Table of radionuclides (Vol .6 - A = 22 to 242)

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

Monographie BIPM-5

Table of Radionuclides (Vol. 6 – A = 22 to 242)

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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 six 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 and Volume 5 includes seventeen new radionuclide evaluations and eight re-evaluations of previous data as identified in the contents page. The present volume 6 contains twenty-one new radionuclide evaluations and four re-evaluations for Cu-64, Np-236, Np-237 and U-239. 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 on-going 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 to 6 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

M. Kühne
Director of the BIPM

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

Monographie BIPM-5 – Table of Radionuclides, Volume 6

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"TABLE DE RADIONUCLÉIDES"

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

^{41}Ar, ^{59}Ni, ^{64}Cu, ^{99}Tc, ^{109}Pd, ^{125}I, ^{132}Te, ^{182}Ta, ^{209}Pb, ^{209}Po, ^{211}Po, ^{215}Po, ^{215}At, ^{219}At, ^{219}Rn, ^{223}Fr, ^{223}Ra, ^{228}Ac, ^{231}Pa, ^{234}Pa, ^{234m}Pa, ^{236}Np, ^{237}Np, ^{239}U, ^{242m}Am

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

"TABLE OF RADIONUCLIDES"

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

^{41}Ar, ^{59}Ni, ^{64}Cu, ^{99}Tc, ^{109}Pd, ^{125}I, ^{132}Te, ^{182}Ta, ^{209}Pb, ^{209}Po, ^{211}Po, ^{215}Po, ^{215}At, ^{219}At, ^{219}Rn, ^{223}Fr, ^{223}Ra, ^{228}Ac, ^{231}Pa, ^{234}Pa, ^{234m}Pa, ^{236}Np, ^{237}Np, ^{239}U, ^{242m}Am

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

"TABELLE DER RADIONUKLIDE"

Zusammenfassung – Dieser Band umfaßt die Evaluation der folgenden Radionuklide:

^{41}Ar, ^{59}Ni, ^{64}Cu, ^{99}Tc, ^{109}Pd, ^{125}I, ^{132}Te, ^{182}Ta, ^{209}Pb, ^{209}Po, ^{211}Po, ^{215}Po, ^{215}At, ^{219}At, ^{219}Rn, ^{223}Fr, ^{223}Ra, ^{228}Ac, ^{231}Pa, ^{234}Pa, ^{234m}Pa, ^{236}Np, ^{237}Np, ^{239}U, ^{242m}Am

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

"ТАБЛИЦА РАДИОНУКЛИДОВ"

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

^{41}Ar, ^{59}Ni, ^{64}Cu, ^{99}Tc, ^{109}Pd, ^{125}I, ^{132}Te, ^{182}Ta, ^{209}Pb, ^{209}Po, ^{211}Po, ^{215}Po, ^{215}At, ^{219}At, ^{219}Rn, ^{223}Fr, ^{223}Ra, ^{228}Ac, ^{231}Pa, ^{234}Pa, ^{234m}Pa, ^{236}Np, ^{237}Np, ^{239}U, ^{242m}Am

Основные рекомендуемые данные включают периоды полураспада, виды распада, Х-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:

^{41}Ar, ^{59}Ni, ^{64}Cu, ^{99}Tc, ^{109}Pd, ^{125}I, ^{132}Te, ^{182}Ta, ^{209}Pb, ^{209}Po, ^{211}Po, ^{215}Po, ^{215}At, ^{219}At, ^{219}Rn, ^{223}Fr, ^{223}Ra, ^{228}Ac, ^{231}Pa, ^{234}Pa, ^{234m}Pa, ^{236}Np, ^{237}Np, ^{239}U, ^{242m}Am

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

TABLE DE RADIONUCLÉIDES

TABLE OF RADIONUCLIDES

TABELLE DER RADIONUKLIDE

ТАБЛИЦА РАДИОНУКЛИДОВ

TABLA DE RADIONUCLEIDOS

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TABLE DE RADIONUCLÉIDES

INTRODUCTION

Le Laboratoire National Henri Becquerel (LNHB) a commencé l'étude des données nucléaires et atomiques qui caractérisent la décroissance des radionucléides en 1974. Ces évaluations ont fait l'objet de la publication des quatre volumes de la Table de Radionucléides [87Ta] et de cinq volumes de la *Monographie* BIPM-5 [99Be, 04Be, 06Be, 08Be, 10Be]. 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 sixième 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 2011, 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 five volumes of evaluations have already been published as *Monographie* BIPM-5 [04Be, 06Be, 08Be, 10Be].
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 sixth 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 *n*th excited level). All transitions are designated by their initial and final levels.
For transitions with weak emission probabilities that are not shown by an arrow in the decay scheme, the initial and final levels are noted (-1, *n*).
For a 511 keV gamma emission, which follows a beta plus disintegration, the adopted numbering is (-1, -1).

UNITS

The recommended values are given:
- for half-lives:

	Symbol
. in seconds for $T_{1/2}$ <= 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 2011. 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, 10Be] 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 sechste 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 2011 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, 10Be].
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 шестой 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 ± 0,011 и
9,2 (11) 9,2 ± 1,1

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

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

НУМЕРАЦИЯ

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

ЕДИНИЦЫ

Рекомендованные значения выражены:

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

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

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

- для энергий значения выражены в килоэлектронвольтах (keV).

ПРИМЕЧАНИЕ

Этот выпуск подготовлен в 2011 г. Новые оценки и обновленные результаты можно найти на сайте:
http://www.nucleide.org/NucData.htm
http://www.bipm.org/en/publications/monographie-ri-5.html

TABLA DE RADIONUCLEIDOS

INTRODUCCION

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

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

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

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

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

VALORES RECOMENDADOS E INCERTIDUMBRES

Las principales etapas para evaluar datos con sus incertidumbres son:
- Un análisis crítico de todas las publicaciones disponibles con el fin de obtener un valor con su incertidumbre, considerada como incertidumbre típica combinada.
- La determinación de un valor recomendado que es, según el caso, una media simple o ponderada de valores obtenidos de publicaciones. Ésto se decide tras el chi-cuadrado reducido. En el caso de una media ponderada para conjuntos de valores discrepantes, el peso estadístico relativo de cada valor es limitado al 50 %. La incertidumbre, $\boldsymbol{u_c}$, 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 $\boldsymbol{U}$:
$\boldsymbol{U}(\mathrm{y}) = k \times \boldsymbol{u_c}(\mathrm{y})$ 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 2011. Para obtener todas las nuevas evaluaciones actualizadas ulteriormente, el lector deberá referirse a los documentos disponibles en:
http://www.nucleide.org/NucData.htm
http://www.bipm.org/en/publications/monographie-ri-5.html

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and
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[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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* : updated evaluations

$^{41}_{18}\text{Ar}_{23}$

1 Decay Scheme

Ar-41 disintegrates by beta minus decay to excited levels and the ground state level of K-41.
L'argon 41 se désintègre par émission bêta moins vers des niveaux excités et le niveau fondamental de potassium 41.

2 Nuclear Data

$T_{1/2}(^{41}\text{Ar})$	:	109,611	(38)	min
$Q^-(^{41}\text{Ar})$	:	2491,6	(4)	keV

2.1 β^- Transitions

	Energy keV	Probability × 100	Nature	lg ft
$\beta^-_{0,2}$	814,6 (4)	0,0515 (49)	1st Forbidden	7,68
$\beta^-_{0,1}$	1197,96 (40)	99,165 (20)	Allowed	5,05
$\beta^-_{0,0}$	2491,6 (4)	0,784 (19)	Unique 1st Forbidden	9,72

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K (10^{-5})	α_L (10^{-5})	α_M (10^{-6})	α_T (10^{-5})	α_π (10^{-6})
$\gamma_{1,0}$(K)	1293,64 (4)	99,165 (20)	M2 + 1,37 % E3	6,36 (9)	0,534 (8)	0,580 (9)	7,44 (11)	4,92 (7)
$\gamma_{2,0}$(K)	1677,0 (3)	0,0515 (49)						

3 Atomic Data

3.1 K

ω_K	:	0,143	(4)
n_{KL}	:	1,654	(6)

3.1.1 X Radiations

		Energy keV		Relative probability
X_K				
	$K\alpha_2$	3,3111		50,55
	$K\alpha_1$	3,3138		100
	$K\beta_1$	3,5896	}	
	$K\beta_5''$	3,6028	}	18,44

4 Electron Emissions

		Energy keV		Electrons per 100 disint.
$\beta^-_{0,2}$	max:	814,6	(4)	0,0515 (49)
$\beta^-_{0,2}$	avg:	293,9	(2)	
$\beta^-_{0,1}$	max:	1197,96	(40)	99,165 (20)
$\beta^-_{0,1}$	avg:	459,18	(18)	
$\beta^-_{0,0}$	max:	2491,6	(4)	0,784 (19)
$\beta^-_{0,0}$	avg:	1076,6	(2)	

5 Photon Emissions

5.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
$XK\alpha_2$	(K)	3,3111		0,000270 (9)	} $K\alpha$
$XK\alpha_1$	(K)	3,3138		0,000533 (17)	}
$XK\beta_1$	(K)	3,5896	}	0,000098 (4)	$K'\beta_1$
$XK\beta_5''$	(K)	3,6028	}		

5.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{1,0}$(K)	1293,64 (4)	99,157 (20)
$\gamma_{2,0}$(K)	1677,0 (3)	0,0515 (49)

6 Main Production Modes

Cl – 41(β)Ar – 41
Ar – 40(n,γ)Ar – 41
Ar – 40(d,pγ)Ar – 41

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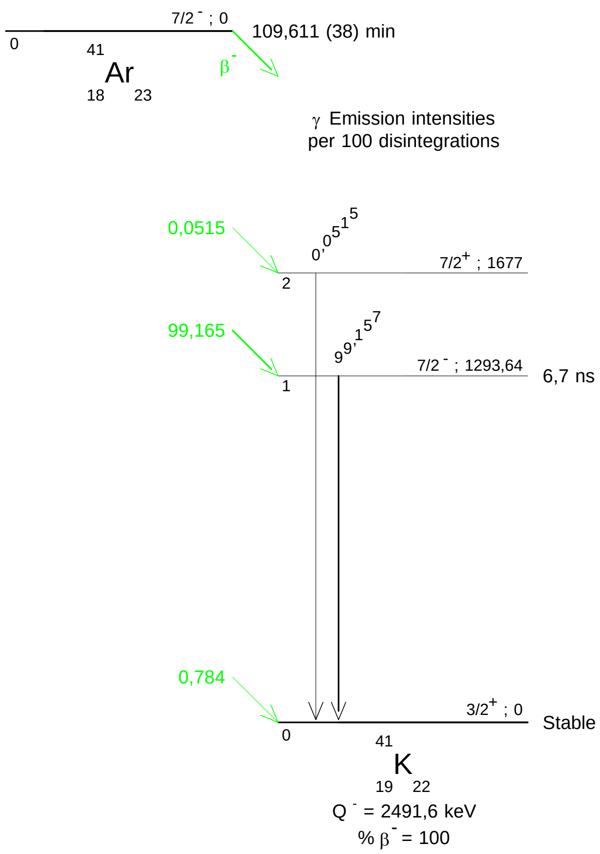

CEA/LNHB / V. Ch isté, M. M. Bé

$^{59}_{28}\mathrm{Ni}_{31}$

1 Decay Scheme

Ni-59 disintigrates by electron capture directly to the ground state level of Co-59.
Le nickel 59 se désintègre par capture électronique directement vers le niveau fondamental du cobalt 59.

2 Nuclear Data

$T_{1/2}$(^{59}Ni)	:	76	(5)	10^3 a
Q^+(^{59}Ni)	:	1072,76	(19)	keV

2.1 Electron Capture Transitions

	Energy keV	Probability × 100	Nature	lg ft	P_K	P_L	P_M
$\epsilon_{0,0}$	1072,76 (19)	99,99996 (1)	2nd Forbidden	11,89	0,8870 (16)	0,0966 (13)	0,0156 (5)

2.2 β^+ Transitions

	Energy keV	Probability × 100	Nature	lg ft
$\beta^+_{0,0}$	50,76 (19)	0,000037 (12)	2nd Forbidden	11,89

3 Atomic Data

3.1 Co

ω_K	:	0,388	(4)
$\bar{\omega}_L$	:	0,0072	(5)
n_{KL}	:	1,418	(4)

3.1.1 X Radiations

		Energy keV		Relative probability
X_K				
	$K\alpha_2$	6,91538		51,16
	$K\alpha_1$	6,9304		100
	$K\beta_1$	7,6495	}	
	$K\beta_5''$	7,706	}	20,74
X_L				
	$L\ell$	0,6793		
	$L\alpha$	0,7787 – 0,7795		
	$L\eta$	0,6949		
	$L\beta$	0,78642 – 0,9251		
	$L\gamma$	0,80198 – 0,80198		

3.1.2 Auger Electrons

	Energy keV	Relative probability
Auger K		
KLL	5,806 – 6,099	100
KLX	6,667 – 6,927	27,4
KXY	7,508 – 7,703	1,88
Auger L	0,68 – 0,83	

4 Electron Emissions

		Energy keV		Electrons per 100 disint.
e_{AL}	(Co)	0,68 - 0,83		134,5 (8)
e_{AK}	(Co)			54,3 (4)
	KLL	5,806 - 6,099	}	
	KLX	6,667 - 6,927	}	
	KXY	7,508 - 7,703	}	
$\beta^+_{0,0}$	max:	50,76 (19)		0,000037 (12)
$\beta^+_{0,0}$	avg:	24,81 (9)		

5 Photon Emissions

5.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(Co)	0,6793 — 0,9251		0,98 (7)	
XKα_2	(Co)	6,91538		10,24 (12)	} Kα
XKα_1	(Co)	6,9304		20,02 (22)	}
XKβ_1	(Co)	7,6495	}	4,15 (6)	K$'\beta_1$
XKβ''_5	(Co)	7,706	}		

5.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma^\pm$	511	0,000072 (24)

6 Main Production Modes

$$\begin{cases} \text{Ni} - 58(\text{n},\gamma)\text{Ni} - 59 \quad \sigma : 4{,}13\ (5)\ \text{barns} \\ \text{Possible impurities : Co} - 58 \end{cases}$$

$$\begin{cases} \text{Ni} - 60(\text{n,2n})\text{Ni} - 59 \\ \text{Possible impurities : Co} - 58 \end{cases}$$

$$\begin{cases} \text{Co} - 59(\text{p,n})\text{Ni} - 59 \\ \text{Possible impurities : Co} - 58 \end{cases}$$

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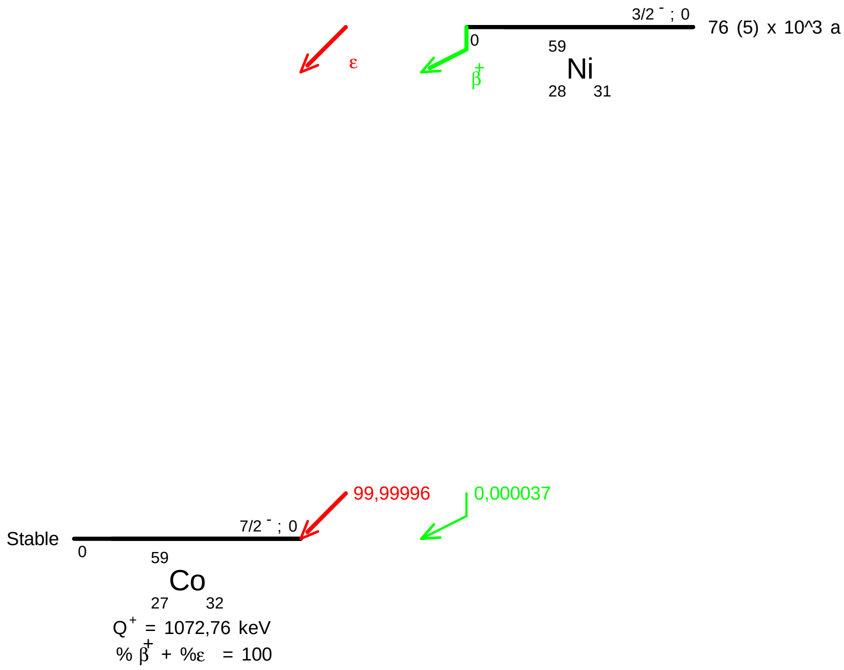

CIEMAT / M. GALAN

$^{64}_{29}$Cu $_{35}$

1 Decay Scheme

Le cuivre 64 se désintègre par émission bêta moins (38%) vers le niveau fondamental de zinc 64 et par capture électronique vers le niveau excité et le fondamental de nickel 64.
Cu-64 disintegrates by beta minus emission to the Zn-64 ground state (38%) and by electron capture to the excited level and the ground state of Ni-64.

2 Nuclear Data

$T_{1/2}(^{64}$Cu$)$	:	12,7003	(20)	h
$Q^-(^{64}$Cu$)$	:	579,4	(7)	keV
$Q^+(^{64}$Cu$)$	:	1675,03	(20)	keV

2.1 β^+ Transitions

	Energy keV	Probability × 100	Nature	lg ft
$\beta^+_{0,0}$	653,1 (2)	17,52 (15)	Allowed	4,97

2.2 Electron Capture Transitions

	Energy keV	Probability × 100	Nature	lg ft	P_K	P_L	P_M
$\epsilon_{0,1}$	329,28 (20)	0,4744 (33)	Allowed	5,51	0,884 (3)	0,099 (2)	0,0162 (5)
$\epsilon_{0,0}$	1675,03 (20)	43,53 (20)	Allowed	4,97	0,888 (3)	0,095 (2)	0,0155 (5)

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2.3 β^- Transitions

	Energy keV	Probability × 100	Nature	lg ft
$\beta^-_{0,0}$	579,4 (7)	38,48 (26)	Allowed	5,29

2.4 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K (10^{-4})	α_L (10^{-4})	α_T (10^{-4})	α_π (10^{-4})
$\gamma_{1,0}$(Ni)	1345,75 (5)	0,4744 (33)	E2	1,112 (2)	0,109 (2)	1,24 (2)	0,394 (6)

3 Atomic Data

3.1 Ni

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

3.1.1 X Radiations

		Energy keV		Relative probability
X_K				
	$K\alpha_2$	7,46093		51,24
	$K\alpha_1$	7,47819		100
	$K\beta_3$	8,2647	}	
	$K\beta_5''$	8,3287	}	13,78
X_L				
	$L\ell$	0,7445		
	$L\alpha$	0,8532 – 0,8539		
	$L\eta$	0,7622		
	$L\beta$	0,86123 – 1,0083		
	$L\gamma$	0,87898 – 0,87898		

3.1.2 Auger Electrons

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

4 Electron Emissions

		Energy keV			Electrons per 100 disint.
e_{AL}	(Ni)	0,6 - 0,9			57,9 (4)
e_{AK}	(Ni)				22,62 (21)
	KLL	6,262 - 6,567		}	
	KLX	7,196 - 7,475		}	
	KXY	8,109 - 8,326		}	
$ec^{\pm}_{1,0}$	(Ni)	323,77	(6)		0,00001875 (37)
$\beta^{+}_{0,0}$	max:	653,1	(2)		17,52 (15)
$\beta^{+}_{0,0}$	avg:	278,21	(9)		
$\beta^{-}_{0,0}$	max:	579,4	(7)		38,48 (26)
$\beta^{-}_{0,0}$	avg:	190,7	(3)		

5 Photon Emissions

5.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(Ni)	0,7445 — 1,0083		0,493 (10)	
XKα_2	(Ni)	7,46093		4,90 (6)	} Kα
XKα_1	(Ni)	7,47819		9,56 (11)	}
XKβ_3	(Ni)	8,2647	}		
XKβ_1	(Ni)		}	1,99 (3)	K$'\beta_1$
XKβ_5''	(Ni)	8,3287	}		

5.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma^{\pm}$	511	35,04 (30)
$\gamma_{1,0}$(Ni)	1345,77 (6)	0,4743 (33)

6 Main Production Modes

{ Cu – 63(n,γ)Cu – 64 σ : 4,50 (2) barns
Possible impurities : Cu – 67

{ Cu – 65(n,2n)Cu – 64
Possible impurities : Ni – 65

{ Zn – 64(n,p)Cu – 64
Possible impurities : Cu – 67, Zn – 63, Ni – 65

{ Zn – 64(d,2p)Cu – 64
Possible impurities : Cu – 67

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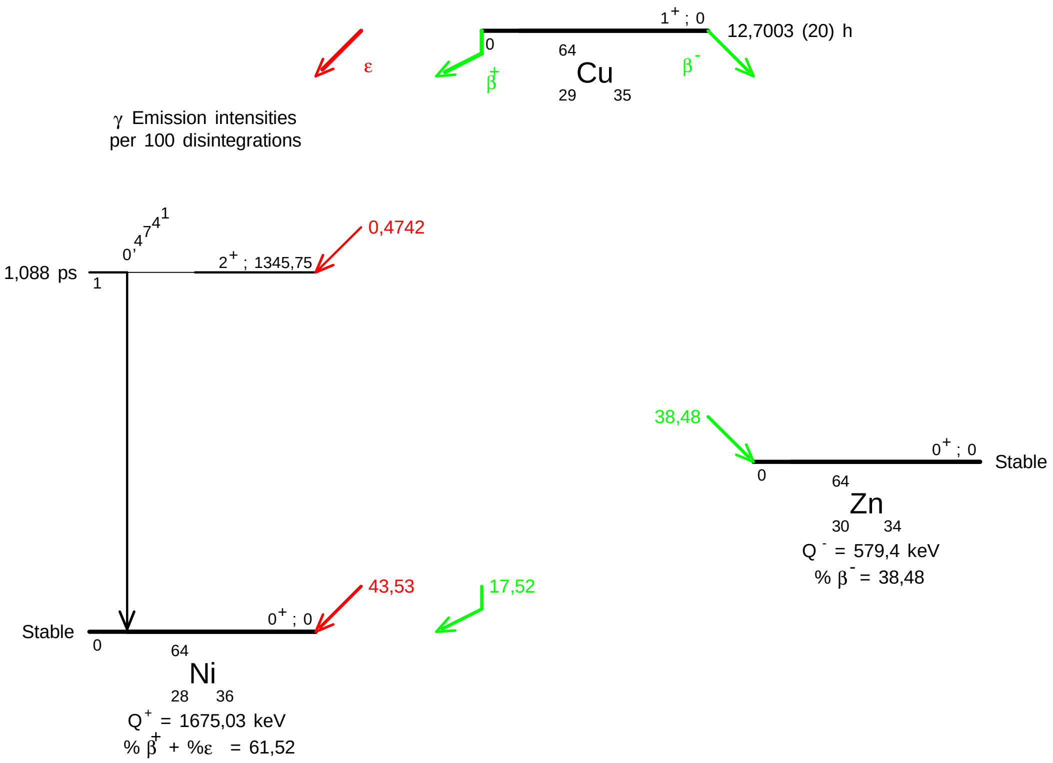

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$^{99}_{43}\mathrm{Tc}_{56}$

1 Decay Scheme

Le technétium 99 se désintègre par émission bêta moins principalement vers le niveau fondamental de Ru-99. Une transition bêta de faible intensité vers le niveau excité de 89,52 keV a été mise en évidence.

Technetium 99 disintegrates by beta minus emission predominately to Ru-99 ground state, and very weakly to an 89,52 keV excited level.

2 Nuclear Data

$T_{1/2}(^{99}\mathrm{Tc})$	:	211,5	(11)	10^3 a
$Q^-(^{99}\mathrm{Tc})$	:	293,8	(14)	keV

2.1 β^- Transitions

	Energy keV	Probability × 100	Nature	lg ft
$\beta^-_{0,1}$	204,3 (14)	0,00145 (30)	Unique 2nd Forbidden	15,8
$\beta^-_{0,0}$	293,8 (14)	99,99855 (30)	2nd Forbidden	12,3

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{1,0}$(Ru)	89,52 (51)	0,00145 (30)	M1+71,0(5)%E2	1,173 (19)	0,265 (5)	0,0497 (9)	1,495 (25)

2.3 Ru

ω_K	:	0,796	(4)
$\bar{\omega}_L$	:	0,0453	(11)
$\bar{\omega}_M$	:	0,0019	
n_{KL}	:	1,000	(4)

2.3.1 X Radiations

		Energy keV		Relative probability
X_K				
	$K\alpha_2$	19,1506		52,7
	$K\alpha_1$	19,2794		100
	$K\beta_3$	21,6349	}	
	$K\beta_1$	21,6565	}	
	$K\beta_5''$	21,832	}	26,9
	$K\beta_2$	22,074	}	
	$K\beta_4$	22,104	}	4,4
X_L				
	$L\ell$	2,2538		
	$L\alpha$	2,5542 – 2,5591		
	$L\eta$	2,3826		
	$L\beta$	2,6831 – 2,9436		
	$L\gamma$	2,8959 – 3,1825		

2.3.2 Auger Electrons

	Energy keV	Relative probability
Auger K		
KLL	15,565 – 16,329	100
KLX	18,267 – 19,277	40,9
KXY	20,947 – 22,113	4,18
Auger L	1,75 – 3,12	

3 Electron Emissions

		Energy keV		Electrons per 100 disint.
e_{AL}	(Ru)	1,75 - 3,12		0,00080 (4)
e_{AK}	(Ru)			0,000139 (27)
	KLL	15,565 - 16,329	}	
	KLX	18,267 - 19,277	}	
	KXY	20,947 - 22,113	}	
$\beta^-_{0,1}$	max:	204,3	(14)	0,00145 (30)
$\beta^-_{0,1}$	avg:			
$\beta^-_{0,0}$	max:	293,8	(14)	99,99855 (30)
$\beta^-_{0,0}$	avg:	94,6	(17)	

4 Photon Emissions

4.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(Ru)	2,2538 — 3,1825		0,000039 (4)	
XKα_2	(Ru)	19,1506		0,000155 (30)	} Kα
XKα_1	(Ru)	19,2794		0,00029 (6)	}
XKβ_3	(Ru)	21,6349	}		
XKβ_1	(Ru)	21,6565	}	0,000079 (15)	K$\beta_1^{'}$
XK$\beta_5^{''}$	(Ru)	21,832	}		
XKβ_2	(Ru)	22,074	}		
XKβ_4	(Ru)	22,104	}	0,0000128 (25)	K$\beta_2^{'}$

4.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{1,0}$(Ru)	89,52 (15)	0,00058 (11)

5 Main Production Modes

Mo − 98(n,γ)Mo − 99 σ : 0,130 (6) barns
Mo − 99(β^-)Tc − 99
$T_{1/2} = 66h$
Fission product.

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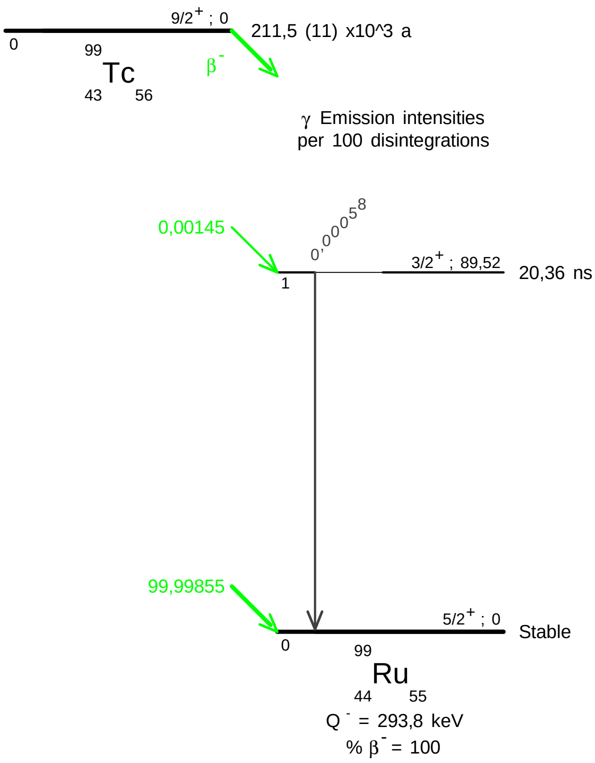

CEA/LNE-LNHB / X. Mougeot, M.-M. Bé, V. Chisté

$^{109}_{46}$ Pd $_{63}$

1 Decay Scheme

Pd-109 decays predominantly by beta- emission to the metastable state of Ag-109 which undergoes 100% IT decay (first excited state; half-life of 39.7(2) s). A full decay scheme has been proposed that encompasses Ag-109m decay to the ground state of Ag-109.
Le palladium 109 se désintègre par émissions bêta moins principalement vers le niveau excité de 39,7 s de période de l'argent 109.

2 Nuclear Data

$T_{1/2}(^{109}Pd)$	:	13,58	(12)	h
$T_{1/2}(^{109}Ag^{m})$	:	39,7	(2)	s
$Q^{-}(^{109}Pd)$	:	1116,1	(20)	keV

2.1 β^- Transitions

	Energy keV	Probability × 100	Nature	lg ft
$\beta^-_{0,23}$	17,6 (20)	0,00018 (3)	(allowed)	6,22
$\beta^-_{0,20}$	204,0 (22)	0,000074 (14)	1st forbidden non-unique	9,87
$\beta^-_{0,19}$	205,1 (20)	0,00166 (17)	allowed	8,53
$\beta^-_{0,16}$	246,6 (20)	0,0194 (9)	allowed	7,72
$\beta^-_{0,15}$	253,3 (20)	0,00167 (10)	1st forbidden non-unique	8,82
$\beta^-_{0,14}$	304,1 (21)	0,000108 (24)	(allowed)	10,3
$\beta^-_{0,11}$	380,8 (20)	0,0334 (15)	allowed	8,096
$\beta^-_{0,10}$	391,8 (20)	0,0204 (9)	(allowed)	8,351
$\beta^-_{0,9}$	409,1 (20)	0,00178 (12)	(allowed)	9,47
$\beta^-_{0,7}$	414,2 (20)	0,00460 (21)	1st forbidden non-unique	9,08
$\beta^-_{0,6}$	418,3 (20)	0,00016 (7)	(allowed)	10,55
$\beta^-_{0,4}$	700,9 (20)	0,0063 (2)	1st forbidden non-unique	9,73
$\beta^-_{0,3}$	804,7 (20)	0,0191 (22)	1st forbidden non-unique	9,46
$\beta^-_{0,1}$	1028,1 (20)	99,891 (3)	allowed	6,134

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{2,1}$(Ag)	44,7 (1)	0,0121 (15)	M1+E2	5,69 (9)	2,69 (5)	0,533 (10)	9,00 (15)
$\gamma_{1,0}$(Ag)	88,03360 (103)	99,951 (4)	E3	11,41 (16)	12,06 (17)	2,47 (4)	26,33 (40)
$\gamma_{4,3}$(Ag)	103,8 (2)	0,00097 (15)	M1+E2	0,329 (6)	0,0411 (7)	0,00783 (13)	0,379 (7)
$\gamma_{14,6}$(Ag)	114,2 (9)	0,000063 (21)	(M1+E2)				
$\gamma_{16,11}$(Ag)	134,2 (2)	0,00132 (12)	M1+E2	0,1658 (25)	0,0212 (4)	0,00404 (6)	0,192 (3)
$\gamma_{16,10}$(Ag)	145,1 (2)	0,00096 (8)	(M1+E2)	0,1326 (20)	0,01670 (25)	0,00318 (5)	0,153 (2)
$\gamma_{7,4}$(Ag)	286,7 (3)	0,000180 (16)	M1+E2	0,0216 (3)	0,00264 (4)	0,000501 (8)	0,0248 (4)
$\gamma_{10,4}$(Ag)	309,1 (3)	0,00416 (23)	(E1)	0,00591 (9)	0,000697 (10)	0,0001317 (19)	0,00677 (10)
$\gamma_{3,0}$(Ag)	311,4 (1)	0,0320 (21)	M1+E2	0,01749 (25)	0,00213 (3)	0,000405 (6)	0,0201 (3)
$\gamma_{4,1}$(Ag)	327,2 (2)	0,000132 (15)	E1	0,00509 (8)	0,000599 (9)	0,0001133 (17)	0,00582 (9)
$\gamma_{7,3}$(Ag)	390,5 (2)	0,00094 (7)	M1+E2	0,00980 (14)	0,001178 (17)	0,000224 (4)	0,01124 (16)
$\gamma_{9,3}$(Ag)	395,6 (3)	0,000068 (13)	(E1)	0,00312 (5)	0,000366 (6)	0,0000692 (10)	0,00357 (5)
$\gamma_{23,6}$(Ag)	400,7 (6)	0,000063 (23)	(M1+E2)				
$\gamma_{10,3}$(Ag)	413,0 (2)	0,0068 (7)	(E1+(M2))	0,00366 (7)	0,000442 (8)	0,0000839 (16)	0,00420 (8)
$\gamma_{4,0}$(Ag)	415,2 (2)	0,0110 (6)	E2	0,00944 (14)	0,001257 (18)	0,000240 (4)	0,01098 (16)
$\gamma_{11,3}$(Ag)	423,9 (2)	0,00093 (7)	E1(+M2)	0,00436 (7)	0,000536 (9)	0,0001020 (16)	0,00502 (8)
$\gamma_{15,4}$(Ag)	447,6 (4)	0,00087 (7)	M1+E2	0,00698 (10)	0,000833 (12)	0,0001580 (23)	0,00800 (12)
$\gamma_{16,4}$(Ag)	454,3 (3)	0,00050 (4)	E1	0,00222 (4)	0,000259 (4)	0,0000490 (7)	0,00253 (4)
$\gamma_{20,4}$(Ag)	496,9 (10)	0,000073 (14)	M1+E2	0,00541 (8)	0,000644 (10)	0,0001222 (18)	0,0062 (1)
$\gamma_{14,3}$(Ag)	500,6 (6)	0,000045 (11)	(E1)	0,001756 (25)	0,000205 (3)	0,0000387 (6)	0,00201 (3)
$\gamma_{15,3}$(Ag)	551,4 (3)	0,00065 (7)	M1+E2	0,00420 (6)	0,000500 (7)	0,0000948 (14)	0,00482 (7)
$\gamma_{16,3}$(Ag)	558,1 (2)	0,00250 (17)	E1(+M2)	0,00207 (4)	0,000249 (4)	0,0000473 (8)	0,00238 (4)
$\gamma_{6,2}$(Ag)	565,1 (5)	0,000108 (14)	(E2)	0,00386 (6)	0,000489 (7)	0,0000931 (14)	0,00446 (7)
$\gamma_{11,2}$(Ag)	602,6 (2)	0,0086 (6)	E2	0,00324 (5)	0,000407 (6)	0,0000774 (11)	0,00374 (6)
$\gamma_{6,1}$(Ag)	609,8 (4)	0,00018 (6)	(M1+E2)				
$\gamma_{10,1}$(Ag)	636,3 (1)	0,0101 (6)	(E2)	0,00281 (4)	0,000350 (5)	0,0000665 (10)	0,00323 (5)
$\gamma_{11,1}$(Ag)	647,3 (1)	0,0252 (14)	M1+E2				
$\gamma_{7,0}$(Ag)	701,9 (2)	0,00348 (20)	M1+E2	0,00239 (4)	0,000280 (4)	0,0000531 (8)	0,00273 (4)
$\gamma_{9,0}$(Ag)	707,0 (2)	0,00171 (12)	(E1)	0,000807 (12)	0,0000933 (13)	0,00001762 (25)	0,000921 (13)
$\gamma_{10,0}$(Ag)	724,4 (1)	0,00025 (3)	(E1)	0,000766 (11)	0,0000885 (13)	0,00001672 (24)	0,000874 (13)
$\gamma_{16,2}$(Ag)	736,7 (2)	0,00181 (13)	E2	0,00193 (3)	0,000236 (4)	0,0000448 (7)	0,00221 (4)
$\gamma_{19,2}$(Ag)	778,3 (5)	0,00148 (17)	M1+E2				
$\gamma_{16,1}$(Ag)	781,4 (1)	0,0123 (9)	M1+E2				
$\gamma_{23,3}$(Ag)	787,1 (3)	0,0000216 (18)	(E1)	0,000644 (9)	0,0000743 (11)	0,00001403 (20)	0,000735 (11)
$\gamma_{19,1}$(Ag)	823,0 (4)	0,000181 (18)	M1+E2				
$\gamma_{15,0}$(Ag)	862,8 (2)	0,000148 (20)	E2	0,001313 (19)	0,0001583 (23)	0,0000300 (5)	0,00151 (2)
$\gamma_{16,0}$(Ag)	869,5 (1)	0,000053 (16)	M2(+E3)	0,00372 (6)	0,000453 (7)	0,0000862 (13)	0,00427 (6)
$\gamma_{23,2}$(Ag)	965,8 (3)	0,000068 (11)					
$\gamma_{23,1}$(Ag)	1010,5 (2)	0,000030 (6)					

3 Atomic Data

3.1 Ag

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

3.1.1 X Radiations

		Energy keV		Relative probability
X_K				
	$K\alpha_2$	21,9906		53
	$K\alpha_1$	22,16317		100
	$K\beta_3$	24,9118	}	
	$K\beta_1$	24,9427	}	
	$K\beta_5''$	25,146	}	27,7
	$K\beta_2$	25,4567	}	
	$K\beta_4$	25,512	}	4,8
X_L				
	$L\ell$	2,634		
	$L\alpha$	2,978 – 2,984		
	$L\eta$	2,806		
	$L\beta$	3,151 – 3,348		
	$L\gamma$	3,52 – 3,75		

3.1.2 Auger Electrons

	Energy keV	Relative probability
Auger K		
KLL	17,79 – 18,69	100
KLX	20,945 – 22,160	42,5
KXY	24,079 – 25,507	4,52
Auger L	1,9 – 3,8	1656

4 Electron Emissions

		Energy keV		Electrons per 100 disint.
e_{AL}	(Ag)	1,9 - 3,8		79,5 (5)
e_{AK}	(Ag)			7,06 (23)
	KLL	17,79 - 18,69	}	
	KLX	20,945 - 22,160	}	
	KXY	24,079 - 25,507	}	
$ec_{1,0\ T}$	(Ag)	62,52 - 88,03		96,29 (6)
$ec_{1,0\ K}$	(Ag)	62,520 (1)		41,7 (4)
$ec_{1,0\ L}$	(Ag)	84,2278 - 84,6825		44,1 (4)
$\beta^-_{0,23}$	max:	17,6 (20)		0,00018 (3)
$\beta^-_{0,23}$	avg:	4,5 (5)		
$\beta^-_{0,20}$	max:	204,0 (22)		0,000074 (14)
$\beta^-_{0,20}$	avg:	56,3 (7)		
$\beta^-_{0,19}$	max:	205,1 (20)		0,00166 (17)
$\beta^-_{0,19}$	avg:	56,7 (6)		
$\beta^-_{0,16}$	max:	246,6 (20)		0,0194 (9)
$\beta^-_{0,16}$	avg:	69,4 (6)		
$\beta^-_{0,15}$	max:	253,3 (20)		0,00167 (10)
$\beta^-_{0,15}$	avg:	71,5 (6)		
$\beta^-_{0,14}$	max:	304,1 (21)		0,000108 (24)
$\beta^-_{0,14}$	avg:	87,7 (7)		
$\beta^-_{0,11}$	max:	380,8 (20)		0,0334 (15)
$\beta^-_{0,11}$	avg:	113,1 (7)		
$\beta^-_{0,10}$	max:	391,8 (20)		0,0204 (9)
$\beta^-_{0,10}$	avg:	116,8 (7)		
$\beta^-_{0,9}$	max:	409,1 (20)		0,00178 (12)
$\beta^-_{0,9}$	avg:	122,8 (7)		
$\beta^-_{0,7}$	max:	414,2 (20)		0,00460 (21)
$\beta^-_{0,7}$	avg:	124,5 (7)		
$\beta^-_{0,6}$	max:	418,3 (20)		0,00016 (7)
$\beta^-_{0,6}$	avg:	125,9 (7)		
$\beta^-_{0,4}$	max:	700,9 (20)		0,0063 (2)
$\beta^-_{0,4}$	avg:	229,7 (8)		
$\beta^-_{0,3}$	max:	804,7 (20)		0,0191 (22)
$\beta^-_{0,3}$	avg:	270,3 (8)		
$\beta^-_{0,1}$	max:	1028,1 (20)		99,891 (3)
$\beta^-_{0,1}$	avg:	361,0 (8)		

5 Photon Emissions

5.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(Ag)	2,634 — 3,75		4,92 (13)	
XKα_2	(Ag)	21,9906		9,92 (23)	} Kα
XKα_1	(Ag)	22,16317		18,7 (5)	}
XKβ_3	(Ag)	24,9118	}		
XKβ_1	(Ag)	24,9427	}	5,18 (13)	K$'\beta_1$
XKβ_5''	(Ag)	25,146	}		
XKβ_2	(Ag)	25,4567	}		
XKβ_4	(Ag)	25,512	}	0,90 (4)	K$'\beta_2$

5.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{2,1}$(Ag)	44,7 (1)	0,00121 (15)
$\gamma_{1,0}$(Ag)	88,03360 (103)	3,66 (6)
$\gamma_{4,3}$(Ag)	103,8 (2)	0,00070 (11)
$\gamma_{14,6}$(Ag)	114,2 (9)	0,000063 (21)
$\gamma_{16,11}$(Ag)	134,2 (2)	0,00111 (10)
$\gamma_{16,10}$(Ag)	145,1 (2)	0,00083 (7)
$\gamma_{7,4}$(Ag)	286,7 (3)	0,000176 (16)
$\gamma_{10,4}$(Ag)	309,1 (3)	0,00413 (23)
$\gamma_{3,0}$(Ag)	311,4 (1)	0,0314 (21)
$\gamma_{4,1}$(Ag)	327,2 (2)	0,000131 (15)
$\gamma_{7,3}$(Ag)	390,5 (2)	0,00093 (7)
$\gamma_{9,3}$(Ag)	395,6 (3)	0,000068 (13)
$\gamma_{23,6}$(Ag)	400,7 (6)	0,000063 (23)
$\gamma_{10,3}$(Ag)	413,0 (2)	0,0068 (7)
$\gamma_{4,0}$(Ag)	415,2 (2)	0,0109 (6)
$\gamma_{11,3}$(Ag)	423,9 (2)	0,00093 (7)
$\gamma_{15,4}$(Ag)	447,6 (4)	0,00086 (7)
$\gamma_{16,4}$(Ag)	454,3 (3)	0,00050 (4)
$\gamma_{20,4}$(Ag)	496,9 (10)	0,000073 (14)
$\gamma_{14,3}$(Ag)	500,6 (6)	0,000045 (11)
$\gamma_{15,3}$(Ag)	551,4 (3)	0,00065 (7)
$\gamma_{16,3}$(Ag)	558,1 (2)	0,00249 (17)
$\gamma_{6,2}$(Ag)	565,1 (5)	0,000108 (14)
$\gamma_{11,2}$(Ag)	602,6 (2)	0,0086 (6)
$\gamma_{6,1}$(Ag)	609,8 (4)	0,00018 (6)
$\gamma_{10,1}$(Ag)	636,3 (1)	0,0101 (6)

	Energy keV	Photons per 100 disint.
$\gamma_{11,1}$(Ag)	647,3 (1)	0,0252 (14)
$\gamma_{7,0}$(Ag)	701,9 (2)	0,00347 (20)
$\gamma_{9,0}$(Ag)	707,0 (2)	0,00171 (12)
$\gamma_{10,0}$(Ag)	724,4 (1)	0,00025 (3)
$\gamma_{16,2}$(Ag)	736,7 (2)	0,00181 (13)
$\gamma_{19,2}$(Ag)	778,3 (5)	0,00148 (17)
$\gamma_{16,1}$(Ag)	781,4 (1)	0,0123 (9)
$\gamma_{23,3}$(Ag)	787,1 (3)	0,0000216 (18)
$\gamma_{19,1}$(Ag)	823,0 (4)	0,000181 (18)
$\gamma_{15,0}$(Ag)	862,8 (2)	0,000148 (20)
$\gamma_{16,0}$(Ag)	869,5 (1)	0,000053 (16)
$\gamma_{23,2}$(Ag)	965,8 (3)	0,000068 (11)
$\gamma_{23,1}$(Ag)	1010,5 (2)	0,000030 (6)

6 Main Production Modes

Pd – 108(n,γ)Pd – 109

Pd – 108(d,p)Pd – 109

Pd – 110(n,2n)Pd – 109

U – 238(n,f)Pd – 109

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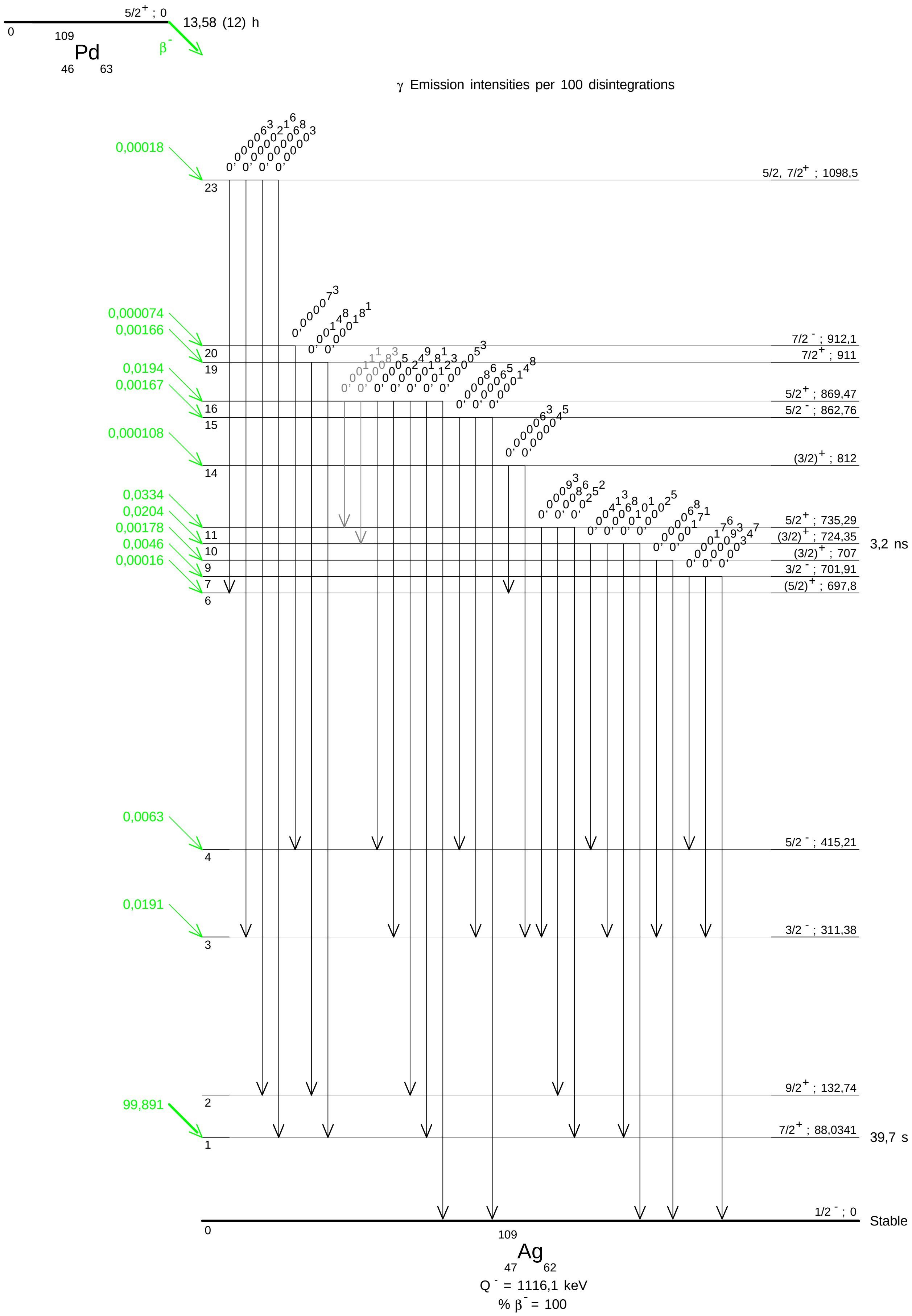
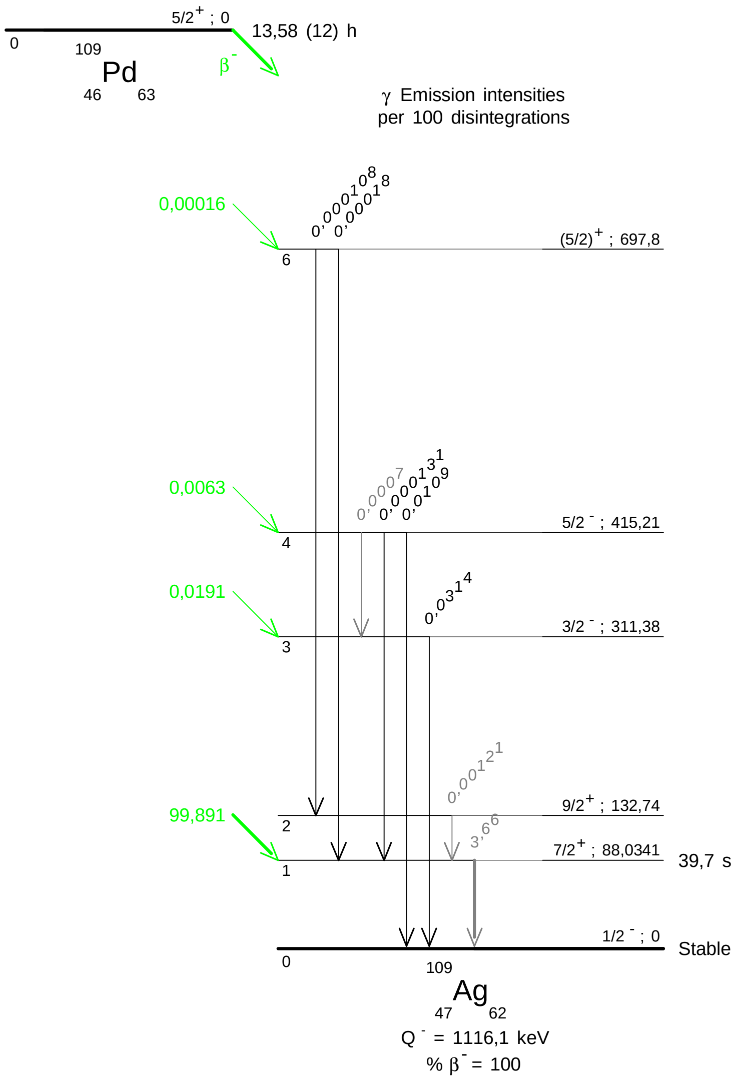

5/2+ ; 0
13,58 (12) h
109 Pd 46 63
β-
γ Emission intensities per 100 disintegrations
0,00018
0,000074
0,00166
0,0194
0,00167
0,000108
0,0334
0,0204
0,00178
0,0046
0,00016
0,0063
0,0191
99,891
5/2, 7/2+ ; 1098,5
7/2 - ; 912,1
7/2+ ; 911
5/2+ ; 869,47
5/2 - ; 862,76
(3/2)+ ; 812
5/2+ ; 735,29
(3/2)+ ; 724,35
(3/2)+ ; 707
3/2 - ; 701,91
(5/2)+ ; 697,8
3,2 ns
5/2 - ; 415,21
3/2 - ; 311,38
9/2+ ; 132,74
7/2+ ; 88,0341
39,7 s
1/2 - ; 0
Stable
109 Ag 47 62
Q - = 1116,1 keV
% β- = 100


5/2+ ; 0
0
109 Pd 46 63
β-
13,58 (12) h
γ Emission intensities
per 100 disintegrations
0,00016
0,0063
0,0191
99,891
6
4
3
2
1
0
(5/2)+ ; 697,8
5/2 - ; 415,21
3/2 - ; 311,38
9/2+ ; 132,74
7/2+ ; 88,0341
39,7 s
1/2 - ; 0
Stable
109 Ag 47 62
Q - = 1116,1 keV
% β- = 100

$^{125}_{53}\mathrm{I}_{72}$

1 Decay Scheme

I-125 disintegrates by 100% electron capture via the excited level of 35,5 keV of Te-125 into the ground state of Te-125. A direct transition to the ground state of Te-125 has not been observed.
L'iode 125 se désintègre à 100% par capture électronique vers le niveau fondamental de tellure 125 via le niveau excité de 35,5 keV.
Aucune transition directe vers le fondamental n'a été observée.

2 Nuclear Data

$T_{1/2}(^{125}\mathrm{I})$: 59,388 (28) d
$Q^{+}(^{125}\mathrm{I})$: 185,77 (6) keV

2.1 Electron Capture Transitions

	Energy keV	Probability × 100	Nature	lg ft	P_K	P_L	P_M
$\epsilon_{0,1}$	150,28 (6)	100	Allowed	5,4	0,8011 (17)	0,1561 (13)	0,0349 (7)

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{1,0}$(Te)	35,4922 (5)	100	M1 + 0,72 % E2	11,70 (17)	1,91 (8)	0,386 (16)	14,08 (22)

3 Atomic Data

3.1 Te

ω_K	:	0,875	(4)
$\bar{\omega}_L$	:	0,086	(4)
$\bar{\omega}_M$	:	0,00298	(20)
n_{KL}	:	0,917	(4)
$\bar{n}_{LM}$	:	1,643	(50)

3.1.1 X Radiations

		Energy keV		Relative probability
X_K				
	Kα_2	27,202		53,7
	Kα_1	27,4726		100
	Kβ_3	30,9446	}	
	Kβ_1	30,996	}	
	Kβ_5''	31,236	}	28,62
	Kβ_2	31,7008	}	
	Kβ_4	31,774	}	6,21
	KO$_{2,3}$	31,812	}	
X_L				
	Lℓ	3,3348		
	Lα	3,7595 – 3,7697		
	Lη	3,6052		
	Lβ	4,0299 – 4,3661		
	Lγ	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 – 4,8	

4 Electron Emissions

		Energy keV	Electrons per 100 disint.
e_{AL}	(Te)	2,3 - 4,8	158,2 (8)
e_{AK}	(Te)		19,7 (7)
	KLL	21,804 - 22,989 }	
	KLX	25,814 - 27,470 }	
	KXY	29,80 - 31,81 }	
$ec_{1,0\ K}$	(Te)	3,6784 (5)	77,6 (13)
$ec_{1,0\ L}$	(Te)	30,5530 - 31,1508	12,7 (5)
$ec_{1,0\ M}$	(Te)	34,4860 - 34,9201	2,56 (11)
$ec_{1,0\ N}$	(Te)	35,3239 - 35,4524	0,497 (20)

5 Photon Emissions

5.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(Te)	3,3348 — 4,8228		14,70 (28)	
$XK\alpha_2$	(Te)	27,202		39,3 (5)	} $K\alpha$
$XK\alpha_1$	(Te)	27,4726		73,2 (8)	}
$XK\beta_3$	(Te)	30,9446	}		
$XK\beta_1$	(Te)	30,996	}	20,9 (3)	$K'\beta_1$
$XK\beta_5''$	(Te)	31,236	}		
$XK\beta_2$	(Te)	31,7008	}		
$XK\beta_4$	(Te)	31,774	}	4,54 (13)	$K'\beta_2$
$XKO_{2,3}$	(Te)	31,812	}		

5.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{1,0}$(Te)	35,4922 (5)	6,63 (6)

6 Main Production Modes

Xe – 124(n,γ)Xe – 125 σ : 165 barns

{ Xe – 125(E.C.)I – 125
Possible impurities : T1/2 = 16,9h

{ Te – 125(d,2n)I – 125
Possible impurities : I – 126

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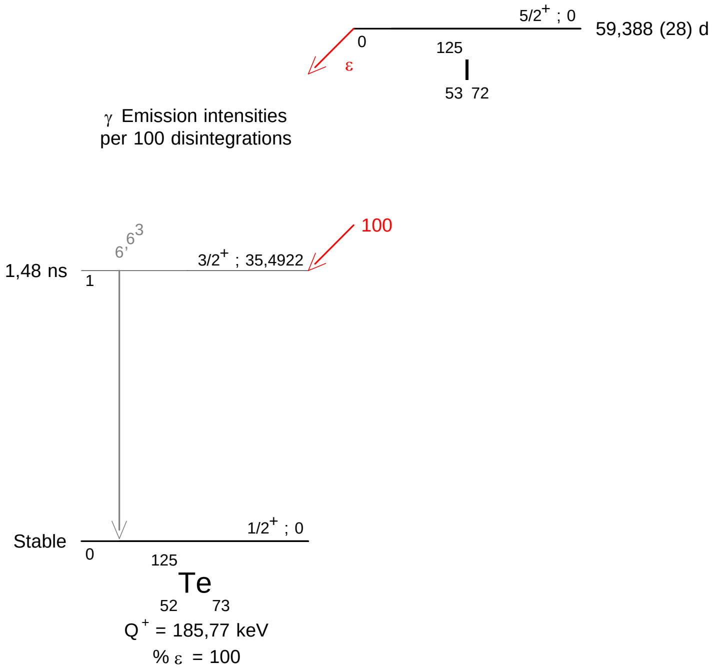
5/2+ ; 0
59,388 (28) d
0
ε
125
53 72
γ Emission intensities
per 100 disintegrations
100
6,63
3/2+ ; 35,4922
1,48 ns
1
Stable
1/2+ ; 0
0
125
Te
52 73
Q+ = 185,77 keV
% ε = 100

$^{132}_{52}$Te $_{80}$

1 Decay Scheme

Te-132 decays solely by one single beta- emission to the 277.86-keV nuclear level of I-132 which undergoes immediate decay to the ground state by means of a cascade of four gamma transitions.
Le tellure 132 se désintègre par une transition bêta moins vers le niveau excité de 277 keV de l'iode 132. Le niveau fondamental de l'iode 132 est atteint par des transitions gamma en cascade.

2 Nuclear Data

$T_{1/2}$(^{132}Te)	:	3,230	(13)	d
$T_{1/2}$(^{132}I)	:	2,295	(13)	h
Q^-(^{132}Te)	:	518	(4)	keV

2.1 β^- Transitions

	Energy keV	Probability × 100	Nature	lg ft
$\beta^-_{0,5}$	240 (4)	100	allowed	4,85

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{2,0}$(I)	49,72 (1)	100	M1	4,83 (7)	0,638 (9)	0,1286 (18)	5,62 (8)
$\gamma_{4,2}$(I)	111,81 (8)	3,2 (3)	M1 + 25 % E2	0,562 (17)	0,115 (9)	0,0238 (18)	0,71 (3)
$\gamma_{5,4}$(I)	116,34 (13)	3,15 (12)	M1 + 22 % E2	0,489 (13)	0,093 (6)	0,0193 (13)	0,606 (20)
$\gamma_{5,2}$(I)	228,327 (3)	96,8 (2)	E2	0,0802 (12)	0,01507 (21)	0,00311 (5)	0,0990 (14)

3 Atomic Data

3.1 I

ω_K	:	0,882	(4)
$\bar{\omega}_L$	:	0,092	(4)
n_{KL}	:	0,909	(4)

3.1.1 X Radiations

		Energy keV		Relative probability
X_K				
	$K\alpha_2$	28,3175		53,9
	$K\alpha_1$	28,6123		100
	$K\beta_3$	32,2397	}	
	$K\beta_1$	32,2951	}	
	$K\beta_5''$	32,544	}	28,8
	$K\beta_2$	33,042	}	
	$K\beta_4$	33,12	}	6,52
	$KO_{2,3}$	33,166	}	
X_L				
	$L\ell$	3,485		
	$L\alpha$	3,926 – 3,938		
	$L\eta$	3,78		
	$L\beta$	4,221 – 4,508		
	$L\gamma$	4,802 – 5,065		

3.1.2 Auger Electrons

	Energy keV	Relative probability
Auger K		
KLL	22,659 – 23,909	100
KLX	26,853 – 28,609	45,9
KXY	31,02 – 33,16	5,27
Auger L	2,37 – 3,88	1219

4 Electron Emissions

		Energy keV	Electrons per 100 disint.
e_{AL}	(I)	2,37 - 3,88	78,0 (13)
e_{AK}	(I)		9,7 (3)
	KLL	22,659 - 23,909	}
	KLX	26,853 - 28,609	}
	KXY	31,02 - 33,16	}
$ec_{2,0}$ K	(I)	16,55 (1)	72,9 (18)
$ec_{2,0}$ L	(I)	44,53 - 45,16	9,63 (23)
$ec_{2,0}$ M	(I)	48,65 - 49,10	1,94 (5)
$ec_{2,0}$ N	(I)	49,53 - 49,67	0,393 (10)
$ec_{4,2}$ K	(I)	78,64 (8)	1,04 (11)
$ec_{5,4}$ K	(I)	83,17 (13)	0,96 (4)
$ec_{4,2}$ L	(I)	106,62 - 107,25	0,21 (3)
$ec_{5,4}$ L	(I)	111,15 - 111,78	0,183 (13)
$ec_{5,2}$ K	(I)	195,158 (3)	7,07 (11)
$ec_{5,2}$ L	(I)	223,139 - 223,770	1,328 (19)
$ec_{5,2}$ M	(I)	227,255 - 227,708	0,274 (4)
$ec_{5,2}$ N	(I)	228,141 - 228,277	0,0539 (8)
$\beta^-_{0,5}$	max:	240 (4)	100
$\beta^-_{0,5}$	avg:	67,0 (13)	

5 Photon Emissions

5.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(I)	3,485 — 5,065		7,9 (4)	
XKα_2	(I)	28,3175		20,6 (5)	} Kα
XKα_1	(I)	28,6123		38,2 (9)	}
XKβ_3	(I)	32,2397	}		
XKβ_1	(I)	32,2951	}	11,0 (3)	K$'\beta_1$
XKβ_5''	(I)	32,544	}		

		Energy keV		Photons per 100 disint.	
XKβ_2	(I)	33,042	}		
XKβ_4	(I)	33,12	}	2,49 (9)	K$'\beta_2$
XKO$_{2,3}$	(I)	33,166	}		

5.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{2,0}$(I)	49,72 (1)	15,1 (3)
$\gamma_{4,2}$(I)	111,81 (8)	1,85 (18)
$\gamma_{5,4}$(I)	116,34 (13)	1,97 (7)
$\gamma_{5,2}$(I)	228,327 (3)	88,12 (13)

6 Main Production Modes

U – 238(n,f)
Cf – 252(sf)

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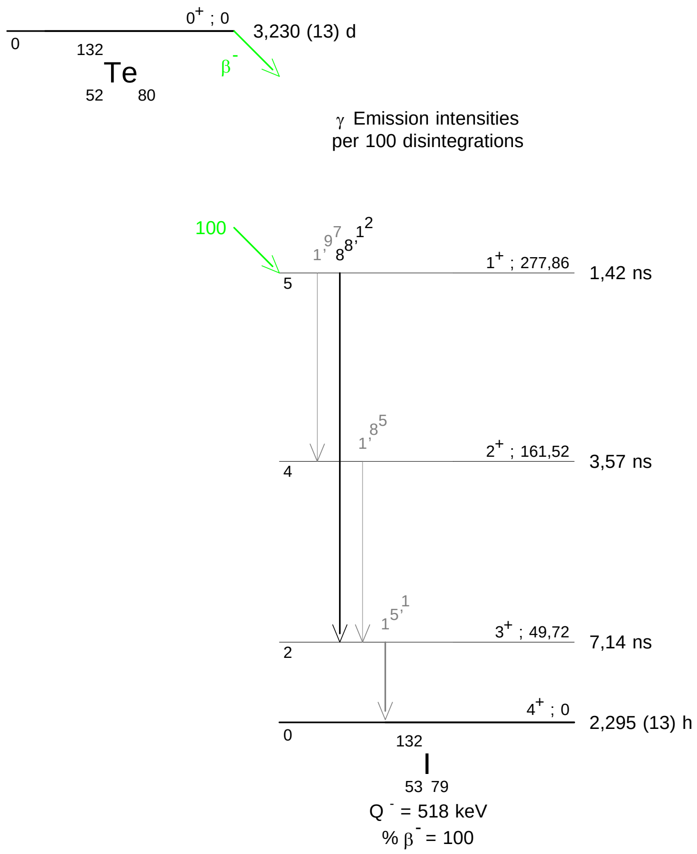
0+ ; 0
3,230 (13) d
0
132
Te
52
80
β-
γ Emission intensities
per 100 disintegrations
100
1+ ; 277,86
1,42 ns
5
2+ ; 161,52
3,57 ns
4
3+ ; 49,72
7,14 ns
2
4+ ; 0
2,295 (13) h
0
132
I
53 79
Q - = 518 keV
% β- = 100

$^{182}_{73}$Ta $_{109}$

1 Decay Scheme

Ta-182 disintegrates by beta minus emissions to excited levels of W-182.
Le tantale 182 se désintègre par émission beta moins vers les niveaux excités du tungstène 182.

2 Nuclear Data

$T_{1/2}$(^{182}Ta) : 114,61 (13) d
Q^-(^{182}Ta) : 1814,3 (17) keV

2.1 β^- Transitions

	Energy keV	Probability × 100	Nature	lg ft
$\beta^-_{0,13}$	261,1 (17)	29,0 (7)	Allowed	7,5
$\beta^-_{0,12}$	304,0 (17)	0,1414 (39)	1st Forbidden	10
$\beta^-_{0,11}$	326,8 (17)	1,5 (7)	Allowed	9,1
$\beta^-_{0,10}$	371,5 (17)	0,563 (10)	1st Forbidden	9,7
$\beta^-_{0,9}$	440,5 (17)	19,9 (7)	Allowed	8,4
$\beta^-_{0,8}$	483,2 (17)	2,39 (15)	1st Forbidden	9,5
$\beta^-_{0,7}$	525,2 (17)	45,1 (23)	Allowed	8,3
$\beta^-_{0,6}$	556,9 (17)	0,22 (21)	1st Forbidden	10,7
$\beta^-_{0,5}$	592,9 (17)	1,6 (22)	1st Forbidden	9,9
$\beta^-_{0,2}$	1484,9 (17)	$\sim$ 0	1st Forbidden	13
$\beta^-_{0,1}$	1714,2 (17)	$\sim$ 0	1st Forbidden	12,2

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{7,6}$(W)	31,7377 (15)	2,20 (16)	E1		1,259 (18)	0,293 (4)	1,628 (23)
$\gamma_{9,8}$(W)	42,7148 (14)	0,463 (12)	E1		0,557 (8)	0,1286 (18)	0,72 (1)
$\gamma_{13,11}$(W)	65,72215 (15)	11,6 (7)	M1+0,88%E2		2,25 (15)	0,52 (4)	2,92 (20)
$\gamma_{7,5}$(W)	67,74970 (10)	53,2 (22)	E1+0,03%M2		0,173 (21)	0,040 (6)	0,22 (3)
$\gamma_{9,7}$(W)	84,68024 (26)	22,7 (6)	M1+8,7%E2	5,88 (9)	1,36 (4)	0,321 (8)	7,66 (11)
$\gamma_{1,0}$(W)	100,10595 (7)	69,5 (12)	E2	0,878 (13)	2,28 (4)	0,576 (8)	3,89 (6)
$\gamma_{13,10}$(W)	110,388 (9)	0,1384 (43)	[E1]	0,238 (4)	0,0408 (6)	0,00931 (13)	0,290 (4)
$\gamma_{11,9}$(W)	113,67170 (22)	7,83 (13)	M1+10,3%E2	2,50 (5)	0,529 (16)	0,124 (4)	3,19 (5)
$\gamma_{9,6}$(W)	116,4179 (6)	0,557 (7)	E1	0,207 (3)	0,0353 (5)	0,00805 (12)	0,253 (4)
$\gamma_{6,4}$(W)	121,50 (14)	0,0060 (21)	[E2]	0,596 (9)	0,936 (15)	0,236 (4)	1,83 (3)
$\gamma_{9,5}$(W)	152,42991 (26)	7,89 (15)	E1	0,1038 (15)	0,01703 (24)	0,00387 (6)	0,1258 (18)
$\gamma_{11,8}$(W)	156,3864 (3)	2,976 (30)	E1	0,0972 (14)	0,01590 (23)	0,00362 (5)	0,1177 (17)
$\gamma_{13,9}$(W)	179,39381 (25)	5,05 (22)	M1+59,4%E2	0,44 (8)	0,148 (7)	0,0358 (21)	0,63 (7)
$\gamma_{11,7}$(W)	198,35187 (29)	1,925 (21)	E2	0,1725 (25)	0,1097 (16)	0,0273 (4)	0,317 (5)
$\gamma_{13,8}$(W)	222,1085 (3)	7,91 (8)	E1	0,0399 (6)	0,00630 (9)	0,001429 (20)	0,0480 (7)
$\gamma_{2,1}$(W)	229,3207 (6)	4,347 (45)	E2	0,1167 (17)	0,0605 (9)	0,01497 (21)	0,196 (3)
$\gamma_{13,7}$(W)	264,0740 (3)	4,054 (41)	E2	0,0799 (12)	0,0347 (5)	0,00852 (12)	0,1254 (18)
$\gamma_{3,2}$(W)	351,02 (6)	0,01219 (39)	E2	0,0380 (6)	0,01210 (17)	0,00293 (5)	0,0538 (8)
$\gamma_{12,3}$(W)	829,80 (9)	0,0142 (25)	[E2]	0,00536 (8)	0,000962 (14)	0,000222 (4)	0,00661 (10)
$\gamma_{5,2}$(W)	891,9733 (12)	0,0573 (25)	E2	0,00464 (7)	0,000810 (12)	0,000187 (3)	0,00569 (8)
$\gamma_{6,2}$(W)	927,9853 (13)	0,617 (7)	E2	0,00429 (6)	0,000738 (11)	0,0001698 (24)	0,00524 (8)
$\gamma_{7,2}$(W)	959,7230 (12)	0,352 (5)	M2+96,8%E3	0,00901 (15)	0,00196 (3)	0,000463 (7)	0,01157 (19)
$\gamma_{8,2}$(W)	1001,6885 (12)	2,08 (5)	M1+98,8%E2	0,00374 (6)	0,000627 (10)	0,0001438 (23)	0,00455 (8)
$\gamma_{4,1}$(W)	1035,80 (14)	0,0060 (21)	E2	0,00346 (5)	0,000575 (8)	0,0001317 (19)	0,00420 (6)
$\gamma_{9,2}$(W)	1044,4033 (12)	0,2394 (42)	E1+18,7%M2	0,00444 (12)	0,000703 (20)	0,000160 (5)	0,00535 (15)
$\gamma_{10,2}$(W)	1113,409 (9)	0,444 (8)	M1+96,1%E2	0,00311 (8)	0,000504 (12)	0,000115 (3)	0,00376 (10)
$\gamma_{5,1}$(W)	1121,290 (3)	35,30 (33)	M1+99,9%E2	0,00297 (5)	0,000483 (7)	0,0001104 (16)	0,00360 (5)
$\gamma_{4,0}$(W)	1135,91 (14)		E0				
$\gamma_{6,1}$(W)	1157,3061 (11)	0,84 (13)	M1+62,8%E2	0,0039 (11)	0,00060 (15)	0,00014 (4)	0,0046 (13)
$\gamma_{11,2}$(W)	1158,0750 (12)	0,296 (18)	E1	0,001159 (17)	0,0001632 (23)	0,0000366 (6)	0,001377 (20)
$\gamma_{12,2}$(W)	1180,82 (7)	0,0872 (29)	E2+88,7%M1	0,0030 (4)	0,00047 (5)	0,000108 (11)	0,0036 (4)
$\gamma_{7,1}$(W)	1189,040 (3)	16,66 (16)	60%E1+13%M2+27%E3	0,003732 (33)	0,000638 (6)	0,0001468 (14)	0,004567 (41)
$\gamma_{5,0}$(W)	1221,395 (3)	27,35 (27)	E2	0,00252 (4)	0,000402 (6)	0,0000915 (13)	0,00305 (5)
$\gamma_{13,2}$(W)	1223,7972 (12)	0,205 (21)	E1+12,6%M2	0,0024 (5)	0,00037 (8)	0,000083 (17)	0,0029 (6)
$\gamma_{8,1}$(W)	1231,004 (3)	11,66 (11)	M1+99,9%E2	0,00249 (4)	0,000395 (6)	0,0000901 (13)	0,00301 (5)
$\gamma_{6,0}$(W)	1257,407 (3)	1,515 (15)	E2	0,00239 (4)	0,000378 (6)	0,0000860 (12)	0,00289 (4)
$\gamma_{9,1}$(W)	1273,719 (3)	0,660 (7)	81%E1+11%M2+7%E3	0,002278 (21)	0,0003583 (31)	0,0000816 (8)	0,002781 (25)
$\gamma_{7,0}$(W)	1289,145 (3)	1,391 (17)	M2	0,01019 (15)	0,001630 (23)	0,000372 (6)	0,01231 (18)
$\gamma_{10,1}$(W)	1342,72 (5)	0,2569 (29)	E2+1,2%M3	0,0023 (5)	0,00036 (9)	0,000082 (21)	0,0028 (6)
$\gamma_{9,0}$(W)	1373,824 (3)	0,2237 (32)	E3	0,00400 (6)	0,000728 (11)	0,0001685 (24)	0,00496 (7)
$\gamma_{11,1}$(W)	1387,390 (3)	0,0729 (11)	M2+87,1%E3	0,00450 (15)	0,000791 (22)	0,000183 (5)	0,00554 (18)
$\gamma_{12,1}$(W)	1410,14 (7)	0,0400 (8)	E2	0,00193 (3)	0,000298 (5)	0,0000676 (10)	0,00235 (4)
$\gamma_{13,1}$(W)	1453,118 (1)	0,037 (7)	M2+81,5%E3	0,0043 (3)	0,00074 (5)	0,000169 (10)	0,0053 (4)

3 Atomic Data

3.1 W

ω_K	:	0,954	(4)
$\bar{\omega}_L$	:	0,283	(11)
n_{KL}	:	0,825	(4)

3.1.1 X Radiations

		Energy keV		Relative probability
X_K				
	$K\alpha_2$	57,9823		57,57
	$K\alpha_1$	59,3189		100
	$K\beta_3$	66,952	}	
	$K\beta_1$	67,2451	}	
	$K\beta_5''$	67,664	}	33,15
	$K\beta_2$	69,033	}	
	$K\beta_4$	69,295	}	9,08
	$KO_{2,3}$	69,484	}	
X_L				
	$L\ell$	7,3881		
	$L\alpha$	8,3352 – 8,3976		
	$L\eta$	8,725		
	$L\beta$	9,526 – 9,9485		
	$L\gamma$	10,9501 – 11,6761		

3.1.2 Auger Electrons

	Energy keV	Relative probability
Auger K		
KLL	45,109 – 48,882	100
KLX	54,514 – 59,312	53,7
KXY	63,89 – 69,51	7,18
Auger L	4,5 – 12,1	

4 Electron Emissions

		Energy keV			Electrons per 100 disint.
e_{AL}	(W)	4,5	-	12,1	59,5 (7)
e_{AK}	(W)				1,68 (15)
	KLL	45,109	-	48,882	}
	KLX	54,514	-	59,312	}
	KXY	63,89	-	69,51	}
$ec_{9,7\ K}$	(W)	15,1553		(14)	15,41 (42)
$ec_{7,6\ L}$	(W)	19,6379	-	21,5309	1,06 (8)
$ec_{7,6\ M}$	(W)	28,9181	-	29,9285	0,246 (18)
$ec_{1,0\ K}$	(W)	30,58098		(7)	12,49 (23)
$ec_{9,8\ L}$	(W)	30,615	-	32,508	0,1498 (45)
$ec_{11,9\ K}$	(W)	44,1467		(14)	4,67 (11)
$ec_{13,11\ L}$	(W)	53,6224	-	55,5154	6,8 (5)
$ec_{7,5\ L}$	(W)	55,6499	-	57,5429	7,5 (10)
$ec_{13,11\ M}$	(W)	62,9026	-	63,9130	1,57 (13)
$ec_{7,5\ M}$	(W)	64,9301	-	65,9405	1,74 (27)
$ec_{13,11\ N}$	(W)	65,1270	-	65,6864	0,374 (29)
$ec_{7,5\ N}$	(W)	67,1550	-	67,7139	0,41 (6)
$ec_{9,7\ L}$	(W)	72,5805	-	74,4735	3,56 (13)
$ec_{9,7\ M}$	(W)	81,8607	-	82,8711	0,841 (28)
$ec_{9,5\ K}$	(W)	82,90491		(26)	0,728 (17)
$ec_{9,7\ N}$	(W)	84,0850	-	84,6445	0,201 (7)
$ec_{11,8\ K}$	(W)	86,8614		(3)	0,2587 (46)
$ec_{1,0\ L}$	(W)	88,0062	-	89,8992	32,4 (7)
$ec_{1,0\ M}$	(W)	97,2864	-	98,2968	8,19 (15)
$ec_{1,0\ N}$	(W)	99,5110	-	100,0702	1,931 (35)
$ec_{11,9\ L}$	(W)	101,5719	-	103,4649	0,989 (32)
$ec_{13,9\ K}$	(W)	109,86881		(25)	1,36 (25)
$ec_{11,9\ M}$	(W)	110,8521	-	111,8625	0,232 (8)
$ec_{11,7\ K}$	(W)	128,82687		(29)	0,2520 (45)
$ec_{9,5\ L}$	(W)	140,3301	-	142,2231	0,1194 (28)
$ec_{13,8\ K}$	(W)	152,5835		(3)	0,301 (5)
$ec_{2,1\ K}$	(W)	159,7957		(6)	0,424 (7)
$ec_{13,9\ L}$	(W)	167,294	-	169,187	0,459 (22)
$ec_{13,9\ M}$	(W)	176,5742	-	177,5846	0,111 (7)
$ec_{11,7\ L}$	(W)	186,2521	-	188,1451	0,1603 (29)
$ec_{13,7\ K}$	(W)	194,5490		(3)	0,288 (5)
$ec_{2,1\ L}$	(W)	217,2209	-	219,1139	0,2199 (39)
$ec_{13,7\ L}$	(W)	251,974	-	253,867	0,1250 (22)
$ec_{5,1\ K}$	(W)	1051,765		(3)	0,1045 (20)
$\beta^-_{0,13}$	max:	261,1		(17)	29,0 (7)
$\beta^-_{0,13}$	avg:	72,5		(5)	
$\beta^-_{0,12}$	max:	304,0		(17)	0,1414 (39)

		Energy keV		Electrons per 100 disint.
$\beta^-_{0,12}$	avg:	85,7	(5)	
$\beta^-_{0,11}$	max:	326,8	(17)	1,5 (7)
$\beta^-_{0,11}$	avg:	92,8	(5)	
$\beta^-_{0,10}$	max:	371,5	(17)	0,563 (10)
$\beta^-_{0,10}$	avg:	107,0	(6)	
$\beta^-_{0,9}$	max:	440,5	(17)	19,9 (7)
$\beta^-_{0,9}$	avg:	129,6	(6)	
$\beta^-_{0,8}$	max:	483,2	(17)	2,39 (15)
$\beta^-_{0,8}$	avg:	143,9	(6)	
$\beta^-_{0,7}$	max:	525,2	(17)	45,1 (23)
$\beta^-_{0,7}$	avg:	158,2	(6)	
$\beta^-_{0,6}$	max:	556,9	(17)	0,22 (21)
$\beta^-_{0,6}$	avg:	169,2	(6)	
$\beta^-_{0,5}$	max:	592,9	(17)	1,6 (22)
$\beta^-_{0,5}$	avg:	181,8	(6)	
$\beta^-_{0,2}$	max:	1484,9	(17)	~ 0
$\beta^-_{0,2}$	avg:	529,0	(7)	
$\beta^-_{0,1}$	max:	1714,2	(17)	~ 0
$\beta^-_{0,1}$	avg:	625,2	(70)	

5 Photon Emissions

5.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(W)	7,3881 — 11,6761		24,4 (5)	
XKα_2	(W)	57,9823		10,06 (17)	} Kα
XKα_1	(W)	59,3189		17,48 (29)	}
XKβ_3	(W)	66,952	}		
XKβ_1	(W)	67,2451	}	5,79 (13)	K$'\beta_1$
XKβ_5''	(W)	67,664	}		
XKβ_2	(W)	69,033	}		
XKβ_4	(W)	69,295	}	1,59 (5)	K$'\beta_2$
XKO$_{2,3}$	(W)	69,484	}		

5.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{7,6}$(W)	31,7377 (15)	0,84 (6)
$\gamma_{9,8}$(W)	42,7148 (14)	0,269 (7)
$\gamma_{13,11}$(W)	65,72215 (15)	2,97 (8)
$\gamma_{7,5}$(W)	67,74970 (10)	43,6 (15)
$\gamma_{9,7}$(W)	84,68024 (26)	2,62 (6)
$\gamma_{1,0}$(W)	100,10595 (7)	14,22 (16)
$\gamma_{13,10}$(W)	110,388 (9)	0,1073 (33)
$\gamma_{11,9}$(W)	113,67170 (22)	1,869 (20)
$\gamma_{9,6}$(W)	116,4179 (6)	0,445 (5)
$\gamma_{6,4}$(W)	121,50 (14)	0,0021 (7)
$\gamma_{9,5}$(W)	152,42991 (26)	7,01 (13)
$\gamma_{11,8}$(W)	156,3864 (3)	2,662 (27)
$\gamma_{13,9}$(W)	179,39381 (25)	3,099 (31)
$\gamma_{11,7}$(W)	198,35187 (29)	1,461 (15)
$\gamma_{13,8}$(W)	222,1085 (3)	7,54 (7)
$\gamma_{2,1}$(W)	229,3207 (6)	3,634 (36)
$\gamma_{13,7}$(W)	264,0740 (3)	3,602 (36)
$\gamma_{3,2}$(W)	351,02 (6)	0,01157 (37)
$\gamma_{12,3}$(W)	829,80 (9)	0,0141 (25)
$\gamma_{5,2}$(W)	891,9710 (12)	0,0570 (25)
$\gamma_{6,2}$(W)	927,9828 (13)	0,614 (7)
$\gamma_{7,2}$(W)	959,7203 (12)	0,348 (5)
$\gamma_{8,2}$(W)	1001,6856 (12)	2,07 (5)
$\gamma_{4,1}$(W)	1035,80 (14)	0,0060 (21)
$\gamma_{9,2}$(W)	1044,4001 (12)	0,2381 (42)
$\gamma_{10,2}$(W)	1113,406 (9)	0,442 (8)
$\gamma_{5,1}$(W)	1121,290 (3)	35,17 (33)
$\gamma_{6,1}$(W)	1157,3022 (11)	0,83 (13)
$\gamma_{11,2}$(W)	1158,0711 (12)	0,295 (18)
$\gamma_{12,2}$(W)	1180,82 (7)	0,0869 (29)
$\gamma_{7,1}$(W)	1189,040 (3)	16,58 (16)
$\gamma_{5,0}$(W)	1221,395 (3)	27,27 (27)
$\gamma_{13,2}$(W)	1223,7928 (12)	0,204 (21)
$\gamma_{8,1}$(W)	1231,004 (3)	11,62 (11)
$\gamma_{6,0}$(W)	1257,407 (3)	1,511 (15)
$\gamma_{9,1}$(W)	1273,719 (3)	0,658 (7)
$\gamma_{7,0}$(W)	1289,145 (3)	1,374 (17)
$\gamma_{10,1}$(W)	1342,72 (5)	0,2562 (28)
$\gamma_{9,0}$(W)	1373,824 (3)	0,2226 (32)
$\gamma_{11,1}$(W)	1387,390 (3)	0,0725 (11)
$\gamma_{12,1}$(W)	1410,14 (7)	0,0400 (8)
$\gamma_{13,1}$(W)	1453,1118 (10)	0,037 (7)

6 Main Production Modes

Ta − 182(β^-)W − 182

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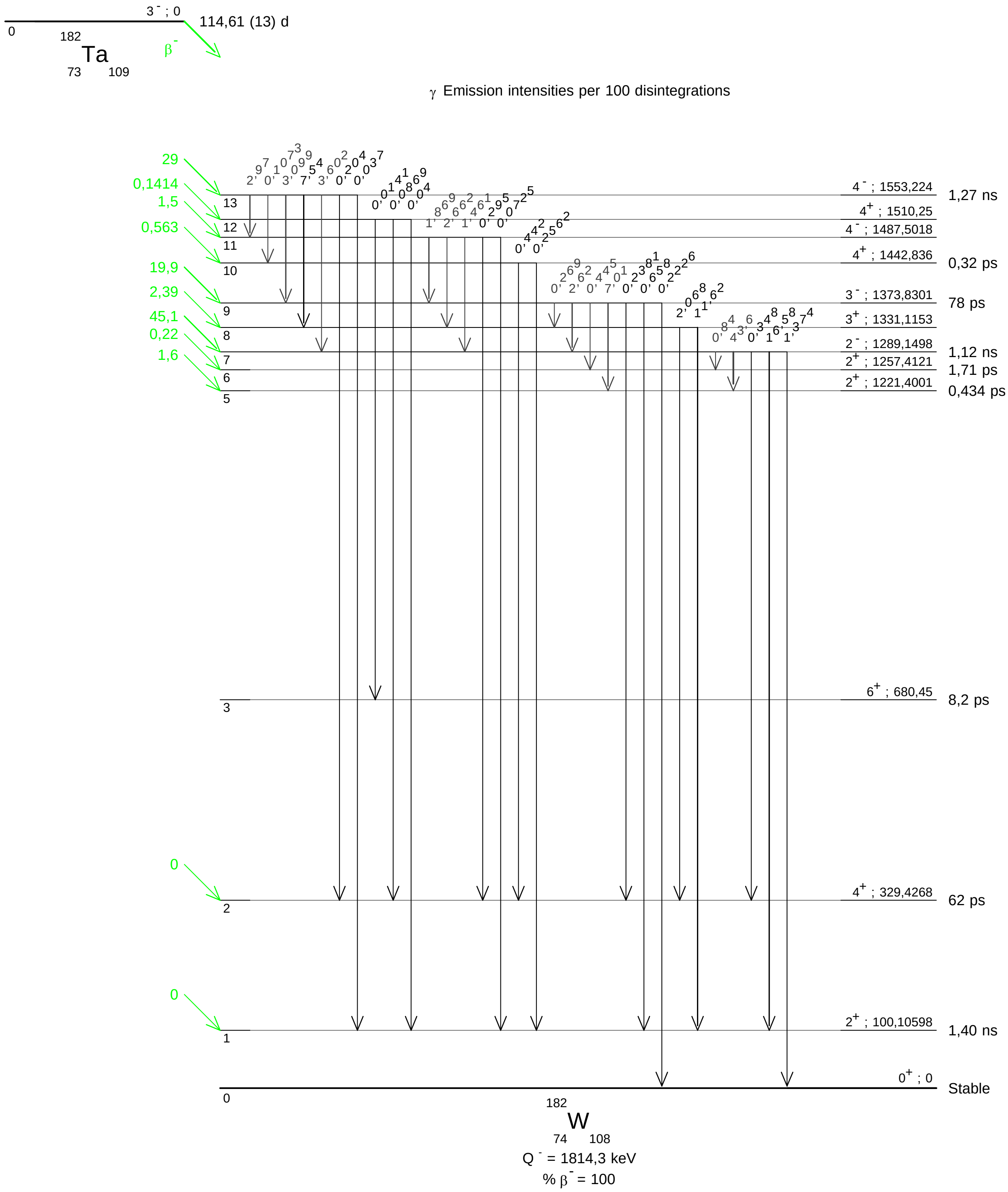
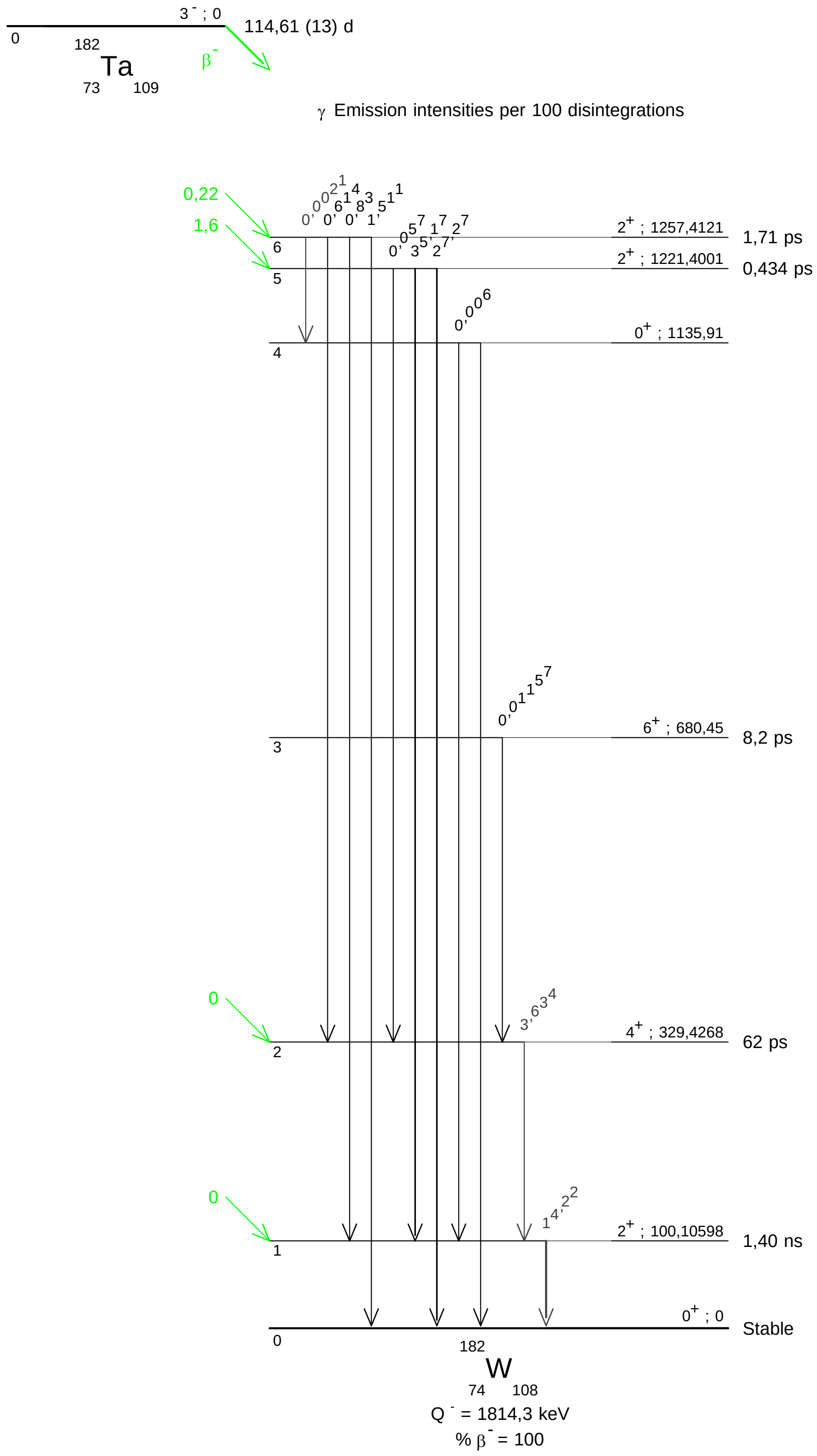

3 - ; 0
0
182
Ta
73 109
β -
114,61 (13) d
γ Emission intensities per 100 disintegrations
29
0,1414
1,5
0,563
19,9
2,39
45,1
0,22
1,6
0
0
13
12
11
10
9
8
7
6
5
3
2
1
0
4 - ; 1553,224
4+ ; 1510,25
4 - ; 1487,5018
4+ ; 1442,836
3 - ; 1373,8301
3+ ; 1331,1153
2 - ; 1289,1498
2+ ; 1257,4121
2+ ; 1221,4001
6+ ; 680,45
4+ ; 329,4268
2+ ; 100,10598
0+ ; 0
1,27 ns
0,32 ps
78 ps
1,12 ns
1,71 ps
0,434 ps
8,2 ps
62 ps
1,40 ns
Stable
182
W
74 108
Q - = 1814,3 keV
% β - = 100



CEA-LNHB / V. Ch isté, M. M. Bé

209	Pb	
82		127

1 Decay Scheme

Pb-209 disintegrates by 100% beta minus decay directly to the ground state of Bi-209.
Le plomb 209 se désintègre par émission bêta moins directement vers le niveau fondamental du bismuth 209.

