1+	77	19	4.39	11	
$^{104}\text{Mo}$	$\beta^-$	2155	0.0	0+	613.9	1+	1.2	4	5.76	15	
$^{104}\text{Mo}$	$\beta^-$	2155	0.0	0+	642.0	1+	5.3	13	5.09	11	
$^{104}\text{Mo}$	$\beta^-$	2155	0.0	0+	728.8	1+	2.7	6	5.28	10	
$^{104}\text{Rh}$	$\beta^-$	2435.8	0.0	1+	0.0	0+	97.6	5	4.561	5	
$^{106}\text{Ru}$	$\beta^-$	39.40	0.0	0+	0.0	1+	100		4.349	7	
$^{106}\text{Rh}$	$\beta^-$	3545	0.0	1+	0.0	0+	78.6	7	5.197	7	
$^{106}\text{Rh}$	$\beta^-$	3545	0.0	1+	1133.75	0+	10.0	4	5.383	18	
$^{106}\text{Ag}$	$\beta^+/\varepsilon$	2965.1	0.0	1+	0.0	0+	82.9	15	4.944	8	
$^{108}\text{Ag}$	$\beta^-$	1645.6	0.0	1+	0.0	0+	95.4	3	4.4454	37	
$^{108}\text{Sn}$	$\beta^+/\varepsilon$	2050	0.0	0+	698.8	1+	87.8	12	3.532	11	
$^{108}\text{Sn}$	$\varepsilon$	2050	0.0	0+	1191.6	1+	5.2	5	4.354	44	
$^{108}\text{Mo}$	$\beta^-$	5174	0.0	0+	326.91	1+	13	3	5.09	10	
$^{108}\text{Mo}$	$\beta^-$	5174	0.0	0+	334.03	1+	11	3	5.16	12	
$^{108}\text{Mo}$	$\beta^-$	5174	0.0	0+	458.76	1+	31	8	4.66	11	
$^{108}\text{Ru}$	$\beta^-$	1370	0.0	0+	164.95	1+	46	10	4.46	10	
$^{108}\text{Rh}$	$\beta^-$	4493	0.0	1+	0.0	0+	56	11	5.54	9	
$^{108}\text{Rh}$	$\beta^-$	4493	0.0	1+	1053.0	0+	15	4	5.61	12	
$^{108}\text{Ag}$	$\beta^+/\varepsilon$	1917.4	0.0	1+	0.0	0+	2.35	16	4.722	30	

**Table 8**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
<sup>110</sup> Sn	$\varepsilon$	628	0.0	0+	342.539	1+	100		3.45	6	
<sup>110</sup> Ag	$\beta^-$	2890.7	0.0	1+	0.0	0+	94.89	25	4.6830	24	
<sup>112</sup> In	$\beta^+/\varepsilon$	2584.7	0.0	1+	0.0	0+	55.0	40	4.671	33	
<sup>112</sup> In	$\beta^+/\varepsilon$	2584.7	0.0	1+	1224.345	0+	1.00	12	5.61	5	
<sup>112</sup> In	$\beta^-$	664.9	0.0	1+	0.0	0+	38	4	4.216	47	
<sup>114</sup> In	$\beta^-$	1989.93	0.0	1+	0.0	0+	99.36	6	4.4957	7	
<sup>114</sup> Ru	$\beta^-$	5.49E3	0.0	0+	0.0	1+	60	14	4.39	11	
<sup>114</sup> Pd	$\beta^-$	1440	0.0	0+	0.0	1+	92.0	5	4.221	15	
<sup>114</sup> Pd	$\beta^-$	1440	0.0	0+	358.5	1+	7.5	6	4.836	38	
<sup>116</sup> Te	$\beta^+/\varepsilon$	1558	0.0	0+	93.75	1+	94.3	10	4.819	21	
<sup>116</sup> Te	$\varepsilon$	1558	0.0	0+	731.70	1+	4.36	10	5.641	34	
<sup>116</sup> Pd	$\beta^-$	2712	0.0	0+	114.70	1+	79	4	4.230	27	
<sup>116</sup> Pd	$\beta^-$	2712	0.0	0+	393.9	1+	21	2	4.600	44	
<sup>118</sup> Sb	$\beta^+/\varepsilon$	3656.6	0.0	1+	0.0	0+	97.50	30	4.556	12	
<sup>118</sup> Te	$\varepsilon$	305	0.0	0+	0.0	1+	100		5.13	7	
<sup>118</sup> Pd	$\beta^-$	4165.4	0.0	0+	396.45	1+	21.8	16	4.685	39	
<sup>118</sup> Pd	$\beta^-$	4165.4	0.0	0+	475.08	1+	44	4	4.340	46	
<sup>118</sup> Pd	$\beta^-$	4165.4	0.0	0+	641.82	1+	11.7	8	4.828	38	
<sup>118</sup> Pd	$\beta^-$	4165.4	0.0	0+	720.42	1+	15.8	22	4.66	6	
<sup>118</sup> Cd	$\beta^-$	527	0.0	0+	0.0	1+	100		3.95	6	
<sup>118</sup> In	$\beta^-$	4425	0.0	1+	0.0	0+	94.9	1	4.820	44	
<sup>120</sup> Sb	$\beta^+/\varepsilon$	2681	0.0	1+	0.0	0+	98.3	11	4.558	8	
<sup>120</sup> Xe	$\beta^+/\varepsilon$	1575	0.0	0+	25.07	1+	38	9	4.83	10	
<sup>120</sup> Xe	$\beta^+/\varepsilon$	1575	0.0	0+	200.95	1+	4.5	12	5.65	12	
<sup>120</sup> Xe	$\beta^+/\varepsilon$	1575	0.0	0+	212.37	1+	3.6	11	5.74	13	
<sup>120</sup> Xe	$\beta^+/\varepsilon$	1575	0.0	0+	375.35	1+	1.50	40	6.00	12	
<sup>120</sup> Xe	$\beta^+/\varepsilon$	1575	0.0	0+	449.32	1+	6.2	7	5.33	5	
<sup>120</sup> Xe	$\varepsilon$	1575	0.0	0+	850.77	1+	5.0	5	5.03	5	
<sup>120</sup> Xe	$\varepsilon$	1575	0.0	0+	965.62	1+	15.9	16	4.37	5	
<sup>120</sup> Xe	$\varepsilon$	1575	0.0	0+	1023.52	1+	2.39	24	5.10	6	
<sup>120</sup> Xe	$\varepsilon$	1575	0.0	0+	1142.86	1+	1.85	19	4.99	6	
<sup>120</sup> Ba	$\beta^+/\varepsilon$	5.00E3	0.0	0+	319.15	1+	29	7	4.71	19	
<sup>120</sup> Cd	$\beta^-$	1770	0.0	0+	0.0	1+	100		4.118	41	
<sup>120</sup> In	$\beta^-$	5370	0.0	1+	0.0	0+	80.6	16	5.050	20	
<sup>120</sup> In	$\beta^-$	5370	0.0	1+	1876.7	0+	1.43	22	5.99	7	
<sup>122</sup> Xe	$\varepsilon$	724	0.0	0+	0.0	1+	83.0	4	5.226	18	
<sup>122</sup> Xe	$\varepsilon$	724	0.0	0+	148.612	1+	3.75	16	6.363	28	
<sup>122</sup> Xe	$\varepsilon$	724	0.0	0+	350.053	1+	9.25	21	5.572	35	
<sup>122</sup> Xe	$\varepsilon$	724	0.0	0+	416.675	1+	2.47	11	5.959	45	
<sup>122</sup> Cs	$\beta^+/\varepsilon$	7210	0.0	1+	0.0	0+	49	5	5.411	46	
<sup>122</sup> Cs	$\beta^+/\varepsilon$	7210	0.0	1+	1149.07	0+	3.10	40	6.21	6	
<sup>122</sup> In	$\beta^-$	6.37E3	0.0	1+	0.0	0+	69	6	5.14	10	
<sup>122</sup> In	$\beta^-$	6.37E3	0.0	1+	2530.02	(0)+	1.83	4	5.74	9	
<sup>122</sup> In	$\beta^-$	6.37E3	0.0	1+	3205.95	(0)+	2.0	4	5.34	13	
<sup>122</sup> I	$\beta^+/\varepsilon$	4234	0.0	1+	0.0	0+	82	6	4.977	33	
<sup>122</sup> I	$\beta^+/\varepsilon$	4234	0.0	1+	1357.42	0+	1.30	40	5.96	13	
<sup>124</sup> Cs	$\beta^+/\varepsilon$	5926	0.0	1+	0.0	0+	49	7	5.13	6	
<sup>124</sup> Cs	$\beta^+/\varepsilon$	5926	0.0	1+	1268.89	0+	4.9	7	5.58	6	
<sup>126</sup> Cs	$\beta^+/\varepsilon$	4796	0.0	1+	0.0	0+	56.4	22	5.085	18	
<sup>126</sup> Cs	$\beta^+/\varepsilon$	4796	0.0	1+	1313.86	0+	5.40	30	5.401	25	
<sup>126</sup> Ba	$\beta^+/\varepsilon$	1681	0.0	0+	0.0	1+	31	6	5.38	10	
<sup>126</sup> Ba	$\beta^+/\varepsilon$	1681	0.0	0+	233.63	1+	16.9	18	5.50	7	
<sup>126</sup> Ba	$\varepsilon$	1681	0.0	0+	681.84	1+	5.4	7	5.66	8	

**Table 8**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
$^{126}\text{Ba}$	$\varepsilon$	1681	0.0	0+	1097.48	1+	5.1	6	5.20	9	
$^{126}\text{Ba}$	$\varepsilon$	1681	0.0	0+	1210.75	1+	3.7	5	5.14	10	
$^{126}\text{Ba}$	$\varepsilon$	1681	0.0	0+	1234.32	1+	9.6	10	4.68	9	
$^{126}\text{Ba}$	$\varepsilon$	1681	0.0	0+	1241.63	1+	3.5	5	5.10	10	
$^{126}\text{Ba}$	$\varepsilon$	1681	0.0	0+	1293.01	1+	9.1	10	4.57	10	
$^{126}\text{Cd}$	$\beta^-$	5553.6	0.0	0+	688.23	1+	85	6	4.043	31	
$^{128}\text{Cs}$	$\beta+/\varepsilon$	3929	0.0	1+	0.0	0+	72.1	14	4.877	9	
$^{128}\text{Cs}$	$\beta+/\varepsilon$	3929	0.0	1+	1582.976	0+	1.52	8	5.609	23	
$^{128}\text{Ba}$	$\varepsilon$	563	0.0	0+	0.0	1+	84.0	8	5.49	5	
$^{128}\text{Ba}$	$\varepsilon$	563	0.0	0+	273.440	1+	15.3	8	5.60	7	
$^{128}\text{Cd}$	$\beta^-$	6952	0.0	0+	1172.88	1+	93	9	4.015	42	
$^{128}\text{I}$	$\beta+/\varepsilon$	1255.8	0.0	1+	0.0	0+	6.783	21	5.083	6	
$^{128}\text{I}$	$\beta^-$	2122.5	0.0	1+	0.0	0+	80.0	3	6.0958	34	
$^{130}\text{Cs}$	$\beta^-$	357	0.0	1+	0.0	0+	1.6	4	5.10	11	
$^{130}\text{Ce}$	$\beta+/\varepsilon$	2204	0.0	0+	131.01	1+	42.0	20	4.918	29	
$^{130}\text{Ce}$	$\beta+/\varepsilon$	2204	0.0	0+	267.31	1+	7.4	10	5.60	6	
$^{130}\text{Ce}$	$\beta+/\varepsilon$	2204	0.0	0+	523.88	1+	3.90	20	5.736	33	
$^{130}\text{Ce}$	$\beta+/\varepsilon$	2204	0.0	0+	1168.72	1+	3.00	20	5.411	47	
$^{130}\text{Ce}$	$\varepsilon$	2204	0.0	0+	1196.79	1+	11	1	4.82	5	
$^{130}\text{Ce}$	$\varepsilon$	2204	0.0	0+	1289.04	1+	4.3	3	5.14	5	
$^{130}\text{Ce}$	$\varepsilon$	2204	0.0	0+	1431.19	1+	1.0	2	5.62	10	
$^{130}\text{Cd}$	$\beta^-$	8789	0.0	0+	2120.2	1+	74	7	4.111	42	
$^{130}\text{Sn}$	$\beta^-$	2153	0.0	0+	702.88	1+	16.3	2	5.248	19	
$^{130}\text{Sn}$	$\beta^-$	2153	0.0	0+	819.09	(1)+	2.1	5	6.00	11	
$^{130}\text{Sn}$	$\beta^-$	2153	0.0	0+	1048.23	1+	80.5	13	4.104	23	
$^{132}\text{Ce}$	$\varepsilon$	1255	0.0	0+	182.071	1+	77.10	35	4.996	40	
$^{132}\text{Ce}$	$\varepsilon$	1255	0.0	0+	279.14	1+	2.1	3	6.48	8	
$^{132}\text{Ce}$	$\varepsilon$	1255	0.0	0+	406.87	1+	6.4	3	5.87	5	
$^{132}\text{Ce}$	$\varepsilon$	1255	0.0	0+	485.04	1+	5.1	3	5.88	6	
$^{132}\text{Ce}$	$\varepsilon$	1255	0.0	0+	523.83	1+	1.48	10	6.37	6	
$^{132}\text{Ce}$	$\varepsilon$	1255	0.0	0+	606.744	1+	4.0	2	5.82	7	
$^{132}\text{Ce}$	$\varepsilon$	1255	0.0	0+	648.33	1+	1.61	14	6.16	8	
$^{132}\text{Ce}$	$\varepsilon$	1255	0.0	0+	731.77	1+	1.74	12	5.99	9	
$^{132}\text{Nd}$	$\beta+/\varepsilon$	3802	0.0	0+	147.72	1+	33.0	20	4.762	42	
$^{132}\text{Nd}$	$\beta+/\varepsilon$	3802	0.0	0+	714.94	1+	23.0	10	4.616	37	
$^{132}\text{Sn}$	$\beta^-$	3088.7	0.0	0+	1325.15	1+	99	4	4.045	20	
$^{132}\text{Te}$	$\beta^-$	515.3	0.0	0+	277.86	1+	100	4	4.863	27	
$^{134}\text{Ce}$	$\varepsilon$	386	0.0	0+	0.0	1+	98.9	2	5.28	8	
$^{134}\text{Ce}$	$\varepsilon$	386	0.0	0+	162.312	1+	0.53	4	7.02	15	
$^{134}\text{Ce}$	$\varepsilon$	386	0.0	0+	252.483	(1)+	0.050	9	7.49	30	
$^{134}\text{Ce}$	$\varepsilon$	386	0.0	0+	294.264	(1)+	0.11	1	6.7	5	
$^{134}\text{Ce}$	$\varepsilon$	386	0.0	0+	355.479	(1)+	0.25	1	4.8	33	
$^{134}\text{Te}$	$\beta^-$	1509.7	0.0	0+	846.688	1+	42	2	4.677	25	
$^{134}\text{Te}$	$\beta^-$	1509.7	0.0	0+	923.431	1+	44	2	4.472	25	
$^{134}\text{Te}$	$\beta^-$	1509.7	0.0	0+	1106.466	1+	14	1	4.420	37	
$^{134}\text{La}$	$\beta+/\varepsilon$	3731	0.0	1+	0.0	0+	94.71	21	4.920	15	
$^{136}\text{Te}$	$\beta^-$	5120	0.0	0+	2656.42	1+	38	4	4.733	47	
$^{136}\text{Te}$	$\beta^-$	5120	0.0	0+	3137.1	1+	4.3	5	5.30	5	
$^{136}\text{Te}$	$\beta^-$	5120	0.0	0+	3235.2	1+	21.4	24	4.51	5	
$^{136}\text{La}$	$\beta+/\varepsilon$	2.85E3	0.0	1+	0.0	0+	97.61	9	4.589	25	
$^{136}\text{Nd}$	$\beta+/\varepsilon$	2141	0.0	0+	149.11	1+	74.2	11	5.039	11	
$^{136}\text{Nd}$	$\beta+/\varepsilon$	2141	0.0	0+	476.63	1+	1.88	21	6.46	5	
$^{136}\text{Nd}$	$\beta+/\varepsilon$	2141	0.0	0+	574.82	1+	12.3	12	5.587	44	

**Table 8**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
<sup>136</sup> Nd	$\beta+\epsilon$	2141	0.0	0+	940.10	(1)+	1.88	14	6.162	35	
<sup>138</sup> Nd	$\beta+\epsilon$	1112	0.0	0+	0.0	1+	95.9	7	5.161	16	
<sup>138</sup> Nd	$\epsilon$	1112	0.0	0+	325.73	1+	2.9	5	6.37	8	
<sup>138</sup> Xe	$\beta-$	2915	0.0	0+	2026.73	1+	35.3	13	4.774	24	
<sup>138</sup> Xe	$\beta-$	2915	0.0	0+	2263.13	1+	10.3	4	4.833	29	
<sup>138</sup> Xe	$\beta-$	2915	0.0	0+	2337.65	1+	3.31	14	5.143	32	
<sup>138</sup> Pr	$\beta+\epsilon$	4437	0.0	1+	0.0	0+	97.2	5	4.643	16	
<sup>140</sup> Pm	$\beta+\epsilon$	6045	0.0	1+	0.0	0+	93.6	6	4.371	13	
<sup>140</sup> Sm	$\beta+\epsilon$	2756	0.0	0+	0.0	1+	75	5	4.953	31	
<sup>140</sup> Eu	$\beta+\epsilon$	8.47E3	0.0	1+	0.0	0+	70.0	40	4.464	29	
<sup>140</sup> Eu	$\beta+\epsilon$	8.47E3	0.0	1+	1599.10	0+	3.5	7	5.30	9	
<sup>140</sup> Gd	$\beta+\epsilon$	5.20E3	0.0	0+	0.0	1+	46	9	4.60	9	
<sup>140</sup> Gd	$\beta+\epsilon$	5.20E3	0.0	0+	749.94	1+	21.0	30	4.62	7	
<sup>140</sup> Xe	$\beta-$	4063	0.0	0+	1427.58	1+	65	7	4.545	47	
<sup>140</sup> Xe	$\beta-$	4063	0.0	0+	2324.31	1+	1.1	2	5.59	8	
<sup>140</sup> Pr	$\beta+\epsilon$	3388	0.0	1+	0.0	0+	99.39	6	4.4589	31	
<sup>140</sup> Nd	$\epsilon$	429	0.0	0+	0.0	1+	100		5.474	18	
<sup>142</sup> Gd	$\beta+\epsilon$	4349	0.0	0+	0.0	1+	52	5	4.828	45	
<sup>142</sup> Dy	$\beta+\epsilon$	6.44E3	0.0	0+	0.0	1+	94.0	20	3.92	9	
<sup>142</sup> Ba	$\beta-$	2182	0.0	0+	1078.71	1+	22.1	8	5.241	24	
<sup>142</sup> Ba	$\beta-$	2182	0.0	0+	1204.35	1+	46.8	17	4.720	24	
<sup>142</sup> Ba	$\beta-$	2182	0.0	0+	1457.90	1+	15.4	6	4.736	25	
<sup>144</sup> Gd	$\beta+\epsilon$	3860	0.0	0+	0.0	1+	80	14	4.99	8	
<sup>144</sup> Eu	$\beta+\epsilon$	6346	0.0	1+	0.0	0+	89.4	7	4.547	7	
<sup>144</sup> Eu	$\beta+\epsilon$	6346	0.0	1+	2477.8	0+	1.56	13	5.275	37	
<sup>146</sup> Tb	$\beta+\epsilon$	8322	0.0	1+	0.0	0+	84.0	20	5.07	22	
<sup>146</sup> Tb	$\beta+\epsilon$	8322	0.0	1+	2164.72	0+	2.90	40	5.87	23	
<sup>146</sup> Dy	$\beta+\epsilon$	5209	0.0	0+	0.0	1+	21	5	5.28	11	
<sup>146</sup> Dy	$\beta+\epsilon$	5209	0.0	0+	354.85	1+	4.4	6	5.82	6	
<sup>146</sup> Dy	$\beta+\epsilon$	5209	0.0	0+	1726.96	1+	18.7	8	4.579	26	
<sup>146</sup> Dy	$\beta+\epsilon$	5209	0.0	0+	1737.40	1+	8.6	5	4.911	31	
<sup>146</sup> Dy	$\beta+\epsilon$	5209	0.0	0+	2082.01	1+	12.0	7	4.606	31	
<sup>146</sup> Dy	$\beta+\epsilon$	5209	0.0	0+	2156.80	1+	15.2	10	4.468	34	
<sup>146</sup> Ba	$\beta-$	4354.9	0.0	0+	372.53	1+	28.2	16	4.910	27	
<sup>146</sup> Ba	$\beta-$	4354.9	0.0	0+	708.84	1+	9.1	6	5.237	31	
<sup>146</sup> Ba	$\beta-$	4354.9	0.0	0+	880.24	1+	8.6	6	5.173	33	
<sup>146</sup> Ba	$\beta-$	4354.9	0.0	0+	1064.51	1+	6.3	4	5.208	30	
<sup>146</sup> Ba	$\beta-$	4354.9	0.0	0+	1181.91	1+	3.15	24	5.443	35	
<sup>146</sup> Ba	$\beta-$	4354.9	0.0	0+	1190.18	1+	3.21	23	5.430	33	
<sup>146</sup> Ba	$\beta-$	4354.9	0.0	0+	1224.10	1+	1.70	23	5.69	6	
<sup>146</sup> Ba	$\beta-$	4354.9	0.0	0+	1268.96	1+	2.39	18	5.512	35	
<sup>146</sup> Ba	$\beta-$	4354.9	0.0	0+	1443.45	1+	3.31	22	5.265	31	
<sup>146</sup> Ba	$\beta-$	4354.9	0.0	0+	1469.15	1+	3.5	3	5.224	39	
<sup>146</sup> Ba	$\beta-$	4354.9	0.0	0+	1481.50	1+	1.83	13	5.498	33	
<sup>146</sup> Ba	$\beta-$	4354.9	0.0	0+	1534.43	1+	4.30	23	5.094	26	
<sup>146</sup> Ba	$\beta-$	4354.9	0.0	0+	1624.43	1+	2.33	16	5.301	32	
<sup>146</sup> Ce	$\beta-$	1048	0.0	0+	351.78	1+	94.3	24	4.04	8	
<sup>146</sup> Ce	$\beta-$	1048	0.0	0+	502.95	1+	3.47	9	5.11	9	
<sup>148</sup> Ce	$\beta-$	2137	0.0	0+	390.684	1+	59	4	4.564	32	
<sup>148</sup> Ce	$\beta-$	2137	0.0	0+	520.83	1+	16.3	9	4.992	28	
<sup>148</sup> Ce	$\beta-$	2137	0.0	0+	765.45	1+	2.1	3	5.61	6	
<sup>150</sup> Dy	$\beta+\epsilon$	1796	0.0	0+	397.2	1+	100.		3.934	7	
<sup>150</sup> Er	$\beta+\epsilon$	4115	0.0	0+	476.0	1+	95.60	10	3.729	17	



**Table 8**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
<sup>150</sup> Er	$\beta+\epsilon$	4115	0.0	0+	1152.0	1+	1.34	21	5.28	7	
<sup>150</sup> Er	$\beta+\epsilon$	4115	0.0	0+	1490.2	1+	1.24	21	5.16	8	
<sup>152</sup> Dy	$\epsilon$	599	0.0	0+	256.93	1+	100		3.92	13	
<sup>152</sup> Er	$\beta+\epsilon$	3104	0.0	0+	179.3	1+	100.		3.138	6	
<sup>152</sup> Yb	$\beta+\epsilon$	5.45E3	0.0	0+	141.7	1+	3.5	9	5.10	12	
<sup>152</sup> Yb	$\beta+\epsilon$	5.45E3	0.0	0+	458.6	1+	8.0	6	4.62	6	
<sup>152</sup> Yb	$\beta+\epsilon$	5.45E3	0.0	0+	482.4	1+	87.2	5	3.57	5	
<sup>152</sup> Nd	$\beta-$	1105	0.0	0+	294.55	1+	47	6	4.54	7	
<sup>152</sup> Nd	$\beta-$	1105	0.0	0+	570.78	1+	1.44	19	5.43	8	
<sup>152</sup> Nd	$\beta-$	1105	0.0	0+	592.40	1+	1.65	22	5.31	8	
<sup>152</sup> Pm	$\beta-$	3509	0.0	1+	0.0	0+	62	4	6.474	32	
<sup>152</sup> Pm	$\beta-$	3509	0.0	1+	1082.77	0+	4.5	5	6.95	5	
<sup>152</sup> Pm	$\beta-$	3509	0.0	1+	1658.7	0+	2.7	3	6.70	5	
<sup>154</sup> Yb	$\beta+\epsilon$	4495	0.0	0+	133.2	1+	5.6	14	3.65	11	
<sup>156</sup> Er	$\beta+\epsilon$	1327	0.0	0+	117.58	1+	52	6	4.59	7	
<sup>156</sup> Sm	$\beta-$	722	0.0	0+	22.6	1+	48	15	6.05	14	
<sup>156</sup> Sm	$\beta-$	722	0.0	0+	291.4	1+	44	8	5.37	8	
<sup>156</sup> Eu	$\beta-$	2452.5	0.0	0+	1965.91	1+	29	3	7.342	46	
<sup>156</sup> Eu	$\beta-$	2452.5	0.0	0+	2026.60	1+	5.7	6	7.856	47	
<sup>156</sup> Eu	$\beta-$	2452.5	0.0	0+	2186.74	1+	10.3	10	6.934	46	
<sup>156</sup> Eu	$\beta-$	2452.5	0.0	0+	2269.89	1+	4.2	4	6.809	49	
<sup>156</sup> Eu	$\beta-$	2452.5	0.0	0+	2300.75	1+	0.123	11	8.09	5	
<sup>156</sup> Eu	$\beta-$	2452.5	0.0	0+	2360.78	1+	0.026	3	8.09	7	
<sup>158</sup> Er	$\epsilon$	884	0.0	0+	146.801	1+	76	11	4.82	8	
<sup>158</sup> Er	$\epsilon$	884	0.0	0+	385.708	1+	4.4	3	5.69	8	
<sup>158</sup> Er	$\epsilon$	884	0.0	0+	433.168	1+	4.0	4	5.63	10	
<sup>158</sup> Er	$\epsilon$	884	0.0	0+	461.698	1+	8.9	7	5.22	10	
<sup>160</sup> Yb	$\beta+\epsilon$	2138	0.0	0+	215.84	1+	80	8	4.29	5	
<sup>160</sup> Yb	$\beta+\epsilon$	2138	0.0	0+	494.49	1+	1.94	24	5.76	6	
<sup>160</sup> Yb	$\beta+\epsilon$	2138	0.0	0+	547.38	1+	4.3	5	5.38	6	
<sup>160</sup> Yb	$\beta+\epsilon$	2138	0.0	0+	605.37	1+	5.7	16	5.22	13	
<sup>160</sup> Yb	$\beta+\epsilon$	2138	0.0	0+	797.96	1+	1.29	21	5.75	8	
<sup>162</sup> Gd	$\beta-$	1598.8	0.0	0+	442.11	1+	95.5	5	4.749	12	
<sup>162</sup> Ho	$\epsilon$	2140.6	0.0	1+	1400.29	0+	4.1	3	5.096	43	
<sup>162</sup> Yb	$\beta+\epsilon$	1656	0.0	0+	163.351	1+	73	8	4.69	5	
<sup>162</sup> Yb	$\beta+\epsilon$	1656	0.0	0+	415.88	1+	1.70	30	6.15	8	
<sup>162</sup> Yb	$\epsilon$	1656	0.0	0+	739.45	1+	3.3	4	5.59	6	
<sup>162</sup> Yb	$\epsilon$	1656	0.0	0+	771.00	1+	2.1	4	5.75	9	
<sup>162</sup> Yb	$\epsilon$	1656	0.0	0+	782.64	1+	1.9	3	5.78	8	
<sup>164</sup> Ho	$\epsilon$	987.1	0.0	1+	0.0	0+	41	6	4.64	6	
<sup>164</sup> Ho	$\beta-$	962.1	0.0	1+	0.0	0+	28	5	5.59	8	
<sup>164</sup> Tm	$\beta+\epsilon$	4034	0.0	1+	0.0	0+	63.0	30	4.901	32	
<sup>164</sup> Tm	$\beta+\epsilon$	4034	0.0	1+	1246.07	0+	1.08	10	6.127	47	
<sup>164</sup> Tm	$\beta+\epsilon$	4034	0.0	1+	1702.20	0+	1.63	13	5.745	42	
<sup>164</sup> Tm	$\beta+\epsilon$	4034	0.0	1+	1765.85	0+	1.34	11	5.802	43	
<sup>164</sup> Tm	$\beta+\epsilon$	4034	0.0	1+	2172.96	0+	1.54	15	5.55	5	
<sup>166</sup> Hf	$\beta+\epsilon$	2162	0.0	0+	135.9	1+	71	6	4.602	46	
<sup>166</sup> Hf	$\beta+\epsilon$	2162	0.0	0+	543.7	1+	9.2	13	5.28	7	
<sup>166</sup> W	$\beta+\epsilon$	4210	0.0	0+	125.79	1+	90	11	4.08	6	
<sup>166</sup> W	$\beta+\epsilon$	4210	0.0	0+	395.93	1+	10.0	15	4.93	7	
<sup>166</sup> Dy	$\beta-$	485.9	0.0	0+	425.987	1+	1.17	18	5.30	7	
<sup>166</sup> Yb	$\epsilon$	293	0.0	0+	82.29	1+	100		4.90	8	
<sup>168</sup> W	$\beta+\epsilon$	3501	0.0	0+	178.43	1+	96	20	4.18	9	

**Table 8**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
$^{168}\text{Dy}$	$\beta^-$	1.50E3	0.0	0+	192.57	1+	33	3	5.47	21	
$^{168}\text{Dy}$	$\beta^-$	1.50E3	0.0	0+	630.41	1+	61	3	4.56	31	
$^{170}\text{Lu}$	$\beta^+/\varepsilon$	3458	0.0	0+	2039.85	1+	3.84	20	8.137	28	
$^{170}\text{Lu}$	$\varepsilon$	3458	0.0	0+	2661.02	1+	0.29	5	8.73	8	
$^{170}\text{Lu}$	$\varepsilon$	3458	0.0	0+	2783.12	1+	1.60	9	7.834	39	
$^{170}\text{Lu}$	$\varepsilon$	3458	0.0	0+	2956.55	1+	0.501	25	8.055	45	
$^{170}\text{Lu}$	$\varepsilon$	3458	0.0	0+	2965.66	1+	2.32	13	7.371	47	
$^{170}\text{Lu}$	$\varepsilon$	3458	0.0	0+	3042.46	1+	0.21	4	8.25	10	
$^{170}\text{Lu}$	$\varepsilon$	3458	0.0	0+	3065.36	1+	0.34	8	7.98	11	
$^{170}\text{Lu}$	$\varepsilon$	3458	0.0	0+	3131.10	1+	0.23	5	7.97	11	
$^{170}\text{Lu}$	$\varepsilon$	3458	0.0	0+	3146.03	1+	0.49	3	7.59	7	
$^{170}\text{Lu}$	$\varepsilon$	3458	0.0	0+	3202.94	1+	0.46	12	7.40	14	
$^{170}\text{Lu}$	$\varepsilon$	3458	0.0	0+	3258.18	1+	0.27	4	7.36	13	
$^{170}\text{Lu}$	$\varepsilon$	3458	0.0	0+	3291.82	1+	0.19	5	7.30	18	
$^{170}\text{Lu}$	$\varepsilon$	3458	0.0	0+	3301.95	1+	0.37	5	6.93	17	
$^{170}\text{Hf}$	$\varepsilon$	1052	0.0	0+	98.49	1+	2.3	7	7.55	14	
$^{170}\text{Hf}$	$\varepsilon$	1052	0.0	0+	116.00	(1)+	3.4	10	7.37	13	
$^{170}\text{Hf}$	$\varepsilon$	1052	0.0	0+	198.37	1+	15	4	6.64	12	
$^{170}\text{Hf}$	$\varepsilon$	1052	0.0	0+	349.00	1+	1.2	4	7.55	15	
$^{170}\text{Hf}$	$\varepsilon$	1052	0.0	0+	785.46	1+	43	12	5.03	19	
$^{172}\text{Er}$	$\beta^-$	891.0	0.0	0+	610.062	1+	46.6	22	5.606	31	
$^{172}\text{Hf}$	$\varepsilon$	334	0.0	0+	109.41	(1)+	5.9	13	8.71	17	
$^{172}\text{Hf}$	$\varepsilon$	334	0.0	0+	179.85	(1)+	19	2	7.76	24	
$^{172}\text{Hf}$	$\varepsilon$	334	0.0	0+	191.60	(1)+	58	5	7.17	27	
$^{172}\text{Hf}$	$\varepsilon$	334	0.0	0+	232.33	(1)+	6.4	10	7.64	49	
$^{180}\text{Ta}$	$\varepsilon$	845.8	0.0	1+	0.0	0+	61	2	5.761	15	
$^{180}\text{Ta}$	$\beta^-$	702.6	0.0	1+	0.0	0+	11.1	15	6.89	6	
$^{182}\text{Pt}$	$\beta^+/\varepsilon$	2883	0.0	0+	210.97	1+	54	14	4.80	11	
$^{182}\text{Pt}$	$\beta^+/\varepsilon$	2883	0.0	0+	1002.36	1+	7.0	14	5.34	9	
$^{182}\text{Pt}$	$\beta^+/\varepsilon$	2883	0.0	0+	1024.87	(1)+	2.5	5	5.78	9	
$^{184}\text{Pt}$	$\beta^+/\varepsilon$	2278	0.0	0+	428.24	1+	3.0	10	6.51	15	
$^{184}\text{Pt}$	$\beta^+/\varepsilon$	2278	0.0	0+	478.73	(1)+	1.10	30	6.92	12	
$^{184}\text{Pt}$	$\beta^+/\varepsilon$	2278	0.0	0+	484.88	1+	3.63	10	6.396	22	
$^{184}\text{Pt}$	$\beta^+/\varepsilon$	2278	0.0	0+	903.84	1+	29.0	30	5.25	5	
$^{184}\text{Pt}$	$\beta^+/\varepsilon$	2278	0.0	0+	924.98	1+	2.61	17	6.281	38	
$^{184}\text{Pt}$	$\beta^+/\varepsilon$	2278	0.0	0+	1065.26	1+	11.5	8	5.537	41	
$^{184}\text{Pt}$	$\beta^+/\varepsilon$	2278	0.0	0+	1086.59	1+	23.3	15	5.214	39	
$^{184}\text{Hg}$	$\beta^+/\varepsilon$	3974	0.0	0+	306.90	1+	6.9	19	5.40	12	
$^{184}\text{Hg}$	$\beta^+/\varepsilon$	3974	0.0	0+	364.19	1+	3.6	10	5.66	12	
$^{184}\text{Hg}$	$\beta^+/\varepsilon$	3974	0.0	0+	490.91	1+	58	7	4.41	5	
$^{186}\text{Hg}$	$\beta^+/\varepsilon$	3176	0.0	0+	363.61	1+	82	8	4.45	5	
$^{188}\text{Hg}$	$\beta^+/\varepsilon$	2173	0.0	0+	82.7	1+	65.0	40	4.624	34	
$^{188}\text{Hg}$	$\beta^+/\varepsilon$	2173	0.0	0+	217.5	(1)+	1.21	14	6.29	5	
$^{188}\text{Hg}$	$\varepsilon$	2173	0.0	0+	1205.0	(1)+	1.02	15	5.72	7	
$^{190}\text{W}$	$\beta^-$	1214	0.0	0+	319.7	1+	99.7	3	5.11	7	
$^{192}\text{Hg}$	$\varepsilon$	761	0.0	0+	306.47	1+	66	5	5.13	7	
$^{192}\text{Pb}$	$\beta^+/\varepsilon$	3320	0.0	0+	1195.46	1+	58	7	4.78	6	
$^{194}\text{Pb}$	$\beta^+/\varepsilon$	2730	0.0	0+	1519.33	1+	24.3	16	5.128	42	
$^{204}\text{Po}$	$\beta^+/\varepsilon$	2305	0.0	0+	895.70	1+	4.90	30	7.333	29	
$^{204}\text{Po}$	$\varepsilon$	2305	0.0	0+	1255.30	1+	11.2	5	6.700	25	
$^{206}\text{Po}$	$\varepsilon$	1840	0.0	0+	931.67	(1)+	19.3	5	8.106	18	
$^{206}\text{Po}$	$\varepsilon$	1840	0.0	0+	1389.42	(1)+	74.1	13	6.830	26	
$^{206}\text{Po}$	$\varepsilon$	1840	0.0	0+	1523.58	(1)+	0.75	3	8.444	40	

**Table 8**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
$^{206}\text{Po}$	$\varepsilon$	1840	0.0	0+	1600.15	(1)+	0.97	3	8.01	5	
$^{210}\text{Rn}$	$\varepsilon$	2367	0.0	0+	1488.59	(1)+	1.6	1	7.277	35	
$^{210}\text{Rn}$	$\varepsilon$	2367	0.0	0+	1525.52	(1)+	1.9	1	7.162	32	
$^{214}\text{Pb}$	$\beta^-$	1018	0.0	0+	838.994	1+	2.75	8	4.53	9	
$^{244}\text{Am}$	$\beta^-$	1427.3	89.5	1+	984.914	0+	1.5	3	6.67	10	

15.3.  $\Delta J=0$ ,  $\Delta\pi=no$ ,  $\log ft \geq 4$ , not  $0^+ \rightarrow 0^+$

**Table 9**

List of allowed transitions with  $\Delta J=0$  and  $\Delta\pi=no$ , but also  $\log ft \geq 4$ , and not  $0^+ \rightarrow 0^+$ .

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	$\log ft$	Unc.	Pand.
<sup>8</sup> Li	$\beta^-$	1.600413E4	0.	2+	3030	2+	100		5.5933	16	
<sup>9</sup> Li	$\beta^-$	1.360645E4	0.0	3/2-	0.0	3/2-	40.9	54	5.41	5	
<sup>9</sup> Li	$\beta^-$	1.360645E4	0.0	3/2-	2830	3/2-	9.3	10	5.566	48	
<sup>9</sup> Li	$\beta^-$	1.360645E4	0.0	3/2-	7940	3/2-	6.79	76	4.39	6	
<sup>11</sup> Li	$\beta^-$	2.05511E4	0.0	3/2-	2654	3/2-	17	4	5.06	10	
<sup>11</sup> Li	$\beta^-$	2.05511E4	0.0	3/2-	8020	3/2-	15.5	31	4.35	9	
<sup>11</sup> Li	$\beta^-$	2.05511E4	0.0	3/2-	8813	3/2-	8.9	14	4.45	7	
<sup>11</sup> Be	$\beta^-$	1.150946E4	0.0	1/2+	6791.80	1/2+	6.47	45	5.937	30	
<sup>13</sup> B	$\beta^-$	1.34369E4	0.0	3/2-	3684.507	3/2-	7.6	8	4.454	46	P
<sup>15</sup> C	$\beta^-$	9771.7	0.0	1/2+	5298.822	1/2+	63.2	8	4.114	6	
<sup>16</sup> N	$\beta^-$	1.04209E4	0.0	2-	8871.9	2-	1.06	7	4.356	29	
<sup>17</sup> N	$\beta^-$	8679	0.0	1/2-	5931.6	1/2-	6.69	31	4.385	23	
<sup>17</sup> Ne	$\beta+\epsilon$	1.454875E4	0.0	1/2-	6037	1/2-	7.80	20	4.555	12	
<sup>18</sup> N	$\beta^-$	1.3896E4	0.0	1-	4455.52	1-	47.2	9	5.168	9	
<sup>18</sup> N	$\beta^-$	1.3896E4	0.0	1-	6198.22	1-	1.2	2	6.34	7	
<sup>18</sup> N	$\beta^-$	1.3896E4	0.0	1-	7620	1-	6.8	5	5.174	33	
<sup>18</sup> N	$\beta^-$	1.3896E4	0.0	1-	8040	1-	1.8	2	5.612	49	
<sup>19</sup> O	$\beta^-$	4820.3	0.0	5/2+	197.143	5/2+	45.4	15	5.379	14	
<sup>20</sup> F	$\beta^-$	7024.469	0.0	2+	1633.674	2+	99.9914	6	4.97926	31	
<sup>20</sup> Na	$\beta+\epsilon$	1.38924E4	0.0	2+	1633.674	2+	79.44	27	4.9906	27	
<sup>20</sup> Na	$\beta+\epsilon$	1.38924E4	0.0	2+	7421.9	2+	15.96	22	4.201	6	
<sup>21</sup> F	$\beta^-$	5684.2	0.0	5/2+	350.727	5/2+	74.1	22	4.659	13	
<sup>21</sup> Mg	$\beta+\epsilon$	1.30887E4	0.0	5/2+	331.93	5/2+	41	5	4.80	5	P
<sup>21</sup> Mg	$\beta+\epsilon$	1.30887E4	0.0	5/2+	4294	5/2+	5.40	30	4.822	26	P
<sup>22</sup> Al	$\beta+\epsilon$	1.860E4	0.0	(4)+	6307	4+	4.7	6	5.52	10	P
<sup>23</sup> O	$\beta^-$	1.134E4	0.0	1/2+	2244	(1/2)+	45.8	16	4.308	49	P
<sup>23</sup> Ne	$\beta^-$	4375.81	0.0	5/2+	440.3	5/2+	31.9	10	5.386	14	P
<sup>24</sup> Na	$\beta^-$	5515.677	0.0	4+	4122.889	4+	99.855	5	6.12436	12	
<sup>24</sup> Al	$\beta+\epsilon$	1.388477E4	0.0	4+	4122.889	4+	7.7	10	6.13	6	
<sup>24</sup> Al	$\beta+\epsilon$	1.388477E4	0.0	4+	6010.84	4+	1.20	10	6.435	36	
<sup>24</sup> Al	$\beta+\epsilon$	1.388477E4	0.0	4+	9301.15	4+	2.50	20	4.805	35	
<sup>25</sup> Ne	$\beta^-$	7322	0.0	1/2+	1069.32	1/2+	19.5	20	4.731	46	P
<sup>25</sup> Na	$\beta^-$	3835.0	0.0	5/2+	0.0	5/2+	62.5	20	5.257	15	P
<sup>25</sup> Si	$\beta+\epsilon$	1.2743E4	0.0	5/2+	0.0	5/2+	25	7	5.25	12	P
<sup>25</sup> Si	$\beta+\epsilon$	1.2743E4	0.0	5/2+	4582	5/2+	3.20	30	5.115	41	P
<sup>25</sup> Si	$\beta+\epsilon$	1.2743E4	0.0	5/2+	5802	5/2+	1.70	10	5.008	26	P
<sup>26</sup> Na	$\beta^-$	9353.8	0.0	3+	3941.48	3+	1.31	4	5.875	13	
<sup>26</sup> Na	$\beta^-$	9353.8	0.0	3+	4350.02	3+	3.17	7	5.334	10	
<sup>26</sup> Na	$\beta^-$	9353.8	0.0	3+	6125.00	3+	1.72	4	4.742	10	
<sup>27</sup> Na	$\beta^-$	9068.8	0.0	5/2+	1698.06	5/2+	11.3	7	5.012	28	P
<sup>27</sup> Mg	$\beta^-$	2610.27	0.0	1/2+	843.76	1/2+	70.94	9	4.7341	14	
<sup>28</sup> Na	$\beta^-$	1.4032E4	0.0	1+	4561.0	1+	3.2	4	5.08	5	P
<sup>28</sup> Na	$\beta^-$	1.4032E4	0.0	1+	5270.1	1+	1.5	5	5.25	14	P
<sup>28</sup> P	$\beta+\epsilon$	1.43449E4	0.0	3+	6276.40	3+	7.60	40	4.794	23	
<sup>28</sup> P	$\beta+\epsilon$	1.43449E4	0.0	3+	7799.21	3+	2.44	9	4.793	16	
<sup>28</sup> P	$\beta+\epsilon$	1.43449E4	0.0	3+	8588.80	3+	3.64	11	4.309	13	
<sup>29</sup> Mg	$\beta^-$	7595.40	0.0	3/2+	2224.1	3/2+	21	6	4.75	13	P
<sup>29</sup> Mg	$\beta^-$	7595.40	0.0	3/2+	2865.6	3/2+	7.8	15	4.93	9	P
<sup>29</sup> Al	$\beta^-$	3687.32	0.0	5/2+	2028.17	5/2+	3.8	1	5.748	12	
<sup>30</sup> Na	$\beta^-$	1.73560E4	0.0	2+	1483.1	2+	5	1	6.13	9	P
<sup>30</sup> Na	$\beta^-$	1.73560E4	0.0	2+	5094.8	2+	7.1	8	5.43	5	P

**Table 9**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
<sup>30</sup> Na	$\beta^-$	1.73560E4	0.0	2+	5413.1	2+	7.8	9	5.34	5	P
<sup>30</sup> Al	$\beta^-$	8568.8	0.0	3+	4830.84	3+	6.6	2	4.995	15	P
<sup>30</sup> Al	$\beta^-$	8568.8	0.0	3+	5231.56	3+	2.6	2	5.180	34	P
<sup>31</sup> Na	$\beta^-$	1.5368E4	0.0	3/2+	673.08	3/2+	6	1	5.46	7	P
<sup>31</sup> Cl	$\beta^+/\epsilon$	1.20080E4	0.0	3/2+	4207.69	(3/2)+	4.15	27	4.809	28	P
<sup>31</sup> Cl	$\beta^+/\epsilon$	1.20080E4	0.0	3/2+	4519.71	3/2+	1.13	9	5.278	35	P
<sup>31</sup> Cl	$\beta^+/\epsilon$	1.20080E4	0.0	3/2+	6390.23	3/2+	3.38	12	4.114	16	P
<sup>32</sup> Cl	$\beta^+/\epsilon$	1.26808E4	0.0	1+	4695.5	1+	6.10	9	4.892	7	
<sup>33</sup> Ar	$\beta^+/\epsilon$	1.16190E4	0.0	1/2+	810.63	1/2+	41.0	8	4.522	10	
<sup>33</sup> Ar	$\beta^+/\epsilon$	1.16190E4	0.0	1/2+	4441	1/2+	2.375	20	4.807	6	
<sup>35</sup> P	$\beta^-$	3988.4	0.0	1/2+	1572.29	1/2+	98.80	3	4.129	7	
<sup>35</sup> S	$\beta^-$	167.322	0.0	3/2+	0.0	3/2+	100		5.02107	30	
<sup>35</sup> K	$\beta^+/\epsilon$	1.18744E4	0.0	3/2+	0.0	3/2+	19.0	40	5.08	9	P
<sup>36</sup> P	$\beta^-$	1.0413E4	0.0	4-	5021.5	4-	10.7	7	5.721	37	P
<sup>36</sup> K	$\beta^+/\epsilon$	1.281436E4	0.0	2+	1970.84	2+	44.0	40	4.786	40	
<sup>36</sup> K	$\beta^+/\epsilon$	1.281436E4	0.0	2+	4441.54	2+	8.4	10	4.91	5	
<sup>37</sup> S	$\beta^-$	4865.13	0.0	7/2-	3103.510	7/2-	94.0	6	4.3908	33	
<sup>37</sup> Ar	$\epsilon$	813.87	0.0	3/2+	0.0	3/2+	100		5.101	5	
<sup>39</sup> Cl	$\beta^-$	3442	0.0	3/2+	1517.540	3/2+	83	3	5.665	17	
<sup>40</sup> Sc	$\beta^+/\epsilon$	1.43230E4	0.0	4-	5613.1	4-	12.0	30	4.56	11	
<sup>41</sup> Ar	$\beta^-$	2492.04	0.0	7/2-	1293.64	7/2-	99.16	2	5.0551	5	
<sup>41</sup> Ti	$\beta^+/\epsilon$	1.2945E4	0.0	3/2+	2095	3/2+	5.30	30	5.065	25	P
<sup>41</sup> Ti	$\beta^+/\epsilon$	1.2945E4	0.0	3/2+	3560	3/2+	2.40	20	5.075	37	P
<sup>41</sup> Ti	$\beta^+/\epsilon$	1.2945E4	0.0	3/2+	4776	3/2+	2.10	30	4.81	6	P
<sup>41</sup> Ti	$\beta^+/\epsilon$	1.2945E4	0.0	3/2+	5581	3/2+	1.75	10	4.647	27	P
<sup>43</sup> K	$\beta^-$	1833.48	0.0	3/2+	990.257	3/2+	90.9	6	5.6046	36	
<sup>43</sup> Sc	$\beta^+/\epsilon$	2220.7	0.0	7/2-	0.0	7/2-	77.5	7	5.051	5	
<sup>44</sup> Sc	$\beta^+/\epsilon$	3652.7	0.0	2+	1157.039	2+	98.970	20	5.3257	22	
<sup>44</sup> Sc	$\epsilon$	3652.7	0.0	2+	2656.530	2+	1.02	2	5.177	12	
<sup>44</sup> Sc	$\epsilon$	3652.7	271.240	6+	3285.00	6+	1.20	7	5.880	27	
<sup>44</sup> V	$\beta^+/\epsilon$	1.3741E4	0.0	(2)+	2530.98	2+	23.0	30	4.63	6	P
<sup>44</sup> V	$\beta^+/\epsilon$	1.3741E4	0.0	(2)+	4115.3	2+	14.7	22	4.47	7	P
<sup>45</sup> K	$\beta^-$	4196.6	0.0	3/2+	1879.90	3/2+	51	4	5.746	37	
<sup>45</sup> Ti	$\beta^+/\epsilon$	2062.1	0.0	7/2-	0.0	7/2-	99.685	17	4.6000	19	
<sup>46</sup> K	$\beta^-$	7725.7	0.0	2-	5051.96	2-	39.7	13	5.078	14	
<sup>46</sup> Sc	$\beta^-$	2366.6	0.0	4+	2009.846	4+	99.9964	7	6.2108	29	
<sup>47</sup> K	$\beta^-$	6632.7	0.0	1/2+	2599.52	1/2+	80	2	4.816	11	
<sup>47</sup> Ca	$\beta^-$	1992.2	0.0	7/2-	0.0	7/2-	17.7	5	8.507	12	
<sup>47</sup> Sc	$\beta^-$	600.8	0.0	7/2-	159.381	7/2-	68.4	6	5.298	8	
<sup>48</sup> Sc	$\beta^-$	3988.9	0.0	6+	3333.208	6+	90.12	22	5.528	12	
<sup>48</sup> Sc	$\beta^-$	3988.9	0.0	6+	3508.569	6+	9.88	22	6.002	19	
<sup>48</sup> V	$\beta^+/\epsilon$	4014.9	0.0	4+	2295.658	4+	89.50	30	6.1809	27	
<sup>48</sup> V	$\epsilon$	4014.9	0.0	4+	3239.797	4+	7.871	7	6.1756	46	
<sup>49</sup> Ca	$\beta^-$	5262.4	0.0	3/2-	3084.52	3/2-	90.20	5	5.0883	20	
<sup>49</sup> Sc	$\beta^-$	2001.6	0.0	7/2-	0.0	7/2-	99.94	1	5.7210	23	
<sup>49</sup> Cr	$\beta^+/\epsilon$	2629.8	0.0	5/2-	90.6391	5/2-	37.3	14	5.032	17	
<sup>50</sup> Sc	$\beta^-$	6894.7	0.0	5+	4880.4	5+	1.445	32	6.048	10	
<sup>51</sup> Sc	$\beta^-$	6482.6	0.0	(7/2)-	1437.3	7/2-	27.5	6	5.599	10	P
<sup>51</sup> Sc	$\beta^-$	6482.6	0.0	(7/2)-	2691.4	7/2-	2.03	18	6.171	39	P
<sup>51</sup> Ti	$\beta^-$	2470.14	0.0	3/2-	928.63	3/2-	8.1	4	5.363	21	
<sup>51</sup> Cr	$\epsilon$	752.39	0.0	7/2-	0.0	7/2-	90.070	10	5.397	6	
<sup>52</sup> Mn	$\beta^+/\epsilon$	4708.12	0.0	6+	3113.883	6+	90.8	8	5.5626	41	
<sup>52</sup> Mn	$\beta^+/\epsilon$	4708.12	377.749	2+	1434.083	2+	99.7	5	5.3182	47	

**Table 9**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
$^{53}\text{Ti}$	$\beta^-$	4970.2		0.0 (3/2)-	1549.6	(3/2)-	10	3	5.72	13	P
$^{53}\text{Ti}$	$\beta^-$	4970.2		0.0 (3/2)-	2084.0	(3/2)-	6.7	7	5.566	47	P
$^{53}\text{Ti}$	$\beta^-$	4970.2		0.0 (3/2)-	2584.0	(3/2)-	15.0	14	4.860	42	P
$^{53}\text{Ti}$	$\beta^-$	4970.2		0.0 (3/2)-	2930.5	(3/2)-	1.0	3	5.75	13	P
$^{53}\text{Fe}$	$\beta^+/\epsilon$	3742.9		0.0 7/2-	0.0	7/2-	56	8	5.23	6	
$^{55}\text{Co}$	$\beta^+/\epsilon$	3451.43		0.0 7/2-	1316.62	7/2-	5.60	40	6.737	31	
$^{55}\text{Co}$	$\beta^+/\epsilon$	3451.43		0.0 7/2-	1408.50	7/2-	36.4	23	5.796	27	
$^{56}\text{Co}$	$\beta^+/\epsilon$	4566.65		0.0 4+	2085.1045	4+	20.8	16	8.633	33	
$^{56}\text{Co}$	$\beta^+/\epsilon$	4566.65		0.0 4+	3122.970	4+	10.05	6	7.5871	35	
$^{56}\text{Co}$	$\epsilon$	4566.65		0.0 4+	4100.363	4+	12.66	4	6.4479	34	
$^{56}\text{Co}$	$\epsilon$	4566.65		0.0 4+	4298.096	4+	3.688	13	6.4956	40	
$^{56}\text{Co}$	$\epsilon$	4566.65		0.0 4+	4458.406	4+	0.209	7	6.922	16	
$^{57}\text{Mn}$	$\beta^-$	2695.7		0.0 5/2-	136.47376	5/2-	11.5	5	5.575	20	
$^{57}\text{Mn}$	$\beta^-$	2695.7		0.0 5/2-	706.445	5/2-	4.67	20	5.504	20	
$^{57}\text{Ni}$	$\beta^+/\epsilon$	3261.7		0.0 3/2-	1377.666	3/2-	64.5	22	5.649	15	
$^{57}\text{Ni}$	$\beta^+/\epsilon$	3261.7		0.0 3/2-	1757.608	3/2-	5.66	21	6.230	16	
$^{57}\text{Ni}$	$\epsilon$	3261.7		0.0 3/2-	3108.17	(3/2)-	0.060	3	6.120	22	
$^{58}\text{Co}$	$\beta^+/\epsilon$	2308.0		0.0 2+	810.7666	2+	98.80	20	6.6129	28	
$^{58}\text{Co}$	$\epsilon$	2308.0		0.0 2+	1674.736	2+	1.21	2	7.699	8	
$^{58}\text{Cu}$	$\beta^+/\epsilon$	8561.02		0.0 1+	2902.86	1+	4.6	14	5.14	13	P
$^{59}\text{Mn}$	$\beta^-$	5139.6		0.0 5/2-	472.72	5/2-	21	4	5.18	8	P
$^{59}\text{Mn}$	$\beta^-$	5139.6		0.0 5/2-	570.75	5/2-	10.9	20	5.43	8	P
$^{59}\text{Fe}$	$\beta^-$	1564.88		0.0 3/2-	1099.257	3/2-	53.1	15	6.708	12	
$^{59}\text{Fe}$	$\beta^-$	1564.88		0.0 3/2-	1291.601	3/2-	45.3	11	5.993	11	
$^{59}\text{Cu}$	$\beta^+/\epsilon$	4798.38		0.0 3/2-	0.0	3/2-	58.10	40	5.0418	40	P
$^{59}\text{Cu}$	$\beta^+/\epsilon$	4798.38		0.0 3/2-	878.00	3/2-	8.80	40	5.347	20	P
$^{59}\text{Cu}$	$\beta^+/\epsilon$	4798.38		0.0 3/2-	1734.67	3/2-	2.000	40	5.331	9	P
$^{60}\text{Mn}$	$\beta^-$	8445.2	271.21	4+	3072.01	4+	3.2	5	5.96	7	P
$^{60}\text{Cu}$	$\beta^+/\epsilon$	6128.0		0.0 2+	2158.95	2+	15.3	12	6.380	35	
$^{60}\text{Cu}$	$\beta^+/\epsilon$	6128.0		0.0 2+	3124.16	2+	52.3	24	5.101	21	
$^{60}\text{Cu}$	$\beta^+/\epsilon$	6128.0		0.0 2+	3269.48	2+	4.99	23	5.983	21	
$^{61}\text{Co}$	$\beta^-$	1323.9		0.0 7/2-	917.5	(7/2)-	4.4	4	4.794	40	
$^{61}\text{Cu}$	$\beta^+/\epsilon$	2238.0		0.0 3/2-	0.0	3/2-	67	6	5.088	39	
$^{61}\text{Cu}$	$\beta^+/\epsilon$	2238.0		0.0 3/2-	1185.239	3/2-	4.3	8	5.00	8	
$^{61}\text{Zn}$	$\beta^+/\epsilon$	5635		0.0 3/2-	0.0	3/2-	66.7	17	5.411	13	P
$^{61}\text{Zn}$	$\beta^+/\epsilon$	5635		0.0 3/2-	1660.44	3/2-	11.1	7	5.316	29	P
$^{61}\text{Zn}$	$\beta^+/\epsilon$	5635		0.0 3/2-	2358.13	3/2-	1.36	9	5.717	32	P
$^{61}\text{Zn}$	$\beta^+/\epsilon$	5635		0.0 3/2-	2472.50	3/2-	1.37	9	5.618	32	P
$^{61}\text{Zn}$	$\beta^+/\epsilon$	5635		0.0 3/2-	2683.96	3/2-	1.49	10	5.392	33	P
$^{61}\text{Ga}$	$\beta^+/\epsilon$	9214		0.0 3/2-	418.3	3/2-	1.30	40	5.44	13	P
$^{62}\text{Co}$	$\beta^-$	5322		0.0 (2)+	1172.9	2+	66.7	11	5.782	31	P
$^{62}\text{Co}$	$\beta^-$	5322		0.0 (2)+	2301.8	2+	24.3	8	5.613	34	P
$^{62}\text{Co}$	$\beta^-$	5322		0.0 (2)+	3158.0	2+	2.8	6	5.93	10	P
$^{62}\text{Co}$	$\beta^-$	5322		0.0 (2)+	3518.7	2+	1.7	3	5.82	8	P
$^{63}\text{Zn}$	$\beta^+/\epsilon$	3366.4		0.0 3/2-	0.0	3/2-	84.0	7	5.4123	39	
$^{65}\text{Ni}$	$\beta^-$	2137.9		0.0 5/2-	1115.55	5/2-	10.18	13	6.078	6	
$^{65}\text{Zn}$	$\epsilon$	1351.65		0.0 5/2-	1115.549	5/2-	50.04	10	5.897	9	
$^{65}\text{Ga}$	$\beta^+/\epsilon$	3254.5		0.0 3/2-	115.126	3/2-	62	15	4.95	11	P
$^{65}\text{Ga}$	$\beta^+/\epsilon$	3254.5		0.0 3/2-	206.95	3/2-	11.1	23	5.62	9	P
$^{65}\text{Ga}$	$\beta^+/\epsilon$	3254.5		0.0 3/2-	1469.80	3/2-	1.40	30	5.11	9	P
$^{67}\text{Ga}$	$\epsilon$	1001.2		0.0 3/2-	184.576	3/2-	22.71	9	5.520	14	
$^{67}\text{Ga}$	$\epsilon$	1001.2		0.0 3/2-	393.527	3/2-	23.6	3	5.243	15	
$^{67}\text{Ge}$	$\beta^+/\epsilon$	4205.4		0.0 1/2-	167.01	1/2-	76	5	5.617	30	

