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THE LIBRARY OF FISSION PRODUCTS DECAY DATA

BY

J. BLACHOT and C. FICHE (1978)

Contents and Documentation

Abstract

This document summarizes contents and documentation of the 1978 version of the Library of Fission Products Decay Data by J. Blachot and C. Fiche. The Library contains data for 599 fission products. The main data are half-lives, Q-values and branching ratios, energies and intensities of the transitions.

The Library can be obtained on magnetic tape, free of charge, from the IAEA Nuclear Data Section.

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The Library of Fission Products Decay Data

by J. Blachot and C. Fiche

Version of 1978

CONTENTS

The Library contains data for 699 isotopes ranging from 29-Cu-71 through 70-Yb-170 (for a complete list see Annex I).

The data are arranged in an increasing order of atomic number. The following data are given:

- Half-life
- Q-values and branching ratios in percent for various decay modes
- The energies and intensities of the  $\alpha$ ,  $\beta^+$ ,  $\beta^-$  and  $\gamma$  transitions
- Average energy of  $\beta$  for most of the transitions
- Ratio of electron capture in  $\beta^+$  transitions
- Nature of the  $\beta$  transitions (1st and 2nd forbidden)
- Internal conversion coefficients, multipolarity and the mixing ratio for most of the  $\gamma$  rays

Bibliographic references and, for most of the data, uncertainties are also provided.

FORMAT

Format description is summarized in Table I and Annex II.

DOCUMENTATION

- J. Blachot et al., Bibliotheque de donnees nucleaires relatives aux produits de fission, Note CEA-N-1822 (1975)
- J. Blachot, C. Fiche, Gamma-ray and Half-life Data for the Fission Products, At. Data and Nucl. Data Tables 20, 241-310 (1977)
- J. Blachot, C. Fiche, Bibliotheque de donnees nucleaires non neutroniques des isotopes radioactifs produits de fission et noyaux lourds, Proc. of an International Conference on Neutron Physics and Nuclear Data, Harwell Sept. 1978, p. 215

ANNEX I

LIST OF ISOTOPES

F = ground state; M = metastable state, N = third isomer.

29-Cu-71	30-Zn-78	35-Br-82-M
30-Zn-71-M	31-Ga-78	35-Br-82-F
30-Zn-71-F	32-Ge-78	36-Kr-82
31-Ga-71	33-As-78	31-Ga-83
29-Cu-72	34-Se-78	32-Ge-83
30-Zn-72	30-Zn-79	33-As-83
31-Ga-72	31-Ga-79	34-Se-83-M
32-Ge-72	32-Ge-79	34-Se-83-F
29-Cu-73	33-As-79	35-Br-83
30-Zn-73	34-Se-79-M	36-Kr-83-M
31-Ga-73	34-Se-79-F	36-Kr-83-F
32-Ge-73-M	35-Br-79-M	31-Ga-84
32-Ge-73-F	35-Br-79-F	32-Ge-84
30-Zn-74	31-Ga-80	33-As-84
31-Ga-74	32-Ge-80	34-Se-84
32-Ge-74	33-As-80	35-Br-84-M
30-Zn-75	34-Se-80	35-Br-84-F
31-Ga-75	35-Br-80-M	36-Kr-84
32-Ge-75-M	35-Br-80-F	32-Ge-85
32-Ge-75-F	36-Kr-80	33-As-85
33-As-75	31-Ga-81	34-Se-85
30-Zn-76	32-Ge-81	35-Br-85
31-Ga-76	33-As-81	36-Kr-85-M
32-Ge-76	34-Se-81-M	36-Kr-85-F
33-As-76	34-Se-81-F	37-Rb-85
34-Se-76	35-Br-81	32-Ge-86
30-Zn-77	36-Kr-81-M	33-As-86
31-Ga-77	36-Kr-81-F	34-Se-86
32-Ge-77-M	31-Ga-82	35-Br-86
32-Ge-77-F	32-Ge-82	36-Kr-86
33-As-77	33-As-82-M	37-Rb-86-M
34-Se-77-M	33-As-82-F	37-Rb-86-F
34-Se-77-F	34-Se-82	38-Sr-86