2 Nuclear Data

$T_{1/2}(^{209}\mathrm{Pb})$	:	3,277	(15)	h
$T_{1/2}(^{209}\mathrm{Bi})$	:	19	(2)	10^{18} a
$Q^{-}(^{209}\mathrm{Pb})$	:	644,0	(12)	keV

2.1 β^- Transitions

	Energy keV	Probability × 100	Nature	lg ft
$\beta^-_{0,0}$	644,0 (12)	100	1st forbidden non-unique	5,54

3 Electron Emissions

		Energy keV		Electrons per 100 disint.
$\beta^-_{0,0}$	max:	644,0	(12)	100
$\beta^-_{0,0}$	avg:	197,35	(42)	

4 Main Production Modes

$Tl-209(\beta^-)Pb-209$

$Pb-208(n,\gamma)Pb-209$

$Pb-208(d,p)Pb-209$

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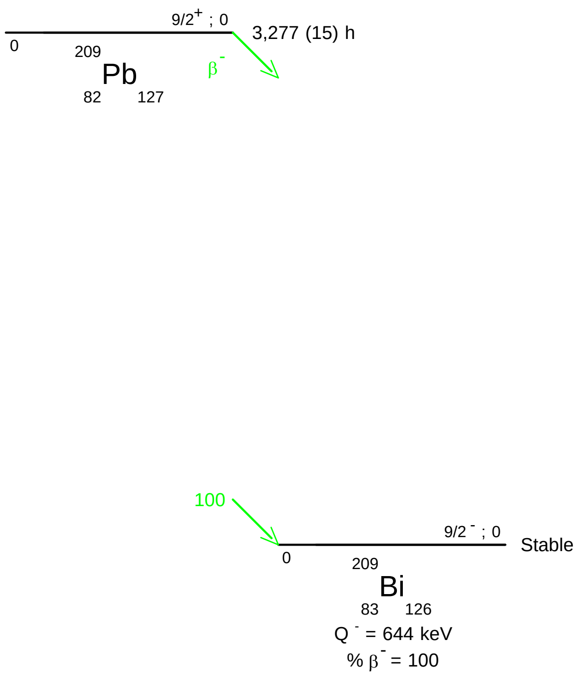
  (Q value)



ANL / F.G. Kondev

^{209} Po
84 125

1 Decay Scheme

Po-209 disintegrates by alpha emissions (99,546 (7) %) to excited levels and to the ground state level in Pb-205 and by electron capture (0,454 (7) %) to the excited level of 896,3 keV in Bi-209.
Le polonium 209 se désintègre par émission alpha (99,546 (7) %) vers des niveaux excités et le niveau fondamental du plomb 205 et par capture électronique (0,454 (7) %) vers le premier niveau excité du bismuth 209.

2 Nuclear Data

$T_{1/2}(^{209}\text{Po})$	:	115	(13)	a
$T_{1/2}(^{209}\text{Bi})$	:	1,9	(2)	10^{19} a
$T_{1/2}(^{205}\text{Pb})$	:	17,3	(7)	10^{6} a
$Q^{\alpha}(^{209}\text{Po})$	:	4979,2	(14)	keV
$Q^{+}(^{209}\text{Po})$	:	1892,5	(16)	keV

2.1 α Transitions

	Energy keV	Probability × 100	F
$\alpha_{0,2}$	4716,4 (14)	0,548 (7)	4,5
$\alpha_{0,1}$	4976,9 (14)	79,2 (32)	1,3
$\alpha_{0,0}$	4979,2 (14)	19,8 (32)	6

2.2 Electron Capture Transitions

	Energy keV	Probability × 100	Nature	lg ft	P_K	P_L	P_M
$\epsilon_{0,1}$	996,2 (16)	0,454 (7)	Unique 2nd Forbidden	14,36	0,70796 (22)	0,21518 (16)	0,07686 (7)

2.3 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{1,0}$(Pb)	2,328 (7)	79,6 (32)					
$\gamma_{2,1}$(Pb)	260,50 (5)	0,411 (6)	M1+E2	0,503 (12)	0,0874 (14)	0,0205 (3)	0,617 (13)
$\gamma_{2,0}$(Pb)	262,80 (5)	0,1370 (33)	M1 + 0,25 % E2	0,500 (9)	0,0857 (13)	0,0201 (3)	0,612 (10)
$\gamma_{1,0}$(Bi)	896,28 (6)	0,454 (7)	M1 + 27,8 % E2	0,0170 (5)	0,00292 (7)	0,000687 (16)	0,0208 (6)

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				
	$K\alpha_2$	74,8157		59,77
	$K\alpha_1$	77,1088		100
	$K\beta_3$	86,835	}	
	$K\beta_1$	87,344	}	
	$K\beta_5''$	87,862	}	34,25
	$K\beta_2$	89,732	}	
	$K\beta_4$	90,074	}	10,48
	$KO_{2,3}$	90,421	}	

		Energy keV		Relative probability
X_L				
	$L\ell$	9,4207		
	$L\alpha$	10,7308 – 10,8387		
	$L\eta$	11,7127		
	$L\beta$	12,4814 – 13,8066		
	$L\gamma$	14,7735 – 15,7084		

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	5,42 – 16,34	

3.2 Pb

ω_K	:	0,963	(4)
$\bar{\omega}_L$	:	0,379	(15)
n_{KL}	:	0,811	(5)

3.2.1 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				
	$L\ell$	9,186		
	$L\alpha$	10,4495 – 10,5512		
	$L\eta$	11,3495		
	$L\beta$	12,1443 – 12,7953		
	$L\gamma$	14,3078 – 15,2169		

3.2.2 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	5,33 – 15,82	

4 α Emissions

	Energy keV	Probability × 100
$\alpha_{0,2}$	4622 (5)	0,548 (7)
$\alpha_{0,1}$	4883 (2)	79,2 (32)
$\alpha_{0,0}$	4885 (2)	19,8 (32)

5 Electron Emissions

		Energy keV	Electrons per 100 disint.
e_{AL}	(Bi)	5,42 - 16,34	0,2240 (27)
e_{AK}	(Bi)		0,0118 (14)
	KLL	57,491 - 63,419	}
	KLX	70,025 - 77,105	}
	KXY	82,53 - 90,52	}
e_{AL}	(Pb)	5,33 - 15,82	0,1044 (14)
e_{AK}	(Pb)		0,0063 (7)
	KLL	56,028 - 61,669	}
	KLX	68,181 - 74,969	}
	KXY	80,3 - 88,0	}
$ec_{2,1\ K}$	(Pb)	172,5 (1)	0,1278 (34)

6 Photon Emissions

6.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(Bi)	9,4207 — 15,7084		0,1411 (24)	
XKα_2	(Bi)	74,8157		0,0927 (16)	} Kα
XKα_1	(Bi)	77,1088		0,1551 (25)	}
XKβ_3	(Bi)	86,835	}		
XKβ_1	(Bi)	87,344	}	0,0531 (12)	K$'\beta_1$
XKβ''_5	(Bi)	87,862	}		
XKβ_2	(Bi)	89,732	}		
XKβ_4	(Bi)	90,074	}	0,0163 (5)	K$'\beta_2$
XKO$_{2,3}$	(Bi)	90,421	}		
XL	(Pb)	9,186 — 15,2169		0,0631 (13)	
XKα_2	(Pb)	72,8049		0,0478 (11)	} Kα
XKα_1	(Pb)	74,97		0,0804 (18)	}
XKβ_3	(Pb)	84,451	}		
XKβ_1	(Pb)	84,937	}	0,0275 (8)	K$'\beta_1$
XKβ''_5	(Pb)	85,47	}		
XKβ_2	(Pb)	87,238	}		
XKβ_4	(Pb)	87,58	}	0,00830 (26)	K$'\beta_2$
XKO$_{2,3}$	(Pb)	87,911	}		

6.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{2,1}$(Pb)	260,50 (5)	0,254 (3)
$\gamma_{2,0}$(Pb)	262,80 (5)	0,085 (2)
$\gamma_{1,0}$(Bi)	896,28 (6)	0,445 (7)

7 Main Production Modes

Bi – 209(d,2n)Po – 209
Bi – 209(p,n)Po – 209
Possible impurities : Po – 208

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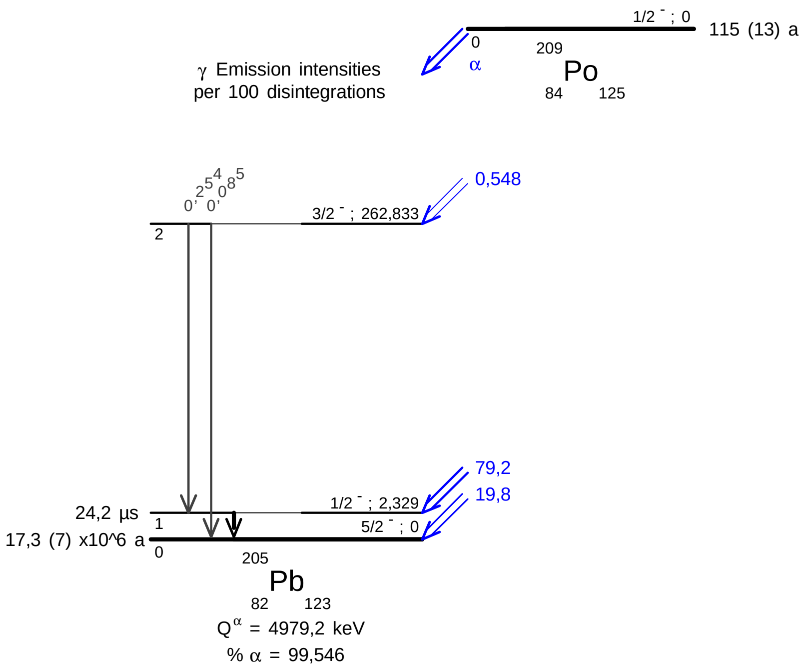
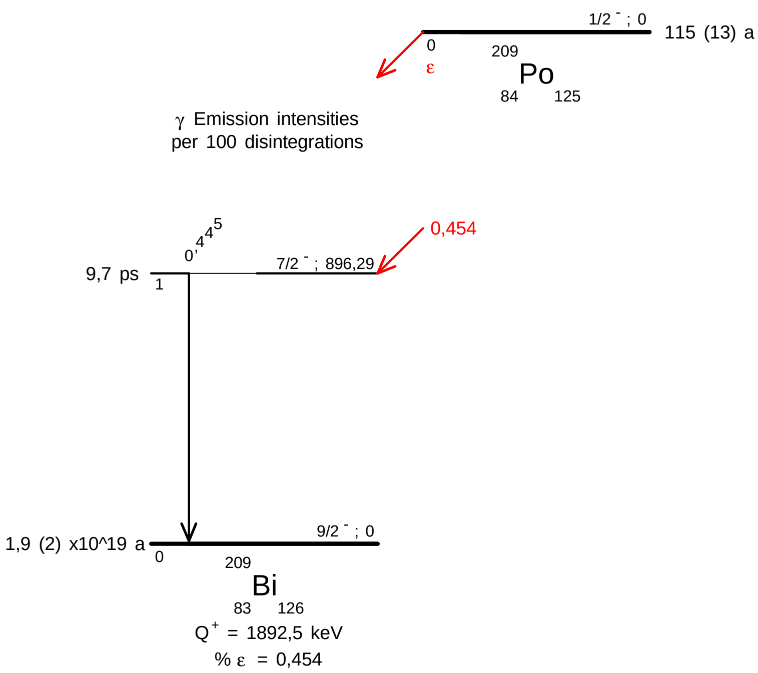

1/2 - ; 0
115 (13) a
0
α
209
Po
84
125
γ Emission intensities
per 100 disintegrations
0,548
3/2 - ; 262,833
2
79,2
19,8
24,2 µs
1/2 - ; 2,329
1
5/2 - ; 0
17,3 (7) x10^6 a
0
205
Pb
82
123
Q^α = 4979,2 keV
% α = 99,546


1/2 - ; 0
115 (13) a
0
ε
209
Po
84 125
γ Emission intensities
per 100 disintegrations
0,454
9,7 ps
7/2 - ; 896,29
1,9 (2) x10^19 a
9/2 - ; 0
0
209
Bi
83 126
Q+ = 1892,5 keV
% ε = 0,454

$^{211}_{84}Po_{127}$

1 Decay Scheme

Po-211 decays 100 % by alpha-particle emissions, populating mainly the ground state of Pb-207.
Le polonium 211 se désintègre par émission alpha vers le niveau fondamental du plomb 207.

2 Nuclear Data

$T_{1/2}(^{211}Po)$	:	0,516	(3)	s
$Q^{\alpha}(^{211}Po)$	:	7594,48	(51)	keV

2.1 α Transitions

	Energy keV	Probability × 100	F
$\alpha_{0,2}$	6695,3 (10)	0,523 (9)	17,9
$\alpha_{0,1}$	7024,4 (10)	0,541 (17)	272
$\alpha_{0,0}$	7594,2 (3)	98,936 (19)	112

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{2,1}$(Pb)	328,2 (2)	0,0043 (15)	M1	0,273 (4)	0,0465 (7)	0,01089 (16)	0,334 (5)
$\gamma_{1,0}$(Pb)	569,65 (15)	0,546 (17)	E2	0,01583 (23)	0,00439 (7)	0,001081 (16)	0,0216 (3)
$\gamma_{2,0}$(Pb)	897,8 (2)	0,519 (9)	M1+E2	0,0192 (3)	0,00318 (5)	0,000741 (11)	0,0233 (4)

3 Atomic Data

3.1 Pb

ω_K	:	0,963	(4)
$\bar{\omega}_L$	:	0,379	(15)
n_{KL}	:	0,811	(5)

3.1.1 X Radiations

		Energy keV		Relative probability
X_K				
	$K\alpha_2$	72,8049		59,44
	$K\alpha_1$	74,97		100
	$K\beta_3$	84,451	}	
	$K\beta_1$	84,937	}	
	$K\beta_5''$	85,47	}	34,22
	$K\beta_2$	87,238	}	
	$K\beta_4$	87,58	}	10,33
	$KO_{2,3}$	87,911	}	
X_L				
	$L\ell$	9,186		
	$L\alpha$	10,4495 – 10,5512		
	$L\eta$	11,3495		
	$L\beta$	12,1443 – 13,3763		
	$L\gamma$	14,3078 – 15,2169		

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	5,33 – 15,82	

4 α Emissions

	Energy keV	Probability × 100
$\alpha_{0,2}$	6568,4 (10)	0,523 (9)
$\alpha_{0,1}$	6891,2 (10)	0,541 (17)
$\alpha_{0,0}$	7450,2 (3)	98,936 (19)

5 Electron Emissions

		Energy keV		Electrons per 100 disint.
e_{AL}	(Pb)	5,33 - 15,82		0,01216 (17)
e_{AK}	(Pb)			0,00071 (8)
	KLL	56,028 - 61,669	}	
	KLX	68,181 - 74,969	}	
	KXY	80,3 - 88,0	}	

6 Photon Emissions

6.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(Pb)	9,186 — 15,2169		0,00740 (16)	
$XK\alpha_2$	(Pb)	72,8049		0,00535 (14)	} $K\alpha$
$XK\alpha_1$	(Pb)	74,97		0,00900 (24)	}
$XK\beta_3$	(Pb)	84,451	}		
$XK\beta_1$	(Pb)	84,937	}	0,00308 (10)	$K'\beta_1$
$XK\beta''_5$	(Pb)	85,47	}		
$XK\beta_2$	(Pb)	87,238	}		
$XK\beta_4$	(Pb)	87,58	}	0,00093 (4)	$K'\beta_2$
$XKO_{2,3}$	(Pb)	87,911	}		

6.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{2,1}$(Pb)	328,2 (2)	0,0032 (11)
$\gamma_{1,0}$(Pb)	569,65 (15)	0,534 (17)
$\gamma_{2,0}$(Pb)	897,8 (2)	0,507 (9)

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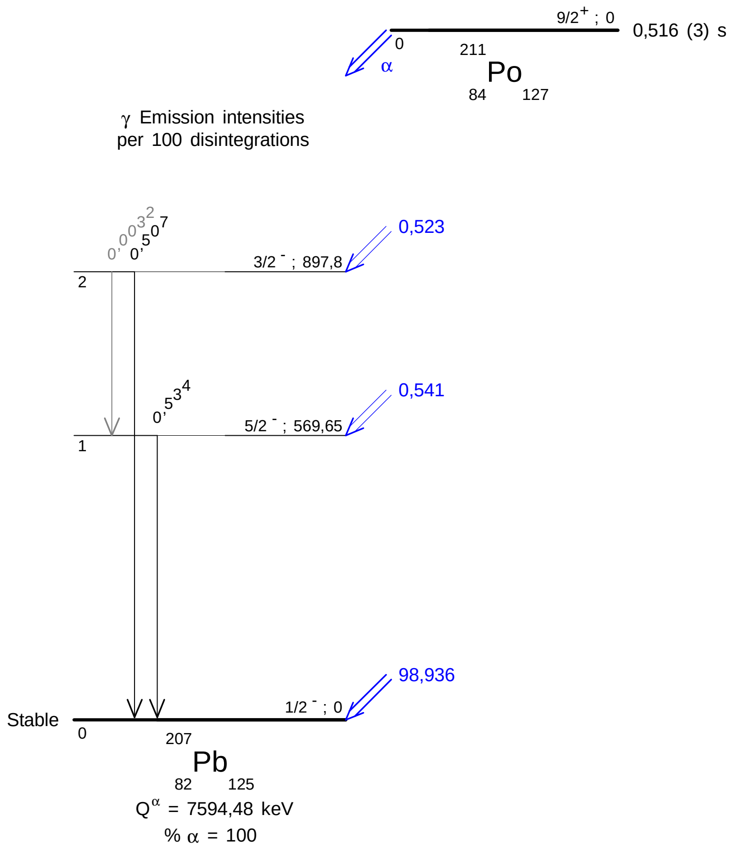

IFIN-HH / A. Luca

215 Po
84 Po 131

1 Decay Scheme

Po-215 decays 100 % by alpha transitions to Pb-211 and 2.3(2) $\times 10^{-4}$ by beta- emission to At215.
Le polonium 215 se désintègre par émissions alpha principalement vers le niveau fondamental du plomb 211. Il existe un faible branchement bêta moins vers l'astate 215.

2 Nuclear Data

$T_{1/2}(^{215}$Po)	:	1,781	(4)	10^{-3} s
$T_{1/2}(^{215}$At)	:	0,10	(2)	10^{-3} s
$T_{1/2}(^{211}$Pb)	:	36,1	(2)	min
$Q^{\alpha}(^{215}$Po)	:	7526,3	(8)	keV
$Q^{-}(^{215}$Po)	:	715	(7)	keV

2.1 α Transitions

	Energy keV	Probability × 100	F
$\alpha_{0,7}$	6632 (3)	0,0003	365
$\alpha_{0,6}$	6711 (3)	0,0020 (6)	109
$\alpha_{0,5}$	6793 (3)	0,0008 (3)	550
$\alpha_{0,4}$	6883 (3)	0,0008 (3)	1170
$\alpha_{0,3}$	6928 (3)	0,0016 (5)	8500
$\alpha_{0,2}$	6942 (3)	0,0004 (2)	3800
$\alpha_{0,1}$	7087,4 (8)	0,06 (2)	82
$\alpha_{0,0}$	7526,3 (8)	99,934 (20)	1,34

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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
$\gamma_{7,2}$(Pb)	310 (4)						
$\gamma_{1,0}$(Pb)	438,9 (2)	0,06 (2)	E2	0,0275 (4)	0,00984 (14)	0,00247 (4)	0,0405 (6)
$\gamma_{2,0}$(Pb)	584 (3)						
$\gamma_{3,0}$(Pb)	598 (3)						
$\gamma_{4,0}$(Pb)	643 (3)		(M1+E2)	0,029 (17)	0,0054 (23)	0,0013 (6)	0,036 (20)
$\gamma_{5,0}$(Pb)	733 (3)						
$\gamma_{6,0}$(Pb)	815 (3)						
$\gamma_{7,0}$(Pb)	894 (3)						

3 Atomic Data

3.1 Pb

ω_K : 0,963 (4)
$\bar{\omega}_L$: 0,379 (15)
n_{KL} : 0,811 (5)

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	}	34,18
	$K\beta_2$	87,238	}	
	$K\beta_4$	87,58	}	10,32
	$KO_{2,3}$	87,911	}	
X_L				
	$L\ell$	9,186		
	$L\alpha$	10,4495 – 10,5512		
	$L\eta$	11,3495		
	$L\beta$	12,1443 – 13,3763		
	$L\gamma$	14,3078 – 15,2169		

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	5,33 – 15,82	

4 α Emissions

	Energy keV	Probability × 100
$\alpha_{0,7}$	6509 (3)	0,0003
$\alpha_{0,6}$	6586 (3)	0,0020 (6)
$\alpha_{0,5}$	6667 (3)	0,0008 (3)
$\alpha_{0,4}$	6755 (3)	0,0008 (3)
$\alpha_{0,3}$	6799 (3)	0,0016 (5)
$\alpha_{0,2}$	6813 (3)	0,0004 (2)
$\alpha_{0,1}$	6955,4 (8)	0,06 (2)
$\alpha_{0,0}$	7386,1 (8)	99,934 (20)

5 Electron Emissions

		Energy keV		Electrons per 100 disint.
e_{AL}	(Pb)	5,33 - 15,82		0,00115 (14)
e_{AK}	(Pb)			0,000059 (21)
	KLL	56,028 - 61,669	}	
	KLX	68,181 - 74,969	}	
	KXY	80,3 - 88,0	}	
$ec_{1,0\ K}$	(Pb)	350,9 (2)		0,0016 (5)
$ec_{1,0\ L}$	(Pb)	423,0 - 425,9		0,00057 (19)
$ec_{1,0\ M}$	(Pb)	435,0 - 436,4		0,000143 (47)

6 Photon Emissions

6.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(Pb)	9,186 — 15,2169		0,00071 (12)	
XKα_2	(Pb)	72,8049		0,00045 (15)	} Kα
XKα_1	(Pb)	74,97		0,00075 (25)	}
XKβ_3	(Pb)	84,451	}		
XKβ_1	(Pb)	84,937	}	0,00026 (9)	K$'\beta_1$
XKβ_5''	(Pb)	85,47	}		
XKβ_2	(Pb)	87,238	}		
XKβ_4	(Pb)	87,58	}	0,000078 (26)	K$'\beta_2$
XKO$_{2,3}$	(Pb)	87,911	}		

6.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{1,0}$(Pb)	438,9 (2)	0,058 (19)

7 Main Production Modes

U – 235 decay chain

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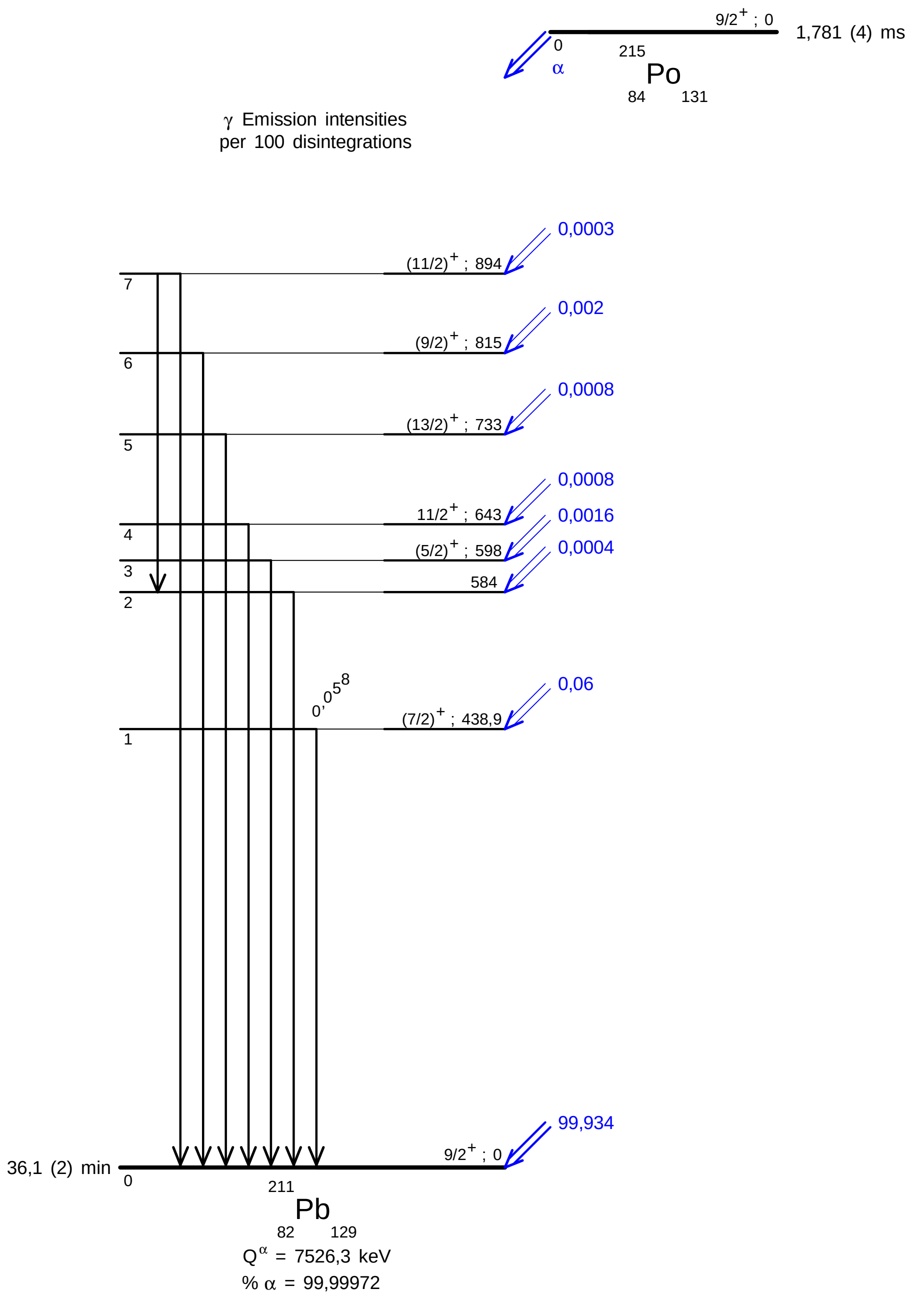

9/2+ ; 0
1,781 (4) ms
0
α
215
Po
84 131
γ Emission intensities
per 100 disintegrations
0,0003
(11/2)+ ; 894
7
0,002
(9/2)+ ; 815
6
0,0008
(13/2)+ ; 733
5
0,0008
11/2+ ; 643
4
0,0016
(5/2)+ ; 598
3
0,0004
584
2
0,058
0,06
(7/2)+ ; 438,9
1
99,934
9/2+ ; 0
36,1 (2) min
0
211
Pb
82 129
Qα = 7526,3 keV
% α = 99,99972

$^{215}_{85}$At $_{130}$

1 Decay Scheme

At-215 decays 100% to levels of Bi-211 by emission of alpha-particles.
L'astate 215 se désintègre par émissions alpha essentiellement vers le niveau fondamental du bismuth 211.

2 Nuclear Data

$T_{1/2}$(^{215}At)	:	0,10	(2)	10^{-3} s
$T_{1/2}$(^{211}Bi)	:	2,15	(2)	min
Q^{α}(^{215}At)	:	8178	(4)	keV

2.1 α Transitions

	Energy keV	Probability × 100	F
$\alpha_{0,1}$	7773 (4)	0,05 (2)	390
$\alpha_{0,0}$	8178 (4)	99,95 (2)	2,8

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)	404,854 (9)	0,05 (2)	M1+E2	0,095 (7)	0,0206 (8)	0,00498 (17)	0,122 (8)

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				
	$K\alpha_2$	74,8157		59,77
	$K\alpha_1$	77,1088		100
	$K\beta_3$	86,835	}	
	$K\beta_1$	87,344	}	
	$K\beta_5''$	87,862	}	34,25
	$K\beta_2$	89,732	}	
	$K\beta_4$	90,074	}	10,49
	$KO_{2,3}$	90,421	}	
X_L				
	$L\ell$	9,4207		
	$L\alpha$	10,7308 – 10,8387		
	$L\eta$	11,7127		
	$L\beta$	12,4814 – 13,8066		
	$L\gamma$	14,7735 – 15,7084		

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	5,42 – 16,34	

4 α Emissions

	Energy keV	alpha per 100 disint.
$\alpha_{0,1}$	7628 (4)	0,05 (2)
$\alpha_{0,0}$	8026 (4)	99,95 (2)

5 Electron Emissions

		Energy keV		Electrons per 100 disint.
e_{AL}	(Bi)	5,42 - 16,34		0,0027 (5)
e_{AK}	(Bi)			0,00015 (7)
	KLL	57,491 - 63,419	}	
	KLX	70,025 - 77,105	}	
	KXY	82,53 - 90,52	}	
$ec_{1,0\ T}$	(Bi)	314,328 - 404,830		0,0055 (22)
$ec_{1,0\ K}$	(Bi)	314,328 (9)		0,0043 (17)
$ec_{1,0\ L}$	(Bi)	388,466 - 391,435		0,00093 (37)
$ec_{1,0\ M}$	(Bi)	400,855 - 402,274		0,00022 (9)
$ec_{1,0\ N}$	(Bi)	403,916 - 404,697		0,000057 (23)

6 Photon Emissions

6.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(Bi)	9,4207 — 15,7084		0,0017 (4)	
$XK\alpha_2$	(Bi)	74,8157		0,0012 (5)	} $K\alpha$
$XK\alpha_1$	(Bi)	77,1088		0,0020 (9)	}
$XK\beta_3$	(Bi)	86,835	}		
$XK\beta_1$	(Bi)	87,344	}	0,00069 (28)	$K'\beta_1$
$XK\beta_5''$	(Bi)	87,862	}		

		Energy keV		Photons per 100 disint.	
$XK\beta_2$	(Bi)	89,732	}		
$XK\beta_4$	(Bi)	90,074	}	0,00021 (9)	$K'\beta_2$
$XKO_{2,3}$	(Bi)	90,421	}		

6.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{1,0}$(Bi)	404,853 (9)	0,045 (18)

7 Main Production Modes

U – 235 decay chain

$$\begin{cases} \mathrm{Th} - 232(\mathrm{p},\,6\mathrm{n})\mathrm{Pa} - 227 \\ \mathrm{Pa} - 227(\alpha)- > \mathrm{Ac} - 223(\alpha)- > \mathrm{Fr} - 219(\alpha)- > \mathrm{At} - 215 \end{cases}$$

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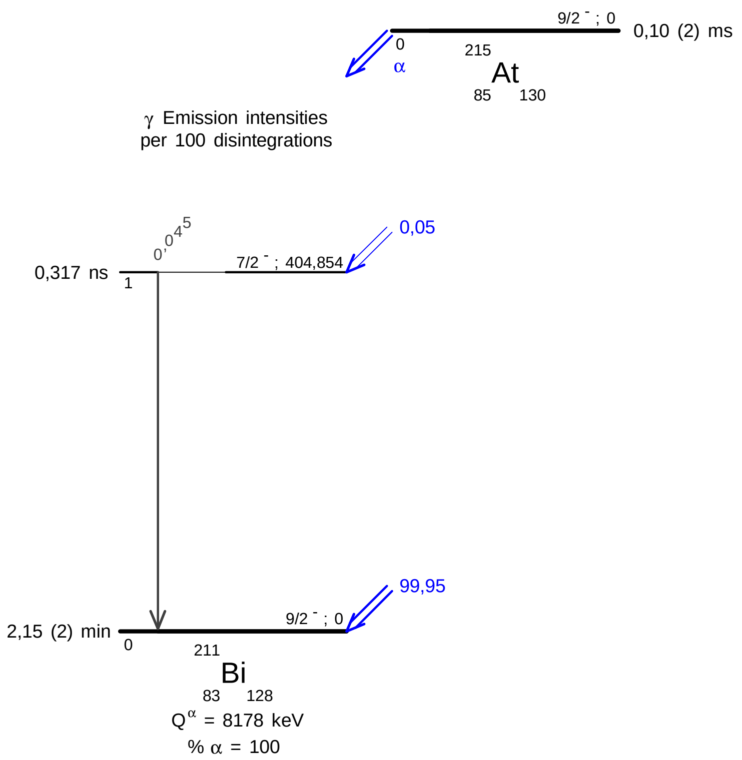

KRI / Chechev V.P.

$^{219}_{85}\mathrm{At}_{134}$

1 Decay Scheme

At-219 undergoes approximately 3% beta-minus decay to the ground state of Rn-219, and approximately 97% alpha-particle decay to the ground state of Bi-215.
L'astate 219 se désintègre par émission bêta moins vers le niveau fondamental du radon 219 (∼ 3 %), et par émission alpha vers le niveau fondamental du bismuth 215 (∼ 97 %).

2 Nuclear Data

$T_{1/2}(^{219}\mathrm{At})$	:	56	(4)	s
$T_{1/2}(^{219}\mathrm{Rn})$	:	3,98	(3)	s
$T_{1/2}(^{215}\mathrm{Bi})$	:	7,6	(2)	min
$Q^{-}(^{219}\mathrm{At})$	:	1566	(3)	keV
$Q^{\alpha}(^{219}\mathrm{At})$	:	6324	(15)	keV

2.1 α Transitions

	Energy keV	Probability × 100	F
$\alpha_{0,0}$	6324 (15)	∼ 97	∼ 1,07

2.2 β^- Transitions

	Energy keV	Probability × 100	Nature	lg ft
$\beta^-_{0,0}$	1566 (3)	∼ 3	1st forbidden	∼ 6,2

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3 α Emissions

	Energy keV	Probability × 100
$\alpha_{0,0}$	6208 (15)	~ 97

4 Electron Emissions

		Energy keV	Electrons per 100 disint.
$\beta^-_{0,0}$	max:	1566 (3)	~ 3
$\beta^-_{0,0}$	avg:	547 (2)	

5 Main Production Modes

U – 235(4n + 3) decay chain

Th – 232(p,x)At – 219

6 References

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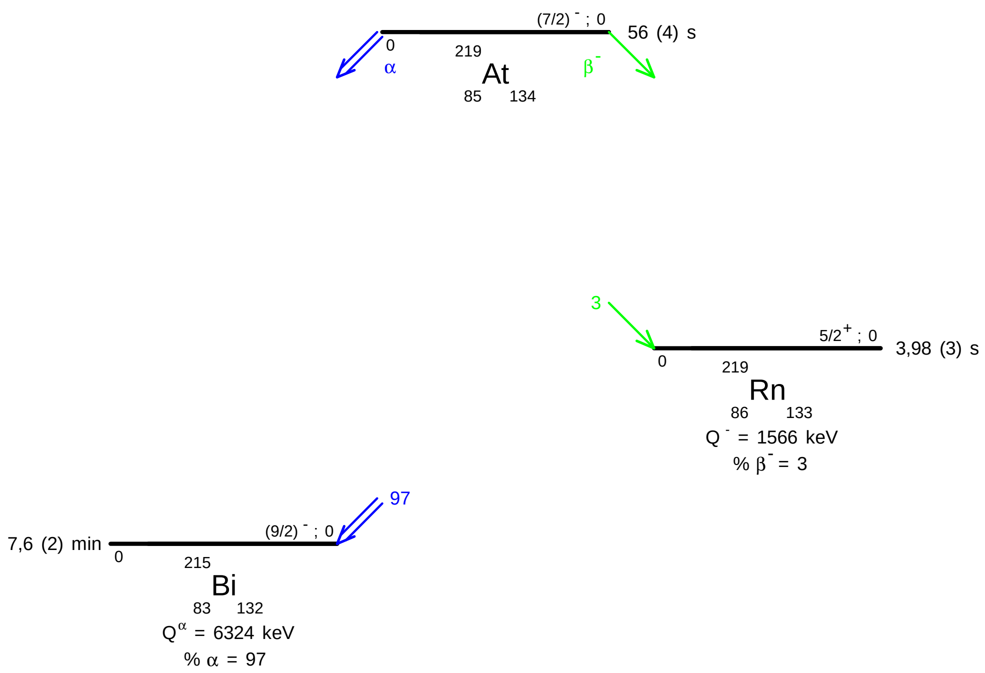

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219 Rn
86 Rn 133

1 Decay Scheme

Rn-219 decays 100% by alpha-particle emission to various nuclear levels of Po-215.
Le radon 215 se désintègre par émissions alpha vers des niveaux excités du polonium 215.

2 Nuclear Data

$T_{1/2}(^{219}\text{Rn})$	:	3,98	(3)	s
$T_{1/2}(^{215}\text{Po})$	:	1,781	(4)	10^{-3} s
$Q^{\alpha}(^{219}\text{Rn})$	:	6946,1	(3)	keV

2.1 α Transitions

	Energy keV	Probability × 100	F
$\alpha_{0,14}$	5851,9 (10)	0,00009 (5)	245
$\alpha_{0,13}$	5872,4 (5)	0,00094 (19)	33
$\alpha_{0,12}$	6016,1 (10)	0,00009 (5)	1590
$\alpha_{0,11}$	6055,0 (4)	0,0021 (3)	103
$\alpha_{0,10}$	6068,9 (7)	0,0003 (1)	830
$\alpha_{0,9}$	6110,8 (4)	0,0032 (5)	120
$\alpha_{0,8}$	6213,4 (5)	0,00123 (12)	880
$\alpha_{0,7}$	6238,0 (6)	0,00064 (12)	2170
$\alpha_{0,6}$	6269,4 (3)	0,0184 (22)	103
$\alpha_{0,5}$	6337,8 (3)	0,0043 (10)	860
$\alpha_{0,4}$	6428,5 (3)	0,048 (3)	184
$\alpha_{0,3}$	6544,3 (3)	7,85 (24)	3,31
$\alpha_{0,2}$	6652,5 (3)	0,098 (5)	710
$\alpha_{0,1}$	6674,9 (3)	12,6 (3)	6,75
$\alpha_{0,0}$	6946,1 (3)	79,4 (10)	11,2

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{3,1}$(Po)	130,58 (1)	0,72 (6)	M1+26.5%E2	3,19 (16)	0,94 (4)	0,234 (10)	4,44 (13)
$\gamma_{4,2}$(Po)	224,04 (7)	0,0019 (3)	(E2)	0,1296 (19)	0,1407 (20)	0,0370 (6)	0,319 (5)
$\gamma_{1,0}$(Po)	271,228 (10)	13,30 (26)	M1+94%E2	0,111 (6)	0,0668 (11)	0,0173 (3)	0,201 (7)
$\gamma_{2,0}$(Po)	293,56 (4)	0,101 (4)	M1+50%E2	0,25 (4)	0,062 (4)	0,0152 (7)	0,34 (5)
$\gamma_{12,5}$(Po)	322 (1)	0,00009 (5)					
$\gamma_{8,3}$(Po)	330,9 (4)	0,00100 (11)					
$\gamma_{11,4}$(Po)	373,5 (3)	0,00025 (3)					
$\gamma_{6,2}$(Po)	383,1 (1)	0,00044 (7)					
$\gamma_{3,0}$(Po)	401,81 (1)	7,12 (23)	E2	0,0351 (5)	0,01528 (22)	0,00390 (6)	0,0555 (8)
$\gamma_{6,1}$(Po)	405,4 (1)	0,00025 (4)					
$\gamma_{7,1}$(Po)	436,9 (5)	0,00031 (6)					
$\gamma_{8,1}$(Po)	461,5 (4)	0,00017 (3)					
$\gamma_{11,3}$(Po)	489,3 (3)	0,00064 (9)					
$\gamma_{4,0}$(Po)	517,60 (6)	0,046 (4)	M1+50%E2	0,058 (9)	0,0115 (11)	0,00277 (24)	0,073 (10)
$\gamma_{13,4}$(Po)	556,1 (4)	0,00006 (4)	M1+50%E2	0,048 (7)	0,0095 (9)	0,00226 (21)	0,061 (8)
$\gamma_{9,1}$(Po)	564,1 (2)	0,0015 (3)					
$\gamma_{14,4}$(Po)	576,6 (10)	0,00009 (5)					
$\gamma_{5,0}$(Po)	608,30 (7)	0,0044 (10)	(M1+E2)				
$\gamma_{11,1}$(Po)	619,9 (3)	0,00033 (11)					
$\gamma_{(-1,1)}$(Po)	665,5 (10)	0,00009 (5)					
$\gamma_{13,3}$(Po)	671,9 (4)	0,00022 (11)	M1+E2				
$\gamma_{6,0}$(Po)	676,66 (7)	0,018 (2)					
$\gamma_{7,0}$(Po)	708,1 (5)	0,00033 (11)					
$\gamma_{8,0}$(Po)	732,7 (4)	0,00007 (4)					
$\gamma_{13,1}$(Po)	802,5 (4)	0,00033 (11)	M1+E2				
$\gamma_{9,0}$(Po)	835,32 (22)	0,0017 (3)					
$\gamma_{10,0}$(Po)	877,2 (6)	0,00033 (11)					
$\gamma_{11,0}$(Po)	891,1 (3)	0,0009 (2)					
$\gamma_{13,0}$(Po)	1073,7 (4)	0,00033 (11)	E2	0,00510 (8)	0,001002 (14)	0,000240 (4)	0,00641 (9)

3 Atomic Data

3.1 Po

ω_K	:	0,965	(4)
$\bar{\omega}_L$	:	0,403	(16)
n_{KL}	:	0,807	(5)

3.1.1 X Radiations

		Energy keV		Relative probability
X_K				
	Kα_2	76,864		60
	Kα_1	79,293		100
	Kβ_3	89,256	}	
	Kβ_1	89,807	}	
	Kβ_5''	90,363	}	34
	Kβ_2	92,263	}	
	Kβ_4	92,618	}	10,7
	KO$_{2,3}$	92,983	}	
X_L				
	Lℓ	9,658		
	Lα	11,016 – 11,13		
	Lη	12,085		
	Lβ	12,823 – 13,778		
	Lγ	15,742 – 16,213		

3.1.2 Auger Electrons

	Energy keV	Relative probability
Auger K		
KLL	58,978 – 65,205	100
KLX	71,902 – 79,289	56
KXY	84,8 – 93,1	7,8
Auger L	5,434 – 10,934	3660

4 α Emissions

	Energy keV	alpha per 100 disint.
$\alpha_{0,14}$	5745 (1)	0,00009 (5)
$\alpha_{0,13}$	5765,1 (5)	0,00094 (19)
$\alpha_{0,12}$	5906,2 (10)	0,00009 (5)
$\alpha_{0,11}$	5944,4 (4)	0,0021 (3)
$\alpha_{0,10}$	5958,1 (7)	0,0003 (1)
$\alpha_{0,9}$	5999,2 (4)	0,0032 (5)
$\alpha_{0,8}$	6099,9 (5)	0,00123 (12)
$\alpha_{0,7}$	6124,1 (6)	0,00064 (12)
$\alpha_{0,6}$	6154,9 (3)	0,0184 (22)
$\alpha_{0,5}$	6222,0 (3)	0,0043 (10)
$\alpha_{0,4}$	6311,1 (3)	0,048 (3)
$\alpha_{0,3}$	6424,8 (3)	7,85 (24)
$\alpha_{0,2}$	6531,0 (3)	0,098 (5)
$\alpha_{0,1}$	6553,0 (3)	12,6 (3)
$\alpha_{0,0}$	6819,2 (3)	79,4 (10)

5 Electron Emissions

		Energy keV		Electrons per 100 disint.
e_{AL}	(Po)	5,434 - 10,934		1,50 (5)
e_{AK}	(Po)			0,067 (9)
	KLL	58,978 - 65,205	}	
	KLX	71,902 - 79,289	}	
	KXY	84,8 - 93,1	}	
$ec_{1,0\ T}$	(Po)	178,130 - 271,227		2,23 (4)
$ec_{1,0\ K}$	(Po)	178,13 (1)		1,23 (2)
$ec_{1,0\ L}$	(Po)	254,30 - 257,43		0,74 (2)
$ec_{1,0\ M}$	(Po)	267,08 - 268,55		0,19 (1)
$ec_{3,0\ K}$	(Po)	308,71 (1)		0,234 (8)
$ec_{3,0\ L}$	(Po)	384,88 - 388,00		0,102 (3)
$ec_{3,0\ M}$	(Po)	397,66 - 399,13		0,026 (1)

6 Photon Emissions

6.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(Po)	9,658 — 16,213		1,01 (5)	
$XK\alpha_2$	(Po)	76,864		0,540 (24)	} $K\alpha$
$XK\alpha_1$	(Po)	79,293		0,90 (4)	}
$XK\beta_3$	(Po)	89,256	}		
$XK\beta_1$	(Po)	89,807	}	0,309 (15)	$K'\beta_1$
$XK\beta_5''$	(Po)	90,363	}		
$XK\beta_2$	(Po)	92,263	}		
$XK\beta_4$	(Po)	92,618	}	0,096 (5)	$K'\beta_2$
$XKO_{2,3}$	(Po)	92,983	}		

6.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{3,1}$(Po)	130,58 (1)	0,133 (11)
$\gamma_{4,2}$(Po)	224,04 (7)	0,0014 (2)
$\gamma_{1,0}$(Po)	271,228 (10)	11,07 (22)
$\gamma_{2,0}$(Po)	293,56 (4)	0,075 (3)
$\gamma_{12,5}$(Po)	322 (1)	0,00009 (5)
$\gamma_{8,3}$(Po)	330,9 (4)	0,00100 (11)
$\gamma_{11,4}$(Po)	373,5 (3)	0,00025 (3)
$\gamma_{6,2}$(Po)	383,1 (1)	0,00044 (7)
$\gamma_{3,0}$(Po)	401,81 (1)	6,75 (22)
$\gamma_{6,1}$(Po)	405,4 (1)	0,00025 (4)
$\gamma_{7,1}$(Po)	436,9 (5)	0,00031 (6)
$\gamma_{8,1}$(Po)	461,5 (4)	0,00017 (3)
$\gamma_{11,3}$(Po)	489,3 (3)	0,00064 (9)
$\gamma_{4,0}$(Po)	517,60 (6)	0,043 (3)
$\gamma_{13,4}$(Po)	556,1 (4)	0,00006 (4)
$\gamma_{9,1}$(Po)	564,1 (2)	0,0015 (3)
$\gamma_{14,4}$(Po)	576,6 (10)	0,00009 (5)
$\gamma_{5,0}$(Po)	608,30 (7)	0,0044 (10)
$\gamma_{11,1}$(Po)	619,9 (3)	0,00033 (11)
$\gamma_{(-1,1)}$(Po)	665,5 (10)	0,00009 (5)
$\gamma_{13,3}$(Po)	671,9 (4)	0,00022 (11)
$\gamma_{6,0}$(Po)	676,66 (7)	0,018 (2)
$\gamma_{7,0}$(Po)	708,1 (5)	0,00033 (11)

	Energy keV	Photons per 100 disint.
$\gamma_{8,0}$(Po)	732,7 (4)	0,00007 (4)
$\gamma_{13,1}$(Po)	802,5 (4)	0,00033 (11)
$\gamma_{9,0}$(Po)	835,32 (22)	0,0017 (3)
$\gamma_{10,0}$(Po)	877,2 (6)	0,00033 (11)
$\gamma_{11,0}$(Po)	891,1 (3)	0,0009 (2)
$\gamma_{13,0}$(Po)	1073,7 (4)	0,00033 (11)

7 Main Production Modes

U – 235 (4n + 3) decay chain

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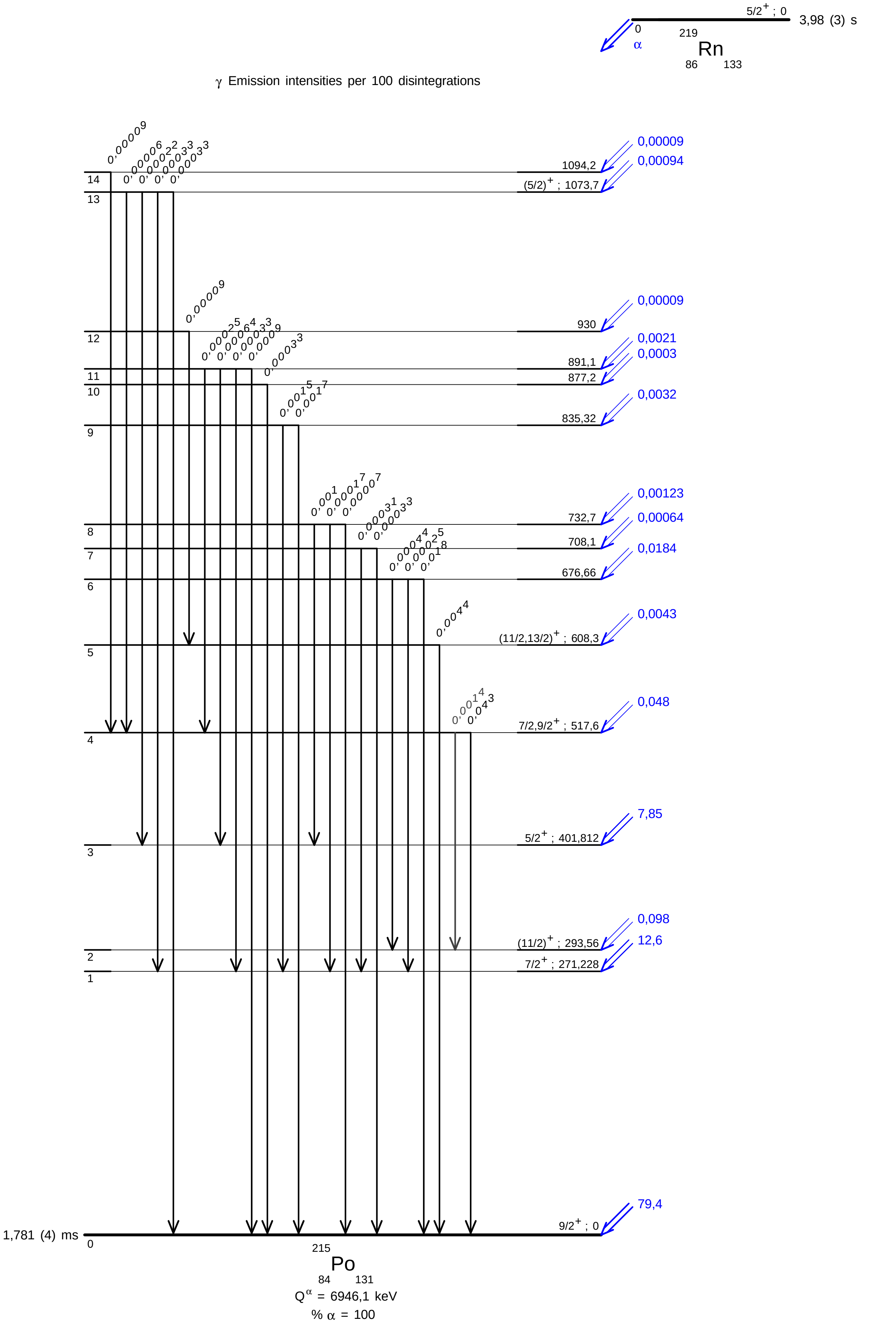

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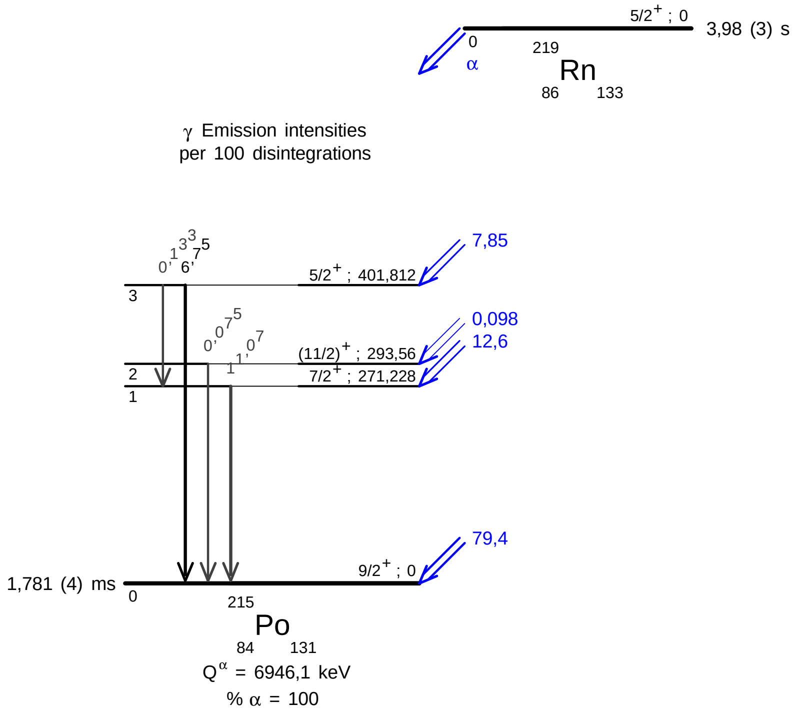

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$^{223}_{87}\mathrm{Fr}_{136}$

1 Decay Scheme

Fr-223 disintegrates 0.020(4)% by alpha emission to excited levels in At-219 and 99.980 (4)% by beta minus emission to exited levels in Ra-223.
Le francium 223 se désintègre par émission alpha (0,020 %) vers des niveaux excités de l'astate 219 et par émission bêta moins (99,980 %) vers le radium 223.

2 Nuclear Data

$T_{1/2}(^{223}\mathrm{Fr})$	:	22,00	(7)	min
$T_{1/2}(^{223}\mathrm{Ra})$	:	11,43	(5)	d
$T_{1/2}(^{219}\mathrm{At})$	:	56	(3)	s
$Q^{\alpha}(^{223}\mathrm{Fr})$	:	5562	(3)	keV
$Q^{-}(^{223}\mathrm{Fr})$	:	1149,2	(9)	keV

2.1 α Transitions

	Energy keV	Probability × 100	F
$\alpha_{0,4}$	5266 (5)	0,0009 (5)	
$\alpha_{0,3}$	5388 (4)	0,0060 (26)	
$\alpha_{0,2}$	5411 (4)	0,0053 (23)	
$\alpha_{0,1}$	5502 (3)	0,0044 (20)	
$\alpha_{0,0}$	5562 (3)	0,0033 (15)	

2.2 β^- Transitions

	Energy keV	Probability × 100	Nature	lg ft
$\beta^-_{0,32}$	120,3 (10)	0,0012 (3)	Super Allowed Or Allowed	7,3
$\beta^-_{0,31}$	124,6 (10)	0,0004 (1)	1st Forbidden	7,82
$\beta^-_{0,30}$	129,9 (10)	0,00046 (12)	1st Forbidden	7,82
$\beta^-_{0,29}$	191,5 (9)	0,020 (4)	Unique th Forbidden	6,7
$\beta^-_{0,28}$	205,9 (9)	0,0082 (18)	Unique th Forbidden	7,19
$\beta^-_{0,27}$	208,4 (9)	0,0051 (12)		7,41
$\beta^-_{0,26}$	222,6 (9)	0,106 (22)	Unique th Forbidden	6,18
$\beta^-_{0,25}$	243,3 (10)	0,0011 (4)	1st Forbidden	8,29
$\beta^-_{0,24}$	281,9 (9)	0,025 (5)	Unique th Forbidden	7,14
$\beta^-_{0,23}$	302,8 (9)	0,088 (18)	1st Forbidden	6,69
$\beta^-_{0,22}$	306,9 (9)	0,035 (7)	Unique th Forbidden	7,11
$\beta^-_{0,21}$	323,3 (9)	0,54 (10)		5,99
$\beta^-_{0,20}$	326,0 (9)	0,014 (3)	Unique th Forbidden	7,59
$\beta^-_{0,19}$	343,8 (9)	0,0040 (8)	Unique th Forbidden	8,21
$\beta^-_{0,18}$	345,4 (9)	0,14 (3)	Unique th Forbidden	6,67
$\beta^-_{0,17}$	362,1 (9)	0,019 (4)	1st Forbidden	7,6
$\beta^-_{0,16}$	366,7 (10)	0,00111 (22)	Unique th Forbidden	8,85
$\beta^-_{0,15}$	555,3 (9)	0,013 (3)	1st Forbidden	8,38
$\beta^-_{0,14}$	773,1 (10)	0,0046 (12)		9,31
$\beta^-_{0,13}$	779,9 (9)	1,8 (4)		6,73
$\beta^-_{0,11}$	806,7 (9)	0,037 (8)	1st Forbidden	8,47
$\beta^-_{0,10}$	814,9 (9)	0,042 (9)	1st Forbidden	8,43
$\beta^-_{0,9}$	819,4 (9)	0,049 (10)	Super Allowed Or Allowed	8,37
$\beta^-_{0,8}$	863,1 (9)	0,032 (9)	1st Forbidden	8,64
$\beta^-_{0,7}$	869,0 (9)	0,004 (4)		9,5
$\beta^-_{0,6}$	914,5 (9)	9,1 (17)		6,27
$\beta^-_{0,5}$	1025,5 (9)	0,24 (6)		8,02
$\beta^-_{0,4}$	1069,6 (9)	15 (3)		6,29
$\beta^-_{0,3}$	1087,8 (9)	0,27 (19)		8,1
$\beta^-_{0,2}$	1099,1 (9)	67 (13)	Super Allowed Or Allowed	5,68
$\beta^-_{0,1}$	1119,3 (9)	6 (6)		6,8
$\beta^-_{0,0}$	1149,2 (9)	1	1st Forbidden	7,6

2.3 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{2,1}$(Ra)	20,27 (5)	12,3 (26)	[E1]		5,77 (16)	1,50 (3)	7,76 (22)
$\gamma_{3,2}$(At)	24,14 (3)	0,012 (6)					
$\gamma_{1,0}$(Ra)	29,78 (4)	26 (7)	M1+8,26%E2		280 (40)	72 (10)	370 (50)
$\gamma_{3,1}$(Ra)	31,69 (5)	0,35	M1+7,27%E2		190 (60)	50 (15)	260 (80)
$\gamma_{9,8}$(Ra)	43,5 (2)	0,0044	E1		0,767 (15)	0,189 (4)	1,015 (19)
$\gamma_{5,4}$(Ra)	44,0 (1)	0,178	M1+21,3%E2		97 (9)	25,5 (24)	131 (12)
$\gamma_{4,1}$(Ra)	49,80 (5)	4,3 (10)	E1		0,535 (8)	0,1309 (19)	0,708 (10)
$\gamma_{2,0}$(Ra)	50,10 (2)	56 (12)	E1		0,526 (8)	0,1288 (18)	0,696 (10)
$\gamma_{1,0}$(At)	58,9 (2)	0,0095 (36)	M1		8,27 (15)	1,96 (4)	10,87 (19)
$\gamma_{3,0}$(Ra)	61,43 (5)	0,34 (7)	E2		71,0 (11)	19,3 (3)	96,5 (14)
$\gamma_{5,3}$(Ra)	62,31 (6)	0,022 (10)	E1		0,294 (5)	0,0716 (11)	0,389 (6)
$\gamma_{5,2}$(Ra)	73,5 (1)	0,054 (38)	E2		30,0 (5)	8,16 (13)	40,8 (6)
$\gamma_{4,0}$(Ra)	79,65 (2)	10,8 (22)	E1		0,1530 (22)	0,0370 (6)	0,202 (3)
$\gamma_{13,7}$(Ra)	89,08 (10)	0,054 (11)					
$\gamma_{5,1}$(Ra)	93,88 (5)	0,067 (16)	E1		0,0989 (14)	0,0239 (4)	0,1305 (18)
$\gamma_{6,5}$(Ra)	111,05 (3)	0,0049 (14)					
$\gamma_{13,6}$(Ra)	134,60 (2)	0,62 (12)	[E1]	0,184 (3)	0,0383 (6)	0,00921 (13)	0,234 (3)
$\gamma_{4,2}$(At)	145,3 (3)	0,00078 (47)	M1+(E2)	1,8 (16)	0,8 (2)	0,20 (6)	2,9 (13)
$\gamma_{2,0}$(At)	150,9 (2)	0,0135 (12)	E2	0,287 (4)	0,836 (13)	0,224 (4)	1,417 (21)
$\gamma_{6,4}$(Ra)	155,5 (5)	0,0027					
$\gamma_{6,3}$(Ra)	173,35 (5)	0,36 (15)	M1, E2	1,4 (12)	0,53 (5)	0,136 (20)	2,1 (12)
$\gamma_{6,2}$(Ra)	184,65 (5)	0,24 (6)	E1	0,0868 (13)	0,01701 (24)	0,00407 (6)	0,1092 (15)
$\gamma_{7,4}$(Ra)	200,7 (2)	0,0027 (10)					
$\gamma_{6,1}$(Ra)	204,85 (5)	2,8 (5)	M1+1,42%E2	1,62 (4)	0,304 (5)	0,0726 (11)	2,02 (5)
$\gamma_{9,5}$(Ra)	205,6 (2)	0,0090 (17)	E2	0,1533 (22)	0,277 (4)	0,0747 (11)	0,530 (8)
$\gamma_{10,5}$(Ra)	210,60 (5)	0,0105 (21)	E1	0,0637 (9)	0,01222 (18)	0,00292 (4)	0,0798 (11)
$\gamma_{7,3}$(Ra)	218,80 (5)	0,0232 (46)	M1	1,368 (20)	0,252 (4)	0,0603 (9)	1,701 (24)
$\gamma_{6,0}$(Ra)	234,70 (5)	6,5 (12)	M1(+0,5%E2)	1,120 (16)	0,207 (3)	0,0495 (7)	1,393 (16)
$\gamma_{8,2}$(Ra)	236,05 (5)	0,029 (8)	E1	0,0489 (7)	0,00922 (13)	0,00220 (3)	0,0610 (9)
$\gamma_{13,5}$(Ra)	245,60 (5)	0,019 (4)					
$\gamma_{7,1}$(Ra)	250,25 (5)	0,035	M1	0,941 (14)	0,1733 (25)	0,0414 (6)	1,170 (16)
$\gamma_{9,4}$(Ra)	250,25 (5)	0,0043	M1+81,5%E2	0,26 (6)	0,132 (4)	0,0344 (8)	0,44 (7)
$\gamma_{10,4}$(Ra)	254,6 (2)	0,0060 (13)	E1	0,0411 (6)	0,00767 (11)	0,00183 (3)	0,0512 (7)
$\gamma_{8,1}$(Ra)	256,18 (5)	0,025 (5)	E2	0,0983 (14)	0,1117 (16)	0,0299 (5)	0,250 (4)
$\gamma_{11,4}$(Ra)	262,9 (2)	0,0037 (12)	E1	0,0382 (6)	0,00709 (10)	0,001692 (24)	0,0475 (7)
$\gamma_{10,3}$(Ra)	272,8 (2)	0,0064 (23)	M1+E2	0,4 (4)	0,112 (25)	0,028 (5)	0,6 (4)
$\gamma_{7,0}$(Ra)	280,7 (5)	0,0003					
$\gamma_{11,3}$(Ra)	280,7 (5)	0,0003					
$\gamma_{8,0}$(Ra)	286,0 (2)	0,0069 (24)	M1+E2	0,4 (3)	0,096 (24)	0,024 (5)	0,5 (4)
$\gamma_{13,4}$(Ra)	289,67 (5)	0,21					
$\gamma_{14,4}$(Ra)	296,5 (2)	0,0022 (7)	M1+1,66%E2	0,581 (9)	0,1074 (16)	0,0257 (4)	0,723 (9)
$\gamma_{9,1}$(Ra)	299,95 (5)	0,0207 (41)	E1	0,0284 (4)	0,00518 (8)	0,001234 (18)	0,0352 (5)
$\gamma_{10,1}$(Ra)	304,40 (5)	0,0142 (28)	M1+6,3%E2(+E0)	0,518 (12)	0,0978 (16)	0,0234 (4)	0,647 (14)
$\gamma_{15,8}$(Ra)	307,93 (5)	0,012 (3)					
$\gamma_{13,3}$(Ra)	307,93 (5)	0,0013 (13)					
$\gamma_{11,1}$(Ra)	312,65 (5)	0,026 (6)	M1+2,5%E2	0,499 (9)	0,0924 (14)	0,0221 (4)	0,621 (10)
$\gamma_{14,3}$(Ra)	314,6 (2)	0,0023 (7)	E1	0,0255 (4)	0,00463 (7)	0,001103 (16)	0,0316 (5)
$\gamma_{13,2}$(Ra)	319,25 (5)	0,73 (14)	M1+3,14%E2	0,468 (8)	0,0869 (13)	0,0208 (3)	0,583 (10)
$\gamma_{9,0}$(Ra)	329,80 (5)	0,025 (5)	(E1)	0,0230 (4)	0,00415 (6)	0,000988 (14)	0,0285 (4)
$\gamma_{10,0}$(Ra)	334,30 (6)	0,0119 (24)	M1+27,12%E2	0,325 (11)	0,0674 (14)	0,0164 (3)	0,414 (13)
$\gamma_{13,1}$(Ra)	339,50 (5)	0,062 (13)					
$\gamma_{11,0}$(Ra)	342,50 (7)	0,0145 (30)	M1+62,5%E2	0,183 (4)	0,0501 (8)	0,012520 (19)	0,250 (5)
$\gamma_{12,0}$(Ra)	350,5 (2)	0,0028 (15)	E1	0,0202 (3)	0,00361 (5)	0,000858 (12)	0,0249 (4)
$\gamma_{13,0}$(Ra)	369,32 (5)	0,089 (18)					
$\gamma_{18,13}$(Ra)	434,4 (1)	0,0022 (7)					
$\gamma_{16,11}$(Ra)	439,6 (3)	0,00030 (8)					
$\gamma_{17,11}$(Ra)	444,5 (3)	0,0011 (4)					

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{16,9}$(Ra)	452,9 (2)	0,0008					
$\gamma_{17,10}$(Ra)	452,9 (2)	0,0008					
$\gamma_{17,9}$(Ra)	457,5 (2)	0,0008					
$\gamma_{18,10}$(Ra)	469,3 (2)	0,001					
$\gamma_{15,5}$(Ra)	469,3 (2)	0,001					
$\gamma_{19,9}$(Ra)	475,4 (1)	0,0027					
$\gamma_{21,12}$(Ra)	475,4 (1)	0,003					
$\gamma_{20,11}$(Ra)	480,9 (3)	0,0013 (4)					
$\gamma_{20,9}$(Ra)	493,4 (2)	0,0024 (7)					
$\gamma_{17,7}$(Ra)	506,9 (2)	0,0022 (7)					
$\gamma_{23,9}$(Ra)	516,7 (2)	0,0032 (8)					
$\gamma_{24,11}$(Ra)	524,8 (2)	0,0043 (12)					
$\gamma_{24,10}$(Ra)	533,1 (3)	0,0019 (7)					
$\gamma_{24,9}$(Ra)	537,2 (2)	0,0019					
$\gamma_{20,8}$(Ra)	537,2 (2)	0,0032					
$\gamma_{21,8}$(Ra)	539,8 (2)	0,0059 (18)					
$\gamma_{21,7}$(Ra)	545,4 (4)	0,00030 (8)					
$\gamma_{17,6}$(Ra)	552,3 (2)	0,0027 (8)					
$\gamma_{22,8}$(Ra)	556,3 (3)	0,0011 (4)					
$\gamma_{18,6}$(Ra)	569,03 (8)	0,049 (11)					
$\gamma_{25,9}$(Ra)	576,1 (4)	0,0011 (4)					
$\gamma_{24,8}$(Ra)	581,3 (4)	0,0013 (4)					
$\gamma_{26,10}$(Ra)	592,3 (2)	0,0032 (10)					
$\gamma_{26,9}$(Ra)	596,9 (4)	0,0008 (3)					
$\gamma_{28,11}$(Ra)	600,7 (4)	0,00054 (14)					
$\gamma_{22,6}$(Ra)	607,6 (3)	0,0022 (7)					
$\gamma_{28,9}$(Ra)	613,6 (4)	0,0011 (4)					
$\gamma_{24,6}$(Ra)	632,7 (3)	0,0022 (7)					
$\gamma_{17,5}$(Ra)	663,7 (3)	0,0011 (4)					
$\gamma_{29,8}$(Ra)	671,9 (4)	0,00054 (14)					
$\gamma_{17,4}$(Ra)	708,3 (3)	0,0013 (4)					
$\gamma_{23,5}$(Ra)	722,65 (5)	0,038 (9)					
$\gamma_{18,4}$(Ra)	724,15 (5)	0,014 (4)					
$\gamma_{17,2}$(Ra)	737,4 (3)	0,0009 (3)					
$\gamma_{18,3}$(Ra)	742,4 (3)	0,0011 (4)					
$\gamma_{21,4}$(Ra)	746,30 (5)	0,020 (5)					
$\gamma_{18,2}$(Ra)	753,65 (5)	0,0094 (22)					
$\gamma_{17,1}$(Ra)	757,20 (5)	0,0076 (20)					
$\gamma_{22,4}$(Ra)	762,6 (2)	0,0024 (7)					
$\gamma_{23,4}$(Ra)	766,64 (5)	0,022 (5)					
$\gamma_{21,2}$(Ra)	775,83 (5)	0,45 (9)					
$\gamma_{22,3}$(Ra)	780,8 (1)	0,003 (1)					
$\gamma_{23,3}$(Ra)	784,93 (5)	0,0086 (21)					
$\gamma_{17,0}$(Ra)	787,13 (5)	0,0003 (3)					
$\gamma_{24,4}$(Ra)	787,6 (2)	0,0024 (7)					
$\gamma_{22,2}$(Ra)	792,2 (3)	0,00054 (14)					
$\gamma_{23,2}$(Ra)	796,22 (5)	0,0108 (25)					
$\gamma_{18,0}$(Ra)	803,77 (5)	0,059 (14)					
$\gamma_{19,0}$(Ra)	806,0 (2)	0,0013 (4)					
$\gamma_{22,1}$(Ra)	812,40 (6)	0,021 (5)					
$\gamma_{27,5}$(Ra)	816,5 (2)	0,0013 (4)					
$\gamma_{20,0}$(Ra)	823,20 (7)	0,0070 (16)					
$\gamma_{21,0}$(Ra)	825,95 (7)	0,054 (13)					
$\gamma_{29,5}$(Ra)	833,9 (2)	0,0013 (4)					
$\gamma_{24,1}$(Ra)	837,5 (1)	0,0097 (21)					
$\gamma_{22,0}$(Ra)	842,2 (1)	0,0049 (11)					
$\gamma_{26,4}$(Ra)	846,85 (10)	0,049 (13)					
$\gamma_{23,0}$(Ra)	846,85 (10)	0,005 (3)					
$\gamma_{28,4}$(Ra)	863,6 (1)	0,0038 (9)					

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{24,0}$(Ra)	867,4 (1)	0,0016 (4)					
$\gamma_{26,2}$(Ra)	876,5 (1)	0,038 (9)					
$\gamma_{29,4}$(Ra)	878,1 (2)	0,0032 (8)					
$\gamma_{28,2}$(Ra)	893,1 (2)	0,0024 (7)					
$\gamma_{26,1}$(Ra)	896,7 (2)	0,013 (3)					
$\gamma_{29,2}$(Ra)	907,6 (2)	0,014 (3)					
$\gamma_{27,1}$(Ra)	911,3 (3)	0,0008 (3)					
$\gamma_{28,1}$(Ra)	913,6 (3)	0,00041 (14)					
$\gamma_{26,0}$(Ra)	926,5 (3)	0,0016 (4)					
$\gamma_{27,0}$(Ra)	941,2 (3)	0,0030 (8)					
$\gamma_{32,4}$(Ra)	949,3 (4)	0,00032 (8)					
$\gamma_{29,0}$(Ra)	958,0 (7)	0,00035 (8)					
$\gamma_{30,2}$(Ra)	969,2 (4)	0,00032 (8)					
$\gamma_{31,2}$(Ra)	975,2 (5)	0,00016 (5)					
$\gamma_{32,2}$(Ra)	978,7 (4)	0,00067 (12)					
$\gamma_{30,1}$(Ra)	989,4 (5)	0,00014 (3)					
$\gamma_{31,1}$(Ra)	994,3 (3)	0,00011 (3)					
$\gamma_{32,1}$(Ra)	999,3 (5)	0,00019 (4)					
$\gamma_{31,0}$(Ra)	1025,1 (5)	0,00014 (3)					

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	}	35,08
	$K\beta_2$	102,89	}	
	$K\beta_4$	103,295	}	11,51
	$KO_{2,3}$	103,74	}	
X_L				
	$L\ell$	10,6241		
	$L\alpha$	12,1957 – 12,3381		
	$L\eta$	13,6624		
	$L\beta$	14,2373 – 16,1261		
	$L\gamma$	17,2756 – 18,3539		

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 – 12,04	

3.2 At

ω_K : 0,966 (4)
$\bar{\omega}_L$: 0,416 (17)
n_{KL} : 0,805 (5)

3.2.1 X Radiations

		Energy keV		Relative probability
X_K				
	$K\alpha_2$	78,94		60,33
	$K\alpha_1$	81,51		100
	$K\beta_3$	91,73	}	
	$K\beta_1$	92,315	}	
	$K\beta_5''$	92,883	}	34,63
	$K\beta_2$	94,846	}	
	$K\beta_4$	95,211	}	10,91
	$KO_{2,3}$	95,595	}	
X_L				
	$L\ell$	9,8964		
	$L\alpha$	11,3052 – 11,426		
	$L\eta$	12,4653		
	$L\beta$	13,1704 – 14,6997		
	$L\gamma$	15,7394 – 16,7291		

4 α Emissions

	Energy keV	Alpha per 100 disint.
$\alpha_{0,4}$	5172 (5)	0,0009 (5)
$\alpha_{0,3}$	5291 (4)	0,0060 (26)
$\alpha_{0,2}$	5314 (4)	0,0053 (23)
$\alpha_{0,1}$	5403 (3)	0,0044 (20)
$\alpha_{0,0}$	5462 (3)	0,0033 (15)

5 Electron Emissions

		Energy keV		Electrons per 100 disint.
e_{AL}	(Ra)	5,71 - 12,04		29 (4)
e_{AK}	(Ra)			0,159 (21)
	KLL	65,149 - 72,729	}	
	KLX	79,721 - 88,466	}	
	KXY	94,27 - 103,91	}	
$ec_{2,1\ L}$	(Ra)	1,04 - 4,83		8,1 (17)
$ec_{1,0\ L}$	(Ra)	10,55 - 14,34		20 (6)
$ec_{3,1\ L}$	(Ra)	12,46 - 16,25		0,26 (8)
$ec_{2,1\ M}$	(Ra)	15,45 - 17,16		2,10 (45)
$ec_{5,4\ L}$	(Ra)	24,768 - 28,556		0,131 (12)
$ec_{1,0\ M}$	(Ra)	24,96 - 26,68		5,0 (14)
$ec_{4,1\ L}$	(Ra)	30,6 - 34,4		1,34 (32)
$ec_{2,0\ L}$	(Ra)	30,9 - 34,7		17,4 (37)
$ec_{3,0\ L}$	(Ra)	42,20 - 45,99		0,25 (5)
$ec_{4,1\ M}$	(Ra)	45,0 - 46,7		0,33 (8)
$ec_{2,0\ M}$	(Ra)	45,3 - 47,0		4,3 (9)
$ec_{4,0\ L}$	(Ra)	60,42 - 64,21		1,38 (28)
$ec_{6,3\ K}$	(Ra)	69,43 (5)		0,16 (14)
$ec_{4,0\ M}$	(Ra)	74,83 - 76,54		0,33 (7)
$ec_{6,1\ K}$	(Ra)	100,93 (5)		1,47 (28)
$ec_{6,0\ K}$	(Ra)	130,78 (5)		3,0 (6)
$ec_{6,1\ L}$	(Ra)	185,62 - 189,41		0,28 (5)
$ec_{13,2\ K}$	(Ra)	215,33 (5)		0,215 (42)
$ec_{6,0\ L}$	(Ra)	215,5 - 219,3		0,56 (10)
$ec_{6,0\ M}$	(Ra)	229,9 - 231,6		0,134 (25)

		Energy keV		Electrons per 100 disint.
$\beta^-_{0,32}$	max:	120,3	(10)	0,0012 (3)
$\beta^-_{0,32}$	avg:	31,5	(3)	
$\beta^-_{0,31}$	max:	124,6	(10)	0,0004 (1)
$\beta^-_{0,31}$	avg:	32,7	(3)	
$\beta^-_{0,30}$	max:	129,9	(10)	0,00046 (12)
$\beta^-_{0,30}$	avg:	34,1	(3)	
$\beta^-_{0,29}$	max:	191,5	(9)	0,020 (4)
$\beta^-_{0,29}$	avg:	51,5	(3)	
$\beta^-_{0,28}$	max:	205,9	(9)	0,0082 (18)
$\beta^-_{0,28}$	avg:	55,6	(3)	
$\beta^-_{0,27}$	max:	208,4	(9)	0,0051 (12)
$\beta^-_{0,27}$	avg:	56,3	(3)	
$\beta^-_{0,26}$	max:	222,6	(9)	0,106 (22)
$\beta^-_{0,26}$	avg:	60,5	(3)	
$\beta^-_{0,25}$	max:	243,3	(10)	0,0011 (4)
$\beta^-_{0,25}$	avg:	66,6	(3)	
$\beta^-_{0,24}$	max:	281,9	(9)	0,025 (5)
$\beta^-_{0,24}$	avg:	78,1	(3)	
$\beta^-_{0,23}$	max:	302,8	(9)	0,088 (18)
$\beta^-_{0,23}$	avg:	84,4	(3)	
$\beta^-_{0,22}$	max:	306,9	(9)	0,035 (7)
$\beta^-_{0,22}$	avg:	85,7	(3)	
$\beta^-_{0,21}$	max:	323,3	(9)	0,54 (10)
$\beta^-_{0,21}$	avg:	90,7	(3)	
$\beta^-_{0,20}$	max:	326,0	(9)	0,014 (3)
$\beta^-_{0,20}$	avg:	91,5	(3)	
$\beta^-_{0,19}$	max:	343,8	(9)	0,0040 (8)
$\beta^-_{0,19}$	avg:	97,0	(3)	
$\beta^-_{0,18}$	max:	345,4	(9)	0,14 (3)
$\beta^-_{0,18}$	avg:	97,5	(3)	
$\beta^-_{0,17}$	max:	362,1	(9)	0,019 (4)
$\beta^-_{0,17}$	avg:	102,7	(3)	
$\beta^-_{0,16}$	max:	366,7	(10)	0,00111 (22)
$\beta^-_{0,16}$	avg:	104,1	(3)	
$\beta^-_{0,15}$	max:	555,3	(9)	0,013 (3)
$\beta^-_{0,15}$	avg:	165,6	(4)	
$\beta^-_{0,14}$	max:	773,1	(10)	0,0046 (12)
$\beta^-_{0,14}$	avg:	241,3	(4)	
$\beta^-_{0,13}$	max:	779,9	(9)	1,8 (4)
$\beta^-_{0,13}$	avg:	243,7	(4)	
$\beta^-_{0,11}$	max:	806,7	(9)	0,037 (8)
$\beta^-_{0,11}$	avg:	253,3	(4)	

		Energy keV		Electrons per 100 disint.
$\beta^-_{0,10}$	max:	814,9	(9)	0,042 (9)
$\beta^-_{0,10}$	avg:	256,3	(4)	
$\beta^-_{0,9}$	max:	819,4	(9)	0,049 (10)
$\beta^-_{0,9}$	avg:	257,9	(4)	
$\beta^-_{0,8}$	max:	863,1	(9)	0,032 (9)
$\beta^-_{0,8}$	avg:	273,8	(4)	
$\beta^-_{0,7}$	max:	869,0	(9)	0,004 (4)
$\beta^-_{0,7}$	avg:	275,9	(4)	
$\beta^-_{0,6}$	max:	914,5	(9)	9,1 (17)
$\beta^-_{0,6}$	avg:	292,6	(4)	
$\beta^-_{0,5}$	max:	1025,5	(9)	0,24 (6)
$\beta^-_{0,5}$	avg:	333,9	(4)	
$\beta^-_{0,4}$	max:	1069,6	(9)	15 (3)
$\beta^-_{0,4}$	avg:	350,5	(4)	
$\beta^-_{0,3}$	max:	1087,8	(9)	0,27 (19)
$\beta^-_{0,3}$	avg:	357,4	(4)	
$\beta^-_{0,2}$	max:	1099,1	(9)	67 (13)
$\beta^-_{0,2}$	avg:	361,7	(4)	
$\beta^-_{0,1}$	max:	1119,3	(9)	6 (6)
$\beta^-_{0,1}$	avg:	369,4	(4)	
$\beta^-_{0,0}$	max:	1149,2	(9)	1
$\beta^-_{0,0}$	avg:	380,8	(4)	

6 Photon Emissions

6.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(Ra)	10,6241 — 18,3539		24 (3)	
$XK\alpha_2$	(Ra)	85,43		1,44 (19)	} $K\alpha$
$XK\alpha_1$	(Ra)	88,47		2,3 (3)	}
$XK\beta_3$	(Ra)	99,432	}		
$XK\beta_1$	(Ra)	100,13	}	0,83 (11)	$K'\beta_1$
$XK\beta''_5$	(Ra)	100,738	}		
$XK\beta_2$	(Ra)	102,89	}		
$XK\beta_4$	(Ra)	103,295	}	0,27 (4)	$K'\beta_2$
$XKO_{2,3}$	(Ra)	103,74	}		

		Energy keV		Photons per 100 disint.	
XL	(At)	9,8964 — 16,7291		0,0054 (13)	
XKα_2	(At)	78,94		0,00056 (15)	} Kα
XKα_1	(At)	81,51		0,00092 (25)	}
XKβ_3	(At)	91,73	}		
XKβ_1	(At)	92,315	}	0,00031 (11)	K$'\beta_1$
XKβ_5''	(At)	92,883	}		
XKβ_2	(At)	94,846	}		
XKβ_4	(At)	95,211	}	0,00011 (6)	K$'\beta_2$
XKO$_{2,3}$	(At)	95,595	}		

6.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{2,1}$(Ra)	20,27 (5)	1,4 (3)
$\gamma_{1,0}$(Ra)	29,78 (4)	0,070 (17)
$\gamma_{3,1}$(Ra)	31,69 (5)	0,00135
$\gamma_{9,8}$(Ra)	43,5 (2)	0,0022
$\gamma_{5,4}$(Ra)	44,0 (1)	0,00135
$\gamma_{4,1}$(Ra)	49,80 (5)	2,5 (6)
$\gamma_{2,0}$(Ra)	50,10 (2)	33 (7)
$\gamma_{1,0}$(At)	58,9 (2)	0,0008 (3)
$\gamma_{3,0}$(Ra)	61,43 (5)	0,0035 (7)
$\gamma_{5,3}$(Ra)	62,31 (6)	0,016 (7)
$\gamma_{5,2}$(Ra)	73,5 (1)	0,0013 (9)
$\gamma_{4,0}$(Ra)	79,65 (2)	9,0 (18)
$\gamma_{13,7}$(Ra)	89,08 (10)	0,054 (11)
$\gamma_{5,1}$(Ra)	93,88 (5)	0,059 (14)
$\gamma_{6,5}$(Ra)	111,05 (3)	0,0049 (14)
$\gamma_{13,6}$(Ra)	134,60 (2)	0,5 (1)
$\gamma_{4,2}$(At)	145,3 (3)	0,0002 (1)
$\gamma_{2,0}$(At)	150,9 (2)	0,0056 (5)
$\gamma_{6,4}$(Ra)	155,5 (5)	0,0027
$\gamma_{6,3}$(Ra)	173,35 (5)	0,115 (22)
$\gamma_{6,2}$(Ra)	184,65 (5)	0,22 (5)
$\gamma_{7,4}$(Ra)	200,7 (2)	0,0027 (10)
$\gamma_{6,1}$(Ra)	204,85 (5)	0,92 (18)
$\gamma_{9,5}$(Ra)	205,6 (2)	0,0059 (11)
$\gamma_{10,5}$(Ra)	210,60 (5)	0,0097 (19)
$\gamma_{7,3}$(Ra)	218,80 (5)	0,0086 (17)
$\gamma_{6,0}$(Ra)	234,70 (5)	2,7 (5)
$\gamma_{8,2}$(Ra)	236,05 (5)	0,027 (8)

	Energy keV	Photons per 100 disint.
$\gamma_{13,5}$(Ra)	245,60 (5)	0,019 (4)
$\gamma_{7,1}$(Ra)	250,25 (5)	0,016
$\gamma_{9,4}$(Ra)	250,25 (5)	0,003
$\gamma_{10,4}$(Ra)	254,6 (2)	0,0057 (12)
$\gamma_{8,1}$(Ra)	256,18 (5)	0,020 (4)
$\gamma_{11,4}$(Ra)	262,9 (2)	0,0035 (11)
$\gamma_{10,3}$(Ra)	272,8 (2)	0,004 (1)
$\gamma_{11,3}$(Ra)	280,7 (5)	0,0003
$\gamma_{7,0}$(Ra)	280,7 (5)	0,0003
$\gamma_{8,0}$(Ra)	286,0 (2)	0,0046 (10)
$\gamma_{13,4}$(Ra)	289,67 (5)	0,21
$\gamma_{14,4}$(Ra)	296,5 (2)	0,0013 (4)
$\gamma_{9,1}$(Ra)	299,95 (5)	0,020 (4)
$\gamma_{10,1}$(Ra)	304,40 (5)	0,0086 (17)
$\gamma_{13,3}$(Ra)	307,93 (5)	0,0013 (13)
$\gamma_{15,8}$(Ra)	307,93 (5)	0,012 (3)
$\gamma_{11,1}$(Ra)	312,65 (5)	0,016 (4)
$\gamma_{14,3}$(Ra)	314,6 (2)	0,0022 (7)
$\gamma_{13,2}$(Ra)	319,25 (5)	0,46 (9)
$\gamma_{9,0}$(Ra)	329,80 (5)	0,024 (5)
$\gamma_{10,0}$(Ra)	334,30 (6)	0,0084 (17)
$\gamma_{13,1}$(Ra)	339,50 (5)	0,062 (13)
$\gamma_{11,0}$(Ra)	342,50 (7)	0,0116 (24)
$\gamma_{12,0}$(Ra)	350,5 (2)	0,0027 (15)
$\gamma_{13,0}$(Ra)	369,32 (5)	0,089 (18)
$\gamma_{18,13}$(Ra)	434,4 (1)	0,0022 (7)
$\gamma_{16,11}$(Ra)	439,6 (3)	0,00030 (8)
$\gamma_{17,11}$(Ra)	444,5 (3)	0,0011 (4)
$\gamma_{16,9}$(Ra)	452,9 (2)	0,0008
$\gamma_{17,10}$(Ra)	452,9 (2)	0,0008
$\gamma_{17,9}$(Ra)	457,5 (2)	0,0008
$\gamma_{15,5}$(Ra)	469,3 (2)	0,001
$\gamma_{18,10}$(Ra)	469,3 (2)	0,001
$\gamma_{19,9}$(Ra)	475,4 (1)	0,0027
$\gamma_{21,12}$(Ra)	475,4 (1)	0,003
$\gamma_{20,11}$(Ra)	480,9 (3)	0,0013 (4)
$\gamma_{20,9}$(Ra)	493,4 (2)	0,0024 (7)
$\gamma_{17,7}$(Ra)	506,9 (2)	0,0022 (7)
$\gamma_{23,9}$(Ra)	516,7 (2)	0,0032 (8)
$\gamma_{24,11}$(Ra)	524,8 (2)	0,0043 (12)
$\gamma_{24,10}$(Ra)	533,1 (3)	0,0019 (7)
$\gamma_{24,9}$(Ra)	537,2 (2)	0,0019
$\gamma_{20,8}$(Ra)	537,2 (2)	0,0032
$\gamma_{21,8}$(Ra)	539,8 (2)	0,0059 (18)
$\gamma_{21,7}$(Ra)	545,4 (4)	0,00030 (8)
$\gamma_{17,6}$(Ra)	552,3 (2)	0,0027 (8)
$\gamma_{22,8}$(Ra)	556,3 (3)	0,0011 (4)