**Table 9**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
<sup>67</sup> Ge	$\beta+\epsilon$	4205.4	0.0	1/2-	1081.64	1/2-	3.80	40	6.241	46	
<sup>68</sup> As	$\beta+\epsilon$	8084.3	0.0	3+	2429.5	3+	36.3	20	5.898	24	P
<sup>68</sup> Cu	$\beta-$	4440.1	721.26	6-	3610.8	(6)-	6.3	17	5.41	12	P
<sup>69</sup> Cu	$\beta-$	2681.7	0.0	3/2-	834.46	(3/2)-	8.8	15	5.45	8	
<sup>69</sup> Cu	$\beta-$	2681.7	0.0	3/2-	1828.01	3/2-	1.8	3	4.83	8	
<sup>69</sup> Ge	$\beta+\epsilon$	2227.1	0.0	5/2-	574.12	5/2-	12.3	18	6.24	6	
<sup>69</sup> Ge	$\beta+\epsilon$	2227.1	0.0	5/2-	1106.78	5/2-	37.0	40	5.325	47	
<sup>69</sup> Ge	$\epsilon$	2227.1	0.0	5/2-	1723.35	5/2-	0.079	11	7.29	6	
<sup>69</sup> Ge	$\epsilon$	2227.1	0.0	5/2-	2023.68	5/2-	0.63	8	5.58	6	
<sup>69</sup> Ge	$\epsilon$	2227.1	0.0	5/2-	2044.9	5/2-	0.047	8	6.61	7	
<sup>69</sup> As	$\beta+\epsilon$	3988	0.0	5/2-	0.0	5/2-	75.8	9	5.488	22	
<sup>70</sup> As	$\beta+\epsilon$	6228.1	0.0	4+	2806.25	4+	1.30	40	7.39	13	
<sup>70</sup> As	$\beta+\epsilon$	6228.1	0.0	4+	3058.720	4+	38.8	21	5.715	24	
<sup>71</sup> Kr	$\beta+\epsilon$	1018E1	0.0	(5/2)-	407.12	(5/2)-	4.40	40	4.88	5	
<sup>71</sup> Zn	$\beta-$	2810.3	155.62	9/2+	1493.865	9/2+	85.3	12	6.023	7	
<sup>71</sup> As	$\beta+\epsilon$	2013.4	0.0	5/2-	174.948	5/2-	83.9	21	5.869	13	
<sup>71</sup> As	$\epsilon$	2013.4	0.0	5/2-	1026.572	5/2-	1.54	5	6.882	18	
<sup>71</sup> As	$\epsilon$	2013.4	0.0	5/2-	1212.499	5/2-	1.08	6	6.853	27	
<sup>72</sup> Ga	$\beta-$	3997.6	0.0	3-	2515.255	3-	9.18	4	7.5485	21	
<sup>72</sup> Ga	$\beta-$	3997.6	0.0	3-	2943.874	3-	1.953	16	7.6430	38	
<sup>72</sup> Ga	$\beta-$	3997.6	0.0	3-	3325.608	(3)-	22.43	5	5.8591	21	
<sup>72</sup> As	$\beta+\epsilon$	4343.60	0.0	2-	3035.73	2-	0.515	20	7.209	19	
<sup>72</sup> As	$\epsilon$	4343.60	0.0	2-	3341.83	(2)-	0.369	12	7.116	16	
<sup>73</sup> Kr	$\beta+\epsilon$	7094	0.0	(3/2)-	178.04	3/2-	8.8	25	6.24	12	
<sup>73</sup> Zn	$\beta-$	4105.9	0.0	1/2-	0.0	1/2-	86.6	30	5.115	16	P
<sup>73</sup> Ga	$\beta-$	1598.2	0.0	1/2-	66.75	1/2-	5.9	10	7.34	7	
<sup>73</sup> Ga	$\beta-$	1598.2	0.0	1/2-	1131.88	1/2-	7.2	3	5.333	19	
<sup>73</sup> Se	$\beta+\epsilon$	2725	0.0	9/2+	427.65	9/2+	97.3	10	5.377	10	
<sup>73</sup> Se	$\beta+\epsilon$	2725	25.71	3/2-	0.0	3/2-	15.4	11	5.617	37	
<sup>73</sup> Se	$\beta+\epsilon$	2725	25.71	3/2-	393.39	3/2-	1.22	11	6.312	44	
<sup>73</sup> Se	$\beta+\epsilon$	2725	25.71	3/2-	655.36	3/2-	1.85	16	5.842	42	
<sup>75</sup> Se	$\epsilon$	866.04	0.0	5/2+	400.6583	5/2+	96.2	6	6.1155	43	
<sup>75</sup> Br	$\beta+\epsilon$	3062.5	0.0	3/2-	286.55	3/2-	64.0	40	5.411	28	P
<sup>75</sup> Br	$\beta+\epsilon$	3062.5	0.0	3/2-	585.99	3/2-	1.72	19	6.683	49	P
<sup>75</sup> Br	$\beta+\epsilon$	3062.5	0.0	3/2-	859.44	3/2-	6.3	7	5.829	49	P
<sup>75</sup> Br	$\beta+\epsilon$	3062.5	0.0	3/2-	1245.26	3/2-	2.75	25	5.786	40	P
<sup>75</sup> Kr	$\beta+\epsilon$	4783	0.0	5/2+	132.50	(5/2)+	35.0	40	5.68	5	P
<sup>76</sup> Rb	$\beta+\epsilon$	8534.6	0.0	1-	2104.33	1-	5.7	5	6.373	39	
<sup>76</sup> Rb	$\beta+\epsilon$	8534.6	0.0	1-	2571.01	1-	15.50	40	5.759	13	
<sup>76</sup> Rb	$\beta+\epsilon$	8534.6	0.0	1-	3602.81	1-	5.9	6	5.717	45	
<sup>76</sup> As	$\beta-$	2960.6	0.0	2-	2669.875	2-	0.477	9	6.595	9	
<sup>77</sup> Kr	$\beta+\epsilon$	3065.4	0.0	5/2+	129.63	5/2+	49.5	23	5.540	21	P
<sup>77</sup> Rb	$\beta+\epsilon$	5339.0	0.0	3/2-	66.50	3/2-	28	5	6.00	8	P
<sup>77</sup> As	$\beta-$	683.2	0.0	3/2-	239.012	3/2-	1.6	2	6.86	5	
<sup>77</sup> As	$\beta-$	683.2	0.0	3/2-	520.653	3/2-	0.63	10	5.83	7	
<sup>77</sup> Br	$\beta+\epsilon$	1364.7	0.0	3/2-	238.95	3/2-	15.30	40	6.037	13	
<sup>77</sup> Br	$\epsilon$	1364.7	0.0	3/2-	520.58	3/2-	18.6	4	5.699	11	
<sup>77</sup> Br	$\epsilon$	1364.7	0.0	3/2-	1005.09	3/2-	4.46	5	5.562	12	
<sup>79</sup> Rb	$\beta+\epsilon$	3639.5	0.0	5/2+	290.52	5/2+	15.8	8	5.886	24	P
<sup>79</sup> Rb	$\beta+\epsilon$	3639.5	0.0	5/2+	752.03	5/2+	12.8	6	5.593	23	P
<sup>79</sup> As	$\beta-$	2281	0.0	3/2-	527.4	3/2-	1.10	11	6.827	44	
<sup>79</sup> As	$\beta-$	2281	0.0	3/2-	974.0	3/2-	1.77	17	6.111	43	
<sup>81</sup> Rb	$\beta+\epsilon$	2239	0.0	3/2-	636.85	3/2-	21.7	9	5.220	19	

**Table 9**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
$^{81}\text{Sr}$	$\beta+\varepsilon$	3929	0.0	1/2-	574.729	(1/2)-	8.5	11	6.14	6	P
$^{81}\text{As}$	$\beta$ -	3855.7	0.0	3/2-	467.69	3/2-	17.89	11	5.609	11	
$^{81}\text{As}$	$\beta$ -	3855.7	0.0	3/2-	1406.18	3/2-	1.44	7	6.099	24	
$^{82}\text{Rb}$	$\beta+\varepsilon$	4404.0	69.0	5-	3011.25	(5)-	4.98	11	5.905	11	
$^{83}\text{Se}$	$\beta$ -	3673.2	0.0	9/2+	1092.138	9/2+	4.1	6	7.36	6	
$^{83}\text{Se}$	$\beta$ -	3673.2	0.0	9/2+	2738.382	(9/2)+	16.4	2	4.997	10	
$^{83}\text{Rb}$	$\varepsilon$	920.0	0.0	5/2-	561.9586	5/2-	61	4	6.061	30	
$^{83}\text{Rb}$	$\varepsilon$	920.0	0.0	5/2-	690.53	5/2-	0.137	17	8.31	6	
$^{83}\text{Sr}$	$\beta+\varepsilon$	2273	0.0	7/2+	804.77	(7/2)+	25.9	22	5.91	6	
$^{85}\text{Y}$	$\beta+\varepsilon$	3261	19.8	(9/2)+	0.0	9/2+	60.0	40	6.361	37	
$^{85}\text{Y}$	$\beta+\varepsilon$	3261	19.8	(9/2)+	1261.99	9/2+	1.30	14	6.90	5	
$^{85}\text{Kr}$	$\beta$ -	687.0	0.0	9/2+	513.999	9/2+	0.434	10	9.528	19	
$^{85}\text{Sr}$	$\varepsilon$	1064.1	0.0	9/2+	514.0084	9/2+	96	4	6.14	5	
$^{87}\text{Nb}$	$\beta+\varepsilon$	5473	0.0	(1/2)-	336.4	1/2-	100.		5.357	12	
$^{87}\text{Y}$	$\beta+\varepsilon$	1861.7	0.0	1/2-	388.5276	1/2-	6.6	7	6.972	47	
$^{87}\text{Y}$	$\beta+\varepsilon$	1861.7	380.82	9/2+	0.0	9/2+	1.57	11	7.462	31	
$^{87}\text{Zr}$	$\beta+\varepsilon$	3671.2	0.0	9/2+	380.79	9/2+	94.32	15	5.7124	42	
$^{88}\text{Rb}$	$\beta$ -	5312.62	0.0	2-	4514.017	2-	2.319	22	5.5532	42	
$^{89}\text{Rb}$	$\beta$ -	4497	0.0	3/2-	2570.08	(3/2)-	3.3	9	6.81	12	
$^{89}\text{Rb}$	$\beta$ -	4497	0.0	3/2-	3227.89	(3/2)-	35.7	14	5.056	19	
$^{89}\text{Zr}$	$\beta+\varepsilon$	2833.2	0.0	9/2+	909.15	9/2+	98.95	5	6.1705	41	
$^{89}\text{Zr}$	$\varepsilon$	2833.2	0.0	9/2+	2622.2	9/2+	0.745	13	6.201	18	
$^{90}\text{Nb}$	$\beta+\varepsilon$	6111.0	0.0	8+	3589.409	8+	87.0	30	6.048	15	
$^{90}\text{Nb}$	$\varepsilon$	6111.0	0.0	8+	5164.48	(8)+	1.017	24	6.730	13	
$^{91}\text{Tc}$	$\beta+\varepsilon$	6222	0.0	(9/2)+	0.0	9/2+	42	10	6.12	10	P
$^{91}\text{Tc}$	$\beta+\varepsilon$	6222	0.0	(9/2)+	1902.49	9/2+	2.7	7	6.43	11	P
$^{91}\text{Tc}$	$\beta+\varepsilon$	6222	0.0	(9/2)+	2233.70	9/2+	1.20	30	6.58	11	P
$^{91}\text{Tc}$	$\beta+\varepsilon$	6222	0.0	(9/2)+	2450.99	9/2+	22.0	40	5.18	8	P
$^{91}\text{Tc}$	$\beta+\varepsilon$	6222	139.3	(1/2)-	652.94	1/2-	44	7	5.91	7	P
$^{91}\text{Mo}$	$\beta+\varepsilon$	4429	0.0	9/2+	0.0	9/2+	99.13	5	5.6185	38	
$^{92}\text{Nb}$	$\beta+\varepsilon$	2005.7	135.5	(2)+	934.48	2+	97.36	11	6.186	7	
$^{92}\text{Nb}$	$\varepsilon$	2005.7	135.5	(2)+	1847.22	2+	2.64	11	6.490	21	
$^{92}\text{Tc}$	$\beta+\varepsilon$	7882.9	0.0	(8)+	2760.0	8+	90	6	5.451	33	
$^{93}\text{Ru}$	$\beta+\varepsilon$	6389.4	0.0	(9/2)+	0.0	9/2+	90.9	6	5.341	5	
$^{93}\text{Tc}$	$\beta+\varepsilon$	3201.0	0.0	9/2+	1477.16	9/2+	8.5	5	5.728	28	
$^{93}\text{Tc}$	$\varepsilon$	3201.0	0.0	9/2+	2901.87	(9/2)+	1.68	7	4.828	22	
$^{94}\text{Tc}$	$\beta+\varepsilon$	4255.7	76	(2)+	871.098	2+	80.40	40	5.627	9	
$^{94}\text{Tc}$	$\beta+\varepsilon$	4255.7	76	(2)+	1864.31	2+	1.84	17	6.479	41	
$^{94}\text{Tc}$	$\beta+\varepsilon$	4255.7	76	(2)+	2393.02	2+	5.00	30	5.613	28	
$^{95}\text{Rh}$	$\beta+\varepsilon$	5117	0.0	(9/2)+	1352.00	9/2+	8.0	8	5.826	45	
$^{95}\text{Rh}$	$\beta+\varepsilon$	5117	0.0	(9/2)+	3779.2	(9/2)+	1.55	14	4.780	41	
$^{95}\text{Tc}$	$\varepsilon$	1691	0.0	9/2+	947.676	9/2+	1.582	23	6.538	14	
$^{95}\text{Ru}$	$\beta+\varepsilon$	2564	0.0	5/2+	626.91	5/2+	7.4	6	5.759	37	
$^{95}\text{Ru}$	$\beta+\varepsilon$	2564	0.0	5/2+	1433.28	5/2+	24.0	10	4.693	23	
$^{95}\text{Ru}$	$\varepsilon$	2564	0.0	5/2+	1747.05	(5/2)+	4.27	24	5.154	30	
$^{96}\text{Y}$	$\beta$ -	7109	1140	8+	4389.8	8+	80.9	96	4.75	6	P
$^{96}\text{Nb}$	$\beta$ -	3192.06	0.0	6+	2440.803	6+	2.3	3	7.43	6	
$^{96}\text{Tc}$	$\varepsilon$	2973	0.0	7+	2875.35	7+	0.80	5	5.64	7	
$^{96}\text{Rh}$	$\beta+\varepsilon$	6393	0.0	6+	2149.76	6+	10.3	24	6.30	10	
$^{96}\text{Rh}$	$\beta+\varepsilon$	6393	0.0	6+	2891.67	6+	27.7	8	5.406	15	
$^{97}\text{Ru}$	$\varepsilon$	1104	0.0	5/2+	324.491	5/2+	11.01	14	6.319	12	
$^{97}\text{Ru}$	$\varepsilon$	1104	0.0	5/2+	785.030	5/2+	1.115	14	6.506	20	
$^{97}\text{Rh}$	$\beta+\varepsilon$	3523	0.0	9/2+	878.76	(9/2)+	5.6	6	5.95	5	



**Table 9**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
<sup>97</sup> Rh	$\beta+\epsilon$	3523	0.0	9/2+	1229.42	9/2+	3.40	30	5.890	45	
<sup>97</sup> Rb	$\beta-$	1.00615E4	0.0	3/2+	585.06	(3/2)+	14.7	12	5.476	35	P
<sup>98</sup> Nb	$\beta-$	4591	84	(5)+	2506.34	5+	2.4	2	7.753	37	
<sup>99</sup> Rh	$\epsilon$	2041	64.3	9/2+	1277.3	9/2+	3.2	2	5.788	37	
<sup>99</sup> Pd	$\beta+\epsilon$	3402	0.0	(5/2)+	463.9	(5/2)+	8.7	18	5.84	9	
<sup>99</sup> Pd	$\beta+\epsilon$	3402	0.0	(5/2)+	874.0	(5/2)+	4.2	10	5.84	10	
<sup>99</sup> Ag	$\beta+\epsilon$	5470	0.0	(9/2)+	832.45	(9/2)+	7.3	10	5.98	6	P
<sup>99</sup> Ag	$\beta+\epsilon$	5470	0.0	(9/2)+	1102.78	(9/2)+	5.0	5	6.005	45	P
<sup>99</sup> Ag	$\beta+\epsilon$	5470	0.0	(9/2)+	1540.42	(9/2)+	6.3	8	5.65	6	P
<sup>99</sup> Mo	$\beta-$	1357.8	0.0	1/2+	920.637	1/2+	16.4	3	6.233	9	
<sup>100</sup> Rh	$\beta+\epsilon$	3636	0.0	1-	2516.824	1-	1.313	13	7.082	18	
<sup>100</sup> Ag	$\beta+\epsilon$	7075	15.52	(2)+	665.69	2+	37	8	6.09	10	P
<sup>101</sup> Pd	$\beta+\epsilon$	1980.3	0.0	5/2+	478.15	(5/2)+	11.6	10	6.058	38	
<sup>101</sup> Nb	$\beta-$	4628.5	0.0	(5/2)+	454.4	5/2+	5.5	16	5.97	13	P
<sup>102</sup> Rh	$\epsilon$	2323	140	6+	1873.22	6+	35	2	8.290	27	
<sup>102</sup> Ag	$\beta+\epsilon$	5656	9.2	2+	1534.6	2+	4.1	12	6.53	13	P
<sup>103</sup> Tc	$\beta-$	2663	0.0	5/2+	136.079	5/2+	10.1	17	5.69	7	
<sup>103</sup> Tc	$\beta-$	2663	0.0	5/2+	501.06	(5/2)+	3.6	5	5.85	6	
<sup>103</sup> Ru	$\beta-$	764.5	0.0	3/2+	651.798	(3/2)+	0.110	5	7.720	34	
<sup>103</sup> Pd	$\epsilon$	574.7	0.0	5/2+	536.832	5/2+	0.0040	2	7.41	11	
<sup>103</sup> Ag	$\beta+\epsilon$	2654.3	0.0	7/2+	243.93	7/2+	5.50	40	6.144	32	
<sup>103</sup> Ag	$\beta+\epsilon$	2654.3	0.0	7/2+	531.93	7/2+	7.2	7	5.817	43	
<sup>103</sup> Cd	$\beta+\epsilon$	4151.1	0.0	(5/2)+	1461.80	(5/2)+	8.2	11	5.24	6	P
<sup>104</sup> Ag	$\beta+\epsilon$	4278.7	6.9	2+	555.81	2+	70.0	40	5.691	36	
<sup>104</sup> Ag	$\beta+\epsilon$	4278.7	6.9	2+	1341.68	2+	1.70	40	6.76	11	
<sup>105</sup> In	$\beta+\epsilon$	4693	0.0	9/2+	771.00	9/2+	8.1	18	5.93	10	P
<sup>105</sup> In	$\beta+\epsilon$	4693	0.0	9/2+	832.52	9/2+	6.3	11	6.01	8	P
<sup>105</sup> Ru	$\beta-$	1916.7	0.0	3/2+	469.369	3/2+	3.06	18	7.713	26	
<sup>105</sup> Ru	$\beta-$	1916.7	0.0	3/2+	806.045	3/2+	19.22	25	6.474	7	
<sup>105</sup> Ru	$\beta-$	1916.7	0.0	3/2+	1345.135	3/2+	3.84	5	6.131	10	
<sup>105</sup> Ru	$\beta-$	1916.7	0.0	3/2+	1377.024	3/2+	1.764	18	6.383	9	
<sup>105</sup> Rh	$\beta-$	566.6	0.0	7/2+	306.307	7/2+	4.78	7	5.821	14	
<sup>105</sup> Rh	$\beta-$	566.6	0.0	7/2+	442.411	(7/2)+	0.0360	5	6.932	26	
<sup>105</sup> Cd	$\beta+\epsilon$	2737.0	0.0	5/2+	987.312	(5/2)+	3.26	24	5.876	34	
<sup>105</sup> Cd	$\beta+\epsilon$	2737.0	0.0	5/2+	1327.928	5/2+	4.00	30	5.573	35	
<sup>105</sup> Cd	$\beta+\epsilon$	2737.0	0.0	5/2+	1441.59	5/2+	3.20	30	5.594	42	
<sup>105</sup> Cd	$\epsilon$	2737.0	0.0	5/2+	2256.49	5/2+	1.11	9	5.165	40	
<sup>106</sup> In	$\beta+\epsilon$	6524	0.0	7+	3084.03	7+	6.20	40	5.835	30	P
<sup>106</sup> In	$\beta+\epsilon$	6524	0.0	7+	3126.03	7+	2.80	23	6.153	37	P
<sup>106</sup> Rh	$\beta-$	3545	137	(6)+	2076.79	6+	1.65	19	7.87	5	
<sup>107</sup> Rh	$\beta-$	1509	0.0	7/2+	312.24	7/2+	4.2	6	6.19	6	
<sup>107</sup> Rh	$\beta-$	1509	0.0	7/2+	392.46	7/2+	7	1	5.85	7	
<sup>107</sup> In	$\beta+\epsilon$	3424	0.0	9/2+	809.03	9/2+	2.70	20	6.339	34	
<sup>107</sup> In	$\beta+\epsilon$	3424	0.0	9/2+	921.63	(9/2)+	2.60	20	6.276	36	
<sup>108</sup> Ag	$\epsilon$	1917.4	109.466	6+	1771.162	6+	91.3	6	9.245	14	
<sup>108</sup> In	$\beta+\epsilon$	5133	29.75	2+	632.99	2+	33.9	11	6.544	17	P
<sup>108</sup> In	$\beta+\epsilon$	5133	29.75	2+	1601.18	2+	4.80	40	6.830	38	P
<sup>108</sup> In	$\beta+\epsilon$	5133	29.75	2+	2162.6	2+	7.30	40	6.269	26	P
<sup>108</sup> In	$\beta+\epsilon$	5133	29.75	2+	2365.3	2+	4.40	30	6.345	32	P
<sup>108</sup> In	$\beta+\epsilon$	5133	29.75	2+	2486	2+	3.30	20	6.383	29	P
<sup>108</sup> In	$\beta+\epsilon$	5133	29.75	2+	2681.5	2+	3.50	40	6.22	5	P
<sup>108</sup> Tc	$\beta-$	7739	0.0	(2)+	242.23	2+	27.6	25	6.302	40	P
<sup>109</sup> Rh	$\beta-$	2607.2	0.0	7/2+	276.289	7/2+	1.1	3	6.71	12	

**Table 9**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
<sup>109</sup> Rh	$\beta^-$	2607.2	0.0	7/2+	426.140	7/2+	8.3	11	5.71	6	
<sup>109</sup> Sn	$\beta^+/\epsilon$	3859	0.0	5/2+	1099.29	5/2+	3.9	10	6.04	11	
<sup>109</sup> Sn	$\beta^+/\epsilon$	3859	0.0	5/2+	1483.76	5/2+	2.20	17	6.027	34	
<sup>109</sup> Sn	$\epsilon$	3859	0.0	5/2+	2871.19	5/2+	3.42	25	4.907	34	
<sup>110</sup> In	$\beta^+/\epsilon$	3878	62.08	2+	657.792	2+	87.23	19	5.628	9	
<sup>110</sup> In	$\beta^+/\epsilon$	3878	62.08	2+	1783.537	2+	1.17	7	6.713	30	
<sup>110</sup> In	$\beta^+/\epsilon$	3878	62.08	2+	2787.24	2+	2.58	12	5.717	30	
<sup>110</sup> Ag	$\beta^-$	2890.7	117.59	6+	2479.933	6+	30.9	3	8.301	6	
<sup>110</sup> Ag	$\beta^-$	2890.7	117.59	6+	2876.808	6+	0.399	18	8.237	24	
<sup>113</sup> Sb	$\beta^+/\epsilon$	3911	0.0	5/2+	1018.09	5/2+	3.43	16	5.782	23	P
<sup>114</sup> Sb	$\beta^+/\epsilon$	6063	0.0	3+	2514.7	3+	5.6	5	5.716	41	P
<sup>115</sup> Sb	$\beta^+/\epsilon$	3030	0.0	5/2+	986.5	5/2+	1.38	30	6.30	10	P
<sup>115</sup> Sb	$\beta^+/\epsilon$	3030	0.0	5/2+	1734.0	5/2+	1.00	10	5.982	47	P
<sup>115</sup> Cd	$\beta^-$	1451.9	0.0	1/2+	864.14	1/2+	33.1	10	6.401	13	
<sup>117</sup> Te	$\beta^+/\epsilon$	3544	0.0	1/2+	719.7	1/2+	52.3	14	5.537	20	P
<sup>117</sup> Te	$\beta^+/\epsilon$	3544	0.0	1/2+	2285	1/2+	3.20	40	5.77	6	P
<sup>117</sup> Cd	$\beta^-$	2525	0.0	1/2+	749.486	1/2+	13.2	17	7.25	6	
<sup>117</sup> Cd	$\beta^-$	2525	0.0	1/2+	1891.928	1/2+	32	4	5.20	6	
<sup>119</sup> I	$\beta^+/\epsilon$	3405	0.0	5/2+	635.86	5/2+	3.03	10	6.247	21	P
<sup>119</sup> Te	$\beta^+/\epsilon$	2293.0	0.0	1/2+	644.03	1/2+	82.6	5	5.798	5	
<sup>119</sup> Te	$\beta^+/\epsilon$	2293.0	260.96	11/2-	1366.34	11/2-	67.0	30	6.435	20	
<sup>119</sup> Te	$\epsilon$	2293.0	260.96	11/2-	2226.06	11/2-	4.7	4	6.417	38	
<sup>121</sup> Te	$\epsilon$	1056	0.0	1/2+	573.142	1/2+	81.6	6	6.15	6	
<sup>124</sup> In	$\beta^-$	7364	0.0	3+	2836.32	3+	3.5	4	6.09	5	P
<sup>124</sup> Sb	$\beta^-$	2905.07	0.0	3-	2293.712	3-	51.24	19	7.7648	17	
<sup>124</sup> Sb	$\beta^-$	2905.07	0.0	3-	2693.679	3-	8.75	4	7.0126	22	
<sup>124</sup> Sb	$\beta^-$	2905.07	0.0	3-	2865.72	3-	0.0611	24	6.929	18	
<sup>124</sup> Sb	$\beta^-$	2905.07	0.0	3-	2886.37	3-	0.0080	12	6.84	7	
<sup>124</sup> I	$\epsilon$	3159.6	0.0	2-	2701.53	2-	2.02	3	7.079	10	
<sup>125</sup> Sn	$\beta^-$	2361.4	0.0	11/2-	1982.86	11/2-	4.3	12	7.32	12	
<sup>125</sup> Sb	$\beta^-$	766.7	0.0	7/2+	402.09	7/2+	0.0222	11	11.594	23	
<sup>125</sup> Sb	$\beta^-$	766.7	0.0	7/2+	636.090	7/2+	17.88	19	7.272	22	
<sup>125</sup> Sb	$\beta^-$	766.7	0.0	7/2+	642.204	7/2+	5.75	7	7.701	24	
<sup>127</sup> Xe	$\epsilon$	662.3	0.0	1/2+	374.992	1/2+	47.6	14	6.246	16	
<sup>127</sup> Cs	$\beta^+/\epsilon$	2081	0.0	1/2+	0.0	1/2+	12.3	15	6.56	5	
<sup>127</sup> Cs	$\beta^+/\epsilon$	2081	0.0	1/2+	411.957	1/2+	68.1	11	5.584	11	
<sup>127</sup> Ba	$\beta^+/\epsilon$	3422	0.0	1/2+	0.0	1/2+	61.2	24	5.205	28	P
<sup>127</sup> Sb	$\beta^-$	1582.2	0.0	7/2+	685.5	7/2+	35.8	20	7.316	26	
<sup>127</sup> Sb	$\beta^-$	1582.2	0.0	7/2+	924.3	7/2+	1.3	3	8.28	10	
<sup>129</sup> Cs	$\beta^+/\epsilon$	1197.0	0.0	1/2+	0.0	1/2+	34.0	40	6.29	5	
<sup>129</sup> Cs	$\epsilon$	1197.0	0.0	1/2+	411.496	1/2+	55	3	5.704	25	
<sup>129</sup> Ba	$\beta^+/\epsilon$	2438	0.0	1/2+	0.0	1/2+	60.0	10	5.645	41	
<sup>129</sup> Sn	$\beta^-$	4039	0.0	3/2+	913.61	(3/2)+	3.2	2	7.084	33	P
<sup>129</sup> Sb	$\beta^-$	2376	0.0	7/2+	812.96	7/2+	3.1	6	7.96	9	
<sup>129</sup> Sb	$\beta^-$	2376	0.0	7/2+	1318.23	7/2+	4.02	7	7.201	34	
<sup>130</sup> I	$\beta^-$	2944.3	0.0	5+	2362.081	5+	46.7	11	5.707	13	
<sup>130</sup> I	$\beta^-$	2944.3	39.9525	2+	536.068	2+	14.3	17	6.65	5	
<sup>130</sup> I	$\beta^-$	2944.3	39.9525	2+	1122.120	2+	1.18	14	7.26	5	
<sup>130</sup> Sb	$\beta^-$	5067	5.36	(4)+	1981.57	4+	10.8	8	7.015	34	P
<sup>130</sup> Sb	$\beta^-$	5067	5.36	(4)+	2449.45	4+	12.4	11	6.657	40	P
<sup>131</sup> Ba	$\epsilon$	1376.62	0.0	1/2+	620.120	1/2+	52.7	5	6.640	41	
<sup>131</sup> La	$\beta^+/\epsilon$	2910	0.0	3/2+	108.077	3/2+	11.2	10	6.278	44	
<sup>131</sup> La	$\beta^+/\epsilon$	2910	0.0	3/2+	285.251	3/2+	7.00	40	6.380	33	

**Table 9**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	$\text{Log } ft$	Unc.	Pand.
<sup>131</sup> La	$\beta+\epsilon$	2910	0.0	3/2+	525.850	(3/2)+	30.0	9	5.612	26	
<sup>131</sup> Te	$\beta-$	2231.7	182.25	11/2-	1645.991	11/2-	2.6	3	7.78	5	
<sup>131</sup> Te	$\beta-$	2231.7	182.25	11/2-	1924.573	11/2-	2.01	16	7.214	35	
<sup>131</sup> Te	$\beta-$	2231.7	182.25	11/2-	1980.263	11/2-	37.8	10	5.763	12	
<sup>131</sup> I	$\beta-$	970.8	0.0	7/2+	636.991	7/2+	7.23	10	6.902	7	
<sup>132</sup> Cs	$\beta+\epsilon$	2126.3	0.0	2+	667.7159	2+	95.92	10	6.7043	26	
<sup>132</sup> Cs	$\epsilon$	2126.3	0.0	2+	1297.913	2+	0.27	6	8.75	10	
<sup>132</sup> Cs	$\epsilon$	2126.3	0.0	2+	1985.641	2+	0.659	20	6.647	16	
<sup>132</sup> Cs	$\beta-$	1282.2	0.0	2+	464.497	2+	1.51	11	8.857	32	
<sup>132</sup> Cs	$\beta-$	1282.2	0.0	2+	1031.661	2+	0.36	2	7.754	26	
<sup>132</sup> I	$\beta-$	3575.5	0.0	4+	1440.323	4+	19.0	20	7.471	46	
<sup>132</sup> I	$\beta-$	3575.5	0.0	4+	1962.98	4+	12.3	6	7.175	22	
<sup>132</sup> I	$\beta-$	3575.5	0.0	4+	2110.26	4+	9.1	9	7.144	43	
<sup>132</sup> I	$\beta-$	3575.5	0.0	4+	2394.99	4+	19.0	5	6.467	13	
<sup>133</sup> La	$\beta+\epsilon$	2059	0.0	5/2+	291.186	5/2+	1.13	11	7.297	46	
<sup>133</sup> La	$\beta+\epsilon$	2059	0.0	5/2+	923.955	5/2+	1.59	8	6.742	37	
<sup>133</sup> Ce	$\beta+\epsilon$	3076	0.0	1/2+	174.1	1/2+	53	8	5.90	7	P
<sup>133</sup> Ce	$\beta+\epsilon$	3076	37.2	9/2-	1045.925	9/2-	8.7	6	6.726	43	
<sup>133</sup> Ce	$\beta+\epsilon$	3076	37.2	9/2-	1468.86	9/2-	1.24	8	7.340	42	
<sup>133</sup> Ce	$\beta+\epsilon$	3076	37.2	9/2-	1690.64	(9/2)-	3.90	13	6.709	36	
<sup>133</sup> Ce	$\beta+\epsilon$	3076	37.2	9/2-	1735.44	(9/2)-	9.37	21	6.299	35	
<sup>133</sup> Ce	$\beta+\epsilon$	3076	37.2	9/2-	1912.81	9/2-	3.29	9	6.630	39	
<sup>133</sup> Ce	$\beta+\epsilon$	3076	37.2	9/2-	2062.16	9/2-	5.42	13	6.294	41	
<sup>133</sup> Ce	$\epsilon$	3076	37.2	9/2-	2137.18	9/2-	1.52	13	6.78	6	
<sup>133</sup> I	$\beta-$	1786	0.0	7/2+	875.331	7/2+	4.18	13	7.668	17	
<sup>133</sup> I	$\beta-$	1786	0.0	7/2+	1236.449	7/2+	3.15	9	7.019	21	
<sup>133</sup> I	$\beta-$	1786	0.0	7/2+	1386.153	7/2+	1.25	5	6.955	28	
<sup>133</sup> Xe	$\beta-$	427.4	0.0	3/2+	383.8491	3/2+	0.0087	10	6.91	9	
<sup>133</sup> Ba	$\epsilon$	517.4	0.0	1/2+	437.0113	1/2+	85.4	5	6.64	6	
<sup>134</sup> I	$\beta-$	4082.4	0.0	(4)+	1731.16	4+	12.6	21	7.40	7	
<sup>134</sup> I	$\beta-$	4082.4	0.0	(4)+	2352.96	(4)+	11.0	5	6.924	20	
<sup>134</sup> I	$\beta-$	4082.4	0.0	(4)+	2588.45	(4)+	16.2	4	6.507	12	
<sup>134</sup> I	$\beta-$	4082.4	0.0	(4)+	2867.37	(4)+	30.4	8	5.891	13	
<sup>134</sup> Cs	$\beta-$	2058.84	0.0	4+	1400.591	4+	70.17	7	8.9229	7	
<sup>134</sup> Cs	$\beta-$	2058.84	0.0	4+	1969.923	4+	27.27	3	6.5417	38	
<sup>135</sup> I	$\beta-$	2634.2	0.0	7/2+	1131.512	7/2+	1.3	2	8.49	7	
<sup>135</sup> I	$\beta-$	2634.2	0.0	7/2+	1678.065	(7/2)+	21.8	8	6.526	17	
<sup>135</sup> La	$\epsilon$	1207	0.0	5/2+	480.525	5/2+	1.52	24	7.06	7	
<sup>136</sup> Cs	$\beta-$	2548.2	0.0	5+	2373.748	5+	2.4	1	6.737	24	
<sup>137</sup> Nd	$\beta+\epsilon$	3618	0.0	1/2+	857.00	(1/2)+	10.8	15	6.16	6	P
<sup>137</sup> Nd	$\beta+\epsilon$	3618	0.0	1/2+	1001.35	(1/2)+	7.9	11	6.22	6	P
<sup>137</sup> Pm	$\beta+\epsilon$	5511	0.0	11/2-	519.5	11/2-	42	6	5.49	7	P
<sup>137</sup> Pm	$\beta+\epsilon$	5511	0.0	11/2-	1510.5	(11/2)-	13.0	20	5.54	7	P
<sup>137</sup> Ce	$\epsilon$	1222.1	254.29	11/2-	1004.61	11/2-	0.51	4	7.417	35	
<sup>137</sup> Pr	$\beta+\epsilon$	2717	0.0	5/2+	836.70	(5/2)+	1.20	20	6.92	7	
<sup>138</sup> Pr	$\beta+\epsilon$	4437	364	7-	2129.55	7-	91	6	5.659	32	
<sup>139</sup> Sm	$\beta+\epsilon$	5121	457.38	11/2-	188.7	(11/2)-	6.3	5	5.360	43	P
<sup>139</sup> Nd	$\beta+\epsilon$	2812	0.0	3/2+	405.04	3/2+	2.9	5	6.43	8	P
<sup>139</sup> Nd	$\beta+\epsilon$	2812	231.15	11/2-	822.00	11/2-	6.8	15	7.01	10	P
<sup>140</sup> Cs	$\beta-$	6218	0.0	1-	2703.98	1-	3.36	15	7.045	20	
<sup>140</sup> La	$\beta-$	3762.2	0.0	3-	2464.09	3-	5.52	7	8.486	6	
<sup>140</sup> La	$\beta-$	3762.2	0.0	3-	3473.58	3-	0.054	7	8.23	6	
<sup>141</sup> Sm	$\beta+\epsilon$	4589	0.0	1/2+	438.29	(1/2)+	30.7	15	5.882	24	P

**Table 9**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
<sup>141</sup> Sm	$\beta+\epsilon$	4589	175.9	11/2-	628.70	11/2-	11.0	30	6.67	12	P
<sup>141</sup> Sm	$\beta+\epsilon$	4589	175.9	11/2-	2091.66	11/2-	16.2	7	5.760	20	P
<sup>141</sup> Eu	$\beta+\epsilon$	6008	96.45	11/2-	175.8	11/2-	11.0	30	4.73	13	P
<sup>141</sup> Pm	$\beta+\epsilon$	3669	0.0	5/2+	1223.3	5/2+	2.10	30	6.47	6	
<sup>143</sup> Eu	$\beta+\epsilon$	5276	0.0	5/2+	1107.3	5/2+	5.8	6	6.031	45	P
<sup>143</sup> Eu	$\beta+\epsilon$	5276	0.0	5/2+	1536.9	(5/2)+	3.40	30	6.056	39	P
<sup>143</sup> Gd	$\beta+\epsilon$	6.01E3	0.0	(1/2)+	463.61	(1/2)+	33.6	20	5.26	8	P
<sup>143</sup> Gd	$\beta+\epsilon$	6.01E3	152.6	11/2-	1188.43	11/2-	9.7	8	6.02	9	P
<sup>143</sup> Gd	$\beta+\epsilon$	6.01E3	152.6	11/2-	1214.0	11/2-	4.00	40	6.40	9	P
<sup>143</sup> Sm	$\beta+\epsilon$	3443.5	0.0	3/2+	1056.63	3/2+	2.30	30	6.05	6	
<sup>144</sup> Pm	$\epsilon$	2331.9	0.0	5-	2093.33	5-	1.9	1	8.684	31	
<sup>145</sup> Gd	$\beta+\epsilon$	5065	749.1	11/2-	716.1	11/2-	5.7	8	6.20	6	P
<sup>145</sup> Cs	$\beta-$	7462	0.0	3/2+	435.69	3/2+	6.2	1	6.052	9	P
<sup>145</sup> Eu	$\epsilon$	2659.9	0.0	5/2+	1804.24	5/2+	1.17	6	8.393	23	
<sup>145</sup> Eu	$\epsilon$	2659.9	0.0	5/2+	2276.55	5/2+	0.135	7	8.580	24	
<sup>145</sup> Gd	$\beta+\epsilon$	5065	0.0	1/2+	2494.88	1/2+	1.43	8	6.826	27	
<sup>146</sup> Pm	$\epsilon$	1471.6	0.0	3-	1189.73	3-	23.2	15	8.510	33	
<sup>146</sup> Pm	$\beta-$	1542.0	0.0	3-	1380.5	3-	2.26	22	8.99	5	
<sup>146</sup> Eu	$\beta+\epsilon$	3879	0.0	4-	2045.689	4-	8.4	5	8.122	26	
<sup>147</sup> Eu	$\epsilon$	1721.4	0.0	5/2+	1063.390	5/2+	0.302	9	9.349	17	
<sup>147</sup> Eu	$\epsilon$	1721.4	0.0	5/2+	1180.253	5/2+	0.157	8	9.451	25	
<sup>147</sup> Gd	$\beta+\epsilon$	2187.7	0.0	7/2-	1069.39	7/2-	2.7	6	7.73	10	
<sup>147</sup> Gd	$\epsilon$	2187.7	0.0	7/2-	1235.77	7/2-	3.5	3	7.473	38	
<sup>148</sup> Pm	$\beta-$	2470	0.0	1-	1465.129	1-	33.4	8	7.882	14	
<sup>149</sup> Dy	$\beta+\epsilon$	3795	0.0	7/2-	1381.92	7/2-	1.74	12	5.992	37	P
<sup>149</sup> Dy	$\beta+\epsilon$	3795	0.0	7/2-	1735.44	(7/2)-	2.32	6	5.699	24	P
<sup>149</sup> Dy	$\beta+\epsilon$	3795	0.0	7/2-	1776.61	7/2-	1.71	7	5.811	28	P
<sup>149</sup> Dy	$\beta+\epsilon$	3795	0.0	7/2-	2026.32	(7/2)-	1.18	10	5.845	43	P
<sup>149</sup> Dy	$\beta+\epsilon$	3795	0.0	7/2-	2065.37	7/2-	10.50	30	4.875	25	P
<sup>149</sup> Dy	$\beta+\epsilon$	3795	0.0	7/2-	2074.22	7/2-	1.74	9	5.650	31	P
<sup>149</sup> Nd	$\beta-$	1688.9	0.0	5/2-	537.863	5/2-	21.5	9	6.394	19	
<sup>149</sup> Gd	$\epsilon$	1314.1	0.0	7/2-	748.601	7/2-	8.6	5	7.370	28	
<sup>151</sup> Nd	$\beta-$	2443.1	0.0	3/2+	255.692	3/2+	7.5	8	7.007	47	
<sup>151</sup> Nd	$\beta-$	2443.1	0.0	3/2+	840.966	(3/2)+	4.4	3	6.706	30	
<sup>151</sup> Pm	$\beta-$	1190.2	0.0	5/2+	167.751	5/2+	7.9	10	7.88	6	
<sup>151</sup> Pm	$\beta-$	1190.2	0.0	5/2+	395.581	5/2+	1.9	3	8.10	7	
<sup>151</sup> Pm	$\beta-$	1190.2	0.0	5/2+	445.68	5/2+	7.1	8	7.43	5	
<sup>151</sup> Gd	$\epsilon$	464.2	0.0	7/2-	243.25	7/2-	5.5	4	7.761	36	
<sup>152</sup> Tb	$\beta+\epsilon$	3990	0.0	2-	1643.428	2-	1.86	5	8.296	21	
<sup>152</sup> Pr	$\beta-$	6392	0.0	4+	236.55	4+	5.7	9	6.69	7	P
<sup>152</sup> Eu	$\epsilon$	1874.5	0.0	3-	1041.1217	3-	0.067	7	12.532	45	
<sup>152</sup> Eu	$\epsilon$	1874.5	0.0	3-	1579.427	3-	2.082	12	10.0543	45	
<sup>152</sup> Eu	$\epsilon$	1874.5	0.0	3-	1730.207	3-	0.0538	24	10.871	21	
<sup>152</sup> Eu	$\epsilon$	1874.5	0.0	3-	1779.119	3-	0.0124	4	10.978	18	
<sup>152</sup> Eu	$\beta-$	1818.8	0.0	3-	1123.1855	3-	13.74	9	10.7080	32	
<sup>153</sup> Pm	$\beta-$	1912	0.0	5/2-	182.903	5/2-	7.7	8	6.237	46	
<sup>153</sup> Sm	$\beta-$	807.4	0.0	3/2+	103.18018	3/2+	49.2	9	6.741	8	
<sup>153</sup> Tb	$\beta+\epsilon$	1569.3	0.0	5/2+	183.413	5/2+	3.10	24	8.070	34	
<sup>153</sup> Tb	$\beta+\epsilon$	1569.3	0.0	5/2+	303.577	5/2+	5.0	5	7.781	44	
<sup>153</sup> Tb	$\epsilon$	1569.3	0.0	5/2+	937.419	5/2+	0.54	4	8.113	33	
<sup>153</sup> Tb	$\epsilon$	1569.3	0.0	5/2+	955.47	5/2+	0.73	7	7.955	42	
<sup>153</sup> Tb	$\epsilon$	1569.3	0.0	5/2+	1014.76	5/2+	0.31	3	8.232	43	
<sup>153</sup> Tb	$\epsilon$	1569.3	0.0	5/2+	1035.188	5/2+	1.07	9	7.658	38	

**Table 9**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
<sup>153</sup> Tb	$\varepsilon$	1569.3		0.0 5/2+	1131.72	5/2+	0.247	23	8.105	42	
<sup>153</sup> Tb	$\varepsilon$	1569.3		0.0 5/2+	1180.49	5/2+	0.247	18	7.991	34	
<sup>153</sup> Tb	$\varepsilon$	1569.3		0.0 5/2+	1272.70	5/2+	0.136	8	7.981	30	
<sup>153</sup> Tb	$\varepsilon$	1569.3		0.0 5/2+	1328.12	5/2+	0.34	4	7.37	5	
<sup>154</sup> Eu	$\beta^-$	1968.0		0.0 3-	1251.630	3-	0.301	8	12.215	12	
<sup>154</sup> Eu	$\beta^-$	1968.0		0.0 3-	1617.127	3-	1.584	16	10.452	5	
<sup>154</sup> Eu	$\beta^-$	1968.0		0.0 3-	1796.97	3-	0.0662	21	10.839	15	
<sup>155</sup> Eu	$\beta^-$	252.0		0.0 5/2+	86.5462	5/2+	25.5	24	7.950	42	
<sup>155</sup> Tb	$\varepsilon$	820		0.0 3/2+	105.3140	3/2+	38	3	6.736	38	
<sup>155</sup> Tb	$\varepsilon$	820		0.0 3/2+	268.582	3/2+	7.1	4	7.223	32	
<sup>155</sup> Tb	$\varepsilon$	820		0.0 3/2+	427.211	3/2+	4.7	4	7.078	46	
<sup>155</sup> Dy	$\beta+\varepsilon$	2094.5		0.0 3/2-	891.137	3/2-	4.10	9	7.103	13	
<sup>156</sup> Pm	$\beta^-$	5194		0.0 4+	1509.22	4+	11.4	9	6.339	35	P
<sup>157</sup> Eu	$\beta^-$	1364.8		0.0 5/2+	63.919	5/2+	49	10	7.24	9	
<sup>157</sup> Ho	$\beta+\varepsilon$	2592		0.0 7/2-	419.929	7/2-	8.0	9	5.73	5	
<sup>157</sup> Ho	$\beta+\varepsilon$	2592		0.0 7/2-	990.12	7/2-	3.30	30	5.818	43	
<sup>158</sup> Tb	$\varepsilon$	1219.1		0.0 3-	1041.6423	3-	30.2	13	9.536	34	
<sup>159</sup> Er	$\beta+\varepsilon$	2768.5		0.0 3/2-	520.50	3/2-	1.40	30	7.01	9	
<sup>159</sup> Er	$\beta+\varepsilon$	2768.5		0.0 3/2-	580.97	(3/2)-	2.5	5	6.73	9	
<sup>160</sup> Tb	$\beta^-$	1836.0		0.0 3-	1286.694	3-	3.43	7	9.170	9	
<sup>160</sup> Tb	$\beta^-$	1836.0		0.0 3-	1398.940	3-	4.48	10	8.722	10	
<sup>161</sup> Tb	$\beta^-$	593.7		0.0 3/2+	550.236	3/2+	0.064	4	6.425	46	
<sup>161</sup> Ho	$\varepsilon$	859.2		0.0 7/2-	103.067	7/2-	19	4	5.45	9	
<sup>162</sup> Ho	$\varepsilon$	2140.6	105.87	6-	1575.64	6-	1.61	11	6.061	31	
<sup>163</sup> Tb	$\beta^-$	1785.1		0.0 3/2+	766.20	(3/2)+	11.5	11	5.855	43	
<sup>163</sup> Tb	$\beta^-$	1785.1		0.0 3/2+	859.12	(3/2)+	4.5	5	6.113	49	
<sup>163</sup> Tb	$\beta^-$	1785.1		0.0 3/2+	935.11	(3/2)+	15.4	14	5.446	41	
<sup>163</sup> Tb	$\beta^-$	1785.1		0.0 3/2+	1084.27	(3/2)+	1.6	3	6.14	8	
<sup>163</sup> Tm	$\beta+\varepsilon$	2439.0		0.0 1/2+	540.56	1/2+	3.60	17	6.942	21	
<sup>165</sup> Tm	$\beta+\varepsilon$	1591.3		0.0 1/2+	507.429	1/2+	5.90	30	7.436	22	
<sup>165</sup> Tm	$\varepsilon$	1591.3		0.0 1/2+	745.955	1/2+	6.0	3	7.201	22	
<sup>165</sup> Yb	$\beta+\varepsilon$	2635		0.0 5/2-	1251.04	5/2-	5.2	10	5.49	9	
<sup>166</sup> Ta	$\beta+\varepsilon$	7761		0.0 (2)+	158.64	2+	36.0	30	5.890	38	P
<sup>166</sup> Ta	$\beta+\varepsilon$	7761		0.0 (2)+	1218.76	2+	3.40	40	6.60	5	P
<sup>166</sup> Tm	$\beta+\varepsilon$	3038		0.0 2+	785.917	2+	1.40	40	8.15	12	
<sup>166</sup> Tm	$\beta+\varepsilon$	3038		0.0 2+	1528.404	2+	1.03	7	7.903	30	
<sup>167</sup> Ho	$\beta^-$	1010		0.0 7/2-	745.01	7/2-	3.0	9	5.49	13	
<sup>168</sup> Ho	$\beta^-$	2930		0.0 3+	895.73	3+	17.8	22	6.03	6	
<sup>168</sup> Tm	$\varepsilon$	1676.9		0.0 3+	1653.53	3+	0.009	3	7.71	17	
<sup>169</sup> Yb	$\varepsilon$	899.1		0.0 7/2+	316.14633	7/2+	6.1	10	8.29	7	
<sup>169</sup> Lu	$\beta+\varepsilon$	2293.0		0.0 7/2+	0.0	7/2+	10.5	10	8.002	42	
<sup>169</sup> Lu	$\beta+\varepsilon$	2293.0		0.0 7/2+	647.34	7/2+	0.53	7	8.98	6	
<sup>169</sup> Lu	$\beta+\varepsilon$	2293.0		0.0 7/2+	1070.77	7/2+	0.67	5	8.608	33	
<sup>169</sup> Lu	$\varepsilon$	2293.0		0.0 7/2+	1716.02	7/2+	1.69	7	7.511	20	
<sup>169</sup> Lu	$\varepsilon$	2293.0		0.0 7/2+	2065.04	7/2+	0.0125	11	8.697	43	
<sup>172</sup> Tm	$\beta^-$	1882		0.0 2-	1198.51	2-	0.243	25	9.301	46	
<sup>172</sup> Lu	$\varepsilon$	2519.4		0.0 4-	1640.578	4-	1.35	16	8.68	5	
<sup>173</sup> Lu	$\varepsilon$	670.2		0.0 7/2+	350.764	7/2+	22.1	4	8.357	13	
<sup>176</sup> Ta	$\beta+\varepsilon$	3211		0.0 (1)-	1643.41	1-	3.2	5	7.60	7	
<sup>176</sup> Ta	$\beta+\varepsilon$	3211		0.0 (1)-	1722.05	1-	1.30	20	7.95	7	
<sup>176</sup> Ta	$\varepsilon$	3211		0.0 (1)-	2920.27	1-	7.5	9	5.62	13	
<sup>177</sup> Yb	$\beta^-$	1397.5		0.0 9/2+	121.6214	9/2+	7.5	6	7.280	35	
<sup>177</sup> Ta	$\varepsilon$	1166.0		0.0 7/2+	745.91	(7/2)+	0.56	16	7.97	12	

**Table 9**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
<sup>177</sup> W	$\beta+\epsilon$	2013	0.0	1/2-	216.61	1/2-	32.8	23	6.187	35	
<sup>177</sup> W	$\epsilon$	2013	0.0	1/2-	1487.72	(1/2)-	1.67	11	6.34	6	
<sup>177</sup> W	$\epsilon$	2013	0.0	1/2-	1512.44	(1/2)-	11.4	6	5.46	6	
<sup>179</sup> Re	$\beta+\epsilon$	2711	0.0	5/2+	773.71	5/2+	19.0	30	5.70	7	
<sup>180</sup> Lu	$\beta-$	3.10E3	0.0	5+	1742.87	(5)+	9	1	6.02	10	P
<sup>181</sup> W	$\epsilon$	205.1	0.0	9/2+	136.28	9/2+	0.086	3	8.185	41	
<sup>181</sup> Re	$\epsilon$	1717	0.0	5/2+	1469.12	(5/2)+	2.3	3	6.41	9	
<sup>182</sup> Ta	$\beta-$	1815.5	0.0	3-	1373.8301	3-	20.1	7	8.479	16	
<sup>182</sup> Re	$\epsilon$	2.80E3	0.0	7+	1971.09	(7)+	1.70	13	8.26	13	
<sup>183</sup> Os	$\beta+\epsilon$	2.15E3	0.0	9/2+	1002.51	(9/2)+	1.27	6	8.03	5	
<sup>183</sup> Ir	$\beta+\epsilon$	3.46E3	0.0	5/2-	669.09	(5/2)-	2.20	40	7.54	9	P
<sup>183</sup> Ir	$\beta+\epsilon$	3.46E3	0.0	5/2-	2300.03	(5/2)-	8.1	10	6.14	8	P
<sup>184</sup> Ir	$\beta+\epsilon$	4642	0.0	5-	1718.17	5-	7.4	8	7.567	48	P
<sup>184</sup> Ir	$\beta+\epsilon$	4642	0.0	5-	1836.29	5-	2.8	5	7.94	8	P
<sup>186</sup> Ir	$\beta+\epsilon$	3828	0.0	5+	1275.61	5+	3.70	40	8.454	48	
<sup>186</sup> Ir	$\beta+\epsilon$	3828	0.0	5+	1560.1	(5)+	2.64	24	8.482	40	
<sup>186</sup> Au	$\beta+\epsilon$	6150	0.0	3-	1407.79	3-	4.4	7	7.25	7	P
<sup>190</sup> Ir	$\epsilon$	1954.2	0.0	4-	1583.82	4-	10.0	9	7.412	40	
<sup>191</sup> Pt	$\epsilon$	1010.5	0.0	3/2-	658.87	3/2-	0.83	15	7.85	8	
<sup>192</sup> Ir	$\epsilon$	1046.7	0.0	4+	580.2800	4+	0.670	11	9.617	10	
<sup>192</sup> Ir	$\epsilon$	1046.7	0.0	4+	909.55	4+	0.094	8	9.046	46	
<sup>192</sup> Ir	$\beta-$	1452.9	0.0	4+	784.5759	4+	47.98	9	8.612	5	
<sup>192</sup> Ir	$\beta-$	1452.9	0.0	4+	1201.0452	4+	5.60	3	8.156	13	
<sup>192</sup> Au	$\beta+\epsilon$	3516	0.0	1-	1739.432	(1)-	4.0	5	7.61	6	
<sup>194</sup> Au	$\epsilon$	2548.2	0.0	1-	1797.384	1-	11.7	4	7.235	15	
<sup>203</sup> Po	$\beta+\epsilon$	4214	0.0	5/2-	1609.82	(5/2)-	2.16	18	7.503	38	P
<sup>203</sup> At	$\beta+\epsilon$	5148	0.0	9/2-	803.20	9/2-	1.59	11	7.548	33	P
<sup>203</sup> At	$\beta+\epsilon$	5148	0.0	9/2-	1174.87	(9/2)-	1.41	10	7.486	33	P
<sup>205</sup> Bi	$\beta+\epsilon$	2704.6	0.0	9/2-	1575.35	9/2-	0.760	40	9.917	25	
<sup>205</sup> At	$\beta+\epsilon$	4537	0.0	9/2-	669.43	9/2-	5.9	6	7.392	46	P
<sup>205</sup> At	$\beta+\epsilon$	4537	0.0	9/2-	719.28	9/2-	7.5	17	7.27	10	P
<sup>205</sup> At	$\beta+\epsilon$	4537	0.0	9/2-	1426.05	9/2-	1.60	14	7.712	41	P
<sup>207</sup> Rn	$\beta+\epsilon$	4593	0.0	5/2-	673.98	(5/2)-	11.0	8	6.702	33	P
<sup>208</sup> At	$\beta+\epsilon$	4999	0.0	6+	2041.3	6+	3.8	12	7.84	14	
<sup>208</sup> At	$\beta+\epsilon$	4999	0.0	6+	2293.6	6+	4.1	6	7.72	6	
<sup>214</sup> Bi	$\beta-$	3269	0.0	1-	1994.639	1-	1.192	21	7.621	16	
<sup>214</sup> Bi	$\beta-$	3269	0.0	1-	2447.701	1-	2.78	6	6.576	23	
<sup>221</sup> Rn	$\beta-$	1194	0.0	7/2+	279.28	(7/2)+	5.9	6	6.607	46	
<sup>223</sup> Fr	$\beta-$	1149.1	0.0	3/2-	50.093	3/2-	70	7	5.770	43	
<sup>224</sup> Fr	$\beta-$	2923	0.0	1-	215.985	1-	43	6	6.62	6	
<sup>224</sup> Fr	$\beta-$	2923	0.0	1-	1052.95	1-	10.3	14	6.62	6	
<sup>224</sup> Fr	$\beta-$	2923	0.0	1-	1378.35	1-	5.6	7	6.58	6	
<sup>224</sup> Fr	$\beta-$	2923	0.0	1-	1435.47	1-	2.8	4	6.82	6	
<sup>225</sup> Rn	$\beta-$	2714	0.0	7/2-	559.68	7/2-	6.2	4	7.198	31	
<sup>225</sup> Rn	$\beta-$	2714	0.0	7/2-	571.51	(7/2)-	1.11	8	7.936	34	
<sup>225</sup> Rn	$\beta-$	2714	0.0	7/2-	778.64	7/2-	27.0	15	6.383	28	
<sup>225</sup> Rn	$\beta-$	2714	0.0	7/2-	865.74	(7/2)-	5.4	3	7.006	28	
<sup>226</sup> Fr	$\beta-$	3853	0.0	1-	253.726	1-	34	6	6.59	8	P
<sup>226</sup> Fr	$\beta-$	3853	0.0	1-	1048.78	1-	2.5	5	7.30	9	P
<sup>227</sup> Fr	$\beta-$	2505	0.0	1/2+	120.711	1/2+	4.9	16	7.22	14	
<sup>228</sup> Ac	$\beta-$	2123.8	0.0	3+	1022.531	(3)+	3.11	15	8.403	21	
<sup>228</sup> Ac	$\beta-$	2123.8	0.0	3+	1531.478	3+	7.6	4	7.091	24	
<sup>228</sup> Ac	$\beta-$	2123.8	0.0	3+	1646.005	3+	4.19	19	7.041	21	

**Table 9**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
<sup>228</sup> Pa	$\varepsilon$	2152.7	0.0	3+	1645.933	3+	4.1	3	7.448	39	
<sup>228</sup> Pa	$\varepsilon$	2152.7	0.0	3+	1893.017	3+	4.17	13	6.676	33	
<sup>228</sup> Pa	$\varepsilon$	2152.7	0.0	3+	1944.916	3+	7.8	5	6.108	46	
<sup>231</sup> Th	$\beta^-$	391.5	0.0	5/2+	183.4955	5/2+	11.4	6	6.098	25	
<sup>234</sup> Pa	$\beta^-$	2193.9	0.0	4+	1023.9	4+	4.8	8	8.40	7	
<sup>234</sup> Pa	$\beta^-$	2193.9	0.0	4+	1723.4	4+	34	4	6.20	5	
<sup>234</sup> Pa	$\beta^-$	2193.9	0.0	4+	1811.6	4+	1.64	16	7.227	45	
<sup>237</sup> U	$\beta^-$	518.5	0.0	1/2+	332.385	1/2+	3.4	3	7.353	38	
<sup>238</sup> Np	$\beta^-$	1291.45	0.0	2+	44.051	2+	41.1	6	8.499	6	
<sup>238</sup> Np	$\beta^-$	1291.45	0.0	2+	983.02	2+	0.26	3	8.67	5	
<sup>238</sup> Np	$\beta^-$	1291.45	0.0	2+	1028.542	2+	44.8	5	6.220	5	
<sup>239</sup> U	$\beta^-$	1261.7	0.0	5/2+	0.0	5/2+	18.7	24	6.72	6	
<sup>239</sup> Np	$\beta^-$	722.8	0.0	5/2+	285.460	5/2+	45	3	6.971	29	
<sup>245</sup> Am	$\beta^-$	895.9	0.0	(5/2)+	252.72	5/2+	15	2	6.61	6	
<sup>245</sup> Bk	$\varepsilon$	809.3	0.0	3/2-	633.64	(3/2)-	2.6	3	7.21	5	
<sup>249</sup> Es	$\varepsilon$	1452	0.0	7/2+	379.52	7/2+	39	5	6.37	6	
<sup>249</sup> Es	$\varepsilon$	1452	0.0	7/2+	442.98	(7/2)+	3.8	5	7.33	7	
<sup>254</sup> Es	$\beta^-$	1091.6	84.2	2+	44.992	2+	25.0	36	8.62	6	
<sup>254</sup> Es	$\beta^-$	1091.6	84.2	2+	693.66	2+	56	4	7.036	33	

15.4.  $\Delta J=1$ ,  $\Delta\pi=no$ , not  $0^+ \leftrightarrow 1^+$

**Table 10**

List of allowed transitions with  $\Delta J=1$  and  $\Delta\pi=no$ , but not  $0^+ \leftrightarrow 1^+$ .

