Monographie BIPM-5

Table of Radionuclides
(Vol. 3 – A = 3 to 244)

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2006

BUREAU INTERNATIONAL DES POIDS ET MESURES

Pavillon de Breteuil, F-92310 SÈVRES

Édité par le BIPM,
Pavillon de Breteuil
F-92312 Sèvres Cedex
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Imprimé par Reproduction Service

ISBN 92-822-2204-7 (set)
ISBN 92-822-2218-7 (Vol. 3)

Preface

This monograph is one of several published in a series by the Bureau International des Poids et Mesures (BIPM) on behalf of the *Comité Consultatif des Rayonnements Ionisants* (CCRI), previously known as the *Comité Consultatif pour les Etalons de Mesure des Rayonnements Ionisants* (CCEMRI). 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 hoped 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 forty of these radionuclides have already been the subject of comparisons under the auspices of Section II of the CCRI. The material for this monograph is now covered in three 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 those radionuclides with mass number up to and including 150 and Volume 2 for those radionuclides with mass number over 150. Volume 3 contains the equivalent data for twenty-six additional radionuclides as listed and re-evaluation for ^{125}Sb and ^{153}Sm. The data have been collated and evaluated by an international working group (Decay Data Evaluation Project) led by the LNE-LNHB. The evaluators have agreed on the methodologies to be used and the CD-ROM included with this monograph contains the evaluators' comments for each radionuclide in addition to the data tables included in the monograph.

The work involved in evaluating nuclear data is on-going and the recommended values are updated on the LNHB website at http://www.nucleide.org/DDEP_WG/DDEPdata.htm. The publication of further volumes of Monographie 5 is envisaged as and when necessary to add new radionuclide data or re-evaluations in a more permanent format that can be referenced easily.

Although other data sets may still be used when evaluating radionuclide activity, use of this common, recommended data set should help to reduce the uncertainties in activity evaluations and lead to more coherent results for comparisons.

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President of the CCRI

A.J. Wallard
Director of the BIPM

Monographie BIPM-5 – Table of Radionuclides, Volume 3

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"TABLE DE RADIONUCLÉIDES"

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

^{3}H, ^{55}Fe, ^{56}Co, ^{60}Co, ^{63}Ni, ^{65}Zn, ^{79}Se, ^{90}Sr, ^{90}Y, ^{90}Y^{m}, ^{108}Ag, ^{108}Ag^{m}, ^{111}In, ^{125}Sb, ^{137}Cs, ^{153}Sm, ^{159}Gd, ^{203}Pb, ^{233}Pa, ^{233}Th, ^{234}U, ^{236}Np, ^{236}Np^{m}, ^{237}U, ^{238}U, ^{242}Cm, ^{243}Am, ^{244}Cm.

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 :

^{3}H, ^{55}Fe, ^{56}Co, ^{60}Co, ^{63}Ni, ^{65}Zn, ^{79}Se, ^{90}Sr, ^{90}Y, ^{90}Y^{m}, ^{108}Ag, ^{108}Ag^{m}, ^{111}In, ^{125}Sb, ^{137}Cs, ^{153}Sm, ^{159}Gd, ^{203}Pb, ^{233}Pa, ^{233}Th, ^{234}U, ^{236}Np, ^{236}Np^{m}, ^{237}U, ^{238}U, ^{242}Cm, ^{243}Am, ^{244}Cm.

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

^{3}H, ^{55}Fe, ^{56}Co, ^{60}Co, ^{63}Ni, ^{65}Zn, ^{79}Se, ^{90}Sr, ^{90}Y, ^{90}Y^{m}, ^{108}Ag, ^{108}Ag^{m}, ^{111}In, ^{125}Sb, ^{137}Cs, ^{153}Sm, ^{159}Gd, ^{203}Pb, ^{233}Pa, ^{233}Th, ^{234}U, ^{236}Np, ^{236}Np^{m}, ^{237}U, ^{238}U, ^{242}Cm, ^{243}Am, ^{244}Cm.

In diesem Bericht sind evaluierte Werte der Halbwertszeiten, Übergangs-wahrscheinlichkeiten und Übergangsenergien von α, β^{-}-, β^{+}-, EC- und Gammaübergängen, Konversionskoeffizienten von Gammaübergängen, Emissions-wahrscheinlichkeiten von Röntgen- und Gammaquanten, Auger- und Konversions-elektronen.

“TABLA DE RADIONUCLEIDOS”

Prólogo – Este volúmen agrupa la evaluación de los radionucleidos siguientes :

^{3}H, ^{55}Fe, ^{56}Co, ^{60}Co, ^{63}Ni, ^{65}Zn, ^{79}Se, ^{90}Sr, ^{90}Y, ^{90}Y^{m}, ^{108}Ag, ^{108}Ag^{m}, ^{111}In, ^{125}Sb, ^{137}Cs, ^{153}Sm, ^{159}Gd, ^{203}Pb, ^{233}Pa, ^{233}Th, ^{234}U, ^{236}Np, ^{236}Np^{m}, ^{237}U, ^{238}U, ^{242}Cm, ^{243}Am, ^{244}Cm.

Los valores recomendados y las incertidumbres asociadas comprenden : el período radioactivo, 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]. 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 troisième de la Monographie 5 [04Be] 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 uc, 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 :
$U(y) = k \cdot uc(y)$ où k 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 énième 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

	Unités
. en secondes pour $T_{1/2}$ <= 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.

AVERTISSEMENT

Ce document a été imprimé en 2006, pour toutes les nouvelles évaluations et mises à jour ultérieures le lecteur se référera aux documents accessibles sur :
http://www.nucleide.org/NucData.htm

TABLE OF RADIONUCLIDES

INTRODUCTION

The evaluation of decay data for the “Table de Radionucléides” by LNHB (Laboratoire National Henri Becquerel) began in 1974, continued to 1987 and four volumes were published [87Ta] and then, in 1999, the fifth volume was published containing the revised evaluations for 30 selected radionuclides [99Be].
Moreover, LNHB developed a software (NUCLEIDE) 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 third issue of the Monographie 5 published under the BIPM auspices.

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 uc, 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.uc(y)   where k is the coverage factor.
For this publication the expanded uncertainty is computed with 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 nth 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 $T_{1/2}$ <= 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 year = 365,242 198 days = 31 556 926 seconds

- for transition probabilities and number of emitted particles, per 100 disintegrations of the parent nuclide ;

- for energies, in keV.

CAUTION

This report was printed in 2006, new evaluations and up-dated issues will be available in the Internet :
http://www.nucleide.org/NucData.htm

TABELLE DER RADIONUKLIDE

EINLEITUNG

Die Evaluation der Zerfallsdaten für die Table de Radionucléides durch das BNM-LNHB/CEA begann im Jahre 1974, diese Arbeit wurde bis 1987 fortgesetzt, und es wurden vier Bände veröffentlicht [87Ta, 99Be]. Dieser neue Bericht kommt hinzu dem vorhergehend Arbeit.
Übrigens wurde ein Computerform der Table de Radionucléides im LPRI entwikelt. Diese Software 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 Umgebungsüberwachung, der Reaktorabschirmung usw. zur Verfügung zu stellen.
Die Datenbank umfaßt empfohlene Daten und ihre Unsicherheiten, die aus den verfügbaren Daten oder theoretischen Berechnungen gewonnen worden sind. Alle für die Evaluation benutzten Referenzen werden angegeben.
Um die schon 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) einen Vertrag zur Zusammenarbeit. Es schlossen sich das Idaho National Engeneering and Environmental Laboratory (INEEL, USA), das Lawrence Berkeley National Laboratory (LBNL, USA) und das Khlopin Radium Institut (KRI, Rußland) an. Eine der ersten Arbeiten dieser Gruppe war es, die in diesen Evaluationen benutzte Methodologie zu diskutieren und festzulegen.

EMPFOHLENE WERTE UND UNSICHERHEITEN

Die Hauptschritte für die Evaluation der Daten und Unsicherheiten sind:
- Eine kritische Analyse aller verfügbaren Veröffentlichungen, um einen Wert und seine Unsicherheit - auf die kombinierte Standardunsicherheit zurückgeführt - zu berücksichtigen.
- 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 ein Gewicht, das größer ist als 50 %, auf 50 % reduziert. Die Unsicherheit, als uc bezeichnet, ist der größere Wert der inneren oder äußeren Unsicherheit. Für einen diskrepanten Datensatz ist sie so zu vergrößern, 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:
$U(y) = k \cdot uc(y)$ wo k der Erweiterungsfaktor ist.
Für die vorliegende Veröffentlichung ist die erweitere 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.

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 durch einen Pfeil im Zerfallsschema gezeigt sind, werden das Ausgangs- und Endniveau notiert. (-1, n)

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:

	Symbol
. 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 a = 365,242 198 d = 31 556 926 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 2006 erstellt. Alle späteren Fassungen oder neueren Evaluationen können vom Leser unter http://www.nucleide.org/NucData.htm 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]. Новое издание находится в русле предыдущей работы.
В дополнение в LNHB была развита 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 Radionucleides, 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 рассмотрений.

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 (uc) 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.uc(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 ± 0,011 и
9,2(11) 9,2 ± 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 отчет подготовлен в 2006 г. Новые оценки и обновленные результаты можно найти на сайте:
http://www.nucleide.org/NucData.htm

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.

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

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

Los datos recomendados incluyen : el período radioactivote desintegración, 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. Luego se unieron a este acuerdo el *Idaho National Engineering & Environmental Laboratory* (INEEL, USA), *Lawrence Berkeley National Laboratory* LBNL, USA) y *Khoplin Radium Institute* (KRI, Rusia). El primer trabajo de esta colaboración internacional ha sido 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, tales valores fueron obtenidos por cálculos teóricos. Todas las referencias utilizadas para la evaluación de un radionucleido están listadas 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 tipo compuesta.
- La determinación de un valor recomendado que es, según el caso, una media simple o ponderada de valores obtenidos de publicaciones. Ésto es decidido luego de examinar la desviación cuadrática reducida. En el caso de una media ponderada para conjuntos de valores discrepantes, el peso estadístico relativo de cada valor es limitado a 50 %. La incertidumbre, ***uc***, es el mayor de los valores de 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 . ***uc***(y) donde k es el factor de expansión.

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

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

9,230 (11)	significa	9,230 ± 0,011 y
9,2 (11)	significa	9,2 ± 1,1

Valores dados sin incertidumbres son considerados dudosos (usualmente son presentados como valores aproximados, y a menudo estimados a partir de esquemas de desintegración.

NUMERACION

Los niveles de un núcleo están arbitrariamente numerados desde “0” (para el nivel fundamental), hasta “n” para el enésimo nivel excitado. Las diversas transiciones son así señaladas del nivel inicial al nivel 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 son dados :
- para los períodos de desintegración :

	Unidades
. 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:
  - por cada 100 desintegraciones del nucleido padre.

  - para las energías:

  - en keV.

ADVERTENCIA

Este documento ha sido imprimido en el 2006. Para obtener todas las nuevas evaluaciones actualizadas ulteriormente, el lector deberá referirse a los documentos disponibles en el Internet :
http://www.nucleide.org/NucData.htm

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and
M.M. Bé, E. Browne, V. Chechev, V. Chisté, R. Dersch, C. Dulieu, R.G. Helmer, N. Kuzmenco, A.L. Nichols, E. Schönfeld. NUCLEIDE, Table de Radionucléides sur CD-Rom, Version 2-2004, CEA/BNM-LNHB, 91191 Gif-sur-Yvette, France.

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AUTORES PARA CORRESPONDENCIA

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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Table of contents

List of radionuclides included in:

* : updated evaluations

$^{3}_{1}H_{2}$

1 Decay Scheme

H-3 disintegrates 100% by beta-minus decay directly to the ground state of He-3.
Le tritium se désintègre à 100 % par émission bêta moins vers le niveau fondamental d'hélium 3.

2 Nuclear Data

$T_{1/2}(^{3}H)$	:	12,312	(25)	a
$Q^{-}(^{3}H)$	:	18,591	(1)	keV

2.1 β^{-} Transitions

	Energy keV	Probability × 100	Nature	lg ft
$\beta^{-}_{0,0}$	18,591 (1)	100	Super allowed	3,05

3 Electron Emissions

		Energy keV	Electrons per 100 disint.
$\beta^{-}_{0,0}$	max:	18,564 (3)	100
$\beta^{-}_{0,0}$	avg:	5,68 (1)	

4 Main Production Modes

Li – 6(n,α)H – 3
Possible impurities : none

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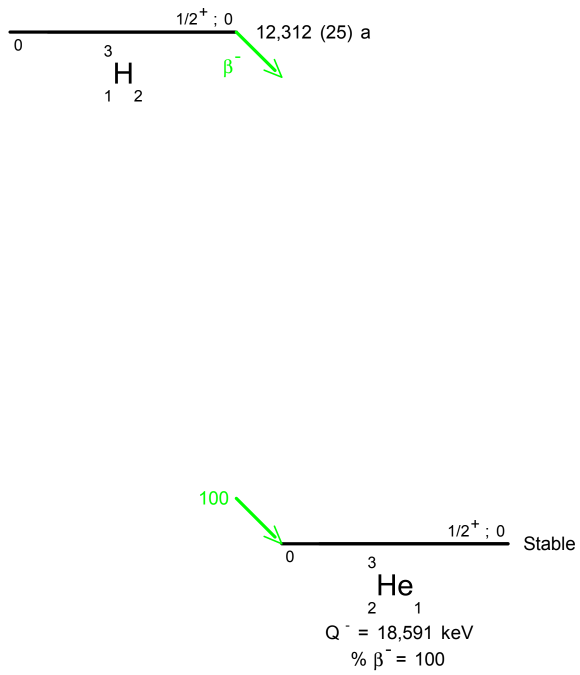
1/2+ ; 0
12,312 (25) a
0
3
H
1 2
β-
100
1/2+ ; 0
Stable
0
3
He
2 1
Q - = 18,591 keV
% β- = 100

$^{55}_{26}$Fe $_{29}$

1 Decay Scheme

Fe-55 disintegrates by electron capture. A gamma transition with a small probability ($1{,}3 \times 10^{-7}$ %) has been observed. A background radiation, due to an inner-bremsstrahlung, with an intensity relative to K capture of $3{,}24(6) \times 10^{-5}$ photons produces a continuous spectrum up to 231,21 keV.

Le Fe-55 se désintègre par capture électronique. Une transition gamma de faible probabilité a été observée. Un rayonnement de freinage interne produit une émission radiative, dont la probabilité relative à la capture électronique K est de $3{,}24(6) \times 10^{-5}$.

2 Nuclear Data

$T_{1/2}(^{55}$Fe)	:	2,747	(8)	a
$Q^{+}(^{55}$Fe)	:	231,21	(18)	keV

2.1 Electron Capture Transitions

	Energy keV	Probability × 100	Nature	lg ft	P_K	P_L	P_{M+}
$\epsilon_{0,1}$	105,26 (18)	0,00000013 (1)	2nd Forbidden	14,2			
$\epsilon_{0,0}$	231,21 (18)	100	Allowed	6	0,8853 (16)	0,0983 (13)	0,0163 (8)

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity
$\gamma_{1,0}$(Mn)	125,949 (10)	0,00000013 (1)	M1+(E2)

3 Atomic Data

3.1 Mn

ω_K	:	0,321	(7)
$\bar{\omega}_L$	:	0,0047	(7)
$\bar{\omega}_M$	:	0,000027	(2)
n_{KL}	:	1,478	(4)
$\bar{n}_{LM}$	:	1,996	(8)

3.1.1 X Radiations

		Energy keV		Relative probability
X_K				
	$K\alpha_2$	5,88765		51
	$K\alpha_1$	5,89875		100
	$K\beta_3$	6,49045	}	
	$K\beta_5''$	6,5352	}	20,5
X_L				
	$L\ell$	0,556		
	$L\eta$	0,567		
	$L\beta$	0,649 – 0,721		

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	0,47 – 0,67	

4 Electron Emissions

		Energy keV		Electrons per 100 disint.
e_{AL}	(Mn)	0,47 - 0,67		140,2 (8)
e_{AK}	(Mn)			60,1 (5)
	KLL	4,953 - 5,210	}	
	KLX	5,671 - 5,895	}	
	KXY	6,370 - 6,532	}	

5 Photon Emissions

5.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(Mn)	0,556 — 0,721		0,524 (21)	
$XK\alpha_2$	(Mn)	5,88765		8,45 (14)	} $K\alpha$
$XK\alpha_1$	(Mn)	5,89875		16,57 (27)	}
$XK\beta_3$	(Mn)	6,49045	}		
$XK\beta_1$	(Mn)		}	3,40 (7)	$K'\beta_1$
$XK\beta_5''$	(Mn)	6,5352	}		
$XK\beta_4$	(Mn)		}		$K'\beta_2$

5.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{1,0}$(Mn)	125,949 (10)	0,00000013 (1)

6 Main Production Modes

{ Fe – 54(n,γ)Fe – 55 σ : 2,25 (1800) barns
Possible impurities : Fe – 59

Mn – 55(p,n)Fe – 55

{ Fe – 54(d,p)Fe – 55
Possible impurities : Co – 55

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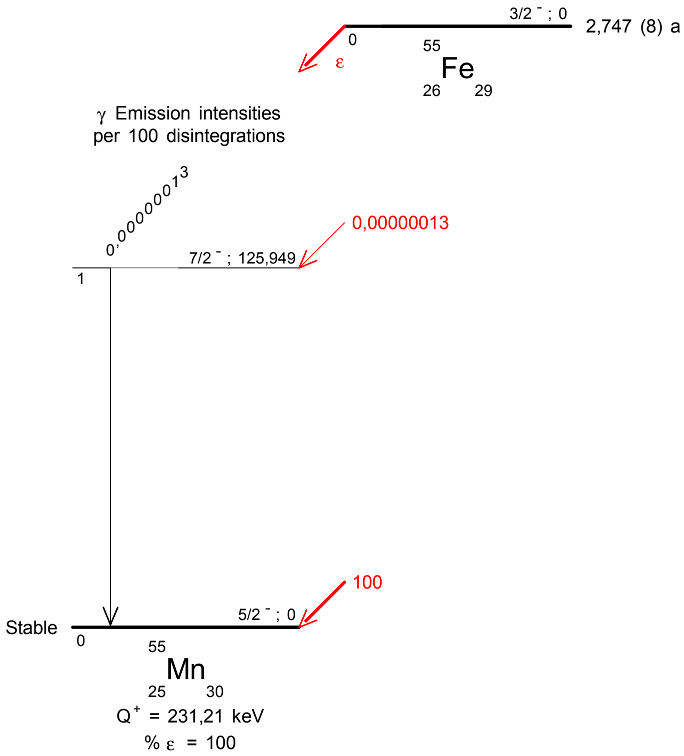
3/2 ⁻ ; 0
2,747 (8) a
0
ε
55
Fe
26
29
γ Emission intensities
per 100 disintegrations
0,00000013
0,00000013
7/2 ⁻ ; 125,949
1
100
Stable
5/2 ⁻ ; 0
0
55
Mn
25
30
Q⁺ = 231,21 keV
% ε = 100

$^{56}_{27}$Co$_{29}$

1 Decay Scheme

Co-56 disintegrates 19.58 (11) % by beta plus emission and 80.42 (11) % by electron capture to Fe-56. Co-56 emits gamma rays with energies up to 3612 keV and the energies and emission probabilities for many of these transitions are useful for the calibration of Ge detectors.
Le cobalt 56 se désintègre à 19,58 (11) % par émission bêta plus et à 80,42 (11) % par capture électronique vers des niveaux excités du fer 56. Le cobalt 56 émets des rayonnements gamma d'énergie allant jusqu'à 3612 keV, ce qui le rend utile pour l'étalonnage des détecteurs germanium.

2 Nuclear Data

$T_{1/2}$(^{56}Co)	:	77,236	(26)	d
Q^+(^{56}Co)	:	4566	(2)	keV

2.1 Electron Capture Transitions

	Energy keV	Probability × 100	Nature	lg ft	P_K	P_L	P_M
$\epsilon_{0,15}$	107,7 (20)	0,209 (7)	Allowed	6,91	0,8766 (17)	0,1055 (14)	0,0171 (6)
$\epsilon_{0,14}$	118,4 (20)	0,0167 (5)		8,1	0,8779 (17)	0,1044 (14)	0,0169 (6)
$\epsilon_{0,13}$	171,2 (20)	0,2159 (18)	Allowed	7,32	0,8816 (17)	0,1013 (13)	0,0164 (6)
$\epsilon_{0,12}$	268 (2)	3,688 (13)	Allowed	6,49	0,8845 (16)	0,0989 (13)	0,0159 (5)
$\epsilon_{0,11}$	446,1 (20)	9,940 (18)	Allowed	6,51	0,8864 (16)	0,0972 (13)	0,0156 (5)
$\epsilon_{0,10}$	465,7 (20)	12,66 (4)	Allowed	6,44	0,8866 (16)	0,0971 (13)	0,0156 (5)
$\epsilon_{0,9}$	517,2 (20)	3,965 (15)	Allowed	7,04	0,8868 (16)	0,0969 (13)	0,0155 (5)
$\epsilon_{0,8}$	709,5 (20)	16,86 (5)	Allowed	6,69	0,8875 (16)	0,0963 (13)	0,0154 (5)
$\epsilon_{0,7}$	1120,7 (20)	21,40 (5)	Allowed	6,98	0,8882 (16)	0,0957 (13)	0,0153 (5)
$\epsilon_{0,6}$	1195,9 (20)	0,015 (5)	2nd Forbidden	10,2	0,8883 (16)	0,0957 (13)	0,0153 (5)
$\epsilon_{0,5}$	1443,1 (20)	8,99 (6)	Allowed	7,58	0,8884 (16)	0,0955 (13)	0,0153 (5)
$\epsilon_{0,4}$	1606,1 (20)	0,023 (6)	2nd Forbidden	10,26	0,8885 (16)	0,0955 (13)	0,0153 (5)
$\epsilon_{0,2}$	2480,9 (20)	2,43 (3)	Allowed	8,62	0,8888 (16)	0,0952 (13)	0,0152 (5)
$\epsilon_{0,1}$	3719,2 (20)	0,005 (3)	2nd Forbidden	11,6	0,8890 (16)	0,0951 (13)	0,0152 (5)

2.2 β^+ Transitions

	Energy keV	Probability × 100	Nature	lg ft
$\beta^+_{0,7}$	98,7 (20)	0,0080 (7)	Allowed	6,98
$\beta^+_{0,6}$	174 (2)	0,000006 (20)	2nd Forbidden	10,2
$\beta^+_{0,5}$	421,1 (20)	1,04 (2)	Allowed	7,58
$\beta^+_{0,4}$	584,1 (20)	0,0086 (22)	2nd Forbidden	10,26
$\beta^+_{0,2}$	1458,9 (20)	18,29 (16)	Allowed	8,62
$\beta^+_{0,1}$	2697,2 (20)	0,25 (17)	2nd Forbidden	11,6

2.3 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_T (10^{-4})	α_π (10^{-4})
$\gamma_{11,8}$(Fe)	263,434 (5)	0,0234 (20)			
$\gamma_{8,7}$(Fe)	411,145 (4)	0,0269 (23)			
$\gamma_{8,6}$(Fe)	486,55 (11)	0,058 (3)			
$\gamma_{10,7}$(Fe)	655,003 (5)	0,038 (8)			
$\gamma_{11,7}$(Fe)	674,579 (5)	0,035 (5)			
$\gamma_{8,5}$(Fe)	733,514 (4)	0,191 (4)	M1+E2		
$\gamma_{7,3}$(Fe)	787,743 (5)	0,310 (4)	M1+E2		
$\gamma_{1,0}$(Fe)	846,770 (2)	99,9702 (23)	E2	3,03 (9)	
$\gamma_{12,7}$(Fe)	852,732 (4)	0,049 (3)			
$\gamma_{8,4}$(Fe)	896,510 (6)	0,0704 (22)			
$\gamma_{10,5}$(Fe)	977,372 (5)	1,422 (7)	M1(+E2)		
$\gamma_{11,5}$(Fe)	996,948 (5)	0,116 (6)	M1+E2		
$\gamma_{5,2}$(Fe)	1037,8427 (39)	14,03 (5)	M1(+E2)		
$\gamma_{9,4}$(Fe)	1088,894 (9)	0,054 (4)	M1+E2		
$\gamma_{10,4}$(Fe)	1140,368 (6)	0,132 (4)			
$\gamma_{11,4}$(Fe)	1159,944 (6)	0,088 (3)	M1+E2		
$\gamma_{12,5}$(Fe)	1175,101 (4)	2,249 (9)	M1+E2		
$\gamma_{8,3}$(Fe)	1198,888 (5)	0,044 (3)			
$\gamma_{2,1}$(Fe)	1238,2883 (31)	66,41 (16)	E2		
$\gamma_{13,5}$(Fe)	1271,92 (6)	0,0202 (8)			
$\gamma_{15,5}$(Fe)	1335,399 (30)	0,1228 (16)			
$\gamma_{7,2}$(Fe)	1360,2117 (39)	4,280 (13)	M1+E2		
$\gamma_{10,3}$(Fe)	1442,746 (6)	0,180 (4)			
$\gamma_{11,3}$(Fe)	1462,322 (6)	0,0778 (9)			
$\gamma_{12,3}$(Fe)	1640,475 (5)	0,0621 (21)			
$\gamma_{8,2}$(Fe)	1771,3567 (39)	15,45 (4)	M1+E2		
$\gamma_{3,1}$(Fe)	1810,757 (4)	0,639 (3)	M1+E2		
$\gamma_{9,2}$(Fe)	1963,741 (8)	0,706 (4)	M1+E2		
$\gamma_{10,2}$(Fe)	2015,2147 (47)	3,017 (14)	M1+E2		
$\gamma_{11,2}$(Fe)	2034,7907 (47)	7,743 (13)	M1+E2		2,7
$\gamma_{4,1}$(Fe)	2113,135 (5)	0,376 (3)	M1+E2		
$\gamma_{12,2}$(Fe)	2212,9437 (39)	0,385 (5)	M1+E2		4,1
$\gamma_{5,1}$(Fe)	2276,1310 (36)	0,1181 (40)	E2		4,5
$\gamma_{15,2}$(Fe)	2373,242 (30)	0,078 (6)			
$\gamma_{6,1}$(Fe)	2523,09 (11)	0,063 (4)	M1+E2		4,8
$\gamma_{7,1}$(Fe)	2598,500 (4)	16,969 (40)	M1+E2		5,2
$\gamma_{3,0}$(Fe)	2657,527 (4)	0,0195 (20)	[E2]		6,3
$\gamma_{8,1}$(Fe)	3009,645 (4)	1,039 (19)	M1+E2		6,8
$\gamma_{9,1}$(Fe)	3202,029 (8)	3,205 (13)	M1+E2		7,8

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_T (10^{-4})	α_π (10^{-4})
$\gamma_{10,1}$(Fe)	3253,5030 (44)	7,877 (30)	E2		8,9
$\gamma_{11,1}$(Fe)	3273,079 (4)	1,856 (9)	M1+E2		8
$\gamma_{6,0}$(Fe)	3369,86 (11)	0,0103 (8)	E2		9,6
$\gamma_{12,1}$(Fe)	3451,232 (4)	0,943 (6)	E2		9,7
$\gamma_{13,1}$(Fe)	3548,05 (6)	0,1958 (16)	M1+E2		9
$\gamma_{14,1}$(Fe)	3600,83 (40)	0,0167 (5)			
$\gamma_{15,1}$(Fe)	3611,53 (3)	0,00841 (40)	[E2]		10,3

3 Atomic Data

3.1 Fe

ω_K : 0,355 (4)
$\bar{\omega}_L$: 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	7,05804	}	
	Kβ_5''	7,1083	}	20,67
X_L				
	Lℓ	0,615		
	Lβ	– 0,792		

3.1.2 Auger Electrons

	Energy keV	Relative probability
Auger K		
KLL	5,370 – 5,645	100
KLX	6,158 – 6,400	27,4
KXY	6,926 – 7,105	1,87
Auger L	0,510 – 0,594	

4 Electron Emissions

		Energy keV		Electrons per 100 disint.
e_{AL}	(Fe)	0,510 - 0,594		111,8 (8)
e_{AK}	(Fe)			46,04 (30)
	KLL	5,370 - 5,645	}	
	KLX	6,158 - 6,400	}	
	KXY	6,926 - 7,105	}	
$\beta^+_{0,2}$	max:	1458,9	(20)	18,29 (16)
$\beta^+_{0,2}$	avg:	631,2	(9)	
$\beta^+_{0,4}$	max:	584,1	(20)	0,0086 (22)
$\beta^+_{0,4}$	avg:	247,1	(9)	
$\beta^+_{0,5}$	max:	421,1	(20)	1,04 (2)
$\beta^+_{0,5}$	avg:	178,7	(8)	
$\beta^+_{0,6}$	max:	174	(2)	0,000006 (20)
$\beta^+_{0,6}$	avg:	76,7	(8)	
$\beta^+_{0,7}$	max:	98,7	(20)	0,0080 (7)
$\beta^+_{0,7}$	avg:	45,3	(9)	
$\beta^+_{0,1}$	max:	2697,2	(20)	0,25 (17)
$\beta^+_{0,1}$	avg:	1205,8	(10)	

5 Photon Emissions

5.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(Fe)	0,615 — 0,792		0,581 (17)	
$XK\alpha_2$	(Fe)	6,39091		7,53 (10)	} $K\alpha$
$XK\alpha_1$	(Fe)	6,40391		14,75 (17)	}
$XK\beta_1$	(Fe)	7,05804	}	3,05 (5)	$K'\beta_1$
$XK\beta_5''$	(Fe)	7,1083	}		

5.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{11,8}$(Fe)	263,41 (10)	0,0234 (20)
$\gamma_{8,7}$(Fe)	411,38 (8)	0,0269 (23)
$\gamma_{8,6}$(Fe)	486,54 (11)	0,058 (3)
$\gamma^{\pm}$	511	39,21 (22)
$\gamma_{10,7}$(Fe)	655,0 (8)	0,038 (8)
$\gamma_{11,7}$(Fe)	674,7 (8)	0,035 (5)
$\gamma_{8,5}$(Fe)	733,5085 (23)	0,191 (4)
$\gamma_{7,3}$(Fe)	787,7391 (23)	0,310 (4)
$\gamma_{1,0}$(Fe)	846,7638 (19)	99,9399 (23)
$\gamma_{12,7}$(Fe)	852,78 (5)	0,049 (3)
$\gamma_{8,4}$(Fe)	896,503 (7)	0,0704 (22)
$\gamma_{10,5}$(Fe)	977,363 (4)	1,422 (7)
$\gamma_{11,5}$(Fe)	996,939 (5)	0,116 (6)
$\gamma_{5,2}$(Fe)	1037,8333 (24)	14,03 (5)
$\gamma_{9,4}$(Fe)	1089,03 (24)	0,054 (4)
$\gamma_{10,4}$(Fe)	1140,356 (7)	0,132 (4)
$\gamma_{11,4}$(Fe)	1159,933 (8)	0,088 (3)
$\gamma_{12,5}$(Fe)	1175,0878 (22)	2,249 (9)
$\gamma_{8,3}$(Fe)	1198,78 (20)	0,044 (3)
$\gamma_{2,1}$(Fe)	1238,2736 (22)	66,41 (16)
$\gamma_{13,5}$(Fe)	1272,2 (6)	0,0202 (8)
$\gamma_{15,5}$(Fe)	1335,380 (29)	0,1228 (16)
$\gamma_{7,2}$(Fe)	1360,196 (4)	4,280 (13)
$\gamma_{10,3}$(Fe)	1442,75 (8)	0,180 (4)
$\gamma_{11,3}$(Fe)	1462,34 (12)	0,0778 (9)
$\gamma_{12,3}$(Fe)	1640,450 (5)	0,0621 (21)
$\gamma_{8,2}$(Fe)	1771,327 (3)	15,45 (4)
$\gamma_{3,1}$(Fe)	1810,726 (4)	0,639 (3)
$\gamma_{9,2}$(Fe)	1963,703 (11)	0,706 (4)

	Energy keV	Photons per 100 disint.
$\gamma_{10,2}$(Fe)	2015,176 (5)	3,017 (14)
$\gamma_{11,2}$(Fe)	2034,752 (5)	7,741 (13)
$\gamma_{4,1}$(Fe)	2113,092 (6)	0,376 (3)
$\gamma_{12,2}$(Fe)	2212,898 (3)	0,385 (5)
$\gamma_{5,1}$(Fe)	2276,36 (16)	0,118 (4)
$\gamma_{15,2}$(Fe)	2373,7 (4)	0,078 (6)
$\gamma_{6,1}$(Fe)	2523,0 (8)	0,063 (4)
$\gamma_{7,1}$(Fe)	2598,438 (4)	16,96 (4)
$\gamma_{3,0}$(Fe)	2657,4 (8)	0,0195 (20)
$\gamma_{8,1}$(Fe)	3009,559 (4)	1,038 (19)
$\gamma_{9,1}$(Fe)	3201,930 (11)	3,203 (13)
$\gamma_{10,1}$(Fe)	3253,402 (5)	7,87 (3)
$\gamma_{11,1}$(Fe)	3272,978 (6)	1,855 (9)
$\gamma_{6,0}$(Fe)	3369,69 (30)	0,0103 (8)
$\gamma_{12,1}$(Fe)	3451,119 (4)	0,942 (6)
$\gamma_{13,1}$(Fe)	3547,93 (6)	0,1956 (16)
$\gamma_{14,1}$(Fe)	3600,71 (40)	0,0167 (5)
$\gamma_{15,1}$(Fe)	3611,8 (8)	0,0084 (4)

6 Main Production Modes

$$\begin{cases} \text{Fe} - 56(\text{p,n})\text{Co} - 56 \\ \text{Possible impurities : } \text{Co} - 57, \text{Co} - 58 \end{cases}$$

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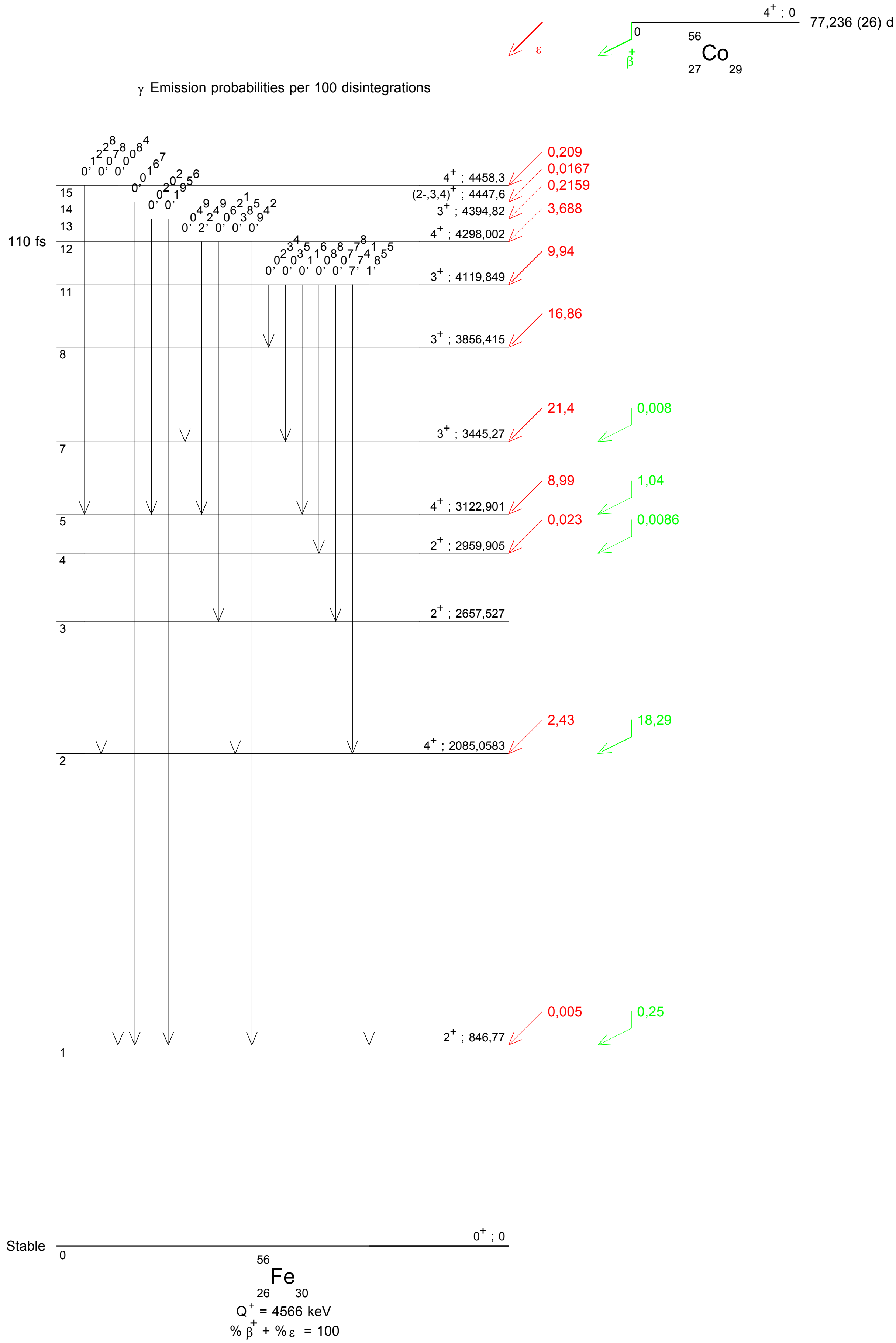
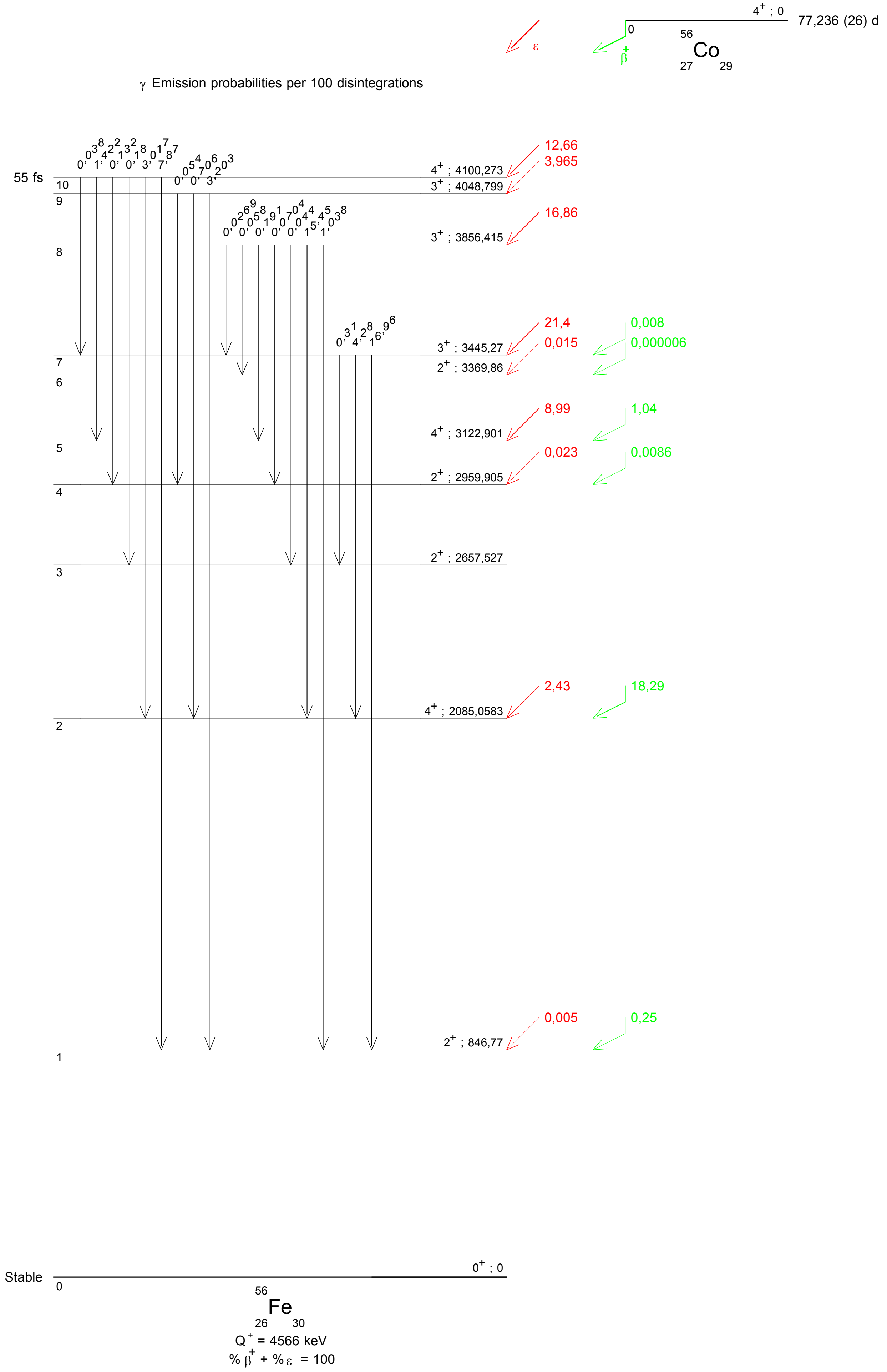
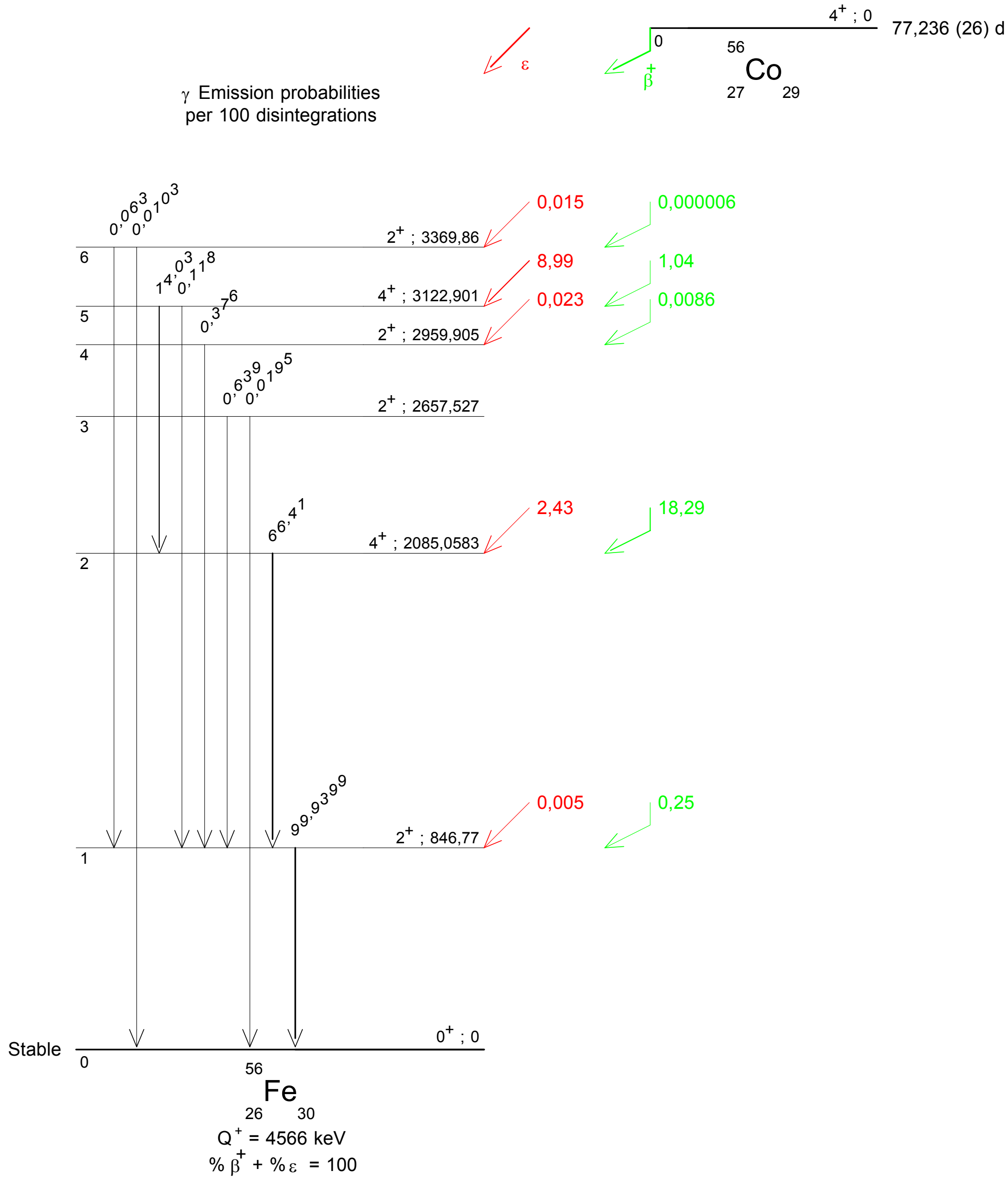

4+ ; 0
77,236 (26) d
ε
β+
56 Co 27 29
γ Emission probabilities per 100 disintegrations
4+ ; 4458,3
(2-,3,4)+ ; 4447,6
3+ ; 4394,82
4+ ; 4298,002
3+ ; 4119,849
3+ ; 3856,415
3+ ; 3445,27
4+ ; 3122,901
2+ ; 2959,905
2+ ; 2657,527
4+ ; 2085,0583
2+ ; 846,77
110 fs
0,209
0,0167
0,2159
3,688
9,94
16,86
21,4
0,008
8,99
1,04
0,023
0,0086
2,43
18,29
0,005
0,25
Stable
0+ ; 0
56 Fe 26 30
Q+ = 4566 keV
% β+ + % ε = 100


4+ ; 0
77,236 (26) d
ε
β+
56 Co 27 29
γ Emission probabilities per 100 disintegrations
55 fs
4+ ; 4100,273
3+ ; 4048,799
3+ ; 3856,415
3+ ; 3445,27
2+ ; 3369,86
4+ ; 3122,901
2+ ; 2959,905
2+ ; 2657,527
4+ ; 2085,0583
2+ ; 846,77
12,66
3,965
16,86
21,4
0,015
8,99
0,023
2,43
0,005
0,008
0,000006
1,04
0,0086
18,29
0,25
Stable
0+ ; 0
56 Fe 26 30
Q+ = 4566 keV
% β+ + % ε = 100


γ Emission probabilities
per 100 disintegrations
ε
β+
4+ ; 0
77,236 (26) d
0
56
Co
27 29
0,015
0,000006
2+ ; 3369,86
8,99
1,04
4+ ; 3122,901
0,023
0,0086
2+ ; 2959,905
2+ ; 2657,527
2,43
18,29
4+ ; 2085,0583
0,005
0,25
2+ ; 846,77
0+ ; 0
Stable
0,063
0,0103
14,03
0,118
0,376
0,639
0,0195
66,41
99,9399
56
Fe
26 30
Q+ = 4566 keV
% β+ + % ε = 100

$^{60}_{27}Co_{33}$

1 Decay Scheme

Co-60 disintegrates by beta minus emissions to excited levels of Ni-60.
Le cobalt 60 se désintègre par émission bêta moins vers des niveaux excités de nickel 60.

