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The NUBASE2012 evaluation of nuclear properties*

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Abstract This paper presents the NUBASE2012 evaluation that contains the recommended values for nuclear and decay properties of nuclides in their ground and excited isomeric ($T_{1/2} \geq 100$ ns) states. All nuclides for which some experimental information is known are considered. NUBASE2012 covers all up to date experimental data published in primary (journal articles) and secondary (mainly laboratory reports and conference proceedings) references, together with the corresponding bibliographical information. During the development of NUBASE2012, the data available in the "Evaluated Nuclear Structure Data File" (ENSDF) database were consulted, and critically assessed of their validity and completeness. Furthermore, a large amount of new and somewhat older experimental results that were missing in ENSDF were compiled, evaluated and included in NUBASE2012. The atomic mass values were taken from the "Atomic Mass Evaluation" (AME2012, second and third parts of the present issue). In cases where no experimental data were available for a particular nuclide, trends in the behavior of specific properties in neighboring nuclei (TNN) were examined. This approach allowed to estimate, whenever possible, values for a range of properties, and are labeled in NUBASE2012 as "non-experimental" (flagged "#"). Evaluation procedures and policies that were used during the development of this database are presented, together with a detailed table of recommended values and their uncertainties.

AMDC: http://amdc.in2p3.fr/ and http://amdc.impcas.ac.cn/

1 Introduction

The NUBASE2012 evaluation responds to the needs expressed by the broader nuclear physics community, from fundamental physics to applied nuclear sciences, for a database that contains values of the main nuclear properties such as masses, excitation energies of isomers, half-lives, spins and parities, decay modes and their intensities, for all known nuclei in their ground and excited isomeric states. The information presented in NUBASE2012 represents the fundamental building blocks of the modern nuclear physics, and specifically, of the nuclear structure and nuclear astrophysics research.

The main application of NUBASE2012 is the "Atomic Mass Evaluation" (AME2012, second and third parts of this issue) where it is imperative to have an unambiguous identification of all states involved in a particular decay, reaction or mass-spectrometer measurement. This is the primary reason for which the two evaluations are coupled together in the present issue, for the second time since the existence of the "Atomic Mass Evaluation".

Furthermore, with the advances of modern mass-spectrometry techniques (see for example Ref. [1] for a recent review) and the availability of intense stable and rare-isotope beams, a large number of unstable nuclei can be produced in a single experiment in their ground and/or isomeric states, and their masses measured with high precision. Thus, NUBASE2012 can be particularly useful for future mass measurements, where an unambiguous identification of complex mass-spectrometry data would be required.

Applications of this database in astrophysics network calculations and in theoretical studies of nuclear properties, where complete and reliable data for all known nuclei are needed, are also envisioned.

Least, but not last, the evaluated data presented in NUBASE2012 could also be useful for specialists in a

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number of applied nuclear fields, such as reactor engineering and design, fuel manufacture and transport, waste management, material analysis, medical diagnostics and radiotherapy, and anywhere when one needs to access basic information on any nuclide.

The information presented in NUBASE2012 fulfills several user-demanded requirements, namely that it is: a) *complete* – includes all measured quantities and their uncertainties, b) *up-to-date* – results from the most recent publications are included, c) *credible and reliable* – identifies and resolves contradictory results that exist in the scientific literature, as well as in other nuclear physics databases, d) *properly referenced* – provides comprehensive information on the validity of all included data.

Most of the data included in NUBASE2012 are in principle available in two other evaluated databases: the "Evaluated Nuclear Structure Data File" (ENSDF) [2] and the "Atomic Mass Evaluation" (AME2012). Therefore, the demand for NUBASE could be partially fulfilled by combining these two databases into a single, 'horizontal' structure, which exists in AME, but not in ENSDF. Therefore, NUBASE2012 could be considered, at a first level, as a critical compilation of those two evaluations.

During the development of the present version of NUBASE, it was imperative to examine all available literature for several nuclides in order to revise results adopted in ENSDF, and to ensure that the recommended data are presented in a consistent way (*credibility and reliability* requirement). It was also necessary to include all the available experimental data, i.e. not only results that were published recently (*up-to-date* requirement), but also somewhat older data that were missing in ENSDF (*completeness* requirement). This implied that some extra evaluation work was carried out, and the corresponding conclusions are added as remarks in the NUBASE2012 table, and in the discussions below. Complete bibliographical references are given for all added experimental data in Table I (see Section 2.7).

There is no strict literature cut-off date for the results presented in the NUBASE2012 evaluation: all data available to the authors until the material was sent for publication (November 18, 2012) have been included. Results that were not incorporated for special reasons, e.g. the need for a heavy revision of the evaluation at a too late stage of development, are added, whenever possible, in remarks to the relevant data.

Note added in proof: ref. [2012Ku.1] reports a large amount of important information, in particular the identification of a series of $N-Z=42$ nuclides between Eu and Yb that we include without any estimated mass, half-life or spin/parity.

The contents of NUBASE2012 are described below, together with the adopted policies that were used during the development of this database. Section 3 presents the updating procedures, while the electronic distribution and interactive display of NUBASE2012 contents by means of a World Wide Web Java program, and by a stand-alone PC-program are described in Section 4.

The present publication includes and updates all the information given in the previous versions of NUBASE: NUBASE1997 [3], and NUBASE2003 [4].

2 Contents of NUBASE2012

The NUBASE2012 evaluation contains recommended values for some of the basic nuclear ground state properties, for 3350 nuclides, derived from all available experimental results, together with some values estimated by extrapolating neighboring ones.

NUBASE2012 also contains data on isomeric states (see Section 2.2 for our current definition). We presently know 1256 nuclides which have one, or more, excited isomers in accordance with our definition. In the very first version, NUBASE1997, we used a limited definition of isomers where only states with half-lives greater than 1 millisecond were considered. In NUBASE2003 we started to extend the definition of isomers to nuclidic species living longer than 100 ns. Now, in NUBASE 2012, we include all isomers that have half-lives beyond 100 ns. We also include the description of those states that are involved in mass measurements and thus found in AME2012, see there, Part I, Section 1.1, p. 1288).

NUBASE2012 also contains data on 186 isobaric analog states (IAS), which have their excitation energies determined either through an "internal relation" and taken from ENSDF, or through an "external relation" and then determined by the AME2012 evaluation.

For each nuclide (A, Z), and for each state (ground or excited isomer), the following properties were compiled and, when necessary, evaluated: mass excess, excitation energy of excited isomeric states, half-life, spin and parity, decay modes and their intensities, isotopic abundance (for a stable nuclide), year of discovery and the corresponding bibliographical information for all experimental values of the above items.

References to published articles in the description sections below are given by means of the keynumber style used in the "Nuclear Science Reference" (NSR) bibliographical database [5]. However, references quoted in the NUBASE2012 tables are abbreviated with the first two digits of the year of publication being omitted from the NSR keynumbers. The complete reference list is given at the end of this issue, together with the references used in AME (see AME2012, Part II, p. 1863 in this issue).

In NUBASE1997, the names and chemical symbols used for elements 104 to 109 were those recommended by the Commission on Nomenclature of Inorganic Chemistry of the International Union of Pure and Applied Chemistry (IUPAC) [6] at that time. Unfortunately, those names were changed shortly before the publication of NUBASE2003, and two of them were displaced, thus resulting in some confusion (see also AME2012, Part I, Section 6.8, p. 1317). Therefore, the users should be careful when comparing results between NUBASE1997, NUBASE2003 and the present NUBASE2012 evaluations for nuclides with $Z \geq 104$. The final adopted names and symbols, as recommended by IUPAC are:

104	rutherfordium	(Rf),
105	dubnium	(Db),
106	seaborgium	(Sg),
107	bohrium	(Bh),
108	hassium	(Hs),
109	meitnerium	(Mt),
110	darmstadtium	(Ds),
111	roentgenium	(Rg),
112	copernicium	(Cn),
114	flerovium	(Fl), and
116	livermorium	(Lv).

The provisional symbols Ed, Ef, Eh, and Ei are used in NUBASE2012 for yet unnamed elements with $Z = 113$, 115, 117, and 118, respectively.

NUBASE2012 contains numerical and bibliographical data for all known nuclides for which at least one property is known experimentally, in their ground state, excited isomeric states with $T_{1/2} \geq 100$ ns, and isobaric analog states. However, it also includes information on, as yet, unobserved nuclides. These were estimated from the observed trends in experimental data of neighboring nuclei (TNN), in order to ensure continuity in the set of considered nuclides simultaneously in N, in Z, in A and in $N - Z$. The chart of nuclides defined in this way has a smooth contour.

For the yet experimentally unknown properties, values were estimated, here also, from the observed trends in experimental data of neighboring nuclei (TNN). Similarly to AME2012, where masses estimated from trends in the mass surface (TMS) are flagged with the symbol '#', the same symbol is used in NUBASE2012 to indicate TNN non-experimental information.

Such an approach allowed to follow the behavior of a particular nuclear property as a function of N and Z in a consistent way, and it proved beneficial in deducing values for other relevant properties. For example, the excitation energy of the J^{π}=11/2^{-} ($h_{11/2}$) isomer in ^{179}Tl is not known experimentally. However, from the extrapolation of values known for the same configuration in the neighboring ^{177}Tl^{m}, ^{181}Tl* and ^{183}Tl^{m} nuclides, one can estimate E_x=825#(10#) keV for ^{179}Tl^{m}. This value, together with the known decay properties of the daughter (^{175}Au^{m}) and grand-daughter (^{171}Ir^{m}) nuclides, allowed to obtain estimates of the excitation energies of similar isomers in the latter nuclides at E_x=167#(12#) and 160#(14#) keV, respectively, which are not directly measured yet.

As a rule, one standard deviations (1 σ) are used in NUBASE2012 to represent the uncertainties associated with the quoted experimental values. Unfortunately, authors of research articles do not always define the meaning of their reported uncertainties and, under such circumstances, those values were assumed to be one standard deviations. In many cases, uncertainties are not even given at all. They are estimated by us, considering the limitations of the experimental method.

Values and corresponding uncertainties for properties given in NUBASE2012 are rounded off, even if unrounded values were given in the literature or in ENSDF. In cases where the two furthest-left significant digits in the uncertainty were larger than a given limit (set to *30* for the energy levels, and to be consistent with AME2012, and set at *25* for all other quantities, as used in ENSDF), values and uncertainties were rounded off accordingly (see examples in the 'Explanation of table'). In a few cases, that were deemed essential for traceability purposes (e.g. isotopic abundances), the original (unrounded) value is also provided in the associated comment.

2.1 Mass excess

In NUBASE2012 the mass excess values (in keV), defined as being differences between the atomic mass (in mass units) and the mass number, together with their one standard deviation uncertainty, are taken from the mass tables of the AME2012 evaluation (in the third part of this issue, see p. 1608).

In general, knowledge of masses can provide valuable information on decay modes, and in particular on particle-decay instability, or beta-delayed particle-decay, for nuclei far from the line of stability. Such information is used in NUBASE2012, and can be seen, for example, in ^{10}He, ^{39}Sc, ^{62}As, or ^{63}As. In some cases, the claimed observations of decay modes were rejected when it was found that they were not allowed through simple energetics.

Fig. 1 is a complement of the main table, and displays the mass precisions, in a color-coded chart, as a function of N and Z.

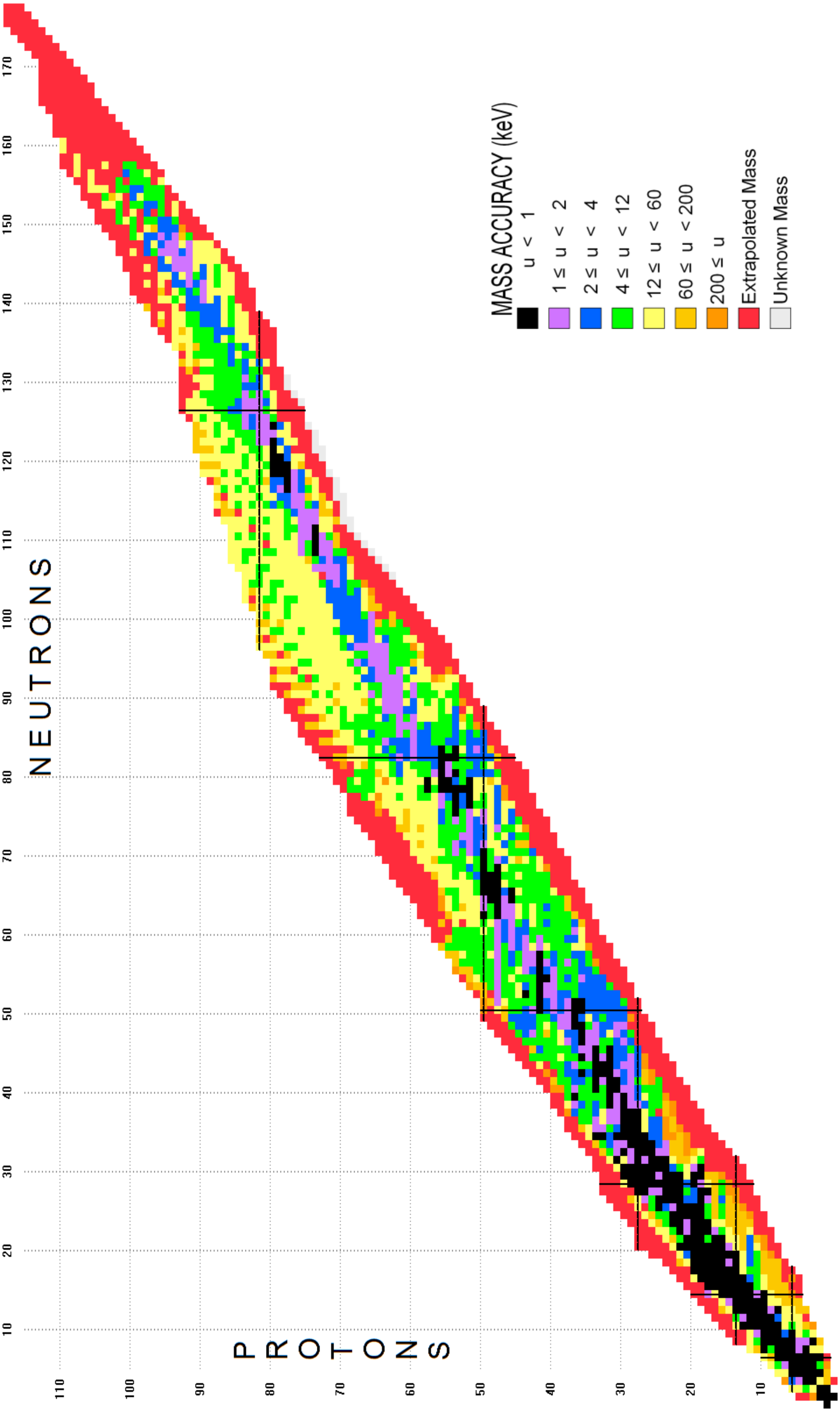

Figure 1: Chart of the nuclides displaying the accuracy 'u' of masses (created by NUCLEUS-AMDC).

2.2 Isomers

In the very first version of NUBASE in 1997 [3], a simple definition for excited isomers, as being excited states with a half-life longer than 1 millisecond, was adopted. All β-decaying states were included in this category, since they have a lower half-life limit of $\sim$1 millisecond (the shortest-lived known β-decaying nuclide is ^{35}Na with a half-life of 1.5 millisecond). However, already at that time, it was noticed that such a definition had several drawbacks, particularly for neutron-deficient alpha- and proton-decaying nuclides, where much shorter-lived states were known to exist. Moreover, several cases are known where isomers with half-lives far below 1 millisecond survive longer than the ground state itself (e.g. ^{216}Fr).

In NUBASE2003, the definition of isomers was extended to include excited states with half-lives longer than 100 ns, and in this new edition all such states are now included. The main reasons for this change were to include:
a) all shorter-lived proton- and alpha-decaying states observed in many neutron-deficient nuclei,
b) short-lived isomers that may be detected in mass-spectrometry experiments performed at accelerator facilities following the immediate detection of the produced nuclei, and
c) all possible isomers that may be detected in such experiments in the future.

In NUBASE2012, isomers are given in order of increasing excitation energy, and identified by appending the letters '*m*', '*n*', '*p*', '*q*', or '*r*' to the nuclide name, e.g. ^{90}Nb for the ground state, $^{90}\mathrm{Nb}^{m}$ for the first excited isomer, $^{90}\mathrm{Nb}^{n}$ for the second one, and $^{90}\mathrm{Nb}^{p}$, $^{90}\mathrm{Nb}^{q}$, and $^{90}\mathrm{Nb}^{r}$ for the third, fourth and fifth ones, respectively. In only two instances, ^{179}Ta and ^{214}Ra, a sixth isomer had to be included. They were labeled provisionally with the letter '*x*'.

The excitation energy of a given isomer can be determined using different experimental methods, which, in general, belong to the category of either internal or external relations. A typical internal relation is via the γ-ray decay energy, or a combination of such γ-ray energies. The most accurate values for the excitation energies of isomers that are deduced by this approach can be found in ENSDF, where a least-squares fitting procedure is applied to all γ rays along the decay path of a particular isomer. However, when no such internal relations can be established, then the relation to other nuclides (external relations) can be used to deduce the mass (or energy) difference between excited and ground state isomers. In all such cases, the most accurate values can only be derived using the AME evaluation procedure. The values are therefore taken from AME2012. The origin (the method used to establish the external relation) of each isomer data element is then indicated by a two-letter code, next to the isomer excitation energy, in the NUBASE2012 table (see the Explanation of Table I, p. 1176). For internal relations, the origin field is left blank and the numerical values are taken either from ENSDF or from literature updates. In the latter case, a least-squares fit to the measured γ-ray decay energies from complex level schemes was applied, in accordance with the current ENSDF policies.

An interesting example is the proton decay of ^{167}Ir, studied using a parent-daughter correlation technique [1997Da07], where the excitation energy of the isomer was determined as $E_x = 175.3(2.2)$ keV. This information is displayed by the 'p' symbol in the origin field. In addition, recent α-decay studies of proton-rich nuclides using a spatial and time correlation technique with highly-segmented silicon strip detectors not only showed that a number of α lines assigned earlier to ground states belong in reality to isomers, but they also determined values for their excitation energies.

Another example is ^{181}Pb, where the α-decay half-life that was previously assigned to $^{181}\mathrm{Pb}^{m}$ is now associated with the ground state [1996To01]. More recent work [2005Ca.A, 2005Ca43,2009An20] established that the main α line feeds the 77 keV excited state in ^{177}Hg, and subsequently decays to the ground state via γ-ray emission.

It also happens that connections between excited and ground state isomers can be obtained by both internal relations and one, or more, external relations with comparable accuracies. All relations are then combined within the AME2012 data by adding an equation that relates the excitation energy obtained from ENSDF (or from literature), so that the AME2012 derives the best combination of all data. For example, the AME2012 derives the mass of $^{178}\mathrm{Lu}^{m}$ at 66% from E_x(IT)=120(3) keV [1993Bu02] and at 34% from ^{176}Lu(t,p)$^{178}\mathrm{Lu}^{m}$=4482(5) keV [1981Gi01]. The adjusted excitation energy is thus 123.8(2.6) keV.

In some cases excitation energies known from internal relations are essential in order to determine the mass of the ground state. Those values are labeled in the NUBASE table with 'IT' in the origin field. They are entered as an equation in AME2012 so that the ground state mass can be derived (e.g. $^{72}\mathrm{Zn}^{m}$, $^{197}\mathrm{Pb}^{m}$, or $^{234}\mathrm{Pa}^{m}$). Similarly, when the precision of the excitation energy is not much higher than that deduced from the energy relation to another nuclide, the internal relation is then added to the AME2012 dataset, in order to use this accuracy (e.g. $^{181}\mathrm{Hg}^{m}$ or $^{185}\mathrm{Tl}^{m}$). An interesting case is the mass and excitation energy of the second excited isomer of ^{186}Tl ($^{186}\mathrm{Tl}^{n}$), where only its mass is experimentally known from a Penning trap (ISOLTRAP) measurement [2012Bo.A]. However, the well known transition from ^{186}Tl^n to ^{186}Tl^m allows to determine not only the mass of the latter isomer, but also the excitation energy of the α-decaying isomer in the parent nuclide, ^{190}Bi^m.

When the existence of an isomer is under discussion, it is flagged with 'EU' ("existence uncertain") in the origin field (e.g. ^{73}Zn^n). A comment is generally added to indicate why this existence is questioned, or where this matter is discussed in more detail. Depending on the degree of confidence in the existence of a particular state, the mass excess and excitation energy values can be given or omitted in the NUBASE table (e.g. ^{138}Pm^n). In the latter case, the label "non existent" appears in the place of the excitation energy field.

When a particular isomer was initially reported as "discovered", but later it was proved to be an error, it is flagged with 'RN' in the origin field, indicating "reported, non existent" (e.g. ^{248}Es^m). In such cases, no mass excess or excitation energy values are given, and, similarly to the 'EU' choice above, a "non existent" label is added.

Note: the use of the two flags, 'EU' and 'RN', was extended to cases where the discovery of a nuclide is questioned (e.g. ^{260}Fm or ^{289}Lv). However, an estimate for the ground state mass, derived from trends in the mass surface (TMS), is always given in AME2012 and NUBASE2012.

In several instances, lower and higher limits for the excitation energy of a particular isomer are presented in ENSDF. The policy of NUBASE2012 is that a uniform distribution of probabilities is assumed, which yields a mid-range value and a 1σ uncertainty correspondint to 29% of the range (see Appendix B of the AME2012, Part I, p. 1326, for a complete description of this procedure). For example, the excitation energy of the ^{162}Tm^m isomer is known from ENSDF to be above the 66.90 keV level. However, there is also solid experimental evidence that it is below the 192 keV level, and so this information is presented (after rounding off) as $E_x = 130(40)$ keV in NUBASE2012. When such a value is based on theoretical considerations, or from TNN, the resulting E_x is considered as a non-experimental quantity and the value is consequently flagged with the '#' symbol.

In cases where the uncertainty of the excitation energy, σ, is relatively large as compared to the E_x value, the assignment of the level as a ground or isomeric state is uncertain. If $\sigma > E_x/2$, a '$*$' flag is added in the NUBASE2012 table.

The ordering of several ground and excited isomeric states were reversed as compared to the recommendations in ENSDF. These cases are flagged with the '&' symbol in the NUBASE2012 table. In several other instances, evidence was found for states located below the adopted ground state in ENSDF. There are also cases where the trends in neighboring nuclides, with the same parities in N and Z, strongly suggest that such a lower state should exist. Such results were added in the NUBASE2012 table and are easily located, as they are flagged with the '&' symbol. In a growing number of cases, new experimental information on masses led to a reversal of the ordering between previously assigned ground and excited isomeric states.

Thanks to the coupling of the NUBASE2012 and AME2012 evaluations, all changes in the ordering of nuclear levels have been carefully synchronized.

Finally, there are cases where data exist on the order of the isomers, e.g. if one of them is known to decay into the other one, or if the Gallagher-Moszkowski rule [7] for relative positions of combinations points strongly to one of the two as being the ground-state. Detailed discussions can be found in Ref. [8]. Only for ^{256}Md, we discovered too late, relative to the publication deadline, that the adopted ordering had to be reversed, we only added a remark to ^{256}Md^m (see p. 1278).

2.2.a Isobaric analog states (IAS)

The recent revived interest in isomeric states has naturally led to taking a closer look at the historically very popular subject of isobaric analog states (see AME2012, Part I, Section 6.4, p. 1314). In NUBASE2012 we have included mainly the $T = 3/2$ to $T = 3$ experimentally observed IAS. These states are generally labelled with i or j superscripts, for members of successively higher multiplets.

Some nuclides belong simultaneously to several categories, for example, they may be in their ground state but they may also be the IAS of some other ground state nucleus, as is the general case for ground state mirror nuclei. Here, the IAS label is not present since these nuclides are already naturally included in the database. Another exception is the set of $N = Z$ $T = 1$ odd-odd ground state nuclides, accessible via super-allowed beta decay, and which are also already part of the original dataset of ground state masses. They are: ^{34}Cl$_{17}$, ^{42}Sc$_{21}$, ^{46}V$_{23}$, ^{50}Mn$_{25}$, ^{54}Co$_{27}$, ^{62}Ga$_{31}$ and ^{70}Br$_{35}$. The reader might note that only the $Z = 29$ and $Z = 33$ do not show up in this series, since their ground states are $T = 0$, as expected from theory. Finally, there are eight excited isomers, ^{16}N^m, ^{26}Al^m ^{34}Cl^m, ^{38}K^m, ^{46}V^m, ^{50}Mn^m, ^{54}Co^m and ^{72}Ga^m which are also IAS. In such cases, the isomer labels ('m', 'n',...) are used preferentially over the IAS labels. Here we note with interest that five of them have experimental excitation energies determined, at least partly, by the JYFLTRAP-Jyväskylä Penning trap (see AME2012, Part I, Section 6.2, p. 1311).

In NUBASE2012 there are roughly 180 unique IAS masses, of which 107 are evaluated in the AME via external relations, and 70 cases previously evaluated through internal relations and published in ENSDF. There are a remaining seven cases where no clear experimental data is available, and although some Isobaric Multiplet Mass Equation (IMME) [9] and Coulomb Displacement Energy (CDE) [10] calculations point to a likely IAS state, their existence cannot yet be certified experimentally (see for example ^{56}Zn^{i} and the discussion in [2007Do17]).

The isospin multiplet appartenance given in the table is the logical IAS multiplet value, and has not necessarily been deduced experimentally.

2.3 Half-life

For some light nuclei, the half-life ($T_{1/2}$) is deduced from the total level width ($\Gamma_{\rm cm}$) by the equation $\Gamma_{\rm cm}\, T_{1/2} \simeq \hbar \times \ln 2$:

$$T_{1/2}\,({\rm s}) \simeq 4.562\,10^{-22}/\Gamma_{\rm cm}\,({\rm MeV}).$$

The following units are used for a convenient display: seconds (s) and its sub-units, minutes (m), hours (h), days (d) and years (y) and its sub-units. Conversion between years and seconds or days could follow various definitions: Julian year, Gregorian year, tropical year 1900, epoch 2000,..., differing only slightly from each other. A fixed value of:

1 y = 31 556 926 s or
1 y = 365.2422 d

was adopted in NUBASE2012.

Asymmetric uncertainties for half-lives, $T_{1/2}{}^{+a}_{-b}$, are often presented in the literature. However, in order for these values to be used in practical applications, they need to be symmetrized. A rough symmetrization procedure was used earlier (see AME1995) where the central value was taken as the mid-value between the upper and lower 1σ-equivalent limits, $T_{1/2}+(a-b)/2$, and the uncertainty was defined to be the average of the two uncertainties, $(a+b)/2$. A strict statistical derivation (see Appendix A) shows that a better approximation for the central value can be obtained by using

$$T_{1/2}+0.64\times(a-b).$$

The exact expression for asymmetric uncertainties, adopted in NUBASE2012, is presented in Appendix A.

When two or more independent measurements were reported in the literature, the corresponding values were weighted by their reported precisions and then averaged. While doing this, the NORMALIZED CHI, χ_n (or 'consistency factor' or 'Birge ratio'), as defined in AME2012, Part I, Section 5.2, p. 1306) is considered. Only when χ_n is larger than 2.5, departure from the statistical result is allowed, and the external uncertainty for the average result is adopted. This follows the same policy that is discussed and adopted in AME2012, Part I, Section 5.4, p. 1307. Very rarely, when χ_n is so large that all individual uncertainties can be considered as irrelevant, the arithmetic (unweighed) average is adopted and the corresponding uncertainty is based on the dispersion of the values. In such cases, the list of values that were averaged, together with the χ_n value (when relevant) and the reason for this choice, are given in the NUBASE2012 table. When contradictory (conflicting) results were identified in the literature, a great deal of attention was focused on establishing the reason for such discrepancies, and consequently, to reject the corresponding bad data. The reasons for such decisions are given as comments in the NUBASE2012 table.

In experiments where extremely rare events are detected and where the results are very asymmetric (e.g. studies of super-heavy nuclei), the half-life values reported in different publications were not directly averaged. Instead, when the information presented in the literature was sufficient (e.g. ^{264}Hs or ^{269}Hs), the delay times associated with the individual events were combined, as prescribed by Schmidt *et. al.* [1984Sc13].

Some experimental results are reported in the literature as a range of values with a most probable lower and upper limit. These are treated, as in the case of isomer excitation energies (see preceding page), as a uniform distribution of probabilities.

In the NUBASE2012 table, an upper or a lower limit on the half-life value is given for nuclides identified using a time-of-flight technique. The following policies were considered:

i) For *observed* nuclides, the lower limit for the half-life is given in place of the uncertainty (see ^{44}Si, p. 1188). However, such limits should be used with caution, since it may be far below the actual half-life. In order to avoid confusion, a somewhat more realistic estimate (flagged with #), derived from trends in the half-life values of neighboring nuclides (TNN), is also given.

ii) For nuclides that were sought for, but *not observed*, the upper limit is given in place of the actual half-life uncertainty. Upper limits for a dozen of undetected nuclides were evaluated by F. Pougheon [1993Po.A], based on the time-of-flight of the experimental setup and the production yields expected from TNN (e.g. ^{21}Al).

When ground state half-lives for nuclides with the same parities in Z and N are found to vary smoothly (see Fig. 2), interpolation or extrapolation procedure is used to obtain reasonable estimates for unknown nuclei.

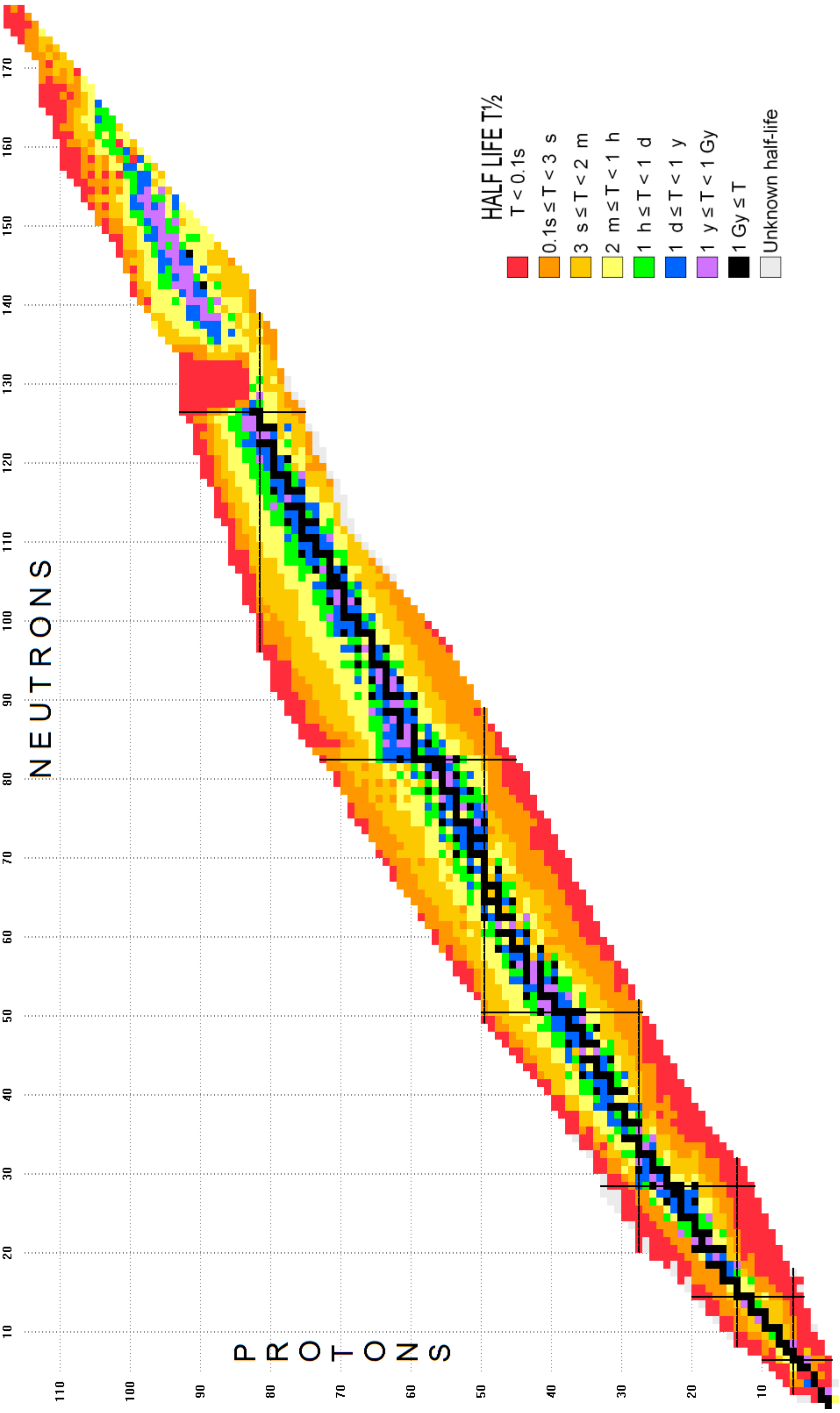

Figure 2: Chart of the nuclides displaying half-lives (created by NUCLEUS-AMDC).

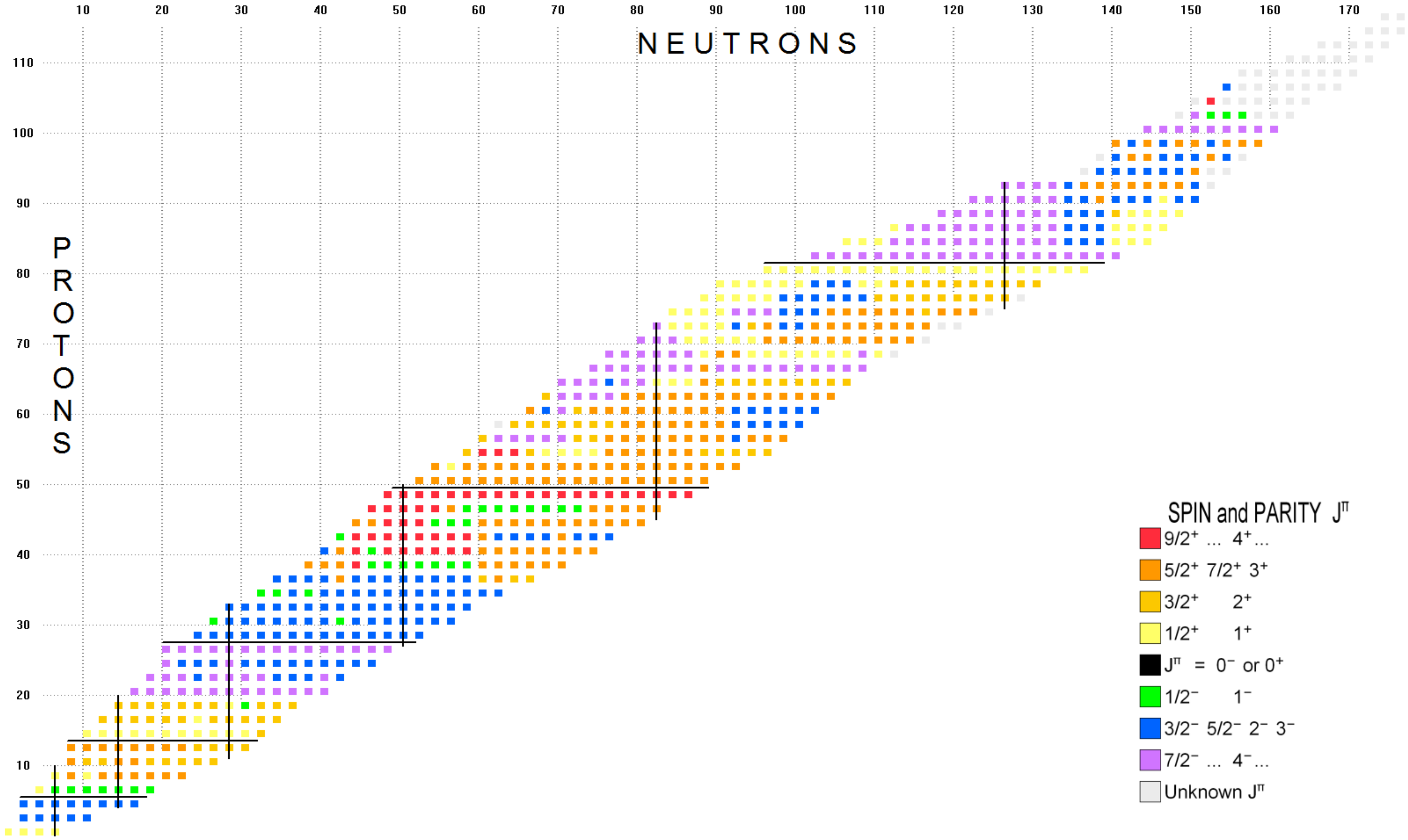

Figure 3: Chart of the nuclides displaying spins and parities. Only the odd-Z even-N nuclides are shown (created by NUCLEUS-AMDC).

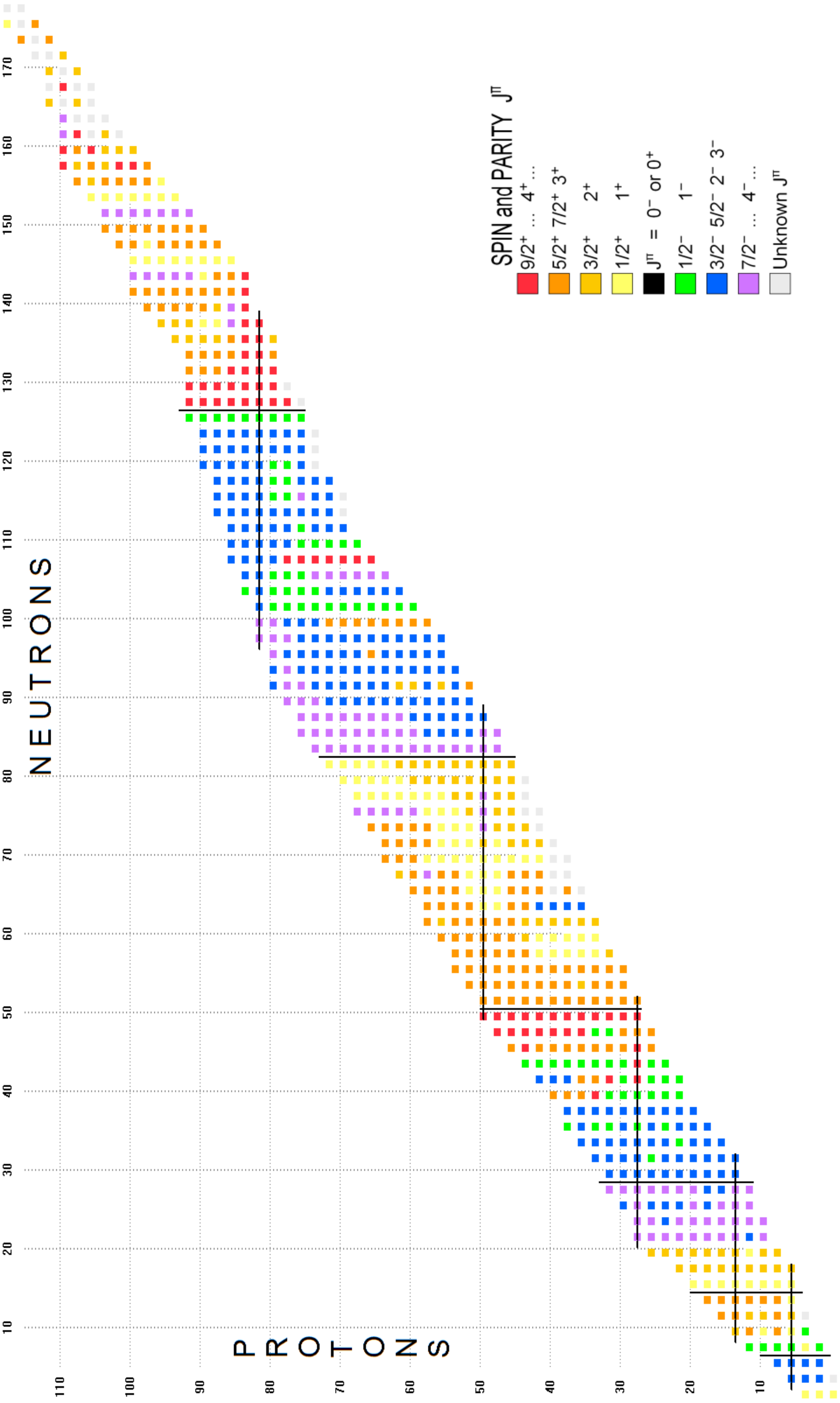

Figure 4: Chart of the nuclides displaying spins and parities. Only the even-Z odd-N nuclides are shown (created by NUCLEUS-AMDC).

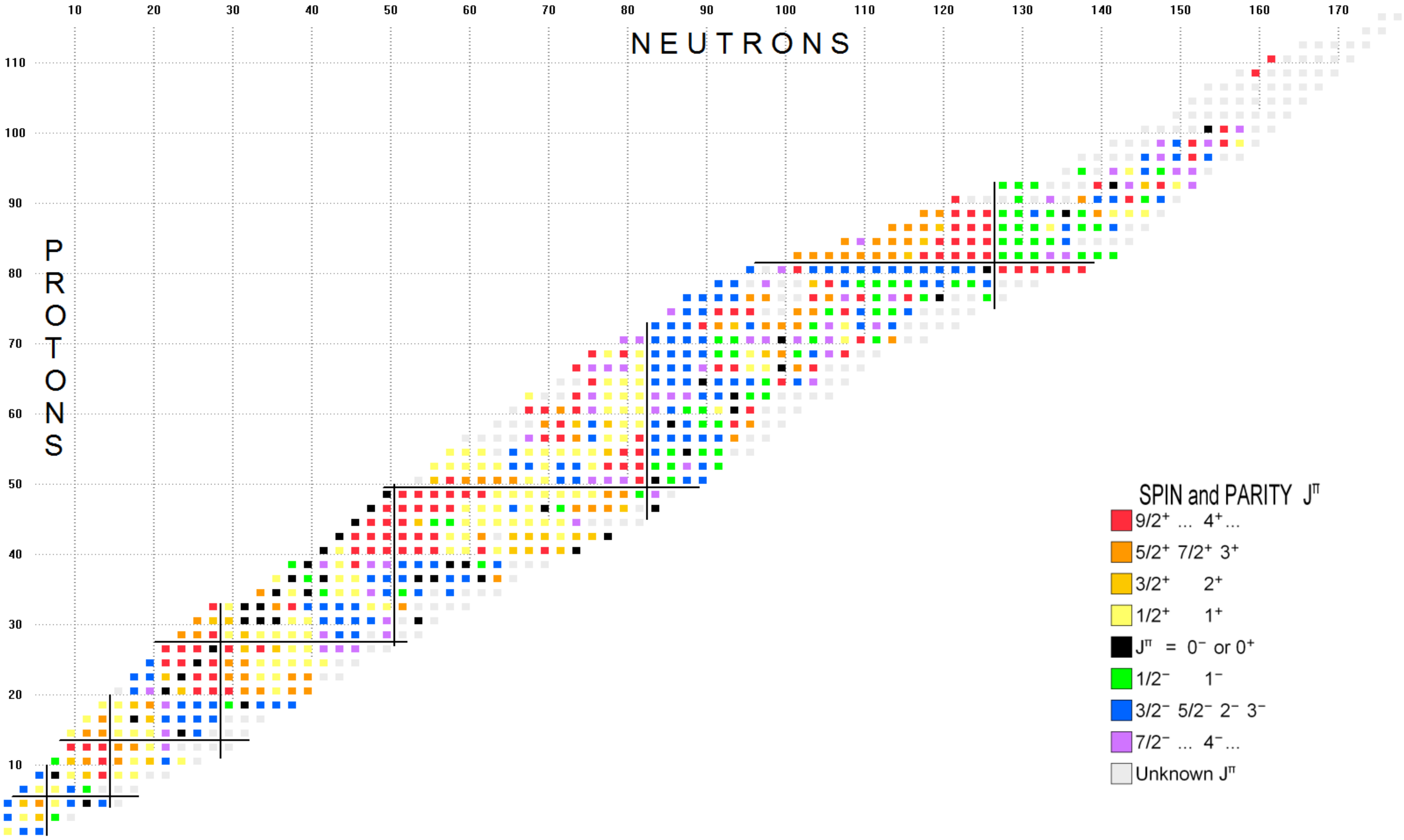

Figure 5: Chart of the nuclides displaying spins and parities. Only the odd-*Z* odd-*N* nuclides are shown (created by NUCLEUS-AMDC).

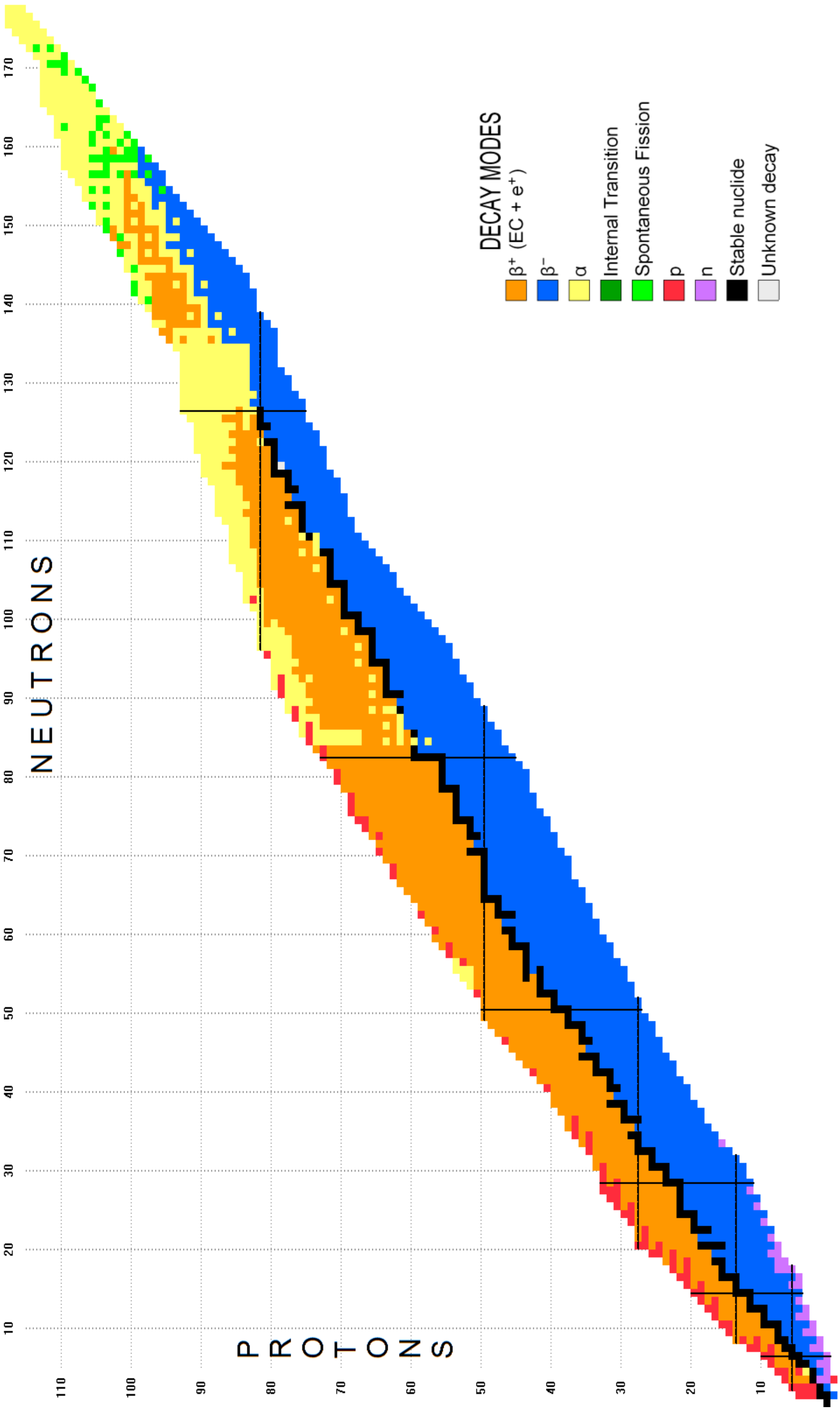

Figure 6: Chart of the nuclides displaying decay modes (created by NUCLEUS-AMDC).

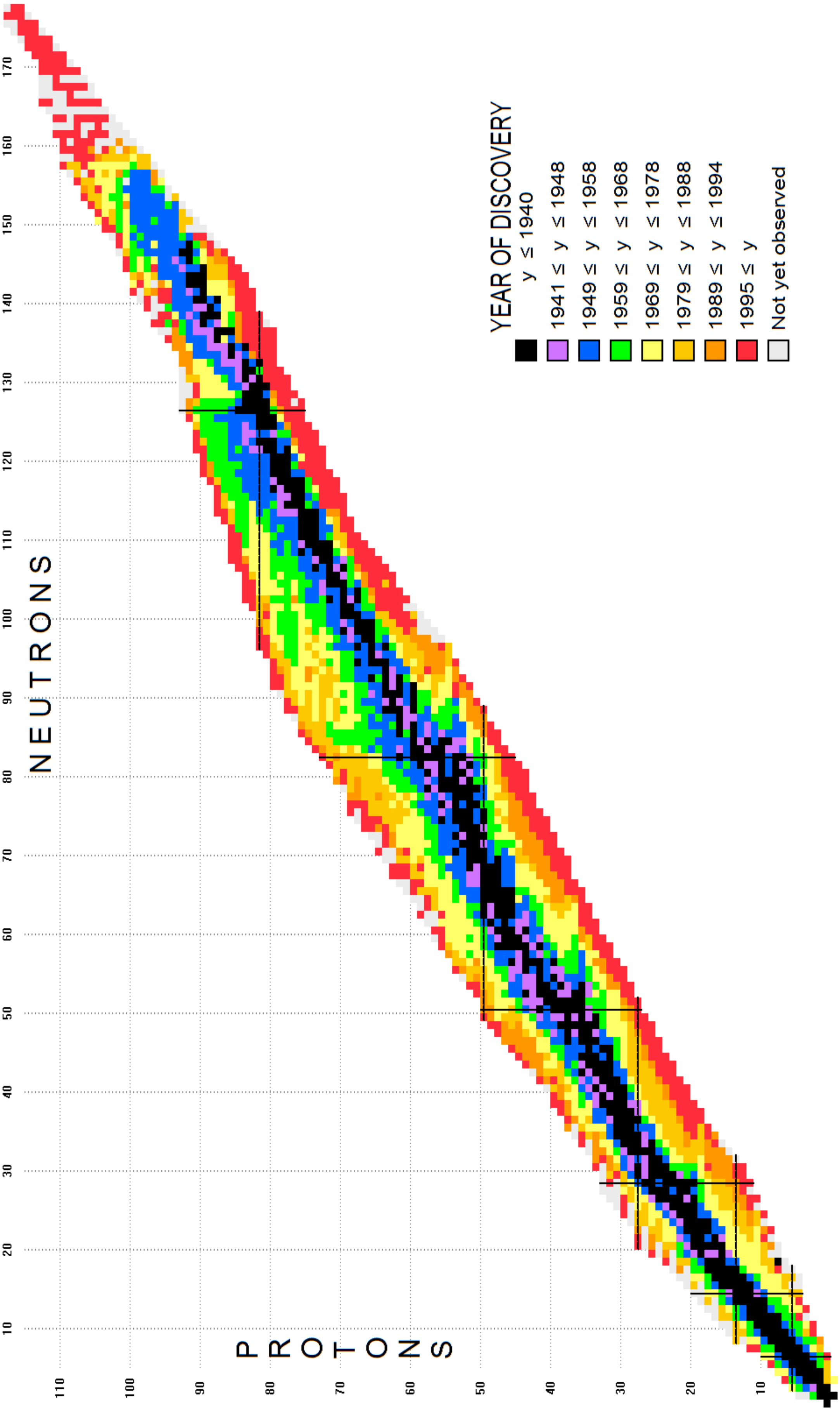

Figure 7: Chart of the nuclides displaying the years of discovery (created by NUCLEUS-AMDC).

2.4 Spin and parity

Similarly to ENSDF, spin and parity values are presented with and without parentheses, based on strong and weak assignment arguments, respectively (see the introductory pages of Ref. [11]). Unfortunately, the latter include estimates from theory or from TNN (trends in neighboring nuclides). In NUBASE2012, following our policy of making a clear distinction between experimental and non-experimental information, parentheses are used if the so-called "weak" argument is based on experimental observations, while the symbol '#' is used for the other cases. It should also be noted that despite the well defined evaluation policies [11], there are a number of inconsistencies in ENSDF regarding the spins and parities for excited states. Often, proposed assignments reflect the interpretation of a particular ENSDF evaluator, rather than that of firm policy rules. As a result, assignments to similar states in neighboring nuclei are put in parenthesis by one evaluator, but not by other, although similar experimental information is available. We have tried to use a consistent approach in assigning spins and parities to excited states, but the survey is still far from complete and the reader may still find inconsistencies. The authors would gratefully appreciate feedback from users on such cases, in order to improve future versions of NUBASE.

If spins and parities are not determined experimentally, they can be estimated from trends in neighboring nuclides (TNN) with the same parities in N and Z. Although, this is frequently the case for odd-A nuclides (see Fig. 3 and Fig. 4), such trends are also sometimes valid for odd–odd isotopes, especially in the neighborhood of magic numbers, as can be seen in Fig. 5. In all cases, the estimated values are flagged with the '#' symbol.

The review of nuclear radii and moments of Otten [1989Ot.A], in which the spins were compiled, was used to check and complete the spin values in NUBASE2012.

Note added in proof : A novel technique based on a condensed-matter device allows to determine absolute values for the spin [2012Vi.1], similarly to the hyperfine method. This technique was applied to ^{159}Tb and confirmed the well known spin of 3/2.

2.5 Decay modes and their intensities

The most important policy in assembling the information for the decay modes was to establish a very clear distinction between a decay mode that is energetically allowed, but not experimentally observed yet (represented by a question mark alone, which thus refers to the decay mode itself), and a decay mode which is actually observed, but for which the intensity could not be determined (represented by '=?', the question mark referring here to the quantity after the equal sign).

Similarly to ENSDF, no corrections were made to normalize the primary intensities to 100%.

In addition to applying direct updates from the literature, partial evaluations completed by other authors were also considered, which are properly referenced. Those cases are mentioned below, when discussing some particular decay modes.

β^+ decay

In the course of this work some definitions and notations for β^+ decay were refined, in order to provide a clearer presentation of the available information. Specifically, β^+ denotes the decay process that includes both electron capture, labeled ε, and decay by positron emission, labeled e^+. One can then symbolically write: $\beta^+ = \varepsilon + e^+$. It is well known that for an available energy below 1022 keV, only electron capture, ε, is allowed, whilst above that value the two processes are in competition.

Remark: this notation is **not** the same as the one used implicitly in ENSDF, where the combination of both modes is denoted "$\varepsilon + \beta^+$".

When both modes compete, the separated intensities are not always experimentally available and frequently they are deduced from model calculations, as is the policy in ENSDF. In continuation of one of the general NUBASE policies, in which only experimental information is used whenever possible, it was decided not to retain the separated values calculated in ENSDF (which are scarce and not always updated). Only in a few very specific cases, where the distinction is of importance, such as in the case of rare or extremely rare processes (e.g. ^{91}Nb, ^{54}Mn, ^{119}Te^m), separate values are given.

By the same token, both electron capture-delayed fission (εSF) and positron-delayed fission (e^+SF) are given with the same symbol β^+SF.

Double-β decay

In the course of this work it was found that half-lives for double β-decaying nuclides were not always consistently given in ENSDF. Since the two-neutrino gs-gs transition is the dominant decay process (one exception may be ^{98}Mo, for which the neutrinoless decay is predicted to be faster, see [2002Tr04]), only those half-life values or their upper-limits were presented in the NUBASE2012 table. No attempt was made to convert the half-life values to the same statistical confidence level (CL) upper limit results given by different authors.

The excellent compilation of Tretyak and Zdesenko [2002Tr04] was of great help in covering such decays.

β-delayed particle decays

For delayed particle decays, intensity relations have to be carefully considered. By definition, the intensity of a decay mode is the percentage of decaying parent nuclei in that mode. But traditionally, the intensities of the pure β decay are summed with those of the delayed particles in order to give an intensity that is assigned to the pure β decay. For example, if the (A, Z) nuclide has a decay described traditionally by 'β^-=100; β^-n=20', this means that for 100 decays of the parent, 80 (A, Z+1) and 20 (A–1, Z+1) daughter nuclei are produced and that 100 electrons and 20 delayed neutrons are emitted. A strict notation in this case, using the definition above, would be 'β^-=80; β^-n=20'. However, in the present work, it has been decided to follow the traditional notation, and so we write: 'β^-=100; β^-n=20'.

This also holds for more complex delayed emissions. For example, a decay described by: 'β^-=100; β^-n=30; β^-2n=20; $\beta^-\alpha$=10' corresponds to the emission of 100 electrons, (30+2×20=70) delayed-neutrons and 10 delayed-α particles; and in terms of residual nuclides, to 40 (A,Z+1), 30 (A–1,Z+1), 20 (A–2,Z+1) and 10 (A–4,Z–1). More generally, the number of emitted neutrons per 100 decays, $P_{\rm n}$, can be written as:

$$P_{\rm n} = \sum_i i \times \beta^-_{i{\rm n}};$$

and similar expressions can be written for α and proton emission. The number of residual daughter nuclides (A, Z+1) populated via β^- decay is then:

$$\beta^- - \sum_i \beta^-_{i{\rm n}} - \sum_j \beta^-_{j\alpha} - \dots$$

Another special remark concerns the intensity of a particular β-delayed mode. In general, the primary (parent) β decay populates several excited states in the daughter nuclide, which can further decay by particle emission. However, in a case where the ground state of the daughter nuclide decays also by the same particle emission, some authors included its decay in the value for the corresponding β-delayed intensity. It has been decided to not use such an approach in NUBASE2012 for two main reasons. First, the energies of delayed particles emitted from excited states are generally much higher than those emitted from the ground state, hence implying different subsequent processes. Secondly, since the characteristic decay times from excited states are related to the parent, whereas decays from the daughter's ground state are connected to the daughter nuclide itself. For example ^{9}C decays via β^+ with an intensity of 100% of which 12% and 11% populate two excited proton-emitting states in ^{9}B, and 17% goes to an α-emitting state. Thus, β^+p=23% and $\beta^+\alpha$=17%, from which the user of the NUBASE2012 table can derive a 60% direct feeding of the ground state of ^{9}B. In a slightly different example, ^{8}B decays to only two excited states in ^{8}Be, which in turn decay by α- and γ-ray emissions, but not to the ^{8}Be ground state. Thus, one may write β^+=100% and $\beta^+\alpha$=100%, the difference of which leaves 0% for the feeding of the daughter's ground state.

Finally, the users should be aware that the percentages given in the NUBASE2012 table are related to 100 parent decaying nuclei, rather than to the primary beta-decay fraction. An illustrative example is given by the decay of ^{228}Np, for which the delayed-fission probability is given in the original paper as 0.020(9)% [1994Kr13], but this value is relative to the ε process, which has an intensity of 59(7)%. Thus, the renormalized delayed-fission intensity is 0.020(9)% × 0.59(7) = 0.012(6)% of the total decay intensity.

In compiling the data for delayed proton and α activities, the remarkable work of Hardy and Hagberg [1989Ha.A], in which the corresponding physics was reviewed and discussed in detail, was consulted. The review of Honkanen, Äystö and Eskola [12] on delayed proton decays has also been used.

Similarly, the review of delayed neutron emission by Hansen and Jonson [13] was carefully examined and used in the NUBASE2012 table, together with the evaluation of Rudstam, Aleklett and Sihver [1993Ru01].

2.6 Isotopic abundances

Isotopic abundances are taken from the compilation of M. Berglund and M.E. Wieser [2011Be53] and the values are listed in the decay field with the symbol *IS*. These data are given in the NUBASE2012 table as presented originally in [2011Be53], and so in this case the rounding off policy was not applied.

2.7 References

The year of the archival file for the nuclides evaluated in ENSDF is indicated, otherwise this entry is left blank.

References for all of the experimental updates are given by the NSR keynumber style [5], and are listed at the end of this issue (p. 1863). They are followed by one, two or three one-letter codes which specify the added or modified physical quantities (see the Explanation of Table I, p. 1176). In cases where more than one reference is needed to describe a particular update, they are given as a remark. No reference is given for estimated values. The initials of the present authors, AHW, FGK, GAU, JBL, MMC, WGM, are used as reference keys in cases where it may not be precisely clear that the re-interpretation of data were made by the present authors.

3 Updating procedure

In general, NUBASE is updated via two routes: from ENSDF after each new A-chain evaluation is published (or from the bi-annual releases), and directly from the literature. Data available in the "Unevaluated Nuclear Data List" (XUNDL) are also regularly consulted [14].

ENSDF files are retrieved from NNDC using the on-line service [2]. The programs, originally developed by O. Bersillon and one of the present authors (JB) [15], are used to successively:

- check that each Z in the A-chain has an 'adopted levels' data set; if not, a corresponding data set is generated from the 'decay' or 'reaction' data set,
- extract the 'adopted levels' data sets from ENSDF,
- extract the required physical quantities from these data sets, and convert them into the NUBASE format.

The processed data are used to manually update the previous version of NUBASE. This step is repeated independently by two, and sometimes by three, of the present authors, and cross-checked until complete agreement is reached.

ENSDF is updated generally by A-chains and more recently also by individual nuclides. Its contents, however, are very large, since it encompasses all of the complex nuclear structure and decay properties. This is a huge effort, and it is not surprising that occasionally some older data (in particular annual reports, conference proceedings, and theses) are missing, and that some recent data have not yet been included. When such cases were revealed, they were analyzed and evaluated, as described above, and the NUBASE2012 database was updated accordingly. In principle, these new data will be included in future ENSDF evaluations and the corresponding references can then be removed from future NUBASE distributions. Unfortunately, it has been observed in the past that such a procedure was not always adhered to. In fact, in some newer ENSDF files, quotations to earlier NUBASE publications were found, which leads to an indesirable loop resulting in non-traceable information.

4 Distribution and displays of NUBASE2012

The full contents of the present evaluation is available on-line at the web site of the Atomic Mass Data Center (AMDC) [16]. An electronic ASCII file for the NUBASE2012 table is also distributed by the AMDC website. These files will **not** be updated, to allow stable reference data for various calculations. Any work using those files should make reference to the present paper and not to the electronic files.

The contents of NUBASE2012 can be displayed by a stand-alone PC-program called "NUCLEUS" [17], which can also be downloaded from the AMDC website. It will be updated on regular basis to allow users to check for the latest available information in NUBASE database.

5 Conclusions

The 'horizontal' evaluated database, NUBASE2012, which contains the recommended values for the main properties of all known nuclides in their ground and excited isomeric states, was developed. This has been completed for the first time by the inclusion of all available IAS data. These data originate from a compilation of two evaluated databases: ENSDF, followed by a critical assessment of the validity and completeness of those data, including new updates from the literature, and AME2012. The main requirement in developing NUBASE2012 was to cover as completely as possible all the available experimental data and to provide proper references to them, especially for cases that are not already included in ENSDF. This traceability allows any user to check the recommended data and, if necessary, to undertake a re-evaluation.

As a result of this 'horizontal' work, better homogeneity in handling and presentation of all data was obtained for all known nuclides. Furthermore, isomeric assignments and their excitation energies were reconsidered on a firmer basis and their data improved.

It is expected to follow up this third version of NUBASE with improved treatments in the future. A foreseeable implementation would be to provide the main α, γ, conversion electrons and X-ray lines accompanying particular decays, as well as to include even shorter-lived excited nuclear isomers. NUBASE could also be extended to other nuclear properties, such as energies of the first 2^+ states in even-even nuclides, radii, moments, etc.

A new feature that was implemented in the present version of NUBASE is the compilation of the year of discovery for each nuclide in its ground or isomeric state. For the former, recent evaluations performed by a group at Michigan State University [18] were adopted. Similar criteria was used when assigning the year of discovery for isomeric states. However, we would like to make the users aware that this feature for excited isomers is not fully checked and that there are still some cases missing.

6 Acknowledgments

We wish to thank many colleagues who answered our questions about their experiments and those who sent us preprints of their papers. We appreciate the help provided by J.K. Tuli in solving some of the puzzles we encountered in ENSDF. Continuous interest, discussions, suggestions and encouragements from K. Blaum, D. Lunney, G. Savard, Zhang Yuhu, Zhongzhou Ren, and Ch. Scheidenberger were highly appreciated. Special thanks to Darian Jenkins for his interest in our work and discussions about the "Year of Discovery" that we finally added to NUBASE, and to Nicolas Savard for helping in its implentation.

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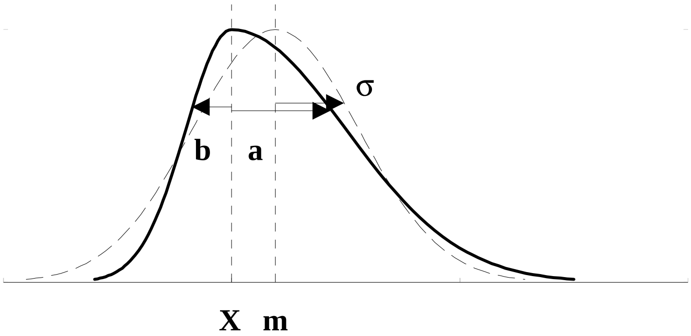

Figure 8: Simulated asymmetric probability density function (heavy solid line) and the equivalent symmetric one (dashed line).

Appendix A Symmetrization of asymmetric uncertainties

Experimental data are sometimes given with asymmetric uncertainties, X^{+a}_{-b}. If these data are to be used in some practical applications, their uncertainties may need to be symmetrized. A simple method (Method 1) that was developed earlier, uses the central value to be in the middle between the upper and lower 1 σ-equivalent limits

$X+(a-b)/2$, with the uncertainty defined to be the average of the two uncertainties

$(a+b)/2$.

An alternative method (Method 2) considers the random variable x associated with the measured quantity. For this random variable, one assumes that the probability density function is an asymmetric normal distribution having a modal (most probable) value of $x = X$, a standard deviation b for $x < X$, and a standard deviation a for $x > X$ (Fig. 8). Then the average value of this distribution is

$$\langle x\rangle = X + \sqrt{2/\pi}\,(a-b),$$

with variance

$$\sigma^2 = (1-2/\pi)\,(a-b)^2 + ab. \qquad (1)$$

The median value m which divides the distribution into two equal areas is given, for $a > b$, by

$$\mathrm{erf}\left(\frac{m-X}{\sqrt{2}a}\right) = \frac{a-b}{2a}, \qquad (2)$$

and by a similar expression for $b > a$.

One can then define the equivalent symmetric normal distribution that have a mean value equal to the median value m of the previous distribution with same variance σ.

If the shift $m-X$ of the central value is small compared to a or b, expression (2) can be written [19]:

$$m - X \simeq \sqrt{\pi/8}\,(a-b)$$

$$m - X \simeq 0.6267\,(a-b).$$

In order to allow for a small non-linearity that appears for higher values of $m-X$, the relation

$$m - X = 0.64\,(a-b).$$

was adopted for Method 2.

Table A illustrates the results from both methods. In NUBASE2012, Method 2 is used for the symmetrization of asymmetric half-lives and decay intensities.

Table A. Examples of two different treatments of asymmetric half-life uncertainties.
Method 1 is the classical method, used previously, as in the AME1995.
Method 2 is the one developed in NUBASE2003, described in this Appendix.

Nuclide	Original $T_{1/2}$		Method 1	Method 2
^{54}Zn	3.2+1.8–0.8	ms	3.7 ± 1.3	3.8 ± 1.3
^{80}Cu	170+110–50	ms	200 ± 80	208 ± 83
^{83}Mo	6+30–3	ms	20 ± 17	23 ± 19
^{100}Kr	7+11–3	ms	11 ± 7	12 ± 8
^{115}Mo	51+79–19	ms	81 ± 49	89 ± 53
^{222}U	1.0+1.0–0.4	μs	1.3 ± 0.7	1.4 ± 0.7
^{264}Hs	327+448–120	μs	490 ± 280	540 ± 300
^{265}Rf	105+503–48	s	332 ± 275	400 ± 320
^{266}Mt	1.01+0.47–0.24	ms	1.1 ± 0.4	1.2 ± 0.4
^{267}Db	73+350–33	m	230 ± 190	280 ± 220

References

*References quoted in the text as [1993Po.A] or [2011Be53] (*NSR *style) are listed under "References used in the* AME2012 *and the* NUBASE2012 *evaluations", p. 1863.*

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Table I. The NUBASE2012 table of nuclear and decay properties

EXPLANATION OF TABLE

Data are presented in groups ordered according to increasing mass number A.

Nuclide	Nuclidic name: mass number $A = N + Z$ and element symbol (for $Z > 109$ see Section 2). Elements with upper suffix 'm', 'n', 'p', 'q', 'r' or 'x' indicate assignments to excited isomeric states (defined as higher states with half-lives greater than 100 ns). Suffixes 'p' and 'q' also indicate non-isomeric levels, but used in the AME2012. Suffix 'r' also indicates a state from a proton resonance occurring in (p,γ) reactions (e.g. ^{28}Si^{r}). Suffix 'x' also applies to mixtures of levels (with relative ratio R, given in the 'Half-life'column), e.g. occurring in spallation reactions (indicated 'spmix' in the 'J^{π}' column) or fission ('fsmix').
Mass excess	Mass excess [M(in u)$-A$], in keV, and its one standard deviation uncertainty as given in the 'Atomic Mass Evaluation' (AME2012, in the second part of this volume). Rounding-off policy: in cases where the furthest-left significant digit in the error is larger than 3, values and errors are rounded-off, but not to more than tens of keV. (Examples: $2345.67 \pm 2.78 \rightarrow 2345.7 \pm 2.8, 2345.67 \pm 4.68 \rightarrow 2346 \pm 5$, but $2346.7 \pm 468.2 \rightarrow 2350 \pm 470$). # instead of a decimal point: value and uncertainty are not derived only from experimental data, but at least partly with estimates from TMS (see AME2012).
Excitation energy	For excited isomers only: energy difference, in keV, between levels adopted as higher level isomer and ground state isomer, and its one standard deviation uncertainty, as given in AME2012 when derived from the AME, otherwise as given by ENSDF. The rounding-off policy is the same as for the mass excesses (see above). # instead of a decimal point: value and uncertainty derived from trends in neighboring nuclides.

The excitation energy is followed by its origin code when derived from a method other than γ-ray spectrometry:

MD	mass doublet
RQ	reaction Q-value
AD	α energy difference
BD	β energy difference
p, 2p	one-, two-proton decay
IT	combination of AME and γ-ray data
Nm	estimated value derived using the Nilsson model

When the existence of an isomer is questionable the following codes are used:

EU	existence of isomer is under discussion (e.g. ^{73}Zn^{n}). If existence is strongly doubted, no excitation energy and no mass are given. They are replaced by the mention "non existent" (e.g. ^{138}Pm^{n}).
RN	isomer has been proven not to exist (e.g. ^{248}Es^{m}). Excitation energy and mass are replaced by the mention "non existent".

Remark: codes EU and RN are also used when the discovery of a nuclide (e.g. ^{260}Fm or ^{289}Lv) is questioned. In this case an estimate derived from trends in the mass surface is always given for the ground state mass.

Isomeric assignment:

*	if the uncertainty σ on the excitation energy E is greater than half the excitation energy ($\sigma > E/2$), these quantities are followed by an asterisk (e.g. ^{130}In and ^{130}In^{m}).
&	when the ordering of the ground state isomer and the excited isomer are reversed as compared to ENSDF, an ampersand sign is added (e.g. ^{102}Y and ^{102}Y^{m}).

Half-life

s = seconds; m = minutes; h = hours; d = days; y = years;
1 y = 31 556 926 s or 365.2422 d
adopted values for NUBASE (see text)
STABLE = stable nuclide, or nuclide for which no finite half-life value has been found.

\# value estimated from trends in neighboring nuclides with the same Z and N parities.

subunits:

ms	:	10^{-3}	s	millisecond	ky	:	10^{3}	y	kiloyear
μs	:	10^{-6}	s	microsecond	My	:	10^{6}	y	megayear
ns	:	10^{-9}	s	nanosecond	Gy	:	10^{9}	y	gigayear
ps	:	10^{-12}	s	picosecond	Ty	:	10^{12}	y	terayear
fs	:	10^{-15}	s	femtosecond	Py	:	10^{15}	y	petayear
as	:	10^{-18}	s	attosecond	Ey	:	10^{18}	y	exayear
zs	:	10^{-21}	s	zeptosecond	Zy	:	10^{21}	y	zettayear
ys	:	10^{-24}	s	yoctosecond	Yy	:	10^{24}	y	yottayear

R: For isomeric mixtures only, it is the production ratio of the excited isomer state to the ground state isomer.

J^{π}

Spin and parity:

()	uncertain spin and/or parity.
#	values estimated from trends in neighboring nuclides with the same Z and N parities.
high	high spin.
low	low spin.
am	same J^{π} as α-decay parent
T	Isopin multiplet for isobaric analog states (IAS).

For isomeric mixtures only: mix (spmix and fsmix if observed in spallation and fission, respectively).

Ens

Year of the ENSDF file archive
(in order to reduce the width of the Table, the two century digits are omitted).

Reference

Reference keys:
(in order to reduce the width of the Table, the two century digits are omitted. However, at the end of this volume the full reference key-number is given, ie. 2010Cr02 as opposed to 10Cr02)

10Cr02	updates to ENSDF derived from a regular journal. These keys are taken from Nuclear Data Sheets. Where not yet available, the style 12Ma.1 is provisionally adopted.
12Dr.A	updates to ENSDF derived from an abstract, preprint, private communication, conference, thesis or annual report.
AHW	(or FGK, GAU, JBL, MMC, WGM), re-interpretation by one of the evaluators of NUBASE.
Mirror	deduced from mirror nuclide properties.
Imme	deduced from Isobaric Multiplet Mass Equation.

The reference key-numbers are followed by one, two or three letter codes which specifies the added or modified physical quantities:

E	for the isomer excitation energy
T	for half-life
J	for spin and/or parity
D	for decay mode and/or intensity
I	for identification

Year of discovery

for ground states [15] and for excited isomers (see text).

Decay modes and intensities

Decay modes followed by their intensities (in %), and their one standard deviation uncertainties. The special notation 1.8e–12 stands for 1.8×10^{-12}.
The uncertainties are given - only in this field - in the ENSDF-style: α=25.9 23 stands for α=25.9 ± 2.3 %
The ordering is according to decreasing intensities.
α ? means α decay is energetically allowed.
α=? means α decay has been observed but not yet quantified.

α	α emission
p 2p	proton emission 2-proton emission
n 2n	neutron emission 2-neutron emission
ε	electron capture
e^+	positron emission
β^+	β^+ decay ($\beta^+ = \varepsilon + e^+$)
β^-	β^- decay
$2\beta^-$	double β^- decay
$2\beta^+$	double β^+ decay
β^-n	β^- delayed neutron emission
β^-2n	β^- delayed 2-neutron emission
β^+p	β^+ delayed proton emission
β^+2p	β^+ delayed 2-proton emission
$\beta^-\alpha$	β^- delayed α emission
$\beta^+\alpha$	β^+ delayed α emission
β^-d	β^- delayed deuteron emission
IT	internal transition
SF	spontaneous fission
β^+SF	β^+ delayed fission
β^-SF	β^- delayed fission
^{24}Ne	heavy cluster emission
...	list is continued in a remark, at the end of the *A*-group

For long-lived nuclides:

IS	Isotopic abundance (from [2011Be53])

* A remark on the corresponding nuclide is given below the block of data corresponding to the same *A*.

Remarks. For nuclides marked with an asterisk at the end of the line, extra comments have been added. They are collected in groups at the end of each block of data corresponding to the same *A*. They start with a letter code, similar the ones following the reference key-number, as given above, indicating to which quantity the remark applies. They give:

i) Continuation for the list of decays. In this case, the remark starts with three dots.
ii) Information explaining how a value has been derived.
iii) Reasons for changing a value or its uncertainty as given by the authors, or for rejecting it.
iv) Complementary references to updated data.
v) Separate values used in the adopted average.

TNN : Trends from neighboring nuclides.

Table I. The NUBASE2012 table (Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{1}n	8071.3171	0.0005				613.9	s	0.6	$1/2^+$	06			1932	β^-=100	*
^{1}H	7288.9705	0.0001				STABLE			$1/2^+$	06	11Be53	D	1920	IS=99.9885 70	
*^{1}n	T : also 12Ar05=611.1(1.5) mean life=881.6(2.1)														**
^{2}H	13135.7217	0.0001				STABLE			1^+	03			1932	IS=0.0115 70	
^{3}H	14949.8061	0.0022				12.32	y	0.02	$1/2^+$	00			1934	β^-=100	
^{3}He	14931.2155	0.0023				STABLE			$1/2^+$	98			1934	IS=0.000134 3	
^{3}Li	28670#	2000#				p-unstable				98			1969	p ?	*
*^{3}Li	I : identification in 69Wi13 not accepted, see ENSDF'98														**
^{4}H	24620	100				139	ys	10	2^-	98	03Me11	T	1981	n=100	*
^{4}He	2424.9156	0.0001				STABLE			0^+	98			1908	IS=99.999866 3	
^{4}Li	25320	210				91	ys	9	2^-	98	65Ce02	T	1965	p=100	
*^{4}H	T : width=3.28(0.23) MeV; also 91Go19=4.7(1.0) outweighed, not used														**
^{5}H	32890	90				$>$ 910	ys		$(1/2^+)$	02	03Go11	T	1987	2n=100	*
^{5}He	11231	20				700	ys	30	$3/2^-$	02			1937	n=100	
^{5}Li	11680	50				370	ys	30	$3/2^-$	02			1941	p=100	
^{5}Be	37140#	2000#							$1/2^+$#	02				p ?	
*^{5}H	T : from width $<$ 0.5 MeV; conflicting with 01Ko52=280(50) ys, width=1.9(0.4)														**
*^{5}H	T : (same authors) but with instrumental resolution=1.3 MeV														**
*^{5}H	T : others 91Go19=66(25) ys 95Al31=110 ys probably for higher state														**
*^{5}H	J : from angular distribution consistent with $l=0$														**
^{6}H	41880	250				290	ys	70	2^-#	02			1984	n ?; 3n ?	
^{6}He	17592.09	0.05				806.92	ms	0.24	0^+	02	09Ra33	D	1936	β^-=100; β^-d=0.000165 10	*
^{6}Li	14086.8789	0.0014				STABLE			1^+	02			1921	IS=7.59 4	
^{6}Li^{i}	17649.76	0.10	3562.88	0.10		56	as	14	0^+T=1	02	81Ro02	E	1981	IT=100	
^{6}Be	18375	5				5.0	zs	0.3	0^+	02			1958	2p=100	
^{6}B	47320#	2000#				p-unstable#			2^-#					2p ?	
*^{6}He	T : symmetrized from 12Kn01=806.89(0.11)(+0.23–0.19)														**
^{7}H	49140#	1000#				500#	ys		$1/2^+$#				2003	2n ?	
^{7}He	26073	8				3.1	zs	0.4	$(3/2)^-$	03	08De29	T	1967	n=100	*
^{7}Li	14907.105	0.004				STABLE			$3/2^-$	03			1921	IS=92.41 4	
^{7}Li^{i}	26150	30	11250	30	RQ				$3/2^-$T=3/2	03					
^{7}Be	15769.00	0.07				53.22	d	0.06	$3/2^-$	03			1938	ε=100	
^{7}Be^{i}	26750	30	10980	30	RQ				$3/2^-$T=3/2	03				p ?; 3He ?; α ?	
^{7}B	27677	25				570	ys	140	$(3/2^-)$	03	11Ch32	T	1967	p=100	*
*^{7}He	T : average 08De29=125(+40–15) 02Me07=150(80) 69St02=160(30) → 150(21) keV														**
*^{7}B	T : from width 0.80(0.20) MeV 570(143) ys														**
^{8}He	31609.68	0.09				119.1	ms	1.2	0^+	05			1965	β^-=100; β^-n=16 1; β^-t=0.9 1	
^{8}Li	20945.80	0.05				839.40	ms	0.36	2^+	05	10Fl01	T	1935	β^-=100; $\beta^-\alpha$=100	*
^{8}Li^{i}	31768	5	10822	5	RQ				0^+T=2	05					
^{8}Be	4941.67	0.04				81.9	as	3.7	0^+	05			1932	α=100	
^{8}Be^{i}	21568	3	16626	3					2^+frg.T=1		04Ti06	E	2004	$\alpha\approx$100	*
^{8}Be^{j}	32436.0	2.0	27494.3	2.0	RQ				0^+T=2	05				n=39.4; d=27.0; 3H=11.7; α=7.9; …	
^{8}B	22921.6	1.0				770	ms	3	2^+	05			1950	β^+=100; $\beta^+\alpha$=100	*
^{8}Bx^{i}	33546	8	10624	8	RQ				0^+T=2	05			1975		
^{8}C	35064	18				3.5	zs	1.4	0^+	05	11Ch32	T	1974	2p=100	*
*^{8}Li	D : β^- decay to first 2^+ state in ^{8}Be, which decays 100% in 2 α														**
*^{8}Be^{i}	E : strongest frg; other: 296(3) higher I(16626)/I(16922)=1.22 in ^{6}Li(^{6}Li,α)														**
*^{8}Be^{i}	E : and 1.15 in ^{10}B(d,α); see 04Ti06 p.213														**
*^{8}B	D : β^+ to 2 excited states in ^{8}Be, then α and γ, but not to ^{8}Be ground-state														**
*^{8}C	T : from width 130(50) keV 3.51(1.35) zs														**
^{9}He	40940	50				8	zs	5	$1/2^-$	06			1987	n=100	*
^{9}Li	24954.90	0.19				178.3	ms	0.4	$3/2^-$	06	95Re.A	D	1951	β^-=100; β^-n=50.8 2	
^{9}Be	11348.45	0.08				STABLE			$3/2^-$	06			1921	IS=100.	
^{9}Be^{i}	25738.9	1.8	14390.5	1.8	RQ	1.25	as	0.10	$3/2^-$T=3/2	06			1976		
^{9}B	12416.5	0.9				800	zs	300	$3/2^-$	06			1940	p=100	
^{9}Bx^{i}	27071.1	2.3	14654.7	2.5	RQ				$3/2^-$T=3/2	06					
^{9}C	28911.0	2.1				126.5	ms	0.9	$(3/2^-)$	06			1964	β^+=100; β^+p=61.6; $\beta^+\alpha$=38.4	
*^{9}He	T : derived from width 99Bo26=100(60) keV hence T=4.6(+6.8–1.8) zs														**
*^{9}He	I : $1/2^+$, width 01Ch31=60 keV was assigned to ground-state with s-wave scattering														**
*^{9}He	I : length as=–10 fm, questioned in 10Jo06, where as=–3.17(66) fm														**

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{10}He	49170	100				3.1	zs	2.0	0^+	07			1994	2n=100	*
^{10}Li	33053	13				2.0	zs	0.5	$(1^-,2^-)$	07	94Yo01	TJ	1975	n=100	
^{10}Li^m	33250	40	200	40	RQ	3.7	zs	1.5	1^+	07	97Zi04	T	1994	IT=100	*
^{10}Li^n	33530	40	480	40	RQ	1.35	zs	0.24	(2^+)	07	94Yo01	T	1993	IT=100	*
^{10}Be	12607.49	0.08				1.51	My	0.04	0^+	07			1935	β^-=100	
^{10}Be^i	33787	20	21179	20	RQ				(2^-)T=2	07				n ?; p ?; 3H ?	
^{10}B	12050.7	0.4				STABLE			3^+	07			1920	IS=19.9 7	
^{10}B^i	13790.8	0.4	1740.05	0.04					0^+T=1	07				IT=100	
^{10}C	15698.8	0.4				19.306	s	0.004	0^+	07	09Ba04	T	1949	β^+=100	*
^{10}N	38800	400				200	ys	140	(2^-)	07	02Le16	TJ	2002	p ?	
*^{10}He	D : most probably 2 neutron emitter from S_{2n}=–1420(100) keV														**
*^{10}Li^m	T : average 97Zi04=120(+100–50) 94Yo01=100(70) keV														**
*^{10}Li^n	T : average 94Yo01=358(23) 93Bo03=150(70) keV, Birge ratio B=2.8														**
*^{10}C	T : average 09Ba04=19.282(0.011) 08Ia01=19.310(0.004) 90Ba02=19.295(0.015)														**
^{11}Li	40728.3	0.6				8.75	ms	0.14	$3/2^-$	12	12Ke01	D	1966	β^-=100; β^-n=86.3 9; …	*
^{11}Be	20177.17	0.24				13.76	s	0.07	$1/2^+$	12	81Al03	D	1958	β^-=100; $\beta^-\alpha$=2.9 4; β^-n ?	
^{11}B	8667.9	0.4				STABLE			$3/2^-$	12			1920	IS=80.1 7	
^{11}B^i	21228	9	12560	9	RQ				T=3/2 $1/2^+,(3/2^+)$	12			1963		
^{11}C	10650.3	0.9				20.364	m	0.014	$3/2^-$	12			1934	β^+=100	
^{11}C^i	22810	40	12160	40	RQ				$1/2^+$T=3/2	12	71Wa21	D	1971	p=?	
^{11}N	24300	50				550	ys	20	$1/2^+$	12			1974	p=100	*
^{11}N^m	25040	80	740	60		690	ys	80	$1/2^-$	12	96Ax01	ETJ	1974	p=100	
*^{11}Li	D : …; β^-2n=4.1 4; β^-3n=1.9 2; $\beta^-\alpha$=1.7 3; β^-d=0.0130 13; β^-t=0.0093 8														**
*^{11}Li	D : total β^- delayed neutron emission Pn=100.3(1.4)%														**
*^{11}N	T : from ENSDF : width=830(30) keV														**
^{12}Li	48920	15				< 10	ns			00	74Bo05	I	2008	n ?	
^{12}Be	25077.8	1.9				21.50	ms	0.04	0^+	00	01Be53	T	1966	β^-=100; β^-n=0.50 3	*
^{12}Be^m	27328.8	2.1	2251	1		229	ns	8	0^+		07Sh37	EJT	2007	IT=100	
^{12}B	13369.4	1.3				20.20	ms	0.02	1^+	00	66Sc23	D	1935	β^-=100; $\beta^-\alpha$=1.6 3	
^{12}B^i	26088	19	12719	19	RQ				0^+T=2	00	08Ch28	J			*
^{12}C	0.0	0.0				STABLE			0^+	00			1919	IS=98.93 8	
^{12}C^i	15108	3	15108	3	RQ				1^+T=1	00				IT=?; α ?	
^{12}C^j	27595.0	2.4	27595.0	2.4	RQ				0^+T=2	00					
^{12}N	17338.1	1.0				11.000	ms	0.016	1^+	00	66Sc23	D	1949	β^+=100; $\beta^+\alpha$=3.5 5	
^{12}O	31915	24				> 6.3	zs		0^+	00	12Ja11	T	1978	2p=60 30	*
*^{12}Be	D : from 99Be53; also 95Re.A=0.52(0.09)% outweighed, not used														**
*^{12}B^i	J : 08Ch28 "suggests that the 12.75-MeV, ….was a T=1 state, not the IAS"														**
*^{12}O	T : from width 12Ja11<72 keV; others 09Su14=600(500)keV 95Kr03t=578(205)keV														**
^{13}Li	58340	350							$3/2^-$#		08Ak03	D	2008	2n=100	
^{13}Be	33659	10				1.0	zs	0.7	$(1/2^-)$		10Ko17	TJ	1983	n ?	*
^{13}Be^p	35160	50	1500	50	RQ				$(5/2^+)$				1992		
^{13}B	16562.1	1.1				17.33	ms	0.17	$3/2^-$	00			1956	β^-=100; β^-n=0.28 4	
^{13}C	3125.0087	0.0002				STABLE			$1/2^-$	01			1929	IS=1.07 8	
^{13}C^i	18233.8	1.1	15108.8	1.1	RQ				$3/2^-$T=3/2	00				IT=0.82 7; N ?; α ?	
^{13}N	5345.48	0.27				9.965	m	0.004	$1/2^-$	00			1934	β^+=100	
^{13}N^i	20410.59	0.18	15065.1	0.3	RQ				$3/2^-$T=3/2	00				IT=4.9 3; P ?; α ?	
^{13}O	23115	10				8.58	ms	0.05	$(3/2^-)$	00	70Es03	D	1963	β^+=100; β^+p=10.9 20	
*^{13}Be	T : from width 10Ko17=450(30) MeV; other 95Pe12=300(200) keV														**
*^{13}Be	J : 1/2$^+$ assigned to ground state in 01Th01 and 08Ch07, questioned in 10Ko17														**
*^{13}Be	J : see discussion in AME2012, Part I, Section≈6.3, p.1313														**
^{14}Be	39950	130				4.35	ms	0.17	0^+	01	02Je11	D	1973	β^-=100; β^-n=98 2; …	*
^{14}Be^p	41470	60	1520	150	RQ				(2^+)		95Bo10		1995		
^{14}B	23664	21				12.5	ms	0.5	2^-	01	95Re.A	D	1966	β^-=100; β^-n=6.04 23; β^-2n ?	
^{14}C	3019.893	0.004				5.70	ky	0.03	0^+	01			1936	β^-=100	
^{14}C^i	25120	100	22100	100					(2^-)T=2	01			1989	IT=100	
^{14}N	2863.4166	0.0001				STABLE			1^+	01			1920	IS=99.636 20	
^{14}N^i	5176.007	0.010	2312.590	0.010					0^+T=1	01	01Ba06	E	1963	IT=100	
^{14}O	8007.46	0.11				70.621	s	0.014	0^+	01	04Ba78	T	1949	β^+=100	*
^{14}F	31960	40				500	ys	60	2^-		10Go16	TJ	2010	p ?	
*^{14}Be	D : …; β^-2n=0.8 08; β^-3n=0.2 2; β^-t=0.02 1; $\beta^-\alpha$<0.004														**
*^{14}Be	D : supersedes 99Be53, same group														**
*^{14}O	T : average 04Ba78=70.641(0.020) 78Wi04=70.613(0.025) 73Cl12=70.590(0.030);														**
*^{14}O	T : other unweighed : 06Bu12=70.696(0.052) 01Ga59=70.560(0.049)														**

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{15}Be	49760#	400#				<200	ns				03Ba47	I		n ?	
^{15}B	28958	21				9.93	ms	0.07	$3/2^-$	02	95Re.A	D	1966	β^-=100; β^-n=93.6 12; β^-2n=0.4 2	∗
^{15}C	9873.1	0.8				2.449	s	0.005	$1/2^+$	02			1950	β^-=100	
^{15}N	101.4387	0.0006				STABLE			$1/2^-$	02			1929	IS=0.364 20	
^{15}N^i	11717	4	11615	4	RQ				$1/2^+$T=3/2	02				n ?; p ?; IT=0.00523 19	
^{15}O	2855.6	0.5				122.24	s	0.16	$1/2^-$	02			1934	β^+=100	
^{15}O^i	14020#	40#	11165#	35#					$(1/2^+)$T=3/2	02	Imme	E		p=100	
^{15}F	16810	60				410	ys	60	$1/2^+$	02	04Go15	J	1978	p=100	∗
∗^{15}B	D : β^-2n intensity is from 89Re.A J : given in 91Aj01														∗∗
∗^{15}B	T : also 03Ye02=9.86(+0.15–0.19)														∗∗
∗^{15}F	T : average 01Ze.A=1.23(0.22)MeV 78Be16=1.2(0.3) 78Ke06=0.8(0.3)														∗∗
^{16}Be	57450	170				650	ys	130	0^+		12Sp02	TD	2012	2n=100	∗
^{16}B	37112	25				< 190	ps		0^-#	99			2000	n ?	
^{16}C	13694	4				747	ms	8	0^+	99	89Re.A	D	1961	β^-=100; β^-n=97.9 23	
^{16}N	5683.9	2.3				7.13	s	0.02	2^-	99	74Ne10	D	1933	β^-=100; $\beta^-\alpha$=0.00100 7	
^{16}N^m	5804.3	2.3	120.42	0.12		5.25	μs	0.06	0^-T=1	99			1993	IT=100	
^{16}N^j	15613	7	9929	7	RQ				0^+T=2	99					
^{16}O	−4737.0013	0.0001				STABLE			0^+	99			1919	IS=99.757 16	
^{16}O^i	8059	4	12796	4	RQ				0^-T=1	99				IT=100	
^{16}O^j	17984	4	22721	4	RQ				0^+T=2	99					
^{16}F	10680	8				11	zs	6	0^-	99			1964	p=100	
^{16}Ne	23986	20				9	zs		0^+	99			1977	2p=100	
∗^{16}Be	T : from decay width 0.8(+0.1–0.2) MeV														∗∗
^{17}B	43770	170				5.08	ms	0.05	$(3/2^-)$	99	88Du09	D	1973	β^-=100; β^-n=63 1; …	∗
^{17}C	21031	17				193	ms	5	$(3/2^+)$	99	01Ma08	J	1968	β^-=100; β^-n=28.4 13; β^-2n ?	∗
^{17}N	7870	15				4.173	s	0.004	$1/2^-$	99	94Do08	D	1949	β^-=100; β^-n=95 1; $\beta^-\alpha$=0.0025 4	∗
^{17}O	−808.7636	0.0006				STABLE			$5/2^+$	99			1925	IS=0.038 1	
^{17}O^i	10270.02	0.17	11078.78	0.17	RQ				$1/2^-$T=3/2	99				β^- ?; N ?; IT=0.42 14	
^{17}F	1951.70	0.25				64.49	s	0.16	$5/2^+$	99			1934	β^+=100	
^{17}F^i	13144.7	1.9	11193.0	1.9	RQ				$1/2^-$T=3/2	99					
^{17}Ne	16500.5	0.4				109.2	ms	0.6	$1/2^-$	99	88Bo39	D	1963	β^+=100; β^+p=96.0 9; $\beta^+\alpha$=2.7 9	
∗^{17}B	D : …; β^-2n=11 7; β^-3n=3.5 7; β^-4n=0.4 3														∗∗
∗^{17}C	T : average 95Sc03=193(6) 95Re.A=188(10) 86Cu01=202(17)														∗∗
∗^{17}C	D : β^-n intensity is from 95Re.A														∗∗
^{18}B	51850	170				< 26	ns		(2^-)		10Sp02	J	2010	n ?	∗
^{18}C	24920	30				92	ms	2	0^+	96			1969	β^-=100; β^-n=31.5 15; β^-2n ?	
^{18}N	13113	19				619.2	ms	1.9	1^-	96	05Li60	TD	1964	β^-=100; β^-n=7.0 15; $\beta^-\alpha$=12.2 6; β^-2n ?	∗
^{18}O	−782.8156	0.0007				STABLE			0^+	96			1929	IS=0.205 14	
^{18}O^i	15495	20	16278	20					1^-T=2		AHW	E			∗
^{18}F	873.1	0.5				109.771	m	0.020	1^+	96	02Un02	T	1937	β^+=100	
^{18}F^m	1994.5	0.5	1121.36	0.15		162	ns	7	5^+	96				IT=100	
^{18}F^i	1914.7	0.5	1041.55	0.08					0^+T=1	96				IT=100	
^{18}Ne	5317.6	0.4				1.6656	s	0.0019	0^+	96	07Gr18	T	1954	β^+=100	
^{18}Na	25040	110				1.3	zs	0.4	1^-#		04Ze05	TD	2004	p=?	
∗^{18}B	I : 93Po.A<26 ns; 84Mu27 ^{18}B n-unstable														∗∗
∗^{18}N	D : $\beta^-\alpha$ intensity from 89Zh04														∗∗
∗^{18}N	D : other β^-n 94Sc01=2.2(0.4)% 95Re.A=10.9(0.9) 91Re02=14.3(2.0)(same group)														∗∗
∗^{18}N	T : average 05Li60=619(2) 99Og03=620(14) 82Ol01=624(12) 64Ch19=630(30)														∗∗
∗^{18}O^i	E : assuming 16399(5), 17025(10) levels to be IAS's of 114.90(0.18), 747(10)														∗∗
∗^{18}O^i	E : levels in ^{18}N (see 95Ti07)														∗∗
^{19}B	58780#	400#				2.92	ms	0.13	$3/2^-$#	96	03Yo02	TD	1984	β^-=100; β^-n=71 9; β^-2n=17 5; β^-3n<9.1	∗
^{19}C	32410	100				46.2	ms	2.3	$(1/2^+)$	96	88Du09	TD	1974	β^-=100; β^-n=47 3; β^-2n=7 3	∗
^{19}N	15856	16				336	ms	3	$1/2^-$	96	06Su12	TJD	1968	β^-=100; β^-n=41.8 9	
^{19}O	3332.9	2.6				26.464	s	0.009	$5/2^+$	96	94It.A	T	1936	β^-=100	
^{19}F	−1487.4443	0.0009				STABLE			$1/2^+$	96			1920	IS=100.	
^{19}F^i	6052.2	0.9	7539.6	0.9					$5/2^+$T=3/2	96				IT=100	
^{19}Ne	1752.05	0.16				17.262	s	0.007	$1/2^+$	96	12Tr06	T	1939	β^+=100	∗
^{19}Ne^i	9368	16	7616	16					$(5/2)^+$T=3/2	96	MMC127	J			∗
^{19}Na	12929	11				> 1	as		$5/2^+$#	96	10Mu12	TD	1969	p=100	∗
^{19}Mg	31830	50				5	ps	3	$1/2^-$#	96	09Mu17	TD	2007	2p=100	∗
∗^{19}B	D : symmetrized from 71.8(+8.3–9.1)% 16.0(+5.6–4.8)%														∗∗
∗^{19}C	T : average 88Du09=49(4) 95Re.A=44(4) 95Oz02=45.5(4.0)														∗∗
∗^{19}C	J : from 01Ma08, 99Na27 and 95Ba28														∗∗
∗^{19}Ne	T : also 94Ko.A=17.296(0.005) conflicting, not used														∗∗
∗^{19}Ne	T : 92Ge08=18.5(0.6) for q=10^+ (bare ion)														∗∗
∗^{19}Ne^i	J : if this is the IAS of ^{19}O ground-state $5/2^+$; not yet confirmed														∗∗
∗^{19}Na	T : from upper limit of 40 keV, dominated by resolution: <1 eV suggested														∗∗
∗^{19}Na	D : proton emission measured in 10Mu12 and 04Ze05														∗∗
∗^{19}Mg	T : symmetrized from 6(+2–4); supersedes 07Mu15=4.0(1.5) ps														∗∗

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life	J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{20}B	67130#	700#										n ?; β^-n ?; β^-2n ?	
^{20}C	37560	240				16 ms 3	0^+	98	90Mu06	TD	1981	β^-=100; β^-n=70 11; …	*
^{20}N	21770	60				136 ms 3		98	06Su12	TD	1969	β^-=100; β^-n=42.9 14; β^-2n ?	
^{20}O	3796.2	0.9				13.51 s 0.05	0^+	98			1959	β^-=100	
^{20}F	−17.463	0.030				11.163 s 0.008	2^+	98	98Ti06	T	1935	β^-=100	
^{20}F^i	6503	3	6521	3	RQ		0^+T=2	98					
^{20}Ne	−7041.9306	0.0016				STABLE	0^+	98			1913	IS=90.48 3	
^{20}Ne^i	3230.5	2.0	10272.5	2.0	RQ		2^+T=1	98				IT=100	
^{20}Ne^j	9690.9	2.8	16732.8	2.8	RQ		0^+T=2	98				IT=100	
^{20}Na	6850.6	1.1				447.9 ms 2.3	2^+	98	89Cl02	D	1950	β^+=100; $\beta^+\alpha$=25.0 4	
^{20}Na^i	13375	14	6525	14	p		0^+T=2	98			1979	p=100	
^{20}Mg	17559	27				90 ms 6	0^+	98	95Pi03	TD	1974	β^+=100; β^+p=30.4 16	*

*^{20}C D : …; β^-2n<18.6 **

*^{20}C D : average β^-n 03Yo02=65(+19–18)% 90Mu06=72(14)% **

*^{20}C T : average 90Mu06=14(+6–5) 95Re.A 16.7(3.5); also 03Yo02=21.8(+15.0–7.4) **

*^{20}Mg T : average 95Pi03=95(3) 92Go10=82(4), with Birge ratio B=2.6 **

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life	J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{21}B	75720#	900#				<260 ns	$3/2^-$#	04	03Oz01	I		n ?	
^{21}C	45640#	400#				<30 ns	$1/2^+$#	04	93Po.A	I		n ?	
^{21}N	25250	100				83 ms 8	$(1/2^-)$	10			1970	β^-=100; β^-n=90.5 42; β^-2n ?	
^{21}O	8062	12				3.42 s 0.10	$(5/2^+)$	04			1968	β^-=100; β^-n ?	
^{21}F	−47.6	1.8				4.158 s 0.020	$5/2^+$	04			1955	β^-=100	
^{21}Ne	−5731.78	0.04				STABLE	$3/2^+$	04			1928	IS=0.27 1	
^{21}Ne^i	3127.4	1.4	8859.2	1.4		T=3/2	$(3/2,5/2)^+$	04					
^{21}Na	−2184.64	0.28				22.49 s 0.04	$3/2^+$	04			1940	β^+=100	
^{21}Na^i	6790	4	8975	4	p		$5/2^+$T=3/2	04					
^{21}Mg	10914	16				122 ms 2	$5/2^+$	04			1963	β^+=100; β^+p=32.6 10; …	*
^{21}Al	26990#	400#				<35 ns	$5/2^+$#	04	93Po.A	I		p ?	