	Energy keV	Photons per 100 disint.
$\gamma_{18,6}$(Ra)	569,03 (8)	0,049 (11)
$\gamma_{25,9}$(Ra)	576,1 (4)	0,0011 (4)
$\gamma_{24,8}$(Ra)	581,3 (4)	0,0013 (4)
$\gamma_{26,10}$(Ra)	592,3 (2)	0,0032 (10)
$\gamma_{26,9}$(Ra)	596,9 (4)	0,0008 (3)
$\gamma_{28,11}$(Ra)	600,7 (4)	0,00054 (14)
$\gamma_{22,6}$(Ra)	607,6 (3)	0,0022 (7)
$\gamma_{28,9}$(Ra)	613,6 (4)	0,0011 (4)
$\gamma_{24,6}$(Ra)	632,7 (3)	0,0022 (7)
$\gamma_{17,5}$(Ra)	663,7 (3)	0,0011 (4)
$\gamma_{29,8}$(Ra)	671,9 (4)	0,00054 (14)
$\gamma_{17,4}$(Ra)	708,3 (3)	0,0013 (4)
$\gamma_{23,5}$(Ra)	722,65 (5)	0,038 (9)
$\gamma_{18,4}$(Ra)	724,15 (5)	0,014 (4)
$\gamma_{17,2}$(Ra)	737,4 (3)	0,0009 (3)
$\gamma_{18,3}$(Ra)	742,4 (3)	0,0011 (4)
$\gamma_{21,4}$(Ra)	746,30 (5)	0,020 (5)
$\gamma_{18,2}$(Ra)	753,65 (5)	0,0094 (22)
$\gamma_{17,1}$(Ra)	757,20 (5)	0,0076 (20)
$\gamma_{22,4}$(Ra)	762,6 (2)	0,0024 (7)
$\gamma_{23,4}$(Ra)	766,64 (5)	0,022 (5)
$\gamma_{21,2}$(Ra)	775,83 (5)	0,45 (9)
$\gamma_{22,3}$(Ra)	780,8 (1)	0,003 (1)
$\gamma_{23,3}$(Ra)	784,93 (5)	0,0086 (21)
$\gamma_{24,4}$(Ra)	787,6 (2)	0,0024 (7)
$\gamma_{17,0}$(Ra)	787,6 (2)	0,0003 (3)
$\gamma_{22,2}$(Ra)	792,2 (3)	0,00054 (14)
$\gamma_{23,2}$(Ra)	796,22 (5)	0,0108 (25)
$\gamma_{18,0}$(Ra)	803,77 (5)	0,059 (14)
$\gamma_{19,0}$(Ra)	806,0 (2)	0,0013 (4)
$\gamma_{22,1}$(Ra)	812,40 (6)	0,021 (5)
$\gamma_{27,5}$(Ra)	816,5 (2)	0,0013 (4)
$\gamma_{20,0}$(Ra)	823,20 (7)	0,0070 (16)
$\gamma_{21,0}$(Ra)	825,95 (7)	0,054 (13)
$\gamma_{29,5}$(Ra)	833,9 (2)	0,0013 (4)
$\gamma_{24,1}$(Ra)	837,5 (1)	0,0097 (21)
$\gamma_{22,0}$(Ra)	842,2 (1)	0,0049 (11)
$\gamma_{26,4}$(Ra)	846,85 (10)	0,049 (13)
$\gamma_{23,0}$(Ra)	846,85 (10)	0,005 (3)
$\gamma_{28,4}$(Ra)	863,6 (1)	0,0038 (9)
$\gamma_{24,0}$(Ra)	867,4 (1)	0,0016 (4)
$\gamma_{26,2}$(Ra)	876,5 (1)	0,038 (9)
$\gamma_{29,4}$(Ra)	878,1 (2)	0,0032 (8)
$\gamma_{28,2}$(Ra)	893,1 (2)	0,0024 (7)
$\gamma_{26,1}$(Ra)	896,7 (2)	0,013 (3)
$\gamma_{29,2}$(Ra)	907,6 (2)	0,014 (3)
$\gamma_{27,1}$(Ra)	911,3 (3)	0,0008 (3)

	Energy keV	Photons per 100 disint.
$\gamma_{28,1}$(Ra)	913,6 (3)	0,00041 (14)
$\gamma_{26,0}$(Ra)	926,5 (3)	0,0016 (4)
$\gamma_{27,0}$(Ra)	941,2 (3)	0,0030 (8)
$\gamma_{32,4}$(Ra)	949,3 (4)	0,00032 (8)
$\gamma_{29,0}$(Ra)	958,0 (7)	0,00035 (8)
$\gamma_{30,2}$(Ra)	969,2 (4)	0,00032 (8)
$\gamma_{31,2}$(Ra)	975,2 (5)	0,00016 (5)
$\gamma_{32,2}$(Ra)	978,7 (4)	0,00067 (12)
$\gamma_{30,1}$(Ra)	989,4 (5)	0,00014 (3)
$\gamma_{31,1}$(Ra)	994,3 (3)	0,00011 (3)
$\gamma_{32,1}$(Ra)	999,3 (5)	0,00019 (4)
$\gamma_{31,0}$(Ra)	1025,1 (5)	0,00014 (3)

7 Main Production Modes

U – 235 decay chain

8 References

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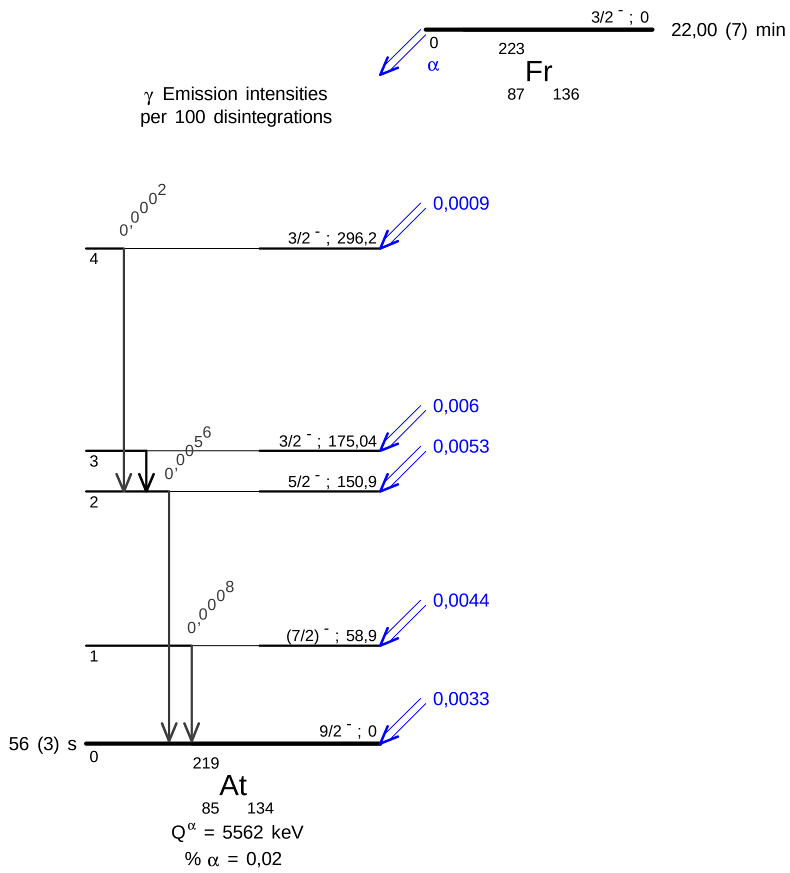

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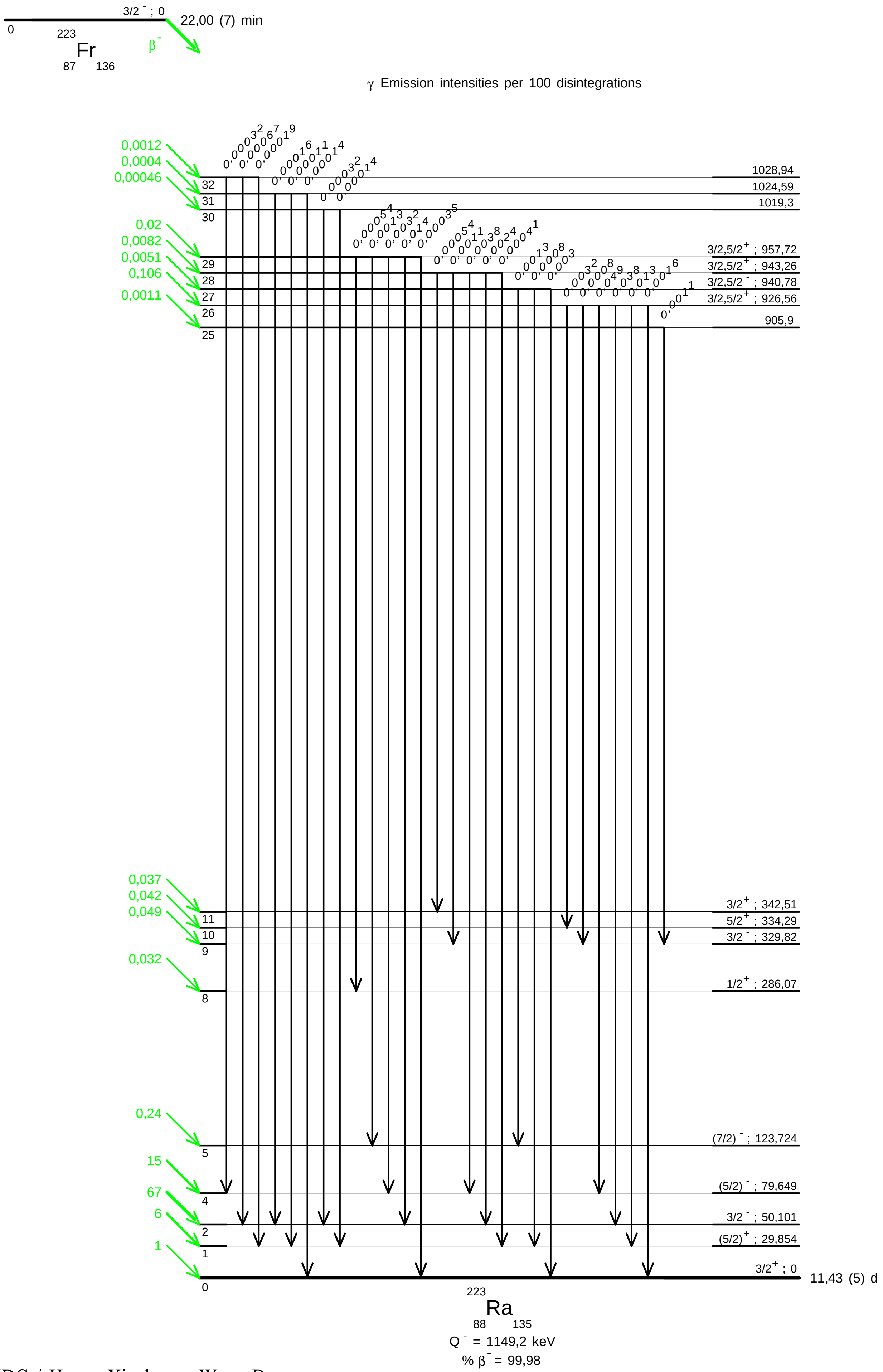

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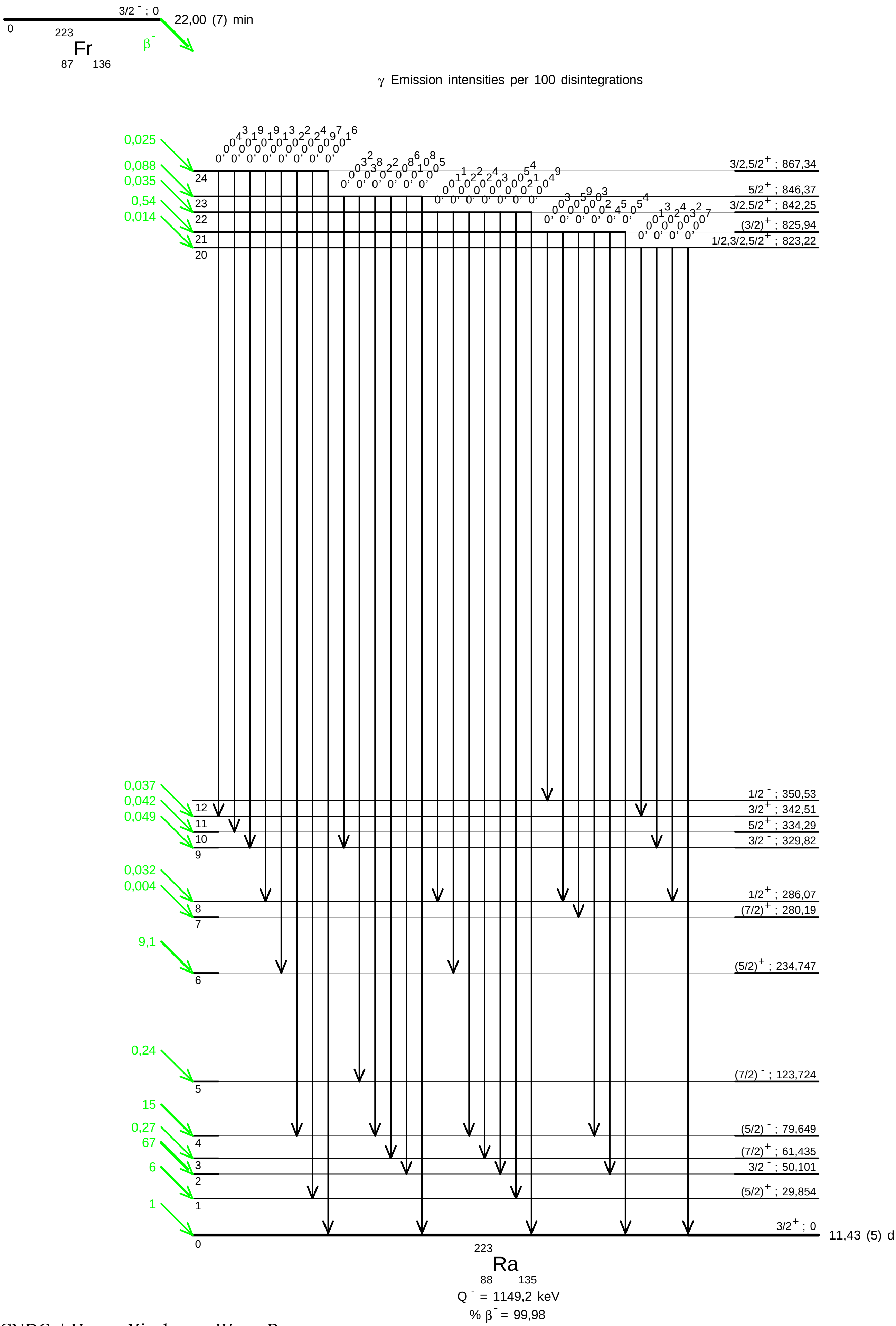

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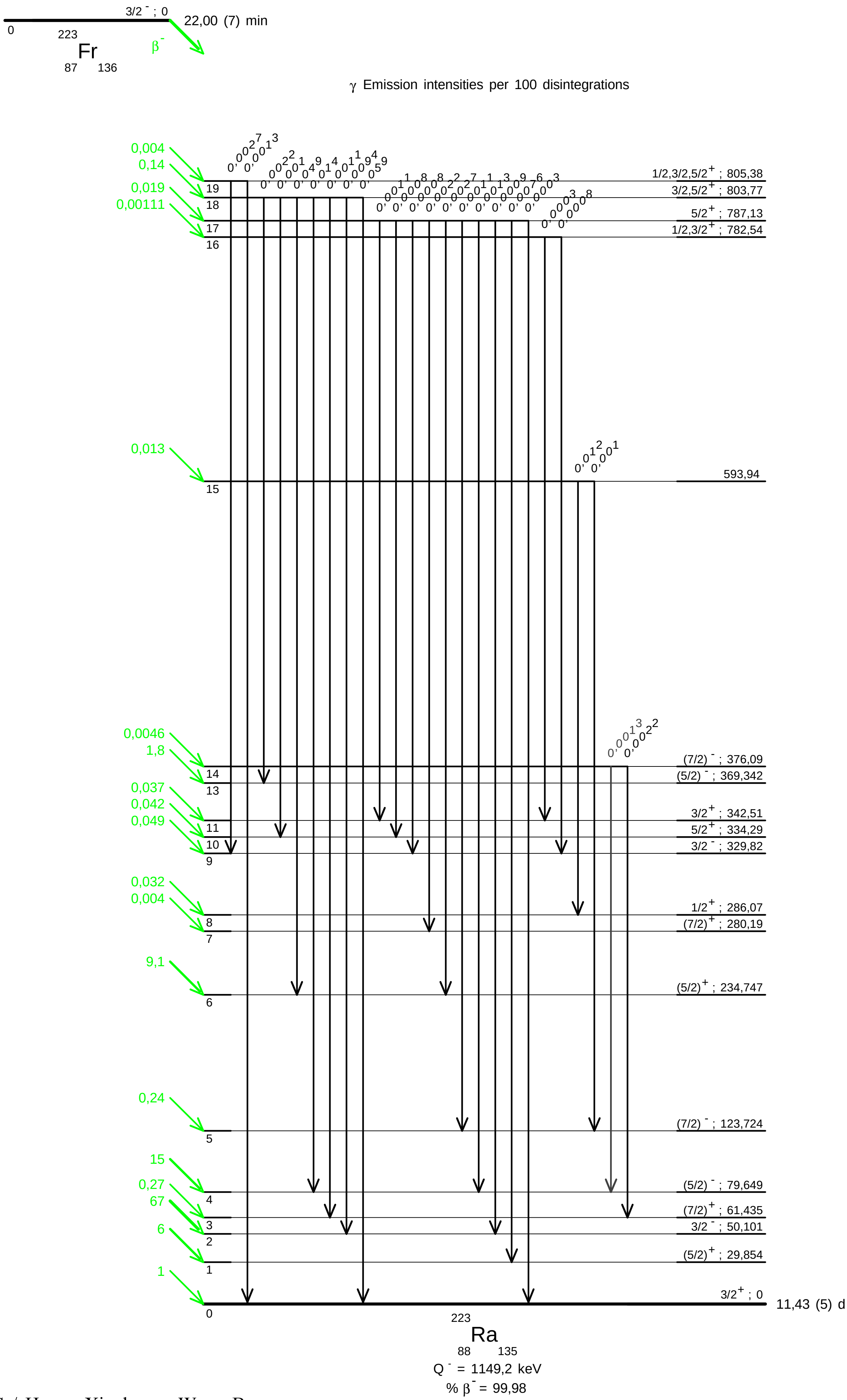

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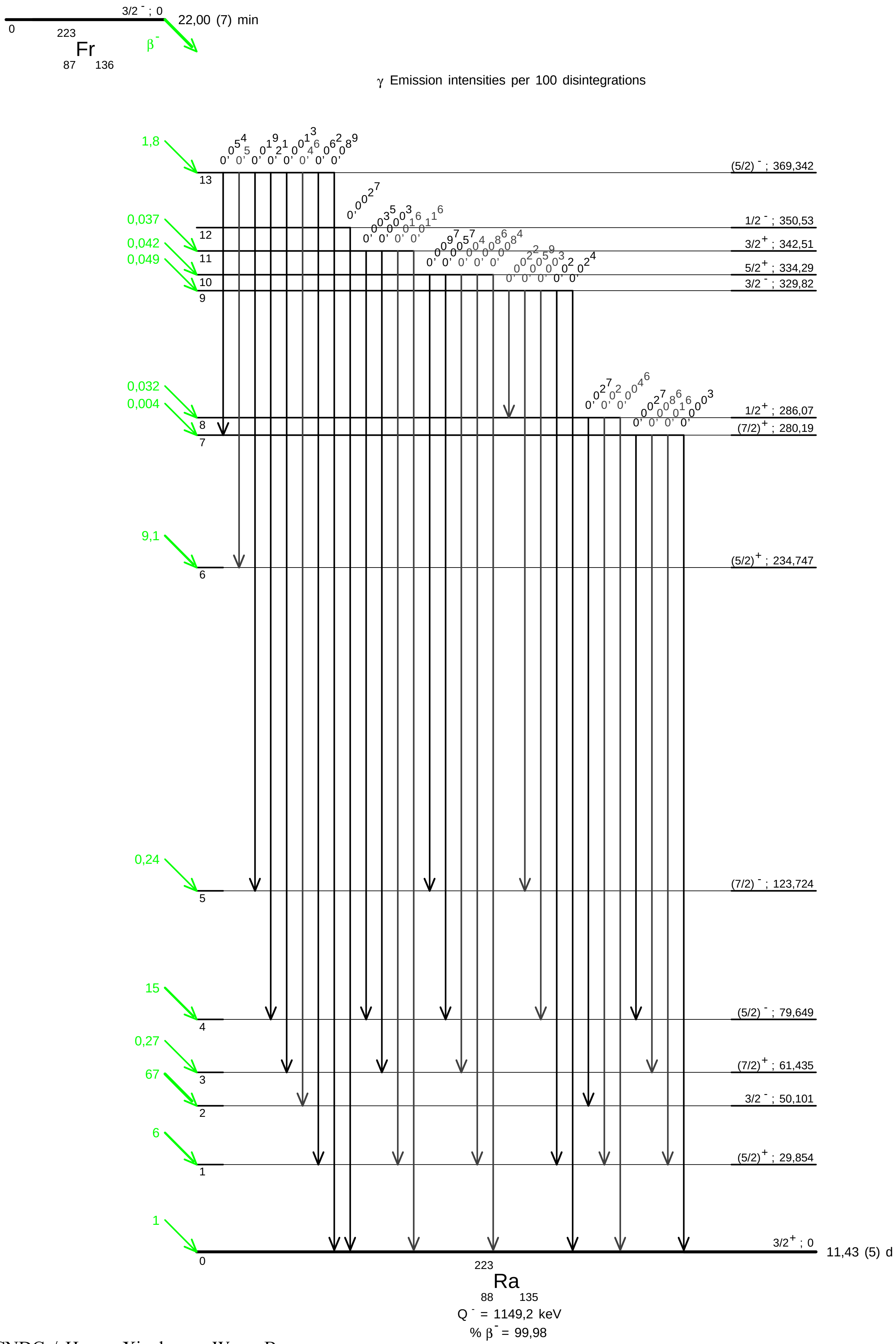

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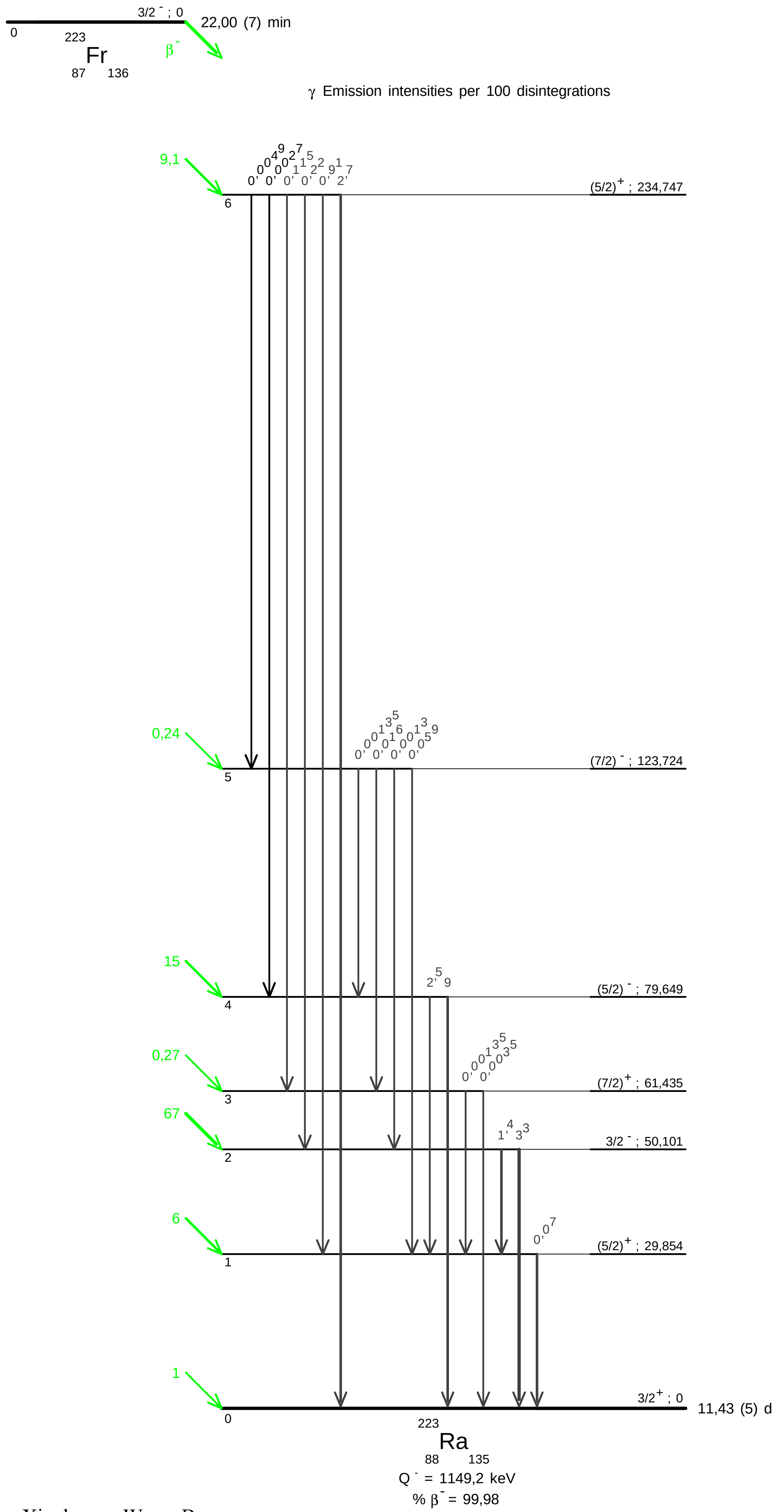

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$^{223}_{88}\text{Ra}_{135}$

1 Decay Scheme

Ra-223 decays by alpha emissions to excited levels in Rn-219.
Le radium 223 se désintègre par émissions alpha vers des niveaux excités du radon 219.

2 Nuclear Data

$T_{1/2}(^{223}\text{Ra})$	:	11,43	(3)	d
$T_{1/2}(^{219}\text{Rn})$	:	3,98	(3)	s
$Q^{\alpha}(^{223}\text{Ra})$	:	5978,99	(21)	keV

2.1 α Transitions

	Energy keV	Probability × 100	F
$\alpha_{0,30}$	5106	~ 0,00044	~ 117
$\alpha_{0,29}$	5118	~ 0,00063	~ 97
$\alpha_{0,28}$	5128	~ 0,0004	~ 175
$\alpha_{0,27}$	5149	~ 0,0002	~ 468
$\alpha_{0,26}$	5179	~ 0,0003	~ 470
$\alpha_{0,25}$	5206	~ 0,0006	~ 339
$\alpha_{0,24}$	5231	~ 0,0017	~ 168
$\alpha_{0,23}$	5246,19 (23)	0,021	16,6
$\alpha_{0,22}$	5267,69 (23)	0,026	17,9
$\alpha_{0,21}$	5306,4 (5)	0,0053	147
$\alpha_{0,20}$	5332,89 (23)	0,041	27
$\alpha_{0,19}$	5355,31 (21)	0,042	35
$\alpha_{0,18}$	5380,27 (21)	0,093	21,8
$\alpha_{0,17}$	5384,89 (23)	0,16 (4)	13
$\alpha_{0,16}$	5437,00 (21)	~ 0,13	~ 32
$\alpha_{0,14}$	5464,49 (23)	~ 0,13	~ 45
$\alpha_{0,12}$	5532,17 (21)	0,50 (8)	27
$\alpha_{0,11}$	5533,96 (21)	1,60 (24)	9

	Energy keV	Probability × 100	F
$\alpha_{0,10}$	5581,9 (5)	~ 0,008	~ 3150
$\alpha_{0,8}$	5602,73 (21)	0,74 (25)	44
$\alpha_{0,6}$	5640,72 (21)	10,6 (10)	4,8
$\alpha_{0,5}$	5709,51 (21)	25,8 (11)	4,5
$\alpha_{0,4}$	5820,35 (21)	49,6 (12)	8,4
$\alpha_{0,3}$	5852,22 (21)	10,0 (3)	60
$\alpha_{0,2}$	5964,62 (21)	0,32 (4)	6480
$\alpha_{0,0}$	5978,99 (21)	1,0 (2)	2420

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{1,0}$(Rn)	4,47 (1)	54,9 (23)	E2			510000	860000
$\gamma_{2,1}$(Rn)	9,90 (2)	15,7 (21)	M1+E2			750 (30)	990 (40)
$\gamma_{2,0}$(Rn)	14,37 (1)	10,0 (8)	M1+E2			409 (11)	539 (15)
$\gamma_{4,3}$(Rn)	31,87 (2)	0,21 (4)	(E2)		1490 (22)	398 (6)	2010 (30)
$\gamma_{9,7}$(Rn)	34,5 (2)	0,14 (6)					
$\gamma_{12,9}$(Rn)	69,5 (1)	0,059 (25)	M1		5,60 (9)	1,33 (2)	7,36 (11)
$\gamma_{15,12}$(Rn)	70,9 (2)	0,0036 (11)					
$\gamma_{11,7}$(Rn)	102,2 (2)	0,0008 (4)					
$\gamma_{17,13}$(Rn)	103,2 (2)	0,064 (35)	M1+E2	5 (5)	3,5 (17)	0,9 (5)	9,6 (24)
$\gamma_{12,7}$(Rn)	104,04 (4)	0,20 (5)	M1+E2	5 (5)	3,3 (16)	0,9 (5)	9,4 (24)
$\gamma_{11,6}$(Rn)	106,78 (3)	0,277 (17)	(M1)	8,77 (13)	1,608 (23)	0,382 (6)	10,89 (16)
$\gamma_{12,6}$(Rn)	108,5 (2)	0,006 (3)					
$\gamma_{5,4}$(Rn)	110,856 (10)	0,369 (26)	E2	0,363 (5)	3,69 (6)	0,994 (14)	5,36 (8)
$\gamma_{22,18}$(Rn)	112,6	0,045					
$\gamma_{13,8}$(Rn)	114,7 (2)	0,010 (4)					
$\gamma_{3,1}$(Rn)	122,319 (10)	10,32 (21)	M1+E2	5,88 (9)	1,109 (17)	0,265 (4)	7,34 (11)
$\gamma_{20,14}$(Rn)	131,6 (2)	0,006 (3)					
$\gamma_{14,8}$(Rn)	138,3 (3)	0,0017 (7)					
$\gamma_{4,2}$(Rn)	144,27 (2)	18,8 (5)	M1+E2	3,69 (6)	0,684 (10)	0,1629 (23)	4,59 (7)
$\gamma_{17,12}$(Rn)	147,2 (3)	0,006 (3)					
$\gamma_{4,1}$(Rn)	154,208 (10)	28,2 (7)	M1	3,09 (5)	0,560 (8)	0,1331 (19)	3,83 (6)
$\gamma_{4,0}$(Rn)	158,635 (10)	3,18 (11)	M1+E2	2,77 (13)	0,523 (13)	0,125 (4)	3,46 (12)
$\gamma_{16,8}$(Rn)	165,8 (2)	0,0054 (28)					
$\gamma_{11,5}$(Rn)	175,65 (15)	0,017 (4)					
$\gamma_{12,5}$(Rn)	177,3 (1)	0,047 (4)					
$\gamma_{6,4}$(Rn)	179,54 (6)	0,480 (45)	M1+E2	1,62 (7)	0,376 (6)	0,0922 (16)	2,12 (7)
$\gamma_{20,12}$(Rn)	199,3 (3)	0,0030 (14)					
$\gamma_{18,9}$(Rn)	221,32 (24)	0,038 (6)	E1	0,0543 (8)	0,01005 (15)	0,00239 (4)	0,0675 (10)
$\gamma_{19,8}$(Rn)	247,2 (5)	0,0097 (28)					
$\gamma_{8,3}$(Rn)	249,49 (3)	0,061 (22)	M1+E2	0,5 (4)	0,125 (20)	0,031 (4)	0,6 (4)
$\gamma_{17,7}$(Rn)	251,6 (3)	0,088 (27)	M1+E2	0,4 (4)	0,122 (20)	0,030 (4)	0,6 (4)
$\gamma_{5,2}$(Rn)	255,2 (2)	0,048 (7)					
$\gamma_{17,6}$(Rn)	255,7 (3)	0,0055 (28)					
$\gamma_{18,6}$(Rn)	260,4 (3)	0,0067 (28)					
$\gamma_{5,0}$(Rn)	269,463 (10)	25,5 (6)	M1+E2	0,637 (12)	0,1157 (17)	0,0275 (4)	0,789 (14)
$\gamma_{10,3}$(Rn)	270,3 (4)	0,0007 (4)					
$\gamma_{23,12}$(Rn)	286,0 (4)	0,0011 (6)					

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{12,4}$(Rn)	288,18 (3)	0,167 (5)	E1	0,0295 (5)	0,00527 (8)	0,001249 (18)	0,0364 (6)
$\gamma_{6,2}$(Rn)	323,871 (10)	5,98 (14)	M1+E2	0,382 (15)	0,0691 (17)	0,0164 (4)	0,473 (17)
$\gamma_{7,2}$(Rn)	328,38 (3)	0,209 (10)	(E1)	0,0220 (3)	0,00387 (6)	0,000916 (13)	0,0271 (4)
$\gamma_{6,1}$(Rn)	334,01 (6)	0,110 (7)	(E2)	0,0546 (8)	0,0343 (5)	0,00895 (13)	0,1007 (15)
$\gamma_{6,0}$(Rn)	338,282 (10)	4,08 (9)	M1	0,348 (5)	0,0622 (9)	0,01475 (21)	0,430 (6)
$\gamma_{7,0}$(Rn)	342,78 (2)	0,232 (13)	E1	0,0200 (3)	0,00351 (5)	0,000828 (12)	0,0246 (4)
$\gamma_{23,9}$(Rn)	355,5 (2)	0,0043 (14)					
$\gamma_{14,4}$(Rn)	355,7 (2)	0,0028 (14)					
$\gamma_{8,2}$(Rn)	361,89 (2)	0,028 (7)					
$\gamma_{9,2}$(Rn)	362,9 (2)	0,016 (7)					
$\gamma_{22,7}$(Rn)	368,56 (12)	0,009 (4)					
$\gamma_{8,1}$(Rn)	371,676 (15)	0,665 (15)	M1	0,270 (4)	0,0481 (7)	0,01139 (16)	0,333 (5)
$\gamma_{9,1}$(Rn)	372,86 (6)	0,052	E1	0,01667 (24)	0,00289 (4)	0,000682 (10)	0,0205 (3)
$\gamma_{8,0}$(Rn)	376,26 (2)	0,013 (4)					
$\gamma_{16,4}$(Rn)	383,35 (2)	0,007 (4)					
$\gamma_{14,3}$(Rn)	387,7 (2)	0,016 (6)					
$\gamma_{23,7}$(Rn)	390,1 (2)	0,0046 (21)					
$\gamma_{11,2}$(Rn)	430,6 (3)	0,020 (6)					
$\gamma_{12,2}$(Rn)	432,45 (3)	0,0356 (29)					
$\gamma_{11,0}$(Rn)	445,033 (12)	1,542 (48)	M1	0,1661 (24)	0,0295 (5)	0,00698 (10)	0,205 (3)
$\gamma_{20,4}$(Rn)	487,5 (2)	0,011 (2)					
$\gamma_{(-1,1)}$(Rn)	490,8 (3)	0,0017 (7)					
$\gamma_{14,2}$(Rn)	500,0 (4)	0,0014 (6)					
$\gamma_{14,1}$(Rn)	510,0 (4)	0,0004 (3)					
$\gamma_{(-1,2)}$(Rn)	523,2 (4)	0,0014 (6)					
$\gamma_{16,2}$(Rn)	527,611 (13)	0,073 (4)					
$\gamma_{(-1,3)}$(Rn)	532,9 (4)	0,0014 (6)					
$\gamma_{16,1}$(Rn)	537,6 (1)	0,0021 (7)					
$\gamma_{16,0}$(Rn)	541,99 (2)	0,0014 (6)					
$\gamma_{21,3}$(Rn)	545,8 (5)	0,0011 (6)					
$\gamma_{23,4}$(Rn)	574,1 (7)	0,0011 (6)					
$\gamma_{17,2}$(Rn)	579,6 (3)	0,0014 (6)					
$\gamma_{18,2}$(Rn)	584,3 (3)	0,0014 (6)					
$\gamma_{17,0}$(Rn)	594,0 (3)	0,0014 (6)					
$\gamma_{18,0}$(Rn)	598,721 (24)	0,092 (4)					
$\gamma_{19,2}$(Rn)	609,31 (4)	0,057 (3)					
$\gamma_{19,1}$(Rn)	619,1 (4)	0,0036 (11)					
$\gamma_{19,0}$(Rn)	623,68 (4)	0,009 (4)					
$\gamma_{20,2}$(Rn)	631,7 (7)	0,0004 (3)					
$\gamma_{20,1}$(Rn)	641,7 (4)	0,0017 (7)					
$\gamma_{20,0}$(Rn)	646,1 (5)	0,0004 (4)					
$\gamma_{22,2}$(Rn)	696,9 (7)	0,0007 (3)					
$\gamma_{22,0}$(Rn)	711,3 (2)	0,0037 (10)					
$\gamma_{23,2}$(Rn)	718,4 (4)	0,0014 (6)					
$\gamma_{23,1}$(Rn)	728,4 (8)	0,00028 (14)					
$\gamma_{23,0}$(Rn)	732,8 (6)	0,0006 (3)					
$\gamma_{(-1,25)}$(Rn)	737,2 (8)	0,00028 (14)					

3 Atomic Data

3.1 Rn

ω_K	:	0,967	(4)
$\bar{\omega}_L$	:	0,428	(17)
n_{KL}	:	0,804	(5)

3.1.1 X Radiations

		Energy keV		Relative probability
X_K				
	$K\alpha_2$	81,07		60,62
	$K\alpha_1$	83,78		100
	$K\beta_3$	94,247	}	
	$K\beta_1$	94,868	}	
	$K\beta_5''$	95,449	}	34,68
	$K\beta_2$	97,48	}	
	$K\beta_4$	97,853	}	11,097
	$KO_{2,3}$	98,357	}	
X_L				
	$L\ell$	10,1372		
	$L\alpha$	11,5981 – 11,7259		
	$L\eta$	12,8551		
	$L\beta$	13,5219 – 14,5189		
	$L\gamma$	16,2398 – 17,2578		

3.1.2 Auger Electrons

	Energy keV	Relative probability
Auger K		
KLL	62,017 – 68,885	100
KLX	75,744 – 83,785	57
KXY	89,45 – 98,39	8,12
Auger L	5,66 – 17,95	

4 α Emissions

	Energy keV	alpha per 100 disint.
$\alpha_{0,30}$	5014,3	~ 0,00044
$\alpha_{0,29}$	5026,1	~ 0,00063
$\alpha_{0,28}$	5035,9	~ 0,0004
$\alpha_{0,27}$	5056,5	~ 0,0002
$\alpha_{0,26}$	5086	~ 0,0003
$\alpha_{0,25}$	5112,5	~ 0,0006
$\alpha_{0,24}$	5137,1	~ 0,0017
$\alpha_{0,23}$	5151,98 (23)	0,021
$\alpha_{0,22}$	5173,10 (23)	0,026
$\alpha_{0,21}$	5211,1 (5)	0,0053
$\alpha_{0,20}$	5237,12 (23)	0,041
$\alpha_{0,19}$	5259,14 (21)	0,042
$\alpha_{0,18}$	5283,65 (21)	0,093
$\alpha_{0,17}$	5288,19 (23)	0,16 (4)
$\alpha_{0,16}$	5339,37 (21)	~ 0,13
$\alpha_{0,14}$	5366,37 (23)	~ 0,13
$\alpha_{0,12}$	5432,83 (21)	0,50 (8)
$\alpha_{0,11}$	5434,60 (21)	1,60 (24)
$\alpha_{0,10}$	5481,7 (5)	~ 0,008
$\alpha_{0,8}$	5502,12 (21)	0,74 (25)
$\alpha_{0,6}$	5539,43 (21)	10,6 (10)
$\alpha_{0,5}$	5606,99 (21)	25,8 (11)
$\alpha_{0,4}$	5715,84 (21)	49,6 (12)
$\alpha_{0,3}$	5747,14 (21)	10,0 (3)
$\alpha_{0,2}$	5857,52 (21)	0,32 (4)
$\alpha_{0,0}$	5871,63 (21)	1,0 (2)

5 Electron Emissions

		Energy keV		Electrons per 100 disint.
e_{AL}	(Rn)	5,66 - 17,95		30,1 (4)
e_{AK}	(Rn)			1,73 (21)
	KLL	62,017 - 68,885	}	
	KLX	75,744 - 83,785	}	
	KXY	89,45 - 98,39	}	
$ec_{17,13\ K}$	(Rn)	4,8 (2)		0,03 (3)
$ec_{2,1\ M}$	(Rn)	5,4 - 7,0		11,8 (16)

		Energy keV		Electrons per 100 disint.
$ec_{12,7\ K}$	(Rn)	5,64	(4)	0,1 (1)
$ec_{11,6\ K}$	(Rn)	8,38	(3)	0,204 (13)
$ec_{2,1\ N}$	(Rn)	8,8	- 9,7	3,05 (41)
$ec_{2,0\ M}$	(Rn)	9,90	- 11,49	7,6 (6)
$ec_{5,4\ K}$	(Rn)	12,46	(1)	0,0211 (15)
$ec_{2,0\ N}$	(Rn)	13,28	- 14,15	1,96 (15)
$ec_{4,3\ L}$	(Rn)	13,82	- 17,26	0,156 (31)
$ec_{3,1\ K}$	(Rn)	23,92	(1)	7,28 (16)
$ec_{3,1\ T}$	(Rn)	23,922	- 122,276	9,09 (19)
$ec_{4,3\ M}$	(Rn)	27,40	- 28,99	0,042 (8)
$ec_{4,3\ N}$	(Rn)	30,78	- 31,65	0,0108 (22)
$ec_{4,2\ T}$	(Rn)	45,87	- 144,23	15,42 (44)
$ec_{4,2\ K}$	(Rn)	45,87	(2)	12,40 (36)
$ec_{12,9\ L}$	(Rn)	51,5	- 54,9	0,039 (17)
$ec_{4,1\ K}$	(Rn)	55,81	(1)	18,0 (5)
$ec_{4,1\ T}$	(Rn)	55,811	- 154,165	22,4 (6)
$ec_{4,0\ T}$	(Rn)	60,238	- 158,592	2,47 (10)
$ec_{4,0\ K}$	(Rn)	60,24	(1)	1,98 (10)
$ec_{6,4\ K}$	(Rn)	81,14	(6)	0,249 (25)
$ec_{17,13\ L}$	(Rn)	85,2	- 88,6	0,021 (15)
$ec_{12,7\ L}$	(Rn)	85,99	- 89,43	0,064 (32)
$ec_{11,6\ L}$	(Rn)	88,73	- 92,17	0,0375 (23)
$ec_{5,4\ L}$	(Rn)	92,808	- 96,250	0,214 (15)
$ec_{12,7\ M}$	(Rn)	99,57	- 101,16	0,017 (10)
$ec_{3,1\ L}$	(Rn)	104,271	- 107,710	1,373 (30)
$ec_{5,4\ M}$	(Rn)	106,383	- 107,972	0,0577 (41)
$ec_{5,4\ N}$	(Rn)	109,770	- 110,634	0,0150 (11)
$ec_{3,1\ M}$	(Rn)	117,846	- 119,435	0,328 (7)
$ec_{3,1\ N}$	(Rn)	121,230	- 122,097	0,0854 (19)
$ec_{4,2\ L}$	(Rn)	126,22	- 129,66	2,30 (6)
$ec_{4,1\ L}$	(Rn)	136,16	- 139,60	3,27 (9)
$ec_{4,2\ M}$	(Rn)	139,80	- 141,39	0,547 (15)
$ec_{4,0\ L}$	(Rn)	140,587	- 144,020	0,373 (12)
$ec_{4,2\ N}$	(Rn)	143,18	- 144,05	0,143 (4)
$ec_{4,1\ M}$	(Rn)	149,735	- 151,324	0,777 (21)
$ec_{8,3\ K}$	(Rn)	151,09	(3)	0,019 (16)
$ec_{4,1\ N}$	(Rn)	153,120	- 153,986	0,203 (5)
$ec_{17,7\ K}$	(Rn)	153,2	(3)	0,022 (22)
$ec_{4,0\ M}$	(Rn)	154,162	- 155,751	0,0891 (35)
$ec_{4,0\ N}$	(Rn)	157,540	- 158,413	0,0232 (9)
$ec_{6,4\ L}$	(Rn)	161,49	- 164,93	0,058 (5)
$ec_{5,0\ T}$	(Rn)	171,066	- 269,420	11,23 (32)
$ec_{5,0\ K}$	(Rn)	171,07	(1)	9,06 (27)
$ec_{6,4\ M}$	(Rn)	175,07	- 176,66	0,0142 (13)
$ec_{6,2\ K}$	(Rn)	225,47	(1)	1,55 (7)
$ec_{6,2\ T}$	(Rn)	225,474	- 323,828	1,92 (8)
$ec_{6,0\ K}$	(Rn)	239,88	(1)	0,992 (25)

		Energy keV	Electrons per 100 disint.
$ec_{6,0\ T}$	(Rn)	239,885 - 338,239	1,226 (31)
$ec_{5,0\ L}$	(Rn)	251,415 - 254,850	1,65 (4)
$ec_{5,0\ M}$	(Rn)	264,990 - 266,579	0,391 (10)
$ec_{5,0\ N}$	(Rn)	268,370 - 269,241	0,1019 (28)
$ec_{8,1\ K}$	(Rn)	273,279 (15)	0,135 (4)
$ec_{6,2\ L}$	(Rn)	305,823 - 309,260	0,281 (9)
$ec_{6,2\ M}$	(Rn)	319,398 - 320,987	0,0666 (21)
$ec_{6,0\ L}$	(Rn)	320,234 - 323,670	0,177 (5)
$ec_{6,2\ N}$	(Rn)	322,780 - 323,649	0,0174 (5)
$ec_{6,0\ M}$	(Rn)	333,809 - 335,398	0,0420 (11)
$ec_{6,0\ N}$	(Rn)	337,19 - 338,06	0,0109 (3)
$ec_{11,0\ K}$	(Rn)	346,636 (12)	0,213 (7)
$ec_{8,1\ L}$	(Rn)	353,628 - 357,070	0,0240 (6)
$ec_{11,0\ L}$	(Rn)	426,985 - 430,420	0,0378 (13)

6 Photon Emissions

6.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(Rn)	10,1372 — 17,2578		22,1 (4)	
$XK\alpha_2$	(Rn)	81,07		14,86 (23)	} $K\alpha$
$XK\alpha_1$	(Rn)	83,78		24,5 (4)	}
$XK\beta_3$	(Rn)	94,247	}		
$XK\beta_1$	(Rn)	94,868	}	8,50 (18)	$K'\beta_1$
$XK\beta_5''$	(Rn)	95,449	}		
$XK\beta_2$	(Rn)	97,48	}		
$XK\beta_4$	(Rn)	97,853	}	2,72 (7)	$K'\beta_2$
$XKO_{2,3}$	(Rn)	98,357	}		

6.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{1,0}$(Rn)	4,47 (1)	0,0000064
$\gamma_{2,1}$(Rn)	9,90 (2)	0,0158 (20)
$\gamma_{2,0}$(Rn)	14,37 (1)	0,0185 (13)

	Energy keV	Photons per 100 disint.
$\gamma_{4,3}$(Rn)	31,87 (2)	0,000105 (21)
$\gamma_{12,9}$(Rn)	69,5 (1)	0,007 (3)
$\gamma_{15,12}$(Rn)	70,9 (2)	0,0036 (11)
$\gamma_{11,7}$(Rn)	102,2 (2)	0,0008 (4)
$\gamma_{17,13}$(Rn)	103,2 (2)	0,006 (3)
$\gamma_{12,7}$(Rn)	104,04 (4)	0,0194 (21)
$\gamma_{11,6}$(Rn)	106,78 (3)	0,0233 (14)
$\gamma_{12,6}$(Rn)	108,5 (2)	0,006 (3)
$\gamma_{5,4}$(Rn)	110,856 (10)	0,058 (4)
$\gamma_{13,8}$(Rn)	114,7 (2)	0,010 (4)
$\gamma_{3,1}$(Rn)	122,319 (10)	1,238 (19)
$\gamma_{20,14}$(Rn)	131,6 (2)	0,006 (3)
$\gamma_{14,8}$(Rn)	138,3 (3)	0,0017 (7)
$\gamma_{4,2}$(Rn)	144,27 (2)	3,36 (8)
$\gamma_{17,12}$(Rn)	147,2 (3)	0,006 (3)
$\gamma_{4,1}$(Rn)	154,208 (10)	5,84 (13)
$\gamma_{4,0}$(Rn)	158,635 (10)	0,713 (16)
$\gamma_{16,8}$(Rn)	165,8 (2)	0,0054 (28)
$\gamma_{11,5}$(Rn)	175,65 (15)	0,017 (4)
$\gamma_{12,5}$(Rn)	177,3 (1)	0,047 (4)
$\gamma_{6,4}$(Rn)	179,54 (6)	0,154 (14)
$\gamma_{20,12}$(Rn)	199,3 (3)	0,0030 (14)
$\gamma_{18,9}$(Rn)	221,32 (24)	0,036 (6)
$\gamma_{19,8}$(Rn)	247,2 (5)	0,0097 (28)
$\gamma_{8,3}$(Rn)	249,49 (3)	0,038 (10)
$\gamma_{17,7}$(Rn)	251,6 (3)	0,055 (10)
$\gamma_{5,2}$(Rn)	255,2 (2)	0,048 (7)
$\gamma_{17,6}$(Rn)	255,7 (3)	0,0055 (28)
$\gamma_{18,6}$(Rn)	260,4 (3)	0,0067 (28)
$\gamma_{5,0}$(Rn)	269,463 (10)	14,23 (32)
$\gamma_{10,3}$(Rn)	270,3 (4)	0,0007 (4)
$\gamma_{23,12}$(Rn)	286,0 (4)	0,0011 (6)
$\gamma_{12,4}$(Rn)	288,18 (3)	0,161 (5)
$\gamma_{6,2}$(Rn)	323,871 (10)	4,06 (8)
$\gamma_{7,2}$(Rn)	328,38 (3)	0,203 (10)
$\gamma_{6,1}$(Rn)	334,01 (6)	0,100 (6)
$\gamma_{6,0}$(Rn)	338,282 (10)	2,85 (6)
$\gamma_{7,0}$(Rn)	342,78 (2)	0,226 (13)
$\gamma_{23,9}$(Rn)	355,5 (2)	0,0043 (14)
$\gamma_{14,4}$(Rn)	355,7 (2)	0,0028 (14)
$\gamma_{8,2}$(Rn)	361,89 (2)	0,028 (7)
$\gamma_{9,2}$(Rn)	362,9 (2)	0,016 (7)
$\gamma_{22,7}$(Rn)	368,56 (12)	0,009 (4)
$\gamma_{8,1}$(Rn)	371,676 (15)	0,499 (11)
$\gamma_{9,1}$(Rn)	372,86 (6)	0,051
$\gamma_{8,0}$(Rn)	376,26 (2)	0,013 (4)
$\gamma_{16,4}$(Rn)	383,35 (2)	0,007 (4)

	Energy keV	Photons per 100 disint.
$\gamma_{14,3}$(Rn)	387,7 (2)	0,016 (6)
$\gamma_{23,7}$(Rn)	390,1 (2)	0,0046 (21)
$\gamma_{11,2}$(Rn)	430,6 (3)	0,020 (6)
$\gamma_{12,2}$(Rn)	432,45 (3)	0,0356 (29)
$\gamma_{11,0}$(Rn)	445,033 (12)	1,28 (4)
$\gamma_{20,4}$(Rn)	487,5 (2)	0,011 (2)
$\gamma_{(-1,1)}$(Rn)	490,8 (3)	0,0017 (7)
$\gamma_{14,2}$(Rn)	500,0 (4)	0,0014 (6)
$\gamma_{14,1}$(Rn)	510,0 (4)	0,0004 (3)
$\gamma_{(-1,2)}$(Rn)	523,2 (4)	0,0014 (6)
$\gamma_{16,2}$(Rn)	527,611 (13)	0,073 (4)
$\gamma_{(-1,3)}$(Rn)	532,9 (4)	0,0014 (6)
$\gamma_{16,1}$(Rn)	537,6 (1)	0,0021 (7)
$\gamma_{16,0}$(Rn)	541,99 (2)	0,0014 (6)
$\gamma_{21,3}$(Rn)	545,8 (5)	0,0011 (6)
$\gamma_{23,4}$(Rn)	574,1 (7)	0,0011 (6)
$\gamma_{17,2}$(Rn)	579,6 (3)	0,0014 (6)
$\gamma_{18,2}$(Rn)	584,3 (3)	0,0014 (6)
$\gamma_{17,0}$(Rn)	594,0 (3)	0,0014 (6)
$\gamma_{18,0}$(Rn)	598,721 (24)	0,092 (4)
$\gamma_{19,2}$(Rn)	609,31 (4)	0,057 (3)
$\gamma_{19,1}$(Rn)	619,1 (4)	0,0036 (11)
$\gamma_{19,0}$(Rn)	623,68 (4)	0,009 (4)
$\gamma_{20,2}$(Rn)	631,7 (7)	0,0004 (3)
$\gamma_{20,1}$(Rn)	641,7 (4)	0,0017 (7)
$\gamma_{20,0}$(Rn)	646,1 (5)	0,0004 (4)
$\gamma_{22,2}$(Rn)	696,9 (7)	0,0007 (3)
$\gamma_{22,0}$(Rn)	711,3 (2)	0,0037 (10)
$\gamma_{23,2}$(Rn)	718,4 (4)	0,0014 (6)
$\gamma_{23,1}$(Rn)	728,4 (8)	0,00028 (14)
$\gamma_{23,0}$(Rn)	732,8 (6)	0,0006 (3)
$\gamma_{(-1,25)}$(Rn)	737,2 (8)	0,00028 (14)

7 Main Production Modes

U − 235 decay chain

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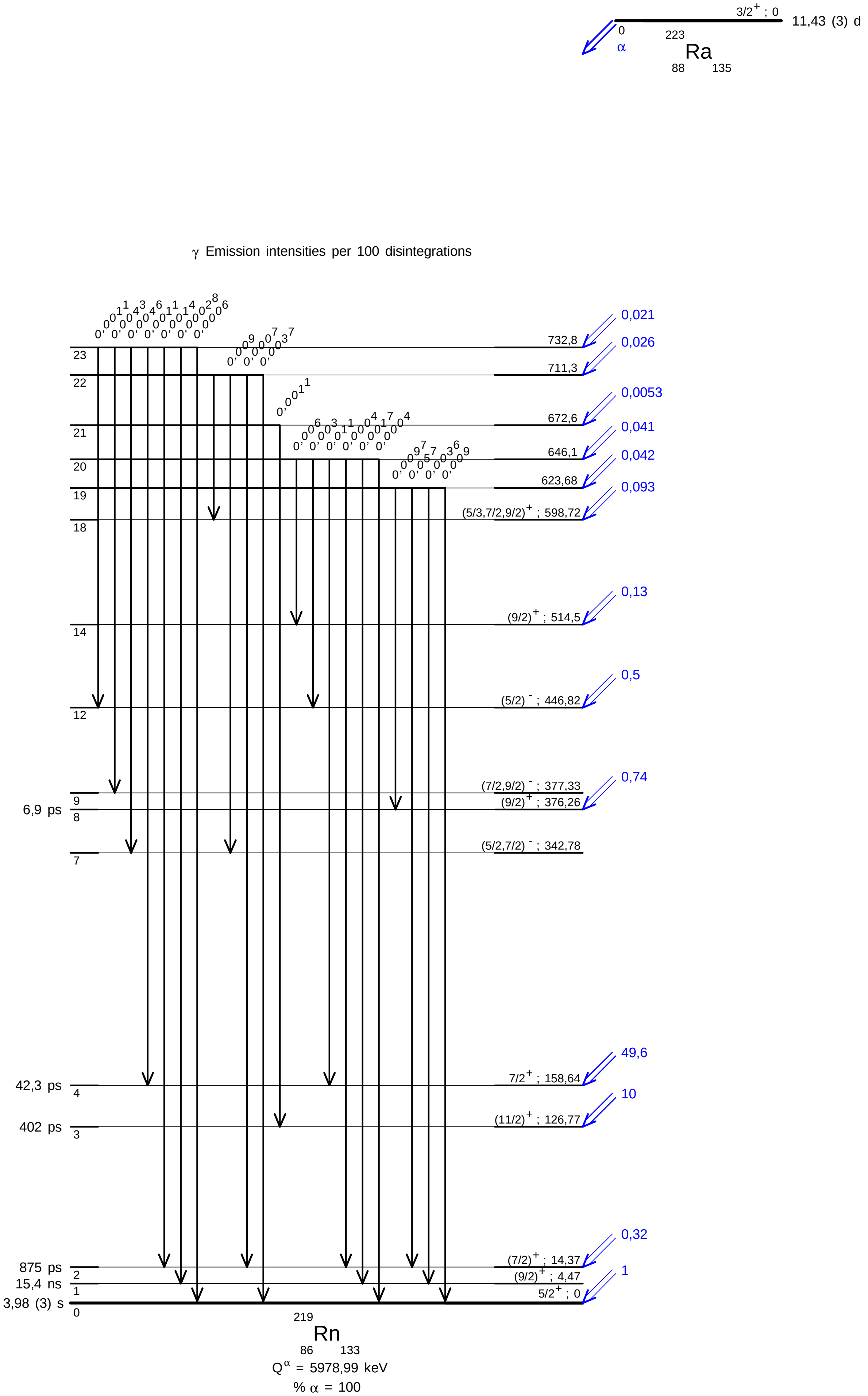

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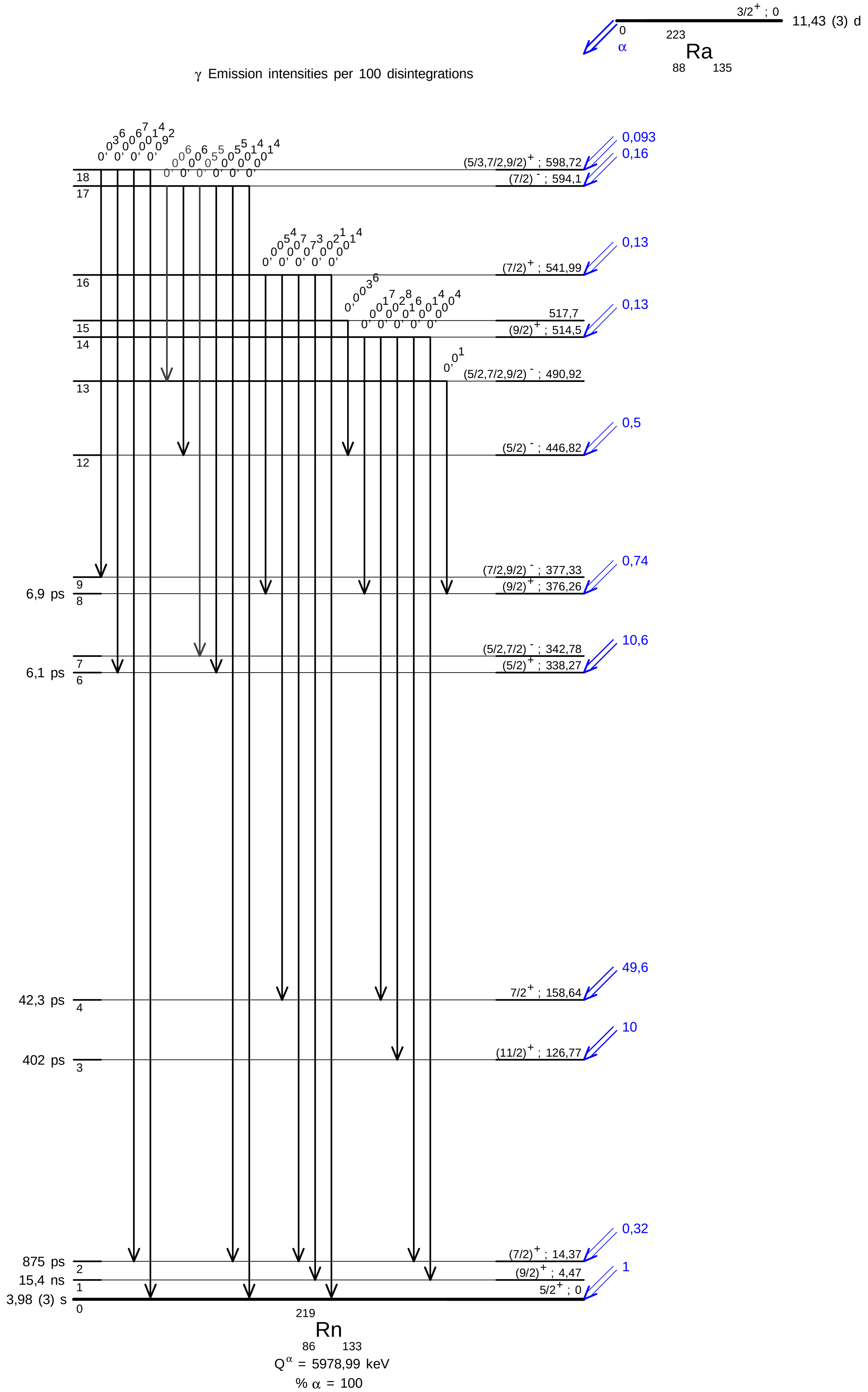
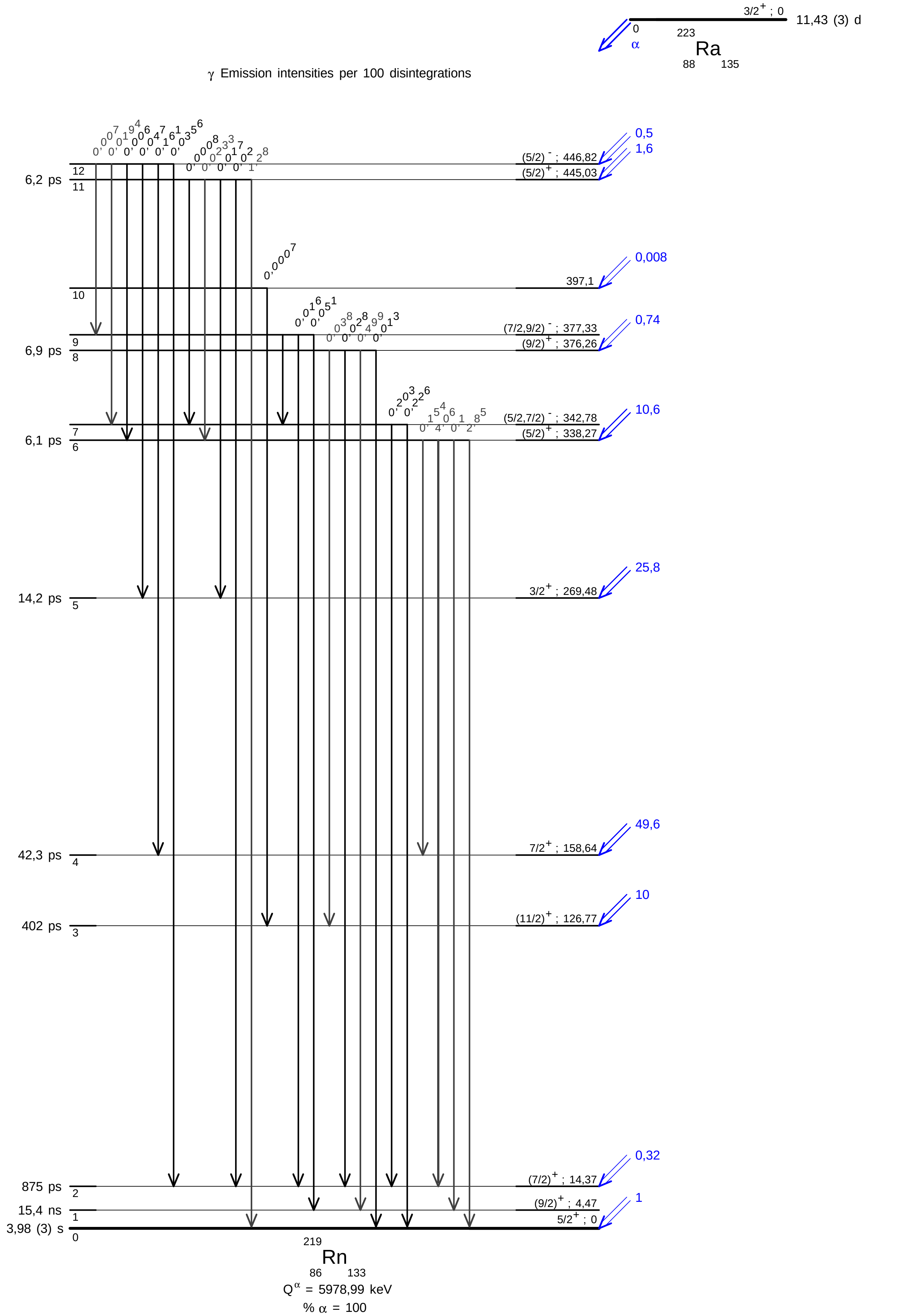

3/2+ ; 0
11,43 (3) d
0
α
223 Ra 88 135
γ Emission intensities per 100 disintegrations
(5/3,7/2,9/2)+ ; 598,72
(7/2) - ; 594,1
(7/2)+ ; 541,99
517,7
(9/2)+ ; 514,5
(5/2,7/2,9/2) - ; 490,92
(5/2) - ; 446,82
(7/2,9/2) - ; 377,33
(9/2)+ ; 376,26
(5/2,7/2) - ; 342,78
(5/2)+ ; 338,27
7/2+ ; 158,64
(11/2)+ ; 126,77
(7/2)+ ; 14,37
(9/2)+ ; 4,47
5/2+ ; 0
0,093
0,16
0,13
0,13
0,5
0,74
10,6
49,6
10
0,32
1
6,9 ps
6,1 ps
42,3 ps
402 ps
875 ps
15,4 ns
3,98 (3) s
219 Rn 86 133
Qα = 5978,99 keV
% α = 100



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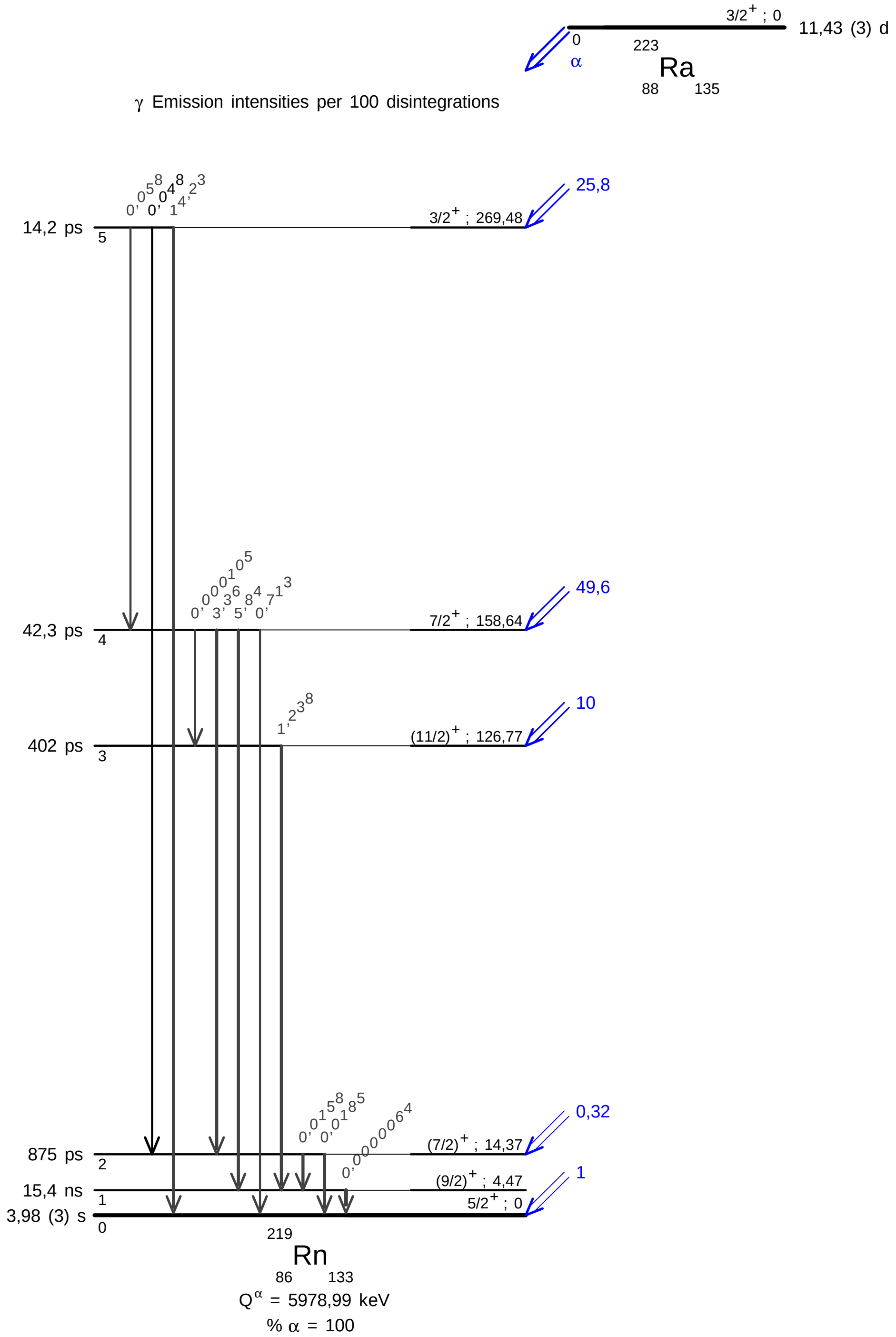

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228		
89	**Ac**	139

1 Decay Scheme

Actinium 228 is the naturally occurring decay daughter of thorium 232 and radium 228. The existence of an alpha branch to francium 224 is unconfirmed.
L'actinium 228 est un radionucléide naturel descendant du thorium 232 et du radium 228. Il se désintègre par transition bêta moins vers le thorium 228. L'existence d'un branchement par transition alpha n'a pas été démontré.

2 Nuclear Data

$T_{1/2}$(^{228}Ac)	:	6,15	(3)	h
$T_{1/2}$(^{228}Th)	:	1,9127	(6)	a
Q^{α}(^{228}Ac)	:	4814	(50)	keV
Q^{-}(^{228}Ac)	:	2123,8	(27)	keV

2.1 β^- Transitions

	Energy keV	Probability × 100	Nature	lg ft
$\beta^-_{0,60}$	0,7 (27)	0,0047 (11)	Allowed	3,3
$\beta^-_{0,59}$	86,8 (27)	0,0069 (11)	Allowed	7,38
$\beta^-_{0,58}$	94,0 (27)	0,026 (4)	Allowed	6,91
$\beta^-_{0,57}$	101,0 (27)	0,061 (6)	Allowed or 1st Forbidden	6,64
$\beta^-_{0,56}$	110,2 (27)	0,0032 (10)	Allowed	8,03
$\beta^-_{0,55}$	113,7 (27)	0,238 (15)	Allowed	6,2
$\beta^-_{0,54}$	136,3 (27)	0,07 (4)	Allowed	7
$\beta^-_{0,53}$	158,8 (27)	0,0132 (14)	Allowed	7,91
$\beta^-_{0,52}$	165,1 (27)	0,0038 (8)	Allowed	8,5
$\beta^-_{0,51}$	178,9 (27)	0,307 (22)	Allowed	6,7
$\beta^-_{0,50}$	186,6 (27)	0,053 (6)	Allowed	7,52
$\beta^-_{0,49}$	195,2 (27)	0,061 (8)	Allowed	7,52
$\beta^-_{0,48}$	217,2 (27)	0,025 (5)	Allowed	8,05

	Energy keV	Probability × 100	Nature	lg ft
$\beta^-_{0,47}$	223,9 (27)	0,069 (8)	Allowed	7,65
$\beta^-_{0,46}$	230,8 (27)	0,109 (8)	Allowed	7,5
$\beta^-_{0,45}$	326,2 (27)	0,051 (8)	Allowed	8,3
$\beta^-_{0,44}$	327,9 (27)	0,035 (6)	Allowed	8,48
$\beta^-_{0,43}$	363,6 (27)	0,139 (12)	Allowed	8,02
$\beta^-_{0,42}$	365,6 (27)	0,060 (8)	Allowed	8,39
$\beta^-_{0,41}$	379,9 (27)	0,378 (16)	Allowed	7,65
$\beta^-_{0,40}$	388,4 (27)	0,149 (11)	Allowed	8,08
$\beta^-_{0,39}$	399,5 (27)	1,93 (8)	Allowed	7,01
$\beta^-_{0,38}$	435,4 (27)	2,50 (16)	Allowed	7,02
$\beta^-_{0,37}$	440,0 (27)	0,20 (3)	1st Forbidden	8,13
$\beta^-_{0,36}$	441,0 (27)	1,21 (4)	Allowed	7,35
$\beta^-_{0,35}$	477,8 (27)	4,12 (20)	Allowed	6,94
$\beta^-_{0,34}$	480,7 (27)	0,82 (3)	1st Forbidden	7,64
$\beta^-_{0,33}$	485,5 (27)	1,23 (6)	Allowed	7,48
$\beta^-_{0,32}$	506,0 (27)	0,071 (10)	Allowed	8,78
$\beta^-_{0,31}$	535,5 (27)	8,8 (23)	1st Forbidden	6,77
$\beta^-_{0,30}$	584,6 (27)	0,030 (6)	Allowed	9,36
$\beta^-_{0,27}$	691,8 (27)	1,6 (5)	Allowed	7,88
$\beta^-_{0,26}$	707,7 (27)	0,060 (8)	Allowed or First Forbidden	9,34
$\beta^-_{0,25}$	779,7 (27)	0,208 (18)	1st Forbidden	8,94
$\beta^-_{0,24}$	826,4 (27)	1,46 (11)	1st Forbidden Unique	8,18
$\beta^-_{0,23}$	897,2 (27)	0,67 (8)	1st Forbidden	8,65
$\beta^-_{0,22}$	948,4 (27)	0,166 (19)	Allowed	9,34
$\beta^-_{0,20}$	955,4 (27)	3,39 (13)	1st Forbidden	8,04
$\beta^-_{0,19}$	970,3 (27)	6 (3)	Allowed	7,8
$\beta^-_{0,18}$	1000,8 (27)	6,67 (18)	1st Forbidden	7,81
$\beta^-_{0,16}$	1063,9 (27)	0,099 (11)	1st Forbidden	9,74
$\beta^-_{0,15}$	1101,3 (27)	3,0 (4)	Allowed	8,31
$\beta^-_{0,14}$	1107,4 (27)	0,39 (6)	Allowed or 1st Forbidden	9,2
$\beta^-_{0,13}$	1144,3 (27)	0,238 (20)	Allowed	9,47
$\beta^-_{0,12}$	1154,8 (27)	31 (4)	Allowed	7,37
$\beta^-_{0,11}$	1155,4 (27)	0,18 (3)	1st Forbidden	9,6
$\beta^-_{0,10}$	1179,6 (27)	0,087 (16)	Allowed or 1st Forbidden	9,95
$\beta^-_{0,8}$	1249,3 (27)	0,17 (10)	Allowed	9,7
$\beta^-_{0,5}$	1727,7 (27)	12,4 (5)	1st Forbidden	8,4
$\beta^-_{0,4}$	1745,6 (27)	0,147 (21)	Unique 2nd Forbidden	12,29
$\beta^-_{0,3}$	1795,8 (27)	0,72 (23)	Unique 1st Forbidden	10,65
$\beta^-_{0,2}$	1937,0 (27)	0,6 (5)	Allowed	10
$\beta^-_{0,1}$	2066,0 (27)	6 (4)	Allowed	9

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{28,27}$(Th)	18,415 (12)	0,142 (30)	E1		3,82 (6)	2,00 (3)	6,46 (10)
$\gamma_{38,35}$(Th)	42,440 (16)	0,43 (14)	M1		35,0 (5)	8,43 (13)	46,3 (7)
$\gamma_{31,29}$(Th)	56,861 (15)	8 (8)	E1+[M2]		260 (160)	70 (50)	360 (220)
$\gamma_{1,0}$(Th)	57,759 (4)	72,5 (28)	E2		112,2 (16)	30,7 (5)	153,2 (22)
$\gamma_{20,17}$(Th)	77,358 (9)	0,027 (6)	E1		0,1747 (25)	0,0426 (6)	0,232 (4)
$\gamma_{29,27}$(Th)	99,495 (8)	6,10 (21)	M1		2,90 (4)	0,699 (10)	3,84 (6)
$\gamma_{18,15}$(Th)	100,424 (8)	0,114 (6)	E1+M2		2,27 (4)	0,615 (9)	3,10 (5)
$\gamma_{35,29}$(Th)	114,480 (13)	0,102 (46)	M1+E2	5 (5)	3,2 (13)	0,8 (4)	9 (4)
$\gamma_{2,1}$(Th)	129,064 (6)	11,85 (36)	E2	0,264 (4)	2,54 (4)	0,697 (10)	3,74 (6)
$\gamma_{23,17}$(Th)	135,548 (11)	0,024 (6)	E1	0,185 (3)	0,0401 (6)	0,00971 (14)	0,238 (4)
$\gamma_{31,28}$(Th)	137,941 (17)	0,239 (34)	M1	6,00 (9)	1,146 (16)	0,276 (4)	7,52 (11)
$\gamma_{6,4}$(Th)	141,013 (12)	0,055 (11)	E1	0,1690 (24)	0,0362 (5)	0,00876 (13)	0,217 (3)
$\gamma_{20,15}$(Th)	145,848 (8)	0,169 (6)	E1	0,1562 (22)	0,0332 (5)	0,00803 (12)	0,200 (3)
$\gamma_{18,12}$(Th)	153,983 (8)	0,754 (23)	E1	0,1375 (20)	0,0289 (4)	0,00698 (10)	0,1757 (25)
$\gamma_{49,43}$(Th)	168,35 (6)	0,0093 (46)	M1+E2	1,8 (16)	0,70 (7)	0,18 (3)	2,7 (15)
$\gamma_{25,22}$(Th)	168,69 (5)	0,0127 (31)	M1+E2	1,8 (16)	0,70 (7)	0,18 (3)	2,7 (15)
$\gamma_{19,13}$(Th)	173,968 (17)	0,036 (5)	M1+E2	1,6 (15)	0,63 (5)	0,162 (22)	2,5 (14)
$\gamma_{19,12}$(Th)	184,499 (11)	5,5 (29)	E0+M1	80 (30)			100 (40)
$\gamma_{4,2}$(Th)	191,356 (11)	0,236 (14)	E2	0,1710 (24)	0,443 (7)	0,1209 (17)	0,776 (11)
$\gamma_{20,12}$(Th)	199,407 (7)	0,299 (23)	E1	0,0752 (11)	0,01502 (21)	0,00362 (5)	0,0950 (14)
$\gamma_{24,15}$(Th)	204,038 (9)	0,114 (8)	M2	7,26 (11)	2,51 (4)	0,653 (10)	10,65 (15)
$\gamma_{5,2}$(Th)	209,255 (6)	4,31 (14)	E1	0,0672 (10)	0,01333 (19)	0,00321 (5)	0,0848 (12)
$\gamma_{19,9}$(Th)	214,89 (7)	0,047 (8)	E2	0,1399 (20)	0,274 (4)	0,0746 (11)	0,514 (8)
$\gamma_{28,23}$(Th)	223,829 (12)	0,058 (6)	M1+E2	1,48 (4)	0,286 (5)	0,0688 (10)	1,85 (4)
$\gamma_{22,10}$(Th)	231,19 (5)	0,026 (4)	E2	0,1211 (17)	0,199 (3)	0,0539 (8)	0,392 (6)
$\gamma_{27,21}$(Th)	257,471 (19)	0,0286 (19)	M1	1,029 (15)	0,194 (3)	0,0466 (7)	1,285 (18)
$\gamma_{27,20}$(Th)	263,604 (8)	0,0451 (31)	E1	0,0397 (6)	0,00760 (11)	0,00182 (3)	0,0498 (7)
$\gamma_{3,1}$(Th)	270,244 (6)	3,72 (10)	E1	0,0376 (6)	0,00716 (10)	0,001717 (24)	0,0470 (7)
$\gamma_{27,19}$(Th)	278,512 (12)	0,038 (6)	E2	0,0843 (12)	0,0937 (14)	0,0252 (4)	0,212 (3)
$\gamma_{19,8}$(Th)	278,994 (21)	0,33 (9)	M1+E2	0,5 (4)	0,12 (3)	0,031 (6)	0,6 (4)
$\gamma_{28,20}$(Th)	282,019 (11)	0,14 (6)	M1+E2	0,4 (4)	0,12 (3)	0,030 (6)	0,6 (4)
$\gamma_{19,7}$(Th)	321,644 (14)	0,232 (14)	E2	0,0635 (9)	0,0540 (8)	0,01444 (21)	0,1369 (20)
$\gamma_{42,27}$(Th)	326,26 (12)	0,035 (6)	E2	0,0618 (9)	0,0513 (8)	0,01372 (20)	0,1315 (19)
$\gamma_{3,0}$(Th)	328,003 (4)	3,13 (11)	E1	0,0245 (4)	0,00455 (7)	0,001089 (16)	0,0305 (5)
$\gamma_{6,2}$(Th)	332,369 (7)	0,38 (6)	E1	0,0238 (4)	0,00441 (7)	0,001056 (15)	0,0297 (5)
$\gamma_{5,1}$(Th)	338,319 (6)	11,72 (41)	E1	0,0229 (4)	0,00424 (6)	0,001014 (15)	0,0285 (4)
$\gamma_{27,17}$(Th)	340,962 (10)	0,405 (20)	E2+M1	0,071 (19)	0,0451 (21)	0,0119 (5)	0,133 (21)
$\gamma_{51,31}$(Th)	356,560 (18)	0,032 (15)	E1+M2	0,6 (6)	0,17 (17)	0,04 (5)	0,8 (8)
$\gamma_{55,33}$(Th)	371,83 (5)	0,0070 (17)	E2	0,0475 (7)	0,0315 (5)	0,00834 (12)	0,0902 (13)
$\gamma_{29,19}$(Th)	378,007 (12)	0,033 (6)	M1+E2	0,20 (16)	0,049 (19)	0,012 (5)	0,27 (18)
$\gamma_{57,33}$(Th)	384,56 (10)	0,0070 (17)	E2	0,0447 (7)	0,0282 (4)	0,00745 (11)	0,0828 (12)
$\gamma_{49,30}$(Th)	389,36 (11)	0,0108 (17)	M1+E2	0,19 (15)	0,044 (18)	0,011 (4)	0,25 (17)
$\gamma_{50,30}$(Th)	397,95 (13)	0,029 (3)					
$\gamma_{41,25}$(Th)	399,812 (32)	0,0316 (41)	E1	0,01611 (23)	0,00291 (4)	0,000696 (10)	0,0200 (3)
$\gamma_{27,15}$(Th)	409,452 (8)	2,02 (6)	E2+M1	0,16 (13)	0,038 (16)	0,009 (4)	0,21 (15)
$\gamma_{30,18}$(Th)	416,26 (9)	0,0138 (23)	E1	0,01485 (21)	0,00267 (4)	0,000638 (9)	0,0184 (3)
$\gamma_{35,23}$(Th)	419,389 (14)	0,0224 (31)	E1	0,01460 (21)	0,00263 (4)	0,000626 (9)	0,0181 (3)
$\gamma_{29,17}$(Th)	440,457 (10)	0,166 (13)	M1	0,237 (4)	0,0442 (7)	0,01061 (15)	0,295 (5)
$\gamma_{11,6}$(Th)	449,177 (21)	0,053 (6)	E2	0,0331 (5)	0,01653 (24)	0,00432 (6)	0,0554 (8)
$\gamma_{27,13}$(Th)	452,480 (15)	0,0199 (19)	E2	0,0326 (5)	0,01613 (23)	0,00422 (6)	0,0544 (8)
$\gamma_{37,23}$(Th)	457,25 (5)	0,0186 (39)	M1+E2	0,12 (10)	0,028 (13)	0,007 (3)	0,16 (11)
$\gamma_{27,12}$(Th)	463,011 (8)	4,45 (24)	E2	0,0312 (5)	0,01495 (21)	0,00390 (6)	0,0514 (8)
$\gamma_{33,20}$(Th)	469,909 (10)	0,0142 (30)	E1	0,01157 (17)	0,00205 (3)	0,000489 (7)	0,01428 (20)
$\gamma_{26,10}$(Th)	471,91 (6)	0,0357 (42)	E2	0,0301 (5)	0,01407 (20)	0,00367 (6)	0,0491 (7)
$\gamma_{34,20}$(Th)	474,750 (16)	0,026 (5)	M1+E2	0,11 (9)	0,025 (12)	0,006 (3)	0,14 (10)
$\gamma_{8,5}$(Th)	478,395 (19)	0,227 (19)	E1	0,01118 (16)	0,00198 (3)	0,000471 (7)	0,01379 (20)
$\gamma_{48,26}$(Th)	490,53 (12)	0,0116 (25)	E2	0,0280 (4)	0,01242 (18)	0,00323 (5)	0,0447 (7)

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{35,19}$(Th)	492,487 (16)	0,0282 (41)	M1+E2	0,10 (8)	0,022 (11)	0,0055 (24)	0,13 (9)
$\gamma_{39,23}$(Th)	497,718 (9)	0,0062 (19)	M2	0,437 (7)	0,1074 (15)	0,0268 (4)	0,581 (9)
$\gamma_{7,3}$(Th)	503,820 (11)	0,173 (19)	E1	0,01009 (15)	0,001775 (25)	0,000422 (6)	0,01243 (18)
$\gamma_{29,15}$(Th)	508,947 (8)	0,568 (45)	E2+M1	0,0870 (13)	0,0196 (3)	0,00481 (7)	0,1130 (16)
$\gamma_{33,18}$(Th)	515,333 (11)	0,051 (6)	E1	0,00966 (14)	0,001694 (24)	0,000403 (6)	0,01189 (17)
$\gamma_{34,18}$(Th)	520,174 (16)	0,070 (7)	M1+E2	0,09 (7)	0,019 (9)	0,0047 (21)	0,11 (8)
$\gamma_{35,18}$(Th)	523,003 (13)	0,129 (10)	E1	0,00937 (14)	0,001641 (23)	0,000390 (6)	0,01153 (17)
$\gamma_{16,6}$(Th)	540,738 (31)	0,0297 (38)	M1+E2	0,08 (6)	0,017 (9)	0,0042 (19)	0,10 (7)
$\gamma_{8,3}$(Th)	546,470 (18)	0,201 (16)	E1	0,00861 (12)	0,001500 (21)	0,000357 (5)	0,01058 (15)
$\gamma_{39,22}$(Th)	548,89 (5)	0,0264 (47)	M1+E2	0,08 (6)	0,017 (8)	0,0041 (18)	0,10 (7)
$\gamma_{35,17}$(Th)	554,937 (14)	0,048 (6)	M1+E2				
$\gamma_{29,12}$(Th)	562,506 (8)	0,97 (7)	E2+M1	0,07 (5)	0,015 (8)	0,0038 (17)	0,09 (6)
$\gamma_{39,19}$(Th)	570,816 (12)	0,22 (6)	M1	0,1182 (17)	0,0219 (3)	0,00525 (8)	0,1472 (21)
$\gamma_{11,5}$(Th)	572,291 (21)	0,170 (22)	M1+E2	0,07 (5)	0,015 (7)	0,0036 (17)	0,09 (6)
$\gamma_{13,5}$(Th)	583,421 (15)	0,120 (11)	E1	0,00759 (11)	0,001313 (19)	0,000312 (5)	0,00932 (13)
$\gamma_{9,3}$(Th)	610,58 (7)	0,024 (5)	E1	0,00695 (10)	0,001198 (17)	0,000284 (4)	0,00853 (12)
$\gamma_{10,3}$(Th)	616,193 (14)	0,085 (7)	E1	0,00683 (10)	0,001176 (17)	0,000279 (4)	0,00838 (12)
$\gamma_{14,5}$(Th)	620,328 (22)	0,084 (7)					
$\gamma_{35,15}$(Th)	623,427 (13)	0,0128 (33)	M1+E2	0,06 (4)	0,012 (6)	0,0028 (13)	0,07 (5)
$\gamma_{34,14}$(Th)	626,719 (26)	0,015 (3)					
$\gamma_{35,14}$(Th)	629,548 (24)	0,047 (5)	E2	0,01754 (25)	0,00584 (9)	0,001489 (21)	0,0254 (4)
$\gamma_{11,3}$(Th)	640,366 (20)	0,058 (6)	E2	0,01700 (24)	0,00556 (8)	0,001416 (20)	0,0245 (4)
$\gamma_{32,12}$(Th)	648,81 (7)	0,0086 (9)					
$\gamma_{20,6}$(Th)	649,183 (8)	0,043 (11)	E2	0,01658 (24)	0,00536 (8)	0,001362 (19)	0,0238 (4)
$\gamma_{13,3}$(Th)	651,496 (15)	0,094 (10)	E1	0,00615 (9)	0,001053 (15)	0,000250 (4)	0,00754 (11)
$\gamma_{36,15}$(Th)	660,283 (31)	0,00572 (38)	M1+E2	0,05 (4)	0,010 (5)	0,0024 (12)	0,06 (4)
$\gamma_{16,5}$(Th)	663,852 (30)	0,029 (6)	M1+E2	0,05 (4)	0,010 (5)	0,0024 (12)	0,06 (4)
$\gamma_{46,23}$(Th)	666,431 (18)	0,0068 (7)	E1	0,00590 (9)	0,001007 (14)	0,000239 (4)	0,00722 (11)
$\gamma_{35,13}$(Th)	666,455 (18)	0,061 (7)	M1+E2	0,05 (4)	0,010 (5)	0,0024 (11)	0,06 (4)
$\gamma_{38,14}$(Th)	671,988 (24)	0,027 (8)					
$\gamma_{34,12}$(Th)	674,157 (16)	0,105 (10)	M1+E2	0,05 (3)	0,009 (5)	0,0023 (11)	0,06 (4)
$\gamma_{35,12}$(Th)	676,986 (13)	0,065 (6)	M1+E2	0,05 (3)	0,009 (5)	0,0023 (11)	0,06 (4)
$\gamma_{14,3}$(Th)	688,403 (21)	0,070 (7)					
$\gamma_{34,10}$(Th)	698,929 (20)	0,038 (6)	E2	0,01448 (21)	0,00436 (7)	0,001103 (16)	0,0203 (3)
$\gamma_{39,15}$(Th)	701,756 (8)	0,181 (15)	M1	0,0684 (10)	0,01261 (18)	0,00302 (5)	0,0850 (12)
$\gamma_{23,6}$(Th)	707,373 (9)	0,162 (18)	E2	0,01417 (20)	0,00422 (6)	0,001067 (15)	0,0198 (3)
$\gamma_{51,23}$(Th)	718,330 (13)	0,0191 (40)	E1	0,00513 (8)	0,000870 (13)	0,000206 (3)	0,00628 (9)
$\gamma_{18,5}$(Th)	726,873 (8)	0,68 (8)	E2	0,01349 (19)	0,00393 (6)	0,000990 (14)	0,0187 (3)
$\gamma_{43,15}$(Th)	737,691 (25)	0,039 (5)	M1+E2	0,037 (24)	0,007 (4)	0,0018 (9)	0,05 (3)
$\gamma_{39,12}$(Th)	755,315 (8)	1,102 (43)	M1	0,0563 (8)	0,01036 (15)	0,00248 (4)	0,070 (1)
$\gamma_{20,5}$(Th)	772,297 (7)	1,52 (6)	M1+E2	0,0186 (11)	0,00437 (18)	0,00108 (5)	0,0244 (14)
$\gamma_{7,1}$(Th)	774,064 (11)	0,0630 (41)	E2	0,01204 (17)	0,00333 (5)	0,000835 (12)	0,01649 (23)
$\gamma_{51,20}$(Th)	776,520 (12)	0,020 (6)					
$\gamma_{12,2}$(Th)	782,145 (6)	0,508 (41)	E2	0,01182 (17)	0,00324 (5)	0,000812 (12)	0,01615 (23)
$\gamma_{43,12}$(Th)	791,250 (25)	0,0104 (31)	M1+E2	0,031 (19)	0,006 (3)	0,0015 (7)	0,039 (23)
$\gamma_{51,19}$(Th)	791,428 (15)	0,0149 (42)	M1	0,0498 (7)	0,00915 (13)	0,00219 (3)	0,0618 (9)
$\gamma_{13,2}$(Th)	792,676 (15)	0,082 (5)	E2	0,01154 (17)	0,00313 (5)	0,000784 (11)	0,01572 (22)
$\gamma_{18,3}$(Th)	794,948 (7)	4,31 (14)	E2+M1	0,0133 (12)	0,00340 (19)	0,00085 (5)	0,0179 (14)
$\gamma_{38,8}$(Th)	813,921 (21)	0,0073 (17)	M1+E2	0,029 (18)	0,006 (3)	0,0014 (7)	0,036 (22)
$\gamma_{8,1}$(Th)	816,714 (18)	0,0321 (42)	M1+E2	0,028 (18)	0,006 (3)	0,0014 (7)	0,036 (21)
$\gamma_{25,6}$(Th)	824,886 (13)	0,054 (6)	E2	0,01074 (15)	0,00283 (4)	0,000706 (10)	0,01452 (21)
$\gamma_{23,5}$(Th)	830,487 (9)	0,61 (6)	E2+M1	0,01117 (22)	0,00287 (5)	0,000715 (12)	0,0150 (3)
$\gamma_{15,2}$(Th)	835,704 (7)	1,70 (7)	E2	0,01050 (15)	0,00274 (4)	0,000683 (10)	0,01415 (20)
$\gamma_{20,3}$(Th)	840,372 (6)	0,984 (41)	E2	0,01039 (15)	0,00270 (4)	0,000673 (10)	0,0140 (2)
$\gamma_{51,17}$(Th)	853,878 (14)	0,0128 (21)	M1+E2	0,025 (16)	0,0050 (25)	0,0012 (6)	0,032 (19)
$\gamma_{46,15}$(Th)	870,469 (18)	0,046 (5)	M1	0,0387 (6)	0,0071 (1)	0,001699 (24)	0,0481 (7)
$\gamma_{16,2}$(Th)	873,107 (30)	0,032 (7)	E1	0,00361 (5)	0,000601 (9)	0,0001422 (20)	0,00440 (7)
$\gamma_{8,0}$(Th)	874,473 (18)	0,051 (11)	E2	0,00968 (14)	0,00245 (4)	0,000608 (9)	0,01294 (19)
$\gamma_{47,15}$(Th)	877,423 (40)	0,0144 (31)	M1+E2	0,024 (15)	0,0047 (23)	0,0011 (6)	0,030 (18)

