^{154}Eu – Comments on evaluation of decay data by V. P. Chechev and N. K. Kuzmenko

This evaluation was done in June 1999, and revised in January 2003. The literature available by 2003 was included.

1. Decay Scheme

The decay scheme is based on the evaluation of Reich (1998Re22).

The ^{154}Eu→^{154}Gd decay scheme has not been completed yet as there are a few unplaced ^{154}Gd gamma transitions. These transitions are weak, so they do not greatly influence the intensity balances.

The 3rd forbidden β^- transitions to the ground states of ^{154}Gd and ^{154}Sm have not been observed. From the log ft systematics (1998Si17), their log *ft* values should be greater than 17,6 and the corresponding upper limits of their intensities would be expected less than $5 \cdot 10^{-5}$ % and less than $3 \cdot 10^{-7}$ %, respectively.

In the "Adopted Levels" of 1998Re22, there are several ^{154}Gd levels with energies below Q^- that have not been observed in the ^{154}Eu β^- decay. Their energies are 1900,2; 1911,5; 1912,1; 1943,9; 1948,5 and 1963,8 keV. Their respective spins and parities are not known exactly except those for the 1911,5 keV, which is a 6^+ level. The β^- transition to this 1911,5 keV level is 3rd forbidden and its intensity is expected to be less than $5 \cdot 10^{-10}$ % (log ft > 17,6). On the assumption that the remaining levels can be populated by β^- transitions with an order of forbiddenness not lower than 2, their log *ft* values should be greater than 11 and their corresponding branch intensities expected to be less than 0,001%.

Likewise, the intensity of the 3rd forbidden electron-capture transition to the ^{154}Sm 543,7 keV 6^+ level in the decay ^{154}Eu→^{154}Sm is expected to be less than 10^{-8} % (from log ft >17,6).

Therefore, all of the above transitions can be neglected, and thus they are not shown in the ^{154}Eu decay scheme.

2. Nuclear Data

Q^+, Q^- values are from 1995Au04.

The evaluated half-life of ^{154}Eu has been obtained by applying the evaluation procedure from 2000Ch01 (Chechev and Egorov). This value is based on the measured results given in Table .

Table 1. Set of experimental data for the evaluation of ^{154}Eu half-life (in days)

Reference	Author	Data set "1" χ^2 =22,83 $(\chi^2)_8^{0,05}$ =15,51	Data set "2" χ^2 =22,79 $(\chi^2)_7^{0,05}$ = 14,07	Data set "3" χ^2 =22,79 $(\chi^2)_7^{0,05}$ =14,07
2002Un02	Unterweger	3145,2(11) [a]	3145,2(11)	3145,2(11)
1998Si12	Siegert et.al	3138,1(16) [b]	3138,1(16)	3138,1(16)
1998Si12	Siegert et.al	3146(11) [c]	3146(11)	3146(11)
1983Th04	Thompson et.al	3170(55)	3170(55)	3170(55)
1992ScZZ	Schötzig et.al	3139,0(20)	3139,0(20)	3139,0(20)
1988RaZM	Rajput et.al	3143(59)	3143(59)	3143(59)
1986Wo05	Woods et.al	3138,0(20)	3138,0(20)	3138,0(20)
1983Wa26	Walz et.al	3136(4)	3136(4)	3136(4)
1972Em01	Emery et.al	3105(180)	Omitted [d]	-

[a] Latest value from this laboratory. Previous measurements at NIST gave 3101(41) – 1982 HoZJ and 3138,2(61) –1992Un01.

[b] Measured with a pressured $4\pi\gamma$ ionization chamber.

[c] Measured with semiconductor detectors.

[d] Omitted on the basis of statistical considerations.

Data set "1" is the original data; set "2" has the discrepant values deleted, and set "3" would have the uncertainty increased for any value having more than 50% of the relative weight. There are none of the latter values, so set "3" is the same as set "2".