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
<sup>7</sup> Be	$\varepsilon$	861.89	0.0	3/2-	477.612	1/2-	10.44	4	3.48	6	
<sup>9</sup> Li	$\beta^-$	1.360645E4	0.0	3/2-	2429.4	5/2-	37.8	52	5.03	6	
<sup>9</sup> Li	$\beta^-$	1.360645E4	0.0	3/2-	4704	1/2-	2.29	35	5.78	7	
<sup>9</sup> Li	$\beta^-$	1.360645E4	0.0	3/2-	5590	5/2-	2.81	37	5.47	6	
<sup>9</sup> Li	$\beta^-$	1.360645E4	0.0	3/2-	11810	5/2-	2.65	27	2.574	49	
<sup>11</sup> Li	$\beta^-$	2.05511E4	0.0	3/2-	320.04	1/2-	7.7	8	5.660	46	
<sup>11</sup> Li	$\beta^-$	2.05511E4	0.0	3/2-	3889	5/2-	22.7	45	4.78	9	
<sup>11</sup> Li	$\beta^-$	2.05511E4	0.0	3/2-	5255	5/2-	2.4	5	5.58	9	
<sup>11</sup> Li	$\beta^-$	2.05511E4	0.0	3/2-	10590	5/2-	7.8	18	4.17	10	
<sup>11</sup> Be	$\beta^-$	1.150946E4	0.0	1/2+	7977.84	3/2+	4.00	30	5.576	33	
<sup>11</sup> Be	$\beta^-$	1.150946E4	0.0	1/2+	9876	3/2+	3.1	4	4.23	6	
<sup>12</sup> B	$\beta^-$	1.33694E4	0.0	1+	4439.82	2+	1.182	19	5.147	7	
<sup>12</sup> N	$\beta^+$	1.73381E4	0.0	1+	4439.82	2+	1.898	32	5.152	7	
<sup>13</sup> B	$\beta^-$	1.34369E4	0.0	3/2-	0.0	1/2-	92.1	8	4.038	6	
<sup>13</sup> O	$\beta^+/\varepsilon$	1.7770E4	0.0	3/2-	0.0	1/2-	88.7	20	4.088	10	
<sup>14</sup> B	$\beta^-$	2.0644E4	0.0	2-	6093.8	1-	79	6	4.129	37	P
<sup>14</sup> B	$\beta^-$	2.0644E4	0.0	2-	6728.2	3-	8.2	17	5.02	9	P
<sup>16</sup> N	$\beta^-$	1.04209E4	0.0	2-	6129.89	3-	66.2	6	4.4871	43	
<sup>16</sup> N	$\beta^-$	1.04209E4	0.0	2-	7116.85	1-	4.8	4	5.116	36	
<sup>17</sup> N	$\beta^-$	8679	0.0	1/2-	4551.8	3/2-	37.8	11	4.421	15	
<sup>17</sup> N	$\beta^-$	8679	0.0	1/2-	5387.1	3/2-	50.31	99	3.856	12	
<sup>17</sup> Ne	$\beta^+/\varepsilon$	1.454875E4	0.0	1/2-	4640	3/2-	16.54	14	4.581	6	
<sup>17</sup> Ne	$\beta^+/\varepsilon$	1.454875E4	0.0	1/2-	5488	3/2-	59.20	40	3.8201	47	
<sup>18</sup> N	$\beta^-$	1.3896E4	0.0	1-	5530.17	2-	2.7	3	6.162	49	
<sup>18</sup> N	$\beta^-$	1.3896E4	0.0	1-	6880.45	0-	12.8	7	5.126	24	
<sup>18</sup> N	$\beta^-$	1.3896E4	0.0	1-	7771.07	2-	4.3	4	5.324	41	
<sup>19</sup> N	$\beta^-$	1.2523E4	0.0	1/2-	3947.6	3/2-	41.0	10	4.766	12	
<sup>19</sup> O	$\beta^-$	4820.3	0.0	5/2+	1554.038	3/2+	54.4	12	4.621	10	
<sup>21</sup> F	$\beta^-$	5684.2	0.0	5/2+	0.0	3/2+	9.6	30	5.67	14	
<sup>21</sup> F	$\beta^-$	5684.2	0.0	5/2+	1745.910	7/2+	16.1	10	4.721	27	
<sup>21</sup> Na	$\beta^+/\varepsilon$	3546.919	0.0	3/2+	350.727	5/2+	5.07	13	4.602	11	P
<sup>21</sup> Mg	$\beta^+/\varepsilon$	1.30887E4	0.0	5/2+	0.0	3/2+	16.0	40	5.26	11	P
<sup>21</sup> Mg	$\beta^+/\varepsilon$	1.30887E4	0.0	5/2+	1716.0	7/2+	10.9	20	5.11	8	P
<sup>21</sup> Mg	$\beta^+/\varepsilon$	1.30887E4	0.0	5/2+	4468	3/2+	10.5	5	4.487	23	P
<sup>21</sup> Mg	$\beta^+/\varepsilon$	1.30887E4	0.0	5/2+	6512	3/2+	1.07	6	4.841	27	P
<sup>22</sup> Na	$\beta^+/\varepsilon$	2843.32	0.0	3+	1274.53	2+	99.944	14	7.4226	6	
<sup>23</sup> O	$\beta^-$	1.134E4	0.0	1/2+	4066	3/2+	17.1	17	4.28	7	P
<sup>23</sup> Ne	$\beta^-$	4375.81	0.0	5/2+	0.0	3/2+	67	1	5.272	7	P
<sup>23</sup> Ne	$\beta^-$	4375.81	0.0	5/2+	2076.9	7/2+	1.10	6	5.819	24	P
<sup>23</sup> Mg	$\beta^+/\varepsilon$	4056.179	0.0	3/2+	440.2	5/2+	7.85	9	4.441	5	P
<sup>24</sup> Al	$\beta^+/\varepsilon$	1.388477E4	0.0	4+	5235.12	3+	1.40	13	6.588	40	
<sup>24</sup> Al	$\beta^+/\varepsilon$	1.388477E4	425.8	1+	1368.672	2+	3.7	9	5.89	9	
<sup>25</sup> Ne	$\beta^-$	7322	0.0	1/2+	89.53	3/2+	76.6	20	4.432	15	P
<sup>25</sup> Ne	$\beta^-$	7322	0.0	1/2+	2202	3/2+	2.1	5	5.30	10	P
<sup>25</sup> Na	$\beta^-$	3835.0	0.0	5/2+	974.749	3/2+	27.46	22	5.048	6	P
<sup>25</sup> Na	$\beta^-$	3835.0	0.0	5/2+	1611.772	7/2+	9.48	14	5.036	8	P
<sup>25</sup> Si	$\beta^+/\varepsilon$	1.2743E4	0.0	5/2+	945	3/2+	26.0	40	5.06	7	P
<sup>25</sup> Si	$\beta^+/\varepsilon$	1.2743E4	0.0	5/2+	1613	7/2+	15.0	30	5.16	9	P
<sup>25</sup> Si	$\beta^+/\varepsilon$	1.2743E4	0.0	5/2+	2672	3/2+	4.80	30	5.426	28	P
<sup>25</sup> Si	$\beta^+/\varepsilon$	1.2743E4	0.0	5/2+	4189	3/2+	2.990	30	5.254	8	P
<sup>25</sup> Si	$\beta^+/\varepsilon$	1.2743E4	0.0	5/2+	7107	3/2+	3.70	20	4.169	25	P



**Table 10**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	$\text{Log } ft$	Unc.	Pand.
$^{26}\text{F}$	$\beta^-$	1.819E4	0.0	1+	2018.0	2+	36	7	4.55	10	P
$^{26}\text{F}$	$\beta^-$	1.819E4	0.0	1+	2018.0	2+	36	7	4.55	10	P
$^{26}\text{Na}$	$\beta^-$	9353.8	0.0	3+	1808.81	2+	87.80	7	4.7202	10	
$^{26}\text{Na}$	$\beta^-$	9353.8	0.0	3+	4332.02	2+	1.65	3	5.625	8	
$^{26}\text{Na}$	$\beta^-$	9353.8	0.0	3+	4834.92	2+	2.378	19	5.2571	38	
$^{26}\text{P}$	$\beta^+$	1.811E4	0.0	(3)+	1797.27	2+	44	12	4.85	12	P
$^{26}\text{P}$	$\beta^+/\epsilon$	1.811E4	0.0	(3)+	7501	2+	2.40	20	5.14	6	P
$^{27}\text{Na}$	$\beta^-$	9068.8	0.0	5/2+	984.69	3/2+	85.8	11	4.320	10	P
$^{27}\text{Mg}$	$\beta^-$	2610.27	0.0	1/2+	1014.56	3/2+	29.06	9	4.9384	18	
$^{28}\text{Na}$	$\beta^-$	1.4032E4	0.0	1+	4554.6	2+	1.00	25	5.59	11	P
$^{28}\text{Al}$	$\beta^-$	4642.078	0.0	3+	1778.987	2+	99.99	1	4.8719	10	
$^{28}\text{P}$	$\beta^+/\epsilon$	1.43449E4	0.0	3+	1779.030	2+	69.1	7	4.8555	45	
$^{28}\text{P}$	$\beta^+/\epsilon$	1.43449E4	0.0	3+	4617.53	4+	1.29	18	6.00	6	
$^{28}\text{P}$	$\beta^+/\epsilon$	1.43449E4	0.0	3+	7933.52	2+	2.84	20	4.677	31	
$^{29}\text{Mg}$	$\beta^-$	7595.40	0.0	3/2+	0.0	5/2+	27	8	5.34	13	P
$^{29}\text{Mg}$	$\beta^-$	7595.40	0.0	3/2+	3061.7	(5/2)+	6.0	16	4.96	12	P
$^{29}\text{Mg}$	$\beta^-$	7595.40	0.0	3/2+	3184.54	5/2+	28	5	4.23	9	P
$^{29}\text{Mg}$	$\beta^-$	7595.40	0.0	3/2+	3433.0	1/2+	3.0	9	5.09	14	P
$^{29}\text{Al}$	$\beta^-$	3687.32	0.0	5/2+	1273.391	3/2+	89.9	3	5.0619	42	
$^{29}\text{Al}$	$\beta^-$	3687.32	0.0	5/2+	2425.99	3/2+	6.3	2	5.043	14	
$^{29}\text{P}$	$\beta^+/\epsilon$	4942.23	0.0	1/2+	1273.391	3/2+	1.260	20	4.814	7	P
$^{30}\text{Na}$	$\beta^-$	1.73560E4	0.0	2+	4694.7	3+	2.1	3	6.03	6	P
$^{30}\text{Na}$	$\beta^-$	1.73560E4	0.0	2+	4967.0	1+	17	2	5.08	5	P
$^{30}\text{Na}$	$\beta^-$	1.73560E4	0.0	2+	5022.2	1+	6.3	8	5.50	6	P
$^{30}\text{Na}$	$\beta^-$	1.73560E4	0.0	2+	5898.1	1+	2.4	5	5.76	9	P
$^{30}\text{Na}$	$\beta^-$	1.73560E4	0.0	2+	6065.9	3+	3.1	4	5.62	6	P
$^{30}\text{Al}$	$\beta^-$	8568.8	0.0	3+	2235.326	2+	17.1	9	5.627	24	P
$^{30}\text{Al}$	$\beta^-$	8568.8	0.0	3+	3498.50	2+	67.3	11	4.586	10	P
$^{30}\text{Al}$	$\beta^-$	8568.8	0.0	3+	4810.31	2+	5.7	2	5.069	17	P
$^{31}\text{Na}$	$\beta^-$	1.5368E4	0.0	3/2+	2015.08	5/2+	1.1	2	6.00	8	P
$^{31}\text{Na}$	$\beta^-$	1.5368E4	0.0	3/2+	2243.63	1/2+	21	4	4.68	8	P
$^{31}\text{Si}$	$\beta^-$	1491.507	0.0	3/2+	0.0	1/2+	99.94463	7	5.5311	6	
$^{31}\text{S}$	$\beta^+/\epsilon$	5398.01	0.0	1/2+	1266.13	3/2+	1.080	30	4.975	12	
$^{31}\text{Cl}$	$\beta^+$	1.20080E4	0.0	3/2+	0.0	1/2+	7.0	20	5.58	12	P
$^{31}\text{Cl}$	$\beta^+/\epsilon$	1.20080E4	0.0	3/2+	2234.06	5/2+	38.0	30	4.372	34	P
$^{31}\text{Cl}$	$\beta^+/\epsilon$	1.20080E4	0.0	3/2+	3076.44	1/2+	2.54	15	5.338	26	P
$^{31}\text{Cl}$	$\beta^+/\epsilon$	1.20080E4	0.0	3/2+	3283.76	(5/2)+	4.46	25	5.039	24	P
$^{31}\text{Cl}$	$\beta^+/\epsilon$	1.20080E4	0.0	3/2+	4717.79	(5/2)+	1.55	9	5.077	25	P
$^{31}\text{Cl}$	$\beta^+/\epsilon$	1.20080E4	0.0	3/2+	4866.03	(1/2)+	1.64	10	5.004	27	P
$^{32}\text{Al}$	$\beta^-$	1.2978E4	0.0	1+	1941.4	2+	4.7	13	5.28	12	P
$^{32}\text{Al}$	$\beta^-$	1.2978E4	0.0	1+	4230.8	2+	3.0	8	5.00	12	P
$^{32}\text{Cl}$	$\beta^+/\epsilon$	1.26808E4	0.0	1+	2230.4	2+	59.08	38	4.5295	32	
$^{32}\text{Cl}$	$\beta^+/\epsilon$	1.26808E4	0.0	1+	4281.9	2+	2.18	8	5.457	16	
$^{32}\text{Cl}$	$\beta^+/\epsilon$	1.26808E4	0.0	1+	5548.3	2+	3.83	12	4.828	14	
$^{32}\text{Cl}$	$\beta^+/\epsilon$	1.26808E4	0.0	1+	6665.4	2+	2.09	7	4.684	15	
$^{33}\text{Al}$	$\beta^-$	1.2017E4	0.0	5/2+	0.0	3/2+	88	2	4.290	10	P
$^{33}\text{Si}$	$\beta^-$	5823.0	0.0	3/2+	0.0	1/2+	93.7	7	4.963	13	
$^{33}\text{Si}$	$\beta^-$	5823.0	0.0	3/2+	1847.50	5/2+	5.3	6	5.45	5	
$^{33}\text{P}$	$\beta^-$	248.5	0.0	1/2+	0.0	3/2+	100		5.031	7	
$^{33}\text{Ar}$	$\beta^+/\epsilon$	1.16190E4	0.0	1/2+	0.0	3/2+	18.70	40	5.028	11	
$^{33}\text{Ar}$	$\beta^+$	1.16190E4	0.0	1/2+	2352.3	3/2+	1.70	30	5.55	8	
$^{34}\text{P}$	$\beta^-$	5383.0	0.0	1+	2127.564	2+	14.8	20	4.94	6	P
$^{34}\text{Cl}$	$\beta^+/\epsilon$	5491.604	146.36	3+	2127.564	2+	28.5	7	5.991	11	

**Table 10**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
<sup>34</sup> Cl	$\beta+\varepsilon$	5491.604	146.36	3+	3304.212	2+	26.4	5	4.832	8	
<sup>35</sup> Ar	$\beta+\varepsilon$	5966.2	0.0	3/2+	1219.22	1/2+	1.230	30	5.099	11	P
<sup>35</sup> K	$\beta+$	1.18744E4	0.0	3/2+	1184.01	1/2+	2.2	7	5.77	14	P
<sup>35</sup> K	$\beta+\varepsilon$	1.18744E4	0.0	3/2+	1750.7	(5/2)+	11.9	9	4.914	38	P
<sup>35</sup> K	$\beta+\varepsilon$	1.18744E4	0.0	3/2+	4725.9	1/2+	2.10	40	4.86	8	P
<sup>36</sup> P	$\beta-$	1.0413E4	0.0	4-	5206.1	5-	1.9	3	6.40	7	P
<sup>36</sup> P	$\beta-$	1.0413E4	0.0	4-	5251.2	3-	11.9	8	5.588	38	P
<sup>36</sup> P	$\beta-$	1.0413E4	0.0	4-	5830.9	3-	57.3	15	4.669	26	P
<sup>36</sup> K	$\beta+\varepsilon$	1.281436E4	0.0	2+	7338.7	3+	1.93	14	4.533	32	
<sup>37</sup> K	$\beta+\varepsilon$	6147.48	0.0	3/2+	2796.11	5/2+	2.07	11	3.798	23	P
<sup>38</sup> Cl	$\beta-$	4916.71	0.0	2-	3810.187	3-	32.9	5	4.913	7	
<sup>38</sup> K	$\beta+\varepsilon$	5914.067	0.0	3+	2167.6	2+	99.848	10	4.9845	11	
<sup>39</sup> S	$\beta-$	6.64E3	0.0	(7/2)-	1696.78	5/2-	68	7	5.07	5	P
<sup>39</sup> S	$\beta-$	6.64E3	0.0	(7/2)-	2571.10	(9/2)-	12.8	16	5.41	6	P
<sup>39</sup> Cl	$\beta-$	3442	0.0	3/2+	2358.284	1/2+	2.55	8	6.168	16	
<sup>39</sup> Cl	$\beta-$	3442	0.0	3/2+	2503.418	(5/2)+	2.23	7	5.984	17	
<sup>40</sup> Cl	$\beta-$	7482	0.0	2-	3680.53	3-	4.6	11	6.58	11	
<sup>40</sup> Cl	$\beta-$	7482	0.0	2-	4082.60	3-	13.8	15	5.89	5	
<sup>40</sup> Cl	$\beta-$	7482	0.0	2-	4301.01	(3)-	27	5	5.47	8	
<sup>40</sup> Cl	$\beta-$	7482	0.0	2-	5880.1	1-	5.2	5	4.92	6	
<sup>40</sup> Sc	$\beta+\varepsilon$	1.43230E4	0.0	4-	3735.8	3-	19	5	4.81	11	
<sup>40</sup> Sc	$\beta+\varepsilon$	1.43230E4	0.0	4-	4490.6	5-	17	5	4.69	13	
<sup>41</sup> Ti	$\beta+\varepsilon$	1.2945E4	0.0	3/2+	2666	5/2+	4.1	9	5.05	10	P
<sup>41</sup> Ti	$\beta+\varepsilon$	1.2945E4	0.0	3/2+	3414	1/2+	5.0	6	4.79	5	P
<sup>41</sup> Ti	$\beta+\varepsilon$	1.2945E4	0.0	3/2+	4247	5/2+	16.3	6	4.067	18	P
<sup>41</sup> Ti	$\beta+\varepsilon$	1.2945E4	0.0	3/2+	4869	5/2+	3.6	5	4.55	6	P
<sup>41</sup> Ti	$\beta+\varepsilon$	1.2945E4	0.0	3/2+	4929	5/2+	7.6	5	4.208	30	P
<sup>41</sup> Ti	$\beta+\varepsilon$	1.2945E4	0.0	3/2+	5379	5/2+	3.73	12	4.382	17	P
<sup>41</sup> Ti	$\beta+\varepsilon$	1.2945E4	0.0	3/2+	5840	5/2+	5.30	30	4.081	26	P
<sup>41</sup> Ti	$\beta+\varepsilon$	1.2945E4	0.0	3/2+	5885	5/2+	1.10	20	4.75	8	P
<sup>42</sup> Sc	$\beta+\varepsilon$	6426.290	616.28	7+	3189.33	6+	100.		4.1725	28	
<sup>43</sup> K	$\beta-$	1833.48	0.0	3/2+	1394.473	5/2+	2.60	4	6.114	7	
<sup>43</sup> Sc	$\beta+\varepsilon$	2220.7	0.0	7/2-	372.9	5/2-	22.5	7	4.985	14	
<sup>43</sup> Ti	$\beta+\varepsilon$	6873	0.0	7/2-	845.17	5/2-	2.60	40	4.79	7	P
<sup>43</sup> Ti	$\beta+\varepsilon$	6873	0.0	7/2-	2288.40	5/2-	4.6	7	3.87	7	P
<sup>44</sup> K	$\beta-$	5687.2	0.0	2-	3307.864	3-	28.5	5	6.143	8	
<sup>44</sup> K	$\beta-$	5687.2	0.0	2-	4358.43	3-	1.5	3	6.37	9	
<sup>45</sup> K	$\beta-$	4196.6	0.0	3/2+	2392.13	1/2+	10.0	8	5.997	38	
<sup>46</sup> K	$\beta-$	7725.7	0.0	2-	4404.48	3-	5.09	22	6.381	19	
<sup>46</sup> K	$\beta-$	7725.7	0.0	2-	5374.97	3-	5.52	13	5.694	11	
<sup>47</sup> K	$\beta-$	6632.7	0.0	1/2+	2578.31	3/2+	18.4	3	5.465	7	
<sup>47</sup> Ca	$\beta-$	1992.2	0.0	7/2-	1297.12	5/2-	82.2	5	6.0399	38	
<sup>47</sup> Ca	$\beta-$	1992.2	0.0	7/2-	1878.2	9/2-	0.037	8	6.73	10	
<sup>47</sup> Sc	$\beta-$	600.8	0.0	7/2-	0.0	5/2-	31.6	6	6.110	10	
<sup>47</sup> V	$\beta+\varepsilon$	2930.54	0.0	3/2-	0.0	5/2-	99.552	15	4.9144	40	
<sup>47</sup> Cr	$\beta+\varepsilon$	7444	0.0	3/2-	87.525	5/2-	3.9	13	5.07	15	P
<sup>48</sup> V	$\varepsilon$	4014.9	0.0	4+	3223.992	3+	3.252	18	6.577	5	
<sup>49</sup> Ca	$\beta-$	5262.4	0.0	3/2-	4072.07	5/2-	8.198	25	5.0577	36	
<sup>49</sup> Cr	$\beta+\varepsilon$	2629.8	0.0	5/2-	0.0	7/2-	12.4	17	5.61	6	
<sup>49</sup> Cr	$\beta+\varepsilon$	2629.8	0.0	5/2-	152.9282	3/2-	50.3	19	4.828	17	
<sup>50</sup> Sc	$\beta-$	6894.7	0.0	5+	2674.6	4+	9.0	17	6.65	8	
<sup>50</sup> Sc	$\beta-$	6894.7	0.0	5+	3198.4	6+	88.3	17	5.401	9	
<sup>51</sup> Sc	$\beta-$	6482.6	0.0	(7/2)-	2144.0	5/2-	34.0	11	5.210	15	P

**Table 10**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
<sup>51</sup> Ti	$\beta^-$	2470.14	0.0	3/2-	320.077	5/2-	91.9	4	4.9056	21	
<sup>51</sup> Cr	$\epsilon$	752.39	0.0	7/2-	320.0835	5/2-	9.930	10	5.869	6	
<sup>51</sup> Mn	$\beta^+/\epsilon$	3207.49	0.0	5/2-	0.0	7/2-	99.591	12	5.3076	10	
<sup>51</sup> Fe	$\beta^+/\epsilon$	8054.0	0.0	5/2-	237	7/2-	5.0	13	4.88	11	P
<sup>52</sup> V	$\beta^-$	3976.48	0.0	3+	1434.081	2+	99.2	10	5.0091	44	
<sup>52</sup> Mn	$\beta^+/\epsilon$	4708.12	0.0	6+	3615.946	5+	7.69	6	6.1235	41	
<sup>52</sup> Mn	$\epsilon$	4708.12	0.0	6+	4015.52	5+	1.04	5	6.594	21	
<sup>52</sup> Fe	$\beta^+/\epsilon$	2379.29	6958.0	12+	3837.2	11+	100.		4.911	6	
<sup>53</sup> Ti	$\beta^-$	4970.2	0.0	(3/2)-	1904.01	(5/2)-	37	3	4.938	37	P
<sup>53</sup> Ti	$\beta^-$	4970.2	0.0	(3/2)-	1957.6	(1/2)-	4.8	7	5.79	6	P
<sup>53</sup> Ti	$\beta^-$	4970.2	0.0	(3/2)-	2550.6	(1/2)-	4.5	13	5.41	13	P
<sup>53</sup> Ti	$\beta^-$	4970.2	0.0	(3/2)-	2829.5	(5/2)-	11.1	11	4.791	45	P
<sup>53</sup> Fe	$\beta^+/\epsilon$	3742.9	0.0	7/2-	377.90	5/2-	42	8	5.07	8	
<sup>54</sup> Sc	$\beta^-$	1.1306E4	0.0	(3)+	1495.76	(2)+	21	7	5.69	15	P
<sup>54</sup> Sc	$\beta^-$	1.1306E4	0.0	(3)+	2498.2	(4)+	33	4	5.27	5	P
<sup>54</sup> Sc	$\beta^-$	1.1306E4	0.0	(3)+	2516.83	(2)+	10	2	5.78	9	P
<sup>54</sup> Co	$\beta^+/\epsilon$	8244.55	197.1	7+	2948	6+	100.		5.189	6	
<sup>55</sup> Cr	$\beta^-$	2602.22	0.0	3/2-	0.0	5/2-	99.958	4	5.03385	44	
<sup>55</sup> Fe	$\epsilon$	231.12	0.0	3/2-	0.0	5/2-	100		5.9861	35	
<sup>55</sup> Co	$\beta^+/\epsilon$	3451.43	0.0	7/2-	931.27	5/2-	52.0	30	6.256	25	
<sup>55</sup> Co	$\beta^+/\epsilon$	3451.43	0.0	7/2-	2212.2	9/2-	1.87	16	6.115	37	
<sup>56</sup> Mn	$\beta^-$	3695.50	0.0	3+	846.7762	2+	56.6	7	7.111	5	
<sup>56</sup> Mn	$\beta^-$	3695.50	0.0	3+	2657.547	2+	27.5	4	5.631	6	
<sup>56</sup> Mn	$\beta^-$	3695.50	0.0	3+	2959.935	2+	14.5	3	5.347	9	
<sup>56</sup> Mn	$\beta^-$	3695.50	0.0	3+	3369.91	2+	1.20	3	5.186	11	
<sup>56</sup> Co	$\beta^+/\epsilon$	4566.65	0.0	4+	3445.348	3+	21.90	40	6.979	8	
<sup>56</sup> Co	$\epsilon$	4566.65	0.0	4+	3856.495	3+	16.85	5	6.6933	31	
<sup>56</sup> Co	$\epsilon$	4566.65	0.0	4+	4048.888	3+	3.965	13	7.0442	33	
<sup>56</sup> Co	$\epsilon$	4566.65	0.0	4+	4119.936	3+	9.940	18	6.5152	32	
<sup>56</sup> Co	$\epsilon$	4566.65	0.0	4+	4394.93	3+	0.2159	18	7.328	6	
<sup>57</sup> Cr	$\beta^-$	4961.3	0.0	(3/2)-	0.0	5/2-	74	12	5.41	7	P
<sup>57</sup> Mn	$\beta^-$	2695.7	0.0	5/2-	14.41291	3/2-	81	3	4.814	18	
<sup>57</sup> Mn	$\beta^-$	2695.7	0.0	5/2-	366.776	3/2-	1.62	7	6.252	20	
<sup>57</sup> Co	$\epsilon$	836.36	0.0	7/2-	136.47390	5/2-	99.82	19	6.4543	30	
<sup>57</sup> Co	$\epsilon$	836.36	0.0	7/2-	706.438	5/2-	0.186	6	7.686	15	
<sup>57</sup> Ni	$\beta^+/\epsilon$	3261.7	0.0	3/2-	1504.830	1/2-	17.0	5	6.055	13	
<sup>57</sup> Ni	$\beta^+/\epsilon$	3261.7	0.0	3/2-	1919.50	5/2-	12.30	40	5.743	14	
<sup>57</sup> Ni	$\beta^+/\epsilon$	3261.7	0.0	3/2-	2133.06	5/2-	0.0340	19	8.134	24	
<sup>57</sup> Cu	$\beta^+/\epsilon$	8774.95	0.0	3/2-	1112.6	1/2-	8.6	6	4.383	30	P
<sup>58</sup> Cu	$\beta^+/\epsilon$	8561.02	0.0	1+	1454.56	2+	1.40	40	6.21	12	P
<sup>58</sup> Cu	$\beta^+/\epsilon$	8561.02	0.0	1+	3264.64	2+	1.16	7	5.581	26	P
<sup>59</sup> Mn	$\beta^-$	5139.6	0.0	5/2-	726.28	3/2-	32	5	4.89	7	P
<sup>59</sup> Mn	$\beta^-$	5139.6	0.0	5/2-	1161.85	3/2-	10.5	15	5.17	6	P
<sup>59</sup> Fe	$\beta^-$	1564.88	0.0	3/2-	1434.253	1/2-	1.31	5	6.501	17	
<sup>59</sup> Fe	$\beta^-$	1564.88	0.0	3/2-	1481.63	5/2-	0.078	7	7.119	40	
<sup>59</sup> Cu	$\beta^+/\epsilon$	4798.38	0.0	3/2-	339.37	5/2-	5.97	10	5.846	8	P
<sup>59</sup> Cu	$\beta^+/\epsilon$	4798.38	0.0	3/2-	464.92	1/2-	3.40	15	6.018	19	P
<sup>59</sup> Cu	$\beta^+/\epsilon$	4798.38	0.0	3/2-	1301.41	1/2-	19.60	30	4.698	7	P
<sup>59</sup> Cu	$\beta^+/\epsilon$	4798.38	0.0	3/2-	1679.70	5/2-	1.700	30	5.451	8	P
<sup>59</sup> Zn	$\beta^+/\epsilon$	9142.8	0.0	3/2-	491.4	1/2-	4.8	6	4.87	5	P
<sup>59</sup> Zn	$\beta^+/\epsilon$	9142.8	0.0	3/2-	914.2	5/2-	1.10	20	5.40	8	P
<sup>60</sup> Mn	$\beta^-$	8445.2	0.0	1+	823	2+	4.2	12	5.65	13	P
<sup>60</sup> Co	$\beta^-$	2822.81	0.0	5+	2505.748	4+	99.88	3	7.5209	10	

**Table 10**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
<sup>60</sup> Cu	$\beta+\varepsilon$	6128.0	0.0	2+	2626.25	3+	2.90	30	6.773	46	
<sup>60</sup> Cu	$\beta+\varepsilon$	6128.0	0.0	2+	4020.49	1+	1.40	12	5.673	38	
<sup>61</sup> Co	$\beta^-$	1323.9	0.0	7/2-	67.412	5/2-	95.6	4	5.2512	25	
<sup>61</sup> Cu	$\beta+\varepsilon$	2238.0	0.0	3/2-	67.416	5/2-	3.2	6	6.32	8	
<sup>61</sup> Cu	$\beta+\varepsilon$	2238.0	0.0	3/2-	282.955	1/2-	9.6	18	5.56	8	
<sup>61</sup> Cu	$\beta+\varepsilon$	2238.0	0.0	3/2-	656.017	1/2-	13.7	25	4.94	8	
<sup>61</sup> Cu	$\beta+\varepsilon$	2238.0	0.0	3/2-	908.620	5/2-	1.30	24	5.73	8	
<sup>61</sup> Zn	$\beta+\varepsilon$	5635	0.0	3/2-	474.98	1/2-	10.9	6	5.982	25	P
<sup>61</sup> Zn	$\beta+\varepsilon$	5635	0.0	3/2-	2792.98	5/2-	1.74	15	5.220	41	P
<sup>61</sup> Ga	$\beta+\varepsilon$	9214	0.0	3/2-	88.2	1/2-	1.9	6	5.36	14	P
<sup>61</sup> Ga	$\beta+\varepsilon$	9214	0.0	3/2-	123.3	5/2-	1.20	40	5.55	15	P
<sup>62</sup> Co	$\beta^-$	5322	0.0	(2)+	3059.2	3+	1.00	25	6.46	11	P
<sup>62</sup> Co	$\beta^-$	5322	22	(5)+	2336.4	4+	64.0	15	6.141	16	P
<sup>62</sup> Co	$\beta^-$	5322	22	(5)+	3176.7	4+	19.6	6	6.047	21	P
<sup>62</sup> Co	$\beta^-$	5322	22	(5)+	3277.8	4+	5.0	4	6.553	39	P
<sup>62</sup> Co	$\beta^-$	5322	22	(5)+	4055.2	4+	10.2	6	5.413	36	P
<sup>63</sup> Co	$\beta^-$	3661	0.0	7/2-	87.15	5/2-	93	5	4.816	26	
<sup>63</sup> Co	$\beta^-$	3661	0.0	7/2-	1068.99	(5/2)-	3.71	24	5.609	32	P
<sup>63</sup> Ni	$\beta^-$	66.977	0.0	1/2-	0.0	3/2-	100		6.688	6	
<sup>63</sup> Zn	$\beta+\varepsilon$	3366.4	0.0	3/2-	669.66	1/2-	7.90	30	5.830	17	
<sup>63</sup> Zn	$\beta+\varepsilon$	3366.4	0.0	3/2-	962.09	5/2-	6.10	40	5.619	29	
<sup>65</sup> Co	$\beta^-$	5940.6	0.0	(7/2)-	0.0	5/2-	91.7	8	4.449	12	
<sup>65</sup> Ni	$\beta^-$	2137.9	0.0	5/2-	0.0	3/2-	60.0	3	6.5887	23	
<sup>65</sup> Ni	$\beta^-$	2137.9	0.0	5/2-	1481.83	7/2-	28.4	2	4.9177	35	
<sup>65</sup> Zn	$\beta+\varepsilon$	1351.65	0.0	5/2-	0.0	3/2-	49.96	10	7.451	8	
<sup>65</sup> Ga	$\beta+\varepsilon$	3254.5	0.0	3/2-	768.84	5/2-	2.2	5	5.76	10	P
<sup>65</sup> Ga	$\beta+\varepsilon$	3254.5	0.0	3/2-	866.93	1/2-	8.4	17	5.06	9	P
<sup>65</sup> Ga	$\beta+\varepsilon$	3254.5	0.0	3/2-	1047.43	5/2-	2.7	6	5.34	10	P
<sup>65</sup> Ga	$\beta+\varepsilon$	3254.5	0.0	3/2-	1343.94	5/2-	1.10	22	5.36	9	P
<sup>65</sup> Ge	$\beta+\varepsilon$	6179.3	0.0	3/2-	62.0	(1/2)-	30	8	5.49	12	
<sup>65</sup> Ge	$\beta+\varepsilon$	6179.3	0.0	3/2-	190.8	5/2-	4.4	10	6.27	10	
<sup>66</sup> Cu	$\beta^-$	2640.9	0.0	1+	1039.21	2+	9.01	9	5.4430	46	
<sup>67</sup> Ga	$\varepsilon$	1001.2	0.0	3/2-	93.310	1/2-	52.5	11	5.249	16	
<sup>67</sup> Ga	$\varepsilon$	1001.2	0.0	3/2-	887.693	5/2-	0.281	4	5.655	23	
<sup>67</sup> Ge	$\beta+\varepsilon$	4205.4	0.0	1/2-	828.33	3/2-	1.10	30	6.99	12	
<sup>67</sup> Ge	$\beta+\varepsilon$	4205.4	0.0	1/2-	1639.92	3/2-	9.1	5	5.324	25	
<sup>67</sup> Ge	$\beta+\varepsilon$	4205.4	0.0	1/2-	1809.84	3/2-	5.40	40	5.363	33	
<sup>68</sup> As	$\beta+\varepsilon$	8084.3	0.0	3+	2268.6	4+	3.10	40	7.03	6	P
<sup>68</sup> As	$\beta+\varepsilon$	8084.3	0.0	3+	2457.7	2+	3.5	8	6.90	10	P
<sup>68</sup> As	$\beta+\varepsilon$	8084.3	0.0	3+	2830.9	4+	3.34	22	6.755	29	P
<sup>68</sup> As	$\beta+\varepsilon$	8084.3	0.0	3+	3023.6	2+	4.00	30	6.585	33	P
<sup>68</sup> As	$\beta+\varepsilon$	8084.3	0.0	3+	3522.5	2+	1.40	10	6.783	31	P
<sup>68</sup> As	$\beta+\varepsilon$	8084.3	0.0	3+	3809.7	2+	1.20	10	6.686	36	P
<sup>68</sup> Cu	$\beta^-$	4440.1	0.0	1+	1077.7	2+	38	4	5.177	46	P
<sup>68</sup> Cu	$\beta^-$	4440.1	0.0	1+	2339.5	2+	16.0	12	4.679	34	P
<sup>68</sup> Cu	$\beta^-$	4440.1	0.0	1+	2821.4	2+	1.7	4	5.19	10	P
<sup>68</sup> Ga	$\beta+\varepsilon$	2921.1	0.0	1+	1077.36	2+	2.990	30	5.499	9	
<sup>69</sup> Cu	$\beta^-$	2681.7	0.0	3/2-	0.0	1/2-	51	8	5.37	7	
<sup>69</sup> Cu	$\beta^-$	2681.7	0.0	3/2-	531.30	5/2-	2.5	6	6.27	11	
<sup>69</sup> Cu	$\beta^-$	2681.7	0.0	3/2-	1180.73	5/2-	4.2	7	5.41	8	
<sup>69</sup> Zn	$\beta^-$	909.9	0.0	1/2-	0.0	3/2-	99.9986	2	4.501	7	
<sup>69</sup> Ge	$\beta+\varepsilon$	2227.1	0.0	5/2-	0.0	3/2-	31	8	6.50	11	
<sup>69</sup> Ge	$\beta+\varepsilon$	2227.1	0.0	5/2-	872.00	3/2-	11.8	16	6.00	6	

**Table 10**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	$\text{Log } ft$	Unc.	Pand.
$^{69}\text{Ge}$	$\varepsilon$	2227.1	0.0	5/2-	1336.61	7/2-	4.4	7	6.05	7	
$^{69}\text{Ge}$	$\varepsilon$	2227.1	0.0	5/2-	1487.96	7/2-	0.18	3	7.27	7	
$^{69}\text{Ge}$	$\varepsilon$	2227.1	0.0	5/2-	1525.86	3/2-	0.77	10	6.60	6	
$^{69}\text{Ge}$	$\varepsilon$	2227.1	0.0	5/2-	1891.51	3/2-	0.71	9	5.98	6	
$^{69}\text{Ge}$	$\varepsilon$	2227.1	0.0	5/2-	1924.02	7/2-	1.26	16	5.64	6	
$^{69}\text{As}$	$\beta+\varepsilon$	3988	0.0	5/2-	232.736	3/2-	14.6	5	6.048	27	
$^{69}\text{As}$	$\beta+\varepsilon$	3988	0.0	5/2-	1767.14	3/2-	1.01	7	5.811	46	
$^{70}\text{As}$	$\beta+\varepsilon$	6228.1	0.0	4+	2451.30	3+	5.90	20	6.995	15	
$^{70}\text{As}$	$\beta+\varepsilon$	6228.1	0.0	4+	3046.43	3+	34.7	21	5.774	26	
$^{70}\text{Cu}$	$\beta-$	6588.4	0.0	6-	3038.30	5-	58	3	5.255	23	P
$^{71}\text{Zn}$	$\beta-$	2810.3	155.62	9/2+	2247.272	7/2+	5.8	1	6.005	10	
$^{71}\text{Ge}$	$\varepsilon$	232.47	0.0	1/2-	0.0	3/2-	100		4.3461	27	
$^{71}\text{As}$	$\beta+\varepsilon$	2013.4	0.0	5/2-	499.923	3/2-	1.88	5	7.206	15	
$^{71}\text{As}$	$\varepsilon$	2013.4	0.0	5/2-	1095.516	3/2-	4.57	13	6.346	17	
$^{71}\text{As}$	$\varepsilon$	2013.4	0.0	5/2-	1139.446	3/2-	1.01	3	6.959	17	
$^{71}\text{As}$	$\varepsilon$	2013.4	0.0	5/2-	1298.734	3/2-	0.220	11	7.443	25	
$^{71}\text{As}$	$\varepsilon$	2013.4	0.0	5/2-	1406.651	(7/2)-	0.215	7	7.309	20	
$^{71}\text{As}$	$\varepsilon$	2013.4	0.0	5/2-	1506.414	7/2-	0.175	6	7.240	21	
$^{71}\text{As}$	$\varepsilon$	2013.4	0.0	5/2-	1598.533	3/2-	0.231	18	6.941	38	
$^{71}\text{As}$	$\varepsilon$	2013.4	0.0	5/2-	1743.446	3/2-	0.076	5	7.039	36	
$^{71}\text{As}$	$\varepsilon$	2013.4	0.0	5/2-	1965.06	3/2-	0.00115	25	7.20	14	
$^{72}\text{Ga}$	$\beta-$	3997.6	0.0	3-	3036.018	2-	28.87	12	6.3225	23	
$^{72}\text{Ga}$	$\beta-$	3997.6	0.0	3-	3342.135	(2)-	15.71	6	5.9750	25	
$^{72}\text{As}$	$\beta+\varepsilon$	4343.60	0.0	2-	2514.76	3-	1.39	5	7.239	16	
$^{72}\text{As}$	$\beta+\varepsilon$	4343.60	0.0	2-	2939.95	1-	1.760	40	6.747	12	
$^{72}\text{As}$	$\beta+\varepsilon$	4343.60	0.0	2-	2943.43	3-	0.583	16	7.225	14	
$^{72}\text{As}$	$\varepsilon$	4343.60	0.0	2-	3325.10	(3)-	0.073	4	7.834	25	
$^{72}\text{As}$	$\varepsilon$	4343.60	0.0	2-	3550.66	(1)-	0.078	7	7.585	40	
$^{73}\text{Br}$	$\beta+\varepsilon$	4582	0.0	1/2-	25.70	3/2-	22	5	5.70	10	P
$^{73}\text{Kr}$	$\beta+\varepsilon$	7094	0.0	(3/2)-	0.0	1/2-	36	9	5.68	11	
$^{73}\text{Zn}$	$\beta-$	4105.9	0.0	1/2-	217.69	3/2-	5.6	14	6.20	11	P
$^{73}\text{Zn}$	$\beta-$	4105.9	0.0	1/2-	911.03	3/2-	1.8	5	6.32	12	P
$^{73}\text{Zn}$	$\beta-$	4105.9	0.0	1/2-	2109.07	3/2-	2.6	7	5.29	12	P
$^{73}\text{Ga}$	$\beta-$	1598.2	0.0	1/2-	364.07	3/2-	78.6	10	5.842	7	
$^{73}\text{Ga}$	$\beta-$	1598.2	0.0	1/2-	392.46	3/2-	7.1	4	6.847	25	
$^{73}\text{As}$	$\varepsilon$	344.8	0.0	3/2-	66.722	1/2-	100		5.417	20	
$^{73}\text{Se}$	$\beta+\varepsilon$	2725	25.71	3/2-	67.09	5/2-	3.00	40	6.26	6	
$^{73}\text{Se}$	$\beta+\varepsilon$	2725	25.71	3/2-	84.19	(1/2)-	1.55	17	6.53	5	
$^{73}\text{Se}$	$\beta+\varepsilon$	2725	25.71	3/2-	574.43	(1/2)-	1.37	12	6.062	43	
$^{75}\text{Ge}$	$\beta-$	1178.56	0.0	1/2-	0.0	3/2-	87.1	13	5.190	6	
$^{75}\text{Ge}$	$\beta-$	1178.56	0.0	1/2-	264.60	3/2-	11.5	12	5.650	45	
$^{75}\text{Br}$	$\beta+\varepsilon$	3062.5	0.0	3/2-	427.80	5/2-	6.3	10	6.28	7	P
$^{75}\text{Br}$	$\beta+\varepsilon$	3062.5	0.0	3/2-	663.89	5/2-	4.90	30	6.147	28	P
$^{75}\text{Br}$	$\beta+\varepsilon$	3062.5	0.0	3/2-	1073.77	5/2-	1.11	10	6.354	40	P
$^{75}\text{Kr}$	$\beta+\varepsilon$	4783	0.0	5/2+	154.68	(3/2)+	39.5	14	5.617	17	P
$^{75}\text{Kr}$	$\beta+\varepsilon$	4783	0.0	5/2+	374.20	(7/2)+	6.11	22	6.306	18	P
$^{76}\text{Rb}$	$\beta+\varepsilon$	8534.6	0.0	1-	2227.28	2-	7.00	40	6.238	26	
$^{76}\text{Rb}$	$\beta+\varepsilon$	8534.6	0.0	1-	3024.42	2-	7.7	5	5.872	29	
$^{76}\text{As}$	$\beta-$	2960.6	0.0	2-	2429.146	3-	1.52	3	6.978	9	
$^{76}\text{Br}$	$\beta+\varepsilon$	4963	0.0	1-	2670.35	2-	1.70	15	7.497	40	
$^{77}\text{Kr}$	$\beta+\varepsilon$	3065.4	0.0	5/2+	276.21	(3/2)+	41.5	20	5.483	21	P
$^{77}\text{Rb}$	$\beta+\varepsilon$	5339.0	0.0	3/2-	245.30	5/2-	12.9	25	6.25	8	P
$^{77}\text{Rb}$	$\beta+\varepsilon$	5339.0	0.0	3/2-	459.88	1/2-	7.3	14	6.39	8	P

**Table 10**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
<sup>77</sup> Ge	$\beta^-$	2703.5	0.0	7/2+	475.48	9/2+	16.0	10	7.948	27	
<sup>77</sup> Ge	$\beta^-$	2703.5	0.0	7/2+	631.88	5/2+	21.4	17	7.691	35	
<sup>77</sup> Ge	$\beta^-$	2703.5	0.0	7/2+	1528.34	5/2+	1.87	11	7.763	26	
<sup>77</sup> Ge	$\beta^-$	2703.5	0.0	7/2+	1560.47	5/2+	7.5	4	7.114	23	
<sup>77</sup> Ge	$\beta^-$	2703.5	0.0	7/2+	2000.19	5/2+	8.07	21	6.296	12	
<sup>77</sup> Ge	$\beta^-$	2703.5	0.0	7/2+	2110.94	5/2+	2.32	7	6.571	14	
<sup>77</sup> Ge	$\beta^-$	2703.5	0.0	7/2+	2341.75	(5/2)+	2.37	6	5.823	13	
<sup>77</sup> Ge	$\beta^-$	2703.5	159.71	1/2-	0.0	3/2-	58	4	4.975	30	
<sup>77</sup> Ge	$\beta^-$	2703.5	159.71	1/2-	215.53	3/2-	22	4	5.25	8	
<sup>77</sup> As	$\beta^-$	683.2	0.0	3/2-	0.0	1/2-	97.0	3	5.7284	42	
<sup>77</sup> As	$\beta^-$	683.2	0.0	3/2-	249.800	5/2-	0.63	10	7.22	7	
<sup>77</sup> As	$\beta^-$	683.2	0.0	3/2-	439.493	5/2-	0.0017	3	8.96	8	
<sup>77</sup> Br	$\beta^+/\epsilon$	1364.7	0.0	3/2-	0.0	1/2-	44.5	13	5.749	14	
<sup>77</sup> Br	$\beta^+/\epsilon$	1364.7	0.0	3/2-	249.75	5/2-	0.54	9	7.48	7	
<sup>77</sup> Br	$\epsilon$	1364.7	0.0	3/2-	439.43	5/2-	1.46	7	6.884	22	
<sup>77</sup> Br	$\epsilon$	1364.7	0.0	3/2-	817.80	1/2-	10.0	3	5.585	15	
<sup>77</sup> Br	$\epsilon$	1364.7	0.0	3/2-	824.39	(5/2)-	4.7	1	5.902	12	
<sup>77</sup> Br	$\epsilon$	1364.7	0.0	3/2-	1230.64	(5/2)-	0.038	3	6.726	42	
<sup>78</sup> As	$\beta^-$	4209	0.0	2-	3144.52	3-	2.5	3	6.62	5	
<sup>78</sup> Br	$\beta^+/\epsilon$	3573.8	0.0	1+	613.71	2+	13.30	40	5.087	14	
<sup>79</sup> Rb	$\beta^+/\epsilon$	3639.5	0.0	5/2+	129.76	7/2+	11.9	13	6.130	48	P
<sup>79</sup> Rb	$\beta^+/\epsilon$	3639.5	0.0	5/2+	688.16	3/2+	50.5	23	5.053	22	P
<sup>79</sup> Ge	$\beta^-$	4109	0.0	(1/2)-	0.0	3/2-	60	3	5.194	28	P
<sup>79</sup> Ge	$\beta^-$	4109	0.0	(1/2)-	109.51	(3/2)-	22.4	14	5.569	33	P
<sup>79</sup> Ge	$\beta^-$	4109	0.0	(1/2)-	1505.90	(3/2)-	12.1	8	5.027	39	P
<sup>79</sup> As	$\beta^-$	2281	0.0	3/2-	95.5	1/2-	94.2	5	5.287	9	
<sup>79</sup> As	$\beta^-$	2281	0.0	3/2-	364.5	5/2-	1.46	15	6.861	45	
<sup>79</sup> Kr	$\beta^+/\epsilon$	1625.8	0.0	1/2-	0.0	3/2-	62.7	13	5.631	10	
<sup>79</sup> Kr	$\beta^+/\epsilon$	1625.8	0.0	1/2-	261.32	3/2-	11.8	5	6.159	19	
<sup>79</sup> Kr	$\epsilon$	1625.8	0.0	1/2-	606.02	3/2-	12.1	5	5.886	19	
<sup>79</sup> Kr	$\epsilon$	1625.8	0.0	1/2-	1332.31	3/2-	1.27	7	5.757	28	
<sup>80</sup> As	$\beta^-$	5544.9	0.0	1+	666.14	2+	26	3	5.81	5	P
<sup>80</sup> As	$\beta^-$	5544.9	0.0	1+	1448.97	2+	1.1	3	6.84	12	P
<sup>80</sup> As	$\beta^-$	5544.9	0.0	1+	1960.0	2+	1.4	2	6.48	6	P
<sup>80</sup> Br	$\beta^+/\epsilon$	1870.46	0.0	1+	665.8	2+	1.10	10	4.953	40	
<sup>80</sup> Br	$\beta^-$	2004.4	0.0	1+	616.6	2+	6.2	6	5.996	42	
<sup>80</sup> Rb	$\beta^+/\epsilon$	5718.0	0.0	1+	616.8	2+	21.6	26	5.20	5	P
<sup>80</sup> Rb	$\beta^+/\epsilon$	5718.0	0.0	1+	1256.5	2+	2.10	30	5.88	6	P
<sup>81</sup> Rb	$\beta^+/\epsilon$	2239	0.0	3/2-	190.72	1/2-	64.0	30	5.151	21	
<sup>81</sup> Rb	$\beta^+/\epsilon$	2239	0.0	3/2-	700.86	(5/2)-	5.0	10	5.81	9	
<sup>81</sup> Sr	$\beta^+/\epsilon$	3929	0.0	1/2-	301.240	(3/2)-	30	5	5.80	7	P
<sup>81</sup> Sr	$\beta^+/\epsilon$	3929	0.0	1/2-	909.089	(3/2)-	9.5	12	5.82	6	P
<sup>81</sup> Sr	$\beta^+/\epsilon$	3929	0.0	1/2-	1381.89	(3/2)-	5.0	6	5.67	5	P
<sup>81</sup> Ga	$\beta^-$	8663.7	0.0	5/2-	3697.95	(7/2)-	1.13	11	6.079	42	P
<sup>81</sup> As	$\beta^-$	3855.7	0.0	3/2-	0.0	1/2-	66.3	7	5.287	11	
<sup>81</sup> As	$\beta^-$	3855.7	0.0	3/2-	490.91	(5/2)-	8.94	15	5.898	13	
<sup>81</sup> As	$\beta^-$	3855.7	0.0	3/2-	623.95	5/2-	1.58	13	6.574	37	
<sup>81</sup> Se	$\beta^-$	1588.0	0.0	1/2-	0.0	3/2-	98.73	10	5.0271	32	
<sup>82</sup> Y	$\beta^+/\epsilon$	7946	0.0	1+	573.5	2+	21	6	5.48	12	P
<sup>82</sup> Y	$\beta^+/\epsilon$	7946	0.0	1+	1175.6	2+	1.20	40	6.52	15	P
<sup>82</sup> Br	$\beta^-$	3093.1	0.0	5-	2648.368	4-	99.1	13	5.064	7	
<sup>82</sup> Rb	$\beta^+/\epsilon$	4404.0	0.0	1+	776.523	2+	14.10	40	4.886	13	
<sup>82</sup> Rb	$\beta^+/\epsilon$	4404.0	69.0	5-	2648.43	4-	86.4	11	4.958	7	

**Table 10**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	$\text{Log } ft$	Unc.	Pand.
$^{83}\text{Se}$	$\beta^-$	3673.2	0.0	9/2+	2647.187	(7/2)+	30.7	3	4.877	9	
$^{83}\text{Se}$	$\beta^-$	3673.2	0.0	9/2+	2694.305	(7/2)+	26.3	2	4.867	9	
$^{83}\text{Se}$	$\beta^-$	3673.2	228.92	1/2-	0.0	3/2-	31.0	7	5.978	10	P
$^{83}\text{Se}$	$\beta^-$	3673.2	228.92	1/2-	1030.65	(3/2)-	33.2	11	5.369	15	P
$^{83}\text{Br}$	$\beta^-$	976.9	0.0	3/2-	41.5567	1/2-	98.6	4	5.044	7	
$^{83}\text{Sr}$	$\beta+\epsilon$	2273	0.0	7/2+	42.0780	9/2+	23	7	6.63	13	
$^{83}\text{Sr}$	$\beta+\epsilon$	2273	0.0	7/2+	423.613	5/2+	14.7	12	6.46	5	
$^{83}\text{Sr}$	$\beta+\epsilon$	2273	0.0	7/2+	1242.93	(5/2)+	1.90	14	6.72	6	
$^{83}\text{Sr}$	$\epsilon$	2273	0.0	7/2+	1798.57	(5/2)+	0.53	7	6.59	8	
$^{83}\text{Sr}$	$\epsilon$	2273	0.0	7/2+	1952.04	5/2+	4.7	4	5.29	7	
$^{83}\text{Sr}$	$\epsilon$	2273	0.0	7/2+	2189.73	9/2+	0.38	3	5.10	13	
$^{84}\text{Br}$	$\beta^-$	4656	0.0	2-	2699.93	3-	7.3	9	6.78	6	
$^{84}\text{Br}$	$\beta^-$	4656	0.0	2-	3927.30	1-	11.5	13	4.93	8	
$^{84}\text{Br}$	$\beta^-$	4656	3.2E+2	(6)-	2768.6	5-	100		5.14	9	
$^{85}\text{Y}$	$\beta+\epsilon$	3261	19.8	(9/2)+	231.80	7/2+	5.8	18	7.19	14	
$^{85}\text{Y}$	$\beta+\epsilon$	3261	19.8	(9/2)+	1220.75	(11/2)+	1.72	16	6.813	47	
$^{85}\text{Y}$	$\beta+\epsilon$	3261	19.8	(9/2)+	2123.78	(7/2)+	11.7	10	5.284	47	
$^{85}\text{Y}$	$\beta+\epsilon$	3261	19.8	(9/2)+	2172.02	(7/2)+	7.8	6	5.423	44	
$^{85}\text{Y}$	$\epsilon$	3261	19.8	(9/2)+	2351.73	(7/2)+	5.0	4	5.460	47	
$^{85}\text{Se}$	$\beta^-$	6161.8	0.0	(5/2)+	3741.7	(3/2)+	9.7	17	5.26	8	P
$^{85}\text{Se}$	$\beta^-$	6161.8	0.0	(5/2)+	4028.8	(3/2)+	7.3	12	5.15	7	P
$^{85}\text{Br}$	$\beta^-$	2904.9	0.0	3/2-	304.88	1/2-	96	2	5.134	13	
$^{85}\text{Kr}$	$\beta^-$	687.0	304.86	1/2-	151.195	3/2-	78.5	10	5.266	7	
$^{85}\text{Sr}$	$\beta+\epsilon$	1064.1	238.79	1/2-	151.191	3/2-	13.3	8	4.51	5	
$^{86}\text{Y}$	$\beta+\epsilon$	5240	0.0	4-	2672.98	5-	8.4	7	7.084	38	
$^{86}\text{Y}$	$\beta+\epsilon$	5240	0.0	4-	2997.47	3-	24.8	9	6.306	20	
$^{86}\text{Y}$	$\beta+\epsilon$	5240	0.0	4-	3055.90	5-	3.04	24	7.162	37	
$^{86}\text{Y}$	$\beta+\epsilon$	5240	0.0	4-	3185.34	(3)-	5.6	12	6.78	9	
$^{86}\text{Y}$	$\beta+\epsilon$	5240	0.0	4-	3317.74	(5)-	4.6	7	6.74	7	
$^{86}\text{Y}$	$\beta+\epsilon$	5240	0.0	4-	3686.77	3-	1.16	8	7.051	34	
$^{87}\text{Y}$	$\epsilon$	1861.7	0.0	1/2-	873.338	3/2-	93.4	4	5.458	9	
$^{88}\text{Rb}$	$\beta^-$	5312.62	0.0	2-	2734.128	3-	13.59	21	6.788	7	
$^{88}\text{Y}$	$\epsilon$	3622.6	0.0	4-	2734.130	3-	94.4	3	6.866	9	
$^{88}\text{Y}$	$\epsilon$	3622.6	0.0	4-	3584.7	5-	0.066	13	6.91	11	
$^{89}\text{Rb}$	$\beta^-$	4497	0.0	3/2-	2280.14	(1/2)-	37	3	6.013	36	
$^{89}\text{Zr}$	$\epsilon$	2833.2	0.0	9/2+	2529.97	7/2+	0.073	5	7.544	32	
$^{89}\text{Zr}$	$\epsilon$	2833.2	0.0	9/2+	2566.47	11/2+	0.106	5	7.265	25	
$^{89}\text{Zr}$	$\beta+\epsilon$	2833.2	587.83	1/2-	1507.4	3/2-	6.06	15	4.321	12	P
$^{90}\text{Nb}$	$\beta+\epsilon$	6111.0	0.0	8+	5059.97	7+	4.64	9	6.164	12	
$^{91}\text{Tc}$	$\beta+\epsilon$	6222	139.3	(1/2)-	1155.91	3/2-	44.0	40	5.691	42	P
$^{91}\text{Tc}$	$\beta+\epsilon$	6222	139.3	(1/2)-	2083.50	3/2-	4.2	5	6.23	5	P
$^{91}\text{Tc}$	$\beta+\epsilon$	6222	139.3	(1/2)-	2690.35	(3/2)-	6.9	6	5.641	40	P
$^{91}\text{Mo}$	$\beta+\epsilon$	4429	652.9	1/2-	1312.60	3/2-	18.1	14	4.800	34	P
$^{91}\text{Mo}$	$\beta+\epsilon$	4429	652.9	1/2-	1612.53	3/2-	24.2	19	4.469	35	P
$^{91}\text{Mo}$	$\beta+\epsilon$	4429	652.9	1/2-	2345.24	(3/2)-	1.70	13	5.049	34	P
$^{92}\text{Y}$	$\beta^-$	3643	0.0	2-	2339.92	3-	6.5	7	7.019	48	
$^{92}\text{Tc}$	$\beta+\epsilon$	7882.9	0.0	(8)+	4917.4	7+	2.12	13	5.744	31	P
$^{93}\text{Tc}$	$\epsilon$	3201.0	391.84	1/2-	2644.6	(3/2)-	14.3	6	4.358	22	
$^{93}\text{Tc}$	$\epsilon$	3201.0	391.84	1/2-	3220.4	(3/2)-	1.05	9	4.654	40	
$^{93}\text{Rb}$	$\beta^-$	7466	0.0	5/2-	3847.62	(7/2)-	3.73	24	5.719	28	
$^{93}\text{Rb}$	$\beta^-$	7466	0.0	5/2-	3867.40	(7/2)-	5.2	4	5.565	34	
$^{93}\text{Rb}$	$\beta^-$	7466	0.0	5/2-	4913.09	(7/2)-	1.22	9	5.554	33	
$^{93}\text{Tc}$	$\beta+\epsilon$	3201.0	0.0	9/2+	1362.96	7/2+	65.3	6	4.924	11	

**Table 10**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
<sup>93</sup> Tc	$\beta+\epsilon$	3201.0	0.0	9/2+	1520.28	7/2+	23.8	9	5.251	19	
<sup>94</sup> Y	$\beta-$	4918	0.0	2-	2057.64	3-	5.3	5	7.442	41	
<sup>94</sup> Tc	$\beta+\epsilon$	4255.7	0.0	7+	2423.47	6+	81.3	19	5.074	13	P
<sup>94</sup> Tc	$\beta+\epsilon$	4255.7	0.0	7+	2872.7	6+	1.70	30	6.45	8	P
<sup>94</sup> Tc	$\beta+\epsilon$	4255.7	0.0	7+	2955.6	8+	4.00	30	6.019	34	P
<sup>94</sup> Tc	$\beta+\epsilon$	4255.7	0.0	7+	3165.80	6+	3.50	30	5.921	38	P
<sup>94</sup> Tc	$\epsilon$	4255.7	0.0	7+	3339.57	6+	7.9	4	5.413	24	P
<sup>94</sup> Tc	$\beta+\epsilon$	4255.7	76	(2)+	2739.91	1+	9.30	40	5.097	22	
<sup>94</sup> Tc	$\beta+\epsilon$	4255.7	76	(2)+	3128.66	1+	1.60	16	5.597	45	
<sup>95</sup> Rh	$\beta+\epsilon$	5117	0.0	(9/2)+	2246.9	11/2+	3.36	17	5.564	25	
<sup>95</sup> Y	$\beta-$	4452	0.0	1/2-	3249.15	(3/2)-	3.54	24	5.834	31	
<sup>95</sup> Y	$\beta-$	4452	0.0	1/2-	3575.78	(3/2)-	7.4	6	4.997	38	
<sup>95</sup> Zr	$\beta-$	1126.3	0.0	5/2+	724.195	7/2+	44.34	22	7.0068	42	
<sup>95</sup> Zr	$\beta-$	1126.3	0.0	5/2+	756.728	7/2+	54.46	22	6.7953	43	
<sup>95</sup> Nb	$\beta-$	925.60	0.0	9/2+	765.803	7/2+	99.970	6	5.1178	42	
<sup>95</sup> Tc	$\epsilon$	1691	0.0	9/2+	765.793	7/2+	93.77	6	4.959	11	
<sup>95</sup> Tc	$\epsilon$	1691	0.0	9/2+	1073.720	7/2+	4.13	4	5.955	14	
<sup>95</sup> Ru	$\beta+\epsilon$	2564	0.0	5/2+	336.45	7/2+	37.0	11	5.282	16	
<sup>95</sup> Ru	$\beta+\epsilon$	2564	0.0	5/2+	1178.62	7/2+	6.20	30	5.463	24	
<sup>95</sup> Ru	$\epsilon$	2564	0.0	5/2+	1785.35	(7/2)+	1.55	19	5.55	6	
<sup>95</sup> Ru	$\epsilon$	2564	0.0	5/2+	2086.21	3/2+	4.41	24	4.660	35	
<sup>95</sup> Ru	$\epsilon$	2564	0.0	5/2+	2168.36	7/2+	1.95	7	4.843	35	
<sup>95</sup> Ru	$\epsilon$	2564	0.0	5/2+	2267.58	(7/2)+	1.16	8	4.80	5	
<sup>96</sup> Nb	$\beta-$	3192.06	0.0	6+	2438.508	5+	96.7	19	5.815	9	
<sup>96</sup> Tc	$\epsilon$	2973	0.0	7+	2440.71	6+	79	4	5.253	27	
<sup>96</sup> Tc	$\epsilon$	2973	0.0	7+	2755.04	6+	19.5	12	5.042	40	
<sup>96</sup> Tc	$\beta+\epsilon$	2973	34.23	4+	1978.41	3+	2.90	30	5.197	47	
<sup>96</sup> Rh	$\beta+\epsilon$	6393	0.0	6+	3377.57	5+	11.6	6	5.432	24	
<sup>96</sup> Rh	$\beta+\epsilon$	6393	0.0	6+	4777.49	5+	2.04	13	5.137	29	
<sup>96</sup> Rh	$\beta+\epsilon$	6393	0.0	6+	4949.63	5+	1.14	11	5.279	43	
<sup>96</sup> Rh	$\beta+\epsilon$	6393	52.0	3+	832.51	2+	10.0	30	6.17	13	P
<sup>96</sup> Rh	$\beta+\epsilon$	6393	52.0	3+	1931.13	2+	6.3	15	5.85	10	P
<sup>96</sup> Rh	$\beta+\epsilon$	6393	52.0	3+	2283.96	2+	1.70	40	6.22	10	P
<sup>96</sup> Rh	$\beta+\epsilon$	6393	52.0	3+	2576.07	2+	2.20	40	5.93	8	P
<sup>96</sup> Rh	$\beta+\epsilon$	6393	52.0	3+	2739.86	2+	3.9	7	5.58	8	P
<sup>96</sup> Rh	$\beta+\epsilon$	6393	52.0	3+	3090.14	2+	1.80	40	5.68	10	P
<sup>96</sup> Rh	$\beta+\epsilon$	6393	52.0	3+	3260.98	2+	2.3	5	5.44	9	P
<sup>96</sup> Rh	$\beta+\epsilon$	6393	52.0	3+	3291.5	4+	1.70	40	5.55	10	P
<sup>97</sup> Ru	$\epsilon$	1104	0.0	5/2+	215.769	7/2+	87.43	20	5.535	10	
<sup>97</sup> Ru	$\epsilon$	1104	0.0	5/2+	855.423	7/2+	0.0495	23	7.627	31	
<sup>97</sup> Ru	$\epsilon$	1104	0.0	5/2+	969.801	7/2+	0.153	3	6.541	44	
<sup>97</sup> Rh	$\beta+\epsilon$	3523	0.0	9/2+	421.54	7/2+	68.20	40	5.219	26	
<sup>97</sup> Rh	$\beta+\epsilon$	3523	0.0	9/2+	840.18	7/2+	8.1	8	5.82	5	
<sup>97</sup> Rh	$\beta+\epsilon$	3523	0.0	9/2+	1199.02	(11/2)+	1.50	16	6.27	5	
<sup>97</sup> Rh	$\beta+\epsilon$	3523	0.0	9/2+	1932.32	7/2+	3.60	30	5.367	43	
<sup>97</sup> Rh	$\beta+\epsilon$	3523	0.0	9/2+	2150.9	7/2+	1.63	20	5.57	6	
<sup>97</sup> Rh	$\beta+\epsilon$	3523	258.76	1/2-	2197.71	3/2-	21.1	8	4.771	31	
<sup>97</sup> Rh	$\beta+\epsilon$	3523	258.76	1/2-	2245.90	3/2-	18.90	40	4.788	29	
<sup>97</sup> Rh	$\beta+\epsilon$	3523	258.76	1/2-	2564.91	3/2-	9.9	10	4.85	5	
<sup>97</sup> Rh	$\beta+\epsilon$	3523	258.76	1/2-	2647.83	3/2-	7.7	6	4.900	48	
<sup>97</sup> Rh	$\epsilon$	3523	258.76	1/2-	2929.77	3/2-	2.0	3	5.23	8	
<sup>97</sup> Rh	$\epsilon$	3523	258.76	1/2-	3374.7	3/2-	2.33	25	4.50	10	
<sup>97</sup> Rb	$\beta-$	1.00615E4	0.0	3/2+	687.09	5/2+	12.8	11	5.514	37	P