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{9,1}$(Th)	880,82 (7)	0,0066 (19)	E2	0,00956 (14)	0,00240 (4)	0,000597 (9)	0,01276 (18)
$\gamma_{55,18}$(Th)	887,16 (5)	0,029 (3)	M1+E2	0,023 (14)	0,0046 (22)	0,0011 (6)	0,029 (17)
$\gamma_{24,5}$(Th)	901,345 (11)	0,0172 (40)	E2	0,00917 (13)	0,00227 (4)	0,000564 (8)	0,01220 (17)
$\gamma_{17,2}$(Th)	904,194 (9)	0,78 (4)	E2	0,00912 (13)	0,00225 (4)	0,000559 (8)	0,01212 (17)
$\gamma_{12,1}$(Th)	911,209 (6)	26,5 (8)	E2	0,00900 (13)	0,00221 (3)	0,000549 (8)	0,01194 (17)
$\gamma_{55,17}$(Th)	919,09 (5)	0,028 (3)					
$\gamma_{13,1}$(Th)	921,740 (15)	0,0158 (24)	M1+E2	0,021 (13)	0,0041 (20)	0,0010 (5)	0,027 (15)
$\gamma_{47,12}$(Th)	930,982 (40)	0,004 (1)					
$\gamma_{28,6}$(Th)	931,202 (12)	0,0026 (24)	M1+E2	0,021 (12)	0,004 (2)	0,0010 (5)	0,026 (15)
$\gamma_{58,17}$(Th)	938,82 (16)	0,009 (3)					
$\gamma_{10,0}$(Th)	944,196 (13)	0,102 (10)	E1+M2	0,020 (12)	0,0039 (19)	0,0009 (5)	0,025 (14)
$\gamma_{25,5}$(Th)	948,000 (12)	0,111 (10)	M1+E2	0,020 (12)	0,0038 (19)	0,0009 (5)	0,025 (14)
$\gamma_{14,1}$(Th)	958,647 (21)	0,29 (5)					
$\gamma_{15,1}$(Th)	964,768 (7)	4,99 (17)	E2+M1	0,00853 (19)	0,00199 (4)	0,000492 (9)	0,01119 (23)
$\gamma_{12,0}$(Th)	968,968 (5)	16,1 (5)	E2	0,00806 (12)	0,00191 (3)	0,000472 (7)	0,01061 (15)
$\gamma_{51,12}$(Th)	975,927 (12)	0,052 (6)	M1	0,0287 (4)	0,00524 (8)	0,001254 (18)	0,0356 (5)
$\gamma_{13,0}$(Th)	979,499 (14)	0,0283 (30)	E2	0,00791 (11)	0,00186 (3)	0,000459 (7)	0,01039 (15)
$\gamma_{21,2}$(Th)	987,685 (18)	0,14 (6)	M1+E2	0,018 (10)	0,0034 (17)	0,0008 (4)	0,022 (13)
$\gamma_{22,2}$(Th)	988,57 (5)	0,081 (14)	E2	0,00778 (11)	0,00182 (3)	0,000449 (7)	0,01021 (15)
$\gamma_{51,10}$(Th)	1000,699 (17)	0,0054 (3)					
$\gamma_{58,14}$(Th)	1013,43 (16)	0,0097 (16)					
$\gamma_{14,0}$(Th)	1016,406 (21)	0,0194 (31)	M1+E2	0,017 (10)	0,0032 (15)	0,0008 (4)	0,021 (12)
$\gamma_{54,12}$(Th)	1018,49 (10)	0,032 (32)	E2+M3	0,05 (5)	0,014 (12)	0,003 (3)	0,07 (7)
$\gamma_{26,5}$(Th)	1020,03 (6)	0,022 (5)					
$\gamma_{17,1}$(Th)	1033,258 (9)	0,204 (12)	E2	0,0072 (1)	0,001643 (23)	0,000404 (6)	0,00938 (14)
$\gamma_{23,2}$(Th)	1039,742 (8)	0,056 (18)					
$\gamma_{55,12}$(Th)	1041,14 (5)	0,047 (10)	E2+M3	0,05 (5)	0,013 (12)	0,003 (3)	0,07 (6)
$\gamma_{57,12}$(Th)	1053,87 (10)	0,0143 (41)	M1+E2	0,015 (9)	0,0029 (14)	0,0007 (4)	0,019 (10)
$\gamma_{28,5}$(Th)	1054,316 (11)	0,019 (6)	M1+E2	0,015 (9)	0,0029 (14)	0,0007 (4)	0,019 (10)
$\gamma_{50,8}$(Th)	1062,69 (9)	0,011 (4)					
$\gamma_{18,1}$(Th)	1065,192 (7)	0,135 (8)					
$\gamma_{48,7}$(Th)	1074,82 (10)	0,011 (4)					
$\gamma_{26,3}$(Th)	1088,11 (6)	0,0062 (14)					
$\gamma_{19,1}$(Th)	1095,708 (11)	0,126 (10)	M1+E2	0,014 (8)	0,0026 (13)	0,0006 (3)	0,017 (9)
$\gamma_{27,3}$(Th)	1103,976 (7)	0,0102 (11)	E3	0,01377 (20)	0,00429 (6)	0,001090 (16)	0,0195 (3)
$\gamma_{24,2}$(Th)	1110,600 (11)	0,0273 (21)	E1	0,00237 (4)	0,000388 (6)	0,0000915 (13)	0,00288 (4)
$\gamma_{20,1}$(Th)	1110,616 (6)	0,285 (22)	E1	0,00237 (4)	0,000388 (6)	0,0000915 (13)	0,00288 (4)
$\gamma_{22,1}$(Th)	1117,63 (5)	0,061 (7)					
$\gamma_{29,5}$(Th)	1135,396 (8)	0,0102 (17)					
$\gamma_{30,5}$(Th)	1143,13 (9)	0,0108 (22)					
$\gamma_{57,8}$(Th)	1148,37 (10)	0,0062 (14)	M1+E2	0,012 (7)	0,0023 (11)	0,00057 (25)	0,015 (8)
$\gamma_{19,0}$(Th)	1153,467 (10)	0,148 (13)	E1+M2	0,022 (20)	0,004 (5)	0,0011 (10)	0,03 (3)
$\gamma_{25,2}$(Th)	1157,255 (12)	0,0073 (14)	E1+M2	0,022 (20)	0,004 (4)	0,0011 (10)	0,03 (3)
$\gamma_{37,6}$(Th)	1164,63 (5)	0,067 (7)	M1+E2	0,012 (6)	0,0023 (11)	0,00055 (24)	0,015 (8)
$\gamma_{22,0}$(Th)	1175,39 (5)	0,0257 (42)	E1+M2	0,021 (19)	0,004 (4)	0,001 (1)	0,027 (24)
$\gamma_{57,7}$(Th)	1191,02 (10)	0,0065 (17)	M1+E2	0,011 (6)	0,0021 (10)	0,00052 (23)	0,014 (7)
$\gamma_{40,6}$(Th)	1216,258 (26)	0,022 (4)					
$\gamma_{26,2}$(Th)	1229,29 (6)	0,0078 (25)					
$\gamma_{27,2}$(Th)	1245,156 (7)	0,110 (8)	M1+E2	0,010 (5)	0,0019 (9)	0,00046 (20)	0,013 (6)
$\gamma_{34,5}$(Th)	1247,047 (16)	0,524 (24)	M1	0,01505 (21)	0,00274 (4)	0,000654 (10)	0,0187 (3)
$\gamma_{35,5}$(Th)	1249,876 (13)	0,065 (6)					
$\gamma_{44,6}$(Th)	1276,71 (10)	0,015 (3)					
$\gamma_{25,1}$(Th)	1286,319 (12)	0,052 (11)	E1+M2				
$\gamma_{37,5}$(Th)	1287,74 (5)	0,109 (25)	M1+E2	0,009 (5)	0,0018 (8)	0,00042 (18)	0,012 (6)
$\gamma_{33,3}$(Th)	1310,281 (10)	0,020 (7)	E1+M2	0,016 (15)	0,003 (3)	0,0008 (7)	0,020 (18)
$\gamma_{34,3}$(Th)	1315,122 (16)	0,0152 (30)	M1+E2	0,009 (5)	0,0017 (7)	0,00040 (17)	0,011 (6)
$\gamma_{29,2}$(Th)	1344,651 (7)	0,0094 (20)	M1+E2	0,008 (4)	0,0016 (7)	0,00038 (16)	0,011 (5)
$\gamma_{41,5}$(Th)	1347,812 (30)	0,0163 (41)	E1+M2	0,015 (14)	0,003 (3)	0,0007 (7)	0,019 (17)
$\gamma_{40,4}$(Th)	1357,271 (27)	0,021 (5)					

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{41,4}$(Th)	1365,711 (32)	0,0144 (31)	E2+M3	0,025 (21)	0,006 (5)	0,0014 (12)	0,03 (3)
$\gamma_{27,1}$(Th)	1374,220 (7)	0,0196 (14)	E2+M3	0,024 (20)	0,005 (5)	0,0014 (12)	0,03 (3)
$\gamma_{45,5}$(Th)	1401,57 (8)	0,0132 (31)	E1+M2	0,013 (12)	0,0026 (24)	0,0006 (6)	0,017 (15)
$\gamma_{41,3}$(Th)	1415,887 (30)	0,022 (5)	E3	0,00849 (12)	0,00218 (3)	0,000543 (8)	0,01141 (16)
$\gamma_{32,2}$(Th)	1430,96 (7)	0,037 (8)					
$\gamma_{28,0}$(Th)	1450,394 (10)	0,0111 (22)	M1+E2	0,007 (3)	0,0013 (6)	0,00031 (13)	0,009 (4)
$\gamma_{35,2}$(Th)	1459,131 (13)	0,89 (6)	E2	0,00391 (6)	0,000771 (11)	0,000187 (3)	0,00498 (7)
$\gamma_{45,3}$(Th)	1469,65 (8)	0,021 (5)	E1+M2	0,012 (11)	0,0023 (21)	0,0006 (5)	0,015 (14)
$\gamma_{36,2}$(Th)	1495,987 (30)	0,924 (30)	E2	0,00374 (6)	0,000732 (11)	0,0001769 (25)	0,00477 (7)
$\gamma_{38,2}$(Th)	1501,571 (12)	0,513 (17)					
$\gamma_{39,2}$(Th)	1537,460 (7)	0,049 (6)	E2+M3	0,018 (15)	0,004 (4)	0,0010 (8)	0,023 (19)
$\gamma_{40,2}$(Th)	1548,627 (25)	0,040 (5)					
$\gamma_{41,2}$(Th)	1557,067 (30)	0,173 (9)	E2+M1	0,0055 (5)	0,00102 (8)	0,000245 (19)	0,0070 (6)
$\gamma_{32,1}$(Th)	1560,02 (7)	0,021 (5)					
$\gamma_{42,2}$(Th)	1571,42 (12)	0,0059 (17)					
$\gamma_{43,2}$(Th)	1573,395 (24)	0,0341 (40)	E2	0,00342 (5)	0,00066 0(1)	0,0001592 (23)	0,00438 (7)
$\gamma_{33,1}$(Th)	1580,525 (10)	0,624 (40)	M1+E2	0,0057 (24)	0,0011 (4)	0,00025 (10)	0,007 (3)
$\gamma_{35,1}$(Th)	1588,195 (13)	3,06 (12)	E2	0,0057 (23)	0,0010 (4)	0,00025 (10)	0,007 (3)
$\gamma_{54,4}$(Th)	1609,28 (10)	0,0081 (17)	E2	0,00329 (5)	0,000630 (9)	0,0001518 (22)	0,00422 (6)
$\gamma_{36,1}$(Th)	1625,051 (30)	0,270 (23)	E2+M3	0,016 (13)	0,003 (3)	0,0008 (7)	0,020 (17)
$\gamma_{38,1}$(Th)	1630,635 (12)	1,52 (6)	M1+E2	0,0053 (22)	0,0010 (4)	0,00023 (9)	0,007 (3)
$\gamma_{33,0}$(Th)	1638,284 (9)	0,462 (30)	E2	0,00319 (5)	0,000608 (9)	0,0001463 (21)	0,00410 (6)
$\gamma_{39,1}$(Th)	1666,524 (7)	0,173 (9)	M1	0,00702 (10)	0,001269 (18)	0,000303 (5)	0,00895 (13)
$\gamma_{40,1}$(Th)	1677,691 (25)	0,057 (6)					
$\gamma_{41,1}$(Th)	1686,131 (30)	0,094 (7)	E2	0,00303 (5)	0,000573 (8)	0,0001378 (20)	0,00391 (6)
$\gamma_{42,1}$(Th)	1700,48 (12)	0,0105 (25)					
$\gamma_{43,1}$(Th)	1702,459 (24)	0,055 (7)	E2+M3	0,014 (11)	0,0030 (25)	0,0007 (6)	0,018 (15)
$\gamma_{46,2}$(Th)	1706,173 (17)	0,0089 (12)	M1+E2	0,0061 (10)	0,00110 (16)	0,00026 (4)	0,0078 (12)
$\gamma_{47,2}$(Th)	1713,127 (40)	0,0057 (11)	E2+M3	0,014 (11)	0,0029 (24)	0,0007 (6)	0,018 (14)
$\gamma_{39,0}$(Th)	1724,283 (6)	0,030 (4)	E1+M2				
$\gamma_{44,1}$(Th)	1738,14 (10)	0,018 (4)					
$\gamma_{45,1}$(Th)	1739,89 (8)	0,011 (4)					
$\gamma_{49,2}$(Th)	1741,75 (6)	0,0084 (25)	M1+E2				
$\gamma_{50,2}$(Th)	1750,34 (9)	0,0084 (9)					
$\gamma_{51,2}$(Th)	1758,072 (12)	0,0361 (40)	E2+M1	0,00285 (4)	0,000533 (8)	0,0001281 (18)	0,00371 (6)
$\gamma_{52,2}$(Th)	1771,90 (22)	0,0019 (5)	E2+M3	0,013 (10)	0,0027 (22)	0,0007 (6)	0,016 (13)
$\gamma_{60,3}$(Th)	1795,1 (3)	0,0022 (8)					
$\gamma_{45,0}$(Th)	1797,65 (8)	0,0022 (8)	E1+M2	0,007 (7)	0,0014 (13)	0,0003 (3)	0,009 (8)
$\gamma_{54,2}$(Th)	1800,64 (10)	0,0046 (8)					
$\gamma_{55,2}$(Th)	1823,29 (5)	0,046 (5)					
$\gamma_{56,2}$(Th)	1826,78 (30)	0,0022 (8)					
$\gamma_{46,1}$(Th)	1835,237 (17)	0,0381 (40)	E2+M1	0,00291 (8)	0,000536 (14)	0,000128 (4)	0,00382 (10)
$\gamma_{47,1}$(Th)	1842,191 (40)	0,037 (6)	M1+E2	0,00420 (25)	0,00076 (5)	0,000182 (11)	0,0055 (4)
$\gamma_{59,2}$(Th)	1850,17 (17)	0,0046 (8)					
$\gamma_{49,1}$(Th)	1870,81 (6)	0,0257 (24)	M1+E2	0,0038 (14)	0,00070 (24)	0,00017 (6)	0,0051 (18)
$\gamma_{50,1}$(Th)	1879,40 (9)	0,0013 (5)					
$\gamma_{51,1}$(Th)	1887,136 (12)	0,094 (7)	E2+M1	0,0038 (13)	0,00068 (23)	0,00016 (6)	0,0050 (17)
$\gamma_{47,0}$(Th)	1899,95 (4)	0,0030 (6)	E1+M2	0,006 (6)	0,0012 (11)	0,0003 (3)	0,008 (7)
$\gamma_{53,1}$(Th)	1907,22 (7)	0,0124 (13)					
$\gamma_{54,1}$(Th)	1929,7 (1)	0,0208 (14)	E2+M3	0,010 (8)	0,0021 (17)	0,0005 (5)	0,013 (10)
$\gamma_{60,2}$(Th)	1936,28 (30)	0,0022 (6)					
$\gamma_{55,1}$(Th)	1952,35 (5)	0,062 (5)	E2+M3	0,010 (8)	0,0020 (17)	0,0005 (4)	0,013 (10)
$\gamma_{56,1}$(Th)	1955,84 (30)	0,0008 (3)					
$\gamma_{52,0}$(Th)	1958,72 (22)	0,0016 (5)	E1+M2				
$\gamma_{57,1}$(Th)	1965,08 (10)	0,0223 (22)	M1+E2	0,0034 (12)	0,00062 (20)	0,00015 (5)	0,0046 (15)
$\gamma_{58,1}$(Th)	1972,08 (16)	0,0038 (8)					
$\gamma_{59,1}$(Th)	1979,23 (17)	0,0019 (5)					
$\gamma_{58,0}$(Th)	2029,84 (16)	0,0019 (5)	E1+M2	0,005 (5)	0,0010 (9)	0,00024 (22)	0,007 (6)

3 Atomic Data

3.1 Th

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

3.1.1 X Radiations

		Energy keV		Relative probability
X_K				
	$K\alpha_2$	89,954		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 – 16,4253		
	$L\gamma$	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 Electron Emissions

		Energy keV			Electrons per 100 disint.
e_{AL}	(Th)	5,8 - 20,3			40 (8)
e_{AK}	(Th)				27 (8)
	KLL	68,406 - 76,745		}	
	KLX	83,857 - 93,345		}	
	KXY	99,29 - 109,64		}	
$ec_{2,1\ K}$	(Th)	19,414	(6)		0,660 (21)
$ec_{38,35\ L}$	(Th)	21,97 - 26,10			0,32 (11)
$ec_{31,28\ K}$	(Th)	28,291	(17)		0,168 (24)
$ec_{31,29\ L}$	(Th)	36,389 - 40,600			5,2 (35)
$ec_{1,0\ L}$	(Th)	37,287 - 41,500			52,7 (21)
$ec_{18,12\ K}$	(Th)	44,333	(8)		0,104 (4)
$ec_{31,29\ M}$	(Th)	51,679 - 53,529			1,4 (11)
$ec_{1,0\ M}$	(Th)	52,577 - 54,427			14,4 (6)
$ec_{31,29\ N}$	(Th)	55,530 - 56,526			0,40 (26)
$ec_{1,0\ N}$	(Th)	56,430 - 57,424			3,87 (15)
$ec_{19,12\ K}$	(Th)	74,849	(11)		4,3 (22)
$ec_{29,27\ L}$	(Th)	79,023 - 83,200			3,65 (13)
$ec_{18,15\ L}$	(Th)	79,952 - 84,100			0,259 (14)
$ec_{29,27\ M}$	(Th)	94,313 - 96,163			0,881 (31)
$ec_{24,15\ K}$	(Th)	94,388	(9)		0,83 (6)
$ec_{29,27\ N}$	(Th)	98,16 - 99,16			0,234 (8)
$ec_{5,2\ K}$	(Th)	99,605	(6)		0,267 (10)
$ec_{2,1\ L}$	(Th)	108,592 - 112,800			6,35 (20)
$ec_{2,1\ M}$	(Th)	123,882 - 125,732			1,74 (5)
$ec_{2,1\ N}$	(Th)	127,730 - 128,729			0,468 (15)
$ec_{3,1\ K}$	(Th)	160,594	(6)		0,1335 (43)
$ec_{19,8\ K}$	(Th)	169,344	(21)		0,10 (8)
$ec_{24,15\ L}$	(Th)	183,566 - 187,700			0,286 (21)
$ec_{5,1\ K}$	(Th)	228,669	(6)		0,261 (10)
$ec_{27,15\ K}$	(Th)	299,802	(8)		0,32 (26)
$ec_{27,12\ K}$	(Th)	353,361	(8)		0,139 (8)
$ec_{12,1\ K}$	(Th)	801,559	(6)		0,236 (8)
$ec_{12,0\ K}$	(Th)	859,318	(5)		0,128 (5)
$\beta^-_{0,60}$	max:	0,7	(27)		0,0047 (11)
$\beta^-_{0,60}$	avg:	0,18	(68)		
$\beta^-_{0,59}$	max:	86,8	(27)		0,0069 (11)
$\beta^-_{0,59}$	avg:	22,4	(8)		
$\beta^-_{0,58}$	max:	94,0	(27)		0,026 (4)
$\beta^-_{0,58}$	avg:	24,3	(7)		
$\beta^-_{0,57}$	max:	101,0	(27)		0,061 (6)
$\beta^-_{0,57}$	avg:	26,2	(7)		

		Energy keV		Electrons per 100 disint.
$\beta^-_{0,56}$	max:	110,2	(27)	0,0032 (10)
$\beta^-_{0,56}$	avg:	28,7	(7)	
$\beta^-_{0,55}$	max:	113,7	(27)	0,238 (15)
$\beta^-_{0,55}$	avg:	29,7	(8)	
$\beta^-_{0,54}$	max:	136,3	(27)	0,07 (4)
$\beta^-_{0,54}$	avg:	35,9	(8)	
$\beta^-_{0,53}$	max:	158,8	(27)	0,0132 (14)
$\beta^-_{0,53}$	avg:	42,2	(8)	
$\beta^-_{0,52}$	max:	165,1	(27)	0,0038 (8)
$\beta^-_{0,52}$	avg:	43,9	(8)	
$\beta^-_{0,51}$	max:	178,9	(27)	0,307 (22)
$\beta^-_{0,51}$	avg:	47,8	(8)	
$\beta^-_{0,50}$	max:	186,6	(27)	0,053 (6)
$\beta^-_{0,50}$	avg:	50,0	(8)	
$\beta^-_{0,49}$	max:	195,2	(27)	0,061 (8)
$\beta^-_{0,49}$	avg:	52,5	(8)	
$\beta^-_{0,48}$	max:	217,2	(27)	0,025 (5)
$\beta^-_{0,48}$	avg:	58,8	(8)	
$\beta^-_{0,47}$	max:	223,9	(27)	0,069 (8)
$\beta^-_{0,47}$	avg:	60,8	(8)	
$\beta^-_{0,46}$	max:	230,8	(27)	0,109 (8)
$\beta^-_{0,46}$	avg:	62,8	(8)	
$\beta^-_{0,45}$	max:	326,2	(27)	0,051 (8)
$\beta^-_{0,45}$	avg:	91,4	(8)	
$\beta^-_{0,44}$	max:	327,9	(27)	0,035 (6)
$\beta^-_{0,44}$	avg:	91,9	(8)	
$\beta^-_{0,43}$	max:	363,6	(27)	0,139 (12)
$\beta^-_{0,43}$	avg:	103,0	(9)	
$\beta^-_{0,42}$	max:	365,6	(27)	0,060 (8)
$\beta^-_{0,42}$	avg:	103,6	(9)	
$\beta^-_{0,41}$	max:	379,9	(27)	0,378 (16)
$\beta^-_{0,41}$	avg:	108,1	(9)	
$\beta^-_{0,40}$	max:	388,4	(27)	0,149 (11)
$\beta^-_{0,40}$	avg:	110,7	(9)	
$\beta^-_{0,39}$	max:	399,5	(27)	1,93 (8)
$\beta^-_{0,39}$	avg:	114,3	(9)	
$\beta^-_{0,38}$	max:	435,4	(27)	2,50 (16)
$\beta^-_{0,38}$	avg:	125,7	(9)	
$\beta^-_{0,37}$	max:	440,0	(27)	0,20 (3)
$\beta^-_{0,37}$	avg:	127,2	(9)	
$\beta^-_{0,36}$	max:	441,0	(27)	1,21 (4)
$\beta^-_{0,36}$	avg:	127,5	(9)	

		Energy keV		Electrons per 100 disint.
$\beta^-_{0,35}$	max:	477,8	(27)	4,12 (20)
$\beta^-_{0,35}$	avg:	139,5	(9)	
$\beta^-_{0,34}$	max:	480,7	(27)	0,82 (3)
$\beta^-_{0,34}$	avg:	140,4	(9)	
$\beta^-_{0,33}$	max:	485,5	(27)	1,23 (6)
$\beta^-_{0,33}$	avg:	142,0	(9)	
$\beta^-_{0,32}$	max:	506,0	(27)	0,071 (10)
$\beta^-_{0,32}$	avg:	148,7	(9)	
$\beta^-_{0,31}$	max:	535,5	(27)	8,8 (23)
$\beta^-_{0,31}$	avg:	158,5	(9)	
$\beta^-_{0,30}$	max:	584,6	(27)	0,030 (6)
$\beta^-_{0,30}$	avg:	175,0	(9)	
$\beta^-_{0,27}$	max:	691,8	(27)	1,6 (5)
$\beta^-_{0,27}$	avg:	211,8	(10)	
$\beta^-_{0,26}$	max:	707,7	(27)	0,060 (8)
$\beta^-_{0,26}$	avg:	217,3	(10)	
$\beta^-_{0,25}$	max:	779,7	(27)	0,208 (18)
$\beta^-_{0,25}$	avg:	242,7	(10)	
$\beta^-_{0,24}$	max:	826,4	(27)	1,46 (11)
$\beta^-_{0,24}$	avg:	259,4	(10)	
$\beta^-_{0,23}$	max:	897,2	(27)	0,67 (8)
$\beta^-_{0,23}$	avg:	285,1	(10)	
$\beta^-_{0,22}$	max:	948,4	(27)	0,166 (19)
$\beta^-_{0,22}$	avg:	303,9	(10)	
$\beta^-_{0,20}$	max:	955,4	(27)	3,39 (13)
$\beta^-_{0,20}$	avg:	306,4	(10)	
$\beta^-_{0,19}$	max:	970,3	(27)	6 (3)
$\beta^-_{0,19}$	avg:	311,9	(10)	
$\beta^-_{0,18}$	max:	1000,8	(27)	6,67 (18)
$\beta^-_{0,18}$	avg:	323,2	(10)	
$\beta^-_{0,16}$	max:	1063,9	(27)	0,099 (11)
$\beta^-_{0,16}$	avg:	346,7	(11)	
$\beta^-_{0,15}$	max:	1101,3	(27)	3,0 (4)
$\beta^-_{0,15}$	avg:	360,8	(11)	
$\beta^-_{0,14}$	max:	1107,4	(27)	0,39 (6)
$\beta^-_{0,14}$	avg:	363,1	(11)	
$\beta^-_{0,13}$	max:	1144,3	(27)	0,238 (20)
$\beta^-_{0,13}$	avg:	377,1	(11)	
$\beta^-_{0,12}$	max:	1154,8	(27)	31 (4)
$\beta^-_{0,12}$	avg:	381,1	(11)	
$\beta^-_{0,11}$	max:	1155,4	(27)	0,18 (3)
$\beta^-_{0,11}$	avg:	381,4	(11)	

		Energy keV		Electrons per 100 disint.
$\beta^-_{0,10}$	max:	1179,6	(27)	0,087 (16)
$\beta^-_{0,10}$	avg:	390,6	(11)	
$\beta^-_{0,8}$	max:	1249,3	(27)	0,17 (10)
$\beta^-_{0,8}$	avg:	417,2	(11)	
$\beta^-_{0,5}$	max:	1727,7	(27)	12,4 (5)
$\beta^-_{0,5}$	avg:	605,7	(11)	
$\beta^-_{0,4}$	max:	1745,6	(27)	0,147 (21)
$\beta^-_{0,4}$	avg:	587,3	(11)	
$\beta^-_{0,3}$	max:	1795,8	(27)	0,72 (23)
$\beta^-_{0,3}$	avg:	605,4	(11)	
$\beta^-_{0,2}$	max:	1937,0	(27)	0,6 (5)
$\beta^-_{0,2}$	avg:	690,2	(11)	
$\beta^-_{0,1}$	max:	2066,0	(27)	6 (4)
$\beta^-_{0,1}$	avg:	742,8	(11)	

5 Photon Emissions

5.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(Th)	11,1177 — 19,5043		37 (4)	
XKα_2	(Th)	89,954		2,5 (7)	} Kα
XKα_1	(Th)	93,351		4,1 (11)	}
XKβ_3	(Th)	104,819	}		
XKβ_1	(Th)	105,604	}	1,5 (4)	K$'\beta_1$
XKβ_5''	(Th)	106,239	}		
XKβ_2	(Th)	108,509	}		
XKβ_4	(Th)	108,955	}	0,49 (13)	K$'\beta_2$
XKO$_{2,3}$	(Th)	109,442	}		

5.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{28,27}$(Th)	18,415 (12)	0,019 (4)
$\gamma_{38,35}$(Th)	42,46 (5)	0,009 (3)
$\gamma_{31,29}$(Th)	56,88 (5)	0,020 (5)
$\gamma_{1,0}$(Th)	57,752 (13)	0,470 (17)
$\gamma_{20,17}$(Th)	77,34 (3)	0,027 (6)
$\gamma_{29,27}$(Th)	99,505 (12)	1,26 (4)
$\gamma_{18,15}$(Th)	100,41 (3)	0,114 (6)
$\gamma_{35,29}$(Th)	114,56 (7)	0,0102 (22)
$\gamma_{2,1}$(Th)	129,065 (3)	2,50 (7)
$\gamma_{23,17}$(Th)	135,507 (22)	0,024 (6)
$\gamma_{31,28}$(Th)	137,936 (22)	0,028 (4)
$\gamma_{6,4}$(Th)	140,999 (20)	0,045 (9)
$\gamma_{20,15}$(Th)	145,842 (20)	0,169 (6)
$\gamma_{18,12}$(Th)	153,967 (11)	0,754 (23)
$\gamma_{25,22}$(Th)	168,53 (12)	0,0111 (27)
$\gamma_{49,43}$(Th)	168,53 (12)	0,0025 (7)
$\gamma_{19,13}$(Th)	173,96 (3)	0,036 (5)
$\gamma_{19,12}$(Th)	184,547 (19)	0,054 (19)
$\gamma_{4,2}$(Th)	191,351 (17)	0,133 (8)
$\gamma_{20,12}$(Th)	199,402 (15)	0,299 (23)
$\gamma_{24,15}$(Th)	204,029 (11)	0,114 (8)
$\gamma_{5,2}$(Th)	209,248 (7)	3,97 (13)
$\gamma_{19,9}$(Th)	214,89 (10)	0,031 (5)
$\gamma_{28,23}$(Th)	223,793 (21)	0,058 (6)
$\gamma_{22,10}$(Th)	231,42 (10)	0,026 (4)

	Energy keV	Photons per 100 disint.
$\gamma_{27,21}$(Th)	257,482 (21)	0,0286 (19)
$\gamma_{27,20}$(Th)	263,58 (10)	0,043 (3)
$\gamma_{3,1}$(Th)	270,245 (7)	3,55 (10)
$\gamma_{27,19}$(Th)	278,80 (15)	0,031 (5)
$\gamma_{19,8}$(Th)	278,80 (15)	0,204 (28)
$\gamma_{28,20}$(Th)	282,02 (4)	0,09 (3)
$\gamma_{19,7}$(Th)	321,646 (8)	0,232 (14)
$\gamma_{42,27}$(Th)	326,04 (20)	0,035 (6)
$\gamma_{3,0}$(Th)	328,004 (7)	3,04 (11)
$\gamma_{6,2}$(Th)	332,371 (6)	0,37 (6)
$\gamma_{5,1}$(Th)	338,320 (5)	11,4 (4)
$\gamma_{27,17}$(Th)	340,969 (21)	0,405 (20)
$\gamma_{51,31}$(Th)	356,7 (3)	0,0178 (21)
$\gamma_{55,33}$(Th)	372,59 (3)	0,0070 (17)
$\gamma_{29,19}$(Th)	377,99 (10)	0,026 (3)
$\gamma_{57,33}$(Th)	384,47 (9)	0,0070 (17)
$\gamma_{49,30}$(Th)	389,32 (13)	0,0108 (17)
$\gamma_{50,30}$(Th)	397,95 (10)	0,029 (3)
$\gamma_{41,25}$(Th)	399,83 (14)	0,031 (4)
$\gamma_{27,15}$(Th)	409,460 (13)	2,02 (6)
$\gamma_{30,18}$(Th)	415,96 (14)	0,0138 (23)
$\gamma_{35,23}$(Th)	419,38 (7)	0,022 (3)
$\gamma_{29,17}$(Th)	440,450 (24)	0,128 (10)
$\gamma_{11,6}$(Th)	449,11 (6)	0,050 (6)
$\gamma_{27,13}$(Th)	452,50 (6)	0,0199 (19)
$\gamma_{37,23}$(Th)	457,18 (15)	0,016 (3)
$\gamma_{27,12}$(Th)	463,002 (6)	4,45 (24)
$\gamma_{33,20}$(Th)	470,21 (20)	0,014 (3)
$\gamma_{26,10}$(Th)	471,77 (15)	0,034 (4)
$\gamma_{34,20}$(Th)	474,79 (10)	0,023 (4)
$\gamma_{8,5}$(Th)	478,40 (5)	0,224 (19)
$\gamma_{48,26}$(Th)	490,33 (15)	0,0116 (25)
$\gamma_{35,19}$(Th)	492,29 (8)	0,025 (3)
$\gamma_{39,23}$(Th)	497,64 (10)	0,0062 (19)
$\gamma_{7,3}$(Th)	503,819 (23)	0,171 (19)
$\gamma_{29,15}$(Th)	508,955 (13)	0,51 (4)
$\gamma_{33,18}$(Th)	515,12 (7)	0,051 (6)
$\gamma_{34,18}$(Th)	520,16 (3)	0,070 (7)
$\gamma_{35,18}$(Th)	523,129 (22)	0,129 (10)
$\gamma_{16,6}$(Th)	540,67 (5)	0,027 (3)
$\gamma_{8,3}$(Th)	546,445 (21)	0,199 (16)
$\gamma_{39,22}$(Th)	548,73 (11)	0,024 (4)
$\gamma_{35,17}$(Th)	555,07 (16)	0,048 (6)
$\gamma_{29,12}$(Th)	562,496 (7)	0,89 (4)
$\gamma_{39,19}$(Th)	570,88 (4)	0,19 (5)
$\gamma_{11,5}$(Th)	572,10 (5)	0,156 (18)
$\gamma_{13,5}$(Th)	583,391 (10)	0,120 (11)

	Energy keV	Photons per 100 disint.
$\gamma_{9,3}$(Th)	610,65 (10)	0,024 (5)
$\gamma_{10,3}$(Th)	616,21 (3)	0,084 (7)
$\gamma_{14,5}$(Th)	620,32 (7)	0,084 (7)
$\gamma_{35,15}$(Th)	623,48 (22)	0,012 (3)
$\gamma_{34,14}$(Th)	626,80 (22)	0,015 (3)
$\gamma_{35,14}$(Th)	629,41 (5)	0,047 (5)
$\gamma_{11,3}$(Th)	640,32 (4)	0,057 (6)
$\gamma_{32,12}$(Th)	649,02 (12)	0,0086 (9)
$\gamma_{20,6}$(Th)	649,02 (12)	0,0332 (36)
$\gamma_{13,3}$(Th)	651,53 (3)	0,094 (10)
$\gamma_{36,15}$(Th)	660,1 (3)	0,0054 (3)
$\gamma_{16,5}$(Th)	663,88 (8)	0,029 (6)
$\gamma_{35,13}$(Th)	666,45 (5)	0,058 (6)
$\gamma_{46,23}$(Th)	666,45 (5)	0,0068 (7)
$\gamma_{38,14}$(Th)	671,95 (8)	0,027 (8)
$\gamma_{34,12}$(Th)	674,63 (4)	0,105 (10)
$\gamma_{35,12}$(Th)	677,08 (10)	0,065 (6)
$\gamma_{14,3}$(Th)	688,12 (4)	0,070 (7)
$\gamma_{34,10}$(Th)	698,99 (10)	0,038 (6)
$\gamma_{39,15}$(Th)	701,742 (15)	0,181 (15)
$\gamma_{23,6}$(Th)	707,42 (5)	0,162 (18)
$\gamma_{51,23}$(Th)	718,30 (3)	0,019 (4)
$\gamma_{18,5}$(Th)	726,88 (10)	0,68 (8)
$\gamma_{43,15}$(Th)	737,74 (5)	0,039 (5)
$\gamma_{39,12}$(Th)	755,313 (9)	1,03 (4)
$\gamma_{20,5}$(Th)	772,291 (7)	1,52 (6)
$\gamma_{7,1}$(Th)	774,07 (10)	0,062 (4)
$\gamma_{51,20}$(Th)	776,51 (3)	0,020 (6)
$\gamma_{12,2}$(Th)	782,140 (6)	0,50 (4)
$\gamma_{51,19}$(Th)	791,43 (9)	0,014 (4)
$\gamma_{43,12}$(Th)	791,43 (9)	0,010 (3)
$\gamma_{13,2}$(Th)	792,69 (10)	0,081 (5)
$\gamma_{18,3}$(Th)	794,942 (14)	4,31 (14)
$\gamma_{38,8}$(Th)	813,88 (10)	0,0073 (17)
$\gamma_{8,1}$(Th)	816,82 (10)	0,031 (4)
$\gamma_{25,6}$(Th)	824,931 (25)	0,053 (6)
$\gamma_{23,5}$(Th)	830,481 (8)	0,61 (6)
$\gamma_{15,2}$(Th)	835,704 (8)	1,70 (7)
$\gamma_{20,3}$(Th)	840,372 (9)	0,97 (4)
$\gamma_{51,17}$(Th)	853,96 (8)	0,0124 (20)
$\gamma_{46,15}$(Th)	870,47 (7)	0,046 (5)
$\gamma_{16,2}$(Th)	873,10 (15)	0,032 (7)
$\gamma_{8,0}$(Th)	874,45 (8)	0,050 (11)
$\gamma_{47,15}$(Th)	877,38 (7)	0,014 (3)
$\gamma_{9,1}$(Th)	880,76 (10)	0,0065 (19)
$\gamma_{55,18}$(Th)	887,26 (10)	0,029 (3)
$\gamma_{24,5}$(Th)	901,38 (3)	0,017 (4)

	Energy keV	Photons per 100 disint.
$\gamma_{17,2}$(Th)	904,20 (5)	0,78 (4)
$\gamma_{12,1}$(Th)	911,196 (6)	26,2 (8)
$\gamma_{55,17}$(Th)	919,03 (12)	0,028 (3)
$\gamma_{13,1}$(Th)	921,87 (12)	0,0154 (23)
$\gamma_{47,12}$(Th)	930,99 (7)	0,004 (1)
$\gamma_{28,6}$(Th)	930,99 (7)	0,0025 (23)
$\gamma_{58,17}$(Th)	939,89 (15)	0,009 (3)
$\gamma_{10,0}$(Th)	944,19 (3)	0,10 (1)
$\gamma_{25,5}$(Th)	947,976 (24)	0,111 (10)
$\gamma_{14,1}$(Th)	958,59 (4)	0,29 (5)
$\gamma_{15,1}$(Th)	964,786 (8)	4,99 (17)
$\gamma_{12,0}$(Th)	968,960 (9)	15,9 (5)
$\gamma_{51,12}$(Th)	975,98 (5)	0,052 (6)
$\gamma_{13,0}$(Th)	979,49 (10)	0,028 (3)
$\gamma_{21,2}$(Th)	987,87 (10)	0,14 (6)
$\gamma_{22,2}$(Th)	988,65 (20)	0,081 (14)
$\gamma_{51,10}$(Th)	1000,68 (10)	0,0054 (3)
$\gamma_{58,14}$(Th)	1013,55 (13)	0,0097 (16)
$\gamma_{14,0}$(Th)	1016,44 (10)	0,019 (3)
$\gamma_{54,12}$(Th)	1017,94 (20)	0,03 (3)
$\gamma_{26,5}$(Th)	1019,88 (10)	0,022 (5)
$\gamma_{17,1}$(Th)	1033,244 (23)	0,204 (12)
$\gamma_{23,2}$(Th)	1039,83 (7)	0,056 (18)
$\gamma_{55,12}$(Th)	1040,94 (15)	0,047 (10)
$\gamma_{57,12}$(Th)	1053,11 (20)	0,014 (4)
$\gamma_{28,5}$(Th)	1054,13 (20)	0,019 (6)
$\gamma_{50,8}$(Th)	1062,57 (15)	0,011 (4)
$\gamma_{18,1}$(Th)	1065,168 (15)	0,135 (8)
$\gamma_{48,7}$(Th)	1074,73 (15)	0,011 (4)
$\gamma_{26,3}$(Th)	1088,20 (15)	0,0062 (14)
$\gamma_{19,1}$(Th)	1095,671 (23)	0,126 (10)
$\gamma_{27,3}$(Th)	1103,43 (10)	0,0102 (11)
$\gamma_{20,1}$(Th)	1110,604 (9)	0,284 (22)
$\gamma_{24,2}$(Th)	1110,604 (9)	0,0272 (21)
$\gamma_{22,1}$(Th)	1117,65 (10)	0,061 (7)
$\gamma_{29,5}$(Th)	1135,26 (15)	0,0102 (17)
$\gamma_{30,5}$(Th)	1142,87 (15)	0,0108 (22)
$\gamma_{57,8}$(Th)	1148,17 (14)	0,0062 (14)
$\gamma_{19,0}$(Th)	1153,27 (4)	0,148 (13)
$\gamma_{25,2}$(Th)	1157,16 (15)	0,0073 (14)
$\gamma_{37,6}$(Th)	1164,55 (7)	0,067 (7)
$\gamma_{22,0}$(Th)	1175,33 (10)	0,025 (4)
$\gamma_{57,7}$(Th)	1190,83 (20)	0,0065 (17)
$\gamma_{40,6}$(Th)	1217,03 (10)	0,022 (4)
$\gamma_{26,2}$(Th)	1229,42 (15)	0,0078 (25)
$\gamma_{27,2}$(Th)	1245,15 (6)	0,110 (8)
$\gamma_{34,5}$(Th)	1247,10 (5)	0,524 (24)

	Energy keV	Photons per 100 disint.
$\gamma_{35,5}$(Th)	1250,06 (5)	0,065 (6)
$\gamma_{44,6}$(Th)	1276,72 (10)	0,015 (3)
$\gamma_{25,1}$(Th)	1286,29 (20)	0,052 (11)
$\gamma_{37,5}$(Th)	1287,77 (8)	0,109 (25)
$\gamma_{33,3}$(Th)	1309,76 (20)	0,020 (7)
$\gamma_{34,3}$(Th)	1315,33 (10)	0,015 (3)
$\gamma_{29,2}$(Th)	1344,62 (15)	0,0094 (20)
$\gamma_{41,5}$(Th)	1347,50 (15)	0,016 (4)
$\gamma_{40,4}$(Th)	1357,81 (15)	0,021 (5)
$\gamma_{41,4}$(Th)	1365,71 (12)	0,014 (3)
$\gamma_{27,1}$(Th)	1374,24 (7)	0,0196 (14)
$\gamma_{45,5}$(Th)	1401,52 (10)	0,013 (3)
$\gamma_{41,3}$(Th)	1415,55 (14)	0,022 (5)
$\gamma_{32,2}$(Th)	1430,99 (10)	0,037 (8)
$\gamma_{28,0}$(Th)	1451,43 (15)	0,0111 (22)
$\gamma_{35,2}$(Th)	1459,131 (22)	0,87 (5)
$\gamma_{45,3}$(Th)	1469,74 (15)	0,021 (5)
$\gamma_{36,2}$(Th)	1495,904 (16)	0,92 (3)
$\gamma_{38,2}$(Th)	1501,59 (5)	0,513 (17)
$\gamma_{39,2}$(Th)	1537,89 (10)	0,049 (6)
$\gamma_{40,2}$(Th)	1548,65 (6)	0,040 (5)
$\gamma_{41,2}$(Th)	1557,13 (7)	0,173 (9)
$\gamma_{32,1}$(Th)	1560,02 (7)	0,021 (5)
$\gamma_{42,2}$(Th)	1571,55 (20)	0,0059 (17)
$\gamma_{43,2}$(Th)	1573,389 (24)	0,034 (4)
$\gamma_{33,1}$(Th)	1580,531 (25)	0,62 (4)
$\gamma_{35,1}$(Th)	1588,200 (25)	3,06 (12)
$\gamma_{54,4}$(Th)	1609,44 (15)	0,0081 (17)
$\gamma_{36,1}$(Th)	1625,09 (4)	0,270 (23)
$\gamma_{38,1}$(Th)	1630,618 (20)	1,52 (6)
$\gamma_{33,0}$(Th)	1638,272 (23)	0,46 (3)
$\gamma_{39,1}$(Th)	1666,514 (13)	0,173 (9)
$\gamma_{40,1}$(Th)	1677,66 (6)	0,057 (6)
$\gamma_{41,1}$(Th)	1686,22 (11)	0,094 (7)
$\gamma_{42,1}$(Th)	1700,62 (20)	0,0105 (25)
$\gamma_{43,1}$(Th)	1702,40 (8)	0,055 (7)
$\gamma_{46,2}$(Th)	1706,17 (7)	0,0089 (12)
$\gamma_{47,2}$(Th)	1713,49 (20)	0,0057 (11)
$\gamma_{39,0}$(Th)	1724,19 (5)	0,030 (4)
$\gamma_{44,1}$(Th)	1738,46 (5)	0,018 (4)
$\gamma_{45,1}$(Th)	1740,5 (3)	0,011 (4)
$\gamma_{49,2}$(Th)	1742,1 (3)	0,0084 (25)
$\gamma_{50,2}$(Th)	1750,58 (20)	0,0084 (9)
$\gamma_{51,2}$(Th)	1758,11 (5)	0,036 (4)
$\gamma_{52,2}$(Th)	1772,2 (3)	0,0019 (5)
$\gamma_{60,3}$(Th)	1795,13 (6)	0,0022 (8)
$\gamma_{45,0}$(Th)	1797,5 (5)	0,0022 (8)

	Energy keV	Photons per 100 disint.
$\gamma_{54,2}$(Th)	1800,9 (2)	0,0046 (8)
$\gamma_{55,2}$(Th)	1823,22 (10)	0,046 (5)
$\gamma_{56,2}$(Th)	1826,8 (3)	0,0022 (8)
$\gamma_{46,1}$(Th)	1835,29 (10)	0,038 (4)
$\gamma_{47,1}$(Th)	1842,15 (8)	0,037 (6)
$\gamma_{59,2}$(Th)	1850,17 (20)	0,0046 (8)
$\gamma_{49,1}$(Th)	1870,82 (9)	0,0257 (24)
$\gamma_{50,1}$(Th)	1879,6 (3)	0,0013 (5)
$\gamma_{51,1}$(Th)	1887,13 (5)	0,094 (7)
$\gamma_{47,0}$(Th)	1900,16 (20)	0,0030 (6)
$\gamma_{53,1}$(Th)	1907,14 (11)	0,0124 (13)
$\gamma_{54,1}$(Th)	1929,78 (20)	0,0208 (14)
$\gamma_{60,2}$(Th)	1936,3 (3)	0,0022 (6)
$\gamma_{55,1}$(Th)	1952,37 (10)	0,062 (5)
$\gamma_{56,1}$(Th)	1955,9 (5)	0,0008 (3)
$\gamma_{52,0}$(Th)	1958,4 (3)	0,0016 (5)
$\gamma_{57,1}$(Th)	1965,22 (12)	0,0223 (22)
$\gamma_{58,1}$(Th)	1972,0 (3)	0,0038 (8)
$\gamma_{59,1}$(Th)	1979,3 (3)	0,0019 (5)
$\gamma_{58,0}$(Th)	2029,4 (5)	0,0019 (5)

6 Main Production Modes

Th – 232 decay chain

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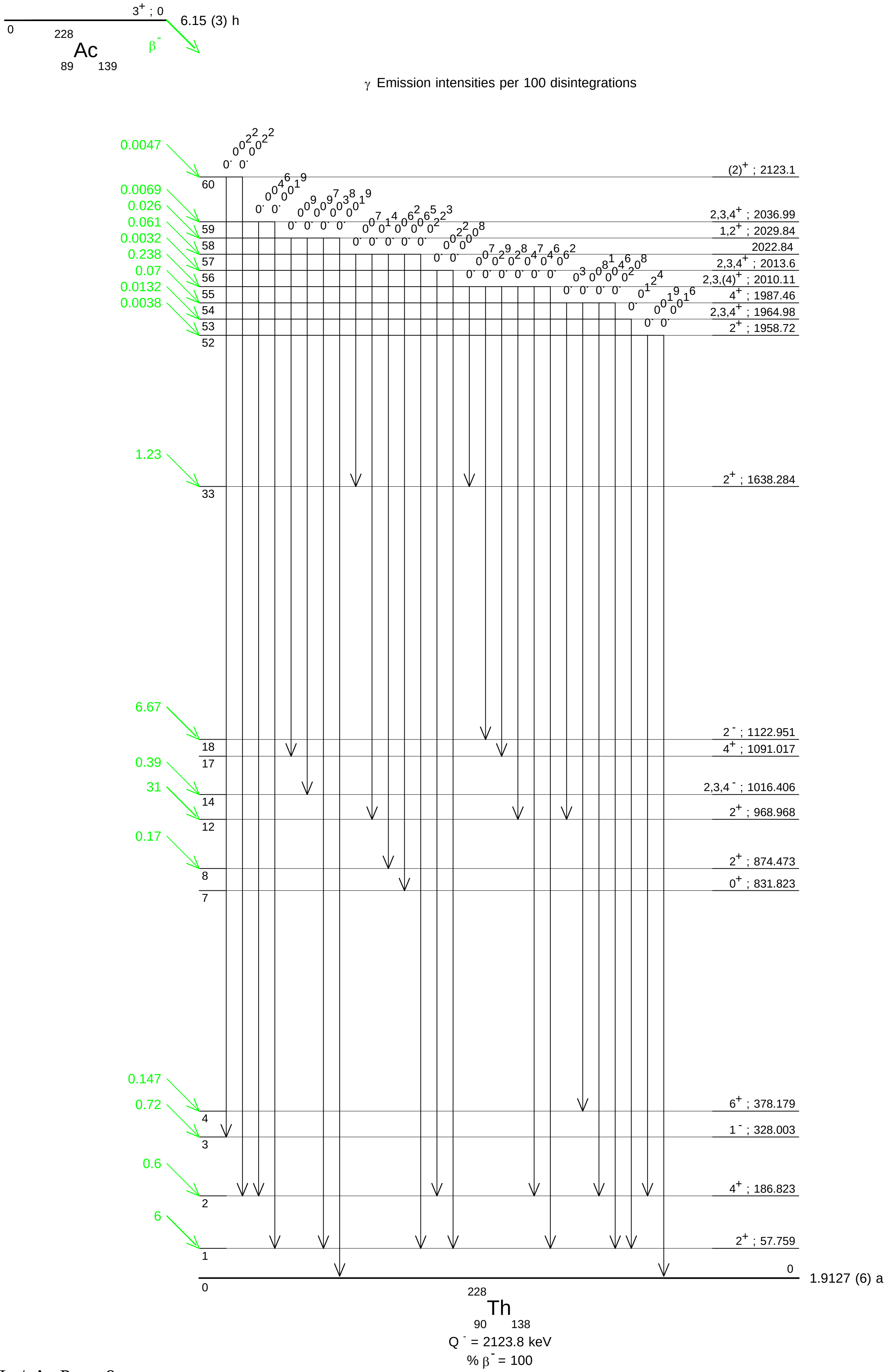
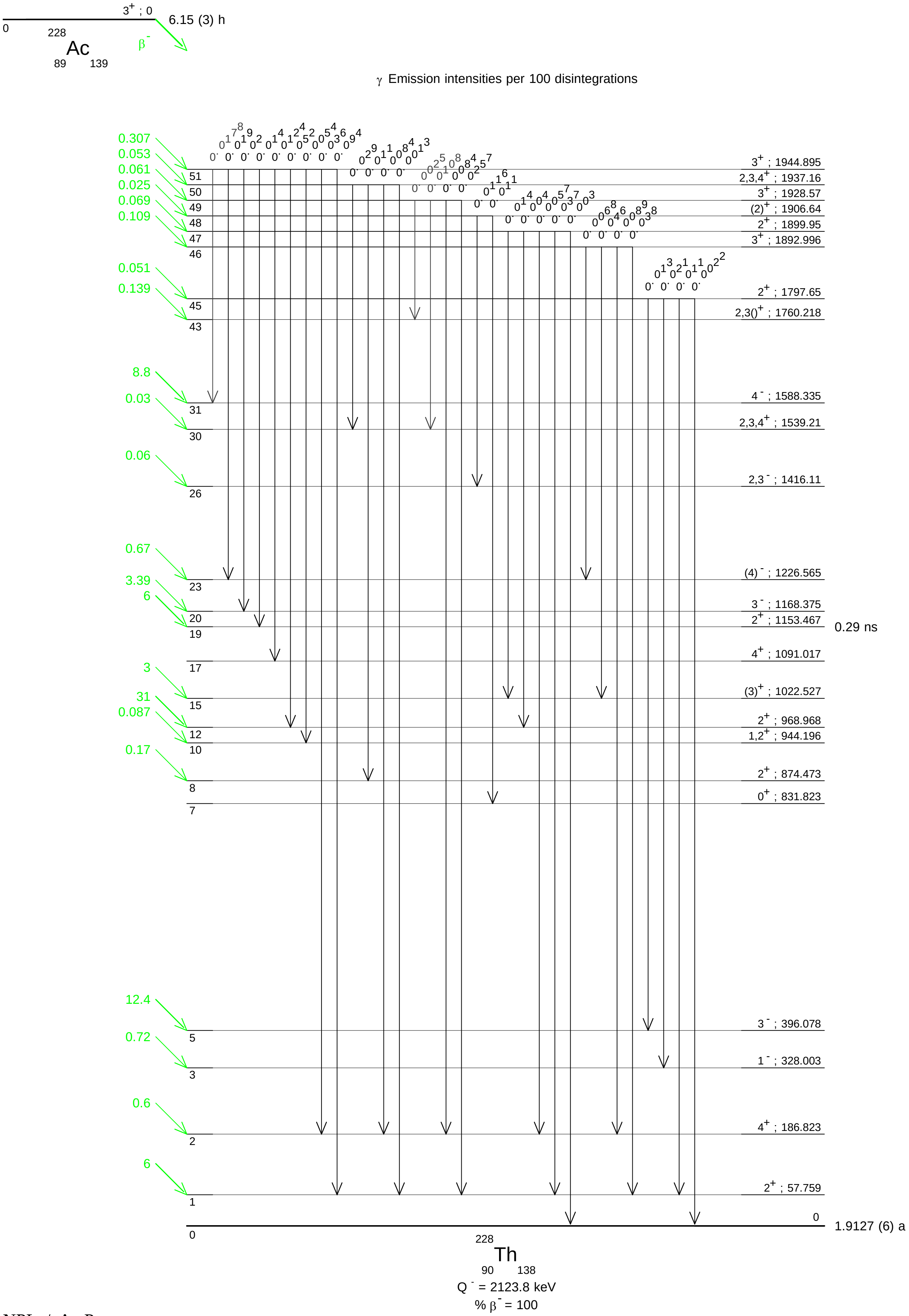
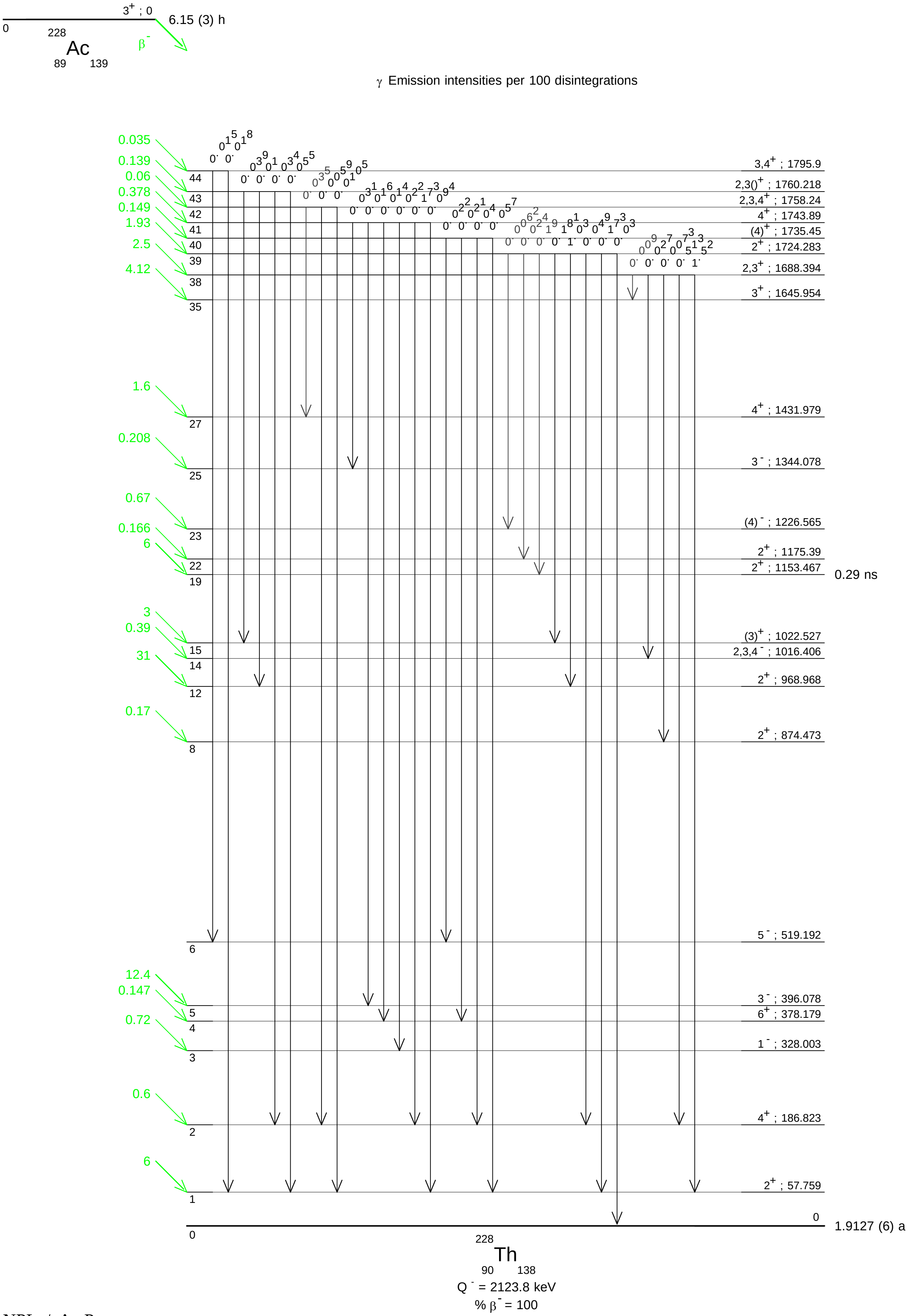
  (BrIcc)

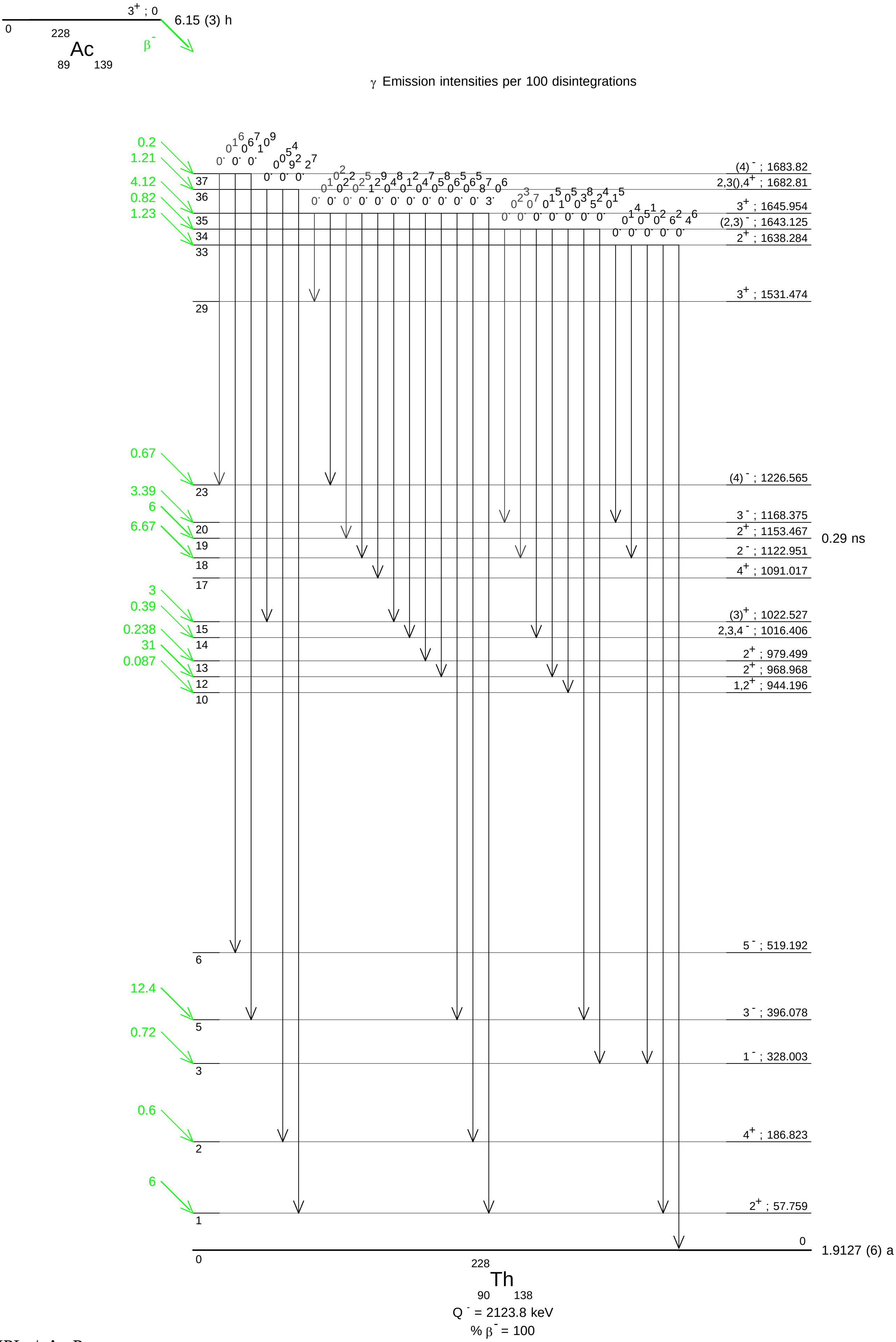

3+ ; 0
0
228 Ac 89 139
β-
6.15 (3) h
γ Emission intensities per 100 disintegrations
0.0047
0.0069
0.026
0.061
0.0032
0.238
0.07
0.0132
0.0038
1.23
6.67
0.39
31
0.17
0.147
0.72
0.6
6
(2)+ ; 2123.1
2,3,4+ ; 2036.99
1,2+ ; 2029.84
2022.84
2,3,4+ ; 2013.6
2,3,(4)+ ; 2010.11
4+ ; 1987.46
2,3,4+ ; 1964.98
2+ ; 1958.72
2+ ; 1638.284
2- ; 1122.951
4+ ; 1091.017
2,3,4- ; 1016.406
2+ ; 968.968
2+ ; 874.473
0+ ; 831.823
6+ ; 378.179
1- ; 328.003
4+ ; 186.823
2+ ; 57.759
0
1.9127 (6) a
228 Th 90 138
Q- = 2123.8 keV
% β- = 100


3+ ; 0
0
228 Ac 89 139
6.15 (3) h
β-
γ Emission intensities per 100 disintegrations
0.307
0.053
0.061
0.025
0.069
0.109
0.051
0.139
8.8
0.03
0.06
0.67
3.39
6
3
31
0.087
0.17
12.4
0.72
0.6
6
3+ ; 1944.895
2,3,4+ ; 1937.16
3+ ; 1928.57
(2)+ ; 1906.64
2+ ; 1899.95
3+ ; 1892.996
2+ ; 1797.65
2,3()+ ; 1760.218
4- ; 1588.335
2,3,4+ ; 1539.21
2,3- ; 1416.11
(4)- ; 1226.565
3- ; 1168.375
2+ ; 1153.467
0.29 ns
4+ ; 1091.017
(3)+ ; 1022.527
2+ ; 968.968
1,2+ ; 944.196
2+ ; 874.473
0+ ; 831.823
3- ; 396.078
1- ; 328.003
4+ ; 186.823
2+ ; 57.759
0
1.9127 (6) a
228 Th 90 138
Q- = 2123.8 keV
% β- = 100

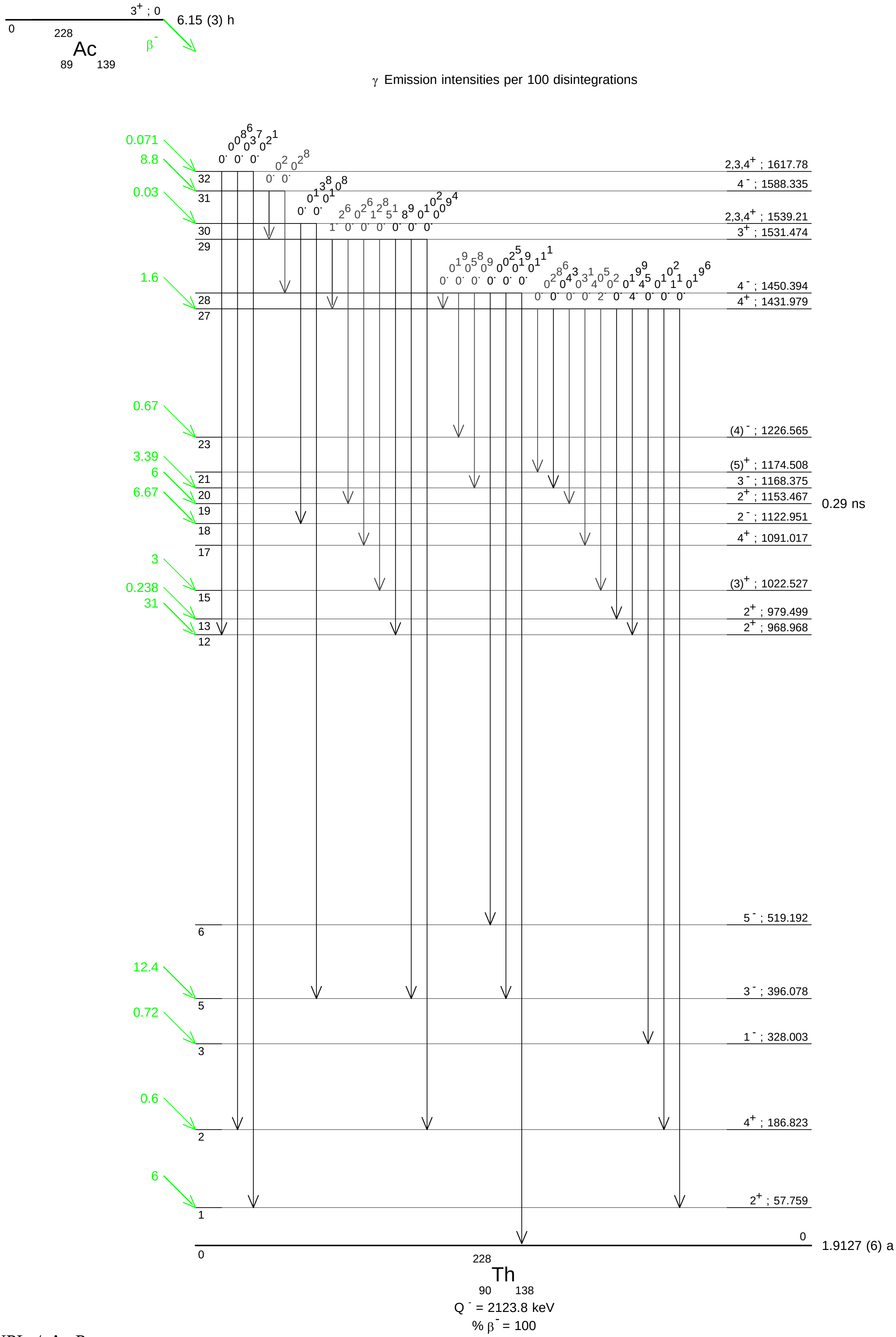
NPL / A. Pearce


3+ ; 0
6.15 (3) h
228 Ac 89 139
β-
γ Emission intensities per 100 disintegrations
3,4+ ; 1795.9
2,3()+ ; 1760.218
2,3,4+ ; 1758.24
4+ ; 1743.89
(4)+ ; 1735.45
2+ ; 1724.283
2,3+ ; 1688.394
3+ ; 1645.954
4+ ; 1431.979
3- ; 1344.078
(4)- ; 1226.565
2+ ; 1175.39
2+ ; 1153.467
0.29 ns
(3)+ ; 1022.527
2,3,4- ; 1016.406
2+ ; 968.968
2+ ; 874.473
5- ; 519.192
3- ; 396.078
6+ ; 378.179
1- ; 328.003
4+ ; 186.823
2+ ; 57.759
0
1.9127 (6) a
0.035
0.139
0.06
0.378
0.149
1.93
2.5
4.12
1.6
0.208
0.67
0.166
6
3
0.39
31
0.17
12.4
0.147
0.72
0.6
6
228 Th 90 138
Q- = 2123.8 keV
% β- = 100

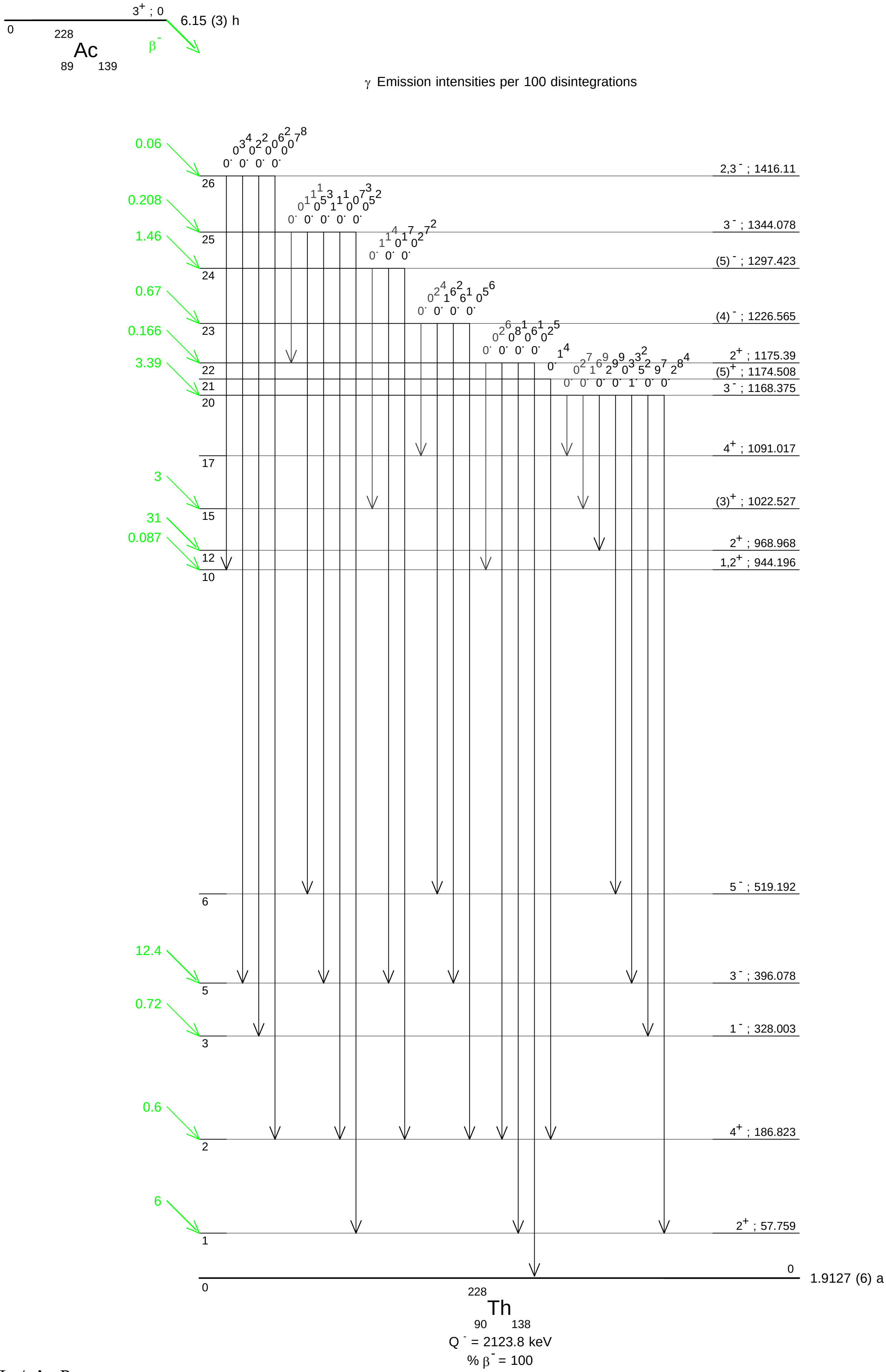
NPL / A. Pearce


3+ ; 0
6.15 (3) h
228 Ac 89 139
β-
γ Emission intensities per 100 disintegrations
0.2
1.21
4.12
0.82
1.23
0.67
3.39
6
6.67
3
0.39
0.238
31
0.087
12.4
0.72
0.6
6
(4)- ; 1683.82
2,3(),4+ ; 1682.81
3+ ; 1645.954
(2,3)- ; 1643.125
2+ ; 1638.284
3+ ; 1531.474
(4)- ; 1226.565
3- ; 1168.375
2+ ; 1153.467
0.29 ns
2- ; 1122.951
4+ ; 1091.017
(3)+ ; 1022.527
2,3,4- ; 1016.406
2+ ; 979.499
2+ ; 968.968
1,2+ ; 944.196
5- ; 519.192
3- ; 396.078
1- ; 328.003
4+ ; 186.823
2+ ; 57.759
0
1.9127 (6) a
228 Th 90 138
Q- = 2123.8 keV
% β- = 100

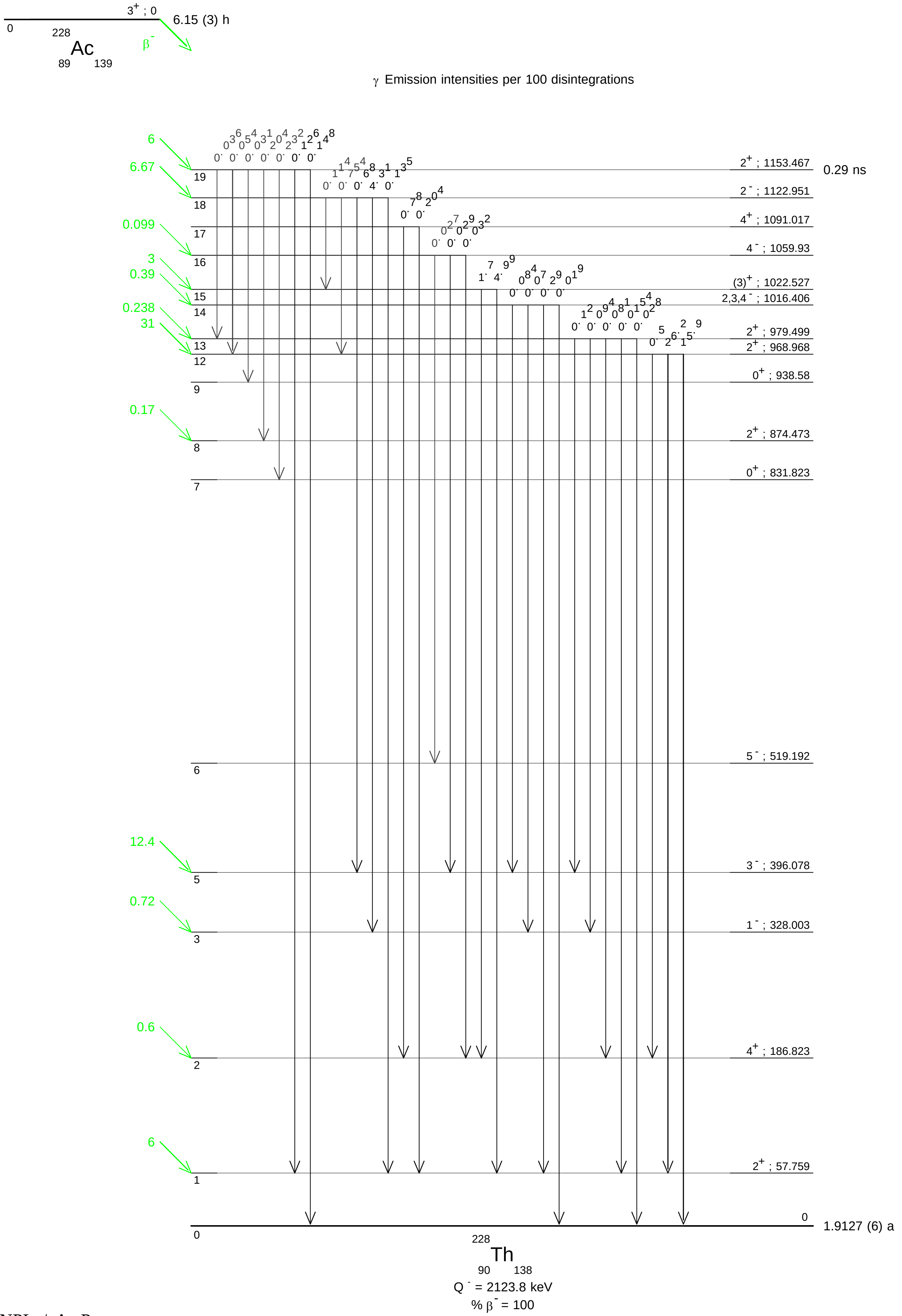
NPL / A. Pearce


3+ ; 0
0
228 Ac 89 139
6.15 (3) h
β-
γ Emission intensities per 100 disintegrations
0.071
8.8
0.03
1.6
0.67
3.39
6
6.67
3
0.238
31
12.4
0.72
0.6
6
2,3,4+ ; 1617.78
4- ; 1588.335
2,3,4+ ; 1539.21
3+ ; 1531.474
4- ; 1450.394
4+ ; 1431.979
(4)- ; 1226.565
(5)+ ; 1174.508
3- ; 1168.375
2+ ; 1153.467
2- ; 1122.951
4+ ; 1091.017
(3)+ ; 1022.527
2+ ; 979.499
2+ ; 968.968
5- ; 519.192
3- ; 396.078
1- ; 328.003
4+ ; 186.823
2+ ; 57.759
0
0.29 ns
1.9127 (6) a
228 Th 90 138
Q- = 2123.8 keV
% β- = 100

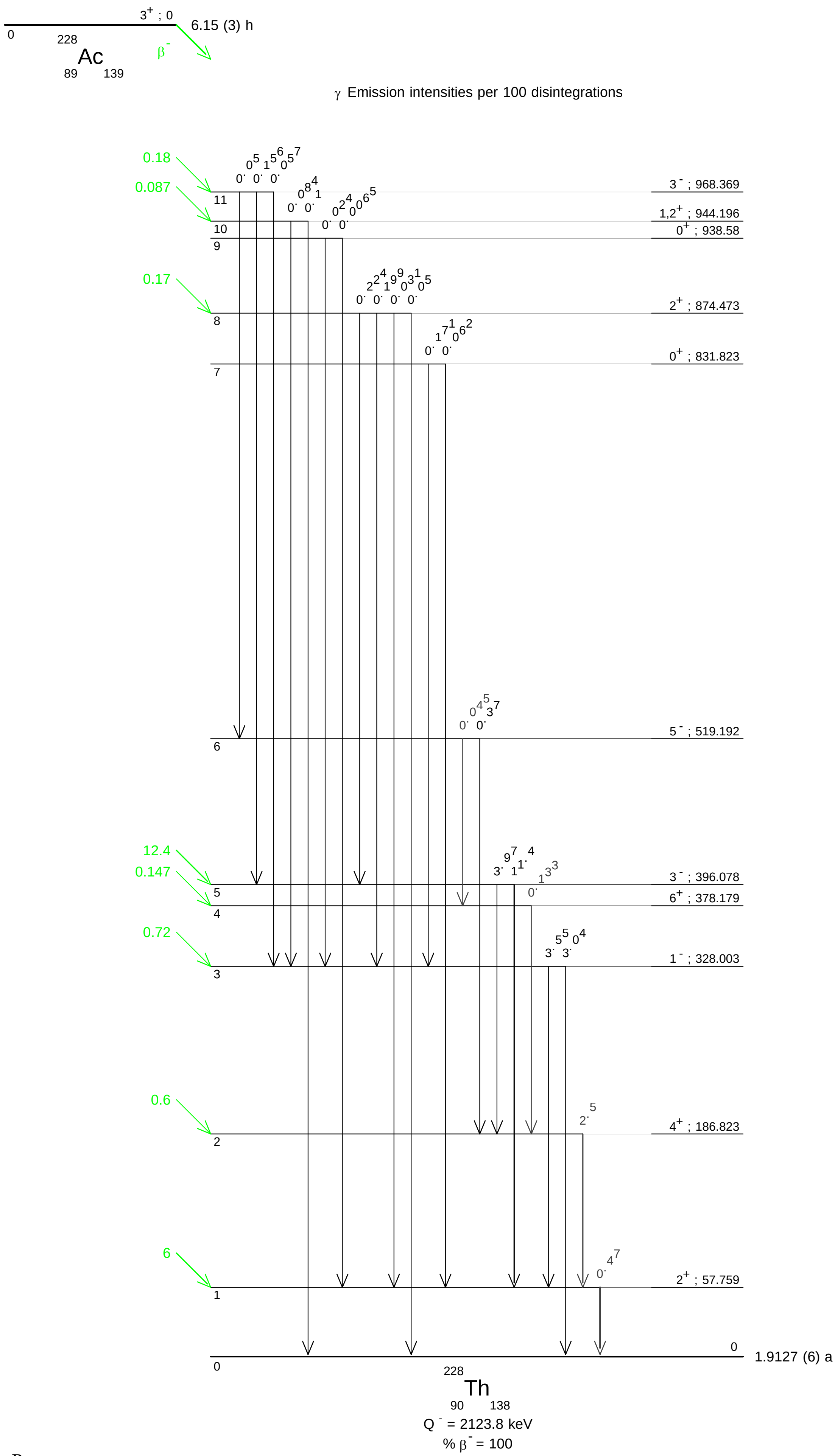
NPL / A. Pearce


3+ ; 0
0
228 Ac 89 139
β-
6.15 (3) h
γ Emission intensities per 100 disintegrations
0.06
0.208
1.46
0.67
0.166
3.39
3
31
0.087
12.4
0.72
0.6
6
2,3 - ; 1416.11
3 - ; 1344.078
(5) - ; 1297.423
(4) - ; 1226.565
2+ ; 1175.39
(5)+ ; 1174.508
3 - ; 1168.375
4+ ; 1091.017
(3)+ ; 1022.527
2+ ; 968.968
1,2+ ; 944.196
5 - ; 519.192
3 - ; 396.078
1 - ; 328.003
4+ ; 186.823
2+ ; 57.759
0
1.9127 (6) a
26
25
24
23
22
21
20
17
15
12
10
6
5
3
2
1
0
228 Th 90 138
Q - = 2123.8 keV
% β- = 100

NPL / A. Pearce


3+ ; 0
6.15 (3) h
0
228 Ac 89 139
β-
γ Emission intensities per 100 disintegrations
2+ ; 1153.467
0.29 ns
2- ; 1122.951
4+ ; 1091.017
4- ; 1059.93
(3)+ ; 1022.527
2,3,4- ; 1016.406
2+ ; 979.499
2+ ; 968.968
0+ ; 938.58
2+ ; 874.473
0+ ; 831.823
5- ; 519.192
3- ; 396.078
1- ; 328.003
4+ ; 186.823
2+ ; 57.759
0
1.9127 (6) a
6
6.67
0.099
3
0.39
0.238
31
0.17
12.4
0.72
0.6
6
228 Th 90 138
Q- = 2123.8 keV
% β- = 100

NPL / A. Pearce


3+ ; 0
6.15 (3) h
228 Ac 89 139
β-
γ Emission intensities per 100 disintegrations
0.18
0.087
0.17
12.4
0.147
0.72
0.6
6
3 - ; 968.369
1,2+ ; 944.196
0+ ; 938.58
2+ ; 874.473
0+ ; 831.823
5 - ; 519.192
3 - ; 396.078
6+ ; 378.179
1 - ; 328.003
4+ ; 186.823
2+ ; 57.759
0
1.9127 (6) a
228 Th 90 138
Q - = 2123.8 keV
% β - = 100

NPL / A. Pearce

$^{231}_{91}$Pa$_{140}$

1 Decay Scheme

Pa-231 is a member of the natural U-235 decay chain. Pa-231 disintegrates by alpha emission to various excited levels and the ground state of Ac-227.
Le protactinium 231 se désintègre par émissions alpha vers des niveaux excités et le niveau fondamental de l'actinium 227.