*^{21}Mg D : …; $\beta^+\alpha$<0.5 **

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life	J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{22}C	53590	250				6.2 ms 1.3	0^+	05			1986	β^-=100; β^-n=61 14; …	*
^{22}N	32040	190				24 ms 5		05			1979	β^-=100; β^-n=36 5; β^-2n<13	
^{22}O	9280	60				2.25 s 0.09	0^+	05			1969	β^-=100; β^-n<22	
^{22}F	2793	12				4.23 s 0.04	(4^+)	05			1965	β^-=100; β^-n<11	
^{22}Ne	−8024.714	0.018				STABLE	0^+	05			1913	IS=9.25 3	
^{22}Ne^i	6035	20	14060	20			(4^+)T=2	05	87Wi03	E			*
^{22}Na	−5181.52	0.17				2.6027 y 0.0010	3^+	05			1935	β^+=100	
^{22}Na^m	−4598.41	0.19	583.11	0.09		243 ns 2	1^+	05				IT=100	
^{22}Na^i	−4524.36	0.21	657.16	0.12			0^+T=1	05				IT=100	
^{22}Mg	−399.9	0.3				3.8755 s 0.0012	0^+	05			1961	β^+=100	
^{22}Mg^i	13648	14	14048	14	p		$(4)^+$T=2	05	MMC12	J		α=?; p=?	*
^{22}Al	18200#	400#				91.1 ms 0.5	$(4)^+$	05	06Ac04	TJD	1982	β^+=100; β^+p=55 2; …	*
^{22}Si	33340#	500#				29 ms 2	0^+	05	96Bl11	D	1987	β^+=100; β^+p=32 4	

*^{22}C D : …; β^-2n<37 **

*^{22}C T : symmetrized from 6.1(+1.4–1.2) D : symmetrized from β^-n=61(+14–13)% **

*^{22}Ne^i E : from 87Wi03; assigned to IAS in 90En08 J : IAS of ^{22}Al and ^{22}F ground-state **

*^{22}Mg^i J : IAS of ^{22}Al and ^{22}F ground-state **

*^{22}Al D : …; β^+2p=1.10 11; $\beta^+\alpha$=0.038 17 **

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life	J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{23}C	64170#	1000#					$3/2^+$#					n ?	
^{23}N	38320#	300#				13.9 ms 1.4	$1/2^-$#	07	03Yo02	TD	1985	β^-=100; β^-n=42 6; β^-2n=8 4; β^-3n<3.4	*
^{23}O	14620	90				97 ms 8	$1/2^+$	07	07Su05	TD	1970	β^-=100; β^-n=7 2	
^{23}F	3310	50				2.23 s 0.14	$5/2^+$	07	95Re.A	D	1970	β^-=100; β^-n<14	
^{23}Ne	−5154.04	0.10				37.14 s 0.05	$5/2^+$	07	07Gr18	T	1936	β^-=100	*
^{23}Na	−9529.8525	0.0018				STABLE	$3/2^+$	07			1921	IS=100.	
^{23}Na^i	−1638.66	0.15	7891.19	0.15			$5/2^+$T=3/2	07				IT=100	
^{23}Mg	−5473.3	0.7				11.317 s 0.011	$3/2^+$	07			1939	β^+=100	
^{23}Mg^i	2328.9	1.6	7802.2	1.4			$5/2^+$T=3/2	07	00Pe28	D	1981	IT≈100; p=0.17 8	
^{23}Al	6748.1	0.3				470 ms 30	$5/2^+$	07			1969	β^+=100; β^+p=0.46 23	
^{23}Al^i	18530	60	11780	60	p		$(5/2)^+$T=5/2	07			1997	p=0.10 5; 2p=3.6 4	
^{23}Si	23700#	500#				42.3 ms 0.4	$3/2^+$#	07	97Bl04	TD	1986	β^+=100; β^+p≈88; …	*

*^{23}N T : symmetrized from 14.1(+1.2–1.5) **

*^{23}N D : symmetrized from 42.2(+6.3–6.5)% 8.0(+3.8–3.4)% **

*^{23}Ne T : average 07Gr18=37.11(0.06) 74Al03=37.24(0.12) **

*^{23}Si D : …; β^+2p=3.6 3 **

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{24}N	46940#	400#				<52 ns				07	93Po.A	I		n ?	
^{24}O	18500	110				65	ms	5	0^+	07			1970	β^-=100; β^-n=58 12	
^{24}F	7560	70				384	ms	16	$(1,2,3)^+$	07	07Su05	T	1970	β^-=100; β^-n<5.9	
^{24}Ne	−5951.6	0.5				3.38	m	0.02	0^+	07			1956	β^-=100	
^{24}Na	−8417.96	0.04				14.997	h	0.012	4^+	07			1934	β^-=100	
^{24}Na^m	−7945.75	0.04	472.2074	0.0008		20.18	ms	0.10	1^+	07			1961	IT≈100; β^-=0.05	
^{24}Na^i	−2450.59	0.14	5967.37	0.13					0^+T=2	07					
^{24}Mg	−13933.569	0.013				STABLE			0^+	07			1920	IS=78.99 4	
^{24}Mg^i	−4417.29	0.04	9516.28	0.04					(4^+)T=1	07					
^{24}Mg^j	1502.8	0.6	15436.4	0.6					0^+T=2	07					
^{24}Al	−47.6	1.1				2.053	s	0.004	4^+	07			1953	β^+=100; $\beta^+\alpha$=0.035 6; …	*
^{24}Al^m	378.2	1.1	425.8	0.1		130	ms	3	1^+	07			1968	IT=82.5 30; β^+=17.5 30; …	*
^{24}Al^i	5900	3	5948	4	p				0^+T=2	07					
^{24}Si	10744	19				140	ms	8	0^+	07	98Cz01	D	1979	β^+=100; β^+p=37.6 25	
^{24}P	33320#	500#							1^+#					p ?; β^+ ?; β^+p ?	
*^{24}Al	D : …; β^+p=0.0016 3														**
*^{24}Al^m	D : …; $\beta^+\alpha$=0.028 6														**
^{25}N	55980#	500#				<260 ns			$1/2^-$#	09	99Sa06	ID		n ?; 2n ?; β^-=0	*
^{25}O	27350	110				2.8	zs	0.5	$3/2^+$#	09	08Ho03	TD	2008	n=100	*
^{25}F	11360	80				80	ms	9	$(5/2^+)$	09			1970	β^-=100; β^-n=23.1 45; β^-2n ?	
^{25}Ne	−2060	40				602	ms	8	$1/2^+$	09			1970	β^-=100	
^{25}Na	−9357.8	1.2				59.1	s	0.6	$5/2^+$	09			1943	β^-=100	
^{25}Mg	−13192.77	0.05				STABLE			$5/2^+$	09			1920	IS=10.00 1	
^{25}Mg^i	−5405.8	0.3	7787.0	0.3					$5/2^+$T=3/2	09					
^{25}Al	−8916.2	0.5				7.183	s	0.012	$5/2^+$	09			1953	β^+=100	
^{25}Al^i	−1015.0	1.9	7901.2	1.8	RQ				$5/2^+$T=3/2	09					
^{25}Si	3827	10				220	ms	3	$5/2^+$	09			1963	β^+=100; β^+p=35 2	
^{25}P	19740#	400#				<30 ns			$1/2^+$#	09	93Po.A	I		p ?	
*^{25}N	D : in 99Sa06 experiment, 240 ^{25}N events expected, none observed														**
*^{25}O	T : from decay width 170(30) keV														**
^{26}O	34730	160				90	zs		0^+	00	12Lu07	TD	2012	2n=100	*
^{26}F	18670	80				9.7	ms	0.7	(1^+)	09			1979	β^-=100; β^-n=11 4; β^-2n ?	
^{26}Ne	479	18				197	ms	1	0^+	09			1970	β^-=100; β^-n=0.13 3	
^{26}Na	−6861	4				1.0713	s	0.0002	3^+	00	05Gr07	T	1958	β^-=100	*
^{26}Na^m	−6779	4	82.5	0.5		9	μs	2	1^+	00			1987	IT=100	
^{26}Mg	−16214.546	0.030				STABLE			0^+	00			1920	IS=11.01 3	
^{26}Al	−12210.11	0.06				717	ky	24	5^+	00			1934	β^+=100	
^{26}Al^m	−11981.81	0.07	228.305	0.013	MD	6.3465	s	0.0008	0^+T=1	00	11Fi01	T	1934	β^+=100	*
^{26}Si	−7140.98	0.11				2.2283	s	0.0027	0^+	00	08Ma39	T	1960	β^+=100	
^{26}Si^i	5926	11	13067	11	p				3^+T=2	00					
^{26}P	10970#	200#				43.7	ms	0.6	(3^+)	00	04Th09	TD	1983	β^+=100; β^+p=39 2; …	*
^{26}S	27080#	600#				<79 ns			0^+		11Fo.A	I		2p ?	
*^{26}O	T : from decay width 5 keV, while the fit was insensitive to the width														**
*^{26}Na	T : 05Gr07=1.07128 (0.00013 stat) (0.00021 sys)														**
*^{26}Al^m	T : unrounded 6.34654(0.00076); others 11Sc22=6.3478(25) 83Ko22=6.3462(26)														**
*^{26}P	D : …; β^+2p=2.16 24														**
^{27}O	44450#	500#				<260 ns			$3/2^+$#		99Sa06	I		n ?; 2n ?	
^{27}F	24630	190				4.9	ms	0.2	$5/2^+$#	11	98No.A	T	1981	β^-=100; β^-n=77 21; β^-2n ?	*
^{27}Ne	7040	70				31.5	ms	1.3	$(3/2^+)$	11			1977	β^-=100; β^-n=2.0 5; β^-2n ?	
^{27}Na	−5518	4				301	ms	6	$5/2^+$	11			1968	β^-=100; β^-n=0.13 4	
^{27}Mg	−14586.61	0.05				9.458	m	0.012	$1/2^+$	11			1934	β^-=100	
^{27}Al	−17196.75	0.10				STABLE			$5/2^+$	11			1922	IS=100.	
^{27}Al^i	−10383.0	0.7	6813.8	0.7					$1/2^+$T=3/2	11				IT=100	
^{27}Si	−12384.39	0.14				4.15	s	0.04	$5/2^+$	11			1939	β^+=100	
^{27}Si^i	−5759.5	2.3	6624.9	2.3	RQ				$1/2^+$T=3/2	11			1977	IT ?	
^{27}P	−722	26				260	ms	80	$1/2^+$	11			1977	β^+=100; β^+p=0.07	
^{27}P^i	12010	30	12730	40	p				$5/2^+$T=5/2	11			1991	IT ?	
^{27}S	17030#	400#				15.5	ms	1.5	$(5/2^+)$	11			1986	β^+=100; β^+p=2.3 9; …	*
*^{27}F	T : others not used: 99Re16=6.5(1.1) 97Ta22=5.3(0.9) outweighed; and														**
*^{27}F	T : 99Dl01=5.2(0.3) same data as in 99Re16														**
*^{27}S	D : …; β^+2p=1.1 5														**

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{28}O	52080#	700#				<100 ns			0^+		98Po.A	I		n ?; 2n ?; β^-=0	∗
^{28}F	32920	200				<40 ns				09	93Po.A	I		n ?	
^{28}Ne	11290	100				18.9	ms	0.4	0^+	08			1979	β^-=100; β^-n=11.9 7; β^-2n=3.6 5	
^{28}Na	−988	10				30.5	ms	0.4	1^+	09			1969	β^-=100; β^-n=0.58 12	
^{28}Mg	−15018.7	2.0				20.915	h	0.009	0^+	09			1953	β^-=100	
^{28}Al	−16850.53	0.12				2.2414	m	0.0012	3^+	01			1934	β^-=100	
^{28}Al^i	−10858.1	0.4	5992.4	0.4					0^+T=2	01					
^{28}Si	−21492.7946	0.0004				STABLE			0^+	01			1920	IS=92.223 19	
^{28}Si^r	−8951.64	0.11	12541.16	0.11	RQ				3^+	01					
^{28}Si^i	−6265.8	1.0	15227	1					0^+T=2	01	68Mc12	D	1968	α=90 11; p=10 11	
^{28}Si^j	−12176.87	0.10	9315.92	0.10					3^+T=1	01					
^{28}P	−7147.7	1.2				270.3	ms	0.5	3^+	01	79Ho27	D	1953	β^+=100; β^+p=0.0013 4; …	∗
^{28}P^i	−1260	20	5887	20	p				0^+T=2	01					
^{28}S	4070	160				125	ms	10	0^+	06			1982	β^+=100; β^+p=20.7 19	
^{28}Cl	27520#	600#							1^+#					p ?	
∗^{28}O	D : in 97Ta22 and 99Sa06, 11 and 37 ^{28}O events expected, none observed														∗∗
∗^{28}P	D : …; $\beta^+\alpha$=0.00086 25														∗∗
^{29}F	39630#	500#				2.5	ms	0.3	$5/2^+$#	12	99Dl01	D	1989	β^-=100; β^-n=60 40; …	∗
^{29}Ne	18400	100				14.7	ms	0.4	$3/2^+$#	12	05Tr13	T	1985	β^-=100; β^-n=28 5; β^-2n=4 1	∗
^{29}Na	2680	7				44.1	ms	0.9	$3/2^{(+\#)}$	12	95Re.A	D	1969	β^-=100; β^-n=25.9 23; β^-2n ?	∗
^{29}Mg	−10603	11				1.30	s	0.12	$3/2^+$	12			1971	β^-=100	
^{29}Al	−18204.7	0.9				6.56	m	0.06	$5/2^+$	12			1939	β^-=100	
^{29}Si	−21895.0787	0.0005				STABLE			$1/2^+$	12			1920	IS=4.685 8	
^{29}Si^i	−13605	5	8290	5					$5/2^+$T=3/2	12				IT=100	
^{29}P	−16952.5	0.6				4.142	s	0.015	$1/2^+$	12			1941	β^+=100	
^{29}P^i	−8570.7	2.5	8381.7	2.4	RQ				$5/2^+$T=3/2	12			1969	IT=100	
^{29}S	−3160	50				188	ms	4	$5/2^+$#	12	79Vi01	D	1964	β^+=100; β^+p=46.4 10	
^{29}Cl	13770#	400#				<20 ns			$3/2^+$#	12	93Po.A	I		p ?	
∗^{29}F	D : …; β^-2n ?														∗∗
∗^{29}F	D : β^-n from 99Dl01=100(80)%														∗∗
∗^{29}Ne	T : average 05Tr13=13.8(0.5) 97No.A=15.6(0.5); others outweighed, not used:														∗∗
∗^{29}Ne	T : 06Tr02=15.1(2.6) 16.4(1.3) 99Dl01=15(4) 99Re16=19(9) 97Ta22=15(3)														∗∗
∗^{29}Na	D : β^-n: average 95Re.A=27.1(1.6)% 84La03=21.5(3.0)%														∗∗
^{30}F	48110#	600#				<260 ns				10	99Sa06	I		n ?	
^{30}Ne	23040	280				7.3	ms	0.3	0^+	10			1985	β^-=100; β^-n=13 4; β^-2n=8.9 23	
^{30}Na	8475	5				48.4	ms	1.7	2^+	10	99Dl01	T	1969	β^-=100; β^-n=30 4; …	∗
^{30}Mg	−8884	3				313	ms	4	0^+	10	84La03	D	1971	β^-=100; β^-n<0.06	∗
^{30}Al	−15872	14				3.62	s	0.06	3^+	10			1961	β^-=100	
^{30}Si	−24432.961	0.022				STABLE			0^+	10			1924	IS=3.092 11	
^{30}P	−20200.6	0.3				2.498	m	0.004	1^+T=0	10			1934	β^+=100	∗
^{30}P^i	−19523.6	0.3	677.01	0.03					0^+T=1	10					
^{30}S	−14059.0	0.4				1.1759	s	0.0017	0^+	10	11So11	T	1961	β^+=100	
^{30}Cl	4440#	200#				<30 ns			3^+#	10	93Po.A	I		p ?	
^{30}Ar	21490#	500#				<20 ns			0^+		93Po.A	I		p ?; 2p ?	
∗^{30}Na	D : …; β^-2n=1.15 25; $\beta^-\alpha$=5.5e–5 2														∗∗
∗^{30}Na	T : average 99Dl01=50(4) 97Ta22=48(5) 84La02=48(2)														∗∗
∗^{30}Mg	T : average 08Hi05=314(5) and 312(7)														∗∗
∗^{30}P	D : first observed radionuclide, in 1934														∗∗
^{31}F	55620#	530#				1#	ms	(>260 ns)	$5/2^+$#	06	99Sa06	I	1999	β^- ?; β^-n ?; β^-2n ?	
^{31}Ne	30820	1620				3.4	ms	0.8	$7/2^-$#	06			1996	β^-=100; β^-n ?; β^-2n ?	
^{31}Na	12261	23				17.0	ms	0.4	$3/2^{(+\#)}$	06	93Kl02	J	1969	β^-=100; β^-n=37 5; …	∗
^{31}Mg	−3122	3				232	ms	15	$1/2^+$	07	08Ko05	J	1977	β^-=100; β^-n=6.2 20	∗
^{31}Al	−14955	20				644	ms	25	$5/2^+$	01	06Hi18	J	1971	β^-=100; β^-n<1.6	
^{31}Si	−22949.04	0.04				157.3	m	0.3	$3/2^+$	01			1934	β^-=100	
^{31}P	−24440.5411	0.0007				STABLE			$1/2^+$	01			1920	IS=100.	
^{31}P^i	−18059.7	1.7	6380.8	1.7					$3/2^+$T=3/2	01				IT=100	
^{31}S	−19042.52	0.23				2.572	s	0.013	$1/2^+$	01			1940	β^+=100	
^{31}S^i	−12775	10	6268	10					$3/2^+$T=3/2	01					
^{31}Cl	−7070	50				150	ms	25	$3/2^+$	01	85Ay02	D	1977	β^+=100; β^+p=0.7	∗
^{31}Cl^i	5256	3	12320	50	RQ				$3/2^+$T=5/2	01					
^{31}Ar	11290#	210#				14.4	ms	0.6	$5/2^{(+\#)}$	06			1986	β^+=100; β^+p=63 7; …	∗
∗^{31}Na	D : …; β^-2n=0.87 24; β^-3n<0.05														∗∗
∗^{31}Mg	D : strongly conflicting with earlier 84La03=1.7(0.3)%														∗∗
∗^{31}Cl	D : β^+p=0.44% for 986 keV protons. Total: 165/100×0.44=0.726%														∗∗
∗^{31}Ar	D : …; β^+2p=7.2 11; β^+3p<1.4; β^+pα<0.38; $\beta^+\alpha$<0.03														∗∗
∗^{31}Ar	D : from 98Ax02														∗∗

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^{π}	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{32}Ne	37000#	500#				3.5	ms	0.9	0^+	11			1990	β^-=100; β^-n=27#; β^-2n=7#	
^{32}Na	18810	120				12.9	ms	0.3	(3^-)	11	08Tr04	TJ	1972	β^-=100; β^-n=24 7; …	∗
^{32}Mg	−829	3				86	ms	5	0^+	11			1977	β^-=100; β^-n=5.5 5	
^{32}Al	−11099	12				33.0	ms	0.2	1^+	11			1971	β^-=100; β^-n=0.7 5	
^{32}Al^{m}	−10142	12	956.6	0.5		200	ns	20	(4^+)	11			1996	IT=100	
^{32}Si	−24077.69	0.30				153	y	19	0^+	11			1953	β^-=100	
^{32}P	−24304.87	0.04				14.263	d	0.003	1^+	11			1934	β^-=100	
^{32}P^{i}	−19232.43	0.07	5072.44	0.06					0^+T=2	11				IT=100	
^{32}S	−26015.5335	0.0013				STABLE			0^+	11			1920	IS=94.99 26	
^{32}S^{i}	−19014.1	0.4	7001.4	0.4					1^+T=1	11				IT=100	
^{32}S^{j}	−13967.57	0.28	12047.96	0.28					0^+T=2	11				IT=100	
^{32}Cl	−13334.7	0.6				298	ms	1	1^+	11			1953	β^+=100; $\beta^+\alpha$=0.054 8; …	∗
^{32}Cl^{i}	−8288.4	0.7	5046.3	0.3					0^+T=2	11				IT=100	
^{32}Ar	−2200.4	1.8				98	ms	2	0^+	11			1977	β^+=100; β^+p=35.58 0.22	
^{32}K	21100#	500#							1^+#					p ?	
^{32}K^{m}	22050#	510#	950#	100#					4^+#		Mirror	I		p ?	
$*^{32}$Na	D : …; β^-2n=8 2														∗∗
$*^{32}$Na	T : average 08Tr04=13.1(0.5) and 11.5(1.2) 98No.A=11.5(0.8) 84La03=13.2(0.4)														∗∗
$*^{32}$Cl	D : …; β^+p=0.026 5														∗∗
^{33}Ne	46000#	600#				<260	ns		$7/2^-$#	11	02No11	I		n ?	∗
^{33}Na	23970#	600#				8.2	ms	0.4	$(3/2^+)$	11			1972	β^-=100; β^-n=47 6; …	∗
^{33}Mg	4962.2	2.9				90.5	ms	1.6	$3/2^-$	11			1979	β^-=100; β^-n=14 2; β^-2n ?	
^{33}Al	−8470	80				41.7	ms	0.2	$(5/2)^+$	11			1971	β^-=100; β^-n=8.5 7	
^{33}Si	−20514.3	0.7				6.18	s	0.18	$3/2^+$	11			1971	β^-=100	
^{33}P	−26337.3	1.1				25.35	d	0.11	$1/2^+$	11			1951	β^-=100	
^{33}S	−26585.8543	0.0014				STABLE			$3/2^+$	11			1926	IS=0.75 2	
^{33}S^{i}	−21106.06	0.13	5479.79	0.13					$1/2^+$T=3/2	11				IT=100	
^{33}Cl	−21003.3	0.4				2.511	s	0.004	$3/2^+$	11			1940	β^+=100	
^{33}Cl^{i}	−15454.9	0.5	5548.4	0.4	RQ				$1/2^+$T=3/2	11				IT=100	
^{33}Ar	−9384.3	0.4				173.0	ms	2.0	$1/2^+$	11			1964	β^+=100; β^+p=38.7 10	
^{33}K	7040#	200#				<25	ns		$3/2^+$#	11	93Po.A	I		p ?	
$*^{33}$Ne	T : estimated half-life 1# ms for β^- decay I : also 02Le.A $< 1.5\,\mu$s														∗∗
$*^{33}$Na	D : …; β^-2n=13 3														∗∗
^{34}Ne	52840#	510#				1#	ms	(>1.5 μs)	0^+	12	02Le.A	I	2002	β^- ?; β^-n ?; β^-2n ?	
^{34}Na	31290#	500#				5.5	ms	1.0	1^+	12	GAu03	D	1983	β^-=100; β^-2n≈50; β^-n≈15	∗
^{34}Mg	8323	29				20	ms	10	0^+	12			1979	β^-=100; β^-n ?; β^-2n ?	
^{34}Al	−3070	70				56.3	ms	0.5	(4^-)	12			1977	β^-=100; β^-n=12.5 25; β^-2n ?	
^{34}Al^{m}	−2520#	120#	550#	100#		26	ms	1	(1^+)		12Ro25	TJ	2012	β^-≈100; β^-n ?; β^-2n ?	
^{34}Si	−19957	14				2.77	s	0.20	0^+	12			1971	β^-=100	
^{34}Si^{m}	−15701	14	4256.1	0.4		< 210	ns		(3^-)	12			1989	IT=100	
^{34}P	−24548.7	0.8				12.43	s	0.10	1^+	12			1945	β^-=100	
^{34}S	−29931.69	0.04				STABLE			0^+	12			1926	IS=4.25 24	
^{34}Cl	−24440.09	0.05				1.5266	s	0.0004	0^+T=1	12			1934	β^+=100	
^{34}Cl^{m}	−24293.73	0.05	146.360	0.027	MD	31.99	m	0.03	3^+T=0	12			1965	β^+=55.4 6; IT=44.6 6	
^{34}Ar	−18378.29	0.08				843.8	ms	0.4	0^+	12			1966	β^+=100	
^{34}Ar^{i}	−10444	5	7934	5	RQ				1^+#T=3	12			1969	β^+ ?; IT ?	
^{34}K	−1220#	300#				<40	ns		1^+#	12	93Po.A	I		p ?	
^{34}Ca	13850#	300#				<35	ns		0^+	12	93Po.A	I		2p ?	
$*^{34}$Na	D : β^-n≈15%, β^-2n≈50% estimated from $P_n = \beta^-$n + 2×β^-2n=115(20)% in 84La03														∗∗
$*^{34}$Na	D : assuming β^-n/β^-2n=0.3 from trends in the ^{30}Na-^{33}Na series: 26 41 3 4														∗∗
^{35}Na	37840#	590#				1.5	ms	0.5	$3/2^+$#	11			1983	β^-=100; β^-n=?; β^-2n ?	
^{35}Mg	15640	180				70	ms	40	$7/2^-$#	11			1989	β^-=100; β^-n=52 46; β^-2n ?	
^{35}Al	−220	70				37.2	ms	0.8	$5/2^+$#	11			1979	β^-=100; β^-n=38 2; β^-2n ?	
^{35}Si	−14360	40				780	ms	120	$7/2^-$#	11	95Re.A	D	1971	β^-=100; β^-n<5	
^{35}P	−24857.8	1.9				47.3	s	0.8	$1/2^+$	11			1971	β^-=100	
^{35}S	−28846.22	0.04				87.37	d	0.04	$3/2^+$	11			1936	β^-=100	
^{35}S^{i}	−19691	10	9155	10	RQ			T=5/2	$(1/2:9/2)^+$	11			1975		
^{35}Cl	−29013.54	0.04				STABLE			$3/2^+$	11			1919	IS=75.76 10	
^{35}Cl^{i}	−23359.06	0.22	5654.48	0.22					$3/2^+$T=3/2	11				IT=100	
^{35}Ar	−23047.4	0.7				1.7756	s	0.0010	$3/2^+$	11			1940	β^+=100	
^{35}Ar^{i}	−17474.7	0.7	5572.66	0.15					$3/2^+$T=3/2	11				IT=100	
^{35}K	−11172.9	0.5				178	ms	8	$3/2^+$	11	06Me04	J	1976	β^+=100; β^+p=0.37 15	
^{35}K^{i}	−2110	40	9060	40	2p				$3/2^+$T=5/2						
^{35}Ca	4790#	200#				25.7	ms	0.2	$1/2^+$#	11			1985	β^+=100; β^+p=95.9 14; …	∗
$*^{35}$Ca	D : …; β^+2p=4.1 6														∗∗

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{36}Na	45910#	590#				<180 ns				12				n ?	
^{36}Mg	20380	460				3.9	ms	1.3	0^+	12			1989	β^-=100; β^-n ?; β^-2n ?	
^{36}Al	5950	100				90	ms	40		12			1979	β^-=100; β^-n<30; β^-2n ?	
^{36}Si	−12390	70				450	ms	60	0^+	12	95Re.A	D	1971	β^-=100; β^-n=12 5	
^{36}P	−20251	13				5.6	s	0.3	(4^-)	12			1971	β^-=100; β^-n ?	
^{36}S	−30664.12	0.19				STABLE			0^+	12			1938	IS=0.01 1	
^{36}Cl	−29522.02	0.04				301.3	ky	1.5	2^+	12			1941	β^-=98.1 1; β^+=1.9 1	
^{36}Cl^i	−25222.35	0.04	4299.667	0.014					$(0)^+$T=2	12				IT=100	
^{36}Ar	−30231.540	0.027				STABLE			0^+	12			1920	IS=0.3336 21; 2β^+ ?	
^{36}Ar^i	−23620.5	0.3	6611.0	0.3					2^+T=1	12				IT=100	
^{36}Ar^j	−19379.4	1.2	10852.1	1.2	RQ				0^+T=2	12				IT=100	
^{36}K	−17417.1	0.3				341	ms	3	2^+	12			1967	β^+=100; β^+p=0.048 14; …	*
^{36}K^i	−13134.6	2.4	4282.4	2.4	p				0^+T=2	12				p=100	*
^{36}Ca	−6450	40				101.2	ms	1.5	0^+	12	07Do17	T	1977	β^+=100; β^+p=51.2 10	*
^{36}Sc	15350#	300#												p ?	
*^{36}K	D : …; $\beta^+\alpha$=0.0034 13														**
*^{36}K^i	E : ENSDF2012 finds 4281.9(0.8) as IAS of ^{36}Ca ground-state														**
*^{36}Ca	T : average 07Do17=100.1(2.3) 95Tr02=102(2)														**
^{37}Na	53140#	610#				1#	ms	(>1.5 μs)	$3/2^+$#	12	02Le.A	I	2002	β^- ?; β^-n ?; β^-2n ?	
^{37}Mg	28290#	500#				8	ms	4	$7/2^-$#	12			1996	β^- ?; β^-n ?; β^-2n ?	
^{37}Al	9810	120				10.7	ms	1.3	$3/2^+$#	12			1979	β^-=100; β^-n ?; β^-2n ?	
^{37}Si	−6590	80				90	ms	60	$7/2^-$#	12			1979	β^-=100; β^-n=17 13; β^-2n ?	
^{37}P	−19000	40				2.31	s	0.13	$1/2^+$#	12			1971	β^-=100; β^-n=0.02#	
^{37}S	−26896.41	0.20				5.05	m	0.02	$7/2^-$	12			1945	β^-=100	
^{37}Cl	−31761.52	0.05				STABLE			$3/2^+$	12			1919	IS=24.24 10	
^{37}Cl^i	−21539.7	0.3	10221.8	0.3	RQ				$7/2^-$T=5/2	12			1984	IT=100	
^{37}Ar	−30947.65	0.21				35.011	d	0.019	$3/2^+$	12			1941	ε=100	
^{37}Ar^i	−25956	6	4992	6	RQ				$3/2^+$T=3/2	12			1973		
^{37}K	−24800.20	0.09				1.225	s	0.007	$3/2^+$	12			1958	β^+=100	
^{37}K^i	−19749.9	0.8	5050.3	0.8	RQ				$3/2^+$T=3/2	12			1973	IT=100	
^{37}Ca	−13136.1	0.6				181.1	ms	1.0	$3/2^+$#	12			1964	β^+=100; β^+p=82.1 7	*
^{37}Sc	3480#	300#							$7/2^-$#					p ?	
*^{37}Ca	TD : also 07Do17=181.7(3.6) ms; 72.2(4.3)%; also β^+p=74.5(0.7)% from 95Tr03														**
^{38}Mg	34070#	500#				1#	ms	(>260 ns)	0^+	08			2002	β^-=100#; β^-n=76#; β^-2n=7.4#	
^{38}Al	16210	250				7.6	ms	0.6		08			1989	β^-=100; β^-n ?; β^-2n ?	
^{38}Si	−4170	70				90#	ms	(>1 μs)	0^+	08			1979	β^-=100#; β^-n ?	
^{38}P	−14670	90				640	ms	140	$(0^-$to$4^-)$	08			1971	β^-=100; β^-n=12 5	
^{38}S	−26861	7				170.3	m	0.7	0^+	08			1958	β^-=100	
^{38}Cl	−29798.09	0.10				37.24	m	0.05	2^-	08			1940	β^-=100	
^{38}Cl^m	−29126.73	0.10	671.365	0.008		715	ms	3	5^-	08			1954	IT=100	
^{38}Cl^i	−21590	24	8208	24	RQ				0^+T=3	08					
^{38}Ar	−34714.82	0.19				STABLE			0^+	08			1934	IS=0.0629 7	
^{38}Ar^i	−24083.9	0.9	10630.9	0.9					(2^-)T=2	08					
^{38}Ar^j	−15940	30	18780	30	RQ				0^+T=3	08					
^{38}K	−28800.75	0.20				7.636	m	0.018	3^+T=0	08			1937	β^+=100	
^{38}K^m	−28670.61	0.20	130.15	0.04	MD	924.46	ms	0.14	0^+T=1	08	10Ba43	T	1953	β^+=100	
^{38}K^n	−25342.61	0.26	3458.14	0.17		21.95	μs	0.11	$(7)^+$	08			1971	IT=100	
^{38}Ca	−22058.50	0.19				443.77	ms	0.36	0^+	08	11Pa38	T	1966	β^+=100	*
^{38}Sc	−4550#	200#				<300 ns			2^-#	08	94Bl10	I		p ?	
^{38}Sc^m	−3880#	220#	670#	100#					5^-#					IT ?; p ?	
^{38}Ti	10670#	300#				<120 ns			0^+	08	96Bl21	I		2p ?	
*^{38}Ca	T : other recent 10Bl09=443.8(1.9) ms														**
^{39}Mg	42280#	510#				<180 ns			$7/2^-$#	07				n ?	*
^{39}Al	21000#	500#				7.6	ms	1.6	$3/2^+$#	11			1989	β^-=100; β^-n ?; β^-2n ?	
^{39}Si	2320	90				47.5	ms	2.0	$7/2^-$#	06			1979	β^- ?; β^-n ?; β^-2n ?	
^{39}P	−12830	90				282	ms	24	$1/2^+$#	06	04Gr20	T	1977	β^-=100; β^-n=26 8	*
^{39}S	−23160	50				11.5	s	0.5	$(7/2)^-$	06			1971	β^-=100	
^{39}Cl	−29800.2	1.7				56.2	m	0.6	$3/2^+$	06			1949	β^-=100	
^{39}Ar	−33242	5				269	y	3	$7/2^-$	06			1950	β^-=100	
^{39}Ar^i	−24161	7	9081	9	RQ			T=5/2	$(3/2,5/2)^+$	06					
^{39}K	−33807.190	0.005				STABLE			$3/2^+$	06			1921	IS=93.2581 44	
^{39}K^i	−27261.2	2.0	6546	2					$7/2^-$T=3/2	06				IT=100	
^{39}Ca	−27282.7	0.6				860.3	ms	0.8	$3/2^+$	06	10Bl09	T	1943	β^+=100	*
^{39}Ca^i	−20917#	9#	6366#	9#					$3/2^+$T=3/2		Imme	E			
^{39}Sc	−14173	24				< 300	ns		$7/2^-$#	06	GAu128	D	1988	p=100	*
^{39}Sc^i	−5344	28	8830	40	2p				$(3/2^-)$T=5/2						
^{39}Ti	2200#	210#				28.5	ms	0.9	$3/2^+$#	06	07Do17	TD	1990	β^+=100; β^+p=93.7 28; …	*
*^{39}Mg	T : estimated half-life 1# ms for β^- decay														**
*^{39}P	T : average 04Gr20=250(80) 98Wi.A=320(30) 95Re.A=190(50)														**
*^{39}Ca	T : average 10Bl09=860.7(1.0) 77Az01=859.4(1.6) 73Al11=860.4(3.0)														**
*^{39}Sc	D : most probably proton emitter from S_p=–597(24) keV														**
*^{39}Ti	D : …; β^+2p=15# D : β^+2p decay observed in 92Mo15														**

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{40}Mg	48610#	600#				1#	ms	(>170 ns)	0$^+$	07			2007	β^- ?; β^-n ?; β^-2n ?	
^{40}Al	27970#	500#				10#	ms	(>260 ns)		04			2002	β^- ?; β^-n ?; β^-2n ?	
^{40}Si	5430	230				33.0	ms	1.0	0$^+$	06	04Gr20	TD	1989	β^-=100; β^-n ?; β^-2n ?	
^{40}P	−8070	110				150	ms	8	(2$^-$,3$^-$)	04			1979	β^-=100; ; β^-n=15.8 21; β^-2n ?	
^{40}S	−22838	4				8.8	s	2.2	0$^+$	04			1971	β^-=100	
^{40}Cl	−27560	30				1.35	m	0.02	2$^-$	04			1956	β^-=100	
^{40}Ar	−35039.8946	0.0022				STABLE			0$^+$	04			1920	IS=99.6035 25	
^{40}K	−33535.49	0.06				1.248	Gy	0.003	4$^-$	04			1935	IS=0.0117 1; …	*
^{40}K^m	−31891.85	0.06	1643.639	0.011		336	ns	12	0$^+$	04			1968	IT=100	
^{40}K^i	−29151.5	0.3	4384.0	0.3					0$^+$T=2	04				IT=100	
^{40}Ca	−34846.386	0.021				STABLE		(>5.9 Zy)	0$^+$	04	99Be64	T	1922	IS=96.94 16; 2β^+ ?	
^{40}Ca^i	−27188.21	0.05	7658.18	0.05					4$^-$T=1	04	AHW	E		IT=100	*
^{40}Ca^j	−22858.4	1.0	11988	1					0$^+$T=2	04				IT=100	
^{40}Sc	−20523.3	2.8				182.3	ms	0.7	4$^-$	04			1955	β^+=100; …	*
^{40}Sc^i	−16164	6	4359	6	RQ				0$^+$T=2	04				IT=100	
^{40}Ti	−8850	160				52.4	ms	0.3	0$^+$	04	07Do17	TD	1982	β^+=100; β^+p=95.8 13	
^{40}V	11890#	400#							2$^-$#					p ?	
*^{40}K	D : …; β^-=89.28 13; β^+=10.72 13														**
*^{40}Ca^i	E : Original 7658.23(0.05) recalibrated -0.05 keV for ^{27}Al+p resonances														**
*^{40}Sc	D : …; β^+p=0.44 7; $\beta^+\alpha$=0.017 5														**
^{41}Al	33890#	600#				2#	ms	(>260 ns)	3/2$^+$#	02			2002	β^- ?; β^-n ?; β^-2n ?	
^{41}Si	12120	370				20.0	ms	2.5	7/2$^-$#	02	04Gr20	TD	1989	β^-=100; β^-n ?; β^-2n ?	
^{41}P	−4980	80				100	ms	5	1/2$^+$#	07			1979	β^-=100; β^-n=30 10; β^-2n ?	
^{41}S	−19009	4				1.99	s	0.05	7/2$^-$#	02			1979	β^-=100; β^-n ?	
^{41}Cl	−27310	70				38.4	s	0.8	(1/2$^+$)	07			1971	β^-=100	
^{41}Ar	−33067.5	0.3				109.61	m	0.04	7/2$^-$	02			1936	β^-=100	
^{41}K	−35559.543	0.004				STABLE			3/2$^+$	02			1921	IS=6.7302 44	
^{41}K^i	−27210	15	8349	15	RQ				7/2$^-$T=5/2	02	75Me10	J	1975		*
^{41}Ca	−35137.89	0.14				99.4	ky	1.5	7/2$^-$	02	12Jo04	T	1939	ε=100	
^{41}Ca^i	−29320.7	0.9	5817.2	0.9				<28fs	3/2$^+$T=3/2	02				IT=100	
^{41}Sc	−28642.41	0.08				596.3	ms	1.7	7/2$^-$	02			1941	β^+=100	
^{41}Sc^r	−25760.09	0.09	2882.33	0.05	RQ				7/2$^+$	02				P=59 2; IT=41 2	
^{41}Sc^i	−22704	3	5939	3	RQ				3/2$^+$T=3/2	02				p=100	
^{41}Ti	−15698	28				82.6	ms	0.5	3/2$^+$	02	07Do17	TD	1964	β^+=100; β^+p=91.1 6	*
^{41}V	200#	300#							7/2$^-$#					p ?	
*^{41}K^i	E : ENSDF=5/2$^-$,7/2$^-$ and T=3/2 ; NUBASE adopts this level as IAS of ^{41}Ar ground-state														**
^{42}Al	40840#	600#				1#	ms	(>170 ns)		07			2007	β^- ?; β^-n ?; β^-2n ?	
^{42}Si	16560#	500#				12.5	ms	3.5	0$^+$	06			1990	β^-=100; β^-n ?; β^-2n ?	
^{42}P	1010	210				48.5	ms	1.5		01	04Gr20	T	1979	β^-=100; β^-n=50 20; β^-2n ?	
^{42}S	−17637.7	2.8				1.013	s	0.015	0$^+$	01			1979	β^-=100; β^-n<4	
^{42}Cl	−24910	140				6.8	s	0.3	2$^-$#	01			1971	β^-=100; β^-n ?	
^{42}Ar	−34423	6				32.9	y	1.1	0$^+$	01			1952	β^-=100	
^{42}K	−35022.03	0.11				12.360	h	0.012	2$^-$	01			1935	β^-=100	
^{42}K^i	−28570	100	6450	100					(0$^+$)T=3	01					
^{42}Ca	−38547.24	0.15				STABLE			0$^+$	01			1934	IS=0.647 23	
^{42}Ca^i	−28797.2	2.0	9750	2					(2$^-$)T=2	01					
^{42}Sc	−32121.14	0.17				681.3	ms	0.7	0$^+$T=1	01			1955	β^+=100	
^{42}Sc^m	−31504.82	0.18	616.32	0.06	MD	61.7	s	0.4	(7)$^+$	01	FGK128	J	1963	β^+=100	*
^{42}Sc^r	−26044.89	0.17	6076.26	0.07	RQ				(1$^+$to4$^+$)	01				IT=100	
^{42}Sc^i	−31510.09	0.17	611.051	0.006					1$^+$T=0	01				IT=100	
^{42}Ti	−25104.66	0.28				208.14	ms	0.45	0$^+$	01	09Ku19	T	1964	β^+=100	
^{42}V	−7620#	300#						<55 ns	2$^-$#	01	92Bo37	I		p ?	
^{42}Cr	6240#	400#				13.3	ms	1.0	0$^+$	09			1996	$\beta^+\approx$100; β^+p=94.4 50; 2p ?	*
*^{42}Sc^m	J : 5$^+$,6$^+$,7$^+$ from β^+ decay to 6$^+$ level; 7$^+$ is most likely from shell model														**
^{43}Al	47940#	700#				1#	ms	(>170 ns)	3/2$^+$#	07			2007	β^- ?; β^-n ?; β^-2n ?	
^{43}Si	23100#	600#				15#	ms	(>260 ns)	3/2$^-$#	06	02No11	I	2002	β^- ?; β^-n ?; β^-2n ?	
^{43}P	4680	370				35.8	ms	1.3	1/2$^+$#	06	04Gr20	T	1989	β^-=100; β^-n=100; β^-2n ?	*
^{43}S	−12195	5				265	ms	13	3/2$^-$#	01	04Gr20	T	1979	β^-=100; β^-n=40 10	*
^{43}S^m	−11875	5	320.0	0.5		415	ns	5	(7/2$^-$)	01	09Ga05	TJE	2000	IT=100	*
^{43}Cl	−24320	100				3.13	s	0.09	(3/2$^+$)	07	06Wi10	J	1976	β^-=100; β^-n ?	
^{43}Ar	−32010	5				5.37	m	0.06	(5/2$^-$)	01			1969	β^-=100	
^{43}K	−36575.4	0.4				22.3	h	0.1	3/2$^+$	01			1949	β^-=100	
^{43}K^m	−35837.3	0.4	738.1	0.1		200	ns	5	7/2$^-$	01			1978	IT=100	
^{43}Ca	−38408.82	0.23				STABLE			7/2$^-$	01			1934	IS=0.135 10	
^{43}Ca^i	−30414	14	7995	14	RQ				(3/2)$^+$T=5/2	01					
^{43}Sc	−36188.1	1.9				3.891	h	0.012	7/2$^-$	01			1935	β^+=100	
^{43}Sc^m	−36036.7	1.9	151.4	0.2		438	μs	5	3/2$^+$	01	77Mi10	T	1964	IT=100	*
^{43}Sc^n	−33064.9	1.9	3123.2	0.3		472	ns	3	19/2$^-$	01	08Fe02	T	1978	IT=100	*
^{43}Sc^i	−31956	3	4232	4	RQ				7/2$^-$T=3/2	01					

… *A*-group is continued on next page …

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

... *A*-group continued ...

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{43}Ti	−29321	7				509	ms	5	$7/2^-$	01			1948	β^+=100	
^{43}Ti^m	−29008	7	313.0	1.0		11.9	μs	0.3	$(3/2^+)$	01	11Ho02	T	1978	IT=100	*
^{43}Ti^n	−26255	7	3066.4	1.0		556	ns	5	$(19/2^-)$	01	11Ho02	T	1978	IT=100	
^{43}Ti^i	−24605	9	4716	6					$7/2^-$T=3/2						
^{43}V	−17920	40				79.3	ms	2.4	$7/2^-$#	01	07Do17	TD	1987	β^+=100; β^+p<2.5	*
^{43}V^i	−9718	15	8200	50	RQ				$3/2^+$T=5/2						
^{43}Cr	−2300#	400#				21.1	ms	0.3	$(3/2^+)$	01	11Po01	TD	1992	β^+=100; β^+p=81 4; ...	*

*^{43}P T : average 04Gr20=36.5(1.5) 95So03=33(3) **
*^{43}S T : average 04Gr20=282(27) 98Wi.A=260(15); other 89Le16=220(+80–50) **
*^{43}S^m T : others recent 12Ka.B=201(+140–70) E=320.9 keV, 00Sa21=478(48) E=319 keV **
*^{43}Sc^m T : average 77Mi10=438(7) 65De15=470(20) 64Ho14=435(7) **
*^{43}Sc^n T : average 08Fe02=481(9) 81Da06=469(4) 78Ha07=473(5) **
*^{43}Sc^n J : from measured magnetic moment, transitions multipolarity and transfer **
*^{43}Sc^n J : reaction L values, as compiled in ENSDF **
*^{43}Ti^m T : average 11Ho02=11.7(0.3) 78Me15=12.6(0.6) **
*^{43}Ti^n T : average 11Ho02=551(7) 81Da06=553(21) 78Ha07=560(6) **
*^{43}Cr D : ...; β^+2p=7.1 4; β^+3p=0.08 3; $\beta^+\alpha$? **
*^{43}Cr T : average 11Po01=20.6(0.9) 07Do17=21.1(0.4) 01Gi01=21.6(0.7) **
*^{43}Cr D : other 07Do17 92.5(2.8) for β^+p + β^+2p +...; β^+2p (IAS in ^{43}V^i)=5.6(0.7) **

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{44}Si	28510#	600#				10#	ms	(>360 ns)	0^+	11			2007	β^- ?; β^-n ?; β^-2n ?	
^{44}P	10440#	500#				18.5	ms	2.5		11			1989	β^-=100; β^-n=18#; β^-2n=71	
^{44}S	−9204	5				100	ms	1	0^+	11			1979	β^-=100; β^-n=18 3	
^{44}S^m	−7839	5	1365.0	0.8		2.619	μs	0.026	0^+	11			2005	IT=100	
^{44}Cl	−20610	190				560	ms	110	(2^-)	11			1979	β^-=100; β^-n<8	
^{44}Ar	−32673.3	1.6				11.87	m	0.05	0^+	11			1969	β^-=100	
^{44}K	−35781.5	0.4				22.13	m	0.19	2^-	11			1954	β^-=100	
^{44}Ca	−41468.7	0.3				STABLE			0^+	11			1922	IS=2.09 11	
^{44}Ca^i	−29619	10	11850	10					2^-T=3	11					
^{44}Sc	−37816.0	1.8				3.97	h	0.04	2^+	11			1937	β^+=100	
^{44}Sc^m	−37748.1	1.8	67.8679	0.0014		154.8	ns	0.8	1^-	11			1967	IT=100	
^{44}Sc^n	−37669.8	1.8	146.1914	0.0020		51.0	μs	0.3	0^-	11			1963	IT=100	
^{44}Sc^p	−37544.8	1.8	271.240	0.010		58.61	h	0.10	6^+	11			1940	IT=98.80 7; β^+=1.20 7	
^{44}Sc^i	−35038.2	2.5	2778	3	RQ				0^+T=2	11					
^{44}Ti	−37548.6	0.7				59.1	y	0.3	0^+	11			1954	ε=100	
^{44}Ti^i	−30942.2	0.9	6606.4	0.5					2^+T=1	11				IT=100	
^{44}Ti^j	−28210.6	2.1	9338	2					0^+frg.T=2	11				IT=100	*
^{44}V	−24120	180			*	111	ms	7	$(2)^+$	11			1971	β^+=100; $\beta^+\alpha$=?; β^+p ?	
^{44}V^m	−23850#	210#	270#	100#	*	150	ms	3	$(6)^+$	11			1997	β^+=100	
^{44}V^n	−23970#	210#	150#	100#					0^-#		Mirror	I			
^{44}V^i	−21124	13	2990	180	p				0^+#T=2		92Bo37	D	1992	p=100	
^{44}Cr	−13640#	300#				42.8	ms	0.6	0^+	11	07Do17	D	1987	β^+=100; β^+p=14.0 9	
^{44}Mn	6660#	500#						<105 ns	2^-#	11				p ?	

*^{44}Ti^j E : strongest fragment 9338(2); other 40(2) lower **

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{45}Si	37210#	700#				1#	ms		$3/2^-$#					β^- ?; β^-n ?; β^-2n ?	
^{45}P	15320#	600#				8#	ms	(>200 ns)	$1/2^+$#	08			1990	β^- ?; β^-n ?; β^-2n ?	
^{45}S	−3990	690				68	ms	2	$3/2^-$#	08			1989	β^-=100; β^-n=54; β^-2n ?	
^{45}Cl	−18360	100				413	ms	25	$3/2^+$#	08			1979	β^-=100; β^-n=24 4	
^{45}Ar	−29770.8	0.5				21.48	s	0.15	$(5/2^-,7/2^-)$	08			1974	β^-=100	
^{45}K	−36615.6	0.5				17.8	m	0.6	$3/2^+$	08			1964	β^-=100	
^{45}Ca	−40812.2	0.4				162.61	d	0.09	$7/2^-$	08			1940	β^-=100	
^{45}Sc	−41071.2	0.7				STABLE			$7/2^-$	08			1923	IS=100.	
^{45}Sc^m	−41058.8	0.7	12.40	0.05		318	ms	7	$3/2^+$	08			1964	IT=100	
^{45}Sc^i	−34372	15	6699	15					$7/2^-$T=5/2	08					
^{45}Ti	−39009.1	0.9				184.8	m	0.5	$7/2^-$	08			1941	β^+=100	
^{45}Ti^m	−38972.6	0.9	36.53	0.15		3.0	μs	0.2	$3/2^-$	08			2006	IT=100	
^{45}Ti^i	−34290	3	4719	3	RQ				$7/2^-$T=3/2	08					
^{45}V	−31881	8				547	ms	6	$7/2^-$	08			1975	β^+=100	
^{45}V^m	−31824	8	56.8	0.6		512	ns	13	$(3/2^-)$	08	11Ho02	T	1980	IT=100	*
^{45}V^i	−27090	9	4791	12	RQ				$7/2^-$T=3/2	08				p=100	
^{45}Cr	−19510	40			*	60.9	ms	0.4	$7/2^-$#	08			1974	β^+=100; β^+p=34.4 8	
^{45}Cr^m	−19400	40	107	1	*	> 80	μs		$(3/2)$	11	11Ho02	ETJ	2011	IT=100	
^{45}Mn	−5130#	400#						<70 ns	$7/2^-$#	08	92Bo37	I		p ?	
^{45}Fe	13430#	400#				2.2	ms	0.3	$3/2^+$#	08	05Do20	T	1996	2p=57 10; β^+<43; β^+p<43	*

*^{45}V^m T : average 11Ho02=468(23) 87Ha.B=430(80) 82Ho11=539(18) 82Al.C=610(80) and **
*^{45}V^m T : 80Gr.A=510(50) **
*^{45}Fe D : ...; β^+p=25 5 **
*^{45}Fe T : average 05Do20=1.6(+0.5–0.3) 02Gi09=4.7(+3.4–1.4) 02Pf02=3.2(+2.6–1.0) **

Table I. The NUBASE2012 **table (continued, Explanation of Table on page 1176)**

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{46}P	22780#	700#				4#	ms	(>200 ns)		00	90Le03	I	1990	β^- ?; β^-n ?; β^-2n ?	
^{46}S	40#	500#				50	ms	8	0^+	10			1989	β^-=100; β^-n ?; β^-2n ?	
^{46}Cl	−13810	160				232	ms	2		00	04Gr20	T	1989	β^-=100; β^-n=60 9; β^-2n ?	
^{46}Ar	−29730	40				8.4	s	0.6	0^+	00			1974	β^-=100	
^{46}K	−35413.9	0.7				105	s	10	$2^{(-)}$	00	82To02	J	1965	β^-=100	
^{46}Ca	−43138.4	2.3				STABLE		(>100 Ey)	0^+	00	99Be64	T	1938	IS=0.004 3; 2β^- ?	∗
^{46}Sc	−41760.5	0.7				83.79	d	0.04	4^+	00			1936	β^-=100	
^{46}Sc^m	−41708.5	0.7	52.011	0.001		9.4	μs	0.8	6^+	00			1966	IT=100	
^{46}Sc^n	−41618.0	0.7	142.528	0.007		18.75	s	0.04	1^-	00			1948	IT=100	
^{46}Sc^i	−36747	4	5014	4	RQ				0^+T=3	00					
^{46}Ti	−44127.0	0.3				STABLE			0^+	00			1934	IS=8.25 3	
^{46}Ti^i	−34961	7	9166	7	RQ				4^+T=2	00					
^{46}Ti^j	−29976	6	14151	6	RQ				0^+T=3	00					
^{46}V	−37074.6	0.3				422.64	ms	0.05	0^+T=1	00	12Pa07	T	1952	β^+=100	∗
^{46}V^m	−36273.1	0.3	801.46	0.10		1.02	ms	0.07	3^+T=0	00			1962	IT=100	
^{46}Cr	−29474	20				257	ms	55	0^+	10	05On03	T	1972	β^+=100	∗
^{46}Cr^i	−20323	15	9151	25	RQ				(4^+)T=2	10				p=?	
^{46}Mn	−12960#	400#			∗	36.2	ms	0.4	(4^+)	10			1987	β^+=100; β^+p=57.0 8; …	∗
^{46}Mn^m	−12810#	410#	150#	100#	∗	1#	ms		1^-#					β^+ ?	
^{46}Mn^i	−7470	50	5480#	400#	p				T=3						
^{46}Fe	590#	500#				13.0	ms	2.0	0^+	10	07Do17	TD	1992	β^+=100; β^+p=78.7 38	∗
∗^{46}Ca	T : limit is for 0ν-$\beta\beta$ decay														∗∗
∗^{46}V	T : average 12Pa07=422.66(0.06) 97Ko65=422.57(0.13)														∗∗
∗^{46}Cr	T : average 05On03=240(140) 72Zi02=260(60)														∗∗
∗^{46}Mn	D : …; β^+2p≈18; $\beta^+\alpha$?														∗∗
∗^{46}Mn	T : others 92Bo37=41(+7–6) 01Gi01=34.0(+4.5–3.5)														∗∗
∗^{46}Mn	D : β^+2p≈18% estimated from $P_p = \beta^+$p + 2×β^+2p=57(1)%														∗∗
∗^{46}Fe	T : other 01Gi01=9.7(+3.5–4.3) D : other 01Gi01=36(20)%														∗∗
^{47}P	29240#	800#				2#	ms		$3/2^+$#					β^- ?; β^-n ?; β^-2n ?	
^{47}S	7410#	500#				20#	ms	(>200 ns)	$3/2^-$#	07	89Gu03	I	1989	β^- ?; β^-n ?; β^-2n ?	
^{47}Cl	−10100#	400#				101	ms	5	$3/2^+$#	07			1989	β^-=100; β^-n<3; β^-2n ?	
^{47}Ar	−25210	90				1.23	s	0.03	$(3/2)^-$	07			1985	β^-=100; β^-n<0.2	
^{47}K	−35712.0	1.4				17.50	s	0.24	$1/2^+$	07			1964	β^-=100	
^{47}Ca	−42343.5	2.2				4.536	d	0.003	$7/2^-$	07			1951	β^-=100	
^{47}Sc	−44335.6	2.0				3.3492	d	0.0006	$7/2^-$	07			1945	β^-=100	
^{47}Sc^m	−43568.8	2.0	766.83	0.09		272	ns	8	$(3/2)^+$	07			1968	IT=100	
^{47}Ti	−44936.4	0.4				STABLE			$5/2^-$	07			1934	IS=7.44 2	
^{47}Ti^i	−37587.4	0.8	7349.0	0.7					$7/2^-$T=5/2	07					
^{47}V	−42005.8	0.3				32.6	m	0.3	$3/2^-$	07			1942	β^+=100	
^{47}V^i	−37855.5	0.3	4150.35	0.11					$5/2^{(-)}$T=3/2	07				IT=100	
^{47}Cr	−34561	7				500	ms	15	$3/2^-$	07			1972	β^+=100	
^{47}Cr^i	−29801	21	4760	20					$(5/2^-)$T=5/2						
^{47}Mn	−22570	30				88.0	ms	1.3	$5/2^-$#	07	07Do17	TD	1987	β^+=100; β^+p<1.7	
^{47}Mn^i	−15193	24	7370	40	RQ				$7/2^-$#T=5/2	07			2001	p=100	
^{47}Fe	−7590#	500#				21.9	ms	0.2	$7/2^-$#	07	07Do17	TD	1992	β^+=100; β^+p=88.4 9	
^{47}Fe^m	−6820#	510#	770#	100#					$3/2^+$#					IT ?	
^{47}Co	9850#	800#							$7/2^-$#	07				p ?	
^{48}S	12760#	600#				10#	ms	(>200 ns)	0^+	06			1990	β^- ?; β^-n ?; β^-2n ?	
^{48}Cl	−4060#	500#				100#	ms	(>200 ns)		06	89Gu03	I	1989	β^- ?; β^-n ?; β^-2n ?	
^{48}Ar	−22440#	300#				475	ms	40	0^+	10			2004	β^-=?; β^-n ?	
^{48}K	−32284.5	0.8				6.8	s	0.2	(1^-)	06	11Bi.A	J	1972	β^-=100; β^-n=1.14 15	
^{48}Ca	−44224.76	0.12				53	Ey	17	0^+	06	00Br63	T	1938	IS=0.187 21; …	∗
^{48}Sc	−44503	5				43.67	h	0.09	6^+	06			1937	β^-=100	
^{48}Ti	−48491.7	0.4				STABLE			0^+	06			1923	IS=73.72 3	
^{48}Ti^i	−37766	6	10726	6					(6^+)T=3	06					
^{48}V	−44476.8	1.0				15.9735	d	0.0025	4^+	06			1937	β^+=100	
^{48}V^i	−41457.9	0.4	3018.9	0.9	RQ				$(0)^+$T=2	06				IT=100	
^{48}Cr	−42822	7				21.56	h	0.03	0^+	06			1952	β^+=100	
^{48}Cr^i	−37029	7	5792.77	0.24					4^+T=1	06			1987	IT=100	
^{48}Cr^j	−34062	15	8760	17	RQ				0^+frg.T=2	06					∗
^{48}Mn	−29320	170				158.1	ms	2.2	4^+	06			1987	β^+=100; β^+p=0.28 4; …	∗
^{48}Mn^i	−26259	14	3060	170	p				0^+T=2	06	MMC12	J		p=100	
^{48}Fe	−18420#	400#				45.3	ms	0.6	0^+	06	07Do17	TD	1987	β^+=100; β^+p=15.9 6	
^{48}Co	870#	800#							6^+#	06				p ?	
^{48}Ni	16480#	510#				2.8	ms	0.8	0^+	06	11Po09	TD	2000	2p=70 20; β^+=30 20; β^+p ?	∗
∗^{48}Ca	D : …; 2β^-=75 +25-38; β^- ?														∗∗
∗^{48}Ca	T : average 00Br63=42(33-13) 96Ba80=43(+24–11 statistics + 14 systematics)														∗∗
∗^{48}Ca	T : also T>36 Ey from 70Ba61. Single β^- decay: T>6 Ey (95% CL), from 85Al17														∗∗
∗^{48}Cr^j	E : strongest frg; other: 10(15)keV lower														∗∗
∗^{48}Mn	D : …; $\beta^+\alpha$=6e–4														∗∗
∗^{48}Ni	T : average 05Do20=2.1(+2.1–0.7) 11Po09=2.1(+1.4–0.4)														∗∗

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{49}S	21200#	670#						<200 ns	$3/2^-$#	08	90Le03	I		n ?; β^-n ?; β^-2n ?	*
^{49}Cl	1150#	600#				50#	ms	(>200 ns)	$3/2^+$#	08	89Gu03	I	1989	β^- ?; β^-n ?; β^-2n ?	
^{49}Ar	−16860#	400#				170	ms	50	$3/2^-$#	08			1989	β^-=100; β^-n=65 20; β^-2n ?	
^{49}K	−29611.5	0.8				1.26	s	0.05	$1/2^{(-)}$	11	11Bi.A	J	1972	β^-=100; β^-n=86 9	
^{49}Ca	−41299.89	0.21				8.718	m	0.006	$3/2^-$	08			1950	β^-=100	
^{49}Sc	−46561.1	2.7				57.18	m	0.13	$7/2^-$	08			1940	β^-=100	
^{49}Ti	−48562.8	0.4				STABLE			$7/2^-$	08			1934	IS=5.41 2	
^{49}V	−47961.0	0.9				330	d	15	$7/2^-$	08			1940	ε=100	
^{49}V^i	−41529	4	6432	4	RQ				$7/2^-$T=5/2						
^{49}Cr	−45332.7	2.4				42.3	m	0.1	$5/2^-$	08			1942	β^+=100	
^{49}Cr^i	−40569	6	4764	5					$(7/2)^-$T=3/2	08	85Fu03	E	1969	IT=100	*
^{49}Mn	−37637	10				382	ms	7	$5/2^-$	08			1970	β^+=100	
^{49}Mn^i	−32804	18	4833	20	p				$(7/2^-)$T=3/2	08				p=100	
^{49}Fe	−24751	24				64.7	ms	0.3	$(7/2^-)$	08	96Fa09	J	1970	β^+=100; β^+p=56.7 4	
^{49}Co	−10330#	700#						<35 ns	$7/2^-$#	08	94Bl10	I		p ?	
^{49}Ni	7170#	800#				7.5	ms	1.0	$7/2^-$#	08			1996	β^+=100; β^+p=83 13	

*^{49}S I : statistics precludes any conclusion, say authors **
*^{49}Cr^i E : strongest component surrounded by several weak l=3 lines **
*^{49}Cr^i E : 85Fu03 cannot confirm IAS identity and frgs **

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{50}Cl	8430#	600#				20#	ms	(>620 ns)		10	09Ta24	I	2009	β^- ?; β^-n ?; β^-2n ?	
^{50}Ar	−12920#	500#				85	ms	30	0^+	10			1989	β^-=100; β^-n=35 10; β^-2n ?	
^{50}K	−25728	8				472	ms	4	$0^{(-)}$	10	11Bi.A	J	1972	β^-=100; β^-n=29 3; β^-2n ?	
^{50}K^m	−25557	8	171.4	0.4		125	ns	40	(2^-)	10	FGK127	J	1999	IT=100	*
^{50}Ca	−39589.2	1.6				13.9	s	0.6	0^+	10			1964	β^-=100	
^{50}Sc	−44548	15				102.5	s	0.5	5^+	10			1959	β^-=100	
^{50}Sc^m	−44291	15	256.895	0.010		350	ms	40	$(2^+,3^+)$	10			1963	IT>97.5; β^-<2.5	
^{50}Ti	−51430.7	0.4				STABLE			0^+	10			1934	IS=5.18 2	
^{50}V	−49223.9	0.9				150	Py	40	6^+	10			1949	IS=0.250 4; β^+=83 11; …	*
^{50}V^i	−44409.5	0.4	4814.4	0.9	RQ				0^+T=3	10					
^{50}Cr	−50261.7	0.9				STABLE		(>1.3 Ey)	0^+	10			1930	IS=4.345 13; 2β^+ ?	*
^{50}Cr^i	−41835	7	8427	7	RQ				6^+T=2	10					
^{50}Cr^j	−37038	6	13224	6	RQ				0^+T=3	10					
^{50}Mn	−42627.2	0.9				283.19	ms	0.10	0^+T=1	10			1952	β^+=100	
^{50}Mn^m	−42401.9	0.9	225.31	0.07	MD	1.75	m	0.03	5^+T=0	10			1962	β^+=100	
^{50}Fe	−34490	60				155	ms	11	0^+	10			1977	β^+=100; β^+p≈0	*
^{50}Fe^i	−26016	14	8470	60	RQ				(6^+)T=2	10					
^{50}Co	−17780#	600#				38.8	ms	0.2	(6^+)	10	96Fa09	J	1987	β^+=100; β^+p=70.5 7; β^+2p ?	
^{50}Co^i	−12770	170	5010#	620#	2p				$(0)^+$T=3	10	07Do17	D		p=100	
^{50}Ni	−4900#	800#				18.5	ms	1.2	0^+	10	07Do17	TD	1994	β^+=100; β^+p=86.7 39; β^+2p ?	*

*^{50}K^m J : E2 to ground-state **
*^{50}K^m T : others recent 12Ka.B=138(+50–41) 09Cr03<500 ns; discovered in 99Le68 **
*^{50}V D : …; β^-=17 11 T : symmetrized from 140(+40–30) **
*^{50}Cr T : 03Bi05>1.3Ey 85No03>0.18Ey **
*^{50}Fe T : from 97Ko46=155(11) **
*^{50}Ni T : other 03Ma34=12(+3–2) D : other 03Ma34=70(20)% **

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{51}Cl	14480#	700#				2#	ms	(>200 ns)	$3/2^+$#	06			1990	β^- ?; β^-n ?; β^-2n ?	
^{51}Ar	−5870#	600#				60#	ms	(>200 ns)	$3/2^-$#	06	89Gu03	I	1989	β^- ?; β^-n ?; β^-2n ?	
^{51}K	−22516	13				365	ms	5	$(3/2^+)$	06	06Pe16	JD	1983	β^-=100; β^-n=65 6; β^-2n ?	*
^{51}Ca	−36339	22				10.0	s	0.8	$(3/2^-)$	06	06Pe16	J	1980	β^-=100; β^-n ?	
^{51}Sc	−43229	20				12.4	s	0.1	$(7/2)^-$	06			1966	β^-=100; β^-n ?	
^{51}Ti	−49731.9	0.6				5.76	m	0.01	$3/2^-$	06			1947	β^-=100	
^{51}V	−52203.7	0.9				STABLE			$7/2^-$	06			1924	IS=99.750 4	
^{51}Cr	−51451.1	0.9				27.7010	d	0.0011	$7/2^-$	06			1940	ε=100	
^{51}Cr^i	−44838	5	6613	5	RQ				$7/2^-$T=5/2	06					
^{51}Mn	−48243.5	0.9				46.2	m	0.1	$5/2^-$	06			1938	β^+=100	
^{51}Mn^i	−43792.1	1.7	4451.4	1.5	RQ				$7/2^-$T=3/2	06				IT=100	*
^{51}Fe	−40202	9				305	ms	5	$5/2^-$	06			1972	β^+=100	
^{51}Co	−27340	50				68.8	ms	1.9	$7/2^-$#	06	07Do17	TD	1987	β^+=100; β^+p<3.8	
^{51}Co^i	−21050	60	6300	80	p				$7/2^-$#T=5/2		07Do17	D		p=100	
^{51}Ni	−12940#	800#				23.8	ms	0.2	$7/2^-$#	06	07Do17	TD	1987	β^+=100; β^+p=87.2 8	

*^{51}K D : average 06Pe16=63(8)% 83La23=68(10)%; other 82Ca04=47(5)% **
*^{51}Mn^i E : NDS916 gives 4450.0(0.6) may be based on mis-interpretation of 86Di01 **

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{52}Ar	−970#	600#				10#	ms		0^+				2009	β^- ?; β^-n ?; β^-2n ?	
^{52}K	−16540#	400#				110	ms	4	(2^-)	07	06Pe16	TJD	1983	β^-=100; β^-n=74 9; β^-2n=2.3 3	∗
^{52}Ca	−34260	60				4.6	s	0.3	0^+	07			1985	β^-=100; β^-n<2	
^{52}Sc	−40170	140				8.2	s	0.2	$3^{(+)}$	07			1980	β^-=100; β^-n ?	
^{52}Ti	−49469	7				1.7	m	0.1	0^+	07			1966	β^-=100	
^{52}V	−51443.6	0.9				3.743	m	0.005	3^+	07			1934	β^-=100	
^{52}Cr	−55418.1	0.6				STABLE			0^+	07			1923	IS=83.789 18	
^{52}Cr^i	−44153.2	0.7	11264.9	0.4					3^+T=3	07				IT=100	
^{52}Mn	−50706.9	1.9				5.591	d	0.003	6^+	07			1938	β^+=100	
^{52}Mn^m	−50329.2	1.9	377.749	0.005		21.1	m	0.2	2^+	07			1937	β^+=98.25 2; IT=1.75 2	∗
^{52}Mn^i	−47784	5	2923	5	RQ				0^+T=2	07				IT=100	
^{52}Fe	−48332	7				8.275	h	0.008	0^+	07			1948	β^+=100	∗
^{52}Fe^m	−41374	7	6958.0	0.4		45.9	s	0.6	12^+	07	05Ga20	D	1979	β^+≈100; IT=0.021 5	
^{52}Fe^i	−42677	7	5655.4	0.5					6^+T=1	07				IT=100	
^{52}Fe^j	−39775	6	8557	9	RQ				0^+frg.T=2	07					∗
^{52}Co	−33990#	200#				115	ms	23	(6^+)	07			1987	β^+=100; β^+p ?	
^{52}Co^m	−33610#	220#	380#	100#		104	ms	11	2^+#		97Ha04	TD	1997	β^+=?; IT ?; β^+p ?	∗
^{52}Co^i	−31564	13	2430#	200#	RQ				0^+T=2						
^{52}Ni	−23470#	700#				40.8	ms	0.2	0^+	07	07Do17	TD	1987	β^+=100; β^+p=31.4 15	
^{52}Cu	−3070#	800#							3^+#					p ?	

∗^{52}K T : average 06Pe16=118(6) 85Hu03=110(30) 83La23=105(5) ∗∗
∗^{52}Mn^m T : other: 95Ir01=22.7(3.0) for q=25$^+$ (bare ion) ∗∗
∗^{52}Fe T : other: 95Ir01=12.5(+1.5–1.2) for q=26$^+$ (bare ion) ∗∗
∗^{52}Fe^j E : probably fragmented, unresolved doublet separated by ≈4 keV ∗∗
∗^{52}Co^m I : tentative: no specific evidence for ^{52}Co^m, say authors in 97Ha04 ∗∗

^{53}Ar	6790#	700#				3#	ms	(>620 ns)	$5/2^-$#	11	09Ta24	I	2009	β^- ?; β^-n ?; β^-2n ?	
^{53}K	−11680#	500#				30	ms	5	$(3/2^+)$	09	06Pe16	JD	1983	β^-=100; β^-n=64 11; β^-2n≈10 5	∗
^{53}Ca	−28460#	400#				461	ms	90	$3/2^-$#	09	10Cr02	T	1983	β^-=100; β^-n>30	∗
^{53}Sc	−38110	270				2.4	s	0.6	$(7/2^-)$	09	10Cr02	TJ	1980	β^-=100; β^-n ?	
^{53}Ti	−46830	100				32.7	s	0.9	$(3/2)^-$	09			1977	β^-=100	
^{53}V	−51850	3				1.543	m	0.014	$7/2^-$	09			1960	β^-=100	
^{53}Cr	−55285.9	0.6				STABLE			$3/2^-$	09			1930	IS=9.501 17	
^{53}Mn	−54689.0	0.6				3.7	My	0.4	$7/2^-$	09	71Ho24	T	1955	ε=100	∗
^{53}Mn^i	−47715	4	6974	4	RQ				$3/2^-$T=5/2	09			1976		
^{53}Fe	−50946.7	1.7				8.51	m	0.02	$7/2^-$	09			1938	β^+=100	∗
^{53}Fe^m	−47906.3	1.7	3040.4	0.3		2.54	m	0.02	$19/2^-$	09			1967	IT=100	
^{53}Fe^i	−46697	3	4250	3					$7/2^-$T=3/2	09					
^{53}Co	−42658.6	1.8				242	ms	8	$7/2^-$#	09	02Lo13	T	1970	β^+=100	∗
^{53}Co^m	−39484.4	1.9	3174.3	0.9	MD	247	ms	12	$(19/2^-)$	09			1970	β^+≈98.5; p≈1.5	∗
^{53}Co^i	−38264	18	4395	18	p				$(7/2^-)$T=3/2	09			1976	p=100	
^{53}Ni	−29631	25				55.2	ms	0.7	$7/2^-$#	09	07Do17	TD	1976	β^+=100; β^+p=23.4 10	
^{53}Cu	−14350#	800#						<300 ns	$3/2^-$#	09	93Bl.A	I		p ?	

∗^{53}Ca D : β^-n=40(10)% is a lower limit (see ENSDF) ∗∗
∗^{53}Ca T : others not used 08Ma01=230(60) 83La23=90(15) ms ∗∗
∗^{53}Mn T : 3.74(0.04) My as given in ENSDF2009 is typo ∗∗
∗^{53}Fe T : other: 95Ir01=8.5(0.3) for q=26$^+$ (bare ion) ∗∗
∗^{53}Co T : average 02Lo13=240(9) 89Ho13=240(20) 73Ko10=262(25) ∗∗
∗^{53}Co^m D : p≈1.5 from ENSDF'90 ∗∗

^{54}K	−5000#	600#				10	ms	5	2^-#	06			1983	β^-=100; β^-n=?; β^-2n ?	
^{54}Ca	−24780#	500#				90	ms	6	0^+	06	08Ma01	TD	1997	β^-=100; β^-n ?; β^-2n ?	∗
^{54}Sc	−33600	360				526	ms	15	$(3)^+$	06	10Cr02	TJD	1990	β^-=100; β^-n=16 9	
^{54}Sc^m	−33490	360	110.5	0.3		2.77	μs	0.02	$(4,5)^+$	06	10Cr02	ETJ	1998	IT=100	∗
^{54}Ti	−45600	120				1.5	s	0.4	0^+	06			1980	β^-=100	
^{54}V	−49892	15				49.8	s	0.5	3^+	06			1970	β^-=100	
^{54}V^m	−49784	15	108	3		900	ns	500	$(5)^+$	06	98Gr14	E	1998	IT=100	
^{54}Cr	−56933.7	0.6				STABLE			0^+	06			1930	IS=2.365 7	
^{54}Mn	−55556.5	1.2				312.05	d	0.04	3^+	06			1938	ε=100; β^-=0.93e–4; …	∗
^{54}Mn^i	−49410.3	2.9	6146.2	3.0	RQ				0^+T=3						
^{54}Fe	−56253.9	0.5				STABLE			0^+	06			1923	IS=5.845 35; 2β^+ ?	
^{54}Fe^m	−49726.8	1.2	6527.1	1.1		364	ns	7	10^+	06			1983	IT=100	
^{54}Fe^j	−41385	20	14869	20	RQ				0^+T=3	06					
^{54}Co	−48009.3	0.5				193.28	ms	0.07	0^+T=1	06			1952	β^+=100	
^{54}Co^m	−47811.7	0.5	197.57	0.10	MD	1.48	m	0.02	7^+T=0	06			1962	β^+=100	
^{54}Ni	−39220	50				104	ms	7	0^+	06			1977	β^+=100; β^+p ?	
^{54}Ni^m	−32760	50	6457	3		152	ns	4	10^+		08Ru09	ETJ	2008	IT=64 2; p=36 2	
^{54}Cu	−21740#	500#						<75 ns	3^+#	06				p ?	
^{54}Zn	−7420#	700#				1.8	ms	0.5	0^+	06	11As08	TD	2005	2p=87 7	∗

∗^{54}Ca T : average 10Cr02=107(14) 08Ma01=86(7) ∗∗
∗^{54}Sc^m T : other recent 12Ka.B=2.78(+31–26) ∗∗
∗^{54}Mn D : …; e$^+$=1.28e–7 25 ∗∗
∗^{54}Mn D : e$^+$ average 98Wu01=1.20(0.26)e–7% 97Za07=2.2(0.9)e–7% ∗∗
∗^{54}Zn T : symmetrized from 11As08=1.59(+0.60–0.35); other 05Bl15=3.2(+1.8–0.8) ∗∗
∗^{54}Zn D : averaged from 11As08=92(+6–13)% 05Bl15=87(+10–17)% ∗∗

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{55}K	710#	700#				3#	ms	(>620 ns)	$3/2^+$#	09	09Ta24	I	2009	β^- ?; β^-n ?; β^-2n ?	
^{55}Ca	−18350#	500#				22	ms	2	$5/2^-$#	09			1997	β^-=100; β^-n ?; β^-2n ?	
^{55}Sc	−29980	460				96	ms	2	$(7/2)^-$	08	10Cr02	TJD	1990	β^-=100; β^-n=17 7; β^-2n ?	*
^{55}Ti	−41670	160				1.3	s	0.1	$(1/2)^-$	10			1980	β^-=100; β^-n ?	
^{55}V	−49140	100				6.54	s	0.15	$7/2^-$#	08			1977	β^-=100	
^{55}Cr	−55108.6	0.6				3.497	m	0.003	$3/2^-$	08			1952	β^-=100	
^{55}Mn	−57711.7	0.4				STABLE			$5/2^-$	08			1923	IS=100.	
^{55}Fe	−57480.6	0.5				2.744	y	0.009	$3/2^-$	09			1939	ε=100	
^{55}Fe^i	−49847	6	7633	6	RQ				$5/2^-$T=5/2	09					
^{55}Co	−54029.3	0.5				17.53	h	0.03	$7/2^-$	09			1938	β^+=100	
^{55}Co^i	−49307.9	0.5	4721.44	0.10					$3/2^-$frg.T=3/2	09			1981	IT=100	*
^{55}Ni	−45335.2	0.8				204.7	ms	1.7	$7/2^-$	08	02Lo13	T	1972	β^+=100	*
^{55}Cu	−31640	160				27	ms	8	$3/2^-$#	08	07Do17	TD	1987	β^+=100; β^+p=15.0 43	
^{55}Zn	−14920#	700#				19.8	ms	1.3	$5/2^-$#	08	07Do17	TD	2001	β^+=100; β^+p=91.0 51	
*^{55}Sc	T : others 04Li75=115(15) 02Sh43=103(7) 98So03=120(40)														**
*^{55}Co^i	E : strongest frg (spectr. factor 0.45); other 26.69(0.15) higher (sf=0.37)														**
*^{55}Ni	T : average 02Lo13=196(5) 99Re06=204(3) 87Ha.A=212.1(3.8) 84Ay01=208(5)														**
*^{55}Ni	T : and 77Ho25=189(5) 76Ed.A=219(6); 97Wo06=204(3) superseded by 99Re06														**
^{56}K	7930#	800#				1#	ms	(>620 ns)	2^-#	11	09Ta24	I	2009	β^- ?; β^-n ?; β^-2n ?	
^{56}Ca	−13900#	600#				11	ms	2	0^+	11			1997	β^-=100; β^-n ?; β^-2n ?	
^{56}Sc	−24730#	400#			*	26	ms	6	(1^+)	11	10Sc02	J	1997	β^-=100; β^-n=?; β^-2n ?	
^{56}Sc^m	−24730#	410#	0#	100#	*	75	ms	6	$(6^+,5^+)$	11	10Sc02	J	2004	β^-=100; β^-n>14 2; β^-2n ?	
^{56}Sc^n	−23960#	400#	774.9	0.3		290	ns	30	(4^+)	11			2004	IT=100	*
^{56}Ti	−39210	140				200	ms	5	0^+	11	98Am04	D	1980	β^-=100; β^-n ?	
^{56}V	−46120	180				216	ms	4	(1^+)	11	98Am04	D	1980	β^-=100; β^-n ?	
^{56}Cr	−55281.2	1.9				5.94	m	0.10	0^+	11	60Dr03	D	1960	β^-=100	
^{56}Mn	−56910.8	0.5				2.5789	h	0.0001	3^+	11			1934	β^-=100	
^{56}Fe	−60606.4	0.5				STABLE			0^+	11			1923	IS=91.754 36	
^{56}Fe^i	−49102.7	0.6	11503.7	0.3					3^+T=3	11					
^{56}Co	−56039.8	0.6				77.236	d	0.026	4^+	11			1941	β^+=100	
^{56}Co^i	−52447	9	3593	9	RQ				(0^+)frg.T=2	11					*
^{56}Ni	−53906.9	0.5				6.075	d	0.010	0^+	11			1952	β^+=100	
^{56}Ni^i	−47475.0	0.9	6431.9	0.7					4^+T=1	11					
^{56}Ni^j	−43963	4	9944	4	RQ				0^+frg.T=2						*
^{56}Cu	−38240#	200#				93	ms	3	(4^+)	11	01Bo54	TJD	1987	β^+=100; β^+p=0.40 12	
^{56}Cu^i	−35120	30	3120#	200#	p				T=2		07Do17	D	2007	p=100	
^{56}Zn	−25580#	500#				30.0	ms	1.7	0^+	11	07Do17	TD	2001	β^+=100; β^+p=86.0 49	*
^{56}Zn^i	−21720#	710#	3860#	510#					3^+#T=3					p ?	
^{56}Ga	−4320#	600#							3^+#					p ?	
*^{56}Sc^n	T : other 12Ka.B=350(+260–120)														**
*^{56}Co^i	E : strongest frg (cross section 115); other 70(9) keV lower (xs=55)														**
*^{56}Ni^j	E : strongest frg; others 68(6) and 98(6) keV higher														**
*^{56}Zn	T : other 95Wa.A=36(10) ms derived from experimental (p,n) cross sections														**
^{57}Ca	−6870#	600#				5#	ms	(>620 ns)	$5/2^-$#	10	09Ta24	I	2009	β^- ?; β^-n=22#; β^-2n=2#	
^{57}Sc	−20710#	500#				22	ms	2	$7/2^-$#	10	10Sc02	T	1997	β^-=100; β^-n=33#; β^-2n=1#	*
^{57}Ti	−33870	250				95	ms	8	$5/2^-$#	10	99So20	T	1985	β^-=100; β^-n=0.3#	*
^{57}V	−44230	230				350	ms	10	$(3/2^-)$	10	03Ma02	TJ	1980	β^-=100; β^-n=0.4#	
^{57}Cr	−52524.1	1.9				21.1	s	1.0	$(3/2)^-$	10			1978	β^-=100	
^{57}Mn	−57486.1	1.5				85.4	s	1.8	$5/2^-$	98			1954	β^-=100	
^{57}Fe	−60181.2	0.5				STABLE			$1/2^-$	98			1935	IS=2.119 10	
^{57}Co	−59344.9	0.6				271.74	d	0.06	$7/2^-$	98			1941	ε=100	
^{57}Co^i	−52091.6	0.6	7253.4	0.6	RQ				$1/2^-$T=5/2		MMC12	J			
^{57}Ni	−56083.2	0.7				35.60	h	0.06	$3/2^-$	98			1938	β^+=100	
^{57}Ni^i	−50844.4	1.0	5238.8	0.7					$7/2^-$frg.T=3/2	98					*
^{57}Cu	−47308.3	0.6				196.3	ms	0.7	$3/2^-$	98			1976	β^+=100	
^{57}Cu^i	−42009	25	5299	25	p				$7/2^-$T=3/2						
^{57}Zn	−32550#	210#				38	ms	4	$7/2^-$#	98	02Lo13	T	1976	β^+=100; β^+p≈65	*
^{57}Ga	−15650#	300#							$1/2^-$#					p ?	
*^{57}Sc	T : other 03So21=13(4)														**
*^{57}Ti	T : average 05Li53=98(5) 99So20=67(25) 96Do23=56(20)														**
*^{57}Ti	T : 98Am04=180(30) conflicting, not used														**
*^{57}Ni^i	E : strongest frg; 79Ik04 others 98(7)keV lower(5.5%) 128(7)keV higher(10.0%)														**
*^{57}Ni^i	E : strongest frg; 78Na11 others 104(5)keV lower, 129(5)keV higher														**
*^{57}Zn	T : average 02Lo13=37(5) 76Vi02=40(10)														**
^{58}Ca	−1920#	700#				3#	ms	(>620 ns)	0^+	10			2009	β^- ?; β^-n ?; β^-2n ?	
^{58}Sc	−14880#	600#				12	ms	5	3^+#	10			1997	β^-=100; β^-n ?; β^-2n ?	
^{58}Ti	−31110#	400#				55	ms	6	0^+	10	11Da08	T	1992	β^-=100; β^-n ?	*
^{58}V	−40320	130				191	ms	10	(1^+)	10			1980	β^-=100; β^-n=0.8#	
^{58}Cr	−51830	200				7.0	s	0.3	0^+	10			1980	β^-=100	

. . . *A*-group is continued on next page . . .

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

… *A*-group continued …

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{58}Mn	−55827.6	2.7				3.0	s	0.1	1^+	10			1961	β^-=100	
^{58}Mn^m	−55755.8	2.7	71.77	0.05		65.4	s	0.5	4^+	10			1961	β^-=?; IT=20#	
^{58}Fe	−62154.5	0.5				STABLE			0^+	10			1935	IS=0.282 4	
^{58}Co	−59846.6	1.2				70.86	d	0.06	2^+	10			1941	β^+=100	
^{58}Co^m	−59821.7	1.2	24.95	0.06		9.10	h	0.09	5^+	10			1950	IT=100	
^{58}Co^n	−59793.5	1.2	53.15	0.07		10.5	μs	0.3	4^+	10			1964	IT=100	
^{58}Co^i	−54094	8	5753	8	RQ				0^+frg.T=3	10					*
^{58}Ni	−60228.2	0.5				STABLE		(>700 Ey)	0^+	10			1921	IS=68.077 19; 2β^+ ?	*
^{58}Ni^i	−51400	40	8830	40	RQ				2^+T=2	10					
^{58}Ni^j	−45689	7	14539	7	RQ				0^+T=3	10	MMC12	J			
^{58}Cu	−51667.1	0.7				3.204	s	0.007	1^+T=0	10			1952	β^+=100	
^{58}Cu^i	−51464.1	0.7	202.99	0.24					0^+T=1	10					
^{58}Zn	−42300	50				86	ms	8	0^+	10			1986	β^+=100; β^+p<3	
^{58}Ga	−23490#	200#			*				2^+#					p ?	
^{58}Ga^m	−23460#	220#	30#	100#	*				5^+#					p ?	
^{58}Ge	−7710#	400#							0^+					2p ?	

*^{58}Ti T : average 11Da08=57(10) 03So21=59(9) 99So20=47(10) **

*^{58}Co^i E : strongest fragment (cross section 98); other 20(8) keV lower (xs=90) **

*^{58}Ni T : >400 Ey to 2^+ level of ^{58}Fe, >700 Ey to ground-state **

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{59}Sc	−10300#	600#				10#	ms	(>620 ns)	$7/2^-$#	09	09Ta24	I	2009	β^- ?; β^-n ?; β^-2n ?	
^{59}Ti	−25640#	400#				28.5	ms	1.9	$5/2^-$#	02	11Da08	T	1997	β^-=100; β^-n ?; β^-2n ?	*
^{59}Ti^m	−25530#	400#	109.0	0.5		590	ns	50	$(1/2^-)$		12Ka.B	ETJ	2012	IT=100	*
^{59}V	−37830	160				95	ms	6	$(5/2^-)$	02	05Li53	TJ	1985	β^-=100; β^-n ?	*
^{59}Cr	−47890	240				1050	ms	90	$(1/2^-)$	02	05Li53	TJ	1980	β^-=100	*
^{59}Cr^m	−47390	240	503.0	1.7		96	μs	20	$(9/2^+)$	02			1998	IT=100	
^{59}Mn	−55525.3	2.3				4.59	s	0.05	$(5/2)^-$	02			1976	β^-=100	
^{59}Fe	−60664.2	0.5				44.495	d	0.009	$3/2^-$	02			1938	β^-=100	
^{59}Co	−62229.1	0.5				STABLE			$7/2^-$	02			1923	IS=100.	
^{59}Ni	−61156.1	0.5				101	ky	13	$3/2^-$	02	94Ru19	T	1951	β^+=100	*
^{59}Ni^i	−53814.2	2.2	7341.9	2.1	RQ				$7/2^-$frg.T=5/2						
^{59}Cu	−56357.7	0.6				81.5	s	0.5	$3/2^-$	02			1947	β^+=100	
^{59}Cu^i	−52472.2	2.2	3885.5	2.1					$3/2^-$frg.T=3/2	02				IT=100	*
^{59}Zn	−47215.0	0.8				182.0	ms	1.8	$3/2^-$	03			1981	β^+=100; β^+p=0.10 3	
^{59}Ga	−33970#	170#						<43 ns	$3/2^-$#		05St29	T		p ?	
^{59}Ge	−16310#	300#							$7/2^-$#					2p ?	

*^{59}Ti T : average 11Da08=27.5(2.5) 03So21=30(3); other 99So20=58(17) **

*^{59}Ti^m T : symmetrized from 587(+57–51) **

*^{59}V T : average 05Li53=97(2) 99So20=75(7) (supersedes 98So03=70(40)) **

*^{59}V T : 98Am04=130(20) conflicting, not used **

*^{59}Cr T : others 96Do23=460(50), 88Bo06=600(300), 85Bo49=1000(400) **

*^{59}Ni T : unweighed average 94Ru19=108(13) 94Ru19(meteorite)=120(22) 81Ni08=76(5) **

*^{59}Ni T : (Birge ratio B=2.05) **

*^{59}Ni^i E : strongest frg(100%); 3 others 40.1(0.3)keV higher (0.140%), 17.7(0.3)keV **

*^{59}Ni^i E : higher (0.122%) and 36.3(0.2)keV lower (0.110%) **

*^{59}Cu^i E : 76Ga19 strongest fragment (sp.factor 0.6); other 21(6) (sf 0.4) higher **

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{60}Sc	−4050#	700#				3#	ms	(>620 ns)	3^+#	09	09Ta24	I	2009	β^- ?; β^-n ?; β^-2n ?	
^{60}Ti	−22330#	500#				22.2	ms	1.6	0^+	03	11Da08	T	1997	β^-=100; β^-n ?; β^-2n ?	*
^{60}V	−33240	220			* &	122	ms	18	3^+#	03			1985	β^-=100; β^-n ?; β^-2n ?	
^{60}V^m	−33240#	270#	0#	150#	* &	40	ms	15	1^+#	03			1999	β^-=?; IT ?; β^-n ?; β^-2n ?	
^{60}V^n	−33040	220	203.7	0.7		230	ns	24	(4^+)	03	12Ka.B	ET	1999	IT=100	*
^{60}Cr	−46500	210				490	ms	10	0^+	03			1980	β^-=100; β^-n ?	
^{60}Mn	−52967.9	2.3				280	ms	20	1^+	03			1978	β^-=100	
^{60}Mn^m	−52696.0	2.3	271.90	0.10		1.77	s	0.02	4^+	03			1978	β^-=88.5 8; IT=11.5 8	*
^{60}Fe	−61412	3				2.62	My	0.04	0^+	93	09Ru08	T	1957	β^-=100	
^{60}Co	−61649.7	0.5				5.2712	y	0.0004	5^+	03			1941	β^-=100	
^{60}Co^m	−61591.1	0.5	58.59	0.01		10.467	m	0.006	2^+	03			1963	IT≈100; β^-=0.24 3	
^{60}Ni	−64472.5	0.5				STABLE			0^+	03			1921	IS=26.223 15	
^{60}Ni^i	−53346	4	11126	4	RQ				5^+T=3						
^{60}Cu	−58344.6	1.6				23.7	m	0.4	2^+	03			1947	β^+=100	
^{60}Cu^i	−55803	5	2541	5	RQ				(0^+)T=2	03				IT=100	
^{60}Zn	−54173.7	0.6				2.38	m	0.05	0^+	03			1955	β^+=100	
^{60}Zn^i	−49321.5	0.9	4852.2	0.7					(2^+)T=1	03				IT=100	
^{60}Zn^j	−46806	24	7367	24	RQ				0^+T=2	03					
^{60}Ga	−39780#	200#				70	ms	10	(2^+)	03	01Ma96	TJ	1995	β^+=100; β^+p=1.6 7; $\beta^+\alpha$<0.023 20	*
^{60}Ga^i	−37240#	210#	2540#	50#											
^{60}Ge	−27610#	200#				30#	ms	(>110 ns)	0^+	09			2005	β^+ ?; β^+p ?	
^{60}As	−5700#	400#							5^+#					p ?	
^{60}As^m	−5640#	400#	60#	20#					2^+#					p ?	

*^{60}Ti T : average 11Da08=22.4(2.5) 03So21=22(2) **

*^{60}V^n T : symmetrized from 12Ka.B=229(+25–23); others 10Da06=320(90) 99Da.A=320(90) **

*^{60}Mn^m I : also an isomer T=1.0(+0.3–0.2) μs decay by 114 keV γ-rays to ground-state or ^{60}Mn^m **

*^{60}Ga T : average 02Lo13=70(13) 01Ma96=70(15) **

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{61}Sc	930#	800#				2#	ms	(>620 ns)	$7/2^-$#	09	09Ta24	I	2009	β^- ?; β^-n ?; β^-2n ?	
^{61}Ti	−16350#	600#				15	ms	4	$1/2^-$#	09	11Da08	T	1997	β^-=100; β^-n=0.8#; β^-2n=0.7#	
^{61}V	−30510	890				47.0	ms	1.2	$3/2^-$#	09			1992	β^-=100; β^-n>6; β^-2n ?	
^{61}Cr	−42460	130				243	ms	9	$(5/2^-)$	09	09Cr02	T	1985	β^-=100; β^-n ?	*
^{61}Mn	−51742.1	2.3				670	ms	40	$(5/2)^-$	09	99Ha05	D	1980	β^-=100; β^-n=?	*
^{61}Fe	−58920.5	2.6				5.98	m	0.06	$3/2^-$	99	08Ho05	J	1957	β^-=100	
^{61}Fe^{m}	−58058.7	2.6	861.80	0.15		241.2	ns	4.5	$9/2^+$	99	08Ho05	EJ	1998	IT=100	*
^{61}Co	−62897.6	0.9				1.650	h	0.005	$7/2^-$	99			1947	β^-=100	
^{61}Ni	−64221.3	0.5				STABLE			$3/2^-$	99			1934	IS=1.1399 13	
^{61}Cu	−61983.8	1.0				3.333	h	0.005	$3/2^-$	99			1937	β^+=100	
^{61}Cu^{i}	−55610	7	6374	7	RQ				$3/2^-$frg.T=5/2						*
^{61}Zn	−56349	16				89.1	s	0.2	$3/2^-$	99			1955	β^+=100	
^{61}Zn^{m}	−56261	16	88.4	0.1		< 430	ms		$1/2^-$	99			1999	IT=100	
^{61}Zn^{n}	−55931	16	418.10	0.15		140	ms	70	$3/2^-$	99			1999	IT=100	
^{61}Zn^{p}	−55593	16	756.02	0.18		< 130	ms		$5/2^-$	99			1999	IT=100	
^{61}Zn^{i}	−53190#	100#	3160#	100#					$3/2^-$T=3/2						
^{61}Zn^{j}	−46360	70	9990	70					$3/2^-$T=5/2						
^{61}Ga	−47130	40				168	ms	3	$3/2^-$	09	02We07	TD	1987	β^+=100; β^+p≈0	
^{61}Ga^{m}	−47040#	110#	90#	100#					$1/2^-$#						
^{61}Ga^{i}	−43770	30	3360	50	p				$(3/2^-)$T=3/2	09			1987	p=100	
^{61}Ge	−33730#	300#				44	ms	6	$3/2^-$#	09			1987	β^+=100; β^+p>58	
^{61}As	−17590#	300#							$3/2^-$#					p ?	

*^{61}Cr T : average 09Cr02=233(11) 99So20=251(22) 98Am04=270(20) **
*^{61}Mn D : delayed neutrons observed in 99Ha05 **
*^{61}Fe^{m} T : average 04Ma80=239(5) 98Gr14=250(10) **
*^{61}Fe^{m} E : derived from least-squares fit to γ-ray energies Eg using 08Ho05 level scheme **
*^{61}Cu^{i} E : strongest frg (xs=55); other 18(7) keV higher (xs=35) **

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{62}Ti	−12570#	700#				10#	ms	(>620 ns)	0^+	12			2009	β^- ?; β^-n ?; β^-2n ?	
^{62}V	−25480#	300#				33.6	ms	2.3	3^+#	12			1997	β^-=100; β^-n ?; β^-2n ?	
^{62}Cr	−40890	150				206	ms	12	0^+	12			1985	β^-=100; β^-n=1#	
^{62}Mn	−48480#	150#			*	92	ms	13	(1^+)	12	99So20	JD	1983	β^-=100; β^-n≈0	
^{62}Mn^{m}	−48181.0	2.6	300#	150#	*	671	ms	5	(3^+)	12	99Ha05	D	1983	β^-=100; β^-n=?; IT ?	
^{62}Fe	−58878.0	2.8				68	s	2	0^+	12			1975	β^-=100	
^{62}Co	−61424	19				1.54	m	0.10	$(2)^+$	12			1949	β^-=100	
^{62}Co^{m}	−61402	20	22	5		13.86	m	0.09	$(5)^+$	12			1957	β^->99; IT<1	
^{62}Ni	−66745.9	0.5				STABLE			0^+	12			1934	IS=3.6346 40	
^{62}Cu	−62787.0	0.7				9.67	m	0.03	1^+	12			1936	β^+=100	
^{62}Cu^{i}	−58173	6	4614	6	RQ				$(0)^+$T=3	12					*
^{62}Zn	−61167.5	0.7				9.193	h	0.015	0^+	12			1948	β^+=100	
^{62}Ga	−51986.4	0.7				116.121	ms	0.021	0^+T=1	12			1978	β^+=100	
^{62}Ga^{j}	−51415.2	0.7	571.2	0.1					$1^{(+)}$T=2	12	98Vi06	EJ	1998	IT=100	
^{62}Ge	−41900#	140#				129	ms	35	0^+	12			1991	β^+=100; β^+p ?	
^{62}As	−24580#	300#							1^+#					p=100#	*

*^{62}Cu^{i} E : ENSDF=4628(10) **
*^{62}As D : most probably p-unstable from estimated S_p=–1860#(420#) keV **

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{63}Ti	−5820#	700#				3#	ms	(>620 ns)	$1/2^-$#	09	09Ta24	I	2009	β^- ?; β^-n ?; β^-2n ?	
^{63}V	−21990#	400#				18.3	ms	1.9	$7/2^-$#	09	11Da08	T	1997	β^-=100; β^-n>35; β^-2n ?	*
^{63}Cr	−35720	460				129	ms	2	$1/2^-$#	09			1992	β^-=100; β^-n ?	*
^{63}Mn	−46887	4				275	ms	4	$5/2^-$#	09			1985	β^-=100; β^-n=?	
^{63}Fe	−55636	4				6.1	s	0.6	$(5/2^-)$	09			1980	β^-=100	
^{63}Co	−61851	19				26.9	s	0.4	$7/2^-$	09	94It.A	T	1960	β^-=100	*
^{63}Ni	−65512.3	0.5				101.2	y	1.5	$1/2^-$	09			1951	β^-=100	
^{63}Ni^{m}	−65425.2	0.5	87.15	0.11		1.67	μs	0.03	$5/2^-$	09			1978	IT=100	
^{63}Cu	−65579.3	0.5				STABLE			$3/2^-$	09			1923	IS=69.15 15	
^{63}Zn	−62213.1	1.6				38.47	m	0.05	$3/2^-$	09			1937	β^+=100	
^{63}Zn^{i}	−56723	6	5490	6	RQ				$3/2^-$T=5/2	09					
^{63}Ga	−56547.1	1.3				32.4	s	0.5	$(3/2^-)$	09			1965	β^+=100	
^{63}Ge	−46920	40				142	ms	8	$3/2^-$#	09	02Lo13	TD	1991	β^+=100; β^+p ?	*
^{63}As	−33630#	200#						<43 ns	$3/2^-$#	09				p=100#	*

*^{63}V T : average 11Da08=19.2(2.4) 03So02=17(3) **
*^{63}Cr T : other 11Da08=128(8) **
*^{63}Co T : average 94It.A=26.41(0.27) 72Jo08=27.5(0.3) 69Wa15=26(1) **
*^{63}Ge T : average 02Lo13=150(9) 93Wi03=95(+23–20) **
*^{63}As D : most probably p-unstable from estimated S_p=–980#(240#) keV **

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{64}V	−16170#	400#				19	ms	8		11			1997	β^-=100; β^-n=33#; β^-2n=4#	
^{64}Cr	−33460#	300#				43	ms	1	0^+	11			1992	β^-=100; β^-n=2#	*
^{64}Mn	−42989	4				88.8	ms	2.4	(1^+)	07	11Da08	T	1985	β^-=100; β^-n=33 2	*
^{64}Mn^m	−42815	4	174.1	0.5		439	μs	31	(4^+)	07	10Da06	E	1998	IT=100	*
^{64}Fe	−54970	5				2.0	s	0.2	0^+	07			1980	β^-=100	
^{64}Co	−59792	20				300	ms	30	1^+	07			1969	β^-=100	
^{64}Co^m	−59686	4	106	20	MD	300#	ms		$5^+\#$		08Bl05	E	2008	β^- ?; IT ?	
^{64}Ni	−67098.5	0.5				STABLE			0^+	07			1935	IS=0.9255 19	
^{64}Cu	−65424.1	0.5				12.701	h	0.002	1^+	07			1936	β^+=61.5 3; β^-=38.5 3	
^{64}Cu^i	−58598	6	6826	6					0^+frg.T=4	07	71Be29	E			*
^{64}Zn	−66003.8	0.7				STABLE		(>8.9 Ey)	0^+	07			1922	IS=49.17 75; 2β^+ ?	
^{64}Ga	−58832.8	1.4				2.627	m	0.012	$0^{(+\#)}$	07			1953	β^+=100	
^{64}Ga^m	−58790.0	1.4	42.85	0.08		21.9	μs	0.7	(2^+)	07			1999	IT=100	
^{64}Ga^i	−56925.7	2.5	1907.1	2.2	RQ				(0^+)T=2	07					
^{64}Ge	−54315	4				63.7	s	2.5	0^+	07			1972	β^+=100	
^{64}As	−39650#	300#				40	ms	30	$0^+\#$	07			1995	β^+=100; β^+p ?	*
^{64}Se	−26930#	500#				30#	ms	(>180 ns)	0^+	07			2005	β^+ ?; β^+p ?	

*^{64}Cr T : other recent 11Li50=44(3) ms, outweighed, not used **

*^{64}Mn T : average 11Da08=90(9) 02So.A=91(4) 99So20=85(5) 99Ha05=89(4) **

*^{64}Mn^m T : average 11Li50=400(40) 05Ga.B=500(50) **

*^{64}Cu^i E : strongest fragment (xs=100); other 16 keV lower (xs=37) **

*^{64}As T : symmetrized from 18(+43–7) **

^{65}V	−11640#	500#				10#	ms	(>620 ns)	$5/2^-\#$	10	09Ta24	I	2009	β^- ?; β^-n ?; β^-2n ?	
^{65}Cr	−27980#	300#				27.5	ms	2.1	$1/2^-\#$	10	11Da08	T	1997	β^-=100; β^-n ?; β^-2n ?	*
^{65}Mn	−40967	4				92	ms	1	$5/2^-\#$	10			1985	β^-=100; β^-n=?	*
^{65}Fe	−51221	7				810	ms	50	$(1/2^-)$	10	09Pa16	J	1980	β^-=100; β^-n ?	
^{65}Fe^m	−50824	7	396.8	0.5		420	ns	13	$5/2^-\#$	10	10Da06	ET	1998	IT=100	*
^{65}Fe^n	−50819	8	402	10	MD	1.12	s	0.15	$(9/2^+)$	10			2008	β^- ?	
^{65}Co	−59185.2	2.1				1.16	s	0.03	$(7/2)^-$	10			1978	β^-=100	
^{65}Ni	−65125.2	0.6				2.5175	h	0.0005	$5/2^-$	10			1946	β^-=100	
^{65}Ni^m	−65061.8	0.6	63.37	0.05		69	μs	3	$1/2^-$	10			1978	IT=100	
^{65}Cu	−67263.5	0.7				STABLE			$3/2^-$	10			1923	IS=30.85 15	
^{65}Zn	−65911.8	0.7				243.93	d	0.09	$5/2^-$	10			1939	β^+=100	
^{65}Zn^m	−65857.9	0.7	53.928	0.010		1.6	μs	0.6	$(1/2)^-$	10				IT=100	
^{65}Ga	−62657.3	0.8				15.2	m	0.2	$3/2^-$	10			1938	β^+=100	
^{65}Ge	−56478.2	2.2				30.9	s	0.5	$3/2^-$	10			1972	β^+=100; β^+p=0.011 3	
^{65}As	−46940	80				170	ms	30	$3/2^-\#$	10	02Lo13	T	1991	β^+=100; β^+p ?	*
^{65}As^i	−43451	17	3490	90	p				$(3/2^-)$T=3/2	10	11Ro47	J	1993	p=100	*
^{65}Se	−33160#	600#				33	ms	4	$3/2^-\#$	10	11Ro47	T	1993	β^+=100; β^+p=?	

*^{65}Cr T : average 11Da08=28(3) 03So21=27(3) **

*^{65}Mn T : other recent 11Da08=84(8), outweighed, not used **

*^{65}Fe^m E : uncertainty not given, estimated by evaluator **

*^{65}Fe^m J : 98Gr14=(5/2$^-$) assuming M2,E2 direct to ground-state; 10De06 shows it is a cascade **

*^{65}As T : average 02Lo13=126(16) 95Mo26=190(11) with Birge ratio B=3.3 **

*^{65}As^i J : IAS studied in 93Ba12 and 11Ro47 **

^{66}V	−5610#	600#				5#	ms	(>620 ns)		10	09Ta24	I	2009	β^- ?; β^-n ?; β^-2n ?	
^{66}Cr	−24540#	500#				23.8	ms	1.8	0^+	10	11Li50	T	1997	β^-=100; β^-n ?; β^-2n ?	*
^{66}Mn	−36750	11				64.2	ms	0.8	(1^+)	10	11Pa.A	TD	1992	β^-=100; β^-n=8.4 9; β^-2n ?	*
^{66}Mn^m	−36286	11	464.5	0.4		780	μs	40	(5^-)		11Li50	ETJ	2005	IT≈100; β^- ?	*
^{66}Fe	−50068	4				351	ms	6	0^+	10	12Li02	T	1985	β^-=100; β^-n ?	
^{66}Co	−56409	14				194	ms	17	(1^+)	10	12Li02	J	1985	β^-=100; β^-n ?	
^{66}Co^m	−56234	14	175.1	0.3		1.21	μs	0.01	(3^+)	10	12Li02	EJ	1998	IT=100	
^{66}Co^n	−55767	15	642	5		> 100	μs		(8^-)	10	98Gr14	ETJ	1998	IT=100	
^{66}Ni	−66006.3	1.4				54.6	h	0.3	0^+	10			1948	β^-=100	
^{66}Cu	−66258.1	0.7				5.120	m	0.014	1^+	10			1937	β^-=100	
^{66}Cu^m	−65103.9	1.6	1154.2	1.4		600	ns	17	$(6)^-$	10	11Lo01	T	1972	IT=100	*
^{66}Zn	−68899.1	0.9				STABLE			0^+	10			1922	IS=27.73 98	
^{66}Ga	−63724	3				9.304	h	0.008	0^+	10	10Se16	T	1937	β^+=100	*
^{66}Ga^i	−59874	6	3850	7	RQ				0^+T=3						
^{66}Ge	−61607.0	2.4				2.26	h	0.05	0^+	10			1950	β^+=100	
^{66}As	−52025	6				95.77	ms	0.23	(0^+)	10	98Gr12	J	1978	β^+=100	
^{66}As^m	−50668	6	1356.63	0.17		1.1	μs	0.1	(5^+)	10			1995	IT=100	
^{66}As^n	−49001	6	3023.8	0.3		8.2	μs	0.5	(9^+)	10			1998	IT=100	
^{66}As^i	−51230	200	800	200					(1^+)T=1		98Gr.A	J			
^{66}Se	−41370#	300#				33	ms	12	0^+	10	02Lo13	TD	1993	β^+=100; β^+p ?	

*^{66}Cr T : average 11Li50=24(2) 11Da08=23(4); other 05Ga01=10(6) outweighed **

*^{66}Mn J : 11Li50=(1$^+$) due to large ground-state feeding from ^{66}Cr **

*^{66}Mn^m E : other 05Ga.B=294 + 170 keV T : other 05Ga.B=750(250) **

*^{66}Cu^m T : average 11Lo01=601(30) 72Bl16=600(20) **

*^{66}Ga T : other 12Gy01=9.312(0.032) not used; ENSDF=9.49(0.03) **

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{67}Cr	−18480#	500#				10#	ms	(>300 ns)	$1/2^-$#	05	97Be70	I	1997	β^- ?; β^-n ?; β^-2n ?	
^{67}Mn	−33310#	400#				46.7	ms	2.3	$5/2^-$#	05	11Da08	TD	1997	β^-=100; β^-n=10 5; β^-2n ?	*
^{67}Fe	−46070	220				394	ms	9	$(1/2^-)$	05	02So.A	TD	1985	β^-=100; β^-n ?	*
^{67}Fe^m	−45670	220	402	9		64	μs	17	$(5/2^+,7/2^+)$	05	11Da08	EJ	1998	IT=100	*
^{67}Fe^n	−45620#	240#	450#	100#		75	μs	21	$(9/2^+)$		08Bl05	TJ	2008	IT ?	*
^{67}Co	−55322	6				329	ms	28	$(7/2^-)$	05	08Pa33	TJ	1985	β^-=100; β^-n ?	
^{67}Co^m	−54830	6	491.6	1.0		496	ms	33	$(1/2^-)$		09Pa16	E	2008	IT>80; β^- ?	*
^{67}Ni	−63742.7	2.9				21	s	1	$1/2^-$	05	00Ri14	J	1978	β^-=100	
^{67}Ni^m	−62736	3	1007.2	1.0		13.3	μs	0.2	$(9/2^+)$	05			1998	IT=100	
^{67}Cu	−67318.8	1.2				61.83	h	0.12	$3/2^-$	05			1948	β^-=100	
^{67}Zn	−67880.1	0.9				STABLE			$5/2^-$	05			1928	IS=4.04 16	
^{67}Zn^m	−67786.8	0.9	93.312	0.005		9.07	μs	0.04	$1/2^-$	05			1972	IT=100	
^{67}Zn^n	−67275.6	0.9	604.48	0.05		333	ns	14	$9/2^+$	05			1973	IT=100	
^{67}Ga	−66878.9	1.2				3.2617	d	0.0005	$3/2^-$	05			1938	ε=100	
^{67}Ge	−62658	5				18.9	m	0.3	$1/2^-$	05			1950	β^+=100	
^{67}Ge^m	−62640	5	18.20	0.05		13.7	μs	0.9	$5/2^-$	05			1978	IT=100	
^{67}Ge^n	−61906	5	751.70	0.06		109.1	ns	3.8	$9/2^+$	05	00Ch07	T	1973	IT=100	*
^{67}As	−56587.2	0.4				42.5	s	1.2	$(5/2^-)$	05			1980	β^+=100	
^{67}Se	−46580	70				133	ms	11	$5/2^-$#	05	95Bl23	T	1991	β^+=100; β^+p=0.5 1	*
^{67}Br	−32930#	500#							$1/2^-$#					p ?	
*^{67}Mn	T : average 11Da08=51(4) 03So21=47(4) 99Ha05=42(4)														**
*^{67}Fe	T : others recent 11Da08=304(81) 08Pa33=416(29), outweighed, not used														**
*^{67}Fe^m	T : average 03Sa02=75(21) 98Gr14=43(30), same authors, different experiment														**
*^{67}Fe^m	E : less than 30 keV above 387.7 level														**
*^{67}Co^m	E : 09Pa16=491.55(0.11) γ ray; 08Pa33=491.6(1.0) D : from 08Pa33														**
*^{67}Ge^n	T : average 00Ch07=101(3) 79Al04=110.9(1.4); Birge ratio B=2.99														**
*^{67}Se	T : average 02Lo13=136(12) 94Ba50=107(35)														**
*^{67}Se	T : values from 95Bl23 for ^{67}Se=60(+17–11) and ^{71}Kr questioned in 97Oi01														**
^{68}Cr	−14880#	700#				5#	ms	(>620 ns)	0^+	12	09Ta24	I	2009	β^- ?; β^-n=15#; β^-2n ?	
^{68}Mn	−28300#	500#				28.4	ms	2.7		12	11Da08	T	1995	β^-=100; β^-n=?; β^-2n ?	*
^{68}Fe	−43830	370				188	ms	4	0^+	12			1985	β^-=100; β^-n>0	
^{68}Co	−51920	150			*	200	ms	20	(7^-)	12			1985	β^-=100; β^-n ?	
^{68}Co^m	−51770#	210#	150#	150#	*	1.6	s	0.3	(1^+)	12			1998	β^-=100	
^{68}Co^n	−51730#	210#	195#	150#	*	101	ns	10	$(0,1)$	12	10Da06	T	2010	IT=100	
^{68}Ni	−63463.8	3.0				29	s	2	0^+	12			1977	β^-=100	
^{68}Ni^m	−61694	3	1770.0	1.0		270	ns	5	0^+	12			1984	IT=100	
^{68}Ni^n	−61262	3	non existent		RN	230	ns	60	0^+		12Di03	TJD		IT=100	*
^{68}Ni^p	−60615	3	2849.1	0.3		860	μs	50	5^-	12			1995	IT=100	
^{68}Cu	−65567.0	1.6				30.9	s	0.6	1^+	12			1953	β^-=100	
^{68}Cu^m	−64845.7	1.6	721.26	0.08		3.75	m	0.05	6^-	12			1969	IT=86 2; β^-=14 2	
^{68}Zn	−70006.8	0.9				STABLE			0^+	12			1922	IS=18.45 63	
^{68}Ga	−67085.7	1.5				67.71	m	0.08	1^+	12			1937	β^+=100	
^{68}Ge	−66978.8	1.9				270.93	d	0.13	0^+	12			1948	ε=100	
^{68}As	−58894.5	1.8				151.6	s	0.8	3^+	12			1971	β^+=100	
^{68}As^m	−58469.4	1.8	425.1	0.2		111	ns	20	1^+	12			1994	IT=100	*
^{68}Se	−54189.4	0.5				35.5	s	0.7	0^+	12			1990	β^+=100	
^{68}Br	−38440#	310#						<1.5 μs	3^+#	12	95Bl06	I		p ?	
*^{68}Mn	T : average 11Da08=29(4) 03So21=28(8) 99Ha05=28(4)														**
*^{68}Co^n	J : 12Li02 strong feeding in β^- of ^{68}Fe (0^+)														**
*^{68}Ni^n	I : reported in 12Di03 at 2202 keV, 168(1) keV above first 2^+ (at 2034.08)														**
*^{68}Ni^n	I : with half-life=216(+66–50)ns. Not confirmed in 12Ch.B using Gammasphere														**
*^{68}As^m	T : symmetrized from 94Ba50=107(+23–16)														**
^{69}Mn	−24540#	600#				16.0	ms	2.8	$5/2^-$#	00	11Da08	T	1995	β^-=100; β^-n=24#; β^-2n ?	*
^{69}Fe	−39060#	400#				110	ms	5	$1/2^-$#	00	11Da08	T	1992	β^-=100; β^-n=7#; β^-2n ?	*
^{69}Co	−50170	190				227	ms	11	$7/2^-$#	00	11Da08	T	1985	β^-=100; β^-n=1#	*
^{69}Ni	−59979	4				11.5	s	0.3	$9/2^+$	00	99Pr10	T	1984	β^-=100	*
^{69}Ni^m	−59658	4	321	2		3.5	s	0.4	$(1/2^-)$	00	98Gr14	E	1998	β^-≈100; IT ?	*
^{69}Ni^n	−57278	4	2701.0	1.0		439	ns	3	$(17/2^-)$	00			1998	IT=100	
^{69}Cu	−65736.2	1.4				2.85	m	0.15	$3/2^-$	00			1966	β^-=100	
^{69}Cu^m	−62994.4	1.7	2741.8	1.0		360	ns	16	$(13/2^+)$	00	12Di03	T	1997	IT=100	*
^{69}Zn	−68417.6	0.9				56.4	m	0.9	$1/2^-$	00			1937	β^-=100	
^{69}Zn^m	−67979.0	0.9	438.636	0.018		13.76	h	0.02	$9/2^+$	00			1970	IT≈100; β^-=0.033 3	
^{69}Ga	−69327.8	1.2				STABLE			$3/2^-$	00			1923	IS=60.108 9	
^{69}Ge	−67100.7	1.3				39.05	h	0.10	$5/2^-$	00			1938	β^+=100	
^{69}Ge^m	−67013.9	1.3	86.765	0.014		5.1	μs	0.2	$1/2^-$	00			1978	IT=100	
^{69}Ge^n	−66702.8	1.3	397.944	0.018		2.81	μs	0.05	$9/2^+$	00			1978	IT=100	

… *A*-group is continued on next page …

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
… *A*-group continued …															
^{69}As	−63110	30				15.2	m	0.2	$5/2^-$	00			1955	β^+=100	
^{69}Se	−56434.7	1.5				27.4	s	0.2	$(1/2^-)$	00	95Po01	J	1974	β^+=100; β^+p=0.045 10	
^{69}Se^m	−56395.3	1.5	39.4	0.1		2.0	μs	0.2	$(5/2^-)$	00			1988	IT=100	
^{69}Se^n	−55860.8	1.8	573.9	1.0		955	ns	16	$9/2^+$	00	00Ch07	T	1988	IT=100	*
^{69}Br	−46110	40			*	< 24	ns		$(1/2^-)$	00	11Ro18	D	1988	p=100	
^{69}Br^m	−46070#	110#	40#	100#	*				$5/2^-$#						
^{69}Br^n	−45540#	110#	570#	100#					$9/2^+$#						
^{69}Br^i	−42770	50	3340	60	p				$(5/2^-)$T=3/2		11Ro47	I	2011	p=100	
^{69}Kr	−32440#	400#				27.4	ms	2.9	$(5/2^-)$	00	11Ro47	TJ	1995	β^+=100; β^+p=?	*
*^{69}Mn	T : average 11Da08=18(4) 99Ha05=14(4) D : β^-n observed in 99Ha05														**
*^{69}Fe	T : average 11Da08=110(6) 03So21=109(9)														**
*^{69}Co	T : average 11Da08=229(24) 02So.A=232(17) 99Mu17=220(20)														**
*^{69}Ni	T : average 99Pr10=11.7(0.6) 85Bo49=11.4(0.3); not used 98Fr15=11.2(0.9)														**
*^{69}Ni^m	T : average 99Mu17=3.5(0.5) 99Pr10=3.4(0.7)														**
*^{69}Ni^m	E : 9/2$^+$ level in isotones: ^{73}Ge=–66 ^{71}Zn=157(1) ^{69}Ni=–321(2) exhibits														**
*^{69}Ni^m	E : unusually strong variations														**
*^{69}Cu^m	T : average 12Di03=360(20) 98Gr14=360(50) 97Is13=360(30)														**
*^{69}Se^n	T : average 00Ch07=950(21) 95Po01=960(23)														**
*^{69}Kr	T : average 11Ro47=27(3) 97Xu01=32(10)														**
^{70}Mn	−19220#	700#				10#	ms	(>620 ns)		09	09Ta24	I	2009	β^- ?; β^-n ?; β^-2n ?	
^{70}Fe	−36310#	500#				77	ms	9	0^+	04	11Da08	T	1997	β^-=100; β^-n ?	*
^{70}Co	−46920	300			*	112.7	ms	4.5	(6^-)	04	11Da08	T	1985	β^-=100; β^-n ?; β^-2n ?	*
^{70}Co^m	−46720#	360#	200#	200#	*	500	ms	180	3^+#	04			1998	$\beta^-\approx$100; IT ?; β^-n ?	
^{70}Ni	−59213.9	2.1				6.0	s	0.3	0^+	04			1987	β^-=100	
^{70}Ni^m	−56353.9	2.9	2860	2		232	ns	1	(8^+)	04			1997	IT=100	
^{70}Cu	−62976.4	1.1				44.5	s	0.2	6^-	04	10Vi07	J	1971	β^-=100	
^{70}Cu^m	−62875.3	1.1	101.1	0.3		33	s	2	3^-	04	10Vi07	J	2002	β^-=52 9; IT=48 9	
^{70}Cu^n	−62733.8	1.2	242.6	0.5		6.6	s	0.2	1^+	04			1971	β^-=93.2 9; IT=6.8 9	
^{70}Zn	−69564.7	1.9				Stable			0^+	04			1922	IS=0.61 10; 2β^- ?	*
^{70}Ga	−68910.1	1.2				21.14	m	0.03	1^+	04			1937	$\beta^-\approx$100; ε=0.41 6	
^{70}Ge	−70561.8	0.8				Stable			0^+	04			1923	IS=20.57 27	
^{70}As	−64340	50				52.6	m	0.3	$4^{(+\#)}$	04			1950	β^+=100	
^{70}As^m	−64310	50	32.008	0.002		96	μs	3	$2^{(+\#)}$	04			1979	IT=100	
^{70}Se	−61929.9	1.6				41.1	m	0.3	0^+	04			1950	β^+=100	
^{70}Br	−51426	15				79.1	ms	0.8	0^+T=1	04			1978	β^+=100; β^+p ?	
^{70}Br^m	−49134	15	2292.3	0.8		2.2	s	0.2	9^+	04			1981	β^+=?; IT ?; β^+p ?	
^{70}Kr	−40950#	200#				52	ms	17	0^+	04			1995	β^+=100; β^+p<1.3	
*^{70}Fe	T : average 11Da08=71(10) 03So21=94(17)														**
*^{70}Co	T : average 11Da08=108(7) 03So21=121(8) 03Sa40=110(9)														**
*^{70}Zn	T : >13 Py in ENSDF is for 0ν-$\beta\beta$ decay														**
^{71}Mn	−15200#	700#				5#	ms	(>400 ns)	$5/2^-$#	10	10Oh02	I	2010	β^- ?; β^-n ?; β^-2n ?	
^{71}Fe	−31000#	600#				28	ms	5	$7/2^+$#	10	11Da08	T	1997	β^-=100; β^-n ?; β^-2n ?	
^{71}Co	−44370	470				80	ms	3	$7/2^-$#	10	05Ma95	D	1992	β^-=100; β^-n>3 1	
^{71}Ni	−55406.2	2.2				2.56	s	0.03	$(9/2^+)$	10			1987	β^-=100	
^{71}Ni^m	−55406.0	2.3	499	5		2.3	s	0.3	$(1/2^-)$	10			2009	β^-=100	
^{71}Cu	−62711.1	1.5				19.4	s	1.4	$3/2^-$	10	10Vi07	J	1983	β^-=100	*
^{71}Cu^m	−59955.4	1.6	2755.7	0.6		271	ns	13	$(19/2^-)$	10	98Gr14	TJ	1998	IT=100	*
^{71}Zn	−67328.8	2.7				2.45	m	0.10	$1/2^-$	10			1955	β^-=100	
^{71}Zn^m	−67171.1	2.4	157.7	1.3	MD	4.125	h	0.007	$9/2^+$	10	12Re05	T	1958	$\beta^-\approx$100; IT$\leq$0.05	
^{71}Ga	−70139.1	0.8				Stable			$3/2^-$	10			1923	IS=39.892 9	
^{71}Ge	−69906.5	0.8				11.43	d	0.03	$1/2^-$	10			1941	ε=100	
^{71}Ge^m	−69708.1	0.8	198.354	0.014		20.41	ms	0.18	$9/2^+$	10			1959	IT=100	
^{71}As	−67893	4				65.30	h	0.07	$5/2^-$	10			1939	β^+=100	
^{71}Se	−63146.5	2.8				4.74	m	0.05	$(5/2^-)$	10			1957	β^+=100	
^{71}Se^m	−63097.7	2.8	48.79	0.05		5.6	μs	0.7	$(1/2^-)$	10			1982	IT=100	
^{71}Se^n	−62886.0	2.8	260.48	0.10		19.0	μs	0.5	$(9/2^+)$	10			1982	IT=100	
^{71}Br	−56502	5				21.4	s	0.6	$(5/2)^-$	10			1981	β^+=100	
^{71}Kr	−46330	130				100	ms	3	$(5/2)^-$	10			1981	β^+=100; β^+p=2.1 7	*
^{71}Rb	−32300#	500#			*				$5/2^-$#					p ?	
^{71}Rb^m	−32250#	510#	50#	100#	*				$1/2^-$#						
^{71}Rb^n	−32040#	510#	260#	100#					$9/2^+$#						
*^{71}Cu	T : average 99Pr10=19(3) 83Ru06=19.5(1.6)														**
*^{71}Cu^m	T : average 98Is11=250(30) 98Gr14=275(14)														**

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{72}Fe	−28100#	700#				10#	ms	(>300 ns)	0^+	10	97Be70	I	1997	β^- ?; β^-n ?; β^-2n ?	
^{72}Co	−39780#	400#				59.9	ms	1.7	6^-#	10	05Ma95	D	1992	β^-=100; β^-n>6 2; β^-2n ?	
^{72}Ni	−54226.1	2.2				1.57	s	0.05	0^+	10			1987	β^-=100; β^-n ?	
^{72}Cu	−59783.0	1.4				6.63	s	0.03	2^-	10	10Fl02	J	1983	β^-=100	*
^{72}Cu^m	−59512.7	1.7	270.3	1.0		1.76	μs	0.03	(6^-)	10			1998	IT=100	*
^{72}Zn	−68145.5	2.1				46.5	h	0.1	0^+	10			1951	β^-=100	
^{72}Ga	−68588.3	0.8				14.10	h	0.02	3^-	10			1939	β^-=100	
^{72}Ga^m	−68468.6	0.8	119.66	0.05		39.68	ms	0.13	(0^+)T=1	10			1968	IT=100	
^{72}Ge	−72585.90	0.08				STABLE			0^+	10			1923	IS=27.45 32	
^{72}Ge^m	−71894.47	0.09	691.43	0.04		444.2	ns	0.8	0^+	10			1984	IT=100	
^{72}As	−68230	4				26.0	h	0.1	2^-	10			1939	β^+=100	
^{72}Se	−67868.2	2.0				8.40	d	0.08	0^+	10			1948	ε=100	
^{72}Br	−59067	7				78.6	s	2.4	1^+	10			1970	β^+=100	
^{72}Br^m	−58966	7	100.76	0.15		10.6	s	0.3	(3^-)	10			1980	IT≈100; β^+=?	
^{72}Kr	−53941	8				17.16	s	0.18	0^+	10	03Pi03	T	1973	β^+=100	*
^{72}Rb	−38120#	500#			*			<1.5 μs	1^+#		95Bl06	I		p ?	
^{72}Rb^m	−38020#	510#	100#	100#	*	1#	μs		3^-#					p ?	
*^{72}Cu	J : using collinear laser spectroscopy at the CERN ISOLDE facility														**
*^{72}Cu^m	D : no β^-decay observed in 05Th.A														**
*^{72}Kr	T : average 03Pi03=17.1(0.2) 73Da22=17.4(0.4)														**
^{73}Fe	−22620#	700#				5#	ms	(>400 ns)	$7/2^+$#	10	10Oh02	I	2010	β^- ?; β^-n ?; β^-2n ?	
^{73}Co	−36900#	500#				41	ms	3	$7/2^-$#	04	11Da08	T	1995	β^-=100; β^-n>9 4; β^-2n ?	*
^{73}Ni	−50108.2	2.4				840	ms	30	$(9/2^+)$	04			1987	β^-=100; β^-n ?	
^{73}Cu	−58987.4	1.9				4.2	s	0.3	$3/2^-$	04	10Vi07	J	1983	β^-=100; β^-n ?	
^{73}Zn	−65593.4	1.9				23.5	s	1.0	$(1/2)^-$	04			1972	β^-=100	
^{73}Zn^m	−65397.9	1.9	195.5	0.2		13.0	ms	0.2	$(5/2^+)$	04			1985	IT=100	
^{73}Zn^n	−65355.8	2.8	237.6	2.0	EU	5.8	s	0.8	$(9/2^+)$	04			1998	IT=?; β^-=?	*
^{73}Ga	−69699.3	1.7				4.86	h	0.03	$1/2^-$	04	11Ch16	J	1949	β^-=100	
^{73}Ge	−71297.52	0.06				STABLE			$9/2^+$	04			1933	IS=7.75 12	
^{73}Ge^m	−71284.24	0.06	13.2845	0.0015		2.92	μs	0.03	$5/2^+$	04			1975	IT=100	
^{73}Ge^n	−71230.79	0.06	66.726	0.009		499	ms	11	$1/2^-$	04			1957	IT=100	
^{73}As	−70953	4				80.30	d	0.06	$3/2^-$	04			1948	ε=100	
^{73}As^m	−70525	4	427.906	0.021		5.7	μs	0.2	$9/2^+$	04			1956	IT=100	
^{73}Se	−68227	7				7.15	h	0.08	$9/2^+$	04			1948	β^+=100	
^{73}Se^m	−68201	7	25.71	0.04		39.8	m	1.3	$3/2^-$	04			1960	IT=72.6 3; β^+=27.4 3	
^{73}Br	−63648	7				3.4	m	0.2	$1/2^-$	04			1970	β^+=100	
^{73}Kr	−56552	7				27.3	s	1.0	$3/2^-$	04			1972	β^+=100; β^+p=0.25 3	
^{73}Kr^m	−56118	7	433.66	0.12		107	ns	10	$(9/2^+)$	04			1993	IT=100	
^{73}Rb	−46080#	100#						<30 ns	$3/2^-$#	04	96Pf01	I		p ?	
^{73}Rb^m	−45650#	140#	430#	100#					$9/2^+$#						
^{73}Rb^i	−42850	40	3230#	110#	p				$1/2^-$T=3/2		93Ba61	JD	1993	p=100	
^{73}Sr	−31950#	400#				> 25	ms		$1/2^-$#	04			1993	β^+=100; β^+p=?	
*^{73}Co	T : average 11Da08(=04Sa59)=41(4) 10Ho12=41(6)														**
*^{73}Co	D : β^-n>9(4)% is from 05Ma95; however β^-n<7.9% in 10Ho12														**
*^{73}Zn^n	E : if 42.1 keV γ feeds ^{73}Zn^m, EU: see discussion in ENSDF'04														**
^{74}Fe	−19240#	800#				2#	ms	(>400 ns)	0^+	10	10Oh02	I	2010	β^- ?; β^-n ?; β^-2n ?	
^{74}Co	−32460#	600#				30	ms	3		06	05Ma95	D	1995	β^-=100; β^-n>26 9; β^-2n ?	*
^{74}Ni	−48460#	400#				680	ms	120	0^+	06	98Fr15	T	1987	β^-=100; β^-n ?	*
^{74}Cu	−56006	6				1.63	s	0.05	2^-	06	10Fl02	J	1987	β^-=100; β^-n=?	
^{74}Zn	−65756.7	2.5				95.6	s	1.2	0^+	06			1972	β^-=100	
^{74}Ga	−68049.6	3.0				8.12	m	0.12	3^-	06	11Ma45	J	1956	β^-=100	
^{74}Ga^m	−67990	3	59.571	0.014		9.5	s	1.0	$(0)^{(+\#)}$	06			1974	IT=75 25; β^- ?	
^{74}Ge	−73422.442	0.013				STABLE			0^+	06			1923	IS=36.50 20	
^{74}As	−70860.1	1.7				17.77	d	0.02	2^-	06			1938	β^+=66 2; β^-=34 2	
^{74}Se	−72213.202	0.015				STABLE			0^+	06			1922	IS=0.89 4; $2\beta^+$?	
^{74}Br	−65288	6				25.4	m	0.3	(0^-)	06			1952	β^+=100	
^{74}Br^m	−65274	6	13.58	0.21		46	m	2	$4^{(+\#)}$	06			1953	β^+=100	
^{74}Kr	−62331.8	2.0				11.50	m	0.11	0^+	06			1960	β^+=100	
^{74}Kr^i	−61790	30	540	30							98Gr.A	E	1998	IT=100	*
^{74}Rb	−51916	3				64.776	ms	0.030	0^+	06			1977	β^+=100; β^+p ?	
^{74}Sr	−40830#	100#				50#	ms	(>1.5 μs)	0^+	06			1995	β^+ ?; β^+p ?	
*^{74}Co	T : others recent 11Da08=19(7) 10Ho12=34(+6–9)					D : β^-n=18(15)% in 10Ho12									**
*^{74}Ni	T : average 98Fr15=900(200) 98Am04=540(160)														**
*^{74}Kr^i	E : E(g)<85 to 2^+ level at 455.61(0.10) keV														**

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{75}Co	−29100#	700#				30	ms	11	$7/2^-$#	99	11Ho21	TD	1995	β^- ?; β^-n<16; β^-2n ?	
^{75}Ni	−44250#	300#				341	ms	22	$7/2^+$#	99	10Ho12	D	1992	β^-=100; β^-n=10 2.8	*
^{75}Cu	−54471.3	2.3				1.2238	s	0.0028	$5/2^-$	99	09Fl03	J	1985	β^-=100; β^-n=3.5 6	*
^{75}Cu^m	−54409.2	2.3	62.1	0.4		370	ns	40	$(1/2^-)$		10Da06	ETJ	2010	IT=100	*
^{75}Cu^n	−54342.5	2.4	128.8	0.5		160	ns	12	$(3/2^-)$		10Da06	ETJ	2010	IT=100	*
^{75}Zn	−62558.9	2.0				10.2	s	0.2	$(7/2^+)$	99	11Il01	J	1974	β^-=100	
^{75}Zn^m	−62431.9	2.0	127.01	0.09		5#	s		$(1/2^-)$		11Il01	EJ	2011	β^- ?; IT ?	
^{75}Ga	−68464.6	2.4				126	s	2	$3/2^-$	99	11Ch16	J	1960	β^-=100	
^{75}Ge	−71856.96	0.05				82.78	m	0.04	$1/2^-$	99			1939	β^-=100	
^{75}Ge^m	−71717.27	0.06	139.69	0.03		47.7	s	0.5	$7/2^+$	99			1952	IT≈100; β^-=0.030 6	
^{75}Ge^n	−71664.78	0.09	192.18	0.07		216	ns	5	$5/2^+$	99			1982	IT=100	
^{75}As	−73034.2	0.9				STABLE			$3/2^-$	99			1920	IS=100.	
^{75}As^m	−72730.3	0.9	303.9241	0.0007		17.62	ms	0.23	$9/2^+$	99			1957	IT=100	
^{75}Se	−72169.48	0.07				119.779	d	0.004	$5/2^+$	99			1947	ε=100	
^{75}Br	−69107	4				96.7	m	1.3	$3/2^-$	99			1948	β^+=100	
^{75}Kr	−64324	8				4.29	m	0.17	$5/2^+$	99			1960	β^+=100	
^{75}Rb	−57218.7	1.2				19.0	s	1.2	$(3/2^-)$	99			1975	β^+=100	
^{75}Sr	−46620	220				88	ms	3	$(3/2^-)$	99	03Hu01	TJD	1991	β^+=100; β^+p=5.2 9	
*^{75}Ni	T : symmetrized from 05Ho08=344(+20–24) ms, also 98Am04=600(200) ms														**
*^{75}Cu	T : average 11Il01=1.222(8) 91Kr15=1.224(3) J : 10Vi07 same authors														**
*^{75}Cu^m	E : average 12Ka.B=62.5(0.5) 10Da06=61.8(0.5, estimated by NUBASE)														**
*^{75}Cu^m	E : average 12Ka.B=129.3(0.7) 10Da06=128.3(0.7, estimated by NUBASE)														**
*^{75}Cu^n	T : average 12Ka.B=134(+25–20) 10Da06=170(15)														**
^{76}Co	−24100#	800#				20#	ms	(>400 ns)		10	10Oh02	I	2010	β^- ?; β^-n ?; β^-2n ?	
^{76}Ni	−41610#	500#				236	ms	17	0^+	07	10Ho12	D	1995	β^-=100; β^-n=14 3.6	*
^{76}Ni^m	−39190#	500#	2418.7	1.0		410	ns	50	(8^+)	07	12Ka.B	ET	2005	IT=100	
^{76}Cu	−50976	7			*	637.7	ms	5.5	(3,4)	95	09Wi03	D	1987	β^-=100; β^-n=7.2 5	*
^{76}Cu^m	−50980#	200#	0#	200#	*	1.27	s	0.30	(1,3)	95	90Wi12	J	1990	β^-=100	
^{76}Zn	−62303.0	1.5				5.7	s	0.3	0^+	95			1974	β^-=100	
^{76}Ga	−66296.6	2.0				32.6	s	0.6	2^-	95	11Ma45	J	1961	β^-=100	
^{76}Ge	−73212.889	0.018				1.58	Zy	0.17	0^+	95	01Kl11	T	1933	IS=7.73 12; 2β^-=100	*
^{76}As	−72291.4	0.9				1.0778	d	0.0020	2^-	95			1934	β^-≈100; ε<0.02	
^{76}As^m	−72247.0	0.9	44.425	0.001		1.84	μs	0.06	$(1)^+$	95			1966	IT=100	
^{76}Se	−75251.950	0.016				STABLE			0^+	95			1922	IS=9.37 29	
^{76}Br	−70289	9				16.2	h	0.2	1^-	95			1952	β^+=100	
^{76}Br^m	−70186	9	102.58	0.03		1.31	s	0.02	$(4)^+$	95			1979	IT>99.4; β^+<0.6	
^{76}Kr	−69014	4				14.8	h	0.1	0^+	95			1954	β^+=100	
^{76}Rb	−60479.1	0.9				36.5	s	0.6	$1^{(-)}$	95			1969	β^+=100; $\beta^+\alpha$=3.8e–7 10	
^{76}Rb^m	−60162.2	0.9	316.93	0.08		3.050	μs	0.007	(4^+)	95	00Ch07	T	1986	IT=100	
^{76}Sr	−54250	30				7.89	s	0.07	0^+	11			1990	β^+=100; β^+p=3.4e–5 8	
^{76}Y	−38600#	500#				500#	ns	(>200 ns)	1^-#	07	01Ki13	I	2001	β^+ ?; p ?; β^+p ?	*
*^{76}Ni	T : symmetrized from 238(+15–18)														**
*^{76}Cu	T : average 10Ho12=599(18) 05Va19=653(24) 91Kr15=641(6)														**
*^{76}Cu	J : from 05Va19 and 90Wi12														**
*^{76}Ge	T : from 01Kl11=1.55(+0.19–0.15); other results from same group:														**
*^{76}Ge	T : 97Gu13=1.77(+0.13–0.11) 94Ba15=1.42(0.13)														**
*^{76}Ge	T : other groups 93Br22=0.84(+0.10–0.08)(2σ) 90Va18=0.90(0.10)														**
*^{76}Ge	T : and 90Mi23=1.1(+0.6–0.3)(2σ)														**
*^{76}Ge	TD : claim for 0ν-$\beta\beta$ 01Kl13=15 Yy 04Kl03=11.2 Yy not trusted. See also														**
*^{76}Ge	TD : 02Aa.A and 02Zd02														**
*^{76}Y	I : also 00We.A>170 ns same group														**
^{77}Ni	−36750#	500#				124	ms	30	$9/2^+$#	12	10Ho12	D	1995	β^-=100; β^-n=30 24; β^-2n ?	*
^{77}Cu	−48510#	150#				467.9	ms	2.1	$5/2^-$	12			1987	β^-=100; β^-n=30.3 20	
^{77}Zn	−58789.2	2.0				2.08	s	0.05	$(7/2^+)$	12			1977	β^-=100	
^{77}Zn^m	−58016.8	2.0	772.440	0.015		1.05	s	0.10	$(1/2^-)$	12	09Pa35	J	1986	β^-=66 7; IT=34 7	
^{77}Ga	−65992.3	2.4				13.2	s	0.2	$3/2^{(-)}$	12			1968	β^-=100	
^{77}Ge	−71212.86	0.05				11.211	h	0.003	$7/2^+$	12			1939	β^-=100	
^{77}Ge^m	−71053.15	0.08	159.71	0.06		53.7	s	0.6	$1/2^-$	12			1947	β^-=81 2; IT=19 2	
^{77}As	−73916.3	1.7				38.79	h	0.05	$3/2^-$	12			1951	β^-=100	
^{77}As^m	−73440.8	1.7	475.48	0.04		114.0	μs	2.5	$9/2^+$	12			1957	IT=100	
^{77}Se	−74599.48	0.06				STABLE			$1/2^-$	12			1922	IS=7.63 16	
^{77}Se^m	−74437.56	0.06	161.9223	0.0010		17.36	s	0.05	$7/2^+$	12			1947	IT=100	
^{77}Br	−73234.8	2.8				57.04	h	0.12	$3/2^-$	12			1948	β^+=100	
^{77}Br^m	−73128.9	2.8	105.86	0.08		4.28	m	0.10	$9/2^+$	12			1961	IT=100	
^{77}Kr	−70169.4	2.0				74.4	m	0.6	$5/2^+$	12			1948	β^+=100	
^{77}Kr^m	−70102.9	2.0	66.50	0.05		118	ns	12	$3/2^-$	12			1975	IT=100	
^{77}Rb	−64830.5	1.3				3.78	m	0.04	$3/2^-$	12			1972	β^+=100	
^{77}Sr	−57803	8				9.0	s	0.2	$5/2^{(+)}$	12			1976	β^+=100; β^+p=0.08 3	
^{77}Y	−46780#	60#				63	ms	17	$5/2^+$#	12	00We.A	D	1999	β^+=?; β^+p ?; p<10	*
*^{77}Ni	T : symmetrized from 05Ho08=128(+27–33)														**
*^{77}Y	D : limit for p is from 00We.A T : symmetrized from 01Ki13=57(+22–12)														**

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^{π}	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{78}Ni	−34130#	800#				140	ms	80	0^+	09			1995	β^-=100; β^-n=49#; β^-2n ?	$*$
^{78}Cu	−44500	500				335	ms	11	(6^-)	09	11Ko36	J	1991	β^-=100; β^-n=65 8; β^-2n ?	$*$
^{78}Zn	−57483.2	1.9				1.47	s	0.15	0^+	09			1977	β^-=100; β^-n ?	
^{78}Zn^m	−54807.9	2.1	2675.3	1.0		320	ns	6	(8^+)	09	12Ka.B	ET	1998	IT=100	$*$
^{78}Ga	−63705.9	1.9				5.09	s	0.05	2^-	09	11Ma45	J	1972	β^-=100	
^{78}Ga^m	−63207.0	2.0	498.9	0.5		110	ns	3		09	10Da06	ET	2010	IT=100	$*$
^{78}Ge	−71862	4				88.0	m	1.0	0^+	09			1953	β^-=100	
^{78}As	−72817	10				90.7	m	0.2	2^-	09			1937	β^-=100	
^{78}Se	−77025.91	0.18				STABLE			0^+	09			1922	IS=23.77 28	
^{78}Br	−73452	4				6.45	m	0.04	1^+	09			1937	$\beta^+\approx$100; $\beta^-<$0.01	
^{78}Br^m	−73271	4	180.89	0.13		119.4	μs	1.0	(4^+)	09			1958	IT=100	
^{78}Kr	−74179.6	0.7				STABLE		(>110 Ey)	0^+	09	94Sa31	T	1920	IS=0.355 3; 2β^+ ?	$*$
^{78}Rb	−66935	3				17.66	m	0.03	$0^{(+)}$	09			1968	β^+=100	
^{78}Rb^m	−66888	3	46.84	0.14		910	ns	40	(1^-)	09			1996	IT=100	
^{78}Rb^n	−66824	3	111.19	0.22		5.74	m	0.03	$4^{(-)}$	09			1968	β^+=91 2; IT=9 2	
^{78}Rb^x	−66861	12	74	12		$R=2.0$ 0.5			spmix						
^{78}Sr	−63174	7				156.1	s	2.7	0^+	09	11Pe29	T	1982	β^+=100	$*$
^{78}Y	−52530#	400#			$*$	54	ms	5	(0^+)	09	01Ga24	TJ	1992	β^+=100; β^+p ?	$*$
^{78}Y^m	−52530#	640#	0#	500#	$*$	5.8	s	0.6	(5^+)	09			1998	β^+=100; β^+p ?	
^{78}Zr	−41300#	500#				50#	ms	(>200 ns)	0^+	09	01Ki13	I	2001	β^+ ?; β^+p ?	$*$

$*^{78}$Ni T : symmetrized from 05Ho08=110(+100–60) $**$
$*^{78}$Cu D : β^-n other 10Ho12=44.0(5.4)% $**$
$*^{78}$Zn^m T : average 12Ka.B=321(9) 00Da07=319(9) $**$
$*^{78}$Ga^m E : this is level 559.6(0.7) <500 ns in ENSDF'09 $**$
$*^{78}$Kr T : limit given here is for the K-e$^+$ decay (theoretically faster) $**$
$*^{78}$Sr T : average 11Pe29=155(3) 97Mu02=168(12) 92Gr09=159(8) $**$
$*^{78}$Y T : average 01Ga24=50(8) 01Ki13=55(+9–6) $**$
$*^{78}$Zr I : also 00We.A>170 ns same group $**$

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^{π}	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{79}Ni	−27710#	800#				100#	ms	(>400 ns)	$5/2^+$#	10	10Oh02	I	2010	β^- ?; β^-n ?; β^-2n ?	
^{79}Cu	−41900#	400#				220	ms	19	$5/2^-$#	02	10Ho12	TD	1991	β^-=100; β^-n=66 10; β^-2n ?	$*$
^{79}Zn	−53432.3	2.2				995	ms	19	$(9/2^+)$	02			1981	β^-=100; β^-n=1.3 4	$*$
^{79}Ga	−62547.7	1.9				2.847	s	0.003	$3/2^-$	02	11Ch16	J	1974	β^-=100; β^-n=0.089 19	
^{79}Ge	−69530	40				18.98	s	0.03	$(1/2)^-$	02			1970	β^-=100	
^{79}Ge^m	−69340	40	185.95	0.04		39.0	s	1.0	$7/2^+$#	02			1970	β^-=96 1; IT=4 1	
^{79}As	−73636	5				9.01	m	0.15	$3/2^-$	02			1950	β^-=100	
^{79}As^m	−72863	5	772.81	0.06		1.21	μs	0.01	$(9/2)^+$	02	98Gr14	T	1998	IT=100	$*$
^{79}Se	−75917.42	0.23				335	ky	18	$7/2^+$	02	10Jo09	T	1950	β^-=100	$*$
^{79}Se^m	−75821.65	0.23	95.77	0.03		3.92	m	0.01	$1/2^-$	02			1950	IT$\approx$100; β^-=0.056 11	
^{79}Br	−76068.1	1.3				STABLE			$3/2^-$	02			1920	IS=50.69 7	
^{79}Br^m	−75860.5	1.3	207.61	0.09		4.86	s	0.04	$9/2^+$	02	09Mu15	J	1954	IT=100	$*$
^{79}Kr	−74442	4				35.04	h	0.10	$1/2^-$	02			1948	β^+=100	
^{79}Kr^m	−74312	4	129.77	0.05		50	s	3	$7/2^+$	02			1940	IT=100	
^{79}Rb	−70803.0	2.1				22.9	m	0.5	$5/2^+$	02			1957	β^+=100	
^{79}Sr	−65477	8				2.25	m	0.10	$3/2^{(-)}$	02			1972	β^+=100	
^{79}Y	−58360	450				14.8	s	0.6	$5/2^+$#	02			1992	β^+=100	
^{79}Zr	−47060#	400#				56	ms	30	$5/2^+$#	02			1999	β^+=100; β^+p ?	

