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JUELGAM - 78

Jülich Decay-Gamma Data File

1978

Contents and Format Description

Abstract

The Jülich Decay-Gamma Data File is a compilation of the γ and X-rays data for about 1300 radionuclides. The total number of lines included amounts to about 32000 γ-lines. This version supersedes the 1975 version.
The library can be obtained on magnetic tape, free of charge, from the IAEA Nuclear Data Section.

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JUELGAM-78

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1. Introduction

The JÜLICH Library is a compilation of the γ-rays and X-rays of a large set of known radionuclides. Actually, this library is a computer readable form of the Table 1 presented in JÜL-1003-AC.

The Library contains a total of about 1300 radionuclides with more than 32000 γ-lines. The newest version of this library at NDS is JÜLICH 78 which supersedes the JÜLICH 75.

The record length is 100-bytes and each nuclide corresponds to a physical data set.

2. Format

For each nuclide there are three types of records. The first two types give general information about the nuclide (e.g. half-life, generating reactions etc) and also the references used for compilation of the set of data on the radionuclide concerned. The third type of record contains the gamma-energies and intensities.

In the following lines the format of each record and also a brief description of each field are presented.

1st-type Record Contains

	Description	Columns	
1.	Atomic number	1-3	(right adjusted)
2.	Symbol	5-6	(" ")
3.	Mass number	8-10	(" ")
4.	Mesomeric states	11	
5.	Half-life	13-21	
6.	Half-life unit	22	
7.	First daughter	24-29	
8.	Comma	30	
9.	Second daughter	31-36	(if exists)
10.	Comma	37	
11.	Third daughter	38-43	
12.	First generation reaction		
	- type	45-47	
	- target nuclide	49-53	
13.	Comma	64	
14.	Second generation reaction		(if exists)
	- type	55-57	
	- target nuclide	59-63	

	Description	Columns	
15.	Comma	64	(if exists)
16.	Third generation reaction		
	- type	65-67	
	- target nuclide	69-73	
17.	Sequence field	95-100	

Field 4 - Mesomeric states

The mesomeric states are characterized by $\underline{\underline{M}}$ or $\underline{\underline{N}}$ after the mass number where N means the state with a higher energy. Mesomeric states with half-life less than 1/10 sec are omitted.

If the energetic order of an isomeric pair is unknown or if radionuclides with the same ZA number but with different decay properties are included they are distinguished by A or B in this field.

Field 5 - Half-lives

Half-lives longer than 1×10^6 years are written in exponential form.

Remarks: As this tape was written by PL/I programs the format of half-lives is not fixed and one should be careful in reading the tape with a FORTRAN program.

Field 6 - Half-life units

The abbreviations used are:

A - years
D - days
H - hours
M - minutes
S - seconds

Field 7, 9, 11 - Daughters

As the γ-ray spectrum of a daughter radionuclide is often valuable in identifying the parent nuclide, the daughter nuclides are listed.

Pure β or α nuclides are omitted.

If mesomeric states occur in the decay scheme they are listed if their half-life is longer than 1/10 sec.

The fission products from spontaneously fissioning nuclides (e.g. Cf-252) are understood as daughter and this type of decay is indicated by SFI (the abundance per 100 decay is then given)

Field 12, 14, 16 - Generation reactions

These fields are divided in type of bombarding particles and target nuclides:

The types are:

NTH Slow neutrons; mainly (n,γ) reactions by thermal and epithermal neutrons and the low energy (n,α) reactions.

NFA Fast neutrons; mainly (n,α)-, (n,p)-, (n,n') and (n,2n)- reactions.

NFI Nuclear fission. The numbers following this symbol are the chain yields in percent for thermal neutron fission of ^{235}U as cited in ref. (10). The symbol "CF 252" at this place indicates that this nuclide is observed in the spontaneous fission of ^{252}Cf.

NAT Naturally occurring radionuclide. The numbers following this symbol give the abundances in percent in the natural isotopic mixture of the element. Nuclide symbols here indicate the membership to one of the natural α-decay series or to the artificial series of ^{233}U.

PHO Photons; mainly (γ,n)-, (γ,γ')- and (γ,p)-reactions, in some cases more complex high energy photon induced reactions.

CHA Charged particles; the symbol includes all types of reactions induced by protons, deuterons, tritons, ^{3}He-ions, alpha particles and heavy ions.

2nd-type Record Contains

	Description		Columns
1.	Number of data points		1-3
2.	First reference		4-10
3.	Comma		11
4.	Second reference		12-18
5.	Comma		19
6.	Third reference		20-26
7.	Comma		27
8.	Fourth reference		28-34
9.	1st Parent Nuclide	Symbol + mass number	37-42
10.		Half life	47-53
11.		Half life unite	54
12.	Comma		55
13.	2nd Parent Nuclide	Symbol + mass number	56-61
14.		Half life	66-72
15.		Half life unit	73
16.	Sequence number		95-100

Field 1 - Number of data points

This is an integer number (right justified only in JÜLICH 78 version) meaning how many 3rd type records we have for this nuclide.

This number may be zero.

Field 2, 4, 6 - References

A listing of references used is given in appendix A. When no

γ-ray line is presented for the nuclide (Field 1 equals zero) in the reference fields "NO GAMMA LINES" is printed.

Field 9 to 15 - Parent nuclides

Precursor with half-life longer than that of the actual nuclide are included with symbol and half life. In this case for half-life and half-life unit see comments of Field 5/6 of the 1st type record.