**Table 10**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
<sup>97</sup> Y	$\beta^-$	6821	667.52	9/2+	1264.35	7/2+	31.6	24	5.173	35	P
<sup>97</sup> Y	$\beta^-$	6821	667.52	9/2+	2234.36	(7/2)+	43.1	21	4.707	24	P
<sup>97</sup> Nb	$\beta^-$	1941.9	0.0	9/2+	658.172	7/2+	98.1	3	5.382	7	
<sup>97</sup> Nb	$\beta^-$	1941.9	0.0	9/2+	1024.528	7/2+	1.12	2	6.774	12	
<sup>98</sup> Y	$\beta^-$	8993	0.0	0-	4165.18	1-	37	4	4.279	47	P
<sup>98</sup> Y	$\beta^-$	8993	0.0	0-	4271.11	1-	4.0	5	5.20	5	P
<sup>98</sup> Y	$\beta^-$	8993	0.0	0-	4399.07	1-	2.9	4	5.29	6	P
<sup>98</sup> Y	$\beta^-$	8993	0.0	0-	4452.58	1-	14.2	15	4.576	46	P
<sup>98</sup> Y	$\beta^-$	8993	0.0	0-	4492.35	1-	2.29	24	5.352	46	P
<sup>98</sup> Nb	$\beta^-$	4591	0.0	1+	787.29	2+	3.0	3	5.662	44	
<sup>98</sup> Nb	$\beta^-$	4591	0.0	1+	1432.37	2+	5.2	5	5.074	43	
<sup>98</sup> Nb	$\beta^-$	4591	0.0	1+	1758.91	2+	7.6	7	4.706	41	
<sup>98</sup> Nb	$\beta^-$	4591	0.0	1+	2207.0	2+	1.13	11	5.220	43	
<sup>98</sup> Nb	$\beta^-$	4591	84	(5)+	2223.823	4+	15.9	2	7.152	8	
<sup>98</sup> Nb	$\beta^-$	4591	84	(5)+	2678.839	6+	27.9	5	6.540	10	
<sup>98</sup> Nb	$\beta^-$	4591	84	(5)+	2767.62	4+	7.7	1	7.019	9	
<sup>98</sup> Nb	$\beta^-$	4591	84	(5)+	3021.71	4+	6.37	8	6.851	9	
<sup>98</sup> Nb	$\beta^-$	4591	84	(5)+	3050.92	4+	2.4	1	7.244	19	
<sup>98</sup> Nb	$\beta^-$	4591	84	(5)+	3326.36	4+	3.30	6	6.789	11	
<sup>98</sup> Nb	$\beta^-$	4591	84	(5)+	3623.50	4+	1.26	9	6.795	33	
<sup>99</sup> Rh	$\beta^+/\epsilon$	2041	64.3	9/2+	340.75	7/2+	65	5	5.186	36	
<sup>99</sup> Rh	$\beta^+/\epsilon$	2041	64.3	9/2+	617.79	7/2+	14.1	12	5.669	40	
<sup>99</sup> Rh	$\epsilon$	2041	64.3	9/2+	1261.19	7/2+	12.7	6	5.207	32	
<sup>99</sup> Pd	$\beta^+/\epsilon$	3402	0.0	(5/2)+	200.3	(7/2)+	49	9	5.29	8	
<sup>99</sup> Pd	$\beta^+/\epsilon$	3402	0.0	(5/2)+	850.7	(7/2)+	6.8	13	5.65	8	
<sup>99</sup> Pd	$\beta^+/\epsilon$	3402	0.0	(5/2)+	1527.4	(3/2)+	1.20	40	5.91	15	
<sup>99</sup> Pd	$\beta^+/\epsilon$	3402	0.0	(5/2)+	2181.0	(3/2)+	4.1	8	4.94	9	
<sup>99</sup> Ag	$\beta^+/\epsilon$	5470	0.0	(9/2)+	264.382	(7/2)+	31.0	30	5.632	43	P
<sup>99</sup> Ag	$\beta^+/\epsilon$	5470	0.0	(9/2)+	1069.84	(11/2)+	5.2	7	6.01	6	P
<sup>99</sup> Ag	$\beta^+/\epsilon$	5470	0.0	(9/2)+	1468.44	(11/2)+	4.2	6	5.87	6	P
<sup>99</sup> Nb	$\beta^-$	3635	0.0	9/2+	235.52	7/2+	82	11	4.73	6	P
<sup>99</sup> Nb	$\beta^-$	3635	0.0	9/2+	865.88	7/2+	1.3	3	6.15	10	P
<sup>99</sup> Nb	$\beta^-$	3635	0.0	9/2+	1142.81	7/2+	1.4	3	5.93	9	P
<sup>99</sup> Nb	$\beta^-$	3635	365.27	1/2-	2641.26	(3/2)-	7.8	10	5.12	7	P
<sup>99</sup> Nb	$\beta^-$	3635	365.27	1/2-	2686.95	(3/2)-	1.38	18	5.81	7	P
<sup>99</sup> Nb	$\beta^-$	3635	365.27	1/2-	2729.9	(3/2)-	1.54	23	5.71	8	P
<sup>99</sup> Mo	$\beta^-$	1357.8	0.0	1/2+	1141.862	3/2+	0.111	3	7.401	13	
<sup>99</sup> Mo	$\beta^-$	1357.8	0.0	1/2+	1172.22	3/2+	0.0019	4	8.96	9	
<sup>100</sup> Rh	$\beta^+/\epsilon$	3636	0.0	1-	2469.388	2-	19.90	20	5.938	18	
<sup>100</sup> Rh	$\epsilon$	3636	0.0	1-	2915.542	2-	68.6	6	4.973	26	
<sup>100</sup> Nb	$\beta^-$	6402	0.0	1+	1463.95	2+	3.4	9	5.80	13	
<sup>100</sup> Nb	$\beta^-$	6402	314	(5)+	1847.16	6+	3.6	7	6.07	9	
<sup>100</sup> Nb	$\beta^-$	6402	314	(5)+	2103.07	4+	12.5	19	5.43	7	
<sup>100</sup> Nb	$\beta^-$	6402	314	(5)+	2564.23	(4)+	12.3	11	5.235	43	
<sup>101</sup> Pd	$\beta^+/\epsilon$	1980.3	0.0	5/2+	181.87	(7/2)+	57.1	13	5.557	11	
<sup>101</sup> Pd	$\beta^+/\epsilon$	1980.3	0.0	5/2+	747.86	(7/2)+	21.6	20	5.607	41	
<sup>101</sup> Pd	$\epsilon$	1980.3	0.0	5/2+	1359.47	7/2+	2.7	3	5.899	49	
<sup>101</sup> Nb	$\beta^-$	4628.5	0.0	(5/2)+	13.5	3/2+	40	13	5.30	14	P
<sup>101</sup> Nb	$\beta^-$	4628.5	0.0	(5/2)+	289.7	3/2+	27	8	5.35	13	P
<sup>101</sup> Nb	$\beta^-$	4628.5	0.0	(5/2)+	351.6	3/2+	1.33	5	6.633	25	P
<sup>101</sup> Nb	$\beta^-$	4628.5	0.0	(5/2)+	479.4	3/2+	8.3	24	5.78	13	P
<sup>101</sup> Mo	$\beta^-$	2825	0.0	1/2+	1028.076	3/2+	7.5	8	6.40	5	
<sup>101</sup> Mo	$\beta^-$	2825	0.0	1/2+	1806.38	3/2+	3.3	1	5.798	42	

**Table 10**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
$^{101}\text{Mo}$	$\beta^-$	2825	0.0	1/2+	1897.97	3/2+	2.61	7	5.749	45	
$^{101}\text{Mo}$	$\beta^-$	2825	0.0	1/2+	2047.72	(3/2)+	20.6	4	4.57	5	
$^{101}\text{Tc}$	$\beta^-$	1614	0.0	9/2+	306.83	7/2+	90.3	2	4.780	32	
$^{101}\text{Tc}$	$\beta^-$	1614	0.0	9/2+	545.06	7/2+	6.44	16	5.593	39	
$^{101}\text{Tc}$	$\beta^-$	1614	0.0	9/2+	842.79	(7/2)+	1.91	5	5.60	5	
$^{101}\text{Rh}$	$\varepsilon$	546	157.41	9/2+	306.858	7/2+	83	7	5.057	40	
$^{101}\text{Rh}$	$\varepsilon$	546	157.41	9/2+	545.118	7/2+	4.8	5	5.43	6	
$^{102}\text{Rh}$	$\varepsilon$	2323	140	6+	2219.17	5+	67	3	7.199	32	
$^{102}\text{Tc}$	$\beta^-$	4534	0.0	1+	475.02	2+	3.5	4	6.02	5	P
$^{102}\text{Tc}$	$\beta^-$	4534	0.0	1+	1580.5	2+	1.17	15	5.90	6	P
$^{103}\text{Tc}$	$\beta^-$	2663	0.0	5/2+	0.0	3/2+	34	8	5.25	10	
$^{103}\text{Tc}$	$\beta^-$	2663	0.0	5/2+	213.52	7/2+	2.5	5	6.24	9	
$^{103}\text{Tc}$	$\beta^-$	2663	0.0	5/2+	346.383	3/2+	30	4	5.06	6	
$^{103}\text{Tc}$	$\beta^-$	2663	0.0	5/2+	661.73	(3/2)+	1.10	17	6.23	7	
$^{103}\text{Ru}$	$\beta^-$	764.5	0.0	3/2+	536.838	5/2+	92.0	4	5.754	14	
$^{103}\text{Ru}$	$\beta^-$	764.5	0.0	3/2+	650.093	5/2+	6.50	6	5.969	28	
$^{103}\text{Pd}$	$\varepsilon$	574.7	0.0	5/2+	39.748	7/2+	99.9	1	5.880	5	
$^{103}\text{Ag}$	$\beta+\varepsilon$	2654.3	0.0	7/2+	0.0	5/2+	16	5	5.86	14	
$^{103}\text{Ag}$	$\beta+\varepsilon$	2654.3	0.0	7/2+	266.87	5/2+	40.0	30	5.265	33	
$^{103}\text{Ag}$	$\beta+\varepsilon$	2654.3	0.0	7/2+	1182.85	(5/2)+	3.530	30	5.701	7	
$^{103}\text{Ag}$	$\beta+\varepsilon$	2654.3	0.0	7/2+	1273.97	(5/2)+	20.6	14	4.875	30	
$^{103}\text{Cd}$	$\beta+\varepsilon$	4151.1	0.0	(5/2)+	0.0	7/2+	12.0	23	6.05	8	P
$^{103}\text{Cd}$	$\beta+\varepsilon$	4151.1	0.0	(5/2)+	1311.68	(7/2)+	1.6	5	6.06	14	P
$^{103}\text{Cd}$	$\beta+\varepsilon$	4151.1	0.0	(5/2)+	1422.07	(3/2)+	1.02	20	6.18	9	P
$^{103}\text{Cd}$	$\beta+\varepsilon$	4151.1	0.0	(5/2)+	1705.14	3/2+	4.4	8	5.34	8	P
$^{103}\text{Cd}$	$\beta+\varepsilon$	4151.1	0.0	(5/2)+	2199.37	(3/2)+	4.4	7	4.99	7	P
$^{104}\text{Rh}$	$\beta^-$	2435.8	0.0	1+	555.81	2+	1.90	20	5.811	46	
$^{104}\text{Ag}$	$\beta+\varepsilon$	4278.7	0.0	5+	2082.38	4+	16.8	17	5.524	44	
$^{104}\text{Ag}$	$\beta+\varepsilon$	4278.7	0.0	5+	2181.56	4+	15.1	17	5.500	49	
$^{104}\text{Ag}$	$\beta+\varepsilon$	4278.7	0.0	5+	2265.36	4+	34.0	30	5.090	39	
$^{104}\text{Ag}$	$\beta+\varepsilon$	4278.7	0.0	5+	3105.1	4+	4.5	6	5.41	6	
$^{105}\text{In}$	$\beta+\varepsilon$	4693	0.0	9/2+	131.18	7/2+	25.9	9	5.786	17	P
$^{105}\text{In}$	$\beta+\varepsilon$	4693	0.0	9/2+	260.38	(7/2)+	9.9	24	6.14	11	P
$^{105}\text{In}$	$\beta+\varepsilon$	4693	0.0	9/2+	604.39	(7/2)+	3.2	7	6.44	10	P
$^{105}\text{In}$	$\beta+\varepsilon$	4693	0.0	9/2+	799.79	11/2+	6.6	5	6.006	34	P
$^{105}\text{Ru}$	$\beta^-$	1916.7	0.0	3/2+	724.244	5/2+	48.4	7	6.189	8	
$^{105}\text{Ru}$	$\beta^-$	1916.7	0.0	3/2+	785.887	1/2+	17.15	18	6.553	6	
$^{105}\text{Ru}$	$\beta^-$	1916.7	0.0	3/2+	969.484	5/2+	4.47	9	6.849	10	
$^{105}\text{Rh}$	$\beta^-$	566.6	0.0	7/2+	0.0	5/2+	77.75	29	5.734	6	
$^{105}\text{Rh}$	$\beta^-$	566.6	0.0	7/2+	319.235	5/2+	17.44	25	5.188	14	
$^{105}\text{Ag}$	$\varepsilon$	1347.1	0.0	1/2-	1088.1	3/2-	17.5	17	6.386	46	
$^{105}\text{Cd}$	$\beta+\varepsilon$	2737.0	0.0	5/2+	25.470	7/2+	57.0	40	5.300	31	
$^{105}\text{Cd}$	$\beta+\varepsilon$	2737.0	0.0	5/2+	1557.881	3/2+	2.26	16	5.661	33	
$^{105}\text{Cd}$	$\varepsilon$	2737.0	0.0	5/2+	1922.97	(7/2)+	2.95	20	5.216	33	
$^{105}\text{Cd}$	$\varepsilon$	2737.0	0.0	5/2+	2333.34	3/2+	4.4	3	4.408	36	
$^{106}\text{Ag}$	$\varepsilon$	2965.1	89.66	6+	2756.85	5+	92	3	5.100	17	
$^{106}\text{Ag}$	$\varepsilon$	2965.1	89.66	6+	2951.84	5+	8.1	6	5.099	45	
$^{106}\text{In}$	$\beta+\varepsilon$	6524	0.0	7+	2491.72	6+	10.6	20	5.97	8	P
$^{106}\text{In}$	$\beta+\varepsilon$	6524	0.0	7+	2502.92	6+	8.3	14	6.07	7	P
$^{106}\text{In}$	$\beta+\varepsilon$	6524	0.0	7+	2924.67	6+	3.50	40	6.19	5	P
$^{106}\text{In}$	$\beta+\varepsilon$	6524	0.0	7+	3043.91	8+	39.8	11	5.054	16	P
$^{106}\text{Rh}$	$\beta^-$	3545	0.0	1+	511.862	2+	8.1	3	5.894	17	
$^{106}\text{Rh}$	$\beta^-$	3545	0.0	1+	1562.26	2+	1.77	6	5.787	16	

**Table 10**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
$^{106}\text{Rh}$	$\beta^-$	3545		137 (6)+	2757.94	5+	85	10	5.24	6	
$^{106}\text{Rh}$	$\beta^-$	3545		137 (6)+	2953.18	5+	14.5	18	5.64	6	
$^{106}\text{Ag}$	$\beta^+/\epsilon$	2965.1		0.0 1+	511.85	2+	16.3	16	5.266	43	
$^{107}\text{Ru}$	$\beta^-$	3001		0.0 (5/2)+	0.0	7/2+	68	4	5.807	28	
$^{107}\text{Rh}$	$\beta^-$	1509		0.0 7/2+	302.76	5/2+	64	5	5.017	39	
$^{107}\text{Rh}$	$\beta^-$	1509		0.0 7/2+	567.65	5/2+	1.8	2	6.16	5	
$^{107}\text{Rh}$	$\beta^-$	1509		0.0 7/2+	670.07	5/2+	9	1	5.28	5	
$^{107}\text{Cd}$	$\beta^+/\epsilon$	1416.4		0.0 5/2+	93.126	7/2+	99.90	20	4.966	11	
$^{107}\text{In}$	$\beta^+/\epsilon$	3424		0.0 9/2+	204.96	7/2+	38.0	30	5.617	35	
$^{107}\text{In}$	$\beta^+/\epsilon$	3424		0.0 9/2+	505.50	7/2+	3.40	40	6.46	5	
$^{107}\text{In}$	$\beta^+/\epsilon$	3424		0.0 9/2+	932.99	11/2+	2.80	10	6.236	20	
$^{107}\text{In}$	$\beta^+/\epsilon$	3424		0.0 9/2+	1268.32	7/2+	8.9	6	5.502	33	
$^{107}\text{In}$	$\beta^+/\epsilon$	3424		0.0 9/2+	1377.37	(7/2)+	3.60	30	5.823	39	
$^{107}\text{In}$	$\beta^+/\epsilon$	3424		0.0 9/2+	1776.37	7/2+	3.40	40	5.60	5	
$^{107}\text{In}$	$\beta^+/\epsilon$	3424		0.0 9/2+	1922.18	7/2+	3.10	30	5.547	46	
$^{107}\text{In}$	$\beta^+/\epsilon$	3424		0.0 9/2+	2006.31	7/2+	3.90	30	5.394	39	
$^{108}\text{Ag}$	$\beta^-$	1645.6		0.0 1+	632.98	2+	1.76	10	5.372	25	
$^{108}\text{In}$	$\beta^+/\epsilon$	5133		0.0 7+	2541.09	6+	11.0	23	5.97	9	
$^{108}\text{In}$	$\beta^+/\epsilon$	5133		0.0 7+	2994.02	6+	8.1	8	5.784	46	
$^{108}\text{In}$	$\beta^+/\epsilon$	5133		0.0 7+	3110.10	(8)+	5.2	7	5.90	6	
$^{108}\text{In}$	$\beta^+/\epsilon$	5133		0.0 7+	3816.07	6+	3.10	30	5.680	47	
$^{108}\text{In}$	$\epsilon$	5133		0.0 7+	4512.44	6+	1.5	2	5.32	6	
$^{108}\text{Rh}$	$\beta^-$	4493		0.0 1+	434.1	2+	23	6	5.73	11	P
$^{108}\text{Rh}$	$\beta^-$	4493		0.0 1+	931.4	2+	6.3	17	6.05	12	P
$^{109}\text{Rh}$	$\beta^-$	2607.2		0.0 7/2+	326.8689	5/2+	67	7	4.886	46	
$^{109}\text{Rh}$	$\beta^-$	2607.2		0.0 7/2+	540.6753	5/2+	9.7	10	5.550	45	
$^{109}\text{Pd}$	$\beta^-$	1112.9		0.0 5/2+	88.0338	7/2+	100	4	6.151	18	
$^{109}\text{Cd}$	$\epsilon$	215.1		0.0 5/2+	88.0341	7/2+	100		6.010	25	
$^{109}\text{In}$	$\beta^+/\epsilon$	2014.8		0.0 9/2+	203.40	7/2+	68.0	6	5.285	14	
$^{109}\text{In}$	$\beta^+/\epsilon$	2014.8		0.0 9/2+	623.88	7/2+	5.35	25	6.127	25	
$^{109}\text{In}$	$\epsilon$	2014.8		0.0 9/2+	997.50	7/2+	4.6	2	5.913	25	
$^{109}\text{In}$	$\epsilon$	2014.8		0.0 9/2+	1352.15	(7/2)+	8.05	19	5.286	21	
$^{109}\text{In}$	$\epsilon$	2014.8		0.0 9/2+	1622.46	(7/2)+	8.07	15	4.808	24	
$^{109}\text{Sn}$	$\beta^+/\epsilon$	3859		0.0 5/2+	2561.02	3/2+	8.7	7	4.745	36	
$^{109}\text{Sn}$	$\beta^+/\epsilon$	3859		0.0 5/2+	2591.87	7/2+	5.00	30	4.963	28	
$^{109}\text{Sn}$	$\epsilon$	3859		0.0 5/2+	2851.72	7/2+	1.52	19	5.28	6	
$^{110}\text{In}$	$\epsilon$	3878		0.0 7+	2876.754	6+	2.33	25	6.27	5	
$^{110}\text{In}$	$\epsilon$	3878		0.0 7+	3064.68	6+	7.7	3	5.562	32	
$^{110}\text{In}$	$\epsilon$	3878		0.0 7+	3121.56	6+	43.8	11	4.742	30	
$^{110}\text{In}$	$\epsilon$	3878		0.0 7+	3187.30	8+	29.6	12	4.831	34	
$^{110}\text{In}$	$\epsilon$	3878		0.0 7+	3239.517	6+	4.10	13	5.619	34	
$^{110}\text{In}$	$\epsilon$	3878		0.0 7+	3525.22	6+	4.21	14	5.065	48	
$^{110}\text{Ag}$	$\beta^-$	2890.7		0.0 1+	657.51	2+	4.44	24	5.546	24	
$^{110}\text{Ag}$	$\beta^-$	2890.7	117.59	6+	2926.7465	5+	67.7	5	5.370	22	
$^{111}\text{Pd}$	$\beta^-$	2229.6		0.0 5/2+	59.87	7/2+	95.3	4	5.9020	43	
$^{111}\text{In}$	$\epsilon$	860.2		0.0 9/2+	416.63	7/2+	100.000	5	5.037	20	
$^{111}\text{Sn}$	$\beta^+/\epsilon$	2453		0.0 7/2+	0.0	9/2+	90.7	6	4.755	9	
$^{111}\text{Sn}$	$\epsilon$	2453		0.0 7/2+	1610.51	9/2+	1.49	10	5.416	31	
$^{112}\text{In}$	$\beta^+/\epsilon$	2584.7		0.0 1+	617.519	2+	5.9	5	5.220	39	
$^{113}\text{Sn}$	$\beta^+/\epsilon$	1039.0	77.38	7/2+	0.0	9/2+	100.		3.62	11	
$^{113}\text{Sb}$	$\beta^+/\epsilon$	3911		0.0 5/2+	498.01	3/2+	87.0	26	4.721	17	P
$^{113}\text{Sb}$	$\beta^+/\epsilon$	3911		0.0 5/2+	1013.22	3/2+	2.60	13	5.906	25	P
$^{113}\text{Sb}$	$\beta^+/\epsilon$	3911		0.0 5/2+	1556.36	3/2+	1.79	10	5.705	27	P

**Table 10**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
$^{114}\text{Sb}$	$\beta+\varepsilon$	6063	0.0	3+	1299.92	2+	68.7	8	5.304	11	P
$^{114}\text{Sb}$	$\beta+\varepsilon$	6063	0.0	3+	2187.5	4+	3.9	10	6.07	11	P
$^{114}\text{Sb}$	$\beta+\varepsilon$	6063	0.0	3+	2239.2	2+	1.58	20	6.43	6	P
$^{114}\text{Sb}$	$\beta+\varepsilon$	6063	0.0	3+	3781.9	2+	1.10	30	5.59	12	P
$^{114}\text{Rh}$	$\beta-$	7.78E3	0.0	1+	1391.66	2+	9	3	6.06	15	P
$^{114}\text{In}$	$\varepsilon$	1445.13	190.2682	5+	1283.67	4+	3.25	24	7.558	35	
$^{115}\text{Sb}$	$\beta+\varepsilon$	3030	0.0	5/2+	497.3	3/2+	96.3	44	4.774	23	
$^{115}\text{Ag}$	$\beta-$	3102	0.0	1/2-	2156.00	(3/2)-	7.4	4	5.562	41	
$^{115}\text{Cd}$	$\beta-$	1451.9	0.0	1/2+	828.59	3/2+	3.3	4	7.49	5	
$^{116}\text{In}$	$\beta-$	3276.22	127.267	5+	2390.921	4+	54.2	6	5.280	5	
$^{116}\text{In}$	$\beta-$	3276.22	127.267	5+	2529.205	4+	32.5	3	5.2690	42	
$^{116}\text{In}$	$\beta-$	3276.22	127.267	5+	2801.206	4+	10.3	1	5.1941	45	
$^{116}\text{In}$	$\beta-$	3276.22	127.267	5+	3046.126	4+	2.82	4	4.992	6	
$^{116}\text{Sb}$	$\beta+\varepsilon$	4704	0.0	3+	1293.550	2+	58	5	5.270	44	
$^{116}\text{Sb}$	$\beta+\varepsilon$	4704	0.0	3+	2225.215	2+	40.0	30	4.811	40	
$^{116}\text{Sb}$	$\beta+\varepsilon$	4704	0.0	3+	2843.61	2+	1.52	14	5.842	46	
$^{116}\text{Sb}$	$\beta+\varepsilon$	4704	383	8-	2908.808	7-	82.0	40	4.886	32	P
$^{116}\text{Sb}$	$\beta+\varepsilon$	4704	383	8-	3209.953	7-	14.8	7	5.445	32	P
$^{117}\text{Te}$	$\beta+\varepsilon$	3544	0.0	1/2+	923.9	3/2+	4.3	7	6.49	7	P
$^{117}\text{Cd}$	$\beta-$	2525	0.0	1/2+	1712.544	3/2+	3.4	5	6.55	6	
$^{117}\text{Cd}$	$\beta-$	2525	0.0	1/2+	1997.366	3/2+	8.2	9	5.51	5	
$^{117}\text{Cd}$	$\beta-$	2525	0.0	1/2+	2022.23	3/2+	2.2	3	6.01	6	
$^{117}\text{Cd}$	$\beta-$	2525	0.0	1/2+	2064.15	3/2+	1.5	2	6.05	6	
$^{117}\text{Cd}$	$\beta-$	2525	0.0	1/2+	2171.74	3/2+	1.9	3	5.56	7	
$^{117}\text{Sb}$	$\beta+\varepsilon$	1758	0.0	5/2+	158.6	3/2+	99.0	7	4.899	11	
$^{118}\text{Sb}$	$\beta+\varepsilon$	3656.6	250	8-	2574.84	7-	98.5	5	4.985	11	
$^{118}\text{I}$	$\beta+\varepsilon$	6720	0.0	2-	1944.34	3-	8.05	5	6.837	20	P
$^{119}\text{I}$	$\beta+\varepsilon$	3405	0.0	5/2+	257.484	3/2+	83.7	25	5.048	20	P
$^{119}\text{In}$	$\beta-$	2366	0.0	9/2+	787.01	7/2+	93	7	4.426	38	
$^{119}\text{Sb}$	$\varepsilon$	589	0.0	5/2+	23.871	3/2+	100		5.091	18	
$^{119}\text{Te}$	$\varepsilon$	2293.0	0.0	1/2+	1749.64	3/2+	4.5	3	6.057	30	
$^{119}\text{Te}$	$\varepsilon$	2293.0	260.96	11/2-	2129.82	9/2-	1.8	1	7.074	26	
$^{119}\text{Te}$	$\varepsilon$	2293.0	260.96	11/2-	2278.92	13/2-	6.6	1	6.102	13	
$^{119}\text{Te}$	$\varepsilon$	2293.0	260.96	11/2-	2283.8	9/2-	0.32	2	7.399	30	
$^{119}\text{Te}$	$\varepsilon$	2293.0	260.96	11/2-	2360.22	9/2-	4.9	1	5.888	17	
$^{120}\text{Sb}$	$\beta+\varepsilon$	2681	0.0	1+	1171.2	2+	1.48	8	5.644	26	
$^{120}\text{I}$	$\beta+\varepsilon$	5615	0.0	2-	2083.3	3-	9.1	7	6.882	34	P
$^{120}\text{In}$	$\beta-$	5370	0.0	1+	1172.5	2+	16.3	14	5.274	43	P
$^{120}\text{In}$	$\beta-$	5370	70	(5)+	2194.25	4+	14.7	22	6.02	8	P
$^{120}\text{In}$	$\beta-$	5370	70	(5)+	2465.61	4+	2.0	6	6.72	14	P
$^{120}\text{In}$	$\beta-$	5370	70	(5)+	2643.34	4+	3.1	3	6.42	6	P
$^{120}\text{In}$	$\beta-$	5370	70	(5)+	2685.02	6+	1.15	12	6.82	7	P
$^{120}\text{In}$	$\beta-$	5370	70	(5)+	3057.91	4+	48.3	19	4.93	6	P
$^{120}\text{In}$	$\beta-$	5370	70	(5)+	3179.06	4+	18.1	8	5.27	6	P
$^{120}\text{In}$	$\beta-$	5370	70	(5)+	3349.90	(4)+	5.5	4	5.65	7	P
$^{120}\text{In}$	$\beta-$	5370	70	(5)+	3438.23	4+	1.59	12	6.11	7	P
$^{120}\text{In}$	$\beta-$	5370	70	(5)+	3777.19	4+	3.68	22	5.42	8	P
$^{121}\text{I}$	$\beta+\varepsilon$	2297	0.0	5/2+	212.197	3/2+	86.54	18	5.189	14	
$^{121}\text{I}$	$\beta+\varepsilon$	2297	0.0	5/2+	532.054	3/2+	7.1	7	6.088	46	
$^{121}\text{Cd}$	$\beta-$	4761	0.0	3/2+	1040.30	(5/2)+	6.3	12	6.08	8	P
$^{121}\text{Cd}$	$\beta-$	4761	0.0	3/2+	2264.89	(5/2)+	7.0	6	5.304	43	P
$^{121}\text{In}$	$\beta-$	3362	0.0	9/2+	925.58	7/2+	100	10	4.357	49	
$^{121}\text{Sn}$	$\beta-$	402.5	0.0	3/2+	0.0	5/2+	100		5.110	9	

**Table 10**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	$\log ft$	Unc.	Pand.
$^{121}\text{Te}$	$\varepsilon$	1056	0.0	1/2+	507.597	3/2+	18.4	6	6.91	5	
$^{122}\text{Cs}$	$\beta+\varepsilon$	7210	0.0	1+	331.17	2+	37.0	40	5.426	49	P
$^{122}\text{In}$	$\beta-$	6.37E3	0.0	1+	1140.31	2+	16	4	5.39	14	P
$^{122}\text{In}$	$\beta-$	6.37E3	0.0	1+	2153.48	2+	2.8	8	5.74	15	P
$^{122}\text{In}$	$\beta-$	6.37E3	40	5+	2142.12	4+	11.6	20	5.98	9	P
$^{122}\text{In}$	$\beta-$	6.37E3	40	5+	2555.57	6+	1.47	22	6.68	8	P
$^{122}\text{In}$	$\beta-$	6.37E3	40	5+	2973.46	4+	11.9	4	5.56	5	P
$^{122}\text{In}$	$\beta-$	6.37E3	40	5+	3082.18	4+	3.0	3	6.10	7	P
$^{122}\text{In}$	$\beta-$	6.37E3	40	5+	3233.79	4+	16.9	4	5.26	6	P
$^{122}\text{In}$	$\beta-$	6.37E3	40	5+	3305.75	4+	35.1	9	4.90	6	P
$^{122}\text{In}$	$\beta-$	6.37E3	40	5+	3627.09	4+	1.40	21	6.10	9	P
$^{122}\text{In}$	$\beta-$	6.37E3	40	5+	3670.36	4+	2.59	18	5.81	7	P
$^{122}\text{In}$	$\beta-$	6.37E3	40	5+	3882.15	4+	3.77	18	5.50	7	P
$^{122}\text{I}$	$\beta+\varepsilon$	4234	0.0	1+	564.117	2+	14.0	40	5.43	12	
$^{123}\text{I}$	$\beta+\varepsilon$	1228.4	0.0	5/2+	159.00	3/2+	97.0	5	5.286	6	
$^{123}\text{I}$	$\varepsilon$	1228.4	0.0	5/2+	687.97	3/2+	1.51	5	6.478	17	
$^{123}\text{Sn}$	$\beta-$	1408.2	24.6	3/2+	160.33	5/2+	99.9	3	5.2740	35	
$^{124}\text{In}$	$\beta-$	7364	0.0	3+	2101.58	4+	2.4	6	6.54	11	P
$^{124}\text{In}$	$\beta-$	7364	0.0	3+	2129.39	2+	17.7	20	5.66	5	P
$^{124}\text{In}$	$\beta-$	7364	0.0	3+	2426.38	2+	1.84	18	6.535	46	P
$^{124}\text{In}$	$\beta-$	7364	0.0	3+	2702.99	2+	1.90	25	6.41	6	P
$^{124}\text{In}$	$\beta-$	7364	0.0	3+	2878.35	2+	1.30	22	6.50	8	P
$^{124}\text{In}$	$\beta-$	7364	0.0	3+	3214.19	2+	25	3	5.07	6	P
$^{124}\text{In}$	$\beta-$	7364	0.0	3+	3264.15	2+	1.30	14	6.33	5	P
$^{124}\text{In}$	$\beta-$	7364	0.0	3+	3741.23	(2)+	2.6	3	5.80	5	P
$^{124}\text{In}$	$\beta-$	7364	0.0	3+	3761.6	2+	1.00	13	6.20	6	P
$^{124}\text{In}$	$\beta-$	7364	0.0	3+	3917.16	2+	9.4	8	5.148	43	P
$^{124}\text{Sb}$	$\beta-$	2905.07	0.0	3-	2701.622	2-	0.558	7	8.156	6	
$^{124}\text{I}$	$\varepsilon$	3159.6	0.0	2-	2293.68	3-	11.64	18	6.898	9	
$^{124}\text{I}$	$\varepsilon$	3159.6	0.0	2-	2693.73	3-	0.941	14	7.427	10	
$^{124}\text{I}$	$\varepsilon$	3159.6	0.0	2-	2834.88	3-	4.27	6	6.433	11	
$^{124}\text{I}$	$\varepsilon$	3159.6	0.0	2-	2886.00	3-	1.05	3	6.878	16	
$^{124}\text{Cs}$	$\beta+\varepsilon$	5926	0.0	1+	354.10	2+	35	5	5.13	6	P
$^{124}\text{Cs}$	$\beta+\varepsilon$	5926	0.0	1+	846.55	2+	3.5	5	5.92	6	P
$^{124}\text{Cs}$	$\beta+\varepsilon$	5926	0.0	1+	1628.64	2+	2.10	30	5.76	6	P
$^{124}\text{Cs}$	$\beta+\varepsilon$	5926	0.0	1+	2519.59	2+	1.42	21	5.43	6	P
$^{125}\text{I}$	$\varepsilon$	185.77	0.0	5/2+	35.4925	3/2+	100		5.4503	38	
$^{125}\text{In}$	$\beta-$	5481.3	0.0	9/2+	854.69	7/2+	1.9	3	6.28	7	P
$^{125}\text{In}$	$\beta-$	5481.3	0.0	9/2+	1059.26	7/2+	9.6	13	5.49	6	P
$^{125}\text{In}$	$\beta-$	5481.3	0.0	9/2+	1362.52	7/2+	79	10	4.44	6	P
$^{125}\text{Sn}$	$\beta-$	2361.4	27.50	3/2+	331.958	5/2+	98.4	15	5.486	13	
$^{125}\text{Sb}$	$\beta-$	766.7	0.0	7/2+	463.365	5/2+	40.3	4	8.074	11	
$^{125}\text{Sb}$	$\beta-$	766.7	0.0	7/2+	671.443	5/2+	13.42	17	6.976	30	
$^{126}\text{Cs}$	$\beta+\varepsilon$	4796	0.0	1+	388.62	2+	29.9	16	5.169	24	P
$^{126}\text{Cs}$	$\beta+\varepsilon$	4796	0.0	1+	879.86	2+	3.9	5	5.79	6	P
$^{126}\text{Cs}$	$\beta+\varepsilon$	4796	0.0	1+	1678.56	2+	2.15	11	5.581	23	P
$^{127}\text{Xe}$	$\varepsilon$	662.3	0.0	1/2+	202.860	3/2+	53.0	14	6.642	13	
$^{127}\text{Xe}$	$\varepsilon$	662.3	0.0	1/2+	618.4	3/2+	0.0143	9	7.46	9	
$^{127}\text{Cs}$	$\beta+\varepsilon$	2081	0.0	1/2+	124.748	3/2+	5.80	30	6.817	24	
$^{127}\text{Cs}$	$\beta+\varepsilon$	2081	0.0	1/2+	587.053	3/2+	9.59	18	6.330	12	
$^{127}\text{Cs}$	$\beta+\varepsilon$	2081	0.0	1/2+	931.065	3/2+	1.160	40	7.012	18	
$^{127}\text{Ba}$	$\beta+\varepsilon$	3422	0.0	1/2+	138.90	(3/2)+	1.20	30	6.83	11	P
$^{127}\text{Ba}$	$\beta+\varepsilon$	3422	0.0	1/2+	180.97	3/2+	29.0	40	5.42	6	P

**Table 10**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
<sup>127</sup> Sb	$\beta^-$	1582.2	0.0	7/2+	473.24	5/2+	23.4	16	7.840	31	
<sup>127</sup> Sb	$\beta^-$	1582.2	0.0	7/2+	783.4	5/2+	18.0	11	7.433	29	
<sup>127</sup> Sb	$\beta^-$	1582.2	0.0	7/2+	1140.9	5/2+	1.55	20	7.61	6	
<sup>127</sup> Sb	$\beta^-$	1582.2	0.0	7/2+	1155.4	5/2+	0.9	3	7.80	15	
<sup>127</sup> Sb	$\beta^-$	1582.2	0.0	7/2+	1290.3	5/2+	0.77	22	7.32	13	
<sup>127</sup> Te	$\beta^-$	702.7	0.0	3/2+	0.0	5/2+	98.79	16	5.523	9	
<sup>127</sup> Te	$\beta^-$	702.7	0.0	3/2+	417.93	5/2+	1.19	16	6.13	6	
<sup>128</sup> Cs	$\beta^+/\epsilon$	3929	0.0	1+	442.911	2+	22.8	12	5.123	23	
<sup>128</sup> Cs	$\beta^+/\epsilon$	3929	0.0	1+	969.475	2+	2.00	11	5.861	24	
<sup>128</sup> In	$\beta^-$	9171	0.0	(3)+	2104.07	(2)+	12.6	10	5.811	38	P
<sup>128</sup> In	$\beta^-$	9171	0.0	(3)+	2258.36	(2)+	3.6	7	6.31	9	P
<sup>128</sup> In	$\beta^-$	9171	0.0	(3)+	2578.62	(2)+	2.36	21	6.403	42	P
<sup>128</sup> In	$\beta^-$	9171	0.0	(3)+	3225.6	(2)+	1.24	14	6.48	5	P
<sup>128</sup> In	$\beta^-$	9171	0.0	(3)+	3519.86	(2)+	18.5	19	5.209	47	P
<sup>128</sup> In	$\beta^-$	9171	0.0	(3)+	3886.39	(2)+	3.9	4	5.756	47	P
<sup>128</sup> In	$\beta^-$	9171	0.0	(3)+	3954.85	(2)+	5.9	5	5.551	40	P
<sup>128</sup> In	$\beta^-$	9171	0.0	(3)+	4038.01	(2)+	2.29	24	5.932	48	P
<sup>128</sup> In	$\beta^-$	9171	0.0	(3)+	4297.70	(2)+	12.9	12	5.082	43	P
<sup>128</sup> Sb	$\beta^-$	4364	0.0	8-	2337.85	(7)-	19	4	7.94	9	
<sup>128</sup> I	$\beta^-$	2122.5	0.0	1+	442.901	2+	11.56	12	6.531	6	
<sup>128</sup> I	$\beta^-$	2122.5	0.0	1+	969.465	2+	1.500	18	6.791	7	
<sup>129</sup> Te	$\beta^-$	1502.3	105.51	11/2-	1401.43	(9/2)-	0.15	3	8.52	9	
<sup>129</sup> Cs	$\epsilon$	1197.0	0.0	1/2+	318.179	3/2+	2.40	14	7.166	26	
<sup>129</sup> Cs	$\epsilon$	1197.0	0.0	1/2+	588.533	3/2+	4.9	3	6.523	28	
<sup>129</sup> Cs	$\epsilon$	1197.0	0.0	1/2+	904.318	3/2+	0.066	4	7.708	32	
<sup>129</sup> Ba	$\beta^+/\epsilon$	2438	0.0	1/2+	135.69	3/2+	8.8	5	6.40	5	
<sup>129</sup> Ba	$\beta^+/\epsilon$	2438	0.0	1/2+	220.74	3/2+	23.5	9	5.924	48	
<sup>129</sup> Ba	$\epsilon$	2438	8.42	7/2+	1648.04	(9/2)+	59.5	13	4.52	6	
<sup>129</sup> Sn	$\beta^-$	4039	0.0	3/2+	644.96	(5/2)+	71	2	5.890	21	P
<sup>129</sup> Sb	$\beta^-$	2376	0.0	7/2+	544.64	5/2+	2.74	17	8.285	34	
<sup>129</sup> Sb	$\beta^-$	2376	0.0	7/2+	633.85	5/2+	1.08	4	8.604	27	
<sup>129</sup> Sb	$\beta^-$	2376	0.0	7/2+	966.86	5/2+	2.29	13	7.918	36	
<sup>129</sup> Sb	$\beta^-$	2376	0.0	7/2+	1600.05	5/2+	2.94	5	6.847	44	
<sup>129</sup> Sb	$\beta^-$	2376	0.0	7/2+	1656.12	5/2+	1.410	23	7.051	47	
<sup>129</sup> Sb	$\beta^-$	2376	0.0	7/2+	1727.95	(9/2)+	29.9	5	5.57	5	
<sup>129</sup> Sb	$\beta^-$	2376	0.0	7/2+	1753.32	5/2+	2.16	5	6.65	5	
<sup>129</sup> Sb	$\beta^-$	2376	0.0	7/2+	1843.62	(9/2)+	25.5	4	5.34	6	
<sup>129</sup> Sb	$\beta^-$	2376	0.0	7/2+	1871.61	5/2+	1.533	23	6.48	7	
<sup>129</sup> Sb	$\beta^-$	2376	0.0	7/2+	2071.42	5/2+	2.46	4	5.55	11	
<sup>129</sup> Sb	$\beta^-$	2376	0.0	7/2+	2114.62	5/2+	2.06	4	5.41	12	
<sup>129</sup> Te	$\beta^-$	1502.3	0.0	3/2+	27.80	5/2+	89	13	5.85	6	
<sup>129</sup> Te	$\beta^-$	1502.3	0.0	3/2+	487.35	5/2+	9.3	7	6.217	33	
<sup>130</sup> I	$\beta^-$	2944.3	0.0	5+	1944.128	6+	47	4	6.539	37	
<sup>131</sup> Cs	$\epsilon$	358.00	0.0	5/2+	0.0	3/2+	100		5.5808	27	
<sup>131</sup> Ba	$\beta^+/\epsilon$	1376.62	0.0	1/2+	216.080	3/2+	21.7	5	7.411	40	
<sup>131</sup> Ba	$\epsilon$	1376.62	0.0	1/2+	373.246	3/2+	20.2	3	7.311	42	
<sup>131</sup> Ba	$\epsilon$	1376.62	0.0	1/2+	585.039	3/2+	1.24	2	8.309	42	
<sup>131</sup> Ba	$\epsilon$	1376.62	0.0	1/2+	696.471	3/2+	0.567	11	8.512	42	
<sup>131</sup> Ba	$\epsilon$	1376.62	0.0	1/2+	1047.670	3/2+	1.47	2	7.422	42	
<sup>131</sup> Ba	$\epsilon$	1376.62	0.0	1/2+	1170.637	3/2+	0.190	13	7.85	5	
<sup>131</sup> La	$\beta^+/\epsilon$	2910	0.0	3/2+	0.0	1/2+	13.6	24	6.26	8	
<sup>131</sup> La	$\beta^+/\epsilon$	2910	0.0	3/2+	316.585	5/2+	2.08	19	6.889	45	
<sup>131</sup> La	$\beta^+/\epsilon$	2910	0.0	3/2+	365.164	1/2+	21.1	7	5.856	26	

**Table 10**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
<sup>131</sup> Te	$\beta^-$	2231.7	0.0	3/2+	149.716	5/2+	59.3	5	6.1723	41	
<sup>131</sup> Te	$\beta^-$	2231.7	0.0	3/2+	876.725	1/2+	1.175	16	7.142	6	
<sup>131</sup> Te	$\beta^-$	2231.7	182.25	11/2-	1899.142	13/2-	16.4	6	6.377	16	
<sup>131</sup> I	$\beta^-$	970.8	0.0	7/2+	364.490	5/2+	89.6	8	6.6772	42	
<sup>131</sup> I	$\beta^-$	970.8	0.0	7/2+	722.909	5/2+	2.08	3	7.025	7	
<sup>132</sup> Cs	$\epsilon$	2126.3	0.0	2+	1803.711	3+	1.29	5	7.196	18	
<sup>132</sup> I	$\beta^-$	3575.5	0.0	4+	2424.78	3+	2.5	2	7.307	35	
<sup>132</sup> I	$\beta^-$	3575.5	0.0	4+	2583.78	5+	3.2	2	6.960	28	
<sup>132</sup> I	$\beta^-$	3575.5	0.0	4+	2613.44	5+	8.2	4	6.503	22	
<sup>132</sup> I	$\beta^-$	3575.5	0.0	4+	2669.99	3+	3.4	2	6.790	27	
<sup>132</sup> I	$\beta^-$	3575.5	0.0	4+	2838.85	5+	13.0	8	5.887	28	
<sup>133</sup> La	$\beta^+/\epsilon$	2059	0.0	5/2+	12.326	3/2+	91	7	5.544	38	
<sup>133</sup> La	$\beta^+/\epsilon$	2059	0.0	5/2+	302.395	3/2+	2.15	11	7.011	30	
<sup>133</sup> La	$\beta^+/\epsilon$	2059	0.0	5/2+	858.499	3/2+	1.16	6	6.929	36	
<sup>133</sup> Ce	$\beta^+/\epsilon$	3076	37.2	9/2-	1857.39	7/2-	2.43	13	6.802	43	
<sup>133</sup> Ce	$\epsilon$	3076	37.2	9/2-	2018.26	7/2-	4.54	25	6.408	45	
<sup>133</sup> I	$\beta^-$	1786	0.0	7/2+	529.872	5/2+	83.4	23	6.884	14	
<sup>133</sup> I	$\beta^-$	1786	0.0	7/2+	1298.234	5/2+	3.78	9	6.764	21	
<sup>133</sup> Xe	$\beta^-$	427.4	0.0	3/2+	80.9979	5/2+	98.5	13	5.656	11	
<sup>133</sup> Ba	$\epsilon$	517.4	0.0	1/2+	383.8491	3/2+	14.5	4	8.03	5	
<sup>134</sup> I	$\beta^-$	4082.4	0.0	(4)+	1919.59	3+	3.3	6	7.83	8	
<sup>134</sup> Cs	$\beta^-$	2058.84	0.0	4+	1643.335	3+	2.499	9	9.6929	18	
<sup>134</sup> La	$\beta^+/\epsilon$	3731	0.0	1+	604.7222	2+	3.34	16	6.030	26	
<sup>135</sup> I	$\beta^-$	2634.2	0.0	7/2+	1260.416	5/2+	23.6	8	7.080	16	
<sup>135</sup> I	$\beta^-$	2634.2	0.0	7/2+	1457.566	5/2+	7.5	3	7.323	18	
<sup>135</sup> I	$\beta^-$	2634.2	0.0	7/2+	1565.288	9/2+	8.0	3	7.139	17	
<sup>135</sup> I	$\beta^-$	2634.2	0.0	7/2+	1791.213	5/2+	8.8	3	6.722	17	
<sup>135</sup> I	$\beta^-$	2634.2	0.0	7/2+	1968.323	(9/2)+	8.0	3	6.400	19	
<sup>135</sup> I	$\beta^-$	2634.2	0.0	7/2+	2045.892	5/2+	1.11	5	7.072	22	
<sup>135</sup> Xe	$\beta^-$	1168.6	0.0	3/2+	249.763	5/2+	96.1	4	5.982	7	
<sup>135</sup> Xe	$\beta^-$	1168.6	0.0	3/2+	608.148	5/2+	3.09	11	6.719	18	
<sup>135</sup> La	$\beta^+/\epsilon$	1207	0.0	5/2+	0.0	3/2+	98.10	30	5.705	15	
<sup>136</sup> Cs	$\beta^-$	2548.2	0.0	5+	2207.134	6+	80.8	11	6.138	10	
<sup>136</sup> Cs	$\beta^-$	2548.2	0.0	5+	2356.57	4+	0.21	3	7.92	6	
<sup>136</sup> La	$\beta^+/\epsilon$	2.85E3	0.0	1+	818.52	2+	1.55	6	5.929	33	
<sup>137</sup> Nd	$\beta^+/\epsilon$	3618	0.0	1/2+	580.63	3/2+	20.5	22	6.03	5	P
<sup>137</sup> Nd	$\beta^+/\epsilon$	3618	0.0	1/2+	761.52	3/2+	11.5	17	6.18	7	P
<sup>137</sup> Pm	$\beta^+/\epsilon$	5511	0.0	11/2-	1100.4	13/2-	8.5	20	5.93	10	P
<sup>137</sup> Ce	$\beta^+/\epsilon$	1222.1	0.0	3/2+	10.59	5/2+	97.84	8	5.411	15	
<sup>137</sup> Ce	$\epsilon$	1222.1	0.0	3/2+	447.17	5/2+	1.95	7	6.709	22	
<sup>137</sup> Pr	$\beta^+/\epsilon$	2717	0.0	5/2+	0.0	3/2+	93.5	8	5.472	8	
<sup>138</sup> Pr	$\beta^+/\epsilon$	4437	364	7-	2765.24	6-	7.00	30	6.434	24	
<sup>139</sup> Ce	$\epsilon$	264.6	0.0	3/2+	165.8576	5/2+	100		5.466	28	
<sup>139</sup> Pr	$\beta^+/\epsilon$	2129.1	0.0	5/2+	0.0	3/2+	98.750	40	5.6710	43	
<sup>139</sup> Nd	$\beta^+/\epsilon$	2812	0.0	3/2+	0.0	5/2+	85.0	20	5.179	17	P
<sup>139</sup> Nd	$\beta^+/\epsilon$	2812	0.0	3/2+	588.82	5/2+	2.6	5	6.38	8	P
<sup>139</sup> Nd	$\beta^+/\epsilon$	2812	231.15	11/2-	1624.37	9/2-	9.9	10	6.40	5	P
<sup>139</sup> Nd	$\epsilon$	2812	231.15	11/2-	2174.55	9/2-	7.4	6	6.09	5	P
<sup>139</sup> Pm	$\beta^+/\epsilon$	4516	0.0	(5/2)+	0.0	3/2+	71	5	5.290	33	P
<sup>139</sup> Pm	$\beta^+/\epsilon$	4516	0.0	(5/2)+	463.10	(3/2)+	6.9	12	6.08	8	P
<sup>140</sup> Pm	$\beta^+/\epsilon$	6045	0.0	1+	773.48	2+	2.8	5	5.59	8	P
<sup>140</sup> Pm	$\beta^+/\epsilon$	6045	0.0	1+	1489.30	(2)+	1.79	23	5.47	6	P
<sup>140</sup> Pm	$\beta^+/\epsilon$	6045	431	8-	2221.51	7-	91.2	22	5.214	19	

**Table 10**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
<sup>140</sup> Eu	$\beta+\epsilon$	8.47E3	0.0	1+	530.95	2+	20.0	40	4.86	9	P
<sup>140</sup> Eu	$\beta+\epsilon$	8.47E3	0.0	1+	990.64	2+	1.60	40	5.83	11	P
<sup>140</sup> Eu	$\beta+\epsilon$	8.47E3	0.0	1+	2284.14	2+	1.31	20	5.49	7	P
<sup>140</sup> Cs	$\beta^-$	6218	0.0	1-	2932.58	2-	5.42	24	6.713	20	
<sup>141</sup> Sm	$\beta+\epsilon$	4589	0.0	1/2+	403.97	3/2+	32.0	7	5.880	14	P
<sup>141</sup> Sm	$\beta+\epsilon$	4589	0.0	1/2+	728.27	3/2+	2.80	40	6.78	6	P
<sup>141</sup> Sm	$\beta+\epsilon$	4589	0.0	1/2+	1292.56	(3/2)+	8.7	5	6.003	27	P
<sup>141</sup> Sm	$\beta+\epsilon$	4589	175.9	11/2-	1166.95	(9/2)-	3.1	8	6.96	11	P
<sup>141</sup> Sm	$\beta+\epsilon$	4589	175.9	11/2-	1983.27	9/2-	14.8	1	5.88	3	P
<sup>141</sup> Eu	$\beta+\epsilon$	6008	0.0	5/2+	1.58	3/2+	73	5	5.116	31	P
<sup>141</sup> Eu	$\beta+\epsilon$	6008	0.0	5/2+	384.46	3/2+	7.0	17	5.99	11	P
<sup>141</sup> Nd	$\beta+\epsilon$	1823.0	0.0	3/2+	0.0	5/2+	98.23	9	5.297	6	
<sup>141</sup> Pm	$\beta+\epsilon$	3669	0.0	5/2+	0.0	3/2+	89.9	7	5.474	7	
<sup>142</sup> Cs	$\beta^-$	7328	0.0	0-	1326.48	1-	16.9	10	5.78	5	
<sup>142</sup> La	$\beta^-$	4509	0.0	2-	2187.20	1-	3.2	2	8.288	28	
<sup>143</sup> Eu	$\beta+\epsilon$	5276	0.0	5/2+	0.0	3/2+	80.0	20	5.377	12	P
<sup>143</sup> Eu	$\beta+\epsilon$	5276	0.0	5/2+	1566.1	(3/2)+	1.70	20	6.34	5	P
<sup>143</sup> Eu	$\beta+\epsilon$	5276	0.0	5/2+	1715.0	(3/2)+	1.33	13	6.376	43	P
<sup>143</sup> Eu	$\beta+\epsilon$	5276	0.0	5/2+	1912.7	(3/2)+	4.40	40	5.758	40	P
<sup>143</sup> Gd	$\beta+\epsilon$	6.01E3	0.0	(1/2)+	258.82	(3/2)+	58.3	20	5.10	8	P
<sup>143</sup> Gd	$\beta+\epsilon$	6.01E3	152.6	11/2-	1057.65	13/2-	9.4	7	6.09	9	P
<sup>143</sup> Sm	$\beta+\epsilon$	3443.5	0.0	3/2+	0.0	5/2+	95.3	5	4.9721	42	
<sup>144</sup> Pr	$\beta^-$	2997.4	0.0	0-	2185.67	1-	1.05	4	6.357	17	
<sup>144</sup> Pm	$\epsilon$	2331.9	0.0	5-	2204.79	4-	0.6	1	8.49	8	
<sup>144</sup> Eu	$\beta+\epsilon$	6346	0.0	1+	1660.1	2+	8.0	5	4.944	28	P
<sup>144</sup> Eu	$\beta+\epsilon$	6346	0.0	1+	2423.3	2+	1.01	8	5.490	35	P
<sup>145</sup> Cs	$\beta^-$	7462	0.0	3/2+	547.09	(5/2)+	3.5	5	6.27	6	P
<sup>145</sup> Eu	$\beta+\epsilon$	2659.9	0.0	5/2+	1547.302	3/2+	19.3	8	7.414	19	
<sup>145</sup> Eu	$\epsilon$	2659.9	0.0	5/2+	1627.74	3/2+	0.650	40	8.819	27	
<sup>145</sup> Eu	$\epsilon$	2659.9	0.0	5/2+	1857.69	7/2+	0.603	23	8.622	17	
<sup>145</sup> Eu	$\epsilon$	2659.9	0.0	5/2+	2385.89	3/2+	0.342	15	7.844	22	
<sup>145</sup> Gd	$\beta+\epsilon$	5065	0.0	1/2+	1041.71	3/2+	8.1	6	6.778	34	
<sup>145</sup> Gd	$\beta+\epsilon$	5065	0.0	1/2+	1758.03	3/2+	34.3	20	5.806	28	
<sup>145</sup> Gd	$\beta+\epsilon$	5065	0.0	1/2+	2642.2	3/2+	2.24	12	6.560	26	
<sup>146</sup> Tb	$\beta+\epsilon$	8322	0.0	1+	1972.02	2+	8.9	18	5.45	23	P
<sup>146</sup> Tb	$\beta+\epsilon$	8322	0.0	1+	3185.95	2+	1.27	18	5.84	23	P
<sup>146</sup> Eu	$\beta+\epsilon$	3879	0.0	4-	1380.289	3-	12.3	10	8.290	36	
<sup>146</sup> Eu	$\beta+\epsilon$	3879	0.0	4-	2083.426	5-	2.43	18	8.641	33	
<sup>146</sup> Eu	$\beta+\epsilon$	3879	0.0	4-	2788.223	5-	4.43	16	7.926	17	
<sup>146</sup> Eu	$\epsilon$	3879	0.0	4-	3259.924	5-	2.19	9	7.714	21	
<sup>146</sup> Eu	$\epsilon$	3879	0.0	4-	3461.557	5-	3.0	4	7.21	6	
<sup>147</sup> Eu	$\epsilon$	1721.4	0.0	5/2+	1054.218	3/2+	5.62	16	8.092	17	
<sup>147</sup> Gd	$\beta+\epsilon$	2187.7	0.0	7/2-	995.17	9/2-	19.8	13	6.924	29	
<sup>147</sup> Gd	$\epsilon$	2187.7	0.0	7/2-	1360.34	9/2-	6.1	6	7.104	43	
<sup>147</sup> Gd	$\epsilon$	2187.7	0.0	7/2-	1554.29	9/2-	37.1	18	6.073	22	
<sup>148</sup> Pm	$\beta^-$	2470	0.0	1-	2057.961	2-	1.36	4	7.933	25	
<sup>148</sup> Eu	$\epsilon$	3039	0.0	5-	2031.423	4-	4.43	16	8.927	19	
<sup>148</sup> Eu	$\epsilon$	3039	0.0	5-	2815.583	4-	0.80	3	8.23	5	
<sup>149</sup> Tb	$\beta+\epsilon$	3638.5	0.0	1/2+	1026.840	3/2+	4.76	18	7.387	17	
<sup>149</sup> Tb	$\beta+\epsilon$	3638.5	0.0	1/2+	1655.19	(3/2)+	1.35	7	7.631	23	
<sup>149</sup> Tb	$\beta+\epsilon$	3638.5	0.0	1/2+	2158.36	(3/2)+	4.32	15	6.851	16	
<sup>149</sup> Tb	$\beta+\epsilon$	3638.5	35.8	11/2-	796.0	9/2-	100.		4.418	6	
<sup>149</sup> Dy	$\beta+\epsilon$	3795	0.0	7/2-	825.12	9/2-	7.5	5	5.617	36	P



**Table 10**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
<sup>149</sup> Dy	$\beta+\epsilon$	3795	0.0	7/2-	1420.55	(9/2)-	1.15	9	6.154	40	P
<sup>149</sup> Dy	$\beta+\epsilon$	3795	0.0	7/2-	1426.13	9/2-	2.08	11	5.894	31	P
<sup>149</sup> Dy	$\beta+\epsilon$	3795	0.0	7/2-	1697.49	9/2-	1.69	10	5.855	33	P
<sup>149</sup> Dy	$\beta+\epsilon$	3795	0.0	7/2-	1728.36	5/2-	8.10	40	5.159	30	P
<sup>149</sup> Dy	$\beta+\epsilon$	3795	0.0	7/2-	1841.63	9/2-	15.5	5	4.821	25	P
<sup>149</sup> Dy	$\beta+\epsilon$	3795	0.0	7/2-	1876.88	5/2-	18.4	6	4.729	26	P
<sup>149</sup> Dy	$\beta+\epsilon$	3795	0.0	7/2-	1883.08	(9/2)-	8.60	30	5.056	26	P
<sup>149</sup> Dy	$\beta+\epsilon$	3795	0.0	7/2-	1953.13	9/2-	3.99	7	5.354	23	P
<sup>149</sup> Dy	$\beta+\epsilon$	3795	0.0	7/2-	2161.04	(9/2)-	1.08	9	5.810	42	P
<sup>149</sup> Nd	$\beta^-$	1688.9	0.0	5/2-	270.170	7/2-	17.5	18	6.825	45	
<sup>149</sup> Nd	$\beta^-$	1688.9	0.0	5/2-	462.191	3/2-	1.2	3	7.75	11	
<sup>149</sup> Nd	$\beta^-$	1688.9	0.0	5/2-	654.843	7/2-	19.3	8	6.270	18	
<sup>149</sup> Gd	$\epsilon$	1314.1	0.0	7/2-	795.030	9/2-	33.0	18	6.705	27	
<sup>149</sup> Gd	$\epsilon$	1314.1	0.0	7/2-	1097.591	(9/2)-	1.18	7	7.283	36	
<sup>149</sup> Gd	$\epsilon$	1314.1	0.0	7/2-	1231.253	9/2-	0.268	15	6.72	9	
<sup>150</sup> Tb	$\beta+\epsilon$	4658	0.0	(2)-	1134.304	3-	3.4	6	7.89	8	
<sup>151</sup> Nd	$\beta^-$	2443.1	0.0	3/2+	0.0	5/2+	14.6	18	6.91	5	
<sup>151</sup> Nd	$\beta^-$	2443.1	0.0	3/2+	324.682	5/2+	3.9	5	7.24	6	
<sup>151</sup> Nd	$\beta^-$	2443.1	0.0	3/2+	426.451	1/2+	2.6	2	7.326	34	
<sup>151</sup> Nd	$\beta^-$	2443.1	0.0	3/2+	914.309	5/2+	8.7	6	6.331	30	
<sup>151</sup> Nd	$\beta^-$	2443.1	0.0	3/2+	1297.682	5/2+	17.9	16	5.545	39	
<sup>151</sup> Nd	$\beta^-$	2443.1	0.0	3/2+	1892.05	(5/2)+	1.49	10	5.499	32	
<sup>151</sup> Pm	$\beta^-$	1190.2	0.0	5/2+	306.79	3/2+	1.7	3	8.32	8	
<sup>151</sup> Pm	$\beta^-$	1190.2	0.0	5/2+	323.941	7/2+	3.3	4	8.00	5	
<sup>151</sup> Pm	$\beta^-$	1190.2	0.0	5/2+	344.909	3/2+	42	5	6.85	5	
<sup>151</sup> Pm	$\beta^-$	1190.2	0.0	5/2+	521.10	3/2+	0.77	10	8.23	6	
<sup>151</sup> Gd	$\epsilon$	464.2	0.0	7/2-	349.813	9/2-	9.9	7	6.737	48	
<sup>152</sup> Eu	$\beta^-$	1818.8	45.5998	0-	1314.62	1-	1.57	25	7.20	7	
<sup>152</sup> Tb	$\beta+\epsilon$	3990	0.0	2-	1123.186	3-	1.67	13	8.591	37	
<sup>152</sup> Tb	$\beta+\epsilon$	3990	501.74	8+	2394.11	7+	17.8	13	4.798	38	P
<sup>152</sup> Ho	$\beta+\epsilon$	6513	160	9+	2437.39	8+	59.0	20	4.614	16	P
<sup>152</sup> Ho	$\beta+\epsilon$	6513	160	9+	2703.19	8+	9.2	6	5.304	29	P
<sup>152</sup> Ho	$\beta+\epsilon$	6513	160	9+	3173.3	10+	1.40	40	5.91	12	P
<sup>152</sup> Ho	$\beta+\epsilon$	6513	160	9+	3184.0	10+	1.20	20	5.97	7	P
<sup>152</sup> Pm	$\beta^-$	3509	0.0	1+	121.85	2+	20.6	18	6.888	41	
<sup>152</sup> Pm	$\beta^-$	3509	0.0	1+	1292.55	2+	1.10	10	7.404	45	
<sup>152</sup> Pm	$\beta^-$	3509	1.5E+2	4-	1041.08	3-	1.61	21	7.79	9	P
<sup>152</sup> Pm	$\beta^-$	3509	1.5E+2	4-	1579.31	3-	1.35	15	7.47	9	P
<sup>152</sup> Pm	$\beta^-$	3509	1.5E+2	4-	1803.91	5-	57	5	5.64	10	P
<sup>152</sup> Eu	$\epsilon$	1874.5	0.0	3-	1529.8019	2-	24.78	11	9.1328	39	
<sup>152</sup> Eu	$\epsilon$	1874.5	0.0	3-	1649.833	2-	0.928	9	10.126	6	
<sup>152</sup> Eu	$\epsilon$	1874.5	0.0	3-	1682.07	4-	0.00364	16	12.367	20	
<sup>152</sup> Eu	$\epsilon$	1874.5	0.0	3-	1822.03	4-	0.0049	12	10.43	11	
<sup>152</sup> Eu	$\epsilon$	1874.5	45.5998	0-	963.40	1-	26	3	5.96	5	
<sup>152</sup> Eu	$\beta^-$	1818.8	0.0	3-	1643.421	2-	1.833	12	9.628	6	
<sup>153</sup> Pm	$\beta^-$	1912	0.0	5/2-	35.845	3/2-	24	5	5.88	9	
<sup>153</sup> Pm	$\beta^-$	1912	0.0	5/2-	127.299	3/2-	42	6	5.55	6	
<sup>153</sup> Sm	$\beta^-$	807.4	0.0	3/2+	0.0	5/2+	19.5	9	7.351	20	
<sup>153</sup> Sm	$\beta^-$	807.4	0.0	3/2+	172.85318	5/2+	30.4	5	6.794	7	
<sup>153</sup> Sm	$\beta^-$	807.4	0.0	3/2+	694.18	5/2+	0.0231	4	7.506	11	
<sup>153</sup> Sm	$\beta^-$	807.4	0.0	3/2+	706.62	5/2+	0.0234	4	7.346	12	
<sup>153</sup> Gd	$\epsilon$	484.5	0.0	3/2-	97.43103	5/2-	39.2	5	7.763	8	
<sup>153</sup> Tb	$\beta+\epsilon$	1569.3	0.0	5/2+	212.014	3/2+	51.0	30	6.835	26	