Annex I (cont'd)

33-As-87	34-Se-92	37-Rb-96
34-Se-87	35-Br-92	38-Sr-97
35-Br-87	36-Kr-92	39-Y-97-M
36-Kr-87	37-Rb-92	39-Y-97-F
37-Rb-87	38-Sr-92	40-Zr-97
38-Sr-87-M	39-Y-92	41-Nb-97-M
38-Sr-87-F	40-Zr-92	41-Nb-97-F
33-As-88	36-Kr-93	42-Mo-97
34-Se-88	37-Rb-93	37-Rb-98
35-Br-88	38-Sr-93	38-Sr-98
36-Kr-88	39-Y-93-M	39-Y-98-M
37-Rb-88	39-Y-93-F	39-Y-98-F
38-Sr-88	40-Zr-93	40-Zr-98
34-Se-89	41-Nb-93-M	41-Nb-98-M
35-Br-89	41-Nb-93-F	41-Nb-98-F
36-Kr-89	36-Kr-94	42-Mo-98
37-Rb-89	37-Rb-94	43-Tc-98
38-Sr-89	38-Sr-94	44-Ru-98
39-Y-89-M	39-Y-94	37-Rb-99
39-Y-89-F	40-Zr-94	38-Sr-99
34-Se-90	41-Nb-94-M	39-Y-99
35-Br-90	41-Nb-94-F	40-Zr-99
36-Kr-90	42-Mo-94	41-Nb-99-M
37-Rb-90-M	36-Kr-95	41-Nb-99-F
37-Rb-90-F	37-Rb-95	42-Mo-99
38-Sr-90	38-Sr-95	43-Tc-99-M
39-Y-90-M	39-Y-95	43-Tc-99-F
39-Y-90-F	40-Zr-95	44-Ru-99
40-Zr-90-M	41-Nb-95-M	39-Y-100
40-Zr-90-F	41-Nb-95-F	40-Zr-100
34-Se-91	42-Mo-95	41-Nb-100-M
35-Br-91	37-Rb-96	41-Nb-100-F
36-Kr-91	38-Sr-96	42-Mo-100
37-Rb-91	39-Y-96-M	43-Tc-100
38-Sr-91	39-Y-96-F	44-Ru-100
39-Y-91-M	40-Zr-96	39-Y-101
39-Y-91-F	41-Nb-96	40-Zr-101
40-Zr-91	42-Mo-96	41-Nb-101

Annex I (cont'd)

42-Mo-101	45-Rh-106-F	45-Rh-111
43-Tc-101	46-Pd-106	46-Pd-111-M
44-Ru-101	42-Mo-107	46-Pd-111-F
39-Y-102	43-Tc-107	47-Ag-111-M
40-Zr-102	44-Ru-107	47-Ag-111-F
41-Nb-102	45-Rh-107	48-Cd-111-M
42-Mo-102	46-Pd-107-M	48-Cd-111-F
43-Tc-102-M	46-Pd-107-F	43-Tc-112
43-Tc-102-F	47-Ag-107-M	44-Ru-112
44-Ru-102	47-Ag-107-F	45-Rh-112
40-Zr-103	42-Mo-108	46-Pd-112
41-Nb-103	43-Tc-108	47-Ag-112
42-Mo-103	44-Ru-108	48-Cd-112
43-Tc-103	45-Rh-108-M	44-Ru-113
44-Ru-103	45-Rh-108-F	45-Rh-113
45-Rh-103-M	46-Pd-108	46-Pd-113
45-Rh-103-F	47-Ag-108-M	47-Ag-113-M
40-Zr-104	47-Ag-108-F	47-Ag-113-F
41-Nb-104-M	48-Cd-108	48-Cd-113-M
41-Nb-104-F	43-Tc-109	48-Cd-113-F
42-Mo-104	44-Ru-109-M	49-In-113-M
43-Tc-104	44-Ru-109-F	49-In-113-F
44-Ru-104	45-Rh-109	45-Rh-114
45-Rh-104-M	46-Pd-109-M	46-Pd-114
45-Rh-104-F	46-Pd-109-F	47-Ag-114-M
46-Pd-104	47-Ag-109-M	47-Ag-114-F
41-Nb-105	47-Ag-109-F	48-Cd-114
42-Mo-105	48-Cd-109	49-In-114-M
43-Tc-105	42-Mo-110	49-In-114-F
44-Ru-105	43-Tc-110	50-Sn-114
45-Rh-105-M	44-Ru-110	46-Pd-115
45-Rh-105-F	45-Rh-110-M	47-Ag-115-M
46-Pd-105	45-Rh-110-F	47-Ag-115-F
41-Nb-106	46-Pd-110	48-Cd-115-M
42-Mo-106	47-Ag-110-M	48-Cd-115-F
43-Tc-106	47-Ag-110-F	49-In-115-M
44-Ru-106	48-Cd-110	49-In-115-F
45-Rh-106-M	44-Ru-111	50-Sn-115