$*^{79}$Cu T : average 10Ho12=257(+29–26) 91Kr15=188(25) $**$
$*^{79}$Cu D : β^-n average 10Ho12=72(12)% 91Kr15=55(17)% $**$
$*^{79}$Zn T : other 10Ho12=746(42) not used D : β^-n 10Ho12=2.2(1.4)% not used $**$
$*^{79}$As^m T : 11Ru.A=1.18(0.03) 98Ho15=0.87(0.06) outweighed, not used $**$
$*^{79}$Se T : average 10Jo09=327(8) 07Bi01=377(19) $**$
$*^{79}$Br^m J : 207.2 keV E3 γ ray to $3/2^-$ $**$

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^{π}	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{80}Cu	−36430#	600#				210	ms	80		05	10Ho12	T	1995	β^- ?; β^-n ?; β^-2n ?	$*$
^{80}Zn	−51648.6	2.6				550	ms	11	0^+	05	10Ho12	T	1981	β^-=100; β^-n=1.0 5	$*$
^{80}Ga	−59223.7	2.9				2.03	s	0.09	(6^-)	05	11Ve.B	TJ	1974	β^-=100; β^-n=0.86 7	
^{80}Ga^m	−59220#	100#	0#	100#		1.4	s	0.1	(3^-)		11Ve.B	TJ	2011	β^- ?; β^-n ?	
^{80}Ge	−69535.3	2.1				29.5	s	0.4	0^+	05			1972	β^-=100	
^{80}As	−72214	3				15.2	s	0.2	1^+	05			1954	β^-=100	
^{80}Se	−77759.5	1.2				STABLE			0^+	05			1922	IS=49.61 41; 2β^- ?	
^{80}Br	−75889.0	1.3				17.68	m	0.02	1^+	05			1937	β^-=91.7 2; β^+=8.3 2	
^{80}Br^m	−75803.2	1.3	85.843	0.004		4.4205	h	0.0008	5^-	05			1937	IT=100	
^{80}Kr	−77893.3	0.7				STABLE			0^+	05			1920	IS=2.286 10	
^{80}Rb	−72175.5	1.9				33.4	s	0.7	1^+	05	93Al03	T	1961	β^+=100	
^{80}Rb^m	−71681.6	2.0	493.9	0.5		1.63	μs	0.04	(6^+)	05	92Do10	E	1980	IT=100	
^{80}Sr	−70311	3				106.3	m	1.5	0^+	05			1961	β^+=100	
^{80}Y	−61147	6				30.1	s	0.5	4^-	05			1981	β^+=100	
^{80}Y^m	−60919	6	228.5	0.1		4.8	s	0.3	1^-	05	01No07	J	1998	IT=81 2; β^+=19 2	$*$
^{80}Y^n	−60834	6	312.6	0.9		4.7	μs	0.3	(2^+)	05			1997	IT=100	
^{80}Zr	−55520	1490				4.6	s	0.6	0^+	05	01Ki13	T	1987	β^+=100	$*$

$*^{80}$Cu T : symmetrized from 10Ho12=170(+110–50) $**$
$*^{80}$Zn T : average 10Ho12=578(21) 91Kr15=540(30) 86Gi07=550(20) 86Ek01=530(20) $**$
$*^{80}$Zn D : β^-n other 10Ho12<1.8% $**$
$*^{80}$Y^m J : 228.5 M3 γ ray to 4^- level $**$
$*^{80}$Zr T : average 01Ki13=5.3(+1.1–0.9) 00Re03=4.1(+0.8–0.6) $**$

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{81}Cu	−31790#	800#					50#	ms	(>400 ns)	5/2$^-$#	10	10Oh02	I	2010	β^- ?; β^-n ?; β^-2n ?	
^{81}Zn	−46200	5					304	ms	13	(5/2$^+$)	08	10Pa33	T	1991	β^-=100; β^-n=9.1 24; β^-2n ?	*
^{81}Ga	−57628	3					1.217	s	0.005	5/2$^-$	08	11Ch16	J	1976	β^-=100; β^-n=11.9 7	
^{81}Ge	−66291.7	2.1					8	s	2	9/2$^+$#	08			1972	β^-=100	*
^{81}Ge^m	−65612.6	2.1	679.14	0.04			8	s	2	(1/2$^+$)	08			1981	β^-≈100; IT<1	
^{81}As	−72533.3	2.7					33.3	s	0.8	3/2$^-$	08			1960	β^-=100	
^{81}Se	−76389.0	1.3					18.45	m	0.12	1/2$^-$	08			1948	β^-=100	
^{81}Se^m	−76286.0	1.3	103.00	0.06			57.28	m	0.02	7/2$^+$	08			1971	IT≈100; β^-=0.051 14	
^{81}Br	−77975.7	1.3					STABLE			3/2$^-$	08			1920	IS=49.31 7	
^{81}Br^m	−77439.5	1.3	536.20	0.09			34.6	μs	2.8	9/2$^+$	08			1967	IT=100	
^{81}Kr	−77694.8	1.4					229	ky	11	7/2$^+$	08			1950	ε=100	
^{81}Kr^m	−77504.2	1.4	190.64	0.04			13.10	s	0.03	1/2$^-$	08			1940	IT≈100; ε=0.0025 4	
^{81}Rb	−75457	5					4.572	h	0.004	3/2$^-$	08			1949	β^+=100	
^{81}Rb^m	−75371	5	86.31	0.07			30.5	m	0.3	9/2$^+$	08			1956	IT=97.6 6; β^+=2.4 6	
^{81}Sr	−71528	3					22.3	m	0.4	1/2$^-$	08			1952	β^+=100	
^{81}Sr^m	−71449	3	79.23	0.04			390	ns	50	(5/2)$^-$	08			1983	IT=100	
^{81}Sr^n	−71439	3	89.05	0.07			6.4	μs	0.5	(7/2$^+$)	08			1989	IT ?	
^{81}Y	−65712	5					70.4	s	1.0	(5/2$^+$)	08			1981	β^+=100	
^{81}Zr	−58400	160					5.5	s	0.4	(3/2$^-$)	08			1997	β^+=100; β^+p=0.12 2	
^{81}Nb	−46950#	400#							<44 ns	3/2$^-$#	08	00We.A	I		p ?; β^+ ?; β^+p ?	*
*^{81}Zn	T : others 12Ma37=304(13) 10Ho12=474(+93–83) 07Ve08=390(70) 91Kr15=290(50)															**
*^{81}Zn	D : β^-n average 12Ma37=12(4) 91Kr15=7.5(3.0)%; other 10Ho12=30(13)% not used															**
*^{81}Ge	T : derived from 7.6(0.6), for mixture of ground-state and isomer with almost same half-life															**
*^{81}Nb	I : also 99Ja02<80 01Ki13<200 ns T : estimated half-life for β^+: 100# ms															**
^{82}Cu	−25670#	800#					50#	ms	(>400 ns)		10	10Oh02	I	2010	β^- ?; β^-n ?; β^-2n ?	
^{82}Zn	−42610#	300#					228	ms	10	0$^+$	03	12Ma37	TD	1997	β^-=100; β^-n=?; β^-2n ?	
^{82}Ga	−52930.7	2.4					599	ms	2	(1,2,3)	03	93Ru01	D	1976	β^-=100; β^-n=21.3 13; β^-2n ?	*
^{82}Ga^m	−52789.7	2.5	141.0	0.5			99	ns	10	2$^-$#		12Ka.B	ETJ	2009	IT=100	*
^{82}Ge	−65415.1	2.2					4.56	s	0.26	0$^+$	11			1972	β^-=100	
^{82}As	−70103	4				*	19.1	s	0.5	(1$^+$)	03			1968	β^-=100	
^{82}As^m	−69975	4	128	6	BD	*	13.6	s	0.4	(5$^-$)	03			1970	β^-=100	
^{82}Se	−77593.9	1.4					97	Ey	5	0$^+$	03	99Pi08	T	1922	IS=8.73 22; 2β^-=100	*
^{82}Br	−77497.3	1.3					35.282	h	0.007	5$^-$	03			1937	β^-=100	
^{82}Br^m	−77451.4	1.3	45.9492	0.0010			6.13	m	0.05	2$^-$	03			1965	IT=97.6 3; β^-=2.4 3	
^{82}Kr	−80590.3	0.9					STABLE			0$^+$	03			1920	IS=11.593 31	
^{82}Rb	−76188	3					1.273	m	0.002	1$^+$	03			1949	β^+=100	
^{82}Rb^m	−76118.8	2.6	69.0	1.5			6.472	h	0.006	5$^-$	03			1957	β^+≈100; IT<0.33	
^{82}Sr	−76010	6					25.36	d	0.03	0$^+$	03	87Ho06	T	1952	ε=100	*
^{82}Y	−68063	6					8.30	s	0.20	1$^+$	03			1980	β^+=100	
^{82}Y^m	−67660	6	402.63	0.14			258	ns	22	4$^-$	03	94Mu02	T	1994	IT=100	*
^{82}Y^n	−67556	6	507.50	0.13			147	ns	7	6$^+$	03			1994	IT=100	
^{82}Zr	−63940#	200#					32	s	5	0$^+$	03			1982	β^+=100	
^{82}Nb	−52200#	300#					50	ms	5	(0$^+$)	08			1992	β^+=100; β^+p ?	
^{82}Nb^m	−51020#	300#	1180	1			92	ns	17	(5$^+$)	08	08Ga04	ETJ	2008	IT=100	
*^{82}Ga	D : average 93Ru01=31.1(4.4)% 86Wa17=19.8(1.7)% 80Lu04=21.4(2.2)%															**
*^{82}Ga^m	T : symmetrized from 12Ka.B=98(+10–9); other 09Fo05<500 ns															**
*^{82}Se	T : average 99Pi08=83(+9–7) 98Ar10=83(12) 92El07=108(+26–6) 88Li11=120(10)															**
*^{82}Sr	T : average 87Ho06=25.36(0.03) 87Ju02=25.342(0.053)															**
*^{82}Y^m	T : average 94Mu02=220(50) 93Wo04=268(25)															**
^{83}Zn	−36740#	500#					127	ms	20	5/2$^+$#	09	12Ma37	TD	1997	β^-=100; β^-n=90#; β^-2n ?	
^{83}Ga	−49257.1	2.6					308.1	ms	1.0	3/2$^-$#	09			1976	β^-=100; β^-n=62.8 25; β^-2n ?	
^{83}Ge	−60976.4	2.4					1.85	s	0.06	(5/2$^+$)	09			1972	β^-=100; β^-n=0.1#	
^{83}As	−69669.3	2.8					13.4	s	0.3	3/2$^-$#	01			1968	β^-=100	
^{83}Se	−75341	3					22.3	m	0.3	9/2$^+$	01			1937	β^-=100	
^{83}Se^m	−75113	3	228.50	0.20			70.1	s	0.4	1/2$^-$	01			1969	β^-=100	
^{83}Br	−79013	4					2.40	h	0.02	3/2$^-$	01			1937	β^-=100	
^{83}Br^m	−75944	4	3068.8	0.6			729	ns	77	(19/2$^-$)	01	11Ru.A	T	1989	IT=100	*
^{83}Kr	−79990.03	0.30					STABLE			9/2$^+$	01			1920	IS=11.500 19	
^{83}Kr^m	−79980.6	0.3	9.4053	0.0008			156.94	ns	0.32	7/2$^+$	01	09Ka30	T	1963	IT=100	
^{83}Kr^n	−79948.5	0.3	41.5569	0.0010			1.830	h	0.013	1/2$^-$	01	10Li13	T	1971	IT=100	
^{83}Rb	−79070.6	2.3					86.2	d	0.1	5/2$^-$	01			1950	ε=100	
^{83}Rb^m	−79028.5	2.3	42.11	0.04			7.8	ms	0.7	9/2$^+$	01	68Et01	T	1968	IT=100	
^{83}Sr	−76798	7					32.41	h	0.03	7/2$^+$	01			1952	β^+=100	
^{83}Sr^m	−76539	7	259.15	0.09			4.95	s	0.12	1/2$^-$	01			1972	IT=100	
^{83}Y	−72205	19					7.08	m	0.06	9/2$^+$	01	92Bu10	J	1962	β^+=100	
^{83}Y^m	−72143	19	61.98	0.11			2.85	m	0.02	(3/2$^-$)	01			1972	β^+=60 5; IT=40 5	

… *A*-group is continued on next page …

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^{π}	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
. . . *A*-group continued . . .															
^{83}Zr	−65911	6				41.6	s	2.4	$1/2^{-}$#	01			1974	β^{+}=100; β^{+}p=?	
^{83}Zr^{m}	−65858	6	52.72	0.05		530	ns	120	$(5/2^{-})$	01			1988	IT=100	
^{83}Zr^{n}	−65834	6	77.04	0.07		132	ns	55	$(7/2^{+})$	01			1988	IT=100	
^{83}Zr^{p}			non existent		RN	8	s	1	high	01	87Ra06	I		β^{+}=100; β^{+}p=?	$*$
^{83}Nb	−58410	300				4.1	s	0.3	$(5/2^{+})$	01			1988	β^{+}=100	
^{83}Mo	−46690#	400#				23	ms	19	$3/2^{-}$#	01	01Ki13	TD	1999	β^{+}=100; β^{+}p ?	$*$
$*^{83}$Br^{m}	T : average 11Ru.A=862(148) 97Is13=700(100) 89Wi01=600(200)														$**$
$*^{83}$Zr^{p}	D : 6(4)% of total β^{+}p go to first excited state in ^{82}Sr														$**$
$*^{83}$Zr^{p}	I : mis-assigned: absence of any radiation suggests no isomer with E>18 keV														$**$
$*^{83}$Mo	T : symmetrized from 6(+30–3)														$**$
^{84}Zn	−32410#	600#				50#	ms	(>400 ns)	0^{+}	10	10Oh02	I	2010	β^{-} ?; β^{-}n ?; β^{-}2n ?	
^{84}Ga	−44280#	400#				85	ms	10	0^{-}#	09	10Wi03	D	1991	β^{-}=100; β^{-}n=72 10; β^{-}2n ?	$*$
^{84}Ge	−58148	3				954	ms	14	0^{+}	09	93Ru01	TD	1972	β^{-}=100; β^{-}n=10.7 6	$*$
^{84}As	−65854	3			$*$	4.02	s	0.03	$(3)^{(+\#)}$	09	93Ru01	TD	1968	β^{-}=100; β^{-}n=0.28 4	
^{84}As^{m}	−65850#	100#	0#	100#	$*$	650	ms	150		09			1974	β^{-}=100	$*$
^{84}Se	−75947.7	2.0				3.26	m	0.10	0^{+}	09			1960	β^{-}=100	
^{84}Br	−77783	26				31.76	m	0.08	2^{-}	09			1943	β^{-}=100	
^{84}Br^{m}	−77470	100	310	100	BD	6.0	m	0.2	$(6)^{-}$	09			1957	β^{-}=100	
^{84}Br^{n}	−77375	26	408.2	0.4		< 140	ns		1^{+}	09			1970	IT=100	
^{84}Kr	−82439.335	0.004				STABLE			0^{+}	09			1920	IS=56.987 15	
^{84}Kr^{m}	−79203.27	0.18	3236.07	0.18		1.83	μs	0.04	8^{+}	09			1982	IT=100	
^{84}Rb	−79759.0	2.2				32.82	d	0.07	2^{-}	09			1947	β^{+}=96.1 20; β^{-}=3.9 20	
^{84}Rb^{m}	−79295.4	2.2	463.59	0.08		20.26	m	0.04	6^{-}	09			1940	IT$\approx$100; β^{+}<0.0012	
^{84}Sr	−80649.6	1.2				STABLE			0^{+}	09			1936	IS=0.56 1; 2β^{+} ?	
^{84}Y	−73893	4				39.5	m	0.8	(6^{+})	09			1962	β^{+}=100	
^{84}Y^{m}	−73826	4	67.0	0.2		4.6	s	0.2	1^{+}	09			1976	β^{+}=100	
^{84}Y^{n}	−73683	4	210.42	0.16		292	ns	10	(4^{-})	09			2005	IT=100	
^{84}Zr	−71421	6				25.8	m	0.5	0^{+}	09			1977	β^{+}=100	
^{84}Nb	−61020#	300#				9.8	s	0.9	(1^{+})	09	09St04	J	1977	β^{+}=100	
^{84}Nb^{m}	−60970#	300#	48	1		176	ns	46	(3^{+})		09Ga40	ETJ	2009	IT=100	
^{84}Nb^{n}	−60680#	300#	337.7	0.4		92	ns	5	(5^{-})	09	09Ga40	T	2000	IT=100	
^{84}Mo	−54500#	400#				2.3	s	0.3	0^{+}	09			1991	β^{+}=100; β^{+}p ?	
$*^{84}$Ga	D : β^{-}n average 10Wi03=74(14)% 91Kr15=70(15)%														$**$
$*^{84}$Ga	I : a β^{-}decaying isomer was identified in 09Le26 and adopted in ENSDF'2009,														$**$
$*^{84}$Ga	I : questioned in 10Wi03														$**$
$*^{84}$Ge	T : average 93Ru01=947(11) 91Kr15=984(23)														$**$
$*^{84}$Ge	D : average 93Ru01=10.8(0.6)% 91Kr15=9.5(2.0)%														$**$
$*^{84}$As^{m}	I : identification discussed in ENSDF2009														$**$
^{85}Zn	−25840#	700#				50#	ms	(>400 ns)	$5/2^{+}$#		10Oh02	I	2010	β^{-} ?; β^{-}n ?; β^{-}2n ?	
^{85}Ga	−40060#	300#				93	ms	7	$3/2^{-}$#	97	12Ma37	TD	1997	β^{-}=100; β^{-}n=?; β^{-}2n ?	
^{85}Ge	−53123	4				540	ms	50	$5/2^{+}$#	97			1991	β^{-}=100; β^{-}n=14 3; β^{-}2n ?	
^{85}As	−63189	3				2.021	s	0.010	$3/2^{-}$#	97			1967	β^{-}=100; β^{-}n=59.4 24	
^{85}Se	−72413.6	2.6				31.7	s	0.9	$5/2^{+}$#	97			1960	β^{-}=100	
^{85}Br	−78575	3				2.90	m	0.06	$3/2^{-}$	91			1943	β^{-}=100	
^{85}Kr	−81480.3	2.0				10.776	y	0.003	$9/2^{+}$	91	02Un02	T	1940	β^{-}=100	
^{85}Kr^{m}	−81175.4	2.0	304.871	0.020		4.480	h	0.008	$1/2^{-}$	91			1937	β^{-}=78.6 4; IT=21.4 4	
^{85}Kr^{n}	−79488.5	2.4	1991.8	1.3		1.82	μs	0.05	$(17/2^{+})$	91	11Ru.A	T	1989	IT=100	
^{85}Rb	−82167.330	0.005				STABLE			$5/2^{-}$	91			1921	IS=72.17 2	
^{85}Rb^{m}	−81653.322	0.005	514.0083	0.0019		1.015	μs	0.001	$9/2^{+}$	91			1964	IT=100	
^{85}Sr	−81103.3	2.8				64.853	d	0.008	$9/2^{+}$	91	02Un02	T	1940	ε=100	
^{85}Sr^{m}	−80864.6	2.8	238.66	0.06		67.63	m	0.04	$1/2^{-}$	91			1940	IT=86.6 4; β^{+}=13.4 4	
^{85}Y	−77842	19				2.68	h	0.05	$(1/2)^{-}$	94			1952	β^{+}=100	
^{85}Y^{m}	−77822	19	19.8	0.5		4.86	h	0.13	$9/2^{+}$	94			1952	$\beta^{+}\approx$100; IT<0.002	
^{85}Y^{n}	−77576	19	266.30	0.20		178	ns	6	$5/2^{-}$	94			1977	IT=100	
^{85}Zr	−73174	6				7.86	m	0.04	$7/2^{+}$	94			1963	β^{+}=100	
^{85}Zr^{m}	−72882	6	292.2	0.3		10.9	s	0.3	$(1/2^{-})$	94			1976	IT$\leq$92; β^{+}>8	
^{85}Nb	−66280	4				20.9	s	0.7	$(9/2^{+})$	91			1988	β^{+}=100	
^{85}Nb^{m}	−66130#	80#	150#	80#		3.3	s	0.9	$(1/2^{-})$	91	05Ka39	TJ	1988	β^{+}=100	$*$
^{85}Mo	−57510	16				3.2	s	0.2	$(1/2^{-})$	97	97Hu15	TD	1992	β^{+}=100; β^{+}p=?	$*$
^{85}Tc	−46030#	400#						<110 ns	$1/2^{-}$#		00We.A	I		p ?	$*$
$*^{85}$Nb^{m}	E : 05Ka39 > 69 keV														$**$
$*^{85}$Nb^{m}	ET : 759.0(1.0) 12(5) s in NUBASE2003 is mis-interpretation of 98Oi02														$**$
$*^{85}$Mo	J : from 05Xu04														$**$
$*^{85}$Tc	I : also 99Ja02<100 ns T : estimated half-life for β^{+} decay: 100# ms														$**$

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{86}Ga	−34460#	700#					30#	ms	(>300 ns)		11	97Be70	I	1997	β^- ?; β^-n ?; β^-2n ?	
^{86}Ge	−49760#	300#					219	ms	40	0^+	11	12Ma.A	TD	1994	β^-=100; β^-n ?	
^{86}As	−58962	3					945	ms	8		11			1973	β^-=100; β^-n=26 7; β^-2n ?	
^{86}Se	−70503.2	2.5					14.3	s	0.3	0^+	11			1973	β^-=100; β^-n ?	
^{86}Br	−75632	3					55.1	s	0.4	(1^-)	11			1962	β^-=100	
^{86}Kr	−83265.665	0.004					STABLE			0^+	01			1920	IS=17.279 41; 2β^- ?	
^{86}Rb	−82747.01	0.20					18.642	d	0.018	2^-	01			1941	β^-≈100; ε=0.0052 5	
^{86}Rb^m	−82190.96	0.27	556.05	0.18			1.017	m	0.003	6^-	01			1951	IT≈100; β^-<0.3	
^{86}Sr	−84523.2	1.1					STABLE			0^+	01			1931	IS=9.86 1	
^{86}Sr^m	−81567.5	1.1	2955.68	0.21			455	ns	7	8^+	01			1971	IT=100	
^{86}Y	−79283	14					14.74	h	0.02	4^-	01			1951	β^+=100	
^{86}Y^m	−79065	14	218.30	0.20			47.2	m	0.4	(8^+)	01	10Ru07	T	1962	IT=99.31 4; β^+=0.69 4	
^{86}Y^n	−78981	14	302.2	0.5			125	ns	6	6^+	01	10Ru07	J	2000	IT=100	
^{86}Zr	−77969	4					16.5	h	0.1	0^+	01			1951	β^+=100	
^{86}Nb	−69133	6				*	88	s	1	(6^+)	01			1974	β^+=100	
^{86}Nb^m	−68880#	160#	250#	160#		*	56.3	s	8.3	high	01	94Sh07	TJD	1994	β^+=100	*
^{86}Mo	−64110	4					19.6	s	1.1	0^+	01			1991	β^+=100	
^{86}Tc	−51300#	300#					55	ms	6	(0^+)	08	01Ga24	T	1992	β^+=100; β^+p ?	*
^{86}Tc^m	−49780#	300#	1524	10			1.10	μs	0.12	(6^+)	08	08Ga04	T	2000	IT=100	*

*^{86}Nb^m I : existence considered as uncertain in ENSDF'01; needs confirmation **
*^{86}Tc T : average 01Ga24=44(12) 01Ki13=59(+8–7) **
*^{86}Tc^m T : average 08Ga04=1.10(0.14) 00Ch07=1.11(0.21) E : unc. estimated by GAu **

^{87}Ga	−29580#	800#					10#	ms	(>400 ns)	$3/2^-$#	10	10Oh02	I	2010	β^- ?; β^-n ?; β^-2n ?	
^{87}Ge	−44080#	400#					150#	ms	(>300 ns)	$5/2^+$#	02	97Be70	I	1997	β^- ?; β^-n ?; β^-2n ?	
^{87}As	−55617.9	3.0					610	ms	120	$3/2^-$#	02	93Ru01	T	1970	β^-=100; β^-n=15.4 22; β^-2n ?	*
^{87}Se	−66426.1	2.2					5.50	s	0.12	$5/2^+$#	02			1968	β^-=100; β^-n=0.20 4	
^{87}Br	−73892	3					55.65	s	0.13	$(5/2^-)$	02	06Po09	J	1943	β^-=100; β^-n=2.60 4	
^{87}Kr	−80709.52	0.25					76.3	m	0.5	$5/2^+$	02			1940	β^-=100	
^{87}Rb	−84597.790	0.006					49.23	Gy	0.22	$3/2^-$	02	82Mi14	T	1921	IS=27.83 2; β^-=100	*
^{87}Sr	−84880.0	1.1					STABLE			$9/2^+$	02			1931	IS=7.00 1	
^{87}Sr^m	−84491.5	1.1	388.533	0.003			2.815	h	0.012	$1/2^-$	02			1940	IT≈100; ε=0.30 8	
^{87}Y	−83018.3	1.6					79.8	h	0.3	$1/2^-$	02			1940	β^+=100	
^{87}Y^m	−82637.5	1.6	380.82	0.07			13.37	h	0.03	$9/2^+$	02			1940	IT=98.43 10; β^+=1.57 10	
^{87}Zr	−79347	4					1.68	h	0.01	$(9/2)^+$	02			1948	β^+=100	
^{87}Zr^m	−79011	4	335.84	0.19			14.0	s	0.2	$(1/2)^-$	02			1972	IT=100	
^{87}Nb	−73873	7					3.75	m	0.09	$(1/2^-)$	02			1971	β^+=100	
^{87}Nb^m	−73869	7	3.84	0.14			2.6	m	0.1	$9/2^+$#	02			1972	β^+=100	
^{87}Mo	−66884.8	2.9					14.05	s	0.23	$7/2^+$#	02	97Hu07	TD	1977	β^+=100; β^+p=15 5	*
^{87}Tc	−57690	4				*	2.18	s	0.16	$9/2^+$#	02	00We.A	TD	1991	β^+=100; β^+p ?	
^{87}Tc^m	−57683	4	7	1		*	2#	s		$1/2^-$#		09Ga40	E		β^+ ?; IT ?	*
^{87}Tc^n	−57619	4	71	1			647	ns	24	$7/2^+$#		09Ga40	ETJ	2009	IT=100	*
^{87}Ru	−45930#	400#					50#	ms	(>1.5 μs)	$1/2^-$#	02	95Ry03	I	1995	β^+ ?; β^+p ?	

*^{87}As T : unweighed average 93Ru01=485(40) 78Cr03=730(60) (Birge ratio B=3.4) **
*^{87}As T : other 12Qu01=1450(550)(+3900–1100) **
*^{87}Rb T : average 82Mi14=49.44(0.28) 74Ne14=48.8(0.8) 77Da22=48.9(0.4) obtained by **
*^{87}Rb T : three methods, respectively: geochronology, decay counting, chemical **
*^{87}Rb T : 77Da22 supersedes 66Mc12=47.2(0.4) using the same material **
*^{87}Mo T : average 97Hu07=13.6(1.1) 91Mi15=14.5(0.3) 83Ha06=13.3(0.4) **
*^{87}Mo D : average 97Hu07=15(6)% (through 3 levels) 83Ha06=15(8)% first 2^+ state **
*^{87}Tc^m E : observed 64 keV γ ray in parallel to 71 keV one depopulating ^{87}Tc^n **
*^{87}Tc^n E : observed 71 keV γ ray; trend of $7/2^+$ in Tc: ^{89}Tc=179 ^{91}Tc=395 **

^{88}Ge	−40140#	500#					100#	ms	(>300 ns)	0^+	05	97Be70	I	1997	β^- ?; β^-n ?; β^-2n ?	
^{88}As	−50720#	200#					270	ms	150		12	12Qu01	TD	1994	β^-=100; β^-n ?; β^-2n ?	*
^{88}Se	−63884	3					1.53	s	0.06	0^+	08			1970	β^-=100; β^-n=0.67 30	*
^{88}Br	−70716	3					16.29	s	0.06	(2^-)	05			1948	β^-=100; β^-n=6.58 18	
^{88}Br^m	−70446	3	270.1	1.1			5.51	μs	0.04	$(4^-,5^-)$	05	11Ru.A	T	1970	IT=100	
^{88}Kr	−79691.3	2.6					2.84	h	0.03	0^+	05			1939	β^-=100	
^{88}Rb	−82608.99	0.16					17.773	m	0.011	2^-	05			1939	β^-=100	
^{88}Rb^m	−81235.8	0.6	1373.2	0.6			123	ns	13	7^+	09	09Po10	ETJ	2000	IT=100	
^{88}Sr	−87921.4	1.1					STABLE			0^+	05			1923	IS=82.58 1	
^{88}Y	−84298.8	1.9					106.626	d	0.021	4^-	05			1948	β^+=100	
^{88}Y^m	−83905.9	1.9	392.86	0.09			301	μs	3	1^+	05			1955	IT=100	
^{88}Y^n	−83624.3	1.9	674.55	0.04			13.97	ms	0.18	8^+	05	07Ch07	J	1962	IT=100	
^{88}Zr	−83628	5					83.4	d	0.3	0^+	05			1951	ε=100	
^{88}Zr^m	−80740	5	2887.79	0.06			1.320	μs	0.025	(8^+)	05			1978	IT=100	
^{88}Nb	−76180	60				*	14.55	m	0.06	(8^+)	05			1964	β^+=100	
^{88}Nb^m	−76040	100	140	120	BD	*	7.78	m	0.05	(4^-)	05			1971	β^+=100	
^{88}Mo	−72687	4					8.0	m	0.2	0^+	06			1971	β^+=100	

… A-group is continued on next page …

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

. . . *A*-group continued . . .

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{88}Tc	−61680	150				∗	6.4	s	0.8	(6$^+$)	05			1991	β^+=100; β^+p ?	
^{88}Tc^m	−61680#	340#	0#	300#		∗	5.8	s	0.2	(3$^+$)	05			1993	β^+=100; β^+p ?	∗
^{88}Tc^n	−61580#	160#	100#	50#			146	ns	12	(4$^+$)	09	09Ga40	TJD	2009	IT=100	
^{88}Ru	−54400#	300#					1.3	s	0.3	0$^+$	05			1994	β^+=100; β^+p ?	∗

∗^{88}As T : symmetrized from 12Qu01=200(5)(+200–90) ∗∗
∗^{88}Se T : other 12Qu01=650(35)(+175–140) ms ∗∗
∗^{88}Tc^m J : 09Ga40 suggest this state to be 2$^+$, plus existence of an isomer 95 keV ∗∗
∗^{88}Tc^m J : above this 2$^+$, that decays by E2, with half-life=146(12) ns ∗∗
∗^{88}Ru T : symmetrized from 01Ki13=1.2(+0.3–0.2) ∗∗

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{89}Ge	−33730#	600#					50#	ms	(>300 ns)	3/2$^+$#	98	97Be70	I	1997	β^- ?; β^-n ?; β^-2n ?	
^{89}As	−46800#	300#					200#	ms	(>150 ns)	3/2$^-$#	98	94Be24	I	1994	β^- ?; β^-n ?; β^-2n ?	
^{89}Se	−58992	4					410	ms	40	5/2$^+$#	98			1971	β^-=100; β^-n=7.8 25	∗
^{89}Br	−68274	3					4.40	s	0.03	(3/2$^-$,5/2$^-$)	98			1959	β^-=100; β^-n=13.8 4	∗
^{89}Kr	−76535.8	2.1					3.15	m	0.04	3/2$^{(+)}$	98	95Ke04	J	1940	β^-=100	∗
^{89}Rb	−81712	5					15.15	m	0.12	3/2$^-$	98			1940	β^-=100	
^{89}Sr	−86208.7	1.1					50.53	d	0.07	5/2$^+$	98			1937	β^-=100	
^{89}Y	−87709.2	2.2					STABLE			1/2$^-$	98			1923	IS=100.	
^{89}Y^m	−86800.2	2.2	908.97	0.03			15.663	s	0.005	9/2$^+$	98	94It.A	T	1951	IT=100	
^{89}Zr	−84876	3					78.41	h	0.12	9/2$^+$	98			1948	β^+=100	
^{89}Zr^m	−84288	3	587.82	0.10			4.161	m	0.017	1/2$^-$	98			1953	IT=93.77 12; β^+=6.23 12	∗
^{89}Nb	−80625	24				∗	2.03	h	0.07	(9/2$^+$)	98			1954	β^+=100	
^{89}Nb^m	−80630#	40#	0#	30#		∗	1.10	h	0.03	(1/2)$^-$	98			1954	β^+=100	
^{89}Mo	−75015	4					2.11	m	0.10	(9/2$^+$)	98			1980	β^+=100	
^{89}Mo^m	−74628	4	387.5	0.2			190	ms	15	(1/2$^-$)	98			1980	IT=100	
^{89}Tc	−67395	4					12.8	s	0.9	(9/2$^+$)	04			1991	β^+=100	
^{89}Tc^m	−67332	4	62.6	0.5			12.9	s	0.8	(1/2$^-$)	04			1991	$\beta^+\approx$100; IT<0.01	
^{89}Ru	−58110#	300#					1.5	s	0.2	(9/2$^+$)	07	12Lo08	D	1992	β^+=100; β^+p=3.1 18	∗
^{89}Rh	−46030#	360#					10#	ms	(>1.5 μs)	7/2$^+$#	04			1995	β^+ ?; β^+p ?	

∗^{89}Se T : others 12Qu01=345(20)(+95–75) 82Re08=560(80) ∗∗
∗^{89}Br T : ENSDF averages 8 values. Also 93Ru01=4.348(0.022) ∗∗
∗^{89}Kr J : positive parity, since no β^- transition to ^{89}Rb ground-state ∗∗
∗^{89}Ru D : β^+p symmetrized from 3.0(+1.9–1.7)% T : other recent 12Lo08=2.2(1.2) ∗∗

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{90}Ge	−29220#	700#					50#	ms	(>400 ns)	0$^+$	10	10Oh02	I	2010	β^- ?; β^-n ?; β^-2n ?	
^{90}As	−41330#	600#					80#	ms	(>300 ns)		09	97Be70	I	1997	β^- ?; β^-n ?; β^-2n ?	
^{90}As^m	−41210#	600#	124.5	0.5			220	ns	100			12Ka.B	ET	2012	IT=100	∗
^{90}Se	−55800	330					210	ms	80	0$^+$	12	12Qu01	TD	1994	β^-=100; β^-n ?	∗
^{90}Br	−64000	3					1.910	s	0.010		98	93Ru01	T	1959	β^-=100; β^-n=25.2 9	∗
^{90}Kr	−74959.2	1.9					32.32	s	0.09	0$^+$	98			1951	β^-=100	
^{90}Rb	−79365	7					158	s	5	0$^-$	98			1951	β^-=100	
^{90}Rb^m	−79258	7	106.90	0.03			258	s	4	3$^-$	98			1967	β^-=97.4 4; IT=2.6 4	
^{90}Rb^x	−79294	14	71	12			$R = 2$ 1			fsmix						
^{90}Sr	−85948.9	2.6					28.79	y	0.06	0$^+$	98			1948	β^-=100	
^{90}Y	−86494.9	2.2					64.00	h	0.21	2$^-$	98			1937	β^-=100	
^{90}Y^m	−85813.2	2.2	681.67	0.10			3.19	h	0.06	7$^+$	98			1961	IT$\approx$100; β^-=0.0018 2	
^{90}Zr	−88773.6	1.8					STABLE			0$^+$	98			1924	IS=51.45 40	
^{90}Zr^m	−86454.6	1.8	2319.000	0.010			809.2	ms	2.0	5$^-$	98			1972	IT=100	
^{90}Zr^n	−85184.2	1.8	3589.419	0.016			131	ns	4	8$^+$	98			1977	IT=100	
^{90}Nb	−82662	4					14.60	h	0.05	8$^+$	98			1951	β^+=100	
^{90}Nb^m	−82540	4	122.370	0.022			63	μs	2	6$^+$	98			1967	IT=100	
^{90}Nb^n	−82537	4	124.67	0.25			18.81	s	0.06	4$^-$	98			1969	IT=100	
^{90}Nb^p	−82491	4	171.10	0.10			< 1	μs		7$^+$	98			1981	IT=100	
^{90}Nb^q	−82280	4	382.01	0.25			6.19	ms	0.08	1$^+$	98			1967	IT=100	
^{90}Nb^r	−80782	4	1880.21	0.20			472	ns	13	(11$^-$)	98	05Ch65	TJ	1978	IT=100	∗
^{90}Mo	−80173	4					5.56	h	0.09	0$^+$	98			1953	β^+=100	
^{90}Mo^m	−77298	4	2874.73	0.15			1.12	μs	0.05	8$^+$#	98			1971	IT=100	
^{90}Tc	−70724.7	1.0					49.2	s	0.4	(8$^+$)	98	93Ru03	J	1974	β^+=100	
^{90}Tc^m	−70580.7	1.3	144.0	1.7	MD		8.7	s	0.2	1$^+$	98			1974	β^+=100	
^{90}Ru	−64884	4					11	s	3	0$^+$	98			1991	β^+=100	
^{90}Rh	−51960#	400#				∗	15	ms	7	0$^+$#	98	01Ki13	TD	1994	β^+=100; β^+p ?	∗
^{90}Rh^m	−51960#	640#	0#	500#		∗	1.1	s	0.3	9$^+$#		01Ki13	TD	2001	β^+=100; β^+p ?	∗

∗^{90}As^m T : symmetrized from 199(+120–85) ∗∗
∗^{90}Se T : symmetrized from 12Qu01=195(7)(+95–65) ∗∗
∗^{90}Br T : supersedes 80Al15=1.92(0.02) same grp; other 12Qu01=1850(110)(+190–170) ∗∗
∗^{90}Nb^r T : average 05Ch65=470(10) 81Fi02=440(20) 78Ha52=477(8) ∗∗
∗^{90}Rh T : symmetrized from 12(+9–4) ∗∗
∗^{90}Rh^m T : symmetrized from 1.0(+0.3–0.2) ∗∗

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{91}As	−36900#	600#					50#	ms	(>300 ns)	$3/2^-$#	99	97Be70	I	1997	β^- ?; β^-n ?; β^-2n ?	
^{91}Se	−50340#	500#					270	ms	50	$1/2^+$#	99			1975	β^-=100; β^-n=21 10; β^-2n ?	
^{91}Br	−61107	4					541	ms	5	$5/2^-$#	99			1974	β^-=100; β^-n=20 3	*
^{91}Kr	−70974.0	2.2					8.57	s	0.04	$5/2^{(+)}$	01			1951	β^-=100; β^-n ?	
^{91}Rb	−77745	8					58.4	s	0.4	$3/2^{(-)}$	99			1951	β^-=100; β^-n ?	
^{91}Sr	−83652	6					9.63	h	0.05	$5/2^+$	01			1943	β^-=100	
^{91}Y	−86351.9	2.6					58.51	d	0.06	$1/2^-$	99			1943	β^-=100	
^{91}Y^m	−85796.3	2.6	555.58	0.05			49.71	m	0.04	$9/2^+$	99			1953	IT>98.5; β^-<1.5	
^{91}Zr	−87896.2	1.8					STABLE			$5/2^+$	01			1934	IS=11.22 5	
^{91}Zr^m	−84728.9	1.8	3167.3	0.4			4.35	μs	0.14	$(21/2^+)$	01			1985	IT=100	
^{91}Nb	−86639	3					680	y	130	$9/2^+$	99	91Hi.A	D	1951	ε≈100; e$^+$=0.0138 25	
^{91}Nb^m	−86534	3	104.60	0.05			60.86	d	0.22	$1/2^-$	99	91Hi.A	D	1950	IT=96.6 5; ε=3.4 5; …	*
^{91}Nb^n	−84605	3	2034.35	0.19			3.76	μs	0.12	$(17/2^-)$	99			1974	IT=100	
^{91}Mo	−82209	6					15.49	m	0.01	$9/2^+$	99			1948	β^+=100	
^{91}Mo^m	−81556	6	653.01	0.09			64.6	s	0.6	$1/2^-$	99			1953	IT=50.0 16; β^+=50.0 16	
^{91}Tc	−75986.3	2.4					3.14	m	0.02	$(9/2)^+$	99			1974	β^+=100	
^{91}Tc^m	−75847.0	2.4	139.3	0.3			3.3	m	0.1	$(1/2)^-$	99			1975	β^+>99; IT<1	
^{91}Ru	−68239.5	2.2				*	9	s	1	$(9/2^+)$	99			1983	β^+=100; β^+p ?	
^{91}Ru^m	−68580	500	−340	500	BD	*	7.6	s	0.8	$(1/2^-)$	99			1983	β^+≈100; β^+p=?; IT ?	
^{91}Rh	−58800#	400#					1.60	s	0.15	$7/2^+$#	99	12Lo08	D	1994	β^+=100; β^+p=1.3 5	*
^{91}Pd	−46280#	500#					10#	ms	(>1.5 μs)	$7/2^+$#	99	95Ry03	I	1995	β^+ ?; β^+p ?	

*^{91}Br T : other 12Qu01=615(35)(+60–50) ms **

*^{91}Nb^m D : … ; e$^+$=0.0028 2 **

*^{91}Rh T : average 04De40=1.7(0.2) 01Ki13=1.47(0.22); 00We.A(same group)=1.74(0.14) **

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{92}As	−30980#	700#					30#	ms	(>300 ns)		01	97Be70	I	1997	β^- ?; β^-n ?; β^-2n ?	
^{92}Se	−46720#	600#					100#	ms	(>300 ns)	0^+	01	97Be70	I	1997	β^- ?; β^-n ?; β^-2n ?	
^{92}Se^m	−44780#	600#	1940	50			12	μs	4			12Ka.B	ET	2012	IT=100	*
^{92}Br	−56233	7					343	ms	15	(2^-)	01			1974	β^-=100; β^-n=33.1 25; β^-2n ?	*
^{92}Br^m	−55571	7	662	1			88	ns	8			12Ka.B	ET	2012	IT=100	*
^{92}Br^n	−55095	7	1138	1			85	ns	10			12Ka.B	ET	2012	IT=100	*
^{92}Kr	−68769.3	2.7					1.840	s	0.008	0^+	04			1951	β^-=100; β^-n=0.0332 25	
^{92}Rb	−74773	6					4.492	s	0.020	0^-	01			1960	β^-=100; β^-n=0.0107 5	
^{92}Sr	−82867	3					2.66	h	0.04	0^+	03			1956	β^-=100	
^{92}Y	−84817	9					3.54	h	0.01	2^-	01			1940	β^-=100	
^{92}Y^m	−84010	50	807	50			3.7	μs	0.5			11Ru.A	ET	2009	IT=100	*
^{92}Zr	−88459.6	1.8					STABLE			0^+	01			1924	IS=17.15 8	
^{92}Nb	−86453.7	2.4					34.7	My	2.4	$(7)^+$	01			1938	β^+≈100; β^-<0.05	
^{92}Nb^m	−86318.2	2.4	135.5	0.4			10.15	d	0.02	$(2)^+$	01			1959	β^+=100	
^{92}Nb^n	−86228.0	2.4	225.7	0.4			5.9	μs	0.2	$(2)^-$	01			1958	IT=100	
^{92}Nb^p	−84250.4	2.4	2203.3	0.4			167	ns	4	(11^-)	01			1989	IT=100	
^{92}Mo	−86807.8	0.8					STABLE		(>190 Ey)	0^+	01	97Ba35	T	1930	IS=14.53 30; 2β^+ ?	*
^{92}Mo^m	−84047.3	0.8	2760.46	0.16			190	ns	3	8^+	01			1964	IT=100	
^{92}Tc	−78926	3					4.25	m	0.15	$(8)^+$	01			1964	β^+=100	
^{92}Tc^m	−78656	3	270.15	0.11			1.03	μs	0.07	(4^+)	01			1976	IT=100	
^{92}Tc^n	−78397	3	529.47	0.15			< 0.1	μs		(3^+)	01			1976	IT=100	
^{92}Tc^p	−78215	3	711.39	0.16			< 0.1	μs		1^+	01			1976	IT=100	
^{92}Ru	−74301.2	2.7					3.65	m	0.05	0^+	01			1971	β^+=100	
^{92}Rh	−62999	4					4.66	s	0.25	(6^+)	01	04De40	TJ	1994	β^+=100; β^+p=1.9 1	*
^{92}Rh^m	−62950#	100#	50#	100#			0.53	s	0.37	(2^+)		04De40	TJD	2004	β^+=100; β^+p=?	*
^{92}Pd	−55070#	500#					1.1	s	0.3	0^+	01	01Ki13	TD	1994	β^+=100; β^+p ?	*

*^{92}Se^m T : symmetrized from 10.3(+5.5–2.8) **

*^{92}Br T : other 12Qu01=290(15)(+70–55) ms **

*^{92}Br I : also an isomer with T<500 ns decaying by γ-rays 1039, 780, 301… keV **

*^{92}Br^m T : symmetrized from 89(+7–8) **

*^{92}Br^n T : symmetrized from 84(+10–9); other 09Fo05<500 ns assuming single isomer **

*^{92}Y^m T : average 11Ru.A=3.3(0.6) 09Fo05=4.2(+0.8–0.6) **

*^{92}Y^m E : observed 315 and 419 γ rays; low energy transition may directly **

*^{92}Y^m E : depopulate the isomer **

*^{92}Mo T : T>190 Ey (2σ) **

*^{92}Rh T : other 12Lo08=5.7(0.1) 01Ki13=5.6(0.5); 01Xu05=3.0(0.8) for gs+m mixture **

*^{92}Rh D : from 12Lo08 **

*^{92}Rh^m I : this state is not observed in 12Lo08 **

*^{92}Pd T : symmetrized from 1.0(+0.3–0.2) **

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^{π}	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{93}Se	−40720#	800#				50#	ms	(>300 ns)	$1/2^{+}$#	11	97Be70	I	1997	β^- ?; β^-n ?; β^-2n ?	
^{93}Se^{m}	−40040#	800#	678.2	0.7		420	ns	100			12Ka.B	ET	2012	IT=100	*
^{93}Br	−52970	450				102	ms	10	$5/2^{-}$#	11			1981	β^-=100; β^-n=68 7; β^-2n ?	
^{93}Kr	−64136.0	2.5				1.286	s	0.010	$1/2^{+}$	11			1951	β^-=100; β^-n=1.95 11	
^{93}Rb	−72620	8				5.84	s	0.02	$5/2^{-}$	11			1960	β^-=100; β^-n=1.39 7	
^{93}Rb^{m}	−72367	8	253.39	0.03		57	μs	15	$3/2^{-}$	11	FGK126	J	1970	IT=100	*
^{93}Rb^{n}	−68197	8	4423.1	1.5		111	ns	11	$(27/2^{-})$	11			2010	IT=100	
^{93}Sr	−80086	8				7.43	m	0.03	$5/2^{+}$	11			1959	β^-=100	
^{93}Y	−84228	11				10.18	h	0.08	$1/2^{-}$	11			1948	β^-=100	
^{93}Y^{m}	−83469	11	758.719	0.021		820	ms	40	$9/2^{+}$	11	07Ch07	J	1974	IT=100	
^{93}Zr	−87122.7	1.8				1.61	My	0.05	$5/2^{+}$	11			1950	β^-=100	
^{93}Nb	−87213.0	1.8				STABLE			$9/2^{+}$	11			1932	IS=100.	
^{93}Nb^{m}	−87182.2	1.8	30.77	0.02		16.12	y	0.12	$1/2^{-}$	11			1965	IT=100	
^{93}Nb^{n}	−79753	17	7460	17		1.5	μs	0.5		11			2007	IT ?	*
^{93}Mo	−86806.3	0.8				4.0	ky	0.8	$5/2^{+}$	11			1946	ε=100	
^{93}Mo^{m}	−84381.4	0.8	2424.95	0.04		6.85	h	0.07	$21/2^{+}$	11			1950	IT≈100; β^+=0.12 1	
^{93}Mo^{n}	−77111	17	9695	17		1.8	μs	1.0	$(39/2^{-})$	11			2005	IT ?	*
^{93}Tc	−83605.4	1.3				2.75	h	0.05	$9/2^{+}$	11			1948	β^+=100	
^{93}Tc^{m}	−83213.6	1.3	391.84	0.08		43.5	m	1.0	$1/2^{-}$	11			1939	IT=77.4 6; β^+=22.6 6	
^{93}Tc^{n}	−81420.2	1.3	2185.16	0.15		10.2	μs	0.3	$(17/2)^{-}$	11			1973	IT=100	
^{93}Ru	−77216.7	2.1				59.7	s	0.6	$(9/2)^{+}$	11			1972	β^+=100	
^{93}Ru^{m}	−76482.3	2.1	734.40	0.10		10.8	s	0.3	$(1/2)^{-}$	11			1983	β^+=78.0 23; …	*
^{93}Ru^{n}	−75134.2	2.3	2082.5	0.9		2.49	μs	0.15	$(21/2)^{+}$	11			1983	IT=100	
^{93}Rh	−69011.8	2.6				13.9	s	1.6	$9/2^{+}$#	11			1994	β^+=100	
^{93}Pd	−59140#	400#				1.15	s	0.05	$(9/2^{+})$	11	12Lo08	TD	1994	β^+=100; β^+p=7.5 5	
^{93}Ag	−46270#	500#				5#	ms	(>1.5 μs)	$9/2^{+}$#	11	95Ry03	I	1994	p ?; β^+ ?; β^+p ?	*

*^{93}Se^{m} T : symmetrized from 393(+120–84) **

*^{93}Rb^{m} J : 253.4 keV M1 (and E2) γ ray to $5/2^-$; β^- feeding from $1/2^+$ ^{93}Kr **

*^{93}Rb^{m} J : low log ft value is inconsistent with $5/2^-$; in ENSDF J=($3/2^-$,$5/2^-$) **

*^{93}Nb^{n} E : ENSDF2011 : x keV above 7435.3(2.1) $37/2^-$ level; NUBASE assumes x<50 **

*^{93}Mo^{n} E : ENSDF2011 : x keV above 9670.0(2.3) (35/2,37/2) level; NUBASE assumes x<50 **

*^{93}Mo^{n} T : symmetrized from 1.1(+1.5–0.4) **

*^{93}Ru^{m} D : …; IT=22.0 23; β^+p=0.027 5 **

*^{93}Ag I : the few events reported in 94He28 are not trusted by NUBASE **

*^{93}Ag I : 10St.A>0.2 μs **

*^{93}Ag T : estimated half-life is for β^+ decay; p-decay would be much shorter **

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^{π}	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{94}Se	−36800#	800#				20#	ms	(>300 ns)	0^{+}	06	97Be70	I	1997	β^- ?; β^-n ?; β^-2n ?	
^{94}Br	−47600#	400#				70	ms	20		06			1981	β^-=100; β^-n=68 16; β^-2n ?	
^{94}Br^{m}	−47310#	400#	294.5	0.7		530	ns	15			12Ka.B	ET	2012	IT=100	
^{94}Kr	−61348	12				212	ms	5	0^{+}	11			1972	β^-=100; β^-n=1.11 7	
^{94}Rb	−68562.8	2.0				2.702	s	0.005	$3^{(-)}$	11			1961	β^-=100; β^-n=10.5 4	
^{94}Rb^{m}	−66487.9	2.4	2074.9	1.4		107	ns	16	(10^{-})	11			2008	IT=100	
^{94}Sr	−78845.7	1.7				75.3	s	0.2	0^{+}	11			1959	β^-=100	
^{94}Y	−82353	6				18.7	m	0.1	2^{-}	06			1948	β^-=100	
^{94}Y^{m}	−81151	6	1202.3	1.0		1.295	μs	0.005	(5^{+})	06	11Ru.A	T	1999	IT=100	
^{94}Zr	−87270.9	1.9				STABLE		(>110 Py)	0^{+}	06	99Ar25	T	1924	IS=17.38 28; 2β^- ?	
^{94}Nb	−86369.2	1.8				20.3	ky	1.6	6^{+}	06			1938	β^-=100	
^{94}Nb^{m}	−86328.3	1.8	40.892	0.012		6.263	m	0.004	3^{+}	06			1962	IT=99.50 6; β^-=0.50 6	
^{94}Mo	−88412.8	0.4				STABLE			0^{+}	06			1930	IS=9.15 9	
^{94}Tc	−84157	4				293	m	1	7^{+}	06			1948	β^+=100	
^{94}Tc^{m}	−84081	5	76	3		52.0	m	1.0	$(2)^{+}$	06			1948	β^+≈100; IT<0.1	
^{94}Ru	−82584	3				51.8	m	0.6	0^{+}	06			1952	β^+=100	
^{94}Ru^{m}	−79940	3	2644.1	0.4		71	μs	4	8^{+}	06			1971	IT=100	
^{94}Rh	−72908	3			*	70.6	s	0.6	(4^{+})	06	06Ba55	J	1979	β^+=100; β^+p=1.8 5	
^{94}Rh^{m}	−72853	3	54.60	0.20		480	ns	30	(2^{+})	06			2004	IT=100	
^{94}Rh^{n}	−72610#	200#	300#	200#	*	25.8	s	0.2	(8^{+})	06			1973	β^+=100	
^{94}Pd	−66101	4				9.0	s	0.5	0^{+}	06			1982	β^+=100	
^{94}Pd^{m}	−61218	4	4883.1	0.4		511.0	ns	7.3	(14^{+})	06	11Br01	T	1995	IT=100	*
^{94}Pd^{n}	−58892	4	7209.1	1.8		197	ns	22	(19^{-})		11Br01	TJ	2011	IT=100	*
^{94}Ag	−52410#	640#				37	ms	18	0^{+}#	06			1994	β^+=100; β^+p ?	*
^{94}Ag^{m}	−51060#	760#	1350#	400#		550	ms	60	(7^{+})	06			1994	β^+=100; β^+p=20	
^{94}Ag^{n}	−46060#	400#	6350#	500#		400	ms	40	(21^{+})	06			2002	β^+=95.4 7; β^+p=27; …	*

*^{94}Pd^{m} T : average 11Br01=499(13) 09Ga40=468(19) 02La18=530(10) **

*^{94}Pd^{n} E : from 4883.1(0.4) for the 14^+ state and 1651(1), 267(1) and 408(1) keV **

*^{94}Pd^{n} E : γ rays in a cascade from (19^-); uncertainties added in quadrature **

*^{94}Ag T : symmetrized from 26(+26–9) **

*^{94}Ag^{n} D : …; p=4.1 6; 2p=0.5 3 **

*^{94}Ag^{n} D : p=1.9(5)+2.2(4) from 2005Mu15, 2p from 2006Mu03 **

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{95}Se	−30460#	800#					10#	ms	(>400 ns)	$3/2^+$#	12	10Oh02	I	2010	β^- ?; β^-n ?; β^-2n ?	
^{95}Br	−43770#	200#					50#	ms	(>300 ns)	$5/2^-$#	10	97Be70	I	1997	β^- ?; β^-n=34#; β^-2n ?	
^{95}Br^m	−43230#	200#	537.9	0.5			6.8	μs	1.0			12Ka.B	ET	2012	IT=100	*
^{95}Kr	−56159	19					114	ms	3	$1/2^{(+)}$	10			1994	β^-=100; β^-n=2.87 18; β^-2n ?	
^{95}Kr^m	−55964	19	195.5	0.3			1.582	μs	0.022	$(7/2^+)$	10	12Ka.B	T	2006	IT=100	*
^{95}Rb	−65894	20					377.7	ms	0.8	$5/2^-$	10			1967	β^-=100; β^-n=8.7 3	
^{95}Rb^m	−65059	20	835.0	0.6			< 500	ns		$9/2^+$#	10			2009	IT=100	
^{95}Sr	−75122	6					23.90	s	0.14	$1/2^+$	10			1961	β^-=100	
^{95}Y	−81211	7					10.3	m	0.1	$1/2^-$	10			1959	β^-=100	
^{95}Y^m	−80123	7	1087.6	0.6			48.6	μs	0.5	$9/2^+$	10	11Ru.A	T	1981	IT=100	
^{95}Zr	−85661.6	1.8					64.032	d	0.006	$5/2^+$	10			1946	β^-=100	
^{95}Nb	−86785.1	0.7					34.991	d	0.006	$9/2^+$	10			1951	β^-=100	
^{95}Nb^m	−86549.4	0.7	235.69	0.02			3.61	d	0.03	$1/2^-$	10			1969	IT=94.4 6; β^-=5.6 6	
^{95}Mo	−87710.6	0.4					STABLE			$5/2^+$	10			1930	IS=15.84 11	
^{95}Tc	−86020	5					20.0	h	0.1	$9/2^+$	10			1947	β^+=100	
^{95}Tc^m	−85981	5	38.91	0.04			61	d	2	$1/2^-$	10			1959	β^+=96.12 32; IT=3.88 32	
^{95}Ru	−83456	10					1.643	h	0.013	$5/2^+$	10			1948	β^+=100	
^{95}Rh	−78341	4					5.02	m	0.10	$(9/2)^+$	10			1967	β^+=100	
^{95}Rh^m	−77798	4	543.3	0.3			1.96	m	0.04	$(1/2)^-$	10			1974	IT=88 5; β^+=12 5	
^{95}Pd	−69965	3					7.5	s	0.5	$9/2^+$#	10	12Lo08	T	1980	β^+=100; β^+p ?	*
^{95}Pd^m	−68090	3	1875.13	0.14			13.3	s	0.3	$(21/2^+)$	10			1982	β^+=?; IT=11 3; β^+p=0.93 15	*
^{95}Ag	−59600#	400#					1.76	s	0.09	$(9/2^+)$	10	12Lo08	TD	1994	β^+=100; β^+p=2.5 3	*
^{95}Ag^m	−59260#	400#	344.2	0.3			< 500	ms		$(1/2^-)$	10			2003	IT=100	
^{95}Ag^n	−57070#	400#	2531.3	1.5			< 16	ms		$(23/2^+)$	10			2003	IT=100	
^{95}Ag^p	−54740#	400#	4860.0	1.5			< 40	ms		$(37/2^+)$	10			2003	IT=100	
^{95}Cd	−46630#	500#					90	ms	40	$9/2^+$#		10St.A	T	2011	β^+ ?; β^+p ?	*
*^{95}Br^m	T : symmetrized from 6.67(+1.10–0.85)															**
*^{95}Kr^m	T : other 11Ru.A=1.28(0.05) 06Ge05=1.4(0.2) E : other 12Ka.B=196.9(0.7)															**
*^{95}Ag	T : average 12Lo08=1.85(0.08) 05Ha45=1.76(0.13) 03Do09=1.85(0.34) and															**
*^{95}Cd	T : symmetrized from 73(+53–28)															**
^{96}Br	−38160#	300#					20#	ms	(>300 ns)		08	97Be70	I	1997	β^- ?; β^-n=27.6#; β^-2n ?	
^{96}Br^m	−37850#	300#	311.5	0.5			3.0	μs	0.9			12Ka.B	ET	2012	IT=100	*
^{96}Kr	−53080	20					80	ms	8	0^+	12			1994	β^-=100; β^-n=3.7 4	
^{96}Rb	−61354	3				*	201	ms	1	2^-	08	93Ru01	T	1967	β^-=100; β^-n=13.3 7; β^-2n ?	*
^{96}Rb^m	−61350#	200#	0#	200#		*	200#	ms	(>1 ms)	$1^{(+\#)}$		81Bo30	JI	1981	β^- ?; IT ?; β^-n ?; β^-2n ?	*
^{96}Rb^n	−60219	3	1134.6	1.1			1.80	μs	0.04	(10^-)	08	12Ka.B	T	1999	IT=100	*
^{96}Sr	−72930	9					1.07	s	0.01	0^+	08			1971	β^-=100; β^-n ?	
^{96}Y	−78342	6					5.34	s	0.05	0^-	08			1975	β^-=100	
^{96}Y^m	−76802	7	1540	9	MD		9.6	s	0.2	8^+	08	07Ch07	J	1974	β^-=100	
^{96}Zr	−85444.6	2.0					20	Ey	4	0^+	08			1934	IS=2.80 9; 2β^-=100	
^{96}Nb	−85607	3					23.35	h	0.05	6^+	08			1949	β^-=100	
^{96}Mo	−88793.6	0.4					STABLE			0^+	08			1930	IS=16.67 15	
^{96}Tc	−85820	5					4.28	d	0.07	7^+	08			1947	β^+=100	
^{96}Tc^m	−85786	5	34.23	0.04			51.5	m	1.0	4^+	08			1950	IT=98.0 5; β^+=2.0 5	
^{96}Ru	−86079.1	0.5					STABLE		(>67 Py)	0^+	08	85No03	T	1931	IS=5.54 14; 2β^+ ?	*
^{96}Rh	−79686	10					9.90	m	0.10	6^+	08			1967	β^+=100	
^{96}Rh^m	−79634	10	51.98	0.09			1.51	m	0.02	3^+	08			1966	IT=60 5; β^+=40 5	
^{96}Pd	−76182	4					122	s	2	0^+	08			1980	β^+=100	
^{96}Pd^m	−73651	4	2530.57	0.23			1.81	μs	0.01	8^+#	08	98Gr.B	TD	1983	IT=100	*
^{96}Ag	−64510	90				*	4.44	s	0.04	$(8)^+$	08	12Lo08	TD	1982	β^+=100; β^+p=6.9 7	*
^{96}Ag^m	−64510#	100#	0#	50#		*	6.9	s	0.5	(2^+)	08	12Lo08	TD	2003	β^+=100; β^+p=15.1 26	*
^{96}Ag^n	−62050	90	2461.4	0.3			100	μs	10	(13^-)		11Bo23	TJD	2011	IT=100	*
^{96}Ag^p	−61830	90	2680	7			1.543	μs	0.028	(15^+)	08	11Bo23	ETJ	2011	IT=100	*
^{96}Ag^q	−57570	90	6945	7			160	ns	30	(19^+)		11Bo23	ETJ	2011	IT=100	*
^{96}Cd	−55570#	400#					880	ms	90	0^+	10	12Lo08	D	2008	β^+=100; β^+p=5.5 40	*
^{96}Cd^m	−50270#	400#	5300#	2000#			300	ms	110	16^+	10	11Na34	TJD	2011	β^+=100; β^+p ?	*
*^{96}Br^m	T : symmetrized from 2.74(+1.10–0.72)															**
*^{96}Rb	J : measured magnetic moment consistent with 2^-															**
*^{96}Rb^m	I : non-observation in 81Th04 is not in contradiction with 81Bo30 experiment															**
*^{96}Rb^n	T : average 12Ka.B=1.73(0.15) 11Ru.A=1.77(0.05) 05Pi13=2.0(0.1) 99Ge01=1.65(0.15)															**
*^{96}Ru	T : $\beta^+\varepsilon$>67Py and $\beta^+\beta^+$>31Py theory says most probable is $\varepsilon\varepsilon$															**
*^{96}Pd^m	T : supersedes 97Gr02=1.7(0.1); others 09Ga40=1.76(0.05) 07My02=2.10(0.21)															**
*^{96}Pd^m	T : 83Gr01=2.2(0.3) J : from 03Ba39															**
*^{96}Ag	T : average 12Lo08=4.40(0.09) 03Ba39=4.40(0.06) 97Sc30=4.50(0.06)															**
*^{96}Ag	D : β^+p average 12Lo08=6.5(0.8) 03Ba39=8.5(1.5)															**
*^{96}Ag^m	T : average 12Lo08=6.8(1.0) 03Ba39=6.9(0.6) D : average 12Lo08=14(3) 03Ba39=18(5)															**
*^{96}Ag^n	E : from least-squares fit to γ-ray energies using 11Bo23 level scheme															**
*^{96}Ag^n	T : other 11Be34=8.6(6.3) μs using a collection time of 12 μs															**
*^{96}Ag^p	E : 25-50 keV above the 2643 13^+ level															**
*^{96}Ag^p	T : average 11Bo23=1.56(0.03) 11Be34=1.45(0.07)															**
*^{96}Ag^q	E : 4265 above the ^{96}Ag^p															**
*^{96}Cd	T : average 11Na34=670(150) 10St.A=990(130) 08Ba53=1030(+240–210)															**
*^{96}Cd^m	T : symmetrized from 11Na34=290(+110–100)															**

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{97}Br	−34060#	400#					10#	ms	(>300 ns)	$5/2^{-}$#	10			1997	β^- ?; β^-n ?; β^-2n ?	
^{97}Kr	−47420	130					62.2	ms	3.2	$3/2^{+}$#	10	11Ni01	T	1997	β^-=100; β^-n=6.7 6; β^-2n ?	*
^{97}Rb	−58519.1	1.9					169.1	ms	0.6	$3/2^{+}$	10			1969	β^-=100; β^-n=25.5 9; β^-2n ?	
^{97}Rb^{m}	−58442.0	2.0	77.1	0.5			6.3	ms	0.4	$(5/2^{-})$		12Ka.B	ETJ	2012	IT=100	*
^{97}Sr	−68582	3					429	ms	5	$1/2^{+}$	10			1978	β^-=100; β^-n<0.05	
^{97}Sr^{m}	−68274	3	308.13	0.11			180.9	ns	2.8	$7/2^{+}$	10	11Ru.A	T	1990	IT=100	
^{97}Sr^{n}	−67751	3	830.83	0.23			520	ns	5	$9/2^{+}$#	10	11Ru.A	T	1974	IT=100	
^{97}Y	−76127	7					3.75	s	0.03	$1/2^{-}$	10	07Ch07	J	1970	β^-=100; β^-n=0.055 4	
^{97}Y^{m}	−75459	7	667.52	0.23			1.17	s	0.03	$9/2^{+}$	10	07Ch07	J	1970	β^->99.3; IT<0.7; β^-n<0.08	*
^{97}Y^{n}	−72604	7	3522.6	0.4			142	ms	8	$(27/2^{-})$	10			1986	IT=94.8 9; β^-=5.2 9	
^{97}Zr	−82948.4	2.0					16.749	h	0.008	$1/2^{+}$	10			1951	β^-=100	
^{97}Zr^{m}	−81684.0	2.0	1264.35	0.16			104.8	ns	1.7	$7/2^{+}$	10	11Ru.A	T	1976	IT=100	*
^{97}Nb	−85608.1	1.8					72.1	m	0.7	$9/2^{+}$	10			1951	β^-=100	
^{97}Nb^{m}	−84864.8	1.8	743.35	0.03			58.7	s	1.8	$1/2^{-}$	10			1950	IT=100	
^{97}Mo	−87543.6	0.5					STABLE			$5/2^{+}$	10			1930	IS=9.60 14	
^{97}Tc	−87219	4					4.21	My	0.16	$9/2^{+}$	10			1946	ε=100	
^{97}Tc^{m}	−87122	4	96.57	0.06			91.0	d	0.6	$1/2^{-}$	10			1954	IT=96.06 18; ε=3.94 18	
^{97}Ru	−86119.3	2.8					2.8370	d	0.0014	$5/2^{+}$	10	09Go29	T	1946	β^+=100	
^{97}Rh	−82600	40					30.7	m	0.6	$9/2^{+}$	10			1955	β^+=100	
^{97}Rh^{m}	−82340	40	258.76	0.18			46.2	m	1.6	$1/2^{-}$	10			1971	β^+=94.4 6; IT=5.6 6	
^{97}Pd	−77806	5					3.10	m	0.09	$5/2^{+}$#	10			1969	β^+=100	
^{97}Ag	−70830	110					25.5	s	0.3	$9/2^{+}$#	10			1978	β^+=100	
^{97}Ag^{m}	−70430#	230#	400#	200#			100#	ms		$1/2^{-}$#					IT ?	
^{97}Cd	−60450#	300#					1.10	s	0.08	$(9/2^{+})$	10	11Lo09	TJD	1978	β^+=100; β^+p=11.8 20	
^{97}Cd^{m}	−58950#	580#	1500#	500#			3.8	s	0.2	$(25/2^{+})$	10	11Lo09	TJD	1982	β^+=100; β^+p=25 4	
^{97}In	−47190#	500#					50	ms	30	$9/2^{+}$#		10St.A	TD	2011	β^+=100; p ?; β^+p ?	*

*^{97}Kr T : average 11Ni01=60(+6–5) 03Be05=63(4) **
*^{97}Zr^{m} T : average 11Ru.A=106.1(2.1) 85Be20=102(3); others outweighed 06Hw01=97(16) **
*^{97}Zr^{m} T : 96Lh03=106(7) **
*^{97}In T : symmetrized from 26(+47–10) **

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{98}Br	−28450#	400#					5#	ms	(>400 ns)		10	10Oh02	I	2010	β^- ?; β^-n ?; β^-2n ?	
^{98}Kr	−44310#	300#					42.8	ms	3.6	0^{+}	03	11Ni01	T	1997	β^-=100; β^-n=7.0 10; β^-2n ?	*
^{98}Rb	−54318	3					114	ms	5	$(0)^{(-\#)}$	03	81Th04	J	1971	β^-=100; β^-n=13.8 6; …	*
^{98}Rb^{m}	−53720	120	600	120	BD		96	ms	3	$(3,4)^{(+\#)}$	03			1980	β^-=100; β^-n ?; β^-2n ?	*
^{98}Rb^{n}	−54140	3	178.3	0.4			358	ns	7		09	12Ka.B	ET	2009	IT=100	*
^{98}Sr	−66426	4					653	ms	2	0^{+}	03			1971	β^-=100; β^-n=0.25 5	
^{98}Y	−72301	8					548	ms	2	$(0)^{-}$	03			1970	β^-=100; β^-n=0.331 24	
^{98}Y^{m}	−72060	28	241	29	BD		2.0	s	0.2	$(5^{+},4^{-})$	03			1977	β^-=?; IT=10#; β^-n=3.4 10	*
^{98}Y^{n}	−72130	8	170.74	0.06			610	ns	9	$(2)^{-}$	03	11Ru.A	T	1972	IT=100	
^{98}Y^{p}	−71805	8	496.19	0.15			6.87	μs	0.05	(4^{-})	03	11Ru.A	T	1970	IT=100	*
^{98}Y^{q}	−71120	8	1181.1	0.4			806	ns	21	(10^{-})	03	11Ru.A	T	1972	IT=100	*
^{98}Zr	−81293	9					30.7	s	0.4	0^{+}	03			1967	β^-=100	
^{98}Zr^{m}	−74689	9	6603.7	0.3			1.9	μs	0.2	(17^{-})		06Si36	EJT	2005	IT=100	
^{98}Nb	−83530	5					2.86	s	0.06	1^{+}	03			1960	β^-=100	
^{98}Nb^{m}	−83446	6	84	4			51.3	m	0.4	(5^{+})	03			1948	$\beta^-\approx$100; IT=0.1#	
^{98}Mo	−88114.8	0.5					STABLE		(>100 Ty)	0^{+}	03	52Fr23	T	1930	IS=24.39 37; 2β^- ?	*
^{98}Tc	−86431	3					4.2	My	0.3	$(6)^{+}$	03			1955	β^-=100; β^+=0	
^{98}Tc^{m}	−86340	3	90.76	0.16			14.7	μs	0.3	$(2)^{-}$	03			1976	IT=100	
^{98}Ru	−88225	6					STABLE			0^{+}	03			1944	IS=1.87 3	
^{98}Rh	−83175	12				*	8.72	m	0.12	$(2)^{+}$	03			1955	β^+=100	
^{98}Rh^{m}	−83120#	50#	60#	50#		*	3.6	m	0.2	(5^{+})	03			1966	IT=89 5; β^+=11 5	
^{98}Pd	−81321	5					17.7	m	0.3	0^{+}	03			1955	β^+=100	
^{98}Ag	−73070	30					47.5	s	0.3	(5^{+})	03	GAu03	J	1978	β^+=100; β^+p=0.0012 5	*
^{98}Ag^{m}	−72900	30	167.83	0.15			220	ns	20	(3^{+})	03	98Gr.B	ETD	1998	IT=100	
^{98}Cd	−67640	50					9.2	s	0.3	0^{+}	03			1978	β^+=100; β^+p<0.025	
^{98}Cd^{m}	−65210	50	2427.5	0.6			189	ns	19	(8^{+})	03	04Bl10	TJ	1996	IT=100	*
^{98}Cd^{n}	−61010	50	6635	2			240	ns	40	(12^{+})		04Bl10	ETJ	2004	IT=100	*
^{98}In	−53900#	200#				*	37	ms	5	0^{+}#	03	12Lo08	TD	1994	β^+=100; β^+p=5.6 3	*
^{98}In^{m}	−53900#	540#	0#	500#		*	1.01	s	0.13		03	12Lo08	TD	2001	β^+=100; β^+p=19 2	*

*^{98}Kr T : average 11Ni01=42(4) 03Be05=46(8) **
*^{98}Rb D : …; β^-2n=0.051 7 T : also 11Ni01=102(4), maybe mixture **
*^{98}Rb^{m} I : also an isomer with T=700(+60–50) ns decaying by γ-rays of 178, 124 keV **
*^{98}Rb^{n} E : average 12Ka.B=178.4(0.5) 09Fo05=178.0(0.7) T : other 09Fo05=700(+60–50) **
*^{98}Y^{m} J : 04Br14=(5^{+}) 95Ha.B=(4^{-}) 94St31=(5^{+}) **
*^{98}Y^{p} J : from 04Br14; ENSDF=(2^{-}) and (p1/2[303]+n9/2[404]) config (in error) **
*^{98}Y^{q} J : from 04Br14; ENSDF=(8^{-}) from (2^{-}) for 496 keV isomer **
*^{98}Mo T : limit given here is for 0ν-$\beta\beta$ decay (theoretically faster, see text) **
*^{98}Ag J : (5^{+}) with experimental basis preferred to (6^{+}), see discussion in ENSDF **
*^{98}Ag D : symmetrized from β^+p=0.0011(+5–4)% **
*^{98}Cd^{m} T : average 04Bl10=170(+60–40) 98Gr.B=190(20), the latter supersedes **
*^{98}Cd^{m} T : 97Gr02=200(+300–170); other 97Go18=480(160) outweighed **
*^{98}Cd^{n} T : symmetrized from 230(+40–30) E : unc. estimated by evaluator **
*^{98}In T : average 12Lo08=47(13) 10St.A=32(6) 08Ba53=44(+13–12) 01Ki13=32(+32–11) **
*^{98}In D : β^+p symmetrized from 12Lo08=5.5(+0.3–0.2) **
*^{98}In^{m} T : average 12Lo08=1.27(0.30) 10St.A=0.86(0.21) 08Ba53=0.92(+0.27–0.17) and **
*^{98}In^{m} T : 01Ki13=1.2(+1.2–0.4) **

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{99}Kr	−38760#	500#				40	ms	11	$5/2^-$#	11	03Be05	TD	1997	β^-=100; β^-n=11 7; β^-2n ?	*
^{99}Rb	−51210	110				54	ms	4	$(5/2^+)$	11			1971	β^-=100; β^-n=15.8 24; β^-2n ?	*
^{99}Sr	−62512	4				269	ms	1	$3/2^+$	11			1975	β^-=100; β^-n=0.100 19	
^{99}Y	−70656	7				1.484	s	0.007	$5/2^+$	11	07Ch07	J	1975	β^-=100; β^-n=1.7 4	
^{99}Y^m	−68514	7	2141.65	0.19		8.6	μs	0.8	$(17/2^+)$	11			1985	IT=100	
^{99}Zr	−77624	11				2.1	s	0.1	$1/2^+$	11	02Ca37	J	1970	β^-=100	
^{99}Zr^m	−77372	11	251.96	0.09		293	ns	10	$7/2^+$	11	FGK126	J	1970	IT=100	*
^{99}Nb	−82332	12				15.0	s	0.2	$9/2^+$	11			1950	β^-=100	
^{99}Nb^m	−81967	12	365.27	0.08		2.5	m	0.2	$1/2^-$	11			1960	β^-=?; IT<3.8	
^{99}Mo	−85969.0	0.5				65.976	h	0.024	$1/2^+$	11			1948	β^-=100	
^{99}Mo^m	−85871.2	0.5	97.785	0.003		15.5	μs	0.2	$5/2^+$	11			1958	IT=100	
^{99}Mo^n	−85284.9	0.5	684.10	0.19		760	ns	60	$11/2^-$	11			1975	IT=100	
^{99}Tc	−87326.8	1.0				211.1	ky	1.2	$9/2^+$	11			1938	β^-=100	
^{99}Tc^m	−87184.1	1.0	142.6832	0.0011		6.0067	h	0.0005	$1/2^-$	11			1958	IT≈100; β^-=0.0037 6	
^{99}Ru	−87621.8	1.1				STABLE			$5/2^+$	11			1931	IS=12.76 14	
^{99}Rh	−85578	7				16.1	d	0.2	$(1/2^-)$	11			1952	β^+=100	
^{99}Rh^m	−85513	7	64.6	0.5		4.7	h	0.1	$9/2^+$	11			1952	β^+≈100; IT<0.16	
^{99}Pd	−82181	5				21.4	m	0.2	$(5/2)^+$	11			1955	β^+=100	
^{99}Ag	−76712	6				2.07	m	0.05	$(9/2)^+$	11			1967	β^+=100	
^{99}Ag^m	−76206	6	506.1	0.4		10.5	s	0.5	$1/2^-$#	11			1978	IT=100	
^{99}Cd	−69931.1	1.6				16	s	3	$5/2^+$#	11			1978	β^+=100; β^+p=0.21 8; …	*
^{99}In	−61380#	200#				3.1	s	0.2	$9/2^+$#	11	12Lo08	TD	1994	β^+=100; β^+p=0.9 4	*
^{99}In^m	−60980#	250#	400#	150#		1#	s		$1/2^-$#					β^+ ?; IT ?	
^{99}Sn	−47940#	500#				5#	ms	(>0.2 μs)	$9/2^+$#		10St.A	I	2011	β^+ ?; β^+p ?	*
^{99}Sn^m	−47540#	510#	400#	100#					$1/2^-$#						

*^{99}Kr T : also 11Ni01=13(+34–6) **

*^{99}Rb T : ENSDF is weighted average of 6 scattered results; also 11Ni01=54.2(1.3) **

*^{99}Zr^m J : 130.2 γ ray, E2 to $3/2^+$ and 121.7 keV, γ ray, M1 to $1/2^+$ **

*^{99}Cd D : …; $\beta^+\alpha$<1e–4 D : symmetrized from β^+p=0.17(+11–5)% **

*^{99}In T : recent not used 01Ki13=3.0(+0.8–0.7) **

*^{99}Sn I : the 3 events reported in 95Ry03 are not trusted by NUBASE **

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{100}Kr	−35050#	400#				12	ms	8	0^+	11	11Ni01	TD	1997	β^-=100; β^-n ?; β^-2n ?	*
^{100}Rb	−46550#	200#				48	ms	3	$(3^+),4^-$#	08	11Ni01	T	1978	β^-=100; β^-n=6 3; …	*
^{100}Sr	−59830	10				202	ms	3	0^+	08			1978	β^-=100; β^-n=0.78 13	
^{100}Sr^m	−58211	10	1618.72	0.20		122	ns	9	(4^-)		12Ka.B	T	1995	IT=100	*
^{100}Y	−67333	11				735	ms	7	(1^-)	08	83Wo10	J	1977	β^-=100; β^-n=0.92 8	*
^{100}Y^m	−67189	11	144	16	MD	940	ms	30	4^+	08	10Ba31	J	1977	β^-=100; β^-n ?	
^{100}Zr	−76382	8				7.1	s	0.4	0^+	08			1970	β^-=100	
^{100}Nb	−79803	8				1.5	s	0.2	1^+	08			1967	β^-=100	
^{100}Nb^m	−79490.6	2.8	313	8	MD	2.99	s	0.11	(5^+)	08			1967	β^-=100	
^{100}Nb^n	−79456	11	347	8		460	ns	60	$(4^-,5^-,6^-)$	08			1986	IT=100	*
^{100}Nb^p	−79069	11	734	8		12.43	μs	0.26	(8^-)	08	11Ru.A	T	1980	IT=100	*
^{100}Mo	−86189.5	1.0				7.3	Ey	0.4	0^+	08			1930	IS=9.82 31; $2\beta^-$=100	
^{100}Tc	−86019.9	1.4				15.46	s	0.19	1^+	08			1952	β^-≈100; ε=0.0018 9	
^{100}Tc^m	−85819.2	1.4	200.67	0.04		8.32	μs	0.14	$(4)^+$	08			1958	IT=100	
^{100}Tc^n	−85776.0	1.4	243.95	0.04		3.2	μs	0.2	$(6)^+$	08			1967	IT=100	
^{100}Ru	−89223.8	1.1				STABLE			0^+	08			1931	IS=12.60 7	
^{100}Rh	−85588	18				20.8	h	0.1	1^-	08			1948	β^+=100; e^+=4.9 5	
^{100}Rh^m	−85513	18	74.782	0.014		214.0	ns	2.0	$(2)^+$	08			1965	IT=100	
^{100}Rh^n	−85480	18	107.6	0.2		4.6	m	0.2	(5^+)	08			1973	IT≈98.3; β^+≈1.7	
^{100}Rh^p	−85368	18	219.61	0.22		130	ns	10	(7^+)	08			1984	IT=100	
^{100}Pd	−85227	18				3.63	d	0.09	0^+	08			1948	ε=100	
^{100}Ag	−78138	5				2.01	m	0.09	$(5)^+$	08			1970	β^+=100	
^{100}Ag^m	−78122	5	15.52	0.16		2.24	m	0.13	$(2)^+$	08			1980	β^+=?; IT ?	
^{100}Cd	−74194.6	1.7				49.1	s	0.5	0^+	10			1970	β^+=100	
^{100}In	−64310	180				5.85	s	0.16	6^+#	10	12Lo08	TD	1982	β^+=100; β^+p=1.64 24	*
^{100}Sn	−57280	300				1.11	s	0.15	0^+	10	12Hi07	T	1994	β^+=100; β^+p<17	*
^{100}Sn^m	−52780#	360#	4500#	200#		100#	ns		6^+#					p ?	

*^{100}Kr T : symmetrized from 11Ni01=7(+11–3) **

*^{100}Rb D : …; β^-2n=0.16 8 **

*^{100}Sr^m T : other 95Pf04=85(7) **

*^{100}Y J : ENSDF=1^-,2^-; but 1^- is favored from (p5/2[303]+n3/2[411]), see 83Wo10 **

*^{100}Nb^n E : 34.3 keV above 5^+ isomer **

*^{100}Nb^p E : 420.7 keV above 5^+ isomer **

*^{100}Nb^p J : 28 keV, (E2) γ to (6^-). Mult. from intensity balances **

*^{100}In D : β^+p average 12Lo08=1.7(0.4) 02Pl03=1.6(0.3) **

*^{100}In T : average 12Lo08=5.7(0.3) 02Pl03=5.9(0.2) 95Sz01=6.1(0.9) **

*^{100}Sn T : average 12Hi07=1.16(0.20) 08Ba53=0.86(+0.37–0.20) 96Ki23=0.94(+0.54–0.26) **

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{101}Kr	−29130#	500#					5#	ms	(>400 ns)		10	10Oh02	I	2010	β^- ?; β^-n ?; β^-2n ?	
^{101}Rb	−42810#	220#					31.8	ms	3.3	$3/2^+$#	06	11Ni01	T	1992	β^-=100; β^-n=28 4; β^-2n ?	*
^{101}Sr	−55560	80					113.8	ms	1.7	$(5/2^-)$	06	11Ni01	T	1983	β^-=100; β^-n=2.37 14	*
^{101}Y	−65067	7					426	ms	20	$5/2^+$	06	07Ch07	J	1983	β^-=100; β^-n=1.94 18	*
^{101}Y^m	−64736	7	331.5	0.7			190	ns	40			12Ka.B	ETD	2012	IT=100	*
^{101}Y^n	−63860	7	1207.0	1.6			870	ns	90			09Fo05	ETD	2009	IT=100	*
^{101}Zr	−73171	8					2.3	s	0.1	$3/2^+$	06	02Ca37	J	1972	β^-=100	
^{101}Nb	−78888	4					7.1	s	0.3	$(5/2\#)^+$	06			1970	β^-=100	*
^{101}Mo	−83516.4	1.1					14.61	m	0.03	$1/2^+$	06			1941	β^-=100	
^{101}Mo^m	−83502.9	1.1	13.497	0.009			226	ns	7	$3/2^+$	06			1977	IT=100	
^{101}Mo^n	−83459.4	1.1	57.015	0.011			133	ns	70	$5/2^+$	06			1977	IT=100	
^{101}Tc	−86341	24					14.22	m	0.01	$9/2^+$	06			1941	β^-=100	
^{101}Tc^m	−86133	24	207.526	0.020			636	μs	8	$1/2^-$	06			1964	IT=100	
^{101}Ru	−87954.6	1.1					STABLE			$5/2^+$	06			1931	IS=17.06 2	
^{101}Ru^m	−87427.0	1.1	527.56	0.10			17.5	μs	0.4	$11/2^-$	06			1974	IT=100	
^{101}Rh	−87411	6					3.3	y	0.3	$1/2^-$	06			1948	ε=100	
^{101}Rh^m	−87254	6	157.32	0.03			4.34	d	0.01	$9/2^+$	06			1944	ε=92.80 25; IT=7.20 25	
^{101}Pd	−85431	5					8.47	h	0.06	$5/2^+$	06			1948	β^+=100	
^{101}Ag	−81334	5					11.1	m	0.3	$9/2^+$	06			1966	β^+=100	
^{101}Ag^m	−81060	5	274.1	0.3			3.10	s	0.10	$(1/2)^-$	06			1975	IT=100	*
^{101}Cd	−75836.5	1.5					1.36	m	0.05	$5/2^+$#	06			1969	β^+=100	
^{101}In	−68610#	300#					15.1	s	1.1	$9/2^+$#	06	97Sz04	T	1988	β^+=100; β^+p=?	*
^{101}In^m	−68060#	320#	550#	100#			10#	s		$1/2^-$#					β^+=95#; IT=5#	
^{101}Sn	−60310	300					1.97	s	0.16	$(7/2^+)$	07	12Lo08	TD	1994	β^+=100; β^+p=21.0 7	*

*^{101}Rb T : average 11Ni01=31(+5–4) 95Lh04=32(5) **

*^{101}Sr T : average 11Ni01=113(2) 86Wa17=114(4) 83Wo10=121(6) **

*^{101}Y T : average 96Me09=400(20) 86Wa17=440(20) 83Wo10=500(50) **

*^{101}Y T : 93Ru01=279(9) conflicting, not used **

*^{101}Y^m T : symmetrized from 187(+49–38) **

*^{101}Y^n T : symmetrized from 860(+90–80) **

*^{101}Y^n E : from a least-squares fit to Eg using 09Fo05 level scheme **

*^{101}Nb J : + due to M1$^+$E2 γ from a + exc. level **

*^{101}Ag^m J : from ENSDF : E3 γ to $(7/2)^+$ level **

*^{101}In T : average 97Sz04=14.9(1.2) 88Hu07=16(3) **

*^{101}Sn T : average 12Lo08=2.1(0.2) 07Se04=1.3(0.5) 07Ka15=1.9(0.3) **

*^{101}Sn D : β^+p average 12Lo08=22(1) 10St.A=20(1) J : from 10Da17 **

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{102}Rb	−37710#	300#					37	ms	3		09			1995	β^-=100; β^-n=18 8; β^-2n ?	*
^{102}Sr	−52360	70					69	ms	6	0^+	09			1986	β^-=100; β^-n=5.5 15	*
^{102}Y	−61173	4				* &	298	ms	9	(2^-)	09	11Ha48	J	1983	β^-=100; β^-n=4.9 12	*
^{102}Y^m	−60970#	200#	200#	200#		* &	360	ms	40	(>5)	09	11Ha48	J	1980	β^-=100; β^-n=4.9 12	
^{102}Zr	−71594	9					2.9	s	0.2	0^+	09			1970	β^-=100	
^{102}Nb	−76311	3					4.3	s	0.4	(4^+)	09			1972	β^-=100	
^{102}Nb^m	−76216	8	94	7	MD		1.3	s	0.2	1^+	09			1976	β^-=100	
^{102}Mo	−83570	8					11.3	m	0.2	0^+	09			1954	β^-=100	
^{102}Tc	−84571	9				*	5.28	s	0.15	1^+	09			1954	β^-=100	
^{102}Tc^m	−84551	13	20	10		*	4.35	m	0.07	$(4,5)$	09			1954	β^-=98 2; IT=2 2	
^{102}Ru	−89102.9	1.1					STABLE			0^+	09			1931	IS=31.55 14	
^{102}Rh	−86780	5					207.0	d	1.5	$(1^-,2^-)$	09	98Sh21	T	1941	β^+=78 5; β^-=22 5	*
^{102}Rh^m	−86639	5	140.73	0.09			3.742	y	0.010	6^+	09	99Gi14	J	1962	$\beta^+\approx$100; IT=0.233 24	
^{102}Pd	−87931.0	2.6					STABLE			0^+	09			1935	IS=1.02 1; 2β^+ ?	
^{102}Ag	−82247	8					12.9	m	0.3	$5^{(+)}$	09			1960	β^+=100	
^{102}Ag^m	−82238	8	9.40	0.07			7.7	m	0.5	2^+	09			1967	β^+=51 5; IT=49 5	
^{102}Cd	−79659.5	1.7					5.5	m	0.5	0^+	09			1969	β^+=100	
^{102}In	−70694	5					23.3	s	0.1	(6^+)	09	95Sz01	J	1981	β^+=100; β^+p=0.0093 13	
^{102}Sn	−64930	100					3.8	s	0.2	0^+	09			1994	β^+=100	*
^{102}Sn^m	−62910	100	2017	2			367	ns	8	(6^+)	09	98Li50	E	1996	IT=100	*

*^{102}Rb T : also 11Ni01=35(+15–8) **

*^{102}Sr T : also 11Ni01=85(15) **

*^{102}Y J : in 11Ha48, combining 07Ch07=(2,3) with spectrocopy data from 91Hill **

*^{102}Rh T : average 98Sh21=207.3(1.7) 61Hi06=206(3) **

*^{102}Sn T : 95Fa.A=4.6(1.4) supersedes 95Sc28=4.5(0.7), preliminary from same group **

*^{102}Sn^m T : from 11Hi.A **

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{103}Rb	−33610#	400#					20#	ms	(>400 ns)	$3/2^+$#	10	10Oh02	I	2010	β^- ?; β^-n ?; β^-2n ?	
^{103}Sr	−47420#	200#					90	ms	40	$5/2^+$#	09	11Ni01	TD	1997	β^-=100; β^-n ?; β^-2n ?	*
^{103}Y	−58458	11					239	ms	12	$5/2^+$#	09	11Ni01	T	1994	β^-=100; β^-n=8.0 17	*
^{103}Zr	−67821	9					1.38	s	0.07	$5/2^-$#	09	09Pe06	TD	1987	β^-=100; β^-n<1	
^{103}Nb	−75025	4					1.5	s	0.2	$5/2^+$#	09			1971	β^-=100; β^-n ?	
^{103}Mo	−80967	9					67.5	s	1.5	$3/2^+$	09	09Ch09	J	1963	β^-=100	
^{103}Tc	−84602	10					54.2	s	0.8	$5/2^+$	09			1957	β^-=100	
^{103}Ru	−87263.6	1.1					39.247	d	0.013	$3/2^+$	09			1945	β^-=100	*
^{103}Ru^m	−87025.4	1.3	238.2	0.7			1.69	ms	0.07	$11/2^-$	09			1964	IT=100	
^{103}Rh	−88028.1	2.4					STABLE			$1/2^-$	09			1934	IS=100.	
^{103}Rh^m	−87988.3	2.4	39.753	0.006			56.114	m	0.009	$7/2^+$	09			1943	IT=100	
^{103}Pd	−87485.0	2.5					16.991	d	0.019	$5/2^+$	09			1950	ε=100	
^{103}Ag	−84800	4					65.7	m	0.7	$7/2^+$	09			1954	β^+=100	
^{103}Ag^m	−84666	4	134.45	0.04			5.7	s	0.3	$1/2^-$	09			1962	IT=100	
^{103}Cd	−80652.0	1.8					7.3	m	0.1	$5/2^+$#	09			1960	β^+=100	
^{103}In	−74630	9					60	s	1	$9/2^+$#	09	97Sz04	T	1978	β^+=100	
^{103}In^m	−73998	9	631.7	0.1			34	s	2	$1/2^-$#	09			1988	β^+=67; IT=33	
^{103}Sn	−66970	70					7.0	s	0.2	$5/2^+$#	09			1981	β^+=100; β^+p=1.2 1	
^{103}Sb	−56180#	300#							<50 ns	$5/2^+$#		11Hi.A	I		p ?	*

*^{103}Sr T : symmetrized from 11Ni01=68(+48–20) **
*^{103}Y T : average 11Ni01=234(+18–15) 09Pe06=260(+40–20) 96Me09=230(20) and **
*^{103}Y T : 96Lh04=190(50) D : average 09Pe06=8(2)% 96Me09=8(3)% **
*^{103}Ru T : other recent 09Go29=39.210(0.038) **
*^{103}Sb I : 10St.A<200ns 95Ry03>1.5 μs **

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{104}Sr	−44110#	300#					44	ms	8	0^+	07	11Ni01	TD	1997	β^-=100; β^-n ?; β^-2n ?	*
^{104}Y	−54060#	400#					197	ms	4		07	11Ni01	T	1994	β^-=100; β^-n=34 10; β^-2n ?	*
^{104}Zr	−65730	10					920	ms	28	0^+	07	09Pe06	TD	1990	β^-=100; β^-n<1	
^{104}Nb	−71825	3				*	4.9	s	0.3	(1^+)	07			1971	β^-=100; β^-n=0.06 3	*
^{104}Nb^m	−71610	120	220	120	BD	*	940	ms	40	high	07			1976	β^-=100; β^-n=0.05 3	
^{104}Mo	−80356	9					60	s	2	0^+	07			1962	β^-=100	
^{104}Tc	−82507	25					18.3	m	0.3	(3^+)	07			1956	β^-=100	
^{104}Tc^m	−82437	25	69.7	0.2			3.5	μs	0.3	(5^+)	07			1981	IT=100	*
^{104}Tc^n	−82401	25	106.1	0.3			400	ns	20	$^{(+)}$	07			1999	IT=100	
^{104}Ru	−88093.7	2.6					STABLE			0^+	07			1931	IS=18.62 27; 2β^- ?	
^{104}Rh	−86955.7	2.4					42.3	s	0.4	1^+	07			1939	$\beta^-\approx$100; β^+=0.45 10	
^{104}Rh^m	−86826.7	2.4	128.9679	0.0005			4.34	m	0.03	5^+	07			1939	IT$\approx$100; β^-=0.13 1	
^{104}Pd	−89395.0	1.3					STABLE			0^+	07			1935	IS=11.14 8	
^{104}Ag	−85116	4					69.2	m	1.0	5^+	07			1955	β^+=100	
^{104}Ag^m	−85109	4	6.90	0.22			33.5	m	2.0	2^+	07			1959	$\beta^+\approx$100; IT<0.07	
^{104}Cd	−83968.2	1.7					57.7	m	1.0	0^+	07			1955	β^+=100	
^{104}In	−76183	6					1.80	m	0.03	(6^+)	07			1977	β^+=100	
^{104}In^m	−76090	6	93.48	0.10			15.7	s	0.5	(3^+)	07			1988	IT=80; β^+=20	
^{104}Sn	−71627	6					20.8	s	0.5	0^+	07			1985	β^+=100	
^{104}Sb	−59170	120					470	ms	130		07	95Fa.A	D	1995	β^+=?; β^+p<7; p<7; α ?	*

*^{104}Sr T : symmetrized from 11Ni01=43(+9–7) **
*^{104}Y D : from 09Pe06 **
*^{104}Nb D : β^-n=0.71% of 83En03, conflicting, not used **
*^{104}Tc^m J : E2 γ to (3^+) level (from ENSDF) **
*^{104}Sb T : symmetrized from 440(+150–110) D : 95Fa.A supersedes 95Sc28 p<1% **

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{105}Sr	−38610#	500#					50	ms	30		05	11Ni01	TD	1997	β^-=100; β^-n ?; β^-2n ?	*
^{105}Y	−50820#	500#					84	ms	5	$5/2^+$#	05	09Pe06	TD	1994	β^-=100; β^-n<82; β^-2n ?	*
^{105}Zr	−61471	12					670	ms	28		05	09Pe06	TD	1992	β^-=100; β^-n<2	
^{105}Nb	−69912	4					2.95	s	0.06	$5/2^+$#	05			1984	β^-=100; β^-n=1.7 9	
^{105}Mo	−77343	9					35.6	s	1.6	$(5/2^-)$	05			1962	β^-=100	
^{105}Tc	−82290	40					7.6	m	0.1	$(3/2^-)$	05			1955	β^-=100	
^{105}Ru	−85932.5	2.6					4.44	h	0.02	$3/2^+$	05			1945	β^-=100	
^{105}Ru^m	−85911.9	2.6	20.610	0.013			340	ns	15	$(5/2)^+$	05			1974	IT=100	
^{105}Rh	−87850.6	2.5					35.357	h	0.037	$7/2^+$	05	09Go29	T	1945	β^-=100	
^{105}Rh^m	−87720.8	2.5	129.782	0.004			42.9	s	0.3	$1/2^-$	05			1950	IT=100	
^{105}Pd	−88417.8	1.1					STABLE			$5/2^+$	05			1935	IS=22.33 8	
^{105}Pd^m	−87928.7	1.1	489.14	0.04			36.1	μs	0.4	$11/2^-$	05			1970	IT=100	
^{105}Ag	−87071	5					41.29	d	0.07	$1/2^-$	05			1939	β^+=100	
^{105}Ag^m	−87046	5	25.479	0.016			7.23	m	0.16	$7/2^+$	05			1969	IT$\approx$100; β^+=0.34 7	
^{105}Cd	−84333.8	1.4					55.5	m	0.4	$5/2^+$	05			1950	β^+=100	

… *A*-group is continued on next page …

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
… *A*-group continued …															
^{105}In	−79641	10				5.07	m	0.07	$9/2^+$	05			1975	β^+=100	
^{105}In^m	−78967	10	674.08	0.25		48	s	6	$(1/2)^-$	05			1975	IT=?; β^+=25#	
^{105}Sn	−73338	4				34	s	1	$(5/2^+)$	05	85De08	J	1981	β^+=100; β^+p=?	
^{105}Sb	−64016	22				1.12	s	0.16	$(5/2^+)$	05	95Fa.A	T	1994	β^+ ?; p<0.1; β^+p ?	$*$
^{105}Te	−52810	300				633	ns	66	$(7/2^+)$	06	06Se08	T	2006	α≈100	$*$
$*^{105}$Sr	T : symmetrized from 11Ni01=40(+36–13)														$**$
$*^{105}$Y	T : symmetrized from 11Ni01=83(+5–4); other not used 09Pe06=160(+85–60)														$**$
$*^{105}$Sb	T : 95Fa.A supersedes 95Sc28=1.30(0.15), preliminary from same group														$**$
$*^{105}$Sb	D : p 05Li47<0.1% above 430 keV disagrees with 94Ti03≈1%														$**$
$*^{105}$Te	T : average 06Li41=620(70) 06Se08=700(+250–170)														$**$
$*^{105}$Te	J : same spin as 171.7 state in ^{101}Sn														$**$
^{106}Sr	−34790#	600#				20#	ms	(>400 ns)	0^+	10	10Oh02	I	2010	β^- ?; β^-n ?; β^-2n ?	
^{106}Y	−46050#	500#				72	ms	20		08	11Ni01	TD	1997	β^-=100; β^-n ?; β^-2n ?	$*$
^{106}Zr	−58910#	200#				187	ms	11	0^+	11	09Pe06	TD	1994	β^-=100; β^-n<7	$*$
^{106}Nb	−66200	4				1050	ms	100	2^+#	08	09Pe06	T	1976	β^-=100; β^-n=4.5 3	$*$
^{106}Nb^m	−65780	100	416	100		670	ns	100			12Ka.B	ET	1999	IT=100	$*$
^{106}Mo	−76141	9				8.73	s	0.12	0^+	08			1969	β^-=100	
^{106}Tc	−79775	12				35.6	s	0.6	$(1,2)$	08			1965	β^-=100	
^{106}Ru	−86322	5				371.8	d	0.18	0^+	08			1948	β^-=100	
^{106}Rh	−86362	5				30.07	s	0.35	1^+	08			1947	β^-=100	
^{106}Rh^m	−86230	10	131	11	BD	131	m	2	$(6)^+$	08			1955	β^-=100	
^{106}Pd	−89907.4	1.1				STABLE			0^+	08			1935	IS=27.33 3	
^{106}Ag	−86942	3				23.96	m	0.04	1^+	08			1937	β^+=?; β^-≈0.5	
^{106}Ag^m	−86852	3	89.66	0.07		8.28	d	0.02	6^+	08			1938	β^+=100; IT≤4.2e–6	
^{106}Cd	−87132.0	1.1				STABLE		(>410 Ey)	0^+	08	02Tr04	T	1935	IS=1.25 6; 2β^+ ?	
^{106}In	−80608	12				6.2	m	0.1	7^+	08			1962	β^+=100	
^{106}In^m	−80579	12	28.6	0.3		5.2	m	0.1	$(2)^+$	08			1966	β^+=100	
^{106}Sn	−77354	5				1.92	m	0.08	0^+	08			1975	β^+=100	
^{106}Sb	−66473	7				600	ms	200	(2^+)	08			1981	β^+=100	
^{106}Sb^m	−66370	7	103.5	0.3		226	ns	14	(4^+)	08	99So08	T	1998	IT=100	$*$
^{106}Te	−58220	100				80	μs	13	0^+	08	05Ja03	T	1981	α=100	$*$
$*^{106}$Y	T : symmetrized from 11Ni01=62(+25–14)														$**$
$*^{106}$Zr	T : symmetrized from 11Ni01=186(+11–10); other not used 09Pe06=260(+40–36)														$**$
$*^{106}$Nb	T : unweighed average 09Pe06=1240(20) 96Me09=900(20) 83Sh06=1020(50)														$**$
$*^{106}$Nb^m	T : symmetrized from 12Ka.B=661(+110–97); other 99Ge01=840(40)														$**$
$*^{106}$Sb^m	T : average 99So08=232(21) 98Li50=220(20)														$**$
$*^{106}$Te	T : average 05Ja03=85(+25–15) 94Pa11=60(+40–20) 81Sc17=60(+30–10)														$**$
^{107}Sr	−28900#	700#				10#	ms	(>400 ns)		10	10Oh02	I	2010	β^- ?; β^-n ?; β^-2n ?	
^{107}Y	−42360#	500#				45	ms	12	$5/2^+$#	08	11Ni01	TD	1997	β^-=100; β^-n ?; β^-2n ?	$*$
^{107}Zr	−54270#	300#				138	ms	4		08	11Ni01	T	1994	β^-=100; β^-n<23	$*$
^{107}Nb	−63720	8				296	ms	7	$5/2^+$#	08	96Me09	TD	1992	β^-=100; β^-n=7.4 8	$*$
^{107}Mo	−72558	9				3.5	s	0.5	$(5/2^+)$	08			1972	β^-=100	
^{107}Mo^m	−72493	9	65.4	0.2		420	ns	30	$(1/2^+)$	08			1976	IT=100	
^{107}Tc	−78748	9				21.2	s	0.2	$3/2^-$#	08			1965	β^-=100	
^{107}Tc^m	−78718	9	30.1	0.1		3.85	μs	0.05	$(1/2^+)$	08			2007	IT=100	
^{107}Tc^n	−78682	9	65.72	0.14		184	ns	3	$(5/2^+)$	08			1974	IT=100	
^{107}Ru	−83860	9				3.75	m	0.05	$(5/2)^+$	08			1951	β^-=100	
^{107}Rh	−86864	12				21.7	m	0.4	$7/2^+$	08			1951	β^-=100	
^{107}Rh^m	−86596	12	268.36	0.04		>10	μs		$1/2^-$	08			1986	IT=100	
^{107}Pd	−88372.5	1.2				6.5	My	0.3	$5/2^+$	08			1958	β^-=100	
^{107}Pd^m	−88256.8	1.2	115.74	0.12		850	ns	100	$1/2^+$	08			1969	IT=100	
^{107}Pd^n	−88157.9	1.2	214.6	0.3		21.3	s	0.5	$11/2^-$	08			1952	IT=100	
^{107}Ag	−88406.6	2.4				STABLE			$1/2^-$	08			1924	IS=51.839 8	
^{107}Ag^m	−88313.5	2.4	93.125	0.019		44.3	s	0.2	$7/2^+$	08			1940	IT=100	
^{107}Cd	−86990.2	1.7				6.50	h	0.02	$5/2^+$	08			1946	β^+=100	
^{107}In	−83564	11				32.4	m	0.3	$9/2^+$	08			1949	β^+=100	
^{107}In^m	−82886	11	678.5	0.3		50.4	s	0.6	$1/2^-$	08			1973	IT=100	
^{107}Sn	−78512	5				2.90	m	0.05	$(5/2^+)$	08			1976	β^+=100	
^{107}Sb	−70653	4				4.0	s	0.2	$5/2^+$#	08			1994	β^+=100	
^{107}Te	−60540	70				3.1	ms	0.1	$5/2^+$#	08			1979	α=70 30; β^+ ?; β^+p ?	
^{107}I	−49570#	300#				20#	μs		$5/2^+$#					α ?	
$*^{107}$Y	T : symmetrized from 11Ni01=41(+15–9)														$**$
$*^{107}$Zr	D : from 09Pe06														$**$
$*^{107}$Nb	T : average 09Pe06=290(11) 96Me09=300(30) 91Hi02=300(10)														$**$
$*^{107}$Nb	D : average 09Pe06=8(1)% 96Me09=6.0(1.5)%														$**$