**Table 10**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
<sup>153</sup> Tb	$\beta+\epsilon$	1569.3	0.0	5/2+	412.91	3/2+	0.054	13	9.67	10	
<sup>153</sup> Tb	$\epsilon$	1569.3	0.0	5/2+	709.04	3/2+	0.40	3	8.528	33	
<sup>153</sup> Tb	$\epsilon$	1569.3	0.0	5/2+	731.62	7/2+	0.64	5	8.299	35	
<sup>153</sup> Tb	$\epsilon$	1569.3	0.0	5/2+	782.569	3/2+	1.56	12	7.855	34	
<sup>153</sup> Tb	$\epsilon$	1569.3	0.0	5/2+	865.595	3/2+	0.60	4	8.167	30	
<sup>153</sup> Tb	$\epsilon$	1569.3	0.0	5/2+	945.159	3/2+	3.50	18	7.290	24	
<sup>153</sup> Tb	$\epsilon$	1569.3	0.0	5/2+	1066.36	3/2+	0.303	17	8.149	26	
<sup>153</sup> Tb	$\epsilon$	1569.3	0.0	5/2+	1101.619	3/2+	2.66	14	7.137	25	
<sup>154</sup> Ho	$\beta+\epsilon$	5755	0.0	2-	1207.98	3-	12.5	9	6.573	32	P
<sup>154</sup> Eu	$\beta-$	1968.0	0.0	3-	1397.506	2-	36.3	3	9.7936	42	
<sup>154</sup> Eu	$\beta-$	1968.0	0.0	3-	1719.560	2-	28.6	2	8.714	5	
<sup>155</sup> Sm	$\beta-$	1627.1	0.0	3/2-	104.320	5/2-	92.5	14	5.591	7	
<sup>155</sup> Eu	$\beta-$	252.0	0.0	5/2+	105.3088	3/2+	46.2	24	7.530	24	
<sup>155</sup> Eu	$\beta-$	252.0	0.0	5/2+	117.9971	7/2+	1.7	3	8.84	8	
<sup>155</sup> Tb	$\epsilon$	820	0.0	3/2+	86.530	5/2+	5.9	19	7.57	14	
<sup>155</sup> Tb	$\epsilon$	820	0.0	3/2+	266.601	5/2+	17.9	10	6.825	31	
<sup>155</sup> Tb	$\epsilon$	820	0.0	3/2+	326.017	5/2+	0.66	5	8.151	40	
<sup>155</sup> Tb	$\epsilon$	820	0.0	3/2+	367.512	1/2+	7.1	4	7.035	34	
<sup>155</sup> Tb	$\epsilon$	820	0.0	3/2+	488.678	5/2+	0.93	7	7.614	47	
<sup>155</sup> Dy	$\beta+\epsilon$	2094.5	0.0	3/2-	226.916	5/2-	66.6	17	6.295	14	
<sup>155</sup> Dy	$\beta+\epsilon$	2094.5	0.0	3/2-	1062.074	5/2-	1.280	40	7.470	16	
<sup>155</sup> Dy	$\epsilon$	2094.5	0.0	3/2-	1155.482	5/2-	9.4	8	6.518	38	
<sup>155</sup> Dy	$\epsilon$	2094.5	0.0	3/2-	1492.635	5/2-	1.61	4	6.873	14	
<sup>155</sup> Dy	$\epsilon$	2094.5	0.0	3/2-	1638.848	5/2-	2.9	7	6.35	11	
<sup>155</sup> Dy	$\epsilon$	2094.5	0.0	3/2-	1664.913	5/2-	4.70	14	6.087	16	
<sup>155</sup> Dy	$\epsilon$	2094.5	0.0	3/2-	1750.098	5/2-	2.19	7	6.202	18	
<sup>156</sup> Ta	$\beta+\epsilon$	1.182E4	102	9+	1959	8+	37	12	4.47	17	P
<sup>157</sup> Eu	$\beta-$	1364.8	0.0	5/2+	474.632	3/2+	22	2	6.987	40	
<sup>157</sup> Dy	$\epsilon$	1339	0.0	3/2-	326.346	5/2-	96	3	5.493	15	
<sup>157</sup> Ho	$\beta+\epsilon$	2592	0.0	7/2-	341.118	5/2-	56	5	4.918	41	
<sup>157</sup> Ho	$\beta+\epsilon$	2592	0.0	7/2-	896.57	(5/2)-	12.0	20	5.31	7	
<sup>157</sup> Er	$\beta+\epsilon$	3419	0.0	3/2-	391.32	5/2-	15.0	20	6.04	6	P
<sup>158</sup> Tb	$\epsilon$	1219.1	0.0	3-	1023.705	2-	44.4	17	9.476	32	
<sup>158</sup> Tb	$\epsilon$	1219.1	0.0	3-	1159.009	4-	0.097	12	10.50	7	
<sup>159</sup> Gd	$\beta-$	970.7	0.0	3/2-	363.5451	5/2-	12.19	6	6.7713	27	
<sup>159</sup> Dy	$\epsilon$	364.73	0.0	3/2-	363.546	5/2-	0.00019	5	5.67	24	
<sup>159</sup> Er	$\beta+\epsilon$	2768.5	0.0	3/2-	624.51	5/2-	33.0	40	5.59	5	
<sup>159</sup> Er	$\beta+\epsilon$	2768.5	0.0	3/2-	649.15	5/2-	26.0	30	5.68	5	
<sup>159</sup> Er	$\beta+\epsilon$	2768.5	0.0	3/2-	1558.3	5/2-	1.04	15	6.56	6	
<sup>159</sup> Er	$\beta+\epsilon$	2768.5	0.0	3/2-	1680.0	5/2-	1.10	20	6.44	8	
<sup>160</sup> Tb	$\beta-$	1836.0	0.0	3-	1264.7470	2-	45.4	10	8.106	10	
<sup>160</sup> Tb	$\beta-$	1836.0	0.0	3-	1358.666	2-	9.92	20	8.504	9	
<sup>160</sup> Tb	$\beta-$	1836.0	0.0	3-	1386.436	4-	1.015	21	9.408	10	
<sup>160</sup> Tb	$\beta-$	1836.0	0.0	3-	1535.151	4-	0.235	6	9.474	12	
<sup>161</sup> Ho	$\epsilon$	859.2	0.0	7/2-	25.656	5/2-	76	14	4.93	8	
<sup>161</sup> Ho	$\epsilon$	859.2	0.0	7/2-	201.077	9/2-	1.8	3	6.34	7	
<sup>162</sup> Ho	$\epsilon$	2140.6	105.87	6-	1485.70	5-	36.7	7	4.820	11	
<sup>162</sup> Tm	$\beta+\epsilon$	4857	0.0	1-	1572.90	2-	8.6	9	6.489	46	P
<sup>163</sup> Tb	$\beta-$	1785.1	0.0	3/2+	737.49	1/2+	11.4	11	5.903	43	
<sup>163</sup> Tb	$\beta-$	1785.1	0.0	3/2+	884.24	1/2+	34.8	24	5.182	31	
<sup>163</sup> Tb	$\beta-$	1785.1	0.0	3/2+	915.67	5/2+	1.6	3	6.46	8	
<sup>163</sup> Tb	$\beta-$	1785.1	0.0	3/2+	949.34	(5/2)+	4.5	5	5.955	49	
<sup>163</sup> Tb	$\beta-$	1785.1	0.0	3/2+	1058.81	1/2+	1.4	3	6.25	9	

**Table 10**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
$^{163}\text{Ho}$	$\varepsilon$	2.831	0.0	7/2-	0.0	5/2-	100		5.116	13	
$^{163}\text{Er}$	$\beta+\varepsilon$	1210.6	0.0	5/2-	0.0	7/2-	99.891	21	4.892	5	
$^{163}\text{Tm}$	$\beta+\varepsilon$	2439.0	0.0	1/2+	462.48	3/2+	1.96	12	7.245	27	
$^{163}\text{Tm}$	$\beta+\varepsilon$	2439.0	0.0	1/2+	619.36	3/2+	2.57	10	7.049	17	
$^{163}\text{Tm}$	$\beta+\varepsilon$	2439.0	0.0	1/2+	1369.46	3/2+	7.84	26	6.080	15	
$^{163}\text{Tm}$	$\varepsilon$	2439.0	0.0	1/2+	1514.61	3/2+	2.72	12	6.406	20	
$^{163}\text{Tm}$	$\varepsilon$	2439.0	0.0	1/2+	1538.79	3/2+	16.9	6	5.589	16	
$^{163}\text{Tm}$	$\varepsilon$	2439.0	0.0	1/2+	1569.80	3/2+	9.7	3	5.797	14	
$^{163}\text{Tm}$	$\varepsilon$	2439.0	0.0	1/2+	1593.03	3/2+	2.46	9	6.368	17	
$^{163}\text{Tm}$	$\varepsilon$	2439.0	0.0	1/2+	1653.15	3/2+	1.11	5	6.646	20	
$^{163}\text{Tm}$	$\varepsilon$	2439.0	0.0	1/2+	1722.39	3/2+	2.86	11	6.149	17	
$^{163}\text{Tm}$	$\varepsilon$	2439.0	0.0	1/2+	1801.56	3/2+	12.9	4	5.385	15	
$^{163}\text{Tm}$	$\varepsilon$	2439.0	0.0	1/2+	1826.49	3/2+	5.33	17	5.732	15	
$^{163}\text{Tm}$	$\varepsilon$	2439.0	0.0	1/2+	1853.54	3/2+	2.06	8	6.102	18	
$^{163}\text{Tm}$	$\varepsilon$	2439.0	0.0	1/2+	1872.79	(3/2)+	2.48	14	5.989	25	
$^{164}\text{Ho}$	$\varepsilon$	987.1	0.0	1+	73.39	2+	19	2	4.907	46	
$^{164}\text{Ho}$	$\beta-$	962.1	0.0	1+	91.39	2+	12	2	5.81	7	
$^{164}\text{Tm}$	$\beta+\varepsilon$	4034	0.0	1+	91.396	2+	22.0	20	5.319	46	
$^{165}\text{Dy}$	$\beta-$	1285.7	0.0	7/2+	995.095	5/2+	1.7	2	5.72	5	
$^{165}\text{Dy}$	$\beta-$	1285.7	108.160	1/2-	515.467	3/2-	1.9	1	5.238	23	
$^{165}\text{Er}$	$\varepsilon$	376.7	0.0	5/2-	0.0	7/2-	100		4.7145	41	
$^{165}\text{Tm}$	$\beta+\varepsilon$	1591.3	0.0	1/2+	534.562	3/2+	1.50	10	8.007	29	
$^{165}\text{Tm}$	$\varepsilon$	1591.3	0.0	1/2+	589.781	3/2+	5.3	2	7.410	17	
$^{165}\text{Tm}$	$\varepsilon$	1591.3	0.0	1/2+	853.514	3/2+	10.2	5	6.844	22	
$^{165}\text{Tm}$	$\varepsilon$	1591.3	0.0	1/2+	999.866	3/2+	0.41	3	8.033	32	
$^{165}\text{Tm}$	$\varepsilon$	1591.3	0.0	1/2+	1103.522	3/2+	0.7	1	7.62	6	
$^{165}\text{Tm}$	$\varepsilon$	1591.3	0.0	1/2+	1411.784	3/2+	0.52	3	6.700	27	
$^{165}\text{Tm}$	$\varepsilon$	1591.3	0.0	1/2+	1427.405	3/2+	7.0	4	5.463	28	
$^{165}\text{Yb}$	$\varepsilon$	2635	0.0	5/2-	1581.76	7/2-	3.5	7	5.41	9	
$^{166}\text{Ho}$	$\beta-$	1853.8	0.0	0-	1662.436	1-	0.302	5	6.980	9	
$^{166}\text{Ho}$	$\beta-$	1853.8	0.0	0-	1830.425	1-	0.0342	6	5.143	47	
$^{166}\text{Ho}$	$\beta-$	1853.8	5.969	7-	1786.969	6-	73.9	10	8.867	16	
$^{166}\text{Ho}$	$\beta-$	1853.8	5.969	7-	1827.552	6-	17.23	16	8.428	34	
$^{166}\text{Tm}$	$\varepsilon$	3038	0.0	2+	2132.951	3+	59	4	5.679	32	
$^{166}\text{Tm}$	$\varepsilon$	3038	0.0	2+	2160.121	3+	16.2	11	6.212	33	
$^{166}\text{Tm}$	$\varepsilon$	3038	0.0	2+	2172.757	3+	2.35	18	7.037	36	
$^{166}\text{Tm}$	$\varepsilon$	3038	0.0	2+	2290.997	(3)+	1.36	11	7.139	39	
$^{166}\text{Lu}$	$\beta+\varepsilon$	5573	0.	6-	1505.38	(5)-	3.2	6	6.38	8	P
$^{167}\text{Ho}$	$\beta-$	1010	0.0	7/2-	346.50	5/2-	21	6	5.96	13	
$^{167}\text{Ho}$	$\beta-$	1010	0.0	7/2-	667.86	(5/2)-	43	12	4.69	12	
$^{167}\text{Tm}$	$\varepsilon$	746.1	0.0	1/2+	531.54	3/2+	1.64	23	7.27	6	
$^{167}\text{Yb}$	$\beta+\varepsilon$	1953.2	0.0	5/2-	292.802	7/2-	95	5	4.638	24	
$^{168}\text{Ho}$	$\beta-$	2930	0.0	3+	821.113	2+	68	8	5.51	6	
$^{168}\text{Ho}$	$\beta-$	2930	0.0	3+	994.67	4+	1.74	23	6.95	6	
$^{168}\text{Ho}$	$\beta-$	2930	0.0	3+	2192.98	2+	1.84	23	5.38	9	
$^{168}\text{Tm}$	$\varepsilon$	1676.9	0.0	3+	821.1643	2+	11.98	10	8.7828	47	
$^{168}\text{Tm}$	$\varepsilon$	1676.9	0.0	3+	1276.298	2+	0.0199	16	10.842	35	
$^{168}\text{Tm}$	$\varepsilon$	1676.9	0.0	3+	1411.100	4+	0.0029	9	11.26	14	
$^{168}\text{Tm}$	$\varepsilon$	1676.9	0.0	3+	1493.26	2+	0.0015	5	11.14	15	
$^{168}\text{Lu}$	$\beta+\varepsilon$	4507	202.81	3+	2204.00	(4)+	41	7	5.02	8	P
$^{169}\text{Yb}$	$\varepsilon$	899.1	0.0	7/2+	332.117	9/2+	0.0143	17	10.89	5	
$^{169}\text{Yb}$	$\varepsilon$	899.1	0.0	7/2+	433.521	(9/2)+	0.114	9	9.800	34	
$^{169}\text{Yb}$	$\varepsilon$	899.1	0.0	7/2+	633.292	5/2+	0.01088	17	10.252	8	

**Table 10**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
<sup>169</sup> Yb	$\epsilon$	899.1	0.0	7/2+	781.796	(5/2)+	6.72E-4	8	10.475	12	
<sup>169</sup> Lu	$\beta+\epsilon$	2293.0	0.0	7/2+	590.67	(5/2)+	0.43	8	9.10	8	
<sup>169</sup> Lu	$\beta+\epsilon$	2293.0	0.0	7/2+	707.03	9/2+	0.80	16	8.77	9	
<sup>169</sup> Lu	$\beta+\epsilon$	2293.0	0.0	7/2+	761.822	(5/2)+	0.54	11	8.91	9	
<sup>169</sup> Lu	$\beta+\epsilon$	2293.0	0.0	7/2+	886.80	9/2+	0.495	20	8.867	19	
<sup>169</sup> Lu	$\beta+\epsilon$	2293.0	0.0	7/2+	1141.44	(9/2)+	0.111	11	9.335	44	
<sup>169</sup> Lu	$\epsilon$	2293.0	0.0	7/2+	1658.10	5/2+	4.86	13	7.143	15	
<sup>169</sup> Lu	$\epsilon$	2293.0	0.0	7/2+	1694.48	5/2+	0.121	8	8.691	30	
<sup>169</sup> Lu	$\epsilon$	2293.0	0.0	7/2+	1908.63	5/2+	2.12	9	7.016	22	
<sup>171</sup> Er	$\beta-$	1492.4	0.0	5/2-	424.948	7/2-	94	4	6.448	19	
<sup>171</sup> Lu	$\epsilon$	1478.4	0.0	7/2+	935.261	9/2+	3.87	10	7.857	14	
<sup>171</sup> Lu	$\epsilon$	1478.4	0.0	7/2+	984.037	(9/2)+	0.139	4	9.211	15	
<sup>171</sup> Lu	$\epsilon$	1478.4	0.0	7/2+	1093.30	9/2+	0.148	4	8.938	15	
<sup>172</sup> Tm	$\beta-$	1882	0.0	2-	1154.91	1-	0.95	9	8.802	43	
<sup>172</sup> Lu	$\beta+\epsilon$	2519.4	0.0	4-	1353.02	(5)-	0.090	20	10.11	10	
<sup>172</sup> Lu	$\epsilon$	2519.4	0.0	4-	1706.455	5-	0.93	15	8.77	7	
<sup>173</sup> Lu	$\epsilon$	670.2	0.0	7/2+	412.967	9/2+	3.04	14	8.990	23	
<sup>173</sup> Hf	$\beta+\epsilon$	1469	0.0	1/2-	263.310	3/2-	32.0	9	6.792	26	
<sup>173</sup> Hf	$\epsilon$	1469	0.0	1/2-	1162.435	3/2-	1.75	5	6.74	10	
<sup>174</sup> Tm	$\beta-$	3080	0.0	(4)-	1884.5	(5)-	83	5	4.78	7	P
<sup>174</sup> Tm	$\beta-$	3080	0.0	(4)-	2378.7	(5)-	14.3	8	4.72	11	P
<sup>174</sup> Lu	$\epsilon$	1374.2	0.0	1-	1318.314	2-	5.2	1	7.088	35	
<sup>174</sup> Ta	$\beta+\epsilon$	4104	0.0	3+	297.38	4+	61	5	6.448	48	P
<sup>174</sup> Ta	$\beta+\epsilon$	4104	0.0	3+	1062.17	4+	2.10	20	7.61	5	P
<sup>174</sup> Ta	$\beta+\epsilon$	4104	0.0	3+	1503.29	(4)+	5.1	5	7.04	5	P
<sup>175</sup> Yb	$\beta-$	470.1	0.0	7/2-	396.328	9/2-	20.4	4	4.523	23	
<sup>176</sup> Ta	$\beta+\epsilon$	3211	0.0	(1)-	1247.69	2-	11.0	20	7.27	8	
<sup>176</sup> Ta	$\beta+\epsilon$	3211	0.0	(1)-	1958.19	2-	8.0	10	7.00	6	
<sup>176</sup> Ta	$\epsilon$	3211	0.0	(1)-	2265.28	(2)-	1.1	2	7.60	9	
<sup>176</sup> Ta	$\epsilon$	3211	0.0	(1)-	2470.84	2-	7	1	6.57	8	
<sup>176</sup> Ta	$\epsilon$	3211	0.0	(1)-	2912.27	(0)-	6.1	9	5.74	14	
<sup>176</sup> Ta	$\epsilon$	3211	0.0	(1)-	2944.19	2-	7.3	9	5.54	15	
<sup>177</sup> Yb	$\beta-$	1397.5	0.0	9/2+	0.0	7/2+	59.4	5	6.5288	40	
<sup>177</sup> Yb	$\beta-$	1397.5	0.0	9/2+	1149.97	7/2+	1.17	5	5.669	20	
<sup>177</sup> Yb	$\beta-$	1397.5	0.0	9/2+	1230.620	11/2+	6.6	3	4.381	22	
<sup>177</sup> Yb	$\beta-$	1397.5	0.0	9/2+	1241.50	7/2+	3.60	17	4.553	23	
<sup>177</sup> Lu	$\beta-$	496.8	0.0	7/2+	321.3162	9/2+	11.66	11	6.148	7	
<sup>177</sup> Ta	$\epsilon$	1166.0	0.0	7/2+	321.3162	9/2+	1.4	4	8.24	12	
<sup>177</sup> Ta	$\epsilon$	1166.0	0.0	7/2+	847.41	9/2+	0.19	6	8.15	14	
<sup>177</sup> W	$\beta+\epsilon$	2013	0.0	1/2-	372.57	3/2-	3.7	6	7.05	7	
<sup>177</sup> W	$\epsilon$	2013	0.0	1/2-	1044.80	3/2-	2.76	19	6.697	42	
<sup>177</sup> W	$\epsilon$	2013	0.0	1/2-	1253.08	3/2-	15.8	8	5.714	44	
<sup>177</sup> W	$\epsilon$	2013	0.0	1/2-	1476.31	(3/2)-	5.7	4	5.82	6	
<sup>177</sup> W	$\epsilon$	2013	0.0	1/2-	1543.46	3/2-	2.58	16	6.04	7	
<sup>179</sup> Lu	$\beta-$	1404	0.0	7/2+	0.0	9/2+	87	3	6.774	17	
<sup>179</sup> Ta	$\epsilon$	105.58	0.0	7/2+	0.0	9/2+	100		6.512	10	
<sup>179</sup> W	$\beta+\epsilon$	1062	0.0	7/2-	30.7	9/2-	99.2	5	4.646	16	
<sup>179</sup> Re	$\beta+\epsilon$	2711	0.0	5/2+	720.19	3/2+	45.0	40	5.350	41	
<sup>179</sup> Re	$\beta+\epsilon$	2711	0.0	5/2+	855.27	7/2+	2.06	19	6.623	43	
<sup>179</sup> Re	$\beta+\epsilon$	2711	0.0	5/2+	1606.35	(3/2)+	6.0	5	5.684	44	
<sup>179</sup> Re	$\beta+\epsilon$	2711	0.0	5/2+	1680.28	(7/2)+	17.6	14	5.153	44	
<sup>179</sup> Re	$\epsilon$	2711	0.0	5/2+	1808.89	(7/2)+	3.3	3	5.76	5	
<sup>179</sup> Pt	$\beta+\epsilon$	5814	0.0	1/2-	193.1	(3/2)-	38	8	5.11	9	P

**Table 10**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	$\log ft$	Unc.	Pand.
<sup>180</sup> Lu	$\beta^-$	3.10E3	0.0	5+	1607.97	(4)+	78	2	5.24	8	P
<sup>180</sup> Ta	$\varepsilon$	845.8	0.0	1+	93.3240	2+	25	1	6.039	18	
<sup>180</sup> Ta	$\beta^-$	702.6	0.0	1+	103.6	2+	3.9	7	7.11	8	
<sup>180</sup> Re	$\beta^+/\varepsilon$	3799	0.0	(1)-	1006.35	2-	79.0	40	4.549	24	P
<sup>180</sup> Re	$\beta^+/\varepsilon$	3799	0.0	(1)-	1831.69	2-	11.70	40	5.024	20	P
<sup>181</sup> W	$\varepsilon$	205.1	0.0	9/2+	0.0	7/2+	26	4	7.27	7	
<sup>181</sup> Re	$\varepsilon$	1717	0.0	5/2+	1365.59	3/2+	22.7	25	5.79	7	
<sup>181</sup> Re	$\varepsilon$	1717	0.0	5/2+	1498.14	7/2+	1.6	4	6.42	13	
<sup>181</sup> Os	$\beta^+/\varepsilon$	2967	0.0	1/2-	599.67	3/2-	7.0	23	7.09	14	
<sup>181</sup> Os	$\beta^+/\varepsilon$	2967	0.0	1/2-	1442.66	3/2-	3.9	7	6.93	8	
<sup>181</sup> Os	$\varepsilon$	2967	0.0	1/2-	2172.3	3/2-	4.9	7	6.23	7	
<sup>181</sup> Os	$\varepsilon$	2967	0.0	1/2-	2482.3	3/2-	1.04	18	6.43	10	
<sup>182</sup> Ta	$\beta^-$	1815.5	0.0	3-	1289.1498	2-	43.2	9	8.400	10	
<sup>182</sup> Ta	$\beta^-$	1815.5	0.0	3-	1487.5018	4-	1.3	3	9.25	10	
<sup>182</sup> Ta	$\beta^-$	1815.5	0.0	3-	1553.2240	4-	29.23	25	7.584	9	
<sup>182</sup> Re	$\beta^+/\varepsilon$	2.80E3	0.0	7+	1756.77	6+	16.4	8	7.49	10	
<sup>183</sup> Ta	$\beta^-$	1072.1	0.0	7/2+	622.77	(9/2)+	6.2	9	7.66	6	
<sup>183</sup> Os	$\beta^+/\varepsilon$	2.15E3	0.0	9/2+	851.54	(7/2)+	5.20	9	7.526	43	
<sup>183</sup> Ir	$\beta^+/\varepsilon$	3.46E3	0.0	5/2-	453.05	3/2-	4.9	13	7.27	12	P
<sup>183</sup> Ir	$\beta^+/\varepsilon$	3.46E3	0.0	5/2-	486.99	7/2-	4.9	15	7.26	14	P
<sup>183</sup> Ir	$\beta^+/\varepsilon$	3.46E3	0.0	5/2-	582.21	(3/2)-	2.5	5	7.52	10	P
<sup>183</sup> Ir	$\beta^+/\varepsilon$	3.46E3	0.0	5/2-	620.78	7/2-	3.1	7	7.41	11	P
<sup>183</sup> Ir	$\beta^+/\varepsilon$	3.46E3	0.0	5/2-	2273.79	(7/2)-	7.6	10	6.19	8	P
<sup>184</sup> Ir	$\beta^+/\varepsilon$	4642	0.0	5-	1620.72	4-	2.3	6	8.11	11	P
<sup>184</sup> Ir	$\beta^+/\varepsilon$	4642	0.0	5-	1707.57	(4)-	1.84	24	8.18	6	P
<sup>184</sup> Ir	$\beta^+/\varepsilon$	4642	0.0	5-	1832.78	6-	4.1	7	7.78	7	P
<sup>184</sup> Ir	$\beta^+/\varepsilon$	4642	0.0	5-	1840.39	(6)-	1.91	24	8.11	6	P
<sup>186</sup> Ir	$\beta^+/\varepsilon$	3828	0.0	5+	868.93	6+	22.3	11	7.833	22	
<sup>186</sup> Ir	$\beta^+/\varepsilon$	3828	0.0	5+	1070.48	4+	5.1	6	8.40	5	
<sup>186</sup> Ir	$\beta^+/\varepsilon$	3828	0.0	5+	1351.99	4+	3.4	6	8.46	8	
<sup>186</sup> Ir	$\beta^+/\varepsilon$	3828	0.0	5+	1460.72	4+	1.8	5	8.69	12	
<sup>186</sup> Ir	$\beta^+/\varepsilon$	3828	0.0	5+	1491.28	6+	8.40	40	8.009	22	
<sup>186</sup> Ir	$\beta^+/\varepsilon$	3828	0.0	5+	1812.45	(6)+	2.70	40	8.36	6	
<sup>186</sup> Ir	$\beta^+/\varepsilon$	3828	0.0	5+	2031.3	4+	2.55	18	8.276	32	
<sup>186</sup> Ir	$\beta^+/\varepsilon$	3828	0.0	5+	2081.59	4+	10.6	7	7.632	30	
<sup>186</sup> Ir	$\beta^+/\varepsilon$	3828	0.0	5+	2666.6	(6)+	1.52	25	8.10	7	
<sup>186</sup> Au	$\beta^+/\varepsilon$	6150	0.0	3-	1633.00	4-	1.10	30	7.78	12	P
<sup>186</sup> Au	$\beta^+/\varepsilon$	6150	0.0	3-	1838.11	(4)-	8.0	6	6.849	39	P
<sup>187</sup> W	$\beta^-$	1312.5	0.0	3/2-	685.797	5/2-	70.7	19	6.402	12	
<sup>187</sup> Pt	$\beta^+/\varepsilon$	2864	0.0	3/2-	388.73	1/2-	1.70	30	7.94	8	
<sup>187</sup> Pt	$\beta^+/\varepsilon$	2864	0.0	3/2-	731.19	5/2-	2.50	40	7.63	7	
<sup>188</sup> Ir	$\varepsilon$	2792	0.0	1-	2348.69	(2)-	9.3	8	6.795	44	
<sup>189</sup> Pt	$\varepsilon$	1980	0.0	3/2-	1184.41	5/2-	6.3	17	6.98	12	
<sup>190</sup> Re	$\beta^-$	3124.8	0.0	(2)-	1386.91	3-	98.0	3	5.199	29	
<sup>190</sup> Ir	$\varepsilon$	1954.2	0.0	4-	1681.60	5-	47	2	6.411	20	
<sup>190</sup> Ir	$\varepsilon$	1954.2	0.0	4-	1872.10	(5)-	3.7	3	5.849	42	
<sup>190</sup> Ir	$\varepsilon$	1954.2	376.4	(11)-	1705.80	(10)-	91.4	2	5.0103	39	
<sup>191</sup> Os	$\beta^-$	313.6	0.0	9/2-	171.278	11/2-	100		5.411	10	
<sup>191</sup> Pt	$\varepsilon$	1010.5	0.0	3/2-	799.75	(5/2)-	0.32	7	7.69	10	
<sup>192</sup> Ir	$\varepsilon$	1046.7	0.0	4+	690.3705	3+	3.93	6	8.574	11	
<sup>192</sup> Ir	$\beta^-$	1452.9	0.0	4+	920.91854	3+	41.42	12	8.342	6	
<sup>192</sup> Ir	$\beta^-$	1452.9	0.0	4+	1406.37	3+	0.0059	5	8.87	8	
<sup>192</sup> Au	$\beta^+/\varepsilon$	3516	0.0	1-	2257.26	(2)-	2.60	40	7.48	7	

**Table 10**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
<sup>193</sup> Os	$\beta^-$	1141.9	0.0	3/2-	740.348	5/2-	0.32	1	8.251	16	
<sup>194</sup> Au	$\epsilon$	2548.2	0.0	1-	1961.328	2-	3.40	11	7.534	15	
<sup>194</sup> Au	$\epsilon$	2548.2	0.0	1-	2239.635	(2)-	0.454	16	7.749	18	
<sup>195</sup> Ir	$\beta^-$	1101.6	100	11/2-	562.78	9/2-	7.7	13	6.66	7	
<sup>195</sup> Ir	$\beta^-$	1101.6	100	11/2-	814.48	9/2-	36	6	5.26	8	
<sup>195</sup> Ir	$\beta^-$	1101.6	100	11/2-	895.34	9/2-	1.9	3	6.21	7	
<sup>195</sup> Ir	$\beta^-$	1101.6	100	11/2-	930.67	9/2-	5.0	9	5.62	8	
<sup>195</sup> Hg	$\epsilon$	1554	0.0	1/2-	1110.78	3/2-	2.1	3	6.94	9	
<sup>196</sup> Au	$\epsilon$	1505.8	0.0	2-	1447.3	(3)-	0.210	9	6.51	6	
<sup>198</sup> Tl	$\beta^+/\epsilon$	3426	543.5	7+	1815.8	6+	1.16	17	7.97	6	P
<sup>199</sup> Pt	$\beta^-$	1705.1	0.0	5/2-	734.64	7/2-	6.36	7	6.539	7	
<sup>200</sup> Au	$\beta^-$	2263	962	12-	2641.60	11-	84	1	6.23	27	
<sup>200</sup> Tl	$\epsilon$	2456	0.0	2-	2151.35	3-	0.014	4	9.14	13	
<sup>201</sup> Bi	$\beta^+/\epsilon$	3842	0.0	9/2-	936.1	7/2-	5.0	9	7.68	8	
<sup>201</sup> Bi	$\beta^+/\epsilon$	3842	0.0	9/2-	990.5	7/2-	4.3	8	7.70	8	
<sup>201</sup> Bi	$\beta^+/\epsilon$	3842	0.0	9/2-	1325.4	7/2-	5.6	4	7.461	36	
<sup>201</sup> Bi	$\epsilon$	3842	0.0	9/2-	2788.8	11/2-	3.00	40	6.93	6	
<sup>203</sup> Bi	$\beta^+/\epsilon$	3262	0.0	9/2-	1536.5	(7/2)-	8.0	5	7.802	31	
<sup>203</sup> Bi	$\beta^+/\epsilon$	3262	0.0	9/2-	1592.9	(7/2)-	1.22	23	8.59	8	
<sup>203</sup> Po	$\beta^+/\epsilon$	4214	0.0	5/2-	908.72	7/2-	9.0	30	7.13	15	P
<sup>203</sup> Po	$\beta^+/\epsilon$	4214	0.0	5/2-	1090.98	7/2-	15.4	22	6.84	6	P
<sup>203</sup> Po	$\beta^+/\epsilon$	4214	0.0	5/2-	1123.72	(7/2)-	20.0	16	6.711	36	P
<sup>203</sup> Po	$\beta^+/\epsilon$	4214	0.0	5/2-	1352.84	7/2-	2.9	6	7.47	9	P
<sup>203</sup> At	$\beta^+/\epsilon$	5148	0.0	9/2-	639.33	7/2-	7.9	5	6.901	30	P
<sup>203</sup> At	$\beta^+/\epsilon$	5148	0.0	9/2-	719.03	7/2-	6.40	40	6.969	30	P
<sup>203</sup> At	$\beta^+/\epsilon$	5148	0.0	9/2-	1029.28	(7/2)-	1.72	14	7.444	38	P
<sup>203</sup> At	$\beta^+/\epsilon$	5148	0.0	9/2-	1112.77	(7/2)-	1.85	12	7.387	31	P
<sup>203</sup> At	$\beta^+/\epsilon$	5148	0.0	9/2-	1153.62	(7/2)-	1.51	10	7.463	31	P
<sup>204</sup> Bi	$\beta^+/\epsilon$	4464	0.0	6+	3215.21	5+	1.35	17	8.26	6	
<sup>205</sup> Bi	$\beta^+/\epsilon$	2704.6	0.0	9/2-	703.44	7/2-	16.34	19	9.111	10	
<sup>205</sup> Bi	$\beta^+/\epsilon$	2704.6	0.0	9/2-	1614.32	7/2-	11.16	13	8.717	11	
<sup>205</sup> Bi	$\epsilon$	2704.6	0.0	9/2-	1764.37	7/2-	32.6	7	8.113	15	
<sup>205</sup> Bi	$\epsilon$	2704.6	0.0	9/2-	1775.80	7/2-	5.52	10	8.873	14	
<sup>205</sup> Bi	$\epsilon$	2704.6	0.0	9/2-	2521.47	(7/2)-	0.32	6	8.35	9	
<sup>205</sup> Po	$\beta^+/\epsilon$	3544	0.0	5/2-	849.84	7/2-	14.3	18	7.17	6	
<sup>205</sup> Po	$\beta^+/\epsilon$	3544	0.0	5/2-	1001.22	7/2-	38.9	19	6.677	30	
<sup>205</sup> Po	$\beta^+/\epsilon$	3544	0.0	5/2-	1239.12	7/2-	4.50	30	7.519	36	
<sup>205</sup> Po	$\beta^+/\epsilon$	3544	0.0	5/2-	2386.10	(3/2)-	2.08	19	7.218	46	
<sup>205</sup> At	$\beta^+/\epsilon$	4537	0.0	9/2-	783.00	7/2-	6.6	6	7.307	42	P
<sup>205</sup> At	$\beta^+/\epsilon$	4537	0.0	9/2-	872.10	7/2-	3.7	7	7.53	8	P
<sup>205</sup> At	$\beta^+/\epsilon$	4537	0.0	9/2-	1030.38	(11/2)-	5.6	6	7.299	49	P
<sup>205</sup> At	$\beta^+/\epsilon$	4537	0.0	9/2-	1167.81	7/2-	2.37	18	7.628	36	P
<sup>205</sup> At	$\beta^+/\epsilon$	4537	0.0	9/2-	1651.35	7/2-	1.94	11	7.550	29	P
<sup>206</sup> At	$\beta^+/\epsilon$	5749	0.0	(5)+	1177.80	4+	18	6	7.18	15	
<sup>206</sup> At	$\beta^+/\epsilon$	5749	0.0	(5)+	1573.38	6+	38.0	40	6.734	47	
<sup>207</sup> Bi	$\epsilon$	2397.4	0.0	9/2-	2339.935	7/2-	7.03	3	8.366	47	
<sup>207</sup> Po	$\beta^+/\epsilon$	2909	0.0	5/2-	742.76	7/2-	11.1	7	7.591	28	
<sup>207</sup> Po	$\beta^+/\epsilon$	2909	0.0	5/2-	992.46	7/2-	64.1	14	6.715	11	
<sup>207</sup> At	$\beta^+/\epsilon$	3918	0.0	9/2-	588.323	7/2-	5.8	11	7.83	8	
<sup>207</sup> At	$\beta^+/\epsilon$	3918	0.0	9/2-	907.046	7/2-	3.4	7	7.96	9	
<sup>207</sup> At	$\beta^+/\epsilon$	3918	0.0	9/2-	1171.586	7/2-	1.10	30	8.35	12	
<sup>207</sup> At	$\beta^+/\epsilon$	3918	0.0	9/2-	1511.07	7/2-	1.44	11	8.106	35	
<sup>207</sup> Rn	$\beta^+/\epsilon$	4593	0.0	5/2-	344.55	7/2-	16.1	21	6.64	6	P

**Table 10**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	$\text{Log } ft$	Unc.	Pand.
<sup>207</sup> Rn	$\beta+\epsilon$	4593	0.0	5/2-	747.19	7/2-	28.0	30	6.273	47	P
<sup>208</sup> At	$\beta+\epsilon$	4999	0.0	6+	2335.4	7+	6.50	49	7.506	34	
<sup>208</sup> At	$\beta+\epsilon$	4999	0.0	6+	2526.3	5+	1.74	21	8.01	5	
<sup>208</sup> At	$\beta+\epsilon$	4999	0.0	6+	2556.3	7+	22.9	16	6.874	32	
<sup>221</sup> Rn	$\beta^-$	1194	0.0	7/2+	234.63	(5/2)+	1.86	17	7.179	42	
<sup>221</sup> Rn	$\beta^-$	1194	0.0	7/2+	253.53	(5/2)+	6.1	6	6.635	45	
<sup>221</sup> Rn	$\beta^-$	1194	0.0	7/2+	294.76	(9/2)+	27.2	20	5.916	35	
<sup>222</sup> Fr	$\beta^-$	2058	0.0	2-	242.11	1-	1.7	4	7.99	10	
<sup>222</sup> Fr	$\beta^-$	2058	0.0	2-	317.29	3-	54	9	6.42	7	
<sup>223</sup> Fr	$\beta^-$	1149.1	0.0	3/2-	79.652	(5/2)-	15	2	6.40	6	
<sup>223</sup> Fr	$\beta^-$	1149.1	0.0	3/2-	369.351	(5/2)-	1.7	1	6.865	26	
<sup>225</sup> Rn	$\beta^-$	2714	0.0	7/2-	721.06	(5/2)-	3.97	24	7.263	30	
<sup>228</sup> Fr	$\beta^-$	4444	0.0	2-	474.18	1-	7.16	6	7.330	12	P
<sup>228</sup> Fr	$\beta^-$	4444	0.0	2-	537.49	3-	7.4	13	7.29	8	P
<sup>228</sup> Ac	$\beta^-$	2123.8	0.0	3+	968.972	2+	29.9	10	7.493	15	
<sup>228</sup> Ac	$\beta^-$	2123.8	0.0	3+	1153.465	2+	5.8	9	7.94	7	
<sup>228</sup> Ac	$\beta^-$	2123.8	0.0	3+	1431.981	4+	1.2	4	8.12	14	
<sup>228</sup> Ac	$\beta^-$	2123.8	0.0	3+	1638.283	2+	1.15	5	7.625	20	
<sup>228</sup> Ac	$\beta^-$	2123.8	0.0	3+	1724.288	2+	1.76	5	7.164	15	
<sup>228</sup> Pa	$\beta+\epsilon$	2152.7	0.0	3+	968.986	2+	1.02	19	8.89	8	
<sup>228</sup> Pa	$\epsilon$	2152.7	0.0	3+	1432.036	4+	31.8	21	6.916	36	
<sup>228</sup> Pa	$\epsilon$	2152.7	0.0	3+	1724.301	2+	2.9	2	7.419	38	
<sup>228</sup> Pa	$\epsilon$	2152.7	0.0	3+	1804.690	4+	1.44	18	7.49	6	
<sup>231</sup> Th	$\beta^-$	391.5	0.0	5/2+	247.320	7/2+	2.9	5	6.20	8	
<sup>234</sup> Pa	$\beta^-$	2193.9	0.0	4+	1090.9	5+	1.18	22	8.92	8	
<sup>234</sup> Pa	$\beta^-$	2193.9	0.0	4+	1552.6	5+	20.4	18	6.870	40	
<sup>234</sup> Pa	$\beta^-$	2193.9	0.0	4+	1737.4	3+	1.20	14	7.61	5	
<sup>237</sup> Pu	$\epsilon$	220.1	0.0	7/2-	59.545	5/2-	8.4	8	7.462	44	
<sup>238</sup> Np	$\beta^-$	1291.45	0.0	2+	1069.924	3+	11.51	11	6.577	5	
<sup>239</sup> U	$\beta^-$	1261.7	0.0	5/2+	31.1309	7/2+	9.4	19	6.98	9	
<sup>239</sup> Np	$\beta^-$	722.8	0.0	5/2+	330.125	7/2+	7	2	7.63	12	
<sup>239</sup> Np	$\beta^-$	722.8	0.0	5/2+	511.81	7/2+	1.70	6	7.392	16	
<sup>241</sup> Cm	$\epsilon$	767.4	0.0	1/2+	653.23	3/2+	0.310	25	8.365	38	
<sup>241</sup> Cm	$\epsilon$	767.4	0.0	1/2+	670.24	3/2+	0.67	5	7.862	37	
<sup>245</sup> Am	$\beta^-$	895.9	0.0	(5/2)+	0.0	7/2+	78	2	6.384	12	
<sup>245</sup> Am	$\beta^-$	895.9	0.0	(5/2)+	295.60	7/2+	6.6	8	6.87	5	
<sup>245</sup> Bk	$\epsilon$	809.3	0.0	3/2-	661.53	5/2-	0.59	6	7.598	47	
<sup>249</sup> Es	$\beta+\epsilon$	1452	0.0	7/2+	144.96	5/2+	6.7	18	7.33	12	
<sup>249</sup> Es	$\epsilon$	1452	0.0	7/2+	437.56	9/2+	8.6	12	6.98	7	
<sup>254</sup> Es	$\beta^-$	1091.6	84.2	2+	733.54	3+	16	4	7.46	11	

## 16. First Forbidden Transitions

### 16.1. First forbidden non-unique ( $\Delta J=0$ )

**Table 11**

List of first forbidden transitions with  $\Delta J=0$  and  $\Delta\pi=yes$ .

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
<sup>11</sup> Be	$\beta^-$	1.150946E4	0.0	1/2+	2124.693	1/2-	31.4	18	6.648	25	
<sup>15</sup> C	$\beta^-$	9771.7	0.0	1/2+	0.0	1/2-	36.8	8	5.934	9	
<sup>17</sup> N	$\beta^-$	8679	0.0	1/2-	870.756	1/2+	2.73	56	6.85	10	
<sup>20</sup> N	$\beta^-$	1.797E4	0.0	2-	1673.60	2+	30.1	20	5.844	32	P
<sup>20</sup> N	$\beta^-$	1.797E4	0.0	2-	4071.1	2+	5.9	13	6.22	10	P
<sup>21</sup> N	$\beta^-$	1.717E4	0.0	1/2-	1222	1/2+	3.5	4	6.52	6	P
<sup>38</sup> Cl	$\beta^-$	4916.71	0.0	2-	2167.467	2+	11.1	2	7.022	8	
<sup>40</sup> Cl	$\beta^-$	7482	0.0	2-	2524.03	2+	1.7	5	7.54	13	
<sup>40</sup> Cl	$\beta^-$	7482	0.0	2-	3207.89	2+	2.1	4	7.15	8	
<sup>40</sup> Cl	$\beta^-$	7482	0.0	2-	3918.82	2+	5.5	12	6.38	10	
<sup>42</sup> K	$\beta^-$	3525.26	0.0	2-	1524.6	2+	17.64	9	7.5575	23	
<sup>43</sup> K	$\beta^-$	1833.48	0.0	3/2+	593.394	3/2-	4.06	13	7.604	14	
<sup>44</sup> Ti	$\epsilon$	267.4	0.0	0+	146.1914	0-	99.6	11	6.498	23	
<sup>46</sup> K	$\beta^-$	7725.7	0.0	2-	1346.00	2+	27.4	21	6.935	33	
<sup>46</sup> K	$\beta^-$	7725.7	0.0	2-	4385.91	2+	4.39	16	6.456	16	
<sup>71</sup> As	$\beta^+/\epsilon$	2013.4	0.0	5/2-	525.111	5/2+	3.04	8	6.977	15	
<sup>71</sup> As	$\epsilon$	2013.4	0.0	5/2-	1205.129	5/2+	0.725	19	7.034	17	
<sup>71</sup> As	$\epsilon$	2013.4	0.0	5/2-	1558.742	5/2+	0.250	7	6.988	20	
<sup>72</sup> Cu	$\beta^-$	8362.5	0.0	2-	652.70	2+	16	4	6.51	11	P
<sup>72</sup> Cu	$\beta^-$	8362.5	0.0	2-	1657.30	2+	6.4	10	6.63	7	P
<sup>72</sup> Ga	$\beta^-$	3997.6	0.0	3-	2065.347	3+	3.21	3	8.4711	41	
<sup>72</sup> As	$\beta^+/\epsilon$	4343.60	0.0	2-	834.01	2+	67.8	15	7.215	10	
<sup>72</sup> As	$\beta^+/\epsilon$	4343.60	0.0	2-	1463.99	2+	6.62	20	7.697	13	
<sup>72</sup> As	$\beta^+/\epsilon$	4343.60	0.0	2-	2402.31	2+	0.380	20	7.926	23	
<sup>72</sup> As	$\beta^+/\epsilon$	4343.60	0.0	2-	3094.29	2+	0.232	21	7.513	40	
<sup>72</sup> As	$\epsilon$	4343.60	0.0	2-	3419.76	2+	0.105	19	7.59	8	
<sup>72</sup> As	$\epsilon$	4343.60	0.0	2-	3708.62	2+	0.084	4	7.357	22	
<sup>72</sup> As	$\epsilon$	4343.60	0.0	2-	3872.2	2+	0.0052	10	8.30	8	
<sup>74</sup> As	$\beta^+/\epsilon$	2562.4	0.0	2-	595.86	2+	59.0	40	6.978	30	
<sup>74</sup> As	$\beta^+/\epsilon$	2562.4	0.0	2-	1204.36	2+	0.820	40	8.259	23	
<sup>74</sup> As	$\epsilon$	2562.4	0.0	2-	2197.89	2+	0.051	4	8.297	36	
<sup>74</sup> As	$\beta^-$	1353.1	0.0	2-	634.78	2+	15.4	11	7.648	31	
<sup>75</sup> Se	$\epsilon$	866.04	0.0	5/2+	279.5428	5/2-	2.1	4	7.98	8	
<sup>75</sup> Se	$\epsilon$	866.04	0.0	5/2+	572.41	5/2-	0.0387	5	9.099	7	
<sup>76</sup> As	$\beta^-$	2960.6	0.0	2-	559.100	2+	31.7	3	8.1739	42	
<sup>76</sup> As	$\beta^-$	2960.6	0.0	2-	1216.153	2+	6.90	15	8.262	9	
<sup>76</sup> As	$\beta^-$	2960.6	0.0	2-	1787.648	2+	1.69	3	8.191	8	
<sup>76</sup> As	$\beta^-$	2960.6	0.0	2-	2514.63	(2)+	0.0268	6	8.468	10	
<sup>76</sup> Br	$\beta^+/\epsilon$	4963	0.0	1-	2950.53	1+	12.4	5	6.332	20	
<sup>76</sup> Br	$\beta^+/\epsilon$	4963	0.0	1-	3351.85	1+	8.70	40	6.101	22	
<sup>76</sup> Br	$\beta^+/\epsilon$	4963	0.0	1-	3604.56	1+	1.82	12	6.586	30	
<sup>77</sup> Ge	$\beta^-$	2703.5	0.0	7/2+	1189.83	7/2-	19.2	12	7.183	27	
<sup>77</sup> Br	$\epsilon$	1364.7	0.0	3/2-	911.49	(3/2)+	0.146	7	7.253	23	
<sup>78</sup> Ga	$\beta^-$	8158.0	0.0	2-	1186.51	2+	7.1	18	6.57	11	P
<sup>78</sup> Ga	$\beta^-$	8158.0	0.0	2-	1842.73	2+	2.9	6	6.77	9	P
<sup>78</sup> As	$\beta^-$	4209	0.0	2-	613.84	2+	18.5	25	7.92	6	
<sup>78</sup> As	$\beta^-$	4209	0.0	2-	1308.66	2+	14.6	23	7.62	7	
<sup>83</sup> Rb	$\epsilon$	920.0	0.0	5/2-	799.49	5/2+	0.90	11	6.88	6	
<sup>84</sup> Rb	$\beta^+/\epsilon$	2680.4	0.0	2-	881.615	2+	68.6	16	7.120	11	



**Table 11**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
<sup>84</sup> Rb	$\varepsilon$	2680.4	0.0	2-	1897.784	2+	1.09	4	8.086	17	
<sup>84</sup> Br	$\beta^-$	4656	0.0	2-	881.61	2+	13.5	16	7.73	5	
<sup>84</sup> Br	$\beta^-$	4656	0.0	2-	1897.63	2+	11.7	22	7.20	8	
<sup>84</sup> Br	$\beta^-$	4656	0.0	2-	2623.01	2+	1.7	3	7.48	8	
<sup>84</sup> Br	$\beta^-$	4656	0.0	2-	2759.1	2+	1.12	23	7.54	9	
<sup>85</sup> Se	$\beta^-$	6161.8	0.0	(5/2)+	345.19	5/2-	11	3	6.88	12	P
<sup>86</sup> Rb	$\beta^-$	1776.10	0.0	2-	1077.0	2+	8.64	4	7.9525	23	
<sup>86</sup> Y	$\beta+\varepsilon$	5240	0.0	4-	2229.89	4+	4.4	11	7.76	11	
<sup>86</sup> Y	$\beta+\varepsilon$	5240	0.0	4-	2878.38	(4)+	1.24	21	7.72	7	
<sup>86</sup> Y	$\beta+\varepsilon$	5240	0.0	4-	3926.10	(4)+	6.68	18	6.123	22	
<sup>87</sup> Kr	$\beta^-$	3888.27	0.0	5/2+	402.588	5/2-	41	3	7.487	32	
<sup>88</sup> Rb	$\beta^-$	5312.62	0.0	2-	1836.077	2+	4.93	24	7.785	21	
<sup>88</sup> Rb	$\beta^-$	5312.62	0.0	2-	3218.55	2+	1.038	12	7.528	5	
<sup>89</sup> Rb	$\beta^-$	4497	0.0	3/2-	3508.71	(3/2)+	1.65	9	5.978	25	
<sup>90</sup> Kr	$\beta^-$	4406	0.0	0+	0.0	0-	29	4	5.93	6	
<sup>90</sup> Rb	$\beta^-$	6585	0.0	0-	0.0	0+	33	4	7.37	5	
<sup>90</sup> Y	$\beta^-$	2275.64	0.0	2-	2186.273	2+	1.4E-6	3	11.03	9	
<sup>91</sup> Y	$\beta^-$	1544.3	0.0	1/2-	1204.81	1/2+	0.26	4	8.93	7	
<sup>91</sup> Nb	$\varepsilon$	1257.6	104.60	1/2-	1204.68	1/2+	2.02	8	6.798	29	
<sup>92</sup> Y	$\beta^-$	3643	0.0	2-	934.49	2+	3.5	10	8.58	12	
<sup>93</sup> Tc	$\beta+\varepsilon$	3201.0	391.84	1/2-	943.7	1/2+	2.00	30	6.52	7	
<sup>93</sup> Rb	$\beta^-$	7466	0.0	5/2-	0.0	5/2+	35	3	6.160	37	
<sup>93</sup> Y	$\beta^-$	2895	0.0	1/2-	947.14	1/2+	2.7	5	8.55	8	
<sup>94</sup> Y	$\beta^-$	4918	0.0	2-	918.75	2+	39.6	22	7.199	24	
<sup>94</sup> Y	$\beta^-$	4918	0.0	2-	1671.39	2+	3.3	4	7.88	5	
<sup>95</sup> Sr	$\beta^-$	6091	0.0	1/2+	0.0	1/2-	55.7	25	6.181	20	P
<sup>95</sup> Y	$\beta^-$	4452	0.0	1/2-	953.86	1/2+	1.9	5	8.00	11	
<sup>95</sup> Nb	$\beta^-$	925.60	234.70	1/2-	786.201	1/2+	0.071	9	8.47	6	
<sup>95</sup> Tc	$\varepsilon$	1691	38.91	1/2-	786.2017	1/2+	38.0	5	7.234	19	
<sup>95</sup> Tc	$\varepsilon$	1691	38.91	1/2-	1039.270	1/2+	30.1	5	7.057	20	
<sup>96</sup> Rb	$\beta^-$	1.1564E4	0.0	2-	814.93	2+	20.9	24	5.65	5	P
<sup>96</sup> Rb	$\beta^-$	1.1564E4	0.0	2-	1506.84	2+	7.6	7	5.958	40	P
<sup>96</sup> Y	$\beta^-$	7109	0.0	0-	0.0	0+	95.5	5	5.616	5	
<sup>96</sup> Y	$\beta^-$	7109	0.0	0-	1581.34	0+	1.26	10	6.999	35	
<sup>97</sup> Ru	$\varepsilon$	1104	0.0	5/2+	656.899	5/2-	0.0326	10	8.349	20	
<sup>97</sup> Rh	$\beta+\varepsilon$	3523	258.76	1/2-	908.29	1/2+	1.7	5	6.83	13	
<sup>97</sup> Rb	$\beta^-$	1.00615E4	0.0	3/2+	644.73	(3/2)-	7.0	6	5.785	37	P
<sup>97</sup> Y	$\beta^-$	6821	0.0	1/2-	0.0	1/2+	40	10	5.76	11	P
<sup>97</sup> Zr	$\beta^-$	2666.1	0.0	1/2+	743.402	1/2-	87.3	9	7.254	6	
<sup>98</sup> Y	$\beta^-$	8993	0.0	0-	1436.16	0+	5.5	7	5.99	6	P
<sup>98</sup> Y	$\beta^-$	8993	0.0	0-	1859.37	0+	11.1	12	5.568	47	P
<sup>99</sup> Rh	$\beta+\varepsilon$	2041	0.0	1/2-	618.09	(1/2)+	45.7	23	7.031	26	
<sup>99</sup> Nb	$\beta^-$	3635	365.27	1/2-	0.0	1/2+	63	5	6.155	49	P
<sup>99</sup> Nb	$\beta^-$	3635	365.27	1/2-	525.193	1/2+	1.04	17	7.67	8	P
<sup>99</sup> Mo	$\beta^-$	1357.8	0.0	1/2+	142.6836	1/2-	82.2	4	7.1249	24	
<sup>101</sup> Mo	$\beta^-$	2825	0.0	1/2+	207.517	1/2-	12.8	5	6.838	24	
<sup>101</sup> Rh	$\varepsilon$	546	0.0	1/2-	325.233	1/2+	89	8	6.92	6	
<sup>103</sup> Ru	$\beta^-$	764.5	0.0	3/2+	294.964	3/2-	0.280	5	9.303	11	
<sup>103</sup> Pd	$\varepsilon$	574.7	0.0	5/2+	357.43	5/2-	0.0248	8	8.651	18	
<sup>103</sup> Cd	$\beta+\varepsilon$	4151.1	0.0	(5/2)+	590.79	(5/2)-	2.10	30	6.45	6	P
<sup>105</sup> Ag	$\varepsilon$	1347.1	0.0	1/2-	344.6	1/2+	67	7	7.035	46	
<sup>105</sup> Ag	$\varepsilon$	1347.1	0.0	1/2-	673.2	1/2+	2.9	3	8.044	46	
<sup>108</sup> In	$\beta+\varepsilon$	5133	0.0	7+	3057.35	7-	1.16	12	6.587	48	

**Table 11**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
<sup>109</sup> Sn	$\beta+\epsilon$	3859	0.0	5/2+	1440.67	5/2-	1.04	12	6.38	5	
<sup>111</sup> Pd	$\beta-$	2229.6	172.2	11/2-	959.0	11/2+	1.6	5	8.12	14	
<sup>111</sup> Ag	$\beta-$	1036.8	0.0	1/2-	0.0	1/2+	92	5	7.344	24	
<sup>113</sup> Sn	$\epsilon$	1039.0	0.0	1/2+	391.699	1/2-	97.79	8	7.033	5	
<sup>115</sup> In	$\beta-$	497.489	326.244	1/2-	0.0	1/2+	5.0	7	6.68	6	
<sup>115</sup> Ag	$\beta-$	3102	0.0	1/2-	0.0	1/2+	60	15	6.70	11	
<sup>115</sup> Cd	$\beta-$	1451.9	0.0	1/2+	336.242	1/2-	62.4	12	7.127	8	
<sup>117</sup> Cd	$\beta-$	2525	0.0	1/2+	315.302	1/2-	21	2	7.431	42	
<sup>117</sup> In	$\beta-$	1454.7	315.302	1/2-	0.0	1/2+	18.3	13	7.013	31	
<sup>118</sup> I	$\beta+\epsilon$	6720	0.0	2-	605.56	2+	34.3	15	6.779	27	P
<sup>118</sup> I	$\beta+\epsilon$	6720	0.0	2-	1150.66	2+	6.6	12	7.28	8	P
<sup>119</sup> Te	$\beta+\epsilon$	2293.0	260.96	11/2-	1407.33	11/2+	7.00	10	7.384	9	
<sup>120</sup> I	$\beta+\epsilon$	5615	0.0	2-	560.29	2+	32.6	8	7.137	13	P
<sup>120</sup> I	$\beta+\epsilon$	5615	0.0	2-	1201.4	2+	3.2	6	7.83	8	P
<sup>120</sup> I	$\beta+\epsilon$	5615	0.0	2-	1535.0	2+	2.42	23	7.775	42	P
<sup>120</sup> I	$\beta+\epsilon$	5615	0.0	2-	2937.0	2+	2.52	21	6.899	37	P
<sup>120</sup> I	$\beta+\epsilon$	5615	0.0	2-	3494.1	2+	1.86	22	6.69	5	P
<sup>121</sup> In	$\beta-$	3362	313.6	1/2-	60.18	1/2+	69	15	6.25	10	
<sup>122</sup> Sb	$\epsilon$	1605.7	0.0	2-	1140.68	2+	0.75	4	7.271	27	
<sup>122</sup> Sb	$\beta-$	1979.1	0.0	2-	564.26	2+	66.8	2	7.6361	28	
<sup>122</sup> Sb	$\beta-$	1979.1	0.0	2-	1256.92	2+	4.6	5	7.721	47	
<sup>123</sup> Sn	$\beta-$	1408.2	0.0	11/2-	1088.65	11/2+	0.60	12	9.06	9	
<sup>124</sup> I	$\beta+\epsilon$	3159.6	0.0	2-	602.74	2+	36.9	6	7.523	8	
<sup>124</sup> I	$\beta+\epsilon$	3159.6	0.0	2-	1325.51	2+	5.71	10	7.898	9	
<sup>124</sup> I	$\beta+\epsilon$	3159.6	0.0	2-	2039.34	2+	0.027	6	9.76	10	
<sup>124</sup> I	$\beta+\epsilon$	3159.6	0.0	2-	2091.67	2+	0.203	5	8.844	12	
<sup>124</sup> I	$\epsilon$	3159.6	0.0	2-	2322.97	2+	0.183	6	8.670	15	
<sup>124</sup> I	$\epsilon$	3159.6	0.0	2-	2454.06	2+	0.354	20	8.230	25	
<sup>124</sup> I	$\epsilon$	3159.6	0.0	2-	2521.33	2+	0.181	4	8.431	11	
<sup>124</sup> I	$\epsilon$	3159.6	0.0	2-	2641.20	2+	0.402	8	7.894	11	
<sup>124</sup> I	$\epsilon$	3159.6	0.0	2-	2681.45	2+	0.391	14	7.832	17	
<sup>125</sup> Sn	$\beta-$	2361.4	0.0	11/2-	1089.51	11/2+	3.0	9	9.33	13	
<sup>125</sup> Sb	$\beta-$	766.7	0.0	7/2+	525.227	7/2-	1.609	19	9.155	13	
<sup>126</sup> I	$\beta+\epsilon$	2153.7	0.0	2-	666.338	2+	28.9	7	7.478	12	
<sup>126</sup> I	$\epsilon$	2153.7	0.0	2-	1420.166	2+	4.46	10	7.656	13	
<sup>126</sup> I	$\epsilon$	2153.7	0.0	2-	2045.11	2+	0.0070	4	8.59	5	
<sup>126</sup> I	$\beta-$	1235.9	0.0	2-	388.634	2+	33.4	6	7.826	11	
<sup>126</sup> I	$\beta-$	1235.9	0.0	2-	879.879	2+	3.62	6	7.501	17	
<sup>127</sup> Sb	$\beta-$	1582.2	0.0	7/2+	631.0	7/2-	4.6	6	8.30	6	
<sup>127</sup> Sb	$\beta-$	1582.2	0.0	7/2+	785.2	7/2-	4.5	3	8.032	31	
<sup>129</sup> Te	$\beta-$	1502.3	105.51	11/2-	695.89	11/2+	3.0	6	9.38	9	
<sup>129</sup> Sb	$\beta-$	2376	0.0	7/2+	759.83	7/2-	3.77	6	7.932	24	
<sup>131</sup> I	$\beta-$	970.8	0.0	7/2+	666.934	7/2-	0.645	23	7.818	16	
<sup>133</sup> Ce	$\beta+\epsilon$	3076	37.2	9/2-	563.348	9/2+	1.83	17	7.66	5	
<sup>133</sup> Ce	$\beta+\epsilon$	3076	37.2	9/2-	950.35	(9/2)+	2.07	21	7.40	5	
<sup>133</sup> Ba	$\epsilon$	517.4	288.252	11/2-	632.59	11/2+	0.0103	7	8.08	6	
<sup>136</sup> Cs	$\beta-$	2548.2	0.0	5+	2140.225	5-	13.6	10	7.167	33	
<sup>137</sup> Xe	$\beta-$	4162.36	0.0	7/2-	0.0	7/2+	67	3	6.599	20	
<sup>137</sup> Ce	$\epsilon$	1222.1	254.29	11/2-	762.30	11/2+	0.197	14	8.212	31	
<sup>138</sup> Cs	$\beta-$	5375	0.0	3-	2445.64	3+	44	1	7.080	12	
<sup>138</sup> Cs	$\beta-$	5375	79.9	6-	2090.7	6+	14.4	25	6.77	8	P
<sup>138</sup> Cs	$\beta-$	5375	79.9	6-	2203.2	6+	2.0	5	7.57	11	P
<sup>139</sup> Cs	$\beta-$	4212.8	0.0	7/2+	0.0	7/2-	84.5	31	6.923	16	