Annex I (cont'd)

46-Pd-116	49-In-120-F	50-Sn-125-M
47-Ag-116-M	50-Sn-120	50-Sn-125-F
47-Ag-116-F	47-Ag-121	51-Sb-125
48-Cd-116	48-Cd-121-M	52-Te-125-M
49-In-116-M	48-Cd-121-F	52-Te-125-F
49-In-116-N	49-In-121-M	48-Cd-126
49-In-116-F	49-In-121-F	49-In-126
50-Sn-116	50-Sn-121-M	50-Sn-126
46-Pd-117	50-Sn-121-F	51-Sb-126-M
47-Ag-117-M	51-Sb-121	51-Sb-126-F
47-Ag-117-F	47-Ag-122	52-Te-126
48-Cd-117-M	48-Cd-122	49-In-127-M
48-Cd-117-F	49-In-122-M	49-In-127-F
49-In-117-M	49-In-122-F	50-Sn-127-M
49-In-117-F	50-Sn-122	50-Sn-127-F
50-Sn-117-M	51-Sb-122-M	51-Sb-127
50-Sn-117-F	51-Sb-122-F	52-Te-127-M
46-Pd-118	52-Te-122	52-Te-127-F
47-Ag-118-M	47-Ag-123	53-I-127
47-Ag-118-F	48-Cd-123	48-Cd-128
48-Cd-118	49-In-123-M	49-In-128
49-In-118-M	49-In-123-F	50-Sn-128
49-In-118-N	50-Sn-123-M	51-Sb-128-M
49-In-118-F	50-Sn-123-F	51-Sb-128-F
50-Sn-118	51-Sb-123	52-Te-128
46-Pd-119	52-Te-123-M	53-I-128
47-Ag-119	52-Te-123-F	54-Xe-128
48-Cd-119-M	48-Cd-124	49-In-129-M
48-Cd-119-F	49-In-124	49-In-129-F
49-In-119-M	50-Sn-124	50-Sn-129-M
49-In-119-F	51-Sb-124-M	50-Sn-129-F
50-Sn-119-M	51-Sb-124-N	51-Sb-129
50-Sn-119-F	51-Sb-124-F	52-Te-129-M
46-Pd-120	52-Te-124	52-Te-129-F
47-Ag-120-M	47-Ag-125	53-I-129
47-Ag-120-F	48-Cd-125	54-Xe-129-M
48-Cd-120	49-In-125-M	54-Xe-129-F
49-In-120-M	49-In-125-F	49-In-130

Annex I (cont'd)