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{108}Y	−37300#	600#				60	ms	40		10	11Ni01	TD	2010	β^-=100; β^-n ?; β^-2n ?	*
^{108}Zr	−51350#	400#				73	ms	4	0^+	11	11Ni01	TD	1997	β^-=100; β^-n ?	
^{108}Zr^m	−49280#	400#	2074.5	0.5		540	ns	30	(6^+)	11	12Ka.B	EJT	2011	IT≈100	*
^{108}Nb	−59546	8				210	ms	5	(2^+)	08	09Pe06	T	1994	β^-=100; β^-n=6.2 5; β^-2n ?	
^{108}Nb^m	−59380	8	166.5	0.7		109	ns	2	$(4^-,5)$		12Ka.B	ETJ	2012	IT=100	*
^{108}Mo	−70762	9				1.105	s	0.010	0^+	08	09Pe06	TD	1972	β^-=100; β^-n<0.5	*
^{108}Tc	−75921	9				5.17	s	0.07	$(2)^+$	08			1970	β^-=100	
^{108}Ru	−83659	9				4.55	m	0.05	0^+	08			1955	β^-=100	
^{108}Rh	−85032	14				16.8	s	0.5	1^+	08			1955	β^-=100	
^{108}Rh^m	−84917	12	115	18	MD	6.0	m	0.3	$(5)^{(+\#)}$	08			1969	β^-=100	
^{108}Pd	−89524.4	1.1				STABLE			0^+	08			1935	IS=26.46 9	
^{108}Ag	−87606.7	2.4				2.382	m	0.011	1^+	08			1937	β^-=97.15 20; β^+=2.85 20	
^{108}Ag^m	−87497.2	2.4	109.466	0.007		438	y	9	6^+	08			1969	β^+=91.3 9; IT=8.7 9	
^{108}Cd	−89252.6	1.1				STABLE		(>410 Py)	0^+	08	95Ge14	T	1935	IS=0.89 3; 2β^+ ?	
^{108}In	−84120	9				58.0	m	1.2	7^+	08			1949	β^+=100	
^{108}In^m	−84090	9	29.75	0.05		39.6	m	0.7	2^+	08			1955	β^+=100	
^{108}Sn	−82070	5				10.30	m	0.08	0^+	08			1968	β^+=100	
^{108}Sb	−72445	5				7.4	s	0.3	(4^+)	08			1976	β^+=100	
^{108}Te	−65782	5				2.1	s	0.1	0^+	08	85Ti02	D	1974	β^+=51 4; α=49 4; …	*
^{108}I	−52650	130				36	ms	6	1^+#	08	94Pa12	D	1991	α=?; β^+=9#; p<1; β^+p ?	*
$*^{108}$Y	T : symmetrized from 11Ni01=25(+66–10)														**
$*^{108}$Zr^m	T : symmetrized from 12Ka.B=536(+26–25); other 11Su11=620(150)														**
$*^{108}$Mo	T : average 09Pe06=1.110(0.011) 95Jo02=1.090(0.020) D : β^-n not allowed														**
$*^{108}$Te	D : …; β^+p=2.4 10; $\beta^+\alpha$<0.065														**
$*^{108}$I	D : β^+=9%# estimated in 94Pa12 using theoretical β^+ half-life ≈400 ms														**
^{109}Y	−33200#	700#				15#	ms	(>400 ns)	$5/2^+$#	10	10Oh02	I	2010	β^- ?; β^-n ?; β^-2n ?	
^{109}Zr	−46190#	500#				80	ms	30		06	11Ni01	TD	1997	β^-=100; β^-n ?; β^-2n ?	*
^{109}Nb	−56620	530				101	ms	9	$5/2^+$#	06	11Ni01	T	1994	β^-=100; β^-n=31 5	*
^{109}Nb^m	−56310	530	312.2	0.5		115	ns	8			12Ka.B	ET	2011	IT=100	
^{109}Mo	−66672	11				700	ms	14	$5/2^+$#	06	09Pe06	TD	1992	β^-=100; β^-n=1.3 6	
^{109}Mo^m	−66602	11	69.7	0.5		210	ns	60	$(1/2^+)$		12Ka.B	ET	2012	IT=100	
^{109}Tc	−74281	10				1.14	s	0.03	$3/2^-$#	06	09Pe06	T	1976	β^-=100; β^-n=0.08 2	
^{109}Ru	−80736	9				34.5	s	1.0	$5/2^+$#	06			1967	β^-=100	
^{109}Ru^m	−80640	9	96.2	0.3		680	ns	30	$(5/2^-)$	06			1976	IT=100	
^{109}Rh	−85000	4				80	s	2	$7/2^+$	06			1972	β^-=100	
^{109}Rh^m	−84774	4	225.974	0.021		1.66	μs	0.04	$3/2^+$	06	FGK127	J	1987	IT=100	*
^{109}Pd	−87606.6	1.1				13.7012	h	0.0024	$5/2^+$	06			1937	β^-=100	
^{109}Pd^m	−87493.2	1.1	113.400	0.010		380	ns	50.	$1/2^+$	06			1978	IT=100	
^{109}Pd^n	−87417.6	1.1	188.990	0.010		4.696	m	0.003	$11/2^-$	06			1957	IT=100	
^{109}Ag	−88719.9	1.3				STABLE			$1/2^-$	06			1924	IS=48.161 8	
^{109}Ag^m	−88631.9	1.3	88.0341	0.0011		39.6	s	0.2	$7/2^+$	06			1967	IT=100	
^{109}Cd	−88504.4	1.5				461.4	d	1.2	$5/2^+$	06			1950	ε=100	
^{109}Cd^m	−88444.9	1.5	59.49	0.11		12	μs	2	$1/2^+$	06			1956	IT=100	
^{109}Cd^n	−88040.9	1.5	463.5	0.3		10.9	μs	0.5	$11/2^-$	06			1964	IT=100	
^{109}In	−86488	4				4.167	h	0.018	$9/2^+$	06			1948	β^+=100	
^{109}In^m	−85838	4	650.1	0.3		1.34	m	0.07	$1/2^-$	06			1966	IT=100	
^{109}In^n	−84386	4	2101.8	0.2		209	ms	6	$(19/2^+)$	06			1963	IT=100	
^{109}Sn	−82631	8				18.0	m	0.2	$5/2^{(+\#)}$	06			1966	β^+=100	
^{109}Sb	−76251	5				17.0	s	0.7	$5/2^+$#	06			1976	β^+=100	
^{109}Te	−67715	4				4.6	s	0.3	$(5/2^+)$	06			1967	β^+=96.1 13; α=3.9 13; …	*
^{109}I	−57673	6				103	μs	5	$1/2^+$	06	07Ma35	D	1984	p=100; α=0.014 4	
^{109}Xe	−46170	300				13	ms	2	$7/2^+$#		06Li41	TDJ	2006	α≈100; β^+ ?; β^+p ?	*
$*^{109}$Zr	T : symmetrized from 11Ni01=63(+38–17)														**
$*^{109}$Nb	T : symmetrized from 11Ni01=100(+9–8); others 09Pe06=130(20) 96Me09=190(30)														**
$*^{109}$Nb	D : 09Pe06 β^-n<15% conflicting														**
$*^{109}$Nb^m	E : other 11Wa03=313.1(0.5) keV														**
$*^{109}$Nb^m	T : symmetrized from 12Ka.B=114(+8–7); other 11Wa03=150(30)														**
$*^{109}$Rh^m	J : 225.9 keV E2 γ ray to $7/2^+$														**
$*^{109}$Te	D : …; β^+p=9.4 31; $\beta^+\alpha$<0.005														**
$*^{109}$Xe	J : same as 150 level in ^{105}Te														**
^{110}Zr	−42890#	600#				42	ms	13	0^+	12			1997	β^-=100; β^-n ?; β^-2n ?	*
^{110}Nb	−52140#	200#				82	ms	4	$(5)^{(+\#)}$	12			1994	β^-=100; β^-n=40 8; β^-2n ?	
^{110}Mo	−64549	24				296	ms	17	0^+	12			1992	β^-=100; β^-n=2.0 7	
^{110}Tc	−71032	10				900	ms	13	$(2^+,3^+)$	12			1976	β^-=100; β^-n=0.04 2	
^{110}Ru	−80071	9				12.04	s	0.17	0^+	12			1970	β^-=100	
^{110}Rh	−82829	18			*	3.35	s	0.12	(1^+)	12			1963	β^-=100	
^{110}Rh^m	−82610#	150#	220#	150#	*	28.5	s	1.3	(6^+)	12			1969	β^-=100	
^{110}Pd	−88331.5	0.7				STABLE		(>600 Py)	0^+	12	52Wi26	T	1935	IS=11.72 9; 2β^- ?	
^{110}Ag	−87457.8	1.3				24.56	s	0.11	1^+	12			1937	β^-≈100; ε=0.30 6	
^{110}Ag^m	−87456.7	1.3	1.112	0.016		660	ns	40	2^-	12			1975	IT=100	
^{110}Ag^n	−87340.2	1.3	117.59	0.05		249.83	d	0.04	6^+	12			1938	β^-=98.67 8; IT=1.33 8	
^{110}Cd	−90348.8	0.6				STABLE			0^+	12			1925	IS=12.49 18	

… *A*-group is continued on next page …

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
… *A*-group continued …															
^{110}In	−86471	12				4.92	h	0.08	7^+	12			1939	β^+=100	
^{110}In^m	−86409	12	62.08	0.04		69.1	m	0.5	2^+	12			1962	β^+=100	
^{110}Sn	−85842	14				4.154	h	0.004	0^+	12			1965	ε=100	
^{110}Sb	−77450	6				23.6	s	0.3	(3^+)	12			1972	β^+=100	
^{110}Te	−72230	7				18.6	s	0.8	0^+	12			1977	$\beta^+\approx$100; α=0.003#	
^{110}I	−60460	50				664	ms	24	(1^+)	12			1977	β^+=83 4; α=17 4; …	∗
^{110}Xe	−51920	100				93	ms	3	0^+	12			1981	α=64 35; β^+ ?; β^+p ?	
∗^{110}Zr	T : symmetrized from 11Ni01=37(+17–9)														∗∗
∗^{110}I	D : …; β^+p=11 3; $\beta^+\alpha$=1.1 3														∗∗
^{111}Zr	−37560#	700#				30#	ms	(>400 ns)		10	10Oh02	I	2010	β^- ?; β^-n ?; β^-2n ?	
^{111}Nb	−48880#	300#				52	ms	6	$5/2^+$#	09	11Ni01	TD	1997	β^-=100; β^-n ?; β^-2n ?	∗
^{111}Mo	−59938	13				186	ms	9	$1/2^+$#	09	11Ku16	T	1994	β^-=100; β^-n<12	∗
^{111}Mo^m	−59840#	50#	100#	50#		200	ms		$7/2^-$#		11Ku16	TD	2011	β^-=100	
^{111}Tc	−69023	11				350	ms	11	$3/2^-$#	09	09Pe06	T	1988	β^-=100; β^-n=0.85 20	
^{111}Ru	−76783	10				2.12	s	0.07	$5/2^+$	09			1971	β^-=100	
^{111}Rh	−82305	7				11	s	1	$(7/2^+)$	09			1975	β^-=100	
^{111}Pd	−85986.5	0.8				23.4	m	0.2	$5/2^+$	09			1937	β^-=100	
^{111}Pd^m	−85814.3	0.8	172.18	0.08		5.5	h	0.1	$11/2^-$	09			1952	IT=73 3; β^-=27 3	
^{111}Ag	−88216.3	1.5				7.45	d	0.01	$1/2^-$	09			1937	β^-=100	
^{111}Ag^m	−88156.5	1.5	59.82	0.04		64.8	s	0.8	$7/2^+$	09			1957	IT=99.3 2; β^-=0.7 2	
^{111}Cd	−89253.1	0.6				STABLE			$1/2^+$	09			1925	IS=12.80 12	
^{111}Cd^m	−88856.9	0.6	396.214	0.021		48.50	m	0.09	$11/2^-$	09			1945	IT=100	
^{111}In	−88391	4				2.8047	d	0.0004	$9/2^+$	09			1947	ε=100	
^{111}In^m	−87854	4	536.99	0.07		7.7	m	0.2	$1/2^-$	09			1966	IT=100	
^{111}Sn	−85940	5				35.3	m	0.6	$7/2^+$	09			1949	β^+=100	
^{111}Sn^m	−85685	5	254.71	0.04		12.5	μs	1.0	$1/2^+$	09			1972	IT=100	
^{111}Sb	−80837	9				75	s	1	$(5/2^+)$	09			1972	β^+=100	
^{111}Te	−73587	6				26.2	s	0.6	$(5/2)^+$	09	05Sh24	T	1967	β^+=100; β^+p=?	∗
^{111}I	−64954	5				2.5	s	0.2	$5/2^+$#	09			1977	$\beta^+\approx$100; $\alpha\approx$0.1; β^+p ?	
^{111}Xe	−54390	90				740	ms	200	$5/2^+$#	09	12Ca03	D	1979	β^+ ?; α=10.4 1.9; β^+p ?	
^{111}Xe^m			non existent		RN	900	ms	200			90Tu.A	T			∗
∗^{111}Nb	T : symmetrized from 11Ni01=51(+6–5)														∗∗
∗^{111}Mo	T : other 09Pe06=200(+41–36)														∗∗
∗^{111}Te	T : others 67Ka01=19.0(7) 67Bo41=19.5(5) conflicting, not used														∗∗
∗^{111}Xe^m	I : from assigning α decay to isomer in older version of ENSDF														∗∗
^{112}Zr	−33810#	700#				15#	ms	(>400 ns)	0^+	10	10Oh02	I	2010	β^- ?; β^-n ?; β^-2n ?	
^{112}Nb	−44270#	300#				35	ms	8	2^+#	97	11Ni01	TD	1997	β^-=100; β^-n ?; β^-2n ?	∗
^{112}Mo	−57460#	200#				121	ms	12	0^+	97	11Ni01	TD	1994	β^-=100; β^-n ?	∗
^{112}Tc	−65255	6				290	ms	11	2^+#	97	09Pe06	TD	1990	β^-=100; β^-n=1.5 2	∗
^{112}Tc^m	−64903	6	352.3	0.7		150	ns	17		97	10Br15	T	2010	IT=100	∗
^{112}Ru	−75629	10				1.75	s	0.07	0^+	97			1970	β^-=100	
^{112}Rh	−79730	40				3.4	s	0.4	1^+	97	99Lh01	T	1972	β^-=100	∗
^{112}Rh^m	−79390	60	340	70	BD	6.73	s	0.15	> 3	97	99Lh01	T	1987	β^-=100	∗
^{112}Pd	−86322	7				21.03	h	0.05	0^+	97			1951	β^-=100	
^{112}Ag	−86583.7	2.4				3.130	h	0.009	$2^{(-)}$	97			1938	β^-=100	
^{112}Cd	−90575.8	0.6				STABLE			0^+	97			1925	IS=24.13 21	
^{112}In	−87991	4				14.97	m	0.10	1^+	97			1947	β^+=56 3; β^-=44 3	
^{112}In^m	−87834	4	156.59	0.05		20.56	m	0.06	4^+	97			1953	IT=100	
^{112}In^n	−87640	4	350.76	0.09		690	ns	50	7^+	97			1976	IT=100	
^{112}In^p	−87377	4	613.69	0.14		2.81	μs	0.03	8^-	97	87Eb02	J	1976	IT=100	
^{112}Sn	−88656.0	0.6				STABLE			0^+	97			1927	IS=0.97 1; 2β^+ ?	∗
^{112}Sb	−81599	18				51.4	s	1.0	3^+	97			1959	β^+=100	
^{112}Sb^m	−80803	18	796.4	0.3		560	ns	120	8^-#	97			1976	IT=100	
^{112}Te	−77568	8				2.0	m	0.2	0^+	97			1976	β^+=100	
^{112}I	−67063	10				3.42	s	0.11	1^+#	97	78Ro19	D	1977	$\beta^+\approx$100; α=0.0012; …	∗
^{112}Xe	−60026	8				2.7	s	0.8	0^+	97	94Pa11	D	1978	$\beta^+\approx$100; α=0.9 8; β^+p ?	∗
^{112}Cs	−46290	90				490	μs	35	1^+#	02	12Ca03	TD	1994	p$\approx$100; α<0.26	∗
∗^{112}Nb	T : symmetrized from 11Ni01=33(+9–6)														∗∗
∗^{112}Mo	T : symmetrized from 11Ni01=120(+13–11)														∗∗
∗^{112}Tc	D : β^-n=1.5(0.2)% from 99Wa09; other 09Pe06=4(1)%														∗∗
∗^{112}Tc	I : also an isomer with T=150(17) ns decaying by γ-rays of 258, 92 keV														∗∗
∗^{112}Tc^m	E : 12Ka.B=93.1(0.5) keV and 259.2(0.5) keV γ rays in cascade to 2^+# ground-state														∗∗
∗^{112}Tc^m	T : other 12Ka.B=218(+60–43)														∗∗
∗^{112}Rh	T : supersedes 91Jo11=2.1(0.3) and 88Ay02=3.8(0.6) of same group														∗∗
∗^{112}Rh^m	T : supersedes 88Ay02=6.8(0.2)														∗∗
∗^{112}Sn	T : >1.3 Zy for neutrinoless $\varepsilon\varepsilon$ transition to 0_3^+ state in ^{112}Cd														∗∗
∗^{112}I	D : …; β^+p=0.88 10; $\beta^+\alpha$=0.104 12														∗∗
∗^{112}I	D : β^+p and $\beta^+\alpha$ are derived from β^+p/α=735(80) β^+p/$\beta^+\alpha$=8.5(2), in 85Ti02														∗∗
∗^{112}Xe	D : α intensity is estimated from 94Pa11=0.8(+1.1–0.5)% and 78Ro19=0.84%														∗∗
∗^{112}Cs	T : average 12Ca03=506(55) 12Wa10=470(50) 94Pa12=500(100)														∗∗

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{113}Nb	−40510#	400#				20#	ms	(>300 ns)	$5/2^+$#	10	97Be70	I	1997	β^- ?; β^-n ?; β^-2n ?	
^{113}Mo	−52770#	300#				79	ms	6	$3/2^+$#	10	11Ni01	TD	1994	β^-=100; β^-n ?	$\ast$
^{113}Tc	−62812	3				169	ms	18	$5/2^+$#	10	09Pe06	T	1992	β^-=100; β^-n=2.1 3	$\ast$
^{113}Tc^m	−62698	3	114.4	0.5		527	ns	16	$(5/2^-)$		12Ka.B	ET	2010	IT=100	$\ast$
^{113}Ru	−71870	40				800	ms	50	$(1/2^+)$	10			1988	β^-=100	
^{113}Ru^m	−71740	40	130	18		510	ms	30	$(7/2^-)$	10	98Ku17	E	1998	IT=?; β^-=?	$\ast$
^{113}Rh	−78768	7				2.80	s	0.12	$(7/2^+)$	10	93Pe11	J	1971	β^-=100	
^{113}Pd	−83591	7				93	s	5	$(5/2^+)$	10			1954	β^-=100	
^{113}Pd^m	−83510	7	81.1	0.3		300	ms	100	$(9/2^-)$	10			1993	IT=100	
^{113}Ag	−87027	17				5.37	h	0.05	$1/2^-$	10			1949	β^-=100	
^{113}Ag^m	−86984	17	43.50	0.10		68.7	s	1.6	$7/2^+$	10			1958	IT=64 7; β^-=36 7	
^{113}Cd	−89043.3	0.4				8.04	Py	0.05	$1/2^+$	10			1925	IS=12.22 12; β^-=100	$\ast$
^{113}Cd^m	−88779.8	0.4	263.54	0.03		13.89	y	0.11	$11/2^-$	10	11Ko01	TD	1965	β^-=99.9036 19; IT=0.0964 19	$\ast$
^{113}In	−89365.8	0.9				STABLE			$9/2^+$	10			1934	IS=4.29 5	
^{113}In^m	−88974.1	0.9	391.699	0.003		1.6579	h	0.0004	$1/2^-$	10			1939	IT=100	$\ast$
^{113}Sn	−88328.2	1.6				115.09	d	0.03	$1/2^+$	10			1939	β^+=100	
^{113}Sn^m	−88250.8	1.6	77.389	0.019		21.4	m	0.4	$7/2^+$	10			1961	IT=91.1 23; β^+=8.9 23	
^{113}Sb	−84417	17				6.67	m	0.07	$5/2^+$	10			1958	β^+=100	
^{113}Te	−78347	28				1.7	m	0.2	$(7/2^+)$	10			1974	β^+=100	
^{113}I	−71120	8				6.6	s	0.2	$5/2^+$#	10			1977	β^+=100; α=3.310e–7; …	$\ast$
^{113}Xe	−62204	7				2.74	s	0.08	$5/2^+$#	10			1973	$\beta^+\approx$100; $\alpha\approx$0.011; …	$\ast$
^{113}Cs	−51764	9				16.7	μs	0.7	$(3/2^+)$	10			1984	p=100	

$\ast^{113}$Mo T : symmetrized from 11Ni01=78(+6–5) $\ast\ast$
$\ast^{113}$Tc T : average 09Pe06=160(+50–40) 99Wa09=170(20) J : 07Ku23 > 5/2 $\ast\ast$
$\ast^{113}$Tc^m T : other recent 10Br15=500(100) E : other 10Br15=114(1) $\ast\ast$
$\ast^{113}$Ru^m E : above the 99 keV level and below 160 keV $\ast\ast$
$\ast^{113}$Cd T : from 07Be61=8.037(0.005)(0.05 systematics); $\ast\ast$
$\ast^{113}$Cd T : other 09Da03=8.00(0.11)(syt 0.24) outweighed $\ast\ast$
$\ast^{113}$Cd^m T : average 11Ko01=13.97(0.13) 72Wa11=14.6(0.5) 65Fl02=13.6(0.2) $\ast\ast$
$\ast^{113}$In^m T : 99.476 m 23 $\ast\ast$
$\ast^{113}$I D : …; $\beta^+\alpha$? $\ast\ast$
$\ast^{113}$Xe D : …; β^+p=7 4; $\beta^+\alpha\approx$0.007 4 $\ast\ast$
$\ast^{113}$Xe D : α=0.0024-0.0204% from estimated limit for the reduced width, see 85Ti02 $\ast\ast$
$\ast^{113}$Xe D : β^+p and $\beta^+\alpha$ derived from β^+p/α=605(35) and β^+p/$\beta^+\alpha$=500-1500 in 85Ti02 $\ast\ast$

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{114}Nb	−35390#	500#				15#	ms	(>400 ns)	0^+	12			2010	β^- ?; β^-n=52.5#; β^-2n=6.2#	
^{114}Mo	−49810#	300#				63	ms	11	0^+	12			1997	β^-=100; β^-n ?	$\ast$
^{114}Tc	−58770#	100#			&	90	ms	20	(1^+)	12	11Ri01	TJ	1994	β^-=100; β^-n=?	$\ast$
^{114}Tc^m	−58438	13	330#	100#	&	100	ms	20	$(4,5)$	12	11Ri01	TJ	2011	β^- ?; β^-n ?	
^{114}Ru	−70222	4				540	ms	30	0^+	12	06Mo07	T	1991	β^-=100; β^-n ?; β^-2n ?	$\ast$
^{114}Rh	−75710	70			$\ast$	1.85	s	0.05	1^+	12			1988	β^-=100	
^{114}Rh^m	−75510#	170#	200#	150#	$\ast$	1.85	s	0.05	(7^-)	12			1987	β^-=100	
^{114}Pd	−83491	7				2.42	m	0.06	0^+	12			1958	β^-=100	
^{114}Ag	−84931	5				4.6	s	0.1	1^+	12			1958	β^-=100	
^{114}Ag^m	−84732	7	199	5		1.50	ms	0.05	$(<6^+)$	12			1990	IT=100	
^{114}Cd	−90014.8	0.4				STABLE		(>92 Py)	0^+	12	95Ge14	T	1925	IS=28.73 42; 2β^- ?	
^{114}In	−88568.4	0.9				71.9	s	0.1	1^+	12			1937	β^-=99.50 15; β^+=0.50 15	
^{114}In^m	−88378.1	0.9	190.2682	0.0008		49.51	d	0.01	5^+	12			1939	IT=96.75 24; β^+=3.25 24	
^{114}In^n	−88066.5	0.9	501.948	0.003		43.1	ms	0.6	8^-	12			1958	IT=100	
^{114}In^p	−87926.7	0.9	641.745	0.003		4.3	μs	0.4	7^+	12			1975	IT=100	$\ast$
^{114}Sn	−90557.3	1.0				STABLE			0^+	12			1927	IS=0.66 1	
^{114}Sn^m	−87469.9	1.0	3087.37	0.07		733	ns	14	7^-	12			1980	IT=100	
^{114}Sb	−84496	22				3.49	m	0.03	3^+	12			1959	β^+=100	
^{114}Sb^m	−84001	22	495.5	0.7		219	μs	12	(8^-)	12			1973	IT=100	
^{114}Te	−81889	28				15.2	m	0.7	0^+	12			1968	β^+=100	
^{114}I	−72800#	300#				2.1	s	0.2	1^+	12			1977	β^+=100; β^+p ?	
^{114}I^m	−72530#	300#	265.9	0.5		6.2	s	0.5	(7)	12	JBl96	D	1995	β^+=91 2; IT=9 2	$\ast$
^{114}Xe	−67086	11				10.0	s	0.4	0^+	12			1977	β^+=100	
^{114}Cs	−54680	70				570	ms	20	(1^+)	12			1978	$\beta^+\approx$100; α=0.018 6; …	$\ast$
^{114}Ba	−45960	110				530	ms	230	0^+	12			1995	$\beta^+\approx$100; β^+p=20 10; …	$\ast$

$\ast^{114}$Mo T : symmetrized from 11Ni01=60(+13–9) $\ast\ast$
$\ast^{114}$Tc T : others, might be mixture of ground-state and m : 06Mo07=91(+62–35) 99Wa09=150(30) $\ast\ast$
$\ast^{114}$Ru T : average 06Mo07=510(+69–65) 92Jo05=530(60) 91Le09=570(50) $\ast\ast$
$\ast^{114}$In^p T : typo in ENSDF2012 : 4.3 ns $\ast\ast$
$\ast^{114}$I^m D : evaluated for NUBASE by J. Blachot, based on ^{114}I IT decay $\ast\ast$
$\ast^{114}$Cs D : …; β^+p=8.7 13; $\beta^+\alpha$=0.19 3 $\ast\ast$
$\ast^{114}$Ba D : …; α=0.9 3; ^{12}C<0.0034 $\ast\ast$
$\ast^{114}$Ba T : symmetrized from 430(+300–150) $\ast\ast$

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{115}Nb	−31350#	500#				10#	ms	(>400 ns)	$5/2^+$#	10	10Oh02	I	2010	β^- ?; β^-n ?; β^-2n ?	
^{115}Mo	−44750#	400#				90	ms	50		10	11Ni01	TD	2010	β^-=100; β^-n ?; β^-2n ?	∗
^{115}Tc	−55910#	200#				85	ms	14	$3/2^-$#	07	11Ni01	T	1994	β^-=100; β^-n=17#	∗
^{115}Ru	−66300	70				322	ms	19	$(3/2^+)$	05	11Ri07	J	1992	β^-=100; β^-n ?	∗
^{115}Ru^m	−66050#	120#	250#	100#		76	ms	6	$(7/2^-)$		10Ku25	TJ	2010	IT=100	
^{115}Rh	−74229	7				990	ms	50	$(7/2^+)$	07	11Ri07	J	1988	β^-=100; β^-n ?	
^{115}Pd	−80427	14				25	s	2	$(1/2^+)$	05	10Ku19	J	1958	β^-=100	∗
^{115}Pd^m	−80338	14	89.18	0.25		50	s	3	$(7/2^-)$	05	10Ku19	J	1987	β^-=92.0 20; IT=8.0 20	∗
^{115}Ag	−84983	18				20.0	m	0.5	$1/2^-$	05			1949	β^-=100	
^{115}Ag^m	−84942	18	41.16	0.10		18.0	s	0.7	$7/2^+$	05			1958	β^-=79.0 3; IT=21.0 3	
^{115}Cd	−88084.4	0.7				53.46	h	0.05	$1/2^+$	05			1939	β^-=100	
^{115}Cd^m	−87903.4	0.9	181.0	0.5		44.56	d	0.24	$11/2^-$	05	FGK127	J	1959	$\beta^-\approx$100; IT<0.003	∗
^{115}In	−89536.343	0.012				441	Ty	25	$9/2^+$	05			1924	IS=95.71 5; β^-=100	
^{115}In^m	−89200.099	0.021	336.244	0.017		4.486	h	0.004	$1/2^-$	05			1961	IT=95.0 7; β^-=5.0 7	
^{115}Sn	−90033.833	0.015				STABLE			$1/2^+$	05			1927	IS=0.34 1	
^{115}Sn^m	−89421.02	0.04	612.81	0.04		3.26	μs	0.08	$7/2^+$	05			1967	IT=100	
^{115}Sn^n	−89320.19	0.12	713.64	0.12		159	μs	1	$11/2^-$	05			1958	IT=100	
^{115}Sb	−87003	16				32.1	m	0.3	$5/2^+$	05			1958	β^+=100	
^{115}Sb^m	−84207	16	2796.26	0.09		159	ns	3	$(19/2)^-$	05			1977	IT=100	
^{115}Te	−82063	28			∗	5.8	m	0.2	$7/2^+$	05			1961	β^+=100	
^{115}Te^m	−82053	29	10	7	∗	6.7	m	0.4	$(1/2)^+$	05	GAu	E	1974	$\beta^+\approx$100; IT<0.06	∗
^{115}Te^n	−81783	28	280.05	0.20		7.5	μs	0.2	$11/2^-$	05			1972	IT=100	
^{115}I	−76338	29				1.3	m	0.2	$5/2^+$#	05			1969	β^+=100	
^{115}Xe	−68657	12				18	s	4	$(5/2^+)$	05			1969	β^+=100; β^+p=0.34 6; …	∗
^{115}Cs	−59700#	300#				1.4	s	0.8	$9/2^+$#	05			1978	β^+=100; β^+p≈0.07	
^{115}Ba	−49030#	500#				450	ms	50	$5/2^+$#	05			1997	β^+=100; β^+p>15	

∗^{115}Mo T : symmetrized from 11Ni01=51(+79–19) ∗∗
∗^{115}Tc T : average 11Ni01=83(+20–13) 06Mo07=73(+32–22) ∗∗
∗^{115}Ru T : average 10Ku25=318(19) 06Mo07=405(+96–80); other 92Ay02=740(80) ∗∗
∗^{115}Ru J : suggested in 11Ri07 from β^- decay study ∗∗
∗^{115}Pd J : previously 04Ur04=$(3/2^+)$ ∗∗
∗^{115}Pd^m J : E3 transition to ground-state, previously 04Ur04=$(9/2^-)$ ∗∗
∗^{115}Cd^m J : measured magnetic moment and L(d,p)=5 ∗∗
∗^{115}Te^m E : less than 20 keV, from ENSDF ∗∗
∗^{115}Xe D : …; α=0.0003 1 ∗∗

^{116}Mo	−41500#	500#				20#	ms	(>400 ns)	0^+	10	10Oh02	I	2010	β^- ?; β^-n ?; β^-2n ?	
^{116}Tc	−51460#	300#				59	ms	13	2^+#	10	11Ni01	TD	1997	β^-=100; β^-n ?; β^-2n ?	∗
^{116}Ru	−64069	4				210	ms	30	0^+	10			1994	β^-=100; β^-n ?	∗
^{116}Rh	−70740	70			∗	685	ms	39	1^+	10	06Mo07	TD	1970	β^-=100; β^-n<2.1	∗
^{116}Rh^m	−70540#	170#	200#	150#	∗	570	ms	50	(6^-)	10			1987	β^-=100	
^{116}Pd	−79832	7				11.8	s	0.4	0^+	10			1970	β^-=100	
^{116}Ag	−82543	3				3.83	m	0.08	(0^-)	10			1958	β^-=100	∗
^{116}Ag^m	−82495	3	47.90	0.10		20	s	1	(3^+)	10			2005	β^-=93.0; IT=7.0	
^{116}Ag^n	−82413	3	129.80	0.22		9.3	s	0.3	(6^-)	10			1970	β^-=92.0; IT=8.0	
^{116}Cd	−88712.56	0.16				30	Ey	4	0^+	10	03Da09	T	1925	IS=7.49 18; 2β^-=100	∗
^{116}In	−88249.75	0.22				14.10	s	0.03	1^+	10			1937	$\beta^-\approx$100; ε=0.023 6	∗
^{116}In^m	−88122.48	0.22	127.267	0.006		54.29	m	0.17	5^+	10			1945	β^-=100	
^{116}In^n	−87960.09	0.22	289.660	0.006		2.18	s	0.04	8^-	10			1950	IT=100	
^{116}Sn	−91525.99	0.10				STABLE			0^+	10			1922	IS=14.54 9	
^{116}Sn^m	−89160.02	0.10	2365.975	0.021		348	ns	19	5^-	10			1964	IT=100	
^{116}Sn^n	−87978.83	0.20	3547.16	0.17		833	ns	30	10^+	10			1978	IT=100	
^{116}Sb	−86822	5				15.8	m	0.8	3^+	10			1949	β^+=100	
^{116}Sb^m	−86728	5	93.99	0.05		194	ns	4	1^+	10			1976	IT=100	
^{116}Sb^n	−86440	40	390	40	BD	60.3	m	0.6	8^-	10			1949	β^+=100	
^{116}Te	−85269	28				2.49	h	0.04	0^+	10			1958	β^+=100	
^{116}I	−77490	100				2.91	s	0.15	1^+	10			1976	β^+=100	
^{116}I^m	−77060	100	430.4	0.5		3.27	μs	0.16	(7^-)	10			1990	IT=100	
^{116}Xe	−73047	13				59	s	2	0^+	10			1969	β^+=100	
^{116}Cs	−62060#	100#			∗	700	ms	40	(1^+)	10	77Bo28	D	1975	β^+=100; β^+p=0.28 7; …	∗
^{116}Cs^m	−61960#	120#	100#	60#	∗	3.85	s	0.13	4^+,5,6	10			1975	β^+=100; β^+p=0.51 15; …	∗
^{116}Ba	−54700#	300#				1.3	s	0.2	0^+	10			1997	β^+=100; β^+p=3 1	
^{116}La	−40700#	220#				10#	ms			10				β^+ ?; β^+p ?; p ?	∗

∗^{116}Tc T : symmetrized from 11Ni01=56(+15–10) ∗∗
∗^{116}Ru T : symmetrized from 06Mo07=204(+32–29) ∗∗
∗^{116}Rh T : average 06Mo07=688(+52–50) 88Ay02=680(60) D : β^-n limit from 06Mo07 ∗∗
∗^{116}Ag T : 230(5) s ∗∗
∗^{116}Cd T : from 29(1 statistics +4–3 systematics) ∗∗
∗^{116}Cd T : 03Da09 supersedes 00Da27=26(1 statistics +7-4 systematics) ∗∗
∗^{116}In D : from 98Bh04; was misprinted “ε=0.23 6” in NUBASE2003 ∗∗
∗^{116}Cs D : …; $\beta^+\alpha$=0.049 25 ∗∗
∗^{116}Cs D : from 77Bo28; ENSDF2010 erroneously gives β^+p=2.8 7 ∗∗
∗^{116}Cs^m D : …; $\beta^+\alpha$=0.008 2 ∗∗
∗^{116}La T : half-life estimate is for β^+ decay; no p-decay within 20 μs-20ms ∗∗

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{117}Mo	−36170#	500#				10#	ms	(>400 ns)		12	10Oh02	I	2010	β^- ?; β^-n ?; β^-2n ?	
^{117}Tc	−48380#	400#				130	ms	70	$3/2^-$#	11	11Ni01	TD	1997	β^-=100; β^-n ?; β^-2n ?	*
^{117}Ru	−59520	590				143	ms	18	$3/2^+$#	11	06Mo07	TD	1994	β^-=100; β^-n=?	*
^{117}Ru^m	−59340	590	184.6	0.5		2.49	μs	0.6			12Ka.B	ETD	2012	IT=100	*
^{117}Rh	−68898	9				421	ms	30	$7/2^+$#	11	06Mo07	TD	1991	β^-=100; β^-n<7.6	*
^{117}Pd	−76425	7				4.3	s	0.3	$(3/2^+)$	11	04Ur04	J	1968	β^-=100	
^{117}Pd^m	−76222	7	203.3	0.3		19.1	ms	0.7	$(9/2^-)$	11	04Ur04	J	1990	IT=100	
^{117}Ag	−82182	14				73.6	s	1.4	$1/2^-$#	11			1958	β^-=100	*
^{117}Ag^m	−82153	14	28.6	0.2		5.34	s	0.05	$7/2^+$#	11			1990	β^-=94.0 15; IT=6.0 15	*
^{117}Cd	−86418.5	1.0				2.49	h	0.04	$1/2^+$	11			1939	β^-=100	
^{117}Cd^m	−86282.1	1.0	136.4	0.2		3.36	h	0.05	$(11/2)^-$	11			1966	β^-≈100; IT≈0	
^{117}In	−88943	5				43.2	m	0.3	$9/2^+$	11			1937	β^-=100	
^{117}In^m	−88628	5	315.303	0.011		116.2	m	0.3	$1/2^-$	11			1940	β^-=52.9 15; IT=47.1 15	
^{117}Sn	−90397.8	0.5				STABLE			$1/2^+$	11			1923	IS=7.68 7	
^{117}Sn^m	−90083.2	0.5	314.58	0.04		14.00	d	0.05	$11/2^-$	12			1950	IT=100	
^{117}Sn^n	−87991.4	0.6	2406.4	0.4		1.75	μs	0.07	$(19/2^+)$	11			1979	IT=100	
^{117}Sb	−88640	8				2.80	h	0.01	$5/2^+$	11			1947	β^+=100	
^{117}Sb^m	−85509	8	3130.76	0.19		355	μs	17	$(25/2)^+$	11			1970	IT=100	
^{117}Sb^n	−85409	8	3230.7	0.2		290	ns	5	$(23/2^-)$	11			1987	IT=100	
^{117}Te	−85095	13				62	m	2	$1/2^+$	11			1958	β^+=100; e$^+$=25 1	
^{117}Te^m	−84799	13	296.1	0.5		103	ms	3	$(11/2^-)$	11	99Mo30	J	1963	IT ?	
^{117}I	−80436	26				2.22	m	0.04	$(5/2)^+$	11			1969	β^+=100; e$^+$≈77	
^{117}Xe	−74185	10				61	s	2	$5/2^{(+)}$	11			1969	β^+=100; β^+p=0.0029 6	
^{117}Cs	−66490	60			*	8.4	s	0.6	$9/2^+$#	11			1972	β^+=100	
^{117}Cs^m	−66340#	100#	150#	80#	*	6.5	s	0.4	$3/2^+$#	11			1978	β^+=100	
^{117}Cs^x	−66440	80	50	50		R =?			spmix						
^{117}Ba	−57620	190				1.75	s	0.07	$(3/2)^{(+\#)}$	11	97Ja12	D	1977	β^+=100; β^+p=13 3; …	*
^{117}La	−46590#	300#				21.7	ms	1.8	$(3/2^+)$	11	11Li28	TJ	2001	p=?; β^+=6.1#; β^+p ?	*
^{117}La^m			non existent		RN	10	ms	5	$(9/2^+)$	11	01So02	I			*

*^{117}Tc T : symmetrized from 11Ni01=89(+95–30) **
*^{117}Ru T : symmetrized from 06Mo07=142(+18–17) **
*^{117}Ru^m T : symmetrized from 12Ka.B=2.487(+0.058–0.055) **
*^{117}Rh T : average 06Mo07=394(+47–43) 91Pe10=440(40) **
*^{117}Ag T : symmetrized from 72.8(+2.0–0.7) **
*^{117}Ag^m J : E3 to ground-state $1/2^-$# **
*^{117}Ba D : …; $\beta^+\alpha$=0.024 8 **
*^{117}Ba D : β^+p from 97Ja12. β^+p/$\beta^+\alpha$=350-1200 from 85Ti02 yields $\beta^+\alpha$=0.011%-0.037% **
*^{117}La T : average 11Li28=20.1(2.5) 01Ma69=24(3) 01So02=22(5) **
*^{117}La^m I : reported in 01So02 with E=121(10) keV. Not observed in 11Li28 **

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{118}Tc	−43790#	400#				30#	ms	(>300 ns)	2^+#	06	95Cz.A	I	2010	β^- ?; β^-n ?; β^-2n ?	
^{118}Ru	−57260#	300#				130	ms	40	0^+	06			1994	β^-=100; β^-n ?	*
^{118}Rh	−64888	24				281	ms	17	$(4^-10)^{(+\#)}$	06	06Mo07	T	1994	β^-=100; β^-n=3.1 14	*
^{118}Pd	−75388.9	2.5				1.9	s	0.1	0^+	06			1969	β^-=100	
^{118}Ag	−79553.8	2.5				3.76	s	0.15	1^-	95	93Ja03	J	1967	β^-=100	
^{118}Ag^m	−79508.0	2.5	45.79	0.09		0.1	μs		$0^{(-)}$to$2^{(-)}$	95			1989	IT=100	
^{118}Ag^n	−79426.2	2.5	127.63	0.10		2.0	s	0.2	$4^{(+)}$	95			1971	β^-=59; IT=41	
^{118}Ag^p	−79274.4	2.5	279.37	0.20		0.1	μs		$(2^+,3^+)$	95			1989	IT=100	
^{118}Cd	−86702	20				50.3	m	0.2	0^+	95			1961	β^-=100	
^{118}In	−87228	8			*	5.0	s	0.5	1^+	95			1949	β^-=100	
^{118}In^m	−87130#	50#	100#	50#	*	4.364	m	0.007	5^+	95	94It.A	T	1964	β^-=100	
^{118}In^n	−86990#	50#	240#	50#		8.5	s	0.3	8^-	95			1969	IT=98.6 3; β^-=1.4 3	*
^{118}Sn	−91652.9	0.5				STABLE			0^+	95			1924	IS=24.22 9	
^{118}Sn^m	−89078.0	0.5	2574.91	0.04		230	ns	10	7^-	95			1961	IT=100	
^{118}Sn^n	−88544.8	0.5	3108.06	0.22		2.52	μs	0.06	(10^+)	95	11Fo15	J	1973	IT=100	
^{118}Sb	−87996	3				3.6	m	0.1	1^+	95			1947	β^+=100	
^{118}Sb^m	−87945	3	50.814	0.021		20.6	μs	0.6	$(3)^+$	95			1975	IT=100	
^{118}Sb^n	−87746	5	250	6	BD	5.00	h	0.02	8^-	95			1947	β^+=100	
^{118}Te	−87697	18				6.00	d	0.02	0^+	95			1948	ε=100	
^{118}I	−80971	20				13.7	m	0.5	2^-	95			1957	β^+=100	
^{118}I^m	−80782	20	188.8	0.7		8.5	m	0.5	(7^-)	95	03Mo36	E	1968	β^+≈100; IT=?	*
^{118}Xe	−78079	10				3.8	m	0.9	0^+	95			1965	β^+=100	
^{118}Cs	−68409	13			*	14	s	2	2	95			1969	β^+=100; β^+p=0.021 14; …	*
^{118}Cs^m	−68310#	60#	100#	60#	*	17	s	3	(7^-)	95	93Be46	J	1972	β^+=100; β^+p=0.021 14; …	*
^{118}Cs^x	−68404	12	5	4		$R < 0.1$			spmix						
^{118}Ba	−62350#	200#				5.2	s	0.2	0^+	06	97Ja12	T	1997	β^+=100	
^{118}La	−49620#	300#				200#	ms							β^+ ?; β^+p ?	

*^{118}Ru T : symmetrized from 06Mo07=123(+48–35) **
*^{118}Rh T : average 06Mo07=266(+22–21) 00Jo18=310(30) J : from 00Jo18 **
*^{118}In^n E : 138.2(0.5) keV above ^{118}In^m, from ENSDF **
*^{118}I^m E : from a least-squares fit to level scheme of 03Mo36 **
*^{118}Cs D : …; $\beta^+\alpha$=0.0012 5 **
*^{118}Cs D : derived from β^+p=0.042(6)%, $\beta^+\alpha$=0.0024(4)% for mixture of ground-state and isomer. **
*^{118}Cs D : Replaced by uniform distributions from zero to values for each isomer **
*^{118}Cs^m D : …; $\beta^+\alpha$=0.0012 5 **

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{119}Tc	−40370#	500#				20#	ms	(>400 ns)	$3/2^-$#	10	10Oh02	I	2010	β^- ?; β^-n ?; β^-2n ?	
^{119}Ru	−52560#	300#				170#	ms	(>300 ns)		09	97Be70	I	1997	β^- ?; β^-n ?; β^-2n ?	
^{119}Ru^m	−52330#	300#	227.1	0.7		384	ns	22			12Ka.B	ETD	2012	IT=100	*
^{119}Rh	−62823	9				171	ms	18	$7/2^+$#	09			1994	β^-=100; β^-n=6.4 16	
^{119}Pd	−71408	8				920	ms	80	$3/2^+$#	09	06Mo07	TD	1991	β^-=100; β^-n=?	*
^{119}Pd^m	−71110#	150#	300#	150#		3#	ms		$11/2^-$#					IT ?; β^- ?	*
^{119}Ag	−78646	15			* &	6.0	s	0.5	$1/2^-$#	09			1975	β^-=100	
^{119}Ag^m	−78626#	25#	20#	20#	* &	2.1	s	0.1	$7/2^+$#	09			1975	β^-=100	*
^{119}Cd	−83980	40				2.69	m	0.02	$1/2^+$	09	12Yo.A	J	1961	β^-=100	*
^{119}Cd^m	−83830	40	146.54	0.11		2.20	m	0.02	$11/2^-$	09	12Yo.A	J	1974	β^-=100	
^{119}In	−87700	7				2.4	m	0.1	$9/2^+$	09			1949	β^-=100	
^{119}In^m	−87389	7	311.37	0.03		18.0	m	0.3	$1/2^-$	09			1973	β^-=95.6; IT=4.4	
^{119}In^n	−87046	7	654.27	0.07		130	ns	15	$(3/2)^+$	09			1974	IT=100	
^{119}In^p	−85043	7	2656.9	1.8		240	ns	25	$(25/2^+)$	09			2002	IT=100	
^{119}Sn	−90065.1	0.7				STABLE			$1/2^+$	09			1925	IS=8.59 4	
^{119}Sn^m	−89975.6	0.7	89.531	0.013		293.1	d	0.7	$11/2^-$	09			1950	IT=100	
^{119}Sn^n	−87938.1	1.2	2127.0	1.0		9.6	μs	1.2	$(19/2^+)$	09			1992	IT=100	
^{119}Sb	−89474	8				38.19	h	0.22	$5/2^+$	09			1947	ε=100	
^{119}Sb^m	−86920	8	2553.6	0.3		130	ns	3	$19/2^-$	09	91Io02	J	1991	IT=100	
^{119}Sb^n	−86622	11	2852	7		850	ms	90	$27/2^+$#	09			1979	IT=100	*
^{119}Te	−87181	8				16.05	h	0.05	$1/2^+$	09			1948	ε=97.94 5; e$^+$=2.06 5	
^{119}Te^m	−86920	8	260.96	0.05		4.70	d	0.04	$11/2^-$	09			1960	ε=99.59 4; e$^+$=0.41 4; IT<0.008	*
^{119}I	−83766	28				19.1	m	0.4	$5/2^+$	09			1954	e$^+$=51 4; ε=49 4	
^{119}Xe	−78794	10				5.8	m	0.3	$5/2^{(+)}$	09	90Ne.A	J	1965	e$^+$=79 5; ε=21 5	
^{119}Cs	−72305	14			*	43.0	s	0.2	$9/2^+$	09	75Ho09	D	1969	β^+=100; $\beta^+\alpha$<2e–6	
^{119}Cs^m	−72260#	30#	50#	30#	*	30.4	s	0.1	$3/2^{(+)}$	09			1978	β^+=100	
^{119}Cs^x	−72289	9	16	11		$R = .5$ .25			spmix						
^{119}Ba	−64590	200				5.4	s	0.3	$(5/2^+)$	09			1974	β^+=100; β^+p=25 2	
^{119}La	−54970#	300#				1#	s		$11/2^-$#					β^+ ?	
^{119}Ce	−44050#	500#				200#	ms		$5/2^+$#					β^+ ?; β^+p ?	
*^{119}Ru^m	T : symmetrized from 12Ka.B=384(+22–21)														**
*^{119}Pd	T : average 06Mo07=918(111) 91Pe04=920(130)														**
*^{119}Ag^m	E : estimated from 7/2$^+$ level in isotopes ^{113}Ag=43 ^{115}Ag=41 ^{117}Ag=28														**
*^{129}Cd	J : laser spectroscopy and magnetic moment in 12Yo.A														**
*^{119}Sb^n	E : estimated less than 20 keV above 2841.7 level														**
^{120}Tc	−35520#	500#				10#	ms	(>400 ns)	0^+	10	10Oh02	I	2010	β^- ?; β^-n ?; β^-2n ?	
^{120}Ru	−50010#	400#				80#	ms	(>300 ns)	0^+	02	95Cz.A	I	2010	β^- ?; β^-n ?	
^{120}Ru^m	−49850#	400#	157.2	0.7		295	ns	16			12Ka.B	ETD	2012	IT=100	*
^{120}Rh	−58820#	200#				126	ms	8		06	06Mo07	TD	1994	β^-=100; β^-n<5.4; β^-2n ?	*
^{120}Pd	−70280.2	2.3				492	ms	33	0^+	02	06Mo07	TD	1993	β^-=100; β^-n<0.7	*
^{120}Ag	−75652	4				1.23	s	0.04	$3^{(+\#)}$	02	93Ru01	D	1971	β^-=100; β^-n<0.003	
^{120}Ag^m	−75449	4	203.0	1.0		371	ms	24	$6^{(-)}$	02	03Wa13	T	1971	β^-≈63; IT≈37	*
^{120}Cd	−83957	4				50.80	s	0.21	0^+	02			1973	β^-=100	
^{120}In	−85730	40			*	3.08	s	0.08	1^+	02			1958	β^-=100	
^{120}In^m	−85680#	50#	50#	60#	* &	46.2	s	0.8	5^+	02	87Eb02	J	1960	β^-=100	
^{120}In^n	−85430#	200#	300#	200#	* &	47.3	s	0.5	$8^{(-)}$	02	79Fo10	J	1960	β^-=100	
^{120}Sn	−91098.6	0.9				STABLE			0^+	02			1926	IS=32.58 9	
^{120}Sn^m	−88617.0	0.9	2481.63	0.06		11.8	μs	0.5	7^-	02			1960	IT=100	
^{120}Sn^n	−88196.4	0.9	2902.22	0.22		6.26	μs	0.11	10^+	02	FGK128	J	1987	IT=100	*
^{120}Sb	−88418	7			*	15.89	m	0.04	1^+	02			1937	β^+=100	
^{120}Sb^m	−88420#	100#	0#	100#	*	5.76	d	0.02	8^-	02			1958	β^+=100	
^{120}Sb^n	−88340	7	78.16	0.05		246	ns	2	(3^+)	02			1976	IT=100	
^{120}Sb^p	−86090	7	2328.3	0.6		400	ns	8		02			1983	IT=100	
^{120}Te	−89368	3				STABLE			0^+	02			1936	IS=0.09 1; 2β^+ ?	
^{120}I	−83753	15				81.67	m	0.18	2^-	02	06Ph01	T	1957	β^+=100	*
^{120}I^m	−83680	15	72.61	0.09		242	ns	5	3^+	02	11Mo27	TJ	1974	IT=100	*
^{120}I^n	−83433	21	320	15		53	m	4	(7^-)	02			1967	β^+=100	
^{120}Xe	−82172	12				46.0	m	0.6	0^+	02	06Ph01	T	1965	β^+=100	
^{120}Cs	−73889	10			*	60.4	s	0.6	$2^{(-\#)}$	02	06Ph01	T	1969	β^+=100; $\beta^+\alpha$<2.0e–5 4; β^+p<7e–6 3	*
^{120}Cs^m	−73790#	60#	100#	60#	*	57	s	6	(7^-)	02	75Ho09	D	1977	β^+=100; $\beta^+\alpha$<2.0e–5 4; β^+p<7e–6 3	*
^{120}Cs^x	−73884	9	5	4		$R < 0.1$			spmix						
^{120}Ba	−68890	300				24	s	2	0^+	02	92Xu04	T	1974	β^+=100	
^{120}La	−57690#	300#				2.8	s	0.2		02			1984	β^+=100; β^+p=?	
^{120}Ce	−49800#	500#				250#	ms		0^+					β^+ ?; β^+p ?	
*^{120}Ru^m	T : symmetrized from 12Ka.B=294(+16–15)														**
*^{120}Rh	T : average 06Mo07=136(+14–13)) 04Wa26=120(10)														**
*^{120}Pd	D : 2ν-$\beta\beta$ decay estimated 150(60) Ey														**
*^{120}Ag^m	T : average 03Wa13=400(30) 71Fo22=320(40)														**
*^{120}Sn^n	J : E2 (from intensity balance) to 8$^+$ I(354.9)/I(65.7)=8.7(1.0)														**
*^{120}I	T : average 06Ph01=82.1(0.6) 00Ho19=81.7(0.2) 65An05=81.0(0.6)														**
*^{120}I^m	T : average 11Mo27=244(5) 74Mu10=228(15)														**
*^{120}Cs	D : isomers not distinguished by 75Ho09 in $\beta^+\alpha$ and β^+p. Values replaced														**
*^{120}Cs	D : by upper limits for both (see ENSDF evaluation of ^{118}Cs)														**
*^{120}Cs	T : average 06Ph01=60.0(7) 93Al03=60(2) 77Ge03=64(3) 69Ch18=61.3(1.4)														**

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{121}Ru	−45050#	400#					60#	ms	(>400 ns)		10	10Oh02	I	2010	β^- ?; β^-n ?; β^-2n ?	
^{121}Rh	−56430#	300#					160	ms	60	$7/2^+$#	10	06Mo07	TD	1994	β^-=100; β^-n=?	*
^{121}Pd	−66182	3					285	ms	24	$3/2^+$#	10			1994	β^-=100; β^-n<0.8	
^{121}Pd^m	−66047	3	135.5	0.5			460	ns	90	$11/2^-$#	10	12Ka.B	ETD	2007	IT=100; β^- ?; β^-n ?	*
^{121}Pd^n	−66000#	40#	180#	40#			460	ns	90			12Ka.B	ETD	2007	IT=100; β^- ?; β^-n ?	*
^{121}Ag	−74403	12				*	780	ms	20	$7/2^+$#	10			1982	β^-=100; β^-n=0.080 13	
^{121}Ag^m	−74383#	23#	20#	20#		*	200#	ms		$1/2^-$#					β^- ?; IT ?	
^{121}Cd	−81073.8	1.9					13.5	s	0.3	$(3/2^+)$	10			1965	β^-=100	
^{121}Cd^m	−80858.9	1.9	214.86	0.15			8.3	s	0.8	$(11/2^-)$	10			1982	β^-=100	
^{121}In	−85836	27					23.1	s	0.6	$9/2^+$	10			1960	β^-=100	
^{121}In^m	−85522	27	313.68	0.07			3.88	m	0.10	$1/2^-$	10			1974	β^-=98.8 2; IT=1.2 2	
^{121}In^n	−83388	27	2448	1			17	μs	2	$(21/2^-)$		10Re01	ETJ	2010	IT=100	*
^{121}Sn	−89197.5	1.0					27.03	h	0.04	$3/2^+$	10			1948	β^-=100	
^{121}Sn^m	−89191.2	1.0	6.31	0.06			43.9	y	0.5	$11/2^-$	10			1962	IT=77.6 20; β^-=22.4 20	
^{121}Sn^n	−87198.7	1.3	1998.8	0.9			5.3	μs	0.5	$(19/2^+)$	10			1995	IT=100	*
^{121}Sn^p	−86362.9	2.1	2834.6	1.8			167	ns	25	$(27/2^-)$	10			1995	IT=100	
^{121}Sb	−89598.6	2.8					STABLE			$5/2^+$	10			1922	IS=57.21 5	
^{121}Sb^m	−86858	12	2741	12			179	μs	6	$(25/2^+)$	10	09Wa02	EJ	2008	IT=100	*
^{121}Te	−88544	26					19.17	d	0.04	$1/2^+$	10			1939	β^+=100	
^{121}Te^m	−88250	26	293.974	0.022			164.2	d	0.8	$11/2^-$	10			1940	IT=88.6 11; β^+=11.4 11	
^{121}I	−86252	5					2.12	h	0.01	$5/2^+$	10			1950	β^+=100	
^{121}I^m	−83875	5	2376.9	0.4			9.0	μs	1.4		10			1982	IT=100	
^{121}Xe	−82481	10					40.1	m	2.0	$5/2^{(+)}$	10			1952	β^+=100	
^{121}Cs	−77102	14					155	s	4	$3/2^{(+)}$	10			1969	β^+=100	
^{121}Cs^m	−77034	14	68.5	0.3			122	s	3	$9/2^{(+)}$	10			1981	β^+=83; IT=17	
^{121}Cs^x	−77056	16	46	8			$R = 21$			spmix						
^{121}Ba	−70740	140					29.7	s	1.5	$5/2^{(+)}$	10	75Bo11	D	1975	β^+=100; β^+p=0.02 1	
^{121}La	−62270#	300#					5.3	s	0.2	$11/2^-$#	10			1988	β^+=100; β^+p ?	
^{121}Ce	−52770#	400#					1.1	s	0.1	$(5/2)^{(+\#)}$	10			1997	β^+=100; β^+p≈1	
^{121}Pr	−41620#	500#					12	ms	5	$(3/2)$	10			2005	p≈100	*

*^{121}Rh T : symmetrized from 06Mo07=151(+67–58) **
*^{121}Pd^m T : symmetrized from 12Ka.B=460(+85–92) E : other 07To23=135(3) keV **
*^{121}Pd^n T : symmetrized from 12Ka.B=463(+83–94) and assuming two cascading isomers **
*^{121}In^n T : other 02Lu15=350(50) ns, assigned J=(25/2$^+$); further studies are needed **
*^{121}In^n E : uncertainty not given, estimated by evaluator **
*^{121}Sn^n E : ^{121}Sn^n=1998.8(0.9) and ^{121}Sn^p=2834.6(1.8) are from ENSDF2000,not in 2010 **
*^{121}Sb^m E : above 2720.9 level and <2761; other 08Jo03=2721.1 + x with x<60 or x<80 **
*^{121}Pr T : symmetrized from 10(+6–3) **

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{122}Ru	−42410#	500#					40#	ms	(>400 ns)	0^+	10	10Oh02	I	2010	β^- ?; β^-n ?; β^-2n ?	
^{122}Ru^m	−42140#	500#	271.0	0.7			830	ns	120			12Ka.B	ETD	2012	IT=100	*
^{122}Rh	−52170#	300#					80#	ms	(>300 ns)		07			1997	β^- ?; β^-n ?; β^-2n ?	
^{122}Pd	−64616	20					175	ms	16	0^+	07			1994	β^-=100; β^-n<2.5	
^{122}Ag	−71110	40				*	529	ms	13	(3^+)	07			1978	β^-=100; β^-n=0.186 10	
^{122}Ag^m	−71030#	60#	80#	50#		*	550	ms	50	(1^-)	07			2000	β^- ?; IT ?; β^-n ?	
^{122}Ag^n	−71030#	60#	80#	50#		*	200	ms	50	(9^-)	07			2000	β^- ?; IT ?; β^-n ?	
^{122}Cd	−80612.4	2.3					5.24	s	0.03	0^+	07			1973	β^-=100	
^{122}In	−83570	50				*	1.5	s	0.3	1^+	07			1963	β^-=100	
^{122}In^m	−83530#	80#	40#	60#		*	10.3	s	0.6	5^+	07			1979	β^-=100	
^{122}In^n	−83290	130	290	140	BD		10.8	s	0.4	(8^-)	07			1979	β^-=100	
^{122}Sn	−89941.5	2.4					STABLE			0^+	07			1928	IS=4.63 3; 2β^- ?	
^{122}Sn^m	−87532.5	2.4	2409.03	0.04			7.5	μs	0.9	7^-	07			1979	IT=100	
^{122}Sn^n	−87175.9	2.6	2765.6	1.0			62	μs	3	(10^+)	07			1992	IT=100	
^{122}Sn^p	−85221.3	2.5	4720.2	0.5			146	ns	15	(15^-)		12As05	EJT	2012	IT=100	
^{122}Sb	−88333.6	2.8					2.7238	d	0.0002	2^-	07			1939	β^-=97.59 12; β^+=2.41 12	*
^{122}Sb^m	−88272.2	2.8	61.4131	0.0005			1.86	μs	0.08	3^+	07			1962	IT=100	
^{122}Sb^n	−88196.1	2.8	137.4726	0.0008			530	μs	30	$(5)^+$	07			1963	IT=100	
^{122}Sb^p	−88170.0	2.8	163.5591	0.0017			4.191	m	0.003	$(8)^-$	07			1947	IT=100	
^{122}Te	−90314.4	1.5					STABLE			0^+	07			1932	IS=2.55 12	
^{122}I	−86080	5					3.63	m	0.06	1^+	07			1950	β^+=100	
^{122}I^m	−85765	5	314.9	0.4			190	ns	10	(7^-)	07	12Mo.A	T	2004	IT=100	
^{122}I^n	−85701	5	379.4	0.5			81	μs	3	(7^-)	07	12Mo.A	T	2004	IT=100	
^{122}I^p	−85686	5	394.1	0.5			81	μs	3	(8^+)	07	12Mo.A	T	2004	IT=100	
^{122}I^q	−85636	5	444.1	0.5			148	ns	5	(8^-)	07	12Mo.A	T	2004	IT=100	
^{122}Xe	−85355	11					20.1	h	0.1	0^+	07			1952	ε=100	
^{122}Cs	−78140	30					21.18	s	0.19	1^+	07	75Ho09	D	1969	β^+=100; $\beta^+\alpha$<2e–7	*
^{122}Cs^m	−78090	30	45.87	0.12			> 1	μs		$(3)^+$	07			1987	IT=100	
^{122}Cs^n	−78005	9	140	30	MD		3.70	m	0.11	8^-	07			1969	β^+=100	
^{122}Cs^p	−78010	30	127.07	0.16			360	ms	20	$(5)^-$	07			1969	IT=100	
^{122}Cs^x	−78130	30	14	7			$R = 0.1.05$			spmix						
^{122}Ba	−74609	28					1.95	m	0.15	0^+	07			1974	β^+=100	
^{122}La	−64540#	300#					8.6	s	0.5		07			1984	β^+=100; β^+p=?	
^{122}Ce	−57870#	400#					2#	s		0^+	07			2005	β^+ ?; β^+p ?	
^{122}Pr	−44950#	500#					500#	ms							β^+ ?; β^+p ?	

*^{122}Ru^m T : symmetrized from 12Ka.B=820(+130–110) **
*^{122}Cs D : $\beta^+\alpha$ intensity upper limit is from 75Ho09 **

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{123}Ru	−37360#	500#					20#	ms	(>400 ns)		10	10Oh02	I	2010	β^- ?; β^-n ?; β^-2n ?	
^{123}Rh	−49510#	400#					60#	ms	(>400 ns)	$7/2^+$#	10	10Oh02	I	2010	β^- ?; β^-n ?; β^-2n ?	
^{123}Pd	−60420#	200#					180	ms	40	$3/2^+$#	04	06Mo07	TD	1994	β^-=100; β^-n=?	*
^{123}Ag	−69550	30				*	300	ms	5	$7/2^+$#	04	06Mo07	D	1976	β^-=100; β^-n=1.0 5	
^{123}Ag^m	−69530#	40#	20#	20#		*	100#	ms		$1/2^-$#					β^- ?; IT ?	
^{123}Ag^n	−68070	60	1481	50			396	ns	37	$(17/2^-)$	09	09St28	TJ	2009	IT=100	*
^{123}Cd	−77414.2	2.7					2.10	s	0.02	$(3/2^+)$	04			1983	β^-=100	
^{123}Cd^m	−77271	3	143	4	MD		1.82	s	0.03	$11/2^-$#	04			1986	β^-=?; IT ?	
^{123}In	−83430	20					6.17	s	0.05	$(9/2)^+$	04			1960	β^-=100	
^{123}In^m	−83103	20	327.21	0.04			47.4	s	0.4	$(1/2)^-$	04			1960	β^-=100	
^{123}In^n	−81352	20	2078.1	0.6			1.4	μs	0.2	$(17/2^-)$		04Sc42	ETJ	2004	IT=100	*
^{123}In^p	−81300	50	2128.1	50.0			> 100	μs		$(21/2^-)$	10	10Re01	EJT	2010	IT=100	*
^{123}Sn	−87816.4	2.4					129.2	d	0.4	$11/2^-$	04			1948	β^-=100	
^{123}Sn^m	−87791.8	2.4	24.6	0.4			40.06	m	0.01	$3/2^+$	04			1948	β^-=100	
^{123}Sn^n	−85871.4	2.6	1945.0	1.0			7.4	μs	2.6	$(19/2^+)$	04			1992	IT=100	
^{123}Sn^p	−85663.4	2.7	2153.0	1.2			6	μs		$(23/2^+)$	04			1994	IT=100	
^{123}Sn^q	−85103.4	2.8	2713.0	1.4			34	μs		$(27/2^-)$	04			1994	IT=100	
^{123}Sb	−89224.8	2.1					STABLE			$7/2^+$	04			1922	IS=42.79 5	
^{123}Sb^m	−86987.0	2.1	2237.8	0.3			214	ns	3	$19/2^-$		09Wa02	ETJ	2005	IT=100	*
^{123}Sb^n	−86611.4	2.1	2613.4	0.4			65	μs	1	$23/2^+$		09Wa02	ETJ	2007	IT=100	*
^{123}Te	−89172.1	1.5					STABLE		(>2 Py)	$1/2^+$	04	03Al02	T	1932	IS=0.89 3; ε=100	
^{123}Te^m	−88924.6	1.5	247.47	0.04			119.2	d	0.1	$11/2^-$	04			1951	IT=100	
^{123}I	−87944	4					13.2235	h	0.0019	$5/2^+$	04			1949	β^+=100	
^{123}Xe	−85249	10					2.08	h	0.02	$1/2^+$	04	90Ne.A	J	1952	β^+=100	
^{123}Xe^m	−85064	10	185.18	0.11			5.49	μs	0.26	$7/2^{(-)}$	04			1981	IT=100	
^{123}Cs	−81044	12					5.88	m	0.03	$1/2^+$	04			1954	β^+=100	
^{123}Cs^m	−80888	12	156.27	0.05			1.64	s	0.12	$(11/2)^-$	04			1972	IT=100	
^{123}Cs^n	−80792	23	252	20			114	ns	5	$(9/2^+)$	04	GAu127	E	2000	IT=100	*
^{123}Cs^x	−81037	13	7	4			$R < 0.1$			spmix						
^{123}Ba	−75655	12					2.7	m	0.4	$5/2^+$	04			1962	β^+=100	
^{123}Ba^m	−75534	12	120.95	0.08			830	ns	60	$1/2^+$#	04			1991	IT=100	
^{123}La	−68650#	200#					17	s	3	$11/2^-$#	04			1978	β^+=100	
^{123}Ce	−60290#	300#					3.8	s	0.2	$(5/2)^{(+\#)}$	04			1984	β^+=100; β^+p=?	
^{123}Pr	−50340#	400#					800#	ms		$3/2^+$#					β^+ ?; β^+p ?	

$*^{123}$Pd T : symmetrized from 174(+38–34) **
$*^{123}$Ag^n E : assumed less than 50 keV above the 1431 keV level **
$*^{123}$In^n E : derived by NUBASE from least-squares fit to γ-ray energies **
$*^{123}$In^p E : no direct depopulating γ seen, assumed less than 50 keV **
$*^{123}$Sb^m E : derived from least-squares fit to γ-ray energies **
$*^{123}$Sb^m ETJ : also 07Ju06 2239.1(1.0) keV, 190(30) ns, $19/2^-$; and **
$*^{123}$Sb^m ETJ : 05Po03 2247.1(0.4) keV, 110(10) ns (conflicting), $(19/2^-)$ **
$*^{123}$Sb^n E : derived from least-squares fit to γ-ray energies **
$*^{123}$Sb^n ETJ : also 07Ju06 2614.1(1.0) keV, 66(4) μs, $23/2^+$; and **
$*^{123}$Sb^n ETJ : 08Jo03 2614.2(0.6) keV, 52(3) μs (conflicting), $23/2^+$ **
$*^{123}$Cs^n E : 231.63 + x; x estimared 20#20 **

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{124}Ru	−34420#	600#					10#	ms	(>400 ns)	0^+	10	10Oh02	I	2010	β^- ?; β^-n ?; β^-2n ?	
^{124}Rh	−45170#	400#					40#	ms	(>400 ns)		10	10Oh02	I	2010	β^- ?; β^-n ?; β^-2n ?	
^{124}Pd	−58550#	300#					50	ms	30	0^+	08			1997	β^-=100; β^-n ?	*
^{124}Pd^m	−58490#	300#	62.2	1.6			> 50	μs				12Ka.B	ET	2012	IT=100; β^- ?	
^{124}Ag	−66200	250				*	172	ms	5	3^+#	08			1984	β^-=100; β^-n=1.3 9	
^{124}Ag^m	−66200#	270#	0#	100#		*	171	ms	10	$(9)^{(-\#)}$	08	11Ba.A	TJ	1995	β^- ?; IT ?	*
^{124}Ag^n	−65970	250	231.1	0.7			1.7	μs	0.3			12Ka.B	ET	2012	IT=100	*
^{124}Cd	−76701.7	3.0					1.25	s	0.02	0^+	08			1974	β^-=100	
^{124}In	−80870	30				*	3.12	s	0.09	$(1)^+$	08			1964	β^-=100	
^{124}In^m	−80890	50	−20	60	BD	*	3.7	s	0.2	$(8)^{(-\#)}$	08			1974	β^-≈100; IT ?	
^{124}Sn	−88234.2	1.0					STABLE		(>100 Py)	0^+	08	52Ka41	T	1922	IS=5.79 5; 2β^- ?	
^{124}Sn^m	−86029.6	1.0	2204.620	0.023			270	ns	60	5^-	08	FGK127	J	1979	IT=100	*
^{124}Sn^n	−85909.2	1.0	2325.01	0.04			3.1	μs	0.5	7^-	08	FGK127	J	1979	IT=100	*
^{124}Sn^p	−85577.6	1.1	2656.6	0.5			45	μs	5	10^+	08	FGK127	J	1992	IT=100	*
^{124}Sn^q	−83682.8	1.2	4551.4	0.7			260	ns	25	15^-		12As05	EJT	2012	IT=100	
^{124}Sb	−87621.0	2.1					60.20	d	0.03	3^-	08			1939	β^-=100	
^{124}Sb^m	−87610.1	2.1	10.8627	0.0008			93	s	5	5^+	08			1947	IT=75 5; β^-=25 5	
^{124}Sb^n	−87584.2	2.1	36.8440	0.0014			20.2	m	0.2	$(8)^-$	08			1947	IT=100	
^{124}Sb^p	−87580.2	2.1	40.8038	0.0007			3.2	μs	0.3	$(3^+,4^+)$	08			1989	IT=100	
^{124}Te	−90525.3	1.5					STABLE			0^+	08			1932	IS=4.74 14	
^{124}I	−87365.7	2.4					4.1760	d	0.0003	2^-	08			1938	β^+=100	

… A-group is continued on next page …

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

. . . *A*-group continued . . .

Nuclide	Mass excess (keV)		Excitation energy (keV)					Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{124}Xe	−87661.1	1.8						STABLE		(>200 Ty)	0^+	08			1922	IS=0.0952 3; 2β^+ ?	
^{124}Cs	−81731	8						30.9	s	0.4	1^+	08			1969	β^+=100	
^{124}Cs^m	−81268	8	462.63	0.14				6.3	s	0.2	$(7)^+$	08			1983	IT=100	
^{124}Cs^x	−81701	22	30	20				$R=?$			spmix						
^{124}Ba	−79090	12						11.0	m	0.5	0^+	08			1967	β^+=100	
^{124}La	−70260	60				∗	&	29.21	s	0.17	$(7^-,8^-)$	08	92Id01	J	1978	β^+=100	
^{124}La^m	−70160#	120#	100#	100#		∗	&	21	s	4	low$^{(+\#)}$	08	92Id01	J	1992	β^+=100	
^{124}Ce	−64920#	300#						9.1	s	1.2	0^+	08	97As05	T	1978	β^+=100	∗
^{124}Pr	−53150#	400#						1.2	s	0.2		08			1986	β^+=100; β^+p=?	
^{124}Nd	−44530#	500#						500#	ms		0^+					β^+ ?; β^+p ?	

∗^{124}Pd T : symmetrized from 38(+38–19) ∗∗
∗^{124}Ag^m T : average 11Ba.A=172(12) and 167(19) ∗∗
∗^{124}Ag^m J : feeding to 8^+ and 10^+ levels in 11Ba.A would be consistent with J=9 ∗∗
∗^{124}Ag^n T : symmetrized from 1.62(+0.29–0.24) ∗∗
∗^{124}Sn^m J : E1 to 4^+; L(p,p)=5 for ^{124}Sn^m; E2 to 5^- for ^{124}Sn^n; E2 to 8^+ for ^{124}Sn^p ∗∗
∗^{124}Ce T : average 97As05=10.8(1.5) 78Bo32=6(2) ∗∗

^{125}Rh	−42210#	500#						20#	ms	(>400 ns)	$7/2^+$#	11	10Oh02	I	2010	β^- ?; β^-n ?; β^-2n ?	
^{125}Pd	−54220#	400#						80#	ms	(>400 ns)	$3/2^+$#	11	08Oh06	I	2008	β^- ?; β^-n=6.2#	∗
^{125}Ag	−64230	600				∗		166	ms	7	$7/2^+$#	11			1994	β^-=100; β^-n=?	
^{125}Ag^m	−64210#	600#	20#	20#		∗		50#	ms		$1/2^-$#					β^- ?; IT ?	
^{125}Ag^n	−62780	600	1453	50				499	ns	21	$(17/2^-)$	11	12Ka.B	ETJ	2009	IT=100	∗
^{125}Cd	−73348.1	2.9						680	ms	40	$3/2^+$#	11			1986	β^-=100	
^{125}Cd^m	−73162	3	186	4	MD			480	ms	30	$11/2^-$#	11			1986	β^-=100	
^{125}Cd^n	−71840	70	1512	70				19	μs	3	$(19/2^+)$		11Si32	EJT	2011	IT=100	∗
^{125}In	−80477	27						2.36	s	0.04	$9/2^+$	11			1967	β^-=100	
^{125}In^m	−80117	27	360.12	0.09				12.2	s	0.2	$1/2^{(-)}$	11			1974	β^-=100	
^{125}In^n	−78468	27	2009.4	0.7				9.4	μs	0.6	$(19/2^+)$	11			1998	IT=100	
^{125}In^p	−78316	27	2161.2	0.9				5.0	ms	1.5	$(23/2^-)$	11			1998	IT=100	
^{125}Sn	−85896.4	1.0						9.64	d	0.03	$11/2^-$	11			1939	β^-=100	
^{125}Sn^m	−85868.9	1.0	27.50	0.14				9.52	m	0.05	$3/2^+$	11			1939	β^-=100	
^{125}Sn^n	−84003.6	1.0	1892.8	0.3				6.2	μs	0.2	$19/2^+$	11	08Lo07	J	2000	IT=100	
^{125}Sn^p	−83836.9	1.1	2059.5	0.4				600	ns	200	$23/2^+$	11	FGK128	J	2008	IT=100	∗
^{125}Sn^q	−83272.9	1.1	2623.5	0.5				230	ns	17	$(27/2^-)$	11	08Lo07	T	2000	IT=100	
^{125}Sb	−88256.3	2.6						2.7586	y	0.0003	$7/2^+$	11			1951	β^-=100	∗
^{125}Sb^m	−86285.1	2.6	1971.25	0.20				4.1	μs	0.2	$15/2^-$	11			2007	IT=100	
^{125}Sb^n	−86144.2	2.6	2112.1	0.3				28.0	μs	0.7	$19/2^-$	11	FGK128	J	2007	IT=100	∗
^{125}Sb^q	−85785.3	2.6	2471.0	0.4				272	ns	16	$(23/2)^+$	11			2007	IT=100	
^{125}Te	−89023.0	1.5						STABLE			$1/2^+$	11			1931	IS=7.07 15	
^{125}Te^m	−88878.2	1.5	144.775	0.008				57.40	d	0.15	$11/2^-$	11			1949	IT=100	
^{125}I	−88837.2	1.5						59.407	d	0.010	$5/2^+$	11			1947	ε=100	
^{125}Xe	−87193.0	1.8						16.9	h	0.2	$1/2^{(+)}$	11			1950	β^+=100	
^{125}Xe^m	−86940.4	1.8	252.61	0.14				56.9	s	0.9	$9/2^{(-)}$	11			1954	IT=100	
^{125}Xe^n	−86897.1	1.8	295.89	0.15				140	ns	30	$7/2^{(+)}$	11			1979	IT=100	
^{125}Cs	−84088	8						46.7	m	0.1	$1/2^{(+)}$	11			1954	β^+=100	
^{125}Cs^m	−83822	8	266.1	1.1				900	μs	30	$(11/2^-)$	11	98Su16	J	1998	IT=100	∗
^{125}Ba	−79669	11						3.3	m	0.3	$1/2^{(+\#)}$	11			1968	β^+=100	
^{125}Ba^m	−79559	23	110	20				2.76	μs	0.14	$(7/2^-)$	11	FGK128	J	1989	IT=100	∗
^{125}La	−73759	26						64.8	s	1.2	$11/2^-$#	11			1973	β^+=100	
^{125}La^m	−73652	26	107.00	0.10				390	ms	40	$(3/2^+)$	11	99Ca21	J	1998	IT=100	∗
^{125}Ce	−66660#	200#						9.7	s	0.3	$(7/2^-)$	11	02Pe15	J	1978	β^+=100; β^+p=?	
^{125}Ce^m	−66570#	200#	93.6	0.4				13	s	10	$(1/2^+)$	11	07Su07	ETJ	2007	IT=100	∗
^{125}Pr	−58030#	300#						3.3	s	0.7	$3/2^+$#	11			2002	β^+=100; β^+p ?	
^{125}Nd	−47600#	400#						650	ms	150	$(5/2)^{(+\#)}$	11			1999	β^+=100; β^+p>0	

∗^{125}Pd I : 08Oh06>400ns (BigRips) 08Be33>300ns (Frs) ∗∗
∗^{125}Ag^n T : other recent 09St28=470(110) ∗∗
∗^{125}Cd^n E : 11Si32=1461.8(0.5) keV above the $11/2^-$ isomer ∗∗
∗^{125}Sn^p J : E2 to $19/2^+$ for ^{125}Sn^p; E2 to $23/2^-$ for ^{125}Sn^q ∗∗
∗^{125}Sb T : rounded from 2.75856(0.00025) ∗∗
∗^{125}Sb^n J : E2 to $15/2^-$ T : others recent 10Re01=25(4) 07Ju06=25(4) ∗∗
∗^{125}Cs^m T : was erroneously 900(30) ms in NUBASE2003 ∗∗
∗^{125}Ba^m E : 67.7(0.4) above $5/2^+$# level at estimated 30#20 J : E1 to $5/2^+$ ∗∗
∗^{125}La^m J : $3/2^+$# from trends in La isotopes; low spin and even-parity from 99Ca21 ∗∗
∗^{125}Ce^m T : symmetrized from 134(+641–61) s for fully ionized ion; icc=38.1 for a ∗∗
∗^{125}Ce^m T : 93.6(0.4) keV, E3 transition; ENSDF quotes 3.4(2.7) s ∗∗

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{126}Rh	−37760#	500#					10#	ms	(>400 ns)		10	10Oh02	I	2010	β^- ?; β^-n ?; β^-2n ?	
^{126}Pd	−52020#	500#					60#	ms	(>400 ns)	0^+	10	08Oh06	I	2008	β^- ?; β^-n ?	
^{126}Ag	−60780#	200#					55	ms	10	2^+#	03	11Ba.A	T	1994	β^-=100; β^-n=?	
^{126}Ag^m	−60680#	220#	100#	100#			98	ms	9	8^-#		11Ba.A	T	1995	β^-=100; IT ?; β^-n ?	
^{126}Ag^n	−60530#	200#	254.8	0.5			> 20	μs				12Ka.B	ET	2012	IT=100	
^{126}Cd	−72256.8	2.5					515	ms	17	0^+	03			1978	β^-=100	
^{126}In	−77773	27				∗	1.53	s	0.01	$3^{(+\#)}$	03			1974	β^-=100	
^{126}In^m	−77710	50	70	60	BD	∗	1.64	s	0.05	$8^{(-\#)}$	03	79Fo10	J	1970	β^-=100	
^{126}In^n	−77530	27	243.3	0.2			22	μs	2	$1^{(-)}$		04Sc42	ETJ	2003	IT=100	
^{126}Sn	−86015	10					230	ky	14	0^+	03			1962	β^-=100	
^{126}Sn^m	−83796	10	2218.99	0.08			5.8	μs	0.7	7^-	03	12As05	T	1979	IT=100	∗
^{126}Sn^n	−83451	10	2564.5	0.5			7.6	μs	0.3	10^+	03	12As05	TJ	2000	IT=100	∗
^{126}Sn^p	−81669	10	4345.7	0.8			160	ns	20	15^-		12As05	EJT	2012	IT=100	
^{126}Sb	−86390	30					12.35	d	0.06	(8^-)	03			1956	β^-=100	
^{126}Sb^m	−86370	30	17.7	0.3			19.15	m	0.08	(5^+)	03			1956	β^-=86 4; IT=14 4	
^{126}Sb^n	−86350	30	40.4	0.3			11	s		(3^-)	03			1976	IT=100	
^{126}Sb^p	−86290	30	104.6	0.3			553	ns	5	(3^+)	03			1976	IT=100	
^{126}Te	−90065.3	1.5					STABLE			0^+	03			1924	IS=18.84 25	
^{126}I	−87911	4					12.93	d	0.05	2^-	03			1938	β^+=52.7 5; β^-=47.3 5	
^{126}I^m	−87800	4	111.00	0.23			128	ns		3^+		12Mo.A	EJT	2012	IT=100	
^{126}Xe	−89146	4					STABLE			0^+	03			1922	IS=0.0890 2; 2β^+ ?	
^{126}Cs	−84350	10					1.64	m	0.02	1^+	03			1954	β^+=100	
^{126}Cs^m	−84077	10	273.0	0.7			> 1	μs			03			1993	IT=100	
^{126}Cs^n	−83754	10	596.1	1.1			171	μs	14		03			1993	IT=100	
^{126}Ba	−82670	12					100	m	2	0^+	03			1954	β^+=100	
^{126}La	−74970	90				∗	54	s	2	$(5)^{(+\#)}$	03			1961	β^+=100	
^{126}La^m	−74760	400	210	410	BD	∗	20	s	20	$(0^-,1^-,2^-)$	03			1997	β^+=100	∗
^{126}Ce	−70821	28					51.0	s	0.3	0^+	03			1978	β^+=100	
^{126}Pr	−60320#	200#					3.12	s	0.18	(4,5,6)	03	88Ba42	T	1983	β^+=100; β^+p=?	∗
^{126}Nd	−52990#	300#					1#	s	(>200 ns)	0^+	03	00So11	I	2000	β^+ ?; β^+p ?	
^{126}Pm	−39200#	500#					500#	ms							β^+ ?; β^+p ?	

∗^{126}Sn^m T : average 12As05=6.6(1.4) 10Tl01=5.6(0.8) ∗∗
∗^{126}Sn^n T : average 12As05=7.7(0.5) 10Tl01=7.5(0.3) ∗∗
∗^{126}La^m T : 97As05: “by far shorter than 50 s” ∗∗
∗^{126}Pr T : average 95Os03=3.14(0.22) 88Ba42=3.0(0.4) 83Ni05=3.2(0.6) ∗∗

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{127}Pd	−47440#	500#					40#	ms	(>400 ns)	$3/2^+$#	12	10Oh02	I	2010	β^- ?; β^-n ?; β^-2n ?	
^{127}Ag	−58580#	200#					79	ms	3	$7/2^+$#	11	96Wo.A	TD	1995	β^-=100; β^-n=?	∗
^{127}Ag^m	−58560#	200#	20#	20#		∗	20#	ms		$1/2^-$#					β^- ?; IT ?	
^{127}Cd	−68491	13				∗	370	ms	70	$3/2^+$#	11			1986	β^-=100; β^-n ?	
^{127}Cd^m	−68490#	100#	0#	100#		∗	200#	ms		$11/2^-$#					β^- ?; IT ?	
^{127}Cd^n	−66930#	100#	1560#	100#			17.5	μs	0.3	$(19/2^+)$		10Na17	ETJ	2010	IT=100	∗
^{127}In	−76898	21					1.09	s	0.01	$9/2^{(+)}$	11	87Eb02	J	1975	β^-=100; β^-n<0.03	
^{127}In^m	−76489	21	408.9	0.3			3.67	s	0.04	$1/2^-$#	11			1974	β^-=100; β^-n=0.69 4	
^{127}In^n	−75030	60	1870	60	BD		1.04	s	0.10	$(21/2^-)$	11			2004	β^-=100; β^-n ?	
^{127}In^p	−74533	21	2364.7	0.9			9	μs	2	$(29/2^+)$	11	04Sc42	ETJ	2004	IT=100	∗
^{127}Sn	−83471	10					2.10	h	0.04	$11/2^-$	11			1951	β^-=100	
^{127}Sn^m	−83466	10	5.07	0.06			4.13	m	0.03	$3/2^+$	11			1962	β^-=100	
^{127}Sn^n	−81644	10	1826.67	0.16			4.52	μs	0.15	$19/2^+$	11	08Lo07	J	2000	IT=100	
^{127}Sn^p	−81540	10	1930.97	0.17			1.26	μs	0.15	$(23/2^+)$	11			2004	IT=100	
^{127}Sn^q	−80919	10	2552.4	1.0			250	ns	30	$(27/2^-)$	11	08Lo07	J	2008	IT=100	
^{127}Sb	−86699	5					3.85	d	0.05	$7/2^+$	11			1939	β^-=100	
^{127}Sb^m	−84779	5	1920.19	0.21			11	μs	1	$15/2^-$	11	09Wa24	J	1974	IT=100	
^{127}Sb^n	−84374	5	2324.7	0.4			234	ns	12	$23/2^+$	11	09Wa24	TJ	2005	IT=100	∗
^{127}Te	−88281.7	1.5					9.35	h	0.07	$3/2^+$	11			1938	β^-=100	
^{127}Te^m	−88193.5	1.5	88.23	0.07			106.1	d	0.7	$11/2^-$	11			1940	IT=97.6 2; β^-=2.4 2	
^{127}I	−88984	4					STABLE			$5/2^+$	11			1920	IS=100.	
^{127}Xe	−88322	4					36.346	d	0.003	$1/2^+$	11			1950	ε=100	
^{127}Xe^m	−88025	4	297.10	0.08			69.2	s	0.9	$9/2^-$	11			1940	IT=100	
^{127}Cs	−86240	6					6.25	h	0.10	$1/2^+$	11			1950	β^+=100	
^{127}Cs^m	−85788	6	452.23	0.21			55	μs	3	$(11/2)^-$	11			1980	IT=100	
^{127}Ba	−82818	11					12.7	m	0.4	$1/2^+$	11			1952	β^+=100	
^{127}Ba^m	−82738	11	80.32	0.11			1.93	s	0.07	$7/2^-$	11			1992	IT=100	
^{127}La	−77896	26					5.1	m	0.1	$(11/2^-)$	11			1963	β^+=100	
^{127}La^m	−77882	26	14.2	0.4			3.7	m	0.4	$(3/2^+)$	11			1963	β^+≈100	
^{127}Ce	−71979	29					34	s	2	$(1/2^+)$	11			1978	β^+=100	
^{127}Ce^m	−71972	29	7.3	1.1			28.6	s	0.7	$5/2^+$#	11			1978	β^+=100	
^{127}Ce^n	−71942	29	36.8	1.2			> 10	μs		$(7/2^-)$	11			1995	IT=100	
^{127}Pr	−64540#	200#					4.2	s	0.3	$3/2^+$#	11			1995	β^+=100	
^{127}Pr^m	−63940#	280#	600#	200#			50#	ms		$11/2^-$	11	98Mo30	J	1998	β^+ ?; IT ?	
^{127}Nd	−55540#	300#					1.8	s	0.4	$5/2^+$#	11			1983	β^+=100; β^+p=?	
^{127}Pm	−44790#	400#					1#	s		$5/2^+$#					β^+ ?; p ?	

∗^{127}Ag T : supersedes 95Fe12=109(25) from same group ∗∗
∗^{127}Cd^n E : 1560.1(0.5) keV above ^{127}Cd^m T : other 12Ka.B=11.0(+9.2–3.5) ∗∗
∗^{127}In^p E : derived by NUBASE from least-squares fit to γ-ray energies ∗∗
∗^{127}Sb^n T : also 05Po03=165(20) conflicting, not used ∗∗

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{128}Pd	−44870#	600#					20#	ms	(>400 ns)	0$^+$	10	10Oh02	I	2010	β^- ?; β^-n ?	
^{128}Ag	−54900#	300#					58	ms	5		01			2000	β^-=100; β^-n=?; β^-2n ?	
^{128}Cd	−67242	7					280	ms	40	0$^+$	01			1986	β^-=100; β^-n ?	
^{128}Cd^m	−65372	7	1870.5	0.4			270	ns	7	(5$^-$)		09Ca02	ETJ	2009	IT=100	
^{128}Cd^n	−64527	7	2714.6	0.5			3.56	μs	0.06	(10$^+$)		09Ca02	ETJ	2009	IT=100	∗
^{128}In	−74150	150					840	ms	60	(3)$^+$	01	93Ru01	D	1975	β^-=100; β^-n=0.038 3	
^{128}In^m	−74060	30	80	160	BD		720	ms	100	(8$^-$)	01			1986	β^-=100	
^{128}In^n	−73900	150	247.87	0.10			23	μs	2	(1)$^-$	01	04Sc42	ETJ	1988	IT=100	
^{128}Sn	−83362	18					59.07	m	0.14	0$^+$	01			1956	β^-=100	
^{128}Sn^m	−81271	18	2091.50	0.11			6.5	s	0.5	(7$^-$)	01			1979	IT=100	
^{128}Sn^n	−80870	18	2491.91	0.17			2.69	μs	0.12	(10$^+$)	01			1981	IT=100	
^{128}Sn^p	−79264	18	4098	1			220	ns	30	(15$^-$)		11Pi05	ETJ	2011	IT=100	
^{128}Sb	−84630	19				∗	9.01	h	0.04	8$^-$	01			1956	β^-=100	
^{128}Sb^m	−84620	18	10	7		∗	10.4	m	0.2	5$^+$	01			1955	β^-=96.4 10; IT=3.6 10	∗
^{128}Te	−88993.7	0.9					2.2	Yy	0.3	0$^+$	01	96Ta04	T	1924	IS=31.74 8; 2β^-=100	∗
^{128}Te^m	−86203.0	1.0	2790.7	0.4			363	ns	27	10$^+$	01	04Va03	T	1998	IT=100	∗
^{128}I	−87739	4					24.99	m	0.02	1$^+$	01			1934	β^-=93.1 8; β^+=6.9 8	
^{128}I^m	−87601	4	137.850	0.004			845	ns	20	4$^-$	01			1982	IT=100	
^{128}I^n	−87572	4	167.367	0.005			175	ns	15	(6)$^-$	01			1991	IT=100	
^{128}Xe	−89860.3	1.1					STABLE			0$^+$	01			1922	IS=1.9102 8	
^{128}Cs	−85932	5					3.640	m	0.014	1$^+$	01	93Al03	T	1951	β^+=100	∗
^{128}Ba	−85379	5					2.43	d	0.05	0$^+$	01			1950	ε=100	
^{128}La	−78630	50				∗	5.18	m	0.14	(5$^+$)	01			1961	β^+=100	
^{128}La^m	−78530#	110#	100#	100#		∗	< 1.4	m		(1$^+$,2$^-$)	01			1995	β^+=100	
^{128}Ce	−75534	28					3.93	m	0.02	0$^+$	01			1968	β^+=100	
^{128}Pr	−66331	30					2.84	s	0.09	(3$^+$)	01	99Xi03	J	1985	β^+=100; β^+p=?	∗
^{128}Nd	−60310#	200#					5#	s		0$^+$	01			1985	β^+ ?	∗
^{128}Pm	−47790#	300#					1.0	s	0.3	(5,6,7)$^{(+\#)}$	01	93Li40	D	1999	$\beta^+\approx$100; β^+p ?; p=0	∗
^{128}Sm	−38730#	500#					500#	ms		0$^+$					β^+ ?; β^+p ?	∗

∗^{128}Cd^n T : other 12Ka.B=3.76(+0.44–0.37) ∗∗
∗^{128}Sb^m E : less than 20 keV above ground state, see ENSDF ∗∗
∗^{128}Te T : see also 92Be30=7.7(0.4) not used for consistency with ^{130}Te (see below) ∗∗
∗^{128}Te^m T : average 04Va03=337(59) 98Zh09=370(30) ∗∗
∗^{128}Cs T : average 93Al03=3.66(0.02) 76He04=3.62(0.02) ∗∗
∗^{128}Pr D : from 85Wi07 ∗∗
∗^{128}Nd T : 83Ni05 gave 4(2) s. Proved, in 85Wi07, to be due to ^{128}Pr, not to ^{128}Nd ∗∗
∗^{128}Pm D : p=0% from 93Li40 J : from 02Xu11 and calculated 6$^+$ ∗∗
∗^{128}Sm D : was erroneously β^+ ?; p ? in NUBASE2003 ∗∗

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{129}Ag	−52210#	300#				∗	44	ms	7	7/2$^+$#	03			2000	β^-=100; β^-n=?	∗
^{129}Ag^m	−52190#	300#	20#	20#		∗	10#	ms		1/2$^-$#	03				β^- ?; β^-n ?	∗
^{129}Cd	−63510#	200#				∗	242	ms	8	3/2$^+$	96	03Pf.A	TD	1986	β^-=100; β^-n=?	∗
^{129}Cd^m	−63510#	280#	0#	200#		∗	104	ms	6	11/2$^-$		03Pf.A	TD	2003	β^-=100; β^-n=?	∗
^{129}In	−72837.9	2.7					611	ms	4	(9/2$^+$)	96	93Ru01	T	1975	β^-=100; β^-n=0.25 5	∗
^{129}In^m	−72379	3	459	4	MD		1.23	s	0.03	(1/2$^-$)	96	04Ga24	J	1976	$\beta^-\approx$100; IT<0.3; …	∗
^{129}In^n	−71149.9	2.7	1688.0	0.5			8.5	μs	0.5	17/2$^-$		03Ge04	ETJ	2003	IT=100	∗
^{129}In^p	−71200	50	1640	50	BD		670	ms	100	23/2$^-$		04Ga24	ETJ	2004	β^-=100	
^{129}In^q	−70926.9	2.7	1911.00	0.20			110	ms	15	29/2$^+$		04Sc42	EJT	2004	IT=100	
^{129}Sn	−80607	19					2.23	m	0.04	3/2$^+$	96	05Le34	J	1962	β^-=100	
^{129}Sn^m	−80572	19	35.2	0.3			6.9	m	0.1	11/2$^-$	96	05Le34	J	1962	$\beta^-\approx$100; IT=0.001#	
^{129}Sn^n	−78846	19	1761.3	1.1			3.49	μs	0.11	19/2$^+$		08Lo07	ETJ	2000	IT=100	∗
^{129}Sn^p	−78805	19	1802.3	1.5			2.22	μs	0.13	23/2$^+$		08Lo07	ETJ	2000	IT=100	∗
^{129}Sn^q	−78054	19	2552.6	1.5			221	ns	18	(27/2$^-$)		08Lo07	EJT	2008	IT=100	∗
^{129}Sb	−84629	21					4.40	h	0.01	7/2$^+$	96			1939	β^-=100	
^{129}Sb^m	−82778	21	1851.05	0.10			17.7	m	0.1	19/2$^-$	96	03Ge04	J	1982	β^-=85; IT=15	
^{129}Sb^n	−82768	21	1860.90	0.10			2.2	μs	0.2	15/2$^-$	96	03Ge04	ETJ	1987	IT=100	
^{129}Sb^p	−82490	21	2138.9	0.5			1.1	μs	0.1	23/2$^+$		03Ge04	ETJ	2003	IT=100	
^{129}Te	−87004.8	0.9					69.6	m	0.3	3/2$^+$	96			1939	β^-=100	
^{129}Te^m	−86899.3	0.9	105.50	0.05			33.6	d	0.1	11/2$^-$	96			1940	IT=63 17; β^-=37 17	
^{129}I	−88507	3					15.7	My	0.4	7/2$^+$	96			1951	β^-=100	
^{129}Xe	−88696.057	0.006					STABLE			1/2$^+$	96			1920	IS=26.4006 82	
^{129}Xe^m	−88459.92	0.05	236.14	0.05			8.88	d	0.02	11/2$^-$	96			1951	IT=100	
^{129}Cs	−87499	5					32.06	h	0.06	1/2$^+$	96			1950	β^+=100	
^{129}Cs^m	−86924	5	575.44	0.05			690	ns	30	(11/2$^-$)	96			1977	IT=100	
^{129}Ba	−85063	11					2.23	h	0.11	1/2$^+$	96			1950	β^+=100	
^{129}Ba^m	−85055	11	8.42	0.06			2.16	h	0.02	7/2$^+$#	96			1950	$\beta^+\approx$100; IT=?	
^{129}La	−81325	21					11.6	m	0.2	3/2$^+$	96			1963	β^+=100	
^{129}La^m	−81153	21	172.1	0.4			560	ms	50	11/2$^-$	96			1969	IT=100	
^{129}Ce	−76287	28					3.5	m	0.3	(5/2$^+$)	97	93Al03	T	1977	β^+=100	∗

… *A*-group is continued on next page …

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

... *A*-group continued ...

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{129}Pr	−69774	30			&	30	s	4	$(3/2^+)$	96	96Gi08	J	1977	β^+=100	
^{129}Pr^m	−69390	30	382.7	0.5	&	1#	ms		$(11/2^-)$		97Gi07	EJD	1997	IT=100	
^{129}Nd	−62320#	200#				6.8	s	0.6	$5/2^+$#	08	10Xu12	T	1977	β^+=100; β^+p=?	*
^{129}Nd^m	−62270#	220#	50#	100#		2.6	s	0.4	$1/2^+$#		10Xu12	TD	2010	β^+=100; β^+p=?	
^{129}Pm	−52880#	300#				2.4	s	0.9	$(5/2^-)$	08			2004	β^+=100; β^+p ?	
^{129}Sm	−42140#	500#				550	ms	100	$(3/2^+,1/2^+)$	08			1999	β^+=100; β^+p ?	

*^{129}Ag T : symmetrized from 46(+5–9) **
*^{129}Ag^m T : 00Kr18≈160 ms is not convincing **
*^{129}Cd J : laser spectroscopy and magnetic moment in 12Yo.A **
*^{129}Cd^m J : laser spectroscopy and magnetic moment in 12Yo.A **
*^{129}In T : average 93Ru01=611(5) 86Wa17=610(10) J : from 04Ga24 **
*^{129}In^m D : ... ; β^-n=2.5 5 **
*^{129}In^n T : other 12Ka.B=11.3(+2.2–1.6) **
*^{129}Sn^n T : average 08Lo07=3.4(0.4) 04Ga24=3.2(0.2) 00Pi03=3.7(0.2) 00Ge07=3.6(0.2) **
*^{129}Sn^n E : for MeV isomers derived from least-squares fit to γ-ray energies **
*^{129}Sn^p T : average 08Lo07=2.4(4) 04Ga24=2.0(2) 00Ge07=2.4(2) **
*^{129}Sn^q T : average 11Pi05=217(19) 08Lo07=270(70) **
*^{129}Ce J : from 96Gi08 (5/2$^+$ in ENSDF was from theory) **
*^{129}Nd T : average 10Xu12=6.7(0.7) 97Gi07=7(1); 85Wi07=4.9(0.2) is for gs+m mixture **

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{130}Ag	−45920#	330#				35	ms	10	0^+	08	05Kr20	T	2000	β^-=100; β^-n=98#; β^-2n=2#	
^{130}Cd	−61530	160				162	ms	7	0^+	08	01Ha39	TD	1986	β^-=100; β^-n=3.5 10	
^{130}Cd^m	−59400	160	2129.5	1.0		240	ns	16	(8^+)	08	12Ka.B	ET	2007	IT=100	*
^{130}In	−69880	40			*	290	ms	20	$1^{(-)}$	08			1973	β^-=100; β^-n=0.93 13	
^{130}In^m	−69830	40	50	50	BD *	540	ms	10	8^-#	08			1973	β^-=100; β^-n=1.65 15	
^{130}In^n	−69480	50	400	60	BD	540	ms	10	(5^+)	08			1986	β^-=100; β^-n=1.65 15	
^{130}In^p	−69490	40	388.3	0.2		5.3	μs	0.4	(3^+)	08	12Ka.B	T	2003	IT=100	*
^{130}Sn	−80132.9	2.1				3.72	m	0.07	0^+	01			1972	β^-=100	
^{130}Sn^m	−78186.0	2.1	1946.88	0.10		1.7	m	0.1	7^-	01	05Le34	J	1974	β^-=100	
^{130}Sn^n	−77698.1	2.1	2434.79	0.12		1.501	μs	0.017	(10^+)	01	11Pi05	T	1981	IT=100	
^{130}Sb	−82286	14				39.5	m	0.8	(8^-)	01	02Ge07	J	1962	β^-=100	
^{130}Sb^m	−82281	14	4.80	0.20		6.3	m	0.2	$(4,5)^+$	01			1962	β^-=100	
^{130}Sb^n	−82201	14	84.67	0.04		800	ns	100	6^-	01	02Ge07	TJ	2002	IT=100	
^{130}Sb^p	−80741	14	1544.7	0.5		1.8	μs	0.2	(13^+)		02Ge07	ETJ	2002	IT=100	
^{130}Te	−87352.947	0.011				790	Ey	100	0^+	01	96Ta04	TD	1924	IS=34.08 62; 2β^-=100	*
^{130}Te^m	−85206.54	0.04	2146.41	0.04		186	ns	11	7^-	01	04Va03	T	1972	IT=100	*
^{130}Te^n	−84685.7	0.8	2667.2	0.8		1.90	μs	0.08	(10^+)	01	04Br19	E	1998	IT=100	*
^{130}Te^p	−82977.5	1.8	4375.4	1.8		261	ns	33		01			1998	IT=100	
^{130}I	−86936	3				12.36	h	0.01	5^+	01			1938	β^-=100	
^{130}I^m	−86896	3	39.9525	0.0013		8.84	m	0.06	2^+	01			1966	IT=84 2; β^-=16 2	
^{130}I^n	−86866	3	69.5865	0.0007		133	ns	7	$(6)^-$	01			1989	IT=100	
^{130}I^p	−86854	3	82.3960	0.0019		315	ns	15	$(8)^-$	01			1989	IT=100	
^{130}I^q	−86851	3	85.1099	0.0010		254	ns	4	$(6)^-$	01			1975	IT=100	
^{130}Xe	−89880.462	0.009				STABLE			0^+	01			1922	IS=4.0710 13	
^{130}Cs	−86900	8				29.21	m	0.04	1^+	01			1952	β^+=98.4; β^-=1.6	
^{130}Cs^m	−86737	8	163.25	0.11		3.46	m	0.06	5^-	01			1977	IT≈100; β^+=0.16 2	
^{130}Cs^x	−86873	17	27	15		$R=.2$		.1	fsmix						
^{130}Ba	−87261.7	2.6				STABLE		(>4.0 Zy)	0^+	01	96Ba24	T	1936	IS=0.106 1; 2β^+ ?	
^{130}Ba^m	−84786.6	2.6	2475.12	0.18		9.54	ms	0.14	8^-	01	02Mo31	T	1969	IT=100	*
^{130}La	−81627	26				8.7	m	0.1	$3^{(+)}$	01			1961	β^+=100	
^{130}Ce	−79423	28				22.9	m	0.5	0^+	01			1965	β^+=100	
^{130}Ce^m	−76969	28	2453.6	0.3		100	ns	8	(7^-)	01			1999	IT=100	
^{130}Pr	−71180	60				40.0	s	0.4	$(6,7)^{(+\#)}$	01	88Ba42	J	1977	β^+=100	
^{130}Pr^m	−71080#	120#	100#	100#		10#	s		2^+#	01	88Ba42	J	1988	β^+ ?	*
^{130}Nd	−66596	28				21	s	3	0^+	01	01Gi17	T	1977	β^+=100	*
^{130}Pm	−55400#	200#				2.6	s	0.2	$(5^+,6^+,4^+)$	01	99Xi03	J	1985	β^+=100; β^+p=?	
^{130}Sm	−47510#	400#				1#	s		0^+	01			1999	β^+ ?	
^{130}Eu	−33820#	500#				1.0	ms	0.4	(1^+)	08			2004	p≈100; β^+=1#; β^+p ?	*

*^{130}Cd^m T : average 12Ka.B=248(+21–19) 07Ju05=220(30) **
*^{130}In^p T : symmetrized from 12Ka.B=5.25(+0.40–0.35); other 04Sc42=3.1(0.3) **
*^{130}Te T : see also numerous (not used) results in 95Tr07 **
*^{130}Te T : treated in ENSDF'01 as a lower limit (not accepted by NUBASE) **
*^{130}Te^m T : other conflicting data: 72Ke28=115(11) J : E1 to 6$^+$, E2 to 4$^+$ **
*^{130}Te^n E : other: less than 25 keV above 2648.57(0.22) (8$^+$) level, see ENSDF'01 **
*^{130}Te^n T : other conflicting data, not used: 98Zh09=4.2(0.9) μs **
*^{130}Ba^m T : others 66Br14=8.8(0.2) 69Wa.A=13.5(1.0) not used **
*^{130}Pr^m J : 88Ba42: there is also a low-spin component in ^{130}Pr activity **
*^{130}Pr^m J : see also the discussion in 01Gi17 on three isomeric states in ^{130}Pr **
*^{130}Nd T : other 00Xu08=13(3) 77Bo02=28(3) conflicting, not used **
*^{130}Eu T : symmetrized from 0.90(+0.49–0.29) D : estim from β^+ half-live=49# ms **

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{131}Cd	−55330#	200#					68	ms	3	$7/2^-$#	06	00Ha55	TD	2000	β^-=100; β^-n=3.5 10; β^-2n ?	
^{131}In	−68025.6	2.7					280	ms	30	$(9/2^+)$	06	93Ru01	D	1976	β^-=100; β^-n=2.2 3	
^{131}In^m	−67660	7	366	8	MD		350	ms	50	$(1/2^-)$	06			1984	$\beta^-\approx$100; . . .	*
^{131}In^n	−64290	90	3740	90	BD		320	ms	60	$(21/2^+)$	06			1984	$\beta^->$99; . . .	*
^{131}In^p	−64242.0	2.7	3783.6	0.5			669	ns	34	$(17/2^+)$		09Go40	TJ	2009	IT=100	*
^{131}Sn	−77272	6					56.0	s	0.5	$3/2^+$	06	05Le34	J	1963	β^-=100	
^{131}Sn^m	−77207	6	65.1	0.3			58.4	s	0.5	$11/2^-$	06	04Fo06	E	1977	β^-=100; IT<0.0004#	*
^{131}Sn^n	−72602	6	4670.0	0.3			304	ns	15	$(23/2^-)$	06	12Ka.B	T	2001	IT=100	*
^{131}Sb	−81981.9	2.1					23.03	m	0.04	$(7/2^+)$	06			1956	β^-=100	
^{131}Sb^m	−80305.8	2.1	1676.06	0.06			91	μs	4	$15/2^-$#	06			1969	IT=100	
^{131}Sb^n	−80294.7	2.3	1687.2	0.9			4.3	μs	0.8	$(19/2^-)$	06			2000	IT=100	
^{131}Sb^p	−79816.3	2.6	2165.6	1.5			1.1	μs	0.2	$(23/2^+)$	06			2000	IT=100	
^{131}Te	−85211.01	0.06					25.0	m	0.1	$3/2^+$	06			1939	β^-=100	
^{131}Te^m	−85028.75	0.06	182.258	0.018			32.48	h	0.11	$11/2^-$	06	08Ea01	T	1940	β^-=74.1 5; IT=25.9 5	
^{131}I	−87442.8	0.6					8.0252	d	0.0006	$7/2^+$	06			1939	β^-=100	
^{131}I^m	−85524.4	0.7	1918.4	0.42			24	μs	1	$19/2^-$		09Wa11	EJT	2009	IT=100	*
^{131}Xe	−88413.63	0.22					STABLE			$3/2^+$	06			1920	IS=21.2324 30	
^{131}Xe^m	−88249.70	0.22	163.930	0.008			11.84	d	0.04	$11/2^-$	06			1966	IT=100	
^{131}Cs	−88059	5					9.689	d	0.016	$5/2^+$	06			1947	ε=100	
^{131}Ba	−86683.9	2.6					11.52	d	0.01	$1/2^+$	06	12Da04	T	1947	β^+=100	
^{131}Ba^m	−86495.9	2.6	187.995	0.009			14.26	m	0.09	$9/2^-$	06	12Da04	T	1963	IT=100	
^{131}La	−83769	28					59	m	2	$3/2^+$	06			1951	β^+=100	
^{131}La^m	−83464	28	304.60	0.24			170	μs	7	$11/2^-$	06			1966	IT=100	
^{131}Ce	−79710	30					10.3	m	0.3	$7/2^+$	06			1966	β^+=100	
^{131}Ce^m	−79650	30	63.09	0.09			5.4	m	0.4	$(1/2^+)$	06	96Gi08	E	1966	β^+=100	
^{131}Pr	−74300	50					1.50	m	0.03	$3/2^+$#	06	96Gi08	T	1977	β^+=100	*
^{131}Pr^m	−74150	50	152.4	0.3			5.73	s	0.20	$(11/2^-)$	06			1996	IT=96.4 12; β^+=3.6 12	
^{131}Nd	−67768	28					25.4	s	0.9	$(5/2)^{(+\#)}$	06			1977	β^+=100; β^+p=?	
^{131}Pm	−59920#	200#					6.3	s	0.8	$(11/2^-)$	06	99Ga41	T	1998	β^+=100	
^{131}Sm	−50130#	400#					1.2	s	0.2	$5/2^+$#	06			1986	β^+=100; β^+p=?	
^{131}Eu	−39270#	400#					17.8	ms	1.9	$3/2^+$	06			1998	p=89 9; β^+ ?; β^+p ?	

∗^{131}In^m D : . . . ; β^-n≤2.0 4; IT≤0.018 ∗∗
∗^{131}In^n D : . . . ; β^-n=0.028 5; IT<1 ∗∗
∗^{131}In^p T : average 12Ka.B=685(+42–39) 09Go40=630(60) J : from 09Go40 ∗∗
∗^{131}Sn^m J : from 05Le34 ∗∗
∗^{131}Sn^n E : 4605.02(0.21) above the 58.4 s 11/2$^-$ level ∗∗
∗^{131}Sn^n T : average 12Ka.B=309(+24–23) 84Fo19=300(20) ∗∗
∗^{131}I^m E : derived from least-squares fit to γ-ray energies ∗∗
∗^{131}Pr T : average 96Gi08=1.57(0.07) 93Al03=1.48(0.02) 83Ga.A=1.58(0.05) ∗∗

^{132}Cd	−50260#	200#					97	ms	10	0^+	05			2000	β^-=100; β^-n=60 15; β^-2n ?	
^{132}In	−62410	60					207	ms	4	(7^-)	05			1973	β^-=100; β^-n=6.3 9; β^-2n ?	
^{132}Sn	−76543.9	2.9					39.7	s	0.8	0^+	05			1963	β^-=100	
^{132}Sn^m	−71695.4	2.9	4848.52	0.20			2.079	μs	0.016	(8^+)	05	12Ka.B	T	1986	IT=100	*
^{132}Sb	−79635.6	2.7					2.79	m	0.07	$(4)^+$	05			1956	β^-=100	
^{132}Sb^m	−79440	30	200	30			4.10	m	0.05	(8^-)	05	89St06	E	1956	β^-=100	
^{132}Sb^n	−79381.1	2.7	254.5	0.3			102	ns	4	(6^-)	05			1974	IT=100	
^{132}Te	−85188	3					3.204	d	0.013	0^+	05			1948	β^-=100	
^{132}Te^m	−83413	3	1774.80	0.09			145	ns	8	6^+	05			1973	IT=100	
^{132}Te^n	−83263	3	1925.47	0.09			28.1	μs	1.5	7^-	05	FGK128	J	1979	IT=100	*
^{132}Te^p	−82465	3	2723.3	0.8			3.70	μs	0.09	(10^+)	05			1979	IT=100	
^{132}I	−85703	4					2.295	h	0.013	4^+	05			1948	β^-=100	
^{132}I^m	−85594	10	110	11	BD		1.387	h	0.015	(8^-)	05			1973	IT=86 2; β^-=14 2	
^{132}Xe	−89278.963	0.005					STABLE			0^+	05			1920	IS=26.9086 33	
^{132}Xe^m	−86526.75	0.17	2752.21	0.17			8.39	ms	0.11	(10^+)	05			1976	IT=100	
^{132}Cs	−87156.2	2.0					6.480	d	0.006	2^+	05			1953	β^+=98.13 9; β^-=1.87 9	
^{132}Ba	−88435.0	1.1					STABLE		(>300 Ey)	0^+	05	96Ba24	T	1936	IS=0.101 1; 2β^+ ?	
^{132}La	−83720	40					4.8	h	0.2	2^-	05			1951	β^+=100	
^{132}La^m	−83530	40	188.20	0.11			24.3	m	0.5	6^-	05			1969	IT=76; β^+=24	
^{132}Ce	−82471	20					3.51	h	0.11	0^+	05			1960	β^+=100	
^{132}Ce^m	−80130	20	2341.15	0.21			9.4	ms	0.3	8^-	05	09Pe31	J	1969	IT=100	
^{132}Pr	−75210	60				*	1.49	m	0.11	(2^+)	05	94Bu18	TJ	1974	β^+=100	*
^{132}Pr^m	−75210#	120#	0#	100#		*	20#	s		(5^+)	05	90Ko25	J	1990	β^+ ?	
^{132}Nd	−71426	24					1.56	m	0.10	0^+	05	95Bu11	T	1977	β^+=100	*
^{132}Pm	−61630#	150#					6.2	s	0.6	(3^+)	05			1977	β^+=100; β^+p≈5e–5	
^{132}Sm	−55080#	300#					4.0	s	0.3	0^+	05			1989	β^+=100; β^+p ?	
^{132}Eu	−42230#	400#					100#	ms			05	93Li40	D		β^+ ?; β^+p ?; p=0	

∗^{132}Sn^m T : average 12Ka.B=2.088(0.017) 94Fo14=2.03(4); other 82Ka25=1.7(2) ∗∗
∗^{132}Te^n J : E1 to 6$^+$ ∗∗
∗^{132}Pr T : average 94Bu18=1.47(0.12) 74Ar27=1.6(0.3) ∗∗
∗^{132}Nd T : average 95Bu11=1.47(0.12) 77Bo02=1.75(0.17) ∗∗

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{133}Cd	−43920#	300#				57	ms	10	$7/2^-$#	11			2010	β^-=100; β^-n=0.47#; β^-2n=98.6#	*
^{133}In	−57460#	200#				165	ms	3	$(9/2^+)$	11	96Ho16	J	1996	β^-=100; β^-n=85 10; β^-2n ?	*
^{133}In^m	−57130#	200#	330#	40#		180#	ms		$(1/2^-)$	11	96Ho16	J	1996	IT ?; β^- ?	
^{133}Sn	−70874.2	2.4				1.46	s	0.03	$(7/2^-)$	11			1973	β^-=100; β^-n=0.0294 24	
^{133}Sb	−78923	3				2.34	m	0.05	$7/2^+$#	11			1966	β^-=100	
^{133}Sb^m	−74360	100	4560	100		16.54	μs	0.19	$(21/2^+)$	11			1978	IT=100	
^{133}Te	−82932	4				12.5	m	0.3	$3/2^+$#	11			1940	β^-=100	
^{133}Te^m	−82598	4	334.26	0.04		55.4	m	0.4	$(11/2^-)$	11			1957	β^-=83.5 20; IT=16.5 20	
^{133}Te^n	−81322	4	1610.4	0.5		100	ns	5	$(19/2^-)$	11			2001	IT=100	
^{133}I	−85887	5				20.83	h	0.08	$7/2^+$	11			1940	β^-=100	
^{133}I^m	−84253	5	1634.148	0.010		9	s	2	$(19/2^-)$	11			1970	IT=100	
^{133}I^n	−84158	5	1729.137	0.010		170	ns		$(15/2^-)$	11			1984	IT=100	
^{133}I^p	−83452	5	2435.00	0.23		780	ns	1606	$(19/2^+)$	11			2004	IT=100	
^{133}I^q	−83393	5	2493.7	0.4		469	ns	15	$(23/2^+)$	11			2009	IT=100	
^{133}Xe	−87643.6	2.4				5.2475	d	0.0005	$3/2^+$	11	02Un02	T	1940	β^-=100	
^{133}Xe^m	−87410.4	2.4	233.221	0.015		2.198	d	0.013	$11/2^-$	11			1951	IT=100	
^{133}Cs	−88070.931	0.008				Stable			$7/2^+$	11			1921	IS=100.	
^{133}Ba	−87553.6	1.0				10.551	y	0.011	$1/2^+$	11			1941	ε=100	
^{133}Ba^m	−87265.3	1.0	288.252	0.009		38.90	h	0.06	$11/2^-$	11	12Da04	T	1941	IT≈100; ε=0.0104 5	*
^{133}La	−85494	28				3.912	h	0.008	$5/2^+$	11			1950	β^+=100	
^{133}Ce	−82418	16				97	m	4	$1/2^+$	11			1951	β^+=100	
^{133}Ce^m	−82381	16	37.2	0.7		5.1	h	0.3	$9/2^-$	11			1951	β^+=100	
^{133}Pr	−77938	12				6.5	m	0.3	$(3/2^+)$	11			1970	β^+=100	
^{133}Pr^m	−77746	12	192.12	0.14		1.1	s	0.2	$(11/2^-)$	11			1995	IT=100	
^{133}Nd	−72330	50				70	s	10	$(7/2^+)$	11			1977	β^+=100	
^{133}Nd^m	−72200	50	127.97	0.12		70	s		$(1/2)^+$	11	95Br24	D	1993	β^+≈100; IT=?	
^{133}Nd^n	−72150	50	176.10	0.10		301	ns	18	$(9/2^-)$	11			1993	IT=100	
^{133}Pm	−65410	50				13.5	s	2.1	$(3/2^+)$	11			1977	β^+=100	
^{133}Pm^m	−65280	50	129.7	0.7		8#	s		$(11/2^-)$	11			1996	β^+ ?; IT ?	*
^{133}Sm	−57230#	300#				2.89	s	0.16	$(5/2^+)$	11			1977	β^+=100; β^+p=?	
^{133}Sm^m	−57110#	310#	120#	60#		3.5	s	0.4	$(1/2^-)$	11			1993	β^+ ?; IT ?; β^+p ?	
^{133}Eu	−47240#	300#				200#	ms		$11/2^-$#					β^+ ?; β^+p ?	
^{133}Gd	−36020#	500#				10#	ms		$5/2^+$#					β^+ ?; β^+p ?	