2 Nuclear Data

$T_{1/2}(^{60}Co)$	:	5,2710	(8)	a
$Q^-(^{60}Co)$	:	2823,07	(21)	keV

2.1 β^- Transitions

	Energy keV	Probability × 100	Nature	lg ft
$\beta^-_{0,3}$	317,32 (21)	99,88 (3)	Allowed	7,51
$\beta^-_{0,2}$	664,46 (21)	0,002	Unique 2nd Forbidden	
$\beta^-_{0,1}$	1490,56 (21)	0,12 (3)	Unique 2nd Forbidden	14,7

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K (10^{-4})	α_L (10^{-4})	α_T (10^{-4})	α_π (10^{-5})
$\gamma_{3,2}$(Ni)	347,14 (7)	0,0075 (4)	[E2]	49,9 (15)	5,03 (15)	55,7 (17)	
$\gamma_{2,1}$(Ni)	826,10 (3)	0,0076 (8)	M1+45%E2	3,0 (4)	0,291 (17)	3,4 (4)	
$\gamma_{3,1}$(Ni)	1173,240 (3)	99,85 (3)	E2(+M3)	1,51 (7)	0,148 (4)	1,68 (4)	0,62 (7)
$\gamma_{1,0}$(Ni)	1332,508 (4)	99,9988 (2)	E2	1,15 (5)	0,113 (3)	1,28 (5)	3,4 (4)
$\gamma_{2,0}$(Ni)	2158,61 (3)	0,0012 (2)	E2	0,445 (14)	0,043 (2)	0,495 (15)	
$\gamma_{3,0}$(Ni)	2505,748 (5)	0,0000020 (4)	E4	0,780 (3)	0,076 (3)	0,86 (3)	

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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				
	$K\alpha_2$	7,46097		51,24
	$K\alpha_1$	7,47824		100
	$K\beta_3$	8,2647	}	
	$K\beta_5''$	8,3287	}	20,84
X_L				
	$L\ell$	0,74		
	$L\gamma$	– 0,94		

3.1.2 Auger Electrons

	Energy keV	Relative probability
Auger K		
KLL	6,26 – 6,54	100
KLX	7,20 – 7,47	27,6
KXY	8,10 – 8,32	1,9
Auger L	0,7 – 0,9	329

4 Electron Emissions

		Energy keV			Electrons per 100 disint.
e_{AL}	(Ni)	0,7	- 0,9		0,0392 (12)
e_{AK}	(Ni)				0,0154 (5)
	KLL	6,26	- 6,54	}	
	KLX	7,20	- 7,47	}	
	KXY	8,10	- 8,32	}	
$ec_{3,1\ K}$	(Ni)	1164,895	(3)		0,0151 (9)
$ec_{1,0\ K}$	(Ni)	1324,157	(6)		0,0115 (6)
$ec_{1,0\ \alpha}$	(Ni)	310,51	(1)		0,0034 (4)
$\beta^-_{0,3}$	max:	317,32	(21)		99,88 (3)
$\beta^-_{0,3}$	avg:	95,6	(1)		
$\beta^-_{0,2}$	max:	664,46	(21)		0,002
$\beta^-_{0,2}$	avg:	274,8	(1)		
$\beta^-_{0,1}$	max:	1490,56	(21)		0,12 (3)
$\beta^-_{0,1}$	avg:	625,6	(1)		

5 Photon Emissions

5.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(Ni)	0,74 — 0,94		0,0002	
$XK\alpha_2$	(Ni)	7,46097		0,00334 (12)	} $K\alpha$
$XK\alpha_1$	(Ni)	7,47824		0,0065 (3)	}
$XK\beta_3$	(Ni)	8,2647	}		
$XK\beta_1$	(Ni)		}	0,00136 (5)	$K'\beta_1$
$XK\beta''_5$	(Ni)	8,3287	}		

5.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{3,2}$(Ni)	347,14 (7)	0,0075 (4)
$\gamma_{2,1}$(Ni)	826,10 (3)	0,0076 (8)
$\gamma_{3,1}$(Ni)	1173,228 (3)	99,85 (3)
$\gamma_{1,0}$(Ni)	1332,492 (4)	99,9826 (6)
$\gamma_{2,0}$(Ni)	2158,57 (3)	0,0012 (2)
$\gamma_{3,0}$(Ni)	2505,692 (5)	0,0000020 (4)

6 Main Production Modes

Co – 59(n,γ)Co – 60 σ : 18,7 (5) barns
Possible impurities : None.

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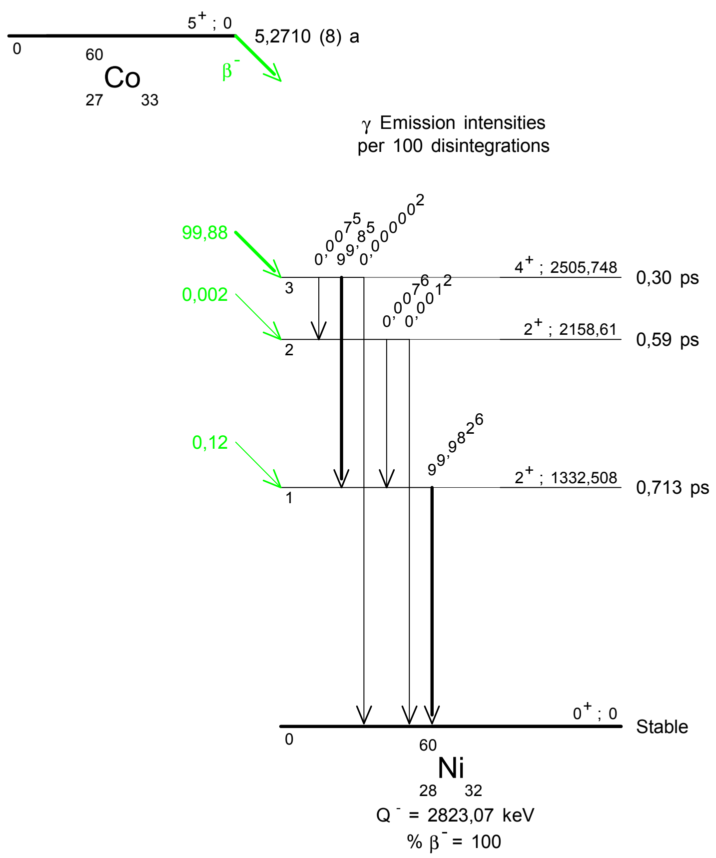
5+ ; 0
5,2710 (8) a
0
60
Co
27 33
β-
γ Emission intensities
per 100 disintegrations
99,88
0,002
0,12
4+ ; 2505,748
0,30 ps
2+ ; 2158,61
0,59 ps
2+ ; 1332,508
0,713 ps
99,9826
0+ ; 0
Stable
60
Ni
28 32
Q - = 2823,07 keV
% β- = 100

63 Ni
28 Ni 35

1 Decay Scheme

Ni-63 decays by beta mimus emission to the Cu-63 fundamental level.
Le nickel 63 se désintègre par émission bêta moins vers le niveau fondamental de cuivre 63.

2 Nuclear Data

$T_{1/2}(^{63}\text{Ni})$	:	98,7	(24)	a
$Q^{-}(^{63}\text{Ni})$	:	66,980	(15)	keV

2.1 β^{-} Transitions

	Energy keV	Probability × 100	Nature	lg ft
$\beta^{-}_{0,0}$	66,980 (15)	100	Allowed	6,7

3 Electron Emissions

		Energy keV	Electrons per 100 disint.
$\beta^{-}_{0,0}$	max:	66,980 (15)	100
$\beta^{-}_{0,0}$	avg:	17,434 (4)	

4 Main Production Modes

$$\begin{cases} \mathrm{Ni}-62(\mathrm{n},\gamma)\mathrm{Ni}-63 \quad \sigma : 14{,}2\ (3)\ \mathrm{barns} \\ \text{Possible impurities : } \mathrm{Ni}-57,\ \mathrm{Ni}-59,\ \mathrm{Ni}-65,\ \mathrm{Ni}-66 \end{cases}$$

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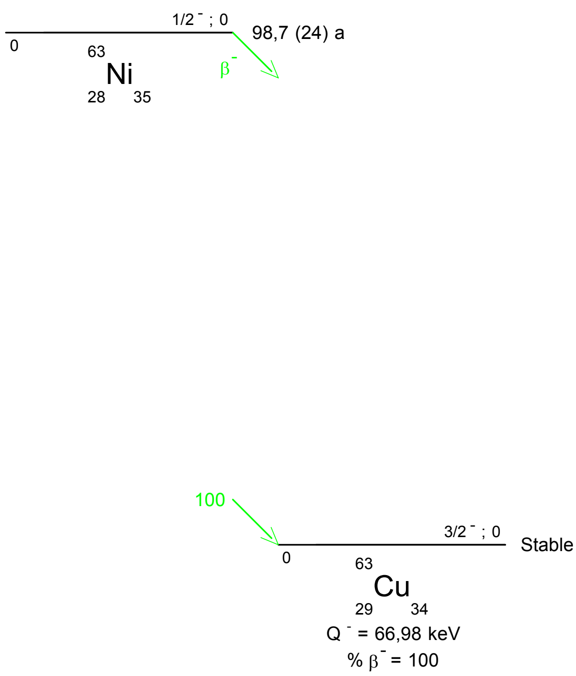
  (Q)


1/2 - ; 0
98,7 (24) a
0
63
Ni
28 35
β-
100
3/2 - ; 0
Stable
0
63
Cu
29 34
Q - = 66,98 keV
% β- = 100

$^{65}_{30}Zn_{35}$

1 Decay Scheme

Zn-65 disintegrates by electron capture to the 1115 keV excited level and by electron capture and beta plus emission to the ground state level of Cu-65.

Le Zn-65 se désintègre par capture électronique vers le niveau excité de 1115 keV du Cu-65 et par capture électronique et émission bêta plus vers le niveau fondamental.

2 Nuclear Data

$T_{1/2}(^{65}Zn)$	:	244,01	(9)	d
$Q^{+}(^{65}Zn)$	:	1352,1	(3)	keV

2.1 Electron Capture Transitions

	Energy keV	Probability × 100	Nature	lg ft	P_K	P_L	P_{M+}
$\epsilon_{0,2}$	236,5 (3)	50,23 (11)	Allowed	5,89	0,8794 (17)	0,1027 (16)	0,0179
$\epsilon_{0,0}$	1352,1 (3)	48,35 (11)	Allowed	7,46	0,8853 (16)	0,0977 (15)	0,017

2.2 β^{+} Transitions

	Energy keV	Probability × 100	Nature	lg ft
$\beta^{+}_{0,0}$	329,9 (3)	1,421 (7)	Allowed	7,46

2.3 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K (10^{-3})	α_L (10^{-3})	α_T (10^{-3})
$\gamma_{2,1}$(Cu)	344,95 (20)	0,00256 (18)	[E2]	5,55 (17)	0,569 (19)	6,20 (19)
$\gamma_{1,0}$(Cu)	770,64 (9)	0,00269 (22)	M1+0,9%E2	0,345 (10)	0,0343 (10)	0,384 (12)
$\gamma_{2,0}$(Cu)	1115,549 (2)	50,23 (11)	M1+16,0%E2	0,166 (6)	0,0162 (5)	0,184 (7)

3 Atomic Data

3.1 Cu

ω_K	:	0,454	(4)
$\bar{\omega}_L$	:	0,0097	(4)
n_{KL}	:	1,357	(4)

3.1.1 X Radiations

		Energy keV		Relative probability
X_K				
	$K\alpha_2$	8,02792		51,33
	$K\alpha_1$	8,04787		100
	$K\beta_1$	8,90539	}	
	$K\beta_5''$	8,9771	}	21,05
X_L				
	$L\ell$	0,811		
	$L\alpha$	0,929 – 0,93		
	$L\beta$	0,932 – 1,022		

3.1.2 Auger Electrons

	Energy keV	Relative probability
Auger K		
KLL	6,76 – 7,12	100
KLX	7,76 – 8,05	27,8
KXY	8,73 – 8,90	1,93
Auger L	0,7 – 1,0	346

4 Electron Emissions

		Energy keV	Electrons per 100 disint.
e_{AL}	(Cu)	0,7 - 1,0	126,6 (7)
e_{AK}	(Cu)		47,5 (4)
	KLL	6,76 - 7,12	}
	KLX	7,76 - 8,05	}
	KXY	8,73 - 8,90	}
$\beta^+_{0,0}$	max:	329,9 (3)	1,421 (7)
$\beta^+_{0,0}$	avg:	143,1 (1)	

5 Photon Emissions

5.1 X-Ray Emissions

		Energy keV	Photons per 100 disint.	
XL	(Cu)	0,811 — 1,022	1,305 (21)	
$XK\alpha_2$	(Cu)	8,02792	11,76 (13)	} $K\alpha$
$XK\alpha_1$	(Cu)	8,04787	22,91 (22)	}
$XK\beta_1$	(Cu)	8,90539 }	4,82 (7)	$K'\beta_1$
$XK\beta''_5$	(Cu)	8,9771 }		

5.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{2,1}$(Cu)	344,95 (20)	0,00254 (18)
$\gamma^{\pm}$	511	2,842 (13)
$\gamma_{1,0}$(Cu)	770,64 (9)	0,00269 (22)
$\gamma_{2,0}$(Cu)	1115,539 (2)	50,22 (11)

6 Main Production Modes

$\left\{ \begin{array}{l} \mathrm{Zn}-64(\mathrm{n},\gamma)\mathrm{Zn}-65 \qquad \sigma : 0{,}76\ (2)\ \mathrm{barns} \\ \text{Possible impurities : } \mathrm{Cu}-64,\ \mathrm{Cu}-67,\ \mathrm{Zn}-69\mathrm{m} \end{array} \right.$

$\left\{ \begin{array}{l} \mathrm{Cu}-65(\mathrm{p,n})\mathrm{Zn}-65 \\ \text{Possible impurities : } \mathrm{Cu}-67,\ \mathrm{Co}-60 \end{array} \right.$

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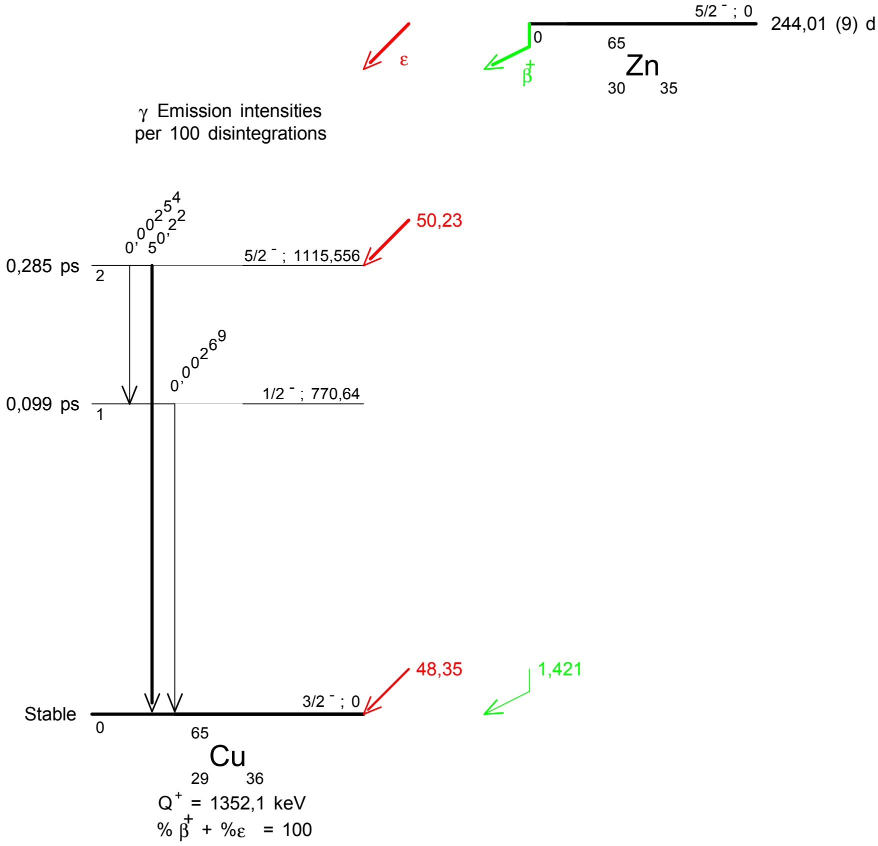
5/2 - ; 0
244,01 (9) d
0
65
Zn
30
35
ε
β+
γ Emission intensities
per 100 disintegrations
0,02254
0,0522
0,285 ps
2
5/2 - ; 1115,556
50,23
0,00269
0,099 ps
1
1/2 - ; 770,64
48,35
1,421
Stable
0
3/2 - ; 0
65
Cu
29
36
Q+ = 1352,1 keV
% β+ + %ε = 100

$^{79}_{34}\mathrm{Se}_{45}$

1 Decay Scheme

Le selenium 79 se désintègre par émission beta moins vers le niveau fondamental de brome 79.
Se-79 disintegrates by beta minus emission to the ground state of Br-79.

2 Nuclear Data

$T_{1/2}$(^{79}Se)	:	3,56	(40)	10^5 a
Q^-(^{79}Se)	:	150,9	(17)	keV

2.1 β^- Transitions

	Energy keV	Probability × 100	Nature	lg ft
$\beta^-_{0,0}$	150,9 (17)	100	1st forbidden unique	10,81

3 Electron Emissions

		Energy keV		Electrons per 100 disint.
$\beta^-_{0,0}$	max:	150,9	(17)	100
$\beta^-_{0,0}$	avg:	52,9	(6)	

4 Main Production Modes

Fission product()

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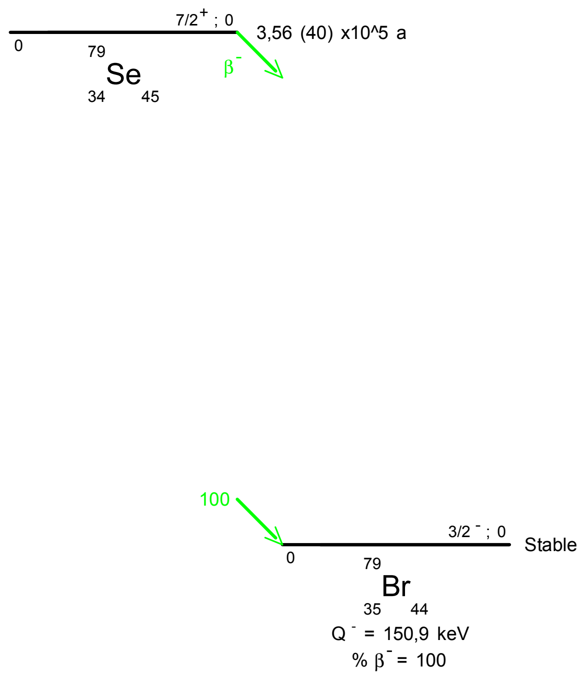
7/2+ ; 0
3,56 (40) x10^5 a
0
79
Se
34 45
β-
100
3/2 - ; 0
Stable
0
79
Br
35 44
Q - = 150,9 keV
% β- = 100

$^{90}_{38}\mathrm{Sr}_{52}$

1 Decay Scheme

Sr-90 disintegrates by beta minus emission to the ground state of Y-90 ($T_{1/2}$ = 2,6684 (13) d).
Le strontium 90 se désintègre par émission bêta moins vers le niveau fondamental d'yttrium 90 ($T_{1/2}$ = 2,6684 (13) d).

2 Nuclear Data

$T_{1/2}(^{90}\mathrm{Sr})$	:	28,80	(7)	a
$T_{1/2}(^{90}\mathrm{Y})$	:	2,6684	(13)	d
$Q^{-}(^{90}\mathrm{Sr})$	:	545,9	(14)	keV

2.1 β^- Transitions

	Energy keV	Probability × 100	Nature	lg ft
$\beta^-_{0,0}$	545,9 (14)	100	Unique 1st Forbidden	9,3

3 Atomic Data

3.1 Y

ω_K	:	0,716	(4)
$\bar{\omega}_L$	:	0,0289	(7)
n_{KL}	:	1,081	(4)

4 Electron Emissions

		Energy keV	Electrons per 100 disint.
$\beta^-_{0,0}$	max:	545,9 (14)	100
$\beta^-_{0,0}$	avg:	196 (1)	

5 Main Production Modes

Fission products
Possible impurities : Sr – 89

6 References

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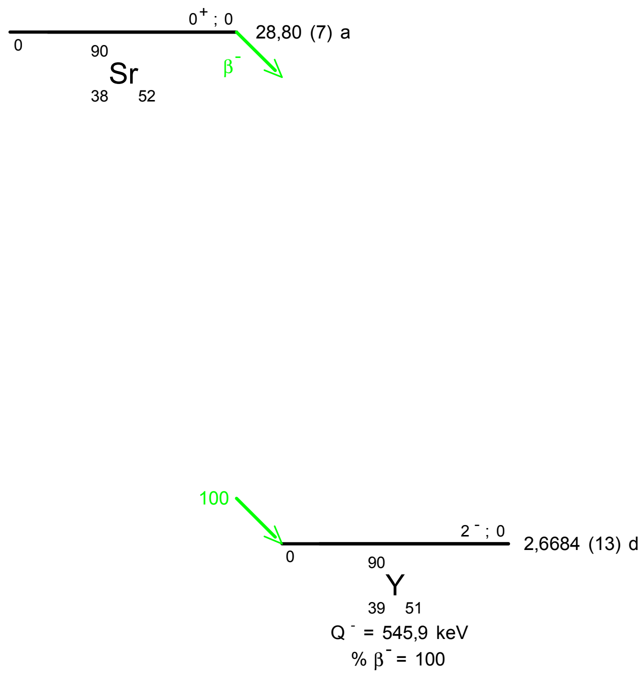
0⁺ ; 0
28,80 (7) a
0
90
Sr
38 52
β⁻
100
2⁻ ; 0
2,6684 (13) d
0
90
Y
39 51
Q⁻ = 545,9 keV
% β⁻ = 100

$^{90}_{39}Y_{51}$

1 Decay Scheme

Y-90 disintegrates by beta minus emission mainly to the Zr-90 fundamental level.
L' yttrium 90 se désintègre par émission bêta moins principalement vers le niveau fondamental du zirconium 90 et vers le niveau excité 1760 keV avec une probabilité de 0,017 %.

2 Nuclear Data

$T_{1/2}(^{90}Y)$	:	2,6684	(13)	d
$Q^-(^{90}Y)$	:	2279,8	(17)	keV

2.1 β^- Transitions

	Energy keV	Probability × 100	Nature	lg ft
$\beta^-_{0,2}$	93,5 (17)	0,0000014 (3)	1st Forbidden	11,1
$\beta^-_{0,1}$	519,1 (17)	0,017 (6)	Unique 1st Forbidden	9,4
$\beta^-_{0,0}$	2279,8 (17)	99,983 (6)	Unique 1st Forbidden	8,05

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_T
$\gamma_{1,0}$(Zr)	1760,7 (2)	0,017 (6)	E0			4,3 (21)
$\gamma_{2,0}$(Zr)	2186,282 (10)	0,0000014 (3)	E2	0,000123 (40)	0,0000133 (40)	0,000139 (40)

3 Atomic Data

3.1 Zr

ω_K	:	0,734	(4)
$\bar{\omega}_L$	:	0,0317	(8)
n_{KL}	:	1,062	(4)

4 Electron Emissions

		Energy keV	Electrons per 100 disint.
$ec^{\pm}_{1,0}$	(Zr)	768,7 (6)	0,00319 (5)
$\beta^-_{0,2}$	max:	93,5 (17)	0,0000014 (3)
$\beta^-_{0,2}$	avg:	24,5 (5)	
$\beta^-_{0,1}$	max:	519,1 (17)	0,017 (6)
$\beta^-_{0,1}$	avg:	163,7 (6)	
$\beta^-_{0,0}$	max:	2279,8 (17)	99,983 (6)
$\beta^-_{0,0}$	avg:	926,7 (8)	

5 Photon Emissions

5.1 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{2,0}$(Zr)	2186,254 (10)	0,0000014 (3)

6 Main Production Modes

Sr – 90(β^-)Y – 90
Y – 89(d,p)Y – 90m
Y – 90m(I.T.)Y – 90
Rb – 87(α,n)Y – 90m
Y – 90m(I.T.)Y – 90
{ Y – 89(n,γ)Y – 90 σ : 1,28 (2) barns
{ Possible impurities : Y – 91

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(Alpha.)
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(Q.)
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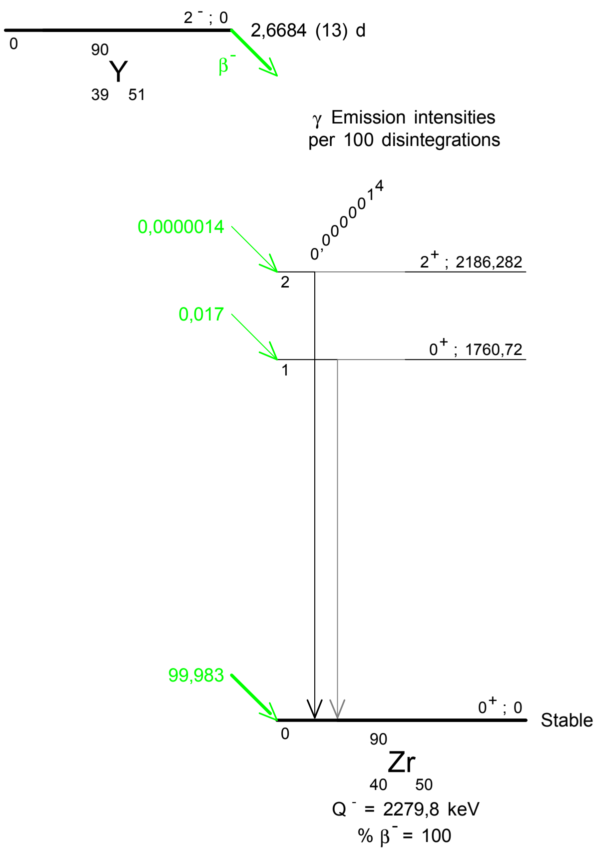
(Half-life)
- R.G.Selwyn, *et al.* Appl. Rad. Isotopes doi:10.1016 (2006)
(internal pair creation coefficient)


2 - ; 0
2,6684 (13) d
0
90
Y
39 51
β-
γ Emission intensities
per 100 disintegrations
0,0000014
0,0000014
2+ ; 2186,282
2
0,017
0+ ; 1760,72
1
99,983
0+ ; 0
Stable
0
90
Zr
40 50
Q - = 2279,8 keV
% β- = 100

90 Y m
39 Y 51

1 Decay Scheme

Y-90m disintegrates 99.9981 (2) % through isomeric transitions to the Y-90 ground state and 0.0019(2) % by beta minus emission to the 2318 keV excited state in Zr-90.
L'yttrium 90 metastable se désexcite pour 99,9981 (2) % vers le niveau fondamental de l'yttrium 90 et se désintègre pour 0,0019 (2) % par émission bêta moins vers le niveau excité de 2318 keV du zirconium 90.

2 Nuclear Data

$T_{1/2}(^{90}\mathrm{Y}^{m})$	:	3,19	(6)	h
$T_{1/2}(^{90}\mathrm{Y})$	:	2,6684	(13)	d
$Q^{-}(^{90}\mathrm{Y}^{m})$	:	2961,8	(17)	keV

2.1 β^- Transitions

	Energy keV	Probability × 100	Nature	lg ft
$\beta^-_{0,1}$	642,9 (17)	0,0019 (2)	Unique 1st Forbidden	9,6

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{1,0}$(Y)	202,53 (3)	99,7 (17)	M1+E2	0,0240 (7)	0,00272 (8)	0,000465 (14)	0,0272 (8)
$\gamma_{2,1}$(Y)	479,51 (7)	99,671 (23)	M4(+E5)	0,0818 (25)	0,01157 (35)	0,00202 (6)	0,0957 (29)
$\gamma_{2,0}$(Y)	682,04 (6)	0,329 (23)	E5	0,0190 (6)	0,00292 (9)	0,000507 (15)	0,0225 (7)
$\gamma_{1,0}$(Zr)	2318,99 (2)	0,0019 (2)	E5	0,000408 (12)	0,0000463 (14)	0,00000804 (24)	0,000463 (14)

3 Atomic Data

3.1 Y

ω_K	:	0,716	(4)
$\bar{\omega}_L$	:	0,0289	(7)
n_{KL}	:	1,081	(4)

3.1.1 X Radiations

		Energy keV		Relative probability
X_K				
	$K\alpha_2$	14,883		52,15
	$K\alpha_1$	14,9581		100
	$K\beta_3$	16,7268	}	
	$K\beta_1$	16,7384	}	
	$K\beta_5''$	16,8792	}	25,11
	$K\beta_5'$	16,8814	}	
	$K\beta_2$	17,0137	}	
	$K\beta_4$	17,0409	}	3,47

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	1,2 – 2,3	

4 Electron Emissions

		Energy keV		Electrons per 100 disint.
e_{AL}	(Y)	1,2 - 2,3		11,56 (10)
e_{AK}	(Y)			2,78 (8)
	KLL	12,205 - 12,784	}	
	KLX	14,238 - 14,956	}	
	KXY	16,251 - 17,034	}	
$ec_{2,1\ K}$	(Y)	462,47 (7)		7,45 (23)
$ec_{2,1\ L}$	(Y)	477,14 - 477,43		1,057 (32)
$ec_{2,1\ M}$	(Y)	479,12 - 479,35		0,185 (5)
$\beta^-_{0,1}$	max:	642,9 (17)		0,0019 (2)
$\beta^-_{0,1}$	avg:	231,9 (7)		

5 Photon Emissions

5.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(Y)	1,6865 — 2,3482		0,343 (8)	
$XK\alpha_2$	(Y)	14,883		2,02 (6)	} $K\alpha$
$XK\alpha_1$	(Y)	14,9581		3,88 (10)	}
$XK\beta_3$	(Y)	16,7268	}		
$XK\beta_1$	(Y)	16,7384	}	0,973 (27)	$K'\beta_1$
$XK\beta''_5$	(Y)	16,8792	}		
$XK\beta'_5$	(Y)	16,8814	}		
$XK\beta_2$	(Y)	17,0137	}		
$XK\beta_4$	(Y)	17,0409	}	0,134 (6)	$K'\beta_2$

5.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{1,0}$(Y)	202,53 (3)	97,1 (14)
$\gamma_{2,1}$(Y)	479,51 (7)	90,97 (24)

	Energy keV	Photons per 100 disint.
$\gamma_{2,0}$(Y)	682,04 (6)	0,322 (22)
$\gamma_{1,0}$(Zr)	2318,958 (20)	0,0019 (2)

6 Main Production Modes

Y − 89(d,p)Y − 90m
Rb − 87(α,n)Y − 90m

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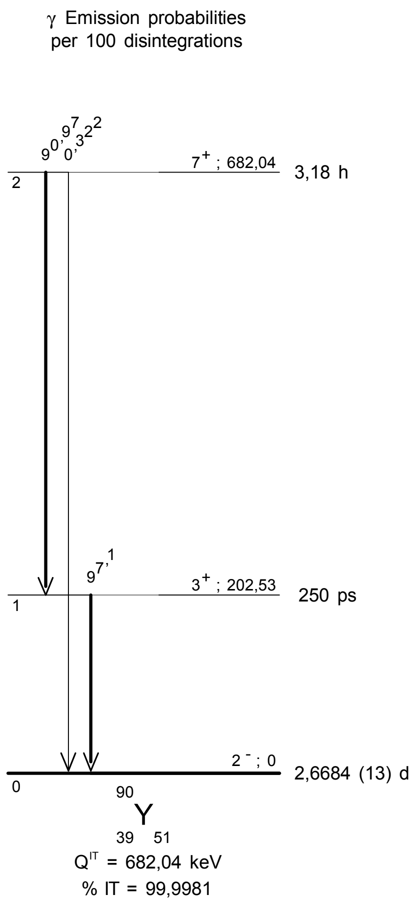
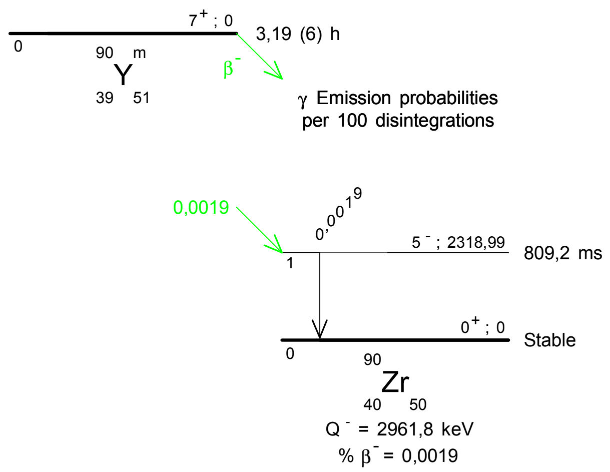

γ Emission probabilities
per 100 disintegrations
90,3
97,22
7+ ; 682,04
3,18 h
2
97,1
3+ ; 202,53
250 ps
1
2- ; 0
2,6684 (13) d
0
90
Y
39 51
Q^IT = 682,04 keV
% IT = 99,9981


7+ ; 0
3,19 (6) h
0
90 m
Y
39 51
β-
γ Emission probabilities
per 100 disintegrations
0,0019
0,0019
5 - ; 2318,99
809,2 ms
1
0+ ; 0
Stable
0
90
Zr
40 50
Q - = 2961,8 keV
% β- = 0,0019

$^{108}_{47}$Ag $_{61}$

1 Decay Scheme

Ag-108 disintegrates by electron capture (2.19 (14) %) and beta plus emission (0.283 (20) %) to excited states in Pd-108 and, by beta minus emission (97.53 (14) %) to excited states in Cd-108.
L'argent 108 se désintègre pour 2,19 (14) % par capture électronique et 0,283 (20) % par émission bêta plus vers les niveaux excités de palladium 108 et pour 97,53 (14) % par émission bêta moins vers le niveau excité de 632 keV et le niveau fondamental de cadmium 108.

2 Nuclear Data

$T_{1/2}(^{108}$Ag)	:	2,382	(11)	min
$Q^{-}(^{108}$Ag)	:	1649	(8)	keV
$Q^{+}(^{108}$Ag)	:	1922	(6)	keV

2.1 β^- Transitions

	Energy keV	Probability × 100	Nature	lg ft
$\beta^-_{0,1}$	1016 (8)	1,63 (26)	Allowed	5,35
$\beta^-_{0,0}$	1649 (8)	95,9 (3)	Allowed	4,43

2.2 β^+ Transitions

	Energy keV	Probability × 100	Nature	lg ft
$\beta^+_{0,1}$	466 (6)	0,0026 (3)	Allowed	5,46
$\beta^+_{0,0}$	900 (6)	0,28 (2)	Allowed	4,7

2.3 Electron Capture Transitions

	Energy keV	Probability × 100	Nature	lg ft	P_K	P_L	P_M
$\epsilon_{0,6}$	382 (6)	0,00224 (27)		6,12	0,8529 (15)	0,1181 (11)	0,0242 (5)
$\epsilon_{0,5}$	481 (6)	0,0170 (21)	Allowed	5,46	0,8560 (14)	0,1157 (11)	0,0237 (5)
$\epsilon_{0,4}$	608 (6)	0,0038 (6)	Allowed	6,37	0,8585 (14)	0,1138 (11)	0,0232 (5)
$\epsilon_{0,3}$	869 (6)	0,243 (39)	Allowed	4,89	0,8611 (14)	0,1118 (11)	0,0227 (5)
$\epsilon_{0,1}$	1488 (6)	0,19 (8)	Allowed	5,46	0,8636 (14)	0,1098 (10)	0,0223 (4)
$\epsilon_{0,0}$	1922 (6)	1,73 (12)	Allowed	4,7	0,8644 (14)	0,1092 (10)	0,0221 (4)

2.4 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{4,2}$(Pd)	383,13 (16)	0,00083 (30)					
$\gamma_{5,3}$(Pd)	388,36 (7)	0,0017 (6)					
$\gamma_{1,0}$(Pd)	433,938 (5)	0,46 (7)	[E2]	0,00784 (24)	0,001021 (31)	0,000192 (6)	0,00909 (27)
$\gamma_{2,1}$(Pd)	497,13 (12)	0,00152 (40)					
$\gamma_{3,1}$(Pd)	618,86 (5)	0,245 (39)					
$\gamma_{1,0}$(Cd)	632,98 (5)	1,63 (26)	E2	0,00300 (9)	0,000380 (11)	0,0000730 (22)	0,00347 (10)
$\gamma_{4,1}$(Pd)	880,26 (10)	0,00298 (48)					
$\gamma_{2,0}$(Pd)	931,07 (12)	0,00048 (8)					
$\gamma_{5,1}$(Pd)	1007,22 (5)	0,0126 (20)					
$\gamma_{6,1}$(Pd)	1106,01 (7)	0,00130 (22)					
$\gamma_{5,0}$(Pd)	1441,16 (5)	0,00269 (44)	[E2]	0,000407 (12)	0,0000469 (14)	0,00000878 (26)	0,000464 (14)
$\gamma_{6,0}$(Pd)	1539,95 (7)	0,00094 (16)					

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

	Energy keV		Relative probability
$K\beta_3$	23,7914	}	
$K\beta_1$	23,819	}	
$K\beta_5''$	24,013	}	27,44
$K\beta_2$	24,2994	}	
$K\beta_4$	24,344	}	4,66

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	1,7 – 3,6	

3.2 Cd

ω_K	:	0,842	(4)
$\bar{\omega}_L$	:	0,0632	(16)
n_{KL}	:	0,953	(4)

3.2.1 X Radiations

		Energy keV		Relative probability
X_K				
	$K\alpha_2$	22,9843		53,17
	$K\alpha_1$	23,1738		100
	$K\beta_3$	26,0615	}	
	$K\beta_1$	26,0958	}	
	$K\beta_5''$	26,304	}	27,87
	$K\beta_2$	26,644	}	
	$K\beta_4$	26,702	}	5,07

3.2.2 Auger Electrons

	Energy keV	Relative probability
Auger K		
KLL	18,556 – 19,507	100
KLX	21,873 – 23,172	43
KXY	25,171 – 26,707	4,63
Auger L	1,8 – 4,0	

4 Electron Emissions

		Energy keV		Electrons per 100 disint.
e_{AL}	(Pd)	1,7 - 3,6		1,97 (4)
e_{AK}	(Pd)			0,341 (25)
	KLL	17,032 - 17,884	}	
	KLX	20,032 - 21,176	}	
	KXY	23,011 - 24,347	}	
e_{AL}	(Cd)	1,8 - 4,0		0,00535 (7)
e_{AK}	(Cd)			0,00084 (5)
	KLL	18,556 - 19,507	}	
	KLX	21,873 - 23,172	}	
	KXY	25,171 - 26,707	}	
$\beta^+_{0,0}$	max:	900	(6)	0,28 (2)
$\beta^+_{0,0}$	avg:	401	(3)	
$\beta^+_{0,1}$	max:	466	(6)	0,0026 (3)
$\beta^+_{0,1}$	avg:	212	(3)	
$\beta^-_{0,1}$	max:	1016	(8)	1,63 (26)
$\beta^-_{0,1}$	avg:	355	(3)	
$\beta^-_{0,0}$	max:	1649	(8)	95,9 (3)
$\beta^-_{0,0}$	avg:	628	(4)	

5 Photon Emissions

5.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
$XK\alpha_2$	(Pd)	21,0203		0,44 (3)	} $K\alpha$
$XK\alpha_1$	(Pd)	21,1774		0,84 (6)	}
$XK\beta_3$	(Pd)	23,7914	}		
$XK\beta_1$	(Pd)	23,819	}	0,230 (16)	$K'\beta_1$
$XK\beta''_5$	(Pd)	24,013	}		
$XK\beta_2$	(Pd)	24,2994	}		
$XK\beta_4$	(Pd)	24,344	}	0,0391 (30)	$K'\beta_2$
$XK\alpha_2$	(Cd)	22,9843		0,00127 (6)	} $K\alpha$
$XK\alpha_1$	(Cd)	23,1738		0,00239 (11)	}
$XK\beta_3$	(Cd)	26,0615	}		
$XK\beta_1$	(Cd)	26,0958	}	0,00067 (4)	$K'\beta_1$
$XK\beta''_5$	(Cd)	26,304	}		
$XK\beta_2$	(Cd)	26,644	}		
$XK\beta_4$	(Cd)	26,702	}	0,000121 (7)	$K'\beta_2$

5.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{4,2}$(Pd)	383,13 (16)	0,00083 (30)
$\gamma_{5,3}$(Pd)	388,36 (7)	0,0017 (6)
$\gamma_{1,0}$(Pd)	433,938 (5)	0,46 (7)
$\gamma_{2,1}$(Pd)	497,13 (12)	0,00152 (40)
$\gamma^{\pm}$	511	0,565 (40)
$\gamma_{3,1}$(Pd)	618,86 (5)	0,245 (39)
$\gamma_{1,0}$(Cd)	632,98 (5)	1,62 (26)
$\gamma_{4,1}$(Pd)	880,26 (10)	0,00298 (48)
$\gamma_{2,0}$(Pd)	931,07 (12)	0,00048 (8)
$\gamma_{5,1}$(Pd)	1007,22 (5)	0,0126 (20)
$\gamma_{6,1}$(Pd)	1106,01 (7)	0,00130 (22)
$\gamma_{5,0}$(Pd)	1441,15 (5)	0,00269 (44)
$\gamma_{6,0}$(Pd)	1539,94 (7)	0,00094 (16)

6 Main Production Modes

Ag – 107(n,γ)Ag – 108
Ag – 107(d,p)Ag – 108

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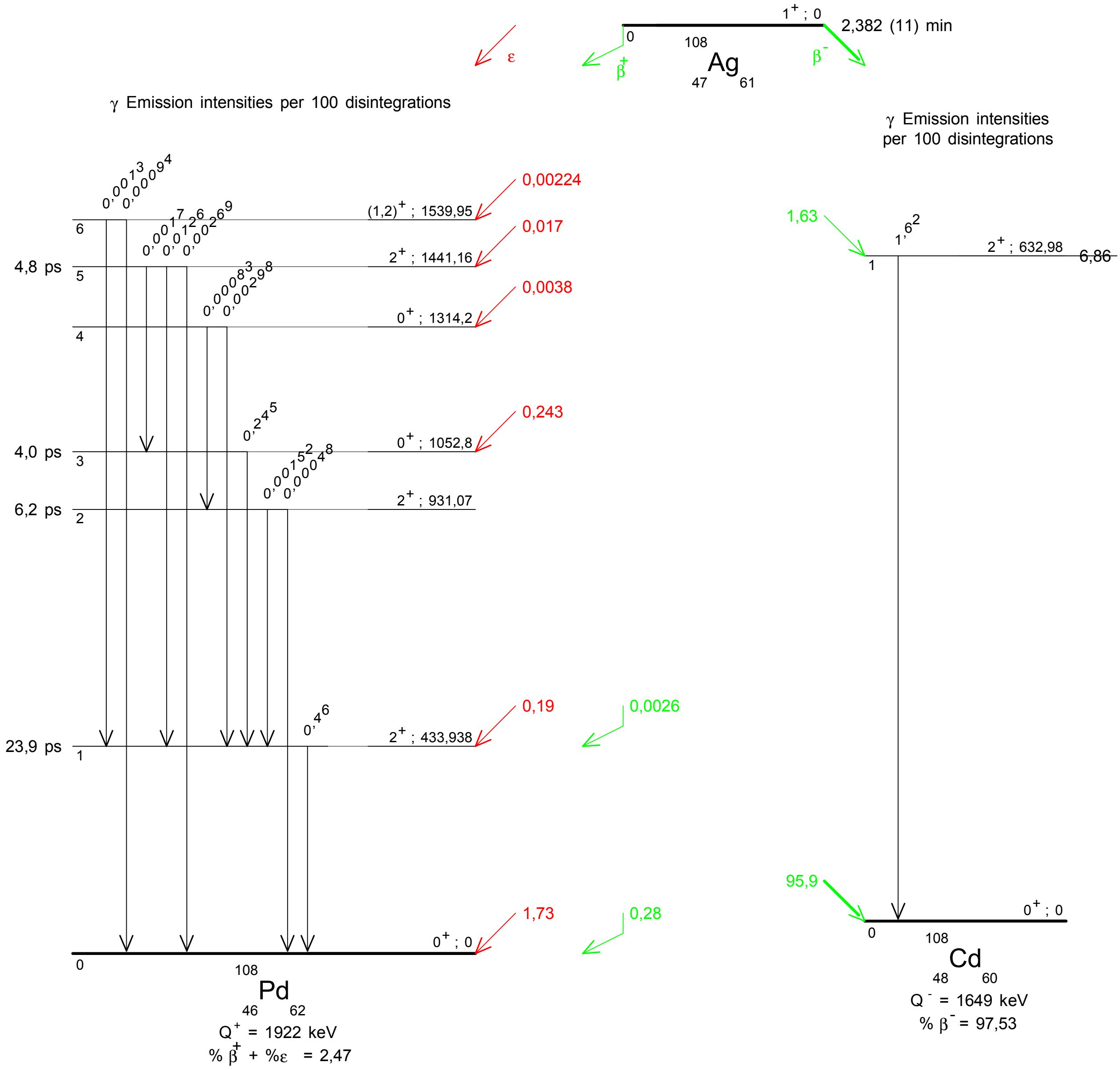
1+ ; 0
2,382 (11) min
108
Ag
47 61
ε
β+
β-
γ Emission intensities per 100 disintegrations
(1,2)+ ; 1539,95
0,00224
2+ ; 1441,16
0,017
0+ ; 1314,2
0,0038
0+ ; 1052,8
0,243
2+ ; 931,07
2+ ; 433,938
0,19
0,0026
0+ ; 0
1,73
0,28
4,8 ps
4,0 ps
6,2 ps
23,9 ps
108
Pd
46 62
Q+ = 1922 keV
% β+ + %ε = 2,47
γ Emission intensities per 100 disintegrations
1,63
2+ ; 632,98
6,86
95,9
0+ ; 0
108
Cd
48 60
Q- = 1649 keV
% β- = 97,53

$^{108}_{47}$Ag$^{m}_{61}$

1 Decay Scheme

Ag-108m disintegrates 90.9(6)% by electron capture to the 1771 keV excited state in Pd-108, and by 9.1(6)% through isomeric transitions (two gamma-rays in cascade) in Ag-108.
L'argent 108 métastable se désintègre pour 90,9(6)% par capture électronique vers le niveau excité de 1771 keV de palladium 108 et se désexcite pour 9,1(6)% vers le niveau fondamental d'argent 108 selon 2 transitions gamma en cascade.