50-Sn-130-M	52-Te-134	55-Cs-138-M
50-Sn-130-F	53-I-134-M	55-Cs-138-F
51-Sb-130-M	53-I-134-F	56-Ba-138
51-Sb-130-F	54-Xe-134-M	52-Te-139
52-Te-130	54-Xe-134-F	53-I-139
53-I-130-M	55-Cs-134-M	54-Xe-139
53-I-130-F	55-Cs-134-F	55-Cs-139
54-Xe-130	56-Ba-134	56-Ba-139
49-In-131-M	50-Sn-135	57-La-139
49-In-131-F	51-Sb-135	52-Te-140
50-Sn-131-M	52-Te-135	53-I-140
50-Sn-131-F	53-I-135	54-Xe-140
51-Sb-131	54-Xe-135-M	55-Cs-140
52-Te-131-M	54-Xe-135-F	56-Ba-140
52-Te-131-F	55-Cs-135	57-La-140
53-I-131	56-Ba-135-M	58-Ce-140
54-Xe-131-M	56-Ba-135-F	52-Te-141
54-Xe-131-F	56-Sn-136	53-I-141
49-In-132	51-Sb-136	54-Xe-141
50-Sn-132	52-Te-136	55-Cs-141
51-Sb-132-M	53-I-136-M	56-Ba-141
51-Sb-132-F	53-I-136-F	57-La-141
52-Te-132	54-Xe-136	58-Ce-141
53-I-132-M	55-Cs-136-M	59-Pr-141
53-I-132-F	55-Cs-136-F	54-Xe-142
54-Xe-132	56-Ba-136-M	55-Cs-142
50-Sn-133	56-Ba-136-F	56-Ba-142
51-Sb-133	51-Sb-137	57-La-142
52-Te-133-M	52-Te-137	58-Ce-142
52-Te-133-F	53-I-137	59-Pr-142-M
53-I-133-M	54-Xe-137	59-Pr-142-F
53-I-133-F	55-Cs-137	60-Nd-142
54-Xe-133-M	56-Ba-137-M	54-Xe-143
54-Xe-133-F	56-Ba-137-F	55-Cs-143
55-Cs-133	51-Sb-138	56-Ba-143
50-Sn-134	52-Te-138	57-La-143
51-Sb-134-M	53-I-138	58-Ce-143
51-Sb-134-F	54-Xe-138	59-Pr-143

Annex I (cont'd)

60-Nd-143	61-Pm-148-M	61-Pm-154-F
54-Xe-144	61-Pm-148-F	62-Sm-154
55-Cs-144	62-Sm-148	63-Eu-154
56-Ba-144	57-La-149	64-Gd-154
57-La-144	58-Ce-149	60-Nd-155
58-Ce-144	59-Pr-149	61-Pm-155
59-Pr-144-M	60-Nd-149	62-Sm-155
59-Pr-144-F	61-Pm-149	63-Eu-155
60-Nd-144	62-Sm-149	64-Gd-155
54-Xe-145	57-La-150	61-Pm-156
55-Cs-145	58-Ce-150	62-Sm-156
56-Ba-145	59-Pr-150	63-Eu-156
57-La-145	60-Nd-150	64-Gd-156
58-Ce-145	61-Pm-150	61-Pm-157
59-Pr-145	62-Sm-150	62-Sm-157
60-Nd-145	58-Ce-151	63-Eu-157
55-Cs-146	59-Pr-151	64-Gd-157
56-Ba-146	60-Nd-151	62-Sm-158
57-La-146-M	61-Pm-151	63-Eu-158
57-La-146-F	62-Sm-151	64-Gd-158
58-Ce-146	63-Eu-151	62-Sm-159
59-Pr-146	59-Pr-152	63-Eu-159
60-Nd-146	60-Nd-152	64-Gd-159
54-Xe-147	61-Pm-152-M	65-Tb-159
55-Cs-147	61-Pm-152-F	63-Eu-160
56-Ba-147	62-Sm-152	64-Gd-160
57-La-147	63-Eu-152-M	65-Tb-160
58-Ce-147	63-Eu-152-N	66-Dy-160
59-Pr-147	63-Eu-152-F	63-Eu-161
60-Nd-147	64-Gd-152	64-Gd-161
61-Pm-147	59-Pr-153	65-Tb-161
62-Sm-147	60-Nd-153	66-Dy-161
56-Ba-148	61-Pm-153	63-Eu-162
57-La-148	62-Sm-153	64-Gd-162
58-Ce-148	63-Eu-153	65-Tb-162
59-Pr-148-M	64-Gd-153	66-Dy-162
59-Pr-148-F	60-Nd-154	64-Gd-163
60-Nd-148	61-Pm-154-M	65-Tb-163