2 Nuclear Data

$T_{1/2}(^{231}$Pa)	:	32670	(260)	a
$T_{1/2}(^{227}$Ac)	:	21,772	(3)	a
$Q^{\alpha}(^{231}$Pa)	:	5149,9	(8)	keV

2.1 α Transitions

	Energy keV	Probability × 100	F
$\alpha_{0,25}$	4493,5 (9)	0,0021 (5)	43
$\alpha_{0,24}$	4587,1 (8)	0,0036 (3)	126
$\alpha_{0,23}$	4612,9 (8)	0,00076 (20)	930
$\alpha_{0,22}$	4648,6 (9)	0,008 (4)	160
$\alpha_{0,21}$	4680,6 (8)	0,015 (7)	146
$\alpha_{0,20}$	4711,9 (8)	0,078 (21)	47
$\alpha_{0,19}$	4714,7 (8)	0,0504 (11)	75,8
$\alpha_{0,18}$	4724,3 (8)	0,080 (6)	56
$\alpha_{0,17}$	4762,6 (8)	1,8 (3)	4,6
$\alpha_{0,16}$	4795,4 (8)	1,20 (22)	11,7
$\alpha_{0,15}$	4819,8 (8)	8,4 (4)	2,46
$\alpha_{0,14}$	4845,1 (8)	0,0032 (9)	9600
$\alpha_{0,12}$	4878,6 (8)	0,040 (15)	1300
$\alpha_{0,11}$	4939,1 (8)	1,40 (15)	94
$\alpha_{0,8}$	4989,9 (22)	0,002 (1)	141000
$\alpha_{0,7}$	5023,0 (8)	2,9 (3)	160

	Energy keV	Probability × 100	F
$\alpha_{0,6}$	5039,9 (8)	22,5 (5)	26,5
$\alpha_{0,5}$	5065,3 (8)	0,4 (1)	2160
$\alpha_{0,4}$	5075,7 (8)	1,6 (2)	629
$\alpha_{0,3}$	5103,5 (8)	25,3 (5)	59,5
$\alpha_{0,2}$	5119,9 (8)	20 (2)	95
$\alpha_{0,1}$	5122,5 (8)	2,8 (3)	707
$\alpha_{0,0}$	5149,9 (8)	11,7 (5)	250

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{3,2}$(Ac)	16,370 (14)	2,12 (9)	E1		5,06 (7)	2,68 (4)	8,58 (12)
$\gamma_{3,1}$(Ac)	18,980 (14)	42 (4)	M1		2,35 (4)	82,7 (12)	113,2 (16)
$\gamma_{11,9}$(Ac)	23,46 (6)	1,16 (15)	M1		182 (3)	44,1 (7)	241 (4)
$\gamma_{16,15}$(Ac)	24,46 (4)	1,05 (21)	M1		161,3 (24)	39,0 (6)	214 (4)
$\gamma_{6,5}$(Ac)	25,390 (22)	18,3 (14)	M1		144,6 (21)	34,9 (5)	191 (3)
$\gamma_{1,0}$(Ac)	27,37 (1)	59 (7)	E1		3,3 (4)	0,87 (13)	4,5 (6)
$\gamma_{2,0}$(Ac)	29,98 (1)	26 (3)	M1+E2		202 (21)	52 (6)	270 (30)
$\gamma_{6,4}$(Ac)	35,800 (22)	0,045 (3)	E1		1,313 (19)	0,327 (5)	1,746 (25)
$\gamma_{5,3}$(Ac)	38,200 (14)	13 (3)	M1+E2		66 (14)	17 (4)	89 (19)
$\gamma_{4,2}$(Ac)	44,160 (14)	2,11 (16)	M1		28,3 (4)	6,79 (10)	37,4 (6)
$\gamma_{3,0}$(Ac)	46,35 (1)	0,357 (19)	E1		0,663 (10)	0,1634 (23)	0,879 (13)
$\gamma_{20,17}$(Ac)	50,73 (5)	0,057 (21)	M1		18,8 (3)	4,52 (7)	24,9 (4)
$\gamma_{7,4}$(Ac)	52,720 (22)	1,77 (10)	M1		16,81 (24)	4,03 (6)	22,2 (4)
$\gamma_{5,2}$(Ac)	54,570 (14)	0,110 (6)	E1		0,430 (6)	0,1053 (15)	0,569 (8)
$\gamma_{15,13}$(Ac)	56,90 (3)	0,18 (4)	M1+E2		28 (5)	7,1 (12)	37 (6)
$\gamma_{5,1}$(Ac)	57,180 (14)	4,6 (5)	E2		108,6 (16)	29,6 (5)	148,1 (21)
$\gamma_{17,15}$(Ac)	57,190 (22)	0,7 (3)	E2		108,5 (16)	29,6 (5)	148,0 (21)
$\gamma_{9,7}$(Ac)	60,46 (4)	0,0076 (10)	E1		0,327 (5)	0,0800 (12)	0,433 (7)
$\gamma_{6,3}$(Ac)	63,590 (22)	3,99 (16)	E2		65,1 (10)	17,8 (3)	88,8 (13)
$\gamma_{(-1,1)}$(Ac)	70,49 (5)	0,0051 (8)					
$\gamma_{10,7}$(Ac)	71,85 (5)	0,019 (7)	M1		6,79 (10)	1,630 (23)	8,98 (13)
$\gamma_{12,10}$(Ac)	72,58 (7)	0,029 (7)	M1		6,59 (10)	1,582 (23)	8,71 (13)
$\gamma_{4,0}$(Ac)	74,14 (1)	0,97 (4)	E2		31,2 (5)	8,53 (12)	42,6 (6)
$\gamma_{9,6}$(Ac)	77,38 (4)	0,50 (4)	M1		5,47 (8)	1,313 (19)	7,23 (11)
$\gamma_{7,2}$(Ac)	96,880 (22)	1,10 (4)	E2		8,81 (13)	2,41 (4)	12,02 (17)
$\gamma_{11,6}$(Ac)	100,84 (5)	0,248 (10)	E2		7,30 (11)	2,00 (3)	9,97 (15)
$\gamma_{9,5}$(Ac)	102,77 (3)	0,20 (4)	E2		6,69 (10)	1,83 (3)	9,12 (13)
$\gamma_{10,4}$(Ac)	124,57 (4)	0,0217 (20)	E2	0,285 (4)	2,75 (4)	0,752 (11)	4,04 (6)
$\gamma_{12,7}$(Ac)	144,43 (6)	0,037 (3)	E2	0,263 (4)	1,407 (20)	0,384 (6)	2,18 (3)
$\gamma_{13,4}$(Ac)	199,00 (3)	0,0030 (12)					
$\gamma_{14,4}$(Ac)	230,59 (5)	0,0017 (8)					
$\gamma_{(-1,2)}$(Ac)	242,18 (8)	0,0099 (10)					
$\gamma_{13,2}$(Ac)	243,16 (3)	0,065 (11)	M1+E2	0,56 (16)	0,176 (10)	0,0445 (16)	0,80 (17)
$\gamma_{15,5}$(Ac)	245,490 (14)	0,042 (3)	M2	3,70 (6)	1,143 (16)	0,293 (5)	5,24 (8)
$\gamma_{13,1}$(Ac)	245,77 (3)	0,013 (4)	E1	0,0455 (7)	0,00867 (13)	0,00208 (3)	0,0570 (8)
$\gamma_{15,4}$(Ac)	255,900 (14)	0,134 (3)	E2	0,0992 (14)	0,1216 (17)	0,0327 (5)	0,264 (4)
$\gamma_{14,3}$(Ac)	258,38 (5)	0,0015 (4)					

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{17,7}$(Ac)	260,37 (3)	0,282 (21)	M1+E2	0,37 (10)	0,133 (7)	0,0340 (13)	0,55 (11)
$\gamma_{13,0}$(Ac)	273,14 (3)	0,101 (7)	M1+E2	0,57 (10)	0,131 (8)	0,0323 (15)	0,74 (11)
$\gamma_{17,6}$(Ac)	277,29 (3)	0,10 (6)	E1+M2	0,4 (7)	0,11 (19)	0,03 (5)	0,5 (9)
$\gamma_{15,3}$(Ac)	283,690 (14)	1,72 (3)	E1	0,0329 (5)	0,00614 (9)	0,001468 (21)	0,0410 (6)
$\gamma_{(-1,3)}$(Ac)	286,58 (10)	0,0104 (5)					
$\gamma_{15,2}$(Ac)	300,060 (14)	4,25 (10)	M1+E2	0,613 (15)	0,1146 (20)	0,0275 (5)	0,764 (17)
$\gamma_{15,1}$(Ac)	302,670 (14)	2,4 (3)	E1	0,0285 (4)	0,00527 (8)	0,001260 (18)	0,0355 (5)
$\gamma_{17,5}$(Ac)	302,680 (22)	0,22 (10)	E1	0,0285 (4)	0,00527 (8)	0,001260 (18)	0,0355 (5)
$\gamma_{(-1,4)}$(Ac)	310,0 (1)	0,00092 (20)					
$\gamma_{17,4}$(Ac)	313,090 (22)	0,129 (9)	M1+E2	0,22 (8)	0,070 (8)	0,0177 (16)	0,31 (9)
$\gamma_{16,1}$(Ac)	327,13 (4)	0,0372 (11)	E1	0,0240 (4)	0,00440 (7)	0,001050 (15)	0,0298 (5)
$\gamma_{15,0}$(Ac)	330,04 (1)	2,09 (5)	M1+E2	0,430 (16)	0,0836 (20)	0,0202 (5)	0,541 (19)
$\gamma_{17,3}$(Ac)	340,880 (22)	0,196 (7)	E1+M2	0,081 (22)	0,020 (6)	0,0050 (15)	0,11 (3)
$\gamma_{18,4}$(Ac)	351,45 (3)	0,0029 (12)	E1	0,0206 (3)	0,00373 (6)	0,000891 (13)	0,0255 (4)
$\gamma_{16,0}$(Ac)	354,50 (4)	0,1094 (23)	M1+E2	0,0855 (12)	0,0386 (6)	0,01003 (14)	0,1375 (20)
$\gamma_{17,2}$(Ac)	357,250 (22)	0,240 (18)	M1+E2	0,34 (9)	0,066 (10)	0,0159 (21)	0,43 (10)
$\gamma_{17,1}$(Ac)	359,860 (22)	0,0085 (3)					
$\gamma_{20,4}$(Ac)	363,82 (4)	0,0080 (3)					
$\gamma_{(-1,5)}$(Ac)	374,95 (10)	0,0045 (3)					
$\gamma_{18,3}$(Ac)	379,24 (3)	0,066 (6)	M1+E2	0,25 (10)	0,052 (11)	0,0125 (24)	0,32 (11)
$\gamma_{21,5}$(Ac)	384,69 (6)	0,00365 (22)					
$\gamma_{17,0}$(Ac)	387,23 (2)	0,00032 (11)	E2	0,0430 (6)	0,0254 (4)	0,00667 (10)	0,0773 (11)
$\gamma_{20,3}$(Ac)	391,61 (4)	0,00687 (22)	E1	0,01636 (23)	0,00293 (5)	0,000697 (10)	0,0202 (3)
$\gamma_{18,2}$(Ac)	395,61 (3)	0,00230 (22)	E1	0,01601 (23)	0,00286 (4)	0,000682 (10)	0,0198 (3)
$\gamma_{18,1}$(Ac)	398,22 (3)	0,0095 (3)					
$\gamma_{19,1}$(Ac)	407,820 (22)	0,0475 (11)	M1	0,269 (4)	0,0496 (7)	0,01187 (17)	0,334 (5)
$\gamma_{20,1}$(Ac)	410,59 (4)	0,00183 (22)	E1	0,01482 (21)	0,00264 (4)	0,000628 (9)	0,0183 (3)
$\gamma_{22,4}$(Ac)	427,14 (7)	0,0007 (4)					
$\gamma_{19,0}$(Ac)	435,19 (2)	0,00294 (17)					
$\gamma_{20,0}$(Ac)	437,96 (4)	0,0045 (3)					
$\gamma_{(-1,6)}$(Ac)	438,72 (10)	0,0013 (4)					
$\gamma_{24,4}$(Ac)	488,66 (10)	0,00165 (17)					
$\gamma_{23,3}$(Ac)	490,65 (10)	0,0004 (1)					
$\gamma_{22,0}$(Ac)	501,28 (7)	0,00076 (18)					
$\gamma_{23,1}$(Ac)	509,63 (10)	0,00036 (17)					
$\gamma_{24,3}$(Ac)	516,45 (10)	0,00137 (15)					
$\gamma_{24,1}$(Ac)	535,43 (10)	0,00061 (12)					
$\gamma_{25,6}$(Ac)	546,5 (3)	0,00083 (13)					
$\gamma_{25,5}$(Ac)	571,9 (3)	0,00048 (20)					
$\gamma_{25,4}$(Ac)	582,3 (3)	0,00031 (17)					
$\gamma_{25,3}$(Ac)	610,1 (3)	0,0005 (4)					

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_K				
	$K\alpha_2$	87,768		61,52
	$K\alpha_1$	90,885		100
	$K\beta_3$	102,101	}	
	$K\beta_1$	102,841	}	
	$K\beta_5''$	103,462	}	35,26
	$K\beta_2$	105,679	}	
	$K\beta_4$	106,098	}	11,74
	$KO_{2,3}$	106,563	}	
X_L				
	$L\ell$	10,8701		
	$L\alpha$	12,5002 – 12,6505		
	$L\eta$	14,0807		
	$L\beta$	14,6024 – 15,9311		
	$L\gamma$	17,813 – 18,9228		

3.1.2 Auger Electrons

	Energy keV	Relative probability
Auger K		
KLL	66,769 – 74,715	100
KLX	81,775 – 90,882	58,2
KXY	96,76 – 106,75	8,47
Auger L	5,87 – 19,69	

4 α Emissions

	Energy keV	Probability × 100
$\alpha_{0,25}$	4415,6 (9)	0,0021 (5)
$\alpha_{0,24}$	4507,6 (8)	0,0036 (3)
$\alpha_{0,23}$	4533,0 (8)	0,00076 (20)
$\alpha_{0,22}$	4568,1 (9)	0,008 (4)
$\alpha_{0,21}$	4599,6 (8)	0,015 (7)
$\alpha_{0,20}$	4630,3 (8)	0,078 (21)
$\alpha_{0,19}$	4633,0 (8)	0,0504 (11)
$\alpha_{0,18}$	4642,5 (8)	0,080 (6)
$\alpha_{0,17}$	4680,1 (8)	1,8 (3)
$\alpha_{0,16}$	4712,3 (8)	1,20 (22)
$\alpha_{0,15}$	4736,3 (8)	8,4 (4)
$\alpha_{0,14}$	4761,2 (8)	0,0032 (9)
$\alpha_{0,12}$	4794,1 (8)	0,040 (15)
$\alpha_{0,11}$	4853,5 (8)	1,40 (15)
$\alpha_{0,8}$	4903,4 (22)	0,002 (1)
$\alpha_{0,7}$	4936,0 (8)	2,9 (3)
$\alpha_{0,6}$	4952,6 (8)	22,5 (5)
$\alpha_{0,5}$	4977,6 (8)	0,4 (1)
$\alpha_{0,4}$	4987,8 (8)	1,6 (2)
$\alpha_{0,3}$	5015,1 (8)	25,3 (5)
$\alpha_{0,2}$	5031,2 (8)	20 (2)
$\alpha_{0,1}$	5033,8 (8)	2,8 (3)
$\alpha_{0,0}$	5060,7 (8)	11,7 (5)

5 Electron Emissions

		Energy keV	Electrons per 100 disint.
e_{AL}	(Ac)	5,87 - 19,69	52,6 (15)
e_{AK}	(Ac)		0,078 (11)
	KLL	66,769 - 74,715	}
	KLX	81,775 - 90,882	}
	KXY	96,76 - 106,75	}

6 Photon Emissions

6.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(Ac)	10,8701 — 18,9228		44,3 (13)	
XKα_2	(Ac)	87,768		0,715 (23)	} Kα
XKα_1	(Ac)	90,885		1,16 (4)	}
XKβ_3	(Ac)	102,101	}		
XKβ_1	(Ac)	102,841	}	0,410 (15)	K$'\beta_1$
XKβ_5''	(Ac)	103,462	}		
XKβ_2	(Ac)	105,679	}		
XKβ_4	(Ac)	106,098	}	0,136 (6)	K$'\beta_2$
XKO$_{2,3}$	(Ac)	106,563	}		

6.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{3,2}$(Ac)	16,370 (14)	0,221 (9)
$\gamma_{3,1}$(Ac)	18,980 (14)	0,37 (3)
$\gamma_{11,9}$(Ac)	23,46 (6)	0,0048 (6)
$\gamma_{16,15}$(Ac)	24,46 (4)	0,0049 (10)
$\gamma_{6,5}$(Ac)	25,390 (22)	0,095 (7)
$\gamma_{1,0}$(Ac)	27,37 (1)	10,8 (4)
$\gamma_{2,0}$(Ac)	29,98 (1)	0,097 (4)
$\gamma_{6,4}$(Ac)	35,800 (22)	0,0163 (10)
$\gamma_{5,3}$(Ac)	38,200 (14)	0,144 (6)
$\gamma_{4,2}$(Ac)	44,160 (14)	0,055 (4)
$\gamma_{3,0}$(Ac)	46,35 (1)	0,19 (1)
$\gamma_{20,17}$(Ac)	50,73 (5)	0,0022 (8)
$\gamma_{7,4}$(Ac)	52,720 (22)	0,076 (4)
$\gamma_{5,2}$(Ac)	54,570 (14)	0,070 (4)
$\gamma_{15,13}$(Ac)	56,90 (3)	0,0047 (7)
$\gamma_{5,1}$(Ac)	57,180 (14)	0,031 (3)
$\gamma_{17,15}$(Ac)	57,190 (22)	0,0046 (21)
$\gamma_{9,7}$(Ac)	60,46 (4)	0,0053 (7)
$\gamma_{6,3}$(Ac)	63,590 (22)	0,0446 (17)
$\gamma_{(-1,1)}$(Ac)	70,49 (5)	0,0051 (8)
$\gamma_{10,7}$(Ac)	71,85 (5)	0,0019 (7)

	Energy keV	Photons per 100 disint.
$\gamma_{12,10}$(Ac)	72,58 (7)	0,0030 (7)
$\gamma_{4,0}$(Ac)	74,14 (1)	0,0223 (9)
$\gamma_{9,6}$(Ac)	77,38 (4)	0,061 (4)
$\gamma_{7,2}$(Ac)	96,880 (22)	0,084 (3)
$\gamma_{11,6}$(Ac)	100,84 (5)	0,0226 (9)
$\gamma_{9,5}$(Ac)	102,77 (3)	0,019 (4)
$\gamma_{10,4}$(Ac)	124,57 (4)	0,0043 (4)
$\gamma_{12,7}$(Ac)	144,43 (6)	0,0115 (9)
$\gamma_{13,4}$(Ac)	199,00 (3)	0,0030 (12)
$\gamma_{14,4}$(Ac)	230,59 (5)	0,0017 (8)
$\gamma_{(-1,2)}$(Ac)	242,18 (8)	0,0099 (10)
$\gamma_{13,2}$(Ac)	243,16 (3)	0,036 (5)
$\gamma_{15,5}$(Ac)	245,490 (14)	0,0067 (5)
$\gamma_{13,1}$(Ac)	245,77 (3)	0,012 (4)
$\gamma_{15,4}$(Ac)	255,900 (14)	0,1059 (22)
$\gamma_{14,3}$(Ac)	258,38 (5)	0,0015 (4)
$\gamma_{17,7}$(Ac)	260,37 (3)	0,182 (4)
$\gamma_{13,0}$(Ac)	273,14 (3)	0,0579 (12)
$\gamma_{17,6}$(Ac)	277,29 (3)	0,0680 (15)
$\gamma_{15,3}$(Ac)	283,690 (14)	1,65 (3)
$\gamma_{(-1,3)}$(Ac)	286,58 (10)	0,0104 (5)
$\gamma_{15,2}$(Ac)	300,060 (14)	2,41 (5)
$\gamma_{15,1}$(Ac)	302,670 (14)	2,3 (3)
$\gamma_{17,5}$(Ac)	302,680 (22)	0,21 (10)
$\gamma_{(-1,4)}$(Ac)	310,0 (1)	0,00092 (20)
$\gamma_{17,4}$(Ac)	313,090 (22)	0,0987 (20)
$\gamma_{16,1}$(Ac)	327,13 (4)	0,0361 (11)
$\gamma_{15,0}$(Ac)	330,04 (1)	1,36 (3)
$\gamma_{17,3}$(Ac)	340,880 (22)	0,177 (4)
$\gamma_{18,4}$(Ac)	351,45 (3)	0,0028 (12)
$\gamma_{16,0}$(Ac)	354,50 (4)	0,0962 (20)
$\gamma_{17,2}$(Ac)	357,250 (22)	0,168 (4)
$\gamma_{17,1}$(Ac)	359,860 (22)	0,0085 (3)
$\gamma_{20,4}$(Ac)	363,82 (4)	0,0080 (3)
$\gamma_{(-1,5)}$(Ac)	374,95 (10)	0,0045 (3)
$\gamma_{18,3}$(Ac)	379,24 (3)	0,0498 (11)
$\gamma_{21,5}$(Ac)	384,69 (6)	0,00365 (22)
$\gamma_{17,0}$(Ac)	387,23 (2)	0,0003 (1)
$\gamma_{20,3}$(Ac)	391,61 (4)	0,00673 (22)
$\gamma_{18,2}$(Ac)	395,61 (3)	0,00226 (22)
$\gamma_{18,1}$(Ac)	398,22 (3)	0,0095 (3)
$\gamma_{19,1}$(Ac)	407,820 (22)	0,0356 (8)
$\gamma_{20,1}$(Ac)	410,59 (4)	0,00180 (22)
$\gamma_{22,4}$(Ac)	427,14 (7)	0,0007 (4)
$\gamma_{19,0}$(Ac)	435,19 (2)	0,00294 (17)
$\gamma_{20,0}$(Ac)	437,96 (4)	0,0045 (3)
$\gamma_{(-1,6)}$(Ac)	438,72 (10)	0,0013 (4)

	Energy keV	Photons per 100 disint.
$\gamma_{24,4}$(Ac)	488,66 (10)	0,00165 (17)
$\gamma_{23,3}$(Ac)	490,65 (10)	0,0004 (1)
$\gamma_{22,0}$(Ac)	501,28 (7)	0,00076 (18)
$\gamma_{23,1}$(Ac)	509,63 (10)	0,00036 (17)
$\gamma_{24,3}$(Ac)	516,45 (10)	0,00137 (15)
$\gamma_{24,1}$(Ac)	535,43 (10)	0,00061 (12)
$\gamma_{25,6}$(Ac)	546,5 (3)	0,00083 (13)
$\gamma_{25,5}$(Ac)	571,9 (3)	0,00048 (20)
$\gamma_{25,4}$(Ac)	582,3 (3)	0,00031 (17)
$\gamma_{25,3}$(Ac)	610,1 (3)	0,0005 (4)

7 Main Production Modes

Th – 232(n, 2n)Th – 231

Th – 231(β^-)Pa – 231

U – 235 decay chain

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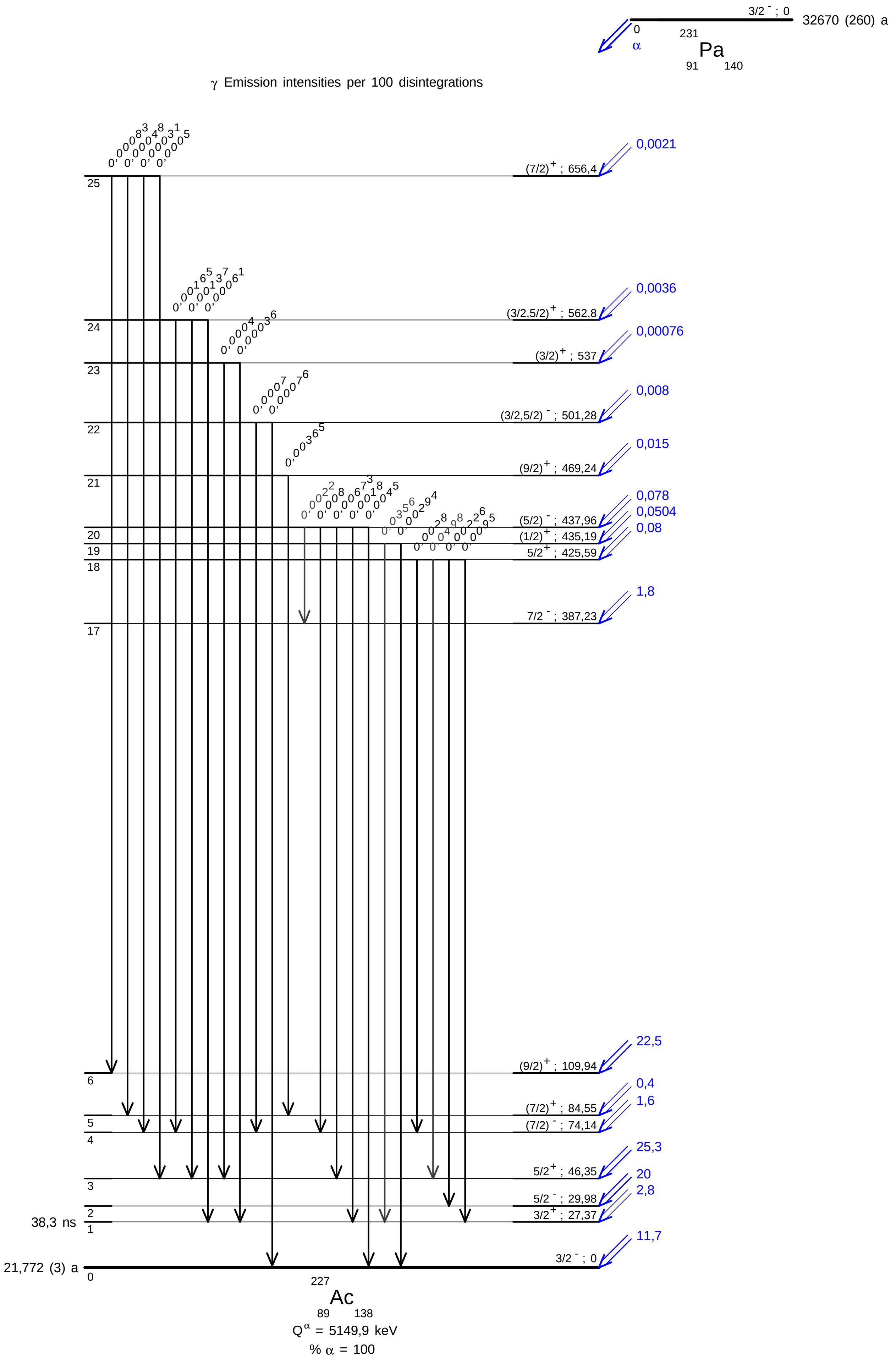
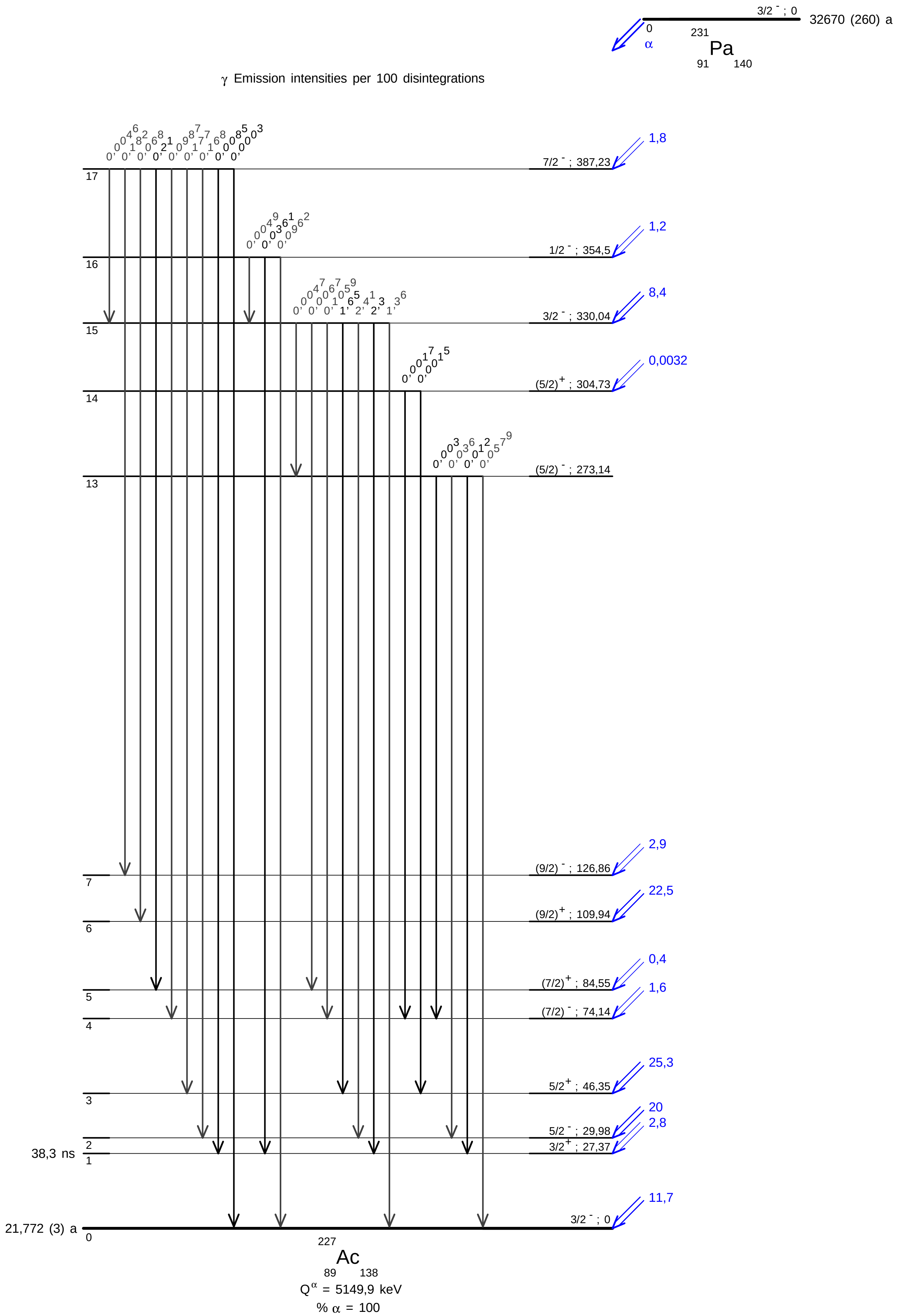
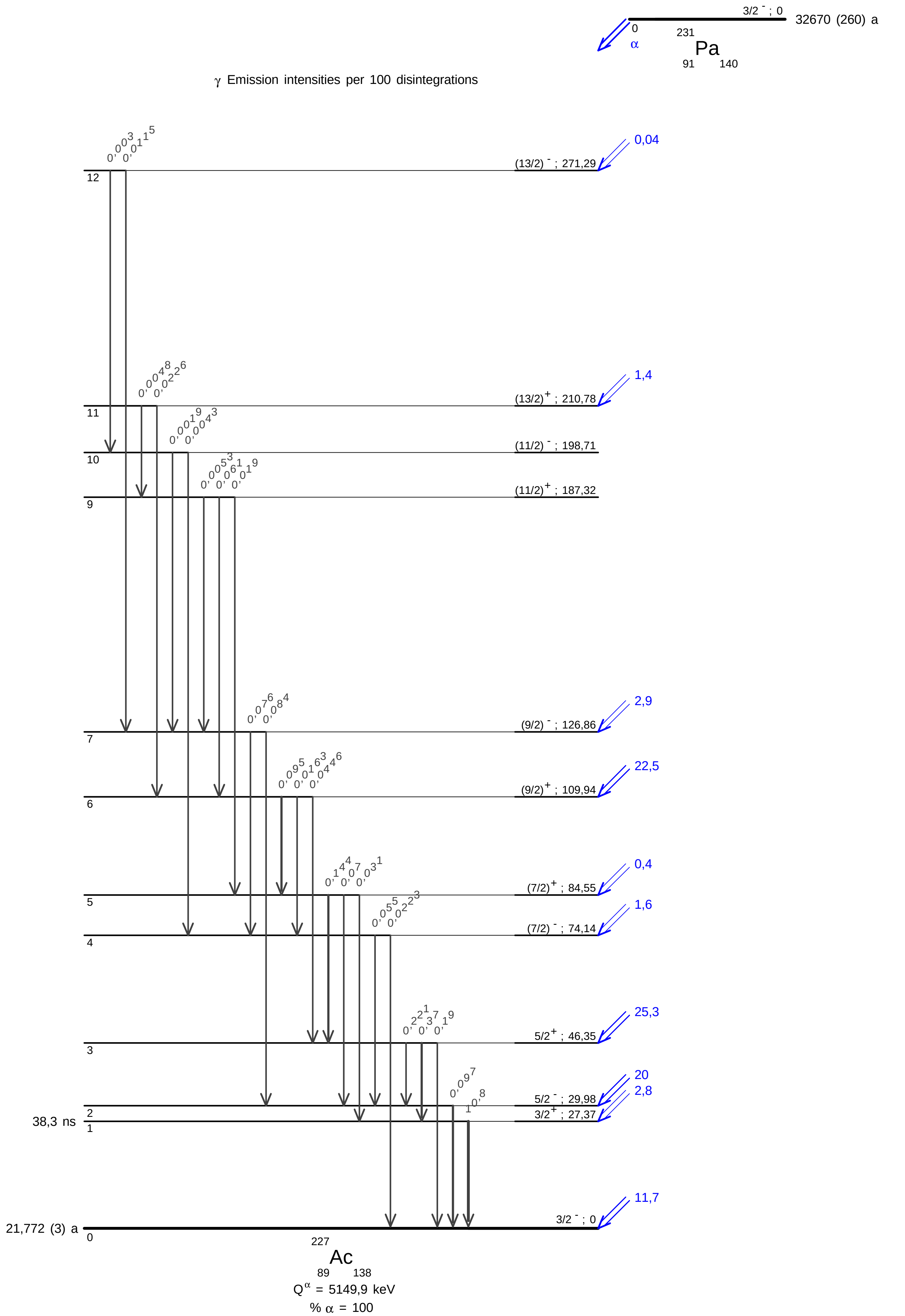

3/2 - ; 0
32670 (260) a
0
α
231 Pa 91 140
γ Emission intensities per 100 disintegrations
(7/2)+ ; 656,4
0,0021
(3/2,5/2)+ ; 562,8
0,0036
(3/2)+ ; 537
0,00076
(3/2,5/2) - ; 501,28
0,008
(9/2)+ ; 469,24
0,015
(5/2) - ; 437,96
0,078
(1/2)+ ; 435,19
0,0504
5/2+ ; 425,59
0,08
7/2 - ; 387,23
1,8
(9/2)+ ; 109,94
22,5
(7/2)+ ; 84,55
0,4
(7/2) - ; 74,14
1,6
5/2+ ; 46,35
25,3
5/2 - ; 29,98
20
3/2+ ; 27,37
2,8
3/2 - ; 0
11,7
25
24
23
22
21
20
19
18
17
6
5
4
3
2
1
0
38,3 ns
21,772 (3) a
227 Ac 89 138
Qα = 5149,9 keV
% α = 100

NPL / A. Arinc


3/2 - ; 0
32670 (260) a
0
α
231
Pa
91
140
γ Emission intensities per 100 disintegrations
7/2 - ; 387,23
1,8
1/2 - ; 354,5
1,2
3/2 - ; 330,04
8,4
(5/2)+ ; 304,73
0,0032
(5/2) - ; 273,14
(9/2) - ; 126,86
2,9
(9/2)+ ; 109,94
22,5
(7/2)+ ; 84,55
0,4
(7/2) - ; 74,14
1,6
5/2+ ; 46,35
25,3
5/2 - ; 29,98
20
3/2+ ; 27,37
2,8
38,3 ns
21,772 (3) a
3/2 - ; 0
11,7
227
Ac
89
138
Qα = 5149,9 keV
% α = 100

NPL / A. Arinc


3/2 - ; 0
32670 (260) a
0
α
231 Pa 91 140
γ Emission intensities per 100 disintegrations
0,04
(13/2) - ; 271,29
12
1,4
(13/2)+ ; 210,78
11
(11/2) - ; 198,71
10
(11/2)+ ; 187,32
9
2,9
(9/2) - ; 126,86
7
22,5
(9/2)+ ; 109,94
6
0,4
(7/2)+ ; 84,55
5
1,6
(7/2) - ; 74,14
4
25,3
5/2+ ; 46,35
3
20
2,8
5/2 - ; 29,98
3/2+ ; 27,37
38,3 ns
2
1
11,7
3/2 - ; 0
21,772 (3) a
0
227 Ac 89 138
Qα = 5149,9 keV
% α = 100

NPL / A. Arinc

$^{234}_{91}$Pa $_{143}$

1 Decay Scheme

Pa-234 disintegrates 100% by beta minus emissions to levels in U-234.
Le protactinium 234 se désintègre par émissions bêta moins vers des niveaux excités de l'uranium 234.

2 Nuclear Data

$T_{1/2}$(^{234}Pa)	:	6,70	(5)	h
Q^-(^{234}Pa)	:	2195	(4)	keV

2.1 β^- Transitions

	Energy keV	Probability × 100	Nature	lg ft
$\beta^-_{0,77}$	51 (4)	0,42 (5)		4,98
$\beta^-_{0,76}$	79 (4)	0,21 (3)		5,87
$\beta^-_{0,75}$	94 (4)	0,064 (11)		6,6
$\beta^-_{0,74}$	126 (4)	0,40 (7)		6,21
$\beta^-_{0,73}$	129 (4)	0,140 (24)		6,69
$\beta^-_{0,72}$	158 (4)	0,055 (8)		7,37
$\beta^-_{0,71}$	161 (4)	0,90 (15)		6,19
$\beta^-_{0,70}$	175 (4)	0,112 (16)		7,2
$\beta^-_{0,69}$	195 (4)	0,122 (16)		7,31
$\beta^-_{0,68}$	214 (4)	0,59 (8)		6,75
$\beta^-_{0,67}$	226 (4)	0,044 (12)		7,95
$\beta^-_{0,66}$	236 (4)	0,44 (19)		7,01
$\beta^-_{0,65}$	254 (4)	0,35 (5)		7,22
$\beta^-_{0,64}$	267 (4)	0,22 (4)		7,49
$\beta^-_{0,63}$	279 (4)	0,21 (3)		7,56
$\beta^-_{0,62}$	313 (4)	0,25 (3)		7,65
$\beta^-_{0,61}$	332 (4)	0,029 (7)		8,66
$\beta^-_{0,60}$	351 (4)	0,17 (3)		7,97

	Energy keV	Probability × 100	Nature	lg ft
$\beta^-_{0,59}$	383 (4)	1,43 (15)		7,17
$\beta^-_{0,58}$	402 (4)	0,41 (8)		7,78
$\beta^-_{0,57}$	411 (4)	0,061 (11)		8,64
$\beta^-_{0,56}$	412 (4)	8 (3)		6,53
$\beta^-_{0,55}$	424 (4)	0,129 (17)		8,36
$\beta^-_{0,54}$	433 (4)	2,8 (4)		7,05
$\beta^-_{0,53}$	457 (4)	0,78 (19)		7,68
$\beta^-_{0,52}$	458 (4)	1,16 (14)		7,51
$\beta^-_{0,50}$	472 (4)	8,4 (9)	1st Forbidden	6,7
$\beta^-_{0,51}$	472 (4)	36 (5)	Allowed	6,06
$\beta^-_{0,49}$	502 (4)	6,9 (8)	1st Forbidden	6,87
$\beta^-_{0,48}$	542 (4)	0,95 (13)		7,84
$\beta^-_{0,47}$	545 (4)	0,18 (4)		8,64
$\beta^-_{0,46}$	576 (4)	0,035 (20)		9,36
$\beta^-_{0,45}$	606 (4)	< 0,7		> 8,1
$\beta^-_{0,44}$	613 (4)	0,05 (3)		9,3
$\beta^-_{0,43}$	642 (4)	19,6 (18)	Allowed	6,77
$\beta^-_{0,42}$	647 (4)	0,078 (20)		9,18
$\beta^-_{0,41}$	651 (4)	0,10 (9)		9,1
$\beta^-_{0,40}$	658 (4)	< 0,9		> 8,1
$\beta^-_{0,39}$	662 (4)	0,21 (4)		8,79
$\beta^-_{0,38}$	693 (4)	0,25 (4)		8,78
$\beta^-_{0,37}$	699 (4)	< 2,7		> 7,8
$\beta^-_{0,36}$	709 (4)	0,12 (3)		9,14
$\beta^-_{0,34}$	747 (4)	0,11 (3)		9,25
$\beta^-_{0,31}$	883 (4)	0,109 (18)		9,5
$\beta^-_{0,26}$	980 (4)	0,30 (12)		9,22
$\beta^-_{0,25}$	1000 (4)	< 1,5		> 8,5
$\beta^-_{0,22}$	1067 (4)	1,9 (10)		8,54
$\beta^-_{0,18}$	1104 (4)	0,69 (20)		9,04
$\beta^-_{0,16}$	1126 (4)	< 8	1st Forbidden	> 8
$\beta^-_{0,15}$	1171 (4)	1,5 (13)		8,8
$\beta^-_{0,14}$	1171 (4)	< 5	1st Forbidden	> 8,3
$\beta^-_{0,13}$	1206 (4)	< 3,1	Unique 1st Forbidden	> 8,5
$\beta^-_{0,12}$	1227 (4)	< 2,5	Allowed	> 8,6
$\beta^-_{0,11}$	1232 (4)	< 0,4		> 9,4
$\beta^-_{0,10}$	1247 (4)	< 0,8	Allowed	> 9,2
$\beta^-_{0,7}$	1346 (4)	< 0,8	1st Forbidden	> 9,3
$\beta^-_{0,2}$	2052 (4)	< 5	Allowed	> 9,2

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{14,13}$(U)	34,30 (4)	8,4 (9)	(E2)		1660 (30)	457 (7)	2270 (40)
$\gamma_{8,6}$(U)	41,82 (11)	0,28 (8)					
$\gamma_{1,0}$(U)	43,49 (2)	86 (23)	E2		520 (8)	143,7 (21)	713 (11)
$\gamma_{16,14}$(U)	45,45 (5)	6,8 (44)	M1+E2		190 (100)	50 (30)	250 (140)
$\gamma_{14,12}$(U)	54,96 (10)	~0,0094	[E1]		0,453 (7)	0,1123 (17)	0,603 (9)
$\gamma_{15,12}$(U)	54,96 (10)	~1,23	[M1+E2]		90 (80)	26 (21)	130 (110)
$\gamma_{45,39}$(U)	55,45 (5)	0,043 (14)	(E1)		0,443 (7)	0,1097 (16)	0,589 (9)
$\gamma_{22,16}$(U)	58,20 (6)	0,47 (16)	(E2)		126,9 (19)	35,1 (6)	174 (3)
$\gamma_{56,51}$(U)	59,19 (5)	2,9 (25)	[M1+E2]		70 (50)	18 (15)	90 (70)
$\gamma_{13,9}$(U)	62,70 (1)	2,3 (7)	E1		0,320 (5)	0,0791 (11)	0,426 (6)
$\gamma_{25,22}$(U)	67,25 (10)	2,1 (8)	M1+E2		42 (8)	11,5 (22)	57 (11)
$\gamma_{25,20}$(U)	69,46 (5)	0,7 (6)	[E2,M1]		32 (23)	9 (7)	40 (30)
$\gamma_{31,27}$(U)	75,0 (3)	0,031 (7)					
$\gamma_{16,13}$(U)	79,84 (2)	2,4 (9)	E2		28,0 (4)	7,76 (11)	38,4 (6)
$\gamma_{14,9}$(U)	97,17 (10)	0,27 (10)	[E1]		0,1012 (15)	0,0248 (4)	0,1343 (20)
$\gamma_{2,1}$(U)	99,86 (2)	46 (9)	E2		9,77 (14)	2,71 (4)	13,42 (19)
$\gamma_{16,12}$(U)	100,89 (2)	0,140 (27)	[E1]		0,0917 (13)	0,0224 (4)	0,1218 (17)
$\gamma_{22,14}$(U)	103,77 (2)	2,93 (49)	(E2)		8,17 (12)	2,27 (4)	11,22 (16)
$\gamma_{16,11}$(U)	106,68 (5)	0,17 (5)	[M1]		2,89 (4)	0,699 (10)	3,83 (6)
$\gamma_{25,16}$(U)	125,46 (1)	4,7 (7)	E2	0,216 (3)	3,41 (5)	0,945 (14)	4,89 (7)
$\gamma_{43,33}$(U)	131,30 (1)	23 (2)	E1	0,204 (3)	0,0463 (7)	0,01128 (16)	0,265 (4)
$\gamma_{51,45}$(U)	134,61 (2)	1,20 (24)	M1	7,54 (11)	1,480 (21)	0,358 (5)	9,50 (14)
$\gamma_{21,13}$(U)	137,23 (5)	0,033 (11)	[E1]	0,184 (3)	0,0413 (6)	0,01006 (15)	0,239 (4)
$\gamma_{13,7}$(U)	140,15 (2)	3,2 (10)	M1+E2	2,9 (22)	1,76 (25)	0,47 (9)	5,3 (18)
$\gamma_{49,43}$(U)	140,91 (3)	0,38 (6)	[E1]	0,1732 (25)	0,0386 (6)	0,00940 (14)	0,224 (4)
$\gamma_{33,30}$(U)	143,78 (2)	2,02 (32)	(M1+E2)	3,24	1,532	0,403	5,31
$\gamma_{30,22}$(U)	149,88 (3)	0,24 (7)	[E2]	0,220 (3)	1,526 (22)	0,422 (6)	2,31 (4)
$\gamma_{3,2}$(U)	152,71 (2)	18,8 (22)	E2	0,217 (3)	1,404 (20)	0,388 (6)	2,14 (3)
$\gamma_{33,28}$(U)	159,48 (2)	0,77 (12)	[E1]	0,1303 (19)	0,0282 (4)	0,00684 (10)	0,1676 (24)
$\gamma_{22,11}$(U)	164,94 (5)	0,23 (14)	[E2,M1]	2,2 (21)	0,91 (9)	0,24 (4)	3,5 (19)
$\gamma_{64,54}$(U)	165,61 (5)	0,084 (25)	[E1]	0,1194 (17)	0,0256 (4)	0,00622 (9)	0,1533 (22)
$\gamma_{51,43}$(U)	170,85 (2)	2,97 (41)	M1	3,84 (6)	0,749 (11)	0,181 (3)	4,83 (7)
$\gamma_{14,7}$(U)	174,55 (3)	0,66 (31)	[M1+E2]	1,9 (18)	0,74 (4)	0,193 (23)	2,9 (17)
$\gamma_{51,41}$(U)	179,80 (8)	0,23 (8)	[M1]	3,33 (5)	0,648 (10)	0,1567 (22)	4,19 (6)
$\gamma_{51,40}$(U)	186,15 (2)	8,5 (9)	M1	3,02 (5)	0,587 (9)	0,142 (2)	3,79 (6)
$\gamma_{56,45}$(U)	193,73 (3)	1,6 (7)	[M1+E2]	1,4 (13)	0,510 (16)	0,132 (6)	2,1 (13)
$\gamma_{23,12}$(U)	196,80 (5)	0,22 (12)	E0+E2+M1	1,4 (13)	0,483 (21)	0,124 (4)	2,0 (13)
$\gamma_{21,9}$(U)	199,95 (5)	0,22 (12)	(E0+E2+M1)	1,4 (13)	0,483 (21)	0,124 (4)	2,0 (13)
$\gamma_{4,3}$(U)	200,97 (3)	1,56 (23)	E2	0,1534 (22)	0,424 (6)	0,1166 (17)	0,734 (11)
$\gamma_{13,5}$(U)	203,12 (3)	3,0 (6)	M1+E2	0,8 (4)	0,422 (10)	0,1113 (16)	1,4 (4)
$\gamma_{16,7}$(U)	220,00 (8)	0,49 (8)	(M1)	1,89 (3)	0,366 (6)	0,0886 (13)	2,37 (4)
$\gamma_{66,53}$(U)	221,15 (10)	0,056 (24)	[E1]	0,0615 (9)	0,01248 (18)	0,00302 (5)	0,0780 (11)
$\gamma_{37,29}$(U)	221,83 (10)	0,110 (33)	[E2]	0,1301 (19)	0,280 (4)	0,0767 (11)	0,513 (8)
$\gamma_{33,25}$(U)	226,50 (3)	11,3 (20)	M1+E2	0,9 (3)	0,297 (15)	0,0759 (23)	1,3 (3)
$\gamma_{51,37}$(U)	227,25 (3)	18,4 (19)	M1	1,724 (25)	0,335 (5)	0,0809 (12)	2,17 (3)
$\gamma_{25,11}$(U)	232,21 (3)	0,40 (16)	[E2,M1]	0,9 (8)	0,27 (5)	0,070 (7)	1,2 (8)
$\gamma_{17,8}$(U)	233,6 (2)	~ 0,019					
$\gamma_{66,51}$(U)	235,11 (3)	0,122 (25)	[E1]	0,0536 (8)	0,01075 (15)	0,00260 (4)	0,0678 (10)
$\gamma_{17,7}$(U)	235,9 (30)	0,005 (3)					
$\gamma_{58,43}$(U)	240,2 (1)	0,11 (6)	[M1,E2]	0,8 (7)	0,24 (5)	0,062 (8)	1,1 (8)
$\gamma_{56,40}$(U)	245,37 (2)	2,09 (30)	M1	1,392 (20)	0,270 (4)	0,0652 (10)	1,749 (25)
$\gamma_{27,13}$(U)	247,79 (7)	0,00037 (4)					
$\gamma_{33,24}$(U)	249,22 (1)	2,65 (42)	E1	0,0470 (7)	0,00935 (13)	0,00226 (4)	0,0594 (9)
$\gamma_{68,51}$(U)	257,2 (1)	0,10 (6)	[M1,E2]	0,7 (6)	0,19 (5)	0,049 (8)	0,9 (7)
$\gamma_{26,10}$(U)	267,12 (5)	0,32 (12)	[E2,M1]	0,6 (5)	0,17 (5)	0,044 (8)	0,8 (6)
$\gamma_{49,33}$(U)	272,28 (5)	2,18 (28)	M1+E2	0,766 (11)	0,1783 (25)	0,0442 (7)	1,004 (14)
$\gamma_{21,8}$(U)	275,04 (10)	0,17 (7)	[M1,E2]	0,6 (5)	0,16 (4)	0,040 (8)	0,8 (6)

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{22,7}$(U)	278,3 (1)	0,052 (14)	[E2]	0,0863 (13)	0,1112 (16)	0,0303 (5)	0,238 (4)
$\gamma_{33,22}$(U)	293,79 (5)	4,3 (6)	M1+E2	0,28 (9)	0,109 (9)	0,0283 (18)	0,42 (10)
$\gamma_{33,20}$(U)	295,91 (8)	0,23 (8)	[M1+E2]	0,5 (4)	0,12 (4)	0,031 (8)	0,6 (5)
$\gamma_{17,5}$(U)	298,7 (2)	0,015 (6)	[E1]	0,0315 (5)	0,00610 (9)	0,001470 (21)	0,0396 (6)
$\gamma_{64,46}$(U)	308,6 (2)	0,025 (7)	[E2]	0,0711 (10)	0,0744 (11)	0,0201 (3)	0,1726 (25)
$\gamma_{71,51}$(U)	310,2 (1)	0,109 (35)	[M1,E2]	0,4 (4)	0,11 (4)	0,027 (7)	0,5 (4)
$\gamma_{27,9}$(U)	310,52 (10)	0,000135 (15)					
$\gamma_{23,8}$(U)	313,5 (1)	0,156 (47)	[E2,M1]	0,4 (4)	0,10 (4)	0,026 (7)	0,5 (4)
$\gamma_{21,6}$(U)	316,7 (1)	0,121 (16)	[E2]	0,0677 (10)	0,0674 (10)	0,0182 (3)	0,1597 (23)
$\gamma_{34,22}$(U)	320,4 (1)	0,078 (24)	[E2,M1]	0,4 (3)	0,10 (4)	0,024 (7)	0,5 (4)
$\gamma_{33,18}$(U)	330,40 (5)	0,80 (9)	[E1]	0,0254 (4)	0,00484 (7)	0,001165 (17)	0,0318 (5)
$\gamma_{37,23}$(U)	330,40 (5)		M1+E2	0,431 (6)	0,0980 (14)	0,0242 (4)	0,562 (8)
$\gamma_{74,52}$(U)	331,4 (1)	0,073 (13)					
$\gamma_{21,5}$(U)	340,2 (1)	0,042 (9)	[E1]	0,0239 (4)	0,00453 (7)	0,001090 (16)	0,0298 (5)
$\gamma_{31,12}$(U)	343,8 (2)	0,035 (8)	[E1]	0,0233 (4)	0,00442 (7)	0,001064 (15)	0,0292 (5)
$\gamma_{33,16}$(U)	351,9 (1)	0,47 (6)	E2	0,0555 (8)	0,0455 (7)	0,01222 (18)	0,1175 (17)
$\gamma_{46,28}$(U)	357,9 (1)	0,050 (19)	[M1,E2]	0,27 (22)	0,07 (3)	0,017 (6)	0,4 (3)
$\gamma_{56,33}$(U)	360,6 (3)	0,018 (7)	[E1]	0,0211 (3)	0,00397 (6)	0,000955 (14)	0,0264 (4)
$\gamma_{31,10}$(U)	365,0 (3)						
$\gamma_{26,7}$(U)	365,0 (3)	0,018 (7)	[E1]	0,0206 (3)	0,00387 (6)	0,000930 (14)	0,0257 (4)
$\gamma_{37,21}$(U)	369,50 (5)	3,91 (47)	M1	0,450 (7)	0,0866 (13)	0,0209 (3)	0,565 (8)
$\gamma_{40,23}$(U)	372,0 (1)	1,87 (21)	M1(+E2)	0,410 (6)	0,0811 (12)	0,0197 (3)	0,517 (8)
$\gamma_{32,11}$(U)	379,1 (1)	0,043 (11)	[E1]	0,0190 (3)	0,00356 (5)	0,000854 (12)	0,0237 (4)
$\gamma_{31,9}$(U)	385,4 (1)	0,043 (11)	[E1]	0,0184 (3)	0,00343 (5)	0,000824 (12)	0,0229 (4)
$\gamma_{27,7}$(U)	387,94 (6)	0,00072 (6)					
$\gamma_{45,25}$(U)	394,1 (1)	0,096 (14)	[E1]	0,01755 (25)	0,00326 (5)	0,000784 (11)	0,0219 (3)
$\gamma_{33,15}$(U)	397,7 (3)	0,063 (16)	[M2]	0,986 (14)	0,270 (4)	0,0687 (10)	1,349 (20)
$\gamma_{40,22}$(U)	409,8 (1)	0,35 (5)	[E1]	0,01620 (23)	0,00300 (5)	0,00072 0(1)	0,0202 (3)
$\gamma_{49,30}$(U)	416,1 (1)	0,039 (12)	[E2]	0,0405 (6)	0,0251 (4)	0,00666 (10)	0,0746 (11)
$\gamma_{37,16}$(U)	426,95 (5)	0,47 (5)	[E1]	0,01491 (21)	0,00274 (4)	0,000658 (10)	0,0185 (3)
$\gamma_{27,6}$(U)	427,4 (4)	0,000031 (10)					
$\gamma_{68,42}$(U)	433,1 (1)	0,094 (14)					
$\gamma_{40,18}$(U)	446,6 (1)	0,153 (20)	[M1]	0,269 (4)	0,0516 (8)	0,01245 (18)	0,338 (5)
$\gamma_{46,24}$(U)	446,6 (1)						
$\gamma_{27,5}$(U)	450,93 (4)	0,0050 (24)	M1+E2	0,187 (3)	0,0400 (6)	0,00980 (14)	0,241 (4)
$\gamma_{42,19}$(U)	452,4 (3)	0,027 (9)					
$\gamma_{33,11}$(U)	458,68 (5)	1,30 (15)	M1+E2	0,11 (4)	0,028 (5)	0,0071 (11)	0,14 (5)
$\gamma_{43,18}$(U)	461,5 (1)						
$\gamma_{45,22}$(U)	461,5 (1)	0,045 (14)	[M1]	0,246 (4)	0,0472 (7)	0,01138 (16)	0,309 (5)
$\gamma_{39,16}$(U)	464,2 (1)	0,040 (14)	[M1]	0,243 (4)	0,0464 (7)	0,01120 (16)	0,304 (5)
$\gamma_{40,16}$(U)	468,0 (1)	0,223 (30)	[E1]	0,01241 (18)	0,00226 (4)	0,000541 (8)	0,01539 (22)
$\gamma_{37,15}$(U)	472,3 (1)	0,46 (5)	[M1]	0,231 (4)	0,0443 (7)	0,01069 (15)	0,290 (4)
$\gamma_{41,16}$(U)	474,2 (2)	0,037 (11)	[E1]	0,01209 (17)	0,00219 (3)	0,000526 (8)	0,01499 (21)
$\gamma_{49,26}$(U)	478,6 (1)						
$\gamma_{42,16}$(U)	478,6 (1)	0,127 (15)	[E1]	0,01187 (17)	0,00215 (3)	0,000516 (8)	0,01472 (21)
$\gamma_{71,43}$(U)	481,0 (1)	0,36 (6)	[M1,E2]	0,13 (10)	0,029 (14)	0,007 (3)	0,16 (12)
$\gamma_{49,25}$(U)	498,0 (1)						
$\gamma_{45,18}$(U)	498,0 (1)	0,078 (15)	[M1]	0,201 (3)	0,0384 (6)	0,00925 (13)	0,252 (4)
$\gamma_{66,35}$(U)	502,2 (1)	0,03 (10)	[E2,M1]	0,11 (9)	0,026 (12)	0,006 (3)	0,15 (10)
$\gamma_{37,13}$(U)	506,76 (5)	1,32 (14)	[E1]	0,01061 (15)	0,00191 (3)	0,000457 (7)	0,01314 (19)
$\gamma_{40,15}$(U)	513,4 (1)	~0,468	[M1]	0,185 (3)	0,0353 (5)	0,00852 (12)	0,232 (4)
$\gamma_{40,14}$(U)	513,5 (1)	~0,77	[E1]	0,01035 (15)	0,00186 (3)	0,000445 (7)	0,01280 (18)
$\gamma_{45,16}$(U)	519,64 (10)	0,41 (5)	[E1]	0,01011 (15)	0,00181 (3)	0,000434 (6)	0,01251 (18)
$\gamma_{49,24}$(U)	521,43 (10)	0,76 (9)	[E1]	0,01004 (14)	0,00180 (3)	0,000431 (6)	0,01242 (18)
$\gamma_{37,12}$(U)	527,99 (10)	0,49 (6)	(M1)	0,1716 (24)	0,0328 (5)	0,00790 (11)	0,215 (3)
$\gamma_{46,18}$(U)	529,2 (3)						
$\gamma_{43,15}$(U)	529,2 (3)	0,102 (46)	[E2,M1]	0,10 (8)	0,022 (11)	0,0054 (25)	0,13 (9)
$\gamma_{76,44}$(U)	534,2 (1)	0,084 (13)	[E1]	0,00958 (14)	0,001715 (24)	0,000410 (6)	0,01185 (17)
$\gamma_{71,37}$(U)	537,4 (1)	0,093 (16)	[M1,E2]	0,09 (7)	0,021 (11)	0,0052 (24)	0,12 (9)

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{39,13}$(U)	543,9 (1)	0,140 (25)	[E2]	0,0247 (4)	0,01049 (15)	0,00273 (4)	0,0389 (6)
$\gamma_{47,19}$(U)	553,87 (10)	0,045 (16)	[E1]	0,00894 (13)	0,001594 (23)	0,000381 (6)	0,01105 (16)
$\gamma_{44,14}$(U)	558,1 (2)	0,097 (24)	[E2]	0,0236 (4)	0,00970 (14)	0,00252 (4)	0,0367 (6)
$\gamma_{51,23}$(U)	558,1 (2)						
$\gamma_{36,9}$(U)	559,4 (2)	0,074 (22)	[E1]	0,00877 (13)	0,001562 (22)	0,000373 (6)	0,01084 (16)
$\gamma_{76,43}$(U)	562,9 (3)	0,040 (13)	[M1,E2]	0,08 (6)	0,018 (9)	0,0045 (21)	0,11 (8)
$\gamma_{49,22}$(U)	565,4 (1)						
$\gamma_{45,15}$(U)	565,4 (1)	1,23 (13)	(M1)	0,1429 (20)	0,0272 (4)	0,00656 (10)	0,179 (3)
$\gamma_{40,12}$(U)	569,1 (2)	4,2 (7)	M1	0,1404 (20)	0,0268 (4)	0,00645 (9)	0,1759 (25)
$\gamma_{37,9}$(U)	569,7 (1)	10,9 (14)	M1	0,1401 (20)	0,0267 (4)	0,00643 (9)	0,1754 (25)
$\gamma_{41,12}$(U)	575,7 (1)	0,03 (1)	[E2,M1]	0,08 (6)	0,017 (9)	0,0043 (20)	0,10 (7)
$\gamma_{43,12}$(U)	584,3 (1)	0,19 (31)	[E2]	0,0217 (3)	0,00845 (12)	0,00219 (3)	0,0331 (5)
$\gamma_{64,32}$(U)	586,5 (1)	0,075 (13)	[E2]	0,0216 (3)	0,00836 (12)	0,00216 (3)	0,0328 (5)
$\gamma_{40,10}$(U)	590,5 (10)	0,040 (12)	[E2,M1]	0,07 (6)	0,016 (8)	0,0040 (19)	0,10 (7)
$\gamma_{50,22}$(U)	595,6 (2)	0,097 (24)	[E2]	0,0210 (3)	0,00799 (12)	0,00207 (3)	0,0317 (5)
$\gamma_{59,26}$(U)	597,1 (1)	0,231 (35)	[M1]	0,1235 (18)	0,0235 (4)	0,00566 (8)	0,1547 (22)
$\gamma_{51,21}$(U)	597,1 (1)						
$\gamma_{49,18}$(U)	602,8 (1)	0,55 (6)	[E1]	0,00762 (11)	0,001345 (19)	0,000321 (5)	0,00939 (14)
$\gamma_{43,10}$(U)	604,8 (3)	0,057 (24)	[E2,M1]	0,07 (5)	0,015 (8)	0,0037 (18)	0,09 (6)
$\gamma_{53,21}$(U)	612,2 (1)	0,43 (6)	(M1)	0,1156 (17)	0,0220 (3)	0,00530 (8)	0,1447 (21)
$\gamma_{41,9}$(U)	617,2 (2)	0,054 (23)	[E2]	0,0197 (3)	0,00720 (11)	0,00186 (3)	0,0294 (5)
$\gamma_{56,23}$(U)	617,2 (2)						
$\gamma_{44,11}$(U)	619,2 (2)	0,039 (12)	[M1+E2]	0,07 (5)	0,014 (7)	0,0035 (17)	0,08 (6)
$\gamma_{49,16}$(U)	624,4 (1)	0,39 (6)	(M1+E2)	0,0799 (12)	0,01627 (23)	0,00396 (6)	0,1015 (15)
$\gamma_{20,4}$(U)	628,3 (1)	0,24 (5)	[E1]	0,00705 (10)	0,001239 (18)	0,000296 (5)	0,00868 (13)
$\gamma_{48,15}$(U)	629,6 (1)	0,40 (7)	(M1)	0,1072 (15)	0,0204 (3)	0,00491 (7)	0,1342 (19)
$\gamma_{51,18}$(U)	632,8 (2)	0,039 (12)	[E2,M1]	0,06 (5)	0,013 (7)	0,0033 (16)	0,08 (6)
$\gamma_{44,10}$(U)	634,5 (2)						
$\gamma_{54,22}$(U)	634,5 (2)	0,153 (27)	[M1]	0,1050 (15)	0,0200 (3)	0,00481 (7)	0,1315 (19)
$\gamma_{37,7}$(U)	646,7 (1)	0,115 (15)	[E1]	0,00668 (10)	0,001170 (17)	0,000279 (4)	0,00822 (12)
$\gamma_{50,16}$(U)	653,9 (1)	0,53 (9)	M1	0,0969 (14)	0,0184 (3)	0,00443 (7)	0,1213 (17)
$\gamma_{64,29}$(U)	653,9 (1)						
$\gamma_{56,22}$(U)	655,4 (2)	0,136 (24)	[E1]	0,00651 (10)	0,001140 (16)	0,000272 (4)	0,00802 (12)
$\gamma_{46,11}$(U)	657,6 (1)	0,40 (5)					
$\gamma_{48,13}$(U)	664,1 (1)	0,54 (9)	[E1]	0,00636 (9)	0,001111 (16)	0,000265 (4)	0,00782 (11)
$\gamma_{11,3}$(U)	666,7 (1)	1,19 (13)	[E1]	0,00631 (9)	0,001103 (16)	0,000263 (4)	0,00777 (11)
$\gamma_{35,5}$(U)	669,9 (1)	<0,0006					
$\gamma_{49,15}$(U)	669,9 (1)	1,01 (10)	[E1]	0,00626 (9)	0,001092 (16)	0,000260 (4)	0,00770 (11)
$\gamma_{24,4}$(U)	675,3 (1)	0,103 (14)	[E2]	0,01674 (24)	0,00558 (8)	0,001427 (20)	0,0242 (4)
$\gamma_{59,22}$(U)	684,1 (2)	0,161 (40)	[E1]	0,00602 (9)	0,001049 (15)	0,000250 (4)	0,00740 (11)
$\gamma_{59,21}$(U)	685,3 (2)		[E2]	0,01631 (23)	0,00535 (8)	0,001369 (20)	0,0235 (4)
$\gamma_{40,8}$(U)	685,3 (1)	0,15 (4)					
$\gamma_{54,16}$(U)	692,8 (1)	1,38 (14)	(M1)	0,0831 (12)	0,01575 (22)	0,00379 (6)	0,1040 (15)
$\gamma_{51,15}$(U)	699,25 (5)	3,6 (4)					
$\gamma_{50,14}$(U)	699,25 (5)		M1	0,0811 (12)	0,01537 (22)	0,00370 (6)	0,1015 (15)
$\gamma_{7,2}$(U)	706,2 (1)	2,31 (23)	[E1]	0,00568 (8)	0,000987 (14)	0,000235 (4)	0,00698 (10)
$\gamma_{8,2}$(U)	708,6 (2)	0,024 (9)	[E2]	0,01537 (22)	0,00489 (7)	0,001246 (18)	0,0219 (3)
$\gamma_{52,14}$(U)	714,0 (1)	0,147 (25)	[E1]	0,00557 (8)	0,000966 (14)	0,000230 (4)	0,00684 (10)
$\gamma_{64,26}$(U)	714,0 (1)						
$\gamma_{62,23}$(U)	716,8 (2)	0,033 (10)	[M1,E2]	0,05 (3)	0,010 (5)	0,0023 (12)	0,06 (4)
$\gamma_{15,3}$(U)	728,1 (2)	0,116 (15)	[E2]	0,01464 (21)	0,00454 (7)	0,001156 (17)	0,0207 (3)
$\gamma_{49,11}$(U)	731,2 (2)	0,67 (11)	[M1,E2]	0,04 (3)	0,009 (5)	0,0022 (11)	0,06 (4)
$\gamma_{50,13}$(U)	733,56 (5)	7,6 (9)	M1	0,0714 (10)	0,01351 (19)	0,00325 (5)	0,0893 (13)
$\gamma_{54,14}$(U)	738,3 (1)	1,26 (14)	(M1)	0,0702 (10)	0,01329 (19)	0,00320 (5)	0,0878 (13)
$\gamma_{5,1}$(U)	743,084 (5)	2,09 (21)	E1	0,00518 (8)	0,000895 (13)	0,000213 (3)	0,00636 (9)
$\gamma_{49,10}$(U)	746,2 (1)	0,32 (5)	[E1]	0,00514 (8)	0,000888 (13)	0,000211 (3)	0,00631 (9)
$\gamma_{52,13}$(U)	748,4 (3)	0,105 (23)	[E1]	0,00511 (8)	0,000883 (13)	0,000210 (3)	0,00628 (9)
$\gamma_{62,22}$(U)	755,3 (1)						
$\gamma_{51,12}$(U)	755,3 (1)	1,29 (15)	(E2,M1)	0,04 (3)	0,008 (5)	0,002 (1)	0,05 (4)

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{56,15}$(U)	759,2 (1)	0,262 (33)	[M1,E2]	0,04 (3)	0,008 (5)	0,002 (1)	0,05 (4)
$\gamma_{50,11}$(U)	761,3 (2)	0,074 (22)	[E2]	0,01353 (19)	0,00403 (6)	0,001023 (15)	0,0189 (3)
$\gamma_{28,4}$(U)	765,1 (2)	0,21 (5)	[M1,E2]	0,04 (3)	0,008 (4)	0,002 (1)	0,05 (3)
$\gamma_{6,1}$(U)	766,7 (2)	0,26 (5)	(E2)	0,01336 (19)	0,00396 (6)	0,001003 (14)	0,0187 (3)
$\gamma_{58,15}$(U)	769,4 (1)	0,196 (22)	[M1,E2]	0,038 (25)	0,008 (4)	0,0019 (10)	0,05 (3)
$\gamma_{54,13}$(U)	772,7 (2)	0,074 (22)	[E2]	0,01318 (19)	0,00388 (6)	0,000983 (14)	0,0184 (3)
$\gamma_{30,4}$(U)	780,7 (2)	0,91 (9)	[E1]	0,00474 (7)	0,000815 (12)	0,000194 (3)	0,00581 (9)
$\gamma_{9,2}$(U)	783,7 (1)	0,305 (41)	[E2]	0,01285 (18)	0,00374 (6)	0,000946 (14)	0,0179 (3)
$\gamma_{5,0}$(U)	786,595 (22)	1,22 (13)	(E1)	0,00467 (7)	0,000804 (12)	0,000191 (3)	0,00573 (8)
$\gamma_{54,12}$(U)	793,1 (3)	0,045 (11)	[E1]	0,00460 (7)	0,000791 (11)	0,000188 (3)	0,00565 (8)
$\gamma_{18,3}$(U)	795,2 (2)	0,69 (11)	[E2]	0,01253 (18)	0,00360 (5)	0,000910 (13)	0,01735 (25)
$\gamma_{51,9}$(U)	796,4 (1)	2,64 (31)	[E2]	0,01249 (18)	0,00359 (5)	0,000906 (13)	0,01730 (25)
$\gamma_{19,3}$(U)	800,0 (2)		E0+E2				
$\gamma_{55,12}$(U)	802,6 (2)	0,033 (10)	[M1]	0,0563 (8)	0,01062 (15)	0,00256 (4)	0,0703 (10)
$\gamma_{10,2}$(U)	804,5 (1)	0,85 (30)	E0+E2	0,1559 (8)	0,11056 (15)	0,10254 (4)	0,37
$\gamma_{7,1}$(U)	806,20 (5)	2,51 (30)	[E1]	0,00447 (7)	0,000768 (11)	0,000183 (3)	0,00549 (8)
$\gamma_{8,1}$(U)	808,8 (3)	0,19 (6)	E0+E2	3,30000 (7)	0,93 (100)		4,2
$\gamma_{6,0}$(U)	810,4 (7)	0,20 (7)	E0				
$\gamma_{53,9}$(U)	811,9 (1)	0,130 (16)	[M1,E2]	0,033 (22)	0,007 (4)	0,0017 (9)	0,04 (3)
$\gamma_{56,12}$(U)	814,6 (1)	0,315 (41)	[E2]	0,01201 (17)	0,00338 (5)	0,000854 (12)	0,01654 (24)
$\gamma_{11,2}$(U)	819,6 (1)	1,91 (20)	[E1]	0,00434 (6)	0,000744 (11)	0,0001770 (25)	0,00533 (8)
$\gamma_{12,2}$(U)	825,5 (2)	1,93 (20)	[E2]	0,01173 (17)	0,00327 (5)	0,000825 (12)	0,01611 (23)
$\gamma_{20,3}$(U)	829,7 (2)	0,36 (11)	[E1]	0,00425 (6)	0,000727 (11)	0,0001729 (25)	0,00521 (8)
$\gamma_{22,3}$(U)	831,9 (1)	4,2 (5)	[E1]	0,00423 (6)	0,000724 (11)	0,0001721 (24)	0,00518 (8)
$\gamma_{75,28}$(U)	839,9 (1)	0,031 (8)					
$\gamma_{49,7}$(U)	844,5 (1)	0,44 (5)	[E2]	0,01127 (16)	0,00309 (5)	0,000777 (11)	0,01540 (22)
$\gamma_{59,11}$(U)	849,4 (2)	0,027 (8)	[E1]	0,00408 (6)	0,000696 (10)	0,0001655 (24)	0,00500 (7)
$\gamma_{8,0}$(U)	852,2 (1)	0,074 (22)	[E2]	0,01109 (16)	0,00302 (5)	0,000759 (11)	0,01513 (22)
$\gamma_{57,9}$(U)	858,1 (2)	0,037 (8)	[E2]	0,01095 (16)	0,00297 (5)	0,000746 (11)	0,01493 (21)
$\gamma_{59,10}$(U)	863,6 (2)	0,076 (23)	[E2,M1]	0,029 (18)	0,006 (3)	0,0014 (7)	0,036 (22)
$\gamma_{77,29}$(U)	870,1 (1)	0,20 (3)					
$\gamma_{50,7}$(U)	874,4 (3)	0,037 (8)	[E2,M1]	0,028 (18)	0,006 (3)	0,0014 (7)	0,035 (21)
$\gamma_{24,3}$(U)	876,4 (1)	2,59 (23)	(E2)	0,01055 (15)	0,00282 (4)	0,000706 (10)	0,01432 (20)
$\gamma_{14,2}$(U)	880,92 (4)	4,3 (6)	[E1]	0,00382 (6)	0,000651 (10)	0,0001547 (22)	0,00468 (7)
$\gamma_{15,2}$(U)	880,92 (4)	6,3 (8)	[E2]	0,01046 (15)	0,00278 (4)	0,000697 (10)	0,01418 (20)
$\gamma_{9,1}$(U)	883,66 (4)	9,8 (11)	E2	0,01040 (15)	0,00276 (4)	0,000692 (10)	0,01409 (20)
$\gamma_{66,16}$(U)	890,5 (4)	0,027 (8)					
$\gamma_{25,3}$(U)	899,06 (5)	3,31 (40)	[E1]	0,00369 (6)	0,000627 (9)	0,0001489 (21)	0,00451 (7)
$\gamma_{10,1}$(U)	904,6 (1)	0,345 (41)	[E2]	0,00998 (14)	0,00260 (4)	0,000652 (10)	0,01346 (19)
$\gamma_{65,15}$(U)	916,9 (2)	0,024 (7)					
$\gamma_{26,3}$(U)	918,8 (1)	0,101 (14)	[E2]	0,00971 (14)	0,00251 (4)	0,000627 (9)	0,01306 (19)
$\gamma_{12,1}$(U)	925,4 (1)	8,0 (9)	(E2)	0,00959 (14)	0,00246 (4)	0,000616 (9)	0,01288 (18)
$\gamma_{16,2}$(U)	926,4 (2)	1,8 (13)	[E1]	0,00350 (5)	0,000594 (9)	0,0001409 (20)	0,00428 (6)
$\gamma_{9,0}$(U)	927,1 (1)	7,4 (12)	(E2)	0,00956 (14)	0,00245 (4)	0,000613 (9)	0,01284 (18)
$\gamma_{66,15}$(U)	936,2 (2)	0,067 (10)					
$\gamma_{17,2}$(U)	942,4 (3)	0,047 (9)	[E2]	0,00929 (13)	0,00236 (4)	0,000589 (9)	0,01244 (18)
$\gamma_{13,1}$(U)	946,39 (3)	13,6 (15)	(E1)	0,00337 (5)	0,000571 (8)	0,0001355 (19)	0,00412 (6)
$\gamma_{18,2}$(U)	948,1 (2)	1,65 (21)	[E2]	0,00919 (13)	0,00232 (4)	0,000580 (9)	0,01230 (18)
$\gamma_{19,2}$(U)	953,1 (1)	0,083 (13)					
$\gamma_{59,8}$(U)	960,4 (1)	0,074 (13)	[E2]	0,00899 (13)	0,00225 (4)	0,000562 (8)	0,01199 (17)
$\gamma_{28,3}$(U)	966,2 (1)	0,49 (6)	[M1,E2]	0,022 (13)	0,0043 (22)	0,0011 (5)	0,027 (16)
$\gamma_{73,18}$(U)	975,5 (1)	0,027 (8)					
$\gamma_{29,3}$(U)	978,6 (3)	0,090 (23)					
$\gamma_{14,1}$(U)	980,7 (1)	~2,71	[E1]	0,00317 (5)	0,000535 (8)	0,0001270 (18)	0,00387 (6)
$\gamma_{15,1}$(U)	980,7 (1)	~1,79	[E2]	0,00866 (13)	0,00214 (3)	0,000534 (8)	0,01152 (17)
$\gamma_{30,3}$(U)	982,0 (3)	0,73 (22)	[E1]	0,00316 (5)	0,000534 (8)	0,0001267 (18)	0,00387 (6)
$\gamma_{22,2}$(U)	984,6 (1)	1,64 (21)	[E1]	0,00315 (5)	0,000531 (8)	0,0001261 (18)	0,00385 (6)
$\gamma_{63,9}$(U)	989,9 (1)	0,104 (14)					
$\gamma_{60,7}$(U)	995,0 (3)	0,062 (22)					

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{73,16}$(U)	998,1 (3)	0,046 (12)					
$\gamma_{71,15}$(U)	1010,3 (3)	0,067 (12)					
$\gamma_{75,18}$(U)	1010,3 (3)						
$\gamma_{76,19}$(U)	1019,9 (4)	0,027 (8)					
$\gamma_{23,2}$(U)	1022,2 (2)	0,156 (41)	[M1]	0,0297 (5)	0,00557 (8)	0,001340 (19)	0,0370 (6)
$\gamma_{24,2}$(U)	1029,1 (1)	0,58 (6)	[E2]	0,00796 (12)	0,00191 (3)	0,000475 (7)	0,01051 (15)
$\gamma_{75,16}$(U)	1033,2 (2)	0,018 (5)					
$\gamma_{69,11}$(U)	1038,3 (2)	0,018 (7)					
$\gamma_{17,1}$(U)	1041,6 (2)	0,033 (11)	[E2,M1]	0,018 (11)	0,0036 (18)	0,0009 (4)	0,023 (13)
$\gamma_{32,3}$(U)	1045,0 (2)	0,031 (3)					
$\gamma_{70,12}$(U)	1052,0 (2)	0,062 (12)					
$\gamma_{70,11}$(U)	1058,4 (3)	0,0177 (16)					
$\gamma_{71,12}$(U)	1065,7 (1)	0,027 (8)					
$\gamma_{69,9}$(U)	1074,2 (2)	0,104 (14)					
$\gamma_{21,1}$(U)	1083,8 (1)	0,53 (6)	(M1)	0,0254 (4)	0,00477 (7)	0,001147 (16)	0,0317 (5)
$\gamma_{17,0}$(U)	1085,9 (3)	0,027 (8)	[E2]	0,00725 (11)	0,001690 (24)	0,000418 (6)	0,00950 (14)
$\gamma_{71,9}$(U)	1107,5 (2)	0,083 (13)					
$\gamma_{66,7}$(U)	1111,2 (1)	0,062 (12)					
$\gamma_{23,1}$(U)	1122,4 (1)	0,257 (41)	M1	0,0232 (4)	0,00434 (6)	0,001045 (15)	0,0289 (4)
$\gamma_{33,3}$(U)	1125,9 (1)	0,36 (8)	[E1]	0,00250 (4)	0,000418 (6)	0,0000991 (14)	0,00305 (5)
$\gamma_{21,0}$(U)	1127,5 (1)	0,303 (40)	[E2]	0,00679 (10)	0,001552 (22)	0,000383 (6)	0,00885 (13)
$\gamma_{69,7}$(U)	1152,1 (3)						
$\gamma_{34,3}$(U)	1152,1 (3)	0,032 (10)	[E1]	0,00240 (4)	0,000402 (6)	0,0000951 (14)	0,00294 (5)
$\gamma_{76,11}$(U)	1154,2 (3)	0,046 (9)					
$\gamma_{26,1}$(U)	1172,0 (1)	0,091 (13)	[E2]	0,00634 (9)	0,001423 (20)	0,000350 (5)	0,00824 (12)
$\gamma_{66,5}$(U)	1173,8 (1)	0,046 (9)					
$\gamma_{71,8}$(U)	1182,8 (2)	~0,0094					
$\gamma_{27,1}$(U)	1194,53 (3)	0,021 (6)	E1	0,00226 (4)	0,000377 (6)	0,0000892 (13)	0,00277 (4)
$\gamma_{77,9}$(U)	1218,1 (1)	0,22 (3)					
$\gamma_{27,0}$(U)	1238,1 (3)	<0,0094	E1	0,00213 (3)	0,000354 (5)	0,0000838 (12)	0,00262 (4)
$\gamma_{40,3}$(U)	1242,0 (1)	0,232 (30)	(E2)	0,00573 (8)	0,001251 (18)	0,000307 (5)	0,00740 (11)
$\gamma_{41,3}$(U)	1248,6 (2)	0,022 (6)	[E2]	0,00567 (8)	0,001237 (18)	0,000304 (5)	0,00733 (11)
$\gamma_{42,3}$(U)	1253,4 (2)	0,018 (8)					
$\gamma_{43,3}$(U)	1257,3 (1)	0,060 (8)	[M1,E2]	0,011 (6)	0,0022 (10)	0,00054 (24)	0,014 (8)
$\gamma_{33,2}$(U)	1278,6 (2)	0,047 (9)	[M2]	0,0370 (6)	0,00771 (11)	0,00188 (3)	0,0473 (7)
$\gamma_{45,3}$(U)	1293,7 (1)	0,48 (6)	M1	0,01592 (23)	0,00297 (5)	0,000715 (10)	0,0199 (3)
$\gamma_{36,2}$(U)	1343,9 (2)	0,012 (5)	[E1]	0,00185 (3)	0,000307 (5)	0,0000726 (11)	0,00232 (4)
$\gamma_{37,2}$(U)	1353,9 (1)	1,18 (12)	M1	0,01412 (20)	0,00263 (4)	0,000633 (9)	0,01766 (25)
$\gamma_{47,3}$(U)	1355,6 (2)	0,14 (4)	[E1]	0,00183 (3)	0,000302 (5)	0,0000715 (10)	0,00229 (4)
$\gamma_{38,2}$(U)	1360,0 (1)	0,156 (25)					
$\gamma_{39,2}$(U)	1390,6 (2)	0,073 (22)	[E1]	0,001749 (25)	0,000289 (4)	0,0000684 (10)	0,00222 (4)
$\gamma_{40,2}$(U)	1394,9 (1)	2,11 (21)	M1	0,01304 (19)	0,00243 (4)	0,000585 (9)	0,01634 (23)
$\gamma_{49,3}$(U)	1398,5 (2)	0,083 (22)	[E1]	0,001733 (25)	0,000286 (4)	0,0000678 (10)	0,00220 (3)
$\gamma_{41,2}$(U)	1401,4 (1)	0,182 (30)	[E2,M1]	0,009 (5)	0,0017 (8)	0,00041 (18)	0,011 (6)
$\gamma_{43,2}$(U)	1410,2 (2)	0,045 (10)					
$\gamma_{35,1}$(U)	1415,5 (2)	<0,0028					
$\gamma_{51,3}$(U)	1428,0 (1)	0,17 (3)					
$\gamma_{36,1}$(U)	1443,9 (2)	0,031 (7)	[E1]	0,001643 (23)	0,000271 (4)	0,0000641 (9)	0,00212 (3)
$\gamma_{45,2}$(U)	1446,5 (1)	0,32 (5)	[M1]	0,01185 (17)	0,00221 (3)	0,000531 (8)	0,01488 (21)
$\gamma_{37,1}$(U)	1453,8 (1)	0,82 (9)	[M1]	0,01169 (17)	0,00218 (3)	0,000524 (8)	0,01468 (21)
$\gamma_{38,1}$(U)	1460,0 (1)	0,094 (23)					
$\gamma_{46,2}$(U)	1476,9 (2)	0,008 (4)					
$\gamma_{56,3}$(U)	1486,5 (2)	0,030 (7)	[M1]	0,01102 (16)	0,00205 (3)	0,000494 (7)	0,01387 (20)
$\gamma_{57,3}$(U)	1489,2 (2)	0,014 (6)					
$\gamma_{40,1}$(U)	1494,8 (1)	0,105 (14)	[E2]	0,00414 (6)	0,000842 (12)	0,000205 (3)	0,00531 (8)
$\gamma_{58,3}$(U)	1497,2 (2)	0,036 (9)					
$\gamma_{41,1}$(U)	1501,2 (2)	0,0111 (40)	[E2]	0,00411 (6)	0,000835 (12)	0,000203 (3)	0,00528 (8)
$\gamma_{48,2}$(U)	1511,3 (2)	<0,0094					
$\gamma_{59,3}$(U)	1516,8 (2)	0,073 (13)					

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{49,2}$(U)	1551,3 (1)	0,073 (13)	[E1]	0,001460 (21)	0,000240 (4)	0,0000568 (8)	0,00196 (3)
$\gamma_{61,3}$(U)	1568,3 (2)	0,0114 (23)					
$\gamma_{51,2}$(U)	1581,2 (1)	0,073 (22)					
$\gamma_{62,3}$(U)	1587,2 (1)	0,146 (17)					
$\gamma_{52,2}$(U)	1595,3 (1)	0,312 (40)	M1,E2	0,006 (3)	0,0012 (5)	0,00029 (12)	0,008 (4)
$\gamma_{54,2}$(U)	1619,6 (2)	0,009 (4)					
$\gamma_{55,2}$(U)	1628,7 (1)	0,076 (11)					
$\gamma_{56,2}$(U)	1639,5 (1)	0,210 (21)	(M1)	0,00850 (12)	0,001581 (23)	0,000380 (6)	0,01083 (16)
$\gamma_{57,2}$(U)	1641,9 (3)	0,010 (4)					
$\gamma_{65,3}$(U)	1646,3 (2)	0,010 (4)					
$\gamma_{58,2}$(U)	1651,6 (2)	<0,006					
$\gamma_{59,2}$(U)	1669,8 (1)	0,78 (9)	(M1)	0,00809 (12)	0,001505 (21)	0,000362 (5)	0,01035 (15)
$\gamma_{67,3}$(U)	1674,3 (1)	0,034 (11)					
$\gamma_{50,1}$(U)	1681,0 (1)	0,077 (18)					
$\gamma_{68,3}$(U)	1687,2 (1)	0,31 (4)					
$\gamma_{52,1}$(U)	1695,3 (2)	0,7 (1)					
$\gamma_{53,1}$(U)	1696,5 (3)	0,27 (7)					
$\gamma_{60,2}$(U)	1702,0 (2)	0,104 (14)					
$\gamma_{61,2}$(U)	1721,3 (2)	0,018 (6)					
$\gamma_{70,3}$(U)	1724,8 (2)	0,016 (4)					
$\gamma_{55,1}$(U)	1729,4 (2)	0,020 (5)					
$\gamma_{62,2}$(U)	1739,3 (2)	0,075 (11)					
$\gamma_{72,3}$(U)	1742,7 (2)	0,049 (8)					
$\gamma_{58,1}$(U)	1751,6 (1)	0,064 (10)					
$\gamma_{59,1}$(U)	1769,6 (3)	0,020 (5)					
$\gamma_{73,3}$(U)	1772,5 (2)	0,068 (17)					
$\gamma_{63,2}$(U)	1774,7 (2)	0,068 (17)					
$\gamma_{64,2}$(U)	1785,4 (2)	0,025 (7)					
$\gamma_{65,2}$(U)	1798,8 (1)	0,24 (3)					
$\gamma_{75,3}$(U)	1807,5 (3)	0,0052 (22)					
$\gamma_{66,2}$(U)	1817,0 (3)	0,009 (4)					
$\gamma_{76,3}$(U)	1821,6 (3)	0,0042 (11)					
$\gamma_{67,2}$(U)	1826,9 (3)	0,009 (4)					
$\gamma_{68,2}$(U)	1839,8 (2)	0,0042 (11)					
$\gamma_{62,1}$(U)	1839,8 (2)						
$\gamma_{63,1}$(U)	1874,7 (2)	0,035 (9)					
$\gamma_{64,1}$(U)	1886,0 (3)	0,016 (5)					
$\gamma_{71,2}$(U)	1892,0 (2)	0,146 (17)					
$\gamma_{72,2}$(U)	1895,3 (3)	~0,0062					
$\gamma_{65,1}$(U)	1898,6 (2)	0,104 (23)					
$\gamma_{66,1}$(U)	1917,5 (3)	0,020 (5)					
$\gamma_{74,2}$(U)	1927,4 (2)	0,30 (5)					
$\gamma_{68,1}$(U)	1939,7 (3)	0,042 (11)					
$\gamma_{75,2}$(U)	1960,0 (4)	0,010 (3)					
$\gamma_{76,2}$(U)	1973,2 (4)	~0,0027					
$\gamma_{70,1}$(U)	1979,4 (4)	0,017 (5)					
$\gamma_{71,1}$(U)	1991,6 (1)	0,007 (4)					
$\gamma_{76,1}$(U)	2074,5 (4)	0,0042 (22)					

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
	$K\alpha_1$	98,44		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				
	$L\ell$	11,6185		
	$L\alpha$	13,4382 – 13,6146		
	$L\eta$	15,399		
	$L\beta$	15,7268 – 18,2061		
	$L\gamma$	19,5072 – 20,7141		

3.1.2 Auger Electrons

	Energy keV	Relative probability
Auger K		
KLL	71,776 – 80,954	100
KLX	88,153 – 98,429	59,6
KXY	104,51 – 115,59	8,88
Auger L	5,9 – 21,6	

4 Electron Emissions

		Energy keV			Electrons per 100 disint.
e_{AL}	(U)	5,9	-	21,6	77 (10)
e_{AK}	(U)				1,08 (6)
	KLL	71,776	-	80,954	}
	KLX	88,153	-	98,429	}
	KXY	104,51	-	115,59	}
$ec_{25,16\ K}$	(U)	9,86		(1)	0,171 (26)
$ec_{14,13\ L}$	(U)	12,5	-	17,1	6,1 (7)
$ec_{43,33\ K}$	(U)	15,70		(1)	3,71 (33)
$ec_{51,45\ K}$	(U)	19,01		(2)	0,86 (17)
$ec_{1,0\ L}$	(U)	21,73	-	26,32	62 (16)
$ec_{16,14\ L}$	(U)	23,69	-	28,28	5,1 (32)
$ec_{13,7\ K}$	(U)	24,55		(2)	1,5 (11)
$ec_{33,30\ K}$	(U)	28,18		(2)	1,04 (16)
$ec_{14,13\ M}$	(U)	28,8	-	30,7	1,69 (18)
$ec_{14,13\ N}$	(U)	32,9	-	33,9	0,46 (5)
$ec_{15,12\ L}$	(U)	33,20	-	37,79	0,8 (8)
$ec_{22,16\ L}$	(U)	36,4	-	41,0	0,34 (11)
$ec_{3,2\ K}$	(U)	37,11		(2)	1,30 (15)
$ec_{56,51\ L}$	(U)	37,43	-	42,02	2,2 (18)
$ec_{1,0\ M}$	(U)	37,94	-	39,94	17,2 (43)
$ec_{16,14\ M}$	(U)	39,9	-	41,9	1,4 (9)
$ec_{13,9\ L}$	(U)	40,9	-	45,5	0,51 (16)
$ec_{1,0\ N}$	(U)	42,05	-	43,11	4,7 (12)
$ec_{16,14\ N}$	(U)	44,01	-	45,07	0,38 (25)
$ec_{25,22\ L}$	(U)	45,49	-	50,08	1,5 (5)
$ec_{25,20\ L}$	(U)	47,70	-	52,29	0,58 (49)
$ec_{22,11\ K}$	(U)	49,34		(5)	0,11 (12)
$ec_{15,12\ M}$	(U)	49,41	-	51,41	0,24 (20)
$ec_{56,51\ M}$	(U)	53,64	-	55,64	0,6 (5)
$ec_{51,43\ K}$	(U)	55,25		(2)	1,96 (27)
$ec_{13,9\ M}$	(U)	57,2	-	59,2	0,127 (40)
$ec_{56,51\ N}$	(U)	57,75	-	58,81	0,16 (14)
$ec_{16,13\ L}$	(U)	58,08	-	62,67	1,7 (6)
$ec_{14,7\ K}$	(U)	58,95		(3)	0,32 (31)
$ec_{25,22\ M}$	(U)	61,7	-	63,7	0,41 (15)
$ec_{25,20\ M}$	(U)	63,91	-	65,91	0,16 (15)
$ec_{51,41\ K}$	(U)	64,20		(8)	0,15 (5)
$ec_{25,22\ N}$	(U)	65,81	-	66,87	0,112 (40)
$ec_{51,40\ K}$	(U)	70,55		(2)	5,4 (6)
$ec_{16,13\ M}$	(U)	74,29	-	76,29	0,48 (17)
$ec_{2,1\ L}$	(U)	78,10	-	82,69	31 (6)
$ec_{56,45\ K}$	(U)	78,13		(3)	0,7 (7)
$ec_{16,13\ N}$	(U)	78,40	-	79,46	0,131 (46)

