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**ABSOLUTE GAMMA BRANCHING  
RATIOS FOR FISSION PRODUCTS  
IN THE MASS RANGE 74-165**

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# ABSOLUTE GAMMA BRANCHING RATIOS FOR FISSION PRODUCTS IN THE MASS RANGE 74–165

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## Abstract

A literature search has been carried out with the goal to list experimental determinations of absolute branching ratios of gamma-rays emitted from fission products. The branching ratios are required in all cases when the number of atoms of a given nuclide in a sample is to be determined by gamma spectroscopy. The mass range covered in the study is 74 – 165. The upper limit of the half-life of the nuclides considered has been chosen to be a few years. Thus very long-lived species are not included.

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## 1 Introduction

Absolute gamma branching ratios are quantities with many applications. These are related to the fact that gamma measurements are comparatively simple to carry out. Standard gamma spectrometers of good resolution are commonly available, and the measurements are little disturbed by background and other difficulties. It is also easy to calibrate the gamma spectrometer by means of sources of known strength so that the number of photons emitted from the source can be evaluated from the number of photons registered in a certain gamma peak. The conversion of this number the number of decays in the sample requires the knowledge of the gamma emission branching ratio, *i.e.* the number of gamma-rays of a given energy which are emitted per decay of the nuclide of interest.

At the Studsvik Neutron Research Laboratory two extensive experiments of survey character on fission products have recently been completed at the isotope-separator-on-line facility OSIRIS [1], one measuring the yield of products in thermal-neutron induced fission of  $^{235}U$  [2] and the other [3] giving the average beta and gamma energies emitted per decay of the fission products, quantities necessary for the determination of the beta and gamma parts of the heat developed in nuclear fuel elements by the decaying fission products when the summation method is used. In both experiments a large number of fission products were included, and the abundance of these fission products in the mass-separated samples was determined by means of gamma spectroscopy. Many of the fission products studied are short-lived and in some cases little studied before. It turned out that gamma branching ratios reported in the literature are often inconsistent with each other. In some cases no values were available at all. Therefore a complementary study of absolute gamma branching ratios using various techniques has been carried out [4]. The results of this experiment and values found in the literature are evaluated in order to produce useful figures for the various applications indicated above. In addition to branching it is also usually necessary to use the half-lives of the nuclides concerned. Therefore also half-lives are included in the evaluation.

Section 2 lists different methods of measuring absolute gamma branching ratios. The results are then given in a series of tables in Section 3. The tables cover known fission products in the mass range 74 – 165. They are restricted to nuclides with half-lives less than a few years.

## 2 Survey of methods to determine absolute gamma branching ratios

### 2.1 Decay schemes

If the decay scheme is known in detail, the absolute gamma branching ratios are also known. This is especially the case for more long-lived nuclides which have been the object of extensive spectroscopic investigations. A word of caution is still necessary, however. Decay schemes are usually constructed from gamma spectroscopy only, and beta particles are seldom measured. This means that ground state beta transitions are often inferred from pieces of information such as spin assignments, *etcetera*. The amount of ground state beta transition is, in general, the main cause of the uncertainty of the gamma branching ratio obtained except when certain spin assignments prohibit ground state to ground state transitions and thereby remove this reason for the branching ratio uncertainty. If the amount of ground state beta emission is known it is possible to derive absolute gamma branching ratios from the structure of the decay scheme.

It must always be remembered that the wanted quantity is the gamma emission branching ratio, not the transition probability. Thus, possible gamma conversion must be taken into account.

Short-lived fission products have often a very complicated decay with hundreds of gamma-rays involved. The construction of a unique decay scheme may meet with great difficulties. This obviously affects the possibility to determine absolute gamma branching ratios from decay schemes and, in particular, to estimate the uncertainty to be assigned to those quantities.

### 2.2 Beta-gamma coincidence methods

One of the most powerful methods for determining branching ratios is the beta-gamma coincidence method. By this method the disintegration rate of the sample is obtained. The gamma branching ratio is immediately obtained by dividing the number of gamma-rays by the disintegration rate. Some precautions must be taken in order to avoid background problems (gamma effect in the beta counter, contaminating gamma-rays, sum-up effects, *etcetera*). Also, one must choose a gamma-ray which is really coincident with the beta particle and not delayed.

## 2.3 Simultaneous measurements of beta particles and photons from the same sample

An obvious way to determine absolute gamma-emission branching ratios is to determine the sample strength by beta counting and, at the same time, register the number of photons emitted. This requires well-calibrated detectors for beta particles and for gamma-rays. In this case the accuracy obtainable is essentially depending on how accurate these calibrations are. It is not easy to calibrate beta detectors absolutely to better than about 5 %, and this is therefore often the practical limit of the uncertainty in absolute branching ratios determined using beta counting.

The beta efficiency curve depends on the energy of the beta particles, and it is necessary to establish an efficiency *versus* beta energy curve. The evaluation of the efficiency to be applied to the beta measurement of a given nuclide requires the knowledge of the energy spectrum of the emitted beta particles. Such information is available for a large number of nuclides in [3].

If a sample contains several components the complex beta spectrum must be decomposed into the contributions from the different components, for instance by following the decay as a function of time and resolving the composite decay curve.

The gamma measurements should also be done as a function of time so that a relation between gamma counting rates and beta counting rates is obtained.

## 2.4 Use of delayed-neutron branching ratios

If the nuclide under study is a delayed-neutron precursor with known branching ratio ( $P_n$ -value), the absolute strength of a sample can be obtained from neutron counting using a well-calibrated neutron counter. In combination with a gamma spectrometer this leads to a determination of the gamma branching ratio on the absolute scale. Again, the energy dependence of the neutron counter must be taken into account. This fact and the error of the delayed-neutron branching ratio leads to an uncertainty of the gamma branching ratio of about the same size as in the preceding method.

## 2.5 Sample strength through fission yields

The strength of a sample can be calculated from a measurement of the total fission rate in a sample if its fission yield is known. This method can also be used for a determination of gamma branching ratios provided that the number of emitted gamma-rays is also measured. The accuracy will normally depend on how well the number of fissions can be determined.

## 2.6 Sample strengths from a measurement of the number of atoms of parent or daughter

Still another method to determine the number of decaying atoms of a nuclear species is to measure, by any of the methods discussed earlier, how many atoms have been formed of daughter or grand-daughter nuclides by the decay of the nuclide under study or the number of parent atoms which have decayed to give the nuclide in question. The number of atoms is then obtained and can be related to the number of gamma-rays of a given energy.

## 3 Tables of gamma emission branching ratios

The gamma emission branching ratios determined in the present work and published in the literature are collected in Tables 1 – 92, one for each mass number. The methods of determination are denoted as follows:

$DS$	Deduced from decay schemes.
$\beta/\gamma$	The experiment was performed with the beta-gamma coincidence technique.
$\beta+\gamma$	Beta particles and photons were counted separately.
$n+\gamma$	Neutrons and photons were counted separately.
$f+\gamma$	The branching ratio was evaluated by relating the number of photons to the fission yield.
$N_P$	The number of photons was related to the abundance of a parent.
$N_D$	The number of photons was related to the abundance of a daughter.
$Ion/\beta$	The number of implanted ions was correlated with the number of electrons detected.
$\beta, \gamma, n, X$	The half-life was determined by counting beta particles, photon, neutrons, or $X$ -rays.
$m$	The half-life was determined via a milking procedure.

The tables also contain references. If the source does not give errors explicitly, those are inferred from pieces of information in the publication such as

limits of ground state beta transitions. If this does not prove to be possible, the value is not included in the determination of average values.

Updating using recent information has sometimes been undertaken. The basis for the recalculation is then noted as a footnote below the table. The *comments* column shows whether the branching ratios are relative and indicates the fraction of ground state to ground state beta transition (*gs*) or the fraction of isomeric transition (*gi*) used in evaluating the branching ratio from decay scheme data.

Finally, weighted averages are formed over all seemingly acceptable determinations, and the result obtained is considered to be a recommended value. In a few cases published values are so discrepant that it has not been possible to assign a "recommended" value. Those cases should be further investigated.

Only the most important gamma-rays have been included for each nuclide. Branching ratios for gamma-rays not given in the table can easily be derived from sets of relative gamma intensities and the absolute branching ratio of one of the lines given in the table.

For nuclides with isomeric states a gamma-ray with a major abundance in the decay of one of the states may also be present as a minor contribution in the decay of the other state. Such a gamma-ray is also included in the latter case since it may have to be used for a correction.

The tables also contain half-lives. This list may not be complete; older determinations with low accuracy have often been omitted because they will hardly affect the averaging procedure.

For half-life determinations errors (one standard deviation) less than 0.5 % of the value are usually adjusted up to this minimum value when calculating the average result. The reason for this is that a very small error, arising from statistical considerations only, may be unrealistic if possible systematic uncertainties have been disregarded.

In most cases references are made to the original publications and the results obtained by the authors of the publications. For nuclides close to stability earlier evaluations such as Nuclear Data Sheets (the authors of the review in question are cited), Table of Radioactive Isotopes [5], or the table published by Blachot, Fiche, and Duchemin [6]. Then no experimental results are entered except when those results are so new that they could not be known to the evaluators mentioned above.

The version date in the title of a table shows the latest date for inclusion of data in that particular table.

## References

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- [5] E. Browne and R. B. Firestone, Table of Radioactive Isotopes, John Wiley & Sons (1986).
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Table 1: Mass 74. Version 1993-07-18

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>74</sup> Cu	1.60(15)a	$\gamma$	1.594(10)	605.8	91b	DS		$gs=0$
	1.59(5)b	$\gamma$		812.6	14.8b	DS		$gs=0$
	1.51(27)c	$Ion/\beta$		1064.4	19.3b	DS		$gs=0$
	1.594(10)d	$\gamma$		1138.0	16.9b	DS		$gs=0$
<sup>74</sup> Zn ( $0^+$ )	95(1)e	$\beta$	96(1)	140.0	38.1(4)g			
	98(2)f	$\beta, \gamma$		190.4	26.8(3)g			
<sup>74m</sup> Ga ( $1^+$ )	9.5g			56.5	74.4g			
<sup>74</sup> Ga ( $3^-$ )	480(3)h	$\gamma$	488(8)	595.9	91.9(1)g			
	495(3)i	$\gamma$		608.5	14.7(4)g			

a) LUN87.  
d) KRA91.  
g) BRO86.

b) WIN89.  
e) GRA74.  
h) TAY75.

c) BER90.  
f) ERD72.  
i) CAM71.

Table 2: Mass 75 continued

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>75</sup> Ga ( $3/2^-$ )	126(2)e 139(6)h	$\beta$ $\gamma$	127(4)	252.8	34(4)f	$\beta+\gamma$		
				574.7	11.0(14)f	$\beta+\gamma$		
				885.4	3.8(4)i			
<sup>75m</sup> Ge ( $7/2^+$ )	47.7(5)h 46.6(5)j 48.9(2)k	$\gamma$ $\gamma$	48.4(6)	139.7	38.8(12)l			
<sup>75</sup> Ge ( $1/2^-$ )	4967(3)l			264.6	11.3(11)l			

\*) The smallest error used in the averaging procedure is 0.5 % of the value.

a) LUN87. b) REE86. c) BER90.

d) KRA91. e) GRA74. f) LUN93.

g) EKS86. h) CHA74.

i) Using relative intensities from BLA86 and the absolute branching of the 252.8 keV line from LUN93.

j) BHA76. k) IMA69. l) BRO86.

Table 2: Mass 75. Version 1993-07-18

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>75</sup> Cu	1.38(8)a	$\gamma$	1.225(7) *)	185				
	1.3(1)b	n		476				
	1.3(3)c	$Ion/\beta$		724				
	1.224(3)d	$\gamma$						
<sup>75</sup> Zn	10.2(3)e	$\beta$		155.9	12(4)f	$\beta+\gamma$	16(3)	$gs < 10\%$
				18.1(24)g	DS			
				228.7	31(4)f	$\beta+\gamma$	31(3)	$gs < 10\%$
				31(4)g	DS			
				432.3	15.6(24)f	$\beta+\gamma$	18(3)	$gs < 10\%$
				21(3)g	DS			
				606.4	9.2(20)f	$\beta+\gamma$	9.6(9)	$gs < 10\%$
				9.7(10)g	DS			

Table 3: Mass 76. Version 1993-07-18

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>76</sup> Cu	0.35(8)a 0.61(10)b 0.57(6)c 0.641(6)d	$\gamma$ n $\gamma$	0.639(13)	598.7				Low-spin
<sup>76</sup> Cu	1.27(30)c	$\gamma$		697.8				High-spin
<sup>76</sup> Zn ( $0^+$ )	5.60(6)e 5.7(3)e	$\gamma$ $\beta$	5.60(6)	172.4	7.8(8)f	DS		$gs=0$
				199.2	81(8)f 105(8)g	$\beta+\gamma$	93(12)	$gs=0$
				275.5	5.2(6)f	DS		$gs=0$
				366.0	7.8(8)f 11.8(14)g	$\beta+\gamma$	8.8(17)	$gs=0$

Table 3: Mass 76. continued

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>76</sup> Ga (3 <sup>-</sup> )	29.8(4)e	$\beta$ $\gamma$	27.6(11)	431.0	9.2h 6.8(4)i	<i>DS</i>		gs=0
	27.1(2)h			545.5	19.2(13)g 26h			gs=0
				562.9	48(3)g 66h			gs=0
				1108.4	12.7(10)g 16h			gs=0

a) LUN87.

b) REE86.

c) WIN90.

d) KRA91.

e) GRA74.

f) EKS86.

g) LUN93.

h) CAM71b.

i) Using relative intensities from BLA86 and the absolute branching of the 562.9 keV line from LUN93.

Table 4: Mass 77 continued

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>77m</sup> Ge (1/2 <sup>-</sup> )	52.9(6)d 55.5(10)e 53.6(9)f 56(2)g	$\beta$ $\gamma$ $\beta$ $\gamma$	53.7(6)	159.7	10.1e	<i>ND</i>	<i>ND</i>	
<sup>77</sup> Ge (7/2 <sup>+</sup> )	40680(360)h			211.0	29.2i			
				215.5	27.1i			
				264.4	51.0i			
				416.3	20.6i			
<sup>77</sup> As (3/2 <sup>-</sup> )	139790 (180)h							

a) KRA91.

b) EKS86.

c) LUN93.

d) GRA74.

e) IMA70.

f) LY057.

g) MEE70.

h) BRO86.

i) BLA86.

Table 4: Mass 77. Version 1993-07-18

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>77</sup> Cu	0.469(8)a	$\gamma$						
<sup>77m</sup> Zn	1.05(10)b	$\gamma$		772.4				Internal transition(b)
<sup>77</sup> Zn	2.08(5)b 2.08(4)c	$\gamma$ $\beta$	2.08(3)	105.7	7.3(15)b	<i>DS</i>		gs $\leq$ 8%
				189.5	26(3)b 26(3)c	<i>DS</i> $\beta+\gamma$	26.0(21)	gs $\leq$ 8%
				473.9	18.2(28)b 19.4(10)c	<i>DS</i> $\beta+\gamma$	19.3(9)	gs $\leq$ 8%
				1832.0	11.4(19)b	<i>DS</i>		gs $\leq$ 8%
<sup>77</sup> Ga (1/2 <sup>-</sup> )	13.0(3)d	$\beta$		421.5	8.8(5)c	$\beta+\gamma$		
				458.6	8.3(5)c	$\beta+\gamma$		
				469.4	16.6(10)c	$\beta+\gamma$		
				1242.9	4.1(3)c	$\beta+\gamma$		

Table 5: Mass 78. Version 1993-07-18

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>78</sup> Cu	0.25(9)a 0.342(11)b	$\gamma$ $\gamma$	0.341(11)	216				
				524				
				737				
<sup>78</sup> Zn (0 <sup>+</sup> )	1.47(15)c	$\gamma$		181.7	28.0c 31(5)d	<i>DS</i> $\beta+\gamma$		gs=0
				224.7	43.7c 38(5)d	<i>DS</i> $\beta+\gamma$		gs=0
				635.6	20.8c 25(4)d	<i>DS</i> $\beta+\gamma$		gs=0
				860.3	27(4)e			

Table 5: Mass 78 continued

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>78</sup> Ga (3)	5.09(5)f	$\beta$	5.11(7)	567.1	15.9(11)d	$\beta+\gamma$	16.6(10)	gs=0
	5.49(25)g	$\gamma$		619.4	67(4)d	$\beta+\gamma$	69(4)	gs=0
				1025.1	76(7)g	DS		
				1186.4	12.2(10)g	$\beta+\gamma$	11.3(7)	gs=0
					19.8(17)g	DS		
<sup>78</sup> Ge (0 <sup>+</sup> )	5280(60)i			277.3	95.6(10)i			
				293.9	4.0(8)i			
<sup>78</sup> As (2 <sup>-</sup> )	5443(11)i			613.6	52(6)j			
				695.4	16.1(21)j			
				1308.8	12.5(18)j			

a) LUN87.

b) KRA91.

c) WOH80.

d) LUN93.

e) Using relative intensities from BLA86 and the absolute branching of the 181.7 keV line from LUN93.

f) GRA74.

g) LEW80.

h) Using relative intensities from BLA86 and the absolute branching of the 619.4 keV line from LUN93.

i) BRO86.

j) SIN82.

Table 6: Mass 79 continued

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>79</sup> Ga (3/2 <sup>-</sup> )	2.847(3)a	$\gamma, n$	2.853(12)	464.8	24.1(16)g	$\beta+\gamma$	24.1(15)	gs<18%
	2.63(9)c	n	*	516.4	19.8(15)g	$\beta+\gamma$	20.0(14)	gs<18%
	2.85(1)d	n		1187.3	11.6(11)g	$\beta+\gamma$	11.8(10)	gs<18%
	2.88(2)e	n			12.8(25)h	DS		
<sup>79m</sup> Ge (7/2 <sup>+</sup> )	3.00(9)f	$\beta$						
	42(2)i	$\gamma$	43.7(16)	109.6	14.4h			gs=0
	40(4)j	$\gamma$		230.6	27(3)g	$\beta+\gamma$		Discrepant data. No average
	41(4)k	m			76.5h	DS		gs=0
<sup>79</sup> Ge (1/2 <sup>-</sup> )	47(2)l	$\gamma$		542.3	25(4)j	DS		gs=75%
	19.1(3)f	$\beta$	18.9(3)	781.5	40.5h			
	18.5(5)m	$\gamma$			15.3h			
<sup>79</sup> As (3/2 <sup>-</sup> )	190.9(g)	$\beta$	190.9(3)	109.6	20.3(15)g	$\beta+\gamma$	20.7(12)	gs=63%
		DS		230.6	21.4(21)h	DS		gs=63%
				503.3	2.16h	DS		gs=63%
				542.3	0.08h	DS		gs=63%
<sup>79m</sup> Se (1/2 <sup>+</sup> )	1396.5	$\beta$	1396.5	1396.5	2.10h	DS		gs=63%
		DS		1505.9	7.9(6)g	$\beta+\gamma$	8.3(6)	gs=63%
					9.2(9)h	DS		
	364.5	$\beta$	364.5	364.5	1.88(25)n			
		DS		432.0	1.50(20)n			
				878.5	1.41(19)n			
					95.5	9.5(3)n		

\*) The smallest error used in the averaging procedure is 0.5 % of the value.

a) KRA91

b) EKS86.

c) RUD76.

d) REE85.

e) RUD93.

f) GRA74.

g) LUN93.

h) HOF81b.

i) KAR70.

j) KLI70.

k) MAR72.

l) KRA75

m) MAT72.

n) BRO86.

Table 7: Mass 80. Version 1993-07-18

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>80</sup> Zn (0 <sup>+</sup> )	0.53(5)a	$\gamma$	0.544(16)	685.6	18.0a	DS		gs=0
	0.55(2)b	$\gamma$		712.5	60.0a	DS		gs=0
	0.54(3)c	$\gamma, n$		715.3	49.0a	DS		gs=0
				964.5	21.6a	DS		gs=0
	1.706(10)c	$\gamma, n$		1.680(14)	523.2	10.8(7)g		
<sup>80</sup> Ga (3 <sup>-</sup> )	1.66(2)d	n		659.1	83(6)h	$\beta+\gamma$		
	1.69(1)e	n			84(6)i	n+ $\gamma$	84(4)	
	1.65(1)f	n		1083.5	58(5)h	$\beta+\gamma$		
					52(4)i	n+ $\gamma$	54(3)	
<sup>80</sup> Ge (0 <sup>+</sup> )	29.5(4)j	$\beta$	Excluded	265.4	48.0m	DS		gs=37%
	24.5(10)k	m		937.0	7.2m	DS		gs=37%
	24(1)l	$\beta$						
<sup>80</sup> As (1 <sup>+</sup> )	16.5(3)n	$\gamma$	15.6(6)	666.2	42(4)g			
	15.2(2)o	$\gamma$		1645.2	7.6(8)g			

a) EKS86.  
d) RUD76.  
g) BRO86.  
j) GRA74.  
m) HOF81b.

b) GIL86.  
e) REE85.  
h) LUN93.  
k) MAR72.  
n) MCM71.

c) KRA91.  
f) RUD93.  
i) HOF81.  
l) OSI70.  
o) KRA75.