It should be noted that there are available the early half-life measurement results which have been omitted because of the very low accuracy: 5,4 years (without uncertainty) – 1949Ha04 and 16(4) years – 1952Ka26. There are also unpublished measurement results of 1978ScZO (7,45- 10,5 years) and 1978GrZR (8,8(1) years) which have not been included in the set “1”.

The weighted mean of data from the final set “3” is 3141,5(14) where the uncertainty has been obtained as an external uncertainty 1,35 multiplied by the Student’s coefficient at the confidence level of 0,68 for 7 degrees of freedom (see 2000Ch01). The internal uncertainty is 0,75.

The adopted value of the ^{154}Eu half-life is 3141,5(14) days, or 8,601(4) years (converted to years with 365,24219 d/y).

2.1. b$^-$ **Transition and Electron Capture Transition**

2.1.1. b$^-$ **Transitions**

The energies of β^- transitions have been computed from the Q$^-$ value and the level energies adopted from 1998Re22. The corrections to the level energies taking into account the evaluated values of gamma transition energies from section 2.2 are negligible.

The probabilities of β^- transitions have been obtained from the P(γ+ce) balance for each level of ^{154}Gd based on the P(γ) normalization factor of 0,3489(34) (see section 4.2.). Since 0,018 % (13) of the decays are *via* electron capture, the value of $P_{\beta1}$=10,3(5), to the first excited level in ^{154}Gd, has been obtained from $P_{\beta1}$=99,982(13) - Σ $P_{\beta i}$, i>1. From the P(γ+ce) balance for this level $P_{\beta1}$= 10,5(13). The more precise value has been adopted.

The more inaccurate experimental values from 1966Ha36 and 1968Ng01 obtained by direct measurements using magnetic beta-spectrometry and beta-gamma coincidences do not conflict with the calculated ones, as seen from Table 2 (except $\beta_{0,2}$).

Table 2. Comparison of the measured and evaluated (calculated) values of b**- transition probabilities**.

	E_β, keV	P_β, % 1966Ha36	P_β, % 1968Ng01	Evaluated (calculated) values
$\beta_{0,26}$	248,8(11)		29,1(25)	28,32(22)
$\beta_{0,16}$	570,9(11)		37,8(35)	36,06(35)
$\beta_{0,8}$	840,6(11)		17,0(39)	17,33(18)
$\beta_{0,6}$	972,1(11)		4,6(38)	2,82(18)
$\beta_{0,5}$	1152,9(11)		0,67(49)	0,33(3)
$\beta_{0,2}$	1597,4(11)	0,19(5)		0,31(7)
$\beta_{0,1}$	1845,3(11)	9,2(15)	10,8(12)	10,3(5)

We are listing below the ^{154}Gd levels from the ^{154}Eu β^- decay (see 1998Re22).

Level number	Energy, keV	Spin and parity	Half-life	Probability of β^- transition (× 100)
0	0,0	0^+	Stable	
1	123,071	2^+	1,18 ns	10,3(5)
2	371,00	4^+	45 ps	0,31(7)
3	680,66	0^+	4,0 ps	
4	717,7	6^+	7,8 ps	
5	815,5	2^+	6,4 ps	0,33(3)
6	996,26	2^+	0,95 ps	2,82(18)
7	1047,6	4^+		0,108(18)
8	1127,8	3^+		17,33(18)
9	1136,0	$1,2^+$		
10	1233,2			
11	1241,3	1^-		
12	1251,6	3^-		0,289(6)
13	1263,78	4^+		0,707(7)
14	1277,0			
15	1294,2	$(2)^+$		
16	1397,5	2^-		36,06(35)
17	1414,4	1^-		
18	1418	2^+		0,075(2)
19	1510,1	(1^-)		0,021(2)
20	1531,3	2^+		0,330(13)
21	1560,0	(4^-)		0,100(4)
22	1617,1	3^-		1,78(3)
23	1645,8	4^+		0,148(4)
24	1660,9	3^+		0,849(9)
25	1698,5	(4^+)		0,0100(4)
26	1719,56	2^-		28,32(22)
27	1770,2	5^+		0,0022(4)
28	1790,2	(4^+)		0,022(1)
29	1797,0	3^-		0,060(6)
30	1838,6	2^+		0,017(5)
31	1861,5	4^-		0,034(3)
32	1878,5			0,0042(3)
33	1894,7	2^+		0,0035(6)

2.1.2. Electron Capture Transitions

The energies of the electron capture, ε, transitions have been calculated from the Q^+ value and the level energies from 1998Re22 (see below).

