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Table of radionuclides (Vol. 5 - A = 22 to 244)

Marie-Martine Bé, Vanessa Chisté, Christophe Dulieu, Xavier Mougeot, Edgardo Browne, Valery Chechev, Nikolay Kuzmenko, Filip Kondev, Aurelian Luca, Monica Galan, et al.

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Monographie BIPM-5

Table of Radionuclides
(Vol. 5 – A = 22 to 244)

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BUREAU INTERNATIONAL DES POIDS ET MESURES

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Preface

This monograph is one of several published in a series by the Bureau International des Poids et Mesures (BIPM) on behalf of the Consultative Committee for Ionizing Radiation (*Comité Consultatif des Rayonnements Ionisants*, CCRI[1]). The aim of this series of publications is to review topics that are of importance for the measurement of ionizing radiation and especially of radioactivity, in particular those techniques normally used by participants in international comparisons. It is expected that these publications will prove to be useful reference volumes both for those who are already engaged in this field and for those who are approaching such measurements for the first time.

The purpose of this monograph, number 5 in the series, is to present the recommended values of nuclear and decay data for a wide range of radionuclides. Activity measurements for more than sixty-three of these radionuclides have already been the subject of comparisons under the auspices of Section II (dedicated to the *Measurement of radionuclides*) of the CCRI. The material for this monograph is now covered in five 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-evaluations for ^{125}Sb and ^{153}Sm; Volume 4 contains the data for a further thirty-one radionuclides with a re-evaluation for ^{226}Ra while the present Volume 5 includes 17 new radionuclide evaluations and 8 re-evaluations of previous data as identified in the contents page. The data have been collated and evaluated by an international working group (Decay Data Evaluation Project, DDEP) led by the Laboratoire national de métrologie et d'essais – Laboratoire national Henri Becquerel (LNE-LNHB). The evaluators have agreed on the methodologies to be used and the CD-ROM included with this monograph contains the evaluators' comments for each radionuclide in addition to the data tables included in the monograph itself.

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

The BIPM and the DDEP are most grateful to the International Atomic Energy Agency (IAEA) for their assistance and financial support to some evaluators in the production of data for Volumes 1 to 3 through their Coordinated Research Project "Update of x-ray and gamma ray decay data standards for detector calibration and other applications" and for Volumes 4 and 5 through their Coordinated Research Project "Updated decay data library for actinides". The BIPM and the DDEP are indebted also to some other evaluators who participate in the United States Nuclear Data Program (USNDP) for their support to these publications.

The publication of further volumes of Monographie 5 is envisaged when necessary to add new radionuclide data or re-evaluations in this more permanent format that can be referenced easily.

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

K. Carneiro
President of the CCRI

A.J. Wallard
Director of the BIPM

[1] Previously known as the *Comité Consultatif pour les Étalons de Mesures des Rayonnements Ionisants* (CCEMRI)

Monographie BIPM-5 – Table of Radionuclides, Volume 5

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"TABLE DE RADIONUCLÉIDES"

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

^{22}Na, ^{40}K, ^{75}Se, ^{124}Sb, ^{207}Bi, ^{211}Bi, ^{217}At, ^{225}Ra, ^{225}Ac, ^{228}Ra, ^{231}Th, ^{232}Th, ^{233}Th, ^{233}Pa, ^{234}Th, ^{235}U, ^{237}U, ^{238}Pu, ^{240}Pu, ^{241}Am, ^{242}Pu, ^{242}Am, ^{243}Am, ^{244}Am, ^{244}Am^{m}.

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:

^{22}Na, ^{40}K, ^{75}Se, ^{124}Sb, ^{207}Bi, ^{211}Bi, ^{217}At, ^{225}Ra, ^{225}Ac, ^{228}Ra, ^{231}Th, ^{232}Th, ^{233}Th, ^{233}Pa, ^{234}Th, ^{235}U, ^{237}U, ^{238}Pu, ^{240}Pu, ^{241}Am, ^{242}Pu, ^{242}Am, ^{243}Am, ^{244}Am, ^{244}Am^{m}.

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

"TABELLE DER RADIONUKLIDE"

Zusammenfassung – Dieser Band umfaßt die Evaluation der folgenden Radionuklide:

^{22}Na, ^{40}K, ^{75}Se, ^{124}Sb, ^{207}Bi, ^{211}Bi, ^{217}At, ^{225}Ra, ^{225}Ac, ^{228}Ra, ^{231}Th, ^{232}Th, ^{233}Th, ^{233}Pa, ^{234}Th, ^{235}U, ^{237}U, ^{238}Pu, ^{240}Pu, ^{241}Am, ^{242}Pu, ^{242}Am, ^{243}Am, ^{244}Am, ^{244}Am^{m}.

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

"ТАБЛИЦА РАДИОНУКЛИДОВ"

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

^{22}Na, ^{40}K, ^{75}Se, ^{124}Sb, ^{207}Bi, ^{211}Bi, ^{217}At, ^{225}Ra, ^{225}Ac, ^{228}Ra, ^{231}Th, ^{232}Th, ^{233}Th, ^{233}Pa, ^{234}Th, ^{235}U, ^{237}U, ^{238}Pu, ^{240}Pu, ^{241}Am, ^{242}Pu, ^{242}Am, ^{243}Am, ^{244}Am, ^{244}Am^{m}.

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

“TABLA DE RADIONUCLEIDOS”

<u>Contenido</u> – Este volúmen agrupa la evaluación de los radionucleidos siguientes:

^{22}Na, ^{40}K, ^{75}Se, ^{124}Sb, ^{207}Bi, ^{211}Bi, ^{217}At, ^{225}Ra, ^{225}Ac, ^{228}Ra, ^{231}Th, ^{232}Th, ^{233}Th, ^{233}Pa, ^{234}Th, ^{235}U, ^{237}U, ^{238}Pu, ^{240}Pu, ^{241}Am, ^{242}Pu, ^{242}Am, ^{243}Am, ^{244}Am, ^{244}Am^{m}.

Los valores recomendados y las incertidumbres asociadas comprenden: el período de semidesintegración radiactiva, los modos de desintegración, las emisiones $\alpha\beta\gamma$ 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] et de quatre volumes de la *Monographie* BIPM-5 [99Be, 04Be, 06Be, 08Be]. 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 cinquième de la *Monographie* 5 publiée sous l'égide du BIPM.

VALEURS RECOMMANDÉES ET INCERTITUDES

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

Pour certaines applications il est nécessaire de définir une incertitude élargie, notée U, telle que :
$U(y) = k \times u_c(y)$ 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 ± 0,011 et
9,2 (11) 9,2 ± 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 :

	Symbole
. 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.

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

AVERTISSEMENT

Ce document a été imprimé en 2010, pour toutes les nouvelles évaluations et mises à jour ultérieures, le lecteur se référera aux documents accessibles sur :
http://www.nucleide.org/NucData.htm
http://www.bipm.org/fr/publications/monographie-ri-5.html

TABLE OF RADIONUCLIDES

INTRODUCTION

The evaluation of decay data for the "Table de Radionucléides" by the Bureau National de Métrologie – Laboratoire National Henri Becquerel/Commissariat à L'Énergie Atomique (BNM – LNHB/CEA) began in 1974, continued to 1987 and four volumes were published [87Ta] and then, in 1999, the fifth volume was published containing the revised evaluations for 30 selected radionuclides [99Be]. This work has been pursued and four volumes of evaluations have already been published as *Monographie* BIPM-5 [04Be, 06Be, 08Be].
Moreover, LNHB developed a database and related software (NUCLÉIDE) with the objectives of making it easier to update and add data and, obviously, to offer easy access to the nuclear and atomic decay data to the user by "click on the button" facilities.
The aim of this Table is to provide recommended data for nuclides of special interest for metrology or practical applications like nuclear medicine, monitoring and reactor shielding, etc.
Primary recommended data comprise half-lives, decay modes, X-rays, gamma-rays, electron emissions, alpha- and beta-particle transitions and emissions, and their uncertainties. All the references used for the evaluations are given.
In order to update the data of the nuclides already present and to add new evaluations, the Laboratoire National Henri Becquerel (LNHB, France) and the Physikalisch-Technische Bundesanstalt (PTB, Germany) established a cooperative agreement; they were then joined by the Idaho National Engineering & Environmental Laboratory (INEEL, USA), the Lawrence Berkeley National Laboratory (LBNL, USA) and the Khlopin Radium Institute (KRI, Russia). This international collaboration is based on an informal agreement, the initial work of this group was to discuss and to agree on a methodology to be used in these evaluations. The data and associated uncertainties were evaluated from all available experiments and taking into account theoretical considerations.

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

RECOMMENDED VALUES AND UNCERTAINTIES

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

For some applications it may be necessary to define an expanded uncertainty, designated U, as:
$U(y) = k \times u_c(y)$ where k is the coverage factor.
In this publication, standard uncertainties are quoted (i.e. $k = 1$).

The value of the uncertainty, in parentheses, applies to the least significant digits, i.e.:
9.230 (11) means 9.230 ± 0.011 and
9.2 (11) 9.2 ± 1.1

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

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

NUMBERING

Nuclear levels are arbitrarily numbered from 0 (for the ground state level) to n (for the 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 = 1 a = 365.242 198 d = 31 556 926 s

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

- for energies, the values are expressed in keV.

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

NOTICE

This report was printed in 2010, new evaluations and updated issues will be available on:
http://www.nucleide.org/NucData.htm
http://www.bipm.org/en/publications/monographie-ri-5.html

TABELLE DER RADIONUKLIDE

EINLEITUNG

Die Evaluation der Zerfallsdaten für die „Table de Radionucléides“ durch das Laboratoire National Henri Becquerel (BNM-LNHB/CEA) begann im Jahre 1974, diese Arbeit wurde bis 1987 fortgesetzt, und es wurden vier Bände veröffentlicht [87Ta]. Seitdem sind des weiteren vier Bände der *Monographie* BIPM-5 [04Be, 06Be, 08Be] erschienen. Der vorliegende neue Band stellt die Fortsetzung der vorhergehenden Arbeit dar.
Darüber hinaus wurde im LNHB eine computerbasierte Datenbank entwickelt. Die Software NUCLEIDE erleichtert die Aktualisierung und die Einbeziehung weiterer Daten und ermöglicht den Zugang zu den Kern- und Atomdaten für den Anwender „auf Tastendruck“.
Der Zweck dieser Tabelle ist es, empfohlene Daten einer begrenzten Anzahl von Radionukliden für metrologische und praktische Anwendungen wie etwa in der Nuklearmedizin, der Umweltüberwachung, dem Brennstoffkreislauf, der Reaktorabschirmung usw. zur Verfügung zu stellen.
Die empfohlenen Daten betreffen die Halbwertszeit, die Art des Zerfalls und die Charakteristika der α-, β-, γ-, Röntgen- und Elektronenemissionen und der entsprechenden Übergänge.
Um die bereits vorliegenden Daten zu aktualisieren und neue Evaluationen schneller einbeziehen zu können, vereinbarten das Laboratoire National Henri Becquerel (LNHB, Frankreich) und die Physikalisch-Technische Bundesanstalt (PTB, Deutschland) eine Übereinkunft zur Zusammenarbeit. Es schlossen sich das Idaho National Engineering and Environmental Laboratory (INEEL, USA), das Lawrence Berkeley National Laboratory (LBNL, USA) und das Khlopin Radium Institute (KRI, Rußland) an. Eine der ersten Arbeiten dieser Gruppe war es, die in diesen Evaluationen benutzte Methodologie zu diskutieren und festzulegen. Die Datenbank umfaßt empfohlene Daten und ihre Unsicherheiten, die aus den verfügbaren experimentellen Daten oder theoretischen Berechnungen gewonnen wurden. Alle für die Evaluation benutzten Referenzen werden angegeben.
Dieser Band ist die fünfte Ausgabe der *Monographie* BIPM-5.

EMPFOHLENE WERTE UND UNSICHERHEITEN

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

Für einige Anwendungen ist es notwendig, eine vergrößerte Unsicherheit, als U bezeichnet, wie folgt zu definieren:
$U(y) = k \times u_c(y)$ 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 ± 0,011 und
9,2(11) bedeutet 9,2 ± 1,1

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

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

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

NUMERIERUNG

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

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

EINHEITEN

Die empfohlenen Werte sind ausgedrückt:
- für Halbwertszeiten:

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

1 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 2010 erstellt. Alle späteren Fassungen oder neueren Evaluationen können vom Leser unter
http://www.nucleide.org/NucData.htm
http://www.bipm.org/en/publications/monographie-ri-5.html
abgerufen werden.

ТАБЛИЦА РАДИОНУКЛИДОВ

ВВЕДЕНИЕ

Оценка данных распада для Table de Radionucléides, BNM – LNHB/CEA, была начата в 1974 г. и продолжалась до 1987 г. К тому времени были опубликованы четыре тома [87Ta] и затем, в 1999 г., был опубликован пятый том, содержащий ревизованные оценки для 30 выбранных радионуклидов [99Be]. Эта работа была продолжена, и три тома были опубликованы как *Monographie* BIPM-5 [04Be, 06Be, 08Be].
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 Radionucléides, и добавить новые оценки, Национальная лаборатория им. Анри Беккереля (LNHB, Франция) и Физико-Технический Институт (PTB, Германия) заключили кооперативное соглашение. К ним затем присоединились Национальная лаборатория прикладных и экологических исследований Айдахо (INEEL, США), Лоуренсовская Национальная Лаборатория Беркли (LBNL, США) и Радиевый институт им. В.Г. Хлопина (KRI, Россия). Это международное сотрудничество основано на неформальном соглашении. Первоначальная работа состояла в обсуждении и принятии согласованной методологии, которая должна быть использована в этих оценках. Данные и связанные с ними погрешности были оценены с использованием всех имеющихся в распоряжении результатов экспериментов и с учетом теоретических рассмотрений.

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

РЕКОМЕНДОВАННЫЕ ЗНАЧЕНИЯ И ПОГРЕШНОСТИ

Основные шаги для оценки данных и их погрешностей следующие:

- критический анализ всех имеющихся оригинальных публикаций, чтобы принять или отвергнуть данное значение и его погрешность, приведенную к комбинированному стандартному отклонению;

- определение лучшего значения, которое является взвешенным или невзвешенным средним сохраненных величин; выбор взвешенного или невзвешенного среднего определяется анализом величины χ^2. В случае среднего взвешенного вес каждого оригинального результата ограничивается 50 %. В качестве итоговой погрешности (u_c) принимается большая из двух погрешностей среднего взвешенного: внутренней и внешней. Для расходящегося набора данных она может быть расширена, чтобы перекрыть самое точное входное значение.

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

Значение погрешности, в скобках, приводится в единицах последней значащей цифры, т.е.:
9,230 (11) означает $9{,}230 \pm 0{,}011$ и
9,2 (11) $9{,}2 \pm 1{,}1$

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

Информацию о процедурах оценки можно получить из публикаций [85Zi, 96He, 99In] или непосредственно от авторов.
Информация о смысле физических величин может быть получена из [99In].

НУМЕРАЦИЯ

Ядерные уровни произвольно пронумерованы от 0 для основного состояния до *n* для n-ого возбужденного уровня. Все переходы обозначаются по их начальному и конечному уровням.
Для слабых переходов, не показанных стрелкой в схеме распада, начальный и конечный уровни обозначаются как (-1, *n*).
Для гамма-излучения с энергией 511 кэВ, которое следует за бета-плюс распадом, принято обозначение (-1, -1).

ЕДИНИЦЫ

Рекомендованные значения выражены:

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

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

- для вероятностей переходов и числа испускаемых частиц значения даны на 100 распадов;

- для энергий значения выражены в килоэлектронвольтах (keV).

ПРИМЕЧАНИЕ

Этот выпуск подготовлен в 2010 г. Новые оценки и обновленные результаты можно найти на сайте:
http://www.nucleide.org/NucData.htm
http://www.bipm.org/en/publications/monographie-ri-5.html

TABLA DE RADIONUCLEIDOS

INTRODUCCION

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

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

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

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

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

VALORES RECOMENDADOS E INCERTIDUMBRES

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

Para ciertas aplicaciones, es necesario definir una incertidumbre expandida, llamada $\boldsymbol{U}$:
$\boldsymbol{U}(y) = k \times \boldsymbol{u}_c(y)$ donde k es el factor de cobertura.
El valor de k utilizado en esta publicación es: $k = 1$.

Los valores de incertidumbres indicados entre paréntesis corresponden a las últimas cifras significativas, por ejemplo:
9,230 (11) significa 9,230 ± 0,011 y
9,2 (11) significa 9,2 ± 1,1

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

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

NUMERACION

Los niveles de un núcleo están arbitrariamente numerados desde “0” (para el nivel fundamental), hasta “*n*” para el enésimo nivel excitado. Las transiciones se representan por sus niveles inicial y final.
En el caso de una transición débil e imposible de situar en el esquema de desintegración, el nivel inicial y el final están designados con la siguiente notación: (-1, *n*).
En el caso de una emisión γ de 511 keV que sigue a una desintegración β^+, la notación adoptada es: (-1, -1).

UNIDADES

Los valores recomendados se dan:
- para los períodos de semidesintegración:

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

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

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

ADVERTENCIA

Este documento ha sido imprimido en el 2010. Para obtener todas las nuevas evaluaciones actualizadas ulteriormente, el lector deberá referirse a los documentos disponibles en:
http://www.nucleide.org/NucData.htm
http://www.bipm.org/en/publications/monographie-ri-5.html

RÉFÉRENCES

REFERENCES

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and
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[06Be] **Marie-Martine BÉ, Vanessa CHISTÉ, Christophe DULIEU; Edgardo BROWNE, Coral BAGLIN; Valery CHECHEV, Nikolay KUZMENKO; Richard G. HELMER; Filip G. KONDEV; T. Desmond MACMAHON; Kyung Beom LEE.** *Table of Radionuclides, Monographie BIPM-5, vol. 3*, ISSN 92-822-2204-7 (set), ISBN 92-822-2218-7 (Vol. 3) and ISBN 92-822-2219-5 (CD), CEA/LNE-LNHB, 91191 Gif-sur-Yvette, France and BIPM, Pavillon de Breteuil, 92312 Sèvres, France.

[08Be] **Marie-Martine BÉ, Vanessa CHISTÉ, Christophe DULIEU; Edgardo BROWNE; Valery CHECHEV, Nikolay KUZMENKO; Filip G. KONDEV; Aurelian LUCA; Mónica GALÁN; Andrew PEARCE; Xiaolong HUANG.** *Table of Radionuclides, Monographie BIPM-5, vol. 4*, ISBN 92-822-2230-6 (Vol. 4) and ISBN 92-822-2231-4 (CD), CEA/LNE-LNHB, 91191 Gif-sur-Yvette, France and BIPM, Pavillon de Breteuil, 92312 Sèvres, France.

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

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

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

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

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56	Mn-56	1	77	155	Eu-155	2	59	233	Pa-233	3	123
56	Co-56	3	11	159	Gd-159	3	109	233	Pa-233*	5	117
57	Co-57	1	83	166	Ho-166	2	67	234	Th-234	5	127
57	Ni-57	1	91	166	Ho-166m	2	75	234	U-234	3	147
59	Fe-59	1	99	169	Yb-169	2	87	235	U-235	5	133
60	Co-60	3	23	170	Tm-170	2	99	236	U-236	4	177
63	Ni-63	3	29	177	Lu-177	2	107	236	Np-236	3	155
64	Cu-64	1	105	186	Re-186	2	113	236	Np-236m	3	163
65	Zn-65	3	33	198	Au-198	2	121	237	U-237	3	169
66	Ga-66	1	113	201	Tl-201	2	129	237	U-237*	5	145
67	Ga-67	1	133	203	Hg-203	2	135	237	Np-237	4	183
75	Se-75	5	13	203	Pb-203	3	115	238	U-238	3	177
79	Se-79	3	39	204	Tl-204	2	141	238	Np-238	4	195
85	Kr-85	1	141	206	Tl-206	4	39	238	Pu-238	2	235
85	Sr-85	1	147	207	Bi-207	5	33	238	Pu-238*	5	153
88	Y-88	1	153	208	Tl-208	2	147	239	U-239	4	205
89	Sr-89	1	161	210	Tl-210	4	45	239	Np-239	4	221
90	Sr-90	3	43	210	Pb-210	4	51	239	Pu-239	4	231
90	Y-90	3	47	210	Bi-210	4	59	240	Pu-240	2	247
90	Y-90m	3	53	210	Po-210	4	65	240	Pu-240*	5	165
93	Nb-93m	1	167	211	Bi-211	5	41	241	Pu-241	4	259
99	Mo-99	1	173	212	Pb-212	2	167	241	Am-241	2	257
99	Tc-99m	1	183	212	Bi-212	2	155	241	Am-241*	5	175
108	Ag-108	3	59	212	Po-212	2	173	242	Pu-242	2	277
108	Ag-108m	3	67	213	Po-213	4	71	242	Pu-242*	5	197
109	Cd-109	1	191	214	Pb-214	4	75	242	Am-242	5	203
110	Ag-110	1	199	214	Bi-214	4	83	242	Cm-242	3	185
110	Ag-110m	1	207	214	Po-214	4	111	243	Am-243	3	195
111	In-111	3	75	216	Po-216	2	177	243	Am-243*	5	209
123	Te-123m	1	229	217	At-217	5	47	244	Am-244	5	217
123	I-123	1	219	217	Rn-217	4	117	244	Am-244m	5	223
124	Sb-124	5	21	218	Po-218	4	121	244	Cm-244	3	203
125	Sb-125	1	235	218	At-218	4	125	246	Cm-246	4	269
125	Sb-125*	3	81	218	Rn-218	4	129	252	Cf-252	4	277

* : updated evaluations

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

* : updated evaluations

$^{22}_{11}\mathrm{Na}_{11}$

1 Decay Scheme

Na-22 disintegrates predominantly to the 1275 keV level of Ne-22 by beta plus emission and electron capture. A very small fraction (0,056 %) disintegrates to the ground state of Ne-22.
Le sodium 22 se désintègre essentiellement vers le niveau de 1275 keV de néon 22 par émission bêta plus et capture électronique. Une faible proportion (0,056 %) se désintègre vers le niveau fondamental.

2 Nuclear Data

$T_{1/2}(^{22}\mathrm{Na})$	:	2,6029	(8)	a
$Q^+(^{22}\mathrm{Na})$	:	2843,02	(21)	keV

2.1 Electron Capture Transitions

	Energy keV	Probability × 100	Nature	lg ft	P_K	P_L
$\epsilon_{0,1}$	1568,44 (21)	9,64 (9)	Allowed	7,41	0,923 (4)	0,077 (4)
$\epsilon_{0,0}$	2843,02 (21)	0,00098 (25)	Unique 2nd Forbidden	14,91		

2.2 β^+ Transitions

	Energy keV	Probability × 100	Nature	lg ft
$\beta^+_{0,1}$	546,44 (21)	90,30 (9)	Allowed	7,4
$\beta^+_{0,0}$	1821,02 (21)	0,055 (14)	Unique 2nd Forbidden	14,9

2.3 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K (10^{-6})	α_T (10^{-6})	α_π (10^{-5})
$\gamma_{1,0}$(Ne)	1274,577 (7)	99,94 (13)	E2	6,36 (9)	6,71 (9)	2,34 (3)

3 Atomic Data

3.1 Ne

ω_K	:	0,0152	(8)
$\bar{\omega}_L$	:	0,0001	(1)
n_{KL}	:	1,985	(6)

3.1.1 X Radiations

		Energy keV	Relative probability
X_K			
	$K\alpha_2$	0,8486	50,28
	$K\alpha_1$	0,8486	100

3.1.2 Auger Electrons

	Energy keV	Relative probability
Auger K		
KLL	0,75 – 0,81	

4 Electron Emissions

		Energy keV		Electrons per 100 disint.
e_{AK}	(Ne)			8,8 (1)
	KLL	0,75 - 0,81	}	
$ec_{1,0\ \alpha}$	(Ne)	252		0,002339 (30)
$\beta^+_{0,0}$	max:	1821,02	(21)	0,055 (14)
$\beta^+_{0,0}$	avg:	835,04	(19)	
$\beta^+_{0,1}$	max:	546,44	(21)	90,30 (9)
$\beta^+_{0,1}$	avg:	215,62	(17)	

5 Photon Emissions

5.1 X-Ray Emissions

		Energy keV	Photons per 100 disint.	
$XK\alpha_2$	(Ne)	0,8486	0,0453 (25)	} $K\alpha$
$XK\alpha_1$	(Ne)	0,8486	0,090 (5)	}

5.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma^{\pm}$	511	180,7 (2)
$\gamma_{1,0}$(Ne)	1274,537 (7)	99,94 (13)

6 Main Production Modes

F – 19(α,n)Na – 22
Mg – 24(d,α)Na – 22

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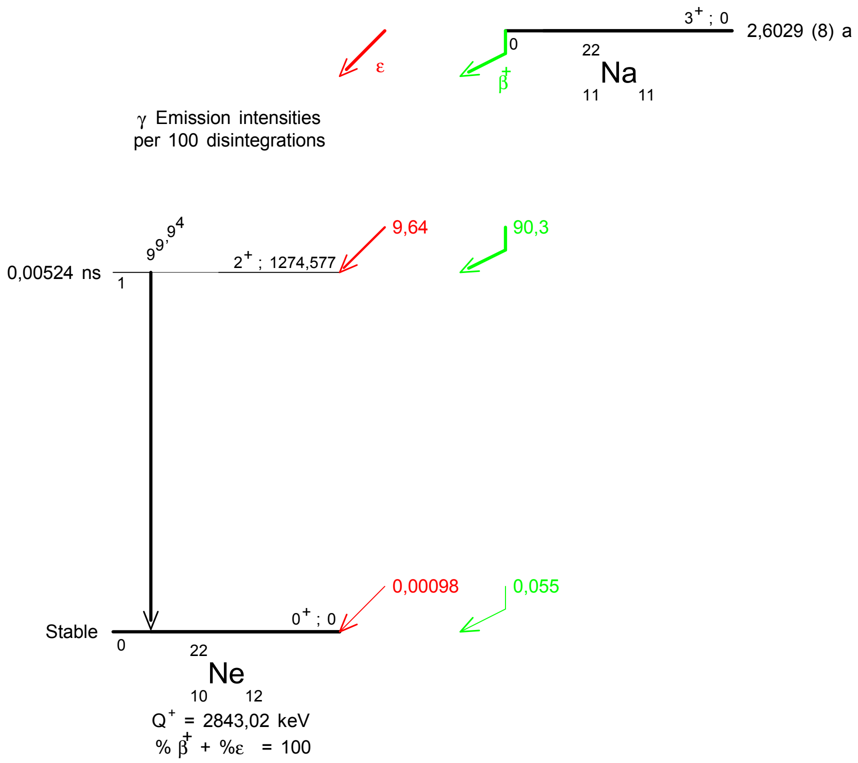
3+ ; 0
2,6029 (8) a
0
22
Na
11 11
ε
β+
γ Emission intensities
per 100 disintegrations
9,64
90,3
99,94
2+ ; 1274,577
0,00524 ns
1
0,00098
0,055
0+ ; 0
Stable
0
22
Ne
10 12
Q+ = 2843,02 keV
% β+ + %ε = 100

$$^{40}_{19}\mathrm{K}_{21}$$

1 Decay Scheme

K-40 is a natural isotope with an isotopic abundance of 0.0117 (1) %. It disintegrates by beta minus emission to the Ca-40 fundamental level for 89.25 (17) %, by electron capture to the 1460 keV level of Ar-40 for 10.55 (11) %, to the ground state level of Ar-40 for 0.2 (1) % and by beta plus for 0.00100 (12) %.
Le potassium 40 est un isotope naturel dont l'abondance est de 0,0117 (1)%. Il se désintègre pour 89,25 (17) % par émission bêta moins vers le niveau fondamental du calcium 40, par capture électronique vers l'argon 40, pour 10,55 (11) % vers le niveau de 1460 keV et pour 0,2 (1) % vers le niveau fondamental.

2 Nuclear Data

$T_{1/2}(^{40}\mathrm{K})$	:	1,2504	(30)	10^9 a
$Q^+(^{40}\mathrm{K})$	:	1504,69	(19)	keV
$Q^-(^{40}\mathrm{K})$	:	1311,07	(11)	keV

2.1 β^- Transitions

	Energy keV	Probability × 100	Nature	lg ft
$\beta^-_{0,0}$	1311,07 (11)	89,25 (17)	Unique 3rd Forbidden	20,58

2.2 β^+ Transitions

	Energy keV	Probability × 100	Nature	lg ft
$\beta^+_{0,0}$	482,9 (3)	0,00100 (12)	Unique 3rd Forbidden	21,35

2.3 Electron Capture Transitions

	Energy keV	Probability × 100	Nature	lg ft	P_K	P_L	P_M
$\epsilon_{0,1}$	44,0 (3)	10,55 (11)	Unique 1st Forbidden	11,55	0,763	0,209	0,027
$\epsilon_{0,0}$	1311,07 (11)	0,2 (1)	Unique 3rd Forbidden	21,35	0,88	0,086	0,013

2.4 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K (10^{-5})	α_L (10^{-6})	α_M (10^{-7})	α_T (10^{-5})	α_π (10^{-5})
$\gamma_{1,0}$(Ar)	1460,822 (6)	10,55 (11)	E2	2,63 (4)	2,15 (3)	2,10 (3)	10,28 (15)	7,3 (5)

3 Atomic Data

3.1 Ar

ω_K : 0,1199 (28)
$\bar{\omega}_L$: 0,00147 (30)
n_{KL} : 1,697 (6)

3.1.1 X Radiations

		Energy keV		Relative probability
X_K				
	$K\alpha_2$	2,95566		50,49
	$K\alpha_1$	2,95774		100
	$K\beta_1$	3,1905	}	
	$K\beta_5''$		}	16,24
X_L				
	$L\ell$	0,2195		
	$L\eta$	0,2215		
	$L\beta$	0,3112 – 0,3114		

3.1.2 Auger Electrons

	Energy keV	Relative probability
Auger K		
KLL	2,511 – 2,669	100
KLX	2,831 – 2,942	21,6
KXY	3,149 – 3,174	1,16
Auger L	0,17 – 0,31	

4 Electron Emissions

		Energy keV				Electrons per 100 disint.
e_{AL}	(Ar)	0,17	-	0,31		2,22 (2)
e_{AK}	(Ar)					7,24 (11)
	KLL	2,511	-	2,669	}	
	KLX	2,831	-	2,942	}	
	KXY	3,149	-	3,174	}	
$ec_{1,0\ T}$	(Ar)	1457,645	-	1460,835		0,001085 (19)
$\beta^+_{0,0}$	max:	482,9		(3)		0,00100 (12)
$\beta^+_{0,0}$	avg:					
$\beta^-_{0,0}$	max:	1311,07		(11)		89,25 (17)
$\beta^-_{0,0}$	avg:	508,32		(6)		

5 Photon Emissions

5.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(Ar)	0,2195 — 0,3114		0,003 (1)	
XKα_2	(Ar)	2,95566		0,299 (9)	} Kα
XKα_1	(Ar)	2,95774		0,592 (17)	}
XKβ_1	(Ar)	3,1905	}	0,096 (4)	K$'\beta_1$

5.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma^{\pm}$	511	0,00200 (24)
$\gamma_{1,0}$(Ar)	1460,822 (6)	10,55 (11)

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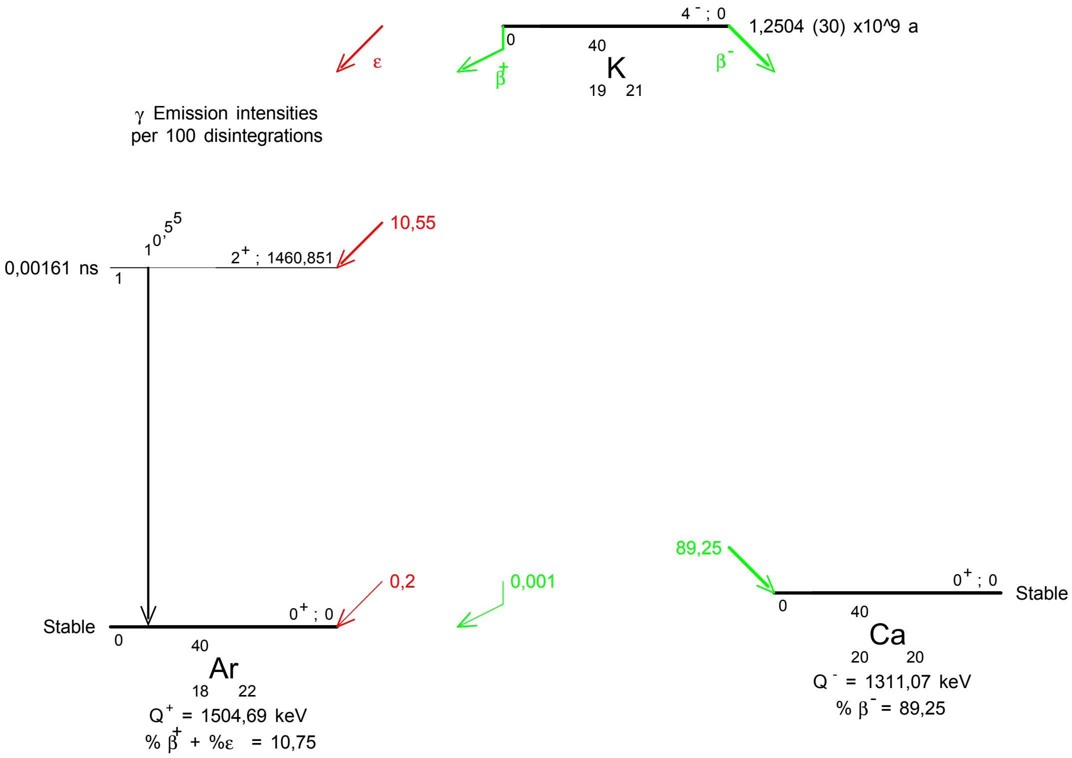
4 - ; 0
1,2504 (30) x10^9 a
ε
β+
β-
0
40
K
19 21
γ Emission intensities
per 100 disintegrations
10,55
2+ ; 1460,851
0,00161 ns
Stable
0+ ; 0
0,2
0,001
89,25
0+ ; 0
Stable
40
Ar
18 22
Q+ = 1504,69 keV
% β+ + %ε = 10,75
40
Ca
20 20
Q- = 1311,07 keV
% β- = 89,25

$^{75}_{34}\mathrm{Se}_{41}$

1 Decay Scheme

Se-75 disintegrates 100% by electron capture to excited levels and to the ground state of As-75.
Le sélénium 75 se désintègre à 100% par capture électronique vers des niveaux excités et le niveau fondamental de l'arsenic 75.

2 Nuclear Data

$T_{1/2}(^{75}\mathrm{Se})$	:	119,781	(24)	d
$Q^{+}(^{75}\mathrm{Se})$	:	863,6	(8)	keV

2.1 Electron Capture Transitions

	Energy keV	Probability × 100	Nature	lg ft	P_K	P_L	P_M
$\epsilon_{0,9}$	42,0 (8)	0,00734 (18)	1st Forbidden	7,9	0,8038 (32)	0,1633 (26)	0,0300 (8)
$\epsilon_{0,8}$	245,9 (8)	0,0126 (6)	1st Forbidden	8,8	0,8724 (16)	0,1071 (13)	0,0186 (4)
$\epsilon_{0,7}$	291,4 (8)	0,03484 (35)	1st Forbidden	9,1	0,8740 (16)	0,1058 (13)	0,0184 (4)
$\epsilon_{0,6}$	395,0 (8)	0,00036 (5)	1st Forbidden	11,1	0,8762 (16)	0,1041 (13)	0,0180 (4)
$\epsilon_{0,5}$	462,9 (8)	94,5 (21)	Allowed	6,1	0,8770 (16)	0,1033 (13)	0,0179 (4)
$\epsilon_{0,3}$	584,1 (8)	2,1 (14)	1st Forbidden	8	0,8781 (15)	0,1025 (13)	0,0177 (4)
$\epsilon_{0,2}$	598,9 (8)	1,3 (21)	1st Forbidden	8,2	0,8782 (15)	0,1024 (13)	0,0177 (4)
$\epsilon_{0,0}$	863,6 (8)	1,42 (22)	1st Forbidden	8,5	0,8794 (15)	0,1014 (12)	0,0175 (4)

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{3,2}$(As)	14,8847 (13)	0,0206 (6)	M1 (+E2)				
$\gamma_{4,3}$(As)	24,3815 (14)	5,5 (13)	M2	165,4 (25)	32,6 (5)	5,13 (10)	204 (3)
$\gamma_{2,1}$(As)	66,0518 (8)	1,400 (42)	M1+ 1,44% E2	0,29 (3)	0,034 (5)	0,0052 (7)	0,33 (3)

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{3,1}$(As)	80,9365 (15)	0,0259 (15)	[E2]	1,486 (21)	0,216 (3)	0,0326 (5)	1,736 (25)
$\gamma_{5,4}$(As)	96,7340 (9)	6,35 (14)	E2	0,772 (11)	0,1044 (15)	0,01576 (22)	0,893 (13)
$\gamma_{5,3}$(As)	121,1155 (11)	17,56 (37)	E1	0,0372 (6)	0,00388 (6)	0,000588 (9)	0,0417 (6)
$\gamma_{5,2}$(As)	136,0001 (6)	59,2 (21)	E1	0,0263 (4)	0,00274 (4)	0,000415 (6)	0,0295 (5)
$\gamma_{1,0}$(As)	198,6060 (12)	1,48 (6)	M1+ 9,03% E2	0,0167 (9)	0,00182 (11)	0,000277 (16)	0,0189 (11)
$\gamma_{9,7}$(As)	249,3 (3)	0,00400 (13)	[M1,E2]	0,015 (9)	0,0017 (10)	0,00026 (15)	0,017 (10)
$\gamma_{2,0}$(As)	264,6576 (9)	59,17 (19)	M1 + 0,89% E2	0,00646 (25)	0,00068 (3)	0,000104 (5)	0,0072 (3)
$\gamma_{3,0}$(As)	279,5422 (10)	25,11 (9)	M1 + 25,04 % E2	0,0081 (4)	0,00087 (4)	0,000133 (6)	0,0091 (4)
$\gamma_{4,0}$(As)	303,9236 (10)	1,379 (5)	E3	0,0469 (7)	0,00592 (9)	0,000899 (13)	0,0538 (8)
$\gamma_{7,1}$(As)	373,61 (24)	0,00258 (11)	[E2]	0,00580 (9)	0,000628 (9)	0,0000954 (14)	0,00653 (10)
$\gamma_{5,0}$(As)	400,6572 (8)	11,403 (43)	E1	0,001202 (17)	0,0001241 (18)	0,0000189 (3)	0,001346 (19)
$\gamma_{8,1}$(As)	419,1 (4)	0,0121 (6)	[M1,E2]	0,003 (1)	0,00032 (11)	0,000049 (16)	0,0034 (11)
$\gamma_{6,0}$(As)	468,6 (4)	0,00036 (5)	[M1,E2]	0,0022 (6)	0,00023 (7)	0,000035 (10)	0,0025 (7)
$\gamma_{9,3}$(As)	542,02 (18)	0,000435 (6)	[M1,E2]	0,0015 (3)	0,00015 (4)	0,000023 (6)	0,0016 (4)
$\gamma_{9,2}$(As)	556,90 (18)	0,00277 (12)	[E2]	0,001628 (25)	0,000172 (3)	0,0000262 (4)	0,00183 (3)
$\gamma_{7,0}$(As)	572,22 (24)	0,03626 (31)	M1 + 3,48 % E2	0,001040 (15)	0,0001079 (16)	0,00001646 (24)	0,001165 (17)
$\gamma_{8,0}$(As)	617,8 (4)	0,00453 (5)	[M1,E2]	0,00103 (18)	0,000108 (20)	0,000017 (3)	0,00116 (20)
$\gamma_{9,0}$(As)	821,56 (18)	0,000134 (8)	[E2]	0,000558 (8)	0,0000582 (9)	0,00000887 (13)	0,000626 (9)

3 Atomic Data

3.1 As

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

3.1.1 X Radiations

		Energy keV		Relative probability
X_K				
	$K\alpha_2$	10,50814		51,53
	$K\alpha_1$	10,5438		100
	$K\beta_3$	11,7204	}	
	$K\beta_1$	11,7263	}	
	$K\beta_5''$	11,821	}	22,87
	$K\beta_2$	11,8643	}	
	$K\beta_4$		}	0,86
X_L				
	$L\ell$	1,1195		
	$L\alpha$	1,2816 – 1,2824		
	$L\eta$	1,1552		
	$L\beta$	1,3152 – 1,4892		
	$L\gamma$	1,3508 – 1,5312		

3.1.2 Auger Electrons

	Energy keV	Relative probability
Auger K		
KLL	8,75 – 9,10	100
KLX	10,12 – 10,54	31
KXY	11,44 – 11,80	2,4
Auger L	1,1 – 1,3	

4 Electron Emissions

		Energy keV			Electrons per 100 disint.
e_{AL}	(As)	1,1	-	1,3	119,6 (15)
e_{AK}	(As)				41,4 (14)
	KLL	8,75	-	9,10	}
	KLX	10,12	-	10,54	}
	KXY	11,44	-	11,80	}
$ec_{4,3\ K}$	(As)	12,5148		(14)	4,5 (12)
$ec_{4,3\ L}$	(As)	22,8550	-	23,0584	0,88 (20)
$ec_{4,3\ M}$	(As)	24,1780	-	24,3403	0,139 (31)
$ec_{2,1\ K}$	(As)	54,1851		(8)	0,305 (32)
$ec_{5,4\ K}$	(As)	84,8673		(9)	2,59 (7)
$ec_{5,4\ L}$	(As)	95,208	-	95,411	0,350 (9)
$ec_{5,4\ M}$	(As)	96,530	-	96,693	0,0528 (13)
$ec_{5,3\ K}$	(As)	109,2488		(11)	0,627 (17)
$ec_{5,3\ L}$	(As)	119,5890	-	119,7924	0,0654 (17)
$ec_{5,2\ K}$	(As)	124,1334		(6)	1,51 (6)
$ec_{5,2\ L}$	(As)	134,4736	-	134,6770	0,158 (6)
$ec_{2,0\ K}$	(As)	252,7909		(9)	0,378 (15)
$ec_{3,0\ K}$	(As)	267,676		(1)	0,202 (10)
$ec_{4,0\ K}$	(As)	292,057		(1)	0,0614 (9)

5 Photon Emissions

5.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(As)	1,1195 — 1,5312		1,93 (5)	
$XK\alpha_2$	(As)	10,50814		16,5 (6)	} $K\alpha$
$XK\alpha_1$	(As)	10,5438		31,9 (11)	}
$XK\beta_3$	(As)	11,7204	}		
$XK\beta_1$	(As)	11,7263	}	7,30 (25)	$K'\beta_1$
$XK\beta_5''$	(As)	11,821	}		
$XK\beta_2$	(As)	11,8643	}		
$XK\beta_4$	(As)		}	0,276 (13)	$K'\beta_2$

5.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{3,2}$(As)	14,8847 (13)	0,0206 (6)
$\gamma_{4,3}$(As)	24,3815 (14)	0,027 (6)
$\gamma_{2,1}$(As)	66,0518 (8)	1,053 (20)
$\gamma_{3,1}$(As)	80,9365 (15)	0,0095 (5)
$\gamma_{5,4}$(As)	96,7340 (9)	3,35 (7)
$\gamma_{5,3}$(As)	121,1155 (11)	16,86 (36)
$\gamma_{5,2}$(As)	136,0001 (6)	57,7 (20)
$\gamma_{1,0}$(As)	198,6060 (12)	1,46 (6)
$\gamma_{9,7}$(As)	249,3 (3)	0,00394 (12)
$\gamma_{2,0}$(As)	264,6576 (9)	58,75 (19)
$\gamma_{3,0}$(As)	279,5422 (10)	24,89 (9)
$\gamma_{4,0}$(As)	303,9236 (10)	1,3082 (50)
$\gamma_{7,1}$(As)	373,61 (24)	0,00256 (11)
$\gamma_{5,0}$(As)	400,6572 (8)	11,388 (42)
$\gamma_{8,1}$(As)	419,1 (4)	0,0121 (6)
$\gamma_{6,0}$(As)	468,6 (4)	0,00036 (5)
$\gamma_{9,3}$(As)	542,02 (18)	0,000435 (6)
$\gamma_{9,2}$(As)	557,8 (9)	0,00276 (12)
$\gamma_{7,0}$(As)	572,22 (24)	0,03622 (31)
$\gamma_{8,0}$(As)	617,8 (4)	0,00453 (5)
$\gamma_{9,0}$(As)	821,56 (18)	0,000134 (8)

6 Main Production Modes

Se – 74(n,γ)Se – 75
As – 75(d,2n)Se – 75
As – 75(p,n)Se – 75

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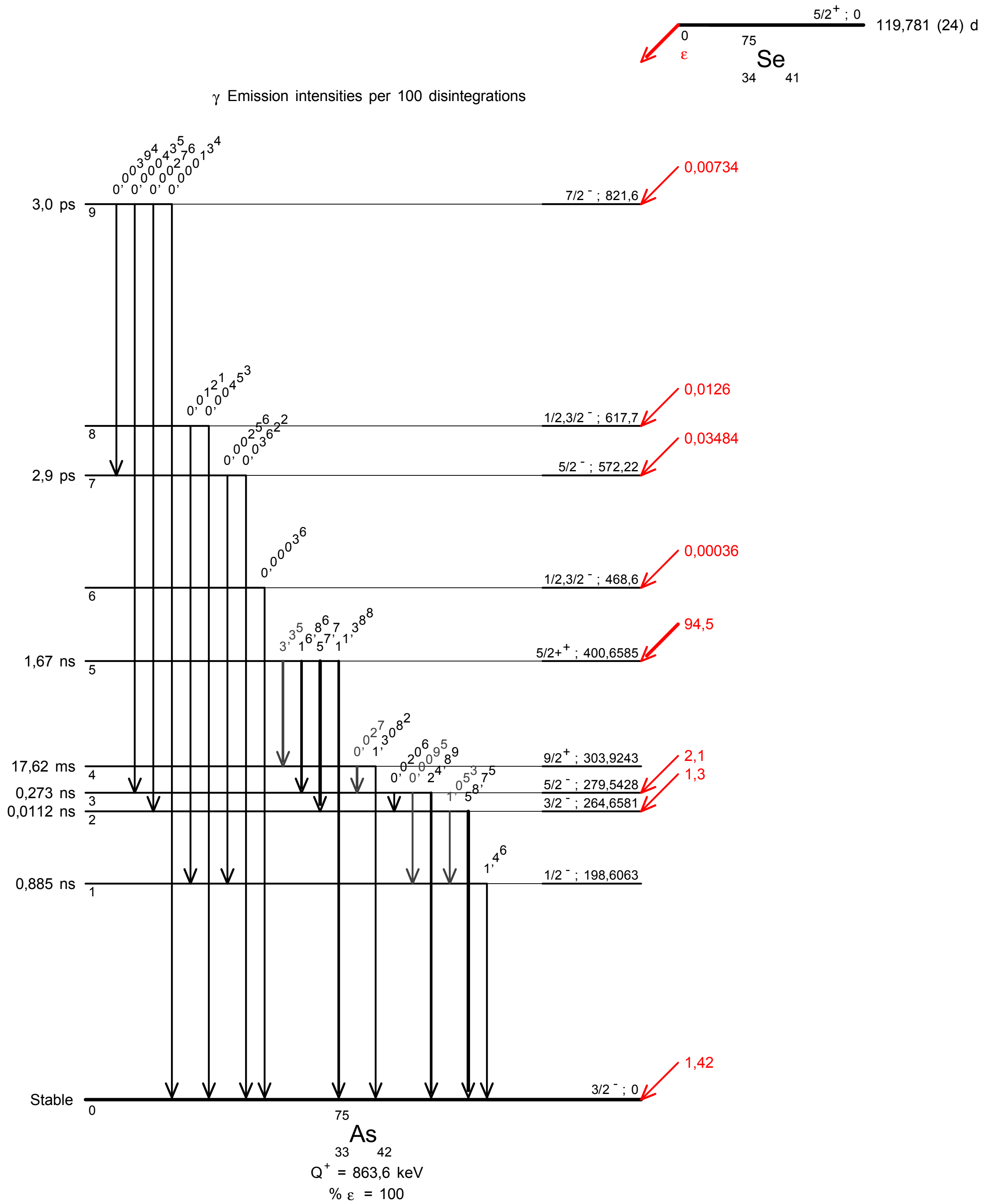

5/2+ ; 0
119,781 (24) d
0
ε
75 Se 34 41
γ Emission intensities per 100 disintegrations
3,0 ps
9
7/2 - ; 821,6
0,00734
8
1/2,3/2 - ; 617,7
0,0126
2,9 ps
7
5/2 - ; 572,22
0,03484
6
1/2,3/2 - ; 468,6
0,00036
1,67 ns
5
5/2+ + ; 400,6585
94,5
17,62 ms
4
9/2 + ; 303,9243
2,1
0,273 ns
3
5/2 - ; 279,5428
1,3
0,0112 ns
2
3/2 - ; 264,6581
0,885 ns
1
1/2 - ; 198,6063
Stable
0
3/2 - ; 0
1,42
75 As 33 42
Q+ = 863,6 keV
% ε = 100

$^{124}_{51}\mathrm{Sb}_{73}$

1 Decay Scheme

L'antimoine 124 se désintègre par émission bêta moins vers des niveaux excités du tellure 124.
Sb-124 disintegrates by beta minus emissions to excited levels in Te-124.

2 Nuclear Data

$T_{1/2}(^{124}\mathrm{Sb})$	:	60,208	(11)	d
$Q^{-}(^{124}\mathrm{Sb})$	:	2904,3	(15)	keV

2.1 β^- Transitions

	Energy keV	Probability × 100	Nature	lg ft
$\beta^-_{0,27}$	17,9 (15)	0,0059 (5)	Allowed	6,9
$\beta^-_{0,26}$	38,6 (15)	0,054 (9)	Allowed	6,9
$\beta^-_{0,25}$	89,7 (15)	0,0207 (12)		8,4
$\beta^-_{0,24}$	96,8 (15)	0,0012 (5)	1st Forbidden	9,8
$\beta^-_{0,23}$	129,2 (15)	0,653 (6)		7,5
$\beta^-_{0,22}$	193,3 (15)	0,106 (6)	1st Forbidden	8,8
$\beta^-_{0,21}$	202,7 (15)	0,571 (25)	Allowed	8
$\beta^-_{0,20}$	210,6 (15)	8,663 (27)	Allowed	7
$\beta^-_{0,19}$	221,8 (15)	0,0242 (22)	1st Forbidden	9,6
$\beta^-_{0,18}$	285,2 (15)	0,0098 (8)		10,4
$\beta^-_{0,17}$	354,6 (15)	0,0364 (22)		10
$\beta^-_{0,16}$	382,8 (15)	0,0529 (5)	1st Forbidden	10
$\beta^-_{0,15}$	392,3 (15)	0,0422 (19)	1st Forbidden	10,2
$\beta^-_{0,14}$	421,0 (15)	0,332 (10)	1st Forbidden	9,4
$\beta^-_{0,13}$	449,3 (15)	0,0050 (26)	1st Forbidden	11,3
$\beta^-_{0,11}$	580,9 (15)	0,0686 (14)	1st Forbidden	10,5
$\beta^-_{0,10}$	610,6 (15)	51,21 (19)	Allowed	7,7
$\beta^-_{0,9}$	679,5 (15)	0,0967 (34)	1st Forbidden	10,6

	Energy keV	Probability × 100	Nature	lg ft
$\beta^-_{0,8}$	721,9 (15)	0,47 (30)	1st Forbidden	10
$\beta^-_{0,7}$	812,6 (15)	0,688 (38)	1st Forbidden	10
$\beta^-_{0,6}$	865,0 (15)	4,143 (18)		9,4
$\beta^-_{0,5}$	946,4 (15)	2,295 (7)	1st Forbidden	9,8
$\beta^-_{0,4}$	1247,7 (15)	0,0053 (10)	3rd Forbidden	12,8
$\beta^-_{0,3}$	1578,8 (15)	4,815 (29)	1st Forbidden	10,3
$\beta^-_{0,2}$	1655,7 (15)	2,472 (33)	1st Forbidden	10,7
$\beta^-_{0,1}$	2301,6 (15)	23,44 (28)	1st Forbidden	10,3

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{14,12}$(Te)	148,02 (5)	0,0037 (6)	E1+M2				
$\gamma_{(-1,1)}$(Te)	159,867 (35)	0,0049 (6)					
$\gamma_{14,10}$(Te)	189,565 (18)	0,0043 (5)					
$\gamma_{20,14}$(Te)	210,402 (19)	0,0053 (7)					
$\gamma_{10,6}$(Te)	254,424 (6)	0,0144 (9)	(E1)	0,01269 (18)	0,001575 (22)	0,000312 (5)	0,01465 (21)
$\gamma_{23,14}$(Te)	291,793 (25)	0,0069 (7)					
$\gamma_{10,5}$(Te)	335,797 (16)	0,073 (1)	E1	0,00612 (9)	0,000754 (11)	0,0001495 (21)	0,00706 (10)
$\gamma_{20,11}$(Te)	370,269 (30)	0,0286 (11)					
$\gamma_{20,10}$(Te)	399,967 (6)	0,1284 (31)	E2	0,01323 (19)	0,00196 (3)	0,000394 (6)	0,01566 (22)
$\gamma_{14,6}$(Te)	443,989 (18)	0,197 (16)	M1+26%E2	0,01092 (16)	0,001360 (19)	0,000271 (4)	0,01261 (18)
$\gamma_{20,9}$(Te)	468,840 (25)	0,0460 (26)	E1	0,00268 (4)	0,000327 (5)	0,0000648 (9)	0,00309 (5)
$\gamma_{23,10}$(Te)	481,36 (2)	0,0232 (31)					
$\gamma_{14,5}$(Te)	525,362 (24)	0,1462 (35)	M1+50%E2	0,0066 (3)	0,000867 (18)	0,000173 (4)	0,0077 (3)
$\gamma_{26,12}$(Te)	530,46 (7)	0,036 (9)					
$\gamma_{26,10}$(Te)	572,01 (5)	0,0176 (8)					
$\gamma_{1,0}$(Te)	602,7278 (21)	98,254 (21)	E2	0,00420 (6)	0,000566 (8)	0,0001132 (16)	0,00490 (7)
$\gamma_{5,3}$(Te)	632,403 (16)	0,1029 (21)					
$\gamma_{2,1}$(Te)	645,8542 (37)	7,452 (15)	E2+0,004%M3	0,00351 (5)	0,000468 (7)	0,0000935 (14)	0,00409 (6)
$\gamma_{21,6}$(Te)	662,334 (10)	0,024 (11)					
$\gamma_{5,2}$(Te)	709,333 (16)	1,368 (5)	M1+3%E2	0,00349 (5)	0,000429 (7)	0,0000853 (13)	0,00402 (6)
$\gamma_{6,3}$(Te)	713,776 (5)	2,281 (7)	M1+50%E2	0,0031 (4)	0,00039 (4)	0,000078 (7)	0,0036 (4)
$\gamma_{3,1}$(Te)	722,7842 (37)	10,742 (22)	M1+92%E2	0,00271 (4)	0,000352 (5)	0,0000702 (10)	0,00314 (5)
$\gamma_{23,6}$(Te)	735,782 (17)	0,1312 (16)					
$\gamma_{7,3}$(Te)	766,168 (21)	0,0105 (9)	E0,M1	0,019 (6)			0,021 (7)
$\gamma_{25,6}$(Te)	775,27 (7)	0,0098 (4)					
$\gamma_{6,2}$(Te)	790,706 (5)	0,7433 (24)	E2	0,00214 (6)	0,000276 (8)	0,000055 (2)	0,00248 (8)
$\gamma_{23,5}$(Te)	817,155 (23)	0,0744 (12)					
$\gamma_{8,3}$(Te)	856,878 (30)	0,0227 (5)					
$\gamma_{9,3}$(Te)	899,327 (25)	0,0179 (7)					
$\gamma_{10,3}$(Te)	968,200 (5)	1,888 (10)	E1+4%M2	0,000569 (9)	0,0000678 (11)	0,00001343 (22)	0,000653 (11)
$\gamma_{9,2}$(Te)	976,257 (25)	0,0832 (7)					
$\gamma_{(-1,2)}$(Te)	997,80 (3)	0,0033 (23)					
$\gamma_{10,2}$(Te)	1045,130 (5)	1,853 (14)	E1+0,09%M2	0,000494 (9)	0,0000587 (11)	0,00001163 (21)	0,000567 (10)
$\gamma_{4,1}$(Te)	1053,87 (30)	0,0053 (10)	E2	0,001117 (16)	0,0001394 (20)	0,0000277 (4)	0,001290 (18)
$\gamma_{12,2}$(Te)	1086,68 (5)	0,0367 (9)	E1	0,000457 (7)	0,0000543 (8)	0,00001074 (15)	0,000524 (8)
$\gamma_{(-1,3)}$(Te)	1235 (1)	0,0073 (26)					
$\gamma_{15,2}$(Te)	1263,46 (7)	0,0422 (19)					
$\gamma_{17,2}$(Te)	1301,15 (9)	0,0364 (22)					
$\gamma_{3,0}$(Te)	1325,512 (3)	1,588 (7)	E2	0,000693 (10)	0,0000848 (12)	0,00001685 (24)	0,000827 (12)
$\gamma_{5,1}$(Te)	1355,187 (16)	1,0423 (38)	E2+9,3%M3	0,0009 (5)	0,00011 (6)	0,000023 (11)	0,0011 (5)

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{20,3}$(Te)	1368,167 (6)	2,621 (8)	E1+0,04%M2	0,000303 (5)	0,0000358 (6)	0,00000709 (10)	0,000478 (7)
$\gamma_{21,3}$(Te)	1376,110 (9)	0,5001 (43)	E1+0,01%M2	0,000300 (5)	0,0000354 (6)	0,00000701 (12)	0,000479 (7)
$\gamma_{22,3}$(Te)	1385,500 (21)	0,062 (6)					
$\gamma_{6,1}$(Te)	1436,5602 (45)	1,235 (8)	M1+69%E2	0,00063 (5)	0,000076 (6)	0,0000151 (11)	0,00078 (5)
$\gamma_{20,2}$(Te)	1445,097 (6)	0,334 (7)	E1+M2	0,00029 (4)	0,000034 (4)	0,0000067 (8)	0,00052 (4)
$\gamma_{7,1}$(Te)	1488,952 (21)	0,6776 (37)	M1+1%E2	0,000659 (14)	0,0000792 (16)	0,0000157 (3)	0,000829 (16)
$\gamma_{23,2}$(Te)	1526,488 (17)	0,414 (5)	E1	0,000252 (4)	0,0000296 (5)	0,00000586 (9)	0,000535 (8)
$\gamma_{25,2}$(Te)	1565,98 (7)	0,0109 (12)					
$\gamma_{8,1}$(Te)	1579,662 (30)	0,412 (5)	M1+E2	0,00054 (5)	0,000065 (6)	0,0000128 (11)	0,00072 (5)
$\gamma_{9,1}$(Te)	1622,111 (25)	0,0416 (19)	E2	0,000467 (7)	0,0000564 (8)	0,00001118 (16)	0,000664 (10)
$\gamma_{4,0}$(Te)	1656,6 (3)		E0				
$\gamma_{10,1}$(Te)	1690,9842 (45)	47,49 (19)	E1+0,01%M2	0,000213 (4)	0,0000250 (4)	0,00000494 (8)	0,000615 (9)
$\gamma_{11,1}$(Te)	1720,682 (30)	0,0947 (6)	M1+E2	0,00045 (4)	0,000054 (4)	0,0000107 (8)	0,00068 (4)
$\gamma_{13,1}$(Te)	1852,23 (7)	0,0030 (9)	M1+E2	0,00039 (3)	0,000047 (4)	0,0000093 (7)	0,00067 (3)
$\gamma_{16,1}$(Te)	1918,75 (6)	0,0529 (5)	M1(+E2)	0,000364 (24)	0,000043 (3)	0,0000086 (6)	0,00067 (3)
$\gamma_{18,1}$(Te)	2016,36 (6)	0,0098 (8)					
$\gamma_{6,0}$(Te)	2039,288 (4)	0,0631 (5)	E2	0,000305 (5)	0,0000364 (5)	0,00000721 (10)	0,000667 (10)
$\gamma_{19,1}$(Te)	2079,77 (13)	0,0224 (22)	M1+E2	0,000311 (18)	0,0000371 (21)	0,0000073 (4)	0,000691 (20)
$\gamma_{20,1}$(Te)	2090,951 (5)	5,498 (24)	E1+0,1%M2	0,0001522 (23)	0,0000178 (3)	0,00000352 (6)	0,000838 (12)
$\gamma_{21,1}$(Te)	2098,894 (9)	0,0471 (33)					
$\gamma_{22,1}$(Te)	2108,284 (21)	0,0444 (23)					
$\gamma_{23,1}$(Te)	2172,342 (17)	0,0029 (16)					
$\gamma_{8,0}$(Te)	2182,39 (3)	0,04147 (31)					
$\gamma_{27,1}$(Te)	2283,64 (6)	0,0059 (5)	E1+M2	0,00033 (21)	0,000040 (25)	0,000008 (5)	0,00091 (5)
$\gamma_{10,0}$(Te)	2293,712 (4)	0,0327 (41)					
$\gamma_{11,0}$(Te)	2323,41 (3)	0,0025 (6)					
$\gamma_{13,0}$(Te)	2454,96 (7)	0,00160 (12)	E2	0,000219 (3)	0,0000259 (4)	0,00000513 (8)	0,000768 (11)
$\gamma_{19,0}$(Te)	2682,50 (15)	0,00176 (6)					
$\gamma_{20,0}$(Te)	2693,679 (10)	0,0032 (14)					
$\gamma_{24,0}$(Te)	2807,55 (24)	0,0012 (5)	E2	0,0001730 (25)	0,0000204 (3)	0,00000404 (6)	0,000878 (13)

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
	$K\alpha_1$	27,4726		100
	$K\beta_3$	30,9446	}	
	$K\beta_1$	30,996	}	
	$K\beta_5''$	31,236	}	28,6

		Energy keV		Relative probability
	$K\beta_2$	31,7008	}	
	$K\beta_4$	31,774	}	6,2
	$KO_{2,3}$	31,812	}	
X_L				
	$L\ell$	3,3348		
	$L\alpha$	3,7595 – 3,7697		
	$L\eta$	3,6052		
	$L\beta$	4,0299 – 4,3661		
	$L\gamma$	4,4448 – 4,8228		

3.1.2 Auger Electrons

	Energy keV	Relative probability
Auger K		
KLL	21,804 – 22,989	100
KLX	25,814 – 27,470	45,3
KXY	29,80 – 31,81	5,13
Auger L	2,3 – 4,9	

4 Electron Emissions

		Energy keV			Electrons per 100 disint.
e_{AL}	(Te)	2,3 - 4,9			0,4829 (26)
e_{AK}	(Te)				0,0628 (22)
	KLL	21,804 - 22,989		}	
	KLX	25,814 - 27,470		}	
	KXY	29,80 - 31,81		}	
$ec_{1,0\ K}$	(Te)	570,9140	(21)		0,411 (6)
$ec_{1,0\ L}$	(Te)	597,7886 - 598,3864			0,0553 (8)
$ec_{1,0\ M}$	(Te)	601,7220 - 602,1557			0,01107 (16)
$ec_{2,1\ K}$	(Te)	614,0404	(37)		0,02605 (37)
$ec_{3,1\ K}$	(Te)	690,9704	(37)		0,02902 (43)
$ec_{10,1\ K}$	(Te)	1659,1704	(45)		0,01011 (19)