Table 8: Mass 81. Version 1993-07-18

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>81</sup> Zn	0.29(5)a	$\gamma, n$						
<sup>81</sup> Ca (5/2 <sup>-</sup> )	1.221(5)a 1.228(5)b 1.218(4)c 1.211(6)d	n n n n	1.220(4) *)	216.5	38(6)e 35(3)f	$\beta+\gamma$ n+ $\gamma$	36(3)	
				711.2	16.5(14)g			
				828.3	19(4)e 20.7(18)g	$\beta+\gamma$	20.4(16)	
<sup>81m</sup> Ge (1/2 <sup>+</sup> )	7.6(6)f	$\gamma$			197.3	16.6h	N <sub>P</sub>	
				290.4	8.7h	N <sub>P</sub>		
				336.0	17.2h	N <sub>P</sub>		
				737.7	14.1h	N <sub>P</sub>		
				2174.3	8.7h	N <sub>P</sub>		
<sup>81</sup> Ge (9/2 <sup>+</sup> )	7.6(6)f 10.1(8)j	$\gamma$ m, $\gamma$	Excluded (mixed)		197.3	9.3h	N <sub>P</sub>	
				290.4	4.9h	N <sub>P</sub>		
				336.0	57.8h 36(4)i	N <sub>P</sub> J+ $\gamma$	Excluded **) Excluded **)	Mixture of two isomers
				737.7	11.8h	N <sub>P</sub>		
				875.8	11.1h	N <sub>P</sub>		
				1495.5	19.5h	N <sub>P</sub>		
				1882.5	12.8h	N <sub>P</sub>		
				2629.9	4.11h	N <sub>P</sub>		
<sup>81</sup> As (3/2 <sup>-</sup> )	34(2)k 35.8(16)l	$\gamma$ $\gamma$	35.1(12)	467.7 $\approx 20j$	22.4(16)e 8.5k	$\beta+\gamma$ N <sub>D</sub>		
				491.2	9.6(10)e 8.5k	$\beta+\gamma$ DS		
<sup>81m</sup> Se (7/2 <sup>+</sup> )	3437(3)m			103.0	9.7(7)m			gs=67%

Table 8: Mass 81 continued

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>81</sup> Se (1/2 <sup>-</sup> )	1110(6)m			275.9	0.87(11)m			
				290.0	0.75(13)m			
				828.3	0.32(5)m			

- a) The smallest error used in the averaging procedure is 0.5% of the value.
- \*\*) Refs. WAD88 and MAR72 do not recognize the existence of two germanium isomers. Thus the measurements refer to a mixture of these isomers. Using the fission yields of RUD90 and the branching ratios of HOF81 gives a combined branching ratio of the 336 keV gamma line of 45% to be compared to 38(4) % from WAD88.
- a) KRA91.
- b) RUD76.
- c) REE85.
- d) RUD93.
- e) LUN93.
- f) HOF81.
- g) Using relative intensities from HOF81b and the absolute branching of the 216.5 keV line from HOF81.
- h) HOF81b.
- i) WAD88.
- j) MAR72.
- k) KRA75.
- l) CHA74b.
- m) BRO86.

Table 9: Mass 82. Version 1993-07-18

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>82</sup> Ga (1 <sup>+</sup> )	0.599(9)a	n	0.603(3)	867.5	9.0(25)e			
	0.609(3)b	n	*	1348.1	67(19)f	$\beta+\gamma$		
	0.598(4)c	n		1909.3	7.1(20)e			
	0.599(2)d	n		2215.0	15(4)e			
<sup>82</sup> Ge (0 <sup>+</sup> )	4.6(4)g	m	4.7(4)	248.8	3.6i	DS		$gs=0$
	5(1)h			843.2	8.4i	DS		$gs=0$
				1091.9	91i	DS		$gs=0$
<sup>82m</sup> As (5 <sup>-</sup> )	14.0(5)h	$\gamma$	13.6(3)	343.5	65j	DS	64	$gs=0$
	13.0(6)j	$\gamma$			63i	DS		$gs=0$
	13.7(8)k	$\gamma$		560.5	18j	DS	16	$gs=0$
					14i	DS		$gs=0$
				818.7	27j	DS	29	$gs=0$
				30i	DS			$gs=0$
				1896.0	41j	DS	42	$gs=0$
					42i	DS		$gs=0$

Table 9: Mass 82 continued

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>82</sup> As (1 <sup>+</sup> )	22.6(14)g	$\gamma$	19.5(8)	1971.0	1.5(3)i	DS		$gs=78\%$
	19.1(5)h	$\gamma$		2346.2	1.6(5)m			
	19.0(15)j	$\gamma$		2353.4	2.0(6)m			

a) The smallest error used in the averaging procedure is 0.5% of the value.

b) REE85.

c) RUD93.

d) KRA91.

e) Using relative intensities from HOF81b and the absolute branching of the 1348.1 keV line from RUD91.

f) RUD91.

g) MAR72.

h) KRA74.

i) HOF81b.

j) KLI70.

k) KAR70.

l) KRA75.

m) BRO86.

Table 10: Mass 83. Version 1993-07-18

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>83</sup> Ga	0.31(1)a	n	0.3080(17)					
	0.308(4)b	n	*					
	0.307(7)c	n						
	0.308(1)d	n						
<sup>83</sup> Ge (5/2 <sup>+</sup> )	1.9(4)e	m	1.85(7)	306.5	42(4)g	DS		$gs=0$
	1.85(6)f	$\gamma$		890.0	4.2(6)g	DS		$gs=0$
				1193.8	8.6(9)g	DS		$gs=0$
<sup>83</sup> As (5/2 <sup>-</sup> )	14.1(11)h	m	13.5(5)	734.5	77(9)i	DS		$gs, gi=0$
	13.3(6)i	$\gamma$			34(3)j	$f+\gamma$		
					66k	DS		$gs, gi=0$
						Discrepant values		
				834.1	13k	DS		$gs, gi=0$
				1113.1	17.4l			
				1331.0	12.1(14)i	DS		$gs, gi=0$
					10k	DS		$gs, gi=0$
				2076.7	21.2(25)i	DS		$gs, gi=0$
				2202.9	17.1(20)i	DS		$gs, gi=0$

Table 10: Mass 83 continued

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>83m</sup> Se (1/2 <sup>-</sup> )	70.4(3)m	$\gamma$		673.9	15.1(6)m			
				987.9	15.3(6)m			
				1030.5	20.9(12)m			
				2051.4	11.0(5)m			
<sup>83</sup> Se (9/2 <sup>+</sup> )	1344(12)n	$\gamma$		225.2	31.9(14)m			
				510.0	44.3(17)m			
				718.0	16.3(7)m			
				836.5	15.9(7)m			
<sup>83</sup> Br (3/2 <sup>-</sup> )	8600(70)m			520.7	0.062 (19)m			
				529.5	1.3(4)m			
<sup>83m</sup> Kr (1/2 <sup>-</sup> )	6700(40)m							

- \*) The smallest error used in the averaging procedure is 0.5% of the value.
- a) RUD76. b) REE85. c) RUD93.
- d) KRA91. e) MAR72. f) WIN88.
- g) Calculated from the decay scheme in WIN88 assuming no ground state beta branch.
- h) MAR68. i) KRA75. j) WAD88.
- k) MEY81. l) BLA86. m) BRO86.
- n) KRA74.

Table 11: Mass 84 continued

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>84</sup> As (3 <sup>-</sup> )	4.02(3)c 5.3(4)e 4.5(2)f 5.8(5)g	$n$ $\gamma$ $\gamma$ $m$	4.04(9)	667.1	34(3)h			
				1455.1	89(8)b	$\beta+\gamma$		
				1843.7	5.4(5)h			
<sup>84</sup> Se (0 <sup>+</sup> )	186(12)i 186(12)j 210(6)k 186(6)l 198(12)m	$\gamma$ $\gamma$ $\gamma$ $m$	196(6)	407.7	100j 100k	$DS$ $f+\gamma$		gs=0
				498.5	2.4(8)i	$DS$		gs=0
<sup>84m</sup> Br (5)	360(12)m	$\beta$		424.0	100(10)n 60(7)o	$DS$ $\beta+\gamma$	73(19)	gs=0
				881.6	98(10)n	$DS$		gs=0
				1462.8	97(10)n 88(10)o	$DS$ $\beta+\gamma$	93(7)	gs=0
<sup>84</sup> Br (2 <sup>-</sup> )	1908(5)p			802.2	6.2n 7.1(4)o 6.0q	$DS$ $\beta+\gamma$ $DS$	6.6(4) *)	gs=33%
				881.6	43n 42q	$DS$ $DS$	43(3) *)	gs=33% gs=33%
				1897.6	13.9n 14.8(10)o 14.7q	$DS$ $\beta+\gamma$ $DS$	14.5(7) *)	gs=33% gs=33%
				2484.1	5.9n 6.7q	$DS$ $DS$	6.2(5) *)	gs=33% gs=33%
				3365.8	2.7n 2.9q	$DS$ $DS$	2.8(2) *)	gs=33% gs=33%

- \*) HAT70 arrives at a ground state - ground state beta branch of 33% from measurements with a  $\beta$ -spectrometer. This figure is used to evaluate the  $\gamma$ -branching ratios. It is also entered into the decay scheme given in HIL72. When calculating the average values the error of the branching ratios obtained from both these sources are assumed to be 10% (relative).
  - a) KRA91. b) OMT91. c) RUD93.
  - d) MAR72. e) KRA75. f) HOF91.
  - g) MAR68.
  - h) Using relative intensities from HOF91 and the absolute branching of the 1455 keV line from FOG91.
    - i) HUR75. j) REN68. k) EID70.
    - l) KRA74. m) SAT60. n) HAT70.
    - o) LUN93. p) BRO86. q) HIL72.

Table 11: Mass 84. Version 1993-07-18

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>84</sup> Ga	0.085(10)a	$n$						
<sup>84</sup> Ge (0 <sup>+</sup> )	0.984(23)a 0.98(5)b 0.947(11)c 1.2(3)d	$n$ $\gamma$ $n$ $m$	0.955(10)	100.0	8.7(20)b 13(3)b	$\beta+\gamma$ $\beta+\gamma$		

Table 12: Mass 85. Version 1993-07-19

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>85</sup> Ge	0.58(5)a 0.535(17)b	$\gamma$ <i>n</i>	0.540 (16)	101.9	$\geq 5a$	$\beta+\gamma$		
<sup>85</sup> As (3/2 <sup>-</sup> )	2.0(1)a 2.032(12)b 2.05(5)c 2.002(13)d 1.9(1)e 2.08(5)f 2.028(12)g	$\gamma$ <i>n</i> <i>n</i> <i>n</i> <i>n</i> <i>n</i> <i>n</i>	2.025(6)	461.5 1114.5	0.60(10)a 4.0(7)a	$\beta+\gamma$ $\beta+\gamma$		
<sup>85</sup> Se (5/2 <sup>+</sup> )	31.4(10)h 33(2)i	$\gamma$ $\gamma$	31.7(9)	345.1 955.4 1426.6 3396.3	45.7j 5.6j 7.7j 8.5j	<i>N<sub>D</sub>, DS</i> <i>N<sub>D</sub>, DS</i> <i>N<sub>D</sub>, DS</i> <i>N<sub>D</sub>, DS</i>	<i>gs=27%</i> •) <i>gs=27%</i> •) <i>gs=27%</i> •) <i>gs=27%</i> •)	
<sup>85</sup> Br (3/2 <sup>-</sup> )	180(3)k 172(2)l	$\beta$ $\beta$	175(4)	802.4 919.1 924.6	2.32(17)m 0.74(15)m 1.51(13)m 0.65(5)n 1.63(13)n	$\beta+\gamma$ <i>N<sub>D</sub></i> $\beta+\gamma$ <i>N<sub>D</sub></i> $\beta+\gamma$	2.38(15) 0.66(5) 1.59(9)	
<sup>85m</sup> Kr (1/2 <sup>-</sup> )	16130(30)o	$\gamma$		151.2 304.9	75.2(25)o 14.0(7)o			

- ) LIN82 measures the *gs*-branch to be 32%. If this value is used instead of 27%, the branching ratios from ZEN80 have to be multiplied by the factor 0.93. This may be taken as an indication of the error of the branching ratios (about 10% relative).  
 a) OMT91b.  
 b) KRA91.  
 c) KRA73.  
 d) RUD93.  
 e) CRA78.  
 f) RUD76.  
 g) TOM68.  
 h) HUR75.  
 i) KRA74.  
 j) ZEN80.  
 k) SUG49.  
 l) GRA74.  
 m) LUN93  
 n) NUH75.  
 o) WOH70.

Table 13: Mass 86. Version 1993-07-19

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>86</sup> As	0.9(1)a 0.9(2)b 0.945(8)c	<i>n</i> $\gamma$ <i>n</i>	0.945(8)	704.1	27(10)f			
<sup>86</sup> Se (0 <sup>+</sup> )	14.4(10)d	$\gamma$		207.5 2010.6 2441.1 2660.0	7.9e 5.9(6)f 44e 22e	<i>N<sub>D</sub></i> <i>f+γ</i> <i>N<sub>D</sub></i> <i>N<sub>D</sub></i>		<i>gs=6.9%</i> •) <i>gs=6.9%</i> •) <i>gs=6.9%</i> •) <i>gs=6.9%</i> •)
<sup>86</sup> Br (2 <sup>-</sup> )	55(2)d 55.7(5)g 53.8(6)g 55.2(5)g 54(2)h	$\gamma$ $\beta$ $\gamma$ $\gamma$ $\beta$	55.0(4)	1361.6 1389.9 1564.9 2751.2	9.8(7)i 9.0(7)i 59(4)i 21.2(21)j	$\beta+\gamma$ $\beta+\gamma$ $\beta+\gamma$ $\beta+\gamma$		

- ) LIN82 measures the *gs*-branch to be 8.2%. If this value is used instead of 6.9%, the branching ratios from ZEN80 will be lowered by 1%.  
 a) KRA73.  
 b) KRA75.  
 c) RUD93.  
 d) HUR75.  
 e) ZEN80.  
 f) WAD88.  
 g) GRA74.  
 h) STE62.  
 i) LUN93.  
 j) Using relative intensities from BLA86 and the absolute branching of the 1564.9 keV line from LUN93.

Table 14: Mass 87. Version 1993-07-19

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>87</sup> As	0.49(4)a	<i>n</i>						
<sup>87</sup> Se	5.29(11)a 5.8(3)b 5.9(2)c 5.41(10)d	<i>n</i> <i>n</i> <i>n</i> <i>n</i>	5.44(12)	242.5 334.0 573.2 1878.1	19.1e 17.9e 9.9e 4.5e	<i>DS</i> <i>DS</i> <i>DS</i> <i>DS</i>		<i>gs=43%</i> <i>gs=43%</i> <i>gs=43%</i> <i>gs=43%</i>

Table 14: Mass 87 continued

Nuclide	Half-life, s			Gamma branching ratio, %					
	Value	Method	Average	Energy keV	Value	Method	Average	Comment	
<sup>87</sup> Br (3/2 <sup>-</sup> )	55.6(3)a	n	55.65(16)	1419.8	21.9(16)j 12(2)k 31.2(3)l 22.0(15)m	$\beta+\gamma$ $\beta+\gamma$ $N_D$ $\beta+\gamma$	22(4) •)		
	55.6(3)f	n		1476.2	8.0(6)j 4.3(8)k 11.4(3)l 7.9(6)n	$\beta+\gamma$ $\beta+\gamma$ $N_D$	7.9(15) •)		
	55.9(16)g	n		1577.7	3.2(6)k 8.4(3)l 6.0(4)n	$\beta+\gamma$ $N_D$	5.9(15) •)		
	56.3(5)h	n, $\beta$		402.6	57(4)j 50(5)p 55(5)q	$\beta+\gamma$ $\beta$ $DS$	54(5)	gs=31%	
	55.5(3)i	n		845.4	6.8(5)j 8.3(8)q	$\beta+\gamma$ $DS$	7.2(7)	gs=31%	
				2554.8	9.9(11)q	$DS$		gs=31%	

a) The reason for the large discrepancies between these determinations is unknown (possibly errors in the absolute calibration of the detectors).

Unweighted averages are calculated for all the gamma lines.

a) RUD93. b) KRA70. c) MAR70.

d) TOM71. e) ZEN80. f) MAR71.

g) KRA74. h) GRA74. i) RUD76.

j) LUN93. k) TOV75. l) NUH77.

m) HOF80. n) Using relative intensities from RAM83 and the absolute branching of the 1419.8 keV line from HOF80.

o) BRO86. p) BOU69.  
q) Using relative intensities from SHI71 and  $\beta$ -branching ratios from WOH73.

Table 15: Mass 88 continued

Nuclide	Half-life, s			Gamma branching ratio, %					
	Value	Method	Average	Energy keV	Value	Method	Average	Comment	
<sup>88</sup> Br (1 <sup>-</sup> )	16.4(6)c	n	16.23(10)	775.2	62(5)i 63(4)j 67(7)k	$\beta+\gamma$ $n+\gamma$ $N_D$		63(3)	
	16.20(10)d	n		802.1	14.0(13)i 13.1(16)j 15(2)k	$\beta+\gamma$ $n+\gamma$ $N_D$		13.9(9)	
	16.34(8)e	n		1440.7	4.7(3)l				
	16.5(2)f	$\beta$ , n		196.3	27(3)i 26.2(15)n	$\beta+\gamma$ $DS$	26.4(13)	gs=13%	
	16.7(2)g	n		834.8	13.1(7)n	$DS$		gs=13%	
	15.9(1)h	n		2195.8	13.3(8)n	$DS$		gs=13%	
<sup>88</sup> Kr (0 <sup>+</sup> )	10220(110)m			2392.1	35.0(18)o	$\beta, \gamma$		gs=13%	
				898.0	13.2(9)i 14.4(8)n	$\beta+\gamma$ $DS$	13.9(6)	gs=77%	
				1836.0	21.6(16)i 21.4(12)o	$\beta+\gamma$ $\beta+\gamma$	21.5(10)	gs=78%	

a) TOM71.

b) ZEN80 normalized to 63% for the 775 keV line in <sup>88</sup>Br.

c) SCH72.

d) PFE86.

e) RUD93.

f) GRA74.

g) RUD76.

h) SIL66.

i) LUN93.

j) HOF81.

k) SLA76.

l) Using relative intensities from HOF80 and the absolute branching of the 775.2 keV line from HOF81.

m) BRO86.

n) BUN76.

o) WOH76.

Table 15: Mass 88. Version 1993-07-19

Nuclide	Half-life, s			Gamma branching ratio, %					
	Value	Method	Average	Energy keV	Value	Method	Average	Comment	
<sup>88</sup> Se	61.53(6)a	m		159.2	10.0b				
				259.2	8.2b				
				1744.5	6.7b				
				1903.7	6.4b				

Table 16: Mass 89. Version 1993-07-19

Nuclide	Half-life, s			Gamma branching ratio, %					
	Value	Method	Average	Energy keV	Value	Method	Average	Comment	
<sup>89</sup> Se	0.41(4)a	m		130	(b)				
<sup>89</sup> Br	4.44(20)c 4.37(3)d 4.55(10)e 4.20(10)f 4.34(8)g 4.6(3)h	n n n n n $\beta$	4.37(3)	775.3 953.3 997.9 1097.8	5.5(5)i 4.5(4)i 4.5(4)i 6.4(5)j	$n+\gamma$			

Table 16: Mass 89 continued

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>89</sup> Kr (5/2 <sup>+</sup> )	189.6(24)k			220.9	20.1(12)i 24.7(15)m	β+γ β+γ	21.9(22)	
				577.0	5.6(5)m 5.7(3)n	β+γ	5.7(3)	
				585.8	18.5(10)m 16.6(10)n	β+γ	17.6(10)	
				1472.8	8.0(6)m 6.9(4)n	β+γ	7.2(5)	
<sup>89</sup> Rb (3/2 <sup>-</sup> )	912(6)k			947.7	11.2(10)m 9.2(8)o	β+γ	10.0(10)	
				1031.9	5.8(5)i 7.0(4)m	β+γ β+γ	6.5(6)	
				1248.1	5.0(3)m 4.3(4)o	β+γ	4.7(4)	
				2196.0	13.3(12)o			

a) TOM71.

b) REN82.

c) KRA74.

d) RUD76.

e) GRA74.

f) PFE86.

g) RUD93.

h) OSI70.

i) Using relative intensities from HOF81c and the absolute branching of the 1097.8 keV line from HOF81.

j) HOF81.

k) BRO86.

l) WOH76.

m) LUN93.

n) Using relative intensities from HEN73 and the absolute branching of the 220.9 keV line from WOH76.

o) Using relative intensities from HEN73 and the absolute branching of the 1031.9 keV line from WOH76.

Table 17: Mass 90 continued

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>90</sup> Kr (0 <sup>+</sup> )	32.32(9)h			γ				
					120.9	3.26(18)i	DS	
					121.8	32.9(19)i	DS	
					539.5	28.6(16)i 40(3)j	DS β+γ	31(5) gs=29%
					1118.7	36.2(20)i 50(3)j 47(3)k	DS β+γ β+γ	42(5) gs=29%
<sup>90m</sup> Rb (4 <sup>-</sup> )	251(10)h 258(5)i 258(4)m			γ	257(3)	831.7	95(5)k 97.7m 97(4)n	β,γ DS DS
						1060.7	3.4(5)m 7.8(3)n	DS DS
						1375.4	19.4(17)j 22(3)m 17.1(7)n	β+γ DS DS
						2752.7	14.1(11)m 11.8(4)n	DS DS
						3317.0	18.4(16)m 14.7(4)n	DS DS
<sup>90</sup> Rb (1 <sup>-</sup> )	153(3)h 156(5)i 162(3)m			γ	157(3)	831.7	39.2m 27.8(11)n	DS DS
						1060.7	9.4(6)j 12.2(17)m 6.6(2)n	β+γ DS DS
						3383.2	6.2(6)m 4.67(14)n	DS DS
						4135.5	7.0(6)m 4.67(17)n	DS DS
								4.8(6) gs=37% gs=53%

Table 17: Mass 90. Version 1993-07-19

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>90</sup> Br	1.71(14)a 1.92(2)b 1.92(6)c 1.92(3)d 1.910(10)e 1.96(5)f	n n n n n n	1.913(8)	655.5	7.7(9)g	N <sub>D</sub>		
				707.1	38(4)g	N <sub>D</sub>		
				1362.0	11.2(15)g	N <sub>D</sub>		

- a) KRA74b.  
d) PFE86.  
g) HOF81c.  
j) LUN93.  
m) HUA77.
- b) ALE80.  
e) RUD93.  
h) CAR69.  
k) WOH76.  
n) TAL81.
- c) EWA84.  
f) RUD76.  
i) DUK79.  
l) AMA67.