*^{133}Cd D : delayed neutrons were observed in 05Kr20 **

*^{133}In D : β^-n intensity is from 93Ru01; delayed neutrons were also seen in 02Di12 **

*^{133}Ba^m T : average 12Da04=38.88(0.08) 11Gr01=38.92(0.09) **

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{134}In	−51660#	300#				140	ms	4	high	04	95Jo.A	D	1996	β^-=100; β^-n=65; β^-2n<4	*
^{134}Sn	−66432	3				1.050	s	0.011	0^+	04			1974	β^-=100; β^-n=17 13	
^{134}Sb	−74020.5	1.7				780	ms	60	(0^-)	11			1967	β^-=100; β^-n ?	
^{134}Sb^m	−73741.5	2.0	279	1		10.07	s	0.05	(7^-)	11			1968	β^-=100; β^-n=0.088 4	
^{134}Te	−82536.0	2.8				41.8	m	0.8	0^+	04			1948	β^-=100	
^{134}Te^m	−80844.7	2.8	1691.34	0.16		164.1	ns	0.9	6^+	04			1970	IT=100	
^{134}I	−84059	6				52.5	m	0.2	$(4)^+$	04			1948	β^-=100	
^{134}I^m	−83743	6	316.49	0.22		3.52	m	0.04	$(8)^-$	04			1970	IT=97.7 10; β^-=2.3 10	
^{134}Xe	−88124.3	0.8				Stable		(>11 Py)	0^+	04	89Ba22	T	1920	IS=10.4357 21; 2β^- ?	*
^{134}Xe^m	−86158.8	0.9	1965.5	0.5		290	ms	17	(7^-)	04			1968	IT=100	
^{134}Xe^n	−85099.1	1.7	3025.2	1.5		5	μs	1	(10^+)	04			2001	IT=100	
^{134}Cs	−86891.154	0.016				2.0652	y	0.0004	4^+	04			1940	β^-=100; ε=0.0003 1	
^{134}Cs^m	−86752.410	0.016	138.7441	0.0026		2.912	h	0.002	8^-	04			1975	IT=100	
^{134}Ba	−88950.05	0.28				Stable			0^+	04			1936	IS=2.417 18	
^{134}Ba^m	−85992.9	0.6	2957.2	0.5		2.63	μs	0.14	(10^+)	04			1982	IT=100	
^{134}La	−85219	20				6.45	m	0.16	1^+	04			1951	β^+=100	
^{134}La^m	−84780#	100#	440#	100#		29	μs	4		04			1985	IT=100	*
^{134}Ce	−84833	20				3.16	d	0.04	0^+	04			1951	ε=100	
^{134}Ce^m	−81624	20	3208.6	0.4		308	ns	5	10^+	04			1980	IT=100	
^{134}Pr	−78528	20				17	m	2	2^-	04			1967	β^+=100	
^{134}Pr^m	−78460	20	68	1		11	m		(6^-)	04	11Ti10	E	1973	β^+=100; IT≈0	
^{134}Nd	−75646	12				8.5	m	1.5	0^+	04			1970	β^+=100	
^{134}Nd^m	−73353	12	2293.0	0.4		410	μs	30	$(8)^-$	04			1969	IT=100	
^{134}Pm	−66740	60			* &	22	s	1	(5^+)	04			1977	β^+=100	
^{134}Pm^m	−66740#	120#	0#	100#	* &	5	s		(2^+)	04			1988	β^+=100	
^{134}Pm^n	−66620#	80#	120#	50#		20	μs	1	(7^-)		09Cu02	TJ	2009	IT=100	*
^{134}Sm	−61380#	200#				9.5	s	0.8	0^+	04			1977	β^+=100	
^{134}Eu	−49930#	300#				500	ms	200		04			1989	β^+=100; β^+p=?	
^{134}Gd	−41300#	400#				400#	ms		0^+	04				β^+ ?; β^+p ?	

*^{134}In D : β^-2n intensity limits is from 95Jo.A **

*^{134}Xe D : and >58Zy and >26Zy for 0ν-$\beta\beta$ $0^+\rightarrow0^+$ and $0^+\rightarrow2^+$ respectively **

*^{134}La^m E : 100#100 keV above 336.44(17) level **

*^{134}Pm^m E : 70.7(0.2) keV above a 6^+ state that decays via a low-energy γ to 5^+ **

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^{π}	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{135}In	−46530#	400#				92	ms	10	$9/2^{+}$#	08			2002	β^{-} ?; β^{-}n=95#; β^{-}2n ?	*
^{135}Sn	−60632	3				530	ms	20	$7/2^{-}$#	08			1994	β^{-}=100; β^{-}n=21 3; β^{-}2n ?	
^{135}Sb	−69689.6	2.9				1.679	s	0.015	$(7/2^{+})$	08			1964	β^{-}=100; β^{-}n=22 3	
^{135}Te	−77727.9	2.7				19.0	s	0.2	$(7/2^{-})$	08			1969	β^{-}=100	
^{135}Te^{m}	−76173.0	2.7	1554.89	0.16		511	ns	20	$(19/2^{-})$	08			1980	IT=100	
^{135}I	−83789	5				6.58	h	0.03	$7/2^{+}$	08			1940	β^{-}=100	
^{135}Xe	−86417	4				9.14	h	0.02	$3/2^{+}$	08			1940	β^{-}=100	
^{135}Xe^{m}	−85890	4	526.551	0.013		15.29	m	0.05	$11/2^{-}$	08			1960	IT≈100; β^{-}=0.30 17	*
^{135}Cs	−87581.8	1.0				2.3	My	0.3	$7/2^{+}$	08			1949	β^{-}=100	
^{135}Cs^{m}	−85948.9	1.8	1632.9	1.5		53	m	2	$19/2^{-}$	08			1962	IT=100	
^{135}Ba	−87850.71	0.27				STABLE			$3/2^{+}$	08			1932	IS=6.592 12	
^{135}Ba^{m}	−87582.49	0.27	268.218	0.020		28.11	h	0.02	$11/2^{-}$	08	12Da04	T	1948	IT=100	
^{135}La	−86644	9				19.5	h	0.2	$5/2^{+}$	08			1948	β^{+}=100	
^{135}Ce	−84616	10				17.7	h	0.3	$1/2^{(+)}$	08			1948	β^{+}=100	
^{135}Ce^{m}	−84170	10	445.81	0.21		20	s	1	$(11/2^{-})$	08			1963	IT=100	
^{135}Pr	−80936	12				24	m	1	$3/2^{(+)}$	08			1954	β^{+}=100	
^{135}Pr^{m}	−80578	12	358.06	0.06		105	μs	10	$(11/2^{-})$	08			1973	IT=100	
^{135}Nd	−76214	19				12.4	m	0.6	$9/2^{(-)}$	08			1970	β^{+}=100	
^{135}Nd^{m}	−76149	19	64.95	0.24		5.5	m	0.5	$(1/2^{+})$	08			1970	β^{+}>99.97; IT<0.03	
^{135}Pm	−70030	70				49	s	3	$(5/2^{+},3/2^{+})$	08			1975	β^{+}=100	
^{135}Pm^{m}	−69830#	50#	200#	80#		40	s	3	$(11/2^{-})$	08	89Ko07	TJ	1989	β^{+}=100	*
^{135}Sm	−62860	150			*	10.3	s	0.5	$(7/2^{+})$	08	77Bo02	J	1977	β^{+}=100; β^{+}p=0.02 1	
^{135}Sm^{m}	−62860#	340#	0#	300#	*	2.4	s	0.9	$(3/2^{+},5/2^{+})$	08	89Vi04	TJD	1989	β^{+}=100	*
^{135}Eu	−54150#	200#				1.5	s	0.2	$11/2^{-}$#	08			1989	β^{+}=100; β^{+}p ?	
^{135}Gd	−44290#	400#				1.1	s	0.2	$(5/2^{+})$	08			1996	β^{+}=100; β^{+}p=18	
^{135}Tb	−32830#	400#				1.01	ms	0.28	$(7/2^{-})$	08			2004	p≈100; β^{+} ?	*

*^{135}In D : delayed neutrons were observed in 02Di12 **
*^{135}Xe^{m} D : β^{-} ranging from 0.004% to 0.6% **
*^{135}Pm^{m} E : Trends of $11/2^{-}$ level in Pm isotopes: ^{133}Pm: 129.7(0.7) ^{135}Pm: 150#50 **
*^{135}Pm^{m} E : ^{137}Pm: 150(50) ^{139}Pm: 188.7(0.3) ^{141}Pm: 628.40(0.10) ^{143}Pm: 959.7(0.1) **
*^{135}Pm^{m} E : (N>82) ^{145}Pm: 794.6(0.4) ^{147}Pm: 649.3(0.4) ^{149}Pm: 240.215(0.007) **
*^{135}Pm^{m} E : ENSDF2008 : 68.7 + y **
*^{135}Sm^{m} I : existence of ^{135}Sm^{m} and spins of both states are discussed in ENSDF **
*^{135}Tb T : symmetrized from 940(+330–220) μs **

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^{π}	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{136}Sn	−55900#	400#				290	ms	13	0^{+}	02	11Ar18	TD	1994	β^{-}=100; β^{-}n=28 3; β^{-}2n ?	*
^{136}Sb	−64510	6				923	ms	14	1^{-}#	02			1976	β^{-}=100; β^{-}n=16.3 32; β^{-}2n=0.28#	*
^{136}Sb^{m}	−64233	6	277.0	0.7		570	ns	5	(6^{-})	02	12Ka.B	ET	2001	IT=100	*
^{136}Te	−74425.8	2.4				17.63	s	0.08	0^{+}	02			1974	β^{-}=100; β^{-}n=1.31 5	
^{136}I	−79545	14				83.4	s	1.0	(1^{-})	02			1949	β^{-}=100	
^{136}I^{m}	−79339	5	206	15	BD	46.9	s	1.0	(6^{-})	02			1959	β^{-}=100; IT=0	
^{136}Xe	−86429.152	0.010				STABLE		(>10 Zy)	0^{+}	02	02Be74	T	1920	IS=8.8573 44; 2β^{-} ?	
^{136}Xe^{m}	−84537.449	0.017	1891.703	0.014		2.95	μs	0.09	6^{+}	02			1969	IT=100	
^{136}Cs	−86338.9	1.9				13.16	d	0.03	5^{+}	02			1951	β^{-}=100	
^{136}Cs^{m}	−85821.0	1.9	517.9	0.1		17.5	s	0.2	8^{-}	02	11Wi09	ET	1981	IT=?; β^{-} ?	*
^{136}Ba	−88887.14	0.27				STABLE			0^{+}	02			1932	IS=7.854 24	
^{136}Ba^{m}	−86856.67	0.27	2030.466	0.018		308.4	ms	1.9	7^{-}	02			1965	IT=100	
^{136}Ba^{n}	−85529.7	0.5	3357.4	0.4		91	ns	2	(10^{+})		04Va03	TD	2004	IT=100	*
^{136}La	−86040	50				9.87	m	0.03	1^{+}	02			1950	β^{+}=100	
^{136}La^{m}	−85780	50	259.3	0.4		114	ms	3	$(7)^{(-\#)}$	02	05Bh06	EJ	1966	IT=100	
^{136}Ce	−86508.6	0.4				STABLE		(>38 Py)	0^{+}	02	01Da22	T	1936	IS=0.185 2; 2β^{+} ?	*
^{136}Ce^{m}	−83413.1	0.6	3095.5	0.4		2.2	μs	0.2	10^{+}	02			1991	IT=100	
^{136}Pr	−81340	11				13.1	m	0.1	2^{+}	02			1968	β^{+}=100	
^{136}Nd	−79199	12				50.7	m	0.3	0^{+}	02			1968	β^{+}=100	
^{136}Pm	−71180	70			* &	107	s	6	$(5)^{(+\#)}$	02	FGK12a	J	1982	β^{+}=100	*
^{136}Pm^{m}	−71070	90	110	120	BD * &	47	s	2	(2)	02	FGK12a	I	1988	β^{+}=100	*
^{136}Pm^{n}	−71110	70	68	25		1.5	μs	0.1	8^{+}#	02	08Ri05	ET	1987	IT=100	*
^{136}Sm	−66811	12				47	s	2	0^{+}	02			1982	β^{+}=100	
^{136}Sm^{m}	−64546	12	2264.7	1.1		15	μs	1	(8^{-})	02			1994	IT=100	
^{136}Eu	−56240#	200#			*	3.3	s	0.3	(7^{+})	02	89Vi04	D	1987	β^{+}=100; β^{+}p=0.09 3	
^{136}Eu^{m}	−56240#	540#	0#	500#	*	3.8	s	0.3	(3^{+})	02	89Vi04	D	1987	β^{+}=100; β^{+}p=0.09 3	
^{136}Gd	−49090#	300#				1#	s	(>200 ns)	0^{+}	02	00So11	I	2000	β^{+} ?; β^{+}p ?	
^{136}Tb	−36060#	500#				200#	ms			02				β^{+} ?; β^{+}p ?	

*^{136}Sn T : average 11Ar18=300(15) 02Sh08=250(30) **
*^{136}Sn D : β^{-}n average 11Ar18=27(4)% 02Sh08=30(5)% **
*^{136}Sb^{m} T : others 07Si27=480(100) 01Mi22=570(50) **
*^{136}Cs^{m} E : also 83We07=518(5) **
*^{136}Ba^{n} T : other 04Sh15=94(10) outweighed **
*^{136}Ce T : also 11Be02>18Py; both for 2ν-$\beta\beta$ and 1 σ **
*^{136}Pm J : expected 5^{+} n9/2[514]+p1/2[550]; supported by observed direct feeding **
*^{136}Pm J : to I=4,5,6 levels following ^{136}Pm β^{+} decay **
*^{136}Pm^{m} I : the existence of this level is uncertain **
*^{136}Pm^{n} E : 08Ri05=42.7(0.2) keV above a lonγ-lived state that could be either the **
*^{136}Pm^{n} E : ground-state or an excited level located <50 keV above the ground-state owing to non- **
*^{136}Pm^{n} E : observation of any decay radiation **

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{137}Sn	−49790#	500#					273	ms	7	5/2$^-$#	07	11Ar18	TD	1994	β^-=100; β^-n=50 8; β^-2n ?	
^{137}Sb	−60030	300					484	ms	22	7/2$^+$#	07	11Ar18	TD	1994	β^-=100; β^-n=49 6; β^-2n ?	
^{137}Te	−69304.2	2.5					2.49	s	0.05	3/2$^-$#	07			1975	β^-=100; β^-n=2.99 16	
^{137}I	−76356	8					24.13	s	0.12	7/2$^+$#	07	93Ru01	T	1943	β^-=100; β^-n=7.14 23	*
^{137}Xe	−82383.40	0.10					3.818	m	0.013	7/2$^-$	07			1943	β^-=100	
^{137}Cs	−86545.8	0.3					30.08	y	0.09	7/2$^+$	07			1951	β^-=100	
^{137}Ba	−87721.45	0.28					STABLE			3/2$^+$	07			1932	IS=11.232 24	
^{137}Ba^m	−87059.79	0.28	661.659	0.003			2.552	m	0.001	11/2$^-$	07			1965	IT=100	
^{137}Ba^n	−85372.3	0.6	2349.1	0.5			590	ns	100	(17/2$^-$)	07			1973	IT=100	
^{137}La	−87140.9	1.7					60	ky	20	7/2$^+$	07			1948	ε=100	
^{137}La^m	−85271.4	1.7	1869.50	0.21			342	ns	25	19/2$^-$	07			1982	IT=100	
^{137}Ce	−85918.8	0.4					9.0	h	0.3	3/2$^+$	07			1948	β^+=100	
^{137}Ce^m	−85664.5	0.4	254.29	0.05			34.4	h	0.3	11/2$^-$	07			1958	IT=99.21 4; β^+=0.79 4	
^{137}Pr	−83202	8					1.28	h	0.03	5/2$^+$	07			1958	β^+=100	
^{137}Pr^m	−82641	8	561.22	0.23			2.66	μs	0.07	11/2$^-$	07			1987	IT=100	
^{137}Nd	−79585	12					38.5	m	1.5	1/2$^+$	07			1970	β^+=100	
^{137}Nd^m	−79066	12	519.43	0.20			1.60	s	0.15	11/2$^-$	07			1970	IT=100	
^{137}Pm	−74073	13				&	2#	m		5/2$^+$#				1975	β^+ ?	
^{137}Pm^m	−73930	50	150	50	BD	&	2.4	m	0.1	11/2$^-$	07			1973	β^+=100	
^{137}Sm	−68030	40					45	s	1	(9/2$^-$)	07			1986	β^+=100	
^{137}Sm^m	−67850#	60#	180#	50#			20#	s		1/2$^+$#					β^+ ?	
^{137}Eu	−60120#	200#					8.4	s	0.5	11/2$^-$#	07	88Be.A	T	1982	β^+=100	
^{137}Gd	−51210#	300#					2.2	s	0.2	(7/2)$^{(+\#)}$	07			1999	β^+=100; β^+p=?	
^{137}Tb	−40970#	500#					600#	ms		11/2$^-$#					p ?; β^+ ?	

*^{137}Sb T : average 11Ar18=492(25) 02Sh08=450(50) **
*^{137}Sb D : β^-n average 11Ar18=49(8)% 02Sh08=49(10)% **
*^{137}Te J : syst of N=85 isotones. ENSDF'07 gives (7/2$^-$) from shell-model prediction **
*^{137}Te D : from 93Ru01 evaluation **
*^{137}I T : supersedes 74Ru08=24.5(0.2) from same group **

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{138}Sn	−44860#	600#					100#	ms	(>400 ns)	0$^+$	10	10Oh02	I	2010	β^- ?; β^-n ?; β^-2n ?	
^{138}Sb	−54540#	300#					350	ms	15	2$^-$#	03	11Ar18	TD	1994	β^-=100; β^-n=72 8; β^-2n ?	
^{138}Te	−65696	4					1.4	s	0.4	0$^+$	03			1975	β^-=100; β^-n=6.3 21	
^{138}I	−71980	6					6.23	s	0.03	(1$^-$)	03	93Ru01	D	1949	β^-=100; β^-n=5.46 18	*
^{138}I^m	−71912	6	67.9	0.5			1.26	μs	0.16	(3$^-$)	03	07Rz01	EJT	2007	IT=100	*
^{138}Xe	−79972.2	2.8					14.08	m	0.08	0$^+$	03			1943	β^-=100	
^{138}Cs	−82887	9					33.41	m	0.18	3$^-$	03			1943	β^-=100	
^{138}Cs^m	−82807	9	79.9	0.3			2.91	m	0.08	6$^-$	03			1971	IT=81 2; β^-=19 2	
^{138}Cs^x	−82847	25	40	23			$R=$?			fsmix						
^{138}Ba	−88261.86	0.29					STABLE			0$^+$	03			1925	IS=71.698 42	
^{138}Ba^m	−86171.32	0.30	2090.54	0.06			800	ns	100	6$^+$	03			1971	IT=100	
^{138}La	−86522	3					102	Gy	1	5$^+$	03			1947	IS=0.08881 71; …	*
^{138}La^m	−86449	3	72.57	0.03			116	ns	5	(3)$^+$	03			1975	IT=100	
^{138}Ce	−87569	10					STABLE		(>57 Py)	0$^+$	03	11Be02	T	1936	IS=0.251 2; 2β^+ ?	*
^{138}Ce^m	−85440	10	2129.17	0.12			8.65	ms	0.20	7$^-$	03			1960	IT=100	
^{138}Pr	−83132	14					1.45	m	0.05	1$^+$	03			1951	β^+=100	
^{138}Pr^m	−82781	18	351	19	BD		2.12	h	0.04	7$^-$	03			1958	β^+=100	
^{138}Nd	−82018	12					5.04	h	0.09	0$^+$	03			1965	β^+=100	
^{138}Nd^m	−78843	12	3174.9	0.4			410	ns	50	10$^+$	03			1975	IT=100	
^{138}Pm	−74940	28				*	10	s	2	1$^+$#	03			1981	β^+=100	
^{138}Pm^m	−74911	13	30	30	BD	*	3.24	m	0.05	5$^-$#	03			1973	β^+=100	
^{138}Pm^n			non existent		EU		3.24	m	0.05	(3$^+$)		81De38	I		β^+=100	*
^{138}Sm	−71498	12					3.1	m	0.2	0$^+$	03			1982	β^+=100	
^{138}Eu	−61750	28					12.1	s	0.6	(6$^-$)	03			1982	β^+=100	
^{138}Gd	−55660#	200#					4.7	s	0.9	0$^+$	03			1985	β^+=100	
^{138}Gd^m	−53430#	200#	2233.1	0.5			6.2	μs	0.2	(8$^-$)	03	11Pr02	T	1997	IT=100	*
^{138}Tb	−43670#	300#					800#	ms	(>200 ns)		03	00So11	I	1993	β^+ ?; β^+p ?; p=0	*
^{138}Dy	−34930#	400#					200#	ms		0$^+$					β^+ ?; β^+p ?	

*^{138}I J : from 07Rz01 **
*^{138}I^m E : unc. assigned by evaluator J : 67.9 E2 γ ray (delayed) to (1$^-$) **
*^{138}La D : …; β^+=65.6 5; β^-=34.4 5 **
*^{138}Ce T : also 01Da22>150Ty; both for 2ν-$\beta\beta$ and 1 σ **
*^{138}Pm^n D : arguments for a second isomer of intermediate spin are not convincing **
*^{138}Gd^m E : for least-squares fit to γ-ray energies in 11Pr02 **
*^{138}Tb D : from 93Li40 **

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{139}Sb	−49790#	400#				93	ms	13	$7/2^+$#	01	11Ar18	TD	1994	β^-=100; β^-n=90 10; β^-2n ?	
^{139}Te	−60205	4				500#	ms	(>150 ns)	$5/2^-$#	01	94Be24	I	1994	β^- ?; β^-n ?	
^{139}I	−68459	29				2.282	s	0.010	$7/2^+$#	01	93Ru01	T	1949	β^-=100; β^-n=10.0 3	*
^{139}Xe	−75644.6	2.1				39.68	s	0.14	$3/2^-$	01			1951	β^-=100	
^{139}Cs	−80701	3				9.27	m	0.05	$7/2^+$	01			1939	β^-=100	
^{139}Ba	−84913.97	0.29				83.25	m	0.08	$(7/2^-)$	01	12Da04	T	1937	β^-=100	*
^{139}La	−87228.6	2.3				STABLE			$7/2^+$	01			1924	IS=99.91119 71	
^{139}La^m	−85428.7	2.4	1799.9	0.5		315	ns	35	$(17/2^+)$		12As06	T	2012	IT=100	
^{139}Ce	−86950	7				137.641	d	0.020	$3/2^+$	01			1948	ε=100	
^{139}Ce^m	−86196	7	754.24	0.08		56.54	s	0.13	$11/2^-$	01	94It.A	T	1967	IT=100	
^{139}Pr	−84821	8				4.41	h	0.04	$5/2^+$	01			1951	β^+=100	
^{139}Nd	−82015	28				29.7	m	0.5	$3/2^+$	01			1951	β^+=100	
^{139}Nd^m	−81784	28	231.15	0.05		5.50	h	0.20	$11/2^-$	01			1951	β^+=88.2 4; IT=11.8 4	
^{139}Nd^n	−79400#	60#	2620#	50#		272	ns	4		01	08Fe02	T	1980	IT=100	*
^{139}Pm	−77501	14				4.15	m	0.05	$(5/2)^+$	01			1967	β^+=100	
^{139}Pm^m	−77312	14	188.7	0.3		180	ms	20	$(11/2)^-$	01			1975	IT≈100; β^+=0.16#	
^{139}Sm	−72380	11				2.57	m	0.10	$1/2^+$	01			1971	β^+=100	
^{139}Sm^m	−71923	11	457.40	0.22		10.7	s	0.6	$11/2^-$	01			1973	IT=93.7 5; β^+=6.3 5	
^{139}Eu	−65398	13				17.9	s	0.6	$(11/2)^-$	01			1975	β^+=100	
^{139}Eu^m	−65250	13	148.2	0.2		10	μs	2	$(7/2^+)$		11Cu01	ETJ	2011	IT=100	
^{139}Gd	−57630#	200#			*	5.7	s	0.3	$9/2^-$#	01	99Xi04	T	1983	β^+=100; β^+p=?	*
^{139}Gd^m	−57380#	250#	250#	150#	*	4.8	s	0.9	$1/2^+$#	01			1983	β^+=100; β^+p=?	*
^{139}Tb	−48130#	300#				1.6	s	0.2	$11/2^-$#	01			1999	β^+=100; β^+p ?	
^{139}Dy	−37640#	500#				600	ms	200	$(7/2^+)$	01			1999	β^+=100; β^+p ?	

*^{139}I T : average 93Ru01=2.280(0.011) 80Al15=2.29(0.02) **
*^{139}Ba T : average 12Da04=83.25(0.08) 72Em01=82.71(0.18) 62Fr04=82.9(0.2) **
*^{139}Ba T : other not used 80Ge04=83.06(0.28) **
*^{139}Nd^n T : 80Mu10 > 141 ns E : 50#50 keV above 2570.9(0.6) level **
*^{139}Gd T : average 99Xi04=5.8(0.9) 88Be.A=5.8(0.4); other 83Ni05=4.9(1.0) not used **
*^{139}Gd T : since it corresponds to a mixture of ground-state and isomer **
*^{139}Gd^m D : assuming that the delayed protons reported in 83Ni05 are from both states **

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{140}Sb	−43940#	600#				100#	ms	(>400 ns)	2^-#	10	10Oh02	I	2010	β^- ?; β^-n=50#; β^-2n=16#	
^{140}Te	−56357	28				300#	ms	(>300 ns)	0^+	07			1994	β^- ?; β^-n ?	
^{140}I	−63600	180				860	ms	40	(4^-)	07			1972	β^-=100; β^-n=9.3 10; β^-2n ?	
^{140}Xe	−72986.5	2.3				13.60	s	0.10	0^+	07			1951	β^-=100	
^{140}Cs	−77050	8				63.7	s	0.3	1^-	07			1950	β^-=100	
^{140}Cs^m	−77036	8	13.931	0.021		471	ns	51	$(2)^-$	07			1974	IT=100	
^{140}Ba	−83270	8				12.7527	d	0.0023	0^+	07			1939	β^-=100	
^{140}La	−84318.2	2.3				40.285	h	0.003	3^-	07			1935	β^-=100	
^{140}Ce	−88079.2	2.2				STABLE			0^+	07			1925	IS=88.450 51	
^{140}Ce^m	−85971.3	2.2	2107.86	0.03		7.3	μs	1.5	6^+	07			1966	IT=100	
^{140}Pr	−84691	6				3.39	m	0.01	1^+	07			1938	e$^+$=51.3 18; ε=48.7 18	*
^{140}Pr^m	−84563	6	127.8	0.3		350	ns	20	5^+	07			1964	IT=100	
^{140}Pr^n	−83927	6	763.7	0.5		3.05	μs	0.20	$(7)^-$	07			1964	IT=100	
^{140}Nd	−84254	26				3.37	d	0.02	0^+	07			1949	ε=100	
^{140}Nd^m	−82033	26	2221.4	0.1		600	μs	50	7^-	07			1962	IT=100	
^{140}Nd^n	−76824	26	7429.6	0.7		1.23	μs	0.07	20^+		08Fe02	ETJ	2008	IT=100	*
^{140}Pm	−78210	40				9.2	s	0.2	1^+	07			1966	β^+=100	
^{140}Pm^m	−77782	13	430	40	BD	5.95	m	0.05	8^-	07			1966	β^+=100	
^{140}Sm	−75456	12				14.82	m	0.12	0^+	07			1967	β^+=100	
^{140}Eu	−66990	50				1.51	s	0.02	1^+	07			1982	β^+=100	
^{140}Eu^m	−66780	50	210	15		125	ms	2	(5^-)	07			1988	IT≈100; β^+<1	*
^{140}Eu^n	−66320	50	669	15		299.8	ns	2.1	(8^+)	07			2002	IT=100	*
^{140}Gd	−61782	28				15.8	s	0.4	0^+	07			1985	β^+=100	
^{140}Tb	−50480	800				2.32	s	0.16	(7^+)	07	06Xu03	T	1986	β^+=100; β^+p=0.26 13	*
^{140}Dy	−42830#	500#				700#	ms		0^+	07			2002	β^+ ?; β^+p ?	
^{140}Dy^m	−40660#	500#	2166.1	0.5		7.0	μs	0.5	(8^-)	07			2002	IT=100	
^{140}Ho	−29260#	500#				6	ms	3	8^+#	07			1999	p=?; β^+=1#; β^+p ?	*

*^{140}Pr T : other: 07Li71=7.3(0.4) for q=59$^+$ (bare ion) 3.04(0.10) for q=58$^+$ **
*^{140}Pr T : (H-like ion) and 3.84(0.15) for q=57$^+$ (He–like ion) **
*^{140}Pr D : e$^+$=42.4(2.3)%; ε=57.6(2.3)% for q=58$^+$ (H-like ion) and **
*^{140}Pr D : e$^+$=51.2(3.1)%; ε=48.8(3.1)% for q=57$^+$ (He–like ion) **
*^{140}Nd^n E : uncertainty not given, estimated by evaluator **
*^{140}Eu^m E : less than 50 keV above 185.3 level, from ENSDF, thus 185.3 + 25(15) **
*^{140}Eu^n E : 459.5(0.3) keV above ^{140}Eu^m **
*^{140}Tb T : average 06Xu03=2.0(0.5) 00Xu08=2.1(0.4) 91Fi03=2.4(0.2) 86Wi15=2.4(0.4) **
*^{140}Ho D : from estimated β^+ half-life 400# ms; p observed in 99Ry04 **

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{141}Te	−50490#	400#					150#	ms	(>150 ns)	$5/2^-$#	01	94Be24	I	1994	β^- ?; β^-n ?; β^-2n ?	
^{141}I	−59900#	200#					430	ms	20	$7/2^+$#	01			1974	β^-=100; β^-n=21 3	*
^{141}Xe	−68197.3	2.9					1.73	s	0.01	$5/2^{(-\#)}$	01			1951	β^-=100; β^-n=0.044 5	
^{141}Cs	−74477	9					24.84	s	0.16	$7/2^+$	01			1962	β^-=100; β^-n=0.035 3	
^{141}Ba	−79733	5					18.27	m	0.07	$3/2^-$	01			1945	β^-=100	
^{141}La	−82935	4					3.92	h	0.03	$(7/2^+)$	01			1951	β^-=100	
^{141}Ce	−85436.0	2.2					32.508	d	0.013	$7/2^-$	01			1948	β^-=100	
^{141}Pr	−86016.4	2.1					STABLE			$5/2^+$	01			1924	IS=100.	
^{141}Nd	−84193	4					2.49	h	0.03	$3/2^+$	01			1949	β^+=100	
^{141}Nd^m	−83436	4	756.51	0.05			62.0	s	0.8	$11/2^-$	01	70Ab05	D	1960	IT≈100; β^+=0.032 8	
^{141}Pm	−80523	14					20.90	m	0.05	$5/2^+$	01			1952	β^+=100	
^{141}Pm^m	−79895	14	628.40	0.10			630	ns	20	$11/2^-$	01			1970	IT=100	
^{141}Pm^n	−77992	14	2530.9	0.5			> 2	μs			01			1985	IT=100	
^{141}Sm	−75934	9					10.2	m	0.2	$1/2^+$	01			1967	β^+=100	
^{141}Sm^m	−75758	9	176.0	0.3			22.6	m	0.2	$11/2^-$	01			1967	β^+≈100; IT=0.31 3	
^{141}Eu	−69926	13					40.7	s	0.7	$5/2^+$	01			1977	β^+=100	
^{141}Eu^m	−69830	13	96.45	0.07			2.7	s	0.3	$11/2^-$	01			1973	IT=86 3; β^+=14 3	*
^{141}Gd	−63224	20					14	s	4	$(1/2^+)$	01			1986	β^+=100; β^+p=0.03 1	*
^{141}Gd^m	−62846	20	377.8	0.2			24.5	s	0.5	$(11/2^-)$	01			1986	β^+=89 2; IT=11 2	
^{141}Tb	−54540	110				*	3.5	s	0.2	$(5/2^-)$	01			1986	β^+=100	
^{141}Tb^m	−54540#	230#	0#	200#	EU	*	7.9	s	0.6	$11/2^-$#	01	88Be.A	I	1988	β^+=100	*
^{141}Dy	−45380#	300#					900	ms	140	$(9/2^-)$	01	06Xu03	T	1984	β^+=100; β^+p=?	*
^{141}Ho	−34360#	500#					4.1	ms	0.3	$(7/2^-)$	02			1998	p=?; β^+=1#; β^+p ?	*
^{141}Ho^m	−34290#	500#	66	2			7.28	μs	0.28	$(1/2^+)$	02	01Se03	ET	1998	p=100	*

*^{141}I D : rounded from 21.2 30; 80Al15=21.2(3.0) included in 93Ru01=22(3) **

*^{141}Eu^m D : symmetrized from IT=87(+2–4)% and β^+=13(+4–2)% **

*^{141}Gd J : weak arguments in ENSDF'2001 for Jpi assignment; same for ^{141}Gd^m **

*^{141}Tb^m I : existence discussed in 88Be.A. Provisionally accepted **

*^{141}Dy T : average 06Xu03=900(200) 86Wi15=900(200) **

*^{141}Ho D : from estimated β^+ half-life 200# ms **

*^{141}Ho^m T : average 08Ka16=7.4(0.3) 01Se03=6.5(+0.9–0.7); other not used 99Ry04=8(3) **

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{142}Te	−46370#	500#					100#	ms	(>150 ns)	0^+	11	94Be24	I	1994	β^- ?; β^-n ?; β^-2n ?	
^{142}I	−54770	370					222	ms	12	2^-#	11			1975	β^-=100; β^-n=25#; β^-2n ?	
^{142}Xe	−65229.6	2.7					1.23	s	0.02	0^+	11			1960	β^-=100; β^-n=0.21 6	*
^{142}Cs	−70518	7					1.684	s	0.014	0^-	11			1962	β^-=100; β^-n=0.090 4	
^{142}Ba	−77843	6					10.6	m	0.2	0^+	11			1959	β^-=100	*
^{142}La	−80024	6					91.1	m	0.5	2^-	11			1953	β^-=100	
^{142}La^m	−79878	6	145.82	0.08			870	ns	170	$(4)^-$	11			1983	IT=100	
^{142}Ce	−84532.7	2.7					STABLE		(>50 Py)	0^+	11			1925	IS=11.114 51; α ?; 2β^- ?	*
^{142}Pr	−83788.3	2.1					19.12	h	0.04	2^-	11			1935	β^-≈100; ε=0.0164 8	
^{142}Pr^m	−83784.6	2.1	3.694	0.003			14.6	m	0.5	5^-	11			1967	IT=100	
^{142}Nd	−85949.9	1.8					STABLE			0^+	11			1924	IS=27.152 40	
^{142}Pm	−81142	24					40.5	s	0.5	1^+	11			1959	e$^+$=77.1 27; ε=22.9 27	
^{142}Pm^m	−80259	24	883.17	0.16			2.0	ms	0.2	$(8)^-$	11			1971	IT=100	
^{142}Pm^n	−78313	24	2828.7	0.6			67	μs	5	(13^-)	11			1974	IT=100	
^{142}Sm	−78987	3					72.49	m	0.05	0^+	11			1959	β^+=100	
^{142}Sm^m	−76615	3	2372.1	0.4			170	ns	2	7^-	11			1975	IT=100	
^{142}Sm^n	−75325	3	3662.2	0.7			480	ns	60	10^+	11			1979	IT=100	
^{142}Eu	−71310	30					2.36	s	0.10	1^+	11	91Fi03	T	1966	β^+=100	*
^{142}Eu^m	−70856	12	460	30	BD		1.223	m	0.008	8^-	11			1966	β^+=100	
^{142}Gd	−66960	28					70.2	s	0.6	0^+	11			1986	ε=52 5,e$^+$=48 5	
^{142}Tb	−56560	700					597	ms	17	1^+	11			1991	β^+=100; β^+p=0.0022 11	
^{142}Tb^m	−56280	700	279.7	0.4			303	ms	17	5^-	11			1986	IT=100	
^{142}Tb^n	−55910	700	652.1	0.6			26	μs	1	8^+	11			1989	IT=100	
^{142}Dy	−50120#	730#					2.3	s	0.3	0^+	11			1986	β^+=100; β^+p=0.06 3	
^{142}Ho	−37250#	500#					400	ms	100	$(7^-,8^+)$	11			2001	β^+≈100; β^+p=?; p≈0	*
^{142}Er	−27850#	500#					10#	μs		0^+					p ?	

*^{142}Xe D : 03Be05=0.21(6) 75As04=0.406(0.034) T 03Be05=1.250(0.025) **

*^{142}Ba D : β^-n=0.091(0.003)% in ENSDF'00 contradicts $Q(\beta^-\mathrm{n})$=–2979(7) keV **

*^{142}Ce T : lower limit is for α decay; for $\beta\beta$ decay 11Be02>300Py 01Da22>260 Py **

*^{142}Pm T : other: 09Wi09=56(3) for q=61$^+$ (bare ion) 39.2(0.7) for q=60$^+$ **

*^{142}Pm T : (H-like ion) and 39.6(1.4) for q=59$^+$ (He–like ion) **

*^{142}Pm D : e$^+$=71.0(1.3)%; ε=29.0(1.3)% for q=60$^+$ (H-like ion) and **

*^{142}Pm D : e$^+$=79.8(1.0)%; ε=20.2(1.0)% for q=59$^+$ (He–like ion) **

*^{142}Eu T : average 91Fi03=2.34(0.12) 75Ke08=2.4(0.2) **

*^{142}Ho D : p=0 from 93Li40 **

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{143}Te	−40280#	500#				100#	ms	(>400 ns)	$7/2^+$#	12			2010	β^- ?; β^-n ?; β^-2n ?	
^{143}I	−50630#	300#				130	ms	45	$7/2^+$#	12			1994	β^- ?; β^-n=40#; β^-2n ?	
^{143}Xe	−60203	5				511	ms	6	$5/2^-$	12	03Be05	D	1951	β^-=100; β^-n=1.00 15	
^{143}Cs	−67674	22				1.791	s	0.007	$3/2^+$	12			1962	β^-=100; β^-n=1.64 7	
^{143}Ba	−73937	7				14.5	s	0.3	$5/2^-$	12			1962	β^-=100	
^{143}La	−78171	7				14.2	m	0.1	$(7/2)^+$	12			1951	β^-=100	
^{143}Ce	−81606.2	2.7				33.039	h	0.006	$3/2^-$	12			1948	β^-=100	
^{143}Pr	−83068.0	2.2				13.57	d	0.02	$7/2^+$	12			1948	β^-=100	
^{143}Nd	−84002.1	1.8				STABLE			$7/2^-$	12			1933	IS=12.174 26	
^{143}Pm	−82960	3				265	d	7	$5/2^+$	12			1952	ε=100; e^+<5.7e–6	
^{143}Sm	−79517	3				8.75	m	0.06	$3/2^+$	12			1956	β^+=100	
^{143}Sm^m	−78763	3	753.99	0.16		66	s	2	$11/2^-$	12			1960	IT≈100; β^+=0.24 5	
^{143}Sm^n	−76723	3	2793.8	1.3		30	ms	3	$23/2^-$	12	FGK128	J	1969	IT=100	*
^{143}Eu	−74241	11				2.59	m	0.02	$5/2^+$	12			1965	β^+=100	
^{143}Eu^m	−73851	11	389.51	0.04		50.0	μs	0.5	$11/2^-$	12			1978	IT=100	
^{143}Gd	−68230	200				39	s	2	$(1/2)^+$	12	78Fi02	D	1975	β^+=100; β^+p=?; $\beta^+\alpha$=?	*
^{143}Gd^m	−68080	200	152.6	0.5		110.0	s	1.4	$11/2^-$	12	78Fi02	D	1973	β^+=100; β^+p=?; $\beta^+\alpha$=?	*
^{143}Tb	−60420	50			*	12	s	1	$(11/2^-)$	12			1985	β^+=100	
^{143}Tb^m	−60420#	110#	0#	100#	*	< 21	s		$5/2^+$#	12			1986	β^+ ?	
^{143}Dy	−52169	13				5.6	s	1.0	$(1/2^+)$	12	03Xu04	J	1983	β^+=100; β^+p=?	*
^{143}Dy^m	−51858	13	310.7	0.6		3.0	s	0.3	$(11/2^-)$	12	03Xu04	EJD	2003	β^+=100; β^+p=?	
^{143}Dy^n	−51763	13	406.3	0.8		1.2	μs	0.3		12	05Ri17	E	2005	IT=100	*
^{143}Ho	−42050#	400#				300#	ms	(>200 ns)	$11/2^-$#	12	00So11	I	2000	β^+ ?; β^+p ?	
^{143}Er	−31090#	400#				200#	ms		$9/2^-$#	12				β^+ ?; β^+p ?	

*^{143}Sm^n J : E3 to $17/2^+$ **
*^{143}Gd D : 78Fi02: β^+p and/or $\beta^+\alpha$ for ^{143}Gd+^{143}Gd^m=0.001%, 39 particles detected **
*^{143}Gd^m J : from 05Ba64 **
*^{143}Dy T : 03Xu04=5.6(1.0); 84Ni03=3.2(0.6) 83Ni05=4.1(0.3) in diff. experiments **
*^{143}Dy^n E : 95.6(0.5) above $11/2^-$ isomer **

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{144}I	−45280#	400#				100#	ms	(>150 ns)	1^-#	01	94Be24	I	1994	β^- ?; β^-n=40#; β^-2n ?	
^{144}Xe	−56872	5				388	ms	7	0^+	01	03Be05	TD	2003	β^-=100; β^-n=3.0 3	
^{144}Cs	−63271	25			*	994	ms	6	$1^{(-)}$	10			1967	β^-=100; β^-n=3.03 13	
^{144}Cs^m	−63179	25	92.2	0.5		1.1	μs	0.1	(4^-)	10			2009	IT=100	
^{144}Cs^n	−62970#	200#	300#	200#	*	< 1	s		(> 3)	10			1978	β^-=?; IT ?	
^{144}Ba	−71767	7				11.5	s	0.2	0^+	01			1967	β^-=100	*
^{144}La	−74850	13				40.8	s	0.4	(3^-)	01			1967	β^-=100	
^{144}Ce	−80432	3				284.91	d	0.05	0^+	01			1945	β^-=100	
^{144}Pr	−80750	3				17.28	m	0.05	0^-	01			1951	β^-=100	
^{144}Pr^m	−80691	3	59.03	0.03		7.2	m	0.3	3^-	01			1970	IT≈100; β^-=0.07	
^{144}Nd	−83747.9	1.8				2.29	Py	0.16	0^+	01			1924	IS=23.798 19; α=100	
^{144}Pm	−81416	3				363	d	14	5^-	01	94Hi05	D	1952	ε=100; e^+<8e–5	
^{144}Pm^m	−80575	3	840.90	0.05		780	ns	200	$(9)^+$	01			1993	IT=100	
^{144}Pm^n	−72820	4	8595.8	2.2		2.7	μs		(27^+)	01			1994	IT=100	
^{144}Sm	−81965.4	1.9				STABLE			0^+	01			1933	IS=3.07 7; 2β^+ ?	
^{144}Sm^m	−79641.8	1.9	2323.60	0.08		880	ns	25	6^+	01			1972	IT=100	
^{144}Eu	−75619	11				10.2	s	0.1	1^+	01			1965	β^+=100	
^{144}Eu^m	−74491	11	1127.6	0.6		1.0	μs	0.1	8^-	01	FGK127	J	1976	IT=100	*
^{144}Gd	−71760	28				4.47	m	0.06	0^+	01			1968	β^+=100	
^{144}Gd^m	−68327	28	3433.1	0.5		145	ns	30	(10^+)	01			1978	IT=100	
^{144}Tb	−62368	28				1	s		1^+	01			1982	β^+=100	
^{144}Tb^m	−61971	28	396.9	0.5		4.25	s	0.15	(6^-)	01			1982	IT=66; β^+=34	*
^{144}Tb^n	−61892	28	476.2	0.5		2.8	μs	0.3	(8^-)	01			1996	IT=100	
^{144}Tb^p	−61851	28	517.1	0.5		670	ns	60	(9^+)	01			1996	IT=100	
^{144}Tb^q	−61824	28	544.5	0.6		< 300	ns		(10^+)	01			1996	IT=100	
^{144}Dy	−56570	7				9.1	s	0.4	0^+	01			1986	β^+=100; β^+p=?	
^{144}Ho	−44610	8				700	ms	100	(5^-)	08			1986	β^+=100; β^+p=?	
^{144}Ho^m	−44345	8	265.3	0.3		519	ns	5	(8^+)	08	10Ma08	T	2001	IT=100	
^{144}Er	−36610#	200#				400#	ms	(>200 ns)	0^+	06			2003	β^+ ?	
^{144}Tm	−22090#	400#				2.3	μs	0.9	(10^+)	08			2005	p=?; β^+=0#	*

*^{144}Ba D : β^-n=3.6(0.7)% in ENSDF'01 belongs in fact to ^{144}Cs; β^-n not allowed **
*^{144}Eu^m J : E2 to 6^- **
*^{144}Tb^m T : other 03Li42=12(2) s for q=65^+ (bare ion) **
*^{144}Tm T : symmetrized from 1.9(+1.2–0.5) μs **

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{145}I	−40940#	500#					100#	ms	(>400 ns)	$7/2^+$#	10	10Oh02	I	2010	β^- ?; β^-n ?; β^-2n ?	
^{145}Xe	−51493	11					188	ms	4	$3/2^-$#	09			2003	β^-=100; β^-n=5.0 6; β^-2n ?	
^{145}Cs	−60056	11					582	ms	6	$3/2^+$	09	93Ru01	T	1971	β^-=100; β^-n=14.7 9	∗
^{145}Ba	−67516	8					4.31	s	0.16	$5/2^-$	09			1974	β^-=100	
^{145}La	−72835	12					24.8	s	2.0	$(5/2^+)$	09			1974	β^-=100	
^{145}Ce	−77070	30					3.01	m	0.06	$5/2^-$#	09			1954	β^-=100	
^{145}Pr	−79626	7					5.984	h	0.010	$7/2^+$	09			1954	β^-=100	
^{145}Nd	−81431.8	1.8					STABLE			$7/2^-$	09			1933	IS=8.293 12	
^{145}Pm	−81267	3					17.7	y	0.4	$5/2^+$	09			1951	ε=100; α=2.8e–7	
^{145}Sm	−80651.2	2.0					340	d	3	$7/2^-$	09			1947	ε=100	
^{145}Sm^m	−71865.0	2.1	8786.2	0.7			990	ns	170	$(49/2^+)$	09			1993	IT=100	∗
^{145}Eu	−77992	3					5.93	d	0.04	$5/2^+$	09			1951	β^+=100	
^{145}Eu^m	−77276	3	716.0	0.3			490	ns	30	$11/2^-$	09			1975	IT=100	
^{145}Gd	−72924	20					23.0	m	0.4	$1/2^+$	09			1959	β^+=100	
^{145}Gd^m	−72175	20	749.1	0.2			85	s	3	$11/2^-$	09			1969	IT=94.3 5; β^+=5.7 5	
^{145}Tb	−66300	100				∗ &	30.9	s	0.6	$(11/2^-)$	09			1981	β^+=100	
^{145}Tb^m	−65540	200	760	220	BD	∗ &				$(3/2^+)$	09			1993	β^+ ?	
^{145}Dy	−58243	7					9.5	s	1.0	$(1/2^+)$	09	93Al03	T	1982	β^+=100; β^+p=?	∗
^{145}Dy^m	−58125	7	118.2	0.2			14.1	s	0.7	$(11/2^-)$	09			1982	β^+=100; β^+p≈50	
^{145}Ho	−49120	7				∗	2.4	s	0.1	$11/2^-$#	09			1987	β^+=100	
^{145}Ho^m	−49020#	100#	100#	100#		∗	100#	ms		$5/2^+$#					β^+ ?; IT ?	
^{145}Er	−39080#	200#					900	ms	300	$1/2^+$#	09			1989	β^+=100; β^+p=?	∗
^{145}Er^m	−38870#	200#	205	4	p		1.0	s	0.3	$11/2^-$#		10Ma20	T	2010	β^+ ?	
^{145}Tm	−27580#	200#					3.17	μs	0.20	$(11/2^-)$	09			1998	p=100	

∗^{145}Cs T : average 93Ru01=579(6) 82Ra13=594(13) ∗∗
∗^{145}Sm^m T : symmetrized from 960(+190–150) ∗∗
∗^{145}Dy T : average 93Al03=10.5(1.5) 93To04=6(2) 84Sc.C=10(1) ∗∗
∗^{145}Er T : 89Vi02=900(300) for mixture gs+isomer; similarly 900(200) from 10Ma20 ∗∗

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{146}Xe	−47955	24					146	ms	6	0^+	97	03Be05	TD	1989	β^-=100; β^-n=6.9 15	
^{146}Cs	−55570	40					323	ms	6	1^-	97	93Ru01	T	1971	β^-=100; β^-n=14.2 5; β^-2n ?	∗
^{146}Ba	−64940	20					2.22	s	0.07	0^+	97	93Ru01	D	1970	β^-=100	∗
^{146}La	−69050	30				∗	6.27	s	0.10	2^-	97	93Ru01	D	1970	β^-=100	∗
^{146}La^m	−68920	130	130	130		∗	10.0	s	0.1	(6^-)	97	79Ke02	E	1969	β^-=100	∗
^{146}Ce	−75635	16					13.52	m	0.13	0^+	97			1953	β^-=100	
^{146}Pr	−76680	30					24.15	m	0.18	$(2)^-$	97			1953	β^-=100	
^{146}Nd	−80925.8	1.8					STABLE			0^+	97			1924	IS=17.189 32; 2β^- ?; α ?	
^{146}Pm	−79454	4					5.53	y	0.05	3^-	99			1960	ε=66.0 13; β^-=34.0 13	
^{146}Sm	−80996	3					68	My	7	0^+	97	12Ki16	T	1953	α=100	
^{146}Eu	−77117	6					4.61	d	0.03	4^-	97			1957	β^+=100	
^{146}Eu^m	−76451	6	666.37	0.16			235	μs	3	9^+	97			1962	IT=100	
^{146}Gd	−76086	4					48.27	d	0.10	0^+	01			1957	ε=100	
^{146}Tb	−67760	40				∗	8	s	4	1^+	97			1974	β^+=100	
^{146}Tb^m	−67610#	110#	150#	100#		∗	24.1	s	0.5	5^-	97	93Al03	T	1974	β^+=100	
^{146}Tb^n	−66830#	110#	930#	100#			1.18	ms	0.02	(10^+)	97			1989	IT=100	∗
^{146}Dy	−62555	7					33.2	s	0.7	0^+	97	93Al03	T	1981	β^+=100	
^{146}Dy^m	−59619	7	2935.7	0.6			150	ms	20	(10^+)	97	FGK128	J	1982	IT=100	∗
^{146}Ho	−51238	7					2.8	s	0.5	(6^-)	97	10Ma37	TJ	1982	β^+=100; β^+p=?	∗
^{146}Er	−44322	7					1.7	s	0.6	0^+	97	93To05	D	1993	β^+=100; β^+p=?	
^{146}Tm	−30890#	200#					155	ms	20	(1^+)		05Ro40	TJD	1993	p≈100; β^+ ?; β^+p ?	∗
^{146}Tm^m	−30590#	200#	304	6	p		75	ms	7	(5^-)	02	06Ta08	TJ	1993	p≈100; β^+ ?; β^+p ?	∗
^{146}Tm^n	−30460#	200#	437	7	p		200	ms	3	(10^+)	02	06Ta08	TJ	1993	p=?; β^+=16#; β^+p ?	∗

∗^{146}Cs T : average 93Ru01=321(2) 76Lu02=343(7) ∗∗
∗^{146}Ba D : 93Ru01 β^-n<0.02% is not relevant since $Q(\beta^-\mathrm{n})$=–176(24) is negative ∗∗
∗^{146}La D : 93Ru01 β^-n<0.007% is not relevant since $Q(\beta^-\mathrm{n})$=–50(50) is negative ∗∗
∗^{146}La^m E : derived from $Q(^{146}\mathrm{La}^m)$=6660(120) in 79Ke02 ∗∗
∗^{146}Tb^n E : 779.6 keV above ^{146}Tb^m, from ENSDF ∗∗
∗^{146}Dy^m J : E3 to (7^-) ∗∗
∗^{146}Ho J : from β^+p branching in 10Ma37; supported by β^+p spectrum from 85Wi15 ∗∗
∗^{146}Tm T : also 05Bb02=190(80) ms ∗∗
∗^{146}Tm^m T : arith aver 06Ta08=68(3) 05Ro40=82(4); 05Bb02=75(3)(superseded in 06Ta08) ∗∗
∗^{146}Tm^n T : average 07DaZU=213(9) 06Ta08=198(3) ∗∗

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{147}Xe	−42610#	200#				130	ms	80	$3/2^-$#	09			1994	β^-=100; β^-n=4.0 23; β^-2n ?	*
^{147}Cs	−52020	50				230	ms	1	$(3/2^+)$	09			1978	β^-=100; β^-n=28.5 17	
^{147}Ba	−60264	20				894	ms	10	$(3/2^+)$	09			1978	β^-=100; β^-n=0.06 3	
^{147}La	−66678	11				4.06	s	0.04	$(5/2^+)$	09	96Ur02	J	1979	β^-=100; β^-n=0.041 4	
^{147}Ce	−72014	9				56.4	s	1.0	$(5/2^-)$	09			1964	β^-=100	
^{147}Pr	−75444	16				13.4	m	0.3	$5/2^+$#	09			1964	β^-=100	
^{147}Nd	−78146.6	1.8				10.98	d	0.01	$5/2^-$	09			1947	β^-=100	
^{147}Pm	−79041.9	1.8				2.6234	y	0.0002	$7/2^+$	09			1947	β^-=100	
^{147}Sm	−79266.0	1.8				106.6	Gy	0.7	$7/2^-$	09	09Ko15	T	1933	IS=14.99 18; α=100	
^{147}Eu	−77544.4	2.8				24.1	d	0.6	$5/2^+$	09			1951	$\beta^+\approx$100; α=0.0022 6	
^{147}Eu^m	−76919.1	2.8	625.27	0.05		765	ns	15	$11/2^-$	09			1970	IT=100	
^{147}Gd	−75356.6	2.3				38.06	h	0.12	$7/2^-$	09			1957	β^+=100	
^{147}Gd^m	−66768.8	2.4	8587.8	0.5		510	ns	20	$(49/2^+)$	09			1982	IT=100	
^{147}Tb	−70743	8				1.64	h	0.03	$(1/2^+)$	09			1969	β^+=100	
^{147}Tb^m	−70692	8	50.6	0.9		1.87	m	0.05	$11/2^-$#	09	93Al03	T	1987	β^+=100	*
^{147}Dy	−64196	9				67	s	7	$(1/2^+)$	09			1975	β^+=100; β^+p≈0.05	
^{147}Dy^m	−63446	9	750.5	0.4		55.2	s	0.5	$(11/2^-)$	09			1976	β^+=68.9 23; IT=31.1 23	
^{147}Dy^n	−60789	9	3407.2	0.8		400	ns	10	$(27/2^-)$	09			1985	IT=100	
^{147}Ho	−55757	5				5.8	s	0.4	$(11/2^-)$	09			1982	β^+=100	
^{147}Ho^m	−53070	5	2687.1	0.4		315	ns	30	$(27/2^-)$	09			1982	IT=100	
^{147}Er	−46610	40			*	3.2	s	1.2	$(1/2^+)$	09	10Ma27	T	1992	β^+=100; β^+p=?	
^{147}Er^m	−46510#	60#	100#	50#	*	1.6	s	0.2	$(11/2^-)$	09	10Ma27	T	1982	β^+=100; β^+p=?	*
^{147}Tm	−35974	7				580	ms	30	$11/2^-$	09			1982	β^+=85 5; p=15 5	
^{147}Tm^m	−35913	7	62	5	p	360	μs	40	$3/2^+$	09			1984	p=100	
*^{147}Xe	T : symmetrized from 100(+100–50) D : from β^-n<8%														**
*^{147}Tb^m	T : average 93Al03=1.92(0.07) 73Bo13=1.83(0.06)														**
*^{147}Er^m	E : estimated from $11/2^-$ level in isotones ^{141}Sm=175 ^{143}Gd=152 ^{145}Dy=118														**
^{148}Xe	−39000#	200#				100#	ms	(>400 ns)	0^+	10	10Oh02	I	2010	β^- ?; β^-n ?; β^-2n ?	
^{148}Cs	−47300	580				146	ms	6		00			1978	β^-=100; β^-n=25.1 25; β^-2n ?	
^{148}Ba	−57590	60				612	ms	17	0^+	00			1979	β^-=100; β^-n=0.4 3	
^{148}La	−62709	19				1.26	s	0.08	(2^-)	00			1982	β^-=100; β^-n=0.15 3	
^{148}Ce	−70398	11				56	s	1	0^+	00			1964	β^-=100	
^{148}Pr	−72535	15			*	2.29	m	0.02	1^-	00			1964	β^-=100	
^{148}Pr^m	−72490#	30#	50#	30#	*	2.01	m	0.07	(4)	00	GAu	E	1964	β^-=100	*
^{148}Nd	−77407.8	2.4				STABLE		(>3.0 Ey)	0^+	00	82Be20	T	1937	IS=5.756 21; 2β^- ?; α ?	*
^{148}Pm	−76865	6				5.368	d	0.002	1^-	00			1947	β^-=100	
^{148}Pm^m	−76727	6	137.9	0.3		41.29	d	0.11	$5^-,6^-$	00			1951	β^-=95.8 6; IT=4.2 6	
^{148}Sm	−79336.1	1.8				7	Py	3	0^+	00			1933	IS=11.24 10; α=100	
^{148}Eu	−76299	10				54.5	d	0.5	5^-	00			1951	β^+=100; α=9.4e–7 28	
^{148}Eu^m	−75579	10	720.4	0.3		162	ns	8	9^+	00			1980	IT=100	
^{148}Gd	−76269.3	1.9				70.9	y	1.0	0^+	00	03Fu10	T	1953	α=100; 2β^+ ?	
^{148}Tb	−70531	13				60	m	1	2^-	00			1960	β^+=100	
^{148}Tb^m	−70441	13	90.1	0.3		2.20	m	0.05	$(9)^+$	00			1973	β^+=100	
^{148}Tb^n	−61912	13	8618.6	1.0		1.310	μs	0.007	(27^+)	00			1980	IT=100	
^{148}Dy	−67853	9				3.3	m	0.2	0^+	00			1974	β^+=100	
^{148}Dy^m	−64934	9	2919.1	1.0		471	ns	20	10^+	00			1978	IT=100	
^{148}Ho	−57990	80				2.2	s	1.1	(1^+)	11			1979	β^+=100	
^{148}Ho^m	−57740#	130#	250#	100#		9.49	s	0.12	5#$^{(-)}$	11	93Al03	T	1979	β^+=100; β^+p=0.08 1	*
^{148}Ho^n	−57050#	130#	940#	100#		2.36	ms	0.06	$(10)^+$	11			1984	IT=100	*
^{148}Er	−51479	10				4.6	s	0.2	0^+	11			1982	β^+=100; β^+p≈0.15	
^{148}Er^m	−48566	10	2913.2	0.4		13	μs	3	(10^+)	11			1982	IT=100	
^{148}Tm	−38765	10				700	ms	200	(10^+)	11			1982	β^+=100; β^+p ?	
^{148}Yb	−30200#	600#				250#	ms		0^+					β^+ ?; β^+p ?	
*^{148}Pr^m	E : derived from ENSDF estimate E<90 keV														**
*^{148}Nd	T : lower limit is for 2β^- decay														**
*^{148}Ho^m	T : average 93Al03=9.30(0.20) 89Ta11=9.59(0.15)														**
*^{148}Ho^m	E : NUBASE2003=400#100, but 07Ra37 E<300														**
*^{148}Ho^n	E : 694.4 keV above ^{148}Ho^m, from ENSDF														**

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{149}Cs	−43760#	200#					150#	ms	(>50 ms)	$3/2^+$#	04			1979	β^- ?; β^-n ?; β^-2n ?	
^{149}Ba	−53020#	200#					344	ms	7	$3/2^-$#	04			1993	β^-=100; β^-n=0.43 12	
^{149}La	−60220	200					1.05	s	0.03	$(3/2^-)$	07			1979	β^-=100; β^-n=1.43 28	
^{149}Ce	−66670	10					5.3	s	0.2	$3/2^-$#	04			1974	β^-=100	
^{149}Pr	−71039	10					2.26	m	0.07	$(5/2^+)$	04			1964	β^-=100	
^{149}Nd	−74375.3	2.4					1.728	h	0.001	$5/2^-$	04			1938	β^-=100	
^{149}Pm	−76063.7	2.5					53.08	h	0.05	$7/2^+$	04			1947	β^-=100	
^{149}Pm^m	−75823.5	2.5	240.214	0.007			35	μs	3	$11/2^-$	04			1966	IT=100	
^{149}Sm	−77135.1	1.7					STABLE		(>2 Py)	$7/2^-$	04			1933	IS=13.82 7; α ?	
^{149}Eu	−76440	4					93.1	d	0.4	$5/2^+$	04			1959	ε=100	
^{149}Eu^m	−75944	4	496.386	0.002			2.45	μs	0.05	$11/2^-$	04			1961	IT=100	
^{149}Gd	−75127	4					9.28	d	0.10	$7/2^-$	04			1951	β^+=100; α=4.3e–4 10	
^{149}Tb	−71489	4					4.118	h	0.025	$1/2^+$	04			1950	β^+=83.3 17; α=16.7 17	
^{149}Tb^m	−71453	4	35.78	0.13			4.16	m	0.04	$11/2^-$	04			1962	$\beta^+\approx$100; α=0.022 3	
^{149}Dy	−67699	9					4.20	m	0.14	$7/2^{(-)}$	04	88Ah02	J	1958	β^+=100	
^{149}Dy^m	−65038	9	2661.1	0.4			490	ms	15	$(27/2^-)$	04			1976	IT=99.3 3; β^+=0.7 3	*
^{149}Ho	−61662	14					21.1	s	0.2	$(11/2^-)$	04			1979	β^+=100	
^{149}Ho^m	−61613	14	48.80	0.20			56	s	3	$(1/2^+)$	04			1988	β^+=100	
^{149}Er	−53742	28					4	s	2	$(1/2^+)$	04			1984	β^+=100; β^+p=7 2	
^{149}Er^m	−53000	28	741.8	0.2			8.9	s	0.2	$(11/2^-)$	04			1984	β^+=96.5 7; IT=3.5 7; …	*
^{149}Er^n	−51131	28	2611.1	0.3			610	ns	80	$(19/2^+)$	04			1987	IT=100	
^{149}Er^p	−50470	30	3272	20			4.8	μs	0.1	$(27/2^-)$	04			1987	IT=100	*
^{149}Tm	−43880#	300#					900	ms	200	$(11/2^-)$	04			1987	β^+=100; β^+p=0.26 15	*
^{149}Yb	−33200#	500#					700	ms	200	$(1/2^+)$	04	05Xu04	J	2001	β^+=100; β^+p$\approx$100	*

*^{149}Dy^m T : other 03Li42=11(1) s for q=66$^+$ (bare ion) **
*^{149}Er^m D : …; β^+p=0.18 7 **
*^{149}Er^p E : 3242.7 + 30(20) keV **
*^{149}Tm D : symmetrized from β^+p=0.2(+0.2–0.1)% **
*^{149}Yb J : (1/2$^+$,3/2$^+$) in ENSDF2004 and 1/2 in 05Xu04; 06Xu07=(1/2$^-$) however, **
*^{149}Yb J : no 1/2$^-$ ground-state or isomer for e–o in this region **

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{150}Cs	−38820#	300#					100#	ms	(>50 ms)		97	87Ra12	I	1979	β^- ?; β^-n ?; β^-2n ?	
^{150}Ba	−50250#	300#					300	ms		0^+	95			1994	β^-=100; β^-n ?	
^{150}La	−56380#	200#					510	ms	30	(3^+)	97	95Ok02	TJ	1993	β^-=100; β^-n=2.7 3	
^{150}Ce	−64847	12					4.0	s	0.6	0^+	95			1970	β^-=100	
^{150}Pr	−68300	9					6.19	s	0.16	$(1)^-$	96			1970	β^-=100	
^{150}Nd	−73679.1	1.7					6.7	Ey	0.7	0^+	96	97De40	TD	1937	IS=5.638 28; 2β^-=100	*
^{150}Pm	−73596	20					2.68	h	0.02	(1^-)	95			1952	β^-=100	
^{150}Sm	−77050.5	1.7					STABLE			0^+	96			1934	IS=7.38 1	
^{150}Eu	−74792	6					36.9	y	0.9	$5^{(-)}$	95			1950	β^+=100	
^{150}Eu^m	−74750	6	42.1	0.5			12.8	h	0.1	0^-	95			1953	β^-=89 2; β^+=11 2; …	*
^{150}Gd	−75764	6					1.79	My	0.08	0^+	96			1953	α=100; 2β^+ ?	
^{150}Tb	−71106	7					3.48	h	0.16	(2^-)	96			1959	$\beta^+\approx$100; α<0.05	
^{150}Tb^m	−70645	26	461	27	MD		5.8	m	0.2	9^+	96			1993	$\beta^+\approx$100; IT ?	
^{150}Dy	−69309	4					7.17	m	0.05	0^+	96			1959	β^+=64 5; α=36 5	
^{150}Ho	−61946	14				*	76.8	s	1.8	2^-	95	93Al03	T	1963	β^+=100	*
^{150}Ho^m	−61950	50	−0	50	BD	*	23.3	s	0.3	$(9)^+$	95			1980	β^+=100	
^{150}Ho^n	−54050	50	7900	50			787	ns	36	(28^-)		06Fu06	EJT	2006	IT=100	*
^{150}Er	−57831	17					18.5	s	0.7	0^+	95			1982	β^+=100	
^{150}Er^m	−55034	17	2797.0	0.5			2.55	μs	0.10	10^+#	95			1984	IT=100	
^{150}Tm	−46490#	200#				* &	3#	s		(1^+)		88Ni02	J	1982	β^+=100	
^{150}Tm^m	−46350#	240#	140#	140#		* &	2.20	s	0.06	(6^-)	95	96Ga24	T	1981	β^+=100; β^+p=1.2 3	*
^{150}Tm^n	−45680#	240#	810#	140#			5.2	ms	0.3	(10^+)	95			1984	IT=100	*
^{150}Yb	−38640#	400#					700#	ms	(>200 ns)	0^+	97	00So11	I	2000	β^+ ?	
^{150}Lu	−24640#	500#					46	ms	6	$(5^-,6^-)$	02	00Gi01	J	1993	p=?; β^+=30#	
^{150}Lu^m	−24620#	500#	22	5	p		40	μs	7	$(1^+,2^+)$	02	00Gi01	J	1998	p=100	*

*^{150}Nd T : from 6.75(+0.37–0.68 statistics + 0.68 systematics) **
*^{150}Eu^m D : …; IT$\leq$5e–8 **
*^{150}Ho T : average 93Al03=78(2) 82No08=72(4) **
*^{150}Ho^n E : 7912.4(2.1) keV above the (9)$^+$ isomer from fit to γ-ray energies **
*^{150}Tm^m T : average 96Ga24=2.22(0.07) 88Ni02=2.15(0.10) 87To05=2.2(0.2) **
*^{150}Tm^m T : 82No08=3.5(0.6) conflicting, not used D : from 88Ni02 **
*^{150}Tm^n E : 671.6 keV above ^{150}Tm^m, from ENSDF **
*^{150}Lu^m T : symmetrized from 39(+8–6) **

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{151}Cs	−34860#	400#					60#	ms	(>50 ms)	$3/2^{+}$#	09			1979	β^- ?; β^-n=85.9#; β^-2n=0.4#	
^{151}Ba	−45390#	300#					200#	ms	(>300 ns)	$3/2^{-}$#	09			1994	β^- ?; β^-n ?	
^{151}La	−53730#	200#					300#	ms	(>300 ns)	$5/2^{+}$#	09			1994	β^- ?; β^-n=5.8#	
^{151}Ce	−61225	18					1.76	s	0.06	$(3/2^{-})$	09	10Si03	J	1997	β^-=100	*
^{151}Pr	−66779	12					18.90	s	0.07	$(3/2^{-})$	09			1990	β^-=100	
^{151}Pr^{m}	−66744	12	35.10	0.10			50	μs	8	$(7/2^{+})$	09	12Ma03	T	2006	IT=100	
^{151}Nd	−70942.3	1.7					12.44	m	0.07	$3/2^{+}$	09			1938	β^-=100	
^{151}Pm	−73385	5					28.40	h	0.04	$5/2^{+}$	09			1952	β^-=100	
^{151}Sm	−74575.6	1.7					90	y	8	$5/2^{-}$	09			1947	β^-=100	
^{151}Sm^{m}	−74314.5	1.7	261.13	0.04			1.4	μs	0.1	$(11/2)^{-}$	09			1973	IT=100	
^{151}Eu	−74652.0	1.7					STABLE		(>1.7 Ey)	$5/2^{+}$	09			1933	IS=47.81 6; α ?	
^{151}Eu^{m}	−74455.8	1.7	196.245	0.010			58.9	μs	0.5	$11/2^{-}$	09			1958	IT=100	
^{151}Gd	−74188	3					123.9	d	1.0	$7/2^{-}$	09			1950	ε=100; α=1.0e–6 6	*
^{151}Tb	−71623	4					17.609	h	0.001	$1/2^{(+)}$	09			1953	$\beta^+\approx$100; α=0.0095 15	
^{151}Tb^{m}	−71523	4	99.53	0.05			25	s	3	$(11/2^{-})$	09			1978	IT=93.4 20; β^+=6.6 20	
^{151}Dy	−68752	3					17.9	m	0.3	$7/2^{(-)}$	09			1959	β^+=?; α=5.6 4	
^{151}Ho	−63623	8					35.2	s	0.1	$11/2^{(-)}$	09	87Ne.A	J	1963	β^+=?; α=22 3	
^{151}Ho^{m}	−63582	8	41.0	0.2			47.2	s	1.3	$1/2^{(+)}$	09	87Ne.A	J	1963	α=77 18; β^+ ?	*
^{151}Er	−58266	16					23.5	s	2.0	$(7/2^{-})$	09			1970	β^+=100	
^{151}Er^{m}	−55680	16	2586.0	0.5			580	ms	20	$(27/2^{-})$	09			1980	IT=95.3 3; β^+=4.7 3	*
^{151}Er^{n}	−47979	16	10286.6	1.0			420	ns	50	$(65/2^{-},61/2^{+})$	09	09Fu05	J	1990	IT=100	
^{151}Tm	−50778	20					4.17	s	0.11	$(11/2^{-})$	09			1982	β^+=100	
^{151}Tm^{m}	−50684	20	94	6	AD		6.6	s	2.0	$(1/2^{+})$	09			1987	β^+=100	
^{151}Tm^{n}	−48122	20	2655.67	0.22			451	ns	34	$(27/2^{-})$	09			1982	IT=100	
^{151}Yb	−41540	300					1.6	s	0.5	$(1/2^{+})$	09	86To12	T	1985	β^+=100; β^+p=?	*
^{151}Yb^{m}	−40790#	320#	750#	100#			1.6	s	0.5	$(11/2^{-})$	09	86To12	T	1986	$\beta^+\approx$100; β^+p=?; IT=0.4#	*
^{151}Yb^{n}	−39000#	580#	2540#	500#			2.6	μs	0.7	$19/2^{-}$#	09			1993	IT=100	*
^{151}Yb^{p}	−39090#	580#	2450#	500#			20	μs	1	$27/2^{-}$#	09			1987	IT=100	*
^{151}Lu	−30110#	400#					80.6	ms	2.0	$11/2^{-}$#	09			1982	p=?; β^+=37#	*
^{151}Lu^{m}	−30030#	400#	77	5	p		16	μs	1	$3/2^{+}$#	09			1998	p=100	

*^{151}Ce I : isomer with T=1.02(0.06) suggested in ENSDF2009 not trusted by NUBASE **

*^{151}Gd D : symmetrized from α=0.8(+0.8–0.4)e–6% **

*^{151}Ho^{m} D : symmetrized from α=80(+15–20)% **

*^{151}Er^{m} T : other 03Li42=19(3) s for q=68^{+} (bare ion) **

*^{151}Yb T : derived from 1.6(0.1), for mixture of ground-state and isomer with almost same half-life **

*^{151}Yb^{m} E : 740# estimated in 90Ak01 (see ENSDF'09) **

*^{151}Yb^{n} E : above the 1791.2 keV level above ^{151}Yb^{m} (see ENSDF'09) **

*^{151}Yb^{p} E : 2448 keV above ^{151}Yb^{m} (see ENSDF'97) **

*^{151}Lu D : p=63.4(0.9)% in ENSDF'09, based on predicted β^+ decay half-life≈220 ms **

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{152}Ba	−42090#	400#					100#	ms	(>400 ns)	0^{+}	10	10Oh02	I	2010	β^- ?; β^-n ?	
^{152}La	−49540#	300#					200#	ms	(>150 ns)		97	94Be24	I	1994	β^- ?; β^-n ?	
^{152}Ce	−59060#	200#					1.1	s	0.3	0^{+}	97	90Ta07	T	1990	β^-=100	*
^{152}Pr	−63758	19					3.63	s	0.12	4^{+}	97	99To04	J	1983	β^-=100	
^{152}Nd	−70149	25					11.4	m	0.2	0^{+}	97			1969	β^-=100	
^{152}Pm	−71254	26				*	4.12	m	0.08	1^{+}	97			1958	β^-=100	
^{152}Pm^{m}	−71110	80	140	90	BD	*	7.52	m	0.08	4^{-}	97			1971	β^-=100	
^{152}Pm^{n}	−71000#	150#	250#	150#		*	13.8	m	0.2	(8)	97			1971	$\beta^-\approx$100; IT=?	*
^{152}Sm	−74762.0	1.6					STABLE			0^{+}	97			1933	IS=26.75 16	
^{152}Eu	−72887.4	1.7					13.537	y	0.006	3^{-}	97			1938	β^+=72.1 3; β^-=27.9 3	
^{152}Eu^{m}	−72841.8	1.7	45.5998	0.0004			9.3116	h	0.0013	0^{-}	97			1958	β^-=72 4; β^+=28 4	
^{152}Eu^{n}	−72822.1	1.7	65.2969	0.0004			940	ns	80	1^{-}	97			1978	IT=100	
^{152}Eu^{p}	−72809.2	1.7	78.2331	0.0004			165	ns	10	1^{+}	97			1978	IT=100	
^{152}Eu^{q}	−72797.6	1.7	89.8496	0.0004			384	ns	10	4^{+}	97			1970	IT=100	
^{152}Eu^{r}	−72739.5	1.7	147.86	0.10			96	m	1	8^{-}	97			1963	IT=100	
^{152}Gd	−74706.3	1.6					108	Ty	8	0^{+}	97			1938	IS=0.20 1; α=100; 2β^+ ?	
^{152}Tb	−70720	40					17.5	h	0.1	2^{-}	98			1959	β^+=100; α<7e–7	
^{152}Tb^{m}	−70380	40	342.15	0.16			960	ns	10	5^{-}	98			1972	IT=100	
^{152}Tb^{n}	−70220	40	501.74	0.19			4.2	m	0.1	8^{+}	98			1971	IT=78.8 8; β^+=21.2 8	
^{152}Dy	−70118	5					2.38	h	0.02	0^{+}	02			1958	$\varepsilon\approx$100; α=0.100 7	
^{152}Ho	−63599	13					161.8	s	0.3	2^{-}	97			1963	β^+=88 3; α=12 3	
^{152}Ho^{m}	−63439	13	160	1			50.0	s	0.4	9^{+}	97			1963	β^+=89.2 17; α=10.8 17	
^{152}Ho^{n}	−60579	13	3019.59	0.19			8.4	μs	0.3	19^{-}	97			1997	IT=100	
^{152}Er	−60494	9					10.3	s	0.1	0^{+}	97			1963	α=90 4; β^+=10 4	
^{152}Tm	−51770	70				*	8.0	s	1.0	$(2\#)^{-}$	97			1980	β^+=100	
^{152}Tm^{m}	−51660#	100#	110#	130#		*	5.2	s	0.6	$(9)^{+}$	97			1980	β^+=100	
^{152}Tm^{n}	−49120#	110#	2655#	80#			294	ns	12	(17^{+})	97			1986	IT=100	*
^{152}Yb	−46320	160					3.04	s	0.06	0^{+}	97			1982	β^+=100	
^{152}Yb^{m}	−43580	160	2744.5	1.0			30	μs	1	(10^{+})	97			1995	IT=100	
^{152}Lu	−33420#	200#					650	ms	70	$(5^{-},6^{-})$	97	88Ni02	T	1987	β^+=100; β^+p=15 7	*

*^{152}Ce T : average 90Ta07=1.4(0.2) 91Ay.A=0.8(0.3) **

*^{152}Pm^{n} E : ENSDF: "Probably feeds 7.52 m level" at 140 keV **

*^{152}Tm^{n} E : 2555.05(0.19) above ^{152}Tm^{m} **

*^{152}Lu T : average 88Ni02=600(100) 87To02=700(100) **

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{153}Ba	−36920#	400#					80#	ms		$5/2^-$#					β^- ?; β^-n ?; β^-2n ?	
^{153}La	−46240#	300#					150#	ms	(>150 ns)	$5/2^+$#	06	94Be24	I	1994	β^- ?; β^-n ?	
^{153}Ce	−55020#	200#					500#	ms	(>150 ns)	$3/2^-$#	06	94Be24	I	1994	β^- ?; β^-n ?	
^{153}Pr	−61568	12					4.28	s	0.11	$5/2^-$#	06			1987	β^-=100; β^-n ?	
^{153}Nd	−67330.3	2.7					31.6	s	1.0	$(3/2)^-$	06			1987	β^-=100	
^{153}Nd^m	−67138.6	2.9	191.7	1.0			1.10	μs	0.04	$(5/2^+)$	06	10Si03	TJ	1996	IT=100	*
^{153}Pm	−70648	9					5.25	m	0.02	$5/2^-$	06			1962	β^-=100	
^{153}Sm	−72559.1	1.6					46.284	h	0.004	$3/2^+$	06			1938	β^-=100	
^{153}Sm^m	−72460.7	1.6	98.37	0.10			10.6	ms	0.3	$11/2^-$	06			1971	IT=100	
^{153}Eu	−73366.3	1.7					STABLE			$5/2^+$	06			1933	IS=52.19 6	
^{153}Eu^m	−71595.3	1.7	1771.0	0.4			475	ns	10	$19/2^-$	06			2000	IT=100	
^{153}Gd	−72881.9	1.6					240.4	d	1.0	$3/2^-$	06			1947	ε=100	
^{153}Gd^m	−72786.7	1.6	95.1736	0.0008			3.5	μs	0.4	$9/2^+$	06			1979	IT=100	
^{153}Gd^n	−72710.7	1.6	171.188	0.004			76.0	μs	1.4	$(11/2^-)$	06			1967	IT=100	
^{153}Tb	−71313	4					2.34	d	0.01	$5/2^+$	06			1957	β^+=100	
^{153}Tb^m	−71150	4	163.175	0.005			186	μs	4	$11/2^-$	06			1965	IT=100	
^{153}Dy	−69143	4					6.4	h	0.1	$7/2^{(-)}$	06			1958	$\beta^+\approx$100; α=0.0094 14	
^{153}Ho	−65012	5					2.01	m	0.03	$11/2^-$	06			1963	$\beta^+\approx$100; α=0.051 25	
^{153}Ho^m	−64943	5	68.7	0.3			9.3	m	0.5	$1/2^+$	06			1963	$\beta^+\approx$100; α=0.18 8	
^{153}Ho^n	−62240	11	2772	10			229	ns	2	$(31/2^+)$	06			1980	IT=100	
^{153}Er	−60472	10					37.1	s	0.2	$7/2^{(-)}$	06	85Ah.A	J	1963	α=53 3; β^+=47 3	*
^{153}Er^m	−57674	10	2798.2	1.0			373	ns	9	$(27/2^-)$	06			1979	IT=100	
^{153}Er^n	−55224	10	5248.1	1.0			248	ns	32	$(41/2^-)$	06			1979	IT=100	
^{153}Tm	−53989	15					1.48	s	0.01	$(11/2^-)$	06			1964	α=91 3; β^+=9 3	
^{153}Tm^m	−53946	15	43.2	0.2			2.5	s	0.2	$(1/2^+)$	06			1988	α=92 3; β^+=?	
^{153}Yb	−47210#	200#					4.2	s	0.2	$7/2^-$#	06	88Wi05	D	1977	β^+=?; α=50#; …	*
^{153}Yb^m	−44510#	220#	2700	100			15	μs	1	$27/2^-$	06			1989	IT=100	*
^{153}Lu	−38420	160					900	ms	200	$11/2^-$	06	97Ir01	D	1989	β^+ ?; α=?; p=0	*
^{153}Lu^m	−38340	160	80	5			1#	s		$1/2^+$	06	97Ir01	ED	1997	β^+ ?; α=?; IT=?; p=0	
^{153}Lu^n	−35920	160	2502.5	0.4			> 100	ns		$23/2^-$	06			1993	IT=100	
^{153}Lu^p	−35790	160	2632.9	0.5			15	μs	3	$27/2^-$	06			1993	IT=100	
^{153}Hf	−27300#	500#					400#	ms	(>200 ns)	$1/2^+$#	06	00So11	I	2000	β^+ ?	
^{153}Hf^m	−26550#	510#	750#	100#			500#	ms		$11/2^-$#					β^+ ?; IT ?	
*^{153}Nd^m	T : average 10Si03=1.17(0.07) 96Ya12=1.06(0.05)															**
*^{153}Er	J : and 89Ot.A															**
*^{153}Yb	D : …; β^+p=0.008 2															**
*^{153}Yb^m	E : in ENSDF 2578.2 + x															**
*^{153}Lu	D : p=0% decay is from 97Ir01															**
^{154}La	−41760#	400#					100#	ms							β^- ?; β^-n ?; β^-2n ?	
^{154}Ce	−52350#	300#					300#	ms	(>150 ns)	0^+	09	94Be24	I	1994	β^- ?; β^-n ?	
^{154}Pr	−58190	150					2.3	s	0.1	(3^+)	09			1988	β^-=100; β^-n ?	
^{154}Nd	−65680	110					25.9	s	0.2	0^+	09			1970	β^-=100	
^{154}Nd^m	−64380	110	1297.9	0.4			3.2	μs	0.3	(4^-)	09	09Si21	ETJ	1970	IT=100	*
^{154}Pm	−68490	40				* &	1.73	m	0.10	$(0^-,1^-)$	09			1958	β^-=100	
^{154}Pm^m	−68370	110	120	120	BD	* &	2.68	m	0.07	$(3,4)$	09			1958	β^-=100	
^{154}Sm	−72454.5	1.8					STABLE		(>2.3 Ey)	0^+	09			1933	IS=22.75 29; 2β^- ?	
^{154}Eu	−71737.2	1.7					8.601	y	0.010	3^-	09			1947	$\beta^-\approx$100; ε=0.018 12	
^{154}Eu^m	−71669.0	1.7	68.1702	0.0004			2.2	μs	0.1	2^+	09			1964	IT=100	
^{154}Eu^n	−71591.9	1.7	145.3	0.3			46.3	m	0.4	(8^-)	09			1975	IT=100	
^{154}Gd	−73705.3	1.6					STABLE			0^+	09			1938	IS=2.18 3	
^{154}Tb	−70160	50				*	21.5	h	0.4	$0^{(+\#)}$	09			1950	$\beta^+\approx$100; β^-<0.1	
^{154}Tb^m	−70150	50	12	7		*	9.994	h	0.039	3^-	09	09Gy01	T	1972	β^+=78.2 7; IT=21.8 7; …	*
^{154}Tb^n	−69960#	160#	200#	150#		*	22.7	h	0.5	7^-	09			1972	β^+=98.2 6; IT=1.8 6	
^{154}Tb^p	−62160#	900#	8000#	900#			513	ns	42		09			1982	IT ?	
^{154}Dy	−70394	7					3.0	My	1.5	0^+	09			1961	α=100; 2β^+ ?	
^{154}Ho	−64639	8					11.76	m	0.19	2^-	09			1966	$\beta^+\approx$100; α=0.019 5	
^{154}Ho^m	−64397	27	243	28	AD		3.10	m	0.14	8^+	09			1968	β^+=100; α<0.001; IT$\approx$0	
^{154}Er	−62605	5					3.73	m	0.09	0^+	09			1963	$\beta^+\approx$100; α=0.47 13	
^{154}Tm	−54427	14				*	8.1	s	0.3	(2^-)	09			1964	α=54 5; β^+=46 5	
^{154}Tm^m	−54350	50	70	50	BD	*	3.30	s	0.07	(9^+)	09			1964	α=58 5; β^+=42 5; IT ?	*
^{154}Yb	−49932	17					409	ms	2	0^+	09			1964	α=92.6 12; β^+=7.4 12	
^{154}Lu	−39720#	200#					1#	s		(2^-)	09			1981	β^+ ?	
^{154}Lu^m	−39660#	200#	60	12	AD		1.12	s	0.08	(9^+)	09	88Vi02	D	1981	$\beta^+\approx$100; β^+p=?; …	*
^{154}Lu^n	−37000#	220#	2720#	100#			35	μs	3	(17^+)	09			1990	IT=100	*
^{154}Hf	−32730#	500#					2	s	1	0^+	09			1981	$\beta^+\approx$100; $\alpha\approx$0	
^{154}Hf^m	−30020#	500#	2710#	30#			9	μs	4	(10^+)	09			1989	IT=100	*
*^{154}Nd^m	E : from a least-squares fit to γ-ray energies in 09Si21															**
*^{154}Tb^m	D : …; β^-<0.1															**
*^{154}Tb^m	E : estimated by NUBASE from 73Ba20<25 keV															**
*^{154}Tm^m	D : IT decay has not been observed															**
*^{154}Lu^m	D : …; $\beta^+\alpha$=?; α=0.002#															**
*^{154}Lu^m	D : β^+p and $\beta^+\alpha$ modes observed in 88Vi02; β^+p confirmed in 90Sh.A															**
*^{154}Lu^n	E : 2431.3 + 130.4 + z, above ^{154}Lu^m ; z estimated 100#100															**
*^{154}Hf^m	E : 42#28 above 2671 level, see ENSDF’09															**

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{155}La	−38180#	400#					60#	ms		$5/2^+$#					β^- ?; β^-n ?; β^-2n ?	
^{155}Ce	−47930#	400#					200#	ms	(>150 ns)	$5/2^-$#	05	94Be24	I	1994	β^- ?; β^-n ?	
^{155}Pr	−55415	17					1#	s	(>300 ns)	$5/2^-$#	05			1992	β^- ?; β^-n ?	
^{155}Nd	−62284	9					8.9	s	0.2	$3/2^-$#	05			1986	β^-=100	
^{155}Pm	−66940	5					41.5	s	0.2	$(5/2^-)$	05			1982	β^-=100	
^{155}Sm	−70190.2	1.8					22.3	m	0.2	$3/2^-$	05			1951	β^-=100	
^{155}Sm^m	−70173.7	1.9	16.5	0.5			2.8	μs	0.5	$5/2^+$		10Si03	ETJ	2010	IT=100	
^{155}Sm^n	−69651.6	1.9	538.6	0.7			1.00	μs	0.08	$11/2^-$		10Si03	ETJ	2010	IT=100	
^{155}Eu	−71817.2	1.8					4.753	y	0.014	$5/2^+$	05			1947	β^-=100	
^{155}Gd	−72069.2	1.6					STABLE			$3/2^-$	05			1933	IS=14.80 12	
^{155}Gd^m	−71948.2	1.6	121.05	0.19			31.97	ms	0.27	$11/2^-$	05			1967	IT=100	
^{155}Tb	−71249	10					5.32	d	0.06	$3/2^+$	05			1957	ε=100	
^{155}Dy	−69155	10					9.9	h	0.2	$3/2^-$	05			1958	β^+=100	
^{155}Dy^m	−68921	10	234.33	0.03			6	μs	1	$(11/2^-)$	05			1970	IT=100	
^{155}Ho	−66039	17					48	m	1	$5/2^+$	05			1959	β^+=100	
^{155}Ho^m	−65897	17	141.97	0.11			880	μs	80	$(11/2^-)$	05			1984	IT=100	
^{155}Er	−62209	6					5.3	m	0.3	$(7/2^-)$	05			1969	$\beta^+\approx$100; α=0.022 7	
^{155}Tm	−56626	10					21.6	s	0.2	$(11/2^-)$	05			1971	β^+=99.11 24; α=0.89 24	
^{155}Tm^m	−56585	12	41	6			45	s	3	$1/2^+$	05	FGK12a	J	1990	β^+>92; α<8	∗
^{155}Yb	−50503	17					1.793	s	0.019	$(7/2^-)$	05			1964	α=89 4; β^+=11 4	
^{155}Lu	−42550	19					68.6	ms	1.6	$(11/2^-)$	05			1965	α=90 2; β^+ ?	
^{155}Lu^m	−42529	20	21	4	AD		138	ms	8	$(1/2^+)$	05			1967	α=76 16; β^+ ?	
^{155}Lu^n	−40769	20	1781.0	2.0	AD		2.69	ms	0.03	$25/2^-$#	05			1981	$\alpha\approx$100; IT ?	
^{155}Hf	−34360#	300#					840	ms	30	$7/2^-$#	05	11Sa59	T	1981	$\beta^+\approx$100; α ?	
^{155}Ta	−23990#	500#					3.2	ms	1.3	$(11/2^-)$	07			2007	p=100	∗

∗^{155}Tm^m J : favored α decay from ^{159}Lu $1/2^+$ ∗∗

∗^{155}Ta T : symmetrized from 2.9(+1.5–1.1) I : NUBASE expects $1/2^+$ 30#20 below ∗∗

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{156}Ce	−44870#	400#					150#	ms		0^+					β^- ?; β^-n ?	
^{156}Pr	−51570#	300#					500#	ms	(>300 ns)			95Cz.A	I	1992	β^- ?; β^-n ?	
^{156}Nd	−60470	200					5.06	s	0.13	0^+	03	07Sh05	T	1987	β^-=100	∗
^{156}Nd^m	−59040	200	1431.3	0.4			365	ns	145	(5^-)	03	09Si21	ET	1998	IT=100	∗
^{156}Pm	−64164	4					26.70	s	0.10	$4^{(+)}$	03	11So05	J	1986	β^-=100	
^{156}Pm^m	−64014	4	150.3	0.1			2.3	s	2.0	(1^+)		07Sh05	ETJ	2007	β^-<2; IT=?	
^{156}Sm	−69363	9					9.4	h	0.2	0^+	03			1951	β^-=100	
^{156}Sm^m	−67965	9	1397.55	0.09			185	ns	7	5^-	03			1974	IT=100	∗
^{156}Eu	−70085	6					15.19	d	0.08	0^+	03			1947	β^-=100	
^{156}Gd	−72534.3	1.6					STABLE			0^+	03			1933	IS=20.47 9	
^{156}Gd^m	−70396.7	1.6	2137.60	0.05			1.3	μs	0.1	7^-	03			1969	IT=100	
^{156}Tb	−70090	4					5.35	d	0.10	3^-	03			1950	$\beta^+\approx$100; β^- ?	
^{156}Tb^m	−70036	5	54	3			24.4	h	1.0	(7^-)	03			1970	IT=100	∗
^{156}Tb^n	−70002	4	88.4	0.2			5.3	h	0.2	(0^+)	03			1950	IT=?; β^+=?	
^{156}Dy	−70528.3	1.6					STABLE		(>1 Ey)	0^+	03	58Ri23	T	1948	IS=0.056 3; α ?; 2β^+ ?	∗
^{156}Ho	−65480	60					56	m	1	4^-	03			1957	β^+=100	
^{156}Ho^m	−65430	60	52.4	0.5			9.5	s	1.5	1^-	03			1995	IT=?; β^+ ?	
^{156}Ho^n	−65304	28	170	70	MD		7.8	m	0.3	(9^+)	03			1975	β^+=75; IT ?	
^{156}Er	−64210	25					19.5	m	1.0	0^+	03			1967	β^+=100; α=17e–6 4	
^{156}Tm	−56829	15					83.8	s	1.8	2^-	03			1971	$\beta^+\approx$100; α=0.064 10	
^{156}Tm^m	−56430#	200#	400#	200#			400	ns		(11^-)	03			1985	IT=100	∗
^{156}Tm^n			non existent		RN		19	s	3	9^+	03	91To08	I			∗
^{156}Yb	−53258	10					26.1	s	0.7	0^+	03			1970	β^+=90 2; α=10 2	
^{156}Lu	−43750	70				∗	494	ms	12	$(2)^-$	03			1965	α=?; β^+=5#	
^{156}Lu^m	−43530#	100#	220#	130#		∗	198	ms	2	$(9)^+$	03	96Pa01	D	1979	α=94 6; β^+ ?	∗
^{156}Hf	−37870	160					23	ms	1	0^+	03	96Pa01	D	1979	α=97 3; β^+ ?	∗
^{156}Hf^m	−35910	160	1959.0	1.0	AD		480	μs	40	8^+	03	96Pa01	T	1979	α=100	∗
^{156}Ta	−26050#	300#					106	ms	4	(2^-)	03	11Da12	TD	1992	p=71 3; β^+=29 3	
^{156}Ta^m	−25960#	300#	94	8	AD		360	ms	40	(9^+)	03			1993	β^+=95.8 9; p=4.2 9	

∗^{156}Nd T : others 89Ok.A=5.51(0.10) 87Gr12=5.47(0.11), see discussion in 07Sh05 ∗∗

∗^{156}Nd^m E : least-squares fit to γ-ray energies in 09Si21 T : 98Ga12=135ns (no unc.) ∗∗

∗^{156}Sm^m T : other recent 09Si21=186(44) ∗∗

∗^{156}Tb^m E : derived from E3 24h to 4^+ 49.630 level and E(IT)< B(L)=9 keV ∗∗

∗^{156}Dy T : lower limit is for α decay ∗∗

∗^{156}Tm^m E : 203.6 keV above unknown level ∗∗

∗^{156}Tm^n I : see also the discussion in ENSDF'03 ∗∗

∗^{156}Lu^m D : derived from original α=98(9)% ∗∗

∗^{156}Hf D : derived from original α=100(6)% ∗∗

∗^{156}Hf^m T : average 96Pa01=520(10) 81Ho.A=444(17) ∗∗

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^{π}	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{157}Ce	−40010#	500#					50#	ms		$7/2^{+}$#					β^- ?; β^-n ?	
^{157}Pr	−48540#	400#					300#	ms		$5/2^{-}$#					β^- ?; β^-n ?	
^{157}Nd	−56462	25					2#	s	(>300 ns)	$5/2^{-}$#	05	95Cz.A	I	1992	β^- ?	
^{157}Pm	−62297	7					10.56	s	0.10	$(5/2^{-})$	05			1987	β^-=100	
^{157}Sm	−66678	4					8.03	m	0.07	$3/2^{-}$#	05			1973	β^-=100	
^{157}Eu	−69458	4					15.18	h	0.03	$5/2^{+}$	05			1951	β^-=100	
^{157}Gd	−70822.8	1.6					STABLE			$3/2^{-}$	05			1933	IS=15.65 2	
^{157}Gd^{m}	−70758.9	1.6	63.917	0.005			460	ns	40	$5/2^{+}$	05			1964	IT=100	
^{157}Gd^{n}	−70396.2	1.6	426.60	0.05			18.5	μs	2.3	$11/2^{-}$	05			1961	IT=100	
^{157}Tb	−70762.8	1.6					71	y	7	$3/2^{+}$	05			1960	ε=100	
^{157}Dy	−69424	5					8.14	h	0.04	$3/2^{-}$	05			1953	β^+=100	
^{157}Dy^{m}	−69262	5	161.99	0.03			1.3	μs	0.2	$9/2^{+}$	05			1974	IT=100	
^{157}Dy^{n}	−69225	5	199.38	0.07			21.6	ms	1.6	$11/2^{-}$	05			1970	IT=100	
^{157}Ho	−66831	23					12.6	m	0.2	$7/2^{-}$	05			1966	β^+=100	
^{157}Er	−63389	25					18.65	m	0.10	$3/2^{-}$	07			1966	β^+=100	
^{157}Er^{m}	−63234	25	155.4	0.3			76	ms	6	$9/2^{+}$	05			1971	IT=100	
^{157}Tm	−58736	26					3.63	m	0.09	$1/2^{+}$	05			1974	β^+=100	
^{157}Yb	−53426	11					38.6	s	1.0	$7/2^{-}$	05			1970	β^+=99.5; α=0.5	
^{157}Lu	−46457	15					6.8	s	1.8	$(1/2^{+},3/2^{+})$	05			1977	β^+ ?; α=?	*
^{157}Lu^{m}	−46436	15	20.9	2.0	AD		4.79	s	0.12	$(11/2^{-})$	05			1972	β^+=?; α=6 2	
^{157}Hf	−38900#	200#					115	ms	1	$7/2^{-}$	05	96Pa01	T	1965	α=86 9; β^+=14 9	
^{157}Ta	−29640	160					10.1	ms	0.4	$1/2^{+}$	05			1979	α=?; p=3.4 12; …	*
^{157}Ta^{m}	−29620	160	22	5	AD		4.3	ms	0.1	$11/2^{-}$	05			1996	α=?; β^+=1#; p=0	
^{157}Ta^{n}	−28050	160	1593	9	AD		1.7	ms	0.1	$25/2^{-}$#	05			1996	α=100	
^{157}W	−19710#	400#					275	ms	40	$(7/2^{-})$		10Bi03	TJD	2010	β^+=100; α=0	
^{157}W^{p}	−19390#	400#	320	30	AD					$(9/2^{-})$		10Bi03	EJ	2010	IT ?	

$*^{157}$Lu T : ENSDF'05 average of very conflicting 91To09=5.7(0.5) 91Le15,92Po14=9.6(8) $**$

$*^{157}$Ta D : …; β^+=1# $**$

^{158}Pr	−44330#	400#					200#	ms							β^- ?; β^-n ?	
^{158}Nd	−54060#	300#					700#	ms	(>300 ns)	0^{+}	04	95Cz.A	I	1992	β^- ?	
^{158}Pm	−59089	13					4.8	s	0.5		04			1987	β^-=100	
^{158}Sm	−65250	5					5.30	m	0.03	0^{+}	04			1970	β^-=100	
^{158}Sm^{m}	−63971	5	1279.1	1.8			115	ns	18	(5^{-})	04			1973	IT=100	
^{158}Eu	−67255	10					45.9	m	0.2	(1^{-})	04			1951	β^-=100	
^{158}Gd	−70688.9	1.6					STABLE			0^{+}	04			1933	IS=24.84 7	
^{158}Tb	−69469.9	1.9					180	y	11	3^{-}	04			1957	β^+=83.4 7; β^-=16.6 7	
^{158}Tb^{m}	−69359.6	2.2	110.3	1.2			10.70	s	0.17	0^{-}	04			1957	IT≈100; β^-<0.6; …	*
^{158}Tb^{n}	−69081.5	2.6	388.4	1.8			400	μs	40	(7^{-})	04			1961	IT=100	
^{158}Dy	−70406.2	2.9					STABLE			0^{+}	04			1938	IS=0.095 3; α ?; 2β^+ ?	
^{158}Ho	−66186	27					11.3	m	0.4	5^{+}	04			1961	β^+≈100; α ?	
^{158}Ho^{m}	−66119	27	67.199	0.010			28	m	2	2^{-}	04			1960	IT>81; β^+<19	
^{158}Ho^{n}	−66010#	80#	180#	70#			21.3	m	2.3	(9^{+})	04			1970	β^+>93; IT<7#	
^{158}Er	−65304	25					2.29	h	0.06	0^{+}	07			1961	ε=100	
^{158}Tm	−58703	25				*	3.98	m	0.06	2^{-}	04			1970	β^+=100	
^{158}Tm^{m}	−58650#	100#	50#	100#		*	20	ns		(5^{+})	04	81Dr07	T	1981	IT ?	*
^{158}Yb	−56010	8					1.49	m	0.13	0^{+}	04			1967	β^+≈100; α≈0.0021 12	
^{158}Lu	−47212	15					10.6	s	0.3	2^{-}	04	95Ga.A	J	1979	β^+=99.09 20; …	*
^{158}Hf	−42103	17					2.85	s	0.07	0^{+}	04			1965	β^+=55.7 19; α=44.3 19	
^{158}Ta	−31170#	200#					49	ms	8	(2^{-})	04	97Da07	TD	1979	α=96 4; β^+ ?	*
^{158}Ta^{m}	−31030#	200#	141	11	AD		36.0	ms	0.8	(9^{+})	04	97Da07	TJE	1979	α=95 5; β^+ ?; IT ?	*
^{158}W	−23700#	500#					1.25	ms	0.21	0^{+}	06			1981	α=100	
^{158}W^{m}	−21810#	500#	1889	8	AD		143	μs	19	(8^{+})	06			1995	α=100	

$*^{158}$Tb^{m} D : …; β^+<0.01 $**$

$*^{158}$Tm^{m} I : T≈20 s in 81Dr07 was a typo. Value in Fig. 2 was correct. See 96Dr.A $**$

$*^{158}$Lu D : …; α=0.91 20 $**$

$*^{158}$Ta T : average 97Da07=72(12) 96Pa01=46(4) with Birge ratio B=2 $**$

$*^{158}$Ta D : derived from original α≈100(8)% $**$

$*^{158}$Ta^{m} T : average 97Da07=37.7(1.5) 96Pa01=35(1) 79Ho10=36.8(1.6) $**$

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{159}Pr	−41090#	500#					100#	ms		$5/2^-$#					β^- ?; β^-n ?	
^{159}Nd	−49810#	400#					500#	ms	(>300 ns)	$7/2^+$#		12Ku26	I	2012	β^- ?; β^-n ?	
^{159}Pm	−56554	10					1.5	s	0.2	$5/2^-$#	12	05Ic02	T	1998	β^-=100	
^{159}Sm	−62208	6					11.37	s	0.15	$5/2^-$	12			1986	β^-=100	
^{159}Sm^m	−60931	6	1276.8	0.5			116	ns	8	$(11/2^-)$	12	09Ur04	ET	2009	IT=100	
^{159}Eu	−66043	4					18.1	m	0.1	$5/2^+$	12			1961	β^-=100	
^{159}Gd	−68560.8	1.6					18.479	h	0.004	$3/2^-$	12			1949	β^-=100	
^{159}Tb	−69531.6	1.8					STABLE			$3/2^+$	12	12Vi.1	J	1933	IS=100.	*
^{159}Dy	−69166.3	2.0					144.4	d	0.2	$3/2^-$	12			1951	ε=100	
^{159}Dy^m	−68813.5	2.0	352.77	0.14			122	μs	3	$11/2^-$	12			1965	IT=100	
^{159}Ho	−67329	3					33.05	m	0.11	$7/2^-$	12			1958	β^+=100	
^{159}Ho^m	−67123	3	205.91	0.05			8.30	s	0.08	$1/2^+$	12			1966	IT=100	
^{159}Er	−64560	4					36	m	1	$3/2^-$	12			1962	β^+=100	
^{159}Er^m	−64377	4	182.602	0.024			337	ns	14	$9/2^+$	12			1971	IT=100	
^{159}Er^n	−64131	4	429.05	0.03			590	ns	60	$11/2^-$	12			1971	IT=100	
^{159}Tm	−60570	28					9.13	m	0.16	$5/2^+$	12			1971	β^+=100	
^{159}Yb	−55839	18					1.67	m	0.09	$5/2^{(-)}$	12			1975	β^+=100	
^{159}Lu	−49710	40				*	12.1	s	1.0	$1/2^+$	12	FGK12a	J	1980	$\beta^+\approx$100; α=0.1#	*
^{159}Lu^m	−49610#	90#	100#	80#		*	10#	s		$11/2^-$#					β^+ ?; IT ?; α ?	
^{159}Hf	−42853	17					5.20	s	0.10	$7/2^-$	12	96Pa01	T	1973	β^+=65 7; α=35 7	
^{159}Ta	−34444	20					1.04	s	0.09	$1/2^+$	12	97Da07	T	1979	β^+ ?; α=34 5	*
^{159}Ta^m	−34381	19	64	5	AD		560	ms	60	$11/2^-$	12			1994	α=55 1; β^+ ?	
^{159}W	−25490#	300#					8.2	ms	0.7	$7/2^-$#	12	96Pa01	TD	1981	α=82 16; β^+ ?	*
^{159}Re	−14740#	510#					40#	μs		$1/2^+$#				2006	p ?; α ?	
^{159}Re^m	−14600#	500#	140#	50#			21.6	μs	3.3	$11/2^-$	12	07Pa27	T	2006	p=?; α=7.5 35	*

$*^{159}$Tb J : 3/2 confirmed by a novel technique in 12Vi.1 (see text) **
$*^{159}$Lu J : favored α decay from ^{163}Ta $1/2^+$ **
$*^{159}$Ta T : average 97Da07=0.83(0.18) 96Pa01=1.10(0.10) **
$*^{159}$W D : derived from original α=92(23)% **
$*^{159}$Re^m T : average 07Pa27=23(6) 06Jo10=21(4) **

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{160}Nd	−47130#	400#					300#	ms	(>300 ns)	0^+		12Ku26	I	1985	β^- ?; β^-n ?	*
^{160}Pm	−53000#	300#					2#	s	(>300 ns)			12Ku26	I	2012	β^- ?; β^-n ?	
^{160}Sm	−60235	6					9.6	s	0.3	0^+	05			1986	β^-=100	
^{160}Sm^m	−58874	6	1361.3	0.4			120	ns	46	(5^-)		09Si21	ETJ	2009	IT=100	
^{160}Eu	−63480	10					38	s	4	$(1)^{(-\#)}$	05			1973	β^-=100	
^{160}Gd	−67940.9	1.7					STABLE		(>31 Ey)	0^+	05	01Da22	T	1933	IS=21.86 19; 2β^- ?	
^{160}Tb	−67835.5	1.8					72.3	d	0.2	3^-	05			1943	β^-=100	
^{160}Dy	−69671.4	1.9					STABLE			0^+	05			1938	IS=2.329 18	
^{160}Ho	−66381	15					25.6	m	0.3	5^+	05			1950	β^+=100	
^{160}Ho^m	−66321	15	59.98	0.03			5.02	h	0.05	2^-	05			1955	IT=73 3; β^+=27 3	
^{160}Ho^n	−66184	22	197	16			3	s		(9^+)	05	GAu	E	1988	IT=100	*
^{160}Er	−66064	24					28.58	h	0.09	0^+	05			1954	ε=100	
^{160}Tm	−60300	30					9.4	m	0.3	1^-	05			1970	β^+=100	
^{160}Tm^m	−60230	40	70	20			74.5	s	1.5	(5^+)	05			1983	IT=85 5; β^+=15 5	
^{160}Tm^n	−60200#	60#	100#	50#			200	ns		(8)	05			1986	IT=100	*
^{160}Yb	−58165	16					4.8	m	0.2	0^+	05			1967	β^+=100	
^{160}Lu	−50270	60				*	36.1	s	0.3	2^-#	05			1979	β^+=100; α<1e–4	
^{160}Lu^m	−50270#	120#	0#	100#		*	40	s	1		05			1980	$\beta^+\approx$100; α ?	
^{160}Hf	−45931	10					13.6	s	0.2	0^+	05			1973	β^+=99.3 2; α=0.7 2	
^{160}Ta	−35870	70				&	1.70	s	0.20	(2^-)	05	96Pa01	JD	1979	β^+ ?; α=?	*
^{160}Ta^m	−35550#	100#	320#	130#		&	1.55	s	0.04	$(9)^+$	05	96Pa01	TJ	1979	β^+=66#; α=?	*
^{160}W	−29380	160					90	ms	5	0^+	05	96Pa01	TD	1979	α=87 8; β^+ ?	*
^{160}Re	−16930#	300#					611	μs	7	(4^-)	05	11Da12	TJD	1992	p=89 1; α=11 1	*
^{160}Re^m	−16750#	300#	184	4			2.8	μs	0.1	(9^+)		11Da01	EJT	2011	IT=100	

$*^{160}$Nd I : first seen in 85Si25 in the thermal fission of ^{252}Cf **
$*^{160}$Ho^n E : less than 55 keV above 169.61 level, from ENSDF **
$*^{160}$Tm^n E : 98.2 + x, x estimated 0#50 **
$*^{160}$Ta J : from α correlation with ^{156}Lu line **
$*^{160}$Ta^m J : from α correlation with ^{156}Lu^m line **
$*^{160}$W T : average 96Pa01=91(5) 81Ho10=81(15) **
$*^{160}$Re J : protons from $d_{3/2}$ orbital; 92Pa05=(2^-) **

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{161}Nd	−42590#	500#					200#	ms		$1/2^-$#					β^- ?; β^-n ?	
^{161}Pm	−50240#	300#					700#	ms	(>300 ns)	$5/2^-$#		12Ku26	I	2012	β^- ?; β^-n ?	
^{161}Sm	−56672	7					4.8	s	0.4	$7/2^+$#	11			1998	β^-=100	
^{161}Eu	−61792	10					26	s	3	$5/2^+$#	11			1986	β^-=100	
^{161}Gd	−65505.0	2.0					3.646	m	0.003	$5/2^-$	11	94It.A	T	1949	β^-=100	
^{161}Tb	−67460.8	1.8					6.89	d	0.02	$3/2^+$	11			1949	β^-=100	
^{161}Dy	−68054.5	1.9					STABLE			$5/2^+$	11			1934	IS=18.889 42	
^{161}Dy^m	−67568.9	1.9	485.56	0.16			760	ns	170	$11/2^-$	11	12Sw01	T	2012	IT=100	
^{161}Ho	−67196.5	2.8					2.48	h	0.05	$7/2^-$	11			1954	ε=100	
^{161}Ho^m	−66985.4	2.8	211.15	0.03			6.76	s	0.07	$1/2^+$	11			1965	IT=100	
^{161}Er	−65200	9					3.21	h	0.03	$3/2^-$	11			1954	β^+=100	
^{161}Er^m	−64804	9	396.44	0.04			7.5	μs	0.7	$11/2^-$	11			1969	IT=100	
^{161}Tm	−61899	28					30.2	m	0.8	$7/2^+$	11			1959	β^+=100	
^{161}Tm^m	−61891	28	7.51	0.24			5#	m		$(1/2^+)$	11			1981	β^+ ?; IT ?	
^{161}Tm^n	−61821	28	78.20	0.03			110	ns	3	$7/2^-$	11			1981	IT=100	
^{161}Yb	−57839	15					4.2	m	0.2	$3/2^-$	11			1974	β^+=100	
^{161}Lu	−52562	28					77	s	2	$1/2^+$	11			1973	β^+=100	
^{161}Lu^m	−52388	28	174	4			7.3	ms	0.4	$(9/2^-)$	11			1973	IT=100	*
^{161}Hf	−46315	23					18.2	s	0.5	$3/2^-$#	11			1973	$\beta^+\approx$100; α<0.13	
^{161}Ta	−38701	25				*	3#	s		$(1/2^+)$	11			1979	β^+ ?; α ?	
^{161}Ta^m	−38694	17	8	23	AD	*	3.08	s	0.11	$(11/2^-)$	11			1979	β^+=95#; α=?	
^{161}W	−30560#	200#					409	ms	16	$7/2^-$#	11	96Pa01	T	1973	α=73 3; β^+=27 3	*
^{161}Re	−20890	160					440	μs	1	$1/2^+$	11	06La16	T	1979	p$\approx$100; α<1.4	
^{161}Re^m	−20770	160	123.7	1.3			14.7	ms	0.3	$11/2^-$	11			1979	α=93.0 3; p=7.0 3	
^{161}Os	−10220#	400#					640	μs	60	$(7/2^-)$	11			2010	$\alpha\approx$100	

*^{161}Lu^m E : 166.5(0.8) keV above (3/2$^+$) level at x<15 keV **
*^{161}W T : average 96Pa01=409(18) 79Ho10=410(40) **

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{162}Pm	−46370#	400#					500#	ms	(>300 ns)			12Ku26	I	2012	β^- ?; β^-n ?	
^{162}Sm	−54530#	200#					2.4	s	0.5	0^+	07			2005	β^-=100	
^{162}Eu	−58690	60					10.6	s	1.0		07			1987	β^-=100	
^{162}Gd	−64280	4					8.4	m	0.2	0^+	07			1967	β^-=100	
^{162}Tb	−65670	40					7.60	m	0.15	(1^-)	07			1965	β^-=100	
^{162}Dy	−68180.2	1.9					STABLE			0^+	07			1934	IS=25.475 36	
^{162}Dy^m	−65992.1	1.9	2188.1	0.3			8.3	μs	0.3	8^+		11Sw02	ETD	2011	IT=100	
^{162}Ho	−66041	4					15.0	m	1.0	1^+	07			1957	β^+=100	
^{162}Ho^m	−65935	4	105.87	0.06			67.0	m	0.7	6^-	07			1961	IT=62; β^+=38	
^{162}Er	−66333.2	1.9					STABLE		(>140 Ty)	0^+	07	56Po16	T	1938	IS=0.139 5; α ?; 2β^+ ?	*
^{162}Er^m	−64307.2	1.9	2026.01	0.13			88	ns	16	$7^{(-)}$	07	12Sw01	TJ	1974	IT=100	
^{162}Tm	−61476	26					21.70	m	0.19	1^-	07			1963	β^+=100	
^{162}Tm^m	−61350	50	130	40			24.3	s	1.7	5^+	07	GAu	E	1974	IT ?; β^+=19 4	*
^{162}Yb	−59827	15					18.87	m	0.19	0^+	07			1963	β^+=100	
^{162}Lu	−52830	80				*	1.37	m	0.02	$1^{(-)}$	07			1978	β^+=100	
^{162}Lu^m	−52710#	220#	120#	200#		*	1.5	m		4^-#	07			1980	$\beta^+\approx$100; IT ?	
^{162}Lu^n	−52530#	220#	300#	200#		*	1.9	m			07			1980	$\beta^+\approx$100; IT ?	
^{162}Hf	−49169	9					39.4	s	0.9	0^+	07			1982	$\beta^+\approx$100; α=0.008 1	
^{162}Ta	−39780	50					3.57	s	0.12	7^+#	07			1985	$\beta^+\approx$100; α=0.074 10	
^{162}W	−34000	18					1.36	s	0.07	0^+	07			1973	β^+ ?; α=45.2 16	
^{162}Re	−22500#	200#					107	ms	13	(2^-)	07			1979	α=94 6; β^+ ?	
^{162}Re^m	−22330#	200#	175	9	AD		77	ms	9	(9^+)	07			1979	α=91 5; β^+ ?	
^{162}Os	−14500#	500#					2.1	ms	0.1	0^+	07			1989	α=100	

*^{162}Er T : lower limit is for α decay **
*^{162}Tm^m E : above 66.90 level and less than 192 keV, from ENSDF **

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{163}Pm	−43250#	500#					200#	ms	(>300 ns)	$5/2^-$#		12Ku26	I	2012	β^- ?; β^-n ?	
^{163}Sm	−50720#	300#					1#	s	(>300 ns)	$1/2^-$#		12Ku26	I	2012	β^- ?	
^{163}Eu	−56640	70					7.7	s	0.4	$5/2^+$#	10	08Os02	T	2007	β^-=100	
^{163}Gd	−61314	8					68	s	3	$7/2^+$#	10			1982	β^-=100	
^{163}Tb	−64595	4					19.5	m	0.3	$3/2^+$	10			1966	β^-=100	
^{163}Dy	−66379.9	1.9					STABLE			$5/2^-$	10			1934	IS=24.896 42	
^{163}Ho	−66377.3	1.9					4.570	ky	0.025	$7/2^-$	10			1957	ε=100	*
^{163}Ho^m	−66079.4	1.9	297.88	0.07			1.09	s	0.03	$1/2^+$	10			1957	IT=100	
^{163}Ho^n	−64267.9	1.9	2109.4	0.4			800	ns	150	$(23/2^+)$		12Sw01	ETJ	2012	IT=100	
^{163}Er	−65167	5					75.0	m	0.4	$5/2^-$	10			1953	β^+=100	
^{163}Er^m	−64722	5	445.5	0.6			580	ns	100	$(11/2^-)$	10			1974	IT=100	
^{163}Tm	−62728	6					1.810	h	0.005	$1/2^+$	10			1959	β^+=100	
^{163}Tm^m	−62641	6	86.92	0.05			380	ns	30	$(7/2)^-$	10			1975	IT=100	
^{163}Yb	−59299	15					11.05	m	0.35	$3/2^-$	10			1967	β^+=100	
^{163}Lu	−54791	28					3.97	m	0.13	$1/2^{(+)}$	10			1979	β^+=100	
^{163}Hf	−49264	25					40.0	s	0.6	$3/2^-$#	10			1982	β^+=100; α<0.0001	

... *A*-group is continued on next page ...

