



Table of radionuclides (Vol. 8 - $A = 41$ to 198)

Marie-Martine Bé, Vanessa Chisté, Christophe Dulieu, Mark Kellett, Xavier Mougeot, Arinc Arzu, Valery Chechev, Nikolay Kuzmenko, Tibor Kibédi, Aurelian Luca, et al.

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Table of Radionuclides (Vol. 8 – $A = 41$ to 198)

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Preface

This monograph is one of several published in a series by the Bureau International des Poids et Mesures (BIPM) on behalf of the Consultative Committee for Ionizing Radiation (*Comité Consultatif des Rayonnements Ionisants*, CCRI¹). The aim of this series of publications is to review topics that are of importance for the measurement of ionizing radiation and especially of radioactivity, in particular those techniques normally used by participants in international comparisons. It is expected that these publications will prove to be useful reference volumes both for those who are already engaged in this field and for those who are approaching such measurements for the first time.

The purpose of this monograph, number 5 in the series, is to present the recommended values of nuclear and decay data for a wide range of radionuclides. Activity measurements for more than sixty-seven of these radionuclides have already been the subject of comparisons under the auspices of Section II (dedicated to the Measurement of radionuclides) of the CCRI. The material for this monograph is now covered in eight volumes. The first two volumes contain the primary recommended data relating to half-lives, decay modes, x-rays, gamma-rays, electron emissions; alpha- and beta-particle transitions and emissions, and their uncertainties for a set of sixty-eight radionuclides, Volume 1 for mass numbers up to and including 150 and Volume 2 for mass numbers over 150. Volume 3 contains the equivalent data for twenty-six additional radionuclides and re-evaluations for ¹²⁵Sb and ¹⁵³Sm. Volume 4 contains the data for a further thirty-one radionuclides with a re-evaluation for ²²⁶Ra. Volume 5 includes seventeen new radionuclide evaluations and eight re-evaluations. Volume 6 contains twenty-one new radionuclide evaluations and four re-evaluations. Volume 7 contains twenty-four new radionuclide evaluations and five re-evaluations. The present Volume 8 contains twenty-three new radionuclide evaluations and nine re-evaluations for ⁸⁸Y, ^{93m}Nb, ¹⁰⁹Cd, ¹³¹I, ^{131m}Xe, ¹³³Ba, ¹⁴⁰Ba, ¹⁴⁰La and ¹⁹⁸Au. The data have been collated and evaluated by an international working group (Decay Data Evaluation Project, DDEP) led by the Laboratoire National de Métrologie et d'Essais – Laboratoire National Henri Becquerel (LNE-LNHB).

The evaluators have agreed on the methodologies to be used and their comments for each radionuclide in addition to the data tables in the present monograph can now both be found on the BIPM website at <http://www.bipm.org/en/publications/scientific-output/monographies-ri.html>. Consequently, the CD-ROM that accompanied previous issues is no longer deemed necessary and has been discontinued.

The work involved in evaluating nuclear data is ongoing and the recommended values are kept up to date on the LNE-LNHB website at http://www.nucleide.org/DDEP_WG/DDEPdata.htm.

The BIPM and the DDEP are most grateful to the International Atomic Energy Agency (IAEA) for their assistance and financial support to some evaluators in the production of data for Volumes 1 to 3 through their Coordinated Research Project "Update of X Ray and Gamma Ray Decay Data Standards for Detector Calibration and Other Applications", for Volumes 4 to 7 through their Coordinated Research Project "Updated Decay Data Library for Actinides" and for Volume 8 through their Coordinated Research Projects "Testing and Improving the International Reactor Dosimetry and Fusion File (IRDF)" and "Nuclear Data for Charged-particle Monitor Reactions and Medical Isotope Production". The BIPM and the DDEP are indebted also to some other evaluators who participate in the United States Nuclear Data Program (USNDP) for their support to these publications. The publication of further volumes of Monographie 5 is envisaged when necessary to add new radionuclide data or re-evaluations in this more permanent format that can be referenced easily.

Although other data sets may still be used when evaluating radionuclide activity, the CCRI encourages the use of this common, recommended data set that should help to reduce the uncertainties in activity evaluations and lead to more coherent results for comparisons (2009, CCRI Report of 21st meeting, section 17.2).

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M.J.T. Milton
Director of the BIPM

¹ previously known as the *Comité Consultatif pour les Étalons de Mesure des Rayonnements Ionisants* (CCEMRI)

Monographie BIPM-5 – Table of Radionuclides, Volume 8

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“TABLE DE RADIONUCLÉIDES”

Sommaire - Ce volume regroupe l'évaluation des radionucléides suivants :

^{41}Ca , ^{47}Sc , ^{52}Fe , ^{58}Co , ^{61}Cu , ^{63}Zn , ^{73}Se , ^{82}Rb , ^{82}Sr , ^{88}Y , ^{89}Zr , ^{93}Zr , $^{93\text{m}}\text{Nb}$, $^{94\text{m}}\text{Tc}$, ^{106}Ru , ^{106}Rh , ^{109}Cd , ^{127}Xe , ^{131}I , $^{131\text{m}}\text{Xe}$, ^{133}Ba , ^{138}La , ^{140}Ba , ^{140}La , ^{144}Ce , ^{144}Pr , $^{144\text{m}}\text{Pr}$, ^{148}Pm , $^{148\text{m}}\text{Pm}$, ^{151}Sm , ^{169}Er , ^{198}Au .

Les valeurs recommandées et les incertitudes associées comprennent : la période radioactive, les modes de décroissance, les émissions α , β , γ , X et électroniques ainsi que les caractéristiques des transitions correspondantes.

“TABLE OF RADIONUCLIDES”

Summary - This volume includes the evaluation of the following radionuclides:

^{41}Ca , ^{47}Sc , ^{52}Fe , ^{58}Co , ^{61}Cu , ^{63}Zn , ^{73}Se , ^{82}Rb , ^{82}Sr , ^{88}Y , ^{89}Zr , ^{93}Zr , $^{93\text{m}}\text{Nb}$, $^{94\text{m}}\text{Tc}$, ^{106}Ru , ^{106}Rh , ^{109}Cd , ^{127}Xe , ^{131}I , $^{131\text{m}}\text{Xe}$, ^{133}Ba , ^{138}La , ^{140}Ba , ^{140}La , ^{144}Ce , ^{144}Pr , $^{144\text{m}}\text{Pr}$, ^{148}Pm , $^{148\text{m}}\text{Pm}$, ^{151}Sm , ^{169}Er , ^{198}Au .

Primary recommended data comprise half-lives, decay modes, X-rays, gamma-rays, electron emissions, alpha- and beta-particle transitions and emissions, and their uncertainties.

“TABELLE DER RADIONUKLIDE”

Zusammenfassung – Dieser Band umfaßt die Evaluation der folgenden Radionuklide:

^{41}Ca , ^{47}Sc , ^{52}Fe , ^{58}Co , ^{61}Cu , ^{63}Zn , ^{73}Se , ^{82}Rb , ^{82}Sr , ^{88}Y , ^{89}Zr , ^{93}Zr , $^{93\text{m}}\text{Nb}$, $^{94\text{m}}\text{Tc}$, ^{106}Ru , ^{106}Rh , ^{109}Cd , ^{127}Xe , ^{131}I , $^{131\text{m}}\text{Xe}$, ^{133}Ba , ^{138}La , ^{140}Ba , ^{140}La , ^{144}Ce , ^{144}Pr , $^{144\text{m}}\text{Pr}$, ^{148}Pm , $^{148\text{m}}\text{Pm}$, ^{151}Sm , ^{169}Er , ^{198}Au .

In diesem Bericht sind evaluierte Werte der Halbwertszeiten, Übergangswahrscheinlichkeiten und Übergangsenergien von α , β^- , β^+ , EC- und Gammaübergängen, Konversionskoeffizienten von Gammaübergängen sowie der Emissionswahrscheinlichkeiten von Röntgen- und Gammaquanten, Auger- und Konversionselektronen und deren Unsicherheiten zusammengefaßt.

“ТАБЛИЦА РАДИОНУКЛИДОВ”

Резюме. Этот том включает оценки характеристик распада для следующих нуклидов:

^{41}Ca , ^{47}Sc , ^{52}Fe , ^{58}Co , ^{61}Cu , ^{63}Zn , ^{73}Se , ^{82}Rb , ^{82}Sr , ^{88}Y , ^{89}Zr , ^{93}Zr , $^{93\text{m}}\text{Nb}$, $^{94\text{m}}\text{Tc}$, ^{106}Ru , ^{106}Rh , ^{109}Cd , ^{127}Xe , ^{131}I , $^{131\text{m}}\text{Xe}$, ^{133}Ba , ^{138}La , ^{140}Ba , ^{140}La , ^{144}Ce , ^{144}Pr , $^{144\text{m}}\text{Pr}$, ^{148}Pm , $^{148\text{m}}\text{Pm}$, ^{151}Sm , ^{169}Er , ^{198}Au .

Основные рекомендуемые данные включают периоды полураспада, виды распада, X-излучение, гамма-излучение, электронное излучение, альфа- и бета- переходы и излучения, а также погрешности рассмотренных величин.

“TABLA DE RADIONUCLEIDOS”

Contenido – Este volumen agrupa la evaluación de los radionucleidos siguientes:

^{41}Ca , ^{47}Sc , ^{52}Fe , ^{58}Co , ^{61}Cu , ^{63}Zn , ^{73}Se , ^{82}Rb , ^{82}Sr , ^{88}Y , ^{89}Zr , ^{93}Zr , $^{93\text{m}}\text{Nb}$, $^{94\text{m}}\text{Tc}$, ^{106}Ru , ^{106}Rh , ^{109}Cd , ^{127}Xe , ^{131}I , $^{131\text{m}}\text{Xe}$, ^{133}Ba , ^{138}La , ^{140}Ba , ^{140}La , ^{144}Ce , ^{144}Pr , $^{144\text{m}}\text{Pr}$, ^{148}Pm , $^{148\text{m}}\text{Pm}$, ^{151}Sm , ^{169}Er , ^{198}Au .

Los valores recomendados y las incertidumbres asociadas comprenden: el período de semidesintegración radiactiva, los modos de desintegración, las emisiones α , β , γ , X y electrónicas incluyendo las características de las transiciones correspondientes.

TABLE DE RADIONUCLÉIDES
TABLE OF RADIONUCLIDES
TABELLE DER RADIONUKLIDE
ТАБЛИЦА РАДИОНУКЛИДОВ
TABLA DE RADIONUCLEIDOS

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TABLE DE RADIONUCLÉIDES

INTRODUCTION

Le Laboratoire National Henri Becquerel (LNHB) a commencé l'étude des données nucléaires et atomiques qui caractérisent la décroissance des radionucléides en 1974. Ces évaluations ont fait l'objet de la publication des quatre volumes de la Table de Radionucléides [87Ta, 99Be] et de sept volumes de la *Monographie* BIPM-5 [04Be, 06Be, 08Be, 10Be, 11Be, 13Be]. Ce nouveau volume s'inscrit dans la continuation du travail précédent.

D'autre part, pour des raisons évidentes, telles la facilité de mise à jour des données ou la commodité de consultation pour les utilisateurs, le LNHB a créé une base de données informatisée. Le logiciel NUCLEIDE est la forme informatisée de cette table, il permet un accès aisé aux différentes informations à l'aide de menus déroulants atteints par un simple « clic » sur un « bouton ».

Le propos de la Table est d'étudier un nombre limité de radionucléides utiles dans le domaine de la métrologie ou dans des domaines variés d'applications (médecine nucléaire, environnement, cycle du combustible, etc.) et d'en présenter une étude complète.

Les données recommandées comprennent : la période radioactive, les modes de décroissance, les émissions α , β , γ , X et électroniques ainsi que les caractéristiques des transitions associées.

Dans le but de mettre à jour et d'ajouter de nouvelles évaluations plus rapidement Le Laboratoire National Henri Becquerel (LNHB, France) et le Physikalisch - Technische Bundesanstalt (PTB, Germany) ont établi un accord de coopération. Ils ont ensuite été rejoints par Idaho National Engineering & Environmental Laboratory (INEEL, USA), Lawrence Berkeley National Laboratory (LBNL, USA) et Khlopin Radium Institute (KRI, Russia). Le premier travail de cette collaboration internationale a été d'établir une méthode et des règles communes d'évaluation. Les évaluations proposent des valeurs recommandées et leurs incertitudes. Ces valeurs ont été évaluées à partir des données expérimentales disponibles. A défaut, elles sont issues de calculs théoriques. Toutes les références utilisées pour l'évaluation d'un radionucléide sont listées à la fin de chaque chapitre.

Ce volume est le huitième de la *Monographie* 5 publiée sous l'égide du BIPM.

VALEURS RECOMMANDÉES ET INCERTITUDES

Les principales étapes pour l'évaluation des données et leurs incertitudes sont :

- une analyse critique de toutes les publications disponibles afin de retenir ou non une valeur et son incertitude, ramenée à l'incertitude-type composée ;
- la détermination d'une valeur recommandée qui est, selon les cas, une moyenne simple ou pondérée des valeurs issues des publications, ceci est décidé après examen du chi carré réduit. Dans le cas d'une moyenne pondérée, le poids relatif de chaque valeur est limité à 50 %. L'incertitude, notée u_c , est la plus grande des valeurs des incertitudes interne ou externe ; dans le cas de valeurs incompatibles elle peut être étendue pour recouvrir la valeur la plus précise.

Pour certaines applications il est nécessaire de définir une incertitude élargie, notée U , telle que :

$$U(y) = k \times u_c(y) \quad \text{où } k \text{ est le facteur d'élargissement.}$$

La valeur de k retenue pour cette publication est : $k = 1$.

Les valeurs d'incertitude indiquées portent sur les derniers chiffres significatifs, ainsi :

9,230 (11) signifie $9,230 \pm 0,011$ et

9,2 (11) $9,2 \pm 1,1$

Si une valeur est donnée sans incertitude, cela signifie qu'elle est considérée comme douteuse. Elle est indiquée à titre indicatif et souvent a été estimée en fonction du schéma de désintégration comme étant « de l'ordre de ».

Des précisions concernant les techniques d'évaluation peuvent être obtenues dans les références [85Zi], [96He], [99In] (voir rubrique Références) ou directement auprès des auteurs.

La description physique des données évaluées est disponible dans la référence [99In].

NUMÉROTAGE

Les niveaux d'un noyau sont numérotés, arbitrairement, de 0 pour le niveau fondamental à n pour le n ème niveau excité. Les diverses transitions sont ainsi repérées par leur niveau de départ et leur niveau d'arrivée. Dans le cas de transition de faible probabilité qu'il n'est pas possible de situer sur le schéma de désintégration, les niveaux de départ et d'arrivée sont notés $(-1, n)$.

Dans le cas de l'émission gamma de 511 keV qui suit une désintégration bêta plus, la notation adoptée est : $(-1, -1)$.

UNITÉS

Les valeurs recommandées sont exprimées :

- pour les périodes :

	Symbole
. en secondes pour $T_{1/2} \leq 60$ secondes	s
. en minutes pour $T_{1/2} > 60$ secondes	min
. en heures pour $T_{1/2} > 60$ minutes	h
. en jours pour $T_{1/2} > 24$ heures	d
. en années pour $T_{1/2} > 365$ jours	a

1 année = 365,242 198 jours = 31 556 926 secondes ;

- pour les probabilités de transition et nombre de particules émises, les valeurs sont données pour 100 désintégrations ;

- les énergies sont exprimées en keV.

Remarque : Si une valeur plus précise de la période est nécessaire, par exemple en jours plutôt qu'en années, le lecteur se référera aux commentaires de l'évaluation inclus sur le CD-Rom ou sur les sites web du LNE-LNHB ou du BIPM. Ceci évitera l'introduction d'erreurs d'arrondi supplémentaires en cas de conversion d'unités.

AVERTISSEMENT

Ce document a été imprimé en 2016, pour toutes les nouvelles évaluations et mises à jour ultérieures, le lecteur se référera aux documents accessibles sur :

<http://www.nucleide.org/NucData.htm>

<http://www.bipm.org/fr/publications/monographie-ri-5.html>

TABLE OF RADIONUCLIDES

INTRODUCTION

The evaluation of decay data for the “Table de Radionucléides” by the Bureau National de Métrologie – Laboratoire National Henri Becquerel/Commissariat à l’Énergie Atomique (BNM – LNHB/CEA) began in 1974, continued to 1987 and four volumes were published [87Ta, 99Be]. This work has been pursued and seven volumes of evaluations have already been published as *Monographie* BIPM-5 [04Be, 06Be, 08Be, 10Be, 11Be, 13Be].

Moreover, LNHB developed a database and related software (NUCLÉIDE) with the objectives of making it easier to update and add data and, obviously, to offer easy access to the nuclear and atomic decay data to the user by “click on the button” facilities.

The aim of this Table is to provide recommended data for nuclides of special interest for metrology or practical applications like nuclear medicine, monitoring and reactor shielding, etc.

Primary recommended data comprise half-lives, decay modes, X-rays, gamma-rays, electron emissions, alpha- and beta-particle transitions and emissions, and their uncertainties. All the references used for the evaluations are given.

In order to update the data of the nuclides already present and to add new evaluations, the Laboratoire National Henri Becquerel (LNHB, France) and the Physikalisch-Technische Bundesanstalt (PTB, Germany) established a cooperative agreement; they were then joined by the Idaho National Engineering & Environmental Laboratory (INEEL, USA), the Lawrence Berkeley National Laboratory (LBNL, USA) and the Khlopin Radium Institute (KRI, Russia). This international collaboration is based on an informal agreement; the initial work of this group was to discuss and to agree on a methodology to be used in these evaluations. The data and associated uncertainties were evaluated from all available experiments and taking into account theoretical considerations.

This volume is the eighth in the series of the *Monographie* 5 published under the auspices of the BIPM.

RECOMMENDED VALUES AND UNCERTAINTIES

The main steps for the evaluation of the data and their uncertainties are:

- a critical analysis of all available original publications in order to accept or not each value and its uncertainty reduced to the combined standard uncertainty;
- the determination of the best value which is either the weighted or the unweighted average of the retained values, this is decided after examination of the reduced χ^2 value. For a weighted average of discrepant data, each weight is limited to 50 %, and the uncertainty, designated u_c , is the larger of the internal or external uncertainty values, which may be expanded to cover the most precise input value.

For some applications it may be necessary to define an expanded uncertainty, designated U , as:

$$U(y) = k \times u_c(y) \quad \text{where } k \text{ is the coverage factor.}$$

In this publication, standard uncertainties are quoted (i.e. $k = 1$).

The value of the uncertainty, in parentheses, applies to the least significant digits, i.e.:

9.230 (11) means 9.230 ± 0.011 and

9.2 (11) 9.2 ± 1.1

A value given without an uncertainty is considered questionable. It is provided for information and often its order of magnitude is estimated from the decay scheme.

Information on evaluation methods may be obtained from references [85Zi, 96He, 99In] or directly from the authors.

Information on the meaning of physical data may be obtained from reference [99In].

NUMBERING

Nuclear levels are arbitrarily numbered from 0 (for the ground state level) to n (for the n th excited level). All transitions are designated by their initial and final levels.

For transitions with weak emission probabilities that are not shown by an arrow in the decay scheme, the initial and final levels are noted $(-1, n)$.

For a 511 keV gamma emission, which follows a beta plus disintegration, the adopted numbering is $(-1, -1)$.

UNITS

The recommended values are given:

- for half-lives:

	Symbol
. in seconds for $T_{1/2} \leq 60$ seconds	s
. in minutes for $T_{1/2} > 60$ seconds	min
. in hours for $T_{1/2} > 60$ minutes	h
. in days for $T_{1/2} > 24$ hours	d
. in years for $T_{1/2} > 365$ days	a

$$1 \text{ year} = 1 \text{ a} = 365.242 \ 198 \text{ d} = 31 \ 556 \ 926 \text{ s}$$

- for transition probabilities and number of emitted particles, the values are given for 100 disintegrations of the parent nuclide.

- for energies, the values are expressed in keV.

Remark: When a more precise evaluation of a half life is required, for example in days instead of years, the reader is referred to the commented evaluation included on the CD ROM or on the websites of the LNE-LNHB or the BIPM. This will avoid the introduction of rounding errors.

NOTICE

This report was printed in 2016. New evaluations and updated issues will be available on:

<http://www.nucleide.org/NucData.htm>

<http://www.bipm.org/en/publications/monographie-ri-5.html>

TABELLE DER RADIONUKLIDE

EINLEITUNG

Die Evaluation der Zerfallsdaten für die „Table de Radionucléides“ durch das Laboratoire National Henri Becquerel (BNM-LNHB/CEA) begann im Jahre 1974, diese Arbeit wurde bis 1987 fortgesetzt, und es wurden vier Bände veröffentlicht [87Ta, 99Be]. Seitdem sind des weiteren sieben Bände der *Monographie* BIPM-5 [04Be, 06Be, 08Be, 10Be, 11Be, 13Be] erschienen. Der vorliegende neue Band stellt die Fortsetzung der vorhergehenden Arbeit dar.

Darüber hinaus wurde im LNHB eine computerbasierte Datenbank entwickelt. Die Software NUCLEIDE erleichtert die Aktualisierung und die Einbeziehung weiterer Daten und ermöglicht den Zugang zu den Kern- und Atomdaten für den Anwender „auf Tastendruck“.

Der Zweck dieser Tabelle ist es, empfohlene Daten einer begrenzten Anzahl von Radionukliden für metrologische und praktische Anwendungen wie etwa in der Nuklearmedizin, der Umweltüberwachung, dem Brennstoffkreislauf, der Reaktorabschirmung usw. zur Verfügung zu stellen.

Die empfohlenen Daten betreffen die Halbwertszeit, die Art des Zerfalls und die Charakteristika der α -, β -, γ -, Röntgen- und Elektronenemissionen und der entsprechenden Übergänge.

Um die bereits vorliegenden Daten zu aktualisieren und neue Evaluationen schneller einbeziehen zu können, vereinbarten das Laboratoire National Henri Becquerel (LNHB, Frankreich) und die Physikalisch-Technische Bundesanstalt (PTB, Deutschland) eine Übereinkunft zur Zusammenarbeit. Es schlossen sich das Idaho National Engineering and Environmental Laboratory (INEEL, USA), das Lawrence Berkeley National Laboratory (LBNL, USA) und das Khlopin Radium Institute (KRI, Rußland) an. Eine der ersten Arbeiten dieser Gruppe war es, die in diesen Evaluationen benutzte Methodologie zu diskutieren und festzulegen. Die Datenbank umfaßt empfohlene Daten und ihre Unsicherheiten, die aus den verfügbaren experimentellen Daten oder theoretischen Berechnungen gewonnen wurden. Alle für die Evaluation benutzten Referenzen werden angegeben.

Dieser Band ist die achte Ausgabe der *Monographie* BIPM-5.

EMPFOHLENE WERTE UND UNSICHERHEITEN

Die Hauptschritte für die Evaluation der Daten und Unsicherheiten sind:

- Eine kritische Analyse aller verfügbaren Veröffentlichungen, um einen jeweils veröffentlichten Wert und seine Unsicherheit - auf die kombinierte Standardunsicherheit zurückgeführt - zu berücksichtigen oder auszuschließen.
- Die Bestimmung eines empfohlenen Wertes, der entweder das gewichtete oder das ungewichtete Mittel der veröffentlichten Werte ist. Die Entscheidung wird nach der Prüfung des reduzierten Chi-Quadrat-Werts getroffen. Im Falle des gewichteten Mittels wird das Gewicht jedes Einzelwerts auf 50 % begrenzt. Die Unsicherheit, als u_c bezeichnet, ist der größere Wert der inneren oder äußeren Unsicherheit. Für einen diskrepanten Datensatz kann sie so vergrößert werden, daß der genaueste Einzelwert in der Unsicherheit mit eingeschlossen ist.

Für einige Anwendungen ist es notwendig, eine vergrößerte Unsicherheit, als U bezeichnet, wie folgt zu definieren:

$$U(y) = k \times u_c(y) \quad \text{wo } k \text{ der Erweiterungsfaktor ist.}$$

Für die vorliegende Veröffentlichung ist die erweiterte Unsicherheit mit $k = 1$ berechnet.

Die Werte der Unsicherheit beziehen sich auf die letzten Stellen, d. h.:

9,230(11) bedeutet $9,230 \pm 0,011$ und

9,2(11) bedeutet $9,2 \pm 1,1$

Wenn ein Wert ohne Unsicherheit angegeben ist, bedeutet das, daß dieser Wert als fragwürdig zu betrachten ist. Er wird zur Information mitgeteilt und ist oft abgeschätzt aus dem Zerfallsschema im Sinne „in der Größenordnung von“.

Informationen über die Evaluationsprozedur können aus den Referenzen [85Zi, 96He, 99In] oder direkt von den Autoren bezogen werden.

Die Bedeutung der evaluierten Daten kann aus Ref. [99In] entnommen werden.

NUMERIERUNG

Die Kernniveaus werden willkürlich numeriert von 0 für den Grundzustand bis zu n für das n -te angeregte Niveau. Alle Übergänge werden durch ihr Ausgangs- und Endniveau gekennzeichnet. Für Übergänge mit geringen Wahrscheinlichkeiten, die nicht im Zerfallsschema gezeigt werden können, werden als Ausgangs- und Endniveau $(-1, n)$ angegeben.

Für die 511 keV-Gamma-Emission, die dem Beta Plus-Zerfall folgt, ist die angenommene Numerierung $(-1, -1)$.

EINHEITEN

Die empfohlenen Werte sind ausgedrückt:

- für Halbwertszeiten:

. in Sekunden für $T_{1/2} \leq 60$ Sekunden	s
. in Minuten für $T_{1/2} > 60$ Sekunden	min
. in Stunden für $T_{1/2} > 60$ Minuten	h
. in Tagen für $T_{1/2} > 24$ Stunden	d
. in Jahren für $T_{1/2} > 365$ Tage	a

$$1 \text{ a} = 365,242 \text{ 198 d} = 31 \text{ 556 926 s}$$

- für Übergangswahrscheinlichkeiten und die Anzahl der emittierten Teilchen werden Werte angegeben, die sich auf 100 Zerfälle beziehen.

- die Werte der Energien sind in keV ausgedrückt.

HINWEIS

Dieses Dokument wurde im Jahre 2016 erstellt. Alle späteren Fassungen oder neueren Evaluationen können vom Leser unter

<http://www.nucleide.org/NucData.htm>

<http://www.bipm.org/en/publications/monographie-ri-5.html>

abgerufen werden.

ТАБЛИЦА РАДИОНУКЛИДОВ

ВВЕДЕНИЕ

Оценка данных распада для Table de Radionucléides, BNM – LNHB/CEA, была начата в 1974 г. и продолжалась до 1987 г. К тому времени были опубликованы четыре тома [87Ta] и затем, в 1999 г., был опубликован пятый том, содержащий ревизованные оценки для 30 выбранных радионуклидов [99Be]. Эта работа была продолжена, и семь томов были опубликованы как *Monographie BIPM-5* [04Be, 06Be, 08Be, 10Be, 11Be, 13Be].

В дополнение в LNHB была разработана компьютерная форма Table de Radionucléides (программа NUCLEIDE) с тем, чтобы обеспечить более простое обновление и дополнение данных и, очевидно, также с целью предложить пользователю более легкий доступ к ядерным и атомным данным распада путем "нажатия кнопки".

Цель настоящего издания - дать рекомендованные данные для нуклидов, представляющих специфический интерес для метрологии или практических приложений, таких как ядерная медицина, мониторинг, реакторная защита и др.

Первичные рекомендованные данные включают периоды полураспада, виды распада, характеристики X- и гамма-излучений, электронных излучений, альфа- и бета-переходов и излучений и погрешности величин этих характеристик. В книге дан полный список литературы, использованной для оценок.

Для того чтобы обновить данные по нуклидам, уже имеющимся в Table de Radionucléides, и добавить новые оценки, Национальная лаборатория им. Анри Беккереля (LNHB, Франция) и Физико-Технический Институт (PTB, Германия) заключили кооперативное соглашение. К ним затем присоединились Национальная лаборатория прикладных и экологических исследований Айдахо (INEEL, США), Лоуренсовская Национальная Лаборатория Беркли (LBNL, США) и Радиевый институт им. В.Г. Хлопина (KRI, Россия). Это международное сотрудничество основано на неформальном соглашении. Первоначальная работа состояла в обсуждении и принятии согласованной методологии, которая должна быть использована в этих оценках. Данные и связанные с ними погрешности были оценены с использованием всех имеющихся в распоряжении результатов экспериментов и с учетом теоретических рассуждений.

Настоящий том представляет собой восьмой выпуск *Monographie BIPM-5*.

РЕКОМЕНДОВАННЫЕ ЗНАЧЕНИЯ И ПОГРЕШНОСТИ

Основные шаги для оценки данных и их погрешностей следующие:

- критический анализ всех имеющихся оригинальных публикаций, чтобы принять или отвергнуть данное значение и его погрешность, приведенную к комбинированному стандартному отклонению;
- определение лучшего значения, которое является взвешенным или невзвешенным средним сохраненных величин; выбор взвешенного или невзвешенного среднего определяется анализом величины χ^2 . В случае среднего взвешенного вес каждого оригинального результата ограничивается 50 %. В качестве итоговой погрешности (u_c) принимается большая из двух погрешностей среднего взвешенного: внутренней и внешней. Для расходящегося набора данных она может быть расширена, чтобы перекрыть самое точное входное значение.

Для некоторых применений может оказаться необходимым расширенная погрешность (U), выраженная как: $U(y) = k \times u_c(y)$, где k - коэффициент перекрытия. Для этой публикации принято $k = 1$.

Значение погрешности, в скобках, приводится в единицах последней значащей цифры, т.е.:

9,230 (11) означает $9,230 \pm 0,011$ и

9,2 (11) $9,2 \pm 1,1$

Если значение величины дается без погрешности, она считается сомнительной и приводится для информации. Такие величины часто оценивались из схемы распада под рубрикой "порядка".

Информацию о процедурах оценки можно получить из публикаций [85Zi, 96He, 99In] или непосредственно от авторов.

Информация о смысле физических величин может быть получена из [99In].

НУМЕРАЦИЯ

Ядерные уровни произвольно пронумерованы от 0 для основного состояния до n для n -ого возбужденного уровня. Все переходы обозначаются по их начальному и конечному уровням.

Для слабых переходов, не показанных стрелкой в схеме распада, начальный и конечный уровни обозначаются как $(-1, n)$.

Для гамма-излучения с энергией 511 кэВ, которое следует за бета-плюс распадом, принято обозначение $(-1, -1)$.

ЕДИНИЦЫ

Рекомендованные значения выражены:

- для периодов полураспада:
 - . в секундах для $T_{1/2} \leq 60$ секунд s
 - . в минутах для $T_{1/2} > 60$ секунд min
 - . в часах для $T_{1/2} > 60$ минут h
 - . в сутках для $T_{1/2} > 24$ часов d
 - . в годах для $T_{1/2} > 365$ суток a

1 год = 365,242198 суток = 31 556 926 секунд

- для вероятностей переходов и числа испускаемых частиц значения даны на 100 распадов;
- для энергий значения выражены в килоэлектронвольтах (keV).

ПРИМЕЧАНИЕ

Этот выпуск подготовлен в 2016 г. Новые оценки и обновленные результаты можно найти на сайте:

<http://www.nucleide.org/NucData.htm>

<http://www.bipm.org/en/publications/monographie-ri-5.html>

TABLA DE RADIONUCLEIDOS

INTRODUCCION

El Laboratorio Nacional Henri Becquerel (LNHB) inició en 1974 el estudio de datos nucleares y atómicos que caracterizan la desintegración de radionucleidos. Esas evaluaciones han permitido la publicación de cuatro volúmenes de la Tabla de Radionucleidos [87Ta, 99Be]. Este nuevo volumen es el siguiente en la continuación del estudio precedente *Monographie* BIPM-5 [04Be, 06Be, 08Be, 10Be, 11Be, 13Be].

Para facilitar la corrección de nueva información y mejorar la comodidad de consulta a los lectores, el LNHB a creado una base de datos informatizada. El programa NUCLEIDE permite el acceso a la Tabla de Radionucleidos con la ayuda de menues en cascada disponibles con un simple « clic ».

El objetivo de la Tabla de Radionucleidos es el de proporcionar información sobre un número limitado de radionucleidos utilizados en el campo de la metrología o en otras disciplinas (medicina nuclear, medio ambiente, ciclo del combustible, etc.)

Los datos recomendados incluyen : el período de semidesintegración, los modos de desintegración, las emisiones α , β , γ , X y de electrones atómicos asociados a las mismas.

Con el propósito de actualizar y agregar nuevas evaluaciones rapidamente el *Laboratoire National Henri Becquerel* (LNHB, Francia) y el *Physikalisch-Technische Bundesanstalt* (PTB, Alemania) establecieron un acuerdo de colaboración. Posteriormente se unieron el *Idaho National Engineering & Environmental Laboratory* (INEEL, USA), *Lawrence Berkeley National Laboratory* (LBNL, USA) y *Khlopin Radium Institute* (KRI, Rusia). El primer trabajo de esta colaboración internacional fue el de establecer el método y las reglas comunes de evaluación. Las evaluaciones proponen valores recomendados e incertidumbres asociadas. Éstos valores han sido evaluados a partir de datos experimentales. En su ausencia, los valores se obtienen por cálculos teóricos. Todas las referencias utilizadas para la evaluación de un radionucleido se citan al final de cada capítulo.

VALORES RECOMENDADOS E INCERTIDUMBRES

Las principales etapas para evaluar datos con sus incertidumbres son:

- Un análisis crítico de todas las publicaciones disponibles con el fin de obtener un valor con su incertidumbre, considerada como incertidumbre típica combinada.
- La determinación de un valor recomendado que es, según el caso, una media simple o ponderada de valores obtenidos de publicaciones. Ésto se decide tras el chi-cuadrado reducido. En el caso de una media ponderada para conjuntos de valores discrepantes, el peso estadístico relativo de cada valor es limitado al 50 %. La incertidumbre, u_c , es el mayor de los valores de las incertidumbres interna o externa. En el caso de conjuntos de valores discrepantes, este valor puede ser extendido con el fin de incluir el valor experimental más preciso.

Para ciertas aplicaciones, es necesario definir una incertidumbre expandida, llamada U :

$U(y) = k \times u_c(y)$ donde k es el factor de cobertura.

El valor de k utilizado en esta publicación es: $k = 1$.

Los valores de incertidumbres indicados entre paréntesis corresponden a las últimas cifras significativas, por ejemplo:

9,230 (11) significa $9,230 \pm 0,011$ y
9,2 (11) significa $9,2 \pm 1,1$

Valores dados sin incertidumbres se consideran dudosos (usualmente se presentan como valores aproximados, y a menudo estimados a partir de los esquemas de desintegración).

Para más información sobre las técnicas de evaluación consultar [85Zi], [96He], [99In] o directamente con el autor.

NUMERACION

Los niveles de un núcleo están arbitrariamente numerados desde “0” (para el nivel fundamental), hasta “ n ” para el n -ésimo nivel excitado. Las transiciones se representan por sus niveles inicial y final.

En el caso de una transición débil e imposible de situar en el esquema de desintegración, el nivel inicial y el final están designados con la siguiente notación: $(-1, n)$.

En el caso de una emisión γ de 511 keV que sigue a una desintegración β^+ , la notación adoptada es: $(-1, -1)$.

UNIDADES

Los valores recomendados se dan:

- para los períodos de semidesintegración:

	Símbolo
. en segundos para $T_{1/2} \leq 60$ segundos	s
. en minutos para $T_{1/2} > 60$ segundos	min
. en horas para $T_{1/2} > 60$ minutos	h
. en días para $T_{1/2} > 24$ horas	d
. en años para $T_{1/2} > 365$ días	a

1 año = 365,242 198 días = 31 556 926 segundos;

- para las probabilidades de transición y número de partículas emitidas, los valores se dan por 100 desintegraciones;
- para las energías, los valores se expresan en keV.

ADVERTENCIA

Este documento ha sido imprimido en el 2016. Para obtener todas las nuevas evaluaciones actualizadas ulteriormente, el lector deberá referirse a los documentos disponibles en:

<http://www.nucleide.org/NucData.htm>

<http://www.bipm.org/en/publications/monographie-ri-5.html>

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Toutes demandes de renseignements concernant les données recommandées et la façon dont elles ont été établies doivent être adressées directement aux auteurs des évaluations.

Information on the data and the evaluation methods is available from the authors listed below.

Informationen über die Daten und Evaluationsprozeduren können bei den im folgenden zusammengestellten Autoren angefordert werden:

Todos los pedidos de información relativos a datos recomendados y la manera de establecerlos deben dirigirse directamente a los autores de las evaluaciones.

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* : updated evaluations

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124	Sb-124	21	135	Xe-135m	23	60	Co-60	23
207	Bi-207	33	139	Ce-139	31	63	Ni-63	29
211	Bi-211	41	206	Tl-206	39	65	Zn-65	33
217	At-217	47	210	Tl-210	45	79	Se-79	39
225	Ra-225	53	210	Pb-210	51	90	Sr-90	43
225	Ac-225	59	210	Bi-210	59	90	Y-90	47
228	Ra-228	81	210	Po-210	65	90	Y-90m	53
231	Th-231	85	213	Po-213	71	108	Ag-108	59
232	Th-232	95	214	Pb-214	75	108	Ag-108m	67
233	Th-233*	101	214	Bi-214	83	111	In-111	75
233	Pa-233*	117	214	Po-214	111	125	Sb-125*	81
234	Th-234	127	217	Rn-217	117	137	Cs-137	91
235	U-235	133	218	Po-218	121	153	Sm-153*	99
237	U-237*	145	218	At-218	125	159	Gd-159	109
238	Pu-238*	153	218	Rn-218	129	203	Pb-203	115
240	Pu-240*	165	221	Fr-221	135	233	Pa-233	123
241	Am-241*	175	222	Rn-222	143	233	Th-233	133
242	Pu-242*	197	226	Ra-226*	149	234	U-234	147
242	Am-242	203	227	Ac-227	155	236	Np-236	155
243	Am-243*	209	232	U-232	169	236	Np-236m	163
244	Am-244	217	236	U-236	177	237	U-237	169
244	Am-244m	223	237	Np-237	183	238	U-238	177
			238	Np-238	195	242	Cm-242	185
			239	U-239	205	243	Am-243	195
			239	Np-239	221	244	Cm-244	203
			239	Pu-239	231			
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			246	Cm-246	269			
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* : updated evaluations

* : updated evaluations

* : updated evaluations

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186	Re-186	113
198	Au-198	121
201	Tl-201	129
203	Hg-203	135
204	Tl-204	141
208	Tl-208	147
212	Bi-212	155
212	Pb-212	167
212	Po-212	173
216	Po-216	177
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33	P-33	41
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46	Sc-46	57
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54	Mn-54	71
56	Mn-56	77
57	Co-57	83
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59	Fe-59	99
64	Cu-64	105
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67	Ga-67	133
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93	Nb-93m	167
99	Mo-99	173
99	Tc-99m	183
109	Cd-109	191
110	Ag-110	199
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123	I-123	219
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125	Sb-125	235
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7	Be-7	1 / 1	93	Nb-93m*	8 / 93	159	Gd-159	3 / 109	226	Ra-226	2 / 195
11	C-11	1 / 7	94	Tc-94m	8 / 99	166	Ho-166	2 / 67	226	Ra-226*	4 / 149
13	N-13	1 / 11	99	Mo-99	1 / 173	166	Ho-166m	2 / 75	227	Ac-227	4 / 155
14	C-14	7 / 1	99	Tc-99	6 / 21	169	Er-169	8 / 245	227	Th-227	2 / 201
15	O-15	1 / 17	99	Tc-99m	1 / 183	169	Yb-169	2 / 87	228	Ra-228	5 / 81
18	F-18	1 / 21	106	Ru-106	8 / 111	170	Tm-170	2 / 99	228	Ac-228	6 / 139
22	Na-22	5 / 1	106	Rh-106	8 / 115	177	Lu-177	2 / 107	228	Th-228	2 / 227
24	Na-24	1 / 27	108	Ag-108	3 / 59	182	Ta-182	6 / 49	228	Th-228*	7 / 171
32	P-32	1 / 35	108	Ag-108m	3 / 67	186	Re-186	2 / 113	231	Th-231	5 / 85
33	P-33	1 / 41	109	Pd-109	6 / 27	195	Au-195	7 / 101	231	Pa-231	6 / 165
35	S-35	7 / 5	109	Cd-109	1 / 191	198	Au-198	2 / 121	232	Th-232	5 / 95
36	Cl-36	7 / 9	109	Cd-109*	8 / 129	198	Au-198*	8 / 251	232	U-232	4 / 169
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40	K-40	5 / 7	110	Ag-110m	1 / 207	203	Hg-203	2 / 135	233	Th-233*	5 / 101
41	Ar-41	6 / 1	111	In-111	3 / 75	203	Pb-203	3 / 115	233	Pa-233	3 / 123
41	Ca-41	8 / 1	123	Te-123m	1 / 229	204	Tl-204	2 / 141	233	Pa-233*	5 / 117
44	Sc-44	1 / 45	123	I-123	1 / 219	206	Hg-206	7 / 107	234	Th-234	5 / 127
44	Ti-44	1 / 51	124	Sb-124	5 / 21	206	Tl-206	4 / 39	234	Pa-234	6 / 177
45	Ca-45	7 / 21	125	Sb-125	1 / 235	207	Tl-207	7 / 113	234	Pa-234m	6 / 213
46	Sc-46	1 / 57	125	Sb-125*	3 / 81	207	Bi-207	5 / 33	234	U-234	3 / 147
47	Sc-47	8 / 7	125	I-125	6 / 37	208	Tl-208	2 / 147	235	U-235	5 / 133
51	Cr-51	1 / 63	127	Sb-127	7 / 47	208	Tl-208*	7 / 119	236	U-236	4 / 177
52	Fe-52	8 / 13	127	Te-127	7 / 57	209	Tl-209	7 / 127	236	Np-236	3 / 155
54	Mn-54	1 / 71	127	Te-127m	7 / 63	209	Pb-209	6 / 61	236	Np-236*	6 / 231
55	Fe-55	3 / 5	127	Xe-127	8 / 137	209	Po-209	6 / 65	236	Np-236m	3 / 163
56	Mn-56	1 / 77	129	I-129	1 / 243	210	Tl-210	4 / 45	237	U-237	3 / 169
56	Co-56	3 / 11	131	I-131	1 / 249	210	Pb-210	4 / 51	237	U-237*	5 / 145
57	Co-57	1 / 83	131	I-131*	8 / 145	210	Bi-210	4 / 59	237	Np-237	4 / 183
57	Ni-57	1 / 91	131	Xe-131m	1 / 257	210	Po-210	4 / 65	237	Np-237*	6 / 239
58	Co-58	8 / 19	131	Xe-131m*	8 / 153	211	Pb-211	7 / 135	238	U-238	3 / 177
59	Fe-59	1 / 99	132	Te-132	6 / 43	211	Bi-211	5 / 41	238	Np-238	4 / 195
59	Ni-59	6 / 7	133	I-133	4 / 1	211	Po-211	6 / 73	238	Pu-238	2 / 235
60	Co-60	3 / 23	133	Xe-133	4 / 11	211	At-211	7 / 143	238	Pu-238*	5 / 153
61	Cu-61	8 / 25	133	Xe-133m	4 / 17	212	Pb-212	2 / 167	239	U-239	4 / 205
63	Ni-63	3 / 29	133	Ba-133	1 / 263	212	Bi-212	2 / 155	239	U-239*	6 / 251
63	Zn-63	8 / 33	133	Ba-133*	8 / 159	212	Po-212	2 / 173	239	Np-239	4 / 221
64	Cu-64	1 / 105	134	Cs-134	7 / 73	213	Bi-213	7 / 153	239	Pu-239	4 / 231
64	Cu-64*	6 / 13	135	Xe-135m	4 / 23	213	Po-213	4 / 71	240	Pu-240	2 / 247
65	Zn-65	3 / 33	137	Cs-137	3 / 91	214	Pb-214	4 / 75	240	Pu-240*	5 / 165
66	Ga-66	1 / 113	138	La-138*	8 / 167	214	Bi-214	4 / 83	241	Pu-241	4 / 259
67	Ga-67	1 / 133	139	Ce-139	4 / 31	214	Po-214	4 / 111	241	Am-241	2 / 257
67	Ga-67*	7 / 25	140	Ba-140	1 / 271	215	Bi-215	7 / 163	241	Am-241*	5 / 175
68	Ga-68	7 / 33	140	Ba-140*	8 / 173	215	Po-215	6 / 79	242	Pu-242	2 / 277
68	Ge-68	7 / 41	140	La-140	1 / 277	215	At-215	6 / 85	242	Pu-242*	5 / 197
73	Se-73	8 / 45	140	La-140*	8 / 181	216	Po-216	2 / 177	242	Am-242	5 / 203
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79	Se-79	3 / 39	144	Ce-144	8 / 191	217	Rn-217	4 / 117	242	Cm-242	3 / 185
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82	Sr-82	8 / 67	144	Pr-144m	8 / 209	218	At-218	4 / 125	243	Am-243	3 / 195
85	Kr-85	1 / 141	147	Nd-147	7 / 87	218	Rn-218	4 / 129	243	Am-243*	5 / 209
85	Sr-85	1 / 147	147	Pm-147	7 / 95	219	At-219	6 / 91	243	Cm-243	7 / 189
88	Y-88	1 / 153	148	Pm-148	8 / 217	219	Rn-219	6 / 95	244	Am-244	5 / 217
88	Y-88*	8 / 71	148	Pm-148m	8 / 227	220	Rn-220	2 / 183	244	Am-244m	5 / 223
89	Sr-89	1 / 161	151	Sm-151	8 / 239	221	Fr-221	4 / 135	244	Cm-244	3 / 203
89	Zr-89	8 / 79	152	Eu-152	2 / 1	222	Rn-222	4 / 143	244	Cm-244*	7 / 201
90	Sr-90	3 / 43	153	Sm-153	2 / 27	223	Fr-223	6 / 105	245	Cm-245	7 / 209
90	Y-90	3 / 47	153	Sm-153*	3 / 99	223	Ra-223	6 / 125	246	Cm-246	4 / 269
90	Y-90m	3 / 53	153	Gd-153	2 / 21	224	Ra-224	2 / 189	252	Cf-252	4 / 277
93	Zr-93	8 / 87	154	Eu-154	2 / 37	225	Ra-225	5 / 53			

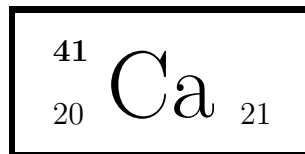
* : updated evaluations

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227	Ac-227	4 / 155	137	Cs-137	3 / 91	33	P-33	1 / 41	79	Se-79	3 / 39
228	Ac-228	6 / 139	61	Cu-61	8 / 25	231	Pa-231	6 / 165	151	Sm-151	8 / 239
108	Ag-108	3 / 59	64	Cu-64	1 / 105	233	Pa-233	3 / 123	153	Sm-153	2 / 27
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110	Ag-110	1 / 199	169	Er-169	8 / 245	234	Pa-234	6 / 177	82	Sr-82	8 / 67
110	Ag-110m	1 / 207	152	Eu-152	2 / 1	234	Pa-234m	6 / 213	85	Sr-85	1 / 147
241	Am-241	2 / 257	154	Eu-154	2 / 37	203	Pb-203	3 / 115	89	Sr-89	1 / 161
241	Am-241*	5 / 175	155	Eu-155	2 / 59	209	Pb-209	6 / 61	90	Sr-90	3 / 43
242	Am-242	5 / 203	18	F-18	1 / 21	210	Pb-210	4 / 51	182	Ta-182	6 / 49
242	Am-242m	6 / 267	52	Fe-52	8 / 13	211	Pb-211	7 / 135	94	Tc-94m	8 / 99
243	Am-243	3 / 195	55	Fe-55	3 / 5	212	Pb-212	2 / 167	99	Tc-99	6 / 21
243	Am-243*	5 / 209	59	Fe-59	1 / 99	214	Pb-214	4 / 75	99	Tc-99m	1 / 183
244	Am-244	5 / 217	221	Fr-221	4 / 135	109	Pd-109	6 / 27	123	Te-123m	1 / 229
244	Am-244m	5 / 223	223	Fr-223	6 / 105	147	Pm-147	7 / 95	127	Te-127	7 / 57
37	Ar-37	7 / 15	66	Ga-66	1 / 113	148	Pm-148	8 / 217	127	Te-127m	7 / 63
41	Ar-41	6 / 1	67	Ga-67	1 / 133	148	Pm-148m	8 / 227	132	Te-132	6 / 43
211	At-211	7 / 143	67	Ga-67*	7 / 25	209	Po-209	6 / 65	227	Th-227	2 / 201
215	At-215	6 / 85	68	Ga-68	7 / 33	210	Po-210	4 / 65	228	Th-228	2 / 227
217	At-217	5 / 47	153	Gd-153	2 / 21	211	Po-211	6 / 73	228	Th-228*	7 / 171
218	At-218	4 / 125	159	Gd-159	3 / 109	212	Po-212	2 / 173	231	Th-231	5 / 85
219	At-219	6 / 91	68	Ge-68	7 / 41	213	Po-213	4 / 71	232	Th-232	5 / 95
195	Au-195	7 / 101	3	H-3	3 / 1	214	Po-214	4 / 111	233	Th-233	3 / 133
198	Au-198	2 / 121	203	Hg-203	2 / 135	215	Po-215	6 / 79	233	Th-233*	5 / 101
198	Au-198*	8 / 251	206	Hg-206	7 / 107	216	Po-216	2 / 177	234	Th-234	5 / 127
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133	Ba-133*	8 / 159	166	Ho-166m	2 / 75	144	Pr-144	8 / 201	201	Tl-201	2 / 129
140	Ba-140	1 / 271	123	I-123	1 / 219	144	Pr-144m	8 / 209	204	Tl-204	2 / 141
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7	Be-7	1 / 1	129	I-129	1 / 243	238	Pu-238*	5 / 153	207	Tl-207	7 / 113
207	Bi-207	5 / 33	131	I-131	1 / 249	239	Pu-239	4 / 231	208	Tl-208	2 / 147
210	Bi-210	4 / 59	131	I-131*	8 / 145	240	Pu-240	2 / 247	208	Tl-208*	7 / 119
211	Bi-211	5 / 41	133	I-133	4 / 1	240	Pu-240*	5 / 165	209	Tl-209	7 / 127
212	Bi-212	2 / 155	111	In-111	3 / 75	241	Pu-241	4 / 259	210	Tl-210	4 / 45
213	Bi-213	7 / 153	40	K-40	5 / 7	242	Pu-242	2 / 277	170	Tm-170	2 / 99
214	Bi-214	4 / 83	85	Kr-85	1 / 141	242	Pu-242*	5 / 197	232	U-232	4 / 169
215	Bi-215	7 / 163	138	La-138*	8 / 167	223	Ra-223	6 / 125	234	U-234	3 / 147
11	C-11	1 / 7	140	La-140	1 / 277	224	Ra-224	2 / 189	235	U-235	5 / 133
14	C-14	7 / 1	140	La-140*	8 / 181	225	Ra-225	5 / 53	236	U-236	4 / 177
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109	Cd-109	1 / 191	56	Mn-56	1 / 77	228	Ra-228	5 / 81	238	U-238	3 / 177
109	Cd-109*	8 / 129	99	Mo-99	1 / 173	82	Rb-82	8 / 57	239	U-239	4 / 205
139	Ce-139	4 / 31	13	N-13	1 / 11	186	Re-186	2 / 113	239	U-239*	6 / 251
141	Ce-141	7 / 81	22	Na-22	5 / 1	106	Rh-106	8 / 115	127	Xe-127	8 / 137
144	Ce-144	8 / 191	24	Na-24	1 / 27	217	Rn-217	4 / 117	131	Xe-131m	1 / 257
252	Cf-252	4 / 277	93	Nb-93m	1 / 167	218	Rn-218	4 / 129	131	Xe-131m*	8 / 153
36	Cl-36	7 / 9	93	Nb-93m*	8 / 93	219	Rn-219	6 / 95	133	Xe-133	4 / 11
242	Cm-242	3 / 185	147	Nd-147	7 / 87	220	Rn-220	2 / 183	133	Xe-133m	4 / 17
242	Cm-242*	7 / 179	57	Ni-57	1 / 91	222	Rn-222	4 / 143	135	Xe-135m	4 / 23
243	Cm-243	7 / 189	59	Ni-59	6 / 7	106	Ru-106	8 / 111	88	Y-88	1 / 153
244	Cm-244	3 / 203	63	Ni-63	3 / 29	35	S-35	7 / 5	88	Y-88*	8 / 71
244	Cm-244*	7 / 201	236	Np-236	3 / 155	124	Sb-124	5 / 21	90	Y-90	3 / 47
245	Cm-245	7 / 209	236	Np-236*	6 / 231	125	Sb-125	1 / 235	90	Y-90m	3 / 53
246	Cm-246	4 / 269	236	Np-236m	3 / 163	125	Sb-125*	3 / 81	169	Yb-169	2 / 87
56	Co-56	3 / 11	237	Np-237	4 / 183	127	Sb-127	7 / 47	63	Zn-63	8 / 33
57	Co-57	1 / 83	237	Np-237*	6 / 239	44	Sc-44	1 / 45	65	Zn-65	3 / 33
58	Co-58	8 / 19	238	Np-238	4 / 195	46	Sc-46	1 / 57	89	Zr-89	8 / 79
60	Co-60	3 / 23	239	Np-239	4 / 221	47	Sc-47	8 / 7	93	Zr-93	8 / 87
51	Cr-51	1 / 63	15	O-15	1 / 17	73	Se-73	8 / 45			

* : updated evaluations



1 Decay Scheme

^{41}Ca disintegrates by 100% electron-capture transition to the ground state of the stable nuclide ^{41}K .

Le calcium 41 se désintègre exclusivement par capture électronique vers le niveau fondamental du potassium 41.

2 Nuclear Data

$$T_{1/2}(^{41}\text{Ca}) : 1,002 \quad (17) \quad 10^5 \text{ a}$$

$$Q^+(^{41}\text{Ca}) : 421,63 \quad (14) \quad \text{keV}$$

2.1 Electron Capture Transitions

	Energy (keV)	Probability (%)	Nature	$\lg ft$	P_K	P_L	P_{M+}
$\epsilon_{0,0}$	421,63 (14)	100	Unique 1st forbidden	10,53	0,894 (9)	0,0916 (9)	0,01482 (15)

3 Atomic Data

3.1 K

$$\omega_K : 0,143 \quad (4)$$

$$\bar{\omega}_L : 0,00181 \quad (36)$$

$$n_{KL} : 1,654 \quad (6)$$

3.1.1 X Radiations

	Energy (keV)		Relative probability	
X _K				
	Kα ₂	3,3111	50,55	
	Kα ₁	3,3138	100	
	Kβ ₁	3,5896	}	18,44
	Kβ ₅ ''	3,6028		
X _L				
	Lℓ	0,2604		
	Lη	0,263		
	Lβ	0,29654 - 0,3618		
	Lγ	0,29917 - 0,29917		

3.1.2 Auger Electrons

		Energy (keV)	Relative probability
Auger K			
	KLL	2,615 - 2,985	100
	KLX	3,183 - 3,296	24,5
	KXY	3,540 - 3,572	1,5
Auger L		0,226 - 0,342	

4 Electron Emissions

		Energy (keV)	Electrons (per 100 disint.)
e _{AL}	(K)	0,226 - 0,342	9,16 (9)
e _{AK}	(K)		} 76,6 (9)
	KLL	2,615 - 2,985	
	KLX	3,183 - 3,296	
	KXY	3,540 - 3,572	

5 Photon Emissions

5.1 X-Ray Emissions

		Energy (keV)	Photons (per 100 disint.)		
XL	(K)	0,2604 - 0,3618	0,017 (4)		
XK α_2	(K)	3,3111	3,82 (12)	}	K α
XK α_1	(K)	3,3138	7,56 (23)		
XK β_1	(K)	3,5896	}	1,40 (5)	K' β_1
XK β_5''	(K)	3,6028			

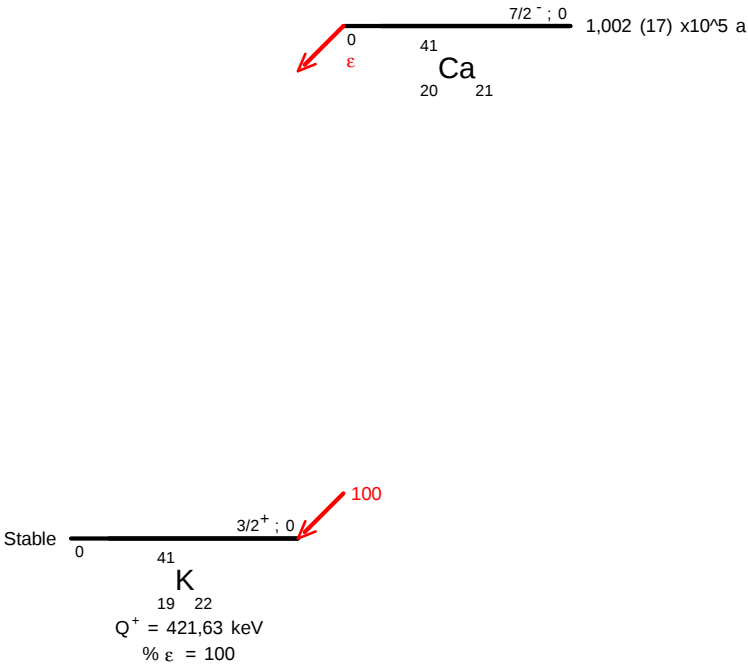
6 Main Production Modes

$$\begin{array}{ll} & {}^{40}\text{Ca}(n,\gamma){}^{41}\text{Ca} \quad \sigma : 0,41 \text{ (2) barns} \\ \text{Possible impurities : } & {}^{44}\text{Ca}(n,\gamma){}^{45}\text{Ca} \quad \sigma : 0,88 \text{ (5) barns} \end{array} \quad \left. \vphantom{\begin{array}{l} \\ \end{array}} \right\}$$

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1 Decay Scheme

Le scandium 47 se désintègre par émission bêta moins vers le niveau excité de 159 keV et le niveau fondamental du titane 47.

Sc-47 decays by beta minus emission to the 159 keV excited level and the ground state of Ti-47.