2 Nuclear Data

$T_{1/2}(^{108}\mathrm{Ag}^{m})$	:	438	(9)	a
$T_{1/2}(^{108}\mathrm{Ag})$	:	2,395	(6)	min
$Q^{+}(^{108}\mathrm{Ag}^{m})$	:	2031	(6)	keV

2.1 Electron Capture Transitions

	Energy keV	Probability × 100	Nature	lg ft	P_K	P_L	P_M
$\epsilon_{0,3}$	260 (6)	90,9 (6)	Allowed	9,24	0,8457 (15)	0,1238 (12)	0,0256 (5)

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{2,1}$(Ag)	30,309 (8)	9,1 (6)	M4	9,77 (29) 10^3	320 (10) 10^3	82,0 (25) 10^3	425 (13) 10^3
$\gamma_{1,0}$(Ag)	79,131 (3)	9,1 (6)	E1	0,269 (8)	0,0336 (10)	0,00633 (19)	0,310 (9)
$\gamma_{1,0}$(Pd)	433,938 (4)	90,9 (6)	[E2]	0,00784 (24)	0,001021 (31)	0,000192 (6)	0,00909 (27)
$\gamma_{2,1}$(Pd)	614,31 (5)	90,8 (16)	E2	0,00291 (9)	0,000360 (11)	0,0000677 (20)	0,00335 (10)
$\gamma_{3,2}$(Pd)	722,91 (5)	91,0 (16)	E2	0,00191 (6)	0,000231 (7)	0,0000434 (13)	0,00219 (7)

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				
	$K\alpha_2$	21,0203		52,93
	$K\alpha_1$	21,1774		100
	$K\beta_3$	23,7914	}	
	$K\beta_1$	23,819	}	
	$K\beta_5''$	24,013	}	27,44
	$K\beta_2$	24,2994	}	
	$K\beta_4$	24,344	}	4,66

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	1,7 – 3,6	

3.2 Ag

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

3.2.1 X Radiations

		Energy keV		Relative probability
X_K				
	$K\alpha_2$	21,9906		53,05
	$K\alpha_1$	22,16317		100
	$K\beta_3$	24,9118	}	
	$K\beta_1$	24,9427	}	
	$K\beta_5''$	25,146	}	27,7
	$K\beta_2$	25,4567	}	
	$K\beta_4$	25,512	}	4,82

3.2.2 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	1,9 – 3,8	

4 Electron Emissions

		Energy keV		Electrons per 100 disint.
e_{AL}	(Pd)	1,7 - 3,6		83,1 (4)
e_{AK}	(Pd)			14,1 (4)
	KLL	17,032 - 17,884	}	
	KLX	20,032 - 21,176	}	
	KXY	23,011 - 24,347	}	
e_{AL}	(Ag)	1,9 - 3,8		8,60 (7)
e_{AK}	(Ag)			0,349 (27)
	KLL	17,79 - 18,69	}	
	KLX	20,945 - 22,160	}	
	KXY	24,079 - 25,507	}	
$ec_{1,0\ K}$	(Ag)	53,617 (3)		1,80 (14)
$ec_{1,0\ L}$	(Ag)	75,325 - 75,780		0,225 (17)
$ec_{1,0\ K}$	(Pd)	409,588 (4)		0,716 (22)
$ec_{1,0\ L}$	(Pd)	430,334 - 430,765		0,0938 (29)
$ec_{2,1\ K}$	(Pd)	589,96 (5)		0,268 (9)
$ec_{3,2\ K}$	(Pd)	698,56 (5)		0,175 (6)

5 Photon Emissions

5.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
$XK\alpha_2$	(Pd)	21,0203		18,38 (18)	} $K\alpha$
$XK\alpha_1$	(Pd)	21,1774		34,72 (30)	}
$XK\beta_3$	(Pd)	23,7914	}		
$XK\beta_1$	(Pd)	23,819	}	9,53 (12)	$K'\beta_1$
$XK\beta_5''$	(Pd)	24,013	}		
$XK\beta_2$	(Pd)	24,2994	}		
$XK\beta_4$	(Pd)	24,344	}	1,62 (6)	$K'\beta_2$
$XK\alpha_2$	(Ag)	21,9906		0,49 (4)	} $K\alpha$
$XK\alpha_1$	(Ag)	22,16317		0,93 (7)	}

		Energy keV		Photons per 100 disint.	
$XK\beta_3$	(Ag)	24,9118	}		
$XK\beta_1$	(Ag)	24,9427	}	0,256 (19)	$K'\beta_1$
$XK\beta_5''$	(Ag)	25,146	}		
$XK\beta_2$	(Ag)	25,4567	}		
$XK\beta_4$	(Ag)	25,512	}	0,045 (4)	$K'\beta_2$

5.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{2,1}$(Ag)	30,309 (8)	0,0000215 (18)
$\gamma_{1,0}$(Ag)	79,131 (3)	6,9 (5)
$\gamma_{1,0}$(Pd)	433,938 (5)	90,1 (6)
$\gamma_{2,1}$(Pd)	614,276 (4)	90,5 (16)
$\gamma_{3,2}$(Pd)	722,907 (10)	90,8 (16)

6 Main Production Modes

Ag – 107(n,γ)Ag – 108m

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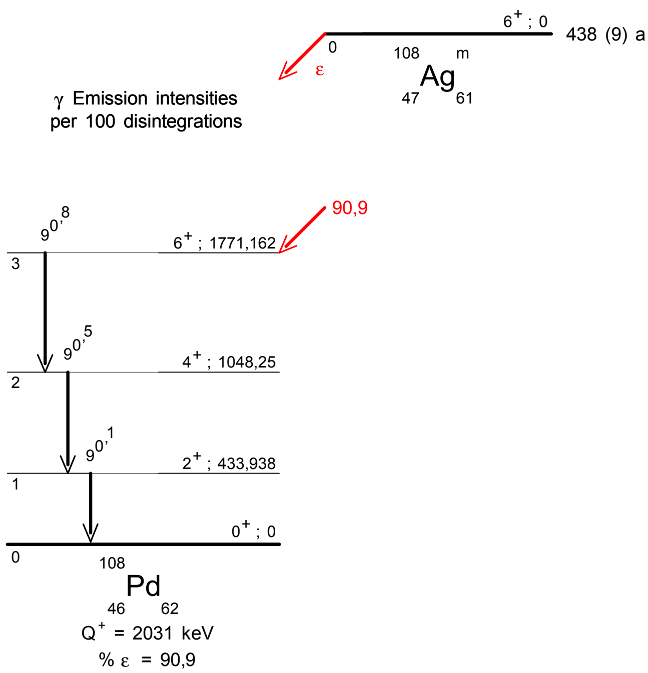
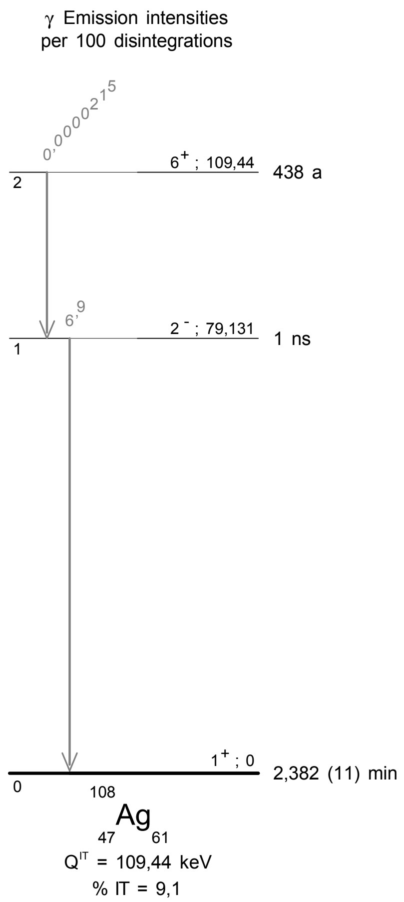

6+ ; 0
438 (9) a
0
ε
108 m
Ag
47 61
γ Emission intensities
per 100 disintegrations
90,9
90,8
6+ ; 1771,162
3
90,5
4+ ; 1048,25
2
90,1
2+ ; 433,938
1
0+ ; 0
0
108
Pd
46 62
Q+ = 2031 keV
% ε = 90,9


γ Emission intensities
per 100 disintegrations
0,0000215
6,9
6+ ; 109,44
438 a
2
2- ; 79,131
1 ns
1
1+ ; 0
2,382 (11) min
0
108
Ag
47
61
QIT = 109,44 keV
% IT = 9,1

$^{111}_{49}In_{62}$

1 Decay Scheme

In-111 disintegrates by > 99.99% electron capture via the excited level of 416.6 keV in Cd-111 and by < 0.01% electron capture via the isomer level in Cd-111 ($T_{1/2}$ = 48.5 min) at 396.2 keV. Transitions to the ground state and the excited level of 245.4 keV in Cd-111 have not been observed.
L'indium 111 se désintègre par capture électronique (> 99,99%) vers le niveau excité de 416 keV et vers le niveau excité de 396 keV et de 48,5 min de période du cadmium 111. Aucune transition vers le niveau de 245 keV et le niveau fondamental n'a été observée.

2 Nuclear Data

$T_{1/2}(^{111}In)$	:	2,8049	(4)	d
$Q^{+}(^{111}In)$	:	861,8	(46)	keV

2.1 Electron Capture Transitions

	Energy keV	Probability × 100	Nature	lg ft	P_K	P_L	P_M
$\epsilon_{0,3}$	445 (5)	99,995 (5)	Allowed	5	0,8518 (2)	0,11835 (13)	0,02989 (4)
$\epsilon_{0,2}$	466 (5)	0,005 (5)	1st Forbidden	9	0,8524 (2)	0,1179 (2)	0,02975 (4)

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{2,1}$(Cd)	150,81 (3)	0,005 (5)	E3	1,45 (3)	0,673 (14)	0,137 (3)	2,28 (5)
$\gamma_{3,1}$(Cd)	171,28 (3)	99,995 (5)	M1 + 2 % E2	0,0897 (22)	0,0113 (3)	0,00217 (5)	0,1036 (24)
$\gamma_{1,0}$(Cd)	245,35 (4)	100	E2	0,0524 (10)	0,00818 (16)	0,00159 (3)	0,0625 (7)

3 Atomic Data

3.1 Cd

ω_K	:	0,842	(4)
$\bar{\omega}_L$	:	0,0632	(16)
n_{KL}	:	0,953	(4)

3.1.1 X Radiations

		Energy keV		Relative probability
X_K				
	$K\alpha_2$	22,9843		53,17
	$K\alpha_1$	23,1739		100
	$K\beta_3$	26,0615	}	
	$K\beta_1$	26,0958	}	
	$K\beta_5''$	26,304	}	27,9
	$K\beta_2$	26,644	}	
	$K\beta_4$	26,7106	}	5,1
X_L				
	$L\ell$	2,77		
	$L\alpha$	3,127 – 3,134		
	$L\eta$	2,957		
	$L\beta$	3,316 – 3,528		
	$L\gamma$	3,718 – 3,95		

3.1.2 Auger Electrons

	Energy keV	Relative probability
Auger K		
KLL	18,675 – 19,636	100
KLX	21,923 – 23,172	43
KXY	25,171 – 26,028	4,63
Auger L	3,4 – 3,8	

4 Electron Emissions

		Energy keV		Electrons per 100 disint.
e_{AL}	(Cd)	3,4 - 3,8		100,5 (8)
e_{AK}	(Cd)			15,5 (4)
	KLL	18,675 - 19,636	}	
	KLX	21,923 - 23,172	}	
	KXY	25,171 - 26,028	}	
$ec_{3,1\ K}$	(Cd)	144,57 (3)		8,13 (20)
$ec_{3,1\ L}$	(Cd)	167,3 - 167,7		1,02 (3)
$ec_{3,1\ M}$	(Cd)	170,51 - 170,88		0,197 (5)
$ec_{1,0\ K}$	(Cd)	218,64 (4)		4,93 (10)
$ec_{1,0\ L}$	(Cd)	241,33 - 241,81		0,770 (15)
$ec_{1,0\ M}$	(Cd)	244,58 - 244,95		0,150 (3)

5 Photon Emissions

5.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(Cd)	2,77 — 3,95		6,78 (14)	
$XK\alpha_2$	(Cd)	22,9843		23,65 (18)	} $K\alpha$
$XK\alpha_1$	(Cd)	23,1739		44,47 (26)	}
$XK\beta_3$	(Cd)	26,0615	}		
$XK\beta_1$	(Cd)	26,0958	}	12,40 (14)	$K'\beta_1$
$XK\beta_5''$	(Cd)	26,304	}		
$XK\beta_2$	(Cd)	26,644	}		
$XK\beta_4$	(Cd)	26,7106	}	2,26 (7)	$K'\beta_2$

5.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{2,1}$(Cd)	150,81 (3)	0,0015 (15)
$\gamma_{3,1}$(Cd)	171,28 (3)	90,61 (20)
$\gamma_{1,0}$(Cd)	245,35 (4)	94,12 (6)

6 Main Production Modes

$\begin{cases} \text{Cd} - 112\text{(p,2n)In} - 111 \\ \text{Possible impurities : none} \end{cases}$

$\begin{cases} \text{Cd} - 111\text{(p,n)In} - 111 \\ \text{Possible impurities : In} - 114\text{m} \end{cases}$

7 References

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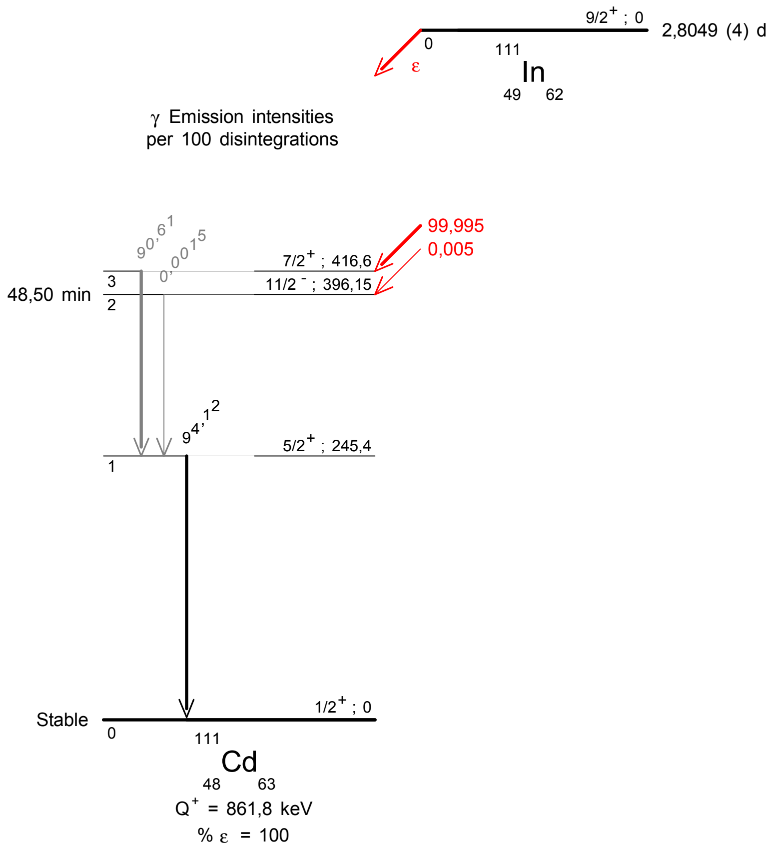
9/2+ ; 0
2,8049 (4) d
0
ε
111
In
49 62
γ Emission intensities
per 100 disintegrations
90,61
0,0015
99,995
0,005
7/2+ ; 416,6
11/2 - ; 396,15
48,50 min
3
2
94,12
5/2+ ; 245,4
1
Stable
1/2+ ; 0
0
111
Cd
48 63
Q+ = 861,8 keV
% ε = 100

$^{125}_{51}$Sb $_{74}$

1 Decay Scheme

Sb-125 decays by beta minus emission to levels in Te-125. The percentage of disintegrations to the Te-125m ($T_{1/2}$ *= 57 d) is p = 22.9 (9)%. The two gamma emission intensities with energy 35-keV and 109-keV are given for the two nuclides being in equilibrium.*
L'antimoine 125 se désintègre par émissions bêta moins vers des niveaux excités de tellure 125. Les intensités des deux émissions gamma de 35 keV et 109 keV sont données pour les deux radionucléides étant à l'équilibre. Le pourcentage de désintégrations conduisant à l'isomère de Te-125 de 57 jours de période est p = 22,9 (9)%.
Le rapport au temps t des activités Te-125m / Sb-125 dans le Sb-125 initialement pur est :
$p \times [T1/(T1 - T2)] \times [1 - e^{-(\mathrm{Log}2 \times [(T1-T2)/(T1 \times T2)] \times t}]$
T1 et T2 étant respectivement les périodes de Sb-125 et Te-125m.
Pour t $\geq$ 1,6 a, ce qui correspond à dix fois la période de Te-125m, ce rapport est égal à :
p × [T1 / (T1-T2)] = 0,243 (10)
avec p = 0,229 (9).

2 Nuclear Data

$T_{1/2}(^{125}\mathrm{Sb})$	:	2,75855	(25)	a
$Q^{-}(^{125}\mathrm{Sb})$	:	766,7	(21)	keV

2.1 β^- Transitions

	Energy keV	Probability × 100	Nature	lg ft
$\beta^-_{0,12}$	95,3 (21)	13,58 (12)	Allowed	6,93
$\beta^-_{0,10}$	124,5 (21)	5,82 (5)	Allowed	7,66
$\beta^-_{0,9}$	130,6 (21)	18,07 (19)	Allowed	7,23
$\beta^-_{0,7}$	241,5 (21)	1,251 (12)	1st forbidden	9,23
$\beta^-_{0,6}$	303,3 (21)	40,3 (4)	Allowed	8,04
$\beta^-_{0,5}$	323,1 (21)	0,089 (10)	2nd forbidden	10,79
$\beta^-_{0,3}$	444,0 (21)	7,54 (9)	1st forbidden	9,32
$\beta^-_{0,2}$	621,0 (21)	13,4 (9)	Unique 1st forbidden	9,77

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{6,5}$(Te)	19,80 (6)	0,248 (9)	[M1]		9,1 (3)	1,82 (5)	11,3 (3)
$\gamma_{1,0}$(Te)	35,489 (5)	88,7 (37)	M1+0,084%E2	12,1 (4)	1,64 (5)	0,329 (10)	14,3 (4)
$\gamma_{2,1}$(Te)	109,276 (15)	24 (8)	M4	182 (5)	135 (4)	31 (1)	354,6 (110)
$\gamma_{9,7}$(Te)	110,895 (12)	0,00125 (10)	[E1]	0,127 (4)	0,0165 (5)	0,00328 (11)	0,147 (4)
$\gamma_{10,7}$(Te)	116,955 (11)	0,2964 (46)	E1	0,109 (3)	0,0141 (4)	0,00281 (8)	0,127 (4)
$\gamma_{9,6}$(Te)	172,719 (8)	0,221 (10)	M1(+E2)	0,129 (4)	0,0168 (5)	0,00337 (11)	0,151 (5)
$\gamma_{3,2}$(Te)	176,314 (2)	7,96 (9)	M1+26,5% E2	0,139 (4)	0,0221 (7)	0,00449 (13)	0,167 (5)
$\gamma_{10,6}$(Te)	178,842 (5)	0,0405 (22)	M1+E2	0,147 (26)	0,026 (11)	0,0054 (21)	0,18 (4)
$\gamma_{10,5}$(Te)	198,654 (11)	0,0152 (8)	[E2]	0,123 (4)	0,0245 (8)	0,00504 (15)	0,154 (5)
$\gamma_{7,3}$(Te)	204,138 (10)	0,353 (17)	M1+72% E2	0,104 (3)	0,0189 (6)	0,00386 (11)	0,128 (4)
$\gamma_{12,6}$(Te)	208,077 (5)	0,269 (9)	M1+1,1% E2	0,0791 (24)	0,0102 (3)	0,00205 (6)	0,092 (3)
$\gamma_{12,5}$(Te)	227,891 (10)	0,142 (3)	(M1+E2)	0,070 (11)	0,011 (4)	0,0023 (6)	0,084 (13)
$\gamma_{9,3}$(Te)	314,95 (11)	0,0043 (3)	(E1)	0,00726 (22)	0,00089 (3)	0,000179 (5)	0,00839 (30)
$\gamma_{10,3}$(Te)	321,040 (4)	0,420 (4)	E1	0,00691 (21)	0,000856 (30)	0,000170 (5)	0,00798 (24)
$\gamma_{7,2}$(Te)	380,452 (8)	1,548 (15)	E2	0,0154 (5)	0,00233 (7)	0,000473 (15)	0,0183 (5)
$\gamma_{5,1}$(Te)	408,065 (10)	0,185 (2)	M1+69% E2	0,0129 (4)	0,00181 (5)	0,00036 (1)	0,0152 (5)
$\gamma_{6,1}$(Te)	427,874 (4)	29,96 (24)	M1+22,4% E2	0,0119 (4)	0,00154 (5)	0,00031 (1)	0,0138 (4)
$\gamma_{5,0}$(Te)	443,555 (9)	0,309 (4)	M1+84% E2	0,0100 (3)	0,00142 (4)	0,00029 (1)	0,0118 (4)
$\gamma_{6,0}$(Te)	463,365 (4)	10,59 (9)	E2	0,0086 (3)	0,00124 (4)	0,00025 (1)	0,0102 (3)
$\gamma_{10,2}$(Te)	497,37 (12)	0,0033 (3)	[M2]	0,0271 (8)	0,00373 (11)	0,00075 (2)	0,0318 (10)
$\gamma_{9,1}$(Te)	600,599 (2)	17,85 (18)	E2	0,00421 (13)	0,00058 (2)	0,000116 (4)	0,00498 (15)
$\gamma_{10,1}$(Te)	606,715 (3)	5,05 (5)	E2	0,00415 (13)	0,00056 (2)	0,000113 (4)	0,00485 (15)
$\gamma_{12,1}$(Te)	635,950 (3)	11,38 (10)	M1+9,9% E2	0,00455 (14)	0,00057 (2)	0,000113 (5)	0,00526 (16)
$\gamma_{12,0}$(Te)	671,443 (6)	1,790 (16)	E2	0,00319 (10)	0,00043 (1)	0,000086 (2)	0,00373 (11)

3 Atomic Data

3.1 Te

ω_K	:	0,875	(4)
$\bar{\omega}_L$	:	0,0862	(35)
n_{KL}	:	0,917	(4)

3.1.1 X Radiations

		Energy keV		Relative probability
X_K				
	$K\alpha_2$	27,202		53,7
	$K\alpha_1$	27,473		100
	$K\beta_3$	30,945	}	
	$K\beta_1$	30,996	}	
	$K\beta_5''$	31,236	}	28,6
	$K\beta_2$	31,701	}	
	$K\beta_4$	31,774	}	6,2

3.1.2 Auger Electrons

	Energy keV	Relative probability
Auger K		
KLL	21,804 – 22,989	100
KLX	25,814 – 27,470	45,5
KXY	29,80 – 31,81	5,1
Auger L	2,3 – 4,8	

4 Electron Emissions

		Energy keV		Electrons per 100 disint.
e_{AL}	(Te)	2,3 - 4,8		70,6 (9)
e_{AK}	(Te)			10,5 (6)
	KLL	21,804 - 22,989	}	
	KLX	25,814 - 27,470	}	
	KXY	29,80 - 31,81	}	
$ec_{1,0\ T}$	(Te)	3,675 - 35,487		82,8 (35)
$ec_{1,0\ K}$	(Te)	3,675 (5)		70,1 (32)
$ec_{6,5\ L}$	(Te)	14,9 - 15,5		0,184 (8)
$ec_{1,0\ L}$	(Te)	30,550 - 31,148		9,5 (4)
$ec_{1,0\ M}$	(Te)	34,483 - 34,917		1,9 (1)
$ec_{2,1\ K}$	(Te)	77,462 (15)		12,43 (41)
$ec_{2,1\ T}$	(Te)	77,462 - 109,274		24 (8)
$ec_{2,1\ L}$	(Te)	104,337 - 104,935		9,22 (32)
$ec_{2,1\ M}$	(Te)	108,270 - 108,704		2,12 (8)
$ec_{2,1\ N}$	(Te)	109,108 - 109,236		0,451 (16)
$ec_{3,2\ K}$	(Te)	144,500 (2)		0,948 (29)
$ec_{3,2\ L}$	(Te)	171,375 - 171,973		0,151 (5)
$ec_{6,1\ K}$	(Te)	396,060 (4)		0,352 (12)
$ec_{6,0\ K}$	(Te)	431,551 (4)		0,0901 (32)
$ec_{9,1\ K}$	(Te)	568,785 (2)		0,0748 (24)
$ec_{12,1\ K}$	(Te)	604,136 (3)		0,0515 (16)
$\beta^-_{0,12}$	max:	95,3 (21)		13,58 (12)
$\beta^-_{0,12}$	avg:	24,9 (6)		
$\beta^-_{0,10}$	max:	124,5 (21)		5,82 (5)
$\beta^-_{0,10}$	avg:	33,0 (6)		
$\beta^-_{0,9}$	max:	130,6 (21)		18,07 (19)
$\beta^-_{0,9}$	avg:	34,7 (6)		
$\beta^-_{0,7}$	max:	241,5 (21)		1,251 (12)

		Energy keV		Electrons per 100 disint.
$\beta^-_{0,7}$	avg:	67,5	(7)	
$\beta^-_{0,6}$	max:	303,3	(21)	40,3 (4)
$\beta^-_{0,6}$	avg:	86,9	(7)	
$\beta^-_{0,5}$	max:	323,1	(21)	0,089 (10)
$\beta^-_{0,5}$	avg:	93,3	(7)	
$\beta^-_{0,3}$	max:	444,0	(21)	7,54 (9)
$\beta^-_{0,3}$	avg:	134,5	(8)	
$\beta^-_{0,2}$	max:	621,0	(21)	13,4 (9)
$\beta^-_{0,2}$	avg:	215,5	(8)	

5 Photon Emissions

5.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(Te)	3,3348 — 4,8228		6,56 (21)	
XKα_2	(Te)	27,202		21,0 (9)	} Kα
XKα_1	(Te)	27,473		39,1 (15)	}
XKβ_3	(Te)	30,945	}		
XKβ_1	(Te)	30,996	}	11,2 (5)	K$'\beta_1$
XKβ_5''	(Te)	31,236	}		
XKβ_2	(Te)	31,701	}		
XKβ_4	(Te)	31,774	}	2,43 (12)	K$'\beta_2$

5.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{6,5}$(Te)	19,80 (6)	0,0202 (5)
$\gamma_{1,0}$(Te)	35,489 (5)	5,79 (18)
$\gamma_{2,1}$(Te)	109,276 (15)	0,0683 (12)
$\gamma_{9,7}$(Te)	110,895 (12)	0,00109 (9)
$\gamma_{10,7}$(Te)	116,955 (11)	0,263 (4)
$\gamma_{9,6}$(Te)	172,719 (8)	0,192 (9)
$\gamma_{3,2}$(Te)	176,314 (2)	6,82 (7)
$\gamma_{10,6}$(Te)	178,842 (5)	0,0343 (15)
$\gamma_{10,5}$(Te)	198,654 (11)	0,0132 (7)
$\gamma_{7,3}$(Te)	204,138 (10)	0,313 (15)
$\gamma_{12,6}$(Te)	208,077 (5)	0,246 (8)
$\gamma_{12,5}$(Te)	227,891 (10)	0,131 (3)
$\gamma_{9,3}$(Te)	314,95 (11)	0,0043 (3)
$\gamma_{10,3}$(Te)	321,040 (4)	0,416 (4)
$\gamma_{7,2}$(Te)	380,452 (8)	1,520 (15)
$\gamma_{5,1}$(Te)	408,065 (10)	0,182 (2)
$\gamma_{6,1}$(Te)	427,874 (4)	29,55 (24)
$\gamma_{5,0}$(Te)	443,555 (9)	0,305 (4)
$\gamma_{6,0}$(Te)	463,365 (4)	10,48 (9)
$\gamma_{10,2}$(Te)	497,37 (12)	0,0032 (3)
$\gamma_{9,1}$(Te)	600,597 (2)	17,76 (18)
$\gamma_{10,1}$(Te)	606,713 (3)	5,02 (5)
$\gamma_{12,1}$(Te)	635,950 (3)	11,32 (10)
$\gamma_{12,0}$(Te)	671,441 (6)	1,783 (16)

6 Main Production Modes

Sn – 124(n,γ)Sn – 125m σ : 0,130 (5) barns

{ Sn – 125m(β^-)Sb – 125
Possible impurities : Half – life = 9,7 min

{ Sn – 124(n,γ)Sn – 125 σ : 0,004 (2) barns
Possible impurities : Half – life = 9,5 d

{ Sn – 125(β^-)Sb – 125
Possible impurities : Sn – 113, Sn – 117m, Sn – 119m, Sn – 121m, Sn – 123m, Sn – 125

{ Fission product()
Possible impurities : Sb – 121m, Sn – 125

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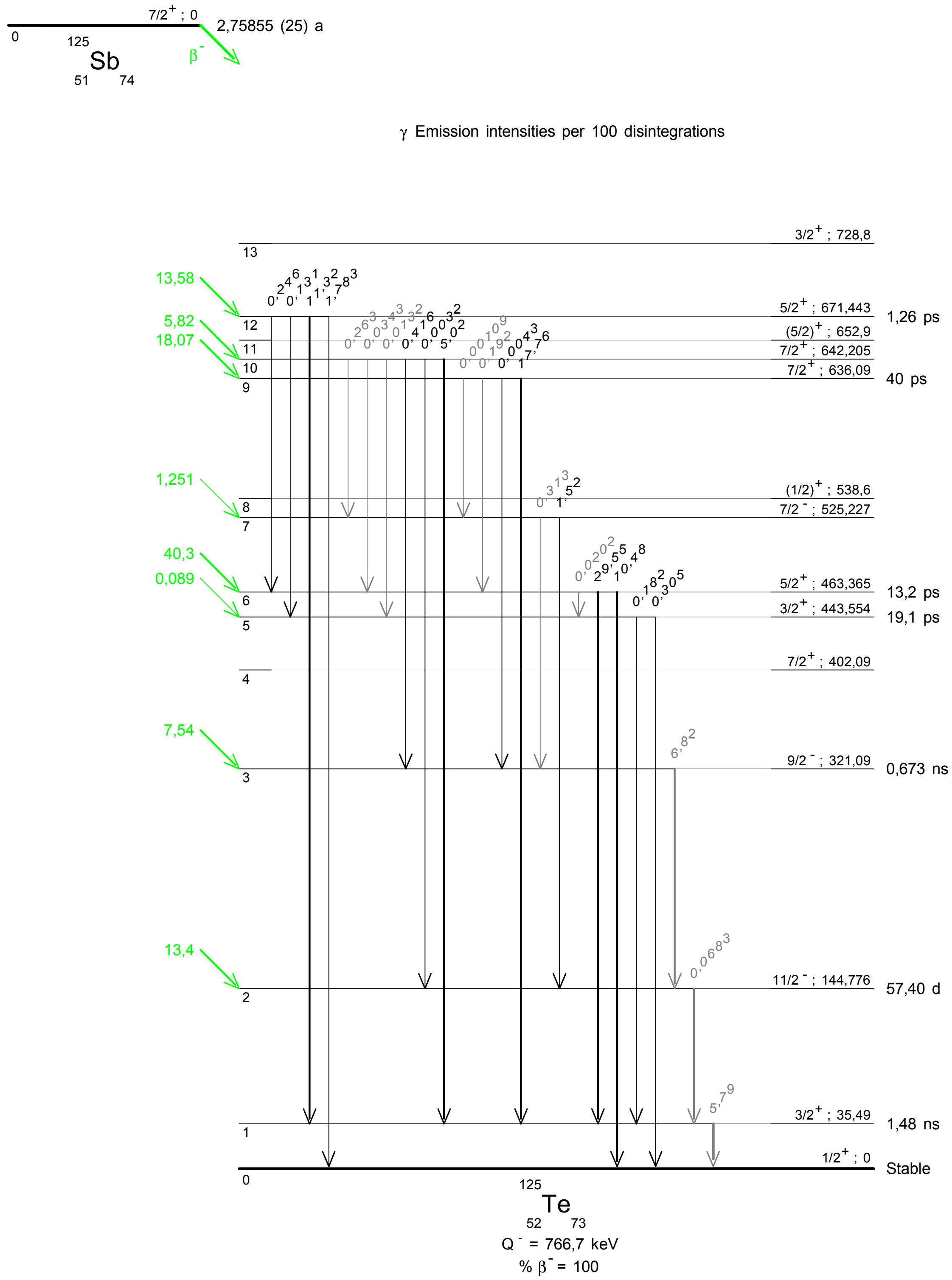
7/2+ ; 0
2,75855 (25) a
0
125 Sb 51 74
β-
γ Emission intensities per 100 disintegrations
13,58
5,82
18,07
1,251
40,3
0,089
7,54
13,4
3/2+ ; 728,8
5/2+ ; 671,443
(5/2)+ ; 652,9
7/2+ ; 642,205
7/2+ ; 636,09
(1/2)+ ; 538,6
7/2 - ; 525,227
5/2+ ; 463,365
3/2+ ; 443,554
7/2+ ; 402,09
9/2 - ; 321,09
11/2 - ; 144,776
3/2+ ; 35,49
1/2+ ; 0
1,26 ps
40 ps
13,2 ps
19,1 ps
0,673 ns
57,40 d
1,48 ns
Stable
125 Te 52 73
Q - = 766,7 keV
% β- = 100

$^{137}_{55}Cs_{82}$

1 Decay Scheme

Cs-137 disintegrates by beta minus emission to the ground state of Ba-137 (5,6 %) and via the 661 keV isomeric level of Ba-137 (94,4 %) which has a half-life of 2,55 min.
Le césium 137 se désintégre par émission bêta moins vers le niveau fondamental de barium 137 (5,6 %) ainsi que vers le niveau isomère de 661 keV (94,4 %) et de 2,55 min de période.

2 Nuclear Data

$T_{1/2}(^{137}Cs)$	:	30,05	(8)	a
$Q^-(^{137}Cs)$	:	1175,63	(17)	keV

2.1 β^- Transitions

	Energy keV	Probability × 100	Nature	lg ft
$\beta^-_{0,2}$	513,97 (17)	94,36 (28)	Unique 1st Forbidden	9,63
$\beta^-_{0,1}$	892,1 (2)	0,00061 (8)	Unique 2nd Forbidden	15,64
$\beta^-_{0,0}$	1175,63 (17)	5,64 (28)	2nd Forbidden	12,06

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{1,0}$(Ba)	283,5 (1)	0,00061 (8)	[M1,E2]	0,046 (3)	0,0073 (10)	0,0015 (2)	0,0557 (13)
$\gamma_{2,0}$(Ba)	661,659 (3)	94,36 (20)	M4	0,0896 (15)	0,0167 (5)		0,1102 (19)

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				
	$K\alpha_2$	31,8174		54,28
	$K\alpha_1$	32,1939		100
	$K\beta_3$	36,3045	}	
	$K\beta_1$	36,3786	}	
	$K\beta_5''$	36,654	}	29,4
	$K\beta_2$	37,258	}	
	$K\beta_4$	37,312	}	7,42
	$KO_{2,3}$	37,425	}	
X_L				
	$L\ell$	3,954		
	$L\gamma$	– 5,809		

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	2,6 – 5,8	

4 Electron Emissions

		Energy keV		Electrons per 100 disint.
e_{AL}	(Ba)	2,6 - 5,8		7,28 (12)
e_{AK}	(Ba)			0,76 (4)
	KLL	25,314 - 26,786	}	
	KLX	30,095 - 32,179	}	
	KXY	34,86 - 37,41	}	
$ec_{2,0\ T}$	(Ba)	624,218 - 661,644		9,37 (14)
$ec_{2,0\ K}$	(Ba)	624,218 (3)		7,62 (13)
$ec_{2,0\ L}$	(Ba)	655,670 - 656,412		1,42 (4)
$\beta^-_{0,2}$	max:	513,97 (17)		94,36 (28)
$\beta^-_{0,2}$	avg:	174,32 (6)		
$\beta^-_{0,1}$	max:	892,1 (2)		0,00061 (8)
$\beta^-_{0,1}$	avg:	300,57 (8)		
$\beta^-_{0,0}$	max:	1175,63 (17)		5,64 (28)
$\beta^-_{0,0}$	avg:	416,26 (8)		

5 Photon Emissions

5.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(Ba)	3,954 — 5,809		0,90 (5)	
$XK\alpha_2$	(Ba)	31,8174		1,95 (4)	} $K\alpha$
$XK\alpha_1$	(Ba)	32,1939		3,59 (7)	}
$XK\beta_3$	(Ba)	36,3045	}		
$XK\beta_1$	(Ba)	36,3786	}	1,055 (22)	$K'\beta_1$
$XK\beta_5''$	(Ba)	36,654	}		
$XK\beta_2$	(Ba)	37,258	}		
$XK\beta_4$	(Ba)	37,312	}	0,266 (8)	$K'\beta_2$
$XKO_{2,3}$	(Ba)	37,425	}		

5.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{1,0}$(Ba)	283,5 (1)	0,00058 (8)
$\gamma_{2,0}$(Ba)	661,657 (3)	84,99 (20)

6 Main Production Modes

Fission product.