		Energy keV		Electrons per 100 disint.
$\beta^-_{0,27}$	max:	17,9	(15)	0,0059 (5)
$\beta^-_{0,27}$	avg:	4,5	(4)	
$\beta^-_{0,26}$	max:	38,6	(15)	0,054 (9)
$\beta^-_{0,26}$	avg:	9,8	(4)	
$\beta^-_{0,25}$	max:	89,7	(15)	0,0207 (12)
$\beta^-_{0,25}$	avg:	23,4	(4)	
$\beta^-_{0,24}$	max:	96,8	(15)	0,0012 (5)
$\beta^-_{0,24}$	avg:	25,3	(4)	
$\beta^-_{0,23}$	max:	129,2	(15)	0,653 (6)
$\beta^-_{0,23}$	avg:	34,4	(4)	
$\beta^-_{0,22}$	max:	193,3	(15)	0,106 (6)
$\beta^-_{0,22}$	avg:	52,9	(5)	
$\beta^-_{0,21}$	max:	202,7	(15)	0,571 (25)
$\beta^-_{0,21}$	avg:	55,7	(5)	
$\beta^-_{0,20}$	max:	210,6	(15)	8,663 (27)
$\beta^-_{0,20}$	avg:	58,0	(5)	
$\beta^-_{0,19}$	max:	221,8	(15)	0,0242 (22)
$\beta^-_{0,19}$	avg:	61,5	(5)	
$\beta^-_{0,18}$	max:	285,2	(15)	0,0098 (8)
$\beta^-_{0,18}$	avg:	81,0	(5)	
$\beta^-_{0,17}$	max:	354,6	(15)	0,0364 (22)
$\beta^-_{0,17}$	avg:	103,6	(5)	
$\beta^-_{0,16}$	max:	382,8	(15)	0,0529 (5)
$\beta^-_{0,16}$	avg:	113,0	(5)	
$\beta^-_{0,15}$	max:	392,3	(15)	0,0422 (19)
$\beta^-_{0,15}$	avg:	116,0	(5)	
$\beta^-_{0,14}$	max:	421,0	(15)	0,332 (10)
$\beta^-_{0,14}$	avg:	126,0	(5)	
$\beta^-_{0,13}$	max:	449,3	(15)	0,0050 (26)
$\beta^-_{0,13}$	avg:	135,8	(6)	
$\beta^-_{0,11}$	max:	580,9	(15)	0,0686 (14)
$\beta^-_{0,11}$	avg:	182,8	(6)	
$\beta^-_{0,10}$	max:	610,6	(15)	51,21 (19)
$\beta^-_{0,10}$	avg:	193,8	(6)	
$\beta^-_{0,9}$	max:	679,5	(15)	0,0967 (34)
$\beta^-_{0,9}$	avg:	219,5	(6)	
$\beta^-_{0,8}$	max:	721,9	(15)	0,47 (30)
$\beta^-_{0,8}$	avg:	236,0	(6)	
$\beta^-_{0,7}$	max:	812,6	(15)	0,688 (38)
$\beta^-_{0,7}$	avg:	271,0	(6)	
$\beta^-_{0,6}$	max:	865,0	(15)	4,143 (18)
$\beta^-_{0,6}$	avg:	292	(1)	

		Energy keV		Electrons per 100 disint.
$\beta^-_{0,5}$	max:	946,4	(15)	2,295 (7)
$\beta^-_{0,5}$	avg:	324	(1)	
$\beta^-_{0,4}$	max:	1247,7	(15)	0,0053 (10)
$\beta^-_{0,4}$	avg:	450	(1)	
$\beta^-_{0,3}$	max:	1578,8	(15)	4,815 (29)
$\beta^-_{0,3}$	avg:	593	(1)	
$\beta^-_{0,2}$	max:	1655,7	(15)	2,472 (33)
$\beta^-_{0,2}$	avg:	627	(1)	
$\beta^-_{0,1}$	max:	2301,6	(15)	23,44 (28)
$\beta^-_{0,1}$	avg:	918	(1)	

5 Photon Emissions

5.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(Te)	3,3348 — 4,8228		0,0449 (9)	
XKα_2	(Te)	27,202		0,1252 (18)	} Kα
XKα_1	(Te)	27,4726		0,233 (3)	}
XKβ_3	(Te)	30,9446	}		
XKβ_1	(Te)	30,996	}	0,0667 (12)	K$'\beta_1$
XKβ''_5	(Te)	31,236	}		
XKβ_2	(Te)	31,7008	}		
XKβ_4	(Te)	31,774	}	0,0145 (5)	K$'\beta_2$
XKO$_{2,3}$	(Te)	31,812	}		

5.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{14,12}$(Te)	148,02 (5)	0,0037 (6)
$\gamma_{(-1,1)}$(Te)	159,867 (35)	0,0049 (6)
$\gamma_{14,10}$(Te)	189,57 (2)	0,0043 (5)
$\gamma_{20,14}$(Te)	210,40 (2)	0,0053 (7)
$\gamma_{10,6}$(Te)	254,42 (1)	0,0142 (9)
$\gamma_{23,14}$(Te)	291,79 (3)	0,0069 (7)

	Energy keV	Photons per 100 disint.
$\gamma_{10,5}$(Te)	335,80 (2)	0,0725 (9)
$\gamma_{20,11}$(Te)	370,27 (3)	0,0286 (11)
$\gamma_{20,10}$(Te)	399,97 (1)	0,1264 (31)
$\gamma_{14,6}$(Te)	444,00 (2)	0,195 (16)
$\gamma_{20,9}$(Te)	468,84 (3)	0,0459 (26)
$\gamma_{23,10}$(Te)	481,36 (2)	0,0232 (31)
$\gamma_{14,5}$(Te)	525,36 (3)	0,1451 (35)
$\gamma_{26,12}$(Te)	530,46 (7)	0,036 (9)
$\gamma_{26,10}$(Te)	572,01 (5)	0,0176 (8)
$\gamma_{1,0}$(Te)	602,7260 (23)	97,775 (20)
$\gamma_{5,3}$(Te)	632,40 (2)	0,1029 (21)
$\gamma_{2,1}$(Te)	645,8520 (19)	7,422 (15)
$\gamma_{21,6}$(Te)	662,33 (1)	0,024 (11)
$\gamma_{5,2}$(Te)	709,33 (2)	1,363 (5)
$\gamma_{6,3}$(Te)	713,776 (4)	2,273 (7)
$\gamma_{3,1}$(Te)	722,782 (3)	10,708 (22)
$\gamma_{23,6}$(Te)	735,78 (2)	0,1312 (16)
$\gamma_{7,3}$(Te)	766,17 (2)	0,0103 (9)
$\gamma_{25,6}$(Te)	775,27 (7)	0,0098 (4)
$\gamma_{6,2}$(Te)	790,706 (7)	0,7415 (24)
$\gamma_{23,5}$(Te)	817,15 (3)	0,0744 (12)
$\gamma_{8,3}$(Te)	856,87 (3)	0,0227 (5)
$\gamma_{9,3}$(Te)	899,32 (3)	0,0179 (7)
$\gamma_{10,3}$(Te)	968,195 (4)	1,887 (10)
$\gamma_{9,2}$(Te)	976,25 (3)	0,0832 (7)
$\gamma_{(-1,2)}$(Te)	997,8 (3)	0,0033 (23)
$\gamma_{10,2}$(Te)	1045,125 (4)	1,852 (14)
$\gamma_{4,1}$(Te)	1053,9 (3)	0,0053 (10)
$\gamma_{12,2}$(Te)	1086,67 (5)	0,0367 (9)
$\gamma_{(-1,3)}$(Te)	1235 (1)	0,0073 (26)
$\gamma_{15,2}$(Te)	1263,45 (7)	0,0422 (19)
$\gamma_{17,2}$(Te)	1301,14 (9)	0,0364 (22)
$\gamma_{3,0}$(Te)	1325,504 (4)	1,587 (7)
$\gamma_{5,1}$(Te)	1355,20 (2)	1,0412 (38)
$\gamma_{20,3}$(Te)	1368,157 (5)	2,620 (8)
$\gamma_{21,3}$(Te)	1376,10 (1)	0,4999 (43)
$\gamma_{22,3}$(Te)	1385,49 (2)	0,062 (6)
$\gamma_{6,1}$(Te)	1436,554 (7)	1,234 (8)
$\gamma_{20,2}$(Te)	1445,09 (1)	0,334 (7)
$\gamma_{7,1}$(Te)	1488,94 (2)	0,6770 (37)
$\gamma_{23,2}$(Te)	1526,48 (2)	0,414 (5)
$\gamma_{25,2}$(Te)	1565,97 (7)	0,0109 (12)
$\gamma_{8,1}$(Te)	1579,65 (3)	0,412 (5)
$\gamma_{9,1}$(Te)	1622,10 (3)	0,0416 (19)
$\gamma_{10,1}$(Te)	1690,971 (4)	47,46 (19)
$\gamma_{11,1}$(Te)	1720,67 (3)	0,0946 (6)
$\gamma_{13,1}$(Te)	1852,22 (7)	0,0030 (9)

	Energy keV	Photons per 100 disint.
$\gamma_{16,1}$(Te)	1918,74 (6)	0,0529 (5)
$\gamma_{18,1}$(Te)	2016,34 (6)	0,0098 (8)
$\gamma_{6,0}$(Te)	2039,27 (1)	0,0631 (5)
$\gamma_{19,1}$(Te)	2079,75 (13)	0,0224 (22)
$\gamma_{20,1}$(Te)	2090,930 (7)	5,493 (24)
$\gamma_{21,1}$(Te)	2098,88 (1)	0,0471 (33)
$\gamma_{22,1}$(Te)	2108,27 (2)	0,0444 (23)
$\gamma_{23,1}$(Te)	2172,32 (2)	0,0029 (16)
$\gamma_{8,0}$(Te)	2182,37 (3)	0,04147 (31)
$\gamma_{27,1}$(Te)	2283,62 (6)	0,0059 (5)
$\gamma_{10,0}$(Te)	2293,69 (1)	0,0327 (41)
$\gamma_{11,0}$(Te)	2323,39 (3)	0,0025 (6)
$\gamma_{13,0}$(Te)	2454,93 (7)	0,00160 (12)
$\gamma_{19,0}$(Te)	2682,47 (13)	0,00176 (6)
$\gamma_{20,0}$(Te)	2693,65 (1)	0,0032 (14)
$\gamma_{24,0}$(Te)	2807,52 (24)	0,0012 (5)

6 Main Production Modes

$$\begin{cases} \mathrm{Sb}-123(\mathrm{n},\gamma)\mathrm{Sb}-124 & \sigma : 3{,}88\ (12)\ \mathrm{barns} \\ \text{Possible impurities : } \mathrm{Sb}-122 & \end{cases}$$

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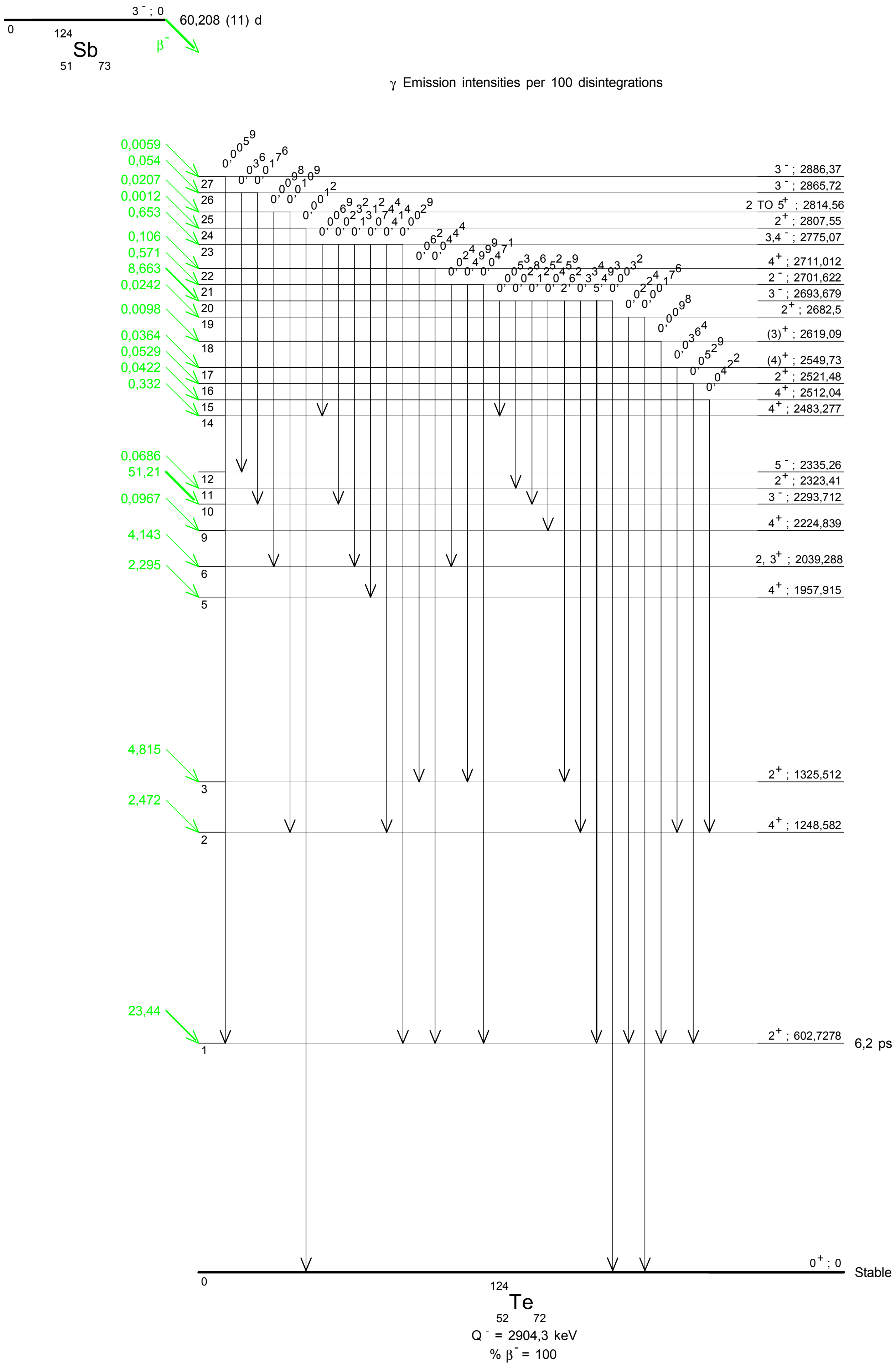
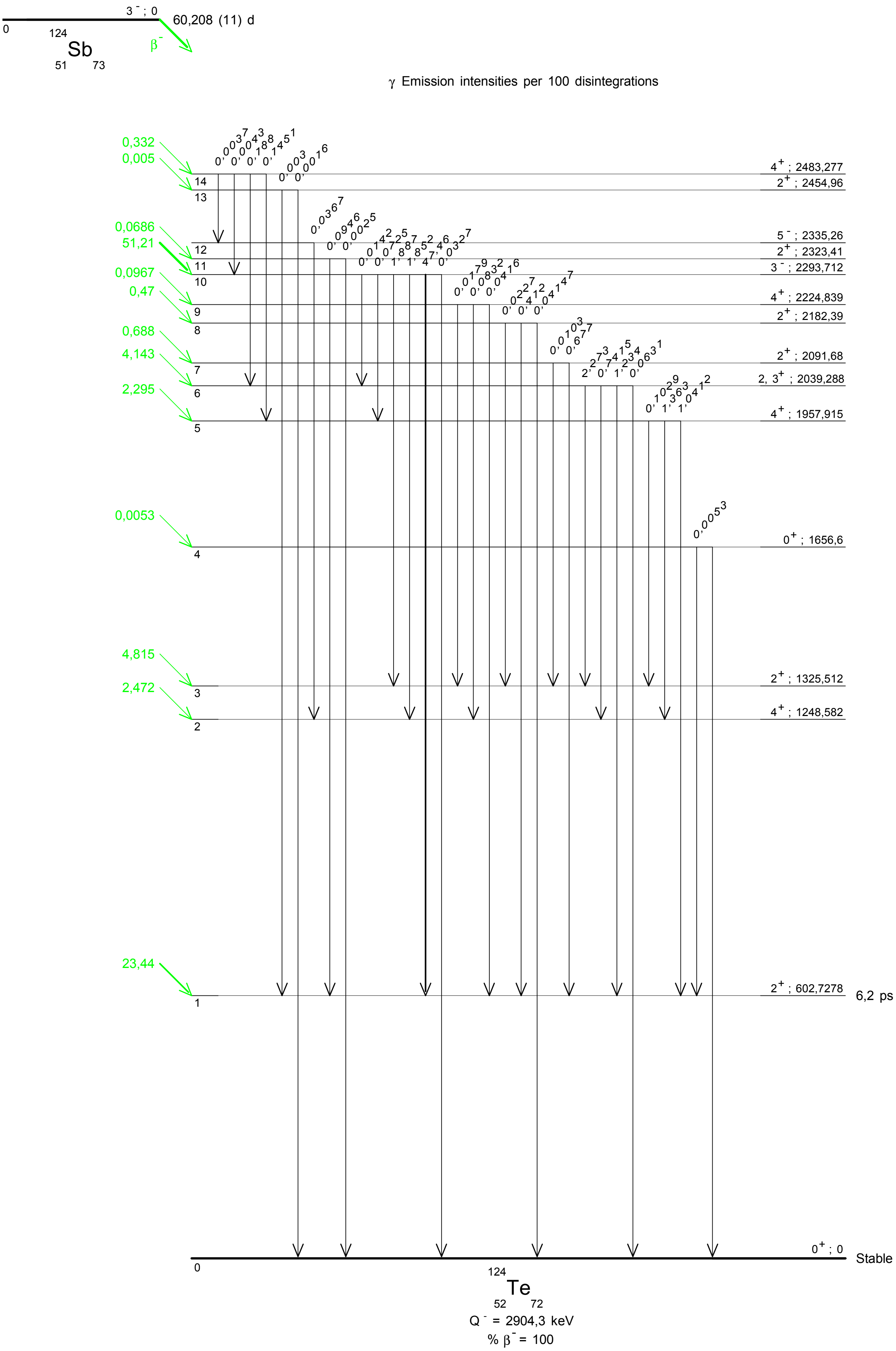
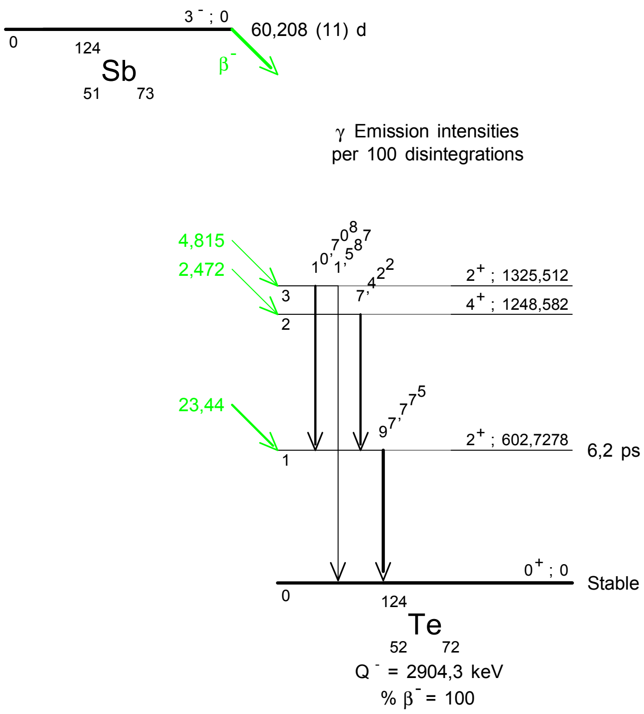

60,208 (11) d
γ Emission intensities per 100 disintegrations
3 - ; 2886,37
3 - ; 2865,72
2 TO 5+ ; 2814,56
2+ ; 2807,55
3,4 - ; 2775,07
4+ ; 2711,012
2 - ; 2701,622
3 - ; 2693,679
2+ ; 2682,5
(3)+ ; 2619,09
(4)+ ; 2549,73
2+ ; 2521,48
4+ ; 2512,04
4+ ; 2483,277
5 - ; 2335,26
2+ ; 2323,41
3 - ; 2293,712
4+ ; 2224,839
2, 3+ ; 2039,288
4+ ; 1957,915
2+ ; 1325,512
4+ ; 1248,582
2+ ; 602,7278
6,2 ps
0+ ; 0
Stable
Q - = 2904,3 keV
% β- = 100


3⁻ ; 0
60,208 (11) d
124 Sb 51 73
β⁻
γ Emission intensities per 100 disintegrations
0,332
0,005
0,0686
51,21
0,0967
0,47
0,688
4,143
2,295
0,0053
4,815
2,472
23,44
4⁺ ; 2483,277
2⁺ ; 2454,96
5⁻ ; 2335,26
2⁺ ; 2323,41
3⁻ ; 2293,712
4⁺ ; 2224,839
2⁺ ; 2182,39
2⁺ ; 2091,68
2, 3⁺ ; 2039,288
4⁺ ; 1957,915
0⁺ ; 1656,6
2⁺ ; 1325,512
4⁺ ; 1248,582
2⁺ ; 602,7278
6,2 ps
0⁺ ; 0
Stable
124 Te 52 72
Q⁻ = 2904,3 keV
% β⁻ = 100


3 - ; 0
60,208 (11) d
0
124
Sb
51 73
β -
γ Emission intensities
per 100 disintegrations
4,815
2,472
23,44
2+ ; 1325,512
4+ ; 1248,582
2+ ; 602,7278
6,2 ps
0+ ; 0
Stable
124
Te
52 72
Q - = 2904,3 keV
% β - = 100

$$^{207}_{83}\mathrm{Bi}_{124}$$

1 Decay Scheme

Le bismuth 207 se désintègre par capture électronique vers le plomb 207. Une faible transition par émission bêta plus a été mise en évidence.
Bi-207 disintegrates by electron capture to Pb-207. A weak transition by positron emission has been reported.

2 Nuclear Data

$T_{1/2}(^{207}\mathrm{Bi})$	:	32,9	(14)	a
$Q^+(^{207}\mathrm{Bi})$	:	2397,5	(21)	keV

2.1 Electron Capture Transitions

	Energy keV	Probability × 100	Nature	lg ft	P_K	P_L	P_{M+}
$\epsilon_{0,4}$	57,6 (21)	7,03 (23)	Allowed	8,3		0,651 (6)	0,349 (6)
$\epsilon_{0,3}$	764,1 (21)	84,1 (6)	Unique 1st Forbidden	10,58	0,733 (7)	0,199 (4)	0,069 (1)
$\epsilon_{0,1}$	1827,8 (21)	8,8 (6)	2nd Forbidden	12,1	0,797 (8)	0,150 (3)	0,049 (1)

2.2 β^+ Transitions

	Energy keV	Probability × 100	Nature	lg ft
$\beta^+_{0,1}$	805,8 (21)	0,012 (2)	2nd Forbidden	12,6

2.3 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K (10^{-2})	α_L (10^{-2})	α_M (10^{-2})	α_T (10^{-2})
$\gamma_{2,1}$(Pb)	328,11 (10)	0,0044 (35)	[M1]				
$\gamma_{1,0}$(Pb)	569,699 (2)	99,87 (4)	E2	1,583 (23)	0,439 (7)	0,1081 (16)	2,16 (3)
$\gamma_{2,0}$(Pb)	897,8 (1)	0,1313 (48)	M1+8,3%E2	1,82 (8)	0,304 (12)	0,071 (3)	2,22 (9)
$\gamma_{3,1}$(Pb)	1063,659 (3)	84,11 (31)	M4+0,01%E5	9,53 (23)	2,47 (7)	0,591 (33)	12,78 (24)
$\gamma_{4,2}$(Pb)	1442,2 (2)	0,1319 (22)	E2	0,271 (4)	0,0468 (7)	0,01098 (16)	0,337 (5)
$\gamma_{4,1}$(Pb)	1770,236 (9)	6,901 (26)	M1+0,0025%E2	0,342 (5)	0,0556 (8)	0,01292 (19)	0,442 (7)

3 Atomic Data

3.1 Pb

ω_K	:	0,963	(4)
$\bar{\omega}_L$	:	0,379	(15)
$\bar{\omega}_M$	:	0,0346	
n_{KL}	:	0,811	(5)
$\bar{n}_{LM}$	:	1,294	

3.1.1 X Radiations

		Energy keV		Relative probability
X_K				
	$K\alpha_2$	72,8049		59,5
	$K\alpha_1$	74,97		100
	$K\beta_3$	84,451	}	
	$K\beta_1$	84,937	}	
	$K\beta_5''$	85,47	}	34,2
	$K\beta_2$	87,238	}	
	$K\beta_4$	87,58	}	10,3
	$KO_{2,3}$	87,911	}	
X_L				
	$L\ell$	9,18		
	$L\alpha$	10,4496 – 10,5516		
	$L\eta$	11,3494		
	$L\beta$	12,143 – 13,015		
	$L\gamma$	15,101 – 15,84		

3.1.2 Auger Electrons

	Energy keV	Relative probability
Auger K		
KLL	56,028 – 61,669	100
KLX	68,181 – 74,969	55,8
KXY	80,3 – 88,0	7,78
Auger L	5,2 – 15,7	

4 Electron Emissions

		Energy keV		Electrons per 100 disint.
e_{AL}	(Pb)	5,2 - 15,7		54,8 (7)
e_{AK}	(Pb)			2,9 (4)
	KLL	56,028 - 61,669	}	
	KLX	68,181 - 74,969	}	
	KXY	80,3 - 88,0	}	
$ec_{1,0\ T}$	(Pb)	481,694 - 569,680		2,112 (29)
$ec_{1,0\ K}$	(Pb)	481,694 (2)		1,548 (22)
$ec_{1,0\ L}$	(Pb)	553,838 - 556,664		0,429 (7)
$ec_{1,0\ M}$	(Pb)	565,848 - 567,215		0,1057 (16)
$ec_{3,1\ T}$	(Pb)	975,655 - 1063,640		9,53 (18)
$ec_{3,1\ K}$	(Pb)	975,655 (3)		7,11 (17)
$ec_{3,1\ L}$	(Pb)	1047,798 - 1050,624		1,84 (5)
$ec_{3,1\ M}$	(Pb)	1059,808 - 1061,175		0,441 (25)
$ec_{3,1\ N}$	(Pb)	1062,765 - 1063,523		0,1193 (30)
$\beta^+_{0,1}$	max:	805,8 (21)		0,012 (2)
$\beta^+_{0,1}$	avg:	383,4 (9)		

5 Photon Emissions

5.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(Pb)	9,18 — 15,84		32,9 (6)	
$XK\alpha_2$	(Pb)	72,8049		21,75 (30)	} $K\alpha$
$XK\alpha_1$	(Pb)	74,97		36,6 (5)	}
$XK\beta_3$	(Pb)	84,451	}		
$XK\beta_1$	(Pb)	84,937	}	12,49 (25)	$K'\beta_1$
$XK\beta_5''$	(Pb)	85,47	}		
$XK\beta_2$	(Pb)	87,238	}		
$XK\beta_4$	(Pb)	87,58	}	3,77 (10)	$K'\beta_2$
$XKO_{2,3}$	(Pb)	87,911	}		

5.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{2,1}$(Pb)	328,11 (10)	0,0044 (35)
$\gamma^{\pm}$	511	0,024 (4)
$\gamma_{1,0}$(Pb)	569,698 (2)	97,76 (3)
$\gamma_{2,0}$(Pb)	897,8 (1)	0,1284 (47)
$\gamma_{3,1}$(Pb)	1063,656 (3)	74,58 (22)
$\gamma_{4,2}$(Pb)	1442,2 (2)	0,1315 (22)
$\gamma_{4,1}$(Pb)	1770,228 (9)	6,871 (26)

6 Main Production Modes

Pb – 206(d,n)Bi – 207
Pb – 207(d,2n)Bi – 207
Pb – 208(d,3n)Bi – 207

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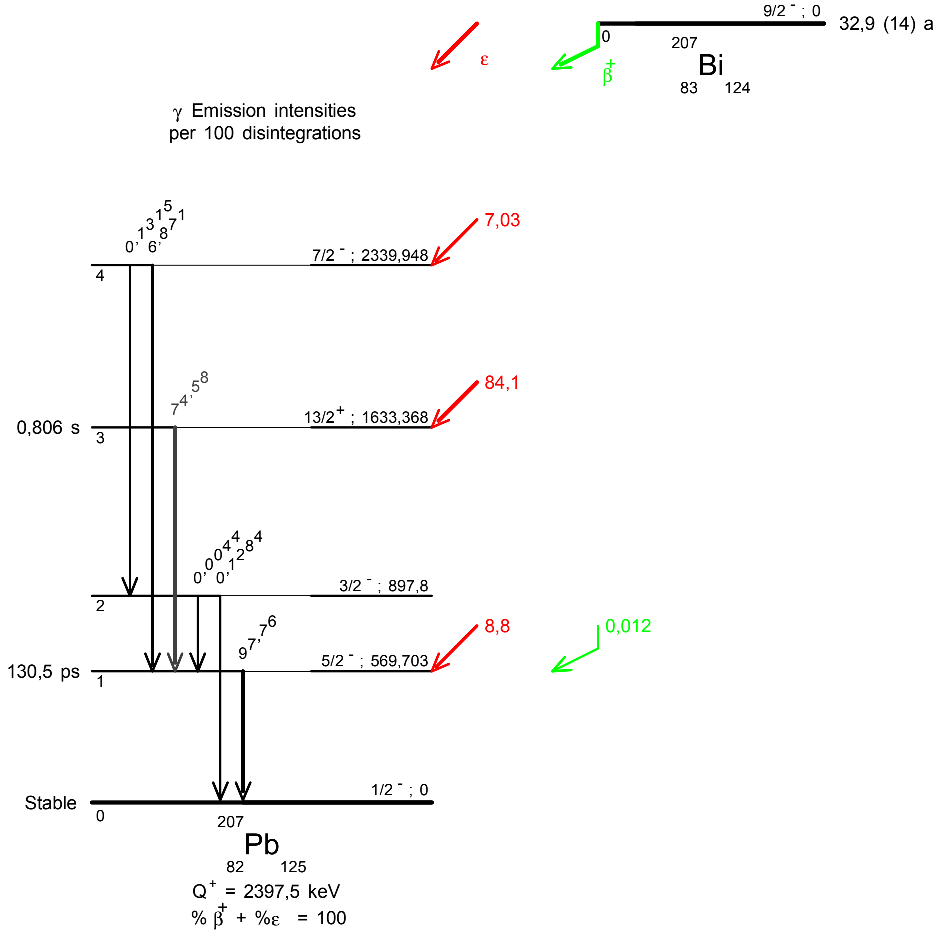
  (Theoretical ICC)


9/2 ⁻ ; 0
32,9 (14) a
0
207
Bi
83 124
ε
β+
γ Emission intensities
per 100 disintegrations
7,03
7/2 ⁻ ; 2339,948
4
84,1
13/2+ ; 1633,368
0,806 s
3
3/2 ⁻ ; 897,8
2
8,8
0,012
5/2 ⁻ ; 569,703
130,5 ps
1
Stable
1/2 ⁻ ; 0
0
207
Pb
82 125
Q+ = 2397,5 keV
% β+ + %ε = 100

$^{211}_{83}\mathrm{Bi}_{128}$

1 Decay Scheme

Bi-211 decays mainly (99.724 (4) %) by alpha-particle emission to the ground state (83.56 (23) %), and (16.16 (23) %) to the 351-keV state in Tl-207. Bi-211 also has a weak beta minus decay branch (0.276 (4) %) that populates the ground state in Po-211.
Le bismuth 211 se désintègre par émission alpha vers l'état fondamental (83,56 (23) %), et l'état excité de 351-keV (16,16 (23) %) du thalium 207. Le bismuth 211 a aussi une faible branche de désintegration bêta moins (0,276 (4) %) vers l'état fondamental du polonium 211.

2 Nuclear Data

$T_{1/2}(^{211}\mathrm{Bi})$	:	2,15	(2)	min
$T_{1/2}(^{211}\mathrm{Po})$	:	0,516	(3)	s
$T_{1/2}(^{207}\mathrm{Tl})$	:	4,77	(2)	min
$Q^{\alpha}(^{211}\mathrm{Bi})$	:	6750,33	(46)	keV
$Q^{-}(^{211}\mathrm{Bi})$	:	574	(5)	keV

2.1 α Transitions

	Energy keV	Probability × 100	F
$\alpha_{0,1}$	6399,8 (9)	16,16 (23)	43
$\alpha_{0,0}$	6750,4 (6)	83,56 (23)	187

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2.2 β^- Transitions

	Energy keV	Probability × 100	Nature	lg ft
$\beta^-_{0,0}$	574 (5)	0,276 (4)	1st Forbidden	5,99

2.3 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{1,0}$(Tl)	351,03 (4)	16,16 (24)	M1+E2	0,199 (3)	0,0342 (5)	0,00801 (12)	0,243 (4)

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				
	$K\alpha_2$	70,8325		59,24
	$K\alpha_1$	72,8725		100
	$K\beta_3$	82,118	}	
	$K\beta_1$	82,577	}	
	$K\beta_5''$	83,115	}	34
	$K\beta_2$	84,838	}	
	$K\beta_4$	85,134	}	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	5,18 – 15,31	

4 α Emissions

	Energy keV	Probability × 100
$\alpha_{0,1}$	6278,5 (9)	16,16 (23)
$\alpha_{0,0}$	6622,4 (6)	83,56 (23)

5 Electron Emissions

		Energy keV	Electrons per 100 disint.
e_{AL}	(Tl)	5,18 - 15,31	1,617 (21)
e_{AK}	(Tl)		0,096 (11)
	KLL	54,587 - 59,954	}
	KLX	66,37 - 72,86	}
	KXY	78,12 - 85,50	}
$ec_{1,0\ K}$	(Tl)	265,50 (4)	2,59 (5)
$ec_{1,0\ L}$	(Tl)	335,68 - 338,37	0,446 (9)
$ec_{1,0\ M}$	(Tl)	347,33 - 348,64	0,1044 (22)
$\beta^-_{0,0}$	max:	574 (5)	0,276 (4)
$\beta^-_{0,0}$	avg:	172,9 (18)	

6 Photon Emissions

6.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(Tl)	8,9531 — 14,7362		0,929 (19)	
$XK\alpha_2$	(Tl)	70,8325		0,726 (16)	} $K\alpha$
$XK\alpha_1$	(Tl)	72,8725		1,225 (27)	}
$XK\beta_3$	(Tl)	82,118	}		
$XK\beta_1$	(Tl)	82,577	}	0,417 (11)	$K'\beta_1$
$XK\beta_5''$	(Tl)	83,115	}		
$XK\beta_2$	(Tl)	84,838	}		
$XK\beta_4$	(Tl)	85,134	}	0,124 (4)	$K'\beta_2$
$XKO_{2,3}$	(Tl)	85,444	}		

6.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{1,0}$(Tl)	351,03 (4)	13,00 (19)

7 Main Production Modes

Pb – 211(β^-)Bi – 211

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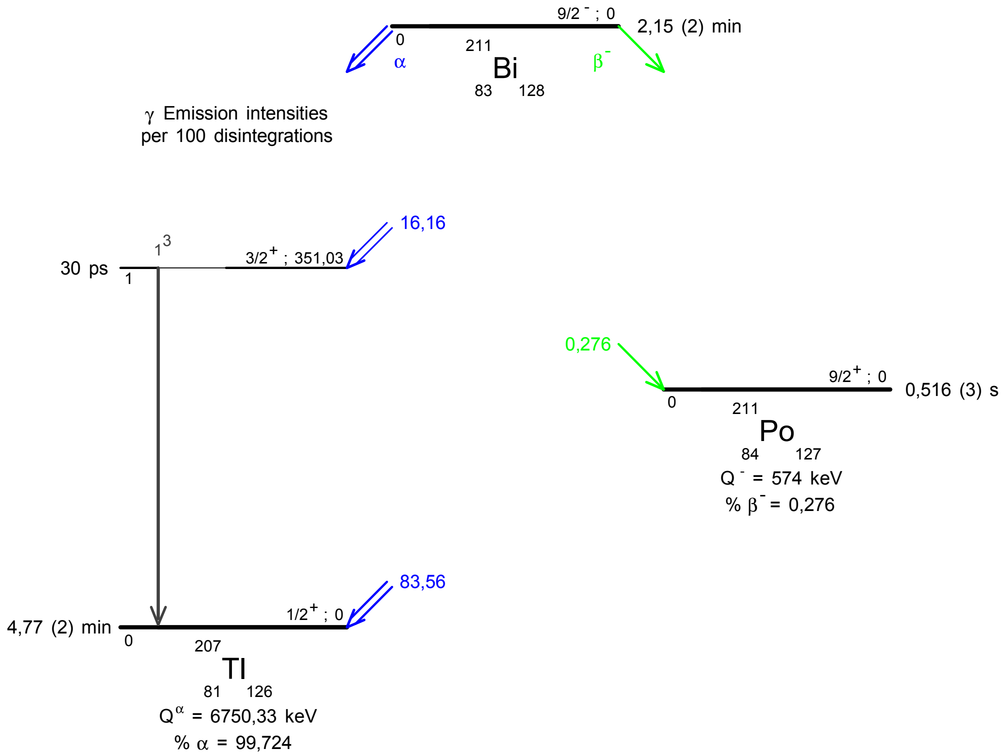
9/2 - ; 0
2,15 (2) min
0
α
211
Bi
83 128
β-
γ Emission intensities
per 100 disintegrations
16,16
1 3
3/2+ ; 351,03
30 ps
1
0,276
9/2+ ; 0
0,516 (3) s
0
211
Po
84 127
Q - = 574 keV
% β- = 0,276
83,56
1/2+ ; 0
4,77 (2) min
0
207
Tl
81 126
Qα = 6750,33 keV
% α = 99,724

$^{217}_{85}\mathrm{At}_{132}$

1 Decay Scheme

At-217 disintegrates 99,9933(24)% by alpha emission to levels in Bi-213 and 0,0067(24)% by beta minus emission to levels in Rn-217. The beta minus decay scheme of At-217 has not been studied.
L'astate 217 se désintègre à 99,9933 % par émission alpha vers des niveaux excités de bismuth 213 et par transitions bêta moins (0,0067 %) vers le radon 217, cette partie n'a pas été étudiée.

2 Nuclear Data

$T_{1/2}(^{217}\mathrm{At})$	:	32,3	(4)	10^{-3} s
$T_{1/2}(^{217}\mathrm{Rn})$	:	0,54	(5)	10^{-3} s
$T_{1/2}(^{213}\mathrm{Bi})$	:	45,59	(6)	min
$Q^{-}(^{217}\mathrm{At})$	:	737	(6)	keV
$Q^{\alpha}(^{217}\mathrm{At})$	:	7201,3	(12)	keV

2.1 α Transitions

	Energy keV	Probability × 100	F
$\alpha_{0,4}$	6150 (3)	0,002	5,2
$\alpha_{0,3}$	6441,0 (16)	0,0049 (4)	36
$\alpha_{0,2}$	6606,5 (16)	0,0167 (8)	49
$\alpha_{0,1}$	6941,8 (16)	0,0384 (15)	379
$\alpha_{0,0}$	7199,6 (16)	99,932 (3)	1,16

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{1,0}$(Bi)	257,88 (4)	0,0446 (13)	M1+29%E2	0,434 (17)	0,0918 (16)	0,02212 (37)	0,555 (26)
$\gamma_{2,1}$(Bi)	335,33 (10)	0,0062 (3)					
$\gamma_{4,2}$(Bi)	455	0,002					
$\gamma_{2,0}$(Bi)	593,1 (1)	0,0115 (5)					
$\gamma_{3,0}$(Bi)	758,9 (1)	0,0049 (4)					

3 Atomic Data

3.1 Bi

ω_K	:	0,964	(4)
$\bar{\omega}_L$	:	0,391	(16)
n_{KL}	:	0,809	(5)

3.1.1 X Radiations

		Energy keV		Relative probability
X_K				
	Kα_2	74,8157		59,77
	Kα_1	77,1088		100
	Kβ_3	86,835	}	
	Kβ_1	87,344	}	
	Kβ_5''	87,862	}	34,25
	Kβ_2	89,732	}	
	Kβ_4	90,074	}	10,48
	KO$_{2,3}$	90,421	}	
X_L				
	Lℓ	9,421		
	Lγ	– 15,708		

3.1.2 Auger Electrons

	Energy keV	Relative probability
Auger K		
KLL	57,491 – 63,419	100
KLX	70,025 – 77,105	56
KXY	82,53 – 90,52	7,84
Auger L	5,3 – 16,4	

4 α Emissions

	Energy keV	Probability × 100
$\alpha_{0,4}$	6037 (3)	0,002
$\alpha_{0,3}$	6322,0 (16)	0,0049 (4)
$\alpha_{0,2}$	6484,7 (16)	0,0167 (8)
$\alpha_{0,1}$	6813,8 (16)	0,0384 (15)
$\alpha_{0,0}$	7066,9 (16)	99,932 (3)

5 Electron Emissions

		Energy keV	Electrons per 100 disint.
e_{AL}	(Bi)	5,3 - 16,4	0,0077 (4)
e_{AK}	(Bi)		0,00044 (3)
	KLL	57,491 - 63,419	}
	KLX	70,025 - 77,105	}
	KXY	82,53 - 90,52	}
$ec_{1,0\ K}$	(Bi)	167,35 (4)	0,0125 (6)

6 Photon Emissions

6.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(Bi)	9,421 — 15,708		0,00497 (23)	
$XK\alpha_2$	(Bi)	74,8157		0,00351 (20)	} $K\alpha$
$XK\alpha_1$	(Bi)	77,1088		0,0059 (4)	}
$XK\beta_3$	(Bi)	86,835	}		
$XK\beta_1$	(Bi)	87,344	}	0,00201 (11)	$K'\beta_1$
$XK\beta_5''$	(Bi)	87,862	}		
$XK\beta_2$	(Bi)	89,732	}		
$XK\beta_4$	(Bi)	90,074	}	0,00062 (4)	$K'\beta_2$
$XKO_{2,3}$	(Bi)	90,421	}		

6.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{1,0}$(Bi)	257,88 (4)	0,0287 (7)
$\gamma_{2,1}$(Bi)	335,33 (10)	0,0062 (3)
$\gamma_{4,2}$(Bi)	455	0,002
$\gamma_{2,0}$(Bi)	593,1 (1)	0,0115 (5)
$\gamma_{3,0}$(Bi)	758,9 (1)	0,0049 (4)

7 Main Production Modes

Ac – 225 decay chain

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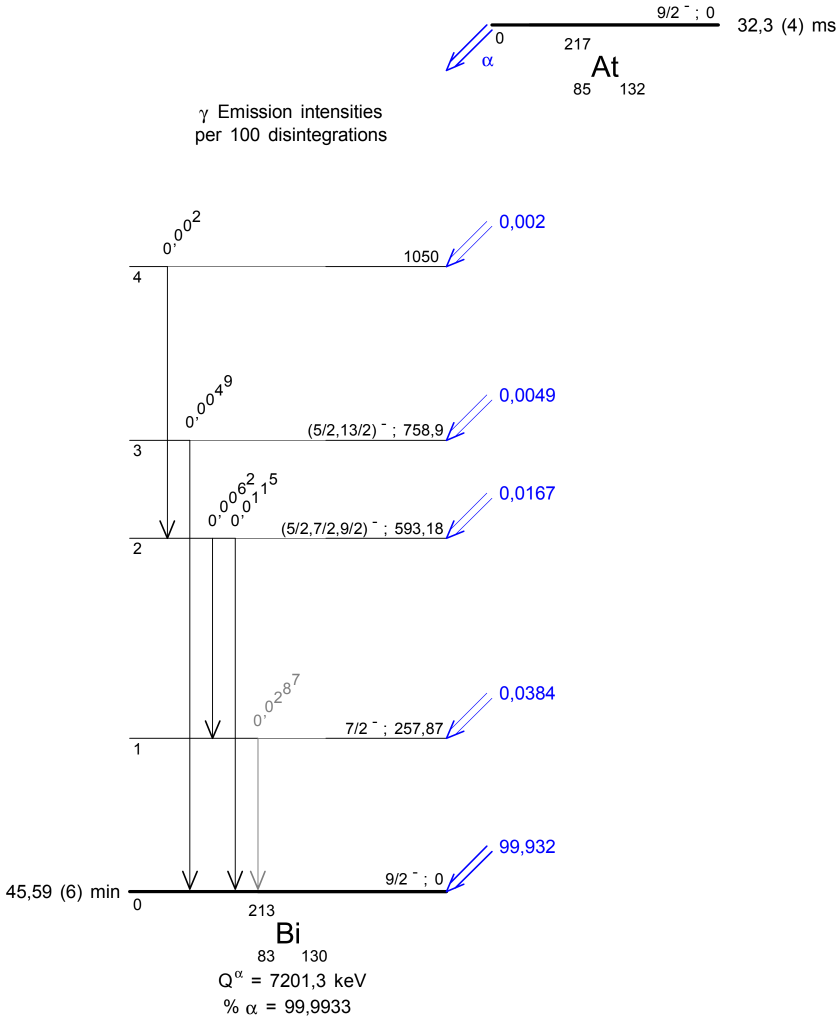
9/2 ⁻ ; 0
32,3 (4) ms
0
α
217
At
85
132
γ Emission intensities
per 100 disintegrations
0,002
1050
0,002
4
0,0049
(5/2,13/2) ⁻ ; 758,9
0,0049
3
0,0062
0,0115
(5/2,7/2,9/2) ⁻ ; 593,18
0,0167
2
0,0287
7/2 ⁻ ; 257,87
0,0384
1
99,932
9/2 ⁻ ; 0
45,59 (6) min
0
213
Bi
83
130
Qᵅ = 7201,3 keV
% α = 99,9933

$^{225}_{88}\mathrm{Ra}_{137}$

1 Decay Scheme

Ra-225 disintegrates 100% by beta minus emission to levels in Ac-225.
Le radium 225 se désintègre par émission bêta moins vers des niveaux excités de l'actinium 225.

2 Nuclear Data

$T_{1/2}(^{225}\mathrm{Ra})$	:	14,82	(19)	d
$T_{1/2}(^{225}\mathrm{Ac})$	:	10,0	(1)	d
$Q^{-}(^{225}\mathrm{Ra})$	:	356	(5)	keV

2.1 β^- Transitions

	Energy keV	Probability × 100	Nature	lg ft
$\beta^-_{0,3}$	200 (5)	< 0,01	2nd Forbidden	> 10,1
$\beta^-_{0,2}$	235 (5)	< 0,01	Unique 1st Forbidden	> 9,9
$\beta^-_{0,1}$	316 (5)	68,8 (20)	Allowed	6,87
$\beta^-_{0,0}$	356 (5)	31,2 (20)	1st Forbidden	7,38

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_L	α_M	α_T
$\gamma_{1,0}$(Ac)	40,09 (5)	68,8 (17)	E1	0,974 (14)	0,24 (4)	1,293 (19)

3 Atomic Data

3.1 Ac

ω_K	:	0,969	(4)
$\bar{\omega}_L$	:	0,464	(18)
n_{KL}	:	0,799	(5)

3.1.1 X Radiations

		Energy keV	Relative probability
X_L			
	$L\ell$	10,8701	
	$L\alpha$	12,5002 – 12,6505	
	$L\eta$	14,0807	
	$L\beta$	14,6024 – 16,6263	
	$L\gamma$	17,813 – 18,9228	

3.1.2 Auger Electrons

	Energy keV	Relative probability
Auger L	5,87 – 19,69	

4 Electron Emissions

		Energy keV		Electrons per 100 disint.
e_{AL}	(Ac)	5,87 - 19,69		15,7 (7)
$ec_{1,0\ L}$	(Ac)	20,24 - 24,22		29,2 (8)
$ec_{1,0\ M}$	(Ac)	35,09 - 36,87		7,2 (12)
$ec_{1,0\ N}$	(Ac)	38,82 - 39,78		1,86 (27)
$\beta^-_{0,3}$	max:	200	(5)	< 0,01
$\beta^-_{0,3}$	avg:	54,0	(15)	
$\beta^-_{0,2}$	max:	235	(5)	< 0,01
$\beta^-_{0,2}$	avg:	70,5	(16)	
$\beta^-_{0,1}$	max:	316	(5)	68,8 (20)
$\beta^-_{0,1}$	avg:	88,3	(16)	
$\beta^-_{0,0}$	max:	356	(5)	31,2 (20)
$\beta^-_{0,0}$	avg:	100,7	(16)	

5 Photon Emissions

5.1 X-Ray Emissions

		Energy keV	Photons per 100 disint.
XL	(Ac)	10,8701 — 18,9228	13,6 (6)

5.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{1,0}$(Ac)	40,09 (5)	30,0 (7)

6 Main Production Modes

Ra – 226(n,2n)Ra – 225

Descendant of U – 233()

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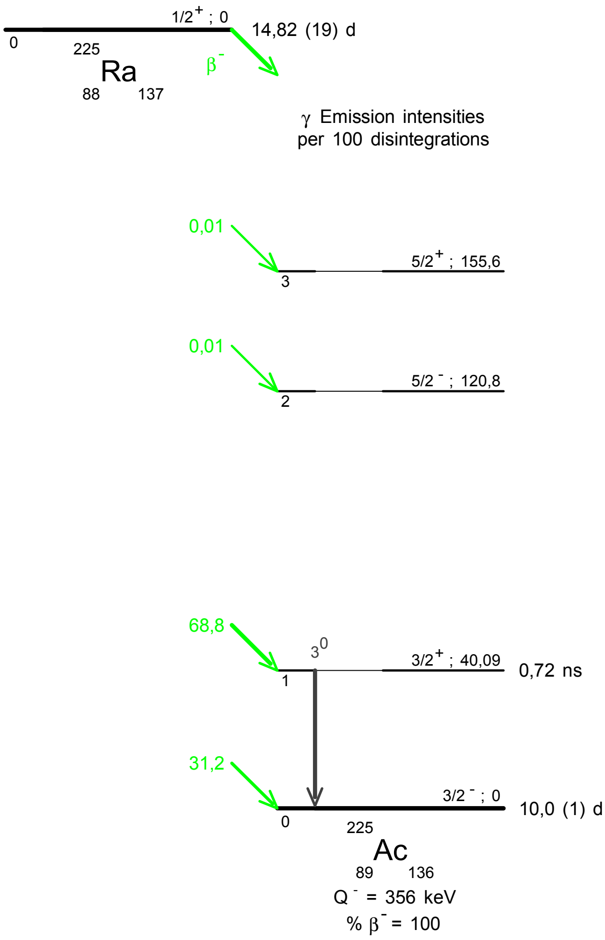
1/2+ ; 0
14,82 (19) d
0
225
Ra
88
137
β-
γ Emission intensities
per 100 disintegrations
0,01
5/2+ ; 155,6
3
0,01
5/2 - ; 120,8
2
68,8
30
3/2+ ; 40,09
0,72 ns
1
31,2
3/2 - ; 0
10,0 (1) d
0
225
Ac
89
136
Q - = 356 keV
% β- = 100

$^{225}_{89}\mathrm{Ac}_{136}$

1 Decay Scheme

Ac-225 disintegrates 100% by alpha emission to the ground state level and to excited levels in Fr-221.
L'actinium se désintègre par émissions alpha vers le niveau fondamental et des niveux excités du francium 225.

2 Nuclear Data

$T_{1/2}(^{225}\mathrm{Ac})$	:	10,0	(1)	d
$T_{1/2}(^{221}\mathrm{Fr})$	:	4,79	(2)	min
$Q^{\alpha}(^{225}\mathrm{Ac})$	:	5935,1	(14)	keV

2.1 α Transitions

	Energy keV	Probability × 100	F
$\alpha_{0,48}$	4992,4 (14)	0,0011 (4)	2,5
$\alpha_{0,47}$	5083,1 (14)	0,0013 (3)	7,7
$\alpha_{0,46}$	5110,1 (14)	0,00015 (5)	98
$\alpha_{0,45}$	5116,5 (14)	0,00083 (21)	19
$\alpha_{0,44}$	5126,6 (14)	0,0021 (3)	8,8
$\alpha_{0,43}$	5155,8 (14)	0,00114 (18)	24
$\alpha_{0,42}$	5168,7 (14)	0,0038 (19)	9
$\alpha_{0,41}$	5186,3 (14)	0,015 (7)	2,8
$\alpha_{0,40}$	5222,0 (14)	0,0058 (8)	11,9
$\alpha_{0,39}$	5255,5 (14)	0,00066 (12)	165
$\alpha_{0,38}$	5289,1 (14)	0,00015 (5)	1140
$\alpha_{0,37}$	5297,5 (14)	0,0101 (10)	18,9
$\alpha_{0,36}$	5304,5 (14)	0,022 (1)	9,5
$\alpha_{0,35}$	5334,1 (14)	0,0026 (5)	119
$\alpha_{0,34}$	5364,5 (14)	0,048 (19)	10
$\alpha_{0,33}$	5383,3 (14)	0,214 (10)	2,76
$\alpha_{0,32}$	5417,5 (14)	0,007 (7)	130

	Energy keV	Probability × 100	F
$\alpha_{0,31}$	5438,6 (14)	0,0027 (8)	450
$\alpha_{0,30}$	5453,1 (14)	0,000097 (2)	14960
$\alpha_{0,29}$	5476,0 (14)	0,0020 (5)	980
$\alpha_{0,28}$	5488,8 (14)	0,0006 (4)	3800
$\alpha_{0,27}$	5512,5 (14)	0,0030 (4)	1020
$\alpha_{0,26}$	5526,5 (14)	0,0023 (3)	1590
$\alpha_{0,25}$	5528,4 (14)	0,0028 (8)	1340
$\alpha_{0,24}$	5534,2 (14)	0,0083 (6)	485
$\alpha_{0,23}$	5541,8 (14)	0,098 (19)	45
$\alpha_{0,22}$	5567,4 (14)	0,00052 (18)	11700
$\alpha_{0,21}$	5586,7 (14)	0,0020 (3)	3860
$\alpha_{0,20}$	5596,9 (14)	0,0022 (7)	4000
$\alpha_{0,19}$	5615,0 (14)	0,0052 (19)	2100
$\alpha_{0,18}$	5623,7 (14)	0,013 (6)	930
$\alpha_{0,17}$	5640,4 (14)	0,0072 (8)	2060
$\alpha_{0,16}$	5646,9 (14)	0,055 (12)	292
$\alpha_{0,15}$	5655,8 (14)	0,084 (10)	213
$\alpha_{0,14}$	5664,0 (14)	0,017 (7)	1160
$\alpha_{0,13}$	5681,5 (14)	0,95 (4)	25,6
$\alpha_{0,12}$	5700,6 (14)	0,114 (7)	268
$\alpha_{0,11}$	5711,0 (14)	1,09 (5)	31,5
$\alpha_{0,10}$	5739,3 (14)	4,16 (23)	11,6
$\alpha_{0,9}$	5785,0 (14)	1,31 (4)	62,9
$\alpha_{0,8}$	5789,3 (14)	0,021 (14)	4100
$\alpha_{0,7}$	5826,7 (14)	2,03 (23)	66
$\alpha_{0,6}$	5834,2 (14)	1,6 (3)	91
$\alpha_{0,5}$	5835,3 (14)	1,24 (10)	119
$\alpha_{0,4}$	5835,6 (17)	9,0 (5)	16,4
$\alpha_{0,3}$	5896,5 (14)	6,2 (9)	48
$\alpha_{0,2}$	5898,0 (21)	18,9 (20)	16
$\alpha_{0,1}$	5909,3 (14)	0,3	1135
$\alpha_{0,0}$	5935,1 (14)	52,4 (24)	8,7

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{2,1}$(Fr)	10,6	7,7 (10)	M1			383 (5)	510 (7)
$\gamma_{1,0}$(Fr)	26,02 (10)	9,4 (13)	E2		4390 (110)	1180 (30)	5940 (150)
$\gamma_{2,0}$(Fr)	36,69 (3)	19,8 (17)	E2		806 (12)	217 (4)	1092 (16)
$\gamma_{3,0}$(Fr)	38,58 (4)	9,1 (9)	E2		630 (10)	169 (3)	854 (13)
$\gamma_{8,4}$(Fr)	46,25 (5)	0,0090 (13)	[E1]		0,636 (9)	0,155 (2)	0,841 (12)
$\gamma_{9,6}$(Fr)	49,12 (4)	0,0137 (14)	[E1]		0,541 (8)	0,1320 (19)	0,715 (11)
$\gamma_{9,5}$(Fr)	50,2	0,15	[E2]		174,2 (25)	47,0 (7)	236,0 (34)
$\gamma_{34,32}$(Fr)	53,4 (4)	0,074	[M1]		13,3 (4)	3,18 (8)	17,6 (5)
$\gamma_{13,10}$(Fr)	57,71 (4)	0,0075 (12)	(E1)		0,352 (5)	0,0854 (12)	0,465 (7)
$\gamma_{6,3}$(Fr)	62,6 (3)	0,44 (10)	[E2]		59,8 (16)	16,2 (5)	81,2 (23)
$\gamma_{4,2}$(Fr)	62,95 (3)	5,81 (36)	M1		8,24 (12)	1,964 (28)	10,85 (15)
$\gamma_{5,2}$(Fr)	63,5 (3)	0,0286 (41)	[E1]		0,273 (5)	0,0660 (12)	0,360 (7)
$\gamma_{6,2}$(Fr)	64,27 (3)	1,13 (21)	M1+E2		17 (3)	4,4 (8)	23 (4)
$\gamma_{7,3}$(Fr)	69,86 (5)	0,23 (6)	E2		35,3 (5)	9,55 (14)	47,9 (7)
$\gamma_{7,2}$(Fr)	71,71 (4)	0,57 (6)	E2		31,1 (5)	8,43 (12)	42,3 (6)
$\gamma_{4,1}$(Fr)	73,55 (9)	0,73 (19)	E2		27,6 (4)	7,48 (11)	37,5 (6)
$\gamma_{5,1}$(Fr)	73,86 (3)	0,383 (29)	E1		0,182 (3)	0,0440 (6)	0,240 (3)
$\gamma_{6,1}$(Fr)	74,83 (5)	0,197 (39)	(M1+E2)		9,06 (13)	2,32 (4)	12,15 (18)
$\gamma_{11,8}$(Fr)	78,8	0,082 (13)	M1		4,27 (6)	1,019 (14)	5,63 (8)
$\gamma_{10,7}$(Fr)	87,41 (3)	1,4 (1)	M1		3,16 (5)	0,754 (10)	4,16 (6)
$\gamma_{10,6}$(Fr)	94,90 (2)	0,449 (43)	M1		2,49 (3)	0,594 (8)	3,28 (5)
$\gamma_{10,5}$(Fr)	96,16 (5)	0,23 (7)	M1+E2		4,5 (10)	1,2 (3)	6,0 (14)
$\gamma_{4,0}$(Fr)	99,67 (5)	3,09 (22)	M1+E2		2,32 (8)	0,56 (2)	3,06 (11)
$\gamma_{5,0}$(Fr)	99,91 (6)	1,20 (9)	E1		0,0814 (11)	0,0196 (3)	0,1073 (15)
$\gamma_{6,0}$(Fr)	100,90 (4)	0,54 (19)	M1+E2		3,4 (14)	0,9 (4)	4,6 (19)
$\gamma_{13,9}$(Fr)	103,48 (10)	0,033 (12)	[M1,E2]	5 (2)	3,7 (18)	1,0 (5)	10 (3)
$\gamma_{7,0}$(Fr)	108,40 (3)	2,87 (19)	M1+E2	7,2 (4)	2,30 (12)	0,58 (4)	10,27 (25)
$\gamma_{9,3}$(Fr)	111,53 (3)	0,427 (29)	(E1)	0,282 (4)	0,0609 (9)	0,01461 (21)	0,363 (5)
$\gamma_{24,16}$(Fr)	112,80 (2)	0,00284 (41)	[E1]	0,275 (4)	0,0591 (9)	0,01417 (21)	0,353 (5)
$\gamma_{23,15}$(Fr)	114	0,0094 (14)	M1	7,93 (12)	1,466 (21)	0,350 (5)	9,86 (14)
$\gamma_{8,1}$(Fr)	119,85 (3)	0,104 (7)	[E1]	0,239 (4)	0,0503 (7)	0,01207 (17)	0,305 (4)
$\gamma_{14,9}$(Fr)	121,08 (7)	0,022 (6)	(E1)	0,233 (4)	0,0490 (7)	0,01176 (17)	0,298 (4)
$\gamma_{11,6}$(Fr)	123,75 (4)	0,112 (8)	[E1]	0,221 (4)	0,0463 (7)	0,0111 (2)	0,282 (4)
$\gamma_{11,5}$(Fr)	124,81 (3)	0,205 (13)	M1+E2	3,87	1,593	0,409	6,01
$\gamma_{12,7}$(Fr)	126,12 (5)	0,0100 (9)	(E1)	0,212 (3)	0,0440 (7)	0,0106 (2)	0,270 (4)
$\gamma_{15,9}$(Fr)	129,22 (7)	0,016 (9)	[M1,E2]	3 (3)	1,5 (5)	0,39 (15)	5 (2)
$\gamma_{12,6}$(Fr)	133,62 (3)	0,0242 (20)	(E1)	0,184 (3)	0,0379 (6)	0,00907 (13)	0,234 (3)
$\gamma_{12,4}$(Fr)	134,854 (30)	0,0393 (37)	(E1)	0,180 (3)	0,0370 (6)	0,00885 (13)	0,229 (3)
$\gamma_{26,14}$(Fr)	137,4 (1)	0,0023 (3)					
$\gamma_{23,13}$(Fr)	139,6	0,0068 (26)	M1+E2	2,4 (21)	1,1 (3)	0,29 (9)	3,9 (17)
$\gamma_{17,9}$(Fr)	144,73 (22)	0,0022 (6)	(M1+E2)	2,57	0,914	0,232	3,79
$\gamma_{13,7}$(Fr)	145,17 (3)	0,174 (11)	(E1)	0,1513 (22)	0,0305 (5)	0,00730 (11)	0,191 (3)
$\gamma_{9,0}$(Fr)	150,06 (3)	0,815 (14)	E1	0,1397 (20)	0,0280 (4)	0,0067 (1)	0,1766 (25)
$\gamma_{13,6}$(Fr)	152,65 (3)	0,0230 (15)	[E1]	0,1341 (19)	0,0268 (4)	0,00640 (9)	0,1694 (24)
$\gamma_{13,4}$(Fr)	153,925 (30)	0,239 (15)	E1	0,1315 (19)	0,0262 (4)	0,00627 (9)	0,1660 (23)
$\gamma_{10,3}$(Fr)	157,253 (30)	1,73 (18)	M1+E2	3,1 (4)	0,59 (3)	0,143 (9)	3,8 (3)
$\gamma_{18,9}$(Fr)	161,35 (7)	0,013 (6)	[M1,E2]	1,6 (14)	0,64 (10)	0,16 (4)	2,5 (13)
$\gamma_{23,11}$(Fr)	169,18 (4)	0,037 (20)	[M1,E2]	1,4 (12)	0,53 (6)	0,136 (24)	2,1 (11)
$\gamma_{10,1}$(Fr)	169,9	0,0139 (14)					
$\gamma_{15,7}$(Fr)	170,77 (5)	0,015 (8)	(E1)	0,1026 (15)	0,0201 (3)	0,00479 (7)	0,1290 (18)
$\gamma_{15,6}$(Fr)	178,31 (3)	0,0180 (13)	E1	0,0925 (13)	0,0180 (3)	0,00429 (6)	0,1162 (16)
$\gamma_{16,7}$(Fr)	179,78 (4)	0,030 (11)	(M1,E2)	1,2 (10)	0,43 (3)	0,109 (14)	1,8 (10)
$\gamma_{11,3}$(Fr)	186,1	0,0127 (14)					
$\gamma_{17,7}$(Fr)	186,29 (3)	0,0046 (6)	E1	0,0834 (12)	0,01607 (23)	0,00383 (6)	0,1045 (15)
$\gamma_{16,6}$(Fr)	187,23	0,0103 (7)					
$\gamma_{11,2}$(Fr)	187,97 (3)	0,584 (33)	E1	0,0816 (12)	0,01571 (22)	0,00375 (6)	0,1023 (14)
$\gamma_{10,0}$(Fr)	195,75 (3)	0,37 (9)	M1+E2	1,1 (6)	0,314 (5)	0,079 (4)	1,5 (6)