2 Nuclear Data

$$\begin{aligned}
 T_{1/2}(^{47}\text{Sc}) &: 3,3485 \quad (9) \quad \text{d} \\
 Q^{-}(^{47}\text{Sc}) &: 600,8 \quad (19) \quad \text{keV}
 \end{aligned}$$

2.1 β^{-} Transitions

	Energy (keV)	Probability (%)	Nature	lg ft
$\beta_{0,1}^{-}$	441,4 (19)	68,5 (5)	Allowed	5,3
$\beta_{0,0}^{-}$	600,8 (19)	31,5 (5)	Allowed	6,1

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy (keV)	P _{$\gamma+ce$} (%)	Multipolarity	α_K (10 ⁻³)	α_L (10 ⁻⁴)	α_M (10 ⁻⁵)	α_T (10 ⁻³)
$\gamma_{1,0}(\text{Ti})$	159,373 (12)	68,5 (5)	M1+0,97(17)%E2	5,60 (12)	5,12 (11)	6,54 (14)	6,18 (13)

3 Atomic Data

3.1 Ti

ω_K	:	0,226	(5)
$\bar{\omega}_L$	:	0,00321	(64)
n_{KL}	:	1,566	(5)

3.1.1 X Radiations

	Energy (keV)	Relative probability
X _K		
K α_2	4,50491	50,76
K α_1	4,5109	100
K β_1	4,93186	} 19,98
K β_5''	4,9623	

3.1.2 Auger Electrons

	Energy (keV)	Relative probability
Auger K		
KLL	3,79 - 4,01	100
KLX	4,33 - 4,48	18,9
KXY	4,83 - 4,90	1,35
Auger L		
	0,3 - 0,5	

4 Electron Emissions

		Energy (keV)	Electrons (per 100 disint.)
e _{AL}	(Ti)	0,3 - 0,5	0,0349 (8)
e _{AK}	(Ti)		
	KLL	3,79 - 4,01	} 0,295 (7)
	KLX	4,33 - 4,48	
	KXY	4,83 - 4,90	
ec _{1,0} K	(Ti)	154,407 (12)	0,381 (9)
ec _{1,0} L	(Ti)	158,809 - 158,918	0,0349 (8)
$\beta_{0,1}^-$	max:	441,4 (19)	} 68,5 (5)
	avg:	142,8 (7)	
$\beta_{0,0}^-$	max:	600,8 (19)	} 31,5 (5)
	avg:	204,2 (8)	

5 Photon Emissions

5.1 X-Ray Emissions

		Energy (keV)	Photons (per 100 disint.)		
XK α_2	(Ti)	4,50491	0,0256 (9)	}	K α
XK α_1	(Ti)	4,5109	0,0505 (16)		
XK β_1	(Ti)	4,93186	0,0101 (4)	}	K' β_1
XK β_5''	(Ti)	4,9623			

5.2 Gamma Emissions

	Energy (keV)	Photons (per 100 disint.)
$\gamma_{1,0}(\text{Ti})$	159,373 (12)	68,1 (5)

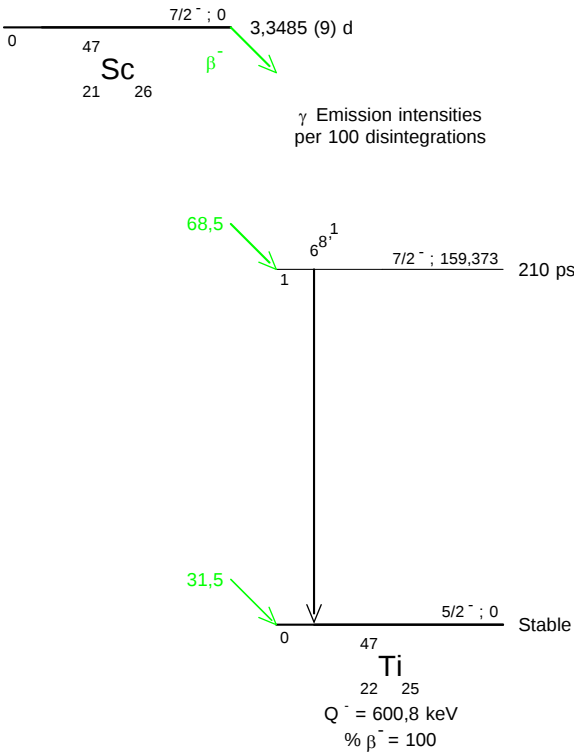
6 Main Production Modes

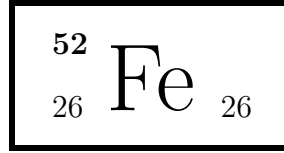
- { Ti – 47(n,p)Sc – 47 σ : 0,23 (4) barns
- { Possible impurities: Sc – 46, Sc – 48, Ca – 45
- { Ca – 48(p,2n)Sc – 47
- { Possible impurities: Sc – 46, Sc – 48
- { Ti – 49(d, α)Sc – 47
- { Possible impurities: Ca – 45
- Ca – 44(α ,p)Sc – 47
- Ca – 46(d,n)Sc – 47
- Ca – 46(p, γ)Sc – 47

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1 Decay Scheme

Fe-52 disintegrates 100% by electron capture and positron decay to excited levels in Mn-52.

Le fer 52 se désintègre par capture électronique et émissions bêta plus sur des niveaux excités de manganèse 52.

2 Nuclear Data

$T_{1/2}(^{52}\text{Fe})$	:	8,273	(8)	h
$T_{1/2}(^{52}\text{Mn})$	:	5,591	(3)	d
$T_{1/2}(^{52\text{m}}\text{Mn})$	:	21,1	(2)	min
$Q^+(^{52}\text{Fe})$	:	2375	(6)	keV

2.1 Electron Capture Transitions

	Energy (keV)	Probability (%)	Nature	lg ft	P_K	P_L	P_M
$\epsilon_{0,3}$	957 (6)	0,095 (4)	Allowed	5,8	0,8892 (16)	0,0950 (13)	0,0151 (5)
$\epsilon_{0,2}$	1829 (6)	43,8 (13)		4,7	0,8898 (16)	0,0946 (13)	0,0150 (5)

2.2 β^+ Transitions

	Energy (keV)	Probability (%)	Nature	lg ft
$\beta_{0,2}^+$	807 (6)	56,1 (7)	Allowed	4,7

2.3 Gamma Transitions and Internal Conversion Coefficients

	Energy (keV)	P _{γ+ce} (%)	Multipolarity	α _K	α _L	α _M	α _T
γ _{2,1} (Mn)	168,689 (8)	99,9 (15)	M1	0,00705 (10)	0,000679 (10)	0,0000922 (13)	0,00783 (11)
γ _{1,0} (Mn)	377,749 (5)	1,705 (42)	E4	0,0356 (5)	0,00382 (6)	0,000515 (8)	0,0399 (6)
γ _{3,1} (Mn)	1039,939 (19)	0,095 (4)	M1+E2	0,000130 (15)	0,0000122 (14)	0,00000165 (19)	0,000143 (16)

3 Atomic Data

3.1 Mn

ω _K	:	0,321	(5)
ω̄ _L	:	0,0047	(7)
n _{KL}	:	1,478	(4)

3.1.1 X Radiations

	Energy (keV)	Relative probability
X _K		
Kα ₂	5,88772	50,99
Kα ₁	5,89881	100
Kβ ₁	6,49051	} 20,52
Kβ ₅ ''	6,5354	
X _L		
Lℓ	0,5576	
Lα	0,6394 - 0,6404	
Lη	0,5695	
Lβ	0,64636 - 0,7694	
Lγ	0,65826 - 0,65826	

3.1.2 Auger Electrons

	Energy (keV)	Relative probability
Auger K		
KLL	4,953 - 5,210	100
KLX	5,671 - 5,895	27,2
KXY	6,370 - 6,532	1,85
Auger L	0,4725 - 0,7653	

4 Electron and Positron Emissions

		Energy (keV)	Electrons (per 100 disint.)
e _{AL}	(Mn)	0,4725 - 0,7653	57,1 (15)
e _{AK}	(Mn)		
	KLL	4,953 - 5,210	} 26,3 (11)
	KLX	5,671 - 5,895	
	KXY	6,370 - 6,532	
ec _{2,1} T	(Mn)	162,150 - 168,689	0,777 (24)
ec _{2,1} K	(Mn)	162,150 (8)	0,699 (21)
ec _{2,1} L	(Mn)	167,920 - 168,049	0,0674 (21)
ec _{1,0} K	(Mn)	371,210 (5)	0,0585 (15)
$\beta_{0,2}^+$	max: avg:	807 (6)	} 56,1 (7)

5 Photon Emissions

5.1 X-Ray Emissions

		Energy (keV)	Photons (per 100 disint.)	
XL	(Mn)	0,5576 - 0,7694	0,213 (10)	
XK α_2	(Mn)	5,88772	3,70 (17)	} K α
XK α_1	(Mn)	5,89881	7,3 (4)	
XK β_1	(Mn)	6,49051	} 1,49 (7)	K' β_1
XK β_5''	(Mn)	6,5354		

5.2 Gamma Emissions

	Energy (keV)	Photons (per 100 disint.)
$\gamma_{2,1}$ (Mn)	168,689 (8)	99,1 (15)
$\gamma_{1,0}$ (Mn)	377,749 (5)	1,64 (4)
$\gamma^\pm$	511	112,2 (14)
$\gamma_{3,1}$ (Mn)	1039,939 (19)	0,095 (4)

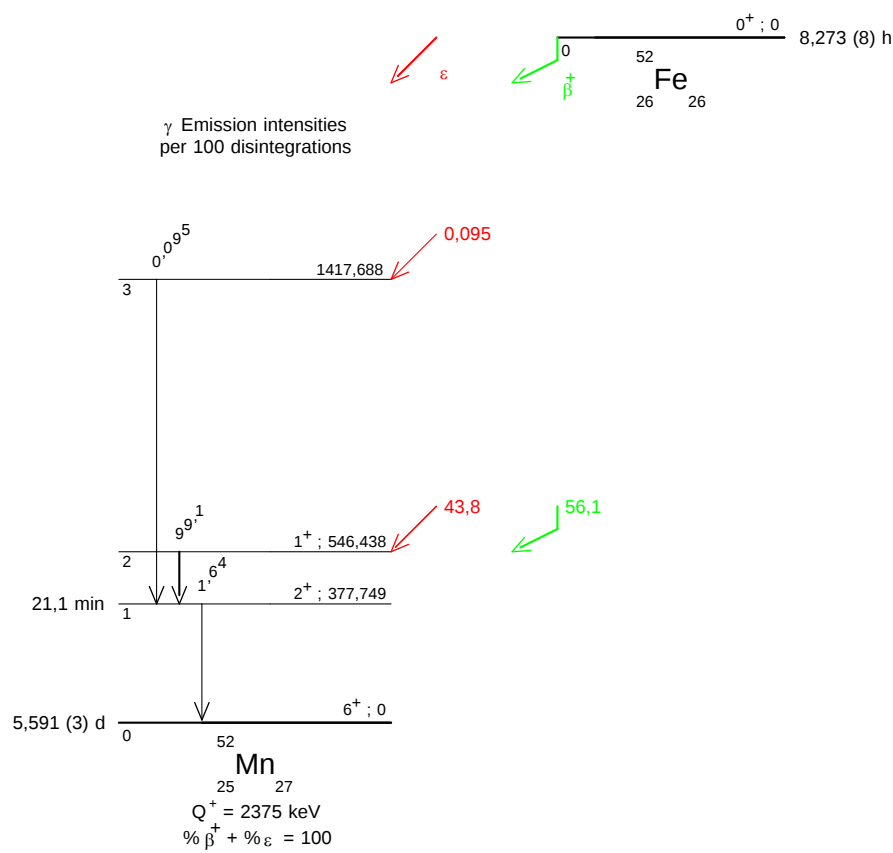
6 Main Production Modes

Cr – 50(α ,2n)Fe – 52

Mn – 55(p,4n)Fe – 52

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(Q)





1 Decay Scheme

Co-58 decays 100% by electron capture and beta plus disintegrations to the two first excited levels in Fe-58.

Le cobalt 58 se désintègre à 100 % par capture électronique et transitions bêta plus vers les deux premiers niveaux excités du fer 58.

2 Nuclear Data

$$T_{1/2}({}^{58}\text{Co}) : 70,85 \quad (3) \quad \text{d}$$

$$Q^+({}^{58}\text{Co}) : 2307,9 \quad (11) \quad \text{keV}$$

2.1 Electron Capture Transitions

	Energy (keV)	Probability (%)	Nature	lg <i>ft</i>	<i>P_K</i>	<i>P_L</i>	<i>P_{M+}</i>
ε _{0,2}	633,2 (11)	1,228 (35)	Allowed	7,7	0,8873 (16)	0,0965 (13)	0,0155 (5)
ε _{0,1}	1497,1 (11)	83,83 (16)	Allowed	6,6	0,8885 (16)	0,0955 (13)	0,0153 (5)

2.2 β⁺ Transitions

	Energy (keV)	Probability (%)	Nature	lg <i>ft</i>
β _{0,1} ⁺	475,1 (11)	14,94 (16)	Allowed	6,6
β _{0,0} ⁺	1285,9 (11)	0,0008 (7)	2nd Forbidden	12,8

2.3 Gamma Transitions and Internal Conversion Coefficients

	Energy (keV)	P _{γ+ce} (%)	Multipolarity	α _K	α _L	α _T	α _π
γ _{1,0} (Fe)	810,7662 (20)	99,473 (20)	E2	0,000299 (5)	0,0000287 (4)	0,000332 (5)	
γ _{2,1} (Fe)	863,965 (6)	0,700 (22)	M1+E2	0,000208 (4)	0,0000199 (4)	0,000231 (4)	
γ _{2,0} (Fe)	1674,731 (6)	0,528 (13)	E2	0,0000577 (8)	0,00000547 (8)	0,000225 (4)	0,0001606 (23)

3 Atomic Data

3.1 Fe

ω _K	:	0,355	(4)
ω̄ _L	:	0,0060	(6)
n _{KL}	:	1,447	(4)

3.1.1 X Radiations

	Energy (keV)	Relative probability
X _K		
Kα ₂	6,39091	51,07
Kα ₁	6,40391	100
Kβ ₁	7,0581	} 20,67
Kβ ₅ ''	7,1083	
X _L		
Lℓ	0,617	
Lα	0,7075 - 0,7084	
Lη	0,6306	
Lβ	0,7148 - 0,8454	
Lγ	0,7284 - 0,7284	

3.1.2 Auger Electrons

	Energy (keV)	Relative probability
Auger K		
KLL	5,37 - 5,65	100
KLX	6,16 - 6,40	27,4
KXY	6,93 - 7,11	1,87
Auger L	0,52 - 0,84	

4 Electron and Positron Emissions

		Energy (keV)	Electrons (per 100 disint.)
e _{AL}	(Fe)	0,52 - 0,84	116,9 (7)
e _{AK}	(Fe)	$\left. \begin{array}{l} \text{KLL} \\ \text{KLX} \\ \text{KXY} \end{array} \right\}$	48,8 (4)
	KLL	5,37 - 5,65	
	KLX	6,16 - 6,40	
	KXY	6,93 - 7,11	
ec _{1,0 K}	(Fe)	803,654 (2)	0,0297 (5)
$\beta_{0,1}^+$	max:	475,1 (11)	} 14,94 (16)
	avg:	201,3 (5)	
$\beta_{0,0}^+$	max:	1285,9 (11)	} 0,0008 (7)
	avg:		

5 Photon Emissions

5.1 X-Ray Emissions

		Energy (keV)	Photons (per 100 disint.)	
XL	(Fe)	0,617 - 0,8454	0,609 (18)	
XK α_2	(Fe)	6,39091	7,98 (11)	} K α
XK α_1	(Fe)	6,40391	15,63 (19)	
XK β_1	(Fe)	7,0581	} 3,23 (5)	K' β_1
XK β_5''	(Fe)	7,1083		

5.2 Gamma Emissions

	Energy (keV)	Photons (per 100 disint.)
$\gamma^\pm$	511	29,88 (32)
$\gamma_{1,0}(\text{Fe})$	810,7602 (20)	99,44 (2)
$\gamma_{2,1}(\text{Fe})$	863,958 (6)	0,700 (22)
$\gamma_{2,0}(\text{Fe})$	1674,705 (6)	0,528 (13)

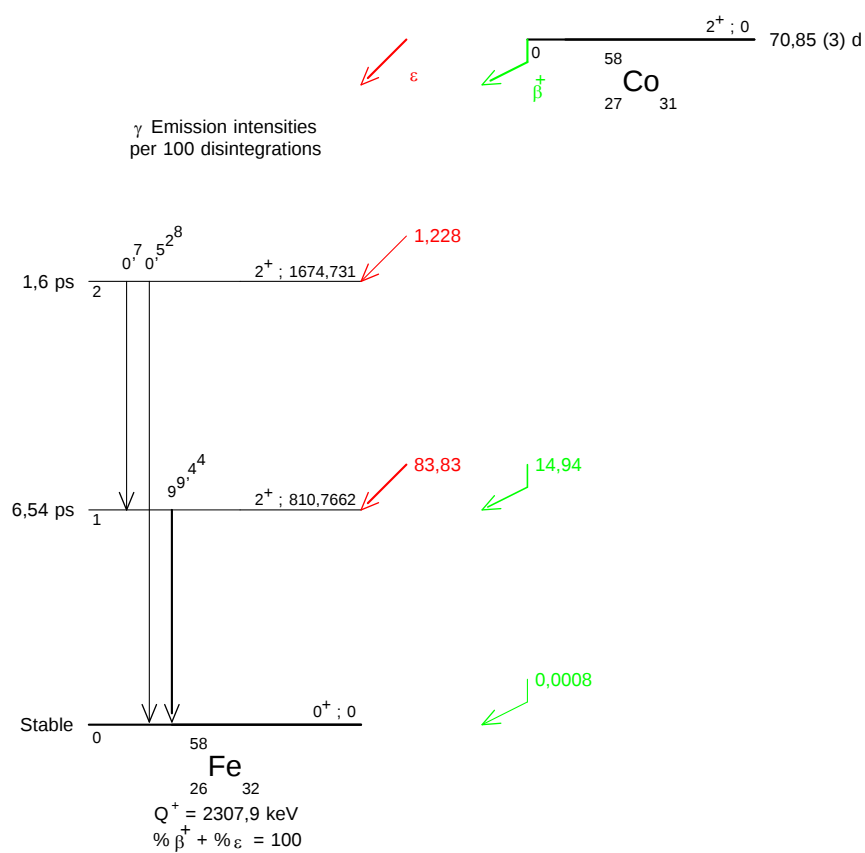
6 Main Production Modes

- { Ni – 58(n,p)Co – 58
Possible impurities : Ni – 63, Co – 57, Co – 58m, Co – 60
- { Mn – 55(α,n)Co – 58
Possible impurities : none
- { Co – 59(n,2n)Co – 58
Possible impurities : Fe – 59, Co – 58m, Co – 60

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(Q)





1 Decay Scheme

Cu-61 decays 100% by electron capture and beta plus disintegrations to various excited levels and to the ground state of Ni-61.

Le cuivre 61 se désintègre par capture électronique et émissions bêta plus vers le niveau fondamental et des niveaux excités du nickel 61.

2 Nuclear Data

$$T_{1/2}({}^{61}\text{Cu}) : 3,366 \quad (33) \quad \text{h}$$

$$Q^+({}^{61}\text{Cu}) : 2237,5 \quad (10) \quad \text{keV}$$

2.1 Electron Capture Transitions

	Energy (keV)	Probability (%)	Nature	lg <i>ft</i>	<i>P_K</i>	<i>P_L</i>	<i>P_M</i>
ε _{0,12}	113,5 (10)	0,040 (5)	Allowed	5	0,8729 (22)	0,1083 (18)	0,0178 (6)
ε _{0,11}	239,8 (10)	0,0043 (14)	Allowed	6,7	0,8808 (17)	0,1016 (14)	0,0166 (5)
ε _{0,10}	508 (1)	0,228 (18)	Allowed	5,7	0,8843 (16)	0,0987 (13)	0,0160 (5)
ε _{0,9}	627,9 (10)	0,063 (7)	Allowed	6,5	0,8849 (16)	0,0982 (13)	0,0160 (5)
ε _{0,8}	1052,3 (10)	4,1 (5)	Allowed	5	0,8859 (16)	0,0974 (13)	0,0158 (5)
ε _{0,7}	1105,2 (10)	0,154 (17)	Allowed	6,5	0,8860 (16)	0,0973 (13)	0,0158 (5)
ε _{0,6}	1137,9 (10)	0,64 (6)	Allowed	5,9	0,8860 (16)	0,0973 (13)	0,0158 (5)
ε _{0,5}	1222,7 (10)	0,006 (6)	2nd Forbidden	7,8	0,8861 (16)	0,0972 (13)	0,0158 (5)
ε _{0,4}	1328,9 (10)	1,32 (15)	Allowed	5,7	0,8862 (16)	0,0971 (13)	0,0158 (5)
ε _{0,3}	1581,5 (10)	10,7 (12)	Allowed	4,9	0,8864 (16)	0,0970 (13)	0,0157 (5)
ε _{0,2}	1954,5 (10)	4,0 (7)	Allowed	5,5	0,8866 (16)	0,0968 (13)	0,0157 (5)
ε _{0,1}	2170,1 (10)	0,79 (20)	Allowed	6,3	0,8866 (16)	0,0968 (13)	0,0157 (5)
ε _{0,0}	2237,5 (10)	16,3 (8)	Allowed	5	0,8867 (16)	0,0967 (13)	0,0157 (5)

2.2 β^+ Transitions

	Energy (keV)	Probability (%)	Nature	lg ft
$\beta_{0,5}^+$	200,7 (10)	0,000032 (32)	2nd Forbidden	7,8
$\beta_{0,4}^+$	306,9 (10)	0,0347 (40)	Allowed	5,7
$\beta_{0,3}^+$	559,5 (10)	2,52 (27)	Allowed	4,9
$\beta_{0,2}^+$	932,5 (10)	5,4 (9)	Allowed	5,5
$\beta_{0,1}^+$	1148,1 (10)	2,1 (5)	Allowed	6,3
$\beta_{0,0}^+$	1215,5 (10)	51,6 (25)	Allowed	5

2.3 Gamma Transitions and Internal Conversion Coefficients

	Energy (keV)	P _{$\gamma+ce$} (%)	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{1,0}(\text{Ni})$	67,412 (3)	4,5 (7)	(M1)	0,1224 (18)	0,01261 (18)	0,001776 (25)	0,1368 (20)
$\gamma_{7,5}(\text{Ni})$	117,5	0,010 (6)					
$\gamma_{2,1}(\text{Ni})$	215,545 (4)	0,013 (7)					
$\gamma_{2,0}(\text{Ni})$	282,9568 (19)	12,0 (17)	(M1)	0,00295 (5)	0,000293 (5)	0,0000413 (6)	0,00329 (5)
$\gamma_{3,2}(\text{Ni})$	373,0552 (36)	2,09 (30)	[M1]	0,00153 (2)	0,000151 (2)	0,0000213 (3)	0,00170 (2)
$\gamma_{8,3}(\text{Ni})$	529,224 (11)	0,38 (5)					
$\gamma_{10,8}(\text{Ni})$	544,8	0,006 (4)					
$\gamma_{3,1}(\text{Ni})$	588,600 (4)	1,15 (16)	[E2]				
$\gamma_{4,2}(\text{Ni})$	625,663 (11)	0,044 (7)	[E2]				
$\gamma_{3,0}(\text{Ni})$	656,012 (3)	10,4 (15)	(M1+E2)				
$\gamma_{9,4}(\text{Ni})$	701,019 (24)	0,0108 (28)					
$\gamma_{6,2}(\text{Ni})$	816,665 (10)	0,32 (5)	M1+5,0(15)%E2				
$\gamma_{10,4}(\text{Ni})$	820,851 (15)	0,0216 (39)					
$\gamma_{4,1}(\text{Ni})$	841,208 (11)	0,224 (34)	M1+77(8)%E2				
$\gamma_{8,2}(\text{Ni})$	902,279 (11)	0,084 (12)					
$\gamma_{4,0}(\text{Ni})$	908,620 (11)	1,12 (16)	M1+3,2(9)%E2				
$\gamma_{5,1}(\text{Ni})$	947,39 (40)	0,0060 (19)	M1+86(5)%E2				
$\gamma_{5,0}(\text{Ni})$	1014,8 (4)	0,0103 (39)	E2+0,09(9)%M3	0,0002 (6)	0,00002 (6)	0,000003 (8)	0,0002 (6)
$\gamma_{6,1}(\text{Ni})$	1032,21 (1)	0,053 (10)					
$\gamma_{7,1}(\text{Ni})$	1064,920 (17)	0,052 (9)	M1+1,9(16)%E2				
$\gamma_{10,3}(\text{Ni})$	1073,459 (10)	0,042 (11)					
$\gamma_{11,4}(\text{Ni})$	1089,1 (9)	0,00060 (8)					
$\gamma_{6,0}(\text{Ni})$	1099,622 (10)	0,257 (39)					
$\gamma_{8,1}(\text{Ni})$	1117,824 (11)	0,039 (9)					
$\gamma_{7,0}(\text{Ni})$	1132,332 (17)	0,092 (13)	M1+18,1(35)%E2				
$\gamma_{8,0}(\text{Ni})$	1185,236 (11)	3,6 (5)	(M1+E2)				
$\gamma_{10,2}(\text{Ni})$	1446,514 (10)	0,046 (7)					
$\gamma_{9,1}(\text{Ni})$	1542,227 (21)	0,029 (5)	M1+0,49(35)%E2				
$\gamma_{9,0}(\text{Ni})$	1609,639 (21)	0,0236 (43)	M1+9,8(42)%E2				
$\gamma_{10,1}(\text{Ni})$	1662,059 (10)	0,051 (8)					
$\gamma_{10,0}(\text{Ni})$	1729,471 (10)	0,065 (14)					
$\gamma_{11,0}(\text{Ni})$	1997,7 (9)	0,0037 (13)	M1+6,8(15)%E2				
$\gamma_{12,0}(\text{Ni})$	2124 (1)	0,040 (6)					

3 Atomic Data

3.1 Ni

ω_K	:	0,421	(4)
$\bar{\omega}_L$	:	0,0084	(4)
n_{KL}	:	1,388	(4)

3.1.1 X Radiations

	Energy (keV)		Relative probability
X _K			
K α_2	7,46097		51,24
K α_1	7,47824		100
K β_1	8,26475	}	20,84
K β_5''	8,3287		
X _L			
L ℓ	0,7445		
L α	0,8532 - 0,8539		
L η	0,7622		
L β	0,86123 - 1,0083		
L γ	0,87898 - 0,87898		

3.1.2 Auger Electrons

	Energy (keV)	Relative probability
Auger K		
KLL	6,262 - 6,567	100
KLX	7,196 - 7,475	27,6
KXY	8,109 - 8,326	1,9
Auger L	0,632 - 1,010	

4 Electron and Positron Emissions

		Energy (keV)		Electrons (per 100 disint.)
e _{AL}	(Ni)	0,632 - 1,010		51,2 (9)
e _{AK}	(Ni)		}	20,0 (9)
	KLL	6,262 - 6,567		
	KLX	7,196 - 7,475		
	KXY	8,109 - 8,326		
ec _{1,0 T}	(Ni)	59,079 - 67,412		0,55 (8)
ec _{1,0 K}	(Ni)	59,079 (3)		0,49 (7)
ec _{1,0 L}	(Ni)	66,404 - 66,557		0,050 (8)
ec _{2,0 K}	(Ni)	274,6240 (19)		0,035 (5)
$\beta_{0,0}^+$	max:	1215,5 (10)	}	51,6 (25)
	avg:	523,8 (5)		
$\beta_{0,1}^+$	max:	1148,1 (10)	}	2,1 (5)
	avg:	493,8 (5)		
$\beta_{0,2}^+$	max:	932,5 (10)	}	5,4 (9)
	avg:	398,9 (5)		
$\beta_{0,3}^+$	max:	559,5 (10)	}	2,52 (27)
	avg:	238,5 (4)		
$\beta_{0,4}^+$	max:	306,9 (10)	}	0,0347 (40)
	avg:	132,8 (4)		
$\beta_{0,5}^+$	max:	200,7 (10)	}	0,000032 (32)
	avg:	88,7 (4)		

5 Photon Emissions

5.1 X-Ray Emissions

		Energy (keV)		Photons (per 100 disint.)	
XL	(Ni)	0,7445 - 1,0083		0,437 (14)	
XK α_2	(Ni)	7,46097		4,33 (20)	} K α
XK α_1	(Ni)	7,47824		8,4 (4)	
XK β_1	(Ni)	8,26475	}	1,76 (9)	K' β_1
XK β_5''	(Ni)	8,3287			

5.2 Gamma Emissions

	Energy (keV)	Photons (per 100 disint.)
$\gamma_{1,0}(\text{Ni})$	67,412 (3)	4,0 (6)
$\gamma_{7,5}(\text{Ni})$	117,5	0,010 (6)
$\gamma_{2,1}(\text{Ni})$	215,55 (18)	0,013 (7)
$\gamma_{2,0}(\text{Ni})$	282,956 (2)	12,0 (17)
$\gamma_{3,2}(\text{Ni})$	373,050 (5)	2,09 (30)
$\gamma^{\pm}$	511	123 (5)
$\gamma_{8,3}(\text{Ni})$	529,169 (22)	0,38 (5)
$\gamma_{10,8}(\text{Ni})$	544,8	0,006 (4)
$\gamma_{3,1}(\text{Ni})$	588,605 (9)	1,15 (16)
$\gamma_{4,2}(\text{Ni})$	625,605 (24)	0,044 (7)
$\gamma_{3,0}(\text{Ni})$	656,008 (4)	10,4 (15)
$\gamma_{9,4}(\text{Ni})$	701,1 (3)	0,0108 (28)
$\gamma_{6,2}(\text{Ni})$	816,692 (13)	0,32 (5)
$\gamma_{10,4}(\text{Ni})$	820,89 (17)	0,0216 (39)
$\gamma_{4,1}(\text{Ni})$	841,211 (17)	0,224 (34)
$\gamma_{8,2}(\text{Ni})$	902,294 (20)	0,084 (12)
$\gamma_{4,0}(\text{Ni})$	908,631 (17)	1,12 (16)
$\gamma_{5,1}(\text{Ni})$	947,4 (4)	0,0060 (19)
$\gamma_{5,0}(\text{Ni})$	1014,8 (4)	0,0103 (39)
$\gamma_{6,1}(\text{Ni})$	1032,162 (10)	0,053 (10)
$\gamma_{7,1}(\text{Ni})$	1064,896 (20)	0,052 (9)
$\gamma_{10,3}(\text{Ni})$	1073,465 (25)	0,042 (11)
$\gamma_{11,4}(\text{Ni})$	1089,11	0,00060 (8)
$\gamma_{6,0}(\text{Ni})$	1099,560 (19)	0,257 (39)
$\gamma_{8,1}(\text{Ni})$	1117,822 (43)	0,039 (9)
$\gamma_{7,0}(\text{Ni})$	1132,35 (3)	0,092 (13)
$\gamma_{8,0}(\text{Ni})$	1185,234 (15)	3,6 (5)
$\gamma_{10,2}(\text{Ni})$	1446,492 (19)	0,046 (7)
$\gamma_{9,1}(\text{Ni})$	1542,204 (23)	0,029 (5)
$\gamma_{9,0}(\text{Ni})$	1609,625 (48)	0,0236 (43)
$\gamma_{10,1}(\text{Ni})$	1662,000 (19)	0,051 (8)
$\gamma_{10,0}(\text{Ni})$	1729,473 (18)	0,065 (14)
$\gamma_{11,0}(\text{Ni})$	1997,7 (9)	0,0037 (13)
$\gamma_{12,0}(\text{Ni})$	2124 (1)	0,040 (6)

6 Main Production Modes

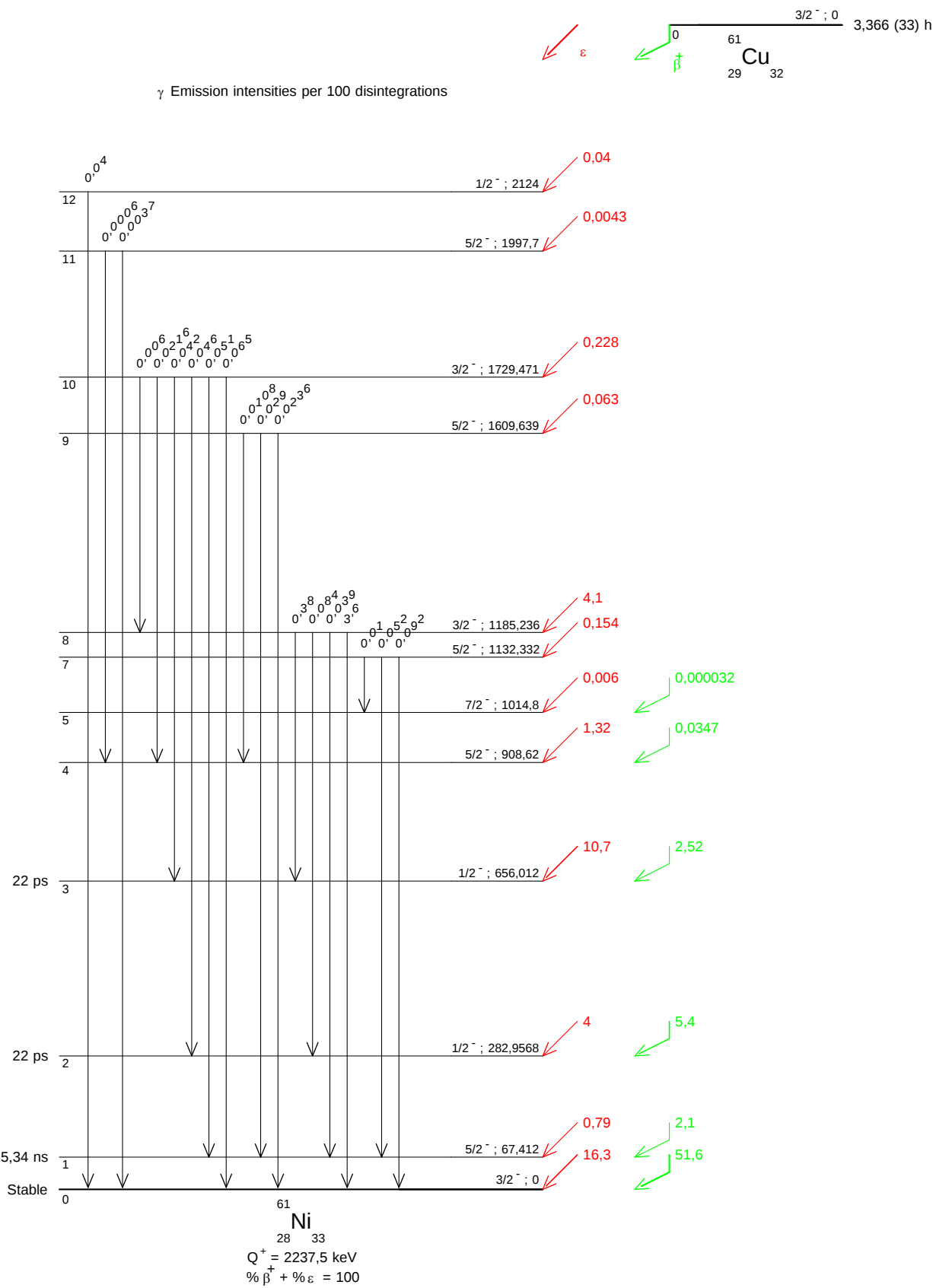
Ni – $61(\text{p,n})\text{Cu} - 61$

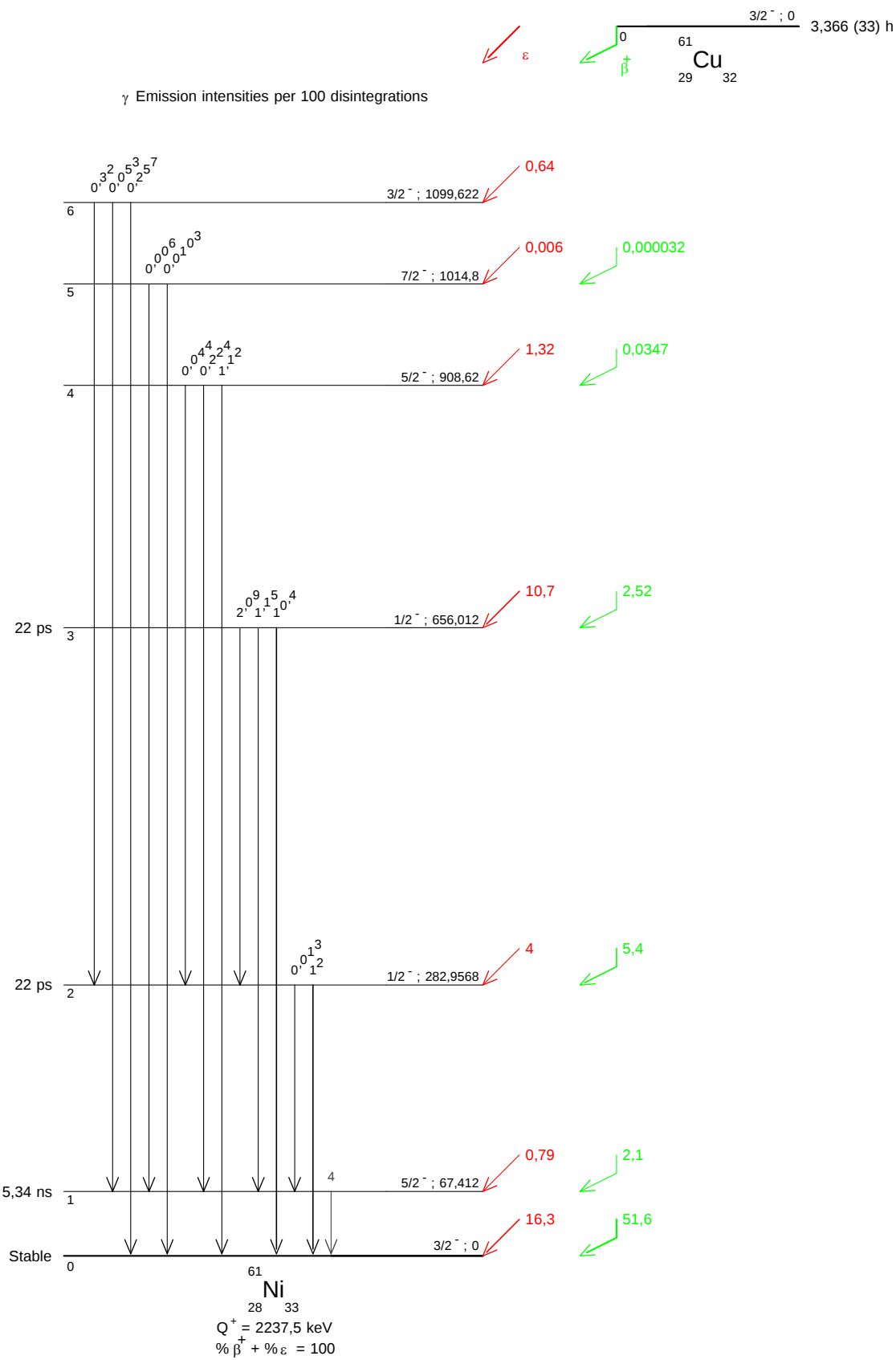
Zn – $64(\text{p},\alpha)\text{Cu} - 61$

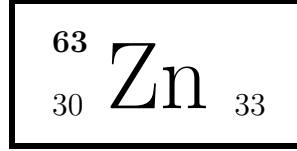
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(Q-value)







1 Decay Scheme

Zn-63 (half-life of 38.33 min) decays by 100% electron capture/beta plus to various excited levels and the ground state of Cu-63 (stable).

Le zinc 63 (38,33 min) se désintègre à 100 % par capture électronique/émission bêta plus vers plusieurs niveaux excités et le niveau fondamental du cuivre 63 (stable).

2 Nuclear Data

$$T_{1/2}({}^{63}\text{Zn}) : 38,33 \quad (10) \quad \text{min}$$

$$Q^+({}^{63}\text{Zn}) : 3366,2 \quad (15) \quad \text{keV}$$

2.1 Electron Capture Transitions

	Energy (keV)	Probability (%)	Nature	lg <i>ft</i>	<i>P_K</i>	<i>P_L</i>	<i>P_{M+}</i>
ε _{0,22}	264,8 (16)	0,0007 (2)	allowed	6,89	0,8802 (16)	0,1020 (13)	0,0168 (5)
ε _{0,21}	323,6 (15)	0,0048 (8)	(allowed)	6,24	0,8814 (16)	0,1010 (13)	0,0166 (5)
ε _{0,20}	477,3 (16)	0,0104 (14)	allowed	6,24	0,8831 (16)	0,0996 (13)	0,0163 (5)
ε _{0,19}	508,3 (15)	0,0069 (12)	(allowed)	6,48	0,8833 (16)	0,0994 (13)	0,0163 (5)
ε _{0,18}	558,1 (15)	0,0052 (10)	allowed	6,68	0,8836 (16)	0,0992 (13)	0,0162 (5)
ε _{0,17}	586,0 (15)	0,0298 (21)	(allowed)	5,97	0,8837 (16)	0,0991 (13)	0,0162 (5)
ε _{0,16}	649,7 (15)	0,082 (7)	allowed	5,62	0,8840 (16)	0,0988 (13)	0,0162 (5)
ε _{0,15}	669,5 (15)	0,122 (6)	allowed	5,47	0,8841 (16)	0,0988 (13)	0,0161 (5)
ε _{0,14}	830,4 (15)	0,261 (14)	(allowed)	5,33	0,8846 (16)	0,0984 (13)	0,0161 (5)
ε _{0,13}	855,1 (15)	0,011 (2)	[allowed]	6,73	0,8846 (16)	0,0983 (13)	0,0161 (5)
ε _{0,12}	869,0 (15)	0,0247 (20)	(allowed)	6,40	0,8846 (16)	0,0983 (13)	0,0161 (5)
ε _{0,11}	1029,7 (15)	0,141 (9)	allowed	5,79	0,8849 (16)	0,0980 (13)	0,0160 (5)
ε _{0,9}	1284,9 (15)	0,035 (7)	(allowed)	6,59	0,8853 (16)	0,0978 (13)	0,0160 (5)
ε _{0,8}	1303,8 (15)	0,153 (13)	(allowed)	5,96	0,8853 (16)	0,0978 (13)	0,0160 (5)
ε _{0,7}	1353,3 (15)	0,0130 (3)	allowed	7,06	0,8853 (16)	0,0977 (13)	0,0160 (5)
ε _{0,5}	1819,2 (15)	0,060 (7)	allowed	6,65	0,8856 (16)	0,0975 (13)	0,0159 (5)
ε _{0,4}	1954,0 (15)	0,42 (2)	allowed	5,87	0,8857 (16)	0,0974 (13)	0,0159 (5)

	Energy (keV)	Probability (%)	Nature	lg <i>ft</i>	<i>P_K</i>	<i>P_L</i>	<i>P_{M+}</i>
ε _{0,2}	2404,2 (15)	1,19 (3)	allowed	5,60	0,8858 (16)	0,0973 (13)	0,0159 (5)
ε _{0,1}	2696,3 (15)	0,92 (1)	allowed	5,81	0,8859 (16)	0,0972 (13)	0,0159 (5)
ε _{0,0}	3366,2 (15)	3,75 (5)	allowed	5,40	0,8860 (16)	0,0971 (13)	0,0158 (5)

2.2 β⁺ Transitions

	Energy (keV)	Probability (%)	Nature	lg <i>ft</i>
β _{0,9} ⁺	262,9 (15)	0,00043 (9)	(allowed)	6,59
β _{0,8} ⁺	281,8 (15)	0,0025 (2)	(allowed)	5,96
β _{0,7} ⁺	331,3 (15)	0,00039 (2)	allowed	7,06
β _{0,5} ⁺	797,2 (15)	0,042 (4)	allowed	6,65
β _{0,4} ⁺	932,0 (15)	0,49 (2)	allowed	5,87
β _{0,2} ⁺	1382,2 (15)	4,96 (13)	allowed	5,60
β _{0,1} ⁺	1674,3 (15)	7,00 (2)	allowed	5,81
β _{0,0} ⁺	2344,2 (15)	80,3 (6)	allowed	5,40

2.3 Gamma Transitions and Internal Conversion Coefficients

	Energy (keV)	P _{γ+ce} (%)	Multipolarity	α _K	α _L	α _T
γ _{17,14} (Cu)	244,40 (22)	0,0054 (8)	(E2)	0,0190 (3)	0,00198 (3)	0,0213 (3)
γ _{3,2} (Cu)	364,74 (6)	0,0115 (25)	M1+0,36%E2	0,00184 (3)	0,000184 (3)	0,00205 (3)
γ _{14,10} (Cu)	443,70 (12)	0,013 (4)	(M1+50%E2)	0,00177 (14)	0,000179 (14)	0,00198 (16)
γ _{4,2} (Cu)	450,14 (5)	0,229 (16)	M1+1,3%E2	0,00114 (4)	0,000113 (5)	0,00127 (5)
γ _{11,6} (Cu)	475,91 (13)	0,006 (3)	M1+E2			
γ _{8,5} (Cu)	515,45 (9)	0,021 (8)	(M1+E2)			
γ _{9,5} (Cu)	534,32 (23)	0,005 (2)	(M1+E2)			
γ _{5,2} (Cu)	584,98 (6)	0,033 (4)	M1+E2			
γ _{16,10} (Cu)	624,34 (13)	0,011 (4)	(E2)			
γ _{1,0} (Cu)	669,93 (4)	8,19 (32)	M1+1,2%E2	0,000466 (7)	0,0000462 (7)	0,000519 (8)
γ _{14,6} (Cu)	675,20 (9)	0,015 (3)	(M1+E2)			
γ _{15,7} (Cu)	683,74 (17)	0,004 (2)	M1+E2			
γ _{4,1} (Cu)	742,23 (6)	0,067 (8)	E2	0,000512 (8)	0,0000511 (8)	0,000571 (8)
γ _{9,3} (Cu)	754,56 (23)	0,016 (6)	M1+E2			
γ _{10,3} (Cu)	765,37 (11)	0,007 (3)	M1+E2			
γ _{5,1} (Cu)	877,07 (6)	0,003 (2)	M1+E2			
γ _{6,2} (Cu)	898,61 (7)	0,009 (3)	M1+E2			
γ _{11,4} (Cu)	924,38 (13)	0,0099 (20)	M1+E2			
γ _{2,0} (Cu)	962,02 (3)	6,50 (16)	M1+18,7%E2	0,000226 (4)	0,0000223 (4)	0,000251 (4)
γ _{14,5} (Cu)	988,83 (9)	0,0038 (11)	(M1+E2)			
γ _{7,2} (Cu)	1050,90 (11)	0,0044 (11)	M1+E2			
γ _{14,4} (Cu)	1123,67 (8)	0,112 (11)	M1+50%E2	0,000171 (4)	0,0000169 (4)	0,000192 (4)
γ _{10,2} (Cu)	1130,11 (10)	0,013 (2)	M1+E2			
γ _{15,5} (Cu)	1149,66 (14)	0,019 (2)	M1+E2			
γ _{16,5} (Cu)	1169,47 (10)	0,0077 (16)	M1+E2			
γ _{14,3} (Cu)	1209,07 (9)	0,014 (3)	(M1+E2)			
γ _{17,5} (Cu)	1233,23 (22)	0,0025 (8)	M1+E2			

	Energy (keV)	P _{γ+ce} (%)	Multipolarity	α _K	α _L	α _T
γ _{3,0} (Cu)	1326,76 (5)	0,069 (4)	E2	0,0001268 (18)	0,00001251 (18)	0,0001757 (25)
γ _{7,1} (Cu)	1342,99 (12)	0,0025 (8)	M1+E2			
γ _{11,2} (Cu)	1374,52 (12)	0,034 (2)	M1+E2			
γ _{16,3} (Cu)	1389,71 (10)	0,043 (6)	(E2)			
γ _{8,1} (Cu)	1392,52 (9)	0,10 (1)	(M1+50%E2)	0,0001098 (19)	0,00001080 (19)	0,000167 (4)
γ _{4,0} (Cu)	1412,16 (4)	0,74 (3)	M1+36,6%E2	0,0001055 (16)	0,00001038 (15)	0,000166 (3)
γ _{19,4} (Cu)	1445,7 (3)	0,0025 (8)	(E2)			
γ _{18,3} (Cu)	1481,34 (9)	0,0016 (8)	E2			
γ _{5,0} (Cu)	1547,00 (5)	0,124 (5)	M1+13,2%E2	0,0000870 (13)	0,00000854 (13)	0,000181 (3)
γ _{14,2} (Cu)	1573,81 (8)	0,016 (2)	(M1+E2)			
γ _{11,1} (Cu)	1666,61 (13)	0,0014 (6)	E2			
γ _(-1,1) (Cu)	1696,6 (10)	0,002 (1)				
γ _{16,2} (Cu)	1754,45 (9)	0,0043 (11)	M1+E2			
γ _{12,1} (Cu)	1827,26 (10)	0,0042 (11)	(M1+E2)			
γ _{6,0} (Cu)	1860,63 (6)	0,011 (3)	E2	0,0000646 (9)	0,00000635 (9)	0,000316 (5)
γ _{14,1} (Cu)	1865,90 (8)	0,0200 (21)	(E2)	0,0000643 (9)	0,00000631 (9)	0,000319 (5)
γ _{20,2} (Cu)	1926,9 (4)	0,0053 (11)	(E2)			
γ _{7,0} (Cu)	2012,92 (11)	0,011 (2)	M1+E2			
γ _{15,1} (Cu)	2026,73 (14)	0,060 (4)	M1+E2			
γ _{16,1} (Cu)	2046,54 (10)	0,0035 (11)	M1+E2			
γ _{8,0} (Cu)	2062,45 (8)	0,034 (3)	(M1+E2)			
γ _{9,0} (Cu)	2081,32 (22)	0,015 (2)	(M1+E2)			
γ _{10,0} (Cu)	2092,13 (10)	0,005 (3)	E2			
γ _{17,1} (Cu)	2110,30 (21)	0,0065 (13)	M1+E2			
γ _(-1,2) (Cu)	2181,8 (7)	0,0013 (8)				
γ _{19,1} (Cu)	2188,0 (3)	0,0016 (8)	M1+E2			
γ _{20,1} (Cu)	2219,0 (4)	0,0029 (8)	M1+E2			
γ _{11,0} (Cu)	2336,54 (12)	0,077 (5)	M1+E2			
γ _{12,0} (Cu)	2497,19 (9)	0,020 (2)	(M1+E2)			
γ _{13,0} (Cu)	2511,06 (6)	0,011 (2)	[M1+E2]			
γ _{14,0} (Cu)	2535,83 (7)	0,067 (3)	(M1+E2)			
γ _{15,0} (Cu)	2696,66 (13)	0,039 (3)	M1+E2			
γ _{16,0} (Cu)	2716,47 (9)	0,012 (1)	M1+E2			
γ _{17,0} (Cu)	2780,23 (21)	0,0154 (12)	M1+E2			
γ _{18,0} (Cu)	2808,10 (8)	0,0036 (6)	M1+E2			
γ _{19,0} (Cu)	2857,9 (3)	0,0028 (5)	M1+E2			
γ _{20,0} (Cu)	2888,9 (4)	0,0021 (2)	M1+E2			
γ _{21,0} (Cu)	3042,59 (8)	0,0048 (8)	M1+E2			
γ _{22,0} (Cu)	3101,4 (4)	0,0007 (2)	M1+E2			

3 Atomic Data

3.1 Cu

ω _K	:	0,454	(4)
ω _L	:	0,0097	(4)
n _{KL}	:	1,357	(4)

3.1.1 X Radiations

	Energy (keV)		Relative probability
X _K			
	Kα ₂	8,02792	51,3
	Kα ₁	8,04787	100
	Kβ ₃	8,90541	}
	Kβ ₁	8,90539	
	Kβ ₅ ''	8,9771	
X _L			
	Lℓ	0,811	
	Lα	0,929 - 0,93	
	Lη	0,831	
	Lβ	0,949 - 1,022	
	Lγ	0,952	

3.1.2 Auger Electrons

		Energy (keV)	Relative probability
Auger K			
	KLL	6,731 - 7,059	100
	KLX	7,746 - 8,064	27,8
	KXY	8,739 - 8,982	1,93
Auger L		0,68 - 0,80	346

4 Electron Emissions

		Energy (keV)	Electrons (per 100 disint.)
e _{AL}	(Cu)	0,68 - 0,80	9,30 (9)
e _{AK}	(Cu)		3,50 (5)
	KLL	6,731 - 7,059	} 80,3 (6)
	KLX	7,746 - 8,064	
	KXY	8,739 - 8,982	
β _{0,0} ⁺	max:	2344,2 (15)	} 80,3 (6)
	avg:	1041,9 (7)	
β _{0,1} ⁺	max:	1674,3 (15)	} 7,00 (2)
	avg:	732,0 (7)	

		Energy (keV)	Electrons (per 100 disint.)
$\beta_{0,2}^+$	max:	1382,2 (15)	} 4,96 (13)
	avg:	599,5 (7)	
$\beta_{0,4}^+$	max:	932,0 (15)	} 0,49 (2)
	avg:	399,7 (7)	
$\beta_{0,5}^+$	max:	797,2 (15)	} 0,042 (4)
	avg:	341,0 (7)	
$\beta_{0,7}^+$	max:	331,3 (15)	} 0,00039 (2)
	avg:	143,6 (6)	
$\beta_{0,8}^+$	max:	281,8 (15)	} 0,0025 (2)
	avg:	123,0 (6)	
$\beta_{0,9}^+$	max:	262,9 (15)	} 0,00043 (9)
	avg:	115,1 (6)	

5 Photon Emissions

5.1 X-Ray Emissions

		Energy (keV)	Photons (per 100 disint.)		
XL	(Cu)	0,811 - 1,022	0,0958 (16)		
XK α_2	(Cu)	8,02792	0,865 (12)	}	K α
XK α_1	(Cu)	8,04787	1,686 (22)		
XK β_3	(Cu)	8,90541	} 0,355 (6)	}	K' β_1
XK β_1	(Cu)	8,90539			
XK β_5''	(Cu)	8,9771			

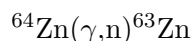
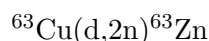
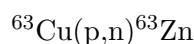
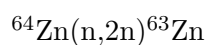
5.2 Gamma Emissions

	Energy (keV)	Photons (per 100 disint.)
$\gamma_{17,14}(\text{Cu})$	244,40 (22)	0,0053 (8)
$\gamma_{3,2}(\text{Cu})$	364,74 (6)	0,0115 (25)
$\gamma_{14,10}(\text{Cu})$	443,70 (12)	0,013 (4)
$\gamma_{4,2}(\text{Cu})$	450,14 (5)	0,229 (16)
$\gamma_{11,6}(\text{Cu})$	475,91 (13)	0,006 (3)
$\gamma^\pm$	511	185,6 (9)
$\gamma_{8,5}(\text{Cu})$	515,45 (9)	0,021 (8)
$\gamma_{9,5}(\text{Cu})$	534,32 (23)	0,005 (2)
$\gamma_{5,2}(\text{Cu})$	584,98 (6)	0,033 (4)
$\gamma_{16,10}(\text{Cu})$	624,34 (13)	0,011 (4)

	Energy (keV)	Photons (per 100 disint.)
$\gamma_{1,0}(\text{Cu})$	669,93 (4)	8,19 (32)
$\gamma_{14,6}(\text{Cu})$	675,20 (9)	0,015 (3)
$\gamma_{15,7}(\text{Cu})$	683,74 (17)	0,004 (2)
$\gamma_{4,1}(\text{Cu})$	742,23 (6)	0,067 (8)
$\gamma_{9,3}(\text{Cu})$	754,56 (23)	0,016 (6)
$\gamma_{10,3}(\text{Cu})$	765,37 (11)	0,007 (3)
$\gamma_{5,1}(\text{Cu})$	877,06 (6)	0,003 (2)
$\gamma_{6,2}(\text{Cu})$	898,60 (7)	0,009 (3)
$\gamma_{11,4}(\text{Cu})$	924,37 (13)	0,0099 (20)
$\gamma_{2,0}(\text{Cu})$	962,01 (3)	6,50 (16)
$\gamma_{14,5}(\text{Cu})$	988,82 (9)	0,0038 (11)
$\gamma_{7,2}(\text{Cu})$	1050,89 (11)	0,0044 (11)
$\gamma_{14,4}(\text{Cu})$	1123,66 (8)	0,112 (11)
$\gamma_{10,2}(\text{Cu})$	1130,10 (10)	0,013 (2)
$\gamma_{15,5}(\text{Cu})$	1149,65 (14)	0,019 (2)
$\gamma_{16,5}(\text{Cu})$	1169,46 (10)	0,0077 (16)
$\gamma_{14,3}(\text{Cu})$	1209,06 (9)	0,014 (3)
$\gamma_{17,5}(\text{Cu})$	1233,22 (22)	0,0025 (8)
$\gamma_{3,0}(\text{Cu})$	1326,75 (5)	0,069 (4)
$\gamma_{7,1}(\text{Cu})$	1342,97 (12)	0,0025 (8)
$\gamma_{11,2}(\text{Cu})$	1374,50 (12)	0,034 (2)
$\gamma_{16,3}(\text{Cu})$	1389,69 (10)	0,043 (6)
$\gamma_{8,1}(\text{Cu})$	1392,50 (9)	0,10 (1)
$\gamma_{4,0}(\text{Cu})$	1412,14 (4)	0,74 (3)
$\gamma_{19,4}(\text{Cu})$	1445,7 (3)	0,0025 (8)
$\gamma_{18,3}(\text{Cu})$	1481,32 (9)	0,0016 (8)
$\gamma_{5,0}(\text{Cu})$	1546,98 (5)	0,124 (5)
$\gamma_{14,2}(\text{Cu})$	1573,79 (8)	0,016 (2)
$\gamma_{11,1}(\text{Cu})$	1666,59 (13)	0,0014 (6)
$\gamma_{(-1,1)}(\text{Cu})$	1696,6 (10)	0,002 (1)
$\gamma_{16,2}(\text{Cu})$	1754,42 (9)	0,0043 (11)
$\gamma_{12,1}(\text{Cu})$	1827,23 (10)	0,0042 (11)
$\gamma_{6,0}(\text{Cu})$	1860,60 (6)	0,011 (3)
$\gamma_{14,1}(\text{Cu})$	1865,87 (8)	0,0200 (21)
$\gamma_{20,2}(\text{Cu})$	1926,9 (4)	0,0053 (11)
$\gamma_{7,0}(\text{Cu})$	2012,89 (11)	0,011 (2)
$\gamma_{15,1}(\text{Cu})$	2026,70 (14)	0,060 (4)
$\gamma_{16,1}(\text{Cu})$	2046,50 (10)	0,0035 (11)
$\gamma_{8,0}(\text{Cu})$	2062,41 (8)	0,034 (3)
$\gamma_{9,0}(\text{Cu})$	2081,28 (22)	0,015 (2)
$\gamma_{10,0}(\text{Cu})$	2092,09 (10)	0,005 (3)
$\gamma_{17,1}(\text{Cu})$	2110,26 (21)	0,0065 (13)
$\gamma_{(-1,2)}(\text{Cu})$	2181,8 (7)	0,0013 (8)
$\gamma_{19,1}(\text{Cu})$	2188,0 (3)	0,0016 (8)
$\gamma_{20,1}(\text{Cu})$	2219,0 (4)	0,0029 (8)
$\gamma_{11,0}(\text{Cu})$	2336,49 (12)	0,077 (5)
$\gamma_{12,0}(\text{Cu})$	2497,14 (9)	0,020 (2)
$\gamma_{13,0}(\text{Cu})$	2511,01 (6)	0,011 (2)

	Energy (keV)	Photons (per 100 disint.)
$\gamma_{14,0}(\text{Cu})$	2535,78 (7)	0,067 (3)
$\gamma_{15,0}(\text{Cu})$	2696,60 (13)	0,039 (3)
$\gamma_{16,0}(\text{Cu})$	2716,41 (9)	0,012 (1)
$\gamma_{17,0}(\text{Cu})$	2780,16 (21)	0,0154 (12)
$\gamma_{18,0}(\text{Cu})$	2808,03 (8)	0,0036 (6)
$\gamma_{19,0}(\text{Cu})$	2857,8 (3)	0,0028 (5)
$\gamma_{20,0}(\text{Cu})$	2888,8 (4)	0,0021 (2)
$\gamma_{21,0}(\text{Cu})$	3042,51 (8)	0,0048 (8)
$\gamma_{22,0}(\text{Cu})$	3101,3 (4)	0,0007 (2)