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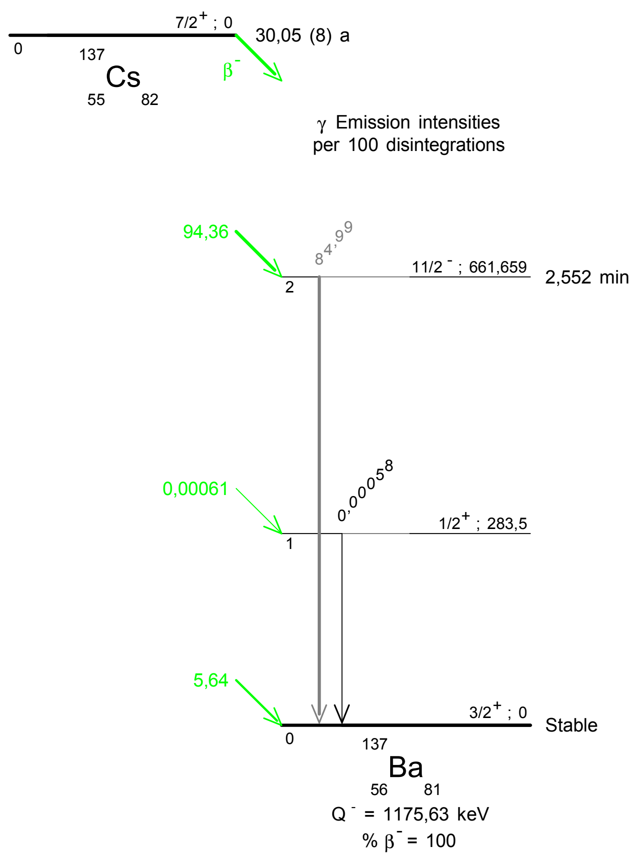
7/2+ ; 0
30,05 (8) a
0
137
Cs
55 82
β-
γ Emission intensities
per 100 disintegrations
94,36
84,99
11/2 - ; 661,659
2,552 min
2
0,00061
0,00058
1/2+ ; 283,5
1
5,64
3/2+ ; 0
Stable
0
137
Ba
56 81
Q - = 1175,63 keV
% β- = 100

153 Sm
62 91

1 Decay Scheme

Sm-153 disintegrates via 3 main branches and at least 15 others very weak branches by 100% beta-emission to levels in Eu-153.
Le samarium 153 se désintègre, par émission bêta moins, vers l'europium 153 avec 3 branchements principaux et au moins 15 autres de faible intensité.

2 Nuclear Data

$T_{1/2}$(^{153}Sm)	:	1,92855	(5)	d
Q^-(^{153}Sm)	:	807,6	(7)	keV

2.1 β^- Transitions

	Energy keV	Probability × 100	Nature	lg ft
$\beta^-_{0,18}$	44,0 (7)	0,000044 (12)		8,9
$\beta^-_{0,17}$	47,2 (8)	0,00098 (5)		7,9
$\beta^-_{0,16}$	88,9 (8)	0,00143 (10)	Allowed	8,4
$\beta^-_{0,15}$	94,5 (8)	0,0141 (5)		7,4
$\beta^-_{0,14}$	101,0 (8)	0,0241 (7)	Allowed	7,3
$\beta^-_{0,13}$	106,1 (8)	0,0076 (6)		8,8
$\beta^-_{0,12}$	113,4 (7)	0,0221 (8)	Allowed	7,4
$\beta^-_{0,11}$	125,7 (7)	0,0083 (6)	1st forbidden	7,9
$\beta^-_{0,10}$	149,9 (8)	0,00090 (6)		9,3
$\beta^-_{0,9}$	171,1 (7)	0,0641 (6)	1st forbidden	7,5
$\beta^-_{0,8}$	172,9 (8)	0,0565 (7)	Allowed	7,6
$\beta^-_{0,7}$	222,6 (8)	0,00227 (5)		9,4
$\beta^-_{0,6}$	537,8 (7)	0,0216 (3)	2nd forbidden	11
$\beta^-_{0,5}$	634,7 (7)	30,4 (8)	Allowed	6,7
$\beta^-_{0,4}$	656,0 (7)	0,042 (8)	Unique 1st forbidden	10
$\beta^-_{0,3}$	704,7 (7)	49,2 (17)	Allowed	6,7

	Energy keV	Probability × 100	Nature	lg ft
$\beta^-_{0,2}$	710,2 (7)	0,62 (8)	1st forbidden	8,6
$\beta^-_{0,0}$	807,6 (7)	19,5 (15)	Allowed	7,3

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{2,1}$(Eu)	14,06383 (24)		E1		8,43 (25)	1,90 (6)	10,78 (32)
$\gamma_{3,1}$(Eu)	19,81296 (21)	0,34 (7)	E2		2490 (70)	578 (17)	3220 (100)
$\gamma_{4,2}$(Eu)	54,1947 (5)	0,036 (8)	M1+E2	6,19 (19)	9,30 (28)	2,17 (7)	18,2 (5)
$\gamma_{4,1}$(Eu)	68,2585 (12)	0,0023 (7)	E1	0,648 (19)	0,1040 (31)	0,0225 (7)	0,781 (23)
$\gamma_{5,3}$(Eu)	69,67300 (13)	29,5 (8)	M1+1,82%E2	4,37 (13)	0,719 (22)	0,1571 (47)	5,28 (16)
$\gamma_{5,2}$(Eu)	75,42213 (21)	0,296 (13)	E1+0,3%M2	0,610 (18)	0,1111 (33)	0,0245 (7)	0,752 (23)
$\gamma_{1,0}$(Eu)	83,36717 (17)	0,915 (35)	M1+40%E2	2,30 (7)	1,119 (34)	0,258 (8)	3,74 (11)
$\gamma_{5,1}$(Eu)	89,48595 (21)	0,57 (6)	M1+5,8%E2	2,10 (6)	0,383 (11)	0,0845 (25)	2,59 (8)
$\gamma_{6,5}$(Eu)	96,8838 (7)	0,024 (4)	M1+E2	1,475 (44)	0,68 (2)	0,1570 (47)	2,35 (10)
$\gamma_{2,0}$(Eu)	97,43100 (21)	0,999 (19)	E1	0,254 (8)	0,0382 (11)	0,00823 (25)	0,302 (9)
$\gamma_{3,0}$(Eu)	103,18012 (17)	78,5 (15)	M1+1,4%E2	1,417 (43)	0,213 (6)	0,0462 (14)	1,69 (5)
$\gamma_{6,4}$(Eu)	118,1105 (10)	0,00027 (7)	[E1]	0,1516 (45)	0,0223 (7)	0,00479 (14)	0,180 (5)
$\gamma_{4,0}$(Eu)	151,6257 (5)	0,01128 (30)	E1	0,0775 (23)	0,01112 (33)	0,00239 (7)	0,0916 (27)
$\gamma_{6,3}$(Eu)	166,5568 (15)	0,00085 (8)	[E2]	0,263 (8)	0,1034 (31)	0,0238 (7)	0,396 (12)
$\gamma_{6,2}$(Eu)	172,3060 (7)	0,000426	(E1)	0,0551 (17)	0,00782 (23)	0,00168 (5)	0,065 (2)
$\gamma_{5,0}$(Eu)	172,85320 (13)	0,1012 (30)	M1+40%E2	0,293 (9)	0,0638 (19)	0,01427 (43)	0,375 (11)
$\gamma_{7,5}$(Eu)	412,17 (15)	0,00191 (5)					
$\gamma_{12,6}$(Eu)	424,45 (11)	0,00195 (6)					
$\gamma_{14,6}$(Eu)	436,89 (9)	0,00158 (5)					
$\gamma_{15,6}$(Eu)	443,38 (20)	0,00041 (32)					
$\gamma_{8,5}$(Eu)	461,81 (12)	0,00158 (26)					
$\gamma_{9,5}$(Eu)	463,62 (10)	0,01270 (24)					
$\gamma_{10,5}$(Eu)	484,82 (14)	0,00038 (3)					
$\gamma_{7,2}$(Eu)	487,59 (15)	0,00036					
$\gamma_{11,5}$(Eu)	509,06 (10)	0,00190 (18)					
$\gamma_{12,5}$(Eu)	521,34 (11)	0,0067 (1)					
$\gamma_{8,3}$(Eu)	531,47 (12)	0,0544 (7)					
$\gamma_{9,3}$(Eu)	533,29 (10)	0,0294 (5)					
$\gamma_{9,2}$(Eu)	539,04 (10)	0,02070 (21)					
$\gamma_{12,4}$(Eu)	542,56 (11)	0,00234 (10)					
$\gamma_{16,5}$(Eu)	545,84 (14)	0,0009 (1)					
$\gamma_{14,4}$(Eu)	555,01 (9)	0,0047 (1)					
$\gamma_{10,1}$(Eu)	574,31 (14)	0,00016 (5)					
$\gamma_{11,3}$(Eu)	578,73 (10)	0,0034 (5)					
$\gamma_{11,2}$(Eu)	584,48 (10)	0,00107 (3)					
$\gamma_{17,5}$(Eu)	587,54 (17)	0,00048 (4)					
$\gamma_{12,3}$(Eu)	591,01 (11)	0,00122 (9)					
$\gamma_{12,2}$(Eu)	596,76 (11)	0,0099 (8)					
$\gamma_{13,3}$(Eu)	598,28 (24)	0,0020 (1)					
$\gamma_{11,1}$(Eu)	598,51 (8)	0,0020 (1)					
$\gamma_{14,3}$(Eu)	603,45 (9)	0,0049 (6)					
$\gamma_{13,2}$(Eu)	604,03 (24)	0,0049 (6)					
$\gamma_{14,2}$(Eu)	609,20 (9)	0,0129 (4)					
$\gamma_{15,3}$(Eu)	609,95 (20)	0,0129 (4)					
$\gamma_{16,3}$(Eu)	615,51 (14)	0,00050 (6)					
$\gamma_{15,2}$(Eu)	615,69 (20)	0,00050 (6)					
$\gamma_{13,1}$(Eu)	618,09 (24)	0,00067 (6)					

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{15,1}$(Eu)	629,75 (20)	0,000099 (15)					
$\gamma_{8,0}$(Eu)	634,66 (12)	0,00050 (3)					
$\gamma_{9,0}$(Eu)	636,47 (10)	0,00195 (7)					
$\gamma_{17,3}$(Eu)	657,21 (7)	0,00037 (2)					
$\gamma_{10,0}$(Eu)	657,67 (25)	0,00037 (2)					
$\gamma_{17,2}$(Eu)	662,96 (17)	0,00007 (7)					
$\gamma_{17,1}$(Eu)	677,02 (17)	0,000044 (15)					
$\gamma_{11,0}$(Eu)	681,88 (8)	0,00015 (12)					
$\gamma_{12,0}$(Eu)	694,19 (11)	0,000020 (6)					
$\gamma_{13,0}$(Eu)	701,46 (24)	0,000029 (6)					
$\gamma_{14,0}$(Eu)	706,63 (9)	0,000023 (12)					
$\gamma_{15,0}$(Eu)	713,12	0,000231 (20)					
$\gamma_{16,0}$(Eu)	718,69 (14)	0,000025 (5)					
$\gamma_{17,0}$(Eu)	760,39 (17)	0,000032 (5)					
$\gamma_{18,0}$(Eu)	763,8 (8)	0,000044 (12)					

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		Relative probability
X_K				
	$K\alpha_2$	40,9024		55,42
	$K\alpha_1$	41,5427		100
	$K\beta_3$	46,904	}	
	$K\beta_1$	47,0384	}	
	$K\beta_5''$	47,373	}	31,5
	$K\beta_2$	48,257	}	
	$K\beta_4$	48,386	}	8,13
	$KO_{2,3}$	48,497	}	
X_L				
	$L\ell$	5,175		
	$L\alpha$	5,815 – 5,8461		
	$L\eta$	5,8149		
	$L\beta$	6,4365 – 6,9193		
	$L\gamma$	7,2538 – 7,791		

3.1.2 Auger Electrons

	Energy keV	Relative probability
Auger K		
KLL	32,24 – 34,38	100
KLX	38,59 – 41,52	51
KXY	44,9 – 48,5	6,5
Auger L	3,4 – 7,8	1870

4 Electron Emissions

		Energy keV		Electrons per 100 disint.
e_{AL}	(Eu)	3,4 - 7,8		53,0 (5)
e_{AK}	(Eu)			4,47 (28)
	KLL	32,24 - 34,38	}	
	KLX	38,59 - 41,52	}	
	KXY	44,9 - 48,5	}	
$ec_{3,1\ L}$	(Eu)	11,76 - 12,84		0,26 (6)
$ec_{3,1\ M}$	(Eu)	18,00 - 18,68		0,061 (13)
$ec_{5,3\ T}$	(Eu)	21,154 - 69,650		24,8 (8)
$ec_{5,3\ K}$	(Eu)	21,154 (2)		20,5 (6)
$ec_{5,2\ K}$	(Eu)	26,903 (2)		0,103 (5)
$ec_{1,0\ K}$	(Eu)	34,848 (1)		0,444 (19)
$ec_{5,1\ K}$	(Eu)	40,967 (1)		0,332 (33)
$ec_{2,0\ K}$	(Eu)	48,912 (1)		0,195 (7)
$ec_{3,0\ T}$	(Eu)	54,661 - 103,160		49,3 (15)
$ec_{3,0\ K}$	(Eu)	54,661 (1)		41,4 (13)
$ec_{5,3\ L}$	(Eu)	61,62 - 62,69		3,37 (11)
$ec_{5,3\ M}$	(Eu)	67,90 - 68,54		0,737 (23)
$ec_{5,3\ N}$	(Eu)	69,31 - 69,54		0,168 (5)
$ec_{1,0\ L}$	(Eu)	75,31 - 76,39		0,216 (9)
$ec_{5,1\ L}$	(Eu)	81,43 - 82,51		0,061 (6)
$ec_{3,0\ L}$	(Eu)	95,13 - 96,20		6,22 (18)
$ec_{3,0\ M}$	(Eu)	101,40 - 102,05		1,349 (42)
$ec_{3,0\ N}$	(Eu)	102,82 - 103,05		0,309 (9)
$\beta^-_{0,18}$	max:	44,0 (7)		0,000044 (12)
$\beta^-_{0,18}$	avg:	11,1 (3)		
$\beta^-_{0,17}$	max:	47,2 (8)		0,00098 (5)
$\beta^-_{0,17}$	avg:	12,0 (2)		

		Energy keV		Electrons per 100 disint.
$\beta^-_{0,16}$	max:	88,9	(8)	0,00143 (10)
$\beta^-_{0,16}$	avg:	23,1	(2)	
$\beta^-_{0,15}$	max:	94,5	(8)	0,0141 (5)
$\beta^-_{0,15}$	avg:	24,6	(2)	
$\beta^-_{0,14}$	max:	101,0	(8)	0,0241 (7)
$\beta^-_{0,14}$	avg:	26,4	(3)	
$\beta^-_{0,13}$	max:	106,1	(8)	0,0076 (6)
$\beta^-_{0,13}$	avg:	27,8	(2)	
$\beta^-_{0,12}$	max:	113,4	(7)	0,0221 (8)
$\beta^-_{0,12}$	avg:	29,8	(2)	
$\beta^-_{0,11}$	max:	125,7	(7)	0,0083 (6)
$\beta^-_{0,11}$	avg:	33,2	(2)	
$\beta^-_{0,10}$	max:	149,9	(8)	0,00090 (6)
$\beta^-_{0,10}$	avg:	40,1	(2)	
$\beta^-_{0,9}$	max:	171,1	(7)	0,0641 (6)
$\beta^-_{0,9}$	avg:	46,1	(2)	
$\beta^-_{0,8}$	max:	172,9	(8)	0,0565 (7)
$\beta^-_{0,8}$	avg:	46,7	(2)	
$\beta^-_{0,7}$	max:	222,6	(8)	0,00227 (5)
$\beta^-_{0,7}$	avg:	61,3	(3)	
$\beta^-_{0,6}$	max:	537,8	(7)	0,0216 (3)
$\beta^-_{0,6}$	avg:	164,7	(3)	
$\beta^-_{0,5}$	max:	634,7	(7)	30,4 (8)
$\beta^-_{0,5}$	avg:	199,7	(3)	
$\beta^-_{0,4}$	max:	656,0	(7)	0,042 (8)
$\beta^-_{0,4}$	avg:	221,2	(3)	
$\beta^-_{0,3}$	max:	704,7	(7)	49,2 (17)
$\beta^-_{0,3}$	avg:	225,3	(3)	
$\beta^-_{0,2}$	max:	710,2	(7)	0,62 (8)
$\beta^-_{0,2}$	avg:	227,4	(3)	
$\beta^-_{0,0}$	max:	807,6	(7)	19,5 (15)
$\beta^-_{0,0}$	avg:	264,3	(3)	

5 Photon Emissions

5.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(Eu)	5,175 — 7,791		10,88 (21)	
$XK\alpha_2$	(Eu)	40,9024		16,6 (4)	} $K\alpha$
$XK\alpha_1$	(Eu)	41,5427		30,0 (7)	}
$XK\beta_3$	(Eu)	46,904	}		
$XK\beta_1$	(Eu)	47,0384	}	9,45 (25)	$K'\beta_1$
$XK\beta_5''$	(Eu)	47,373	}		
$XK\beta_2$	(Eu)	48,257	}		
$XK\beta_4$	(Eu)	48,386	}	2,44 (8)	$K'\beta_2$
$XKO_{2,3}$	(Eu)	48,497	}		

5.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{3,1}$(Eu)	19,81296 (21)	0,000105 (22)
$\gamma_{4,2}$(Eu)	54,1936 (12)	0,0019 (4)
$\gamma_{4,1}$(Eu)	68,2574 (12)	0,0013 (4)
$\gamma_{5,3}$(Eu)	69,67300 (13)	4,691 (41)
$\gamma_{5,2}$(Eu)	75,42213 (23)	0,169 (7)
$\gamma_{1,0}$(Eu)	83,36717 (21)	0,193 (6)
$\gamma_{5,1}$(Eu)	89,48595 (22)	0,158 (15)
$\gamma_{6,5}$(Eu)	96,8824 (7)	0,007 (1)
$\gamma_{2,0}$(Eu)	97,43100 (21)	0,767 (14)
$\gamma_{3,0}$(Eu)	103,18012 (17)	29,19 (16)
$\gamma_{6,4}$(Eu)	118,1105 (10)	0,00023 (6)
$\gamma_{4,0}$(Eu)	151,6244 (12)	0,01033 (27)
$\gamma_{6,3}$(Eu)	166,5546 (15)	0,00061 (6)
$\gamma_{6,2}$(Eu)	172,3032 (13)	0,0004
$\gamma_{5,0}$(Eu)	172,85307 (21)	0,0736 (21)
$\gamma_{7,5}$(Eu)	412,05 (20)	0,00191 (5)
$\gamma_{12,6}$(Eu)	424,4 (3)	0,00195 (6)
$\gamma_{14,6}$(Eu)	436,9 (3)	0,00158 (5)
$\gamma_{15,6}$(Eu)	443,2 (5)	0,00041 (32)
$\gamma_{8,5}$(Eu)	462,0 (3)	0,00158 (26)
$\gamma_{9,5}$(Eu)	463,6 (2)	0,01270 (24)
$\gamma_{10,5}$(Eu)	485,0 (2)	0,00038 (3)
$\gamma_{7,2}$(Eu)	487,75 (23)	0,00036
$\gamma_{11,5}$(Eu)	509,15 (20)	0,00190 (18)
$\gamma_{12,5}$(Eu)	521,30 (25)	0,0067 (1)

	Energy keV	Photons per 100 disint.
$\gamma_{8,3}$(Eu)	531,40 (15)	0,0544 (7)
$\gamma_{9,3}$(Eu)	533,2 (2)	0,0294 (5)
$\gamma_{9,2}$(Eu)	539,1 (2)	0,02070 (21)
$\gamma_{12,4}$(Eu)	542,7 (2)	0,00234 (10)
$\gamma_{16,5}$(Eu)	545,75 (15)	0,0009 (1)
$\gamma_{14,4}$(Eu)	554,94 (10)	0,0047 (1)
$\gamma_{10,1}$(Eu)	574,1 (3)	0,00016 (5)
$\gamma_{11,3}$(Eu)	578,75 (20)	0,0034 (5)
$\gamma_{11,2}$(Eu)	584,55 (20)	0,00107 (3)
$\gamma_{17,5}$(Eu)	587,60 (25)	0,00048 (4)
$\gamma_{12,3}$(Eu)	590,96 (20)	0,00122 (9)
$\gamma_{12,2}$(Eu)	596,7 (2)	0,0099 (8)
$\gamma_{13,3}$(Eu)	598,3 (3)	0,0020 (1)
$\gamma_{11,1}$(Eu)	598,54 (10)	0,0020 (1)
$\gamma_{14,3}$(Eu)	603,6 (4)	0,0049 (6)
$\gamma_{13,2}$(Eu)	604,03 (24)	0,0049 (6)
$\gamma_{14,2}$(Eu)	609,5 (3)	0,0129 (4)
$\gamma_{15,3}$(Eu)	609,95 (20)	0,0129 (4)
$\gamma_{16,3}$(Eu)	615,51 (14)	0,00050 (6)
$\gamma_{15,2}$(Eu)	615,8 (4)	0,00050 (6)
$\gamma_{13,1}$(Eu)	617,9 (3)	0,00067 (6)
$\gamma_{15,1}$(Eu)	630,5 (4)	0,000099 (15)
$\gamma_{8,0}$(Eu)	634,8 (3)	0,00050 (3)
$\gamma_{9,0}$(Eu)	636,5 (2)	0,00195 (7)
$\gamma_{17,3}$(Eu)	657,21 (7)	0,00037 (2)
$\gamma_{10,0}$(Eu)	657,55 (25)	0,00037 (2)
$\gamma_{17,2}$(Eu)	662,4 (6)	0,00007 (7)
$\gamma_{17,1}$(Eu)	677,0 (3)	0,000044 (15)
$\gamma_{11,0}$(Eu)	682,0 (6)	0,00015 (12)
$\gamma_{12,0}$(Eu)	694,1 (3)	0,000020 (6)
$\gamma_{13,0}$(Eu)	701,8 (4)	0,000029 (6)
$\gamma_{14,0}$(Eu)	706,8 (5)	0,000023 (12)
$\gamma_{15,0}$(Eu)	713,9 (3)	0,000231 (20)
$\gamma_{16,0}$(Eu)	719,0 (4)	0,000025 (5)
$\gamma_{17,0}$(Eu)	760,5 (4)	0,000032 (5)
$\gamma_{18,0}$(Eu)	763,8 (6)	0,000044 (12)

6 Main Production Modes

$Sm - 152(n,\gamma)Sm - 153$ σ : 206 barns
$Nd - 150(\alpha,n)Sm - 153$

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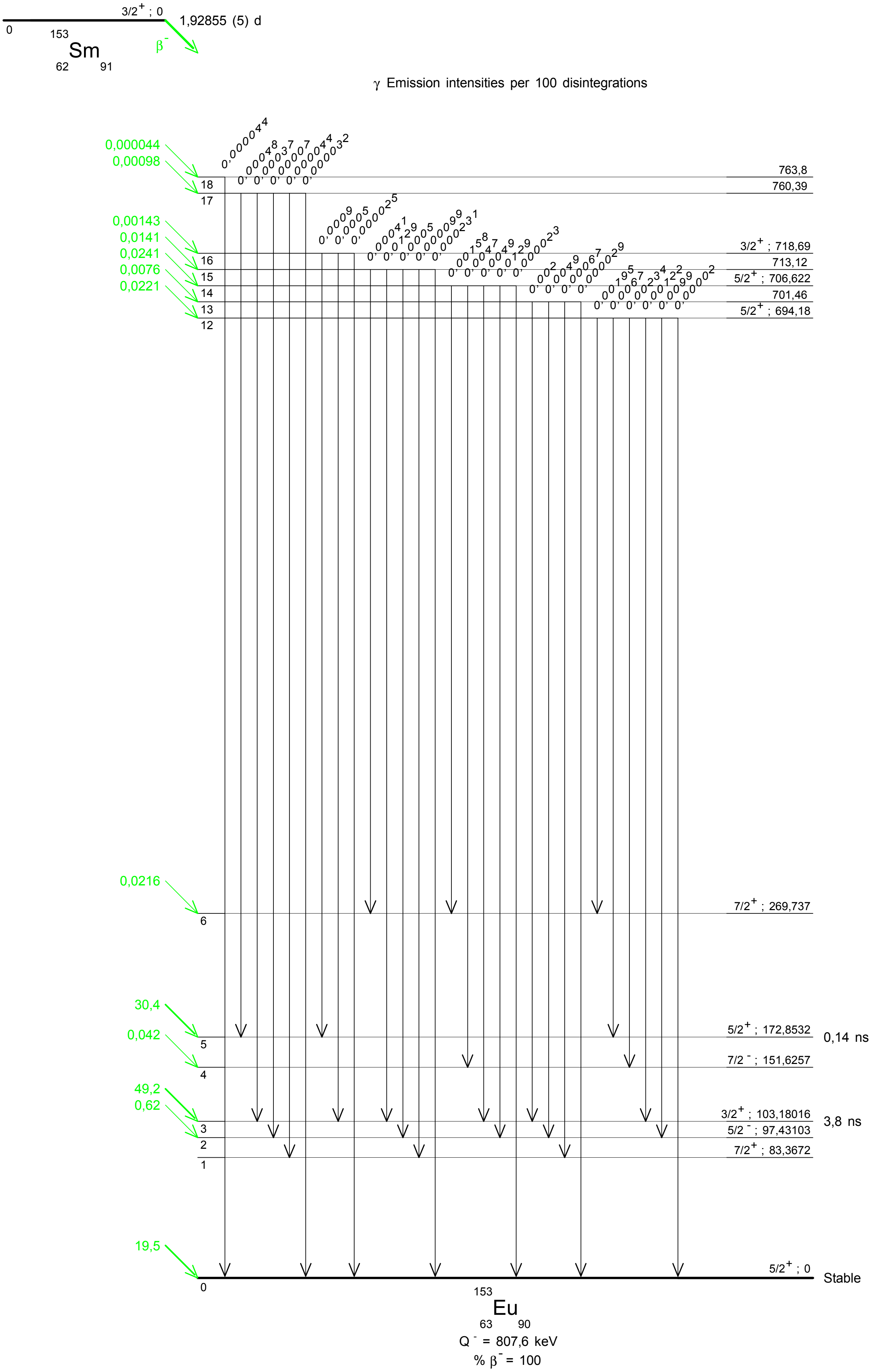
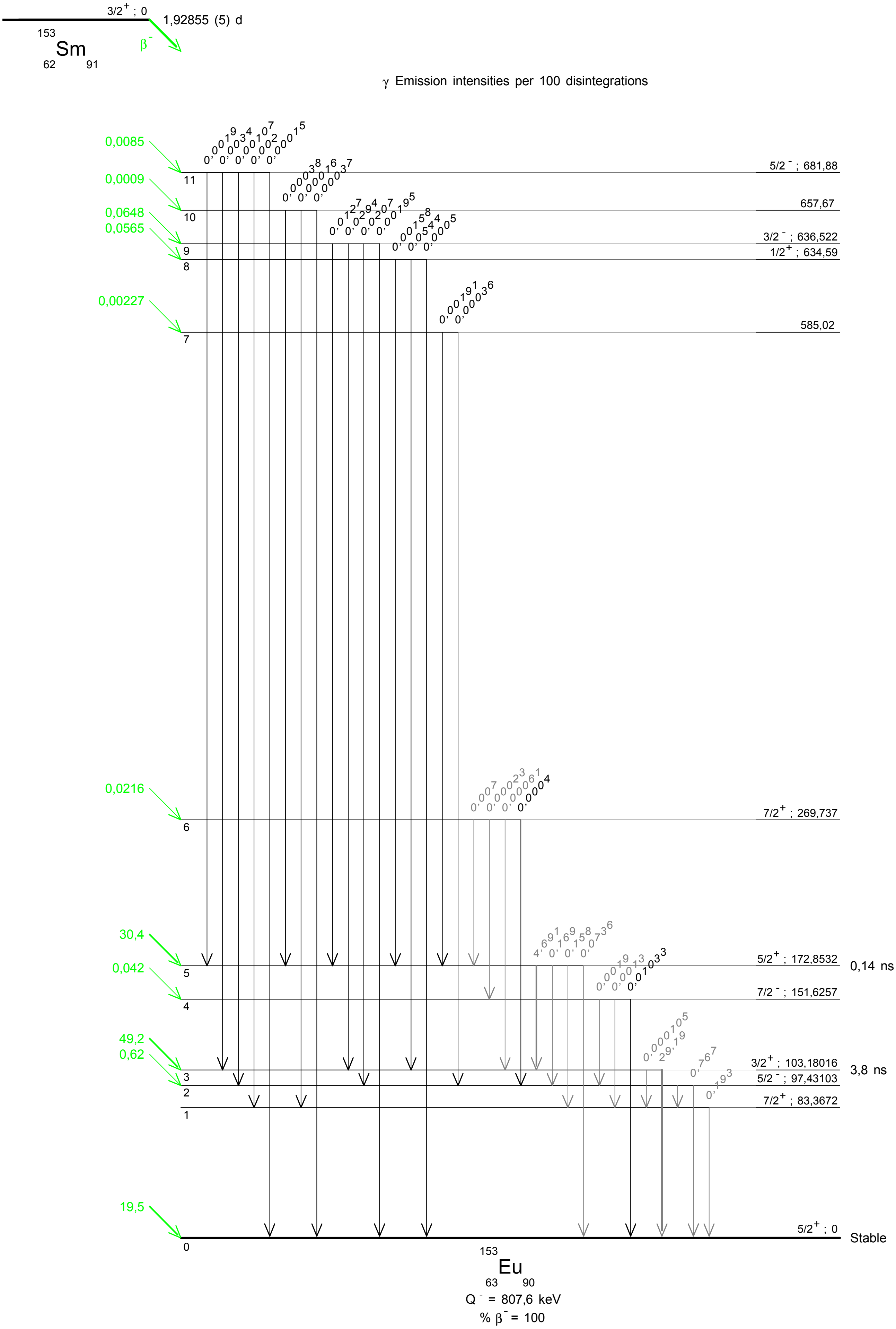


3/2+ ; 0
1,92855 (5) d
153 Sm 62 91
β-
γ Emission intensities per 100 disintegrations
763,8
760,39
3/2+ ; 718,69
713,12
5/2+ ; 706,622
701,46
5/2+ ; 694,18
7/2+ ; 269,737
5/2+ ; 172,8532
0,14 ns
7/2- ; 151,6257
3/2+ ; 103,18016
3,8 ns
5/2- ; 97,43103
7/2+ ; 83,3672
5/2+ ; 0
Stable
153 Eu 63 90
Q- = 807,6 keV
% β- = 100


3/2+ ; 0
1,92855 (5) d
153 Sm 62 91
β-
γ Emission intensities per 100 disintegrations
0,0085
0,0009
0,0648
0,0565
0,00227
0,0216
30,4
0,042
49,2
0,62
19,5
5/2 - ; 681,88
657,67
3/2 - ; 636,522
1/2+ ; 634,59
585,02
7/2+ ; 269,737
5/2+ ; 172,8532
0,14 ns
7/2 - ; 151,6257
3/2+ ; 103,18016
3,8 ns
5/2 - ; 97,43103
7/2+ ; 83,3672
5/2+ ; 0
Stable
153 Eu 63 90
Q - = 807,6 keV
% β- = 100

$^{159}_{64}$Gd $_{95}$

1 Decay Scheme

Gd-159 decays by beta minus emission to levels in Tb-159.
Le gadolinium 159 se désintègre par émission bêta moins vers des niveaux excités du terbium 159.

2 Nuclear Data

$T_{1/2}$(^{159}Gd)	:	18,479	(7)	h
Q^-(^{159}Gd)	:	970,5	(7)	keV

2.1 β^- Transitions

	Energy keV	Probability × 100	Nature	lg ft
$\beta^-_{0,9}$	79,3 (7)	0,0009 (4)	Allowed	8,08
$\beta^-_{0,8}$	115,5 (7)	0,0162 (5)	Allowed	7,31
$\beta^-_{0,7}$	296,3 (7)	0,00388 (10)	1st Forbbiden	9,22
$\beta^-_{0,6}$	352,9 (7)	0,0300 (9)	1st Forbbiden	8,58
$\beta^-_{0,5}$	389,7 (7)	0,0626 (8)	1st Forbbiden	8,41
$\beta^-_{0,4}$	607,0 (7)	12,19 (6)	Allowed	6,76
$\beta^-_{0,3}$	622,2 (7)	0,315 (4)	1st Forbbiden	8,39
$\beta^-_{0,2}$	833,0 (7)	0,012 (9)	Unique 1st Forbbiden	10,6
$\beta^-_{0,1}$	912,5 (7)	29,6 (12)	1st Forbbiden	6,99
$\beta^-_{0,0}$	970,5 (7)	57,8 (12)	1st Forbbiden	6,73

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{1,0}$(Tb)	58,0000 (22)	30,13 (7)	M1+1,4%E2	9,14 (27)	1,55 (5)	0,343 (10)	11,1 (3)
$\gamma_{2,1}$(Tb)	79,5132 (27)	0,2532 (11)	M1+1,56%E2	3,66 (11)	0,584 (18)	0,129 (4)	4,41 (13)
$\gamma_{2,0}$(Tb)	137,515 (5)	0,01188 (15)	[E2]	0,474 (14)	0,277 (8)	0,0653 (19)	0,833 (25)
$\gamma_{3,2}$(Tb)	210,783 (3)	0,0246 (14)	[M1,E2]	0,18 (3)	0,039 (7)	0,0089 (16)	0,23 (7)
$\gamma_{4,2}$(Tb)	226,0406 (18)	0,2244 (21)	E1	0,0290 (9)	0,00414 (12)	0,00089 (3)	0,0343 (10)
$\gamma_{8,6}$(Tb)	237,341 (5)	0,00792 (16)	[E1]	0,0256 (8)	0,00364 (11)	0,00079 (2)	0,0302 (9)
$\gamma_{9,6}$(Tb)	273,62 (12)	0,00071 (41)	[E1]	0,0178 (5)	0,00251 (8)	0,00055 (2)	0,0210 (6)
$\gamma_{8,5}$(Tb)	274,163 (19)	0,0058 (4)	[E1]	0,0177 (5)	0,00250 (8)	0,00054 (2)	0,0209 (6)
$\gamma_{3,1}$(Tb)	290,2865 (25)	0,0353 (5)	[M1,E2]	0,075 (23)	0,014 (1)	0,0031 (1)	0,093 (29)
$\gamma_{4,1}$(Tb)	305,5492 (20)	0,0630 (7)	E1	0,0135 (4)	0,00189 (6)	0,000411 (12)	0,0159 (5)
$\gamma_{3,0}$(Tb)	348,2807 (18)	0,2553 (25)	M1+16%E2	0,056 (2)	0,0084 (3)	0,00180 (5)	0,067 (2)
$\gamma_{4,0}$(Tb)	363,5430 (18)	11,90 (5)	E1	0,00882 (26)	0,00123 (4)	0,000266 (8)	0,0104 (3)
$\gamma_{7,2}$(Tb)	536,730 (17)	0,00164 (5)	M1+E2	0,0200 (6)	0,00280 (8)	0,00061 (2)	0,0236 (7)
$\gamma_{6,1}$(Tb)	559,624 (6)	0,0225 (6)	M1+E2	0,0152 (5)	0,0022 (2)	0,00040 (9)	0,019 (3)
$\gamma_{5,0}$(Tb)	580,809 (6)	0,0703 (8)	[M1,E2]	0,012 (4)	0,0018 (6)		0,015 (5)
$\gamma_{7,1}$(Tb)	616,234 (18)	0,00191 (8)	(M1)	0,0142 (4)	0,00197 (6)	0,00042 (2)	0,0167 (5)
$\gamma_{6,0}$(Tb)	617,616 (8)	0,0162 (5)	(M1)	0,0141 (4)	0,00196 (6)	0,00043 (2)	0,0166 (5)
$\gamma_{7,0}$(Tb)	674,26 (5)	0,000320 (22)	(M1)	0,0113 (3)	0,00157 (5)	0,00034 (1)	0,0133 (4)
$\gamma_{9,2}$(Tb)	753,74 (6)	0,00018 (2)	[E1]	0,00177 (5)	0,000236 (7)	0,000051 (2)	0,00207 (6)
$\gamma_{8,0}$(Tb)	854,949 (20)	0,00246 (14)	[E1]	0,00138 (4)	0,000183 (5)	0,000040 (1)	0,00162 (5)

3 Atomic Data

3.1 Tb

ω_K	:	0,935	(4)
$\bar{\omega}_L$	:	0,186	(8)
n_{KL}	:	0,847	(4)

3.1.1 X Radiations

		Energy keV		Relative probability
X_K				
	$K\alpha_2$	43,7447		55,77
	$K\alpha_1$	44,4821		100
	$K\beta_3$	50,23	}	
	$K\beta_1$	50,383	}	31,9
	$K\beta_2$	51,724	}	
	$K\beta_4$	51,849	}	8,3

3.1.2 Auger Electrons

	Energy keV	Relative probability
Auger K		
KLL	34,398 – 36,773	100
KLX	41,243 – 44,456	52,1
KXY	48,06 – 51,95	6,7
Auger L	3,58 – 8,70	

4 Electron Emissions

		Energy keV		Electrons per 100 disint.
e_{AL}	(Tb)	3,58 - 8,70		0,195 (5)
e_{AK}	(Tb)			1,49 (11)
	KLL	34,398 - 36,773	}	
	KLX	41,243 - 44,456	}	
	KXY	48,06 - 51,95	}	
$ec_{1,0\ T}$	(Tb)	6,004 - 57,715		27,64 (80)
$ec_{1,0\ K}$	(Tb)	6,004 (1)		22,8 (9)
$ec_{2,1\ K}$	(Tb)	27,518 (1)		0,17 (7)
$ec_{1,0\ L}$	(Tb)	49,292 - 50,486		3,86 (16)
$ec_{1,0\ M}$	(Tb)	56,032 - 56,389		0,85 (4)
$ec_{1,0\ N}$	(Tb)	57,602 - 57,715		0,235 (10)
$ec_{4,0\ K}$	(Tb)	311,547 (2)		0,104 (3)
$\beta^-_{0,9}$	max:	79,3 (7)		0,0009 (4)
$\beta^-_{0,9}$	avg:	20,54 (19)		
$\beta^-_{0,8}$	max:	115,5 (7)		0,0162 (5)
$\beta^-_{0,8}$	avg:	30,43 (20)		
$\beta^-_{0,7}$	max:	296,3 (7)		0,00388 (10)
$\beta^-_{0,7}$	avg:	83,82 (22)		
$\beta^-_{0,6}$	max:	352,9 (7)		0,0300 (9)
$\beta^-_{0,6}$	avg:	101,84 (23)		
$\beta^-_{0,5}$	max:	389,7 (7)		0,0626 (8)
$\beta^-_{0,5}$	avg:	113,8 (2)		
$\beta^-_{0,4}$	max:	607,0 (7)		12,19 (6)
$\beta^-_{0,4}$	avg:	189,0 (3)		
$\beta^-_{0,3}$	max:	622,2 (7)		0,315 (4)
$\beta^-_{0,3}$	avg:	194,5 (3)		
$\beta^-_{0,2}$	max:	833,0 (7)		0,012 (9)

		Energy keV		Electrons per 100 disint.
$\beta^-_{0,2}$	avg:	283,9	(3)	
$\beta^-_{0,1}$	max:	912,5	(7)	29,6 (12)
$\beta^-_{0,1}$	avg:	304,1	(3)	
$\beta^-_{0,0}$	max:	970,5	(7)	57,8 (12)
$\beta^-_{0,0}$	avg:	326,9	(3)	

5 Photon Emissions

5.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XKα_2	(Tb)	43,7447		6,09 (25)	} Kα
XKα_1	(Tb)	44,4821		10,9 (5)	}
XKβ_3	(Tb)	50,23	}		
XKβ_1	(Tb)	50,383	}	3,49 (15)	K$'\beta_1$
XKβ_2	(Tb)	51,724	}		
XKβ_4	(Tb)	51,849	}	0,90 (5)	K$'\beta_2$

5.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{1,0}$(Tb)	58,0000 (22)	2,49 (7)
$\gamma_{2,1}$(Tb)	79,5132 (27)	0,0468 (11)
$\gamma_{2,0}$(Tb)	137,515 (5)	0,00648 (15)
$\gamma_{3,2}$(Tb)	210,783 (3)	0,0200 (14)
$\gamma_{4,2}$(Tb)	226,0406 (18)	0,2170 (21)
$\gamma_{8,6}$(Tb)	237,341 (5)	0,00769 (16)
$\gamma_{9,6}$(Tb)	273,62 (12)	0,0007 (4)
$\gamma_{8,5}$(Tb)	274,163 (19)	0,0057 (4)
$\gamma_{3,1}$(Tb)	290,2865 (25)	0,0323 (5)
$\gamma_{4,1}$(Tb)	305,5492 (20)	0,0620 (7)
$\gamma_{3,0}$(Tb)	348,2807 (18)	0,2393 (25)
$\gamma_{4,0}$(Tb)	363,5430 (18)	11,78 (5)
$\gamma_{7,2}$(Tb)	536,730 (12)	0,00160 (5)
$\gamma_{6,1}$(Tb)	559,623 (6)	0,0221 (6)
$\gamma_{5,0}$(Tb)	580,808 (6)	0,0693 (7)
$\gamma_{7,1}$(Tb)	616,233 (18)	0,00188 (8)
$\gamma_{6,0}$(Tb)	617,615 (8)	0,0159 (5)

	Energy keV	Photons per 100 disint.
$\gamma_{7,0}$(Tb)	674,26 (5)	0,000316 (22)
$\gamma_{9,2}$(Tb)	753,74 (6)	0,00018 (2)
$\gamma_{8,0}$(Tb)	854,947 (20)	0,00246 (14)

6 Main Production Modes

Gd – 158(n,γ)Gd – 159

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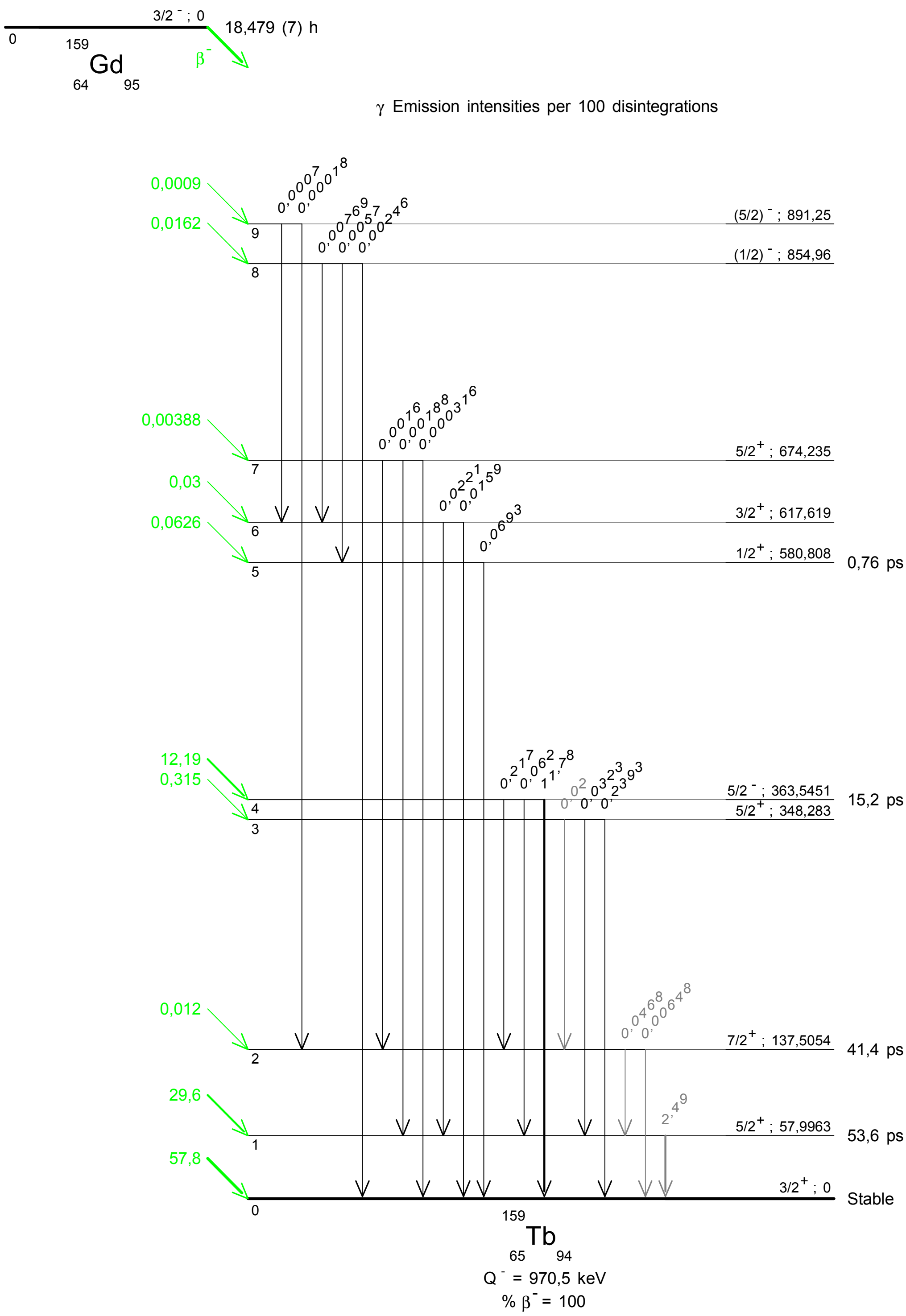
  (Q)


3/2 - ; 0
18,479 (7) h
0
159
Gd
64 95
β-
γ Emission intensities per 100 disintegrations
0,0009
0,0162
0,00388
0,03
0,0626
12,19
0,315
0,012
29,6
57,8
(5/2) - ; 891,25
(1/2) - ; 854,96
5/2+ ; 674,235
3/2+ ; 617,619
1/2+ ; 580,808
0,76 ps
5/2 - ; 363,5451
5/2+ ; 348,283
15,2 ps
7/2+ ; 137,5054
41,4 ps
5/2+ ; 57,9963
53,6 ps
3/2+ ; 0
Stable
159
Tb
65 94
Q - = 970,5 keV
% β- = 100

$^{203}_{82}$Pb $_{121}$

1 Decay Scheme

Pb-203 disintegrates by electron capture to Tl-203 via excited levels.
Le plomb 203 se désintègre par capture électronique vers des niveaux excités du thallium 203.

