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"Strong Gammas"

List of strong gamma-rays emitted from radionuclides

by T. Ichimiya, T. Narita and K. Kitao

Documentation of the PC diskette

Abstract: The PC diskette containing the "List of strong gamma-rays emitted from radionuclides" as published by T. Narita et al. in the report JAERI-M-94-059, March 1994, is described. The diskette is available from the IAEA Nuclear Data Section, costfree, upon request.

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94/11

"Strong Gammas"

List of strong gamma-rays emitted from radionuclides

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The PC diskette (containing 3 files of together about 500 kbytes) is available from the IAEA Nuclear Data Section, costfree, upon request, due to courtesy of the authors. Attached are

- the front page of the report JAERI-M-94-59, and
- a documentation which was provided by the authors together with the diskette;
- sample pages of the files.

For A PC code that uses this database to help identifying radionuclides by their gamma-rays, see IDGAM by R. Paviotti Corcuera (Brazil), IAEA-NDS-135.

The present version of "Strong Gammas" supersedes the earlier version that was called internally "Narita gammas" and was published in the report JAERI-M-92-51, Oct. 1993.

JAERI-M 94-059

List of Strong Gamma-rays Emitted from Radionuclides(Version 2)

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The report is a quick index to identify gamma-emitting nuclides from energy peaks on the gamma-ray spectrum, and it consists of the three strongest gamma-rays, greater than 1 keV, emitted from decay of each radioactive nuclide. This report supersedes JAERI-M 92-051(March 1992), but in this new edition the list of gamma-rays is divided into five part according to the half-life of parent nuclides. These gamma-rays are arranged in the table in order of increasing energy. The lists are derived from Evaluated Nuclear Structure Data File (ENSDF, file as of September 1993) maintained by National Nuclear Data Center at Brookhaven National Laboratory, USA. A list to which the five tables are united has been prepared on a floppy disk in addition to the lists above mentions. In appendix, radionuclides is also listed with known energy values but unknown intensities of all gamma-rays following the decay.

Keywords: Gamma-rays, Radioactive Nuclide, Gamma-ray Spectrometry

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Diskette version (ver. 2) for JAERI-M 92-51

Date: October 1993

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1. Contents of diskette

This diskette consists of three following files:

G3D.DOC	This document
G3D.DAT	List of three strong gamma-rays from radionuclides
NRI.DAT	List of radionuclides with no measured gamma-ray intensities

1.1 **G3D.DAT** is the revised diskette-version for table in the JAERI report "List of Strong Gamma-rays emitted from Radionuclides (JAERI-M 92-51)". The new table is a list of gamma-rays extracted from the radioactive decay data in the updated version of Evaluated Nuclear Structure Data File (ENSDF) (file as September 1993) maintained by the National Nuclear Data Center, BNL, USA. Some entry errors in the former version are also correct. These gamma-rays are arranged in order of increasing energy.

Criteria for the listing are as follows:

a. Three stronger gamma-rays, with energy value greater than 1 keV, in ones emitted from the decay of each radioactive nuclides.

b. In these gamma-rays, one with the intensity less than 0.01 of that of the strongest gamma-ray is omitted.

c. If gamma-rays following the decay of a radionuclide have same intensities, the gamma-rays with greater energy are given priority over lower ones.

d. If the numbers of gamma-rays from a nuclide are three or less, although these intensities are not given in ENSDF, all these gamma-rays are listed.

1.2 **NRI.DAT** is the revised diskette-version for the annex in JAERI-M 92-51. This is a list of radionuclides and their gamma-rays, but intensities of all those gamma-rays have been not reported.

2. Explanation of the format of the file G3D.DAT

Field (Col(s).)	Description
1	Given a symbol (see below) for note on energy value of the gamma-ray.
2- 9	Energy of the gamma-rays in keV.
10	Given a symbol (see below) for note on intensity of the gamma-ray.
11 -16	Gamma-ray intensity per 100 decays of the parent nuclide; the symbol "--" denotes that no intensity is given in ENSDF.
17	Letter "U" denotes that the gamma-ray is not placed in the decay scheme.
18	Blank
19 -24	Element symbol (cols. 19-20) and mass number (cols. 22-24) of the parent nuclide.
25	Blank
26 -28	Decay mode of the parent nuclide; symbols are: B-, B+, EC, A, IT, B-N, B-2, B-P, ECP, and 2B- for negatron decay, positron decay, electron capture, alpha decay, isomeric transition, negatron decay following neutron emission, negatron decay following two neutrons emission, positron decay following proton emission, electron capture following proton emission, and double beta decay.
29 -38	Value (cols. 29-36) and unit (cols. 37-38) of the half-life of the parent nuclide. Symbols for units are: NS, US, MS, S, M, H, D, and Y for Nanoseconds, Microseconds, Milliseconds, Seconds, Minute, Hour, Day, and Year. 2.0+3.0 M means that the parent nuclide is a composite of ones with half-lives of 2.0 min. and 3.0 min..
39 -41	Total numbers of gamma-rays observed in the radioactive decay of the parent nuclide.
42-60,61-79	Energies (cols. 43-50 and 53-58) and parenthesized value of intensities (cols. 62-69 and 72-77) of other two strong gamma-rays. Col. 42 and 61 are the column to give notice on energy values of these gamma-rays, and col. 52 and 71 are those for intensities
59,78	Letter "U" denotes that the gamma-ray is not placed in the decay scheme