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{23,10}$(Fr)	197,50 (3)	0,0284 (33)	E1	0,0726 (11)	0,01386 (20)	0,00331 (5)	0,0908 (13)
$\gamma_{12,2}$(Fr)	197,72 (12)	0,041 (5)	[E1]	0,0724 (11)	0,01382 (20)	0,00330 (5)	0,0906 (13)
$\gamma_{11,1}$(Fr)	198,51 (21)	0,0205 (14)	[E1]	0,0718 (11)	0,01369 (20)	0,00327 (5)	0,0898 (13)
$\gamma_{29,13}$(Fr)	205,19 (12)	0,0015 (5)					
$\gamma_{13,2}$(Fr)	216,90 (3)	0,343 (21)	(E1)	0,0582 (9)	0,01096 (16)	0,00261 (4)	0,0726 (10)
$\gamma_{19,4}$(Fr)	220,43 (8)	0,0060 (18)					
$\gamma_{11,0}$(Fr)	224,67 (3)	0,119 (9)	[E1]	0,0537 (8)	0,01005 (14)	0,00239 (4)	0,0669 (9)
$\gamma_{13,1}$(Fr)	228,2 (4)	0,0046 (12)					
$\gamma_{41,32}$(Fr)	231,19 (7)	0,012 (7)	(M1)	1,079 (16)	0,197 (3)	0,0468 (7)	1,338 (19)
$\gamma_{14,2}$(Fr)	236,0 (6)	0,0017 (3)					
$\gamma_{20,4}$(Fr)	238,64 (8)	0,0022 (7)	(M1)	0,988 (14)	0,180 (3)	0,0428 (6)	1,225 (17)
$\gamma_{15,3}$(Fr)	240,69 (3)	0,0124 (11)	[E1]	0,0457 (7)	0,00847 (12)	0,00202 (3)	0,0568 (8)
$\gamma_{23,9}$(Fr)	243,13 (5)	0,0067 (9)	[M1]	0,938 (14)	0,1707 (24)	0,0407 (6)	1,163 (16)
$\gamma_{16,3}$(Fr)	249,60 (3)	0,0170 (13)	(E2)	0,1033 (15)	0,1145 (16)	0,0305 (5)	0,258 (4)
$\gamma_{13,0}$(Fr)	253,48 (3)	0,139 (8)	[E1]	0,0405 (6)	0,00747 (11)	0,001776 (25)	0,0504 (7)
$\gamma_{17,3}$(Fr)	256,1 (2)	0,00039 (7)	[E1]	0,0396 (6)	0,00729 (11)	0,001733 (25)	0,0492 (7)
$\gamma_{15,0}$(Fr)	279,21 (3)	0,0317 (23)	E1	0,0325 (5)	0,00591 (9)	0,001405 (20)	0,0403 (6)
$\gamma_{36,21}$(Fr)	282,11 (20)	0,00097 (9)	[M1]	0,622 (9)	0,1129 (16)	0,0269 (4)	0,771 (11)
$\gamma_{23,7}$(Fr)	284,78 (3)	0,0077 (6)	[E1]	0,0311 (5)	0,00564 (8)	0,001340 (19)	0,0385 (5)
$\gamma_{33,13}$(Fr)	298,33 (5)						
$\gamma_{25,7}$(Fr)	298,33 (5)	0,0028 (7)	(M1,E2)	0,30 (24)	0,077 (20)	0,019 (4)	0,4 (3)
$\gamma_{33,12}$(Fr)	317,23 (18)		E1	0,0244 (4)	0,00437 (7)	0,001037 (15)	0,0302 (4)
$\gamma_{34,13}$(Fr)	317,23 (18)	0,00065 (33)	M1	0,451 (7)	0,0816 (12)	0,0194 (3)	0,558 (8)
$\gamma_{32,10}$(Fr)	321,77 (4)						
$\gamma_{27,6}$(Fr)	321,77 (4)	0,00340 (41)	[E1]	0,0237 (4)	0,00423 (6)	0,001003 (14)	0,0292 (4)
$\gamma_{21,0}$(Fr)	348,35 (5)	0,0030 (3)					
$\gamma_{23,3}$(Fr)	354,57 (6)	0,0020 (7)	[E1]	0,0191 (3)	0,00338 (5)	0,000800 (12)	0,0236 (3)
$\gamma_{33,10}$(Fr)	356,6	0,00026 (11)					
$\gamma_{24,3}$(Fr)	362,394 (30)	0,0055 (5)	(E1)	0,0182 (3)	0,00321 (6)	0,0007610 (11)	0,0225 (3)
$\gamma_{22,0}$(Fr)	367,74 (12)	0,00052 (18)					
$\gamma_{34,10}$(Fr)	375,03 (5)	0,0019 (5)	[E1]	0,01694 (24)	0,00297 (5)	0,000704 (10)	0,0209 (3)
$\gamma_{31,7}$(Fr)	388,10 (7)	0,00125 (21)					
$\gamma_{37,12}$(Fr)	403,13 (10)	0,00019 (16)					
$\gamma_{33,8}$(Fr)	406,06 (3)	0,0079 (5)	[E1]	0,01432 (20)	0,00249 (4)	0,000589 (9)	0,01759 (25)
$\gamma_{32,5}$(Fr)	417,92 (2)	0,0056 (5)					
$\gamma_{47,27}$(Fr)	429,80 (18)	0,00038 (19)					
$\gamma_{36,10}$(Fr)	434,82 (5)	0,0029 (3)					
$\gamma_{40,14}$(Fr)	442,16 (8)	0,0045 (7)					
$\gamma_{30,3}$(Fr)	443,43 (10)	0,0001					
$\gamma_{33,7}$(Fr)	443,44 (10)	0,0015 (5)	[E2]	0,0310 (5)	0,0137 (2)	0,00353 (5)	0,0494 (7)
$\gamma_{28,0}$(Fr)	446,31 (10)	0,0006 (4)					
$\gamma_{33,6}$(Fr)	451,04 (5)	0,0036 (6)	[M1]	0,1739 (25)	0,0312 (5)	0,00742 (11)	0,215 (3)
$\gamma_{33,4}$(Fr)	452,24 (3)	0,13 (1)	[M1]	0,1727 (25)	0,0310 (5)	0,00737 (11)	0,213 (3)
$\gamma_{29,0}$(Fr)	458,79 (8)	0,00053 (13)					
$\gamma_{34,7}$(Fr)	462,43 (13)	0,00045 (11)	[E1]	0,01092 (16)	0,00187 (3)	0,000442 (7)	0,01338 (19)
$\gamma_{34,6}$(Fr)	469,48 (5)	0,0028 (4)					
$\gamma_{32,2}$(Fr)	480,95 (11)	0,0340 (22)					
$\gamma_{32,1}$(Fr)	491,45 (10)	0,00035 (14)					
$\gamma_{31,0}$(Fr)	496,9 (3)	0,0015 (7)					
$\gamma_{45,19}$(Fr)	498,6 (6)	0,00083 (21)					
$\gamma_{33,3}$(Fr)	512,5 (7)	0,00055 (21)					
$\gamma_{33,2}$(Fr)	515,27 (3)	0,0246 (15)	[M1]	0,1219 (17)	0,0218 (3)	0,00518 (8)	0,1506 (21)
$\gamma_{32,0}$(Fr)	517,64 (3)	0,0159 (10)					
$\gamma_{36,7}$(Fr)	522,17 (4)	0,00208 (15)					
$\gamma_{33,1}$(Fr)	525,95 (17)	0,0403 (25)	[M1]	0,1154 (17)	0,0206 (3)	0,00490 (7)	0,1425 (20)
$\gamma_{36,6}$(Fr)	529,64 (3)	0,0076 (7)					
$\gamma_{36,4}$(Fr)	530,89 (4)	0,0047 (5)					
$\gamma_{34,3}$(Fr)	532,12 (9)	0,00077 (21)	[E1]	0,00823 (12)	0,001389 (20)	0,000327 (5)	0,01005 (14)
$\gamma_{37,4}$(Fr)	538,1 (1)	0,0038 (10)					

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{43,12}$(Fr)	545,8 (6)	0,00053 (14)					
$\gamma_{33,0}$(Fr)	551,81 (3)	0,0059 (16)	[M1]	0,1016 (15)	0,0181 (3)	0,00431 (6)	0,1254 (17)
$\gamma_{35,2}$(Fr)	564,34 (11)	0,00022 (9)					
$\gamma_{40,8}$(Fr)	567,48 (5)	0,0012 (4)					
$\gamma_{34,0}$(Fr)	570,86 (3)	0,0040 (5)	[E1]	0,00716 (10)	0,001201 (17)	0,000283 (4)	0,00874 (12)
$\gamma_{36,3}$(Fr)	590,45 (5)	0,00083 (14)					
$\gamma_{36,2}$(Fr)	594,05 (4)	0,0029 (3)					
$\gamma_{37,2}$(Fr)	600,94 (3)	0,006					
$\gamma_{35,0}$(Fr)	600,94 (3)	0,0024 (5)					
$\gamma_{41,8}$(Fr)	603,13 (4)	0,00173 (21)					
$\gamma_{43,9}$(Fr)	628,95 (10)	0,00032 (7)					
$\gamma_{37,0}$(Fr)	637,1 (7)	0,00012					
$\gamma_{38,0}$(Fr)	645,94 (12)	0,00015 (5)					
$\gamma_{41,5}$(Fr)	649,07 (4)	0,0017 (5)					
$\gamma_{47,10}$(Fr)	656,29 (11)	0,00049 (21)					
$\gamma_{42,7}$(Fr)	657,89 (5)	0,0014 (3)					
$\gamma_{42,4}$(Fr)	667,18 (8)	0,0021 (18)					
$\gamma_{46,9}$(Fr)	674,9 (3)	0,00010 (5)					
$\gamma_{39,0}$(Fr)	679,53 (6)	0,00066 (12)					
$\gamma_{43,5}$(Fr)	679,57 (6)						
$\gamma_{47,9}$(Fr)	702,02 (14)	0,00016 (7)					
$\gamma_{48,10}$(Fr)	747,0 (1)	0,0011 (4)					
$\gamma_{47,4}$(Fr)	752,48 (12)	0,00026 (7)					
$\gamma_{43,1}$(Fr)	754,09 (13)	0,00023 (7)					
$\gamma_{42,0}$(Fr)	767,9 (3)	0,00030 (6)					
$\gamma_{43,0}$(Fr)	780,6 (6)	0,000055 (14)					
$\gamma_{44,0}$(Fr)	808,48 (10)	0,0021 (3)					
$\gamma_{46,0}$(Fr)	824,2 (7)	0,000049					

3 Atomic Data

3.1 Fr

ω_K	:	0,967	(4)
$\bar{\omega}_L$	:	0,440	(18)
n_{KL}	:	0,803	(5)

3.1.1 X Radiations

		Energy keV		Relative probability
X_K				
	$K\alpha_2$	83,23		60,92
	$K\alpha_1$	86,10		100
	$K\beta_3$	96,815	}	
	$K\beta_1$	97,474	}	
	$K\beta_5''$	98,069	}	34,88
	$K\beta_2$	100,16	}	
	$K\beta_4$	100,548	}	11,3
	$KO_{2,3}$	100,972	}	
X_L				
	$L\ell$	10,380		
	$L\alpha$	11,89 – 12,03		
	$L\eta$	13,254		
	$L\beta$	13,877 – 15,639		
	$L\gamma$	16,752 – 17,799		

3.1.2 Auger Electrons

	Energy keV	Relative probability
Auger K		
KLL	63,576 – 70,787	100
KLX	77,720 – 86,101	57,4
KXY	91,84 – 101,12	8,24
Auger L	5,73 – 18,52	

4 α Emissions

	Energy keV	Probability × 100
$\alpha_{0,48}$	4903,6 (14)	0,0011 (4)
$\alpha_{0,47}$	4992,7 (14)	0,0013 (3)
$\alpha_{0,46}$	5019,3 (14)	0,00015 (5)
$\alpha_{0,45}$	5025,5 (14)	0,00083 (21)
$\alpha_{0,44}$	5035,5 (14)	0,0021 (3)
$\alpha_{0,43}$	5064,1 (14)	0,00114 (18)
$\alpha_{0,42}$	5076,8 (14)	0,0038 (19)
$\alpha_{0,41}$	5094,1 (14)	0,015 (7)
$\alpha_{0,40}$	5129,0 (14)	0,0058 (8)
$\alpha_{0,39}$	5162,1 (14)	0,00066 (12)
$\alpha_{0,38}$	5195,1 (14)	0,00015 (5)
$\alpha_{0,37}$	5203,3 (14)	0,0101 (10)
$\alpha_{0,36}$	5210,2 (14)	0,022 (1)
$\alpha_{0,35}$	5239,3 (14)	0,0026 (5)
$\alpha_{0,34}$	5269,1 (14)	0,048 (19)
$\alpha_{0,33}$	5287,6 (14)	0,214 (10)
$\alpha_{0,32}$	5321,2 (14)	0,007 (7)
$\alpha_{0,31}$	5341,9 (14)	0,0027 (8)
$\alpha_{0,30}$	5356,2 (14)	0,000097 (2)
$\alpha_{0,29}$	5379,0 (14)	0,0020 (5)
$\alpha_{0,28}$	5391,2 (14)	0,0006 (4)
$\alpha_{0,27}$	5414,5 (14)	0,0030 (4)
$\alpha_{0,26}$	5428,3 (14)	0,0023 (3)
$\alpha_{0,25}$	5430,1 (14)	0,0028 (8)
$\alpha_{0,24}$	5435,8 (14)	0,0083 (6)
$\alpha_{0,23}$	5443,3 (14)	0,098 (19)
$\alpha_{0,22}$	5468,4 (14)	0,00052 (18)
$\alpha_{0,21}$	5487,4 (14)	0,0020 (3)
$\alpha_{0,20}$	5497,4 (14)	0,0022 (7)
$\alpha_{0,19}$	5515,2 (14)	0,0052 (19)
$\alpha_{0,18}$	5523,7 (14)	0,013 (6)
$\alpha_{0,17}$	5540,1 (14)	0,0072 (8)
$\alpha_{0,16}$	5546,5 (14)	0,055 (12)
$\alpha_{0,15}$	5555,3 (14)	0,084 (10)
$\alpha_{0,14}$	5563,3 (14)	0,017 (7)
$\alpha_{0,13}$	5580,5 (14)	0,95 (4)
$\alpha_{0,12}$	5599,3 (14)	0,114 (7)
$\alpha_{0,11}$	5609,0 (14)	1,09 (5)
$\alpha_{0,10}$	5637,3 (14)	4,16 (23)
$\alpha_{0,9}$	5682,2 (14)	1,31 (4)
$\alpha_{0,8}$	5686,4 (14)	0,021 (14)
$\alpha_{0,7}$	5723,1 (14)	2,03 (23)
$\alpha_{0,6}$	5730,5 (14)	1,6 (3)
$\alpha_{0,5}$	5731,6 (14)	1,24 (10)
$\alpha_{0,4}$	5731,9 (17)	9,0 (5)

	Energy keV	Probability × 100
$\alpha_{0,3}$	5791,7 (14)	6,2 (9)
$\alpha_{0,2}$	5793,1 (21)	18,9 (20)
$\alpha_{0,1}$	5804,2 (14)	0,3
$\alpha_{0,0}$	5829,6 (14)	52,4 (24)

5 Electron Emissions

		Energy keV			Electrons per 100 disint.
e_{AL}	(Fr)	5,73	-	18,52	23,8 (12)
e_{AK}	(Fr)				0,115 (9)
	KLL	63,576	-	70,787	}
	KLX	77,720	-	86,101	}
	KXY	91,84	-	101,12	}
$ec_{13,9\ K}$	(Fr)	2,4		(1)	0,015 (7)
$ec_{7,0\ K}$	(Fr)	7,27		(3)	1,84 (15)
$ec_{7,0\ T}$	(Fr)	7,3	-	108,3	2,62 (18)
$ec_{1,0\ L}$	(Fr)	7,39	-	11,00	7,0 (9)
$ec_{9,3\ K}$	(Fr)	10,40		(3)	0,088 (6)
$ec_{2,0\ L}$	(Fr)	18,06	-	21,66	14,6 (12)
$ec_{8,1\ K}$	(Fr)	18,72		(3)	0,0191 (12)
$ec_{3,0\ L}$	(Fr)	19,95	-	23,56	6,7 (6)
$ec_{1,0\ M}$	(Fr)	21,38	-	23,03	1,88 (25)
$ec_{11,6\ K}$	(Fr)	22,62		(4)	0,0192 (14)
$ec_{11,5\ K}$	(Fr)	23,68		(3)	0,113 (7)
$ec_{1,0\ N}$	(Fr)	24,87	-	25,77	0,49 (7)
$ec_{9,5\ L}$	(Fr)	31,6	-	35,2	0,1080 (16)
$ec_{2,0\ M}$	(Fr)	32,05	-	33,70	3,93 (33)
$ec_{3,0\ M}$	(Fr)	33,94	-	35,59	1,81 (17)
$ec_{2,0\ N}$	(Fr)	35,54	-	36,44	1,02 (9)
$ec_{3,0\ N}$	(Fr)	37,43	-	38,33	0,474 (45)
$ec_{6,3\ L}$	(Fr)	44,0	-	47,6	0,32 (7)
$ec_{13,7\ K}$	(Fr)	44,04		(3)	0,0221 (14)
$ec_{4,2\ L}$	(Fr)	44,32	-	47,92	4,04 (25)
$ec_{9,5\ M}$	(Fr)	45,6	-	47,2	0,02914 (43)
$ec_{6,2\ L}$	(Fr)	45,637	-	49,246	0,80 (16)
$ec_{9,0\ K}$	(Fr)	48,93		(2)	0,0968 (22)
$ec_{7,3\ L}$	(Fr)	51,22	-	54,82	0,166 (42)
$ec_{13,4\ K}$	(Fr)	52,80		(3)	0,0270 (18)
$ec_{7,2\ L}$	(Fr)	53,10	-	56,71	0,411 (41)

		Energy keV			Electrons per 100 disint.
$ec_{4,1\ L}$	(Fr)	54,91	-	58,52	0,52 (14)
$ec_{5,1\ L}$	(Fr)	55,23	-	58,84	0,0562 (43)
$ec_{10,3\ K}$	(Fr)	56,12		(3)	1,12 (17)
$ec_{6,1\ L}$	(Fr)	56,2	-	59,8	0,136 (27)
$ec_{6,3\ M}$	(Fr)	58,0	-	59,6	0,086 (20)
$ec_{4,2\ M}$	(Fr)	58,31	-	59,96	0,96 (6)
$ec_{6,2\ M}$	(Fr)	59,627	-	61,277	0,207 (42)
$ec_{11,8\ L}$	(Fr)	60,2	-	63,8	0,053 (8)
$ec_{7,3\ M}$	(Fr)	65,21	-	66,86	0,045 (11)
$ec_{7,2\ M}$	(Fr)	67,09	-	68,74	0,111 (11)
$ec_{23,11\ K}$	(Fr)	68,05		(4)	0,017 (16)
$ec_{7,3\ N}$	(Fr)	68,7	-	69,6	0,0118 (30)
$ec_{10,7\ L}$	(Fr)	68,78	-	72,38	0,86 (6)
$ec_{4,1\ M}$	(Fr)	68,90	-	70,55	0,142 (37)
$ec_{5,1\ M}$	(Fr)	69,22	-	70,87	0,0136 (10)
$ec_{6,1\ M}$	(Fr)	70,19	-	71,84	0,035 (7)
$ec_{7,2\ N}$	(Fr)	70,58	-	71,48	0,0292 (29)
$ec_{11,8\ M}$	(Fr)	74,2	-	75,8	0,0125 (19)
$ec_{10,6\ L}$	(Fr)	76,3	-	79,9	0,261 (25)
$ec_{10,5\ L}$	(Fr)	77,53	-	81,13	0,149 (46)
$ec_{16,7\ K}$	(Fr)	78,65		(4)	0,013 (11)
$ec_{4,0\ L}$	(Fr)	81,02	-	84,62	1,76 (13)
$ec_{5,0\ L}$	(Fr)	81,28	-	84,88	0,088 (7)
$ec_{6,0\ L}$	(Fr)	82,3	-	85,9	0,33 (14)
$ec_{10,7\ M}$	(Fr)	82,77	-	84,42	0,204 (15)
$ec_{13,9\ L}$	(Fr)	84,85	-	88,46	0,011 (6)
$ec_{11,2\ K}$	(Fr)	86,84		(3)	0,0432 (25)
$ec_{7,0\ L}$	(Fr)	89,8	-	93,4	0,586 (48)
$ec_{10,6\ M}$	(Fr)	90,3	-	91,9	0,062 (6)
$ec_{10,5\ M}$	(Fr)	91,52	-	93,17	0,040 (13)
$ec_{9,3\ L}$	(Fr)	92,9	-	96,5	0,0191 (13)
$ec_{10,0\ K}$	(Fr)	94,62		(3)	0,16 (9)
$ec_{4,0\ M}$	(Fr)	95,01	-	96,66	0,426 (32)
$ec_{5,0\ M}$	(Fr)	95,27	-	96,92	0,0212 (16)
$ec_{6,0\ M}$	(Fr)	96,3	-	97,9	0,086 (39)
$ec_{7,0\ M}$	(Fr)	103,8	-	105,4	0,148 (14)
$ec_{11,5\ L}$	(Fr)	106,18	-	109,78	0,0465 (29)
$ec_{7,0\ N}$	(Fr)	107,3	-	108,2	0,0388 (33)
$ec_{13,2\ K}$	(Fr)	115,77		(3)	0,0186 (12)
$ec_{11,5\ M}$	(Fr)	120,17	-	121,82	0,0119 (7)
$ec_{9,0\ L}$	(Fr)	131,43	-	135,04	0,01940 (44)
$ec_{10,3\ L}$	(Fr)	138,619	-	142,228	0,212 (21)
$ec_{10,3\ M}$	(Fr)	152,609	-	154,259	0,051 (5)
$ec_{10,0\ L}$	(Fr)	177,12	-	180,72	0,0465 (29)
$ec_{10,0\ M}$	(Fr)	191,11	-	192,76	0,0117 (9)
$ec_{33,4\ K}$	(Fr)	351,11		(3)	0,0185 (14)

6 Photon Emissions

6.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(Fr)	10,380 — 17,799		18,7 (9)	
$XK\alpha_2$	(Fr)	83,23		1,00 (8)	} $K\alpha$
$XK\alpha_1$	(Fr)	86,1		1,64 (12)	}
$XK\beta_3$	(Fr)	96,815	}		
$XK\beta_1$	(Fr)	97,474	}	0,57 (5)	$K'\beta_1$
$XK\beta_5''$	(Fr)	98,069	}		
$XK\beta_2$	(Fr)	100,16	}		
$XK\beta_4$	(Fr)	100,548	}	0,19 (2)	$K'\beta_2$
$XKO_{2,3}$	(Fr)	100,972	}		

6.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{2,1}$(Fr)	10,6	0,015 (2)
$\gamma_{1,0}$(Fr)	26,0 (1)	0,00159 (21)
$\gamma_{2,0}$(Fr)	36,69 (3)	0,0181 (15)
$\gamma_{3,0}$(Fr)	38,58 (4)	0,0107 (10)
$\gamma_{8,4}$(Fr)	46,24 (5)	0,0049 (7)
$\gamma_{9,6}$(Fr)	49,12 (4)	0,0080 (8)
$\gamma_{9,5}$(Fr)	50,2	0,00062
$\gamma_{34,32}$(Fr)	53,4 (4)	0,004
$\gamma_{13,10}$(Fr)	57,71 (4)	0,0051 (8)
$\gamma_{6,3}$(Fr)	62,6 (3)	0,0053 (12)
$\gamma_{4,2}$(Fr)	62,94 (3)	0,49 (3)
$\gamma_{5,2}$(Fr)	63,5 (3)	0,021 (3)
$\gamma_{6,2}$(Fr)	64,27 (3)	0,047 (4)
$\gamma_{7,3}$(Fr)	69,86 (5)	0,0047 (12)
$\gamma_{7,2}$(Fr)	71,71 (4)	0,0132 (13)
$\gamma_{4,1}$(Fr)	73,55 (9)	0,019 (5)
$\gamma_{5,1}$(Fr)	73,85 (3)	0,309 (23)
$\gamma_{6,1}$(Fr)	74,82 (5)	0,015 (3)
$\gamma_{11,8}$(Fr)	78,8	0,0123 (19)
$\gamma_{10,7}$(Fr)	87,41 (3)	0,271 (19)
$\gamma_{10,6}$(Fr)	94,90 (2)	0,105 (10)
$\gamma_{10,5}$(Fr)	96,16 (5)	0,033 (7)
$\gamma_{4,0}$(Fr)	99,67 (5)	0,76 (5)

	Energy keV	Photons per 100 disint.
$\gamma_{5,0}$(Fr)	99,89 (6)	1,08 (8)
$\gamma_{6,0}$(Fr)	100,86 (4)	0,096 (8)
$\gamma_{13,9}$(Fr)	103,48 (10)	0,0030 (7)
$\gamma_{7,0}$(Fr)	108,38 (3)	0,255 (16)
$\gamma_{9,3}$(Fr)	111,52 (3)	0,313 (21)
$\gamma_{24,16}$(Fr)	112,80 (2)	0,0021 (3)
$\gamma_{23,15}$(Fr)	114	0,00087 (13)
$\gamma_{8,1}$(Fr)	119,85 (3)	0,080 (5)
$\gamma_{14,9}$(Fr)	121,06 (7)	0,017 (5)
$\gamma_{11,6}$(Fr)	123,75 (4)	0,087 (6)
$\gamma_{11,5}$(Fr)	124,81 (3)	0,0292 (18)
$\gamma_{12,7}$(Fr)	126,10 (5)	0,0079 (7)
$\gamma_{15,9}$(Fr)	129,22 (7)	0,0027 (5)
$\gamma_{12,6}$(Fr)	133,60 (3)	0,0196 (16)
$\gamma_{12,4}$(Fr)	134,85 (3)	0,032 (3)
$\gamma_{26,14}$(Fr)	137,4 (1)	0,0023 (3)
$\gamma_{23,13}$(Fr)	139,6	0,00139 (21)
$\gamma_{17,9}$(Fr)	144,7 (2)	0,00046 (12)
$\gamma_{13,7}$(Fr)	145,15 (3)	0,146 (9)
$\gamma_{9,0}$(Fr)	150,05 (3)	0,693 (12)
$\gamma_{13,6}$(Fr)	152,64 (3)	0,0197 (13)
$\gamma_{13,4}$(Fr)	153,92 (3)	0,205 (13)
$\gamma_{10,3}$(Fr)	157,25 (3)	0,36 (3)
$\gamma_{18,9}$(Fr)	161,35 (7)	0,0036 (9)
$\gamma_{23,11}$(Fr)	169,18 (4)	0,012 (5)
$\gamma_{10,1}$(Fr)	169,9	0,0139 (14)
$\gamma_{15,7}$(Fr)	170,77 (5)	0,013 (7)
$\gamma_{15,6}$(Fr)	178,29 (3)	0,0161 (12)
$\gamma_{16,7}$(Fr)	179,78 (4)	0,0108 (8)
$\gamma_{11,3}$(Fr)	186,1	0,0127 (14)
$\gamma_{17,7}$(Fr)	186,29 (3)	0,0042 (5)
$\gamma_{16,6}$(Fr)	187,2	0,0103 (7)
$\gamma_{11,2}$(Fr)	187,96 (3)	0,53 (3)
$\gamma_{10,0}$(Fr)	195,74 (3)	0,148 (9)
$\gamma_{23,10}$(Fr)	197,50 (3)	0,026 (3)
$\gamma_{12,2}$(Fr)	197,7 (1)	0,038 (5)
$\gamma_{11,1}$(Fr)	198,47 (23)	0,0188 (13)
$\gamma_{29,13}$(Fr)	205,07 (11)	0,0015 (5)
$\gamma_{13,2}$(Fr)	216,89 (3)	0,32 (2)
$\gamma_{19,4}$(Fr)	220,43 (8)	0,0060 (18)
$\gamma_{11,0}$(Fr)	224,59 (3)	0,112 (8)
$\gamma_{13,1}$(Fr)	228,2 (4)	0,0046 (12)
$\gamma_{41,32}$(Fr)	231,16 (7)	0,005 (3)
$\gamma_{14,2}$(Fr)	236,0 (6)	0,0017 (3)
$\gamma_{20,4}$(Fr)	238,64 (8)	0,0010 (3)
$\gamma_{15,3}$(Fr)	240,68 (3)	0,0117 (10)
$\gamma_{23,9}$(Fr)	243,12 (5)	0,0031 (4)

	Energy keV	Photons per 100 disint.
$\gamma_{16,3}$(Fr)	249,60 (3)	0,0135 (10)
$\gamma_{13,0}$(Fr)	253,46 (3)	0,132 (8)
$\gamma_{17,3}$(Fr)	256,0 (2)	0,00037 (7)
$\gamma_{15,0}$(Fr)	279,18 (3)	0,0305 (22)
$\gamma_{36,21}$(Fr)	282,1 (2)	0,00055 (5)
$\gamma_{23,7}$(Fr)	284,75 (3)	0,0074 (6)
$\gamma_{25,7}$(Fr)	298,33 (5)	0,0020 (3)
$\gamma_{34,13}$(Fr)	317,23 (18)	0,00042 (21)
$\gamma_{27,6}$(Fr)	321,77 (4)	0,0033 (4)
$\gamma_{21,0}$(Fr)	348,33 (5)	0,0030 (3)
$\gamma_{23,3}$(Fr)	354,56 (6)	0,0020 (7)
$\gamma_{33,10}$(Fr)	356,6	0,00026 (11)
$\gamma_{24,3}$(Fr)	362,38 (3)	0,0054 (5)
$\gamma_{22,0}$(Fr)	367,74 (12)	0,00052 (18)
$\gamma_{34,10}$(Fr)	374,98 (5)	0,0019 (5)
$\gamma_{31,7}$(Fr)	388,07 (7)	0,00125 (21)
$\gamma_{37,12}$(Fr)	403,13 (10)	0,00019 (16)
$\gamma_{33,8}$(Fr)	405,95 (3)	0,0078 (5)
$\gamma_{32,5}$(Fr)	417,90 (2)	0,0056 (5)
$\gamma_{47,27}$(Fr)	429,80 (18)	0,00038 (19)
$\gamma_{36,10}$(Fr)	434,82 (5)	0,0029 (3)
$\gamma_{40,14}$(Fr)	442,16 (8)	0,0045 (7)
$\gamma_{33,7}$(Fr)	443,43 (10)	0,0014 (5)
$\gamma_{30,3}$(Fr)	443,43 (10)	0,0001
$\gamma_{28,0}$(Fr)	446,31 (10)	0,0006 (4)
$\gamma_{33,6}$(Fr)	451,04 (5)	0,0030 (5)
$\gamma_{33,4}$(Fr)	452,23 (3)	0,107 (8)
$\gamma_{29,0}$(Fr)	458,79 (8)	0,00053 (13)
$\gamma_{34,7}$(Fr)	462,43 (13)	0,00044 (11)
$\gamma_{34,6}$(Fr)	469,48 (5)	0,0028 (4)
$\gamma_{32,2}$(Fr)	480,85 (11)	0,0340 (22)
$\gamma_{32,1}$(Fr)	491,45 (10)	0,00035 (14)
$\gamma_{31,0}$(Fr)	496,9 (3)	0,0015 (7)
$\gamma_{45,19}$(Fr)	498,6 (6)	0,00083 (21)
$\gamma_{33,3}$(Fr)	512,5 (7)	0,00055 (21)
$\gamma_{33,2}$(Fr)	515,13 (3)	0,0214 (13)
$\gamma_{32,0}$(Fr)	517,51 (3)	0,0159 (10)
$\gamma_{36,7}$(Fr)	522,14 (4)	0,00208 (15)
$\gamma_{33,1}$(Fr)	525,94 (17)	0,0353 (22)
$\gamma_{36,6}$(Fr)	529,59 (3)	0,0076 (7)
$\gamma_{36,4}$(Fr)	530,87 (4)	0,0047 (5)
$\gamma_{34,3}$(Fr)	532,11 (9)	0,00076 (21)
$\gamma_{37,4}$(Fr)	538,1 (1)	0,0038 (10)
$\gamma_{43,12}$(Fr)	545,8 (6)	0,00053 (14)
$\gamma_{33,0}$(Fr)	551,79 (3)	0,0052 (14)
$\gamma_{35,2}$(Fr)	564,34 (11)	0,00022 (9)
$\gamma_{40,8}$(Fr)	567,48 (5)	0,0012 (4)

	Energy keV	Photons per 100 disint.
$\gamma_{34,0}$(Fr)	570,69 (3)	0,0040 (5)
$\gamma_{36,3}$(Fr)	590,42 (5)	0,00083 (14)
$\gamma_{36,2}$(Fr)	593,87 (4)	0,0029 (3)
$\gamma_{35,0}$(Fr)	600,92 (3)	0,0024 (5)
$\gamma_{37,2}$(Fr)	600,92 (3)	0,006
$\gamma_{41,8}$(Fr)	603,09 (4)	0,00173 (21)
$\gamma_{43,9}$(Fr)	628,95 (10)	0,00032 (7)
$\gamma_{37,0}$(Fr)	637,1 (7)	0,00012
$\gamma_{38,0}$(Fr)	645,94 (12)	0,00015 (5)
$\gamma_{41,5}$(Fr)	649,03 (4)	0,0017 (5)
$\gamma_{47,10}$(Fr)	656,18 (11)	0,00049 (21)
$\gamma_{42,7}$(Fr)	657,88 (5)	0,0014 (3)
$\gamma_{42,4}$(Fr)	667,14 (8)	0,0021 (18)
$\gamma_{46,9}$(Fr)	674,9 (3)	0,00010 (5)
$\gamma_{39,0}$(Fr)	679,36 (6)	0,00066 (12)
$\gamma_{47,9}$(Fr)	702,00 (14)	0,00016 (7)
$\gamma_{48,10}$(Fr)	747,0 (1)	0,0011 (4)
$\gamma_{47,4}$(Fr)	752,46 (12)	0,00026 (7)
$\gamma_{43,1}$(Fr)	754,04 (13)	0,00023 (7)
$\gamma_{42,0}$(Fr)	767,9 (3)	0,00030 (6)
$\gamma_{43,0}$(Fr)	780,6 (6)	0,000055 (14)
$\gamma_{44,0}$(Fr)	808,48 (10)	0,0021 (3)
$\gamma_{46,0}$(Fr)	824,2 (7)	0,000049

7 Main Production Modes

Ra – 226(d,3n)Ac – 225

Th – 232(p,4n)Ac – 225

U – 233 decay chain

Th – 229 decay chain

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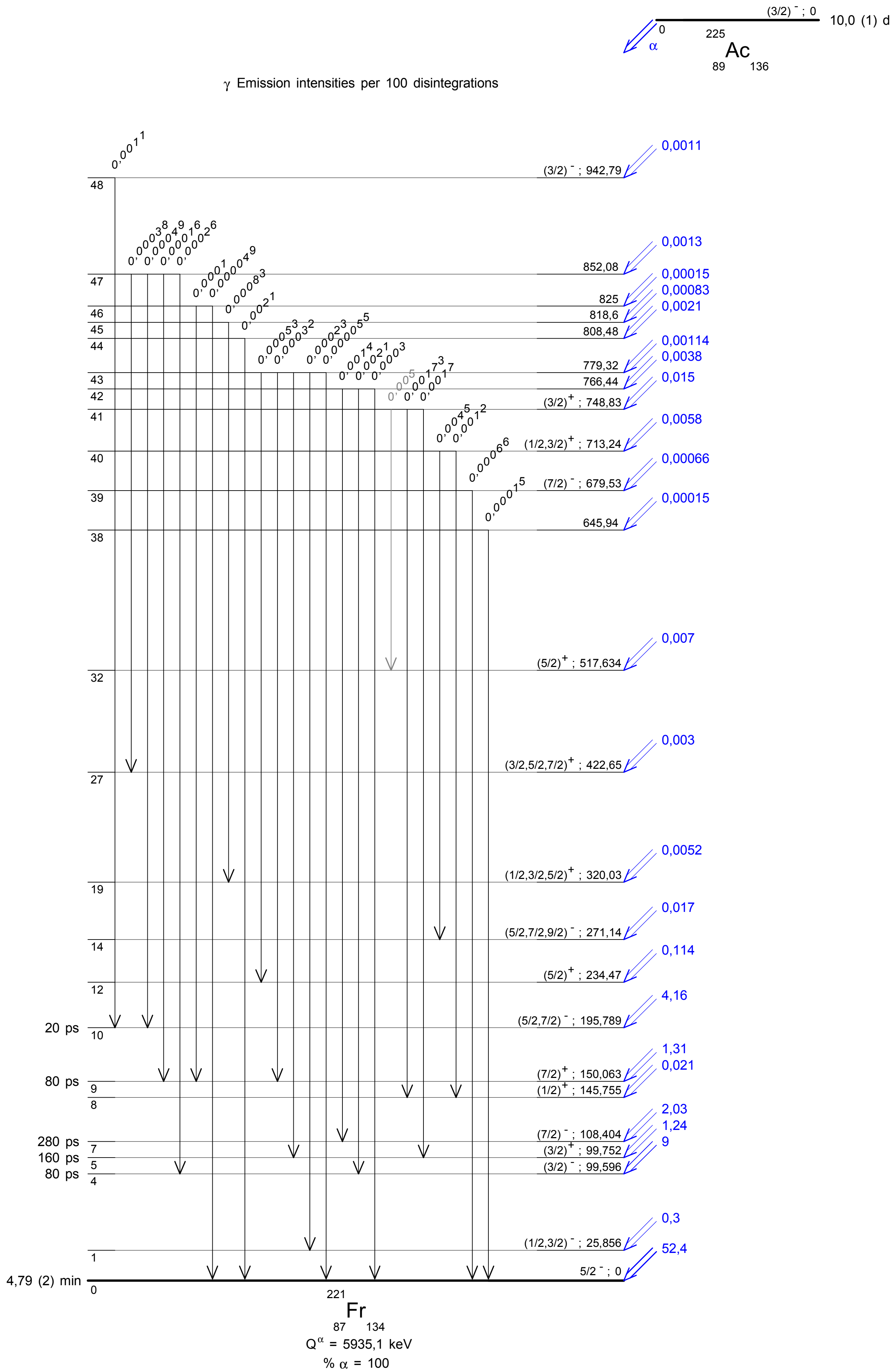
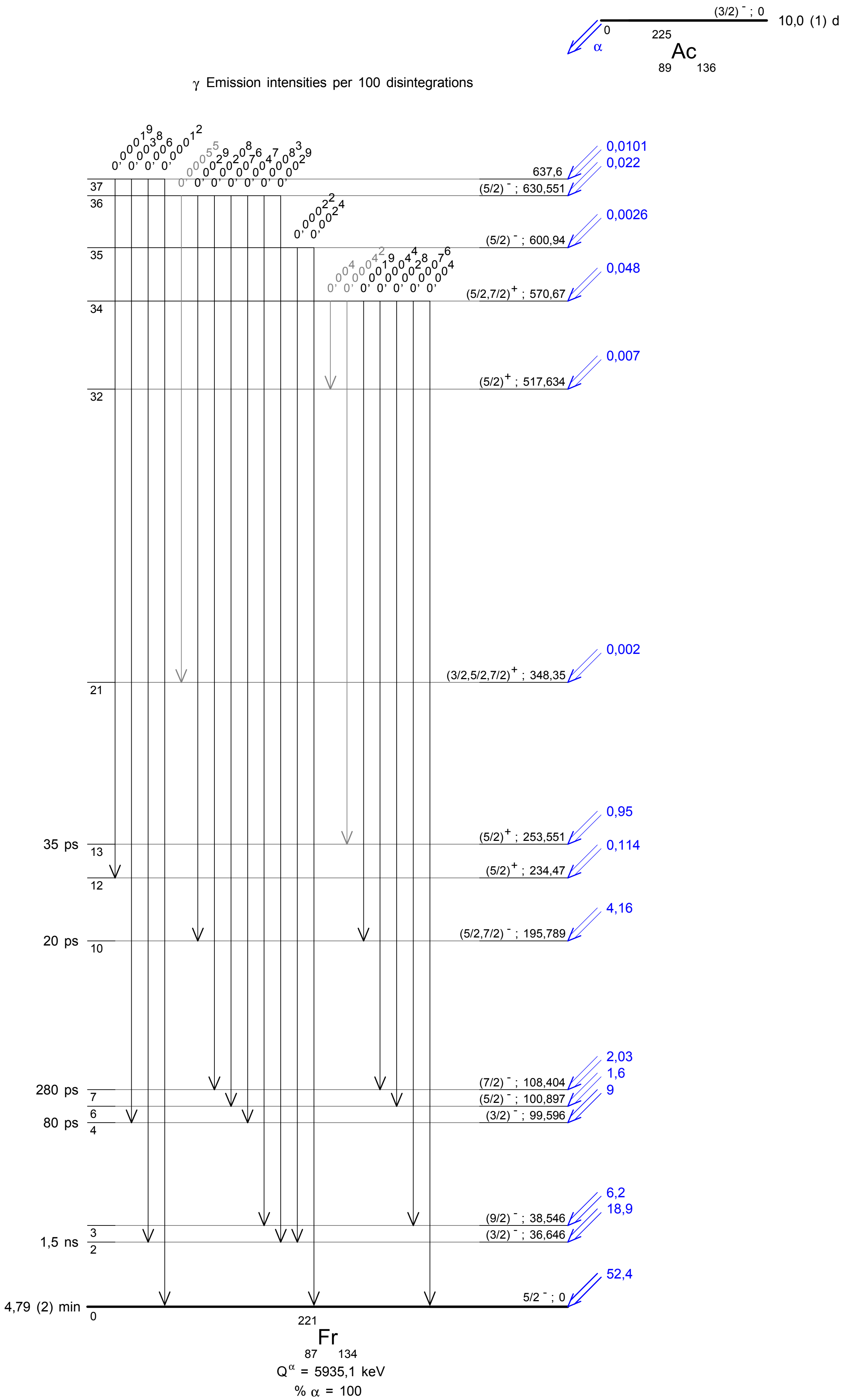
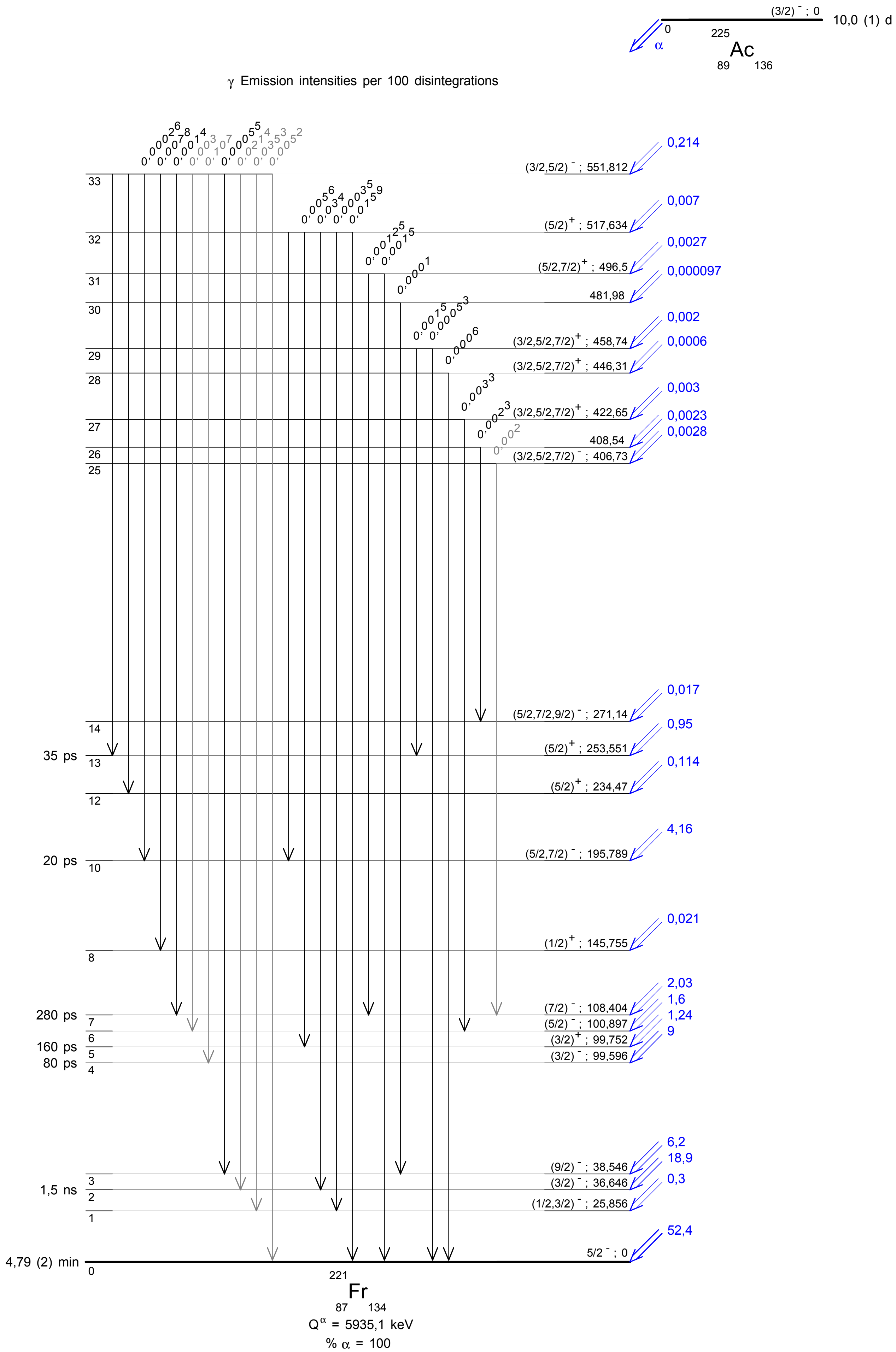
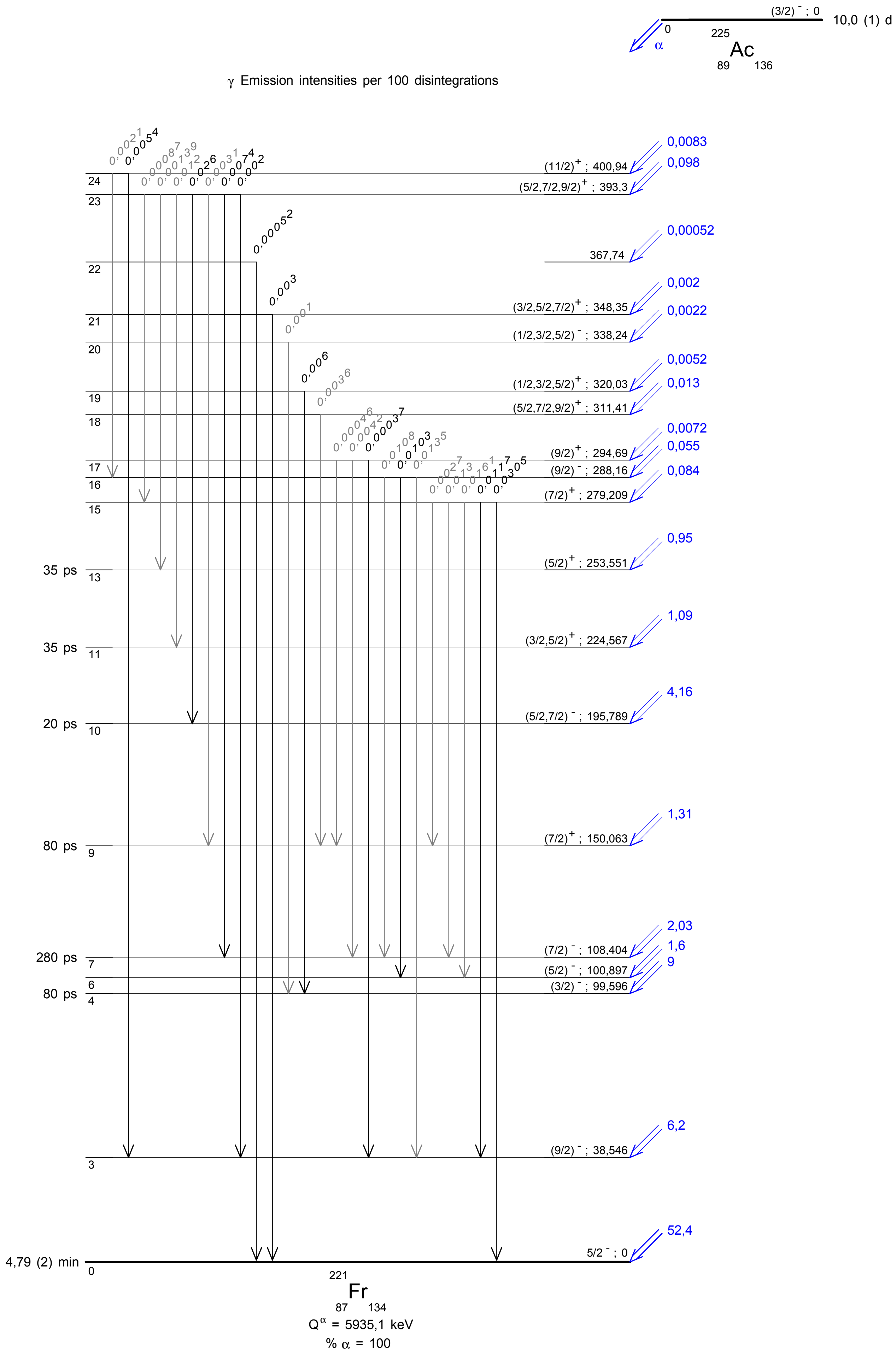
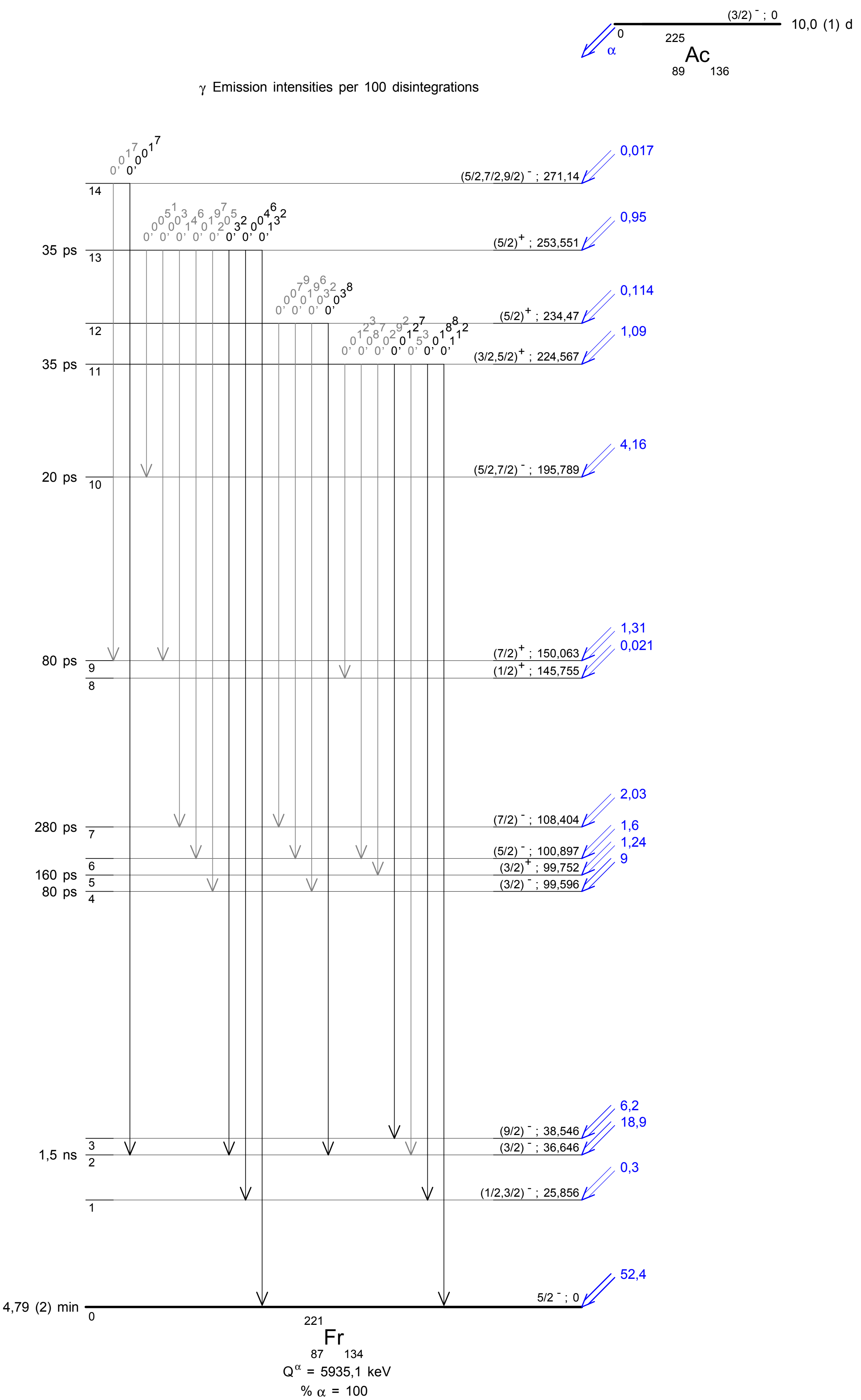
  (Q)

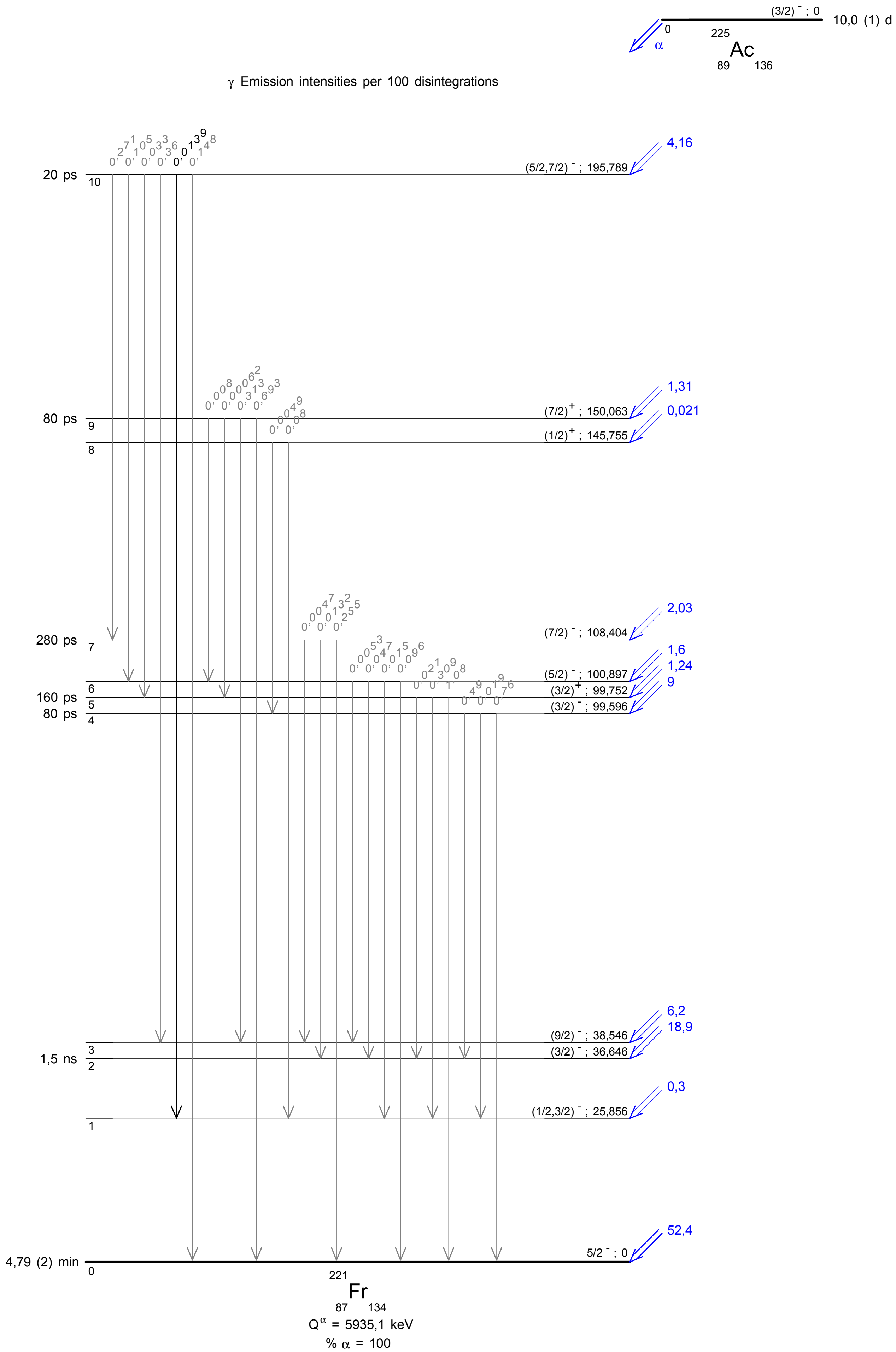

(3/2)⁻ ; 0
10,0 (1) d
225 Ac 89 136
γ Emission intensities per 100 disintegrations
(3/2)⁻ ; 942,79
852,08
825
818,6
808,48
779,32
766,44
(3/2)+ ; 748,83
(1/2,3/2)+ ; 713,24
(7/2)⁻ ; 679,53
645,94
(5/2)+ ; 517,634
(3/2,5/2,7/2)+ ; 422,65
(1/2,3/2,5/2)+ ; 320,03
(5/2,7/2,9/2)⁻ ; 271,14
(5/2)+ ; 234,47
(5/2,7/2)⁻ ; 195,789
(7/2)+ ; 150,063
(1/2)+ ; 145,755
(7/2)⁻ ; 108,404
(3/2)+ ; 99,752
(3/2)⁻ ; 99,596
(1/2,3/2)⁻ ; 25,856
5/2⁻ ; 0
0,0011
0,0013
0,00015
0,00083
0,0021
0,00114
0,0038
0,015
0,0058
0,00066
0,00015
0,007
0,003
0,0052
0,017
0,114
4,16
1,31
0,021
2,03
1,24
9
0,3
52,4
20 ps
80 ps
280 ps
160 ps
80 ps
4,79 (2) min
221 Fr 87 134
Qα = 5935,1 keV
% α = 100

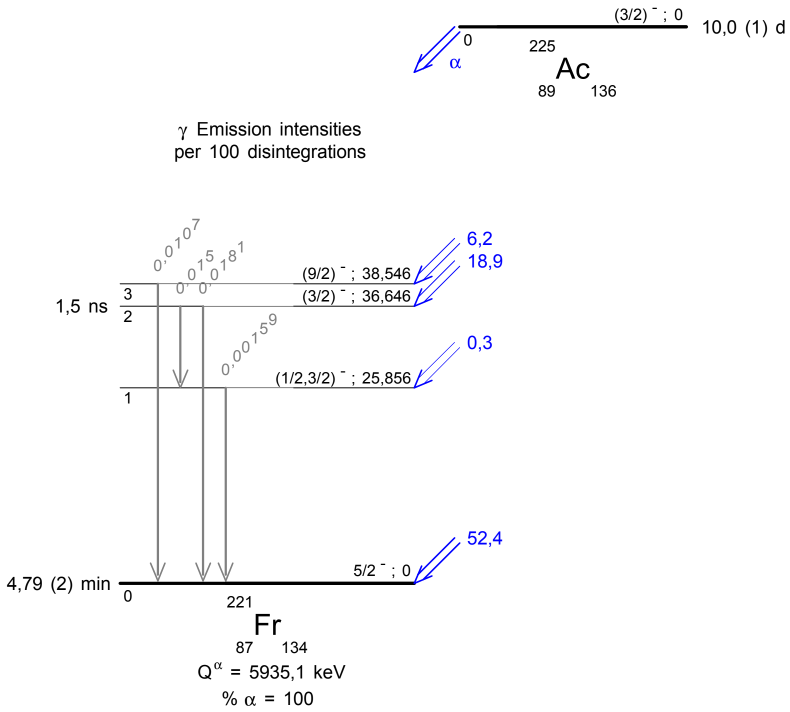

(3/2) ⁻ ; 0
10,0 (1) d
0
α
225
Ac
89 136
γ Emission intensities per 100 disintegrations
637,6
(5/2) ⁻ ; 630,551
(5/2) ⁻ ; 600,94
(5/2,7/2) ⁺ ; 570,67
(5/2) ⁺ ; 517,634
(3/2,5/2,7/2) ⁺ ; 348,35
(5/2) ⁺ ; 253,551
(5/2) ⁺ ; 234,47
(5/2,7/2) ⁻ ; 195,789
(7/2) ⁻ ; 108,404
(5/2) ⁻ ; 100,897
(3/2) ⁻ ; 99,596
(9/2) ⁻ ; 38,546
(3/2) ⁻ ; 36,646
5/2 ⁻ ; 0
0,0101
0,022
0,0026
0,048
0,007
0,002
0,95
0,114
4,16
2,03
1,6
9
6,2
18,9
52,4
37
36
35
34
32
21
35 ps
13
12
20 ps
10
280 ps
7
6
80 ps
4
3
1,5 ns
2
4,79 (2) min
0
221
Fr
87 134
Qα = 5935,1 keV
% α = 100


(3/2)⁻ ; 0
10,0 (1) d
α
225 Ac 89 136
γ Emission intensities per 100 disintegrations
(3/2,5/2)⁻ ; 551,812
0,214
(5/2)⁺ ; 517,634
0,007
(5/2,7/2)⁺ ; 496,5
0,0027
481,98
0,000097
(3/2,5/2,7/2)⁺ ; 458,74
0,002
(3/2,5/2,7/2)⁺ ; 446,31
0,0006
(3/2,5/2,7/2)⁺ ; 422,65
0,003
408,54
0,0023
(3/2,5/2,7/2)⁻ ; 406,73
0,0028
(5/2,7/2,9/2)⁻ ; 271,14
0,017
35 ps
(5/2)⁺ ; 253,551
0,95
(5/2)⁺ ; 234,47
0,114
20 ps
(5/2,7/2)⁻ ; 195,789
4,16
(1/2)⁺ ; 145,755
0,021
280 ps
(7/2)⁻ ; 108,404
2,03
(5/2)⁻ ; 100,897
1,6
160 ps
(3/2)⁺ ; 99,752
1,24
80 ps
(3/2)⁻ ; 99,596
9
(9/2)⁻ ; 38,546
6,2
1,5 ns
(3/2)⁻ ; 36,646
18,9
(1/2,3/2)⁻ ; 25,856
0,3
4,79 (2) min
5/2⁻ ; 0
52,4
221 Fr 87 134
Qα = 5935,1 keV
% α = 100


(3/2)⁻ ; 0
10,0 (1) d
α
225 Ac 89 136
γ Emission intensities per 100 disintegrations
(11/2)+ ; 400,94
0,0083
(5/2,7/2,9/2)+ ; 393,3
0,098
367,74
0,00052
(3/2,5/2,7/2)+ ; 348,35
0,002
(1/2,3/2,5/2)⁻ ; 338,24
0,0022
(1/2,3/2,5/2)+ ; 320,03
0,0052
(5/2,7/2,9/2)+ ; 311,41
0,013
(9/2)+ ; 294,69
0,0072
(9/2)⁻ ; 288,16
0,055
(7/2)+ ; 279,209
0,084
35 ps
(5/2)+ ; 253,551
0,95
35 ps
(3/2,5/2)+ ; 224,567
1,09
20 ps
(5/2,7/2)⁻ ; 195,789
4,16
80 ps
(7/2)+ ; 150,063
1,31
280 ps
(7/2)⁻ ; 108,404
2,03
(5/2)⁻ ; 100,897
1,6
80 ps
(3/2)⁻ ; 99,596
9
(9/2)⁻ ; 38,546
6,2
4,79 (2) min
5/2⁻ ; 0
52,4
221 Fr 87 134
Qα = 5935,1 keV
% α = 100


(3/2) - ; 0
10,0 (1) d
225 Ac 89 136
α
γ Emission intensities per 100 disintegrations
(5/2,7/2,9/2) - ; 271,14
0,017
(5/2)+ ; 253,551
0,95
(5/2)+ ; 234,47
0,114
(3/2,5/2)+ ; 224,567
1,09
(5/2,7/2) - ; 195,789
4,16
(7/2)+ ; 150,063
1,31
(1/2)+ ; 145,755
0,021
(7/2) - ; 108,404
2,03
(5/2) - ; 100,897
1,6
(3/2)+ ; 99,752
1,24
(3/2) - ; 99,596
9
(9/2) - ; 38,546
6,2
(3/2) - ; 36,646
18,9
(1/2,3/2) - ; 25,856
0,3
5/2 - ; 0
52,4
35 ps
35 ps
20 ps
80 ps
280 ps
160 ps
80 ps
1,5 ns
4,79 (2) min
221 Fr 87 134
Qα = 5935,1 keV
% α = 100


(3/2) ⁻ ; 0
10,0 (1) d
0
α
225
Ac
89
136
γ Emission intensities per 100 disintegrations
20 ps
10
(5/2,7/2) ⁻ ; 195,789
4,16
80 ps
9
8
(7/2)⁺ ; 150,063
1,31
(1/2)⁺ ; 145,755
0,021
280 ps
7
(7/2) ⁻ ; 108,404
2,03
6
160 ps
5
80 ps
4
(5/2) ⁻ ; 100,897
1,6
(3/2)⁺ ; 99,752
1,24
(3/2) ⁻ ; 99,596
9
3
1,5 ns
2
(9/2) ⁻ ; 38,546
6,2
(3/2) ⁻ ; 36,646
18,9
1
(1/2,3/2) ⁻ ; 25,856
0,3
4,79 (2) min
0
5/2 ⁻ ; 0
52,4
221
Fr
87
134
Qα = 5935,1 keV
% α = 100


(3/2)⁻ ; 0
10,0 (1) d
0
α
225
Ac
89 136
γ Emission intensities
per 100 disintegrations
0,0107
0,015
0,0181
0,00159
6,2
18,9
0,3
52,4
(9/2)⁻ ; 38,546
(3/2)⁻ ; 36,646
(1/2,3/2)⁻ ; 25,856
5/2⁻ ; 0
1,5 ns
3
2
1
0
4,79 (2) min
221
Fr
87 134
Q^α = 5935,1 keV
% α = 100

$^{228}_{88}$Ra $_{140}$

1 Decay Scheme

Ra-228 disintegrates 100 % by beta minus emissions to the excited states of Ac-228.
Le radium 228 se désintègre par émission bêta moins vers les niveaux excités de l'actinium 228.