2 Nuclear Data

$T_{1/2}$(^{203}Pb)	:	51,929	(10)	h
Q^+(^{203}Pb)	:	975	(6)	keV

2.1 Electron Capture Transitions

	Energy keV	Probability × 100	Nature	lg ft	P_K	P_L	P_{M+}
$\epsilon_{0,2}$	294 (6)	4,80 (8)	Unique 1st Forbidden	6,812	0,7076 (32)	0,2168 (22)	0,0756 (9)
$\epsilon_{0,1}$	696 (6)	95,20 (12)	1st Forbidden	6,404	0,7786 (4)	0,1661 (3)	0,0552 (1)

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{1,0}$(Tl)	279,1952 (10)	99,24 (9)	M1 + E2	0,164 (1)	0,04837 (48)		0,2261 (8)
$\gamma_{2,1}$(Tl)	401,320 (3)	4,04 (8)	M1 + 0,09 % E2	0,1464 (21)	0,0245 (4)	0,00572 (8)	0,1784 (25)
$\gamma_{2,0}$(Tl)	680,515 (3)	0,765 (18)	E2	0,01065 (15)	0,00250 (4)	0,000605 (9)	0,01393 (20)

3 Atomic Data

3.1 Tl

ω_K	:	0,963	(4)
$\bar{\omega}_L$	:	0,367	(15)
n_{KL}	:	0,812	(5)

3.1.1 X Radiations

		Energy keV		Relative probability
X_K				
	$K\alpha_2$	70,8327		59,24
	$K\alpha_1$	72,8738		100
	$K\beta_3$	82,116	}	
	$K\beta_1$	82,5756	}	
	$K\beta_5''$	83,0456	}	34,01
	$K\beta_5'$	83,1417	}	
	$K\beta_2$	84,867	}	
	$K\beta_4$	85,1357	}	10,1
	$KO_{2,3}$	85,444	}	
X_L				
	$L\ell$	8,9531		
	$L\alpha$	10,1718 – 10,2679		
	$L\eta$	10,9942		
	$L\beta$	11,8117 – 12,9566		
	$L\gamma$	13,8528 – 14,7362		

3.1.2 Auger Electrons

	Energy keV	Relative probability
Auger K		
KLL	54,587 – 59,954	100
KLX	66,37 – 72,86	55,4
KXY	78,12 – 85,50	7,67
Auger L	5,43 – 10,93	

4 Electron Emissions

		Energy keV	Electrons per 100 disint.
e_{AL}	(Tl)	5,43 - 10,93	57,9 (6)
e_{AK}	(Tl)		3,4 (4)
	KLL	54,587 - 59,954	}
	KLX	66,37 - 72,86	}
	KXY	78,12 - 85,50	}
$ec_{1,0\ K}$	(Tl)	193,665 (1)	13,27 (12)
$ec_{1,0\ L}$	(Tl)	263,8485 - 266,5377	3,912 (46)
$ec_{1,0\ M}$	(Tl)	275,4911 - 276,8059	1,254 (18)
$ec_{2,1\ K}$	(Tl)	315,790 (3)	0,502 (13)

5 Photon Emissions

5.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(Tl)	8,9531 — 14,7362		33,2 (6)	
$XK\alpha_2$	(Tl)	70,8327		25,61 (19)	} $K\alpha$
$XK\alpha_1$	(Tl)	72,8738		43,24 (25)	}
$XK\beta_3$	(Tl)	82,116	}		
$XK\beta_1$	(Tl)	82,5756	}	14,70 (24)	$K'\beta_1$
$XK\beta_5''$	(Tl)	83,0456	}		
$XK\beta_5'$	(Tl)	83,1417	}		
$XK\beta_2$	(Tl)	84,867	}		
$XK\beta_4$	(Tl)	85,1357	}	4,37 (11)	$K'\beta_2$
$XKO_{2,3}$	(Tl)	85,444	}		

5.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{1,0}$(Tl)	279,1952 (10)	80,94 (5)
$\gamma_{2,1}$(Tl)	401,320 (3)	3,43 (6)
$\gamma_{2,0}$(Tl)	680,515 (3)	0,754 (18)

6 Main Production Modes

Tl – 203(d,2n)Pb – 203
Tl – 203(p,n)Pb – 203
Tl – 203(He – 3,3n)Bi – 203
Bi – 203(E.C.)Pb – 203
Hg – 202(α,3nγ)Pb – 203
Pb – 205(p,t)Pb – 203
Hg – 204(α,5n)Pb – 203
Hg – 202(α,3n)Pb – 203
Pb – 204(γ,n)Pb – 203
Pt – 198(Be – 9,4n)Pb – 203

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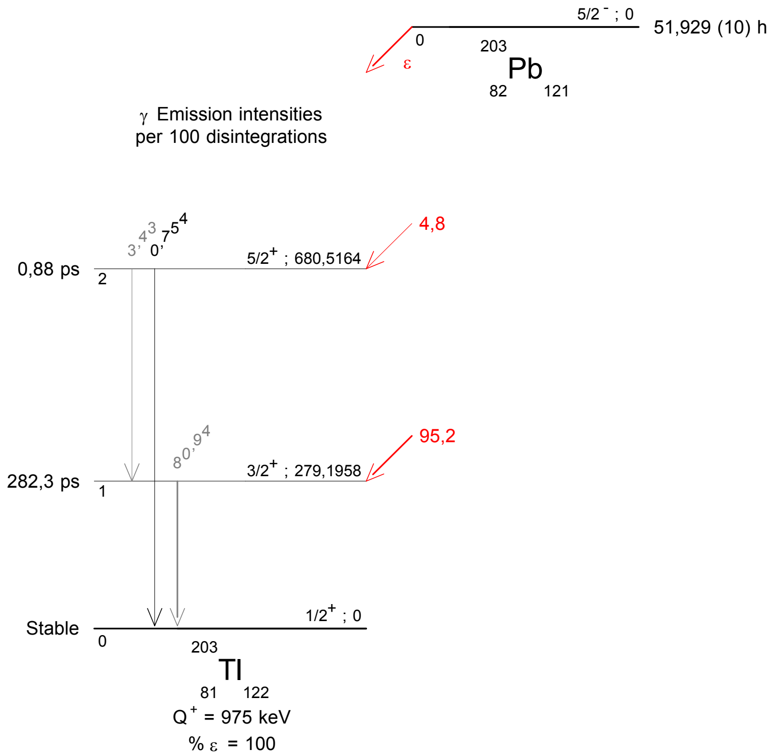
5/2⁻ ; 0
51,929 (10) h
0
ε
203
Pb
82 121
γ Emission intensities
per 100 disintegrations
4,8
5/2+ ; 680,5164
0,88 ps
2
95,2
3/2+ ; 279,1958
282,3 ps
1
1/2+ ; 0
Stable
0
203
Tl
81 122
Q+ = 975 keV
% ε = 100

$^{233}_{91}$Pa $_{142}$

1 Decay Scheme

Pa-233 disintegrates by beta minus emissions to levels in U-233.
Le protactinium 233 se désintègre par émission bêta moins vers des niveaux excités et le niveau fondamental de l'uranium 233.

2 Nuclear Data

$T_{1/2}(^{233}$Pa)	:	26,98	(2)	d
$T_{1/2}(^{233}$U)	:	159,2	(2)	10^3 a
$Q^-(^{233}$Pa)	:	570,1	(20)	keV

2.1 β^- Transitions

	Energy keV	Probability × 100	Nature	lg ft
$\beta^-_{0,11}$	114,1 (20)	0,0011 (2)	1st forbidden	10
$\beta^-_{0,10}$	154,3 (20)	25,3 (11)	1st forbidden	6
$\beta^-_{0,9}$	171,5 (20)	15,5 (9)	1st forbidden	6,4
$\beta^-_{0,8}$	189,8 (20)	0,020 (3)	1st forbidden unique	9,4
$\beta^-_{0,7}$	229,6 (20)	25,6 (29)	1st forbidden	6,6
$\beta^-_{0,6}$	249,4 (20)	0,020 (2)	2nd forbidden	9,8
$\beta^-_{0,5}$	258,2 (20)	26,7 (29)	1st forbidden	6,7
$\beta^-_{0,4}$	268,1 (20)	0,010 (2)	Allowed	10,2
$\beta^-_{0,3}$	271,3 (20)	0,12 (5)	Allowed	9
$\beta^-_{0,1}$	529,8 (20)	≈ 3,4	1st forbidden unique	9
$\beta^-_{0,0}$	570,1 (20)	≈ 3,3	1st forbidden	8,5

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{10,9}$(U)	17,2 (1)	2	M1 + E2			373 (12)	498 (15)
$\gamma_{7,5}$(U)	28,559 (10)	22,1 (27)	M1 + E2		230 (10)	59,4 (26)	310 (13)
$\gamma_{1,0}$(U)	40,349 (5)	17,0 (28)	M1 + E2		427 (40)	117 (11)	584 (54)
$\gamma_{7,3}$(U)	41,663 (10)	0,031 (7)	(E1)		0,93 (2)	0,235 (5)	1,24 (3)
$\gamma_{2,1}$(U)	51,8 (5)	0,05 (4)	(M1+ E2)		99 (60)	28 (17)	136 (80)
$\gamma_{10,7}$(U)	75,269 (10)	16,1 (11)	M1+E2		8,6 (6)	2,10 (17)	11,4 (8)
$\gamma_{9,5}$(U)	86,595 (10)	16,0 (9)	M1+E2		5,32 (10)	1,29 (3)	7,06 (14)
$\gamma_{2,0}$(U)	92,1 (5)	0,041 (21)	(E2)		14,2 (30)	3,98 (8)	19,6 (4)
$\gamma_{10,5}$(U)	103,86 (1)	4,44 (16)	M1+ E2		3,17 (14)	0,77 (4)	4,21 (18)
$\gamma_{6,2}$(U)	228,57 (5)	0,0042 (7)					
$\gamma_{7,2}$(U)	248,38 (4)	0,0818 (15)	(E2)	0,104 (2)	0,175 (4)	0,0479 (10)	0,344 (7)
$\gamma_{3,1}$(U)	258,45 (2)	0,0289 (6)	(E1)	0,0430 (9)	0,00856 (17)	0,0207 (4)	0,0544 (11)
$\gamma_{5,1}$(U)	271,555 (10)	0,406 (4)	E2	0,089 (2)	0,123 (3)	0,0334 (7)	0,256 (5)
$\gamma_{6,1}$(U)	280,61 (5)	0,011 (2)					
$\gamma_{8,2}$(U)	288,42 (10)	0,016 (3)					
$\gamma_{3,0}$(U)	298,81 (2)	0,12 (5)	(E1)	0,0314 (6)	0,00609 (12)	0,00147 (3)	0,0394 (8)
$\gamma_{7,1}$(U)	300,129 (5)	12,3 (4)	M1+ E2	0,70 (2)	0,133 (4)	0,033 (1)	0,87 (2)
$\gamma_{4,0}$(U)	301,99 (10)	0,010 (2)					
$\gamma_{5,0}$(U)	311,904 (5)	68,8 (8)	M1+ E2	0,64 (2)	0,126 (4)	0,031 (1)	0,80 (2)
$\gamma_{6,0}$(U)	320,73 (10)	0,0051 (4)					
$\gamma_{7,0}$(U)	340,476 (5)	7,24 (10)	M1+ E2	0,50 (2)	0,103 (3)	0,022 (1)	0,62 (2)
$\gamma_{10,1}$(U)	375,404 (5)	0,751 (8)	E2	0,0486 (10)	0,0359 (7)	0,00962 (19)	0,0974 (19)
$\gamma_{8,0}$(U)	380,28 (10)	0,0037 (9)					
$\gamma_{9,0}$(U)	398,492 (5)	1,525 (15)	E2	0,0434 (9)	0,0291 (6)	0,00775 (15)	0,0829 (17)
$\gamma_{10,0}$(U)	415,764 (5)	1,993 (18)	M1+E2	0,097 (8)	0,0326 (16)	0,00837 (25)	0,141 (9)
$\gamma_{11,0}$(U)	455,96 (10)	0,0011 (2)					

3 Atomic Data

3.1 U

ω_K	:	0,970	(4)
$\bar{\omega}_L$	:	0,500	(19)
n_{KL}	:	0,794	(5)

3.1.1 X Radiations

		Energy keV		Relative probability
X_K				
	$K\alpha_2$	94,666		62,47
	$K\alpha_1$	98,44		100
	$K\beta_3$	110,421	}	
	$K\beta_1$	111,298	}	
	$K\beta_5''$	111,964	}	36,08
	$K\beta_2$	114,407	}	
	$K\beta_4$	115,012	}	12,34
	$KO_{2,3}$	115,377	}	
X_L				
	$L\ell$	11,619		
	$L\alpha$	13,438 – 13,615		
	$L\eta$	15,399		
	$L\beta$	15,727 – 18,206		
	$L\gamma$	19,507 – 20,714		

3.1.2 Auger Electrons

	Energy keV	Relative probability
Auger K		
KLL	71,776 – 80,954	100
KLX	88,153 – 98,429	59,6
KXY	104,51 – 115,59	8,88
Auger L	0,1 – 21,6	

4 Electron Emissions

		Energy keV		Electrons per 100 disint.
e_{AL}	(U)	0,1 - 21,6		41,5 (10)
e_{AK}	(U)			0,95 (13)
	KLL	71,776 - 80,954	}	
	KLX	88,153 - 98,429	}	
	KXY	104,51 - 115,59	}	
$ec_{7,5\ L}$	(U)	6,80 - 11,39		16,3 (19)
$ec_{10,9\ M}$	(U)	11,65 - 13,65		1,5
$ec_{1,0\ L}$	(U)	18,59 - 23,18		12,4 (21)
$ec_{7,5\ M}$	(U)	23,01 - 25,01		4,2 (5)
$ec_{1,0\ M}$	(U)	34,8 - 36,8		3,4 (6)
$ec_{10,7\ L}$	(U)	53,51 - 58,10		11,2 (9)
$ec_{9,5\ L}$	(U)	64,84 - 69,43		10,6 (6)
$ec_{10,7\ M}$	(U)	69,72 - 71,72		2,73 (23)
$ec_{9,5\ M}$	(U)	81,05 - 83,05		2,57 (15)
$ec_{10,5\ L}$	(U)	82,10 - 86,69		2,70 (12)
$ec_{10,5\ M}$	(U)	98,31 - 100,31		0,66 (3)
$ec_{7,1\ K}$	(U)	184,527 (5)		4,62 (20)
$ec_{5,0\ K}$	(U)	196,302 (2)		24,5 (8)
$ec_{7,0\ K}$	(U)	224,874 (2)		2,23 (9)
$ec_{7,1\ L}$	(U)	278,37 - 282,96		0,88 (3)
$ec_{9,0\ K}$	(U)	282,890 (5)		0,0611 (13)
$ec_{5,0\ L}$	(U)	290,15 - 294,74		4,82 (16)
$ec_{7,1\ M}$	(U)	294,58 - 296,58		0,22 (1)
$ec_{10,0\ K}$	(U)	300,162 (7)		0,170 (13)
$ec_{5,0\ M}$	(U)	306,36 - 308,35		1,190 (39)
$ec_{7,0\ L}$	(U)	318,72 - 323,31		0,460 (14)
$ec_{7,0\ M}$	(U)	334,93 - 336,93		0,098 (5)
$ec_{10,0\ L}$	(U)	394,01 - 398,60		0,057 (30)
$\beta^-_{0,11}$	max:	114,1 (20)		0,0011 (2)
$\beta^-_{0,11}$	avg:	29,8 (5)		
$\beta^-_{0,10}$	max:	154,3 (20)		25,3 (11)
$\beta^-_{0,10}$	avg:	40,9 (5)		
$\beta^-_{0,9}$	max:	171,5 (20)		15,5 (9)
$\beta^-_{0,9}$	avg:	45,7 (5)		
$\beta^-_{0,8}$	max:	189,8 (20)		0,020 (3)
$\beta^-_{0,8}$	avg:	50,9 (6)		
$\beta^-_{0,7}$	max:	229,6 (20)		25,6 (29)
$\beta^-_{0,7}$	avg:	62,4 (6)		
$\beta^-_{0,6}$	max:	249,4 (20)		0,020 (2)
$\beta^-_{0,6}$	avg:	68,2 (6)		
$\beta^-_{0,5}$	max:	258,2 (20)		26,7 (29)

		Energy keV		Electrons per 100 disint.
$\beta^-_{0,5}$	avg:	70,8	(6)	
$\beta^-_{0,4}$	max:	268,1	(20)	0,010 (2)
$\beta^-_{0,4}$	avg:	73,7	(6)	
$\beta^-_{0,3}$	max:	271,3	(20)	0,12 (5)
$\beta^-_{0,3}$	avg:	74,6	(6)	
$\beta^-_{0,1}$	max:	529,8	(20)	3,4
$\beta^-_{0,1}$	avg:	156,1	(6)	
$\beta^-_{0,0}$	max:	570,1	(20)	3,3
$\beta^-_{0,0}$	avg:	169,6	(6)	

5 Photon Emissions

5.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(U)	11,619 — 20,714		41,5 (10)	
XKα_2	(U)	94,666		9,09 (25)	} Kα
XKα_1	(U)	98,44		14,6 (4)	}
XKβ_3	(U)	110,421	}		
XKβ_1	(U)	111,298	}	5,25 (21)	K$'\beta_1$
XKβ_5''	(U)	111,964	}		
XKβ_2	(U)	114,407	}		
XKβ_4	(U)	115,012	}	1,80 (8)	K$'\beta_2$
XKO$_{2,3}$	(U)	115,377	}		

5.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{10,9}$(U)	17,2 (1)	0,0041
$\gamma_{7,5}$(U)	28,559 (10)	0,071 (8)
$\gamma_{1,0}$(U)	40,349 (5)	0,029 (4)
$\gamma_{7,3}$(U)	41,663 (10)	0,014 (3)
$\gamma_{2,1}$(U)	51,8 (5)	0,0004 (2)

	Energy keV	Photons per 100 disint.
$\gamma_{10,7}$(U)	75,269 (10)	1,30 (3)
$\gamma_{9,5}$(U)	86,595 (10)	1,99 (11)
$\gamma_{2,0}$(U)	92,1 (5)	0,002 (1)
$\gamma_{10,5}$(U)	103,86 (1)	0,853 (6)
$\gamma_{6,2}$(U)	228,57 (5)	0,0042 (7)
$\gamma_{7,2}$(U)	248,38 (4)	0,0609 (11)
$\gamma_{3,1}$(U)	258,45 (2)	0,0274 (6)
$\gamma_{5,1}$(U)	271,555 (10)	0,323 (3)
$\gamma_{6,1}$(U)	280,61 (5)	0,011 (2)
$\gamma_{8,2}$(U)	288,42 (10)	0,016 (3)
$\gamma_{3,0}$(U)	298,81 (2)	0,12 (5)
$\gamma_{7,1}$(U)	300,129 (5)	6,60 (21)
$\gamma_{4,0}$(U)	301,99 (10)	0,010 (2)
$\gamma_{5,0}$(U)	311,904 (5)	38,25 (23)
$\gamma_{6,0}$(U)	320,73 (10)	0,0051 (4)
$\gamma_{7,0}$(U)	340,476 (5)	4,47 (3)
$\gamma_{10,1}$(U)	375,404 (5)	0,684 (7)
$\gamma_{8,0}$(U)	380,28 (10)	0,0037 (9)
$\gamma_{9,0}$(U)	398,492 (5)	1,408 (14)
$\gamma_{10,0}$(U)	415,764 (5)	1,747 (7)
$\gamma_{11,0}$(U)	455,96 (10)	0,0011 (2)

6 Main Production Modes

Th – 232(n,γ)Pa – 233
Possible impurities : Th – 233,Th – 234

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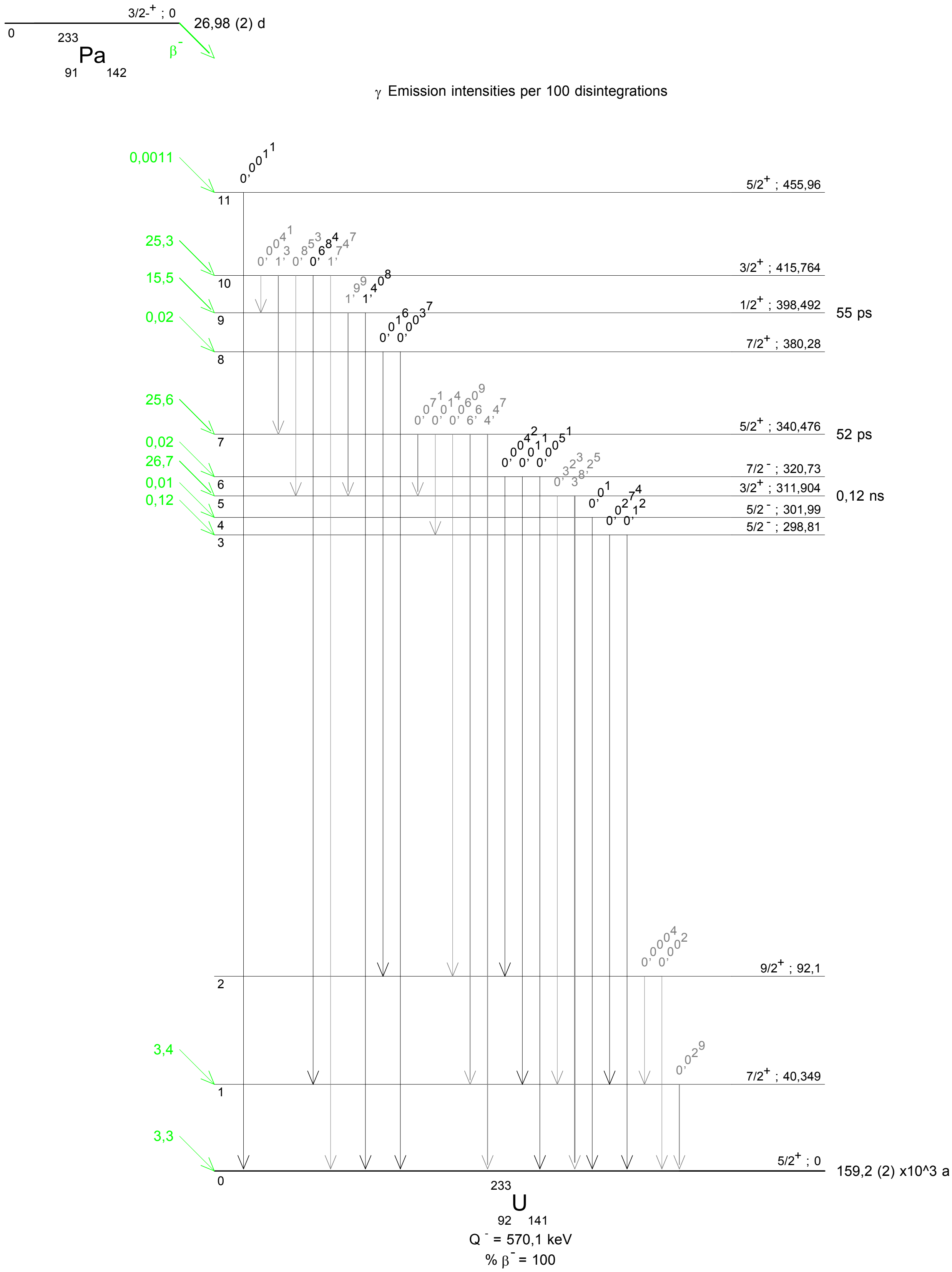
3/2-+ ; 0
26,98 (2) d
233
Pa
91 142
β-
γ Emission intensities per 100 disintegrations
0,0011
25,3
15,5
0,02
25,6
0,02
26,7
0,01
0,12
3,4
3,3
5/2+ ; 455,96
3/2+ ; 415,764
1/2+ ; 398,492
55 ps
7/2+ ; 380,28
5/2+ ; 340,476
52 ps
7/2 - ; 320,73
3/2+ ; 311,904
0,12 ns
5/2 - ; 301,99
5/2 - ; 298,81
9/2+ ; 92,1
7/2+ ; 40,349
5/2+ ; 0
159,2 (2) x10^3 a
233
U
92 141
Q - = 570,1 keV
% β- = 100

233 Th
90 143

1 Decay Scheme

Th-233 decays by beta minus emission to levels in Pa-233.
Le thorium 233 se désintègre par émission beta moins vers des niveaux excités du protactinium 233.

2 Nuclear Data

$T_{1/2}$(^{233}Th)	:	22,15	(15)	min
$T_{1/2}$(^{233}Pa)	:	26,975	(13)	d
Q^-(^{233}Th)	:	1243,1	(14)	keV

2.1 β^- Transitions

	Energy keV	Probability × 100	Nature	lg ft
$\beta^-_{0,20}$	224,4 (14)	0,056		6,6
$\beta^-_{0,19}$	258,3 (14)	0,32	allowed	6
$\beta^-_{0,18}$	431,5 (14)	0,54	allowed	6,5
$\beta^-_{0,17}$	478,5 (14)	1,58	allowed	6,2
$\beta^-_{0,16}$	573,2 (14)	0,02	1st forbidden	8,3
$\beta^-_{0,15}$	657,6 (14)	0,22	allowed	7,5
$\beta^-_{0,14}$	689,2 (14)	1,7	allowed	6,7
$\beta^-_{0,13}$	788,7 (14)	0,27	allowed	7,7
$\beta^-_{0,12}$	795,3 (14)	1,18	1st forbidden	7
$\beta^-_{0,11}$	985,8 (14)	0,08	1st forbidden unique	8,5
$\beta^-_{0,8}$	1041,4 (14)	0,04	allowed	8,9
$\beta^-_{0,7}$	1073,9 (14)	0,9	allowed	7,6
$\beta^-_{0,5}$	1148,4 (14)	16	allowed	6,4
$\beta^-_{0,1}$	1236,4 (14)	46	1st forbidden	6,1
$\beta^-_{0,0}$	1243,1 (14)	34	1st forbidden	6,3

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2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{(-1,1)}$(Pa)							
$\gamma_{1,0}$(Pa)	6,65 (5)	48	(M1)			2231	3016
$\gamma_{5,4}$(Pa)	8,22 (5)	19					
$\gamma_{6,4}$(Pa)	17,40 (5)						
$\gamma_{4,2}$(Pa)	29,373 (10)	10,3	E1		2,32	0,6	3,12
$\gamma_{6,2}$(Pa)	46,53 (4)						
$\gamma_{2,0}$(Pa)	57,10 (2)	9,72	E2		131	36,1	180
$\gamma_{3,1}$(Pa)	63,92 (6)	0,084	(E2)		76	21	104
$\gamma_{3,0}$(Pa)	70,49 (10)	0,032	[M1+E2]		2,8	7,7	39
$\gamma_{7,5}$(Pa)	74,51 (5)	0,6	[M1]		7,96	1,93	10,6
$\gamma_{(-1,42)}$(Pa)	80						
$\gamma_{4,0}$(Pa)	86,477 (10)	6,7	E1		1,13 (4)	0,22 (4)	1,43 (8)
$\gamma_{5,1}$(Pa)	87,99 (3)	0,21	[E1]		0,13	0,032	0,17
$\gamma_{5,0}$(Pa)	94,66 (5)	0,9	E1		0,11	0,026	0,15
$\gamma_{(-1,2)}$(Pa)	105,2 (1)	0,043					
$\gamma_{9,6}$(Pa)	108,5 (1)	0,0029	M1+E2		2,8	0,69	3,8
$\gamma_{8,4}$(Pa)	115,14 (5)	0,0253	[M1+E2]	5,7	3,5	0,94	10,5
$\gamma_{9,5}$(Pa)	117,692 (20)	0,021	M1+E2	10,1	2,3	0,56	13,2
$\gamma_{8,3}$(Pa)	131,101 (25)	0,084	E1	0,21	0,049	0,012	0,26
$\gamma_{10,6}$(Pa)	134,285 (20)	0,021	[M1+E2]	6,6	1,57	0,39	8,5
$\gamma_{9,3}$(Pa)	141,74 (10)						
$\gamma_{10,5}$(Pa)	143,23 (2)	0,11	M1+E2	5,47	1,28	0,319	7,07
$\gamma_{10,4}$(Pa)	151,409 (20)	0,056	M1+E2	3,72	1,14	0,29	5,14
$\gamma_{11,6}$(Pa)	153,49 (18)	0,077	[E1]	0,14	0,032	0,0079	0,18
$\gamma_{9,2}$(Pa)	155,239 (20)	0,001	E1	0,14	0,032	0,0077	0,18
$\gamma_{7,1}$(Pa)	162,504 (12)	0,17	[E1]	0,127	0,028	0,0068	0,16
$\gamma_{11,5}$(Pa)	162,504	0,2	[E1]	0,127	0,028	0,0068	0,16
$\gamma_{7,0}$(Pa)	169,159 (10)	0,39	[E1]	0,12	0,025	0,0061	0,15
$\gamma_{11,4}$(Pa)	170,60 (6)	0,15	[E1]	0,113	0,025	0,0059	0,14
$\gamma_{17,15}$(Pa)	179,05 (8)	0,17	(M1+E2)	2,82	0,641	0,16	3,62
$\gamma_{10,2}$(Pa)	180,76 (3)	0,0008	[E1]	0,099	0,021	0,0052	0,13
$\gamma_{11,3}$(Pa)	186,80 (18)	0,11	(M1+E2)	1,57	0,55	0,14	2,3
$\gamma_{12,11}$(Pa)	190,552 (14)	0,59	M1	2,8	0,54	0,13	3,5
$\gamma_{8,1}$(Pa)	194,97 (7)	0,18	E1	0,081	0,017	0,004	0,103
$\gamma_{8,0}$(Pa)	201,62 (5)	0,033	E1	0,076	0,016	0,0037	0,096
$\gamma_{17,14}$(Pa)	210,67 (8)	0,092	(M1+E2)	1,16	0,37	0,094	1,62
$\gamma_{(-1,3)}$(Pa)	211,3 (2)	0,019					
$\gamma_{9,0}$(Pa)	212,34 (5)	0,0016	E1	0,067	0,014	0,0033	0,085
$\gamma_{13,10}$(Pa)	216,54 (8)	0,038	(M1+E2)	1,09	0,29	0,074	1,5
$\gamma_{18,15}$(Pa)	226,1 (2)	0,072	M1+(E2)	1,74	0,33	0,079	2,15
$\gamma_{10,0}$(Pa)	237,86 (2)	0,0023	[E1]	0,052	0,011	0,0025	0,062
$\gamma_{12,8}$(Pa)	246,14 (6)		[E1]	0,048	0,0095	0,0023	0,061
$\gamma_{11,1}$(Pa)	250,65 (16)	0,0062	[E2]	0,105	0,16	0,044	0,32
$\gamma_{13,8}$(Pa)	252,78 (9)	0,029	[M1+E2]	1,12	0,229	0,0559	1,39
$\gamma_{11,0}$(Pa)	257,30 (15)	0,13	[M1+E2]	0,66	0,19	0,047	0,9
$\gamma_{18,14}$(Pa)	257,7 (2)						
$\gamma_{(-1,4)}$(Pa)	278,7 (4)	0,0078					
$\gamma_{13,7}$(Pa)	285,24 (7)	0,042	(M1+E2)	0,79	0,16	0,039	0,99
$\gamma_{15,10}$(Pa)	347,64 (6)	0,019	[M1]	0,54	0,099	0,024	0,67
$\gamma_{13,5}$(Pa)	359,74 (4)	0,12	M1				
$\gamma_{12,4}$(Pa)	361,285 (22)	0,039	[E1]	0,021	0,0039	0,00093	0,26
$\gamma_{13,4}$(Pa)	367,92 (7)	0,0074	[M1]	0,46	0,086	0,021	0,56
$\gamma_{12,3}$(Pa)	377,27 (11)	0,057	[M1+E2]	0,39	0,076	0,019	0,49
$\gamma_{19,15}$(Pa)	398,8 (5)	0,021	[M1]	0,36	0,069	0,016	0,46
$\gamma_{(-1,5)}$(Pa)	408,8 (5)	0,0038					
$\gamma_{16,11}$(Pa)	412,5 (5)	0,019	(M1)	0,33	0,063	0,015	0,42
$\gamma_{(-1,6)}$(Pa)	418,4 (5)	0,012					

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{19,14}$(Pa)	430,9 (4)	0,032	(M1)	0,29	0,056	0,0015	0,37
$\gamma_{20,15}$(Pa)	433,2 (4)	0,015					
$\gamma_{(-1,7)}$(Pa)	435,0 (5)						
$\gamma_{12,1}$(Pa)	440,94 (4)	0,31	(M1+E2)	0,25	0,049	0,012	0,32
$\gamma_{12,0}$(Pa)	447,762 (20)	0,19	(M1+E2)	0,26	0,048	0,012	0,31
$\gamma_{(-1,8)}$(Pa)	454,2 (5)	0,04					
$\gamma_{14,5}$(Pa)	459,222 (7)	1,835	M1	0,249	0,0465	0,0013	0,32
$\gamma_{14,4}$(Pa)	467,40 (6)	0,021	[M1, E2]	0,14	0,03	0,007	0,18
$\gamma_{(-1,9)}$(Pa)	473,9 (5)	0,0035					
$\gamma_{15,5}$(Pa)	490,80 (6)	0,22	M1	0,21	0,038	0,0094	0,26
$\gamma_{(-1,10)}$(Pa)	497,1 (4)	0,021					
$\gamma_{15,4}$(Pa)	499,02 (4)	0,26	M1	0,19	0,038	0,0089	0,25
$\gamma_{(-1,11)}$(Pa)	505,5 (6)	0,0049					
$\gamma_{(-1,12)}$(Pa)	513,4 (4)	0,02					
$\gamma_{(-1,13)}$(Pa)	517,0 (4)	0,0068					
$\gamma_{17,10}$(Pa)	526,69 (6)	0,007	[M1, E2]	0,1	0,021	0,005	0,13
$\gamma_{(-1,14)}$(Pa)	531,8 (4)	0,0042					
$\gamma_{17,9}$(Pa)	552,21 (8)	0,027	[M1]	0,09	0,019	0,0046	0,11
$\gamma_{(-1,15)}$(Pa)	554,9 (5)	0,0035					
$\gamma_{17,8}$(Pa)	562,93 (8)	0,083	M1	0,15	0,027	0,0065	0,18
$\gamma_{18,10}$(Pa)	573,7 (4)	0,049	[M1]	0,14	0,025	0,0062	0,17
$\gamma_{17,7}$(Pa)	595,39 (6)	0,19	(M1)	0,125	0,023	0,0056	0,16
$\gamma_{18,9}$(Pa)	599,3 (2)	0,054	M1	0,13	0,023	0,0055	0,16
$\gamma_{18,8}$(Pa)	610,0 (3)	0,097	[M1]	0,12	0,022	0,0052	0,15
$\gamma_{18,7}$(Pa)	642,4 (2)	0,032	[M1]	0,11	0,019	0,0045	0,13
$\gamma_{16,1}$(Pa)	663,3 (5)	0,0027	[M1]	0,094	0,018	0,0042	0,12
$\gamma_{16,0}$(Pa)	669,9 (5)	0,0019	(M1)				
$\gamma_{17,5}$(Pa)	669,902 (16)	0,76	M1+E2	0,092	0,017	0,00415	0,12
$\gamma_{17,4}$(Pa)	678,04 (10)	0,087	[M1,E2]				
$\gamma_{(-1,16)}$(Pa)	681,2 (6)	0,016					
$\gamma_{(-1,17)}$(Pa)	698,5 (6)	0,012					
$\gamma_{(-1,18)}$(Pa)	703,7 (6)	0,011					
$\gamma_{18,6}$(Pa)	707,8 (3)	0,01	[E2]	0,014	0,0046	0,0012	0,021
$\gamma_{18,5}$(Pa)	717,0 (2)	0,061	[M1]	0,076	0,014	0,0033	0,094
$\gamma_{18,4}$(Pa)	725,1 (2)	0,09	[M1]	0,074	0,014	0,0033	0,092
$\gamma_{18,3}$(Pa)	741,1 (2)	0,031	[E1]	0,0051	0,00087	0,0002	0,0063
$\gamma_{(-1,19)}$(Pa)	744,9 (5)	0,0068					
$\gamma_{(-1,20)}$(Pa)	751,6 (6)	0,0024					
$\gamma_{17,1}$(Pa)	757,90 (7)	0,042					
$\gamma_{17,0}$(Pa)	764,55 (6)	0,12					
$\gamma_{(-1,21)}$(Pa)	774,0 (4)	0,014					
$\gamma_{19,8}$(Pa)	783,2 (5)	0,0065	[M1]	0,06	0,011	0,0027	0,075
$\gamma_{(-1,22)}$(Pa)	784,2 (5)	0,0049					
$\gamma_{18,1}$(Pa)	804,8 (4)	0,031	[E1]	0,0043	0,00074	0,00018	0,0054
$\gamma_{20,9}$(Pa)	806,4 (5)	0,013					
$\gamma_{18,0}$(Pa)	811,6 (2)	0,0079	[E1]	0,0044	0,00073	0,00018	0,0053
$\gamma_{19,7}$(Pa)	815,9 (4)	0,028	(M1)	0,0023	0,0099	0,0023	0,067
$\gamma_{20,8}$(Pa)	817,0 (6)	0,016					
$\gamma_{(-1,23)}$(Pa)	832,0 (3)	0,0081					
$\gamma_{(-1,24)}$(Pa)	846,8 (7)	0,0014					
$\gamma_{20,7}$(Pa)	849,5 (5)	0,0047					
$\gamma_{(-1,25)}$(Pa)	870,7 (7)	0,0021					
$\gamma_{(-1,26)}$(Pa)	874,0 (5)	0,0062					
$\gamma_{19,6}$(Pa)	880,9 (5)	0,0078		0,01	0,0027	0,00065	0,012
$\gamma_{19,5}$(Pa)	890,1 (5)	0,15	[M1]	0,044	0,0078	0,0018	0,048
$\gamma_{19,4}$(Pa)	898,3 (5)	0,0034	[M1]	0,043	0,0077	0,0018	0,048
$\gamma_{(-1,27)}$(Pa)	918,9 (5)	0,007					
$\gamma_{(-1,28)}$(Pa)	935,2 (7)	0,049					
$\gamma_{(-1,29)}$(Pa)	941,9 (8)	0,0078					

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{20,3}$(Pa)	948,3 (5)	0,0075					
$\gamma_{(-1,30)}$(Pa)	955 (1)	0,0054					
$\gamma_{(-1,31)}$(Pa)	960,8 (8)	0,0068					
$\gamma_{(-1,32)}$(Pa)	962,8 (9)	0,0014					
$\gamma_{(-1,33)}$(Pa)	968,2 (9)	0,0011					
$\gamma_{19,1}$(Pa)	978,2 (5)	0,0075	[E1]	0,0032	0,00052	0,00012	0,0036
$\gamma_{19,0}$(Pa)	984,8 (5)	0,0014	[E1]	0,0031	0,00051	0,00012	0,0036
$\gamma_{(-1,34)}$(Pa)	994 (1)	0,00094					
$\gamma_{(-1,35)}$(Pa)	1001 (1)	0,0012					
$\gamma_{(-1,36)}$(Pa)	1007 (1)	0,0028					
$\gamma_{(-1,37)}$(Pa)	1011 (1)	0,004					
$\gamma_{(-1,38)}$(Pa)	1026,5 (10)	0,0081					
$\gamma_{(-1,39)}$(Pa)	1092,5 (10)	0,007					
$\gamma_{(-1,40)}$(Pa)	1144 (1)	0,0029					
$\gamma_{(-1,41)}$(Pa)	1201 (1)	0,007					

3 Atomic Data

3.1 Pa

ω_K	:	0,970	(4)
$\bar{\omega}_L$	:	0,488	(18)
$\bar{\omega}_M$	:	0,0477	
n_{KL}	:	0,795	(5)
$\bar{n}_{LM}$	:	1,186	

3.1.1 X Radiations

		Energy keV		Relative probability
X_K				
	$K\alpha_2$	92,288		62,14
	$K\alpha_1$	95,869		100
	$K\beta_3$	107,595	}	
	$K\beta_1$	108,422	}	
	$K\beta_5''$	109,072	}	34,78
	$K\beta_2$	111,405	}	
	$K\beta_4$	111,87	}	11,22
	$KO_{2,3}$	112,38	}	
X_L				
	$L\ell$	11,3676		
	$L\alpha$	13,1215 – 13,2887		
	$L\eta$	14,9488		
	$L\beta$	15,3584 – 17,6655		
	$L\gamma$	18,9396 – 20,1126		

3.1.2 Auger Electrons

	Energy keV	Relative probability
Auger K		
KLL	70,081 – 78,822	100
KLX	88,03 – 95,56	60
KXY	101,78 – 112,30	8,76
Auger L	5,9 – 20,9	

4 Electron Emissions

		Energy keV				Electrons per 100 disint.
e_{AL}	(Pa)	5,9	-	20,9		9,2
e_{AK}	(Pa)					0,051
	KLL	70,081	-	78,822	}	
	KLX	88,03	-	95,56	}	
	KXY	101,78	-	112,30	}	
$ec_{1,0\ M}$	(Pa)	1,29	-	3,21		35,7
$ec_{4,2\ L}$	(Pa)	8,27	-	12,64		5,8
$ec_{4,2\ M}$	(Pa)	24,01	-	25,93		1,5
$ec_{10,5\ K}$	(Pa)	30,6		(1)		0,076
$ec_{2,0\ L}$	(Pa)	36,00	-	40,37		7,1
$ec_{3,1\ L}$	(Pa)	42,82	-	47,19		0,061
$ec_{2,0\ M}$	(Pa)	51,74	-	53,66		2
$ec_{7,5\ L}$	(Pa)	53,41	-	57,78		0,41
$ec_{4,0\ L}$	(Pa)	65,37	-	69,74		3,05
$ec_{17,15\ K}$	(Pa)	66,45		(8)		0,11
$ec_{5,0\ L}$	(Pa)	73,48	-	77,85		0,088
$ec_{11,3\ K}$	(Pa)	74,20		(18)		0,1
$ec_{4,0\ M}$	(Pa)	81,12	-	83,04		0,59
$ec_{11,0\ K}$	(Pa)	144,7		(15)		0,082
$ec_{12,1\ K}$	(Pa)	328,34		(4)		0,059
$ec_{14,5\ K}$	(Pa)	346,626		(7)		0,35
$ec_{14,5\ L}$	(Pa)	438,117	-	442,489		0,065
$ec_{17,5\ K}$	(Pa)	557,306		(16)		0,062
$\beta^-_{0,20}$	max:	224,4		(14)		0,056
$\beta^-_{0,20}$	avg:	61				
$\beta^-_{0,19}$	max:	258,3		(14)		0,32
$\beta^-_{0,19}$	avg:	71				