Table 18: Mass 91. Version 1993-07-12

Nuclide	Half-lives			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>91</sup> Se	0.27(5)a	n						
<sup>91</sup> Br	0.60(5)a 0.510(20)b 0.63(7)c 0.541(5)d 0.53(3)e 0.549(9)f	n n n n n n	0.542(5)	143.9 301.0 351.7 707.0	41g 67g 34g 100g			Relative Relative Relative Relative
<sup>91</sup> Kr (5/2 <sup>+</sup> )	8.57(4)h 8.6(1)i	$\gamma$ $\beta$	8.57(4)	108.8 506.6 612.9 1108.7	41(5)i 45(3)j 42(3)k 43(3)l 15.3(12)i 17.0(12)j 19.0(13)l 5.7(6)i 7.0(6)j 7.6(4)l 6.3(6)i 5.5(5)j 7.1(4)l	DS $\beta+\gamma$ DS DS $\beta+\gamma$ DS $\beta+\gamma$ DS $\beta+\gamma$ DS	43.2(15) 17.3(10) 7.0(5)	gs=20% gs=10% gs=20% gs=10% gs=20% gs=10%
<sup>91</sup> Rb (3/2 <sup>-</sup> )	58.2(2)h 59.6(2)m	$\gamma$ $\beta$	58.9(7)	93.6 345.4 1971.0 2564.2	33(3)i 34.2(23)j 32.0(21)k 32.1(16)l 5.3(5)i 8.4(5)j 7.9(4)l 4.8(5)i 5.7(4)j 6.4(3)l 8.9(9)i 11.9(6)l	DS $\beta+\gamma$ ND DS DS $\beta+\gamma$ DS DS $\beta+\gamma$ DS DS	32.6(10) 7.3(9) 5.9(4) 11.0(13)	gs=60% gs=5% *) gs=60% gs=5% *) gs=60% gs=5% *) gs=60% gs=5% *)

Table 18: Mass 91 continued

Nuclide	Half-lives			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>91</sup> Sr (5/2 <sup>+</sup> )	34270(210)n			749.8 1024.3	25o 36o	DS DS		gs=31% gs=31%
<sup>91m</sup> Y (9/2 <sup>+</sup> )	2983(2)n			555.6	94.9n			

\*) ACH74 and GLA76 arrive at very similar results in spite of the large differences assumed for the gs-transition.

- a) ASG75.
- b) KRA88.
- c) KRA74.
- d) RUD76.
- e) EWA84.
- f) RUD93.
- g) FOG89.
- h) CAR69.
- i) ACH74.
- j) LUN93.
- k) WOH76.
- l) GLA76.
- m) ENG79.
- n) BRO86.
- o) HAL73.

Table 19: Mass 92. Version 1993-07-12

Nuclide	Half-lives			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>92</sup> Br	0.310(10)a 0.26(4)b 0.35(4)c 0.31(2)d	n n n n	0.310(9)					
<sup>92</sup> Kr (0 <sup>+</sup> )	1.840(8)e 1.86(1)f 1.86(1)g	$\gamma$ n n	1.851(7)	142.4 548.3 812.6 1218.6	53(5)h 32.7i 11.1(9)h 7.13i 12.2(10)h 7.42i 41(4)h 30.5i	$\beta+\gamma$ DS $\beta+\gamma$ DS $\beta+\gamma$ DS $\beta+\gamma$ DS	*) *) *) *)	gs=50% gs=50% gs=50% gs=50%
<sup>92</sup> Rb (0 <sup>-</sup> )	4.50(3)e 4.48(2)g 4.54(2)j 4.43(5)k 4.46(2)l 4.57(7)m 4.50(4)n	$\gamma, \beta$ n $\beta$ n $\beta$ $\beta$ $\beta$	4.494(13)	569.8 814.7 1384.6 1712.4	0.87(6)h 0.70i 4.1(3)h 4.09i 0.45i 0.45(3)o 0.54i 0.54(4)o	$\beta+\gamma$ DS $\beta+\gamma$ DS DS DS DS	**) **) **) **)	gs=94% gs=94% gs=94% gs=94%

Table 19: Mass 92 continued

Nuclide	Half-lives			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>92</sup> Sr (0 <sup>+</sup> )	9756(72)p	$\beta$	9760(30)	241.5	3.0(3)r			
	9756(36)q	$\gamma$		430.6	3.3(4)r			
				953.3	3.5(4)r			
				1384.9	90(10)s	$\beta+\gamma$		
<sup>92</sup> Y (2 <sup>-</sup> )				934.5	13.9s			
				1405.4	4.80s			

a) Excluded because of uncertain  $\beta$ -feeding of the ground state. CL173 indicates 2% rather than 50% which would increase the branching ratios considerably.

\*\*) No error estimate possible because of too uncertain ground state  $\beta$ -feeding.

a) KRA88. b) KRA74. c) CRA78.

d) EWA84. e) CAR69. f) TAL69.

g) ASG75. h) LUN93. i) OLS72.

j) REE75. k) AMA69. l) RUD93.

m) ENG79. n) GRA74.

o) Using relative intensities from OLS72 and the absolute branching of the 814.7 keV line from LUN93.

p) FR160. q) PAR71.

r) Using relative intensities from OLS72 and the absolute branching of the 1384.9 keV line from HEA57.

s) HEA57. t) BRO86.

Table 20: Mass 93 continued

Nuclide	Half-lives			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>93</sup> Kr (1/2 <sup>+</sup> )	1.29(1)c 1.27(2)d 1.29(1)e	n n n	1.29(1)	252.5	20.0(9)f 28.0(24)g	DS DS	22(3)	gs=0 gs=0
				253.4	42.0(22)f 42(5)g	DS DS	42.0(20)	gs=0 gs=0
				266.8	21.0(10)f 28.0(9)g 17.2(20)h	DS DS $\beta+\gamma$	21.2(21)	gs=0 gs=0
				323.9	24.6(12)f 28.0(20)g 19.8(21)h	DS DS $\beta+\gamma$	24.4(19)	gs=0 gs=0
<sup>93</sup> Rb (5/2 <sup>-</sup> )	5.86(13)c 5.86(13)d 5.89(4)i 5.85(5)j 5.86(3)k 5.80(5)l 5.74(8)m 6.01(2)n 6.12(8)o	n n n n n $\beta$ n $\beta$ $\beta$	5.91(3) **)	432.5	16.4(6)h 13.7(10)p 18.5(18)q	$\beta+\gamma$ n+ $\gamma$ DS	15.9(10)	gs=59%
				986.1	6.08(25)h 6.3(2)q	$\beta+\gamma$ DS	6.21(16)	gs=59%
				1808.5	2.21(20)h 2.3(2)q	$\beta+\gamma$ DS	2.26(14)	gs=59%
				1870.0	1.77(13)h 1.56(15)q	$\beta+\gamma$ DS	1.68(10)	gs=59%
<sup>93</sup> Sr (7/2 <sup>+</sup> )	439(6)r 444.6(24)s 445.8(18)t	$\gamma$ $\gamma$ $\gamma$	445.0(14)	168.7	18.0(10)f	DS		gs=0
				432.7	1.45(9)f	DS		gs=0
				590.3	67(4)f 73(4)g	DS DS	70(3)	gs=0 gs=0
				875.7	23.9(13)f 24.5(21)g	DS DS	24.1(11)	gs=0 gs=0
				888.1	21.6(11)f 23.7(21)g	DS DS	22.1(10)	gs=0 gs=0
<sup>93m</sup> Y (9/2 <sup>+</sup> )	0.82(4)u			168.4	51u			
				590.2	100u			

Table 20: Mass 93. Version 1993-07-12

Nuclide	Half-lives			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>93</sup> Br	0.102(10)a	n		117.4	100b			Relative •) Relative •) Relative •) Relative •)
				237.4	29.6b			
				242.0	59.8b			
				709.8	19.7b			

Table 20: Mass 93 continued

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>93</sup> Y (1/2 <sup>-</sup> )	36900 (40)u			266.9				

\*) Not corrected for electron conversion.

\*\*) The smallest error used in the averaging procedure is 0.5 % of the value.

a) KRA88. b) WHÖ. c) TAL69.

d) ASG75.

e) ASG75b.

f) BIS77.

g) ACH74b.

h) LUN93.

i) AMA67.

j) RUD76.

k) RUD93.

l) GRA74.

m) ENG81.

n) ENG79.

o) REE75.

p) HOF81.

q) ACH74b using the gs-value 59(3)% determined by the authors. Note that BRI75 gives a gs-value of 42(4)%. The use of this value instead would lower the branching ratios considerably.

r) CAR69.

s) OKA86c.

t) HER72.

u) BRO86.

Table 21: Mass 94. Version 1993-07-12

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>94</sup> Br	0.070(20)a	n						
<sup>94</sup> Kr (0 <sup>+</sup> )	0.22(2)b	n		187.4	20(6)c			
				219.6	34(11)d	$\beta+\gamma$		
				359.0	19(6)c			
				629.3	51(17)d	$\beta+\gamma$		
<sup>94</sup> Rb (3 <sup>-</sup> )	2.67(6)b 2.76(8)e 2.73(2)f 2.80(4)g 2.83(3)h 2.69(2)i 2.76(6)j 2.711(14)k 2.78(5)l	n n $\beta$ n $\beta$ n n $\beta$	2.726(16)	836.9	65(6)d 79(8)m 78(6)n	$\beta+\gamma$ $f+\gamma$ $n+\gamma$	73(5)	
				1089.4	12.3(7)d	$\beta+\gamma$		
				1309.1	12.1(8)o			
				1577.5	23.0(21)d	$\beta+\gamma$		
<sup>94</sup> Sr (0 <sup>+</sup> )	76.7(9)g 75.3(7)l 75.3(2)p	$\beta$ $\beta$ $\gamma$	75.4(2)	621.9	1.98(12)q	DS		gs=0
				724.1	2.42(13)q	DS		gs=0
				1428.3	95(1)q	DS		gs=0

Table 21: Mass 94 continued

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>94</sup> Y (2 <sup>-</sup> )	1218(12)r 1164(30)s	$\gamma$ $\beta$		1211(19)	550.1 918.2 1139.1	4.9(3)t 56(3)t 6.0(4)t		

- a) KRA88. b) ASG75.  
c) Using relative intensities from LHE89 and the absolute branching of the 219.6 keV line from LUN93.  
d) LUN93. e) ROE74. f) RIS79.  
g) ENG79. h) REE75. i) RUD76.  
j) ENG81. k) RUD93. l) GRA74.  
m) WAD88. n) HOF81.  
o) Using relative intensities from BLA86 and the absolute branching of the 836.9 keV line from LUN93.  
p) OKA86c. q) FUN84. r) FRI61.  
s) EHR72.

Table 22: Mass 95. Version 1993-07-12

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>95</sup> Kr	0.78(3)a							
<sup>95</sup> Rb (5/2 <sup>-</sup> )	0.383(6)b 0.37(4)c 0.377(6)d 0.377(4)e 0.40(1)f 0.400(4)g 0.377(1)h 0.402(8)i 0.379(2)j	n n $\beta$ n n $\beta$ n $\beta$ n	0.379(2)	204.0 328.7 352.0 680.7	18.0(9)k 11.2(6)k 59(3)k 57(4)l 46(5)m 57(4)n 40(3)o	DS DS DS DS	52(4)	gs=3% gs=3% gs=3% gs=3%
<sup>95</sup> Sr (1/2 <sup>+</sup> )	26(1)n 23.8(3)o 26.8(15)p 26.0(9)q	$\beta$ $\gamma$ $\beta$ $\gamma$	24.3(5)	685.6 945.0 2247.6 2717.3	21.8(18)o 24(2)r 28(4)s 4.9(7)t	N <sub>D</sub> N <sub>D</sub> N <sub>D</sub> N <sub>D</sub>	23.3(13)	

Table 22: Mass 95 continued

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
$^{95}\text{Y}$ ( $1/2^-$ )	612(6)p 654(12)u 654(6)v 642(12)w	$\beta$ $\beta$ $\beta$ $\beta$	636(11)	954.2 1324.3 2176.0 3577.0	19.0(21)t 9(2)w 5.3(12)t 8.2(19)t 7.6(18)t	$\beta+\gamma$		*)

- \*) Large difference between the value for this  $\gamma$ -ray in KLI67 and BRO86. All branching ratios for  $^{95}\text{Y}$  are therefore doubtful.
- a) AHR76.
  - b) ROE74.
  - c) ASG75.
  - d) RIS79.
  - e) REE75.
  - f) ENG81.
  - g) RUD76.
  - h) REE85.
  - i) ENG79.
  - j) RUD93.
  - k) KRA83 with  $P_n = 8.27\%$  (RUD91b) and assuming  $gs = 3(3)\%$  (KRA83 claims  $\leq 6\%$ ).
  - l) HOF81.
  - m) WAD88.
  - n) AMA67.
  - o) OKA86c.
  - p) GRA74.
  - q) MAC90.
  - r) HER74.
  - s) PFE84.
  - t) BRO86.
  - u) FRI61.
  - v) NOR66.
  - w) KLI67.

Table 23: Mass 96 continued

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
$^{96m}\text{Y}$ ( $3^+$ )	9.6(3)n 10.0(3)q	$\gamma$ $\gamma$	9.8(2)	617.5 914.9 1106.9 1750.0	55(3)q 59(3)q 48(3)q 89(5)q	DS DS DS DS		$gs=0$ $gs=0$ $gs=0$ $gs=0$
$^{96}\text{Y}$ ( $0^-$ )	5.34(5)l 5.4(1)m 6.0(3)q	$\gamma$ $\gamma$ $\beta$	5.87(7)	1750.4	2.35(24)l	$\beta+\gamma$		

- a) ROE74.
- b) RIS79.
- c) REE75.
- d) RUD76.
- e) ENG81.
- f) RUD93.
- g) ENG79.
- h) WOH78.
- i) PEU79.
- j) Using relative intensities from BLA86 and the absolute branching of the 815.0 keV line from HOF81.
- k) HOF81.
- l) MAC90.
- m) MAC88.
- n) BAI75.
- o) Using relative intensities from JUN81 and the absolute branching of the 809.4 keV line from WAD88.
- p) WAD88.
- q) SAD75.

Table 23: Mass 96. Version 1993-07-13

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
$^{96}\text{Rb}$ ( $2^+$ )	0.199(4)a 0.197(5)b 0.205(4)c 0.203(3)d 0.22(1)e 0.201(1)f 0.217(9)g 0.203(4)h 0.188(2)i	n n $\beta$ n n n $\beta$ $\beta$ $\gamma$	0.199(2)	692.0 813.2 815.0	7.3(6)j 6.5(5)j 72(6)k			
$^{96}\text{Sr}$ ( $0^+$ )	1.10(2)g 1.015(19)h 1.07(1)l 1.04(1)m 1.06(4)n	$\beta$ $\beta,\gamma$ $\gamma$ $\gamma$ $\gamma$	1.055(12)	122.3 530.0 809.4 931.7	66(6)o 7.7(8)o 62(6)p 10.2(10)o	$f+\gamma$		

Table 24: Mass 97. Version 1993-07-13

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
$^{97}\text{Rb}$ ( $3/2^+$ )	0.172(6)a 0.171(4)b 0.182(7)c 0.20(2)d 0.169(1)e 0.169(2)f 0.168(1)g 0.187(19)h 0.173(3)i 0.170(2)j	n n $\beta$ n n n n $\beta$ $\gamma$ $\beta$	0.169(1)	167.1 417.9 585.2 600.5 11.0(6)k	26.8(11)k 6.1(5)k 21.7(9)k 11.0(6)k	DS DS DS DS		$gs=15\%$ $gs=15\%$ $gs=15\%$ $gs=15\%$
$^{97}\text{Sr}$ ( $1/2^+$ )	0.39(3)d 0.429(5)e 0.420(30)f 0.441(15)j 0.42(4)l 0.43(3)m	n n $\beta$ n n $\beta$	0.429(5)	307.1 652.2 953.8 1905.0	10(1)n 11.3(11)n 21.3(21)n 25(3)n			

Table 24: Mass 97 continued

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
$^{97m}Y$ (9/2 <sup>+</sup> )	1.18(4)e	n	1.21(2)	161.4	71(14)q			
	1.21(3)o	$\gamma$		1103.1	89(18)q			
	1.25(8)p	$\gamma$						
$^{97m}Zr$ (27/2 <sup>-</sup> )	0.144(10)b	$\gamma$		162				
$^{97}Y$ (1/2 <sup>-</sup> )	3.1(2)d	n	3.75(4)	1103.1	5.1(13)q			
	3.76(2)e	n		1996.6	7.5(19)q			
	3.50(20)f	n		2743.0	6.6(17)q			
	3.3(2)h	$\beta$		3287.6	18(3)q			
	3.6(4)i	n		3401.3	14(4)q			
	3.7(1)o	$\gamma$						
$^{97}Zr$ (1/2 <sup>+</sup> )	60840 (180)q			743.3	92.8(3)q			
$^{97m}Nb$ (1/2 <sup>-</sup> )	60(8)q			743.4	98.0(1)q			
$^{97}Nb$ (9/2 <sup>+</sup> )	4330(40)q			657.9	98.3(1)q			

Table 25: Mass 98. Version 1993-07-13

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>98</sup> Rb	0.106(6)a	n	0.108(1)	144.6	51.0j			
	0.114(13)b	n		289.4	16.6j			
	0.11(2)c	n		1693.3	6.68j			
	0.106(1)d	n		2171.8	8.77j			
	0.102(2)e	n						
	0.109(1)f	n						
	0.10(2)g	$\beta$						
	0.108(5)h	$\beta, \gamma$						
	0.112(4)i	n						
	0.109(12)j	$\gamma$						
<sup>98</sup> Sr (0 <sup>+</sup> )	0.653(2)d	n	0.635(3) *)	119.4	23(8)l			
	0.650(40)e	n		428.6	7.4(3)l			
	0.660(70)h	$\beta, \gamma$		444.6	8.1(3)l			
	0.645(50)k	n						
<sup>98m</sup> Y (4 <sup>-</sup> )	2.1(3)c	n	2.05(15)	620.5	72(4)l			
	2.1(3)g	$\beta$		647.6	54(3)l			
	2.0(2)m	$\gamma$		1222.8	93(2)l			
				1801.6	44(3)l			
<sup>98</sup> Y (1 <sup>+</sup> )	0.548(1)d	n	0.549(3) *)	268.4	2.5(8)l			
	0.550(30)e	n		1222.8	12(4)l			
	0.655(50)k	n		1590.7	4.9(16)l			
	0.65(5)m	$\gamma$		2941.3	5.8(19)l			
<sup>98</sup> Zr (0 <sup>+</sup> )	30.01(15)f	$\beta$						
<sup>98m</sup> Nb (5 <sup>+</sup> )	3078(24)l			335.2	10.7(10)l			
				722.5	71(7)l			
				787.2	93(9)l			
				1168.8	18.0(17)l			

Table 25: Mass 98 continued

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>98</sup> Nb (1 <sup>+</sup> )	2.86(6)i			787.4	3.2(5)i			
				1024.3	1.6(3)i			

\*) The smallest half-life error used in the averaging procedure is 0.5 % of the value given.

- a) ROE74.
- b) RIS79.
- c) ENG81.
- d) REE85.
- e) PFE86.
- f) RUD93.
- g) ENG79.
- h) WOH78.
- i) PEU79.
- j) BLA86.
- k) GAB82.
- l) BRO86.
- m) SIS77.

Table 26: Mass 99. Version 1993-07-13

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>99</sup> Rb	0.059(1)a	n	0.056(2)	144.5	8.1(18)f			
	0.059(1)b	n		259.6	2.4(5)f			
	0.058(2)b	n						
	0.0503(7)c	n						
	0.059(4)d	n						
	0.059(4)e	$\beta, \gamma$						
<sup>99</sup> Sr	0.269(1)a	n	0.269(1)	125.1	16.8(24)i	DS		gs=30%
	0.285(30)b	n	*	1198.0	9.6(16)i	DS		gs=30%
	0.270(20)b	n		2239.3	7.7(12)i	DS		gs=30%
	0.290(40)e	$\beta, \gamma$		2279.0	7.9(12)i	DS		gs=30%
	0.30(3)g	n						
<sup>99</sup> Y (1/2 <sup>-</sup> )	0.270(10)h	$\gamma$						
	1.470(7)a	n	1.478(5)	121.7	41(5)k	DS	44(5)	gs=20%
	1.46(10)b	n			54(10)i	f+ $\gamma$		
	1.40(5)b	n						
	1.486(7)c	n		575.4	10.2(18)k	DS		gs=20%
	1.40(15)g	n						
	1.47(22)j	n		724.2	19(3)k	DS	15.6(13)	gs=20%
<sup>99</sup> Zr (1/2 <sup>+</sup> )	1.51(8)k	$\gamma$			14(4)k	$N_D$		
					15.0(15)i	f+ $\gamma$		
	2.1(1)k	$\gamma$	2.10(8)	461.8	8.2(17)o			
	1.8(3)m	m		469.3	38(4)k	$N_D$		
	2.0(2)m	$\gamma$			28(2)p	$\beta, \gamma$	30(4)	

Table 26: Mass 99 continued

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>99m</sup> Nb (1/2 <sup>-</sup> )	156(12)q				97.9	6.7(8)q		gs=65%
					137.5	3.14(10)r		gs=17%
					253.5	3.71(20)q		gs=65%
					2641.3	3.70(22)q		gs=17%
					2851.5	3.10(20)q		gs=65%
<sup>99</sup> Nb (9/2 <sup>+</sup> )	15.0(2)q				97.9	43.5s		
<sup>99</sup> Mo (1/2 <sup>+</sup> )	237380(40)q				137.5	90.0s		
					140.5	5.1(4)t	<i>ND</i>	4.7(3)
					181.1	4.52(23)u		
					739.5	6.08(12)u		
<sup>99m</sup> Tc (1/2 <sup>-</sup> )	21600(40)q				140.5	12.7(2)u		

\*) The smallest half-life error used in the averaging procedure is 0.5 % of the value given.

- a) REE85.
- b) PFE86.
- c) RUD93.
- d) PEU79.
- e) KOG78.
- f) BRO86.
- g) GAB82.
- h) PET85.
- i) PET85 with ground state beta branch assumed to be 30(10)% (from the spread of values for different gamma-rays).
- j) ASG75.
- k) SEL79.
- l) WAD88.
- m) TRA72.
- n) EID70.
- o) Using relative branching ratios of SEL79 and the absolute branching ratio for the 469.3 keV gamma-ray from the same publication.
- p) JOH92.
- q) MUL86.
- r) DEN93.
- s) BLA86.
- t) SIM81.
- u) SIN82b.