2 Nuclear Data

$T_{1/2}(^{228}\mathrm{Ra})$	:	5,75	(4)	a
$T_{1/2}(^{228}\mathrm{Ac})$	:	6,15	(2)	h
$Q^{-}(^{228}\mathrm{Ra})$	:	45,8	(7)	keV

2.1 β^- Transitions

	Energy keV	Probability × 100	Nature	lg ft
$\beta^-_{0,4}$	12,7 (7)	30 (10)	Allowed	5,11
$\beta^-_{0,3}$	25,6 (7)	8,7 (9)	1st Forbidden	6,2
$\beta^-_{0,2}$	39,1 (7)	49 (10)	Allowed	6,45
$\beta^-_{0,1}$	39,5 (7)	12 (10)	1st Forbidden	7,07

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_L	α_M	α_T
$\gamma_{1,0}$(Ac)	6,28 (3)	12 (10)	M2		4930000 (140000)	6680000 (190000)
$\gamma_{2,0}$(Ac)	6,67 (2)	89 (14)	E2		1172000 (24000)	1560000 (40000)
$\gamma_{4,3}$(Ac)	12,88 (11)	2,30 (46)	E1		5,11 (14)	6,67 (18)
$\gamma_{3,2}$(Ac)	13,520 (36)	11,0 (7)	E1		4,48 (7)	5,86 (10)
$\gamma_{4,2}$(Ac)	26,40 (11)	28 (10)	M1 + E2	151 (3)	37,2 (7)	201 (4)

3 Atomic Data

3.1 Ac

ω_K	:	0,969	(4)
$\bar{\omega}_L$	:	0,464	(18)
n_{KL}	:	0,799	(5)

4 Electron Emissions

		Energy keV	Electrons per 100 disint.
e_{AL}	(Ac)	5,87 - 19,67	12 (5)
$ec_{1,0\ M}$	(Ac)	1,28 - 3,06	9 (7)
$ec_{2,0\ M}$	(Ac)	1,67 - 3,45	67 (11)
$ec_{1,0\ N}$	(Ac)	5,01 - 5,97	2,5 (21)
$ec_{2,0\ N}$	(Ac)	5,40 - 6,36	17,8 (28)
$ec_{4,2\ L}$	(Ac)	6,6 - 10,5	21 (8)
$ec_{4,3\ M}$	(Ac)	7,88 - 9,66	1,53 (31)
$ec_{3,2\ M}$	(Ac)	8,52 - 10,30	7,17 (46)
$ec_{4,3\ N}$	(Ac)	11,61 - 12,57	0,39 (8)
$ec_{3,2\ N}$	(Ac)	12,25 - 13,21	1,82 (12)
$ec_{4,2\ M}$	(Ac)	21,4 - 23,2	5,2 (19)
$ec_{4,2\ N}$	(Ac)	25,1 - 26,1	1,38 (49)
$\beta^-_{0,4}$	max:	12,7 (7)	30 (10)
$\beta^-_{0,4}$	avg:		
$\beta^-_{0,3}$	max:	25,6 (7)	8,7 (9)
$\beta^-_{0,3}$	avg:		
$\beta^-_{0,2}$	max:	39,1 (7)	49 (10)
$\beta^-_{0,2}$	avg:		
$\beta^-_{0,1}$	max:	39,5 (7)	12 (10)
$\beta^-_{0,1}$	avg:		

5 Photon Emissions

5.1 X-Ray Emissions

		Energy keV	Photons per 100 disint.
XL	(Ac)	10,8701 — 18,9228	9,6 (19)

5.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{1,0}$(Ac)	6,28 (3)	0,0000018 (15)
$\gamma_{2,0}$(Ac)	6,67 (2)	0,000057 (9)
$\gamma_{4,3}$(Ac)	12,88 (11)	0,30 (6)
$\gamma_{3,2}$(Ac)	13,520 (36)	1,6 (1)
$\gamma_{4,2}$(Ac)	26,40 (11)	0,14 (5)

6 Main Production Modes

Th – 232(α)Ra – 228

7 References

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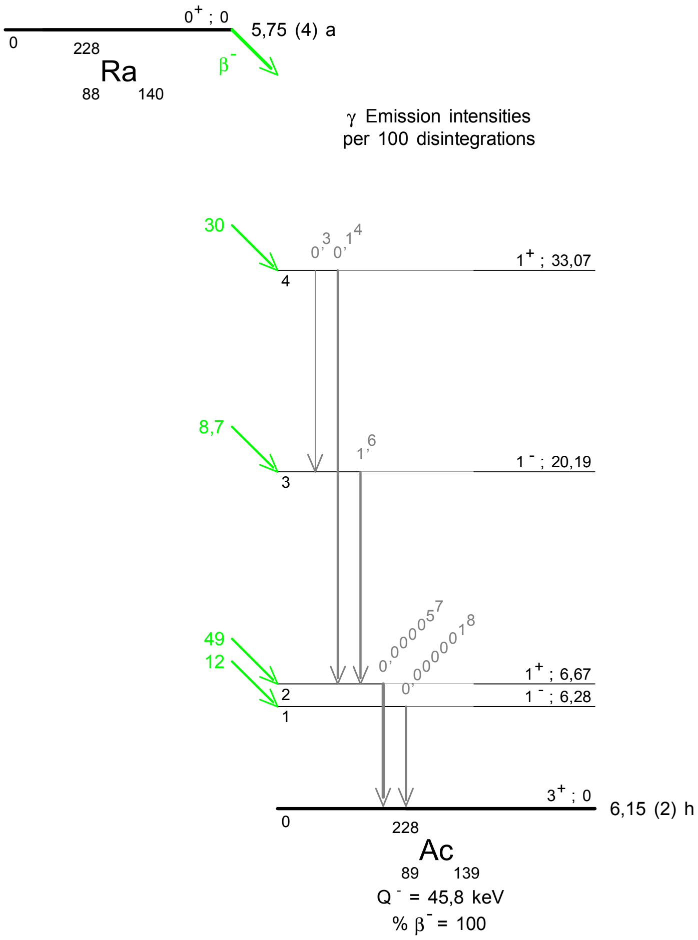
  (Q)


0+ ; 0
5,75 (4) a
0
228
Ra
88 140
β-
γ Emission intensities
per 100 disintegrations
30
8,7
49
12
0,3
0,14
1,6
0,000057
0,0000018
4
3
2
1
0
1+ ; 33,07
1- ; 20,19
1+ ; 6,67
1- ; 6,28
3+ ; 0
6,15 (2) h
228
Ac
89 139
Q- = 45,8 keV
% β- = 100

$^{231}_{90}\mathrm{Th}_{141}$

1 Decay Scheme

Th-231 disintegrates 100 % by beta minus emission to the levels in Pa-231.
Le thorium 231 se désintègre par émissions bêta moins vers des niveaux excités de protactinium 231.

2 Nuclear Data

$T_{1/2}(^{231}\mathrm{Th})$	:	25,522	(10)	h
$T_{1/2}(^{231}\mathrm{Pa})$	:	32,76	(11)	10^3 a
$Q^-(^{231}\mathrm{Th})$	:	391,6	(15)	keV

2.1 β^- Transitions

	Energy keV	Probability × 100	Nature	lg ft
$\beta^-_{0,14}$	39,8 (15)	0,0032 (2)		7,33
$\beta^-_{0,13}$	71,4 (15)	0,066 (2)	1st Forbidden	6,79
$\beta^-_{0,12}$	73,6 (15)	0,00078 (5)		8,76
$\beta^-_{0,11}$	144,3 (15)	2,7 (4)	Allowed	6,11
$\beta^-_{0,10}$	173,4 (15)	0,31 (23)		7,3
$\beta^-_{0,9}$	208,1 (15)	12,2 (15)	Allowed	5,95
$\beta^-_{0,8}$	217,4 (15)	1,36 (24)		6,96
$\beta^-_{0,6}$	289,3 (15)	13 (8)	Allowed	6,4
$\beta^-_{0,5}$	290,2 (15)	41 (16)	Allowed	5,88
$\beta^-_{0,4}$	307,4 (15)	29 (18)	Allowed	6,1
$\beta^-_{0,3}$	313,9 (15)	0,43 (2)	1st Forbidden	7,97
$\beta^-_{0,2}$	333,0 (15)	0,17 (17)	1st Forbidden	8,2
$\beta^-_{0,0}$	391,6 (15)	0,022 (7)	1st Forbidden	9,57

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{1,0}$(Pa)	9,2	0,498					
$\gamma_{7,5}$(Pa)	10,25	0,737					
$\gamma_{5,4}$(Pa)	17,2	45 (16)	(M1)			135,7	193
$\gamma_{6,4}$(Pa)	18,07	22 (10)	M1+E2		349	304	800
$\gamma_{4,2}$(Pa)	25,65 (2)	74,6 (39)	E1		3,26 (5)	0,843 (12)	4,37 (7)
$\gamma_{5,2}$(Pa)	42,89 (7)	0,1275 (34)	[E1]		0,85 (2)	0,21 (1)	1,14 (2)
$\gamma_{10,8}$(Pa)	44,08 (17)	0,22 (23)	[M1+E2]		240 (210)	70 (60)	300 (300)
$\gamma_{2,0}$(Pa)	58,5719 (24)	75,1 (27)	E2		113,6 (16)	31,3 (5)	155,5 (22)
$\gamma_{11,9}$(Pa)	63,86 (3)	0,82 (36)	M1+E2		25 (11)	6,6 (31)	34 (15)
$\gamma_{3,1}$(Pa)	68,5 (1)	0,438 (13)	E2		53,5 (8)	14,8 (3)	73,3 (12)
$\gamma_{8,5}$(Pa)	72,7518 (45)	0,333 (22)	[E1]		0,211 (3)	0,0517 (7)	0,280 (4)
$\gamma_{3,0}$(Pa)	77,69	0,0042 (7)					
$\gamma_{9,6}$(Pa)	81,2280 (14)	8,2 (13)	M1(+E2)		6,1 (10)	1,5 (3)	8,1 (14)
$\gamma_{9,5}$(Pa)	82,0870 (17)	3,7 (6)	M1(+E2)		5,9 (9)	1,5 (3)	7,9 (13)
$\gamma_{4,0}$(Pa)	84,2148 (13)	23,4 (17)	E1		1,77 (2)	0,57 (10)	2,50 (25)
$\gamma_{8,4}$(Pa)	89,95 (2)	1,171 (35)	E1		0,121 (2)	0,0294 (4)	0,1598 (22)
$\gamma_{6,1}$(Pa)	93,02 (4)	0,0459 (34)	[E1]		0,110 (2)	0,0269 (4)	0,1463 (21)
$\gamma_{9,4}$(Pa)	99,2814 (31)	0,96 (7)	M1+E2		4,43 (24)	1,13 (7)	6,0 (4)
$\gamma_{6,0}$(Pa)	102,2700 (13)	0,491 (12)	E1		0,086 (1)	0,0210 (3)	0,1141 (16)
$\gamma_{9,3}$(Pa)	105,81 (3)	0,0087 (6)	[E1]		0,0787 (11)	0,0192 (3)	0,1043 (15)
$\gamma_{10,7}$(Pa)	106,61 (3)	0,0197 (8)	[E1]		0,0772 (11)	0,0188 (3)	0,1023 (14)
$\gamma_{8,2}$(Pa)	115,63 (3)	0,0121 (47)	[M1+E2]	5,4 (52)	3,3 (12)	0,9 (4)	10 (4)
$\gamma_{10,5}$(Pa)	116,831 (23)	0,0302 (12)	E1	0,262 (4)	0,0608 (9)	0,01478 (21)	0,342 (5)
$\gamma_{9,2}$(Pa)	124,916 (19)	0,0763 (20)	E1	0,226 (4)	0,0511 (8)	0,01241 (18)	0,294 (4)
$\gamma_{10,4}$(Pa)	134,03 (2)	0,0318 (10)	E1	0,192 (3)	0,0426 (6)	0,01033 (15)	0,249 (4)
$\gamma_{11,7}$(Pa)	135,667 (11)	0,72 (9)	M1(+E2)	6,1 (14)	1,40 (19)	0,35 (6)	8,0 (11)
$\gamma_{13,9}$(Pa)	136,75 (7)	0,00547 (19)	[E1]	0,184 (3)	0,0404 (6)	0,00981 (14)	0,237 (3)
$\gamma_{10,3}$(Pa)	140,55 (4)	0,0047 (19)	[M1+E2]	3 (3)	1,5 (4)	0,40 (12)	5,3 (25)
$\gamma_{11,6}$(Pa)	145,061 (40)	0,0201 (11)	[E2]	0,237 (4)	1,627 (23)	0,448 (7)	2,46 (3)
$\gamma_{11,5}$(Pa)	145,941 (20)	0,198 (27)	M1+E2	3,4 (10)	1,27 (10)	0,33 (4)	5,1 (8)
$\gamma_{11,4}$(Pa)	163,105 (4)	0,92 (7)	M1(+E2)	3,9 (4)	0,783 (22)	0,190 (9)	4,9 (4)
$\gamma_{8,1}$(Pa)	165,00 (5)	0,00857 (35)	[E2]	0,209 (3)	0,917 (13)	0,252 (4)	1,464 (2)
$\gamma_{11,3}$(Pa)	169,66 (3)	0,00161 (8)	[E1]	0,1113 (16)	0,0233 (4)	0,00564 (8)	0,1421 (20)
$\gamma_{8,0}$(Pa)	174,16 (2)	0,067 (27)	[M1+E2]	1,8 (16)	0,68 (5)	0,177 (22)	2,7 (15)
$\gamma_{9,0}$(Pa)	183,486 (25)	0,0375 (9)	E1	0,0928 (13)	0,0191 (3)	0,00463 (7)	0,1181 (17)
$\gamma_{11,2}$(Pa)	188,76 (2)	0,00378 (33)	[E1]	0,0869 (13)	0,01782 (25)	0,00431 (6)	0,1105 (15)
$\gamma_{13,6}$(Pa)	217,94 (3)	0,0434 (9)	E1	0,0624 (9)	0,01248 (18)	0,00301 (5)	0,0789 (11)
$\gamma_{13,4}$(Pa)	236,01 (3)	0,01002 (32)	[E1]	0,0521 (8)	0,01028 (15)	0,00248 (4)	0,0657 (9)
$\gamma_{12,3}$(Pa)	240,275 (50)	0,000308 (43)	[E1]	0,0500 (7)	0,00984 (14)	0,00237 (4)	0,0630 (9)
$\gamma_{13,3}$(Pa)	242,52 (4)	0,0016 (6)	[M1+E2]	0,7 (6)	0,22 (4)	0,055 (7)	1,0 (7)
$\gamma_{14,6}$(Pa)	249,60 (7)	0,00085 (7)	[E1]	0,0459 (7)	0,00898 (13)	0,00216 (3)	0,0578 (8)
$\gamma_{14,5}$(Pa)	250,45 (7)	0,00071 (7)	[E1]	0,0455 (7)	0,00891 (13)	0,00215 (3)	0,0573 (8)
$\gamma_{14,4}$(Pa)	267,63 (8)	0,00148 (15)	[E1]	0,0393 (6)	0,00760 (11)	0,00183 (3)	0,0493 (7)
$\gamma_{14,3}$(Pa)	274,1 (1)	0,000058 (27)	[M1+E2]	0,5 (4)	0,15 (4)	0,038 (8)	0,7 (5)
$\gamma_{12,1}$(Pa)	308,78 (7)	0,0003748 (19)	[E1]	0,0287 (4)	0,00544 (8)	0,001306 (19)	0,0358 (5)
$\gamma_{13,1}$(Pa)	311,00 (5)	0,005 (1)	M1+E2	0,5 (3)	0,11 (3)	0,027 (6)	0,6 (3)
$\gamma_{12,0}$(Pa)	317,89 (8)	0,0001039 (5)	[E1]	0,0269 (4)	0,00508 (8)	0,001221 (18)	0,0336 (5)
$\gamma_{13,0}$(Pa)	320,21 (8)	0,00022 (7)	[M1+E2]	0,34 (27)	0,09 (4)	0,023 (7)	0,5 (4)
$\gamma_{14,0}$(Pa)	351,84 (11)	0,000090 (24)	[M1+E2]	0,26 (21)	0,066 (24)	0,016 (6)	0,35 (25)

3 Atomic Data

3.1 Pa

ω_K	:	0,970	(4)
$\bar{\omega}_L$	:	0,488	(18)
n_{KL}	:	0,795	(5)

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	}	35,84
	$K\beta_2$	111,405	}	
	$K\beta_4$	111,87	}	12,15
	$KO_{2,3}$	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	85,989 – 95,858	59,2
KXY	101,87 – 112,59	8,76
Auger L	5,9 – 21,0	

4 Electron Emissions

		Energy keV		Electrons per 100 disint.
e_{AL}	(Pa)	5,9 - 21,0		68 (3)
e_{AK}	(Pa)			0,038 (5)
	KLL	70,081 - 78,822	}	
	KLX	85,989 - 95,858	}	
	KXY	101,87 - 112,59	}	
$ec_{4,2\ L}$	(Pa)	4,540 - 8,912		45,3 (24)
$ec_{5,4\ M}$	(Pa)	11,8 - 13,8		31 (11)
$ec_{6,4\ M}$	(Pa)	12,71 - 14,63		8,2 (36)
$ec_{4,2\ M}$	(Pa)	20,284 - 22,203		11,7 (6)
$ec_{5,2\ L}$	(Pa)	21,78 - 26,16		0,0507 (14)
$ec_{10,8\ L}$	(Pa)	22,98 - 27,35		0,16 (16)
$ec_{11,7\ K}$	(Pa)	23,071 (11)		0,49 (11)
$ec_{11,5\ K}$	(Pa)	33,34 (2)		0,110 (33)
$ec_{2,0\ L}$	(Pa)	37,467 - 41,839		54,5 (20)
$ec_{11,9\ L}$	(Pa)	42,76 - 47,13		0,59 (26)
$ec_{3,1\ L}$	(Pa)	47,4 - 51,8		0,316 (9)
$ec_{11,4\ K}$	(Pa)	50,509 (4)		0,61 (7)
$ec_{8,5\ L}$	(Pa)	51,647 - 56,019		0,0549 (37)
$ec_{2,0\ M}$	(Pa)	53,211 - 55,130		15,0 (5)
$ec_{11,9\ M}$	(Pa)	58,50 - 60,42		0,16 (7)
$ec_{9,6\ L}$	(Pa)	60,123 - 64,495		5,5 (9)
$ec_{9,5\ L}$	(Pa)	60,982 - 65,354		2,47 (38)
$ec_{3,1\ M}$	(Pa)	63,1 - 65,1		0,0873 (28)
$ec_{4,0\ L}$	(Pa)	63,110 - 67,482		11,86 (18)
$ec_{8,4\ L}$	(Pa)	68,84 - 73,22		0,1222 (42)
$ec_{9,6\ M}$	(Pa)	75,867 - 77,786		1,36 (27)
$ec_{9,5\ M}$	(Pa)	76,726 - 78,645		0,63 (13)
$ec_{9,4\ L}$	(Pa)	78,176 - 82,548		0,607 (42)
$ec_{4,0\ M}$	(Pa)	78,854 - 80,773		3,8 (7)
$ec_{9,4\ M}$	(Pa)	93,920 - 95,839		0,155 (12)
$ec_{11,7\ L}$	(Pa)	114,562 - 118,934		0,112 (15)
$ec_{11,4\ L}$	(Pa)	142,000 - 146,372		0,122 (5)
$\beta^-_{0,14}$	max:	39,8 (15)		0,0032 (2)
$\beta^-_{0,14}$	avg:	10,1 (5)		
$\beta^-_{0,13}$	max:	71,4 (15)		0,066 (2)
$\beta^-_{0,13}$	avg:	18,3 (4)		
$\beta^-_{0,12}$	max:	73,6 (15)		0,00078 (5)
$\beta^-_{0,12}$	avg:	18,9 (4)		
$\beta^-_{0,11}$	max:	144,3 (15)		2,7 (4)
$\beta^-_{0,11}$	avg:	38,1 (5)		
$\beta^-_{0,10}$	max:	173,4 (15)		0,31 (23)

		Energy keV		Electrons per 100 disint.
$\beta^-_{0,10}$	avg:	46,2	(5)	
$\beta^-_{0,9}$	max:	208,1	(15)	12,2 (15)
$\beta^-_{0,9}$	avg:	56,2	(5)	
$\beta^-_{0,8}$	max:	217,4	(15)	1,36 (24)
$\beta^-_{0,8}$	avg:	58,9	(5)	
$\beta^-_{0,6}$	max:	289,3	(15)	13 (8)
$\beta^-_{0,6}$	avg:	80,1	(5)	
$\beta^-_{0,5}$	max:	290,2	(15)	41 (16)
$\beta^-_{0,5}$	avg:	80,4	(5)	
$\beta^-_{0,4}$	max:	307,4	(15)	29 (18)
$\beta^-_{0,4}$	avg:	85,6	(5)	
$\beta^-_{0,3}$	max:	313,9	(15)	0,43 (2)
$\beta^-_{0,3}$	avg:	87,6	(5)	
$\beta^-_{0,2}$	max:	333,0	(15)	0,17 (17)
$\beta^-_{0,2}$	avg:	93,4	(5)	
$\beta^-_{0,0}$	max:	391,6	(15)	0,022 (7)
$\beta^-_{0,0}$	avg:	111,6	(5)	

5 Photon Emissions

5.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(Pa)	11,3676 — 20,1126		65 (3)	
XKα_2	(Pa)	92,288		0,37 (4)	} Kα
XKα_1	(Pa)	95,869		0,59 (7)	}
XKβ_3	(Pa)	107,595	}		
XKβ_1	(Pa)	108,422	}	0,21 (2)	K$'\beta_1$
XKβ_5''	(Pa)	109,072	}		
XKβ_2	(Pa)	111,405	}		
XKβ_4	(Pa)	111,87	}	0,071 (8)	K$'\beta_2$
XKO$_{2,3}$	(Pa)	112,38	}		

5.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{4,2}$(Pa)	25,64 (2)	13,9 (7)
$\gamma_{5,2}$(Pa)	42,86 (7)	0,0596 (15)
$\gamma_{10,8}$(Pa)	44,08 (17)	0,00074 (21)
$\gamma_{2,0}$(Pa)	58,5700 (24)	0,480 (16)
$\gamma_{11,9}$(Pa)	63,86 (3)	0,0235 (21)
$\gamma_{3,1}$(Pa)	68,5 (1)	0,00590 (15)
$\gamma_{8,5}$(Pa)	72,7510 (25)	0,260 (17)
$\gamma_{3,0}$(Pa)	77,69	0,0042 (7)
$\gamma_{9,6}$(Pa)	81,2280 (14)	0,905 (23)
$\gamma_{9,5}$(Pa)	82,0870 (13)	0,418 (13)
$\gamma_{4,0}$(Pa)	84,2140 (13)	6,70 (7)
$\gamma_{8,4}$(Pa)	89,95 (2)	1,01 (3)
$\gamma_{6,1}$(Pa)	93,02 (4)	0,040 (3)
$\gamma_{9,4}$(Pa)	99,278 (3)	0,137 (6)
$\gamma_{6,0}$(Pa)	102,2700 (13)	0,441 (11)
$\gamma_{9,3}$(Pa)	105,81 (3)	0,0079 (5)
$\gamma_{10,7}$(Pa)	106,61 (3)	0,0179 (7)
$\gamma_{8,2}$(Pa)	115,63 (3)	0,00110 (16)
$\gamma_{10,5}$(Pa)	116,82 (2)	0,0225 (9)
$\gamma_{9,2}$(Pa)	124,914 (17)	0,0590 (15)
$\gamma_{10,4}$(Pa)	134,03 (2)	0,0255 (8)
$\gamma_{11,7}$(Pa)	135,664 (11)	0,0797 (22)
$\gamma_{13,9}$(Pa)	136,75 (7)	0,00442 (15)
$\gamma_{10,3}$(Pa)	140,54 (4)	0,00074 (7)
$\gamma_{11,6}$(Pa)	145,06 (4)	0,0058 (3)
$\gamma_{11,5}$(Pa)	145,94 (2)	0,0324 (12)
$\gamma_{11,4}$(Pa)	163,101 (4)	0,156 (5)
$\gamma_{8,1}$(Pa)	165,00 (5)	0,00348 (14)
$\gamma_{11,3}$(Pa)	169,66 (3)	0,00141 (7)
$\gamma_{8,0}$(Pa)	174,15 (2)	0,0180 (6)
$\gamma_{9,0}$(Pa)	183,480 (25)	0,0335 (8)
$\gamma_{11,2}$(Pa)	188,76 (2)	0,0034 (3)
$\gamma_{13,6}$(Pa)	217,94 (3)	0,0402 (8)
$\gamma_{13,4}$(Pa)	236,01 (3)	0,0094 (3)
$\gamma_{12,3}$(Pa)	240,27 (5)	0,00029 (4)
$\gamma_{13,3}$(Pa)	242,50 (4)	0,00082 (5)
$\gamma_{14,6}$(Pa)	249,60 (7)	0,00080 (7)
$\gamma_{14,5}$(Pa)	250,45 (7)	0,00067 (7)
$\gamma_{14,4}$(Pa)	267,62 (8)	0,00141 (14)
$\gamma_{14,3}$(Pa)	274,1 (1)	0,000034 (12)
$\gamma_{12,1}$(Pa)	308,78 (7)	0,0003618 (18)
$\gamma_{13,1}$(Pa)	311,00 (5)	0,00315 (14)
$\gamma_{12,0}$(Pa)	317,87 (8)	0,0001005 (5)
$\gamma_{13,0}$(Pa)	320,15 (8)	0,00015 (3)
$\gamma_{14,0}$(Pa)	351,8 (1)	0,000067 (13)

6 Main Production Modes

Th − 230(n,γ)Th − 231

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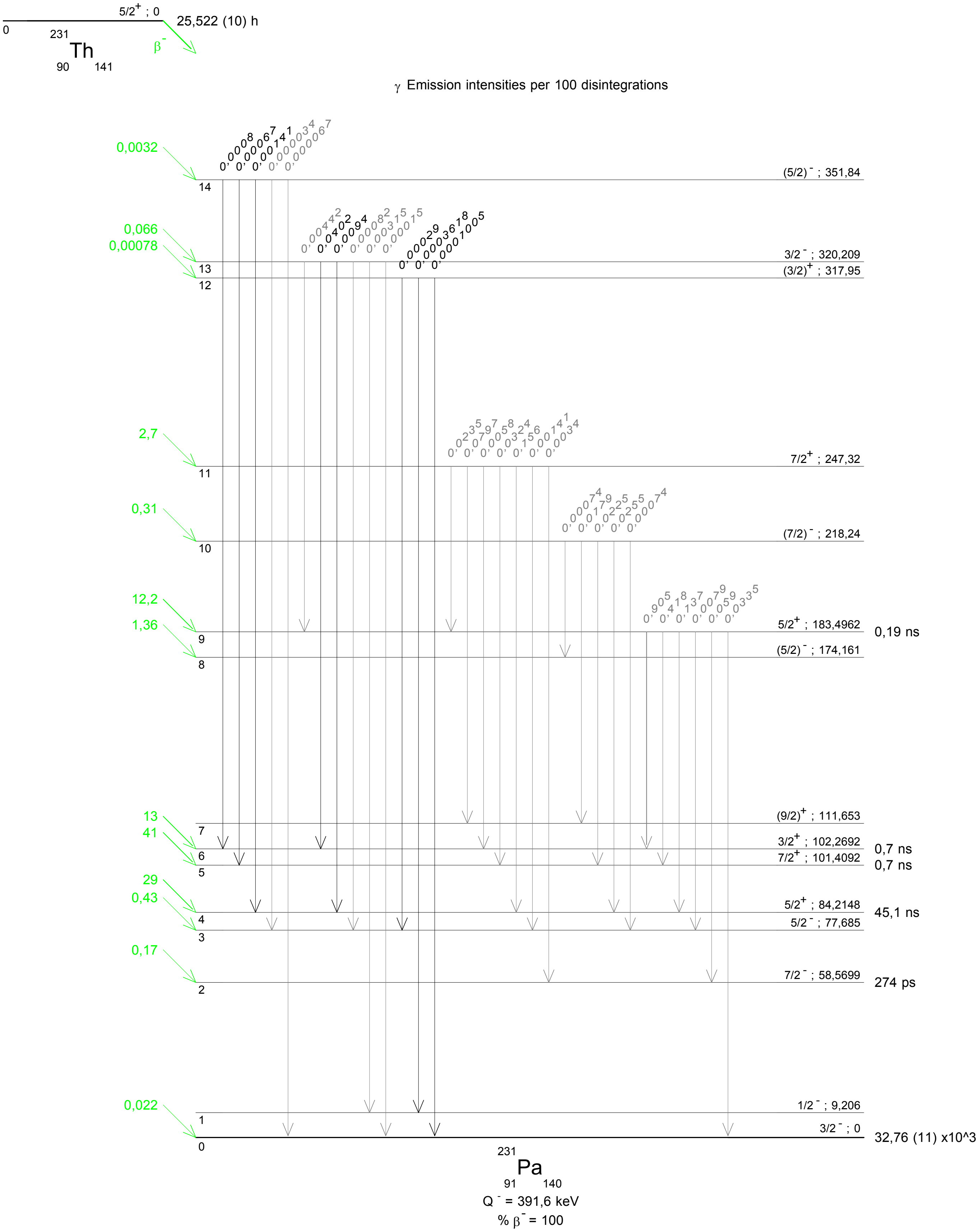
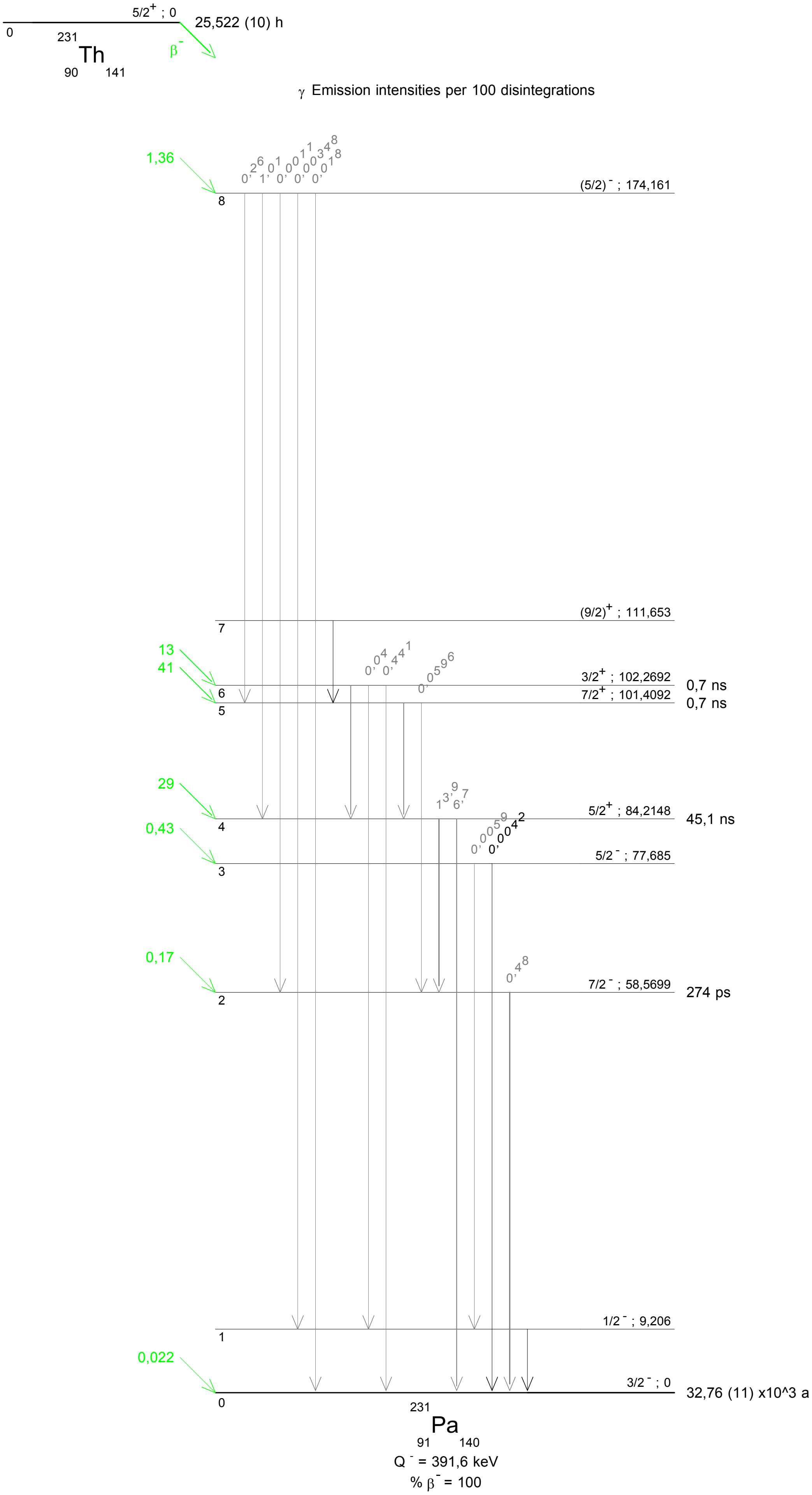


5/2+ ; 0
0
231 Th 90 141
β-
25,522 (10) h
γ Emission intensities per 100 disintegrations
0,0032
0,066
0,00078
2,7
0,31
12,2
1,36
13
41
29
0,43
0,17
0,022
(5/2) - ; 351,84
3/2 - ; 320,209
(3/2)+ ; 317,95
7/2+ ; 247,32
(7/2) - ; 218,24
5/2+ ; 183,4962
(5/2) - ; 174,161
(9/2)+ ; 111,653
3/2+ ; 102,2692
7/2+ ; 101,4092
5/2+ ; 84,2148
5/2 - ; 77,685
7/2 - ; 58,5699
1/2 - ; 9,206
3/2 - ; 0
0,19 ns
0,7 ns
0,7 ns
45,1 ns
274 ps
32,76 (11) x10^3
231 Pa 91 140
Q - = 391,6 keV
% β- = 100


5/2+ ; 0
25,522 (10) h
231 Th 90 141
β-
γ Emission intensities per 100 disintegrations
1,36
(5/2)- ; 174,161
(9/2)+ ; 111,653
13
41
3/2+ ; 102,2692
7/2+ ; 101,4092
0,7 ns
0,7 ns
29
5/2+ ; 84,2148
45,1 ns
0,43
5/2- ; 77,685
0,17
7/2- ; 58,5699
274 ps
1/2- ; 9,206
0,022
3/2- ; 0
32,76 (11) x10^3 a
231 Pa 91 140
Q- = 391,6 keV
% β- = 100

$^{232}_{90}\mathrm{Th}_{142}$

1 Decay Scheme

Le thorium 232 se désintègre par émission alpha vers le radium 228 de période 5,75 a.
Th-232 disintegrates by alpha emissions to Ra-228 which has a half-life of 5,75 a.

2 Nuclear Data

$T_{1/2}(^{232}\mathrm{Th})$	:	14,02	(6)	10^9 a
$T_{1/2}(^{228}\mathrm{Ra})$	:	5,75	(3)	a
$Q^{\alpha}(^{232}\mathrm{Th})$	:	4081,6	(14)	keV

2.1 α Transitions

	Energy keV	Probability × 100	F
$\alpha_{0,2}$	3876,9 (14)	0,068 (20)	16
$\alpha_{0,1}$	4017,8 (14)	21,0 (13)	1,02
$\alpha_{0,0}$	4081,6 (14)	78,9 (13)	1

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{1,0}$(Ra)	63,811 (10)	21,1 (13)	E2		59,1 (9)	16,05 (23)	80,4 (12)
$\gamma_{2,1}$(Ra)	140,88 (1)	0,068 (20)	E2	0,283 (4)	1,450 (21)	0,394 (6)	2,26 (4)

NPL /A.Arinc

3 Atomic Data

3.1 Ra

ω_K	:	0,968	(4)
$\bar{\omega}_L$	:	0,452	(18)
n_{KL}	:	0,801	(5)

3.1.1 X Radiations

		Energy keV		Relative probability
X_K				
	$K\alpha_2$	85,43		61,22
	$K\alpha_1$	88,47		100
	$K\beta_3$	99,432	}	
	$K\beta_1$	100,13	}	
	$K\beta_5''$	100,738	}	35,09
	$K\beta_2$	102,89	}	
	$K\beta_4$	103,295	}	11,51
	$KO_{2,3}$	103,74	}	
X_L				
	$L\ell$	10,624		
	$L\alpha$	12,196 – 12,338		
	$L\eta$	13,662		
	$L\beta$	14,237 – 15,448		
	$L\gamma$	17,276 – 18,354		

3.1.2 Auger Electrons

	Energy keV	Relative probability
Auger K		
KLL	65,149 – 72,729	100
KLX	79,721 – 88,466	57,8
KXY	94,27 – 103,91	8,35
Auger L	5,71 – 19,09	

4 α Emissions

	Energy keV	Probability × 100
$\alpha_{0,2}$	3810,0 (14)	0,068 (20)
$\alpha_{0,1}$	3948,5 (14)	21,0 (13)
$\alpha_{0,0}$	4011,2 (14)	78,9 (13)

5 Electron Emissions

		Energy keV		Electrons per 100 disint.
e_{AL}	(Ra)	5,71 - 19,09		8,18 (29)
e_{AK}	(Ra)			0,00019 (6)
	KLL	65,149 - 72,729	}	
	KLX	79,721 - 88,466	}	
	KXY	94,27 - 103,91	}	
$ec_{2,1\ L}$	(Ra)	121,65 - 125,44		0,030 (9)

6 Photon Emissions

6.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(Ra)	10,624 — 18,354		7,2 (3)	
$XK\alpha_2$	(Ra)	85,43		0,0017 (5)	} $K\alpha$
$XK\alpha_1$	(Ra)	88,47		0,0028 (8)	}
$XK\beta_3$	(Ra)	99,432	}		
$XK\beta_1$	(Ra)	100,13	}	0,00097 (28)	$K'\beta_1$
$XK\beta_5''$	(Ra)	100,738	}		
$XK\beta_2$	(Ra)	102,89	}		
$XK\beta_4$	(Ra)	103,295	}	0,00032 (10)	$K'\beta_2$
$XKO_{2,3}$	(Ra)	103,74	}		

6.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{1,0}$(Ra)	63,811 (10)	0,259 (15)
$\gamma_{2,1}$(Ra)	140,88 (1)	0,021 (6)

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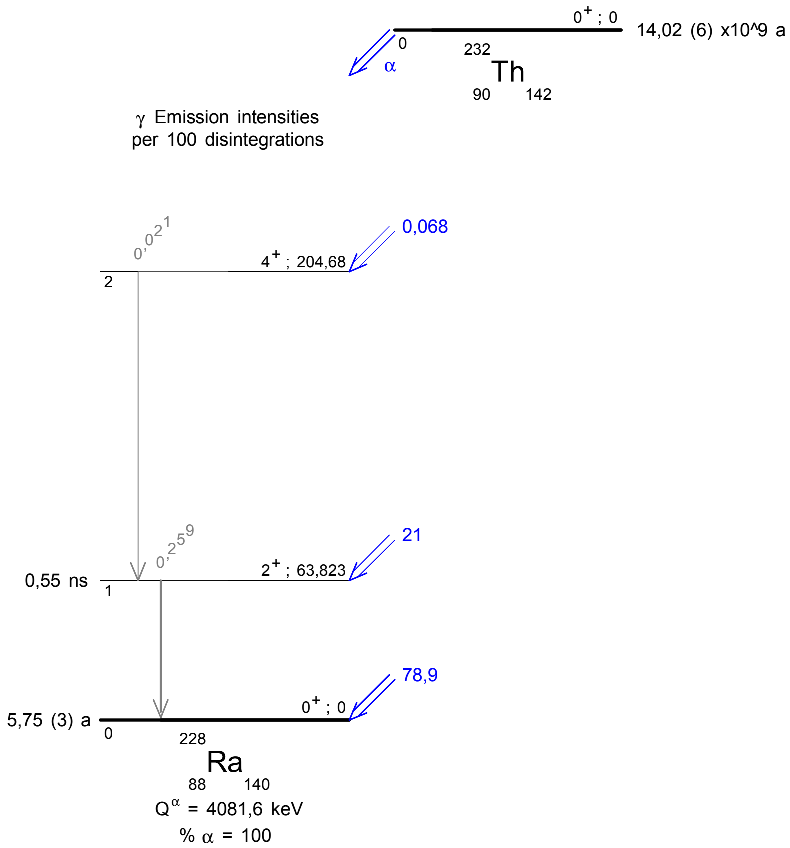
0+ ; 0
14,02 (6) x10^9 a
0
α
232
Th
90
142
γ Emission intensities
per 100 disintegrations
0,021
4+ ; 204,68
0,068
2
0,259
0,55 ns
1
2+ ; 63,823
21
5,75 (3) a
0
0+ ; 0
78,9
228
Ra
88
140
Qα = 4081,6 keV
% α = 100

$^{233}_{90}\mathrm{Th}_{143}$

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

$T_{1/2}(^{233}\mathrm{Th})$	:	22,15	(8)	min
$T_{1/2}(^{233}\mathrm{Pa})$	:	26,98	(2)	d
$Q^{-}(^{233}\mathrm{Th})$	:	1243,1	(14)	keV

2.1 β^- Transitions

	Energy keV	Probability × 100	Nature	lg ft
$\beta^-_{0,20}$	224,4 (14)	0,0434 (9)		6,7
$\beta^-_{0,19}$	258,3 (14)	0,205 (2)	allowed	6,2
$\beta^-_{0,18}$	431,5 (14)	0,385 (4)	allowed	6,6
$\beta^-_{0,17}$	478,5 (14)	1,19 (3)	allowed	6,3
$\beta^-_{0,16}$	573,2 (14)	0,0174 (22)	1st forbidden	8,4
$\beta^-_{0,15}$	657,6 (14)	0,15 (3)	allowed	7,6
$\beta^-_{0,14}$	689,2 (14)	1,23 (3)	allowed	6,8
$\beta^-_{0,13}$	788,7 (14)	0,217 (13)	allowed	7,7
$\beta^-_{0,12}$	795,3 (14)	0,821 (14)	1st forbidden	7,2
$\beta^-_{0,11}$	985,8 (14)	0,60 (3)	1st forbidden unique	8,1
$\beta^-_{0,8}$	1041,4 (14)	0,074 (8)	allowed	8,6
$\beta^-_{0,7}$	1073,9 (14)	0,692 (12)	allowed	7,7
$\beta^-_{0,5}$	1148,4 (14)	10,4 (4)	allowed	6,6
$\beta^-_{0,1}$	1236,4 (14)	50 (6)	1st forbidden	6,1
$\beta^-_{0,0}$	1243,1 (14)	34 (6)	1st forbidden	6,2

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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
$\gamma_{1,0}$(Pa)	6,65 (5)	51 (6)	(M1)			2280 (50)	3080 (60)
$\gamma_{5,4}$(Pa)	8,22 (5)	12,3 (4)	(M1+E2)				
$\gamma_{6,4}$(Pa)	17,40 (5)						
$\gamma_{4,2}$(Pa)	29,373 (10)	8,83 (31)	E1		2,29 (5)	0,586 (12)	3,07 (6)
$\gamma_{6,2}$(Pa)	46,53 (4)						
$\gamma_{2,0}$(Pa)	57,10 (2)	8,81 (33)	E2		128,4 (26)	35,4 (7)	176 (4)
$\gamma_{3,1}$(Pa)	63,92 (6)	0,072 (31)	(E2)		74,6 (15)	20,6 (4)	102,1 (21)
$\gamma_{3,0}$(Pa)	70,49 (10)	0,029 (27)	[M1+E2]		28 (19)	7 (6)	40 (30)
$\gamma_{7,5}$(Pa)	74,51 (5)	0,436 (20)	[M1]		7,43 (15)	1,79 (4)	9,85 (20)
$\gamma_{(-1,1)}$(Pa)	80						
$\gamma_{4,0}$(Pa)	86,477 (10)	4,48 (16)	E1		1,13 (4)	0,22 (6)	1,43 (8)
$\gamma_{5,1}$(Pa)	87,99 (3)	0,1985 (24)	[E1]		0,128 (3)	0,0312 (6)	0,169 (3)
$\gamma_{5,0}$(Pa)	94,65 (5)	0,884 (11)	E1		0,105 (2)	0,0257 (5)	0,140 (3)
$\gamma_{(-1,2)}$(Pa)	105,2 (1)	0,041					
$\gamma_{9,6}$(Pa)	108,5 (1)	0,0027	M1+E2	0,00303 (5)	2,7 (5)	0,65 (13)	3,5 (6)
$\gamma_{8,4}$(Pa)	115,14 (5)	0,03 (8)	[M1+E2]	5 (6)	3,4 (13)	0,9 (4)	10 (4)
$\gamma_{9,5}$(Pa)	117,692 (20)	0,038 (4)	M1+E2	9,3 (5)	2,16 (12)	0,53 (4)	12,2 (4)
$\gamma_{8,3}$(Pa)	131,101 (25)	0,0641 (17)	E1	0,202 (4)	0,0451 (9)	0,01094 (22)	0,262 (5)
$\gamma_{10,6}$(Pa)	134,285 (20)	0,016 (5)	[M1+E2]	6,1 (17)	1,48 (24)	0,37 (8)	8,0 (14)
$\gamma_{9,3}$(Pa)	141,74 (10)						
$\gamma_{10,5}$(Pa)	143,23 (2)	0,088 (15)	M1+E2	5,0 (14)	1,21 (16)	0,30 (6)	6,7 (12)
$\gamma_{(-1,3)}$(Pa)	147,5	0,0018 (6)					
$\gamma_{10,4}$(Pa)	151,409 (20)	0,040 (4)	[M1+E2]	3,4 (7)	1,08 (6)	0,276 (19)	4,9 (6)
$\gamma_{11,6}$(Pa)	153,49 (18)	0,0480 (8)	[E1]	0,140 (3)	0,0301 (6)	0,00728 (14)	0,180 (4)
$\gamma_{9,2}$(Pa)	155,239 (20)	0,000270 (35)	E1	0,137 (3)	0,0292 (6)	0,00708 (10)	0,176 (4)
$\gamma_{7,1}$(Pa)	162,504 (12)	0,194 (3)	[E1]	0,123 (3)	0,0260 (5)	0,0063 (1)	0,157 (3)
$\gamma_{11,5}$(Pa)	162,504	0,185	[E1]	0,1230 (18)	0,0260 (5)	0,0063 (1)	0,157 (3)
$\gamma_{7,0}$(Pa)	169,162 (10)	0,287 (5)	[E1]	0,1120 (22)	0,0235 (5)	0,00568 (12)	0,1431 (29)
$\gamma_{11,4}$(Pa)	170,60 (6)	0,578 (10)	[E1]	0,1099 (20)	0,0230 (5)	0,00556 (11)	0,1403 (28)
$\gamma_{17,15}$(Pa)	179,05 (8)	0,125 (25)	(M1+E2)	2,7 (8)	0,602 (15)	0,148 (10)	3,5 (8)
$\gamma_{10,2}$(Pa)	180,76 (3)	0,000123 (3)	[E1]	0,096 (2)	0,0199 (4)	0,0048 (1)	0,1223 (24)
$\gamma_{11,3}$(Pa)	186,80 (18)	0,067 (27)	[M1+E2]	1,5 (13)	0,531 (9)	0,137 (10)	2,2 (13)
$\gamma_{12,11}$(Pa)	190,552 (14)	0,367 (8)	M1	2,60 (5)	0,499 (10)	0,1204 (24)	3,26 (6)
$\gamma_{8,1}$(Pa)	194,97 (7)	0,1183 (19)	E1	0,0806 (16)	0,0164 (3)	0,00397 (8)	0,1024 (20)
$\gamma_{8,0}$(Pa)	201,62 (5)	0,0242 (9)	E1	0,0746 (15)	0,0151 (3)	0,00365 (7)	0,0946 (19)
$\gamma_{17,14}$(Pa)	210,67 (8)	0,044 (18)	[M1+E2]	1,1 (9)	0,35 (3)	0,0890 (21)	1,5 (10)
$\gamma_{(-1,4)}$(Pa)	211,3 (2)	0,0202 (9)					
$\gamma_{9,0}$(Pa)	212,34 (5)	0,0070 (7)	E1	0,0662 (12)	0,01331 (26)	0,00321 (6)	0,0839 (17)
$\gamma_{13,10}$(Pa)	216,54 (8)	0,031 (12)	(M1+E2)	1,0 (9)	0,32 (4)	0,081 (4)	1,4 (9)
$\gamma_{18,15}$(Pa)	226,1 (2)	0,0516 (22)	M1+(E2)	1,61 (3)	0,308 (6)	0,0743 (15)	2,02 (4)
$\gamma_{10,0}$(Pa)	237,86 (6)	0,00202 (43)	[E1]	0,0511 (10)	0,0101 (2)	0,00243 (5)	0,0645 (13)
$\gamma_{(-1,5)}$(Pa)	242,3	0,0029 (6)					
$\gamma_{12,8}$(Pa)	246,14 (6)	0,0043 (6)	[E1]	0,0473 (9)	0,00929 (19)	0,00224 (4)	0,0596 (12)
$\gamma_{11,1}$(Pa)	250,65 (16)	0,0062 (4)	[E2]	0,1043 (21)	0,156 (3)	0,0423 (8)	0,317 (6)
$\gamma_{13,8}$(Pa)	252,78 (9)	0,0152 (21)	[M1+E2]	1,0 (3)	0,215 (20)	0,052 (4)	1,3 (3)
$\gamma_{11,0}$(Pa)	257,30 (15)	0,09 (3)	[M1+E2]	0,6 (6)	0,18 (4)	0,045 (7)	0,8 (6)
$\gamma_{12,7}$(Pa)	278,7 (4)	0,0047 (6)					
$\gamma_{13,7}$(Pa)	285,24 (7)	0,030 (4)	[M1+E2]	0,74 (20)	0,152 (18)	0,037 (4)	0,94 (22)
$\gamma_{(-1,6)}$(Pa)	309,9	0,0032 (3)					
$\gamma_{14,10}$(Pa)	316,1	0,00383 (41)	E1	0,0272 (4)	0,00515 (10)	0,00124 (2)	0,0340 (7)
$\gamma_{15,10}$(Pa)	347,64 (6)	0,0234 (13)	[M1]	0,49 (1)	0,0932 (18)	0,0224 (5)	0,613 (12)
$\gamma_{13,5}$(Pa)	359,74 (4)	0,1355 (21)	M1	0,446 (9)	0,0848 (19)	0,0204 (4)	0,559 (11)
$\gamma_{12,4}$(Pa)	361,285 (22)	0,0224 (6)	[E1]	0,0205 (4)	0,00380 (8)	0,000912 (2)	0,0255 (5)
$\gamma_{13,4}$(Pa)	367,92 (7)	0,0056 (11)	[M1]	0,420 (8)	0,0797 (16)	0,0192 (4)	0,525 (10)
$\gamma_{12,3}$(Pa)	377,27 (11)	0,040 (3)	[M1+E2]	0,36 (7)	0,071 (8)	0,0172 (17)	0,46 (8)
$\gamma_{(-1,7)}$(Pa)	383,5	0,0019 (6)					
$\gamma_{19,15}$(Pa)	398,8 (5)	0,0158 (10)	[M1]	0,337 (7)	0,0639 (13)	0,0154 (3)	0,422 (8)

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{(-1,8)}$(Pa)	408,8 (5)	0,0005 (4)					
$\gamma_{16,11}$(Pa)	412,5 (5)	0,0115 (10)	[M1]	0,308 (6)	0,0583 (12)	0,0140 (3)	0,385 (8)
$\gamma_{(-1,9)}$(Pa)	418,4 (5)	0,0091 (7)					
$\gamma_{19,14}$(Pa)	430,9 (4)	0,0239 (5)	(M1)	0,273 (5)	0,0517 (10)	0,01245 (24)	0,342 (6)
$\gamma_{20,15}$(Pa)	433,2 (4)	0,0117 (4)					
$\gamma_{12,1}$(Pa)	440,94 (4)	0,249 (10)	(M1+E2)	0,24 (4)	0,046 (6)	0,0111 (13)	0,30 (5)
$\gamma_{12,0}$(Pa)	447,762 (20)	0,134 (5)	[M1+E2]	0,23 (4)	0,045 (5)	0,0108 (11)	0,29 (4)
$\gamma_{(-1,10)}$(Pa)	454,2 (5)	0,04					
$\gamma_{14,5}$(Pa)	459,222 (7)	1,274 (17)	M1	0,230 (5)	0,0435 (9)	0,01047 (21)	0,288 (6)
$\gamma_{(-1,11)}$(Pa)	464,8	0,0026 (3)					
$\gamma_{14,4}$(Pa)	467,40 (6)	0,0167 (17)	[M1,E2]	0,13 (10)	0,029 (13)	0,007	0,16 (11)
$\gamma_{(-1,12)}$(Pa)	473,9 (5)	0,0033 (7)					
$\gamma_{15,5}$(Pa)	490,80 (6)	0,1338 (21)	M1	0,193 (4)	0,0363 (7)	0,00874 (18)	0,241 (5)
$\gamma_{(-1,13)}$(Pa)	497,1 (4)	0,0128 (4)					
$\gamma_{15,4}$(Pa)	499,02 (4)	0,1938 (27)	M1	0,184 (3)	0,0347 (5)	0,00835 (12)	0,230 (5)
$\gamma_{(-1,14)}$(Pa)	505,5 (6)	0,0055 (3)					
$\gamma_{(-1,15)}$(Pa)	513,4 (4)	0,0133 (4)					
$\gamma_{(-1,16)}$(Pa)	517,0 (4)	0,0046 (3)					
$\gamma_{17,10}$(Pa)	526,69 (6)	0,052 (4)	[M1,E2]	0,09 (7)	0,02 (1)	0,005 (3)	0,12 (8)
$\gamma_{(-1,17)}$(Pa)	531,8 (4)	0,0070 (7)					
$\gamma_{17,9}$(Pa)	552,21 (8)	0,0194 (6)	(M1)	0,1404 (28)	0,0264 (5)	0,00635 (13)	0,1754 (35)
$\gamma_{(-1,18)}$(Pa)	553,7	0,0030 (3)					
$\gamma_{(-1,19)}$(Pa)	554,9	0,0031 (3)					
$\gamma_{17,8}$(Pa)	562,93 (8)	0,0636 (8)	[M1]	0,1334 (27)	0,0251 (5)	0,00603 (12)	0,167 (3)
$\gamma_{18,10}$(Pa)	573,7 (4)	0,0384 (12)	[M1]	0,1268 (25)	0,0238 (5)	0,00573 (12)	0,158 (3)
$\gamma_{(-1,20)}$(Pa)	578,7	0,0017 (5)					
$\gamma_{(-1,21)}$(Pa)	583,2	0,0016 (5)					
$\gamma_{17,7}$(Pa)	595,39 (6)	0,1346 (19)	(M1)	0,1148 (22)	0,0216 (4)	0,00518 (10)	0,143 (3)
$\gamma_{18,9}$(Pa)	599,3 (2)	0,0335 (6)	[M1]	0,1129 (22)	0,0212 (4)	0,00509 (10)	0,141 (3)
$\gamma_{18,8}$(Pa)	610,0 (3)	0,0643 (14)	[M1]	0,1077 (20)	0,0202 (4)	0,00485 (9)	0,134 (3)
$\gamma_{18,7}$(Pa)	642,4 (2)	0,0226 (6)	[M1]	0,0938 (19)	0,0176 (4)	0,00422 (8)	0,1171 (23)
$\gamma_{16,1}$(Pa)	663,3 (5)	0,0041 (6)	[M1]	0,0862 (17)	0,0161 (3)	0,00388 (8)	0,1075 (22)
$\gamma_{16,0}$(Pa)	669,9 (5)	0,0018					
$\gamma_{17,5}$(Pa)	669,901 (16)	0,557 (7)	[M1]	0,0839 (17)	0,0157 (3)	0,00377 (8)	0,1047 (21)
$\gamma_{17,4}$(Pa)	678,04 (10)	0,0686 (28)	[M1,E2]	0,05 (4)	0,010 (5)	0,0025 (12)	0,06 (4)
$\gamma_{(-1,22)}$(Pa)	681,2 (6)	0,0143 (4)					
$\gamma_{(-1,23)}$(Pa)	690	0,0021 (5)					
$\gamma_{(-1,24)}$(Pa)	698,5 (6)	0,0106 (5)					
$\gamma_{(-1,25)}$(Pa)	703,7 (6)	0,0091 (5)					
$\gamma_{18,6}$(Pa)	707,8 (3)	0,0093 (5)	[E2]	0,0148 (3)	0,00455 (9)	0,00115 (2)	0,0209 (4)
$\gamma_{18,5}$(Pa)	717,0 (2)	0,0458 (10)	(M1)	0,0701 (14)	0,0131 (3)	0,00314 (6)	0,0874 (17)
$\gamma_{18,4}$(Pa)	725,1 (2)	0,0687 (11)	(M1)	0,068 (1)	0,01271 (25)	0,00305 (6)	0,0848 (17)
$\gamma_{(-1,26)}$(Pa)	727,8	0,0029 (2)					
$\gamma_{18,3}$(Pa)	741,1 (2)	0,0237 (5)	[E1]	0,00502 (10)	0,000860 (17)	0,000204 (4)	0,00615 (12)
$\gamma_{(-1,27)}$(Pa)	744,9 (5)	0,0053 (2)					
$\gamma_{(-1,28)}$(Pa)	751,6 (6)	0,0023 (4)					
$\gamma_{17,1}$(Pa)	757,90 (7)	0,0324 (7)					
$\gamma_{17,0}$(Pa)	764,55 (6)	0,0891 (13)					
$\gamma_{(-1,29)}$(Pa)	767,5	0,0032 (2)					
$\gamma_{(-1,30)}$(Pa)	774,0 (4)	0,0108 (5)					
$\gamma_{19,8}$(Pa)	783,2 (5)	0,00600 (32)	[M1]	0,05550 (11)	0,01034 (20)	0,00248 (5)	0,0692 (14)
$\gamma_{(-1,31)}$(Pa)	784,2 (5)	0,0022 (2)					
$\gamma_{18,1}$(Pa)	805,0 (2)	0,0215 (6)	[E1]	0,00432 (9)	0,00073 (2)	0,000174 (4)	0,00529 (11)
$\gamma_{20,9}$(Pa)	806,4 (5)	0,0123 (5)					
$\gamma_{18,0}$(Pa)	811,6 (2)	0,0060 (2)	[E1]	0,00426 (9)	0,000720 (15)	0,000171 (4)	0,00521 (10)
$\gamma_{19,7}$(Pa)	815,9 (4)	0,0207 (6)	[M1]	0,0498 (10)	0,0093 (2)	0,00223 (5)	0,0621 (12)
$\gamma_{20,8}$(Pa)	817,0 (6)	0,0095 (5)					
$\gamma_{(-1,32)}$(Pa)	832,0 (3)	0,0075					
$\gamma_{(-1,33)}$(Pa)	846,8 (7)	0,0013					

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{20,7}$(Pa)	849,5 (5)	0,0039 (3)					
$\gamma_{(-1,34)}$(Pa)	870,7 (7)	0,0031 (2)					
$\gamma_{(-1,35)}$(Pa)	874,0 (5)	0,00120 (4)					
$\gamma_{19,6}$(Pa)	880,9 (5)	0,0098 (4)	E2	0,0100 (2)	0,00258 (5)	0,000640 (13)	0,0135 (3)
$\gamma_{19,5}$(Pa)	890,1 (5)	0,1104 (15)	[M1]	0,0396 (8)	0,00735 (15)	0,00176 (4)	0,0493 (10)
$\gamma_{19,4}$(Pa)	898,3 (5)	0,0023 (4)	[M1]	0,0386 (8)	0,00717 (14)	0,00172 (3)	0,0481 (10)
$\gamma_{(-1,36)}$(Pa)	918,9 (5)	0,006					
$\gamma_{(-1,37)}$(Pa)	935,2 (7)	0,0369 (7)					
$\gamma_{(-1,38)}$(Pa)	941,9 (8)	0,0048 (3)					
$\gamma_{(-1,39)}$(Pa)	942,8	0,0019 (3)					
$\gamma_{20,3}$(Pa)	948,3 (5)	0,0060 (3)					
$\gamma_{(-1,40)}$(Pa)	955 (1)	0,0002 (3)					
$\gamma_{(-1,41)}$(Pa)	960,8 (8)	0,0041 (2)					
$\gamma_{(-1,42)}$(Pa)	962,8 (9)	0,0015 (2)					
$\gamma_{(-1,43)}$(Pa)	968,2 (9)	0,0083 (3)					
$\gamma_{19,1}$(Pa)	978,2 (5)	0,00582 (30)	[E1]	0,00306 (6)	0,00051 (1)	0,000121 (2)	0,00374 (7)
$\gamma_{19,0}$(Pa)	984,8 (5)	0,01024 (30)	[E1]	0,00303 (6)	0,00051 (1)	0,000120 (2)	0,00369 (7)
$\gamma_{(-1,44)}$(Pa)	994 (1)	0,0006 (1)					
$\gamma_{(-1,45)}$(Pa)	1001 (1)	0,0008 (2)					
$\gamma_{(-1,46)}$(Pa)	1007 (1)	0,0014 (2)					
$\gamma_{(-1,47)}$(Pa)	1011 (1)	0,0019 (2)					
$\gamma_{(-1,48)}$(Pa)	1026,5 (10)	0,0075					
$\gamma_{(-1,49)}$(Pa)	1092,5 (10)	0,006					
$\gamma_{(-1,50)}$(Pa)	1132,1	0,0006 (2)					
$\gamma_{(-1,51)}$(Pa)	1139,1	0,0004 (1)					
$\gamma_{(-1,52)}$(Pa)	1144 (1)	0,0027					
$\gamma_{(-1,53)}$(Pa)	1201 (1)	0,006					

3 Atomic Data

3.1 Pa

ω_K : 0,970 (4)
$\bar{\omega}_L$: 0,488 (18)
n_{KL} : 0,795 (5)

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	}	

		Energy keV	Relative probability
X_L			
	$L\ell$	11,366	
	$L\alpha$	13,122 – 13,291	
	$L\eta$	14,946	
	$L\beta$	15,3 – 16,7	
	$L\gamma$	19,9 – 21,6	

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 – 112,40	8,76
Auger L	5,9 – 21,6	

4 Electron Emissions

		Energy keV	Electrons per 100 disint.
e_{AL}	(Pa)	5,9 - 21,6	8,6 (10)
e_{AK}	(Pa)		0,041 (5)
	KLL	70,081 - 78,822	}
	KLX	88,03 - 95,56	}
	KXY	101,78 - 112,40	}
$ec_{1,0\ M}$	(Pa)	1,29 - 3,21	34,2 (9)
$ec_{8,4\ K}$	(Pa)	2,54 (5)	0,013
$ec_{9,5\ K}$	(Pa)	5,10 (2)	0,0270 (31)
$ec_{1,0\ N}$	(Pa)	5,27 - 6,30	9,27 (26)
$ec_{4,2\ L}$	(Pa)	8,268 - 12,640	4,97 (19)
$ec_{8,3\ K}$	(Pa)	18,5 (1)	0,013
$ec_{10,6\ K}$	(Pa)	21,689 (20)	0,015
$ec_{4,2\ M}$	(Pa)	24,012 - 25,931	1,272 (49)
$ec_{4,2\ N}$	(Pa)	27,990 - 29,018	0,332 (12)