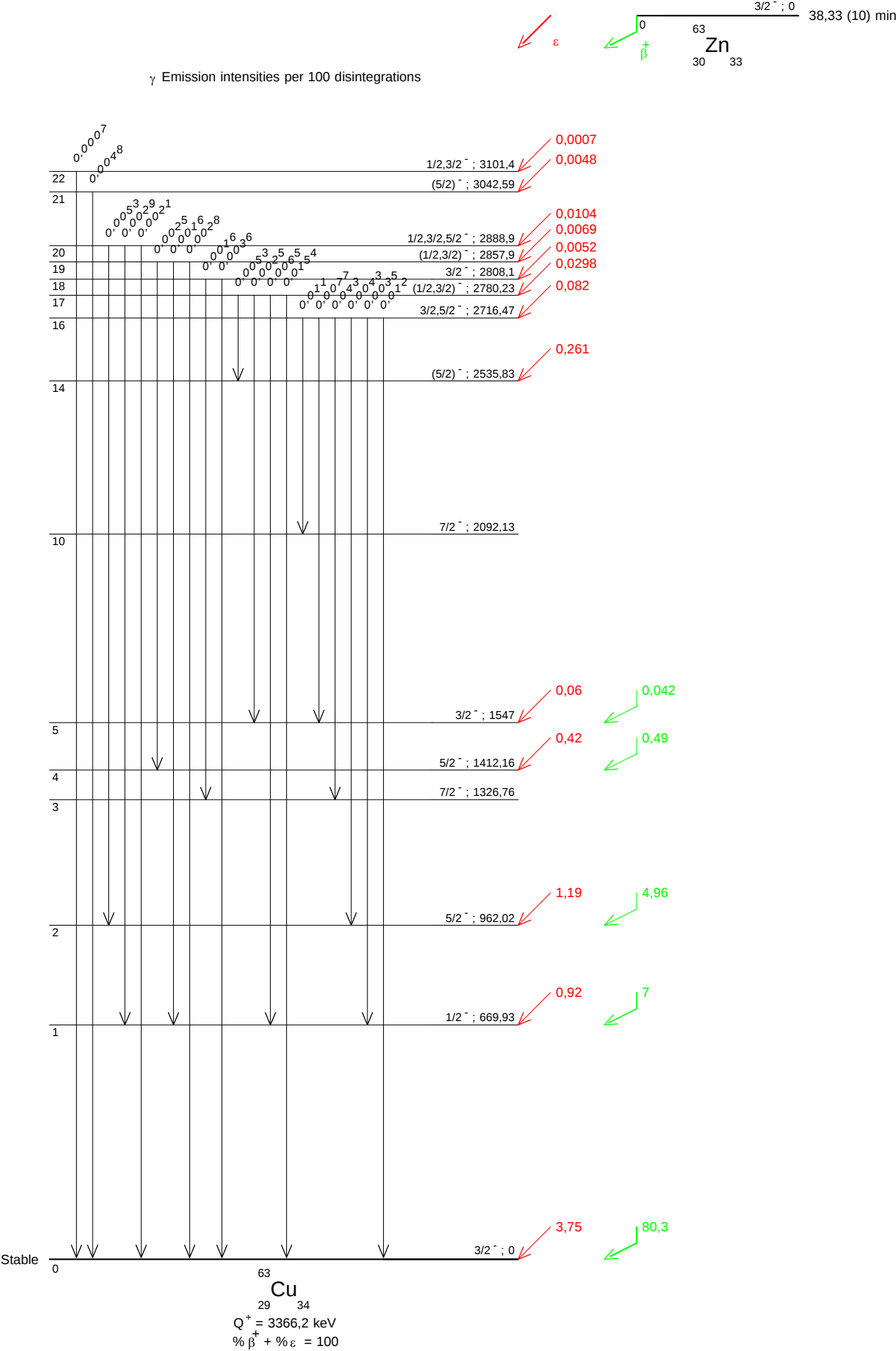
6 Main Production Modes

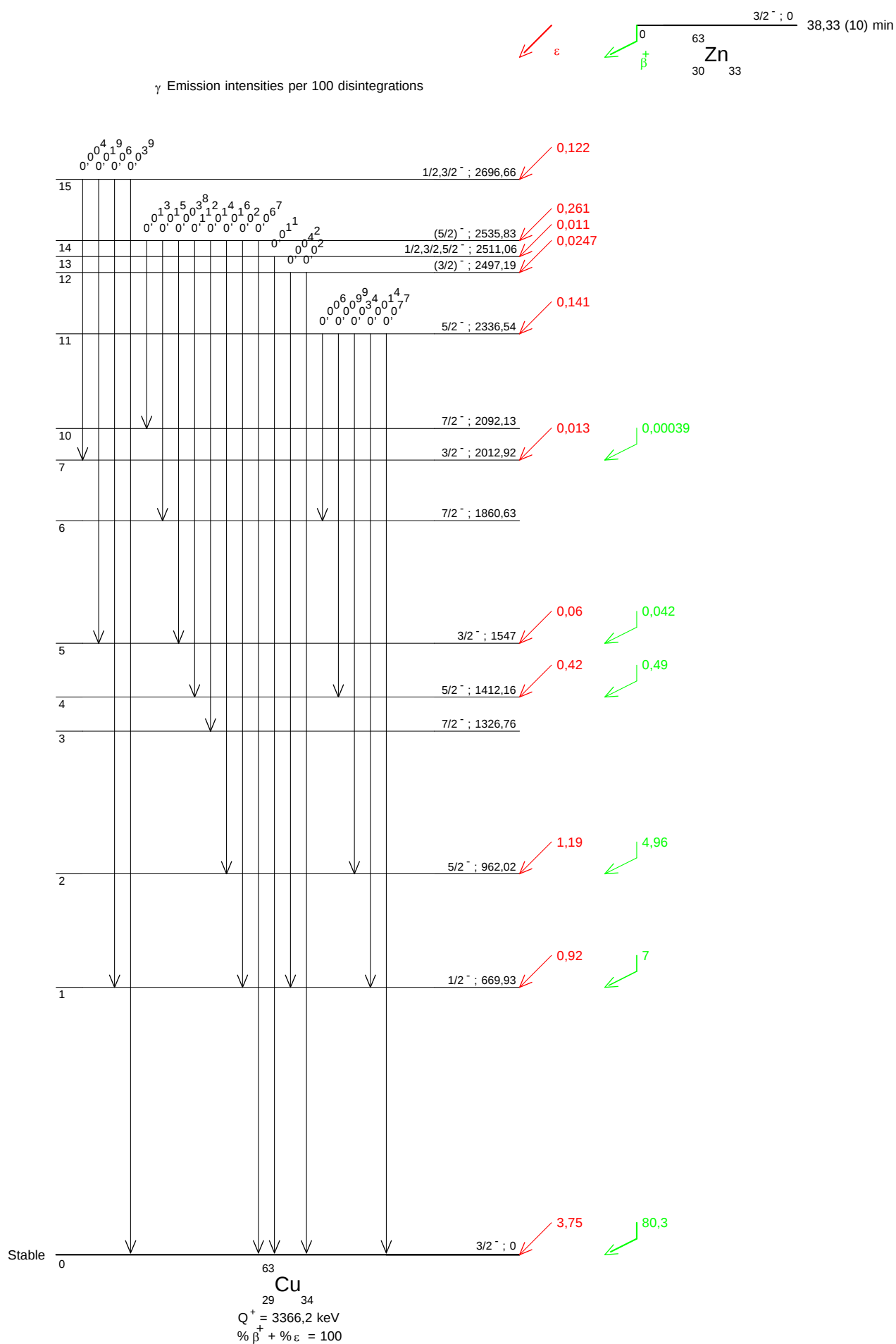


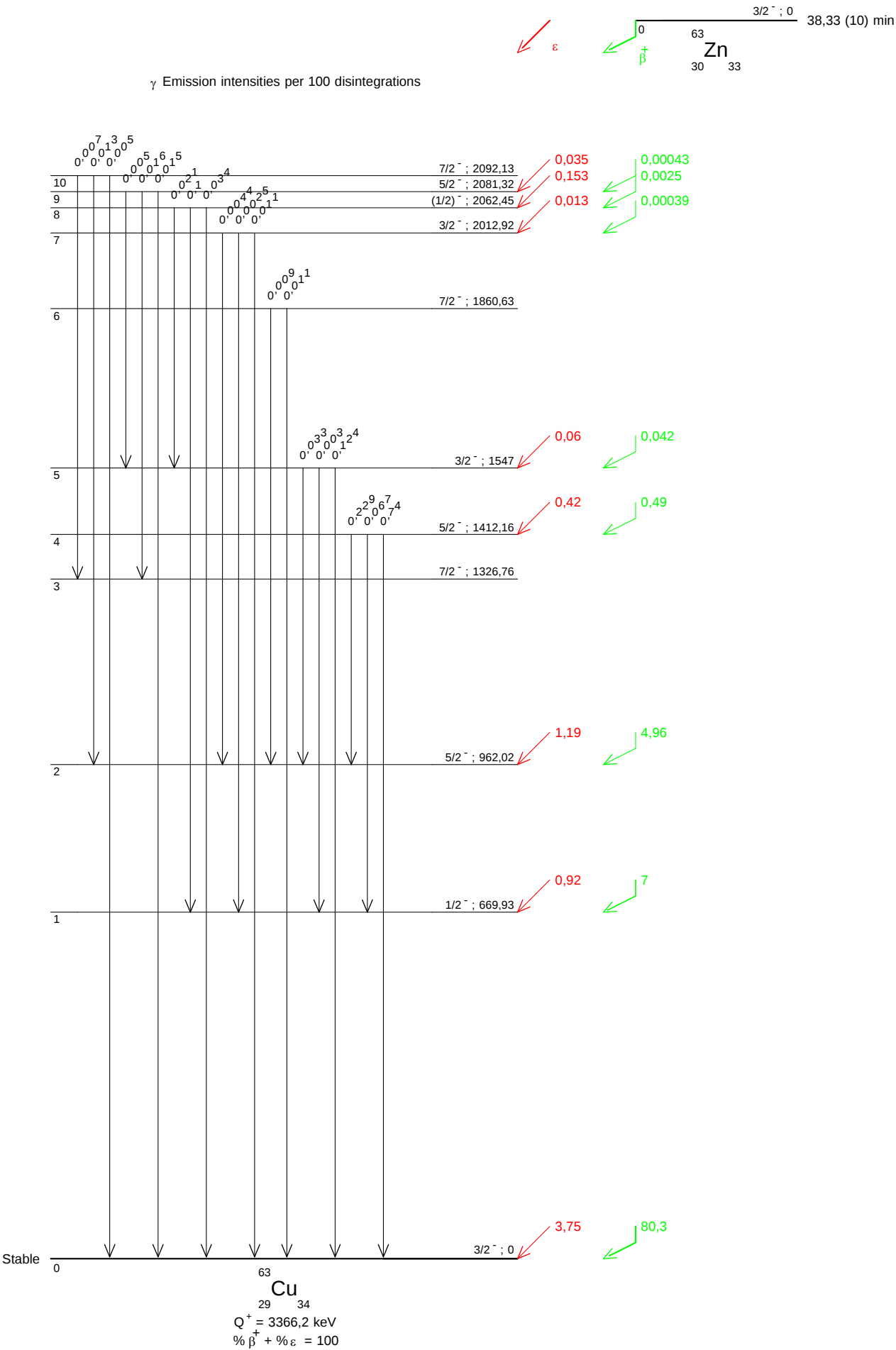
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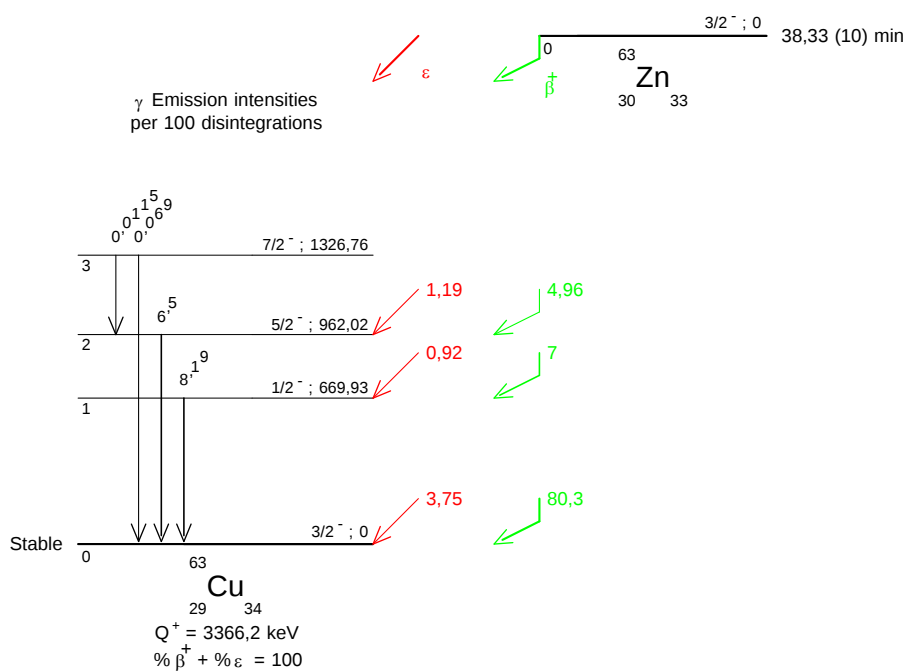
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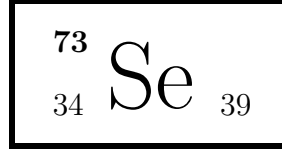
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1 Decay Scheme

Se-73 (half-life of 7.10 h) decays by 100% electron capture/beta plus to various excited levels of As-73 that populate the ground state of As-73 (half-life of 80.30 d).

Le selenium 73 (7,10 h) se désintègre à 100% par capture électronique et transitions bêta plus vers plusieurs niveaux excités de l'arsenic 73.

2 Nuclear Data

$T_{1/2}(^{73}\text{Se})$	:	7,10	(9)	h
$T_{1/2}(^{73}\text{As})$	:	80,30	(6)	d
$Q^+(^{73}\text{Se})$	:	2725	(7)	keV

2.1 Electron Capture Transitions

	Energy (keV)	Probability (%)	Nature	lg ft	P_K	P_L	P_M
$\epsilon_{0,20}$	141 (7)	0,0155 (20)	(non-unique 1st forbidden)	6,2	0,8646 (19)	0,1136 (16)	0,0199 (5)
$\epsilon_{0,19}$	242 (7)	0,0087 (20)	(allowed)	7	0,8723 (16)	0,1072 (13)	0,0186 (4)
$\epsilon_{0,18}$	249 (7)	0,0029 (10)	(allowed)	7,5	0,8726 (16)	0,1070 (13)	0,0186 (4)
$\epsilon_{0,17}$	291 (7)	0,0048 (19)	(non-unique 2nd forbidden)	7,4	0,8740 (16)	0,1058 (13)	0,0184 (4)
$\epsilon_{0,16}$	413 (7)	0,157 (6)	(allowed)	6,2	0,8764 (16)	0,1038 (13)	0,0180 (4)
$\epsilon_{0,15}$	544 (7)	0,030 (8)	(allowed)	7,1	0,8778 (15)	0,1027 (13)	0,0178 (4)
$\epsilon_{0,14}$	750 (7)	0,094 (3)	(allowed)	6,9	0,8789 (15)	0,1018 (13)	0,0176 (4)
$\epsilon_{0,13}$	763 (7)	0,017 (5)	(allowed)	7,7	0,8790 (15)	0,1017 (13)	0,0176 (4)
$\epsilon_{0,12}$	815 (7)	0,060 (7)	(allowed)	7,2	0,8792 (15)	0,1016 (13)	0,0175 (4)
$\epsilon_{0,11}$	874 (7)	0,433 (11)	(allowed)	6,4	0,8794 (15)	0,1014 (12)	0,0175 (4)
$\epsilon_{0,10}$	1396 (7)	0,129 (3)	(allowed)	7,3	0,8804 (15)	0,1006 (12)	0,0173 (4)
$\epsilon_{0,8}$	1432 (7)	0,435 (19)	(allowed)	6,8	0,8804 (15)	0,1006 (12)	0,0173 (4)
$\epsilon_{0,7}$	1450 (7)	0,0057 (19)	(allowed)	8,7	0,8804 (15)	0,1006 (12)	0,0173 (4)
$\epsilon_{0,6}$	1547 (7)	0,178 (2)	(non-unique 1st forbidden)	7,3	0,8805 (15)	0,1005 (12)	0,0173 (4)
$\epsilon_{0,2}$	2297 (7)	33,3 (5)	allowed	5,36	0,8810 (15)	0,1001 (12)	0,0172 (4)
$\epsilon_{0,1}$	2658 (7)	0,51 (9)	unique 1st forbidden	8,7	0,8811 (15)	0,1000 (12)	0,0172 (4)

2.2 β^+ Transitions

	Energy (keV)	Probability (%)	Nature	lg <i>ft</i>
$\beta_{0,10}^+$	374 (7)	0,0034 (2)	(allowed)	7,3
$\beta_{0,8}^+$	410 (7)	0,017 (2)	(allowed)	6,8
$\beta_{0,7}^+$	428 (7)	0,0003 (1)	(allowed)	8,7
$\beta_{0,6}^+$	525 (7)	0,017 (1)	(non-unique 1st forbidden)	7,3
$\beta_{0,2}^+$	1275 (7)	63,9 (5)	allowed	5,36
$\beta_{0,1}^+$	1636 (7)	0,69 (11)	unique 1st forbidden	8,7

2.3 Gamma Transitions and Internal Conversion Coefficients

	Energy (keV)	P _{$\gamma+ce$} (%)	Multipolarity	α_K (10 ⁻⁵)	α_L (10 ⁻⁶)	α_M (10 ⁻⁶)	α_T (10 ⁻⁴)	α_π (10 ⁻⁵)
$\gamma_{1,0}(\text{As})$	67,039 (8)	90 (9)	100%M1	24100 (400)	26400 (400)	4040 (60)	2720 (40)	
$\gamma_{2,1}(\text{As})$	360,867 (23)	98,18 (20)	M2+0.12%E3	1165 (17)	1286 (18)	197 (3)	131,5 (19)	
$\gamma_{2,0}(\text{As})$	427,906 (21)	0,079 (14)	E3	1195 (17)	1397 (20)	213 (3)	135,7 (19)	
$\gamma_{3,1}(\text{As})$	443,016 (19)	0,050 (3)	(E1)	92,6 (13)	95,5 (14)	14,54 (21)	10,37 (15)	
$\gamma_{3,0}(\text{As})$	510,055 (17)	0,26 (3)	(E1)	65,0 (10)	67,0 (10)	10,20 (15)	7,28 (11)	
$\gamma_{11,8}(\text{As})$	557,50 (11)	0,052 (2)	(M1+E2)					
$\gamma_{11,7}(\text{As})$	575,45 (9)	0,146 (7)	(M1+E2)					
$\gamma_{(-1,1)}(\text{As})$	600,3 (3)	0,020 (3)						
$\gamma_{5,2}(\text{As})$	609,22 (4)	0,049 (4)	(E2)	125,8 (18)	132,7 (19)	20,2 (3)	14,12 (20)	
$\gamma_{14,9}(\text{As})$	682,04 (11)	0,019 (2)	(E1)	33,0 (5)	33,8 (5)	5,15 (8)	3,69 (6)	
$\gamma_{14,7}(\text{As})$	700,27 (13)	0,044 (2)	(M1+E2)					
$\gamma_{7,3}(\text{As})$	765,09 (7)	0,127 (2)	(M1+E2)					
$\gamma_{9,3}(\text{As})$	783,32 (4)	0,058 (2)	(M1+E2)					
$\gamma_{(-1,2)}(\text{As})$	793,0 (5)	0,064 (2)						
$\gamma_{11,5}(\text{As})$	813,46 (6)	0,009 (1)	(E2)	57,3 (8)	59,7 (9)	9,10 (13)	6,42 (9)	
$\gamma_{10,3}(\text{As})$	818,84 (5)	0,036 (2)	(M1+E2)					
$\gamma_{7,2}(\text{As})$	847,23 (7)	0,078 (6)	(M1+E2)					
$\gamma_{11,4}(\text{As})$	856,82 (5)	0,023 (6)	(E1)	20,3 (3)	20,7 (3)	3,16 (5)	2,27 (4)	
$\gamma_{8,2}(\text{As})$	865,18 (10)	0,50 (2)	(M1+E2)					
$\gamma_{9,2}(\text{As})$	865,46 (3)	0,02 (1)	(M1+E2)					
$\gamma_{12,5}(\text{As})$	873,00 (12)	0,038 (7)	(E2)	47,9 (7)	49,9 (7)	7,60 (11)	5,37 (8)	
$\gamma_{15,9}(\text{As})$	887,29 (10)	0,011 (8)	(M1+E2)					
$\gamma_{10,2}(\text{As})$	900,98 (5)	0,135 (2)	(M1+E2)					
$\gamma_{4,1}(\text{As})$	926,727 (14)	0,004 (1)	(M1+E2)					
$\gamma_{(-1,3)}(\text{As})$	930,09 (15)	0,005 (1)						
$\gamma_{13,4}(\text{As})$	968,0 (2)	0,012 (5)						
$\gamma_{16,10}(\text{As})$	982,74 (8)	0,034 (1)	(M1+E2)					
$\gamma_{4,0}(\text{As})$	993,766 (12)	0,005 (1)	(E2)	35,0 (5)	36,3 (5)	5,52 (8)	3,92 (6)	
$\gamma_{15,6}(\text{As})$	1002,61 (10)	0,004 (1)	(E1)	14,84 (21)	15,17 (22)	2,31 (4)	1,660 (24)	
$\gamma_{16,9}(\text{As})$	1018,26 (7)	0,053 (2)	(M1+E2)					
$\gamma_{16,7}(\text{As})$	1036,49 (9)	0,015 (1)	(M1+E2)					
$\gamma_{6,1}(\text{As})$	1111,013 (23)	0,201 (2)	(M1+E2)					
$\gamma_{19,10}(\text{As})$	1153,98 (24)	0,005 (1)	(M1+E2)					
$\gamma_{17,7}(\text{As})$	1159,0 (4)	0,003 (1)						
$\gamma_{7,1}(\text{As})$	1208,10 (7)	0,004 (1)	(E1)	10,50 (15)	10,72 (15)	1,632 (23)	1,700 (24)	5,25 (8)
$\gamma_{(-1,4)}(\text{As})$	1215,4 (8)	0,063 (10)						
$\gamma_{9,1}(\text{As})$	1226,33 (3)	0,003 (2)	(E1)	10,23 (15)	10,43 (15)	1,589 (23)	1,79 (3)	6,43 (9)
$\gamma_{(-1,5)}(\text{As})$	1249,9 (2)	0,004 (1)						
$\gamma_{7,0}(\text{As})$	1275,14 (7)	0,007 (1)	(M2)	39,4 (6)	40,8 (6)	6,23 (9)	4,46 (7)	0,416 (6)
$\gamma_{20,7}(\text{As})$	1308,95 (13)	0,004 (1)	(E1)	9,12 (13)	9,30 (13)	1,417 (20)	2,22 (4)	12,03 (17)

	Energy (keV)	P _{γ+ce} (%)	Multipolarity	α _K (10 ⁻⁵)	α _L (10 ⁻⁶)	α _M (10 ⁻⁶)	α _T (10 ⁻⁴)	α _π (10 ⁻⁵)
γ _{16,4} (As)	1317,86 (6)	0,006 (1)	(E1)	9,02 (13)	9,19 (13)	1,40 (2)	2,27 (4)	12,61 (18)
γ _(-1,6) (As)	1323,81 (20)	0,007 (1)						
γ _{11,3} (As)	1340,54 (5)	0,069 (2)	(E2)	18,0 (3)	18,5 (3)	2,82 (4)	2,39 (4)	3,76 (6)
γ _{20,6} (As)	1406,04 (11)	0,002 (1)	(M1+E2)					
γ _{11,2} (As)	1422,68 (6)	0,135 (5)	(M1+E2)					
γ _{18,5} (As)	1439,0 (2)	0,002 (1)						
γ _{13,3} (As)	1451,7 (2)	0,006 (2)						
γ _{12,2} (As)	1482,22 (6)	0,022 (1)	(M1+E2)					
γ _{14,2} (As)	1547,50 (11)	0,031 (1)	(M1+E2)					
γ _{15,3} (As)	1670,61 (10)	0,005 (1)	(M1+E2)					
γ _(-1,7) (As)	1738,4 (5)	0,002 (1)						
γ _{15,2} (As)	1752,75 (10)	0,011 (1)	(M1+E2)					
γ _{16,3} (As)	1801,58 (6)	0,019 (5)	(M1+E2)					
γ _(-1,8) (As)	1847,8 (3)	0,008 (1)						
γ _{16,2} (As)	1883,72 (6)	0,030 (2)	(M1+E2)					
γ _(-1,9) (As)	1889,57 (20)	0,003 (1)						
γ _{19,3} (As)	1972,82 (23)	0,001 (1)	(M1+E2)					
γ _{17,2} (As)	2006,2 (4)	0,002 (1)						
γ _(-1,10) (As)	2023,9 (3)	0,002 (1)						
γ _{18,2} (As)	2048,2 (2)	0,001 (1)						
γ _{19,2} (As)	2054,96 (23)	0,003 (1)	(M1+E2)					
γ _{20,2} (As)	2156,18 (11)	0,005 (1)	(E1)	4,13 (6)	4,19 (6)	0,638 (9)	7,85 (11)	73,9 (11)
γ _(-1,11) (As)	2170,5 (3)	0,002 (1)						
γ _{20,1} (As)	2517,05 (11)	0,005 (1)	(M1+E2)					

3 Atomic Data

3.1 As

ω_K	:	0,575	(4)
$\bar{\omega}_L$	:	0,0155	(5)
n_{KL}	:	1,232	(4)

3.1.1 X Radiations

	Energy (keV)	Relative probability
X _K		
K α_2	10,50814	51,2
K α_1	10,5438	100
K β_3	11,7204	} 22,8
K β_1	11,7263	
K β_5''	11,821	
K β_2	11,8643	0,86
X _L		
L ℓ	1,12	
L α	1,282	
L η	1,155	
L β	1,317 - 1,388	
L γ	1,524	

3.1.2 Auger Electrons

	Energy (keV)	Relative probability
Auger K		
KLL	8,746 - 9,149	100
KLX	10,114 - 10,541	31,3
KXY	11,460 - 11,862	2,45
Auger L	0,90 - 1,23	416

4 Electron and Positron Emissions

		Energy (keV)	Electrons (per 100 disint.)
e _{AL}	(As)	0,90 - 1,23	65,3 (15)
e _{AK}	(As)		21,0 (8)
	KLL	8,746 - 9,149	}
	KLX	10,114 - 10,541	
	KXY	11,460 - 11,862	
ec _{1,0} T	(As)	55,172 - 67,037	19 (11)
ec _{1,0} K	(As)	55,172 (8)	17 (10)
ec _{1,0} L	(As)	65,513 - 65,716	1,8 (10)
ec _{1,0} M+	(As)	66,836 - 67,037	0,32 (18)
ec _{2,1} T	(As)	349,00 - 360,86	1,27 (30)
ec _{2,1} K	(As)	349,00 (3)	1,13 (25)
ec _{2,1} L	(As)	359,34 - 359,54	0,12 (3)
ec _{2,1} M+	(As)	360,66 - 360,86	0,021 (5)
$\beta_{0,1}^+$	max:	1636 (7)	}
	avg:	745 (3)	
$\beta_{0,2}^+$	max:	1275 (7)	}
	avg:	555 (3)	
$\beta_{0,6}^+$	max:	525 (7)	}
	avg:	228 (3)	
$\beta_{0,7}^+$	max:	428 (7)	}
	avg:	187 (3)	
$\beta_{0,8}^+$	max:	410 (7)	}
	avg:	179 (3)	
$\beta_{0,10}^+$	max:	374 (7)	}
	avg:	164 (3)	

5 Photon Emissions

5.1 X-Ray Emissions

		Energy (keV)	Photons (per 100 disint.)		
XL	(As)	1,12 - 1,524	1,05 (3)		
XK α_2	(As)	10,50814	8,3 (3)	}	K α
XK α_1	(As)	10,5438	16,2 (6)		
XK β_3	(As)	11,7204	3,70 (14)	}	K' β_1
XK β_1	(As)	11,7263			
XK β_5''	(As)	11,821			
XK β_2	(As)	11,8643	0,140 (7)		K' β_2

5.2 Gamma Emissions

	Energy (keV)	Photons (per 100 disint.)
$\gamma_{1,0}(\text{As})$	67,039 (8)	70,7 (70)
$\gamma_{2,1}(\text{As})$	360,866 (23)	96,91 (20)
$\gamma_{2,0}(\text{As})$	427,905 (21)	0,078 (14)
$\gamma_{3,1}(\text{As})$	443,015 (19)	0,050 (3)
$\gamma_{3,0}(\text{As})$	510,053 (17)	0,26 (3)
$\gamma^\pm$	511	129 (8)
$\gamma_{11,8}(\text{As})$	557,50 (11)	0,052 (2)
$\gamma_{11,7}(\text{As})$	575,45 (9)	0,146 (7)
$\gamma_{(-1,1)}(\text{As})$	600,3 (3)	0,020 (3)
$\gamma_{5,2}(\text{As})$	609,22 (4)	0,049 (4)
$\gamma_{14,9}(\text{As})$	682,04 (11)	0,019 (2)
$\gamma_{14,7}(\text{As})$	700,27 (13)	0,044 (2)
$\gamma_{7,3}(\text{As})$	765,09 (7)	0,127 (2)
$\gamma_{9,3}(\text{As})$	783,32 (4)	0,058 (2)
$\gamma_{(-1,2)}(\text{As})$	793,0 (5)	0,064 (2)
$\gamma_{11,5}(\text{As})$	813,46 (6)	0,009 (1)
$\gamma_{10,3}(\text{As})$	818,84 (5)	0,036 (2)
$\gamma_{7,2}(\text{As})$	847,22 (7)	0,078 (6)
$\gamma_{11,4}(\text{As})$	856,81 (5)	0,023 (6)
$\gamma_{8,2}(\text{As})$	865,17 (10)	0,50 (2)
$\gamma_{9,2}(\text{As})$	865,45 (3)	0,02 (1)
$\gamma_{12,5}(\text{As})$	872,99 (12)	0,038 (7)
$\gamma_{15,9}(\text{As})$	887,28 (10)	0,011 (8)
$\gamma_{10,2}(\text{As})$	900,97 (5)	0,135 (2)
$\gamma_{4,1}(\text{As})$	926,721 (14)	0,004 (1)
$\gamma_{(-1,3)}(\text{As})$	930,09 (15)	0,005 (1)
$\gamma_{13,4}(\text{As})$	968,0 (2)	0,012 (5)

	Energy (keV)	Photons (per 100 disint.)
$\gamma_{16,10}(\text{As})$	982,73 (8)	0,034 (1)
$\gamma_{4,0}(\text{As})$	993,759 (12)	0,005 (1)
$\gamma_{15,6}(\text{As})$	1002,60 (10)	0,004 (1)
$\gamma_{16,9}(\text{As})$	1018,25 (7)	0,053 (2)
$\gamma_{16,7}(\text{As})$	1036,48 (9)	0,015 (1)
$\gamma_{6,1}(\text{As})$	1111,004 (23)	0,201 (2)
$\gamma_{19,10}(\text{As})$	1153,97 (24)	0,005 (1)
$\gamma_{17,7}(\text{As})$	1159,0 (4)	0,003 (1)
$\gamma_{7,1}(\text{As})$	1208,09 (7)	0,004 (1)
$\gamma_{(-1,4)}(\text{As})$	1215,4 (8)	0,063 (10)
$\gamma_{9,1}(\text{As})$	1226,32 (3)	0,003 (2)
$\gamma_{(-1,5)}(\text{As})$	1249,9 (2)	0,004 (1)
$\gamma_{7,0}(\text{As})$	1275,13 (7)	0,007 (1)
$\gamma_{20,7}(\text{As})$	1308,94 (13)	0,004 (1)
$\gamma_{16,4}(\text{As})$	1317,85 (6)	0,006 (1)
$\gamma_{(-1,6)}(\text{As})$	1323,81 (20)	0,007 (1)
$\gamma_{11,3}(\text{As})$	1340,53 (5)	0,069 (2)
$\gamma_{20,6}(\text{As})$	1406,03 (11)	0,002 (1)
$\gamma_{11,2}(\text{As})$	1422,67 (6)	0,135 (5)
$\gamma_{18,5}(\text{As})$	1439,0 (2)	0,002 (1)
$\gamma_{13,3}(\text{As})$	1451,7 (2)	0,006 (2)
$\gamma_{12,2}(\text{As})$	1482,20 (6)	0,022 (1)
$\gamma_{14,2}(\text{As})$	1547,48 (11)	0,031 (1)
$\gamma_{15,3}(\text{As})$	1670,59 (10)	0,005 (1)
$\gamma_{(-1,7)}(\text{As})$	1738,4 (5)	0,002 (1)
$\gamma_{15,2}(\text{As})$	1752,73 (10)	0,011 (1)
$\gamma_{16,3}(\text{As})$	1801,56 (6)	0,019 (5)
$\gamma_{(-1,8)}(\text{As})$	1847,8 (3)	0,008 (1)
$\gamma_{16,2}(\text{As})$	1883,69 (6)	0,030 (2)
$\gamma_{(-1,9)}(\text{As})$	1889,57 (20)	0,003 (1)
$\gamma_{19,3}(\text{As})$	1972,79 (23)	0,001 (1)
$\gamma_{17,2}(\text{As})$	2006,2 (4)	0,002 (1)
$\gamma_{(-1,10)}(\text{As})$	2023,9 (3)	0,002 (1)
$\gamma_{18,2}(\text{As})$	2048,2 (2)	0,001 (1)
$\gamma_{19,2}(\text{As})$	2054,93 (23)	0,003 (1)
$\gamma_{20,2}(\text{As})$	2156,15 (11)	0,005 (1)
$\gamma_{(-1,11)}(\text{As})$	2170,5 (3)	0,002 (1)
$\gamma_{20,1}(\text{As})$	2517,00 (11)	0,005 (1)

6 Main Production Modes

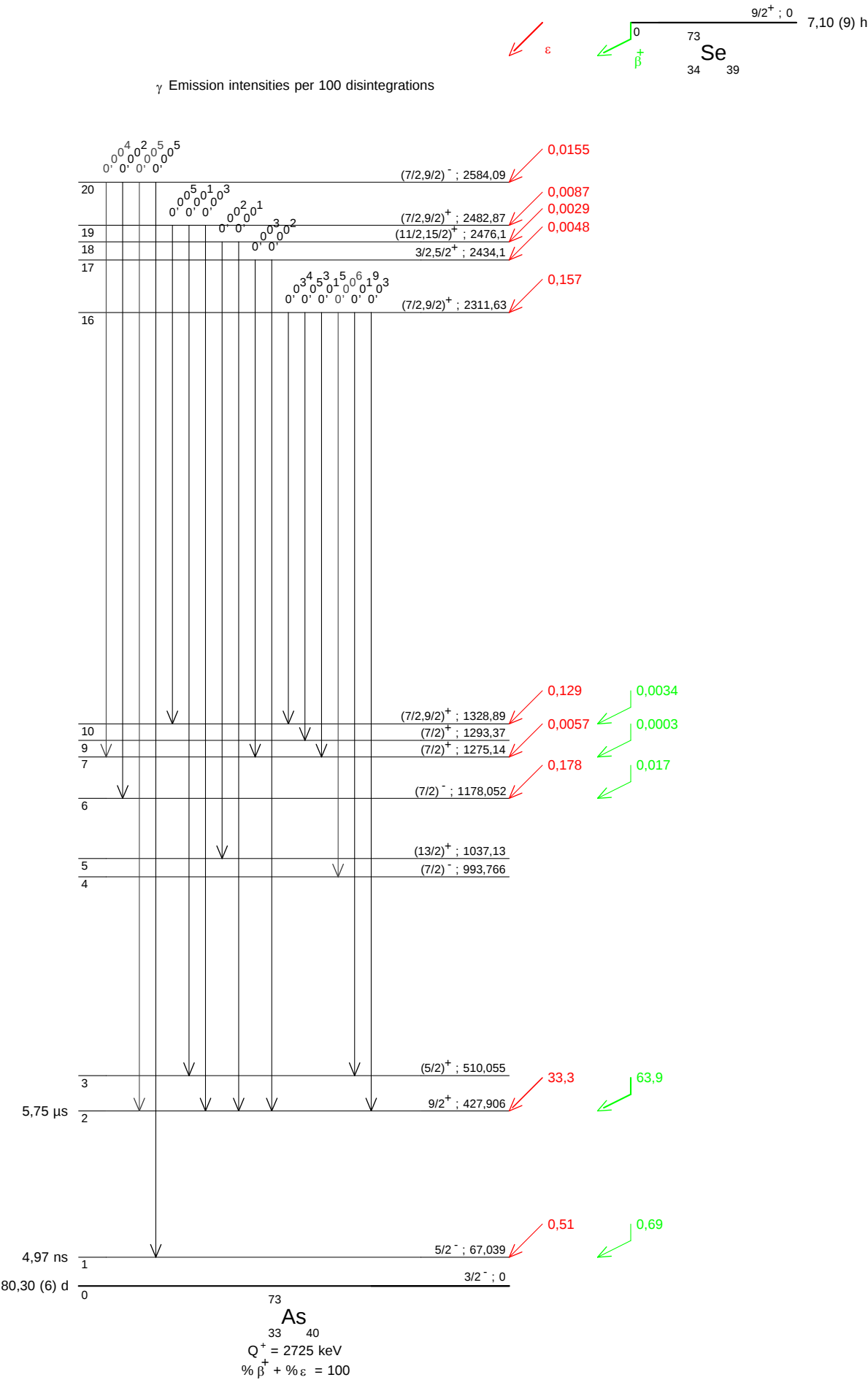
- { Ge – 70(α ,n)Se – 73
Possible impurities : As – 72, Se – 72, Se – 73m
- { Se – 74(n,2n)Se – 73
Possible impurities : As – 74, Se – 73m
- { Se – 74(γ ,n)Se – 73
Possible impurities : Se – 73m

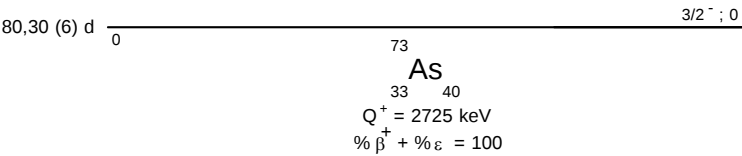
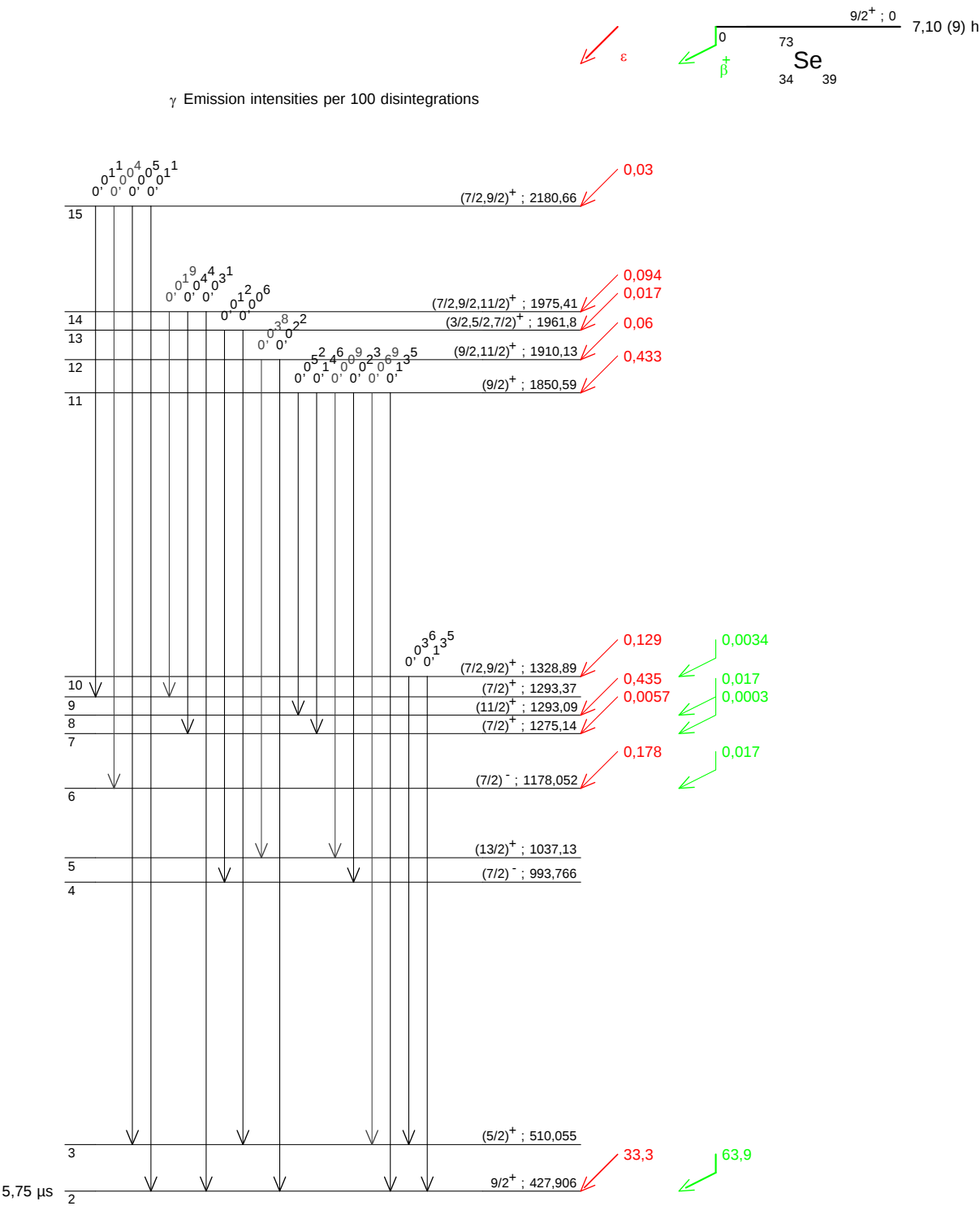
- { As – 75(p,3n)Se – 73
- { Possible impurities : As – 74, Se – 73m
- { Ge – 72(He – 3,d)Se – 73
- { Possible impurities : Se – 73m
- { Ni – 60(O – 16,p2n)Se – 73
- { Possible impurities : Se – 73m

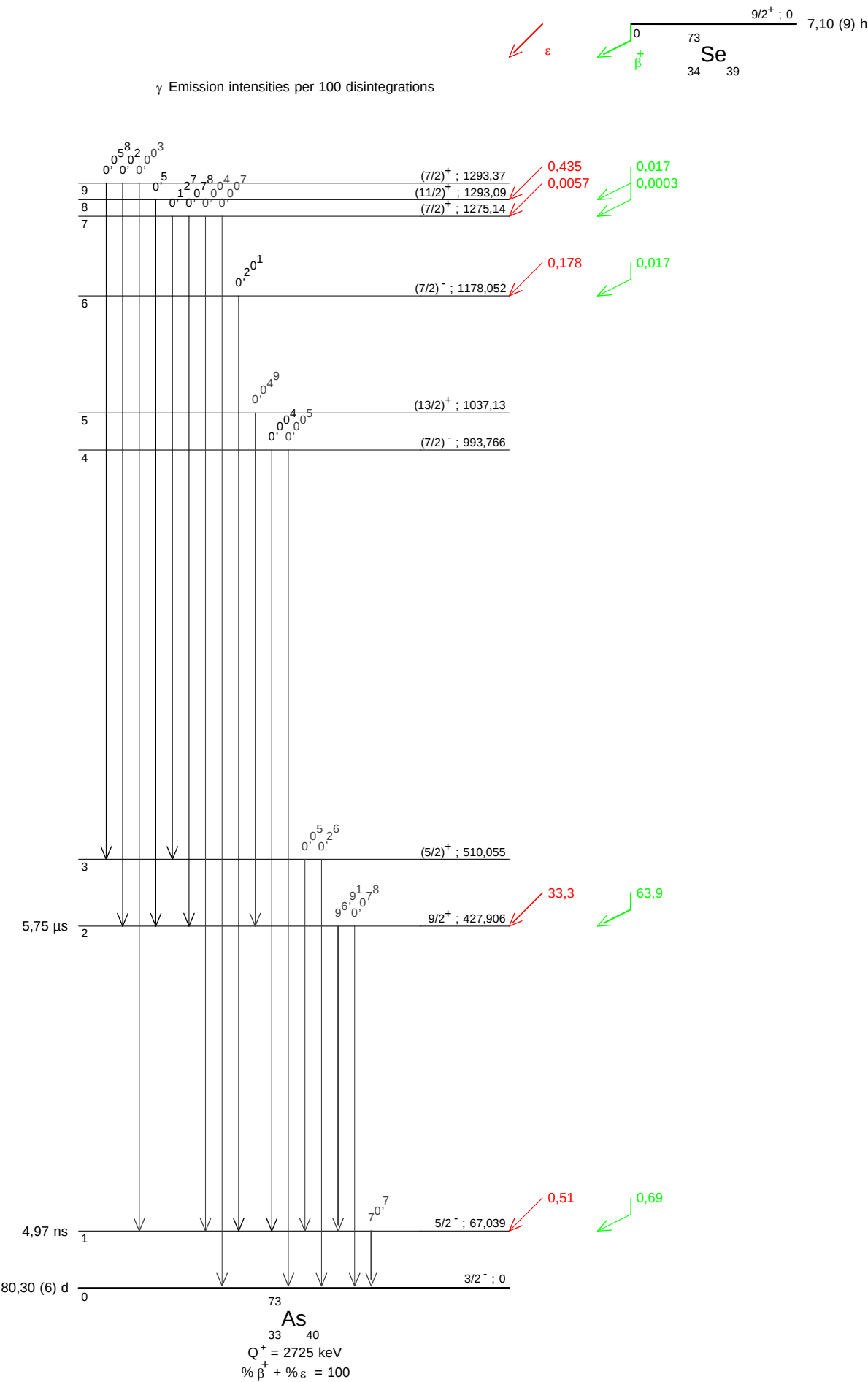
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1 Decay Scheme

Le rubidium 82 se désintègre par capture électronique vers des niveaux excités et le niveau fondamental du krypton 82.

Rb-82 decays by electron capture to excited levels and to the ground state of Kr-82.

2 Nuclear Data

$T_{1/2}(^{82}\text{Rb})$: 1,2652 (45) min
 $Q^+(^{82}\text{Rb})$: 4403 (3) keV

2.1 Electron Capture Transitions

	Energy (keV)	Probability (%)	Nature	lg <i>ft</i>	<i>P_K</i>	<i>P_L</i>	<i>P_M</i>
ε _{0,24}	446,9 (30)	0,00009 (2)		7,1	0,8722 (15)	0,1061 (12)	0,0192 (4)
ε _{0,23}	491,9 (30)	0,00010 (2)		7,1			
ε _{0,22}	521,9 (30)	0,00024 (5)		6,8			
ε _{0,21}	567,2 (30)	0,00089 (5)		6,3			
ε _{0,20}	587,9 (30)	0,0019 (8)		5,6			
ε _{0,19}	661 (3)	0,0036 (6)		5,9			
ε _{0,18}	686,2 (30)	0,008 (3)		5,8			
ε _{0,17}	838,4 (30)	0,0034 (31)		6			
ε _{0,16}	945,5 (30)	0,000111 (23)		7,7			
ε _{0,15}	1047,7 (30)	0,00134 (13)		6,7			
ε _{0,14}	1216,2 (30)	0,0265 (15)		5,5	0,8763 (15)	0,1028 (12)	0,0185 (4)
ε _{0,13}	1458,9 (30)	0,0500 (19)		5,4	0,8766 (15)	0,1025 (12)	0,0185 (4)
ε _{0,12}	1747,2 (30)	0,0142 (17)		6,1	0,8770 (14)	0,1022 (12)	0,0184 (4)
ε _{0,11}	1841,3 (30)	0,0011 (6)		7,3			
ε _{0,10}	1846,7 (30)	0,00023 (11)		10			
ε _{0,9}	1894 (3)	0,0011 (6)		7,4			
ε _{0,8}	1923,3 (30)	0,0682 (14)		5,5	0,8771 (14)	0,1021 (12)	0,0184 (4)
ε _{0,7}	1952,9 (30)	0,0105 (8)		6,3	0,8771 (14)	0,1021 (12)	0,0184 (4)
ε _{0,6}	2231,3 (30)	0,283 (5)	Allowed	5	0,8773 (14)	0,1019 (12)	0,0184 (4)
ε _{0,5}	2446,2 (30)	0,0047 (8)		6,7			
ε _{0,4}	2582,4 (30)	0,00003 (3)	Unique 2nd Forbidden	11,5			
ε _{0,3}	2915,4 (30)	0,0096 (9)	Allowed	6,7			

	Energy (keV)	Probability (%)	Nature	lg <i>ft</i>	<i>P_K</i>	<i>P_L</i>	<i>P_M</i>
ε _{0,2}	2928,1 (30)	0,0284 (14)	Allowed	6,3	0,8776 (14)	0,1017 (12)	0,0183 (4)
ε _{0,1}	3626,5 (30)	1,06 (2)	Allowed	4,8	0,8778 (14)	0,1016 (12)	0,0183 (4)
ε _{0,0}	4403 (3)	3,01 (3)	Allowed	4,6	0,8779 (14)	0,1014 (12)	0,0183 (4)

2.2 β⁺ Transitions

	Energy (keV)	Probability (%)	Nature	lg <i>ft</i>
β _{0,12} ⁺	725,2 (30)	0,00284 (34)		6,1
β _{0,11} ⁺	819,3 (30)	0,00033 (19)		7,3
β _{0,10} ⁺	824,7 (30)	0,00007 (4)		10
β _{0,9} ⁺	872 (3)	0,00041 (25)		7,4
β _{0,8} ⁺	901,3 (30)	0,0288 (7)		5,5
β _{0,7} ⁺	930,9 (30)	0,0050 (4)		6,3
β _{0,6} ⁺	1209,3 (30)	0,317 (6)	Allowed	5
β _{0,5} ⁺	1424,2 (30)	0,00890 (14)		6,7
β _{0,4} ⁺	1560,4 (30)	0,00007 (7)	Unique 2nd Forbidden	11,5
β _{0,3} ⁺	1893,4 (30)	0,0444 (41)	Allowed	6,7
β _{0,2} ⁺	1906,1 (30)	0,135 (7)	Allowed	6,3
β _{0,1} ⁺	2604,5 (30)	13,10 (19)	Allowed	4,8
β _{0,0} ⁺	3381 (3)	81,81 (24)	Allowed	4,6

2.3 Gamma Transitions and Internal Conversion Coefficients

	Energy (keV)	P _{γ+ce} (%)	Multipolarity	α _K (10 ⁻⁴)	α _L (10 ⁻⁵)	α _M (10 ⁻⁶)	α _T (10 ⁻⁴)
γ _{8,5} (Kr)	522,923 (36)	0,0045 (15)					
γ _{6,2} (Kr)	696,786 (32)	0,071 (6)					
γ _{2,1} (Kr)	698,372 (14)	0,159 (11)					
γ _{3,1} (Kr)	711,10 (7)	0,060 (4)					
γ _{1,0} (Kr)	776,522 (10)	15,03 (19)	E2	8,19 (12)	8,84 (13)	14,3 (2)	9,23 (13)
γ _{20,13} (Kr)	871 (1)	0,0014 (8)					
γ _{7,2} (Kr)	975,20 (9)	0,0084 (11)					
γ _{8,3} (Kr)	992,10 (8)	0,0018 (8)					
γ _{9,3} (Kr)	1021,4 (5)	0,0015 (9)					
γ _{4,1} (Kr)	1044,08 (40)	0,0009 (6)					
γ _{10,2} (Kr)	1081,4 (7)	0,00030 (15)					
γ _{11,2} (Kr)	1086,8 (5)	0,0014 (8)					
γ _{13,4} (Kr)	1123,54 (40)	0,0008 (6)					
γ _{12,3} (Kr)	1168,20 (12)	0,0014 (6)					
γ _{5,1} (Kr)	1180,275 (22)	0,0165 (15)					
γ _{12,2} (Kr)	1180,93 (10)	0,0030 (15)					
γ _{6,1} (Kr)	1395,158 (32)	0,529 (8)	E2	2,12 (3)	2,24 (4)	3,63 (5)	2,90 (4)
γ _{2,0} (Kr)	1474,894 (10)	0,0904 (24)	E2	1,90 (3)	2,00 (3)	3,24 (5)	2,89 (4)
γ _{17,5} (Kr)	1607,8 (3)	0,00225 (30)					
γ _{7,1} (Kr)	1673,57 (9)	0,0071 (5)					
γ _{14,3} (Kr)	1699,20 (9)	0,0015 (8)					
γ _{8,1} (Kr)	1703,198 (32)	0,0505 (11)					

	Energy (keV)	P _{γ+ce} (%)	Multipolarity	α _K (10 ⁻⁴)	α _L (10 ⁻⁵)	α _M (10 ⁻⁶)	α _T (10 ⁻⁴)
γ _{14,2} (Kr)	1711,93 (5)	0,00165 (30)					
γ _{19,5} (Kr)	1785,16 (8)	0,0030 (6)					
γ _{12,1} (Kr)	1879,3 (1)	0,0101 (6)					
γ _{5,0} (Kr)	1956,797 (20)	0,0068 (6)					
γ _{13,1} (Kr)	2167,618 (41)	0,0431 (6)					
γ _{18,2} (Kr)	2241,94 (15)	0,0009 (8)					
γ _{14,1} (Kr)	2410,30 (5)	0,0233 (12)					
γ _{8,0} (Kr)	2479,72 (3)	0,0401 (16)					
γ _{15,1} (Kr)	2578,80 (19)	0,00105 (11)					
γ _{12,0} (Kr)	2655,82 (10)	0,0026 (6)					
γ _{17,1} (Kr)	2788,08 (30)	0,00114 (8)					
γ _{18,1} (Kr)	2940,31 (15)	0,0071 (29)					
γ _{13,0} (Kr)	2944,14 (4)	0,0075 (15)					
γ _{19,1} (Kr)	2965,44 (8)	0,00060 (5)					
γ _{21,1} (Kr)	3059,3 (5)	0,00068 (5)					
γ _{22,1} (Kr)	3104,6 (5)	0,00015 (5)					
γ _{15,0} (Kr)	3355,32 (19)	0,000285 (30)					
γ _{16,0} (Kr)	3457,5 (7)	0,000111 (23)					
γ _{20,0} (Kr)	3815,1 (10)	0,000451 (31)					
γ _{21,0} (Kr)	3835,8 (5)	0,000219 (23)					
γ _{22,0} (Kr)	3881,1 (5)	0,000087 (21)					
γ _{23,0} (Kr)	3911,1 (10)	0,000105 (15)					
γ _{24,0} (Kr)	3956,1 (10)	0,000090 (15)					

3 Atomic Data

3.1 Kr

ω _K	:	0,652	(4)
ω _L	:	0,0215	(6)
n _{KL}	:	1,149	(4)

3.1.1 X Radiations

	Energy (keV)	Relative probability
X _K		
Kα ₂	12,599	51,86
Kα ₁	12,65	100
Kβ ₃	14,105	23,96
Kβ ₁	14,113	
Kβ ₅ ''	14,238	
Kβ ₂	14,315	2,42
Kβ ₄	14,328	
X _L		
Lℓ	1,387	
Lα	1,585 - 1,586	
Lη	1,439	
Lβ	1,637 - 1,831	
Lγ	1,706 - 1,911	

3.1.2 Auger Electrons

	Energy (keV)	Relative probability
Auger K		
KLL	10,398 - 10,885	100
KLX	12,077 - 12,637	34,7
KXY	13,741 - 14,298	3,02
Auger L		
	1,09 - 1,91	

4 Electron and Positron Emissions

		Energy (keV)	Electrons (per 100 disint.)
e _{AL}	(Kr)	1,09 - 1,91	4,961 (25)
e _{AK}	(Kr)		
	KLL	10,398 - 10,885	1,394 (20)
	KLX	12,077 - 12,637	
	KXY	13,741 - 14,298	
$\beta_{0,0}^+$	max:	3381 (3)	81,81 (24)
	avg:	1535,6 (15)	
$\beta_{0,1}^+$	max:	2604,5 (30)	13,10 (19)
	avg:	1168,5 (15)	
$\beta_{0,2}^+$	max:	1906,1 (30)	0,135 (7)
	avg:	844,1 (14)	
$\beta_{0,3}^+$	max:	1893,4 (30)	0,0444 (41)
	avg:	838,3 (14)	
$\beta_{0,4}^+$	max:	1560,4 (30)	0,00007 (7)
	avg:	735,6 (15)	
$\beta_{0,5}^+$	max:	1424,2 (30)	0,00890 (14)
	avg:	624,8 (14)	
$\beta_{0,6}^+$	max:	1209,3 (30)	0,317 (6)
	avg:	528,6 (14)	
$\beta_{0,7}^+$	max:	930,9 (30)	0,0050 (4)
	avg:	405,7 (14)	
$\beta_{0,8}^+$	max:	901,3 (30)	0,0288 (7)
	avg:	392,7 (14)	
$\beta_{0,9}^+$	max:	872 (3)	0,00041 (25)
	avg:	380,0 (14)	
$\beta_{0,10}^+$	max:	824,7 (30)	0,00007 (4)
	avg:	359,4 (14)	
$\beta_{0,11}^+$	max:	819,3 (30)	0,00033 (19)
	avg:	357,0 (14)	

		Energy (keV)	Electrons (per 100 disint.)
$\beta_{0,12}^+$	max:	725,2 (30)	0,00284 (34)
	avg:	316,2 (13)	

5 Photon Emissions

5.1 X-Ray Emissions

		Energy (keV)	Photons (per 100 disint.)	
XL	(Kr)	1,387 - 1,911	0,1066 (18)	
XK α_2	(Kr)	12,599	0,760 (9)	} K α
XK α_1	(Kr)	12,65	1,466 (16)	
XK β_3	(Kr)	14,105	0,351 (5)	} K' β_1
XK β_1	(Kr)	14,113		
XK β_5''	(Kr)	14,238		
XK β_2	(Kr)	14,315	0,0354 (12)	} K' β_2
XK β_4	(Kr)	14,328		

5.2 Gamma Emissions

	Energy (keV)	Photons (per 100 disint.)
$\gamma^\pm$	511	190,9 (6)
$\gamma_{8,5}(\text{Kr})$	522,8 (5)	0,0045 (15)
$\gamma_{6,2}(\text{Kr})$	696,86 (15)	0,071 (6)
$\gamma_{2,1}(\text{Kr})$	698,37 (5)	0,159 (11)
$\gamma_{3,1}(\text{Kr})$	711,2 (1)	0,060 (4)
$\gamma_{1,0}(\text{Kr})$	776,52 (1)	15,02 (19)
$\gamma_{20,13}(\text{Kr})$	869,3 (4)	0,0014 (8)
$\gamma_{7,2}(\text{Kr})$	975,2 (1)	0,0084 (11)
$\gamma_{8,3}(\text{Kr})$	992,2 (1)	0,0018 (8)
$\gamma_{9,3}(\text{Kr})$	1021,4 (5)	0,0015 (9)
$\gamma_{4,1}(\text{Kr})$	1044,1 (5)	0,0009 (6)
$\gamma_{10,2}(\text{Kr})$	1081,4 (7)	0,00030 (15)
$\gamma_{11,2}(\text{Kr})$	1086,8 (5)	0,0014 (8)
$\gamma_{13,4}(\text{Kr})$	1123,6 (7)	0,0008 (6)
$\gamma_{12,3}(\text{Kr})$	1168,2 (2)	0,0014 (6)
$\gamma_{5,1}(\text{Kr})$	1180,27 (2)	0,0165 (15)
$\gamma_{12,2}(\text{Kr})$	1181,3	0,0030 (15)
$\gamma_{6,1}(\text{Kr})$	1395,14 (3)	0,529 (8)
$\gamma_{2,0}(\text{Kr})$	1474,88 (1)	0,0904 (24)

	Energy (keV)	Photons (per 100 disint.)
$\gamma_{17,5}(\text{Kr})$	1607,7 (3)	0,00225 (30)
$\gamma_{7,1}(\text{Kr})$	1673,55 (9)	0,0071 (5)
$\gamma_{14,3}(\text{Kr})$	1698,7 (3)	0,0015 (8)
$\gamma_{8,1}(\text{Kr})$	1703,19 (4)	0,0505 (11)
$\gamma_{14,2}(\text{Kr})$	1711,9 (4)	0,00165 (30)
$\gamma_{19,5}(\text{Kr})$	1785,13 (7)	0,0030 (6)
$\gamma_{12,1}(\text{Kr})$	1879,18 (15)	0,0101 (6)
$\gamma_{5,0}(\text{Kr})$	1956,75 (4)	0,0068 (6)
$\gamma_{13,1}(\text{Kr})$	2167,59 (4)	0,0431 (6)
$\gamma_{18,2}(\text{Kr})$	2241,98 (17)	0,0009 (8)
$\gamma_{14,1}(\text{Kr})$	2410,26 (5)	0,0233 (12)
$\gamma_{8,0}(\text{Kr})$	2479,65 (4)	0,0401 (16)
$\gamma_{15,1}(\text{Kr})$	2578,7 (2)	0,00105 (11)
$\gamma_{12,0}(\text{Kr})$	2655,85 (15)	0,0026 (6)
$\gamma_{17,1}(\text{Kr})$	2788,4 (5)	0,00114 (8)
$\gamma_{18,1}(\text{Kr})$	2940,0 (3)	0,0071 (29)
$\gamma_{13,0}(\text{Kr})$	2944,0 (2)	0,0075 (15)
$\gamma_{19,1}(\text{Kr})$	2966,3 (7)	0,00060 (5)
$\gamma_{21,1}(\text{Kr})$	3059,2 (5)	0,00068 (5)
$\gamma_{22,1}(\text{Kr})$	3104,5 (5)	0,00015 (5)
$\gamma_{15,0}(\text{Kr})$	3355,6 (5)	0,000285 (30)
$\gamma_{16,0}(\text{Kr})$	3457,4 (7)	0,000111 (23)
$\gamma_{20,0}(\text{Kr})$	3815 (1)	0,000451 (31)
$\gamma_{21,0}(\text{Kr})$	3836 (1)	0,000219 (23)
$\gamma_{22,0}(\text{Kr})$	3881 (1)	0,000087 (21)
$\gamma_{23,0}(\text{Kr})$	3911 (1)	0,000105 (15)
$\gamma_{24,0}(\text{Kr})$	3956 (1)	0,000090 (15)