List of ^{154}Sm levels from the ^{154}Eu electron capture decay

Level number	Energy, keV	Spin and parity	Half-life	Probability of electron capture (× 100)
0	0,0	0^+	Stable	
1	81,98	2^+	3,02 ns	0,013(13)
2	266,79	4^+	172 ps	0,0047(8)
3	543,73	6^+	22,7 ps	

The transition probabilities have been obtained from the P(γ+ce) balance for each ^{154}Sm level using a P(γ) normalization factor of 0,3489(34).

Fractional electron capture probabilities P_K, P_L, P_M have been calculated from 1998Sc28 using the program EC-CAPTURE.

2.2. Gamma Transitions and Internal Conversion Coefficients

The evaluated energies of gamma-ray transitions include the recoil energy of $E_\gamma^2/2Mc^2$, where M is mass of the daughter nucleus (^{154}Gd or ^{154}Sm).

The gamma-ray transition probabilities have been deduced from their emission probabilities and total internal conversion coefficients (ICC).

The ICC are theoretical values from 1978Ro22 for the adopted energies and multipolarities. Other values have been taken from the evaluation 1998Re22, based on experimental data from 1957Ke08, 1962Lu03, 1966Za02, 1969An01, 1972Na21, 1977Ya04 and 1996Al31. Total ICC values for $\gamma_{1,0}$(Gd) have been obtained as weighted averages of measured values, 1,200(20) - 1962Lu03 and 1,194(19) - 1995Ma03, and taking into account the rule of “the smallest experimental uncertainty” (see 2000Ch01).

The relative uncertainties of α_K, α_L, α_M for pure multipolarities have been adopted 2%.

3. ATOMIC DATA

3.1. Fluorescence Yields

The fluorescence yield data are from 1996Sc06 (Schönfeld and Janßen).

3.2. X-Radiations

The X-ray energies are based on their wavelengths in the compilation of 1967Be65 (Bearden). The relative KX-ray emission probabilities have been taken from 1996Sc06 and 1999Schönfeld.

3.3. Auger Electrons

The energies of Auger electrons are from 1977La19 (Larkins) and 1987Lagoutine.

The ratios P(KLX)/P(KLL), P(KXY)/P(KLL) are taken from 1996Sc06.

4. PHOTON EMISSIONS

4.1. X-Ray Emissions

The total absolute emission probability of Gd KX-rays has been computed using the adopted value of ω_k (Gd) and the evaluated total absolute emission probability of K conversion electrons in the decay ^{154}Eu→^{154}Gd, namely, P_{ceK} = 27,3(6)%. The emission probability of Sm KX-rays has been computed using the adopted value of ω_K (Sm), the evaluated probability of K electron capture to ^{154}Sm levels $P_{\varepsilon K}$ =0,015(11) % and the evaluated emission probability of K conversion electrons in the decay ^{154}Eu→^{154}Sm, namely, P_{ceK} = 0,007(4) %.

The absolute emission probabilities of the Gd KX-ray components have been computed using the relative probabilities from Section 3.2 and the total value of P_{XK}(Gd) = 25,4(6) % .

4.2. Gamma-Ray Emissions

The energies of prominent gamma-rays $\gamma_{1,0}$(123,1), $\gamma_{2,1}$(247,9), $\gamma_{5,2}$(444,5), $\gamma_{26,8}$(591,7), $\gamma_{6,2}$(625,2), $\gamma_{5,1}$(692,4), $\gamma_{26,6}$(723,3), $\gamma_{8,2}$(756,8), $\gamma_{24,5}$(845,4), $\gamma_{6,1}$(873,2), $\gamma_{13,2}$(892,8), $\gamma_{26,5}$(904,1), $\gamma_{12,1}$(1128,5), $\gamma_{13,1}$(1140,7), $\gamma_{22,2}$(1246,1), $\gamma_{16,1}$(1274,4), $\gamma_{22,1}$(1494,0), $\gamma_{26,1}$(1596,5) have been taken from 2000He14 (Helmer and Van der Leun).