**Table 11**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
<sup>139</sup> Ba	$\beta^-$	2308.5	0.0	7/2-	0.0	7/2+	69.98	31	6.8787	20	
<sup>140</sup> Ba	$\beta^-$	1044	0.0	0+	581.073	0-	24.7	3	7.105	26	
<sup>140</sup> La	$\beta^-$	3762.2	0.0	3-	2412.02	3+	43.9	4	7.6498	43	
<sup>141</sup> Sm	$\beta+\epsilon$	4589	175.9	11/2-	974.06	11/2+	5.6	11	6.79	9	P
<sup>141</sup> Cs	$\beta^-$	5255	0.0	7/2+	55.001	(7/2)-	60	11	6.12	8	
<sup>141</sup> Ce	$\beta^-$	583.5	0.0	7/2-	145.440	7/2+	70.0	6	7.024	5	
<sup>142</sup> Cs	$\beta^-$	7328	0.0	0-	0.0	0+	40.6	20	5.78	4	
<sup>142</sup> Cs	$\beta^-$	7328	0.0	0-	1535.53	0+	3.3	2	6.42	5	
<sup>142</sup> La	$\beta^-$	4509	0.0	2-	641.287	2+	3.7	2	9.15	3	
<sup>142</sup> La	$\beta^-$	4509	0.0	2-	2004.32	2+	1.6	1	8.724	28	
<sup>142</sup> La	$\beta^-$	4509	0.0	2-	2364.56	2+	1.5	1	8.478	29	
<sup>142</sup> La	$\beta^-$	4509	0.0	2-	2542.66	2+	17.3	4	7.265	12	
<sup>142</sup> La	$\beta^-$	4509	0.0	2-	2696.47	2+	6.7	2	7.537	14	
<sup>142</sup> La	$\beta^-$	4509	0.0	2-	3304.4	2+	1.0	1	7.682	44	
<sup>142</sup> La	$\beta^-$	4509	0.0	2-	3612.1	2+	5.0	2	6.512	20	
<sup>142</sup> La	$\beta^-$	4509	0.0	2-	4043.0	2+	1.5	1	6.048	35	
<sup>142</sup> Pr	$\beta^-$	2163.7	0.0	2-	1575.6	2+	3.7	5	7.14	6	
<sup>143</sup> Gd	$\beta+\epsilon$	6.01E3	152.6	11/2-	1057.33	11/2+	3.3	5	6.55	11	P
<sup>143</sup> Gd	$\beta+\epsilon$	6.01E3	152.6	11/2-	1256.87	11/2+	1.40	20	6.84	10	P
<sup>143</sup> Cs	$\beta^-$	6262	0.0	3/2+	228.83	(3/2)-	12	2	5.96	7	P
<sup>143</sup> Cs	$\beta^-$	6262	0.0	3/2+	306.56	(3/2)-	5.8	10	6.25	7	P
<sup>143</sup> Ce	$\beta^-$	1461.8	0.0	3/2-	350.624	3/2+	48.2	5	7.227	5	
<sup>143</sup> Ce	$\beta^-$	1461.8	0.0	3/2-	1160.601	(3/2)+	0.461	8	7.299	12	
<sup>143</sup> Pr	$\beta^-$	934.1	0.0	7/2+	0.0	7/2-	100		7.6497	24	
<sup>144</sup> Ce	$\beta^-$	318.6	0.0	0+	0.0	0-	76.88	35	7.4704	41	
<sup>144</sup> Pr	$\beta^-$	2997.4	0.0	0-	0.0	0+	97.9	4	6.5752	26	
<sup>145</sup> Pr	$\beta^-$	1806	0.0	7/2+	0.0	7/2-	97.6	1	7.003	7	
<sup>145</sup> Pm	$\epsilon$	164.5	0.0	5/2+	72.4	5/2-	10.3	5	8.092	46	
<sup>145</sup> Sm	$\epsilon$	616.1	0.0	7/2-	61.22	7/2+	91.4	8	7.826	8	
<sup>145</sup> Eu	$\epsilon$	2659.9	0.0	5/2+	1658.562	5/2-	16.4	10	7.390	27	
<sup>145</sup> Eu	$\epsilon$	2659.9	0.0	5/2+	1996.959	5/2-	7.4	4	7.358	24	
<sup>145</sup> Eu	$\epsilon$	2659.9	0.0	5/2+	2346.39	5/2-	0.456	17	7.854	19	
<sup>146</sup> Eu	$\beta+\epsilon$	3879	0.0	4-	1381.292	4+	16.9	13	8.151	34	
<sup>146</sup> Eu	$\beta+\epsilon$	3879	0.0	4-	2280.882	4+	7.03	24	8.071	16	
<sup>146</sup> Eu	$\beta+\epsilon$	3879	0.0	4-	2439.070	4+	6.1	6	8.037	43	
<sup>146</sup> Eu	$\beta+\epsilon$	3879	0.0	4-	2531.933	4+	2.79	8	8.317	14	
<sup>146</sup> Eu	$\beta+\epsilon$	3879	0.0	4-	2678.274	4+	6.77	21	7.828	15	
<sup>147</sup> Nd	$\beta^-$	895.2	0.0	5/2-	91.1052	5/2+	80.9	5	7.4404	32	
<sup>147</sup> Nd	$\beta^-$	895.2	0.0	5/2-	530.996	5/2+	15.2	4	6.999	12	
<sup>147</sup> Nd	$\beta^-$	895.2	0.0	5/2-	685.901	5/2+	2.23	8	7.061	16	
<sup>147</sup> Eu	$\beta+\epsilon$	1721.4	0.0	5/2+	121.212	5/2-	20.9	16	8.317	35	
<sup>147</sup> Eu	$\epsilon$	1721.4	0.0	5/2+	1077.049	5/2-	9.5	3	7.832	18	
<sup>147</sup> Gd	$\beta+\epsilon$	2187.7	0.0	7/2-	778.01	7/2+	2.90	40	7.91	6	
<sup>147</sup> Gd	$\beta+\epsilon$	2187.7	0.0	7/2-	1122.83	7/2+	10.2	6	7.110	26	
<sup>148</sup> Eu	$\epsilon$	3039	0.0	5-	2147.516	5+	17.2	23	8.23	6	
<sup>148</sup> Eu	$\epsilon$	3039	0.0	5-	2214.217	5+	9.4	3	8.418	19	
<sup>148</sup> Eu	$\epsilon$	3039	0.0	5-	2641.237	5+	1.44	6	8.550	32	
<sup>148</sup> Eu	$\epsilon$	3039	0.0	5-	2727.31	5+	0.191	16	9.19	5	
<sup>148</sup> Eu	$\epsilon$	3039	0.0	5-	2801.736	5+	8.48	23	7.263	48	
<sup>148</sup> Eu	$\epsilon$	3039	0.0	5-	2830.665	5+	6.98	20	7.21	6	
<sup>149</sup> Tb	$\beta+\epsilon$	3638.5	0.0	1/2+	1205.66	(1/2)-	35.8	9	6.425	12	
<sup>149</sup> Nd	$\beta^-$	1688.9	0.0	5/2-	211.308	5/2+	24.7	16	6.742	28	
<sup>149</sup> Nd	$\beta^-$	1688.9	0.0	5/2-	396.774	5/2+	3.31	12	7.394	16	

**Table 11**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
<sup>149</sup> Pm	$\beta^-$	1071.5	0.0	7/2+	0.0	7/2-	95.6	5	7.1414	37	
<sup>149</sup> Pm	$\beta^-$	1071.5	0.0	7/2+	636.54	7/2-	0.027	2	9.328	33	
<sup>149</sup> Eu	$\varepsilon$	694.6	0.0	5/2+	22.5002	5/2-	77	4	7.549	24	
<sup>149</sup> Eu	$\varepsilon$	694.6	0.0	5/2+	277.072	5/2-	5.30	6	8.264	11	
<sup>149</sup> Eu	$\varepsilon$	694.6	0.0	5/2+	558.374	5/2-	0.164	5	8.594	38	
<sup>149</sup> Gd	$\beta^+/\varepsilon$	1314.1	0.0	7/2-	149.732	7/2+	34.2	19	7.432	26	
<sup>149</sup> Gd	$\varepsilon$	1314.1	0.0	7/2-	534.295	7/2+	1.05	7	8.581	31	
<sup>149</sup> Gd	$\varepsilon$	1314.1	0.0	7/2-	938.609	7/2+	14.0	8	6.768	29	
<sup>150</sup> Eu	$\beta^+/\varepsilon$	2259	41.7	0-	0.0	0+	6.9	19	7.51	12	
<sup>150</sup> Eu	$\beta^+/\varepsilon$	2259	41.7	0-	740.38	0+	2.7	5	7.53	8	
<sup>150</sup> Eu	$\beta^-$	971.7	42.7	0-	0.0	0+	89	2	6.513	12	
<sup>150</sup> Tb	$\beta^+/\varepsilon$	4658	0.0	(2)-	638.047	2+	25.0	40	7.26	7	
<sup>150</sup> Tb	$\beta^+/\varepsilon$	4658	0.0	(2)-	1430.471	(2)+	1.7	5	8.05	13	
<sup>150</sup> Tb	$\beta^+/\varepsilon$	4658	0.0	(2)-	1518.368	2+	3.30	40	7.72	6	
<sup>150</sup> Tb	$\beta^+/\varepsilon$	4658	0.0	(2)-	1955.373	2+	3.40	40	7.50	6	
<sup>150</sup> Tb	$\beta^+/\varepsilon$	4658	0.0	(2)-	2091.625	2+	6.6	9	7.15	6	
<sup>150</sup> Tb	$\beta^+/\varepsilon$	4658	0.0	(2)-	2179.909	2+	2.00	30	7.63	7	
<sup>150</sup> Tb	$\beta^+/\varepsilon$	4658	0.0	(2)-	2408.53	2+	1.30	20	7.70	7	
<sup>151</sup> Nd	$\beta^-$	2443.1	0.0	3/2+	540.372	3/2-	3.09	24	7.151	34	
<sup>151</sup> Pm	$\beta^-$	1190.2	0.0	5/2+	168.40	(5/2)-	1.4	3	8.63	9	
<sup>151</sup> Sm	$\beta^-$	76.6	0.0	5/2-	0.0	5/2+	99.09	6	7.587	39	
<sup>151</sup> Gd	$\varepsilon$	464.2	0.0	7/2-	21.501	7/2+	74	6	7.329	37	
<sup>151</sup> Gd	$\varepsilon$	464.2	0.0	7/2-	307.519	(7/2)+	1.22	9	8.034	41	
<sup>152</sup> Eu	$\beta^-$	1818.8	45.5998	0-	0.0	0+	70	3	7.476	19	
<sup>152</sup> Tb	$\beta^+/\varepsilon$	3990	0.0	2-	344.2790	2+	12.7	17	8.08	6	
<sup>152</sup> Tb	$\beta^+/\varepsilon$	3990	0.0	2-	930.560	2+	8.06	22	7.999	19	
<sup>152</sup> Tb	$\beta^+/\varepsilon$	3990	0.0	2-	1109.203	2+	2.79	10	8.374	22	
<sup>152</sup> Tb	$\beta^+/\varepsilon$	3990	0.0	2-	1318.355	2+	2.73	9	8.285	22	
<sup>152</sup> Tb	$\beta^+/\varepsilon$	3990	0.0	2-	1605.60	2+	2.30	5	8.223	19	
<sup>152</sup> Tb	$\beta^+/\varepsilon$	3990	0.0	2-	1941.17	2+	4.28	6	7.791	21	
<sup>152</sup> Tb	$\beta^+/\varepsilon$	3990	0.0	2-	2246.80	2+	3.75	6	7.691	24	
<sup>152</sup> Tb	$\beta^+/\varepsilon$	3990	0.0	2-	2709.43	2+	1.650	30	7.767	32	
<sup>152</sup> Tb	$\beta^+/\varepsilon$	3990	0.0	2-	2719.64	2+	1.390	30	7.833	33	
<sup>152</sup> Tb	$\beta^+/\varepsilon$	3990	0.0	2-	2729.17	2+	1.000	30	7.970	35	
<sup>152</sup> Tb	$\beta^+/\varepsilon$	3990	0.0	2-	2880.67	2+	1.820	30	7.594	35	
<sup>152</sup> Ho	$\beta^+/\varepsilon$	6513	160	9+	2906.0	9-	2.10	30	5.85	6	P
<sup>152</sup> Pm	$\beta^-$	3509	1.5E+2	4-	366.52	4+	19	6	7.13	15	P
<sup>152</sup> Pm	$\beta^-$	3509	1.5E+2	4-	1371.63	4+	2.0	3	7.46	10	P
<sup>152</sup> Pm	$\beta^-$	3509	1.5E+2	4-	2895.45	4+	1.06	17	5.93	22	P
<sup>152</sup> Eu	$\varepsilon$	1874.5	0.0	3-	1233.8626	3+	17.09	8	9.8833	32	
<sup>152</sup> Eu	$\beta^-$	1818.8	0.0	3-	1434.020	3+	2.432	15	10.5937	37	
<sup>153</sup> Sm	$\beta^-$	807.4	0.0	3/2+	636.47	3/2-	0.0649	6	7.611	7	
<sup>153</sup> Gd	$\varepsilon$	484.5	0.0	3/2-	103.18016	3/2+	44.2	10	7.697	11	
<sup>153</sup> Tb	$\beta^+/\varepsilon$	1569.3	0.0	5/2+	41.549	5/2-	16	5	7.45	14	
<sup>153</sup> Tb	$\beta^+/\varepsilon$	1569.3	0.0	5/2+	109.742	(5/2)-	3.5	11	8.06	14	
<sup>153</sup> Tb	$\beta^+/\varepsilon$	1569.3	0.0	5/2+	249.562	5/2-	2.01	13	8.214	29	
<sup>153</sup> Tb	$\varepsilon$	1569.3	0.0	5/2+	548.665	5/2-	0.34	7	8.75	9	
<sup>153</sup> Tb	$\varepsilon$	1569.3	0.0	5/2+	607.13	5/2-	0.11	3	9.19	12	
<sup>154</sup> Ho	$\beta^+/\varepsilon$	5755	0.0	2-	334.62	2+	15.7	18	6.82	5	P
<sup>154</sup> Ho	$\beta^+/\varepsilon$	5755	0.0	2-	905.26	2+	10.4	8	6.778	34	P
<sup>154</sup> Ho	$\beta^+/\varepsilon$	5755	0.0	2-	1027.20	2+	9.6	6	6.762	28	P
<sup>154</sup> Eu	$\beta^-$	1968.0	0.0	3-	1127.804	3+	16.8	5	10.712	13	
<sup>154</sup> Eu	$\beta^-$	1968.0	0.0	3-	1660.910	3+	0.822	13	10.550	8	

**Table 11**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
<sup>155</sup> Sm	$\beta^-$	1627.1	0.0	3/2-	245.734	3/2+	4.62	12	6.732	11	
<sup>155</sup> Eu	$\beta^-$	252.0	0.0	5/2+	60.0098	5/2-	8.2	4	8.645	22	
<sup>155</sup> Tb	$\varepsilon$	820	0.0	3/2+	286.944	3/2-	1.18	7	7.970	33	
<sup>155</sup> Tb	$\varepsilon$	820	0.0	3/2+	450.609	3/2-	0.054	7	8.96	6	
<sup>155</sup> Tb	$\varepsilon$	820	0.0	3/2+	592.060	3/2-	0.183	15	7.94	6	
<sup>155</sup> Tb	$\varepsilon$	820	0.0	3/2+	614.791	3/2-	0.051	4	8.38	7	
<sup>155</sup> Dy	$\beta^+/\varepsilon$	2094.5	0.0	3/2-	0.0	3/2+	1.50	40	8.06	12	
<sup>156</sup> Eu	$\beta^-$	2452.5	0.0	0+	1952.38	0-	0.92	8	8.880	39	
<sup>157</sup> Eu	$\beta^-$	1364.8	0.0	5/2+	434.427	5/2-	15	1	7.222	30	
<sup>157</sup> Tb	$\varepsilon$	60.05	0.0	3/2+	0.0	3/2-	99.89	1	7.079	44	
<sup>159</sup> Gd	$\beta^-$	970.7	0.0	3/2-	0.0	3/2+	58.6	10	6.805	7	
<sup>159</sup> Dy	$\varepsilon$	364.73	0.0	3/2-	0.0	3/2+	73.4	14	7.278	8	
<sup>159</sup> Er	$\beta^+/\varepsilon$	2768.5	0.0	3/2-	814.99	3/2+	1.10	20	6.97	8	
<sup>160</sup> Tb	$\beta^-$	1836.0	0.0	3-	1049.1017	3+	6.49	16	9.431	11	
<sup>161</sup> Tb	$\beta^-$	593.7	0.0	3/2+	74.56670	3/2-	65	4	6.789	27	
<sup>161</sup> Tb	$\beta^-$	593.7	0.0	3/2+	418.238	3/2-	0.0331	21	8.564	29	
<sup>163</sup> Tb	$\beta^-$	1785.1	0.0	3/2+	421.88	(3/2)-	9.1	15	6.42	7	
<sup>163</sup> Tm	$\beta^+/\varepsilon$	2439.0	0.0	1/2+	345.62	1/2-	5.5	5	6.853	40	
<sup>165</sup> Dy	$\beta^-$	1285.7	0.0	7/2+	0.0	7/2-	83	2	6.247	11	
<sup>165</sup> Tm	$\beta^+/\varepsilon$	1591.3	0.0	1/2+	297.372	1/2-	35.9	18	6.812	22	
<sup>165</sup> Tm	$\varepsilon$	1591.3	0.0	1/2+	589.905	1/2-	4.9	2	7.444	18	
<sup>165</sup> Tm	$\varepsilon$	1591.3	0.0	1/2+	920.727	1/2-	3.8	2	7.184	23	
<sup>166</sup> Ho	$\beta^-$	1853.8	0.0	0-	0.0	0+	48.8	12	8.165	11	
<sup>166</sup> Ho	$\beta^-$	1853.8	0.0	0-	1460.025	0+	0.943	13	7.487	7	
<sup>166</sup> Lu	$\beta^+/\varepsilon$	5573	0.	6-	667.95	6+	5.7	12	6.46	9	P
<sup>167</sup> Tm	$\varepsilon$	746.1	0.0	1/2+	207.801	1/2-	69	18	6.59	11	
<sup>168</sup> Ho	$\beta^-$	2930	0.0	3+	1541.35	3-	2.2	3	6.30	7	
<sup>168</sup> Tm	$\varepsilon$	1676.9	0.0	3+	1431.454	3-	0.151	11	9.459	33	
<sup>168</sup> Tm	$\varepsilon$	1676.9	0.0	3+	1541.5520	3-	43.66	12	6.299	18	
<sup>169</sup> Er	$\beta^-$	353.5	0.0	1/2-	0.0	1/2+	55	5	6.517	40	
<sup>169</sup> Yb	$\varepsilon$	899.1	0.0	7/2+	379.26678	7/2-	81.1	9	7.054	5	
<sup>169</sup> Lu	$\beta^+/\varepsilon$	2293.0	0.0	7/2+	647.847	7/2-	2.06	7	8.392	16	
<sup>169</sup> Lu	$\beta^+/\varepsilon$	2293.0	0.0	7/2+	807.079	(7/2)-	0.62	7	8.820	49	
<sup>169</sup> Lu	$\beta^+/\varepsilon$	2293.0	0.0	7/2+	960.612	7/2-	25.2	7	7.111	14	
<sup>169</sup> Lu	$\varepsilon$	2293.0	0.0	7/2+	1343.57	(7/2)-	1.38	6	8.064	20	
<sup>169</sup> Lu	$\varepsilon$	2293.0	0.0	7/2+	1449.781	7/2-	15.8	4	6.896	14	
<sup>169</sup> Lu	$\varepsilon$	2293.0	0.0	7/2+	1463.412	7/2-	5.07	17	7.375	17	
<sup>169</sup> Lu	$\varepsilon$	2293.0	0.0	7/2+	1689.290	7/2-	1.62	5	7.572	16	
<sup>169</sup> Lu	$\varepsilon$	2293.0	0.0	7/2+	1708.52	7/2-	0.84	7	7.827	37	
<sup>169</sup> Lu	$\varepsilon$	2293.0	0.0	7/2+	1781.696	7/2-	3.25	8	7.111	15	
<sup>169</sup> Lu	$\varepsilon$	2293.0	0.0	7/2+	1973.97	7/2-	1.02	9	7.144	41	
<sup>169</sup> Lu	$\varepsilon$	2293.0	0.0	7/2+	2029.87	7/2-	1.14	6	6.893	29	
<sup>170</sup> Hf	$\varepsilon$	1052	0.0	0+	407.47	(0)-	6.0	17	6.77	13	
<sup>171</sup> Er	$\beta^-$	1492.4	0.0	5/2-	913.02	5/2+	2.19	8	7.150	16	
<sup>171</sup> Tm	$\beta^-$	96.5	0.0	1/2+	0.0	1/2-	98.04	14	6.396	14	
<sup>171</sup> Lu	$\beta^+/\varepsilon$	1478.4	0.0	7/2+	208.019	7/2-	3.82	24	8.652	28	
<sup>171</sup> Lu	$\varepsilon$	1478.4	0.0	7/2+	835.083	7/2-	61.5	16	6.817	14	
<sup>171</sup> Lu	$\varepsilon$	1478.4	0.0	7/2+	1024.627	7/2-	0.225	15	8.919	30	
<sup>171</sup> Lu	$\varepsilon$	1478.4	0.0	7/2+	1377.506	7/2-	0.401	9	6.899	36	
<sup>172</sup> Tm	$\beta^-$	1882	0.0	2-	78.750	2+	36	6	8.67	7	
<sup>172</sup> Tm	$\beta^-$	1882	0.0	2-	1117.80	2+	0.291	24	9.391	37	
<sup>172</sup> Tm	$\beta^-$	1882	0.0	2-	1465.849	2+	10.1	10	6.958	46	
<sup>172</sup> Tm	$\beta^-$	1882	0.0	2-	1476.62	2+	1.10	10	7.883	43	

**Table 11**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
$^{172}\text{Tm}$	$\beta^-$	1882	0.0	2-	1608.417	2+	10.0	10	6.37	5	
$^{172}\text{Lu}$	$\beta^+/\epsilon$	2519.4	0.0	4-	1286.50	4+	0.059	10	10.35	7	
$^{172}\text{Lu}$	$\epsilon$	2519.4	0.0	4-	1803.113	4+	0.60	10	8.84	7	
$^{172}\text{Lu}$	$\epsilon$	2519.4	0.0	4-	2073.128	4+	65.8	11	6.346	12	
$^{172}\text{Lu}$	$\epsilon$	2519.4	0.0	4-	2181.28	(4)+	0.015	5	9.71	15	
$^{172}\text{Lu}$	$\epsilon$	2519.4	0.0	4-	2285.410	4+	6.00	15	6.718	19	
$^{172}\text{Lu}$	$\epsilon$	2519.4	0.0	4-	2343.725	4+	2.41	6	6.784	23	
$^{173}\text{Lu}$	$\epsilon$	670.2	0.0	7/2+	78.647	7/2-	50	3	8.611	27	
$^{173}\text{Lu}$	$\epsilon$	670.2	0.0	7/2+	636.128	7/2-	2.93	6	6.43	6	
$^{173}\text{Hf}$	$\beta^+/\epsilon$	1469	0.0	1/2-	425.320	1/2+	37.4	9	6.592	27	
$^{174}\text{Lu}$	$\epsilon$	1374.2	170.83	6-	1518.10	6+	0.62	2	6.28	8	
$^{175}\text{Tm}$	$\beta^-$	2.38E3	0.0	1/2+	919.9	1/2-	12.4	9	6.39	7	
$^{175}\text{Yb}$	$\beta^-$	470.1	0.0	7/2-	0.0	7/2+	72.9	5	6.4976	47	
$^{175}\text{Ta}$	$\beta^+/\epsilon$	2073	0.0	7/2+	348.35	7/2-	26.5	18	6.885	35	
$^{176}\text{Ta}$	$\beta^+/\epsilon$	3211	0.0	(1)-	1672.36	(1)+	4.9	8	7.40	7	
$^{176}\text{Ta}$	$\beta^+/\epsilon$	3211	0.0	(1)-	1862.82	1+	9.0	10	7.02	5	
$^{177}\text{Yb}$	$\beta^-$	1397.5	0.0	9/2+	150.3986	9/2-	18.5	17	6.852	40	
$^{177}\text{Lu}$	$\beta^-$	496.8	0.0	7/2+	0.0	7/2-	79.44	23	6.7653	27	
$^{177}\text{Lu}$	$\beta^-$	496.8	970.1757	23/2-	1315.4502	23/2+	77.30	8	6.512	7	
$^{177}\text{Ta}$	$\beta^+/\epsilon$	1166.0	0.0	7/2+	0.0	7/2-	62	9	6.89	6	
$^{177}\text{Ta}$	$\epsilon$	1166.0	0.0	7/2+	604.49	7/2-	0.16	5	8.79	14	
$^{177}\text{Ta}$	$\epsilon$	1166.0	0.0	7/2+	1057.74	7/2-	0.61	17	6.31	13	
$^{177}\text{W}$	$\beta^+/\epsilon$	2013	0.0	1/2-	487.64	1/2+	9.6	10	6.57	5	
$^{179}\text{Lu}$	$\beta^-$	1404	0.0	7/2+	214.33	7/2-	11	3	7.41	12	
$^{181}\text{Hf}$	$\beta^-$	1036.1	0.0	1/2-	615.12	1/2+	93	3	7.288	15	
$^{181}\text{W}$	$\epsilon$	205.1	0.0	9/2+	6.24	9/2-	74	4	6.782	27	
$^{181}\text{Re}$	$\epsilon$	1717	0.0	5/2+	1248.85	5/2-	1.8	3	7.18	8	
$^{182}\text{Ta}$	$\beta^-$	1815.5	0.0	3-	1331.1153	3+	2.37	5	9.540	10	
$^{182}\text{Re}$	$\epsilon$	2.80E3	0.0	7+	1916.94	(7)-	0.46	9	8.89	14	
$^{182}\text{Re}$	$\epsilon$	2.80E3	0.0	7+	1960.33	(7)-	23	5	7.14	15	
$^{182}\text{Re}$	$\epsilon$	2.80E3	0.0	7+	1978.37	(7)-	24	5	7.10	15	
$^{183}\text{Ta}$	$\beta^-$	1072.1	0.0	7/2+	453.0685	7/2-	93	6	6.952	30	
$^{183}\text{Re}$	$\epsilon$	556	0.0	5/2+	99.0802	5/2-	4.4	13	8.69	13	
$^{183}\text{Re}$	$\epsilon$	556	0.0	5/2+	291.7286	5/2-	15.6	15	7.57	6	
$^{183}\text{Os}$	$\beta^+/\epsilon$	2.15E3	0.0	9/2+	496.26	9/2-	74.0	14	6.594	35	
$^{183}\text{Os}$	$\epsilon$	2.15E3	0.0	9/2+	1554.09	(9/2)-	2.45	4	7.12	9	
$^{183}\text{Os}$	$\beta^+/\epsilon$	2.15E3	170.70	1/2-	878.91	1/2+	1.70	30	7.99	8	
$^{183}\text{Os}$	$\beta^+/\epsilon$	2.15E3	170.70	1/2-	1101.95	(1/2)+	45.6	16	6.406	45	
$^{183}\text{Ir}$	$\beta^+/\epsilon$	3.46E3	0.0	5/2-	800.56	(5/2)+	1.9	5	7.55	12	P
$^{184}\text{Ir}$	$\beta^+/\epsilon$	4642	0.0	5-	1428.25	5+	3.20	30	8.041	42	P
$^{184}\text{Ir}$	$\beta^+/\epsilon$	4642	0.0	5-	2399.05	(5)+	5.20	40	7.446	36	P
$^{185}\text{Os}$	$\epsilon$	1013.14	0.0	1/2-	646.119	1/2+	77	3	7.383	17	
$^{185}\text{Os}$	$\epsilon$	1013.14	0.0	1/2-	880.282	1/2+	7.1	3	7.204	19	
$^{186}\text{Ir}$	$\beta^+/\epsilon$	3828	0.0	5+	1628.57	5-	2.90	24	8.411	37	
$^{186}\text{Au}$	$\beta^+/\epsilon$	6150	0.0	3-	956.55	3+	6.6	8	7.23	6	P
$^{186}\text{Au}$	$\beta^+/\epsilon$	6150	0.0	3-	1417.90	(3)+	1.72	15	7.658	44	P
$^{187}\text{Ir}$	$\beta^+/\epsilon$	1670	0.0	3/2+	501.44	3/2-	11.40	30	7.033	29	
$^{187}\text{Ir}$	$\epsilon$	1670	0.0	3/2+	725.76	3/2-	1.05	5	7.872	38	
$^{187}\text{Pt}$	$\beta^+/\epsilon$	2864	0.0	3/2-	189.59	3/2+	10.2	12	7.25	5	
$^{187}\text{Pt}$	$\beta^+/\epsilon$	2864	0.0	3/2-	819.06	3/2+	13.2	13	6.868	47	
$^{188}\text{Ir}$	$\epsilon$	2792	0.0	1-	2098.98	(1)+	9.2	9	7.236	45	
$^{188}\text{Ir}$	$\epsilon$	2792	0.0	1-	2214.60	(1)+	26.6	22	6.599	40	
$^{188}\text{Ir}$	$\epsilon$	2792	0.0	1-	2347.49	(1)+	1.02	12	7.76	6	

**Table 11**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
$^{189}\text{Re}$	$\beta^-$	1008	0.0	5/2+	233.54	5/2-	0.21	4	9.28	8	
$^{189}\text{Re}$	$\beta^-$	1008	0.0	5/2+	275.90	5/2-	5.6	10	7.77	8	
$^{189}\text{Re}$	$\beta^-$	1008	0.0	5/2+	672.18	5/2-	0.045	13	8.74	13	
$^{189}\text{Re}$	$\beta^-$	1008	0.0	5/2+	716.82	5/2-	0.32	8	7.68	12	
$^{189}\text{Ir}$	$\varepsilon$	537	0.0	3/2+	0.0	3/2-	40	7	7.23	8	
$^{189}\text{Ir}$	$\varepsilon$	537	0.0	3/2+	95.23	3/2-	11.6	17	7.58	7	
$^{189}\text{Pt}$	$\beta^+/\varepsilon$	1980	0.0	3/2-	721.41	3/2+	21	6	6.89	12	
$^{190}\text{Re}$	$\beta^-$	3124.8	0.0	(2)-	1995.59	(2)+	1.1	2	6.45	8	P
$^{190}\text{Ir}$	$\varepsilon$	1954.2	0.0	4-	955.24	4+	5.1	8	8.67	7	
$^{190}\text{Ir}$	$\varepsilon$	1954.2	0.0	4-	1163.11	4+	25	3	7.76	5	
$^{191}\text{Pt}$	$\varepsilon$	1010.5	0.0	3/2-	178.934	3/2+	11.4	18	7.56	7	
$^{191}\text{Pt}$	$\varepsilon$	1010.5	0.0	3/2-	538.839	3/2+	33	5	6.55	7	
$^{191}\text{Pt}$	$\varepsilon$	1010.5	0.0	3/2-	762.52	3/2+	0.37	7	7.82	8	
$^{192}\text{Au}$	$\beta^+/\varepsilon$	3516	0.0	1-	2149.385	1+	2.70	40	7.54	7	
$^{192}\text{Au}$	$\beta^+/\varepsilon$	3516	0.0	1-	2319.11	1+	4.0	5	7.25	6	
$^{192}\text{Au}$	$\beta^+/\varepsilon$	3516	0.0	1-	2335.465	1+	11.4	14	6.78	6	
$^{193}\text{Os}$	$\beta^-$	1141.9	0.0	3/2-	0.0	3/2+	59	3	7.541	22	
$^{193}\text{Os}$	$\beta^-$	1141.9	0.0	3/2-	180.070	3/2+	1.5	2	8.87	6	
$^{193}\text{Os}$	$\beta^-$	1141.9	0.0	3/2-	460.552	3/2+	7.74	11	7.634	8	
$^{193}\text{Os}$	$\beta^-$	1141.9	0.0	3/2-	712.197	3/2+	0.513	8	8.142	10	
$^{193}\text{Au}$	$\varepsilon$	1075	0.0	3/2+	114.158	3/2-	12.4	18	7.11	6	
$^{193}\text{Au}$	$\varepsilon$	1075	0.0	3/2+	187.81	3/2-	26	4	6.71	7	
$^{193}\text{Au}$	$\varepsilon$	1075	0.0	3/2+	269.83	(3/2)-	15.7	20	6.84	6	
$^{193}\text{Au}$	$\varepsilon$	1075	0.0	3/2+	439.05	(3/2)-	3.7	5	7.24	6	
$^{193}\text{Hg}$	$\beta^+/\varepsilon$	2343	0.0	3/2-	224.81	(3/2)+	35.0	40	6.75	5	
$^{193}\text{Hg}$	$\beta^+/\varepsilon$	2343	0.0	3/2-	1118.97	(3/2)+	24.0	30	6.41	6	
$^{194}\text{Os}$	$\beta^-$	96.6	0.0	0+	43.119	0-	76	10	6.39	8	
$^{194}\text{Au}$	$\varepsilon$	2548.2	0.0	1-	1924.282	1+	4.16	14	7.506	15	
$^{194}\text{Au}$	$\varepsilon$	2548.2	0.0	1-	2043.715	1+	4.81	16	7.234	15	
$^{194}\text{Au}$	$\varepsilon$	2548.2	0.0	1-	2114.102	1+	0.62	8	7.97	6	
$^{194}\text{Au}$	$\varepsilon$	2548.2	0.0	1-	2215.530	1+	6.9	4	6.648	26	
$^{194}\text{Au}$	$\varepsilon$	2548.2	0.0	1-	2298.160	1+	0.693	23	7.329	18	
$^{194}\text{Au}$	$\varepsilon$	2548.2	0.0	1-	2365.932	1+	0.0731	25	7.919	22	
$^{194}\text{Au}$	$\varepsilon$	2548.2	0.0	1-	2412.744	1+	0.056	4	7.622	40	
$^{194}\text{Pb}$	$\beta^+/\varepsilon$	2730	0.0	0+	192.14	(0)-	3.40	20	6.673	37	
$^{195}\text{Ir}$	$\beta^-$	1101.6	0.0	3/2+	211.30	3/2-	4.3	11	7.20	12	
$^{195}\text{Au}$	$\varepsilon$	226.8	0.0	3/2+	98.858	3/2-	58.2	19	6.589	19	
$^{195}\text{Au}$	$\varepsilon$	226.8	0.0	3/2+	199.46	3/2-	0.0142	13	8.26	6	
$^{195}\text{Au}$	$\varepsilon$	226.8	0.0	3/2+	211.4071	3/2-	0.0195	20	7.29	11	
$^{195}\text{Hg}$	$\beta^+/\varepsilon$	1554	0.0	1/2-	61.434	1/2+	71	11	6.57	7	
$^{195}\text{Hg}$	$\varepsilon$	1554	176.07	13/2+	878.86	13/2-	6.5	5	7.679	45	
$^{195}\text{Hg}$	$\varepsilon$	1554	176.07	13/2+	1559.60	13/2-	1.40	12	6.61	21	
$^{195}\text{Tl}$	$\beta^+/\varepsilon$	2858	0.0	1/2+	764.53	1/2-	2.40	30	7.42	6	
$^{195}\text{Tl}$	$\beta^+/\varepsilon$	2858	0.0	1/2+	1400.92	1/2-	15.4	15	6.28	5	
$^{196}\text{Au}$	$\beta^+/\varepsilon$	1505.8	0.0	2-	355.73	2+	67.0	21	7.466	14	
$^{196}\text{Au}$	$\varepsilon$	1505.8	0.0	2-	688.76	2+	24.6	10	7.583	18	
$^{196}\text{Au}$	$\beta^-$	687.2	0.0	2-	426.10	2+	6.85	25	7.093	23	
$^{196}\text{Tl}$	$\beta^+/\varepsilon$	4329	0.0	2-	425.67	2+	37	6	7.11	7	P
$^{196}\text{Tl}$	$\beta^+/\varepsilon$	4329	0.0	2-	2012.3	(2)+	6.4	6	7.295	44	P
$^{196}\text{Pb}$	$\beta^+/\varepsilon$	2148	0.0	0+	191.7	0-	11.0	30	6.45	12	
$^{197}\text{Pt}$	$\beta^-$	720.0	0.0	1/2-	77.35	1/2+	81.2	30	6.401	16	
$^{197}\text{Tl}$	$\beta^+/\varepsilon$	2186	0.0	1/2+	0.0	1/2-	53	12	6.51	10	
$^{197}\text{Pb}$	$\beta^+/\varepsilon$	3609	0.0	3/2-	1155.96	3/2+	8.9	22	6.10	14	P

**Table 11**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
<sup>197</sup> Pb	$\beta+\epsilon$	3609	319.31	13/2+	1304.23	13/2-	4.4	14	7.20	14	P
<sup>197</sup> Pb	$\beta+\epsilon$	3609	319.31	13/2+	1553.76	(13/2)-	3.5	8	7.20	10	P
<sup>197</sup> Pb	$\beta+\epsilon$	3609	319.31	13/2+	1994.89	13/2-	2.9	6	7.08	9	P
<sup>197</sup> Pb	$\beta+\epsilon$	3609	319.31	13/2+	2011.04	13/2-	1.5	5	7.36	15	P
<sup>197</sup> Pb	$\beta+\epsilon$	3609	319.31	13/2+	2113.90	13/2-	5.4	11	6.76	9	P
<sup>198</sup> Au	$\beta-$	1373.52	0.0	2-	411.80250	2+	98.990	9	7.4588	8	
<sup>198</sup> Au	$\beta-$	1373.52	0.0	2-	1087.6874	2+	0.986	6	7.6997	36	
<sup>198</sup> Tl	$\beta+\epsilon$	3426	0.0	2-	1087.67	2+	7.3	8	7.71	6	
<sup>198</sup> Tl	$\beta+\epsilon$	3426	0.0	2-	1612.42	2+	9.3	13	7.36	7	
<sup>198</sup> Tl	$\beta+\epsilon$	3426	0.0	2-	1832.58	2+	11.7	15	7.14	7	
<sup>198</sup> Tl	$\beta+\epsilon$	3426	0.0	2-	1858.82	2+	4.9	7	7.51	8	
<sup>198</sup> Tl	$\beta+\epsilon$	3426	0.0	2-	2267.7	2+	1.54	21	7.73	7	
<sup>198</sup> Tl	$\epsilon$	3426	0.0	2-	2465.42	2+	1.54	22	7.56	8	
<sup>198</sup> Tl	$\epsilon$	3426	0.0	2-	2782.74	2+	1.10	13	7.32	7	
<sup>199</sup> Pt	$\beta-$	1705.1	0.0	5/2-	317.174	5/2+	3.28	7	7.389	10	
<sup>199</sup> Pt	$\beta-$	1705.1	0.0	5/2-	542.884	5/2+	12.01	12	6.543	6	
<sup>199</sup> Au	$\beta-$	452.3	0.0	3/2+	208.20494	3/2-	21.5	4	6.210	9	
<sup>199</sup> Tl	$\beta+\epsilon$	1487	0.0	1/2+	0.0	1/2-	48	5	6.61	5	
<sup>199</sup> Pb	$\beta+\epsilon$	2828	0.0	3/2-	366.89	3/2+	17.0	40	6.87	11	
<sup>200</sup> Tl	$\beta+\epsilon$	2456	0.0	2-	367.943	2+	25.2	6	7.752	15	
<sup>200</sup> Tl	$\epsilon$	2456	0.0	2-	1573.665	2+	30	3	6.880	46	
<sup>200</sup> Tl	$\epsilon$	2456	0.0	2-	1593.426	2+	1.4	4	8.19	12	
<sup>200</sup> Tl	$\epsilon$	2456	0.0	2-	1730.925	2+	5.8	6	7.407	48	
<sup>200</sup> Tl	$\epsilon$	2456	0.0	2-	1882.857	2+	7.7	7	7.055	44	
<sup>200</sup> Tl	$\epsilon$	2456	0.0	2-	1972.276	2+	1.30	14	7.66	5	
<sup>200</sup> Tl	$\epsilon$	2456	0.0	2-	2126.856	2+	0.66	8	7.55	6	
<sup>200</sup> Tl	$\epsilon$	2456	0.0	2-	2288.95	2+	0.149	19	7.37	8	
<sup>200</sup> Tl	$\epsilon$	2456	0.0	2-	2331.784	2+	0.029	3	7.65	10	
<sup>200</sup> Pb	$\epsilon$	796	0.0	0+	147.634	0-	68	3	6.173	29	
<sup>201</sup> Tl	$\epsilon$	482	0.0	1/2+	167.48	1/2-	39.8	4	6.17	5	
<sup>201</sup> Pb	$\beta+\epsilon$	1910	0.0	5/2-	692.52	5/2+	6.2	8	7.45	6	
<sup>201</sup> Pb	$\epsilon$	1910	0.0	5/2-	1479.85	5/2+	2.66	18	6.81	6	
<sup>201</sup> Bi	$\beta+\epsilon$	3842	0.0	9/2-	1415.4	9/2+	4.2	8	7.57	8	
<sup>201</sup> Bi	$\beta+\epsilon$	3842	0.0	9/2-	1737.3	9/2+	3.9	5	7.46	6	
<sup>201</sup> Bi	$\beta+\epsilon$	3842	0.0	9/2-	1875.6	9/2+	2.20	30	7.65	6	
<sup>201</sup> Bi	$\beta+\epsilon$	3842	0.0	9/2-	2119.5	9/2+	1.40	30	7.71	11	
<sup>201</sup> Bi	$\beta+\epsilon$	3842	0.0	9/2-	2506.8	9/2+	6.9	6	6.821	44	
<sup>202</sup> Tl	$\epsilon$	1364.9	0.0	2-	439.512	2+	94.3	10	7.481	11	
<sup>202</sup> Tl	$\epsilon$	1364.9	0.0	2-	959.92	2+	0.69	6	8.805	40	
<sup>203</sup> Pb	$\epsilon$	975	0.0	5/2-	680.5160	5/2+	4.70	8	6.895	27	
<sup>203</sup> Bi	$\beta+\epsilon$	3262	0.0	9/2-	1547.7	9/2+	3.5	5	8.15	6	
<sup>203</sup> Bi	$\beta+\epsilon$	3262	0.0	9/2-	1641.5	9/2+	2.20	40	8.30	8	
<sup>203</sup> Bi	$\epsilon$	3262	0.0	9/2-	2568.8	9/2+	3.6	5	7.30	7	
<sup>203</sup> Bi	$\epsilon$	3262	0.0	9/2-	2713.3	9/2+	21.2	10	6.295	38	
<sup>203</sup> Bi	$\epsilon$	3262	0.0	9/2-	2753.6	(9/2)+	7.8	5	6.652	45	
<sup>203</sup> Bi	$\epsilon$	3262	0.0	9/2-	2794.2	(9/2)+	1.45	20	7.30	7	
<sup>203</sup> Po	$\beta+\epsilon$	4214	0.0	5/2-	1488.14	5/2+	5.6	10	7.13	8	P
<sup>203</sup> At	$\beta+\epsilon$	5148	0.0	9/2-	1129.27	9/2+	3.4	6	7.12	8	P
<sup>203</sup> At	$\beta+\epsilon$	5148	0.0	9/2-	1379.62	(9/2)+	3.70	30	7.003	38	P
<sup>204</sup> Bi	$\beta+\epsilon$	4464	0.0	6+	3397.48	6-	1.68	20	8.01	5	
<sup>204</sup> Bi	$\epsilon$	4464	0.0	6+	3637.91	6-	9.8	10	7.009	48	
<sup>204</sup> Bi	$\epsilon$	4464	0.0	6+	4094.29	6-	1.02	11	7.18	6	
<sup>204</sup> Bi	$\epsilon$	4464	0.0	6+	4183.88	6-	1.56	17	6.69	7	



**Table 11**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
<sup>205</sup> Hg	$\beta^-$	1533.1	0.0	1/2-	0.0	1/2+	96.8	15	5.348	11	
<sup>205</sup> Bi	$\beta^+/\epsilon$	2704.6	0.0	9/2-	1593.57	9/2+	8.21	10	8.869	12	
<sup>205</sup> Bi	$\epsilon$	2704.6	0.0	9/2-	2488.08	(9/2)+	1.08	3	8.045	37	
<sup>205</sup> Bi	$\epsilon$	2704.6	0.0	9/2-	2565.12	9/2+	9.32	13	6.50	6	
<sup>205</sup> Bi	$\epsilon$	2704.6	0.0	9/2-	2606.87	9/2+	3.69	7	6.34	8	
<sup>205</sup> Po	$\beta^+/\epsilon$	3544	0.0	5/2-	1970.25	5/2+	6.5	5	7.005	40	
<sup>205</sup> At	$\beta^+/\epsilon$	4537	0.0	9/2-	1400.80	9/2+	6.6	5	7.105	36	P
<sup>205</sup> At	$\beta^+/\epsilon$	4537	0.0	9/2-	1539.94	9/2+	2.85	17	7.422	30	P
<sup>205</sup> At	$\beta^+/\epsilon$	4537	0.0	9/2-	1912.00	9/2+	3.80	40	7.163	48	P
<sup>205</sup> At	$\beta^+/\epsilon$	4537	0.0	9/2-	2355.56	9/2+	3.60	30	7.009	40	P
<sup>205</sup> At	$\beta^+/\epsilon$	4537	0.0	9/2-	2799.20	(9/2)+	2.73	14	6.918	28	P
<sup>205</sup> At	$\beta^+/\epsilon$	4537	0.0	9/2-	2930.82	(9/2)+	1.83	9	7.020	28	P
<sup>206</sup> Hg	$\beta^-$	1308	0.0	0+	0.0	0-	62	7	5.50	6	
<sup>206</sup> Tl	$\beta^-$	1532.2	0.0	0-	0.0	0+	99.885	14	5.2711	14	
<sup>207</sup> Tl	$\beta^-$	1418	0.0	1/2+	0.0	1/2-	99.729	10	5.202	6	
<sup>207</sup> Po	$\epsilon$	2909	0.0	5/2-	2405.68	5/2+	3.12	9	6.759	21	
<sup>207</sup> At	$\beta^+/\epsilon$	3918	0.0	9/2-	2230.244	9/2+	11.3	6	6.881	26	
<sup>207</sup> At	$\beta^+/\epsilon$	3918	0.0	9/2-	2294.21	(9/2)+	1.04	7	7.882	32	
<sup>207</sup> At	$\beta^+/\epsilon$	3918	0.0	9/2-	2303.301	9/2+	17.5	8	6.651	24	
<sup>208</sup> Tl	$\beta^-$	4998.4	0.0	5+	3197.717	5-	49.1	7	5.703	6	
<sup>208</sup> Tl	$\beta^-$	4998.4	0.0	5+	3708.41	5-	24.2	3	5.472	6	
<sup>208</sup> Tl	$\beta^-$	4998.4	0.0	5+	3960.93	5-	3.18	6	6.013	9	
<sup>208</sup> At	$\beta^+/\epsilon$	4999	0.0	6+	3564.5	6-	25.9	15	6.325	28	
<sup>209</sup> Tl	$\beta^-$	3970	0.0	1/2+	2149.42	1/2-	97	4	5.275	19	
<sup>209</sup> Pb	$\beta^-$	644.0	0.0	9/2+	0.0	9/2-	100		5.6267	27	
<sup>209</sup> At	$\beta^+/\epsilon$	3482	0.0	9/2-	2312.04	9/2+	70.9	19	6.222	14	
<sup>210</sup> Pb	$\beta^-$	63.5	0.0	0+	46.539	0-	84	3	5.557	43	
<sup>210</sup> At	$\beta^+/\epsilon$	3981	0.0	(5)+	2910.0	5-	70.0	30	6.319	30	
<sup>210</sup> At	$\epsilon$	3981	0.0	(5)+	3026.2	5-	19	1	6.778	33	
<sup>210</sup> At	$\epsilon$	3981	0.0	(5)+	3428.3	5-	2.2	1	7.183	34	
<sup>211</sup> Pb	$\beta^-$	1366	0.0	9/2+	0.0	9/2-	91.32	12	6.084	6	
<sup>211</sup> Pb	$\beta^-$	1366	0.0	9/2+	831.960	9/2-	6.28	10	5.826	15	
<sup>211</sup> At	$\epsilon$	785.3	0.0	9/2-	0.0	9/2+	57.93	1	6.056	6	
<sup>211</sup> Rn	$\epsilon$	2892	0.0	1/2-	2479.2	(1/2)+	68	4	5.677	34	
<sup>213</sup> Bi	$\beta^-$	1422	0.0	9/2-	0.0	9/2+	65.9	4	6.416	6	
<sup>214</sup> Bi	$\beta^-$	3269	0.0	1-	1764.520	1+	16.90	11	6.733	12	
<sup>214</sup> Bi	$\beta^-$	3269	0.0	1-	2118.535	1+	4.33	4	6.900	16	
<sup>214</sup> Bi	$\beta^-$	3269	0.0	1-	2204.103	1+	5.56	5	6.671	17	
<sup>221</sup> Rn	$\beta^-$	1194	0.0	7/2+	108.387	(7/2)-	8.1	25	6.73	13	
<sup>221</sup> Rn	$\beta^-$	1194	0.0	7/2+	195.788	(7/2)-	2.1	3	7.19	6	
<sup>222</sup> Fr	$\beta^-$	2058	0.0	2-	111.12	2+	38	12	6.75	14	
<sup>225</sup> Rn	$\beta^-$	2714	0.0	7/2-	198.23	(7/2)+	3.3	6	7.73	8	
<sup>225</sup> Rn	$\beta^-$	2714	0.0	7/2-	293.23	(7/2)+	2.88	25	7.725	39	
<sup>225</sup> Rn	$\beta^-$	2714	0.0	7/2-	665.18	(7/2)+	1.11	9	7.862	38	
<sup>227</sup> Fr	$\beta^-$	2505	0.0	1/2+	296.576	1/2-	3.0	6	7.30	9	
<sup>227</sup> Fr	$\beta^-$	2505	0.0	1/2+	675.863	1/2-	48.6	20	5.784	19	
<sup>228</sup> Fr	$\beta^-$	4444	0.0	2-	770.71	2+	1.85	19	7.783	46	P
<sup>228</sup> Fr	$\beta^-$	4444	0.0	2-	846.14	2+	3.0	3	7.538	45	P
<sup>228</sup> Fr	$\beta^-$	4444	0.0	2-	1013.24	2+	2.8	4	7.49	6	P
<sup>228</sup> Fr	$\beta^-$	4444	0.0	2-	2138.3	2+	1.22	13	7.174	48	P
<sup>228</sup> Fr	$\beta^-$	4444	0.0	2-	2161.3	2+	2.29	24	6.884	47	P
<sup>228</sup> Ac	$\beta^-$	2123.8	0.0	3+	396.083	3-	11.65	24	8.537	9	
<sup>228</sup> Ac	$\beta^-$	2123.8	0.0	3+	1168.377	3-	3.11	7	8.187	11	

**Table 11**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
<sup>231</sup> Ac	$\beta^-$	1947	0.0	1/2+	554.651	(1/2)-	88	5	5.623	29	
<sup>231</sup> Th	$\beta^-$	391.5	0.0	5/2+	77.694	5/2-	0.53	8	7.99	7	
<sup>233</sup> Pa	$\beta^-$	570.3	0.0	3/2-	311.905	3/2+	25	4	7.49	7	
<sup>233</sup> Pa	$\beta^-$	570.3	0.0	3/2-	415.761	3/2+	28	3	6.74	5	
<sup>237</sup> U	$\beta^-$	518.5	0.0	1/2+	281.368	1/2-	51	4	6.503	34	
<sup>237</sup> Pu	$\epsilon$	220.1	0.0	7/2-	33.207	7/2+	11.8	14	7.54	5	
<sup>238</sup> Np	$\beta^-$	1291.45	0.0	2+	985.47	2-	0.521	7	8.362	6	
<sup>238</sup> Am	$\beta^+/\epsilon$	2.26E3	0.0	1+	605.13	1-	14.8	18	7.05	6	
<sup>238</sup> Am	$\beta^+/\epsilon$	2.26E3	0.0	1+	962.85	1-	54	6	6.26	7	
<sup>238</sup> Am	$\epsilon$	2.26E3	0.0	1+	1447.25	1-	1.12	14	7.49	10	
<sup>238</sup> Am	$\epsilon$	2.26E3	0.0	1+	1621.29	1-	4.1	5	6.68	12	
<sup>238</sup> Am	$\epsilon$	2.26E3	0.0	1+	1636.42	1-	1.89	24	7.00	12	
<sup>239</sup> U	$\beta^-$	1261.7	0.0	5/2+	74.6640	5/2-	69.0	14	6.059	9	
<sup>239</sup> Np	$\beta^-$	722.8	0.0	5/2+	505.2	5/2-	0.0074	2	9.795	13	
<sup>239</sup> Am	$\epsilon$	802.1	0.0	(5/2)-	285.46	5/2+	71	8	6.090	49	
<sup>241</sup> Cm	$\epsilon$	767.4	0.0	1/2+	652.089	(1/2)-	26.7	12	6.440	24	
<sup>243</sup> Cm	$\epsilon$	6.9	0.0	5/2+	0.0	5/2-	0.29	3	7.37	43	
<sup>249</sup> Es	$\epsilon$	1452	0.0	7/2+	852.19	(7/2)-	2.2	3	7.04	8	
<sup>249</sup> Es	$\epsilon$	1452	0.0	7/2+	1218.50	(7/2)-	1.6	2	6.05	21	
<sup>250</sup> Bk	$\beta^-$	1781.7	0.0	2-	1031.852	2+	83.4	16	6.346	10	

16.2. First forbidden non-unique ( $\Delta J=1$ )

**Table 12**

List of first forbidden transitions with  $\Delta J=1$  and  $\Delta\pi=\text{yes}$ .