Table 27: Mass 100. Version 1993-07-14

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>100</sup> Rb	0.059(10)a	n	0.056(8)	129.2	100e			Relative
	0.053(20)b	n		288.4	36e			Relative
	0.051(17)c	n						
	0.050(10)d	$\beta, \gamma$						

Table 27: Mass 100 continued

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
$^{100}\text{Sr}$ ( $0^+$ )	0.207(10)b	n	0.202(3)	194.9	3.8(6)i 3.5(3)k	DS	3.6(3)	gs=0
	0.170(80)d	$\beta,\gamma$		449.5	4.2(6)l			
	0.214(8)f	$\gamma$		899.5	21(4)j 18.9(13)k		19.1(12)	
	0.204(2)g	n		964.7	24(4)j 22.0(13)k		22.2(12)	
	0.193(4)h	$\gamma$						
	0.165(24)i	n						
				212.5	75(15)n			
				351.9	25(3)n			
				614.0	10.5(23)n			
				878.1	13.5(23)n			
$^{100}\text{Y}$ ( $1^+$ )	0.740(20)b	n	0.730(10)	118.5	15.1(21)h 14.0(21)o	ND	14.6(15)	
	0.682(18)f	$\gamma$		212.5	72(10)h 61(9)o		66(7)	
	0.735(4)g	n						
	0.735(7)h	$\gamma$						
$^{100}\text{Zr}$ ( $0^+$ )	0.638(17)i	n				f+ $\gamma$ $\beta+\gamma$		Excluded 32(2)
	7.1(4)p	m		400.6	18.6(24)q			
				504.3	19(2)r 31(4)s 33(3)t			
$^{100m}\text{Nb}$ ( $4^+, 5^+$ )	2.99(11)u	$\gamma$	3.00(10)	535.7	95(2)u	DS		gs=0
	3.1(3)v	$\gamma$		600.5	64(2)u			
				966.5	18.9(17)u			
				1280.6	23.3(16)u			

Table 27: Mass 100 continued

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
$^{100}\text{Nb}$	1.5(2)v	$\gamma$			535.2	45.7(1)e		

\*) Not found by WOH86.

a) REE85.

c) PEU79.

d) KOG78.

f) MÜN83.

g) REE86.

h) WOH86.

j) MÜN85 assuming the ground state beta transition to be 15(15)% (the authors give an upper limit of 30%).

k) WOH87.

l) Using relative intensities from BLA86 and the absolute branching of the 964.7 keV line from MÜN85.

m) KHA77.

n) BRO86.

o) MÜN85 assuming the ground state beta transition to be 13(13)% (the authors give an upper limit of 25%).

p) PFE77.

q) Using relative branching ratios of PFE77 and the absolute branching ratio for the 504.3 KeV gamma-ray from DEN80.

r) WAD88.

s) DEN80.

t) JOH92.

u) MEN87.

v) AHR76b.

Table 28: Mass 101. Version 1993-07-14

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
$^{101}\text{Rb}$	0.032(5)a	n						
$^{101}\text{Sr}$ ( $3/2^+$ )	0.104(15)a 0.121(6)b 0.114(4)c	$\gamma$ n	0.116(3)	128.3 163.4 474.1	18(5)b 3.5(9)b 3.8(10)b	DS DS DS		gs=35% gs=35% gs=35%
$^{101}\text{Y}$ ( $5/2^+$ )	0.565(50)a 0.431(7)c 0.279(9)d 0.500(50)e	n n n $\gamma$	0.38(4)	98.3 133.8 232.1	100f 18.8(18)f 11.9(15)f			Relative Relative Relative

Table 28: Mass 101 continued

Nuclide	Half-lives, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>101</sup> Zr (3/2 <sup>+</sup> )	2.0(2)g	$\gamma$	2.36(13)	119.4	11(3)h	f+ $\gamma$	6.9(6)	
	2.0(3)g	m		206.0	6.1(15)h	f+ $\gamma$		
	2.2(3)g	m		7.1(7)i	f+ $\gamma$			
	2.5(1)h	$\gamma$		598.0	2.9(7)h	f+ $\gamma$		
				1958.8	3.3(8)h	f+ $\gamma$		
				2010.7	3.5(9)h	f+ $\gamma$		
<sup>101</sup> Nb	7.1(3)g	$\gamma$	7.03(17)	157.3	6.0(7)k			
	7.0(2)j	$\gamma$		276.4	18.6(17)l	$\beta+\gamma$		
<sup>101</sup> Mo (1/2 <sup>+</sup> )	877(2)m			191.9	18.8(19)n		Relative	
				506.0	11.8(14)n			
				590.9	16.4(22)n			
				1012.5	12.8(15)n			
<sup>101</sup> Tc (9/2 <sup>+</sup> )	853(1)m			127.2	2.86(19)n		Relative	
				184.1	1.69(12)n			
				306.8	88(6)n			

a) PFE86.

b) PET88.

c) REE86.

d) RUD93.

e) WOH83.

f) OHM87.

g) TRA72.

h) OHM91.

i) WAD88.

j) EID70.

k) Using relative intensities from BLA91 and the absolute branching of the 276.4 keV line from JOH92.

l) JOH92

m) BLA91.

n) BRO86.

Table 29: Mass 102. Version 1993-07-14

Nuclide	Half-lives, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>102</sup> Rb	0.037(5)a	n						
<sup>102</sup> Sr (0 <sup>+</sup> )	0.072(10)a	n	0.069(6)	93.9	13(3)b	N <sub>D</sub>		
	0.068(8)b	$\gamma$		150.2	18(5)b	N <sub>D</sub>		
	0.069(15)c	n		243.8	53(16)b	N <sub>D</sub>		
				254.0	13(4)b	N <sub>D</sub>		
<sup>102m</sup> Y	0.36(4)d,e	$\gamma$			151.7	79(10)d,e		Relative
				159.8	8.0(8)d,e			Relative
				1091.3	33(3)d,e			Relative
<sup>102</sup> Y (1 <sup>+</sup> )	0.44(6)c	n	0.30(2)	151.9	100(4)e			Relative
	0.30(1)e	$\gamma$		1159.5	16.0(19)e			Relative
<sup>102</sup> Zr (0 <sup>+</sup> )	2.9(2)f				136.5	1.8(2)g		
				156.6	3.3(3)g			
				535.3	10.5(11)g			
				599.6	15.0(15)h	f+ $\gamma$		
<sup>102m</sup> Nb	1.3(2)f				296.0			
				397.6				
				551.4				
				847.4				
<sup>102</sup> Nb (1 <sup>+</sup> )	4.3(4)f				295.9	79(8)f		
				447.1	20(2)f			
				551.6	30(4)f			
				847.4	19(2)f			

Table 29: Mass 102 continued

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>102</sup> Mo (0 <sup>+</sup> )	678(12)f			148.2	3.8(5)i			
				211.7	3.8(5)i			
				223.8	1.44(20)i			
<sup>102m</sup> Tc (4)	261(4)f			475.2	85.3(20)i			
				628.1	25.0(12)i			
				630.2	15.8(10)i			
				1615.3	15.4(7)i			
				468.9	0.88(10)i			
<sup>102</sup> Tc (1 <sup>+</sup> )	5.28(15)f			475.0	6.7(5)i			
				628.1	0.77(8)i			
				865.6	0.87(21)i			
				1105.5	0.69(9)i			

a) PFE86.  
 b) HIL86.  
 c) REE86.  
 d) SHI83.  
 e) HIL91.  
 f) DEF91.  
 g) Using relative intensities from BLA86 and the absolute branching of the 599.6 keV line from WAD88.  
 h) WAD88.  
 i) BRO86.

Table 30: Mass 103. Version 1993-07-14

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>103</sup> Zr	1.3a			247	29(3)a	$\beta+\gamma$		
<sup>103m</sup> Nb	1.5(2)b	$\gamma$		102.6	18.4(18)c			
				138.5	2.5(3)c			
				538.5	6.3(7)c			
				641.1	10.2(8)d	$\beta+\gamma$		

Table 30: Mass 103 continued

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>103</sup> Mo	67.5(15)e			424.0	6.8(7)d	$\beta+\gamma$		
<sup>103</sup> Tc	54.2(8)e			136.1	15.4(8)e			
				210.4	9.2(5)e			
				346.4	16.2(8)e			
				562.9	6.5(5)e			
<sup>103</sup> Ru	3391500(700)e			497.1	88.7(23)e			

a) WAD88.  
 b) SHI84.  
 c) Using relative intensities from SHI84 and the absolute branching of the 641.1 keV line from JOH92.  
 d) JOH92.  
 e) BRO86.  
 f) Using relative intensities from BRO86 and the absolute branching of the 424.0 keV line from JOH92.

Table 31: Mass 104. Version 1993-07-14

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>104</sup> Zr (0 <sup>+</sup> )	1.2(3)a 1.1(1)b	$\beta$ $\gamma$		1.11(9)	100.9	6.1(6)c	$\beta+\gamma$	
				210.5	2.2(2)d			
	0.92(4)e	$\gamma$		213.0	3.2(3)d			
				263.7	4.1(4)d			
<sup>104m</sup> Nb	4.8(4)f	$\gamma$		192.2	(f)			
<sup>104</sup> Nb				368.5	(f)			
<sup>104</sup> Mo (0 <sup>+</sup> )	60(2)e			376.0	4.7(11)e			
				393.1	1.3(3)e			
				421.0	2.6(6)e			

Table 31: Mass 104 continued

Nuclide	Half-life, s			Gamma branching ratio, %				Comment
	Value	Method	Average	Energy keV	Value	Method	Average	
<sup>104</sup> Tc (3 <sup>+</sup> )	1080(18)g	γ		358.0	89(3)e			
				530.5	15.6(12)e			
				535.1	14.7(11)e			
				884.4	10.9(12)e			

a) SCH79.

b) SHI83b.

c) WAD88.

d) Using relative intensities from BLA91b and the absolute branching of the 100.9 keV line from WAD88.

e) BLA91b.

f) AHR76b.

g) TRA72.

Table 32: Mass 105. Version 1993-07-14

Nuclide	Half-life, s			Gamma branching ratio, %				Comment			
	Value	Method	Average	Energy keV	Value	Method	Average				
<sup>105</sup> Zr	1.0 <sup>+1.2</sup> a -0.4	X, γ						Relative			
				94.8	258(13)b						
				137.9	100(4)b						
				246.9	203(10)b						
<sup>105</sup> Nb				309.9	108(6)b						
<sup>105</sup> Mo	48(4)c	m						Relative			
				147.9	9.8(10)d	β+γ					
				108.0	9.6(16)e						
				138.3	2.9(5)e						
<sup>105</sup> Tc				143.2	10.7(15)e						
				159.3	7.0(12)e						
<sup>105</sup> Ru (3/2 <sup>+</sup> )	15980(70)e							Relative			
				724.3	46.7(5)e						
<sup>105m</sup> Rh (1/2 <sup>-</sup> )	45e							Relative			
				129.6	100e						
<sup>105</sup> Rh (7/2 <sup>+</sup> )	127300(200)e							Relative			
				319.2	19.0(4)e						

a) AYS92.

b) SHI84.

c) TRA72

d) JOH92.

Table 33: Mass 106. Version 1993-07-14

Nuclide	Half-life, s			Gamma branching ratio, %				Comment
	Value	Method	Average	Energy keV	Value	Method	Average	
<sup>106</sup> Nb	1.02(5)a							
				171.8	90(6)b			
				351.0	35.1(24)b			
<sup>106</sup> Mo (0 <sup>+</sup> )	11(2)c 9.5(5)d 7.9(12)e	m m γ		714.3	27(5)b			
				725.2	15(5)b			
				465.7	35(3)f	β+γ		
				270.1	30(3)f			
<sup>106</sup> Tc	36(1)c 37(4)g 35.6(6)h	γ m γ		522.4	4.0(5)i			
				1969.3	4.8(7)i			
				2239.4	7.3(10)i			

a) SHI83c.

b) BRO86.

c) TRA72.

d) HAS69.

e) WIL70.

f) JOH92.

g) BAE65.

h) WIL69.

i) Using relative intensities from BRO86 and the absolute branching of the 270.1 keV line from JOH92.

Table 34: Mass 107. Version 1993-07-15

Nuclide	Half-life, s			Gamma branching ratio, %				Comment
	Value	Method	Average	Energy keV	Value	Method	Average	
<sup>107</sup> Nb	0.330(50)a							
				358.5	27.5c			
				384.4	57.6c			
<sup>107</sup> Mo	3.5(5)b							Relative
				400.3	100c			
				483.6	41.6c			
<sup>107</sup> Tc	21.2(2)d 21(1)e 21(2)e	γ m γ	21.2(2)	102.7	21.2(22)c			Relative
				106.3	7.6(6)c			
				177.0	9.2(7)c			
				561.4	5.6(6)c			

Table 34: Mass 107 continued

Nuclide	Half-lives			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>107</sup> Ru (5/2 <sup>+</sup> )	225(3)f	$\gamma$		194.0	10.6(17)g	f+ $\gamma$	10.7(7)	
				10.7(8)h	f+ $\gamma$			
				374.3	3.2(6)g	f+ $\gamma$		
				462.6	3.9(5)g	f+ $\gamma$		
<sup>107</sup> Rh (7/2 <sup>+</sup> )	1302(24)b			847.9	5.7(6)g	f+ $\gamma$		
				302.8	66(7)c			
				312.2	4.8(6)c			
				392.5	8.8(11)c			
<sup>107m</sup> Pd (11/2 <sup>-</sup> )	21.3(5)b			670.1	2.22(28)c			
				215	100b			

a) AYS91.  
d) WIL69.  
g) KAF86.

b) BRO86.  
e) TRA72.  
h) SHI92.

c) BLA91c.  
f) FRA78.

Table 35: Mass 108 continued

Nuclide	Half-lives			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>108m</sup> Rh (1 <sup>+</sup> )	17(1)e 18(1)g 16.8(5)h	$\gamma$		17.0(4)	434.1	43(11)i		
					497.3	5.1(13)i		
					618.9	15(4)i		
					931.7	1.5(4)i		
<sup>108</sup> Rh (5 <sup>+</sup> )	352(10)j	$\beta$			434.2	87.7(15)d		
					581.1	60(5)d		
					901.4	28(3)d		
					931.3	12.3(18)d		
					947.1	49(3)d		

a) TRA72.  
d) BLA91d.  
g) BAR55.  
j) PIN69.

b) WIL70.  
e) FRA78.  
h) PIE62.

c) JOH92.  
f) SHI92.  
i) BRO86.

Table 35: Mass 108. Version 1993-07-15

Nuclide	Half-lives			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>108</sup> Mo (0 <sup>+</sup> )	1.5(4)a 0.9(4)b	m $\gamma$	1.2(3)	268.2	29(2)c	$\beta+\gamma$		
<sup>108</sup> Tc	5.0(2)a 5.17(7)b	m $\gamma$	5.15(7)	242.3	81.6(7)d			
				465.6	14.3(12)d			
				707.8	11.4(8)d			
				974.8	9.8(8)d			
				1583.5	9.8(8)d			
<sup>108</sup> Ru (0 <sup>+</sup> )	273(3)e	$\gamma$		91.3	2.4(5)d			
				150.5	7.8(17)d			
				165.0	28(3)f	f+ $\gamma$		

Table 36: Mass 109. Version 1993-07-15

Nuclide	Half-lives			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>109</sup> Mo	0.53(6)a 0.59(11)b	X X		0.54(3)				
<sup>109</sup> Tc	0.87(4)b 0.9(1)c 0.86(8)d 1.4(4)e	$\gamma$		0.88(3)	95.9	44(1)b 64(6)c		Relative
					128.4	45(1)b 54(5)c		Relative
					137.8	24(1)b 27(3)c		Relative
					194.9	100(2)b 100(5)c		Relative
<sup>109m</sup> Ru	12.9(10)f -	m						Relative

Table 36: Mass 109 continued

Nuclide	Half-lives			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>109</sup> Ru (5/2 <sup>+</sup> )	34.5(10)f	$\gamma$ m $\gamma$	34.5(2)	206.3	22(6)h	f+ $\gamma$		
	34.5(24)g			226.0	20(5)h	f+ $\gamma$		
	358.8			14(4)h 16.4(24)i	f+ $\gamma$ f+ $\gamma$		15.8(21)	
	426.8			10(3)h	f+ $\gamma$			
<sup>109</sup> Rh (7/2 <sup>+</sup> )	79.8(10)f	$\gamma$ , m		178.0	7.6(9)j			
				291.4	7.5(9)j			
				326.7	54(6)j			
				426.1	7.7(11)j			
<sup>109m</sup> Pd (11/2 <sup>-</sup> )	281.8(2)k	$\gamma$		188.9	55.8(7)j			
				311.4	0.032(3)j			
<sup>109</sup> Pd (5/2 <sup>+</sup> )	49324 (9)k	$\gamma$		647.3	0.024(1)j			

\*) Not found by KAF87.

a) AYS92.

d) PEN90.

g) FRI67.

j) BRO86.

b) PEN92.

e) TRA76.

h) KAF87.

k) ABZ90.

c) ALT90.

f) FRA78.

i) SHI92.

Table 37: Mass 110 continued

Nuclide	Half-lives			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>110</sup> Ru (0 <sup>+</sup> )	12.6(5)f	$\gamma$ $\gamma$	12.2(5)	96.0	1.25(45)g	DS		gs=70%
	11.6(6)g			112.2	25(9)g 16(4)h	DS f+ $\gamma$	17(4)	gs=70%
				166.1	0.65(23)g	DS		gs=70%
				251.6	0.53(19)g	DS		gs=70%
<sup>110m</sup> Rh ( $\geq$ 4)	28.5(15)i			373.8	91(1)j			
				546.3	36(3)j			
				687.9	28(4)j			
				904.7	27(3)j			
<sup>110</sup> Rh (1 <sup>+</sup> )	3.2(2)i			373.8	51(8)j			
				439.9	5.1(10)j			

a) AYS92.

d) WIL69.

g) JOK91.

j) BRO86.

b) ALT90.

e) AYS90.

h) DEG83.

i) SHI92.

c) TRA76.

f) FRA78.

i) SHI92.

Table 37: Mass 110. Version 1993-07-15

Nuclide	Half-lives			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>110</sup> Mo	0.25(10)a	X						
<sup>110</sup> Tc	0.9(1)b 1.0(2)c 0.83(4)d 0.92(3)e	$\gamma$ $\gamma$ $\gamma$ $\gamma$	0.89(3)	240.7 372.0 612.7 619.2	1000e 170(9)e 160(8)e 140(10)e			Relative Relative Relative Relative

Table 38: Mass 111. Version 1993-07-15

Nuclide	Half-lives			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>111</sup> Tc	0.30(3)a	$\gamma$		103.9	20(3)b			Relative
				150.4	100(5)b			Relative
				175.0	34(4)b			Relative
				368.0	71(6)b			Relative
<sup>111</sup> Ru	2.12(7)a 3(1)c 1.5(2)d	$\gamma$ $\gamma$ $m$	2.12(7)	211.7	12.3b	DS		gs=60%
				303.8	15.8b 21(4)e	DS f+ $\gamma$		gs=60%
				382.0	6.5b	DS		gs=60%
				1515.9	4.4b	DS		gs=60%

Table 38: Mass 111 continued

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>111</sup> Rh (7/2 <sup>+</sup> )	11(1)c	$\gamma$		123.0	2.00(9)b			Relative
				191.2	1.95(15)b			Relative
				275.4	100(4)b			Relative
				411.8	9.42(18)b			Relative
<sup>111m</sup> Pd (11/2 <sup>-</sup> )	19800(360)f			172.2	33.6(50)f			
				391.2	5.4(9)f			
				575.0	3.2(6)f			
				632.5	3.6(6)f			
<sup>111</sup> Pd (5/2 <sup>+</sup> )	1404(12)f			376.6	0.44(3)f			
				580.0	0.84f			
				650.4	0.55(3)f			
				1458.9	0.54(9)f			
<sup>111m</sup> Ag (7/2 <sup>+</sup> )	64.8(8)f			620.1	0.12(4)f			
				245.4	1.24(9)f			
				342.1	6.7(3)f			
				150.8	29.1(9)f			
<sup>111</sup> Ag (1/2 <sup>-</sup> )	636000 (7000)g	$\beta$		245.4	1.24(9)f			
				342.1	6.7(3)f			
				150.8	29.1(9)f			
				245.4	94.0(2)f			

a) PEN88.  
d) FET75.  
g) BAB70.

b) PEN92.  
e) SHI92.

c) FRA78.  
f) BRO86.

Table 39: Mass 112. Version 1993-07-15

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>112</sup> Ru (0 <sup>+</sup> )	1.75(7)a 3.6(5)b	$\gamma$ $\gamma$	Excluded	82.3 244.8 327.0 588.1	7.0(35)c 7.0(35)c 22(11)c 2.1(11)c			
<sup>112</sup> Rh (1 <sup>+</sup> )	3.8(6)a 2.1(3)c	$\gamma$ $\gamma$	2.4(7)	348.7	(d)			
<sup>112</sup> Rh ( $\geq$ 4)	6.8(2)a	$\gamma$		388.2 560.5	357(27)d 259(18)d			Relative Relative
<sup>112</sup> Pd (0 <sup>+</sup> )	72420(220)e	$\beta$						
<sup>112</sup> Ag (2 <sup>-</sup> )	11300(70)f	$\beta, \gamma$		617.5 694.9 1387.8 1613.8	43(4)g 3.0(4)g 5.4(8)g 2.8(4)g			

a) PEN88.  
d) AYS88.  
g) BRO86.

b) FRA78.  
e) BAB70.

c) JOK91.  
f) WAL72.