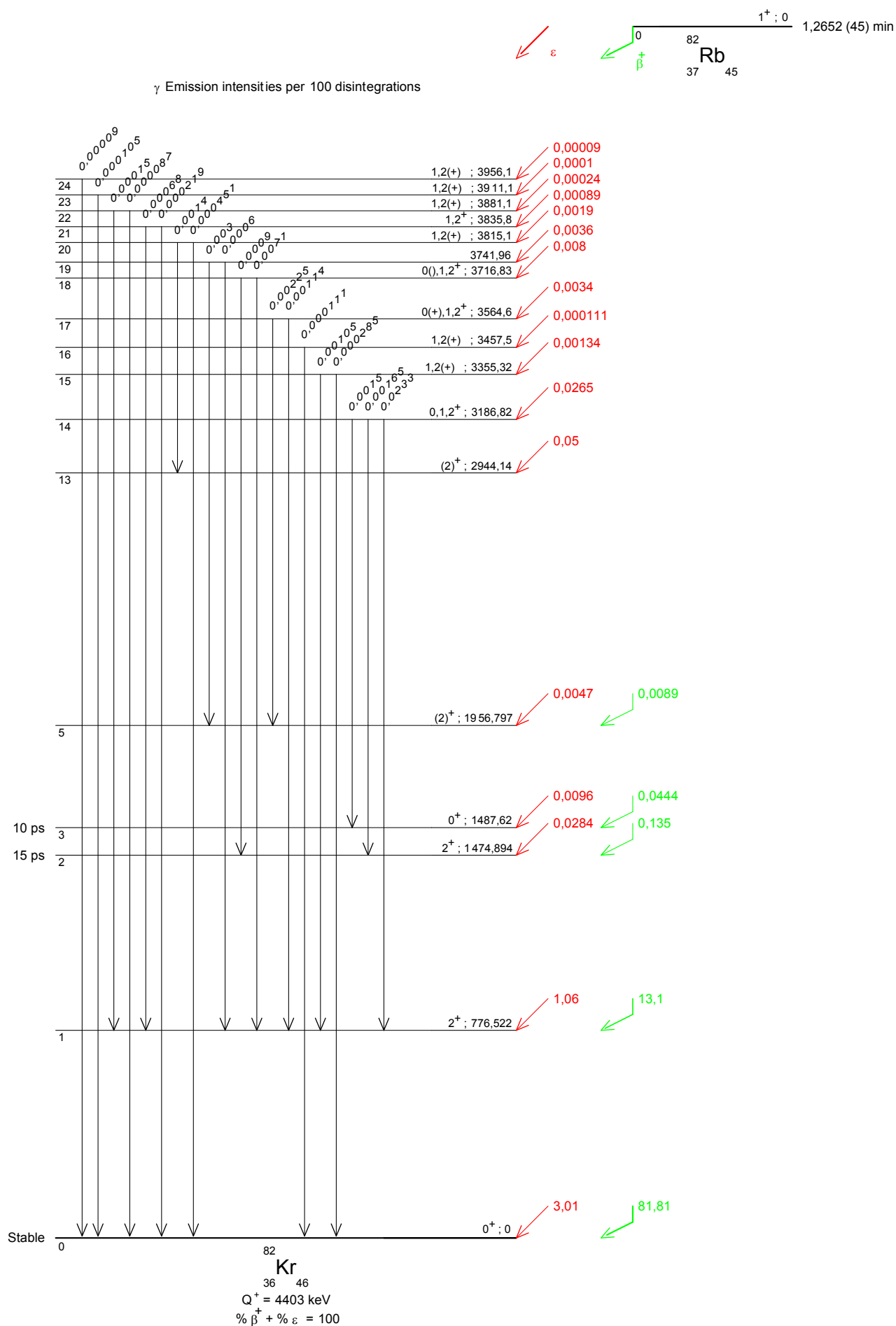
6 Main Production Modes

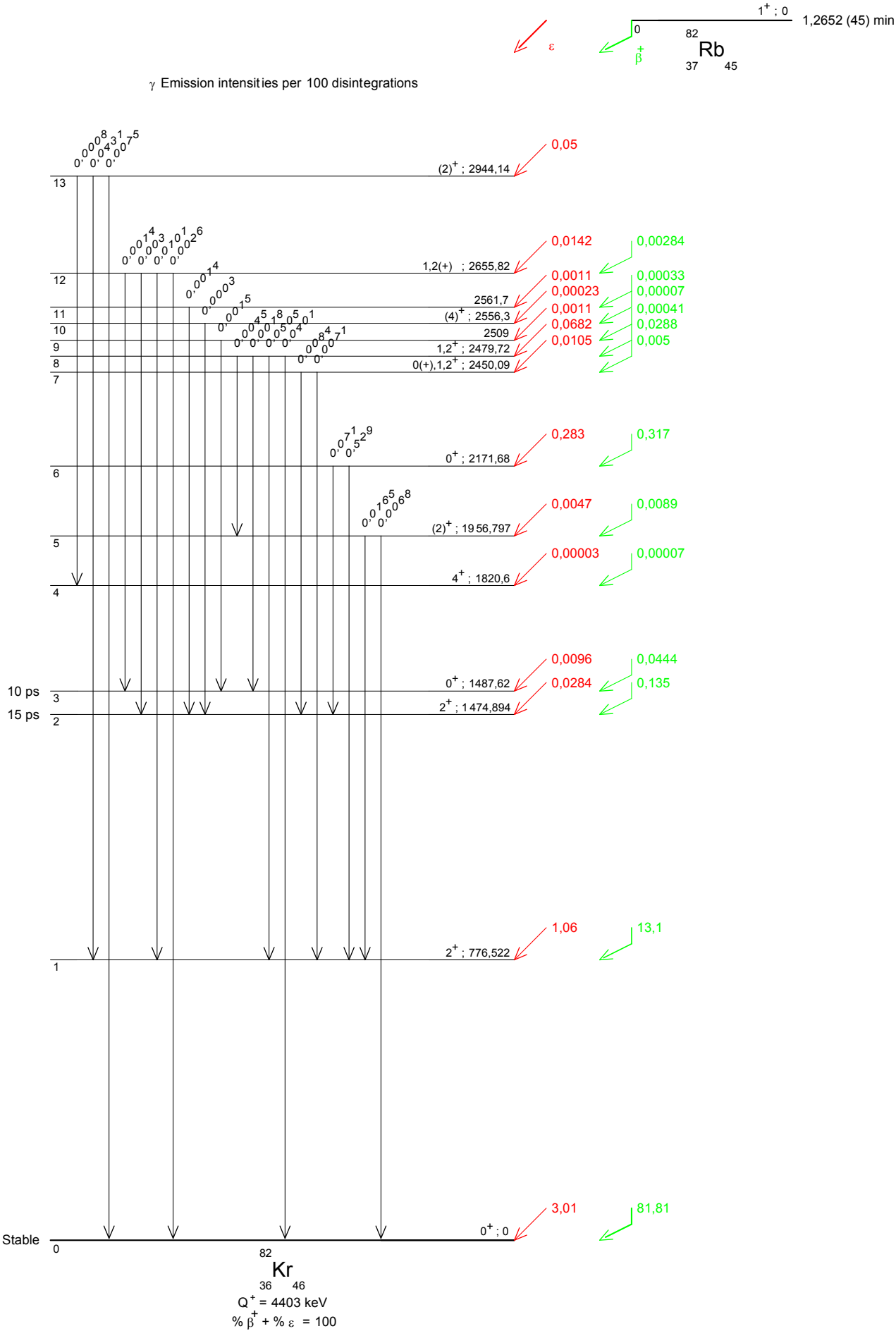
- { Rb – nat(p,xn)Sr – 82
- { Possible impurities: Sr – 85
- { Rb – 85(p,4n)Sr – 82
- { Possible impurities: Sr – 85
- Sr – 82(E.C.)Rb – 82

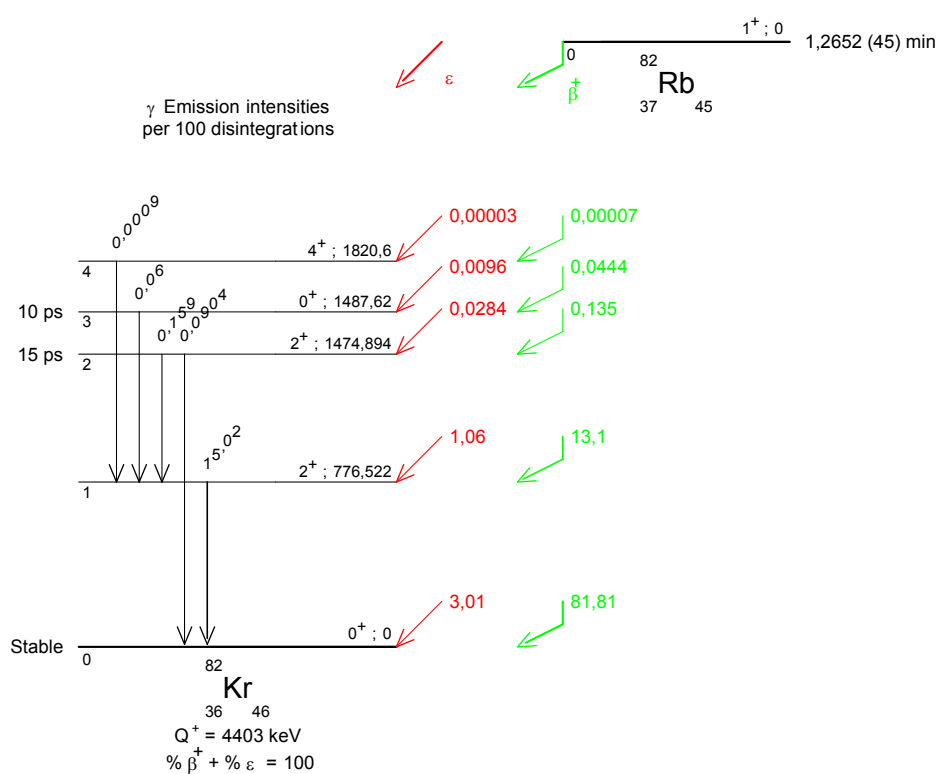
7 References

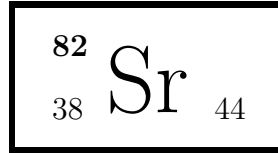
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(Q)









1 Decay Scheme

Sr-82 decays by electron capture to the ground state of Rb-82 ($T_{1/2} = 1,2652$ (45) min). There is no decay to the excited level of Rb-82m ($T_{1/2} = 6,47$ h).

Le strontium 82 se désintègre par capture électronique vers le niveau fondamental du rubidium 82 ($T_{1/2}=1,2652$ (45) min), le niveau excité de période 6,47 h n'est pas atteint.

2 Nuclear Data

$T_{1/2}(^{82}\text{Sr})$	:	25,347	(17)	d
$T_{1/2}(^{82}\text{Rb})$	:	1,2652	(45)	min
$Q^+(^{82}\text{Sr})$	:	178	(7)	keV

2.1 Electron Capture Transitions

	Energy (keV)	Probability (%)	Nature	lg ft	P_K	P_L	P_M
$\epsilon_{0,0}$	178 (7)	100	Allowed	4,7	0,859 (2)	0,116 (2)	0,022 (1)

3 Atomic Data

3.1 Rb

ω_K	:	0,674	(4)
$\bar{\omega}_L$	:	0,0237	(6)
n_{KL}	:	1,125	(4)

3.1.1 X Radiations

	Energy (keV)	Relative probability
X _K		
Kα ₂	13,3359	51,95
Kα ₁	13,3955	100
Kβ ₃	14,9519	} 24,34
Kβ ₁	14,9614	
Kβ ₅ ''	15,085	
Kβ ₂	15,1856	} 2,82
Kβ ₄	15,205	
X _L		
Lℓ	1,484	
Lα	1,693 - 1,695	
Lη	1,543	
Lβ	1,752 - 1,954	
Lγ	1,831 - 2,051	

3.1.2 Auger Electrons

	Energy (keV)	Relative probability
Auger K		
KLL	10,987 - 11,503	100
KLX	12,782 - 13,381	35,8
KXY	14,556 - 15,172	3,2
Auger L		
	1,16 - 2,05	

4 Electron Emissions

	Energy (keV)	Electrons (per 100 disint.)
e _{AL} (Rb)	1,16 - 2,05	105,7 (5)
e_{AK} (Rb)		
KLL	10,987 - 11,503	} 28,0 (4)
KLX	12,782 - 13,381	
KXY	14,556 - 15,172	

5 Photon Emissions

5.1 X-Ray Emissions

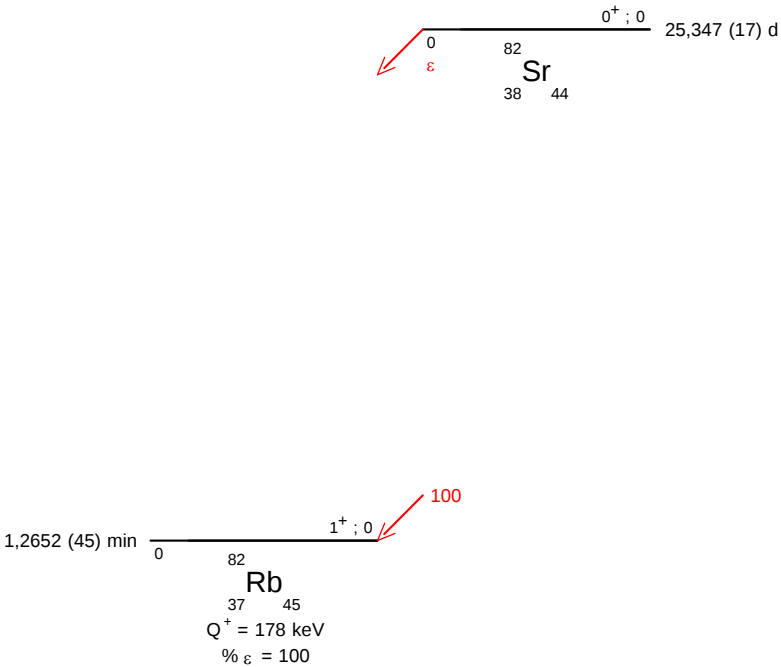
		Energy (keV)	Photons (per 100 disint.)		
XL	(Rb)	1,484 - 2,051	2,52 (5)		
XK α_2	(Rb)	13,3359	16,79 (14)	}	K α
XK α_1	(Rb)	13,3955	32,32 (22)		
XK β_3	(Rb)	14,9519	7,87 (9)	}	K' β_1
XK β_1	(Rb)	14,9614			
XK β_5''	(Rb)	15,085			
XK β_2	(Rb)	15,1856	0,91 (4)	}	K' β_2
XK β_4	(Rb)	15,205			

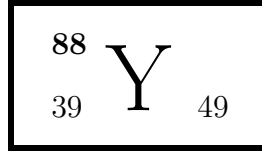
6 Main Production Modes

- { Rb – nat(p,xn)Sr – 82
- { Possible impurities: Sr – 85
- { Rb – 85(p,4n)Sr – 82
- { Possible impurities: Sr – 85

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(Q)





1 Decay Scheme

L'yttrium 88 se désintègre par capture électronique et émission bêta plus vers les niveaux excités du strontium 88. Aucune transition (EC/β^+) vers le niveau fondamental du strontium 88 n'a été mise en évidence.

Y-88 decays by electron capture and β^+ emission to excited levels of Sr-88. No (EC/β^+) transition to the ground state of Sr-88 was found.

2 Nuclear Data

$$\begin{aligned}
 T_{1/2}({}^{88}\text{Y}) &: 106,63 \quad (5) \quad \text{d} \\
 Q^+({}^{88}\text{Y}) &: 3622,6 \quad (15) \quad \text{keV}
 \end{aligned}$$

2.1 Electron Capture Transitions

	Energy (keV)	Probability (%)	Nature	lg ft	P_K	P_L	P_M
$\epsilon_{0,4}$	37,8 (15)	0,048 (18)	Allowed	7	0,721 (12)	0,225 (10)	0,0542 (25)
$\epsilon_{0,3}$	404,1 (15)	0,023 (4)	Unique 1st Forbidden	9,5	0,8521 (2)	0,1209 (1)	0,02701 (3)
$\epsilon_{0,2}$	888,5 (15)	94,3 (3)	Allowed	6,9	0,8726 (15)	0,1046 (14)	0,0229 (6)
$\epsilon_{0,1}$	1786,5 (15)	5,7 (3)	Unique 1st Forbidden	9,8	0,8393 (3)	0,100085 (4)	0,02206 (8)

2.2 β^+ Transitions

	Energy (keV)	Probability (%)	Nature	lg ft
$\beta_{0,1}^+$	764,5 (15)	0,21 (1)	Unique 1st Forbidden	9,8

2.3 Gamma Transitions and Internal Conversion Coefficients

	Energy (keV)	P _{γ+ce} (%)	Multipolarity	α _K (10 ⁻³)	α _L (10 ⁻⁴)	α _M (10 ⁻⁵)	α _N (10 ⁻⁶)	α _T (10 ⁻³)	α _π (10 ⁻⁴)
γ _{3,2} (Sr)	484,352 (23)	0,0009 (9)	[E1]	1,079 (16)	1,165 (17)	1,95 (3)	2,45 (4)	1,217 (17)	
γ _{4,2} (Sr)	850,647 (21)	0,048 (18)	E2	0,754 (11)	0,828 (12)	1,39 (2)	1,739 (25)	0,853 (12)	
γ _{2,1} (Sr)	898,047 (11)	93,7 (3)	E1(+M2)	0,273 (4)	0,292 (4)	0,489 (7)	0,614 (9)	0,307 (5)	
γ _{3,1} (Sr)	1382,399 (23)	0,016 (3)	M1+E2	0,255 (4)	0,273 (4)	0,458 (7)	0,577 (8)	0,288 (4)	0,378 (6)
γ _{1,0} (Sr)	1836,090 (8)	99,385 (25)	E2	0,1449 (21)	0,1550 (22)	0,260 (4)	0,327 (5)	0,163 (2)	2,30 (4)
γ _{2,0} (Sr)	2734,137 (8)	0,608 (25)	(E3)	0,1098 (16)	0,1176 (17)	0,197 (3)	0,248 (4)	0,124 (2)	4,40 (7)
γ _{3,0} (Sr)	3218,489 (22)	0,0071 (20)	E2	0,0545 (8)	0,0577 (8)	0,0967 (14)	0,1219 (17)	0,0613 (8)	8,69 (13)

3 Atomic Data

3.1 Sr

ω _K	:	0,696	(4)
ω̄ _L	:	0,0262	(7)
n _{KL}	:	1,102	(4)

3.1.1 X Radiations

	Energy (keV)		Relative probability
X _K			
Kα ₂	14,098		52,05
Kα ₁	14,1652		100
Kβ ₃	15,8252	}	24,69131
Kβ ₁	15,8359		
Kβ ₅ ''	15,969		
Kβ ₂	16,0847	}	3,20987
Kβ ₄	16,104		
X _L			
Lℓ	1,5833		
Lα	1,8054 - 1,8071		
Lη	1,6501		
Lβ	1,8722 - 1,9466		
Lγ	1,9707 - 2,1971		

3.1.2 Auger Electrons

	Energy (keV)	Relative probability
Auger K		
KLL	11,587 - 12,134	100
KLX	13,498 - 14,145	36,7
KXY	15,390 - 16,065	3,37
Auger L		
	1,2246 - 2,1944	

4 Electron Emissions

		Energy (keV)	Electrons (per 100 disint.)
e _{AL}	(Sr)	1,2246 - 2,1944	103,8 (5)
e _{AK}	(Sr)		
	KLL	11,587 - 12,134	} 26,5 (4)
	KLX	13,498 - 14,145	
	KXY	15,390 - 16,065	
ec _{1,0} [±]	(Sr)	814,072 (8)	0,02285 (40)
ec _{2,1} T	(Sr)	881,942 - 898,045	0,02877 (48)
ec _{2,0} [±]	(Sr)	1712,094 (8)	0,000268 (12)
ec _{1,0} T	(Sr)	1819,99 - 1836,09	0,0162 (2)
β _{0,1} ⁺	max:	764,5 (15)	} 0,21 (1)
	avg:	359,5 (7)	

5 Photon Emissions

5.1 X-Ray Emissions

		Energy (keV)	Photons (per 100 disint.)	
XL	(Sr)	1,5833 - 2,1971	2,76 (5)	
XKα ₂	(Sr)	14,098	17,55 (16)	} Kα
XKα ₁	(Sr)	14,1652	33,71 (26)	
XKβ ₃	(Sr)	15,8252	} 8,32 (10)	K'β ₁
XKβ ₁	(Sr)	15,8359		
XKβ ₅ ^{''}	(Sr)	15,969		
XKβ ₂	(Sr)	16,0847	} 1,08 (4)	K'β ₂
XKβ ₄	(Sr)	16,104		

5.2 Gamma Emissions

	Energy (keV)	Photons (per 100 disint.)
$\gamma_{3,2}(\text{Sr})$	484,352 (23)	0,0009 (9)
$\gamma^{\pm}$	511	0,46 (3)
$\gamma_{4,2}(\text{Sr})$	850,643 (21)	0,048 (18)
$\gamma_{2,1}(\text{Sr})$	898,042 (11)	93,7 (3)
$\gamma_{3,1}(\text{Sr})$	1382,387 (23)	0,016 (3)
$\gamma_{1,0}(\text{Sr})$	1836,070 (8)	99,346 (25)
$\gamma_{2,0}(\text{Sr})$	2734,092 (8)	0,608 (25)
$\gamma_{3,0}(\text{Sr})$	3218,426 (22)	0,0071 (20)

6 Main Production Modes

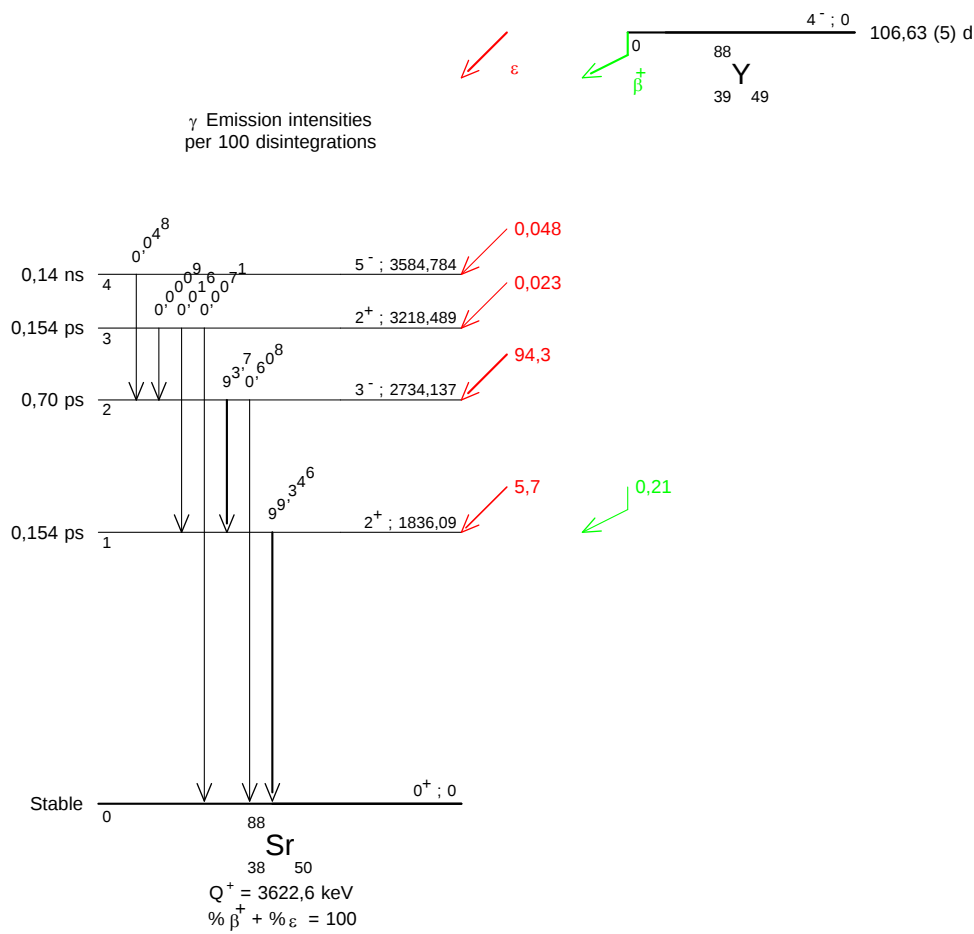
- { Sr – 88(p,n)Y – 88
- { Possible impurities: Y – 84, Y – 85, Y – 86, Y – 87, Rb – 83, Rb – 84, Rb – 86
- { Sr – 88(d,2n)Y – 88
- { Possible impurities: Y – 84, Y – 87, Sr – 89

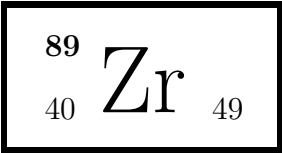
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1 Decay Scheme

Zr-89 (half-life of 78.42 h) undergoes 100% EC/positron decay (Q_{EC} of 2832.8(28) keV) to various nuclear levels, including the metastable and ground states of Y-89.

Le zirconium 89 se désintègre par capture électronique et/ou transitions bêta plus vers plusieurs niveaux de l'yttrium 89, y compris le niveau isomérique et le niveau fondamental.

2 Nuclear Data

$T_{1/2} (^{89}\text{Zr})$	:	78,42	(13)	h
$T_{1/2} (^{89\text{m}}\text{Y})$	:	15,84	(18)	s
$Q^+ (^{89}\text{Zr})$	:	2832,8	(28)	keV

2.1 Electron Capture Transitions

	Energy (keV)	Probability (%)	Nature	lg ft	P_K	P_L	P_M
$\epsilon_{0,5}$	211 (3)	0,745 (10)	allowed	6,18	0,8575 (17)	0,1165 (13)	0,0223 (5)
$\epsilon_{0,4}$	266 (3)	0,106 (5)	allowed	7,25	0,8615 (16)	0,1134 (13)	0,0216 (5)
$\epsilon_{0,3}$	303 (3)	0,074 (5)	allowed	7,52	0,8632 (16)	0,1120 (13)	0,0213 (4)
$\epsilon_{0,2}$	1088 (3)	0,123 (4)	unique 1st forbidden	9,09	0,8677 (15)	0,1082 (12)	0,0208 (4)
$\epsilon_{0,1}$	1924 (3)	76,2 (3)	allowed	6,152	0,8731 (15)	0,1041 (12)	0,0196 (4)

2.2 β^+ Transitions

	Energy (keV)	Probability (%)	Nature	lg ft
$\beta_{0,1}^+$	902 (3)	22,8 (3)	allowed	6,152

2.3 Gamma Transitions and Internal Conversion Coefficients

	Energy (keV)	P _{γ+ce} (%)	Multipolarity	α _K (10 ⁻³)	α _L (10 ⁻⁴)	α _M (10 ⁻⁴)	α _T (10 ⁻³)	α _π (10 ⁻⁴)
γ _{1,0} (Y)	908,97 (3)	99,873 (23)	M4	7,43 (11)	9,06 (13)	1,561 (22)	8,51 (12)	
γ _{3,1} (Y)	1620,83 (20)	0,074 (5)	M1+E2					
γ _{4,1} (Y)	1657,58 (15)	0,106 (5)	M1+E2					
γ _{5,1} (Y)	1713,1 (3)	0,745 (10)	M1+E2					
γ _{2,0} (Y)	1744,74 (18)	0,1231 (40)	E2	0,1722 (25)	0,186 (3)	0,0317 (5)	0,382 (6)	1,88 (3)

3 Atomic Data

3.1 Y

ω _K	:	0,716	(4)
ω _L	:	0,0289	(7)
n _{KL}	:	1,081	(4)

3.1.1 X Radiations

	Energy (keV)		Relative probability
X _K			
Kα ₂	14,8829		52,1
Kα ₁	14,9585		100
Kβ ₃	16,7259	}	25,1
Kβ ₁	16,7381		
Kβ ₅ ''	16,88		
Kβ ₂	17,0156	}	3,48
Kβ ₄	17,0362		
X _L			
Lℓ	1,686		
Lα	1,92 - 1,923		
Lη	1,762		
Lβ	1,996 - 2,078		
Lγ	2,153 - 2,347		

3.1.2 Auger Electrons

	Energy (keV)	Relative probability
Auger K		
KLL	12,205 - 12,784	100
KLX	14,238 - 14,956	37,6
KXY	16,251 - 17,034	3,53
Auger L	1,27 - 1,89	579

4 Electron and Positron Emissions

		Energy (keV)	Electrons (per 100 disint.)
e _{AL}	(Y)	1,27 - 1,89	79,5 (7)
e _{AK}	(Y)		
	KLL	12,205 - 12,784	} 19,4 (3)
	KLX	14,238 - 14,956	
	KXY	16,251 - 17,034	
ec _{1,0} T	(Y)	891,93 - 908,97	0,84 (3)
ec _{1,0} K	(Y)	891,93 (3)	0,73 (3)
ec _{1,0} L	(Y)	906,60 - 906,89	0,089 (3)
ec _{1,0} M+	(Y)	908,58 - 908,97	0,017 (1)
$\beta_{0,1}^+$	max:	902 (3)	} 22,8 (3)
	avg:	395,7 (14)	

5 Photon Emissions**5.1 X-Ray Emissions**

		Energy (keV)	Photons (per 100 disint.)	
XL	(Y)	1,686 - 2,347	2,36 (5)	
XK α_2	(Y)	14,8829	14,08 (13)	} K α
XK α_1	(Y)	14,9585	27,01 (20)	
XK β_3	(Y)	16,7259	} 6,78 (8)	K' β_1
XK β_1	(Y)	16,7381		
XK β_5''	(Y)	16,88		
XK β_2	(Y)	17,0156	} 0,94 (4)	K' β_2
XK β_4	(Y)	17,0362		

5.2 Gamma Emissions

	Energy (keV)	Photons (per 100 disint.)
$\gamma^\pm$	511	45,6 (6)
$\gamma_{1,0}(Y)$	908,97 (3)	99,03 (2)
$\gamma_{3,1}(Y)$	1620,81 (20)	0,074 (5)
$\gamma_{4,1}(Y)$	1657,56 (15)	0,106 (5)
$\gamma_{5,1}(Y)$	1713,1 (3)	0,745 (10)
$\gamma_{2,0}(Y)$	1744,72 (18)	0,123 (4)

6 Main Production Modes

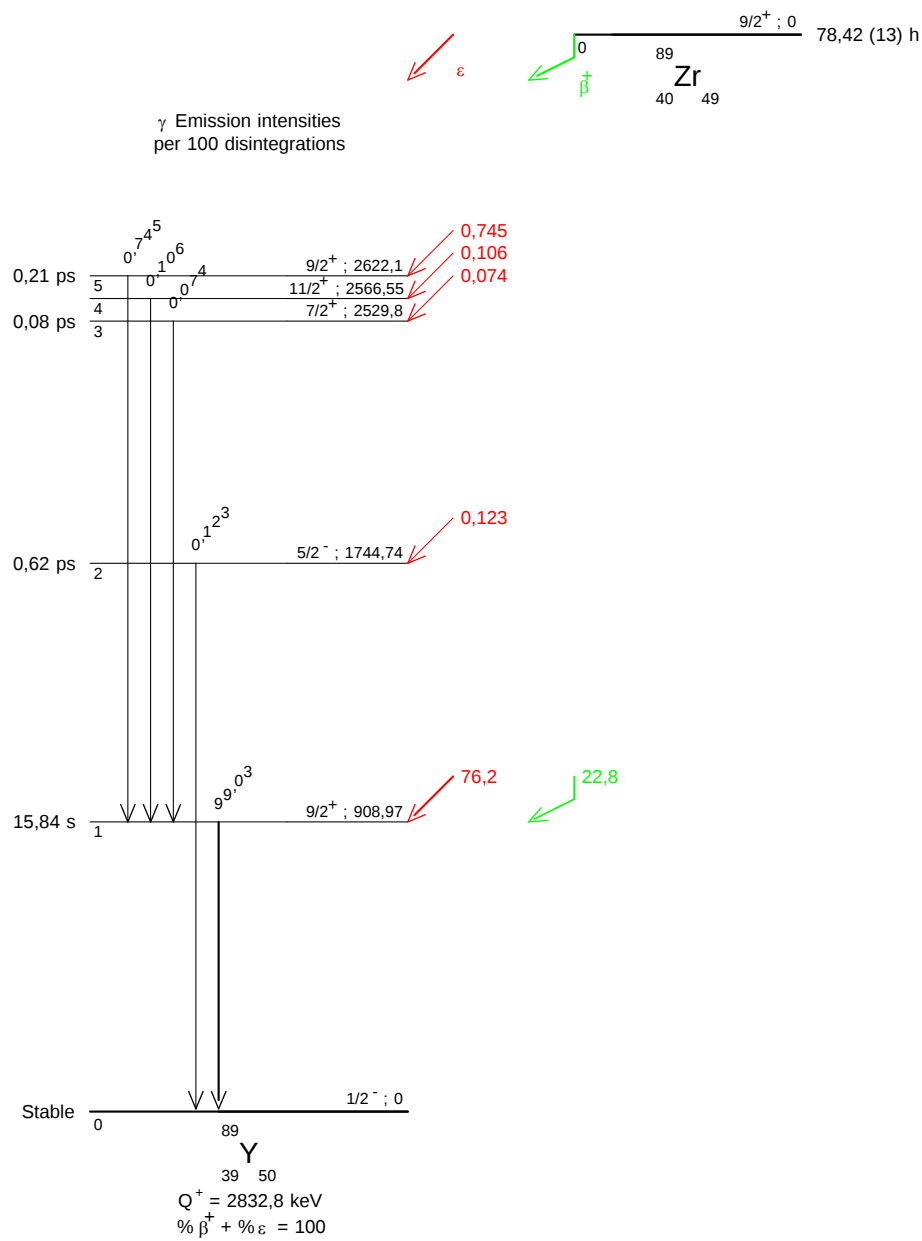
$$\begin{aligned}
 & \left\{ \begin{array}{l} Y - 89(p,n)Zr - 89 \\ \text{Possible impurities: } Zr - 88(EC)Y - 88, Zr - 89m \end{array} \right. \\
 & Y - 89(d,2n)Zr - 89 \\
 & Y - 89(\alpha,p3n)Zr - 89 \\
 & \left\{ \begin{array}{l} Zr - 90(n,2n)Zr - 89 \\ \text{Possible impurities: } Zr - 89m \end{array} \right. \\
 & Zr - 90(p,2n)Nb - 89(EC)Zr - 89 \\
 & Zr - 90(p,pn)Zr - 89 \\
 & Zr - 90(\gamma,n)Zr - 89
 \end{aligned}$$

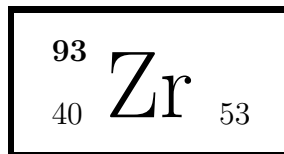
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1 Decay Scheme

Zr-93 decays via two beta minus transitions, 73(5)% to Nb-93m and 27(5)% to Nb-93.

Le zirconium-93 se désintègre 100 % par émission bêta vers le niveau isomérique (73 (5) %) et le niveau fondamental (27 (5) %) du niobium 93.

2 Nuclear Data

$$\begin{aligned}
T_{1/2}(^{93}\text{Zr}) &: 1,61 \quad (6) \quad 10^6 \text{ a} \\
Q^-(^{93}\text{Zr}) &: 90,3 \quad (15) \quad \text{keV}
\end{aligned}$$

2.1 β^- Transitions

	Energy (keV)	Probability (%)	Nature	lg <i>ft</i>
$\beta_{0,1}^-$	59,5 (15)	73 (5)	Unique 1st Forbidden	10,16
$\beta_{0,0}^-$	90,3 (15)	27 (5)	2nd Forbidden	12,09

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy (keV)	P _{$\gamma+ce$} (%)	Multipolarity	α_K (10 ⁵)	α_L (10 ⁵)	α_M (10 ⁵)	α_T (10 ⁵)
$\gamma_{1,0}(\text{Nb})$	30,77 (2)	73 (5)	M4	0,260 (4)	1,151 (17)	0,249 (4)	1,693 (25)

3 Atomic Data

3.1 Nb

ω_K	:	0,751	(4)
$\bar{\omega}_L$	:	0,0347	(9)
n_{KL}	:	1,045	(4)

3.1.1 X Radiations

	Energy (keV)		Relative probability
X _K			
K α_2	16,5213		52,36
K α_1	16,6152		100
K β_3	18,607	}	25,87
K β_1	18,623		
K β_5''	18,78		
K β_2	18,953	}	3,88
K β_4	18,981		
X _L			
L ℓ	1,9		
L α	2,16 - 2,17		
L η	2		
L β	2,26 - 2,49		
L γ	2,41 - 2,67		

3.1.2 Auger Electrons

	Energy (keV)	Relative probability
Auger K		
KLL	13,49 - 14,14	100
KLX	15,78 - 16,61	39,1
KXY	18,05 - 18,98	3,81
Auger L	1,4 - 2,7	

4 Electron Emissions

		Energy (keV)	Electrons (per 100 disint.)
e _{AL}	(Nb)	1,4 - 2,7	59,1 (4)
e _{AK}	(Nb)	$\left. \begin{array}{l} \text{KLL} \quad 13,49 - 14,14 \\ \text{KLX} \quad 15,78 - 16,61 \\ \text{KXY} \quad 18,05 - 18,98 \end{array} \right\}$	2,78 (21)
ec _{1,0 T}	(Nb)	11,78 - 30,77	73 (5)
ec _{1,0 K}	(Nb)	11,78 (2)	11,2 (8)
ec _{1,0 L}	(Nb)	28,07 - 28,40	49,5 (35)
ec _{1,0 M}	(Nb)	30,30 - 30,57	10,7 (8)
ec _{1,0 N}	(Nb)	30,71 - 30,77	1,39 (10)
$\beta_{0,1}^-$	max:	59,5 (15)	} 73 (5)
	avg:	18,75 (54)	
$\beta_{0,0}^-$	max:	90,3 (15)	} 27 (5)
	avg:	23,64 (42)	

5 Photon Emissions

5.1 X-Ray Emissions

		Energy (keV)	Photons (per 100 disint.)	
XL	(Nb)	1,9 - 2,67	2,1 (1)	
XK α_2	(Nb)	16,5213	2,41 (18)	} K α
XK α_1	(Nb)	16,6152	4,6 (4)	
XK β_3	(Nb)	18,607	} 1,19 (9)	K' β_1
XK β_1	(Nb)	18,623		
XK β_5''	(Nb)	18,78		
XK β_2	(Nb)	18,953	} 0,179 (15)	K' β_2
XK β_4	(Nb)	18,981		

5.2 Gamma Emissions

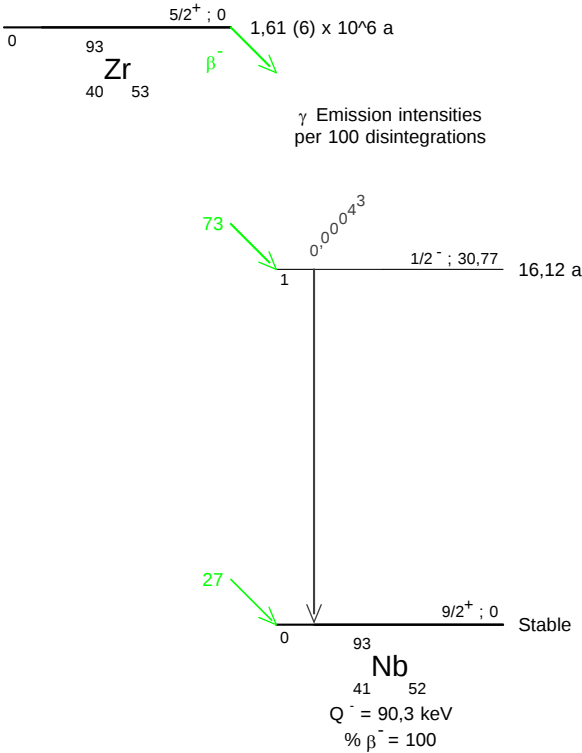
	Energy (keV)	Photons (per 100 disint.)
$\gamma_{1,0}(\text{Nb})$	30,77 (2)	0,00043 (3)

6 Main Production Modes

- $\left\{ \begin{array}{l} \text{U} - 235(\text{n},\text{f})\text{Zr} - 93 \\ \text{Possible impurities : Fe} - 55, \text{Mo} - 93, \text{Nb} - 93\text{m} \end{array} \right.$
- $\left\{ \begin{array}{l} \text{Zr} - 92(\text{n},\gamma)\text{Zr} - 93 \\ \text{Possible impurities : Nb} - 93\text{m} \end{array} \right.$

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(Q)





1 Decay Scheme

Nb-93m disintegrates by 100% gamma transition to the ground state of the stable nuclide Nb-93.
Le niobium 93m se désexcite à 100 % par transition gamma vers le noyau stable de niobium 93.

2 Nuclear Data

$T_{1/2}({}^{93\text{m}}\text{Nb})$: 16,12 (15) a
 $Q^{IT}({}^{93\text{m}}\text{Nb})$: 30,77 (2) keV

2.1 Gamma Transitions and Internal Conversion Coefficients

	Energy (keV)	P _{γ+ce} (%)	Multipolarity	α _K (10 ⁵)	α _L (10 ⁵)	α _M (10 ⁵)	α _T (10 ⁵)
γ _{1,0} (Nb)	30,77 (2)	100	M4	0,260 (4)	1,151 (17)	0,249 (4)	1,693 (25)

3 Atomic Data

3.1 Nb

ω_K	:	0,751	(4)
$\bar{\omega}_L$	:	0,0347	(9)
n_{KL}	:	1,045	(4)

3.1.1 X Radiations

	Energy (keV)		Relative probability
X _K			
Kα ₂	16,5213		52,36
Kα ₁	16,6152		100
Kβ ₃	18,607	}	25,8
Kβ ₁	18,623		
Kβ ₅ ''	18,78		
Kβ ₂	18,952	}	3,86
Kβ ₄	18,982		
X _L			
Lℓ	1,9		
Lα	2,16 - 2,17		
Lη	2		
Lβ	2,26 - 2,37		
Lγ	2,41 - 2,67		

3.1.2 Auger Electrons

	Energy (keV)	Relative probability
Auger K		
KLL	13,49 - 14,14	100
KLX	15,79 - 16,58	39,1
KXY	18,02 - 18,91	3,81
Auger L		
	1,4 - 2,6	

4 Electron Emissions

		Energy (keV)	Electrons (per 100 disint.)
e _{AL}	(Nb)	1,4 - 2,6	81,25 (28)
e _{AK}	(Nb)	$\left. \begin{array}{l} \text{KLL} \\ \text{KLX} \\ \text{KXY} \end{array} \right\}$	3,83 (11)
	KLL	13,49 - 14,14	
	KLX	15,79 - 16,58	
	KXY	18,02 - 18,91	
ec _{1,0 T}	(Nb)	11,78 - 30,77	99,999409 (9)
ec _{1,0 K}	(Nb)	11,78 (2)	15,37 (33)
ec _{1,0 L}	(Nb)	28,07 - 28,40	68,0 (14)
ec _{1,0 M}	(Nb)	30,30 - 30,57	14,72 (33)
ec _{1,0 N}	(Nb)	30,71 - 30,77	1,91 (4)

5 Photon Emissions

5.1 X-Ray Emissions

		Energy (keV)	Photons (per 100 disint.)	
XL	(Nb)	1,9 - 2,67	2,88 (6)	
XK α_2	(Nb)	16,5213	3,32 (8)	} K α
XK α_1	(Nb)	16,6152	6,34 (15)	
XK β_3	(Nb)	18,607	} 1,64 (4)	K' β_1
XK β_1	(Nb)	18,623		
XK β_5''	(Nb)	18,78		
XK β_2	(Nb)	18,952	} 0,246 (11)	K' β_2
XK β_4	(Nb)	18,982		

5.2 Gamma Emissions

	Energy (keV)	Photons (per 100 disint.)
$\gamma_{1,0}(\text{Nb})$	30,77 (2)	0,000591 (9)

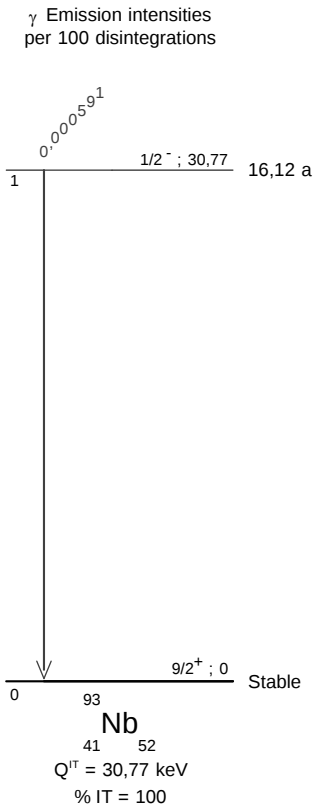
6 Main Production Modes

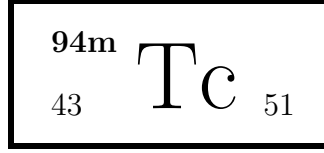
- { Nb – ⁹³(n,n')Nb – ^{93m}
- { Possible impurities : Nb – ^{92m}, Nb – ⁹⁴, Nb – ⁹⁵
- Mo – ⁹²(n,γ)Mo – ⁹³
- { Separation from Zr – ⁹³ + Nb – ^{93m} (Fission products)
- { Possible impurities : Nb – ⁹⁴
- Mo – ⁹³(EC)Nb – ^{93m}

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1 Decay Scheme

Tc-94m (half-life of 51.9 (10) min) undergoes 100% EC/positron decay (Q(EC) of 4332(5) keV) to various excited nuclear levels and the ground state of Mo-94.

Le technétium 94 métastable se désintègre à 100 % par capture électronique et bêta plus vers des niveaux excités et le niveau fondamental du molybdène 94.

2 Nuclear Data

$$\begin{aligned}
 T_{1/2}({}^{94m}\text{Tc}) &: 51,9 \quad (10) \quad \text{min} \\
 Q^+({}^{94m}\text{Tc}) &: 4332 \quad (5) \quad \text{keV}
 \end{aligned}$$

2.1 Electron Capture Transitions

	Energy (keV)	Probability (%)	Nature	lg <i>ft</i>	<i>P_K</i>	<i>P_L</i>	<i>P_M</i>
ε _{0,27}	440 (5)	0,212 (13)	(allowed)	5,6	0,8620 (15)	0,1121 (12)	0,0220 (4)
ε _{0,26}	539 (5)	0,169 (20)	(allowed)	5,9	0,8639 (15)	0,1106 (11)	0,0216 (4)
ε _{0,25}	798 (5)	0,106 (3)	(allowed)	6,4	0,8664 (15)	0,1086 (11)	0,0212 (4)
ε _{0,24}	820 (5)	0,121 (10)	(allowed)	6,4	0,8666 (15)	0,1085 (11)	0,0212 (4)
ε _{0,23}	884 (5)	0,118 (19)	(allowed)	6,4	0,8669 (14)	0,1082 (11)	0,0211 (4)
ε _{0,22}	931 (5)	0,36 (4)	(allowed)	6	0,8672 (14)	0,1080 (11)	0,0211 (4)
ε _{0,20}	1000 (5)	0,234 (20)	(allowed)	6,3	0,8675 (14)	0,1078 (11)	0,0210 (4)
ε _{0,18}	1169 (5)	0,058 (17)	(allowed)	7	0,8681 (14)	0,1073 (11)	0,0209 (4)
ε _{0,17}	1203 (5)	1,63 (9)	(allowed)	5,57	0,8682 (14)	0,1072 (11)	0,0209 (4)
ε _{0,16}	1367 (5)	0,093 (14)	(allowed)	6,9	0,8686 (14)	0,1069 (11)	0,0208 (4)
ε _{0,13}	1462 (5)	0,15 (3)	(allowed)	6,8	0,8688 (14)	0,1067 (11)	0,0208 (4)
ε _{0,11}	1592 (5)	10,1 (4)	(allowed)	5,03	0,8690 (14)	0,1066 (11)	0,0207 (4)
ε _{0,7}	1939 (5)	4,0 (2)	(allowed)	5,6	0,8694 (14)	0,1062 (11)	0,0207 (4)
ε _{0,5}	2265 (5)	0,34 (5)	(allowed)	6,8	0,8697 (14)	0,1060 (11)	0,0206 (4)
ε _{0,4}	2468 (5)	0,39 (9)	(allowed)	6,82	0,8699 (14)	0,1059 (11)	0,0206 (4)
ε _{0,1}	3461 (5)	12,8 (1)	(allowed)	5,61	0,8704 (14)	0,1055 (11)	0,0205 (4)

2.2 β^+ Transitions

	Energy (keV)	Probability (%)	Nature	lg ft
$\beta_{0,16}^+$	345 (5)	0,00058 (9)	(allowed)	6,9
$\beta_{0,13}^+$	440 (5)	0,0024 (5)	(allowed)	6,8
$\beta_{0,11}^+$	570 (5)	0,427 (21)	(allowed)	5,03
$\beta_{0,7}^+$	917 (5)	0,91 (6)	(allowed)	5,6
$\beta_{0,5}^+$	1243 (5)	0,22 (3)	(allowed)	6,8
$\beta_{0,4}^+$	1446 (5)	0,41 (10)	(allowed)	6,82
$\beta_{0,1}^+$	2439 (5)	67,2 (4)	(allowed)	5,61

2.3 Gamma Transitions and Internal Conversion Coefficients

	Energy (keV)	P _{$\gamma+ce$} (%)	Multipolarity	α_K (10 ⁻²)	α_L (10 ⁻³)	α_M (10 ⁻⁴)	α_T (10 ⁻²)	α_π (10 ⁻⁶)
$\gamma_{7,5}(\text{Mo})$	325,67 (9)	0,027 (2)	M1+50%E2	1,28 (8)	1,56 (11)	2,80 (19)	1,47 (9)	
$\gamma_{18,12}(\text{Mo})$	358,3 (3)	0,0084 (7)	M1+10,9%E2	0,80 (4)	0,93 (5)	1,67 (8)	0,92 (4)	
$\gamma_{7,4}(\text{Mo})$	528,71 (8)	0,032 (2)	M1+50%E2	0,325 (8)	0,378 (11)	0,676 (19)	0,371 (9)	
$\gamma_{11,5}(\text{Mo})$	672,56 (9)	0,17 (3)	M1+50%E2	0,176 (3)	0,201 (4)	0,359 (7)	0,200 (3)	
$\gamma_{2,1}(\text{Mo})$	702,66 (4)	0,18 (2)	E2	0,1608 (23)	0,187 (3)	0,334 (5)	0,183 (3)	
$\gamma_{13,5}(\text{Mo})$	802,55 (10)	0,0246 (14)	M1+50%E2	0,1146 (16)	0,1301 (19)	0,232 (4)	0,1303 (19)	
$\gamma_{3,1}(\text{Mo})$	870,55 (22)	0,26 (3)	E2	0,0940 (14)	0,1075 (15)	0,192 (3)	0,1070 (15)	
$\gamma_{1,0}(\text{Mo})$	871,098 (16)	94,04 (21)	E2	0,0939 (14)	0,1073 (15)	0,192 (3)	0,1068 (15)	
$\gamma_{11,4}(\text{Mo})$	875,60 (9)	1,0 (3)	M1+1,0%E2	0,0945 (14)	0,1056 (15)	0,189 (3)	0,1072 (15)	
$\gamma_{16,5}(\text{Mo})$	898,06 (9)	0,0098 (5)	M1+80%E2	0,0877 (13)	0,0996 (14)	0,1778 (25)	0,0997 (15)	
$\gamma_{4,1}(\text{Mo})$	993,21 (5)	2,21 (18)	M1+80%E2	0,0696 (13)	0,0786 (13)	0,1403 (22)	0,0791 (15)	
$\gamma_{11,3}(\text{Mo})$	998,26 (17)	0,24 (2)	M1	0,071 (1)	0,0792 (11)	0,1413 (20)	0,0806 (12)	
$\gamma_{13,4}(\text{Mo})$	1005,59 (9)	0,09 (3)	M1+0,25%E2	0,0699 (10)	0,0779 (11)	0,139 (2)	0,0793 (12)	
$\gamma_{17,5}(\text{Mo})$	1061,31 (9)	0,016 (2)	M1+24,5%E2	0,0616 (10)	0,0688 (10)	0,1227 (18)	0,0699 (11)	
$\gamma_{16,4}(\text{Mo})$	1101,10 (8)	0,042 (14)	M1+0,80%E2	0,0576 (8)	0,0640 (9)	0,1142 (16)	0,0653 (10)	0,492 (8)
$\gamma_{5,1}(\text{Mo})$	1196,25 (6)	0,71 (7)	M1+2,20%E2	0,0483 (7)	0,0536 (8)	0,0957 (14)	0,0553 (8)	5,77 (9)
$\gamma_{17,4}(\text{Mo})$	1264,35 (9)	0,22 (2)	M1+0,64%E2	0,0431 (6)	0,0478 (7)	0,0852 (12)	0,0503 (7)	15,16 (22)
$\gamma_{16,2}(\text{Mo})$	1391,65 (7)	0,0267 (10)	M1+0,64%E2	0,0353 (5)	0,0391 (6)	0,0698 (10)	0,0441 (7)	40,4 (6)
$\gamma_{26,7}(\text{Mo})$	1399,85 (16)	0,041 (3)	M1+E2					
$\gamma_{20,4}(\text{Mo})$	1467,43 (18)	0,072 (5)	M1+8,3%E2	0,0316 (15)	0,0350 (15)	0,062 (3)	0,0419 (9)	61 (10)
$\gamma_{27,7}(\text{Mo})$	1499,14 (9)	0,067 (11)	M1+E2					
$\gamma_{7,1}(\text{Mo})$	1521,92 (6)	4,48 (28)	M1+1,42%E2	0,0295 (5)	0,0326 (5)	0,0581 (9)	0,0411 (6)	77,6 (11)
$\gamma_{22,4}(\text{Mo})$	1536,52 (18)	0,014 (3)						
$\gamma_{25,4}(\text{Mo})$	1670,01 (10)	0,037 (2)	M1+2,20%E2	0,0245 (4)	0,0270 (4)	0,0481 (7)	0,0410 (6)	132 (3)
$\gamma_{20,2}(\text{Mo})$	1757,98 (17)	0,15 (2)	M1+1,0%E2	0,0221 (3)	0,0244 (4)	0,0435 (6)	0,0418 (6)	167,7 (24)
$\gamma_{24,3}(\text{Mo})$	1770,21 (21)	0,025 (6)	(M1+E2)					
$\gamma_{27,5}(\text{Mo})$	1824,81 (9)	0,023 (1)	(M1+E2)					
$\gamma_{4,0}(\text{Mo})$	1864,31 (5)	0,23 (3)	E2	0,0189 (3)	0,0209 (3)	0,0372 (6)	0,0455 (7)	241 (4)
$\gamma_{11,1}(\text{Mo})$	1868,81 (7)	5,49 (28)	M1+1,42%E2	0,0196 (3)	0,0216 (3)	0,0385 (6)	0,0438 (7)	215 (3)
$\gamma_{26,4}(\text{Mo})$	1928,56 (16)	0,075 (19)	M1+E2					
$\gamma_{13,1}(\text{Mo})$	1998,80 (8)	0,0123 (6)	M1+62,8%E2	0,0168 (3)	0,0186 (3)	0,0331 (6)	0,0484 (10)	293 (9)
$\gamma_{27,4}(\text{Mo})$	2027,85 (9)	0,021 (4)	(M1+E2)					
$\gamma_{5,0}(\text{Mo})$	2067,35 (6)	0,11 (1)	E2	0,01562 (22)	0,01722 (25)	0,0307 (5)	0,0515 (8)	338 (5)
$\gamma_{16,1}(\text{Mo})$	2094,31 (6)	0,0156 (6)	M1+54,8%E2	0,0155 (3)	0,0171 (4)	0,0304 (6)	0,0512 (14)	336 (15)
$\gamma_{17,1}(\text{Mo})$	2257,56 (7)	0,057 (5)	M1+35,4%E2	0,01356 (20)	0,01491 (22)	0,0266 (4)	0,0561 (9)	407 (8)
$\gamma_{18,1}(\text{Mo})$	2292,19 (19)	0,050 (17)	M1+2,8%E2	0,01330 (19)	0,01461 (21)	0,0260 (4)	0,0562 (8)	411 (6)
$\gamma_{7,0}(\text{Mo})$	2393,02 (6)	0,50 (4)	E2	0,01203 (17)	0,01322 (19)	0,0235 (4)	0,0633 (9)	496 (7)
$\gamma_{20,1}(\text{Mo})$	2460,64 (17)	0,011 (2)	(M1+E2)					
$\gamma_{22,1}(\text{Mo})$	2529,73 (17)	0,34 (4)						

	Energy (keV)	P _{γ+ce} (%)	Multipolarity	α _K (10 ⁻²)	α _L (10 ⁻³)	α _M (10 ⁻⁴)	α _T (10 ⁻²)	α _π (10 ⁻⁶)
γ _{23,1} (Mo)	2576,5 (4)	0,11 (2)	M1+78,3%E2	0,01061 (15)	0,01164 (17)	0,0207 (3)	0,0694 (12)	574 (11)
γ _{24,1} (Mo)	2640,76 (14)	0,033 (4)	(M1+E2)					
γ _{25,1} (Mo)	2663,22 (9)	0,066 (2)	M1+8,3%E2	0,01009 (15)	0,01106 (16)	0,0197 (3)	0,0699 (11)	585 (10)
γ _{11,0} (Mo)	2739,91 (7)	3,53 (20)	M1	0,00959 (14)	0,01051 (15)	0,0187 (3)	0,0725 (11)	616 (9)
γ _{13,0} (Mo)	2869,90 (8)	0,016 (2)	E2	0,00881 (13)	0,00964 (14)	0,01717 (24)	0,0816 (12)	717 (10)
γ _{27,1} (Mo)	3021,06 (7)	0,087 (14)	(M1+E2)					
γ _{17,0} (Mo)	3128,66 (7)	1,34 (9)	M1	0,00758 (11)	0,00829 (12)	0,01476 (21)	0,0871 (13)	785 (11)
γ _{22,0} (Mo)	3400,83 (17)	0,005 (2)						
γ _{23,0} (Mo)	3447,6 (4)	0,006 (1)						
γ _{24,0} (Mo)	3511,86 (14)	0,063 (7)	(M1+E2)					
γ _{25,0} (Mo)	3534,32 (9)	0,0034 (4)	E2	0,00625 (9)	0,00682 (10)	0,01215 (17)	0,1065 (15)	994 (14)
γ _{26,0} (Mo)	3792,87 (15)	0,052 (5)	E2	0,00559 (8)	0,00609 (9)	0,01084 (16)	0,1149 (16)	1086 (16)
γ _{27,0} (Mo)	3892,16 (7)	0,014 (2)						

3 Atomic Data

3.1 Mo

ω _K	:	0,767	(4)
ω _L	:	0,0381	(9)
n _{KL}	:	1,029	(4)

3.1.1 X Radiations

	Energy (keV)	Relative probability
X _K		
Kα ₂	17,3745	52,4
Kα ₁	17,47954	100
Kβ ₃	19,5904	} 26,3
Kβ ₁	19,6085	
Kβ ₅ ''	19,774	
Kβ ₂	19,9653	} 4,04
Kβ ₄	19,998	
X _L		
Lℓ	2,016	
Lα	2,29 - 2,293	
Lη	2,12	
Lβ	2,395 - 2,518	
Lγ	2,623 - 2,831	

3.1.2 Auger Electrons

	Energy (keV)	Relative probability
Auger K		
KLL	14,172 - 14,855	100
KLX	16,592 - 17,478	39,8
KXY	18,990 - 19,996	3,94
Auger L	1,48 - 2,25	682

4 Electron and Positron Emissions

		Energy (keV)		Electrons (per 100 disint.)
e _{AL}	(Mo)	1,48 - 2,25		29,8 (4)
e _{AK}	(Mo)			
	KLL	14,172 - 14,855	}	6,28 (15)
	KLX	16,592 - 17,478		
	KXY	18,990 - 19,996		
$\beta_{0,1}^+$	max:	2439 (5)	}	67,2 (4)
	avg:	1094,4 (24)		
$\beta_{0,4}^+$	max:	1446 (5)	}	0,41 (10)
	avg:	639,6 (23)		
$\beta_{0,5}^+$	max:	1243 (5)	}	0,22 (3)
	avg:	548,7 (23)		
$\beta_{0,7}^+$	max:	917 (5)	}	0,91 (6)
	avg:	404,8 (22)		
$\beta_{0,11}^+$	max:	570 (5)	}	0,427 (21)
	avg:	254,3 (22)		
$\beta_{0,13}^+$	max:	440 (5)	}	0,0024 (5)
	avg:	198,5 (22)		
$\beta_{0,16}^+$	max:	345 (5)	}	0,00058 (9)
	avg:	157,5 (22)		