		Energy keV		Electrons per 100 disint.
$\beta^-_{0,18}$	max:	431,5	(14)	0,54
$\beta^-_{0,18}$	avg:	124		
$\beta^-_{0,17}$	max:	478,5	(14)	1,58
$\beta^-_{0,17}$	avg:	140		
$\beta^-_{0,16}$	max:	573,2	(14)	0,02
$\beta^-_{0,16}$	avg:	171		
$\beta^-_{0,15}$	max:	657,6	(14)	0,22
$\beta^-_{0,15}$	avg:	200		
$\beta^-_{0,14}$	max:	689,2	(14)	1,7
$\beta^-_{0,14}$	avg:	211		
$\beta^-_{0,13}$	max:	788,7	(14)	0,27
$\beta^-_{0,13}$	avg:	246		
$\beta^-_{0,12}$	max:	795,3	(14)	1,18
$\beta^-_{0,12}$	avg:	248		
$\beta^-_{0,11}$	max:	985,8	(14)	0,08
$\beta^-_{0,11}$	avg:	317		
$\beta^-_{0,8}$	max:	1041,4	(14)	0,04
$\beta^-_{0,8}$	avg:	338		
$\beta^-_{0,7}$	max:	1073,9	(14)	0,9
$\beta^-_{0,7}$	avg:	350		
$\beta^-_{0,5}$	max:	1148,4	(14)	16
$\beta^-_{0,5}$	avg:	378		
$\beta^-_{0,1}$	max:	1236,4	(14)	46
$\beta^-_{0,1}$	avg:	411		
$\beta^-_{0,0}$	max:	1243,1	(14)	34
$\beta^-_{0,0}$	avg:	414		

5 Photon Emissions

5.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(Pa)	11,3676 — 20,1126		8,8	
$XK\alpha_2$	(Pa)	92,288		0,48	} $K\alpha$
$XK\alpha_1$	(Pa)	95,869		0,78	}
$XK\beta_3$	(Pa)	107,595	}		
$XK\beta_1$	(Pa)	108,422	}	0,28	$K'\beta_1$
$XK\beta''_5$	(Pa)	109,072	}		

		Energy keV		Photons per 100 disint.	
XKβ_2	(Pa)	111,405	}		
XKβ_4	(Pa)	111,87	}	0,095	K$'\beta_2$
XKO$_{2,3}$	(Pa)	112,38	}		

5.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{1,0}$(Pa)	6,65 (5)	0,016
$\gamma_{4,2}$(Pa)	29,373 (10)	2,5
$\gamma_{2,0}$(Pa)	57,10 (2)	0,054
$\gamma_{3,1}$(Pa)	63,92 (6)	0,0008
$\gamma_{3,0}$(Pa)	70,49 (10)	0,0008
$\gamma_{7,5}$(Pa)	74,51 (5)	0,052
$\gamma_{4,0}$(Pa)	86,477 (10)	2,7
$\gamma_{5,1}$(Pa)	87,99 (3)	0,18
$\gamma_{5,0}$(Pa)	94,65 (5)	0,8
$\gamma_{(-1,2)}$(Pa)	105,2 (1)	0,043
$\gamma_{9,6}$(Pa)	108,5 (1)	0,0006
$\gamma_{8,4}$(Pa)	115,14 (5)	0,0022
$\gamma_{9,5}$(Pa)	117,692 (20)	0,0015
$\gamma_{8,3}$(Pa)	131,101 (25)	0,066
$\gamma_{10,6}$(Pa)	134,285 (20)	0,0022
$\gamma_{10,5}$(Pa)	143,23 (2)	0,014
$\gamma_{10,4}$(Pa)	151,409 (20)	0,009
$\gamma_{11,6}$(Pa)	153,49 (18)	0,066
$\gamma_{9,2}$(Pa)	155,239 (20)	0,0009
$\gamma_{7,1}$(Pa)	162,504 (12)	0,15
$\gamma_{11,5}$(Pa)	162,504	0,17
$\gamma_{7,0}$(Pa)	169,159 (10)	0,34
$\gamma_{11,4}$(Pa)	170,60 (6)	0,13
$\gamma_{17,15}$(Pa)	179,05 (8)	0,038
$\gamma_{10,2}$(Pa)	180,76 (3)	0,0007
$\gamma_{11,3}$(Pa)	186,80 (18)	0,034
$\gamma_{12,11}$(Pa)	190,552 (14)	0,13
$\gamma_{8,1}$(Pa)	194,97 (7)	0,16
$\gamma_{8,0}$(Pa)	201,62 (5)	0,031
$\gamma_{17,14}$(Pa)	210,67 (8)	0,035
$\gamma_{(-1,3)}$(Pa)	211,3 (2)	0,019
$\gamma_{9,0}$(Pa)	212,34 (5)	0,0015
$\gamma_{13,10}$(Pa)	216,54 (8)	0,015
$\gamma_{18,15}$(Pa)	226,1 (2)	0,023
$\gamma_{10,0}$(Pa)	237,86 (2)	0,0021
$\gamma_{11,1}$(Pa)	250,65 (16)	0,0047
$\gamma_{13,8}$(Pa)	252,78 (9)	0,012

	Energy keV	Photons per 100 disint.
$\gamma_{11,0}$(Pa)	257,30 (15)	0,068
$\gamma_{(-1,4)}$(Pa)	278,7 (4)	0,0078
$\gamma_{13,7}$(Pa)	285,24 (7)	0,021
$\gamma_{15,10}$(Pa)	347,64 (6)	0,012
$\gamma_{13,5}$(Pa)	359,74 (4)	0,12
$\gamma_{12,4}$(Pa)	361,285 (22)	0,038
$\gamma_{13,4}$(Pa)	367,92 (7)	0,0047
$\gamma_{12,3}$(Pa)	377,27 (11)	0,038
$\gamma_{19,15}$(Pa)	398,8 (5)	0,014
$\gamma_{(-1,5)}$(Pa)	408,8 (5)	0,0038
$\gamma_{16,11}$(Pa)	412,5 (5)	0,013
$\gamma_{(-1,6)}$(Pa)	418,4 (5)	0,012
$\gamma_{19,14}$(Pa)	430,9 (4)	0,023
$\gamma_{20,15}$(Pa)	433,2 (4)	0,015
$\gamma_{12,1}$(Pa)	440,94 (4)	0,23
$\gamma_{12,0}$(Pa)	447,762 (20)	0,15
$\gamma_{(-1,8)}$(Pa)	454,2 (5)	0,04
$\gamma_{14,5}$(Pa)	459,222 (7)	1,4
$\gamma_{14,4}$(Pa)	467,40 (6)	0,018
$\gamma_{(-1,9)}$(Pa)	473,9 (5)	0,0035
$\gamma_{15,5}$(Pa)	490,80 (6)	0,17
$\gamma_{(-1,10)}$(Pa)	497,1 (4)	0,021
$\gamma_{15,4}$(Pa)	499,02 (4)	0,21
$\gamma_{(-1,11)}$(Pa)	505,5 (6)	0,0049
$\gamma_{(-1,12)}$(Pa)	513,4 (4)	0,02
$\gamma_{(-1,13)}$(Pa)	517,0 (4)	0,0068
$\gamma_{17,10}$(Pa)	526,69 (6)	0,0063
$\gamma_{(-1,14)}$(Pa)	531,8 (4)	0,0042
$\gamma_{17,9}$(Pa)	552,21 (8)	0,024
$\gamma_{(-1,15)}$(Pa)	554,9 (5)	0,0035
$\gamma_{17,8}$(Pa)	562,93 (8)	0,07
$\gamma_{18,10}$(Pa)	573,7 (4)	0,042
$\gamma_{17,7}$(Pa)	595,39 (6)	0,16
$\gamma_{18,9}$(Pa)	599,3 (2)	0,047
$\gamma_{18,8}$(Pa)	610,0 (3)	0,085
$\gamma_{18,7}$(Pa)	642,4 (2)	0,028
$\gamma_{16,1}$(Pa)	663,3 (5)	0,0024
$\gamma_{16,0}$(Pa)	669,9 (5)	0,0019
$\gamma_{17,5}$(Pa)	669,902 (16)	0,68
$\gamma_{17,4}$(Pa)	678,04 (10)	0,087
$\gamma_{(-1,16)}$(Pa)	681,2 (6)	0,016
$\gamma_{(-1,17)}$(Pa)	698,5 (6)	0,012
$\gamma_{(-1,18)}$(Pa)	703,7 (6)	0,011
$\gamma_{18,6}$(Pa)	707,8 (3)	0,012
$\gamma_{18,5}$(Pa)	717,0 (2)	0,056
$\gamma_{18,4}$(Pa)	725,1 (2)	0,087
$\gamma_{18,3}$(Pa)	741,1 (2)	0,031

	Energy keV	Photons per 100 disint.
$\gamma_{(-1,19)}$(Pa)	744,9 (5)	0,0068
$\gamma_{(-1,20)}$(Pa)	751,6 (6)	0,0024
$\gamma_{17,1}$(Pa)	757,90 (7)	0,042
$\gamma_{17,0}$(Pa)	764,55 (6)	0,12
$\gamma_{(-1,21)}$(Pa)	774,0 (4)	0,014
$\gamma_{19,8}$(Pa)	783,2 (5)	0,0061
$\gamma_{(-1,22)}$(Pa)	784,2 (5)	0,0049
$\gamma_{18,1}$(Pa)	804,8 (4)	0,031
$\gamma_{20,9}$(Pa)	806,4 (5)	0,013
$\gamma_{18,0}$(Pa)	811,6 (2)	0,0078
$\gamma_{19,7}$(Pa)	815,9 (4)	0,028
$\gamma_{20,8}$(Pa)	817,0 (6)	0,016
$\gamma_{(-1,23)}$(Pa)	832,0 (3)	0,0081
$\gamma_{(-1,24)}$(Pa)	846,8 (7)	0,0014
$\gamma_{20,7}$(Pa)	849,5 (5)	0,0047
$\gamma_{(-1,25)}$(Pa)	870,7 (7)	0,0021
$\gamma_{(-1,26)}$(Pa)	874,0 (5)	0,0062
$\gamma_{19,6}$(Pa)	880,9 (5)	0,0078
$\gamma_{19,5}$(Pa)	890,1 (5)	0,14
$\gamma_{19,4}$(Pa)	898,3 (5)	0,0033
$\gamma_{(-1,27)}$(Pa)	918,9 (5)	$<$ 0,007
$\gamma_{(-1,28)}$(Pa)	935,2 (7)	0,049
$\gamma_{(-1,29)}$(Pa)	941,9 (8)	0,0078
$\gamma_{20,3}$(Pa)	948,3 (5)	0,0075
$\gamma_{(-1,30)}$(Pa)	955 (1)	0,0054
$\gamma_{(-1,31)}$(Pa)	960,8 (8)	0,0068
$\gamma_{(-1,32)}$(Pa)	962,8 (9)	0,0014
$\gamma_{(-1,33)}$(Pa)	968,2 (9)	0,011
$\gamma_{19,1}$(Pa)	978,2 (5)	0,0075
$\gamma_{19,0}$(Pa)	984,8 (5)	0,0014
$\gamma_{(-1,34)}$(Pa)	994 (1)	0,00094
$\gamma_{(-1,35)}$(Pa)	1001 (1)	0,0012
$\gamma_{(-1,36)}$(Pa)	1007 (1)	0,0028
$\gamma_{(-1,37)}$(Pa)	1011 (1)	0,004
$\gamma_{(-1,38)}$(Pa)	1026,5 (10)	0,0081
$\gamma_{(-1,39)}$(Pa)	1092,5 (10)	$<$ 0,007
$\gamma_{(-1,40)}$(Pa)	1144 (1)	0,0029
$\gamma_{(-1,41)}$(Pa)	1201 (1)	$<$ 0,007

6 Main Production Modes

$\begin{cases} \text{Th} - 232(\text{n},\gamma)\text{Th} - 233 \\ \text{Possible impurities : Th} - 232,\text{Th} - 234 \end{cases}$

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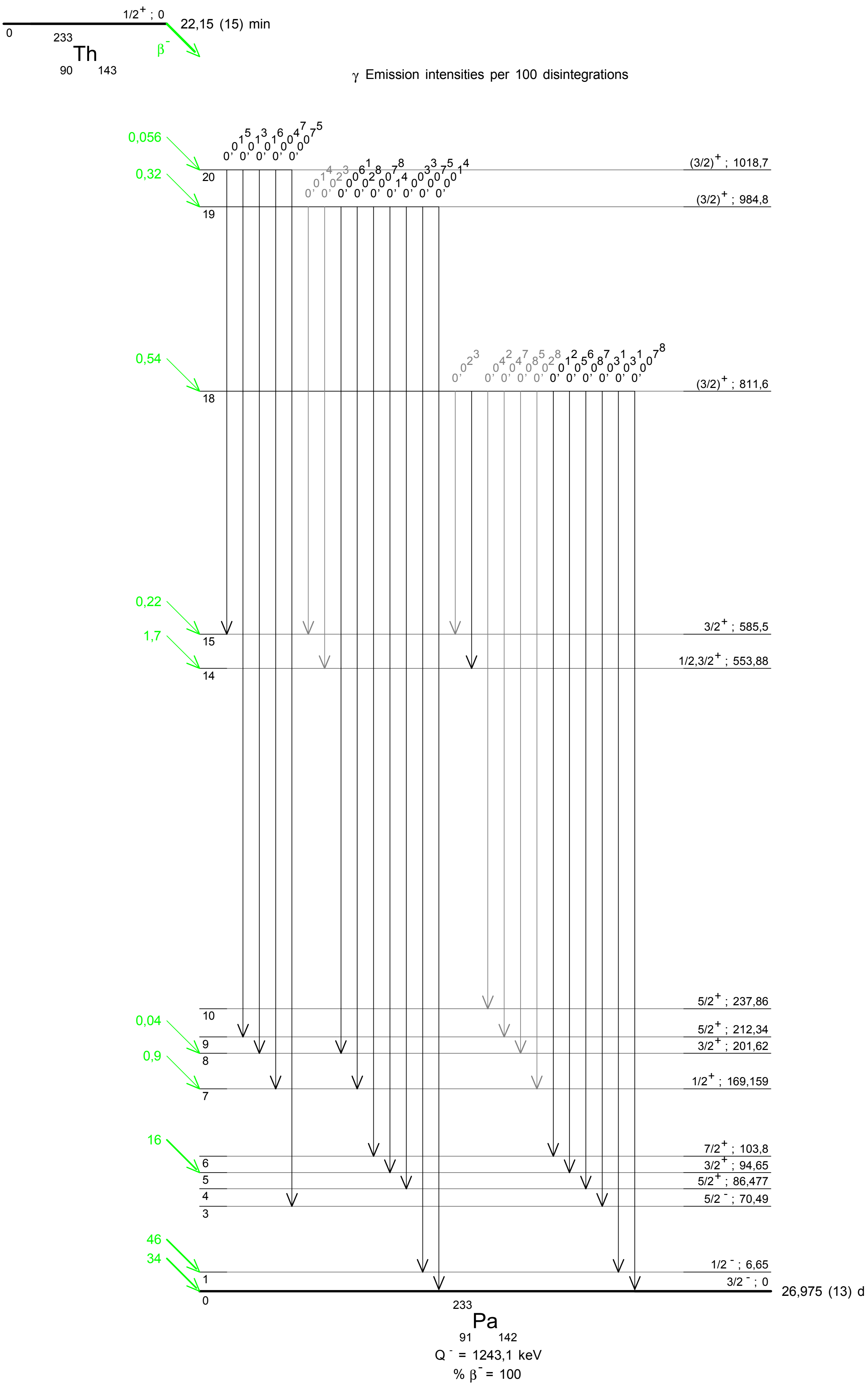
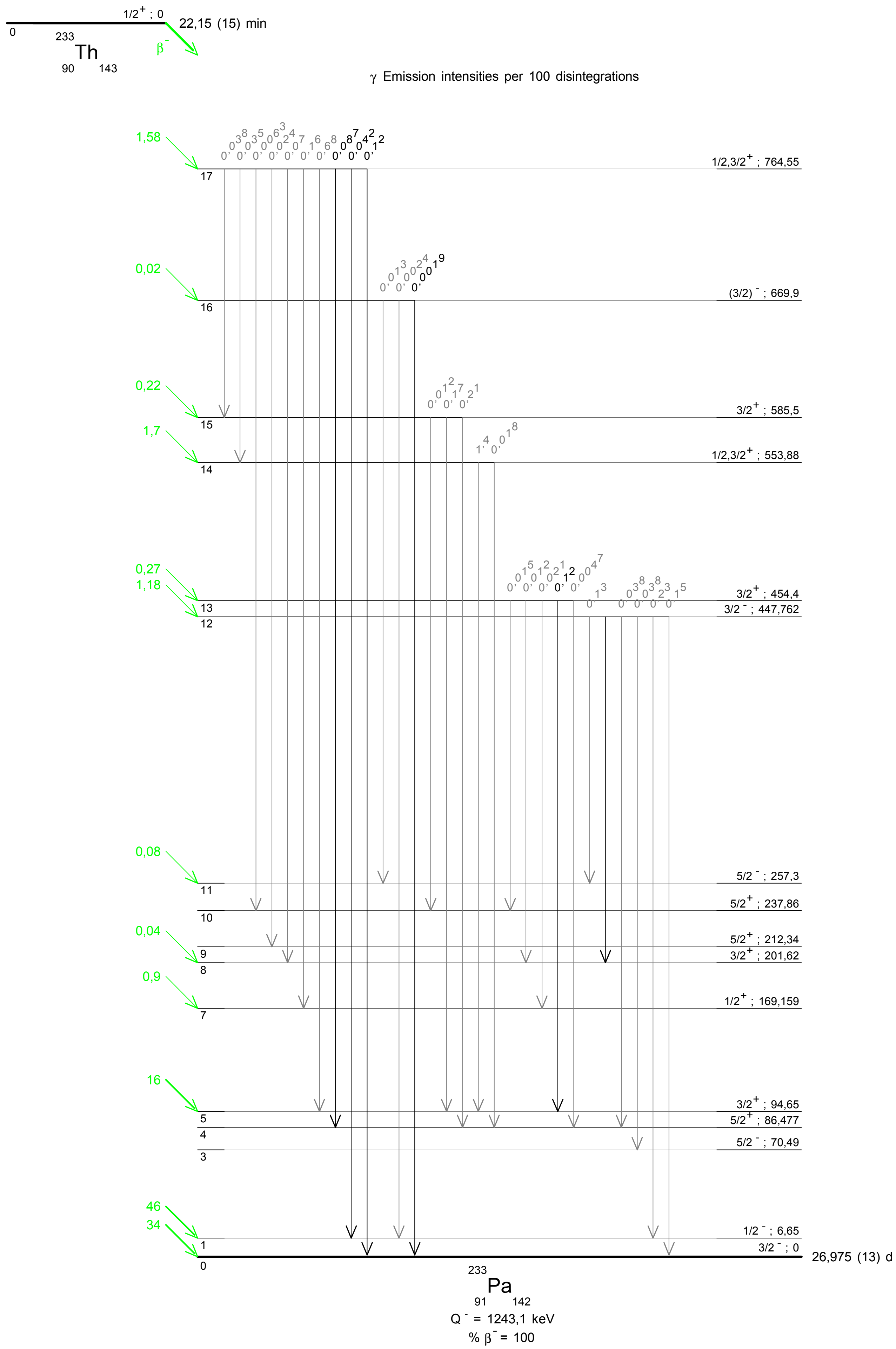
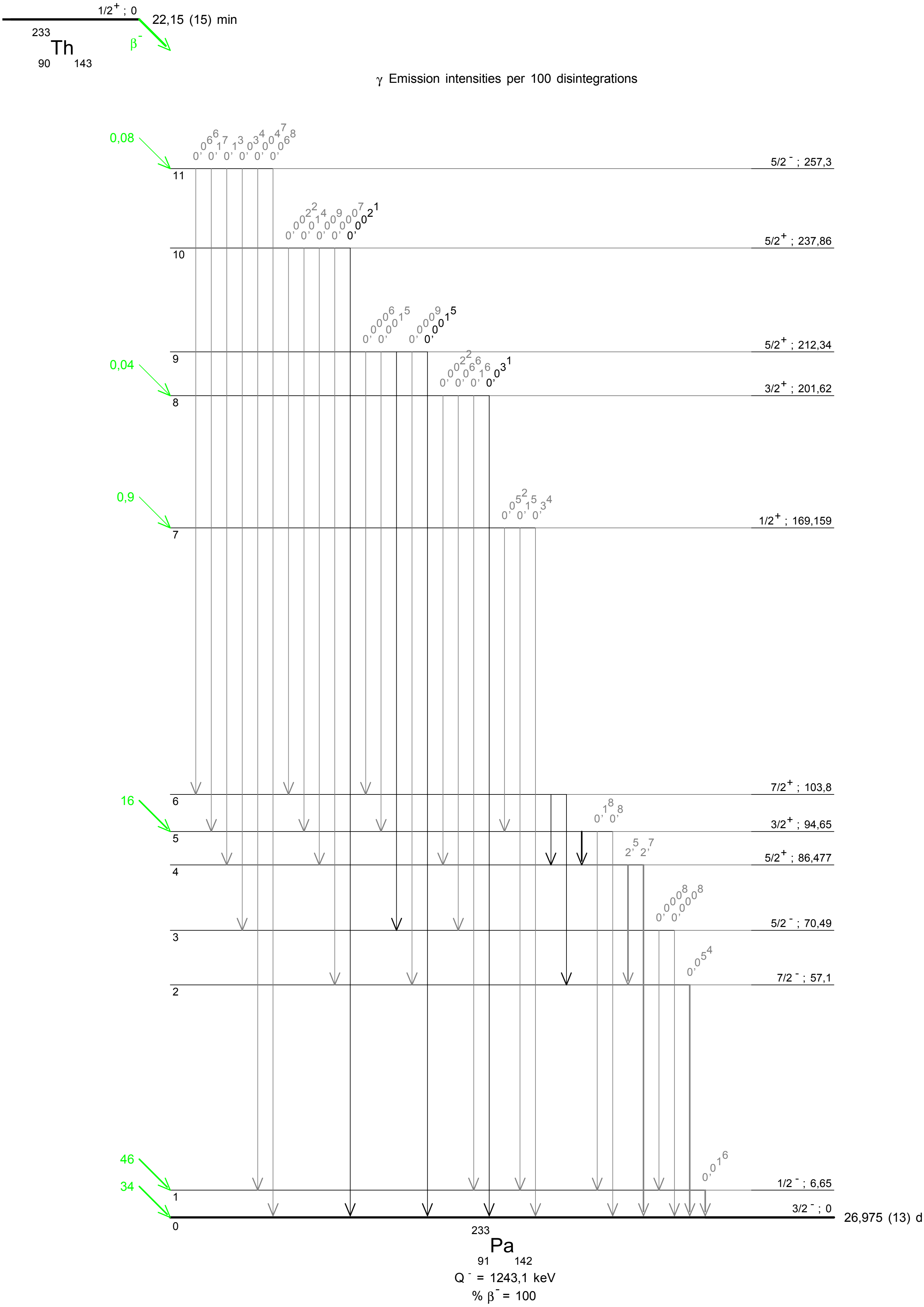

1/2+ ; 0
0
233 Th 90 143
22,15 (15) min
β-
γ Emission intensities per 100 disintegrations
0,056
0,32
0,54
0,22
1,7
0,04
0,9
16
46
34
20
19
18
15
14
10
9
8
7
6
5
4
3
1
0
(3/2)+ ; 1018,7
(3/2)+ ; 984,8
(3/2)+ ; 811,6
3/2+ ; 585,5
1/2,3/2+ ; 553,88
5/2+ ; 237,86
5/2+ ; 212,34
3/2+ ; 201,62
1/2+ ; 169,159
7/2+ ; 103,8
3/2+ ; 94,65
5/2+ ; 86,477
5/2 - ; 70,49
1/2 - ; 6,65
3/2 - ; 0
26,975 (13) d
233 Pa 91 142
Q - = 1243,1 keV
% β- = 100


1/2+ ; 0
22,15 (15) min
233 Th 90 143
β-
γ Emission intensities per 100 disintegrations
1,58
0,02
0,22
1,7
0,27
1,18
0,08
0,04
0,9
16
46
34
1/2,3/2+ ; 764,55
(3/2) - ; 669,9
3/2+ ; 585,5
1/2,3/2+ ; 553,88
3/2+ ; 454,4
3/2 - ; 447,762
5/2 - ; 257,3
5/2+ ; 237,86
5/2+ ; 212,34
3/2+ ; 201,62
1/2+ ; 169,159
3/2+ ; 94,65
5/2+ ; 86,477
5/2 - ; 70,49
1/2 - ; 6,65
3/2 - ; 0
26,975 (13) d
233 Pa 91 142
Q- = 1243,1 keV
% β- = 100


1/2+ ; 0
22,15 (15) min
233 Th 90 143
β-
γ Emission intensities per 100 disintegrations
0,08
0,04
0,9
16
46
34
5/2 - ; 257,3
5/2+ ; 237,86
5/2+ ; 212,34
3/2+ ; 201,62
1/2+ ; 169,159
7/2+ ; 103,8
3/2+ ; 94,65
5/2+ ; 86,477
5/2 - ; 70,49
7/2 - ; 57,1
1/2 - ; 6,65
3/2 - ; 0
26,975 (13) d
233 Pa 91 142
Q- = 1243,1 keV
% β- = 100

234	U	
92		142

1 Decay Scheme

U-234 disintegrates by alpha emission mostly to the 53.2-keV level and to the ground state level of Th-230. Branching of U-234 decay by spontaneous fission is 1,6(2) $\times 10^{-9}$ %.
L'uranium 234 se désintègre par émission alpha, principalement vers le niveau excité de 53,20 keV et le fondamental du thorium 230. Le rapport de branchement de décroissance par fission spontanée est 1,6(2) $\times 10^{-9}$ *%.*

2 Nuclear Data

$T_{1/2}(^{234}U)$	:	2,455	(6)	10^5 a
$T_{1/2}(^{230}Th)$	:	75,38	(30)	10^3 a
$Q^{\alpha}(^{234}U)$	:	4857,7	(7)	keV

2.1 α Transitions

	Energy keV	Probability × 100	F
$\alpha_{0,5}$	4180,1 (7)	0,000007	63
$\alpha_{0,4}$	4222,8 (7)	0,000026	39
$\alpha_{0,3}$	4349,6 (7)	0,00004 (1)	288
$\alpha_{0,2}$	4683,6 (7)	0,210 (2)	21
$\alpha_{0,1}$	4804,5 (7)	28,42 (2)	1,1
$\alpha_{0,0}$	4857,6 (7)	71,37 (2)	1

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{1,0}$(Th)	53,20 (2)	28,7 (13)	E2		167 (5)	45,6 (14)	228 (7)
$\gamma_{2,1}$(Th)	120,900 (36)	0,228 (48)	E2	0,244 (7)	3,42 (10)	0,940 (28)	4,92 (15)
$\gamma_{3,1}$(Th)	454,96 (5)	0,000025 (6)	E1	0,01235 (37)	0,00220 (7)	0,000525 (16)	0,01526 (46)
$\gamma_{5,2}$(Th)	503,5 (1)	0,00000095	[E2]	0,0264 (8)	0,01141 (34)	0,00296 (9)	0,0418 (13)
$\gamma_{3,0}$(Th)	508,16 (5)	0,0000152 (39)	E1	0,00991 (30)	0,00174 (5)	0,000415 (12)	0,01221 (37)
$\gamma_{4,1}$(Th)	581,7 (1)	0,000012 (5)	E2	0,0202 (6)	0,00734 (22)	0,00188 (6)	0,0300 (9)
$\gamma_{5,1}$(Th)	624,4 (1)	0,00005	E0+E2+M1				5,1 (20)
$\gamma_{4,0}$(Th)	634,9 (1)	0,000014 (7)	E0				
$\gamma_{5,0}$(Th)	677,6 (1)	0,000001	[E2]	0,01526 (46)	0,00475 (14)	0,001204 (36)	0,0216 (6)

3 Atomic Data

3.1 Th

ω_K : 0,969 (4)
$\bar{\omega}_L$: 0,476 (18)
n_{KL} : 0,797 (5)

3.1.1 X Radiations

		Energy keV		Relative probability
X_K				
	$K\alpha_2$	89,9566		61,82
	$K\alpha_1$	93,3479		100
	$K\beta_3$	104,8172	}	
	$K\beta_1$	105,602	}	
	$K\beta_5''$	106,1564	}	35,58
	$K\beta_5'$	106,3149	}	
	$K\beta_2$	108,581	}	
	$K\beta_4$	108,953	}	11,99
	$KO_{2,3}$	109,442	}	
X_L				
	$L\ell$	11,118		
	$L\alpha$	12,808 – 12,967		
	$L\eta$	14,509		
	$L\beta$	14,972 – 16,4253		
	$L\gamma$	18,363 – 19,504		

3.1.2 Auger Electrons

	Energy keV	Relative probability
Auger K		
KLL	68,406 – 76,745	100
KLX	83,857 – 93,345	58,8
KXY	99,29 – 109,64	8,64
Auger L	5,8 – 20,3	

4 α Emissions

	Energy keV	Probability × 100
$\alpha_{0,5}$	4108,6 (7)	0,000007
$\alpha_{0,4}$	4150,6 (7)	0,000026
$\alpha_{0,3}$	4275,2 (7)	0,00004 (1)
$\alpha_{0,2}$	4603,5 (7)	0,210 (2)
$\alpha_{0,1}$	4722,4 (7)	28,42 (2)
$\alpha_{0,0}$	4774,6 (7)	71,37 (2)

5 Electron Emissions

		Energy keV	Electrons per 100 disint.
e_{AL}	(Th)	5,8 - 20,3	10,8 (4)
e_{AK}	(Th)		0,00029 (5)
	KLL	68,406 - 76,745	}
	KLX	83,857 - 93,345	}
	KXY	99,29 - 109,64	}
$ec_{1,0\ L}$	(Th)	32,7 - 36,9	20,9 (12)
$ec_{1,0\ M}$	(Th)	48,0 - 49,9	5,70 (32)
$ec_{1,0\ N}$	(Th)	51,9 - 52,9	1,53 (9)
$ec_{2,1\ L}$	(Th)	100,4 - 104,6	0,132 (12)

6 Photon Emissions

6.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(Th)	11,118 — 19,504		10,2 (4)	
XKα_2	(Th)	89,9566		0,00269 (25)	} Kα
XKα_1	(Th)	93,3479		0,0044 (4)	}
XKβ_3	(Th)	104,8172	}		
XKβ_1	(Th)	105,602	}	0,00155 (15)	K$'\beta_1$
XKβ_5''	(Th)	106,1564	}		
XKβ_5'	(Th)	106,3149	}		
XKβ_2	(Th)	108,581	}		
XKβ_4	(Th)	108,953	}	0,00052 (5)	K$'\beta_2$
XKO$_{2,3}$	(Th)	109,442	}		

6.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{1,0}$(Th)	53,20 (2)	0,1253 (40)
$\gamma_{2,1}$(Th)	120,90 (4)	0,0386 (32)
$\gamma_{3,1}$(Th)	454,96 (5)	0,000025 (6)
$\gamma_{5,2}$(Th)	503,5 (1)	0,00000095
$\gamma_{3,0}$(Th)	508,16 (5)	0,0000150 (39)
$\gamma_{4,1}$(Th)	581,7 (1)	0,000012 (5)
$\gamma_{5,1}$(Th)	624,4 (1)	0,00000082
$\gamma_{5,0}$(Th)	677,6 (1)	0,000001

7 Main Production Modes

U – 238 decay
Pu – 238 decay

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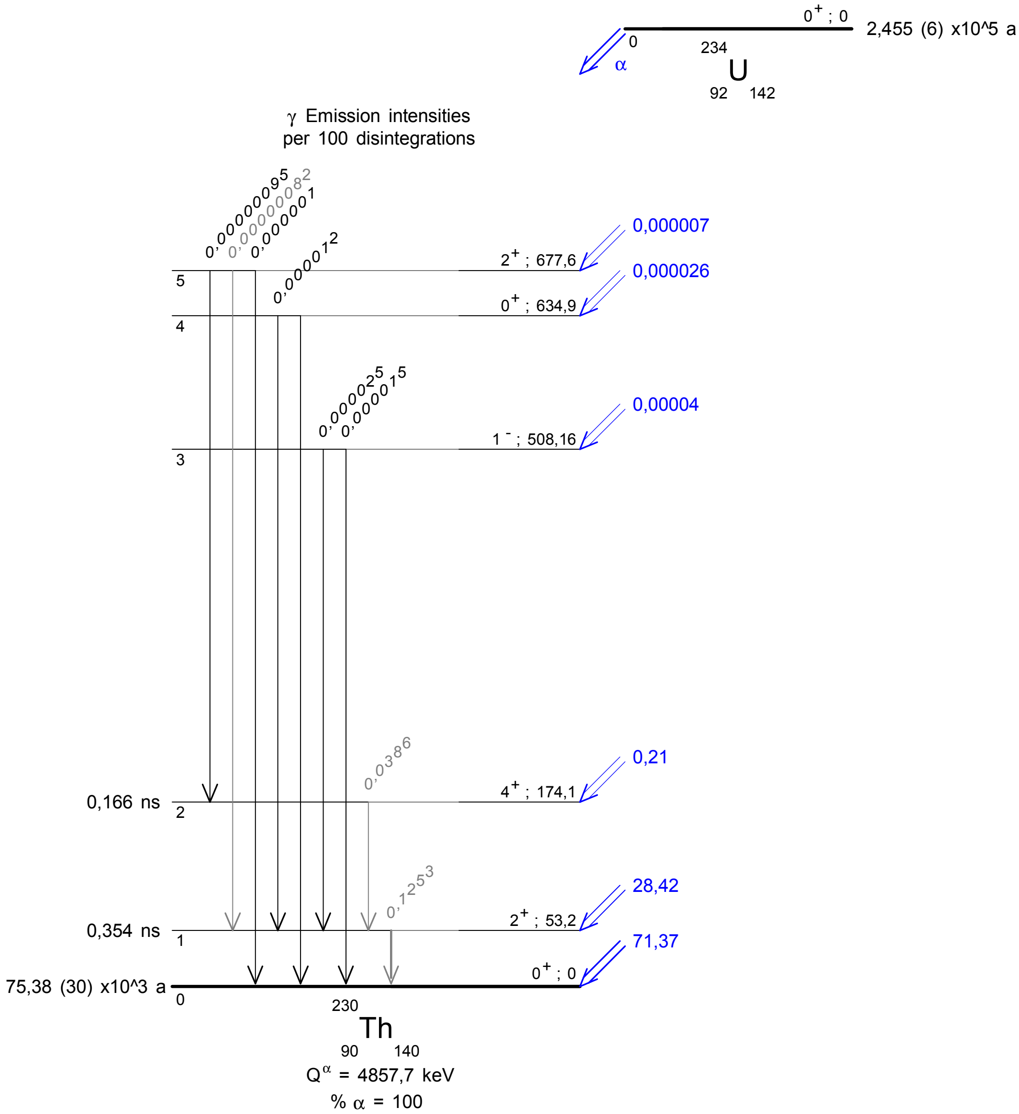
0+ ; 0
2,455 (6) x10^5 a
α
0
234
U
92 142
γ Emission intensities
per 100 disintegrations
0,0000095
0,0000082
0,0000001
0,000012
0,000025
0,00015
0,0386
0,1253
2+ ; 677,6
0,000007
0+ ; 634,9
0,000026
1- ; 508,16
0,00004
4+ ; 174,1
0,21
2+ ; 53,2
28,42
0+ ; 0
71,37
0,166 ns
0,354 ns
75,38 (30) x10^3 a
5
4
3
2
1
0
230
Th
90 140
Qα = 4857,7 keV
% α = 100

$^{236}_{93}Np_{143}$

1 Decay Scheme

Np-236 decays 87,8(6) % by electron capture to U-236, 12,0(6) % by beta minus emission to Pu236 and 0,16(6)% by alpha emission to Pa-232.
Le neptunium 236 se désintègre majoritairement (87,8 %) par capture électronique vers l'uranium 236 et par transition beta moins (12 %) vers le plutonium 236. Une faible branche par transition alpha vers le protactinium 232 est possible.

2 Nuclear Data

$T_{1/2}(^{236}Np)$	:	1,55	(8)	10^5 a
$T_{1/2}(^{236}U)$	:	23,42	(4)	10^6 a
$T_{1/2}(^{236}Pu)$	:	2,87	(1)	a
$T_{1/2}(^{232}Pa)$	:	1,31	(2)	d
$Q^-(^{236}Np)$	:	480	(50)	keV
$Q^+(^{236}Np)$	:	930	(50)	keV
$Q^\alpha(^{236}Np)$	:	5010	(50)	keV

2.1 Electron Capture Transitions

	Energy keV	Probability × 100	Nature	lg ft	P_K	P_L	P_{M+}
$\epsilon_{0,6}$	80 (50)	≈ 0,096	allowed	14,6	0	0,6	0,4
$\epsilon_{0,3}$	620 (50)	87,8 (43)	1st forbidden	14,1	0,726 (8)	0,201 (5)	0,073 (2)
$\epsilon_{0,2}$	780 (50)	< 4,4	1st forbidden unique	> 15,9	0,74	0,19	0,07

2.2 β^- Transitions

	Energy keV	Probability × 100	Nature	lg ft
$\beta^-_{0,3}$	170 (50)	11,8 (12)	1st forbidden	14,5
$\beta^-_{0,2}$	330 (50)	< 1,6	1st forbidden unique	> 16

2.3 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{1,0}$(Pu)	44,63 (10)	12,0 (6)	E2		540 (11)	151 (3)	743 (15)
$\gamma_{1,0}$(U)	45,242 (3)	87,8 (6)	E2		429 (9)	118,6 (24)	589 (12)
$\gamma_{5,4}$(U)	56,6 (5)	≈ 0,08	(E2)		145 (3)	40,2 (8)	199 (4)
$\gamma_{2,1}$(Pu)	102,82 (2)	12,0 (6)	E2		10,1 (2)	2,82 (6)	13,9 (3)
$\gamma_{6,5}$(U)	104,1	≈ 0,096	E2		8,05 (16)	2,23 (5)	11,0 (2)
$\gamma_{2,1}$(U)	104,234 (6)	87,8 (6)	E2		8,00 (16)	2,22 (5)	11,0 (2)
$\gamma_{3,2}$(Pu)	158,35 (2)	11,8 (12)	E2	0,193 (4)	1,41 (3)	0,395 (8)	2,14 (4)
$\gamma_{3,2}$(U)	160,307 (3)	87,8 (43)	E2	0,208 (4)	1,13 (2)	0,313 (7)	1,76 (4)
$\gamma_{4,2}$(U)	538,11 (10)	≈ 0,0008	E3	0,0622 (13)	0,0587 (12)	0,0160 (4)	0,143 (3)
$\gamma_{5,2}$(U)	594,5 (3)	≈ 0,008					
$\gamma_{4,1}$(U)	642,35 (9)	≈ 0,068	E1+(M2+E3)	0,112 (10)	0,031 (3)	0,0080 (8)	0,15 (2)
$\gamma_{4,0}$(U)	687,60 (5)	≈ 0,021	E1+(M2+E3)	0,219 (12)	0,068 (6)	0,018 (2)	0,31 (2)
$\gamma_{6,2}$(U)	699						

3 Atomic Data

3.1 U

ω_K	:	0,970	(4)
$\bar{\omega}_L$	:	0,500	(19)
$\bar{\omega}_M$	:	0,050	(5)
n_{KL}	:	0,794	(5)

3.1.1 X Radiations

		Energy keV		Relative probability
X_K				
	$K\alpha_2$	94,666		62,47
	$K\alpha_1$	98,44		100
	$K\beta_3$	110,421	}	
	$K\beta_1$	111,298	}	
	$K\beta_5''$	111,964	}	36,08

		Energy keV		Relative probability
	$K\beta_2$	114,407	}	
	$K\beta_4$	115,012	}	12,34
	$KO_{2,3}$	115,377	}	
X_L				
	$L\ell$	11,618		
	$L\alpha$	13,438 – 13,614		
	$L\eta$	15,399		
	$L\beta$	15,726 – 18,206		
	$L\gamma$	19,507 – 20,714		

3.1.2 Auger Electrons

	Energy keV	Relative probability
Auger K		
KLL	71,776 – 80,954	100
KLX	88,153 – 98,429	59,6
KXY	104,51 – 115,59	8,88
Auger L	6,4 – 21,6	

3.2 Pu

ω_K	:	0,971	(4)
$\bar{\omega}_L$	:	0,521	(20)
$\bar{\omega}_M$	:	0,555	(5)
n_{KL}	:	0,790	(5)

3.2.1 X Radiations

		Energy keV		Relative probability
X_K				
	$K\alpha_2$	99,525		63,17
	$K\alpha_1$	103,734		100
	$K\beta_3$	116,244	}	
	$K\beta_1$	117,228	}	
	$K\beta_5''$	117,918	}	36,7
	$K\beta_2$	120,54	}	
	$K\beta_4$	120,969	}	12,74
	$KO_{2,3}$	121,543	}	
X_L				
	$L\ell$	12,124		
	$L\alpha$	14,083 – 14,279		
	$L\eta$	16,334		
	$L\beta$	16,498 – 19,331		
	$L\gamma$	20,708 – 21,984		

3.2.2 Auger Electrons

	Energy keV	Relative probability
Auger K		
KLL	75,263 – 85,357	100
KLX	92,607 – 103,729	60,6
KXY	109,93 – 121,78	9,18
Auger L	6,6 – 23,0	

4 Electron Emissions

		Energy keV	Electrons per 100 disint.
e_{AL}	(U)	6,4 - 21,6	128,8 (19)
e_{AK}	(U)		2,1 (3)
	KLL	71,776 - 80,954	}
	KLX	88,153 - 98,429	}
	KXY	104,51 - 115,59	}
e_{AL}	(Pu)	6,6 - 23,0	10,9 (6)
e_{AK}	(Pu)		0,021 (3)
	KLL	75,263 - 85,357	}
	KLX	92,607 - 103,729	}
	KXY	109,93 - 121,78	}
$ec_{1,0\ L}$	(Pu)	21,53 - 26,57	8,7 (5)
$ec_{1,0\ L}$	(U)	23,484 - 28,074	63,9 (19)
$ec_{3,2\ K}$	(Pu)	36,56 (2)	0,73 (8)
$ec_{3,2\ T}$	(Pu)	36,56 - 158,34	8,1 (9)
$ec_{1,0\ M}$	(Pu)	38,70 - 40,86	2,43 (14)
$ec_{1,0\ M}$	(U)	39,694 - 41,690	17,7 (5)
$ec_{3,2\ T}$	(U)	44,705 - 160,298	56,0 (29)
$ec_{3,2\ K}$	(U)	44,705 (3)	6,6 (3)
$ec_{2,1\ L}$	(Pu)	79,72 - 84,76	8,2 (4)
$ec_{2,1\ L}$	(U)	82,476 - 87,066	58,6 (17)
$ec_{2,1\ M}$	(Pu)	96,89 - 99,04	2,28 (12)
$ec_{2,1\ M}$	(U)	98,686 - 100,680	16,25 (50)
$ec_{3,2\ L}$	(Pu)	135,25 - 140,29	5,4 (6)
$ec_{3,2\ L}$	(U)	138,549 - 143,139	35,9 (15)
$ec_{3,2\ M}$	(Pu)	152,42 - 154,57	1,50 (16)
$ec_{3,2\ M}$	(U)	154,759 - 156,760	9,9 (5)
$\beta^-_{0,3}$	max:	170 (50)	11,8 (12)
$\beta^-_{0,3}$	avg:	46 (15)	
$\beta^-_{0,2}$	max:	330 (50)	1,6
$\beta^-_{0,2}$	avg:	99 (15)	