Table 40: Mass 113. Version 1993-07-15

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>113</sup> Tc	0.13(5)a	X						
<sup>113</sup> Ru	0.80(10)b 0.80(6)c	$\gamma$ $\gamma$	0.80(5)	211.7 263.2 337.5 657.9	31.0(15)c 100(4)c 27.9(24)c 24.0(18)c			Relative Relative Relative Relative

Table 40: Mass 113 continued

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>113</sup> Rh ( $7/2^+$ )	2.72(22)b	$\gamma$	2.78(11)	189.8	45.0(8)c			Relative
	2.80(12)c	$\gamma$		219.6	10.3(6)c			Relative
				348.9	100.0(9)c			Relative
				409.3	42.2(8)c			Relative
				81.3				
<sup>113m</sup> Pd	0.4(1)c	$\gamma$		91.0(13)	95.8	6.5(7)f	DS	
		$\gamma$			222.1	2.3(3)d	$\beta+\gamma$	
					643.6	6.0(6)f	DS	gs=0
					739.4	4.8(5)f	DS	gs=0
								gs=0
<sup>113m</sup> Ag ( $7/2^+$ )	70.0(25)g	$\gamma$	69.2(9)	298.4	32(4)j			
	69(1)h	$\beta$		316.1	61(6)j			
	72(9)i	$\beta$		392.3	34(4)j			
				708.3	12.4(12)k			
				709.0	3.1(3)k			
<sup>113</sup> Ag ( $1/2^-$ )	19330(180)l			258.8	1.64m			
				298.6	10.0m			
				316.3	0.49m			

a) AYS92.

d) FOG90.

g) BRÜ82.

j) LUN93.

k) Using relative intensities from BLA86 and the absolute branching of the 316.1 keV line from LUN93.

l) BRO86.

b) PEN88.

e) MEI81.

h) GRA74.

i) ALE58.

m) BLA86.

c) PEN92.

f) FOG87.

j) LEI91.

d) FOG90.

g) From gamma ratios in KOP89 and absolute branching ratio of 558.2 keV gamma-ray in <sup>114</sup>Ag (average of determinations FOG90 and LUN93).

h) Using relative intensities from BLA86 and the absolute branching of the 126.3 keV line from FOG90.

i) From gamma ratios in MEI81 and absolute branching ratio of 558.2 keV gamma-ray in <sup>114</sup>Ag (average of determinations FOG90 and LUN93).

j) GRA74.

k) WAL72b

l) LUN93.

n) Using relative intensities from LUN84 and the absolute branching of the 558.2 keV line from LUN93.

Table 41: Mass 114. Version 1993-07-15

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>114</sup> Ru ( $0^+$ )	0.53(6)a	$\gamma$	0.55(4)	87.7	2.9(10)b	DS		gs=58%
	0.57(6)b	$\gamma$		127.0	24(8)b	DS		gs=58%
				128.2	10(4)b	DS		gs=58%
				179.7	7(3)b	DS		gs=58%
<sup>114</sup> Rh ( $\geq 4$ )	1.85(5)c							
<sup>114</sup> Rh ( $1^+$ )	1.85(5)c			332.5	1000c			Relative
				519.8	391(8)c			Relative
<sup>114</sup> Pd ( $0^+$ )	146(6)d	$\gamma$	148.5(18)	126.3	4.6(4)d	$\beta+\gamma$	4.5(3)	
	145(9)e	$\beta$		136.2	0.85(15)g		0.93(7)	
	148.9(19)f	$\gamma$		231.6	5.0(4)h		5.0(3)	
				358.0	1.55(22)g		1.19(16)	
					1.12(10)h			
<sup>114</sup> Ag ( $1^+$ )	4.3(1)j	$\beta$	4.45(7)	558.2	17.6(17)d	$\beta+\gamma$	18.5(19)	
	4.52(7)k	$\gamma$		10(4)k	20.4(13)m	$\beta+\gamma$		
	4.5(3)l			575.8	1.69(18)n			
				1994.6	1.16(10)n			

\*) This value is obtained from gamma-ray ratios and an estimate of the (n,p)-yield of <sup>114</sup>Cd.

a) LEI91. b) JOK92. c) AYS88.

d) FOG90. e) KOP89. f) MEI81.

g) From gamma ratios in KOP89 and absolute branching ratio of 558.2 keV gamma-ray in <sup>114</sup>Ag (average of determinations FOG90 and LUN93).

h) Using relative intensities from BLA86 and the absolute branching of the 126.3 keV line from FOG90.

i) From gamma ratios in MEI81 and absolute branching ratio of 558.2 keV gamma-ray in <sup>114</sup>Ag (average of determinations FOG90 and LUN93).

j) GRA74. k) WAL72b l) FOG71.

m) LUN93.

n) Using relative intensities from LUN84 and the absolute branching of the 558.2 keV line from LUN93.

Table 42: Mass 115. Version 1993-07-15

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>115</sup> Ru	0.40(10)a 0.74(8)b	X $\gamma$	0.61(17)					
<sup>115</sup> Rh (7/2 <sup>+</sup> )	0.99(5)c 1.02(3)d	$\gamma$ $\gamma$	1.01(3)	125.6 127.9 164.5 296.5	40c 77c 17c 17c	DS DS DS DS	gs=0 gs=0 gs=0 gs=0	
<sup>115m</sup> Pd (11/2 <sup>-</sup> )	50(3)e 56.6(15)f	$\gamma$ $\gamma$	55(3)	749	10.0(10)e	$\beta+\gamma$		
<sup>115</sup> Pd (5/2 <sup>+</sup> )	25(2)e 27.7(49)f	$\gamma$ $\gamma$	25.4(19)	556	5.9(7)e	$\beta+\gamma$		
<sup>115m</sup> Ag (7/2 <sup>+</sup> )	18.0(7)g 19.2(14)h 49(6)i	$\beta$ $\gamma$ m	18.2(6)	388.8 Excluded	31(3)e 43.8(24)j	$\beta+\gamma$ $\beta+\gamma$	39(6)	
<sup>115</sup> Ag (1/2 <sup>-</sup> )	1223(100)e 1200(30)k	$\beta,\gamma$	1200(30)	212.8 649.1 698.1 2156.1	8.8(9)e 4.8(11)j 4.6(9)j 5.7(9)j	$\beta+\gamma$ $\beta+\gamma$ $\beta+\gamma$ $\beta+\gamma$	8.8(8) • • •	•
<sup>115</sup> Cd (1/2 <sup>+</sup> )	192500(300)k			336.3 527.9	50.1(20)k 27.5(13)k			

- ) A list of relative gamma intensities is found in MAT78. The authors give a conversion factor based on a comparison with <sup>198</sup>Au. This conversion factor gives absolute branching ratios which are about a factor of two lower than those from FOG90 and LUN93, and they are omitted here. The relative gamma intensities agree with those determined at Studsvik.
- a) AYS91.  
b) AYS92.  
c) AYS87.  
d) PEN92.  
e) FOG90.  
f) ROG84.  
g) GRA74.  
h) BRÜ82.  
i) KJE68.  
j) LUN93.  
k) BRO86.

Table 43: Mass 116. Version 1993-07-15

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>116</sup> Rh (1 <sup>+</sup> )	0.68(7)a	$\gamma$		340.5	(b)			
<sup>116</sup> Rh ( $\geq$ 5)	0.9(4)a	$\gamma$		398.1 639.4	250(40)b 286(42)b			Relative Relative
<sup>116</sup> Pd (0 <sup>+</sup> )	11.5(4)c 10.8(2)d 10.6(5)e	$\gamma$ $\gamma$ $\gamma$	10.9(2)	101.5 114.7	7.9d 86(9)c 78d	$\beta+\gamma$		
<sup>116m</sup> Ag (6 <sup>+</sup> )	8.2(2)c 8.5(2)g 10.5(6)h 10.4(8)i 10.5(5)j	$\gamma$ $\beta$ $\gamma$ $\gamma$ $\gamma$	8.7(4)	705.5 708.8 806.8 1028.9	58(3)k 64(6)l 22.2(22)l 18.8(14)m	$\beta+\gamma$ $DS$	59(3) 19.8(15)	gs=0 gs=0
<sup>116</sup> Ag (1 <sup>+</sup> )	162(5)c 155(5)g 159(4)j 150(6)n	$\gamma$ $\beta$ $\gamma$ $\beta$	157.3(24)	639.9 1304.1 2477.9	2.48(19)k 5.5(6)c 4.6(3)k 10.1(8)o	$\beta+\gamma$ $\beta+\gamma$ $\beta+\gamma$	25.8(24) 4.8(4)	gs=0

- a) AYS87.  
b) AYS88.  
c) FOG90.  
d) KOP89.  
e) ROG84.  
f) Using relative intensities from BLA86 and the absolute branching of the 114.7 keV line from FOG90.  
g) GRA74.  
h) BRÜ82.  
i) FOG71.  
j) BJO74.  
k) LUN93.  
l) BRÜ82 with the conservative error of 10 % for the ground-state beta transition.  
m) Using relative intensities from BLA86 and the absolute branching of the 1028.9 keV line from LUN93.  
n) ALE88.  
o) Using relative intensities from BRÜ82 and the average branching of the 1304.1 keV line.



Table 45: Mass 118 continued

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
$^{118m}Ag$ (6 <sup>-</sup> )	1.9(2)b	$\gamma$	2.11(23)	127.7	7.2(12)g			
	2.8(3)e	$\gamma$		770.9	20(3)g			
	2.0(2)f	$\gamma$		1058.6	32(5)g			
$^{118}Ag$ (3 <sup>+</sup> )	3.7(2)e	$\gamma$	3.74(12)	770.9	0.6g			
	3.76(15)f	$\gamma$		781.5	6.5g			
				797.8	7.8g			
				1058.6	2.3g			
				2101.5	8.9g			
$^{118}Cd$ (0 <sup>+</sup> )	3018(12)h	$\beta$	3017(12)					
	2940(90)i	$\beta$						
$^{118m}In$ (8 <sup>-</sup> )	8.5(1)j	$\gamma$		138.2	21.6g			
				253.7	0.021g			
				1050.8	0.023g			
				1229.7	0.023g			
$^{118m^2}In$ (5 <sup>+</sup> )	264(3)g			683.1	54(2)k	DS	gs=0	
				1050.8	81(3)k	DS		
				1229.5	96(3)k	DS		
				528.3	0.7(3)l			
$^{118}In$ (1 <sup>+</sup> )	5.0(5)h	$\beta, \gamma$	5.1(4)	528.3	0.7(3)l			
	5.1(5)i	$\beta$		1229.5	5(2)l			

a) AYS87b.  
d) JAN92.  
e) FOG71.  
g) BRO86.  
j) HAT69.

b) KOP89.  
e) FOG71.  
h) SCH68.  
k) RAM88.

c) WEI69.  
f) HIL78.  
i) GLE61.  
l) DEF77.

Table 46: Mass 119. Version 1993-07-15

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
$^{119}Pd$	0.92(13)a				129.9	100b		Relative
					256.6	63b		Relative
					326.1	52b		Relative
$^{119}Ag$ (7/2 <sup>+</sup> )	2.1(1)c				213.4	7.2(17)d		
					366.2	9.9(21)d		
					399.1	8.9(23)d		
					626.4	10.7(22)d		
$^{119m}Cd$ (11/2 <sup>-</sup> )	132.0(12)e				422.4	9.4(15)g		
	160(30)f	$\gamma, \beta$	132.0(12)		720.8	18(3)g		
					1025.0	24(4)g		
					2021.3	21(3)g		
$^{119}Cd$ (1/2 <sup>+</sup> )	161.4(12)e	$\gamma$			292.9	25.0(12)g		
					342.9	12.9(12)g		
					1316.9	6.9(4)g		
					1609.7	7.9(5)g		
$^{119m}In$ (1/2 <sup>-</sup> )	1080(18)e	$\gamma, \beta$	1081(17)		311.4	0.99i		
	1090(70)f	$\beta$			1065.6	0.13i		
	1080(60)h	$\beta$			1163.9	0.054i		
					1249.7	0.073i		
$^{119}In$ (9/2 <sup>+</sup> )	144(6)e	$\gamma, \beta$	142(9)		763.1	99.1(2)i		
	168(18)f	$\beta$						
	120(12)h	$\beta$						

a) PEN91.  
d) KAW75.  
e) SCH76.  
f) SCH68.  
g) MCD74 with the assumption that the ground-state beta branch is 15(15)% ( $\leq 30\%$  is indicated in MCD74) for  $^{119m}Cd$ . For  $^{119}Cd$  the authors assume 40 % direct feeding of the 331.3 keV level in  $^{119}In$ .  
h) GLE61b.  
i) BRO86.

Table 47: Mass 120. Version 1993-07-15

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
$^{120}Pd$	0.50(10)a	$\gamma$						
$^{120m}Ag$ (6 <sup>-</sup> )	0.32(4)b	$\gamma$		203.0	34(3)c			
$^{120}Ag$ (3 <sup>+</sup> )	1.17(5)b 1.25(3)d	$\gamma$ $\beta$	1.23(4)	505.5 697.6 818.4	80e 34.4e 11.6(23)f			
$^{120}Cd$ (0 <sup>+</sup> )	50.8(2)g	$\beta$						
$^{120m}In$ (8 <sup>-</sup> )	47.3(5)h	$\gamma$		197.0 965.0 1023.0 1171.2	81(3)h 87(8)i 81(8)j 58.7(12)h 73(7)i 61.3(22)j 98(4)h 100(8)i 99j 100(3)h 100(8)i 100(3)j	DS DS DS DS DS DS DS	82(3) 59.6(16) 98(4) 100(2)	gs=0 gs=0 gs=0 gs=0 gs=0 gs=0 gs=0
$^{120m^2}In$ (4,5 <sup>+</sup> )	46.2(8)h	$\gamma$		863.8 1023.2 1171.6 1294.7	33.8(16)h 35.0(11)j 57(12)h 56j 100(10)h 97(3)j 12.7(10)h 12.3(4)j	DS DS DS DS	34.6(9) 97(3) 12.4(4)	gs=0 gs=0 gs=0 gs=0

Table 47: Mass 120 continued

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
$^{120}In$ ( $1^+$ )	3.08(8)g	$\beta, \gamma$		1172.3	19.0(15)g			
				1185.8	0.93(15)g			
				1250.8	0.24(7)g			
				2039.8	1.86(25)g			

a) AYS91.

d) REE83b.

(1) FOG73b

g) SCH73. h) CHE78. i) FOG79.

g) SCH73.  
i) RAMBB.

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Table 48: Mass 121. Version 1993-05-11

Nuclide	Half-life, s			Gamma branching ratio, %			
	Value	Method	Average	Energy keV	Value	Method	Average
<sup>121</sup> Ag	0.78(1)a	$\beta^-$	0.78(2)	314.8	31.5b 27(3)c	DS $\beta + \gamma$	gs=0
	0.91(6)a			353.7	19.5b 16.6(18)d		
	0.72(10)b			369.6	6.0b 5.1(6)d		
				500.7	9.1b 7.7(8)c		
<sup>121m</sup> Cd (11/2 <sup>-</sup> )	8.3(8)b	$\gamma$	Discre- pant data	988.1	13.6(13)f	DS	-)
	4.8(4)e			1020.9	18.9(18)f		
				1181.6	12.4(12)f		
				2060.0	21(2)f		
<sup>121</sup> Cd (3/2 <sup>+</sup> )	12.5(15)f	$\gamma$		324.4	50(5)f	DS	--)
				349.4	13.0(13)f		
				987.9	1.9(2)f		
				1040.6	17.0(17)f		

Table 48: Mass 121 continued

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
$^{121m}In$ ( $1/2^-$ )	233(6)g 186(18)h 198(60)i 186(24)j	$\beta$ $\beta$ $\beta$ $\beta$	226(10)	1041.2 1102.2 1120.4	1.12k 0.92k 0.51k			
$^{121}In$ ( $9/2^+$ )	30.0(2)e 22.6(2)g 23.1(6)g 30(3)h 29(8)i	$\gamma$ $\gamma$ $\beta$ $\beta$ $\beta$	26.1(18)	262.0 657.3 925.6	7.9(5)l 7.1(5)l 87(6)l	DS DS DS		gs=0 gs=0 gs=0
$^{121}Sn$	97400(110)m 96700(700)n 97200(2200)o 99000(1800)p	$\beta$ $\beta$ $\beta$ $\beta$	97390(110)					

- a) Assuming negligible  $\beta$ -feeding of the  $^{121}In$  ground state and the absence of an isomeric transition in  $^{121}Cd$ .
- \*\*) Assuming the absence of  $\beta$ -feeding of the isomeric state in  $^{121}In$ .
- a) REE83.  
b) FOG82b.
- c) Using relative intensities from FOG82b and the absolute branching of the 353.7 keV line from LUN93.
- d) LUN93.  
e) SCH74.  
f) FOG82.
- g) GRA74.  
h) YUT60.  
i) WAH65.
- j) WEI65.  
k) BRO86.
- l) FOG76 assuming 100% beta feeding of the level at 925.6 keV.
- m) ERD68.  
n) LAW66.  
o) NEL50.
- p) LEE49.

Table 49: Mass 122 continued

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
$^{122m}In$ ( $8^-$ )	10.8(4)f	$\gamma$		103.6 163.2 1121.5 1140.2	87.5f 82(8)g 81h 71.2f 69(7)g 66h 60.9f 68(7)g 61.2h 100f 100(10)g 100h	DS DS DS DS DS DS DS		gs=0 gs=0 gs=0 gs=0 gs=0 gs=0 gs=0
$^{122m^2}In$ ( $4,5^+$ )	10.3(6)f	$\gamma$		974.4 1001.4 1140.3 1163.6 1190.3 1140.3	13.0f 14.3(20)g 13.2h 58.5f 54(8)g 51.7h 100f 100(14)g 100h 14.5f 26(4)g 15.7h 14.5f 28(4)g 15.7h 29(5)d	DS DS DS DS DS DS DS		gs=0 gs=0 gs=0 gs=0 gs=0 gs=0 gs=0
$^{122}In$ ( $1^+$ )	1.5(3)i	$\gamma$		1389.7 2065.6 2759.1	1.8(3)j 2.0(4)j 3.1(6)j	$\beta+\gamma$		gs=0 gs=0 gs=0

- a) SHI78.  
d) SCH73.  
g) FOG79.
- b) REE83.  
e) GRA74.  
h) RAM88.
- c) FOG71.  
f) CHE79.  
i) TAK71.
- j) Using relative intensities from FOG79 and the absolute branching of the 1140.3 keV line from SCH73.

Table 49: Mass 122. Version 1993-05-11

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
$^{122}Ag$	0.48(8)a 0.57(3)b 1.5(5)c	$\gamma$ $n$ $\gamma$	0.56(4)	569.4 650.2 759.7 798.4	95(4)a 20.2(9)a 31.7(13)a 12.3(5)a	DS DS DS DS		gs=0 gs=0 gs=0 gs=0
$^{122}Cd$	5.78(9)d 3.13(12)e	$\beta$ $\beta$	4.8(13)					

Table 50: Mass 123. Version 1993-05-11

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>123</sup> Ag	0.39(3)a	n	0.309(15)	116.4	8.3(1)c	DS		gs=0
	0.30(1)b	n		263.9	39.3(3)c	DS		gs=0
	0.35(4)c	γ		409.8	14.5(5)c	DS		gs=0
	0.30(2)d	γ		591.3	9.0(5)c	DS		gs=0
<sup>123m</sup> Cd (11/2 <sup>-</sup> )	1.88(6)d	γ	1.82(3)	371.3	0.9(1)e	DS		gs=0
	1.81(3)e	γ		1027.5	22.3(14)e	DS		gs=0
				1052.3	0.3e	DS		gs=0
				1165.9	25.2(15)e	DS		gs=0
				1438.1	0.11e	DS		gs=0
<sup>123</sup> Cd (3/2 <sup>+</sup> )	2.11(6)d	γ	2.12(3)	371.4	52(3)e	DS		gs=0
	2.12(3)e	γ		1052.3	25.1(16)e	DS		gs=0
	2.19(10)f	γ		1438.1	8.4(7)e	DS		gs=0
		*		1842.9	7.8(5)e	DS		gs=0
<sup>123m</sup> In (1/2 <sup>-</sup> )	45.9(10)f	γ	47.4(8)	125.8	45(5)f	β+γ	46(3)	
	47.8(5)g	β		46(3)i	β+γ			
				896.5	0.075(23)h			
				1170.0	0.10(3)h			
<sup>123</sup> In (9/2 <sup>+</sup> )			6.05(15)	3234.0	0.12(4)h			
	6.68(20)f	γ		618.8	2.8(3)f	β+γ	2.66(17)	gs=0
	5.98(6)g	β		2.6(2)j	DS			
	6.8(4)g	γ		1019.7	27(4)i	β+γ	31.0(20)	gs=0
				32(2)j	DS			
				1130.5	55(7)i	β+γ	61(3)	gs=0
				63(4)j	DS			

Table 50: Mass 123 continued

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>123m</sup> Sn (3/2 <sup>+</sup> )	2403.6(6)k	γ		160.3	85.6(20)h			

\*) This value is doubtful because of contribution from the isomer.

- a) LUN76.  
 b) REE83.  
 c) HUC89.  
 d) MAC86b.  
 e) HUC89b.  
 f) GOK86.  
 g) GRA74.  
 h) BRO86.  
 i) LUN93.  
 j) FOG76.  
 k) ABZ90.

Table 51: Mass 124. Version 1993-05-11

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>124</sup> Ag	0.54(8)a 0.17(3)b	n γ	0.22(12)	613.0				
<sup>124</sup> Cd (0 <sup>+</sup> )	1.2(1)a 1.23(2)b 0.9(2)c 1.29(3)d	β γ γ γ	1.25(2)	143.3 179.9	12.9(16)c 49(5)c			
<sup>124m</sup> In (8 <sup>-</sup> )	3.7(2)e	γ		102.9 120.3 969.9 1072.9 1359.9	45(3)f 38(3)f 51(4)f 47(4)f 38(3)f	DS DS DS DS DS		gs=0 gs=0 gs=0 gs=0 gs=0
<sup>124</sup> In (3 <sup>+</sup> )	3.09(10)e 3.3(3)g	γ γ	3.11(9)	997.8 1131.6 1470.7 3214.2	17(2)e 21.1(15)f 68(6)f 21.5(20)f	β+γ DS DS DS	19.6(20)	gs=0 gs=0 gs=0 gs=0

- a) REE83.  
 d) MAC86b.  
 g) TAY83.

- b) HIL84.  
 e) GOK86.

- c) FOG74.  
 f) FOG79.