5 Photon Emissions

5.1 X-Ray Emissions

		Energy (keV)	Photons (per 100 disint.)		
XL	(Mo)	2,016 - 2,831	1,198 (22)		
XK α_2	(Mo)	17,3745	5,93 (11)	}	K α
XK α_1	(Mo)	17,47954	11,31 (19)		
XK β_3	(Mo)	19,5904	2,97 (6)	}	K' β_1
XK β_1	(Mo)	19,6085			
XK β_5''	(Mo)	19,774			
XK β_2	(Mo)	19,9653	0,457 (18)	}	K' β_2
XK β_4	(Mo)	19,998			

5.2 Gamma Emissions

	Energy (keV)	Photons (per 100 disint.)
$\gamma_{7,5}(\text{Mo})$	325,67 (9)	0,027 (2)
$\gamma_{18,12}(\text{Mo})$	358,3 (3)	0,0084 (7)
$\gamma^\pm$	511	138 (1)
$\gamma_{7,4}(\text{Mo})$	528,71 (8)	0,032 (2)
$\gamma_{11,5}(\text{Mo})$	672,56 (9)	0,17 (3)
$\gamma_{2,1}(\text{Mo})$	702,66 (4)	0,18 (2)
$\gamma_{13,5}(\text{Mo})$	802,55 (10)	0,0246 (14)
$\gamma_{3,1}(\text{Mo})$	870,55 (22)	0,26 (3)
$\gamma_{1,0}(\text{Mo})$	871,094 (16)	94,04 (21)
$\gamma_{11,4}(\text{Mo})$	875,60 (9)	1,0 (3)
$\gamma_{16,5}(\text{Mo})$	898,06 (9)	0,0098 (5)
$\gamma_{4,1}(\text{Mo})$	993,20 (5)	2,21 (18)
$\gamma_{11,3}(\text{Mo})$	998,25 (17)	0,24 (2)
$\gamma_{13,4}(\text{Mo})$	1005,58 (9)	0,09 (3)
$\gamma_{(-1,-2)}(\text{Mo})$	1022	0,027 (14)
$\gamma_{(-1,1)}(\text{Mo})$	1037,2 (3)	0,044 (14)
$\gamma_{17,5}(\text{Mo})$	1061,30 (9)	0,016 (2)
$\gamma_{16,4}(\text{Mo})$	1101,09 (8)	0,042 (14)
$\gamma_{5,1}(\text{Mo})$	1196,24 (6)	0,71 (7)
$\gamma_{17,4}(\text{Mo})$	1264,34 (9)	0,22 (2)
$\gamma_{(-1,2)}(\text{Mo})$	1357,4 (15)	0,19 (8)
$\gamma_{16,2}(\text{Mo})$	1391,64 (7)	0,0267 (10)
$\gamma_{26,7}(\text{Mo})$	1399,84 (16)	0,041 (3)
$\gamma_{20,4}(\text{Mo})$	1467,42 (18)	0,072 (5)
$\gamma_{27,7}(\text{Mo})$	1499,13 (9)	0,067 (11)
$\gamma_{7,1}(\text{Mo})$	1521,91 (6)	4,48 (28)

	Energy (keV)	Photons (per 100 disint.)
$\gamma_{22,4}(\text{Mo})$	1536,51 (18)	0,014 (3)
$\gamma_{25,4}(\text{Mo})$	1669,99 (10)	0,037 (2)
$\gamma_{20,2}(\text{Mo})$	1757,96 (17)	0,15 (2)
$\gamma_{24,3}(\text{Mo})$	1770,19 (21)	0,025 (6)
$\gamma_{27,5}(\text{Mo})$	1824,79 (9)	0,023 (1)
$\gamma_{4,0}(\text{Mo})$	1864,29 (5)	0,23 (3)
$\gamma_{11,1}(\text{Mo})$	1868,79 (7)	5,49 (28)
$\gamma_{26,4}(\text{Mo})$	1928,54 (16)	0,075 (19)
$\gamma_{13,1}(\text{Mo})$	1998,78 (8)	0,0123 (6)
$\gamma_{27,4}(\text{Mo})$	2027,83 (9)	0,021 (4)
$\gamma_{5,0}(\text{Mo})$	2067,33 (6)	0,11 (1)
$\gamma_{16,1}(\text{Mo})$	2094,28 (6)	0,0156 (6)
$\gamma_{17,1}(\text{Mo})$	2257,53 (7)	0,057 (5)
$\gamma_{18,1}(\text{Mo})$	2292,16 (19)	0,050 (17)
$\gamma_{7,0}(\text{Mo})$	2392,99 (6)	0,50 (4)
$\gamma_{20,1}(\text{Mo})$	2460,61 (17)	0,011 (2)
$\gamma_{22,1}(\text{Mo})$	2529,69 (17)	0,34 (4)
$\gamma_{23,1}(\text{Mo})$	2576,5 (4)	0,11 (2)
$\gamma_{24,1}(\text{Mo})$	2640,72 (14)	0,033 (4)
$\gamma_{25,1}(\text{Mo})$	2663,18 (9)	0,066 (2)
$\gamma_{11,0}(\text{Mo})$	2739,87 (7)	3,53 (20)
$\gamma_{13,0}(\text{Mo})$	2869,85 (8)	0,016 (2)
$\gamma_{27,1}(\text{Mo})$	3021,01 (7)	0,087 (14)
$\gamma_{(-1,3)}(\text{Mo})$	3065,6 (3)	0,011 (4)
$\gamma_{(-1,4)}(\text{Mo})$	3085,8 (3)	0,016 (4)
$\gamma_{17,0}(\text{Mo})$	3128,60 (7)	1,34 (9)
$\gamma_{22,0}(\text{Mo})$	3400,76 (17)	0,005 (2)
$\gamma_{23,0}(\text{Mo})$	3447,5 (4)	0,006 (1)
$\gamma_{24,0}(\text{Mo})$	3511,79 (14)	0,063 (7)
$\gamma_{25,0}(\text{Mo})$	3534,25 (9)	0,0034 (4)
$\gamma_{(-1,5)}(\text{Mo})$	3640,6 (3)	0,007 (2)
$\gamma_{26,0}(\text{Mo})$	3792,79 (15)	0,052 (5)
$\gamma_{27,0}(\text{Mo})$	3892,07 (7)	0,014 (2)
$\gamma_{(-1,6)}(\text{Mo})$	4136,2 (3)	0,007 (1)

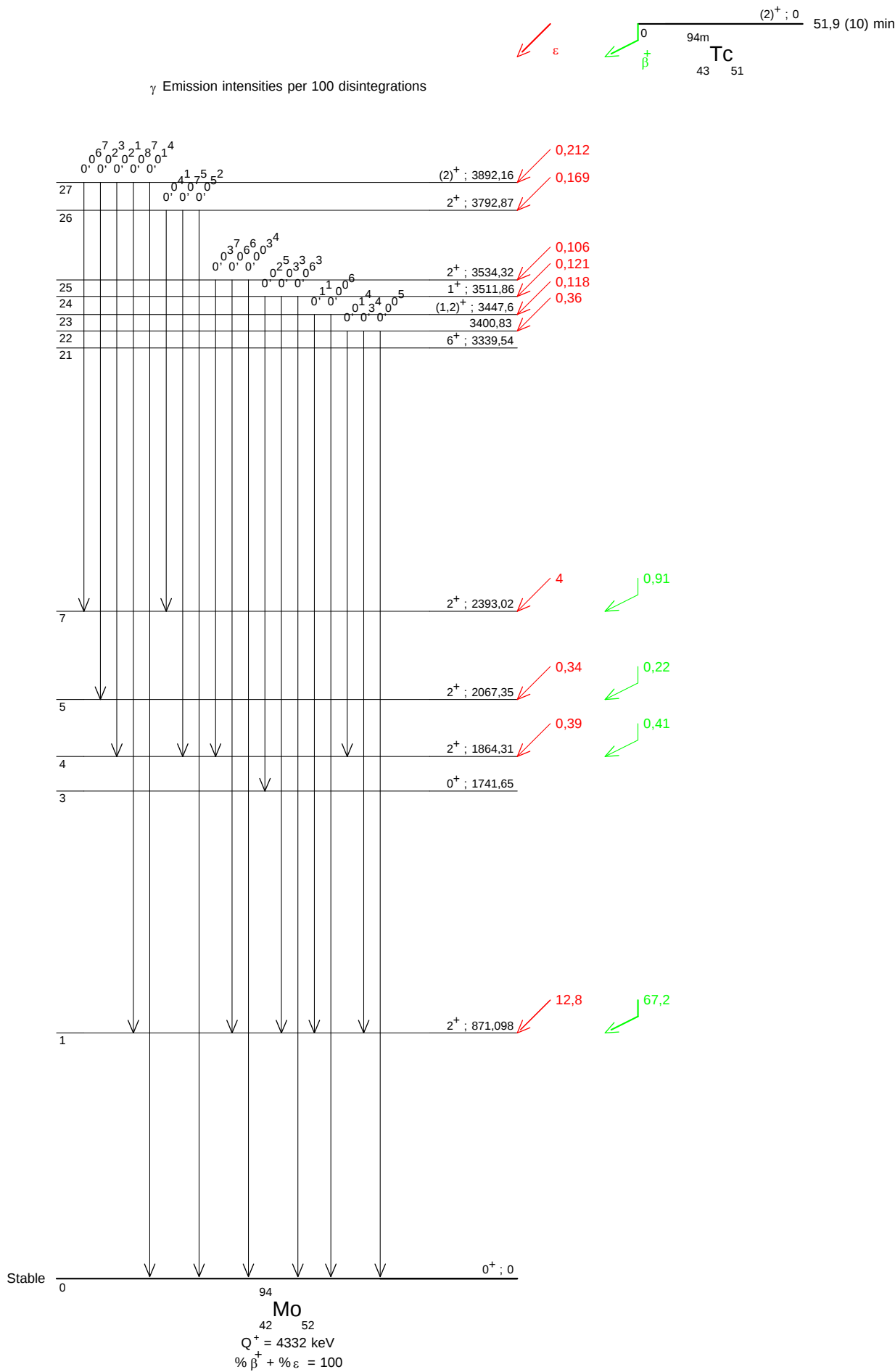
6 Main Production Modes

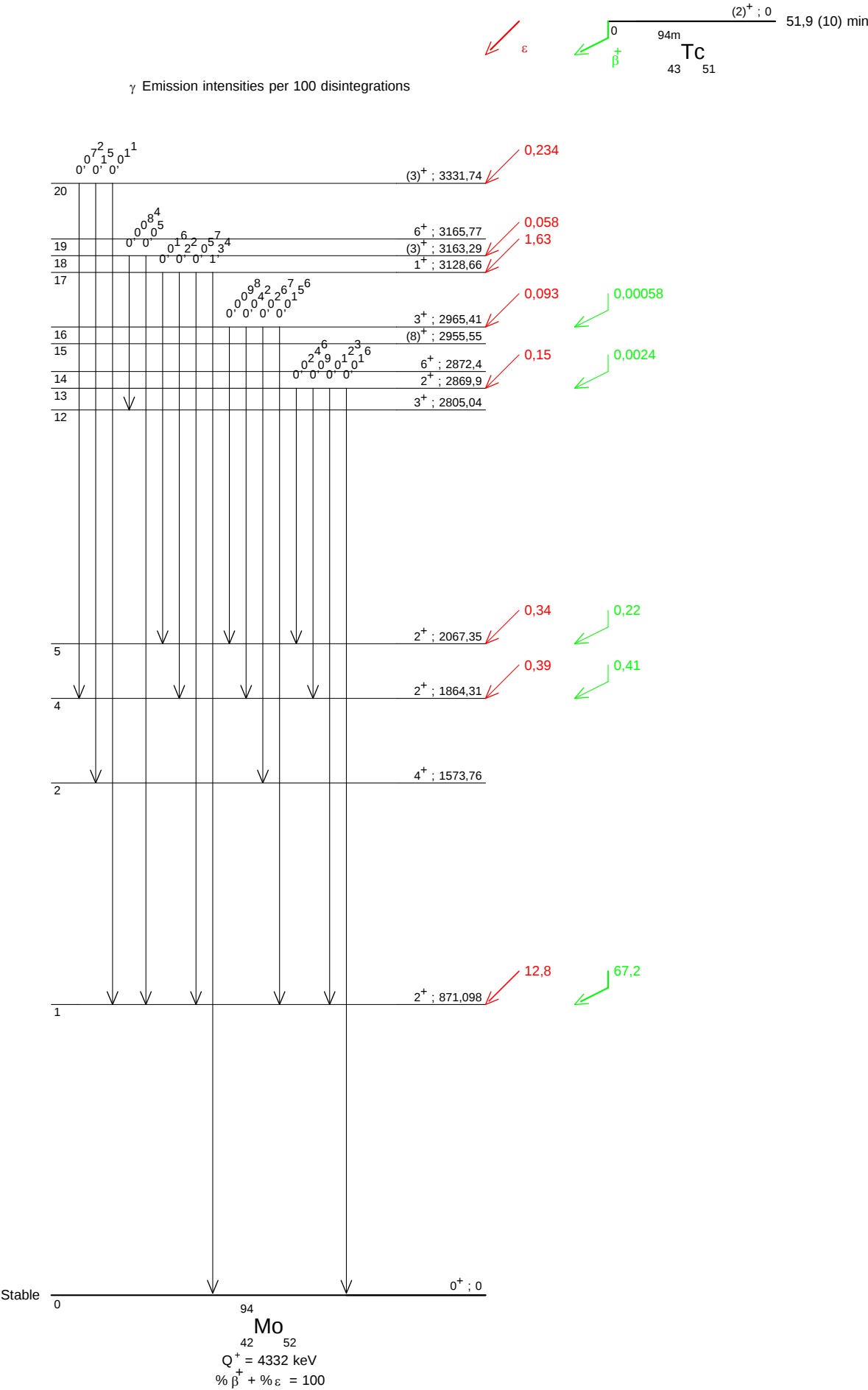
- { Mo – 94(p,n)Tc – 94m
- { Possible impurities: Tc – 94 ground state.
- { Mo – 94(d,2n)Tc – 94m
- { Possible impurities: Tc – 94 ground state.
- Mo – 92(α ,2n)Ru – 94(EC)Tc – 94m

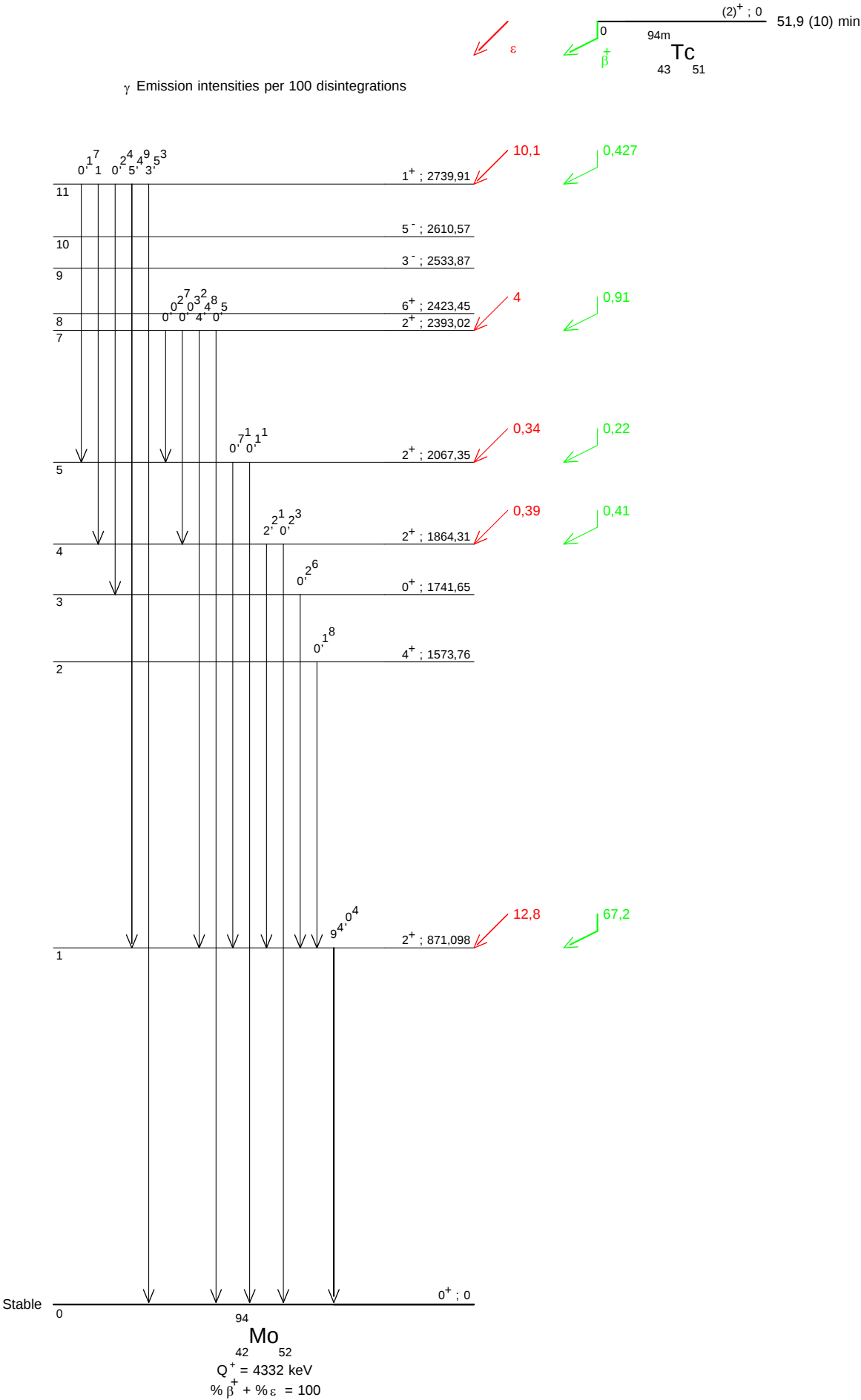
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(Q-value)









1 Decay Scheme

Ru-106 desintegrates by beta minus emission to the ground state of Rh-106.

Le ruthénium 106 se désintègre 100% par émission bêta vers le niveau fondamental du rhodium 106.

2 Nuclear Data

$T_{1/2}(^{106}\text{Ru})$	:	371,5	(21)	d
$T_{1/2}(^{106}\text{Rh})$	:	30,1	(3)	s
$Q^-(^{106}\text{Ru})$	:	39,40	(21)	keV

2.1 β^- Transitions

	Energy (keV)	Probability (%)	Nature	lg ft
$\beta^-_{0,0}$	39,40 (21)	100	Allowed	4,31

3 Atomic Data

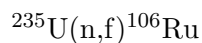
3.1 Rh

ω_K	:	0,809	(4)
$\bar{\omega}_L$	:	0,0494	(12)
n_{KL}	:	0,987	(4)

4 Electron Emissions

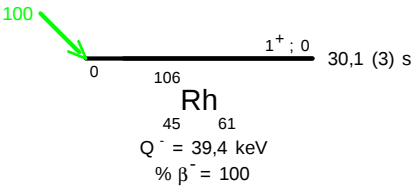
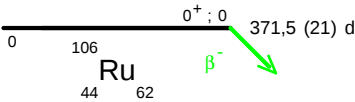
	Energy (keV)	Electrons (per 100 disint.)
$\beta^-_{0,0}$	max: 39,40 (21) avg: 10,03 (6)	100

5 Main Production Modes



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(Q value)





1 Decay Scheme

Rh-106 disintegrates by beta minus emission to the ground state and excited levels of Pd-106.

Le rhodium 106 se désintègre par émission bêta principalement vers le niveau fondamental et les niveaux excités du palladium 106.

2 Nuclear Data

$$\begin{aligned}
T_{1/2}(^{106}\text{Rh}) &: 30,1 \quad (3) \quad \text{s} \\
Q^{-}(^{106}\text{Rh}) &: 3546 \quad (5) \quad \text{keV}
\end{aligned}$$

2.1 β^{-} Transitions

	Energy (keV)	Probability (%)	Nature	lg <i>ft</i>
$\beta_{0,37}^{-}$	144 (5)	0,0000125 (19)		
$\beta_{0,36}^{-}$	169 (5)	0,000025 (9)		
$\beta_{0,35}^{-}$	226 (5)	0,00087 (8)	Allowed	5,71
$\beta_{0,34}^{-}$	247 (5)	0,000082 (21)		
$\beta_{0,33}^{-}$	272 (5)	0,000049 (14)		
$\beta_{0,32}^{-}$	294 (5)	0,00021 (4)	Allowed	6,7
$\beta_{0,31}^{-}$	296 (5)	0,000086 (16)	Allowed	7,09
$\beta_{0,30}^{-}$	325 (5)	0,00402 (13)	Allowed	5,56
$\beta_{0,29}^{-}$	382 (5)	0,00070 (5)	(Allowed)	6,55
$\beta_{0,28}^{-}$	462 (5)	0,00278 (13)		
$\beta_{0,27}^{-}$	491 (5)	0,0101 (5)	Allowed	5,76
$\beta_{0,26}^{-}$	509 (5)	0,0022 (3)		
$\beta_{0,25}^{-}$	577 (5)	0,00022 (4)	Unique 1st Forbidden	7,82
$\beta_{0,24}^{-}$	628 (5)	0,0183 (7)	Allowed	5,87
$\beta_{0,23}^{-}$	644 (5)	0,00760 (18)	Allowed	6,29
$\beta_{0,22}^{-}$	668 (5)	0,0262 (9)	Allowed	5,81
$\beta_{0,21}^{-}$	718 (5)	0,00731 (19)	Allowed	6,47
$\beta_{0,20}^{-}$	725 (5)	0,0090 (3)	Allowed	6,4

	Energy (keV)	Probability (%)	Nature	lg <i>ft</i>
$\beta_{0,19}^-$	762 (5)	0,00117 (8)	Allowed	7,36
$\beta_{0,18}^-$	828 (5)	0,00023 (12)		
$\beta_{0,17}^-$	841 (5)	0,0106 (4)	(Allowed)	6,56
$\beta_{0,16}^-$	922 (5)	0,090 (3)	Allowed	5,78
$\beta_{0,15}^-$	1046 (5)	0,0284 (6)	1st Forbidden	6,48
$\beta_{0,14}^-$	1061 (5)	0,00093 (15)	(1st Forbidden)	7,99
$\beta_{0,13}^-$	1107 (5)	0,0208 (5)	Allowed	6,71
$\beta_{0,12}^-$	1237 (5)	0,0430 (7)	Allowed	6,57
$\beta_{0,11}^-$	1268 (5)	0,043 (5)	Allowed	6,62
$\beta_{0,10}^-$	1304 (5)	0,0372 (8)	Allowed	6,72
$\beta_{0,9}^-$	1545 (5)	0,448 (9)	Allowed	5,93
$\beta_{0,8}^-$	1637 (5)	0,00277 (21)	(Allowed)	8,24
$\beta_{0,7}^-$	1840 (5)	0,0664 (10)	Allowed	7,06
$\beta_{0,6}^-$	1984 (5)	1,67 (3)	Allowed	5,79
$\beta_{0,4}^-$	2317 (5)	0,0051 (5)	Unique 2nd Forbidden	11
$\beta_{0,3}^-$	2412 (5)	9,82 (15)	Allowed	5,37
$\beta_{0,2}^-$	2418 (5)	0,608 (21)	Allowed	6,58
$\beta_{0,1}^-$	3034 (5)	8,2 (3)	Allowed	5,87
$\beta_{0,0}^-$	3546 (5)	78,80 (24)	Allowed	5,18

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy (keV)	P _{$\gamma+ce$} (%)	Multipolarity	α_K (10 ⁻³)	α_L (10 ⁻⁴)	α_M (10 ⁻⁵)	α_T (10 ⁻³)	α_π (10 ⁻⁴)
$\gamma_{6,3}$ (Pd)	428,49 (5)	0,0711 (24)	E2	8,17 (12)	10,63 (15)	20,0 (3)	9,47 (14)	
$\gamma_{6,2}$ (Pd)	434,23 (4)	0,020 (4)	E2	7,85 (11)	10,19 (15)	19,2 (3)	9,09 (13)	
$\gamma_{9,6}$ (Pd)	439,23 (6)	0,0111 (16)						
$\gamma_{1,0}$ (Pd)	511,8547 (23)	20,63 (23)	E2	4,84 (7)	6,12 (9)	11,53 (17)	5,59 (8)	
$\gamma_{7,2}$ (Pd)	578,42 (6)	0,0090 (6)	E2	3,43 (5)	4,27 (6)	8,04 (12)	3,95 (6)	
$\gamma_{2,1}$ (Pd)	616,17 (3)	0,733 (17)	M1+98%E2	2,89 (4)	3,57 (5)	6,71 (10)	3,33 (5)	
$\gamma_{3,1}$ (Pd)	621,91 (4)	9,90 (15)	E2	2,82 (4)	3,48 (5)	6,54 (10)	3,24 (5)	
$\gamma_{10,6}$ (Pd)	680,23 (6)	0,0103 (6)	E1+14%M2	2,34 (4)	2,74 (4)	5,15 (8)	2,68 (4)	
$\gamma_{10,5}$ (Pd)	684,80 (6)	0,00552 (21)						
$\gamma_{17,9}$ (Pd)	702,8 (10)	0,00029 (18)						
$\gamma_{11,6}$ (Pd)	715,86 (9)	0,0099 (4)						
$\gamma_{4,1}$ (Pd)	717,45 (4)	0,0067 (4)	E2	1,94 (3)	2,36 (4)	4,43 (7)	2,23 (4)	
$\gamma_{12,5}$ (Pd)	751,26 (20)	0,00121 (23)						
$\gamma_{9,2}$ (Pd)	873,46 (6)	0,436 (8)	E2	1,201 (17)	1,432 (20)	2,69 (4)	1,375 (20)	
$\gamma_{15,5}$ (Pd)	942,63 (9)	0,00060 (18)						
$\gamma_{5,1}$ (Pd)	1045,83 (4)	0,0131 (16)	M1+94%E2	0,803 (12)	0,942 (14)	1,766 (25)	0,918 (13)	
$\gamma_{6,1}$ (Pd)	1050,40 (3)	1,492 (25)	M1+5,4%E2	0,883 (13)	1,018 (15)	1,91 (3)	1,007 (15)	
$\gamma_{16,6}$ (Pd)	1062,15 (6)	0,0304 (19)						
$\gamma_{10,3}$ (Pd)	1108,72 (6)	0,0056 (3)						
$\gamma_{10,2}$ (Pd)	1114,46 (6)	0,0117 (3)	M1+69%E2	0,720 (12)	0,838 (14)	1,570 (25)	0,823 (14)	0,00830 (17)
$\gamma_{2,0}$ (Pd)	1128,02 (3)	0,398 (8)	E2	0,675 (10)	0,790 (11)	1,479 (21)	0,773 (11)	0,01341 (19)
$\gamma_{3,0}$ (Pd)	1133,76 (4)		E0					
$\gamma_{11,2}$ (Pd)	1150,09 (9)	0,00287 (17)	E2	0,648 (9)	0,757 (11)	1,417 (20)	0,742 (11)	0,0248 (4)
$\gamma_{18,5}$ (Pd)	1159,91 (21)	0,00023 (12)						
$\gamma_{12,2}$ (Pd)	1180,80 (6)	0,0144 (3)	M1+0,4%E2	0,689 (10)	0,792 (12)	1,482 (22)	0,790 (12)	0,0421 (7)
$\gamma_{7,1}$ (Pd)	1194,59 (5)	0,0573 (8)	E2	0,597 (9)	0,696 (10)	1,304 (19)	0,689 (10)	0,0664 (10)
$\gamma_{13,4}$ (Pd)	1209,80 (8)	0,00039 (8)						
$\gamma_{20,6}$ (Pd)	1258,72 (9)	0,00066 (8)						

	Energy (keV)	P _{γ+ce} (%)	Multipolarity	α _K (10 ⁻³)	α _L (10 ⁻⁴)	α _M (10 ⁻⁵)	α _T (10 ⁻³)	α _π (10 ⁻⁴)
γ _{21,6} (Pd)	1266,04 (9)	0,00109 (10)						
γ _{13,3} (Pd)	1305,34 (8)	0,00109 (12)						
γ _{22,6} (Pd)	1315,67 (8)	0,0030 (5)	E2	0,489 (7)	0,567 (8)	1,061 (15)	0,586 (9)	0,280 (4)
γ _{24,6} (Pd)	1355,61 (9)	0,00060 (25)						
γ _{24,5} (Pd)	1360,18 (9)	0,0018 (4)						
γ _{15,2} (Pd)	1372,29 (9)	0,00199 (15)						
γ _{8,1} (Pd)	1397,52 (16)	0,00277 (21)						
γ _{9,1} (Pd)	1489,63 (5)	0,0018 (3)						
γ _{16,2} (Pd)	1496,38 (6)	0,0240 (17)						
γ _{27,5} (Pd)	1498,74 (16)	0,0068 (4)						
γ _{6,0} (Pd)	1562,25 (3)	0,156 (8)						
γ _{17,3} (Pd)	1572,48 (20)	0,00185 (19)						
γ _{17,2} (Pd)	1577,28 (9)	0,00105 (16)						
γ _{20,3} (Pd)	1687,21 (10)	0,00055 (16)						
γ _{20,2} (Pd)	1693,2 (3)	0,00082 (14)						
γ _{10,1} (Pd)	1730,46 (20)	0,00209 (13)						
γ _{11,1} (Pd)	1766,26 (9)	0,030 (5)	E2	0,274 (4)	0,314 (5)	0,586 (9)	0,506 (7)	1,93 (3)
γ _{23,2} (Pd)	1774,46 (10)	0,00094 (8)						
γ _{24,3} (Pd)	1784,10 (9)	0,00043 (12)						
γ _{12,1} (Pd)	1796,97 (5)	0,0274 (5)	M1+5,9%E2	0,287 (4)	0,327 (5)	0,611 (9)	0,516 (8)	1,89 (3)
γ _{28,4} (Pd)	1854,91 (20)	0,00125 (10)						
γ _{26,2} (Pd)	1909,30 (17)	0,00107 (25)						
γ _{13,1} (Pd)	1927,25 (7)	0,0147 (4)	M1+0,5%E2	0,250 (4)	0,285 (4)	0,533 (8)	0,532 (8)	2,47 (4)
γ _{28,2} (Pd)	1954,9 (4)	0,00020 (4)						
γ _{14,1} (Pd)	1973,4 (8)	0,00017 (4)						
γ _{15,1} (Pd)	1988,46 (8)	0,0258 (5)	E1+0,25%M2	0,1173 (22)	0,1318 (25)	0,246 (5)	0,735 (11)	6,02 (9)
γ _{30,2} (Pd)	2093,35 (25)	0,00029 (6)	E2	0,200 (3)	0,228 (4)	0,426 (6)	0,576 (8)	3,48 (5)
γ _{16,1} (Pd)	2112,55 (5)	0,0351 (7)	E2	0,197 (3)	0,224 (4)	0,419 (6)	0,581 (9)	3,57 (5)
γ _{35,3} (Pd)	2185,7 (5)	0,00025 (6)						
γ _{17,1} (Pd)	2193,19 (10)	0,00495 (21)	M1+2,8%E2	0,194 (3)	0,220 (3)	0,412 (6)	0,594 (9)	3,73 (6)
γ _{10,0} (Pd)	2242,48 (5)	0,00195 (8)						
γ _{19,1} (Pd)	2271,89 (21)	0,00117 (8)						
γ _{20,1} (Pd)	2309,12 (9)	0,00575 (16)						
γ _{21,1} (Pd)	2316,44 (9)	0,00622 (16)	E2	0,1670 (24)	0,189 (3)	0,354 (5)	0,646 (9)	4,56 (7)
γ _{22,1} (Pd)	2366,07 (7)	0,0232 (7)	E2	0,1608 (23)	0,182 (3)	0,341 (5)	0,663 (10)	4,80 (7)
γ _{23,1} (Pd)	2390,63 (10)	0,00660 (16)	M1+1,0%E2	0,1645 (24)	0,186 (3)	0,349 (5)	0,654 (10)	4,67 (7)
γ _{24,1} (Pd)	2406,01 (8)	0,0145 (4)	M1+0,25%E2	0,1626 (23)	0,184 (3)	0,344 (5)	0,659 (10)	4,74 (7)
γ _{13,0} (Pd)	2439,10 (7)	0,00464 (13)	E2	0,1525 (22)	0,1727 (25)	0,323 (5)	0,689 (10)	5,15 (8)
γ _{25,1} (Pd)	2456,83 (21)	0,00022 (4)						
γ _{14,0} (Pd)	2484,66 (20)	0,00076 (14)						
γ _{26,1} (Pd)	2525,47 (17)	0,00011 (3)						
γ _{27,1} (Pd)	2542,82 (10)	0,00289 (9)	M1+0,5%E2	0,1464 (21)	0,1657 (24)	0,310 (5)	0,705 (10)	5,39 (8)
γ _{28,1} (Pd)	2571,19 (20)	0,00133 (6)						
γ _{29,1} (Pd)	2651,43 (20)	0,00068 (4)						
γ _{17,0} (Pd)	2705,30 (8)	0,00248 (13)						
γ _{30,1} (Pd)	2709,52 (25)	0,00373 (11)	E2	0,1271 (18)	0,1436 (21)	0,268 (4)	0,785 (11)	6,41 (9)
γ _{32,1} (Pd)	2740,2 (4)	0,00021 (4)						
γ _{34,1} (Pd)	2788,2 (5)	0,000082 (21)						
γ _{35,1} (Pd)	2809,1 (3)	0,00062 (4)	E2	0,1195 (17)	0,1349 (19)	0,252 (4)	0,822 (12)	6,86 (10)
γ _{20,0} (Pd)	2821,2 (3)	0,00120 (4)						
γ _{36,1} (Pd)	2865 (1)	0,000014 (8)						
γ _{23,0} (Pd)	2902,6 (5)	0,000066 (21)						
γ _{24,0} (Pd)	2917,6 (3)	0,00094 (4)						
γ _{26,0} (Pd)	3037,4 (3)	0,00105 (4)						
γ _{27,0} (Pd)	3055,1 (3)	0,00036 (4)						
γ _{29,0} (Pd)	3164,7 (10)	0,000023 (12)						
γ _{31,0} (Pd)	3249,9 (5)	0,000086 (16)						
γ _{33,0} (Pd)	3273,5 (7)	0,000049 (14)						
γ _{36,0} (Pd)	3376,0 (14)	0,0000113 (21)						
γ _{37,0} (Pd)	3401,9 (9)	0,0000125 (19)						

3 Atomic Data

3.1 Pd

ω_K	:	0,820	(4)
$\bar{\omega}_L$	:	0,0536	(13)
n_{KL}	:	0,975	(4)

3.1.1 X Radiations

	Energy (keV)		Relative probability
X _K			
Kα ₂	21,0203		52,93
Kα ₁	21,1774		100
Kβ ₃	23,7914	}	27,44
Kβ ₁	23,819		
Kβ ₅ ''	24,013		
Kβ ₂	24,2994	}	4,66
Kβ ₄	24,344		
X _L			
Lℓ	2,5045		
Lα	2,8337 - 2,839		
Lη	2,6611		
Lβ	2,9904 - 3,1715		
Lγ	3,2464 - 3,5545		

3.1.2 Auger Electrons

	Energy (keV)	Relative probability
Auger K		
KLL	17,032 - 17,884	100
KLX	20,032 - 21,176	42
KXY	23,011 - 24,347	4,4
Auger L	1,83 - 3,60	

4 Electron Emissions

		Energy (keV)	Electrons (per 100 disint.)
e _{AL}	(Pd)	1,83 - 3,60	0,1377 (8)
e _{AK}	(Pd)		
	KLL	17,032 - 17,884	0,0238 (7)
	KLX	20,032 - 21,176	
	KXY	23,011 - 24,347	
$\beta_{0,37}^-$	max: avg:	144 (5)	0,0000125 (19)
$\beta_{0,36}^-$	max: avg:	169 (5)	0,000025 (9)
$\beta_{0,35}^-$	max: avg:	226 (5) 62,9 (16)	0,00087 (8)
$\beta_{0,34}^-$	max: avg:	247 (5)	0,000082 (21)
$\beta_{0,33}^-$	max: avg:	272 (5)	0,000049 (14)
$\beta_{0,32}^-$	max: avg:	294 (5) 84,5 (17)	0,00021 (4)
$\beta_{0,31}^-$	max: avg:	296 (5) 85,2 (17)	0,000086 (16)
$\beta_{0,30}^-$	max: avg:	325 (5) 94,5 (17)	0,00402 (13)
$\beta_{0,29}^-$	max: avg:	382 (5) 113,8 (17)	0,00070 (5)
$\beta_{0,28}^-$	max: avg:	462 (5)	0,00278 (13)
$\beta_{0,27}^-$	max: avg:	491 (5) 151,8 (18)	0,0101 (5)
$\beta_{0,26}^-$	max: avg:	509 (5)	0,0022 (3)
$\beta_{0,25}^-$	max: avg:	577 (5) 202,8 (19)	0,00022 (4)
$\beta_{0,24}^-$	max: avg:	628 (5) 202,3 (19)	0,0183 (7)
$\beta_{0,23}^-$	max: avg:	644 (5) 208,1 (19)	0,00760 (18)
$\beta_{0,22}^-$	max: avg:	668 (5) 217,5 (20)	0,0262 (9)
$\beta_{0,21}^-$	max: avg:	718 (5) 236,6 (20)	0,00731 (19)
$\beta_{0,20}^-$	max: avg:	725 (5) 239,4 (20)	0,0090 (3)

		Energy (keV)		Electrons (per 100 disint.)	
$\beta_{0,19}^-$	max:	762	(5)	}	0,00117 (8)
	avg:	254	(2)		
$\beta_{0,18}^-$	max:	828	(5)	}	0,00023 (12)
	avg:				
$\beta_{0,17}^-$	max:	841	(5)	}	0,0106 (4)
	avg:	285,1	(20)		
$\beta_{0,16}^-$	max:	922	(5)	}	0,090 (3)
	avg:	317,8	(21)		
$\beta_{0,15}^-$	max:	1046	(5)	}	0,0284 (6)
	avg:	369,0	(21)		
$\beta_{0,14}^-$	max:	1061	(5)	}	0,00093 (15)
	avg:	375,6	(21)		
$\beta_{0,13}^-$	max:	1107	(5)	}	0,0208 (5)
	avg:	394,7	(21)		
$\beta_{0,12}^-$	max:	1237	(5)	}	0,0430 (7)
	avg:	450,1	(22)		
$\beta_{0,11}^-$	max:	1268	(5)	}	0,043 (5)
	avg:	463,3	(22)		
$\beta_{0,10}^-$	max:	1304	(5)	}	0,0372 (8)
	avg:	478,7	(22)		
$\beta_{0,9}^-$	max:	1545	(5)	}	0,448 (9)
	avg:	584,3	(23)		
$\beta_{0,8}^-$	max:	1637	(5)	}	0,00277 (21)
	avg:	625,2	(23)		
$\beta_{0,7}^-$	max:	1840	(5)	}	0,0664 (10)
	avg:	716,4	(23)		
$\beta_{0,6}^-$	max:	1984	(5)	}	1,67 (3)
	avg:	781,9	(23)		
$\beta_{0,4}^-$	max:	2317	(5)	}	0,0051 (5)
	avg:	951,8	(23)		
$\beta_{0,3}^-$	max:	2412	(5)	}	9,82 (15)
	avg:	978,9	(24)		
$\beta_{0,2}^-$	max:	2418	(5)	}	0,608 (21)
	avg:	981,6	(24)		
$\beta_{0,1}^-$	max:	3034	(5)	}	8,2 (3)
	avg:	1269,5	(24)		
$\beta_{0,0}^-$	max:	3546	(5)	}	78,80 (24)
	avg:	1511,1	(24)		

5 Photon Emissions

5.1 X-Ray Emissions

		Energy (keV)	Photons (per 100 disint.)		
XL	(Pd)	2,5045 - 3,5545	0,00785 (14)		
XK α_2	(Pd)	21,0203	0,0310 (5)	}	K α
XK α_1	(Pd)	21,1774	0,0586 (9)		
XK β_3	(Pd)	23,7914	0,01608 (29)	}	K' β_1
XK β_1	(Pd)	23,819			
XK β_5''	(Pd)	24,013			
XK β_2	(Pd)	24,2994	0,00273 (10)	}	K' β_2
XK β_4	(Pd)	24,344			

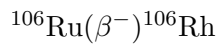
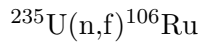
5.2 Gamma Emissions

	Energy (keV)	Photons (per 100 disint.)
$\gamma_{6,3}$ (Pd)	428,49 (5)	0,0704 (24)
$\gamma_{6,2}$ (Pd)	434,23 (4)	0,020 (4)
$\gamma_{9,6}$ (Pd)	439,23 (6)	0,0111 (16)
$\gamma_{1,0}$ (Pd)	511,8534 (23)	20,52 (23)
$\gamma_{7,2}$ (Pd)	578,42 (6)	0,0090 (6)
$\gamma_{2,1}$ (Pd)	616,16 (3)	0,731 (17)
$\gamma_{3,1}$ (Pd)	621,90 (4)	9,87 (15)
$\gamma_{10,6}$ (Pd)	680,23 (6)	0,0103 (6)
$\gamma_{10,5}$ (Pd)	684,80 (6)	0,00552 (21)
$\gamma_{17,9}$ (Pd)	702,8 (10)	0,00029 (18)
$\gamma_{11,6}$ (Pd)	715,86 (9)	0,0099 (4)
$\gamma_{4,1}$ (Pd)	717,44 (4)	0,0067 (4)
$\gamma_{12,5}$ (Pd)	751,26 (20)	0,00121 (23)
$\gamma_{9,2}$ (Pd)	873,46 (6)	0,435 (8)
$\gamma_{15,5}$ (Pd)	942,63 (9)	0,00060 (18)
$\gamma_{5,1}$ (Pd)	1045,82 (4)	0,0131 (16)
$\gamma_{6,1}$ (Pd)	1050,39 (3)	1,490 (25)
$\gamma_{16,6}$ (Pd)	1062,14 (6)	0,0304 (19)
$\gamma_{10,3}$ (Pd)	1108,71 (6)	0,0056 (3)
$\gamma_{10,2}$ (Pd)	1114,45 (6)	0,0117 (3)
$\gamma_{2,0}$ (Pd)	1128,01 (3)	0,398 (8)
$\gamma_{11,2}$ (Pd)	1150,08 (9)	0,00287 (17)
$\gamma_{18,5}$ (Pd)	1159,90 (21)	0,00023 (12)
$\gamma_{12,2}$ (Pd)	1180,79 (6)	0,0144 (3)
$\gamma_{7,1}$ (Pd)	1194,58 (5)	0,0573 (8)
$\gamma_{13,4}$ (Pd)	1209,79 (8)	0,00039 (8)
$\gamma_{20,6}$ (Pd)	1258,71 (9)	0,00066 (8)

	Energy (keV)	Photons (per 100 disint.)
$\gamma_{21,6}(\text{Pd})$	1266,03 (9)	0,00109 (10)
$\gamma_{13,3}(\text{Pd})$	1305,33 (8)	0,00109 (12)
$\gamma_{22,6}(\text{Pd})$	1315,66 (8)	0,0030 (5)
$\gamma_{24,6}(\text{Pd})$	1355,60 (9)	0,00060 (25)
$\gamma_{24,5}(\text{Pd})$	1360,17 (9)	0,0018 (4)
$\gamma_{15,2}(\text{Pd})$	1372,28 (9)	0,00199 (15)
$\gamma_{8,1}(\text{Pd})$	1397,51 (16)	0,00277 (21)
$\gamma_{9,1}(\text{Pd})$	1489,61 (5)	0,0018 (3)
$\gamma_{16,2}(\text{Pd})$	1496,37 (6)	0,0240 (17)
$\gamma_{27,5}(\text{Pd})$	1498,73 (16)	0,0068 (4)
$\gamma_{6,0}(\text{Pd})$	1562,24 (3)	0,156 (8)
$\gamma_{17,3}(\text{Pd})$	1572,47 (20)	0,00185 (19)
$\gamma_{17,2}(\text{Pd})$	1577,27 (9)	0,00105 (16)
$\gamma_{20,3}(\text{Pd})$	1687,2 (1)	0,00055 (16)
$\gamma_{20,2}(\text{Pd})$	1693,2 (3)	0,00082 (14)
$\gamma_{10,1}(\text{Pd})$	1730,44 (20)	0,00209 (13)
$\gamma_{11,1}(\text{Pd})$	1766,24 (9)	0,030 (5)
$\gamma_{23,2}(\text{Pd})$	1774,44 (10)	0,00094 (8)
$\gamma_{24,3}(\text{Pd})$	1784,08 (9)	0,00043 (12)
$\gamma_{12,1}(\text{Pd})$	1796,95 (5)	0,0274 (5)
$\gamma_{28,4}(\text{Pd})$	1854,89 (20)	0,00125 (10)
$\gamma_{26,2}(\text{Pd})$	1909,28 (17)	0,00107 (25)
$\gamma_{13,1}(\text{Pd})$	1927,23 (7)	0,0147 (4)
$\gamma_{28,2}(\text{Pd})$	1954,9 (4)	0,00020 (4)
$\gamma_{14,1}(\text{Pd})$	1973,4 (8)	0,00017 (4)
$\gamma_{15,1}(\text{Pd})$	1988,44 (8)	0,0258 (5)
$\gamma_{30,2}(\text{Pd})$	2093,33 (25)	0,00029 (6)
$\gamma_{16,1}(\text{Pd})$	2112,52 (5)	0,0351 (7)
$\gamma_{35,3}(\text{Pd})$	2185,7 (5)	0,00025 (6)
$\gamma_{17,1}(\text{Pd})$	2193,17 (10)	0,00495 (21)
$\gamma_{10,0}(\text{Pd})$	2242,45 (5)	0,00195 (8)
$\gamma_{19,1}(\text{Pd})$	2271,86 (21)	0,00117 (8)
$\gamma_{20,1}(\text{Pd})$	2309,09 (9)	0,00575 (16)
$\gamma_{21,1}(\text{Pd})$	2316,41 (9)	0,00622 (16)
$\gamma_{22,1}(\text{Pd})$	2366,04 (7)	0,0232 (7)
$\gamma_{23,1}(\text{Pd})$	2390,6 (1)	0,00659 (16)
$\gamma_{24,1}(\text{Pd})$	2405,98 (8)	0,0145 (4)
$\gamma_{13,0}(\text{Pd})$	2439,07 (7)	0,00464 (13)
$\gamma_{25,1}(\text{Pd})$	2456,79 (21)	0,00022 (4)
$\gamma_{14,0}(\text{Pd})$	2484,63 (20)	0,00076 (14)
$\gamma_{26,1}(\text{Pd})$	2525,43 (17)	0,00011 (3)
$\gamma_{27,1}(\text{Pd})$	2542,79 (10)	0,00289 (9)
$\gamma_{28,1}(\text{Pd})$	2571,16 (20)	0,00133 (6)
$\gamma_{29,1}(\text{Pd})$	2651,39 (20)	0,00068 (4)
$\gamma_{17,0}(\text{Pd})$	2705,26 (8)	0,00248 (13)
$\gamma_{30,1}(\text{Pd})$	2709,48 (25)	0,00373 (11)
$\gamma_{32,1}(\text{Pd})$	2740,1 (4)	0,00021 (4)
$\gamma_{34,1}(\text{Pd})$	2788,2 (5)	0,000082 (21)

	Energy (keV)	Photons (per 100 disint.)
$\gamma_{35,1}(\text{Pd})$	2809,1 (3)	0,00062 (4)
$\gamma_{20,0}(\text{Pd})$	2821,2 (3)	0,00120 (4)
$\gamma_{36,1}(\text{Pd})$	2865 (1)	0,000014 (8)
$\gamma_{23,0}(\text{Pd})$	2902,6 (5)	0,000066 (21)
$\gamma_{24,0}(\text{Pd})$	2917,6 (3)	0,00094 (4)
$\gamma_{26,0}(\text{Pd})$	3037,3 (3)	0,00105 (4)
$\gamma_{27,0}(\text{Pd})$	3055,0 (3)	0,00036 (4)
$\gamma_{29,0}(\text{Pd})$	3164,6 (10)	0,000023 (12)
$\gamma_{31,0}(\text{Pd})$	3249,8 (5)	0,000086 (16)
$\gamma_{33,0}(\text{Pd})$	3273,4 (7)	0,000049 (14)
$\gamma_{36,0}(\text{Pd})$	3375,9 (14)	0,0000113 (21)
$\gamma_{37,0}(\text{Pd})$	3401,8 (9)	0,0000125 (19)

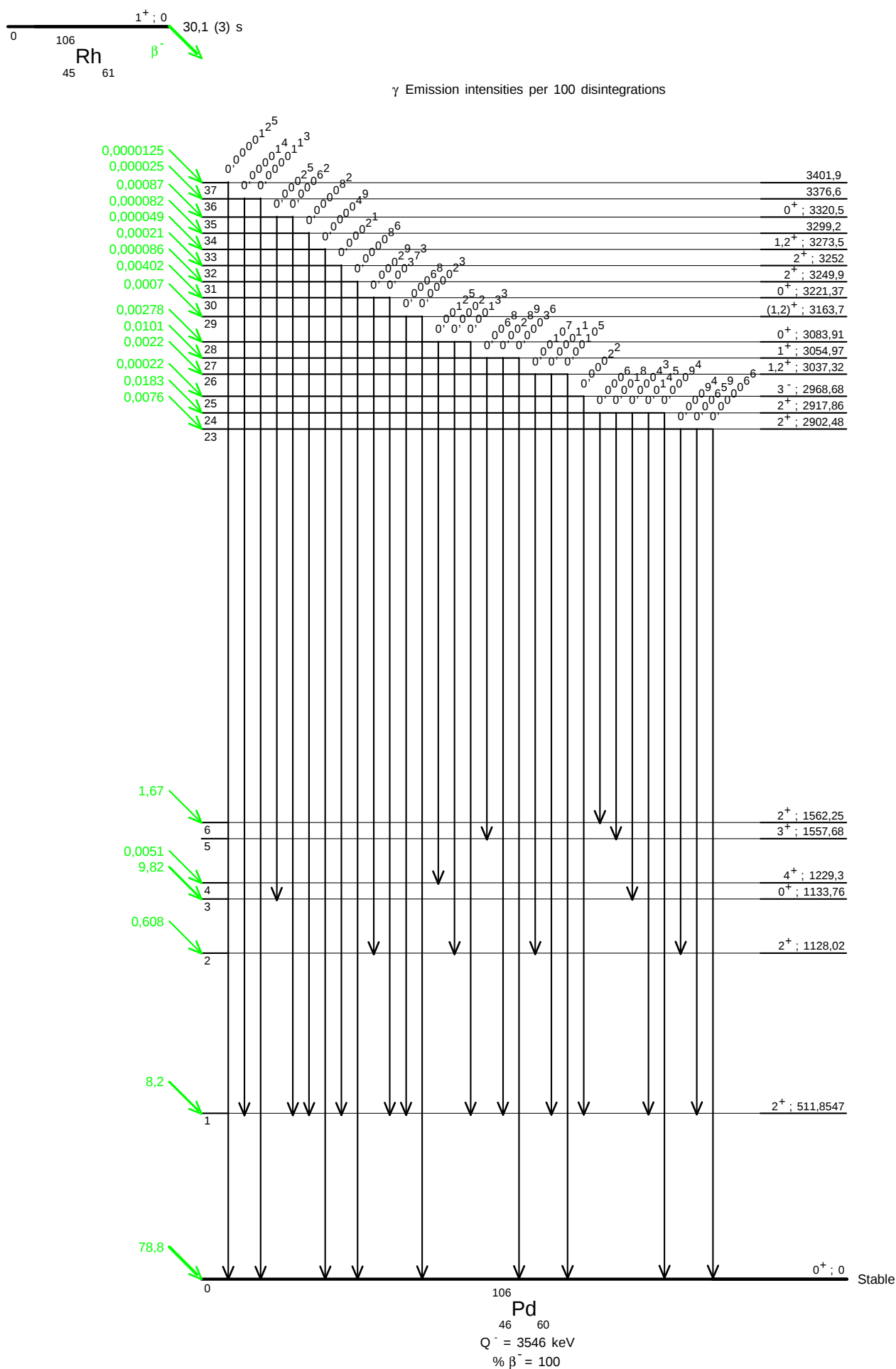
6 Main Production Modes

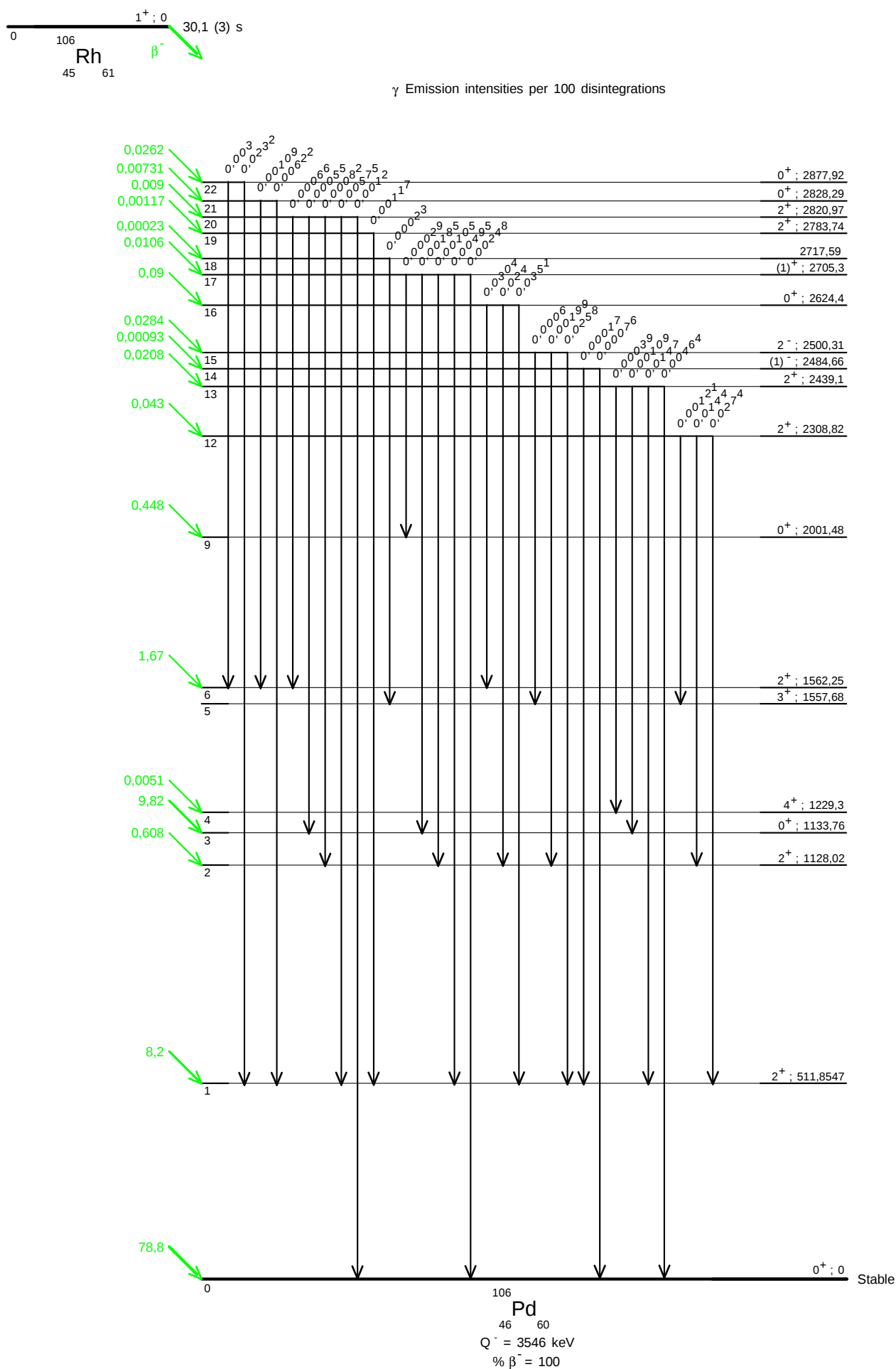


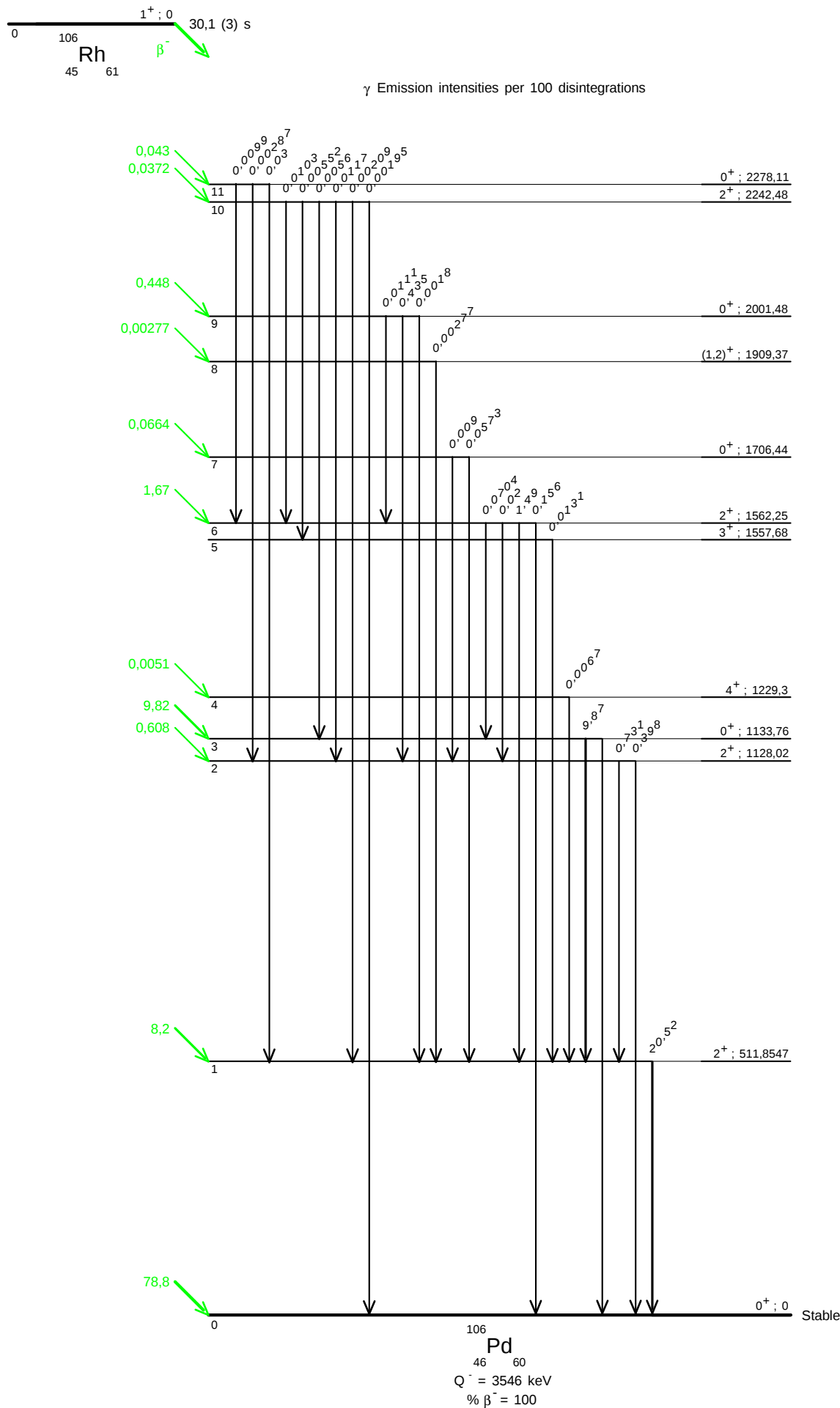
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(Q value)









1 Decay Scheme

Cd-109 decays by electron capture to the isomeric state (88 keV) of Ag-109.
Le cadmium 109 se désintègre uniquement par capture électronique vers l'état isomérique de l'argent 109 (88 keV).