3rd type Record Contains

	Description	Columns
1.	γ or X energy	1-8
2.	Intensity	10-18
3.	Code	20-23
4.	Atomic number	81-83
5.	Symbol	85-86
6.	Mass number	88-90
7.	Mesomeric state	91
8.	Sequence number	95-100

Field 2 - Intensity

The scape lines are listed together with other γ-lines. For reasons of clarity and economy of space only the more intense escape are given and marked as "PAIR PEAK" in the intensity column.

Field 3 - Codes

The following codes are in use:

A Absolute intensity (γ-ray abundance, photons per 100 decays)

R Relative intensity (intensity of the γ-ray relative to the most intense γ-line of the nuclide, taken as 100)

X X-ray line

A X Absolute intensity of an X-ray line (photons per 100 decay events)

R X Relative intensity of an X-ray line. This value is in accord with the intensity scale mentioned under "R". The most intense line may also be an X-ray line

D Unresolved doublet-line

C Complex line, contains two or more unresolved γ-lines

W γ-line with weak intensity

? Existence of γ-transition is doubtful

< Intensity is smaller or equal to the value given

In consequence of the occasionally changing concept in the history of this table's compilation, the remarks D, C, W, ?, and < have not been consistently used and are omitted, with the data sets of some nuclides.

The following figure gives an example of the JÜLICH 78 library:

```
1st type  4 BE   7      53.4D                    CHA LI  7,CHA LI  6,PHO BE
2nd type  170 MA 3
3rd type 0.47755  10.30000 A
1st type  4 BE  10     1.6E+06A                  NTH BE  9,CHA BE  9
2nd type  ONO GAMMA LINES
1st type  4 BE  11       13.8S                   NFA  B 11
2nd type 1071 AL 1
          1.10280 PAIR PEAK
          1.61380 PAIR PEAK
          1.77220    0.28000 A
3rd type  2.12480   33.00000 A
          2.89310    0.09300 A
          4.66630    2.00000 A
          5.01930    0.47000 A
          5.85180    2.13000 A
          6.79050    4.51000 A
          7.97470    1.74000 A
          4 BE  12      0.0114S  B 12            CHA  0 18
          ONO GAMMA LINES
          5  B   8        0.77S                  CHA LI  6
          168 LE 1
         0.51100 200.00000 A
```

So, for each nuclide we always have <u>one</u> record of the 1st type, <u>one</u> record of the 2nd type and zero or more records of the 3rd type.

Appendix B gives a resumed description of the 3 record types presented here.

3. Documentation

G. Erdtmann, W. Soyka, "Die γ-linien der Radionuklide," JÜl-1003-AC (2 Vol.), April 1974

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13.	Comma	64	
14.	Second generation reaction		(if exists)
	- type	55-57	
	- target nuclide	59-63	

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? Existence of γ-transition is doubtful

< Intensity is smaller or equal to the value given

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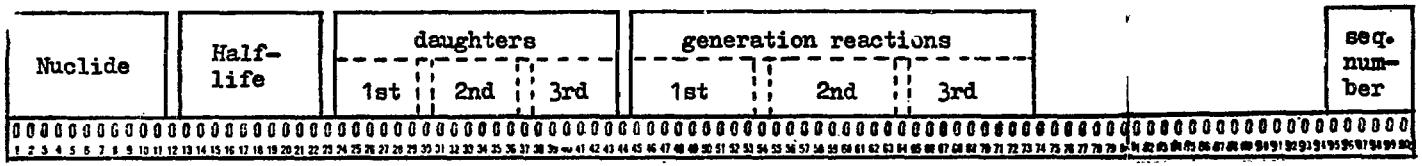

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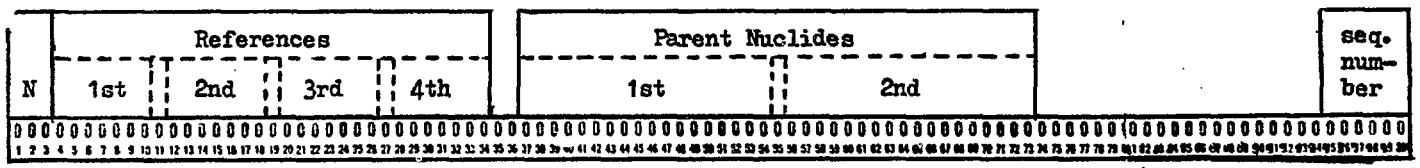

N = number of data points

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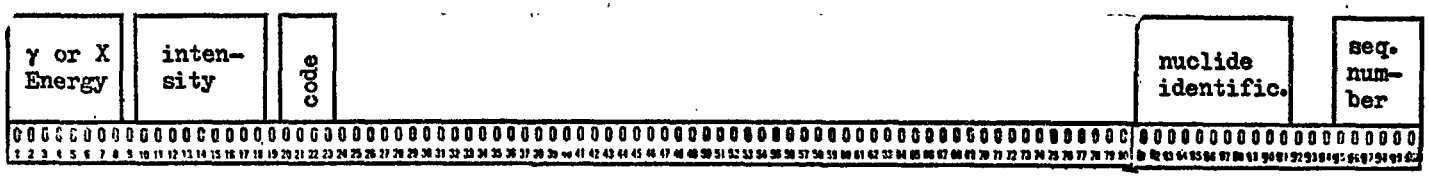

APPENDIX B