		Energy keV		Electrons per 100 disint.
$ec_{10,5\ K}$	(Pa)	30,63	(2)	0,057 (16)
$ec_{2,0\ L}$	(Pa)	36,0 - 40,4		6,39 (23)
$ec_{10,4\ K}$	(Pa)	38,9	(2)	0,034
$ec_{3,1\ L}$	(Pa)	42,82 - 47,19		0,052 (22)
$ec_{3,0\ L}$	(Pa)	49,38 - 53,76		0,020 (17)
$ec_{7,1\ K}$	(Pa)	49,908	(12)	0,0206 (6)
$ec_{11,5\ K}$	(Pa)	50		0,01968 (29)
$ec_{2,0\ M}$	(Pa)	51,7 - 53,7		1,76 (6)
$ec_{7,5\ L}$	(Pa)	53,40 - 57,78		0,299 (14)
$ec_{2,0\ N}$	(Pa)	55,7 - 56,7		0,475 (16)
$ec_{7,0\ K}$	(Pa)	56,57	(1)	0,0281 (7)
$ec_{11,4\ K}$	(Pa)	58,00	(6)	0,0557 (14)
$ec_{3,1\ M}$	(Pa)	58,56 - 60,48		0,014 (6)
$ec_{4,0\ L}$	(Pa)	65,372 - 69,744		2,08 (8)
$ec_{17,15\ K}$	(Pa)	66,45	(8)	0,075 (22)
$ec_{5,1\ L}$	(Pa)	66,88 - 71,26		0,0217 (6)
$ec_{7,5\ M}$	(Pa)	69,15 - 71,07		0,0720 (34)
$ec_{7,5\ N}$	(Pa)	73,13 - 74,16		0,0193 (9)
$ec_{5,0\ L}$	(Pa)	73,54 - 77,91		0,0814 (18)
$ec_{11,3\ K}$	(Pa)	74,20	(18)	0,031 (27)
$ec_{12,11\ K}$	(Pa)	77,956	(14)	0,224 (6)
$ec_{4,0\ M}$	(Pa)	81,116 - 83,035		0,41 (7)
$ec_{5,0\ M}$	(Pa)	89,29 - 91,21		0,01992 (45)
$ec_{17,14\ K}$	(Pa)	98,07	(8)	0,020 (16)
$ec_{13,10\ K}$	(Pa)	104	(2)	0,029
$ec_{18,15\ K}$	(Pa)	113,5	(2)	0,0275 (12)
$ec_{10,5\ L}$	(Pa)	122,12 - 126,50		0,0138 (20)
$ec_{10,4\ L}$	(Pa)	130,4 - 134,8		0,011
$ec_{13,8\ K}$	(Pa)	140,18	(9)	0,014
$ec_{11,0\ K}$	(Pa)	144,70	(15)	0,031 (31)
$ec_{11,4\ L}$	(Pa)	149,5 - 153,9		0,01166 (33)
$ec_{17,15\ L}$	(Pa)	157,95 - 162,32		0,0167 (6)
$ec_{11,3\ L}$	(Pa)	165,7 - 170,1		0,0111 (5)
$ec_{12,11\ L}$	(Pa)	169,447 - 173,819		0,0430 (11)
$ec_{13,7\ K}$	(Pa)	172,64	(7)	0,017
$ec_{12,11\ M}$	(Pa)	185,191 - 187,110		0,01037 (27)
$ec_{12,3\ K}$	(Pa)	264,67	(11)	0,015
$ec_{12,1\ K}$	(Pa)	328,34	(4)	0,046 (8)
$ec_{12,0\ K}$	(Pa)	335,17	(2)	0,0240 (42)
$ec_{14,5\ K}$	(Pa)	346,626	(7)	0,227 (6)
$ec_{12,3\ L}$	(Pa)	356,2 - 360,6		0,029
$ec_{15,5\ K}$	(Pa)	378,2	(6)	0,035
$ec_{15,4\ K}$	(Pa)	386,42	(4)	0,042
$ec_{14,5\ L}$	(Pa)	438,117 - 442,489		0,043 (1)
$ec_{17,8\ K}$	(Pa)	450,33	(8)	0,01
$ec_{14,5\ M}$	(Pa)	453,861 - 455,780		0,01035 (24)
$ec_{17,7\ K}$	(Pa)	482,79	(6)	0,02

		Energy keV		Electrons per 100 disint.
$ec_{17,5\ K}$	(Pa)	557,305	(16)	0,0423 (10)
$\beta^-_{0,20}$	max:	224,4	(14)	0,0434 (9)
$\beta^-_{0,20}$	avg:	60,9	(4)	
$\beta^-_{0,19}$	max:	258,3	(14)	0,205 (2)
$\beta^-_{0,19}$	avg:	70,8	(4)	
$\beta^-_{0,18}$	max:	431,5	(14)	0,385 (4)
$\beta^-_{0,18}$	avg:	124,3	(5)	
$\beta^-_{0,17}$	max:	478,5	(14)	1,19 (3)
$\beta^-_{0,17}$	avg:	139,5	(5)	
$\beta^-_{0,16}$	max:	573,2	(14)	0,0174 (22)
$\beta^-_{0,16}$	avg:	170,8	(5)	
$\beta^-_{0,15}$	max:	657,6	(14)	0,15 (3)
$\beta^-_{0,15}$	avg:	199,6	(5)	
$\beta^-_{0,14}$	max:	689,2	(14)	1,23 (3)
$\beta^-_{0,14}$	avg:	210,5	(5)	
$\beta^-_{0,13}$	max:	788,7	(14)	0,217 (13)
$\beta^-_{0,13}$	avg:	245,5	(5)	
$\beta^-_{0,12}$	max:	795,3	(14)	0,821 (14)
$\beta^-_{0,12}$	avg:	247,8	(5)	
$\beta^-_{0,11}$	max:	985,8	(14)	0,60 (3)
$\beta^-_{0,11}$	avg:	317,0	(6)	
$\beta^-_{0,8}$	max:	1041,4	(14)	0,074 (8)
$\beta^-_{0,8}$	avg:	337,6	(6)	
$\beta^-_{0,7}$	max:	1073,9	(14)	0,692 (12)
$\beta^-_{0,7}$	avg:	349,7	(6)	
$\beta^-_{0,5}$	max:	1148,4	(14)	10,4 (4)
$\beta^-_{0,5}$	avg:	377,8	(6)	
$\beta^-_{0,1}$	max:	1236,4	(14)	50 (6)
$\beta^-_{0,1}$	avg:	411,2	(6)	
$\beta^-_{0,0}$	max:	1243,1	(14)	34 (6)
$\beta^-_{0,0}$	avg:	413,8	(6)	

5 Photon Emissions

5.1 X-Ray Emissions

		Energy keV	Photons per 100 disint.
XL	(Pa)	11,366 — 21,6	8,2 (9)

		Energy keV		Photons per 100 disint.	
$XK\alpha_2$	(Pa)	92,288		0,39 (1)	} $K\alpha$
$XK\alpha_1$	(Pa)	95,869		0,615 (13)	}
$XK\beta_3$	(Pa)	107,595	}		
$XK\beta_1$	(Pa)	108,422	}	0,235 (6)	$K'\beta_1$
$XK\beta_5''$	(Pa)	109,072	}		
$XK\beta_2$	(Pa)	111,405	}		
$XK\beta_4$	(Pa)	111,87	}	0,079 (3)	$K'\beta_2$
$XKO_{2,3}$	(Pa)	112,38	}		

5.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{1,0}$(Pa)	6,65 (5)	0,0165 (18)
$\gamma_{4,2}$(Pa)	29,373 (10)	2,17 (7)
$\gamma_{2,0}$(Pa)	57,10 (2)	0,0498 (15)
$\gamma_{3,1}$(Pa)	63,92 (6)	0,0007 (3)
$\gamma_{3,0}$(Pa)	70,49 (10)	0,0007 (4)
$\gamma_{7,5}$(Pa)	74,51 (5)	0,0402 (17)
$\gamma_{4,0}$(Pa)	86,477 (10)	1,843 (22)
$\gamma_{5,1}$(Pa)	87,99 (3)	0,1698 (20)
$\gamma_{5,0}$(Pa)	94,65 (5)	0,775 (9)
$\gamma_{(-1,2)}$(Pa)	105,2 (1)	0,041
$\gamma_{9,6}$(Pa)	108,5 (1)	0,0006
$\gamma_{8,4}$(Pa)	115,14 (5)	0,003 (7)
$\gamma_{9,5}$(Pa)	117,692 (20)	0,0029 (3)
$\gamma_{8,3}$(Pa)	131,101 (25)	0,0508 (13)
$\gamma_{10,6}$(Pa)	134,285 (20)	0,0018 (5)
$\gamma_{10,5}$(Pa)	143,23 (2)	0,0114 (7)
$\gamma_{(-1,3)}$(Pa)	147,5	0,0018 (6)
$\gamma_{10,4}$(Pa)	151,409 (20)	0,0067 (3)
$\gamma_{11,6}$(Pa)	153,49 (18)	0,0407 (7)
$\gamma_{9,2}$(Pa)	155,239 (20)	0,00023 (3)
$\gamma_{11,5}$(Pa)	162,504	0,16
$\gamma_{7,1}$(Pa)	162,504 (12)	0,1674 (26)
$\gamma_{7,0}$(Pa)	169,162 (10)	0,251 (4)
$\gamma_{11,4}$(Pa)	170,60 (6)	0,507 (9)
$\gamma_{17,15}$(Pa)	179,05 (8)	0,0278 (7)
$\gamma_{10,2}$(Pa)	180,76 (3)	0,00011 (3)
$\gamma_{11,3}$(Pa)	186,80 (18)	0,0209 (9)
$\gamma_{12,11}$(Pa)	190,552 (14)	0,0861 (15)
$\gamma_{8,1}$(Pa)	194,97 (7)	0,1073 (17)
$\gamma_{8,0}$(Pa)	201,62 (5)	0,0221 (8)
$\gamma_{17,14}$(Pa)	210,67 (8)	0,0178 (11)

	Energy keV	Photons per 100 disint.
$\gamma_{(-1,4)}$(Pa)	211,3 (2)	0,0202 (9)
$\gamma_{9,0}$(Pa)	212,34 (5)	0,0065 (6)
$\gamma_{13,10}$(Pa)	216,54 (8)	0,0130 (7)
$\gamma_{18,15}$(Pa)	226,1 (2)	0,0171 (7)
$\gamma_{10,0}$(Pa)	237,86 (6)	0,0019 (4)
$\gamma_{(-1,5)}$(Pa)	242,3	0,0029 (6)
$\gamma_{12,8}$(Pa)	246,14 (6)	0,0041 (6)
$\gamma_{11,1}$(Pa)	250,65 (16)	0,0047 (3)
$\gamma_{13,8}$(Pa)	252,78 (9)	0,0066 (3)
$\gamma_{11,0}$(Pa)	257,30 (15)	0,0524 (12)
$\gamma_{12,7}$(Pa)	278,7 (4)	0,0047 (6)
$\gamma_{13,7}$(Pa)	285,24 (7)	0,0154 (9)
$\gamma_{(-1,6)}$(Pa)	309,9	0,0032 (3)
$\gamma_{14,10}$(Pa)	316,1	0,0037 (4)
$\gamma_{15,10}$(Pa)	347,64 (6)	0,0145 (8)
$\gamma_{13,5}$(Pa)	359,74 (4)	0,0869 (12)
$\gamma_{12,4}$(Pa)	361,285 (22)	0,0218 (6)
$\gamma_{13,4}$(Pa)	367,92 (7)	0,0037 (7)
$\gamma_{12,3}$(Pa)	377,27 (11)	0,0275 (9)
$\gamma_{(-1,7)}$(Pa)	383,5	0,0019 (6)
$\gamma_{19,15}$(Pa)	398,8 (5)	0,0111 (7)
$\gamma_{(-1,8)}$(Pa)	408,8 (5)	0,0005 (4)
$\gamma_{16,11}$(Pa)	412,5 (5)	0,0083 (7)
$\gamma_{(-1,9)}$(Pa)	418,4 (5)	0,0091 (7)
$\gamma_{19,14}$(Pa)	430,9 (4)	0,0178 (4)
$\gamma_{20,15}$(Pa)	433,2 (4)	0,0117 (4)
$\gamma_{12,1}$(Pa)	440,94 (4)	0,1912 (23)
$\gamma_{12,0}$(Pa)	447,762 (20)	0,1043 (14)
$\gamma_{(-1,10)}$(Pa)	454,2 (5)	0,04
$\gamma_{14,5}$(Pa)	459,222 (7)	0,989 (12)
$\gamma_{(-1,11)}$(Pa)	464,8	0,0026 (3)
$\gamma_{14,4}$(Pa)	467,40 (6)	0,0144 (4)
$\gamma_{(-1,12)}$(Pa)	473,9 (5)	0,0033 (7)
$\gamma_{15,5}$(Pa)	490,80 (6)	0,1078 (16)
$\gamma_{(-1,13)}$(Pa)	497,1 (4)	0,0128 (4)
$\gamma_{15,4}$(Pa)	499,02 (4)	0,1576 (21)
$\gamma_{(-1,14)}$(Pa)	505,5 (6)	0,0055 (3)
$\gamma_{(-1,15)}$(Pa)	513,4 (4)	0,0133 (4)
$\gamma_{(-1,16)}$(Pa)	517,0 (4)	0,0046 (3)
$\gamma_{17,10}$(Pa)	526,69 (6)	0,0463 (11)
$\gamma_{(-1,17)}$(Pa)	531,8 (4)	0,0070 (7)
$\gamma_{17,9}$(Pa)	552,21 (8)	0,0165 (5)
$\gamma_{(-1,18)}$(Pa)	553,7	0,0030 (3)
$\gamma_{(-1,19)}$(Pa)	554,9	0,0031 (3)
$\gamma_{17,8}$(Pa)	562,93 (8)	0,0545 (7)
$\gamma_{18,10}$(Pa)	573,7 (4)	0,0332 (10)
$\gamma_{(-1,20)}$(Pa)	578,7	0,0017 (5)

	Energy keV	Photons per 100 disint.
$\gamma_{(-1,21)}$(Pa)	583,2	0,0016 (5)
$\gamma_{17,7}$(Pa)	595,39 (6)	0,1178 (16)
$\gamma_{18,9}$(Pa)	599,3 (2)	0,0294 (5)
$\gamma_{18,8}$(Pa)	610,0 (3)	0,0567 (12)
$\gamma_{18,7}$(Pa)	642,4 (2)	0,0202 (5)
$\gamma_{16,1}$(Pa)	663,3 (5)	0,0037 (5)
$\gamma_{16,0}$(Pa)	669,9 (5)	0,0018
$\gamma_{17,5}$(Pa)	669,901 (16)	0,504 (6)
$\gamma_{17,4}$(Pa)	678,04 (10)	0,0647 (9)
$\gamma_{(-1,22)}$(Pa)	681,2 (6)	0,0143 (4)
$\gamma_{(-1,23)}$(Pa)	690	0,0021 (5)
$\gamma_{(-1,24)}$(Pa)	698,5 (6)	0,0106 (5)
$\gamma_{(-1,25)}$(Pa)	703,7 (6)	0,0091 (5)
$\gamma_{18,6}$(Pa)	707,8 (3)	0,0091 (5)
$\gamma_{18,5}$(Pa)	717,0 (2)	0,0421 (9)
$\gamma_{18,4}$(Pa)	725,1 (2)	0,0633 (10)
$\gamma_{(-1,26)}$(Pa)	727,8	0,0029 (2)
$\gamma_{18,3}$(Pa)	741,1 (2)	0,0236 (5)
$\gamma_{(-1,27)}$(Pa)	744,9 (5)	0,0053 (2)
$\gamma_{(-1,28)}$(Pa)	751,6 (6)	0,0023 (4)
$\gamma_{17,1}$(Pa)	757,90 (7)	0,0324 (7)
$\gamma_{17,0}$(Pa)	764,55 (6)	0,0891 (13)
$\gamma_{(-1,29)}$(Pa)	767,5	0,0032 (2)
$\gamma_{(-1,30)}$(Pa)	774,0 (4)	0,0108 (5)
$\gamma_{19,8}$(Pa)	783,2 (5)	0,0056 (3)
$\gamma_{(-1,31)}$(Pa)	784,2 (5)	0,0022 (2)
$\gamma_{18,1}$(Pa)	805,0 (2)	0,0214 (6)
$\gamma_{20,9}$(Pa)	806,4 (5)	0,0123 (5)
$\gamma_{18,0}$(Pa)	811,6 (2)	0,0060 (2)
$\gamma_{19,7}$(Pa)	815,9 (4)	0,0195 (6)
$\gamma_{20,8}$(Pa)	817,0 (6)	0,0095 (5)
$\gamma_{(-1,32)}$(Pa)	832,0 (3)	0,0075
$\gamma_{(-1,33)}$(Pa)	846,8 (7)	0,0013
$\gamma_{20,7}$(Pa)	849,5 (5)	0,0039 (3)
$\gamma_{(-1,34)}$(Pa)	870,7 (7)	0,0031 (2)
$\gamma_{(-1,35)}$(Pa)	874,0 (5)	0,00120 (4)
$\gamma_{19,6}$(Pa)	880,9 (5)	0,0097 (4)
$\gamma_{19,5}$(Pa)	890,1 (5)	0,1052 (14)
$\gamma_{19,4}$(Pa)	898,3 (5)	0,0022 (4)
$\gamma_{(-1,36)}$(Pa)	918,9 (5)	0,006
$\gamma_{(-1,37)}$(Pa)	935,2 (7)	0,0369 (7)
$\gamma_{(-1,38)}$(Pa)	941,9 (8)	0,0048 (3)
$\gamma_{(-1,39)}$(Pa)	942,8	0,0019 (3)
$\gamma_{20,3}$(Pa)	948,3 (5)	0,0060 (3)
$\gamma_{(-1,40)}$(Pa)	955 (1)	0,0002 (3)
$\gamma_{(-1,41)}$(Pa)	960,8 (8)	0,0041 (2)
$\gamma_{(-1,42)}$(Pa)	962,8 (9)	0,0015 (2)

	Energy keV	Photons per 100 disint.
$\gamma_{(-1,43)}$(Pa)	968,2 (9)	0,0083 (3)
$\gamma_{19,1}$(Pa)	978,2 (5)	0,0058 (3)
$\gamma_{19,0}$(Pa)	984,8 (5)	0,0102 (3)
$\gamma_{(-1,44)}$(Pa)	994 (1)	0,0006 (1)
$\gamma_{(-1,45)}$(Pa)	1001 (1)	0,0008 (2)
$\gamma_{(-1,46)}$(Pa)	1007 (1)	0,0014 (2)
$\gamma_{(-1,47)}$(Pa)	1011 (1)	0,0019 (2)
$\gamma_{(-1,48)}$(Pa)	1026,5 (10)	0,0075
$\gamma_{(-1,49)}$(Pa)	1092,5 (10)	0,006
$\gamma_{(-1,50)}$(Pa)	1132,1	0,0006 (2)
$\gamma_{(-1,51)}$(Pa)	1139,1	0,0004 (1)
$\gamma_{(-1,52)}$(Pa)	1144 (1)	0,0027
$\gamma_{(-1,53)}$(Pa)	1201 (1)	0,006

6 Main Production Modes

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

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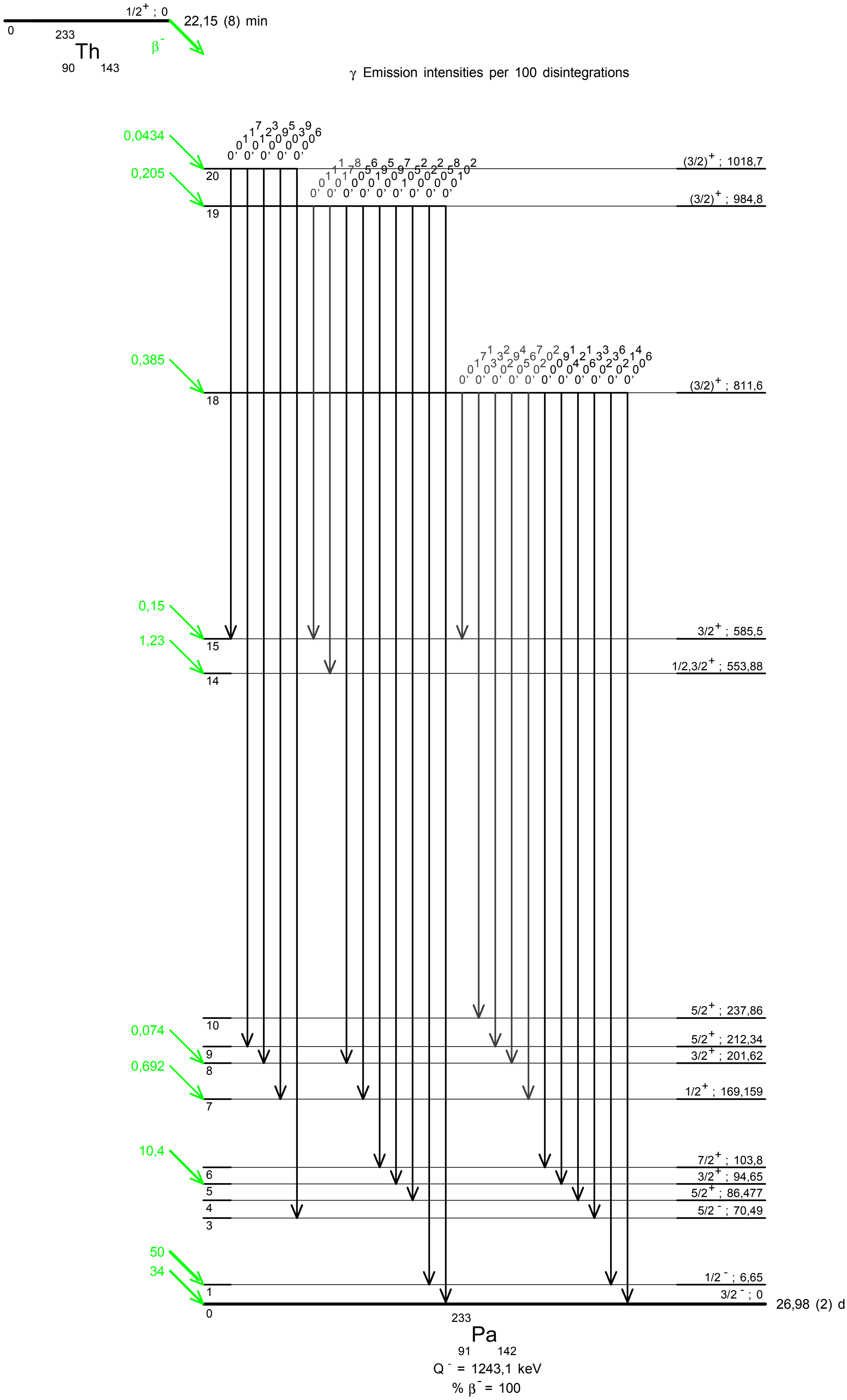
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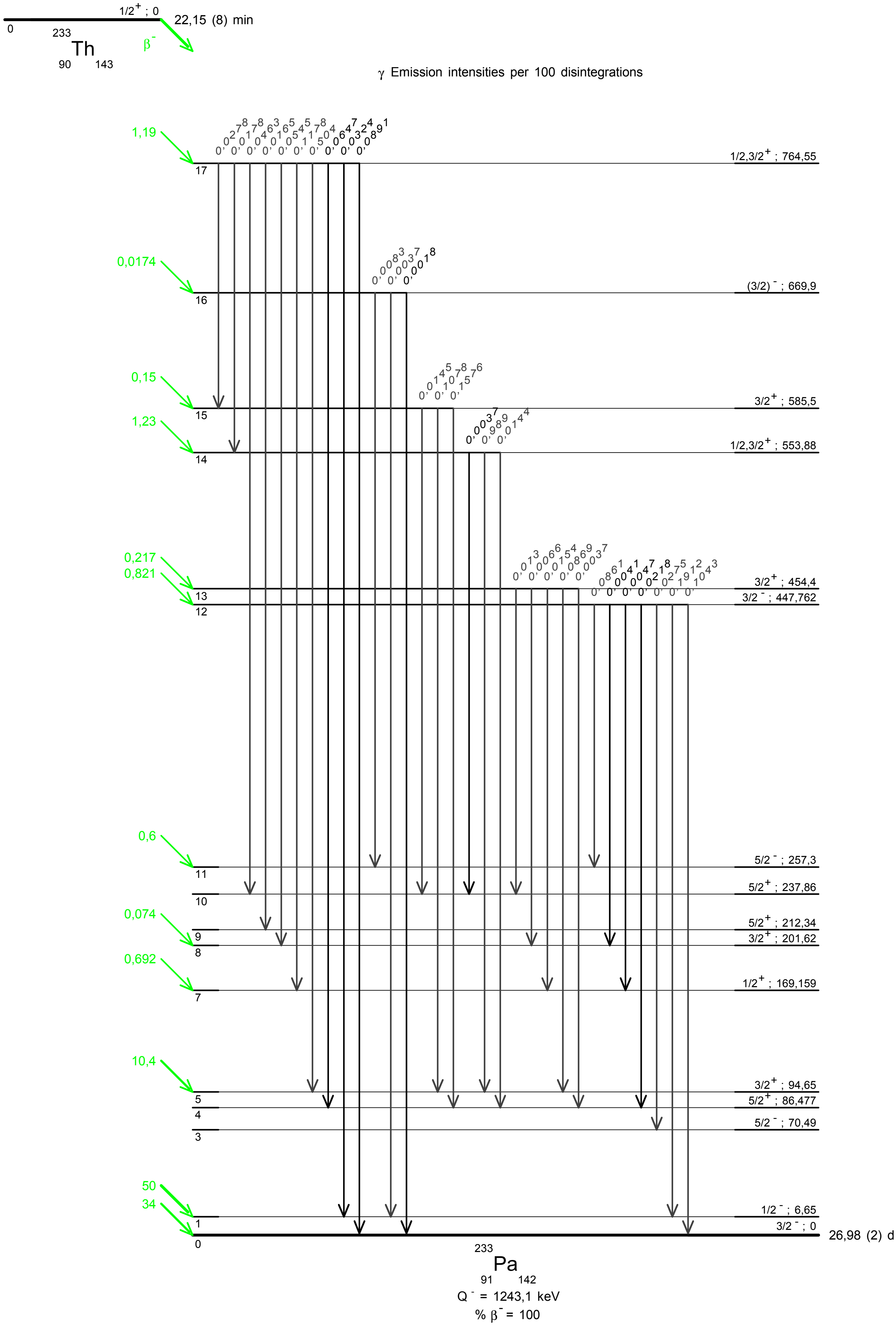
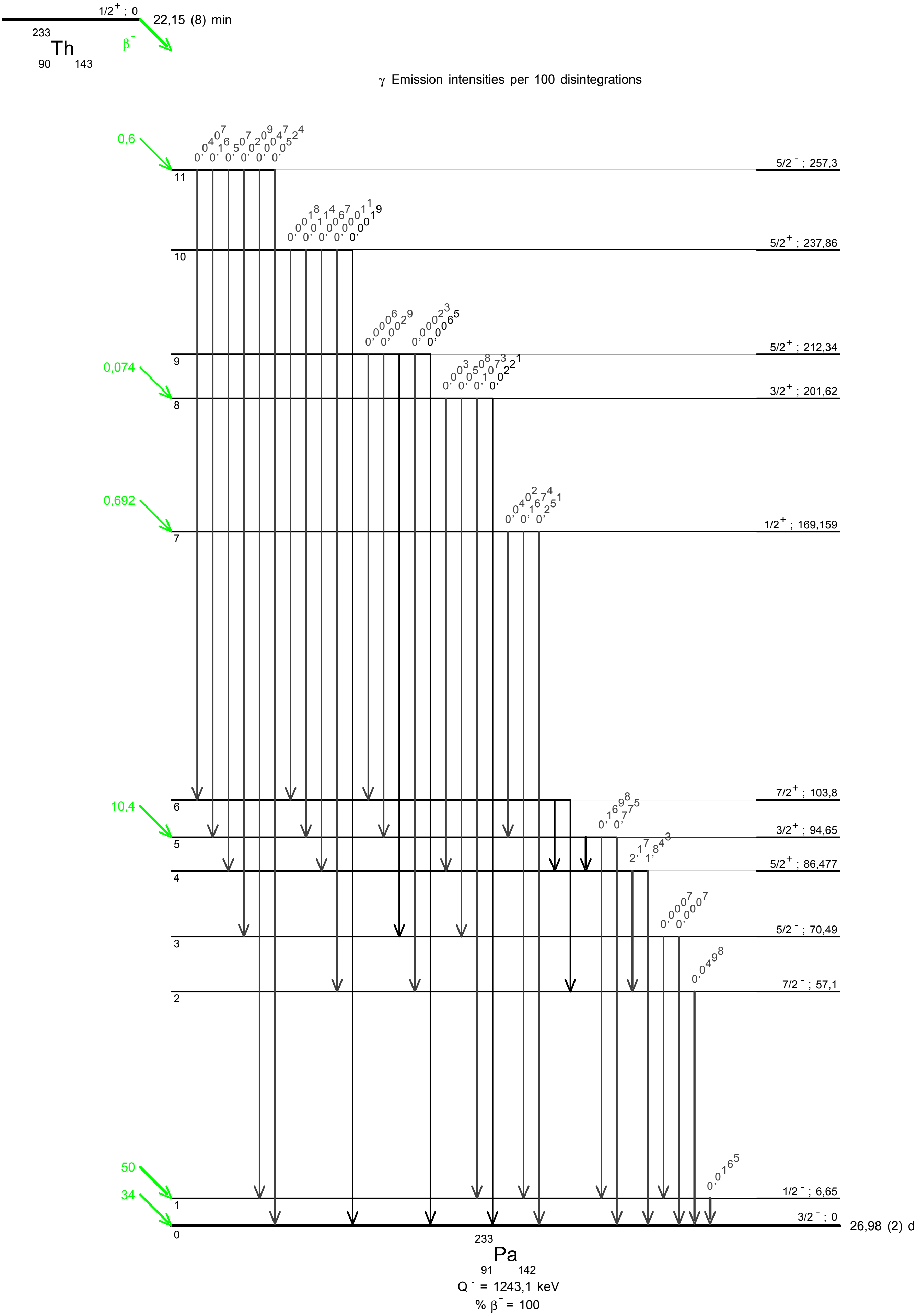
0
233 Th 90 143
22,15 (8) min
β-
γ Emission intensities per 100 disintegrations
0,0434
0,205
0,385
0,15
1,23
0,074
0,692
10,4
50
34
20
19
18
15
14
10
9
8
7
6
5
4
3
1
0
(3/2)+ ; 1018,7
(3/2)+ ; 984,8
(3/2)+ ; 811,6
3/2+ ; 585,5
1/2,3/2+ ; 553,88
5/2+ ; 237,86
5/2+ ; 212,34
3/2+ ; 201,62
1/2+ ; 169,159
7/2+ ; 103,8
3/2+ ; 94,65
5/2+ ; 86,477
5/2- ; 70,49
1/2- ; 6,65
3/2- ; 0
26,98 (2) d
233 Pa 91 142
Q- = 1243,1 keV
% β- = 100


1/2+ ; 0
22,15 (8) min
233 Th 90 143
β-
γ Emission intensities per 100 disintegrations
1,19
0,0174
0,15
1,23
0,217
0,821
0,6
0,074
0,692
10,4
50
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
26,98 (2) d
233 Pa 91 142
Q - = 1243,1 keV
% β- = 100


1/2+ ; 0
22,15 (8) min
233 Th 90 143
β-
γ Emission intensities per 100 disintegrations
0,6
0,074
0,692
10,4
50
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
26,98 (2) d
233 Pa 91 142
Q - = 1243,1 keV
% β- = 100

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

1 Decay Scheme

Pa-233 decays by beta minus emission to levels in U-233.
Le protactinium 233 se désintègre par émission bêta moins vers des niveaux excités 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	10,6
$\beta^-_{0,10}$	154,3 (20)	25,4 (16)	1st forbidden	6,7
$\beta^-_{0,9}$	171,5 (20)	15,4 (8)	1st forbidden	7
$\beta^-_{0,8}$	189,8 (20)	0,020 (3)	1st forbidden unique	9,4
$\beta^-_{0,7}$	229,6 (20)	25,9 (32)	1st forbidden	7,2
$\beta^-_{0,6}$	249,4 (20)	0,020 (5)	2nd forbidden	10,4
$\beta^-_{0,5}$	258,2 (20)	26,6 (32)	1st forbidden	7,3
$\beta^-_{0,4}$	268,1 (20)	0,010 (2)	Allowed	11,8
$\beta^-_{0,3}$	271,3 (20)	0,12 (5)	Allowed	9,8
$\beta^-_{0,1}$	529,8 (20)	0,3 (19)	1st forbidden unique	10,2
$\beta^-_{0,0}$	570,1 (20)	6,3 (23)	1st forbidden	9,1

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{10,9}$(U)	17,262 (6)	2,07	M1+1,66%E2			374	503
$\gamma_{7,5}$(U)	28,559 (10)	22,3 (28)	M1+2,44%E2		233 (13)	60 (4)	313 (18)
$\gamma_{1,0}$(U)	40,349 (5)	13,9 (19)	M1+54%E2		430 (50)	117 (12)	580 (60)
$\gamma_{7,3}$(U)	41,663 (10)	0,032 (7)	[E1]		0,939 (19)	0,235 (5)	1,253 (25)
$\gamma_{2,1}$(U)	51,81 (4)	0,055	[M1+28%E2]		79	21	108
$\gamma_{10,7}$(U)	75,269 (10)	16,1 (16)	M1+2,2%E2		8,6 (9)	2,11 (24)	11,4 (12)
$\gamma_{9,5}$(U)	86,595 (5)	16,1 (9)	M1+0,31%E2		5,33 (11)	1,29 (3)	7,08 (14)
$\gamma_{2,0}$(U)	92,16 (4)	0,0492	[E2]		14,2	3,95	19,5
$\gamma_{10,5}$(U)	103,86 (1)	4,44 (18)	M1+(1%E2)		3,17 (15)	0,77 (5)	4,21 (21)
$\gamma_{6,2}$(U)	228,57 (5)	0,0042 (7)					
$\gamma_{7,2}$(U)	248,38 (4)	0,082 (2)	[E2]	0,1065 (21)	0,175 (4)	0,0479 (10)	0,346 (7)
$\gamma_{3,1}$(U)	258,45 (2)	0,0289 (6)	[E1]	0,0433 (9)	0,00857 (17)	0,00207 (4)	0,0547 (11)
$\gamma_{5,1}$(U)	271,555 (10)	0,406 (4)	E2	0,0904 (18)	0,1226 (25)	0,0334 (7)	0,258 (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]	0,0315 (6)	0,00609 (12)	0,00147 (3)	0,0396 (8)
$\gamma_{7,1}$(U)	300,129 (5)	12,3 (4)	M1+0,6%E2	0,70 (2)	0,133 (4)	0,031 (1)	0,87 (2)
$\gamma_{4,0}$(U)	301,99 (10)	0,010 (2)					
$\gamma_{5,0}$(U)	311,904 (5)	68,9 (12)	M1+1%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+5%E2	0,50 (2)	0,103 (3)	0,022 (1)	0,62 (2)
$\gamma_{10,1}$(U)	375,404 (5)	0,751 (7)	E2	0,0491 (10)	0,0360 (7)	0,00962 (19)	0,0981 (20)
$\gamma_{8,0}$(U)	380,28 (10)	0,0037 (9)					
$\gamma_{9,0}$(U)	398,492 (5)	1,526 (15)	E2	0,0439 (9)	0,0291 (6)	0,00777 (16)	0,0835 (17)
$\gamma_{10,0}$(U)	415,764 (5)	1,97 (12)	M1+83%E2	0,09 (6)	0,032 (9)	0,0081 (21)	0,13 (8)
$\gamma_{11,0}$(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	71,78 – 80,95	100
KLX	88,15 – 98,34	59,6
KXY	104,42 – 115,40	8,88
Auger L	5,9 – 21,6	

4 Electron Emissions

		Energy keV	Electrons per 100 disint.
e_{AL}	(U)	5,9 - 21,6	42,2 (13)
e_{AK}	(U)		0,95 (13)
	KLL	71,78 - 80,95	}
	KLX	88,15 - 98,34	}
	KXY	104,42 - 115,40	}
$ec_{7,5\ L}$	(U)	6,80 - 11,39	16,5 (21)
$ec_{10,9\ M}$	(U)	11,714 - 13,710	1,53
$ec_{1,0\ L}$	(U)	18,59 - 23,18	10,3 (15)
$ec_{7,3\ L}$	(U)	19,9 - 24,5	0,013 (3)
$ec_{7,5\ M}$	(U)	23,01 - 25,01	4,3 (6)
$ec_{7,5\ N}$	(U)	27,118 - 28,180	1,14 (15)
$ec_{2,1\ L}$	(U)	30,05 - 34,64	0,04
$ec_{1,0\ M}$	(U)	34,8 - 36,8	2,8 (4)
$ec_{1,0\ N}$	(U)	38,908 - 39,970	0,77 (12)
$ec_{2,1\ M}$	(U)	46,26 - 48,26	0,011
$ec_{10,7\ L}$	(U)	53,51 - 58,10	11,2 (12)
$ec_{9,5\ L}$	(U)	64,84 - 69,43	10,6 (6)
$ec_{10,7\ M}$	(U)	69,72 - 71,72	2,7 (3)
$ec_{2,0\ L}$	(U)	70,40 - 74,99	0,034
$ec_{10,7\ N}$	(U)	73,828 - 74,890	0,74 (9)
$ec_{9,5\ M}$	(U)	81,05 - 83,04	2,57 (14)
$ec_{10,5\ L}$	(U)	82,10 - 86,69	2,70 (13)
$ec_{9,5\ N}$	(U)	85,154 - 86,216	0,695 (38)
$ec_{10,5\ M}$	(U)	98,31 - 100,31	0,66 (4)
$ec_{10,5\ N}$	(U)	102,42 - 103,48	0,18 (1)
$ec_{5,1\ K}$	(U)	155,95 (1)	0,0292 (6)
$ec_{7,1\ K}$	(U)	184,527 (5)	4,62 (20)
$ec_{7,1\ T}$	(U)	184,527 - 300,120	5,74 (23)
$ec_{5,0\ K}$	(U)	196,302 (5)	24,5 (8)
$ec_{5,0\ T}$	(U)	196,302 - 311,895	30,6 (9)
$ec_{7,0\ K}$	(U)	224,874 (5)	2,24 (9)
$ec_{7,0\ T}$	(U)	224,874 - 340,468	2,77 (9)
$ec_{7,2\ L}$	(U)	226,62 - 231,21	0,0107 (3)
$ec_{5,1\ L}$	(U)	249,80 - 254,39	0,0396 (9)
$ec_{10,1\ K}$	(U)	259,802 (5)	0,0336 (8)
$ec_{5,1\ M}$	(U)	266,01 - 268,00	0,0108 (3)
$ec_{7,1\ L}$	(U)	278,37 - 282,96	0,88 (4)
$ec_{9,0\ K}$	(U)	282,890 (5)	0,0618 (12)
$ec_{5,0\ L}$	(U)	290,15 - 294,74	4,83 (17)
$ec_{7,1\ M}$	(U)	294,58 - 296,58	0,22 (1)
$ec_{7,1\ N}$	(U)	298,688 - 299,750	0,0659 (25)
$ec_{10,0\ K}$	(U)	300,162 (7)	0,16 (10)
$ec_{5,0\ M}$	(U)	306,36 - 308,35	1,19 (4)

		Energy keV		Electrons per 100 disint.
$ec_{5,0\ N}$	(U)	310,463 - 311,525		0,343 (6)
$ec_{7,0\ L}$	(U)	318,72 - 323,31		0,460 (14)
$ec_{7,0\ M}$	(U)	334,93 - 336,93		0,098 (5)
$ec_{7,0\ N}$	(U)	339,035 - 340,097		0,024 (8)
$ec_{10,1\ L}$	(U)	353,65 - 358,24		0,0246 (5)
$ec_{9,0\ L}$	(U)	376,73 - 381,32		0,0410 (9)
$ec_{9,0\ M}$	(U)	392,94 - 394,94		0,01094 (25)
$ec_{10,0\ L}$	(U)	394,01 - 398,60		0,056 (16)
$ec_{10,0\ M}$	(U)	410,22 - 412,21		0,014 (3)
$\beta^-_{0,11}$	max:	114,1	(20)	0,0011 (2)
$\beta^-_{0,11}$	avg:	29,8	(5)	
$\beta^-_{0,10}$	max:	154,3	(20)	25,4 (16)
$\beta^-_{0,10}$	avg:	40,9	(5)	
$\beta^-_{0,9}$	max:	171,5	(20)	15,4 (8)
$\beta^-_{0,9}$	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)	25,9 (32)
$\beta^-_{0,7}$	avg:	62,4	(6)	
$\beta^-_{0,6}$	max:	249,4	(20)	0,020 (5)
$\beta^-_{0,6}$	avg:	68,2	(6)	
$\beta^-_{0,5}$	max:	258,2	(20)	26,6 (32)
$\beta^-_{0,5}$	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)	0,3 (19)
$\beta^-_{0,1}$	avg:	156,1	(6)	
$\beta^-_{0,0}$	max:	570,1	(20)	6,3 (23)
$\beta^-_{0,0}$	avg:	169,6	(6)	

5 Photon Emissions

5.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(U)	11,619 — 20,714		40,6 (11)	
$XK\alpha_2$	(U)	94,666		9,10 (26)	} $K\alpha$
$XK\alpha_1$	(U)	98,44		14,6 (4)	}
$XK\beta_3$	(U)	110,421	}		
$XK\beta_1$	(U)	111,298	}	5,25 (18)	$K'\beta_1$
$XK\beta_5''$	(U)	111,964	}		
$XK\beta_2$	(U)	114,407	}		
$XK\beta_4$	(U)	115,012	}	1,80 (7)	$K'\beta_2$
$XKO_{2,3}$	(U)	115,377	}		

5.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{10,9}$(U)	17,262 (6)	0,0041
$\gamma_{7,5}$(U)	28,559 (10)	0,071 (8)
$\gamma_{1,0}$(U)	40,349 (5)	0,024 (2)
$\gamma_{7,3}$(U)	41,663 (10)	0,014 (3)
$\gamma_{2,1}$(U)	51,81 (4)	0,0005
$\gamma_{10,7}$(U)	75,269 (10)	1,30 (3)
$\gamma_{9,5}$(U)	86,595 (5)	1,99 (10)
$\gamma_{2,0}$(U)	92,16 (4)	0,0024
$\gamma_{10,5}$(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)	38,3 (5)
$\gamma_{6,0}$(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)

	Energy keV	Photons per 100 disint.
$\gamma_{8,0}$(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)Th – 233
Th – 233(β^-)Pa – 233

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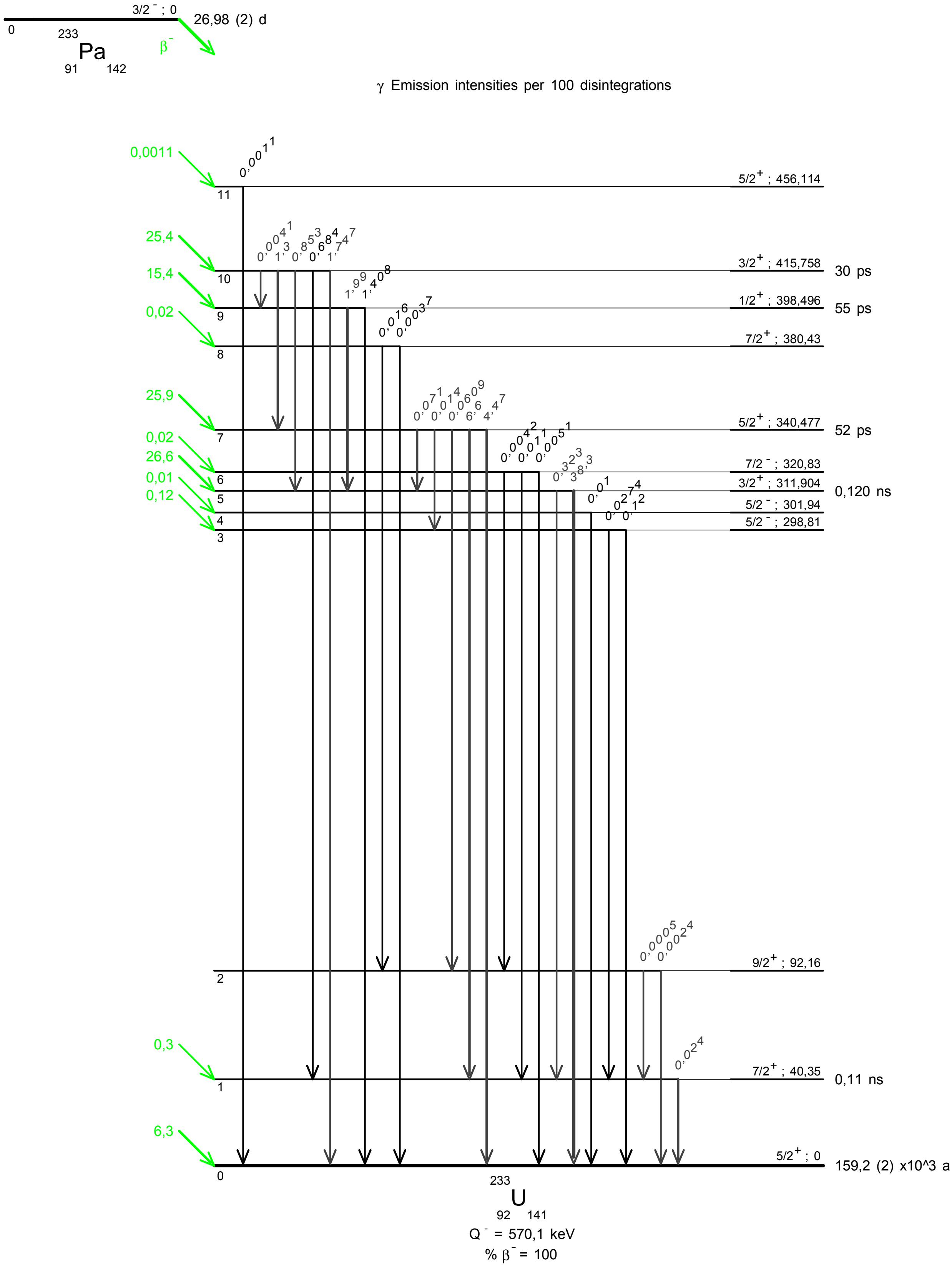
3/2 - ; 0
26,98 (2) d
233 Pa 91 142
β-
γ Emission intensities per 100 disintegrations
5/2+ ; 456,114
3/2+ ; 415,758
30 ps
1/2+ ; 398,496
55 ps
7/2+ ; 380,43
5/2+ ; 340,477
52 ps
7/2 - ; 320,83
3/2+ ; 311,904
0,120 ns
5/2 - ; 301,94
5/2 - ; 298,81
9/2+ ; 92,16
7/2+ ; 40,35
0,11 ns
5/2+ ; 0
159,2 (2) x10^3 a
0,0011
25,4
15,4
0,02
25,9
0,02
26,6
0,01
0,12
0,3
6,3
233 U 92 141
Q - = 570,1 keV
% β- = 100

$^{234}_{90}\mathrm{Th}_{144}$

1 Decay Scheme

Th-234 decays 100 % by beta minus particle emissions, mainly to Pa-234m, the 1,159 min half-life metastable state of Pa-234.
Le thorium 234 se désintègre 100 % par émissions bêta, principalement vers le niveau métastable du protactinium 234 de 1,159 min de période.

2 Nuclear Data

$T_{1/2}(^{234}\mathrm{Th})$	:	24,10	(3)	d
$T_{1/2}(^{234}\mathrm{Pa})$	:	6,70	(5)	h
$Q^{-}(^{234}\mathrm{Th})$	:	272	(10)	keV

2.1 β^- Transitions

	Energy keV	Probability × 100	Nature	lg ft
$\beta^-_{0,7}$	85 (10)	1,6 (6)	Allowed	7
$\beta^-_{0,6}$	95 (10)	0,016 (5)	1st Forbidden	9,1
$\beta^-_{0,5}$	105 (10)	6,5 (7)	Allowed	6,7
$\beta^-_{0,4}$	106 (10)	14,1 (12)	1st Forbidden	6,3
$\beta^-_{0,2}$	198 (10)	77,8 (15)	1st Forbidden	6,4

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{7,5}$(Pa)	20,01 (2)	1,2 (6)	M1+E2		70 (40)	124 (21)	240 (70)
$\gamma_{3,2}$(Pa)	29,50 (2)	5,4 (6)	E2		3210 (50)	880 (13)	4390 (70)
$\gamma_{4,3}$(Pa)	62,88 (2)	0,43 (11)	M1+E2		19 (4)	4,8 (9)	25 (5)
$\gamma_{5,3}$(Pa)	63,30 (2)	5,27 (11)	E1		0,305 (5)	0,0749 (11)	0,405 (6)

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{1,0}$(Pa)	73,92 (2)	0,154 (17)	M1+E2		7,96 (25)	1,94 (7)	10,6 (4)
$\gamma_{7,3}$(Pa)	83,31 (5)	0,073 (6)	E1		0,1475 (21)	0,0361 (5)	0,196 (3)
$\gamma_{4,2}$(Pa)	92,38 (1)	13,7 (12)	M1		3,98 (6)	0,960 (14)	5,27 (8)
$\gamma_{5,2}$(Pa)	92,80 (2)	2,47 (22)	E1		0,1110 (16)	0,0271 (4)	0,1472 (21)
$\gamma_{6,2}$(Pa)	103,35 (10)	0,0154 (48)	M1		2,88 (5)	0,694 (10)	3,81 (6)
$\gamma_{7,2}$(Pa)	112,81 (5)	0,264 (40)	E1	0,21 (13)	0,0666 (10)	0,01620 (23)	0,23 (14)

3 Atomic Data

3.1 Pa

ω_K	:	0,970	(4)
$\bar{\omega}_L$	:	0,488	(18)
n_{KL}	:	0,795	(5)

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	}	35,84
	$K\beta_2$	111,405	}	
	$K\beta_4$	111,87	}	12,15
	$KO_{2,3}$	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	85,989 – 95,858	59,2
KXY	101,87 – 112,59	8,76
Auger L	5,9 – 21,6	

4 Electron Emissions

		Energy keV		Electrons per 100 disint.
e_{AL}	(Pa)	5,9 - 21,6		7,7 (6)
e_{AK}	(Pa)			0,0014 (9)
	KLL	70,081 - 78,822	}	
	KLX	85,989 - 95,858	}	
	KXY	101,87 - 112,59	}	
$ec_{3,2\ L}$	(Pa)	8,4 - 12,8		3,95 (45)
$ec_{7,5\ M}$	(Pa)	14,65 - 16,57		0,63 (28)
$ec_{7,5\ N}$	(Pa)	18,63 - 19,65		0,17 (8)
$ec_{3,2\ M}$	(Pa)	24,1 - 26,1		1,08 (12)
$ec_{3,2\ N}$	(Pa)	28,1 - 29,1		0,292 (34)
$ec_{4,3\ L}$	(Pa)	41,78 - 46,15		0,31 (8)
$ec_{5,3\ L}$	(Pa)	42,2 - 46,6		1,144 (31)
$ec_{1,0\ L}$	(Pa)	52,82 - 57,19		0,106 (12)
$ec_{5,3\ M}$	(Pa)	57,9 - 59,9		0,281 (7)
$ec_{4,2\ L}$	(Pa)	71,27 - 75,65		8,7 (8)
$ec_{5,2\ L}$	(Pa)	71,7 - 76,1		0,239 (21)
$ec_{4,2\ M}$	(Pa)	87,02 - 88,94		2,09 (18)
$ec_{4,2\ N}$	(Pa)	91,00 - 92,02		0,56 (5)
$\beta^-_{0,7}$	max:	85	(10)	1,6 (6)
$\beta^-_{0,7}$	avg:	22	(3)	
$\beta^-_{0,6}$	max:	95	(10)	0,016 (5)
$\beta^-_{0,6}$	avg:	25	(3)	
$\beta^-_{0,5}$	max:	105	(10)	6,5 (7)
$\beta^-_{0,5}$	avg:	27	(3)	
$\beta^-_{0,4}$	max:	106	(10)	14,1 (12)
$\beta^-_{0,4}$	avg:	28	(3)	

		Energy keV		Electrons per 100 disint.
$\beta^-_{0,2}$	max:	198	(10)	77,8 (15)
$\beta^-_{0,2}$	avg:	53	(3)	

5 Photon Emissions

5.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(Pa)	11,3676 — 20,1126		7,1 (3)	
XKα_2	(Pa)	92,288		0,013 (9)	} Kα
XKα_1	(Pa)	95,869		0,021 (13)	}
XKβ_3	(Pa)	107,595	}		
XKβ_1	(Pa)	108,422	}	0,007 (5)	K$'\beta_1$
XKβ''_5	(Pa)	109,072	}		
XKβ_2	(Pa)	111,405	}		
XKβ_4	(Pa)	111,87	}	0,0025 (16)	K$'\beta_2$
XKO$_{2,3}$	(Pa)	112,38	}		

5.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{7,5}$(Pa)	20,01 (2)	0,0051 (21)
$\gamma_{3,2}$(Pa)	29,50 (2)	0,00123 (14)
$\gamma_{4,3}$(Pa)	62,88 (2)	0,0164 (28)
$\gamma_{5,3}$(Pa)	63,30 (2)	3,75 (8)
$\gamma_{1,0}$(Pa)	73,92 (2)	0,0133 (14)
$\gamma_{7,3}$(Pa)	83,31 (5)	0,061 (5)
$\gamma_{4,2}$(Pa)	92,38 (1)	2,18 (19)
$\gamma_{5,2}$(Pa)	92,80 (2)	2,15 (19)
$\gamma_{6,2}$(Pa)	103,35 (10)	0,0032 (10)
$\gamma_{7,2}$(Pa)	112,81 (5)	0,215 (22)

6 Main Production Modes

U – 238(α,)Th – 234

7 References

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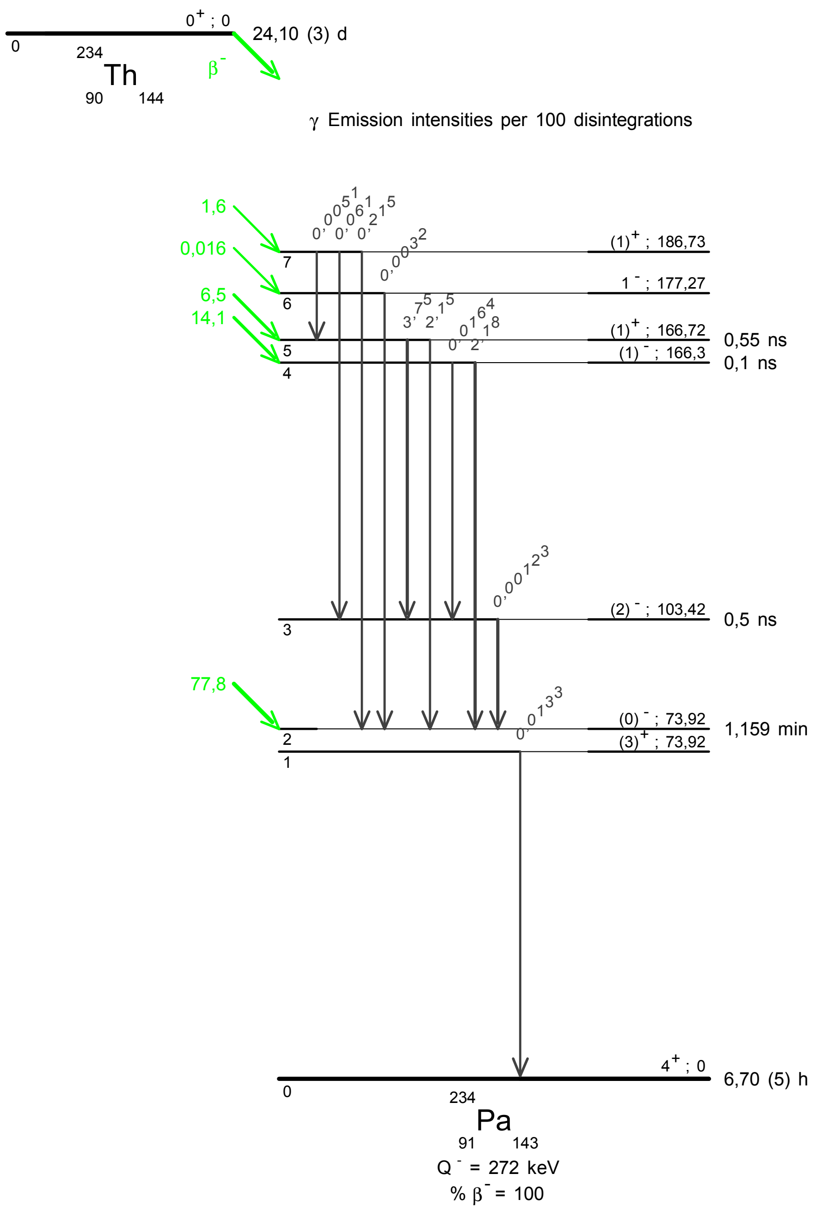
0+ ; 0
24,10 (3) d
0
234 Th 90 144
β-
γ Emission intensities per 100 disintegrations
1,6
0,016
6,5
14,1
77,8
(1)+ ; 186,73
1- ; 177,27
(1)+ ; 166,72
(1)- ; 166,3
(2)- ; 103,42
(0)- ; 73,92
(3)+ ; 73,92
4+ ; 0
0,55 ns
0,1 ns
0,5 ns
1,159 min
6,70 (5) h
234 Pa 91 143
Q- = 272 keV
% β- = 100

235 U
92 143

1 Decay Scheme

U-235 disintegrates by alpha emission to levels in Th-231. The spontaneous fission branching ratio is 7,0 (2) E-9 %.
L'uranium 235 se désintègre par émission alpha vers des niveaux du thorium 231. Le pourcentage de fission spontanée est de 7,0 (2) E-9 %.