2 Nuclear Data

$T_{1/2}(^{109}\text{Cd})$: 461,9 (4) d
 $Q^+(^{109}\text{Cd})$: 215,5 (18) keV

2.1 Electron Capture Transitions

	Energy (keV)	Probability (%)	Nature	lg <i>ft</i>	<i>P_K</i>	<i>P_L</i>	<i>P_M</i>
$\epsilon_{0,1}$	127,5 (18)	100	Allowed	6	0,812 (3)	0,150 (3)	0,0321 (9)

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy (keV)	$P_{\gamma+ce}$ (%)	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{1,0}(\text{Ag})$	88,0341 (10)	100	E3	11,41 (16)	12,06 (17)	2,47 (4)	26,3 (4)

3 Atomic Data

3.1 Ag

ω_K : 0,831 (4)
 $\bar{\omega}_L$: 0,0583 (14)
 n_{KL} : 0,964 (4)

3.1.1 X Radiations

	Energy (keV)	Relative probability
X _K		
Kα ₂	21,9906	53,05
Kα ₁	22,16317	100
Kβ ₃	24,9118	} 27,7
Kβ ₁	24,9427	
Kβ ₅ ''	25,146	
Kβ ₂	25,4567	} 4,82
Kβ ₄	25,512	
X _L		
Lℓ	2,634	
Lα	2,977 - 2,985	
Lη	2,807	
Lβ	3,151 - 3,438	
Lγ	3,431 - 3,748	

3.1.2 Auger Electrons

	Energy (keV)	Relative probability
Auger K		
KLL	17,79 - 18,69	100
KLX	20,945 - 22,160	42,5
KXY	24,079 - 25,507	4,51
Auger L		
	1,8 - 3,8	1194

4 Electron Emissions

	Energy (keV)	Electrons (per 100 disint.)
e _{AL}	(Ag) 1,8 - 3,8	167,3 (8)
e _{AK}	(Ag)	
	KLL 17,79 - 18,69	} 20,8 (6)
	KLX 20,945 - 22,160	
	KXY 24,079 - 25,507	
ec _{1,0} K	(Ag) 62,520 (1)	41,8 (8)
ec _{1,0} L	(Ag) 84,2279 - 84,6826	44,1 (9)
ec _{1,0} M	(Ag) 87,3162 - 87,6670	9,04 (19)
ec _{1,0} N	(Ag) 87,9385 - 88,0304	1,413 (29)

5 Photon Emissions

5.1 X-Ray Emissions

		Energy (keV)	Photons (per 100 disint.)		
XL	(Ag)	2,634 - 3,748	10,37 (27)		
XK α_2	(Ag)	21,9906	29,21 (30)	}	K α
XK α_1	(Ag)	22,16317	55,1 (5)		
XK β_3	(Ag)	24,9118	} 15,25 (20)	}	K' β_1
XK β_1	(Ag)	24,9427			
XK β_5''	(Ag)	25,146			
XK β_2	(Ag)	25,4567	} 2,65 (10)	}	K' β_2
XK β_4	(Ag)	25,512			

5.2 Gamma Emissions

		Energy (keV)	Photons (per 100 disint.)
$\gamma_{1,0}(\text{Ag})$	88,0336 (10)	3,66 (5)	

6 Main Production Modes

- { Cd – 108(n, γ)Cd – 109 σ : 1,1 (3) barns
- { Possible impurities: Ag – 110m
- { Ag – 109(p,n)Cd – 109
- { Possible impurities: none

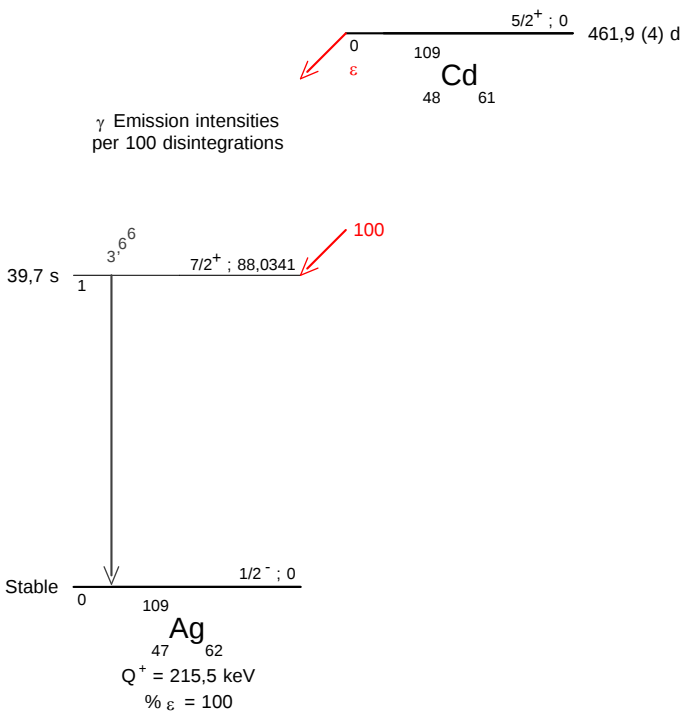
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(Half-life)





1 Decay Scheme

Xe-127 decays by electron capture to excited levels in I-127.

Le Xe-127 se désintègre par capture électronique vers des niveaux excités de I-127.

2 Nuclear Data

$$T_{1/2}(^{127}\text{Xe}) : 36,358 \quad (31) \quad \text{d}$$

$$Q^+(^{127}\text{Xe}) : 662,3 \quad (20) \quad \text{keV}$$

2.1 Electron Capture Transitions

	Energy (keV)	Probability (%)	Nature	lg <i>ft</i>	<i>P_K</i>	<i>P_L</i>	<i>P_M</i>
ε _{0,4}	43,9 (21)	0,0142 (9)	Allowed	7,42	0,31 (6)	0,523 (44)	0,137 (12)
ε _{0,3}	287,3 (20)	47,3 (7)	Allowed	6,21	0,830 (8)	0,134 (1)	0,0294 (6)
ε _{0,2}	459,4 (20)	52,7 (14)	Allowed	6,61	0,842 (8)	0,125 (1)	0,0272 (5)

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy (keV)	P _{γ+ce} (%)	Multipolarity	α _K	α _L	α _M	α _T
γ _{1,0} (I)	57,609 (11)	6,00 (18)	M1 + 0,68 (8) % E2	3,16 (5)	0,449 (8)	0,0910 (16)	3,72 (6)
γ _{2,1} (I)	145,251 (14)	6,22 (11)	E2	0,357 (5)	0,0906 (13)	0,0189 (3)	0,471 (7)
γ _{3,2} (I)	172,132 (12)	29,74 (45)	M1 + 0,72 (10) % E2	0,1419 (20)	0,0185 (3)	0,00373 (6)	0,1649 (24)
γ _{2,0} (I)	202,860 (8)	76,3 (5)	M1 + 21,1 (17) % E2	0,0964 (15)	0,0142 (3)	0,00289 (6)	0,1142 (18)
γ _{3,0} (I)	374,992 (9)	17,60 (28)	E2	0,01671 (24)	0,00257 (4)	0,000524 (8)	0,0199 (3)
γ _{4,0} (I)	618,4 (3)	0,0142 (9)	M1 + 0,65 (29) % E2	0,00528 (8)	0,000656 (10)	0,0001316 (19)	0,00609 (9)

3 Atomic Data

3.1 I

ω_K	:	0,8842	(40)
$\bar{\omega}_L$	:	0,092	(4)
n_{KL}	:	0,909	(4)

3.1.1 X Radiations

	Energy (keV)		Relative probability
X _K			
K α_2	28,3175		53,84
K α_1	28,6123		100
K β_3	32,2397	}	28,81
K β_1	32,2951		
K β_5''	32,544		
K β_2	33,042	}	6,51
K β_4	33,12		
KO _{2,3}	33,166		
X _L			
L ℓ	3,4848		
L α	3,9269 - 3,9382		
L η	3,7791		
L β	4,2212 - 4,5678		
L γ	4,6668 - 5,0595		

3.1.2 Auger Electrons

	Energy (keV)	Relative probability
Auger K		
KLL	22,66 - 23,91	100
KLX	26,85 - 28,56	45,8
KXY	30,99 - 33,07	6,2
Auger L		
	2,4 - 5,1	

4 Electron Emissions

		Energy (keV)	Electrons (per 100 disint.)
eAL	(I)	2,4 - 5,1	96,4 (6)
eAK	(I)	}	11,8 (5)
	KLL	22,66 - 23,91	
	KLX	26,85 - 28,56	
	KXY	30,99 - 33,07	
ec _{1,0} T	(I)	24,440 - 57,606	4,73 (15)
ec _{1,0} K	(I)	24,440 (11)	4,02 (13)
ec _{1,0} L	(I)	52,421 - 53,052	0,571 (19)
ec _{1,0} M	(I)	56,537 - 56,990	0,1158 (38)
ec _{1,0} N	(I)	57,423 - 57,559	0,0233 (8)
ec _{2,1} T	(I)	112,082 - 145,248	1,992 (44)
ec _{2,1} K	(I)	112,082 (14)	1,510 (33)
ec _{3,2} K	(I)	138,963 (12)	3,62 (7)
ec _{3,2} T	(I)	138,963 - 172,129	4,21 (9)
ec _{2,1} L	(I)	140,063 - 140,694	0,383 (8)
ec _{2,1} M	(I)	144,179 - 144,632	0,0799 (18)
ec _{2,1} N	(I)	145,065 - 145,201	0,01561 (36)
ec _{3,2} L	(I)	166,944 - 167,575	0,472 (10)
ec _{2,0} T	(I)	169,69 - 202,86	7,82 (13)
ec _{2,0} K	(I)	169,691 (8)	6,60 (11)
ec _{3,2} M	(I)	171,060 - 171,513	0,0952 (21)
ec _{3,2} N	(I)	171,946 - 172,082	0,01925 (40)
ec _{2,0} L	(I)	197,67 - 198,30	0,972 (22)
ec _{2,0} M	(I)	201,79 - 202,24	0,1978 (43)
ec _{2,0} N	(I)	202,67 - 202,81	0,0396 (9)
ec _{3,0} K	(I)	341,823 (9)	0,288 (6)
ec _{3,0} L	(I)	369,804 - 370,435	0,0444 (10)

5 Photon Emissions

5.1 X-Ray Emissions

		Energy (keV)	Photons (per 100 disint.)		
XL	(I)	3,4848 - 5,0595	9,60 (19)		
XK α_2	(I)	28,3175	25,0 (4)	}	K α
XK α_1	(I)	28,6123	46,5 (8)		
XK β_3	(I)	32,2397	13,39 (25)	}	K' β_1
XK β_1	(I)	32,2951			
XK β_5''	(I)	32,544			
XK β_2	(I)	33,042	3,03 (9)	}	K' β_2
XK β_4	(I)	33,12			
XKO _{2,3}	(I)	33,166			

5.2 Gamma Emissions

	Energy (keV)	Photons (per 100 disint.)
$\gamma_{1,0}(I)$	57,61 (2)	1,272 (35)
$\gamma_{2,1}(I)$	145,252 (10)	4,23 (7)
$\gamma_{3,2}(I)$	172,132 (10)	25,53 (38)
$\gamma_{2,0}(I)$	202,86 (1)	68,45 (45)
$\gamma_{3,0}(I)$	374,991 (12)	17,26 (27)
$\gamma_{4,0}(I)$	618,41 (14)	0,0141 (9)

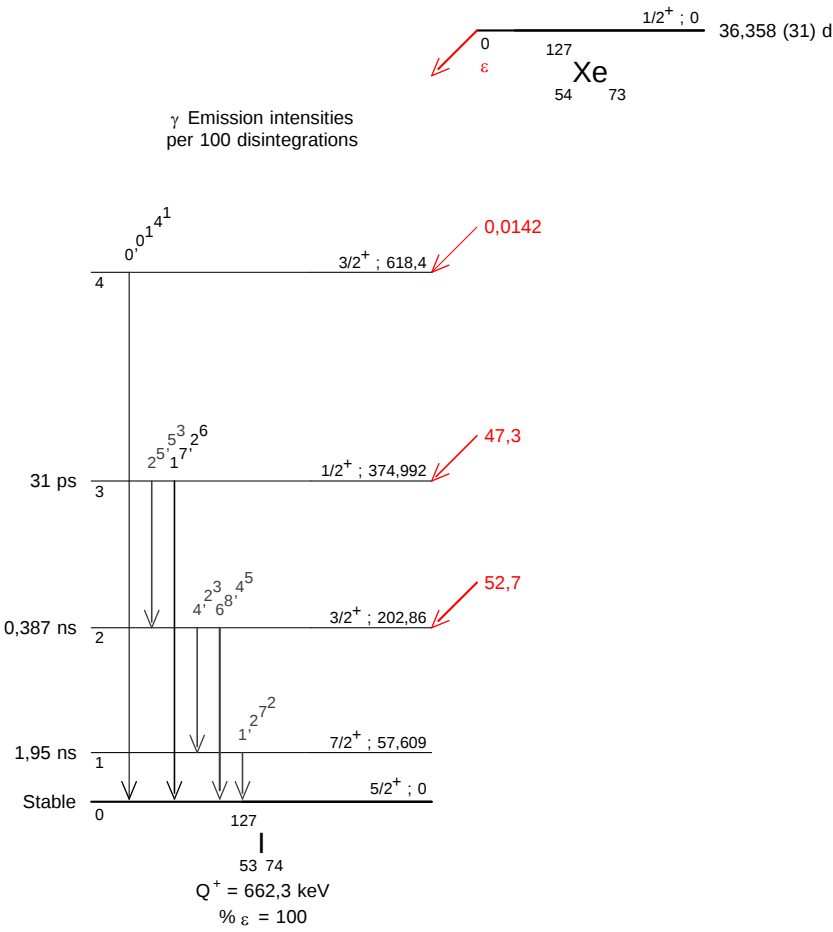
6 Main Production Modes

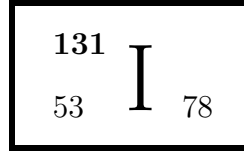
$$\begin{aligned}
 & \left\{ \begin{array}{l} \text{Xe} - 126(n,\gamma)\text{Xe} - 127 \quad \sigma : 3,5 (8) \text{ barns} \\ \text{Possible impurities : } \text{Xe} - 129\text{m}, \text{Xe} - 131\text{m} \end{array} \right. \\
 & \left\{ \begin{array}{l} \text{I} - 127(p,n)\text{Xe} - 127\text{m} \\ \text{Possible impurities : } \text{Xe} - 122, \text{Xe} - 125 \end{array} \right. \\
 & \left\{ \begin{array}{l} \text{I} - 127(d,2n)\text{Xe} - 127\text{m} \\ \text{Possible impurities : } \text{I} - 126 \end{array} \right. \\
 & \text{Xe} - 126(n,\gamma)\text{Xe} - 127\text{m} \\
 & \text{Xe} - 127\text{m(I.T.)Xe} - 127 \quad T_{1/2} : 69 \text{ s}
 \end{aligned}$$

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(Gamma-ray emission probabilities)





1 Decay Scheme

L'iode 131 se désintègre par émission bêta moins vers les niveaux excités de xénon 131, incluant l'isomère xénon 131m de 11,962 (20) jours de période. L'état d'équilibre idéal, c'est à dire l'activité de l'iode 131 étant égale à l'activité de xénon 131m, est obtenue uniquement à $t_m = 14,04$ (9) jours.

I-131 disintegrates through beta minus emissions to excited levels of Xe-131, including the isomeric state Xe-131m. The radioactive equilibrium, i.e. when the activity of I-131 is equal to the activity of Xe-131m, is valid only at $t_m = 14.04$ (9) days.

Pour cette évaluation, l'intensité de la raie gamma de 163,9 keV est donnée, et est valable seulement, au temps $t = t_m$.

For this evaluation, the intensity of the 163.9 keV gamma ray given is only valid at $t = t_m$.

2 Nuclear Data

$$\begin{aligned}
T_{1/2}(^{131}\text{I}) &: 8,0233 \quad (19) \quad \text{d} \\
Q^-(^{131}\text{I}) &: 970,8 \quad (6) \quad \text{keV}
\end{aligned}$$

2.1 β^- Transitions

	Energy (keV)	Probability (%)	Nature	lg ft
$\beta_{0,8}^-$	247,9 (6)	2,130 (21)	Allowed	6,98
$\beta_{0,7}^-$	303,9 (6)	0,643 (27)	1st Forbidden	7,79
$\beta_{0,6}^-$	333,8 (6)	7,20 (7)	Allowed	6,86
$\beta_{0,4}^-$	606,3 (6)	89,4 (8)	Allowed	6,64
$\beta_{0,3}^-$	629,7 (6)	0,060 (12)	1st Forbidden	9,8
$\beta_{0,2}^-$	806,9 (6)	0,386 (23)	Unique 1st Forbidden	10,03

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy (keV)	P _{γ+ce} (%)	Multipolarity	α _K	α _L	α _M	α _T
γ _{1,0} (Xe)	80,1854 (19)	6,63 (15)	M1	1,32 (4)	0,175 (5)	0,036 (1)	1,544 (46)
γ _{8,6} (Xe)	85,919 (8)	0,0163 (23)	[M1, E2]	1,50 (6)	0,56 (2)		2,2 (1)
γ _{2,0} (Xe)	163,930 (8)	1,087 (21)	M4	31,6 (5)	14,75 (21)	3,38 (5)	50,5 (7)
γ _{3,2} (Xe)	177,214 (12)	0,344 (9)	M1+94,9(9)%E2	0,187 (6)	0,0427 (13)	0,00901 (27)	0,241 (7)
γ _{6,5} (Xe)	232,175 (8)	0,0025 (10)	[E2]	0,0782 (22)	0,0151 (5)	0,0031 (1)	0,097 (2)
γ _{6,4} (Xe)	272,500 (8)	0,0612 (16)	M1+12,6(6)%E2	0,0453 (7)	0,0061 (3)	0,00125 (6)	0,0530 (9)
γ _{4,1} (Xe)	284,305 (5)	6,45 (6)	E2	0,0408 (6)	0,00714 (10)	0,001479 (21)	0,0497 (7)
γ _{6,3} (Xe)	295,846 (13)	0,0012 (6)	[E1]	0,0093 (2)	0,00117 (3)	0,00024 (4)	0,0108 (3)
γ _{7,4} (Xe)	302,444 (13)	0,0046 (7)	[E1]	0,0088 (2)	0,00111 (1)	0,00022 (1)	0,0102 (2)
γ _{8,5} (Xe)	318,094 (8)	0,0835 (21)	M1+1,2(9)%E2	0,0301 (5)	0,00388 (6)	0,000786 (12)	0,0350 (5)
γ _{5,1} (Xe)	324,630 (6)	0,0252 (26)	M1+E2	0,0278 (10)	0,0041 (4)	0,00083 (9)	0,0329 (6)
γ _{7,3} (Xe)	325,790 (18)	0,283 (8)	M1+39(34)%E2	0,0288 (9)	0,00376 (11)	0,000765 (23)	0,0335 (10)
γ _{8,4} (Xe)	358,419 (8)	0,017 (8)	[M1,E2]	0,0210 (12)	0,00301 (18)	0,00061 (5)	0,0248 (10)
γ _{4,0} (Xe)	364,490 (4)	83,1 (5)	M1+95,4(23)%E2	0,0190 (3)	0,00300 (5)	0,000616 (9)	0,0228 (4)
γ _{5,0} (Xe)	404,815 (4)	0,0562 (17)	M1+50%E2	0,0151 (13)	0,00210 (4)	0,000429 (11)	0,0177 (12)
γ _{7,2} (Xe)	503,004 (17)	0,3571 (46)	E2	0,00748 (11)	0,001083 (16)	0,000221 (3)	0,00883 (13)
γ _{6,0} (Xe)	636,990 (4)	7,15 (7)	E2	0,00401 (6)	0,000551 (8)	0,0001123 (16)	0,00470 (7)
γ _{8,1} (Xe)	642,724 (6)	0,2193 (26)	[E2]	0,0039 (1)	0,00054 (1)	0,00011 (2)	0,0046 (1)
γ _{8,0} (Xe)	722,909 (4)	1,794 (19)	M1+4,1(1)%E2	0,00390 (6)	0,000488 (7)	0,0000987 (14)	0,00451 (7)

3 Atomic Data

3.1 Xe

ω _K	:	0,888	(5)
ω _L	:	0,097	(5)
n _{KL}	:	0,902	(4)

3.1.1 X Radiations

	Energy (keV)		Relative probability
X _K			
	Kα ₂	29,459	53,98
	Kα ₁	29,779	100
	Kβ ₃	33,562	} 28,99
	Kβ ₁	33,625	
	Kβ ₅ ''	33,881	
	Kβ ₂	34,415	} 6,84
	Kβ ₄	34,496	
	KO _{2,3}	34,552	
X _L			
	Lℓ	3,64	
	Lα	4,1 - 4,11	
	Lη	3,96	
	Lβ	4,42 - 4,78	
	Lγ	4,89 - 5,3	

3.1.2 Auger Electrons

	Energy (keV)	Relative probability
Auger K		
KLL	23,512 - 24,842	100
KLX	27,897 - 29,770	46,5
KXY	32,27 - 34,54	5,41
Auger L	2,50 - 5,43	

4 Electron Emissions

		Energy (keV)		Electrons (per 100 disint.)
e _{AL}	(Xe)	2,50 - 5,43		5,87 (4)
e _{AK}	(Xe)			0,67 (4)
	KLL	23,512 - 24,842	}	
	KLX	27,897 - 29,770		
	KXY	32,27 - 34,54		
ec _{1,0} T	(Xe)	45,6209 - 80,1732		4,03 (13)
ec _{1,0} K	(Xe)	45,6209 (19)		3,44 (11)
ec _{1,0} L	(Xe)	74,7325 - 75,4031		0,456 (14)
ec _{1,0} M	(Xe)	79,0366 - 79,5086		0,0939 (29)
ec _{1,0} N	(Xe)	79,9720 - 80,1178		0,01921 (39)
ec _{2,0} T	(Xe)	129,366 - 163,917		1,066 (47)
ec _{2,0} K	(Xe)	129,366 (8)		0,662 (29)
ec _{2,0} L	(Xe)	158,477 - 159,148		0,315 (14)
ec _{2,0} M	(Xe)	162,781 - 163,253		0,0727 (32)
ec _{2,0} N	(Xe)	163,717 - 163,862		0,0148 (7)
ec _{4,1} K	(Xe)	249,741 (5)		0,2505 (44)
ec _{4,1} L	(Xe)	278,852 - 279,523		0,0438 (7)
ec _{4,0} K	(Xe)	329,926 (4)		1,543 (26)
ec _{4,0} T	(Xe)	329,93 - 364,48		1,851 (34)
ec _{4,0} L	(Xe)	359,04 - 359,71		0,2436 (43)
ec _{4,0} M	(Xe)	363,34 - 363,81		0,0500 (8)
ec _{4,0} N	(Xe)	364,28 - 364,42		0,01020 (16)
ec _{6,0} K	(Xe)	602,426 (4)		0,0286 (5)
$\beta_{0,8}^-$	max:	247,9 (6)	}	2,130 (21)
	avg:	69,35 (19)		
$\beta_{0,7}^-$	max:	303,9 (6)	}	0,643 (27)
	avg:	86,94 (19)		
$\beta_{0,6}^-$	max:	333,8 (6)	}	7,20 (7)
	avg:	96,61 (19)		
$\beta_{0,4}^-$	max:	606,3 (6)	}	89,4 (8)
	avg:	191,59 (22)		

		Energy (keV)		Electrons (per 100 disint.)
$\beta_{0,3}^-$	max:	629,7	(6)	} 0,060 (12)
	avg:	200,23	(22)	
$\beta_{0,2}^-$	max:	806,9	(6)	} 0,386 (23)
	avg:	267,91	(23)	

5 Photon Emissions

5.1 X-Ray Emissions

		Energy (keV)	Photons (per 100 disint.)		
XL	(Xe)	3,64 - 5,3	0,631 (13)		
XK α_2	(Xe)	29,459	1,52 (4)	}	K α
XK α_1	(Xe)	29,779	2,81 (6)		
XK β_3	(Xe)	33,562	}	0,816 (19)	K' β_1
XK β_1	(Xe)	33,625			
XK β_5''	(Xe)	33,881			
XK β_2	(Xe)	34,415	}	0,193 (6)	K' β_2
XK β_4	(Xe)	34,496			
XKO $_{2,3}$	(Xe)	34,552			

5.2 Gamma Emissions

	Energy (keV)	Photons (per 100 disint.)
$\gamma_{1,0}$ (Xe)	80,185 (2)	2,607 (35)
$\gamma_{8,6}$ (Xe)	85,9 (2)	0,0051 (7)
$\gamma_{2,0}$ (Xe)	163,930 (8)	0,0211 (3)
$\gamma_{3,2}$ (Xe)	177,214 (20)	0,277 (7)
$\gamma_{6,5}$ (Xe)	232,18 (15)	0,0023 (9)
$\gamma_{6,4}$ (Xe)	272,498 (17)	0,0581 (15)
$\gamma_{4,1}$ (Xe)	284,305 (5)	6,14 (6)
$\gamma_{6,3}$ (Xe)	295,8 (2)	0,0012 (6)
$\gamma_{7,4}$ (Xe)	302,4 (2)	0,0046 (7)
$\gamma_{8,5}$ (Xe)	318,088 (16)	0,0807 (20)
$\gamma_{5,1}$ (Xe)	324,651 (25)	0,0244 (25)
$\gamma_{7,3}$ (Xe)	325,789 (4)	0,274 (8)
$\gamma_{8,4}$ (Xe)	358,4 (2)	0,017 (8)
$\gamma_{4,0}$ (Xe)	364,489 (5)	81,2 (5)
$\gamma_{5,0}$ (Xe)	404,814 (4)	0,0552 (17)

	Energy (keV)	Photons (per 100 disint.)
$\gamma_{7,2}(\text{Xe})$	503,004 (4)	0,3540 (46)
$\gamma_{6,0}(\text{Xe})$	636,989 (4)	7,12 (7)
$\gamma_{8,1}(\text{Xe})$	642,719 (5)	0,2183 (26)
$\gamma_{8,0}(\text{Xe})$	722,911 (5)	1,786 (19)

6 Main Production Modes

Fission product

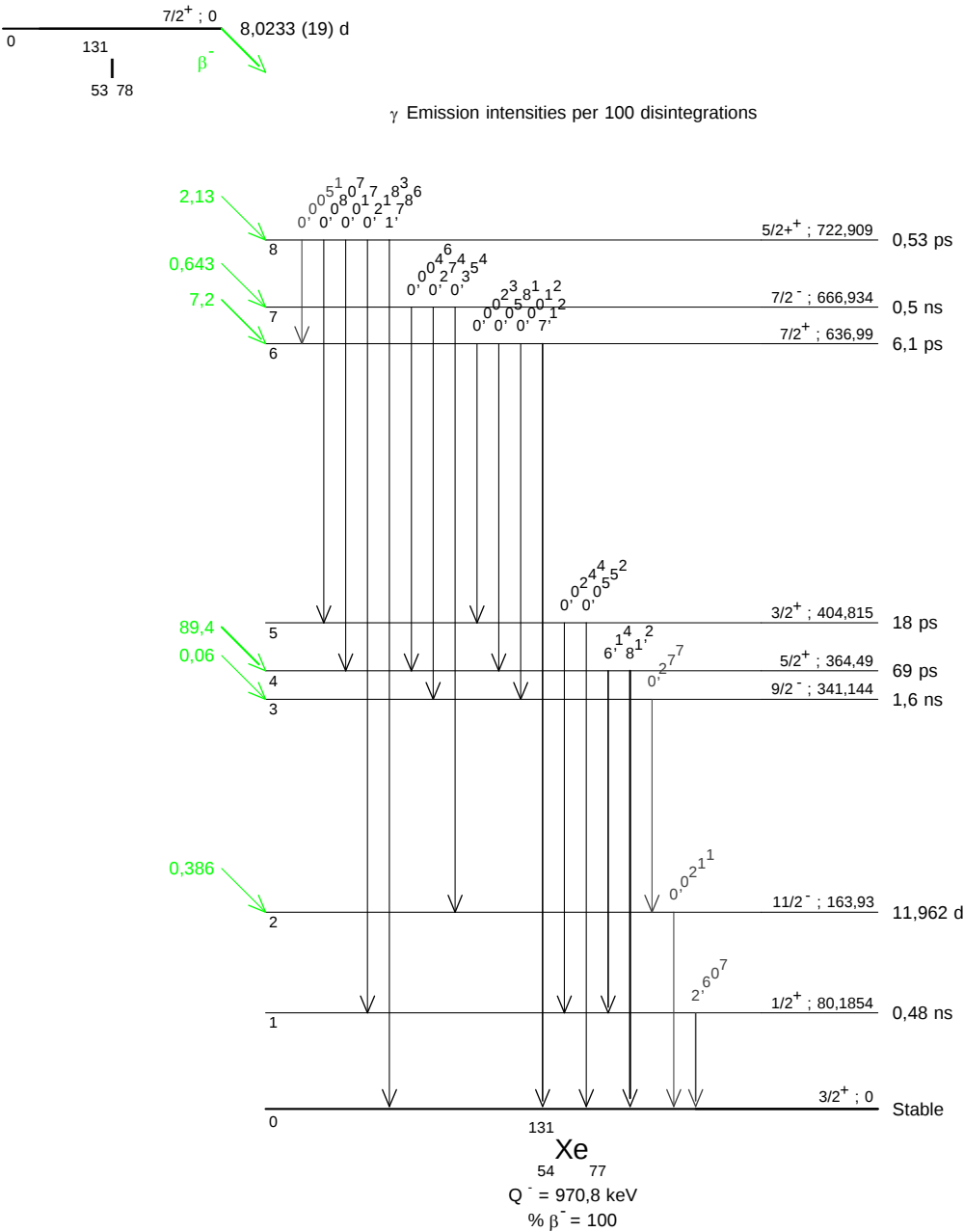
- $\left\{ \begin{array}{l} \text{Te} - 130(\text{n},\gamma)\text{Te} - 131 \quad \sigma : 0,27 \text{ (6) barns} \\ \text{Possible impurities: Te} - 121\text{m}, \text{Te} - 121, \text{Te} - 123\text{m}, \text{Te} - 125\text{m}, \text{Te} - 127, \text{Te} - 129\text{m} \end{array} \right.$
- $\text{Te} - 131(\beta^-)\text{I} - 131 \quad T_{1/2} : 25 \text{ min}$
- $\left\{ \begin{array}{l} \text{Te} - 130(\text{n},\gamma)\text{Te} - 131\text{m} \quad \sigma : 0,02 \text{ (1) barns} \\ \text{Possible impurities: Te} - 121\text{m}, \text{Te} - 121, \text{Te} - 123\text{m}, \text{Te} - 125\text{m}, \text{Te} - 127, \text{Te} - 129\text{m} \end{array} \right.$
- $\text{Te} - 131\text{m}(\beta^-)\text{I} - 131 \quad T_{1/2} : 30 \text{ h}$

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1 Decay Scheme

Le xénon 131 métastable se désexcite par une transition gamma (163,930 keV) fortement convertie.
Xe-131m decays by a strongly converted gamma transition.

2 Nuclear Data

$T_{1/2} (^{131m}\text{Xe})$: 11,962 (20) d
 $Q^{IT} (^{131m}\text{Xe})$: 163,930 (8) keV

2.1 Gamma Transitions and Internal Conversion Coefficients

	Energy (keV)	P _{γ+ce} (%)	Multipolarity	α _K	α _L	α _M	α _T
γ _{1,0} (Xe)	163,930 (8)	100	M4	31,6 (5)	14,75 (21)	3,38 (5)	50,5 (7)

3 Atomic Data

3.1 Xe

ω_K : 0,888 (5)
ω̄_L : 0,097 (5)
n_{KL} : 0,902 (4)

3.1.1 X Radiations

	Energy (keV)	Relative probability
X _K		
Kα ₂	29,459	53,98
Kα ₁	29,779	100

	Energy (keV)		Relative probability
K β_3	33,562	}	28,99
K β_1	33,625		
K β_5''	33,881		
K β_2	34,415	}	6,84
K β_4	34,496		
KO _{2,3}	34,552		
X _L			
L ℓ	3,64		
L α	4,1 - 4,11		
L η	3,96		
L β	4,42 - 4,78		
L γ	4,89 - 5,3		

3.1.2 Auger Electrons

	Energy (keV)	Relative probability
Auger K		
KLL	23,512 - 24,842	100
KLX	27,897 - 29,770	46,5
KXY	32,27 - 34,54	5,41
Auger L		
	2,50 - 5,43	

4 Electron Emissions

		Energy (keV)	Electrons (per 100 disint.)
e _{AL}	(Xe)	2,50 - 5,43	75,8 (5)
e _{AK}	(Xe)		6,9 (4)
	KLL	23,512 - 24,842	}
	KLX	27,897 - 29,770	
	KXY	32,27 - 34,54	
ec _{1,0} K	(Xe)	129,366 (8)	61,4 (13)
ec _{1,0} L	(Xe)	158,48 - 159,15	28,6 (6)
ec _{1,0} M	(Xe)	162,78 - 163,25	6,56 (13)
ec _{1,0} N	(Xe)	163,72 - 163,86	1,342 (26)

5 Photon Emissions

5.1 X-Ray Emissions

		Energy (keV)	Photons (per 100 disint.)		
XL	(Xe)	3,64 - 5,3	8,12 (16)		
XK α_2	(Xe)	29,459	15,5 (4)	}	K α
XK α_1	(Xe)	29,779	28,7 (7)		
XK β_3	(Xe)	33,562	}	8,31 (22)	K' β_1
XK β_1	(Xe)	33,625			
XK β_5''	(Xe)	33,881			
XK β_2	(Xe)	34,415	}	1,96 (7)	K' β_2
XK β_4	(Xe)	34,496			
XKO _{2,3}	(Xe)	34,552			

5.2 Gamma Emissions

	Energy (keV)	Photons (per 100 disint.)
$\gamma_{1,0}(\text{Xe})$	163,930 (8)	1,942 (26)

6 Main Production Modes

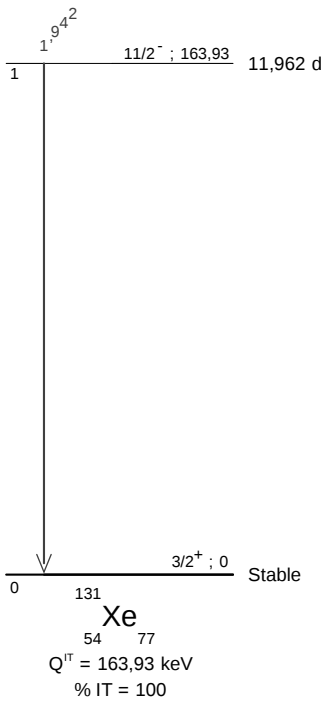
- { Fission product
- { Possible impurities: Xe – 127, Xe – 129m, Xe – 133, Xe – 133m, Xe – 135
- { Xe – 130(n, γ)Xe – 131m σ : 0,45 (10) barns
- { Possible impurities: Xe – 129m
- I – 131(β^-)Xe – 131m

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γ Emission intensities
per 100 disintegrations





1 Decay Scheme

^{133}Ba disintegrates by electron capture mainly to two ^{133}Cs excited levels of 437 keV (85.4%) and of 383 keV (14.5%) with three very minor branches to the 160 keV, 81 keV excited levels and the ground state.

Le baryum 133 se désintègre par capture électronique principalement vers deux niveaux excités de 437 keV et 383 keV du césium 133.

2 Nuclear Data

$$T_{1/2}(^{133}\text{Ba}) : 10,539 \quad (6) \quad \text{a}$$

$$Q^+(^{133}\text{Ba}) : 517,3 \quad (10) \quad \text{keV}$$

2.1 Electron Capture Transitions

	Energy (keV)	Probability (%)	Nature	lg ft	P_K	P_L	P_M
$\epsilon_{0,4}$	80,3 (10)	85,41 (53)	Allowed	6,63	0,671 (5)	0,251 (4)	0,0777 (11)
$\epsilon_{0,3}$	133,5 (10)	14,46 (51)	Allowed	8,03	0,7727 (9)	0,1755 (7)	0,05174 (23)
$\epsilon_{0,2}$	356,7 (10)	<0,3	2nd Forbidden	>10,6	0,83	0,13	0,037
$\epsilon_{0,1}$	436,3 (10)	<0,7	2nd Forbidden	>10,9	0,84	0,13	0,037
$\epsilon_{0,0}$	517,3 (10)	<0,0005	Unique 2nd Forbidden	>13,9	0,77	0,18	0,05

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy (keV)	P _{γ+ce} (%)	Multipolarity	α _K	α _L	α _M	α _T
γ _{4,3} (Cs)	53,1622 (18)	14,25 (46)	M1+E2	4,78 (7)	0,70 (5)	0,144 (12)	5,66 (11)
γ _{2,1} (Cs)	79,6142 (19)	7,3 (5)	M1+E2	1,495 (22)	0,217 (6)	0,0447 (13)	1,77 (3)
γ _{1,0} (Cs)	80,9979 (11)	90,05 (6)	M1+E2	1,431 (20)	0,216 (4)	0,0447 (8)	1,703 (24)
γ _{2,0} (Cs)	160,6121 (16)	0,826 (9)	M1+E2	0,234 (4)	0,0471 (13)	0,0099 (3)	0,294 (6)
γ _{3,2} (Cs)	223,237 (2)	0,494 (6)	M1+E2	0,0836 (12)	0,01103 (16)	0,00226 (4)	0,0975 (14)
γ _{4,2} (Cs)	276,3992 (21)	7,53 (6)	E2	0,0460 (7)	0,00842 (12)	0,001763 (25)	0,0566 (8)
γ _{3,1} (Cs)	302,8512 (16)	19,10 (12)	M1+E2	0,0373 (6)	0,00484 (7)	0,000988 (14)	0,0434 (6)
γ _{4,1} (Cs)	356,0134 (17)	63,63 (20)	E2	0,0211 (3)	0,00346 (5)	0,000721 (10)	0,0254 (4)
γ _{3,0} (Cs)	383,8491 (12)	9,12 (6)	E2	0,01684 (24)	0,00270 (4)	0,000560 (8)	0,0202 (3)

3 Atomic Data

3.1 Cs

ω _K	:	0,894	(4)
ω _L	:	0,104	(5)
n _{KL}	:	0,895	(4)

3.1.1 X Radiations

	Energy (keV)		Relative probability
X _K			
Kα ₂	30,6254		54,13
Kα ₁	30,9731		100
Kβ ₃	34,9197	}	29,21532
Kβ ₁	34,9873		
Kβ ₅ ''	35,252		
Kβ ₂	35,822	}	7,12854
Kβ ₄	35,907		
KO _{2,3}	35,972		
X _L			
Lℓ	3,7946		
Lα	4,2729 - 4,2866		
Lη	4,1418		
Lβ	4,62 - 4,9333		
Lγ	5,1308 - 5,5525		

3.1.2 Auger Electrons

	Energy (keV)	Relative probability
Auger K		
KLL	24,411 - 25,804	100
KLX	28,991 - 30,961	47,2
KXY	33,55 - 35,96	5,56
Auger L	2,5777 - 5,5590	

4 Electron Emissions

		Energy (keV)	Electrons (per 100 disint.)
e _{AL}	(Cs)	2,5777 - 5,5590	136,8 (8)
e _{AK}	(Cs)		
	KLL	24,411 - 25,804	} 14,1 (6)
	KLX	28,991 - 30,961	
	KXY	33,55 - 35,96	
ec _{4,3} T	(Cs)	17,1776 - 53,1508	12,11 (41)
ec _{4,3} K	(Cs)	17,1776 (18)	10,23 (32)
ec _{2,1} T	(Cs)	43,6296 - 79,6028	4,66 (35)
ec _{2,1} K	(Cs)	43,6296 (19)	3,93 (29)
ec _{1,0} K	(Cs)	45,0133 (11)	47,7 (8)
ec _{1,0} T	(Cs)	45,0133 - 80,9865	56,7 (9)
ec _{4,3} L	(Cs)	47,4479 - 48,1503	1,50 (11)
ec _{4,3} M	(Cs)	51,9451 - 52,4367	0,308 (27)
ec _{4,3} N	(Cs)	52,9314 - 53,0857	0,065 (5)
ec _{2,1} L	(Cs)	73,8999 - 74,6023	0,571 (44)
ec _{1,0} L	(Cs)	75,2836 - 75,9860	7,19 (15)
ec _{2,1} M	(Cs)	78,3971 - 78,8887	0,118 (9)
ec _{2,1} N	(Cs)	79,3834 - 79,5377	0,0247 (19)
ec _{1,0} M	(Cs)	79,7808 - 80,2724	1,489 (30)
ec _{1,0} N	(Cs)	80,7671 - 80,9214	0,313 (6)
ec _{2,0} K	(Cs)	124,6275 (16)	0,1493 (29)
ec _{2,0} L	(Cs)	154,8978 - 155,6002	0,0300 (9)
ec _{3,2} K	(Cs)	187,252 (2)	0,0376 (7)
ec _{4,2} K	(Cs)	240,4146 (21)	0,328 (6)
ec _{3,1} T	(Cs)	266,8666 - 302,8398	0,795 (12)
ec _{3,1} K	(Cs)	266,8666 (16)	0,683 (12)
ec _{4,2} L	(Cs)	270,6849 - 271,3873	0,060 (1)
ec _{4,2} M	(Cs)	275,1821 - 275,6737	0,01257 (21)
ec _{3,1} L	(Cs)	297,1369 - 297,8393	0,0886 (14)
ec _{3,1} M	(Cs)	301,6341 - 302,1257	0,01809 (28)
ec _{4,1} T	(Cs)	320,0288 - 356,0020	1,576 (25)

		Energy (keV)	Electrons (per 100 disint.)
ec _{4,1} K	(Cs)	320,0288 (17)	1,309 (19)
ec _{3,0} K	(Cs)	347,8645 (12)	0,1505 (24)
ec _{4,1} L	(Cs)	350,2991 - 351,0015	0,2147 (32)
ec _{4,1} M	(Cs)	354,7963 - 355,2879	0,0447 (6)
ec _{3,0} L	(Cs)	378,1348 - 378,8372	0,02414 (39)

5 Photon Emissions

5.1 X-Ray Emissions

		Energy (keV)	Photons (per 100 disint.)		
XL	(Cs)	3,7946 - 5,5525	15,87 (26)		
XK α_2	(Cs)	30,6254	33,8 (4)	}	K α
XK α_1	(Cs)	30,9731	62,4 (7)		
XK β_3	(Cs)	34,9197	18,24 (29)	}	K' β_1
XK β_1	(Cs)	34,9873			
XK β_5''	(Cs)	35,252			
XK β_2	(Cs)	35,822	4,45 (12)	}	K' β_2
XK β_4	(Cs)	35,907			
XKO _{2,3}	(Cs)	35,972			

5.2 Gamma Emissions

	Energy (keV)	Photons (per 100 disint.)
$\gamma_{4,3}(\text{Cs})$	53,1622 (18)	2,14 (6)
$\gamma_{2,1}(\text{Cs})$	79,6142 (19)	2,63 (19)
$\gamma_{1,0}(\text{Cs})$	80,9979 (11)	33,31 (30)
$\gamma_{2,0}(\text{Cs})$	160,6121 (16)	0,638 (6)
$\gamma_{3,2}(\text{Cs})$	223,2368 (13)	0,450 (5)
$\gamma_{4,2}(\text{Cs})$	276,3989 (12)	7,13 (6)
$\gamma_{3,1}(\text{Cs})$	302,8508 (5)	18,31 (11)
$\gamma_{4,1}(\text{Cs})$	356,0129 (7)	62,05 (19)
$\gamma_{3,0}(\text{Cs})$	383,8485 (12)	8,94 (6)

6 Main Production Modes

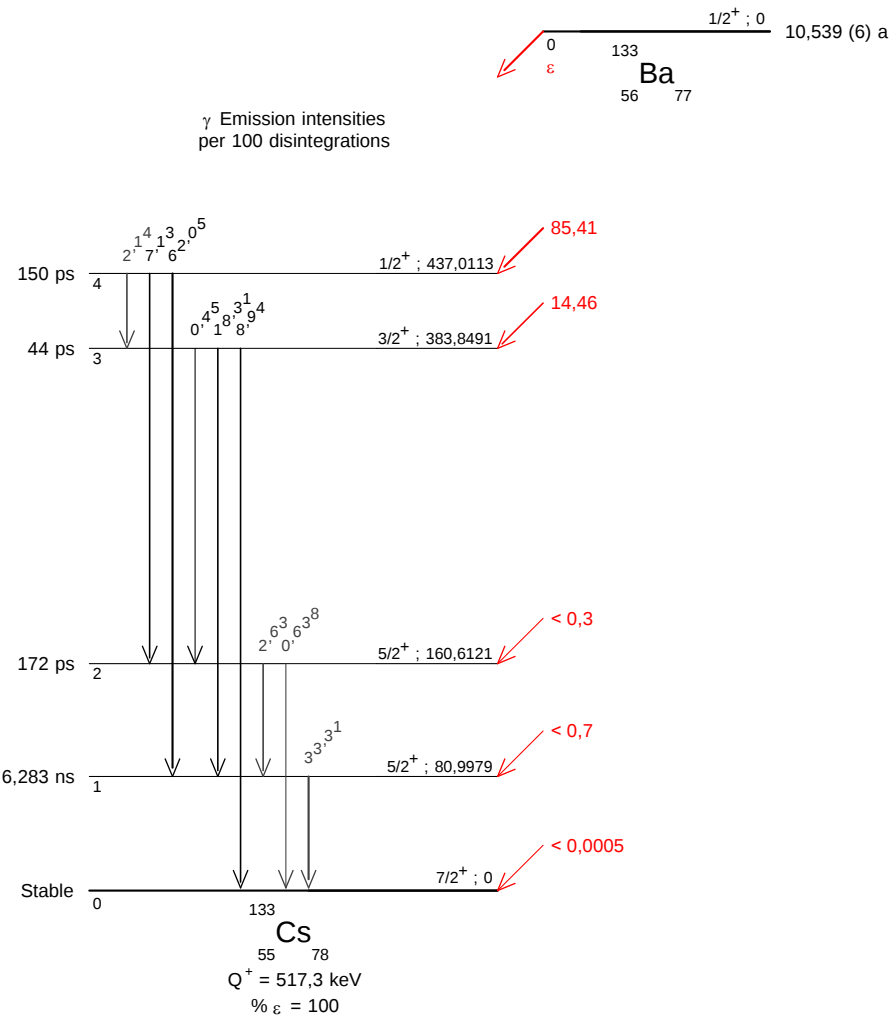
- { Ba – 132(n,γ)Ba – 133 σ : 6,5 (8) barns
- { Possible impurities: Ba – 131, Ba – 140
- Ba – 132(n,γ)Ba – 133m σ : 0,5 barns
- { Ca – 133(p,n)Ba – 133
- { Possible impurities: Cs – 132

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1 Decay Scheme

La-138 decays by an electron capture transition and a β^- decay to the first excited levels of Ba-138 and of Ce-138 respectively.

Le lanthane 138 se désintègre par une transition capture électronique et un bêta moins vers les premiers niveaux excités, respectivement, du baryum 138 et du cérium 138.

2 Nuclear Data

$$\begin{array}{lll} T_{1/2}(^{138}\text{La}) & : & 103,6 \quad (20) \quad 10^9 \text{ a} \\ Q^+(^{138}\text{La}) & : & 1740,0 \quad (34) \quad \text{keV} \\ Q^-(^{138}\text{La}) & : & 1051,7 \quad (40) \quad \text{keV} \end{array}$$

2.1 Electron Capture Transitions

	Energy (keV)	Probability (%)	Nature	$\lg ft$	P_K	P_L	P_M
$\epsilon_{0,1}$	304,2 (34)	65,2 (6)	Unique 2nd Forbidden	17,2	0,637 (5)	0,275 (3)	0,0880 (11)

2.2 β^- Transitions

	Energy (keV)	Probability (%)	Nature	lg ft
$\beta_{0,1}^-$	263 (4)	34,8 (6)	Unique 2nd Forbidden	18,7

2.3 Gamma Transitions and Internal Conversion Coefficients

	Energy (keV)	P _{γ+ce} (%)	Multipolarity	α_K (10 ⁻³)	α_L (10 ⁻⁴)	α_M (10 ⁻⁴)	α_T (10 ⁻³)	α_π (10 ⁻⁴)
$\gamma_{1,0}(\text{Ce})$	788,744 (8)	34,8 (6)	E2	2,91 (4)	4,06 (6)	0,852 (12)	3,42 (5)	
$\gamma_{1,0}(\text{Ba})$	1435,816 (10)	65,2 (6)	E2	0,742 (11)	0,937 (14)	0,192 (3)	0,917 (13)	0,572 (8)

3 Atomic Data

3.1 Ba

ω_K	:	0,900	(4)
$\bar{\omega}_L$	:	0,110	(5)
n_{KL}	:	0,888	(4)

3.1.1 X Radiations

	Energy (keV)		Relative probability
X _K			
Kα ₂	31,8174		54,28
Kα ₁	32,1939		100
Kβ ₃	36,3045	}	29,41
Kβ ₁	36,3786		
Kβ ₅ ''	36,654		
Kβ ₂	37,258	}	7,41
Kβ ₄	37,312		
KO _{2,3}	37,425		
X _L			
Lℓ	3,9544		
Lα	4,4515 - 4,4666		
Lη	4,3307		
Lβ	4,8278 - 5,207		
Lγ	5,3715 - 5,8104		

3.1.2 Auger Electrons

	Energy (keV)	Relative probability
Auger K		
KLL	25,314 - 26,786	100
KLX	30,095 - 32,179	47,7
KXY	34,86 - 37,41	5,7
Auger L		
	2,66 - 5,81	

3.2 Ce

ω_K	:	0,910	(4)
$\bar{\omega}_L$	:	0,125	(5)
n_{KL}	:	0,876	(4)

3.2.1 X Radiations

	Energy (keV)		Relative probability
X _K			
Kα ₂	34,2793		54,6
Kα ₁	34,72		100
Kβ ₃	39,1705	}	30,1
Kβ ₁	39,2578		
Kβ ₅ ''	39,549		
Kβ ₂	40,233	}	7,7
Kβ ₄	40,337		
KO _{2,3}	40,423		
X _L			
Lℓ	4,2868		
Lα	4,822 - 4,8411		
Lη	4,7274		
Lβ	5,2625 - 5,665		
Lγ	5,8755 - 6,3412		

3.2.2 Auger Electrons

	Energy (keV)	Relative probability
Auger K		
KLL	27,190 - 28,828	100
KLX	32,392 - 34,700	48,9
KXY	37,57 - 40,40	5,97
Auger L		
	2,85 - 6,51	

4 Electron Emissions

	Energy (keV)	Electrons (per 100 disint.)
e _{AL}	(Ba) 2,66 - 5,81	48,8 (4)
e _{AK}	(Ba)	4,16 (18)
	KLL 25,314 - 26,786	}
	KLX 30,095 - 32,179	
	KXY 34,86 - 37,41	
e _{AL}	(Ce) 2,85 - 6,51	0,0895 (7)
e _{AK}	(Ce)	0,0091 (5)
	KLL 27,190 - 28,828	}
	KLX 32,392 - 34,700	
	KXY 37,57 - 40,40	

		Energy (keV)	Electrons (per 100 disint.)
ec _{1,0} K	(Ce)	748,301 (8)	0,1010 (22)
ec _{1,0} L	(Ce)	782,195 - 783,021	0,01409 (32)
ec _{1,0} K	(Ba)	1398,38 (1)	0,0483 (8)
$\beta_{0,1}^-$	max: avg:	263 (4) 91,1 (21)	} 34,8 (6)

5 Photon Emissions

5.1 X-Ray Emissions

		Energy (keV)	Photons (per 100 disint.)		
XL	(Ba)	3,9544 - 5,8104	6,03 (10)		
XK α_2	(Ba)	31,8174	10,63 (15)	}	K α
XK α_1	(Ba)	32,1939	19,58 (26)		
XK β_3	(Ba)	36,3045	}	}	K' β_1
XK β_1	(Ba)	36,3786			
XK β_5''	(Ba)	36,654			
XK β_2	(Ba)	37,258	}	}	K' β_2
XK β_4	(Ba)	37,312			
XKO _{2,3}	(Ba)	37,425			
XL	(Ce)	4,2868 - 6,3412	0,01301 (29)		
XK α_2	(Ce)	34,2793	0,0261 (6)	}	K α
XK α_1	(Ce)	34,72	0,0478 (11)		
XK β_3	(Ce)	39,1705	}	}	K' β_1
XK β_1	(Ce)	39,2578			
XK β_5''	(Ce)	39,549			
XK β_2	(Ce)	40,233	}	}	K' β_2
XK β_4	(Ce)	40,337			
XKO _{2,3}	(Ce)	40,423			

5.2 Gamma Emissions

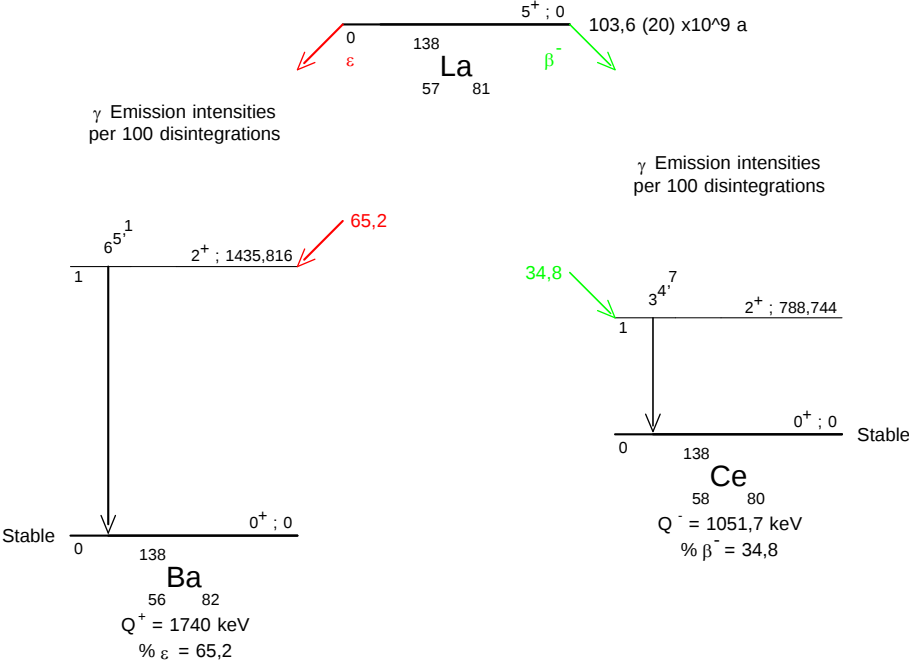
	Energy (keV)	Photons (per 100 disint.)
$\gamma_{1,0}(\text{Ce})$	788,742 (8)	34,7 (6)
$\gamma_{1,0}(\text{Ba})$	1435,795 (10)	65,1 (6)

6 Main Production Modes

- { Naturally occurring
- { Possible impurities: Ac – 227

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(Q(β^-) and end-point, β^- spectrum shape, L/K capture ratio)





1 Decay Scheme

Ba-140 decays by beta minus emission to various excited levels of La-140. The activity ratio La-140/Ba-140 at time t (for initially pure Ba-140) is given by:

$$\frac{T_1}{T_1 - T_2} (1 - e^{-t \times \ln(2) \times \frac{T_1 - T_2}{T_1 \times T_2}}).$$

where T_1 is the half-life of Ba-140 and T_2 is the half-life of La-140.

At equilibrium ($t \geq 19$ d) the activity ratio is simply: $T_1/(T_1 - T_2) = 1.1516 \pm 0.0005$.

Le baryum 140 se désintègre par émission bêta moins vers des niveaux excités de lanthane 140. Le rapport au temps t des activités La-140/Ba-140 dans le Ba-140 initialement pur s'écrit :

$$\frac{T_1}{T_1 - T_2} (1 - e^{-t \times \ln(2) \times \frac{T_1 - T_2}{T_1 \times T_2}}).$$

T_1 et T_2 étant respectivement les périodes de Ba-140 et La-140.

À l'équilibre ($t \geq 19$ jours) ce rapport est égal à : $T_1/(T_1 - T_2) = 1,1516 \pm 0,0005$.