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
... *A*-group continued ...																
^{163}Ta	−42530	40					10.6	s	1.8	$1/2^+$	10	FGK12a	J	1985	$\beta^+\approx100$; $\alpha\approx0.2$	*
^{163}Ta^m	−42410#	40#	129#	20#	AD		10#	s		$(9/2^-)$		FGK12a	J		β^+ ?; α ?; IT ?	*
^{163}W	−34910	50					2.63	s	0.09	$7/2^-$	10			1973	β^+ ?; α=14 2	*
^{163}W^m	−34430	50	480.3	0.7			154	ns	3	$13/2^+$	10			2010	IT=100	
^{163}Re	−26007	19					390	ms	70	$1/2^+$	10			1979	β^+ ?; α=32 3	
^{163}Re^m	−25888	19	120	5	AD		214	ms	5	$11/2^-$	10			1979	α=66 4; β^+ ?	
^{163}Os	−16390#	300#					5.5	ms	0.6	$7/2^-$#	10			1981	$\alpha\approx100$; β^+ ?	
*^{163}Ho	T : other: 92Ju01=47(+5–4) d for q=66$^+$ (bare ion)															**
*^{163}Ta	J : favored a-decay from 1/2$^+$ isomer in ^{167}Re															**
*^{163}Ta^m	J : favored a-decay from (9/2$^-$) ground-state in ^{167}Re															**
*^{163}Ta^m	E : *E*(a)=5277.3(2.7) to ^{159}Lu ground-state															**
^{164}Sm	−48100#	300#					500#	ms	(>300 ns)	0^+		12Ku26	I	2012	β^- ?; β^-n ?	
^{164}Eu	−53330#	210#					4.2	s	0.2		08	08Os02	T	2007	β^-=100	
^{164}Gd	−59770#	200#					45	s	3	0^+	06			1988	β^-=100	
^{164}Tb	−62080	100					3.0	m	0.1	(5^+)	01			1968	β^-=100	
^{164}Dy	−65966.7	1.9					STABLE			0^+	01			1934	IS=28.260 54	
^{164}Ho	−64980.8	2.3					29	m	1	1^+	01			1938	ε=60 5; β^-=40 5	
^{164}Ho^m	−64841.0	2.3	139.77	0.08			36.4	m	0.3	6^-	01	08Ha21	T	1966	IT=100	*
^{164}Er	−65941.6	1.9					STABLE			0^+	01			1938	IS=1.601 3; α ?; 2β^+ ?	
^{164}Er^m	−62565.5	2.2	3376.1	1.1			> 170	ns		(12^+)	01			1980	IT=100	
^{164}Tm	−61904	24				*	2.0	m	0.1	1^+	01			1960	ε=61 1; e$^+$=39 1	
^{164}Tm^m	−61894	25	10	6		*	5.1	m	0.1	6^-	01	GAu	E	1971	IT≈80; $\beta^+\approx20$	*
^{164}Yb	−61018	15					75.8	m	1.7	0^+	01			1960	ε=100	
^{164}Lu	−54642	28					3.14	m	0.03	$1^{(-)}$	01			1977	β^+=100	*
^{164}Hf	−51818	16					111	s	8	0^+	01			1981	β^+=100	
^{164}Ta	−43283	28					14.2	s	0.3	(3^+)	01			1982	β^+=100	*
^{164}W	−38228	11					6.3	s	0.2	0^+	01			1973	β^+=96.2 12; α=3.8 12	
^{164}Re	−27520	70				*	719	ms	161	(2^-)	01	09Ha42	TD	1979	α=?; β^+=42#	*
^{164}Re^m	−27370#	100#	160#	130#		*	890	ms	130	(9^+)		09Ha42	TD	2009	β^+ ?; α=3 1	*
^{164}Os	−20470	160					21	ms	1	0^+	01			1981	α=?; β^+=2#	
^{164}Ir	−7540#	310#					1#	ms		2^-#	06				p ?; α ?; β^+ ?	
^{164}Ir^m	−7260#	300#	280#	110#			94	μs	27	(9^+)	06	02Ma61	T	2001	p=?; α ?; β^+ ?	*
*^{164}Ho^m	T : other 66Jo07=37.5(+1.5–0.5)															**
*^{164}Tm^m	E : less than 20 keV, from ENSDF															**
*^{164}Lu	J : negative parity proposed in 98Ge13; odd-odd ^{160}Tm ^{162}Tm ^{162}Lu have 1$^-$ ground-state															**
*^{164}Ta	D : was erroneously considered as α emitter, instead of ^{163}Ta in 83Sc18															**
*^{164}Re	T : average 09Ha42=848(+140–105) 96Pa01=380(160) 81Ho10=880(240)															**
*^{164}Re^m	T : symmetrized from 864(+150–110)															**
*^{164}Ir^m	T : average 02Ma61=58(+46–18) 01Ke05=110(+60–30)															**
^{165}Sm	−43810#	400#					200#	ms	(>300 ns)	$5/2^-$#		12Ku26	I	2012	β^- ?; β^-n ?	
^{165}Eu	−50690#	320#					2.7	s	0.3	$5/2^+$#	08	08Os02	TD	2007	β^-=100; β^-n ?	
^{165}Gd	−56490#	300#					10.3	s	1.6	$1/2^-$#	06			1998	β^-=100	
^{165}Tb	−60570#	200#					2.11	m	0.10	$3/2^+$#	06			1983	β^-=100	
^{165}Dy	−63611.3	1.9					2.334	h	0.001	$7/2^+$	06			1935	β^-=100	
^{165}Dy^m	−63503.1	1.9	108.1552	0.0013			1.257	m	0.006	$1/2^-$	06			1963	IT=97.76 11; β^-=2.24 11	
^{165}Ho	−64898.3	2.0					STABLE			$7/2^-$	06			1934	IS=100.	
^{165}Ho^m	−64536.6	2.0	361.675	0.011			1.512	μs	0.004	$3/2^+$	06			1958	IT=100	
^{165}Ho^n	−64183.0	2.0	715.33	0.02			< 100	ns		$7/2^+$	06			1958	IT=100	
^{165}Er	−64520.4	2.0					10.36	h	0.04	$5/2^-$	06			1950	ε=100	
^{165}Er^m	−63969.1	2.1	551.3	0.6			250	ns	30	$11/2^-$	06			1970	IT=100	
^{165}Er^n	−62697.4	2.1	1823.0	0.6			370	ns	40	$(19/2)$		12Sw01	EJT	2012	IT=100	
^{165}Tm	−62928.8	2.4					30.06	h	0.03	$1/2^+$	06			1953	β^+=100	
^{165}Tm^m	−62848.4	2.4	80.37	0.06			80	μs	3	$7/2^+$	06			1967	IT=100	
^{165}Tm^n	−62768.3	2.4	160.47	0.06			9.0	μs	0.5	$7/2^-$	06			1968	IT=100	
^{165}Yb	−60295	27					9.9	m	0.3	$5/2^-$	06			1964	β^+=100	
^{165}Yb^m	−60168	27	126.80	0.09			300	ns	30	$9/2^+$	06			1980	IT=100	
^{165}Lu	−56442	27					10.74	m	0.10	$1/2^+$	06			1973	β^+=100	
^{165}Hf	−51636	28					76	s	4	$(5/2^-)$	06			1981	β^+=100	
^{165}Ta	−45848	14					31.0	s	1.5	$(1/2^+,3/2^+)$	06	FGK12a	J	1982	β^+=100	*
^{165}Ta^m	−45823	17	24	18	AD		30#	s		$(9/2^-)$		FGK12a	J		β^+ ?; α ?	*
^{165}W	−38861	25					5.1	s	0.5	$(5/2^-)$	06			1975	$\beta^+\approx100$; $\alpha<0.2$	
^{165}Re	−30644	25				*	2.62	s	0.14	$(1/2^+)$	06	05Sc22	TD	1981	β^+ ?; $\alpha<5$	*
^{165}Re^m	−30609	17	35	23	AD	*	2.32	s	0.09	$(11/2^-)$	06			1978	β^+=87 3; α=13 3	*
^{165}Os	−21800#	200#					71	ms	3	$(7/2^-)$	06			1978	$\alpha>60$; $\beta^+<40$	
^{165}Ir	−11640#	170#					50#	ns	<1 μs	$1/2^+$#	06	97Da07	I		p ?; α ?	
^{165}Ir^m	−11460	160	180#	50#			300	μs	60	$(11/2^-)$	06			1996	p=87 4; α=13 4	
*^{165}Ta	J : favored α decay from ^{169}Re^m (J=(1/2$^+$,3/2$^+$))															**
*^{165}Ta^m	J : favored α decay from ^{169}Re (J=(9/2$^-$))															**
*^{165}Re	T : symmetrized from 05Sc22=2.614(+0.142–0.128)															**
*^{165}Re	J : favored α decay from the (1/2$^+$) ground state of the ^{169}Ir parent															**
*^{165}Re^m	J : favored α decay from the (11/2$^-$) isomeric state of the ^{169}Ir parent															**

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{166}Eu	−46930#	300#				1.7	s	0.3			08Os02	TD	2007	β^-=100; β^-n ?	
^{166}Gd	−54530#	600#				4.8	s	1.0	0^+	08			2005	β^-=100	
^{166}Tb	−57880	70				25.1	s	2.1	(2^-)	08			1996	β^-=100	
^{166}Dy	−62583.5	1.9				81.6	h	0.1	0^+	08			1949	β^-=100	
^{166}Ho	−63070.6	2.0				26.824	h	0.012	0^-	08			1936	β^-=100	
^{166}Ho^m	−63064.6	2.0	5.969	0.012		1.133	ky	0.05	7^-	08	12Ne05	T	1952	β^-=100	
^{166}Ho^n	−62879.7	2.0	190.9021	0.0020		185	μs	15	3^+	08			1960	IT=100	
^{166}Er	−64925.6	2.0				STABLE			0^+	08			1934	IS=33.503 36	
^{166}Tm	−61888	12				7.70	h	0.03	2^+	08			1948	β^+=100	
^{166}Tm^m	−61771	13	117	5		348	ms	21	(6^-)	08	96Dr07	T	1996	IT=100	*
^{166}Tm^n	−61649	13	239	5		2	μs	1	(6^-)	08	96Dr07	EDT	1995	IT=100	*
^{166}Yb	−61595	7				56.7	h	0.1	0^+	08			1954	ε=100	
^{166}Lu	−56021	30				2.65	m	0.10	6^-	08			1969	β^+=100	
^{166}Lu^m	−55990	30	34.37	0.22		1.41	m	0.10	$3^{(-)}$	08			1974	β^+=58 5; IT=42 5	
^{166}Lu^n	−55980	30	43.0	0.4		2.12	m	0.10	0^-	08			1974	β^+>80; IT<20	
^{166}Hf	−53859	28				6.77	m	0.30	0^+	08			1965	β^+=100	
^{166}Ta	−46098	28				34.4	s	0.5	$(2)^+$	08			1977	β^+=100	
^{166}W	−41888	10				19.2	s	0.6	0^+	08			1975	$\beta^+\approx$100; α=0.035 12	
^{166}Re	−31890	70				2.25	s	0.21	(7^+)	08	92Me10	J	1978	β^+=?; α=5 2	*
^{166}Re^p	−31740#	90#	150#	50#					3^-#	08					
^{166}Os	−25437	18				216	ms	9	0^+	08	96Pa01	T	1977	α=72 13; β^+=28 13	*
^{166}Ir	−13350#	200#				10.5	ms	2.2	(2^-)	08			1981	α=93 3; p=7 3	*
^{166}Ir^m	−13180#	200#	172	6	p	15.1	ms	0.9	(9^+)	08			1996	α=98.2 6; p=1.8 6	
^{166}Pt	−4790#	500#				300	μs	100	0^+	08			1996	α=100	

*^{166}Tm^m E : less than 16 keV above 109.338 level **
*^{166}Tm^m T : average 340(25) (34.4 keV γ-time) 370(40) (74.9 keV γ-time) **
*^{166}Tm^n E : 121.710 keV above the 340 ms isomer **
*^{166}Tm^n T : other 02Ca46=36(2) ns adopted in ENSDF'08 **
*^{166}Re D : from 2% $< \alpha <$ 8% as discussed in ENSDF J : 92Me10 β^+ to 6^+ state **
*^{166}Os T : average 96Pa01=220(7) 91Se01=194(17) **

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{167}Eu	−43880#	400#				200#	ms	(>300 ns)	$5/2^+$#		12Ku26	I	2012	β^- ?; β^-n ?	
^{167}Gd	−50810#	400#				3#	s	(>300 ns)	$5/2^-$#		12Ku26	I	2012	β^- ?	
^{167}Tb	−55930#	200#				19	s	3	$3/2^+$#	00	99As03	T	1999	β^-=100	
^{167}Dy	−59930	60				6.20	m	0.08	$(1/2^-)$	00			1960	β^-=100	
^{167}Ho	−62281	6				3.1	h	0.1	$7/2^-$	00			1955	β^-=100	
^{167}Ho^m	−62022	6	259.34	0.11		6.0	μs	1.0	$3/2^+$	00			1977	IT=100	
^{167}Er	−63290.7	2.0				STABLE			$7/2^+$	00			1934	IS=22.869 9	
^{167}Er^m	−63082.9	2.0	207.801	0.005		2.269	s	0.006	$1/2^-$	00			1986	IT=100	
^{167}Tm	−62544.1	2.3				9.25	d	0.02	$1/2^+$	00			1948	ε=100	
^{167}Tm^m	−62364.6	2.3	179.480	0.019		1.16	μs	0.06	$(7/2)^+$	00			1964	IT=100	
^{167}Tm^n	−62251.3	2.3	292.820	0.020		0.9	μs	0.1	$7/2^-$	00			1965	IT=100	
^{167}Yb	−60591	4				17.5	m	0.2	$5/2^-$	00			1954	β^+=100	
^{167}Yb^m	−60019	4	571.548	0.022		180	ns		$(11/2)^-$	00			1976	IT=100	
^{167}Lu	−57500	30			*	51.5	m	1.0	$7/2^+$	06			1958	β^+=100	
^{167}Lu^m	−57500#	40#	0#	30#	*	> 1	m		$1/2^{(-\#)}$	06			1998	IT ?; β^+ ?	
^{167}Hf	−53468	28				2.05	m	0.05	$(5/2)^-$	00			1969	β^+=100	
^{167}Ta	−48351	28				1.33	m	0.07	$(3/2^+)$	00			1982	β^+=100	
^{167}W	−42099	18				19.9	s	0.5	$3/2^-$#	00			1985	β^+=99.96 1; α=0.04 1	*
^{167}Re	−34840#	40#			&	3.4	s	0.4	$(9/2^-)$	00	10An01	J	1992	$\alpha\approx$100; β^+ ?	
^{167}Re^m	−34700	40	140#	16#	&	5.9	s	0.3	$1/2^+$	00	11Ko.B	EJ	1984	$\beta^+\approx$99; $\alpha\approx$1	
^{167}Os	−26500	70				839	ms	5	$7/2^-$	09	10Sc02	TJD	1977	α=51 4; β^+ ?	*
^{167}Os^m	−26060	70	435.1	1.0		672	ns	7	$(13/2^+)$	09	10Sc02	E	2009	IT=100	*
^{167}Ir	−17078	19				29.3	ms	0.6	$1/2^+$	02	05Sc22	TD	1981	α=43 2; p=39.3 13; β^+ ?	*
^{167}Ir^m	−16902	19	175.5	2.1	p	25.7	ms	0.8	$11/2^-$	02	04Ke06	T	1995	α=90 3; β^+ ?; …	*
^{167}Pt	−6810#	310#				800	μs	160	$7/2^-$#	00	04Ke06	T	1996	α=100	*

*^{167}W J : lowest observed state in 92Th06 is $13/2^+$ **
*^{167}Os D : average 10Sc02=51(5)% 96Pa01=49(7)% 81Ho10=58(12)% **
*^{167}Os^m E : also 10Sc02=434.3(1.1), unc. estimated by evaluator, based on Table II **
*^{167}Ir T : from p-decay; α-decay 05Sc22=30.9(1.3) 97Da07=35.2(2.0) not used **
*^{167}Ir^m D : …; p=0.42 8 D : p from 05Sc22 **
*^{167}Ir^m T : other not used 05Sc22=28.7(3.3) from α-decay and 28.8(1.3) from p-decay **
*^{167}Ir^m T : 97Da07=30.0(0.6) conflicting, not used **
*^{167}Pt T : average 04Ke06=900(+300–200) 96Bi07=700(200) **

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{168}Eu								(>300 ns)			12Ku26	I	2012	β^- ?; β^-n ?	
^{168}Gd	−48360#	400#				300#	ms	(>300 ns)	0$^+$		12Ku26	I	1985	β^- ?	*
^{168}Tb	−52720#	300#				8.2	s	1.3	4$^-$#	10			1999	β^-=100	
^{168}Dy	−58560	140				8.7	m	0.3	0$^+$	10			1982	β^-=100	
^{168}Ho	−60060	30				2.99	m	0.07	3$^+$	10			1960	β^-=100	
^{168}Ho^m	−60000	30	59	1		132	s	4	(6$^+$)	10	90Ch37	E	1990	IT≈100; β^-<0.5	
^{168}Ho^n	−59920	30	143.43	0.17		> 4	μs		(1)$^-$	10			1990	IT=100	
^{168}Ho^p	−59870	30	192.57	0.20		108	ns	11	1$^+$	10			1990	IT=100	
^{168}Er	−62990.7	2.0				STABLE			0$^+$	10			1934	IS=26.978 18	
^{168}Er^m	−61896.7	2.0	1094.0383	0.0016		109.0	ns	0.7	4$^-$	10			1974	IT=100	
^{168}Tm	−61313.3	2.6				93.1	d	0.2	3$^+$	10			1949	β^+≈100; β^-=0.010 7	
^{168}Yb	−61581.4	2.0				STABLE		(>130 Ty)	0$^+$	10	56Po16	T	1938	IS=0.123 3; α ?; 2β^+ ?	*
^{168}Lu	−57070	40				5.5	m	0.1	6$^{(-)}$	10			1960	β^+=100	
^{168}Lu^m	−56870	40	202.81	0.12		6.7	m	0.4	3$^+$	10			1960	β^+>99.6 4; IT<0.8	
^{168}Hf	−55361	28				25.95	m	0.20	0$^+$	10			1961	ε≈98; e$^+$≈2	
^{168}Ta	−48394	28				2.0	m	0.1	(2$^-$,3$^+$)	10			1969	β^+=100	*
^{168}W	−44893	13				50.9	s	1.9	0$^+$	10			1971	β^+≈100; α=0.0032 10	
^{168}Re	−35790	30				4.4	s	0.1	(7$^+$)	10			1992	β^+≈100; α≈0.005	
^{168}Os	−29987	11				2.1	s	0.1	0$^+$	10			1977	β^+=57 4; α=43 4	
^{168}Ir	−18720	70				230	ms	50	(2$^-$)	10			1978	α≈100; β^+ ?; β^+p ?	*
^{168}Ir^m	−18460#	100#	250#	130#		163	ms	16	(9$^+$)	10	09Ha42	TD	1996	α=77 9; β^+ ?; β^+p ?	*
^{168}Pt	−11060	160				2.02	ms	0.10	0$^+$	10			1981	α≈100; β^+=0.2#	

$*^{168}$Gd	I : first seen in 85Si25 via thermal fission of ^{252}Cf	**
$*^{168}$Yb	T : lower limit is for α decay	**
$*^{168}$Ta	T : other: 02At01=5.2(0.7) for q=73$^+$ (bare ion)	**
$*^{168}$Ir	T : symmetrized from 09Ha42=222(+60–40)	**
$*^{168}$Ir	J : from correlations between α's depopulating (2$^-$) isomers down to ^{152}Tm	**
$*^{168}$Ir^m	T : average 09Ha42=160(+30–20) 09Ha42=153(+40–30)(indept) 96Pa01=161(21)	**
$*^{168}$Ir^m	J : from correlations between α's depopulating (9$^+$) isomers down to ^{152}Tm	**

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{169}Gd	−44150#	500#				1#	s	(>300 ns)	7/2$^-$#		12Ku26	I	2012	β^- ?; β^-n ?	
^{169}Tb	−50330#	300#				2#	s	(>300 ns)	3/2$^+$#		12Ku26	I	2012	β^- ?; β^-n ?	
^{169}Dy	−55600	300				39	s	8	(5/2)$^-$	08			1990	β^-=100	
^{169}Ho	−58798	20				4.72	m	0.10	7/2$^-$	08			1963	β^-=100	
^{169}Ho^m	−57412	20	1386.2	0.4		118	μs	6	(19/2$^+$)		10Dr05	ETJ	2010	IT=100	
^{169}Er	−60922.6	2.0				9.392	d	0.018	1/2$^-$	08			1956	β^-=100	
^{169}Er^m	−60830.6	2.0	92.05	0.10		285	ns	20	(5/2)$^-$	08			1969	IT=100	
^{169}Er^n	−60678.9	2.0	243.69	0.17		200	ns	10	7/2$^+$	08			1969	IT=100	
^{169}Tm	−61275.6	2.1				STABLE			1/2$^+$	08			1934	IS=100.	
^{169}Tm^m	−60959.5	2.1	316.1463	0.0001		659.9	ns	2.3	7/2$^+$	08			1950	IT=100	*
^{169}Yb	−60377.1	2.1				32.018	d	0.005	7/2$^+$	08			1946	ε=100	
^{169}Yb^m	−60352.9	2.1	24.1999	0.0016		46	s	2	1/2$^-$	08			1949	IT=100	
^{169}Lu	−58084	4				34.06	h	0.05	7/2$^+$	08			1955	β^+=100	
^{169}Lu^m	−58055	4	29.0	0.5		160	s	10	(1/2$^-$)	08			1965	IT=100	
^{169}Hf	−54717	28				3.24	m	0.04	(5/2$^-$)	08			1969	β^+=100	
^{169}Ta	−50290	28				4.9	m	0.4	(5/2$^+$)	08	98Zh03	J	1969	β^+=100	
^{169}W	−44918	15				74	s	6	5/2$^-$#	08			1985	β^+=100	
^{169}Re	−38409	11				8.1	s	0.5	(9/2$^-$)	08	92Me10	D	1978	β^+=?; α=0.005 3	*
^{169}Re^m	−38234	14	175	13	AD	15.1	s	1.5	(1/2$^+$,3/2$^+$)	08	FGK129	J	1984	β^+ ?; α≈0.2; IT ?	*
^{169}Os	−30723	25				3.46	s	0.11	(5/2$^-$)	08	96Pa01	T	1972	β^+=86.3 8; α=13.7 8	*
^{169}Ir	−22078	25				353	ms	4	(1/2$^+$)	08			1978	α=45 12; β^+ ?	
^{169}Ir^m	−21918	17	160	22	AD	281	ms	4	(11/2$^-$)	08			1984	α=72 7; β^+ ?; p ?	
^{169}Pt	−12510#	200#				6.99	ms	0.09	(7/2$^-$)	08	09Go16	T	1981	α=?; β^+=1#	*
^{169}Au	−1790#	300#				150#	μs		1/2$^+$#					p ?; α ?; β^+ ?	

$*^{169}$Tm^m	E : ENSDF2008=316.14633 0.00011	**
$*^{169}$Re	D : α=0.005(3)% derived from original α=0.001% - 0.01%	**
$*^{169}$Re	J : favored α decay from (11/2$^-$) 173Ir to (11/2$^-$) level at 136.2 keV	**
$*^{169}$Re^m	J : favored α decay from (1/2$^+$,3/2$^+$) 173Ir ground-state	**
$*^{169}$Os	T : average 96Pa01=3.6(0.2) 95Hi02=3.2(0.3) 84Sc06=3.5(0.2) 82En03=3.4(0.2)	**
$*^{169}$Pt	T : average 09Go16=6.99(0.10) 04Ke06=7.0(0.2)	**

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{170}Gd									(>300 ns)	0^+		12Ku26	I	2012	β^- ?; β^-n ?	
^{170}Tb	−46720#	400#					3#	s	(>300 ns)			12Ku26	I	2012	β^- ?; β^-n ?	
^{170}Dy	−53660#	200#					30#	s		0^+	10	10So03	I	2010	β^- ?	
^{170}Ho	−56240	50				∗	2.76	m	0.05	6^+#	02			1960	β^-=100	
^{170}Ho^m	−56140	60	100	80	BD	∗	43	s	2	(1^+)	02			1960	β^-=100	
^{170}Er	−60109.1	2.4					STABLE		(>320 Py)	0^+	02	96De60	T	1934	IS=14.910 36; …	∗
^{170}Tm	−59796.3	2.1					128.6	d	0.3	1^-	02			1936	$\beta^-\approx$100; ε=0.131 10	
^{170}Tm^m	−59613.1	2.1	183.197	0.004			4.12	μs	0.13	$(3)^+$	02			1967	IT=100	
^{170}Yb	−60764.7	2.1					STABLE			0^+	02			1938	IS=2.982 39	
^{170}Yb^m	−59506.2	2.1	1258.46	0.14			370	ns	15	4^-	02			1981	IT=100	
^{170}Lu	−57307	17					2.012	d	0.020	0^+	02			1951	β^+=100	
^{170}Lu^m	−57214	17	92.91	0.09			670	ms	100	$(4)^-$	02			1965	IT=100	
^{170}Hf	−56254	28					16.01	h	0.13	0^+	06			1961	ε=100	
^{170}Ta	−50138	28					6.76	m	0.06	$(3)^{(+\#)}$	02			1969	β^+=100	
^{170}W	−47290	13					2.42	m	0.04	0^+	02			1971	$\beta^+\approx$100; $\alpha<$1#	
^{170}Re	−38918	26					9.2	s	0.2	(5^+)	02			1974	$\beta^+\approx$100; $\alpha<$0.01#	
^{170}Os	−33926	10					7.37	s	0.18	0^+	08			1972	β^+=?; α=9.5 10	
^{170}Ir	−23360#	90#					910	ms	150	(3^-)	08			1977	β^+ ?; α=5.2 17	∗
^{170}Ir^m	−23200	70	160#	50#			811	ms	18	(8^+)	08			1977	α=36 10; β^+ ?; IT ?	
^{170}Pt	−16305	19					13.93	ms	0.16	0^+	02	04Ke06	T	1981	α=?; β^+=2#	∗
^{170}Au	−3750#	200#					290	μs	50	(2^-)	02	04Ke06	TD	2002	p=89 10; α=11 10	∗
^{170}Au^m	−3470#	200#	280	13	p		620	μs	50	(9^+)	02	04Ke06	TD	2002	p=58 5; α=42 5	∗

∗^{170}Er D : …; 2β^- ?; α ? ∗∗
∗^{170}Ir T : symmetrized from 870(+180–120) ∗∗
∗^{170}Pt T : average 04Ke06=14.0(0.2) 98Ki20=13.5(0.3) 96Bi07=14.7(0.5) ∗∗
∗^{170}Au T : symmetrized from 286(+50–40) ∗∗
∗^{170}Au^m T : 04Ke06=617(+50–40); other 02Ma61=570(+310–150) D : and 02Ma61=75(15)% ∗∗

^{171}Tb	−44030#	500#					500#	ms	(>300 ns)	$3/2^+$#		12Ku26	I	2012	β^- ?; β^-n ?	
^{171}Dy	−50190#	300#					6#	s	(>300 ns)	$7/2^-$#		12Ku26	I	2012	β^- ?	
^{171}Ho	−54520	600					53	s	2	$7/2^-$#	02			1989	β^-=100	
^{171}Er	−57719.4	2.4					7.516	h	0.002	$5/2^-$	02			1938	β^-=100	
^{171}Er^m	−57520.8	2.4	198.6	0.1			210	ns	10	$1/2^-$	02			1969	IT=100	
^{171}Tm	−59211.5	2.2					1.92	y	0.01	$1/2^+$	02			1948	β^-=100	
^{171}Tm^m	−58786.5	2.2	424.9560	0.0015			2.60	μs	0.02	$7/2^-$	02			1948	IT=100	
^{171}Tm^n	−57537.0	2.2	1674.5	0.3			1.7	μs	0.2	$19/2^+$		09Wa06	ETJ	2009	IT=100	
^{171}Yb	−59308.0	2.0					STABLE			$1/2^-$	02			1934	IS=14.09 14	
^{171}Yb^m	−59212.7	2.0	95.282	0.002			5.25	ms	0.24	$7/2^+$	02			1968	IT=100	
^{171}Yb^n	−59185.6	2.0	122.416	0.002			265	ns	20	$5/2^-$	02			1968	IT=100	
^{171}Lu	−57830.0	2.5					8.24	d	0.03	$7/2^+$	02			1951	β^+=100	
^{171}Lu^m	−57758.9	2.5	71.13	0.08			79	s	2	$1/2^-$	02			1965	IT=100	
^{171}Hf	−55431	29					12.1	h	0.4	$7/2^+$	02	00Ye02	J	1951	β^+=100	
^{171}Hf^m	−55409	29	21.93	0.09			29.5	s	0.9	$1/2^-$	02	00Ye02	J	1997	IT$\approx$100; β^+ ?	
^{171}Ta	−51720	28					23.3	m	0.3	$(5/2^-)$	02			1969	β^+=100	
^{171}W	−47086	28					2.38	m	0.04	$(5/2^-)$	02			1983	β^+=100	
^{171}Re	−41250	28					15.2	s	0.4	$(9/2^-)$	02			1987	β^+=100	
^{171}Os	−34303	18					8.3	s	0.2	$(5/2^-)$	02			1972	β^+ ?; α=1.80 21	
^{171}Ir	−26420	40					3.1	s	0.3	$1/2^+$	02	11Ko.B	TJ	1967	$\alpha\approx$100; β^+ ?	∗
^{171}Ir^m	−26260#	40#	160#	14#			1.47	s	0.06	$(11/2^-)$	02	11Ko.B	T	1967	α=54 5; β^+ ?; p ?	∗
^{171}Pt	−17470	70					45.5	ms	2.5	$7/2^-$	10	10Sc02	J	1981	α=90 7; β^+ ?	
^{171}Pt^m	−17060	70	412.6	1.0			901	ns	9	$13/2^+$	10	FGK128	J	2010	IT=100	∗
^{171}Au	−7568	21					22.3	μs	2.4	$(1/2^+)$	02	04Ke06	T	1997	p$\approx$100; α ?	∗
^{171}Au^m	−7313	19	255	10	p		1.036	ms	0.016	$11/2^-$	02	04Ke06	TD	1996	α=60.0 28; p=40.0 28	∗
^{171}Hg	3290#	310#					70	μs	30	$3/2^-$#	04			2004	$\alpha\approx$100; β^+=0.01#	∗

∗^{171}Ir T : other 02Ro17=3.2(+1.3–0.7) ∗∗
∗^{171}Ir^m D : average 10An01=53(5)% 96Pa01=58(11)% ∗∗
∗^{171}Ir^m T : average 11Ko.B=1.50(0.07) 10An01=1.40(0.10) ∗∗
∗^{171}Pt^m J : M2 to $9/2^-$ ∗∗
∗^{171}Au T : average 04Ke06=22(+3–2) 99Po09=17(+9–5) ∗∗
∗^{171}Au T : other 03Ba20=37(+7–5) conflicting, not used ∗∗
∗^{171}Au^m T : average 04Ke06=1.09(0.03) 03Ba20=1.014(0.019) ∗∗
∗^{171}Au^m D : average 04Ke06=34(4)% 97Da07=46(4)%; Birge ratio B=2.1 ∗∗
∗^{171}Hg T : symmetrized from 59(+36–16) ∗∗

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{172}Tb								(>300 ns)			12Ku26	I	2012	β^- ?; β^-n ?	
^{172}Dy	−48010#	300#				3#	s	(>300 ns)	0^+		12Ku26	I	2012	β^- ?	
^{172}Ho	−51480#	200#				25	s	3		95			1991	β^-=100	
^{172}Er	−56484	4				49.3	h	0.3	0^+	95			1956	β^-=100	
^{172}Er^m	−54983	4	1500.9	0.3		579	ns	62	(6^+)		10Dr02	ETJ	2006	IT=100	
^{172}Tm	−57375	6				63.6	h	0.2	2^-	95			1956	β^-=100	
^{172}Tm^m	−56899	6	476.2	1.0		132	μs	7	6^+		08Hu05	ETJ	2008	IT=100	*
^{172}Yb	−59256.2	2.0				STABLE			0^+	95			1934	IS=21.68 13	
^{172}Yb^m	−57705.8	2.0	1550.43	0.06		3.6	μs	0.1	6^-	95			1969	IT=100	
^{172}Lu	−56738.1	2.8				6.70	d	0.03	4^-	95			1951	β^+=100	
^{172}Lu^m	−56696.2	2.8	41.86	0.04		3.7	m	0.5	1^-	95			1962	IT=100; β^+<0.18	
^{172}Lu^n	−56672.3	2.8	65.79	0.04		332	ns	20	$(1)^+$	95			1965	IT=100	
^{172}Lu^p	−56628.7	2.8	109.41	0.10		440	μs	12	$(1)^+$	95			1965	IT=100	
^{172}Lu^q	−56524.5	2.8	213.57	0.17		150	ns		(6^-)	95			1974	IT=100	
^{172}Hf	−56402	24				1.87	y	0.03	0^+	95			1951	ε=100	
^{172}Hf^m	−54396	24	2005.84	0.11		163	ns	3	(8^-)	95			1976	IT=100	
^{172}Ta	−51330	28				36.8	m	0.3	(3^+)	95			1964	β^+=100	
^{172}W	−49097	28				6.6	m	0.9	0^+	95			1964	β^+=100	
^{172}Re	−41530	40			*	15	s	3	(5)	95			1972	β^+=100	
^{172}Re^m	−41530#	110#	0#	100#	*	55	s	5	(2)	95			1977	β^+=100	
^{172}Os	−37244	13				19.2	s	0.9	0^+	95	95Hi02	D	1971	β^+=?; α=1.1 2	
^{172}Ir	−27380	30				4.4	s	0.3	(3^+)	95			1967	β^+=98; α=2	
^{172}Ir^m	−27240	30	139	10	AD	2.0	s	0.1	(7^+)	95			1967	β^+=77 3; α=23 3	
^{172}Pt	−21097	12				97.6	ms	1.3	0^+	10	10An02	D	1981	α=97 3; β^+ ?	*
^{172}Au	−9370	80				28	ms	4	(2^-)	10			1993	α=?; p<2; β^+ ?	*
^{172}Au^m	−9010#	100#	360#	130#		11.0	ms	1.0	(9^+)	10	09Ha42	T	1993	α=?; p<2	*
^{172}Hg	−1110	160				231	μs	9	0^+	10			1999	$\alpha\approx$100; β^+=0.1#	

*^{172}Tm^m T : mean-life 190(10) μs **
*^{172}Au T : symmetrized from 09Ha42=22(+6–4) **
*^{172}Au J : from correlations between α's depopulating (2^-) isomers down to ^{152}Tm **
*^{172}Au^m T : average 09Ha42=9(+2–1) 09Ha42=8(+5–2) (independent measurements) **
*^{172}Au^m T : others 96Pa01=6.3(1.5) 93Se09=4(1) **

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{173}Dy	−43940#	400#				2#	s	(>300 ns)	$9/2^+$#		12Ku26	I	2012	β^- ?	
^{173}Ho	−49350#	300#				10#	s	(>300 ns)	$7/2^-$#		12Ku26	I	2012	β^- ?	
^{173}Er	−53650#	200#				1.434	m	0.017	$(7/2^-)$	95	94It.A	T	1972	β^-=100	
^{173}Tm	−56254	5				8.24	h	0.08	$(1/2^+)$	95			1961	β^-=100	
^{173}Tm^m	−55936	5	317.73	0.20		10	μs	3	$(7/2^-)$	95			1972	IT=100	
^{173}Yb	−57552.2	2.0				STABLE			$5/2^-$	95			1934	IS=16.103 63	
^{173}Yb^m	−57153.3	2.1	398.9	0.5		2.9	μs	0.1	$1/2^-$	95			1963	IT=100	
^{173}Lu	−56882.6	2.2				1.37	y	0.01	$7/2^+$	95			1951	ε=100	
^{173}Lu^m	−56758.9	2.2	123.672	0.013		74.2	μs	1.0	$5/2^-$	95			1962	IT=100	
^{173}Hf	−55412	28				23.6	h	0.1	$1/2^-$	06			1951	β^+=100	
^{173}Hf^m	−55305	28	107.16	0.05		180	ns	8	$5/2^-$	06			1973	IT=100	
^{173}Hf^n	−55215	28	197.47	0.10		160	ns	40	$7/2^+$	06			1973	IT=100	
^{173}Ta	−52397	28				3.14	h	0.13	$5/2^-$	95			1960	β^+=100	
^{173}Ta^m	−52224	28	173.10	0.21		225	ns	15	$9/2^-$	95	95Ca27	E	1977	IT=100	*
^{173}Ta^n	−50678	28	1719.4	1.0		132	ns	3	$21/2^-$		06Th07	ETJ	2006	IT=100	
^{173}W	−48727	28				7.6	m	0.2	$5/2^-$	95			1963	β^+=100	
^{173}Re	−43554	28				2.0	m	0.3	$(5/2^-)$	95			1986	β^+=100	
^{173}Os	−37438	15				22.4	s	0.9	$(5/2^-)$	95	95Hi02	TD	1971	$\beta^+\approx$100; α=0.4 2	
^{173}Ir	−30268	11				9.0	s	0.8	$(1/2^+,3/2^+)$	95	01Ko44	J	1967	β^+>93; α<7	*
^{173}Ir^m	−30042	11	226	9	AD	2.20	s	0.05	$(11/2^-)$	95	01Ko44	J	1967	β^+=88 1; α=12 1	*
^{173}Pt	−21940	60				382	ms	2	$(5/2^-)$	06			1966	α=86 4; β^+ ?	
^{173}Au	−12816	24				25	ms	1	$(1/2^+)$	03			1983	α=86 13; β^+=6#	*
^{173}Au^m	−12597	17	220	21	AD	14.0	ms	0.9	$(11/2^-)$	03			1984	α=89 11; β^+=4#	
^{173}Hg	−2710#	200#				910	μs	260	$3/2^-$#	03	04Ke06	T	1999	α=100	

*^{173}Ta^m T : other recent 06Th07=163(2), conflicting, not used **
*^{173}Ir J : favored α decay from $(1/2^+,3/2^+)$ 177Au ground-state **
*^{173}Ir^m J : favored α decay from $(11/2^-)$ 177Au isomer **
*^{173}Au D : from 94(+6–19)%; and for isomer ^{173}Au^m 92(+8–13)% **

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{174}Dy								(>300 ns)	0^+		12Ku26	I	2012	β^- ?; β^-n ?	
^{174}Ho	−45690#	300#				8#	s	(>300 ns)			12Ku26	I	2012	β^- ?	
^{174}Er	−51950#	300#				3.2	m	0.2	0^+	99			1989	β^-=100	
^{174}Er^m	−50840#	300#	1111.6	1.1		4.02	s	0.35	8^-		09Dr06	T	2006	IT=100	∗
^{174}Tm	−53870	40				5.4	m	0.1	$(4)^-$	99			1960	β^-=100	
^{174}Tm^m	−53620	40	252.4	0.5		2.29	s	0.01	(0^+)		06Ch10	TJD	2006	IT>98.5; β^-<1.5	∗
^{174}Yb	−56945.5	2.0				STABLE			0^+	99			1934	IS=32.026 80	
^{174}Yb^m	−55427.4	2.0	1518.148	0.013		830	μs	40	6^+	99			1964	IT=100	
^{174}Yb^n	−55180.3	2.1	1765.2	0.5		256	ns	11	7^-		05Dr05	EJT	2005	IT=100	
^{174}Lu	−55572.1	2.1				3.31	y	0.05	1^-	99	98Ge13	J	1951	β^+=100	
^{174}Lu^m	−55401.3	2.1	170.83	0.05		142	d	2	6^-	99	98Ge13	J	1960	IT=99.38 2; ε=0.62 2	
^{174}Lu^n	−55331.3	2.1	240.818	0.004		395	ns	15	(3^+)	99			1980	IT=100	
^{174}Lu^p	−55206.9	2.1	365.183	0.006		145	ns	3	(4^-)	99			1980	IT=100	
^{174}Lu^q	−53716.4	2.2	1855.7	0.5		194	ns	24	13^+		09Ko19	ETJ	2009	IT=100	
^{174}Lu^r	−49722.5	2.3	5849.6	0.9		242	ns	19	(26^-)		09Ko19	ETJ	2009	IT=100	
^{174}Hf	−55846.7	2.7				2.0	Py	0.4	0^+	04			1939	IS=0.16 1; α=100; 2β^+ ?	
^{174}Hf^m	−54297	3	1549.3	1.8		138	ns	4	6^+	04	FGK129	J	1976	IT=100	∗
^{174}Hf^n	−54049	3	1797.5	1.8		2.39	μs	0.04	8^-	04	FGK129	J	1974	IT=100	
^{174}Hf^p	−52535	3	3311.7	1.8		3.7	μs	0.2	14^+	04	FGK129	J	1974	IT=100	
^{174}Ta	−51741	28				1.14	h	0.08	3^+	99			1960	β^+=100	
^{174}W	−50227	28				33.2	m	2.1	0^+	99			1964	β^+=100	
^{174}W^m	−48555	28	1672.0	0.5		> 187	ns			99			1976	IT=100	
^{174}W^n	−48307	28	1919.7	0.5		187	ns	25		99			1976	IT=100	
^{174}W^p	−47959	28	2267.8	0.4		158	ns	3	8^-		06Ta13	ETJ	2006	IT=100	∗
^{174}W^q	−45711	28	4515.6	0.4		128	ns	8	12^+		06Ta13	ETJ	2006	IT=100	∗
^{174}Re	−43673	28				2.40	m	0.04	3^+#	99			1972	β^+=100	
^{174}Re^m	−43570#	60#	100#	50#		1#	m	(>1 μs)	7^+#		12Gu14	T	2012	IT ?; β^+ ?	
^{174}Os	−39995	10				44	s	4	0^+	99			1971	$\beta^+\approx$100; α=0.024 7	∗
^{174}Ir	−30869	28				7.9	s	0.6	(3^+)	99			1967	β^+=99.5 3; α=0.5 3	
^{174}Ir^m	−30676	26	193	11	AD	4.9	s	0.3	(7^+)	99			1992	β^+=97.5 3; α=2.5 3	
^{174}Pt	−25318	10				889	ms	17	0^+	99			1966	α=76 8; β^+ ?	
^{174}Au	−14240#	90#				139	ms	3	low	99	02Ro17	TD	1983	α=90 6; β^+ ?	∗
^{174}Au^m	−13990	70	250#	50#		171	ms	29	high		96Pa01	TJ	1995	α=?; β^+ ?	
^{174}Hg	−6646	19				2.0	ms	0.4	0^+	99	99Se14	T	1997	$\alpha\approx$100; β^+=0.4#	∗
∗^{174}Er^m	E : uncertainty estimated by NUBASE														∗∗
∗^{174}Tm^m	E : uncertainty estimated by NUBASE														∗∗
∗^{174}Hf^m	J : multiple decay branches, transition mult., magnetic moment; also n and p														∗∗
∗^{174}W^p	E : derived from least-squares fit to γ-ray energies														∗∗
∗^{174}W^q	E : derived from least-squares fit to γ-ray energies														∗∗
∗^{174}Os	D : symmetrized from 71Bo06 α=0.020(+10–4)%														∗∗
∗^{174}Au	T : others 96Pa01=171(29) 83Sc24=120(20)														∗∗
∗^{174}Hg	T : symmetrized from 1.9(+0.4–0.3)														∗∗
^{175}Ho	−43200#	400#				5#	s	(>300 ns)	$7/2^-$#		12Ku26	I	2012	β^- ?; β^-n ?	
^{175}Er	−48650#	400#				1.2	m	0.3	$9/2^+$#	04			1996	β^-=100	
^{175}Tm	−52310	50				15.2	m	0.5	$1/2^+$#	04			1961	β^-=100	
^{175}Yb	−54696.6	2.0				4.185	d	0.001	$(7/2^-)$	04			1945	β^-=100	
^{175}Yb^m	−54181.7	2.0	514.866	0.004		68.2	ms	0.3	$1/2^-$	04			1972	IT=100	
^{175}Lu	−55167.6	1.9				STABLE			$7/2^+$	04			1934	IS=97.401 13	
^{175}Lu^m	−54814.1	1.9	353.48	0.13		1.49	μs	0.07	$5/2^-$	04			1965	IT=100	
^{175}Lu^n	−53775.4	2.0	1392.2	0.6		984	μs	30	$19/2^+$	04	98Wh02	J	1998	IT=100	
^{175}Hf	−54483.8	2.7				70	d	2	$5/2^{(-)}$	04			1949	ε=100	
^{175}Hf^m	−54357.9	2.7	125.89	0.12		53.7	μs	1.5	$1/2^-$	04			1964	IT=100	
^{175}Hf^n	−53050.4	2.7	1433.41	0.12		1.10	μs	0.08	$19/2^+$	04	95Gj01	J	1990	IT=100	
^{175}Hf^p	−51468.2	2.7	3015.6	0.4		1.21	μs	0.15	$35/2^-$	04	95Gj01	J	1980	IT=100	
^{175}Hf^q	−49847.6	3.0	4636.2	1.2		1.9	μs	0.1	$45/2^+$	04	04Ko.A	JT	1990	IT=100	
^{175}Ta	−52409	28				10.5	h	0.2	$7/2^+$	04			1960	β^+=100	
^{175}Ta^m	−52278	28	131.41	0.17		222	ns	8	$9/2^-$	04	96Ko17	JT	1972	IT=100	
^{175}Ta^n	−52070	28	339.2	1.3		170	ns	20	$(1/2^+)$	04			1969	IT=100	
^{175}Ta^p	−50841	28	1567.6	0.3		1.95	μs	0.15	$21/2^-$	04	96Ko17	JT	1996	IT=100	
^{175}W	−49633	28				35.2	m	0.6	$(1/2^-)$	04			1963	β^+=100	
^{175}W^m	−49398	28	234.96	0.15		216	ns	6	$(7/2^+)$	04			1978	IT=100	
^{175}Re	−45288	28				5.89	m	0.05	$5/2^-$#	04			1967	β^+=100	
^{175}Os	−40105	12				1.4	m	0.1	$(5/2^-)$	04			1972	β^+=100	
^{175}Ir	−33394	12				9	s	2	$5/2^-$#	04			1967	β^+=99.15 28; α=0.85 28	
^{175}Pt	−25700	18				2.53	s	0.06	$(7/2^-)$	04			1966	α=64 5; β^+ ?	
^{175}Au	−17420	40				188	ms	12	$1/2^+$	04	11Ko.B	TJD	1975	α=87 4; β^+ ?	∗
^{175}Au^m	−17250#	40#	167#	12#	AD	134	ms	4	$(11/2^-)$	04	11Ko.B	TD	1975	α=75 4; β^+ ?	∗
^{175}Hg	−7970	70				10.6	ms	0.4	$(7/2^-)$	09			1983	α=?; β^+=1#	
^{175}Hg^m	−7480	70	494	2		340	ns	30	$(13/2^+)$	09			2009	IT=100	
∗^{175}Au	J : favored α decay to $1/2^+$ states in ^{171}Ir and ^{167}Re and from $1/2^+$ in ^{179}Tl														∗∗
∗^{175}Au	D : α=87(4) from 11Ko.B, after correction for α=64(5) of ^{175}Pt daughter														∗∗
∗^{175}Au^m	T : average 11Ko.B=124(8) 10An01=138(5); the former supersedes 01Ko44=143(8)														∗∗
∗^{175}Au^m	T : others 02Ro17=158(3) 96Pa01=185(30) 83Sc24=200(22) for mixture ground-state and m														∗∗
∗^{175}Au^m	J : favored α decay to $(11/2^-)$ excited isomer ^{171}Ir^m														∗∗
∗^{175}Au^m	D : α=75(4)% from 11Ko.B, after correction for α=64(5)% of ^{175}Pt daughter														∗∗

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^{π}	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{176}Ho									(>300 ns)			12Ku26	I	2012	β^{-} ?; β^{-}n ?	
^{176}Er	−46630#	400#					20#	s	(>300 ns)	0^{+}		12Ku26	I	2012	β^{-} ?	
^{176}Tm	−49370	100					1.85	m	0.03	(4^{+})	06	94It.A	T	1961	β^{-}=100	
^{176}Yb	−53489.7	2.2					STABLE		(>160 Py)	0^{+}	06	96De60	T	1934	IS=12.996 83; …	∗
^{176}Yb^{m}	−52439.9	2.3	1049.8	0.6			11.4	s	0.3	8^{-}	06			1967	IT=?; β^{-}<10#	
^{176}Lu	−53384.2	1.9					37.6	Gy	0.7	7^{-}	06			1935	IS=2.599 13; β^{-}=100	
^{176}Lu^{m}	−53261.4	1.9	122.845	0.004			3.664	h	0.019	1^{-}	06			1935	$\beta^{-}\approx$100; ε=0.095 16	
^{176}Lu^{n}	−51869.7	2.0	1514.5	0.5			312	ns	69	12^{+}	06			2000	IT=100	
^{176}Lu^{p}	−51796.7	2.2	1587.5	1.1			40	μs	3	14^{+}	06	FGK128	J	2000	IT=100	∗
^{176}Hf	−54578.4	2.0					STABLE			0^{+}	06			1934	IS=5.26 7	
^{176}Hf^{m}	−53245.3	2.0	1333.07	0.07			9.6	μs	0.3	6^{+}	06			1964	IT=100	
^{176}Hf^{n}	−53019.1	2.0	1559.31	0.09			9.9	μs	0.2	8^{-}	06			1967	IT=100	
^{176}Hf^{p}	−51712.6	2.1	2865.8	0.7			401	μs	6	14^{-}	06			1975	IT=100	
^{176}Hf^{q}	−49714.9	2.6	4863.5	1.6			43	μs		22^{-}	06	10Mu13	JT	1976	IT=100	
^{176}Ta	−51370	30					8.09	h	0.05	$(1)^{-}$	06			1948	β^{+}=100	
^{176}Ta^{m}	−51270	30	103.0	1.0			1.08	ms	0.07	(7^{+})	06	78Du06	ET	1971	IT=100	∗
^{176}Ta^{n}	−49900	30	1474.0	1.4			3.8	μs	0.4	14^{-}	06			1978	IT=100	∗
^{176}Ta^{p}	−48500	30	2874.0	1.4			970	μs	70	20^{-}	06			1994	IT=100	∗
^{176}W	−50642	28					2.5	h	0.1	0^{+}	06			1950	ε=100	
^{176}Re	−45063	28					5.3	m	0.3	(3^{+})	06			1967	β^{+}=100	
^{176}Os	−42098	28					3.6	m	0.5	0^{+}	06			1970	β^{+}=100	
^{176}Ir	−33859	20					8.7	s	0.5		06			1967	β^{+}=96.9 6; α=3.1 6	
^{176}Pt	−28934	13					6.33	s	0.15	0^{+}	06			1966	β^{+} ?; α=40 2	
^{176}Au	−18400	30				∗	1.05	s	0.01	(5^{-})	06	GAu	J	1975	α=?; β^{+} ?	∗
^{176}Au^{m}	−18380	30	14	13	AD	∗	860	ms	160	(7^{+})	06	02Ro17	T	2002	α=?; β^{+} ?	∗
^{176}Hg	−11773	13					20.3	ms	1.4	0^{+}	06			1983	α=90 9; β^{+} ?	∗
^{176}Tl	580	80					6.2	ms	2.3	$(3^{-},4^{-},5^{-})$	09			2004	p$\approx$100; α ?; β^{+} ?	∗

∗^{176}Yb D : …; 2β^{-} ?; α ? ∗∗
∗^{176}Lu^{p} J : 73.0 γ (E2) to 12^{+} state ∗∗
∗^{176}Ta^{m} T : average 78Du06=1.05(0.10) 71Go21=1.1(0.1) J : from 98Ko09 ∗∗
∗^{176}Ta^{n} E : 1371(1) keV above 176Tam ∗∗
∗^{176}Ta^{p} E : 2771(1) keV above 176Tam ∗∗
∗^{176}Au J : from α decay to ^{172}Ir 168.4 level ∗∗
∗^{176}Au^{m} T : symmetrized from 840(+170–140) J : from α decay to ^{172}Ir^{m} ∗∗
∗^{176}Hg D : α symmetrized from 99Po09=94(+6–12)% ∗∗
∗^{176}Tl T : symmetrized from 5.2(+3.0–1.4) ∗∗

^{177}Er	−42860#	500#					3#	s	(>300 ns)	$1/2^{-}$#		12Ku26	I	2012	β^{-} ?	
^{177}Tm	−47470#	300#					90	s	6	$(7/2^{-})$	03			1989	β^{-}=100	
^{177}Yb	−50984.8	2.3					1.911	h	0.003	$(9/2^{+})$	03			1945	β^{-}=100	
^{177}Yb^{m}	−50653.3	2.3	331.5	0.3			6.41	s	0.02	$(1/2^{-})$	03			1962	IT=100	
^{177}Lu	−52385.8	1.9					6.647	d	0.004	$7/2^{+}$	03			1945	β^{-}=100	
^{177}Lu^{m}	−52235.4	1.9	150.3967	0.0010			130	ns	3	$9/2^{-}$	03			1949	IT=100	
^{177}Lu^{n}	−51816.1	1.9	569.7068	0.0016			155	μs	7	$1/2^{+}$	03			1965	IT=100	
^{177}Lu^{p}	−51415.6	1.9	970.1750	0.0024			160.44	d	0.06	$23/2^{-}$	03			1962	β^{-}=78.6 8; IT=21.4 8	
^{177}Lu^{q}	−49614.2	2.0	2771.6	0.7			625	ns	62	$33/2^{+}$		04Dr06	ETJ	2004	IT=100	
^{177}Lu^{r}	−48855.5	2.0	3530.3	0.7			6	μs	2	$39/2^{-}$	03	11Ko.A	T	2003	IT=100	∗
^{177}Hf	−52883.0	1.9					STABLE			$7/2^{-}$	03			1934	IS=18.60 9	
^{177}Hf^{m}	−51567.5	1.9	1315.4504	0.0008			1.09	s	0.05	$23/2^{+}$	03			1966	IT=100	
^{177}Hf^{n}	−51540.6	1.9	1342.38	0.20			55.9	μs	1.2	$(19/2^{-})$	03			1976	IT=100	
^{177}Hf^{p}	−50143.0	1.9	2740.02	0.15			51.4	m	0.5	$37/2^{-}$	03			1971	IT=100	∗
^{177}Ta	−51717	4					56.56	h	0.06	$7/2^{+}$	03			1948	β^{+}=100	
^{177}Ta^{m}	−51644	4	73.36	0.15			410	ns	7	$9/2^{-}$	03			1973	IT=100	
^{177}Ta^{n}	−51531	4	186.15	0.06			3.62	μs	0.10	$5/2^{-}$	03			1971	IT=100	
^{177}Ta^{p}	−50362	4	1355.01	0.19			5.31	μs	0.25	$21/2^{-}$	03			1971	IT=100	
^{177}Ta^{q}	−47061	4	4656.3	0.5			133	μs	4	$49/2^{-}$	03			1994	IT=100	
^{177}W	−49702	28					132	m	2	$1/2^{-}$	03			1950	β^{+}=100	
^{177}Re	−46269	28					14	m	1	$5/2^{-}$	03			1957	β^{+}=100	
^{177}Re^{m}	−46184	28	84.71	0.10			50	μs	10	$5/2^{+}$	03			1972	IT=100	
^{177}Os	−41949	16					3.0	m	0.2	$1/2^{-}$	03			1970	β^{+}=100	
^{177}Ir	−36047	20					30	s	2	$5/2^{-}$	03			1967	$\beta^{+}\approx$100; α=0.06 1	
^{177}Pt	−29370	15					10.6	s	0.4	$5/2^{-}$	03			1966	β^{+}=94.3 5; α=5.7 5	
^{177}Pt^{m}	−29223	15	147.4	0.4			2.2	μs	0.3	$1/2^{-}$	03			1979	IT=100	
^{177}Au	−21545	10					1.46	s	0.03	$(1/2^{+},3/2^{+})$	03	01Ko44	TJ	1968	α=40 6; β^{+} ?	∗
^{177}Au^{m}	−21356	10	189	8	AD		1.180	s	0.012	$11/2^{-}$	03	01Ko44	ETJ	1975	α=66 10; β^{+} ?	∗
^{177}Hg	−12780	80					127.3	ms	1.8	$(7/2^{-})$	03	05Ca43	J	1975	α=85; β^{+}=15	∗
^{177}Hg^{m}	−12460	80	323	1			1.50	μs	0.15	$(13/2^{+})$		03Me20	ETJ	2003	IT=100	
^{177}Tl	−3325	23					18	ms	5	$(1/2^{+})$	03			1999	α=73 13; p=27 13	
^{177}Tl^{m}	−2518	15	807	18	p		180	μs	60	$(11/2^{-})$	03	04Ke06	TD	1997	p=51 8; α=49 8	∗

∗^{177}Lu^{r} E : derived by NUBASE from least-squares fit to γ-ray energies ∗∗
∗^{177}Lu^{r} T : 04Al04=7(2) m, not trusted ∗∗
∗^{177}Hf^{p} T : other 04Al04=76(+16–9) from decay growth ∗∗
∗^{177}Au T : average 09An14=1.53(0.07) 01Ko44=1.46(0.03) D : from 09An14 ∗∗
∗^{177}Au^{m} D : from 09An14 ∗∗
∗^{177}Hg J : also 09An20 ∗∗
∗^{177}Tl^{m} T : 04Ke06=160(+70–40) D : also 04Ke06=55(20)% ∗∗

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^{π}	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{178}Er									(>300 ns)	0^+		12Ku26	I	2012	β^- ?; β^-n ?	
^{178}Tm	−44120#	400#					30#	s	(>300 ns)		11	09St16	I	2008	β^- ?	
^{178}Yb	−49694	10					74	m	3	0^+	09			1973	β^-=100	
^{178}Lu	−50339.8	2.7					28.4	m	0.2	$1^{(+)}$	09			1957	β^-=100	
^{178}Lu^{m}	−50216	3	123.8	2.6	RQ		23.1	m	0.3	$9^{(-)}$	09	98Ge13	J	1951	β^-=100	
^{178}Hf	−52437.7	1.9					STABLE			0^+	09			1934	IS=27.28 7	
^{178}Hf^{m}	−51290.3	1.9	1147.416	0.006			4.0	s	0.2	8^-	09			1960	IT=100	
^{178}Hf^{n}	−49991.6	1.9	2446.09	0.08			31	y	1	16^+	09			1968	IT=100	
^{178}Hf^{p}	−49865.3	1.9	2572.4	0.3			68	μs	2	14^-	09			1977	IT=100	
^{178}Ta	−50600#	50#				*	2.36	h	0.08	7^-#	09			1950	β^+=100	
^{178}Ta^{m}	−50501	15	100#	50#		*	9.31	m	0.03	1^+#	09	96Ko13	E	1950	β^+=100	*
^{178}Ta^{n}	−49130#	50#	1467.82	0.16			59	ms	3	15^-	09	96Ko13	ETJ	1979	IT=100	*
^{178}Ta^{p}	−47700#	50#	2901.9	0.7			290	ms	12	21^-	09	96Ko13	ETJ	1996	IT=100	*
^{178}W	−50409	15					21.6	d	0.3	0^+	09			1950	ε=100	
^{178}W^{m}	−43836	15	6572.7	0.3			220	ns	10	25^+	09			1998	IT=100	
^{178}Re	−45653	28					13.2	m	0.2	(3^+)	09			1957	β^+=100	
^{178}Os	−43544	14					5.0	m	0.4	0^+	09			1967	β^+=100	
^{178}Ir	−36252	20					12	s	2		09			1972	β^+=100	
^{178}Pt	−31997	10					20.7	s	0.7	0^+	09			1966	β^+=92.3 3; α=7.7 3	
^{178}Au	−22330	60					2.6	s	0.5		09			1968	β^+<60; α>40	
^{178}Au^{p}	−21920	60	407	25	AD											
^{178}Hg	−16316	11					266.5	ms	2.4	0^+	09			1971	α=?; β^+=30#	
^{178}Tl	−4790#	100#					255	ms	10		09			1997	α=?; β^+=47#	*
^{178}Pb	3569	24					230	μs	150	0^+	09	01Ro.B	T	2001	$\alpha\approx$100; β^+ ?	*

*^{178}Ta^{m} E : 1^+ state (p9/2$^-$[514]+n7/2$^-$[514]) is expected 104 keV above the 7^- ground-state, **
*^{178}Ta^{m} E : based on E=220 keV for 8^+ (p9/2$^-$[514]+n7/2$^-$[514]) and residual energy **
*^{178}Ta^{m} E : shift of 50 keV from known Gallagher-Moszkowski splitting energy **
*^{178}Ta^{n} E : from least-squares fit to γ-rays in 96Ko13 **
*^{178}Ta^{n} T : average 96Ko13=58(4) 79Du02=60(5) **
*^{178}Ta^{p} E : from least-squares fit to γ-rays in 96Ko13 **
*^{178}Tl T : symmetrized from 02Ro17=254(+11–9) **
*^{178}Pb T : two events at 202 and 147 μs, see 84Sc13 **

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^{π}	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{179}Tm	−41600#	500#					20#	s	(>300 ns)	$1/2^+$#		12Ku26	I	2012	β^- ?; β^-n ?	
^{179}Yb	−46540#	200#					8.0	m	0.4	$(1/2^-)$	09			1982	β^-=100	
^{179}Lu	−49061	5					4.59	h	0.06	$7/2^+$	09			1961	β^-=100	
^{179}Lu^{m}	−48469	5	592.4	0.4			3.1	ms	0.9	$1/2^+$	09			1982	IT=100	
^{179}Hf	−50465.4	1.9					STABLE			$9/2^+$	09			1934	IS=13.62 2	
^{179}Hf^{m}	−50090.4	1.9	375.0352	0.0025			18.67	s	0.04	$1/2^-$	09			1962	IT=100	
^{179}Hf^{n}	−49359.7	1.9	1105.74	0.16			25.05	d	0.25	$25/2^-$	09			1970	IT=100	
^{179}Hf^{p}	−46690.2	2.8	3775.2	2.1			15	μs	5	$(43/2^+)$	09			2000	IT=100	
^{179}Ta	−50359.8	1.9					1.82	y	0.03	$7/2^+$	09			1950	ε=100	
^{179}Ta^{m}	−50329.1	1.9	30.7	0.1			1.42	μs	0.08	$9/2^-$	09			1964	IT=100	
^{179}Ta^{n}	−49839.6	1.9	520.23	0.18			280	ns	80	$1/2^+$	09	FGK128	J	1974	IT=100	
^{179}Ta^{p}	−49107.2	1.9	1252.60	0.23			322	ns	16	$21/2^-$	09	97Ko13	J	1982	IT=100	
^{179}Ta^{q}	−49042.6	1.9	1317.2	0.4			9.0	ms	0.2	$25/2^+$	09	97Ko13	J	1982	IT=100	
^{179}Ta^{r}	−49031.8	1.9	1328.0	0.4			1.6	μs	0.4	$23/2^-$	09	97Ko13	J	1982	IT=100	
^{179}Ta^{x}	−47720.5	2.0	2639.3	0.5			54.1	ms	1.7	$37/2^+$	09	97Ko13	J	1982	IT=100	
^{179}W	−49297	15					37.05	m	0.16	$7/2^-$	09			1950	β^+=100	
^{179}W^{m}	−49075	15	221.91	0.03			6.40	m	0.07	$1/2^-$	09			1950	IT$\approx$100; β^+=0.29 4	
^{179}W^{n}	−47665	15	1631.90	0.08			390	ns	30	$21/2^+$	09	94Wa05	J	1978	IT=100	
^{179}W^{p}	−45949	15	3348.41	0.14			750	ns	80	$35/2^-$	09	94Wa05	J	1978	IT=100	
^{179}Re	−46585	25					19.5	m	0.1	$5/2^+$	09			1960	β^+=100	
^{179}Re^{m}	−46520	25	65.35	0.09			95	μs	25	$(5/2^-)$	09			1972	IT=100	
^{179}Re^{n}	−44760	60	1822	50			408	ns	12	$(23/2^+)$	09			1972	IT=100	*
^{179}Re^{p}	−41177	25	5408.0	0.5			466	μs	15	$(47/2^+,49/2^+)$	09			1989	IT=100	
^{179}Os	−43019	17					6.5	m	0.3	$1/2^-$	09			1968	β^+=100	
^{179}Os^{m}	−42874	17	145.41	0.12			500	ns		$(7/2)^-$	09			1983	IT=100	
^{179}Os^{n}	−42776	17	243.0	0.8			783	ns	14	$(9/2)^+$	09			1983	IT=100	
^{179}Ir	−38079	10					79	s	1	$(5/2)^-$	09			1992	β^+=100	
^{179}Pt	−32268	8					21.2	s	0.4	$1/2^-$	09			1966	$\beta^+\approx$100; α=0.24 3	
^{179}Au	−24989	12					7.1	s	0.3	$(1/2^+,3/2^+)$	09			1968	β^+=78.0 9; α=22.0 9	
^{179}Au^{m}	−24900	12	89.5	0.5			328	ns	2	$(3/2^-)$		11Ve01	ETD	2011	IT=100	*
^{179}Hg	−16924	27					1.05	s	0.03	$7/2^-$	09	02Ko09	J	1970	α=55 25; β^+=?; β^+p$\approx$0.15	
^{179}Hg^{m}	−16753	27	171.4	0.4			6.4	μs	0.9	$13/2^+$	09	02Je09	J	2002	IT=100	
^{179}Tl	−8280	40					480	ms	20	$1/2^+$	09	FGK128	J	1983	α=?; β^+=30#	*
^{179}Tl^{m}	−7460#	40#	825#	10#			1.41	ms	0.03	$(11/2^-)$	09	11Ko.B	TJ	1983	$\alpha\approx$100; IT ?; β^+ ?	*
^{179}Pb	2050	80					3.9	ms	1.1	$(9/2^-)$	10	10An01	TDJ	2010	α=100	*

*^{179}Re^{n} E : x keV above 1772.20(0.22) level; x estimated 50(50) by NUBASE **
*^{179}Au^{m} E : uncertainty estimated by NUBASE **
*^{179}Au^{p} E : 44(15) above 89.5 keV level **
*^{179}Tl T : average 11Ko.B=489(21) 02Ro17=415(55) **
*^{179}Tl J : α decay to $1/2^+$ in ^{175}Au **
*^{179}Tl^{m} J : from α decay to ^{175}Au^{m} E : estimated from trends in ^{177,181,183}Tl **
*^{179}Tl^{m} T : average 11Ko.B=1.36(0.04) 10An01=1.46(0.04) **
*^{179}Pb T : symmetrized from 3.5(+1.4–0.8) **

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^{π}	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{180}Tm								(>300 ns)			12Ku26	I	2012	β^- ?; β^-n ?	
^{180}Yb	−44600#	300#				2.4	m	0.5	0^+	04			1987	β^-=100	
^{180}Lu	−46680	70				5.7	m	0.1	5^+	04			1971	β^-=100	
^{180}Lu^{m}	−46670	70	13.9	0.3		1	s		3^-	04	95Me03	JT	1995	β^- ?; IT ?	
^{180}Lu^{n}	−46060	70	624.0	0.5		> 1	ms		(9^-)		01Wh02	EJT	2001	IT=100	
^{180}Hf	−49781.8	1.9				STABLE			0^+	04			1934	IS=35.08 16	
^{180}Hf^{m}	−48640.3	1.9	1141.50	0.05		5.47	h	0.04	8^-	04			1951	IT≈100; β^-=0.3 1	
^{180}Hf^{n}	−48407.7	1.9	1374.15	0.04		570	μs	20	(4^-)	04			1990	IT=100	∗
^{180}Hf^{p}	−47295.5	2.1	2486.3	0.9		880	ns	90	12^+	04	11Ch.A	T	2000	IT=100	
^{180}Hf^{q}	−47243.5	2.2	2538.3	1.2		> 10	μs		(14^+)	04			1999	IT=100	
^{180}Hf^{r}	−46182.5	2.6	3599.3	1.8		90	μs	10	(18^-)	04			1999	IT=100	
^{180}Ta	−48936.2	2.3				8.154	h	0.006	1^+	04			1938	ε=86 3; β^-=14 3	
^{180}Ta^{m}	−48860.9	1.9	75.3	1.4	RQ	STABLE		(>1.2 Py)	9^-	04			1940	IS=0.01201 32; β^- ?	
^{180}Ta^{n}	−47483.8	2.3	1452.40	0.18		31.2	μs	1.4	15^-	04			1996	IT=100	
^{180}Ta^{p}	−45257.2	2.5	3679.0	1.1		2.0	μs	0.5	(22^-)	04			2000	IT=100	
^{180}Ta^{q}	−44764.0	2.8	4172.2	1.6		17	μs	5	(24^+)	04	00Wh04	EJ	2000	IT=100	
^{180}W	−49638.6	1.9				1.8	Ey	0.2	0^+	04	04Co26	TD	1937	IS=0.12 1; α≈100; 2β^+ ?	∗
^{180}W^{m}	−48109.6	1.9	1529.01	0.03		5.47	ms	0.09	8^-	04			1978	IT=100	
^{180}W^{n}	−46374.0	1.9	3264.56	0.21		2.33	μs	0.19	14^-	04			1966	IT=100	
^{180}Re	−45837	21				2.44	m	0.06	$(1)^-$	04			1955	β^+=100	
^{180}Re^{m}	−45750#	40#	90#	30#		> 1	μs		$(4^+,5^+)$	04	05El10	J	2005	IT≈100; β^+ ?	∗
^{180}Re^{n}	−42280#	40#	3561#	30#		9.0	μs	0.7	(21^-)	04	05El10	TJD	2005	IT=100	∗
^{180}Os	−44362	16				21.5	m	0.4	0^+	04			1967	β^+=100	
^{180}Ir	−37978	22				1.5	m	0.1	$(4,5)^{(+\#)}$	04			1972	β^+=100	
^{180}Pt	−34436	11				56	s	2	0^+	04			1966	β^+≈100; α≈0.3	
^{180}Au	−25594	20				8.1	s	0.3		04			1977	β^+<98.2; α>1.8	
^{180}Hg	−20250	13				2.575	s	0.014	0^+	04	00Ko48	T	1970	β^+=52 4; α=48 4	∗
^{180}Tl	−9260	60				1.09	s	0.01	$4^{(-)}$	04	10An13	TD	1987	β^+=94 4; α=6 4; …	∗
^{180}Pb	−1930	14				4.2	ms	0.5	0^+	11			1996	α=100	
∗^{180}Hf^{n}	I : isomer at 2425.8(1.0) 15(5) μs (10^+) reported then retracted by authors														∗∗
∗^{180}W	T : also indication in 03Da05 for 1.1(+0.8–0.4) Ey, but important background														∗∗
∗^{180}W	T : 03Da09>80 Py for 2β^- decay														∗∗
∗^{180}Re^{n}	E : 3471.0(0.8) above (5^+) level, most likely isomer, estimated to be 90#30 keV														∗∗
∗^{180}Hg	T : average 00Ko48=2.59(0.02) 93Wa03=2.56(0.02)														∗∗
∗^{180}Tl	D : … ; β^+SF=0.0036 7 J : from 12Bi.A; other 11El07=(4^-,5^-)														∗∗
^{181}Tm								(>300 ns)			12Ku26	I	2012	β^- ?; β^-n ?	
^{181}Yb	−41090#	300#				1#	m	(>300 ns)	$3/2^-\#$	06	09St16	I	2000	β^- ?	
^{181}Lu	−44800	160				3.5	m	0.3	$7/2^+\#$	06			1982	β^-=100	
^{181}Hf	−47405.3	1.9				42.39	d	0.06	$1/2^-$	06			1935	β^-=100	
^{181}Hf^{m}	−46810.0	1.9	595.27	0.04		80	μs	5	$9/2^+$	06	01Sh36	T	2001	IT=100	
^{181}Hf^{n}	−46361.8	2.1	1043.5	0.8		100	μs		$(17/2^+)$	06			2001	IT=100	
^{181}Hf^{p}	−45663.4	2.3	1741.9	1.3		1.5	ms	0.5	$(25/2^-)$	06			2001	IT=100	
^{181}Ta	−48441.6	1.8				STABLE			$7/2^+$	06			1932	IS=99.98799 32	
^{181}Ta^{m}	−48435.4	1.8	6.237	0.020		6.05	μs	0.12	$9/2^-$	06			1979	IT=100	
^{181}Ta^{n}	−47826.4	1.8	615.19	0.03		18	μs	1	$1/2^+$	06			1948	IT=100	
^{181}Ta^{p}	−47014	14	1428	14		140	ns	36	$(19/2^+)$	06			1998	IT=100	∗
^{181}Ta^{q}	−46958.2	1.8	1483.43	0.21		25.2	μs	1.8	$21/2^-$	06	98Wh02	T	1998	IT=100	∗
^{181}Ta^{r}	−46213.7	2.0	2227.9	0.9		210	μs	20	$29/2^-$	06	98Wh02	J	1998	IT=100	
^{181}W	−48253	5				121.2	d	0.2	$9/2^+$	06			1947	ε=100	
^{181}W^{m}	−47887	5	365.55	0.13		14.59	μs	0.15	$5/2^-$	06			1968	IT=100	
^{181}W^{n}	−46600	5	1653.1	0.6		140	ns	20	$21/2^+$	06			1973	IT=100	
^{181}Re	−46521	13				19.9	h	0.7	$5/2^+$	06			1957	β^+=100	
^{181}Re^{m}	−46258	13	262.91	0.11		156.7	ns	1.9	$9/2^-$	06			1967	IT=100	
^{181}Re^{n}	−44865	13	1656.37	0.14		250	ns	10	$21/2^-$	06			1974	IT=100	
^{181}Re^{p}	−44640	13	1880.57	0.16		11.5	μs	0.9	$25/2^+$	06			2000	IT=100	
^{181}Re^{q}	−42652	13	3869.40	0.18		1.2	μs	0.2	$(35/2^-)$	06			2000	IT=100	
^{181}Os	−43550	25				105	m	3	$1/2^-$	06			1966	β^+=100	
^{181}Os^{m}	−43501	25	49.20	0.14		2.7	m	0.1	$7/2^-$	06			1966	β^+=100	
^{181}Os^{n}	−43393	25	156.91	0.15		262	ns	6	$9/2^+$	06			1974	IT=100	
^{181}Ir	−39472	26				4.90	m	0.15	$5/2^-$	06			1972	β^+=100	
^{181}Ir^{m}	−39183	26	289.33	0.13		298	ns		$5/2^+$	06			1992	IT=100	
^{181}Ir^{n}	−39106	26	366.30	0.22		126	ns	6	$9/2^-$	06			1992	IT=100	
^{181}Pt	−34374	15				52.0	s	2.2	$1/2^-$	06	95Bi01	D	1966	β^+≈100; α=0.074 10	
^{181}Pt^{m}	−34257	15	116.65	0.08		> 300	ns		$(7/2)^-$	06			1992	IT=100	
^{181}Au	−27871	20				13.7	s	1.4	$(3/2^-)$	06			1968	β^+=?; α=2.7 5	
^{181}Hg	−20661	15				3.6	s	0.1	$1/2^{(-\#)}$	06			1969	β^+=73 2; α=27 2; …	∗
^{181}Hg^{m}	−20450	50	210	50		480	μs	20	$13/2^+$	06	09An17	T	2009	IT ?	
^{181}Tl	−12799	9				3.2	s	0.3	$1/2^+$	09	09An14	J	1996	β^+ ?; α<10	∗
^{181}Tl^{m}	−11963	9	835.9	0.4		1.40	ms	0.03	$(9/2^-)$	09	09An14	J	1984	IT=99.60 4; α=0.40 6; β^+ ?	
^{181}Pb	−3120	80				39.0	ms	0.8	$(9/2^-)$	06	09An20	TJ	1989	α=?; β^+=2#	∗
^{181}Pb^{m}			non existent		RN				$13/2^+\#$		96To01	I			
∗^{181}Ta^{p}	E : x keV above 1403.2(0.6) level; x<50														∗∗
∗^{181}Ta^{q}	T : average 98Wh02=25(2) 98Dr09=23(+6–2)														∗∗
∗^{181}Hg	D : … ; β^+p=0.013 3; $\beta^+\alpha$=9e–6 6														∗∗
∗^{181}Tl	T : average 98To14=3.2(0.3) 92Bo.D=3.4(0.6)														∗∗
∗^{181}Pb	T : average 09An20=36(2) 05Ca.A=39.6(0.9)														∗∗

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{182}Yb									(>300 ns)	0^+		12Ku26	I	2012	β^- ?	
^{182}Lu	−41880#	200#					2.0	m	0.2	1^-#	10			1982	β^-=100	
^{182}Hf	−46052	6					8.9	My	0.9	0^+	10			1961	β^-=100	
^{182}Hf^m	−44879	6	1172.87	0.18			61.5	m	1.5	$(8)^-$	10	FGK128	J	1971	β^-=54 2; IT=46 2	∗
^{182}Hf^n	−43480	7	2572.2	2.5			40	μs	10	(13^+)	10			1999	IT=100	
^{182}Ta	−46433.2	1.8					114.74	d	0.12	3^-	10			1938	β^-=100	
^{182}Ta^m	−46416.9	1.8	16.273	0.004			283	ms	3	5^+	10			1968	IT ?	
^{182}Ta^n	−45913.6	1.8	519.577	0.016			15.84	m	0.10	10^-	10			1947	IT=100	
^{182}W	−48247.7	0.8					STABLE		(>7.7 Zy)	0^+	10			1930	IS=26.50 16; α ?	
^{182}W^m	−46017.0	0.8	2230.65	0.14			1.3	μs	0.1	(10^+)	10			1969	IT=100	
^{182}Re	−45450	100				∗	64.0	h	0.5	7^+	10			1950	β^+=100	
^{182}Re^m	−45388	20	60	100	BD	∗	12.7	h	0.2	2^+	10			1950	β^+=100	
^{182}Re^n	−45150	140	300	100			585	ns	30	$(2)^-$	10			1969	IT=100	∗
^{182}Re^p	−44930	140	520	100			780	ns	90	(4^-)	10			1984	IT=100	∗
^{182}Os	−44609	22					21.84	h	0.20	0^+	10			1950	ε=100	
^{182}Os^m	−42778	22	1831.4	0.3			780	μs	70	$(8)^-$	10			1966	IT=100	
^{182}Os^n	−37560	22	7049.5	0.4			150	ns	10	(25^+)	10			1988	IT=100	
^{182}Ir	−39052	21					15	m	1	3^+	10			1961	β^+=100	
^{182}Ir^m	−38981	21	71.02	0.17			170	ns	40	(5^+)	10			1990	IT=100	
^{182}Ir^n	−38876	21	176.4	0.3			130	ns	50	(6^-)	10			1990	IT=100	
^{182}Pt	−36168	13					2.67	m	0.12	0^+	10			1963	$\beta^+\approx$100; α=0.038 2	
^{182}Au	−28301	20					15.5	s	0.4	(2^+)	10			1970	$\beta^+\approx$100; α=0.13 5	
^{182}Hg	−23577	10					10.83	s	0.06	0^+	10	97Ba21	D	1968	β^+=86.2 9; α=13.8 9; …	∗
^{182}Tl	−13310	60					2.2	s	0.3	(7^+)	10	91Bo22	TJ	1991	β^+=97.5 25; α<5	∗
^{182}Tl^m	−13210#	80#	100#	50#			3#	s		2^-#						
^{182}Tl^p	−12810#	120#	500#	100#						10^-						
^{182}Pb	−6826	12					55	ms	5	0^+	10			1986	α=?; β^+=2#	

∗^{182}Hf^m J : E1 to 8^+ ∗∗
∗^{182}Re^n E : 235.732(0.022) above ^{182}Re^m ∗∗
∗^{182}Re^p E : 461.3(0.1) above ^{182}Re^m ∗∗
∗^{182}Hg D : …; β^+p<1e–5 ∗∗
∗^{182}Hg D : α average 97Ba21=13.3(0.5)% 80Sc09=15.2(0.8)%; β^+p is from 71Ho07 ∗∗
∗^{182}Tl T : average 91Bo22=3.1(1.0) 92Bo.D(α)=2.8(0.6) (β^+)=2.0(0.3) ∗∗

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{183}Yb									(>300 ns)			12Ku26	I	2012	β^- ?	
^{183}Lu	−39720	90					58	s	4	$(7/2^+)$	91			1983	β^-=100	
^{183}Hf	−43290	30					1.018	h	0.002	$(3/2^-)$	91	06Vo12	T	1956	β^-=100	
^{183}Hf^m	−41830	70	1464	64			40	s	30	$27/2^-$#		10Re07	ETJ	2010	IT<100; β^- ?	∗
^{183}Ta	−45296.1	1.9					5.1	d	0.1	$7/2^+$	91			1950	β^-=100	
^{183}Ta^m	−45222.9	1.9	73.174	0.012			106	ns	10	$(9/2)^-$	91	09Sh17	T	1967	IT=100	∗
^{183}Ta^n	−43960	15	1336	15			900	ns	300	$(19/2^+)$		09Sh17	ETJ	2009	IT=100	∗
^{183}W	−46367.2	0.8					STABLE		(>4.1 Zy)	$1/2^-$	01	04Co26	T	1930	IS=14.31 4; α ?	∗
^{183}W^m	−46057.7	0.8	309.493	0.003			5.2	s	0.3	$11/2^+$	01			1961	IT=100	
^{183}Re	−45811	8					70.0	d	1.4	$5/2^+$	99			1950	ε=100	
^{183}Re^m	−43903	8	1907.6	0.3			1.04	ms	0.04	$(25/2^+)$	99			1966	IT=100	
^{183}Os	−43660	50					13.0	h	0.5	$9/2^+$	91			1950	β^+=100	
^{183}Os^m	−43490	50	170.71	0.05			9.9	h	0.3	$1/2^-$	91				β^+=85 2; IT=15 2	
^{183}Ir	−40203	24					58	m	5	$5/2^-$	91	61Di04	T	1961	$\beta^+\approx$100; α=0.05#	∗
^{183}Pt	−35772	16					6.5	m	1.0	$1/2^-$	93	95Bi01	D	1963	$\beta^+\approx$100; α=0.0096 5	
^{183}Pt^m	−35738	16	34.50	0.08			43	s	5	$(7/2)^-$	93			1979	$\beta^+\approx$100; α<4e–4; IT ?	
^{183}Pt^n	−35576	16	195.68	0.11			> 150	ns		$(9/2)^+$	93			1990	IT=100	
^{183}Au	−30189	9					42.8	s	1.0	$5/2^-$	99	94Pa37	J	1968	$\beta^+\approx$100; α=0.55 25	
^{183}Au^m	−30116	9	73.3	0.4			> 1	μs		$(1/2)^+$	99			1984	IT=100	
^{183}Au^p	−29958	9	230.6	0.6			< 1	μs		$(11/2)^-$	99			1984	IT=100	
^{183}Hg	−23805	7					9.4	s	0.7	$1/2^-$	00			1969	β^+=88.3 20; α=11.7 20; …	∗
^{183}Hg^m	−23601	13	204	14	AD		> 8#	μs		$13/2^+$#		81Mi12	I		β^+ ?	∗
^{183}Tl	−16587	9					6.9	s	0.7	$1/2^{(+)}$	02	12Bi.A	J	1980	β^+=?; α=2#	
^{183}Tl^m	−15959	9	628.7	0.5			60	ms	15	$(9/2^-)$	02	11Ve.A	EJD	1980	IT=?; α=1.5 3; β^+ ?	∗
^{183}Tl^n	−15612	9	975.5	0.6			1.48	μs	0.10	$(13/2^+)$	02	01Mu26	EJ	2001	IT=100	∗
^{183}Pb	−7571	28					535	ms	30	$3/2^-$	03	09Se13	J	1980	α=?; β^+=10#	
^{183}Pb^m	−7477	28	94	8	AD		415	ms	20	$13/2^+$	03	09Se13	J	1980	$\alpha\approx$100; β^+ ?	

∗^{183}Hf^m T : for q=71^+ (H+ like ion); symmetrized from 10(+48–5) ∗∗
∗^{183}Ta^m T : average 09Sh17=101(20) 67Mo13=107(11) ∗∗
∗^{183}Ta^n E : less than 50 keV above 1311 level ∗∗
∗^{183}W T : also 03Da05>80 Ey 03Ce01>13 Ey 97Ge15>1.9 Ey ∗∗
∗^{183}Ir T : average 61Di04=55(7) 61La05=60(6) ∗∗
∗^{183}Hg D : …; β^+p=2.6e–4 8 ∗∗
∗^{183}Hg^m I : lack of E(a)=6073-γ coinc. in ^{187}Pb^m decay; no isomer seen in 01Sc41 ∗∗
∗^{183}Tl^m E : uncertainty estimated by NUBASE D : α from 06An11; IT from 11Ve.A ∗∗
∗^{183}Tl^n E : 346.8(0.3) keV above ^{183}Tl^m ∗∗

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{184}Yb									(>300 ns)	0^+		12Ku26	I	2012	β^- ?	
^{184}Lu	−36410#	300#					20	s	3	(3^+)	10	95Kr04	TJ	1989	β^-=100	
^{184}Hf	−41500	40					4.12	h	0.05	0^+	10			1973	β^-=100	
^{184}Hf^m	−40230	40	1272.2	0.4			48	s	10	(8^-)	10	12Re.A	D	1995	IT=?; β^-=?	*
^{184}Hf^n	−39020	40	2477	10			16	m	7	15^+#	10	10Re07	ET	2010	β^- ?; IT ?	*
^{184}Ta	−42842	26					8.7	h	0.1	(5^-)	10			1955	β^-=100	
^{184}W	−45707.6	0.9					STABLE		(>8.9 Zy)	0^+	10	04Co26	T	1930	IS=30.64 2; α ?	
^{184}W^m	−44422.6	0.9	1284.997	0.008			8.33	μs	0.18	5^-	10			1969	IT=100	
^{184}W^n	−41844.4	2.7	3863.2	2.5			188	ns	38	$(14^-,15,17^-)$	10			2004	IT=100	
^{184}Re	−44225	4					35.4	d	0.7	$3^{(-)}$	10			1940	β^+=100	
^{184}Re^m	−44037	4	188.0463	0.0017			169	d	8	$8^{(+)}$	10			1964	IT=74.5 8; ε=25.5 8	
^{184}Os	−44256.6	1.3					STABLE		(>56 Ty)	0^+	10			1937	IS=0.02 1; α ?; 2β^+ ?	*
^{184}Ir	−39611	28					3.09	h	0.03	5^-	10			1960	β^+=100	
^{184}Ir^m	−39385	28	225.65	0.11			470	μs	30	3^+	10			1988	IT=100	
^{184}Ir^n	−39283	28	328.40	0.24			350	ns	90	$(7)^+$	10			1988	IT=100	
^{184}Pt	−37339	15					17.3	m	0.2	0^+	10	95Bi01	D	1963	$\beta^+\approx$100; α=0.0017 7	
^{184}Pt^m	−35499	15	1840.3	0.8			1.01	ms	0.05	8^-	10			1966	IT=100	
^{184}Au	−30319	22					20.6	s	0.9	5^+	10			1969	$\beta^+\approx$100; $\alpha<$0.016	
^{184}Au^m	−30251	22	68.46	0.04			47.6	s	1.4	2^+	10			1969	β^+=?; IT=30 10; $\alpha<$0.016	
^{184}Hg	−26349	10					30.87	s	0.26	0^+	10			1969	β^+=98.89 6; α=1.11 6	
^{184}Tl	−16873	20				*	10.1	s	0.5	2^-#	10			1976	β^+=97.9 7; α=2.1 7	
^{184}Tl^m	−16920	40	−50	30	AD	*	10#	s		7^+#					β^+ ?; IT ?	
^{184}Tl^n	−16420	40	450	30	AD		> 20	ns		(10^-)	10	84Sc.A	T	1984	IT ?	*
^{184}Pb	−11052	13					490	ms	25	0^+	10	04An07	D	1980	α=80 11; β^+ ?	*
^{184}Bi	1190	80				* &	6.6	ms	1.5	3^+#	10			2003	α= ?	
^{184}Bi^m	1340#	130#	150#	100#		* &	13	ms	2	10^-#	10			2002	α= ?	

*^{184}Hf^m E : 10Re07=1264(10) T : 10Re07=113(+74–40) for q=72$^+$ (bare ion) **
*^{184}Hf^n T : symmetrized from 10Re07=12(+10–4) for q=72$^+$; also 12Re.A=12(+8–6) **
*^{184}Os T : lower limit is for α decay **
*^{184}Tl^n T : α-decay from ^{188}Bi^m not coincident with X(K) and γ I : in 02Sc.A **
*^{184}Tl^n E : 500.7(6.3) keV above ^{184}Tl^m, from Ea difference 7462.9(5) - 6962.2(3.9) **
*^{184}Pb D : average 04An07=80(15)% 03Va16=80(15)% **

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{185}Yb									(>300 ns)			12Ku26	I	2012	β^- ?	
^{185}Lu	−33890#	300#					6#	s	(>300 ns)	$7/2^+$#		09St16	I	2009	β^- ?	
^{185}Hf	−38320	90					3.5	m	0.6	$3/2^-$#	06			1993	β^-=100	
^{185}Ta	−41396	14					49.4	m	1.5	$7/2^+$#	06			1950	β^-=100	
^{185}Ta^m	−40990	14	406	1			900	ns	300	$(3/2^+)$	06	07Sh42	ETJ	2007	IT=100	
^{185}Ta^n	−40123	14	1273.4	0.4			11.8	ms	1.4	$21/2^-$	06	09La17	EJT	1999	IT=100	
^{185}W	−43389.9	0.9					75.1	d	0.3	$3/2^-$	06			1940	β^-=100	
^{185}W^m	−43192.5	0.9	197.383	0.023			1.597	m	0.004	$11/2^+$	06	94It.A	T	1950	IT=100	
^{185}Re	−43822.6	1.2					STABLE			$5/2^+$	06			1931	IS=37.40 2	
^{185}Re^m	−41698.8	1.6	2123.8	1.1			121	ns	13	$(21/2)$	06			1997	IT=100	
^{185}Os	−42809.8	1.3					92.95	d	0.09	$1/2^-$	06	12Kr05	T	1947	ε=100	
^{185}Os^m	−42707.4	1.3	102.37	0.11			3.0	μs	0.4	$7/2^-$	06	FGK128	J	1970	IT=100	*
^{185}Os^n	−42534.3	1.3	275.53	0.12			780	ns	50	$11/2^+$	06			1970	IT=100	
^{185}Ir	−40336	28					14.4	h	0.1	$5/2^-$	06			1958	β^+=100	
^{185}Ir^m	−38140	40	2197	23			120	ns	20		06			1979	IT=100	*
^{185}Pt	−36688	26					70.9	m	2.4	$(9/2^+)$	06			1960	$\beta^+\approx$100; α=0.0050 20	*
^{185}Pt^m	−36585	26	103.41	0.05			33.0	m	0.8	$(1/2^-)$	06			1970	β^+=?; IT<2	
^{185}Pt^n	−36487	26	200.89	0.04			728	ns	20	$5/2^-$	06			1996	IT=100	
^{185}Au	−31867	26				*	4.25	m	0.06	$5/2^-$	06			1960	$\beta^+\approx$100; α=0.26 6	
^{185}Au^m	−31770#	100#	100#	100#		*	6.8	m	0.3	$1/2^+$#	06			1960	$\beta^+<$100; IT ?	
^{185}Hg	−26176	16					49.1	s	1.0	$1/2^-$	06			1960	β^+=94 1; α=6 1	
^{185}Hg^m	−26072	16	103.8	1.0			21.6	s	1.5	$13/2^+$	06	87Ki.A	E	1970	IT=54 10; β^+=46 10; $\alpha\approx$0.03	*
^{185}Tl	−19758	21					19.5	s	0.5	$1/2^+$#	06			1976	β^+=?; α ?	
^{185}Tl^m	−19303	21	454.8	1.5			1.93	s	0.08	$9/2^-$#	06			1976	IT$\approx$100; α=?; β^+ ?	
^{185}Pb	−11541	16				*	6.3	s	0.4	$3/2^-$	06			1975	α=34 25; β^+ ?	
^{185}Pb^m	−11470	50	70	50	AD	*	4.07	s	0.15	$13/2^+$	06	02An15	T	1975	α=50 25; β^+ ?	*
^{185}Bi	−2240#	80#				* &	2#	ms		$9/2^-$#		96Da06	J	1996	p ?; α ?	*
^{185}Bi^m	−2156	13	80#	80#		* &	58	μs	4	$1/2^+$	06			1996	p=90 2; α=10 2	
^{185}Bi^n	−2060#	100#	180#	60#	EU		50	μs	10	$13/2^+$#		04An07	ITD	2004	p=?; α=?	*

*^{185}Os^m J : E1 from 9/2$^+$ **
*^{185}Ir^m E : x<80 keV above 2157.3(0.5) level **
*^{185}Pt D : if the 4444(10) keV α line is from ground-state; otherwise α=0.0010(4)% from isomer **
*^{185}Hg^m E : ENSDF gives 99.3(0.5) plus "8-keV uncertainty", but missed 87Ki.A work **
*^{185}Pb^m T : average 02An15=4.3(0.2) 80Sc09=3.73(0.24) (excluding the 6.1 s activity) **
*^{185}Bi T : estimated from 9/2$^-$ isomers in odd Bi and Tl isotopes **
*^{185}Bi^n E : 100 keV above ^{185}Bi^m T : similar to ^{185}Bi^m **

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{186}Lu									(>300 ns)			12Ku26	I	2012	β^- ?	
^{186}Hf	−36420	50					2.6	m	1.2	0^+	03			1998	β^-=100	
^{186}Hf^m	−33450	70	2968	43			> 20	s		17^+#		10Re07	ET	2010	β^- ?; IT ?	*
^{186}Ta	−38610	60					10.5	m	0.3	$(2^-,3^-)$	03			1955	β^-=100	
^{186}Ta^m	−38270	60	336	20			1.54	m	0.05	9^+#		04Xu08	T	2010	β^- ?; IT ?	*

… A-group is continued on next page …

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
… *A*-group continued …																
^{186}W	−42510.8	1.5					STABLE		(>4.1 Ey)	0^+	03	03Da09	T	1930	IS=28.43 19; $2\beta^-$?; α ?	∗
^{186}W^m	−40993.6	1.6	1517.2	0.6			18	μs	1	(7^-)	03			1998	IT=100	
^{186}W^n	−38968.0	2.6	3542.8	2.1			8	s	4	(16^+)	03	98Wh02	J	1998	IT=100	∗
^{186}Re	−41930.6	1.2					3.7183	d	0.0011	1^-	03			1939	β^-=92.53 10; ε=7.47 10	
^{186}Re^m	−41782	7	149	7			200	ky		(8^+)	03	72Se06	T	1972	IT=?; β^-<10	∗
^{186}Os	−43002.4	1.5					2.0	Py	1.1	0^+	03			1931	IS=1.59 3; α=100	
^{186}Ir	−39175	17					16.64	h	0.03	5^+	03			1958	β^+=100	
^{186}Ir^m	−39174	17	0.8	0.4			1.92	h	0.05	2^-	03	91Be25	ET	1962	$\beta^+\approx$75; IT$\approx$25	∗
^{186}Pt	−37864	22					2.08	h	0.05	0^+	03			1961	β^+=100; $\alpha\approx$1.4e–4	
^{186}Au	−31715	21					10.7	m	0.5	3^-	03			1960	β^+=100; α=0.0008 2	
^{186}Au^m	−31487	21	227.77	0.07			110	ns	10	2^+	03			1983	IT=100	
^{186}Au^p			non existent		RN		< 2	m				83Po10	I			
^{186}Hg	−28539	12					1.38	m	0.06	0^+	03			1960	$\beta^+\approx$100; α=0.016 5	
^{186}Hg^m	−26322	12	2217.3	0.4			82	μs	5	(8^-)	03			1984	IT=100	
^{186}Tl	−19887	22				∗ &	40#	s		(2^-)	03	91Va04	I	1975	β^+ ?	∗
^{186}Tl^m	−19860	30	20	40		∗ &	27.5	s	1.0	(7^+)	03			1975	$\beta^+\approx$100; $\alpha\approx$0.006	
^{186}Tl^n	−19490	30	400	40	MD		2.9	s	0.2	$10^{(-)}$	03	12Bi.A	J	1977	IT=100	∗
^{186}Pb	−14682	11					4.82	s	0.03	0^+	03			1972	β^+ ?; α=40 8	
^{186}Bi	−3130	60				∗	14.8	ms	0.7	(3^+)	03	03An27	T	1997	$\alpha\approx$100; β^+ ?	∗
^{186}Bi^m	−2960#	120#	170#	100#		∗	9.8	ms	0.4	(10^-)	03	03An27	T	1984	$\alpha\approx$100; β^+ ?	
^{186}Po	4090	30					40#	μs		0^+		05Hu.A	D	2005	$\alpha\approx$100; p ?	

∗^{186}Hf^m T : for q=72$^+$ (bare ion) in 10Re07 ∗∗
∗^{186}Ta^m T : 10Re07=3.4(+2.4–1.4) for q=72$^+$ (H+ like ion); also 12Re.A=3.0(+1.5–0.8) ∗∗
∗^{186}W T : given limit is for $2\beta^-$ decay ∗∗
∗^{186}W T : for α decay: 04Co26>8.2 Zy, 03Da05>170 Ey, 03Ce01>27 Ey, ∗∗
∗^{186}W T : and 97Ge15>6.5 Ey ∗∗
∗^{186}W^n T : symmetrized from 12Re.A=7.5(+4.8–3.3) for q=72$^+$ ∗∗
∗^{186}Re^m T : uncertainty 50 ky estimated in ENSDF'89 evaluator, not traceable ∗∗
∗^{186}Ir^m T : average 91Be25=1.90(0.05) 70Fi.A=2.0(0.1) ∗∗
∗^{186}Ir^m E : E is positive and below 1.5 keV ∗∗
∗^{186}Tl I : identified as decay level from ^{190}Bi in 91Va04 ∗∗
∗^{186}Tl^n E : 374.0(0.2) keV above ^{186}Tl^m ∗∗
∗^{186}Bi T : average 03An27=14.8(0.8) 97Ba21=15.0(1.7) ∗∗

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{187}Lu									(>300 ns)			12Ku26	I	2012	β^- ?	
^{187}Hf	−32820#	300#					30#	s	(>300 ns)	$3/2^-$#	09	99Be63	I	1999	β^- ?	
^{187}Hf^m	−32320#	420#	500#	300#		∗	270	ns	80	$9/2^-$#		09Al30	TD	2009	IT=100	
^{187}Ta	−36900	70					2.3	m	6	$7/2^+$#	09	10Re07	T	1999	β^- ?	
^{187}Ta^m	−35110	70	1789	13			22	s	9	$27/2^-$#		10Re07	ET	2010	β^- ?; IT ?	∗
^{187}Ta^n	−33970	70	2935	14			> 5	m		$41/2^+$#		10Re07	ET	2010	β^- ?; IT ?	∗
^{187}W	−39906.3	1.5					24.000	h	0.004	$3/2^-$	09			1940	β^-=100	
^{187}W^m	−39496.2	1.5	410.06	0.04			1.38	μs	0.07	$(11/2^+)$	09			2008	IT=100	
^{187}Re	−41218.5	1.5					43.3	Gy	0.07	$5/2^+$	09			1931	IS=62.60 2; β^-=100; α<0.0001	∗
^{187}Re^m	−41012.3	1.5	206.2473	0.0010			555.3	ns	1.7	$9/2^-$	09			1949	IT=100	
^{187}Re^n	−39536.9	1.5	1681.63	0.15			114	ns	23	$(19/2^+)$	09			2003	IT=100	
^{187}Os	−41221.0	1.5					STABLE			$1/2^-$	09			1931	IS=1.96 2	
^{187}Os^m	−41120.6	1.5	100.45	0.04			112	ns	6	$7/2^-$	09			1964	IT=100	
^{187}Os^n	−40963.9	1.5	257.10	0.07			231	μs	2	$11/2^+$	09			1964	IT=100	
^{187}Ir	−39549	28					10.5	h	0.3	$3/2^+$	09			1958	β^+=100	
^{187}Ir^m	−39363	28	186.16	0.04			30.3	ms	0.6	$9/2^-$	09			1963	IT=100	
^{187}Ir^n	−39115	28	433.75	0.06			152	ns	12	$11/2^-$	09			1969	IT=100	
^{187}Ir^p	−37061	28	2487.7	0.4			1.8	μs	0.5	$29/2^-$		10Mo09	ETJ	2010	IT=100	
^{187}Pt	−36685	24					2.35	h	0.03	$3/2^-$	09			1961	β^+=100	
^{187}Pt^m	−36511	24	174.38	0.22			311	μs	15	$(11/2^+)$	09			1976	IT=100	
^{187}Au	−33028	22					8.3	m	0.2	$1/2^{(+)}$	09			1955	$\beta^+\approx$100; α=0.003#	
^{187}Au^m	−32908	22	120.33	0.14			2.3	s	0.1	$9/2^{(-)}$	09			1983	IT=100	
^{187}Hg	−28118	14				&	1.9	m	0.3	$3/2^{(-)}$	09	70Ha18	TD	1960	β^+=100; α>1.2e–4	∗
^{187}Hg^m	−28059	19	59	16	MD	&	2.4	m	0.3	$13/2^+$	09	70Ha18	D	1970	β^+=100; α>2.5e–4	
^{187}Tl	−22443	8					51	s		$(1/2^+)$	09			1976	β^+<100; α=0.03#	
^{187}Tl^m	−22108	8	335	3	AD		15.60	s	0.12	$(9/2^-)$	09			1976	IT=?; β^+ ?; α=0.15 5	
^{187}Tl^n	−20960	50	1480	50			1.11	μs			09			2000	IT=100	∗
^{187}Tl^p	−19861	8	2582.5	0.3			690	ns	40	$(25/2^-,27/2,.)$	09			2000	IT=100	
^{187}Pb	−14987	5				∗ &	15.2	s	0.3	$3/2^-$	09	09Se13	J	1972	β^+ ?; α=9.5 20	
^{187}Pb^m	−14968	11	19	10	MD	∗ &	18.3	s	0.3	$13/2^+$	09	09Se13	J	1972	β^+ ?; α=12 2	
^{187}Bi	−6383	10					37	ms	2	$9/2^-$#	09			1999	α=100	
^{187}Bi^m	−6275	12	108	8	AD		370	μs	20	$1/2^+$#	09			1984	α=100	
^{187}Bi^n	−6131	21	252	18			7	μs	5	$(13/2^+)$	09	02Hu14	ETJ	2002	IT=100	∗
^{187}Po	2830	30				∗	1.40	ms	0.25	$(1/2^-,5/2^-)$	09			2005	$\alpha\approx$100; β^+ ?	
^{187}Po^m	2840	30	4	27	AD	∗	0.5	ms		$13/2^+$#		06An11	ETD	2006	α=?; β^+ ?	

∗^{187}Ta^m T : for q=73$^+$ (bare ion) in 10Re07 ∗∗
∗^{187}Ta^n T : for q=73$^+$ (bare ion) in 10Re07 ∗∗
∗^{187}Re T : other: 96Bo37=32.9(2.0) y for q=75$^+$ (bare ion) ∗∗
∗^{187}Hg T : from 70Ha18; 98Ru04=2.4 m, not documented, no uncertainty given ∗∗
∗^{187}Tl^n E : x above 1433.23(0.19) level; x=50(50) keV estimated by NUBASE ∗∗
∗^{187}Bi^n T : symmetrized from 3.2(+7.6–2.0) ∗∗

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{188}Lu									(>300 ns)			12Ku26	I	2012	β^- ?	
^{188}Hf	−30880#	300#					20#	s	(>300 ns)	0^+	02	99Be63	I	1999	β^- ?	
^{188}Ta	−33610	70					19.6	s	2.0		02	09Al30	TD	1999	β^-=100	
^{188}Ta^m	−33320	70	292.4	0.2			3.6	μs	0.4			05Ca02	ET	2005	IT=100	*
^{188}W	−38670	3					69.78	d	0.05	0^+	02			1951	β^-=100	
^{188}W^m	−36741	3	1929.3	1.6			109.5	ns	3.5	8^-		10La16	ETJ	2010	IT=100	
^{188}Re	−39018.9	1.5					17.0040	h	0.0022	1^-	02			1939	β^-=100	
^{188}Re^m	−38846.8	1.5	172.069	0.009			18.59	m	0.04	$(6)^-$	02			1953	IT=100	
^{188}Os	−41139.3	1.5					STABLE			0^+	02			1931	IS=13.24 8	
^{188}Ir	−38351	10					41.5	h	0.5	1^-	02			1950	β^+=100	
^{188}Ir^m	−37380	30	970	30			4.2	ms	0.2	11^-#	02	GAu	E	1971	IT≈100; β^+ ?	*
^{188}Pt	−37829	6					10.2	d	0.3	0^+	02			1954	ε=100; α=2.6e–5 3	
^{188}Au	−32277	15					8.84	m	0.06	$1^{(-)}$	02			1955	β^+=100	
^{188}Hg	−30211	11					3.25	m	0.15	0^+	02			1960	β^+=100; α=3.7e–5 8	
^{188}Hg^m	−27487	11	2724.3	0.4			134	ns	15	(12^+)	02			1983	IT=100	*
^{188}Tl	−22336	30				*	71	s	2	(2^-)	02			1970	β^+=100	
^{188}Tl^m	−22308	9	30	30	MD	*	71	s	1	(7^+)	02			1970	β^+=100	
^{188}Tl^n	−22030	40	310	30			41	ms	4	(9^-)	02			1981	IT≈100; β^+ ?	*
^{188}Pb	−17815	11					25.1	s	0.1	0^+	02	03Va16	D	1972	β^+=?; α=9.3 8	*
^{188}Pb^m	−15237	11	2578.2	0.7			1.15	μs	0.03	(8^-)	02	04Dr04	T	1999	IT=100	
^{188}Pb^n	−15105	11	2709.7	0.3			136	ns	18	(12^+)	02	04Dr04	ETJ	2004	IT=100	
^{188}Pb^p	−13032	11	4783.2	0.3			630	ns	80	(19^-)	02	04Dr04	ETJ	2000	IT=100	
^{188}Bi	−7185	21				&	61.2	ms	2.7	3^+#	02	06An04	T	1980	α=?; β^+ ?	*
^{188}Bi^m	−7120	40	66	30	AD		> 5	μs		7^+#		06An04	ET	1984	IT ?	*
^{188}Bi^n	−7030	40	153	30	AD	&	273	ms	8	(10^-)	02	06An04	T	1984	α=?; β^+ ?	*
^{188}Po	−544	20					275	μs	30	0^+	02	03Va16	T	1999	α=?; β^+ ?	

*^{188}Ta^m T : average 11St21=3.5(0.4) 09Al30=4.4(1.0); other 05Ca02=5(2) **
*^{188}Ir^m E : less than 100 keV above 923.5 level, from ENSDF **
*^{188}Hg^m T : other 04Gl04=270(51) **
*^{188}Tl^n E : 268.8(0.2) keV above ^{188}Tl^m, from 91Va04 **
*^{188}Pb D : also 03Va16=8.0(0.6)% **
*^{188}Bi T : average 06An04=66(6) 03An26=60(3); others 97Wa05=46(7) 84Sc.A=44(3) **
*^{188}Bi^n T : average 06An04=280(20) 03An26=265(15) **
*^{188}Bi^n T : others 97Wa05=218(50) 84Sc.A=210(90) **

^{189}Hf	−27160#	300#					2#	s	(>300 ns)	$3/2^-$#	12	09Al30	I	2009	β^- ?	
^{189}Ta	−31830#	300#					3#	s	(>300 ns)	$7/2^+$#	03	99Be63	I	1999	β^- ?	
^{189}Ta^m	−30230#	500#	1600#	400#			1.6	μs	0.2			09Al30	TD	2009	IT=100	*
^{189}W	−35620	40					10.7	m	0.5	$3/2^-$#	03			1963	β^-=100	
^{189}Re	−37981	8					24.3	h	0.4	$5/2^+$	03			1963	β^-=100	
^{189}Os	−38988.5	1.6					STABLE			$3/2^-$	03			1931	IS=16.15 5	
^{189}Os^m	−38957.7	1.6	30.812	0.015			5.81	h	0.06	$9/2^-$	03			1960	IT=100	
^{189}Ir	−38457	13					13.2	d	0.1	$3/2^+$	03			1955	ε=100	
^{189}Ir^m	−38085	13	372.17	0.04			13.3	ms	0.3	$11/2^-$	03			1960	IT=100	
^{189}Ir^n	−36124	13	2333.2	0.5			3.7	ms	0.2	$(25/2)^+$	03			1975	IT=100	
^{189}Pt	−36485	11					10.87	h	0.12	$3/2^-$	03			1955	β^+=100	
^{189}Pt^m	−36312	11	172.80	0.06			464	ns	25	$9/2^-$	03			1970	IT=100	
^{189}Pt^n	−36294	11	191.5	0.7			143	μs	5	$(13/2^+)$	03			1976	IT=100	
^{189}Au	−33582	20					28.7	m	0.3	$1/2^+$	03			1955	β^+=100; α<3e–5	
^{189}Au^m	−33335	20	247.23	0.16			4.59	m	0.11	$11/2^-$	03			1966	β^+≈100; IT=?	
^{189}Au^n	−33257	20	325.11	0.16			190	ns	15	$9/2^-$	03			1975	IT=100	
^{189}Au^p	−31027	20	2554.7	1.2			242	ns	10	$31/2^+$	03			1975	IT=100	
^{189}Hg	−29630	30					7.6	m	0.1	$3/2^-$	03			1955	β^+=100; α<3e–5	
^{189}Hg^m	−29548	18	80	30	MD		8.6	m	0.1	$13/2^+$	03			1966	β^+=100; α<3e–5	
^{189}Tl	−24602	11					2.3	m	0.2	$(1/2^+)$	11			1972	β^+=100	
^{189}Tl^m	−24319	10	283	6	AD		1.4	m	0.1	$9/2^{(-)}$	11	85Bo46	J	1972	β^+≈100; IT<4	
^{189}Pb	−17880	30				*	50.5	s	2.1	$3/2^-$	11	09Sa09	T	1972	β^+≈100; α≈0.4	*
^{189}Pb^m	−17840#	50#	40#	30#		*	39	s	8	$13/2^+$	11	09Sa09	T	2009	β^+≈100; α<1; IT ?	*
^{189}Pb^n	−15410#	40#	2475#	30#			26	μs	5	$(31/2^-)$	11			2005	IT=100	*
^{189}Bi	−10065	21					658	ms	47	$(9/2^-)$	11			1973	α≈100	
^{189}Bi^m	−9881	21	184	5	AD		4.9	ms	0.3	$(1/2^+)$	11	03An26	T	1984	α>50; β^+<50	*
^{189}Bi^n	−9707	21	357.6	0.5			880	ns	50	$(13/2^+)$	11			2001	IT≈100	
^{189}Po	−1422	22					3.8	ms	0.4	$(5/2^-)$	07	05Va04	T	1999	α≈100; β^+ ?	*

*^{189}Ta^m T : other 11St21=0.58(0.22), possibly a different isomer **
*^{189}Pb T : average 09Sa09=50(3) 72Ga27=51(3) J : 09Se13: α to ^{185}Hg 26.1 level **
*^{189}Pb^m J : 09Se13: from α decay from ^{193}Po^m **
*^{189}Pb^n E : 2434.50(0.18) keV above ^{189}Pb^m (13/2$^+$) **
*^{189}Pb^n T : from mean life 05Ba51=32(+10–2) μs, or T=22.2(+6.9–1.4) **
*^{189}Bi^m T : average 03An26=4.9(0.5) 03Ke08=4.6(+0.8–0.6) 97An09=4.8(0.5) **
*^{189}Bi^m T : and 97Wa05=5.2(0.6); 95Ba75=7.0(0.2), conflicting not used **
*^{189}Po T : average 05Va04=3.5(0.5) 99An52=5(1) J : favored decay to (5/2$^-$) level **

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{190}Hf									(>300 ns)	0^+		12Ku26	I	2012	β^- ?	
^{190}Ta	−28510#	200#				*	5.3	s	0.7	(3)	10	09Al30	TJD	2009	β^-=100	
^{190}Ta^m	−28310#	250#	200#	150#		*	42	ns	7		10	09Al30	TD	2009	IT=100	
^{190}W	−34380	40					30.0	m	1.5	0^+	03			1976	β^-=100	
^{190}W^m	−32640	40	1742.0	2.0			111	ns	17	8^+		10La16	ETJ	2010	IT=100	
^{190}W^n	−32540	40	1839.0	2.2			166	μs	6	10^-	03	10La16	ETJ	2000	IT=100	*
^{190}Re	−35630	70					3.1	m	0.3	$(2)^-$	03			1955	β^-=100	
^{190}Re^m	−35430	70	204	10			3.2	h	0.2	(6^-)	03	12Re.A	E	1962	β^-=54.4 20; IT ?	*
^{190}Os	−38709.4	1.6					STABLE			0^+	03			1931	IS=26.26 2	
^{190}Os^m	−37004.0	1.6	1705.4	0.2			9.86	m	0.03	10^-	03	12Kr05	T	1950	IT=100	*
^{190}Ir	−36755.6	2.0					11.78	d	0.10	4^-	03			1947	β^+=100; e$^+$<0.002	
^{190}Ir^m	−36729.5	2.0	26.1	0.1			1.120	h	0.003	(1^-)	03			1964	IT=100	
^{190}Ir^n	−36719.4	2.0	36.154	0.025			> 2	μs		$(4)^+$	03			1996	IT=100	
^{190}Ir^p	−36379.2	2.0	376.4	0.1			3.087	h	0.012	$(11)^-$	03			1950	β^+=91.4 2; IT=8.6 2	
^{190}Pt	−37325	6					650	Gy	30	0^+	03			1949	IS=0.012 2; α=100; …	*
^{190}Au	−32883	16				*	42.8	m	1.0	1^-	03			1959	β^+=100; α<1e–6	
^{190}Au^m	−32680#	150#	200#	150#		*	125	ms	20	11^-#	03			1982	IT≈100; β^+ ?	
^{190}Hg	−31370	16					20.0	m	0.5	0^+	03			1959	ε≈100; e$^+$<1; …	*
^{190}Tl	−24380#	50#				*	2.6	m	0.3	$2^{(-)}$	03			1970	β^+=100	
^{190}Tl^m	−24289	6	90#	50#		*	3.7	m	0.3	$7^{(+\#)}$	03			1970	β^+=100	
^{190}Tl^n	−24090#	90#	290#	70#			750	μs	40	(8^-)	03			1981	IT=100	*
^{190}Tl^p	−23970#	90#	410#	70#			> 1	μs		9^-	03	91Va04	ET	1991	IT ?	*
^{190}Pb	−20416	13					71	s	1	0^+	03			1972	β^+ ?; α=0.40 4	
^{190}Pb^m	−17801	13	2614.8	0.8			150	ns	14	10^+	03	01Dr05	J	1998	IT=100	*
^{190}Pb^n	−17798	24	2618	20			24.3	μs	2.1	(12^+)	03			1998	IT ?	*
^{190}Pb^p	−17758	13	2658.2	0.8			7.7	μs	0.3	11^-	03	01Dr05	JT	1985	IT=100	*
^{190}Bi	−10599	23					6.3	s	0.1	(3^+)	03	91Va04	J	1972	α=77 21; β^+=?	*
^{190}Bi^m	−10470	30	130	40	AD		6.2	s	0.1	(10^-)	03	91Va04	J	1988	α=70 9; β^+ ?; β^+p ?	
^{190}Bi^n	−10478	27	121	15			175	ns	8	(5^-)		09An11	ET	2009	IT=100	*
^{190}Bi^p	−10200	50	404	40			1.3	μs	0.8	(8^-)	03	09An11	EJT	2001	IT=100	*
^{190}Po	−4564	13					2.46	ms	0.05	0^+	03			1996	α≈100; β^+=0.1#	

*^{190}W^n T : others 11St21=108(9) 09Al30=106(18) μs 05Ca02=60(+1500–30) μs 00Po26<3.1ms **
*^{190}W^n E : other 00Po26=2381 **
*^{190}Os^m J : M2 + E3 to 8^+ member of the ground-state band **
*^{190}Pt D : …; 2β^+ ? **
*^{190}Hg D : …; α<3.4e–7 **
*^{190}Tl^n E : 161.9 keV above ^{190}Tl^m **
*^{190}Tl^p E : 236.2 keV above ^{190}Tl^m **
*^{190}Pb^m T : uncertainty from 12Dr.A **
*^{190}Pb^n E : above ^{190}Pb^m, see 01Dr05 T : uncertainty from 12Dr.A **
*^{190}Pb^p T : average 01Dr05=7.2(0.6) 85St16=7.9(0.4) **
*^{190}Bi D : symmetrized from α=90(+10–30)% **
*^{190}Bi^n J : E1 and M1(+E2) γs in cascade to (3^+), absence of direct γ to (3^+) **
*^{190}Bi^p E : 274(1) keV above the (10^-) isomer J : E2 to (10^-) **
*^{190}Bi^p T : symmetrized from 09An11=1.0(+1.0–0.5) **

^{191}Ta	−26490#	300#					3#	s	(>300 ns)		11	09St16	I	2009	β^- ?	
^{191}W	−31180	40				*	20#	s	(>300 ns)	$3/2^-$#	07	99Be63	I	1999	β^- ?	
^{191}W^m	−30950	60	235	50		*	340	ns	14			11St21	ETD	2009	IT=100	*
^{191}Re	−34352	10					9.8	m	0.5	$(3/2^+,1/2^+)$	07			1963	β^-=100	*
^{191}Re^m	−32830	500	1520	500			77	μs	33	high		11St21	ETJ	2011	IT=100	*
^{191}Os	−36396.9	1.6					14.99	d	0.02	$9/2^-$	07	12Kr05	T	1940	β^-=100	
^{191}Os^m	−36322.5	1.6	74.382	0.003			13.10	h	0.05	$3/2^-$	07	12Kr05	T	1952	IT=100	*
^{191}Ir	−36710.8	1.9					STABLE			$3/2^+$	07			1935	IS=37.3 2	
^{191}Ir^m	−36539.5	1.9	171.29	0.04			4.899	s	0.023	$(11/2^-)$	07			1955	IT=100	
^{191}Ir^n	−34609.8	2.1	2101.0	0.9			5.7	s	0.4	$31/2^{(+)}$	07	12Dr02	ETJ	1979	IT=100	*
^{191}Pt	−35701	5					2.83	d	0.02	$3/2^-$	07			1948	ε=100	
^{191}Pt^m	−35600	5	100.663	0.020			> 1	μs		$(9/2)^-$	07			1976	IT=100	
^{191}Pt^n	−35552	5	149.035	0.022			95	μs	5	$(13/2)^+$	07			1967	IT=100	
^{191}Au	−33810	40					3.18	h	0.08	$3/2^+$	07			1954	β^+=100	
^{191}Au^m	−33540	40	266.2	0.7			920	ms	110	$(11/2^-)$	07			1971	IT=100	
^{191}Au^n	−31320	40	2489.6	0.9			402	ns	20	$(31/2^+)$	07			1985	IT=100	
^{191}Hg	−30593	23					49	m	10	$3/2^{(-)}$	07	86Ul02	J	1954	β^+=100; α<5e–6	
^{191}Hg^m	−30470	30	128	22			50.8	m	1.5	$13/2^{(+)}$	07	01Sc41	E	1954	β^+=100; α<5e–6	*
^{191}Tl	−26283	7					20#	m		$(1/2^+)$	07			1974	β^+ ?	
^{191}Tl^m	−25986	7	297	7	BD		5.22	m	0.16	$9/2^{(-)}$	07			1970	β^+=100	
^{191}Pb	−20240	40				*	1.33	m	0.08	$(3/2^-)$	07	10Co13	JD	1974	β^+≈100; α=0.51 5	
^{191}Pb^m	−20230	28	10	50	MD	*	2.18	m	0.08	$13/2^{(+)}$	07	88Me.A	J	1975	β^+≈100; α≈0.02	
^{191}Pb^n	−17620	60	2620	50			180	ns	80	$(33/2^+)$	07			1999	IT=100	*
^{191}Bi	−13240	7					12.4	s	0.3	$(9/2^-)$	07			1972	α=51 10; β^+=49 10	
^{191}Bi^m	−13000	9	240	4	AD		124	ms	5	$(1/2^+)$	07	03Ke04	T	1981	α=68 5; IT=32 5	*
^{191}Bi^n	−12810	7	429.7	0.5			547	ns	15	$13/2^+$#	07			2001	IT=100	

… *A*-group is continued on next page …

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

… *A*-group continued …

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{191}Po	−5069	7					22	ms	1	(3/2$^-$)	07			1993	α=?; β^+=1#	
^{191}Po^m	−5008	12	61	11	AD		93	ms	3	(13/2$^+$)	07			1999	α=?; β^+=4#	
^{191}At	3864	16					2.1	ms	0.8	(1/2$^+$)	07			2003	α≈100; β^+ ?	∗
^{191}At^m	3922	18	58	20	AD		2.2	ms	0.4	(7/2$^-$)	07			2003	α≈100; β^+ ?	∗
∗^{191}W^m	T : average 11St21=360(20) 09Al30=320(20) ns E : 68 + 167 keV γ-rays															∗∗
∗^{191}Re	I : also an isomer with T=77(33) μs decaying by g of 444, 419, 225, 139 keV															∗∗
∗^{191}Re^m	E : 135,140,158,225,419,444 keV γ rays															∗∗
∗^{191}Os^m	T : other 12Kr05=13.6(0.2) from the decay growth J : M3 + E4 to 9/2$^-$															∗∗
∗^{191}Ir^n	T : average 12Dr02=5.8(0.6) 79Lu01=5.5(0.7)															∗∗
∗^{191}Ir^n	E : from least-squares fit to γ-ray energies using 12Dr02 level scheme															∗∗
∗^{191}Hg^m	E : original uncertainty (8 keV) increased by 20 for gs+m lines in trap															∗∗
∗^{191}Pb^n	E : 2602.31(0.24) above ^{191}Pb^m T : symmetrized from 150(+100–50)															∗∗
∗^{191}Bi^m	T : average 03Ke04=121(+8–5) 99An36=115(10) 81Le23=150(15)															∗∗
∗^{191}At	T : symmetrized from 1.7(+1.1–0.5)															∗∗
∗^{191}At^m	T : symmetrized from 2.1(+0.4–0.3)															∗∗

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{192}Ta	−23160#	400#					2.2	s	0.7	(2)		09Al30	TJD	2009	β^-=100	
^{192}W	−29650#	200#					30#	s	(>300 ns)	0$^+$		99Be63	I	1999	β^- ?	
^{192}Re	−31590	80					16.0	s	0.9		98	12Al05	T	1965	β^-=100	∗
^{192}Re^m	−31430	80	159	1			88	μs	8			11St21	ETD	2005	IT=100	∗
^{192}Re^n	−31320	80	267	10			70	s	30			12Re.A	ET	2012	β^-=?; IT=?	∗
^{192}Os	−35883.9	2.7					STABLE		(>9.8 Ty)	0$^+$	98			1931	IS=40.78 19; 2β^- ?; α ?	∗
^{192}Os^m	−33868.5	2.7	2015.40	0.11			5.9	s	0.1	10$^-$	98	FGK12a	J	1965	IT>87; β^-<13	∗
^{192}Os^n	−31303.6	2.9	4580.3	1.0			205	ns		(20$^+$)		12Dr.1	ETJ	2004	IT=100	∗
^{192}Ir	−34837.6	1.9					73.827	d	0.013	4$^+$	98			1937	β^-=95.13 14; ε=4.87 14	
^{192}Ir^m	−34780.9	1.9	56.720	0.005			1.45	m	0.05	1$^-$	98			1937	IT≈100; β^-=0.0175	
^{192}Ir^n	−34669.5	1.9	168.14	0.12			241	y	9	(11$^-$)	98			1959	IT=100	
^{192}Pt	−36292	3					STABLE			0$^+$	98			1935	IS=0.782 24	
^{192}Pt^m	−34120	3	2172.36	0.13			280	ns	30	(10)$^-$	98			1976	IT=100	
^{192}Au	−32776	16					4.94	h	0.09	1$^-$	98			1948	β^+=100	
^{192}Au^m	−32641	16	135.41	0.25			29	ms		5#$^+$	98			1976	IT=100	
^{192}Au^n	−32344	16	431.6	0.5			160	ms	20	(11$^-$)	98			1976	IT=100	
^{192}Hg	−32011	16					4.85	h	0.20	0$^+$	00			1952	ε=100; α<4e–6	
^{192}Tl	−25870	30					9.6	m	0.4	(2$^-$)	99			1961	β^+=100	
^{192}Tl^m	−25710	60	160	50			10.8	m	0.2	(7$^+$)	99	91Va04	E	1961	β^+=100	
^{192}Tl^n	−25460	60	407	54			296	ns	5	(8$^-$)	99			1980	IT=100	
^{192}Tl^p	−25694	25	180	40	AD					(3$^+$)		91Va04	E	1991		
^{192}Pb	−22565	12					3.5	m	0.1	0$^+$	05			1974	β^+≈100; α=0.0059 7	
^{192}Pb^m	−19984	12	2581.1	0.4			166	ns	6	10$^+$	05	01Dr05	JT	1985	IT=100	∗
^{192}Pb^n	−19940	12	2625.1	1.1			1.09	μs	0.03	12$^+$	05	07Io03	JT	1979	IT=100	∗
^{192}Pb^p	−19822	12	2743.5	0.4			757	ns	14	11$^-$	05	01Dr05	ETJ	1991	IT=100	∗
^{192}Bi	−13540	30					34.6	s	0.9	(3$^+$)	98			1971	β^+=88 5; α=12 5	
^{192}Bi^m	−13398	9	140	30	MD		39.6	s	0.4	(10$^-$)	98			1966	β^+=90 3; α=10 3	
^{192}Po	−8071	11					32.2	ms	0.3	0$^+$	98	99He32	T	1977	α=?; β^+=0.5#	∗
^{192}Po^m	−5780	50	2295	50			580	ns	100	12$^+$#		03Va16	T	1999	IT=100	∗
^{192}At	2940	30				∗ &	11.5	ms	0.6	3$^+$#	06	06An04	TD	2006	α=100	
^{192}At^m	2940	30	0	40	AD	∗ &	88	ms	6	(9$^-$,10$^-$)	06	06An04	ETD	2006	α=100	
∗^{192}Re	T : average 12Al05=16(2) 79Ka.B=16(1)															∗∗
∗^{192}Re^m	T : average 11St21=85(10) 09Al30=93(15); also 05Ca02=120(+210–50) μs															∗∗
∗^{192}Re^m	T : and 12Re.A=61(+40–20) s for q=75$^+$															∗∗
∗^{192}Re^m	E : 159.3 keV γ and X rays seen only in 11St21															∗∗
∗^{192}Re^n	T : symmetrized from 12Re.A=61(+40–20) s for q=75$^+$															∗∗
∗^{192}Os	T : lower limit is for 0ν-$\beta\beta$ decay															∗∗
∗^{192}Os^m	J : M2 to 8$^+$, E3 to 7$^+$															∗∗
∗^{192}Os^n	ETJ : other: 04Va03 4115 keV (16$^+$) 190(96) ns; no coincidence, unreliable															∗∗
∗^{192}Pb^m	T : average 07Io03=170(10) 01Dr05=164(7); other 85St16=100(15)															∗∗
∗^{192}Pb^n	T : average 07Io03=1.08(0.04) 85St16=1.10(0.05)															∗∗
∗^{192}Pb^p	T : average 07Io03=758(20) 01Dr05=756(21); other 91La07=95(15)															∗∗
∗^{192}Po	T : others 03Va16=31.8(1.5) 98Al27=31(4) 96Bi17=33.2(1.4) 81Le23=34(3), all															∗∗
∗^{192}Po	T : outweighed, not used															∗∗
∗^{192}Po^m	E : 154 γ above (10$^+$) 2141 level T : 99He32 of the order of 1 μs															∗∗

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{193}Ta									(>300 ns)			12Ku26	I	2012	β^- ?	
^{193}W	−26290#	200#					1#	s	(>300 ns)		11	09St16	I	2009	β^- ?	
^{193}Re	−30240	40					20#	s	(>300 ns)	5/2$^+$#	06	99Be63	I	1999	β^- ?	
^{193}Re^m	−30090	40	146.0	0.2			69	μs	6	(9/2$^-$)	06	11St21	ETJ	2005	IT=100	∗
^{193}Os	−33396.0	2.7					29.830	h	0.018	3/2$^-$	06	12Kr05	T	1940	β^-=100	
^{193}Os^m	−33154.0	2.7	242.0	0.5			132	ns	29			11St21	ETD	2011	IT=100	
^{193}Ir	−34538.3	1.9					STABLE			3/2$^+$	06			1935	IS=62.7 2	
^{193}Ir^m	−34458.1	1.9	80.239	0.006			10.53	d	0.04	11/2$^-$	06			1957	IT=100	
^{193}Ir^n	−32260.8	2.1	2277.5	1.0			124.8	μs	2.1	31/2$^+$		12Dr02	ETJ	2012	IT=100	
^{193}Pt	−34481.7	2.0					50	y	6	1/2$^-$	06			1948	ε=100	
^{193}Pt^m	−34331.9	2.0	149.78	0.04			4.33	d	0.03	13/2$^+$	06			1949	IT=100	

… *A*-group is continued on next page …

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

... *A*-group continued ...