2 Nuclear Data

$T_{1/2}(^{235}\text{U})$	:	704	(1)	10^6 a
$T_{1/2}(^{231}\text{Th})$	:	25,52	(1)	h
$Q^{\alpha}(^{235}\text{U})$	:	4678,3	(7)	keV

2.1 α Transitions

	Energy keV	Probability × 100	F
$\alpha_{0,22}$	4045 (5)	≈ 0,0011	79
$\alpha_{0,21}$	4082,7 (8)	0,0396 (10)	4,86
$\alpha_{0,20}$	4148,1 (7)	0,016 (12)	46
$\alpha_{0,19}$	4224 (5)	0,294 (13)	11,6
$\alpha_{0,18}$	4287,7 (19)	5,95 (12)	2
$\alpha_{0,17}$	4292,6 (7)	0,01732 (12)	714
$\alpha_{0,16}$	4300,8 (7)	0,122 (6)	119
$\alpha_{0,15}$	4322 (5)	0,069 (10)	343
$\alpha_{0,14}$	4340 (5)	0,22 (3)	150
$\alpha_{0,13}$	4353,4 (7)	0,0329 (5)	1185
$\alpha_{0,12}$	4361,1 (7)	0,065 (13)	690
$\alpha_{0,11}$	4376,6 (7)	0,00959 (13)	6260
$\alpha_{0,10}$	4397 (4)	3,33 (6)	28,1
$\alpha_{0,9}$	4402,8 (7)	0,405 (13)	241
$\alpha_{0,8}$	4437,4 (7)	0,206 (21)	890
$\alpha_{0,7}$	4441,7 (20)	18,80 (13)	10,47

	Energy keV	Probability × 100	F
$\alpha_{0,6}$	4457,0 (7)	0,106 (16)	2460
$\alpha_{0,5}$	4474,0 (13)	57,19 (20)	6,08
$\alpha_{0,4}$	4491,3 (5)	3,01 (16)	164
$\alpha_{0,3}$	4514,7 (40)	0,236 (25)	3170
$\alpha_{0,2}$	4580,4 (7)	1,28 (5)	1856
$\alpha_{0,1}$	4635,0 (4)	3,79 (6)	1586
$\alpha_{0,0}$	4676,0 (13)	4,74 (6)	2571

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{5,4}$(Th)	19,56 (5)	60 (1)	[M1,E2]		6000 (90)	3000 (45)	10000 (150)
$\gamma_{7,5}$(Th)	31,61 (5)	11,4 (40)	M1+E2		491	131,7	667
$\gamma_{10,7}$(Th)	41,4 (3)	1,5 (6)	[M1]		37,7 (10)	9,08 (24)	49,9 (13)
$\gamma_{1,0}$(Th)	42,01 (6)	24,7 (43)	M1+E2		325 (22)	88 (6)	440 (30)
$\gamma_{7,4}$(Th)	51,21 (4)	9,4 (19)	[E2]		201 (3)	54,9 (8)	274 (4)
$\gamma_{9,6}$(Th)	54,1 (1)	0,24	[E2]		154 (3)	42,1 (7)	210 (4)
$\gamma_{2,1}$(Th)	54,25 (5)	2,1	[M1+E2]		52,7 (20)	14,0 (6)	71 (3)
$\gamma_{19,18}$(Th)	64,45 (5)	0,26	[M1]		10,28 (15)	2,47 (4)	13,6 (2)
$\gamma_{10,5}$(Th)	72,7 (2)	1,86	M1+E2		11,4 (19)	2,9 (6)	15 (3)
$\gamma_{7,3}$(Th)	74,94 (3)	0,064 (8)	[E1]		0,190 (3)	0,0464 (7)	0,252 (4)
$\gamma_{12,6}$(Th)	95,7						
$\gamma_{2,0}$(Th)	96,13 (2)	1,33 (16)	[E2]		9,93 (14)	2,73 (4)	13,58 (19)
$\gamma_{14,7}$(Th)	97 (4)	0,22 (7)	[E2]		9,5 (21)	2,6 (6)	13 (3)
$\gamma_{5,2}$(Th)	109,19 (7)	1,81 (14)	[E1]		0,0704 (10)	0,01708 (24)	0,0932 (14)
$\gamma_{10,3}$(Th)	115,48 (6)	0,040 (13)	[E1]	0,267 (4)	0,0609 (9)	0,01475 (21)	0,348 (5)
$\gamma_{3,1}$(Th)	120,35 (5)	0,31	[M1]	8,73 (13)	1,678 (24)	0,404 (6)	10,95 (16)
$\gamma_{16,8}$(Th)	136,62 (5)	0,103	[M1]	6,11 (9)	1,168 (17)	0,281 (4)	7,66 (11)
$\gamma_{7,2}$(Th)	140,77 (2)	0,244 (12)	[E1]	0,1696 (24)	0,0364 (5)	0,00879 (13)	0,218 (3)
$\gamma_{20,18}$(Th)	142,40 (5)	0,018	[E2]	0,253 (4)	1,627 (23)	0,446 (7)	2,48 (4)
$\gamma_{4,1}$(Th)	143,768 (3)	13,20 (8)	E1	0,1615 (23)	0,0344 (5)	0,00833 (12)	0,207 (3)
$\gamma_{18,8}$(Th)	147						
$\gamma_{18,7}$(Th)	150,936 (15)	0,61 (20)	[M1]	4,60 (7)	0,877 (13)	0,211 (3)	5,76 (8)
$\gamma_{5,1}$(Th)	163,358 (3)	5,855 (36)	(E1)	0,1197 (17)	0,0248 (4)	0,00599 (9)	0,1526 (22)
$\gamma_{16,5}$(Th)	173 (1)	0,007 (6)	[E1]	0,1047 (21)	0,0215 (5)	0,00518 (11)	0,133 (3)
$\gamma_{10,2}$(Th)	181,87						
$\gamma_{18,5}$(Th)	182,63 (5)	1,70 (22)	[M1]	2,69 (4)	0,510 (8)	0,1226 (18)	3,36 (5)
$\gamma_{4,0}$(Th)	185,722 (4)	63,52 (35)	E1	0,0887 (13)	0,0179 (3)	0,00433 (6)	0,1124 (16)
$\gamma_{7,1}$(Th)	194,947 (8)	0,693 (11)	[E1]	0,0792 (11)	0,01589 (23)	0,00383 (6)	0,1002 (14)
$\gamma_{8,1}$(Th)	198,902 (15)	0,131 (7)	M1	2,11 (3)	0,401 (6)	0,0963 (14)	2,64 (4)
$\gamma_{18,4}$(Th)	202,12 (1)	3,81 (8)	[M1]	2,02 (3)	0,383 (6)	0,0920 (13)	2,53 (4)
$\gamma_{5,0}$(Th)	205,316 (4)	5,465 (33)	(E1)	0,0703 (10)	0,01397 (20)	0,00336 (5)	0,0887 (13)
$\gamma_{19,7}$(Th)	215,28 (4)	0,090 (9)	[M1]	1,693 (24)	0,321 (5)	0,0770 (11)	2,12 (3)
$\gamma_{6,0}$(Th)	221,386 (14)	0,349 (15)	M1	1,566 (22)	0,296 (5)	0,0712 (10)	1,96 (3)
$\gamma_{13,2}$(Th)	228,76 (5)	0,021	M1	1,429 (20)	0,270 (4)	0,0649 (9)	1,79 (3)
$\gamma_{9,1}$(Th)	233,504 (20)	0,102 (11)	M1	1,350 (19)	0,255 (4)	0,0613 (9)	1,687 (24)
$\gamma_{8,0}$(Th)	240,88 (4)	0,181 (19)	M1(+E2)	1,14 (21)	0,228 (13)	0,0553 (21)	1,45 (22)
$\gamma_{19,5}$(Th)	246,865 (20)	0,134 (7)	[M1]	1,157 (17)	0,218 (3)	0,0525 (8)	1,445 (21)
$\gamma_{15,2}$(Th)	255,395 (20)	0,017	M1	1,052 (15)	0,199 (3)	0,0477 (7)	1,315 (19)
$\gamma_{19,4}$(Th)	266,47 (4)	0,0097 (7)	[E2]	0,0921 (13)	0,1121 (16)	0,0303 (5)	0,245 (4)
$\gamma_{12,1}$(Th)	275,35 (15)	0,094 (11)	M1+E2	0,65 (5)	0,144 (5)	0,0355 (10)	0,84 (6)
$\gamma_{9,0}$(Th)	275,49 (6)	0,065	M1(+E2)	0,81 (11)	0,157 (9)	0,0379 (18)	1,02 (12)

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{16,2}$(Th)	281,42 (5)	0,013	M1	0,804 (12)	0,1515 (22)	0,0364 (5)	1,005 (14)
$\gamma_{13,1}$(Th)	282,94 (5)	0,013	[M1]	0,792 (12)	0,1493 (21)	0,0359 (5)	0,990 (14)
$\gamma_{17,2}$(Th)	289,56 (4)	0,0142	[M1]	0,743 (11)	0,140 (2)	0,0336 (5)	0,929 (13)
$\gamma_{19,3}$(Th)	291,2						
$\gamma_{18,2}$(Th)	291,71 (3)	0,042 (6)	[E1]	0,0317 (5)	0,00598 (9)	0,001433 (20)	0,0396 (6)
$\gamma_{11,0}$(Th)	301,7 (1)	0,01	M1	0,664 (10)	0,1249 (18)	0,0300 (5)	0,829 (12)
$\gamma_{15,1}$(Th)	310,69 (6)	0,011	(E2)	0,068 (1)	0,0616 (9)	0,01650 (24)	0,1517 (22)
$\gamma_{12,0}$(Th)	317,15 (8)	0,0019	M1	0,579 (9)	0,1088 (16)	0,0261 (4)	0,723 (11)
$\gamma_{17,1}$(Th)	343,6 (2)	0,0032					
$\gamma_{18,1}$(Th)	345,93 (3)	0,041 (6)	[E1]	0,0219 (3)	0,00403 (6)	0,000964 (14)	0,0272 (4)
$\gamma_{15,0}$(Th)	350 (5)	0,009	M1	0,442 (19)	0,083 (4)	0,0199 (9)	0,552 (24)
$\gamma_{19,2}$(Th)	356,05 (5)	0,0054	[E1]	0,0206 (3)	0,00377 (6)	0,000903 (13)	0,0255 (4)
$\gamma_{18,0}$(Th)	387,84 (3)	0,041 (6)	[E1]	0,01717 (24)	0,00312 (5)	0,000745 (11)	0,0213 (3)
$\gamma_{21,5}$(Th)	390,27 (20)	0,040 (1)					
$\gamma_{19,1}$(Th)	410,29 (4)	0,0033	[E1]	0,01527 (22)	0,00275 (4)	0,000657 (10)	0,0189 (3)
$\gamma_{22,4}$(Th)	448,40 (6)	0,0011					

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				
	$K\alpha_2$	89,954		61,82
	$K\alpha_1$	93,351		100
	$K\beta_3$	104,819	}	
	$K\beta_1$	105,604	}	
	$K\beta_5''$	106,239	}	35,58
	$K\beta_2$	108,509	}	
	$K\beta_4$	108,955	}	11,99
	$KO_{2,3}$	109,442	}	
X_L				
	$L\ell$	11,1177		
	$L\alpha$	12,8085 – 12,967		
	$L\eta$	14,509		
	$L\beta$	14,972 – 17,1383		
	$L\gamma$	18,3633 – 19,5043		

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
$\alpha_{0,22}$	3976 (5)	≈ 0,0011
$\alpha_{0,21}$	4013,2 (8)	0,0396 (10)
$\alpha_{0,20}$	4077,5 (7)	0,016 (12)
$\alpha_{0,19}$	4152 (5)	0,294 (13)
$\alpha_{0,18}$	4214,7 (19)	5,95 (12)
$\alpha_{0,17}$	4219,5 (7)	0,01732 (12)
$\alpha_{0,16}$	4227,6 (7)	0,122 (6)
$\alpha_{0,15}$	4248 (5)	0,069 (10)
$\alpha_{0,14}$	4266 (5)	0,22 (3)
$\alpha_{0,13}$	4279,3 (7)	0,0329 (5)
$\alpha_{0,12}$	4286,9 (7)	0,065 (13)
$\alpha_{0,11}$	4302,1 (7)	0,00959 (13)
$\alpha_{0,10}$	4322 (4)	3,33 (6)
$\alpha_{0,9}$	4327,9 (7)	0,405 (13)
$\alpha_{0,8}$	4361,9 (7)	0,206 (21)
$\alpha_{0,7}$	4366,1 (20)	18,80 (13)
$\alpha_{0,6}$	4381,1 (7)	0,106 (16)
$\alpha_{0,5}$	4397,8 (13)	57,19 (20)
$\alpha_{0,4}$	4414,9 (5)	3,01 (16)
$\alpha_{0,3}$	4437,9 (40)	0,236 (25)
$\alpha_{0,2}$	4502,4 (7)	1,28 (5)
$\alpha_{0,1}$	4556,0 (4)	3,79 (6)
$\alpha_{0,0}$	4596,4 (13)	4,74 (6)

5 Electron Emissions

		Energy keV	Electrons per 100 disint.
e_{AL}	(Th)	5,8 - 20,3	24 (3)
e_{AK}	(Th)		0,381 (9)
	KLL	68,406 - 76,745	}
	KLX	83,857 - 93,345	}
	KXY	99,29 - 109,64	}
$ec_{7,5\ L}$	(Th)	11,117 - 15,300	8,3 (29)
$ec_{10,7\ L}$	(Th)	20,6 - 24,8	1,09 (42)
$ec_{1,0\ L}$	(Th)	21,484 - 25,700	18,2 (32)
$ec_{7,5\ M}$	(Th)	26,407 - 28,257	2,2 (8)
$ec_{7,5\ N}$	(Th)	30,260 - 31,254	0,60 (23)
$ec_{7,4\ L}$	(Th)	30,709 - 34,900	6,8 (14)
$ec_{9,6\ L}$	(Th)	33,602 - 37,800	0,1771 (34)
$ec_{10,7\ M}$	(Th)	35,9 - 37,8	0,26 (10)
$ec_{1,0\ M}$	(Th)	36,774 - 38,624	4,9 (9)
$ec_{10,7\ N}$	(Th)	39,8 - 40,8	0,070 (27)
$ec_{1,0\ N}$	(Th)	40,630 - 41,621	1,32 (23)
$ec_{19,18\ L}$	(Th)	43,87 - 48,00	0,1850 (27)
$ec_{7,4\ M}$	(Th)	45,999 - 47,849	1,87 (39)
$ec_{7,4\ N}$	(Th)	49,850 - 50,846	0,5 (1)
$ec_{2,0\ L}$	(Th)	75,66 - 79,80	0,90 (11)
$ec_{4,0\ K}$	(Th)	76,072 (4)	5,06 (8)
$ec_{2,0\ M}$	(Th)	90,95 - 92,80	0,248 (30)
$ec_{2,0\ N}$	(Th)	94,8 - 95,8	0,067 (8)
$ec_{4,0\ L}$	(Th)	165,25 - 169,40	1,020 (18)
$ec_{4,0\ M}$	(Th)	180,54 - 182,39	0,2468 (37)
$ec_{4,0\ N}$	(Th)	184,390 - 185,387	0,0651 (10)

6 Photon Emissions

6.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(Th)	11,1177 — 19,5043		22 (3)	
$XK\alpha_2$	(Th)	89,954		3,56 (9)	} $K\alpha$
$XK\alpha_1$	(Th)	93,351		5,76 (14)	}
$XK\beta_3$	(Th)	104,819	}		
$XK\beta_1$	(Th)	105,604	}	2,06 (5)	$K'\beta_1$
$XK\beta_5''$	(Th)	106,239	}		
$XK\beta_2$	(Th)	108,509	}		
$XK\beta_4$	(Th)	108,955	}	0,685 (18)	$K'\beta_2$
$XKO_{2,3}$	(Th)	109,442	}		

6.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{7,5}$(Th)	31,60 (5)	0,017 (6)
$\gamma_{10,7}$(Th)	41,4 (3)	0,029 (11)
$\gamma_{1,0}$(Th)	42,01 (6)	0,056 (9)
$\gamma_{7,4}$(Th)	51,21 (4)	0,034 (7)
$\gamma_{9,6}$(Th)	54,1 (1)	0,00115
$\gamma_{2,1}$(Th)	54,25 (5)	0,0285
$\gamma_{19,18}$(Th)	64,45 (5)	0,018
$\gamma_{10,5}$(Th)	72,7 (2)	0,116
$\gamma_{7,3}$(Th)	74,94 (3)	0,051 (6)
$\gamma_{2,0}$(Th)	96,09 (2)	0,091 (11)
$\gamma_{14,7}$(Th)	97 (4)	0,016 (4)
$\gamma_{5,2}$(Th)	109,19 (7)	1,66 (13)
$\gamma_{10,3}$(Th)	115,45 (5)	0,03 (1)
$\gamma_{3,1}$(Th)	120,35 (5)	0,026
$\gamma_{16,8}$(Th)	136,55 (5)	0,012
$\gamma_{7,2}$(Th)	140,76 (2)	0,20 (1)
$\gamma_{20,18}$(Th)	142,40 (5)	0,0051
$\gamma_{4,1}$(Th)	143,767 (3)	10,94 (6)
$\gamma_{18,7}$(Th)	150,936 (15)	0,09 (3)
$\gamma_{5,1}$(Th)	163,356 (3)	5,08 (3)
$\gamma_{16,5}$(Th)	173 (1)	0,006 (5)
$\gamma_{18,5}$(Th)	182,62 (5)	0,39 (5)
$\gamma_{4,0}$(Th)	185,720 (4)	57,1 (3)
$\gamma_{7,1}$(Th)	194,940 (6)	0,63 (1)

	Energy keV	Photons per 100 disint.
$\gamma_{8,1}$(Th)	198,894 (14)	0,036 (2)
$\gamma_{18,4}$(Th)	202,12 (1)	1,08 (2)
$\gamma_{5,0}$(Th)	205,316 (4)	5,02 (3)
$\gamma_{19,7}$(Th)	215,28 (4)	0,029 (3)
$\gamma_{6,0}$(Th)	221,386 (14)	0,118 (5)
$\gamma_{13,2}$(Th)	228,76 (5)	0,0074
$\gamma_{9,1}$(Th)	233,50 (2)	0,038 (4)
$\gamma_{8,0}$(Th)	240,88 (4)	0,074 (4)
$\gamma_{19,5}$(Th)	246,83 (2)	0,055 (3)
$\gamma_{15,2}$(Th)	255,365 (10)	0,0074
$\gamma_{19,4}$(Th)	266,47 (4)	0,0078 (6)
$\gamma_{12,1}$(Th)	275,35 (15)	0,051 (6)
$\gamma_{9,0}$(Th)	275,49 (6)	0,032
$\gamma_{16,2}$(Th)	281,42 (5)	0,0063
$\gamma_{13,1}$(Th)	282,94 (5)	0,0063
$\gamma_{17,2}$(Th)	289,56 (4)	0,0074
$\gamma_{18,2}$(Th)	291,65 (3)	0,040 (6)
$\gamma_{11,0}$(Th)	301,7 (1)	0,0053
$\gamma_{15,1}$(Th)	310,69 (6)	0,0094
$\gamma_{12,0}$(Th)	317,10 (8)	0,0011
$\gamma_{17,1}$(Th)	343,5 (2)	0,0032
$\gamma_{18,1}$(Th)	345,92 (3)	0,040 (6)
$\gamma_{15,0}$(Th)	350 (5)	0,006
$\gamma_{19,2}$(Th)	356,03 (5)	0,0053
$\gamma_{18,0}$(Th)	387,84 (3)	0,040 (6)
$\gamma_{21,5}$(Th)	390,27 (20)	0,040 (1)
$\gamma_{19,1}$(Th)	410,29 (4)	0,0032
$\gamma_{22,4}$(Th)	448,40 (6)	0,0011

7 Main Production Modes

Natural source

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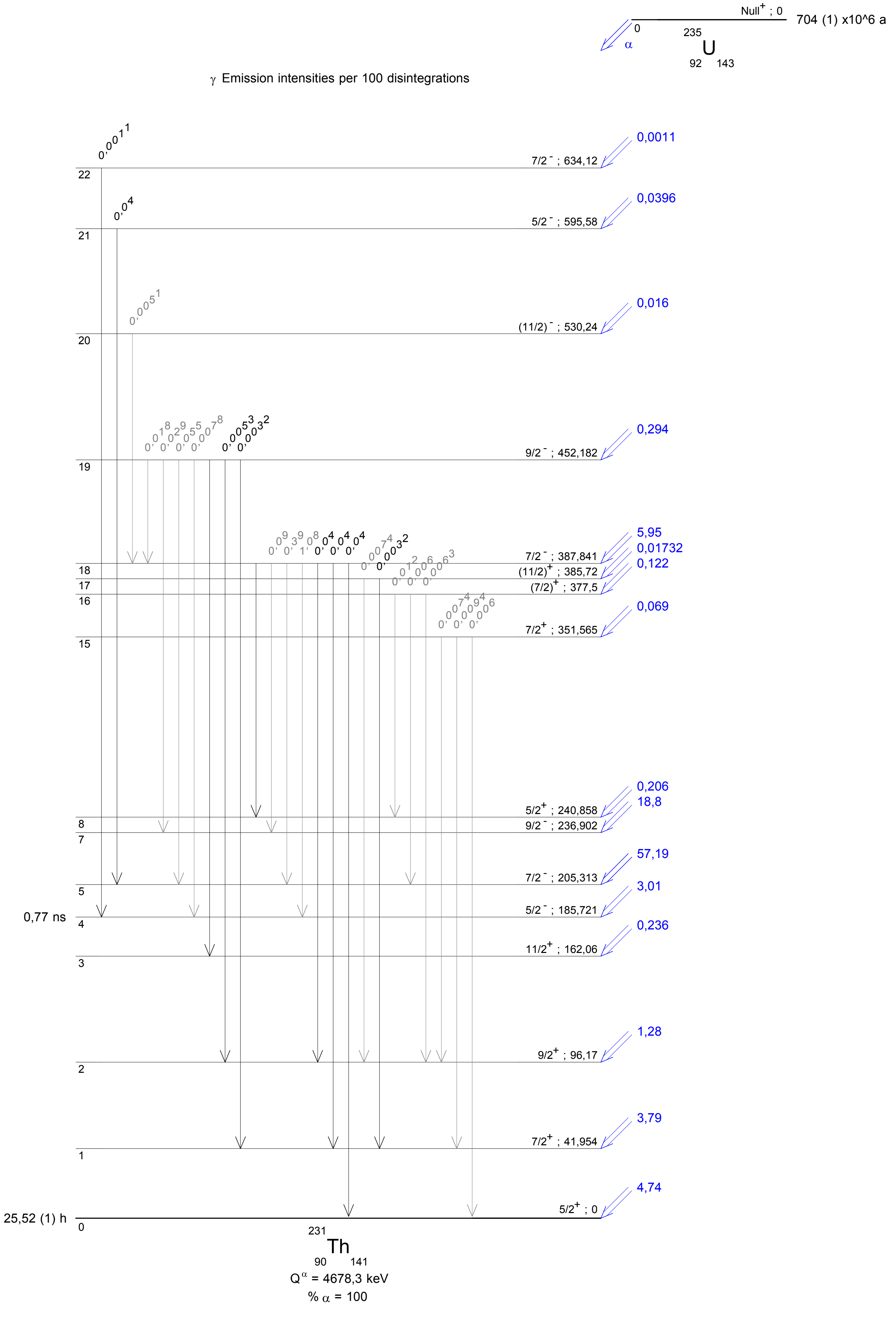
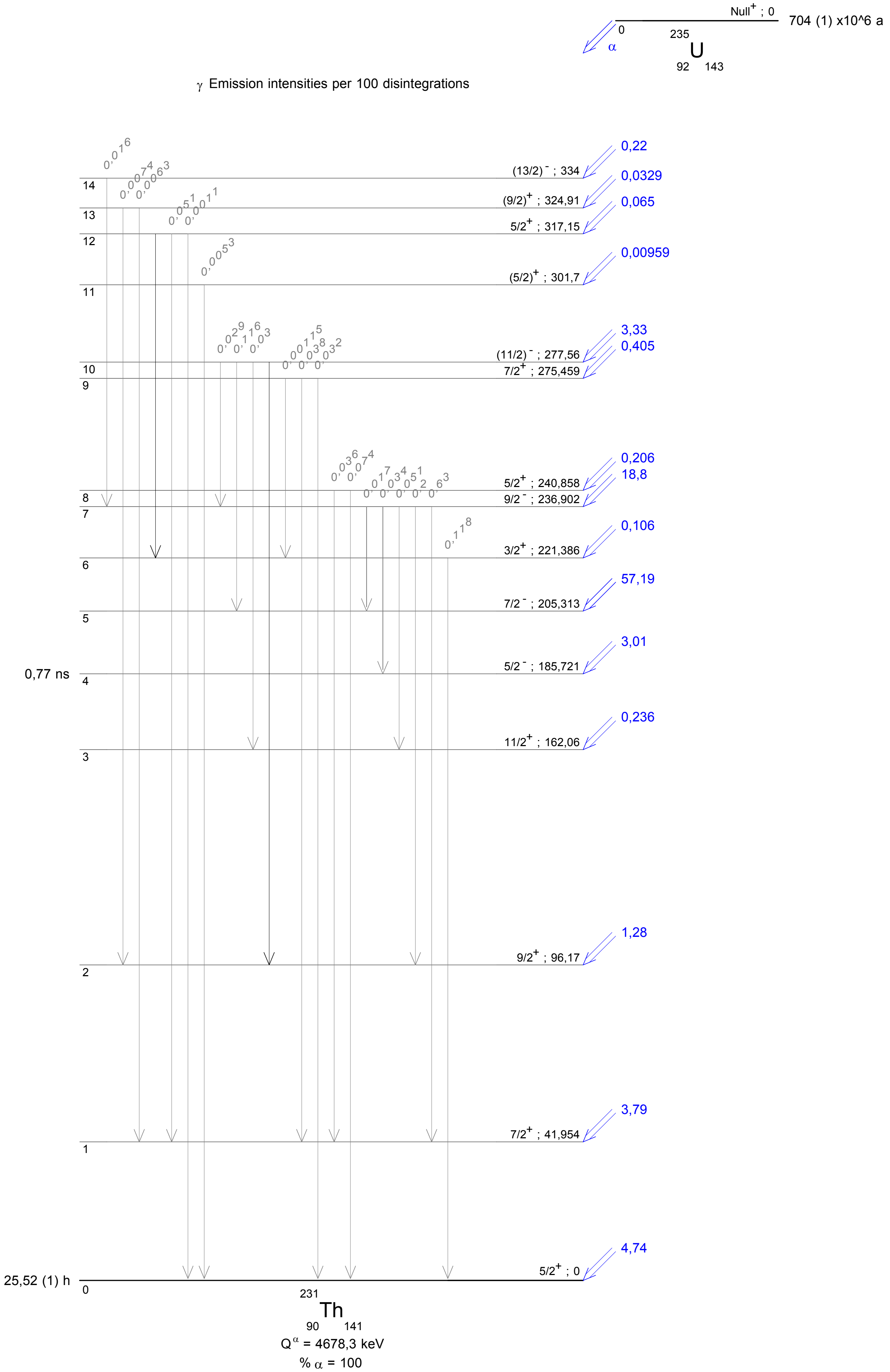
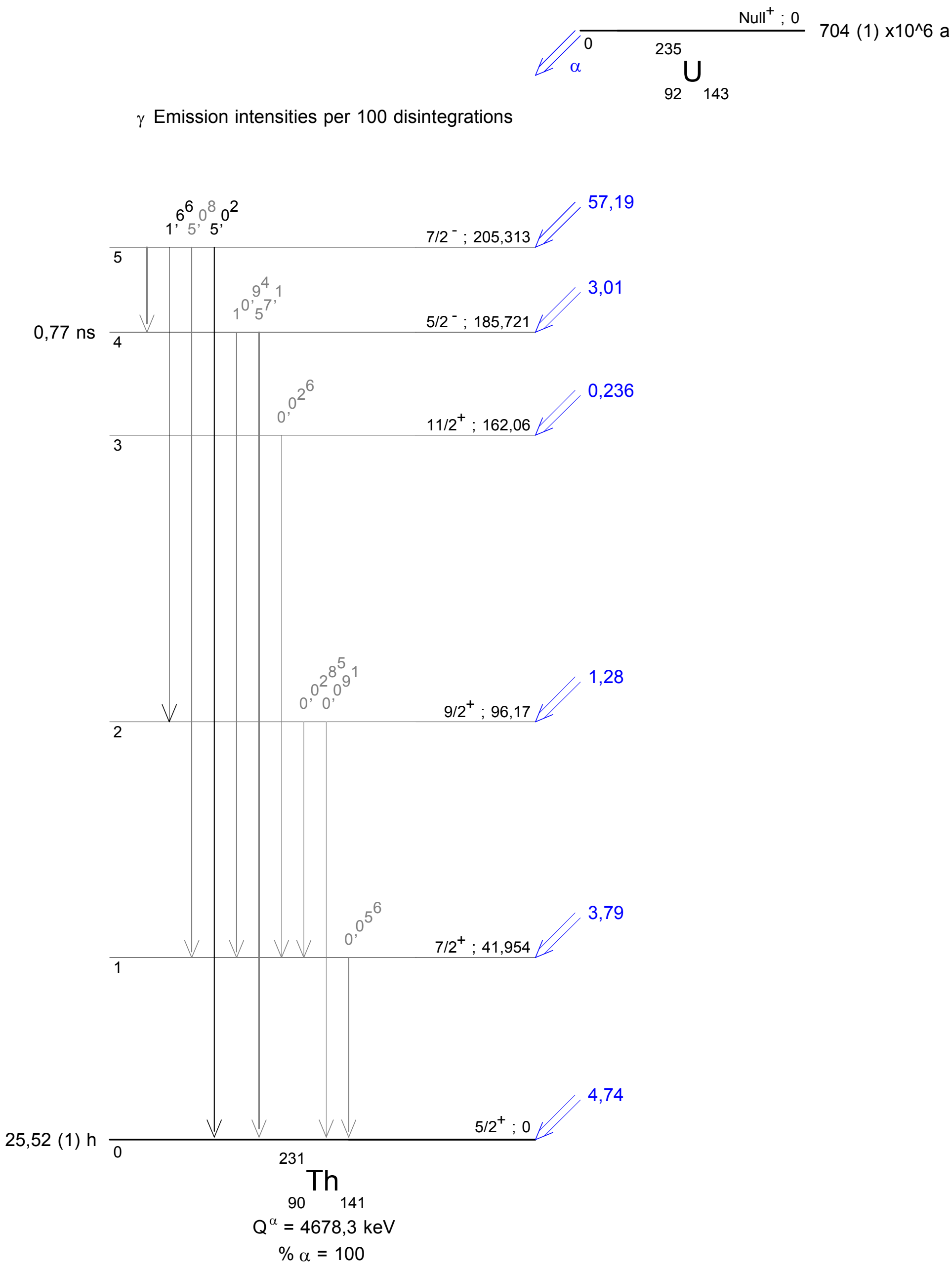

Null+ ; 0
704 (1) x10^6 a
235 U 92 143
γ Emission intensities per 100 disintegrations
7/2- ; 634,12
0,0011
5/2- ; 595,58
0,0396
(11/2)- ; 530,24
0,016
9/2- ; 452,182
0,294
7/2- ; 387,841
5,95
(11/2)+ ; 385,72
0,01732
(7/2)+ ; 377,5
0,122
7/2+ ; 351,565
0,069
5/2+ ; 240,858
0,206
9/2- ; 236,902
18,8
7/2- ; 205,313
57,19
5/2- ; 185,721
3,01
0,77 ns
11/2+ ; 162,06
0,236
9/2+ ; 96,17
1,28
7/2+ ; 41,954
3,79
5/2+ ; 0
4,74
25,52 (1) h
231 Th 90 141
Qα = 4678,3 keV
% α = 100


Null+ ; 0
704 (1) x10^6 a
0
α
235
U
92 143
γ Emission intensities per 100 disintegrations
(13/2)- ; 334
0,22
(9/2)+ ; 324,91
0,0329
5/2+ ; 317,15
0,065
(5/2)+ ; 301,7
0,00959
(11/2)- ; 277,56
3,33
7/2+ ; 275,459
0,405
5/2+ ; 240,858
0,206
9/2- ; 236,902
18,8
3/2+ ; 221,386
0,106
7/2- ; 205,313
57,19
0,77 ns
5/2- ; 185,721
3,01
11/2+ ; 162,06
0,236
9/2+ ; 96,17
1,28
7/2+ ; 41,954
3,79
25,52 (1) h
5/2+ ; 0
4,74
231
Th
90 141
Qα = 4678,3 keV
% α = 100


Null+ ; 0
704 (1) x10^6 a
0
α
235
U
92 143
γ Emission intensities per 100 disintegrations
57,19
7/2- ; 205,313
5
3,01
5/2- ; 185,721
0,77 ns
4
0,236
11/2+ ; 162,06
3
1,28
9/2+ ; 96,17
2
3,79
7/2+ ; 41,954
1
4,74
5/2+ ; 0
25,52 (1) h
0
231
Th
90 141
Qα = 4678,3 keV
% α = 100

$^{237}_{92}U_{145}$

1 Decay Scheme

U-237 decays by beta minus emission to levels in Np-237.
L'uranium 237 se désintègre par émission beta moins vers les niveaux du neptunium 237.

2 Nuclear Data

$T_{1/2}(^{237}U)$	:	6,749	(16)	d
$T_{1/2}(^{237}Np)$	:	2,144	(7)	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 (9)	allowed	7,32
$\beta^-_{0,7}$	186,2 (6)	2,9 (9)	super-allowed	7,28
$\beta^-_{0,6}$	237,2 (6)	48,2 (25)	1st forbidden	6,39
$\beta^-_{0,5}$	251,1 (6)	40,9 (31)	1st forbidden	6,54
$\beta^-_{0,2}$	459,1 (6)	7 (4)	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 (2)	48,8 (25)	M1+0,1%E2			364 (13)	492 (16)
$\gamma_{2,1}$(Np)	26,34463 (24)	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)	33,19629 (22)	23 (3)	M1+1,66%E2		131 (17)	33 (5)	175 (24)
$\gamma_{9,7}$(Np)	38,54 (3)	0,9 (9)	M1+15%E2		210 (160)	60 (50)	280 (210)
$\gamma_{3,1}$(Np)	42,704 (5)	0,65	M1+1,66%E2		56 (7)	13,9 (19)	75 (9)
$\gamma_{4,2}$(Np)	43,420 (3)	4,3 (7)	M1+16,8%E2		132 (17)	35 (5)	180 (23)
$\gamma_{7,6}$(Np)	51,01 (3)	0,596 (25)	E1		0,565 (12)	0,140 (3)	0,753 (15)
$\gamma_{2,0}$(Np)	59,54092 (10)	73,7 (31)	E1		0,84 (6)	0,226 (7)	1,16 (7)
$\gamma_{7,5}$(Np)	64,83 (2)	1,800 (26)	E1		0,301 (6)	0,0744 (15)	0,400 (8)
$\gamma_{4,1}$(Np)	69,76 (3)	0,0013 (3)	(E1)		0,248 (5)	0,0612 (12)	0,330 (7)
$\gamma_{3,0}$(Np)	75,899 (5)	0,05	(E2)		38,9 (8)	10,8 (2)	53,4 (11)
$\gamma_{4,0}$(Np)	102,959 (3)	0,0072 (10)	E1		0,0894 (18)	0,0219 (4)	0,119 (3)
$\gamma_{(-1,1)}$(Np)	114,09 (5)						
$\gamma_{5,4}$(Np)	164,61 (2)	5,02 (11)	E2	0,195 (4)	1,095 (20)	0,304 (6)	1,70 (4)
$\gamma_{5,2}$(Np)	208,00 (1)	84,8 (19)	M1+2,4%E2	2,35 (5)	0,473 (10)	0,115 (3)	2,98 (7)
$\gamma_{6,2}$(Np)	221,80 (4)	0,0316 (13)	E2	0,130 (3)	0,304 (6)	0,0839 (17)	0,547 (11)
$\gamma_{5,1}$(Np)	234,40 (4)	0,189 (8)	M2	5,560 (12)	1,95 (4)	0,511 (10)	8,24 (16)
$\gamma_{5,0}$(Np)	267,556 (12)	1,5 (4)	E1+19,4%M2	0,74 (4)	0,238 (12)	0,062 (3)	1,06 (6)
$\gamma_{8,3}$(Np)	292,77 (6)	0,0030 (9)	(E2)	0,0796 (16)	0,0991 (19)	0,0270 (6)	0,215 (4)
$\gamma_{8,2}$(Np)	309,1 (3)	0,00028	(E1)	0,0300 (6)	0,00585 (12)	0,00143 (3)	0,0377 (8)
$\gamma_{7,0}$(Np)	332,376 (16)	1,374 (19)	E2	0,0631 (12)	0,0611 (12)	0,0164 (4)	0,146 (3)
$\gamma_{8,1}$(Np)	335,38 (4)	0,162 (9)	M1+17,5%E2	0,54 (7)	0,113 (8)	0,0278 (17)	0,69 (8)
$\gamma_{9,1}$(Np)	337,7 (2)	0,0101 (6)	(E2)	0,0612 (12)	0,0575 (12)	0,0157 (3)	0,139 (3)
$\gamma_{(-1,2)}$(Np)	340,45	0,0016 (3)					
$\gamma_{8,0}$(Np)	368,602 (20)	0,0675 (28)	M1(+E2)	0,494 (10)	0,0963 (20)	0,0233 (5)	0,622 (13)
$\gamma_{9,0}$(Np)	370,928 (23)	0,167 (8)	M1+15,6%E2	0,42 (6)	0,086 (8)	0,0211 (17)	0,53 (7)

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	}	36,45
	$K\beta_2$	117,476	}	
	$K\beta_4$	117,876	}	12,54
	$KO_{2,3}$	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	

4 Electron Emissions

		Energy keV	Electrons per 100 disint.
e_{AL}	(Np)	5,04 - 13,52	58,5 (21)
e_{AK}	(Np)		1,49 (21)
	KLL	73,50 - 83,13	}
	KLX	90,36 - 97,28	}
	KXY	107,10 - 114,58	}
$ec_{2,1\ L}$	(Np)	3,918 - 8,731	14,6 (50)
$ec_{6,5\ M}$	(Np)	8,07 - 10,15	36,0 (19)
$ec_{1,0\ L}$	(Np)	10,769 - 15,586	17,0 (23)
$ec_{6,5\ N}$	(Np)	12,31 - 13,41	9,79 (43)
$ec_{9,7\ L}$	(Np)	16,11 - 20,93	0,7 (7)
$ec_{3,1\ L}$	(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	3,2 (5)
$ec_{1,0\ M}$	(Np)	27,457 - 29,532	4,3 (7)
$ec_{7,6\ L}$	(Np)	28,58 - 33,40	0,19 (8)
$ec_{1,0\ N}$	(Np)	31,695 - 32,793	1,16 (17)

		Energy keV	Electrons per 100 disint.
$ec_{9,7\ M}$	(Np)	32,80 - 34,88	0,2 (2)
$ec_{3,1\ M}$	(Np)	36,965 - 39,040	0,12
$ec_{9,7\ N}$	(Np)	37,04 - 38,14	0,05 (5)
$ec_{2,0\ L}$	(Np)	37,114 - 41,931	28,6 (22)
$ec_{4,2\ M}$	(Np)	37,684 - 39,759	0,84 (14)
$ec_{4,2\ N}$	(Np)	41,92 - 43,02	0,233 (37)
$ec_{7,5\ L}$	(Np)	42,40 - 47,22	0,387 (9)
$ec_{5,4\ K}$	(Np)	45,94 (2)	0,363 (9)
$ec_{2,0\ M}$	(Np)	53,802 - 55,877	7,7 (3)
$ec_{2,0\ N}$	(Np)	58,040 - 59,138	0,846 (24)
$ec_{7,5\ M}$	(Np)	59,09 - 61,17	0,096 (2)
$ec_{5,2\ K}$	(Np)	89,331 (10)	50,1 (13)
$ec_{5,1\ K}$	(Np)	115,73 (4)	0,114 (5)
$ec_{5,4\ L}$	(Np)	142,18 - 147,00	2,04 (5)
$ec_{5,0\ K}$	(Np)	148,87 (4)	0,53 (3)
$ec_{5,4\ M}$	(Np)	158,87 - 160,95	0,565 (14)
$ec_{5,4\ N}$	(Np)	163,11 - 164,21	0,1546 (33)
$ec_{5,2\ L}$	(Np)	185,573 - 190,390	10,1 (3)
$ec_{5,2\ M}$	(Np)	202,261 - 204,336	2,45 (7)
$ec_{5,2\ N}$	(Np)	206,499 - 207,597	0,662 (14)
$ec_{7,0\ K}$	(Np)	213,69 (4)	0,0757 (18)
$ec_{8,1\ K}$	(Np)	216,71 (4)	0,052 (7)
$ec_{5,0\ L}$	(Np)	245,11 - 249,93	0,172 (9)
$ec_{7,0\ L}$	(Np)	309,93 - 314,75	0,0733 (17)
$\beta^-_{0,9}$	max:	147,7 (6)	1,3 (9)
$\beta^-_{0,9}$	avg:	39,0 (2)	
$\beta^-_{0,7}$	max:	186,2 (6)	2,9 (9)
$\beta^-_{0,7}$	avg:	49,8 (2)	
$\beta^-_{0,6}$	max:	237,2 (6)	48,2 (25)
$\beta^-_{0,6}$	avg:	64,5 (2)	
$\beta^-_{0,5}$	max:	251,1 (6)	40,9 (31)
$\beta^-_{0,5}$	avg:	68,6 (2)	
$\beta^-_{0,2}$	max:	459,1 (6)	7 (4)
$\beta^-_{0,2}$	avg:	137,6 (2)	

5 Photon Emissions

5.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(Np)	11,89 — 22,2		59,0 (21)	
XKα_2	(Np)	97,069		14,8 (4)	} Kα
XKα_1	(Np)	101,059		23,5 (6)	}
XKβ_3	(Np)	113,303	}		
XKβ_1	(Np)	114,234	}	8,57 (27)	K$'\beta_1$
XKβ_5''	(Np)	114,912	}		
XKβ_2	(Np)	117,476	}		
XKβ_4	(Np)	117,876	}	2,95 (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)	26,34463 (24)	2,43 (6)
$\gamma_{1,0}$(Np)	33,19629 (22)	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)	0,340 (14)
$\gamma_{2,0}$(Np)	59,54091 (10)	34,1 (9)
$\gamma_{7,5}$(Np)	64,83 (2)	1,286 (17)
$\gamma_{4,1}$(Np)	69,76 (3)	0,00095 (19)
$\gamma_{3,0}$(Np)	75,899 (5)	0,00091
$\gamma_{4,0}$(Np)	102,959 (3)	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)	0,0205 (8)
$\gamma_{5,0}$(Np)	267,556 (12)	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)	332,376 (16)	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)	368,602 (20)	0,0416 (17)
$\gamma_{9,0}$(Np)	370,928 (23)	0,109 (2)

6 Main Production Modes

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

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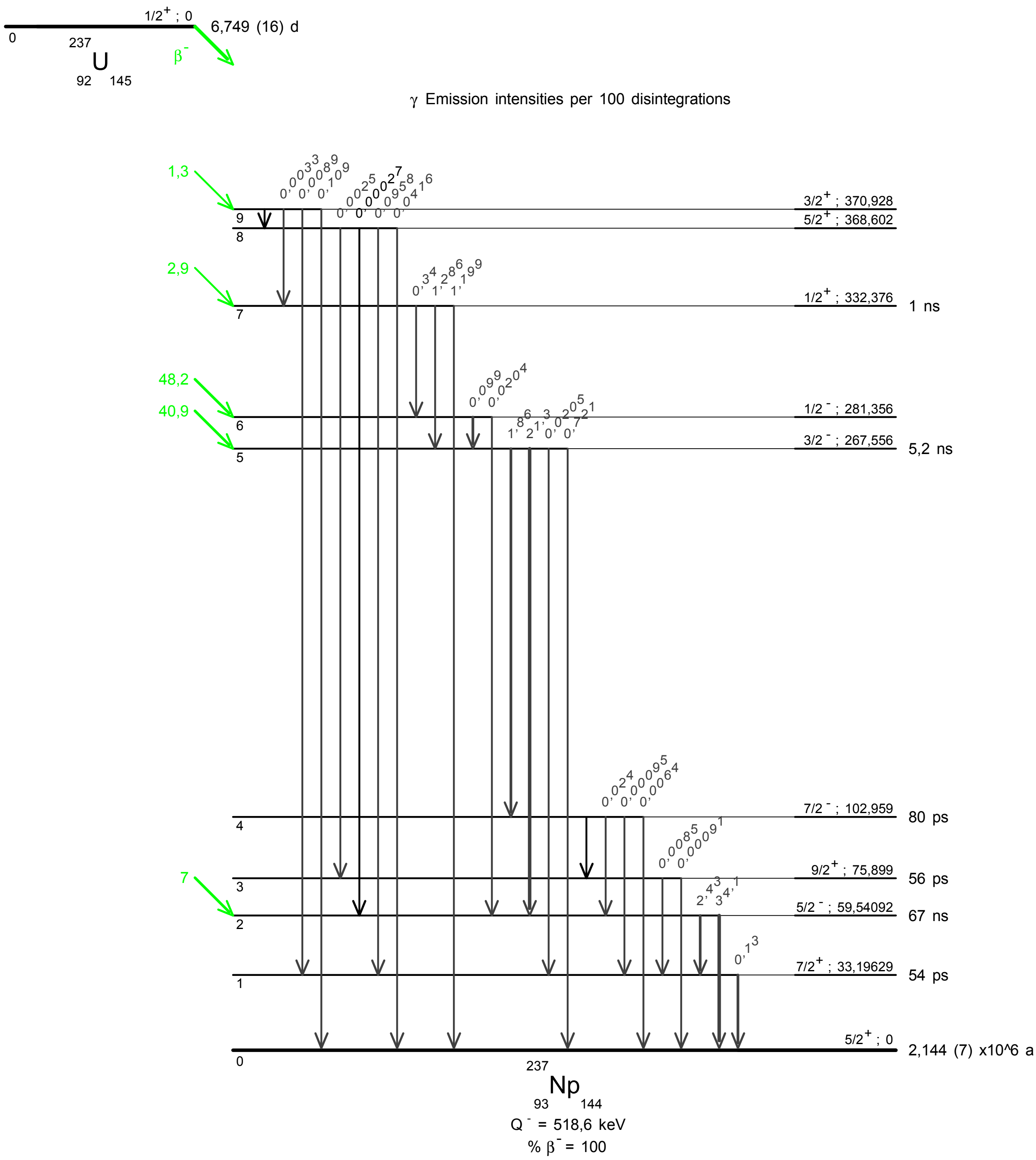
1/2+ ; 0
6,749 (16) d
237 U 92 145
β-
γ Emission intensities per 100 disintegrations
1,3
2,9
48,2
40,9
7
3/2+ ; 370,928
5/2+ ; 368,602
1/2+ ; 332,376
1 ns
1/2 - ; 281,356
3/2 - ; 267,556
5,2 ns
7/2 - ; 102,959
80 ps
9/2+ ; 75,899
56 ps
5/2 - ; 59,54092
67 ns
7/2+ ; 33,19629
54 ps
5/2+ ; 0
2,144 (7) x10^6 a
237 Np 93 144
Q - = 518,6 keV
% β- = 100

$$^{238}_{94}\mathrm{Pu}_{144}$$

1 Decay Scheme

Pu-238 decays 100% by alpha transitions to U-234. Most of the alpha decay populates the U-234 ground state (71.04 %) and the U-234 first excited level with energy of 43.50 keV (28.85 %). Branching of Pu-238 decay by spontaneous fission is 1.85 (5)E-7 %.
Le plutonium 238 se désintègre par émission alpha vers les niveaux fondamental (71,04 %) et excité de 43,5 keV (28,85 %). Le nombre de désintegrations par fission spontanée est de 1,85 (5)E-7 %

2 Nuclear Data

$T_{1/2}(^{238}\mathrm{Pu})$	:	87,74	(3)	a
$T_{1/2}(^{234}\mathrm{U})$	:	2,455	(6)	10^5 a
$Q^{\alpha}(^{238}\mathrm{Pu})$	:	5593,20	(19)	keV

2.1 α Transitions

	Energy keV	Probability × 100	F
$\alpha_{0,14}$	4507,94 (20)	∼ 0,0000012	3,5
$\alpha_{0,13}$	4548,66 (20)	0,00000117 (7)	7,5
$\alpha_{0,12}$	4569,43 (20)	∼ 0,0000002	64
$\alpha_{0,11}$	4603,77 (20)	0,000000150 (16)	155
$\alpha_{0,10}$	4645,56 (20)	0,00000023	21
$\alpha_{0,9}$	4666,48 (20)	0,00000130 (5)	53
$\alpha_{0,8}$	4741,46 (20)	0,0000081	30,5
$\alpha_{0,7}$	4743,93 (20)	0,000000075 (22)	3400
$\alpha_{0,6}$	4783,29 (20)	0,0001	5
$\alpha_{0,5}$	4806,91 (20)	0,00000821 (16)	89
$\alpha_{0,4}$	5096,16 (20)	0,00000680 (23)	10000
$\alpha_{0,3}$	5297,13 (19)	0,00292 (4)	440
$\alpha_{0,2}$	5449,85 (19)	0,104 (3)	102
$\alpha_{0,1}$	5549,70 (19)	28,85 (6)	1,39
$\alpha_{0,0}$	5593,20 (19)	71,04 (6)	1

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{8,6}$(U)	41,82 (11)	0,0000026 (14)	[E2]		630 (13)	174 (4)	863 (18)
$\gamma_{1,0}$(U)	43,498 (1)	28,3 (8)	E2		520 (11)	143,5 (29)	713 (15)
$\gamma_{11,9}$(U)	62,70 (1)	0,000000016 (4)	E1		0,320 (7)	0,0791 (16)	0,426 (9)
$\gamma_{2,1}$(U)	99,852 (3)	0,1060 (23)	E2		9,77 (20)	2,71 (6)	13,42 (27)
$\gamma_{11,7}$(U)	140,15 (2)	0,000000021 (7)	M1 + 63% E2	2,6 (8)	1,79 (5)	0,48 (14)	5,1 (15)
$\gamma_{3,2}$(U)	152,719 (2)	0,00292 (4)	E2	0,217 (4)	1,404 (28)	0,388 (8)	2,14 (4)
$\gamma_{13,8}$(U)	192,91 (7)	0,0000000012 (4)	[E2]	0,1635 (33)	0,505 (10)	0,1391 (28)	0,856 (17)
$\gamma_{4,3}$(U)	200,97 (3)	0,00000680 (23)	E2	0,1534 (31)	0,424 (9)	0,1166 (23)	0,734 (15)
$\gamma_{11,5}$(U)	203,12 (3)	0,000000021 (5)	M1 + 66% E2	0,90 (17)	0,423 (9)	0,1113 (23)	1,5 (3)
$\gamma_{14,8}$(U)	233,6 (2)	0,00000041	(E0 + E2)				
$\gamma_{13,6}$(U)	234,6 (2)	0,0000001	E0				
$\gamma_{14,7}$(U)	235,9 (3)	0,000000010 (5)	[E1]	0,0532 (11)	0,01067 (21)	0,00258 (5)	0,0673 (14)
$\gamma_{13,5}$(U)	258,227 (3)	0,000000074 (12)	(E1)	0,0434 (9)	0,00859 (17)	0,00207 (4)	0,0548 (11)
$\gamma_{14,5}$(U)	299,1 (2)	0,000000046 (3)	[E1]	0,0314 (6)	0,00608 (12)	0,001466 (29)	0,0395 (8)
$\gamma_{7,2}$(U)	705,9 (1)	0,000000050 (13)	[E1]	0,00568 (12)	0,000987 (20)	0,000235 (5)	0,00698 (14)
$\gamma_{8,2}$(U)	708,3 (2)	0,00000050 (3)	[E2]	0,01537 (31)	0,00489 (10)	0,001246 (25)	0,0219 (5)
$\gamma_{12,3}$(U)	727,8 (2)	0,0000000028 (3)	(E2)	0,01464 (29)	0,00454 (9)	0,001156 (23)	0,0207 (4)
$\gamma_{5,1}$(U)	742,813 (5)	0,00000513 (13)	E1	0,00518 (10)	0,000895 (18)	0,000213 (4)	0,00636 (13)
$\gamma_{6,1}$(U)	766,38 (2)	0,0000223 (5)	E2	0,01336 (27)	0,00396 (8)	0,001003 (20)	0,0187 (4)
$\gamma_{9,2}$(U)	783,4 (1)	0,000000022 (3)	[E2]	0,01285 (26)	0,00374 (8)	0,000946 (19)	0,0179 (4)
$\gamma_{5,0}$(U)	786,27 (3)	0,00000322 (9)	E1	0,00467 (9)	0,000804 (16)	0,000191 (4)	0,00573 (12)
$\gamma_{10,2}$(U)	804,4 (3)	0,00000017	E0 + E2				0,57
$\gamma_{7,1}$(U)	805,80 (5)	0,000000056 (15)	[E1]	0,00447 (9)	0,000768 (16)	0,000183 (4)	0,00549 (11)
$\gamma_{8,1}$(U)	808,2 (1)	0,0000041	E0 + 17% E2	3,31	0,94		4,3
$\gamma_{6,0}$(U)	810,0 (5)	≥ 0,000077	E0	≥ 60			
$\gamma_{8,0}$(U)	851,7 (1)	0,00000129 (4)	[E2]	0,01109 (22)	0,00302 (6)	0,000759 (16)	0,01513 (30)
$\gamma_{12,2}$(U)	880,5 (1)	≥ 0,00000015	(E0 + E2)				
$\gamma_{9,1}$(U)	883,24 (4)	0,00000073 (4)	E2	0,01040 (21)	0,00276 (6)	0,000692 (14)	0,01409 (28)
$\gamma_{10,1}$(U)	904,37 (15)	0,000000062 (11)	[E2]	0,00998 (20)	0,00260 (5)	0,000652 (13)	0,01346 (27)
$\gamma_{9,0}$(U)	926,72 (1)	0,000000565 (25)	(E2)	0,00956 (20)	0,00245 (5)	0,000613 (12)	0,01284 (26)
$\gamma_{14,2}$(U)	941,94 (10)	0,000000472 (23)	[E2]	0,00929 (20)	0,00236 (5)	0,000589 (12)	0,01244 (25)
$\gamma_{11,1}$(U)	946,00 (3)	0,000000092 (13)	(E1)	0,00337 (7)	0,000571 (12)	0,0001355 (27)	0,00412 (8)
$\gamma_{12,1}$(U)	980,3 (1)	0,000000042	(E2)	0,00866 (18)	0,00214 (4)	0,000534 (11)	0,01152 (23)
$\gamma_{13,1}$(U)	1001,03 (3)	0,00000099 (4)	E2	0,00835 (17)	0,00204 (4)	0,000507 (11)	0,01107 (22)
$\gamma_{14,1}$(U)	1041,7 (2)	≥0,0000002	(E0 + E2)				
$\gamma_{14,0}$(U)	1085,4 (2)	0,000000078 (9)	(E2)	0,00725 (15)	0,00169 (3)	0,000418 (8)	0,00950 (19)

3 Atomic Data

3.1

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
	$K\alpha_1$	98,440		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	71,78 – 80,95	100
KLX	88,15 – 98,43	59,6
KXY	104,51 – 115,59	8,88
Auger L	5,9 – 21,6	

4 α Emissions

	Energy keV	Probability × 100
$\alpha_{0,14}$	4432,1 (2)	~ 0,0000012
$\alpha_{0,13}$	4472,1 (2)	0,00000117 (7)
$\alpha_{0,12}$	4492,5 (2)	~ 0,0000002

	Energy keV	Probability × 100
$\alpha_{0,11}$	4526,3 (2)	0,000000150 (16)
$\alpha_{0,10}$	4567,4 (2)	0,00000023
$\alpha_{0,9}$	4587,9 (2)	0,00000130 (5)
$\alpha_{0,8}$	4661,7 (2)	0,0000081
$\alpha_{0,7}$	4664,1 (2)	0,000000075 (22)
$\alpha_{0,6}$	4702,8 (2)	0,0001
$\alpha_{0,5}$	4726,0 (2)	0,00000821 (16)
$\alpha_{0,4}$	5010,4 (2)	0,00000680 (23)
$\alpha_{0,3}$	5208,0 (2)	0,00292 (4)
$\alpha_{0,2}$	5358,1 (2)	0,104 (3)
$\alpha_{0,1}$	5456,3 (2)	28,85 (6)
$\alpha_{0,0}$	5499,03 (20)	71,04 (6)

5 Electron Emissions

		Energy keV	Electrons per 100 disint.
e_{AL}	(U)	5,9 - 21,6	10,6 (4)
e_{AK}	(U)		0,0000110 (15)
	KLL	71,78 - 80,95	}
	KLX	88,15 - 98,43	}
	KXY	104,51 - 115,59	}
$ec_{1,0\ L}$	(U)	21,74 - 26,33	20,6 (6)
$ec_{1,0\ M}$	(U)	37,95 - 39,95	5,7 (12)
$ec_{1,0\ N}$	(U)	42,057 - 43,119	1,544 (39)
$ec_{2,1\ L}$	(U)	78,095 - 82,685	0,0718 (17)

6 Photon Emissions

6.1 X-Ray Emissions

		Energy keV	Photons per 100 disint.
XL	(U)	11,619 — 20,714	10,63 (8)

		Energy keV		Photons per 100 disint.	
$XK\alpha_2$	(U)	94,666		0,000106 (3)	} $K\alpha$
$XK\alpha_1$	(U)	98,440		0,000169 (5)	}
$XK\beta_3$	(U)	110,421	}		
$XK\beta_1$	(U)	111,298	}	0,0000609 (22)	$K'\beta_1$
$XK\beta_5''$	(U)	111,964	}		
$XK\beta_2$	(U)	114,407	}		
$XK\beta_4$	(U)	115,012	}	0,0000208 (6)	$K'\beta_2$
$XKO_{2,3}$	(U)	115,377	}		

6.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{8,6}$(U)	41,82 (11)	0,0000000030 (16)
$\gamma_{1,0}$(U)	43,498 (1)	0,0397 (8)
$\gamma_{11,9}$(U)	62,70 (1)	0,000000011 (3)
$\gamma_{2,1}$(U)	99,852 (3)	0,00735 (8)
$\gamma_{11,7}$(U)	140,15 (2)	0,0000000035 (7)
$\gamma_{3,2}$(U)	152,719 (2)	0,000930 (7)
$\gamma_{13,8}$(U)	192,91 (7)	0,00000000066 (20)
$\gamma_{4,3}$(U)	200,97 (3)	0,00000392 (13)
$\gamma_{11,5}$(U)	203,12 (3)	0,0000000085 (15)
$\gamma_{14,7}$(U)	235,9 (3)	0,000000009 (5)
$\gamma_{13,5}$(U)	258,227 (3)	0,000000070 (11)
$\gamma_{14,5}$(U)	299,1 (2)	0,000000044 (3)
$\gamma_{7,2}$(U)	705,9 (1)	0,000000050 (13)
$\gamma_{8,2}$(U)	708,3 (2)	0,00000049 (3)
$\gamma_{12,3}$(U)	727,8 (2)	0,0000000027 (3)
$\gamma_{5,1}$(U)	742,813 (5)	0,00000510 (13)
$\gamma_{6,1}$(U)	766,38 (2)	0,0000219 (5)
$\gamma_{9,2}$(U)	783,4 (1)	0,000000022 (3)
$\gamma_{5,0}$(U)	786,27 (3)	0,00000320 (9)
$\gamma_{10,2}$(U)	804,4 (3)	0,00000011 (5)
$\gamma_{7,1}$(U)	805,80 (5)	0,000000056 (15)
$\gamma_{8,1}$(U)	808,2 (1)	0,000000767 (25)
$\gamma_{8,0}$(U)	851,7 (1)	0,00000127 (4)
$\gamma_{12,2}$(U)	880,5 (1)	0,00000015 (4)
$\gamma_{9,1}$(U)	883,24 (4)	0,00000072 (4)
$\gamma_{10,1}$(U)	904,37 (15)	0,000000061 (11)
$\gamma_{9,0}$(U)	926,72 (1)	0,000000558 (25)
$\gamma_{14,2}$(U)	941,94 (10)	0,000000466 (23)
$\gamma_{11,1}$(U)	946,00 (3)	0,000000092 (13)

	Energy keV	Photons per 100 disint.
$\gamma_{12,1}$(U)	980,3 (1)	0,000000042
$\gamma_{13,1}$(U)	1001,03 (3)	0,00000098 (4)
$\gamma_{14,1}$(U)	1041,7 (2)	0,000000197 (16)
$\gamma_{14,0}$(U)	1085,4 (2)	0,000000077 (9)

7 Main Production Modes

Np – 237(n,γ)Np – 238

Np – 238(β^-)Pu – 238

Cm – 242(α)Pu – 238

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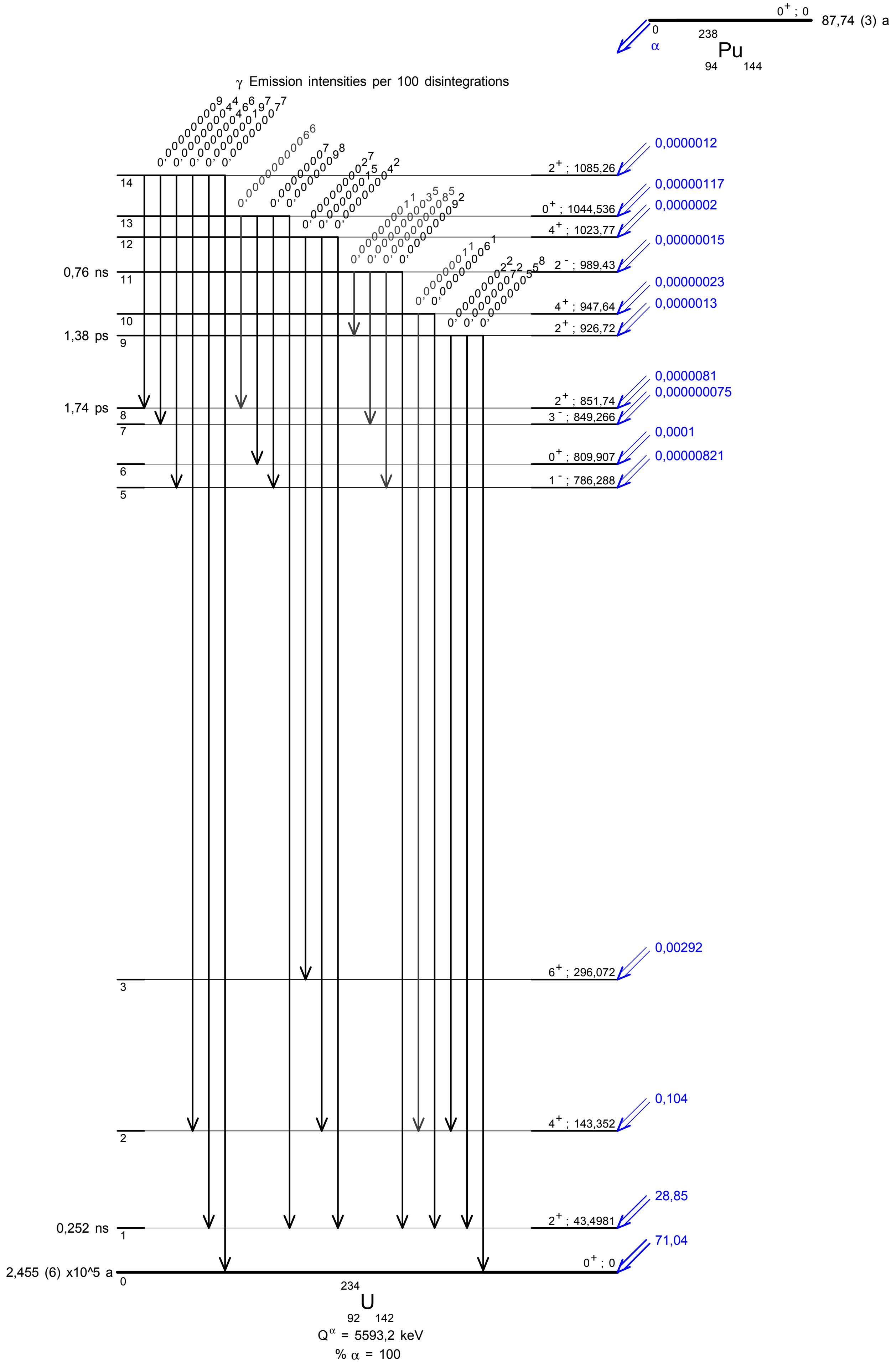
γ Emission intensities per 100 disintegrations
0+ ; 0
87,74 (3) a
α
238 Pu 94 144
2+ ; 1085,26
0,0000012
0+ ; 1044,536
0,00000117
4+ ; 1023,77
0,0000002
2 - ; 989,43
0,00000015
4+ ; 947,64
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2+ ; 926,72
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2+ ; 851,74
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3 - ; 849,266
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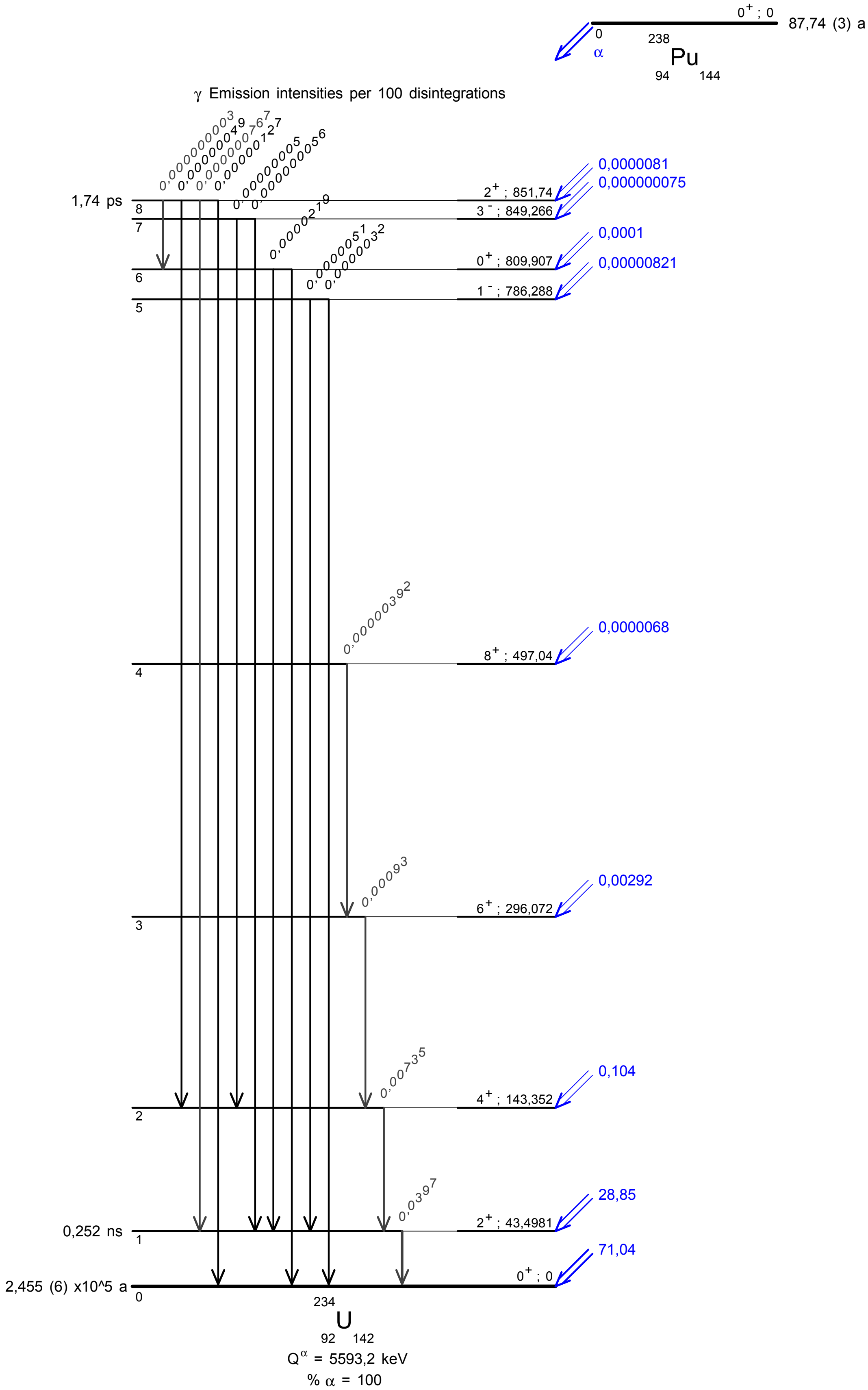
0+ ; 809,907
0,0001
1 - ; 786,288
0,00000821
6+ ; 296,072
0,00292
4+ ; 143,352
0,104
2+ ; 43,4981
28,85
0+ ; 0
71,04
0,76 ns
1,38 ps
1,74 ps
0,252 ns
2,455 (6) x10^5 a
234 U 92 142
Qα = 5593,2 keV
% α = 100



KRI /V. Chechev

$$^{240}_{94}\mathrm{Pu}_{146}$$

1 Decay Scheme

Pu-240 decays 100% by alpha transitions to U-236 and by spontaneous fission with branching fraction of 5.7 (2) 10^{-6} %. Most of the alpha decay populates the U-236 ground state (72.7 %) and the U-236 first excited level with energy of 45.24 keV (27.2 %).
Le plutonium 240 décroit à 100% par émission alpha vers l'uranium 236, et pour une faible proportion par fission spontanée (5,7 (2) 10^{-6} %). Les branchements alpha principaux se font vers le niveau fondamental (72,7 %) et le niveau excité de 45,24 keV (27,2 %).