3. Explanation of the format of the file NRI.DAT

Field (Col(s).)	Description
1	Blank
2- 7	Elemental symbol of the parent nuclide.
8	Blank
9	Given a symbol (see below) for note on energy value of the gamma-ray.
10-17	Gamma-ray energy in keV.
18	Blank.
19-21	Decay mode of the parent nuclide. See above for symbols.
22	Blank.
23-32	Value (cols. 23-30) and unit (cols. 31-32) of the half-life of the parent nuclide. For symbols, see above.

4. Other symbols

< Less than or equal to.

> Greater or equal to.

~ Approximate value.

* Relative value.

? Calculated or estimated value.

B - 12	3214.83	B-	20.20	MS
	4438.03			
Ne- 24	472.2	B-	3.38	M
	874.41			
Ne- 26	82.5	B-	0.23	S
	151.1			
	233.6			
Na- 24	472.2	IT	20 20	MS
Na- 34	885.5	B-2	5.5	MS
Al- 24	425.8	IT	131.3	MS
Cl- 41	167.3	B-	38.4	S
	348.7			
	515.			
	516.			
	518.7			
	834.			
	838.			
	867.4			
	1186.7			
	1353.			
	1354.			
Ca- 48	130.94	B-	6E+18	Y
Ca- 48	983.52	2B-	6E+18	Y
	2013.66			
Sc- 50	256.89	IT	0.35	S
Fe- 60	58.6	B-	1.5E+6	Y
Co- 60	58.6	IT	10.467	M
Co- 62	22.	IT	13.91	M
Zn- 73	195.5	IT	5.8	S
Zn- 73	42.1	B-	5.8	S
Zn- 76	75.7	B-	5.7	S
	172.5			
	199.6			
	275.3			
	281.7			
	290.1			
	365.9			
	748.8			
	755.			
	831.2			
	1030.6			
	2091.			
Zn- 77	772.39	IT	1.05	S
Ga- 74	56.5	IT	9.5	S
	59.7			
Ge- 69	390.	IT	3.2	US
Ge- 69	85.	IT	5.1	US
As- 75	304.	IT	16.79	MS
As- 86	704.1	B-	0.9	S
Kr- 73	860.	B+P	27.0	S
Rb- 90	106.92	IT	258	S
Rb- 97	235.	B-N	169.9	MS
	414.			
	651.			
	692.			
	815.			
	1507.			
Y - 86	10.2	IT	48	M
	208.1			
Zr- 82	129.	B+	32	S
	144.			
	248.			
	278.			
	397.			
	525.			
Zr- 88	392.9	EC	83.4	D
Zr- 93	30.77	B-	1.53E+6	Y
Nb- 83	24.3	EC	4.1	S
	52.7			
Nb-100	159.3	B-	1.5+3.1	S
	461.8			
	527.9			
	535.2			
	600.1			
	635.2			
	638.4			
	694.5			
	702.6			
	707.3			
	768.3			
	792.4			
	928.1			
	952.5			
	966.1			
	1063.7			
	1071.3			
	1280.3			
	1427.6			
	1499.9			
	1565.8			
Nb-102	296.	B-	1.3	S
	397.6			
	400.6			
	551.4			
	847.4			
	949.			
Mo- 93	30.77	EC	3.5E+3	Y
Mo-108	125.5	B-	1.5	S
	258.53			
	268.21			
Tc- 95	38.9	IT	61	D
Tc-111	104.	B-	0.30	S
	150.4			
Ru- 90	992.	EC	13	S
	1002.			
Ru-112	82.4	B-	1.75	S
	244.6			
	327.			
Rh-105	129.57	IT	45	S
Pd- 95	146.3	B+P	13.3	S
	311.6			
	756.			