		Energy keV			Electrons per 100 disint.
$ec_{23,12}$ K	(U)	81,20		(5)	0,1 (1)
$ec_{22,14}$ L	(U)	82,01	-	86,60	1,96 (33)
$ec_{21,9}$ K	(U)	84,35		(5)	0,1 (1)
$ec_{16,11}$ L	(U)	84,92	-	89,51	0,104 (32)
$ec_{4,3}$ K	(U)	85,37		(3)	0,138 (20)
$ec_{13,5}$ K	(U)	87,52		(3)	1,0 (5)
$ec_{2,1}$ M	(U)	94,31	-	96,31	8,7 (16)
$ec_{22,14}$ M	(U)	98,22	-	100,22	0,54 (9)
$ec_{2,1}$ N	(U)	98,42	-	99,48	2,36 (44)
$ec_{22,14}$ N	(U)	102,33	-	103,39	0,148 (25)
$ec_{25,16}$ L	(U)	103,70	-	108,29	2,69 (41)
$ec_{16,7}$ K	(U)	104,40		(8)	0,276 (47)
$ec_{43,33}$ L	(U)	109,5	-	114,1	0,84 (8)
$ec_{33,25}$ K	(U)	110,90		(3)	4,4 (16)
$ec_{51,37}$ K	(U)	111,65		(3)	10 (1)
$ec_{51,45}$ L	(U)	112,85	-	117,44	0,169 (34)
$ec_{25,11}$ K	(U)	116,61		(3)	0,16 (15)
$ec_{13,7}$ L	(U)	118,39	-	122,98	0,90 (18)
$ec_{25,16}$ M	(U)	119,91	-	121,91	0,75 (11)
$ec_{33,30}$ L	(U)	122,02	-	126,61	0,49 (8)
$ec_{25,16}$ N	(U)	124,02	-	125,08	0,203 (31)
$ec_{43,33}$ M	(U)	125,8	-	127,8	0,205 (18)
$ec_{30,22}$ L	(U)	128,12	-	132,71	0,111 (34)
$ec_{56,40}$ K	(U)	129,77		(2)	1,06 (15)
$ec_{3,2}$ L	(U)	130,95	-	135,54	8,4 (10)
$ec_{33,24}$ K	(U)	133,62		(1)	0,118 (19)
$ec_{13,7}$ M	(U)	134,6	-	136,6	0,24 (6)
$ec_{33,30}$ M	(U)	138,23	-	140,23	0,129 (20)
$ec_{3,2}$ M	(U)	147,16	-	149,16	2,33 (27)
$ec_{51,43}$ L	(U)	149,09	-	153,68	0,38 (5)
$ec_{3,2}$ N	(U)	151,27	-	152,33	0,63 (7)
$ec_{26,10}$ K	(U)	151,52		(5)	0,11 (9)
$ec_{14,7}$ L	(U)	152,79	-	157,38	0,126 (23)
$ec_{49,33}$ K	(U)	156,68		(5)	0,83 (11)
$ec_{51,40}$ L	(U)	164,39	-	168,98	1,04 (11)
$ec_{56,45}$ L	(U)	171,97	-	176,56	0,255 (42)
$ec_{33,22}$ K	(U)	178,19		(5)	0,84 (29)
$ec_{4,3}$ L	(U)	179,21	-	183,80	0,38 (6)
$ec_{51,40}$ M	(U)	180,6	-	182,6	0,253 (27)
$ec_{13,5}$ L	(U)	181,36	-	185,95	0,52 (6)
$ec_{4,3}$ M	(U)	195,42	-	197,42	0,105 (15)
$ec_{13,5}$ M	(U)	197,57	-	199,57	0,138 (17)
$ec_{33,25}$ L	(U)	204,7	-	209,3	1,46 (19)
$ec_{51,37}$ L	(U)	205,49	-	210,08	1,94 (20)
$ec_{33,25}$ M	(U)	221	-	223	0,372 (47)
$ec_{51,37}$ M	(U)	221,7	-	223,7	0,469 (49)
$ec_{56,40}$ L	(U)	223,61	-	228,20	0,205 (30)

		Energy keV		Electrons per 100 disint.
$ec_{33,25\ N}$	(U)	225,1 - 226,1		0,100 (13)
$ec_{51,37\ N}$	(U)	225,81 - 226,87		0,126 (13)
$ec_{49,33\ L}$	(U)	250,52 - 255,11		0,194 (25)
$ec_{37,21\ K}$	(U)	253,90	(5)	1,12 (14)
$ec_{40,23\ K}$	(U)	256,4	(1)	0,50 (6)
$ec_{33,22\ L}$	(U)	272,03 - 276,62		0,33 (5)
$ec_{33,11\ K}$	(U)	343,08	(5)	0,125 (47)
$ec_{37,21\ L}$	(U)	347,7 - 352,3		0,216 (26)
$ec_{40,23\ L}$	(U)	350,242 - 354,832		0,100 (11)
$ec_{45,15\ K}$	(U)	449,8	(1)	0,149 (16)
$ec_{40,12\ K}$	(U)	453,5	(2)	0,51 (8)
$ec_{37,9\ K}$	(U)	454,1	(1)	1,30 (17)
$ec_{37,9\ L}$	(U)	547,9 - 552,5		0,248 (32)
$ec_{54,16\ K}$	(U)	577,2	(1)	0,104 (11)
$ec_{50,13\ K}$	(U)	617,96	(5)	0,50 (6)
$ec_{9,1\ K}$	(U)	768,06	(4)	0,101 (12)
$\beta^-_{0,77}$	max:	51	(4)	0,42 (5)
$\beta^-_{0,77}$	avg:	13,0	(11)	
$\beta^-_{0,76}$	max:	79	(4)	0,21 (3)
$\beta^-_{0,76}$	avg:	20,4	(11)	
$\beta^-_{0,75}$	max:	94	(4)	0,064 (11)
$\beta^-_{0,75}$	avg:	24,2	(11)	
$\beta^-_{0,74}$	max:	126	(4)	0,40 (7)
$\beta^-_{0,74}$	avg:	33,1	(11)	
$\beta^-_{0,73}$	max:	129	(4)	0,140 (24)
$\beta^-_{0,73}$	avg:	33,8	(11)	
$\beta^-_{0,72}$	max:	158	(4)	0,055 (8)
$\beta^-_{0,72}$	avg:	41,9	(12)	
$\beta^-_{0,71}$	max:	161	(4)	0,90 (15)
$\beta^-_{0,71}$	avg:	42,9	(12)	
$\beta^-_{0,70}$	max:	175	(4)	0,112 (16)
$\beta^-_{0,70}$	avg:	46,7	(12)	
$\beta^-_{0,69}$	max:	195	(4)	0,122 (16)
$\beta^-_{0,69}$	avg:	52,2	(12)	
$\beta^-_{0,68}$	max:	214	(4)	0,59 (8)
$\beta^-_{0,68}$	avg:	57,8	(12)	
$\beta^-_{0,67}$	max:	226	(4)	0,044 (12)
$\beta^-_{0,67}$	avg:	61,3	(12)	
$\beta^-_{0,66}$	max:	236	(4)	0,44 (19)
$\beta^-_{0,66}$	avg:	64,3	(12)	
$\beta^-_{0,65}$	max:	254	(4)	0,35 (5)
$\beta^-_{0,65}$	avg:	69,7	(12)	
$\beta^-_{0,64}$	max:	267	(4)	0,22 (4)

		Energy keV		Electrons per 100 disint.
$\beta^-_{0,64}$	avg:	73,5	(12)	
$\beta^-_{0,63}$	max:	279	(4)	0,21 (3)
$\beta^-_{0,63}$	avg:	76,9	(12)	
$\beta^-_{0,62}$	max:	313	(4)	0,25 (3)
$\beta^-_{0,62}$	avg:	87,3	(13)	
$\beta^-_{0,61}$	max:	332	(4)	0,029 (7)
$\beta^-_{0,61}$	avg:	93,0	(13)	
$\beta^-_{0,60}$	max:	351	(4)	0,17 (3)
$\beta^-_{0,60}$	avg:	98,9	(13)	
$\beta^-_{0,59}$	max:	383	(4)	1,43 (15)
$\beta^-_{0,59}$	avg:	108,9	(13)	
$\beta^-_{0,58}$	max:	402	(4)	0,41 (8)
$\beta^-_{0,58}$	avg:	114,8	(13)	
$\beta^-_{0,57}$	max:	411	(4)	0,061 (11)
$\beta^-_{0,57}$	avg:	117,6	(13)	
$\beta^-_{0,56}$	max:	412	(4)	8 (3)
$\beta^-_{0,56}$	avg:	118,1	(13)	
$\beta^-_{0,55}$	max:	424	(4)	0,129 (17)
$\beta^-_{0,55}$	avg:	121,8	(13)	
$\beta^-_{0,54}$	max:	433	(4)	2,8 (4)
$\beta^-_{0,54}$	avg:	124,7	(13)	
$\beta^-_{0,53}$	max:	457	(4)	0,78 (19)
$\beta^-_{0,53}$	avg:	132,3	(14)	
$\beta^-_{0,52}$	max:	458	(4)	1,16 (14)
$\beta^-_{0,52}$	avg:	132,5	(14)	
$\beta^-_{0,50}$	max:	472	(4)	8,4 (9)
$\beta^-_{0,50}$	avg:	137,2	(13)	
$\beta^-_{0,51}$	max:	472	(4)	36 (5)
$\beta^-_{0,51}$	avg:	137,1	(13)	
$\beta^-_{0,49}$	max:	502	(4)	6,9 (8)
$\beta^-_{0,49}$	avg:	146,8	(14)	
$\beta^-_{0,48}$	max:	542	(4)	0,95 (13)
$\beta^-_{0,48}$	avg:	160,1	(14)	
$\beta^-_{0,47}$	max:	545	(4)	0,18 (4)
$\beta^-_{0,47}$	avg:	164,6	(13)	
$\beta^-_{0,46}$	max:	576	(4)	0,035 (20)
$\beta^-_{0,46}$	avg:	171,4	(14)	
$\beta^-_{0,45}$	max:	606	(4)	$< 0,7$
$\beta^-_{0,45}$	avg:	181,7	(14)	
$\beta^-_{0,44}$	max:	613	(4)	0,05 (3)
$\beta^-_{0,44}$	avg:	184,1	(14)	
$\beta^-_{0,43}$	max:	642	(4)	19,6 (18)

		Energy keV		Electrons per 100 disint.
$\beta^-_{0,43}$	avg:	194,0	(14)	
$\beta^-_{0,42}$	max:	647	(4)	0,078 (20)
$\beta^-_{0,42}$	avg:	195,6	(14)	
$\beta^-_{0,41}$	max:	651	(4)	0,10 (9)
$\beta^-_{0,41}$	avg:	197,1	(14)	
$\beta^-_{0,40}$	max:	658	(4)	0,9
$\beta^-_{0,40}$	avg:	199,3	(14)	
$\beta^-_{0,39}$	max:	662	(4)	0,21 (4)
$\beta^-_{0,39}$	avg:	200,6	(14)	
$\beta^-_{0,38}$	max:	693	(4)	0,25 (4)
$\beta^-_{0,38}$	avg:	211,3	(14)	
$\beta^-_{0,37}$	max:	699	(4)	< 2,7
$\beta^-_{0,37}$	avg:	213,5	(14)	
$\beta^-_{0,36}$	max:	709	(4)	0,12 (3)
$\beta^-_{0,36}$	avg:	216,9	(14)	
$\beta^-_{0,34}$	max:	747	(4)	0,11 (3)
$\beta^-_{0,34}$	avg:	230,3	(14)	
$\beta^-_{0,31}$	max:	883	(4)	0,109 (18)
$\beta^-_{0,31}$	avg:	278,7	(15)	
$\beta^-_{0,26}$	max:	980	(4)	0,30 (12)
$\beta^-_{0,26}$	avg:	314,2	(15)	
$\beta^-_{0,25}$	max:	1000	(4)	< 1,5
$\beta^-_{0,25}$	avg:	312,6	(14)	
$\beta^-_{0,22}$	max:	1067	(4)	1,9 (10)
$\beta^-_{0,22}$	avg:	346,5	(15)	
$\beta^-_{0,18}$	max:	1104	(4)	0,69 (20)
$\beta^-_{0,18}$	avg:	360,2	(15)	
$\beta^-_{0,16}$	max:	1126	(4)	< 8
$\beta^-_{0,16}$	avg:	368,3	(15)	
$\beta^-_{0,15}$	max:	1171	(4)	1,5 (13)
$\beta^-_{0,15}$	avg:	385,4	(16)	
$\beta^-_{0,14}$	max:	1171,2	(40)	5
$\beta^-_{0,14}$	avg:	385,4	(16)	
$\beta^-_{0,13}$	max:	1206	(4)	< 3,1
$\beta^-_{0,13}$	avg:	398,5	(16)	
$\beta^-_{0,12}$	max:	1227	(4)	< 2,5
$\beta^-_{0,12}$	avg:	406,4	(16)	
$\beta^-_{0,11}$	max:	1232	(4)	< 0,4
$\beta^-_{0,11}$	avg:	408,7	(16)	
$\beta^-_{0,10}$	max:	1247	(4)	< 0,8
$\beta^-_{0,10}$	avg:	414,4	(16)	
$\beta^-_{0,7}$	max:	1346	(4)	< 0,8

		Energy keV		Electrons per 100 disint.
$\beta^-_{0,7}$	avg:	452,1	(16)	
$\beta^-_{0,2}$	max:	2052	(4)	< 5
$\beta^-_{0,2}$	avg:	732,2	(17)	

5 Photon Emissions

5.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(U)	11,6185 — 20,7141		77 (10)	
$XK\alpha_2$	(U)	94,666		10,5 (6)	} $K\alpha$
$XK\alpha_1$	(U)	98,44		16,8 (9)	}
$XK\beta_3$	(U)	110,421	}		
$XK\beta_1$	(U)	111,298	}	6,1 (4)	$K'\beta_1$
$XK\beta''_5$	(U)	111,964	}		
$XK\beta_2$	(U)	114,407	}		
$XK\beta_4$	(U)	115,012	}	2,0 (1)	$K'\beta_2$
$XKO_{2,3}$	(U)	115,377	}		

5.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{14,13}$(U)	34,30 (4)	0,0037 (4)
$\gamma_{1,0}$(U)	43,49 (2)	0,12 (3)
$\gamma_{16,14}$(U)	45,45 (5)	0,027 (9)
$\gamma_{14,12}$(U)	54,96 (10)	~ 0,0094
$\gamma_{15,12}$(U)	54,96 (10)	~ 0,0094
$\gamma_{45,39}$(U)	55,45 (5)	0,027 (9)
$\gamma_{22,16}$(U)	58,20 (6)	0,0027 (9)
$\gamma_{56,51}$(U)	59,19 (5)	0,032 (11)
$\gamma_{13,9}$(U)	62,70 (1)	1,6 (5)
$\gamma_{25,22}$(U)	67,25 (10)	0,036 (11)
$\gamma_{25,20}$(U)	69,46 (5)	0,018 (8)
$\gamma_{16,13}$(U)	79,84 (2)	0,062 (22)
$\gamma_{14,9}$(U)	97,17 (10)	0,24 (9)

	Energy keV	Photons per 100 disint.
$\gamma_{2,1}$(U)	99,86 (2)	3,2 (6)
$\gamma_{16,12}$(U)	100,89 (2)	0,125 (24)
$\gamma_{22,14}$(U)	103,77 (2)	0,24 (4)
$\gamma_{16,11}$(U)	106,68 (5)	0,036 (11)
$\gamma_{25,16}$(U)	125,46 (1)	0,79 (12)
$\gamma_{43,33}$(U)	131,30 (1)	18,2 (16)
$\gamma_{51,45}$(U)	134,61 (2)	0,114 (23)
$\gamma_{21,13}$(U)	137,23 (5)	0,027 (9)
$\gamma_{13,7}$(U)	140,15 (2)	0,51 (7)
$\gamma_{49,43}$(U)	140,91 (3)	0,31 (5)
$\gamma_{33,30}$(U)	143,78 (2)	0,32 (5)
$\gamma_{30,22}$(U)	149,88 (3)	0,073 (22)
$\gamma_{3,2}$(U)	152,71 (2)	6,0 (7)
$\gamma_{33,28}$(U)	159,48 (2)	0,66 (10)
$\gamma_{22,11}$(U)	164,94 (5)	0,052 (22)
$\gamma_{64,54}$(U)	165,61 (5)	0,073 (22)
$\gamma_{51,43}$(U)	170,85 (2)	0,51 (7)
$\gamma_{14,7}$(U)	174,55 (3)	0,17 (3)
$\gamma_{51,41}$(U)	179,80 (8)	0,045 (16)
$\gamma_{51,40}$(U)	186,15 (2)	1,78 (19)
$\gamma_{56,45}$(U)	193,73 (3)	0,50 (8)
$\gamma_{23,12}$(U)	196,80 (5)	0,073 (22)
$\gamma_{21,9}$(U)	199,95 (5)	0,073 (22)
$\gamma_{4,3}$(U)	200,97 (3)	0,90 (13)
$\gamma_{13,5}$(U)	203,12 (3)	1,24 (15)
$\gamma_{16,7}$(U)	220,00 (8)	0,146 (25)
$\gamma_{66,53}$(U)	221,15 (10)	0,052 (22)
$\gamma_{37,29}$(U)	221,83 (10)	0,073 (22)
$\gamma_{33,25}$(U)	226,50 (3)	4,9 (6)
$\gamma_{51,37}$(U)	227,25 (3)	5,8 (6)
$\gamma_{25,11}$(U)	232,21 (3)	0,18 (3)
$\gamma_{66,51}$(U)	235,11 (3)	0,114 (23)
$\gamma_{17,7}$(U)	235,9 (30)	0,005 (3)
$\gamma_{58,43}$(U)	240,2 (1)	0,052 (22)
$\gamma_{56,40}$(U)	245,37 (2)	0,76 (11)
$\gamma_{27,13}$(U)	247,79 (7)	0,00037 (4)
$\gamma_{33,24}$(U)	249,22 (1)	2,5 (4)
$\gamma_{68,51}$(U)	257,2 (1)	0,052 (22)
$\gamma_{26,10}$(U)	267,12 (5)	0,18 (3)
$\gamma_{49,33}$(U)	272,28 (5)	1,09 (14)
$\gamma_{21,8}$(U)	275,04 (10)	0,094 (23)
$\gamma_{22,7}$(U)	278,3 (1)	0,042 (11)
$\gamma_{33,22}$(U)	293,79 (5)	3,0 (4)
$\gamma_{33,20}$(U)	295,91 (8)	0,146 (25)
$\gamma_{17,5}$(U)	298,7 (2)	0,014 (6)
$\gamma_{64,46}$(U)	308,6 (2)	0,021 (6)
$\gamma_{71,51}$(U)	310,2 (1)	0,073 (13)

	Energy keV	Photons per 100 disint.
$\gamma_{27,9}$(U)	310,52 (10)	0,000135 (15)
$\gamma_{23,8}$(U)	313,5 (1)	0,104 (14)
$\gamma_{21,6}$(U)	316,7 (1)	0,104 (14)
$\gamma_{34,22}$(U)	320,4 (1)	0,052 (8)
$\gamma_{33,18}$(U)	330,40 (5)	0,78 (9)
$\gamma_{74,52}$(U)	331,4 (1)	0,073 (13)
$\gamma_{21,5}$(U)	340,2 (1)	0,041 (9)
$\gamma_{31,12}$(U)	343,8 (2)	0,034 (8)
$\gamma_{33,16}$(U)	351,9 (1)	0,42 (5)
$\gamma_{46,28}$(U)	357,9 (1)	0,036 (11)
$\gamma_{56,33}$(U)	360,6 (3)	0,018 (7)
$\gamma_{26,7}$(U)	365,0 (3)	0,018 (7)
$\gamma_{37,21}$(U)	369,50 (5)	2,5 (3)
$\gamma_{40,23}$(U)	372,0 (1)	1,23 (14)
$\gamma_{32,11}$(U)	379,1 (1)	0,042 (11)
$\gamma_{31,9}$(U)	385,4 (1)	0,042 (11)
$\gamma_{27,7}$(U)	387,94 (6)	0,00072 (6)
$\gamma_{45,25}$(U)	394,1 (1)	0,094 (14)
$\gamma_{33,15}$(U)	397,7 (3)	0,027 (7)
$\gamma_{(-1,2)}$(U)	401,8 (2)	0,036 (11)
$\gamma_{40,22}$(U)	409,8 (1)	0,34 (5)
$\gamma_{49,30}$(U)	416,1 (1)	0,036 (11)
$\gamma_{(-1,3)}$(U)	425,3 (2)	0,036 (11)
$\gamma_{37,16}$(U)	426,95 (5)	0,46 (5)
$\gamma_{27,6}$(U)	427,4 (4)	0,000031 (10)
$\gamma_{68,42}$(U)	433,1 (1)	0,094 (14)
$\gamma_{40,18}$(U)	446,6 (1)	0,114 (15)
$\gamma_{27,5}$(U)	450,93 (4)	0,0040 (19)
$\gamma_{42,19}$(U)	452,4 (3)	0,027 (9)
$\gamma_{33,11}$(U)	458,68 (5)	1,14 (12)
$\gamma_{45,22}$(U)	461,5 (1)	0,034 (11)
$\gamma_{39,16}$(U)	464,2 (1)	0,031 (11)
$\gamma_{40,16}$(U)	468,0 (1)	0,22 (3)
$\gamma_{37,15}$(U)	472,3 (1)	0,36 (4)
$\gamma_{41,16}$(U)	474,2 (2)	0,036 (11)
$\gamma_{42,16}$(U)	478,6 (1)	0,125 (15)
$\gamma_{71,43}$(U)	481,0 (1)	0,31 (4)
$\gamma_{45,18}$(U)	498,0 (1)	0,062 (12)
$\gamma_{66,35}$(U)	502,0 (1)	0,027 (90)
$\gamma_{37,13}$(U)	506,75 (5)	1,30 (14)
$\gamma_{40,15}$(U)	513,4 (1)	~ 0,38
$\gamma_{40,14}$(U)	513,5 (1)	~ 0,76
$\gamma_{45,16}$(U)	519,6 (1)	0,40 (5)
$\gamma_{49,24}$(U)	521,4 (1)	0,75 (9)
$\gamma_{37,12}$(U)	527,9 (1)	0,40 (5)
$\gamma_{43,15}$(U)	529,1 (3)	0,09 (4)
$\gamma_{76,44}$(U)	534,1 (1)	0,083 (13)

	Energy keV	Photons per 100 disint.
$\gamma_{71,37}$(U)	537,2 (1)	0,083 (13)
$\gamma_{39,13}$(U)	543,8 (1)	0,135 (24)
$\gamma_{47,19}$(U)	553,7 (1)	0,045 (16)
$\gamma_{44,14}$(U)	558,0 (2)	0,094 (23)
$\gamma_{36,9}$(U)	559,2 (2)	0,073 (22)
$\gamma_{76,43}$(U)	562,8 (3)	0,036 (11)
$\gamma_{45,15}$(U)	565,2 (1)	1,04 (11)
$\gamma_{40,12}$(U)	568,9 (2)	3,6 (6)
$\gamma_{37,9}$(U)	569,5 (1)	9,3 (12)
$\gamma_{41,12}$(U)	575,5 (1)	0,027 (9)
$\gamma_{43,12}$(U)	584,1 (1)	0,18 (30)
$\gamma_{64,32}$(U)	586,3 (1)	0,073 (13)
$\gamma_{40,10}$(U)	590,3 (10)	0,036 (11)
$\gamma_{50,22}$(U)	595,4 (2)	0,094 (23)
$\gamma_{59,26}$(U)	596,9 (1)	0,20 (3)
$\gamma_{49,18}$(U)	602,6 (1)	0,54 (6)
$\gamma_{43,10}$(U)	604,6 (3)	0,052 (22)
$\gamma_{53,21}$(U)	612,0 (1)	0,38 (5)
$\gamma_{41,9}$(U)	617,0 (2)	0,052 (22)
$\gamma_{44,11}$(U)	619,0 (2)	0,036 (11)
$\gamma_{49,16}$(U)	624,2 (1)	0,35 (5)
$\gamma_{20,4}$(U)	628,1 (1)	0,24 (5)
$\gamma_{48,15}$(U)	629,4 (1)	0,35 (6)
$\gamma_{51,18}$(U)	632,6 (2)	0,036 (11)
$\gamma_{54,22}$(U)	634,3 (2)	0,135 (24)
$\gamma_{(-1,4)}$(U)	643,2 (2)	0,027 (9)
$\gamma_{37,7}$(U)	646,5 (1)	0,114 (15)
$\gamma_{50,16}$(U)	653,7 (1)	0,47 (8)
$\gamma_{56,22}$(U)	655,2 (2)	0,135 (24)
$\gamma_{46,11}$(U)	657,4 (1)	0,40 (5)
$\gamma_{(-1,5)}$(U)	659,8 (1)	0,27 (4)
$\gamma_{48,13}$(U)	663,9 (1)	0,54 (9)
$\gamma_{11,3}$(U)	666,5 (1)	1,18 (13)
$\gamma_{49,15}$(U)	669,7 (1)	1,0 (1)
$\gamma_{35,5}$(U)	669,7 (1)	<0,0006
$\gamma_{24,4}$(U)	675,1 (1)	0,101 (14)
$\gamma_{59,22}$(U)	683,9 (2)	0,16 (4)
$\gamma_{40,8}$(U)	685,1 (2)	0,15 (4)
$\gamma_{54,16}$(U)	692,6 (1)	1,25 (13)
$\gamma_{51,15}$(U)	699,03 (5)	3,6 (4)
$\gamma_{7,2}$(U)	705,9 (1)	2,29 (23)
$\gamma_{8,2}$(U)	708,3 (2)	0,023 (9)
$\gamma_{(-1,6)}$(U)	711,5 (1)	0,156 (25)
$\gamma_{52,14}$(U)	713,7 (1)	0,146 (25)
$\gamma_{62,23}$(U)	716,5 (2)	0,031 (9)
$\gamma_{15,3}$(U)	727,8 (2)	0,114 (15)
$\gamma_{49,11}$(U)	730,9 (2)	0,63 (10)

	Energy keV	Photons per 100 disint.
$\gamma_{50,13}$(U)	733,39 (5)	7,0 (8)
$\gamma_{54,14}$(U)	738,0 (1)	1,16 (13)
$\gamma_{5,1}$(U)	742,813 (5)	2,08 (21)
$\gamma_{49,10}$(U)	745,9 (1)	0,32 (5)
$\gamma_{52,13}$(U)	748,1 (3)	0,104 (23)
$\gamma_{51,12}$(U)	755,0 (1)	1,23 (13)
$\gamma_{56,15}$(U)	758,9 (1)	0,25 (3)
$\gamma_{50,11}$(U)	761,0 (2)	0,073 (22)
$\gamma_{28,4}$(U)	764,8 (2)	0,20 (5)
$\gamma_{6,1}$(U)	766,4 (2)	0,26 (5)
$\gamma_{58,15}$(U)	769,1 (1)	0,187 (20)
$\gamma_{54,13}$(U)	772,4 (2)	0,073 (22)
$\gamma_{(-1,7)}$(U)	778,6 (2)	0,046 (10)
$\gamma_{30,4}$(U)	780,4 (2)	0,90 (9)
$\gamma_{9,2}$(U)	783,4 (1)	0,30 (4)
$\gamma_{5,0}$(U)	786,272 (22)	1,21 (13)
$\gamma_{54,12}$(U)	792,8 (3)	0,045 (11)
$\gamma_{18,3}$(U)	794,9 (2)	0,68 (11)
$\gamma_{51,9}$(U)	796,1 (1)	2,6 (3)
$\gamma_{55,12}$(U)	802,3 (2)	0,031 (9)
$\gamma_{10,2}$(U)	804,1 (1)	0,62 (22)
$\gamma_{7,1}$(U)	805,80 (5)	2,5 (3)
$\gamma_{8,1}$(U)	808,4 (3)	0,036 (11)
$\gamma_{53,9}$(U)	811,5 (1)	0,125 (15)
$\gamma_{56,12}$(U)	814,2 (1)	0,31 (4)
$\gamma_{11,2}$(U)	819,2 (1)	1,9 (2)
$\gamma_{(-1,8)}$(U)	824,2 (2)	1,25 (15)
$\gamma_{12,2}$(U)	825,1 (2)	1,9 (2)
$\gamma_{20,3}$(U)	829,3 (2)	0,36 (11)
$\gamma_{22,3}$(U)	831,5 (1)	4,2 (5)
$\gamma_{75,28}$(U)	839,5 (1)	0,031 (8)
$\gamma_{49,7}$(U)	844,1 (1)	0,43 (5)
$\gamma_{(-1,9)}$(U)	846,1 (2)	0,052 (12)
$\gamma_{59,11}$(U)	848,9 (2)	0,027 (8)
$\gamma_{8,0}$(U)	851,8 (1)	0,073 (22)
$\gamma_{57,9}$(U)	857,7 (2)	0,036 (8)
$\gamma_{59,10}$(U)	863,2 (2)	0,073 (22)
$\gamma_{77,29}$(U)	869,7 (1)	0,20 (3)
$\gamma_{50,7}$(U)	874,0 (3)	0,036 (8)
$\gamma_{24,3}$(U)	876,0 (1)	2,55 (23)
$\gamma_{14,2}$(U)	880,52 (4)	4,3 (6)
$\gamma_{15,2}$(U)	880,52 (4)	6,2 (8)
$\gamma_{9,1}$(U)	883,24 (4)	9,7 (11)
$\gamma_{66,16}$(U)	890,1 (4)	0,027 (8)
$\gamma_{25,3}$(U)	898,67 (5)	3,3 (4)
$\gamma_{10,1}$(U)	904,2 (1)	0,34 (4)
$\gamma_{65,15}$(U)	916,5 (2)	0,024 (7)

	Energy keV	Photons per 100 disint.
$\gamma_{26,3}$(U)	918,4 (1)	0,100 (14)
$\gamma_{(-1,10)}$(U)	920,5 (2)	0,029 (8)
$\gamma_{12,1}$(U)	925,0 (1)	7,9 (9)
$\gamma_{16,2}$(U)	926,0 (2)	1,8 (13)
$\gamma_{9,0}$(U)	926,7 (1)	7,3 (12)
$\gamma_{66,15}$(U)	935,8 (2)	0,067 (10)
$\gamma_{17,2}$(U)	942,0 (3)	0,046 (9)
$\gamma_{13,1}$(U)	946,00 (3)	13,5 (15)
$\gamma_{18,2}$(U)	947,7 (2)	1,63 (21)
$\gamma_{19,2}$(U)	952,7 (1)	0,083 (13)
$\gamma_{59,8}$(U)	960,0 (1)	0,073 (13)
$\gamma_{28,3}$(U)	965,8 (1)	0,48 (6)
$\gamma_{73,18}$(U)	975,1 (1)	0,027 (8)
$\gamma_{29,3}$(U)	978,2 (3)	0,090 (23)
$\gamma_{14,1}$(U)	980,3 (1)	~ 2,7
$\gamma_{15,1}$(U)	980,3 (1)	~ 1,77
$\gamma_{30,3}$(U)	981,6 (3)	0,73 (22)
$\gamma_{22,2}$(U)	984,2 (1)	1,63 (21)
$\gamma_{63,9}$(U)	989,5 (1)	0,104 (14)
$\gamma_{(-1,11)}$(U)	992,0 (2)	0,083 (22)
$\gamma_{60,7}$(U)	994,6 (3)	0,062 (22)
$\gamma_{73,16}$(U)	997,7 (3)	0,046 (12)
$\gamma_{71,15}$(U)	1009,9 (3)	0,067 (12)
$\gamma_{76,19}$(U)	1019,5 (4)	0,027 (8)
$\gamma_{23,2}$(U)	1021,8 (2)	0,15 (4)
$\gamma_{(-1,12)}$(U)	1023,6 (2)	0,062 (22)
$\gamma_{(-1,13)}$(U)	1025,3 (2)	0,052 (22)
$\gamma_{24,2}$(U)	1028,7 (1)	0,57 (6)
$\gamma_{75,16}$(U)	1032,8 (2)	0,018 (5)
$\gamma_{(-1,14)}$(U)	1035,9 (2)	0,026 (10)
$\gamma_{69,11}$(U)	1037,9 (2)	0,018 (7)
$\gamma_{17,1}$(U)	1041,1 (2)	0,032 (11)
$\gamma_{32,3}$(U)	1044,4 (2)	0,031 (3)
$\gamma_{70,12}$(U)	1051,4 (2)	0,062 (12)
$\gamma_{70,11}$(U)	1057,8 (3)	0,0177 (16)
$\gamma_{71,12}$(U)	1065,1 (1)	0,027 (8)
$\gamma_{69,9}$(U)	1073,6 (2)	0,104 (14)
$\gamma_{21,1}$(U)	1083,2 (1)	0,51 (6)
$\gamma_{17,0}$(U)	1085,3 (3)	0,027 (8)
$\gamma_{71,9}$(U)	1106,9 (2)	0,083 (13)
$\gamma_{66,7}$(U)	1110,6 (1)	0,062 (12)
$\gamma_{23,1}$(U)	1121,7 (1)	0,25 (4)
$\gamma_{33,3}$(U)	1125,2 (1)	0,36 (8)
$\gamma_{21,0}$(U)	1126,8 (1)	0,30 (4)
$\gamma_{34,3}$(U)	1151,4 (3)	0,032 (10)
$\gamma_{76,11}$(U)	1153,5 (3)	0,046 (9)
$\gamma_{26,1}$(U)	1171,3 (1)	0,090 (13)

	Energy keV	Photons per 100 disint.
$\gamma_{66,5}$(U)	1173,1 (1)	0,046 (9)
$\gamma_{71,8}$(U)	1182,1 (2)	~ 0,0094
$\gamma_{27,1}$(U)	1193,77 (2)	0,021 (6)
$\gamma_{77,9}$(U)	1217,3 (1)	0,22 (3)
$\gamma_{(-1,15)}$(U)	1220,4 (2)	0,062 (12)
$\gamma_{27,0}$(U)	1237,3 (3)	<0,0094
$\gamma_{40,3}$(U)	1241,2 (1)	0,23 (3)
$\gamma_{41,3}$(U)	1247,8 (2)	0,022 (6)
$\gamma_{42,3}$(U)	1252,6 (2)	0,018 (8)
$\gamma_{43,3}$(U)	1256,5 (1)	0,059 (8)
$\gamma_{33,2}$(U)	1277,7 (2)	0,045 (9)
$\gamma_{45,3}$(U)	1292,8 (1)	0,47 (6)
$\gamma_{(-1,16)}$(U)	1296,4 (2)	0,029 (7)
$\gamma_{(-1,17)}$(U)	1301,2 (2)	0,018 (5)
$\gamma_{(-1,18)}$(U)	1327,0 (2)	0,018 (5)
$\gamma_{36,2}$(U)	1342,9 (2)	0,012 (5)
$\gamma_{37,2}$(U)	1352,9 (1)	1,16 (12)
$\gamma_{47,3}$(U)	1354,6 (2)	0,14 (4)
$\gamma_{38,2}$(U)	1359,0 (1)	0,156 (25)
$\gamma_{39,2}$(U)	1389,6 (2)	0,073 (22)
$\gamma_{40,2}$(U)	1393,9 (1)	2,08 (21)
$\gamma_{49,3}$(U)	1397,5 (2)	0,083 (22)
$\gamma_{41,2}$(U)	1400,3 (1)	0,18 (3)
$\gamma_{43,2}$(U)	1409,1 (2)	0,045 (10)
$\gamma_{35,1}$(U)	1414,4 (2)	<0,0028
$\gamma_{51,3}$(U)	1426,9 (1)	0,17 (3)
$\gamma_{36,1}$(U)	1442,8 (2)	0,031 (7)
$\gamma_{45,2}$(U)	1445,4 (1)	0,32 (5)
$\gamma_{37,1}$(U)	1452,7 (1)	0,81 (9)
$\gamma_{38,1}$(U)	1458,9 (1)	0,094 (23)
$\gamma_{46,2}$(U)	1475,8 (2)	0,008 (4)
$\gamma_{56,3}$(U)	1485,4 (2)	0,030 (7)
$\gamma_{57,3}$(U)	1488,0 (2)	0,014 (6)
$\gamma_{40,1}$(U)	1493,6 (1)	0,104 (14)
$\gamma_{58,3}$(U)	1496,0 (2)	0,036 (9)
$\gamma_{41,1}$(U)	1500,0 (2)	0,011 (4)
$\gamma_{(-1,19)}$(U)	1507,3 (2)	0,020 (5)
$\gamma_{48,2}$(U)	1510,1 (2)	<0,0094
$\gamma_{59,3}$(U)	1515,6 (2)	0,073 (13)
$\gamma_{(-1,20)}$(U)	1520,7 (2)	0,0094 (9)
$\gamma_{(-1,21)}$(U)	1538,8 (2)	0,014 (4)
$\gamma_{49,2}$(U)	1550,1 (1)	0,073 (13)
$\gamma_{61,3}$(U)	1567,0 (2)	0,0114 (23)
$\gamma_{51,2}$(U)	1579,9 (1)	0,073 (22)
$\gamma_{62,3}$(U)	1585,9 (1)	0,146 (17)
$\gamma_{52,2}$(U)	1594,0 (1)	0,31 (4)
$\gamma_{54,2}$(U)	1618,3 (2)	0,009 (4)

	Energy keV	Photons per 100 disint.
$\gamma_{55,2}$(U)	1627,3 (1)	0,076 (11)
$\gamma_{56,2}$(U)	1638,1 (1)	0,208 (21)
$\gamma_{57,2}$(U)	1640,5 (3)	0,010 (4)
$\gamma_{65,3}$(U)	1644,9 (2)	0,010 (4)
$\gamma_{58,2}$(U)	1650,2 (2)	<0,006
$\gamma_{(-1,22)}$(U)	1655,7 (1)	0,026 (4)
$\gamma_{(-1,23)}$(U)	1664,8 (3)	0,018 (7)
$\gamma_{59,2}$(U)	1668,4 (1)	0,77 (9)
$\gamma_{67,3}$(U)	1672,8 (1)	0,034 (11)
$\gamma_{50,1}$(U)	1679,5 (1)	0,077 (18)
$\gamma_{68,3}$(U)	1685,7 (1)	0,31 (4)
$\gamma_{52,1}$(U)	1693,8 (2)	0,7 (1)
$\gamma_{53,1}$(U)	1695,0 (3)	0,27 (7)
$\gamma_{60,2}$(U)	1700,5 (2)	0,104 (14)
$\gamma_{61,2}$(U)	1719,7 (2)	0,018 (6)
$\gamma_{70,3}$(U)	1723,2 (2)	0,016 (4)
$\gamma_{55,1}$(U)	1727,8 (2)	0,020 (5)
$\gamma_{62,2}$(U)	1737,7 (2)	0,075 (11)
$\gamma_{72,3}$(U)	1741,1 (2)	0,049 (8)
$\gamma_{(-1,24)}$(U)	1743,2 (2)	0,033 (8)
$\gamma_{58,1}$(U)	1750,0 (1)	0,064 (10)
$\gamma_{(-1,25)}$(U)	1757,5 (1)	0,024 (6)
$\gamma_{59,1}$(U)	1768,0 (3)	0,020 (5)
$\gamma_{73,3}$(U)	1770,8 (2)	0,068 (17)
$\gamma_{63,2}$(U)	1773,0 (2)	0,068 (17)
$\gamma_{64,2}$(U)	1783,7 (2)	0,025 (7)
$\gamma_{65,2}$(U)	1797,1 (1)	0,24 (3)
$\gamma_{75,3}$(U)	1805,8 (3)	0,0052 (22)
$\gamma_{66,2}$(U)	1815,3 (3)	0,009 (4)
$\gamma_{76,3}$(U)	1819,8 (3)	0,0042 (11)
$\gamma_{67,2}$(U)	1825,1 (3)	0,009 (4)
$\gamma_{(-1,26)}$(U)	1830,8 (3)	0,0042 (11)
$\gamma_{68,2}$(U)	1838,0 (2)	0,0042 (11)
$\gamma_{(-1,27)}$(U)	1849,8 (2)	0,028 (7)
$\gamma_{63,1}$(U)	1872,8 (2)	0,035 (9)
$\gamma_{64,1}$(U)	1884,1 (3)	0,016 (5)
$\gamma_{71,2}$(U)	1890,1 (2)	0,146 (17)
$\gamma_{72,2}$(U)	1893,4 (3)	~ 0,0062
$\gamma_{65,1}$(U)	1896,7 (2)	0,104 (23)
$\gamma_{66,1}$(U)	1915,5 (3)	0,020 (5)
$\gamma_{74,2}$(U)	1925,4 (2)	0,30 (5)
$\gamma_{(-1,28)}$(U)	1927,9 (4)	0,054 (12)
$\gamma_{(-1,29)}$(U)	1935,2 (4)	~ 0,0094
$\gamma_{68,1}$(U)	1937,7 (3)	0,042 (11)
$\gamma_{75,2}$(U)	1958,0 (4)	0,010 (3)
$\gamma_{76,2}$(U)	1971,2 (4)	~ 0,0027
$\gamma_{70,1}$(U)	1977,4 (4)	0,017 (5)

	Energy keV	Photons per 100 disint.
$\gamma_{71,1}$(U)	1989,6 (4)	0,007 (4)
$\gamma_{76,1}$(U)	2072,2 (4)	0,0042 (22)

6 Main Production Modes

U – 238 decay chain member

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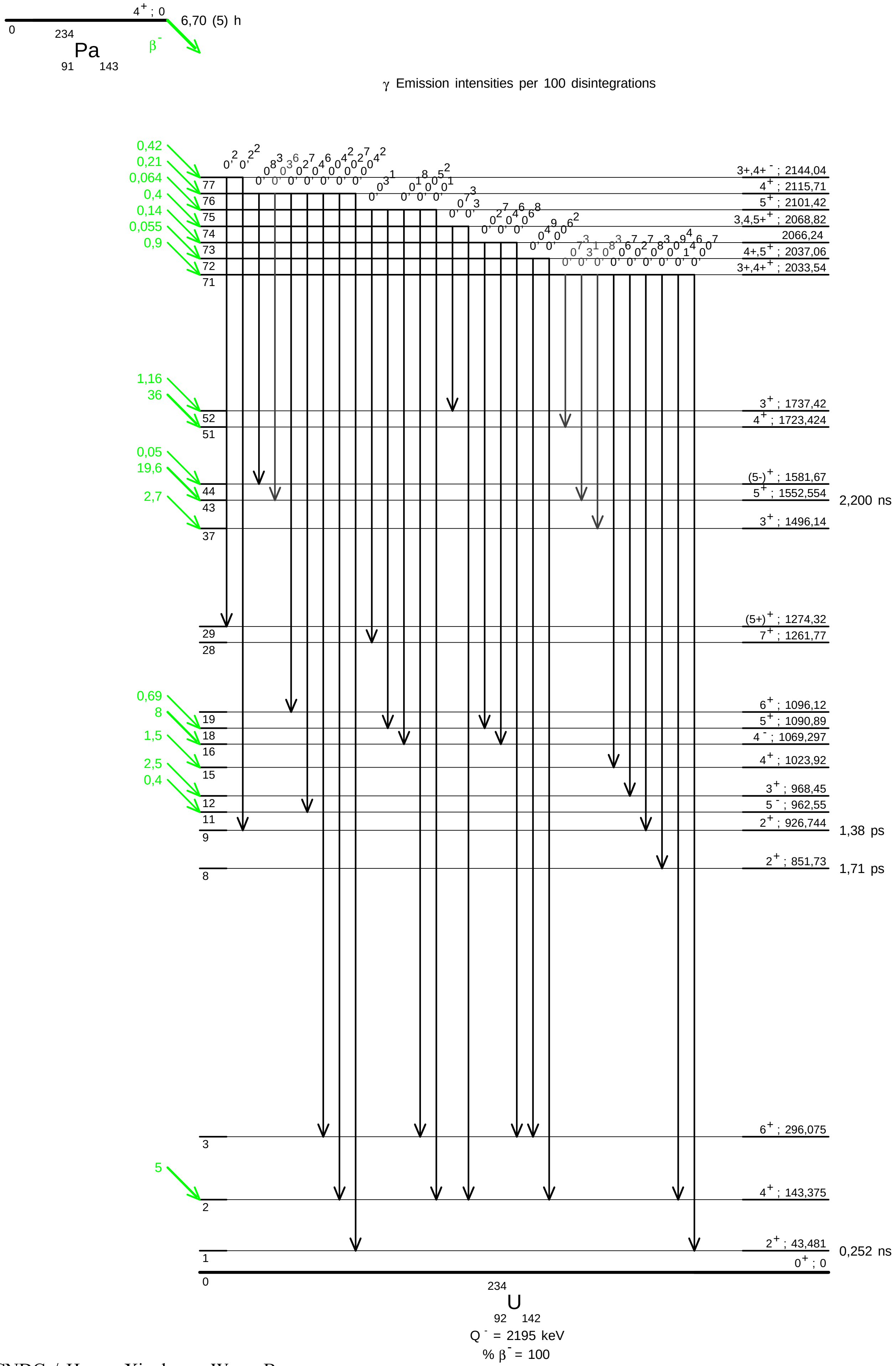

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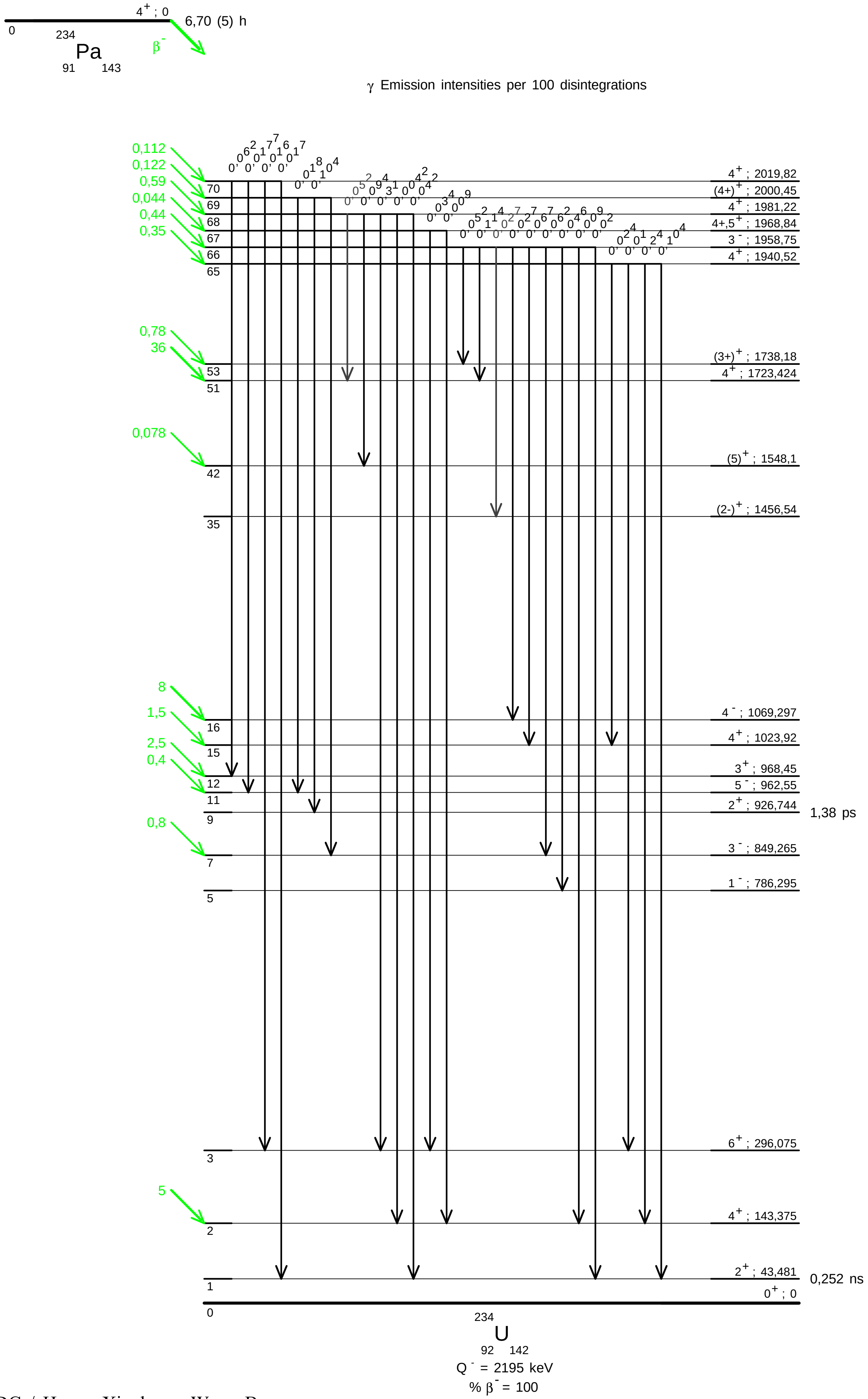

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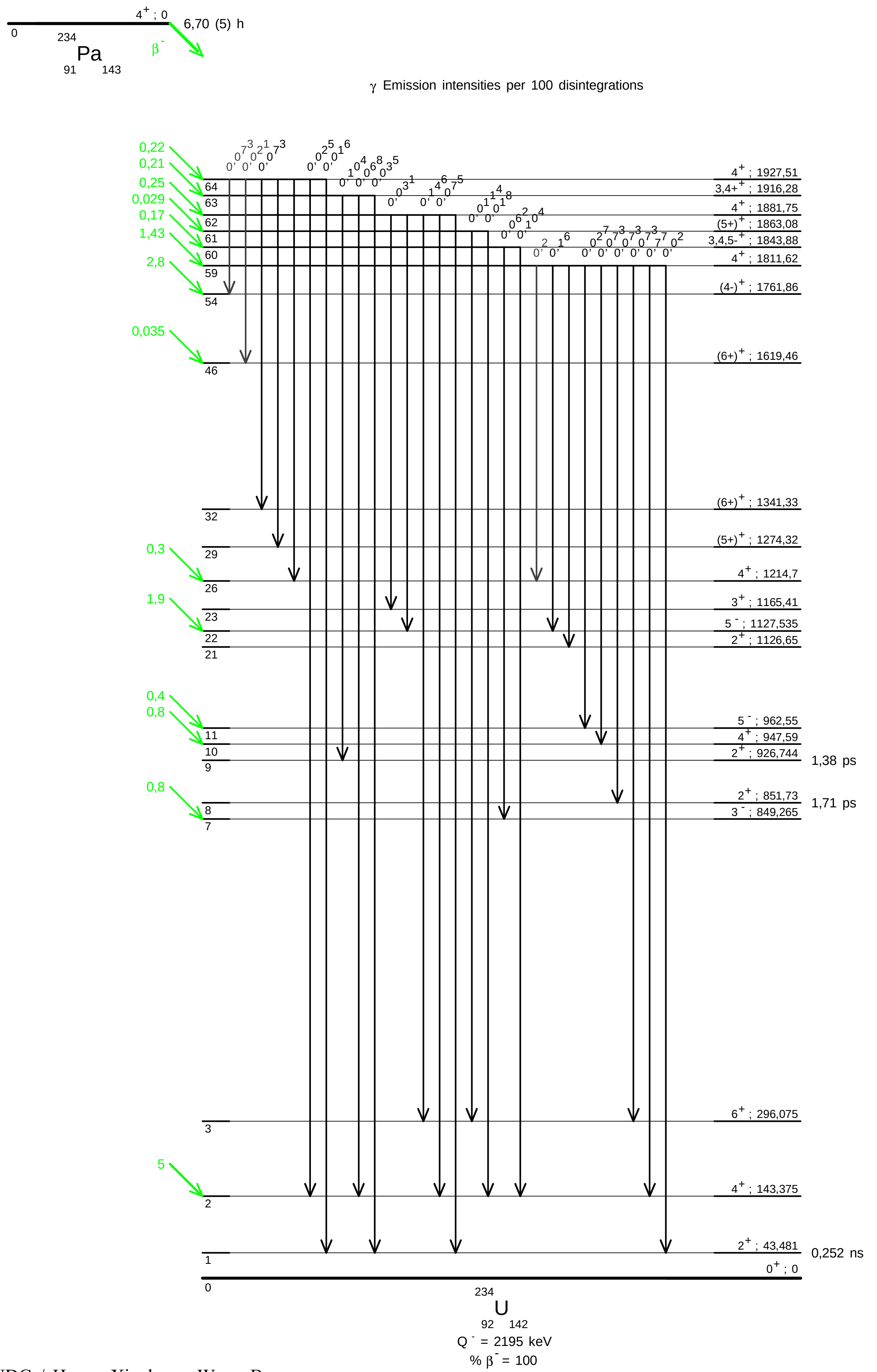

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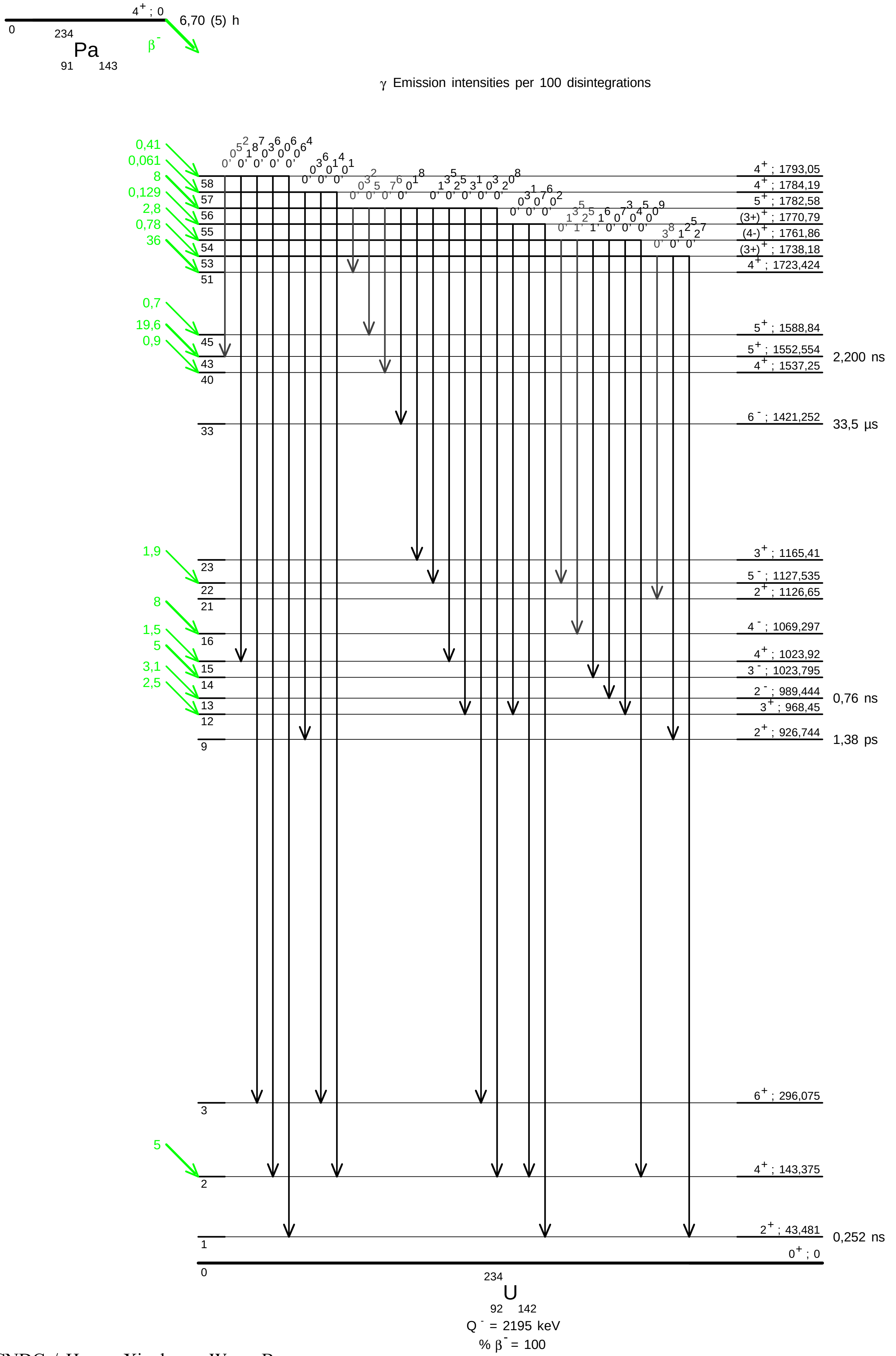

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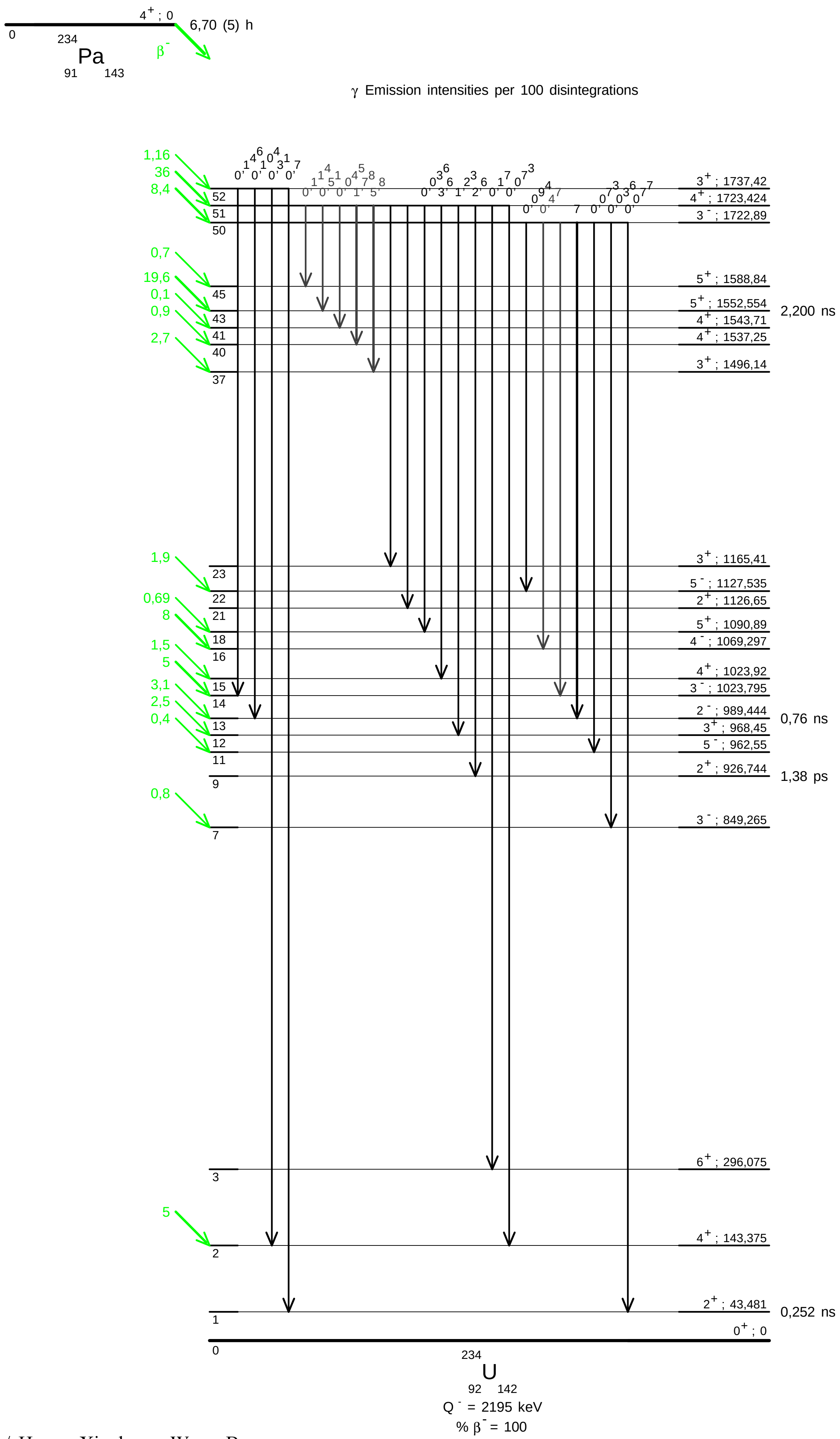

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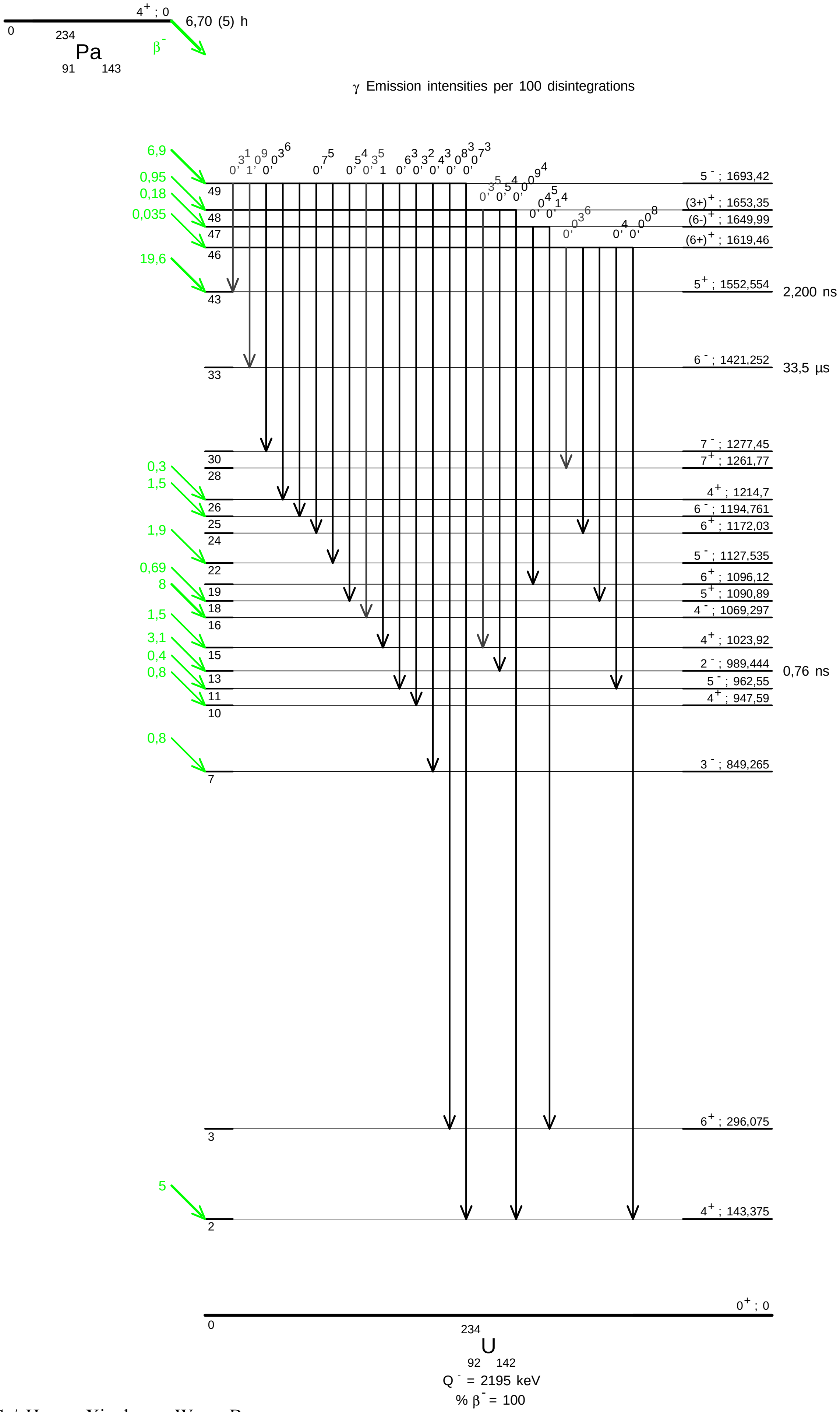

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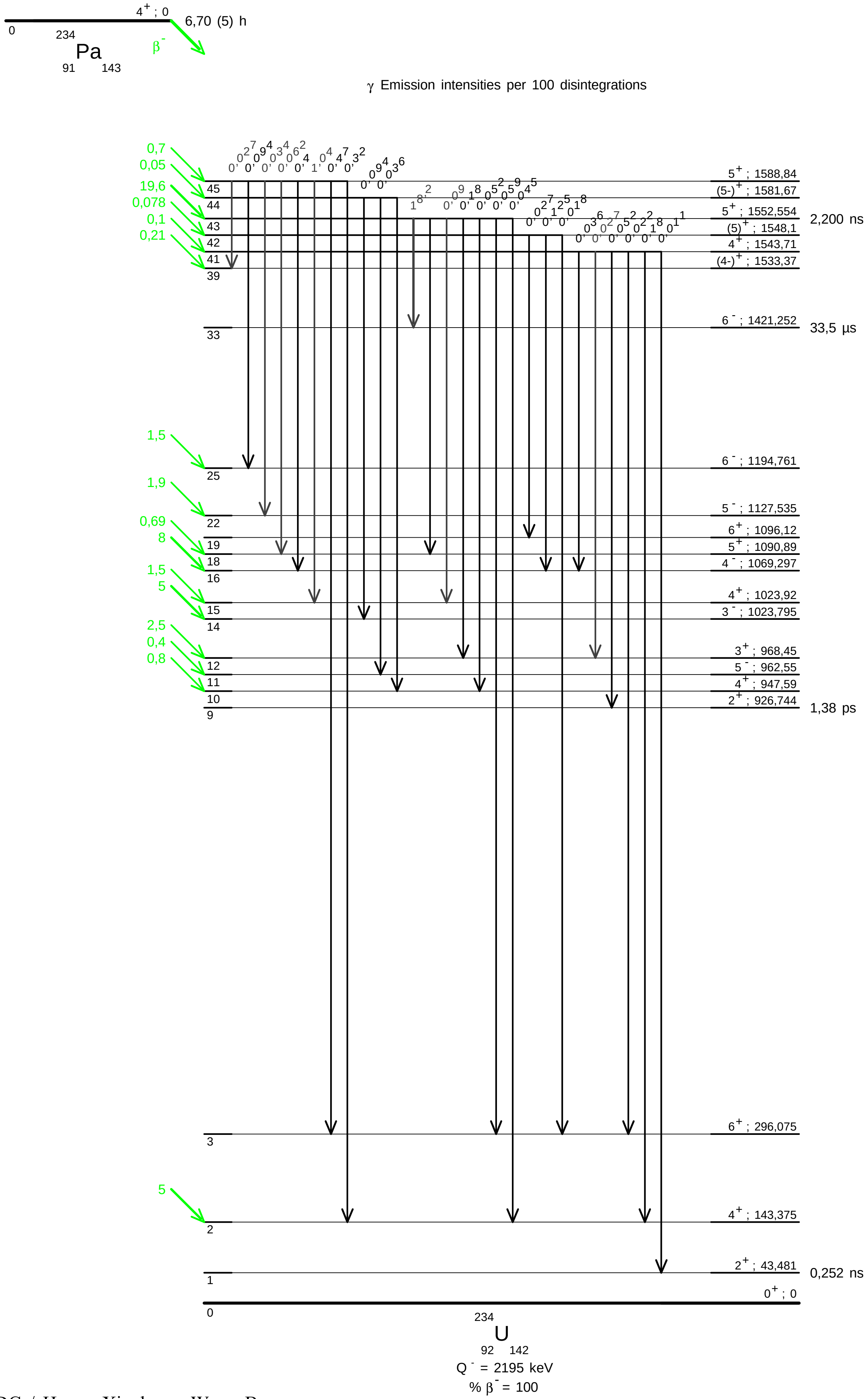

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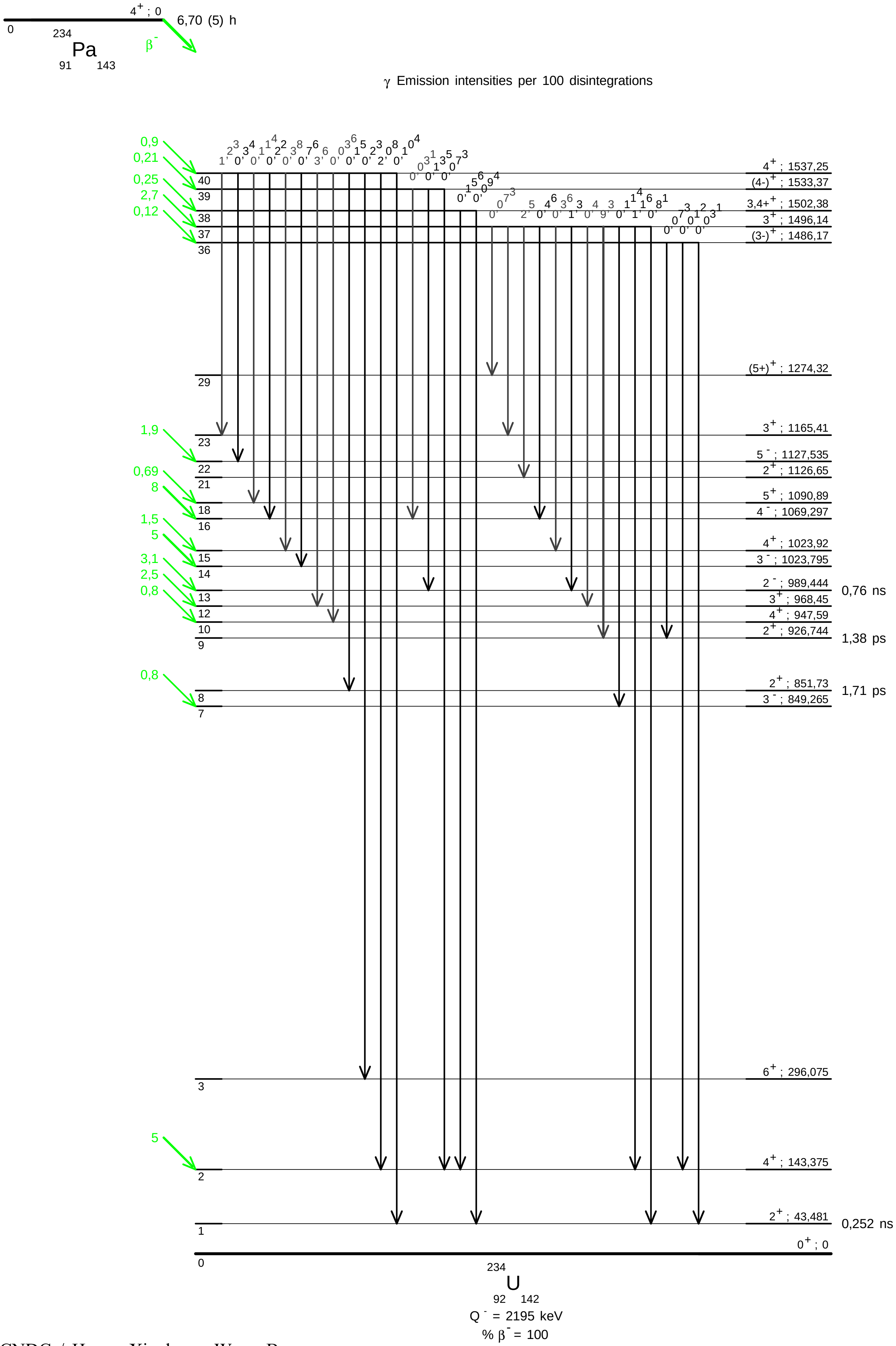

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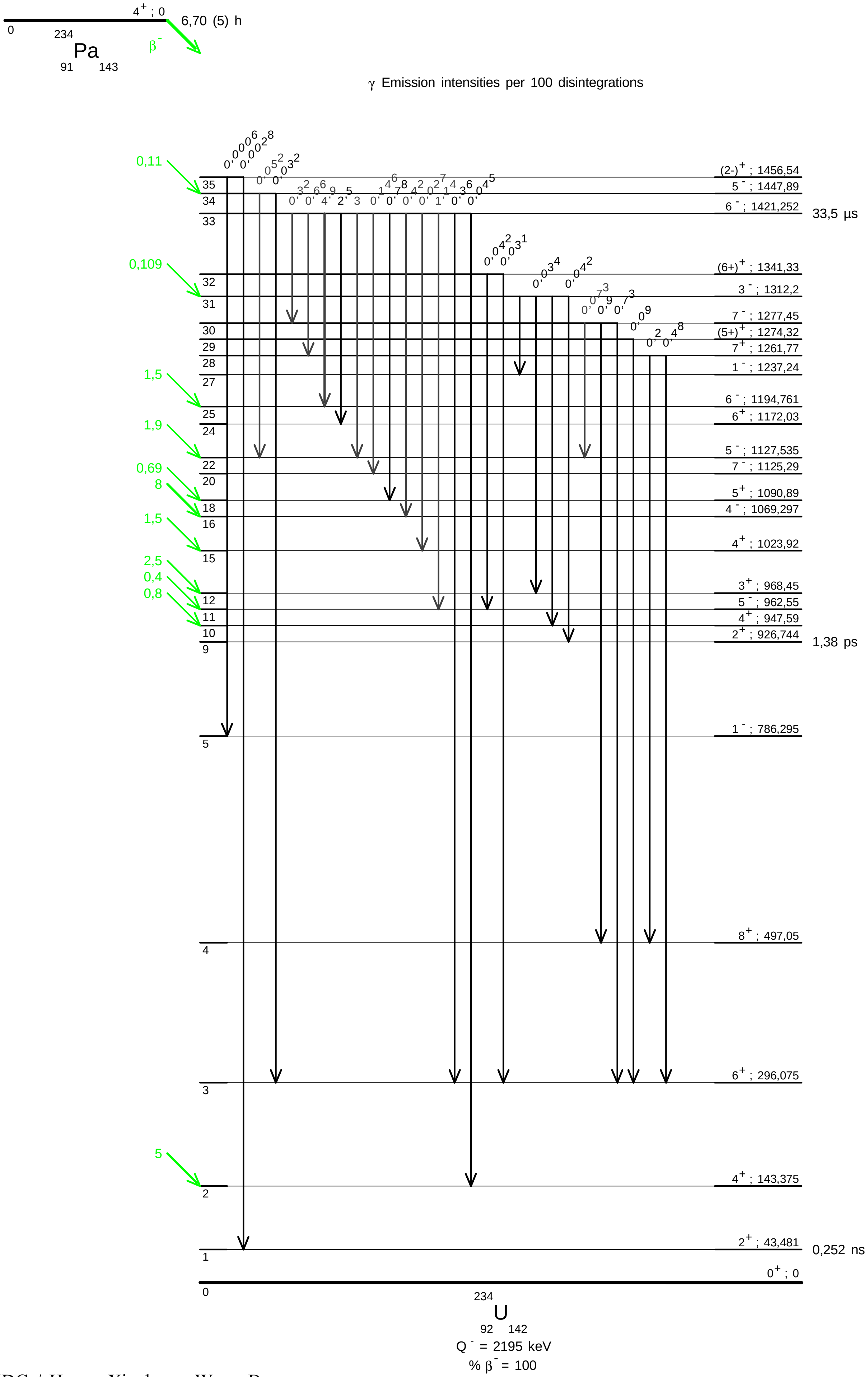

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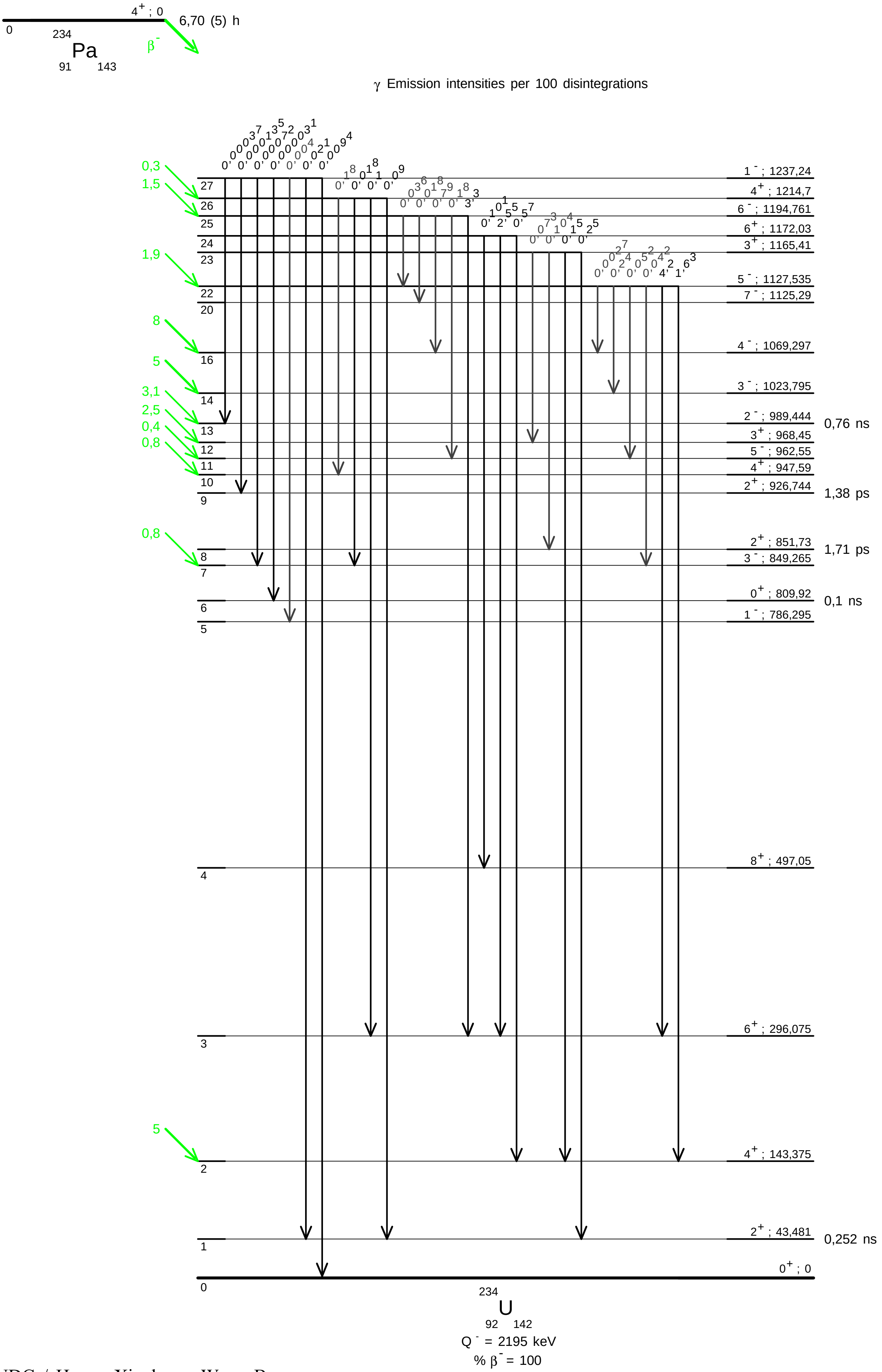

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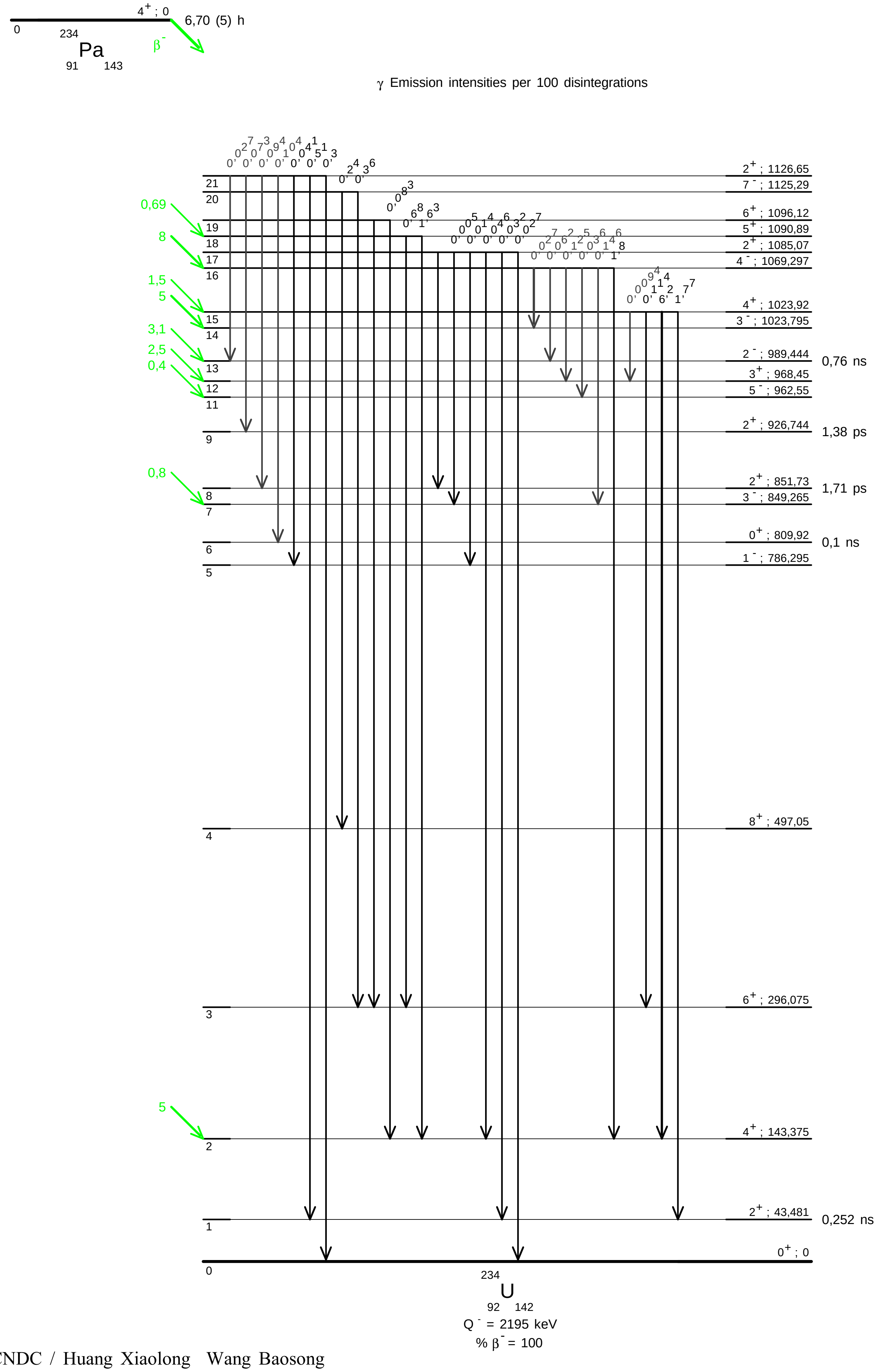

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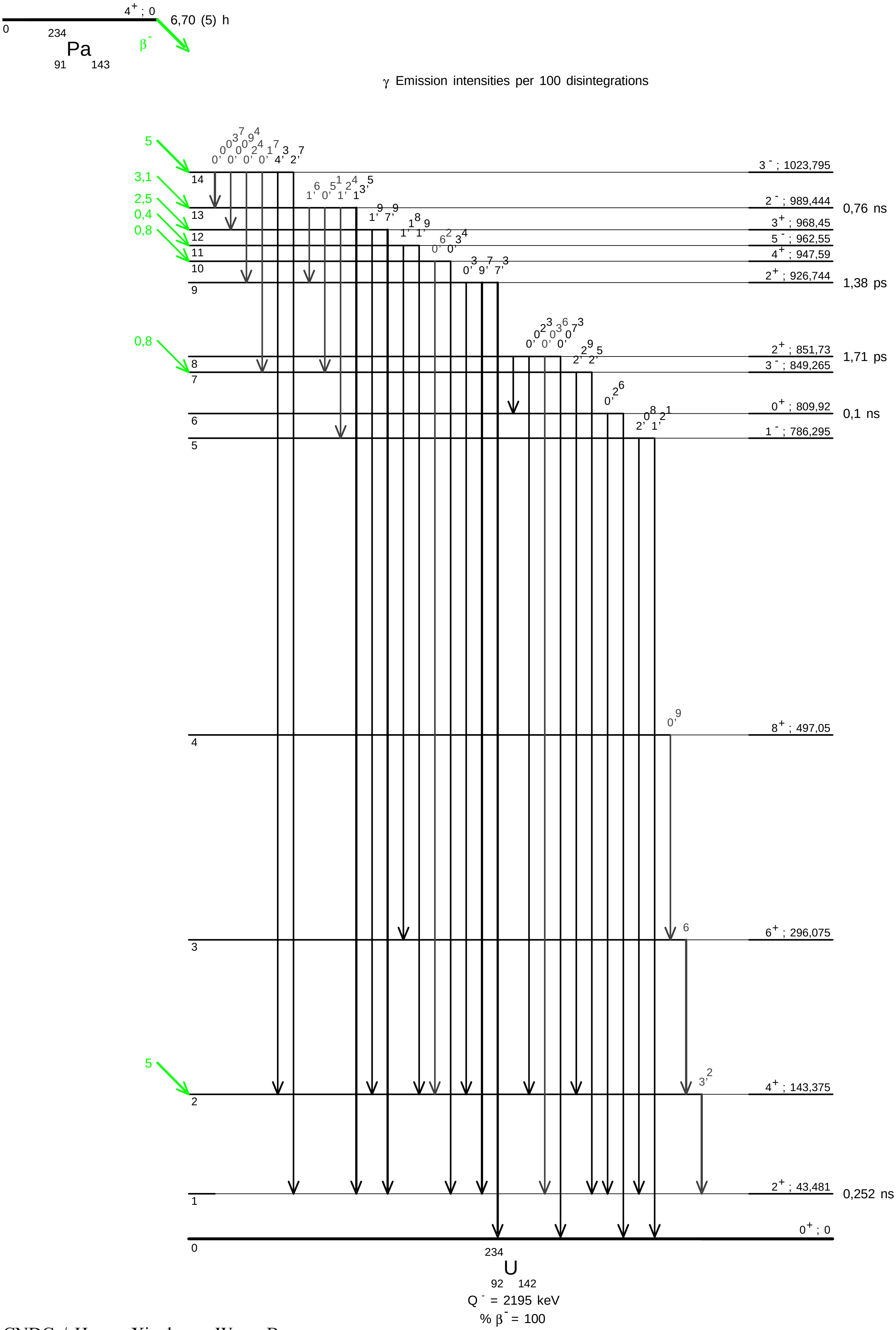

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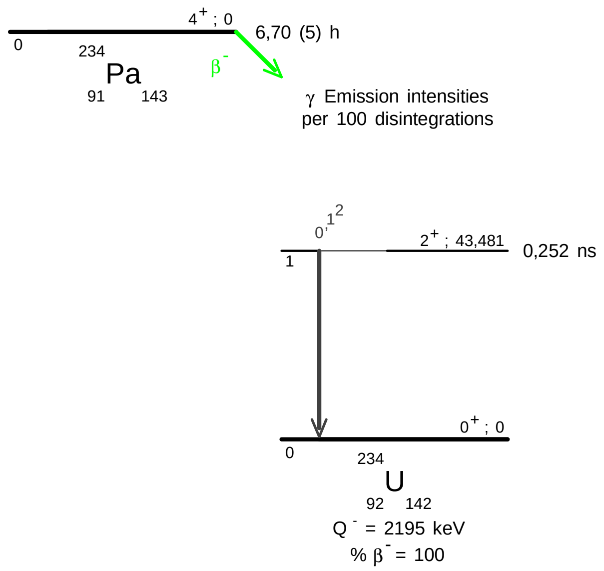

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$^{234m}_{91}$ Pa $_{143}$

1 Decay Scheme

Pa-234m disintegrates 99.85(1)% by beta minus emissions to levels in U-234 and 0.15(1)% through isomeric transition to the Pa-234 ground state.
Le protactinium metastable se désintègre par émissions bêta moins vers des niveaux excités de l'uranium 234 et par transition isomère vers le niveau fondamental du protactinium.