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
<sup>11</sup> Be	$\beta^-$	1.150946E4	0.0	1/2+	0.0	3/2-	54.7	20	6.830	16	
<sup>33</sup> Mg	$\beta^-$	1.3460E4	0.0	3/2-	0.0	(5/2)+	37	8	5.23	9	P
<sup>45</sup> K	$\beta^-$	4196.6	0.0	3/2+	174.28	5/2-	7.9	8	7.605	46	
<sup>48</sup> V	$\epsilon$	4014.9	0.0	4+	3358.80	3-	0.138	11	7.786	35	
<sup>66</sup> Ga	$\beta+/\epsilon$	5175.5	0.0	0+	3380.944	1-	2.01	17	6.530	38	
<sup>70</sup> As	$\beta+/\epsilon$	6228.1	0.0	4+	2562.05	3-	1.70	40	7.46	10	
<sup>72</sup> Ga	$\beta^-$	3997.6	0.0	3-	834.416	2+	6.80	15	9.051	10	
<sup>72</sup> Ga	$\beta^-$	3997.6	0.0	3-	1464.295	2+	9.38	6	8.4973	29	
<sup>72</sup> As	$\beta+/\epsilon$	4343.60	0.0	2-	2064.87	3+	0.047	15	9.22	14	
<sup>73</sup> Kr	$\beta+/\epsilon$	7094	0.0	(3/2)-	286.09	(5/2)+	3.8	10	6.56	12	
<sup>74</sup> As	$\epsilon$	2562.4	0.0	2-	1696.97	(3)+	0.0071	18	9.92	11	
<sup>75</sup> Se	$\epsilon$	866.04	0.0	5/2+	821.73	7/2-	0.000160	10	9.642	28	
<sup>75</sup> Br	$\beta+/\epsilon$	3062.5	0.0	3/2-	1198.61	5/2+	1.59	15	6.070	42	P
<sup>76</sup> Br	$\beta+/\epsilon$	4963	0.0	1-	0.0	0+	6.0	10	8.94	7	
<sup>76</sup> Br	$\beta+/\epsilon$	4963	0.0	1-	559.17	2+	28.1	11	7.968	19	
<sup>76</sup> Br	$\beta+/\epsilon$	4963	0.0	1-	1122.33	0+	1.78	16	8.819	40	
<sup>76</sup> Br	$\beta+/\epsilon$	4963	0.0	1-	1216.35	2+	3.9	12	8.41	13	
<sup>76</sup> Br	$\beta+/\epsilon$	4963	0.0	1-	3069.98	2+	18.9	8	6.026	21	
<sup>77</sup> As	$\beta^-$	683.2	0.0	3/2-	301.169	5/2+	0.013	2	8.72	7	
<sup>77</sup> Br	$\beta+/\epsilon$	1364.7	0.0	3/2-	301.09	5/2+	0.060	12	8.39	9	
<sup>81</sup> Kr	$\epsilon$	280.85	0.0	7/2+	275.991	5/2-	0.30	2	9.38	13	
<sup>83</sup> Sr	$\beta+/\epsilon$	2273	0.0	7/2+	0.0	5/2-	23.5	20	6.667	42	
<sup>83</sup> Sr	$\beta+/\epsilon$	2273	0.0	7/2+	1102.90	9/2-	0.0100	30	9.11	14	
<sup>85</sup> Se	$\beta^-$	6161.8	0.0	(5/2)+	0.0	3/2-	31	6	6.54	8	P
<sup>85</sup> Sr	$\epsilon$	1064.1	0.0	9/2+	868.06	7/2-	0.0123	7	9.10	6	
<sup>87</sup> Kr	$\beta^-$	3888.27	0.0	5/2+	0.0	3/2-	30.5	22	7.823	31	
<sup>88</sup> Kr	$\beta^-$	2917.7	0.0	0+	196.292	(1)-	2.0	3	8.68	7	
<sup>89</sup> Rb	$\beta^-$	4497	0.0	3/2-	0.0	5/2+	18.8	13	7.631	30	
<sup>90</sup> Rb	$\beta^-$	6585	106.90	3-	831.67	2+	15	4	7.69	12	
<sup>90</sup> Rb	$\beta^-$	6585	106.90	3-	1655.89	4+	3.5	6	8.03	7	
<sup>90</sup> Rb	$\beta^-$	6585	106.90	3-	1892.34	2+	4.2	4	7.856	42	
<sup>93</sup> Sr	$\beta^-$	4141	0.0	5/2+	2543.93	3/2-	3.8	3	6.125	37	
<sup>93</sup> Y	$\beta^-$	2895	0.0	1/2-	266.87	3/2+	4.9	9	8.83	8	
<sup>95</sup> Rb	$\beta^-$	9227	0.0	5/2-	556.06	(7/2)+	6.0	12	6.04	9	P
<sup>95</sup> Rb	$\beta^-$	9227	0.0	5/2-	1121.01	3/2+	2.5	6	6.28	10	P
<sup>95</sup> Sr	$\beta^-$	6091	0.0	1/2+	685.8	3/2-	8.9	7	6.742	34	P
<sup>95</sup> Y	$\beta^-$	4452	0.0	1/2-	2372.17	3/2+	3.79	22	6.749	26	
<sup>95</sup> Nb	$\beta^-$	925.60	234.70	1/2-	204.116	3/2+	2.4	3	8.37	5	
<sup>95</sup> Tc	$\beta+/\epsilon$	1691	38.91	1/2-	204.1177	3/2+	7.68	10	8.364	18	
<sup>95</sup> Tc	$\epsilon$	1691	38.91	1/2-	820.627	3/2+	5.95	8	8.006	19	
<sup>95</sup> Tc	$\epsilon$	1691	38.91	1/2-	1620.25	3/2+	0.0511	25	8.10	6	
<sup>96</sup> Rh	$\beta+/\epsilon$	6393	0.0	6+	2588.36	5-	1.72	7	6.814	19	
<sup>97</sup> Ru	$\epsilon$	1104	0.0	5/2+	580.33	3/2-	0.0020	3	9.70	7	
<sup>97</sup> Rh	$\beta+/\epsilon$	3523	258.76	1/2-	189.24	3/2+	12.4	21	6.49	8	
<sup>97</sup> Rh	$\beta+/\epsilon$	3523	258.76	1/2-	771.38	3/2+	3.1	6	6.67	9	
<sup>97</sup> Rb	$\beta^-$	1.00615E4	0.0	3/2+	713.82	(5/2)-	3.1	4	6.12	6	P
<sup>97</sup> Zr	$\beta^-$	2666.1	0.0	1/2+	1251.186	3/2-	4.27	8	8.034	10	
<sup>99</sup> Rh	$\beta+/\epsilon$	2041	0.0	1/2-	322.43	3/2+	5.0	5	8.185	45	
<sup>99</sup> Nb	$\beta^-$	3635	365.27	1/2-	351.20	3/2+	1.5	4	7.60	12	P
<sup>99</sup> Nb	$\beta^-$	3635	365.27	1/2-	548.71	3/2+	1.50	22	7.50	7	P
<sup>99</sup> Nb	$\beta^-$	3635	365.27	1/2-	792.92	3/2+	1.16	19	7.47	8	P

**Table 12**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
<sup>99</sup> Nb	$\beta^-$	3635	365.27	1/2-	890.58	3/2+	1.47	20	7.31	7	P
<sup>99</sup> Mo	$\beta^-$	1357.8	0.0	1/2+	509.125	3/2-	1.16	2	8.393	8	
<sup>99</sup> Mo	$\beta^-$	1357.8	0.0	1/2+	671.500	3/2-	0.057	3	9.370	23	
<sup>99</sup> Mo	$\beta^-$	1357.8	0.0	1/2+	1129.123	(3/2)-	0.012	1	8.446	37	
<sup>100</sup> Rh	$\beta^+/\epsilon$	3636	0.0	1-	0.0	0+	2.9	7	8.57	11	
<sup>100</sup> Rh	$\beta^+/\epsilon$	3636	0.0	1-	539.511	2+	1.7	5	8.42	13	
<sup>101</sup> Rh	$\epsilon$	546	0.0	1/2-	422.23	3/2+	0.84	8	8.38	8	
<sup>103</sup> Ru	$\beta^-$	764.5	0.0	3/2+	0.0	1/2-	0.87	5	9.548	25	
<sup>103</sup> Ru	$\beta^-$	764.5	0.0	3/2+	357.408	5/2-	0.0083	5	10.622	27	
<sup>103</sup> Pd	$\epsilon$	574.7	0.0	5/2+	295.00	3/2-	0.00044	11	10.64	11	
<sup>105</sup> Ag	$\beta^+/\epsilon$	1347.1	0.0	1/2-	280.5	3/2+	1.20	40	8.84	14	
<sup>105</sup> Ag	$\epsilon$	1347.1	0.0	1/2-	560.7	3/2+	0.14	4	9.50	12	
<sup>105</sup> Ag	$\epsilon$	1347.1	0.0	1/2-	650.8	(3/2)+	7.2	7	7.678	43	
<sup>106</sup> Ag	$\epsilon$	2965.1	89.66	6+	2397.6	(5)-	0.10	3	8.79	13	
<sup>108</sup> In	$\beta^+/\epsilon$	5133	0.0	7+	2975.11	6-	1.26	14	6.60	5	
<sup>110</sup> Ag	$\beta^-$	2890.7	117.59	6+	2539.672	5-	0.061	5	10.828	36	
<sup>110</sup> Ag	$\beta^-$	2890.7	117.59	6+	2659.857	5-	0.036	5	10.63	6	
<sup>110</sup> Ag	$\beta^-$	2890.7	117.59	6+	2842.62	(5)-	0.0232	9	9.785	20	
<sup>111</sup> Ag	$\beta^-$	1036.8	0.0	1/2-	342.13	3/2+	7.1	5	7.826	31	
<sup>113</sup> Sn	$\epsilon$	1039.0	0.0	1/2+	646.833	3/2-	2.21	8	8.221	17	
<sup>115</sup> Ag	$\beta^-$	3102	0.0	1/2-	229.04	(3/2)+	12.5	15	7.24	5	
<sup>115</sup> Cd	$\beta^-$	1451.9	0.0	1/2+	597.14	3/2-	1.17	6	8.428	22	
<sup>117</sup> Cd	$\beta^-$	2525	0.0	1/2+	588.652	3/2-	3.7	6	7.95	7	
<sup>117</sup> In	$\beta^-$	1454.7	315.302	1/2-	158.6	3/2+	9.7	10	7.127	45	
<sup>118</sup> I	$\beta^+/\epsilon$	6720	0.0	2-	1891.7	(3)+	2.15	15	7.436	36	P
<sup>119</sup> Te	$\epsilon$	2293.0	0.0	1/2+	1413.21	3/2-	1.26	9	7.045	32	
<sup>119</sup> Te	$\beta^+/\epsilon$	2293.0	260.96	11/2-	970.90	9/2+	0.28	7	9.07	11	
<sup>120</sup> I	$\beta^+/\epsilon$	5615	0.0	2-	2455.6	1+	3.74	24	7.036	29	P
<sup>121</sup> Cd	$\beta^-$	4761	0.0	3/2+	313.69	1/2-	3.3	10	6.70	13	P
<sup>121</sup> Cd	$\beta^-$	4761	0.0	3/2+	1078.99	5/2-	1.9	6	6.59	14	P
<sup>121</sup> In	$\beta^-$	3362	313.6	1/2-	1101.8	3/2+	2.0	4	7.16	9	
<sup>121</sup> Te	$\epsilon$	1056	293.991	11/2-	946.991	9/2+	0.079	8	9.93	8	
<sup>121</sup> Te	$\epsilon$	1056	293.991	11/2-	1035.433	9/2+	0.078	8	9.70	10	
<sup>121</sup> Te	$\epsilon$	1056	293.991	11/2-	1144.66	9/2+	0.00148	22	11.01	15	
<sup>123</sup> Sn	$\beta^-$	1408.2	0.0	11/2-	1030.23	9/2+	0.031	7	10.59	10	
<sup>124</sup> Sb	$\beta^-$	2905.07	0.0	3-	602.7278	2+	23.2	3	10.280	6	
<sup>124</sup> Sb	$\beta^-$	2905.07	0.0	3-	1248.582	4+	2.57	13	10.662	22	
<sup>124</sup> Sb	$\beta^-$	2905.07	0.0	3-	1325.512	2+	4.88	5	10.3022	45	
<sup>124</sup> Sb	$\beta^-$	2905.07	0.0	3-	1957.915	4+	2.144	20	9.8196	41	
<sup>124</sup> Sb	$\beta^-$	2905.07	0.0	3-	2039.288	2+	3.994	23	9.4076	25	
<sup>124</sup> Sb	$\beta^-$	2905.07	0.0	3-	2091.680	2+	0.685	6	10.0758	38	
<sup>124</sup> Sb	$\beta^-$	2905.07	0.0	3-	2182.39	2+	0.45	5	10.075	48	
<sup>124</sup> Sb	$\beta^-$	2905.07	0.0	3-	2224.839	4+	0.091	4	10.677	19	
<sup>124</sup> Sb	$\beta^-$	2905.07	0.0	3-	2323.41	2+	0.059	6	10.629	44	
<sup>124</sup> Sb	$\beta^-$	2905.07	0.0	3-	2454.96	2+	0.0079	14	11.12	8	
<sup>124</sup> Sb	$\beta^-$	2905.07	0.0	3-	2483.277	4+	0.326	5	9.414	7	
<sup>124</sup> Sb	$\beta^-$	2905.07	0.0	3-	2521.48	2+	0.0545	16	10.054	13	
<sup>124</sup> Sb	$\beta^-$	2905.07	0.0	3-	2682.50	2+	0.022	4	9.68	8	
<sup>124</sup> Sb	$\beta^-$	2905.07	0.0	3-	2711.012	4+	0.106	4	8.812	16	
<sup>124</sup> Sb	$\beta^-$	2905.07	0.0	3-	2807.55	2+	0.00147	20	9.74	6	
<sup>124</sup> Sb	$\beta^-$	2905.07	0.0	3-	2814.56	2+	0.023	4	8.45	8	
<sup>125</sup> Sn	$\beta^-$	2361.4	0.0	11/2-	1806.70	(9/2)+	0.13	4	9.40	13	
<sup>125</sup> Sn	$\beta^-$	2361.4	0.0	11/2-	2240.73	9/2+	0.58	16	6.61	12	

**Table 12**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
$^{125}\text{Sb}$	$\beta^-$	766.7	0.0	7/2+	321.090	9/2-	7.18	8	9.374	8	
$^{129}\text{Te}$	$\beta^-$	1502.3	105.51	11/2-	729.57	(9/2)+	0.70	14	9.95	9	
$^{130}\text{Sb}$	$\beta^-$	5067	5.36	(4)+	2101.14	5-	3.1	3	7.485	43	P
$^{133}\text{Ce}$	$\beta^+/\varepsilon$	3076	37.2	9/2-	130.804	7/2+	2.7	8	7.74	13	
$^{133}\text{Ce}$	$\beta^+/\varepsilon$	3076	37.2	9/2-	495.02	7/2+	1.33	9	7.841	42	
$^{133}\text{I}$	$\beta^-$	1786	0.0	7/2+	743.752	9/2-	1.83	6	8.241	17	
$^{137}\text{Xe}$	$\beta^-$	4162.36	0.0	7/2-	455.490	5/2+	31	3	6.717	42	
$^{138}\text{Xe}$	$\beta^-$	2915	0.0	0+	412.263	1-	15.0	8	6.885	24	
$^{138}\text{Cs}$	$\beta^-$	5375	0.0	3-	1898.64	4+	13.7	7	7.900	23	
$^{138}\text{Cs}$	$\beta^-$	5375	0.0	3-	2217.92	2+	12.9	4	7.750	15	
$^{138}\text{Cs}$	$\beta^-$	5375	0.0	3-	2307.59	4+	7.3	3	7.944	19	
$^{138}\text{Cs}$	$\beta^-$	5375	0.0	3-	2639.53	2+	8.8	3	7.656	16	
$^{138}\text{Cs}$	$\beta^-$	5375	0.0	3-	2779.44	4+	1.59	8	8.304	23	
$^{138}\text{Cs}$	$\beta^-$	5375	79.9	6-	2415.2	5+	2.8	6	7.30	9	P
$^{139}\text{Cs}$	$\beta^-$	4212.8	0.0	7/2+	1283.32	(9/2)-	6.2	13	7.39	9	
$^{139}\text{Ba}$	$\beta^-$	2308.5	0.0	7/2-	165.859	5/2+	29.68	31	7.1201	46	
$^{140}\text{Cs}$	$\beta^-$	6218	0.0	1-	0.0	0+	35.9	17	7.093	21	
$^{140}\text{Cs}$	$\beta^-$	6218	0.0	1-	602.31	2+	14.9	18	7.28	5	
$^{140}\text{Cs}$	$\beta^-$	6218	0.0	1-	1510.64	2+	3.7	3	7.549	36	
$^{140}\text{Cs}$	$\beta^-$	6218	0.0	1-	1823.80	0+	1.65	11	7.770	29	
$^{140}\text{Cs}$	$\beta^-$	6218	0.0	1-	2237.21	2+	2.8	3	7.355	47	
$^{140}\text{Cs}$	$\beta^-$	6218	0.0	1-	2870.63	2+	1.03	9	7.469	38	
$^{140}\text{Ba}$	$\beta^-$	1044	0.0	0+	43.8132	1-	40	10	8.06	11	
$^{140}\text{Ba}$	$\beta^-$	1044	0.0	0+	467.5350	1-	9.6	2	7.839	23	
$^{140}\text{La}$	$\beta^-$	3762.2	0.0	3-	1596.24	2+	5.9	16	9.32	12	
$^{140}\text{La}$	$\beta^-$	3762.2	0.0	3-	2083.26	4+	20.2	9	8.351	19	
$^{140}\text{La}$	$\beta^-$	3762.2	0.0	3-	2347.89	2+	4.97	5	8.6727	46	
$^{140}\text{La}$	$\beta^-$	3762.2	0.0	3-	2480.93	4+	1.124	20	9.155	8	
$^{140}\text{La}$	$\beta^-$	3762.2	0.0	3-	2515.77	4+	5.63	5	8.4106	42	
$^{140}\text{La}$	$\beta^-$	3762.2	0.0	3-	2521.43	2+	11.05	8	8.1102	36	
$^{140}\text{La}$	$\beta^-$	3762.2	0.0	3-	2899.66	2+	0.109	7	9.537	28	
$^{140}\text{La}$	$\beta^-$	3762.2	0.0	3-	3001.12	2+	0.082	9	9.467	48	
$^{140}\text{La}$	$\beta^-$	3762.2	0.0	3-	3118.55	2+	0.0248	10	9.731	18	
$^{140}\text{La}$	$\beta^-$	3762.2	0.0	3-	3320.4	2+	0.0038	3	9.991	35	
$^{141}\text{Sm}$	$\beta^+/\varepsilon$	4589	175.9	11/2-	837.10	9/2+	3.7	4	7.04	3	P
$^{141}\text{Ce}$	$\beta^-$	583.5	0.0	7/2-	0.0	5/2+	30.0	6	7.803	8	
$^{142}\text{Ba}$	$\beta^-$	2182	0.0	0+	255.303	1-	3.5	7	6.97	9	
$^{142}\text{Ba}$	$\beta^-$	2182	0.0	0+	432.30	1-	4.3	2	6.714	23	
$^{142}\text{La}$	$\beta^-$	4509	0.0	2-	2397.92	1+	17.8	4	7.376	11	
$^{142}\text{La}$	$\beta^-$	4509	0.0	2-	2666.7	1+	3.1	2	7.899	29	
$^{142}\text{La}$	$\beta^-$	4509	0.0	2-	3675.6	1+	1.2	1	7.017	38	
$^{142}\text{La}$	$\beta^-$	4509	0.0	2-	3717.43	1+	1.0	1	7.018	45	
$^{143}\text{Gd}$	$\beta^+/\varepsilon$	6.01E3	152.6	11/2-	906.94	9/2+	1.20	40	7.05	17	P
$^{143}\text{Cs}$	$\beta^-$	6262	0.0	3/2+	534.83	5/2-	1.2	2	6.86	7	P
$^{143}\text{Cs}$	$\beta^-$	6262	0.0	3/2+	729.27	5/2-	1.6	3	6.67	8	P
$^{143}\text{Ce}$	$\beta^-$	1461.8	0.0	3/2-	57.360	5/2+	36.8	23	7.726	27	
$^{143}\text{Ce}$	$\beta^-$	1461.8	0.0	3/2-	721.927	5/2+	13.47	16	7.144	7	
$^{143}\text{Ce}$	$\beta^-$	1461.8	0.0	3/2-	740.261	(1/2)+	0.038	3	9.655	35	
$^{143}\text{Ce}$	$\beta^-$	1461.8	0.0	3/2-	1060.218	5/2+	0.214	11	8.040	23	
$^{143}\text{Pm}$	$\beta^+/\varepsilon$	1041.6	0.0	5/2+	0.0	7/2-	61.3	25	8.433	21	
$^{143}\text{Pm}$	$\varepsilon$	1041.6	0.0	5/2+	741.98	3/2-	38.7	25	7.467	32	
$^{144}\text{Ce}$	$\beta^-$	318.6	0.0	0+	80.111	1-	3.87	21	8.365	24	
$^{144}\text{Ce}$	$\beta^-$	318.6	0.0	0+	133.5172	1-	19.25	28	7.321	9	

**Table 12**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
$^{144}\text{Pm}$	$\varepsilon$	2331.9	0.0	5-	1314.662	4+	55.3	13	8.593	20	
$^{144}\text{Pm}$	$\varepsilon$	2331.9	0.0	5-	1791.433	6+	42.0	8	8.134	19	
$^{144}\text{Pm}$	$\varepsilon$	2331.9	0.0	5-	2109.964	4+	0.0043	1	11.254	24	
$^{145}\text{Cs}$	$\beta^-$	7462	0.0	3/2+	175.28	(1/2)-	7.3	11	6.05	7	P
$^{145}\text{Cs}$	$\beta^-$	7462	0.0	3/2+	198.69	(5/2)-	8.5	24	5.98	12	P
$^{145}\text{Pr}$	$\beta^-$	1806	0.0	7/2+	748.278	9/2-	1.04	2	8.093	14	
$^{145}\text{Pm}$	$\varepsilon$	164.5	0.0	5/2+	0.0	7/2-	82.5	10	7.900	22	
$^{145}\text{Pm}$	$\varepsilon$	164.5	0.0	5/2+	67.2	3/2-	7.2	4	8.322	45	
$^{145}\text{Sm}$	$\varepsilon$	616.1	0.0	7/2-	0.0	5/2+	8.6	8	8.949	41	
$^{145}\text{Eu}$	$\beta^+/\varepsilon$	2659.9	0.0	5/2+	0.0	7/2-	7.25	10	8.709	7	
$^{145}\text{Eu}$	$\beta^+/\varepsilon$	2659.9	0.0	5/2+	893.788	3/2-	43.4	40	7.483	40	
$^{145}\text{Eu}$	$\varepsilon$	2659.9	0.0	5/2+	1876.64	7/2-	1.33	7	8.257	23	
$^{145}\text{Eu}$	$\varepsilon$	2659.9	0.0	5/2+	1972.719	3/2-	0.611	26	8.475	19	
$^{145}\text{Eu}$	$\varepsilon$	2659.9	0.0	5/2+	2133.420	3/2-	0.465	16	8.345	16	
$^{145}\text{Gd}$	$\beta^+/\varepsilon$	5065	0.0	1/2+	1600.26	3/2-	1.25	12	7.321	43	
$^{145}\text{Gd}$	$\beta^+/\varepsilon$	5065	0.0	1/2+	1761.32	3/2-	1.25	10	7.243	37	
$^{146}\text{Gd}$	$\varepsilon$	1032	0.0	0+	384.80	1-	72.1	14	7.288	16	
$^{146}\text{Ba}$	$\beta^-$	4354.9	0.0	0+	439.04	1-	1.4	4	6.18	12	P
$^{146}\text{Pm}$	$\varepsilon$	1471.6	0.0	3-	453.83	2+	42.2	22	9.456	24	
$^{146}\text{Pm}$	$\varepsilon$	1471.6	0.0	3-	1043.5	4+	0.36	9	10.73	11	
$^{146}\text{Pm}$	$\beta^-$	1542.0	0.0	3-	747.24	2+	32.0	15	10.111	22	
$^{147}\text{Nd}$	$\beta^-$	895.2	0.0	5/2-	410.516	3/2+	0.64	6	8.785	41	
$^{147}\text{Nd}$	$\beta^-$	895.2	0.0	5/2-	489.245	7/2+	0.83	4	8.416	21	
$^{147}\text{Nd}$	$\beta^-$	895.2	0.0	5/2-	680.435	7/2+	0.090	6	8.491	29	
$^{147}\text{Pm}$	$\beta^-$	224.06	0.0	7/2+	121.223	5/2-	0.00569	23	10.660	18	
$^{147}\text{Eu}$	$\beta^+/\varepsilon$	1721.4	0.0	5/2+	0.0	7/2-	17.0	23	8.47	6	
$^{147}\text{Eu}$	$\beta^+/\varepsilon$	1721.4	0.0	5/2+	197.284	3/2-	25.0	11	8.194	22	
$^{147}\text{Eu}$	$\varepsilon$	1721.4	0.0	5/2+	798.731	3/2-	18.7	5	7.867	16	
$^{147}\text{Eu}$	$\varepsilon$	1721.4	0.0	5/2+	1449.113	7/2-	0.293	10	8.513	21	
$^{147}\text{Eu}$	$\varepsilon$	1721.4	0.0	5/2+	1453.220	3/2-	1.18	4	7.893	21	
$^{147}\text{Gd}$	$\beta^+/\varepsilon$	2187.7	0.0	7/2-	0.0	5/2+	0.60	20	9.01	14	
$^{147}\text{Gd}$	$\varepsilon$	2187.7	0.0	7/2-	1905.64	5/2+	1.63	10	6.650	30	
$^{148}\text{Pm}$	$\beta^-$	2470	0.0	1-	0.0	0+	55.5	11	9.165	10	
$^{148}\text{Pm}$	$\beta^-$	2470	0.0	1-	550.274	2+	9.4	3	9.498	15	
$^{148}\text{Pm}$	$\beta^-$	2470	0.0	1-	1424.46	0+	0.236	9	10.096	19	
$^{148}\text{Pm}$	$\beta^-$	2470	0.0	1-	1454.217	2+	0.093	4	10.454	21	
$^{148}\text{Pm}$	$\beta^-$	2470	0.0	1-	1664.160	2+	0.018	4	10.81	10	
$^{148}\text{Pm}$	$\beta^-$	2470	0.0	1-	1921.58	0+	0.0138	14	10.344	47	
$^{148}\text{Pm}$	$\beta^-$	2470	0.0	1-	2314.01	2+	0.0091	15	8.76	9	
$^{148}\text{Eu}$	$\beta^+/\varepsilon$	3039	0.0	5-	1733.476	4+	12.7	23	8.70	8	
$^{148}\text{Eu}$	$\beta^+/\varepsilon$	3039	0.0	5-	1894.832	4+	2.62	18	9.270	31	
$^{148}\text{Eu}$	$\beta^+/\varepsilon$	3039	0.0	5-	1905.864	6+	10.20	40	8.670	20	
$^{148}\text{Eu}$	$\varepsilon$	3039	0.0	5-	2095.593	6+	3.34	10	8.990	18	
$^{148}\text{Eu}$	$\varepsilon$	3039	0.0	5-	2111.058	4+	2.7	3	9.07	5	
$^{148}\text{Eu}$	$\varepsilon$	3039	0.0	5-	2194.052	6+	1.35	4	9.283	18	
$^{148}\text{Eu}$	$\varepsilon$	3039	0.0	5-	2228.057	4+	0.29	5	9.91	8	
$^{148}\text{Eu}$	$\varepsilon$	3039	0.0	5-	2327.426	4+	2.41	9	8.873	22	
$^{148}\text{Eu}$	$\varepsilon$	3039	0.0	5-	2490.017	4+	2.51	7	8.615	23	
$^{148}\text{Eu}$	$\varepsilon$	3039	0.0	5-	2524.390	4+	4.2	3	8.331	37	
$^{148}\text{Eu}$	$\varepsilon$	3039	0.0	5-	2673.07	4+	0.216	10	9.293	35	
$^{148}\text{Eu}$	$\varepsilon$	3039	0.0	5-	2723.517	4+	1.34	4	8.354	36	
$^{149}\text{Tb}$	$\beta^+/\varepsilon$	3638.5	0.0	1/2+	1992.49	3/2-	8.50	30	6.654	16	
$^{149}\text{Pm}$	$\beta^-$	1071.5	0.0	7/2+	277.093	5/2-	0.027	2	10.223	32	

**Table 12**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
$^{149}\text{Pm}$	$\beta^-$	1071.5	0.0	7/2+	285.948	9/2-	3.4	2	8.105	26	
$^{149}\text{Pm}$	$\beta^-$	1071.5	0.0	7/2+	558.352	5/2-	0.035	3	9.455	38	
$^{149}\text{Pm}$	$\beta^-$	1071.5	0.0	7/2+	590.883	9/2-	0.090	7	8.950	34	
$^{149}\text{Pm}$	$\beta^-$	1071.5	0.0	7/2+	785.23	5/2-	0.00037	7	10.60	8	
$^{149}\text{Eu}$	$\varepsilon$	694.6	0.0	5/2+	350.036	3/2-	5.53	6	8.059	13	
$^{149}\text{Eu}$	$\varepsilon$	694.6	0.0	5/2+	528.592	3/2-	1.308	16	7.923	28	
$^{149}\text{Eu}$	$\varepsilon$	694.6	0.0	5/2+	636.421	7/2-	0.00048	2	9.88	13	
$^{149}\text{Gd}$	$\varepsilon$	1314.1	0.0	7/2-	812.631	5/2+	0.264	22	8.770	38	
$^{149}\text{Gd}$	$\varepsilon$	1314.1	0.0	7/2-	875.939	5/2+	0.337	19	8.535	28	
$^{149}\text{Gd}$	$\varepsilon$	1314.1	0.0	7/2-	933.119	(9/2)+	0.88	5	7.983	29	
$^{149}\text{Gd}$	$\varepsilon$	1314.1	0.0	7/2-	1220.56	5/2+	0.0043	6	8.70	9	
$^{151}\text{Pm}$	$\beta^-$	1190.2	0.0	5/2+	104.833	3/2-	3.0	9	8.39	13	
$^{151}\text{Pm}$	$\beta^-$	1190.2	0.0	5/2+	208.995	(7/2)-	2.3	3	8.35	6	
$^{151}\text{Pm}$	$\beta^-$	1190.2	0.0	5/2+	490.32	(7/2)-	0.47	6	8.52	6	
$^{151}\text{Sm}$	$\beta^-$	76.6	0.0	5/2-	21.543	7/2+	0.91	6	9.190	49	
$^{151}\text{Gd}$	$\varepsilon$	464.2	0.0	7/2-	260.45	5/2+	0.16	2	9.21	6	
$^{151}\text{Gd}$	$\varepsilon$	464.2	0.0	7/2-	307.27	(5/2)+	0.028	6	9.67	10	
$^{152}\text{Ho}$	$\beta^+/\varepsilon$	6513	160	9+	3227.6	8-	1.00	30	6.03	13	P
$^{152}\text{Eu}$	$\beta^+/\varepsilon$	1874.5	0.0	3-	121.7818	2+	1.6	5	11.83	14	
$^{152}\text{Eu}$	$\beta^+/\varepsilon$	1874.5	0.0	3-	366.4795	4+	0.850	40	11.965	21	
$^{152}\text{Eu}$	$\beta^+/\varepsilon$	1874.5	0.0	3-	810.453	2+	1.175	15	11.510	6	
$^{152}\text{Eu}$	$\varepsilon$	1874.5	0.0	3-	1022.969	4+	0.233	4	12.010	8	
$^{152}\text{Eu}$	$\varepsilon$	1874.5	0.0	3-	1085.8408	2+	21.50	11	9.9750	32	
$^{152}\text{Eu}$	$\varepsilon$	1874.5	0.0	3-	1292.753	2+	0.625	8	11.231	6	
$^{152}\text{Eu}$	$\varepsilon$	1874.5	0.0	3-	1371.721	4+	0.853	17	10.959	9	
$^{152}\text{Eu}$	$\varepsilon$	1874.5	0.0	3-	1612.88	4+	0.0205	6	11.939	13	
$^{152}\text{Eu}$	$\varepsilon$	1874.5	0.0	3-	1757.001	4+	0.054	3	10.618	26	
$^{152}\text{Eu}$	$\varepsilon$	1874.5	0.0	3-	1769.130	2+	0.0816	21	10.296	15	
$^{152}\text{Eu}$	$\varepsilon$	1874.5	0.0	3-	1776.56	2+	0.0086	6	11.174	32	
$^{152}\text{Eu}$	$\beta^-$	1818.8	0.0	3-	344.2789	2+	8.25	19	12.116	10	
$^{152}\text{Eu}$	$\beta^-$	1818.8	0.0	3-	755.3960	4+	0.914	10	12.5416	49	
$^{152}\text{Eu}$	$\beta^-$	1818.8	0.0	3-	930.546	2+	0.284	6	12.767	9	
$^{152}\text{Eu}$	$\beta^-$	1818.8	0.0	3-	1109.200	2+	0.264	9	12.455	15	
$^{152}\text{Eu}$	$\beta^-$	1818.8	0.0	3-	1282.24	4+	0.0232	12	13.095	23	
$^{152}\text{Eu}$	$\beta^-$	1818.8	0.0	3-	1318.456	2+	0.0189	10	13.081	23	
$^{152}\text{Eu}$	$\beta^-$	1818.8	0.0	3-	1550.17	4+	0.0456	22	11.816	21	
$^{152}\text{Eu}$	$\beta^-$	1818.8	0.0	3-	1605.596	2+	0.1068	22	11.128	10	
$^{153}\text{Sm}$	$\beta^-$	807.4	0.0	3/2+	97.43099	5/2-	0.58	6	8.682	45	
$^{153}\text{Gd}$	$\varepsilon$	484.5	0.0	3/2-	172.85318	5/2+	16.0	5	7.939	15	
$^{153}\text{Tb}$	$\beta^+/\varepsilon$	1569.3	0.0	5/2+	361.480	3/2-	0.30	7	8.96	10	
$^{153}\text{Tb}$	$\varepsilon$	1569.3	0.0	5/2+	636.503	7/2-	0.43	3	8.570	31	
$^{153}\text{Tb}$	$\varepsilon$	1569.3	0.0	5/2+	857.611	3/2-	1.14	9	7.899	35	
$^{154}\text{Eu}$	$\varepsilon$	717.2	0.0	3-	266.67	4+	0.0051	13	12.88	11	
$^{154}\text{Eu}$	$\beta^-$	1968.0	0.0	3-	123.071	2+	10.0	12	12.21	5	
$^{154}\text{Eu}$	$\beta^-$	1968.0	0.0	3-	371.000	4+	0.19	5	13.69	11	
$^{154}\text{Eu}$	$\beta^-$	1968.0	0.0	3-	1047.584	4+	0.131	4	12.961	13	
$^{154}\text{Eu}$	$\beta^-$	1968.0	0.0	3-	1263.778	4+	0.728	8	11.806	5	
$^{154}\text{Eu}$	$\beta^-$	1968.0	0.0	3-	1418.146	2+	0.106	3	12.274	12	
$^{154}\text{Eu}$	$\beta^-$	1968.0	0.0	3-	1531.284	2+	0.320	10	11.459	14	
$^{154}\text{Eu}$	$\beta^-$	1968.0	0.0	3-	1645.85	4+	0.172	4	11.296	11	
$^{155}\text{Sm}$	$\beta^-$	1627.1	0.0	3/2-	307.32	5/2+	1.91	11	7.040	25	
$^{155}\text{Eu}$	$\beta^-$	252.0	0.0	5/2+	0.0	3/2-	17.7	11	8.684	27	
$^{155}\text{Eu}$	$\beta^-$	252.0	0.0	5/2+	146.0698	7/2-	0.72	7	8.901	44	

**Table 12**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
$^{155}\text{Tb}$	$\varepsilon$	820	0.0	3/2+	59.9994	5/2-	5.2	5	7.657	44	
$^{155}\text{Tb}$	$\varepsilon$	820	0.0	3/2+	321.293	5/2-	0.305	22	8.495	38	
$^{155}\text{Tb}$	$\varepsilon$	820	0.0	3/2+	451.572	1/2-	0.020	3	9.39	7	
$^{155}\text{Tb}$	$\varepsilon$	820	0.0	3/2+	454.459	5/2-	0.104	9	8.662	48	
$^{155}\text{Tb}$	$\varepsilon$	820	0.0	3/2+	559.319	1/2-	0.139	11	8.20	6	
$^{155}\text{Tb}$	$\varepsilon$	820	0.0	3/2+	647.770	5/2-	0.054	5	8.16	8	
$^{155}\text{Tb}$	$\varepsilon$	820	0.0	3/2+	658.96	5/2-	0.0039	4	9.22	9	
$^{155}\text{Dy}$	$\beta+\varepsilon$	2094.5	0.0	3/2-	65.4609	5/2+	1.10	20	8.16	8	
$^{156}\text{Er}$	$\varepsilon$	1327	0.0	0+	215.74	1-	2.6	5	5.81	10	
$^{156}\text{Pm}$	$\beta-$	5194	0.0	4+	1515.04	5-	23.0	15	6.032	30	P
$^{156}\text{Eu}$	$\beta-$	2452.5	0.0	0+	1242.47	1-	5.3	5	9.472	41	
$^{156}\text{Eu}$	$\beta-$	2452.5	0.0	0+	1366.45	1-	2.1	2	9.701	42	
$^{156}\text{Eu}$	$\beta-$	2452.5	0.0	0+	1946.46	1-	0.39	4	9.270	46	
$^{156}\text{Eu}$	$\beta-$	2452.5	0.0	0+	1962	1-	0.059	13	10.05	10	
$^{156}\text{Eu}$	$\beta-$	2452.5	0.0	0+	2205.47	1-	2.2	2	7.503	44	
$^{156}\text{Eu}$	$\beta-$	2452.5	0.0	0+	2259.95	1-	0.052	5	8.788	48	
$^{156}\text{Eu}$	$\beta-$	2452.5	0.0	0+	2293.44	1-	0.90	7	7.291	45	
$^{156}\text{Eu}$	$\beta-$	2452.5	0.0	0+	2344.4	1-	0.010	2	8.73	10	
$^{157}\text{Tb}$	$\varepsilon$	60.05	0.0	3/2+	54.54	5/2-	0.11	1	7.10	9	
$^{158}\text{Tb}$	$\varepsilon$	1219.1	0.0	3-	261.4572	4+	3.25	6	12.164	28	
$^{158}\text{Tb}$	$\varepsilon$	1219.1	0.0	3-	1187.145	2+	3.92	17	8.166	49	
$^{158}\text{Tb}$	$\beta-$	936.3	0.0	3-	98.9180	2+	15.5	8	12.108	35	
$^{158}\text{Tb}$	$\beta-$	936.3	0.0	3-	317.139	4+	1.1	1	12.800	48	
$^{159}\text{Gd}$	$\beta-$	970.7	0.0	3/2-	57.9963	5/2+	28.8	10	7.017	15	
$^{159}\text{Dy}$	$\varepsilon$	364.73	0.0	3/2-	57.998	5/2+	26.6	14	7.546	23	
$^{159}\text{Dy}$	$\varepsilon$	364.73	0.0	3/2-	348.289	5/2+	0.0012	1	8.253	40	
$^{159}\text{Er}$	$\beta+\varepsilon$	2768.5	0.0	3/2-	671.26	5/2+	1.7	5	6.85	13	
$^{160}\text{Tb}$	$\beta-$	1836.0	0.0	3-	283.8220	4+	0.15	5	12.15	14	
$^{160}\text{Tb}$	$\beta-$	1836.0	0.0	3-	966.1686	2+	28.1	6	8.949	10	
$^{160}\text{Tb}$	$\beta-$	1836.0	0.0	3-	1155.812	4+	0.214	6	10.692	12	
$^{161}\text{Tb}$	$\beta-$	593.7	0.0	3/2+	131.7585	5/2-	25.7	16	7.023	27	
$^{161}\text{Tb}$	$\beta-$	593.7	0.0	3/2+	366.968	1/2-	0.065	5	8.620	34	
$^{161}\text{Tb}$	$\beta-$	593.7	0.0	3/2+	451.455	5/2-	0.0100	11	8.801	49	
$^{162}\text{Tm}$	$\beta+\varepsilon$	4857	0.0	1-	102.04	2+	4.1	10	7.43	11	P
$^{163}\text{Tb}$	$\beta-$	1785.1	0.0	3/2+	475.34	(5/2)-	3.9	6	6.73	7	
$^{163}\text{Tm}$	$\beta+\varepsilon$	2439.0	0.0	1/2+	404.00	3/2-	1.90	30	7.29	7	
$^{163}\text{Tm}$	$\beta+\varepsilon$	2439.0	0.0	1/2+	717.39	3/2-	1.42	7	7.255	22	
$^{163}\text{Tm}$	$\varepsilon$	2439.0	0.0	1/2+	2052.50	3/2-	1.15	7	5.953	28	
$^{165}\text{Dy}$	$\beta-$	1285.7	0.0	7/2+	94.700	9/2-	15	2	6.87	6	
$^{165}\text{Tm}$	$\beta+\varepsilon$	1591.3	0.0	1/2+	356.530	3/2-	12.2	7	7.238	25	
$^{165}\text{Tm}$	$\varepsilon$	1591.3	0.0	1/2+	608.498	3/2-	1.50	8	7.941	23	
$^{165}\text{Tm}$	$\varepsilon$	1591.3	0.0	1/2+	962.415	3/2-	0.9	1	7.749	48	
$^{165}\text{Tm}$	$\varepsilon$	1591.3	0.0	1/2+	1289.092	3/2-	0.39	2	7.395	23	
$^{165}\text{Tm}$	$\varepsilon$	1591.3	0.0	1/2+	1416.90	3/2-	0.12	2	7.30	7	
$^{166}\text{Dy}$	$\beta-$	485.9	0.0	0+	82.4695	1-	97	6	5.967	27	
$^{166}\text{Dy}$	$\beta-$	485.9	0.0	0+	373.13	(1)-	0.016	5	8.00	14	
$^{166}\text{Ho}$	$\beta-$	1853.8	5.969	7-	545.451	6+	3.3	3	14.334	40	
$^{166}\text{Ho}$	$\beta-$	1853.8	5.969	7-	911.204	8+	1.16	7	14.270	26	
$^{166}\text{Ho}$	$\beta-$	1853.8	5.969	7-	1215.963	6+	2.27	18	13.389	35	
$^{166}\text{Ho}$	$\beta-$	1853.8	5.969	7-	1555.739	8+	0.385	6	13.080	8	
$^{167}\text{Tm}$	$\varepsilon$	746.1	0.0	1/2+	264.873	3/2-	29	7	6.85	10	
$^{168}\text{Ho}$	$\beta-$	2930	0.0	3+	1093.93	4-	1.5	5	6.93	15	
$^{168}\text{Tm}$	$\varepsilon$	1676.9	0.0	3+	1094.0449	4-	46.6	14	7.834	14	



**Table 12**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
$^{168}\text{Tm}$	$\varepsilon$	1676.9	0.0	3+	1403.718	(2)-	0.0234	13	10.382	25	
$^{168}\text{Tm}$	$\varepsilon$	1676.9	0.0	3+	1569.452	(2)-	0.591	8	7.849	25	
$^{168}\text{Tm}$	$\varepsilon$	1676.9	0.0	3+	1615.339	4-	0.70	4	6.891	48	
$^{169}\text{Er}$	$\beta^-$	353.5	0.0	1/2-	8.41017	3/2+	45	5	6.570	48	
$^{169}\text{Yb}$	$\varepsilon$	899.1	0.0	7/2+	345.028	5/2-	0.0139	11	10.881	34	
$^{169}\text{Yb}$	$\varepsilon$	899.1	0.0	7/2+	430.121	(9/2)-	0.00440	15	11.220	15	
$^{169}\text{Yb}$	$\varepsilon$	899.1	0.0	7/2+	472.88128	9/2-	12.27	16	7.681	6	
$^{169}\text{Lu}$	$\beta^+/\varepsilon$	2293.0	0.0	7/2+	389.523	9/2-	0.79	20	8.94	11	
$^{169}\text{Lu}$	$\beta^+/\varepsilon$	2293.0	0.0	7/2+	569.837	5/2-	1.01	8	8.743	35	
$^{169}\text{Lu}$	$\beta^+/\varepsilon$	2293.0	0.0	7/2+	748.923	(9/2)-	0.67	10	8.82	7	
$^{169}\text{Lu}$	$\beta^+/\varepsilon$	2293.0	0.0	7/2+	911.38	(5/2)-	0.145	17	9.38	5	
$^{169}\text{Lu}$	$\beta^+/\varepsilon$	2293.0	0.0	7/2+	1078.335	9/2-	3.14	10	7.933	15	
$^{169}\text{Lu}$	$\varepsilon$	2293.0	0.0	7/2+	1406.35	9/2-	0.69	9	8.30	6	
$^{169}\text{Lu}$	$\varepsilon$	2293.0	0.0	7/2+	1540.69	9/2-	0.69	9	8.15	6	
$^{169}\text{Lu}$	$\varepsilon$	2293.0	0.0	7/2+	1554.876	9/2-	1.63	15	7.759	41	
$^{169}\text{Lu}$	$\varepsilon$	2293.0	0.0	7/2+	1972.35	9/2-	0.41	6	7.55	7	
$^{170}\text{Tm}$	$\varepsilon$	312.2	0.0	1-	0.0	0+	0.102	8	10.022	35	
$^{170}\text{Tm}$	$\varepsilon$	312.2	0.0	1-	78.7	2+	0.029	3	10.262	46	
$^{170}\text{Tm}$	$\beta^-$	968.6	0.0	1-	0.0	0+	81.9	5	8.9926	31	
$^{170}\text{Tm}$	$\beta^-$	968.6	0.0	1-	84.25476	2+	18.1	5	9.507	12	
$^{170}\text{Lu}$	$\beta^+/\varepsilon$	3458	0.0	0+	1364.53	1-	0.90	30	9.13	15	
$^{170}\text{Lu}$	$\beta^+/\varepsilon$	3458	0.0	0+	1512.37	1-	0.59	18	9.24	13	
$^{170}\text{Lu}$	$\beta^+/\varepsilon$	3458	0.0	0+	2126.14	1-	10.4	5	7.647	27	
$^{170}\text{Lu}$	$\beta^+/\varepsilon$	3458	0.0	0+	2275.49	1-	1.88	12	8.282	34	
$^{170}\text{Lu}$	$\beta^+/\varepsilon$	3458	0.0	0+	2364.06	1-	14.9	7	7.312	29	
$^{170}\text{Lu}$	$\beta^+/\varepsilon$	3458	0.0	0+	2367.65	(1)-	5.16	25	7.769	30	
$^{170}\text{Lu}$	$\varepsilon$	3458	0.0	0+	2496.20	1-	1.77	11	8.119	35	
$^{170}\text{Lu}$	$\varepsilon$	3458	0.0	0+	2536.97	1-	0.39	4	8.74	5	
$^{170}\text{Lu}$	$\varepsilon$	3458	0.0	0+	2748.08	1-	4.73	22	7.411	35	
$^{170}\text{Lu}$	$\varepsilon$	3458	0.0	0+	2775.66	1-	2.81	15	7.600	38	
$^{170}\text{Lu}$	$\varepsilon$	3458	0.0	0+	2929.60	1-	3.68	20	7.239	44	
$^{170}\text{Lu}$	$\varepsilon$	3458	0.0	0+	2939.73	1-	7.3	4	6.923	45	
$^{170}\text{Lu}$	$\varepsilon$	3458	0.0	0+	2947.84	1-	3.35	15	7.246	43	
$^{170}\text{Lu}$	$\varepsilon$	3458	0.0	0+	2969.45	1-	0.62	4	7.937	49	
$^{170}\text{Lu}$	$\varepsilon$	3458	0.0	0+	2975.32	1-	0.70	6	7.87	6	
$^{170}\text{Lu}$	$\varepsilon$	3458	0.0	0+	3007.6	1-	0.26	7	8.24	12	
$^{170}\text{Lu}$	$\varepsilon$	3458	0.0	0+	3067.62	1-	0.61	5	7.72	6	
$^{170}\text{Lu}$	$\varepsilon$	3458	0.0	0+	3115.58	1-	2.11	13	7.05	6	
$^{170}\text{Lu}$	$\varepsilon$	3458	0.0	0+	3123.94	1-	0.29	7	7.89	12	
$^{170}\text{Lu}$	$\varepsilon$	3458	0.0	0+	3149.09	1-	0.60	5	7.49	7	
$^{170}\text{Lu}$	$\varepsilon$	3458	0.0	0+	3165.59	1-	1.13	6	7.16	7	
$^{170}\text{Lu}$	$\varepsilon$	3458	0.0	0+	3179.76	1-	0.50	4	7.46	8	
$^{170}\text{Lu}$	$\varepsilon$	3458	0.0	0+	3195.58	1-	0.52	5	7.38	9	
$^{170}\text{Lu}$	$\varepsilon$	3458	0.0	0+	3213.27	1-	0.27	8	7.59	15	
$^{170}\text{Lu}$	$\varepsilon$	3458	0.0	0+	3274.17	1-	0.22	4	7.35	15	
$^{170}\text{Lu}$	$\varepsilon$	3458	0.0	0+	3384.87	1-	0.097	19	6.4	5	
$^{170}\text{Hf}$	$\varepsilon$	1052	0.0	0+	164.71	1-	2.7	9	7.42	15	
$^{170}\text{Hf}$	$\varepsilon$	1052	0.0	0+	244.81	1-	1.0	3	7.76	14	
$^{170}\text{Hf}$	$\varepsilon$	1052	0.0	0+	470.24	1-	3.0	9	6.97	14	
$^{171}\text{Tm}$	$\beta^-$	96.5	0.0	1/2+	66.731	3/2-	1.96	14	6.55	6	
$^{171}\text{Lu}$	$\beta^+/\varepsilon$	1478.4	0.0	7/2+	317.310	9/2-	1.88	9	8.879	22	
$^{171}\text{Lu}$	$\varepsilon$	1478.4	0.0	7/2+	944.35	5/2-	0.070	4	9.584	26	
$^{171}\text{Lu}$	$\varepsilon$	1478.4	0.0	7/2+	948.371	9/2-	9.88	15	7.427	11	

**Table 12**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
<sup>171</sup> Lu	$\varepsilon$	1478.4	0.0	7/2+	1080.971	5/2-	0.158	10	8.941	29	
<sup>172</sup> Er	$\beta^-$	891.0	0.0	0+	407.338	(1)-	4.2	14	7.42	15	
<sup>172</sup> Er	$\beta^-$	891.0	0.0	0+	535.140	(1)-	46.6	24	5.937	29	
<sup>172</sup> Tm	$\beta^-$	1882	0.0	2-	1172.322	3+	6.5	7	7.932	48	
<sup>172</sup> Tm	$\beta^-$	1882	0.0	2-	1549.06	3+	2.39	22	7.269	45	
<sup>172</sup> Tm	$\beta^-$	1882	0.0	2-	1662.740	3+	1.29	12	6.96	5	
<sup>172</sup> Tm	$\beta^-$	1882	0.0	2-	1700.57	3+	0.229	22	7.45	6	
<sup>172</sup> Lu	$\beta^+/\varepsilon$	2519.4	0.0	4-	1172.386	3+	6.7	17	8.37	11	
<sup>172</sup> Lu	$\varepsilon$	2519.4	0.0	4-	1662.815	3+	3.72	11	8.213	15	
<sup>172</sup> Lu	$\varepsilon$	2519.4	0.0	4-	1700.651	3+	3.01	13	8.263	20	
<sup>172</sup> Lu	$\varepsilon$	2519.4	0.0	4-	1927.022	5+	0.54	5	8.705	41	
<sup>172</sup> Lu	$\varepsilon$	2519.4	0.0	4-	2175.103	3+	2.29	14	7.545	29	
<sup>172</sup> Lu	$\varepsilon$	2519.4	0.0	4-	2192.154	5+	5.86	13	7.085	16	
<sup>173</sup> Lu	$\varepsilon$	670.2	0.0	7/2+	179.364	9/2-	20.9	7	8.810	17	
<sup>173</sup> Hf	$\beta^+/\varepsilon$	1469	0.0	1/2-	434.914	3/2+	21.3	6	6.828	29	
<sup>174</sup> Lu	$\beta^+/\varepsilon$	1374.2	0.0	1-	0.0	0+	38.3	30	9.888	35	
<sup>174</sup> Lu	$\beta^+/\varepsilon$	1374.2	0.0	1-	76.468	2+	57	5	9.664	39	
<sup>175</sup> Tm	$\beta^-$	2.38E3	0.0	1/2+	992.0	3/2-	5.5	4	6.65	7	
<sup>175</sup> Yb	$\beta^-$	470.1	0.0	7/2-	113.806	9/2+	6.7	4	7.139	26	
<sup>175</sup> Ta	$\beta^+/\varepsilon$	2073	0.0	7/2+	185.92	9/2-	8.2	20	7.48	11	
<sup>175</sup> Ta	$\beta^+/\varepsilon$	2073	0.0	7/2+	474.97	9/2-	5.90	40	7.468	35	
<sup>176</sup> Lu	$\beta^-$	1193.03	0.0	7-	596.82	6+	99.61	4	19.2403	27	
<sup>176</sup> Lu	$\beta^-$	1193.03	0.0	7-	997.73	8+	0.39	4	20.076	45	
<sup>176</sup> Lu	$\beta^-$	1193.03	123.0	1-	0.0	0+	39	2	6.921	22	
<sup>176</sup> Lu	$\beta^-$	1193.03	123.0	1-	88.361	2+	61	2	6.615	15	
<sup>176</sup> Ta	$\beta^+/\varepsilon$	3211	0.0	(1)-	1912.02	(2)+	8.0	10	7.03	6	
<sup>176</sup> Ta	$\varepsilon$	3211	0.0	(1)-	2817.55	(2)+	2.0	3	6.51	11	
<sup>177</sup> Yb	$\beta^-$	1397.5	0.0	9/2+	289.0142	11/2-	1.86	21	7.662	49	
<sup>177</sup> Lu	$\beta^-$	496.8	0.0	7/2+	112.9498	9/2-	8.89	24	7.347	12	
<sup>177</sup> Ta	$\beta^+/\varepsilon$	1166.0	0.0	7/2+	112.9498	9/2-	35	11	7.04	14	
<sup>177</sup> W	$\beta^+/\varepsilon$	2013	0.0	1/2-	497.44	3/2+	4.9	11	6.86	10	
<sup>177</sup> W	$\varepsilon$	2013	0.0	1/2-	1476.58	(3/2)+	9.5	5	5.60	6	
<sup>179</sup> Lu	$\beta^-$	1404	0.0	7/2+	337.70	9/2-	1.9	6	7.99	14	
<sup>179</sup> Re	$\beta^+/\varepsilon$	2711	0.0	5/2+	531.41	7/2-	1.70	40	6.86	10	
<sup>181</sup> W	$\varepsilon$	205.1	0.0	9/2+	158.56	11/2-	0.0185	10	8.45	5	
<sup>181</sup> Re	$\beta^+/\varepsilon$	1717	0.0	5/2+	409.21	7/2-	4.9	12	7.71	11	
<sup>181</sup> Re	$\beta^+/\varepsilon$	1717	0.0	5/2+	475.65	7/2-	10.3	25	7.34	11	
<sup>181</sup> Re	$\beta^+/\varepsilon$	1717	0.0	5/2+	661.75	7/2-	2.2	7	7.86	14	
<sup>181</sup> Re	$\varepsilon$	1717	0.0	5/2+	726.28	3/2-	16	5	6.94	14	
<sup>182</sup> Ta	$\beta^-$	1815.5	0.0	3-	100.10598	2+	0.058	6	13.102	45	
<sup>182</sup> Ta	$\beta^-$	1815.5	0.0	3-	329.4268	4+	0.096	10	12.647	45	
<sup>182</sup> Ta	$\beta^-$	1815.5	0.0	3-	1221.4001	2+	3.2	5	9.71	7	
<sup>182</sup> Ta	$\beta^-$	1815.5	0.0	3-	1442.836	4+	0.565	8	9.789	8	
<sup>182</sup> Ta	$\beta^-$	1815.5	0.0	3-	1510.25	4+	0.142	4	10.109	14	
<sup>182</sup> Re	$\varepsilon$	2.80E3	0.0	7+	1829.53	6-	14	4	7.49	16	
<sup>182</sup> Re	$\varepsilon$	2.80E3	0.0	7+	1960.79	6-	2.8	6	8.06	15	
<sup>182</sup> Re	$\varepsilon$	2.80E3	0.0	7+	2114.43	(8)-	1.03	19	8.30	17	
<sup>182</sup> Re	$\varepsilon$	2.80E3	0.0	7+	2204.56	(8)-	4.5	3	7.53	18	
<sup>183</sup> Ta	$\beta^-$	1072.1	0.0	7/2+	595.339	9/2-	0.94	11	8.57	5	
<sup>183</sup> Re	$\varepsilon$	556	0.0	5/2+	208.8114	3/2-	69	7	7.22	5	
<sup>183</sup> Re	$\varepsilon$	556	0.0	5/2+	412.1017	7/2-	0.59	14	8.25	13	
<sup>183</sup> Re	$\varepsilon$	556	0.0	5/2+	453.0779	7/2-	4.7	5	6.85	15	
<sup>183</sup> Os	$\beta^+/\varepsilon$	2.15E3	0.0	9/2+	664.09	11/2-	17.80	40	7.115	38	

**Table 12**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
$^{183}\text{Os}$	$\beta+\varepsilon$	2.15E3	170.70	1/2-	1034.73	(3/2)+	2.6	5	7.70	9	
$^{183}\text{Os}$	$\beta+\varepsilon$	2.15E3	170.70	1/2-	1107.89	(3/2)+	18.6	6	6.792	45	
$^{183}\text{Ir}$	$\beta+\varepsilon$	3.46E3	0.0	5/2-	896.76	7/2+	1.10	30	7.75	13	P
$^{183}\text{Ir}$	$\beta+\varepsilon$	3.46E3	0.0	5/2-	1977.95	(3/2)+	2.20	40	6.93	10	P
$^{184}\text{Ir}$	$\beta+\varepsilon$	4642	0.0	5-	774.17	6+	8.1	22	7.88	12	P
$^{184}\text{Ir}$	$\beta+\varepsilon$	4642	0.0	5-	1225.04	4+	5.6	5	7.873	40	P
$^{184}\text{Ir}$	$\beta+\varepsilon$	4642	0.0	5-	1500.63	4+	1.95	17	8.229	39	P
$^{184}\text{Ir}$	$\beta+\varepsilon$	4642	0.0	5-	1613.18	6+	2.20	19	8.134	39	P
$^{184}\text{Ir}$	$\beta+\varepsilon$	4642	0.0	5-	1877.61	6+	1.82	15	8.115	38	P
$^{184}\text{Pt}$	$\beta+\varepsilon$	2278	0.0	0+	499.93	1-	2.5	6	6.55	11	
$^{185}\text{W}$	$\beta-$	431.2	0.0	3/2-	0.0	5/2+	99.928	3	7.5890	29	
$^{185}\text{Os}$	$\varepsilon$	1013.14	0.0	1/2-	717.432	3/2+	5.0	4	8.342	35	
$^{185}\text{Os}$	$\varepsilon$	1013.14	0.0	1/2-	874.815	3/2+	6.4	3	7.306	21	
$^{185}\text{Os}$	$\varepsilon$	1013.14	0.0	1/2-	931.06	(3/2)+	0.049	2	8.604	20	
$^{186}\text{Re}$	$\varepsilon$	581.3	0.0	1-	0.0	0+	5.83	10	7.533	9	
$^{186}\text{Re}$	$\varepsilon$	581.3	0.0	1-	122.64	2+	1.67	1	7.844	5	
$^{186}\text{Re}$	$\beta-$	1072.7	0.0	1-	0.0	0+	70.93	17	7.8160	16	
$^{186}\text{Re}$	$\beta-$	1072.7	0.0	1-	137.15	2+	21.48	7	8.1226	19	
$^{186}\text{Re}$	$\beta-$	1072.7	0.0	1-	767.47	2+	0.0628	7	9.024	6	
$^{186}\text{Au}$	$\beta+\varepsilon$	6150	0.0	3-	191.53	2+	25	7	6.89	12	P
$^{186}\text{Au}$	$\beta+\varepsilon$	6150	0.0	3-	490.34	4+	14.6	18	7.03	6	P
$^{186}\text{Au}$	$\beta+\varepsilon$	6150	0.0	3-	607.15	2+	8.4	16	7.23	9	P
$^{186}\text{Au}$	$\beta+\varepsilon$	6150	0.0	3-	798.49	2+	5.3	9	7.37	8	P
$^{186}\text{Au}$	$\beta+\varepsilon$	6150	0.0	3-	991.51	4+	3.9	5	7.44	6	P
$^{186}\text{Au}$	$\beta+\varepsilon$	6150	0.0	3-	1176.03	2+	1.88	20	7.70	5	P
$^{186}\text{Au}$	$\beta+\varepsilon$	6150	0.0	3-	1222.59	4+	3.20	30	7.453	46	P
$^{186}\text{Au}$	$\beta+\varepsilon$	6150	0.0	3-	2159.6	4+	1.18	12	7.569	49	P
$^{186}\text{Hg}$	$\beta+\varepsilon$	3176	0.0	0+	113.94	1-	3.0	7	5.98	11	P
$^{186}\text{Hg}$	$\beta+\varepsilon$	3176	0.0	0+	189.74	1-	2.30	30	6.06	7	P
$^{187}\text{W}$	$\beta-$	1312.5	0.0	3/2-	0.0	5/2+	11.6	24	8.32	9	
$^{187}\text{Ir}$	$\beta+\varepsilon$	1670	0.0	3/2+	187.42	5/2-	5.50	40	7.567	39	
$^{187}\text{Ir}$	$\varepsilon$	1670	0.0	3/2+	586.31	5/2-	3.33	14	7.498	34	
$^{187}\text{Ir}$	$\varepsilon$	1670	0.0	3/2+	711.29	5/2-	4.58	16	7.246	35	
$^{187}\text{Pt}$	$\beta+\varepsilon$	2864	0.0	3/2-	106.480	1/2+	11.6	13	7.22	5	
$^{187}\text{Pt}$	$\beta+\varepsilon$	2864	0.0	3/2-	110.075	5/2+	15.7	18	7.09	5	
$^{187}\text{Pt}$	$\beta+\varepsilon$	2864	0.0	3/2-	311.66	5/2+	14.4	15	7.047	48	
$^{188}\text{W}$	$\beta-$	349.0	0.0	0+	0.0	1-	98.98	9	7.261	12	
$^{188}\text{W}$	$\beta-$	349.0	0.0	0+	290.6796	1-	0.89	5	6.89	8	
$^{188}\text{Re}$	$\beta-$	2120.42	0.0	1-	0.0	0+	70.7	6	8.2062	37	
$^{188}\text{Re}$	$\beta-$	2120.42	0.0	1-	155.044	2+	25.8	5	8.516	8	
$^{188}\text{Re}$	$\beta-$	2120.42	0.0	1-	633.045	2+	1.85	13	9.200	31	
$^{188}\text{Ir}$	$\beta+\varepsilon$	2792	0.0	1-	0.0	0+	0.64	6	9.708	41	
$^{188}\text{Ir}$	$\beta+\varepsilon$	2792	0.0	1-	155.031	2+	3.00	40	8.98	6	
$^{188}\text{Ir}$	$\beta+\varepsilon$	2792	0.0	1-	633.033	2+	5.4	6	8.521	49	
$^{188}\text{Ir}$	$\beta+\varepsilon$	2792	0.0	1-	1304.84	2+	0.45	12	9.25	12	
$^{188}\text{Ir}$	$\beta+\varepsilon$	2792	0.0	1-	1457.39	2+	2.80	30	8.361	48	
$^{188}\text{Ir}$	$\beta+\varepsilon$	2792	0.0	1-	1478.08	0+	0.32	5	9.29	7	
$^{188}\text{Ir}$	$\beta+\varepsilon$	2792	0.0	1-	1620.47	2+	2.70	25	8.258	42	
$^{188}\text{Ir}$	$\beta+\varepsilon$	2792	0.0	1-	1729.50	2+	4.80	40	7.918	38	
$^{188}\text{Ir}$	$\varepsilon$	2792	0.0	1-	1807.59	2+	3.2	3	8.024	42	
$^{188}\text{Ir}$	$\varepsilon$	2792	0.0	1-	1842.85	(2)+	8.2	8	7.581	44	
$^{188}\text{Ir}$	$\varepsilon$	2792	0.0	1-	1965.00	(2)+	0.71	7	8.515	45	
$^{188}\text{Ir}$	$\varepsilon$	2792	0.0	1-	2068.55	(2)+	1.61	16	8.034	46	

**Table 12**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
$^{188}\text{Ir}$	$\varepsilon$	2792	0.0	1-	2166.02	(2)+	0.93	9	8.134	45	
$^{188}\text{Ir}$	$\varepsilon$	2792	0.0	1-	2204.72	2+	5.4	5	7.308	44	
$^{188}\text{Ir}$	$\varepsilon$	2792	0.0	1-	2251.94	2+	7.0	9	7.11	6	
$^{188}\text{Hg}$	$\beta+\varepsilon$	2173	0.0	0+	114.2	(1)-	2.50	30	6.03	6	
$^{188}\text{Hg}$	$\beta+\varepsilon$	2173	0.0	0+	304.9	(1)-	7.20	40	5.475	32	
$^{189}\text{Re}$	$\beta-$	1008	0.0	5/2+	0.0	3/2-	62	7	7.21	5	
$^{189}\text{Re}$	$\beta-$	1008	0.0	5/2+	216.68	7/2-	13	2	7.52	7	
$^{189}\text{Re}$	$\beta-$	1008	0.0	5/2+	219.399	7/2-	7.4	13	7.76	8	
$^{189}\text{Re}$	$\beta-$	1008	0.0	5/2+	549.89	3/2-	0.24	5	8.45	9	
$^{189}\text{Re}$	$\beta-$	1008	0.0	5/2+	599.57	3/2-	1.3	2	7.55	7	
$^{189}\text{Ir}$	$\varepsilon$	537	0.0	3/2+	69.512	5/2-	35	5	7.15	7	
$^{189}\text{Ir}$	$\varepsilon$	537	0.0	3/2+	233.53	5/2-	1.09	12	8.21	7	
$^{189}\text{Ir}$	$\varepsilon$	537	0.0	3/2+	275.84	5/2-	10.1	11	7.08	8	
$^{189}\text{Pt}$	$\beta+\varepsilon$	1980	0.0	3/2-	317.68	5/2+	15.0	40	7.29	12	
$^{190}\text{Ir}$	$\varepsilon$	1954.2	0.0	4-	1446.02	(5)+	1.1	1	8.690	40	
$^{191}\text{Pt}$	$\varepsilon$	1010.5	0.0	3/2-	82.405	1/2+	25	7	7.32	12	
$^{191}\text{Pt}$	$\varepsilon$	1010.5	0.0	3/2-	351.139	(5/2)+	12.7	17	7.29	6	
$^{191}\text{Pt}$	$\varepsilon$	1010.5	0.0	3/2-	747.78	(5/2)+	0.30	5	7.97	7	
$^{192}\text{Ir}$	$\beta-$	1452.9	0.0	4+	1378.03	3-	0.1026	17	8.261	43	
$^{192}\text{Au}$	$\beta+\varepsilon$	3516	0.0	1-	316.50645	2+	11.3	16	7.75	6	
$^{192}\text{Au}$	$\beta+\varepsilon$	3516	0.0	1-	612.46318	2+	3.9	7	8.10	8	
$^{192}\text{Au}$	$\beta+\varepsilon$	3516	0.0	1-	2047.89	(2)+	1.11	14	7.99	6	
$^{192}\text{Au}$	$\beta+\varepsilon$	3516	0.0	1-	2171.37	2+	2.40	40	7.58	7	
$^{192}\text{Au}$	$\beta+\varepsilon$	3516	0.0	1-	2237.52	(2)+	8.0	10	7.01	6	
$^{193}\text{Os}$	$\beta-$	1141.9	0.0	3/2-	73.037	1/2+	17	3	7.98	8	
$^{193}\text{Os}$	$\beta-$	1141.9	0.0	3/2-	138.946	5/2+	10.6	2	8.084	9	
$^{193}\text{Os}$	$\beta-$	1141.9	0.0	3/2-	361.858	5/2+	0.72	2	8.868	13	
$^{193}\text{Os}$	$\beta-$	1141.9	0.0	3/2-	557.396	(1/2)+	2.33	4	7.929	10	
$^{193}\text{Os}$	$\beta-$	1141.9	0.0	3/2-	559.293	5/2+	0.72	1	8.434	9	
$^{193}\text{Os}$	$\beta-$	1141.9	0.0	3/2-	695.142	5/2+	0.095	3	8.930	16	
$^{193}\text{Os}$	$\beta-$	1141.9	0.0	3/2-	848.905	5/2+	0.0079	8	9.416	45	
$^{193}\text{Os}$	$\beta-$	1141.9	0.0	3/2-	964.41	1/2+	0.0033	2	9.108	32	
$^{193}\text{Pt}$	$\varepsilon$	56.63	0.0	1/2-	0.0	3/2+	100		7.23	5	
$^{193}\text{Au}$	$\beta+\varepsilon$	1075	0.0	3/2+	14.276	5/2-	20.0	40	6.99	9	
$^{193}\text{Au}$	$\varepsilon$	1075	0.0	3/2+	232.16	(5/2)-	3.8	7	7.50	8	
$^{193}\text{Au}$	$\varepsilon$	1075	0.0	3/2+	491.24	(5/2)-	2.7	4	7.30	7	
$^{194}\text{Ir}$	$\beta-$	2228.3	0.0	1-	0.0	0+	85.4	19	8.304	10	
$^{194}\text{Ir}$	$\beta-$	2228.3	0.0	1-	328.475	2+	9.3	13	9.00	6	
$^{194}\text{Ir}$	$\beta-$	2228.3	0.0	1-	622.023	2+	1.26	17	9.59	6	
$^{194}\text{Ir}$	$\beta-$	2228.3	0.0	1-	1267.203	0+	1.78	24	8.63	6	
$^{194}\text{Au}$	$\beta+\varepsilon$	2548.2	0.0	1-	0.0	0+	23.0	20	8.083	38	
$^{194}\text{Au}$	$\beta+\varepsilon$	2548.2	0.0	1-	328.474	2+	29.1	12	7.845	18	
$^{194}\text{Au}$	$\beta+\varepsilon$	2548.2	0.0	1-	1267.198	0+	0.49	6	9.11	5	
$^{194}\text{Au}$	$\beta+\varepsilon$	2548.2	0.0	1-	1479.270	0+	1.130	40	8.581	16	
$^{194}\text{Au}$	$\beta+\varepsilon$	2548.2	0.0	1-	1512.002	2+	0.499	21	8.907	19	
$^{194}\text{Au}$	$\varepsilon$	2548.2	0.0	1-	1547.273	0+	1.36	5	8.440	16	
$^{194}\text{Au}$	$\varepsilon$	2548.2	0.0	1-	1622.197	2+	0.128	15	9.39	5	
$^{194}\text{Au}$	$\varepsilon$	2548.2	0.0	1-	1670.656	2+	2.27	8	8.094	16	
$^{194}\text{Au}$	$\varepsilon$	2548.2	0.0	1-	1778.579	2+	0.89	3	8.377	15	
$^{194}\text{Au}$	$\varepsilon$	2548.2	0.0	1-	1816.585	(2)+	0.069	9	9.44	6	
$^{194}\text{Au}$	$\varepsilon$	2548.2	0.0	1-	1893.574	0+	0.039	8	9.58	9	
$^{194}\text{Au}$	$\varepsilon$	2548.2	0.0	1-	1930.369	2+	0.470	16	8.444	16	
$^{194}\text{Au}$	$\varepsilon$	2548.2	0.0	1-	2053.016	(2)+	0.072	6	9.041	37	