Table 52: Mass 125. Version 1993-05-11

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
$^{125m}Cd$ (11/2 <sup>-</sup> )	0.48(3)a 0.66(3)b	$\gamma$ $\gamma$	0.57(9)	736.6	13.9(8)a	DS		gs=0
				1027.5	28.4(17)a	DS		gs=0
				1173.2	27.6(17)a	DS		gs=0
				1613.7	12.1(13)a	DS		gs=0
$^{125}Cd$ (3/2 <sup>+</sup> )	0.68(4)a 0.64(3)b	$\gamma$ $\gamma$	0.654(24)	436.3	43(3)a	DS		gs=0
				1099.5	25.6(21)a	DS		gs=0
				1701.6	12.4(9)a	DS		gs=0
				2147.2	21.9(13)a	DS		gs=0
$^{125m}In$ (1/2 <sup>-</sup> )	12.2(3)c 12.2(1)d 11.8(9)d	$\beta, \gamma$ $\beta$ $\gamma$	12.20(9)	187.6	52(6)c 52(3)e	$\beta+\gamma$ $\beta+\gamma$	52(3)	
$^{125}In$ (9/2 <sup>+</sup> )	2.50(10)c 2.33(4)d	$\beta, \gamma$ $\beta$	2.35(6)	617.9	7.4(8)c 8.0(4)f	$\beta+\gamma$ DS	7.9(4)	gs=0
				1031.7	11.4(8)e 10.3(6)f	$\beta+\gamma$ DS	10.7(5)	gs=0
				1335.0	72(4)e 76(4)f			
$^{125m}Sn$ (3/2 <sup>+</sup> )	571(3)g	$\beta$	83400(2000)	331.9	98(5)e 98.0(2)h	$\beta+\gamma$	98.0(2)	
				1403.7	0.70(3)h			
$^{125}Sn$ (11/2 <sup>-</sup> )	85400(6000)g 83200(2000)i	$\beta$ $\beta$	83400(2000)	822.4	4.0(11)h			
				915.5	3.9(11)h			
				1067.0	9.0(17)h			
				1089.2	4.3(12)h			

a) HUC89.  
d) FRA74.  
g) ERD68.

b) MAC86b.  
e) LUN93.  
h) BRO86.

c) GOK86.  
f) FOG76.  
i) LAW66.

Table 53: Mass 126. Version 1993-05-10

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
$^{126}Cd$ (0 <sup>+</sup> )	0.53(1)a 0.506(15)c 0.60(3)d	$\gamma$ $\gamma$	0.528(16)	260.1	94(5)b			
				428.1	79(4)e 52(6)f	$\beta+\gamma$	71(12)	
				688.2	5.6(3)e			
$^{126m}In$ (8 <sup>-</sup> )	1.64(3)d 1.45(15)g	$\gamma$ $\gamma$	1.63(4)	111.8	88(8)g	DS		gs=0
				315.9	11.6(10)g	DS		gs=0
				908.6	99(7)g	DS		gs=0
				1636.5	29.6(20)g	DS		gs=0
$^{126}In$ (3 <sup>+</sup> )	1.60(10)d 1.5(2)g	$\gamma$ $\gamma$	1.58(9)	631.8	1.6(1)g	DS		gs=0
				969.6	15.5(20)d 14.9(10)g	$\beta+\gamma$ DS	15.0(9)	gs=0
				1571.0	2.6(2)g	DS		gs=0
				3344.6	21.6(20)g	DS		gs=0

a) GRA74b.

d) GOK86.

e) GAR78 using the absolute branching ratio of the 260 keV gamma-ray from FOG89.

f) LUN93.

g) FOG79.

Table 54: Mass 127. Version 1993-05-10

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
$^{127}Cd$ (3/2 <sup>+</sup> )	0.43(3)a 0.30(3)b	$\gamma$ $\gamma$	0.37(6)	376.3	8(3)a 13(3)c	$\beta+\gamma$ DS	11(3)	
				523.6	8.7(25)c	DS		
				1067.0	8.5(24)c	DS		
				1235.1	14(4)c	DS		

Table 54: Mass 127 continued

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>127m</sup> In (1/2 <sup>-</sup> )	3.8(2)a	$\gamma$	3.67(4)	252.3	38(5)a	$\beta+\gamma$	42.5(21)	
	3.7(1)d	$\beta$		43.5(23)h	43.5(23)h	$\beta+\gamma$		
	3.76(3)e	n		832.8	2.2(3)i			
	3.70(4)f	n		948.4	3.0(4)i			
	3.580(25)g	n		3074.0	3.2(4)i			
<sup>127</sup> In (9/2 <sup>+</sup> )	1.22(5)a	$\gamma$	1.087(15)	646.1	9.3(7)h	$\beta+\gamma$	7.5(15)	
	1.083(7)g	n		62(6)a	6.2(6)a	$\beta+\gamma$		
	1.15(5)j	$\gamma$		805.1	6.8(14)k			
				1048.6	6.4(13)k			
<sup>127m</sup> Sn (3/2 <sup>+</sup> )	248(2)d	$\beta$	248(2)	491.3	98(4)h	$\beta+\gamma$	63(4)	
	219(18)d	$\gamma$		1348.0	5.3(14)n			
	246(18)l	$\gamma$		1564.0	4.4(18)n			
	276(24)m	$\beta$		491.3	5.3(8)n			
<sup>127</sup> Sn (11/2 <sup>-</sup> )	7560(140)n			805.9	8.2(12)n			
				823.1	10.6(26)n			
				1095.6	19(5)n			
				1114.3	29(4)h			
					38(5)n	$\beta+\gamma$	33(4)	
<sup>127</sup> Sb (7/2 <sup>+</sup> )	332600			473.0	24.7(9)n			
	(4300)n			685.7	35.3(8)n			
				783.7	14.5(4)n			

a) GOK86.

b) MAC86b.

c) HOF86.

d) GRA74.

e) LUN80.

f) REE85.

g) RUD93.

h) LUN93.

i) Using relative intensities from DEG80 and the average branching of the 252.3 keV line.

j) DEG80.

k) Using relative intensities from DEG80 and the average branching of the 646.1 keV line.

l) KAU65.

m) HAG62.

n) BRO86.

Table 55: Mass 128. Version 1993-05-10

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>128</sup> Cd (0 <sup>+</sup> )	0.34(3)a	$\gamma$	0.28(4)	247.9	75(7)b			
	0.26(2)c	$\gamma$		462.7	17.4(17)b			
				857.0	71(7)b			
				925.0	10.8(3)b			
<sup>128m</sup> In (8 <sup>-</sup> )	0.72(10)a	$\gamma$	0.81(9)	831.5	100(5)d	DS		gs=0
	0.9(1)d	$\gamma$		1168.8	100(5)d	DS		gs=0
				1867.0	32.3(20)d	DS	29(6)	gs=0
				72(3)e	$\beta+\gamma$			
<sup>128</sup> In (3 <sup>+</sup> )	0.84(6)a	$\gamma$	0.86(5)	935.2	8.0(5)d	DS	7.8(4)	gs=0
	0.9(1)d	$\gamma$		7.0(11)e	$\beta+\gamma$			
				1089.5	7.4(5)d	DS	7.2(4)	gs=0
				6.8(8)e	$\beta+\gamma$			
<sup>128m</sup> Sn (7 <sup>-</sup> )	6.5(5)f			1168.8	50(5)d	DS		gs=0
				3519.8	16.6(15)d	DS		gs=0
				4297.6	11.8(8)d	DS		gs=0
<sup>128</sup> Sn (0 <sup>+</sup> )	3550(30)g	$\beta$		831.5	100f			
				1168.8	100f			
				482.3	58(6)g	DS	61(4)	gs=0
				63(6)h	DS			gs=0
<sup>128</sup> Sb (5 <sup>+</sup> )	624(12)f			557.3	16(2)g	DS	16.5(13)	gs=0
				16.9(17)h	DS			gs=0
				680.5	16(2)g	DS	15.9(12)	gs=0
				15.8(16)h	DS			gs=0
				314.0	89(7)f			
				743.2	96(5)f			
				753.9	96(5)f			
				787.6	7.1(11)f			

Table 55: Mass 128 continued

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
$^{128}Sb$ ( $8^-$ )	32440(110)f			314.1	61(4)f			
				526.5	45(3)f			
				628.7	31(2)f			
				636.2	36(2)f			
				743.3	100(5)f			
				754.0	100(5)f			

a) GOK86.  
d) FOG79.  
g) NUN76.

b) EKS88.  
e) LUN93.  
h) IMA75.

c) MAC86b.  
f) BRO86.

Table 56: Mass 129, Version 1993-05-10

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
$^{129}Cd$	0.27(4)a	$\gamma$						
$^{129m}In$ ( $1/2^+$ )	1.30(10)a 1.26(2)b 1.18(3)c	$\gamma$ $n$ $n$	1.24(3)	315.3 906.7 1222.2	20(4)a 1.13(23)d 1.8(4)d	$\beta+\gamma$		
$^{129}In$ ( $9/2^+$ )	0.68(5)a 0.59(2)b 0.61(1)c 0.611(5)f	$\gamma$ $n$ $n$ $n$	0.610(4)	769.3 1008.3 1865.0 2118.0	12.1(25)e 8.0(17)e 43(9)a 59(12)e	$\beta+\gamma$		
$^{129m}Sn$ ( $11/2^-$ )	528(36)g 414(6)h 534(36)j 450(6)k	m $\gamma$ $\beta$ m	435(14)	307.0 760.8 1128.4 1161.3	14.2(16)h 15.8(22)h 16.2(8)i 47(5)h 53(3)h	DS $\beta+\gamma$ DS DS	16.2(8) gs=0 gs=0 gs=0	

Table 56: Mass 129 continued

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
$^{129}Sn$ ( $3/2^+$ )	134(2)j 150(6)h 151(7)l	$\beta$ $\gamma$ $\gamma$	137(4)	645.1 913.2 1110.7	99(1)h 5.0(10)h 4.0(10)h	DS $\beta+\gamma$ DS	97(6)	gs=0 gs=0 gs=0
$^{129m}Sb$ ( $19/2^-$ )	1062(6)h	$\gamma$			433.8 657.8 759.8	43h 73h 100h		Relative Relative Relative
$^{129}Sb$ ( $7/2^+$ )	15800 (400)m				544.3 812.4 914.3 1029.7	17.9(10)m 43.0(23)m 20.0(12)m 12.6(9)m		
$^{129}Te$ ( $3/2^+$ )	4176(18)m				459.6	7.7(6)m		

a) GOK86.  
b) LUN80.  
c) REE85.  
d) Using relative intensities from DEG80 and the absolute branching of the 315.3 keV line from GOK86.  
e) Using relative intensities from DEG80 and the absolute branching of the 1865.0 keV line from GOK86.  
f) RUD92.  
g) HAG62.  
h) HUC82.  
i) LUN93.  
j) GRA74.  
k) BIR67.  
l) IZA72.  
m) BRO86.

Table 57: Mass 130, Version 1993-05-10

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
$^{130}Cd$	0.195(35)a	n						
$^{130m}In$ ( $10^-$ )	0.53(3)b	$\gamma$		391.0 2259.0	11.4(12)b 88(8)b	DS DS		gs=0 gs=0

Table 57: Mass 130 continued

Nuclide	Half-life, s			Gamma branching ratio, %				Comment
	Value	Method	Average	Energy keV	Value	Method	Average	
$^{130m}In$ ( $5^+$ )	0.53(3)b	$\gamma$	0.276(6)	1221.0	85(9)b	DS		$gs=0$
				2028.3	12.3(13)b	DS		$gs=0$
				2377.1	15.0(15)b	DS		$gs=0$
				3184.0	9.0(9)b	DS		$gs=0$
$^{130}In$ ( $1^-$ )	0.33(3)b 0.278(3)c 0.256(9)d	$\gamma$ $n$ $n$	0.276(6)	129.8	65(7)b	DS		$gs=0$
				952.0	17.0(17)b	DS		$gs=0$
				1905.0	80(8)b	DS		$gs=0$
				1945.8	6.6(7)b	DS		$gs=0$
$^{130m}Sn$ ( $7^-$ )	102(6)e	$\gamma$	2190(210)	144.9	43(4)e	DS		$gs=0$
				899.2	21.1(21)e	DS		$gs=0$
$^{130}Sn$ ( $0^+$ )	228(6)e	$\gamma$	2190(210)	192.5	74(7)e	DS		$gs=0$
				229.2	25(3)e	DS		$gs=0$
				779.8	62(6)e	DS		$gs=0$
				330.3	74(7)g 78(4)h	DS DS	77(3)	$gs=0$ $gs=0$
$^{130m}Sb$ ( $8^-$ )	2400(120)e 1980(120)f	$\gamma$ $m, \beta$	2190(210)	469.5	17.0(17)g 18.0(9)h	DS DS	17.8(8)	$gs=0$ $gs=0$
				731.2	18.0(18)g 22.0(11)h	DS DS	20.9(18)	$gs=0$ $gs=0$
				935.0	18.1(18)g 19.0(10)h	DS DS	18.8(9)	$gs=0$ $gs=0$
				793.0	81(10)g	DS		$gs=0$
$^{130}Sb$ ( $4^+$ )	396(24)e 462(24)f 391(4)i 360(6)i	$\gamma$ $m, \beta$ $\beta$ $\gamma$	383(10)	1017.5	26(3)g	DS		$gs=0$

a) KRA86.  
d) RUD91.  
g) ERT74.b) FOG81.  
e) KER74.  
h) KER72.c) REE85.  
f) HAG62.  
i) GRA74.

Table 58: Mass 131. Version 1993-05-10

Nuclide	Half-life, s			Gamma branching ratio, %				Comment
	Value	Method	Average	Energy keV	Value	Method	Average	
$^{131m}In$ ( $21/2^+$ )	0.32(6)a	$\gamma$	59.1(22)	173.3	29(3)a	DS		$gs=0$
				284.5	45(6)a	DS		$gs=0$
				2095.5	45(9)a	DS		$gs=0$
				4273.2	100(10)a	DS		$gs=0$
$^{131m}In$ ( $1/2^-$ )	0.35(5)a	$\gamma$		331.6	3.6(5)a	DS		$gs=96\%$
$^{131}In$ ( $9/2^+$ )	0.28(3)a	$\gamma$		2434.0	91(3)a	DS		$gs=0$
$^{131m}Sn$ ( $3/2^+$ )	39(2)b	$\gamma$		798.2	74b			*
$^{131}Sn$ ( $11/2^-$ )	50(2)b 61(1)c 63(3)d 65(6)e 55(4)f	$\gamma$ $\gamma$	1226.2 1229.0	450.4	31(4)c	DS		$gs=0$
				798.2	29(4)c	DS		$gs=0, *$
				1226.2	34(4)c	DS		$gs \approx 0$
				1229.0	10.4(12)c	DS		$gs \approx 0$
$^{131}Sb$ ( $7/2^+$ )	1382(2)g	$\beta$	108000(7000)g	642.3	22(4)g			
				933.1	25(3)g			
				943.4	44(4)g			
				773.7	38.1(14)g			In equilibrium with $gs$
$^{131m}Te$ ( $11/2^-$ )	108000(7000)g		793.7 852.2 1125.4	13.8(5)g				
				852.2	20.6(7)g			
				1125.4	11.4(4)g			
				149.7	68.9(9)g			
$^{131}Te$ ( $3/2^+$ )	1500(6)g		452.4	18.2(5)g				
				364.5	81.2(18)g			
$^{131}I$ ( $7/2^+$ )	694660(90)g							

\*) SCH77 and HUC81 get different half-lives for the gamma-peak at 798.2 keV. If this gamma-line should belong to the  $11/2$ -isomer, the  $3/2$ -isomer is doubtful.a) FOG84.  
b) SCH77.  
c) HUC81.  
d) IZA72.  
e) FOW74.  
f) GRA74.  
g) BRO86.

Table 59: Mass 132. Version 1993-05-10

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>132</sup> In (7 <sup>-</sup> )	0.186(22)a	$\gamma$	0.202(11)	299.2	50(6)a	DS	gs=0	
	0.12(2)b	$\beta$		374.7	63(7)a	DS		
	0.22(3)c	n		479.1	30(6)a	DS		
	0.204(6)d	n		4040.6	62(7)a	DS		
	0.221(11)e	n						
<sup>132</sup> Sn (0 <sup>+</sup> )	40(1)f	$\gamma$	39.6(5)	246.7	42(2)f	DS	gs=0	
	41.1(13)g	$\gamma$		44.5(22)i	DS			
	41.0(15)h	$\beta$		48(4)m	$\beta+\gamma$			
	39.0(10)i	$\gamma$		340.2	43(2)f	DS		
	40.6(8)j	X, $\gamma$		49.8(25)i	DS	46.4(23)		
	38.2(7)k	$\gamma$		49(3)m	$\beta+\gamma$			
				898.5	42(2)f	DS		
				44.0(22)i	DS			
				39(3)m	$\beta+\gamma$			
				992.2	38(2)f	DS		
<sup>132m</sup> Sb (4 <sup>+</sup> )	168(4)k	$\gamma$	168(3)	635.6	9.5(8)m	$\beta+\gamma$	9.7(6)	
	168(6)n	$\gamma$			9.9(10)n	DS		
				816.6	10.9(11)n	DS		
				989.6	16.8(13)m	$\beta+\gamma$		
					14.9(7)n	DS		
<sup>132</sup> Sb (8 <sup>-</sup> )	246(2)k	$\gamma$	247(2)	150.6	66(7)n	DS	gs=0	
	252(6)n	$\gamma$		496.5	13.0(13)n	DS		
				1041.5	18.0(18)n	DS		
				1166.9	10.0(10)n	DS		
<sup>132</sup> Te (0 <sup>+</sup> )	282000(3000)o			228.2	88.2(18)o			
<sup>132m</sup> I (8 <sup>-</sup> )	5000(110)o			599.8	13.2(21)o			
				667.7	13(4)o			
				772.6	13(4)o			

Table 59: Mass 132 continued

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>132</sup> I (4 <sup>+</sup> )	8222(7)o				522.6	16.1(6)o		
					630.2	13.8(6)o		
					667.7	98.7(2)o		
					772.6	76.2(18)o		
					954.6	18.1(6)o		

a) BJO86.  
d) REE85.  
g) IZA72.  
j) NUN72.  
m) LUN93.

b) KER73.  
e) RUD93.  
h) GRA74.  
k) BAI75.  
n) KER74.

c) LUN80.  
f) KER72b.  
i) NAE72.  
l) STO89.  
o) BRO86.

Table 60: Mass 133. Version 1993-05-10

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>133</sup> In								
<sup>133</sup> Sn (7/2 <sup>-</sup> )	1.20(5)a	n	1.37(13)	962.2	12(2)c	$\beta+\gamma$		
	1.47(4)b	$\beta$						
<sup>133</sup> Sb (7/2 <sup>+</sup> )	140(3)d	$\gamma$	4.7(3)	816.8	12(3)d	$N_D$	9.7(9)	
	160(20)e	m						
	138(12)f	$\gamma$						
	148.2(12)g	$\gamma$						
	162(6)h	$\gamma$						
<sup>133m</sup> Te (11/2 <sup>-</sup> )	3324(24)j	$\beta$			836.9	5.9(6)i	$\beta+\gamma$	
					1096.2	32(2)d	$N_D$	
					647.4	22(3)k		
					863.9	15.5(11)i	$\beta+\gamma$	15.3(10)
					912.6	56(8)d	$N_D$	
					914.7	10.0(15)d	$N_D$	
<sup>133</sup> Te (3/2 <sup>+</sup> )	747(17)l	$\gamma$			312.1	70(3)d	$N_D$	72.5(7)
					407.9	72.6(7)m	DS	gs=0
					1333.4	10.2(6)m	DS	gs=0

Table 60: Mass 133 continued

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
$^{133m}I$ ( $19/2^-$ )	9.0(20)n			647.0	99.6(20)n			
				913.0	99.8(20)n			
$^{133}I$ ( $7/2^+$ )	74900(400)n			529.9	86.0(20)n			
$^{133m}Xe$ ( $11/2^-$ )	190000(3000)n			233.2	10.3(3)n			
$^{133}Xe$	453200(500)n			81.0	37.0(10)n			

a) RUD93.

d) BRA84.

g) RUD70.

j) BER68.

k) Relative intensities from PAR68 and the sum of absolute intensities of 912.6 and 914.7 keV gamma-rays from BRA84.

l) PRU65.

b) BOR73.

e) STR66.

h) FOW74.

i) LUN93.

c) BLO83.

f) ERT73.

j) LUN93.

n) BRO86.

Table 61: Mass 134. Version 1993-05-10

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
$^{134}Sn$ ( $0^+$ )	1.20(10)a 1.050(11)b	$\gamma$ n	1.052(16)	317.8	3.0a	DS		gs=70%
				554.4	1.7a	DS		gs=70%
				872.2	6.0a	DS		gs=70%
				962.2	1.4a	DS		gs=70%
$^{134m}Sb$ ( $0^-$ )	0.75(7)a 0.744(4)c 0.85(10)d	$\gamma$ $\beta$ $\beta$	0.744(4)	1279.0	1.10(5)e			
				1352.1	0.93(5)e			
				2631.5	0.96(7)e			

Table 61: Mass 134 continued

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
$^{134}Sb$ ( $7^-$ )	10.07(5)b 10.3(5)d 11.3(3)f 10.3(4)g 10.2(3)h	n $\gamma$ n $\beta$	10.11(10)	115.2	49.0(25)d 48.4(22)i	DS $\beta+\gamma$	48.7(17)	gs=0
				297.0	97(5)d 96(4)i	DS $\beta+\gamma$	96(3)	gs=0
				706.3	57(3)d 58(3)i	DS $\beta+\gamma$	57.5(21)	gs=0
				1279.1	100(5)d 93(4)i	DS $\beta+\gamma$	96(3)	gs=0
$^{134}Te$ ( $0^+$ )	2510(50)j	$\gamma$		180.9	17.8(14)j 16.2(12)k	DS	16.9(9)	gs=0
				210.5	23.0(16)j 19.7(15)k	DS	21.2(16)	gs=0
				277.9	17.6(14)j 19.2(14)k	DS	18.4(10)	gs=0
				767.2	27(2)j	DS		gs=0
$^{134m}I$ ( $8^-$ )	210.0(12)l			271.5	79(3)l			
$^{134}I$ ( $4^+$ )	3150(6)m	$\beta$		847.0	95.4(10)m	DS		gs=0
				884.1	65.9(11)m	DS		gs=0
				1072.6	16.3(6)m	DS		gs=0
				1136.3	11.3(5)m	DS		gs=0

a) FOG90b.

d) KER72.

g) LUN80.

j) BER67.

k) Using relative intensities from MEY76 and the absolute branching of the 767.2 keV line from BER67.

l) BRO86.

b) RUD93.

e) FOG89.

h) GRA74.

i) LUN93.

c) RUD91.

f) TOM68.

i) LUN93.

m) TAK69.