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{193}Au	−33406	9					17.65	h	0.15	$3/2^+$	06			1948	β^+=100; α<1e–5	
^{193}Au^m	−33116	9	290.19	0.03			3.9	s	0.3	$11/2^-$	06			1955	IT≈100; β^+≈0.03	
^{193}Au^n	−30920	9	2486.5	0.6			150	ns	50	$31/2^+$	06	07Ok05	J	1985	IT=100	
^{193}Hg	−31063	16					3.80	h	0.15	$3/2^{(-)}$	06			1952	β^+=100	
^{193}Hg^m	−30922	16	140.76	0.05			11.8	h	0.2	$13/2^{(+)}$	06			1973	β^+=92.8 5; IT=7.2 5	
^{193}Tl	−27477	7					21.6	m	0.8	$1/2^{(+\#)}$	06			1960	β^+=100	
^{193}Tl^m	−27105	8	372	4			2.11	m	0.15	$(9/2^-)$	06			1963	IT=75; β^+=25	*
^{193}Pb	−22190	50				*	5#	m		$(3/2^-)$	06	GAu	J	1974	β^+ ?	*
^{193}Pb^m	−22060#	90#	130#	80#		*	5.8	m	0.2	$13/2^+$	06	91Du07	J	1974	β^+=100	
^{193}Pb^n	−19450#	90#	2742#	80#			180	ns	15	$33/2^+$	06	04Io01	J	1991	IT=100	*
^{193}Bi	−15873	10					63.6	s	3.0	$(9/2^-)$	06			1971	β^+ ?; α=3.5 15	*
^{193}Bi^m	−15564	12	308	7	AD		3.2	s	0.5	$(1/2^+)$	06			1970	α=84 16; β^+ ?	
^{193}Bi^n	−15268	10	605.5	0.5			153	ns	10	$(13/2^+)$	06			2004	IT=100	
^{193}Bi^p	−13690#	50#	2180#	50#			> 10	μs			06	04Ni06	ET	2004	IT=100	*
^{193}Bi^q	−13470#	50#	2400#	50#			3.0	μs	0.1	$(29/2^-)$	06			2004	IT=100	*
^{193}Po	−8360	30					370	ms	40	$(3/2^-)$	06			1967	α=?; β^+=5#	*
^{193}Po^m	−8260#	50#	100#	30#			245	ms	22	$(13/2^+)$	06	GAu	J	1981	α=?; β^+=3#	
^{193}At	−68	22				*	29	ms	5	$1/2^+\#$	06			2003	α≈100	*
^{193}At^m	−59	21	8	9	AD	*	21	ms	5	$7/2^-\#$	06			1995	α≈100	
^{193}At^n	−26	21	42	9	AD		28	ms	4	$13/2^+\#$	06			2003	α=24 10; IT=76 10	*
^{193}Rn	9043	25					1.15	ms	0.27	$3/2^-\#$	07	06An36	TD	2006	α≈100	

*^{193}Re^m E : a γ of 11St21=145.2(0.5) 09Al30=146.1(0.2) keV is observed in decay **
*^{193}Re^m T : average 11St21=65(9) 09Al30=72(8); also 05Ca02=75(+450–40) μs **
*^{193}Os T : other 92An13=30.11(0.01); large syst. unc due to large dead-time effect **
*^{193}Os I : also an isomer with T=132(29) decaying via a 242 keV γ-ray **
*^{193}Tl^m E : less than 13 keV above 365.2 level, from ENSDF **
*^{193}Pb J : from α decay from ^{197}Po **
*^{193}Pb T : T=4.0 m reported in Karlsruhe charts 1981 and 1995. Not traceable **
*^{193}Pb^n E : 2612.5(0.5) above ^{193}Pb^m **
*^{193}Bi D : α=3.5 15 is from ENSDF'98, wrongly attributed in ENSDF'2006 to NUBASE **
*^{193}Bi^p E : ENSDF'06 2127.9 + x **
*^{193}Bi^q E : ENSDF'06 2357 + x **
*^{193}Po T : symmetrized from 370(+46–40) J : α decay to ^{189}Pb **
*^{193}At T : symmetrized from 28(+5–4) **
*^{193}At^n T : symmetrized from 27(+4–3) **

^{194}Ta									(>300 ns)			12Ku26	I	2012	β^- ?	
^{194}W	−24530#	300#					1#	s	(>300 ns)		11			2008	β^- ?	
^{194}Re	−27240#	200#					1.0	s	0.5		11			1999	β^-=100	*
^{194}Re^m	−26960#	200#	285	40			25	s	8			12Re.A	E	2012	β^-=100	*
^{194}Re^n	−26410#	200#	833	33			100	s	10			12Re.A	E	2012	β^-=100	
^{194}Re^p	−26140#	200#	1100#	1000#			45	μs	18			11St21	TD	2011	IT=100	*
^{194}Re^q	−25240#	200#	2000#	1000#			38	μs	37		11			2005	IT=?	*
^{194}Os	−32437.2	2.8					6.0	y	0.2	0^+	06			1951	β^-=100	
^{194}Ir	−32533.8	1.9					19.28	h	0.13	1^-	06			1937	β^-=100	
^{194}Ir^m	−32386.7	1.9	147.072	0.002			31.85	ms	0.24	4^+	06			1959	IT=100	
^{194}Ir^n	−32160	70	370	70	BD		171	d	11	$(10,11)^{(-\#)}$	06			1968	β^-=100	
^{194}Pt	−34762.6	0.9					STABLE			0^+	06			1935	IS=32.86 40	
^{194}Au	−32213.2	2.1					38.02	h	0.10	1^-	06			1948	β^+=100	
^{194}Au^m	−32105.8	2.2	107.4	0.5			600	ms	8	(5^+)	06			1975	IT=100	
^{194}Au^n	−31737.4	2.2	475.8	0.6			420	ms	10	(11^-)	06			1953	IT=100	
^{194}Hg	−32183.9	2.9					440	y	80	0^+	06			1962	ε=100	
^{194}Tl	−26937	14					33.0	m	0.5	2^-	06			1960	β^+=100; α<1e–7	
^{194}Tl^m	−26677	4	260	14	MD		32.8	m	0.2	(7^+)	06			1960	β^+=100	
^{194}Pb	−24207	17					10.7	m	0.6	0^+	06			1960	β^+=100; α=7.3e–6 29	
^{194}Pb^m	−21579	17	2628.1	0.4			370	ns	13	12^+	06	FGK128	J	1972	IT=100	*
^{194}Pb^n	−21274	17	2933.0	0.4			133	ns	7	11^-	06			1986	IT=100	*
^{194}Bi	−16040#	50#				*	95	s	3	(3^+)	06			1971	β^+≈100; α=0.46 25	
^{194}Bi^m	−15880	50	160#	70#	MD	*	125	s	2	$(6^+,7^+)$	06			1976	β^+≈100; α ?	
^{194}Bi^n	−15849	8	190#	50#	AD		115	s	4	(10^-)	06			1988	β^+≈100; α=0.20 7	
^{194}Po	−11005	13					392	ms	4	0^+	06			1967	α≈100; β^+ ?	
^{194}Po^m	−8480	13	2525.2	0.8			15	μs	2	(11^-)	06			1999	IT=100	
^{194}At	−712	27					253	ms	10	$(4^-,5^-)$	06	09An11	T	2009	α≈100; β^+ ?	*
^{194}At^m	−710	30	0	40	AD		310	ms	8	$(9^-,10^-)$	06	09An11	T	1984	α≈100; IT ?	*
^{194}Rn	5723	17					780	μs	160	0^+	07			2006	α≈100; β^+ ?	

*^{194}Re T : also 12Al05=5(1) **
*^{194}Re^m T : from 12Al05 two exc. isomers with 25(8) s 100(10) s; could be exchanged **
*^{194}Re^p D : only 86.3 keV γ is seen, but not those seen in ^{194}Re^q **
*^{194}Re^q I : decaying by delayed γ-rays of 464, 148, 128 **
*^{194}Pb^m J : E2 to 10^+; magnetic moment **
*^{194}Pb^n J : E2 to 9^-; magnetic moment **
*^{194}At J : favored α-decay to (5^-) isomer in ^{190}Bi **
*^{194}At^m J : favored α-decay to (10^-) isomer in ^{190}Bi **

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{195}W									(>300 ns)			12Ku26	I	2012	β^- ?	
^{195}Re	−25580#	300#					6	s	1	$5/2^+$#	11			2008	β^-=100	
^{195}Os	−29510	60					9#	m	(>300 ns)	$3/2^-$#	07	09St16	I	2004	β^- ?	*
^{195}Os^m	−29060	60	454	10			2	h	1.7	$13/2^+$#		12Re.A	ETD	2012	β^-=?; IT=?	*
^{195}Ir	−31694.3	1.9					2.5	h	0.2	$(3/2^+)$	07			1952	β^-=100	
^{195}Ir^m	−31594	5	100	5			3.8	h	0.2	$(11/2^-)$	07			1968	β^-=95 5; IT=5 5	
^{195}Ir^n	−29340	6	2354	6			4.4	μs	0.6	$(27/2^+)$		11St21	ETJ	2011	IT=100	*
^{195}Pt	−32796.3	0.9					STABLE			$1/2^-$	07			1935	IS=33.78 24	
^{195}Pt^m	−32537.0	0.9	259.30	0.08			4.010	d	0.005	$13/2^+$	07			1960	IT=100	
^{195}Au	−32569.5	1.4					186.10	d	0.05	$3/2^+$	07			1948	ε=100	
^{195}Au^m	−32250.9	1.4	318.58	0.04			30.5	s	0.2	$11/2^-$	07			1952	IT=100	
^{195}Hg	−31000	23					10.53	h	0.03	$1/2^-$	07			1952	β^+=100	
^{195}Hg^m	−30824	23	176.07	0.04			41.6	h	0.8	$13/2^+$	07			1951	IT=54.2 20; β^+=45.8 20	
^{195}Tl	−28155	11					1.16	h	0.05	$1/2^+$	07			1955	β^+=100	
^{195}Tl^m	−27672	11	482.63	0.17			3.6	s	0.4	$9/2^-$	07			1957	IT=100	
^{195}Pb	−23713	23					15	m		$3/2^-$#	07			1957	β^+ ?; α ?	
^{195}Pb^m	−23510	23	202.9	0.7			15.0	m	1.2	$13/2^{(+)}$	07	91Gr12	E	1957	IT=100	*
^{195}Pb^n	−21954	23	1759.0	0.7			10.0	μs	0.7	$(21/2^-)$	07			1976	IT=100	
^{195}Bi	−18026	5					183	s	4	$(9/2^-)$	07	GAu	J	1971	$\beta^+\approx$100; α=0.03 2	
^{195}Bi^m	−17626	8	399	6	AD		87	s	1	$(1/2^+)$	07	GAu	J	1974	β^+=67 17; α=33 17	*
^{195}Bi^n	−15670	50	2360	50			750	ns	50	$29/2^-$#	07			2003	IT ?	*
^{195}Po	−11060	40					4.64	s	0.09	$(3/2^-)$	07	05Uu02	J	1967	α=94 4; β^+=6 4	*
^{195}Po^m	−10965	28	100	50	AD		1.92	s	0.02	$(13/2^+)$	07	05Uu02	J	1967	$\alpha\approx$90; $\beta^+\approx$10; IT<0.01	
^{195}At	−3476	9					328	ms	20	$1/2^+$	07			1999	$\alpha\approx$100; β^+ ?	
^{195}At^m	−3442	8	34	7	AD		147	ms	5	$7/2^-$	07			1995	α=?; β^+<25#	
^{195}Rn	5050	50				*	7	ms	3	$(3/2^-)$	07			2001	$\alpha\approx$100	*
^{195}Rn^m	5131	17	80	50	AD	*	6	ms	3	$(13/2^+)$	07			2001	$\alpha\approx$100	*

*^{195}Os I : identification in 57Ba08 with T=6.5 m has been questioned, see ENSDF'07 **
*^{195}Os^m T : symmetrized from 32(+154–16) m for q=76$^+$ (bare ion) **
*^{195}Ir^n E : 268.4, 404.4, 476.4, 537.8, 566.7 γs in cascade to ^{195}Ir^m **
*^{195}Pb^m J : same as ^{199}Po^m and ^{203}Rn^m, from α-decay **
*^{195}Bi^m J : spins of ground-state and of isomer derived from α-decay **
*^{195}Bi^n E : x keV above 2311.4 level; x=50#50 estimated by NUBASE **
*^{195}Po D : from 10Co13 **
*^{195}Rn T : symmetrized from 6(+3–2) **
*^{195}Rn^m T : symmetrized from 5(+3–2) **

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{196}W									(>300 ns)	0^+		12Ku26	I	2012	β^- ?	
^{196}Re	−22540#	300#					2.4	s	15			11Be.A	T	2008	β^- ?	*
^{196}Re^m	−22420#	300#	120#	40#			3.6	μs	0.6			11St21	T	2009	IT=100	*
^{196}Os	−28280	40					34.9	m	0.2	0^+	07			1977	β^-=100	
^{196}Ir	−29440	40					52	s	1	(0^-)	07			1966	β^-=100	
^{196}Ir^m	−29229	20	210	40	BD		1.40	h	0.02	$(10,11^-)$	07			1959	$\beta^-\approx$100; IT<0.3	
^{196}Pt	−32646.9	0.9					STABLE			0^+	07			1935	IS=25.21 34	
^{196}Au	−31139.9	3.0					6.1669	d	0.0006	2^-	07			1937	β^+=92.8 8; β^-=7.2 8	
^{196}Au^m	−31055	3	84.656	0.020			8.1	s	0.2	(5^+)	07			1971	IT=100	
^{196}Au^n	−30544	3	595.66	0.04			9.6	h	0.1	12^-	07			1960	IT=100	
^{196}Hg	−31826.8	3.0					STABLE		(>2.5 Ey)	0^+	07	90Bu28	T	1930	IS=0.15 1; 2β^+ ?	
^{196}Tl	−27497	12					1.84	h	0.03	2^-	07			1955	β^+=100	
^{196}Tl^m	−27103	12	394.2	0.5			1.41	h	0.02	(7^+)	07			1960	β^+=96.2 4; IT=3.8 4	
^{196}Pb	−25361	14					37	m	3	0^+	07			1957	β^+=100; α<3e–5	
^{196}Pb^m	−23623	14	1738.27	0.12			< 1	μs		4^+	07			1973	IT=100	
^{196}Pb^n	−23563	14	1797.51	0.14			140	ns	14	5^-	07			1973	IT=100	
^{196}Pb^p	−22666	14	2694.6	0.3			270	ns	4	12^+	07			1973	IT=100	
^{196}Bi	−18009	24					5.1	m	0.2	(3^+)	07			1976	$\beta^+\approx$100; α=0.00115 34	
^{196}Bi^m	−17843	25	166.4	2.9	AD		0.6	s	0.5	(7^+)	07			1987	IT=?; β^+ ?	
^{196}Bi^n	−17738	25	272	3	AD		4.00	m	0.05	(10^-)	07			1987	β^+=74.2 25; IT=25.8 25; …	*
^{196}Po	−13483	13					5.56	s	0.09	0^+	07	05Uu02	T	1967	$\alpha\approx$98; $\beta^+\approx$2	*
^{196}Po^m	−10989	13	2493.9	0.4			856	ns	17	11^-	07			1995	IT=100	
^{196}At	−3910	30				*	388	ms	7	(3^+)	07			1967	α=?; β^+=5#	*
^{196}At^m	−3950	18	−40	40	AD	*	20#	ms		(10^-)		96En01	D	1996	$\alpha\approx$100	*
^{196}At^n	−3750	30	157.9	0.1			11	μs	2	(5^+)	07			2000	IT=100	
^{196}Rn	1971	14					4.7	ms	1.1	0^+	07			1995	$\alpha\approx$100; β^+=0.06#	*

*^{196}Re T : symmetrized from 11Be.A=3(+1–2) **
*^{196}Re^m D : only Kx-rays observed; E>72 keV (K-shell binding energy) **
*^{196}Bi^n D : …; α=0.00038 10 **
*^{196}Po T : average 05Uu02=5.1(+3.1–1.4) 97Pu01=5.5(0.1) 93Wa04=5.8(0.2) **
*^{196}Po T : other not used : 10He25=4.1(+5.6–1.5) ms **
*^{196}At J : same as ^{192}Bi, from α-decay **
*^{196}At^m I : level not accepted in ENSDF **
*^{196}Rn T : symmetrized from 4.4(+1.3–0.9) **

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^{π}	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{197}W									(>300 ns)			12Ku26	I	2012	β^- ?	
^{197}Re	−20500#	300#					300#	ms	(>300 ns)	$5/2^+$#		09St16	I	2009	β^- ?	
^{197}Os	−25310#	200#					2.8	m	0.6	$5/2^-$#	09			2003	β^-=100	
^{197}Ir	−28266	20					5.8	m	0.5	$(3/2^+)$	05			1952	β^-=100	
^{197}Ir^m	−28151	21	115	5			8.9	m	0.3	$(11/2^-)$	05			1976	$\beta^-\approx$100; IT=0.25 10	
^{197}Ir^n	−27870#	200#	400#	200#			30	μs	8			05Ca02	T	2005	IT=100	
^{197}Pt	−30422.0	0.9					19.8915	h	0.0019	$1/2^-$	05			1936	β^-=100	
^{197}Pt^m	−30022.4	0.9	399.59	0.20			95.41	m	0.18	$13/2^+$	05			1941	IT=96.7 4; β^-=3.3 4	
^{197}Au	−31141.0	0.7					STABLE			$3/2^+$	05			1935	IS=100.	
^{197}Au^m	−30731.9	0.7	409.15	0.08			7.73	s	0.06	$11/2^-$	05			1945	IT=100	
^{197}Au^n	−28608.5	1.2	2532.5	1.0			150	ns	5	$27/2^+$#		06Wh02	ETJ	2006	IT=100	
^{197}Hg	−30541	3					64.94	h	0.07	$1/2^-$	05	01Li17	T	1941	ε=100	∗
^{197}Hg^m	−30242	3	298.93	0.08			23.8	h	0.1	$13/2^+$	05			1943	IT=91.4 7; ε=8.6 7	
^{197}Tl	−28340	16					2.84	h	0.04	$1/2^+$	05			1955	β^+=100	
^{197}Tl^m	−27732	16	608.22	0.08			540	ms	10	$9/2^-$	05	12Bi.A	J	1953	IT=100	
^{197}Pb	−24749	6					8.1	m	1.7	$3/2^-$	05			1955	β^+=100	
^{197}Pb^m	−24429	6	319.31	0.11			42.9	m	0.9	$13/2^+$	05			1957	β^+=81 2; IT=19 2	
^{197}Pb^n	−22835	6	1914.10	0.25			1.15	μs	0.20	$21/2^-$	05			1978	IT=100	
^{197}Bi	−19687	8					9.33	m	0.50	$(9/2^-)$	05			1971	β^+=100; α=1e–4#	∗
^{197}Bi^m	−19155	8	532	12	AD		5.04	m	0.16	$(1/2^+)$	05			1966	α=55 40; β^+=45 40; …	∗
^{197}Bi^n	−17284	14	2403	12			263	ns	13	$(29/2^-)$	05	86Ch01	TJD	1986	IT=100	∗
^{197}Bi^p	−16758	8	2929.5	0.5			209	ns	30	$(31/2^-)$	05	86Ch01	TJD	1986	IT=100	
^{197}Po	−13360	50					53.6	s	0.9	$(3/2^-)$	05	93Wa04	T	1965	β^+ ?; α=44 7	∗
^{197}Po^m	−13130#	90#	230#	80#			25.8	s	0.1	$(13/2^+)$	05	93Wa04	T	1967	α=84 9; β^+ ?; IT=0.01#	∗
^{197}At	−6340	50				∗	388.2	ms	5.6	$(9/2^-)$	05	05De01	T	1967	α=96.1 12; β^+=3.9 12	∗
^{197}At^m	−6293	13	50	50	AD	∗	2.0	s	0.2	$(1/2^+)$	05			1985	$\alpha\approx$100; β^+ ?; IT<0.004; β^+ ?	
^{197}At^n	−6030	50	310.7	0.2			1.3	μs	0.2	$(13/2^+)$		08An11	ETJ	1999	IT=100	∗
^{197}Rn	1480	40					54	ms	6	$(3/2^-)$	05	08An05	T	1995	$\alpha\approx$100; β^+ ?	∗
^{197}Rn^m	1670#	50#	200#	30#			25.6	ms	2.5	$(13/2^+)$	05	08An05	T	1996	$\alpha\approx$100; β^+ ?	∗

∗^{197}Hg T : 66El09=64.14(0.05) strongly conflicting: Birge ratio would be B=9.3 ∗∗
∗^{197}Bi I : ENSDF'05 reported an isomer at 2129.3(0.4) keV, 204(18) ns, $(23/2^-)$, ∗∗
∗^{197}Bi I : not trusted by NUBASE, see fig.3 in 86Ch01 ∗∗
∗^{197}Bi^m D : … ; IT<0.3 J : α-decay to ^{193}Tl ground-state ∗∗
∗^{197}Bi^n T : more recent 95Zh36=252.6(38.7) outweighed, not used ∗∗
∗^{197}Bi^n E : 95Zh36=2383.1 + x, with x<40 keV; 86Ch01=2360.4 + x is the same level ∗∗
∗^{197}Bi^n E : but authors mis-assigned the 97 keV γ-ray, see Fig.1 of 95Zh36 ∗∗
∗^{197}Po T : average 93Wa04=53(1) 71Ho01=60(6) 67Le21=58(3) 67Si09=52(4); other not ∗∗
∗^{197}Po T : used 96Ta18=84(16) ∗∗
∗^{197}Po^m T : others not used 71Ho01=27(3) 67Le21=29(9) 67Si09=26(2); ∗∗
∗^{197}Po^m T : also 10He25=14.45(+14.45–4.9) ms for 3 events, strongly conflicting ∗∗
∗^{197}At T : average 05De01=390(16) 99Sm07=388(6) ∗∗
∗^{197}At^n T : other 99Sm07=5.5(1.4) ∗∗
∗^{197}Rn T : symmetrized from 08An05=53(+7–5) J : from α decay to ^{193}Po ∗∗
∗^{197}Rn^m T : symmetrized from 08An05=25(+3–2) J : from α decay to ^{193}Po^m ∗∗
∗^{197}Rn^m T : others 05Uu02=30(+150–15) 96En02=19(+8–4) 95Mo14=18(+9–5) ∗∗

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^{π}	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{198}Re	−17140#	400#					300#	ms	(>300 ns)			09St16	I	2009	β^- ?; β^-n ?	∗
^{198}Os	−23840#	200#					1#	m	(>300 ns)	0^+	10	09Po02	I	2008	β^- ?	
^{198}Ir	−25820#	200#					8	s	1		09			1973	β^-=100	∗
^{198}Pt	−29905.7	2.2					STABLE		(>320 Ty)	0^+	09	52Fr23	T	1935	IS=7.36 13; 2β^- ?; α ?	∗
^{198}Au	−29582.0	0.7					2.6948	d	0.0012	2^-	09	11Ch22	T 4	1937	-=100	∗
^{198}Au^m	−29269.8	0.7	312.2200	0.0020			124	ns	4	5^+	09			1968	IT=100	
^{198}Au^n	−28770.3	1.7	811.7	1.5			2.272	d	0.016	12^-	09	FGK128	J	1972	IT=100	∗
^{198}Hg	−30954.8	0.5					STABLE			0^+	10			1925	IS=9.97 20	
^{198}Tl	−27490	80					5.3	h	0.5	2^-	09			1949	β^+=100	
^{198}Tl^m	−26950	80	543.6	0.4			1.87	h	0.03	7^+	09			1949	β^+=55.9 23; IT=44.1 23	
^{198}Tl^n	−26800	80	687.2	0.5			150	ns	40	(5^+)	09			1977	IT=100	
^{198}Tl^p	−26750	80	742.4	0.4			32.1	ms	1.0	10^-	09	FGK128	J	1975	IT=100	∗
^{198}Pb	−26050	15					2.4	h	0.1	0^+	09			1955	β^+=100	
^{198}Pb^m	−23909	15	2141.4	0.4			4.19	μs	0.10	7^-	09	FGK128	J	1972	IT=100	∗
^{198}Pb^n	−23819	15	2231.4	0.5			137	ns	10	9^-	09	FGK128	J	1989	IT=100	∗
^{198}Pb^p	−23230	15	2820.5	0.7			212	ns	4	12^+	09	FGK128	J	1973	IT=100	∗

… *A*-group is continued on next page …

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^{π}	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
… *A*-group continued …															
^{198}Bi	−19369	28				10.3	m	0.3	$(2^+,3^+)$	09			1950	β^+=100	
^{198}Bi^m	−19085	28	280	40	MD	11.6	m	0.3	(7^+)	09			1992	β^+=100	
^{198}Bi^n	−18837	28	530	40	MD	7.7	s	0.5	(10^-)	09	FGK128	J	1972	IT=100	∗
^{198}Po	−15473	17				1.77	m	0.03	0^+	09			1965	α=57 2; β^+=43 2	
^{198}Po^m	−12907	17	2565.92	0.20		200	ns	20	11^-	09			1990	IT=100	
^{198}Po^n	−12730	50	2740	50		750	ns	50	12^+	09			1990	IT ?	
^{198}At	−6720#	50#				4.21	s	0.22	(3^+)	09	95Bi.A	D	1967	α>94; β^+ ?	∗
^{198}At^m	−6429	8	290#	50#	AD	1.09	s	0.11	(10^-)	09	95Bi.A	D	1967	α>86; β^+ ?	∗
^{198}Rn	−1230	13				65	ms	3	0^+	09			1984	α=?; β^+=1#	
^{198}Rn^m			non existent		EU	50	ms	9						α=?; β^+=?; IT=?	∗

∗^{198}Re I : other 12Ku26>300 ns ∗∗

∗^{198}Ir T : other 11Be.A=8(2) ∗∗

∗^{198}Pt T : lower limit is for 0ν-$\beta\beta$ decay ∗∗

∗^{198}Au T : several conflicting values, evaluated in 11Ch22 ∗∗

∗^{198}Au^n J : M4 to 8^+; magnetic moment ∗∗

∗^{198}Tl^p J : E3 to 7^+ ∗∗

∗^{198}Pb^m J : E2 to 5^-; magnetic moment ∗∗

∗^{198}Pb^n J : E2 to 7^- ∗∗

∗^{198}Pb^p J : E2 to 10^+; magnetic moment ∗∗

∗^{198}Bi^n E : 248.5(0.5) keV above ^{198}Bi^m, from 92Hu04 J : E3 to (7^+) ∗∗

∗^{198}At T : average 05Uu02=3.8(0.4) 92Hu04=4.2(0.3) 67Tr06=4.9(0.5) ∗∗

∗^{198}At T : other recen not used 12Fo09=4.2(2.0) ∗∗

∗^{198}At^m T : average 05Uu02=1.04(0.15) 92Hu04=1.0(0.2) 67Tr06=1.5(0.3) ∗∗

∗^{198}Rn^m I : α decay assigned to isomer in ENSDF'95, not accepted by NUBASE ∗∗

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^{π}	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{199}Re						(>300 ns)					12Ku26	I	2012	β^- ?	
^{199}Os	−20480#	200#				6	s	3	$5/2^-$#	07	11Be.A	T	2008	β^-=100	∗
^{199}Ir	−24400	40				7	s	5	$3/2^+$#	07	11Be.A	T	1993	β^- ?	∗
^{199}Ir^m	−24270#	60#	130#	40#		235	ns	90	$11/2^-$#	07			2005	IT=100	∗
^{199}Pt	−27390.4	2.2				30.80	m	0.21	$5/2^-$	07			1937	β^-=100	
^{199}Pt^m	−26966.4	3.0	424	2		13.6	s	0.4	$(13/2)^+$	07			1959	IT=100	
^{199}Au	−29095.0	0.7				3.139	d	0.007	$3/2^+$	07			1937	β^-=100	
^{199}Au^m	−28546.1	0.7	548.9405	0.0021		440	μs	30	$(11/2)^-$	07			1968	IT=100	
^{199}Hg	−29546.4	0.4				STABLE			$1/2^-$	07			1925	IS=16.87 22	
^{199}Hg^m	−29013.9	0.4	532.48	0.10		42.67	m	0.09	$13/2^+$	07			1948	IT=100	
^{199}Tl	−28059	28				7.42	h	0.08	$1/2^+$	07			1949	β^+=100	
^{199}Tl^m	−27310	28	748.87	0.06		28.4	ms	0.2	$9/2^-$	07			1963	IT=100	
^{199}Pb	−25232	10				90	m	10	$3/2^-$	07			1950	β^+=100	
^{199}Pb^m	−24803	10	429.5	2.7		12.2	m	0.3	$(13/2^+)$	07			1955	IT=93; β^+=7	∗
^{199}Pb^n	−22668	10	2563.8	2.7		10.1	μs	0.2	$(29/2^-)$	07			1981	IT=100	∗
^{199}Bi	−20797	11				27	m	1	$9/2^-$	07			1950	β^+=100	
^{199}Bi^m	−20131	11	667	3		24.70	m	0.15	$(1/2^+)$	07			1950	β^+=?; IT<2; $\alpha\approx$0.01	
^{199}Bi^n	−18850	18	1947	14		100	ns	30	$25/2^+$#	07			1974	IT=100	∗
^{199}Bi^p	−18249	18	2548	14		168	ns	13	$29/2^-$#	07			1985	IT=100	∗
^{199}Po	−15214	23				5.47	m	0.15	$3/2^-$#	07			1965	β^+=92.5 3; α=7.5 3	∗
^{199}Po^m	−14904	23	309.9	2.6	AD	4.17	m	0.05	$13/2^{(+)}$	07			1964	β^+=73.5 10; α=24 1; IT=2.5 10	∗
^{199}At	−8823	5				7.02	s	0.12	$(9/2^-)$	07	05De01	T	1967	α=89 6; β^+ ?	∗
^{199}At^m	−8250	5	572.9	0.1		70	ns	20	$(13/2^+)$	07	10Ja05	ETJ	2000	IT=100	
^{199}At^n	−6530	5	2293.4	0.5		800	ns	50	$(29/2^+)$		10Ja05	ETJ	2010	IT=100	
^{199}Rn	−1500	60				590	ms	30	$(3/2^-)$	07	05Uu02	J	1980	α=?; β^+=6#	
^{199}Rn^m	−1335	29	160	70	AD	310	ms	20	$(13/2^+)$	07	05Uu02	J	1981	α=?; β^+=3#	
^{199}Fr	6760	40				16	ms	7	$1/2^+$#	07			1999	$\alpha\approx$100; β^+ ?	∗

∗^{199}Os T : symmetrized from 11Be.A=5(+4–2) ∗∗

∗^{199}Ir T : symmetrized from 11Be.A=6(+5–4) ∗∗

∗^{199}Ir^m T : range 80-390 ns ∗∗

∗^{199}Pb^m E : 424.8(0.2) + x; x < 9.3 keV D : from 78Le.A ∗∗

∗^{199}Pb^n E : 2559.1(0.4) + x; x < 9.3 keV ∗∗

∗^{199}Bi^n E : 1922.3 + x ; x<50 in ENSDF'07 ∗∗

∗^{199}Bi^p E : 2523.2 + x ; x<50 in ENSDF'07 ∗∗

∗^{199}Po J : not yet known, will be same as ^{195}Pb, from α-decay ∗∗

∗^{199}Po^m J : same as ^{203}Rn^m, from α-decay ∗∗

∗^{199}At T : average 12Fo09=6.7(0.5) 05De01=6.92(0.13) 05Uu02=7.8(0.4) 67Tr06=7.2(0.5) ∗∗

∗^{199}At D : symmetrized from α=92(+3–8)% ∗∗

∗^{199}Fr T : symmetrized from 12(+10–4) J : same as ^{195}At ∗∗

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^{π}	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{200}Os	−18780#	300#					7	s	4	0^+	08	11Be.A	T	2005	β^-=100	*
^{200}Ir	−21610#	200#					44	s	6		11	11Be.A	T	2008	β^-=100	*
^{200}Pt	−26601	20					12.6	h	0.3	0^+	07			1957	β^-=100	
^{200}Au	−27240	27					48.4	m	0.3	$1^{(-)}$	07			1951	β^-=100	
^{200}Au^{m}	−26233	26	1010	40	BD		18.7	h	0.5	12^-	07			1968	β^-=82 2; IT=18 2	
^{200}Hg	−29503.6	0.4					STABLE			0^+	07			1925	IS=23.10 19	
^{200}Tl	−27048	6					26.1	h	0.1	2^-	07			1949	β^+=100	
^{200}Tl^{m}	−26294	6	753.6	0.24			34.0	ms	0.9	7^+	07			1963	IT=100	
^{200}Tl^{n}	−26286	6	762.00	0.24			330	ns	50	5^+	07			1972	IT=100	
^{200}Pb	−26251	11					21.5	h	0.4	0^+	07			1950	ε=100	
^{200}Pb^{m}	−24068	11	2183.3	1.1			448	ns	12	(9^-)	07			1972	IT=100	
^{200}Pb^{n}	−23245	11	3005.8	1.2			199	ns	3	(12^+)	07			1975	IT=100	
^{200}Bi	−20371	22				*	36.4	m	0.5	7^+	07			1950	β^+=100	
^{200}Bi^{m}	−20270#	70#	100#	70#		*	31	m	2	(2^+)	07			1978	β^+<100; IT ?	
^{200}Bi^{n}	−19943	22	428.20	0.10			400	ms	50	(10^-)	07			1972	IT=100	
^{200}Po	−16954	14					11.51	m	0.08	0^+	07			1951	β^+=88.9 3; α=11.1 3	
^{200}Po^{m}	−14358	14	2596.1	0.3			100	ns	10	11^-	07			1985	IT=100	*
^{200}Po^{n}	−14137	16	2817	8			268	ns	3	12^+	07			1985	IT=100	*
^{200}At	−8988	24					43.2	s	0.9	(3^+)	07	96Ta18	T	1963	α=52 3; β^+=48 3	*
^{200}At^{m}	−8875	25	112.9	2.9	AD		47	s	1	(7^+)	07			1967	α=43 7; β^+=?; IT ?	
^{200}At^{n}	−8644	25	343.8	3.0	AD		8.0	s	2.1	(10^-)	07			1967	IT<89.5 3; $\alpha\approx$10.5 3; β^+ ?	*
^{200}Rn	−4014	13					1.09	s	0.16	0^+	07			1971	α=92 8; β^+ ?	*
^{200}Rn^{m}	−1694	24	2320	20			28	μs	9		07			2002	IT=100	*
^{200}Fr	6130	60				*	49	ms	4	(3^+)	07			1995	α=100	
^{200}Fr^{m}	6180	50	40	80	AD	*	190	ms	120	10^-#		96En01	TD	1996	$\alpha\approx$100; IT ?	*

*^{200}Os T : symmetrized from 11Be.A=6(+4–3); other 05Ku.A=4.6(1.3) same group **
*^{200}Ir T : symmetrized from 11Be.A=43(+6–5) **
*^{200}Po^{n} E : Ex<25 keV above 2804.5(0.6) level **
*^{200}At T : average 96Ta18=44(2) 92Hu04=43(1) **
*^{200}At^{n} E : 230.9(0.2) keV above ^{200}At^{m}, from ENSDF **
*^{200}At^{n} T : symmetrized from 7.3(+2.6–1.5) **
*^{200}Rn T : symmetrized from 1.03(+0.20–0.11) D : symmetrized from 86(+14–4)% **
*^{200}Rn^{m} E : Estimated 20#(20#) keV above 2300.5(0.5) level **
*^{200}Rn^{m} T : symmetrized from 25(+11–6) **
*^{200}Fr^{m} I : two events with 100 ms and $E(a)$=7550 correlated with $E(a)$=6880 **
*^{200}Fr^{m} I : assigned by evaluators to ^{200}Fr^{m} and ^{196}At^{m} **
*^{200}Fr^{m} I : existence under discussion, level not accepted in ENSDF **
*^{200}Fr^{m} T : symmetrized from 100(+180–40) (2 evts with half-life=100ms), see 84Sc13 **

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^{π}	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{201}Os	−15240#	300#					1#	s	(>300 ns)	$1/2^-$#		09St16	I	2009	β^- ?	
^{201}Ir	−19900#	200#					21	s	5	$3/2^+$#	11	11Be.A	T	2008	β^-=100	
^{201}Pt	−23740	50					2.5	m	0.1	$(5/2^-)$	07			1962	β^-=100	
^{201}Au	−26401	3					26.0	m	0.8	$3/2^+$	07			1952	β^-=100	
^{201}Au^{m}	−25807	6	594	5			730	μs	630	$(11/2^-)$	07	11St21	ETJ	1981	IT=100	*
^{201}Au^{n}	−24791	6	1610	5			5.6	μs	2.4			11St21	ETD	2011	IT=100	*
^{201}Hg	−27662.7	0.6					STABLE			$3/2^-$	07			1925	IS=13.18 9	
^{201}Hg^{m}	−26896.5	0.6	766.22	0.15			94.0	μs	2.0	$13/2^+$	07			1961	IT=100	
^{201}Tl	−27179	14					3.0421	d	0.0017	$1/2^+$	07			1950	ε=100	
^{201}Tl^{m}	−26260	14	919.16	0.21			2.01	ms	0.07	$(9/2^-)$	07			1962	IT=100	
^{201}Pb	−25259	22					9.33	h	0.03	$5/2^-$	07			1950	β^+=100	
^{201}Pb^{m}	−24630	22	629.1	0.3			60.8	s	1.8	$13/2^+$	07			1952	IT$\approx$100; β^+ ?	
^{201}Pb^{n}	−22321	30	2938	20			508	ns	3	$(29/2^-)$	07			1981	IT=100	*
^{201}Bi	−21415	15					103	m	3	$9/2^-$	07			1950	β^+=100	
^{201}Bi^{m}	−20569	15	846.35	0.18			57.5	m	2.1	$1/2^+$	07			1950	β^+>91.1#; IT<8.6; α=?	*
^{201}Bi^{n}	−19442	27	1973	23			118	ns	28	$25/2^+$#	07			1982	IT=100	*
^{201}Bi^{p}	−19403	27	2012	23			105	ns	75	$27/2^+$#	07			1985	IT=100	*
^{201}Bi^{q}	−18634	27	2781	23			124	ns	4	$29/2^-$#	07			1982	IT=100	
^{201}Po	−16525	6					15.6	m	0.1	$3/2^-$	07			1951	β^+=98.87 3; α=1.13 3	
^{201}Po^{m}	−16101	6	424.1	2.4	AD		8.96	m	0.12	$13/2^+$	07			1962	IT=56.2 12; β^+=41.4 7; α=2.4 5	
^{201}At	−10789	8					85.2	s	1.6	$(9/2^-)$	07			1963	α=71 7; β^+=29 7	
^{201}Rn	−4070	50					7.0	s	0.4	$(3/2^-)$	07			1967	α=?; β^+=49#	
^{201}Rn^{m}	−3790#	90#	280#	80#			3.8	s	0.1	$(13/2^+)$	07			1967	β^+=66#; α=?	*
^{201}Fr	3600	70					62	ms	5	$(9/2^-)$	07			1980	α=100	
^{201}Fr^{m}	3740	50	140	90	AD		27	ms	13	$(1/2^+)$	07			2005	α=100	*
^{201}Ra	11840#	110#					1#	ms		$3/2^-$#				2005	α ?	
^{201}Ra^{m}	12170#	70#	320#	120#			6	ms	5	$(13/2^+)$	07			2005	α=100	*

*^{201}Au^{m} T : symmetrized from 340(+900–290) μs **
*^{201}Au^{n} E : 378.2, 638 γs above ^{201}Au^{m} **
*^{201}Pb^{n} E : estimated 20#(20#) keV above 2917.6(0.9) level **
*^{201}Bi^{m} D : α decay is observed. Its branching ratio is estimated 0.3%# in ENSDF **
*^{201}Bi^{n} E : 1933.3(0.4) + x ; x<80 **
*^{201}Bi^{p} E : 1972.3(0.4) + x ; x<80 **
*^{201}Bi^{q} E : 2741.0(0.3) + x ; x<80 **
*^{201}Rn^{m} T : other 10He25=3.24(+3.24–1.08) ms **
*^{201}Fr^{m} T : symmetrized from 19(+19–6) **
*^{201}Ra^{m} T : symmetrized from 1.6(+7.7–0.7) **

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{202}Os	−13090#	400#				200#	ms	(>300 ns)	0^+		09St16	I	2009	β^- ?	*
^{202}Ir	−16780#	300#				13	s	2	1^-#	08	11Be.A	T	2008	β^-=100	*
^{202}Ir^m	−14780#	300#	2000#	1000#		3.4	μs	0.6			11St21	TD	2011	IT=100	*
^{202}Pt	−22692	25				44	h	15	0^+	08			1992	β^-=100	
^{202}Pt^m	−20904	25	1788.5	0.4		141	μs	7	(7^-)	08	11St21	T	2005	IT≈100	
^{202}Au	−24353	23				28.4	s	1.2	(1^-)	08			1967	β^-=100	
^{202}Hg	−27345.5	0.6				STABLE			0^+	08			1920	IS=29.86 26	*
^{202}Tl	−25986	14				12.31	d	0.08	2^-	08			1940	ε=100	
^{202}Tl^m	−25036	14	950.19	0.10		591	μs	3	7^+	08			1958	IT=100	
^{202}Pb	−25940	4				52.5	ky	2.8	0^+	08			1954	ε=100	
^{202}Pb^m	−23770	4	2169.85	0.08		3.54	h	0.02	9^-	08			1954	IT=90.5 5; β^+=9.5 5	
^{202}Pb^n	−21800	50	4140	50		110	ns	5	16^+#	08			1986	IT=100	*
^{202}Pb^p	−20640	50	5300	50		107	ns	3	19^-#	08			1987	IT=100	*
^{202}Bi	−20741	15				1.72	h	0.05	$5^{(+\#)}$	08			1951	β^+=100; α<1e–5	*
^{202}Bi^m	−20116	19	625	12		3.04	μs	0.06	10^-#	08			1981	IT=100	*
^{202}Bi^n	−18124	19	2617	12		310	ns	50	(17^+)	08			1981	IT=100	*
^{202}Po	−17924	15				44.6	m	0.4	0^+	08			1951	β^+=?; α=1.92 7	
^{202}Po^m	−16212	19	1712	12		110	ns	15	8^+	08			1971	IT=100	*
^{202}At	−10591	28				184	s	1	$(2^+,3^+)$	08			1961	β^+=?; α=37 7	
^{202}At^m	−10401	28	190	40	MD	182	s	2	(7^+)	08			1992	IT ?; β^+ ?; α=8.7 15	
^{202}At^n	−10010	28	580	40	MD	460	ms	50	(10^-)	08			1992	IT≈100; α=0.096 11; …	*
^{202}Rn	−6274	18				9.7	s	0.1	0^+	08			1967	α=78 8; β^+ ?	
^{202}Rn^m	−3960#	50#	2310#	50#		2.22	μs	0.07	11^-#		02Do19	T	2002	IT=100	
^{202}Fr	3090#	50#				300	ms	50	(3^+)	08			1980	α=?; β^+=14#	
^{202}Fr^m	3381	10	290#	50#	AD	290	ms	50	(10^-)	08			1980	α=?; β^+=14#	
^{202}Ra	9091	24				31	ms	20	0^+	08			2005	α=100	*

$*^{202}$Os I : other 12Ku26>300 ns **
$*^{202}$Ir T : average 11Be.A=11(3) using β^--t and 15(3) using γ-t **
$*^{202}$Ir^m D : 311.5, 655.9, 737.2, 889.2, 967.6 γ rays seen in decay **
$*^{202}$Hg D : lower half-life limit for ^{24}Ne decay T>3.7 Zy, from 90Bu28 **
$*^{202}$Pb^n E : 4091.0(0.7) + x; x estimated 50(50) **
$*^{202}$Pb^p E : 5251.0(0.5) + u; u estimated 50(50) **
$*^{202}$Bi J : re-evaluation to a possible 6^+ is discussed in 96Ca02 **
$*^{202}$Bi^m E : 605 + x with x<40 keV **
$*^{202}$Bi^n E : 2597.07(0.25) + x, with x<40 keV **
$*^{202}$Po^m E : 1691.5(0.4) + x, with x<40 keV **
$*^{202}$At^n D : … ; β^+=0.033# **
$*^{202}$At^n E : 391.7(0.5) keV above ^{202}At^m **
$*^{202}$Ra T : symmetrized from 16(+30–7) **

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{203}Os								(>300 ns)			12Ku26	I	2012	β^- ?	
^{203}Ir	−14690#	400#				1#	s	(>300 ns)	$3/2^+$#		09St16	I	2009	β^- ?	
^{203}Ir^m	−12550#	400#	2140#	50#		798	ns	350	$(23/2^+)$		11St21	TJD	2011	IT=100	*
^{203}Pt	−19630#	200#				22	s	4	$1/2^-$#	06	11Be.A	T	2008	β^-=100#	*
^{203}Pt^m	−16530#	200#	3100#	1000#		641	ns	55	$33/2^+$#		11St21	TJD	2011	IT=100	
^{203}Au	−23143	3				60	s	6	$3/2^+$	05			1952	β^-=100	
^{203}Au^m	−22502	4	641	3		140	μs	44	$11/2^-$#	05	11St21	TJ	2005	IT=100	*
^{203}Hg	−25268.8	1.7				46.594	d	0.012	$5/2^-$	05			1943	β^-=100	
^{203}Hg^m	−24335.7	1.7	933.14	0.23		21.9	μs	1.0	$(13/2^+)$	05	11St21	T	1964	IT=100	
^{203}Hg^n	−16987.8	1.8	8281.0	0.5		146	ns	30	$(53/2^+)$		11Sz01	EJT	2011	IT=100	
^{203}Tl	−25760.8	1.3				STABLE			$1/2^+$	05			1931	IS=29.52 1	
^{203}Tl^m	−22200	50	3565	50		7.7	μs	0.5	$(25/2^+)$	05			1998	IT=100	*
^{203}Pb	−24786	7				51.92	h	0.03	$5/2^-$	05			1942	ε=100	
^{203}Pb^m	−23961	7	825.2	0.3		6.21	s	0.11	$13/2^+$	05			1955	IT=100	
^{203}Pb^n	−21837	7	2949.2	0.4		480	ms	7	$29/2^-$	05			1977	IT=100	
^{203}Pb^p	−21820	50	2970	50		122	ns	4	$25/2^-$#	05			1988	IT=100	*
^{203}Bi	−21524	13				11.76	h	0.05	$9/2^-$	05			1950	β^+=100	
^{203}Bi^m	−20426	13	1098.12	0.12		305	ms	5	$1/2^+$	05			1984	IT=100	
^{203}Bi^n	−19483	13	2041.5	0.6		194	ns	30	$25/2^+$	05			1978	IT=100	
^{203}Po	−17311	9				36.7	m	0.5	$5/2^-$	05			1951	β^+≈100; α=0.11 2	
^{203}Po^m	−16669	9	641.68	0.17		45	s	2	$13/2^+$	05			1969	IT≈100; α=0.04#	
^{203}Po^n	−15153	9	2158.5	0.6		> 200	ns			05			1986	IT=100	
^{203}At	−12163	11				7.4	m	0.2	$9/2^-$	05			1951	β^+=69 3; α=31 3	
^{203}Rn	−6159	24				44	s	2	$3/2^-$#	05			1967	α=66 9; β^+ ?	*
^{203}Rn^m	−5799	23	360	4	AD	26.9	s	0.5	$13/2^{(+)}$	05	87Bo29	J	1967	α=75 10; β^+ ?	
^{203}Fr	876	6				550	ms	10	$9/2^-$#	05			1967	α≈100; β^+=5#	
^{203}Ra	8670	80				36	ms	13	$(3/2^-)$	05	96Le09	J	1996	α≈100; β^+ ?	*
^{203}Ra^m	8855	30	190	90	AD	25	ms	5	$(13/2^+)$	05	96Le09	J	1996	α≈100; β^+ ?	*

$*^{203}$Ir^m E : 207.0, 841.3, 894.7 γs in cascade to $11/2^-$ estimated at 200(50) keV **
$*^{203}$Pt T : 05Ku.A=10(3) same author **
$*^{203}$Tl^m E : 3514.6 + x and x estimated 50(50) keV **
$*^{203}$Pb^p E : 2923.4(0.7) + x ; x estimated 50(50) **
$*^{203}$Rn J : not yet known, will be same as ^{195}Pb and ^{199}Po, from α-decay **
$*^{203}$Ra T : symmetrized from 31(+17–9) **
$*^{203}$Ra^m T : symmetrized from 24(+6–4) **

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{204}Ir	−9690#	400#				200#	ms							β^- ?; β^-n ?	
^{204}Pt	−17920#	200#				10.3	s	1.4	0^+	10			2008	β^-=100	∗
^{204}Pt^m	−15930#	200#	1995.1	0.7		5.5	μs	0.7	(5^-)	10	11St21	E	2009	IT=100	∗
^{204}Pt^n	−15890#	200#	2035	23		55	μs	3	(7^-)	10			2009	IT ?	∗
^{204}Pt^p	−14730#	200#	3193	23		146	ns	14	(10^+)	10			2009	IT=100	∗
^{204}Au	−20650#	200#				38.2	s	1.4	(2^-)	10	11Be.A	T	1972	β^-=100	∗
^{204}Au^m	−16830#	200#	3816#	1000#		2.1	μs	0.3	16^+#	10	11St21	JD	2008	IT=100	∗
^{204}Hg	−24690.2	0.5				STABLE			0^+	10			1920	IS=6.87 15; 2β^- ?	
^{204}Tl	−24345.6	1.2				3.783	y	0.012	2^-	10			1953	β^-=97.08 7; ε+β^+=2.92 7	
^{204}Tl^m	−23241.5	1.2	1104.1	0.2		61.7	μs	1.0	7^+	10	11Br12	EJ	1972	IT=100	
^{204}Tl^n	−22026.6	1.2	2319.0	0.3		2.6	μs	0.2	12^-	10	11Br12	EJ	1998	IT=100	
^{204}Tl^p	−19954.0	1.3	4391.6	0.5		420	ns	30	18^+	10	11Br12	ETJ	1998	IT=100	
^{204}Tl^q	−18106.2	1.3	6239.4	0.5		90	ns	3	22^-	10	11Br12	ETJ	2011	IT=100	
^{204}Pb	−25109.4	1.2				STABLE		(>140 Py)	0^+	10			1932	IS=1.4 1; α ?	
^{204}Pb^m	−23835.3	1.2	1274.13	0.05		265	ns	6	4^+	10			1963	IT=100	
^{204}Pb^n	−22923.5	1.2	2185.88	0.08		66.93	m	0.10	9^-	10			1956	IT=100	
^{204}Pb^p	−22845.0	1.2	2264.42	0.06		490	ns	70	7^-	10			1978	IT=100	∗
^{204}Bi	−20646	9				11.22	h	0.10	6^+	10			1947	β^+=100	
^{204}Bi^m	−19841	9	805.5	0.3		13.0	ms	0.1	10^-	10			1974	IT=100	
^{204}Bi^n	−17813	9	2833.4	1.1		1.07	ms	0.03	17^+	10			1974	IT=100	
^{204}Po	−18341	11				3.519	h	0.012	0^+	10			1951	β^+=99.33 3; α=0.67 3	
^{204}Po^m	−16702	11	1639.03	0.06		158.6	ns	1.8	8^+	10	10Ka29	T	1970	IT=100	∗
^{204}At	−11875	22				9.12	m	0.11	7^+	10			1961	β^+=96.2 2; α=3.8 2	∗
^{204}At^m	−11288	22	587.30	0.20		108	ms	10	10^-	10			1969	IT=100	
^{204}Rn	−7983	15				1.242	m	0.023	0^+	10			1967	α=72.4 9; β^+ ?	
^{204}Fr	607	25				1.75	s	0.26	(3^+)	10	95Bi.A	D	1964	α=96 2; β^+ ?	∗
^{204}Fr^m	658	25	51	4	AD	2.30	s	0.24	(7^+)	10	95Bi.A	D	1967	α=90 2; β^+ ?	∗
^{204}Fr^n	935	25	327	4	AD	0.8	s	0.2	(10^-)	10			1992	α=74 8; IT=26 8	∗
^{204}Ra	6047	14				60	ms	9	0^+	10	05Uu02	T	1995	$\alpha\approx$100; β^+=0.3#	∗

∗^{204}Pt T : other 11Be.A=16(+6–5) ∗∗

∗^{204}Pt^m E : 872.4(0.5),1122.7(0.5) γs to 0^+ ∗∗

∗^{204}Pt^n E : 1995.1(0.7) + X ; x < 80 keV ∗∗

∗^{204}Pt^p E : 1157.5(0.5) γ to ^{204}Pt^n ∗∗

∗^{204}Au T : average 11Be.A=37.0(0.8) 84Cr01=39.8(0.9); other 72Pa06=40(3) ∗∗

∗^{204}Au^m E : 839.0, 976.6 γs in cascade to 12^-# estimated at 2000#(1000#) keV ∗∗

∗^{204}Pb^p T : symmetrized from 450(+100–30) ∗∗

∗^{204}Po^m T : average 10Ka29=161(4) 87Ra04=158(2); others 90Fa03=150(10) 83He08=150(10) ∗∗

∗^{204}Po^m T : 71Ha01=140(5) 70Ya03=190(20) 70Br.A=143(5) ∗∗

∗^{204}At T : other 10Ka29=9.6(2) ∗∗

∗^{204}Fr T : average 05Uu02=1.9(0.5) 92Hu04=1.7(0.3) ∗∗

∗^{204}Fr^m T : average 05Uu02=1.6(+0.5–0.3) 92Hu04=2.6(0.3) ∗∗

∗^{204}Fr^n E : 276.1 keV above ^{204}Fr^m, from 95Bi.A D : α intensity is from 95Bi.A ∗∗

∗^{204}Ra T : average 05Uu02=54(+19–11) 96Le09=59(+12–9); other 10He25=44(+44–15) ∗∗

∗^{204}Ra T : 95Le04=45(+55–21) ∗∗

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{205}Ir								(>300 ns)			12Ku26	I	2012	β^- ?; β^-n ?	
^{205}Pt	−12970#	300#				1#	s	(>300 ns)	$9/2^+$#	11	10Al24	I	2009	β^- ?	
^{205}Au	−18770#	200#				32.5	s	1.4	$3/2^+$#	04	09Po01	T	1994	β^-=100	∗
^{205}Au^m	−17860#	200#	907	5		6	s	2	$11/2^-$#		09Po01	ETJ	2009	IT=?; β^-=?	
^{205}Au^n	−15920#	200#	2850	5		163	ns	5	$19/2^+$#		11St21	ET	2011	IT=100	
^{205}Hg	−22287	4				5.14	m	0.09	$1/2^-$	04			1940	β^-=100	
^{205}Hg^m	−20731	4	1556.40	0.17		1.09	ms	0.04	$13/2^+$	04			1985	IT=100	
^{205}Hg^n	−18971	4	3315.8	0.9		5.89	μs	0.18	$(23/2^-)$		11St21	ETJ	2011	IT=100	∗
^{205}Tl	−23820.3	1.3				STABLE			$1/2^+$	04			1931	IS=70.48 1	
^{205}Tl^m	−20529.7	1.3	3290.60	0.17		2.6	μs	0.2	$25/2^+$	04			1976	IT=100	
^{205}Tl^n	−18984.7	2.0	4835.6	1.5		235	ns	10	$(35/2^-)$	04			2004	IT=100	
^{205}Pb	−23769.7	1.2				17.3	My	0.7	$5/2^-$	04			1954	ε=100	
^{205}Pb^m	−23767.4	1.2	2.329	0.007		24.2	μs	0.4	$1/2^-$	04			1994	IT=100	
^{205}Pb^n	−22755.9	1.2	1013.85	0.03		5.55	ms	0.02	$13/2^+$	04			1960	IT=100	
^{205}Pb^p	−20574.0	1.3	3195.7	0.5		217	ns	5	$25/2^-$	04			1973	IT=100	
^{205}Bi	−21064	5				15.31	d	0.04	$9/2^-$	04			1951	β^+=100	
^{205}Bi^m	−19567	5	1497.17	0.09		7.9	μs	0.7	$1/2^+$	04			1972	IT=100	
^{205}Bi^n	−18925	5	2139.0	0.7		220	ns	25	$25/2^+$	04			1978	IT=100	
^{205}Po	−17509	20				1.74	h	0.08	$5/2^-$	04			1951	$\beta^+\approx$100; α=0.04 1	
^{205}Po^m	−17366	20	143.166	0.017		310	ns	60	$1/2^-$	04			1960	IT=100	
^{205}Po^n	−16629	20	880.31	0.07		645	μs	20	$13/2^+$	04			1962	IT=100	
^{205}Po^p	−16048	20	1461.21	0.21		57.4	ms	0.9	$19/2^-$	04			1973	IT=100	
^{205}Po^q	−14422	20	3087.2	0.4		115	ns	10	$29/2^-$	04			1985	IT=100	
^{205}At	−12970	15				33.8	m	0.2	$9/2^-$	04	10Ka29	T	1951	β^+ ?; α=10 2	
^{205}At^m	−10630	15	2339.65	0.23		7.76	μs	0.14	$29/2^+$	04			1982	IT=100	
^{205}Rn	−7710	50				2.83	m	0.07	$5/2^-$	04			1967	β^+ ?; α=24.6 9	
^{205}Rn^m	−7050	50	657.1	0.5		> 10	s		$13/2^+$#	04	10De04	ED	2010	IT$\approx$100; α ?; β^+ ?	
^{205}Fr	−1310	8				3.82	s	0.06	$(9/2^-)$	04	10De04	T	1964	$\alpha\approx$100; β^+<1	∗
^{205}Fr^m	−766	8	544.0	1.0		80	ns	20	$(13/2^+)$		12Ja01	EJT	2012	IT=100	
^{205}Fr^n	−701	9	609	5		1.15	ms	0.04	$(1/2^+)$		12Ja01	ETJ	2012	IT=100	

… *A*-group is continued on next page …

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

… *A*-group continued …

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{205}Ra	5840	70				220	ms	50	$(3/2^-)$	04			1987	α=?; β^+ ?	*
^{205}Ra^m	6140#	100#	300#	100#		180	ms	50	$(13/2^+)$	04			1995	α=?; IT ?; β^+ ?	*
*^{205}Au	T : average 09Po01=34(2) 94We02=31(2)														**
*^{205}Hg	T : other 10Ku02=5.61(0.38) for q=80$^+$ (bare ion)														**
*^{205}Hg^n	E : least-squares fit to γ-ray energies 227.6(0.5), 722.6(0.5), 810.0(0.5) 1014.7(0.5)														**
*^{205}Fr	T : unweighed average 10De04=4.03(0.08) 05De01=3.80(0.03) 81Ri04=3.96(0.04)														**
*^{205}Fr	T : 74Ho27=3.7(0.1) 67Va20=3.7(0.2) 64Gr04=3.7(0.4)														**
*^{205}Ra	T : symmetrized from 210(+60–40)														**
*^{205}Ra^m	T : symmetrized from 170(+60–40); other 10He25=68(+68–23) ms														**
^{206}Pt	−9630#	300#				1#	s	(>300 ns)	0^+		12Ku26	I	2012	β^- ?; β^-n ?	
^{206}Au	−14220#	300#				30#	s	(>300 ns)		11	09St16	I	2009	β^- ?	
^{206}Hg	−20945	20				8.32	m	0.07	0^+	08			1961	β^-=100	
^{206}Hg^m	−18843	20	2102.4	0.3		2.09	μs	0.02	5^-	08	11St21	T	1982	IT=100	*
^{206}Hg^n	−17223	20	3722.3	1.0		106	ns	6	(10^+)	08	11St21	ETJ	2001	IT=100	*
^{206}Tl	−22252.8	1.4				4.202	m	0.011	0^-	08			1935	β^-=100	
^{206}Tl^m	−19609.7	1.4	2643.10	0.18		3.74	m	0.03	(12^-)	08			1976	IT=100	
^{206}Pb	−23785.1	1.2				STABLE			0^+	08			1927	IS=24.1 1	
^{206}Pb^m	−21584.9	1.2	2200.16	0.04		125	μs	2	7^-	08			1953	IT=100	
^{206}Pb^n	−19757.8	1.4	4027.3	0.7		202	ns	3	12^+	08			1971	IT=100	
^{206}Bi	−20028	8				6.243	d	0.003	$6^{(+)}$	08			1947	β^+=100	
^{206}Bi^m	−19968	8	59.897	0.017		7.7	μs	0.2	(4^+)	08			1957	IT=100	
^{206}Bi^n	−18983	8	1044.8	0.7		890	μs	10	(10^-)	08			1974	IT=100	
^{206}Po	−18188	4				8.8	d	0.1	0^+	08			1947	β^+=94.55 5; α=5.45 5	
^{206}Po^m	−16602	4	1585.90	0.11		232	ns	4	8^+#	08			1970	IT=100	*
^{206}Po^n	−15926	4	2262.09	0.12		1.05	μs	0.06	9^-#	08			1970	IT=100	
^{206}At	−12429	15				30.6	m	0.8	$(5)^+$	08			1961	β^+=99.10 8; α=0.90 8	
^{206}At^m	−11619	15	810	3		813	ns	21	$(10)^-$	08	09Dr08	T	1999	IT=100	*
^{206}Rn	−9115	15				5.67	m	0.17	0^+	08			1954	α=62 3; β^+=38 3	
^{206}Fr	−1242	28				16	s		$(2^+,3^+)$	08	92Hu04	D	1964	β^+=?; α=42 24	*
^{206}Fr^m	−1048	28	190	40		16	s		(7^+)	08	92Hu04	D	1964	α=42 24; β^+ ?; IT ?	
^{206}Fr^n	−517	28	730	40	MD	700	ms	100	(10^-)	08			1983	IT=?; $\alpha\approx$5#	*
^{206}Fr^x	−1140	100	100	100	MD	$R=?$			spmix						
^{206}Ra	3566	18				240	ms	20	0^+	08			1967	α=?; β^+=2.5#	
^{206}Ac	13460#	70#				25	ms	7	(3^+)	08			1998	$\alpha\approx$100; β^+=0.2#	*
^{206}Ac^m	13710	30	250#	80#	AD	41	ms	16	(10^-)	08			1996	$\alpha\approx$100; β^+ ?	*
*^{206}Hg^m	T : average 11St21(=09Si35)=2.09(0.02) 82Be38=2.15(0.21)														**
*^{206}Hg^n	T : average 11St21(=09Si35)=112(4) 09Al29=96(15) 01Fo08=92(8) 01La09=90(10)														**
*^{206}Po^m	E : less than 40 keV above 1573.4 level, from ENSDF														**
*^{206}At^m	T : others 10Ka29=377(44) 99Fe10=410(80)														**
*^{206}At^m	E : from ENSDF'08 806.7(1.4) + x; x<6 estimated by NUBASE														**
*^{206}Fr	D : α=84(2)% for mixture of ^{206}Fr and ^{206}Fr^m, in 92Hu04. Value replaced by														**
*^{206}Fr	D : uniform distribution 0%-84% for each isomer														**
*^{206}Fr^n	E : 531(2) keV above ^{206}Fr^m, from 81Ri04														**
*^{206}Ac	T : symmetrized from 98Es02=22(+9–5)														**
*^{206}Ac^m	T : symmetrized from 98Es02=33(+22–9)														**
^{207}Pt								(>300 ns)			12Ku26	I	2012	β^- ?; β^-n ?	
^{207}Au	−10810#	300#				10#	s	(>300 ns)	$3/2^+$#	11			2010	β^- ?; β^-n ?	
^{207}Hg	−16487	30				2.9	m	0.2	$9/2^+$#	11			1982	β^-=100	
^{207}Tl	−21033	5				4.77	m	0.02	$1/2^+$	11			1908	β^-=100	*
^{207}Tl^m	−19685	5	1348.18	0.16		1.33	s	0.11	$11/2^-$	11			1965	IT$\approx$100; β^-<0.1#	
^{207}Pb	−22451.5	1.2				STABLE			$1/2^-$	11			1927	IS=22.1 1	
^{207}Pb^m	−20818.1	1.2	1633.356	0.004		806	ms	5	$13/2^+$	11			1951	IT=100	
^{207}Bi	−20054.1	2.4				31.55	y	0.04	$9/2^-$	11			1950	β^+=100	
^{207}Bi^m	−17952.5	2.4	2101.61	0.16		182	μs	6	$21/2^+$	11			1967	IT=100	
^{207}Po	−17145	7				5.80	h	0.02	$5/2^-$	11			1947	$\beta^+\approx$100; α=0.021 2	
^{207}Po^m	−17076	7	68.557	0.014		205	ns	10	$1/2^-$	11			1963	IT=100	
^{207}Po^n	−16030	7	1115.076	0.017		49	μs	4	$13/2^+$	11			1962	IT=100	
^{207}Po^p	−15762	7	1383.16	0.07		2.79	s	0.08	$19/2^-$	11			1961	IT=100	
^{207}At	−13227	12				1.81	h	0.03	$9/2^-$	11			1951	β^+ ?; $\alpha\approx$10	
^{207}At^m	−11110	12	2117.3	0.6		108	ns	2	$25/2^+$	11			1981	IT=100	
^{207}Rn	−8635	8				9.25	m	0.17	$5/2^-$	11			1954	β^+=79 3; α=21 3	
^{207}Rn^m	−7736	8	899.1	1.0		184.5	μs	0.9	$13/2^+$	11			1974	IT=100	
^{207}Fr	−2844	18				14.8	s	0.1	$9/2^-$	11			1964	α=95 2; β^+ ?	
^{207}Ra	3540	60				1.38	s	0.18	$5/2^-$#	11			1967	$\alpha\approx$86; β^+ ?	*
^{207}Ra^m	4094	25	560	50	AD	57	ms	8	$13/2^+$#	11	96Le09	T	1987	IT=85#; α=?; …	*
^{207}Ac	11150	50				31	ms	8	$9/2^-$#	11	98Es02	T	1994	$\alpha\approx$100	*
*^{207}Tl	T : other 05Oh08=4.25(0.14) 10Ku02=4.70(0.19) for q=81$^+$ (bare ion)														**
*^{207}Ra	T : average 95Uu01=1.1(+0.9–0.3) 68Lo15=1.8(0.5) 67Va22=1.3(0.2)														**
*^{207}Ra^m	D : …; β^+=0.55#														**
*^{207}Ra^m	T : average 96Le09=63(16) 87He10=55(10)														**
*^{207}Ac	T : average 98Es02=27(+11–6) 94Le05=22(+40–9)														**
*^{207}Ac	J : Unhindered α-decay to ^{203}Fr $9/2^-$#														**

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{208}Pt								(>300 ns)	0^+		12Ku26	I	2012	β^- ?; β^-n ?	
^{208}Au	−6100#	300#				10#	s	(>300 ns)		11	10Al24	I	2010	β^- ?; β^-n ?	
^{208}Hg	−13270	30				42	m	5	0^+	10			1994	β^-=100	*
^{208}Tl	−16749.2	2.0				3.053	m	0.004	5^+	07			1909	β^-=100	
^{208}Pb	−21748.1	1.2				STABLE			0^+	07			1927	IS=52.4 1	
^{208}Pb^m	−16852.9	1.2	4895.23	0.05		500	ns	10	10^+	07	98Pf02	T	1998	IT=100	
^{208}Bi	−18869.7	2.4				368	ky	4	5^+	07			1953	β^+=100	
^{208}Bi^m	−17298.6	2.4	1571.1	0.4		2.58	ms	0.04	10^-	07			1961	IT=100	
^{208}Po	−17469.2	1.8				2.898	y	0.002	0^+	07			1947	$\alpha\approx$100; β^+=0.0040 4	
^{208}Po^m	−15941.0	1.8	1528.22	0.04		350	ns	20	8^+	07			1968	IT=100	
^{208}At	−12470	9				1.63	h	0.03	6^+	07			1950	β^+=99.45 6; α=0.55 6	
^{208}At^m	−10194	9	2276.4	1.8		1.5	μs	0.2	16^-	07			1991	IT=100	
^{208}Rn	−9655	11				24.35	m	0.14	0^+	07			1955	α=62 7; β^+=38 7	
^{208}Rn^m	−7827	11	1828.3	0.4		487	ns	12	8^+	07			1979	IT=100	*
^{208}Fr	−2666	11				59.1	s	0.3	7^+	07			1964	α=89 3; β^+=11 3	
^{208}Fr^m	−1839	21	827	18		432	ns	11	(10^-)	07	09Dr08	T	2009	IT=100	*
^{208}Ra	1715	15				1.110	s	0.045	0^+	07	10He25	TD	1967	α=87 3; β^+ ?	*
^{208}Ra^m	3862	15	2147.4	0.4		263	ns	17	(8^+)	07	05Re02	T	1998	IT=100	*
^{208}Ac	10760	60				97	ms	16	(3^+)	07	96Ik01	T	1994	α=?; β^+=1#	*
^{208}Ac^m	11258	28	500	50	AD	28	ms	7	(10^-)	07	96Ik01	T	1994	α=?; IT<10#; β^+=1#	*
^{208}Th	16670	30				2.4	ms	1.2		11			2010	$\alpha\approx$100	*

*^{208}Hg T : symmetrized from 98Zh22=41(+5–4) **
*^{208}Rn^m T : other 10Ka29=590(144) ns **
*^{208}Fr^m T : from meanlife 09Dr08=623(16); other 10Ka29=233(18), not trusted **
*^{208}Fr^m T : also 06Me03=446(14) originally assigned to ^{209}Fr, see 09Dr04 **
*^{208}Ra T : other 68Lo15=1.8(0.5) 67Va22=1.2(0.2) **
*^{208}Ra^m T : average 05Re02=250(30) 99Co13=270(21) **
*^{208}Ac T : average 96Ik01=83(+34–19) 94Le05=95(+24–16) **
*^{208}Ac^m E : if α decay goes to (7^+) ^{204}Fr^m, instead of (10^-) as assumed in AME, then **
*^{208}Ac^m E : E will become 234(22) keV **
*^{208}Ac^m T : average 96Ik01=21(+28–8) 94Le05=25(+9–5) **
*^{208}Th T : symmetrized from 10He25=1.7(+1.7–0.6) **

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{209}Au	−2470#	400#				1#	s	(>300 ns)	$3/2^+$#	11	10Al24	I	2010	β^- ?; β^-n ?	
^{209}Hg	−8640#	150#				37	s	8	$9/2^+$#	08			1998	β^-=100; β^-n ?	*
^{209}Tl	−13638	8				2.161	m	0.007	$(1/2^+)$	91	94Ar23	T	1950	β^-=100; β^-n ?	
^{209}Pb	−17614.1	1.8				3.253	h	0.014	$9/2^+$	91			1940	β^-=100	
^{209}Bi	−18258.2	1.4				19.9	Ey	0.7	$9/2^-$	91	12Be06	T	1924	IS=100.; α=100	*
^{209}Po	−16365.6	1.8				102	y	5	$1/2^-$	91			1949	$\alpha\approx$100; β^+=0.48 4	
^{209}Po^m	−12100.0	1.8	4265.6	0.1		119	ns	4	$(31/2^-)$	91			1974	IT=100	
^{209}At	−12882	5				5.41	h	0.05	$9/2^-$	91			1951	β^+=95.9 5; α=4.1 5	
^{209}At^m	−10453	5	2429.25	0.23		890	ns	40	$(29/2)^+$	91			1975	IT=100	
^{209}Rn	−8929	20				28.5	m	1.0	$5/2^-$	91			1952	β^+=83 2; α=17 2	
^{209}Rn^m	−7755	20	1173.98	0.13		13.4	μs	1.3	$13/2^+$	91			1985	IT=100	
^{209}Rn^n	−5292	20	3636.78	0.23		3.0	μs	0.3	$(35/2^+)$	91			1985	IT=100	
^{209}Fr	−3768	15				50.0	s	0.3	$9/2^-$	91			1964	α=89 3; β^+=11 3	
^{209}Fr^m	892	15	4659.8	0.7		420	ns	18	$45/2^-$		09Dr04	ETJ	2009	IT=100	*
^{209}Ra	1850	50				4.71	s	0.08	$5/2^-$	91	08Ha12	T	1967	$\alpha\approx$90; $\beta^+\approx$10	
^{209}Ra^m	2730	50	882.8	0.7		117	μs	5	$13/2^+$		08Ha12	ETJ	2008	$\alpha\approx$90; $\beta^+\approx$10	
^{209}Ac	8840	50				92	ms	11	$(9/2^-)$	91	00He17	T	1968	α=?; β^+=1#	*
^{209}Th	16540	90				3.1	ms	1.2	$5/2^-$#	97	10He25	TD	1996	α=?; β^+ ?	*

*^{209}Hg T : symmetrized from 98Zh22=35(+9–6) **
*^{209}Bi T : average 12Be06=20.1(0.8) 03De11=19(2) **
*^{209}Fr^m T : from meanlife 09Dr04=606(26); **
*^{209}Fr^m T : also 06Me03=360(140) originally assigned to ^{210}Fr **
*^{209}Ac T : average 00He17=98(+59–27) 96Ik01=82(+18–13) 94Le05=91(+21–14) **
*^{209}Ac T : and 68Va04=100(50) **
*^{209}Th T : average 10He25=1.9(+1.9–0.7) 96Ik01=3.8(+6.9–1.5) **

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{210}Au	2330#	400#				1#	s	(>300 ns)		11	10Al24	I	2010	β^- ?; β^-n ?	
^{210}Hg	−5370#	200#				10#	m	(>300 ns)	0^+	03	98Pf02	I	1998	β^- ?; β^-n ?	
^{210}Tl	−9246	12				1.30	m	0.03	5^+#	03			1909	β^-=100; β^-n=0.009 6	$*$
^{210}Pb	−14728.0	1.5				22.20	y	0.22	0^+	03			1900	β^-=100; α=1.9e–6 4	
^{210}Pb^m	−13450	5	1278	5		201	ns	17	8^+	03			1980	IT=100	
^{210}Bi	−14791.5	1.4				5.012	d	0.005	1^-	03			1905	β^-=100; α=13.2e–5 10	
^{210}Bi^m	−14520.2	1.4	271.31	0.11		3.04	My	0.06	9^-	03			1953	α=100	
^{210}Po	−15952.7	1.2				138.376	d	0.002	0^+	03			1898	α=100	
^{210}Po^m	−14395.7	1.2	1556.96	0.03		98.9	ns	2.5	8^+	03			1968	IT=100	
^{210}Po^n	−10895.1	1.2	5057.61	0.04		263	ns	5	16^+	03			1985	IT=100	
^{210}At	−11972	8				8.1	h	0.4	$(5)^+$	03			1949	$\beta^+\approx$100; α=0.175 20	
^{210}At^m	−9422	8	2549.6	0.2		482	ns	6	$(15)^-$	03			1970	IT=100	
^{210}At^n	−7944	8	4027.7	0.2		5.66	μs	0.07	$(19)^+$	03			1975	IT=100	
^{210}Rn	−9605	5				2.4	h	0.1	0^+	03			1952	α=96 1; β^+ ?	
^{210}Rn^m	−7900	30	1710	30	AD	644	ns	40	8^+#	03			1979	IT ?	
^{210}Rn^n	−5750	30	3857	30		1.06	μs	0.05	$(17)^-$	03			1979	IT=100	$*$
^{210}Rn^p	−3090	30	6514	30		1.04	μs	0.07	$(22)^+$	03			1986	IT=100	$*$
^{210}Fr	−3333	15				3.18	m	0.06	6^+	03	05Ku06	D	1964	α=71 4; β^+ ?	$*$
^{210}Ra	460	15				4.0	s	0.1	0^+	03	08Ha12	T	1967	α=?; β^+=4#	$*$
^{210}Ra^m	2510	15	2050.0	1.1		2.32	μs	0.03	8^+	03	04Re04	ETJ	1998	IT=100	$*$
^{210}Ac	8790	60				350	ms	40	7^+#	03	00He17	T	1968	α=?; β^+=9#	$*$
^{210}Th	14060	19				16.0	ms	3.6	0^+	03	10He25	T	1995	α=?; β^+=1#	

$*^{210}$Tl D : symmetrized from β^-n=0.007(+7–4)% $**$
$*^{210}$Rn^n E : ENSDF2003: 2147.4(0.2) keV above the 8^+ level, quoted 3812.0(0.2) + x $**$
$*^{210}$Rn^p E : ENSDF2003: 4803.7(0.4) keV above the 8^+ level, quoted 6468.3(0.4) + x $**$
$*^{210}$Fr T : other 10Ka09=3.4(0.2) $**$
$*^{210}$Fr I : an isomer was claimed in 06Me03=360(140)ns ; but has been re-assigned to $**$
$*^{210}$Fr I : ^{209}Fr in 09Dr04 $**$
$*^{210}$Ra T : also 07Le14=2.5(+1.4–0.7) and 3.5(+4.8–1.3) $**$
$*^{210}$Ra^m T : average 06Ha17=2.28(0.08) 04Re04=2.1(0.1) 04He25=2.36(0.04) $**$
$*^{210}$Ac T : average 00He17=335(+64–46) 68Va04=350(50) $**$

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{211}Hg	−620#	200#				10#	s	(>300 ns)	$9/2^+$#	11	10Al24	I	2010	β^- ?; β^-n ?	
^{211}Tl	−6080	40				100	s	40	$1/2^+$#	04	12Be28	T	1998	β^-=100; β^-n ?	$*$
^{211}Pb	−10491.3	2.6				36.1	m	0.2	$9/2^+$	04			1904	β^-=100	
^{211}Pb^m	−8787	15	1704	15		159	ns	28	$(27/2^+)$		05La01	ET	2005	IT=100	$*$
^{211}Bi	−11858	5				2.14	m	0.02	$9/2^-$	04			1905	$\alpha\approx$100; β^-=0.276 4	
^{211}Bi^m	−10601	11	1257	10		1.4	μs	0.3	$(25/2^-)$	04			1998	IT=100	
^{211}Po	−12432.1	1.3				516	ms	3	$9/2^+$	04			1913	α=100	
^{211}Po^m	−10970	5	1462	5	AD	25.2	s	0.6	$(25/2^+)$	04			1954	$\alpha\approx$100; IT=0.016 4	
^{211}Po^n	−10296.4	1.6	2135.7	0.9		243	ns	21	$(31/2^-)$	04			1998	IT$\approx$100; α ?	
^{211}Po^p	−7558.8	2.1	4873.3	1.7		2.8	μs	0.7	$(43/2^+)$	04			1998	IT$\approx$100; α ?	
^{211}At	−11646.8	2.8				7.214	h	0.007	$9/2^-$	04			1940	ε=58.20 8; α=41.80 8	
^{211}At^m	−6831	3	4816.2	1.7		4.23	μs	0.07	$39/2^-$	04	01Ba79	TJ	1971	IT=100	
^{211}Rn	−8755	7				14.6	h	0.2	$1/2^-$	04			1952	β^+=72.6 17; α=27.4 17	
^{211}Rn^m	−7152	16	1603	14		596	ns	28	$(17/2^-)$	04			1981	IT=100	$*$
^{211}Rn^n	125	16	8880	14		201	ns	4	$(63/2^-)$	04			1981	IT=100	$*$
^{211}Fr	−4140	12				3.10	m	0.02	$9/2^-$	04	05Ku06	D	1964	α=87 3; β^+ ?	
^{211}Fr^m	−1717	12	2423.2	0.2		146	ns	14	$(29/2^+)$	04			1986	IT=100	
^{211}Fr^n	517	12	4657.3	0.4		123	ns	14	$(45/2^-)$	04			1986	IT=100	
^{211}Ra	832	8				13.2	s	1.4	$5/2^{(-)}$	04	07Le14	T	1967	α>93; β^+<7	$*$
^{211}Ra^m	2030	8	1198.1	0.5		9.7	μs	0.6	$13/2^+$		06Ha17	TJ	2004	IT=100	$*$
^{211}Ac	7200	50				213	ms	25	$9/2^-$#	04	00He17	T	1968	$\alpha\approx$100; β^+<0.2	$*$
^{211}Th	13910	70				48	ms	20	$5/2^-$#	04	95Uu01	T	1995	α=?; β^+=0.5#	$*$

$*^{211}$Tl T : symmetrized from 88(+46–29) $**$
$*^{211}$Pb^m E : E=1679.1 + x in 05La01, where x<50 keV $**$
$*^{211}$Rn^m E : 1577.8 + x ; x<50 $**$
$*^{211}$Rn^n E : 8854.7(0.4) + y ; y<50 $**$
$*^{211}$Ra T : average 07Le14=9(5) 68Lo15=12(2) 67Va22=15(2) $**$
$*^{211}$Ra^m T : other 04He25=4.0(0.5) $**$
$*^{211}$Ac T : average 00He17=200(29) 68Va04=250(50) $**$
$*^{211}$Th T : symmetrized from 37(+28–11) $**$

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^{π}	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{212}Hg	2760#	300#				1#	m	(>300 ns)	0^+	11	10Al24	I	2010	β^- ?; β^-n ?	
^{212}Tl	−1550#	200#				100	s	40	5^+#	05	12Be28	T	1998	β^-=100; β^-n ?	
^{212}Pb	−7547.2	2.2				10.64	h	0.01	0^+	05			1905	β^-=100	
^{212}Pb^{m}	−6212.2	3.0	1335	2		5.0	μs	0.3	8^+#	05	12Re.B	ET	1998	IT=100	*
^{212}Bi	−8117.0	2.0				60.55	m	0.06	$1^{(-)}$	05	89Ha.A	D	1905	β^-=64.06 6; α=35.94 6; …	*
^{212}Bi^{m}	−7870	30	250	30	AD	25.0	m	0.2	$(8^-,9^-)$	05			1978	α=67 1; β^-=33 1; $\beta^-\alpha$=30 1	
^{212}Bi^{n}	−6639	30	1478	30	MD	7.0	m	0.3	>16	05			1978	$\beta^-\approx$100; IT ?	
^{212}Po	−10369.0	1.2				299	ns	2	0^+	05			1906	α=100	
^{212}Po^{m}	−7446	5	2923	4	AD	45.1	s	0.6	(18^+)	05			1962	$\alpha\approx$100; IT=0.07 2	
^{212}At	−8627.8	2.4				314	ms	2	(1^-)	05			1954	$\alpha\approx$100; β^+<0.03; β^-<2e–6	
^{212}At^{m}	−8404.9	2.4	222.9	0.9	AD	119	ms	3	9^-#	05			1970	α>99; IT<1	
^{212}At^{n}	−3856.2	2.6	4771.6	1.1		152	μs	5	(25^-)	05			1998	IT=100	
^{212}Rn	−8659	3				23.9	m	1.2	0^+	05			1950	α=100; 2β^+ ?	
^{212}Rn^{m}	−7019	3	1639.8	0.3		118	ns	14	6^+	05	FGK128	J	1971	IT=100	*
^{212}Rn^{n}	−6965	3	1694.0	0.4		910	ns	30	8^+	05	FGK128	J	1971	IT=100	
^{212}Rn^{p}	−2485	3	6174.0	0.4		104.0	ns	2.8	22^+	05	09Dr12	ETJ	1977	IT=100	
^{212}Rn^{q}	−80	3	8579.0	0.5		154	ns	14	30^+	05	09Dr12	EJ	1977	IT=100	
^{212}Fr	−3516	9				20.0	m	0.6	5^+	05			1950	β^+=57 2; α=43 2	
^{212}Fr^{m}	−1965	9	1551.4	0.3		31.9	μs	0.7	(11^+)	05			1977	IT=100	
^{212}Fr^{n}	−1024	9	2492.2	0.4		604	ns	28	(15^-)	05			1977	IT=100	
^{212}Fr^{p}	2339	9	5854.7	0.6		312	ns	21	(27^-)	05			1986	IT=100	
^{212}Fr^{q}	5017	9	8533.4	1.1		23.6	μs	2.1	34^+#	05			1990	IT=100	
^{212}Ra	−199	11				13.0	s	0.2	0^+	05			1967	α=?; β^+=15#	
^{212}Ra^{m}	1759	11	1958.4	0.5		10.5	μs	0.3	$(8)^+$	05	06Ha17	T	1986	IT=100	*
^{212}Ra^{n}	2414	11	2613.4	0.5		850	ns	130	$(11)^-$	05			1986	IT=100	
^{212}Ac	7280	50				920	ms	50	6^+#	05	00He17	T	1968	α=?; β^+=3#	*
^{212}Th	12098	16				31.7	ms	1.3	0^+	05	10He25	T	1980	$\alpha\approx$100; β^+=0.3#	
^{212}Pa	21610	70				8	ms	5	7^+#	05			1997	α=100	*

$*^{212}$Pb^{m} T : other 98Pf02=5(1) $**$

$*^{212}$Bi D : … ; $\beta^-\alpha$=0.014 $**$

$*^{212}$Rn^{m} J : E2 to 4^+ for ^{212}Rn^{m}; E2 to $6^+$for ^{212}Rn^{n}; magnetic moment measurement $**$

$*^{212}$Ra^{m} T : average 06Ha17=9.7(0.6) 86Ko01=10.9(0.4); other 04He25=8.31(0.25) $**$

$*^{212}$Ac T : average 00He17=880(110) 68Va04=930(50) $**$

$*^{212}$Ac J : ENSDF proposes to assign 7^+, if the observed α feeds the ^{208}Fr 7^+ ground-state $**$

$*^{212}$Pa T : symmetrized from 5.1(+6.1–1.9) $**$

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^{π}	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{213}Hg	7670#	300#				1#	s	(>300 ns)	$5/2^+$#	11	10Al24	I	2010	β^- ?; β^-n ?	
^{213}Tl	1784	27				60	s	40	$1/2^+$		12Be28	T	2010	β^-=100; β^-n ?	*
^{213}Pb	−3202	7				10.2	m	0.3	$(9/2^+)$	07			1964	β^-=100	
^{213}Bi	−5230	5				45.59	m	0.06	$9/2^-$	07			1947	β^-=97.91 3; α=2.09 3	
^{213}Bi^{m}	−3930#	200#	1300#	200#		> 168	s		$25/2^-$#		08Ch.A	T	2008		
^{213}Po	−6653	3				3.72	μs	0.02	$9/2^+$	07			1947	α=100	
^{213}At	−6579	5				125	ns	6	$9/2^-$	07			1968	α=100	
^{213}At^{m}	−5210	50	1370	50		110	ns	17		07			1980	IT=100	*
^{213}At^{n}	−3600	50	2980	50		45	μs	4	$(49/2^+)$	07			2003		*
^{213}Rn	−5698	6				19.5	ms	0.1	$9/2^+$#	07			1967	α=100	*
^{213}Rn^{m}	−3990	50	1710	50		1.00	μs	0.21	$(25/2^+)$	07			1988	IT=100	*
^{213}Rn^{n}	−3460	50	2240	50		1.36	μs	0.07	$(31/2^-)$	07			1988	IT=100	*
^{213}Rn^{p}	280	50	5980	50		164	ns	11	$(55/2^+)$	07			1988	IT=100	*
^{213}Fr	−3553	5				34.82	s	0.14	$9/2^-$	07			1964	α=99.44 5; β^+=0.56 5	
^{213}Fr^{m}	−1963	5	1590.41	0.18		505	ns	14	$21/2^-$	07			1971	IT=100	
^{213}Fr^{n}	−1015	5	2537.62	0.23		238	ns	6	$29/2^+$	07			1971	IT=100	
^{213}Fr^{p}	4542	5	8094.8	0.7		3.1	μs	0.2	$(65/2^-)$	07			1989	IT=100	
^{213}Ra	358	21				2.73	m	0.05	$1/2^-$	07			1955	α=80 5; β^+ ?	
^{213}Ra^{m}	2126	21	1768	4	AD	2.20	ms	0.05	$(17/2^-)$	07	06Ku26	TD	1976	IT$\approx$99; α=0.6 4	*
^{213}Ac	6160	50				738	ms	16	$9/2^-$#	07			1968	α=?; β^+ ?	
^{213}Th	12120	70				144	ms	21	$5/2^-$#	07			1968	α=?; β^+=1.4#	
^{213}Th^{m}	13300	70	1180	3		1.4	μs	0.4	$13/2^+$#		07Kh22	TD	2007	IT=100	*
^{213}Th^{p}	12380#	90#	260#	50#											
^{213}Pa	19660	70				7	ms	3	$9/2^-$#	07	95Ni05	TD	1995	α=100	*

$*^{213}$Tl T : symmetrized from 12Be28=46(+55–26); other 10Ch19=101(+484–46) s $**$

$*^{213}$At^{m} E : 1318.1(0.6) + x ; x estimated 50(50) by NUBASE $**$

$*^{213}$At^{n} E : 2926 + y ; y estimated 50(50) by NUBASE $**$

$*^{213}$Rn^{m} E : 1664.0(1.0) + x ; x=50(50) estimated by NUBASE $**$

$*^{213}$Rn^{n} E : 2186.7 + x ; x=50(50) estimated by NUBASE $**$

$*^{213}$Rn^{p} E : 5929 + y ; y=50(50) estimated by NUBASE $**$

$*^{213}$Ra^{m} E : derived from difference in α decay energy in the AME evaluation. $**$

$*^{213}$Ra^{m} E : 76Ra37 less than 10 keV above 1769.7 level, thus 1775(3) keV $**$

$*^{213}$Ra^{m} J : 17/2$^-$ or 13/2$^+$ as proposed in 76Ra37 $**$

$*^{213}$Th^{m} E : uncertainty estimated by NUBASE $**$

$*^{213}$Pa T : symmetrized from 5.3(+4.0–1.6) $**$

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{214}Hg	11180#	400#				1#	s	(>300 ns)	0^+	11	10Al24	I	2010	β^- ?; β^-n ?	
^{214}Tl	6470#	200#				10#	s	(>300 ns)	5^+#	11	10Al24	I	2010	β^- ?; β^-n ?	
^{214}Pb	−180.8	2.3				26.8	m	0.9	0^+	09			1904	β^-=100	
^{214}Pb^m	1210	30	1390	30		5.9	μs	0.1	8^+#		12Re.B	ETD	2012	IT=100	*
^{214}Bi	−1200	11				19.9	m	0.4	1^-	09	89Ha.A	D	1904	β^-≈100; α=0.021 1; $\beta^-\alpha$=0.003	
^{214}Bi^m	−1000#	100#	200#	100#		> 93	s		8^-#		08Ch.A	T	2008		
^{214}Po	−4469.6	1.5				164.3	μs	2.0	0^+	09			1912	α=100	
^{214}At	−3379	4				558	ns	10	1^-	09			1949	α=100	
^{214}At^m	−3320	8	59	9	AD	265	ns	30		09			1982	α<100	
^{214}At^n	−3146	5	234	6	AD	760	ns	15	9^-	09			1982	α<100	
^{214}Rn	−4319	9				270	ns	20	0^+	09			1970	α=100	
^{214}Rn^m	276	9	4595.4	1.8		245	ns	30	(22^+)	09			1983	IT=100	
^{214}Fr	−958	9				5.0	ms	0.2	(1^-)	09			1967	α=100	
^{214}Fr^m	−837	8	122	5	AD	3.35	ms	0.05	(8^-)	09			1962	α=100	
^{214}Fr^n	−320	10	638	5		103	ns	4	(11^+)	09			1993	IT=100	
^{214}Fr^p	5620	100	6580	100		108	ns	7	(33^+)	09			1994	IT ?	*
^{214}Ra	93	5				2.46	s	0.03	0^+	09			1967	α≈100; β^+=0.059 4	
^{214}Ra^m	1913	5	1819.7	1.8		118	ns	7	6^+	09			2004	IT=100	
^{214}Ra^n	1958	5	1865.2	1.8		67.3	μs	1.5	8^+	09			1971	IT≈100; α=0.09 7	
^{214}Ra^p	2776	5	2683.2	1.8		295	ns	7	11^-	09			1979	IT=100	
^{214}Ra^q	3571	5	3478.4	1.8		279	ns	4	14^+	09			1979	IT=100	
^{214}Ra^r	4240	5	4146.8	1.8		225	ns	4	17^-	09			1979	IT=100	
^{214}Ra^x	6670	5	6577.0	1.8		128	ns	4	(25^-)	09			1992	IT=100	
^{214}Ac	6445	15				8.2	s	0.2	5^+#	09			1968	α>89 3; β^+<11 3	
^{214}Th	10712	16				87	ms	10	0^+	09			1968	α≈100; β^+=0.1#	
^{214}Th^m	12893	16	2181.0	2.7		1.24	μs	0.12	8^+#	09			2007	IT=100	
^{214}Pa	19490	80				17	ms	3		09	95Ni05	D	1995	α≈100	

*^{214}Pb^m E : 1360 + y ; y=30(30) estimated by NUBASE **
*^{214}Fr^p E : 6477 + y ; y=100(100) estimated by NUBASE **

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{215}Hg	16210#	400#				1#	s	(>300 ns)	$3/2^+$#	11	10Al24	I	2010	β^- ?; β^-n ?	
^{215}Tl	9910#	300#				5#	s	(>300 ns)	$1/2^+$#	11	10Al24	I	2010	β^- ?; β^-n ?	
^{215}Pb	4420#	100#				2.45	m	0.20	$9/2^+$#	11			1998	β^-=100	*
^{215}Bi	1649	15				7.6	m	0.2	$(9/2^-)$	01			1953	β^-=100	
^{215}Bi^m	2997	15	1347.5	2.5		36.9	s	0.6	$(25/2^-)$	01	03Ku26	ETD	2001	IT=76.2 4; β^-=23.8 4	*
^{215}Po	−540.1	2.5				1.781	ms	0.004	$9/2^+$	01			1911	α=100; β^-=2.3e–4 2	
^{215}At	−1255	7				100	μs	20	$9/2^-$	01			1944	α=100	
^{215}Rn	−1168	8				2.30	μs	0.10	$9/2^+$	01			1952	α=100	
^{215}Fr	318	7				86	ns	5	$9/2^-$	01			1970	α=100	
^{215}Ra	2534	8				1.67	ms	0.01	$9/2^+$#	01	00He17	T	1967	α=100	*
^{215}Ra^m	4412	8	1877.8	0.5		7.31	μs	0.13	$(25/2^+)$	01	04He25	T	1983	IT=100	*
^{215}Ra^n	4781	8	2246.9	0.5		1.39	μs	0.07	$(29/2^-)$	01			1998	IT=100	
^{215}Ra^p	6340	50	3810	50		555	ns	10	$(43/2^-)$	01			1987	IT=100	*
^{215}Ac	6031	12				170	ms	10	$9/2^-$	01			1968	α≈100; β^+=0.09 2	
^{215}Ac^m	7827	12	1796.0	0.9		185	ns	30	$21/2^-$	01			1983	IT=100	
^{215}Ac^n	8520	50	2490	50		335	ns	10	$(29/2^+)$	01			1983	IT=100	*
^{215}Th	10922	9				1.2	s	0.2	$(1/2^-)$	01			1968	α=100	*
^{215}Th^m	12343	9	1421.3	0.3		770	ns	60	$9/2^+$#		05Ku31	ETD	2005	IT=100	
^{215}Pa	17870	70				14	ms	2	$9/2^-$#	01			1979	α=100	

*^{215}Pb T : other preliminary result 96Ry.B=36(1) s **
*^{215}Bi^m E : 1347.3(0.2) + x ; x=20(20) estimated by NUBASE **
*^{215}Bi^m T : early unpublished report by the same group 02Fr.B=36.9(0.6) s, was **
*^{215}Bi^m T : erroneously 36.4 m in NUBASE2003 **
*^{215}Ra T : also 05Li17=1.64(0.04) not used **
*^{215}Ra^m T : average 04He25=7.6(0.2) 98St24=6.9(0.3) 88Fu10=7.2(0.2) **
*^{215}Ra^p E : 3756.6(0.6) + x ; x=50(50) estimated by NUBASE **
*^{215}Ac^n E : 2438 + x ; x=50(50) from ENSDF'2001 **
*^{215}Th T : also 07Le14=0.63(+1.26–0.21) **

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{216}Hg	19860#	400#					100#	ms	(>300 ns)	0^+	11	10Al24	I	2010	β^- ?; β^-n ?	
^{216}Tl	14720#	300#					2#	s	(>300 ns)	5^+#	11	10Al24	I	2010	β^- ?; β^-n ?	
^{216}Pb	7480#	200#					7#	m	(>300 ns)	0^+	11	10Al24	I	2009	β^- ?	
^{216}Pb^m	8980#	200#	1500	40			400	ns	10	8^+#		12Re.B	ETD	2012	IT=100	∗
^{216}Bi	5874	11				∗	2.25	m	0.05	$(6^-,7^-)$	07			1989	$\beta^-\approx$100	
^{216}Bi^m	5898	15	24	19	MD	∗	6.6	m	2.1	$(3)^{(-\#)}$	07			1989	$\beta^-\approx$100	
^{216}Po	1784.0	2.2					145	ms	2	0^+	07			1910	α=100; 2β^- ?	
^{216}At	2258	4					300	μs	30	$1^{(-)}$	07			1948	$\alpha\approx$100; β^-<0.006; ε<3e–7	
^{216}At^m	2418	10	161	11	AD		100#	μs		9^-#	07			1971	α=100	
^{216}Rn	253	6					45	μs	5	0^+	07			1949	α=100	
^{216}Fr	2971	4					700	ns	20	(1^-)	07			1970	α=100; β^+<2e–7#	
^{216}Fr^m	3190	6	219	6	AD		850	ns	30	(9^-)		07Ku30	TJD	2007	α=?; β^+ ?	
^{216}Ra	3291	9					182	ns	10	0^+	07			1972	α=100; ε<1e–8	
^{216}Ac	8145	11					440	μs	16	(1^-)	07			1967	α=100; β^+=7e–5#	
^{216}Ac^m	8188	10	44	8	AD		441	μs	7	(9^-)	07			1966	α=100; β^+=7e–5#	
^{216}Ac^n	8570#	100#	420#	100#			300	ns			07			2006	IT=100	∗
^{216}Th	10299	12					26.0	ms	0.2	0^+	07			1968	$\alpha\approx$100; β^+=0.01#	
^{216}Th^m	12342	14	2043	9	AD		134	μs	4	(8^+)	07			1983	IT ?; α=2.8 9	
^{216}Th^n	12946	12	2646.8	0.1			580	ns	30	(11^-)	07	01Ha46	J	1983	IT=100	
^{216}Th^p	13980	12	3681.4	0.7			740	ns	70	(14^+)	07			2001	IT=100	
^{216}Pa	17800	50					105	ms	12		07	96An21	T	1972	α=?; β^+=2#	∗
∗^{216}Pb^m	E : 1458 + y ; y=40(40) estimated by NUBASE															∗∗
∗^{216}Ac^n	E : 322 + x, x=100#100															∗∗
∗^{216}Pa	T : others 98Ik01=150(70-40), 140(50-30) 79Sc09=170(100-40) 71Su14=200(40)															∗∗
^{217}Tl	18310#	400#					1#	s	(>300 ns)	$1/2^+$#	11	10Al24	I	2010	β^- ?; β^-n ?	
^{217}Pb	12240#	300#					30#	s	(>300 ns)	$9/2^+$#	11	10Al24	I	2009	β^- ?	
^{217}Bi	8730	18					98.5	s	0.8	$9/2^-$#	03	03Ku25	T	1998	β^-=100	∗
^{217}Bi^m	10200	40	1470	40			2.31	μs	0.06	$27/2^-$#		12Go.A	ET	2012	IT=100	∗
^{217}Po	5885	6					1.514	s	0.026	$(9/2^+)$	03	04Li28	TJ	1956	α>95; β^-<5	∗
^{217}At	4396	5					32.3	ms	0.4	$9/2^-$	03	97Ch53	D	1947	$\alpha\approx$100; β^-=0.008 2	∗
^{217}Rn	3659	4					540	μs	50	$9/2^+$	03			1949	α=100	
^{217}Fr	4315	7					16.8	μs	1.9	$9/2^-$	03	90An19	T	1968	α=100	∗
^{217}Ra	5888	9					1.63	μs	0.17	$(9/2^+)$	03	90An19	T	1970	α=100	∗
^{217}Ac	8704	11					69	ns	4	$9/2^-$	03			1972	α=100; β^+=6.9e–9	
^{217}Ac^m	10716	18	2012	20	AD		740	ns	40	$(29/2)^+$	03			1973	IT=95.7 10; α=4.3 10	
^{217}Th	12218	21					247	μs	4	$9/2^+$#	03	05Ku31	T	1968	α=100	∗
^{217}Th^m	12892	21	673.8	1.8			141	ns	50	$(15/2^-)$	03			1989	IT=100	∗
^{217}Pa	17070	50					3.48	ms	0.09	$9/2^-$#	03	02He29	T	1968	α=100; B=0.0024#	∗
^{217}Pa^m	18930	50	1860	7	AD		1.08	ms	0.03	$29/2^+$#	03	02He29	TD	1979	α=73 4; IT ?	
^{217}U	22970#	100#					800	μs	700	$1/2^-$#	03	05Le42	T	2000	$\alpha\approx$100; B=0.05#	∗
∗^{217}Bi	T : other not used 96Ry.B=97(3)															∗∗
∗^{217}Bi^m	E : 1429 + y ; y=40(40) estimated by NUBASE															∗∗
∗^{217}Po	T : average 03Ku25=1.53(0.03) 96Ry.B=1.47(0.05); other 04Li28=1.6(0.2)															∗∗
∗^{217}At	D : average β^- 97Ch53=0.0067(24)% 69Le.A=0.012(4)%															∗∗
∗^{217}Fr	T : average 90An19=16(2) 70Bo13=22(5)															∗∗
∗^{217}Ra	T : average 90An19=1.7(0.3) 70Bo13=1.6(0.2)															∗∗
∗^{217}Th	T : unweighed aver. 05Ku31=257(2) 02He29=237(2) 00He17=247(3) 73Ha32=252(7)															∗∗
∗^{217}Th	T : other 05Li17=310(70)															∗∗
∗^{217}Th^m	E : uncertainty estimated by NUBASE															∗∗
∗^{217}Pa	T : average 02He29=3.8(0.2) 00He17=3.4(0.1)															∗∗
∗^{217}U	T : symmetrized from 0.19(+1.13–0.10) ms; other 00Ma65=15.6(+21.3–5.7) ms															∗∗
^{218}Tl	23090#	400#					200#	ms		5^+#					β^- ?; β^-n ?	
^{218}Pb	15450#	300#					2#	m	(>300 ns)	0^+	11	10Al24	I	2009	β^- ?	
^{218}Bi	13216	27					33	s	1	$(6^-,7^-,8^-)$	06	04De16	J	1998	β^-=100	
^{218}Po	8358.8	2.3					3.098	m	0.012	0^+	06			1904	$\alpha\approx$100; β^-=0.02#	
^{218}At	8099	12					1.5	s	0.3	1^-#	06			1943	$\alpha\approx$100; β^-=0.1#	
^{218}Rn	5217.8	2.4					35	ms	5	0^+	06			1948	α=100	
^{218}Fr	7059	5					1.0	ms	0.6	1^-	06			1949	α=100	
^{218}Fr^m	7146	6	86	4	AD		22.0	ms	0.5		06			1982	$\alpha\approx$100; IT ?	
^{218}Fr^p	7260#	150#	200#	150#						high						
^{218}Ra	6651	11					25.2	μs	0.3	0^+	06			1970	α=100; 2β^+ ?	
^{218}Ac	10840	50					1.08	μs	0.09	1^-#	06			1970	α=100	
^{218}Ac^m	10990#	70#	150#	50#			32	ns	9	(9^-)		94De04	ET	1994		∗
^{218}Ac^n	11370#	70#	530#	50#			103	ns	11	(11^+)	06			1994	IT=100	∗
^{218}Th	12367	11					117	ns	9	0^+	06			1973	α=100	
^{218}Pa	18684	18					113	μs	10		06			1979	α=100	
^{218}U	21912	18					550	μs	140	0^+	06			1992	α=100	∗
^{218}U^m	24015	24	2103	19	AD		640	μs	200	(8^+)	06			2005	α=100	∗
∗^{218}Ac^m	E : at least 122.5 in 94De04															∗∗
∗^{218}Ac^n	E : 384.49(0.13) keV above ^{218}Ac^m, from ENSDF															∗∗
∗^{218}U	T : symmetrized from 510(+170–100)															∗∗
∗^{218}U^m	T : symmetrized from 560(+260–140)															∗∗

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{219}Pb	20280#	400#				10#	s	(>300 ns)	$9/2^+$#	11	10Al24	I	2009	β^- ?	
^{219}Bi	16280#	200#				22	s	7	$9/2^-$#	11	12Be28	T	2009	β^-=100	
^{219}Po	12681	16				2#	m	(>300 ns)	$9/2^+$#	08	98Pf02	I	1998	β^- ?; α ?	
^{219}At	10397	4				56	s	3	$5/2^-$#	01			1953	$\alpha\approx$97; $\beta^-\approx$3	
^{219}Rn	8830.9	2.5				3.96	s	0.01	$5/2^+$	01			1903	α=100	
^{219}Fr	8619	7				20	ms	2	$9/2^-$	01			1948	α=100	
^{219}Ra	9395	8				10	ms	3	$(7/2)^+$	01			1952	α=100	
^{219}Ac	11570	50				11.8	μs	1.5	$9/2^-$	01			1970	α=100; β^+=1e–6#	
^{219}Th	14470	50				1.05	μs	0.03	$9/2^+$#	01			1973	α=100; β^+=1e–7#	
^{219}Pa	18540	50				53	ns	10	$9/2^-$	01			2005	α=100; β^+=5e–9#	
^{219}U	23290	50				55	μs	25	$9/2^+$#	01			1993	α=100; β^+=1.4e–5#	*
^{219}Np	29280#	200#				55#	μs		$9/2^-$#					α ?	
*^{219}U	T : symmetrized from 42(+34–13); also 05Le42=80(+100–30)														**
^{220}Pb	23670#	400#				30#	s	(>300 ns)	0^+	11	10Al24	I	2010	β^- ?	
^{220}Bi	20820#	300#				7#	s	(>300 ns)	1^-#	11	10Al24	I	2009	β^- ?; β^-n ?	
^{220}Po	15263	18				40#	s	(>300 ns)	0^+	11	98Pf02	I	1998	β^- ?	
^{220}At	14376	14				3.71	m	0.04	$3^{(-\#)}$	11			1989	β^-=92 2; α=8 2	
^{220}Rn	10613.6	2.2				55.6	s	0.1	0^+	11			1900	α=100; 2β^- ?	
^{220}Fr	11483	4				27.4	s	0.3	1^+	11			1948	$\alpha\approx$100; β^-=0.35 5	
^{220}Ra	10271	8				17.9	ms	1.4	0^+	11	00He17	T	1949	α=100	*
^{220}Ac	13744	6				26.36	ms	0.19	(3^-)	11	90An19	T	1970	α=100; β^+=5e–4#	*
^{220}Th	14669	22				9.7	μs	0.6	0^+	11			1973	α=100; ε=2e–7#	
^{220}Pa	20220#	50#				780	ns	160	1^-#	11			2005	α=100; β^+=3e–7#	
^{220}U	22930#	100#				60#	ns		0^+					α ?; β^+ ?	
^{220}Np	30310#	200#				100#	ns		1^-#					α ?	
*^{220}Ra	T : average 00He17=18(2) 90An19=17(2) 61Ru06=23(5)														**
*^{220}Ac	T : average 90An19=26.4(0.2) 70Bo13=26.1(0.5)														**
^{221}Bi	24100#	300#				5#	s	(>300 ns)	$9/2^-$#	11	10Al24	I	2009	β^- ?; β^-n ?	
^{221}Po	19774	20				2.2	m	0.7	$9/2^+$#		10Ch19	T	2010	β^- ?	*
^{221}At	16783	14				2.3	m	0.2	$3/2^-$#	07			1989	β^-=100	
^{221}Rn	14473	6				25.7	m	0.5	$7/2^+$	07	97Li23	T	1956	β^-=78 1; α=22 1	
^{221}Fr	13279	5				4.777	m	0.013	$5/2^-$	07	10Wa42	T	1947	$\alpha\approx$100; β^-=0.0048 15; …	*
^{221}Ra	12964	5				28	s	2	$5/2^+$	07	94Bo28	D	1949	α=100; ^{14}C=1.2e–10 9	
^{221}Ac	14520	50				52	ms	2	$9/2^-$#	07			1968	α=100	
^{221}Th	16938	9				1.68	ms	0.06	$(7/2^+)$	07			1970	α=100	*
^{221}Pa	20380	50				5.9	μs	1.7	$9/2^-$	07			1983	α=100	
^{221}U	24480#	100#				700#	ns		$9/2^+$#	07				α ?; β^+ ?	
^{221}Np	29850#	200#				100#	ns		$9/2^-$#					α ?	
*^{221}Po	T : symmetrized from 10Ch19=112(+58–28) s														**
*^{221}Fr	D : …; ^{14}C=8.8e–11 11														**
*^{221}Fr	D : β^- intensity is from 97Ch53; ^{14}C intensity is from 94Bo28														**
*^{221}Fr	T : average 10Wa42=4.768(0.017) 07Je07=4.79(0.02)														**
*^{221}Th	T : also 05Li17=2.3(0.4) 00He17=2.0(+0.3–0.2)														**
^{222}Bi	28670#	300#				2#	s	(>300 ns)	1^-#		10Al24	I	2009	β^- ?; β^-n ?	
^{222}Po	22490	40				9.1	m	7.2	0^+	11			2010	β^- ?	*
^{222}At	20953	16				54	s	10		11			1989	β^-=100	
^{222}Rn	16374.0	2.3				3.8235	d	0.0003	0^+	11			1899	α=100	
^{222}Fr	16350	21				14.2	m	0.3	2^-	11			1975	β^-=100	
^{222}Ra	14322	5				33.6	s	0.4	0^+	11	12Po13	T	1948	α=100; ^{14}C=3.0e–8 10	*
^{222}Ac	16622	5			*	5.0	s	0.5	1^-	11			1949	α=99 1; β^+=1 1	
^{222}Ac^m	16830#	150#	200#	150#	*	1.05	m	0.05	high	11			1972	α=?; IT<10; β^+=1.4 4	*
^{222}Th	17203	12				2.05	ms	0.07	0^+	11	00He17	T	1970	α=100; ε<1.3e–8#	*
^{222}Pa	22160#	70#				3.2	ms	0.3		11	95Ni.A	T	1970	α=100	*
^{222}U	24220#	100#				1.5	μs	0.8	0^+	11			1983	α=100; β^+<1e–6#	*
^{222}Np	31020#	200#				3#	μs		1^-#					α ?	
*^{222}Po	T : symmetrized from 10Ch19=145(+694–66) s														**
*^{222}Ra	T : others not used 95Ko54=36.17(0.10) 82Bo04=43(4)														**
*^{222}Ac^m	D : derived from 0.7% < β^+ < 2%, in ENSDF														**
*^{222}Th	T : average 00He17=2.0(0.1) 99Gr28=2.1(0.1); other 05Li17=2.4(0.3)														**
*^{222}Pa	T : average 95Ni.A=3.3(0.3) 79Sc09=2.9(+0.6–0.4)														**
*^{222}Pa	T : 70Bo13=5.7(0.5) conflicting, not used														**
*^{222}U	T : symmetrized from 1.0(+1.2–0.4)														**