2 Nuclear Data

$T_{1/2}(^{234m}Pa)$	:	1,159	(11)	min
$T_{1/2}(^{234}Pa)$	:	6,70	(5)	h
$Q^-(^{234m}Pa)$	:	2269	(4)	keV + x keV (x < 10)
$Q^{IT}(^{234m}Pa)$	:	73,92	(2)	keV + x keV (x < 10)

2.1 β^- Transitions

	Energy keV	Probability × 100	Nature	lg ft
$\beta^-_{0,30}$	299 (4)	0,00389 (22)		6,8
$\beta^-_{0,29}$	332 (4)	0,0108 (3)		6,6
$\beta^-_{0,28}$	358 (4)	0,0452 (8)		6
$\beta^-_{0,27}$	394 (4)	0,0258 (3)		6,4
$\beta^-_{0,26}$	406 (4)	0,00311 (19)		7,4
$\beta^-_{0,25}$	460 (4)	0,0146 (7)		6,9
$\beta^-_{0,24}$	473 (4)	0,0021 (3)		7,7
$\beta^-_{0,23}$	488 (4)	0,0357 (18)		6,6
$\beta^-_{0,22}$	575 (4)	0,0024 (3)		8
$\beta^-_{0,21}$	602 (4)	0,0061 (3)		7,6
$\beta^-_{0,20}$	667 (4)	0,00127 (23)		8,5
$\beta^-_{0,19}$	677 (4)	0,0249 (5)		7,2
$\beta^-_{0,18}$	698 (4)	0,00231 (19)		8,4
$\beta^-_{0,17}$	715 (4)	0,0320 (6)		7,2

	Energy keV	Probability × 100	Nature	lg ft
$\beta^-_{0,16}$	768 (4)	0,0131 (6)		7,7
$\beta^-_{0,14}$	834 (4)	0,0092 (11)		7,9
$\beta^-_{0,13}$	1032 (4)	0,0121 (11)		8,2
$\beta^-_{0,12}$	1095 (4)	0,0046 (3)		8,7
$\beta^-_{0,9}$	1224 (4)	1,006 (13)		6,5
$\beta^-_{0,4}$	1459 (4)	0,945 (12)		6,8
$\beta^-_{0,3}$	1483 (4)	0,049 (3)		8
$\beta^-_{0,0}$	2269 (4)	97,599 (24)	Allowed	5,5

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{2,1}$(Pa)	< 10	0,15 (1)					
$\gamma_{6,4}$(U)	41,82	0,0136 (7)					
$\gamma_{1,0}$(U)	43,49 (2)	1,414 (26)	E2		520 (8)	143,7 (21)	713 (11)
$\gamma_{8,7}$(U)	62,70 (1)	0,0019 (6)	E1		0,320 (5)	0,0791 (11)	0,426 (6)
$\gamma_{1,0}$(Pa)	73,92 (2)	0,15 (1)	(M1+E2)		7,96 (25)	1,94 (7)	10,6 (4)
$\gamma_{2,1}$(U)	99,86 (2)	0,0082 (7)	E2		9,77 (14)	2,71 (4)	13,42 (19)
$\gamma_{18,14}$(U)	135,32 (8)	0,0000052 (6)	[E1]	0,190 (3)	0,0428 (6)	0,01043 (15)	0,247 (4)
$\gamma_{11,8}$(U)	137,23 (5)	0,000059 (21)	[E1]	0,184 (3)	0,0413 (6)	0,01006 (15)	0,239 (4)
$\gamma_{8,5}$(U)	140,1 (10)	<0,008	M1+E2	2,9 (22)	1,76 (25)	0,47 (9)	5,3 (18)
$\gamma_{20,14}$(U)	166,5 (1)	0,000000273 (6)	[E1]	0,1179 (17)	0,0253 (4)	0,00613 (9)	0,1514 (22)
$\gamma_{12,8}$(U)	185,0 (4)	0,00172 (15)					
$\gamma_{9,6}$(U)	193,4 (8)	0,00133 (28)	[E2]	0,163 (3)	0,500 (12)	0,138 (4)	0,847 (18)
$\gamma_{14,13}$(U)	197,91 (15)	0,000081 (39)	[M1,E2]	1,3 (12)	0,473 (22)	0,122 (4)	2,0 (12)
$\gamma_{11,7}$(U)	199,9 (10)	0,0017 (8)	(E0+E2+M1)	1,3 (12)	0,473 (22)	0,122 (4)	1,9 (12)
$\gamma_{8,3}$(U)	203,3 (8)	0,0029 (5)	M1+E2	0,8 (4)	0,420 (12)	0,1109 (23)	1,4 (4)
$\gamma_{23,18}$(U)	209,9 (4)	0,00132 (15)					
$\gamma_{10,6}$(U)	233,6 (2)	∼ 0,00085					
$\gamma_{10,5}$(U)	235,9 (3)	0,000096 (43)	[E1]	0,0532 (8)	0,01067 (16)	0,00258 (4)	0,0673 (10)
$\gamma_{9,4}$(U)	236 (1)	0,074 (8)	E0				
$\gamma_{13,8}$(U)	247,7 (8)	0,0019 (8)	[M1,E2]	0,7 (7)	0,22 (5)	0,056 (8)	1,0 (7)
$\gamma_{9,3}$(U)	258,227 (3)	0,0778 (8)	(E1)	0,0434 (6)	0,00859 (12)	0,00207 (3)	0,0548 (8)
$\gamma_{11,6}$(U)	275,5 (8)	0,00056 (22)	[M1,E2]	0,5 (5)	0,16 (4)	0,039 (8)	0,8 (6)
$\gamma_{10,3}$(U)	299 (1)	0,00067 (14)	[E1]	0,0315 (5)	0,00608 (10)	0,001467 (24)	0,0395 (7)
$\gamma_{13,7}$(U)	311 (1)	0,00054 (11)	[E1]	0,0289 (5)	0,00556 (9)	0,001339 (22)	0,0363 (6)
$\gamma_{11,4}$(U)	316,7 (1)	0,00022 (6)	[E2]	0,0677 (10)	0,0674 (10)	0,0182 (3)	0,1597 (23)
$\gamma_{24,15}$(U)	338,1 (8)	0,00113 (23)					
$\gamma_{11,3}$(U)	340,2 (1)	0,000074 (22)	[E1]	0,0239 (4)	0,00453 (7)	0,001090 (16)	0,0298 (5)
$\gamma_{28,17}$(U)	357,5 (10)	0,00080 (17)					
$\gamma_{24,14}$(U)	362,8 (10)	0,00069 (15)					
$\gamma_{13,5}$(U)	387,6 (8)	0,000512 (44)	[E2]	0,0463 (7)	0,0321 (5)	0,00858 (14)	0,0899 (14)
$\gamma_{12,3}$(U)	387,6 (8)	0,00097 (15)					
$\gamma_{13,4}$(U)	427,4 (2)	0,000020 (5)	[E1]	0,01488 (21)	0,00274 (4)	0,000657 (10)	0,0185 (3)
$\gamma_{14,8}$(U)	445,91 (10)	0,000037 (9)	[M1,E2]	0,15 (12)	0,036 (16)	0,009 (4)	0,20 (14)
$\gamma_{13,3}$(U)	450,98 (10)	0,00385 (16)	M1+E2	0,187 (3)	0,0400 (6)	0,00979 (14)	0,241 (4)
$\gamma_{28,15}$(U)	453,58 (10)	0,00282 (16)	[M1]	0,258 (4)	0,0495 (7)	0,01193 (17)	0,324 (5)
$\gamma_{22,13}$(U)	456,7 (10)	0,00095 (20)	[M1]	0,253 (4)	0,0485 (8)	0,01171 (18)	0,318 (5)

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{17,10}$(U)	468,43 (10)	0,00206 (12)					
$\gamma_{28,14}$(U)	475,74 (10)	0,00305 (17)	[M1]	0,227 (4)	0,0434 (6)	0,01048 (15)	0,285 (4)
$\gamma_{18,10}$(U)	485,44 (7)	0,0000217 (28)	[M1,E2]	0,12 (10)	0,028 (13)	0,007 (3)	0,16 (11)
$\gamma_{19,10}$(U)	507,6 (10)	0,00158 (15)					
$\gamma_{17,9}$(U)	509,3 (8)	0,0022 (3)					
$\gamma_{20,10}$(U)	516,74 (6)	0,000015 (2)	(M1)	0,182 (3)	0,0347 (5)	0,00837 (12)	0,228 (4)
$\gamma_{18,9}$(U)	526,16 (10)	0,0000110 (12)	[M1]	0,1732 (25)	0,0331 (5)	0,00797 (12)	0,217 (3)
$\gamma_{23,13}$(U)	544,14 (10)	0,00349 (15)					
$\gamma_{20,9}$(U)	557,41 (6)	0,0000098 (13)	(M1)	0,1485 (21)	0,0283 (4)	0,00682 (10)	0,186 (3)
$\gamma_{25,13}$(U)	572,2 (10)	0,00102 (20)	[M1]	0,1384 (21)	0,0264 (4)	0,00636 (10)	0,173 (3)
$\gamma_{18,8}$(U)	581,37 (10)	0,000081 (9)	[E1]	0,00815 (12)	0,001445 (21)	0,000345 (5)	0,01006 (14)
$\gamma_{14,4}$(U)	624,8 (10)	0,000117 (12)	[E1]	0,00712 (11)	0,001252 (18)	0,000299 (5)	0,00877 (13)
$\gamma_{14,3}$(U)	649,2 (10)	0,000064 (9)	[M1,E2]	0,06 (4)	0,012 (7)	0,0031 (15)	0,08 (5)
$\gamma_{16,6}$(U)	649,2 (10)	0,0010 (3)					
$\gamma_{23,11}$(U)	655,5 (10)	0,00139 (15)					
$\gamma_{15,3}$(U)	671 (1)	0,0004 (1)	[M1,E2]	0,05 (4)	0,011 (6)	0,0028 (14)	0,07 (5)
$\gamma_{28,13}$(U)	674,1 (10)	0,00071 (14)	[M1]	0,0894 (13)	0,01695 (25)	0,00408 (6)	0,1118 (17)
$\gamma_{25,11}$(U)	683,7 (10)	0,00058 (12)	[E1]	0,00603 (9)	0,001050 (15)	0,000250 (4)	0,00741 (11)
$\gamma_{16,4}$(U)	691,3 (3)	0,00898 (19)					
$\gamma_{23,10}$(U)	695,8 (10)	0,00164 (14)					
$\gamma_{29,13}$(U)	699,28 (10)	0,0058 (3)					
$\gamma_{17,6}$(U)	702,26 (10)	0,00721 (16)					
$\gamma_{5,2}$(U)	706,20 (12)	0,0052 (6)	[E1]	0,00568 (8)	0,000987 (14)	0,000235 (4)	0,00698 (10)
$\gamma_{6,2}$(U)	708,5 (10)	<0,00072	[E2]	0,01537 (22)	0,00489 (7)	0,001247 (19)	0,0219 (4)
$\gamma_{18,6}$(U)	719,29 (7)	0,0000271 (24)	[M1+E2]	0,05 (3)	0,009 (5)	0,0023 (12)	0,06 (4)
$\gamma_{30,13}$(U)	732,8 (10)	0,00130 (15)					
$\gamma_{19,6}$(U)	740,40 (8)	0,0118 (3)					
$\gamma_{3,1}$(U)	743,115 (5)	0,0946 (30)	E1	0,00518 (8)	0,000895 (13)	0,000213 (3)	0,00636 (9)
$\gamma_{20,6}$(U)	750,42 (6)	0,0000184 (22)	(M1)	0,0672 (10)	0,01272 (18)	0,00306 (5)	0,0841 (12)
$\gamma_{18,4}$(U)	760,84 (15)	0,0000046 (10)	[M1]	0,0648 (9)	0,01226 (18)	0,00295 (5)	0,0811 (12)
$\gamma_{4,1}$(U)	766,708 (20)	0,3290 (41)	(E2)	0,01336 (19)	0,00396 (6)	0,001004 (14)	0,0187 (3)
$\gamma_{19,4}$(U)	782,05 (10)	0,00782 (18)					
$\gamma_{7,2}$(U)	783,7 (1)	0,000040 (7)	[E2]	0,01285 (18)	0,00374 (6)	0,000946 (14)	0,0179 (3)
$\gamma_{3,0}$(U)	786,573 (22)	0,0539 (7)	E1+M2	0,00467 (7)	0,000804 (12)	0,000191 (3)	0,00573 (8)
$\gamma_{20,4}$(U)	792,25 (5)	0,0000106 (14)	[M1]	0,0582 (9)	0,01100 (16)	0,00265 (4)	0,0728 (11)
$\gamma_{5,1}$(U)	806,05 (10)	0,0062 (8)	[E1]	0,00447 (7)	0,000768 (11)	0,000183 (3)	0,00549 (8)
$\gamma_{6,1}$(U)	808,52 (10)	0,00281 (17)					
$\gamma_{4,0}$(U)	810,3 (7)	0,72	E0	0,00447 (7)	0,000768 (11)	0,000183 (3)	0,00549 (8)
$\gamma_{21,5}$(U)	818,6 (5)	0,0010 (3)					
$\gamma_{28,10}$(U)	825,9 (2)	0,0014 (4)					
$\gamma_{22,5}$(U)	844,5 (8)	0,00109 (23)					
$\gamma_{6,0}$(U)	852,0 (1)	0,00707 (15)	[E2]	0,01109 (16)	0,00302 (5)	0,000760 (11)	0,01514 (22)
$\gamma_{28,9}$(U)	867,2 (10)	0,00116 (16)					
$\gamma_{21,3}$(U)	880,93 (4)	0,00392 (5)					
$\gamma_{7,1}$(U)	883,65 (3)	0,00386 (5)	E2	0,01040 (15)	0,00276 (4)	0,000692 (10)	0,01409 (20)
$\gamma_{28,8}$(U)	922,13 (10)	0,01275 (20)					
$\gamma_{7,0}$(U)	927,05 (10)	0,00127 (13)	(E2)	0,00956 (14)	0,00245 (4)	0,000613 (9)	0,01284 (18)
$\gamma_{26,7}$(U)	936,75 (100)	0,00102 (17)					
$\gamma_{10,2}$(U)	942,39 (10)	0,00253 (9)	[E2]	0,00929 (13)	0,00236 (4)	0,000589 (9)	0,01244 (18)
$\gamma_{8,1}$(U)	946,362 (16)	0,01064 (14)	(E1)	0,00337 (5)	0,000571 (8)	0,0001355 (19)	0,00412 (6)
$\gamma_{25,5}$(U)	960,4 (10)	0,0009 (3)					
$\gamma_{23,3}$(U)	996,5 (20)	0,0059 (17)					
$\gamma_{9,1}$(U)	1001,441 (18)	0,856 (8)	E2	0,00835 (12)	0,00204 (3)	0,000507 (8)	0,01107 (16)
$\gamma_{10,1}$(U)	1042,1 (1)	0,00122 (8)	[E2,M1]	0,018 (11)	0,0036 (18)	0,0009 (4)	0,023 (13)
$\gamma_{28,6}$(U)	1059,9 (8)	0,00111 (22)					
$\gamma_{28,5}$(U)	1062,46 (10)	0,00224 (9)					
$\gamma_{11,1}$(U)	1082,5 (10)	0,00094 (20)	(M1)	0,0255 (4)	0,00478 (7)	0,001151 (17)	0,0318 (5)
$\gamma_{10,0}$(U)	1084,84 (10)	0,00081 (40)	[E2]	0,00726 (11)	0,001694 (24)	0,000419 (6)	0,00952 (14)
$\gamma_{30,5}$(U)	1121,2 (8)	0,00173 (15)					

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{28,3}$(U)	1125,54 (10)	0,00347 (9)					
$\gamma_{11,0}$(U)	1125,54 (10)	0,00039 (9)	[E2]	0,00681 (10)	0,001558 (22)	0,000385 (6)	0,00888 (13)
$\gamma_{12,0}$(U)	1174,8 (10)	0,00192 (19)					
$\gamma_{13,1}$(U)	1194,51 (3)	0,01363 (18)	E1	0,00226 (4)	0,000377 (6)	0,0000892 (13)	0,00277 (4)
$\gamma_{13,0}$(U)	1237,93 (10)	0,00529 (11)	E1	0,00213 (3)	0,000354 (5)	0,0000838 (12)	0,00262 (4)
$\gamma_{14,1}$(U)	1393,5 (9)	0,0029 (11)	E1	0,001743 (25)	0,000288 (4)	0,0000682 (10)	0,00221 (4)
$\gamma_{15,1}$(U)	1414,87 (10)	0,00229 (8)	[E1]	0,001700 (24)	0,000281 (4)	0,0000664 (10)	0,00217 (3)
$\gamma_{14,0}$(U)	1435,05 (10)	0,00975 (16)	E1	0,001660 (24)	0,000274 (4)	0,0000648 (9)	0,00213 (3)
$\gamma_{16,1}$(U)	1459,6 (15)	0,0019 (5)					
$\gamma_{16,0}$(U)	1501,8 (20)	0,0013					
$\gamma_{17,1}$(U)	1511,29 (10)	0,01308 (19)					
$\gamma_{18,1}$(U)	1528,42 (10)	0,00237 (8)	M1+E2	0,007 (4)	0,0014 (6)	0,00033 (14)	0,009 (4)
$\gamma_{19,1}$(U)	1551,4 (10)	0,00137 (15)					
$\gamma_{17,0}$(U)	1554,52 (10)	0,00826 (14)					
$\gamma_{20,1}$(U)	1559,7 (10)	0,00074 (9)	M1	0,00971 (14)	0,00181 (3)	0,000434 (7)	0,01228 (18)
$\gamma_{18,0}$(U)	1571,93 (10)	0,00111 (8)	M1	0,00951 (14)	0,001769 (25)	0,000425 (6)	0,01204 (17)
$\gamma_{19,0}$(U)	1594,8 (1)	0,00235 (12)					
$\gamma_{20,0}$(U)	1603,1 (15)	0,00048 (22)	(M1)	0,00902 (13)	0,001679 (24)	0,000403 (6)	0,01146 (17)
$\gamma_{21,0}$(U)	1668,9 (10)	0,00118 (6)					
$\gamma_{22,0}$(U)	1695,4 (10)	0,00038 (2)					
$\gamma_{23,1}$(U)	1739,36 (10)	0,0214 (3)					
$\gamma_{25,1}$(U)	1767,14 (10)	0,0084 (6)					
$\gamma_{24,0}$(U)	1798,0 (9)	0,00031 (5)					
$\gamma_{25,0}$(U)	1810,77 (10)	0,00376 (7)					
$\gamma_{26,1}$(U)	1821,58 (10)	0,00089 (5)					
$\gamma_{27,1}$(U)	1833,13 (10)	0,01759 (23)					
$\gamma_{26,0}$(U)	1864,81 (10)	0,00120 (5)					
$\gamma_{28,1}$(U)	1869,6 (1)	0,00932 (12)					
$\gamma_{27,0}$(U)	1876,8 (1)	0,00819 (14)					
$\gamma_{29,1}$(U)	1895,55 (11)	0,00218 (6)					
$\gamma_{28,0}$(U)	1913,20 (11)	0,00628 (9)					
$\gamma_{30,1}$(U)	1928,5 (10)	0,00045 (4)					
$\gamma_{29,0}$(U)	1939,01 (13)	0,00285 (5)					
$\gamma_{30,0}$(U)	1972,4 (8)	0,00041 (4)					

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				
	$L\ell$	11,6185		
	$L\alpha$	13,4382 – 13,6146		
	$L\eta$	15,399		
	$L\beta$	15,7268 – 18,2061		
	$L\gamma$	19,5072 – 20,7141		

3.1.2 Auger Electrons

	Energy keV	Relative probability
Auger K		
KLL	71,776 – 80,954	100
KLX	88,153 – 98,429	59,6
KXY	104,51 – 115,59	8,88
Auger L	5,9 – 21,6	

4 Electron Emissions

		Energy keV		Electrons per 100 disint.
e_{AL}	(U)	5,9 - 21,6		0,856 (19)
e_{AK}	(U)			0,0203 (3)
	KLL	71,776 - 80,954	}	
	KLX	88,153 - 98,429	}	
	KXY	104,51 - 115,59	}	
e_{AL}	(Pa)	5,9 - 20,9		0,048 (4)
e_{AK}	(Pa)			
$ec_{1,0\ L}$	(U)	21,73 - 26,32		1,030 (19)
$ec_{1,0\ M}$	(U)	37,94 - 39,94		0,285 (5)
$ec_{1,0\ N}$	(U)	42,05 - 43,11		0,0770 (14)
$ec_{1,0\ L}$	(Pa)	52,82 - 57,19		0,103 (8)
$ec_{1,0\ M}$	(Pa)	68,56 - 70,48		0,025 (2)
$ec_{4,0\ T}$	(U)	694,4 - 789,0		0,72
$\beta^-_{0,30}$	max:	299	(4)	0,00389 (22)
$\beta^-_{0,30}$	avg:	83,0	(13)	
$\beta^-_{0,29}$	max:	332	(4)	0,0108 (3)
$\beta^-_{0,29}$	avg:	93,0	(13)	
$\beta^-_{0,28}$	max:	358	(4)	0,0452 (8)
$\beta^-_{0,28}$	avg:	101,0	(13)	
$\beta^-_{0,27}$	max:	394	(4)	0,0258 (3)
$\beta^-_{0,27}$	avg:	112,3	(13)	
$\beta^-_{0,26}$	max:	406	(4)	0,00311 (19)
$\beta^-_{0,26}$	avg:	116,0	(13)	
$\beta^-_{0,25}$	max:	460	(4)	0,0146 (7)
$\beta^-_{0,25}$	avg:	133,3	(13)	
$\beta^-_{0,24}$	max:	473	(4)	0,0021 (3)
$\beta^-_{0,24}$	avg:	137,4	(14)	
$\beta^-_{0,23}$	max:	488	(4)	0,0357 (18)
$\beta^-_{0,23}$	avg:	142,3	(14)	
$\beta^-_{0,22}$	max:	575	(4)	0,0024 (3)
$\beta^-_{0,22}$	avg:	171,2	(14)	
$\beta^-_{0,21}$	max:	602	(4)	0,0061 (3)
$\beta^-_{0,21}$	avg:	180,1	(14)	
$\beta^-_{0,20}$	max:	667	(4)	0,00127 (23)
$\beta^-_{0,20}$	avg:	202,5	(14)	
$\beta^-_{0,19}$	max:	677	(4)	0,0249 (5)
$\beta^-_{0,19}$	avg:	205,8	(14)	
$\beta^-_{0,18}$	max:	698	(4)	0,00231 (19)

		Energy keV		Electrons per 100 disint.
$\beta^-_{0,18}$	avg:	213,3	(14)	
$\beta^-_{0,17}$	max:	715	(4)	0,0320 (6)
$\beta^-_{0,17}$	avg:	219,2	(14)	
$\beta^-_{0,16}$	max:	768	(4)	0,0131 (6)
$\beta^-_{0,16}$	avg:	237,6	(15)	
$\beta^-_{0,14}$	max:	834	(4)	0,0092 (11)
$\beta^-_{0,14}$	avg:	261,1	(15)	
$\beta^-_{0,13}$	max:	1032	(4)	0,0121 (11)
$\beta^-_{0,13}$	avg:	333,1	(15)	
$\beta^-_{0,12}$	max:	1095	(4)	0,0046 (3)
$\beta^-_{0,12}$	avg:	356,7	(15)	
$\beta^-_{0,9}$	max:	1224	(4)	1,006 (13)
$\beta^-_{0,9}$	avg:	405,6	(16)	
$\beta^-_{0,4}$	max:	1459	(4)	0,945 (12)
$\beta^-_{0,4}$	avg:	496,0	(16)	
$\beta^-_{0,3}$	max:	1483	(4)	0,049 (3)
$\beta^-_{0,3}$	avg:	505,3	(16)	
$\beta^-_{0,0}$	max:	2269	(4)	97,599 (24)
$\beta^-_{0,0}$	avg:	820,5	(17)	

5 Photon Emissions

5.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(U)	11,6185 — 20,7141		0,856 (19)	
XKα_2	(U)	94,666		0,1973 (25)	} Kα
XKα_1	(U)	98,44		0,316 (4)	}
XKβ_3	(U)	110,421	}		
XKβ_1	(U)	111,298	}	0,115 (2)	K$'\beta_1$
XKβ''_5	(U)	111,964	}		
XKβ_2	(U)	114,407	}		
XKβ_4	(U)	115,012	}	0,0382 (5)	K$'\beta_2$
XKO$_{2,3}$	(U)	115,377	}		
XL	(Pa)	11,3676 — 20,1126		0,046 (4)	

5.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{1,0}$(U)	43,49 (2)	0,00198 (2)
$\gamma_{8,7}$(U)	62,70 (1)	0,0013 (4)
$\gamma_{1,0}$(Pa)	73,92 (2)	0,0129 (9)
$\gamma_{2,1}$(U)	99,86 (2)	0,00057 (5)
$\gamma_{18,14}$(U)	135,32 (8)	0,0000042 (5)
$\gamma_{11,8}$(U)	137,23 (5)	0,000048 (17)
$\gamma_{8,5}$(U)	140,1 (10)	<0,00127
$\gamma_{20,14}$(U)	166,5 (1)	0,000000237 (5)
$\gamma_{12,8}$(U)	185,0 (4)	0,00172 (15)
$\gamma_{9,6}$(U)	193,4 (8)	0,00072 (15)
$\gamma_{14,13}$(U)	197,91 (15)	0,000027 (7)
$\gamma_{11,7}$(U)	199,9 (10)	0,00058 (12)
$\gamma_{8,3}$(U)	203,3 (8)	0,00119 (9)
$\gamma_{23,18}$(U)	209,9 (4)	0,00132 (15)
$\gamma_{10,5}$(U)	235,9 (3)	0,00009 (4)
$\gamma_{(-1,1)}$(U)	243,5 (8)	0,00050 (9)
$\gamma_{13,8}$(U)	247,7 (8)	0,00097 (22)
$\gamma_{9,3}$(U)	258,227 (3)	0,0738 (8)
$\gamma_{11,6}$(U)	275,5 (8)	0,00031 (6)
$\gamma_{10,3}$(U)	299 (1)	0,00064 (13)
$\gamma_{13,7}$(U)	311 (1)	0,00052 (11)
$\gamma_{11,4}$(U)	316,7 (1)	0,00019 (5)
$\gamma_{24,15}$(U)	338,1 (8)	0,00113 (23)
$\gamma_{11,3}$(U)	340,2 (1)	0,000072 (21)
$\gamma_{28,17}$(U)	357,5 (10)	0,00080 (17)
$\gamma_{24,14}$(U)	362,8 (10)	0,00069 (15)
$\gamma_{12,3}$(U)	387,6 (8)	0,00097 (15)
$\gamma_{13,5}$(U)	387,6 (8)	0,00047 (4)
$\gamma_{13,4}$(U)	427,4 (2)	0,000020 (5)
$\gamma_{14,8}$(U)	445,91 (10)	0,000031 (7)
$\gamma_{13,3}$(U)	450,98 (10)	0,00310 (13)
$\gamma_{28,15}$(U)	453,58 (10)	0,00213 (12)
$\gamma_{22,13}$(U)	456,7 (10)	0,00072 (15)
$\gamma_{17,10}$(U)	468,43 (10)	0,00206 (12)
$\gamma_{28,14}$(U)	475,74 (10)	0,00237 (13)
$\gamma_{18,10}$(U)	485,44 (7)	0,0000187 (17)
$\gamma_{19,10}$(U)	507,5 (10)	0,00158 (15)
$\gamma_{17,9}$(U)	509,2 (8)	0,0022 (3)
$\gamma_{20,10}$(U)	516,60 (6)	0,0000122 (16)
$\gamma_{18,9}$(U)	526,02 (10)	0,000009 (1)
$\gamma_{23,13}$(U)	543,98 (10)	0,00349 (15)
$\gamma_{20,9}$(U)	557,24 (6)	0,0000083 (11)
$\gamma_{(-1,2)}$(U)	557,3 (10)	0,00072 (17)
$\gamma_{25,13}$(U)	572 (1)	0,00087 (17)
$\gamma_{18,8}$(U)	581,19 (10)	0,000080 (9)

	Energy keV	Photons per 100 disint.
$\gamma_{14,4}$(U)	624,6 (10)	0,000116 (12)
$\gamma_{(-1,3)}$(U)	647,7 (8)	0,00158 (15)
$\gamma_{14,3}$(U)	649 (1)	0,000059 (8)
$\gamma_{16,6}$(U)	649 (1)	0,0010 (3)
$\gamma_{23,11}$(U)	655,3 (10)	0,00139 (15)
$\gamma_{15,3}$(U)	670,8 (10)	0,00037 (9)
$\gamma_{28,13}$(U)	673,9 (10)	0,00064 (13)
$\gamma_{25,11}$(U)	683,4 (10)	0,00058 (12)
$\gamma_{16,4}$(U)	691,0 (3)	0,00898 (19)
$\gamma_{23,10}$(U)	695,5 (10)	0,00164 (14)
$\gamma_{29,13}$(U)	699,02 (10)	0,0058 (3)
$\gamma_{17,6}$(U)	702,0 (1)	0,00721 (16)
$\gamma_{5,2}$(U)	705,94 (12)	0,0052 (6)
$\gamma_{6,2}$(U)	708,2 (10)	<0,0007
$\gamma_{18,6}$(U)	719,01 (7)	0,0000256 (20)
$\gamma_{30,13}$(U)	732,5 (10)	0,00130 (15)
$\gamma_{19,6}$(U)	740,10 (8)	0,0118 (3)
$\gamma_{3,1}$(U)	742,813 (5)	0,094 (3)
$\gamma_{20,6}$(U)	750,12 (6)	0,000017 (2)
$\gamma_{(-1,4)}$(U)	760,3 (10)	0,00158 (15)
$\gamma_{18,4}$(U)	760,53 (15)	0,0000043 (9)
$\gamma_{4,1}$(U)	766,361 (20)	0,323 (4)
$\gamma_{19,4}$(U)	781,75 (10)	0,00782 (18)
$\gamma_{7,2}$(U)	783,4 (1)	0,000039 (7)
$\gamma_{3,0}$(U)	786,272 (22)	0,0536 (7)
$\gamma_{20,4}$(U)	791,94 (5)	0,0000099 (13)
$\gamma_{5,1}$(U)	805,75 (10)	0,0062 (8)
$\gamma_{6,1}$(U)	808,2 (1)	0,00281 (17)
$\gamma_{21,5}$(U)	818,2 (5)	0,0010 (3)
$\gamma_{28,10}$(U)	825,5 (2)	0,0014 (4)
$\gamma_{22,5}$(U)	844,1 (8)	0,00109 (23)
$\gamma_{6,0}$(U)	851,6 (1)	0,00696 (15)
$\gamma_{28,9}$(U)	866,8 (10)	0,00116 (16)
$\gamma_{21,3}$(U)	880,52 (4)	0,00392 (5)
$\gamma_{7,1}$(U)	883,24 (3)	0,00381 (5)
$\gamma_{(-1,5)}$(U)	887,29 (100)	0,00708 (14)
$\gamma_{28,8}$(U)	921,72 (10)	0,01275 (20)
$\gamma_{7,0}$(U)	926,61 (10)	0,00125 (13)
$\gamma_{26,7}$(U)	936,3 (10)	0,00102 (17)
$\gamma_{10,2}$(U)	941,96 (10)	0,00250 (9)
$\gamma_{8,1}$(U)	945,961 (16)	0,01060 (14)
$\gamma_{25,5}$(U)	960 (1)	0,0009 (3)
$\gamma_{23,3}$(U)	996,1 (20)	0,0059 (17)
$\gamma_{9,1}$(U)	1001,026 (18)	0,847 (8)
$\gamma_{10,1}$(U)	1041,7 (1)	0,00119 (8)
$\gamma_{28,6}$(U)	1059,4 (8)	0,00111 (22)
$\gamma_{28,5}$(U)	1061,86 (10)	0,00224 (9)

	Energy keV	Photons per 100 disint.
$\gamma_{11,1}$(U)	1081,9 (10)	0,00091 (19)
$\gamma_{10,0}$(U)	1084,25 (10)	0,0008 (4)
$\gamma_{30,5}$(U)	1120,6 (8)	0,00173 (15)
$\gamma_{28,3}$(U)	1124,93 (10)	0,00347 (9)
$\gamma_{11,0}$(U)	1124,93 (10)	0,00039 (9)
$\gamma_{12,0}$(U)	1174,2 (10)	0,00192 (19)
$\gamma_{13,1}$(U)	1193,77 (3)	0,01359 (18)
$\gamma_{(-1,6)}$(U)	1220,37 (10)	0,00091 (9)
$\gamma_{13,0}$(U)	1237,28 (10)	0,00528 (11)
$\gamma_{(-1,7)}$(U)	1353,0 (15)	0,0015 (5)
$\gamma_{14,1}$(U)	1392,6 (9)	0,0029 (11)
$\gamma_{15,1}$(U)	1413,89 (10)	0,00229 (8)
$\gamma_{14,0}$(U)	1434,16 (10)	0,00973 (16)
$\gamma_{16,1}$(U)	1458,5 (15)	0,0019 (5)
$\gamma_{16,0}$(U)	1501 (2)	0,0013
$\gamma_{17,1}$(U)	1510,22 (10)	0,01308 (19)
$\gamma_{18,1}$(U)	1527,28 (10)	0,00235 (8)
$\gamma_{19,1}$(U)	1550,1 (10)	0,00137 (15)
$\gamma_{17,0}$(U)	1553,77 (10)	0,00826 (14)
$\gamma_{20,1}$(U)	1558,4 (10)	0,00073 (9)
$\gamma_{18,0}$(U)	1570,67 (10)	0,00110 (8)
$\gamma_{19,0}$(U)	1593,5 (6)	0,00235 (12)
$\gamma_{20,0}$(U)	1601,8 (15)	0,00047 (22)
$\gamma_{21,0}$(U)	1667,6 (10)	0,00118 (6)
$\gamma_{22,0}$(U)	1694,1 (10)	0,00038 (2)
$\gamma_{(-1,8)}$(U)	1720,5 (15)	0,00033 (15)
$\gamma_{(-1,9)}$(U)	1732,2 (15)	0,0019 (3)
$\gamma_{23,1}$(U)	1737,77 (10)	0,0214 (3)
$\gamma_{(-1,10)}$(U)	1759,81 (10)	0,00146 (5)
$\gamma_{25,1}$(U)	1765,44 (10)	0,0084 (6)
$\gamma_{24,0}$(U)	1796,3 (9)	0,00031 (5)
$\gamma_{25,0}$(U)	1809,05 (10)	0,00376 (7)
$\gamma_{26,1}$(U)	1819,69 (10)	0,00089 (5)
$\gamma_{27,1}$(U)	1831,37 (10)	0,01759 (23)
$\gamma_{26,0}$(U)	1863,09 (10)	0,00120 (5)
$\gamma_{28,1}$(U)	1867,7 (1)	0,00932 (12)
$\gamma_{27,0}$(U)	1874,9 (1)	0,00819 (14)
$\gamma_{29,1}$(U)	1893,51 (11)	0,00218 (6)
$\gamma_{28,0}$(U)	1911,20 (11)	0,00628 (9)
$\gamma_{30,1}$(U)	1926,5 (10)	0,00045 (4)
$\gamma_{29,0}$(U)	1937,01 (13)	0,00285 (5)
$\gamma_{30,0}$(U)	1970,3 (8)	0,00041 (4)
$\gamma_{(-1,11)}$(U)	2022,24 (12)	0,000186 (3)
$\gamma_{(-1,12)}$(U)	2041,23 (13)	0,00011 (1)
$\gamma_{(-1,13)}$(U)	2065,80 (13)	0,00007
$\gamma_{(-1,14)}$(U)	2093,19 (38)	0,00002
$\gamma_{(-1,15)}$(U)	2102,14 (15)	0,00006

	Energy keV	Photons per 100 disint.
$\gamma_{(-1,16)}$(U)	2136,69 (14)	0,00007

6 Main Production Modes

U – 238 natural decay chain member

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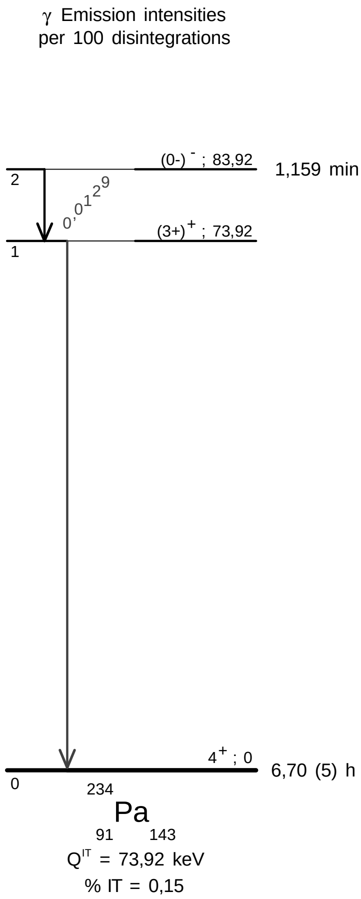

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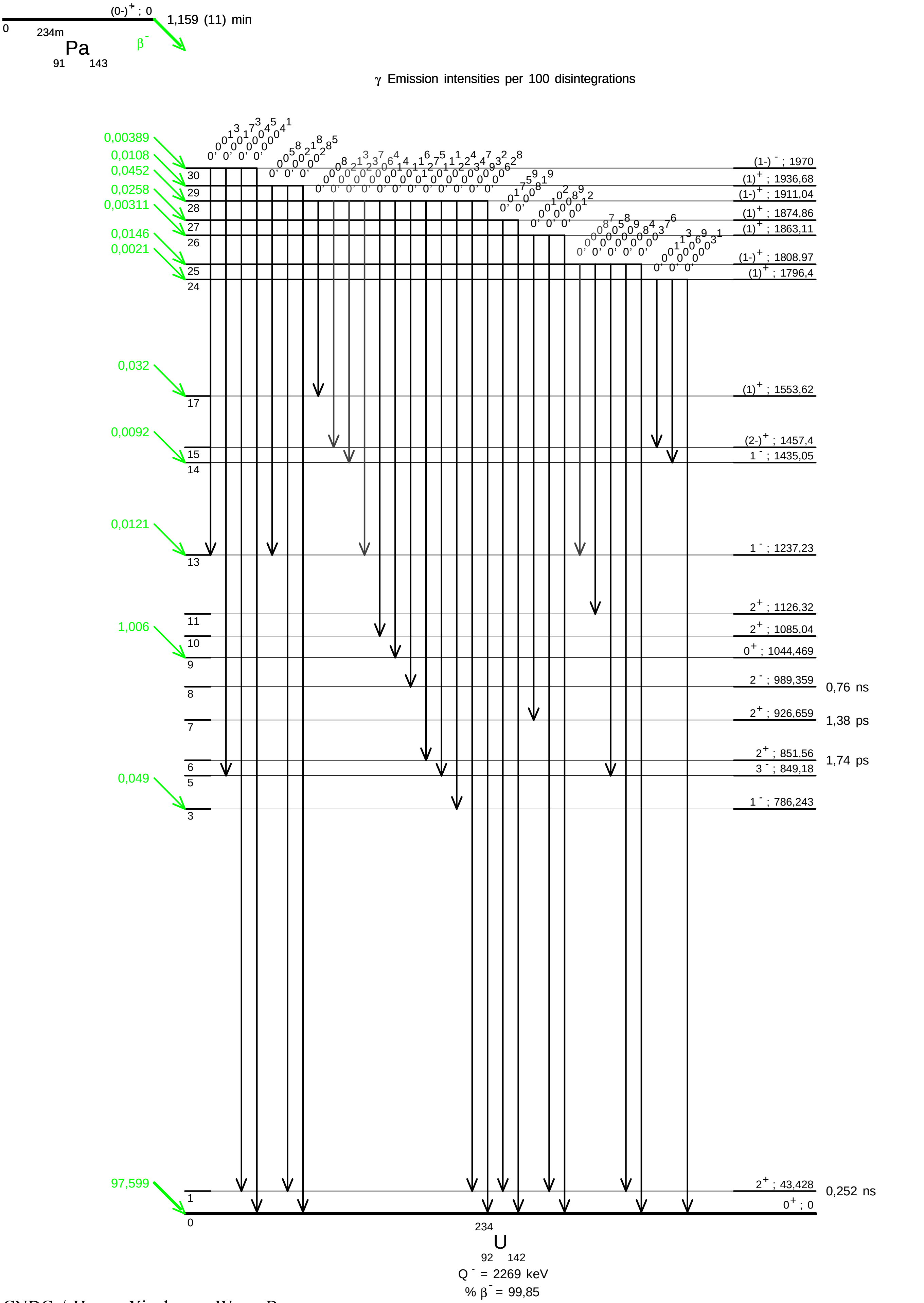

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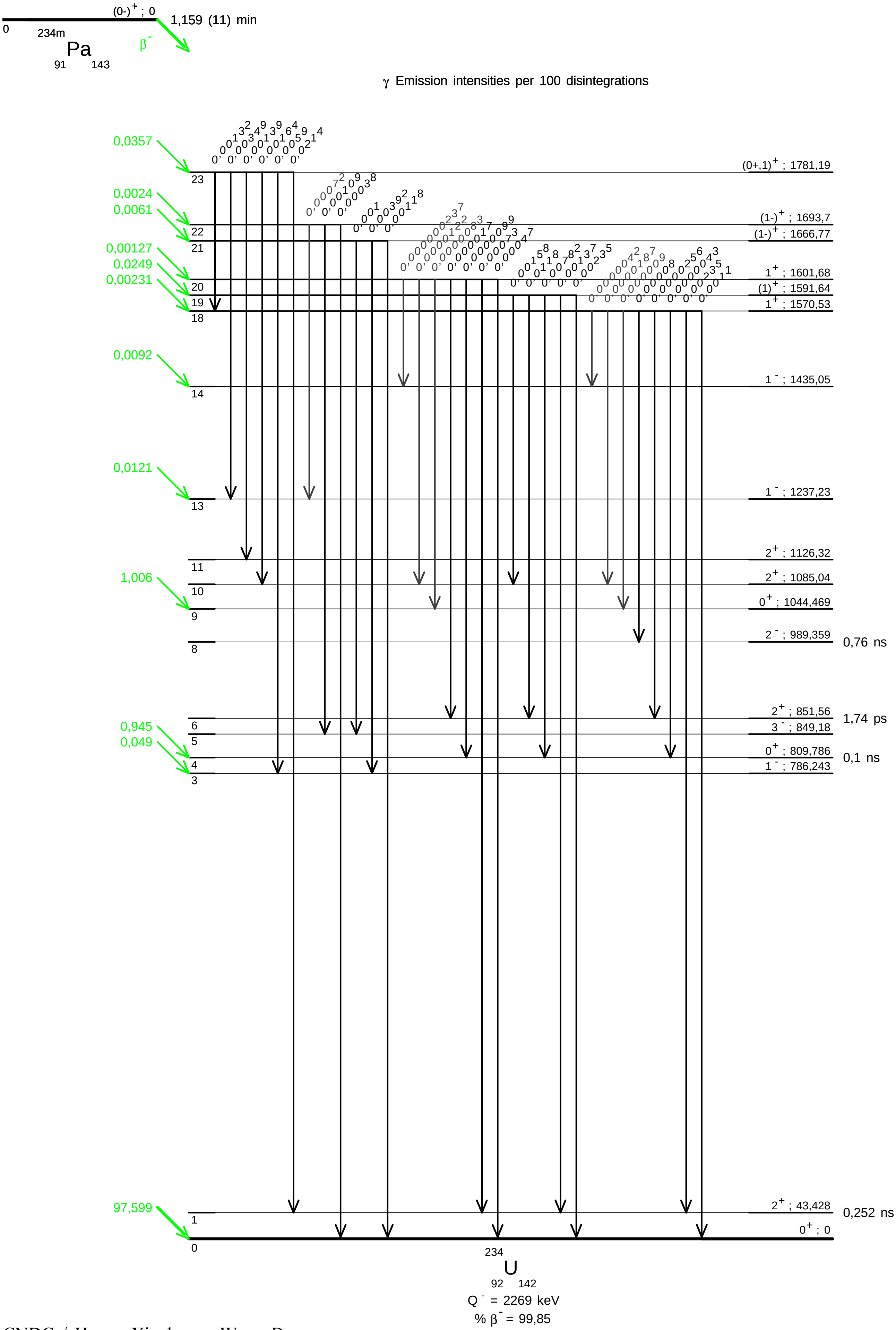

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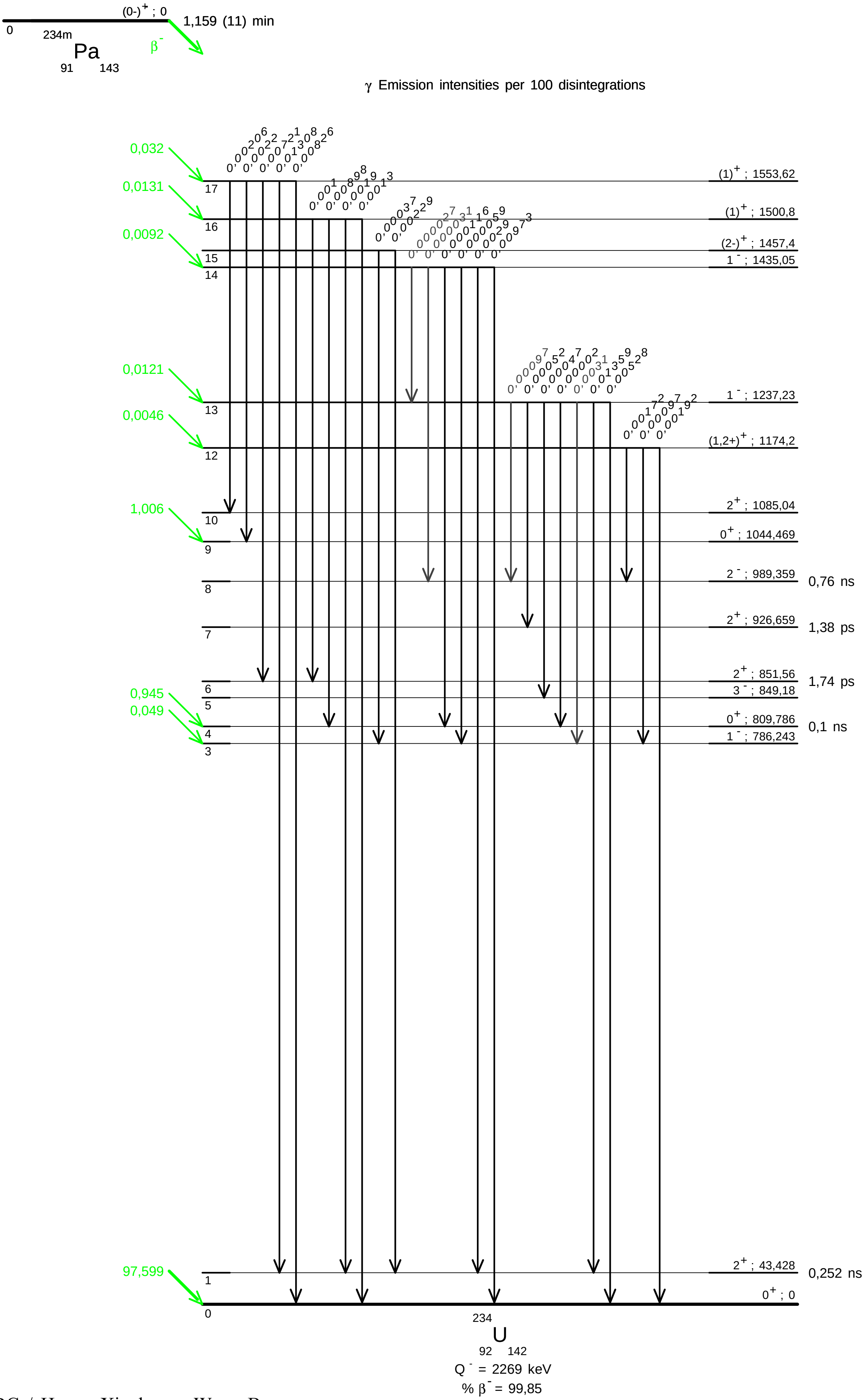

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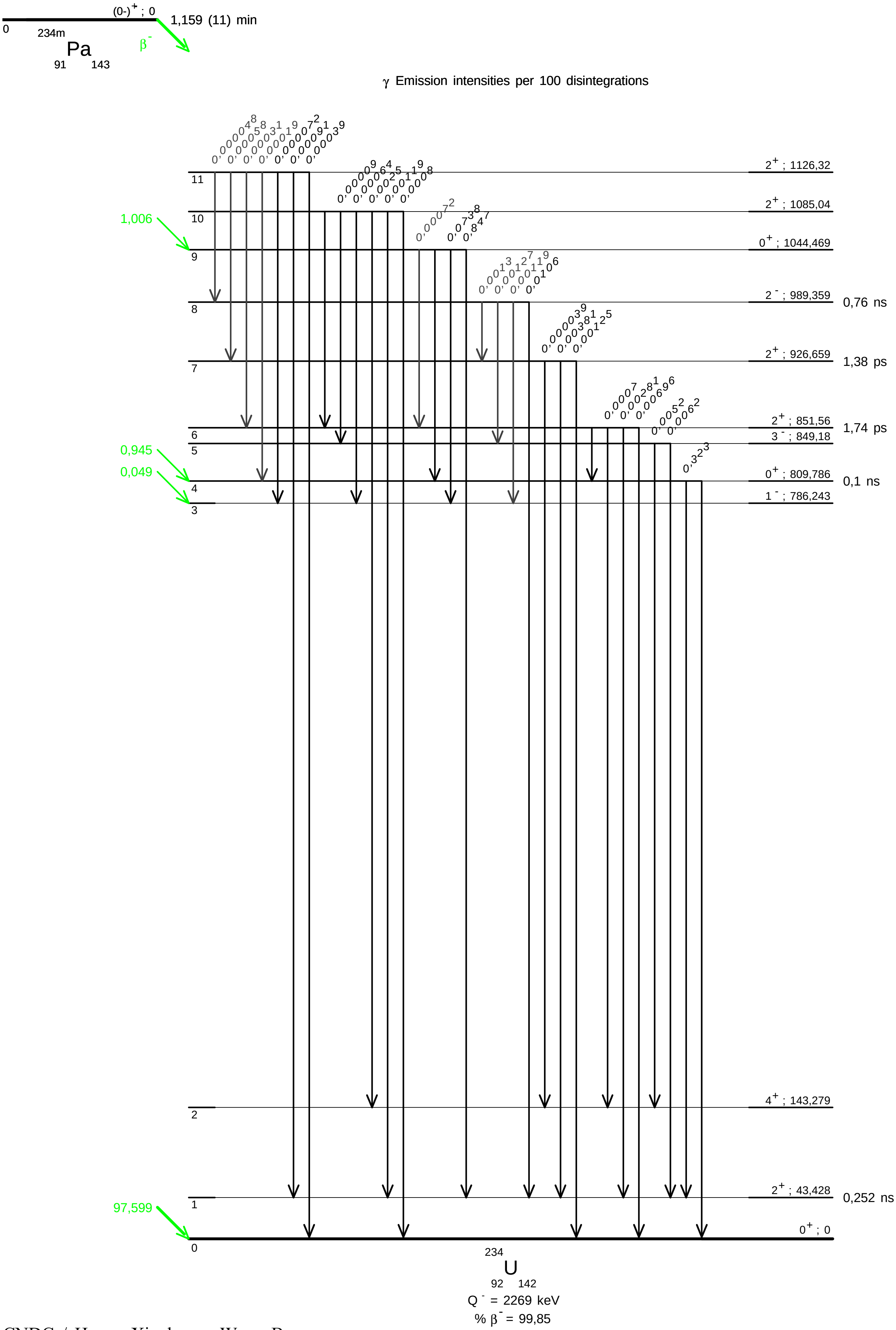

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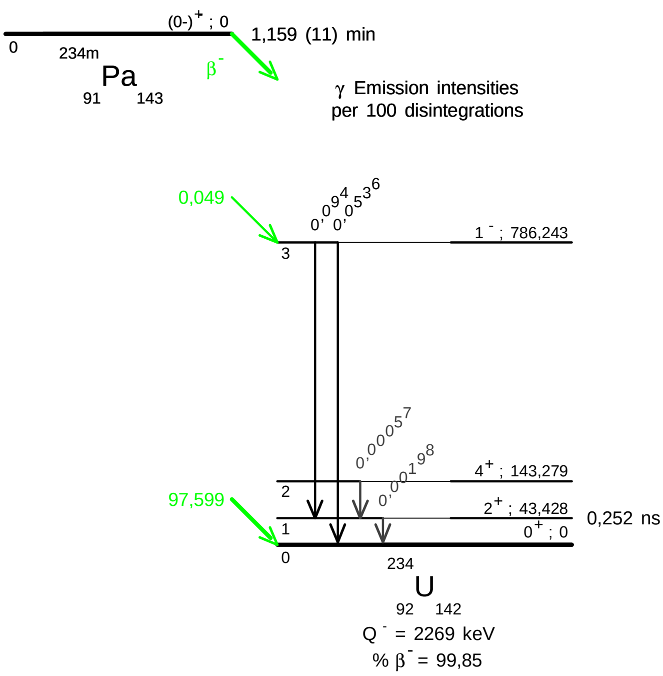

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236 Np
93 Np 143

1 Decay Scheme

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

2 Nuclear Data

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

2.1 β^- Transitions

	Energy keV	Probability × 100	Nature	lg ft
$\beta^-_{0,3}$	174 (50)	11,8 (12)	1st forbidden	14,5
$\beta^-_{0,2}$	333 (50)	< 1,6	1st forbidden unique	> 16

2.2 Electron Capture Transitions

	Energy keV	Probability × 100	Nature	lg ft	P_K	P_L	P_M
$\epsilon_{0,6}$	82 (50)	~ 0,096	allowed	14,6		0,6	0,4

	Energy keV	Probability × 100	Nature	lg ft	P_K	P_L	P_M
$\epsilon_{0,3}$	620 (50)	87,8 (43)	1st forbidden	14,1	0,726 (8)	0,201 (5)	0,073 (2)
$\epsilon_{0,2}$	781 (50)	< 4,4	1st forbidden unique	> 15,9	0,74	0,19	0,07

2.3 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{1,0}$(Pu)	44,63 (10)	11,9 (7)	E2		538 (11)	150 (3)	741 (15)
$\gamma_{1,0}$(U)	45,244 (2)	87,8 (6)	E2		429 (9)	118,6 (24)	589 (12)
$\gamma_{5,4}$(U)	56,6 (5)	~ 0,08	(E2)		145 (7)	40,1 (19)	199 (10)
$\gamma_{2,1}$(Pu)	102,82 (2)	12,0 (6)	E2		10,06 (20)	2,82 (6)	13,87 (28)
$\gamma_{6,5}$(U)	104,1 (10)	~ 0,096	E2		8,1 (4)	2,23 (11)	11,1 (6)
$\gamma_{2,1}$(U)	104,233 (5)	87,8 (6)	E2		8,00 (16)	2,22 (5)	10,99 (22)
$\gamma_{3,2}$(Pu)	158,35 (2)	11,8 (12)	E2	0,193 (4)	1,41 (3)	0,394 (8)	2,14 (4)
$\gamma_{3,2}$(U)	160,308 (3)	87,8 (43)	E2	0,208 (4)	1,13 (2)	0,313 (7)	1,76 (4)
$\gamma_{4,2}$(U)	538,1 (1)	~ 0,0008	E3	0,0622 (13)	0,0587 (12)	0,0160 (3)	0,143 (3)
$\gamma_{5,2}$(U)	594,5 (3)	~ 0,008					
$\gamma_{4,1}$(U)	642,34 (5)	~ 0,068	E1+(M2+E3)	0,112 (10)	0,031 (3)	0,0080 (8)	0,15 (2)
$\gamma_{4,0}$(U)	687,59 (4)	~ 0,021	E1+(M2+E3)	0,219 (12)	0,068 (6)	0,018 (2)	0,31 (2)

3 Atomic Data

3.1 U

ω_K	:	0,970	(4)
$\bar{\omega}_L$	:	0,500	(19)
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 – 98,43	59,6
KXY	104,51 – 115,59	8,88
Auger L	6,07 – 21,68	

3.2 Pu

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

3.2.1 X Radiations

		Energy keV		Relative probability
X_K				
	$K\alpha_2$	99,525		63,17
	$K\alpha_1$	103,734		100
	$K\beta_3$	116,244	}	
	$K\beta_1$	117,228	}	
	$K\beta_5''$	117,918	}	36,7
	$K\beta_2$	120,54	}	
	$K\beta_4$	120,969	}	12,74
	$KO_{2,3}$	121,543	}	
X_L				
	$L\ell$	12,1246		
	$L\alpha$	14,083 – 14,279		
	$L\eta$	16,334		
	$L\beta$	16,499 – 18,543		
	$L\gamma$	20,708 – 21,984		

3.2.2 Auger Electrons

	Energy keV	Relative probability
Auger K		
KLL	75,26 – 85,36	100
KLX	92,61 – 103,73	60,6
KXY	109,93 – 121,78	9,18
Auger L	6,19 – 23,10	

4 Electron Emissions

		Energy keV	Electrons per 100 disint.
e_{AL}	(U)	6,07 - 21,68	128,8 (19)
e_{AK}	(U)		2,1 (3)
	KLL	71,78 - 80,95	}
	KLX	88,15 - 98,43	}
	KXY	104,51 - 115,59	}
e_{AL}	(Pu)	6,19 - 23,10	10,7 (3)
e_{AK}	(Pu)		0,021 (4)
	KLL	75,26 - 85,36	}
	KLX	92,61 - 103,73	}
	KXY	109,93 - 121,78	}
$ec_{1,0\ L}$	(Pu)	21,53 - 26,57	8,7 (5)
$ec_{1,0\ L}$	(U)	23,486 - 28,076	63,9 (19)
$ec_{3,2\ K}$	(Pu)	36,56 (2)	0,73 (8)
$ec_{1,0\ M}$	(Pu)	38,70 - 40,86	2,42 (14)
$ec_{1,0\ M}$	(U)	39,696 - 41,690	17,7 (5)
$ec_{3,2\ K}$	(U)	44,706 (3)	6,6 (3)
$ec_{2,1\ L}$	(Pu)	79,72 - 84,76	8,1 (6)
$ec_{2,1\ L}$	(U)	82,475 - 87,065	58,6 (16)
$ec_{2,1\ M}$	(Pu)	96,89 - 99,04	2,28 (18)
$ec_{2,1\ M}$	(U)	98,685 - 100,680	16,25 (47)
$ec_{3,2\ L}$	(Pu)	135,25 - 140,29	5,4 (6)
$ec_{3,2\ L}$	(U)	138,55 - 143,14	36,0 (18)
$ec_{3,2\ M}$	(Pu)	152,42 - 154,57	1,50 (16)
$ec_{3,2\ M}$	(U)	154,76 - 156,76	10,0 (5)
$\beta^-_{0,3}$	max:	174 (50)	11,8 (12)
$\beta^-_{0,3}$	avg:	46 (15)	
$\beta^-_{0,2}$	max:	333 (50)	$< 1,6$
$\beta^-_{0,2}$	avg:	92 (16)	

5 Photon Emissions

5.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(U)	11,619 — 20,714		117,5 (30)	
$XK\alpha_2$	(U)	94,666		20,2 (3)	} $K\alpha$
$XK\alpha_1$	(U)	98,44		32,4 (5)	}
$XK\beta_3$	(U)	110,421	}		
$XK\beta_1$	(U)	111,298	}	11,69 (25)	$K'\beta_1$
$XK\beta_5''$	(U)	111,964	}		
$XK\beta_2$	(U)	114,407	}		
$XK\beta_4$	(U)	115,012	}	4,00 (11)	$K'\beta_2$
$XKO_{2,3}$	(U)	115,377	}		
XL	(Pu)	12,1246 — 21,984		12,1 (4)	
$XK\alpha_2$	(Pu)	99,525		0,212 (23)	} $K\alpha$
$XK\alpha_1$	(Pu)	103,734		0,33 (4)	}
$XK\beta_3$	(Pu)	116,244	}		
$XK\beta_1$	(Pu)	117,228	}	0,123 (14)	$K'\beta_1$
$XK\beta_5''$	(Pu)	117,918	}		
$XK\beta_2$	(Pu)	120,54	}		
$XK\beta_4$	(Pu)	120,969	}	0,043 (5)	$K'\beta_2$
$XKO_{2,3}$	(Pu)	121,543	}		

5.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{1,0}$(Pu)	44,63 (10)	0,0161 (9)
$\gamma_{1,0}$(U)	45,244 (2)	0,149 (3)
$\gamma_{5,4}$(U)	56,6 (5)	~ 0,0004
$\gamma_{2,1}$(Pu)	102,82 (2)	0,81 (6)
$\gamma_{6,5}$(U)	104,1 (10)	~ 0,008
$\gamma_{2,1}$(U)	104,234 (6)	7,32 (13)
$\gamma_{3,2}$(Pu)	158,35 (3)	3,8 (4)
$\gamma_{3,2}$(U)	160,307 (3)	31,8 (15)
$\gamma_{4,2}$(U)	538,1 (1)	~ 0,0007
$\gamma_{5,2}$(U)	594,5 (3)	~ 0,008
$\gamma_{4,1}$(U)	642,34 (5)	~ 0,059
$\gamma_{4,0}$(U)	687,60 (5)	~ 0,016

6 Main Production Modes

U − 235(d,n)Np − 236
U − 235(α,p2n)Np − 236

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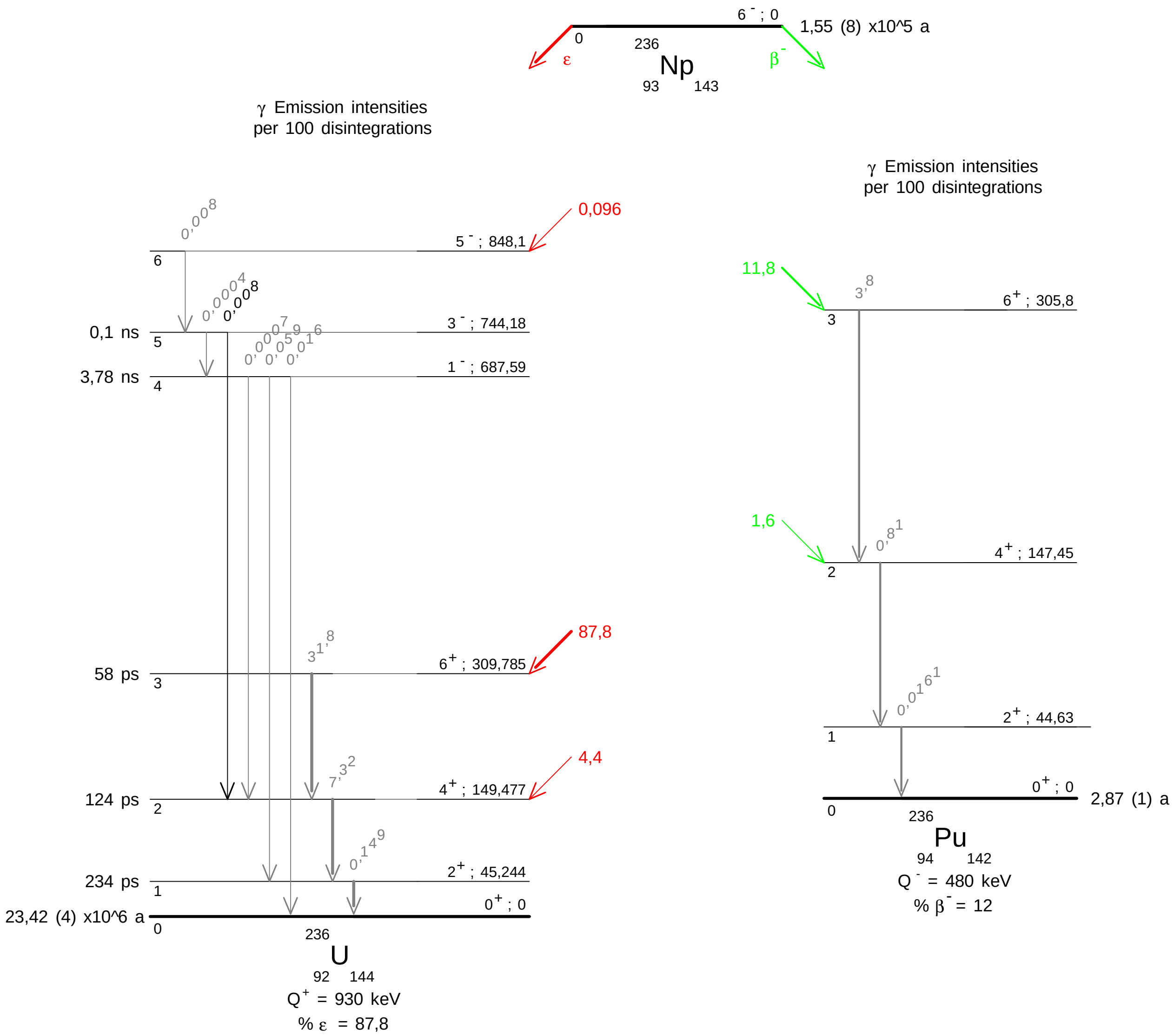

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237 Np
93 144

1 Decay Scheme

Np-237 disintegrates by alpha transitions to the ground state and excited states of Pa-233.
Le neptunium 237 se désintègre par émission alpha vers les niveaux excités et le niveau fondamental de protactinium 233.

2 Nuclear Data

$T_{1/2}(^{237}\mathrm{Np})$	:	2,144	(7)	10^6 a
$T_{1/2}(^{233}\mathrm{Pa})$	:	26,98	(2)	d
$Q^{\alpha}(^{237}\mathrm{Np})$	:	4958,3	(12)	keV

2.1 α Transitions

	Energy keV	Probability × 100	F
$\alpha_{0,20}$	4592,4 (12)	0,038 (4)	65
$\alpha_{-1,1}$	4629 (3)	0,011 (3)	84000
$\alpha_{0,18}$	4654,7 (12)	0,048 (23)	139
$\alpha_{0,17}$	4657,8 (12)	0,393 (23)	19,1
$\alpha_{0,16}$	4678,6 (12)	0,373 (9)	27
$\alpha_{0,15}$	4701,2 (13)	0,032 (8)	46000
$\alpha_{0,14}$	4720,4 (12)	6,43 (3)	3,14
$\alpha_{0,13}$	4745,9 (12)	3,46 (3)	8,9
$\alpha_{0,12}$	4756,7 (12)	0,38 (2)	
$\alpha_{0,11}$	4779,2 (13)	0,535 (10)	99
$\alpha_{0,10}$	4789,1 (12)}		> 56
$\alpha_{0,9}$	4795,0 (12)}	1,174 (13)	> 51
$\alpha_{0,8}$	4826,1 (16)	0,019	5932
$\alpha_{0,7}$	4849,3 (12)	9,5 (3)	17,9
$\alpha_{0,6}$	4854,7 (12)	23,0 (3)	7,8
$\alpha_{0,4}$	4871,8 (12)	47,64 (6)	5
$\alpha_{0,3}$	4887,8 (12)	2,02 (2)	152

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	Energy keV	Probability × 100	F
$\alpha_{0,2}$	4901,2 (12)	2,430 (17)	156
$\alpha_{0,1}$	4951,6 (12)	0,51 (3)	1570
$\alpha_{0,0}$	4958,3 (12)	2,41 (3)	387

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{7,6}$(Pa)	5,18						
$\gamma_{1,0}$(Pa)	6,65 (5)		(M1)			2280 (60)	3080 (90)
$\gamma_{5,4}$(Pa)	8,22 (5)	≈ 9					
$\gamma_{6,5}$(Pa)	9						
$\gamma_{13,12}$(Pa)	10,7						
$\gamma_{6,4}$(Pa)	17,40 (5)		M1+E2				
$\gamma_{(-1,1)}$(Pa)	21,5						
$\gamma_{7,4}$(Pa)	22,6						
$\gamma_{8,7}$(Pa)	24,14 (10)						
$\gamma_{(-1,2)}$(Pa)	27,7						
$\gamma_{4,2}$(Pa)	29,374 (20)	58,2 (26)	E1		2,29 (5)	0,585 (12)	3,07 (6)
$\gamma_{(-1,3)}$(Pa)	29,6						
$\gamma_{12,10}$(Pa)	32,46						
$\gamma_{14,12}$(Pa)	36,32 (2)	0,50 (14)	M1 + 1,20 % E2		74 (15)	18 (4)	99 (20)
$\gamma_{13,10}$(Pa)	43,2						
$\gamma_{6,2}$(Pa)	46,53 (6)	0,209 (8)	[E1]		0,687 (14)	0,171 (4)	0,914 (18)
$\gamma_{19,15}$(Pa)	48,96 (10)						
$\gamma_{9,7}$(Pa)	54,4 (1)						
$\gamma_{2,0}$(Pa)	57,104 (20)	67,4 (40)	E2		128 (3)	35,3 (7)	176 (4)
$\gamma_{17,14}$(Pa)	62,59 (10)	0,4 (3)	[M1 + 50 % E2]		50 (40)	13 (10)	60 (50)
$\gamma_{3,1}$(Pa)	63,9 (1)	1,10 (5)	(E2)		74,7 (15)	20,6 (4)	102,3 (20)
$\gamma_{3,0}$(Pa)	70,49 (10)	0,42 (28)	[M1 + 50 % E2]		28 (19)	7,5 (54)	38 (26)
$\gamma_{10,5}$(Pa)	74,54 (10)	0,13 (3)	[M1]		7,42 (15)	1,79 (4)	9,84 (20)
$\gamma_{4,0}$(Pa)	86,477 (10)	29,8 (10)	E1		1,13 (5)	0,22 (6)	1,43 (8)
$\gamma_{5,1}$(Pa)	87,99 (3)	0,167 (4)	[E1]		0,128 (3)	0,0312 (6)	0,169 (4)
$\gamma_{5,0}$(Pa)	94,64 (5)	0,75 (8)	E1		0,1054 (21)	0,0257 (5)	0,140 (3)
$\gamma_{9,2}$(Pa)	106,15 (25)	0,523 (31)	[E2]		6,78 (14)	1,87 (4)	9,28 (19)
$\gamma_{13,6}$(Pa)	108,7	0,32 (4)	M1 + 4,62 % E2		2,7 (5)	0,65 (13)	3,5 (6)
$\gamma_{11,3}$(Pa)	109,1 (1)						
$\gamma_{12,4}$(Pa)	115,40 (35)	0,0029 (14)	[M1+E2]	5 (6)	3,3 (13)	0,9 (4)	10 (4)
$\gamma_{13,5}$(Pa)	117,702 (20)	2,26 (12)	M1 + 8,26 % E2	9,3 (5)	2,16 (12)	0,53 (4)	12,2 (6)
$\gamma_{12,3}$(Pa)	131,101 (25)	0,106 (6)	E1	0,202 (4)	0,0451 (9)	0,01094 (22)	0,262 (5)
$\gamma_{14,6}$(Pa)	134,285 (20)	0,62 (9)	[M1+E2]	6,1 (10)	1,5 (3)	0,37 (8)	8,0 (11)
$\gamma_{18,9}$(Pa)	139,9 (1)	0,00560 (49)	[E1]	0,174 (3)	0,0381 (8)	0,00925 (19)	0,225 (5)
$\gamma_{13,3}$(Pa)	141,74 (10)						
$\gamma_{14,5}$(Pa)	143,249 (20)	3,3 (3)	M1 + 7,76 % E2	5,38 (12)	1,171 (24)	0,287 (6)	6,94 (14)
$\gamma_{14,4}$(Pa)	151,414 (20)	1,39 (14)	M1 + 32,89 % E2	3,4 (5)	1,09 (4)	0,277 (14)	4,9 (6)
$\gamma_{20,13}$(Pa)	153,37 (10)	0,021 (6)	[E2]	0,226 (5)	1,267 (3)	0,349 (7)	1,96 (4)
$\gamma_{15,6}$(Pa)	153,37						
$\gamma_{13,2}$(Pa)	155,239 (20)	0,103 (9)	E1	0,1368 (27)	0,0292 (6)	0,00708 (14)	0,176 (4)
$\gamma_{15,5}$(Pa)	162,41						
$\gamma_{10,1}$(Pa)	162,41 (8)	0,0382 (12)	[E1]	0,1232 (25)	0,0260 (5)	0,00630 (13)	0,158 (3)
$\gamma_{10,0}$(Pa)	169,156 (20)	0,0768 (4)	[E1]	0,1120 (22)	0,0235 (5)	0,00568 (11)	0,143 (3)
$\gamma_{15,4}$(Pa)	170,59						
$\gamma_{16,7}$(Pa)	170,59 (6)	0,100 (22)	[M1 + 13,79 % E2]	3,1 (5)	0,70 (7)	0,17 (1)	4,0 (5)
$\gamma_{16,6}$(Pa)	176,12 (6)	0,070 (16)	[M1 + 13,79 % E2]	2,8 (4)	0,63 (7)	0,16 (1)	3,7 (5)

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{14,2}$(Pa)	180,794 (19)	0,0180 (11)	[E1]	0,0960 (19)	0,0199 (4)	0,0048 (1)	0,1223 (25)
$\gamma_{15,3}$(Pa)	186,86						
$\gamma_{20,11}$(Pa)	186,86 (35)	0,003 (3)	[E1]	0,0889 (19)	0,0183 (4)	0,00442 (9)	0,1131 (23)
$\gamma_{17,7}$(Pa)	191,46 (5)	0,074 (9)	[M1 + 13,79 % E2]	2,2 (3)	0,49 (5)	0,12 (1)	2,9 (4)
$\gamma_{16,4}$(Pa)	193,26 (5)	0,167 (18)	[M1 + 13,79 % E2]	2,2 (3)	0,48 (5)	0,12 (1)	2,8 (4)
$\gamma_{18,7}$(Pa)	194,67 (20)						
$\gamma_{12,1}$(Pa)	194,95 (3)	0,192 (22)	E1	0,0806 (16)	0,0164 (4)	0,00397 (8)	0,1024 (21)
$\gamma_{17,6}$(Pa)	196,86 (5)	0,078 (6)	[M1 + 13,79 % E2]	2,1 (3)	0,45 (5)	0,11 (1)	2,7 (3)
$\gamma_{18,6}$(Pa)	199,95 (6)	0,020 (3)	[M1]	2,27 (5)	0,436 (9)	0,105 (2)	2,85 (6)
$\gamma_{15,2}$(Pa)	199,95						
$\gamma_{12,0}$(Pa)	201,62 (5)	0,0429 (10)	E1	0,0746 (15)	0,0151 (3)	0,00365 (7)	0,0946 (19)
$\gamma_{20,9}$(Pa)	202,9 (2)	0,0052 (21)	[E1]	0,0735 (50)	0,0149 (3)	0,00360 (7)	0,0932 (19)
$\gamma_{16,3}$(Pa)	209,19 (5)	0,0163 (16)	[E1]	0,0686 (14)	0,0138 (3)	0,00333 (7)	0,0868 (17)
$\gamma_{13,0}$(Pa)	212,29 (5)	0,184 (11)	E1	0,0663 (13)	0,0133 (3)	0,00321 (7)	0,0839 (17)
$\gamma_{17,4}$(Pa)	214,01 (5)	0,115 (13)	[M1 + 13,79 % E2]	1,64 (23)	0,35 (1)	0,09 (1)	2,1 (3)
$\gamma_{19,4}$(Pa)	219,8						
$\gamma_{16,2}$(Pa)	222,6 (2)						
$\gamma_{17,3}$(Pa)	229,94 (5)	0,015 (3)	[E1]	0,0552 (11)	0,0110 (2)	0,00264 (5)	0,0697 (14)
$\gamma_{14,0}$(Pa)	237,86 (2)	0,0610 (6)	[E1]	0,0511 (10)	0,01010 (15)	0,00243 (5)	0,0645 (13)
$\gamma_{19,2}$(Pa)	248,95 (10)	0,012 (3)	[M1 + 13,79 % E2]	1,08 (15)	0,22 (1)	0,055 (6)	1,37 (16)
$\gamma_{15,1}$(Pa)	250,58						
$\gamma_{15,0}$(Pa)	257,09						
$\gamma_{20,7}$(Pa)	257,09 (20)	0,048 (24)	[M1]	1,125 (23)	0,215 (4)	0,0518 (11)	1,41 (3)
$\gamma_{20,6}$(Pa)	262,44 (20)	0,01120 (49)	[M1]	1,063 (21)	0,203 (4)	0,0489 (10)	1,33 (3)
$\gamma_{20,4}$(Pa)	279,65 (20)	0,01320 (49)	[E2]	0,0847 (17)	0,100 (2)	0,0272 (6)	0,222 (5)
$\gamma_{(-1,4)}$(Pa)	288,3						

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	}	

		Energy keV	Relative probability
X_L			
	$L\ell$	11,368	
	$L\alpha$	13,122 – 13,289	
	$L\eta$	14,949	
	$L\beta$	15,358 – 17,666	
	$L\gamma$	18,94 – 20,113	

3.1.2 Auger Electrons

	Energy keV	Relative probability
Auger K		
KLL	70,08 – 78,82	100
KLX	85,99 – 95,86	59,2
KXY	101,87 – 112,59	8,76
Auger L	5,90 – 21,01	

4 α Emissions

	Energy keV	Probability × 100
$\alpha_{0,20}$	4515,1 (19)	0,038 (4)
$\alpha_{-1,1}$	4550,5 (22)	0,011 (3)
$\alpha_{0,18}$	4573 (3)	0,048 (23)
$\alpha_{0,17}$	4578,6 (14)	0,393 (23)
$\alpha_{0,16}$	4599,1 (18)	0,373 (9)
$\alpha_{0,15}$	4619,7 (21)	0,032 (8)
$\alpha_{0,14}$	4640 (1)	6,43 (3)
$\alpha_{0,13}$	4665,0 (9)	3,46 (3)
$\alpha_{0,12}$	4676,4	0,38 (2)
$\alpha_{0,11}$	4698,2 (8)	0,535 (10)
$\alpha_{0,10}$	4708,3 (20)}	
$\alpha_{0,9}$	4712,3 (20)}	1,174 (13)
$\alpha_{0,8}$	4741,3 (20)	0,019
$\alpha_{0,7}$	4766,5 (8)	9,5 (3)
$\alpha_{0,6}$	4771,4 (8)	23,0 (3)
$\alpha_{0,4}$	4788,0 (9)	47,64 (6)
$\alpha_{0,3}$	4803,5 (10)	2,02 (2)
$\alpha_{0,2}$	4816,8 (10)	2,430 (17)
$\alpha_{0,1}$	4866,4 (14)	0,51 (3)
$\alpha_{0,0}$	4872,7 (14)	2,41 (3)

5 Electron Emissions

		Energy keV	Electrons per 100 disint.
e_{AL}	(Pa)	5,90 - 21,01	47,1 (20)
e_{AK}	(Pa)		0,167 (24)
	KLL	70,08 - 78,82	}
	KLX	85,99 - 95,86	}
	KXY	101,87 - 112,59	}
$ec_{13,5\ K}$	(Pa)	5,11 (2)	1,59 (9)
$ec_{4,2\ L}$	(Pa)	8,269 - 12,641	32,7 (15)
$ec_{14,12\ L}$	(Pa)	15,22 - 19,59	0,37 (11)
$ec_{4,2\ M}$	(Pa)	24,013 - 25,932	8,4 (4)
$ec_{6,2\ L}$	(Pa)	25,42 - 29,80	0,075 (3)
$ec_{14,5\ K}$	(Pa)	30,65 (2)	2,26 (22)
$ec_{14,12\ M}$	(Pa)	30,96 - 32,88	0,090 (27)
$ec_{2,0\ L}$	(Pa)	35,999 - 40,371	48,9 (29)
$ec_{14,4\ K}$	(Pa)	38,82 (2)	0,80 (12)
$ec_{17,14\ L}$	(Pa)	41,48 - 45,86	0,3 (2)
$ec_{3,1\ L}$	(Pa)	42,8 - 47,2	0,80 (4)
$ec_{3,0\ L}$	(Pa)	49,38 - 53,76	0,3 (2)
$ec_{2,0\ M}$	(Pa)	51,743 - 53,662	13,4 (8)
$ec_{17,14\ M}$	(Pa)	57,23 - 59,15	0,08 (6)
$ec_{3,1\ M}$	(Pa)	58,5 - 60,5	0,220 (9)
$ec_{3,0\ M}$	(Pa)	65,13 - 67,05	0,08 (6)
$ec_{4,0\ L}$	(Pa)	65,372 - 69,744	13,9 (6)
$ec_{5,0\ L}$	(Pa)	73,54 - 77,91	0,070 (7)
$ec_{4,0\ M}$	(Pa)	81,116 - 83,035	2,7 (7)
$ec_{13,5\ L}$	(Pa)	96,597 - 100,969	0,369 (22)
$ec_{13,5\ M}$	(Pa)	112,341 - 114,260	0,091 (7)
$ec_{14,5\ L}$	(Pa)	122,144 - 126,516	0,49 (5)
$ec_{14,4\ L}$	(Pa)	130,309 - 134,681	0,257 (10)
$ec_{14,5\ M}$	(Pa)	137,888 - 139,807	0,121 (12)
$ec_{14,4\ M}$	(Pa)	146,053 - 147,972	0,0654 (34)

6 Photon Emissions

6.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(Pa)	11,368 — 20,113		59,7 (32)	
XKα_2	(Pa)	92,288		1,813 (20)	} Kα
XKα_1	(Pa)	95,869		2,906 (20)	}
XKβ_3	(Pa)	107,595	}		
XKβ_1	(Pa)	108,422	}	1,06 (10)	K$'\beta_1$
XKβ_5''	(Pa)	109,072	}		
XKβ_2	(Pa)	111,405	}		
XKβ_4	(Pa)	111,87	}	0,380 (9)	K$'\beta_2$
XKO$_{2,3}$	(Pa)	112,38	}		

6.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{7,6}$(Pa)	5,18	0,220 (5)
$\gamma_{5,4}$(Pa)	8,22 (5)	0,12 (5)
$\gamma_{(-1,1)}$(Pa)	21,5	0,352 (13)
$\gamma_{(-1,2)}$(Pa)	27,7	0,84 (7)
$\gamma_{4,2}$(Pa)	29,374 (20)	14,3 (6)
$\gamma_{14,12}$(Pa)	36,32 (2)	0,005 (1)
$\gamma_{6,2}$(Pa)	46,53 (6)	0,109 (4)
$\gamma_{2,0}$(Pa)	57,104 (20)	0,381 (21)
$\gamma_{17,14}$(Pa)	62,59 (10)	0,006 (2)
$\gamma_{3,1}$(Pa)	63,9 (1)	0,0107 (4)
$\gamma_{3,0}$(Pa)	70,49 (10)	0,0107 (4)
$\gamma_{10,5}$(Pa)	74,54 (10)	0,012 (3)
$\gamma_{4,0}$(Pa)	86,477 (10)	12,26 (12)
$\gamma_{5,1}$(Pa)	87,99 (3)	0,143 (3)
$\gamma_{5,0}$(Pa)	94,64 (5)	0,66 (7)
$\gamma_{9,2}$(Pa)	106,15 (25)	0,0509 (29)
$\gamma_{13,6}$(Pa)	108,7	0,071 (3)
$\gamma_{12,4}$(Pa)	115,40 (35)	0,0026 (8)
$\gamma_{13,5}$(Pa)	117,702 (20)	0,171 (4)
$\gamma_{12,3}$(Pa)	131,101 (25)	0,084 (5)
$\gamma_{14,6}$(Pa)	134,285 (20)	0,069 (5)
$\gamma_{18,9}$(Pa)	139,9 (1)	0,0046 (4)
$\gamma_{14,5}$(Pa)	143,249 (20)	0,42 (4)
$\gamma_{14,4}$(Pa)	151,414 (20)	0,234 (2)

	Energy keV	Photons per 100 disint.
$\gamma_{20,13}$(Pa)	153,37 (10)	0,007 (2)
$\gamma_{13,2}$(Pa)	155,239 (20)	0,088 (8)
$\gamma_{10,1}$(Pa)	162,41 (8)	0,033 (1)
$\gamma_{10,0}$(Pa)	169,156 (20)	0,0672 (3)
$\gamma_{16,7}$(Pa)	170,59 (6)	0,020 (4)
$\gamma_{16,6}$(Pa)	176,12 (6)	0,015 (3)
$\gamma_{14,2}$(Pa)	180,81 (10)	0,016 (1)
$\gamma_{20,11}$(Pa)	186,86 (35)	0,003 (3)
$\gamma_{17,7}$(Pa)	191,46 (5)	0,019 (1)
$\gamma_{16,4}$(Pa)	193,26 (5)	0,044 (1)
$\gamma_{18,7}$(Pa)	194,67 (20)	0,033 (1)
$\gamma_{12,1}$(Pa)	194,95 (3)	0,174 (20)
$\gamma_{17,6}$(Pa)	196,86 (5)	0,0210 (1)
$\gamma_{18,6}$(Pa)	199,95 (6)	0,0053 (8)
$\gamma_{12,0}$(Pa)	201,62 (5)	0,0392 (9)
$\gamma_{20,9}$(Pa)	202,9 (2)	0,0048 (19)
$\gamma_{16,3}$(Pa)	209,19 (5)	0,0150 (15)
$\gamma_{13,0}$(Pa)	212,29 (5)	0,17 (1)
$\gamma_{17,4}$(Pa)	214,01 (5)	0,037 (2)
$\gamma_{16,2}$(Pa)	222,6 (2)	0,002 (2)
$\gamma_{17,3}$(Pa)	229,94 (5)	0,014 (3)
$\gamma_{14,0}$(Pa)	237,86 (2)	0,0573 (6)
$\gamma_{19,2}$(Pa)	248,95 (10)	0,005 (1)
$\gamma_{20,7}$(Pa)	257,09 (20)	0,02 (1)
$\gamma_{20,6}$(Pa)	262,44 (20)	0,0048 (2)
$\gamma_{20,4}$(Pa)	279,65 (20)	0,0108 (4)
$\gamma_{(-1,4)}$(Pa)	288,3	0,0162 (5)

7 Main Production Modes

$U - 237(\beta^-)Np - 237$

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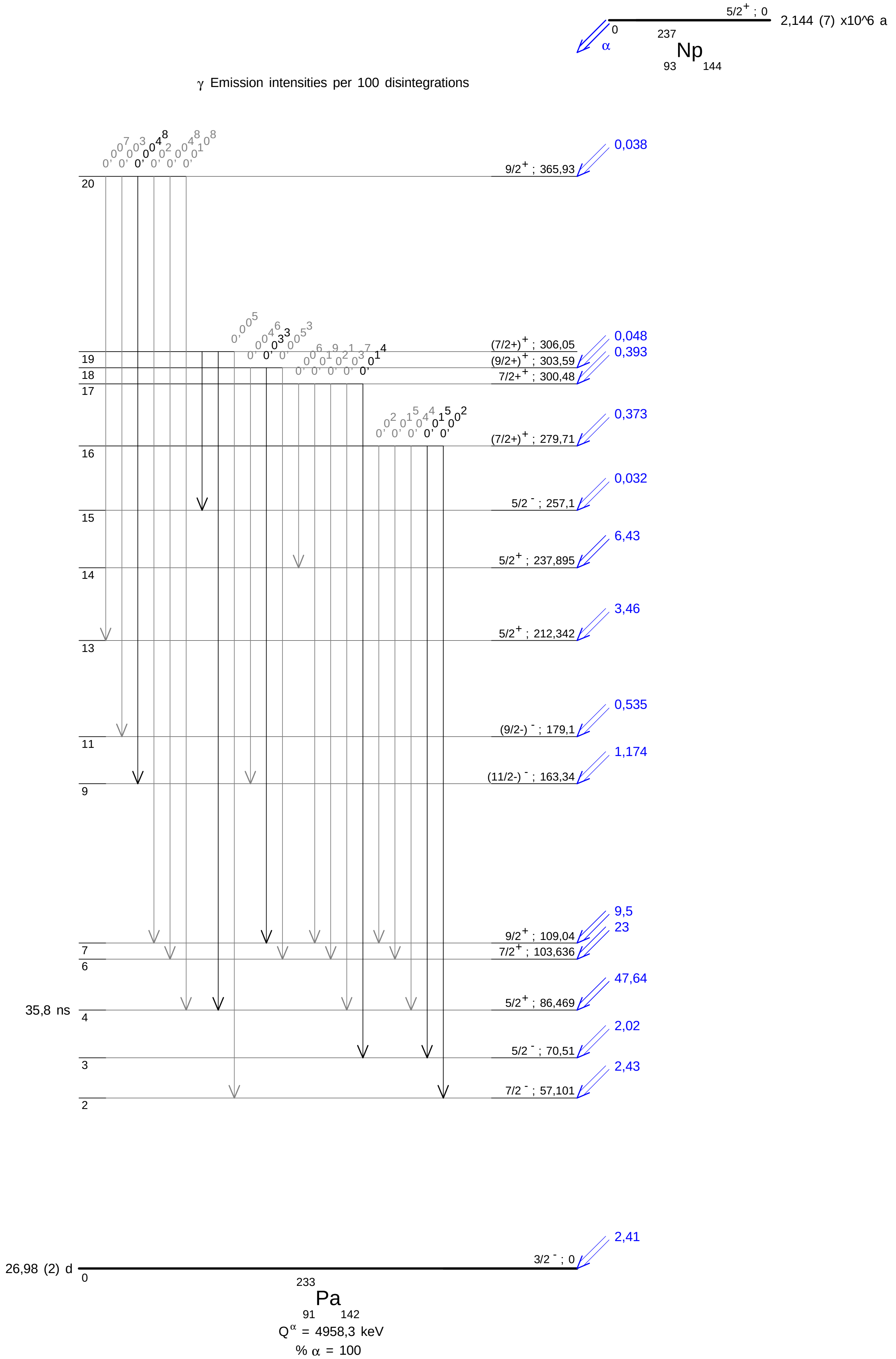

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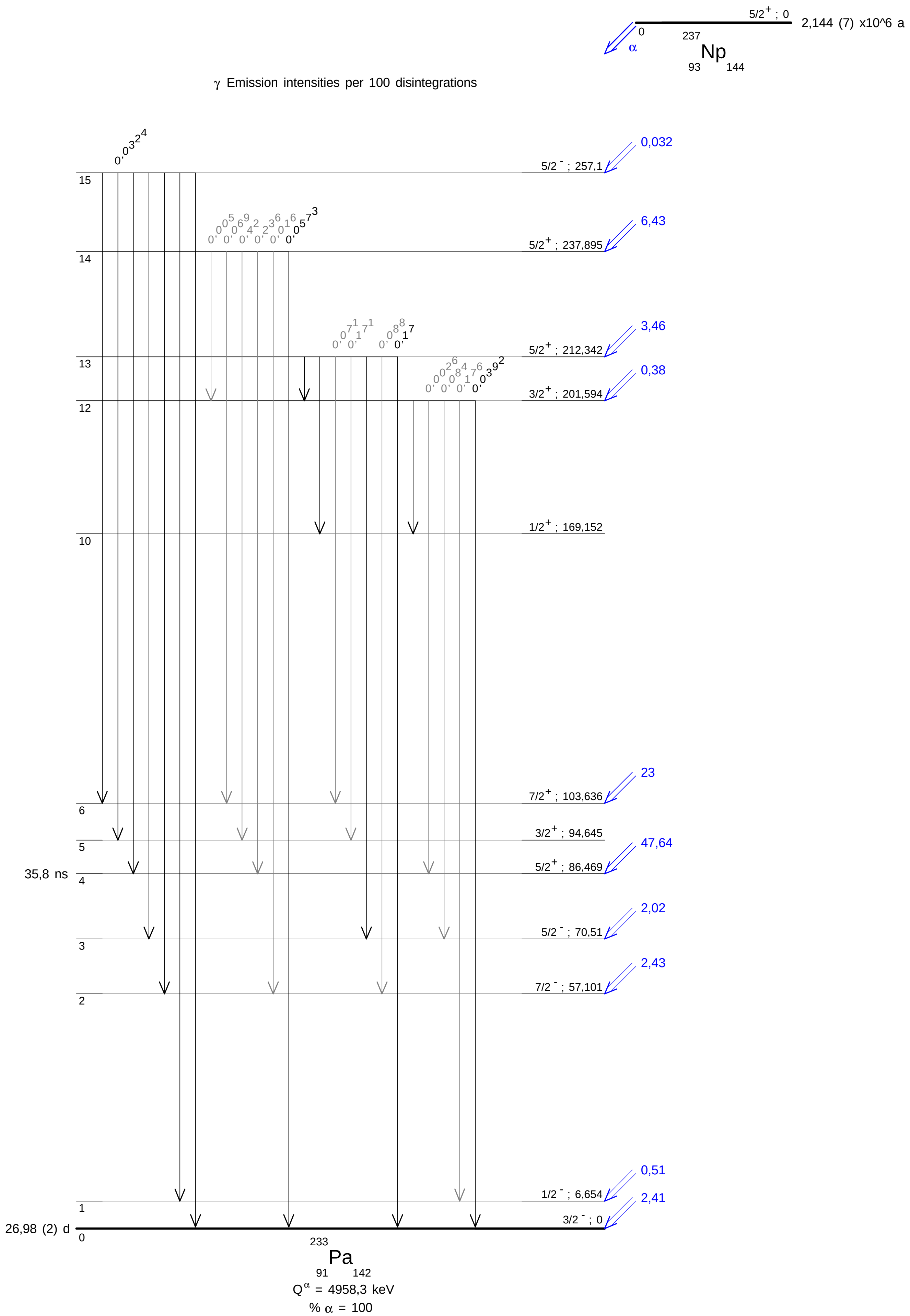

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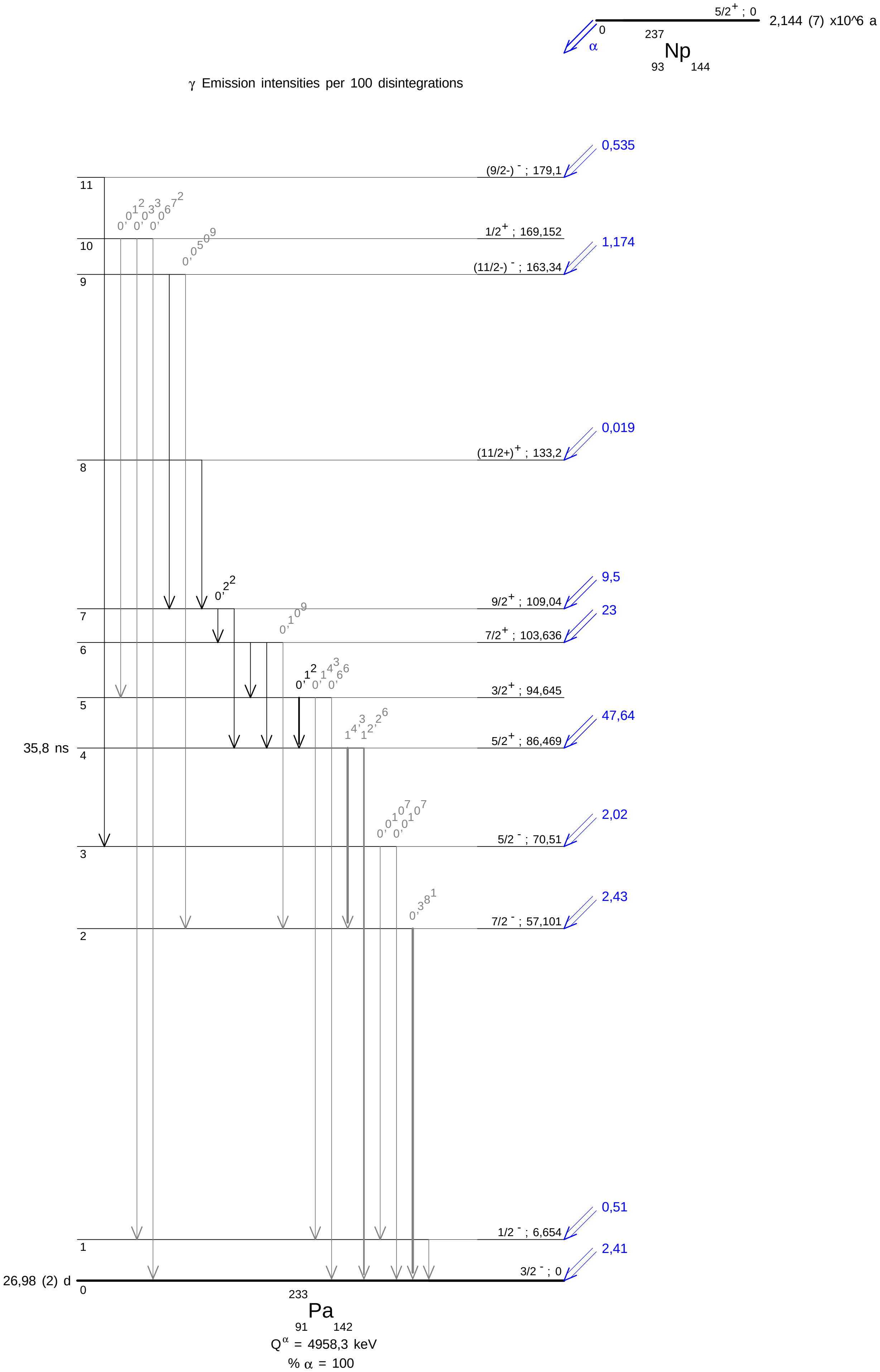
5/2+ ; 0
2,144 (7) x10^6 a
0
α
237 Np 93 144
γ Emission intensities per 100 disintegrations
(9/2-) - ; 179,1
0,535
1/2+ ; 169,152
(11/2-) - ; 163,34
1,174
(11/2+)+ ; 133,2
0,019
9/2+ ; 109,04
9,5
7/2+ ; 103,636
23
3/2+ ; 94,645
5/2+ ; 86,469
47,64
35,8 ns
5/2 - ; 70,51
2,02
7/2 - ; 57,101
2,43
1/2 - ; 6,654
0,51
3/2 - ; 0
2,41
26,98 (2) d
233 Pa 91 142
Qα = 4958,3 keV
% α = 100

$^{239}_{92}\mathrm{U}_{147}$

1 Decay Scheme

U-239 disintegrates by beta minus emission to levels in Np-239.
L'uranium 239 se désintègre par émission bêta vers des niveaux excités du neptunium 239.