	1.58	--	Sm-141	IT	22.6	M	2	174.20	(--)		
	1.64	--	Pt-193	IT	4.33	D	3	12.63	(--)	135.50	(--)
	5.	--	Po-203	A	36.7	M	1				
	6.24	1.03	W -181	EC	121.2	D	3	136.28	(0.03)		
	6.29	--	Sn-121	IT	55	Y	1				
	6.5	--	At-201	EC	89	S	3	417.90	(--)	571.00	(--)
	6.9	--	Ag-104	IT	33.5	M	1				
	7.13	4.95	Er-160	EC	28.58	H	2	59.98	(0.07)		
	8.41	0.16	Er-169	B-	9.40	D	3				
	9.3	3E-06	Ag-102	IT	7.7	M	1				
	9.3	--	Ac-227	B-	21.773	Y	3	15.20	(--)	24.50	(--)
	9.4	4.9	Kr- 83	IT	1.83	H	2	32.15	(0.05)		
<	10.	--	Pa-234	IT	1.17	M	2	73.92	(--)		
	10.2	--	Y - 86	IT	48	M	2	208.10	(--)		
	10.86	3E-03	Sb-124	IT	93	S	1				
	11.23	0.94	Cs-134	IT	2.91	H	3	127.50	(12.7)		
	12.33	1.5	Ba-133	IT	38.9	H	3	275.93	(17.5)		
	12.4	0.16	Sc- 45	IT	318	MS	1				
	12.47	3E-06	Ca- 45	B-	163.8	D	1				
	12.63	--	Pt-193	IT	4.33	D	3	1.64	(--)	135.50	(--)
	12.76	0.3 U	Ra-228	B-	5.75	Y	11	13.52	(1.6 U)	16.18	(0.72U)
	13.5 *	32.	Nb-101	B-	7.1	S	47	157.50	(* 32.)	276.10	(*100.)
	13.52	1.6 U	Ra-228	B-	5.75	Y	11	12.76	(0.3 U)	16.18	(0.72U)
	14.	--	Gd-155	IT	31	MS	3	22.00	(--)	86.00	(--)
	14.41	10.6	Mn- 57	B-	85.4	S	23	122.06	(13.9)	692.00	(5.5)
	14.41	9.16	Co- 57	EC	271.79	D	10	122.06	(85.6)	136.47	(10.7)
	15.	--	Hg-185	A	49	S	3	79.00	(--)	94.00	(--)
	15.2	--	Ac-227	B-	21.773	Y	3	9.30	(--)	24.50	(--)
	16.	8.0	Nd-152	B-	11.4	M	7	250.10	(21.8)	278.50	(32.)
	16.18	0.72U	Ra-228	B-	5.75	Y	11	12.76	(0.3 U)	13.52	(1.6 U)
	16.21	0.16	Hg-195	IT	41.6	H	4	37.09	(1.84)	122.78	(0.03)
	16.26	--	Ta-182	IT	283	MS	1				
	16.4	8.29	Zn- 72	B-	46.5	H	9	144.70	(82.9)	191.50	(9.37)
	17.	18.	Ti- 52	B-	1.7	M	2	124.45	(100.)		
	17.1	--	Gd-159	IT	26.2	NS	3	50.70	(--)	67.80	(--)
	17.7	4E-05	Sb-126	IT	19.0	M	1				
	18.21	1.26	Eu-152	IT	96	M	5	89.85	(69.9)		
	18.5	27.2	Pd-112	B-	21.03	H	1				
	19.39	13.7	Lu-171	EC	8.24	D	101	667.40	(11.)	739.78	(47.8)
	19.84	7.0	Ho-166	IT	185	US	4	116.83	(13.)	136.66	(50.)
<	20.	--	Sb-128	IT	10.4	M	1				
	20.1	17.3	Os-180	EC	21.5	M	21				
	21.54	0.03	Sm-151	B-	90	Y	1				
	21.6	--	Te-117	IT	103	MS	3	274.40	(--)		
	21.8	2.16	La-136	IT	114	MS	8	33.50	(39.2)	95.70	(44.4)
	22.	--	Co- 62	IT	13.91	M	1				
	22.	--	Gd-155	IT	31	MS	3	14.00	(--)	86.00	(--)
	22.51	2.4	Eu-149	EC	93.1	D	27	277.09	(3.55)	327.53	(4.03)
	22.92	3.14	Tb-151	IT	25	S	4	49.46	(22.4)		
	23.87	16.	In-119	B-	2.4	M	5	763.14	(99.2)		
	23.87	16.1	Sb-119	EC	38.19	H	1				
	23.88	16.1	Sn-119	IT	293.1	D	3	25.27	(14.3 U)		
	23.98	20.3	Hf-172	EC	1.87	Y	32	67.35	(5.31)	125.82	(11.3)
	24.2	4E-04	Yb-169	IT	46	S	1				
	24.3	--	Nb- 83	EC	4.1	S	2	52.70	(--)		
	24.5	--	Ac-227	B-	21.773	Y	3	9.30	(--)	15.20	(--)