2 Nuclear Data

$T_{1/2}({}^{140}\text{Ba})$	:	12,753	(5)	d
$T_{1/2}({}^{140}\text{La})$	:	1,67858	(21)	d
$Q^-({}^{140}\text{Ba})$	:	1048	(8)	keV

2.1 β^- Transitions

	Energy (keV)	Probability (%)	Nature	lg ft
$\beta_{0,6}^-$	467 (8)	24,94 (50)	1st Forbidden	7,1
$\beta_{0,5}^-$	580 (8)	9,71 (12)	1st Forbidden	7,8
$\beta_{0,4}^-$	885 (8)	4,14 (31)	Unique 1st Forbidden	9,3
$\beta_{0,2}^-$	1004 (8)	35,6 (31)	1st Forbidden	8
$\beta_{0,1}^-$	1018 (8)	25,6 (42)	Unique 1st Forbidden	8,7

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy (keV)	P _{γ+ce} (%)	Multipolarity	α _K	α _L	α _M	α _T
γ _{2,1} (La)	13,880 (18)	63,8 (31)	M1+E2		42,8 (15)	8,9 (4)	54,0 (19)
γ _{1,0} (La)	29,9641 (6)	91,7 (29)	M1(+E2)		4,26 (6)	0,885 (13)	5,37 (8)
γ _{3,0} (La)	63,1790 (7)	0,00015 (8)	M1	3,45 (5)	0,472 (7)	0,0983 (14)	4,05 (6)
γ _{4,3} (La)	99,4801 (20)	0,00006 (4)	[E2]	1,235 (18)	0,620 (9)	0,1371 (20)	2,03 (3)
γ _{6,5} (La)	113,48 (4)	0,0302 (23)	M1	0,645 (9)	0,0872 (13)	0,0181 (3)	0,755 (11)
γ _{4,2} (La)	118,815 (18)	0,101 (4)	M1	0,566 (8)	0,0765 (11)	0,01591 (23)	0,663 (10)
γ _{4,1} (La)	132,695 (2)	0,300 (9)	M1	0,415 (6)	0,0560 (8)	0,01163 (17)	0,485 (7)
γ _{4,0} (La)	162,6591 (19)	8,3 (3)	M1(+E2)	0,235 (4)	0,0317 (5)	0,00659 (11)	0,275 (4)
γ _{5,4} (La)	304,971 (30)	4,55 (9)	M1(+E2)	0,0434 (6)	0,00573 (8)	0,001189 (17)	0,0506 (7)
γ _{5,2} (La)	423,786 (35)	3,20 (6)	M1	0,0186 (3)	0,00243 (4)	0,000503 (7)	0,0217 (3)
γ _{5,1} (La)	437,666 (30)	1,98 (4)	M1	0,01716 (24)	0,00224 (4)	0,000464 (7)	0,0200 (3)
γ _{6,2} (La)	537,262 (25)	24,9 (5)	M1	0,01029 (15)	0,001332 (19)	0,000276 (4)	0,01197 (17)
γ _{6,1} (La)	551,142 (18)	0,0049 (20)	[E2]	0,00666 (10)	0,000997 (14)	0,000209 (3)	0,00792 (11)

3 Atomic Data

3.1

ω _K	:	0,905	(4)
ω̄ _L	:	0,117	(5)
n _{KL}	:	0,882	(4)
n̄ _{LM}	:	1,61	(3)

3.1.1 X Radiations

	Energy (keV)		Relative probability
X _K			
Kα ₂	33,0344		54,44
Kα ₁	33,4421		100
Kβ ₃	37,7206	}	29,8
Kβ ₁	37,8015		
Kβ ₅ ''	38,075		
Kβ ₅	39,095		
Kβ ₂	38,7303	}	7,5
Kβ ₄	38,828		
KO _{2,3}	39,91		
X _L			
Lℓ	4,1174		
Lα	4,6338 - 4,6504		
Lη	4,5248		
Lβ	5,0412 - 5,3814		
Lγ	5,6198 - 6,0724		

3.1.2 Auger Electrons

	Energy (keV)	Relative probability
Auger K		
KLL	26,240 - 27,795	100
KLX	31,231 - 33,428	47,8
KXY	36,2 - 38,9	6,65
Auger L	2,7 - 6,2	

4 Electron Emissions

		Energy (keV)		Electrons (per 100 disint.)
e _{AL}	(La)	2,7 - 6,2		99,5 (19)
e _{AK}	(La)			
	KLL	26,240 - 27,795	}	0,208 (11)
	KLX	31,231 - 33,428		
	KXY	36,2 - 38,9		
ec _{2,1} L	(La)	7,61 - 8,40		49,6 (24)
ec _{2,1} M	(La)	12,52 - 13,05		10,3 (6)
ec _{2,1} N	(La)	13,61 - 13,78		2,26 (11)
ec _{1,0} L	(La)	23,6978 - 24,4814		61,3 (19)
ec _{1,0} M	(La)	28,6028 - 29,1324		12,74 (40)
ec _{1,0} N	(La)	29,6937 - 29,8652		2,79 (9)
ec _{6,5} K	(La)	74,56 (4)		0,0111 (9)
ec _{4,2} K	(La)	79,890 (18)		0,0346 (13)
ec _{4,1} K	(La)	93,770 (2)		0,0838 (28)
ec _{4,0} T	(La)	123,7345 - 162,6447		1,78 (8)
ec _{4,0} K	(La)	123,7345 (19)		1,53 (7)
ec _{4,1} L	(La)	126,429 - 127,212		0,01131 (37)
ec _{4,0} L	(La)	156,3928 - 157,1764		0,206 (9)
ec _{4,0} M	(La)	161,2978 - 161,8274		0,0428 (19)
ec _{5,4} K	(La)	266,05 (3)		0,1884 (47)
ec _{5,4} L	(La)	298,705 - 299,488		0,0249 (6)
ec _{5,2} K	(La)	384,861 (35)		0,0582 (15)
ec _{5,1} K	(La)	398,74 (3)		0,0333 (8)
ec _{6,2} K	(La)	498,337 (25)		0,253 (6)
ec _{6,2} L	(La)	530,996 - 531,779		0,0328 (8)
$\beta_{0,6}^-$	max:	467 (8)	}	24,94 (50)
	avg:	141 (3)		
$\beta_{0,5}^-$	max:	580 (8)	}	9,71 (12)
	avg:	181 (3)		
$\beta_{0,4}^-$	max:	885 (8)	}	4,14 (31)
	avg:	311 (3)		

		Energy (keV)	Electrons (per 100 disint.)
$\beta_{0,2}^-$	max:	1004 (8)	35,6 (31)
	avg:	345 (3)	
$\beta_{0,1}^-$	max:	1018 (8)	25,6 (42)
	avg:	362 (3)	

5 Photon Emissions

5.1 X-Ray Emissions

		Energy (keV)	Photons (per 100 disint.)		
XL	(La)	4,1174 - 6,0724	13,7 (4)		
XK α_2	(La)	33,0344	0,562 (19)	}	K α
XK α_1	(La)	33,4421	1,03 (4)		
XK β_3	(La)	37,7206	0,307 (11)	}	K' β_1
XK β_1	(La)	37,8015			
XK β_5''	(La)	38,075			
XK β_5'	(La)	39,095			
XK β_2	(La)	38,7303	0,078 (3)	}	K' β_2
XK β_4	(La)	38,828			
XKO _{2,3}	(La)	39,91			

5.2 Gamma Emissions

	Energy (keV)	Photons (per 100 disint.)
$\gamma_{2,1}(\text{La})$	13,880 (18)	1,16 (4)
$\gamma_{1,0}(\text{La})$	29,9641 (6)	14,4 (4)
$\gamma_{3,0}(\text{La})$	63,1790 (7)	0,000030 (15)
$\gamma_{4,3}(\text{La})$	99,4801 (20)	0,000020 (12)
$\gamma_{6,5}(\text{La})$	113,48 (4)	0,0172 (13)
$\gamma_{4,2}(\text{La})$	118,815 (18)	0,0610 (21)
$\gamma_{4,1}(\text{La})$	132,695 (2)	0,202 (6)
$\gamma_{4,0}(\text{La})$	162,6591 (19)	6,49 (27)
$\gamma_{5,4}(\text{La})$	304,971 (30)	4,33 (9)
$\gamma_{5,2}(\text{La})$	423,786 (35)	3,13 (6)
$\gamma_{5,1}(\text{La})$	437,666 (30)	1,94 (4)
$\gamma_{6,2}(\text{La})$	537,261 (25)	24,6 (5)
$\gamma_{6,1}(\text{La})$	551,141 (18)	0,0049 (20)

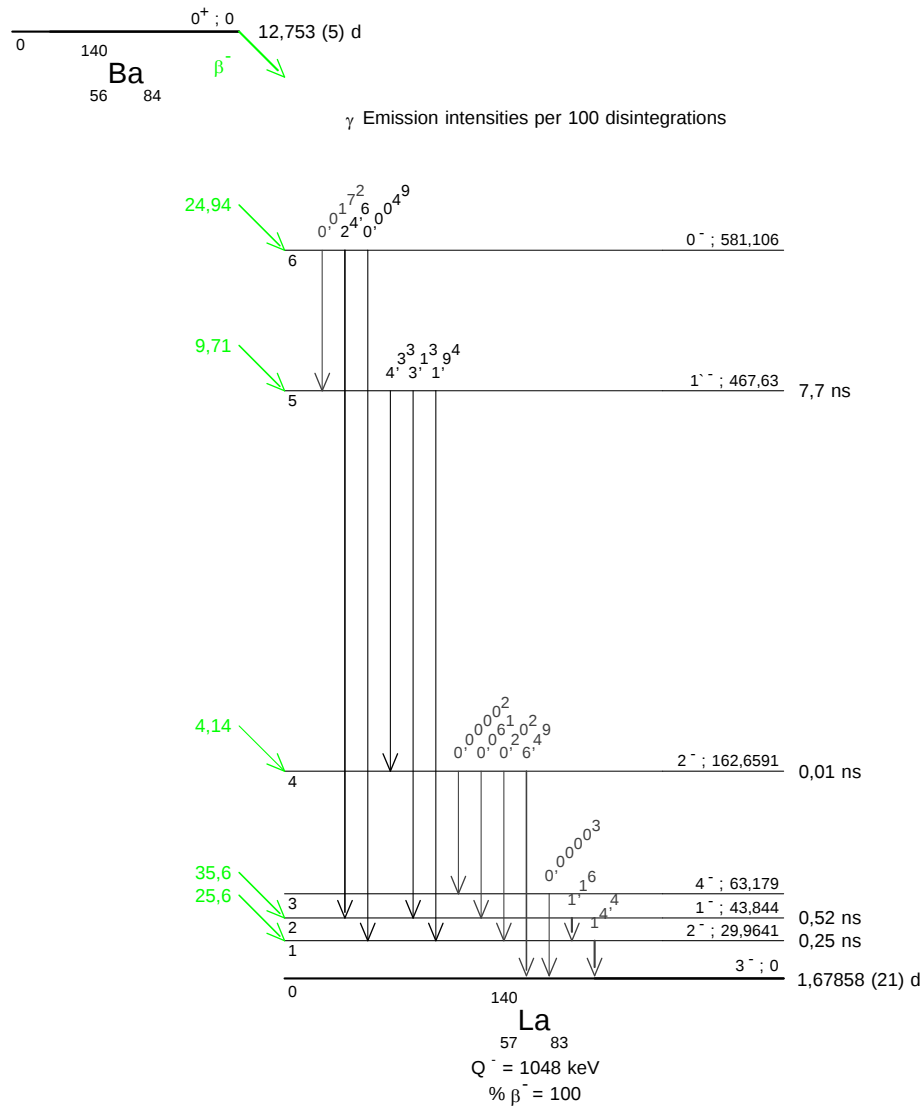
6 Main Production Modes

- { Fission product
- { Possible impurities: none

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1 Decay Scheme

Le lanthane 140 se désintègre par émission bêta moins vers les niveaux excités du cérium 140.
La-140 decays by beta minus emission to the Ce-140 excited levels.

2 Nuclear Data

$T_{1/2}(^{140}\text{La})$: 1,67858 (21) d
 $Q^-(^{140}\text{La})$: 3760,9 (18) keV

2.1 β^- Transitions

	Energy (keV)	Probability (%)	Nature	lg ft
$\beta_{0,19}^-$	240,1 (18)	0,011 (3)	1st Forbidden	8,6
$\beta_{0,18}^-$	287,4 (18)	0,052 (7)	Allowed	8,2
$\beta_{0,17}^-$	366,1 (18)	0,020 (4)	Allowed	9
$\beta_{0,16}^-$	441,3 (18)	0,0039 (3)	1st Forbidden	9,9
$\beta_{0,15}^-$	642,5 (18)	0,027 (1)	1st Forbidden	9,6
$\beta_{0,14}^-$	760,0 (18)	0,085 (9)	1st Forbidden	9,4
$\beta_{0,13}^-$	861,2 (18)	0,112 (6)	1st Forbidden	9,5
$\beta_{0,12}^-$	1213,7 (18)	0,636 (7)	Unique 1st Forbidden	10
$\beta_{0,11}^-$	1239,5 (18)	11,11 (9)	1st Forbidden	8,1
$\beta_{0,10}^-$	1245,2 (18)	5,80 (4)	1st Forbidden	8,4
$\beta_{0,9}^-$	1280,0 (18)	1,14 (2)	1st Forbidden	9,1
$\beta_{0,8}^-$	1296,8 (18)	5,60 (7)	Allowed	8,44
$\beta_{0,7}^-$	1348,9 (18)	44,8 (4)	1st Forbidden	7,6
$\beta_{0,6}^-$	1411,1 (18)	0,262 (22)	Unique 1st Forbidden	10,7
$\beta_{0,5}^-$	1413,0 (18)	5,03 (12)	1st Forbidden	8,6
$\beta_{0,3}^-$	1677,7 (18)	20,8 (6)	1st Forbidden	8,3
$\beta_{0,1}^-$	2164,7 (18)	4,5 (6)	1st Forbidden	9,4

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy (keV)	$P_{\gamma+ce}$ (%)	Multipolarity	α_K (10^{-3})	α_L (10^{-2})	α_M (10^{-2})	α_N (10^{-3})	α_T (10^{-2})	α_π (10^{-5})
$\gamma_{4,3}(\text{Ce})$	24,594 (4)	0,480 (11)	E2		54500 (800)	12200 (180)	25900 (400)	69600 (1000)	
$\gamma_{7,5}(\text{Ce})$	64,129 (4)	0,073 (11)	M1	3610 (50)	49,9 (7)	10,46 (15)	23,2 (4)	424 (6)	
$\gamma_{9,7}(\text{Ce})$	68,923 (5)	0,342 (10)	M1	2930 (50)	40,5 (6)	8,48 (12)	18,8 (3)	344 (5)	
$\gamma_{11,7}(\text{Ce})$	109,417 (4)	0,423 (12)	M1+E2	787 (12)	12,8 (4)	2,71 (8)	5,97 (18)	94,9 (15)	
$\gamma_{9,6}(\text{Ce})$	131,121 (4)	0,729 (16)	M1+E2	468 (7)	6,60 (22)	1,39 (5)	3,07 (11)	55,2 (9)	
$\gamma_{11,5}(\text{Ce})$	173,546 (5)	0,158 (6)	M1	214 (3)	2,91 (4)	0,609 (9)	1,350 (19)	25,1 (4)	
$\gamma_{6,4}(\text{Ce})$	241,959 (6)	0,480 (11)	M1+E2	84 (3)	1,30 (11)	0,275 (25)	0,61 (6)	10,05 (18)	
$\gamma_{6,3}(\text{Ce})$	266,554 (5)	0,531 (10)	M1+E2	67,1 (11)	0,906 (17)	0,190 (4)	0,420 (9)	7,85 (12)	
$\gamma_{2,1}(\text{Ce})$	307,08 (4)	0,023 (5)	E2	36,2 (6)	0,695 (10)	0,1495 (21)	0,326 (5)	4,50 (7)	
$\gamma_{7,3}(\text{Ce})$	328,761 (4)	21,7 (3)	M1+E2	38,8 (6)	0,516 (8)	0,1078 (15)	0,239 (4)	4,53 (7)	
$\gamma_{9,3}(\text{Ce})$	397,674 (6)	0,0765 (31)	(E2)	16,89 (24)	0,288 (4)	0,0615 (9)	0,1347 (19)	2,05 (3)	
$\gamma_{10,3}(\text{Ce})$	432,513 (8)	3,063 (31)	M1+E2	17,9 (4)	0,245 (4)	0,0514 (8)	0,1138 (17)	2,10 (4)	
$\gamma_{11,3}(\text{Ce})$	438,178 (6)	0,017 (10)	M1	18,6 (3)	0,244 (4)	0,0510 (8)	0,1132 (16)	2,17 (3)	
$\gamma_{5,2}(\text{Ce})$	444,57 (4)	0,003 (1)	[E2]	12,34 (18)	0,202 (3)	0,0429 (6)	0,0942 (14)	1,490 (21)	
$\gamma_{3,1}(\text{Ce})$	487,022 (6)	46,6 (5)	E2	9,63 (14)	0,1526 (22)	0,0324 (5)	0,0711 (10)	1,156 (17)	
$\gamma_{11,2}(\text{Ce})$	618,12 (4)	0,041 (3)	[E2]	5,20 (8)	0,0768 (11)	0,01619 (23)	0,0357 (5)	0,617 (9)	
$\gamma_{5,1}(\text{Ce})$	751,655 (7)	4,41 (5)	M1+E2	4,71 (8)	0,0613 (10)	0,01277 (20)	0,0283 (5)	0,548 (9)	
$\gamma_{7,1}(\text{Ce})$	815,784 (6)	23,83 (20)	M1+E2	4,05 (6)	0,0521 (8)	0,01085 (16)	0,0241 (4)	0,471 (7)	
$\gamma_{8,1}(\text{Ce})$	867,842 (16)	5,59 (7)	E1+M2	0,977 (22)	0,0122 (3)	0,00253 (7)	0,00561 (14)	0,113 (3)	
$\gamma_{10,1}(\text{Ce})$	919,536 (10)	2,74 (3)	M1+E2	2,19 (6)	0,0295 (7)	0,00616 (13)	0,0136 (3)	0,257 (6)	
$\gamma_{11,1}(\text{Ce})$	925,201 (7)	7,06 (7)	M1+E2	2,96 (5)	0,0381 (6)	0,00792 (12)	0,0176 (3)	0,344 (6)	
$\gamma_{12,1}(\text{Ce})$	950,991 (20)	0,533 (7)	M1+E2	2,82 (4)	0,0361 (5)	0,00752 (11)	0,01669 (24)	0,328 (5)	
$\gamma_{18,9}(\text{Ce})$	992,64 (18)	0,010 (3)	[E1]	0,743 (11)	0,00924 (13)	0,00191 (3)	0,00423 (6)	0,0860 (12)	
$\gamma_{17,6}(\text{Ce})$	1045,02 (9)	0,020 (4)	[E1]	0,675 (10)	0,00837 (12)	0,001733 (25)	0,00384 (6)	0,0781 (11)	
$\gamma_{14,2}(\text{Ce})$	1097,58 (9)	0,023 (5)	[E2]	1,42 (2)	0,0188 (3)	0,00392 (6)	0,00868 (13)	0,1658 (24)	
$\gamma_{13,1}(\text{Ce})$	1303,35 (7)	0,045 (6)	[M1+E2+E0]	1,2 (2)	0,015 (2)	0,0032 (5)		0,14 (2)	
$\gamma_{14,1}(\text{Ce})$	1404,67 (9)	0,062 (8)	[M1+E2]	1,01 (15)	0,0129 (18)	0,0027 (4)	0,0059 (8)	0,117 (15)	4,73 (8)
$\gamma_{1,0}(\text{Ce})$	1596,213 (13)	95,49 (5)	E2	0,676 (10)	0,00863 (12)	0,00179 (3)	0,00397 (6)	0,0787 (13)	11,28 (16)
$\gamma_{18,1}(\text{Ce})$	1877,34 (18)	0,041 (6)	[E1]	0,245 (4)	0,00300 (5)	0,000621 (9)	0,001377 (20)	0,0284 (4)	49,9 (7)
$\gamma_{2,0}(\text{Ce})$	1903,29 (4)	0,0146 (15)	E0						
$\gamma_{19,1}(\text{Ce})$	1924,5 (2)	0,011 (3)	[E2]	0,478 (7)	0,00601 (9)	0,001247 (18)	0,00276 (4)	0,0554 (8)	25,7 (4)
$\gamma_{3,0}(\text{Ce})$	2083,236 (14)	0,036 (7)	E4	1,162 (17)	0,01598 (23)	0,00335 (5)	0,00743 (11)	0,1364 (19)	
$\gamma_{5,0}(\text{Ce})$	2347,868 (14)	0,846 (16)	E2	0,333 (5)	0,00415 (6)	0,000860 (12)	0,00191 (3)	0,0386 (5)	46,0 (7)
$\gamma_{8,0}(\text{Ce})$	2464,054 (20)	0,0097 (13)	[E3]	0,515 (8)	0,00661 (10)	0,001375 (20)	0,00305 (5)	0,0598 (8)	33,1 (5)
$\gamma_{11,0}(\text{Ce})$	2521,410 (14)	3,41 (5)	E2	0,294 (5)	0,00365 (6)	0,000756 (11)	0,001676 (24)	0,0340 (5)	54,2 (8)
$\gamma_{12,0}(\text{Ce})$	2547,200 (23)	0,1021 (20)	M1	0,320 (5)	0,00398 (6)	0,000824 (12)	0,00183 (3)	0,0370 (5)	59,3 (9)
$\gamma_{13,0}(\text{Ce})$	2899,56 (7)	0,0661 (10)	E2	0,231 (4)	0,00284 (4)	0,000588 (9)	0,001306 (19)	0,0266 (4)	71,4 (10)
$\gamma_{15,0}(\text{Ce})$	3118,53 (10)	0,026 (1)	(E2)	0,204 (3)	0,00250 (4)	0,000518 (8)	0,001149 (16)	0,0234 (3)	80,8 (12)
$\gamma_{16,0}(\text{Ce})$	3319,56 (24)	0,0039 (3)	E2	0,183 (3)	0,00225 (4)	0,000464 (7)	0,001031 (15)	0,0211 (3)	89,2 (13)

3 Atomic Data

3.1 Ce

ω_K	:	0,910	(4)
$\bar{\omega}_L$	:	0,125	(5)
n_{KL}	:	0,876	(4)
$\bar{n}_{LM}$	:	1,57	(3)

3.1.1 X Radiations

	Energy (keV)		Relative probability
X _K			
Kα ₂	34,2793		54,6
Kα ₁	34,72		100
Kβ ₃	39,1705	}	30,31
Kβ ₁	39,2578		
Kβ ₅ ''	39,549		
Kβ ₂	40,233	}	9,8
Kβ ₄	40,337		
X _L			
Lℓ	4,2868		
Lα	4,822 - 4,8411		
Lη	4,7274		
Lβ	5,2625 - 5,6103		
Lγ	5,8755 - 6,3412		

3.1.2 Auger Electrons

	Energy (keV)	Relative probability
Auger K		
KLL	27,190 - 28,828	100
KLX	32,392 - 34,700	48,3
KXY	37,57 - 40,40	6,77
Auger L	2,8 - 6,5	

4 Electron Emissions

		Energy (keV)	Electrons (per 100 disint.)
eAL	(Ce)	2,8 - 6,5	2,360 (13)
eAK	(Ce)		
	KLL	27,190 - 28,828	} 0,206 (10)
	KLX	32,392 - 34,700	
	KXY	37,57 - 40,40	
ec _{4,3} L	(Ce)	18,045 - 18,871	0,376 (12)
ec _{4,3} M	(Ce)	23,159 - 23,711	0,0841 (26)
ec _{7,5} K	(Ce)	23,686 (4)	0,051 (7)
ec _{4,3} N	(Ce)	24,304 - 24,594	0,0178 (6)
ec _{9,7} K	(Ce)	28,480 (5)	0,226 (7)
ec _{9,7} L	(Ce)	62,374 - 63,200	0,0312 (9)
ec _{11,7} K	(Ce)	68,974 (4)	0,171 (5)
ec _{9,6} K	(Ce)	90,678 (4)	0,220 (6)
ec _{11,7} L	(Ce)	102,868 - 103,694	0,0278 (12)
ec _{9,6} L	(Ce)	124,572 - 125,398	0,0310 (12)
ec _{11,5} K	(Ce)	133,103 (5)	0,0270 (11)
ec _{6,4} K	(Ce)	201,516 (6)	0,0366 (16)
ec _{6,3} K	(Ce)	226,111 (5)	0,0330 (8)
ec _{7,3} T	(Ce)	288,318 - 328,741	0,942 (20)
ec _{7,3} K	(Ce)	288,318 (4)	0,807 (17)
ec _{7,3} L	(Ce)	322,212 - 323,038	0,1073 (23)
ec _{7,3} M	(Ce)	327,326 - 327,878	0,02242 (45)
ec _{10,3} K	(Ce)	392,070 (8)	0,0537 (13)
ec _{3,1} T	(Ce)	446,579 - 487,002	0,533 (10)
ec _{3,1} K	(Ce)	446,579 (6)	0,444 (8)
ec _{3,1} L	(Ce)	480,473 - 481,299	0,0703 (13)
ec _{3,1} M	(Ce)	485,587 - 486,139	0,01494 (28)
ec _{5,1} K	(Ce)	711,212 (7)	0,02068 (42)
ec _{7,1} K	(Ce)	775,341 (6)	0,0961 (16)
ec _{7,1} L	(Ce)	809,235 - 810,061	0,01236 (22)
ec _{11,1} K	(Ce)	884,758 (7)	0,02084 (41)
ec _{1,0} K	(Ce)	1555,770 (13)	0,0645 (10)
$\beta^-_{0,19}$	max:	240,1 (18)	} 0,011 (3)
	avg:	66,7 (6)	
$\beta^-_{0,18}$	max:	287,4 (18)	} 0,052 (7)
	avg:	81,4 (6)	
$\beta^-_{0,17}$	max:	366,1 (18)	} 0,020 (4)
	avg:	106,7 (6)	
$\beta^-_{0,16}$	max:	441,3 (18)	} 0,0039 (3)
	avg:	132,0 (6)	
$\beta^-_{0,15}$	max:	642,5 (18)	} 0,027 (1)
	avg:	203,7 (7)	
$\beta^-_{0,14}$	max:	760,0 (18)	} 0,085 (9)
	avg:	248,0 (7)	

		Energy (keV)		Electrons (per 100 disint.)	
$\beta_{0,13}^-$	max:	861,2	(18)	}	0,112 (6)
	avg:	287,3	(7)		
$\beta_{0,12}^-$	max:	1213,7	(18)	}	0,636 (7)
	avg:	438,4	(7)		
$\beta_{0,11}^-$	max:	1239,5	(18)	}	11,11 (9)
	avg:	441,4	(8)		
$\beta_{0,10}^-$	max:	1245,2	(18)	}	5,80 (4)
	avg:	443,8	(8)		
$\beta_{0,9}^-$	max:	1280,0	(18)	}	1,14 (2)
	avg:	458,4	(8)		
$\beta_{0,8}^-$	max:	1296,8	(18)	}	5,60 (7)
	avg:	465,6	(8)		
$\beta_{0,7}^-$	max:	1348,9	(18)	}	44,8 (4)
	avg:	487,6	(8)		
$\beta_{0,6}^-$	max:	1411,1	(18)	}	0,262 (22)
	avg:	518,8	(8)		
$\beta_{0,5}^-$	max:	1413,0	(18)	}	5,03 (12)
	avg:	515,0	(8)		
$\beta_{0,3}^-$	max:	1677,7	(18)	}	20,8 (6)
	avg:	629,7	(8)		
$\beta_{0,1}^-$	max:	2164,7	(18)	}	4,5 (6)
	avg:	846,4	(8)		

5 Photon Emissions

5.1 X-Ray Emissions

		Energy (keV)	Photons (per 100 disint.)		
XL	(Ce)	4,2868 - 6,3412	0,343 (7)		
XK α_2	(Ce)	34,2793	0,591 (8)	}	K α
XK α_1	(Ce)	34,72	1,082 (13)		
XK β_3	(Ce)	39,1705	}	0,326 (6)	K' β_1
XK β_1	(Ce)	39,2578			
XK β_5''	(Ce)	39,549			
XK β_2	(Ce)	40,233	}	0,0828 (21)	K' β_2
XK β_4	(Ce)	40,337			

5.2 Gamma Emissions

	Energy (keV)	Photons (per 100 disint.)
$\gamma_{4,3}(\text{Ce})$	24,595 (4)	0,000689 (19)
$\gamma_{7,5}(\text{Ce})$	64,129 (4)	0,014 (2)
$\gamma_{9,7}(\text{Ce})$	68,923 (5)	0,077 (2)
$\gamma_{11,7}(\text{Ce})$	109,417 (4)	0,217 (6)
$\gamma_{9,6}(\text{Ce})$	131,121 (4)	0,47 (1)
$\gamma_{11,5}(\text{Ce})$	173,546 (5)	0,126 (5)
$\gamma_{6,4}(\text{Ce})$	241,959 (6)	0,436 (10)
$\gamma_{6,3}(\text{Ce})$	266,554 (5)	0,492 (9)
$\gamma_{2,1}(\text{Ce})$	307,08 (4)	0,022 (5)
$\gamma_{7,3}(\text{Ce})$	328,761 (4)	20,8 (3)
$\gamma_{9,3}(\text{Ce})$	397,674 (6)	0,075 (3)
$\gamma_{10,3}(\text{Ce})$	432,513 (8)	3,00 (3)
$\gamma_{11,3}(\text{Ce})$	438,178 (6)	0,017 (10)
$\gamma_{5,2}(\text{Ce})$	444,57 (4)	0,003 (1)
$\gamma_{3,1}(\text{Ce})$	487,022 (6)	46,1 (5)
$\gamma_{11,2}(\text{Ce})$	618,12 (4)	0,041 (3)
$\gamma_{5,1}(\text{Ce})$	751,653 (7)	4,39 (5)
$\gamma_{7,1}(\text{Ce})$	815,784 (6)	23,72 (20)
$\gamma_{8,1}(\text{Ce})$	867,839 (16)	5,58 (7)
$\gamma_{10,1}(\text{Ce})$	919,533 (10)	2,73 (3)
$\gamma_{11,1}(\text{Ce})$	925,198 (7)	7,04 (7)
$\gamma_{12,1}(\text{Ce})$	950,988 (20)	0,531 (7)
$\gamma_{18,9}(\text{Ce})$	992,64 (18)	0,010 (3)
$\gamma_{17,6}(\text{Ce})$	1045,02 (9)	0,020 (4)
$\gamma_{14,2}(\text{Ce})$	1097,58 (9)	0,023 (5)
$\gamma_{13,1}(\text{Ce})$	1303,34 (7)	0,045 (6)
$\gamma_{14,1}(\text{Ce})$	1404,66 (9)	0,062 (8)
$\gamma_{1,0}(\text{Ce})$	1596,203 (13)	95,40 (5)
$\gamma_{18,1}(\text{Ce})$	1877,33 (18)	0,041 (6)
$\gamma_{19,1}(\text{Ce})$	1924,5 (2)	0,011 (3)
$\gamma_{3,0}(\text{Ce})$	2083,219 (14)	0,036 (7)
$\gamma_{5,0}(\text{Ce})$	2347,847 (14)	0,845 (16)
$\gamma_{8,0}(\text{Ce})$	2464,031 (20)	0,0097 (13)
$\gamma_{11,0}(\text{Ce})$	2521,390 (14)	3,41 (5)
$\gamma_{12,0}(\text{Ce})$	2547,180 (23)	0,102 (2)
$\gamma_{13,0}(\text{Ce})$	2899,53 (7)	0,066 (1)
$\gamma_{15,0}(\text{Ce})$	3118,49 (10)	0,026 (1)
$\gamma_{16,0}(\text{Ce})$	3319,52 (24)	0,0039 (3)

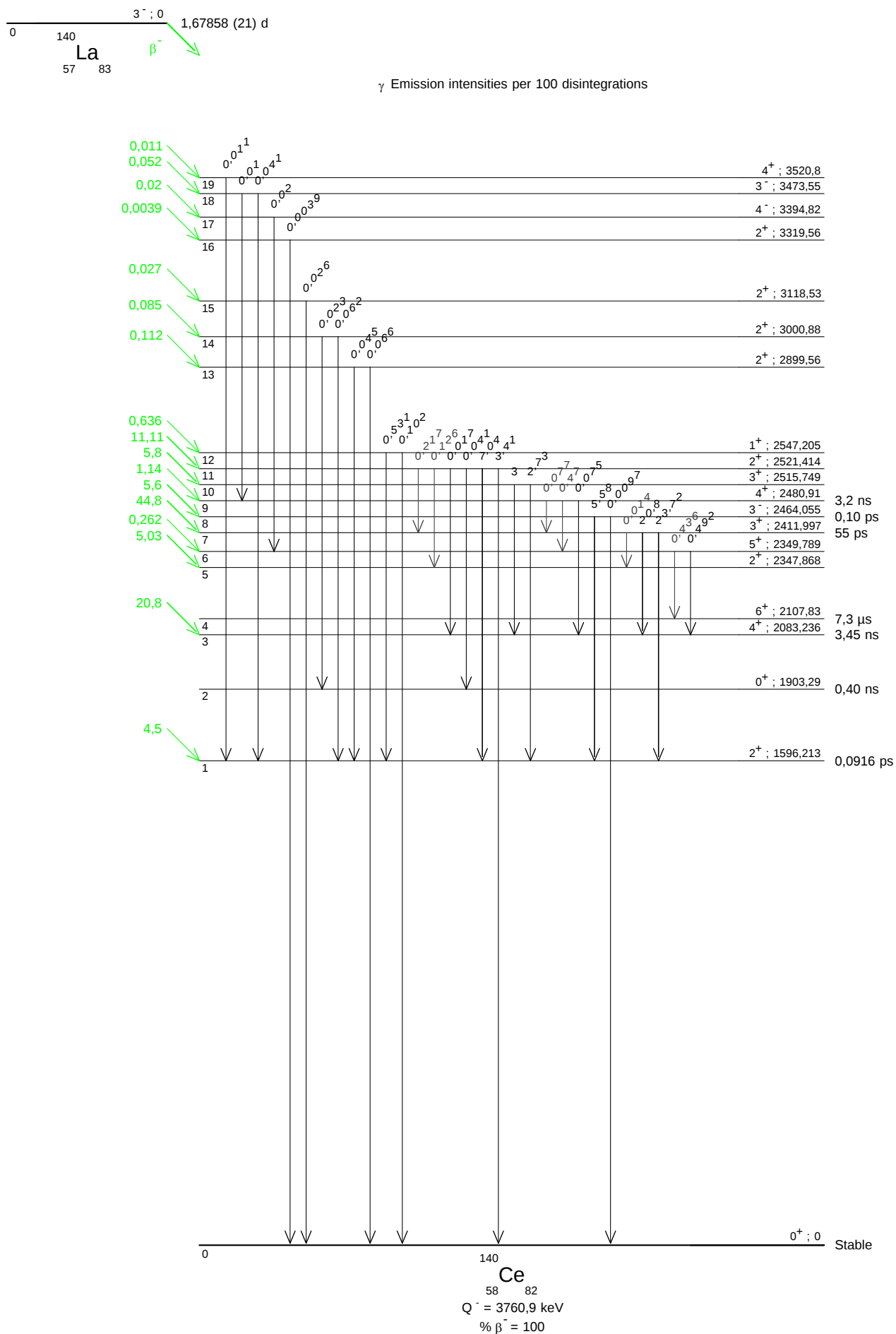
6 Main Production Modes

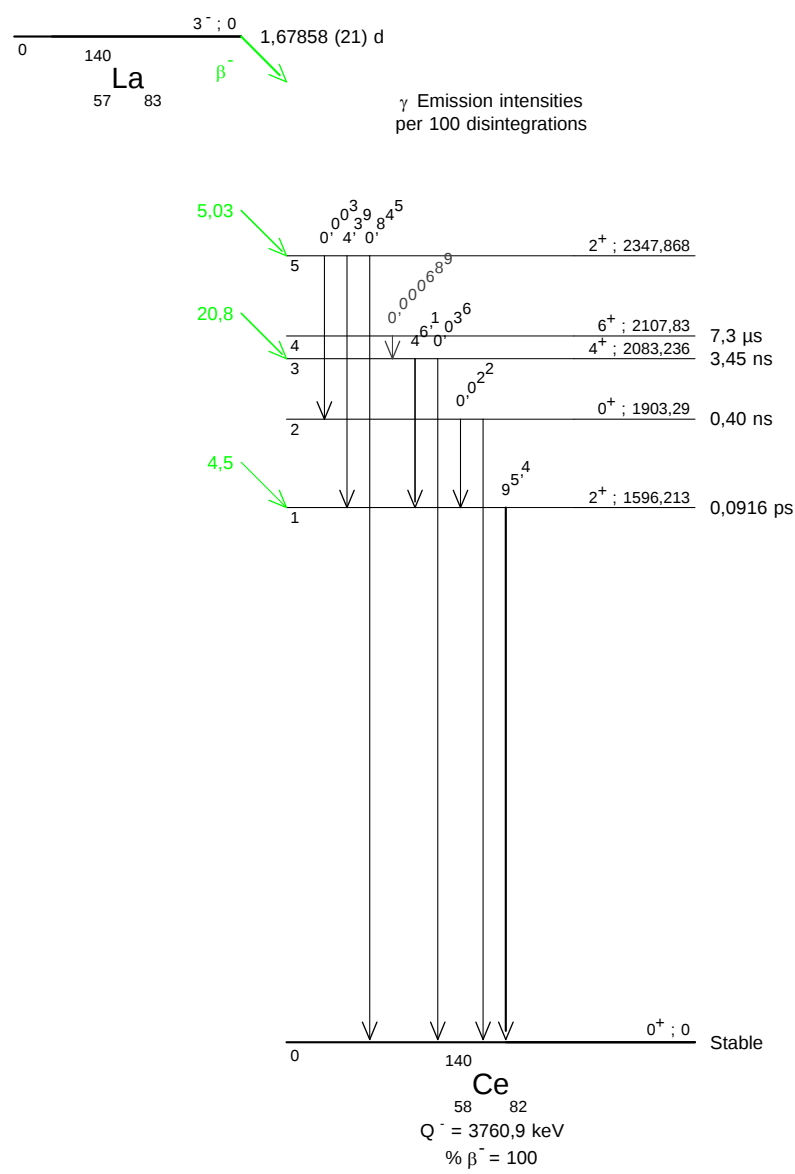
- { Separation from Ba – 140 & La – 140
- { Possible impurities: Ba – 140
- { La – $^{139}(\text{n},\gamma)\text{La} - 140$ $\sigma : 8,93$ (4) barns
- { Possible impurities: La – 141

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1 Decay Scheme

Ce-144 (half-life 284.89 d) undergoes 100% beta minus decay to Pr-144m (half-life of 7.2 min) with a branching fraction of 0.0115, and Pr-144 (half-life of 17.29 min) with a branching fraction of 0.9885.

Le cérium 144 (284,89 d) se désintègre par émission bêta moins, pour 1,15 % vers le praséodyme 144m (7,2 min) et pour 98,85 % vers le praséodyme 144 (17,29 min).

2 Nuclear Data

$$\begin{array}{lll} T_{1/2}(^{144}\text{Ce}) & : & 284,89 \quad (6) \quad \text{d} \\ T_{1/2}(^{144}\text{Pr}) & : & 17,29 \quad (4) \quad \text{min} \\ Q^-(^{144}\text{Ce}) & : & 318,6 \quad (8) \quad \text{keV} \end{array}$$

2.1 β^- Transitions

	Energy (keV)	Probability (%)	Nature	lg ft
$\beta_{0,4}^-$	185,1 (8)	19,2 (1)	1st forbidden non-unique	7,27
$\beta_{0,2}^-$	238,5 (8)	3,9 (2)	1st forbidden non-unique	8,33
$\beta_{0,0}^-$	318,6 (8)	76,9 (3)	1st forbidden non-unique	7,42

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy (keV)	$P_{\gamma+ce}$ (%)	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{4,3}(\text{Pr})$	33,563 (9)	1,28 (6)	M1		3,70 (6)	0,780 (11)	4,69 (7)
$\gamma_{3,1}(\text{Pr})$	40,92 (3)	1,16 (18)	M1		2,06 (3)	0,434 (7)	2,61 (4)
$\gamma_{4,2}(\text{Pr})$	53,395 (5)	0,90 (4)	M1	6,75 (10)	0,942 (14)	0,199 (3)	7,94 (12)
$\gamma_{1,0}(\text{Pr})$	59,03 (3)	1,15 (23)	M3	408 (6)	618 (9)	155,0 (23)	1221 (18)
$\gamma_{2,0}(\text{Pr})$	80,120 (4)	4,83 (17)	M1	2,08 (3)	0,288 (4)	0,0608 (9)	2,45 (4)
$\gamma_{3,0}(\text{Pr})$	99,952 (9)	0,128 (6)	E2	1,214 (17)	0,71 (1)	0,1599 (23)	2,12 (3)
$\gamma_{4,0}(\text{Pr})$	133,5152 (20)	17,01 (19)	M1	0,486 (7)	0,0668 (10)	0,01408 (20)	0,571 (8)

3 Atomic Data

3.1 Pr

ω_K	:	0,914	(4)
$\bar{\omega}_L$	:	0,132	(5)
n_{KL}	:	0,871	(4)

3.1.1 X Radiations

	Energy (keV)		Relative probability
X _K			
Kα ₂	35,5506		54,8
Kα ₁	36,0267		100
Kβ ₃	40,6533	}	30,5
Kβ ₁	40,7487		
Kβ ₅ ''	41,05		
Kβ ₂	41,774	}	7,8
Kβ ₄	41,877		
KO _{2,3}	41,968		
X _L			
Lℓ	4,453		
Lα	5,013 - 5,033		
Lη	4,929		
Lβ	5,489 - 5,851		
Lγ	6,327 - 6,617		

3.1.2 Auger Electrons

	Energy (keV)	Relative probability
Auger K		
KLL	28,162 - 29,890	100
KLX	33,576 - 36,004	49,4
KXY	38,97 - 41,95	6,1
Auger L	2,90 - 4,91	1922

4 Electron Emissions

		Energy (keV)		Electrons (per 100 disint.)
e _{AL}	(Pr)	2,90 - 4,91		9,88 (10)
e _{AK}	(Pr)			0,80 (4)
	KLL	28,162 - 29,890	}	
	KLX	33,576 - 36,004		
	KXY	38,97 - 41,95		
ec _{4,2} T	(Pr)	11,404 - 53,373		0,802 (42)
ec _{4,2} K	(Pr)	11,404 (5)		0,682 (35)
ec _{1,0} T	(Pr)	17,04 - 59,01		1,15 (23)
ec _{1,0} K	(Pr)	17,04 (3)		0,38 (8)
ec _{4,3} T	(Pr)	26,728 - 33,563		1,05 (6)
ec _{4,3} L	(Pr)	26,728 - 27,599		0,83 (5)
ec _{4,3} M	(Pr)	32,052 - 32,632		0,175 (10)
ec _{4,3} N	(Pr)	33,259 - 33,561		0,039 (2)
ec _{3,1} T	(Pr)	34,09 - 40,90		0,84 (13)
ec _{3,1} L	(Pr)	34,09 - 34,96		0,66 (10)
ec _{2,0} T	(Pr)	38,129 - 80,120		3,43 (18)
ec _{2,0} K	(Pr)	38,129 (4)		2,91 (15)
ec _{3,1} M	(Pr)	39,41 - 39,99		0,139 (22)
ec _{3,1} N	(Pr)	40,62 - 40,92		0,0311 (49)
ec _{4,2} L	(Pr)	46,560 - 47,431		0,0951 (49)
ec _{4,2} M	(Pr)	51,884 - 52,464		0,0201 (10)
ec _{4,2} N	(Pr)	53,091 - 53,393		0,00448 (23)
ec _{1,0} L	(Pr)	52,20 - 53,07		0,58 (12)
ec _{1,0} M	(Pr)	57,52 - 58,10		0,146 (30)
ec _{1,0} N	(Pr)	58,73 - 59,03		0,033 (7)
ec _{2,0} L	(Pr)	73,285 - 74,156		0,403 (21)
ec _{2,0} M	(Pr)	78,609 - 79,189		0,085 (4)
ec _{2,0} N	(Pr)	79,816 - 80,118		0,019 (1)
ec _{4,0} T	(Pr)	91,524 - 133,515		6,18 (22)
ec _{4,0} K	(Pr)	91,524 (2)		5,26 (19)
ec _{4,0} L	(Pr)	126,680 - 127,551		0,723 (25)
ec _{4,0} M	(Pr)	132,004 - 132,584		0,152 (5)
ec _{4,0} N	(Pr)	133,211 - 133,513		0,0341 (12)
$\beta_{0,4}^-$	max:	185,1 (8)	}	19,2 (1)
	avg:	50,29 (24)		
$\beta_{0,2}^-$	max:	238,5 (8)	}	3,9 (2)
	avg:	66,24 (25)		
$\beta_{0,0}^-$	max:	318,6 (8)	}	76,9 (3)
	avg:	91,3 (3)		

5 Photon Emissions

5.1 X-Ray Emissions

		Energy (keV)	Photons (per 100 disint.)	
XL	(Pr)	4,453 - 6,617	1,54 (4)	
XK α_2	(Pr)	35,5506	2,41 (5)	} K α
XK α_1	(Pr)	36,0267	4,40 (9)	
XK β_3	(Pr)	40,6533	} 1,34 (3)	K' β_1
XK β_1	(Pr)	40,7487		
XK β_5''	(Pr)	41,05		
XK β_2	(Pr)	41,774	} 0,343 (10)	K' β_2
XK β_4	(Pr)	41,877		
XKO $_{2,3}$	(Pr)	41,968		

5.2 Gamma Emissions

	Energy (keV)	Photons (per 100 disint.)
$\gamma_{4,3}(\text{Pr})$	33,563 (9)	0,225 (11)
$\gamma_{3,1}(\text{Pr})$	40,92 (3)	0,32 (5)
$\gamma_{4,2}(\text{Pr})$	53,395 (5)	0,101 (5)
$\gamma_{1,0}(\text{Pr})$	59,03 (3)	0,00094 (19)
$\gamma_{2,0}(\text{Pr})$	80,120 (4)	1,40 (5)
$\gamma_{3,0}(\text{Pr})$	99,952 (9)	0,041 (2)
$\gamma_{4,0}(\text{Pr})$	133,5152 (20)	10,83 (12)

6 Main Production Modes

- U – 235(n,f)Ce – 144
- U – 238(n,f)Ce – 144
- Pu – 239(n,f)Ce – 144

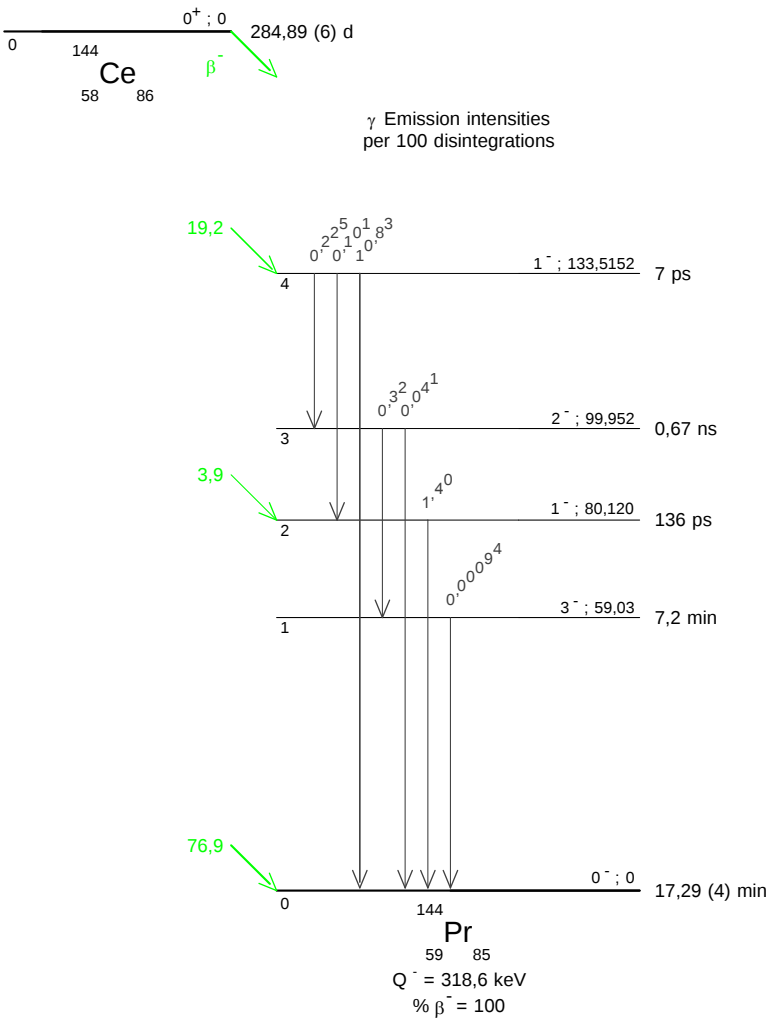
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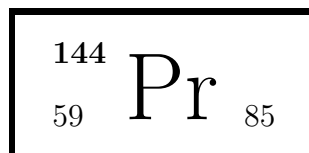
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1 Decay Scheme

Pr-144 (half-life of 17.29 min) undergoes 100% beta minus decay to various excited levels and predominantly to the ground state of Nd-144.

Le praséodyme 144 (17,29 min) se désintègre à 100 % par émission bêta moins vers les niveaux excités et le niveau fondamental du néodyme 144.

2 Nuclear Data

$T_{1/2}(^{144}\text{Pr})$	:	17,29	(4)	min
$T_{1/2}(^{144}\text{Nd})$	:	2,3	(3)	10^{15} a
$Q^-(^{144}\text{Pr})$	:	2997,4	(24)	keV

2.1 β^- Transitions

	Energy (keV)	Probability (%)	Nature	lg ft
$\beta_{0,12}^-$	254,4 (24)	0,00035 (6)	1st forbidden non-unique	8,1
$\beta_{0,11}^-$	321,8 (24)	0,00096 (8)	1st forbidden non-unique	8
$\beta_{0,10}^-$	341,9 (24)	0,00018 (3)	1st forbidden non-unique	8,8
$\beta_{0,8}^-$	628,6 (24)	0,00027 (6)	1st forbidden unique	9,7
$\beta_{0,7}^-$	811,7 (24)	1,021 (10)	allowed	6,32
$\beta_{0,6}^-$	912,7 (24)	0,00708 (6)	1st forbidden non-unique	8,7
$\beta_{0,5}^-$	924,5 (24)	0,00065 (6)	1st forbidden unique	10,2
$\beta_{0,4}^-$	1436,5 (24)	0,0017 (3)	1st forbidden unique	10,8
$\beta_{0,1}^-$	2300,8 (24)	1,116 (3)	1st forbidden unique	9,17
$\beta_{0,0}^-$	2997,4 (24)	97,852 (10)	1st forbidden non-unique	6,53

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy (keV)	P _{γ+ce} (%)	Multipolarity	α _K (10 ⁻³)	α _L (10 ⁻⁴)	α _M (10 ⁻⁴)	α _T (10 ⁻³)	α _π (10 ⁻⁴)
γ _{7,4} (Nd)	624,83 (3)	0,00118 (3)	E1	2,07 (3)	2,67 (4)	0,561 (8)	2,41 (4)	
γ _{7,3} (Nd)	674,88 (4)	0,00301 (14)	E2	4,60 (7)	6,86 (10)	1,465 (21)	5,47 (8)	
γ _{1,0} (Nd)	696,507 (4)	1,42 (7)	E2	4,27 (6)	6,31 (9)	1,348 (19)	5,07 (7)	
γ _{3,1} (Nd)	814,310 (23)	0,00331 (14)	E1	1,198 (17)	1,528 (22)	0,321 (5)	1,391 (20)	
γ _{4,1} (Nd)	864,359 (16)	0,00270 (14)	M1+48,5%E2	3,38 (14)	4,56 (16)	0,96 (4)	3,96 (16)	
γ _{12,4} (Nd)	1182,07 (7)	0,00006 (3)	E2	1,353 (19)	1,82 (3)	0,384 (6)	1,587 (23)	0,0410 (6)
γ _{5,1} (Nd)	1376,35 (3)	0,00041 (4)	M1+10,4%E2	1,35 (3)	1,75 (4)	0,368 (8)	1,61 (4)	0,398 (6)
γ _{6,1} (Nd)	1388,12 (4)	0,00707 (6)	E2	0,984 (14)	1,297 (19)	0,274 (4)	1,190 (17)	0,416 (6)
γ _{7,1} (Nd)	1489,156 (3)	0,286 (3)	E1	0,397 (6)	0,495 (7)	0,1038 (15)	0,663 (10)	2,04 (3)
γ _{4,0} (Nd)	1560,920 (13)	0,00021 (3)	E2	0,786 (11)	1,024 (15)	0,216 (3)	1,014 (15)	0,981 (14)
γ _{8,1} (Nd)	1672,26 (4)	0,00021 (6)	M1+2,5%E2	0,892 (14)	1,146 (18)	0,241 (4)	1,189 (18)	1,519 (22)
γ _{11,1} (Nd)	1979,05 (8)	0,00096 (8)	E2	0,505 (7)	0,647 (9)	0,1360 (19)	0,868 (13)	2,81 (4)
γ _{12,1} (Nd)	2046,43 (7)	0,00030 (6)	E2	0,475 (7)	0,607 (9)	0,1277 (18)	0,865 (13)	3,13 (5)
γ _{5,0} (Nd)	2072,91 (3)	0,00024 (3)	E2	0,465 (7)	0,593 (9)	0,1246 (18)	0,865 (13)	3,26 (5)
γ _{7,0} (Nd)	2185,663 (5)	0,731 (10)	E1	0,213 (3)	0,264 (4)	0,0552 (8)	0,959 (14)	7,12 (10)
γ _{8,0} (Nd)	2368,82 (4)	0,000051 (14)	E2	0,365 (6)	0,463 (7)	0,0973 (14)	0,891 (13)	4,67 (7)
γ _{10,0} (Nd)	2655,54 (3)	0,00018 (3)	M1+E2					

3 Atomic Data

3.1 Nd

ω _K	:	0,918	(4)
ω _L	:	0,140	(6)
n _{KL}	:	0,866	(4)

3.1.1 X Radiations

	Energy (keV)	Relative probability
X _K		
Kα ₂	36,8478	55
Kα ₁	37,3614	100
Kβ ₃	42,167	30,7
Kβ ₁	42,2717	
Kβ ₅ ''	42,58	
Kβ ₂	43,335	7,9
Kβ ₄	43,451	
KO _{2,3}	43,548	
X _L		
Lℓ	4,633	
Lα	5,208 - 5,23	
Lη	5,146	
Lβ	5,722 - 6,09	
Lγ	6,604 - 6,901	

3.1.2 Auger Electrons

	Energy (keV)	Relative probability
Auger K		
KLL	29,154 - 30,978	100
KLX	34,798 - 37,340	50
KXY	40,42 - 43,53	6,2
Auger L	3,01 - 5,10	1655

4 Electron Emissions

		Energy (keV)		Electrons (per 100 disint.)
e _{AL}	(Nd)	3,01 - 5,10		0,00551 (18)
e _{AK}	(Nd)			0,00052 (4)
	KLL	29,154 - 30,978	}	
	KLX	34,798 - 37,340		
	KXY	40,42 - 43,53		
$\beta_{0,12}^-$	max:	254,4 (24)	}	0,00035 (6)
	avg:	71,05 (8)		
$\beta_{0,11}^-$	max:	321,8 (24)	}	0,00096 (8)
	avg:	92,21 (8)		
$\beta_{0,10}^-$	max:	341,9 (24)	}	0,00018 (3)
	avg:	98,68 (8)		
$\beta_{0,8}^-$	max:	628,6 (24)	}	0,00027 (6)
	avg:	213,04 (9)		
$\beta_{0,7}^-$	max:	811,7 (24)	}	1,021 (10)
	avg:	267,12 (9)		
$\beta_{0,6}^-$	max:	912,7 (24)	}	0,00708 (6)
	avg:	306,67 (10)		
$\beta_{0,5}^-$	max:	924,5 (24)	}	0,00065 (6)
	avg:	322,77 (9)		
$\beta_{0,4}^-$	max:	1436,5 (24)	}	0,0017 (3)
	avg:	526,25 (10)		
$\beta_{0,1}^-$	max:	2300,8 (24)	}	1,116 (3)
	avg:	894,90 (11)		
$\beta_{0,0}^-$	max:	2997,4 (24)	}	97,852 (10)
	avg:	1221,990 (1)		

5 Photon Emissions

5.1 X-Ray Emissions

		Energy (keV)	Photons (per 100 disint.)		
XL	(Nd)	4,633 - 6,901	0,00092 (3)		
XK α_2	(Nd)	36,8478	0,00165 (9)	}	K α
XK α_1	(Nd)	37,3614	0,00300 (15)		
XK β_3	(Nd)	42,167	0,00092 (5)	}	K' β_1
XK β_1	(Nd)	42,2717			
XK β_5''	(Nd)	42,58			
XK β_2	(Nd)	43,335	0,000237 (13)	}	K' β_2
XK β_4	(Nd)	43,451			
XKO $_{2,3}$	(Nd)	43,548			

5.2 Gamma Emissions

	Energy (keV)	Photons (per 100 disint.)
$\gamma_{7,4}(\text{Nd})$	624,83 (3)	0,00118 (3)
$\gamma_{7,3}(\text{Nd})$	674,88 (4)	0,00299 (14)
$\gamma_{1,0}(\text{Nd})$	696,505 (4)	1,41 (7)
$\gamma_{3,1}(\text{Nd})$	814,308 (23)	0,00331 (14)
$\gamma_{4,1}(\text{Nd})$	864,356 (16)	0,00269 (14)
$\gamma_{12,4}(\text{Nd})$	1182,06 (7)	0,00006 (3)
$\gamma_{5,1}(\text{Nd})$	1376,34 (3)	0,00041 (4)
$\gamma_{6,1}(\text{Nd})$	1388,11 (4)	0,00706 (6)
$\gamma_{7,1}(\text{Nd})$	1489,148 (3)	0,286 (3)
$\gamma_{4,0}(\text{Nd})$	1560,911 (13)	0,00021 (3)
$\gamma_{8,1}(\text{Nd})$	1672,25 (4)	0,00021 (6)
$\gamma_{11,1}(\text{Nd})$	1979,04 (8)	0,00096 (8)
$\gamma_{12,1}(\text{Nd})$	2046,41 (7)	0,00030 (6)
$\gamma_{5,0}(\text{Nd})$	2072,89 (3)	0,00024 (3)
$\gamma_{7,0}(\text{Nd})$	2185,645 (5)	0,73 (1)
$\gamma_{8,0}(\text{Nd})$	2368,80 (4)	0,000051 (14)
$\gamma_{10,0}(\text{Nd})$	2655,51 (3)	0,00018 (3)

6 Main Production Modes

U – 235(n,f)Pr – 144

U – 238(n,f)Pr – 144

Pu – 239(n,f)Pr – 144

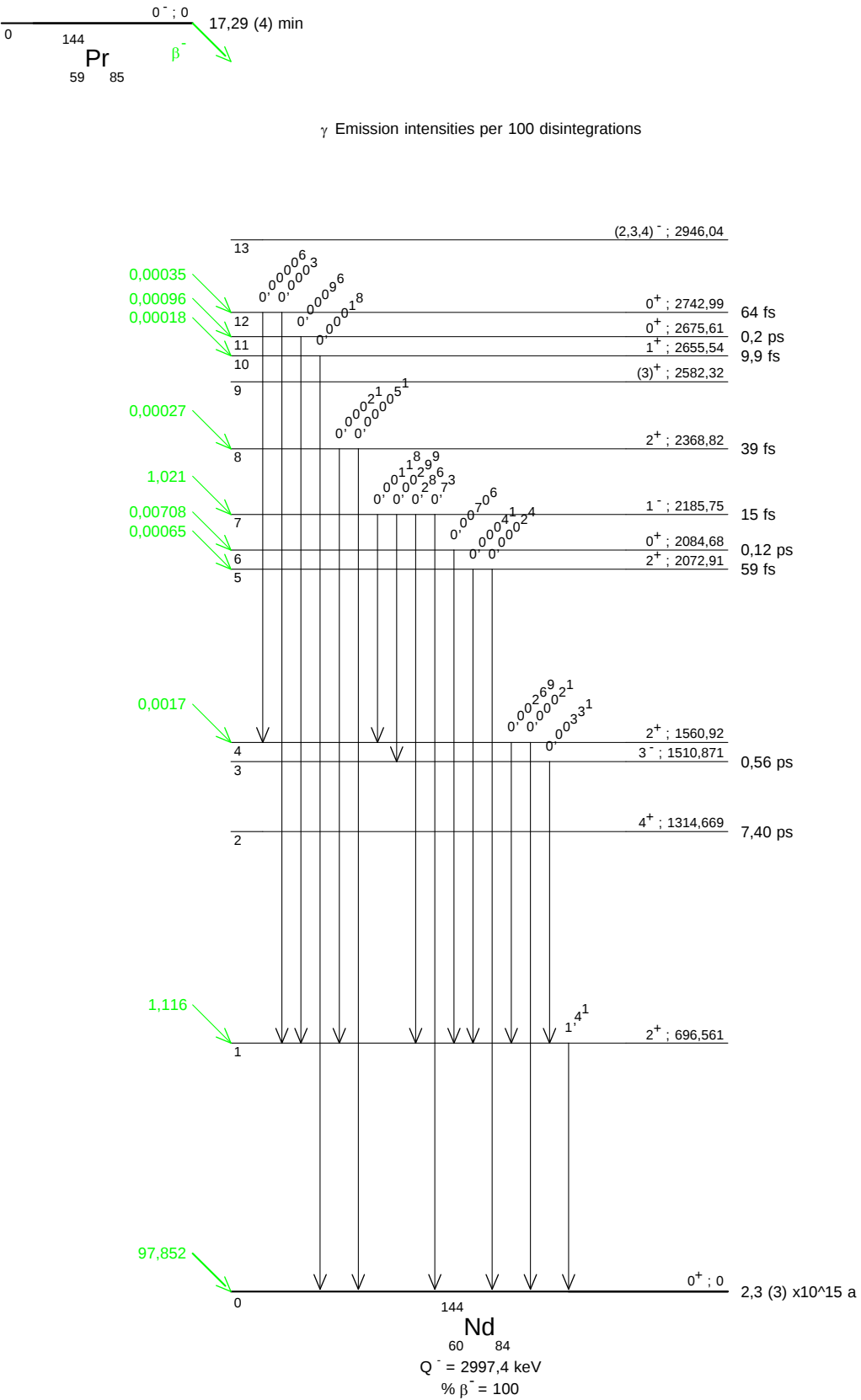
Ce – 144(β^-)Pr – 144

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(Q-value)





1 Decay Scheme

Pr-144m (half-life of 7.2 min) decays 99.94(2)% by an isomeric transition to Pr-144 and 0.06(2)% by beta minus emission to various excited levels of Nd-144.

Le praséodyme 144m (7,2 min) se désintègre à 99,94 % par transition isomérique vers le praséodyme 144 et par émission bêta moins vers trois niveaux excités du néodyme 144.