2 Nuclear Data

$T_{1/2}(^{239}\mathrm{U})$	:	23,46	(5)	min
$T_{1/2}(^{239}\mathrm{Np})$	:	2,356	(3)	d
$Q^{-}(^{239}\mathrm{U})$	:	1261,5	(16)	keV

2.1 β^- Transitions

	Energy keV	Probability × 100	Nature	lg ft
$\beta^-_{0,32}$	164,5 (16)	0,0060 (5)		
$\beta^-_{0,31}$	212,3 (16)	0,0059 (4)		
$\beta^-_{0,30}$	221,1 (16)	0,0077 (4)		
$\beta^-_{0,29}$	247,9 (16)	0,0074 (4)		
$\beta^-_{0,28}$	269,3 (16)	0,0262 (9)		
$\beta^-_{0,27}$	295,0 (16)	0,0008 (2)		
$\beta^-_{0,26}$	297,3 (16)	0,211 (3)		
$\beta^-_{0,25}$	302,3 (16)	0,0284 (7)	1 st Forbidden	
$\beta^-_{0,24}$	398,1 (16)	0,0005 (2)		
$\beta^-_{0,23}$	412,0 (16)	0,0264 (4)	1 st Forbidden	
$\beta^-_{0,22}$	417,4 (16)	0,215 (3)		
$\beta^-_{0,21}$	442,2 (16)	0,228 (3)		
$\beta^-_{0,18}$	566,3 (16)	0,0118 (11)		
$\beta^-_{0,17}$	599,2 (16)	0,261 (6)	1 st Forbidden	7,35
$\beta^-_{0,15}$	697,6 (16)	0,0247 (7)		
$\beta^-_{0,14}$	731,2 (16)	0,0029 (4)		
$\beta^-_{0,13}$	743,5 (16)	0,063 (2)		

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	Energy keV	Probability × 100	Nature	lg ft
$\beta^-_{0,12}$	787,1 (16)	0,0033 (4)		
$\beta^-_{0,4}$	1143,9 (16)	2,2 (4)	1st Forbidden	7,4
$\beta^-_{0,3}$	1186,5 (16)	72,8 (19)	1st Forbidden	5,91
$\beta^-_{0,1}$	1230,4 (16)	9,4 (15)	Allowed	6,83
$\beta^-_{0,0}$	1261,5 (16)	14,4 (22)	Allowed	6,7

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{1,0}$(Np)	31,1310 (12)	19,0 (14)	M1+E2		195 (10)	50 (3)	263 (13)
$\gamma_{4,3}$(Np)	43,1	2,0 (4)	M1+E2		114 (13)	30 (4)	154 (18)
$\gamma_{3,1}$(Np)	43,533 (1)	9,3 (6)	E1		0,856 (17)	0,215 (4)	1,14 (3)
$\gamma_{(-1,1)}$(Np)	46,6	0,009 (4)					
$\gamma_{6,4}$(Np)	55,37 (5)	0,0076 (25)	M1+E2		63 (20)	17 (6)	90 (30)
$\gamma_{2,0}$(Np)	71,210 (2)	0,141 (4)	E2		52,3 (10)	14,6 (3)	71,9 (14)
$\gamma_{3,0}$(Np)	74,664 (1)	65,8 (17)	E1		0,207 (4)	0,0512 (10)	0,276 (6)
$\gamma_{4,1}$(Np)	86,72 (7)	0,065 (6)	E1		0,140 (3)	0,0344 (7)	0,186 (4)
$\gamma_{15,11}$(Np)	111,0 (2)	0,0202 (5)					
$\gamma_{4,0}$(Np)	117,727 (20)	0,123 (10)	E1		0,0632 (13)	0,0155 (3)	0,0841 (17)
$\gamma_{(-1,2)}$(Np)	134,71 (13)	0,0019 (3)					
$\gamma_{(-1,3)}$(Np)	142,5 (1)	0,0045 (6)					
$\gamma_{7,2}$(Np)	170,15 (5)	0,031 (1)					
$\gamma_{(-1,4)}$(Np)	174,07 (6)	0,0097 (3)					
$\gamma_{8,3}$(Np)	186,15 (4)	0,10 (5)	[M1+E2]	1,7 (16)	0,645 (13)	0,167 (14)	2,6 (16)
$\gamma_{10,8}$(Np)	187,28 (8)	0,020 (9)	[M1+E2]	1,7 (16)	0,631 (13)	0,164 (14)	2,6 (16)
$\gamma_{9,7}$(Np)	197,28 (12)	0,0024 (3)					
$\gamma_{24,17}$(Np)	201,18 (6)	0,0005 (2)					
$\gamma_{(-1,5)}$(Np)	220,52 (4)	0,0282 (7)					
$\gamma_{(-1,6)}$(Np)	236,28 (14)	0,00092 (18)					
$\gamma_{21,16}$(Np)	239,86 (5)	0,00087 (23)					
$\gamma_{21,15}$(Np)	255,37 (5)	0,0011 (2)					
$\gamma_{30,19}$(Np)	258,44 (6)	0,00073 (18)					
$\gamma_{8,0}$(Np)	260,80 (2)	0,00310 (21)	[E1]	0,0434 (9)	0,0087 (2)	0,00211 (4)	0,0549 (11)
$\gamma_{(-1,7)}$(Np)	262,89 (19)	0,0008 (3)					
$\gamma_{(-1,8)}$(Np)	265,44 (17)	0,0009 (3)					
$\gamma_{28,18}$(Np)	296,93 (13)	0,0024 (8)	[M1+E2]	0,5 (4)	0,13 (4)	0,034 (9)	0,7 (5)
$\gamma_{25,17}$(Np)	296,93 (13)		[M1+E2]	0,5 (4)	0,13 (4)	0,034 (9)	0,7 (5)
$\gamma_{26,17}$(Np)	301,95 (3)	0,0018 (7)	[M1+E2]	0,5 (4)	0,13 (4)	0,032 (9)	0,6 (5)
$\gamma_{32,20}$(Np)	312,05 (3)	0,0006					
$\gamma_{22,13}$(Np)	326,21 (7)	0,0044 (2)					
$\gamma_{(-1,9)}$(Np)	330,14 (14)	0,00069 (13)					
$\gamma_{(-1,10)}$(Np)	332,06 (14)	0,0012 (2)					
$\gamma_{30,18}$(Np)	345,13 (8)	0,0039 (2)					
$\gamma_{(-1,11)}$(Np)	348,23 (18)	0,0007 (3)					
$\gamma_{(-1,12)}$(Np)	351,33 (15)	0,0007 (2)					
$\gamma_{(-1,13)}$(Np)	361,83 (8)	0,0044 (3)					
$\gamma_{10,3}$(Np)	373,51 (4)	0,034 (10)	[M1+E2]	0,26 (22)	0,07 (3)	0,017 (6)	0,35 (22)
$\gamma_{11,3}$(Np)	378,06 (6)	0,0101 (4)					
$\gamma_{11,2}$(Np)	381,27 (16)	0,0006 (2)					

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{(-1,14)}$(Np)	393,01 (18)	0,0006 (2)					
$\gamma_{25,15}$(Np)	395,19 (11)	0,0021 (2)					
$\gamma_{12,3}$(Np)	399,13 (13)	0,0016 (3)					
$\gamma_{(-1,15)}$(Np)	400,55 (15)	0,0009 (2)					
$\gamma_{(-1,16)}$(Np)	404,84 (18)	0,0009 (3)					
$\gamma_{32,17}$(Np)	434,71 (4)	0,00122 (20)	(E1)	0,0148 (3)	0,00276 (5)	0,00066 (1)	0,0184 (4)
$\gamma_{(-1,17)}$(Np)	445,81 (12)	0,0011 (2)					
$\gamma_{10,0}$(Np)	448,18 (2)	0,00920 (31)	[E1]	0,0139 (3)	0,00258 (5)	0,00062 (1)	0,0173 (4)
$\gamma_{(-1,18)}$(Np)	452,17 (12)	0,0016 (2)					
$\gamma_{14,3}$(Np)	455,63 (6)	0,0008 (3)					
$\gamma_{12,0}$(Np)	474,36 (6)	0,0017 (2)					
$\gamma_{(-1,19)}$(Np)	478,13 (19)	0,00055 (23)					
$\gamma_{(-1,20)}$(Np)	479,55 (14)	0,0010 (2)					
$\gamma_{13,1}$(Np)	486,87 (3)	0,0627 (14)	[E1]	0,0118 (3)	0,00217 (5)	0,00052 (1)	0,0147 (4)
$\gamma_{(-1,21)}$(Np)	490,33 (13)	0,0007 (1)					
$\gamma_{15,2}$(Np)	492,76 (7)	0,0050 (2)					
$\gamma_{14,1}$(Np)	499,1 (1)	0,0021 (2)					
$\gamma_{(-1,22)}$(Np)	502,12 (17)	0,0006 (2)					
$\gamma_{16,3}$(Np)	504,76 (8)	0,00545 (31)	[E2]	0,0293 (6)	0,0143 (3)	0,0038 (1)	0,0488 (10)
$\gamma_{(-1,23)}$(Np)	506,80 (14)	0,0010 (2)					
$\gamma_{13,0}$(Np)	518,00 (2)	0,00456 (30)	[E1]	0,01050 (15)	0,00190 (4)	0,00046 (1)	0,01300 (19)
$\gamma_{18,6}$(Np)	522,12 (10)	0,00274 (33)	[M1+E2]	0,11 (9)	0,025 (13)	0,006 (3)	0,14 (10)
$\gamma_{15,1}$(Np)	532,86 (10)	0,0023 (2)					
$\gamma_{(-1,24)}$(Np)	541,32 (10)	0,0029 (3)					
$\gamma_{17,4}$(Np)	544,48 (9)	0,0041 (5)	[M1+E2]	0,10 (8)	0,022 (11)	0,005 (3)	0,13 (9)
$\gamma_{16,1}$(Np)	547,99 (12)	0,00202 (30)	[E1]	0,00941 (19)	0,00170 (4)	0,00041 (1)	0,01170 (24)
$\gamma_{(-1,25)}$(Np)	558,46 (17)	0,0006 (2)					
$\gamma_{29,11}$(Np)	560,63 (7)	0,0058 (3)					
$\gamma_{15,0}$(Np)	563,89 (4)	0,0004 (2)					
$\gamma_{(-1,26)}$(Np)	567,88 (18)	0,0004 (1)					
$\gamma_{(-1,27)}$(Np)	575,27 (5)	0,0131 (4)					
$\gamma_{(-1,28)}$(Np)	577,15 (14)	0,0014 (3)					
$\gamma_{(-1,29)}$(Np)	585,49 (14)	0,0012 (2)					
$\gamma_{17,3}$(Np)	587,62 (2)	0,0214 (15)	[M1+E2]	0,08 (6)	0,018 (9)	0,004 (2)	0,11 (7)
$\gamma_{23,8}$(Np)	588,70 (8)	0,0055 (3)					
$\gamma_{(-1,30)}$(Np)	591,82 (19)	0,0009 (4)					
$\gamma_{(-1,31)}$(Np)	599,13 (15)	0,0007 (2)					
$\gamma_{(-1,32)}$(Np)	602,79 (8)	0,0048 (3)					
$\gamma_{(-1,33)}$(Np)	604,85 (6)	0,00096 (27)					
$\gamma_{23,7}$(Np)	607,96 (15)	0,0013 (3)					
$\gamma_{(-1,34)}$(Np)	614,53 (17)	0,0006 (2)					
$\gamma_{(-1,35)}$(Np)	618,03 (16)	0,0007 (2)					
$\gamma_{18,2}$(Np)	624,11 (7)	0,00626 (30)	[E1]	0,00737 (15)	0,00131 (3)	0,00031 (1)	0,0091 (2)
$\gamma_{(-1,36)}$(Np)	629,00 (11)	0,0027 (3)					
$\gamma_{17,1}$(Np)	631,10 (3)	0,0676 (20)	[E1]	0,0072 (2)	0,00128 (3)	0,00031 (1)	0,00892 (17)
$\gamma_{32,11}$(Np)	644,253 (30)	0,0019 (4)					
$\gamma_{21,6}$(Np)	646,26 (10)	0,0029 (3)					
$\gamma_{(-1,37)}$(Np)	649,79 (19)	0,0009 (4)					
$\gamma_{17,0}$(Np)	662,28 (2)	0,171 (5)	[E1]	0,00660 (13)	0,001170 (17)	0,00028 (1)	0,00815 (16)
$\gamma_{18,1}$(Np)	664,17 (9)	0,00544 (40)	[E1]	0,00657 (13)	0,001160 (17)	0,00028 (1)	0,00811 (16)
$\gamma_{(-1,38)}$(Np)	668,76 (18)	0,00055 (18)					
$\gamma_{(-1,39)}$(Np)	670,88 (20)	0,0006 (3)					
$\gamma_{(-1,40)}$(Np)	691,01 (6)	0,0074 (3)					
$\gamma_{(-1,41)}$(Np)	692,61 (13)	0,0016 (3)					
$\gamma_{18,0}$(Np)	695,23 (2)	0,00363 (30)	[E1]	0,00604 (13)	0,001060 (15)	0,00025 (1)	0,00745 (15)
$\gamma_{(-1,42)}$(Np)	701,21 (10)	0,0024 (2)					
$\gamma_{26,8}$(Np)	703,63 (10)	0,00235 (20)	[E2]	0,0162 (3)	0,00537 (11)	0,00138 (3)	0,0234 (5)
$\gamma_{19,3}$(Np)	707,38 (9)	0,0022 (2)					
$\gamma_{20,3}$(Np)	710,35 (15)	0,003					

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{(-1,43)}$(Np)	714,22 (9)	0,0030 (3)					
$\gamma_{26,7}$(Np)	722,85 (4)	0,0276 (7)	[E2]	0,0155 (3)	0,00499 (10)	0,001060 (18)	0,0222 (4)
$\gamma_{23,5}$(Np)	727,52 (10)	0,0026 (3)					
$\gamma_{(-1,44)}$(Np)	730,95 (6)	0,0090 (3)					
$\gamma_{(-1,45)}$(Np)	746,06 (11)	0,0043 (5)					
$\gamma_{21,2}$(Np)	748,09 (3)	0,0890 (4)					
$\gamma_{29,8}$(Np)	752,84 (8)	0,0013 (3)					
$\gamma_{(-1,46)}$(Np)	764,04 (11)	0,0026 (3)					
$\gamma_{(-1,47)}$(Np)	768,15 (11)	0,0020 (2)					
$\gamma_{(-1,48)}$(Np)	769,52 (17)	0,0004 (1)					
$\gamma_{22,2}$(Np)	772,94 (9)	0,0029 (2)					
$\gamma_{23,3}$(Np)	774,77 (4)	0,015 (4)					
$\gamma_{30,8}$(Np)	779,57 (14)	0,0006 (1)					
$\gamma_{21,1}$(Np)	788,19 (7)	0,0049 (2)					
$\gamma_{26,6}$(Np)	791,13 (5)	0,0075 (2)					
$\gamma_{(-1,49)}$(Np)	795,13 (15)	0,0008 (2)					
$\gamma_{22,1}$(Np)	812,89 (3)	0,0685 (3)					
$\gamma_{21,0}$(Np)	819,26 (3)	0,129 (3)					
$\gamma_{(-1,50)}$(Np)	829,59 (17)	0,00046 (13)					
$\gamma_{(-1,51)}$(Np)	831,89 (9)	0,0021 (2)					
$\gamma_{25,4}$(Np)	841,45 (4)	0,0025 (4)					
$\gamma_{22,0}$(Np)	844,10 (3)	0,139 (3)					
$\gamma_{26,4}$(Np)	846,39 (4)	0,0324 (13)	[M1+E2]	0,032 (21)	0,007 (4)	0,0016 (8)	0,04 (3)
$\gamma_{23,0}$(Np)	849,44 (9)	0,0020 (2)					
$\gamma_{(-1,52)}$(Np)	862,56 (18)	0,0004 (1)					
$\gamma_{30,6}$(Np)	867,11 (11)	0,00076 (8)					
$\gamma_{28,5}$(Np)	869,57 (9)	0,0016 (1)					
$\gamma_{28,4}$(Np)	874,43 (3)	0,00343 (22)	[M1+E2]	0,030 (19)	0,006 (4)	0,0015 (8)	0,038 (23)
$\gamma_{25,3}$(Np)	884,45 (5)	0,0086 (2)					
$\gamma_{25,2}$(Np)	887,97 (3)	0,0023 (2)					
$\gamma_{26,3}$(Np)	889,49 (4)	0,0217 (7)	[M1+E2]	0,029 (18)	0,006 (3)	0,0014 (7)	0,036 (22)
$\gamma_{27,2}$(Np)	895,15 (15)	0,0008 (2)					
$\gamma_{(-1,53)}$(Np)	913,68 (9)	0,0019 (1)					
$\gamma_{28,3}$(Np)	917,40 (8)	0,00279 (12)	[M1+E2]	0,026 (17)	0,005 (3)	0,0013 (7)	0,034 (22)
$\gamma_{28,2}$(Np)	920,95 (8)	0,00261 (10)	[E1]	0,00366 (6)	0,00063 (1)	0,00015 (1)	0,00450 (9)
$\gamma_{30,4}$(Np)	922,83 (13)	0,0006 (1)					
$\gamma_{25,1}$(Np)	928,05 (3)	0,0051 (2)					
$\gamma_{31,4}$(Np)	931,51 (5)	0,00547 (33)	[M1+E2]	0,026 (16)	0,005 (3)	0,0013 (7)	0,032 (19)
$\gamma_{26,1}$(Np)	933,09 (3)	0,0263 (6)	[E1]	0,00358 (7)	0,00061 (1)	0,00015 (1)	0,00439 (9)
$\gamma_{29,3}$(Np)	938,98 (8)	0,00031 (8)					
$\gamma_{(-1,54)}$(Np)	948,88 (19)	0,00024 (10)					
$\gamma_{25,0}$(Np)	959,18 (3)	0,0078 (3)					
$\gamma_{28,1}$(Np)	960,99 (5)	0,01054 (30)	[E1]	0,00340 (7)	0,00058 (1)	0,00014 (1)	0,00417 (9)
$\gamma_{26,0}$(Np)	964,23 (2)	0,0909 (20)	[E1]	0,00338 (7)	0,00058 (1)	0,00014 (1)	0,00415 (8)
$\gamma_{(-1,55)}$(Np)	970,07 (14)	0,0009 (2)					
$\gamma_{31,3}$(Np)	974,58 (4)	0,00040 (8)	[E2]	0,00917 (18)	0,00234 (5)	0,00059 (1)	0,0123 (5)
$\gamma_{(-1,56)}$(Np)	988,51 (14)	0,00044 (9)					
$\gamma_{28,0}$(Np)	992,16 (2)	0,00281 (10)	[E1]	0,00322 (7)	0,00055 (1)	0,00013 (1)	0,00395 (8)
$\gamma_{(-1,57)}$(Np)	1002,40 (13)	0,00049 (9)					
$\gamma_{(-1,58)}$(Np)	1005,27 (13)	0,0006 (1)					
$\gamma_{(-1,59)}$(Np)	1009,38 (18)	0,0003 (1)					
$\gamma_{30,0}$(Np)	1040,37 (4)	0,0011 (1)					
$\gamma_{32,1}$(Np)	1065,76 (12)	0,00060 (8)	[M1+E2]	0,018 (11)	0,004 (2)	0,0009 (4)	0,023 (13)
$\gamma_{32,0}$(Np)	1096,99 (3)	0,00164 (10)	[M1+E2]	0,017 (11)	0,003 (2)	0,0008 (4)	0,022 (13)
$\gamma_{(-1,60)}$(Np)	1101,99 (16)	0,00031 (1)					

3 Atomic Data

3.1 Np

ω_K	:	0,971	(4)
$\bar{\omega}_L$	:	0,511	(20)
$\bar{\omega}_M$	:	0,0528	
n_{KL}	:	0,791	(5)
$\bar{n}_{LM}$	:	1,163	

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 – 13,12	

4 Electron Emissions

		Energy keV	Electrons per 100 disint.
e_{AL}	(Np)	6,04 - 13,12	14,7 (7)
e_{AK}	(Np)		0,0091 (13)
	KLL	73,501 - 83,134	}
	KLX	90,358 - 101,054	}
	KXY	107,19 - 118,66	}
$ec_{1,0\ L}$	(Np)	8,704 - 13,520	14,0 (11)
$ec_{4,3\ L}$	(Np)	20,7 - 25,5	1,48 (28)
$ec_{3,1\ L}$	(Np)	21,106 - 25,920	3,72 (25)
$ec_{1,0\ M}$	(Np)	25,392 - 27,467	3,6 (3)
$ec_{1,0\ N}$	(Np)	29,630 - 30,728	0,99 (8)
$ec_{6,4\ L}$	(Np)	32,94 - 37,76	0,0053 (17)
$ec_{4,3\ M}$	(Np)	37,4 - 39,4	0,39 (8)
$ec_{3,1\ M}$	(Np)	37,794 - 39,869	0,94 (6)
$ec_{4,3\ N}$	(Np)	41,6 - 42,7	0,10 (13)
$ec_{3,1\ N}$	(Np)	42,032 - 43,130	0,248 (16)
$ec_{2,0\ L}$	(Np)	48,78 - 53,60	0,115 (21)
$ec_{6,4\ M}$	(Np)	49,63 - 51,71	0,0014 (5)
$ec_{3,0\ L}$	(Np)	52,237 - 57,050	10,7 (3)
$ec_{4,1\ L}$	(Np)	64,29 - 69,11	0,0077 (7)
$ec_{2,0\ M}$	(Np)	65,47 - 67,55	0,032 (3)
$ec_{8,3\ K}$	(Np)	67,48 (4)	0,049 (46)
$ec_{10,8\ K}$	(Np)	68,61 (8)	0,010 (9)
$ec_{3,0\ M}$	(Np)	68,925 - 71,000	2,64 (8)
$ec_{2,0\ N}$	(Np)	69,71 - 70,81	0,0088 (16)
$ec_{3,0\ N}$	(Np)	73,163 - 74,261	0,704 (21)
$ec_{4,1\ M}$	(Np)	80,98 - 83,06	0,00189 (18)
$ec_{4,0\ L}$	(Np)	95,30 - 100,12	0,0071 (6)
$ec_{4,0\ M}$	(Np)	111,988 - 114,063	0,00175 (14)
$ec_{8,3\ L}$	(Np)	163,72 - 168,54	0,0186 (6)
$ec_{10,8\ L}$	(Np)	164,85 - 169,67	0,00353 (20)
$ec_{8,3\ M}$	(Np)	180,41 - 182,49	0,00481 (42)
$ec_{8,3\ N}$	(Np)	184,65 - 185,75	0,00132 (9)
$ec_{10,3\ K}$	(Np)	254,84 (4)	0,007 (6)
$ec_{10,3\ L}$	(Np)	351,08 - 355,90	0,0018 (9)
$ec_{17,3\ K}$	(Np)	468,95 (2)	0,0015 (12)
$ec_{17,0\ K}$	(Np)	543,61 (2)	0,001122 (40)
$ec_{26,4\ K}$	(Np)	727,72 (4)	0,0010 (7)
$\beta^-_{0,32}$	max:	164,5 (16)	0,0060 (5)
$\beta^-_{0,32}$	avg:	43,7 (5)	
$\beta^-_{0,31}$	max:	212,3 (16)	0,0059 (4)
$\beta^-_{0,31}$	avg:	57,3 (5)	
$\beta^-_{0,30}$	max:	221,1 (16)	0,0077 (4)

		Energy keV		Electrons per 100 disint.
$\beta^-_{0,30}$	avg:	59,9	(5)	
$\beta^-_{0,29}$	max:	247,9	(16)	0,0074 (4)
$\beta^-_{0,29}$	avg:	67,6	(5)	
$\beta^-_{0,28}$	max:	269,3	(16)	0,0262 (9)
$\beta^-_{0,28}$	avg:	74,0	(5)	
$\beta^-_{0,27}$	max:	295,0	(16)	0,0008 (2)
$\beta^-_{0,27}$	avg:	81,7	(5)	
$\beta^-_{0,26}$	max:	297,3	(16)	0,211 (3)
$\beta^-_{0,26}$	avg:	82,4	(5)	
$\beta^-_{0,25}$	max:	302,3	(16)	0,0284 (7)
$\beta^-_{0,25}$	avg:	83,9	(5)	
$\beta^-_{0,24}$	max:	398,1	(16)	0,0005 (2)
$\beta^-_{0,24}$	avg:	113,4	(5)	
$\beta^-_{0,23}$	max:	412,0	(16)	0,0264 (4)
$\beta^-_{0,23}$	avg:	117,8	(5)	
$\beta^-_{0,22}$	max:	417,4	(16)	0,215 (3)
$\beta^-_{0,22}$	avg:	119,6	(5)	
$\beta^-_{0,21}$	max:	442,2	(16)	0,228 (3)
$\beta^-_{0,21}$	avg:	127,4	(5)	
$\beta^-_{0,18}$	max:	566,3	(16)	0,0118 (11)
$\beta^-_{0,18}$	avg:	168,0	(5)	
$\beta^-_{0,17}$	max:	599,2	(16)	0,261 (6)
$\beta^-_{0,17}$	avg:	179,0	(5)	
$\beta^-_{0,15}$	max:	697,6	(16)	0,0247 (7)
$\beta^-_{0,15}$	avg:	212,6	(5)	
$\beta^-_{0,14}$	max:	731,2	(16)	0,0029 (4)
$\beta^-_{0,14}$	avg:	224,3	(5)	
$\beta^-_{0,13}$	max:	743,5	(16)	0,063 (2)
$\beta^-_{0,13}$	avg:	228,6	(5)	
$\beta^-_{0,12}$	max:	787,1	(16)	0,0033 (4)
$\beta^-_{0,12}$	avg:	244,0	(5)	
$\beta^-_{0,4}$	max:	1143,9	(16)	2,2 (4)
$\beta^-_{0,4}$	avg:	374,0	(5)	
$\beta^-_{0,3}$	max:	1186,5	(16)	72,8 (19)
$\beta^-_{0,3}$	avg:	390,4	(5)	
$\beta^-_{0,1}$	max:	1230,4	(16)	9,4 (15)
$\beta^-_{0,1}$	avg:	406,8	(5)	
$\beta^-_{0,0}$	max:	1261,5	(16)	14,4 (22)
$\beta^-_{0,0}$	avg:	418,6	(5)	

5 Photon Emissions

5.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(Np)	11,871 — 21,491		16,1 (5)	
$XK\alpha_2$	(Np)	97,069		0,091 (3)	} $K\alpha$
$XK\alpha_1$	(Np)	101,059		0,144 (5)	}
$XK\beta_3$	(Np)	113,303	}		
$XK\beta_1$	(Np)	114,234	}	0,052 (2)	$K'\beta_1$
$XK\beta_5''$	(Np)	114,912	}		
$XK\beta_2$	(Np)	117,463	}		
$XK\beta_4$	(Np)	117,876	}	0,018 (1)	$K'\beta_2$
$XKO_{2,3}$	(Np)	118,429	}		

5.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{1,0}$(Np)	31,1310 (12)	0,072 (4)
$\gamma_{4,3}$(Np)	43,06 (2)	0,013 (2)
$\gamma_{3,1}$(Np)	43,533 (1)	4,35 (28)
$\gamma_{(-1,1)}$(Np)	46,6	0,009 (4)
$\gamma_{6,4}$(Np)	55,37 (5)	0,0000836 (20)
$\gamma_{2,0}$(Np)	71,210 (2)	0,00193 (4)
$\gamma_{3,0}$(Np)	74,664 (1)	51,6 (13)
$\gamma_{4,1}$(Np)	86,72 (7)	0,055 (5)
$\gamma_{15,11}$(Np)	111,0 (2)	0,0202 (5)
$\gamma_{4,0}$(Np)	117,727 (20)	0,113 (9)
$\gamma_{(-1,2)}$(Np)	134,71 (13)	0,0019 (3)
$\gamma_{(-1,3)}$(Np)	142,5 (1)	0,0045 (6)
$\gamma_{7,2}$(Np)	170,15 (5)	0,031 (1)
$\gamma_{(-1,4)}$(Np)	174,07 (6)	0,0097 (3)
$\gamma_{8,3}$(Np)	186,15 (4)	0,0288 (7)
$\gamma_{10,8}$(Np)	187,28 (8)	0,0056 (3)
$\gamma_{9,7}$(Np)	197,28 (12)	0,0024 (3)
$\gamma_{24,17}$(Np)	201,18 (6)	0,0005 (2)
$\gamma_{(-1,5)}$(Np)	220,52 (4)	0,0282 (7)
$\gamma_{(-1,6)}$(Np)	236,28 (14)	0,00092 (18)
$\gamma_{21,16}$(Np)	239,86 (5)	0,00087 (23)
$\gamma_{21,15}$(Np)	255,37 (5)	0,0011 (2)

	Energy keV	Photons per 100 disint.
$\gamma_{30,19}$(Np)	258,44 (6)	0,00073 (18)
$\gamma_{8,0}$(Np)	260,80 (2)	0,0031 (2)
$\gamma_{(-1,7)}$(Np)	262,89 (19)	0,0008 (3)
$\gamma_{(-1,8)}$(Np)	265,44 (17)	0,0009 (3)
$\gamma_{28,18}$(Np)	296,93 (13)	0,0014 (2)
$\gamma_{26,17}$(Np)	301,95 (3)	0,0011 (3)
$\gamma_{32,20}$(Np)	312,05 (3)	0,0006
$\gamma_{22,13}$(Np)	326,21 (7)	0,0044 (2)
$\gamma_{(-1,9)}$(Np)	330,14 (14)	0,00069 (13)
$\gamma_{(-1,10)}$(Np)	332,06 (14)	0,0012 (2)
$\gamma_{30,18}$(Np)	345,13 (8)	0,0039 (2)
$\gamma_{(-1,11)}$(Np)	348,23 (18)	0,0007 (3)
$\gamma_{(-1,12)}$(Np)	351,33 (15)	0,0007 (2)
$\gamma_{(-1,13)}$(Np)	361,83 (8)	0,0044 (3)
$\gamma_{10,3}$(Np)	373,51 (4)	0,025 (6)
$\gamma_{11,3}$(Np)	378,06 (6)	0,0101 (4)
$\gamma_{11,2}$(Np)	381,27 (16)	0,0006 (2)
$\gamma_{(-1,14)}$(Np)	393,01 (18)	0,0006 (2)
$\gamma_{25,15}$(Np)	395,19 (11)	0,0021 (2)
$\gamma_{12,3}$(Np)	399,13 (13)	0,0016 (3)
$\gamma_{(-1,15)}$(Np)	400,55 (15)	0,0009 (2)
$\gamma_{(-1,16)}$(Np)	404,84 (18)	0,0009 (3)
$\gamma_{32,17}$(Np)	434,71 (4)	0,0012 (2)
$\gamma_{(-1,17)}$(Np)	445,81 (12)	0,0011 (2)
$\gamma_{10,0}$(Np)	448,18 (2)	0,0090 (3)
$\gamma_{(-1,18)}$(Np)	452,17 (12)	0,0016 (2)
$\gamma_{14,3}$(Np)	455,63 (6)	0,0008 (3)
$\gamma_{12,0}$(Np)	474,36 (6)	0,0017 (2)
$\gamma_{(-1,19)}$(Np)	478,13 (19)	0,00055 (23)
$\gamma_{(-1,20)}$(Np)	479,55 (14)	0,0010 (2)
$\gamma_{13,1}$(Np)	486,87 (3)	0,0618 (14)
$\gamma_{(-1,21)}$(Np)	490,33 (13)	0,0007 (1)
$\gamma_{15,2}$(Np)	492,76 (7)	0,0050 (2)
$\gamma_{14,1}$(Np)	499,1 (1)	0,0021 (2)
$\gamma_{(-1,22)}$(Np)	502,12 (17)	0,0006 (2)
$\gamma_{16,3}$(Np)	504,76 (8)	0,0052 (3)
$\gamma_{(-1,23)}$(Np)	506,80 (14)	0,0010 (2)
$\gamma_{13,0}$(Np)	518,00 (2)	0,0045 (3)
$\gamma_{18,6}$(Np)	522,12 (10)	0,0024 (2)
$\gamma_{15,1}$(Np)	532,86 (10)	0,0023 (2)
$\gamma_{(-1,24)}$(Np)	541,32 (10)	0,0029 (3)
$\gamma_{17,4}$(Np)	544,48 (9)	0,0036 (3)
$\gamma_{16,1}$(Np)	547,99 (12)	0,0020 (3)
$\gamma_{(-1,25)}$(Np)	558,46 (17)	0,0006 (2)
$\gamma_{29,11}$(Np)	560,63 (7)	0,0058 (3)
$\gamma_{15,0}$(Np)	563,89 (4)	0,0004 (2)
$\gamma_{(-1,26)}$(Np)	567,88 (18)	0,0004 (1)

	Energy keV	Photons per 100 disint.
$\gamma_{(-1,27)}$(Np)	575,27 (5)	0,0131 (4)
$\gamma_{(-1,28)}$(Np)	577,15 (14)	0,0014 (3)
$\gamma_{(-1,29)}$(Np)	585,49 (14)	0,0012 (2)
$\gamma_{17,3}$(Np)	587,62 (2)	0,0193 (5)
$\gamma_{23,8}$(Np)	588,70 (8)	0,0055 (3)
$\gamma_{(-1,30)}$(Np)	591,82 (19)	0,0009 (4)
$\gamma_{(-1,31)}$(Np)	599,13 (15)	0,0007 (2)
$\gamma_{(-1,32)}$(Np)	602,79 (8)	0,0048 (3)
$\gamma_{(-1,33)}$(Np)	604,85 (6)	0,00096 (27)
$\gamma_{23,7}$(Np)	607,96 (15)	0,0013 (3)
$\gamma_{(-1,34)}$(Np)	614,53 (17)	0,0006 (2)
$\gamma_{(-1,35)}$(Np)	618,03 (16)	0,0007 (2)
$\gamma_{18,2}$(Np)	624,11 (7)	0,0062 (3)
$\gamma_{(-1,36)}$(Np)	629,00 (11)	0,0027 (3)
$\gamma_{17,1}$(Np)	631,10 (3)	0,067 (2)
$\gamma_{32,11}$(Np)	644,253 (30)	0,0019 (4)
$\gamma_{21,6}$(Np)	646,26 (10)	0,0029 (3)
$\gamma_{(-1,37)}$(Np)	649,79 (19)	0,0009 (4)
$\gamma_{17,0}$(Np)	662,28 (2)	0,170 (5)
$\gamma_{18,1}$(Np)	664,17 (9)	0,0054 (4)
$\gamma_{(-1,38)}$(Np)	668,76 (18)	0,00055 (18)
$\gamma_{(-1,39)}$(Np)	670,88 (20)	0,0006 (3)
$\gamma_{(-1,40)}$(Np)	691,01 (6)	0,0074 (3)
$\gamma_{(-1,41)}$(Np)	692,61 (13)	0,0016 (3)
$\gamma_{18,0}$(Np)	695,23 (2)	0,0036 (3)
$\gamma_{(-1,42)}$(Np)	701,21 (10)	0,0024 (2)
$\gamma_{26,8}$(Np)	703,63 (10)	0,0023 (2)
$\gamma_{19,3}$(Np)	707,38 (9)	0,0022 (2)
$\gamma_{20,3}$(Np)	710,35 (15)	0,003
$\gamma_{(-1,43)}$(Np)	714,22 (9)	0,0030 (3)
$\gamma_{26,7}$(Np)	722,85 (4)	0,0270 (7)
$\gamma_{23,5}$(Np)	727,52 (10)	0,0026 (3)
$\gamma_{(-1,44)}$(Np)	730,95 (6)	0,0090 (3)
$\gamma_{(-1,45)}$(Np)	746,06 (11)	0,0043 (5)
$\gamma_{21,2}$(Np)	748,09 (3)	0,0890 (4)
$\gamma_{29,8}$(Np)	752,84 (8)	0,0013 (3)
$\gamma_{(-1,46)}$(Np)	764,04 (11)	0,0026 (3)
$\gamma_{(-1,47)}$(Np)	768,15 (11)	0,0020 (2)
$\gamma_{(-1,48)}$(Np)	769,52 (17)	0,0004 (1)
$\gamma_{22,2}$(Np)	772,94 (9)	0,0029 (2)
$\gamma_{23,3}$(Np)	774,77 (4)	0,015 (4)
$\gamma_{30,8}$(Np)	779,57 (14)	0,0006 (1)
$\gamma_{21,1}$(Np)	788,19 (7)	0,0049 (2)
$\gamma_{26,6}$(Np)	791,13 (5)	0,0075 (2)
$\gamma_{(-1,49)}$(Np)	795,13 (15)	0,0008 (2)
$\gamma_{22,1}$(Np)	812,89 (3)	0,0685 (3)
$\gamma_{21,0}$(Np)	819,26 (3)	0,129 (3)

	Energy keV	Photons per 100 disint.
$\gamma_{(-1,50)}$(Np)	829,59 (17)	0,00046 (13)
$\gamma_{(-1,51)}$(Np)	831,89 (9)	0,0021 (2)
$\gamma_{25,4}$(Np)	841,45 (4)	0,0025 (4)
$\gamma_{22,0}$(Np)	844,10 (3)	0,139 (3)
$\gamma_{26,4}$(Np)	846,39 (4)	0,0312 (8)
$\gamma_{23,0}$(Np)	849,44 (9)	0,0020 (2)
$\gamma_{(-1,52)}$(Np)	862,56 (18)	0,0004 (1)
$\gamma_{30,6}$(Np)	867,11 (11)	0,00076 (8)
$\gamma_{28,5}$(Np)	869,57 (9)	0,0016 (1)
$\gamma_{28,4}$(Np)	874,43 (3)	0,0033 (2)
$\gamma_{25,3}$(Np)	884,45 (5)	0,0086 (2)
$\gamma_{25,2}$(Np)	887,97 (3)	0,0023 (2)
$\gamma_{26,3}$(Np)	889,49 (4)	0,0209 (5)
$\gamma_{27,2}$(Np)	895,15 (15)	0,0008 (2)
$\gamma_{(-1,53)}$(Np)	913,68 (9)	0,0019 (1)
$\gamma_{28,3}$(Np)	917,40 (8)	0,0027 (1)
$\gamma_{28,2}$(Np)	920,95 (8)	0,0026 (1)
$\gamma_{30,4}$(Np)	922,83 (13)	0,0006 (1)
$\gamma_{25,1}$(Np)	928,05 (3)	0,0051 (2)
$\gamma_{31,4}$(Np)	931,51 (5)	0,0053 (3)
$\gamma_{26,1}$(Np)	933,09 (3)	0,0262 (6)
$\gamma_{29,3}$(Np)	938,98 (8)	0,00031 (8)
$\gamma_{(-1,54)}$(Np)	948,88 (19)	0,00024 (10)
$\gamma_{25,0}$(Np)	959,18 (3)	0,0078 (3)
$\gamma_{28,1}$(Np)	960,99 (5)	0,0105 (3)
$\gamma_{26,0}$(Np)	964,23 (2)	0,0905 (20)
$\gamma_{(-1,55)}$(Np)	970,07 (14)	0,0009 (2)
$\gamma_{31,3}$(Np)	974,58 (4)	0,00040 (8)
$\gamma_{(-1,56)}$(Np)	988,51 (14)	0,00044 (9)
$\gamma_{28,0}$(Np)	992,16 (2)	0,0028 (1)
$\gamma_{(-1,57)}$(Np)	1002,40 (13)	0,00049 (9)
$\gamma_{(-1,58)}$(Np)	1005,27 (13)	0,0006 (1)
$\gamma_{(-1,59)}$(Np)	1009,38 (18)	0,0003 (1)
$\gamma_{30,0}$(Np)	1040,37 (4)	0,0011 (1)
$\gamma_{32,1}$(Np)	1065,76 (12)	0,00059 (8)
$\gamma_{32,0}$(Np)	1096,99 (3)	0,0016 (1)
$\gamma_{(-1,60)}$(Np)	1101,99 (16)	0,00031 (1)

6 Main Production Modes

U – 238(n,γ)U – 239
Possible impurities : U – 238

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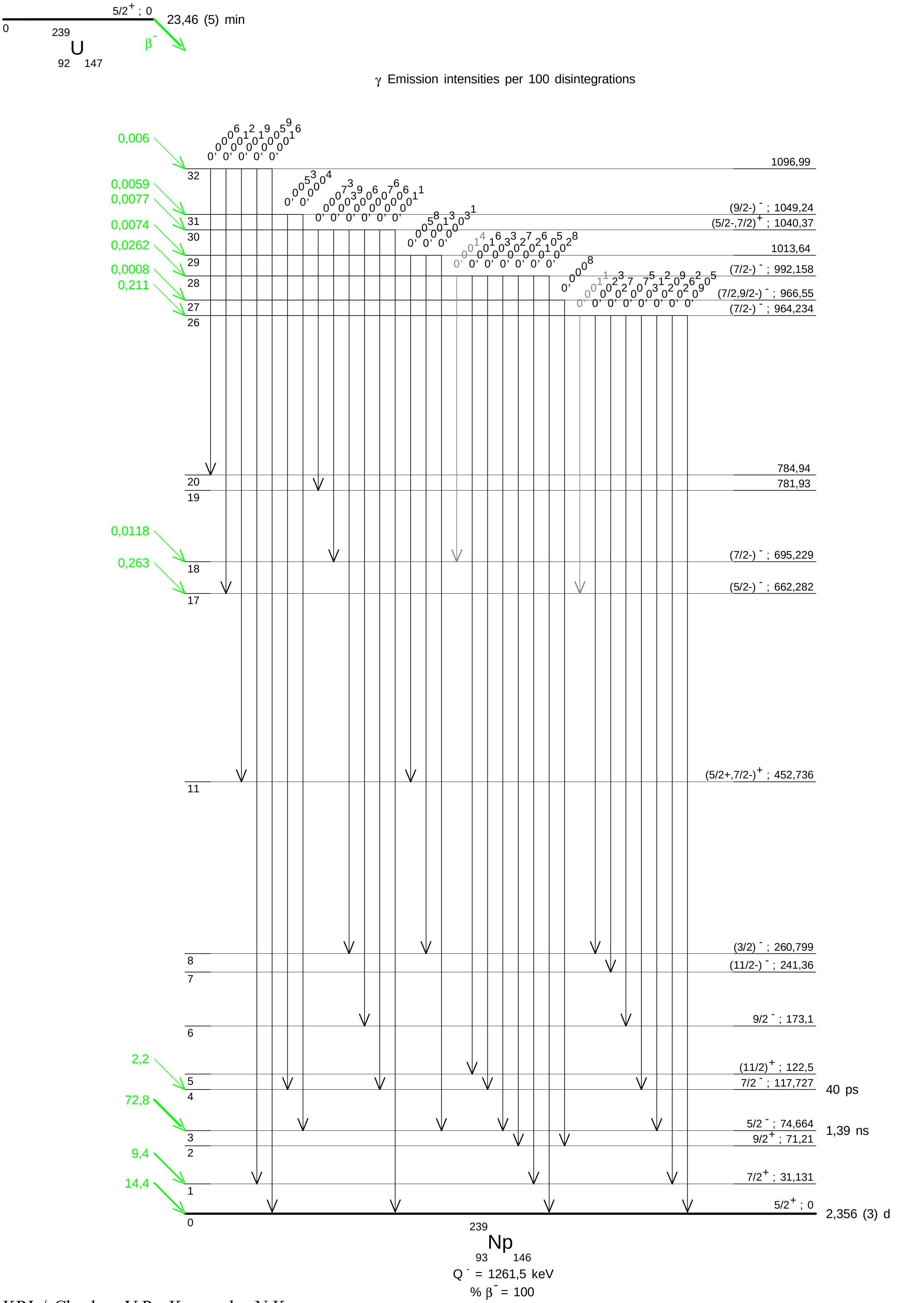

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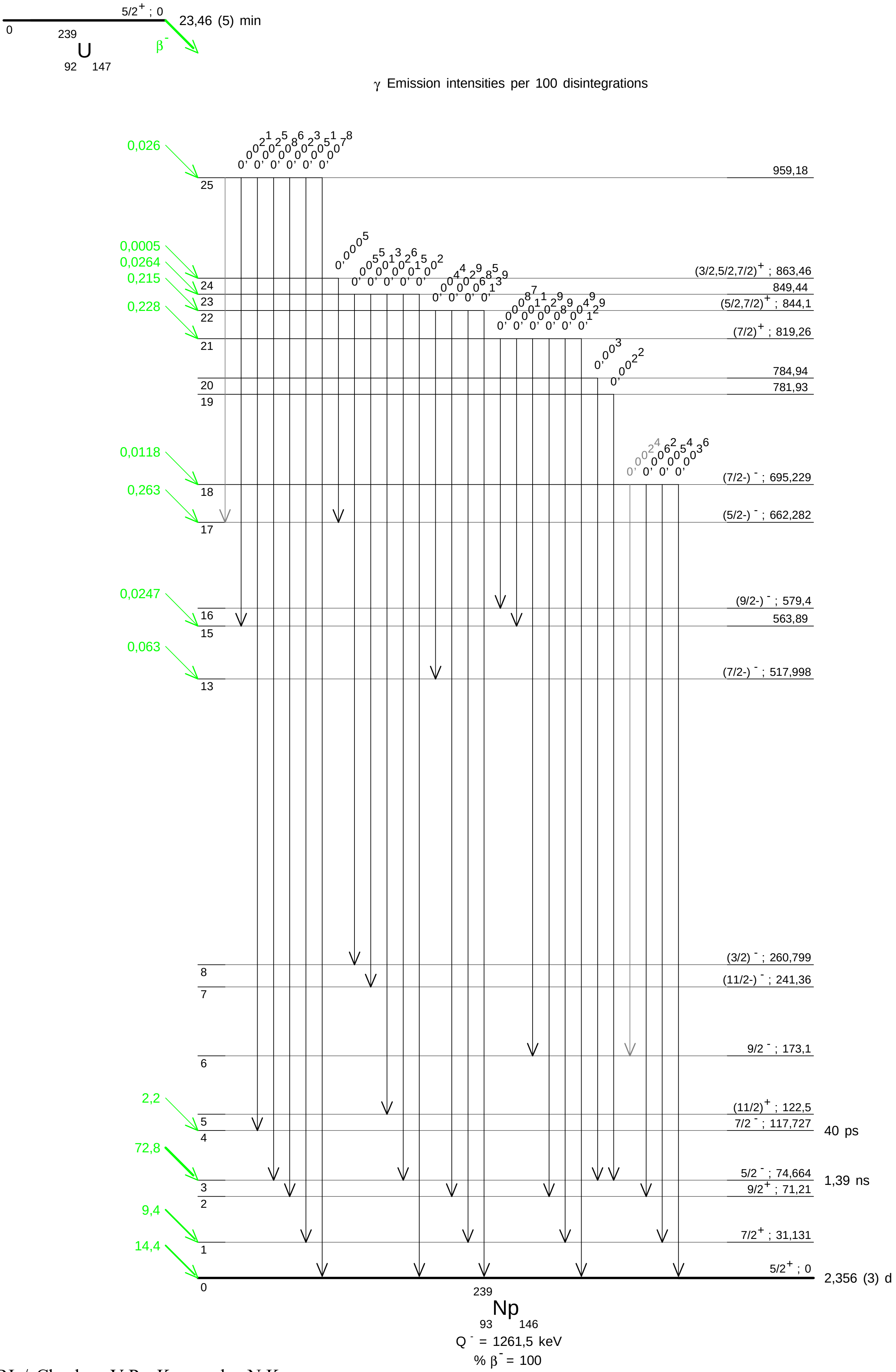

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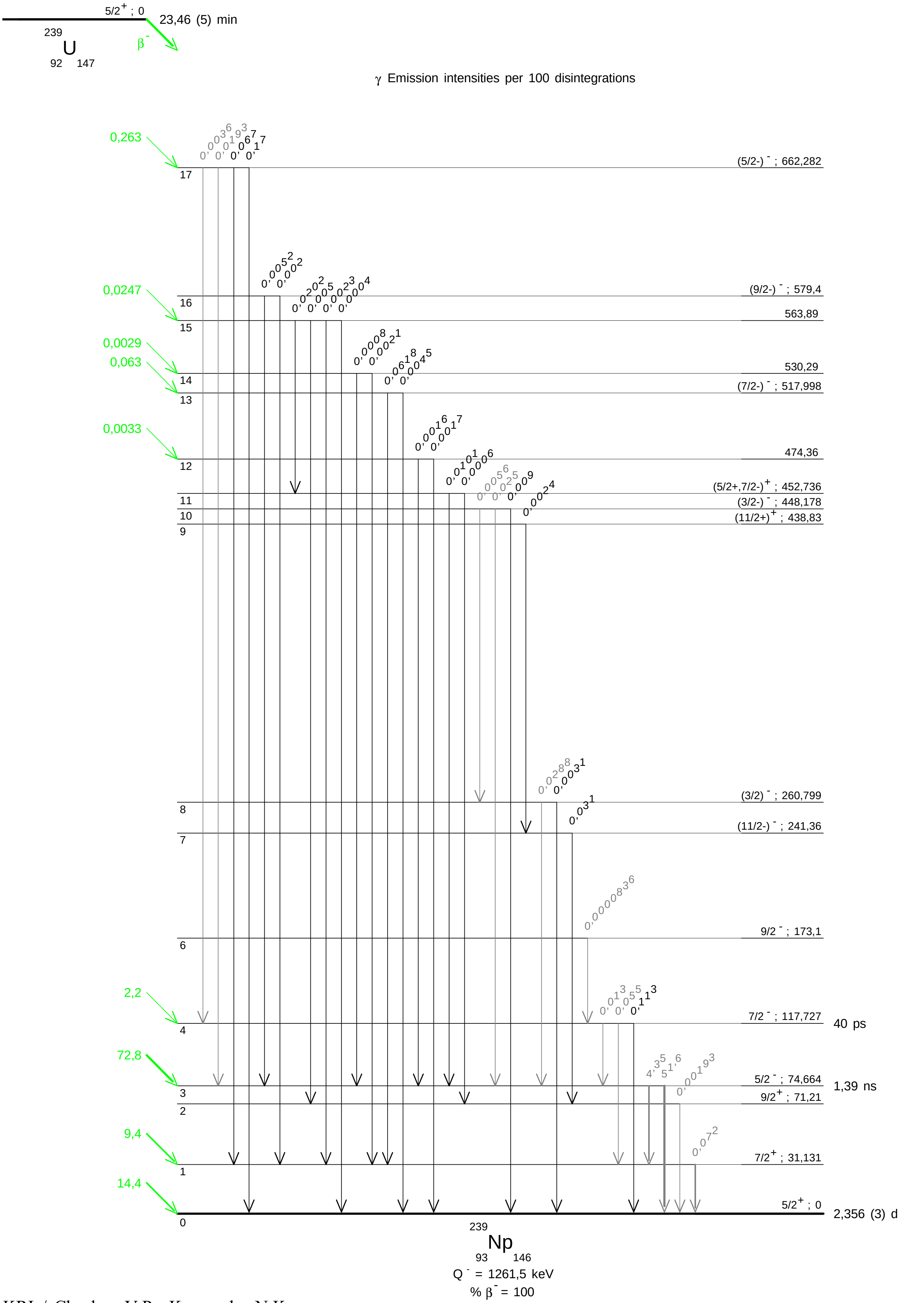

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1 Decay Scheme

Am-242m undergoes 99.54% IT decay directly to the ground state of Am-242, along with a small alpha-decay branch of 0.46% to various nuclear levels of Np-238. A small spontaneous fission branch of 1.5(6) $\times 10^{-8}$% has been determined by Caldwell *et al.* (1967), compared with an upper limit of only 4.8 $\times 10^{-9}$% quoted by Zelenkov *et al.* (1986).
L'américium 242 métastable se désintègre principalement (99,54 %) par transition isomérique vers l'américium 242. Un faible branchement par transition alpha peuple des niveaux excités du neptunium 238.

2 Nuclear Data

$T_{1/2}$(^{242m}Am)	:	143	(2)	a
$T_{1/2}$(^{242}Am)	:	16,01	(2)	h
$T_{1/2}$(^{238}Np)	:	2,102	(5)	d
Q^{α}(^{242m}Am)	:	5637,10	(25)	keV
Q^{IT}(^{242m}Am)	:	48,60	(5)	keV

2.1 α Transitions

	Energy keV	Probability × 100	F
$\alpha_{0,68}$	5059 (3)	0,000009 (5)	2400
$\alpha_{0,64}$	5111,8 (15)	0,00009 (5)	540
$\alpha_{0,59}$	5153 (3)	0,0012 (3)	81
$\alpha_{0,57}$	5168,0 (12)	0,00014 (5)	840
$\alpha_{0,56}$	5177,5 (7)	0,0009 (3)	146
$\alpha_{0,48}$	5229,51 (26)	0,0258 (11)	11,2
$\alpha_{0,47}$	5239,8 (15)	0,00009 (5)	3600
$\alpha_{0,42}$	5260,40 (26)	0,00009 (5)	4900
$\alpha_{0,41}$	5262,4 (10)	0,00009 (5)	5000
$\alpha_{0,36}$	5294,67 (25)	0,409 (9)	1,8
$\alpha_{0,35}$	5303,1 (7)	0,00014 (5)	6000
$\alpha_{0,28}$	5336,36 (25)	0,0018 (5)	730

	Energy keV	Probability × 100	F
$\alpha_{0,27}$	5336,42 (26)	0,0018 (5)	730
$\alpha_{0,25}$	5337,87 (26)	0,00009 (5)	14800
$\alpha_{0,23}$	5340,07 (25)	0,00009 (5)	15300
$\alpha_{0,20}$	5361,58 (25)	0,0046 (5)	414
$\alpha_{0,14}$	5404,27 (25)	0,0028 (5)	1250
$\alpha_{0,11}$	5421,58 (25)	0,0007 (5)	6400
$\alpha_{0,9}$	5457,95 (25)	0,0051 (9)	1430
$\alpha_{0,6}$	5501,06 (25)	0,0046 (9)	2820
$\alpha_{0,3}$	5550,43 (25)	0,00064 (18)	39000
$\alpha_{0,1}$	5610,67 (25)	0,000014 (14)	4000000

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{3,2}$(Np)	24,34 (1)	0,021 (3)	M1+E2		242 (4)	59,6 (9)	322 (5)
$\gamma_{1,0}$(Np)	26,427 (2)	< 0,24	M1+E2		252 (4)	63,7 (9)	338 (5)
$\gamma_{11,10}$(Np)	32,64 (1)	0,0026 (4)	M1+E2		102,6 (15)	25,0 (4)	136,4 (20)
$\gamma_{9,6}$(Np)	43,11 (1)	0,0040 (9)	M1+E2		46,1 (7)	11,25 (16)	61,3 (9)
$\gamma_{19,11}$(Np)	43,33 (1)	0,00112 (18)	M1+E2		93,5 (14)	24,6 (4)	126,7 (18)
$\gamma_{10,6}$(Np)	46,833 (3)	0,00037 (7)	M1+E2		36,7 (6)	8,97 (13)	48,8 (7)
$\gamma_{1,0}$(Am)	48,60 (5)	99,54 (1)	E4		333000 (5000)	266000 (5000)	704000 (8000)
$\gamma_{6,3}$(Np)	49,371 (3)	0,244 (8)	E1		0,615 (9)	0,1536 (22)	0,821 (12)
$\gamma_{14,9}$(Np)	53,67 (1)	0,097 (13)	M1+E2		34,2 (5)	8,73 (13)	46,0 (7)
$\gamma_{30,19}$(Np)	53,85 (2)	0,00011 (6)	M1+E2		27,8 (4)	6,93 (10)	37,2 (6)
$\gamma_{9,5}$(Np)	57,51 (1)	0,0015 (4)	E1		0,412 (6)	0,1023 (15)	0,549 (8)
$\gamma_{3,1}$(Np)	60,247 (3)	0,132 (12)	M1+E2		17,34 (25)	4,23 (6)	23,1 (4)
$\gamma_{36,20}$(Np)	66,92 (1)	0,0205 (6)	E1		0,277 (4)	0,0684 (10)	0,368 (6)
$\gamma_{28,14}$(Np)	67,92 (2)	0,100 (8)	M1+E2		17,7 (19)	4,6 (6)	24 (3)
$\gamma_{6,2}$(Np)	73,72 (1)	0,0101 (7)	E1		0,214 (3)	0,0529 (8)	0,285 (4)
$\gamma_{19,10}$(Np)	75,98 (1)	0,00052 (8)	E2		38,4 (6)	10,70 (15)	52,8 (8)
$\gamma_{11,6}$(Np)	79,48 (1)	0,0033 (8)	M1+E2		19 (3)	5,2 (8)	26 (4)
$\gamma_{27,11}$(Np)	85,16 (7)	0,020 (7)	M1+E2		14,3 (18)	3,9 (6)	19 (3)
$\gamma_{3,0}$(Np)	86,674 (2)	0,205 (7)	M1+E2		5,98 (9)	1,459 (21)	7,95 (12)
$\gamma_{(-1,1)}$(Np)	89,60 (5)	0,0013 (3)					
$\gamma_{9,3}$(Np)	92,48 (1)	0,00324 (35)	E1		0,1184 (17)	0,0291 (4)	0,1574 (22)
$\gamma_{11,5}$(Np)	93,88 (1)	0,0042 (5)	E1		0,1138 (16)	0,0280 (4)	0,1513 (22)
$\gamma_{14,6}$(Np)	96,78 (1)	0,0059 (10)	E2		12,28 (18)	3,42 (5)	16,90 (24)
$\gamma_{30,11}$(Np)	97,18 (2)	0,00013 (7)	E2		12,05 (17)	3,36 (5)	16,58 (24)
$\gamma_{36,14}$(Np)	109,61 (1)	≤ 0,14	M1+E2		4,9 (5)	1,32 (14)	6,7 (7)
$\gamma_{6,1}$(Np)	109,618 (3)	≤ 0,02	E1		0,0760 (11)	0,0186 (3)	0,1010 (15)
$\gamma_{14,5}$(Np)	111,18 (1)	0,0027 (5)	E1		0,0733 (11)	0,0180 (3)	0,0974 (14)
$\gamma_{19,6}$(Np)	122,81 (1)	0,00039 (18)	M1+E2	5,4 (12)	3,11 (22)	0,83 (7)	9,6 (9)
$\gamma_{36,11}$(Np)	126,92 (1)	0,0008 (4)	E2	0,196 (3)	3,51 (5)	0,979 (14)	5,03 (7)
$\gamma_{23,8}$(Np)	131,50 (5)	0,00034 (8)	E1	0,205 (3)	0,0475 (7)	0,01161 (17)	0,268 (4)
$\gamma_{28,8}$(Np)	135,21 (2)	0,0085 (5)	E1	0,192 (3)	0,0443 (7)	0,01081 (16)	0,251 (4)
$\gamma_{6,0}$(Np)	136,045 (2)	0,0118 (3)	E1	0,190 (3)	0,0436 (6)	0,01064 (15)	0,247 (4)
$\gamma_{28,7}$(Np)	139,05 (3)	≤ 0,00014	E1	0,180 (3)	0,0412 (6)	0,01006 (15)	0,235 (4)
$\gamma_{8,1}$(Np)	139,11 (2)	≤ 0,00049	E2	0,211 (3)	2,32 (4)	0,646 (9)	3,40 (5)
$\gamma_{30,7}$(Np)	151,01 (3)	0,000099 (22)	E1	0,1495 (21)	0,0334 (5)	0,00814 (12)	0,194 (3)

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{19,4}$(Np)	152,70 (2)	≤ 0,00082	E1	0,1458 (21)	0,0325 (5)	0,00791 (11)	0,189 (3)
$\gamma_{9,1}$(Np)	152,73 (1)	≤ 0,00082	E1	0,1457 (21)	0,0324 (5)	0,00791 (11)	0,189 (3)
$\gamma_{11,2}$(Np)	153,19 (1)	0,00037 (4)	E1	0,1447 (21)	0,0322 (5)	0,00785 (11)	0,187 (3)
$\gamma_{20,5}$(Np)	153,87 (1)	0,0266 (8)	M1+E2	5,53 (8)	1,123 (16)	0,273 (4)	7,02 (10)
$\gamma_{10,1}$(Np)	156,451 (3)	0,00032 (5)	E1	0,1379 (20)	0,0305 (5)	0,00744 (11)	0,1784 (25)
$\gamma_{(-1,2)}$(Np)	160,61 (2)	0,0004 (2)					
$\gamma_{34,8}$(Np)	163,1 (5)	≤ 0,079	M1+E2	2,5 (5)	1,04 (3)	0,273 (11)	3,9 (5)
$\gamma_{36,9}$(Np)	163,29 (1)	≤ 0,079	M1+E2	2,5 (5)	1,04 (3)	0,272 (11)	3,9 (5)
$\gamma_{(-1,3)}$(Np)	165,97 (15)	0,000046 (23)					
$\gamma_{45,13}$(Np)	170,7 (8)	0,00280 (22)	M1+E2	2,2 (5)	0,882 (23)	0,230 (9)	3,4 (5)
$\gamma_{48,14}$(Np)	174,76 (6)	0,00720 (16)	M1+E2	2,1 (5)	0,809 (17)	0,211 (7)	3,1 (4)
$\gamma_{30,6}$(Np)	176,66 (2)	0,00006 (3)	E2	0,181 (3)	0,804 (12)	0,223 (4)	1,285 (18)
$\gamma_{10,0}$(Np)	182,878 (2)	0,00103 (4)	E1	0,0965 (14)	0,0206 (3)	0,00502 (7)	0,1238 (18)
$\gamma_{11,1}$(Np)	189,10 (1)	0,00030 (5)	E1	0,0894 (13)	0,0190 (3)	0,00462 (7)	0,1146 (16)
$\gamma_{23,4}$(Np)	190,88 (5)	0,00012 (3)	E1	0,0875 (13)	0,0185 (3)	0,00451 (7)	0,1121 (16)
$\gamma_{28,4}$(Np)	194,59 (2)	0,00157 (5)	E1	0,0837 (12)	0,01768 (25)	0,00430 (6)	0,1072 (15)
$\gamma_{19,2}$(Np)	196,52 (1)	0,00011 (5)	E1	0,0819 (12)	0,01725 (25)	0,00419 (6)	0,1048 (15)
$\gamma_{36,6}$(Np)	206,39 (1)	0,0027 (3)	E2	0,1454 (21)	0,412 (6)	0,1138 (16)	0,711 (10)
$\gamma_{20,2}$(Np)	213,19 (1)	0,00015 (5)	M1+E2	1,19 (24)	0,401 (11)	0,1032 (17)	1,73 (25)
$\gamma_{11,0}$(Np)	215,522 (4)	0,00064 (10)	E1	0,0664 (10)	0,01376 (20)	0,00334 (5)	0,0847 (12)
$\gamma_{19,1}$(Np)	232,43 (1)	0,00060 (3)	E1	0,0560 (8)	0,01145 (16)	0,00278 (4)	0,0712 (10)
$\gamma_{(-1,4)}$(Np)	233,69 (10)	0,00013 (3)					
$\gamma_{25,2}$(Np)	236,90 (6)	0,00010 (5)	M1+E2	0,89 (18)	0,280 (12)	0,0717 (21)	1,27 (19)
$\gamma_{27,2}$(Np)	238,35 (7)	0,000017 (9)	E1	0,0530 (8)	0,01078 (16)	0,00261 (4)	0,0673 (10)
$\gamma_{17,0}$(Np)	250,33 (3)	≤ 0,0012	(M1+E2)	0,77 (15)	0,233 (12)	0,0595 (21)	1,08 (16)
$\gamma_{30,2}$(Np)	250,37 (2)	≤ 0,0006	E1	0,0475 (7)	0,00958 (14)	0,00232 (4)	0,0602 (9)
$\gamma_{42,4}$(Np)	270,55 (7)	0,000030 (9)	E1	0,0400 (6)	0,00798 (12)	0,00193 (3)	0,0506 (7)
$\gamma_{25,1}$(Np)	272,80 (6)	0,000069 (15)	M1+E2	0,61 (12)	0,176 (11)	0,0448 (21)	0,85 (13)
$\gamma_{36,2}$(Np)	280,11 (1)	0,000063 (7)	E1	0,0371 (6)	0,00735 (11)	0,00178 (3)	0,0468 (7)
$\gamma_{25,0}$(Np)	299,23 (6)	0,000046 (23)	M1+E2	0,48 (9)	0,131 (9)	0,0332 (19)	0,65 (10)

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		63,3
	$K\alpha_1$	101,059		100
	$K\beta_3$	113,303	}	
	$K\beta_1$	114,234	}	
	$K\beta_5''$	114,912	}	36,7
	$K\beta_2$	117,463	}	
	$K\beta_4$	117,876	}	12,3
	$KO_{2,3}$	118,429	}	
X_L				
	$L\ell$	11,871		
	$L\alpha$	13,761 – 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	63,6
KXY	107,19 – 118,66	9,09
Auger L	6,036 – 13,516	

4 α Emissions

	Energy keV	Probability × 100
$\alpha_{0,68}$	4975 (3)	0,000009 (5)
$\alpha_{0,64}$	5027,3 (15)	0,00009 (5)
$\alpha_{0,59}$	5068 (3)	0,0012 (3)
$\alpha_{0,57}$	5082,6 (12)	0,00014 (5)
$\alpha_{0,56}$	5091,9 (7)	0,0009 (3)
$\alpha_{0,48}$	5143,07 (26)	0,0258 (11)
$\alpha_{0,47}$	5153,2 (15)	0,00009 (5)
$\alpha_{0,42}$	5173,45 (26)	0,00009 (5)
$\alpha_{0,41}$	5175,4 (10)	0,00009 (5)
$\alpha_{0,36}$	5207,15 (25)	0,409 (9)
$\alpha_{0,35}$	5215,4 (7)	0,00014 (5)
$\alpha_{0,28}$	5248,15 (25)	0,0018 (5)
$\alpha_{0,27}$	5248,21 (26)	0,0018 (5)
$\alpha_{0,25}$	5249,64 (26)	0,00009 (5)
$\alpha_{0,23}$	5251,80 (25)	0,00009 (5)
$\alpha_{0,20}$	5272,96 (25)	0,0046 (5)
$\alpha_{0,14}$	5314,95 (25)	0,0028 (5)
$\alpha_{0,11}$	5331,97 (25)	0,0007 (5)
$\alpha_{0,9}$	5367,73 (25)	0,0051 (9)
$\alpha_{0,6}$	5410,13 (25)	0,0046 (9)
$\alpha_{0,3}$	5458,68 (25)	0,00064 (18)
$\alpha_{0,1}$	5517,93 (25)	0,000014 (14)

5 Electron Emissions

		Energy keV	Electrons per 100 disint.
e_{AL}	(Am)	7,143 - 15,146	22,1 (11)
e_{AL}	(Np)	6,036 - 13,516	0,35 (4)
e_{AK}	(Np)		0,0019 (7)
	KLL	73,501 - 83,134	}
	KLX	90,358 - 101,054	}
	KXY	107,19 - 118,66	}
$ec_{1,0\ L}$	(Am)	24,79 - 30,10	47,1 (10)
$ec_{1,0\ M}$	(Am)	42,47 - 44,78	37,6 (9)
$ec_{1,0\ N}$	(Am)	47,0 - 48,2	11,9 (3)

6 Photon Emissions

6.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(Am)	12,377 — 22,836		25,0 (11)	
XL	(Np)	11,871 — 21,491		0,37 (4)	
XKα_2	(Np)	97,069		0,019 (9)	} Kα
XKα_1	(Np)	101,059		0,030 (14)	}
XKβ_3	(Np)	113,303	}		
XKβ_1	(Np)	114,234	}	0,011 (5)	K$'\beta_1$
XKβ_5''	(Np)	114,912	}		
XKβ_2	(Np)	117,463	}		
XKβ_4	(Np)	117,876	}	0,0037 (17)	K$'\beta_2$
XKO$_{2,3}$	(Np)	118,429	}		

6.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{3,2}$(Np)	24,34 (1)	0,000064 (9)
$\gamma_{1,0}$(Np)	26,427 (2)	< 0,000708
$\gamma_{11,10}$(Np)	32,64 (1)	0,000019 (3)
$\gamma_{9,6}$(Np)	43,11 (1)	0,000064 (14)
$\gamma_{19,11}$(Np)	43,33 (1)	0,0000087 (14)
$\gamma_{10,6}$(Np)	46,833 (3)	0,0000074 (14)
$\gamma_{1,0}$(Am)	48,60 (5)	0,0001414 (22)
$\gamma_{6,3}$(Np)	49,371 (3)	0,134 (4)
$\gamma_{14,9}$(Np)	53,67 (1)	0,0021 (3)
$\gamma_{30,19}$(Np)	53,85 (2)	0,0000028 (14)
$\gamma_{9,5}$(Np)	57,51 (1)	0,00097 (23)
$\gamma_{3,1}$(Np)	60,247 (3)	0,0055 (5)
$\gamma_{36,20}$(Np)	66,92 (1)	0,0150 (5)
$\gamma_{28,14}$(Np)	67,92 (2)	0,0040 (3)
$\gamma_{6,2}$(Np)	73,72 (1)	0,0079 (6)
$\gamma_{19,10}$(Np)	75,98 (1)	0,0000097 (14)
$\gamma_{11,6}$(Np)	79,48 (1)	0,000124 (23)
$\gamma_{27,11}$(Np)	85,16 (7)	0,0010 (3)
$\gamma_{3,0}$(Np)	86,674 (2)	0,0229 (7)
$\gamma_{(-1,1)}$(Np)	89,60 (5)	0,0013 (3)
$\gamma_{9,3}$(Np)	92,48 (1)	0,0028 (3)
$\gamma_{11,5}$(Np)	93,88 (1)	0,0036 (4)
$\gamma_{14,6}$(Np)	96,78 (1)	0,00033 (6)

	Energy keV	Photons per 100 disint.
$\gamma_{30,11}$(Np)	97,18 (2)	0,000007 (4)
$\gamma_{36,14}$(Np)	109,61 (1)	≤ 0,0184
$\gamma_{6,1}$(Np)	109,618 (3)	≤ 0,0184
$\gamma_{14,5}$(Np)	111,18 (1)	0,0025 (4)
$\gamma_{19,6}$(Np)	122,81 (1)	0,00004 (2)
$\gamma_{36,11}$(Np)	126,92 (1)	0,00013 (7)
$\gamma_{23,8}$(Np)	131,50 (5)	0,00027 (6)
$\gamma_{28,8}$(Np)	135,21 (2)	0,0068 (4)
$\gamma_{6,0}$(Np)	136,045 (2)	0,0094 (3)
$\gamma_{28,7}$(Np)	139,05 (3)	≤ 0,00011
$\gamma_{8,1}$(Np)	139,11 (2)	≤ 0,00011
$\gamma_{30,7}$(Np)	151,01 (3)	0,000083 (18)
$\gamma_{19,4}$(Np)	152,70 (2)	≤ 0,00069
$\gamma_{9,1}$(Np)	152,73 (1)	≤ 0,00069
$\gamma_{11,2}$(Np)	153,19 (1)	0,00031 (4)
$\gamma_{20,5}$(Np)	153,87 (1)	0,00332 (10)
$\gamma_{10,1}$(Np)	156,451 (3)	0,00027 (5)
$\gamma_{(-1,2)}$(Np)	160,61 (2)	0,00041 (18)
$\gamma_{34,8}$(Np)	163,1 (5)	≤ 0,0161
$\gamma_{36,9}$(Np)	163,29 (1)	≤ 0,0161
$\gamma_{(-1,3)}$(Np)	165,97 (15)	0,000046 (23)
$\gamma_{45,13}$(Np)	170,7 (8)	0,00063 (5)
$\gamma_{48,14}$(Np)	174,76 (6)	0,00017 (4)
$\gamma_{30,6}$(Np)	176,66 (2)	0,000028 (14)
$\gamma_{10,0}$(Np)	182,878 (2)	0,00092 (3)
$\gamma_{11,1}$(Np)	189,10 (1)	0,00027 (5)
$\gamma_{23,4}$(Np)	190,88 (5)	0,000106 (24)
$\gamma_{28,4}$(Np)	194,59 (2)	0,00142 (5)
$\gamma_{19,2}$(Np)	196,52 (1)	0,00010 (5)
$\gamma_{36,6}$(Np)	206,39 (1)	0,00156 (18)
$\gamma_{20,2}$(Np)	213,19 (1)	0,000055 (18)
$\gamma_{11,0}$(Np)	215,522 (4)	0,00059 (10)
$\gamma_{19,1}$(Np)	232,43 (1)	0,00056 (3)
$\gamma_{(-1,4)}$(Np)	233,69 (10)	0,00013 (3)
$\gamma_{25,2}$(Np)	236,90 (6)	0,000046 (23)
$\gamma_{27,2}$(Np)	238,35 (7)	0,000016 (8)
$\gamma_{17,0}$(Np)	250,33 (3)	≤ 0,00056
$\gamma_{30,2}$(Np)	250,37 (2)	≤ 0,00056
$\gamma_{42,4}$(Np)	270,55 (7)	0,000029 (8)
$\gamma_{25,1}$(Np)	272,80 (6)	0,000037 (8)
$\gamma_{36,2}$(Np)	280,11 (1)	0,000060 (6)
$\gamma_{25,0}$(Np)	299,23 (6)	0,000028 (14)

7 Main Production Modes

Am – 241(n,γ)Am – 242m

U – 238(n,γ), beta decay and (n,γ)

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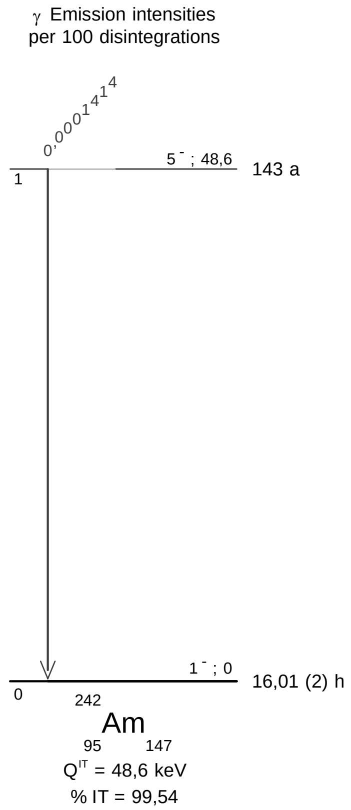
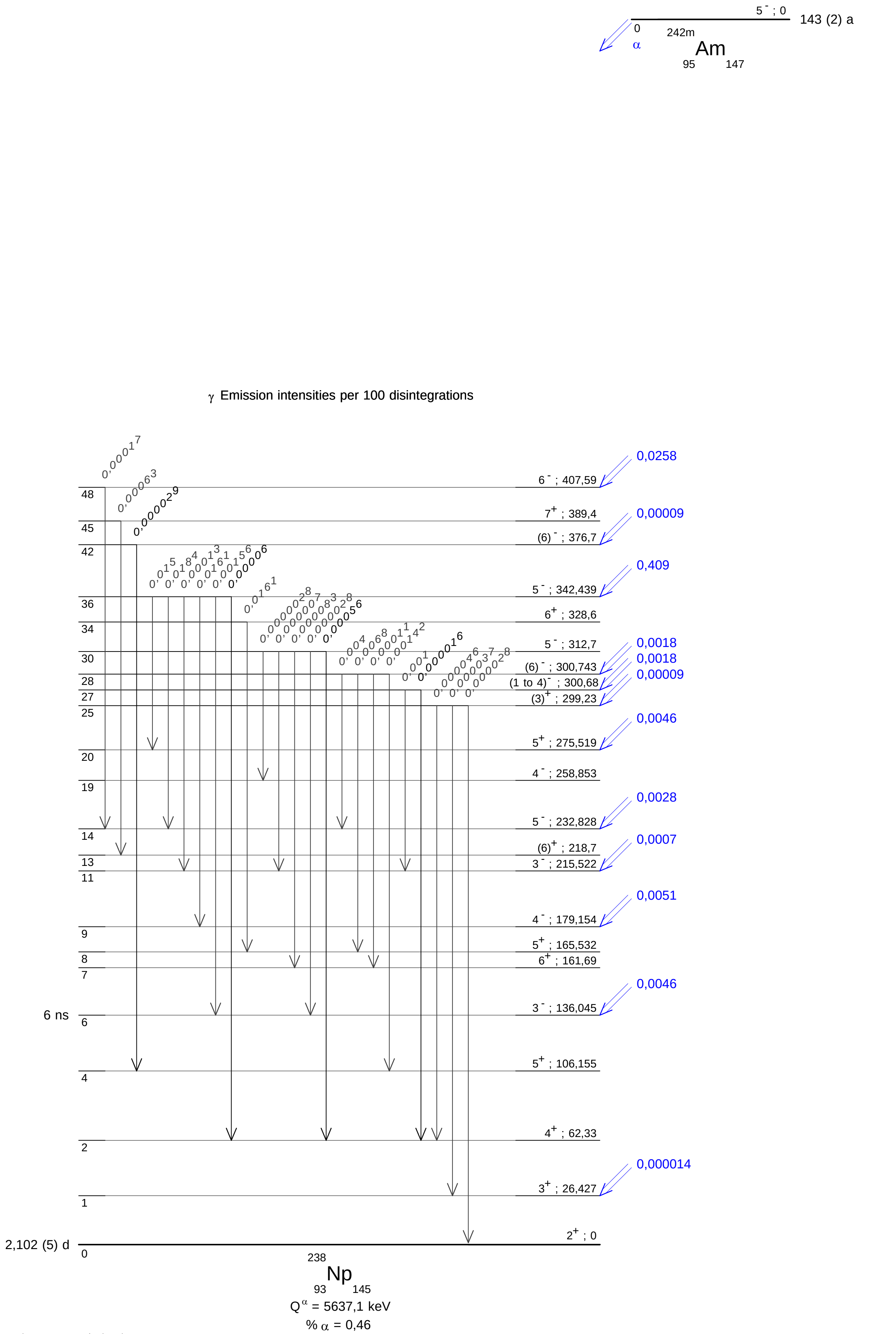
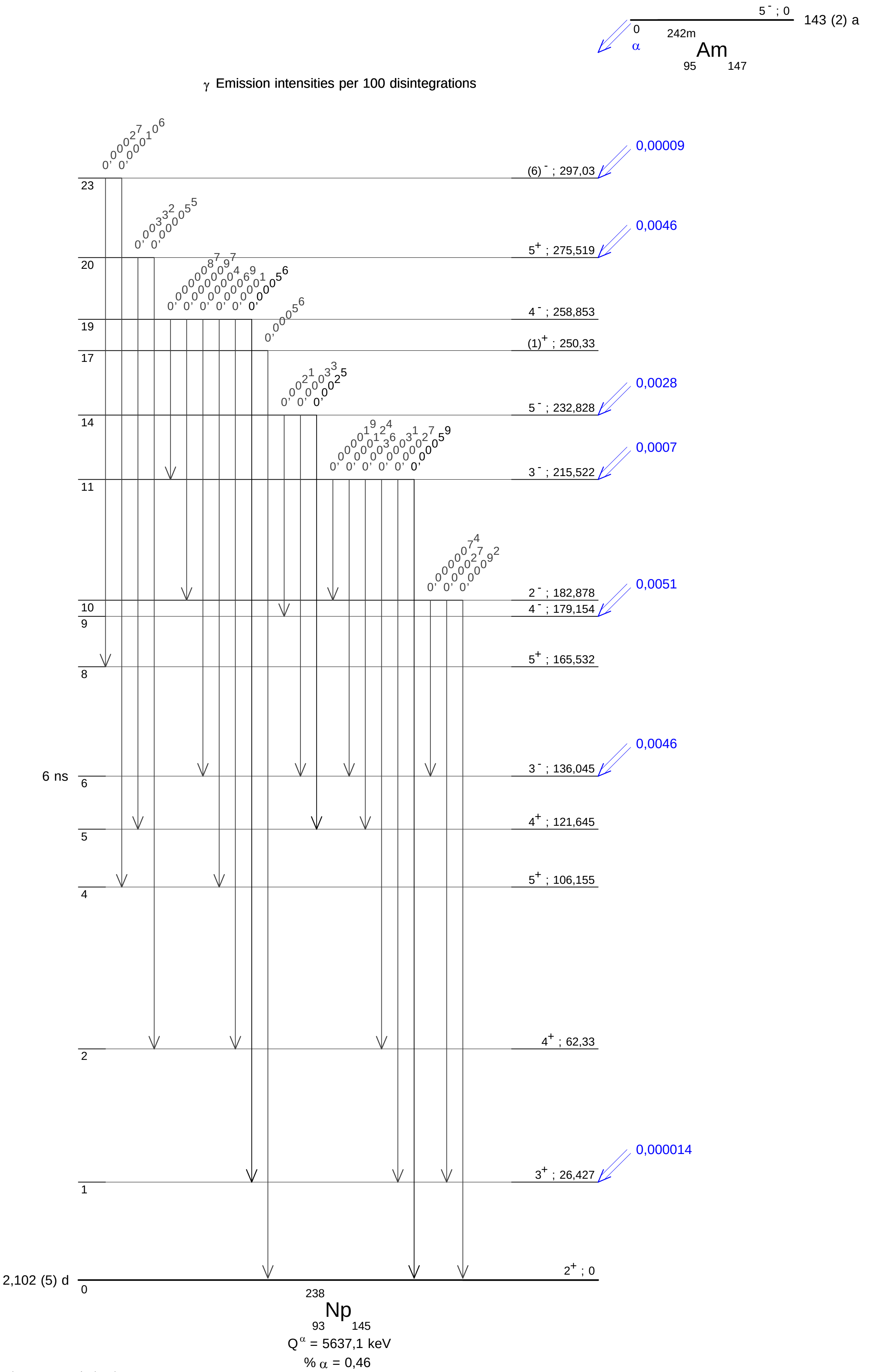
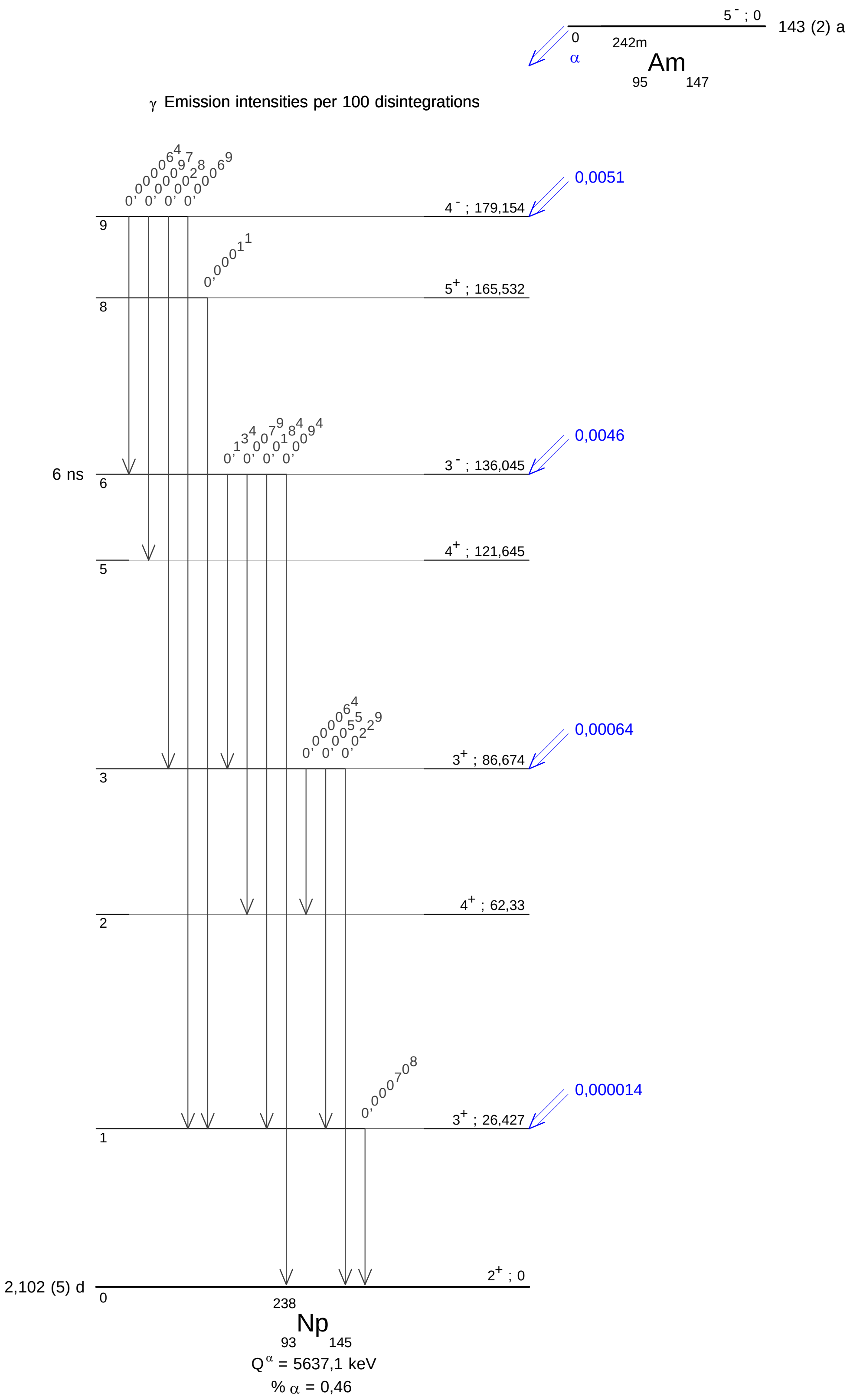

γ Emission intensities
per 100 disintegrations
0,000141
5⁻ ; 48,6
143 a
1
1⁻ ; 0
16,01 (2) h
0
242
Am
95
147
Q^IT = 48,6 keV
% IT = 99,54

$^{242m}_{95}Am_{147}$




5 - ; 0
143 (2) a
0
α
242m
Am
95 147
γ Emission intensities per 100 disintegrations
0,00009
0,0046
0,0028
0,0007
0,0051
0,0046
0,000014
(6) - ; 297,03
5+ ; 275,519
4 - ; 258,853
(1)+ ; 250,33
5 - ; 232,828
3 - ; 215,522
2 - ; 182,878
4 - ; 179,154
5+ ; 165,532
3 - ; 136,045
4+ ; 121,645
5+ ; 106,155
4+ ; 62,33
3+ ; 26,427
2+ ; 0
6 ns
2,102 (5) d
238
Np
93 145
Qα = 5637,1 keV
% α = 0,46



5⁻ ; 0
143 (2) a
0
α
242m Am 95 147
γ Emission intensities per 100 disintegrations
0,0051
4⁻ ; 179,154
5⁺ ; 165,532
0,0046
6 ns
3⁻ ; 136,045
4⁺ ; 121,645
0,00064
3⁺ ; 86,674
4⁺ ; 62,33
0,000014
3⁺ ; 26,427
2,102 (5) d
2⁺ ; 0
238 Np 93 145
Qα = 5637,1 keV
% α = 0,46

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