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{223}Bi	32140#	400#				1#	s	(>300 ns)	$9/2^-$#	11	10Al24	I	2009	β^- ?; β^-n ?	
^{223}Po	27080#	200#				1#	m	(>300 ns)	$9/2^+$#	11	10Al24	I	2010	β^- ?	
^{223}At	23428	14				50	s	7	$3/2^-$#	01			1989	$\beta^-\approx$100; α=0.008#	
^{223}Rn	20390	8				24.3	m	0.4	$7/2^{(-\#)}$	01			1964	β^-=100; α=0.0004#	
^{223}Fr	18384.0	2.4				22.00	m	0.07	$3/2^{(-)}$	01			1939	$\beta^-\approx$100; α=0.006	
^{223}Ra	17234.8	2.5				11.43	d	0.05	$3/2^+$	01			1905	α=100; ^{14}C=8.9e–8 4	
^{223}Ac	17827	7				2.10	m	0.05	$(5/2^-)$	01			1948	α=99; ε=1	
^{223}Th	19386	9				600	ms	20	$(5/2)^+$	01			1952	α=100	
^{223}Pa	22320	70				5.1	ms	0.3	$9/2^-$#	01	99Ho28	T	1970	α=100; β^+<0.001#	*
^{223}U	25840	70				21	μs	8	$7/2^+$#	01			1991	$\alpha\approx$100; β^+=0.2#	*
^{223}Np	30600#	200#				1#	μs		$9/2^-$#					α ?	
*^{223}Pa	T : average 99Ho28=4.9(0.4) 95Ni.A=5.0(1.0) 70Bo13=6.5(1.0)														**
*^{223}U	T : symmetrized from 18(+10–5)														**
^{224}Bi	36770#	400#				300#	ms	(>300 ns)	1^-#	11	10Al24	I	2010	β^- ?; β^-n ?	
^{224}Po	29910#	200#				1#	m	(>300 ns)	0^+	11	10Al24	I	2010	β^- ?	
^{224}At	27711	22				2.5	m	1.5		12			2010	β^- ?	*
^{224}Rn	22445	10				107	m	3	0^+	97			1964	β^-=100	
^{224}Fr	21795	13				3.33	m	0.10	1^-	97			1969	β^-=100	
^{224}Fr^x	21900#	100#	100#	100#	MD	*contamnt*	n								
^{224}Ra	18827.3	2.2				3.66	d	0.04	0^+	97			1902	α=100; ^{14}C=4.0e–9 12	
^{224}Ac	20235	4				2.78	h	0.17	0^-	97			1948	β^+=90.6 17; α=9.4 17; β^-<1.6#	*
^{224}Th	19994	10				1.05	s	0.02	0^+	97			1949	α=100; 2β^+ ?	
^{224}Pa	23863	8				844	ms	19	5^-#	97	97Wi15	T	1958	$\alpha\approx$100; β^+=0.1#	*
^{224}U	25714	25				940	μs	270	0^+	97	92To02	T	1991	α=100; β^+<1.2e–4#	*
^{224}Np	31880#	200#				100#	μs		1^-#					α ?	
*^{224}At	T : symmetrized from 10Ch19=76(+138–23) s														**
*^{224}Ac	D : symmetrized from β^+=90.9(+1.4–2.0)%; α=9.1(+2.0–1.4)%														**
*^{224}Pa	T : average 97Wi15=850(20) 96Li05=790(60)														**
*^{224}U	T : average 92To02=1000(400) 91An10=700(+500–200)														**
^{225}Po	34530#	300#				20#	s	(>300 ns)	$9/2^+$#	11	10Al24	I	2010	β^- ?	
^{225}At	30400#	300#				2#	m	(>300 ns)	$1/2^+$#	11	10Al24	I	2010	β^- ?	
^{225}Rn	26534	11				4.66	m	0.04	$7/2^-$	09			1969	β^-=100	
^{225}Fr	23821	12				3.95	m	0.14	$3/2^-$	09			1969	β^-=100	
^{225}Ra	21994.3	2.9				14.9	d	0.2	$1/2^+$	09			1947	β^-=100	
^{225}Ac	21639	5				9.920	d	0.003	$3/2^-$#	09	12Po14	T	1947	α=100; ^{14}C=4.5e–12 14	
^{225}Th	22311	5				8.75	m	0.04	$(3/2^+)$	09			1949	$\alpha\approx$90; $\varepsilon\approx$10	
^{225}Pa	24340	70				1.7	s	0.2	$5/2^-$#	09			1958	α=100	
^{225}U	27378	12				61	ms	4	$5/2^+$#	09	00He17	T	1989	α=100	*
^{225}Np	31590	70				3#	ms	(>2 μs)	$9/2^-$#	09	94Ye08	ID	1994	α=100	
*^{225}U	T : symmetrized from 00He17=59(+5–2); others not used 03Ni10=135(+93–39)														**
*^{225}U	T : 01Ku07=84(4) 94An02=68(+45–20) 92To02=95(15) and 89He13=80(+40–10)														**
^{226}Po	37550#	400#				20#	s	(>300 ns)	0^+	11	10Al24	I	2010	β^- ?	
^{226}At	34610#	300#				20#	s	(>300 ns)		11	10Al24	I	2010	β^- ?; β^-n ?	
^{226}Rn	28747	10				7.4	m	0.1	0^+	96			1969	β^-=100	
^{226}Fr	27541	12				49	s	1	1^-	96			1969	β^-=100	
^{226}Ra	23669.6	2.3				1.600	ky	0.007	0^+	96	90We01	D	1898	α=100; ^{14}C=2.6e–9 6; 2β^- ?	*
^{226}Ac	24310	3				29.37	h	0.12	$(1)^{(-\#)}$	96			1950	β^-=83 3; ε=17 3; α=0.006 2	
^{226}Th	23197	5				30.70	m	0.03	0^+	96	01Bo11	D	1948	α=100; ^{18}O<3.2e–12	*
^{226}Pa	26033	11				1.8	m	0.2		96			1949	α=74 5; β^+=26 5	
^{226}U	27329	13				269	ms	6	0^+	96	01Ca.B	T	1973	α=100	*
^{226}Np	32780#	90#				35	ms	10		96			1990	α=100; β^+=0.003#	
*^{226}Ra	D : ^{14}C: average 90We01=2.3(0.8)e–9% 86Ba26=2.9(1.0)e–9% 85Ho21=3.2(1.6)e–9%														**
*^{226}Th	T : from 12Po13; other 87Mi10=30.57(0.10)														**
*^{226}U	T : average 01Ca.B=258(13) 00He17=281(9) 99Gr28=260(10)														**
^{227}Po	42280#	400#				5#	s	(>300 ns)	$9/2^+$#	11	10Al24	I	2010	β^- ?	
^{227}At	37480#	300#				20#	s	(>300 ns)	$1/2^+$#	11	10Al24	I	2010	β^- ?; β^-n ?	
^{227}Rn	32886	14				20.8	s	0.7	$5/2^{(+\#)}$	01	97Ku20	J	1986	β^-=100	
^{227}Fr	29686	13				2.47	m	0.03	$1/2^+$	01			1972	β^-=100	
^{227}Ra	27179.5	2.3				42.2	m	0.5	$3/2^+$	01			1953	β^-=100	
^{227}Ac	25851.1	2.4				21.772	y	0.003	$3/2^-$	01			1902	β^-=98.62 36; α=1.38 36	
^{227}Th	25806.3	2.5				18.68	d	0.09	$1/2^+$	01			1906	α=100	
^{227}Pa	26832	7				38.3	m	0.3	$(5/2^-)$	01			1948	α=85 2; ε=15 2	
^{227}U	29022	17				1.1	m	0.1	$(3/2^+)$	01			1952	α=100; β^+<0.001#	
^{227}Np	32560	70				510	ms	60	$5/2^-$#	01			1990	$\alpha\approx$100; β^+=0.05#	

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)		Half-life			J^{π}	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{228}At	41680#	400#			5#	s	(>300 ns)		11	10Al24	I	2010	β^- ?; β^-n ?	
^{228}Rn	35243	18			65	s	2	0^+	97			1989	β^-=100	
^{228}Fr	33369	13			38	s	1	2^-	97			1972	β^-=100	$*$
^{228}Ra	28942.2	2.4			5.75	y	0.03	0^+	97			1907	β^-=100	
^{228}Ac	28896.4	2.5			6.15	h	0.02	3^+	97			1908	β^-=100	$*$
^{228}Th	26772.3	2.2			1.9116	y	0.0016	0^+	97			1905	α=100; ^{20}O=1.13e–11 22	
^{228}Pa	28924	4			22	h	1	3^+	97			1948	β^+=98.0 2; α=2.0 2	
^{228}U	29222	14			9.1	m	0.2	0^+	97			1949	$\alpha>95$; $\varepsilon<5$	
^{228}Np	33600	50			61.4	s	1.4		97	94Kr13	D	1994	ε=60 7; α=40 7; β^+SF=0.012 6	$*$
^{228}Pu	36080	30			2.1	s	1.3	0^+	97	03Ni10	T	1994	$\alpha\approx$100; β^+=0.1#	$*$
$*^{228}$Fr	I : 08Ch.A reports an excited isomer with half-life=94(+170–29) s													$**$
$*^{228}$Ac	I : 08Ch.A reports an excited isomer with half-life=149(+95–42) s													$**$
$*^{228}$Np	D : β^+SF=0.020(9)% defined in 94Kr13 relative to ε, thus 0.012(6)% of total													$**$
$*^{228}$Pu	T : symmetrized from 1.1(+2.0–0.5)													$**$
^{229}At	44820#	400#			5#	s	(>300 ns)	$1/2^+$#	11	10Al24	I	2010	β^- ?; β^-n ?	
^{229}Rn	39362	13			11.9	s	1.3	$5/2^+$#	09			2009	β^- ?	$*$
^{229}Fr	35674	14			50.2	s	0.4	$1/2^+$#	08	92Bo05	T	1975	β^-=100	
^{229}Ra	32549	14			4.0	m	0.2	$5/2^+$	08			1975	β^-=100	
^{229}Ac	30698	12			62.7	m	0.5	$(3/2^+)$	08			1952	β^-=100	
^{229}Th	29586.8	2.8			7.932	ky	0.055	$5/2^+$	08	11Ki16	T	1947	α=100	
^{229}Th^m	29586.8	2.8	0.0076	0.0005	> 1	m		$3/2^+$#	08	09In01	T	1994	IT ?; α ?	$*$
^{229}Pa	29898	4			1.50	d	0.05	$(5/2^+)$	08			1949	$\varepsilon\approx$100; α=0.48 5	
^{229}Pa^m	29910	4	11.6	0.3	420	ns	30	$3/2^-$	08	98Le15	EJD	1982	IT=100	
^{229}U	31211	6			58	m	3	$(3/2^+)$	08			1949	$\beta^+\approx$80; $\alpha\approx$20	
^{229}Np	33780	90			4.00	m	0.18	$5/2^+$#	08	04Sa05	TD	1968	α=68 11; β^+ ?	$*$
^{229}Np^p	33940#	100#	160#	50#				$5/2^-$#						
^{229}Pu	37390	50			91	s	26	$3/2^+$#	08	10Kh06	TD	1994	α=50 20; β^+=50 20; SF<7	$*$
$*^{229}$Rn	T : symmetrized from 09Ne03=12.0(+1.2–1.3)													$**$
$*^{229}$Th^m	T : lower limit from 09In01(1m<T<3m); others 09Ki14<2h 03Mi02(same group													$**$
$*^{229}$Th^m	T : as 09Ki14)=13.9(3.0)h 01Br20(T<6 h or T>20d) 94He08=70(50)h													$**$
$*^{229}$Np	T : average 04Sa05=4.0(0.4) 68Ha14=4.0(0.2)													$**$
$*^{229}$Pu	T : average 10Kh06=67(+41–19) 01Ca.B=90(+71–27)													$**$
$*^{229}$Pu	D : from ENSDF'97													$**$
^{230}Rn	42050#	200#			10#	s	(>300 ns)	0^+	11	10Al24	I	2010	β^- ?	
^{230}Fr	39511	16			19.1	s	0.5		07			1987	β^-=100	
^{230}Ra	34516	10			93	m	2	0^+	07			1978	β^-=100	
^{230}Ac	33838	16			122	s	3	(1^+)	07			1973	β^-=100; β^-SF=1.2e–6 4	
^{230}Th	30864.2	1.8			75.4	ky	0.3	0^+	07			1907	α=100; SF<4e–12; …	$*$
^{230}Pa	32175	3			17.4	d	0.5	(2^-)	07			1948	β^+=92.2 7; β^-=7.8 7; …	$*$
^{230}U	31615	5			20.23	d	0.02	0^+	07	12Po12	T	1948	α=100; 22Ne=4.8e–12 20; …	$*$
^{230}Np	35240	50			4.6	m	0.3		07			1968	$\beta^+<97$; $\alpha>3$	
^{230}Pu	36934	15			1.70	m	0.17	0^+	07	01Ca.B	T	1990	$\alpha\approx$100; β^+ ?	
^{230}Am	42930#	130#			1.4	m	1.3		07			2003	β^+=100	$*$
$*^{230}$Th	D : …; ^{24}Ne=5.8e–11 13													$**$
$*^{230}$Pa	D : …; α=0.0032 1													$**$
$*^{230}$U	D : …; SF<1.4e–10#; $2\beta^+$?													$**$
$*^{230}$Am	T : symmetrized from 17(+119–17) s													$**$
^{231}Rn	46450#	300#			300#	ms	(>300 ns)	$1/2^+$#	11	10Al24	I	2010	β^- ?	
^{231}Fr	42064	25			17.6	s	0.6	$1/2^+$#	01			1985	β^-=100	
^{231}Ra	38216	11			104.0	s	0.8	$(5/2^+)$	01	06Bo33	T	1983	β^-=100	$*$
^{231}Ra^m	38282	11	66.21	0.09	53	μs		$(1/2^+)$	01			2001	IT=100	
^{231}Ac	35763	13			7.5	m	0.1	$(1/2^+)$	01			1973	β^-=100	
^{231}Th	33817.5	1.8			25.52	h	0.01	$5/2^+$	01			1911	β^-=100; α=4e–11#	
^{231}Pa	33426.0	2.2			32.76	ky	0.11	$3/2^-$	01			1918	α=100; SF$\leq$2e–11; …	$*$
^{231}U	33808	3			4.2	d	0.1	$(5/2)^{(+\#)}$	01			1949	$\varepsilon\approx$100; α=0.004 1	
^{231}Np	35630	50			48.8	m	0.2	$(5/2)^{(+\#)}$	01			1950	β^+=98 1; α=2 1	
^{231}Pu	38286	26			8.6	m	0.5	$3/2^+$#	01	99La14	D	1999	β^+=87 5; α=13 5	$*$
^{231}Am	42440#	300#			1#	m							β^+ ?; α ?	
$*^{231}$Ra	T : average 06Bo33=104.1(0.8) 85Hi02=103(3)													$**$
$*^{231}$Pa	D : …; ^{24}Ne=13.4e–10 17; ^{23}F=9.9e–13													$**$
$*^{231}$Pu	D : symmetrized from 90(+3–7)% and 10(+7–3)%													$**$

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)		Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{232}Fr	45990#	160#			5.5	s	0.6	(5)	06			1990	β^-=100; β^-SF<2e–4	
^{232}Ra	40497	9			4.0	m	0.3	0^+	06	08Ch.A	T	1983	β^-=100	*
^{232}Ac	39154	13			1.98	m	0.08	(1^+)	06			1986	β^-=100	
^{232}Th	35448.7	1.9			14.0	Gy	0.1	0^+	06			1898	IS=100.; α=100; SF=1.1e–9 4; ...	*
^{232}Pa	35948	8			1.32	d	0.02	(2^-)	06			1949	$\beta^-\approx$100; ε=0.003 1	
^{232}U	34610.9	2.2			68.9	y	0.4	0^+	06			1949	α=100; ^{24}Ne=8.9e–10 7; ...	*
^{232}Np	37360#	100#			14.7	m	0.3	(4^+)	06			1950	$\beta^+\approx$100; $\alpha\approx$0.0002#	
^{232}Pu	38363	18			33.7	m	0.5	0^+	06			1973	ε=90#; α=11 6	*
^{232}Am	43270#	300#			1.31	m	0.04	1^-#	06			1967	β^+=?; α=3#; β^+SF=0.069 10	
^{232}Cm	46400#	200#			30#	s		0^+					β^+ ?; α ?	

*^{232}Ra T : average 08Ch.A=4.00(0.33) 86Gi08=4.2(0.8) **
*^{232}Th D : ... ; ^{24}Ne+^{26}Ne<2.78e–10; 2β^- ? **
*^{232}U D : ... ; SF=2.7e–12 6; ^{28}Mg<5e–12 **
*^{232}Pu T : average 00La25=33.1(0.8) 73Ja06=34.1(0.7) D : 52Or.A α>1.6% 73Ja06<20% **

Nuclide	Mass excess (keV)		Excitation energy (keV)		Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{233}Fr	49030#	300#			5#	s	(>300 ns)	$1/2^+$#	11	10Al24	I	2010	β^- ?; β^-n ?	
^{233}Ra	44322	16			30	s	5	$1/2^+$#	05			1990	β^-=100	
^{233}Ac	41308	13			145	s	10	$(1/2^+)$	05			1983	β^-=100	
^{233}Th	38733.6	2.0			21.83	m	0.04	$(1/2)^+$	05			1935	β^-=100	
^{233}Pa	37490.0	2.1			26.975	d	0.013	$3/2^-$	05			1938	β^-=100	
^{233}U	36920.3	2.7			159.2	ky	0.2	$5/2^+$	05			1947	α=100; SF<6e–11; ...	*
^{233}Np	37950	50			36.2	m	0.1	$5/2^+$#	05	50Ma14	D	1950	$\beta^+\approx$100; α=0.0007	*
^{233}Np^p	38000#	60#	50#	30#				$(5/2^-)$	05					
^{233}Pu	40050	50			20.9	m	0.4	$5/2^+$#	05			1957	$\beta^+\approx$100; α=0.12 5	
^{233}Am	43260#	100#			3.2	m	0.8	$5/2^-$#	05	00Sa52	TD	2000	β^+ ?; α=4.5 9	*
^{233}Cm	47290	70			27	s	10	$3/2^+$#	05	10Kh06	TD	2001	α=20 10; β^+=80 10	*

*^{233}U D : ... ; ^{24}Ne=7.2e–11 9; ^{28}Mg<1.3e–13 **
*^{233}Np D : α observed in 50Ma14 with β^+/α=1.5e5 **
*^{233}Am D : combining 10Kh06 α<6 and 00Sa52 α>3 **
*^{233}Cm T : symmetrized from 23(+13–6) **

Nuclide	Mass excess (keV)		Excitation energy (keV)		Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{234}Ra	46890	30			30	s	10	0^+	07			1990	β^-=100; β^-SF<1e–4	
^{234}Ac	44841	14			45	s	2	1^+#	07	08Ch.A	T	1986	β^-=100	*
^{234}Th	40614	3			24.10	d	0.03	0^+	07			1900	β^-=100; α<1e–4	
^{234}Pa	40340	5			6.70	h	0.05	4^+	07	78Ga07	D	1913	β^-=100; SF<3e–10	
^{234}Pa^m	40419	4	79	3	1.159	m	0.011	(0^-)	07	78Ga07	D	1951	$\beta^-\approx$100; IT=0.16 4; SF<1e–10	*
^{234}U	38146.8	1.8			245.5	ky	0.6	0^+	07			1912	IS=0.0054 5; α=100; ...	*
^{234}U^m	39568.1	1.8	1421.257	0.017	33.5	μs	2.0	6^-	07			1963	IT=100	
^{234}Np	39957	9			4.4	d	0.1	(0^+)	07			1949	β^+=100	
^{234}Pu	40350	7			8.8	h	0.1	0^+	07			1949	$\varepsilon\approx$94; $\alpha\approx$6	
^{234}Am	44460#	160#			2.32	m	0.08		07	90Ha02	D	1967	$\beta^+\approx$100; α=0.039 12; ...	*
^{234}Cm	46724	18			51	s	12	0^+	07	10Kh06	D	2001	$\beta^+\approx$71; $\alpha\approx$27; SF$\approx$2	
^{234}Bk	53340#	140#			2.43	m	0.17		07			2003	α>80; β^+<20	*

*^{234}Ac I : 08Ch.A reports two excited isomers with T>93 s and T=149(+95–42) s **
*^{234}Pa^m E : less than 10 keV above (3^+) level at 73.92(0.02), see ENSDF2007 **
*^{234}U D : ... ; SF=1.64e–9 22; ^{28}Mg=1.4e–11 3; ^{24}Ne+^{26}Ne=9e–12 7 **
*^{234}Am D : ... ; β^+SF=0.0066 18 T : also 04Sa05=3.5(1.3) not used **
*^{234}Bk T : symmetrized from 140(+14–5) s **

Nuclide	Mass excess (keV)		Excitation energy (keV)		Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{235}Ra	51200#	300#			3#	s		$5/2^+$#					β^- ?	
^{235}Ac	47357	14			62	s	4	$1/2^+$#	08	08Ch.A	T	2006	β^- ?	
^{235}Th	44018	13			7.2	m	0.1	$1/2^+$#	03			1969	β^-=100	
^{235}Pa	42289	14			24.44	m	0.11	$(3/2^-)$	03			1950	β^-=100	
^{235}U	40920.7	1.8			704	My	1	$7/2^-$	03			1935	IS=0.7204 6; α=100; ...	*
^{235}U^m	40920.8	1.8	0.0765	0.0004	26	m		$1/2^+$	03			1966	IT=100	
^{235}Np	41044.9	2.0			396.1	d	1.2	$5/2^+$	03			1949	$\varepsilon\approx$100; α=0.00260 13	
^{235}Pu	42184	21			25.3	m	0.5	$(5/2^+)$	03			1957	$\beta^+\approx$100; α=0.0028 7	
^{235}Am	44630	50			10.3	m	0.6	$5/2^-$#	03	04Sa05	T	1996	$\beta^+\approx$100; α=0.40 5	
^{235}Cm	48010#	200#			5#	m		$5/2^+$#	03				β^+ ?; α ?	
^{235}Cm^p	48060#	210#	50#	50#				*am*						
^{235}Bk	52700#	400#			1#	m							β^+ ?; α ?	

*^{235}U D : ... ; SF=7e–9 2; ^{20}Ne=8e–10 4; ^{25}Ne$\approx$8e–10; ^{28}Mg=8e–10 **

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{236}Ac	51220	40				4.5	m	3.6			10Ch19	T	2010	β^- ?	*
^{236}Th	46255	14				37.3	m	1.5	0^+	06			1973	β^-=100	
^{236}Pa	45334	14				9.1	m	0.1	$1^{(-)}$	06			1963	β^-=100; β^-SF=6e–8 4	*
^{236}U	42446.5	1.8				23.42	My	0.03	0^+	06			1951	α=100; SF=9.4e–8 4	*
^{236}U^m	45197	3	2750	3		120	ns	2	(0^+)	06			1969	IT=87 6; SF=13 6; α<10	
^{236}Np	43380	50			*	153	ky	5	(6^-)	06			1949	ε=86.3 8; β^-=13.5 8; α=0.16 4	
^{236}Np^m	43439	7	60	50	*	22.5	h	0.4	1	06			1949	ε=50 3; β^-=50 3	
^{236}Np^p	43618	14	240	50	AD				(3^-)	06					
^{236}Pu	42902.9	2.2				2.858	y	0.008	0^+	06	90Og01	D	1949	α=100; SF=1.9e–7 4; 28Mg=2e–12; 2β^+ ?	*
^{236}Pu^m	44088.4	2.2	1185.45	0.15		1.2	μs	0.3	5^-	06			2005	IT=100	
^{236}Am	46040#	110#				3.6	m	0.1	(5^-)	06	04Sa05	D	1998	β^+=?; α=4.0e–3 1	
^{236}Am^m	46090#	120#	50#	50#		2.9	m	0.2	(1^-)	06			2004	β^+=?; α=?	
^{236}Cm	47855	18				6.8	m	0.8	0^+	06	10Kh06	TD	2010	β^+=82 2; α=18 2; SF<0.1	
^{236}Bk	53540#	400#				2#	m			06				β^+ ?; α ?	
*^{236}Ac	T : symmetrized from 10Ch19=72(+345–33) s														**
*^{236}Pa	D : β^-SF decay questioned in 90Ha02														**
*^{236}U	D : and Ne+Mg < 4e–10%, from 89Mi.A														**
^{237}Ac	54280#	400#				4#	m		$1/2^+$#					β^- ?	
^{237}Th	49955	16				4.8	m	0.5	$5/2^+$#	06			1993	β^-=100	
^{237}Pa	47528	13				8.7	m	0.2	$(1/2^+)$	06			1954	β^-=100	
^{237}U	45392.1	1.8				6.752	d	0.002	$1/2^+$	06			1940	β^-=100	
^{237}U^m	45666.1	2.1	274.0	1.0		155	ns	6	$(7/2)^-$	06			1968	IT=100	
^{237}Np	44873.5	1.8				2.144	My	0.007	$5/2^+$	06	89Pr.A	D	1948	α=100; SF<2e–10; ^{30}Mg<4e–12	*
^{237}Np^m	45818.7	1.8	945.20	0.10		710	ns	40	(11/2,13/2)	06			1990	IT=100	
^{237}Pu	45093.5	2.2				45.64	d	0.04	$7/2^-$	06			1949	$\varepsilon\approx$100; α=0.0042 4	
^{237}Pu^m	45239.0	2.2	145.543	0.008		180	ms	20	$1/2^+$	06			1972	IT=100	
^{237}Pu^n	47990	250	2900	250		1.1	μs	0.1		06			1970	SF=?	
^{237}Am	46570#	60#				73.6	m	0.8	$5/2^{(-)}$	06			1970	$\beta^+\approx$100; α=0.025 3	
^{237}Cm	49250	70				20#	m		$5/2^+$#	06	02As08	D	2002	β^+ ?; α=1.8	*
^{237}Cm^p	49450#	170#	200#	150#					$7/2^-$						
^{237}Bk	53190#	220#				2#	m		$(3/2^-)$					β^+ ?; α ?	
^{237}Cf	57940	90				0.8	s	0.2	$5/2^+$#	06	10Kh06	TD	1995	α=70 10; SF=30 10; β^+ ?	*
*^{237}Np	D : and cluster (Z=10-14) < 1.8e–12%, from 92Mo03														**
*^{237}Cm	D : partial α T=6.6e4 s or 1100 m														**
*^{237}Cf	T : others not used 95La09=2.1(0.3)														**
^{238}Th	52630#	280#				9.4	m	2.0	0^+	02			1999	β^-=100	
^{238}Pa	50894	16				2.27	m	0.09	3^-#	02	85Ba57	D	1968	β^-=100; β^-SF<2.6e–6	
^{238}U	47309.1	1.9				4.468	Gy	0.003	0^+	02	91Tu02	D	1896	IS=99.2742 10; α=100; …	*
^{238}U^m	49867.0	2.0	2557.9	0.5		280	ns	6	0^+	02			1979	IT=?; SF=2.6 4; α<0.5	
^{238}Np	47456.5	1.8				2.117	d	0.002	2^+	02			1949	β^-=100	
^{238}Np^m	49760#	200#	2300#	200#		112	ns	39		02			1970	SF$\approx$100; IT ?	
^{238}Pu	46164.9	1.8				87.7	y	0.1	0^+	02	89Wa10	D	1949	α=100; SF=1.9e–7 1; …	*
^{238}Am	48420	50				98	m	2	1^+	02			1950	β^+=100; α=1.0e–4 4	
^{238}Am^m	50920#	210#	2500#	200#		35	μs	18		02			1967	SF$\approx$100; IT ?	
^{238}Cm	49445	12				2.2	h	0.4	0^+	02	02As08	T	1994	ε ?; $\alpha\leq$10	*
^{238}Bk	54220#	260#				2.40	m	0.08		02	94Kr03	D	1994	$\beta^+\approx$100; α ?; β^+SF=0.048 2	
^{238}Cf	57280#	300#				21.2	ms	1.3	0^+	02	01Og08	TD	1995	SF$\approx$100; $\alpha\approx$0.2; β^+ ?	*
*^{238}U	D : …; SF=5.45e–5 7; 2β^-=2.2e–10 7														**
*^{238}U	D : 2β^-=2.2(7)e–10% derived from 2β^- half-life T=2.0(0.6) Zy, in 91Tu02														**
*^{238}Pu	D : …; ^{32}Si$\approx$1.4e–14; ^{28}Mg+^{30}Mg$\approx$6e–15														**
*^{238}Cm	T : same value quoted in 06As03; others not used 52Hi.A=2.3 48St.A=2.5														**
*^{238}Cf	T : average 10Kh06=22(5) 01Og08=21.1(+1.9–1.7) 95La09=21(2)														**
*^{238}Cf	D : also 10Kh06 α<5														**
^{239}Th	56610#	400#				2#	m		$7/2^+$#					β^- ?	
^{239}Pa	53340#	200#				1.8	h	0.5	$(3/2)^{(-\#)}$	03			1995	β^-=100	
^{239}U	50574.0	1.9				23.45	m	0.02	$5/2^+$	03			1937	β^-=100	
^{239}U^m	50594#	20#	20#	20#		> 250	ns		$(5/2^+)$	03			1994	β^-=100	
^{239}U^n	50707.8	1.9	133.7990	0.0010		780	ns	40	$1/2^+$	03			1975	IT=100	
^{239}Np	49312.6	2.0				2.356	d	0.003	$5/2^+$	03			1940	β^-=100; α=5e–10#	
^{239}Pu	48590.1	1.8				24.11	ky	0.03	$1/2^+$	03			1946	α=100; SF=3.1e–10 6	
^{239}Pu^m	48981.7	1.8	391.584	0.003		193	ns	4	$7/2^-$	03			1955	IT=100	
^{239}Pu^n	51690	200	3100	200		7.5	μs	1.0	$(5/2^+)$	03			1970	SF$\approx$100; IT ?	
^{239}Am	49392.2	2.4				11.9	h	0.1	$(5/2)^-$	03			1949	$\varepsilon\approx$100; α=0.010 1	
^{239}Am^m	51890	200	2500	200		163	ns	12	$(7/2^+)$	03			1969	SF$\approx$100; IT ?	
^{239}Cm	51150	50				2.5	h	0.4	$(7/2^-)$	03	02Sh.C	TD	1952	$\beta^+\approx$100; α=6.2e–3 14	*
^{239}Cm^p	51390#	110#	240#	100#					$1/2^+$						
^{239}Bk	54250#	210#				4#	m		$(7/2^+)$	03	89Ha27	J		β^+>99#; α<1; SF<1	
^{239}Bk^p	54290#	210#	41	11	AD				$(3/2^-)$		89Ha27	J			
^{239}Cf	58250#	210#				60	s	30	$5/2^+$#	03			1981	α=?; β^+ ?	*
^{239}Es	63560#	300#				1#	s		$5/2^+$#					α ?; β^+ ?; SF ?	
*^{239}Cm	D : 08Qi03<.001														**
*^{239}Cf	T : symmetrized from 39(+37–12)														**

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{240}Pa	56800#	300#					2#	m							β^- ?	
^{240}U	52716	5					14.1	h	0.1	0^+	08			1953	β^-=100; α<1e–10#	
^{240}Np	52318	17				*	61.9	m	0.2	(5^+)	08			1953	β^-=100	
^{240}Np^m	52336	13	18	14		*	7.22	m	0.02	(1^+)	08	81Hs02	E		β^-≈100; IT=0.12 1	
^{240}Pu	50127.2	1.8					6.561	ky	0.007	0^+	08			1949	α=100; SF=5.7e–6 2; 34Si<1.3e–11	*
^{240}Pu^m	51435.9	1.8	1308.74	0.05			165	ns	10	(5^-)	08			1967	IT=100	
^{240}Am	51512	14					50.8	h	0.3	(3^-)	08			1949	β^+=100; α≈1.9e–4 7	
^{240}Am^m	54510	200	3000	200			940	μs	40		08			1967	SF≈100; IT ?	
^{240}Cm	51725.6	2.2					27	d	1	0^+	08			1949	α≈100; ε<0.5; SF=3.9e–6 8	
^{240}Bk	55670#	150#					4.8	m	0.8		08			1980	β^+ ?; α=10#; β^+SF=0.0020 13	*
^{240}Bk^p	55910#	180#	240#	100#						*am*						
^{240}Cf	57991	19					40.3	s	0.9	0^+	08	10As.A	T	1970	α=98.5 2; SF=1.5 2; β^+?	*
^{240}Es	64200#	400#					1#	s							α ?; β^+ ?	
*^{240}Pu	D : was erroneously ^{34}Si<1.3e–13% in NUBASE2003															**
*^{240}Bk	D : symmetrized from β^+SF=0.0013(+18–7)%															**
*^{240}Cf	D : from 10Kh06; also 95La09 α≈98; SF≈2															**
^{241}Pa	59690#	400#					2#	m		$3/2^-$#					β^- ?	
^{241}U	56200#	300#					5#	m		$7/2^+$#					β^- ?	
^{241}Np	54260	70					13.9	m	0.2	$(5/2^+)$	05			1959	β^-=100; α<10e–6	
^{241}Pu	52957.0	1.8					14.290	y	0.006	$5/2^+$	05			1949	β^-≈100; α=0.00245 2; …	*
^{241}Pu^m	53118.7	1.8	161.6852	0.0009			880	ns	50	$1/2^+$	05			1975	IT=100	
^{241}Pu^n	55160	200	2200	200			21	μs	3		05			1970	SF=100	
^{241}Am	52936.2	1.8					432.6	y	0.6	$5/2^-$	05			1949	α=100; SF=3.6e–10 9; …	*
^{241}Am^m	55140	100	2200	100			1.2	μs	0.3		05			1969	SF=100	
^{241}Cm	53703.6	2.1					32.8	d	0.2	$1/2^+$	05			1952	ε=99.0 1; α=1.0 1	
^{241}Bk	56030#	200#					4.6	m	0.4	$(7/2^+)$	05			2003	α ?; β^+ ?	
^{241}Bk^p	56080#	200#	51	3	AD					$(3/2^-)$	05					
^{241}Cf	59330#	170#					2.35	m	0.18	$7/2^-$#	05	10As.A	T	1970	β^+ ?; α≈25	*
^{241}Cf^p	59480#	190#	150#	100#	Nm					$(1/2^+)$	05					
^{241}Es	63860#	230#					10	s	5	$(3/2^-)$	05	96Ni09	TJD	1996	α=?; β^+ ?	*
^{241}Es^p	64020#	300#	160#	200#						*am*						
^{241}Fm	69130#	300#					730	μs	60	$5/2^+$#	11	08Kh10	TD	2008	SF=?; α<14; β^+<12	*
*^{241}Pu	D : …; SF<2.4e–14															**
*^{241}Am	D : …; ^{34}Si<7.4e–14															**
*^{241}Cf	T : from 10As.A=141(11) s; other 70Si19=3.78(0.70) m															**
*^{241}Es	T : symmetrized from 8(+6–4)															**
*^{241}Fm	D : only SF observed, other modes are to be confirmed															**
^{242}U	58620#	200#					16.8	m	0.5	0^+	02			1979	β^-=100	
^{242}Np	57420	200				*	2.2	m	0.2	(1^+)	02			1979	β^-=100	
^{242}Np^m	57420#	210#	0#	50#		*	5.5	m	0.1	6^+#	02			1981	β^-=100	
^{242}Pu	54718.6	1.8					375	ky	2	0^+	02			1950	α=100; SF=5.50e–4 6	
^{242}Am	55469.9	1.8					16.02	h	0.02	1^-	02			1949	β^-=82.7 3; ε=17.3 3	
^{242}Am^m	55518.5	1.8	48.60	0.05			141	y	2	5^-	02			1950	IT≈100; α=0.45 2; SF<4.7e–9	
^{242}Am^n	57670	80	2200	80			14.0	ms	1.0	$(2^+,3^-)$	02			1962	SF≈100; IT=?; α ?	
^{242}Cm	54805.4	1.8					162.8	d	0.2	0^+	02			1949	α=100; SF=6.2e–6 3; …	*
^{242}Cm^m	57610	100	2800	100			180	ns	70		02			1971	SF ?; IT ?	
^{242}Bk	57740#	200#					7.0	m	1.3	2^-#	02	80Ga07	D	1972	β^+≈100; β^+SF<3e–5; α ?	
^{242}Bk^m	57940#	280#	200#	200#			600	ns	100		02			1972	SF≈100; IT ?	
^{242}Bk^p	57990#	220#	250#	100#						4^-						
^{242}Cf	59387	13					3.49	m	0.15	0^+	02	70Si19	T	1967	α=80 20; β^+ ?; SF<0.014	*
^{242}Es	64800#	260#					17.8	s	1.6		02	10An08	TD	1994	α=57 3; β^+=43 3; β^+SF=0.6 2	*
^{242}Fm	68400#	400#					800	μs	200	0^+	02			1975	SF=?; α ?	*
*^{242}Cm	D : …; ^{34}Si=1.1e–14 4; 2β^+ ? D : symmetrized from ^{34}Si=1.0(+4–3)e–14															**
*^{242}Cf	T : average 70Si19=3.68(0.44) 67Si07=3.4(0.2) 67Fi04=3.2(0.5) 67Il01=3.7(0.3)															**
*^{242}Es	T : others 00Sh10=11(3) 96Ni09=16(+6–4)															**
*^{242}Es	D : β^+SF from 00Sh10; other 10An08=1.3(+1.2–0.7)%															**
*^{242}Fm	T : conflicting 08Kh10 excludes 4 μs-1s															**

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{243}U	62400#	400#					10#	m		$9/2^-$#					β^- ?	
^{243}Np	59880#	30#					1.85	m	0.15	$(5/2^-)$	04			1979	β^-=100	
^{243}Np^p	59927	11	50#	30#	Nm					$(5/2^-)$						
^{243}Pu	57756	3					4.956	h	0.003	$7/2^+$	04			1951	β^-=100	
^{243}Pu^m	58140	3	383.6	0.4			330	ns	30	$(1/2^+)$	04			1975	IT=100	
^{243}Am	57176.3	2.3					7.37	ky	0.04	$5/2^-$	04			1950	α=100; SF=3.7e–9 2	
^{243}Am^m	59480	200	2300	200			5.5	μs	0.5		04			1970	SF≈100; IT ?	
^{243}Cm	57183.8	2.1					29.1	y	0.1	$5/2^+$	04			1950	α≈100; ε=0.29 3; SF=5.3e–9 9	
^{243}Cm^m	57271.2	2.1	87.4	0.1			1.08	μs	0.03	$1/2^+$	04			1971	IT=100	
^{243}Cm^p	57279	16	96	16	AD					$(7/2^+)$	04			1984	IT=100	
^{243}Bk	58691	5					4.5	h	0.2	$3/2^-$#	04			1950	β^+≈100; α≈0.15	
^{243}Bk^p	58710	19	18	20	AD					$(7/2^-)$						
^{243}Cf	60990#	110#					10.7	m	0.5	$1/2^+$#	04			1967	β^+≈86; α≈14	
^{243}Es	64750#	210#					21.6	s	1.6	$(7/2^+)$	04	10An08	TJD	1973	α=61 6; β^+=39 6; SF<1	∗
^{243}Fm	69360#	220#					231	ms	9	$7/2^-$#	04	08Kh10	TD	1981	α=91 3; SF=9 1; β^+ ?	
∗^{243}Es	T : average 10An08=23(3) 89Ha27=21(5) 73Es02=21(2)															∗∗
^{244}Np	63200#	300#					2.29	m	0.16	(7^-)	03			1987	β^-=100	
^{244}Pu	59807	5					80.0	My	0.9	0^+	03	92Mo25	D	1954	α≈100; SF=0.121 4; …	∗
^{244}Am	59881.1	2.1					10.1	h	0.1	6^-#	03			1950	β^-=100	
^{244}Am^m	59969.7	2.3	88.6	1.7	RQ		26	m	1	1^+	03			1950	β^-≈100; ε=0.0361 13	
^{244}Am^n	60080#	200#	200#	200#			900	μs	150		03			1967	SF≈100; IT ?	
^{244}Am^p	60080#	200#	200#	200#			6.5	μs			03			1969	SF≈100; IT ?	
^{244}Cm	58453.8	1.8					18.10	y	0.02	0^+	03			1950	α=100; SF=1.37e–4 3	
^{244}Cm^m	59494.0	1.8	1040.188	0.012			34	ms	2	6^+	03			1963	IT=100	
^{244}Cm^n	59550#	900#	1100#	900#			> 500	ns			03			1969	SF≈100; IT ?	
^{244}Bk	60716	14					4.35	h	0.15	4^-#	03			1972	β^+ ?; α=0.006 3	
^{244}Bk^m	61220#	300#	500#	300#			820	ns	60		03			1972	SF≈100; IT ?	
^{244}Bk^p	60860#	50#	140#	50#						*am*						
^{244}Cf	61479.4	2.9					19.4	m	0.6	0^+	03			1956	α≈100; ε ?	
^{244}Es	66030#	180#					37	s	4		03			1973	β^+=?; α=5 3; β^+SF=0.01	∗
^{244}Es^p	66230#	240#	200#	150#						*am*						
^{244}Fm	68970#	200#					3.12	ms	0.08	0^+	03	08Kh10	TD	1967	SF≈100; β^+<2; α=0.4#	
∗^{244}Pu	D : …; 2β^-<7.3e–9															∗∗
∗^{244}Pu	T : and $T(2\beta^-) > 1.1$ Ey, from 92Mo25; thus 2$\beta^- <$ 7.3 e–9%															∗∗
∗^{244}Es	D : symmetrized from α=4(+3–2)%															∗∗
^{245}Np	65950#	400#					2#	m		$5/2$#					β^- ?	
^{245}Pu	63180	14					10.5	h	0.1	$(9/2^-)$	11			1955	β^-=100	
^{245}Pu^m	63445	14	264.5	0.3			330	ns	20	$(5/2^+)$	11			2007	IT=100	
^{245}Am	61902	3					2.05	h	0.01	$(5/2)^+$	11			1955	β^-=100	
^{245}Am^m	64300#	400#	2400#	400#			640	ns	60		11			1972	SF≈100; IT ?	
^{245}Cm	61004.9	2.1					8.423	ky	0.074	$7/2^+$	11			1954	α=100; SF=6.1e–7 9	
^{245}Cm^m	61360.8	2.1	355.92	0.10			290	ns	20	$1/2^+$	11			1975	IT=100	
^{245}Bk	61815.6	2.3					4.95	d	0.03	$3/2^-$	11			1951	ε≈100; α=0.12 1	
^{245}Bk^p	61870#	30#	50#	30#						$(7/2^-)$						
^{245}Cf	63386.9	2.8					45.0	m	1.5	$1/2^+$	11			1956	β^+ ?; α=36 3	
^{245}Es	66370#	200#					1.1	m	0.1	$(3/2^-)$	11			1967	β^+ ?; α=40 10	
^{245}Es^p	66650#	200#	283	15						$(7/2^-)$	11			2005	IT=100	∗
^{245}Es^q	66700#	230#	330#	100#						$(1/2^-)$						
^{245}Fm	70190#	200#					4.2	s	1.3	$1/2^+$#	11			1967	α=?; β^+=4.2#; SF=0.13#	
^{245}Md	75270#	310#				∗ &	400	ms	200	$(7/2^-)$	11	96Ni09	TJD	1996	α=?; β^+ ?	∗
^{245}Md^m	75370#	330#	100#	100#		∗ &	900	μs	250	$1/2^-$#	11			1996	SF=?; α ?	
∗^{245}Es^p	E : 253.2 keV above the $7/2^+$ [633] level at 30(15) keV															∗∗
∗^{245}Md	T : symmetrized from 96Ni09=350(+230–160)															∗∗
^{246}Pu	65396	15					10.84	d	0.02	0^+	11			1955	β^-=100	
^{246}Am	64995#	18#					39	m	3	(7^-)	11			1955	β^-=100	
^{246}Am^m	65025	15	30#	10#			25.0	m	0.2	$2^{(-)}$	11			1955	β^-≈100; IT<0.02	
^{246}Am^n	67000#	800#	2000#	800#			73	μs	10		11			1972	SF≈100; IT ?	
^{246}Cm	62618.6	2.0					4.706	ky	0.040	0^+	11			1954	α≈100; SF=0.02615 7	
^{246}Bk	63970	60					1.80	d	0.02	$2^{(-)}$	11			1954	β^+≈100; α=0.1#	
^{246}Cf	64091.9	2.1					35.7	h	0.5	0^+	11			1951	α=100; SF=2.4e–4 4; ε<4e–3	
^{246}Es	67900#	220#					7.5	m	0.5	4^-#	11			1954	β^+=90.1 18; α=9.9 18; …	∗
^{246}Es^p	68250#	300#	350#	200#						*am*						∗
^{246}Fm	70189	15					1.54	s	0.04	0^+	11	10An08	T	1966	α=?; SF=6.8 6; ε<1.3; …	∗
^{246}Md	76120#	260#					0.92	s	0.18		11	10An08	TD	1996	α=100	∗
^{246}Md^m	76170#	260#	60	60	AD		4.4	s	0.8		11			2010	β^+>77; β^+SF>10; α<23	
∗^{246}Es	D : …; β^+SF≈0.003															∗∗
∗^{246}Es^p	E : above level decaying by 152.3(0.5) keV γ															∗∗
∗^{246}Fm	D : …; β^+SF=10 5															∗∗
∗^{246}Md	T : average 10An08=0.9(0.2) 96Ni09=1.0(0.4)															∗∗

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{247}Pu	69110#	200#					2.27	d	0.23	$1/2^+$#	04			1983	β^-=100	
^{247}Am	67150#	100#					23.0	m	1.3	5/2#	04			1967	β^-=100	
^{247}Cm	65534	4					15.6	My	0.5	$9/2^-$	04			1954	α=100	
^{247}Cm^m	65761	4	227.38	0.02			26.3	μs	0.3	$5/2^+$	04			1968	IT=100	
^{247}Cm^n	65939	4	404.90	0.03			100.6	ns	0.6	$1/2^+$	04			2003	IT=100	
^{247}Bk	65491	5					1.38	ky	0.25	$(3/2^-)$	04			1965	$\alpha\approx$100; SF ?	
^{247}Cf	66104	15					3.11	h	0.03	$7/2^+$#	04			1954	$\varepsilon\approx$100; α=0.035 5	
^{247}Es	68578	19					4.55	m	0.26	$(7/2^+)$	04	89Ha27	J	1967	$\beta^+\approx$93; $\alpha\approx$7; SF$\approx$9e–5#	
^{247}Fm	71670#	120#					31	s	1	$(7/2^+)$	04	06He27	TJ	1967	α>50; β^+<50	*
^{247}Fm^m	71720#	110#	49	8	AD		5.1	s	0.2	$(1/2^+)$	04	06He27	TJ	1967	$\alpha\approx$100; IT ?	*
^{247}Md	75940#	210#					1.19	s	0.09	$(7/2^-)$	04	10An08	TJD	1981	$\alpha\approx$100; SF<0.1	*
^{247}Md^m	76200#	210#	260	40	AD		250	ms	40	$(1/2^-)$		10An08	TJD	1993	α=79 5; SF=21 5	*
*^{247}Fm	T : supersedes 04He28=29(1) of same group															**
*^{247}Fm^m	T : supersedes 04He28=4.3(0.4) of same group; other not used 67Fl15=9.2(2.3)															**
*^{247}Md	T : average 10An08=1.2(0.1) 93Ho.A=1.12(0.22)															**
*^{247}Md^m	T : supersedes 93Ho.A=230(+190–120)															**
^{248}Am	70560#	200#					3#	m			99				β^- ?	
^{248}Cm	67393	5					348	ky	6	0^+	99			1956	α=91.61 16; SF=8.39 16; …	*
^{248}Bk	68080#	70#				*	> 9	y		6^+#	99			1956	α ?	
^{248}Bk^m	68110	21	30#	70#		*	23.7	h	0.2	$1^{(-)}$	99			1956	β^-=70 5; ε=30 5; α=0.001#	
^{248}Bk^p	68130	50	50#	50#						(5^-)						
^{248}Cf	67240	5					334	d	3	0^+	99			1954	$\alpha\approx$100; SF=0.0029 3	
^{248}Es	70300#	50#					27	m	5	2^-#,0^+#	99			1956	$\beta^+\approx$100; $\alpha\approx$0.25; β^+SF=3e–5	
^{248}Es^m			non existent		RN		41	m				89Ha27	I			
^{248}Fm	71899	9					35.1	s	0.8	0^+	99	11Ga19	T	1958	α=93 7; β^+=7 7; SF=0.10 5	*
^{248}Md	77150#	240#					7	s	3		99			1973	β^+=80 10; α=20 10; …	*
^{248}No	80620#	220#							<2 μs	0^+		03Be18	I		SF ?	
*^{248}Cm	D : …; 2β^- ?															**
*^{248}Fm	T : others 04He28=36(2) 67Nu01=38(4) 66Ak01=36(4)															**
*^{248}Md	D : …; β^+SF<0.05															**
^{249}Am	73100#	300#					1#	m							β^- ?	
^{249}Cm	70751	5					64.15	m	0.03	$(1/2^+)$	11			1956	β^-=100	
^{249}Cm^m	70800	5	48.76	0.04			23	μs		$(7/2^+)$	11			1966	α=100	
^{249}Bk	69850.6	2.6					330	d	4	$7/2^+$	11			1954	$\beta^-\approx$100; α=0.00145 8; …	*
^{249}Bk^m	69859.4	2.6	8.777	0.014			300	μs		$(3/2^-)$	11			1975	IT=100	
^{249}Cf	69726.0	2.2					351	y	2	$9/2^-$	11			1954	α=100; SF=5.0e–7 4	
^{249}Cf^m	69871.0	2.2	144.98	0.05			45	μs	5	$5/2^+$	11			1967	IT=100	
^{249}Es	71180#	30#					102.2	m	0.6	$7/2^+$	11			1956	$\beta^+\approx$100; α=0.57 8	
^{249}Fm	73521	6					1.6	m	0.1	$(7/2^+)$	11	11Lo06	J	1960	β^+ ?; α=33 9	*
^{249}Md	77230#	200#					23.4	s	2.4	$(7/2^-)$	11	01He35	J	1973	α>60; β^+ ?	*
^{249}Md^m	77330#	220#	100#	100#			1.9	s	0.9	$(1/2^-)$	11	01He35	TJD	2001	α=100	*
^{249}No	81780#	280#					57	μs	12	$5/2^+$#	11	03Be18	T	2003	β^+ ?; α ?	*
*^{249}Bk	D : …; SF=47e–9 2															**
*^{249}Fm	T : from 04He28; others 66Ak01=2.6(0.7) 59Pe27=2.5(1.0)															**
*^{249}Md	T : average 09He20=23(3) 73Es01=24(4)															**
*^{249}Md^m	T : symmetrized from 1.5(+1.2–0.5)															**
*^{249}No	T : symmetrized from 54.0(+13.9–9.2)															**
^{250}Cm	72990	11					8300#	y		0^+	01			1966	SF$\approx$74; $\alpha\approx$18; $\beta^-\approx$8	
^{250}Bk	72952	4					3.212	h	0.005	2^-	01			1954	β^-=100	
^{250}Bk^m	72988	4	35.59	0.10			29	μs	1	4^+	01	08Ah02	EJ	1966	IT=100	
^{250}Bk^n	73036	4	84.1	2.1	AD		213	μs	8	7^+	01	08Ah02	EJ	1972	IT ?	
^{250}Cf	71172.0	2.0					13.08	y	0.09	0^+	01			1954	$\alpha\approx$100; SF=0.077 3	
^{250}Es	73230#	100#				*	8.6	h	0.1	(6^+)	01			1956	β^+>97; α ?	
^{250}Es^m	73430#	180#	200#	150#		*	2.22	h	0.05	$1^{(-)}$	01			1970	$\beta^+\approx$100; α ?	
^{250}Fm	74073	8					30.4	m	1.5	0^+	01	06Ba09	T	1954	α>90; ε<10; SF=0.0069 10	*
^{250}Fm^m	75272	8	1199.2	1.0			1.92	s	0.05	(8^-)	01	08Gr17	ETJ	1973	IT>80; α<20; β^+ ?; …	*
^{250}Md	78630#	300#					52	s	5		01	08An16	TD	1973	β^+=93 1; α=7 1; β^+SF=0.02	*
^{250}No	81560#	200#					5.0	μs	0.6	0^+	06	06Pe17	TD	2003	SF$\approx$100; α<2.1	*
^{250}No^m	82610#	280#	1050#	200#			51	μs	18	(6^+)	06	06Pe17	T	2001	SF$\approx$100; IT ?; α ?	*
*^{250}Fm	T : others not used 06Fo02=18(+13–6) 66Ak01=30(3)															**
*^{250}Fm^m	D : …; SF<8.2E-5															**
*^{250}Md	T : average 08An16=50(+10–7) 73Es01=52(6)															**
*^{250}Md	D : other recent 06Fo02 β^+=91(+7–19)%; α=9(+19–7)%															**
*^{250}No	D : …; β^+=0.00025#															**
*^{250}No	T : average 06Pe17=3.7(+1.1–0.8) 03Be18=5.6(+0.9–0.7)															**
*^{250}No^m	T : average 06Pe17=43(+22–15) 03Be18=46(+22–14) 01Og08=36(+11–6)															**

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{251}Cm	76649	23					16.8	m	0.2	$(1/2^+)$	06			1978	β^-=100	
^{251}Bk	75229	11					55.6	m	1.1	$(3/2^-)$	06			1967	β^-=100	
^{251}Bk^m	75265	11	35.5	1.3			58	μs	4	$7/2^+$#	06			1966	IT=100	
^{251}Cf	74136	4					900	y	40	$1/2^+$	06			1954	α≈100; SF ?	
^{251}Cf^m	74506	4	370.47	0.03			1.3	μs	0.1	$11/2^-$	06			1971	IT=100	
^{251}Es	74514	6					33	h	1	$(3/2^-)$	06			1956	ε ?; α=0.5 2	
^{251}Fm	75954	15					5.30	h	0.08	$(9/2^-)$	06			1957	β^+=98.20 12; α=1.80 12	
^{251}Fm^m	76154	15	200.09	0.11			21.1	μs	1.6	$(5/2^+)$	06	11As03	ET	1970	IT=100	*
^{251}Md	78967	19					4.21	m	0.23	$(7/2^-)$	11	06Ch52	TJD	1973	β^+ ?; α=10 1	*
^{251}Md^p	79022	18	55	8	AD					$(1/2^-)$	11	06Ch52	J	2006	IT ?	
^{251}No	82850#	110#					800	ms	10	$(7/2^+)$	07	06He27	J	1967	α=83 16; β^+ ?; SF<0.3	*
^{251}No^m	82960#	110#	106	6			1.02	s	0.03	$(1/2^+)$	07	06He27	ETD	1997	α=100	
^{251}No^n	84600#	120#	1750	50			2	μs			07			2006	IT ?	*
^{251}Lr	87730#	300#					150#	μs							β^+ ?; α ?	

*^{251}Fm^m T : average 11As03=21.1(1.9) 06He20=21(3); other 71Di03=15.2(2.3) **
*^{251}Fm^m E : also 06He20=199.9(0.3) **
*^{251}Md T : average 06Ch52=4.27(0.26) 73Es01=4.0(0.5) **
*^{251}No D : symmetrized from α=91(+9–22)% **
*^{251}No^n E : 1699.7(0.8) + x ; x estimated 50(50) **

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{252}Cm	79060#	300#					1#	m	<2d	0^+	06	66Rg01	I		β^- ?	
^{252}Bk	78540#	200#					1.8	m	0.5		06	92Kr.A	TD	1992	β^-=?; α ?	
^{252}Cf	76035	5					2.645	y	0.008	0^+	06			1954	α=96.908 8; SF=3.092 8	
^{252}Es	77300	50					471.7	d	1.9	(4^+)	06	FGK12a	J	1956	α=78 2; ε=22 2	*
^{252}Fm	76818	6					25.39	h	0.04	0^+	06			1956	α≈100; SF=0.0023 2; 2β^+ ?	
^{252}Md	80510#	130#					2.3	m	0.8		06			1973	β^+>50; α ?	
^{252}Md^p	80550	80	40#	100#						*am*						
^{252}No	82872	9					2.45	s	0.02	0^+	06	11Ga19	T	1967	α>66.7 6; SF=32.2 5; β^+<1.1 4	*
^{252}No^m	84127	9	1254.5	0.7			109	ms	4	(8^-)		11Lo06	T	2007	IT=100	*
^{252}Lr	88740#	240#					369	ms	75		06	08Ne01	TD	2001	β^+=71#; α=?; SF<1	*
^{252}Lr^p	88910#	240#	170	30	AD											

*^{252}Es J : strong direct ε feeding to 3^+; known structures in TNN **
*^{252}No T : average 11Ga19=2.47(0.02) 01Og08=2.44(0.04) **
*^{252}No D : SF 01Og08=32.2(0.5)%; other 11Ga19=29.3(0.5)% **
*^{252}No^m E : average 08Ro21=1255(1) 07Su19=1254(1) **
*^{252}No^m T : average 11Lo06=110(8) 08Ro21=109(6) 07Su19=110(10) **
*^{252}No^m J : from 08Ro21 based on comparison with theory; other 07Su19=(8^+) **
*^{252}Lr T : average 08Ne01=270(+180–80) 01He35=360(+110–70) **

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{253}Bk	80930#	360#					10#	m				91Kr.A	I	1991	β^- ?	*
^{253}Cf	79302	6					17.81	d	0.08	$(7/2^+)$	06			1954	β^-≈100; α=0.31 4	
^{253}Es	79014.6	2.6					20.47	d	0.03	$7/2^+$	06	05Ah03	D	1954	α=100; SF=10e–6 1	*
^{253}Fm	79349	3					3.00	d	0.12	$(1/2)^+$	06			1957	ε=88 1; α=12 1	
^{253}Fm^m	79700	7	351	6			560	ns	60	$(11/2^-)$		11An13	ETJ	2011	IT=100	*
^{253}Md	81180#	30#					12	m	8	$(7/2^-)$	06			1992	β^+≈100; α=0.6#	*
^{253}Md^p	81180#	40#	0#	30#						$1/2^-$#						
^{253}No	84360	7					1.56	m	0.02	$(9/2^-)$	06	11Lo06	J	1967	α=?; β^+=6#; SF=0.001#	*
^{253}No^m	84527	7	167.34	0.45			30.3	μs	1.6	$(5/2^+)$	06	09He23	T	1973	α=?	*
^{253}No^n	85560	110	1200	110			706	μs	24	$>21/2$		11Lo06	T	2011	IT ?	*
^{253}Lr	88580#	200#				* &	632	ms	46	$(7/2^-)$	06	01He35	TJD	1985	α=90 10; SF=2.6 21; β^+=1#	*
^{253}Lr^m	88610#	230#	30#	100#		* &	1.32	s	0.14	$(1/2^-)$	06	09He20	TJD	1985	α=90 10; SF=8 5; β^+=1#	*
^{253}Rf	93560#	410#				*	13	ms	5	$(7/2)^{(+\#)}$	06	95Ho.B	TJ	1997	SF=?; α ?	*
^{253}Rf^m	93760#	440#	200#	150#		*	52	μs	14	$(1/2)^{(-\#)}$	06	97He29	J	1995	SF=?; α=5#	*

*^{253}Bk I : possible identification in 91Kr.A; needs confirmation **
*^{253}Es D : SF=8.7(0.3)e–6% from ENSDF'99 : from α/SF=1.15(0.03)e7 (1965Me02) **
*^{253}Fm^m E : 211 keV above (7/2$^+$) level at 130-150 keV **
*^{253}Md T : symmetrized from 6.4(+11.6–3.6) **
*^{253}No T : average 09He23=1.56(0.02) m 09Qi04=1.57(+0.18–0.15) m 67Mi03=95(10) s **
*^{253}No T : and 67Gh01=105(20) s **
*^{253}No J : from ref. 11Lo06 and 10St14 D : ε/e$^+$=0.45(0.03) **
*^{253}No^m E : average 11An13=167.5(0.5) 10St14=166.7(1.0) **
*^{253}No^m T : average 09He23=28(3) 07Lo11=31.1(2.1) 73Be33=31.3(4.1); **
*^{253}No^m T : others 11An13=22.7(0.5) and 10St14=24(2) disagree **
*^{253}No^n T : other 11An13=627(5) **
*^{253}No^n E : greater than 1011 and less than 1380 keV **
*^{253}Lr T : average 09He20=670(60) 01He35=570(+70–60) **
*^{253}Lr D : symmetrized from SF=1.3(+3.0–1.0)% **
*^{253}Lr T : other not used 10He11=700(+500–200) **
*^{253}Lr^m T : supersedes 01He35=1.49(+0.30–0.21); other 10He11=1.2(+0.7–0.4) **
*^{253}Rf I : the state with ≈1.8 s reported in earlier ENSDF is not confirmed **
*^{253}Rf T : symmetrized from 11(+6–3) **
*^{253}Rf^m T : symmetrized from 48(+17–10) **

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)					Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{254}Bk	84390#	300#						1#	m			05				β^- ?	
^{254}Cf	81342	12						60.5	d	0.2	0^+	05			1955	SF$\approx$100; α=0.31 2; 2β^- ?	
^{254}Es	81992	4						275.7	d	0.5	(7^+)	05			1954	$\alpha\approx$100; ε=0.03#; …	*
^{254}Es^m	82076	3	84.2	2.5	AD			39.3	h	0.2	2^+	05			1954	β^-=98 2; IT<3; α=0.32 1; …	*
^{254}Fm	80904.4	2.8						3.240	h	0.002	0^+	05			1954	$\alpha\approx$100; SF=0.0592 3	
^{254}Md	83450#	100#				*		10	m	3	0^-#	05			1970	$\beta^+\approx$100; α ?	
^{254}Md^m	83500#	140#	50#	100#		*		28	m	8	3^-#	05			1970	$\beta^+\approx$100; α ?	
^{254}No	84725	10						51.2	s	0.4	0^+	05	06He19	T	1966	α=90 1; β^+=10 1; SF=0.23 1	*
^{254}No^m	86020	10	1295	2				264.9	ms	1.4	(8^-)	05	11Lo06	T	1973	IT>80; SF=0.020 12; α=0.01	*
^{254}No^n	87950#	300#	3220#	300#				183.8	μs	1.6	(16^+)		10He10	ETD	2006	IT=100; SF<0.012	*
^{254}Lr	89870#	300#						17.1	s	1.8		05	08An16	TD	1981	α=72 2; β^+=28 2; SF ?	*
^{254}Lr^p	89940#	310#	60	50	AD												
^{254}Lr^q	90090#	330#	220#	120#													
^{254}Rf	93200#	280#						23	μs	3	0^+	05			1997	SF=?; α<1.5	
*^{254}Es	D : …; β^-=1.74e–4 8; SF<3e–6																**
*^{254}Es^m	D : …; ε=0.076 7; SF<0.045																**
*^{254}No	D : from 10He10																**
*^{254}No^m	T : average 11Lo06=259(17) 10Cl01=263(2) 10He10=275(7) 06He19=266(2)																**
*^{254}No^m	T : 06Ta19=266(10); other 73Gh03=280(40)																**
*^{254}No^n	T : average 06He19=184(3) 10He10=198(13) 10Cl01=184(2) 06Ta19=171(9)																**
*^{254}No^n	E : 2917(3) + x ; x estimated 300#300; 10Cl01=2930(2) but their level																**
*^{254}No^n	E : scheme is disputed J : from 06He19																**
*^{254}Lr	T : average 08An16=18(2) 01Ga20=13.4(4.2); 85He22=13(+3–2) same group; other																**
*^{254}Lr	T : 06Fo02=22(+9–6) D : not used 06Fo02 α=60(+11–15)%; β^+=40(+15–11)%																**
^{255}Cf	84810#	200#						85	m	18	$(7/2^+)$	99			1981	β^-=100; SF<0.001#; α=2e–7#	
^{255}Es	84091	11						39.8	d	1.2	$(7/2^+)$	99			1954	β^-=92.0 4; α=8.0 4; SF=0.0041 2	
^{255}Fm	83801	5						20.07	h	0.07	$7/2^+$	99			1954	α=100; SF=2.4e–5 10	
^{255}Fm^p	84050#	100#	250#	100#	Nm						$(9/2^+)$						
^{255}Md	84844	7						27	m	2	$(7/2^-)$	99			1958	β^+=92 2; α=8 2; SF<0.15	
^{255}Md^p	84850#	70#	10#	70#							$1/2^-$#						
^{255}No	86807	15						3.52	m	0.18	$(1/2^+)$	99	11As03	TJ	1967	α=61 3; β^+=39 3	
^{255}No^p	86910#	70#	100#	70#	Nm						$(7/2^+)$						
^{255}Lr	89947	18						31.1	s	1.1	$(1/2^-)$	99	08Ha31	TD	1971	α=?; β^+=26 5; SF<1#	*
^{255}Lr^m	89986	19	39	8	AD			2.54	s	0.04	$(7/2^-)$		06Ch52	TJD	2006	α=100	*
^{255}Lr^n	91410	22	1463	12				1.63	ms	0.12	$(25/2^+)$		09Je02	ETJ	2008	IT=100; α<0.15	*
^{255}Rf	94330#	120#				*		1.66	s	0.07	$(9/2^-)$	07	06He27	TJ	1975	α=?; SF=52 6; β^+<1	*
^{255}Rf^m	94250#	120#	−85	17	AD	*		1.0	s	0.4	$5/2^+$#		97He29	TD	1997	α=100	*
^{255}Db	99730#	420#						1.7	s	0.5		99			1977	α ?; SF$\approx$20	*
*^{255}Lr	T : average 08Ha31=31(2) 06Ch52=31.1(1.3)																**
*^{255}Lr	T : others not used 08An16>19.1 01Ga20=21(8) 76Be.A=22(5) 71Es01=22(5)																**
*^{255}Lr^m	T : average 08Ha31=2.6(0.1) 08An16=2.53(0.05) 06Ch52=2.53(0.13)																**
*^{255}Lr^n	E : 09Je02=1409 keV above $9/2^+$, which is <30 above 255Lrm;																**
*^{255}Lr^n	E : others recent 08An16>1600 08Ha31>720 D : α from 09Je02																**
*^{255}Lr^n	T : unweighed average 09Je02=1.70(0.03) 08An16=1.81(0.02) 08Ha31=1.4(0.1)																**
*^{255}Rf	T : average 06He27=1.68(0.09) 01He35=1.64(0.11)																**
*^{255}Rf^m	T : symmetrized from 0.8(+0.5–0.2) I : discarded in ENSDF2007																**
*^{255}Db	T : symmetrized from 1.6(+0.6–0.4)																**
^{256}Cf	87040#	310#						12.3	m	1.2	0^+	99			1980	SF=100; α=6.2e–7#; 2β^- ?	
^{256}Es	87190#	100#				*		25.4	m	2.4	$(1^+,0^-)$	99			1981	β^-=100	
^{256}Es^m	87190#	140#	0#	100#		*		7.6	h		(8^+)	99			1976	$\beta^-\approx$100; β^-SF=0.002	
^{256}Fm	85487	7						157.6	m	1.3	0^+	99			1955	SF=91.9 3; α=8.1 3	
^{256}Md	87460#	120#				*	&	30#	m		7^-#					β^+ ?; α ?; SF ?	
^{256}Md^m	87620	70	160#	100#		*	&	77	m	2	(1^-)	99	FGK12b	I	1955	β^+=?; α=9.2 7; SF<3	*
^{256}Md^p	87700#	120#	240#	140#							*am*						
^{256}No	87824	8						2.91	s	0.05	0^+	99			1963	$\alpha\approx$100; SF=0.53 6; ε<0.01#	
^{256}Lr	91750	80						27	s	3		99			1965	α=85 10; β^+=15 10; SF<0.03	
^{256}Lr^p	91980#	90#	230#	40#													
^{256}Rf	94223	18						6.64	ms	0.07	0^+	99	12Gr12	T	1975	SF=?; α=0.32 17	*
^{256}Rf^m	95340#	100#	1120#	100#				25	μs	2			09Je01	TD	2009	IT=100; SF ?	*
^{256}Rf^n	95620#	100#	1400#	100#				17	μs	2			09Je01	TD	2009	IT=100; SF ?	
^{256}Rf^p	96620#	200#	2400#	200#				27	μs	5			09Je01	TD	2009	IT=100; SF ?	
^{256}Db	100500#	240#						1.9	s	0.4		99	01He35	TD	2001	α=67 8; β^+=33 8; SF=?	*
*^{256}Md^m	I : Following the Gallagher-Moskowsky rule, this should be the ground-state; could not																**
*^{256}Md^m	I : be modified while in proof (November 2012)																**
*^{256}Rf	T : aver. 12Gr12=6.9(0.2) 09Je01=6.67(0.09) 97He29=6.2(0.2) 84Og02=6.7(0.2);																**
*^{256}Rf	T : other recent 10St14=5.1(1.0-0.7) D : other 10St14 SF=97(+2–6)%																**
*^{256}Rf^m	T : a 15(5) μs isomer was identified in 11Ro20																**
*^{256}Db	T : average 01He35=1.6(+0.5–0.3) 83Og.A=2.6(+1.4–0.8)																**
*^{256}Db	D : 01He35 β^+=36(12)% 08Ne01 α=70(11)%																**

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{257}Es	89400#	410#					7.7	d	0.2	$7/2^+$#	99			1987	β^-=100; α=4e–4#	
^{257}Fm	88591	6					100.5	d	0.2	$(9/2^+)$	99			1964	$\alpha\approx$100; SF=0.210 4	
^{257}Md	88997.2	2.7					5.52	h	0.05	$(7/2^-)$	99			1965	ε=85 3; α=15 3; SF<4	
^{257}No	90250	7					24.5	s	0.5	$(7/2^+)$	99	02Ho11	D	1967	α=?; β^+=15 8	∗
^{257}No^p	90550#	110#	300#	110#						*am*						
^{257}Lr	92610#	40#					6.0	s	0.4	$(1/2^-)$	99	10St14	T	1971	$\alpha\approx$100; β^+=0.01#; SF=0.001#	∗
^{257}Lr^p	92760#	110#	150#	100#						*am*						
^{257}Rf	95868	11					4.82	s	0.13	$(1/2^+)$	99	FGK10a	J	1969	α=?; β^+=19.4 14; SF=1.3 3	∗
^{257}Rf^m	95941	10	73	11	AD		4.3	s	0.2	$(11/2^-)$	99	10Be16	T	1997	$\alpha\approx$100; SF=0.7#; β^+ ?	∗
^{257}Rf^n	97023	11	1155	11	AD		134.9	μs	7.7	$(21/2^+)$	99	10Be16	TJD	2009	IT=100	∗
^{257}Db	100210#	200#				∗ &	2.3	s	0.2	$(9/2^+)$	99	09He20	T	1985	α>94; SF<6; β^+=1#	∗
^{257}Db^m	100350#	230#	140#	110#		∗ &	670	ms	60	$(1/2^-)$	99	09He20	T	1985	α>87; SF<13; β^+=1#	∗

∗^{257}No T : from 05As05 ∗∗
∗^{257}Lr T : average 10St14=6.3(+0.9–0.7)) and 5.8 (0.5) ∗∗
∗^{257}Lr T : others not used 97He29=3.3(+0.5–0.4) 97He29=4.3(+1.3–0.8) ∗∗
∗^{257}Lr T : 76Be.A=0.646(0.025) 71Es01=0.6(0.1) ∗∗
∗^{257}Lr J : feeding in ε decay of $1/2^+$ ^{257}Rf; and trends for e–o neighbors ∗∗
∗^{257}Rf J : favorite α to the $1/2^+$ state at 670 keV D : also 09Qi04 SF=2(1)% ∗∗
∗^{257}Rf T : average 10St14=5.5(0.4) 10Be16=4.8(0.2) 09Qi04=4.7(0.3) ∗∗
∗^{257}Rf T : 85So03=3.8(0.8) 74Be.A=4.8(0.3) 71Gh03=4.8(0.5) ∗∗
∗^{257}Rf^m E : 97He29=118(4) keV from direct comparison of two α lines ∗∗
∗^{257}Rf^m T : average 10Be16=4.6(0.3) 08Dr05=4.1(+0.7–0.6) 97He29=3.9(0.4) ∗∗
∗^{257}Rf^m T : 09Qi04=4.1(+2.4–1.3) maybe to a $11/2^-$ level in ^{257}Lr ∗∗
∗^{257}Rf^n E : 1082(4) keV above ^{257}Rf^m T : not used 09Qi04=160(+42–31) ∗∗
∗^{257}Db T : supersedes 01He35=1.50(+0.19–0.15); other 10He11=1.5(+0.9–0.4) ∗∗
∗^{257}Db^m T : supersedes 01He35=760(+150–110); other 10He11=360(+220–90) ∗∗

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{258}Es	92700#	300#					3#	m							β^- ?; α ?	
^{258}Fm	90430#	200#					370	μs	14	0^+	01	86Hu05	T	1971	SF$\approx$100; α ?	∗
^{258}Md	91688	5				∗	51.5	d	0.3	8^-#	01	93Mo18	D	1970	$\alpha\approx$100; β^+<0.0015; β^-<0.0015	∗
^{258}Md^m	91690#	200#	0#	200#		∗	57.0	m	0.9	1^-#	01	93Mo18	D	1980	ε=?; SF<20; β^-<10#; α<1.2	∗
^{258}No	91480#	100#					1.2	ms	0.2	0^+	01			1989	SF$\approx$100; α=0.001#; 2β^+ ?	
^{258}Lr	94780#	100#					4.1	s	0.3		01			1971	α>95; β^+<5	
^{258}Lr^p	95020#	140#	240#	100#						*am*						
^{258}Rf	96340	30					13.8	ms	0.9	0^+	01	08Ga08	T	1969	SF=87 2; α=13 2	∗
^{258}Db	101800#	310#				∗	4.5	s	0.4		01	09He20	T	1981	α=63 6; β^+=37 6; SF<1#	∗
^{258}Db^m	101860#	320#	60#	100#		∗	1.9	s	0.5		01	09He20	T	1985	$\beta^+\approx$100; IT ?	
^{258}Sg	105240#	410#					2.7	ms	0.5	0^+	01	09Fo02	T	1997	SF=?; α<20	∗

∗^{258}Fm T : average 86Hu05=360(20) 71Hu03=380(20) (all 1σ) ENSDF gives 3σ ∗∗
∗^{258}Md D : derived from: “the sum of SF, ε and β^- decay branches < 0.003%” in ∗∗
∗^{258}Md D : 93Mo18 and T(SF)>150000 y, from 86Lo16, thus SF<1e–4%# ∗∗
∗^{258}Md^m D : SF<20% derived from 93Mo18 “the sum of SF and β^- decay branches < 30%” ∗∗
∗^{258}Rf T : average 08Ga08=14.7(+1.2–1.0) 85So03=13(3) 69Gh01=11(2) ∗∗
∗^{258}Db T : average 09He20=4.3(0.5) 06Fo02=4.8(+1.0–0.8) 01Ga20=4.3(1.1) and ∗∗
∗^{258}Db T : 85He22=4.4(+0.9–0.6) ∗∗
∗^{258}Db D : average β^+ 06Fo02=39(+11–9)% 85He22=33(+9–5)% ∗∗
∗^{258}Sg T : symmetrized from 09Fo02=2.6(+0.6–0.4); combining with earlier work ∗∗

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{259}Fm	93710#	280#					1.5	s	0.3	$3/2^+$#	99			1980	SF=100	
^{259}Md	93630#	200#					1.60	h	0.06	$7/2^-$#	99	93Mo18	T	1982	SF=?; α<1.3	
^{259}No	94110#	100#					58	m	5	$9/2^+$#	99			1973	α=75 4; ε=25 4; SF<10	
^{259}No^p	94340#	180#	230#	150#												
^{259}Lr	95850#	70#					6.2	s	0.3	$1/2^-$#	99			1971	α=78 2; SF=22 2; β^+=0.6#	
^{259}Lr^p	96200#	170#	350#	150#												
^{259}Rf	98360#	70#					2.63	s	0.26	$7/2^+$#	99	08Ga08	T	1969	α=92 2; SF=8 2; β^+=0.3#	∗
^{259}Rf^p	98430#	100#	60	70	Nm					$(3/2^+)$						
^{259}Rf^q	98570#	110#	210	90	Nm					$(9/2^+)$						
^{259}Db	101990	50					510	ms	160		99	01Ga20	TD	2001	α=100	
^{259}Sg	106560#	120#					280	ms	50	$1/2^+$#	99	09He20	T	1985	α=90 10; SF<20	

∗^{259}Rf T : average 08Ga08=2.5(+0.4–0.3) 94Gr08=1.7(+0.8–0.5) ∗∗
∗^{259}Rf T : others 06Gr24=1.9(+1.3–0.5) 04Fo08=2.2(+1.7–0.8) 03Gi05=4.0(+7.3–1.6) ∗∗
∗^{259}Rf T : 98Ho13=2.6(+1.4–0.7) 85So03=3.4(1.7) 81Be03=3.0(1.3) ∗∗
∗^{259}Rf T : 73Dr10=3.2(0.8) and 69Gh01=3.2(0.8); 10Ni14(1 event)=107 ms rejected ∗∗
∗^{259}Rf I : 08Ga08 suggest existence of an isomer formed only in direct production ∗∗
∗^{259}Rf D : 08Ga08 estimates ε=15(4)% to ^{259}Lr followed by SF ∗∗

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)					Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{260}Fm	95770#	510#			EU			1#	m		0^+					SF ?	$*$
^{260}Md	96550#	320#						27.8	d	0.8		99	92Lo.B	TD	1989	SF=?; α<5; ε<5; β^-<3.5	$*$
^{260}No	95610#	200#						106	ms	8	0^+	99			1985	SF=100	
^{260}Lr	98280#	120#						3.0	m	0.5		99			1971	α=80 20; β^+=20 20	
^{260}Rf	99150#	200#						21	ms	1	0^+	99			1985	SF=?; α=2#; ε=0.01#	$*$
^{260}Db	103670#	90#						1.52	s	0.13		99			1970	α>90.4 6; SF<9.6 6; β^+<2.5	$*$
^{260}Db^p	103870#	180#	200#	150#													
^{260}Sg	106548	21						4.95	ms	0.33	0^+	99	09He20	T	1984	SF=60 30; α=40 30	$*$
^{260}Bh	113320#	250#						41	ms	14		99	08Ne01	TD	2008	$\alpha\approx$100; β^+ ?; SF ?	$*$
$*^{260}$Fm	I : half-life $\approx$4 ms and SF=100 mode were reported in the 92Lo.B internal																$**$
$*^{260}$Fm	I : report. Not confirmed in subsequent experiment by same group (97Lo.A)																$**$
$*^{260}$Fm	I : Discovery of this nuclide is considered unproven																$**$
$*^{260}$Md	T : supersedes 86Hu01=31.8(0.5) of same group																$**$
$*^{260}$Rf	T : also 08Ga08=22.2(+3.0–2.4) 08Go.A=21(+7.3,–4.3)																$**$
$*^{260}$Db	T : also 04Mo26=1.5(+0.8–0.4) 04Ga29=0.89(+0.79–0.35)																$**$
$*^{260}$Sg	T : supersedes 85Mu11=3.6(+0.9–0.6)																$**$
$*^{260}$Sg	D : symmetrized from SF=50(+30–20)% and α=50(+20–30)%																$**$
$*^{260}$Bh	T : symmetrized from 35(+19–9)																$**$

Nuclide	Mass excess (keV)		Excitation energy (keV)					Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{261}Md	98580#	570#						40#	m		$7/2^-$#					α ?	
^{261}No	98460#	200#						3#	h		$3/2^+$#					α ?	
^{261}Lr	99560#	200#						39	m	12		99			1987	SF=?; α ?	
^{261}Rf	101320	50				$*$	&	2.2	s	0.3	$3/2^+$#	09	11Ha13	TD	1970	SF=73 6; α=27 6	$*$
^{261}Rf^m	101390#	110#	70#	100#		$*$	&	81	s	9	$9/2^+$#	09	02Ho11	TD	1970	α=?; β^+<15; SF<10	$*$
^{261}Rf^p	101620#	110#	300#	100#													
^{261}Db	104250#	110#						4.5	s	1.1		99	10St14	TD	1970	SF=73 11; α=?	$*$
^{261}Db^p	104550#	230#	300#	200#													
^{261}Sg	108006	19						183	ms	5	$(3/2^+)$	99	10St14	TJD	1984	α=98.1 4; β^+=1.3 3; SF=0.6 2	$*$
^{261}Sg^m	108110#	50#	100#	50#				9.3	μs	1.8	$(11/2^-)$	99	10Be16	TJ	2010	IT=100	$*$
^{261}Bh	113140#	210#						12.8	ms	3.2	$(5/2^-)$	99	10He11	TJD	1989	α=95 5; SF<5	$*$
$*^{261}$Rf	T : average 12Ha05=2.6(+0.7–0.5) 11Ha13=1.9(0.4) 08Go.A=2.2(+0.9–0.5)																$**$
$*^{261}$Rf	T : others 08Dv02=3(1) 08Mo09 2 events at 2.97 and 8.3s 02Ho11=4.2(+3.4–1.3)																$**$
$*^{261}$Rf	D : SF others 12Ha05=82(9)%, 08Dv02=91% for 11 events																$**$
$*^{261}$Rf^m	T : symmetrized from 78(+11–6); other 08Dv02=20(+110–10)																$**$
$*^{261}$Db	T : symmetrized from 4.1(+1.4–0.8)																$**$
$*^{261}$Db	D : observed 11 SF and 4 α decays; uncertainty evaluated by NUBASE																$**$
$*^{261}$Sg	T : average 10St14=184(5) 10Be16=178(14)																$**$
$*^{261}$Sg^m	T : symmetrized from 9.0(+2.0–1.5)																$**$
$*^{261}$Bh	T : symmetrized from 10He11=11.8(+3.9–2.4); others not used 06Fo02=10(+14–5)																$**$
$*^{261}$Bh	T : and 08Ne08=6.7(+3.8–1.8)																$**$

Nuclide	Mass excess (keV)		Excitation energy (keV)					Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{262}Md	101630#	420#						3#	m							SF ?; α ?	
^{262}No	100100#	360#						5	ms		0^+	01			1989	SF$\approx$100; α ?	
^{262}Lr	102100#	200#						4	h			01			1987	β^+=?; SF<10; α ?	
^{262}Rf	102390#	220#				$*$		250	ms	100	0^+	01	08Go.A	TD	1985	SF$\approx$100	$*$
^{262}Rf^m	102990#	460#	600#	400#		$*$		47	ms	5	high		96La11	I	1978	SF=100	$*$
^{262}Db	106260#	140#						35	s	5		01			1971	$\alpha\approx$67; SF$\approx$30; β^+=3#	
^{262}Db^p	106310#	160#	50#	70#												α ?	
^{262}Sg	108370	40						10.9	ms	2.3	0^+	01	06Gr24	TD	2001	SF$\approx$100; α ?	$*$
^{262}Sg^m	109220	90	860	90	AD			330	ms	222			11Ac.A	TD	2011	α=100	$*$
^{262}Bh	114540#	310#						84	ms	11		01	09He20	T	1981	α=?; SF<20	$*$
^{262}Bh^m	114760#	310#	220	50	AD			9.5	ms	1.6		01	06Fo02	T	1981	α=?; SF<10	$*$
$*^{262}$Rf	T : symmetrized from 08Go.A=210(+128–58) ms; 7 SF events																$**$
$*^{262}$Rf	T : conflicting 96La11=2.1(0.2) 94La22=1.2(+1.0–0.5)																$**$
$*^{262}$Rf	T : 11Ha13 and 08Go.A suggest these activities belong to ^{261}Rf																$**$
$*^{262}$Rf	D : this suggestion contradicts 96La11 α<0.8; not adopted by NUBASE																$**$
$*^{262}$Rf^m	I : assigned in 96La11 to K-isomeric state																$**$
$*^{262}$Sg	T : 06Gr24=15(+5–3) 01Ho06=6.9(+3.8–1.8) D : no α observed α<16%																$**$
$*^{262}$Sg^m	T : symmetrized from 74(+354–34) ms																$**$
$*^{262}$Bh	T : average 09He20=83(14) 06Fo02=84(+21–16)																$**$
$*^{262}$Bh	T : other 08Ne08(10 events)=120(+55–29) not used																$**$
$*^{262}$Bh^m	T : 06Fo02=9.6(+3.6–2.4) 97Ho14(11 events)=12.2(+5.5–2.8) 89Mu09=8.0(2.1)																$**$
$*^{262}$Bh^m	T : also 09He20=22(4) 08Ne08(4 events)=16(+14–5) not used																$**$

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{263}No	103130#	490#					20#	m							α ?; SF ?	
^{263}Lr	103730#	280#					5#	h							α ?	
^{263}Rf	104790#	180#					11	m	3	$3/2^+$#	99	93Gr.C	TD	2003	SF=?; α=30	*
^{263}Rf^p	105090#	270#	300#	200#												
^{263}Db	107110#	170#					29	s	9		99	92Kr01	D	1992	SF=56 14; α=?; β^+=6.9 16	*
^{263}Db^p	107370#	260#	260#	200#												
^{263}Sg	110190#	100#				*	940	ms	140	$7/2^+$#	99	06Gr24	TD	1974	α=87 8; SF=13 8	*
^{263}Sg^m	110240#	100#	51	19	Nm	*	420	ms	100	$3/2^+$#	99	04Fo08	T	1995	α=?; IT ?	*
^{263}Sg^p	110290#	100#	100	30	AD											
^{263}Bh	114500#	310#					200#	ms			99				α ?	
^{263}Hs	119720#	130#					760	μs	40	$7/2^+$#	99	09Dr02	TD	2009	α=?; SF<8.4	*
^{263}Hs^m	120040#	130#	320	70	AD		760	μs	40	low#		09Dr02	TD	2009	α=?; SF ?	

*^{263}Rf T : average 03Kr20=24(+19–7) m 93Gr.C=500(+300–200) s 92Cz.A=600(+300–200) s **
*^{263}Rf T : also one SF event 08Dv02=8(+40–4) s **
*^{263}Db D : SF from 92Kr01=57(+13–15)%; β^+ average 03Kr20=3(+4–1)% 93Gr.C=8(2)% **
*^{263}Db T : Possibly a candidate for the 54(+98–21) s SF decay observed in 98Ik02 **
*^{263}Db T : symmetrized from 27(+10–7) **
*^{263}Sg T : average 06Gr24=820(+370–190) 94Gr08=553(+336–152) 74Gh04=900(200); all **
*^{263}Sg T : produced via direct production mechanisms **
*^{263}Sg^m T : average 04Fo08=290(+170–90) 04Mo40=549(+300–143) ms 03Gi05=222(+404–87) **
*^{263}Sg^m T : and 98Ho13=310(+160–80) ms; all produced via α-decay of parent **
*^{263}Sg^m T : also 10Ni14 at t=702ms via α-decay of parent, but with low energy **
*^{263}Hs T : symmetrized from 740(+48–21) D : no SF observed **

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{264}No	105010#	650#					1#	m		0^+					α ?; SF ?	
^{264}Lr	106380#	440#					10#	h							α ?; SF ?	
^{264}Rf	106080#	360#					1#	h		0^+					α ?	
^{264}Db	109360#	240#					3#	m							α ?	
^{264}Sg	110780#	280#					47	ms	20	0^+	06			2006	SF≈100; α ?	*
^{264}Bh	116060#	180#					1.07	s	0.21		99	04Mo26	TD	1995	α=86; SF=14; β^+ ?	*
^{264}Bh^p	116290#	230#	230#	150#						*am*						
^{264}Hs	119564	29					540	μs	300	0^+	99	95Ho.B	T	1986	α≈50; SF≈50	*

*^{264}Sg T : symmetrized from 37(+27–11); also 10Ni14(1 event)=86.4 ms **
*^{264}Sg D : no α observed α<36% **
*^{264}Bh T : average 04Mo26=0.9(+0.3–0.2) 04Ga29=1.17(+0.88–0.44) and **
*^{264}Bh T : 02Ho11=1.02(+0.69–0.29) **
*^{264}Hs T : 95Ho.B (2 events 76 μs and 825 μs) 87Mu15 (1 event 80 μs); average of the **
*^{264}Hs T : 3 events: 327(+448–120) μs, see 84Sc13 **

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{265}Lr	108230#	610#					10#	h							α ?; SF ?	
^{265}Rf	108690#	360#					6.6	m	5.3	$3/2^+$#	11	10El06	TD	2010	SF≈100; α ?	*
^{265}Db	110490#	220#					15#	m							α ?	
^{265}Sg	112800#	120#				&	9.2	s	1.6	$9/2^+$#	09	12Ha05	T	1994	α>50; SF ?	*
^{265}Sg^m	112870#	120#	70#	150#		&	16	s	2.4	$3/2^+$#	09	12Ha05	T	1994	α>65 16; SF ?	*
^{265}Bh	116360#	230#					1.19	s	0.52		99	04Ga29	TD	2004	α=?	*
^{265}Hs	120901	24					1.96	ms	0.16	$3/2^+$#	99	09He20	T	1984	α≈100; SF<1	*
^{265}Hs^m	121131	24	229	22	AD		360	μs	150	$9/2^+$#	99	09He20	T	1995	α≈100; IT ?	*
^{265}Mt	126680#	450#					2#	ms							α ?	

*^{265}Rf T : one SF at 152 s, thus 105(+503–48) s **
*^{265}Sg T : average 12Ha05=8.5(+2.6,–1.6) 08Du09=8.9(+2.7–1.9) **
*^{265}Sg^m T : average 12Ha05=14.4(+3.7,–2.5) 08Du09=16.2(+4.7–3.5) **
*^{265}Bh T : symmetrized from 0.94(+0.70–0.31) **
*^{265}Hs T : average 09He20=1.9(0.2) 99He11=2.0(+0.3–0.2) **
*^{265}Hs^m T : symmetrized from 300(+200–100); other 99He11=750(+170–120) **

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{266}Lr	111620#	520#					1#	h							α ?; SF ?	
^{266}Rf	110080#	470#					4#	h		0^+					α ?; SF ?	
^{266}Db	112740#	280#					80	m	70		07	07Og02	T	2007	α ?; SF ?; β^+ ?	*
^{266}Sg	113620#	250#					460	ms	180	0^+	05	08Dv02	TD	2006	SF=100	*
^{266}Bh	118110#	160#					2.5	s	1.6		05	08Mo09	T	2000	α≈100; β^+ ?; SF ?	*
^{266}Hs	121140	40					3.02	ms	0.54	0^+	05	11Ac.A	T	2001	α=?; SF≈1.4#	*
^{266}Hs^m	122240	80	1100	70	AD		280	ms	220	9^-#		11Ac.A	T	2001	α=?	*
^{266}Mt	127960#	310#					1.2	ms	0.4		05	97Ho14	T	1982	α=?; SF<5.5	*
^{266}Mt^m	129100#	310#	1140	80	AD		6	ms	3			97Ho14	TD	1984	α=100	*

*^{266}Db T : one event at 31.74 m, yields 22(+105–10), see 84Sc13 **
*^{266}Sg T : not used 08Dv02=360(+250–100) ms ; supersedes 06Dv01=444(+444–148) **
*^{266}Sg I : 98Tu01=21(+20–12) s 94La22=10-30 s with 18%<α<50% 50%<SF<82% re-assigned **
*^{266}Sg I : to ^{265}Sg, see 08Dv02; 10Gr04 one SF event after 23 ms, not trusted **
*^{266}Bh T : 2 events at 2.469 and 1.31 s; other 06Qi03=0.66(+0.59–0.26) **
*^{266}Hs T : average 11Ac.A=2.97(+0.78–0.51) 01Ho06=2.3(+1.3–0.6) **
*^{266}Hs^m T : symmetrized from 11Ac.A=74(+354–34); 01Ho06<20ms **
*^{266}Mt T : 10 events yielding 1.01(+0.47–0.24), see 84Sc13 **
*^{266}Mt^m T : 3 events at 7.8, 2.0 and 5.0 yield 3.4(+4.7–1.3), see 84Sc13 **

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)					Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{267}Rf	113450#	580#						2.5	h	1.5		05	06Og05	TD	2004	SF=100	*
^{267}Rf^{p}	113670#	580#	220#	100#													*
^{267}Db	114080#	410#						4.6	h	3.7		05	04Og03	TD	2004	SF=100	*
^{267}Sg	115840#	280#						1.8	m	0.7			08Dv02	TD	2008	SF=83; α=17	*
^{267}Sg^{p}	115910#	290#	70#	100#													
^{267}Bh	118770#	260#						22	s	10		05			2000	α=100	*
^{267}Hs	122650#	100#						55	ms	11	$5/2^+$#	05			1995	α>80; SF ?	*
^{267}Hs^{m}	122690#	100#	39	24	AD			990	μs	90		05	04Fo08	TD	2004	α=?; IT ?	*
^{267}Mt	127790#	500#						10#	ms							α ?	
^{267}Ds	133920#	140#						10	μs	8	$9/2^+$#	05	95Gh04	T	1995	α=100	*
*^{267}Rf	T : symmetrized from 1.3(+2.3–0.5); supersedes 04Og12 one event at 2.3 h																**
*^{267}Db	T : symmetrized from 73(+350–33) m																**
*^{267}Sg	T : symmetrized from 80(+60–20) s ; other 99Og.B=19 ms not trusted																**
*^{267}Bh	T : symmetrized from 00Wi15=17(+14–6)																**
*^{267}Hs	T : symmetrized from 52(+13–8)																**
*^{267}Hs^{m}	T : 04Fo08(2 events)=940(+120–45); other not trusted 04Mo40(1 event)=803 ms																**
*^{267}Ds	T : one single event, lifetime 4 μs, thus T=2.8(+13.0–1.3), see 84Sc13																**
^{268}Rf	115480#	710#						1#	h		0^+					α ?; SF ?	
^{268}Db	117060#	530#						30.8	h	5.0		05	12Og02	T	2004	SF≈100; β^+ ?	*
^{268}Db^{p}	117220#	540#	160#	100#													
^{268}Sg	116800#	470#						2#	m		0^+					α ?; SF ?	
^{268}Bh	120810#	380#						25#	s							α ?; SF ?	
^{268}Hs	122830#	280#						1.42	s	1.13	0^+		10Ni14	TD	2010	α≈100	*
^{268}Mt	129150#	230#						27	ms	6	5^+#,6^+#	05	04Mo26	T	1995	α=100	*
^{268}Ds	133650#	300#						100#	μs		0^+					α ?	
*^{268}Db	T : average 12Og02=27.9(+7.8–5.0) 07St18=28(+11–4)																**
*^{268}Db	T : 12Og02 supersedes 05Og02=29(+9–6) and 04Og03=16(+19–6)																**
*^{268}Hs	T : symmetrized from 0.38(+1.8–0.17)																**
*^{268}Mt	T : mean lifetime of 14 events in 04Mo26=30 ms and 6 events in 02Ho11=60 ms																**
^{269}Db	119150#	680#						3#	h							α ?; SF ?	
^{269}Sg	119820#	360#						8.0	m	6.3		05	10El06	TD	2010	α≈100; SF ?	*
^{269}Bh	121480#	370#						1#	m							α ?	
^{269}Hs	124590#	130#						27	s	17	$9/2^+$#	05	02Ho11	T	1996	α=100	*
^{269}Mt	129310#	460#						100#	ms							α ?	
^{269}Ds	134840	30						230	μs	110	$9/2^+$#	05	95Ho03	T	1995	α=100	*
*^{269}Sg	T : one α event at 185 s, thus T=128(+613–58) s																**
*^{269}Sg	T : ENSDF00=22(+32–11) s based on 99Ni03 work retracted by authors in 02Ni10																**
*^{269}Hs	T : 2 events at 19.7 and 22.0 s yield 14(+26–6), see 84Sc13																**
*^{269}Ds	T : symmetrized from 170(+160–60)																**
^{270}Db	122360#	600#						90	h	70		10	10Og01	TD	2010	SF=100	*
^{270}Sg	121490#	560#						3#	m		0^+					α ?; SF ?	
^{270}Bh	124230#	290#						3.8	m	3.0		07	07Og02	TD	2007	α=100	*
^{270}Bh^{p}	124830#	350#	600#	200#													
^{270}Hs	125090#	250#						30#	s		0^+	05	03Tu05	D	2006	α=100	
^{270}Mt	130710#	170#						6.3	ms	1.5		05			2004	α≈100	*
^{270}Ds	134680	50						205	μs	48	0^+	05	11Ac.A	T	2001	α≈100; SF<0.2	*
^{270}Ds^{m}	136070	60	1390	60	AD			10	ms	6	$(10)^{(-\#)}$	05			2001	α=?; IT ?	*
*^{270}Db	T : one event at 33.4 h, yields 23.15(110.9-10.6), see 84Sc13																**
*^{270}Bh	T : symmetrized from 61(+292–28) s																**
*^{270}Mt	T : symmetrized from 5.0(+2.4–0.3)																**
*^{270}Ds	T : average 11Ac.A=200(+70–40) 01Ho06=100(+140–40)																**
*^{270}Ds^{m}	T : symmetrized from 6.0(+8.2–2.2)																**
^{271}Sg	124760#	590#						3.1	m	1.6		06	06Og05	TD	2004	α=70; SF=30	*
^{271}Bh	125990#	440#						1#	m			05				α ?; SF ?	
^{271}Hs	127770#	300#						10#	s						2008	α ?; SF ?	
^{271}Mt	131100#	330#						400#	ms							α ?	
^{271}Ds	135950#	100#				*	&	90	ms	40	$13/2^-$#	05			1998	α=100	*
^{271}Ds^{m}	136020#	100#	68	27	AD	*	&	1.7	ms	0.4	$9/2^+$#	05			1995	α=100	*
*^{271}Sg	T : symmetrized from 1.9(+2.4–0.6); supersedes 04Og12=2.4(4.3-1.0) α=50; SF=50																**
*^{271}Ds	T : symmetrized from 69(+56–21)																**
*^{271}Ds^{m}	T : symmetrized from 1.63(+0.44–0.29)																**

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)				Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{272}Sg	126580#	770#					4#	m		0^+					α ?; SF ?	
^{272}Bh	128790#	540#					8.8	s	2.1		05	12Og02	T	2004	α≈100	*
^{272}Bh^{p}	128970#	550#	180#	100#												
^{272}Hs	129010#	510#					10#	s		0^+					α ?; SF ?	
^{272}Mt	133580#	490#					400#	ms							α ?; SF ?	
^{272}Ds	136020#	410#					200#	ms		0^+					SF ?	
^{272}Rg	142770#	230#					4.5	ms	1.0	$5^+\#,6^+\#$	05	04Mo26	T	1995	α=100	*
*^{272}Bh	T : symmetrized from 8.2(+2.5–1.6); supersedes 04Og03=9.8(+11.7–3.5)															**
*^{272}Rg	T : mean lifetime of 14 events in 04Mo26=5.5 ms and 6 events in 02Ho11=2.3															**
^{273}Sg	130020#	500#					5#	m							SF ?	
^{273}Bh	130630#	740#					1#	m							α ?; SF ?	
^{273}Hs	131970#	370#					910	ms	720	$3/2^+\#$	05	10El06	TD	2010	α≈100	*
^{273}Hs^{p}	132080#	380#	110#	100#											α ?; SF ?	
^{273}Mt	134510#	480#					800#	ms							α ?; SF ?	
^{273}Ds	138380#	130#					240	μs	120	$13/2^-\#$	05			1996	α=100	*
^{273}Ds^{m}	138580#	130#	198	20	EU		120	ms		$3/2^+\#$	05			1996	α=100	
^{273}Rg	142640#	530#					2#	ms							α ?	
*^{273}Hs	T : one α event at 346 ms, thus T=240(+1150–110) ms															**
*^{273}Hs	T : 99Ni03=1.2(+1.7–0.6) s α-decay retracted by authors in 02Ni10															**
*^{273}Ds	T : symmetrized from 170(+170–60)															**
^{274}Bh	133710#	600#					3.4	m	2.7		10	10Og01	TD	2010	α=100	*
^{274}Hs	133490#	590#					500#	ms		0^+					α ?; SF ?	
^{274}Mt	137160#	350#					850	ms	540		07	07Og02	TD	2007	α=100	*
^{274}Ds	139180#	390#					10#	ms		0^+					α ?; SF ?	
^{274}Rg	144620#	180#					29	ms	18		05	08Mo09	TD	2004	α≈100	*
*^{274}Bh	T : one event at 1.3 m, yields 0.901(+4.32–0.41), see 84Sc13															**
*^{274}Mt	T : symmetrized from 440(+810–170)ms															**
*^{274}Rg	T : 2 events at 9.26 and 34.3 ms															**
^{275}Bh	135690#	600#					5#	m							SF ?	
^{275}Hs	136620#	590#					290	ms	150		05	06Og05	TD	2004	α=100	*
^{275}Hs^{p}	136860#	600#	240#	100#												
^{275}Mt	138630#	470#					40	ms	30		05	04Og03	TD	2004	α=100	*
^{275}Ds	141620#	420#					10#	ms							α ?; SF ?	
^{275}Rg	145260#	520#					5#	ms							α ?	
*^{275}Hs	T : symmetrized from 190(+220–70) ms; supersedes 04Og12=150(+270–60)															**
*^{275}Mt	T : symmetrized from 9.7(+46–4.4)															**
^{276}Hs	138290#	800#					100#	ms		0^+					α ?; SF ?	
^{276}Mt	141210#	550#				*	730	ms	160		05	12Og02	T	2004	α=100	*
^{276}Mt^{m}	141350#	550#	140	70	AD	*	10	s	5			12Og02	TD	2012	α=100	*
^{276}Mt^{p}	141510#	560#	300#	100#												
^{276}Ds	142540#	550#					100#	ms		0^+					α ?; SF ?	
^{276}Rg	147490#	630#					10#	ms							α ?; SF ?	
^{276}Cn	150350#	600#					100#	μs		0^+					α ?; SF ?	
*^{276}Mt	T : symmetrized from 680(+200–120); supersedes 04Og03=720(+870–250)															**
*^{276}Mt^{m}	T : symmetrized from 6(+8–2)															**
^{277}Hs	141490#	540#					11	ms	9	$3/2^+\#$	05	10Du06	TD	2010	SF=100	*
^{277}Hs^{m}	141590#	550#	100#	100#			130	s	100			12Ho12	TD	2012	SF=100	*
^{277}Hs^{p}	141960#	550#	470#	100#												
^{277}Mt	142770#	770#					10#	s							α ?; SF ?	
^{277}Ds	145230#	380#					22	ms	17	$11/2^+\#$	05	10El06	TD	2010	α≈100; SF ?	*
^{277}Rg	148170#	570#					10#	ms							α ?; SF ?	
^{277}Cn	152430#	140#					990	μs	490	$3/2^+\#$	05			1996	α=100	*
*^{277}Hs	T : symmetrized from 3.0(+14.4–1.4); 99Og10 one SF event at 16.5m, not trusted															**
*^{277}Hs^{m}	T : (SF 1 event) symmetrized from 34(+164–16) s															**
*^{277}Ds	T : one α event at 8.21 ms, thus 5.7(+27.3–2.6)															**
*^{277}Ds	T : 99Ni03=3.0(+4.7–1.5) ms α-decay retracted by authors in 02Ni10															**
*^{277}Cn	T : four events at 280 μs, 1406 μs, 1100 μs and 1220 μs, see 84Sc13															**

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)		Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{278}Mt	145600#	630#			29	s	23		10	10Og01	TD	2010	α=100	*
^{278}Mt^p	145980#	660#	380#	200#										
^{278}Ds	146280#	630#			270#	ms		0^+					α ?; SF ?	
^{278}Rg	150430#	360#			8	ms	5		07	07Og02	TD	2007	α=100	*
^{278}Cn	152910#	440#			2#	ms		0^+					α ?; SF ?	
^{278}Ed	158890#	180#			2.3	ms	1.3		05	12Mo25	TD	2004	α≈100	*
*^{278}Mt	T : 10Og01 one α-decay event at 11.0 s													**
*^{278}Rg	T : symmetrized from 4.2(+7.5–1.7)													**
*^{278}Ed	T : 3 events at 0.344, 4.930 and 0.667 ms; supersedes 08Mo09													**
^{279}Mt	147250#	670#			30#	s							α ?; SF ?	
^{279}Ds	149130#	600#			210	ms	50		05	06Og05	TD	2004	SF=90; α=10	*
^{279}Ds^p	149320#	610#	190#	100#										
^{279}Rg	151570#	470#			640	ms	510		05	04Og03	TD	2004	α=100	*
^{279}Rg^p	151780#	480#	210#	100#										
^{279}Cn	155130#	470#			5#	ms							α ?; SF ?	
^{279}Ed	159240#	700#			1#	ms							α ?; SF ?	
*^{279}Ds	T : symmetrized from 200(+50–40); supersedes 04Og12=180(+50–30) and													**
*^{279}Ds	T : 04Og07=290(+350–100);													**
*^{279}Ds	T : others : 09St21 one SF event at 185 ms, 07Ei02 one SF event at 536 ms													**
*^{279}Rg	T : symmetrized from 170(+810–80)													**
^{280}Ds	150260#	820#			11	s	6	0^+	05	01Og01	TD	1999	SF=100	*
^{280}Rg	153830#	560#			3.8	s	0.8		05	12Og02	T	2004	α=100	*
^{280}Rg^p	153950#	570#	120#	100#										
^{280}Cn	155700#	580#			5#	ms		0^+					α ?; SF ?	
^{280}Ed	161080#	700#			10#	ms							α ?; SF ?	
*^{280}Ds	T : 3 events at 6.93, 14.3 and 7.4 yield 6.6(+9–2.4), see 84Sc13													**
*^{280}Rg	T : symmetrized from 3.53(+0.99–0.63); supersedes 04Og03=3.6(+4.3–1.3)													**
^{281}Ds	153240#	550#			14	s	4	$3/2^+$#	05	10Du06	TD	2004	SF=85 12; α=15 12	*
^{281}Ds^m	153470#	550#	230#	160#	0.9	s	0.7			12Ho12	TD	2012	α=100	*
^{281}Rg	154960#	820#			37	s	17		10	10Og01	TD	2010	SF=100	*
^{281}Cn	158120#	390#			370	ms	290	$3/2^+$#	05	10El06	TD	2010	α≈100; SF ?	*
^{281}Ed	161600#	700#			100#	ms							α ?; SF ?	
*^{281}Ds	T : average 10Du06=20(+20–7) 07Og01=11.1(+5.0–2.7); supersedes													**
*^{281}Ds	T : 04Og07=9.6(+5.0–2.5); 99Og10 one α event at 1.6 m, not trusted													**
*^{281}Ds	D : symmetrized from SF=91(+7–16)%; α=9(+16–7)%													**
*^{281}Ds^m	T : symmetrized from 0.25(+1.18–0.11) s													**
*^{281}Rg	T : symmetrized from 26(+25–8)													**
*^{281}Cn	T : one α event at 140 ms, thus 97(+465–44)													**
*^{281}Cn	T : 99Ni03=0.89(+1.30–0.45) α-decay retracted by authors in 02Ni10													**
^{282}Rg	157530#	670#			1.9	s	1.5		05	10Og01	TD	2010	α=100	*
^{282}Cn	158820#	660#			900	μs	240	0^+	05	06Og05	TD	2004	SF=100	*
^{282}Ed	163640#	360#			140	ms	90		07	07Og02	TD	2007	α=100	*
*^{282}Rg	T : one event at 740 ms, yields 513(2457-234) ms, see 84Sc13													**
*^{282}Cn	T : symmetrized from SF=820(+300–180); supersedes 04Og12=500(+330–140)													**
*^{282}Cn	T : also 10El06 one SF event at 522 μs; 09St21 one SF at 3600 μs													**
*^{282}Ed	T : symmetrized from 73(+134–29)													**
^{283}Rg	158860#	730#			30#	s							α ?; SF ?	
^{283}Cn	161400#	610#			4.1	s	1.0		06	06Og05	TD	2004	α=?; SF<10	*
^{283}Ed	164480#	480#			380	ms	310		05	04Og03	TD	2004	α=100	*
*^{283}Cn	T : symmetrized from 3.8(+1.2–0.7); supersedes 04Og12=4.0(+1.3–0.7) and													**
*^{283}Cn	T : 04Og07=6.1(+7.2–2.2); other 07Ho18=6.9(+6.9–2.3), SF=50													**
*^{283}Cn	T : 09St21 one α event at 1.92 s													**
*^{283}Cn	T : Four SF events at 99Og07=9.3 m, 3.8 m, 99Og05=3.0 m, 0.9 m, not trusted													**
*^{283}Ed	T : symmetrized from 100(+490–45)													**
^{284}Cn	162230#	850#			104	ms	20	0^+	05	10Du06	TD	2004	SF=100	*
^{284}Ed	166480#	580#			1.01	s	0.24		05	12Og02	T	2004	α=100	*
*^{284}Cn	T : average 10Du06=101(+50–25) 07Og01=97(+31–19); supersedes													**
*^{284}Cn	T : 04Og12=101(+41–22) and 04Og07=98(+41–23)													**
*^{284}Cn	TD : 01Og01 3 α's at 53.9 s, 10.3 s, 18.0 s, not trusted													**
*^{284}Ed	T : symmetrized from 940(+290–180)ms; supersedes 04Og03=480(+580–170)ms													**

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)			Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{285}Cn	164980#	560#				32	s	9	$5/2^+$#	05	10Du06	TD	2004	α=100	*
^{285}Cn^m	165740#	560#	750#	170#		15	s	12			12Ho12	TD	2012	α=100	*
^{285}Ed	167420#	830#				8	s	4		10	10Og01	TD	2010	α=100	*
^{285}Fl	171060#	440#				470	ms	380			10El06	TD	2010	$\alpha\approx$100; SF ?	*
*^{285}Cn	T : average 10Du06=30(+30–10) 07Og01=29(+13–7); supersedes														**
*^{285}Cn	T : 04Og07=34(+17–9); 99Og10 one event at 15.4 m, not trusted														**
*^{285}Cn^m	T : symmetrized from 4.0(+19.1–1.8) s														**
*^{285}Ed	T : symmetrized from 5.5(+5.0–1.8)														**
*^{285}Fl	T : one α event at 181 ms, thus 125(+600–57); escape α, no Q$_\alpha$ measured														**
*^{285}Fl	T : 99Ni03=580(+870–290) α-decay retracted by authors in 02Ni10														**
^{286}Ed	169730#	670#				70	s	60		10	10Og01	TD	2010	α=100	*
^{286}Ed^p	170040#	680#	310#	100#											
^{286}Fl	171610#	660#				140	ms	30	0^+	05	06Og05	TD	2004	SF$\approx$60; $\alpha\approx$40	*
*^{286}Ed	T : one event at 28.3 s, yields 19.6(93.9-12.9), see 84Sc13														**
*^{286}Fl	T : symmetrized from 130(+40–20); supersedes 04Og12=160(+70–30) and														**
*^{286}Fl	T : 04Og07=290(+540–110); also one α each 10El06=76 ms, 09St21=301 ms														**
^{287}Ed	170830#	760#				2#	m							α ?; SF ?	
^{287}Fl	173990#	610#				520	ms	130		05	06Og05	TD	2004	α=100	*
^{287}Ef	177640#	490#				120	ms	100		05	04Og03	TD	2004	α=100	*
*^{287}Fl	T : symmetrized from 480(+160–90); supersedes 04Og12=510(+180–100)														**
*^{287}Fl	T : supersedes 04Og07=1.1(+1.3–0.4); 99Og07 2 evts 1.32, 14.4 s not trusted														**
*^{287}Fl	T : also 09St21 one α event at 815 ms														**
*^{287}Ef	T : symmetrized from 32(+155–14)														**
^{288}Fl	174720#	850#				750	ms	140	0^+	05	11Ga19	TD	2004	α=100	*
^{288}Ef	179540#	580#				190	ms	40		05	12Og02	T	2004	α=100	*
*^{288}Fl	T : average 11Ga19=520(+220–130) 07Og01=800(+270–160); supersedes														**
*^{288}Fl	T : 10Du06=470(+240–120); 04Og12=800(+320–180)and 04Og07=630(+270–140)														**
*^{288}Fl	T : 01Og01=1800(+2100–600) re-assigned to ^{289}Fl														**
*^{288}Ef	T : symmetrized from 173(+52–32); supersedes 04Og03=87(+105–30)														**
^{289}Fl	177370#	560#				2.4	s	0.6	$5/2^+$#	05	10Du06	TD	2004	α=100	*
^{289}Fl^m	178330#	560#	960#	190#		1.1	s	0.8			12Ho12	TD	2012	α=100	*
^{289}Ef	180360#	830#				340	ms	180		10	10Og01	TD	2010	α=100	*
^{289}Lv	184590#	530#			RN	2#	ms		$5/2^+$#	00	02Ni10	I		α ?	*
*^{289}Fl	T : average 10Du06=0.97(+0.97–0.32) 07Og01=2.6(+1.2–0.7);														**
*^{289}Fl	T : supersedes 04Og07=2.7(+1.4–0.7);														**
*^{289}Fl	T : 99Og10 one event at 30.4 s, not trusted														**
*^{289}Fl^m	T : symmetrized from 0.28(+1.35–0.13) s														**
*^{289}Ef	T : symmetrized from 220(+260–80)														**
*^{289}Lv	T : 99Ni03=600(+860–300) α-decay retracted by authors in 02Ni10														**
^{290}Ef	182550#	680#				60	ms	50		10	10Og01	TD	2010	α=100	*
^{290}Ef^p	182660#	690#	110#	100#											
^{290}Lv	185030#	660#				8	ms	3	0^+	05	06Og05	TD	2004	α=100	*
*^{290}Ef	T : one event at 23 ms, yields 15.9(+76.2–7.3), see 84Sc13														**
*^{290}Lv	T : symmetrized from 7.1(+3.2–1.7); supersedes 04Og07=15(+26–6)														**
^{291}Ef	183570#	820#				1#	s							α ?; SF ?	
^{291}Lv	187300#	610#				28	ms	15		05	06Og05	TD	2004	α=100	*
^{291}Eh	191450#	630#				2#	ms							α ?; SF ?	
*^{291}Lv	T : symmetrized from 18(+22–6); supersedes 04Og07=6.3(+11.6–2.5)														**
^{292}Lv	187920#	850#				24	ms	12	0^+	05	04Og12	TD	2004	α=100	*
^{292}Eh	193250#	700#				10#	ms							α ?; SF ?	
*^{292}Lv	T : symmetrized from 18(+16–6)														**
*^{292}Lv	T : 01Og01 reported one event at 46.9 ms, re-assigned to next isotope														**

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)		Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{293}Lv	190480#	560#			80	ms	40		05	07Og01	TD	2004	α=100	*
^{293}Lv^m	191410#	560#	930#	200#	80	ms	60			12Ho12	TD	2012	α=100	*
^{293}Eh	193970#	830#			18	ms	8		10	10Og01	TD	2010	α=100	*
^{293}Ei	198930#	730#		RN	1#	ms		$1/2^+$#	00	02Ni10	I		α ?	*
*^{293}Lv	T : symmetrized from 61(+57–20); supersedes 04Og07=53(+62–19)													**
*^{293}Lv^m	T : symmetrized from 20(+96–9) ms													**
*^{293}Eh	T : symmetrized from 14(+11–4)													**
*^{293}Ei	T : 99Ni03=120(+180–60) α-decay retracted by authors in 02Ni10													**
^{294}Eh	196040#	690#			290	ms	230		10	10Og01	TD	2010	α=100	*
^{294}Ei	199270#	660#			1.4	ms	0.7	0^+	05	06Og05	TD	2006	α=100	*
*^{294}Eh	T : one event at 112 ms, yields 78(+374–36), see 84Sc13													**
*^{294}Ei	T : symmetrized from 890(+1070–310) μs; supersedes 04Og12 one event at 1.8 ms													**
^{295}Ei	201430#	640#			10#	ms				04Og05	TD		α ?	*
*^{295}Ei	T : 04Og05 reports one α event at 2.55 ms ; re-assigned to ^{294}Ei													**