2 Nuclear Data

$T_{1/2}(^{240}\mathrm{Pu})$	:	6561	(7)	a
$T_{1/2}(^{236}\mathrm{U})$	:	23,43	(6)	10^6 a
$Q^{\alpha}(^{240}\mathrm{Pu})$	:	5255,75	(15)	keV

2.1 α Transitions

	Energy keV	Probability × 100	F
$\alpha_{0,10}$	4289,13 (18)	< 0,0000001	
$\alpha_{0,9}$	4295,5 (4)	< 0,00000013	
$\alpha_{0,8}$	4297,85 (23)	< 0,00000017	
$\alpha_{0,7}$	4336,61 (23)	0,00000065 (8)	27
$\alpha_{0,6}$	4511,57 (17)	0,000000013 (7)	35000
$\alpha_{0,5}$	4568,16 (16)	0,0000193 (4)	65,9
$\alpha_{0,4}$	4733,50 (16)	0,000047 (5)	471
$\alpha_{0,3}$	4945,97 (15)	0,001082 (18)	646
$\alpha_{0,2}$	5106,27 (15)	0,0863 (18)	94,6
$\alpha_{0,1}$	5210,54 (15)	27,16 (19)	1,4
$\alpha_{0,0}$	5255,75 (15)	72,74 (18)	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
$\gamma_{1,0}$(U)	45,244 (2)	27,3 (8)	E2		429 (9)	118,6 (24)	589 (12)
$\gamma_{6,5}$(U)	56,6 (5)		(E2)		145 (7)	40,1 (19)	199 (10)
$\gamma_{2,1}$(U)	104,233 (5)	0,0856 (14)	E2		8,00 (16)	2,22 (4)	10,99 (22)
$\gamma_{3,2}$(U)	160,308 (3)	0,001116 (17)	E2	0,208 (4)	1,132 (23)	0,313 (6)	1,76 (4)
$\gamma_{4,3}$(U)	212,46 (5)	0,0000464 (48)	E2	0,140 (3)	0,335 (7)	0,0920 (18)	0,599 (12)
$\gamma_{10,6}$(U)	222,44						
$\gamma_{10,5}$(U)	279,0 (1)		(M1+E2)	0,5 (5)	0,15 (4)	0,038 (8)	0,7 (5)
$\gamma_{5,2}$(U)	538,1 (1)	0,000000168 (14)	E3	0,0623 (12)	0,0587 (12)	0,0160 (3)	0,143 (3)
$\gamma_{6,2}$(U)	594,5 (3)						
$\gamma_{5,1}$(U)	642,34 (5)	0,00001449 (43)	E1+(M2+E3)	0,112 (10)	0,031 (3)		0,15 (2)
$\gamma_{5,0}$(U)	687,56 (10)	0,00000466 (14)	E1	0,219 (14)	0,069 (9)		0,31 (2)
$\gamma_{6,1}$(U)	698,94	< 0,000000025					
$\gamma_{9,2}$(U)	810,8	< 0,000000043					
$\gamma_{7,1}$(U)	874,0 (2)	0,00000059 (6)	(E2)	0,01060 (15)	0,00283 (6)	0,000711 (14)	0,0144 (3)
$\gamma_{8,1}$(U)	912,4 (3)	< 0,00000007	(M1)	0,0400 (8)	0,00753 (11)	0,00181 (4)	0,050 (1)
$\gamma_{9,1}$(U)	915,1 (3)	< 0,000000063	(M1+E0)				
$\gamma_{7,0}$(U)	918,9 (3)	≈0,00000006	(E0)				
$\gamma_{10,1}$(U)	921,2 (2)	< 0,000000022	E1	0,00353 (7)	0,000599 (12)	0,000142 (3)	0,00432 (9)
$\gamma_{8,0}$(U)	958,0 (2)	< 0,0000001					
$\gamma_{9,0}$(U)	960,3	< 0,00000005					
$\gamma_{10,0}$(U)	966,9 (2)	< 0,00000005	E1	0,00324 (6)	0,000549 (11)	0,000130 (3)	0,00397 (8)

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	}	36,06
	$K\beta_2$	114,407	}	
	$K\beta_4$	115,012	}	12,33
	$KO_{2,3}$	115,377	}	

		Energy keV	Relative probability
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	71,78 – 80,95	100
KLX	88,15 – 98,43	59,6
KXY	104,51 – 115,59	8,88
Auger L	5,01 – 21,60	

4 α Emissions

	Energy keV	Probability × 100
$\alpha_{0,10}$	4217,6 (2)	< 0,0000001
$\alpha_{0,9}$	4223,8 (4)	< 0,00000013
$\alpha_{0,8}$	4226,1 (3)	< 0,00000017
$\alpha_{0,7}$	4264,3 (3)	0,00000065 (8)
$\alpha_{0,6}$	4436,4 (2)	0,000000013 (7)
$\alpha_{0,5}$	4492,0 (2)	0,0000193 (4)
$\alpha_{0,4}$	4654,5 (2)	0,000047 (5)
$\alpha_{0,3}$	4863,5 (2)	0,001082 (18)
$\alpha_{0,2}$	5021,1 (2)	0,0863 (18)
$\alpha_{0,1}$	5123,6 (2)	27,16 (19)
$\alpha_{0,0}$	5168,13 (15)	72,74 (18)

5 Electron Emissions

		Energy keV		Electrons per 100 disint.
e_{AL}	(U)	5,01 - 21,60		10,3 (8)
e_{AK}	(U)			0,0000027 (4)
	KLL	71,78 - 80,95	}	
	KLX	88,15 - 98,43	}	
	KXY	104,51 - 115,59	}	
$ec_{1,0\ L}$	(U)	23,486 - 28,076		19,8 (6)
$ec_{1,0\ M}$	(U)	39,696 - 41,690		5,48 (15)
$ec_{1,0\ N}$	(U)	43,803 - 44,865		1,483 (40)
$ec_{2,1\ L}$	(U)	82,475 - 87,067		0,0571 (10)

6 Photon Emissions

6.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(U)	11,619 — 20,714		10,34 (15)	
$XK\alpha_2$	(U)	94,666		0,0000260 (6)	} $K\alpha$
$XK\alpha_1$	(U)	98,44		0,0000416 (9)	}
$XK\beta_3$	(U)	110,421	}		
$XK\beta_1$	(U)	111,298	}	0,0000150 (4)	$K'\beta_1$
$XK\beta_5''$	(U)	111,964	}		
$XK\beta_2$	(U)	114,407	}		
$XK\beta_4$	(U)	115,012	}	0,00000513 (16)	$K'\beta_2$
$XKO_{2,3}$	(U)	115,377	}		

6.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{1,0}$(U)	45,244 (2)	0,0462 (9)
$\gamma_{2,1}$(U)	104,233 (5)	0,00714 (7)
$\gamma_{3,2}$(U)	160,308 (3)	0,0004045 (22)

	Energy keV	Photons per 100 disint.
$\gamma_{4,3}$(U)	212,46 (5)	0,000029 (3)
$\gamma_{5,2}$(U)	538,1 (1)	0,000000147 (12)
$\gamma_{5,1}$(U)	642,34 (5)	0,0000126 (3)
$\gamma_{5,0}$(U)	687,56 (10)	0,00000356 (9)
$\gamma_{6,1}$(U)	698,94	< 0,000000025
$\gamma_{9,2}$(U)	810,8	< 0,000000043
$\gamma_{7,1}$(U)	874,0 (2)	0,00000058 (6)
$\gamma_{8,1}$(U)	912,4 (3)	< 0,00000007
$\gamma_{9,1}$(U)	915,1 (3)	< 0,000000063
$\gamma_{10,1}$(U)	921,2 (2)	< 0,000000022
$\gamma_{8,0}$(U)	958,0 (2)	< 0,0000001
$\gamma_{9,0}$(U)	960,3	< 0,00000005
$\gamma_{10,0}$(U)	966,9 (2)	< 0,00000005

7 Main Production Modes

U – 238(n,γ)Np – 240
U – 238(α,2n)Pu – 240
U – 238(α,pn)Np – 240
Np – 240(β^-)Pu – 240

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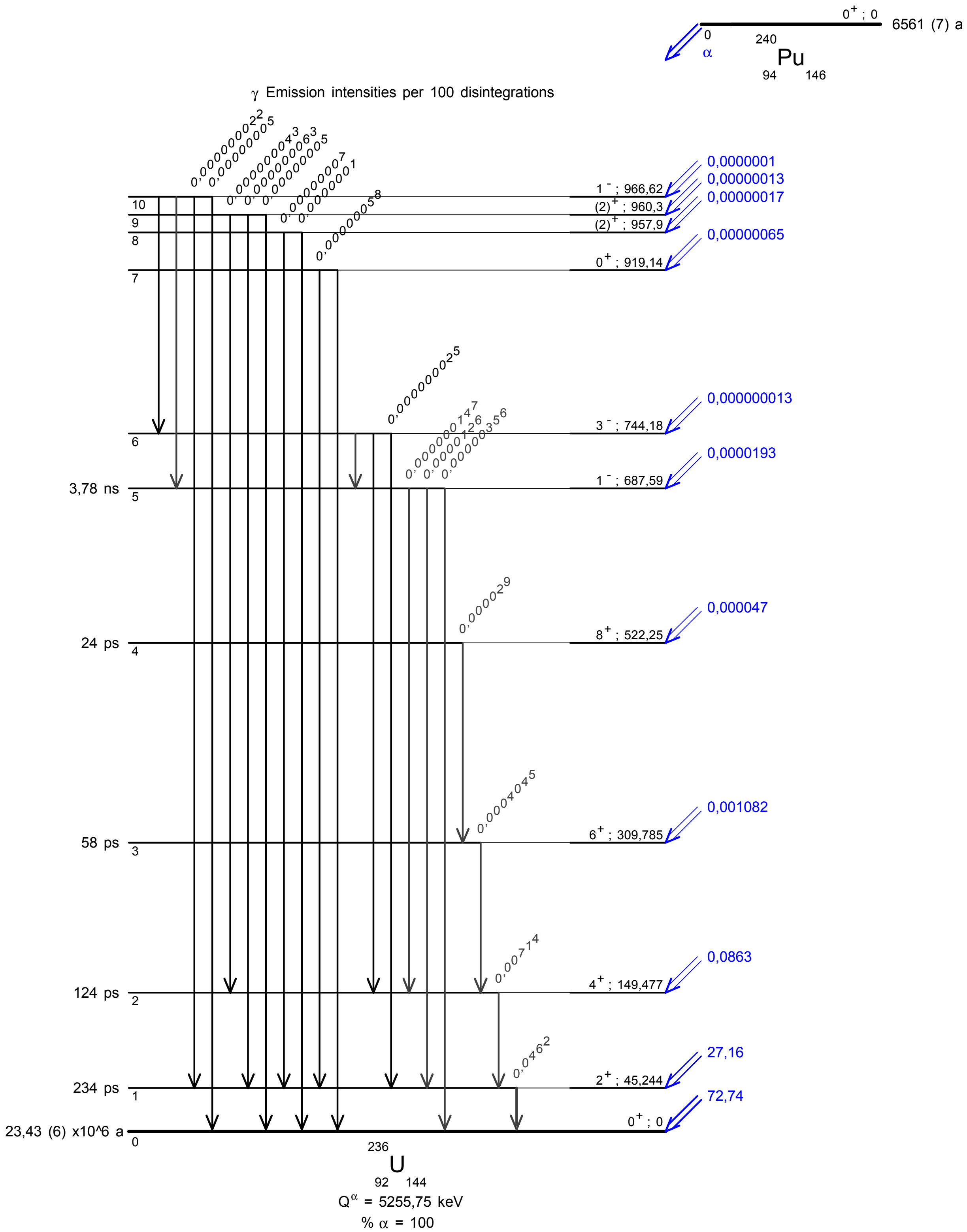
0+ ; 0
6561 (7) a
0
α
240 Pu 94 146
γ Emission intensities per 100 disintegrations
1 - ; 966,62
(2)+ ; 960,3
(2)+ ; 957,9
0+ ; 919,14
3 - ; 744,18
1 - ; 687,59
8+ ; 522,25
6+ ; 309,785
4+ ; 149,477
2+ ; 45,244
0+ ; 0
0,0000001
0,00000013
0,00000017
0,00000065
0,000000013
0,0000193
0,000047
0,001082
0,0863
27,16
72,74
3,78 ns
24 ps
58 ps
124 ps
234 ps
23,43 (6) x10^6 a
236 U 92 144
Qα = 5255,75 keV
% α = 100

$^{241}_{95}\mathrm{Am}_{146}$

1 Decay Scheme

Am-241 decays 100% by alpha transitions to Np-237. Most of the decay (84.6 %) populate the excited level of Np-237 with energy of 59.54 keV. Branching of Am-241 decay by spontaneous fission is 3,6 (9) E-10 %.

L'américium 241 se désintègre à 100 % par émission alpha vers le neptunium 237. Le branchement principal (84,6 %) se fait vers le niveau excité de 59 keV. Un faible branchement (3,6 (9) E-10 %) par fission spontanée a été observé.

2 Nuclear Data

$T_{1/2}(^{241}\mathrm{Am})$	:	432,6	(6)	a
$T_{1/2}(^{237}\mathrm{Np})$	:	2,144	(7)	10^6 a
$Q^{\alpha}(^{241}\mathrm{Am})$	:	5637,82	(12)	keV

2.1 α Transitions

	Energy keV	Probability × 100	F
$\alpha_{0,36}$	4838,00 (13)	0,00004 (3)	47
$\alpha_{0,34}$	4882,14 (13)	0,000086	44
$\alpha_{0,33}$	4915,86 (13)	0,0007	9,5
$\alpha_{0,32}$	4971,62 (15)		
$\alpha_{0,30}$	5039,83 (15)		
$\alpha_{0,29}$	5045,49 (14)		
$\alpha_{0,28}$	5047,73 (13)		
$\alpha_{0,27}$	5091,70 (14)	0,0001	1000
$\alpha_{0,25}$	5140,81 (13)		
$\alpha_{0,24}$	5151,60 (15)	0,00011	2300
$\alpha_{0,23}$	5178,13 (13)	$\sim$ 0,0004	$\sim$ 1000
$\alpha_{0,22}$	5185,27 (13)	$\sim$ 0,0004	$\sim$ 1000
$\alpha_{0,21}$	5193,04 (16)		
$\alpha_{0,20}$	5203,70 (13)	0,0004	1400

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	Energy keV	Probability × 100	F
$\alpha_{0,19}$	5219,6 (2)		
$\alpha_{0,18}$	5242,25 (13)	0,0007	1400
$\alpha_{0,17}$	5266,89 (13)	0,0003	4600
$\alpha_{0,16}$	5269,21 (13)	0,0009	1600
$\alpha_{0,15}$	5277,90 (23)	0,0006	2700
$\alpha_{0,14}$	5305,44 (13)		
$\alpha_{0,13}$	5313,40 (13)	0,0013	2100
$\alpha_{0,12}$	5321,0 (3)		
$\alpha_{0,11}$	5332,77 (13)	0,0022 (3)	1600
$\alpha_{0,9}$	5370,25 (13)	0,0005	12000
$\alpha_{0,8}$	5411,82 (13)	0,014 (3)	770
$\alpha_{0,6}$	5479,32 (13)	1,66 (3)	16,4
$\alpha_{0,5}$	5507,83 (13)	$\sim$ 0,01	$\approx$ 4000
$\alpha_{0,4}$	5534,86 (12)	13,23 (10)	4,3
$\alpha_{0,3}$	5561,92 (12)	$<$ 0,04	$>$ 2000
$\alpha_{0,2}$	5578,28 (12)	84,45 (10)	1,3
$\alpha_{0,1}$	5604,62 (12)	0,23 (1)	600
$\alpha_{0,0}$	5637,82 (12)	0,38 (1)	610

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{10,9}$(Np)	13,81 (2)		M1 + 0,10 % E2			365 (7)	494 (10)
$\gamma_{2,1}$(Np)	26,34460 (24)	21 (5)	E1 anomalous		6 (2)	1,6 (2)	8 (2)
$\gamma_{4,3}$(Np)	27,06 (1)						
$\gamma_{27,26}$(Np)	31,92 (8)						
$\gamma_{(-1,1)}$(Np)	32,183	0,0174 (4)					
$\gamma_{1,0}$(Np)	33,1963 (3)	21,3 (30)	M1 + 1,66 % E2		131 (17)	33 (5)	175 (24)
$\gamma_{17,14}$(Np)	38,54 (3)		M1 + $>$ 30 % E2		$>$ 94	$>$ 345	$>$ 472
$\gamma_{3,1}$(Np)	42,704 (5)	$\approx$ 0,42 (9)	(M1 + $\approx$ 1,7 % E2)		$\approx$ 56 (5)	$\approx$ 13,9 (14)	$\approx$ 75 (7)
$\gamma_{4,2}$(Np)	43,420 (3)	12,1 (16)	M1 + 16,6 % E2		132 (17)	35 (5)	180 (23)
$\gamma_{14,10}$(Np)	51,01 (3)	0,000046 (21)	E1		0,564 (11)	0,141 (3)	0,753 (11)
$\gamma_{5,3}$(Np)	54,09 (3)						
$\gamma_{6,4}$(Np)	55,56 (2)	1,19 (16)	M1 + 17,5 % E2		48 (4)	12,6 (11)	65 (6)
$\gamma_{13,9}$(Np)	56,86 (3)						
$\gamma_{(-1,2)}$(Np)	57,85 (5)						
$\gamma_{2,0}$(Np)	59,5409 (1)	77,6 (25)	E1 anomalous		0,84 (6)	0,226 (7)	1,16 (7)
$\gamma_{7,5}$(Np)	61,56 (7)						
$\gamma_{14,9}$(Np)	64,83 (2)	0,000196 (28)	E1		0,301 (6)	0,0744 (15)	0,400 (8)
$\gamma_{8,6}$(Np)	67,50 (2)	0,013 (4)	(M1 + 17 % E2)		22 (5)	5,7 (13)	29 (6)
$\gamma_{4,1}$(Np)	69,76 (3)	0,0039 (5)	(E1)		0,248 (5)	0,0612 (12)	0,330 (7)
$\gamma_{3,0}$(Np)	75,90 (1)	0,032	(E2)		38,6 (8)	10,76 (22)	53,1 (11)
$\gamma_{36,33}$(Np)	77,86 (4)						
$\gamma_{11,8}$(Np)	79,05 (3)						
$\gamma_{15,9}$(Np)	92,35 (20)						
$\gamma_{5,1}$(Np)	96,79 (3)	0,000047 (16)					
$\gamma_{6,2}$(Np)	98,97 (2)	0,329 (10)	E2		11,07 (22)	3,08 (6)	15,2 (3)

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{4,0}$(Np)	102,98 (2)	0,0218 (5)	E1		0,0895 (18)	0,0219 (4)	0,1189 (24)
$\gamma_{(-1,3)}$(Np)	106,42 (5)						
$\gamma_{20,13}$(Np)	109,70 (7)	0,000051	[E2]		6,86 (14)	1,91 (4)	9,44 (19)
$\gamma_{7,3}$(Np)	115,65 (6)						
$\gamma_{21,13}$(Np)	120,36 (8)						
$\gamma_{8,4}$(Np)	123,05 (1)	0,00675 (30)	E2	0,184 (4)	4,05 (8)	1,127 (23)	5,75 (12)
$\gamma_{6,1}$(Np)	125,30 (2)	0,00533 (26)	(E1)	0,228 (5)	0,0538 (11)	0,0132 (3)	0,299 (6)
$\gamma_{(-1,4)}$(Np)	128,05						
$\gamma_{20,11}$(Np)	129,07 (6)						
$\gamma_{23,13}$(Np)	135,27 (4)						
$\gamma_{(-1,5)}$(Np)	136,7						
$\gamma_{30,23}$(Np)	138,30 (9)						
$\gamma_{29,22}$(Np)	139,44 (8)	0,000023 (5)	[E2]	0,211 (4)	2,29 (5)	0,638 (13)	3,37 (7)
$\gamma_{11,6}$(Np)	146,55 (3)	0,00172 (5)	E2	0,210 (4)	1,83 (4)	0,51 (1)	2,73 (6)
$\gamma_{8,3}$(Np)	150,04 (3)	0,000087 (6)	[E1]	0,152 (3)	0,0339 (7)	0,00827 (17)	0,197 (4)
$\gamma_{26,15}$(Np)	154,27 (20)	0,000004	[M1]	5,59 (11)	1,108 (22)	0,269 (6)	7,06 (14)
$\gamma_{(-1,6)}$(Np)	156,4 (3)						
$\gamma_{29,20}$(Np)	159,26 (20)	0,0000016 (6)	[E1]	0,132 (3)	0,0292 (6)	0,00711 (14)	0,171 (4)
$\gamma_{24,13}$(Np)	161,54 (10)	0,000011	[M1]	4,91 (10)	0,971 (19)	0,236 (5)	6,20 (12)
$\gamma_{9,4}$(Np)	164,61 (2)	0,000178 (9)	E2	0,195 (4)	1,095 (22)	0,304 (6)	1,70 (4)
$\gamma_{13,6}$(Np)	165,81 (6)	0,00011 (5)	[M1 + E2]	2,4 (22)	0,98 (8)	0,26 (4)	3,7 (22)
$\gamma_{18,8}$(Np)	169,56 (3)	0,000427 (26)	E2	0,189 (4)	0,961 (19)	0,267 (6)	1,51 (3)
$\gamma_{11,5}$(Np)	175,07 (4)	0,000021 (3)	[E1]	0,1066 (21)	0,0230 (5)	0,00560 (11)	0,137 (3)
$\gamma_{(-1,7)}$(Np)	190,4						
$\gamma_{25,11}$(Np)	191,96 (4)	0,0000415 (20)	[E2]	0,162 (3)	0,561 (11)	0,155 (3)	0,932 (19)
$\gamma_{29,18}$(Np)	196,76 (8)	0,00000054	[E1]	0,0816 (16)	0,0172 (4)	0,00418 (9)	0,1045 (21)
$\gamma_{(-1,8)}$(Np)	201,70 (14)	0,0000008					
$\gamma_{18,7}$(Np)	204,06 (6)	0,00000226 (7)	[E1]	0,0752 (15)	0,0157 (3)	0,00382 (8)	0,0960 (19)
$\gamma_{9,2}$(Np)	208,005 (23)	0,00313 (6)	M1 + 2,38 % E2	2,35 (5)	0,473 (9)	0,1149 (23)	2,98 (6)
$\gamma_{13,4}$(Np)	221,46 (3)	0,00011 (5)	[M1 + E2]	1,1 (10)	0,35 (5)	0,090 (7)	1,5 (10)
$\gamma_{26,10}$(Np)	232,81 (5)	0,0000155 (4)	[M1]	1,76 (4)	0,345 (7)	0,0837 (17)	2,22 (5)
$\gamma_{9,1}$(Np)	234,40 (4)	0,0000080 (8)	M2	5,60 (11)	1,95 (4)	0,511 (10)	8,24 (17)
$\gamma_{26,9}$(Np)	246,73 (10)	0,00000703 (22)	[M1]	1,49 (3)	0,294 (6)	0,0711 (14)	1,88 (4)
$\gamma_{13,3}$(Np)	248,52 (3)	0,00000155 (3)	[E1]	0,0482 (10)	0,00975 (20)	0,00236 (5)	0,0612 (12)
$\gamma_{24,8}$(Np)	260,22 (9)						
$\gamma_{22,7}$(Np)	261,00 (7)	0,00000169 (8)	[E2]	0,0979 (20)	0,156 (3)	0,0428 (9)	0,312 (6)
$\gamma_{27,10}$(Np)	264,76 (7)						
$\gamma_{13,2}$(Np)	264,88 (3)	0,000018 (7)	[M1 + E2]	0,7 (6)	0,19 (5)	0,049 (9)	0,9 (7)
$\gamma_{9,0}$(Np)	267,54 (4)	0,000055 (2)	E1 + 19,4 % M2	0,74 (4)	0,238 (12)	0,062 (2)	1,06 (6)
$\gamma_{(-1,9)}$(Np)	270,63 (15)						
$\gamma_{(-1,10)}$(Np)	271,54						
$\gamma_{20,6}$(Np)	275,77 (8)	0,000011 (4)	[M1 + E2]	0,6 (5)	0,17 (5)	0,043 (9)	0,8 (6)
$\gamma_{27,9}$(Np)	278,04 (15)	0,00000270 (8)	[M1]	1,072 (21)	0,210 (4)	0,0509 (10)	1,35 (3)
$\gamma_{13,1}$(Np)	291,3 (2)	0,00000318 (8)	[E1]	0,0341 (7)	0,00671 (14)	0,00162 (3)	0,0430 (9)
$\gamma_{16,3}$(Np)	292,77 (6)	0,0000173 (4)	[E2]	0,0796 (16)	0,0991 (20)	0,0270 (6)	0,215 (4)
$\gamma_{15,2}$(Np)	300,13 (6)						
$\gamma_{20,5}$(Np)	304,21 (20)	0,000000966 (21)	[E1]	0,0310 (6)	0,00607 (12)	0,00147 (3)	0,0391 (8)
$\gamma_{16,2}$(Np)	309,1 (3)	0,00000210 (31)	[E1]	0,0300 (6)	0,00585 (12)	0,00142 (3)	0,0377 (8)
$\gamma_{12,0}$(Np)	316,8 (2)						
$\gamma_{28,9}$(Np)	322,52 (4)						
$\gamma_{22,5}$(Np)	322,56 (3)	0,000257 (7)	(M1 + 26,5 % E2)	0,541 (8)	0,1204 (17)	0,0297 (5)	0,702 (12)
$\gamma_{(-1,11)}$(Np)	324,69	0,0000018 (3)					
$\gamma_{(-1,12)}$(Np)	329,69	0,0000011 (2)					
$\gamma_{14,0}$(Np)	332,35 (3)	0,000172 (5)	E2	0,0631 (13)	0,0611 (12)	0,0165 (4)	0,147 (3)
$\gamma_{16,1}$(Np)	335,37 (3)	0,00084 (4)	M1 + 17,3 % E2	0,54 (7)	0,113 (8)	0,0278 (10)	0,69 (8)
$\gamma_{17,1}$(Np)	337,7 (2)	0,00000556 (10)	(E2)	0,0612 (12)	0,0575 (11)	0,0156 (3)	0,140 (3)
$\gamma_{(-1,13)}$(Np)	350,71	0,00000139 (5)					
$\gamma_{20,3}$(Np)	358,25 (20)	0,00000133 (5)	[E1]	0,0220 (4)	0,00419 (8)	0,00101 (2)	0,0275 (6)
$\gamma_{16,0}$(Np)	368,62 (3)	0,000347 (9)	(M1)	0,494 (10)	0,0963 (19)	0,0233 (5)	0,622 (12)

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{17,0}$(Np)	370,94 (3)	0,000080 (4)	M1 + 16 % E2	0,42 (6)	0,086 (8)	0,0211 (10)	0,53 (7)
$\gamma_{(-1,14)}$(Np)	374,83	0,00000313 (5)					
$\gamma_{22,3}$(Np)	376,65 (3)	0,000225 (9)	(M1)	0,466 (9)	0,0908 (18)	0,0220 (5)	0,586 (12)
$\gamma_{23,3}$(Np)	383,81 (3)	0,000037 (7)	[M1 + E2]	0,25 (20)	0,06 (3)	0,015 (6)	0,33 (23)
$\gamma_{(-1,15)}$(Np)	389,0 (3)	0,0000005					
$\gamma_{(-1,16)}$(Np)	390,61 (5)	0,00000573 (8)					
$\gamma_{32,9}$(Np)	398,64 (15)						
$\gamma_{29,7}$(Np)	400,78 (10)	0,00000018 (5)	[M1 + E2]	0,22 (18)	0,054 (23)	0,013 (6)	0,29 (21)
$\gamma_{30,7}$(Np)	406,35 (15)	0,00000175 (28)	[M1 + E2]	0,21 (17)	0,052 (22)	0,013 (5)	0,28 (20)
$\gamma_{(-1,17)}$(Np)	411,27	0,00000018 (4)					
$\gamma_{22,1}$(Np)	419,33 (4)	0,000036 (5)	[M1 + E2]	0,19 (16)	0,047 (21)	0,012 (5)	0,26 (18)
$\gamma_{23,1}$(Np)	426,47 (4)	0,000039 (9)	[M1 + E2]	0,19 (15)	0,045 (20)	0,011 (5)	0,25 (18)
$\gamma_{(-1,18)}$(Np)	429,9 (1)	0,00000109 (5)					
$\gamma_{(-1,19)}$(Np)	440,63	0,00000056 (3)					
$\gamma_{(-1,20)}$(Np)	442,81 (7)	0,00000331 (7)					
$\gamma_{35,13}$(Np)	446,15 (6)	0,00000011 (2)					
$\gamma_{22,0}$(Np)	452,6 (2)	0,00000251 (7)	[E2]	0,0357 (7)	0,0205 (4)	0,00543 (11)	0,0635 (13)
$\gamma_{26,2}$(Np)	454,66 (8)	0,0000129 (2)	[M1]	0,279 (6)	0,0542 (11)	0,0131 (3)	0,351 (7)
$\gamma_{23,0}$(Np)	459,68 (10)	0,0000043 (5)	[M1 + E2]	0,15 (12)	0,036 (17)	0,009 (4)	0,20 (14)
$\gamma_{29,5}$(Np)	462,34 (8)	0,0000012	[M1 + E2]	0,15 (12)	0,035 (17)	0,009 (4)	0,20 (14)
$\gamma_{30,5}$(Np)	468,12 (15)	0,0000032 (4)	[M1 + E2]	0,15 (12)	0,034 (16)	0,008 (4)	0,19 (14)
$\gamma_{(-1,21)}$(Np)	486,05	0,00000105 (6)					
$\gamma_{28,4}$(Np)	487,13 (4)	0,00000080 (6)	[M1]	0,232 (6)	0,0449 (9)	0,0109 (2)	0,291 (6)
$\gamma_{(-1,22)}$(Np)	494,39	0,00000010 (2)					
$\gamma_{(-1,23)}$(Np)	501,39	0,00000014 (2)					
$\gamma_{27,1}$(Np)	512,5 (3)	0,00000210 (41)	[E1]	0,0107 (2)	0,00195 (4)	0,00047 (1)	0,0133 (3)
$\gamma_{26,0}$(Np)	514,0 (5)	0,0000039 (2)	[E1]	0,0106 (2)	0,00194 (4)	0,00047 (1)	0,0132
$\gamma_{30,3}$(Np)	522,06 (15)	0,00000113 (11)	[M1 + E2]	0,11 (9)	0,025 (13)	0,006 (3)	0,14 (10)
$\gamma_{(-1,24)}$(Np)	525,14	0,00000016 (3)					
$\gamma_{38,13}$(Np)	529,17 (20)	0,00000072 (5)	[E2]	0,0269 (5)	0,0124 (2)	0,00324 (6)	0,0437 (9)
$\gamma_{(-1,25)}$(Np)	532,44	0,00000008 (2)					
$\gamma_{27,0}$(Np)	546,12 (6)	0,00000025 (3)	[E1]	0,00947 (19)	0,00171 (3)	0,00041 (1)	0,0117 (2)
$\gamma_{(-1,26)}$(Np)	548,15	0,00000005 (2)					
$\gamma_{(-1,27)}$(Np)	555,25	0,00000009 (2)					
$\gamma_{33,6}$(Np)	563,46 (2)	0,000000460 (21)	[E2]	0,0241 (5)	0,0102 (2)	0,00266 (5)	0,0378 (8)
$\gamma_{36,8}$(Np)	573,94 (20)	0,00000142 (12)	[M1 + E2]	0,09 (7)	0,019 (10)	0,0027 (16)	0,11 (8)
$\gamma_{(-1,28)}$(Np)	582,89	0,00000101 (6)					
$\gamma_{31,2}$(Np)	586,59 (20)	0,00000128 (5)	[E2]	0,0224 (4)	0,00903 (18)	0,00235 (5)	0,0346 (7)
$\gamma_{28,0}$(Np)	590,09 (4)	0,00000283 (6)	[E1]	0,00818 (16)	0,00147 (3)	0,000351 (7)	0,0101 (2)
$\gamma_{34,6}$(Np)	597,19 (2)	0,0000080 (5)	[M1 + E2]	0,08 (6)	0,017 (9)	0,0042 (20)	0,10 (7)
$\gamma_{(-1,29)}$(Np)	600,26	0,00000022 (3)					
$\gamma_{33,4}$(Np)	619,01 (2)	0,000065 (5)	[M1 + E2]	0,07 (5)	0,016 (8)	0,0037 (10)	0,09 (7)
$\gamma_{38,8}$(Np)	627,18 (20)	0,00000056 (4)	[M1 + E2]	0,07 (5)	0,015 (8)	0,0037 (10)	0,09 (6)
$\gamma_{32,1}$(Np)	632,93 (15)	0,00000124 (5)					
$\gamma_{(-1,30)}$(Np)	636,9	0,00000021 (3)					
$\gamma_{36,6}$(Np)	641,32 (4)	0,0000076 (5)	[M1 + E2]	0,06 (5)	0,014 (8)	0,0035 (10)	0,08 (6)
$\gamma_{34,4}$(Np)	652,73 (2)	0,0000410 (25)	[M1 + E2]	0,06 (5)	0,013 (7)	0,0033 (10)	0,08 (6)
$\gamma_{33,2}$(Np)	662,40 (2)	0,00045 (10)	(E0+M1+E2)	0,18 (4)	0,045 (15)		0,23 (5)
$\gamma_{32,0}$(Np)	666,2 (2)	0,00000095 (7)					
$\gamma_{36,5}$(Np)	669,83 (2)	0,00000051 (7)	[E1]	0,00647 (13)	0,00114 (2)	0,00073 (1)	0,0080 (2)
$\gamma_{37,5}$(Np)	675,78 (13)	0,00000091 (7)	[E2,M1]	0,06 (4)	0,012 (7)	0,0030 (15)	0,07 (5)
$\gamma_{34,3}$(Np)	679,79 (2)	0,00000334 (8)	[E1]	0,00630 (13)	0,00111 (2)	0,000265 (5)	0,00776 (16)
$\gamma_{33,1}$(Np)	688,72 (4)	0,0000325 (6)	[E1]	0,00615 (12)	0,00108 (2)	0,000259 (5)	0,00758 (16)
$\gamma_{(-1,31)}$(Np)	693,46	0,00000354 (7)					
$\gamma_{34,2}$(Np)	696,14 (2)	0,0000055 (3)	[M1 + E2]	0,05 (4)	0,011 (6)	0,0028 (10)	0,07 (5)
$\gamma_{(-1,32)}$(Np)	709,42 (5)	0,00000641 (18)					
$\gamma_{(-1,33)}$(Np)	712,5	0,00000020 (3)					
$\gamma_{33,0}$(Np)	721,96 (2)	0,000197 (5)	[E1]	0,0056 (1)	0,00099 (2)	0,00024 (1)	0,0070 (2)
$\gamma_{37,3}$(Np)	729,72 (15)	0,00000151 (6)	[M1]	0,079 (2)	0,0151 (4)	0,0036 (1)	0,099 (2)

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{(-1,34)}$(Np)	731,44	0,00000046 (4)					
$\gamma_{(-1,35)}$(Np)	736,68	0,00000128 (5)					
$\gamma_{35,1}$(Np)	737,34 (5)	0,00000794 (8)					
$\gamma_{(-1,36)}$(Np)	740,51	0,00000019 (3)					
$\gamma_{(-1,37)}$(Np)	742,9 (3)	0,00000035					
$\gamma_{(-1,38)}$(Np)	745,02	0,00000009 (2)					
$\gamma_{(-1,39)}$(Np)	750,39	0,00000006 (2)					
$\gamma_{34,0}$(Np)	755,68 (2)	0,00000789 (11)	[E1]	0,0052 (1)	0,00091 (1)	0,000217 (4)	0,0064 (1)
$\gamma_{(-1,40)}$(Np)	759,5 (1)	0,00000181 (5)					
$\gamma_{(-1,41)}$(Np)	763,31	0,00000023 (2)					
$\gamma_{36,1}$(Np)	766,62 (4)	0,00000504 (6)	[E1]	0,00507 (10)	0,00088 (2)	0,000211 (4)	0,00623 (12)
$\gamma_{35,0}$(Np)	770,57 (10)	0,00000481 (5)					
$\gamma_{37,1}$(Np)	772,57 (12)	0,00000303 (5)	[M1]	0,0675 (14)	0,0129 (3)	0,00312 (6)	0,0847 (17)
$\gamma_{(-1,42)}$(Np)	774,67	0,00000011 (2)					
$\gamma_{(-1,43)}$(Np)	777,39	0,00000015 (2)					
$\gamma_{(-1,44)}$(Np)	780,53	0,00000031 (2)					
$\gamma_{(-1,45)}$(Np)	782,2 (5)	0,00000015					
$\gamma_{39,3}$(Np)	786,00 (15)	0,00000062 (0)					
$\gamma_{(-1,46)}$(Np)	789,0 (3)	0,00000042 (6)					
$\gamma_{(-1,47)}$(Np)	792,6	0,00000003 (1)					
$\gamma_{(-1,48)}$(Np)	794,92 (20)	0,00000094					
$\gamma_{39,2}$(Np)	801,94 (20)	0,00000123 (7)					
$\gamma_{(-1,49)}$(Np)	803,19	0,00000016 (3)					
$\gamma_{37,0}$(Np)	805,77 (12)	0,00000033	[M1,E2]	0,037 (24)	0,008 (4)	0,0019 (10)	0,05 (3)
$\gamma_{(-1,50)}$(Np)	811,9 (3)	0,00000063 (6)					
$\gamma_{(-1,51)}$(Np)	819,33	0,00000043 (6)					
$\gamma_{(-1,52)}$(Np)	822,21	0,00000024 (6)					
$\gamma_{39,1}$(Np)	828,60 (12)	0,00000021 (4)					
$\gamma_{(-1,53)}$(Np)	835,21	0,00000003 (1)					
$\gamma_{(-1,54)}$(Np)	838,88	0,00000004 (1)					
$\gamma_{(-1,55)}$(Np)	841,14	0,00000010 (3)					
$\gamma_{(-1,56)}$(Np)	843,7	0,00000097 (8)					
$\gamma_{(-1,57)}$(Np)	846,86	0,00000016 (3)					
$\gamma_{(-1,58)}$(Np)	847,4 (5)	0,0000003					
$\gamma_{(-1,59)}$(Np)	851,6 (10)	0,00000041 (6)					
$\gamma_{(-1,60)}$(Np)	854,95	0,00000023 (4)					
$\gamma_{(-1,61)}$(Np)	856,26	0,00000010 (3)					
$\gamma_{40,2}$(Np)	861,34 (20)	0,00000008					
$\gamma_{39,0}$(Np)	861,80 (12)	0,00000061 (6)					
$\gamma_{(-1,62)}$(Np)	870,63	0,00000150 (3)					
$\gamma_{(-1,63)}$(Np)	882	0,00000004 (1)					
$\gamma_{(-1,64)}$(Np)	886,53	0,00000015 (3)					
$\gamma_{40,1}$(Np)	887,68 (20)	0,00000033 (6)					
$\gamma_{(-1,65)}$(Np)	890,38	0,00000032 (5)					
$\gamma_{(-1,66)}$(Np)	894,47	0,00000003 (1)					
$\gamma_{(-1,67)}$(Np)	898,17	0,00000006 (2)					
$\gamma_{(-1,68)}$(Np)	902,61	0,00000033 (3)					
$\gamma_{(-1,69)}$(Np)	909,95	0,00000005 (1)					
$\gamma_{(-1,70)}$(Np)	912,4	0,00000028 (3)					
$\gamma_{40,0}$(Np)	920,88 (20)	0,00000019 (3)					
$\gamma_{(-1,71)}$(Np)	928,95	0,00000009 (2)					
$\gamma_{(-1,72)}$(Np)	939,2	0,00000005 (1)					
$\gamma_{41,0}$(Np)	946,06	0,000000010 (3)					
$\gamma_{(-1,73)}$(Np)	952,72	0,00000003 (1)					
$\gamma_{(-1,74)}$(Np)	955,91	0,00000060 (5)					
$\gamma_{42,0}$(Np)	962,19	0,00000004 (1)					
$\gamma_{(-1,75)}$(Np)	969,09	0,00000003 (1)					
$\gamma_{(-1,76)}$(Np)	980,84	0,00000003 (1)					
$\gamma_{43,0}$(Np)	1014,33	0,0000010 (2)					

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				
	$L\ell$	11,89		
	$L\alpha$	13,76 – 13,944		
	$L\eta$	15,876		
	$L\beta$	16,13 – 17,79		
	$L\gamma$	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	6,04 – 13,52	55000000

4 α Emissions

	Energy keV	Probability × 100
$\alpha_{0,36}$	4757,58 (13)	0,00004 (3)
$\alpha_{0,34}$	4800,99 (13)	0,000086
$\alpha_{0,33}$	4834,15 (13)	0,0007
$\alpha_{0,32}$	4888,98 (15)	
$\alpha_{0,30}$	4956,06 (15)	
$\alpha_{0,29}$	4961,63 (14)	
$\alpha_{0,28}$	4963,83 (13)	
$\alpha_{0,27}$	5007,07 (14)	0,0001
$\alpha_{0,25}$	5055,36 (13)	
$\alpha_{0,24}$	5065,97 (15)	0,00011
$\alpha_{0,23}$	5092,06 (13)	$\sim$ 0,0004
$\alpha_{0,22}$	5099,08 (13)	$\sim$ 0,0004
$\alpha_{0,21}$	5106,72 (16)	
$\alpha_{0,20}$	5117,21 (13)	0,0004
$\alpha_{0,19}$	5132,8 (2)	
$\alpha_{0,18}$	5155,12 (13)	0,0007
$\alpha_{0,17}$	5179,35 (13)	0,0003
$\alpha_{0,16}$	5181,63 (13)	0,0009
$\alpha_{0,15}$	5190,17 (23)	0,0006
$\alpha_{0,14}$	5217,26 (13)	
$\alpha_{0,13}$	5225,08 (13)	0,0013
$\alpha_{0,12}$	5232,6 (3)	
$\alpha_{0,11}$	5244,13 (13)	0,0022 (3)
$\alpha_{0,9}$	5280,99 (13)	0,0005
$\alpha_{0,8}$	5321,87 (13)	0,014 (3)
$\alpha_{0,6}$	5388,25 (13)	1,66 (3)
$\alpha_{0,5}$	5416,28 (13)	$\sim$ 0,01
$\alpha_{0,4}$	5442,86 (12)	13,23 (10)
$\alpha_{0,3}$	5469,47 (12)	$<$ 0,04
$\alpha_{0,2}$	5485,56 (12)	84,45 (10)
$\alpha_{0,1}$	5511,46 (12)	0,23 (1)
$\alpha_{0,0}$	5544,11 (12)	0,38 (1)

5 Electron Emissions

		Energy keV	Electrons per 100 disint.
e_{AL}	(Np)	6,04 - 13,52	33,4 (17)
e_{AK}	(Np)		0,000114 (16)
	KLL	73,50 - 83,13	}
	KLX	90,36 - 97,28	}
	KXY	107,10 - 114,58	}
$ec_{2,1\ L}$	(Np)	3,92 - 8,73	14 (5)
$ec_{1,0\ L}$	(Np)	10,769 - 15,590	15,9 (21)
$ec_{3,1\ L}$	(Np)	20,28 - 25,09	0,31 (7)
$ec_{2,1\ M}$	(Np)	20,606 - 22,681	3,7 (5)
$ec_{4,2\ L}$	(Np)	20,99 - 25,81	8,8 (12)
$ec_{1,0\ M}$	(Np)	27,46 - 29,53	4,0 (6)
$ec_{1,0\ N}$	(Np)	31,70 - 32,79	1,08 (16)
$ec_{6,4\ L}$	(Np)	33,13 - 37,95	0,87 (11)
$ec_{3,1\ M}$	(Np)	36,97 - 39,04	0,076 (17)
$ec_{2,0\ L}$	(Np)	37,114 - 41,930	30,2 (22)
$ec_{4,2\ M}$	(Np)	37,68 - 39,76	2,3 (4)
$ec_{4,2\ N}$	(Np)	41,92 - 43,02	0,65 (9)
$ec_{6,4\ M}$	(Np)	49,82 - 51,90	0,228 (30)
$ec_{2,0\ M}$	(Np)	53,802 - 55,877	8,12 (25)
$ec_{6,4\ N}$	(Np)	54,06 - 55,16	0,062 (8)
$ec_{6,2\ L}$	(Np)	76,54 - 81,36	0,225 (5)
$ec_{6,2\ M}$	(Np)	93,23 - 95,31	0,0625 (16)

6 Photon Emissions

6.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(Np)	11,89 — 22,2		36,7 (21)	
$XK\alpha_2$	(Np)	97,069		0,00113 (3)	} $K\alpha$
$XK\alpha_1$	(Np)	101,059		0,00181 (5)	}
$XK\beta_3$	(Np)	113,303	}		
$XK\beta_1$	(Np)	114,234	}	0,000658 (21)	$K'\beta_1$
$XK\beta_5''$	(Np)	114,912	}		
$XK\beta_2$	(Np)	117,463	}		
$XK\beta_4$	(Np)	117,876	}	0,000226 (8)	$K'\beta_2$

		Energy keV	Photons per 100 disint.
$XKO_{2,3}$	(Np)	118,429	}

6.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{2,1}$(Np)	26,3446 (2)	2,31 (8)
$\gamma_{(-1,1)}$(Np)	32,183	0,0174 (4)
$\gamma_{1,0}$(Np)	33,1963 (3)	0,1215 (28)
$\gamma_{3,1}$(Np)	42,704 (5)	0,0055 (11)
$\gamma_{4,2}$(Np)	43,420 (3)	0,0669 (29)
$\gamma_{14,10}$(Np)	51,01 (3)	0,000026 (12)
$\gamma_{6,4}$(Np)	55,56 (2)	0,0181 (18)
$\gamma_{(-1,2)}$(Np)	57,85 (5)	0,0052 (15)
$\gamma_{2,0}$(Np)	59,5409 (1)	35,92 (17)
$\gamma_{14,9}$(Np)	64,83 (2)	0,00014 (2)
$\gamma_{8,6}$(Np)	67,50 (2)	0,00042 (10)
$\gamma_{4,1}$(Np)	69,76 (3)	0,0029 (4)
$\gamma_{3,0}$(Np)	75,90 (1)	0,0006
$\gamma_{5,1}$(Np)	96,79 (3)	0,000047 (16)
$\gamma_{6,2}$(Np)	98,97 (2)	0,0203 (4)
$\gamma_{4,0}$(Np)	102,98 (2)	0,0195 (4)
$\gamma_{(-1,3)}$(Np)	106,42 (5)	0,000015
$\gamma_{20,13}$(Np)	109,70 (7)	0,0000049
$\gamma_{21,13}$(Np)	120,36 (8)	0,0000045
$\gamma_{8,4}$(Np)	123,05 (1)	0,00100 (4)
$\gamma_{6,1}$(Np)	125,30 (2)	0,0041 (2)
$\gamma_{29,22}$(Np)	139,44 (8)	0,0000053 (11)
$\gamma_{11,6}$(Np)	146,55 (3)	0,00046 (1)
$\gamma_{8,3}$(Np)	150,04 (3)	0,000073 (5)
$\gamma_{26,15}$(Np)	154,27 (20)	0,0000005
$\gamma_{29,20}$(Np)	159,26 (20)	0,0000014 (5)
$\gamma_{24,13}$(Np)	161,54 (10)	0,0000015
$\gamma_{9,4}$(Np)	164,61 (2)	0,000066 (3)
$\gamma_{13,6}$(Np)	165,81 (6)	0,000023 (1)
$\gamma_{18,8}$(Np)	169,56 (3)	0,00017 (1)
$\gamma_{11,5}$(Np)	175,07 (4)	0,000018 (3)
$\gamma_{(-1,7)}$(Np)	190,4	0,0000022 (5)
$\gamma_{25,11}$(Np)	191,96 (4)	0,0000215 (10)
$\gamma_{29,18}$(Np)	196,76 (8)	0,00000049
$\gamma_{(-1,8)}$(Np)	201,70 (14)	0,0000008
$\gamma_{18,7}$(Np)	204,06 (6)	0,00000206 (6)

	Energy keV	Photons per 100 disint.
$\gamma_{9,2}$(Np)	208,005 (23)	0,000786 (9)
$\gamma_{13,4}$(Np)	221,46 (3)	0,0000434 (8)
$\gamma_{26,10}$(Np)	232,81 (5)	0,00000482 (9)
$\gamma_{9,1}$(Np)	234,40 (4)	0,00000087 (8)
$\gamma_{26,9}$(Np)	246,73 (10)	0,00000244 (7)
$\gamma_{13,3}$(Np)	248,52 (3)	0,00000146 (3)
$\gamma_{22,7}$(Np)	261,00 (7)	0,00000129 (6)
$\gamma_{13,2}$(Np)	264,88 (3)	0,00000943 (12)
$\gamma_{9,0}$(Np)	267,54 (4)	0,0000268 (6)
$\gamma_{(-1,9)}$(Np)	270,63 (15)	0,0000005 (2)
$\gamma_{(-1,10)}$(Np)	271,54	0,00000144 (5)
$\gamma_{20,6}$(Np)	275,77 (8)	0,00000632 (10)
$\gamma_{27,9}$(Np)	278,04 (15)	0,00000115 (3)
$\gamma_{13,1}$(Np)	291,3 (2)	0,00000305 (8)
$\gamma_{16,3}$(Np)	292,77 (6)	0,0000142 (3)
$\gamma_{20,5}$(Np)	304,21 (20)	0,00000093 (2)
$\gamma_{16,2}$(Np)	309,1 (3)	0,0000020 (3)
$\gamma_{22,5}$(Np)	322,56 (3)	0,000151 (4)
$\gamma_{(-1,11)}$(Np)	324,69	0,0000018 (3)
$\gamma_{(-1,12)}$(Np)	329,69	0,0000011 (2)
$\gamma_{14,0}$(Np)	332,35 (3)	0,000150 (4)
$\gamma_{16,1}$(Np)	335,37 (3)	0,000496 (7)
$\gamma_{17,1}$(Np)	337,7 (2)	0,00000488 (9)
$\gamma_{(-1,13)}$(Np)	350,71	0,00000139 (5)
$\gamma_{20,3}$(Np)	358,25 (20)	0,00000129 (5)
$\gamma_{16,0}$(Np)	368,62 (3)	0,000214 (5)
$\gamma_{17,0}$(Np)	370,94 (3)	0,0000520 (8)
$\gamma_{(-1,14)}$(Np)	374,83	0,00000313 (6)
$\gamma_{22,3}$(Np)	376,65 (3)	0,000137 (3)
$\gamma_{23,3}$(Np)	383,81 (3)	0,0000281 (6)
$\gamma_{(-1,15)}$(Np)	389,0 (3)	0,00000049
$\gamma_{(-1,16)}$(Np)	390,61 (5)	0,00000573 (10)
$\gamma_{29,7}$(Np)	400,78 (10)	0,00000014 (3)
$\gamma_{30,7}$(Np)	406,35 (15)	0,00000137 (5)
$\gamma_{(-1,17)}$(Np)	411,27	0,00000018 (4)
$\gamma_{22,1}$(Np)	419,33 (4)	0,0000284 (4)
$\gamma_{23,1}$(Np)	426,47 (4)	0,000031 (6)
$\gamma_{(-1,18)}$(Np)	429,9 (1)	0,00000109 (5)
$\gamma_{(-1,19)}$(Np)	440,63	0,00000056 (3)
$\gamma_{(-1,20)}$(Np)	442,81 (7)	0,00000331 (8)
$\gamma_{35,13}$(Np)	446,15 (6)	0,00000011 (2)
$\gamma_{22,0}$(Np)	452,6 (2)	0,00000236 (7)
$\gamma_{26,2}$(Np)	454,66 (8)	0,00000953 (12)
$\gamma_{23,0}$(Np)	459,68 (10)	0,00000355 (7)
$\gamma_{29,5}$(Np)	462,34 (8)	0,000001
$\gamma_{30,5}$(Np)	468,12 (15)	0,00000269 (6)
$\gamma_{(-1,21)}$(Np)	486,05	0,00000105 (6)

	Energy keV	Photons per 100 disint.
$\gamma_{28,4}$(Np)	487,13 (4)	0,00000062 (5)
$\gamma_{(-1,22)}$(Np)	494,39	0,00000010 (2)
$\gamma_{(-1,23)}$(Np)	501,39	0,00000014 (2)
$\gamma_{27,1}$(Np)	512,5 (3)	0,0000021 (4)
$\gamma_{26,0}$(Np)	514,0 (5)	0,0000038 (2)
$\gamma_{30,3}$(Np)	522,06 (15)	0,00000099 (5)
$\gamma_{(-1,24)}$(Np)	525,14	0,00000016 (3)
$\gamma_{38,13}$(Np)	529,17 (20)	0,00000069 (5)
$\gamma_{(-1,25)}$(Np)	532,44	0,00000008 (2)
$\gamma_{27,0}$(Np)	546,12 (6)	0,00000025 (3)
$\gamma_{(-1,26)}$(Np)	548,15	0,00000005 (2)
$\gamma_{(-1,27)}$(Np)	555,25	0,00000009 (2)
$\gamma_{33,6}$(Np)	563,46 (2)	0,00000044 (2)
$\gamma_{36,8}$(Np)	573,94 (20)	0,00000128 (5)
$\gamma_{(-1,28)}$(Np)	582,89	0,00000101 (6)
$\gamma_{31,2}$(Np)	586,59 (20)	0,00000124 (5)
$\gamma_{28,0}$(Np)	590,09 (4)	0,00000280 (6)
$\gamma_{34,6}$(Np)	597,19 (2)	0,00000729 (11)
$\gamma_{(-1,29)}$(Np)	600,26	0,00000022 (3)
$\gamma_{33,4}$(Np)	619,01 (2)	0,000060 (2)
$\gamma_{38,8}$(Np)	627,18 (20)	0,00000051 (2)
$\gamma_{32,1}$(Np)	632,93 (15)	0,00000124 (5)
$\gamma_{(-1,30)}$(Np)	636,9	0,00000021 (3)
$\gamma_{36,6}$(Np)	641,32 (4)	0,00000704 (10)
$\gamma_{34,4}$(Np)	652,73 (2)	0,0000376 (9)
$\gamma_{33,2}$(Np)	662,40 (2)	0,000367 (6)
$\gamma_{32,0}$(Np)	666,2 (2)	0,00000095 (7)
$\gamma_{36,5}$(Np)	669,83 (2)	0,00000051 (7)
$\gamma_{37,5}$(Np)	675,78 (13)	0,00000085 (5)
$\gamma_{34,3}$(Np)	679,79 (2)	0,00000331 (8)
$\gamma_{33,1}$(Np)	688,72 (4)	0,0000323 (6)
$\gamma_{(-1,31)}$(Np)	693,46	0,00000354 (8)
$\gamma_{34,2}$(Np)	696,14 (2)	0,00000517 (8)
$\gamma_{(-1,32)}$(Np)	709,42 (5)	0,00000641 (19)
$\gamma_{(-1,33)}$(Np)	712,5	0,00000020 (3)
$\gamma_{33,0}$(Np)	721,96 (2)	0,000196 (5)
$\gamma_{37,3}$(Np)	729,72 (15)	0,00000137 (5)
$\gamma_{(-1,34)}$(Np)	731,44	0,00000046 (4)
$\gamma_{(-1,35)}$(Np)	736,68	0,00000128 (5)
$\gamma_{35,1}$(Np)	737,34 (5)	0,00000794 (11)
$\gamma_{(-1,36)}$(Np)	740,51	0,00000019 (3)
$\gamma_{(-1,37)}$(Np)	742,9 (3)	0,00000035
$\gamma_{(-1,38)}$(Np)	745,02	0,00000009 (2)
$\gamma_{(-1,39)}$(Np)	750,39	0,00000006 (2)
$\gamma_{34,0}$(Np)	755,68 (2)	0,00000784 (11)
$\gamma_{(-1,40)}$(Np)	759,5 (1)	0,00000181 (5)
$\gamma_{(-1,41)}$(Np)	763,31	0,00000023 (2)

	Energy keV	Photons per 100 disint.
$\gamma_{36,1}$(Np)	766,62 (4)	0,00000501 (6)
$\gamma_{35,0}$(Np)	770,57 (10)	0,00000481 (7)
$\gamma_{37,1}$(Np)	772,57 (12)	0,00000279 (4)
$\gamma_{(-1,42)}$(Np)	774,67	0,00000011 (2)
$\gamma_{(-1,43)}$(Np)	777,39	0,00000015 (2)
$\gamma_{(-1,44)}$(Np)	780,53	0,00000031 (2)
$\gamma_{(-1,45)}$(Np)	782,2 (5)	0,00000015
$\gamma_{39,3}$(Np)	786,00 (15)	0,00000062
$\gamma_{(-1,46)}$(Np)	789,0 (3)	0,00000042 (6)
$\gamma_{(-1,47)}$(Np)	792,6	0,00000003 (1)
$\gamma_{(-1,48)}$(Np)	794,92 (20)	0,00000094
$\gamma_{39,2}$(Np)	801,94 (20)	0,00000123 (7)
$\gamma_{(-1,49)}$(Np)	803,19	0,00000016 (3)
$\gamma_{37,0}$(Np)	805,77 (12)	0,00000031
$\gamma_{(-1,50)}$(Np)	811,9 (3)	0,00000063 (6)
$\gamma_{(-1,51)}$(Np)	819,33	0,00000043 (6)
$\gamma_{(-1,52)}$(Np)	822,21	0,00000024 (6)
$\gamma_{39,1}$(Np)	828,60 (12)	0,00000021 (4)
$\gamma_{(-1,53)}$(Np)	835,21	0,00000003 (1)
$\gamma_{(-1,54)}$(Np)	838,88	0,00000004 (1)
$\gamma_{(-1,55)}$(Np)	841,14	0,00000010 (3)
$\gamma_{(-1,56)}$(Np)	843,7	0,00000097 (8)
$\gamma_{(-1,57)}$(Np)	846,86	0,00000016 (3)
$\gamma_{(-1,58)}$(Np)	847,4 (5)	0,00000027 (3)
$\gamma_{(-1,59)}$(Np)	851,6 (10)	0,00000041 (6)
$\gamma_{(-1,60)}$(Np)	854,95	0,00000023 (4)
$\gamma_{(-1,61)}$(Np)	856,26	0,00000010 (3)
$\gamma_{40,2}$(Np)	861,34 (20)	0,00000008 (3)
$\gamma_{39,0}$(Np)	861,80 (12)	0,00000061 (6)
$\gamma_{(-1,62)}$(Np)	870,63	0,00000150 (4)
$\gamma_{(-1,63)}$(Np)	882	0,00000004 (1)
$\gamma_{(-1,64)}$(Np)	886,53	0,00000015 (3)
$\gamma_{40,1}$(Np)	887,68 (20)	0,00000033 (6)
$\gamma_{(-1,65)}$(Np)	890,38	0,00000032 (5)
$\gamma_{(-1,66)}$(Np)	894,47	0,00000003 (1)
$\gamma_{(-1,67)}$(Np)	898,17	0,00000006 (2)
$\gamma_{(-1,68)}$(Np)	902,61	0,00000033 (3)
$\gamma_{(-1,69)}$(Np)	909,95	0,00000005 (1)
$\gamma_{(-1,70)}$(Np)	912,4	0,00000028 (3)
$\gamma_{40,0}$(Np)	920,88 (20)	0,00000019 (3)
$\gamma_{(-1,71)}$(Np)	928,95	0,00000009 (2)
$\gamma_{(-1,72)}$(Np)	939,2	0,00000005 (1)
$\gamma_{41,0}$(Np)	946,06	0,000000010 (2)
$\gamma_{(-1,73)}$(Np)	952,72	0,00000003 (1)
$\gamma_{(-1,74)}$(Np)	955,91	0,00000060 (5)
$\gamma_{42,0}$(Np)	962,19	0,00000004 (1)
$\gamma_{(-1,75)}$(Np)	969,09	0,00000003 (1)

	Energy keV	Photons per 100 disint.
$\gamma_{(-1,76)}$(Np)	980,84	0,00000003 (1)
$\gamma_{43,0}$(Np)	1014,33	0,0000010 (2)