5 Photon Emissions

5.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(U)	11,618 — 20,714		117,5 (30)	
$XK\alpha_2$	(U)	94,666		20,2 (3)	} $K\alpha$
$XK\alpha_1$	(U)	98,44		32,4 (5)	}
$XK\beta_3$	(U)	110,421	}		
$XK\beta_1$	(U)	111,298	}	11,68 (25)	$K'\beta_1$
$XK\beta_5''$	(U)	111,964	}		
$XK\beta_2$	(U)	114,407	}		
$XK\beta_4$	(U)	115,012	}	3,99 (11)	$K'\beta_2$
$XKO_{2,3}$	(U)	115,377	}		
XL	(Pu)	12,124 — 21,984		12,2 (5)	
$XK\alpha_2$	(Pu)	99,525		0,210 (22)	} $K\alpha$
$XK\alpha_1$	(Pu)	103,734		0,33 (4)	}
$XK\beta_3$	(Pu)	116,244	}		
$XK\beta_1$	(Pu)	117,228	}	0,122 (13)	$K'\beta_1$
$XK\beta_5''$	(Pu)	117,918	}		
$XK\beta_2$	(Pu)	120,54	}		
$XK\beta_4$	(Pu)	120,969	}	0,042 (4)	$K'\beta_2$
$XKO_{2,3}$	(Pu)	121,543	}		

5.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{1,0}$(Pu)	44,63 (10)	0,0161 (9)
$\gamma_{1,0}$(U)	45,242 (3)	0,149 (3)
$\gamma_{5,4}$(U)	56,6 (5)	0,0004
$\gamma_{2,1}$(Pu)	102,82 (2)	0,81 (6)
$\gamma_{6,5}$(U)	104,1 (10)	0,008
$\gamma_{2,1}$(U)	104,23 (2)	7,32 (13)
$\gamma_{3,2}$(Pu)	158,35 (2)	3,8 (4)
$\gamma_{3,2}$(U)	160,33 (2)	31,8 (15)
$\gamma^{\pm}$	511	185 (9)
$\gamma_{4,2}$(U)	538,11 (10)	0,0007
$\gamma_{5,2}$(U)	594,5 (3)	0,008
$\gamma_{4,1}$(U)	642,35 (9)	0,059
$\gamma_{4,0}$(U)	687,60 (5)	0,016

6 Main Production Modes

U − 235(d,n)Np − 236

U − 235(α,p,2n)Np − 236

7 References

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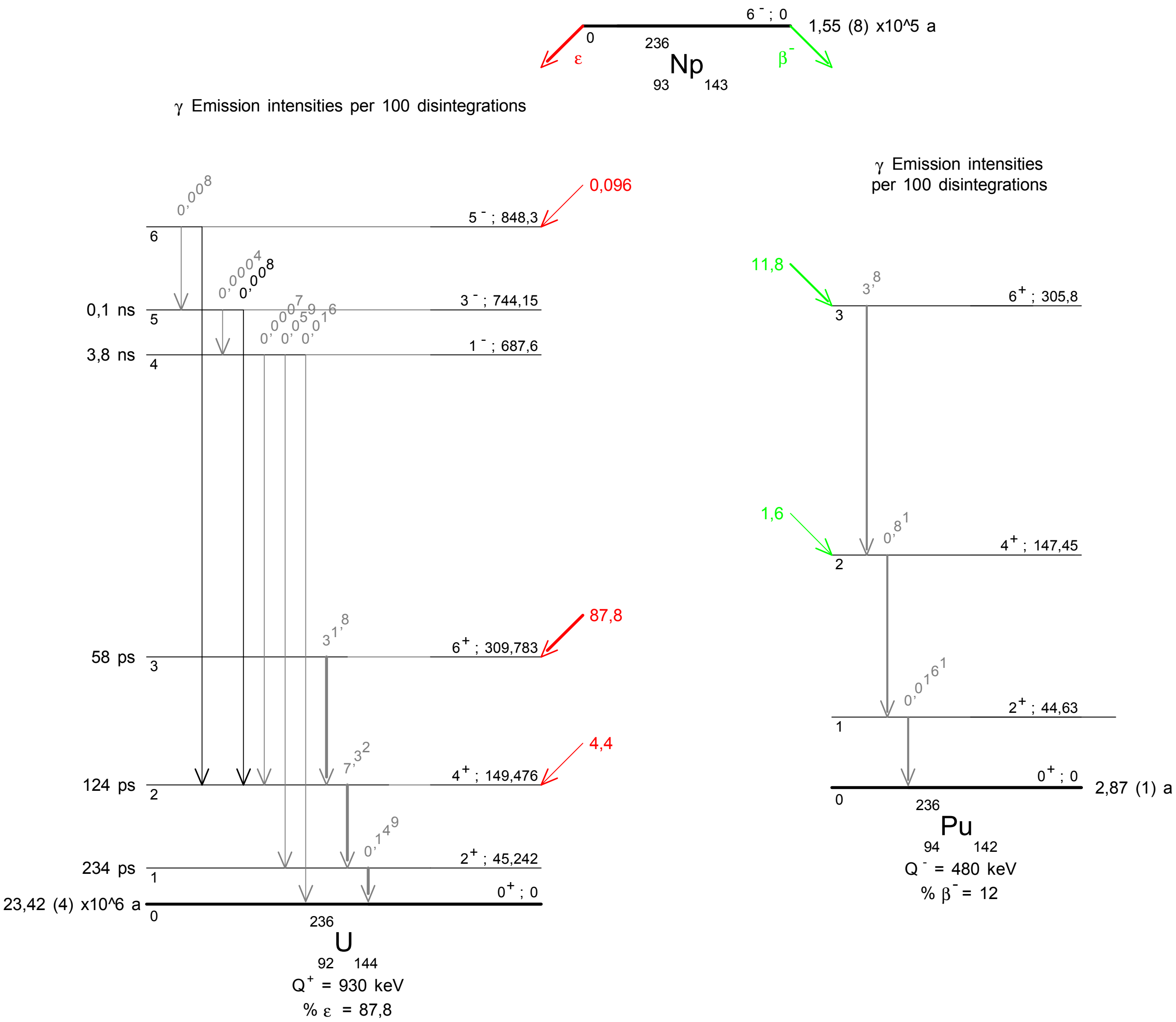
6 ⁻ ; 0
1,55 (8) x10^5 a
0
236
Np
93 143
ε
β⁻
γ Emission intensities per 100 disintegrations
0,096
5 ⁻ ; 848,3
3 ⁻ ; 744,15
1 ⁻ ; 687,6
0,1 ns
3,8 ns
87,8
6⁺ ; 309,783
58 ps
4,4
4⁺ ; 149,476
124 ps
2⁺ ; 45,242
234 ps
0⁺ ; 0
23,42 (4) x10^6 a
236
U
92 144
Q⁺ = 930 keV
% ε = 87,8
γ Emission intensities
per 100 disintegrations
11,8
6⁺ ; 305,8
1,6
4⁺ ; 147,45
2⁺ ; 44,63
0⁺ ; 0
2,87 (1) a
236
Pu
94 142
Q⁻ = 480 keV
% β⁻ = 12

$^{236}_{93}\mathrm{Np}^{m}_{143}$

1 Decay Scheme

Np-236m (isomer state of 236Np, J=1, E1 =60 keV) decays 53(1) % by electron capture to U-236 and 47(1) % by beta minus emission to Pu-236.
Le neptunium 236 isomère se désintègre par capture électronique (53%) vers l'uranium 236 et par transition beta moins vers le plutonium 236.

2 Nuclear Data

$T_{1/2}(^{236}\mathrm{Np}^{m})$	:	22,5	(4)	h
$T_{1/2}(^{236}\mathrm{U})$	:	23,42	(4)	10^6 a
$T_{1/2}(^{236}\mathrm{Pu})$	:	2,87	(1)	a
$Q^-(^{236}\mathrm{Np}^{m})$	:	537	(8)	keV
$Q^+(^{236}\mathrm{Np}^{m})$	:	993	(13)	keV

2.1 Electron Capture Transitions

	Energy keV	Probability × 100	Nature	lg ft	P_K	P_L	P_{M+}
$\epsilon_{0,4}$	306 (13)	1,64 (9)	1st forbidden	7,3	0,621 (10)	0,274 (7)	0,105 (3)
$\epsilon_{0,1}$	948 (13)	8,3 (30)	allowed	7,8	0,751 (1)	0,184 (1)	0,0652 (1)
$\epsilon_{0,0}$	993 (13)	43,1 (32)	allowed	7,1	0,753 (1)	0,182 (1)	0,0646 (1)

2.2 β^- Transitions

	Energy keV	Probability × 100	Nature	lg ft
$\beta^-_{0,1}$	492 (8)	11 (4)	allowed	7,2
$\beta^-_{0,0}$	537 (8)	36 (4)	allowed	6,8

2.3 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{1,0}$(Pu)	44,63 (10)	11,2 (37)	E2		540 (11)	151 (3)	743 (15)
$\gamma_{1,0}$(U)	45,242 (3)	9,6 (30)	E2		429 (9)	118,6 (24)	589 (12)
$\gamma_{2,1}$(U)	104,234 (15)	0,0143 (17)	E2		8,00 (16)	2,22 (5)	11,0 (2)
$\gamma_{4,2}$(U)	538,11 (10)	0,0143 (17)	E3	0,0622 (13)	0,0587 (12)	0,0160 (4)	0,143 (3)
$\gamma_{4,1}$(U)	642,35 (9)	1,24 (8)	E1+(M2+E3)	0,112 (10)	0,031 (3)	0,0080 (8)	0,15 (2)
$\gamma_{4,0}$(U)	687,60 (5)	0,383 (28)	E1	0,219 (12)	0,068 (6)	0,018 (2)	0,31 (2)

3 Atomic Data

3.1 U

ω_K	:	0,970	(4)
$\bar{\omega}_L$	:	0,500	(19)
$\bar{\omega}_M$	:	0,050	(5)
n_{KL}	:	0,794	(5)

3.1.1 X Radiations

		Energy keV		Relative probability
X_K				
	$K\alpha_2$	94,666		62,47
	$K\alpha_1$	98,44		100
	$K\beta_3$	110,421	}	
	$K\beta_1$	111,298	}	
	$K\beta_5''$	111,964	}	36,08
	$K\beta_2$	114,407	}	
	$K\beta_4$	115,012	}	12,34
	$KO_{2,3}$	115,377	}	
X_L				
	$L\ell$	11,618		
	$L\alpha$	13,438 – 13,614		
	$L\eta$	15,399		
	$L\beta$	15,726 – 18,206		
	$L\gamma$	19,507 – 20,714		

3.1.2 Auger Electrons

	Energy keV	Relative probability
Auger K		
KLL	71,776 – 80,954	100
KLX	88,153 – 98,429	59,6
KXY	104,51 – 115,59	8,88
Auger L	6,4 – 21,6	

3.2 Pu

ω_K	:	0,971	(4)
$\bar{\omega}_L$	:	0,521	(20)
$\bar{\omega}_M$	:	0,555	(5)
n_{KL}	:	0,790	(5)

4 Electron Emissions

		Energy keV	Electrons per 100 disint.
e_{AL}	(U)	6,4 - 21,6	21,7 (15)
e_{AK}	(U)		1,03 (17)
	KLL	71,776 - 80,954	}
	KLX	88,153 - 98,429	}
	KXY	104,51 - 115,59	}
e_{AL}	(Pu)	6,6 - 23,0	3,8 (14)
$ec_{1,0\ L}$	(Pu)	21,53 - 26,57	8 (3)
$ec_{1,0\ L}$	(U)	23,484 - 28,074	6,9 (22)
$ec_{1,0\ M}$	(Pu)	38,70 - 40,86	2,2 (8)
$ec_{1,0\ M}$	(U)	39,694 - 41,690	1,9 (6)
$ec_{4,1\ K}$	(U)	526,75 (9)	0,121 (13)
$ec_{4,0\ K}$	(U)	572,00 (5)	0,064 (6)
$\beta^-_{0,1}$	max:	492 (8)	11 (4)
$\beta^-_{0,1}$	avg:	143 (3)	
$\beta^-_{0,0}$	max:	537 (8)	36 (4)
$\beta^-_{0,0}$	avg:	158 (3)	

5 Photon Emissions

5.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(U)	11,618 — 20,714		21,3 (18)	
XKα_2	(U)	94,666		9,9 (10)	} Kα
XKα_1	(U)	98,44		15,8 (15)	}
XKβ_3	(U)	110,421	}		
XKβ_1	(U)	111,298	}	5,7 (6)	K$'\beta_1$
XKβ_5''	(U)	111,964	}		
XKβ_2	(U)	114,407	}		
XKβ_4	(U)	115,012	}	1,95 (15)	K$'\beta_2$
XKO$_{2,3}$	(U)	115,377	}		
XL	(Pu)	12,124 — 21,984		4,2 (16)	

5.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{1,0}$(Pu)	44,63 (10)	0,015 (5)
$\gamma_{1,0}$(U)	45,242 (3)	0,016 (5)
$\gamma_{2,1}$(U)	104,234 (6)	0,00119 (14)
$\gamma^{\pm}$	511	
$\gamma_{4,2}$(U)	538,11 (10)	0,0125 (15)
$\gamma_{4,1}$(U)	642,35 (9)	1,08 (6)
$\gamma_{4,0}$(U)	687,60 (5)	0,292 (21)

6 Main Production Modes

U – 235(d,n)Np – 236m

U – 235(α,p,2n)Np – 236m

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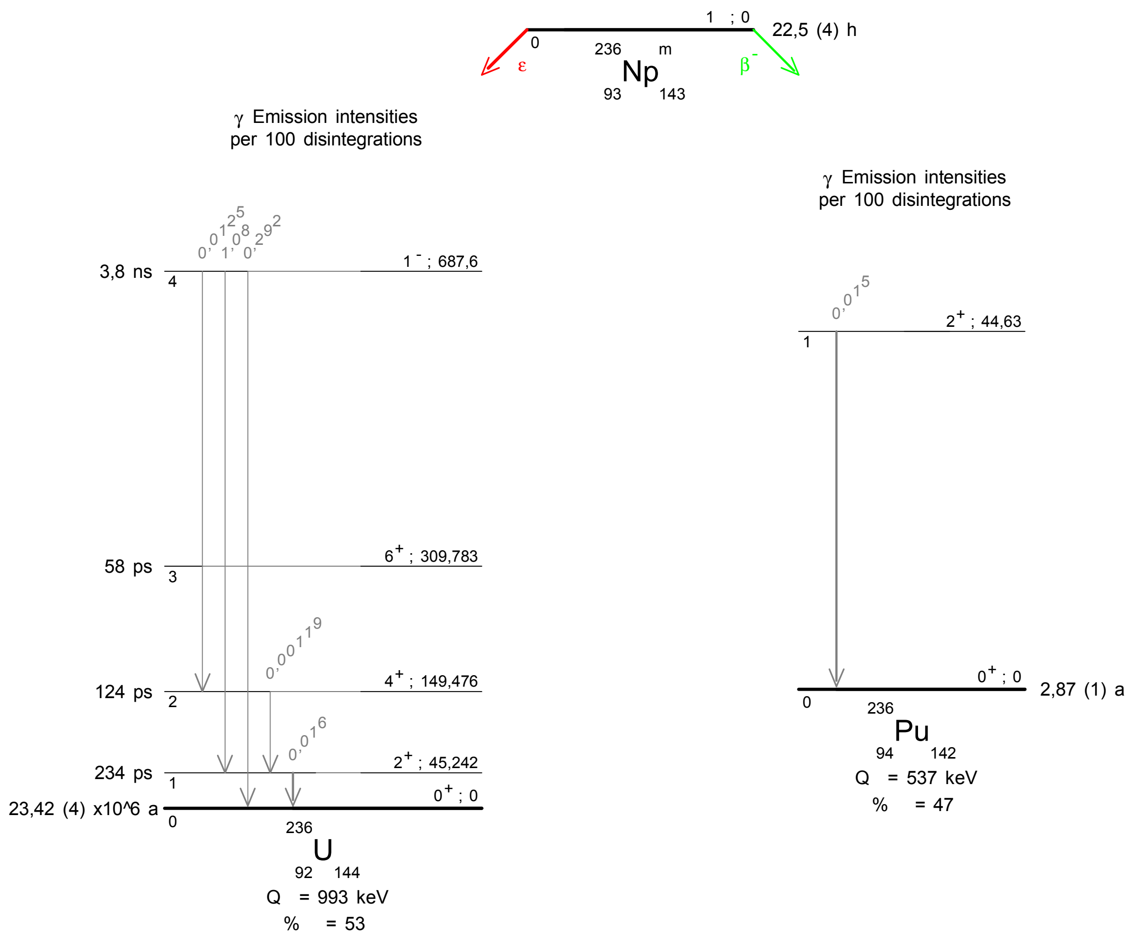
1 ; 0
22,5 (4) h
0
236 m
Np
93 143
ε
β-
γ Emission intensities
per 100 disintegrations
3,8 ns
4
1 - ; 687,6
58 ps
3
6 + ; 309,783
124 ps
2
4 + ; 149,476
234 ps
1
2 + ; 45,242
23,42 (4) x10^6 a
0
0 + ; 0
236
U
92 144
Q = 993 keV
% = 53
γ Emission intensities
per 100 disintegrations
2 + ; 44,63
1
0 + ; 0
2,87 (1) a
0
236
Pu
94 142
Q = 537 keV
% = 47

237	U	
92		145

1 Decay Scheme

U-237 disintegrates by beta minus emission to the levels in Np-237.
L'uranium 237 se désintègre par émission bêta moins vers des niveaux excités du neptunium 237.

2 Nuclear Data

$T_{1/2}(^{237}U)$	:	6,749	(16)	d
$T_{1/2}(^{237}Np)$	:	2,14	(1)	10^6 a
$Q^-(^{237}U)$	:	518,6	(6)	keV

2.1 β^- Transitions

	Energy keV	Probability × 100	Nature	lg ft
$\beta^-_{0,9}$	147,7 (6)	1,3 (7)	allowed	7,32
$\beta^-_{0,7}$	186,2 (6)	2,9 (7)	super-allowed	7,28
$\beta^-_{0,6}$	237,2 (6)	48,1 (25)	1st forbidden	6,39
$\beta^-_{0,5}$	251,1 (6)	40,7 (32)	1st forbidden	6,54
$\beta^-_{0,2}$	459,1 (6)	7 (6)	1st forbidden unique	8,1

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{9,8}$(Np)	2,3	0,232 (5)					
$\gamma_{6,5}$(Np)	13,81 (4)	48,7 (25)	M1 + 0,1% E2			364 (13)	491 (16)
$\gamma_{2,1}$(Np)	26,3446 (2)	22 (5)	E1		6 (2)	1,6 (2)	8 (2)
$\gamma_{4,3}$(Np)	27,020 (7)	0,7 (4)					

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	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{1,0}$(Np)	33,1963 (3)	23 (3)	M1 + 1,66% E2		130 (18)	33 (5)	175 (19)
$\gamma_{9,7}$(Np)	38,54 (3)	0,9 (6)	M1 + 15% E2		205 (82)	55 (22)	279 (112)
$\gamma_{3,1}$(Np)	42,704 (5)	≈ 0,64	M1 + 1,66% E2		55,6 (11)	13,9 (3)	74,4 (15)
$\gamma_{4,2}$(Np)	43,420 (3)	4,3 (4)	M1 + 16,6% E2		131 (7)	35,1 (19)	178 (10)
$\gamma_{7,6}$(Np)	51,01 (3)	0,63 (12)	E1		0,560 (12)	0,014 (3)	0,748 (15)
$\gamma_{2,0}$(Np)	59,5409 (1)	74 (3)	E1		0,84 (6)	0,226 (7)	1,16 (3)
$\gamma_{7,5}$(Np)	64,83 (2)	1,80 (3)	E1		0,299 (6)	0,0742 (15)	0,398 (8)
$\gamma_{4,1}$(Np)	69,76 (3)	0,0013 (3)	(E1)		0,246 (5)	0,0611 (12)	0,328 (7)
$\gamma_{3,0}$(Np)	75,8 (2)	≈ 0,05	(E2)		38,8 (8)	10,8 (2)	53,40 (11)
$\gamma_{4,0}$(Np)	102,98 (2)	0,0072 (10)	E1		0,0891 (18)	0,0219 (4)	0,119 (3)
$\gamma_{(-1,1)}$(Np)	114,09 (5)						
$\gamma_{5,4}$(Np)	164,61 (2)	5,00 (11)	E2	0,189 (4)	1,093 (20)	0,304 (6)	1,69 (4)
$\gamma_{5,2}$(Np)	208,00 (1)	84,6 (19)	M1 + 2,4% E2	2,34 (5)	0,472 (10)	0,115 (3)	2,97 (7)
$\gamma_{6,2}$(Np)	221,80 (4)	0,0315 (13)	E2	0,127 (3)	0,304 (6)	0,0838 (17)	0,544 (11)
$\gamma_{5,1}$(Np)	234,40 (4)	0,198 (17)	M2	5,512 (12)	1,94 (4)	0,51 (1)	8,15 (16)
$\gamma_{5,0}$(Np)	267,54 (4)	1,5 (4)	E1 + 19,4% M2	0,73 (4)	0,237 (12)	0,062 (4)	1,05 (5)
$\gamma_{8,3}$(Np)	292,77 (6)	0,0030 (7)	(E2)	0,0783 (16)	0,0990 (19)	0,0270 (6)	0,214 (4)
$\gamma_{8,2}$(Np)	309,1 (3)	≈ 0,00027	(E1)				
$\gamma_{7,0}$(Np)	332,36 (4)	1,373 (19)	E2	0,0622 (12)	0,0610 (12)	0,0165 (4)	0,145 (3)
$\gamma_{8,1}$(Np)	335,38 (4)	0,162 (4)	M1 + 17,5% E2	0,538 (11)	0,113 (2)	0,0278 (6)	0,689 (14)
$\gamma_{9,1}$(Np)	337,7 (2)	0,0101 (6)	(E2)	0,0604 (12)	0,0575 (12)	0,0156 (3)	0,139 (3)
$\gamma_{(-1,2)}$(Np)	340,45	0,0016 (3)					
$\gamma_{8,0}$(Np)	368,59 (4)	0,0674 (28)	M1 (+ E2)	0,493 (10)	0,0963 (20)	0,0233 (5)	0,621 (13)
$\gamma_{9,0}$(Np)	370,94 (3)	0,167 (3)	M1 + 15,6% E2	0,416 (8)	0,0861 (17)	0,0210 (4)	0,531 (11)

3 Atomic Data

3.1 Np

ω_K : 0,971 (4)
$\bar{\omega}_L$: 0,511 (20)
n_{KL} : 0,791 (5)

3.1.1 X Radiations

		Energy keV		Relative probability
X_K				
	$K\alpha_2$	97,069		62,82
	$K\alpha_1$	101,059		100
	$K\beta_3$	113,303	}	
	$K\beta_1$	114,234	}	
	$K\beta_5''$	114,912	}	36,465
	$K\beta_2$	117,463	}	
	$K\beta_4$	117,876	}	12,544
	$KO_{2,3}$	118,429	}	

		Energy keV	Relative probability
X_L			
	$L\ell$	11,89	
	$L\alpha$	13,76 – 13,94	
	$L\eta$	15,88	
	$L\beta$	16,13 – 17,99	
	$L\gamma$	20,12 – 22,2	

3.1.2 Auger Electrons

	Energy keV	Relative probability
Auger K		
KLL	73,50 – 83,13	100
KLX	90,36 – 97,28	60,2
KXY	107,10 – 114,58	9,06
Auger L	5,04 – 13,52	56,1

4 Electron Emissions

		Energy keV	Electrons per 100 disint.
e_{AL}	(Np)	5,04 - 13,52	48,8 (26)
e_{AK}	(Np)		1,47 (21)
	KLL	73,50 - 83,13	}
	KLX	90,36 - 97,28	}
	KXY	107,10 - 114,58	}
$ec_{2,1\ L}$	(Np)	3,918 - 8,735	14,6 (50)
$ec_{6,5\ M}$	(Np)	8,07 - 10,15	36,0 (19)
$ec_{1,0\ L}$	(Np)	10,769 - 15,586	16,9 (24)
$ec_{9,7\ L}$	(Np)	16,11 - 20,93	0,7 (5)
$ec_{3,1\ L}$	(Np)	20,277 - 25,094	0,47
$ec_{2,1\ M}$	(Np)	20,606 - 22,681	3,9 (5)
$ec_{4,2\ L}$	(Np)	20,996 - 25,813	3,1 (3)
$ec_{1,0\ M}$	(Np)	27,457 - 29,532	4,3 (7)
$ec_{7,6\ L}$	(Np)	28,58 - 33,40	0,20 (4)
$ec_{9,7\ M}$	(Np)	32,80 - 34,88	0,18 (13)
$ec_{3,1\ M}$	(Np)	36,965 - 39,040	0,12
$ec_{2,0\ L}$	(Np)	37,114 - 41,931	28,6 (22)
$ec_{4,2\ M}$	(Np)	37,684 - 39,759	0,84 (8)

		Energy keV		Electrons per 100 disint.
$ec_{7,5\ L}$	(Np)	42,40 - 47,22		0,385 (9)
$ec_{5,4\ K}$	(Np)	45,94	(2)	0,352 (9)
$ec_{2,0\ M}$	(Np)	53,802 - 55,877		7,7 (3)
$ec_{7,5\ M}$	(Np)	59,09 - 61,17		0,095 (2)
$ec_{5,2\ K}$	(Np)	89,331	(10)	49,8 (13)
$ec_{5,1\ K}$	(Np)	115,73	(4)	0,119 (10)
$ec_{5,4\ L}$	(Np)	142,18 - 147,00		2,03 (5)
$ec_{5,0\ K}$	(Np)	148,87	(4)	0,53 (3)
$ec_{5,4\ M}$	(Np)	158,87 - 160,95		0,565 (14)
$ec_{5,2\ L}$	(Np)	185,573 - 190,390		10,1 (3)
$ec_{5,2\ M}$	(Np)	202,261 - 204,336		2,45 (7)
$ec_{7,0\ K}$	(Np)	213,69	(4)	0,0746 (17)
$ec_{8,1\ K}$	(Np)	216,71	(4)	0,0515 (16)
$ec_{5,0\ L}$	(Np)	245,11 - 249,93		0,171 (9)
$ec_{7,0\ L}$	(Np)	309,93 - 314,75		0,0731 (17)
$\beta^-_{0,9}$	max:	147,7	(6)	1,3 (7)
$\beta^-_{0,9}$	avg:	39,0	(2)	
$\beta^-_{0,7}$	max:	186,2	(6)	2,9 (7)
$\beta^-_{0,7}$	avg:	49,8	(2)	
$\beta^-_{0,6}$	max:	237,2	(6)	48,1 (25)
$\beta^-_{0,6}$	avg:	64,5	(2)	
$\beta^-_{0,5}$	max:	251,1	(6)	40,7 (32)
$\beta^-_{0,5}$	avg:	68,6	(2)	
$\beta^-_{0,2}$	max:	459,1	(6)	7 (6)
$\beta^-_{0,2}$	avg:	137,6	(2)	

5 Photon Emissions

5.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(Np)	11,89 — 22,2		51,3 (3)	
XKα_2	(Np)	97,069		14,7 (4)	} Kα
XKα_1	(Np)	101,059		23,4 (6)	}
XKβ_3	(Np)	113,303	}		
XKβ_1	(Np)	114,234	}	8,50 (27)	K$'\beta_1$
XKβ_5''	(Np)	114,912	}		
XKβ_2	(Np)	117,463	}		
XKβ_4	(Np)	117,876	}	2,92 (10)	K$'\beta_2$
XKO$_{2,3}$	(Np)	118,429	}		

5.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{6,5}$(Np)	13,81 (2)	0,099 (4)
$\gamma_{2,1}$(Np)	26,3446 (2)	2,43 (6)
$\gamma_{1,0}$(Np)	33,1963 (3)	0,130 (5)
$\gamma_{9,7}$(Np)	38,54 (3)	0,0033 (20)
$\gamma_{3,1}$(Np)	42,704 (5)	0,0085
$\gamma_{4,2}$(Np)	43,420 (3)	0,024 (2)
$\gamma_{7,6}$(Np)	51,01 (3)	0,36 (7)
$\gamma_{2,0}$(Np)	59,5409 (1)	34,1 (8)
$\gamma_{7,5}$(Np)	64,83 (2)	1,286 (17)
$\gamma_{4,1}$(Np)	69,76 (3)	0,00095 (19)
$\gamma_{3,0}$(Np)	75,8 (2)	0,00091
$\gamma_{4,0}$(Np)	102,98 (2)	0,0064 (9)
$\gamma_{5,4}$(Np)	164,61 (2)	1,86 (3)
$\gamma_{5,2}$(Np)	208,00 (1)	21,3 (3)
$\gamma_{6,2}$(Np)	221,80 (4)	0,0204 (8)
$\gamma_{5,1}$(Np)	234,40 (4)	0,0216 (18)
$\gamma_{5,0}$(Np)	267,54 (4)	0,721 (10)
$\gamma_{8,3}$(Np)	292,77 (6)	0,0025 (7)
$\gamma_{8,2}$(Np)	309,1 (3)	0,00027
$\gamma_{7,0}$(Np)	332,36 (4)	1,199 (16)
$\gamma_{8,1}$(Np)	335,38 (4)	0,0958 (22)
$\gamma_{9,1}$(Np)	337,7 (2)	0,0089 (5)
$\gamma_{(-1,2)}$(Np)	340,45	0,0016 (3)
$\gamma_{8,0}$(Np)	368,59 (4)	0,0416 (17)
$\gamma_{9,0}$(Np)	370,94 (3)	0,109 (2)

6 Main Production Modes

$$\begin{cases} U-236(n,\gamma)U-237 \\ \text{Possible impurities : } U-236, U-238 \end{cases}$$

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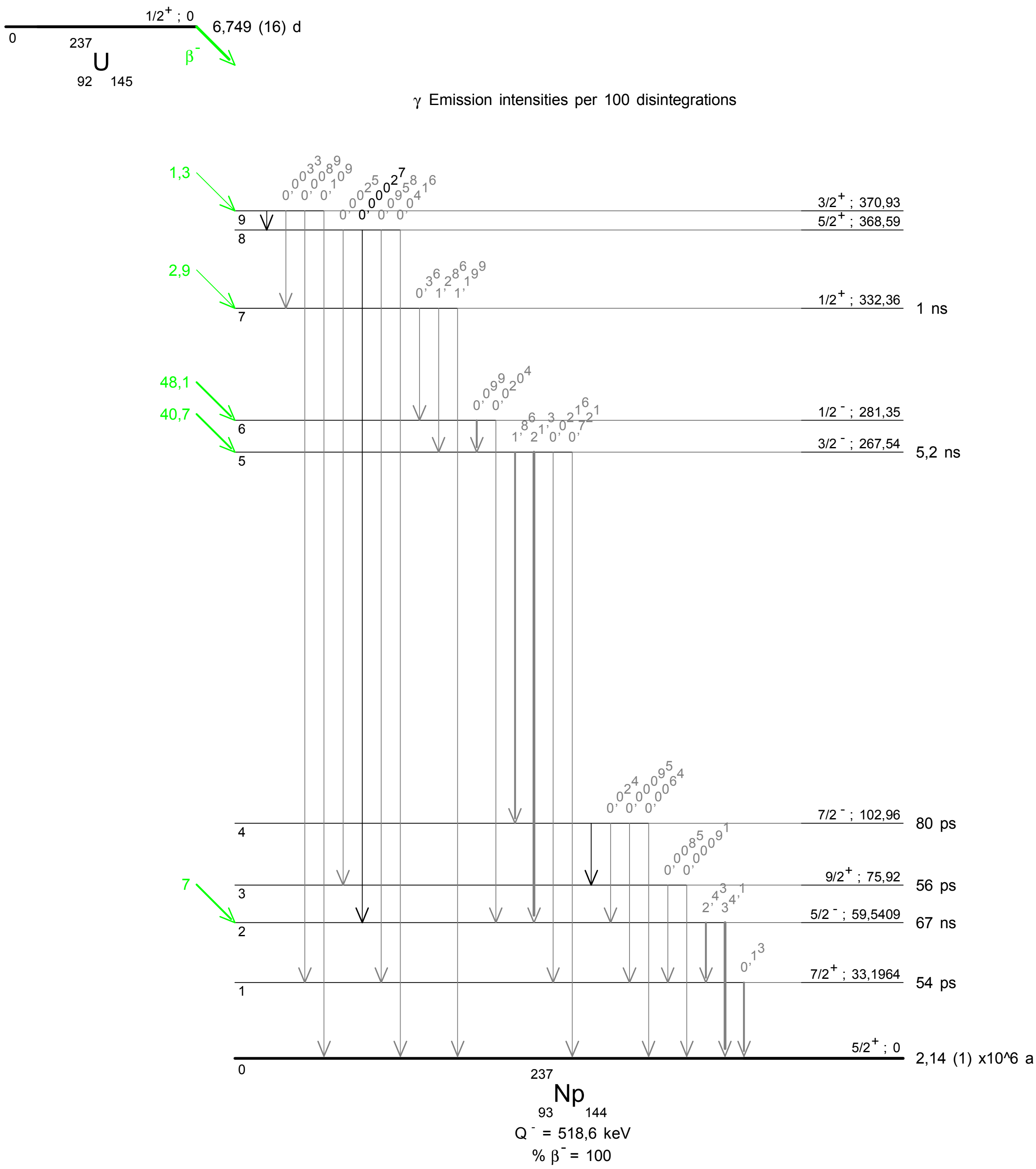
1/2+ ; 0
6,749 (16) d
237 U 92 145
β-
γ Emission intensities per 100 disintegrations
1,3
2,9
48,1
40,7
7
3/2+ ; 370,93
5/2+ ; 368,59
1/2+ ; 332,36
1 ns
1/2 - ; 281,35
3/2 - ; 267,54
5,2 ns
7/2 - ; 102,96
80 ps
9/2+ ; 75,92
56 ps
5/2 - ; 59,5409
67 ns
7/2+ ; 33,1964
54 ps
5/2+ ; 0
2,14 (1) x10^6 a
237 Np 93 144
Q - = 518,6 keV
% β- = 100

238		
92	U	146

1 Decay Scheme

U-238 disintegrates by alpha emission to two excited levels and to the ground state of Th-234. Branching of U-238 decay by spontaneous fission is 5,45 (4) E-05 %.
L'uranium 238 se désintègre par émission alpha, principalement vers un niveau excité et le fondamental du thorium 234. Le rapport de branchement par fission spontanée est 5,45 (4)E-05 %.

2 Nuclear Data

$T_{1/2}(^{238}U)$	:	4,468	(5)	10^9 a
$T_{1/2}(^{234}Th)$	:	24,10	(3)	d
$Q^{\alpha}(^{238}U)$	:	4269,7	(29)	keV

2.1 α Transitions

	Energy keV	Probability × 100	F
$\alpha_{0,2}$	4106,7 (29)	0,13 (3)	24
$\alpha_{0,1}$	4220,2 (29)	22,33 (50)	1,33
$\alpha_{0,0}$	4269,7 (29)	77,54 (50)	1

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{1,0}$(Th)	49,55 (6)	22,46 (50)	E2		235 (7)	64,4 (19)	321 (10)
$\gamma_{2,1}$(Th)	113,5 (1)	0,13 (3)	[E2]	0,219 (7)	4,57 (14)	1,257 (38)	6,47 (19)

3 Atomic Data

3.1 Th

ω_K	:	0,969	(4)
$\bar{\omega}_L$	:	0,476	(18)
n_{KL}	:	0,797	(5)

3.1.1 X Radiations

		Energy keV		Relative probability
X_K				
	$K\alpha_2$	89,9566		61,82
	$K\alpha_1$	93,3479		100
	$K\beta_3$	104,8172	}	
	$K\beta_1$	105,602	}	
	$K\beta_5''$	106,1564	}	35,58
	$K\beta_5'$	106,3149	}	
	$K\beta_2$	108,581	}	
	$K\beta_4$	108,953	}	11,99
	$KO_{2,3}$	109,442	}	
X_L				
	$L\ell$	11,118		
	$L\alpha$	12,8085 – 12,967		
	$L\eta$	14,509		
	$L\beta$	14,972 – 17,1383		
	$L\gamma$	18,3633 – 19,504		

3.1.2 Auger Electrons

	Energy keV	Relative probability
Auger K		
KLL	68,406 – 76,745	100
KLX	83,857 – 93,345	58,8
KXY	99,29 – 109,64	8,64
Auger L	5,8 – 20,3	

4 α Emissions

	Energy keV	Probability × 100
$\alpha_{0,2}$	4038 (5)	0,13 (3)
$\alpha_{0,1}$	4151 (5)	22,33 (50)
$\alpha_{0,0}$	4198 (3)	77,54 (50)

5 Electron Emissions

		Energy keV		Electrons per 100 disint.
e_{AL}	(Th)	5,8 - 20,3		8,43 (25)
e_{AK}	(Th)			0,00012 (4)
	KLL	68,406 - 76,745	}	
	KLX	83,857 - 93,345	}	
	KXY	99,29 - 109,64	}	
$ec_{1,0\ L}$	(Th)	29,08 - 33,20		16,3 (8)
$ec_{1,0\ M}$	(Th)	44,37 - 46,22		4,46 (21)
$ec_{1,0\ N}$	(Th)	48,22 - 49,22		1,19 (6)
$ec_{2,1\ L}$	(Th)	93,0 - 97,2		0,080 (22)

6 Photon Emissions

6.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(Th)	11,118 — 19,504		7,94 (28)	
XKα_2	(Th)	89,9566		0,00109 (30)	} Kα
XKα_1	(Th)	93,3479		0,0018 (5)	}
XKβ_3	(Th)	104,8172	}		
XKβ_1	(Th)	105,602	}	0,00063 (17)	K$'\beta_1$
XKβ_5''	(Th)	106,1564	}		
XKβ_5'	(Th)	106,3149	}		
XKβ_2	(Th)	108,581	}		
XKβ_4	(Th)	108,953	}	0,00021 (6)	K$'\beta_2$
XKO$_{2,3}$	(Th)	109,442	}		

6.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{1,0}$(Th)	49,55 (6)	0,0697 (26)
$\gamma_{2,1}$(Th)	113,5 (1)	0,0174 (47)

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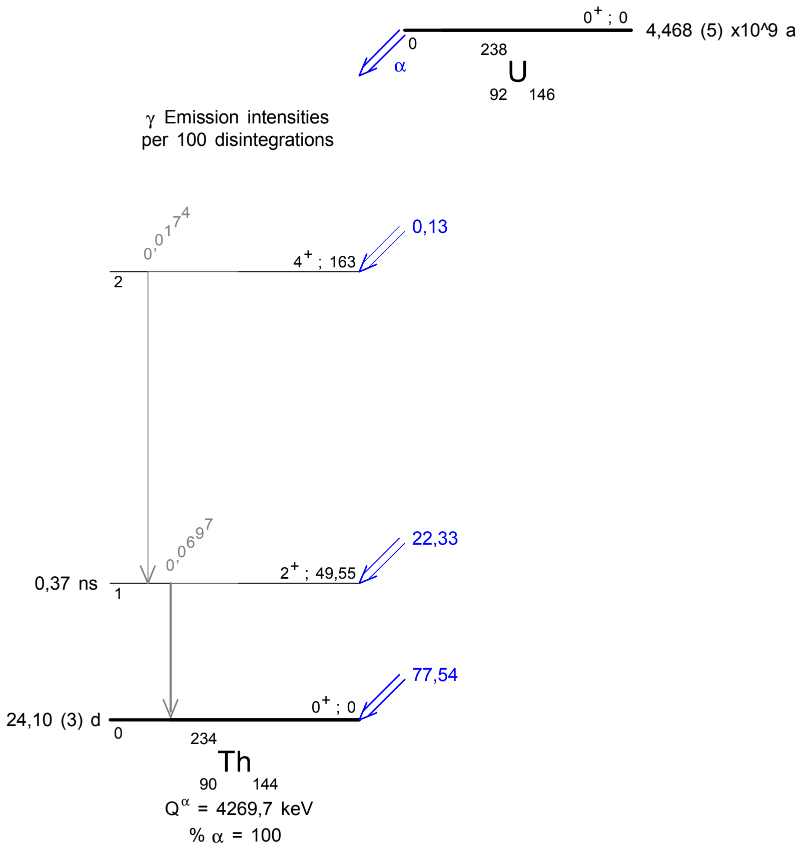
0+ ; 0
4,468 (5) x10^9 a
0
238
U
92 146
α
γ Emission intensities
per 100 disintegrations
0,0174
4+ ; 163
0,13
2
0,0697
2+ ; 49,55
22,33
0,37 ns
1
0+ ; 0
77,54
24,10 (3) d
0
234
Th
90 144
Qα = 4269,7 keV
% α = 100

$^{242}_{96}\mathrm{Cm}_{146}$

1 Decay Scheme

Cm-242 decays 100% by alpha transitions to Pu-238 and by spontaneous fission with branching fraction of 6.36 (14) E-6 %.
Le curium 242 se désintègre à 100% par transition alpha vers le plutonium 238 et par fission spontanée pour 6,36 (14)E-06 %.