Annex I (cont'd)

66-Dy-163	67-Ho-166-M	66-Dy-169
64-Gd-164	67-Ho-166-F	67-Ho-169
65-Tb-164	68-Er-166	68-Er-169
66-Dy-164	66-Dy-167	69-Tm-169
65-Tb-165	67-Ho-167	66-Dy-170
66-Dy-165-M	68-Er-167-M	67-Ho-170-M
66-Dy-165-F	68-Er-167-F	67-Ho-170-F
67-Ho-165	66-Dy-168	68-Er-170
65-Tb-166	67-Ho-168	69-Tm-170
66-Dy-166	68-Er-168	70-Yb-170



ANNEX II

VARIABLES AND THEIR DESCRIPTION

Variable	Description
Z	Atomic number
ANUC (S)	Chemical symbol
IAT (A)	Mass number
ISOM (I)	Isomeric state
T	Half-life
DT	Uncertainty on T
UT (U)	Unit of T; S: Second M: Minute H: Hour J: Day A: Year
RT	Reference for T
JPAR	Spin and Parity
MODE	Decay modes: QBF-: $\beta^-$ decay to funda- mental level QBM-: $\beta^-$ decay to meta- stablestate EIT-: Isomeric transition QBF+: $\beta^+$ decay to funda- mental level QBM+: $\beta^+$ decay to meta- stablestate END : Delayed neutrons ( $\beta^-, n$ ) ALFA: $\alpha$ decay to funda- mental level ALFM: $\alpha$ decay to meta- stablestate FISP: Spontaneous fission QH+: Proton emission
Q	Q value (keV)
DQ	Uncertainty on Q (keV)
RO	Reference for Q

Variable	Description
B	Branching ratio (%)
DB	Uncertainty on B
RB	Reference for B
JPAR	Spin and parity of the daughter nucleus
SPEC	Spectrum: 3TA-: $\beta^-$ spectrum 3TA+: $\beta^+$ spectrum GAMA: $\gamma$ spectrum APHA: $\alpha$ spectrum
NTR	Number of transitions
FN	Normalization
AR	<u>A</u> bsolut or <u>R</u> elatif values
DFN	Uncertainty on FN
NVTR	Number of values per transition: For $\beta^{\pm}$ : NVTR = 6 or 4 " $\gamma$ : NVTR = 8 " $\alpha$ : NVTR = 4
E	Energy (keV)
DE	Uncertainty on E (keV)
I	Intensity
DI	Uncertainty on I
EM	Average energy of $\beta^-$ (keV)
DEM	Uncertainty on EM
FCE	Electron capture ratio (%)
A	Total conversion coeffi- cient

Annex II (cont'd)

Variable	Description
DA	Uncertainty on A
MP	Multipolarity of $\gamma$
ML	Mixing ratio
SUPP	Supplementary Data
NC	Number of cards containing the supplementary data
NVC	Number of values per card (= 6)
CK	Ratio of K capture (%)
CL	Ratio of L capture (%)
CM	Ratio of M capture (%)

Variable	Description
CN	Ratio of N capture (%)
K/T	K conversion coefficient
L/T	L conversion coefficient
IESM	Value 1.0 is imposed
EMSP	Keyword
ESM	Average energy
CESM	Comments on ESM
DESM	Uncertainty on ESM (keV)
CMN	Comment
NC	Number of comment cards