**Table 12**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
<sup>194</sup> Au	$\varepsilon$	2548.2	0.0	1-	2063.739	2+	0.266	11	8.451	19	
<sup>194</sup> Au	$\varepsilon$	2548.2	0.0	1-	2085.474	0+	0.77	3	7.944	18	
<sup>194</sup> Au	$\varepsilon$	2548.2	0.0	1-	2109.088	(2)+	0.154	6	8.589	18	
<sup>194</sup> Au	$\varepsilon$	2548.2	0.0	1-	2163.745	0+	0.81	8	7.732	43	
<sup>194</sup> Au	$\varepsilon$	2548.2	0.0	1-	2311.879	2+	0.427	15	7.473	19	
<sup>194</sup> Au	$\varepsilon$	2548.2	0.0	1-	2356.065	0+	0.31	5	7.36	7	
<sup>194</sup> Au	$\varepsilon$	2548.2	0.0	1-	2397.320	2+	0.068	3	7.694	29	
<sup>194</sup> Hg	$\varepsilon$	28.0	0.0	0+	0.0	1-	100		7.41	20	
<sup>195</sup> Ir	$\beta^-$	1101.6	100	11/2-	259.28	13/2+	33	7	6.61	9	
<sup>195</sup> Ir	$\beta^-$	1101.6	100	11/2-	432.03	9/2+	7.3	12	6.96	7	
<sup>195</sup> Au	$\varepsilon$	226.8	0.0	3/2+	0.0	1/2-	9.5	4	8.147	19	
<sup>195</sup> Au	$\varepsilon$	226.8	0.0	3/2+	129.734	5/2-	32.2	15	6.404	27	
<sup>195</sup> Hg	$\beta^+/\varepsilon$	1554	0.0	1/2-	0.0	3/2+	10.0	20	7.46	9	
<sup>195</sup> Hg	$\beta^+/\varepsilon$	1554	0.0	1/2-	241.56	3/2+	1.90	40	8.03	9	
<sup>195</sup> Hg	$\varepsilon$	1554	0.0	1/2-	841.23	3/2+	9.4	11	6.76	6	
<sup>195</sup> Hg	$\varepsilon$	1554	0.0	1/2-	1172.44	3/2+	3.3	5	6.59	10	
<sup>195</sup> Hg	$\beta^+/\varepsilon$	1554	176.07	13/2+	318.59	11/2-	32.0	30	7.455	45	
<sup>195</sup> Hg	$\beta^+/\varepsilon$	1554	176.07	13/2+	706.48	15/2-	1.77	16	8.417	47	
<sup>195</sup> Hg	$\varepsilon$	1554	176.07	13/2+	1280.52	11/2-	0.41	7	8.26	9	
<sup>195</sup> Hg	$\varepsilon$	1554	176.07	13/2+	1346.20	11/2-	0.66	6	7.89	8	
<sup>195</sup> Tl	$\beta^+/\varepsilon$	2858	0.0	1/2+	595.48	(3/2)-	3.20	40	7.37	6	
<sup>195</sup> Tl	$\beta^+/\varepsilon$	2858	0.0	1/2+	600.63	3/2-	12.3	13	6.79	5	
<sup>195</sup> Tl	$\beta^+/\varepsilon$	2858	0.0	1/2+	893.12	3/2-	2.20	40	7.40	8	
<sup>196</sup> Pb	$\beta^+/\varepsilon$	2148	0.0	0+	366.5	1-	25.0	40	6.01	8	
<sup>196</sup> Pb	$\beta^+/\varepsilon$	2148	0.0	0+	493.9	1-	11.5	21	6.28	9	
<sup>197</sup> Pt	$\beta^-$	720.0	0.0	1/2-	0.0	3/2+	10.6	28	7.45	11	
<sup>197</sup> Pt	$\beta^-$	720.0	0.0	1/2-	268.78	3/2+	8.2	8	6.883	42	
<sup>197</sup> Pt	$\beta^-$	720.0	399.59	13/2+	409.0	11/2-	3.3	4	6.84	5	
<sup>197</sup> Hg	$\varepsilon$	599.5	298.93	13/2+	409.17	11/2-	8.6	7	6.778	37	
<sup>197</sup> Tl	$\beta^+/\varepsilon$	2186	0.0	1/2+	578.01	(3/2)-	21.0	40	6.63	8	
<sup>197</sup> Tl	$\beta^+/\varepsilon$	2186	0.0	1/2+	585.38	(3/2)-	4.7	10	7.27	9	
<sup>197</sup> Tl	$\beta^+/\varepsilon$	2186	0.0	1/2+	892.53	(3/2)-	1.60	40	7.55	11	
<sup>197</sup> Pb	$\beta^+/\varepsilon$	3609	319.31	13/2+	1382.91	11/2-	6.1	16	7.02	11	P
<sup>197</sup> Pb	$\beta^+/\varepsilon$	3609	319.31	13/2+	1720.27	15/2-	3.5	8	7.13	10	P
<sup>197</sup> Pb	$\beta^+/\varepsilon$	3609	319.31	13/2+	1954.01	11/2-	6.9	15	6.73	10	P
<sup>197</sup> Pb	$\beta^+/\varepsilon$	3609	319.31	13/2+	2570.03	15/2-	1.02	22	7.21	9	P
<sup>198</sup> Tl	$\beta^+/\varepsilon$	3426	0.0	2-	1847.20	3+	5.9	8	7.43	7	
<sup>198</sup> Tl	$\beta^+/\varepsilon$	3426	0.0	2-	2360.76	3+	6.3	8	7.04	7	
<sup>198</sup> Tl	$\beta^+/\varepsilon$	3426	543.5	7+	1909.7	6-	8.4	17	7.07	9	P
<sup>198</sup> Tl	$\beta^+/\varepsilon$	3426	543.5	7+	2059.1	6-	2.10	30	7.60	6	P
<sup>198</sup> Pb	$\beta^+/\varepsilon$	1461	0.0	0+	290.31	1-	27	8	6.18	13	
<sup>198</sup> Pb	$\beta^+/\varepsilon$	1461	0.0	0+	382.10	1-	5.9	10	6.77	8	
<sup>198</sup> Pb	$\varepsilon$	1461	0.0	0+	648.90	1-	2.9	3	6.81	5	
<sup>198</sup> Pb	$\varepsilon$	1461	0.0	0+	865.33	1-	10.5	11	5.95	5	
<sup>199</sup> Pt	$\beta^-$	1705.1	0.0	5/2-	0.0	3/2+	70.7	12	6.389	8	
<sup>199</sup> Pt	$\beta^-$	1705.1	0.0	5/2-	323.605	3/2+	1.54	10	7.710	28	
<sup>199</sup> Pt	$\beta^-$	1705.1	0.0	5/2-	791.760	3/2+	4.26	5	6.620	7	
<sup>199</sup> Au	$\beta^-$	452.3	0.0	3/2+	0.0	1/2-	6.5	13	7.59	9	
<sup>199</sup> Au	$\beta^-$	452.3	0.0	3/2+	158.37859	5/2-	72.0	13	5.941	8	
<sup>199</sup> Tl	$\beta^+/\varepsilon$	1487	0.0	1/2+	208.20616	3/2-	9.3	17	7.19	8	
<sup>199</sup> Tl	$\varepsilon$	1487	0.0	1/2+	403.51	3/2-	1.77	23	7.75	7	
<sup>199</sup> Tl	$\varepsilon$	1487	0.0	1/2+	492.297	3/2-	7.3	8	7.06	6	
<sup>199</sup> Pb	$\beta^+/\varepsilon$	2828	0.0	3/2-	0.0	1/2+	30	10	6.76	15	

**Table 12**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
<sup>199</sup> Pb	$\beta+\epsilon$	2828	0.0	3/2-	720.35	(5/2)+	2.4	8	7.57	15	
<sup>200</sup> Tl	$\epsilon$	2456	0.0	2-	1630.892	1+	0.38	12	8.71	14	
<sup>200</sup> Tl	$\epsilon$	2456	0.0	2-	1718.303	1+	0.33	7	8.67	9	
<sup>200</sup> Tl	$\epsilon$	2456	0.0	2-	1734.344	3+	2.4	5	7.79	9	
<sup>200</sup> Tl	$\epsilon$	2456	0.0	2-	1775.582	3+	13.6	12	6.976	42	
<sup>200</sup> Tl	$\epsilon$	2456	0.0	2-	1845.778	3+	1.33	13	7.880	46	
<sup>200</sup> Tl	$\epsilon$	2456	0.0	2-	1974.336	(3)+	0.116	20	8.70	8	
<sup>200</sup> Tl	$\epsilon$	2456	0.0	2-	2061.253	1+	0.088	10	8.62	6	
<sup>200</sup> Tl	$\epsilon$	2456	0.0	2-	2114.357	(3)+	0.27	4	7.98	7	
<sup>200</sup> Tl	$\epsilon$	2456	0.0	2-	2229.265	1+	0.14	3	7.80	10	
<sup>200</sup> Tl	$\epsilon$	2456	0.0	2-	2296.28	1+	0.057	7	7.73	8	
<sup>200</sup> Tl	$\epsilon$	2456	0.0	2-	2343.595	(3)+	0.060	8	7.17	12	
<sup>200</sup> Tl	$\epsilon$	2456	0.0	2-	2370.042	1+	0.048	7	6.86	13	
<sup>200</sup> Pb	$\epsilon$	796	0.0	0+	257.183	1-	2.2	7	7.48	14	
<sup>200</sup> Pb	$\epsilon$	796	0.0	0+	289.92	1-	9.0	10	6.81	6	
<sup>200</sup> Pb	$\epsilon$	796	0.0	0+	450.56	1-	5.10	19	6.655	45	
<sup>200</sup> Pb	$\epsilon$	796	0.0	0+	525.54	1-	14.3	6	5.93	6	
<sup>200</sup> Pb	$\epsilon$	796	0.0	0+	605.45	1-	1.20	9	6.58	10	
<sup>201</sup> Tl	$\epsilon$	482	0.0	1/2+	32.169	3/2-	11.9	4	7.15	4	
<sup>201</sup> Pb	$\beta+\epsilon$	1910	0.0	5/2-	331.17	3/2+	52	6	6.76	5	
<sup>201</sup> Pb	$\epsilon$	1910	0.0	5/2-	1238.83	3/2+	7.4	6	6.806	47	
<sup>201</sup> Pb	$\epsilon$	1910	0.0	5/2-	1420.04	7/2+	1.56	16	7.18	6	
<sup>201</sup> Bi	$\beta+\epsilon$	3842	0.0	9/2-	1447.9	(11/2)+	4.6	5	7.52	5	
<sup>201</sup> Bi	$\beta+\epsilon$	3842	0.0	9/2-	1651.0	7/2+	3.3	5	7.58	6	
<sup>201</sup> Bi	$\beta+\epsilon$	3842	0.0	9/2-	1843.8	11/2+	2.00	30	7.70	7	
<sup>201</sup> Bi	$\beta+\epsilon$	3842	0.0	9/2-	2151.9	7/2+	3.0	6	7.37	8	
<sup>201</sup> Bi	$\epsilon$	3842	0.0	9/2-	3050.7	(7/2)+	3.8	5	6.56	6	
<sup>202</sup> Pb	$\epsilon$	39.8	2169.83	9-	1340.13	8+	6.4	8	6.70	5	
<sup>202</sup> Pb	$\epsilon$	39.8	2169.83	9-	1552.09	8+	2.1	4	6.91	8	
<sup>203</sup> Au	$\beta-$	2125.8	0.0	3/2+	0.0	5/2-	72	15	5.28	10	
<sup>203</sup> Hg	$\beta-$	492.1	0.0	5/2-	279.1955	3/2+	100		6.552	8	
<sup>203</sup> Pb	$\epsilon$	975	0.0	5/2-	279.1954	3/2+	95.3	3	6.477	11	
<sup>203</sup> Po	$\beta+\epsilon$	4214	0.0	5/2-	1312.97	3/2+	8.8	19	7.00	9	P
<sup>203</sup> At	$\beta+\epsilon$	5148	0.0	9/2-	1280.34	(11/2)+	2.00	40	7.30	9	P
<sup>203</sup> At	$\beta+\epsilon$	5148	0.0	9/2-	1671.28	(11/2)+	1.79	12	7.225	32	P
<sup>204</sup> Bi	$\beta+\epsilon$	4464	0.0	6+	2696.57	7-	1.30	30	8.59	10	
<sup>204</sup> Bi	$\beta+\epsilon$	4464	0.0	6+	2919.55	5-	2.7	8	8.15	13	
<sup>204</sup> Bi	$\beta+\epsilon$	4464	0.0	6+	2928.76	5-	11.3	14	7.52	6	
<sup>204</sup> Bi	$\beta+\epsilon$	4464	0.0	6+	3029.14	5-	10.0	12	7.52	5	
<sup>204</sup> Bi	$\beta+\epsilon$	4464	0.0	6+	3092.11	5-	6.3	7	7.67	5	
<sup>204</sup> Bi	$\beta+\epsilon$	4464	0.0	6+	3170.23	5-	14.7	21	7.25	6	
<sup>204</sup> Bi	$\beta+\epsilon$	4464	0.0	6+	3232.13	5-	3.20	40	7.87	6	
<sup>204</sup> Bi	$\beta+\epsilon$	4464	0.0	6+	3301.60	5-	2.30	30	7.96	6	
<sup>204</sup> Bi	$\epsilon$	4464	0.0	6+	3782.14	5-	1.76	19	7.57	5	
<sup>204</sup> Bi	$\epsilon$	4464	0.0	6+	4165.88	5-	1.8	3	6.70	8	
<sup>204</sup> Po	$\epsilon$	2305	0.0	0+	1369.34	1-	51.3	18	5.931	23	
<sup>204</sup> Po	$\epsilon$	2305	0.0	0+	1404.23	1-	4.5	3	6.952	34	
<sup>204</sup> Po	$\epsilon$	2305	0.0	0+	1634.17	1-	23.8	9	5.946	29	
<sup>205</sup> Bi	$\epsilon$	2704.6	0.0	9/2-	2203.87	11/2+	2.78	12	8.569	25	
<sup>205</sup> Bi	$\epsilon$	2704.6	0.0	9/2-	2252.29	(7/2)+	1.26	6	8.809	27	
<sup>205</sup> Po	$\beta+\epsilon$	3544	0.0	5/2-	1709.18	3/2+	16.0	13	6.755	41	
<sup>205</sup> At	$\beta+\epsilon$	4537	0.0	9/2-	1553.17	(11/2)+	4.40	40	7.230	42	P
<sup>205</sup> At	$\beta+\epsilon$	4537	0.0	9/2-	1856.20	11/2+	2.43	11	7.378	25	P

**Table 12**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
<sup>205</sup> At	$\beta+\varepsilon$	4537	0.0	9/2-	2149.35	(7/2)+	1.73	17	7.413	46	P
<sup>205</sup> At	$\beta+\varepsilon$	4537	0.0	9/2-	2187.88	(11/2)+	2.23	15	7.287	33	P
<sup>205</sup> At	$\beta+\varepsilon$	4537	0.0	9/2-	3046.72	7/2+	1.09	8	7.176	37	P
<sup>205</sup> At	$\beta+\varepsilon$	4537	0.0	9/2-	3052.2	(7/2)+	1.21	15	7.13	6	P
<sup>205</sup> At	$\beta+\varepsilon$	4537	0.0	9/2-	3170.9	(7/2)+	1.44	8	6.975	31	P
<sup>206</sup> Hg	$\beta$ -	1308	0.0	0+	304.896	1-	35	7	5.33	9	
<sup>206</sup> Hg	$\beta$ -	1308	0.0	0+	649.42	1-	3.0	4	5.76	7	
<sup>207</sup> Po	$\varepsilon$	2909	0.0	5/2-	2060.39	3/2+	21.2	5	6.439	15	
<sup>208</sup> Tl	$\beta$ -	4998.4	0.0	5+	3475.088	4-	22.2	5	5.776	10	
<sup>208</sup> At	$\beta+\varepsilon$	4999	0.0	6+	3553.6	5-	5.3	6	7.02	5	
<sup>208</sup> At	$\beta+\varepsilon$	4999	0.0	6+	3609.8	5-	3.28	43	7.19	6	
<sup>208</sup> At	$\varepsilon$	4999	0.0	6+	4166.3	7-	5.43	81	6.50	7	
<sup>209</sup> At	$\varepsilon$	3482	0.0	9/2-	2864.50	11/2+	8.4	3	6.537	19	
<sup>209</sup> At	$\varepsilon$	3482	0.0	9/2-	2902.35	11/2+	1.30	5	7.284	21	
<sup>209</sup> At	$\varepsilon$	3482	0.0	9/2-	2908.46	11/2+	4.59	13	6.726	17	
<sup>209</sup> At	$\varepsilon$	3482	0.0	9/2-	2978.26	11/2+	5.08	13	6.551	18	
<sup>210</sup> Pb	$\beta$ -	63.5	0.0	0+	0.0	1-	16	3	8.02	8	
<sup>210</sup> Bi	$\beta$ -	1161.2	0.0	1-	0.0	0+	100		8.1153	12	
<sup>210</sup> At	$\varepsilon$	3981	0.0	(5)+	3727.2	(6)-	5.4	1	5.943	48	
<sup>211</sup> Pb	$\beta$ -	1366	0.0	9/2+	404.866	7/2-	1.63	9	7.284	25	
<sup>213</sup> Bi	$\beta$ -	1422	0.0	9/2-	440.445	7/2+	30.79	24	6.166	9	
<sup>214</sup> Pb	$\beta$ -	1018	0.0	0+	0.0	1-	12.7	9	6.354	35	
<sup>214</sup> Pb	$\beta$ -	1018	0.0	0+	295.2236	1-	39.0	5	5.350	24	
<sup>214</sup> Bi	$\beta$ -	3269	0.0	1-	0.0	0+	19.2	4	7.974	11	
<sup>214</sup> Bi	$\beta$ -	3269	0.0	1-	1377.681	2+	7.22	8	7.474	11	
<sup>214</sup> Bi	$\beta$ -	3269	0.0	1-	1543.370	2+	3.09	4	7.692	12	
<sup>214</sup> Bi	$\beta$ -	3269	0.0	1-	1729.613	2+	17.55	10	6.753	12	
<sup>214</sup> Bi	$\beta$ -	3269	0.0	1-	1847.446	2+	8.16	5	6.958	13	
<sup>214</sup> Bi	$\beta$ -	3269	0.0	1-	1890.306	(2)+	1.589	17	7.620	14	
<sup>214</sup> Bi	$\beta$ -	3269	0.0	1-	2017.315	0+	2.460	15	7.277	14	
<sup>221</sup> Rn	$\beta$ -	1194	0.0	7/2+	100.93	(5/2)-	8.8	15	6.70	8	
<sup>223</sup> Fr	$\beta$ -	1149.1	0.0	3/2-	234.779	(5/2)+	10.1	2	6.330	9	
<sup>224</sup> Fr	$\beta$ -	2923	0.0	1-	1437.08	2+	1.9	3	6.99	7	
<sup>224</sup> Fr	$\beta$ -	2923	0.0	1-	1652.42	2+	1.8	3	6.76	7	
<sup>225</sup> Rn	$\beta$ -	2714	0.0	7/2-	151.63	5/2+	2.4	5	7.90	9	
<sup>225</sup> Rn	$\beta$ -	2714	0.0	7/2-	346.03	(9/2)+	3.0	7	7.67	10	
<sup>226</sup> Fr	$\beta$ -	3853	0.0	1-	1156.21	2+	2.2	4	7.29	8	P
<sup>226</sup> Fr	$\beta$ -	3853	0.0	1-	1390.04	2+	3.9	7	6.89	8	P
<sup>226</sup> Fr	$\beta$ -	3853	0.0	1-	1723.4	2+	1.01	18	7.24	8	P
<sup>227</sup> Fr	$\beta$ -	2505	0.0	1/2+	90.0343	3/2-	18	5	6.67	12	
<sup>227</sup> Fr	$\beta$ -	2505	0.0	1/2+	523.851	(3/2)-	6.4	4	6.795	28	
<sup>228</sup> Ac	$\beta$ -	2123.8	0.0	3+	1122.949	2-	5.90	14	7.979	11	
<sup>228</sup> Pa	$\varepsilon$	2152.7	0.0	3+	1450.408	4-	8.7	8	7.453	45	
<sup>231</sup> Ac	$\beta$ -	1947	0.0	1/2+	593.618	(3/2)-	6.5	7	6.71	5	
<sup>231</sup> Th	$\beta$ -	391.5	0.0	5/2+	320.211	3/2-	0.067	2	6.895	31	
<sup>233</sup> Pa	$\beta$ -	570.3	0.0	3/2-	0.0	5/2+	8.8	14	9.05	7	
<sup>233</sup> Pa	$\beta$ -	570.3	0.0	3/2-	340.478	5/2+	27	6	7.29	10	
<sup>233</sup> Pa	$\beta$ -	570.3	0.0	3/2-	398.496	1/2+	12.9	23	7.22	8	
<sup>234</sup> Pa	$\beta$ -	2193.9	0.0	4+	1693.4	5-	7.3	8	6.959	49	
<sup>234</sup> Pa	$\beta$ -	2193.9	0.0	4+	1722.9	3-	12.9	12	6.625	42	
<sup>237</sup> U	$\beta$ -	518.5	0.0	1/2+	267.561	3/2-	42	3	6.664	31	
<sup>237</sup> Pu	$\varepsilon$	220.1	0.0	7/2-	0.0	5/2+	79	2	6.955	15	
<sup>238</sup> Np	$\beta$ -	1291.45	0.0	2+	605.16	1-	0.102	3	10.210	13	

**Table 12**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
$^{238}\text{Np}$	$\beta^-$	1291.45	0.0	2+	661.43	3-	0.0384	21	10.510	24	
$^{238}\text{Np}$	$\beta^-$	1291.45	0.0	2+	962.765	1-	1.254	13	8.0787	49	
$^{238}\text{Np}$	$\beta^-$	1291.45	0.0	2+	1202.62	(3)-	0.54	5	6.690	41	
$^{238}\text{Am}$	$\beta^+/\varepsilon$	2.26E3	0.0	1+	985.53	2-	2.30	30	7.61	8	
$^{239}\text{U}$	$\beta^-$	1261.7	0.0	5/2+	117.715	7/2-	1.96	24	7.55	5	
$^{239}\text{Np}$	$\beta^-$	722.8	0.0	5/2+	391.586	7/2-	44	2	6.594	20	
$^{239}\text{Np}$	$\beta^-$	722.8	0.0	5/2+	492.2	3/2-	0.020	1	9.442	22	
$^{239}\text{Am}$	$\varepsilon$	802.1	0.0	(5/2)-	511.84	7/2+	18.1	21	6.02	5	
$^{241}\text{Cm}$	$\varepsilon$	767.4	0.0	1/2+	471.810	3/2-	26	6	7.74	10	
$^{241}\text{Cm}$	$\varepsilon$	767.4	0.0	1/2+	636.861	3/2-	42.2	21	6.372	26	
$^{242}\text{Am}$	$\varepsilon$	751.1	0.0	1-	0.0	0+	6.7	9	7.63	6	
$^{242}\text{Am}$	$\varepsilon$	751.1	0.0	1-	44.54	2+	10.6	8	7.368	33	
$^{242}\text{Am}$	$\beta^-$	664.31	0.0	1-	0.0	0+	37	5	7.16	6	
$^{242}\text{Am}$	$\beta^-$	664.31	0.0	1-	42.13	2+	46	5	6.974	47	
$^{245}\text{Bk}$	$\varepsilon$	809.3	0.0	3/2-	252.838	5/2+	90	10	7.129	49	
$^{245}\text{Bk}$	$\varepsilon$	809.3	0.0	3/2-	355.95	1/2+	6.1	5	8.076	36	
$^{245}\text{Bk}$	$\varepsilon$	809.3	0.0	3/2-	740.97	(1/2)+	1.0	1	6.51	5	
$^{249}\text{Bk}$	$\beta^-$	123.60	0.0	7/2+	0.0	9/2-	100		7.1735	43	
$^{249}\text{Es}$	$\beta^+/\varepsilon$	1452	0.0	7/2+	0.0	9/2-	25	8	6.86	14	
$^{249}\text{Es}$	$\varepsilon$	1452	0.0	7/2+	813.20	(5/2)-	10.0	11	6.45	7	
$^{250}\text{Bk}$	$\beta^-$	1781.7	0.0	2-	1071.37	3+	6.23	18	7.394	14	



16.3. First forbidden unique

**Table 13**

List of first forbidden unique transitions with  $\Delta J=2$  and  $\Delta\pi=\text{yes}$ .

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
<sup>16</sup> N	$\beta^-$	1.04209E4	0.0	2-	0.0	0+	28.0	4	9.076	6	
<sup>17</sup> N	$\beta^-$	8679	0.0	1/2-	0.0	5/2+	1.61	50	9.56	14	
<sup>20</sup> N	$\beta^-$	1.797E4	0.0	2-	5384.2	0+	2.9	7	8.89	11	P
<sup>37</sup> S	$\beta^-$	4865.13	0.0	7/2-	0.0	3/2+	5.6	6	9.332	47	
<sup>38</sup> S	$\beta^-$	2937	0	0+	0.0	2-	9.3	20	9.26	9	
<sup>38</sup> Cl	$\beta^-$	4916.71	0.0	2-	0.0	0+	56.0	6	9.2410	47	
<sup>39</sup> Cl	$\beta^-$	3442	0.0	3/2+	0.0	7/2-	7	2	9.34	12	
<sup>39</sup> Ar	$\beta^-$	565	0.0	7/2-	0.0	3/2+	100		10.104	24	
<sup>40</sup> K	$\epsilon$	1504.40	0.0	4-	1460.851	2+	10.31	4	11.537	8	
<sup>41</sup> Ca	$\epsilon$	421.64	0.0	7/2-	0.0	3/2+	100		10.500	44	
<sup>42</sup> Ar	$\beta^-$	599	0.0	0+	0.0	2-	100		9.325	27	
<sup>42</sup> K	$\beta^-$	3525.26	0.0	2-	0.0	0+	81.90	9	9.4836	6	
<sup>43</sup> K	$\beta^-$	1833.48	0.0	3/2+	0.0	7/2-	1.54	18	9.74	5	
<sup>44</sup> K	$\beta^-$	5687.2	0.0	2-	0.0	0+	34	10	9.66	13	
<sup>44</sup> K	$\beta^-$	5687.2	0.0	2-	1883.515	0+	1.5	3	9.90	9	
<sup>46</sup> K	$\beta^-$	7725.7	0.0	2-	2574.53	4+	1.15	14	9.72	5	
<sup>47</sup> Ca	$\beta^-$	1992.2	0.0	7/2-	766.83	(3/2)+	0.087	3	10.680	15	
<sup>71</sup> Zn	$\beta^-$	2810.3	155.62	9/2+	487.395	5/2-	4.6	8	9.47	8	
<sup>72</sup> As	$\beta+\epsilon$	4343.60	0.0	2-	0.0	0+	17.2	18	9.845	45	
<sup>72</sup> As	$\beta+\epsilon$	4343.60	0.0	2-	1728.29	4+	0.095	24	10.34	11	
<sup>73</sup> Se	$\beta+\epsilon$	2725	0.0	9/2+	67.10	5/2-	1.10	10	8.782	41	
<sup>74</sup> As	$\beta+\epsilon$	2562.4	0.0	2-	1482.81	0+	0.0180	30	10.35	7	
<sup>74</sup> As	$\beta^-$	1353.1	0.0	2-	0.0	0+	18.6	23	9.39	5	
<sup>75</sup> Se	$\epsilon$	866.04	0.0	5/2+	468.6	1/2-	0.00037	6	11.15	7	
<sup>76</sup> As	$\beta^-$	2960.6	0.0	2-	0.0	0+	55.9	4	9.6995	32	
<sup>76</sup> As	$\beta^-$	2960.6	0.0	2-	1122.257	0+	0.69	3	10.371	19	
<sup>76</sup> As	$\beta^-$	2960.6	0.0	2-	1330.855	4+	0.0595	20	11.132	15	
<sup>77</sup> Rb	$\beta+\epsilon$	5339.0	0.0	3/2-	149.94	7/2+	1.6	5	8.86	14	P
<sup>77</sup> Ge	$\beta^-$	2703.5	0.0	7/2+	215.54	3/2-	4.1	13	9.99	14	
<sup>77</sup> As	$\beta^-$	683.2	0.0	3/2-	161.942	7/2+	0.092	16	8.44	8	
<sup>78</sup> Ga	$\beta^-$	8158.0	0.0	2-	1570.19	4+	6.0	9	8.57	7	P
<sup>78</sup> As	$\beta^-$	4209	0.0	2-	0.0	0+	32	8	9.65	11	
<sup>78</sup> As	$\beta^-$	4209	0.0	2-	2682.09	4+	15.9	19	7.30	5	
<sup>78</sup> As	$\beta^-$	4209	0.0	2-	3294.73	4+	3.5	5	6.72	7	
<sup>79</sup> Se	$\beta^-$	150.6	0.0	7/2+	0.0	3/2-	100		10.783	40	
<sup>81</sup> Kr	$\epsilon$	280.85	0.0	7/2+	0.0	3/2-	99.70	2	11.030	22	
<sup>82</sup> Br	$\beta^-$	3093.1	45.9492	2-	0.0	0+	2.1	3	8.90	6	
<sup>83</sup> Sr	$\beta+\epsilon$	2273	0.0	7/2+	821.62	(3/2)-	0.022	7	9.86	15	
<sup>84</sup> Rb	$\beta+\epsilon$	2680.4	0.0	2-	0.0	0+	26.5	11	9.517	18	
<sup>84</sup> Br	$\beta^-$	4656	0.0	2-	0.0	0+	33	5	9.49	7	
<sup>85</sup> Kr	$\beta^-$	687.0	0.0	9/2+	0.0	5/2-	99.563	10	9.460	7	
<sup>86</sup> Rb	$\epsilon$	518.67	0.0	2-	0.0	0+	5.2E-3	5	9.791	42	
<sup>86</sup> Rb	$\beta^-$	1776.10	0.0	2-	0.0	0+	91.36	4	9.4568	6	
<sup>87</sup> Kr	$\beta^-$	3888.27	0.0	5/2+	845.44	(1/2)-	7.3	4	9.385	24	
<sup>88</sup> Kr	$\beta^-$	2917.7	0.0	0+	0.0	2-	14	4	9.34	12	
<sup>88</sup> Kr	$\beta^-$	2917.7	0.0	0+	862.349	2-	1.3	3	9.46	10	
<sup>88</sup> Rb	$\beta^-$	5312.62	0.0	2-	0.0	0+	76.51	11	9.2622	8	
<sup>88</sup> Y	$\beta+\epsilon$	3622.6	0.0	4-	1836.083	2+	5.50	40	9.812	33	
<sup>88</sup> Y	$\epsilon$	3622.6	0.0	4-	3218.6	2+	0.028	6	9.46	9	
<sup>89</sup> Sr	$\beta^-$	1502.18	0.0	5/2+	0.0	1/2-	99.99036	5	9.4498	6	
<sup>89</sup> Zr	$\beta+\epsilon$	2833.2	0.0	9/2+	1744.5	5/2-	0.1230	40	9.106	16	

**Table 13**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
<sup>90</sup> Rb	$\beta^-$	6585	0.0	0-	831.68	2+	26	2	9.123	36	
<sup>90</sup> Rb	$\beta^-$	6585	0.0	0-	1892.36	2+	2.7	4	9.54	7	
<sup>90</sup> Sr	$\beta^-$	546.0	0.0	0+	0.0	2-	100		9.416	6	
<sup>90</sup> Y	$\beta^-$	2275.64	0.0	2-	0.0	0+	99.9885	14	9.2367	5	
<sup>90</sup> Y	$\beta^-$	2275.64	0.0	2-	1760.74	0+	0.0115	14	9.65	5	
<sup>91</sup> Y	$\beta^-$	1544.3	0.0	1/2-	0.0	5/2+	99.74	4	9.5990	29	
<sup>91</sup> Nb	$\beta^+/\epsilon$	1257.6	104.60	1/2-	0.0	5/2+	1.40	30	9.76	9	
<sup>92</sup> Y	$\beta^-$	3643	0.0	2-	0.0	0+	85.7	16	9.287	11	
<sup>92</sup> Y	$\beta^-$	3643	0.0	2-	1382.99	0+	2.3	3	9.60	6	
<sup>92</sup> Y	$\beta^-$	3643	0.0	2-	1495.60	4+	1.15	20	9.77	8	
<sup>93</sup> Y	$\beta^-$	2895	0.0	1/2-	0.0	5/2+	89.5	16	9.114	13	
<sup>93</sup> Zr	$\beta^-$	90.8	0.0	5/2+	30.77	1/2-	73	6	10.19	6	
<sup>93</sup> Mo	$\epsilon$	405.8	0.0	5/2+	30.77	1/2-	88	12	10.09	10	
<sup>94</sup> Y	$\beta^-$	4918	0.0	2-	0.0	0+	41	4	9.370	43	
<sup>94</sup> Y	$\beta^-$	4918	0.0	2-	1300.12	0+	1.83	20	9.884	48	
<sup>94</sup> Y	$\beta^-$	4918	0.0	2-	1469.64	4+	4.1	4	9.404	43	
<sup>95</sup> Rb	$\beta^-$	9227	0.0	5/2-	1864.17	1/2+	1.02	24	8.60	10	P
<sup>95</sup> Y	$\beta^-$	4452	0.0	1/2-	0.0	5/2+	64.0	17	8.644	13	
<sup>95</sup> Zr	$\beta^-$	1126.3	0.0	5/2+	235.690	1/2-	1.08	7	10.303	28	
<sup>95</sup> Nb	$\beta^-$	925.60	234.70	1/2-	0.0	5/2+	3.2	10	9.22	14	
<sup>95</sup> Tc	$\beta^+/\epsilon$	1691	38.91	1/2-	0.0	5/2+	13.56	9	9.274	18	
<sup>95</sup> Tc	$\epsilon$	1691	38.91	1/2-	1056.753	5/2+	0.0185	16	10.463	45	
<sup>95</sup> Tc	$\epsilon$	1691	38.91	1/2-	1426.13	(5/2)+	0.00837	22	9.374	41	
<sup>96</sup> Rb	$\beta^-$	1.1564E4	0.0	2-	1464.6	0+	1.11	16	9.19	6	P
<sup>96</sup> Rb	$\beta^-$	1.1564E4	0.0	2-	1792.78	4+	3.7	4	8.572	47	P
<sup>96</sup> Y	$\beta^-$	7109	0.0	0-	1750.60	2+	1.91	20	8.616	46	
<sup>97</sup> Tc	$\epsilon$	320.3	96.5	1/2-	0.0	5/2+	3.94	18	7.451	31	
<sup>98</sup> Y	$\beta^-$	8993	0.0	0-	1744.61	2+	3.0	4	8.28	6	P
<sup>99</sup> Rh	$\beta^+/\epsilon$	2041	0.0	1/2-	576.27	5/2+	0.37	6	10.05	7	
<sup>99</sup> Rh	$\beta^+/\epsilon$	2041	0.0	1/2-	734.10	5/2+	0.30	8	9.94	12	
<sup>103</sup> Cd	$\beta^+/\epsilon$	4151.1	0.0	(5/2)+	134.45	1/2-	3.4	9	7.99	12	P
<sup>105</sup> Ag	$\epsilon$	1347.1	0.0	1/2-	727.3	5/2+	0.036	4	10.01	5	
<sup>106</sup> In	$\beta^+/\epsilon$	6524	0.0	7+	2629.02	5-	2.50	23	7.964	42	P
<sup>107</sup> Pd	$\beta^-$	34.0	0.0	5/2+	0.0	1/2-	100		9.96	11	
<sup>108</sup> In	$\beta^+/\epsilon$	5133	0.0	7+	2601.41	5-	3.0	7	7.73	10	
<sup>108</sup> In	$\beta^+/\epsilon$	5133	0.0	7+	2706.96	5-	2.4	7	7.73	13	
<sup>110</sup> In	$\beta^+/\epsilon$	3878	0.0	7+	2659.792	5-	1.74	15	7.307	49	
<sup>111</sup> Ag	$\beta^-$	1036.8	0.0	1/2-	245.42	5/2+	1.0	2	9.26	9	
<sup>115</sup> Cd	$\beta^-$	1451.9	0.0	1/2+	1041.4	5/2-	0.00008	2	11.42	11	
<sup>118</sup> I	$\beta^+/\epsilon$	6720	0.0	2-	957.33	0+	1.20	30	9.87	11	P
<sup>118</sup> I	$\beta^+/\epsilon$	6720	0.0	2-	1206.25	4+	4.2	8	9.19	9	P
<sup>118</sup> I	$\beta^+/\epsilon$	6720	0.0	2-	1702.9	(4)+	2.59	18	9.101	37	P
<sup>119</sup> Te	$\beta^+/\epsilon$	2293.0	260.96	11/2-	270.54	7/2+	5.4	5	9.427	41	
<sup>120</sup> I	$\beta^+/\epsilon$	5615	0.0	2-	0.0	0+	22.3	8	9.294	17	P
<sup>120</sup> I	$\beta^+/\epsilon$	5615	0.0	2-	1161.6	4+	1.35	11	9.793	36	P
<sup>121</sup> Sn	$\beta^-$	402.5	6.30	11/2-	37.15	7/2+	22.4	20	9.667	42	
<sup>121</sup> Te	$\beta^+/\epsilon$	1056	293.991	11/2-	37.138	7/2+	8.7	10	9.76	6	
<sup>122</sup> Sb	$\beta^+/\epsilon$	1605.7	0.0	2-	0.0	0+	1.66	11	9.020	30	
<sup>122</sup> Sb	$\beta^-$	1979.1	0.0	2-	0.0	0+	26.1	2	9.6728	43	
<sup>122</sup> Sb	$\beta^-$	1979.1	0.0	2-	1179.3	4+	0.012	3	10.84	11	
<sup>122</sup> Sb	$\beta^-$	1979.1	0.0	2-	1357.6	0+	0.0108	10	10.325	41	
<sup>123</sup> Sn	$\beta^-$	1408.2	0.0	11/2-	0.0	7/2+	99.37	13	9.9083	45	
<sup>124</sup> I	$\beta^+/\epsilon$	3159.6	0.0	2-	0.0	0+	34.6	8	9.307	11	

**Table 13**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	Log $ft$	Unc.	Pand.
<sup>124</sup> I	$\beta+\epsilon$	3159.6	0.0	2-	1248.60	4+	0.040	10	11.21	11	
<sup>124</sup> I	$\beta+\epsilon$	3159.6	0.0	2-	1657.28	0+	0.1100	40	10.335	17	
<sup>124</sup> I	$\epsilon$	3159.6	0.0	2-	2308.39	0+	0.0084	10	10.44	5	
<sup>125</sup> Sn	$\beta-$	2361.4	0.0	11/2-	0.0	7/2+	81.4	50	10.160	27	
<sup>125</sup> Sn	$\beta-$	2361.4	0.0	11/2-	1349.65	7/2+	0.38	11	10.41	13	
<sup>125</sup> Sb	$\beta-$	766.7	0.0	7/2+	144.776	11/2-	13.6	9	9.794	30	
<sup>126</sup> I	$\beta+\epsilon$	2153.7	0.0	2-	0.0	0+	19.4	7	9.233	17	
<sup>126</sup> I	$\epsilon$	2153.7	0.0	2-	1873.1	0+	0.00046	14	10.16	14	
<sup>126</sup> I	$\beta-$	1235.9	0.0	2-	0.0	0+	10.3	7	9.635	30	
<sup>127</sup> Sb	$\beta-$	1582.2	0.0	7/2+	87.7	11/2-	2.0	5	10.24	11	
<sup>127</sup> Te	$\beta-$	702.7	88.26	11/2-	57.64	7/2+	2.14	30	10.01	6	
<sup>127</sup> Te	$\beta-$	702.7	88.26	11/2-	628.6	7/2+	7.7E-5	19	11.41	11	
<sup>129</sup> Te	$\beta-$	1502.3	105.51	11/2-	0.0	7/2+	32	8	10.18	11	
<sup>129</sup> Te	$\beta-$	1502.3	105.51	11/2-	768.76	(7/2)+	0.028	6	11.69	9	
<sup>129</sup> Te	$\beta-$	1502.3	105.51	11/2-	1050.21	(7/2)+	0.037	8	10.67	9	
<sup>129</sup> Sb	$\beta-$	2376	0.0	7/2+	105.49	11/2-	3	1	9.78	15	
<sup>131</sup> Te	$\beta-$	2231.7	182.25	11/2-	0.0	7/2+	3.8	4	10.728	46	
<sup>131</sup> I	$\beta-$	970.8	0.0	7/2+	163.930	11/2-	0.39	9	9.86	10	
<sup>132</sup> La	$\beta+\epsilon$	4711	0.0	2-	0.0	0+	14.0	20	9.53	7	
<sup>133</sup> Ce	$\beta+\epsilon$	3076	37.2	9/2-	87.940	5/2+	2.70	40	9.16	7	
<sup>133</sup> I	$\beta-$	1786	0.0	7/2+	233.221	11/2-	1.08	11	9.992	45	
<sup>135</sup> I	$\beta-$	2634.2	0.0	7/2+	526.551	11/2-	1.9	2	10.007	46	
<sup>137</sup> Cs	$\beta-$	1175.63	0.0	7/2+	661.659	11/2-	94.8	2	9.6553	12	
<sup>138</sup> Cs	$\beta-$	5375	0.0	3-	2583.14	1+	1.67	8	9.735	23	
<sup>140</sup> Ba	$\beta-$	1044	0.0	0+	162.6585	2-	3.8	2	9.328	31	
<sup>140</sup> La	$\beta-$	3762.2	0.0	3-	2349.81	5+	0.207	25	10.84	5	
<sup>140</sup> La	$\beta-$	3762.2	0.0	3-	2547.24	1+	0.622	8	10.002	6	
<sup>142</sup> Cs	$\beta-$	7328	0.0	0-	1424.06	2+	1.9	2	8.624	46	
<sup>142</sup> La	$\beta-$	4509	0.0	2-	0.0	0+	13.9	10	10.57	3	
<sup>142</sup> Pr	$\beta-$	2163.7	0.0	2-	0.0	0+	96.3	5	8.9411	29	
<sup>143</sup> Pr	$\beta-$	934.1	0.0	7/2+	742.10	3/2-	1.2E-6	4	12.78	15	
<sup>144</sup> Pr	$\beta-$	2997.4	0.0	0-	696.51	2+	1.04	2	9.241	9	
<sup>145</sup> Cs	$\beta-$	7462	0.0	3/2+	112.64	(7/2)-	4.3	8	8.41	8	P
<sup>145</sup> Sm	$\epsilon$	616.1	0.0	7/2-	492.55	3/2+	0.0033	2	9.422	46	
<sup>145</sup> Eu	$\beta+\epsilon$	2659.9	0.0	5/2+	1423.24	9/2-	0.120	20	10.46	7	
<sup>145</sup> Eu	$\beta+\epsilon$	2659.9	0.0	5/2+	1607.28	1/2-	0.047	15	10.57	14	
<sup>145</sup> Eu	$\epsilon$	2659.9	0.0	5/2+	1780.32	9/2-	0.011	2	10.88	8	
<sup>146</sup> Gd	$\epsilon$	1032	0.0	0+	230.23	2-	26.5	16	8.268	33	
<sup>146</sup> Gd	$\epsilon$	1032	0.0	0+	690.71	(2)-	0.067	10	9.27	8	
<sup>146</sup> Eu	$\beta+\epsilon$	3879	0.0	4-	1811.694	6+	2.09	14	10.026	30	
<sup>147</sup> Pm	$\beta-$	224.06	0.0	7/2+	197.298	3/2-	4.8E-7	8	12.00	7	
<sup>147</sup> Eu	$\epsilon$	1721.4	0.0	5/2+	809.355	9/2-	0.0276	19	11.154	32	
<sup>148</sup> Eu	$\epsilon$	3039	0.0	5-	2391.77	7+	0.016	3	11.12	9	
<sup>149</sup> Pm	$\beta-$	1071.5	0.0	7/2+	350.08	3/2-	0.0013	3	11.68	10	
<sup>149</sup> Pm	$\beta-$	1071.5	0.0	7/2+	664.40	11/2-	0.00077	11	10.69	6	
<sup>149</sup> Eu	$\epsilon$	694.6	0.0	5/2+	590.880	9/2-	0.000142	14	9.96	8	
<sup>150</sup> Tb	$\beta+\epsilon$	4658	0.0	(2)-	1207.139	0+	1.02	23	9.90	10	
<sup>150</sup> Tb	$\beta+\epsilon$	4658	0.0	(2)-	1288.42	4+	1.70	30	9.62	8	
<sup>152</sup> Eu	$\beta-$	1818.8	45.5998	0-	344.29	2+	1.7	3	9.58	8	
<sup>152</sup> Tb	$\beta+\epsilon$	3990	0.0	2-	0.0	0+	25.0	40	9.54	7	
<sup>152</sup> Tb	$\beta+\epsilon$	3990	0.0	2-	615.38	0+	6.85	24	9.722	26	
<sup>152</sup> Tb	$\beta+\epsilon$	3990	0.0	2-	1047.78	0+	1.35	7	10.145	34	
<sup>152</sup> Pm	$\beta-$	3509	1.5E+2	4-	1085.77	2+	1.7	3	8.98	12	P

**Table 13**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	$\text{Log } ft$	Unc.	Pand.
<sup>154</sup> Ho	$\beta+\epsilon$	5755	0.0	2-	747.02	4+	7.2	10	8.73	6	P
<sup>156</sup> Eu	$\beta-$	2452.5	0.0	0+	1319.63	2-	0.28	5	11.26	8	
<sup>156</sup> Eu	$\beta-$	2452.5	0.0	0+	1780	2-	0.022	5	11.18	10	
<sup>156</sup> Eu	$\beta-$	2452.5	0.0	0+	2121.42	2-	0.13	1	8.924	39	
<sup>156</sup> Eu	$\beta-$	2452.5	0.0	0+	2199.50	2-	0.079	8	8.62	5	
<sup>159</sup> Dy	$\epsilon$	364.73	0.0	3/2-	137.507	7/2+	0.0028	6	10.39	9	
<sup>161</sup> Tb	$\beta-$	593.7	0.0	3/2+	212.923	7/2-	0.0117	16	9.95	6	
<sup>166</sup> Ho	$\beta-$	1853.8	0.0	0-	80.5775	2+	49.9	12	9.031	11	
<sup>166</sup> Ho	$\beta-$	1853.8	0.0	0-	785.865	2+	0.0070	12	11.67	7	
<sup>166</sup> Ho	$\beta-$	1853.8	0.0	0-	1528.12	2+	0.00268	12	9.534	20	
<sup>166</sup> Lu	$\beta+\epsilon$	5573	0.	6-	330.48	4+	4.2	14	8.51	15	P
<sup>167</sup> Tm	$\epsilon$	746.1	0.0	1/2+	346.5	5/2-	0.025	5	9.43	9	
<sup>168</sup> Tm	$\epsilon$	1676.9	0.0	3+	1358.910	1-	0.0466	23	9.717	24	
<sup>169</sup> Er	$\beta-$	353.5	0.0	1/2-	118.18945	5/2+	0.0048	10	9.61	9	
<sup>169</sup> Yb	$\epsilon$	899.1	0.0	7/2+	474.970	(3/2)-	3.55E-4	8	11.961	11	
<sup>169</sup> Lu	$\beta+\epsilon$	2293.0	0.0	7/2+	929.17	11/2-	0.33	7	9.84	9	
<sup>170</sup> Lu	$\beta+\epsilon$	3458	0.0	0+	1717.95	(2)-	0.26	7	10.53	12	
<sup>171</sup> Er	$\beta-$	1492.4	0.0	5/2-	0.0	1/2+	2.3	2	9.415	38	
<sup>171</sup> Lu	$\epsilon$	1478.4	0.0	7/2+	487.28	11/2-	0.013	4	11.43	13	
<sup>171</sup> Lu	$\epsilon$	1478.4	0.0	7/2+	902.251	3/2-	0.151	5	9.353	18	
<sup>172</sup> Tm	$\beta-$	1882	0.0	2-	0.0	0+	29	4	9.83	6	
<sup>172</sup> Tm	$\beta-$	1882	0.0	2-	260.269	4+	1.16	23	10.86	9	
<sup>172</sup> Tm	$\beta-$	1882	0.0	2-	1042.84	0+	0.29	3	9.921	47	
<sup>172</sup> Tm	$\beta-$	1882	0.0	2-	1286.4	4+	0.0089	25	10.68	12	
<sup>172</sup> Lu	$\beta+\epsilon$	2519.4	0.0	4-	1465.964	2+	0.23	7	10.20	13	
<sup>172</sup> Lu	$\epsilon$	2519.4	0.0	4-	1608.62	2+	0.063	15	10.49	10	
<sup>175</sup> Ta	$\beta+\epsilon$	2073	0.0	7/2+	196.43	3/2-	3.70	30	8.919	45	
<sup>182</sup> Hf	$\beta-$	381	0.0	0+	270.408	2-	100		12.62	9	
<sup>182</sup> Re	$\epsilon$	2.80E3	0.0	7+	1809.66	5-	7.1	23	8.33	26	
<sup>185</sup> W	$\beta-$	431.2	0.0	3/2-	125.358	7/2+	0.072	3	9.970	19	
<sup>186</sup> Re	$\beta-$	1072.7	0.0	1-	910.6	3+	2.2E-5	7	11.04	14	
<sup>186</sup> Ir	$\beta+\epsilon$	3828	0.0	5+	1480.4	(3)-	1.40	30	10.08	9	
<sup>187</sup> Re	$\beta-$	2.4709	0.0	5/2+	0.0	1/2-	100		11.026	7	
<sup>187</sup> Pt	$\beta+\epsilon$	2864	0.0	3/2-	285.08	7/2+	5.4	6	8.85	6	
<sup>187</sup> Pt	$\beta+\epsilon$	2864	0.0	3/2-	471.22	7/2+	2.00	30	9.14	7	
<sup>193</sup> Os	$\beta-$	1141.9	0.0	3/2-	357.764	7/2+	0.013	4	10.94	13	
<sup>196</sup> Au	$\epsilon$	1505.8	0.0	2-	877.0	4+	0.380	15	9.238	20	
<sup>196</sup> Tl	$\beta+\epsilon$	4329	0.0	2-	1060.9	4+	3.8	11	9.43	13	P
<sup>197</sup> Pb	$\beta+\epsilon$	3609	319.31	13/2+	2019.31	17/2-	1.20	30	8.57	11	P
<sup>198</sup> Au	$\beta-$	1373.52	0.0	2-	0.0	0+	0.025	5	12.35	9	
<sup>198</sup> Tl	$\beta+\epsilon$	3426	543.5	7+	1910.6	9-	1.80	40	8.92	10	P
<sup>200</sup> Tl	$\beta+\epsilon$	2456	0.0	2-	0.0	0+	6.26	40	9.840	31	
<sup>201</sup> Bi	$\beta+\epsilon$	3842	0.0	9/2-	629.1	13/2+	19.0	30	8.74	7	
<sup>202</sup> Tl	$\beta+\epsilon$	1364.9	0.0	2-	0.0	0+	5.0	11	9.93	10	
<sup>202</sup> Pb	$\epsilon$	39.8	0.0	0+	0.0	2-	100		8.95	14	
<sup>203</sup> Bi	$\beta+\epsilon$	3262	0.0	9/2-	825.2	13/2+	6.9	12	9.51	8	
<sup>203</sup> At	$\beta+\epsilon$	5148	0.0	9/2-	641.54	13/2+	18.6	12	8.317	31	P
<sup>204</sup> Tl	$\epsilon$	344.1	0.0	2-	0.0	0+	2.92	7	9.569	18	
<sup>204</sup> Tl	$\beta-$	763.75	0.0	2-	0.0	0+	97.08	7	10.1736	15	
<sup>205</sup> Pb	$\epsilon$	50.6	0.0	5/2-	0.0	1/2+	100		11.739	27	
<sup>205</sup> Bi	$\epsilon$	2704.6	0.0	9/2-	1842.05	(13/2)+	0.157	22	10.73	6	
<sup>207</sup> Bi	$\epsilon$	2397.4	0.0	9/2-	1633.358	13/2+	84.0	5	10.658	12	
<sup>207</sup> At	$\beta+\epsilon$	3918	0.0	9/2-	1115.071	13/2+	6.7	19	9.03	12	

**Table 13**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	$\text{Log } ft$	Unc.	Pand.
<sup>208</sup> Bi	$\varepsilon$	2878.4	0.0	5+	2614.5	3-	100		12.538	22	
<sup>225</sup> Rn	$\beta^-$	2714	0.0	7/2-	142.59	(3/2)+	2.4	3	9.13	6	
<sup>228</sup> Fr	$\beta^-$	4444	0.0	2-	204.68	4+	7.8	18	9.05	10	P

## 17. Second Forbidden Transitions

### 17.1. Second forbidden non-unique

**Table 14**

List of second forbidden non-unique transitions with  $\Delta J=2$  and  $\Delta\pi=no$ .

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	$\text{Log } ft$	Unc.	Pand.
<sup>36</sup> Cl	$\beta+/\varepsilon$	1142.13	0.0	2+	0.0	0+	1.90	10	14.230	24	
<sup>36</sup> Cl	$\beta^-$	709.534	0.0	2+	0.0	0+	98.1	1	13.6665	22	
<sup>46</sup> Sc	$\beta^-$	2366.6	0.0	4+	889.286	2+	3.6E-3	7	13.81	8	
<sup>53</sup> Mn	$\varepsilon$	597.27	0.0	7/2-	0.0	3/2-	100		12.994	48	
<sup>55</sup> Fe	$\varepsilon$	231.12	0.0	3/2-	126.0	7/2-	1.3E-7	1	12.762	34	
<sup>59</sup> Fe	$\beta^-$	1564.88	0.0	3/2-	0.0	7/2-	0.18	4	12.05	10	
<sup>59</sup> Ni	$\beta+/\varepsilon$	1073.01	0.0	3/2-	0.0	7/2-	99.9970	30	12.532	29	
<sup>60</sup> Fe	$\beta^-$	237.3	0.0	0+	58.603	2+	100		11.834	39	
<sup>89</sup> Sr	$\beta^-$	1502.18	0.0	5/2+	908.960	9/2+	0.00964	5	11.2944	26	
<sup>91</sup> Nb	$\beta+/\varepsilon$	1257.6	0.0	9/2+	0.0	5/2+	100.		11.37	8	
<sup>93</sup> Zr	$\beta^-$	90.8	0.0	5/2+	0.0	9/2+	27	6	11.30	10	
<sup>94</sup> Nb	$\beta^-$	2045.0	0.0	6+	1573.72	4+	100		12.003	11	
<sup>95</sup> Zr	$\beta^-$	1126.3	0.0	5/2+	0.0	9/2+	0.103	11	11.875	46	
<sup>95</sup> Nb	$\beta^-$	925.60	0.0	9/2+	0.0	5/2+	0.030	5	11.70	7	
<sup>97</sup> Tc	$\varepsilon$	320.3	0.0	9/2+	0.0	5/2+	100		12.798	34	
<sup>98</sup> Tc	$\beta^-$	1793	0.0	6+	1397.77	4+	100		13.984	48	
<sup>99</sup> Tc	$\beta^-$	297.5	0.0	9/2+	0.0	5/2+	99.9984	4	12.104	7	
<sup>129</sup> I	$\beta^-$	188.9	0.0	7/2+	39.578	3/2+	100	1	12.893	41	
<sup>134</sup> Cs	$\varepsilon$	1234.669	0.0	4+	847.0	2+	0.00030	12	12.77	17	
<sup>135</sup> Cs	$\beta^-$	268.70	0.0	7/2+	0.0	3/2+	100		12.96	6	
<sup>137</sup> Cs	$\beta^-$	1175.63	0.0	7/2+	0.0	3/2+	5.2	2	12.778	17	
<sup>137</sup> La	$\varepsilon$	580.5	0.0	7/2+	0.0	3/2+	100		12.53	14	
<sup>148</sup> Eu	$\varepsilon$	3039	0.0	5-	2128.62	7-	0.106	25	10.92	10	
<sup>148</sup> Eu	$\varepsilon$	3039	0.0	5-	2339.19	3-	0.0056	6	11.72	5	
<sup>158</sup> Tb	$\varepsilon$	1219.1	0.0	3-	977.136	1-	0.319	18	11.086	38	
<sup>207</sup> Bi	$\beta+/\varepsilon$	2397.4	0.0	9/2-	569.6988	5/2-	8.9	5	13.246	26	
<sup>208</sup> Po	$\varepsilon$	1400.9	0.0	0+	925.06	2+	0.0040	4	13.050	45	

### 17.2. Second forbidden unique

**Table 15**

List of second forbidden unique transitions with  $\Delta J=3$  and  $\Delta\pi=no$ .

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	$\text{Log } ft$	Unc.	Pand.
<sup>10</sup> Be	$\beta^-$	556.88	0.0	0+	0.0	3+	100.0		13.8383	38	
<sup>22</sup> Na	$\beta+/\varepsilon$	2843.32	0.0	3+	0.0	0+	0.056	14	14.93	11	
<sup>26</sup> Al	$\beta+/\varepsilon$	4004.40	0.0	5+	1808.72	2+	97.24	20	15.726	16	
<sup>26</sup> Al	$\beta+/\varepsilon$	4004.40	0.0	5+	2938.41	2+	2.74	20	14.577	46	
<sup>60</sup> Co	$\beta^-$	2822.81	0.0	5+	1332.508	2+	0.12	3	14.71	11	
<sup>92</sup> Nb	$\varepsilon$	2005.7	0.0	7+	1495.6	4+	100		14.460	35	
<sup>99</sup> Tc	$\beta^-$	297.5	0.0	9/2+	89.50	3/2+	0.0016	4	15.84	11	

**Table 15**  
(continued)

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	$\text{Log } ft$	Unc.	Pand.
<sup>115</sup> In	$\beta^-$	497.489	0.0	9/2+	497.342	3/2+	0.000102	13	14.59	12	<sup>4</sup>
<sup>137</sup> Cs	$\beta^-$	1175.63	0.0	7/2+	283.50	1/2+	0.00058	8	16.64	6	
<sup>138</sup> La	$\varepsilon$	1748.40	0.0	5+	1435.803	2+	65.5	4	17.326	11	
<sup>138</sup> La	$\beta^-$	1052.46	0.0	5+	788.744	2+	34.5	4	18.081	8	
<sup>209</sup> Po	$\varepsilon$	1892.6	0.0	1/2-	896.28	7/2-	0.454	7	14.571	14	

## 18. Third Forbidden Transitions

### 18.1. Third Forbidden non-unique

**Table 16**

List of third forbidden non-unique transitions with  $\Delta J=3$  and  $\Delta\pi=\text{yes}$ .

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	$\text{Log } ft$	Unc.	Pand.
<sup>87</sup> Rb	$\beta^-$	282.275	0.0	3/2-	0.0	9/2+	100		17.0724	25	

### 18.2. Third forbidden unique

**Table 17**

List of third forbidden unique transitions with  $\Delta J=4$  and  $\Delta\pi=\text{yes}$ .

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	$\text{Log } ft$	Unc.	Pand.
<sup>40</sup> K	$\beta+/\varepsilon$	1504.40	0.0	4-	0.0	0+	0.099	25	21.64	11	
<sup>40</sup> K	$\beta^-$	1310.91	0.0	4-	0.0	0+	89.59	5	20.5932	10	

## 19. Fourth Forbidden Transitions

### 19.1. Fourth forbidden non-unique

**Table 18**

List of fourth forbidden non-unique transitions with  $\Delta J=4$  and  $\Delta\pi=\text{no}$ .

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	$\text{Log } ft$	Unc.	Pand.
<sup>50</sup> V	$\varepsilon$	2208.63	0.0	6+	1553.77	2+	99.3	7	24.338	27	
<sup>113</sup> Cd	$\beta^-$	323.84	0.0	1/2+	0.0	9/2+	100		22.8060	38	
<sup>115</sup> In	$\beta^-$	497.489	0.0	9/2+	0.0	1/2+	100		22.991	25	

<sup>4</sup>Lowest beta transition energy in our tables. Determination of  $\text{log } ft$  without atomic overlap (cf. section 2).

## 20. Additional tables of interest

### 20.1. Lowest and highest $\log ft$ values

**Table 19**

Compilation of the five transitions with the lowest, and highest  $\log ft$  values of this work, respectively.

Nuclide	Decay	$Q$ [keV]	$E_P$ [keV]	$J\pi$	$E_D$ [keV]	$J\pi$	Branch [%]	Unc.	$\log ft$	Unc.	Pand.
<sup>9</sup> Li	$\beta^-$	1.360645E4	0.0	3/2-	11810	5/2-	2.65	27	2.574	49	
<sup>100</sup> Sn	$\beta^+/\varepsilon$	7.03E3	0.0	0+	2745	1+	100.		2.66	14	
<sup>6</sup> He	$\beta^-$	3505.21	0.0	0+	0.0	1+	100		2.90924	8	
<sup>31</sup> Ar	$\beta^+/\varepsilon$	1.836E4	0.0	5/2+	12282	5/2+	5.30	30	2.98	9	P
<sup>1</sup> n	$\beta^-$	782.34700	0.0	1/2+	0.0	1/2+	100		3.01944	25	
<sup>40</sup> K	$\beta^-$	1310.91	0.0	4-	0.0	0+	89.59	5	20.5932	10	
<sup>40</sup> K	$\beta^+/\varepsilon$	1504.40	0.0	4-	0.0	0+	0.099	25	21.64	11	
<sup>113</sup> Cd	$\beta^-$	323.84	0.0	1/2+	0.0	9/2+	100		22.8060	38	
<sup>115</sup> In	$\beta^-$	497.489	0.0	9/2+	0.0	1/2+	100		22.991	25	
<sup>50</sup> V	$\varepsilon$	2208.63	0.0	6+	1553.77	2+	99.3	7	24.338	27	