Table 62: Mass 135. Version 1993-05-10

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
$^{135}Sb$ (7/2 <sup>+</sup> )	1.69(2)a	n	1.70(4)	1127.0	7.1(11)e	<i>N</i> <sub>D</sub>		
	1.60(15)b	n		1179.9	3.3(5)e	<i>N</i> <sub>D</sub>		
	1.662(10)c	n		1246.2	5.0(8)e	<i>N</i> <sub>D</sub>		
	1.819(16)d	n		1279.1	6.7(10)e	<i>N</i> <sub>D</sub>		
$^{135}Te$ (7/2 <sup>-</sup> )	17.51(4)d	n	17.7(2)	266.8	5.9(13)j	$\beta+\gamma$	8.5(22)	
	18.6(4)f	$\gamma$		10.3(11)k	DS			<i>gs</i> =50%
	18(2)g	m		603.4	27.7(22)j	$\beta+\gamma$	30(4)	
	19.2(2)h	$\beta$		37(4)k	DS			<i>gs</i> =50%
	19.6(2)h	$\gamma$		870.3	5.1(4)j	$\beta+\gamma$	5.6(10)	
	18(1)i	$\gamma$		7.7(8)k	DS			<i>gs</i> =50%
$^{135}I$ (7/2 <sup>+</sup> )	23580(110)l			1131.5	17(3)j	$\beta+\gamma$	22.2(12)	
				1260.4	22.5(7)l	$\beta+\gamma$	28.5(10)	
$^{135m}Xe$ (11/2 <sup>-</sup> )	939(6)l			526.6	81.2(10)l			
				249.8	90(3)l			

a) TOM68.

b) LUN80.

c) RUD93.

d) LUN76.

e) HOF89.

f) SAM85.

g) DEN69.

h) GRA74.

i) BOR73.

j) LUN93.

k) SAM85 with ground state beta transition assumed to be 50(10) %.

l) BRO86.

Table 63: Mass 136 continued

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
$^{136}Te$ (0 <sup>+</sup> )	17.66(9)a	n	17.7(4)	332.6	24d	<i>DS</i>		<i>gs</i> =0
	17.5(2)c	n		578.6	23d	<i>DS</i>		<i>gs</i> =0
	20.9(5)d	$\gamma$		630.7	13.2d	<i>DS</i>		<i>gs</i> =0
				2077.9	28d	<i>DS</i>		<i>gs</i> =0
$^{136m}I$ (6 <sup>-</sup> )	48(2)e	$\beta, \gamma$	45.4(9)	197.3	77(5)e	<i>DS</i>	72(4)	<i>gs</i> =0
	45(5)f	$\gamma$		74(4)g	<i>DS</i>			<i>gs</i> =0
	44.8(10)g	$\gamma$		60(6)h	$\beta+\gamma$			
				370.1	13(2)e	<i>DS</i>	15.1(11)	<i>gs</i> =0
$^{136}I$ (2 <sup>-</sup> )	16.4(9)g			16.4(9)g	<i>DS</i>			<i>gs</i> =0
	13.3(13)h			13.3(13)h	$\beta+\gamma$			<i>gs</i> =0
	381.4	100(5)e	<i>DS</i>	94(5)g	94(5)g	<i>DS</i>	94(5)	<i>gs</i> =0
		94(5)g	$\beta+\gamma$	1313.0	100(5)e	<i>DS</i>	97(3)	<i>gs</i> =0
	83(3)e	$\beta, \gamma$	84.5(17)	1313.0	68e	<i>DS</i>		<i>gs</i> =0
	85.1(20)g	$\gamma$		68g	<i>DS</i>			<i>gs</i> =0
				1321.1	21.9e	<i>DS</i>	25.0(17)	<i>gs</i> =0
				25.1(18)g	25.1(18)g	$\beta+\gamma$		<i>gs</i> =0
	24(5)h			24(5)h	24(5)h			
				2289.6	9.9e	<i>DS</i>		<i>gs</i> =0
					10.5(5)g	<i>DS</i>		<i>gs</i> =0

a) RUD93.

d) SCH77b.

g) WES77.

b) RUD77.

e) LUN71.

h) LUN93.

c) CRA78.

f) ERT75.

Table 63: Mass 136. Version 1993-05-10

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
$^{136}Sb$	0.923(14)a	n	0.922(14)					
	0.75(20)b	n						
	0.90(10)c	n						

Table 64: Mass 137. Version 1993-05-10

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
$^{137}Te$ (7/2 <sup>-</sup> )	2.1(5)a	n	2.50(5)	243.6	73(4)c	<i>DS</i>		<i>gs</i> =0
	2.59(12)b	n		359.5	13.7(14)c	<i>DS</i>		<i>gs</i> =0
	2.49(5)c	$\gamma$		469.6	15(3)c	<i>DS</i>		<i>gs</i> =0
				554.3	24.5(25)c	<i>DS</i>		<i>gs</i> =0

Table 64: Mass 137 continued

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>137</sup> I (7/2 <sup>+</sup> )	24.2(2)a	n	24.31(10)	600.5	4.8(5)h 4.2(3)i	DS $\beta+\gamma$	4.4(3)	gs=47%
	24.13(12)b	n		1218.6	12.8(13)h 13.5(9)i 11.9(10)j	DS $\beta+\gamma$ $n+\gamma$	12.8(6)	gs=47%
	24.7(2)d	n		1302.8	4.4(5)h 3.8(3)i	DS $\beta+\gamma$	4.0(3)	gs=47%
	24.3(8)e	n		2029.8	1.75(20)h	DS		gs=47%
	24.5(2)f	$\beta, n$						
	24.4(4)g	n						
<sup>137</sup> Xe (7/2 <sup>-</sup> )	241(3)f	$\beta$	230.0(21)	455.5	33.9(21)i 31(3)m	$\beta+\gamma$ DS	33.0(17)	gs=67%

a) ASG75.  
d) MAR71.  
g) PER59.  
j) HOF81.  
m) WES77b.

b) RUD93.  
e) SCH72.  
h) FOG80.  
k) SUG49.

c) SAM85.  
f) GRA74.  
i) LUN93.  
l) CAR69.

Table 65: Mass 138 continued

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>138</sup> Xe (0 <sup>+</sup> )	850(4)i	$\gamma$	848(3)	258.4	23.3(21)g 32.5(12)j	$\beta+\gamma$ $\beta+\gamma$	30(4)	
	845(5)j	$\gamma$		434.6	14.9(13)g 20.2(9)j	$\beta+\gamma$ $\beta+\gamma$	18.5(25)	
				1768.3	16.6(8)j	$\beta+\gamma$		
				2015.8	11.2(5)j	$\beta+\gamma$		
<sup>138m</sup> Cs (6 <sup>-</sup> )	174(6)k	$\gamma$		191.7	15.4(25)i			
				462.8	19(3)i			
				1435.9	19(3)i			
<sup>138</sup> Cs (3 <sup>-</sup> )	1932(6)i			191.7	0.53(11)k	DS		gs=0, -)
				462.8	27.6(15)k	DS		gs=0, -)
				547.0	9.9(10)k	DS		gs=0, -)
				1009.8	30.0(15)k	DS		gs=0, -)
				1435.9	76(4)k	DS		gs=0, -)
				2218.0	15.2(15)k	DS		gs=0, -)

\*) Uncertainty in intensity values assumed to be 5% above 30% branching ratio and 10% below.

a) ASG75. b) GRA74. c) SUG49.

d) KRA74. e) RUD93.

f) Using relative intensities from HOF79 and the absolute branching of the 588.8 keV line from HOF81.

g) LUN93. h) HOF81. i) CAR69.

j) MON72. k) CAR71. l) BRO86.

Table 65: Mass 138. Version 1993-05-10

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>138</sup> Te (0 <sup>+</sup> )	1.4(4)a	n						
<sup>138</sup> I (2 <sup>-</sup> )	6.5(2)a	n	6.27(6)	483.7	3.53(25)f 4.0(6)g	$\beta+\gamma$	3.60(23)	
	6.62(9)b	$\beta$						
	5.9(4)c	m						
	6.21(20)d	n						
	6.23(3)e	n						
				588.8	54(4)g 56(4)h	$\beta+\gamma$ $n+\gamma$	55(3)	
				875.2	8.9(10)f			
				1277.5	2.37(21)f 1.8(7)g	$\beta+\gamma$	2.32(20)	

Table 66: Mass 139. Version 1993-05-10

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>139</sup> I	2.47(15)a 2.7(1)b 2.27(27)c 2.4(2)d 2.29(2)e 2.280(11)f	n m n n n n	2.287(19)	527.7 536.6 571.2	7.6(7)g 5.1(5)g 7.4(7)h	n+γ		
<sup>139</sup> Xe (3/2 <sup>-</sup> )	40.8(7)a 39.68(14)i 39.3(7)j 41.2(2)k	β γ β γ	39.71(14)	175.0 218.6 289.8 296.5 393.5	18.5(11)l 52(3)l 64(4)m 82(6)n 8.5(5)l 11.0(5)m 12.6(9)n 20.2(11)l 25.0(9)m 31.8(23)n 6.2(3)l 9.1(6)m 10.6(8)n	DS DS DS DS DS DS DS DS DS	60(7) 10.1(11) 23.8(23) 7.2(11)	gs=21% gs=15% gs=21% gs=15% gs=21% gs=15%
<sup>139</sup> Cs (7/2 <sup>+</sup> )	556(3)i	γ		1283.2 1420.8	7.7(4)l 7.5(5)m 0.85(5)l 0.70(9)m	DS DS DS DS	7.6(3) 0.81(6)	gs=83% gs=83%
<sup>139</sup> Ba (7/2 <sup>-</sup> )	5076(25)o			165.9	22.0(10)o			

a) GRA74.

d) ASG75.

g) Using relative intensities from ROB85 and the absolute branching of the 571.2 keV line from HOF81.

h) HOF81.

k) ARC86.

n) FAL88.

b) SUG49.

e) ALE80.

i) CAR69.

l) LEE80.

o) BRO86.

c) KRA74.

f) RUD93.

j) ALV68.

m) LUN93.

Table 67: Mass 140. Version 1993-05-10

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>140</sup> I	0.59(1)a 0.89(12)b 0.86(4)c	n m	0.61(5)	372.4	≈ 60d 17(15)e			
<sup>140</sup> Xe (0 <sup>+</sup> )	14.3(13)f 15.4(3)g 13.60(10)h 13.7(2)i	γ β γ γ	13.8(3)	557.3 662.0 805.5 1315.1 1413.7	5.6(3)e 5.0(5)j 21.5(8)e 20(2)j 7.9(4)e 8.2(8)j	β+γ ND β+γ ND β+γ ND	5.4(3) 21.3(7) 8.0(4)	
<sup>140</sup> Cs (1 <sup>-</sup> )	65.7(16)f 65.5(7)g 63.7(3)h 63.8(12)i	β β γ γ	64.0(4)	528.2 602.3 908.5 1200.7	3.0(6)e 45.6(17)e 51(3)k 4.16(24)k	β+γ DS β+γ DS β+γ DS	2.96(16) 45.6(17) 7.6(4) 4.16(24)k	gs=40%
<sup>140</sup> Ba (0 <sup>+</sup> )	1101300(900)d			537.3	24.4(2)d			
<sup>140</sup> La (3 <sup>-</sup> )	145000(30)d			328.8 487.0 815.8 1596.5	20.7(4)d 45.9(9)d 23.6(5)d 95.4(1)d			

a) LUN76.

d) BRO86.

g) GRA74.

j) OTE81.

b) KRA74.

e) LUN93.

h) CAR69.

k) SCH73b.

c) HER70.

f) ALV68.

i) ARC66.

Table 68: Mass 141. Version 1993-05-10

Nuclide	Half-life, s			Gamma branching ratio, %				Comment
	Value	Method	Average	Energy keV	Value	Method	Average	
<sup>141</sup> I	0.48(3)a	n	0.47(3)	191.3	30.0c			Relative
	0.45(10)b	$\gamma$		303.3	60.0c			Relative
	0.43(8)b	m		387.3	40.0c			Relative
				578.8	100.0c			Relative
<sup>141</sup> Xe (5/2 <sup>-</sup> )	1.73(1)d	n		118.7	20.2(15)i	$\beta+\gamma$	20.2(13)	
	1.8(2)e	$\beta$		20(3)j	DS			$gs=10\%, \alpha$
	1.7(2)f	$\beta$		459.3	5.9(12)i	$\beta+\gamma$	6.5(7)	$gs=10\%, \alpha$
	1.720	$\gamma$		6.9(9)j	DS			
	(13)g			540.1	6.6(9)j	DS		$gs=10\%, \alpha$
	1.6(1)h	m		909.4	28(3)i	$\beta+\gamma$	29.0(21)	$gs=10\%, \alpha$
				30(3)j	DS			
<sup>141</sup> Cs (7/2 <sup>+</sup> )	22.2(4)a	n	24.5(3)	555.1	3.7(3)n	DS		$gs=0$
	25.6(3)f	$\beta$		561.5	4.7(4)n	DS		$gs=0$
	24.7(4)g	$\gamma$		588.6	4.4(4)i	$\beta+\gamma$	4.0(3)	$gs=0$
	24.8(8)k	n		3.79(24)n	DS			
	24.9(2)l	n		1147.0	2.77(20)i	$\beta+\gamma$	2.78(19)	$gs=0$
	24.3(1)m	n		2.9(7)n	DS			
				1194.0	4.4(4)i	$\beta+\gamma$	4.07(21)	$gs=0$
<sup>141</sup> Ba (3/2 <sup>-</sup> )	1096(1)c			3.95(24)n	DS			
				190.3	46(4)c			
				276.9	23.3(19)c			
				304.2	25.2(21)c			
<sup>141</sup> La (7/2 <sup>+</sup> )	343.7			343.7	14.2(12)c			
	14100(100)o	$\gamma$		1354.5	1.643(21)o	$\beta+\gamma$		
	2808000(900)c			145.4	48.4(4)c			

a) The ground-state  $\beta$ -transition is assumed to be 10(10)%  
(FAL88 indicates an upper limit of 20%), and  $\alpha_{tot}$  is taken to be  
7.55 for the 69.05 keV gamma-line (= theoretical value for  $\alpha_k$ ).

- a) LUN76. b) HER70. c) BRO86.
- d) ASG75b. e) ALV68. f) GRA74.
- g) CAR69. h) COR67. i) LUN93.
- j) FAL88. k) LUN80. l) ASG75.
- m) RUD93. n) YAM82. o) GEH81.

Table 69: Mass 142. Version 1993-05-10

Nuclide	Half-life, s			Gamma branching ratio, %				Comment
	Value	Method	Average	Energy keV	Value	Method	Average	
<sup>142</sup> Xe (0 <sup>+</sup> )	1.24(2)a	$\gamma$	1.216(21)	538.1	27.8e			
	1.18(4)b	m		571.7	37.0e			
	1.15(4)c	m		617.8	28.2e			
	1.29(14)d	$\gamma$		656.8	30.5e			
<sup>142</sup> Cs	1.68(2)a	$\beta, \gamma$	1.74(3)	359.5	25(3)k	$\beta+\gamma$	26.5(21)	
	2.04(4)f	$\beta$		28(3)l	$N_D$			
	1.68(2)g	n		966.9	11(3)k	$\beta+\gamma$	9.5(8)	
	1.70(2)h	n		9.3(9)l	$N_D$			
	1.75(6)h	n		9.7(22)m				
	1.78(1)i	n		1175.9	4.3(14)l	$N_D$	3.5(7)	
	1.684(14)j	n		3.2(8)m				
<sup>142</sup> Ba (0 <sup>+</sup> )	642(6)a	$\gamma$	632(9)	231.6	11.2(19)i	$N_D$	12.4(4)	
	618(6)f	$\beta$		12.5(4)o	$DS$			$gs=0$
	648(12)n	$\beta$		255.3	20.7(21)l	$N_D$	21.1(5)	
				21.1(5)o	$DS$			$gs=0$
<sup>142</sup> La (2 <sup>-</sup> )	895.2	$\gamma$		12.6(9)l	$N_D$	13.9(7)		$gs=0$
				14.3(5)o	$DS$			
	1078.7	$\gamma$		11.4(10)l	$N_D$	11.7(4)		
				11.8(4)o	$DS$			$gs=0$

- a) CAR69. b) COR67. c) PAT65.
- d) KRA71. e) BLA86. f) GRA74.
- g) ASG67b. h) REE80. i) LUN80.
- j) RUD93. k) LUN93. l) SOH84.
- m) Using relative intensities from LAR71 and the average absolute branching of the 359.5 keV gamma-line given above.
- n) EHR72. o) CHU83. p) GEH81.
- q) BRO86.

Table 70: Mass 143. Version 1993-05-10

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
$^{143m}Xe$	0.96(2)a 0.99(14)b	m $\gamma$	0.961(20)	139.5 194.2	(b) (b)			
$^{143}Xe$	0.30(3)c 0.4(1)d	$\beta$ $\gamma$	0.30(3)	90	(d)			
$^{143}Cs$ (3/2 <sup>+</sup> )	1.69(13)e 1.76(3)f 1.79(4)g 1.78(1)h 1.83(4)i 1.809(9)j 1.60(14)k	n n n n n n $\beta$	1.794(8)	195.0	14.3(8)l 12.6(19)m 16.5(11)n	$\beta+\gamma$ $N_D$ n+ $\gamma$	14.8(9)	
				232.3	10.8(7)l 10.0(9)m 8.6(13)o	$\beta+\gamma$ $N_D$	10.2(5)	
				306.4	7.8(6)l 6.9(12)m 7.0(11)o	$\beta+\gamma$ $N_D$	7.5(5)	
				466.6	9.2(9)l 4.8(7)o	$\beta+\gamma$	6.5(21)	
$^{143}Ba$ (5/2 <sup>-</sup> )	13.6(2)p 13.2(3)q	$\beta$ m	13.48(18)	211.5 291.2 798.8 980.4	25(3)m 8.2(10)r 15.1(15)m 10.7(13)r			
$^{143}La$ (3/2 <sup>+</sup> )	854(8)s 848(10)t	$\gamma$ $\gamma$	852(6)	620.5 621.4 643.8 1556.4	1.0(4)u 0.48(19)u 0.7(3)u 0.42(17)u			
$^{143}Ce$ (3/2 <sup>-</sup> )	118800(700)u			293.3	42(4)u			
$^{143}Pr$	1173000(3000)u							

a) PAT65.  
b) KRA71.  
c) AMI72.  
d) FAL88.  
e) AMA69.  
f) RIS79.  
g) REE80.  
h) LUN80.  
i) ENG81.  
j) RUD93.  
k) AMA67  
l) LUN93.  
m) SOH84.  
n) HOF81b.

o) Using relative intensities from ROB89 and the absolute branching of the 195.0 keV line from SOH84.  
p) GRA74.  
q) RUN69.  
r) Using relative intensities from RAP85 and the absolute branching of the 211.5 keV line from SOH84.  
s) BJO77.  
t) YAM81  
u) BRO86.

Table 71: Mass 144. Version 1993-05-10

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
$^{144}Xe$ (0 <sup>+</sup> )	1.15(20)a	m						
$^{144}Cs$ (1)	1.05(14)b 1.00(10)c 1.00(4)d 1.00(2)e 1.12(8)f 0.982(5)g 1.02(4)h	n n n n n n $\beta, \gamma$	0.987(5)	199.3 559.8 639.2 758.9	46(4)i 47(3)j 9.3(9)k	$\beta+\gamma$ $n+\gamma$ $\beta+\gamma$	46.6(24) 9.2(8) 9.3(9)	
$^{144}Ba$ (0 <sup>+</sup> )	12.3(4)h 10.7(2)l 11.9(3)m 11.5(2)n	$\beta, \gamma$ $\beta$ m $\gamma$	11.3(3)	103.9 156.6 172.8 430.5	25.7(11)n 27(3)o 17.6(18)o 23.0(23)o	DS DS DS DS	25.9(10) 16.9(7) gs=0 20.6(10)	gs=0
$^{144}La$	39.9(5)l 39.8(6)p 41(3)q	$\beta$ $\gamma$ $\beta$	40.4(3)	397.3 541.1 584.9 844.8	90(9)r 38(4)r 10.4(10)r 23.6(24)r	DS DS DS DS		gs=0, -) gs=0, -) gs=0, -) gs=0, -)
$^{144}Ce$ (0 <sup>+</sup> )	24615000 (17000)s			133.5	11.1(4)s			

\* Error of gamma-lines not given in the publication. A conservative estimate of 10 % is assumed here.

a) AHR76.  
b) AMA69.  
c) RIS79.  
d) REE80.  
e) LUN80.  
f) ENG81.  
g) RUD93.  
h) WOH78.  
i) LUN93.  
j) HOF81b.

k) Using relative intensities from MON77b and the average value of the branching of the 199.3 keV gamma-line given above.

l) GRA74.  
m) RUN69.  
n) CHU82.  
o) SOH84.  
p) WIL70.  
q) AMA67.  
r) MON77b.  
s) BRO86.

Table 72: Mass 145. Version 1993-05-10

Nuclide	Half-lives			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>145</sup> Cs (3/2 <sup>+</sup> )	0.61(2)a	n	0.586(5)	112.6	8.9(9)h	DS	9.1(15)	gs=3%
	0.616(20)b	n		19(6)i	19(6)i	β+γ		
	0.590(20)c	β, γ		175.5	20.4(20)h	DS	20.6(19)	gs=3%
	0.65(4)d	n		22(6)i	22(6)i	β+γ		
	0.58(1)e	n						
	0.579(6)f	n		199.0	13.8(14)h	DS		
	0.61(3)g	n		30(7)i	30(7)i	β+γ	14(3)	gs=3%
<sup>145</sup> Ba (5/2 <sup>-</sup> )	0.594(13)h	γ		435.7	8.9(9)h	DS		
	4.31(16)c	β, γ	4.39(17)	96.9	20.2(15)m			
	4.5(5)j	γ		378.8	6.5(8)m			
	4.2(5)k	β		417.5	5.9(7)m			
<sup>145</sup> La	5.6(6)l	γ		544.1	5.1(7)m			
	24(3)i	γ		28.5(10)	70.0	10.4(20)m		
	32(4)k	β			118.2	3.5(7)m		
	29.2(8)l	γ			169.8	3.1(6)m		
	20(5)n	γ			355.8	3.7(7)m		
<sup>145</sup> Ce	25(3)o	γ						
	230(30)k	β		182(4)	284.0	8.9(14)m		
	181(4)p	γ			439.6	6.5(10)m		
	186(12)q	β			723.6	59(7)m		
<sup>145</sup> Pr (7/2 <sup>+</sup> )					1147.6	9.4(15)m		
	21530(70)m				748.3	0.43(7)m		

- a) ROE74.  
d) REE80.  
g) ENG81.  
j) PFE78.  
m) BRO86.  
p) YAM80.
- b) RIS79.  
e) LUN80.  
h) RAP82.  
k) GRA74.  
n) ARO74.  
q) VIL60.
- c) WOH78.  
f) RUD93.  
i) LUN93.  
l) WIL70.  
o) SKA77.