2 Nuclear Data

$T_{1/2}(^{144\text{m}}\text{Pr})$	:	7,2	(2)	min
$T_{1/2}(^{144}\text{Nd})$	:	2,3	(3)	10^{15} a
$T_{1/2}(^{144}\text{Pr})$	:	17,29	(4)	min
$Q^{IT}(^{144\text{m}}\text{Pr})$	:	59,03	(3)	keV
$Q^{-}(^{144\text{m}}\text{Pr})$	:	3056,4	(24)	keV

2.1 β^{-} Transitions

	Energy (keV)	Probability (%)	Nature	lg ft
$\beta_{0,13}^{-}$	110,4 (24)	0,030 (3)	(allowed)	4,65
$\beta_{0,9}^{-}$	474,1 (24)	0,010 (3)	(1st forbidden non-unique)	7,15
$\beta_{0,3}^{-}$	1545,5 (24)	0,02 (1)	allowed	8,7

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy (keV)	$P_{\gamma+ce}$ (%)	Multipolarity	α_K	α_L	α_M	α_T	α_{π}
$\gamma_{1,0}(\text{Pr})$	59,03 (3)	99,94 (2)	M3	408 (6)	618 (9)	155,0 (23)	1221 (18)	
$\gamma_{2,1}(\text{Nd})$	618,108 (16)	0,030 (3)	E2	0,00568 (8)	0,000869 (13)	0,000186 (3)	0,00679 (10)	
$\gamma_{1,0}(\text{Nd})$	696,507 (4)	0,06 (2)	E2	0,00427 (6)	0,000631 (9)	0,0001348 (19)	0,00507 (7)	
$\gamma_{3,1}(\text{Nd})$	814,310 (23)	0,02 (1)	E1	0,001198 (17)	0,0001528 (22)	0,0000321 (5)	0,001391 (20)	
$\gamma_{13,2}(\text{Nd})$	1631,37 (10)	0,030 (3)						
$\gamma_{9,1}(\text{Nd})$	1885,76 (6)	0,010 (3)	M1+1,7%E2	0,000686 (10)	0,0000878 (13)	0,0000185 (3)	0,001052 (15)	0,000255 (4)

3 Atomic Data

3.1 Nd

ω_K	:	0,918	(4)
$\bar{\omega}_L$	:	0,140	(6)
n_{KL}	:	0,866	(4)

3.1.1 X Radiations

	Energy (keV)	Relative probability
X _K		
K α_2	36,8478	54,1
K α_1	37,3614	100
K β_3	42,167	30,5
K β_1	42,2717	
K β_5''	42,58	
K β_2	43,335	7,73
K β_4	43,451	
KO _{2,3}	43,548	

3.1.2 Auger Electrons

	Energy (keV)	Relative probability
Auger K		
KLL	29,154 - 30,978	100
KLX	34,798 - 37,340	50
KXY	40,42 - 43,53	6,25
Auger L	3,01 - 5,10	1667

3.2 Pr

ω_K	:	0,914	(4)
$\bar{\omega}_L$	:	0,132	(5)
n_{KL}	:	0,871	(4)

3.2.1 X Radiations

	Energy (keV)	Relative probability
X _K		
Kα ₂	33,5506	54,8
Kα ₁	36,0267	100
Kβ ₃	40,6533	}
Kβ ₁	40,7487	
Kβ ₅ ''	41,05	
Kβ ₂	41,774	}
Kβ ₄	41,877	
KO _{2,3}	41,968	
X _L		
Lℓ	4,453	
Lα	5,013 - 5,033	
Lη	4,929	
Lβ	5,489 - 5,851	
Lγ	6,327	

3.2.2 Auger Electrons

	Energy (keV)	Relative probability
Auger K		
KLL	28,162 - 29,890	100
KLX	33,576 - 36,004	49,2
KXY	38,97 - 41,95	6,11
Auger L	2,90 - 4,91	3730

4 Electron Emissions

		Energy (keV)	Electrons (per 100 disint.)
e _{AL}	(Nd)	3,01 - 5,10	0,00040 (5)
e _{AK}	(Nd)		0,000038 (8)
	KLL	29,154 - 30,978	}
	KLX	34,798 - 37,340	
	KXY	40,42 - 43,53	
e _{AL}	(Pr)	2,90 - 4,91	69 (10)
e _{AK}	(Pr)		2,87 (15)
	KLL	28,162 - 29,890	}
	KLX	33,576 - 36,004	
	KXY	38,97 - 41,95	
ec _{1,0} T	(Pr)	17,04 - 59,01	99,9 (21)
ec _{1,0} K	(Pr)	17,04 (3)	33,4 (7)
ec _{1,0} L	(Pr)	52,20 - 53,07	50,6 (10)
ec _{1,0} M	(Pr)	57,52 - 58,10	12,68 (26)
ec _{1,0} N	(Pr)	58,73 - 59,03	2,84 (6)
ec _{1,0} O	(Pr)	58,99 - 59,01	0,411 (9)
$\beta_{0,13}^-$	max:	110,4 (24)	}
	avg:	29,0 (7)	
$\beta_{0,9}^-$	max:	474,1 (24)	}
	avg:	143,0 (8)	
$\beta_{0,3}^-$	max:	1545,5 (24)	}
	avg:	570,0 (11)	

5 Photon Emissions

5.1 X-Ray Emissions

		Energy (keV)	Photons (per 100 disint.)	
XK α_2	(Nd)	36,8478	0,000119 (23)	} K α
XK α_1	(Nd)	37,3614	0,00022 (5)	
XK β_3	(Nd)	42,167	}	K' β_1
XK β_1	(Nd)	42,2717		
XK β_5''	(Nd)	42,58		
XK β_2	(Nd)	43,335	}	K' β_2
XK β_4	(Nd)	43,451		
XKO _{2,3}	(Nd)	43,548		

		Energy (keV)	Photons (per 100 disint.)		
XL	(Pr)	4,453 - 6,617	10,5 (5)		
XK α_2	(Pr)	33,5506	8,66 (19)	}	K α
XK α_1	(Pr)	36,0267	15,8 (4)		
XK β_3	(Pr)	40,6533	4,81 (12)	}	K' β_1
XK β_1	(Pr)	40,7487			
XK β_5''	(Pr)	41,05			
XK β_2	(Pr)	41,774	1,23 (4)	}	K' β_2
XK β_4	(Pr)	41,877			
XKO _{2,3}	(Pr)	41,968			

5.2 Gamma Emissions

	Energy (keV)	Photons (per 100 disint.)
$\gamma_{1,0}(\text{Pr})$	59,03 (3)	0,0818 (12)
$\gamma_{2,1}(\text{Nd})$	618,107 (16)	0,030 (3)
$\gamma_{1,0}(\text{Nd})$	696,505 (4)	0,06 (2)
$\gamma_{3,1}(\text{Nd})$	814,308 (23)	0,02 (1)
$\gamma_{13,2}(\text{Nd})$	1631,36 (10)	0,030 (3)
$\gamma_{9,1}(\text{Nd})$	1885,75 (6)	0,010 (3)

6 Main Production Modes

U – 235(n,f)Pr – 144m

U – 238(n,f)Pr – 144m

Pu – 239(n,f)Pr – 144m

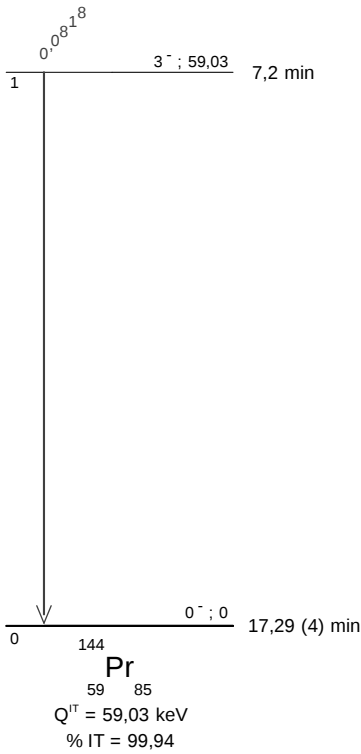
Ce – 144(β^-)Pr – 144m

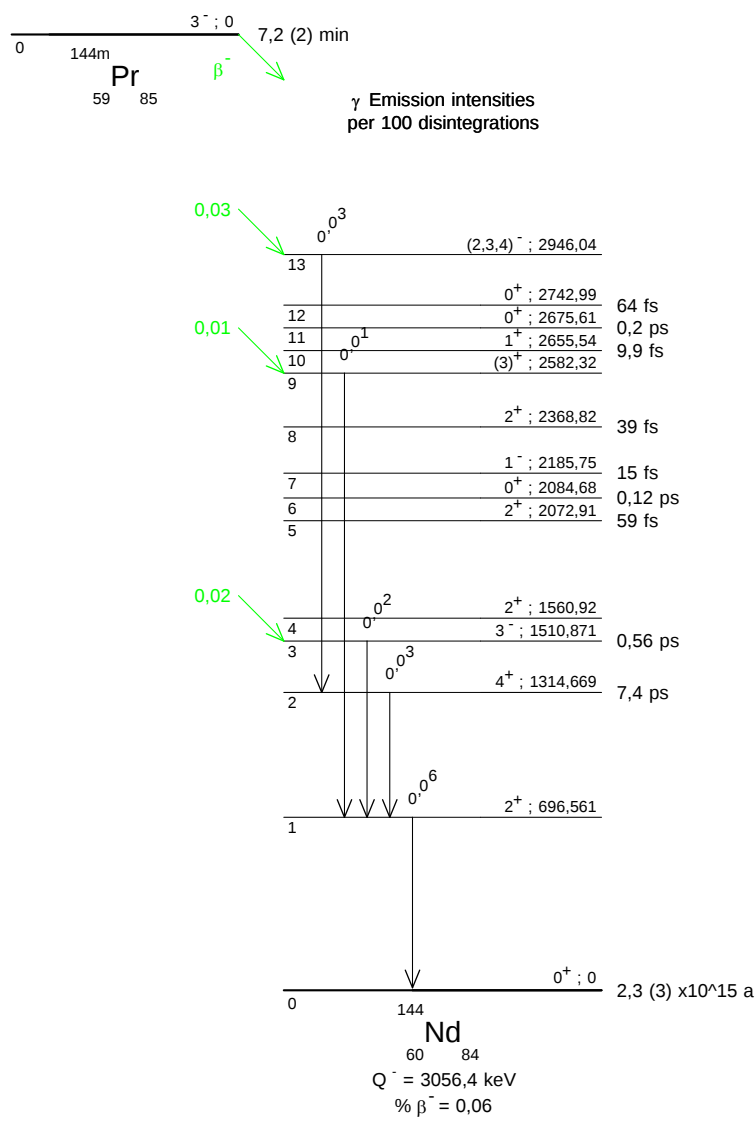
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γ Emission intensities
per 100 disintegrations







1 Decay Scheme

Pm-148 decays via beta minus transitions to nine excited levels and the ground state of Sm-148.

Le prométhéum 148 se désintègre 100 % par émission bêta vers neuf niveaux excités et le niveau fondamental du samarium 148.

2 Nuclear Data

$$\begin{aligned}
 T_{1/2}(^{148}\text{Pm}) &: 5,370 \quad (15) \quad \text{d} \\
 Q^{-}(^{148}\text{Pm}) &: 2471 \quad (6) \quad \text{keV}
 \end{aligned}$$

2.1 β^{-} Transitions

	Energy (keV)	Probability (%)	Nature	lg ft
$\beta_{0,10}^{-}$	157 (6)	0,0091 (15)	1st Forbidden	8,7
$\beta_{0,9}^{-}$	187 (6)	0,0965 (34)	Super Allowed Or Allowed	7,9
$\beta_{0,8}^{-}$	413 (6)	1,360 (22)	Allowed	7,9
$\beta_{0,7}^{-}$	549 (6)	0,0138 (14)	1st Forbidden	10,3
$\beta_{0,6}^{-}$	807 (6)	0,018 (3)	1st Forbidden	10,8
$\beta_{0,5}^{-}$	1006 (6)	33,3 (6)	Super Allowed Or Allowed	7,8
$\beta_{0,4}^{-}$	1017 (6)	0,093 (3)	1st Forbidden	10,4
$\beta_{0,3}^{-}$	1047 (6)	0,236 (9)	1st Forbidden	10,1
$\beta_{0,1}^{-}$	1921 (6)	9,3 (6)	1st Forbidden	9,5
$\beta_{0,0}^{-}$	2471 (6)	55,5 (7)	1st Forbidden	9,1

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy (keV)	$P_{\gamma+ce}$ (%)	Multipolarity	α_K (10^{-3})	α_L (10^{-4})	α_M (10^{-5})	α_T (10^{-3})	α_π (10^{-5})
$\gamma_{5,2}(\text{Sm})$	303,592 (31)	0,0397 (47)	E2	42,3 (6)	93,1 (13)	207 (3)	54,2 (8)	
$\gamma_{8,6}(\text{Sm})$	393,801 (30)	0,0155 (22)	E1	6,43 (9)	8,62 (12)	18,4 (3)	7,52 (11)	
$\gamma_{1,0}(\text{Sm})$	550,274 (17)	22,7 (6)	E2	8,25 (12)	13,60 (19)	29,6 (5)	9,98 (14)	
$\gamma_{8,5}(\text{Sm})$	592,832 (29)	0,355 (10)	M1	11,98 (17)	16,21 (23)	34,7 (5)	14,04 (20)	
$\gamma_{2,1}(\text{Sm})$	611,263 (29)	1,043 (40)	E1+0,07%M2	2,39 (5)	3,15 (6)	6,70 (13)	2,79 (5)	
$\gamma_{9,5}(\text{Sm})$	819,276 (28)	0,0134 (22)	M1	5,42 (8)	7,26 (11)	15,51 (22)	6,35 (9)	
$\gamma_{3,1}(\text{Sm})$	874,186 (43)	0,241 (10)	E2	2,80 (4)	4,06 (6)	8,74 (13)	3,32 (5)	
$\gamma_{8,2}(\text{Sm})$	896,424 (33)	0,984 (20)	M1+64%E2	3,28 (8)	4,56 (10)	9,77 (20)	3,86 (9)	
$\gamma_{4,1}(\text{Sm})$	903,943 (29)	0,0422 (20)	M1+84%E2	2,87 (5)	4,06 (7)	8,72 (14)	3,39 (6)	
$\gamma_{5,1}(\text{Sm})$	914,855 (25)	12,0 (5)	E1	1,050 (15)	1,354 (19)	2,88 (4)	1,221 (17)	
$\gamma_{6,1}(\text{Sm})$	1113,886 (27)	0,0223 (23)	M1+24%E2	2,39 (4)	3,19 (5)	6,81 (10)	2,79 (5)	0,0565 (8)
$\gamma_{10,2}(\text{Sm})$	1152,47 (15)	0,0029 (13)	E1+1%M2	0,73 (13)	0,95 (18)	2,0 (4)	0,86 (15)	0,98 (3)
$\gamma_{7,1}(\text{Sm})$	1371,31 (20)	0,0138 (14)	E2	1,119 (16)	1,507 (22)	3,22 (5)	1,347 (19)	3,64 (6)
$\gamma_{4,0}(\text{Sm})$	1454,217 (23)	0,0512 (25)	E2	1,000 (14)	1,338 (19)	2,86 (4)	1,230 (18)	6,03 (9)
$\gamma_{5,0}(\text{Sm})$	1465,129 (19)	22,2 (5)	E1	0,449 (7)	0,570 (8)	1,208 (17)	0,704 (10)	18,3 (3)
$\gamma_{8,1}(\text{Sm})$	1507,687 (28)	0,0056 (9)	E1	0,428 (6)	0,542 (8)	1,150 (17)	0,711 (10)	21,4 (3)
$\gamma_{6,0}(\text{Sm})$	1664,160 (21)	0,0113 (11)	E2	0,775 (11)	1,024 (15)	2,18 (3)	1,042 (15)	13,75 (20)
$\gamma_{9,1}(\text{Sm})$	1734,131 (27)	0,0386 (11)	E1	0,339 (5)	0,428 (6)	0,907 (13)	0,777 (11)	38,3 (6)
$\gamma_{10,1}(\text{Sm})$	1763,74 (15)	0,0062 (7)	M1+83%E2	0,732 (22)	0,96 (3)	2,05 (6)	1,04 (3)	18,3 (3)
$\gamma_{9,0}(\text{Sm})$	2284,405 (21)	0,0445 (24)	E1	0,219 (3)	0,274 (4)	0,581 (9)	1,027 (15)	77,4 (11)

3 Atomic Data

3.1 Sm

ω_K	:	0,926	(4)
$\bar{\omega}_L$	:	0,158	(6)
n_{KL}	:	0,857	(4)

3.1.1 X Radiations

	Energy (keV)		Relative probability
X _K			
K α_2	39,5229		55,25
K α_1	40,1186		100
K β_3	45,289	}	31,26
K β_1	45,413		
K β_5''	45,731		
K β_2	46,575	}	8,07
K β_4	46,705		
KO _{2,3}	46,813		
X _L			
L ℓ	4,9909		
L α	5,6088 - 5,6376		
L η	5,586		
L β	6,1928 - 6,6557		
L γ	6,9644 - 7,4871		

3.1.2 Auger Electrons

	Energy (keV)	Relative probability
Auger K		
KLL	31,190 - 33,218	100
KLX	37,302 - 40,097	50,7
KXY	43,39 - 46,79	6,42
Auger L		
	3,27 - 7,69	

4 Electron Emissions

		Energy (keV)	Electrons (per 100 disint.)
eAL	(Sm)	3,27 - 7,69	0,1883 (16)
eAK	(Sm)		
	KLL	31,190 - 33,218	} 0,0163 (10)
	KLX	37,302 - 40,097	
	KXY	43,39 - 46,79	
ec _{1,0} K	(Sm)	503,440 (17)	0,186 (6)
ec _{1,0} L	(Sm)	542,537 - 543,558	0,0306 (9)
ec _{5,1} K	(Sm)	868,021 (25)	0,0126 (6)
$\beta^-_{0,10}$	max:	157 (6)	} 0,0091 (15)
	avg:	42,1 (18)	
$\beta^-_{0,9}$	max:	187 (6)	} 0,0965 (34)
	avg:	50,7 (18)	
$\beta^-_{0,8}$	max:	413 (6)	} 1,360 (22)
	avg:	121,9 (21)	
$\beta^-_{0,7}$	max:	549 (6)	} 0,0138 (14)
	avg:	169,0 (22)	
$\beta^-_{0,6}$	max:	807 (6)	} 0,018 (3)
	avg:	264,4 (23)	
$\beta^-_{0,5}$	max:	1006 (6)	} 33,3 (6)
	avg:	342,7 (24)	
$\beta^-_{0,4}$	max:	1017 (6)	} 0,093 (3)
	avg:	347,1 (25)	
$\beta^-_{0,3}$	max:	1047 (6)	} 0,236 (9)
	avg:	359,1 (25)	
$\beta^-_{0,1}$	max:	1921 (6)	} 9,3 (6)
	avg:	731,6 (27)	
$\beta^-_{0,0}$	max:	2471 (6)	} 55,5 (7)
	avg:	977,7 (28)	

5 Photon Emissions

5.1 X-Ray Emissions

		Energy (keV)	Photons (per 100 disint.)		
XL	(Sm)	4,9909 - 7,4871	0,0363 (8)		
XK α_2	(Sm)	39,5229	0,0581 (16)	}	K α
XK α_1	(Sm)	40,1186	0,1051 (28)		
XK β_3	(Sm)	45,289	0,0328 (10)	}	K' β_1
XK β_1	(Sm)	45,413			
XK β_5''	(Sm)	45,731			
XK β_2	(Sm)	46,575	0,00847 (30)	}	K' β_2
XK β_4	(Sm)	46,705			
XKO $_{2,3}$	(Sm)	46,813			

5.2 Gamma Emissions

	Energy (keV)	Photons (per 100 disint.)
$\gamma_{5,2}(\text{Sm})$	303,59 (3)	0,0377 (45)
$\gamma_{8,6}(\text{Sm})$	393,80 (3)	0,0155 (22)
$\gamma_{1,0}(\text{Sm})$	550,27 (3)	22,5 (6)
$\gamma_{8,5}(\text{Sm})$	592,83 (3)	0,35 (1)
$\gamma_{2,1}(\text{Sm})$	611,26 (3)	1,04 (4)
$\gamma_{9,5}(\text{Sm})$	819,27 (3)	0,0133 (22)
$\gamma_{3,1}(\text{Sm})$	874,18 (3)	0,24 (1)
$\gamma_{8,2}(\text{Sm})$	896,42 (3)	0,98 (2)
$\gamma_{4,1}(\text{Sm})$	903,94 (3)	0,042 (2)
$\gamma_{5,1}(\text{Sm})$	914,85 (3)	12,0 (5)
$\gamma_{6,1}(\text{Sm})$	1113,88 (3)	0,0222 (23)
$\gamma_{10,2}(\text{Sm})$	1152,5 (2)	0,0029 (13)
$\gamma_{7,1}(\text{Sm})$	1371,3 (2)	0,0138 (14)
$\gamma_{4,0}(\text{Sm})$	1454,21 (3)	0,0511 (25)
$\gamma_{5,0}(\text{Sm})$	1465,12 (3)	22,2 (5)
$\gamma_{8,1}(\text{Sm})$	1507,68 (3)	0,0056 (9)
$\gamma_{6,0}(\text{Sm})$	1664,15 (3)	0,0113 (11)
$\gamma_{9,1}(\text{Sm})$	1734,12 (3)	0,0386 (11)
$\gamma_{10,1}(\text{Sm})$	1763,7 (2)	0,0062 (7)
$\gamma_{9,0}(\text{Sm})$	2284,39 (3)	0,0444 (24)

6 Main Production Modes

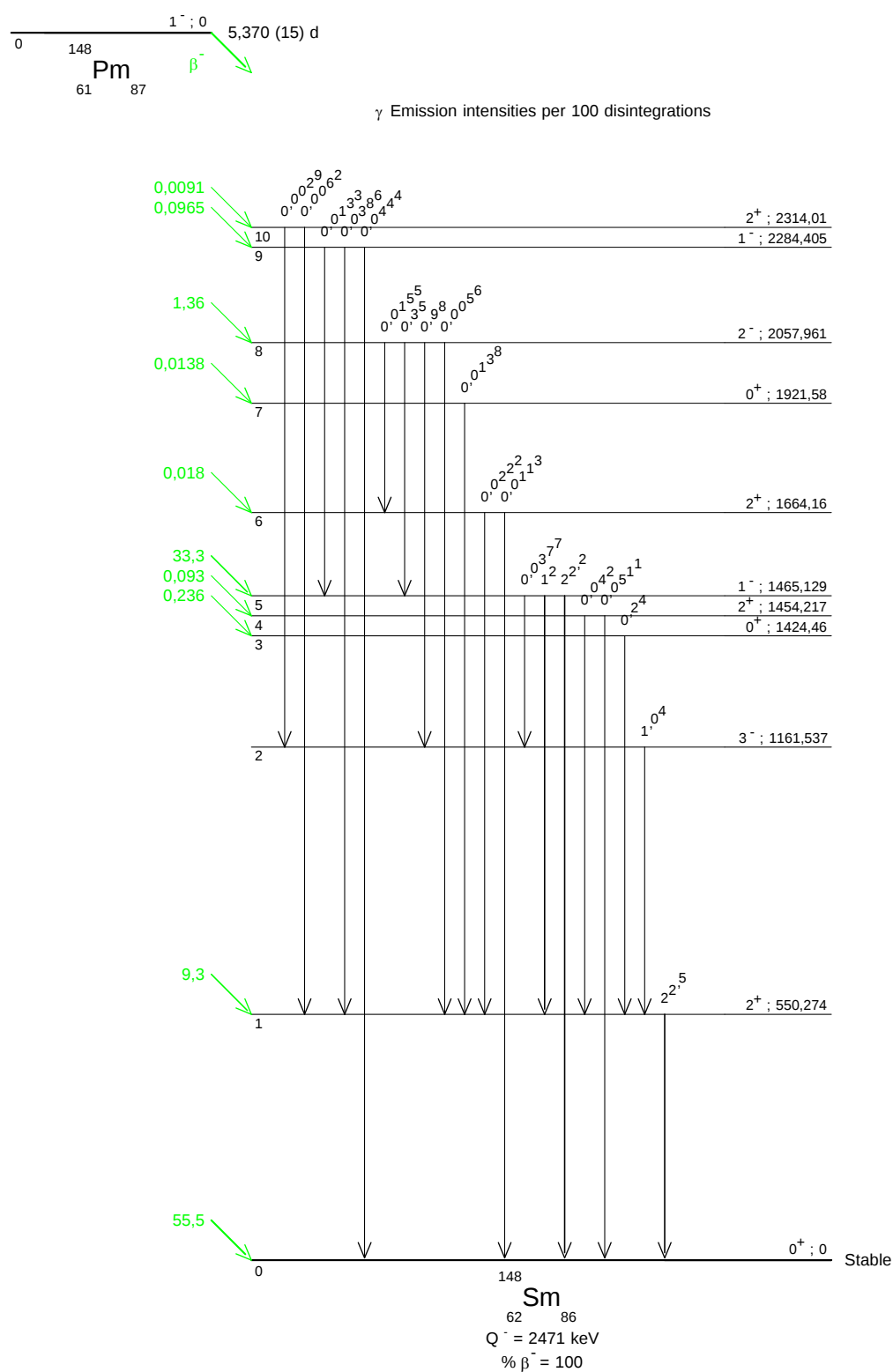
- $\left\{ \begin{array}{l} ^{148}\text{Nd}(\text{p},\text{n})^{148}\text{Pm} \\ \text{Possible impurities : } ^{148\text{m}}\text{Pm} \end{array} \right.$
- $\left\{ \begin{array}{l} ^{148}\text{Nd}(\text{d},2\text{n})^{148}\text{Pm} \\ \text{Possible impurities : } ^{148\text{m}}\text{Pm} \end{array} \right.$
- $\left\{ \begin{array}{l} ^{147}\text{Pm}(\text{n},\gamma)^{148}\text{Pm} \quad \sigma : 80 \text{ barns} \\ \text{Possible impurities : } ^{148\text{m}}\text{Pm} (70 \text{ barns}); ^{149,150}\text{Pm} \text{ from } ^{148,149}\text{Pm}(\text{n},\gamma) \end{array} \right.$
- $\left\{ \begin{array}{l} ^{238}\text{U}(\text{p},\text{f})^{148}\text{Pm} \\ \text{Possible impurities : } ^{148\text{m}}\text{Pm} \end{array} \right.$

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1 Decay Scheme

Pm-148m decays 94.4 (5) % via beta minus emission to four excited levels of Sm-148, and via an isomeric transition of 5.6 (5) %.

Le prométhéum 148m se désintègre 94,4 (5) % par émission bêta vers quatre niveaux excités du samarium 148 et 5,6 (5) % par transition isomérique.

2 Nuclear Data

$T_{1/2}(^{148\text{m}}\text{Pm})$	:	41,29	(13)	d
$T_{1/2}(^{148}\text{Pm})$	:	5,370	(15)	d
$Q^{-}(^{148\text{m}}\text{Pm})$	:	2608	(6)	keV
$Q^{IT}(^{148\text{m}}\text{Pm})$	:	137	(3)	keV

2.1 β^{-} Transitions

	Energy (keV)	Probability (%)	Nature	lg ft
$\beta_{0,9}^{-}$	414 (6)	54,0 (9)	1st Forbidden	7,18
$\beta_{0,8}^{-}$	513 (6)	18,1 (9)	1st Forbidden	7,96
$\beta_{0,7}^{-}$	702 (6)	21,8 (7)	1st Forbidden	8,35
$\beta_{0,4}^{-}$	1014 (6)	0,93 (45)	Allowed	10,29

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy (keV)	$P_{\gamma+ce}$ (%)	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{2,1}(\text{Pm})$	61,30 (5)	5,6 (5)	E4	30 (5)	10000 (4000)	2900 (1200)	14000 (6000)
$\gamma_{1,0}(\text{Pm})$	75,8 (1)	5,6 (5)	M1	2,9 (4)	0,41 (6)	0,088 (11)	3,4 (5)
$\gamma_{9,8}(\text{Sm})$	98,48 (6)	8,1 (7)	M1+3%E2	1,488 (21)	0,236 (4)	0,0511 (8)	1,79 (3)
$\gamma_{8,7}(\text{Sm})$	189,63 (6)	1,44 (8)	E2	0,1769 (25)	0,0565 (8)	0,01284 (18)	0,249 (4)

	Energy (keV)	P _{γ+ce} (%)	Multipolarity	α _K	α _L	α _M	α _T
γ _{9,7} (Sm)	288,11 (6)	13,1 (4)	M1+0,8%E2	0,0763 (11)	0,01062 (15)	0,00228 (4)	0,0898 (13)
γ _{9,6} (Sm)	299,12 (13)	0,14 (4)	E2	0,0442 (7)	0,00982 (14)	0,00219 (3)	0,0567 (8)
γ _{7,4} (Sm)	311,63 (6)	3,82 (11)	E1	0,01141 (16)	0,001546 (22)	0,000330 (5)	0,01337 (19)
γ _{8,5} (Sm)	362,09 (6)	0,176 (13)	E2	0,0253 (4)	0,00504 (7)	0,001114 (16)	0,0318 (5)
γ _{4,3} (Sm)	414,07 (6)	18,47 (33)	E1+0,017%M2	0,00572 (9)	0,000766 (13)	0,000163 (3)	0,00670 (11)
γ _{4,2} (Sm)	432,78 (6)	5,29 (13)	E2	0,01544 (22)	0,00281 (4)	0,000617 (9)	0,0190 (3)
γ _{9,5} (Sm)	460,57 (6)	0,41 (1)	E2	0,01306 (19)	0,00231 (4)	0,000507 (7)	0,01601 (23)
γ _{8,4} (Sm)	501,26 (6)	6,62 (11)	E1+0,029%M2	0,00369 (7)	0,000489 (9)	0,0001042 (20)	0,00431 (8)
γ _{1,0} (Sm)	550,27 (3)	94,4 (5)	E2	0,00825 (12)	0,001360 (19)	0,000296 (5)	0,00998 (14)
γ _{5,3} (Sm)	553,24 (6)	0,35 (4)	M1+73%E2	0,0098 (4)	0,00150 (4)	0,000324 (8)	0,0117 (4)
γ _{5,2} (Sm)	571,95 (6)	0,212 (7)	E1	0,00274 (4)	0,000361 (5)	0,0000768 (11)	0,00320 (5)
γ _{9,4} (Sm)	599,74 (6)	12,39 (22)	E1+0,04%M2	0,00249 (4)	0,000327 (6)	0,0000696 (12)	0,00290 (5)
γ _{2,1} (Sm)	611,26 (5)	5,6 (2)	E1	0,00237 (4)	0,000312 (5)	0,0000663 (10)	0,00277 (4)
γ _{3,1} (Sm)	629,97 (5)	88,4 (19)	E2	0,00591 (9)	0,000932 (13)	0,000202 (3)	0,0071 (1)
γ _{6,3} (Sm)	714,69 (13)	0,045 (5)	M1+E2	0,0060 (16)	0,00084 (18)	0,00018 (4)	0,0070 (18)
γ _{7,3} (Sm)	725,70 (6)	32,5 (6)	E2	0,00424 (6)	0,000642 (9)	0,0001389 (20)	0,00506 (7)
γ _{8,3} (Sm)	915,33 (6)	18,0 (5)	E2	0,00254 (4)	0,000364 (6)	0,0000783 (11)	0,00300 (5)
γ _{9,3} (Sm)	1013,81 (6)	19,9 (4)	E2+0,06%M3	0,00206 (4)	0,000290 (5)	0,0000622 (10)	0,00243 (4)
γ _{6,1} (Sm)	1344,66 (12)	0,057 (5)	E2	0,001162 (17)	0,0001570 (22)	0,0000335 (5)	0,001392 (20)

3 Atomic Data

3.1 Sm

ω _K	:	0,926 (4)
ω _L	:	0,158 (6)
n _{KL}	:	0,857 (4)

3.1.1 X Radiations

	Energy (keV)	Relative probability
X _K		
Kα ₂	39,5229	55,25
Kα ₁	40,1186	100
Kβ ₃	45,289	31,26
Kβ ₁	45,413	
Kβ ₅ ''	45,731	
Kβ ₂	46,575	8,07
Kβ ₄	46,705	
KO _{2,3}	46,813	
X _L		
Lℓ	4,9909	
Lα	5,6088 - 5,6376	
Lη	5,586	
Lβ	6,1928 - 6,6557	
Lγ	6,9644 - 7,4871	

3.1.2 Auger Electrons

	Energy (keV)	Relative probability
Auger K		
KLL	31,190 - 33,218	100
KLX	37,302 - 40,097	50,7
KXY	43,39 - 46,79	6,42
Auger L	3,27 - 7,69	

3.2 P_m

$$\omega_K : 0,922 \quad (4)$$

$$\bar{\omega}_L : 0,148 \quad (6)$$

$$n_{KL} : 0,861 \quad (4)$$

3.2.1 X Radiations

	Energy (keV)	Relative probability
X _K		
K α_2	38,1716	55,08
K α_1	38,7251	100
K β_3	43,713	}
K β_1	43,826	
K β_5''	44,145	
K β_2	44,937	}
K β_4	45,064	
KO _{2,3}	45,162	
X _L		
L ℓ	4,81	
L α	5,4061 - 5,4325	
L η	5,363	
L β	5,9552 - 6,3985	
L γ	6,6814 - 7,1893	

3.2.2 Auger Electrons

	Energy (keV)	Relative probability
Auger K		
KLL	30,162 - 32,086	100
KLX	36,035 - 38,703	50,3
KXY	41,88 - 45,14	6,32
Auger L	3,16 - 7,38	

4 Electron Emissions

		Energy (keV)	Electrons (per 100 disint.)
e _{AL}	(Sm)	3,27 - 7,69	6,23 (10)
e _{AK}	(Sm)		
	KLL	31,190 - 33,218	} 0,54 (5)
	KLX	37,302 - 40,097	
	KXY	43,39 - 46,79	
e _{AL}	(Pm)	3,16 - 7,38	6,59 (10)
e _{AK}	(Pm)		
	KLL	30,162 - 32,086	} 0,287 (23)
	KLX	36,035 - 38,703	
	KXY	41,88 - 45,14	
ec _{2,1} T	(Pm)	16,1 - 61,3	5,6 (34)
ec _{2,1} K	(Pm)	16,12 (5)	0,012 (5)
ec _{1,0} T	(Pm)	30,6 - 75,8	4,3 (9)
ec _{1,0} K	(Pm)	30,6 (1)	3,7 (8)
ec _{9,8} K	(Sm)	51,65 (6)	4,37 (39)
ec _{9,8} T	(Sm)	51,65 - 98,46	5,26 (47)
ec _{2,1} L	(Pm)	53,9 - 54,8	4,0 (23)
ec _{2,1} M	(Pm)	59,6 - 60,3	1,2 (7)
ec _{2,1} N	(Pm)	61,0 - 61,3	0,24 (16)
ec _{1,0} L	(Pm)	68,4 - 69,3	0,52 (11)
ec _{1,0} M	(Pm)	74,1 - 74,8	0,112 (22)
ec _{1,0} N	(Pm)	75,5 - 75,8	0,025 (5)
ec _{9,8} L	(Sm)	90,74 - 91,76	0,69 (6)
ec _{9,8} M	(Sm)	96,76 - 97,40	0,150 (13)
ec _{9,8} N	(Sm)	98,13 - 98,47	0,0339 (30)
ec _{8,7} K	(Sm)	142,80 (6)	0,205 (11)
ec _{8,7} L	(Sm)	181,89 - 182,91	0,0655 (35)
ec _{8,7} M	(Sm)	187,91 - 188,55	0,0149 (8)
ec _{9,7} K	(Sm)	241,28 (6)	0,925 (31)
ec _{9,7} T	(Sm)	241,28 - 288,09	1,088 (37)

		Energy (keV)	Electrons (per 100 disint.)
ec _{7,4} K	(Sm)	264,80 (6)	0,0432 (14)
ec _{9,7} L	(Sm)	280,37 - 281,39	0,1287 (43)
ec _{9,7} M	(Sm)	286,39 - 287,03	0,0276 (10)
ec _{4,3} K	(Sm)	367,24 (6)	0,1054 (22)
ec _{4,2} K	(Sm)	385,95 (6)	0,0806 (22)
ec _{4,3} L	(Sm)	406,33 - 407,35	0,01408 (29)
ec _{4,2} L	(Sm)	425,04 - 426,06	0,01467 (40)
ec _{8,4} K	(Sm)	454,43 (6)	0,0243 (5)
ec _{1,0} T	(Sm)	503,44 - 550,25	0,933 (19)
ec _{1,0} K	(Sm)	503,44 (3)	0,776 (16)
ec _{1,0} L	(Sm)	542,53 - 543,55	0,1280 (26)
ec _{1,0} M	(Sm)	548,55 - 549,19	0,0279 (6)
ec _{9,4} K	(Sm)	552,91 (6)	0,0310 (7)
ec _{2,1} K	(Sm)	564,43 (5)	0,0134 (5)
ec _{3,1} K	(Sm)	583,14 (5)	0,522 (10)
ec _{3,1} T	(Sm)	583,14 - 629,95	0,627 (12)
ec _{3,1} L	(Sm)	622,23 - 623,25	0,0823 (16)
ec _{3,1} M	(Sm)	628,25 - 628,89	0,01784 (35)
ec _{7,3} K	(Sm)	678,87 (6)	0,1378 (28)
ec _{7,3} L	(Sm)	718 - 719	0,02086 (42)
ec _{8,3} K	(Sm)	868,50 (6)	0,0457 (15)
ec _{9,3} K	(Sm)	966,98 (6)	0,0411 (10)
$\beta^-_{0,9}$	max:	414 (6)	} 54,0 (9)
	avg:	122,3 (26)	
$\beta^-_{0,8}$	max:	513 (6)	} 18,1 (9)
	avg:	156,0 (27)	
$\beta^-_{0,7}$	max:	702 (6)	} 21,8 (7)
	avg:	224,7 (29)	
$\beta^-_{0,4}$	max:	1014 (6)	} 0,93 (45)
	avg:	345,9 (31)	

5 Photon Emissions

5.1 X-Ray Emissions

		Energy (keV)	Photons (per 100 disint.)		
XL	(Sm)	4,9909 - 7,4871	1,20 (4)		
XK α_2	(Sm)	39,5229	1,92 (11)	}	K α
XK α_1	(Sm)	40,1186	3,47 (19)		
XK β_3	(Sm)	45,289	}	1,09 (6)	K' β_1
XK β_1	(Sm)	45,413			
XK β_5''	(Sm)	45,731			
XK β_2	(Sm)	46,575	}	0,280 (17)	K' β_2
XK β_4	(Sm)	46,705			
XKO $_{2,3}$	(Sm)	46,813			
XL	(Pm)	4,81 - 7,1893	1,20 (4)		
XK α_2	(Pm)	38,1716	0,96 (6)	}	K α
XK α_1	(Pm)	38,7251	1,75 (11)		
XK β_3	(Pm)	43,713	}	0,54 (4)	K' β_1
XK β_1	(Pm)	43,826			
XK β_5''	(Pm)	44,145			
XK β_2	(Pm)	44,937	}	0,139 (9)	K' β_2
XK β_4	(Pm)	45,064			
XKO $_{2,3}$	(Pm)	45,162			

5.2 Gamma Emissions

	Energy (keV)	Photons (per 100 disint.)
$\gamma_{2,1}(\text{Pm})$	61,30 (5)	0,00040 (17)
$\gamma_{1,0}(\text{Pm})$	75,8 (1)	1,27 (20)
$\gamma_{9,8}(\text{Sm})$	98,48 (3)	2,92 (26)
$\gamma_{8,7}(\text{Sm})$	189,63 (3)	1,15 (6)
$\gamma_{9,7}(\text{Sm})$	288,11 (3)	12,0 (4)
$\gamma_{9,6}(\text{Sm})$	299,1 (2)	0,13 (4)
$\gamma_{7,4}(\text{Sm})$	311,63 (3)	3,77 (11)
$\gamma_{8,5}(\text{Sm})$	362,09 (3)	0,171 (13)
$\gamma_{4,3}(\text{Sm})$	414,07 (3)	18,35 (33)
$\gamma_{4,2}(\text{Sm})$	432,78 (3)	5,19 (13)
$\gamma_{9,5}(\text{Sm})$	460,57 (3)	0,40 (1)
$\gamma_{8,4}(\text{Sm})$	501,26 (3)	6,59 (11)
$\gamma_{1,0}(\text{Sm})$	550,27 (3)	93,5 (14)

	Energy (keV)	Photons (per 100 disint.)
$\gamma_{5,3}(\text{Sm})$	553,24 (3)	0,35 (4)
$\gamma_{5,2}(\text{Sm})$	571,95 (3)	0,211 (7)
$\gamma_{9,4}(\text{Sm})$	599,74 (3)	12,35 (22)
$\gamma_{2,1}(\text{Sm})$	611,26 (3)	5,6 (2)
$\gamma_{3,1}(\text{Sm})$	629,97 (3)	87,8 (14)
$\gamma_{6,3}(\text{Sm})$	714,7 (2)	0,045 (5)
$\gamma_{7,3}(\text{Sm})$	725,70 (3)	32,3 (6)
$\gamma_{8,3}(\text{Sm})$	915,33 (3)	17,9 (5)
$\gamma_{9,3}(\text{Sm})$	1013,81 (3)	19,8 (4)
$\gamma_{6,1}(\text{Sm})$	1344,6 (2)	0,057 (5)

6 Main Production Modes

- $\left\{ \begin{array}{l} ^{148}\text{Nd}(\text{p},\text{n})^{148\text{m}}\text{Pm} \\ \text{Possible impurities : } ^{148}\text{Pm} \end{array} \right.$
- $\left\{ \begin{array}{l} ^{148}\text{Nd}(\text{d},2\text{n})^{148\text{m}}\text{Pm} \\ \text{Possible impurities : } ^{148}\text{Pm} \end{array} \right.$
- $\left\{ \begin{array}{l} ^{147}\text{Pm}(\text{n},\gamma)^{148\text{m}}\text{Pm} \quad \sigma : 70 \text{ barns} \\ \text{Possible impurities : } ^{148}\text{Pm} (80 \text{ barns}); ^{149,150}\text{Pm} \text{ from } ^{148,149}\text{Pm}(\text{n},\gamma) \end{array} \right.$
- $\left\{ \begin{array}{l} ^{238}\text{U}(\text{p},\text{f})^{148\text{m}}\text{Pm} \\ \text{Possible impurities : } ^{148}\text{Pm} \end{array} \right.$

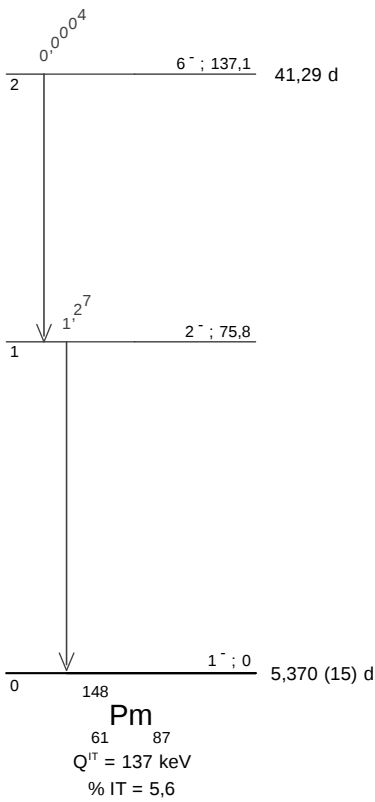
7 References

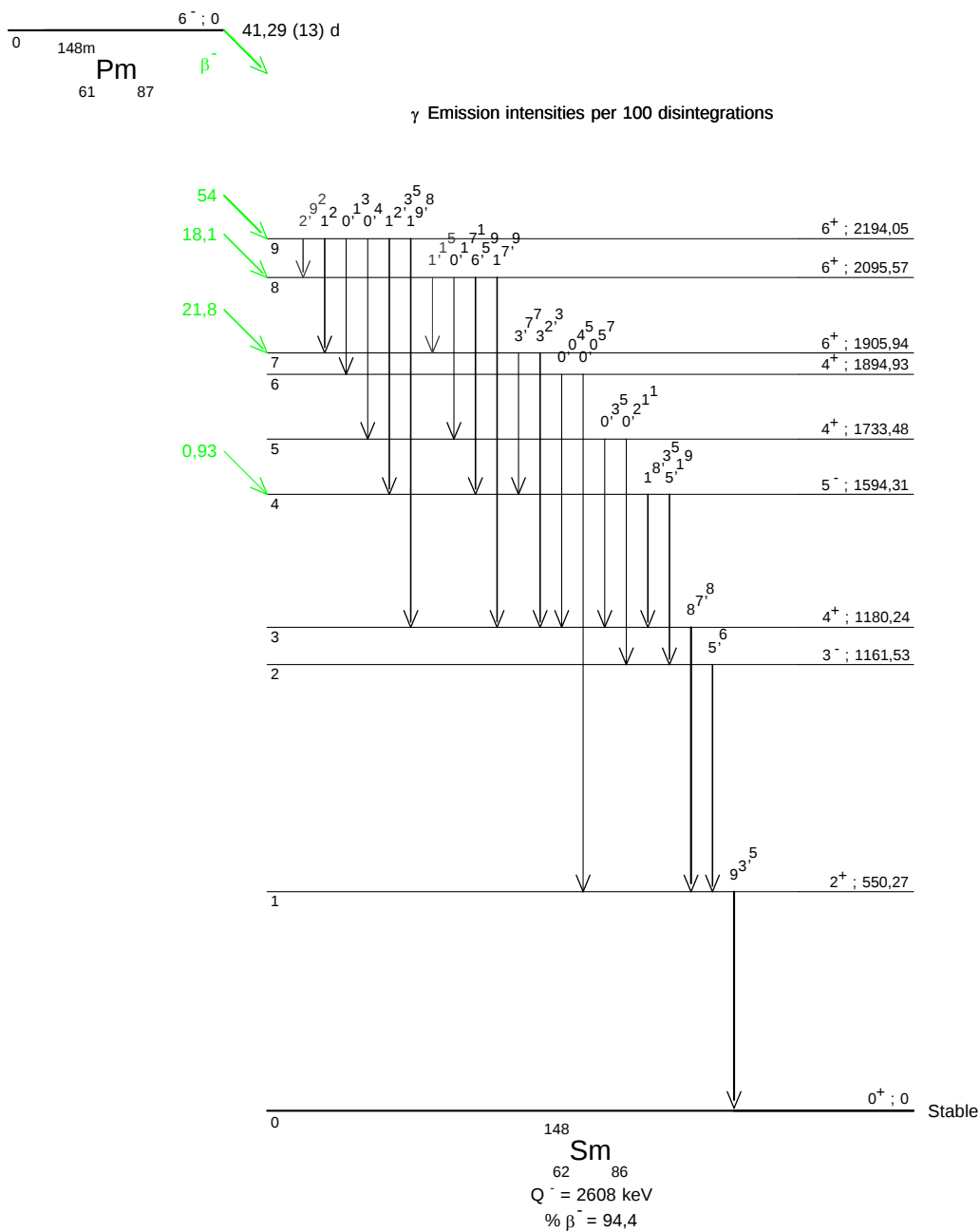
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(Q)

γ Emission intensities
per 100 disintegrations







1 Decay Scheme

Le samarium 151 se désintègre par émission bêta moins principalement vers le niveau fondamental de l'euporium 151.

Sm-151 decays by beta minus emission mainly to the Eu-151 ground state.

Probabilité d'ionisation interne dans la couche K, lors la désintégration bêta moins de Sm-151:

Internal ionisation probability in the K shell following beta minus decay:

Pk: 2,0 (2) E-4 %

et probabilité d'ionisation interne dans la couche L:

and internal ionisation probability in the L shell:

PL: 31 (3) E-2 %

2 Nuclear Data

$T_{1/2}(^{151}\text{Sm})$: 94,7 (6) a
 $Q^-(^{151}\text{Sm})$: 76,4 (5) keV

2.1 β^- Transitions

	Energy (keV)	Probability (%)	Nature	lg ft
$\beta_{0,1}^-$	54,9 (5)	0,93 (4)	1st Forbidden	7,5
$\beta_{0,0}^-$	76,4 (5)	99,07 (4)	1st Forbidden	9

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy (keV)	P _{$\gamma+ce$} (%)	Multipolarity	α_L	α_M	α_N	α_T
$\gamma_{1,0}(\text{Eu})$	21,541 (3)	0,93 (4)	M1+0,085(5)%E2	21,7 (4)	4,71 (8)	0,168 (3)	27,6 (5)

3 Atomic Data

3.1 Eu

ω_K	:	0,929	(4)
$\bar{\omega}_L$	:	0,168	(7)
n_{KL}	:	0,853	(4)

3.1.1 X Radiations

Energy (keV)	
X _L	
Lℓ	5,175
Lα	5,815 - 5,846
Lη	5,815
Lβ	6,436 - 6,839
Lγ	7,254 - 7,791

3.1.2 Auger Electrons

	Energy (keV)	Relative probability
Auger L	3,377 - 7,786	100

4 Electron Emissions

		Energy (keV)	Electrons (per 100 disint.)
e _{AL}	(Eu)	3,377 - 7,786	0,581 (19)
ec _{1,0 L}	(Eu)	13,489 - 14,564	0,703 (31)
ec _{1,0 M}	(Eu)	19,70 - 20,41	0,153 (7)
ec _{1,0 N}	(Eu)	21,181 - 21,408	0,0348 (15)
$\beta^-_{0,1}$	max:	54,9 (5)	} 0,93 (4)
	avg:	14,0 (2)	
$\beta^-_{0,0}$	max:	76,4 (5)	} 99,07 (4)
	avg:	19,7 (2)	

5 Photon Emissions

5.1 X-Ray Emissions

	Energy (keV)	Photons (per 100 disint.)
XL (Eu)	5,175 - 7,791	0,121 (4)

5.2 Gamma Emissions

	Energy (keV)	Photons (per 100 disint.)
$\gamma_{1,0}(\text{Eu})$	21,541 (3)	0,0324 (13)

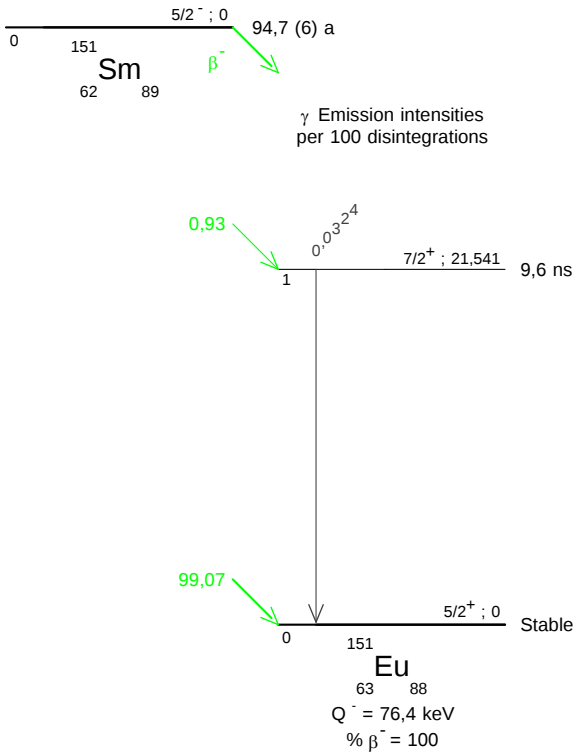
6 Main Production Modes

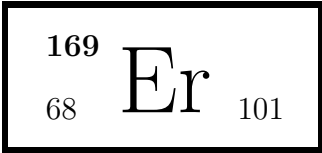
- { Fission product
- { Possible impurities: Sm – 153
- { Sm – 149(n, γ)Sm – 151 σ : 104 (5) barns
- { Possible impurities: Sm – 153

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1 Decay Scheme

L’erbium 169 se désintègre par émission bêta moins vers les niveaux excités ou le niveau fondamental de thulium 169.

Er-169 disintegrates by beta minus emissions to Tm-169.

2 Nuclear Data

$T_{1/2} (^{169}\text{Er})$: 9,38 (2) d
 $Q^- (^{169}\text{Er})$: 353,0 (12) keV

2.1 β^- Transitions

	Energy (keV)	Probability (%)	Nature	lg <i>ft</i>
$\beta_{0,2}^-$	234,8 (12)	~ 0,016	Unique 1st Forbidden	9,5
$\beta_{0,1}^-$	344,6 (12)	44 (5)	1st Forbidden	6,5
$\beta_{0,0}^-$	353,0 (12)	56 (5)	1st Forbidden	6,3

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy (keV)	P _{$\gamma+ce$} (%)	Multipolarity	α_K	α_L	α_M	α_N	α_O	α_T
$\gamma_{1,0}(\text{Tm})$	8,4102 (1)	44 (6)	M1+0,094%(E2)			199 (8)	45,8 (18)	6,1 (2)	251 (10)
$\gamma_{2,1}(\text{Tm})$	109,77930 (14)	0,0152 (30)	M1+2,17%E2	1,96 (3)	0,316 (5)	0,0710 (12)	0,017 (1)	0,0024 (1)	2,37 (4)
$\gamma_{2,0}(\text{Tm})$	118,1895 (1)	0,0013	E2	0,70 (1)	0,721 (10)	0,1759 (25)	0,040 (1)	0,0047 (1)	1,642 (23)

3 Atomic Data

3.1 Tm

ω_K	:	0,945	(4)
$\bar{\omega}_L$	:	0,227	(9)
$\bar{\omega}_M$	:	0,0127	(12)
n_{KL}	:	0,835	(4)

3.1.1 Auger Electrons

	Mean Energy (keV)	Relative probability
Auger MNO		
M	0,70	36,69
N	0,10	57,11
O	0,02	6,20
Auger total	0,32	100

4 Electron Emissions

		Energy (keV)		Electrons (per 100 disint.)
eATotal	(Tm)			
	avg M	0,70	}	203,3
	avg N	0,10		
	avg O	0,02		
ec _{1,0} M	(Tm)	6,1034 - 6,9425		34,8 (44)
ec _{1,0} N	(Tm)	7,9385 - 8,4049		8 (1)
ec _{1,0} O	(Tm)	8,3570 - 8,3779		1,07 (13)
ec _{2,1} T	(Tm)	50,3897 - 109,7470		0,0107 (21)
$\beta_{0,2}^-$	max:	234,8 (12)	}	0,016
	avg:	73,0 (5)		
$\beta_{0,1}^-$	max:	344,6 (12)	}	44 (5)
	avg:	96,5 (5)		
$\beta_{0,0}^-$	max:	353,0 (12)	}	56 (5)
	avg:	99,1 (5)		

5 Photon Emissions

5.1 Gamma Emissions

	Energy (keV)	Photons (per 100 disint.)
$\gamma_{1,0}(\text{Tm})$	8,4102 (1)	0,174 (21)
$\gamma_{2,1}(\text{Tm})$	109,77930 (14)	0,0045 (9)
$\gamma_{2,0}(\text{Tm})$	118,1895 (1)	0,0005

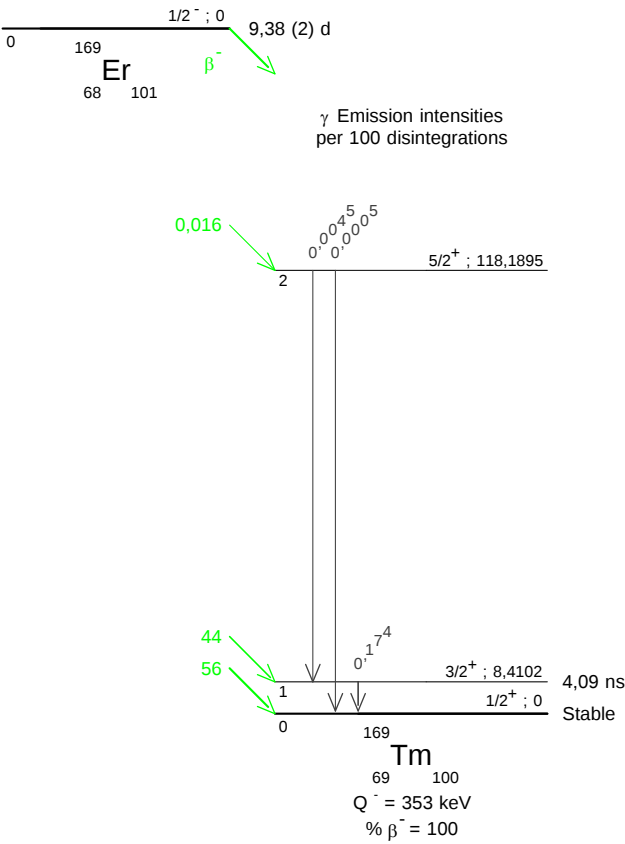
6 Main Production Modes

- { Er – 168(d,p)Er – 169
Possible impurities: Er – 165, Er – 171
- { Er – 170(n,2n)Er – 169
Possible impurities: Ho – 167
- { Er – 168(n, γ)Er – 169 σ : 2,0 (1) barns
Possible impurities: Er – 165, Er – 171

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(Mixing ratio)





1 Decay Scheme

Au-198 decays via beta minus transitions to two excited levels and the ground state of Hg-198.
L’or 198 se désintègre 100 % par émission bêta vers deux niveaux excités et le niveau fondamental du mercure 198.

2 Nuclear Data

$T_{1/2} (^{198}\text{Au})$: 2,6943 (3) d
 $Q^- (^{198}\text{Au})$: 1372,8 (5) keV

2.1 β^- Transitions

	Energy (keV)	Probability (%)	Nature	lg <i>ft</i>
$\beta_{0,2}^-$	285,1 (5)	0,985 (5)	1st Forbidden	7,6
$\beta_{0,1}^-$	961,0 (5)	98,99 (6)	1st Forbidden	7,37
$\beta_{0,0}^-$	1372,8 (5)	0,025 (5)	Unique 1st Forbidden	12,4

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy (keV)	P _{γ+ce} (%)	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{1,0}(\text{Hg})$	411,80250 (17)	99,82 (9)	E2	0,0300 (5)	0,01055 (15)	0,00263 (4)	0,0439 (7)
$\gamma_{2,1}(\text{Hg})$	675,8849 (5)	0,825 (5)	M1+E2	0,0216 (17)	0,00389 (24)	0,00091 (6)	0,0267 (20)
$\gamma_{2,0}(\text{Hg})$	1087,6874 (5)	0,1599 (21)	E2	0,00414 (6)	0,000751 (11)	0,0001766 (25)	0,00512 (8)

3 Atomic Data

3.1 Hg

ω_K	:	0,962	(4)
$\bar{\omega}_L$	:	0,355	(14)
n_{KL}	:	0,813	(4)

3.1.1 X Radiations

	Energy (keV)		Relative probability
X _K			
	K α_2	68,895	58,99
	K α_1	70,82	100
	K β_3	79,823	} 33,94
	K β_1	80,254	
	K β_5''	80,762	
	K β_2	82,435	} 9,94
	K β_4	82,776	
	KO _{2,3}	83,028	
X _L			
	L ℓ	8,7226	
	L α	9,8981 - 9,9886	
	L η	10,6473	
	L β	11,4835 - 12,5471	
	L γ	13,4081 - 14,2672	

3.1.2 Auger Electrons

		Energy (keV)	Relative probability
Auger K			
	KLL	53,178 - 58,277	100
	KLX	64,594 - 70,811	55,2
	KXY	75,98 - 83,09	7,62
Auger L			
		5,16 - 14,82	

4 Electron Emissions

		Energy (keV)	Electrons (per 100 disint.)
eAL	(Hg)	5,161 - 14,822	2,156 (24)
eAK	(Hg)		
	KLL	53,178 - 58,277	} 0,110 (12)
	KLX	64,594 - 70,811	
	KXY	75,98 - 83,09	
ec _{1,0} T	(Hg)	328,7002 - 411,7947	4,20 (7)
ec _{1,0} K	(Hg)	328,70020 (17)	2,869 (48)
ec _{1,0} L	(Hg)	396,9632 - 399,5186	1,009 (14)
ec _{1,0} M	(Hg)	408,2409 - 409,5076	0,2515 (38)
ec _{1,0} N	(Hg)	411,0000 - 411,7026	0,0626 (10)
ec _{2,1} K	(Hg)	592,7826 (5)	0,0174 (14)
$\beta_{0,2}^-$	max:	285,1 (5)	} 0,985 (5)
	avg:	79,5 (2)	
$\beta_{0,1}^-$	max:	961,0 (5)	} 98,99 (6)
	avg:	314,7 (2)	
$\beta_{0,0}^-$	max:	1372,8 (5)	} 0,025 (5)
	avg:	467,3 (2)	

5 Photon Emissions

5.1 X-Ray Emissions

		Energy (keV)	Photons (per 100 disint.)	
XL	(Hg)	8,7226 - 14,2672	1,203 (22)	
XK α_2	(Hg)	68,895	0,807 (15)	} K α
XK α_1	(Hg)	70,82	1,369 (24)	
XK β_3	(Hg)	79,823	} 0,465 (11)	K' β_1
XK β_1	(Hg)	80,254		
XK β_5''	(Hg)	80,762		
XK β_2	(Hg)	82,435	} 0,136 (4)	K' β_2
XK β_4	(Hg)	82,776		
XK $\alpha_{2,3}$	(Hg)	83,028		

5.2 Gamma Emissions

	Energy (keV)	Photons (per 100 disint.)
$\gamma_{1,0}(\text{Hg})$	411,80205 (17)	95,62 (6)
$\gamma_{2,1}(\text{Hg})$	675,8836 (7)	0,804 (5)
$\gamma_{2,0}(\text{Hg})$	1087,6842 (7)	0,1591 (21)

6 Main Production Modes

$\left\{ \begin{array}{l} \text{Au} - 197(\text{n},\gamma)\text{Au} - 198 \\ \text{Possible impurities: Au} - 199 \end{array} \right.$

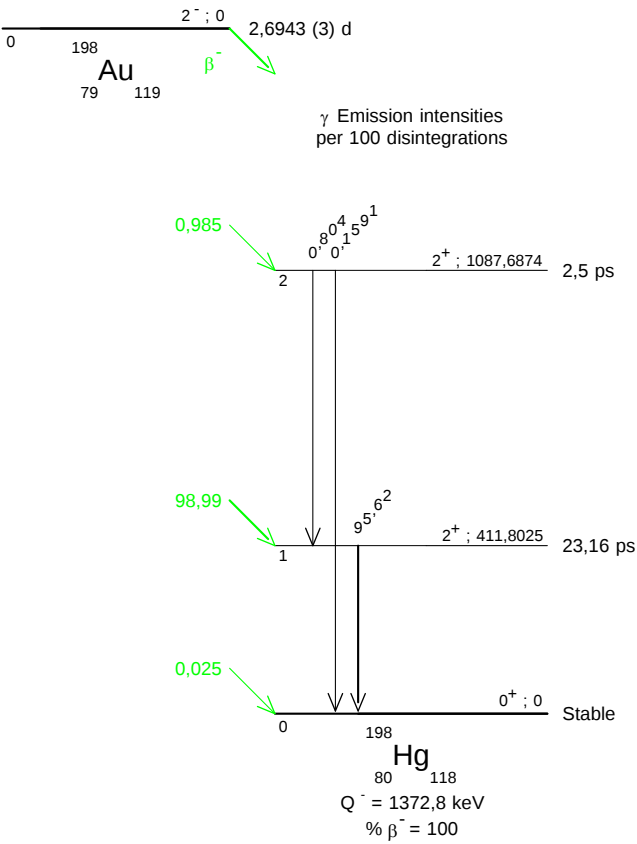
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