2 Nuclear Data

$T_{1/2}(^{242}\mathrm{Cm})$	:	162,86	(8)	d
$T_{1/2}(^{238}\mathrm{Pu})$	:	87,74	(3)	a
$Q^{\alpha}(^{242}\mathrm{Cm})$	:	6215,56	(8)	keV

2.1 α Transitions

	Energy keV	Probability × 100	F
$\alpha_{0,15}$	4951,27 (24)	0,00000052 (14)	6
$\alpha_{0,14}$	4986,87 (24)	0,00000055 (15)	10
$\alpha_{0,13}$	5089,77 (19)	0,00000031 (10)	88
$\alpha_{0,12}$	5186,94 (10)	0,0000037 (10)	32
$\alpha_{0,11}$	5197,0 (3)	$\leq$ 0,0000002	$\geq$ 700
$\alpha_{0,10}$	5232,56 (12)	0,0000017 (5)	137
$\alpha_{0,9}$	5252,84 (11)	0,00000113 (21)	278
$\alpha_{0,8}$	5274,13 (12)	0,000035 (7)	12
$\alpha_{0,7}$	5452,34 (15)	$\leq$ 0,00000022	$\geq$ 24000
$\alpha_{0,6}$	5554,28 (14)	0,000013 (3)	1700
$\alpha_{0,5}$	5610,48 (11)	0,00025 (5)	183
$\alpha_{0,4}$	5701,94 (18)	0,00002	7500
$\alpha_{0,3}$	5912,14 (11)	0,0046 (5)	458
$\alpha_{0,2}$	6069,56 (10)	0,034 (2)	390
$\alpha_{0,1}$	6171,48 (9)	25,94 (7)	1,733
$\alpha_{0,0}$	6215,56 (8)	74,06 (7)	1

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2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{1,0}$(Pu)	44,08 (3)	25,98 (7)	E2		570 (12)	159 (3)	785 (16)
$\gamma_{2,1}$(Pu)	101,92 (4)	0,039 (2)	E2		10,5 (2)	2,93 (6)	14,4 (3)
$\gamma_{3,2}$(Pu)	157,42 (9)	0,0046 (5)	[E2]	0,186 (4)	1,45 (3)	0,405 (8)	2,18 (4)
$\gamma_{4,3}$(Pu)	210,20 (14)	0,00002	E2	0,137 (3)	0,414 (8)	0,115 (2)	0,706 (14)
$\gamma_{8,5}$(Pu)	336,36 (15)	0,0000007 (3)	[E1]	0,0256 (5)	0,00502 (10)	0,00122 (3)	0,0322 (7)
$\gamma_{9,5}$(Pu)	357,64 (7)	0,000000054 (11)	M1 + E2	0,132 (10)	0,060 (5)	0,0158 (12)	0,213 (16)
$\gamma_{7,3}$(Pu)	459,8 (2)	0,00000006 (3)					
$\gamma_{6,2}$(Pu)	515,25 (19)	0,0000046 (12)	E1+M2	0,017 (3)	0,0037 (7)	0,00092 (17)	0,022 (4)
$\gamma_{5,1}$(Pu)	561,02 (10)	0,00015 (4)	E1	0,00928 (19)	0,00169 (4)	0,000407 (8)	0,0115 (2)
$\gamma_{5,0}$(Pu)	605,04 (10)	0,000105 (30)	E1	0,00806 (16)	0,00146 (3)	0,000350 (7)	0,0100 (2)
$\gamma_{6,1}$(Pu)	617,20 (12)	0,0000079 (21)	E1+M2	0,0095 (11)	0,00185 (22)	0,00045 (5)	0,0120 (14)
$\gamma_{7,2}$(Pu)	617,22 (13)	0,00000016	E1+M2				
$\gamma_{10,2}$(Pu)	837,01 (15)	0,00000019 (6)	[E2]	0,0125 (3)	0,00366 (8)	0,00093 (2)	0,0174 (4)
$\gamma_{12,2}$(Pu)	882,63 (3)	0,000000068 (15)	(E2)	0,0114 (2)	0,00320 (7)	0,00081 (2)	0,0157 (3)
$\gamma_{8,1}$(Pu)	897,33 (10)	0,000022 (6)	(E2)	0,0111 (2)	0,00308 (6)	0,00078 (2)	0,0152 (3)
$\gamma_{9,1}$(Pu)	918,7 (2)	0,00000054 (15)	E1	0,00383 (8)	0,00066 (1)	0,000158 (3)	0,0047 (1)
$\gamma_{10,1}$(Pu)	938,91 (10)	0,0000009 (3)	E0+E2				4,4 (4)
$\gamma_{8,0}$(Pu)	941,5 (2)		E0				
$\gamma_{9,0}$(Pu)	962,8 (2)	0,00000053 (15)	E1	0,00353 (7)	0,00061 (1)	0,000145 (3)	0,00433 (9)
$\gamma_{11,1}$(Pu)	974,5 (3)	0,0000002	E1+M2				
$\gamma_{13,2}$(Pu)	979,8 (2)	0,00000026 (8)					
$\gamma_{10,0}$(Pu)	983,0 (3)	0,00000050 (18)	[E2]	0,00945 (19)	0,00246 (5)	0,00062 (1)	0,0128 (3)
$\gamma_{12,1}$(Pu)	984,5 (1)	0,0000020 (6)	M1+E2	0,00948 (19)	0,00246 (5)	0,00062 (1)	0,0128 (3)
$\gamma_{12,0}$(Pu)	1028,5 (2)	0,0000016 (5)	E2	0,00874 (18)	0,00221 (5)	0,00055 (1)	0,0117 (2)
$\gamma_{13,1}$(Pu)	1081,7 (3)	0,00000005 (2)					
$\gamma_{15,2}$(Pu)	1118,3 (3)	0,00000017 (9)	[E2]	0,00756 (15)	0,00182 (4)	0,00045 (1)	0,0100 (2)
$\gamma_{14,1}$(Pu)	1184,6 (3)	0,00000050 (15)	E2	0,00685 (14)	0,00160 (3)	0,00040 (1)	0,0090 (2)
$\gamma_{15,1}$(Pu)	1220,2 (3)	0,00000035 (11)	E0+E2+(M1)				0,26 (3)
$\gamma_{14,0}$(Pu)	1228,7 (3)		E0				

3 Atomic Data

3.1 Pu

ω_K	:	0,971	(4)
$\bar{\omega}_L$	:	0,521	(20)
n_{KL}	:	0,790	(5)

3.1.1 X Radiations

		Energy keV		Relative probability
X_K				
	$K\alpha_2$	99,525		63,17
	$K\alpha_1$	103,734		100
	$K\beta_3$	116,244	}	
	$K\beta_1$	117,228	}	
	$K\beta_5''$	117,918	}	36,36
	$K\beta_2$	120,54	}	
	$K\beta_4$	120,969	}	12,61
	$KO_{2,3}$	121,543	}	
X_L				
	$L\ell$	12,12		
	$L\alpha$	14,087 – 14,282		
	$L\eta$	16,333		
	$L\beta$	16,5 – 19,33		
	$L\gamma$	20,71 – 23,07		

3.1.2 Auger Electrons

	Energy keV	Relative probability
Auger K		
KLL	75,2 – 85,3	100
KLX	92,6 – 103,6	60,6
KXY	109,8 – 121,5	9,2
Auger L	6,1 – 22,9	

4 α Emissions

	Energy keV	Probability × 100
$\alpha_{0,15}$	4869,43 (23)	0,00000052 (14)
$\alpha_{0,14}$	4904,44 (23)	0,00000055 (15)
$\alpha_{0,13}$	5005,64 (19)	0,00000031 (10)
$\alpha_{0,12}$	5101,21 (10)	0,0000037 (10)
$\alpha_{0,11}$	5111,1 (3)	$\leq$ 0,0000002
$\alpha_{0,10}$	5146,07 (12)	0,0000017 (5)
$\alpha_{0,9}$	5165,95 (16)	0,00000113 (21)

	Energy keV	Probability × 100
$\alpha_{0,8}$	5186,95 (12)	0,000035 (7)
$\alpha_{0,7}$	5366,22 (15)	≤ 0,00000022
$\alpha_{0,6}$	5462,47 (14)	0,000013 (3)
$\alpha_{0,5}$	5517,75 (11)	0,00025 (5)
$\alpha_{0,4}$	5607,76 (16)	0,00002
$\alpha_{0,3}$	5816,39 (11)	0,0046 (5)
$\alpha_{0,2}$	5969,24 (9)	0,034 (2)
$\alpha_{0,1}$	6069,37 (9)	25,94 (7)
$\alpha_{0,0}$	6112,72 (8)	74,06 (7)

5 Electron Emissions

		Energy keV	Electrons per 100 disint.
e_{AL}	(Pu)	6,1 - 22,9	9,0 (5)
e_{AK}	(Pu)		0,0000079 (17)
	KLL	75,2 - 85,3	}
	KLX	92,6 - 103,6	}
	KXY	109,8 - 121,5	}
$ec_{1,0\ L}$	(Pu)	20,98 - 26,02	18,8 (6)
$ec_{1,0\ M}$	(Pu)	38,15 - 40,31	5,25 (15)
$ec_{2,1\ L}$	(Pu)	78,82 - 83,86	0,0263 (16)
$ec_{2,1\ M}$	(Pu)	95,99 - 98,15	0,0074 (4)
$ec_{3,2\ K}$	(Pu)	35,63 (5)	0,00027 (3)
$ec_{3,2\ L}$	(Pu)	134,32 - 139,36	0,00210 (24)
$ec_{3,2\ M}$	(Pu)	151,49 - 152,65	0,00059 (7)

6 Photon Emissions

6.1 X-Ray Emissions

		Energy keV	Photons per 100 disint.	
XL	(Pu)	12,12 — 23,07	9,8 (5)	
XKα_2	(Pu)	99,525	0,000079 (13)	} Kα
XKα_1	(Pu)	103,734	0,000125 (21)	}

		Energy keV		Photons per 100 disint.	
$XK\beta_3$	(Pu)	116,244	}		
$XK\beta_1$	(Pu)	117,228	}	0,000045 (8)	$K'\beta_1$
$XK\beta_5''$	(Pu)	117,918	}		
$XK\beta_2$	(Pu)	120,54	}		
$XK\beta_4$	(Pu)	120,969	}	0,000016 (3)	$K'\beta_2$
$XKO_{2,3}$	(Pu)	121,543	}		

6.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{1,0}$(Pu)	44,08 (3)	0,0330 (7)
$\gamma_{2,1}$(Pu)	101,92 (4)	0,00251 (14)
$\gamma_{3,2}$(Pu)	157,42 (9)	0,00145 (16)
$\gamma_{4,3}$(Pu)	210,20 (14)	0,000012
$\gamma_{8,5}$(Pu)	336,36 (15)	0,0000007 (3)
$\gamma_{9,5}$(Pu)	357,64 (7)	0,000000045 (9)
$\gamma_{7,3}$(Pu)	459,8 (2)	0,00000006 (3)
$\gamma_{6,2}$(Pu)	515,25 (19)	0,0000045 (12)
$\gamma_{5,1}$(Pu)	561,02 (10)	0,00015 (4)
$\gamma_{5,0}$(Pu)	605,04 (10)	0,000105 (30)
$\gamma_{7,2}$(Pu)	617,22 (13)	0,00000016
$\gamma_{6,1}$(Pu)	617,22 (12)	0,0000079 (21)
$\gamma_{10,2}$(Pu)	837,01 (15)	0,00000019 (6)
$\gamma_{12,2}$(Pu)	882,63 (3)	0,000000067 (15)
$\gamma_{8,1}$(Pu)	897,33 (10)	0,000022 (6)
$\gamma_{9,1}$(Pu)	918,7 (2)	0,00000054 (15)
$\gamma_{10,1}$(Pu)	938,91 (10)	0,00000018 (6)
$\gamma_{9,0}$(Pu)	962,8 (2)	0,00000053 (15)
$\gamma_{11,1}$(Pu)	974,5 (3)	0,0000002
$\gamma_{13,2}$(Pu)	979,8 (2)	0,00000026 (8)
$\gamma_{10,0}$(Pu)	983,0 (3)	0,00000050 (18)
$\gamma_{12,1}$(Pu)	984,5 (1)	0,0000020 (6)
$\gamma_{12,0}$(Pu)	1028,5 (2)	0,0000016 (5)
$\gamma_{13,1}$(Pu)	1081,7 (3)	0,00000005 (2)
$\gamma_{15,2}$(Pu)	1118,3 (3)	0,00000017 (9)
$\gamma_{14,1}$(Pu)	1184,6 (3)	0,00000050 (15)
$\gamma_{15,1}$(Pu)	1220,2 (3)	0,00000028 (9)

7 Main Production Modes

$$\begin{cases} \mathrm{Am}-241(\mathrm{n},\gamma)\mathrm{Am}-242 \\ \text{Possible impurities: } \mathrm{Am}-241,\mathrm{Cm}-243,\mathrm{Cm}-244 \end{cases}$$

$\mathrm{Am}-242(\beta^-)\mathrm{Cm}-242$

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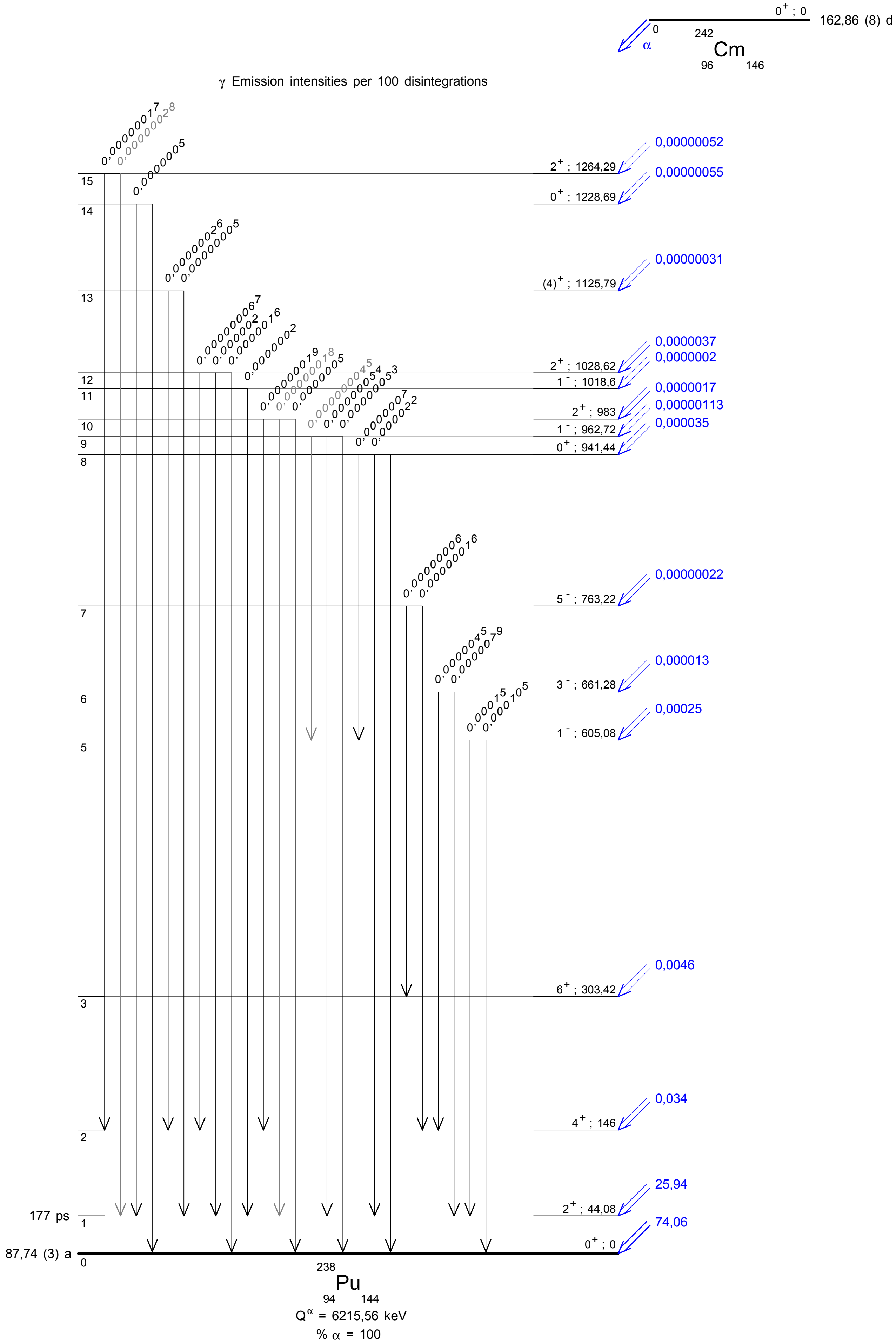
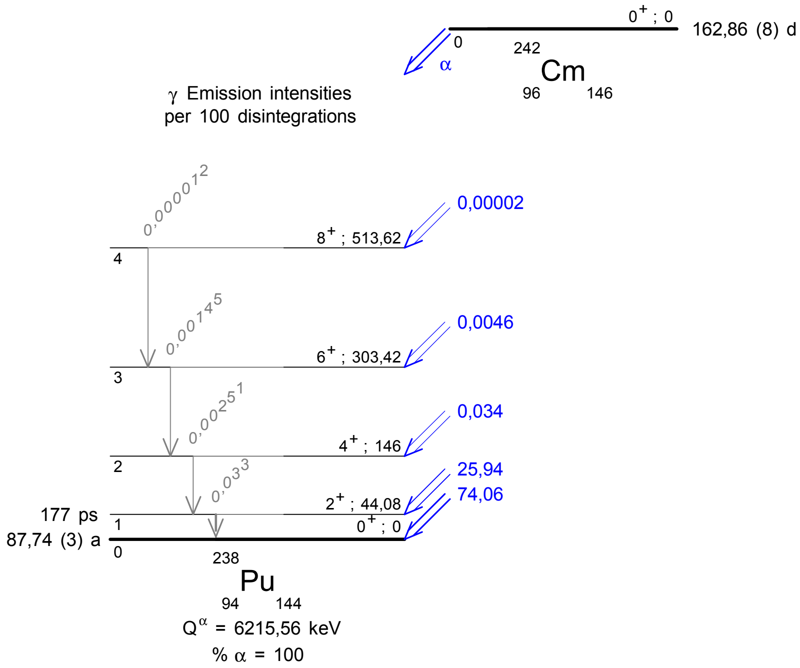

0+ ; 0
162,86 (8) d
α
242 Cm 96 146
γ Emission intensities per 100 disintegrations
2+ ; 1264,29
0,00000052
0+ ; 1228,69
0,00000055
(4)+ ; 1125,79
0,00000031
2+ ; 1028,62
0,0000037
1- ; 1018,6
0,0000002
2+ ; 983
0,0000017
1- ; 962,72
0,00000113
0+ ; 941,44
0,000035
5- ; 763,22
0,00000022
3- ; 661,28
0,000013
1- ; 605,08
0,00025
6+ ; 303,42
0,0046
4+ ; 146
0,034
2+ ; 44,08
25,94
0+ ; 0
74,06
177 ps
87,74 (3) a
238 Pu 94 144
Qα = 6215,56 keV
% α = 100


0+ ; 0
162,86 (8) d
0
α
242
Cm
96
146
γ Emission intensities
per 100 disintegrations
0,000012
0,00002
8+ ; 513,62
4
0,00145
0,0046
6+ ; 303,42
3
0,00251
0,034
4+ ; 146
2
0,033
25,94
74,06
2+ ; 44,08
177 ps
1
0+ ; 0
87,74 (3) a
0
238
Pu
94
144
Qα = 6215,56 keV
% α = 100

243 Am
95 Am 148

1 Decay Scheme

Am-243 decays by emission of alpha particles to Np-239, with a minute branch of 3.8 (7) E-09 % by spontaneous fission.
L'américium 243 se désintègre par émission alpha vers le neptunium 239. Un faible branchement (3,8 (7) E-09 %) par fission spontanée existe.

2 Nuclear Data

$T_{1/2}$(^{243}Am)	:	7370	(17)	a
$T_{1/2}$(^{239}Np)	:	2,355	(4)	d
Q^{α}(^{243}Am)	:	5438,8	(10)	keV

2.1 α Transitions

	Energy keV	Probability × 100	F
$\alpha_{0,16}$	4774 (3)	0,0017 (5)	7,2
$\alpha_{0,15}$	5001 (3)	0,000085	5400
$\alpha_{0,14}$	5013 (3)	0,00018	3000
$\alpha_{0,13}$	5029 (3)	0,00034	2000
$\alpha_{0,12}$	5081 (3)	0,0018 (4)	900
$\alpha_{0,11}$	5092 (3)	0,0018	
$\alpha_{0,10}$	5113 (3)	0,0039 (6)	700
$\alpha_{0,9}$	5119 (3)	0,0039	
$\alpha_{0,8}$	5173 (5)	0,0055 (6)	1100
$\alpha_{0,7}$	5199 (1)	0,010 (1)	900
$\alpha_{0,6}$	5268 (1)	1,383 (7)	17,7
$\alpha_{0,4}$	5320,9 (10)	11,46 (5)	4,71
$\alpha_{0,3}$	5363,6 (10)	86,74 (5)	1,14
$\alpha_{0,1}$	5410 (1)	0,192 (3)	95
$\alpha_{0,0}$	5438,9 (23)	0,240 (3)	1120

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{1,0}$(Np)	31,130 (21)	9,3 (11)	M1 + 0,06% E2		144 (12)	36 (3)	193 (15)
$\gamma_{4,3}$(Np)	43,1	10,5	M1 + 12,6% E2		118 (4)	31,5 (9)	161 (5)
$\gamma_{3,1}$(Np)	43,53 (2)	12,7 (3)	E1		0,868 (26)	0,22 (1)	1,16 (3)
$\gamma_{6,5}$(Np)	50,62	0,011 (2)	(E1)		0,59 (2)	0,150 (5)	0,783 (20)
$\gamma_{6,4}$(Np)	55,18	1,51 (44)	M1 + 26,5% E2		65 (19)	18 (5)	89 (26)
$\gamma_{3,0}$(Np)	74,66 (2)	86,0 (16)	E1		0,21 (1)	0,052 (2)	0,28 (1)
$\gamma_{4,1}$(Np)	86,71 (2)	0,41 (1)	E1		0,140 (4)	0,035 (1)	0,19 (1)
$\gamma_{6,3}$(Np)	98,5	0,26 (4)	(E2)		11,5 (3)	3,2 (1)	15,9 (5)
$\gamma_{4,0}$(Np)	117,84 (15)	0,62 (5)	E1		0,064 (2)	0,0160 (5)	0,089 (3)
$\gamma_{6,1}$(Np)	141,90 (6)	0,14 (1)	E1	0,174 (5)	0,040 (1)	0,0097 (3)	0,227 (7)
$\gamma_{7,2}$(Np)	169	0,001	(E1)	0,117 (4)	0,0255 (1)	0,0062 (2)	0,151 (5)
$\gamma_{9,5}$(Np)	195	0,001	(E1)	0,084 (3)	0,0178 (1)	0,0043 (1)	0,108 (3)

3 Atomic Data

3.1 Np

ω_K	:	0,971	(4)
$\bar{\omega}_L$	:	0,511	(20)
n_{KL}	:	0,791	(5)

3.1.1 X Radiations

		Energy keV		Relative probability
X_K				
	$K\alpha_2$	97,069		62,82
	$K\alpha_1$	101,059		100
	$K\beta_3$	113,303	}	
	$K\beta_1$	114,234	}	
	$K\beta_5''$	114,912	}	36,21
	$K\beta_2$	117,463	}	
	$K\beta_4$	117,876	}	12,47
	$KO_{2,3}$	118,429	}	
X_L				
	$L\ell$	11,871		
	$L\alpha$	13,671 – 13,946		
	$L\eta$	15,861		
	$L\beta$	16,109 – 17,992		
	$L\gamma$	20,784 – 21,491		

3.1.2 Auger Electrons

	Energy keV	Relative probability
Auger K		
KLL	73,501 – 83,134	100
KLX	90,358 – 101,054	60,2
KXY	107,19 – 118,66	9,06
Auger L	6,04 – 13,52	

4 α Emissions

	Energy keV	Probability × 100
$\alpha_{0,16}$	4695 (3)	0,0017 (5)
$\alpha_{0,15}$	4919 (3)	0,000085
$\alpha_{0,14}$	4930 (3)	0,00018
$\alpha_{0,13}$	4946 (3)	0,00034
$\alpha_{0,12}$	4997 (3)	0,0018 (4)
$\alpha_{0,11}$	5008 (3)	0,0018
$\alpha_{0,10}$	5029 (3)	0,0039 (6)
$\alpha_{0,9}$	5035 (3)	0,0039
$\alpha_{0,8}$	5088 (5)	0,0055 (6)
$\alpha_{0,7}$	5113 (1)	0,010 (1)
$\alpha_{0,6}$	5181 (1)	1,383 (7)
$\alpha_{0,4}$	5233,3 (10)	11,46 (5)
$\alpha_{0,3}$	5275,3 (10)	86,74 (5)
$\alpha_{0,1}$	5321 (1)	0,192 (3)
$\alpha_{0,0}$	5349,4 (23)	0,240 (3)

5 Electron Emissions

		Energy keV	Electrons per 100 disint.
e_{AL}	(Np)	6,04 - 13,52	23,2 (5)
e_{AK}	(Np)		0,00059 (7)
	KLL	73,501 - 83,134	}
	KLX	90,358 - 101,054	}
	KXY	107,19 - 118,66	}

		Energy keV	Electrons per 100 disint.
$ec_{1,0\ L}$	(Np)	8,713 - 13,530	6,9 (8)
$ec_{4,3\ L}$	(Np)	20,673 - 25,490	7,67 (26)
$ec_{3,1\ L}$	(Np)	21,103 - 25,920	5,11 (18)
$ec_{1,0\ M}$	(Np)	25,401 - 27,476	1,7 (2)
$ec_{1,0\ N}$	(Np)	29,639 - 30,737	0,47 (5)
$ec_{6,4\ L}$	(Np)	32,753 - 37,570	1,10 (33)
$ec_{4,3\ M}$	(Np)	37,361 - 39,436	2,05 (6)
$ec_{3,1\ M}$	(Np)	37,791 - 39,866	1,30 (6)
$ec_{4,3\ N}$	(Np)	41,599 - 42,697	0,57 (2)
$ec_{3,1\ N}$	(Np)	42,029 - 43,127	0,35 (1)
$ec_{6,4\ M}$	(Np)	49,441 - 51,516	0,30 (9)
$ec_{3,0\ L}$	(Np)	52,233 - 57,050	14,1 (7)
$ec_{6,4\ N}$	(Np)	53,679 - 54,777	0,08 (2)
$ec_{3,0\ M}$	(Np)	68,921 - 70,996	3,49 (15)
$ec_{3,0\ N}$	(Np)	73,159 - 74,257	0,94 (3)
$ec_{6,3\ L}$	(Np)	76,073 - 80,890	0,17 (2)
$ec_{6,3\ M}$	(Np)	92,761 - 94,836	0,05 (1)

6 Photon Emissions

6.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(Np)	11,871 — 21,491		17,8 (4)	
XKα_2	(Np)	97,069		0,0058 (5)	} Kα
XKα_1	(Np)	101,059		0,0093 (7)	}
XKβ_3	(Np)	113,303	}		
XKβ_1	(Np)	114,234	}	0,00338 (26)	K$'\beta_1$
XKβ_5''	(Np)	114,912	}		
XKβ_2	(Np)	117,463	}		
XKβ_4	(Np)	117,876	}	0,00116 (9)	K$'\beta_2$
XKO$_{2,3}$	(Np)	118,429	}		

6.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{1,0}$(Np)	31,13 (3)	0,048 (4)
$\gamma_{4,3}$(Np)	43,1	0,065
$\gamma_{3,1}$(Np)	43,53 (2)	5,89 (10)
$\gamma_{6,5}$(Np)	50,6	0,0062 (10)
$\gamma_{6,4}$(Np)	55,18	0,0168 (11)
$\gamma_{3,0}$(Np)	74,66 (2)	67,2 (12)
$\gamma_{4,1}$(Np)	86,71 (2)	0,346 (9)
$\gamma_{6,3}$(Np)	98,5	0,0151 (21)
$\gamma_{4,0}$(Np)	117,60 (15)	0,57 (5)
$\gamma_{6,1}$(Np)	141,90 (6)	0,115 (8)
$\gamma_{7,2}$(Np)	169	0,0012
$\gamma_{9,5}$(Np)	195	0,00085

7 Main Production Modes

Multiple neutron capture from Pu – 239()
Multiple neutron capture from U – 238()

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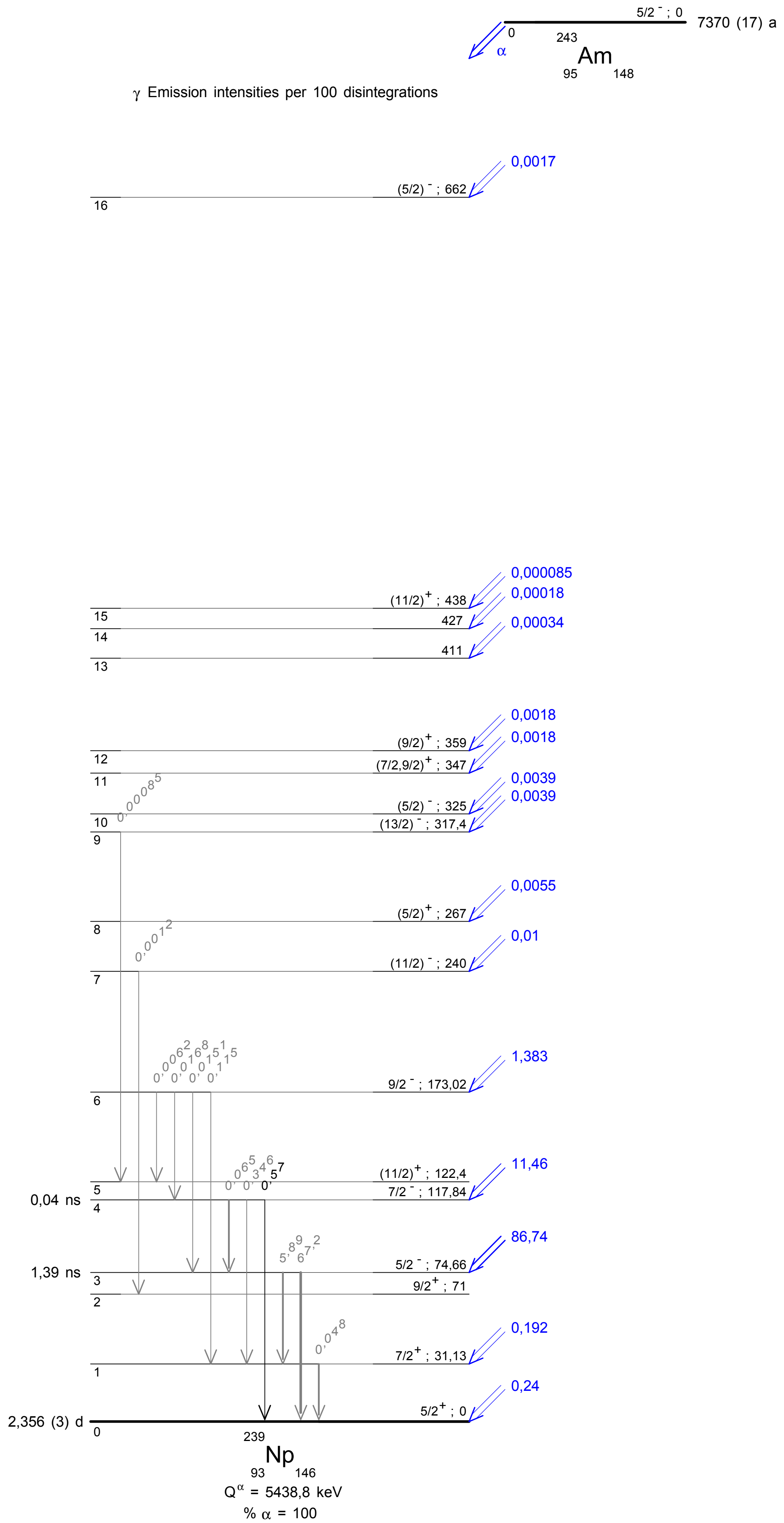

5/2 - ; 0
7370 (17) a
0
α
243
Am
95
148
γ Emission intensities per 100 disintegrations
0,0017
(5/2) - ; 662
16
0,000085
0,00018
0,00034
(11/2)+ ; 438
15
427
14
411
13
0,0018
0,0018
(9/2)+ ; 359
12
(7/2,9/2)+ ; 347
11
0,0039
0,0039
(5/2) - ; 325
10
(13/2) - ; 317,4
9
0,0055
(5/2)+ ; 267
8
0,01
(11/2) - ; 240
7
1,383
9/2 - ; 173,02
6
11,46
(11/2)+ ; 122,4
5
7/2 - ; 117,84
0,04 ns
4
86,74
5/2 - ; 74,66
1,39 ns
3
9/2+ ; 71
2
0,192
7/2+ ; 31,13
1
0,24
5/2+ ; 0
2,356 (3) d
0
239
Np
93
146
Qα = 5438,8 keV
% α = 100

$^{244}_{96}$Cm $_{148}$

1 Decay Scheme

Cm-244 decays 100% by alpha transitions to Pu-240 and by spontaneous fission with branching fraction of 1.36 (1) E-4 %.
Le curium 244 se désintègre par émission alpha et par fission spontanée dans une dans une proportion de 1,36 (1) E-4%.
Le nombre moyen de neutrons émis par fission spontanée est de 2,731 (20).
Le nombre de neutrons émis pour 100 désintégrations de Cm-244 est : 3,71 (5) E-4%.

2 Nuclear Data

$T_{1/2}(^{244}$Cm)	:	18,11	(3)	a
$T_{1/2}(^{240}$Pu)	:	6561	(7)	a
$Q^{\alpha}(^{244}$Cm)	:	5901,74	(5)	keV

2.1 α Transitions

	Energy keV	Probability × 100	F
$\alpha_{0,9}$	4963,68 (8)	0,0000047 (11)	33
$\alpha_{0,8}$	5001,42 (7)	0,000050 (5)	5,6
$\alpha_{0,7}$	5041,03 (9)	0,000149 (16)	3,5
$\alpha_{0,6}$	5252,89 (7)	0,0000042 (30)	3100
$\alpha_{0,5}$	5304,40 (7)	0,000055 (9)	500
$\alpha_{0,4}$	5362,2	0,00004	
$\alpha_{0,3}$	5607,42 (6)	0,00352 (18)	512
$\alpha_{0,2}$	5760,05 (5)	0,0204 (15)	636
$\alpha_{0,1}$	5858,92 (5)	23,3 (4)	1,94
$\alpha_{0,0}$	5901,74 (5)	76,7 (4)	1

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{1,0}$(Pu)	42,824 (8)	23,3 (4)	E2		656 (13)	183 (4)	904 (18)
$\gamma_{2,1}$(Pu)	98,860 (13)	0,0240 (15)	E2		12,06 (24)	3,44 (7)	16,6 (3)
$\gamma_{3,2}$(Pu)	152,63 (2)	0,00356 (18)	(E2)	0,189 (4)	1,66 (3)	0,465 (9)	2,48 (5)
$\gamma_{4,3}$(Pu)	202,4	0,00004	(E2)	0,144 (3)	0,486 (10)	0,135 (3)	0,813 (16)
$\gamma_{8,6}$(Pu)	251,47 (6)	0,0000121 (24)	(E1)	0,0476 (10)	0,00982 (20)	0,00239 (5)	0,0606 (12)
$\gamma_{7,5}$(Pu)	263,37 (8)	0,000065 (10)	(E1)	0,0430 (9)	0,00880 (18)	0,00214 (4)	0,0547 (11)
$\gamma_{9,6}$(Pu)	289,21 (7)	0,0000006 (3)	E2+M3				
$\gamma_{8,5}$(Pu)	302,98 (6)	0,0000200 (31)	(E1)	0,0318 (7)	0,00636 (13)	0,00154 (3)	0,0403 (8)
$\gamma_{9,5}$(Pu)	340,72 (7)	0,0000019 (9)					
$\gamma_{6,2}$(Pu)	507,16 (5)	0,0000088 (28)	(E1)	0,01124 (23)	0,00208 (4)	0,00050 (1)	0,01423 (29)
$\gamma_{5,1}$(Pu)	554,52 (4)	0,000088 (11)	(E1)	0,00949 (19)	0,00174 (4)	0,000417 (9)	0,01179 (24)
$\gamma_{5,0}$(Pu)	597,34 (4)	0,000054 (7)	(E1)	0,00826 (17)	0,00150 (3)	0,000359 (7)	0,01024 (21)
$\gamma_{6,1}$(Pu)	606,03 (4)	0,0000081 (14)					
$\gamma_{8,2}$(Pu)	758,63 (5)	0,0000141 (20)	(E2)	0,0148 (3)	0,00473 (9)	0,001211 (24)	0,0211 (4)
$\gamma_{7,1}$(Pu)	817,89 (7)	0,000069 (9)	(E2)	0,0130 (3)	0,00389 (8)	0,000989 (20)	0,0182 (4)
$\gamma_{8,1}$(Pu)	857,50 (4)	0,0000057 (8)					
$\gamma_{7,0}$(Pu)	860,71 (7)	0,0000082 (20)	(E0)				
$\gamma_{9,1}$(Pu)	895,24 (6)	0,0000018 (6)	E1+M2				
$\gamma_{8,0}$(Pu)	900,32 (4)	0,0000013 (6)					
$\gamma_{9,0}$(Pu)	938,06 (6)	0,0000004 (4)					

3 Atomic Data

3.1 Pu

ω_K	:	0,971	(4)
$\bar{\omega}_L$	:	0,521	(20)
$\bar{\omega}_M$	:	0,0555	(5)
n_{KL}	:	0,790	(5)

3.1.1 X Radiations

		Energy keV		Relative probability
X_K				
	$K\alpha_2$	99,525		63,17
	$K\alpha_1$	103,734		100
	$K\beta_3$	116,244	}	
	$K\beta_1$	117,228	}	
	$K\beta_5''$	117,918	}	36,36
	$K\beta_2$	120,54	}	
	$K\beta_4$	120,969	}	12,61
	$KO_{2,3}$	121,543	}	

		Energy keV	Relative probability
X_L			
	$L\ell$	12,125	
	$L\alpha$	14,083 – 14,279	
	$L\eta$	16,334	
	$L\beta$	16,499 – 19,331	
	$L\gamma$	20,708 – 21,984	

3.1.2 Auger Electrons

	Energy keV	Relative probability
Auger K		
KLL	75,263 – 85,357	100
KLX	92,607 – 103,729	60,6
KXY	109,93 – 121,78	9,18
Auger L	6,1 – 22,9	

4 α Emissions

	Energy keV	Probability × 100
$\alpha_{0,9}$	4882,12 (8)	0,0000047 (11)
$\alpha_{0,8}$	4919,24 (7)	0,000050 (5)
$\alpha_{0,7}$	4958,20 (9)	0,000149 (16)
$\alpha_{0,6}$	5166,58 (7)	0,0000042 (30)
$\alpha_{0,5}$	5217,24 (7)	0,000055 (9)
$\alpha_{0,4}$	5315,3	0,00004
$\alpha_{0,3}$	5515,29 (6)	0,00352 (18)
$\alpha_{0,2}$	5665,41 (5)	0,0204 (15)
$\alpha_{0,1}$	5762,65 (5)	23,3 (4)
$\alpha_{0,0}$	5804,77 (5)	76,7 (4)

5 Electron Emissions

		Energy keV		Electrons per 100 disint.
e_{AL}	(Pu)	6,1 - 22,9		8,1 (4)
e_{AK}	(Pu)			0,0000059 (6)
	KLL	75,263 - 85,357	}	
	KLX	92,607 - 103,729	}	
	KXY	109,93 - 121,78	}	
$ec_{1,0\ T}$	(Pu)	19,70 - 39,05		23,3 (8)
$ec_{1,0\ L}$	(Pu)	19,720 - 24,767		16,9 (6)
$ec_{1,0\ M}$	(Pu)	36,891 - 39,049		4,72 (16)

6 Photon Emissions

6.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(Pu)	12,125 — 21,984		8,77 (6)	
$XK\alpha_2$	(Pu)	99,525		0,000059 (5)	} $K\alpha$
$XK\alpha_1$	(Pu)	103,734		0,000094 (5)	}
$XK\beta_3$	(Pu)	116,244	}		
$XK\beta_1$	(Pu)	117,228	}	0,0000341 (17)	$K'\beta_1$
$XK\beta_5''$	(Pu)	117,918	}		
$XK\beta_2$	(Pu)	120,54	}		
$XK\beta_4$	(Pu)	120,969	}	0,0000116 (6)	$K'\beta_2$
$XKO_{2,3}$	(Pu)	121,543	}		

6.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{1,0}$(Pu)	42,824 (8)	0,0258 (7)
$\gamma_{2,1}$(Pu)	98,860 (13)	0,00136 (9)

	Energy keV	Photons per 100 disint.
$\gamma_{3,2}$(Pu)	152,63 (2)	0,00102 (5)
$\gamma_{4,3}$(Pu)	202,4	0,000022
$\gamma_{8,6}$(Pu)	251,47 (6)	0,0000114 (23)
$\gamma_{7,5}$(Pu)	263,37 (8)	0,000062 (9)
$\gamma_{9,6}$(Pu)	289,21 (7)	0,0000006 (3)
$\gamma_{8,5}$(Pu)	302,98 (6)	0,000019 (3)
$\gamma_{9,5}$(Pu)	340,72 (7)	0,0000018 (9)
$\gamma_{6,2}$(Pu)	507,16 (5)	0,0000087 (28)
$\gamma_{5,1}$(Pu)	554,52 (4)	0,000087 (11)
$\gamma_{5,0}$(Pu)	597,34 (4)	0,000053 (7)
$\gamma_{6,1}$(Pu)	606,03 (4)	0,0000081 (14)
$\gamma_{8,2}$(Pu)	758,63 (5)	0,0000138 (19)
$\gamma_{7,1}$(Pu)	817,89 (7)	0,000068 (9)
$\gamma_{8,1}$(Pu)	857,50 (4)	0,0000057 (8)
$\gamma_{9,1}$(Pu)	895,24 (6)	0,0000018 (6)
$\gamma_{8,0}$(Pu)	900,32 (4)	0,0000013 (6)
$\gamma_{9,0}$(Pu)	938,06 (6)	0,0000004 (4)

7 Main Production Modes

Multiple n capture (U – 238,)

Multiple n capture (Pu – 239,)

Multiple n capture (Am – 243,)

8 References

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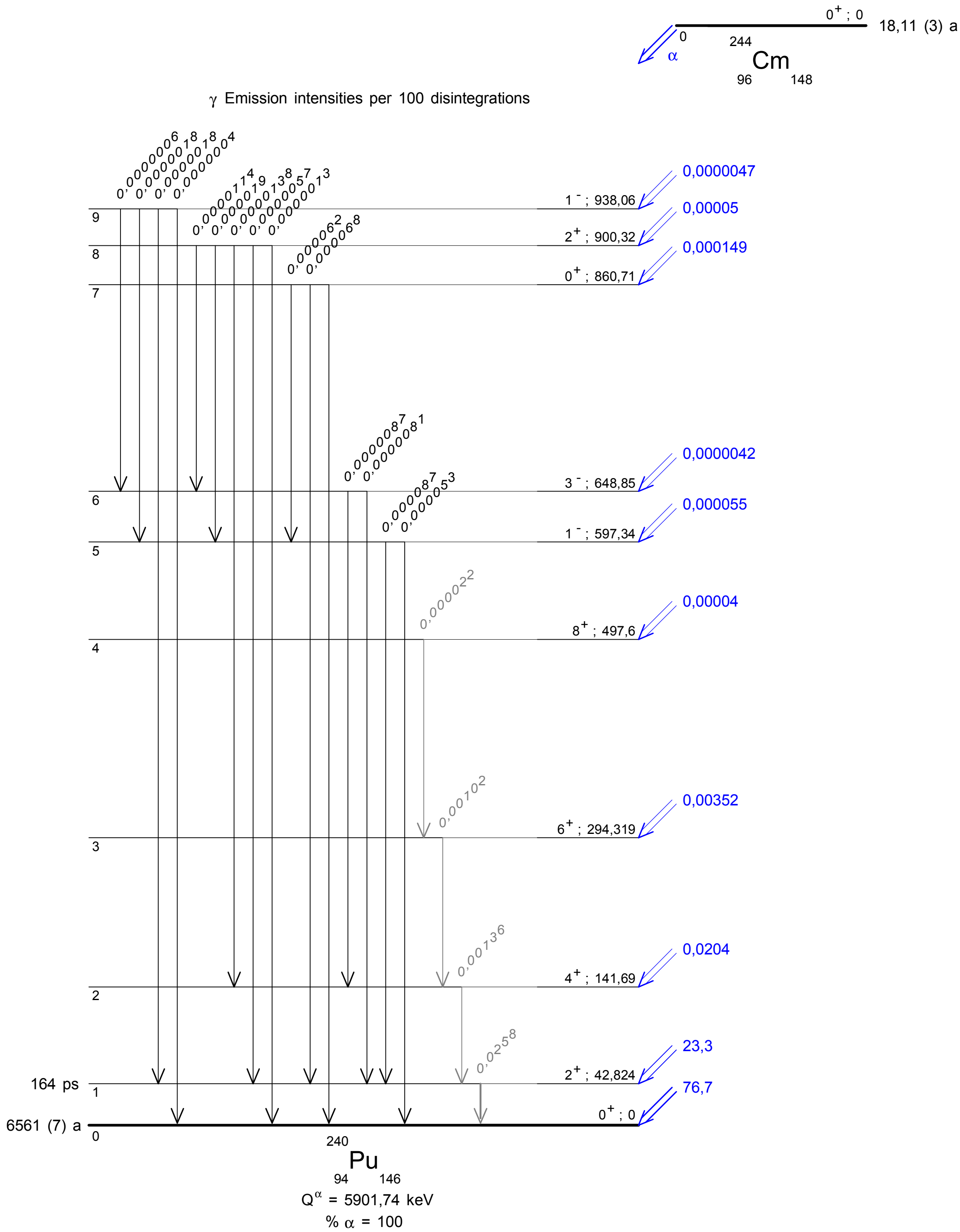

γ Emission intensities per 100 disintegrations
0+ ; 0
18,11 (3) a
244 Cm 96 148
α
1 - ; 938,06
0,0000047
2+ ; 900,32
0,00005
0+ ; 860,71
0,000149
3 - ; 648,85
0,0000042
1 - ; 597,34
0,000055
8+ ; 497,6
0,00004
6+ ; 294,319
0,00352
4+ ; 141,69
0,0204
2+ ; 42,824
23,3
0+ ; 0
76,7
164 ps
6561 (7) a
0,00022
0,00102
0,00136
0,0258
240 Pu 94 146
Qα = 5901,74 keV
% α = 100

Reproduction Service
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92190 MEUDON

Achevé d'imprimer : décembre 2006
Imprimé en France

ISBN 92-822-2204-7 (set)
ISBN 92-822-2218-7 (Vol. 3)
ISBN 92-822-2219-5 (Vol. 3 – CD)