Table 73: Mass 146. Version 1993-05-11

Nuclide	Half-lives			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>146</sup> Cs (2 <sup>-</sup> )	0.35(4)a	n	0.3221(13)	181.0	57(3)h			
	0.325(10)b	n		332.4	6.4(3)h			
	0.322(1)c	n		557.8	9.2(5)h			
	0.38(5)d	n		0.343(7)f	n			
	0.321(2)e	n		0.305(10)g	β, γ		739.0	3.02(16)h
<sup>146</sup> Ba (0 <sup>+</sup> )	2.18(11)g	β, γ	2.21(6)	121.2	14.2(14)i	N <sub>D</sub>	14.2(4)	
	2.22(7)i	γ		140.7	23(3)i	N <sub>D</sub>	20.3(6)	gs=0
				197.0	20.2(6)j	D <sub>S</sub>		
				12.7(13)i	12.6(5)j	N <sub>D</sub>	12.6(5)	gs=0
				251.2	18.0(20)i	N <sub>D</sub>	19.4(7)	
				19.6(7)j	D <sub>S</sub>			
<sup>146m</sup> La (6)	10.0(1)k			258.5	93(19)k			
				409.9	81(16)k			
				503.1	26(5)k			
				514.6	31(6)k			
				702.3	10.5(11)k			
				958.5	13(3)k			
<sup>146</sup> La (2 <sup>-</sup> )	6.27(10)k			258.5	64(3)i	N <sub>D</sub>		
				409.9	3.9(4)i	N <sub>D</sub>		
				666.1	5.7(6)i	N <sub>D</sub>		
				702.3	6.4(6)i	N <sub>D</sub>		
				924.6	7.7(8)i	N <sub>D</sub>		
<sup>146</sup> Ce (0 <sup>+</sup> )	811(8)l	γ		133.5	8.8(5)i	N <sub>D</sub>		
				218.2	22.4(8)i	N <sub>D</sub>		
				264.6	8.8(8)i	N <sub>D</sub>		
				316.7	56(3)i	N <sub>D</sub>		

Table 73: Mass 146 continued

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>146</sup> Pt (2 <sup>+</sup> )	1449(11)k			453.9	48(15)k			
				735.7	7.4(23)k			
				1524.7	16(5)k			

a) ROE74.	b) RIS79.	c) REE80.
d) ENG81	e) RUD93	f) LUN76.
g) WOH78.	h) SCO80.	i) SOH84.
j) CHU85.	k) BRO86.	l) YAM80.

Table 74: Mass 147. Version 1993-05-11

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
$^{147}\text{Cs}$ (3/2 <sup>+</sup> )	0.214(30)a	n	0.2293(14)	85.2	13.7f	DS		gs=37% *)
	0.229(1)b	n		109.7	5.9f	DS		gs=37% *)
	0.235(3)c	n		245.8	2.5f	DS		gs=37% *)
	0.218(8)d	$\beta, \gamma$		596.0	2.3f	DS		gs=37% *)
	0.212(10)e	$\beta$						gs=37% *)
$^{147}\text{Ba}$ (3/2 <sup>-</sup> )	0.894(10)c	n	0.889(10)	105.2	6.2k			
	0.70(6)d	$\beta, \gamma$		167.4	14.0f	DS		gs=41% *)
	0.93(5)e	$\beta, \gamma$		196.1	6.7f	DS		gs=41% *)
	0.70(4)g	n		249.3	6.6f	DS		gs=41% *)
	0.70(5)h	n						
	0.91(4)i	n						
	0.892(1)j	n						
$^{147}\text{La}$ (5/2 <sup>+</sup> )	4.10(2)c	n	4.09(5)	117.6	12.7(12)f	ND		**)
	4.48(8)e	$\beta, \gamma$		186.9	8.6(5)f	ND		**)
	4.10(25)g	n		438.4	5.5(5)f	ND		**)
	4.4(4)h	n						
	4.48(8)i	n						
	4.02(1)j	n						

Table 74: Mass 147 continued

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>147</sup> Ce (7/2)	56.4(12)m	$\gamma$	55.7(20)	218.3	2.7(6)l	<i>N</i> <sub>D</sub>	..)	..)
	58(3)n	$\gamma$		268.7	6.3(10)l	<i>N</i> <sub>D</sub>		
	47(3)o	$\beta$		374.1	3.3(4)l	<i>N</i> <sub>D</sub>		
	65(6)p	$\beta$		467.1	2.5(3)l	<i>N</i> <sub>D</sub>		
<sup>147</sup> Pr (5/2 <sup>+</sup> )	804(18)q	.		127.9	8.8(11)q	..)	..)	..)
				314.6	24(3)q			
				577.9	16.3(25)q			
				641.3	19(3)q			
<sup>147</sup> Nd (5/2 <sup>-</sup> )	948700(900)q	.		91.1	28.0(18)q	..)	..)	..)
				531.0	13.1(11)q			

•) No intensity errors are given in SCH81.

--> These values depend on the reference line 314.6 keV in the decay of  $^{147}\text{Pr}$ . SOH84 uses here a branching ratio of 12.6% (PIN75) whereas BRO86 gives 24(3) %. Moreover, the decay data given in YAM81 indicate a branching ratio of 31 % for this gamma-ray. It may also be noted that a branching ratio of the 117.6 keV gamma line in  $^{147}\text{La}$  of 37% can be deduced from the level scheme given in ROB89 to be compared to 12.7% in SOH84.

- - -) PIN75 gives branching ratios roughly half of those in BRO86

a) RIS79. b) REE85. c) RUD93  
d) WOU73. e) SHM81. f) SCH93

d) WOH78. e) SHM81. f) SCH81.  
g) ENG81 h) CAR82 i) BEE82

g) ENG81. h) GAB82. i) REE83.  
j) REE86.

k) Using relative intensities from BLA86 and the absolute bra-

by using relative intensities from BEA86 and the absolute branching of the 167.4 keV line from SCH81.

l) SOH84. m) ARO74b n) ARO74  
→ GP-171 → PDE-17 → PDE-17

o) GRA74. p) BIR67. q) BRO86

Table 75: Mass 148. Version 1993-05-11

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>148</sup> Cs	0.146(3)a 0.140(12)b	n n	0.146(3)					
<sup>148</sup> Ba (0 <sup>+</sup> )	0.653(2)a 0.55(5)b 0.47(3)c 0.63(5)d 0.607(2)e 0.61(3)f	n n n n n γ	0.629(11)	133.5 215.0 415.9 444.3	3.88(12)f 2.34(11)f 3.59(13)f 2.54(11)f	DS DS DS DS		gs=0 gs=0 gs=0 gs=0
<sup>148</sup> La (2 <sup>-</sup> )	1.38(2)a 1.428(12)b 1.55(3)d 1.42(7)e 1.05(1)g	n n n n γ	1.25(10)	158.5 601.9 760.3 989.9	56(2)g 7.7(2)g 8.6(4)g 9.4(3)g	DS DS DS DS		gs=0, +) gs=0, +) gs=0, +) gs=0, +)
<sup>148</sup> Ce (0 <sup>+</sup> )	45(5)h 48.1(11)i 56(1)j	γ γ γ	53(3)	99.0 121.2 269.5 291.7	12.4(8)j 13.2(9)j 17.0(12)j 16.7(10)j	DS DS DS DS		gs=4% gs=4% gs=4% gs=4%
<sup>148m</sup> Pr (4 <sup>-</sup> )	121(5)k 120(6)l	γ γ	121(4)	301.7 450.8 697.5	95(8)i 50(4)i 40(3)i	DS DS DS		gs=0 gs=0 gs=0
<sup>148</sup> Pr (1 <sup>-</sup> )	135(5)k 136.2(24)l	γ γ	136.0(22)	301.7 697.5 721.2 1022.8	61(3)i 4.09(18)i 4.3(3)i 4.8(4)i	DS DS DS DS		gs=30% gs=30% gs=30% gs=30% gs=30% gs=30% gs=30%)

a) Uncertainty of the conversion coefficient of the 158.5 keV gamma-ray not included in the error.

\*\*) Error for the ground-state beta branch not included.

- |           |           |            |
|-----------|-----------|------------|
| a) REE86. | b) RUD93. | c) ENG81.  |
| d) GAB82. | e) REE83. | f) CHU84.  |
| g) GIL83. | h) ARO74. | i) ARO74b. |
| j) ARA83. | k) WAL86. | l) IKE79.  |

Table 76: Mass 149. Version 1993-05-11

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
<sup>149</sup> Ba	0.356(8)a 0.324(18)b	n n	0.351(12)					
<sup>149</sup> La	1.07(3)b 1.04(4)c	n n	1.059(24)					
<sup>149</sup> Ce	5.0(5)d 5.4(3)e	γ β	5.3(3)	86.4 380.0 864.5 892.7	20.2(20)d 34(3)d 7.8(8)d 8.0(8)d			Relative Relative Relative Relative
<sup>149</sup> Pr (5/2 <sup>+</sup> )	138(12)f 174(6)g 135(5)h	γ γ γ	150(13)	138.5 165.1 258.3 333.0	11.0(17)h 9.9(15)h 5.7(9)h 6.2(9)h	DS DS DS DS		gs=18% gs=18% gs=18% gs=18%
<sup>149</sup> Nd (5/2 <sup>-</sup> )	6230(40)i				114.3 211.3 270.2 326.5	18.8(19)i 27.3(18)i 10.7(11)i 4.7(4)i		
<sup>149</sup> Pm (7/2 <sup>+</sup> )	191090(180)i				286.0	2.85(17)i		

a) REE86.  
d) PFE77.  
g) OHY72.

b) RUD93.  
e) RUD91.  
h) PIN77.

c) REE85.  
f) KLI67b.  
i) BRO86.

Table 77: Mass 150. Version 1993-05-11

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
$^{150}\text{Ba}$	0.28(2)a	$\gamma$						
$^{150}\text{La}$	0.84(5)a 0.86(5)b	$\gamma$ $n$	0.85(4)					
$^{150}\text{Ce} (0^+)$	4.0(6)c 4.8(6)d	$\gamma$ $\gamma$	4.4(4)	109.9 721.9 851.9 1140.5	100(20)e 20(4)e 21(4)e 22(4)e			Relative Relative Relative Relative
$^{150}\text{Pr} (1^-)$	6.2(2)c 8.6(8)d 6.1(5)f	$\gamma$ $\gamma$ $\gamma$	6.3(4)	130.2 720.5 722.8 852.9 1141.3	30f 4.3f 6.5f 5.7f 5.0f	DS DS DS DS DS		gs=30% gs=30% gs=30% gs=30% gs=30%
					3.5g 5.9g 5.4g			

a) HEL91.  
d) PFE77.  
g) KAR88.

b) RUD93.  
e) BRO86.

c) ARO74c.  
f) FOG86.

Table 78: Mass 151 continued

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
$^{151}\text{Nd} (3/2^+)$	746(4)a				116.7 255.6 736.8 1180.6	47(6)a 16.8(22)a 7.2(11)a 15.0(20)a		
$^{151}\text{Pr}_m (5/2^+)$	102240(150)a				167.7 340.1 445.6 717.7	7.8(12)a 22(3)a 4.0(6)a 4.0(6)a		

a) BRO86 gives a different half-life: 4.0(7).

a) BRO86.

b) AND90.

c) BLA86

Table 79: Mass 152. Version 1993-05-11

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
$^{152}\text{Ce} (0^+)$	1.4(2)a 0.8(3)b	$\gamma$ $\gamma$	1.2(3)		97.8 114.8	42a 100a		Relative Relative
$^{152}\text{Pr} (3)$	3.24(19)c 3.7(2)d	$\gamma$ $\beta,\gamma$	3.46(23)		164.2 284.9 1363.8 1469.8	100e 81e 37e 78e		Relative Relative Relative Relative
$^{152}\text{Nd} (0^+)$	684(12)f				250.1 278.5 294.6	21.8f 32.0f 3.8f		
$^{152m2}\text{Pr}_m$	900(60)f				137.4 200.3			

Table 78: Mass 151. Version 1993-05-11

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
$^{151}\text{Ce}$	1.02(6)a							
$^{151}\text{Pr}$	18.90(7)b •)	$\beta,\gamma$		189.1 484.6 495.4 880.3	170c 162c 161c 187c			Relative Relative Relative Relative

Table 79: Mass 152 continued

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
$^{152m}Pm$ ( $4^-$ )	451(5)f			121.8	45(4)f			
				244.7	78(7)f			
				340.4	31(3)f			
				1097.1	29(3)f			
				1437.5	22.7(20)f			
$^{152}Pm$ ( $1^+$ )	246(6)f			121.8	15.7(22)f			
				244.7	0.51(9)f			
				841.4	2.2(3)f			
				961.1	1.9(3)f			

a) TAG90.  
d) AND90.

b) AYS91.  
e) KAR88.

c) HIL83.  
f) BRO86.

Table 81: Mass 154. Version 1993-05-11

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
$^{154}Pr$	2.3(1)a	$\chi, \gamma$			70.8	73.8a		Relative
					162.4	100.0a		Relative
					932.1	76.9a		Relative
					956.9	44.7a		Relative
$^{154}Nd$ ( $0^+$ )	25.9(2)b 26(2)c	$\beta, \gamma$	25.9(2)		130.2	61c		Relative
					151.9	100c		Relative
		$\gamma$			180.9	68c		Relative
					799.8	81c		Relative
$^{154m}Pm$ ( $3,4$ )	162(6)d				184.9	39(5)d		
					547.0	13.3(18)d		
					839.8	2.7(5)d		
					1358.6	11.4(15)d		
					1440.5 +1440.7	25(5)d		
$^{154}Pm$ ( $0,1$ )	102(12)d				184.9	4.8(12)d		
					839.8	12.9(21)d		
					1358.6	0.25(7)d		
					1394.0	13(7)d		
					1440.7	0.22(7)d		
					2059.0	19(4)d		
					2141.2	11.0(18)d		

a) KAW88.  
d) BRO86.

b) AND90.

c) KAR85.

Table 80: Mass 153. Version 1993-05-11

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
$^{153}Pr$	4.28(11)a	$\beta, \gamma$						
$^{153}Nd$	28.9(4)a	$\beta, \gamma$						
$^{153}Pm$ ( $5/2^-$ )	315(1)a	$\beta, \gamma$		119.8	6.0b			
				127.3	14.0b			
				175.4	2.0b			
				182.9	2.7b			
$^{153}Sm$ ( $3/2^+$ )	168200(300)c	$\beta$		103.2	28.3(6)d			

a) AND90.  
d) BRO86.

b) BLA86.

c) BAB70.

Table 82: Mass 155. Version 1993-05-11

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
$^{155}\text{Nd}$	9.5(7)a 8.9(2)b	$\text{X},\gamma$ $\beta,\gamma$	8.9(2)	180.7	100a			Relative
				418.9	82a			Relative
				955.1	48a			Relative
$^{155}\text{Pm}$ ( $5/2^+$ )	41.5(2)b 48(4)c	$\beta,\gamma$ $\gamma$	41.5(3)	409.8	2.0d			
				725.4	5.0d			
				762.0	1.4d			
				778.6	7.3d			
$^{155}\text{Sm}$ ( $3/2^-$ )	1326(12)e			104.3	75(4)e			
				141.4	2.03(8)e			
				245.7	3.80(20)e			

a) OKA86.  
d) BLA86.b) AND90.  
e) BRO86.

c) BAK82.

Table 83: Mass 156. Version 1993-05-11

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
$^{156}\text{Nd}$ (0+)	5.47(11)a	$\beta,\gamma$						
$^{156}\text{Pm}$ (-)	26.70(10)a 28.2(11)b 29(2)c 26.7(1)d	$\beta,\gamma$ $\gamma$ $X,\gamma$ $X,\gamma$	26.71(7)	117.4	13.8(7)e	DS		$gs=0$
				173.8	52.0(20)e	DS		$gs=0$
				267.3	13.3(7)e	DS		$gs=0$
				1147.8	20.5(1)e	DS		$gs=0$
$^{156}\text{Sm}$ (0+)	33800(1000)f			87.6	23.8g			
				165.8	14.7g			
				203.8	23.0g			

Table 83: Mass 156 continued

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
$^{156}\text{Eu}$ (0+)	1310600 (2100)h				646.3	7.0(5)f		
					811.8	10.2(5)f		
					1230.7	8.8(5)f		
					1242.5	6.6(5)f		

a) AND90.  
d) GRE87.  
g) BLA86.b) MAC86.  
c) HEL90.  
h) BAB70.c) OKA86b.  
f) BRO86.

Table 84: Mass 157. Version 1993-05-11

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
$^{157}\text{Pm}$	10.50(12)a	$\beta,\gamma$						
$^{157}\text{Sm}$	483(2)a 480(60)b 480(30)c 402(24)d 487(8)e	$\beta,\gamma$ $\gamma$ $\gamma$ $X,\gamma$	483(4)	196.4	32f			Relative
				197.8	100f			Relative
				394.2	24.0f			Relative
				844.0	9.3f			Relative
$^{157}\text{Eu}$ ( $5/2^+$ )	54540(140)f	$\gamma$ $X,\gamma$		318.7	13(3)f			
				370.5	48(10)f			
				410.7	76(15)f			
				619.3	16(3)f			

a) AND90.  
d) MAC86.b) DAU73.  
e) BAK80.c) KAF73.  
f) BRO86.

Table 85: Mass 158. Version 1993-05-11

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
$^{158}Pm$	4.8(5)a	$\beta, \gamma$						
$^{158}Sm$ (0+)	318(2)a 312(12)b 331(5)c	$\beta, \gamma$ $\gamma$ $\gamma$	320(3)	189.4 224.1 324.5 361.7 363.6	15.1(20)c 8.5(10)c 10.6(12)c 6.6(9)c 12.4(16)c	$N_D$ $N_D$ $N_D$ $N_D$ $N_D$		
$^{158}Eu$ (1-)	2754(12)d	$\beta$		897.7 944.1 977.1	10.4(5)e 25.0(5)e 13.5(7)e			

a) AND90.  
d) MÜN65.b) MAC86.  
e) BRO86.

c) BAK80.

Table 87: Mass 160. Version 1993-05-11

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
$^{160}Sm$	8.7(14)a 9.6(3)b	$\gamma$ $\beta, \gamma$		9.6(3)	109.7			
$^{160}Eu$ (0-)	31(4)a 41(4)c 50(10)d 53(10)e	$\gamma$ $\gamma$ $\gamma$ $\beta, \gamma$	38(4)	172.6 411.1 513.6 821.6	100f 56f 60f 49f			Relative Relative Relative Relative

a) MAC86.  
d) DAU73.b) AND90.  
e) MOR73.c) BAK82.  
f) BRO86.

Table 86: Mass 159. Version 1993-05-11

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
$^{159}Sm$ (5/2-)	15(2)a 11.37(15)b	$\gamma$ $\beta, \gamma$	11.4(3)	189.8 254.4 797.2 862.0	100c 21.2c 13.2c 39.6c			Relative Relative Relative Relative
$^{159}Eu$ (5/2+)	1084(5)d	$\beta$		95.7 102.5 121.9 596.0	4.26e 3.96e 2.38e 1.98e			
$^{159}Gd$ (3/2-)	66800(300)f			363.5	11(3)f			

a) MAC86.  
d) MÜN65.b) AND90.  
e) BLA86.c) WIL87.  
f) BRO86.

Table 88: Mass 161. Version 1993-05-11

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
$^{161}Eu$	27(3)a 24(4)b	$\gamma$ $\beta, \gamma$	25.9(24)	91.9 163.7 293.9 314.3				
$^{161}Gd$ (5/2-)	222(6)c			102.3 314.9 360.9	14.0(8)c 22.9(9)c 60.6(15)c			
$^{161}Tb$ (3/2+)	597000 (2000)c			74.6 88.0 103.1	9.8(22)c 0.21(4)c 0.114(14)c			

a) MAC86.

b) AND90.

c) BRO86.

Table 89: Mass 162. Version 1993-05-11

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
$^{162}\text{Eu}$	10.6(10)a	$\beta, \gamma$						
$^{162}\text{Gd} (0^+)$	516(18)b			402.8	46(2)b			
				441.6	53(5)b			
$^{162}\text{Tb} (1^-)$	462(12)b			185.0 +185.3	15.8(22)b			
				260.1	79(5)b			
				807.5	45(4)b			
				888.1	39(4)b			

a) AND90.

b) BRO86.

Table 91: Mass 164. Version 1993-05-11

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
$^{164}\text{Gd} (0^+)$	45(3)a	$\beta$						
$^{164}\text{Tb} (5^+)$	180(6)b			168.8	24.0(17)b			
				215.1	20.0(10)b			
				688.4	20.0(16)b			
				754.8	22.1(18)b			

a) GRE88.

b) BRO86.

Table 90: Mass 163. Version 1993-05-11

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
$^{163}\text{Gd}$	68(3)a	$\gamma$		214.0	7.4b			
				287.8	16b			
				373.4	4.0b			
				1562.0	5.8b			
				1684.5	5.1b			
$^{163}\text{Tb} (3/2^+)$	1170(18)c			351.2	26(3)c			
				389.8	24(3)c			
				421.9	11.4(13)c			
				494.5	22.4(14)c			

a) GEH82.

b) BLA86.

c) BRO86.

Table 92: Mass 165. Version 1993-05-11

Nuclide	Half-life, s			Gamma branching ratio, %				
	Value	Method	Average	Energy keV	Value	Method	Average	Comment
$^{165}\text{Tb}$	127(6)a	$\gamma$						
$^{165m}\text{Dy}$	75.4(4)b				108.2	3.01(12)b		
					515.5	1.56(14)b		
$^{165}\text{Dy}$	8402(22)b				94.7	3.6(5)b		
					279.8	0.50(7)b		
					361.7	0.84(11)b		
					633.4	0.57(7)b		
					715.3	0.53(6)b		

a) GRE83.

b) BRO86.

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