7 Main Production Modes

$\mathrm{Pu} - 241(\beta^-)\mathrm{Am} - 241$

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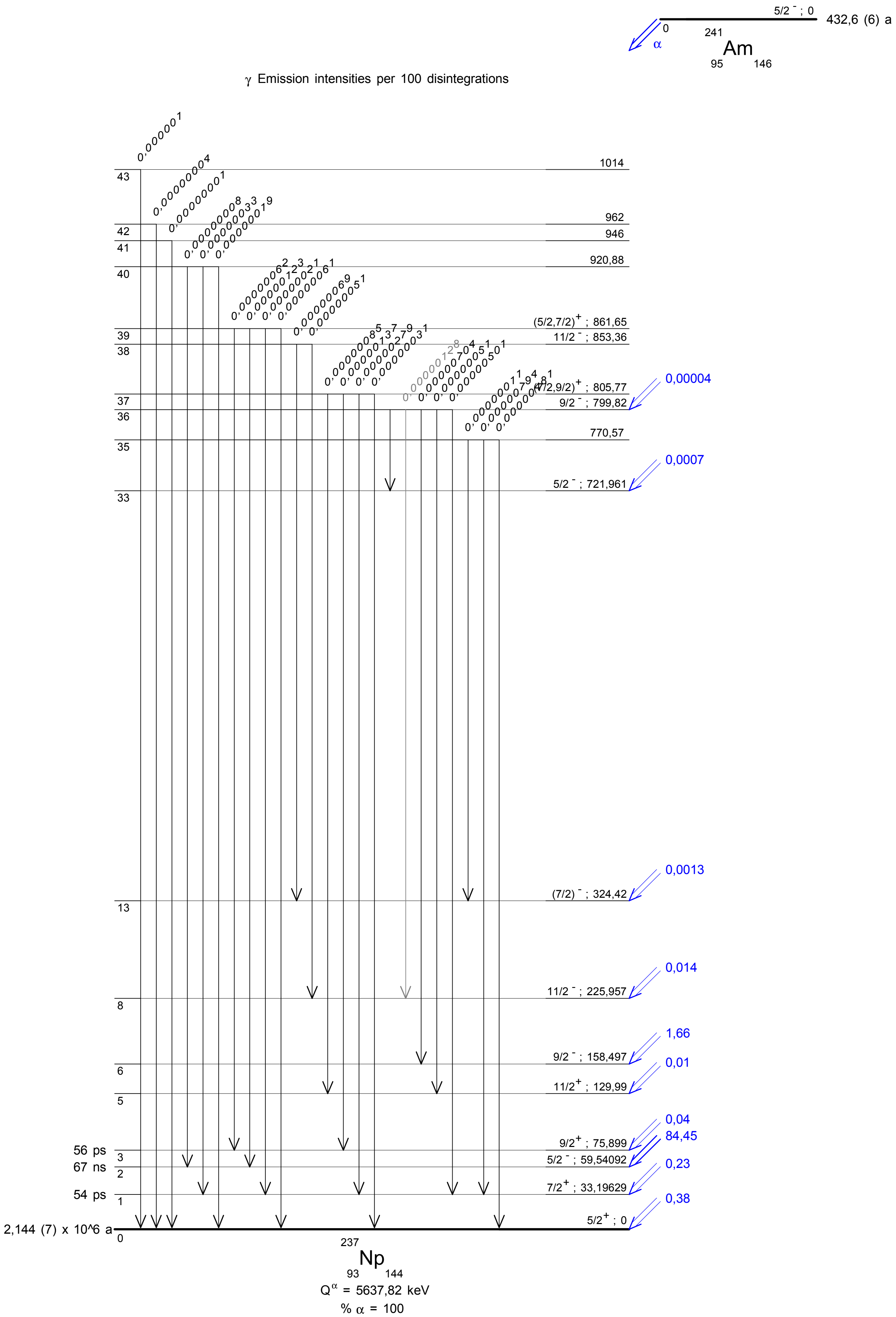
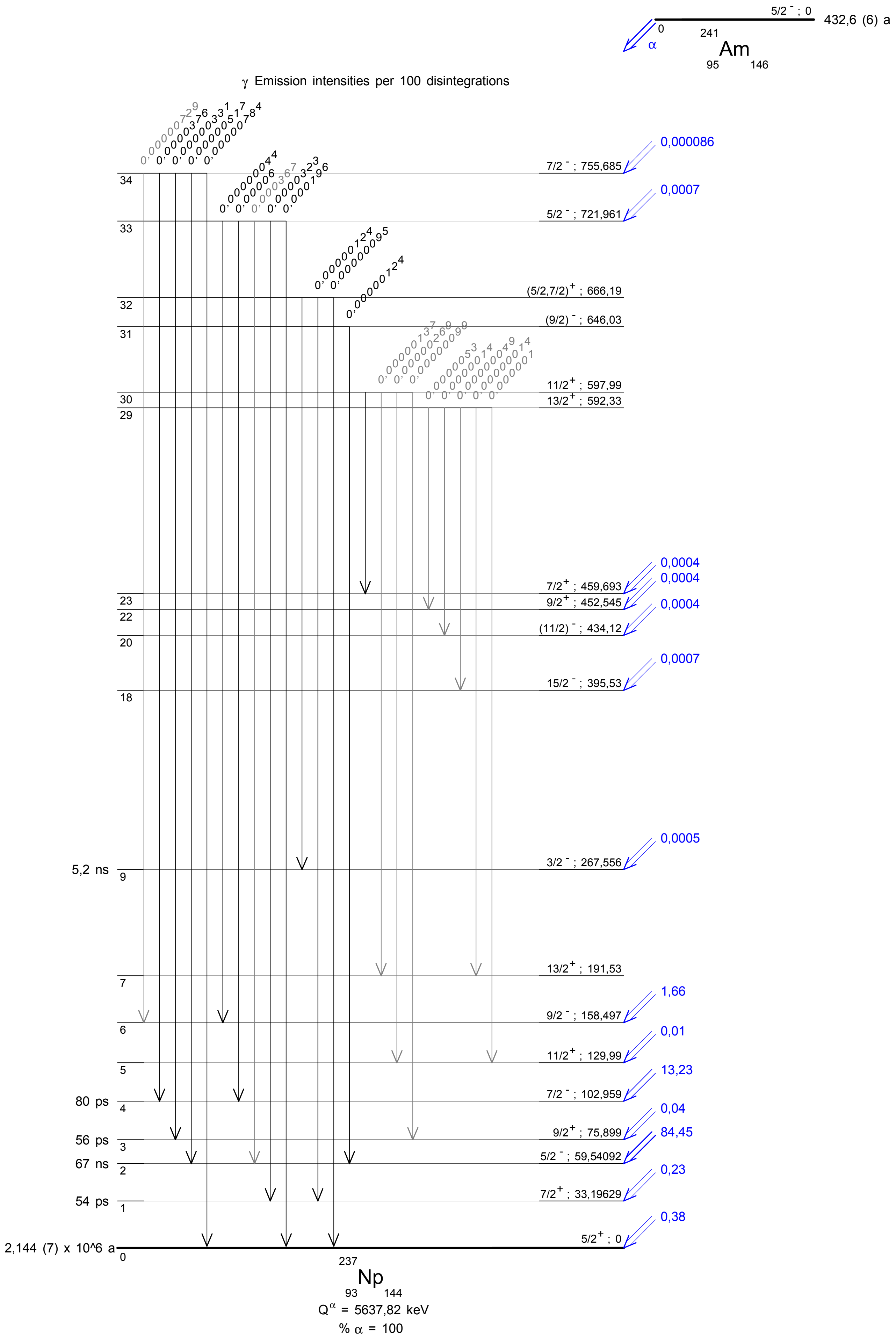
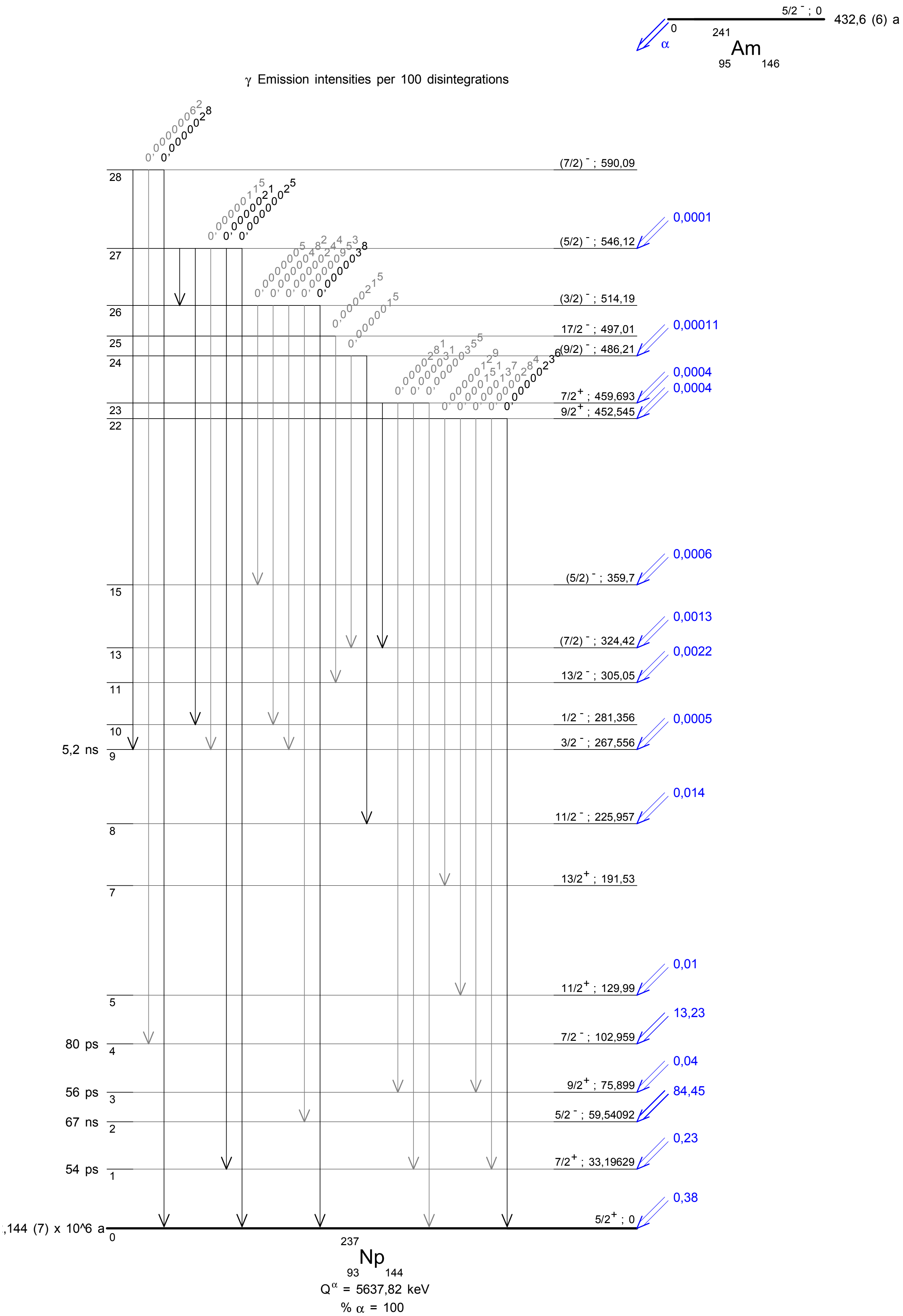
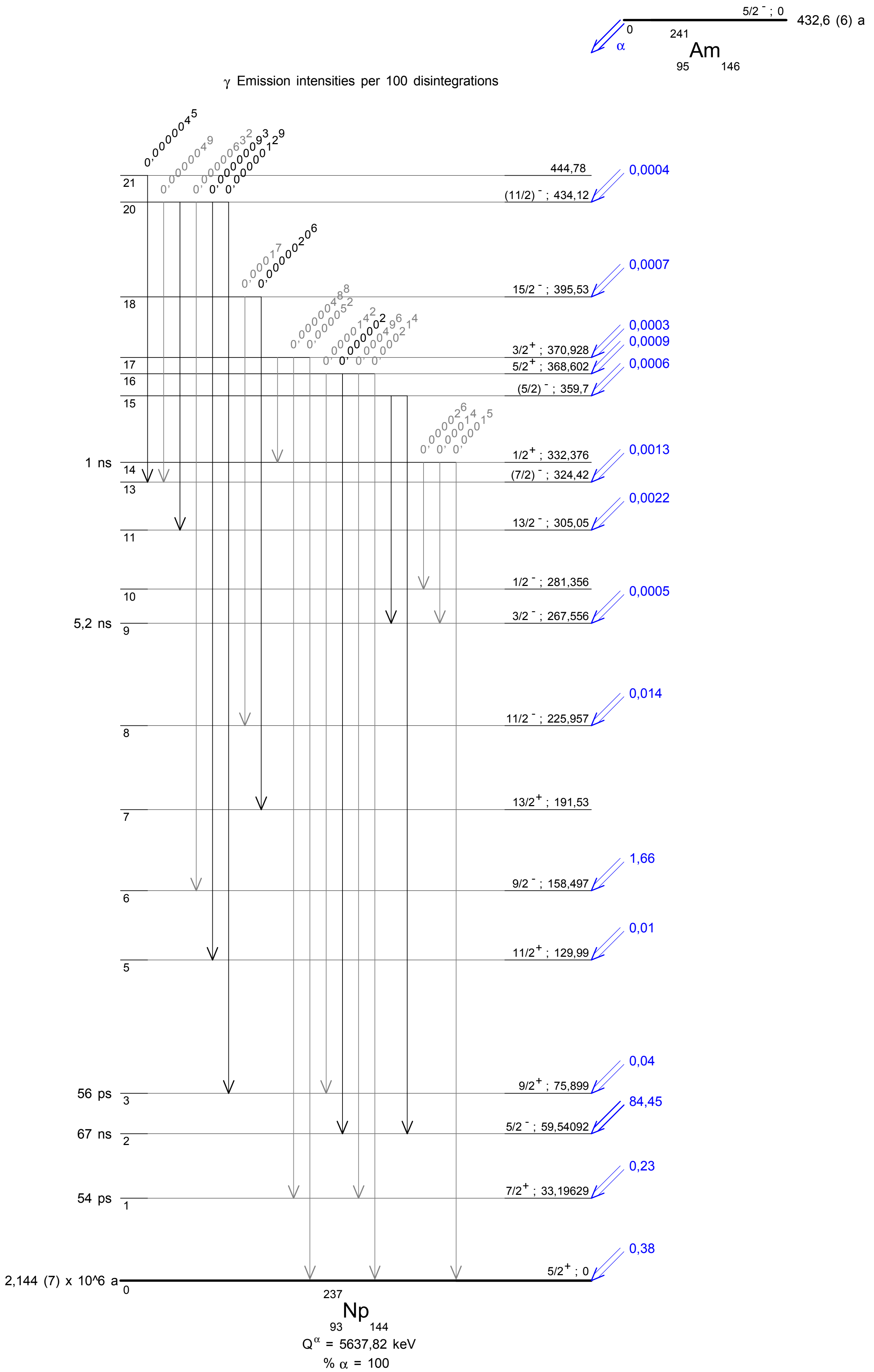
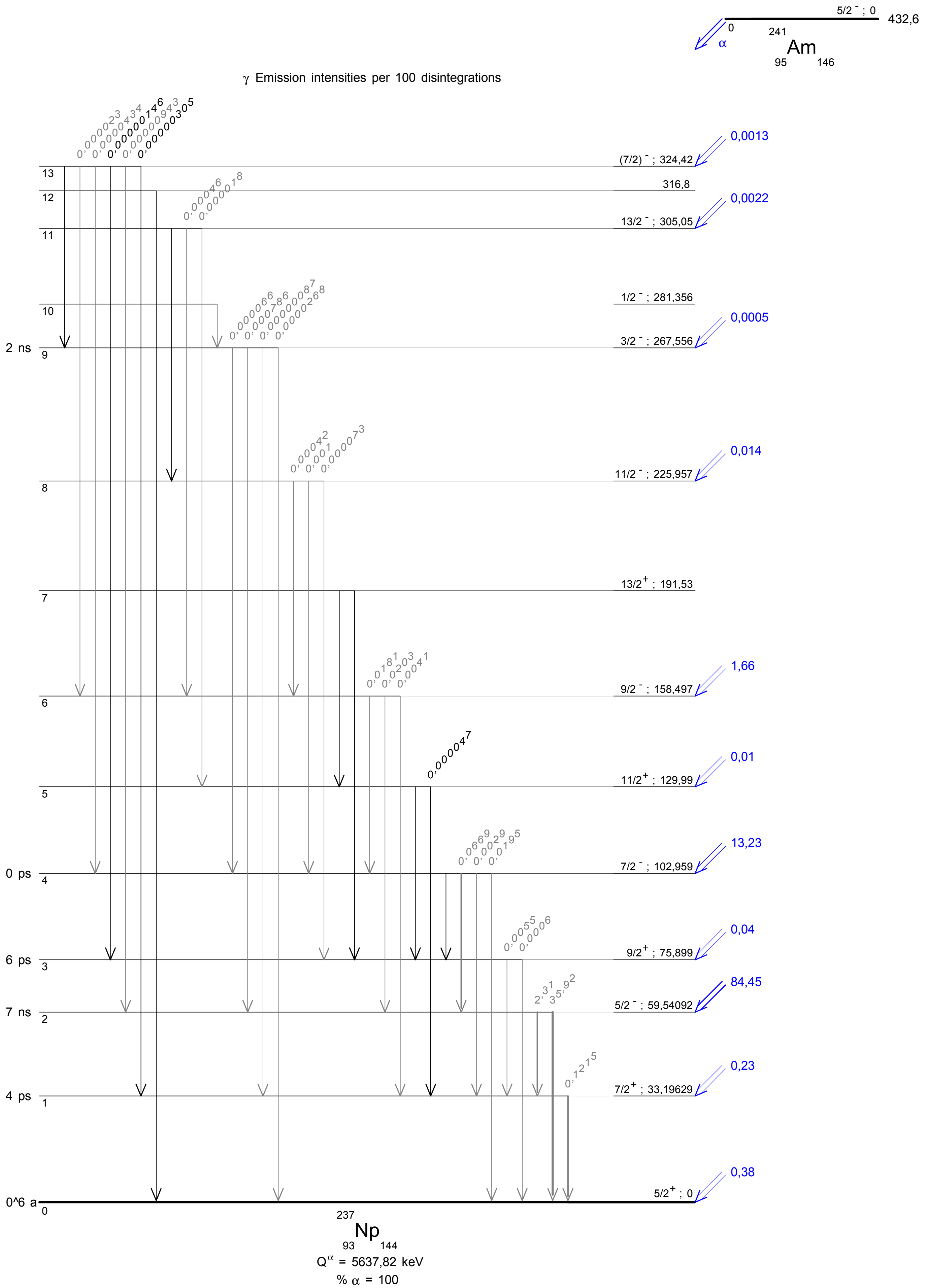

5/2 ⁻ ; 0
432,6 (6) a
α
241 Am 95 146
γ Emission intensities per 100 disintegrations
1014
962
946
920,88
(5/2,7/2)+ ; 861,65
11/2 ⁻ ; 853,36
(7/2,9/2)+ ; 805,77
9/2 ⁻ ; 799,82
770,57
5/2 ⁻ ; 721,961
(7/2) ⁻ ; 324,42
11/2 ⁻ ; 225,957
9/2 ⁻ ; 158,497
11/2+ ; 129,99
9/2+ ; 75,899
5/2 ⁻ ; 59,54092
7/2+ ; 33,19629
5/2+ ; 0
0,00004
0,0007
0,0013
0,014
1,66
0,01
0,04
84,45
0,23
0,38
56 ps
67 ns
54 ps
2,144 (7) x 10^6 a
237 Np 93 144
Qα = 5637,82 keV
% α = 100


5/2 - ; 0
432,6 (6) a
241 Am 95 146
γ Emission intensities per 100 disintegrations
7/2 - ; 755,685
0,000086
5/2 - ; 721,961
0,0007
(5/2,7/2)+ ; 666,19
(9/2) - ; 646,03
11/2+ ; 597,99
13/2+ ; 592,33
7/2+ ; 459,693
0,0004
9/2+ ; 452,545
0,0004
(11/2) - ; 434,12
0,0004
15/2 - ; 395,53
0,0007
5,2 ns
3/2 - ; 267,556
0,0005
13/2+ ; 191,53
9/2 - ; 158,497
1,66
11/2+ ; 129,99
0,01
80 ps
7/2 - ; 102,959
13,23
56 ps
9/2+ ; 75,899
0,04
67 ns
5/2 - ; 59,54092
84,45
54 ps
7/2+ ; 33,19629
0,23
2,144 (7) x 10^6 a
5/2+ ; 0
0,38
237 Np 93 144
Qα = 5637,82 keV
% α = 100



γ Emission intensities per 100 disintegrations
5/2 ⁻ ; 0
432,6 (6) a
241 Am 95 146
(7/2) ⁻ ; 590,09
(5/2) ⁻ ; 546,12
(3/2) ⁻ ; 514,19
17/2 ⁻ ; 497,01
(9/2) ⁻ ; 486,21
7/2⁺ ; 459,693
9/2⁺ ; 452,545
(5/2) ⁻ ; 359,7
(7/2) ⁻ ; 324,42
13/2 ⁻ ; 305,05
1/2 ⁻ ; 281,356
3/2 ⁻ ; 267,556
11/2 ⁻ ; 225,957
13/2⁺ ; 191,53
11/2⁺ ; 129,99
7/2 ⁻ ; 102,959
9/2⁺ ; 75,899
5/2 ⁻ ; 59,54092
7/2⁺ ; 33,19629
5/2⁺ ; 0
0,0001
0,00011
0,0004
0,0004
0,0006
0,0013
0,0022
0,0005
0,014
0,01
13,23
0,04
84,45
0,23
0,38
5,2 ns
80 ps
56 ps
67 ns
54 ps
,144 (7) x 10^6 a
237 Np 93 144
Q^α = 5637,82 keV
% α = 100


5/2 - ; 0
432,6 (6) a
241 Am 95 146
α
γ Emission intensities per 100 disintegrations
444,78
0,0004
(11/2) - ; 434,12
0,0007
15/2 - ; 395,53
0,0003
0,0009
3/2+ ; 370,928
5/2+ ; 368,602
0,0006
(5/2) - ; 359,7
1 ns
0,0013
1/2+ ; 332,376
(7/2) - ; 324,42
0,0022
13/2 - ; 305,05
1/2 - ; 281,356
0,0005
5,2 ns
3/2 - ; 267,556
0,014
11/2 - ; 225,957
13/2+ ; 191,53
1,66
9/2 - ; 158,497
0,01
11/2+ ; 129,99
0,04
56 ps
9/2+ ; 75,899
84,45
67 ns
5/2 - ; 59,54092
0,23
54 ps
7/2+ ; 33,19629
0,38
2,144 (7) x 10^6 a
5/2+ ; 0
237 Np 93 144
Qα = 5637,82 keV
% α = 100


5/2 - ; 0
432,6
241 Am 95 146
α
γ Emission intensities per 100 disintegrations
(7/2) - ; 324,42
0,0013
316,8
13/2 - ; 305,05
0,0022
1/2 - ; 281,356
3/2 - ; 267,556
0,0005
11/2 - ; 225,957
0,014
13/2+ ; 191,53
9/2 - ; 158,497
1,66
11/2+ ; 129,99
0,01
7/2 - ; 102,959
13,23
9/2+ ; 75,899
0,04
5/2 - ; 59,54092
84,45
7/2+ ; 33,19629
0,23
5/2+ ; 0
0,38
2 ns
0 ps
6 ps
7 ns
4 ps
0^6 a
237 Np 93 144
Qα = 5637,82 keV
% α = 100

$^{242}_{94}$Pu $_{148}$

1 Decay Scheme

Pu-242 decays 100% by alpha transitions to U-238 and by spontaneous fission with branching fraction of 5.5 10^{-4} %. Most of the alpha decay populates the U-238 ground state (76.5 %) and the U-238 first excited level with energy of 44.9 keV (23.4 %).
Le plutonium 242 se désintègre par émission alpha et par fission spontanée dans une proportion de 5,5 10^{-4} %. L' émission alpha a lieu principalement vers le niveau excité de 44,9 keV (23,4 %) et le niveau fondamental (76,5 %) de l'uranium 238.

2 Nuclear Data

$T_{1/2}$(^{242}Pu)	:	3,73	(3)	10^5 a
$T_{1/2}$(^{238}U)	:	4,468	(5)	10^9 a
Q^{α}(^{242}Pu)	:	4984,5	(10)	keV

2.1 α Transitions

	Energy keV	Probability × 100	F
$\alpha_{0,3}$	4677,3 (10)	0,00084 (6)	609
$\alpha_{0,2}$	4836,1 (10)	0,0304 (13)	238
$\alpha_{0,1}$	4939,6 (10)	23,44 (17)	1,62
$\alpha_{0,0}$	4984,5 (10)	76,53 (17)	1

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{1,0}$(U)	44,915 (13)	23,5 (7)	E2		445 (9)	122,8 (25)	610 (12)
$\gamma_{2,1}$(U)	103,50 (4)	0,0313 (16)	E2		8,27 (17)	2,29 (5)	11,36 (23)
$\gamma_{3,2}$(U)	158,80 (8)	0,00084 (6)	E2	0,210 (4)	1,180 (24)	0,326 (7)	1,83 (4)

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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	}	36,06
	$K\beta_2$	114,407	}	
	$K\beta_4$	115,012	}	12,33
	$KO_{2,3}$	115,377	}	
X_L				
	$L\ell$	11,62		
	$L\alpha$	13,44 – 13,62		
	$L\eta$	15,4		
	$L\beta$	15,73 – 18,21		
	$L\gamma$	19,51 – 21,73		

3.1.2 Auger Electrons

	Energy keV	Relative probability
Auger K		
KLL	71,78 – 80,95	100
KLX	88,15 – 98,43	59,6
KXY	104,51 – 115,59	8,88
Auger L	5,1 – 21,6	

4 α Emissions

	Energy keV	Probability × 100
$\alpha_{0,3}$	4600,1 (10)	0,00084 (6)
$\alpha_{0,2}$	4756,2 (10)	0,0304 (13)
$\alpha_{0,1}$	4858,2 (10)	23,44 (17)
$\alpha_{0,0}$	4902,3 (10)	76,53 (17)

5 Electron Emissions

		Energy keV		Electrons per 100 disint.
e_{AL}	(U)	5,1 - 21,6		8,40 (19)
e_{AK}	(U)			0,00000188 (29)
	KLL	71,78 - 80,95	}	
	KLX	88,15 - 98,43	}	
	KXY	104,51 - 115,59	}	
$ec_{1,0\ L}$	(U)	23,157 - 27,747		17,1 (5)
$ec_{1,0\ M}$	(U)	39,367 - 41,360		4,72 (14)
$ec_{1,0\ N}$	(U)	43,474 - 44,536		1,28 (4)

6 Photon Emissions

6.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(U)	11,62 — 21,73		8,71 (21)	
$XK\alpha_2$	(U)	94,666		0,0000180 (13)	} $K\alpha$
$XK\alpha_1$	(U)	98,44		0,0000288 (21)	}
$XK\beta_3$	(U)	110,421	}		
$XK\beta_1$	(U)	111,298	}	0,0000104 (8)	$K'\beta_1$
$XK\beta_5''$	(U)	111,964	}		
$XK\beta_2$	(U)	114,407	}		
$XK\beta_4$	(U)	115,012	}	0,00000355 (27)	$K'\beta_2$
$XKO_{2,3}$	(U)	115,377	}		

6.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{1,0}$(U)	44,915 (13)	0,0384 (8)
$\gamma_{2,1}$(U)	103,50 (4)	0,00253 (12)
$\gamma_{3,2}$(U)	158,80 (8)	0,000298 (20)

7 Main Production Modes

$\begin{cases} \text{Pu} - 241(\text{n},\gamma)\text{Pu} - 242 \\ \text{Possible impurities : Pu} - 238, \text{Pu} - 239, \text{Pu} - 240, \text{Pu} - 241, \text{Am} - 241 \end{cases}$

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

Am – 242(E.C.)Pu – 242

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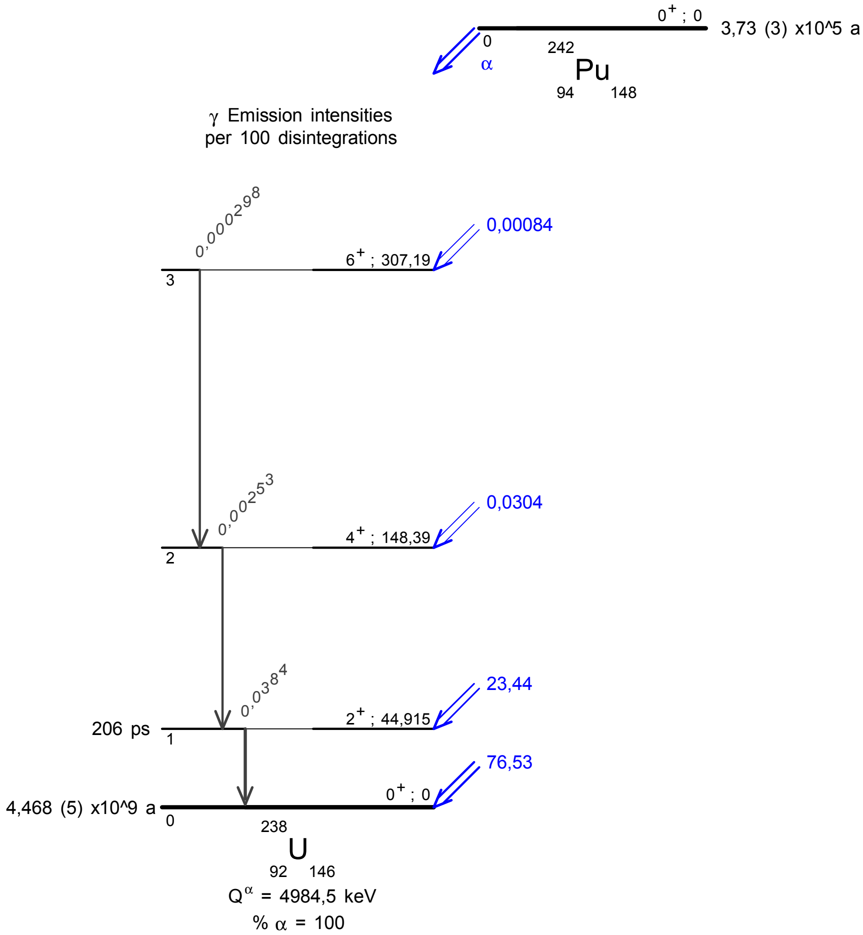
0+ ; 0
3,73 (3) x10^5 a
0
α
242
Pu
94
148
γ Emission intensities
per 100 disintegrations
0,000298
0,00084
6+ ; 307,19
3
0,00253
0,0304
4+ ; 148,39
2
0,0384
23,44
206 ps
2+ ; 44,915
1
76,53
0+ ; 0
4,468 (5) x10^9 a
0
238
U
92
146
Qα = 4984,5 keV
% α = 100

$^{242}_{95}\mathrm{Am}_{147}$

1 Decay Scheme

Am-242 decays by beta- emission to the first excited level and ground state of Cm-242 (83.1 %), and by electron capture decay to the first excited level and ground state of Pu-242 (16.9 %).
L'américium 242 se désintègre par émission bêta moins (83,1 %) vers un niveau excité et le niveau fondamental de curium 242, et par capture électronique vers le plutonium 242.

2 Nuclear Data

$T_{1/2}(^{242}\mathrm{Am})$	:	16,01	(2)	h
$T_{1/2}(^{242}\mathrm{Pu})$	:	3,73	(3)	10^5 a
$T_{1/2}(^{242}\mathrm{Cm})$	:	162,86	(8)	d
$Q^-(^{242}\mathrm{Am})$	:	664,5	(4)	keV
$Q^+(^{242}\mathrm{Am})$	:	751,3	(7)	keV

2.1 β^- Transitions

	Energy keV	Probability × 100	Nature	lg ft
$\beta^-_{0,1}$	622,4 (4)	45,8 (23)	1st forbidden non-unique	6,84
$\beta^-_{0,0}$	664,5 (4)	37,3 (23)	1st forbidden non-unique	7,03

2.2 Electron Capture Transitions

	Energy keV	Probability × 100	Nature	lg ft	P_K	P_L	P_M
$\epsilon_{0,1}$	706,8 (7)	10,6 (5)	1st forbidden non-unique	7,26	0,7261 (23)	0,2016 (15)	0,0532 (10)
$\epsilon_{0,0}$	751,3 (7)	6,3 (6)	1st forbidden non-unique	7,55	0,7303 (22)	0,1987 (15)	0,0522 (10)

2.3 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_L	α_M	α_T
$\gamma_{1,0}$(Cm)	42,13 (5)	45,8 (23)	E2	836 (13)	235 (4)	1155 (17)
$\gamma_{1,0}$(Pu)	44,54 (2)	10,6 (5)	E2	543 (8)	151,6 (22)	748 (11)

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		63,4
	$K\alpha_1$	103,734		100
	$K\beta_3$	116,244	}	
	$K\beta_1$	117,228	}	
	$K\beta_5''$	117,918	}	36,8
	$K\beta_2$	120,54	}	
	$K\beta_4$	120,969	}	12,9
	$KO_{2,3}$	121,543	}	
X_L				
	$L\ell$	12,124		
	$L\alpha$	14,087 – 14,282		
	$L\eta$	16,333		
	$L\beta$	16,498 – 18,541		
	$L\gamma$	21,42 – 22,153		

3.1.2 Auger Electrons

	Energy keV	Relative probability
Auger K		
KLL	75,263 – 85,357	100
KLX	92,607 – 103,729	60,5
KXY	109,93 – 121,78	9,05
Auger L	6,09 – 13,83	4700

3.2 Cm

ω_K	:	0,972	(4)
$\bar{\omega}_L$	:	0,538	(23)
n_{KL}	:	0,785	(5)

3.2.1 X Radiations

		Energy keV	Relative probability
X_L			
	Lℓ	12,633	
	Lα	14,746 – 14,961	
	Lη	17,314	
	Lβ	17,286 – 19,688	
	Lγ	22,735 – 23,527	

3.2.2 Auger Electrons

	Energy keV	Relative probability
Auger L	6,19 – 14,46	

4 Electron Emissions

		Energy keV		Electrons per 100 disint.
e_{AL}	(Pu)	6,09 - 13,83		9,9 (5)
e_{AK}	(Pu)			0,36 (4)
	KLL	75,263 - 85,357	}	
	KLX	92,607 - 103,729	}	
	KXY	109,93 - 121,78	}	
e_{AL}	(Cm)	6,19 - 14,46		15,4 (10)
e_{AK}	(Cm)			
$ec_{1,0\ L}$	(Cm)	17,60 - 23,16		33,1 (18)
$ec_{1,0\ L}$	(Pu)	21,44 - 26,48		7,7 (4)
$ec_{1,0\ M+}$	(Cm)	35,79 - 42,11		12,7 (7)
$ec_{1,0\ M+}$	(Pu)	38,61 - 44,53		2,9 (2)
$\beta^-_{0,1}$	max:	622,4	(4)	45,8 (23)
$\beta^-_{0,1}$	avg:	185,92	(14)	
$\beta^-_{0,0}$	max:	664,5	(4)	37,3 (23)
$\beta^-_{0,0}$	avg:	200,17	(14)	

5 Photon Emissions

5.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(Pu)	12,124 — 22,153		10,8 (5)	
$XK\alpha_2$	(Pu)	99,525		3,55 (17)	} $K\alpha$
$XK\alpha_1$	(Pu)	103,734		5,6 (3)	}
$XK\beta_3$	(Pu)	116,244	}		
$XK\beta_1$	(Pu)	117,228	}	2,06 (11)	$K'\beta_1$
$XK\beta_5''$	(Pu)	117,918	}		
$XK\beta_2$	(Pu)	120,54	}		
$XK\beta_4$	(Pu)	120,969	}	0,72 (4)	$K'\beta_2$
$XKO_{2,3}$	(Pu)	121,543	}		
XL	(Cm)	12,633 — 23,527		18,0 (11)	

5.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{1,0}$(Cm)	42,13 (5)	0,040 (2)
$\gamma_{1,0}$(Pu)	44,54 (2)	0,014 (1)

6 Main Production Modes

Am – 241(n,γ)Am – 242

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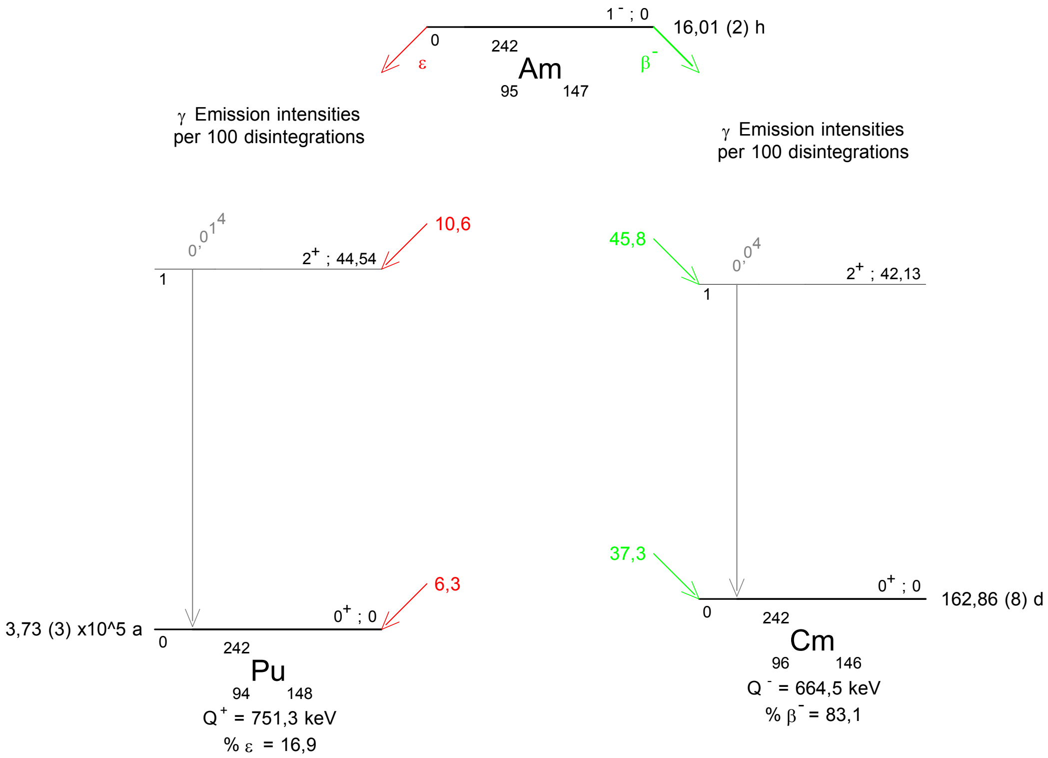
1$^-$; 0
16,01 (2) h
0
242
Am
95
147
ε
β$^-$
γ Emission intensities
per 100 disintegrations
γ Emission intensities
per 100 disintegrations
0' 0 1 4
10,6
2$^+$; 44,54
1
6,3
0$^+$; 0
3,73 (3) x10^5 a
0
242
Pu
94
148
Q$^+$ = 751,3 keV
% ε = 16,9
45,8
0' 0 4
2$^+$; 42,13
1
37,3
0$^+$; 0
162,86 (8) d
0
242
Cm
96
146
Q$^-$ = 664,5 keV
% β$^-$ = 83,1

$^{243}_{95}$Am $_{148}$

1 Decay Scheme

Am-243 decays by emission of alpha particles to Np-239, with a minute branch of 3.8 (7) 10^{-9} % by spontaneous fission.
L'américium 243 se désintègre par émission alpha vers le neptunium 239. Un faible branchement (3,8 (7) 10^{-9} %) par fission spontanée existe.

2 Nuclear Data

$T_{1/2}$(^{243}Am)	:	7367	(23)	a
$T_{1/2}$(^{239}Np)	:	2,356	(3)	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)	0,0009 (4)	900
$\alpha_{0,11}$	5092 (3)	0,0009 (4)	
$\alpha_{0,10}$	5113 (3)	0,0020 (6)	700
$\alpha_{0,9}$	5119 (3)	0,0020 (6)	
$\alpha_{0,8}$	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)	12,7 (30)	M1+3,08%E2		195 (10)	50 (3)	263 (13)
$\gamma_{4,3}$(Np)	43,2	10,1	M1+12,6%E2		114 (13)	30 (4)	154 (18)
$\gamma_{3,1}$(Np)	43,53 (2)	12,62 (23)	E1		0,856 (12)	0,215 (3)	1,143 (16)
$\gamma_{6,5}$(Np)	50,6 (10)	0,011 (2)	(E1)		0,58 (4)	0,144 (9)	0,77 (5)
$\gamma_{6,4}$(Np)	55,18 (5)	1,81 (26)	M1+26,4%E2		78 (10)	21 (3)	107 (14)
$\gamma_{3,0}$(Np)	74,66 (2)	85,7 (16)	E1		0,207 (3)	0,0512 (8)	0,276 (4)
$\gamma_{4,1}$(Np)	86,71 (2)	0,41 (1)	E1		0,1401 (20)	0,0345 (5)	0,186 (3)
$\gamma_{6,3}$(Np)	98,360 (44)	0,25 (4)	(E2)		11,31 (20)	3,15 (6)	15,6 (3)
$\gamma_{4,0}$(Np)	117,84 (15)	0,62 (5)	E1		0,0634 (10)	0,01551 (23)	0,0842 (13)
$\gamma_{6,1}$(Np)	141,90 (6)	0,141 (10)	E1	0,1723 (25)	0,0391 (6)	0,00955 (14)	0,224 (4)
$\gamma_{7,2}$(Np)	169	0,0014	(E1)	0,1156 (23)	0,0251 (6)	0,00612 (13)	0,149 (3)
$\gamma_{9,5}$(Np)	195,0 (18)	0,001	(E1)	0,0833 (22)	0,0176 (5)	0,00428 (12)	0,107 (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)	0,0009 (4)
$\alpha_{0,11}$	5008 (3)	0,0009 (4)
$\alpha_{0,10}$	5029 (3)	0,0020 (6)
$\alpha_{0,9}$	5035 (3)	0,0020 (6)
$\alpha_{0,8}$	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	18,4 (11)
e_{AK}	(Np)		0,00058 (9)
	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)	8,70 - 13,52	9,4 (22)
$ec_{4,3\ L}$	(Np)	20,8 - 25,6	7,4 (8)
$ec_{3,1\ L}$	(Np)	21,10 - 25,92	5,04 (11)
$ec_{1,0\ M}$	(Np)	25,39 - 27,47	2,4 (6)
$ec_{1,0\ N}$	(Np)	29,63 - 30,73	0,65 (15)
$ec_{6,4\ L}$	(Np)	32,753 - 37,570	1,10 (33)
$ec_{4,3\ M}$	(Np)	37,5 - 39,5	1,95 (26)
$ec_{3,1\ M}$	(Np)	37,79 - 39,87	1,266 (28)
$ec_{4,3\ N}$	(Np)	41,7 - 42,8	0,53 (6)
$ec_{3,1\ N}$	(Np)	42,03 - 43,13	0,336 (7)
$ec_{6,4\ M}$	(Np)	49,441 - 51,516	0,30 (9)
$ec_{3,0\ L}$	(Np)	52,23 - 57,05	13,91 (32)
$ec_{6,4\ N}$	(Np)	53,679 - 54,777	0,08 (2)
$ec_{3,0\ M}$	(Np)	68,92 - 71,00	3,44 (8)
$ec_{3,0\ N}$	(Np)	73,16 - 74,26	0,917 (21)
$ec_{6,3\ L}$	(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		18,9 (7)	
$XK\alpha_2$	(Np)	97,069		0,0058 (4)	} $K\alpha$
$XK\alpha_1$	(Np)	101,059		0,0092 (7)	}
$XK\beta_3$	(Np)	113,303	}		
$XK\beta_1$	(Np)	114,234	}	0,00335 (25)	$K'\beta_1$
$XK\beta''_5$	(Np)	114,912	}		
$XK\beta_2$	(Np)	117,463	}		
$XK\beta_4$	(Np)	117,876	}	0,00115 (9)	$K'\beta_2$
$XKO_{2,3}$	(Np)	118,429	}		

6.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{1,0}$(Np)	31,14 (3)	0,048 (11)
$\gamma_{4,3}$(Np)	43,1	0,065
$\gamma_{3,1}$(Np)	43,53 (2)	5,89 (10)
$\gamma_{6,5}$(Np)	50,6 (10)	0,0062 (10)
$\gamma_{6,4}$(Np)	55,18 (5)	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 (2)	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 (18)	0,00085

7 Main Production Modes

Pu – 239(mult. n capture)
U – 238(mult. n capture)

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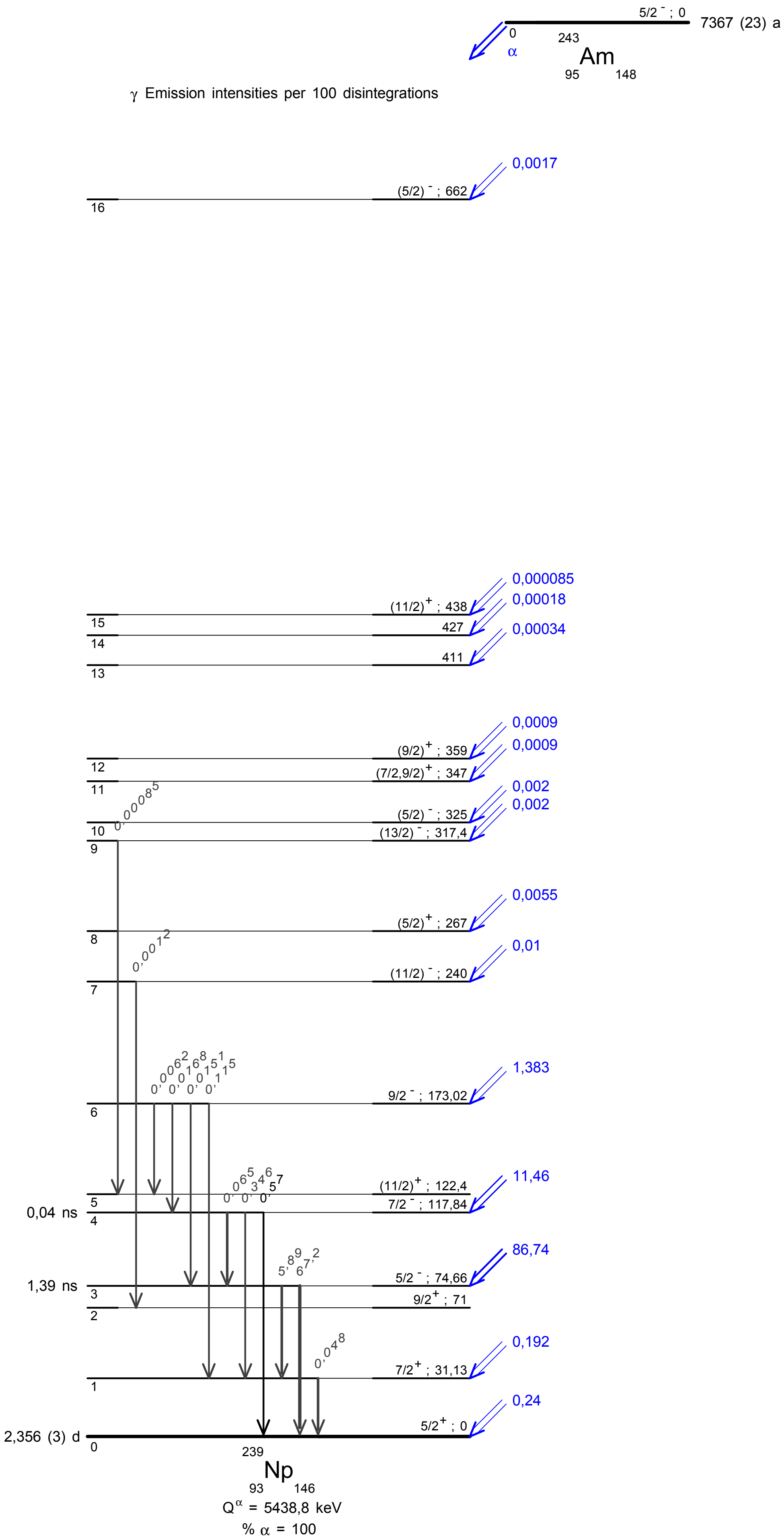
5/2 - ; 0
7367 (23) a
0
α
243
Am
95
148
γ Emission intensities per 100 disintegrations
0,0017
(5/2) - ; 662
16
0,000085
0,00018
0,00034
(11/2)+ ; 438
427
411
15
14
13
0,0009
0,0009
(9/2)+ ; 359
(7/2,9/2)+ ; 347
12
11
0,002
0,002
(5/2) - ; 325
(13/2) - ; 317,4
10
9
0,0055
(5/2)+ ; 267
8
0,01
(11/2) - ; 240
7
1,383
9/2 - ; 173,02
6
11,46
(11/2)+ ; 122,4
7/2 - ; 117,84
0,04 ns
5
4
86,74
5/2 - ; 74,66
9/2+ ; 71
1,39 ns
3
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

$^{244}_{95}$Am $_{149}$

1 Decay Scheme

Am-244 decays by beta minus emission to a single excited level of Cm-244 with energy 1040 keV.
L'américium 244 se désintègre à 100% par émission bêta vers le niveau excité de 1040 keV du curium 244, qui se déexcite par transitions gamma vers le niveau fondamental.

2 Nuclear Data

$T_{1/2}$(^{244}Am)	:	10,1	(1)	h
$T_{1/2}$(^{244}Cm)	:	18,11	(3)	a
Q^{-}(^{244}Am)	:	1427,3	(10)	keV

2.1 β^{-} Transitions

	Energy keV	Probability × 100	Nature	lg ft
$\beta^{-}_{0,9}$	387,1 (10)	100	1st forbidden non-unique	5,63

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{1,0}$(Cm)	42,965 (10)	100	E2		760 (11)	214 (3)	1050 (15)
$\gamma_{2,1}$(Cm)	99,383 (4)	100	E2		13,93 (20)	3,94 (6)	19,3 (3)
$\gamma_{3,2}$(Cm)	153,863 (2)	72 (15)	E2	0,1741 (25)	1,90 (3)	0,536 (8)	2,81 (4)
$\gamma_{4,3}$(Cm)	205,575 (4)	0,66 (15)	E2	0,1409 (20)	0,541 (8)	0,1514 (22)	0,887 (13)
$\gamma_{9,4}$(Cm)	538,402 (16)	0,69 (20)	E2	0,0292 (4)	0,01492 (21)	0,00396 (6)	0,0495 (7)
$\gamma_{9,3}$(Cm)	743,977 (5)	71 (9)	M1+0,46% E2	0,059 (4)	0,0130 (7)	0,00321 (15)	0,077 (5)
$\gamma_{9,2}$(Cm)	897,840 (7)	28 (8)	E2	0,01215 (17)	0,00358 (5)	0,000912 (13)	0,01697 (24)

3 Atomic Data

3.1 Cm

ω_K	:	0,972	(4)
$\bar{\omega}_L$	:	0,538	(23)
n_{KL}	:	0,785	(5)

3.1.1 X Radiations

		Energy keV		Relative probability
X_K				
	$K\alpha_2$	104,59		64,7
	$K\alpha_1$	109,271		100
	$K\beta_3$	122,304	}	
	$K\beta_1$	123,403	}	
	$K\beta_5''$	124,124	}	37,9
	$K\beta_2$	126,889	}	
	$K\beta_4$	127,352	}	13,2
	$KO_{2,3}$	127,97	}	
X_L				
	$L\ell$	12,633		
	$L\alpha$	14,746 – 14,961		
	$L\eta$	17,314		
	$L\beta$	17,286 – 19,688		
	$L\gamma$	22,735 – 23,527		

3.1.2 Auger Electrons

	Energy keV	Relative probability
Auger K		
KLL	78,858 – 89,973	100
KLX	97,226 – 109,267	62
KXY	115,57 – 128,23	9,5
Auger L	6,19 – 14,46	69000

4 Electron Emissions

		Energy keV	Electrons per 100 disint.
e_{AL}	(Cm)	6,19 - 14,46	86 (9)
e_{AK}	(Cm)		0,213 (27)
	KLL	78,858 - 89,973	}
	KLX	97,226 - 109,267	}
	KXY	115,57 - 128,23	}
$ec_{1,0\ L}$	(Cm)	18,439 - 24,000	73 (15)
$ec_{3,2\ K}$	(Cm)	25,622 (2)	3,3 (7)
$ec_{1,0\ M}$	(Cm)	36,628 - 38,956	21 (4)
$ec_{1,0\ N}$	(Cm)	41,281 - 42,500	5,7 (12)
$ec_{2,1\ L}$	(Cm)	74,857 - 80,410	70 (15)
$ec_{2,1\ M}$	(Cm)	93,046 - 95,374	20 (4)
$ec_{2,1\ N}$	(Cm)	97,699 - 98,910	5,5 (12)
$ec_{3,2\ L}$	(Cm)	129,337 - 134,890	36 (8)
$ec_{3,2\ M}$	(Cm)	147,526 - 149,854	10,2 (21)
$ec_{3,2\ N}$	(Cm)	152,179 - 153,390	2,8 (6)
$ec_{4,3\ L}$	(Cm)	181,049 - 186,600	0,19 (4)
$ec_{9,3\ K}$	(Cm)	615,736 (5)	3,9 (5)
$ec_{9,3\ L}$	(Cm)	719,451 - 725,010	0,86 (11)
$ec_{9,3\ M}$	(Cm)	737,640 - 739,968	0,21 (3)
$ec_{9,2\ K}$	(Cm)	769,599 (7)	0,34 (10)
$ec_{9,2\ L}$	(Cm)	873,31 - 878,87	0,10 (3)
$\beta^-_{0,9}$	max:	387,1 (10)	100
$\beta^-_{0,9}$	avg:	109,6 (3)	

5 Photon Emissions

5.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(Cm)	12,633 — 23,527		100 (10)	
XKα_2	(Cm)	104,59		2,2 (3)	} Kα
XKα_1	(Cm)	109,271		3,4 (4)	}
XKβ_3	(Cm)	122,304	}		
XKβ_1	(Cm)	123,403	}	1,29 (16)	K$'\beta_1$
XKβ''_5	(Cm)	124,124	}		
XKβ_2	(Cm)	126,889	}		
XKβ_4	(Cm)	127,352	}	0,45 (6)	K$'\beta_2$
XKO$_{2,3}$	(Cm)	127,97	}		

5.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{1,0}$(Cm)	42,965 (10)	0,096 (20)
$\gamma_{2,1}$(Cm)	99,383 (4)	5,0 (11)
$\gamma_{3,2}$(Cm)	153,863 (2)	19 (4)
$\gamma_{4,3}$(Cm)	205,575 (4)	0,35 (8)
$\gamma_{9,4}$(Cm)	538,402 (16)	0,66 (19)
$\gamma_{9,3}$(Cm)	743,977 (5)	66 (8)
$\gamma_{9,2}$(Cm)	897,840 (7)	28 (8)

6 Main Production Modes

Am – 243(n,γ)Am – 244

7 References

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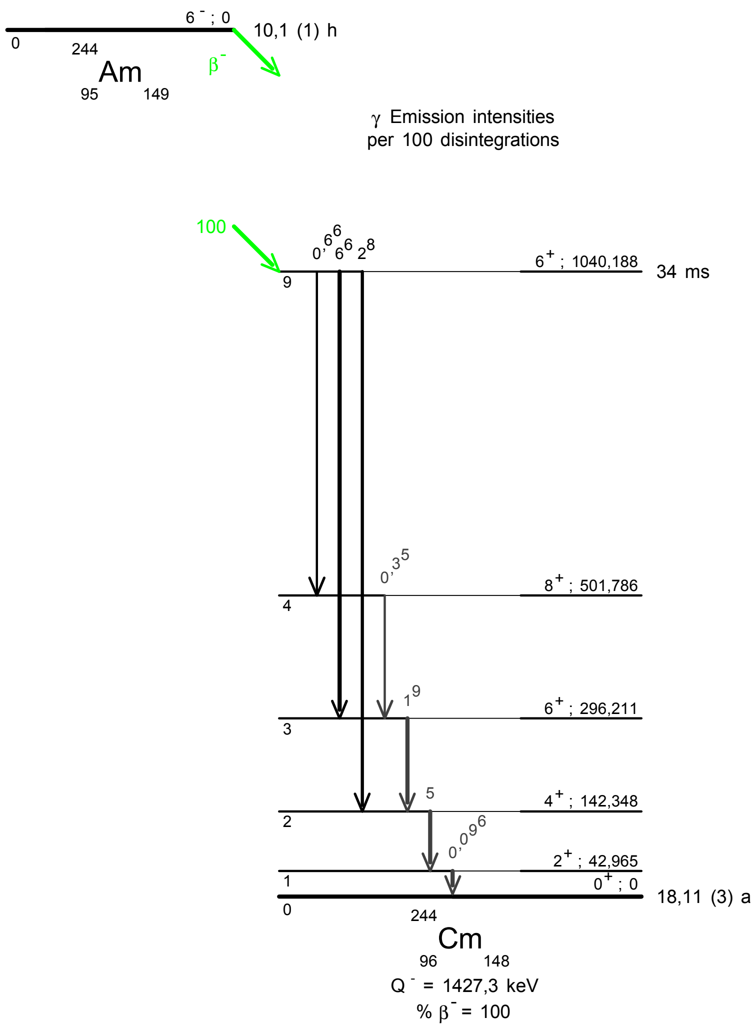
6 - ; 0
10,1 (1) h
0
244
Am
95
149
β-
γ Emission intensities
per 100 disintegrations
100
0,66
6,6
28
6+ ; 1040,188
34 ms
9
0,35
8+ ; 501,786
4
19
6+ ; 296,211
3
5
4+ ; 142,348
2
0,096
2+ ; 42,965
1
0+ ; 0
18,11 (3) a
0
244
Cm
96
148
Q - = 1427,3 keV
% β- = 100

$$^{244}_{95}\mathrm{Am}^{\mathrm{m}}_{149}$$

1 Decay Scheme

Am-244m decays predominantly by beta minus emission to a number of excited levels and the ground state of Cm-244. A small electron capture branch also occurs directly to the ground state of Pu-244.
L'américium 244 métastable se désintègre principalement vers des niveaux excités et le niveau fondamental du curium 244. Un faible branchement par capture électronique vers le plutonium 244 a été observé.

2 Nuclear Data

$T_{1/2}(^{244}\mathrm{Am}^{\mathrm{m}})$	:	26	(3)	min
$T_{1/2}(^{244}\mathrm{Pu})$	:	80,0	(9)	10^6 a
$T_{1/2}(^{244}\mathrm{Cm})$	:	18,11	(3)	a
$Q^-(^{244}\mathrm{Am}^{\mathrm{m}})$	:	1516	(3)	keV
$Q^+(^{244}\mathrm{Am}^{\mathrm{m}})$	:	164	(9)	keV

2.1 Electron Capture Transitions

	Energy keV	Probability × 100	Nature	lg ft	P_K	P_L	P_M
$\epsilon_{0,0}$	164 (9)	0,036 (1)	allowed	6,37	0,24 (5)	0,53 (4)	0,168 (12)

2.2 β^- Transitions

	Energy keV	Probability × 100	Nature	lg ft
$\beta^-_{0,11}$	410 (3)	0,35 (9)	(1st forbidden non-unique)	6,8
$\beta^-_{0,10}$	432 (3)	0,56 (13)	(allowed)	6,67
$\beta^-_{0,7}$	496 (3)	0,08 (2)	(allowed)	7,7

	Energy keV	Probability × 100	Nature	lg ft
$\beta^-_{0,6}$	531,1 (30)	1,36 (16)	allowed	6,58
$\beta^-_{0,1}$	1473 (3)	31 (9)	allowed	6,74
$\beta^-_{0,0}$	1516 (3)	67 (9)	allowed	6,45

2.3 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{1,0}$(Cm)	42,965 (10)	32 (9)	E2		760 (11)	214 (3)	1050 (15)
$\gamma_{6,1}$(Cm)	941,95 (3)	0,36 (12)	E2	0,01120 (16)	0,00318 (5)	0,000807 (12)	0,01547 (22)
$\gamma_{7,1}$(Cm)	977,80 (4)	0,08 (2)	E0 (+ M1+E2)				
$\gamma_{6,0}$(Cm)	984,91 (2)	1,0 (1)	E0				
$\gamma_{10,1}$(Cm)	1041,22 (3)	0,19 (6)	(M1+E2)				
$\gamma_{11,1}$(Cm)	1062,95 (3)	0,30 (9)	anomalous E1	0,09 (3)	0,015 (4)	0,0032 (1)	0,11 (3)
$\gamma_{10,0}$(Cm)	1084,181 (14)	0,37 (12)	anomalous (E2)	0,030 (8)	0,008 (2)	0,0020 (1)	0,041 (11)
$\gamma_{11,0}$(Cm)	1105,91 (2)	0,05 (2)	anomalous (E1)	0,14 (3)	0,024 (6)	0,0058 (1)	0,17 (4)

3 Atomic Data

3.1 Cm

ω_K	:	0,972	(4)
$\bar{\omega}_L$	:	0,538	(23)
n_{KL}	:	0,785	(5)

3.1.1 X Radiations

		Energy keV		Relative probability
X_K				
	$K\alpha_2$	104,59		65
	$K\alpha_1$	109,271		100
	$K\beta_3$	122,304	}	
	$K\beta_1$	123,403	}	
	$K\beta_5''$	124,124	}	38
	$K\beta_2$	126,889	}	
	$K\beta_4$	127,352	}	13,5
	$KO_{2,3}$	127,97	}	

		Energy keV	Relative probability
X_L			
	$L\ell$	12,633	
	$L\alpha$	14,746 – 14,961	
	$L\eta$	17,314	
	$L\beta$	17,286 – 19,688	
	$L\gamma$	22,735 – 23,527	

3.1.2 Auger Electrons

	Energy keV	Relative probability
Auger K		
KLL	78,858 – 89,973	100
KLX	97,226 – 109,267	61,6
KXY	115,57 – 128,23	9,5
Auger L	6,19 – 14,46	1450000

4 Electron Emissions

		Energy keV	Electrons per 100 disint.
e_{AL}	(Pu)	6,09 - 13,83	0,0124 (11)
e_{AK}	(Pu)		0,000253 (45)
	KLL	75,263 - 85,357	}
	KLX	92,607 - 103,729	}
	KXY	109,93 - 121,78	}
e_{AL}	(Cm)	6,19 - 14,46	10,6 (23)
e_{AK}	(Cm)		0,00125 (27)
	KLL	78,858 - 89,973	}
	KLX	97,226 - 109,267	}
	KXY	115,57 - 128,23	}
$ec_{1,0\ L}$	(Cm)	18,439 - 23,995	23 (7)
$ec_{1,0\ M+}$	(Cm)	36,628 - 42,948	9 (3)
$\beta^-_{0,11}$	max:	410 (3)	0,35 (9)
$\beta^-_{0,11}$	avg:	116,9 (7)	

		Energy keV		Electrons per 100 disint.
$\beta^-_{0,10}$	max:	432	(3)	0,56 (13)
$\beta^-_{0,10}$	avg:	123,7	(7)	
$\beta^-_{0,7}$	max:	496	(3)	0,08 (2)
$\beta^-_{0,7}$	avg:	144,0	(7)	
$\beta^-_{0,6}$	max:	531,1	(30)	1,36 (16)
$\beta^-_{0,6}$	avg:	155,7	(7)	
$\beta^-_{0,1}$	max:	1473	(3)	31 (9)
$\beta^-_{0,1}$	avg:	495,8	(9)	
$\beta^-_{0,0}$	max:	1516	(3)	67 (9)
$\beta^-_{0,0}$	avg:	512,3	(9)	

5 Photon Emissions

5.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(Cm)	12,633 — 23,527		12,3 (27)	
$XK\alpha_2$	(Cm)	104,59		0,013 (4)	} $K\alpha$
$XK\alpha_1$	(Cm)	109,271		0,020 (6)	}
$XK\beta_3$	(Cm)	122,304	}		
$XK\beta_1$	(Cm)	123,403	}	0,0076 (21)	$K'\beta_1$
$XK\beta''_5$	(Cm)	124,124	}		
$XK\beta_2$	(Cm)	126,889	}		
$XK\beta_4$	(Cm)	127,352	}	0,0027 (8)	$K'\beta_2$
$XKO_{2,3}$	(Cm)	127,97	}		

5.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{1,0}$(Cm)	42,965 (10)	0,030 (9)
$\gamma_{6,1}$(Cm)	941,95 (3)	0,35 (12)
$\gamma_{10,1}$(Cm)	1041,22 (3)	0,19 (6)
$\gamma_{11,1}$(Cm)	1062,95 (3)	0,27 (8)
$\gamma_{10,0}$(Cm)	1084,181 (14)	0,36 (12)
$\gamma_{11,0}$(Cm)	1105,91 (2)	0,04 (2)

6 Main Production Modes

Am – 243(n,γ)Am – 244m

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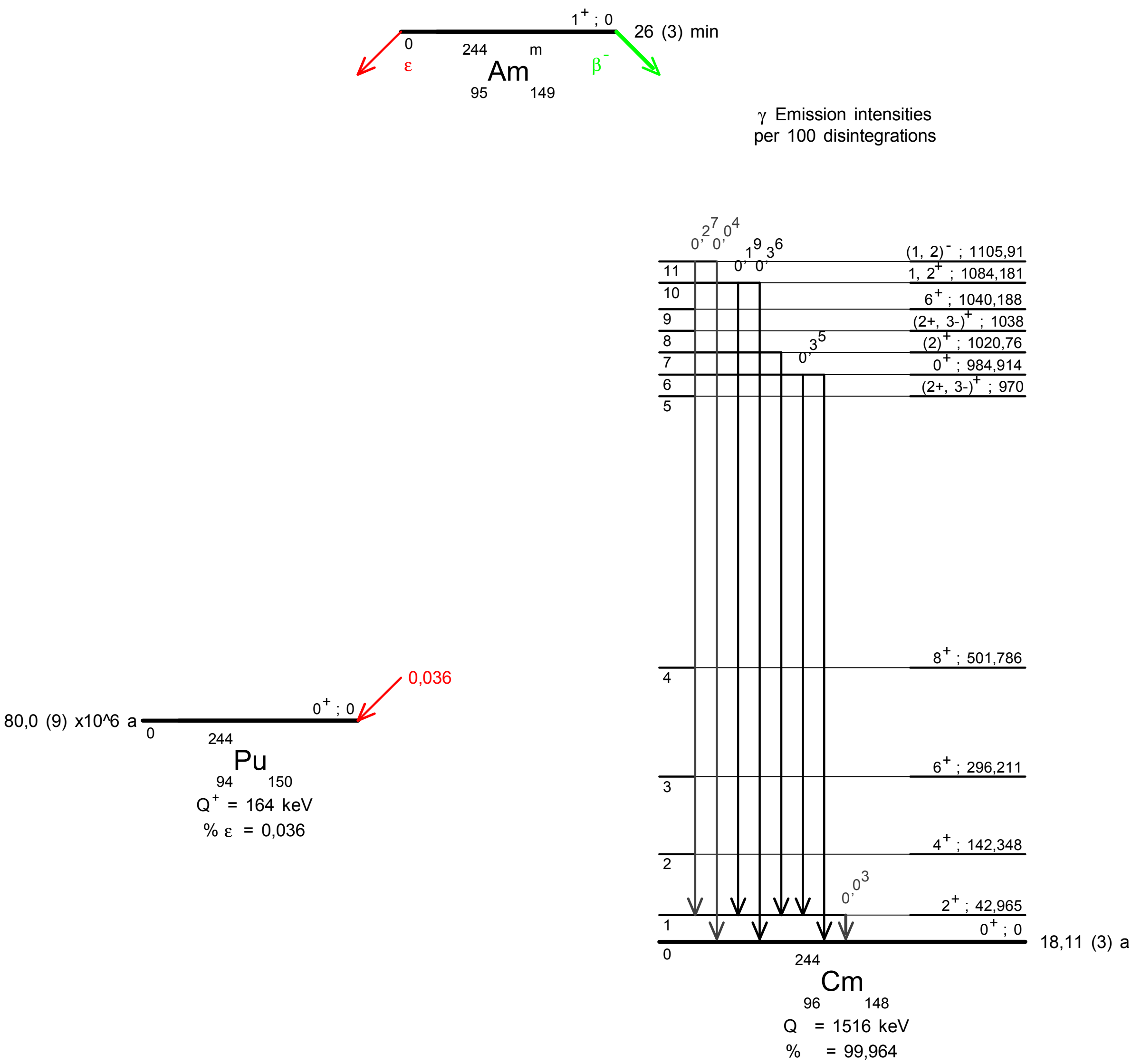

1+ ; 0
26 (3) min
0
244 m
Am
95 149
ε
β-
γ Emission intensities
per 100 disintegrations
0,036
0+ ; 0
80,0 (9) x10^6 a
244
Pu
94 150
Q+ = 164 keV
% ε = 0,036
(1, 2)- ; 1105,91
1, 2+ ; 1084,181
6+ ; 1040,188
(2+, 3-)+ ; 1038
(2)+ ; 1020,76
0+ ; 984,914
(2+, 3-)+ ; 970
8+ ; 501,786
6+ ; 296,211
4+ ; 142,348
2+ ; 42,965
0+ ; 0
18,11 (3) a
244
Cm
96 148
Q = 1516 keV
% = 99,964

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