The energies of the gamma rays $\gamma_{26,20}$(188,2), $\gamma_{16,6}$ (401,2), $\gamma_{26,12}$(467,8), $\gamma_{26,11}$(478,3),$\gamma_{3,1}$(557,6), $\gamma_{16,5}$(582,0), $\gamma_{7,2}$(676,6), $\gamma_{20,5}$(715,8), $\gamma_{5,0}$(815,5), $\gamma_{20,3}$(850,6), $\gamma_{12,2}$(880,6), $\gamma_{7,1}$(924,6), $\gamma_{6,0}$(996,3),

$\gamma_{8,1}$(1004,7), $\gamma_{11,1}$(1118,5), $\gamma_{20,2}$(1160,4), $\gamma_{21,2}$(1188,1), $\gamma_{11,0}$(1241,4), $\gamma_{24,2}$(1290,5), $\gamma_{19,1}$(1397,4), $\gamma_{24,1}$(1537,8) have been evaluated using the experimental data of 1990He05, 1992Sm02, 1990Me15 along with taking into account a correction of the gamma-ray energetic scale in 2000He14 (lowering by 5,8 ppm) (Table 3).

Table 3. Measured and evaluated values of some gamma ray energies in the decay of ^{154}Eu (keV)

	1990He05	1990Me05	1992Sm02	Evaluated
$\gamma_{26,20}$	188,252(8)	188,22(4)	188,29(7)	188,24(2)
$\gamma_{16,6}$	401,258(14)	401,30(5)		401,259(14)
$\gamma_{26,12}$	467,84(5)			467,84(5)
$\gamma_{26,11}$		478,26(5)	478,29(7)	478,27(5)
$\gamma_{3,1}$		557,56(5)	557,61(7)	557,58(5)
$\gamma_{16,5}$		582,00(5)	582,03(7)	582,01(5)
$\gamma_{7,2}$	676,600(12)	676,60(5)		676,596(12)
$\gamma_{20,5}$	715,786(18)	715,77(5)	715,75(7)	715,77(3)
$\gamma_{5,0}$		815,57(5)	815,45(7)	815,53(5)
$\gamma_{20,3}$	850,643(12)	850,66(5)	850,61(7)	850,64(3)
$\gamma_{12,2}$	880,61(3)			880,60(3)
$\gamma_{7,1}$	924,64(5)			924,63(5)
$\gamma_{6,0}$	996,262(6)	996,35(4)	996,21(3)	996,25(5)
$\gamma_{8,1}$	1004,725(7)	1004,79(4)	1004,67(3)	1004,718(7)
$\gamma_{11,1}$		1118,53(6)		1118,52(6)
$\gamma_{20,2}$	1160,37(8)			1160,36(8)
$\gamma_{21,2}$	1188,10(4)	1188,60(10)		1188,34(17)
$\gamma_{11,0}$	1241,38(5)	1241,62(9)		1241,43(10)
$\gamma_{24,2}$	1290,51(10)			1290,50(10)
$\gamma_{19,1}$	1397,35(5)			1397,34(5)
$\gamma_{24,1}$	1537,80(4)	1537,84(5)		1537,81(4)

The energies of the gamma rays $\gamma_{15,8}$(165,9), $\gamma_{22,17}$(202,5), $\gamma_{14,7}$(229,0), $\gamma_{22,5}$(801,2) have been taken from 1992El11. The energy of the gamma ray $\gamma_{1,0}$ Sm (82,0) has been adopted from measurements of conversion electrons (1958Ch36). The unplaced gamma ray 197 keV has been reported in 1980Sh15 and 1989Ki10. The energy of the gamma ray $\gamma_{7,4}$(329,9) has been adopted from 1974HeYW. The energy 533,1 keV (twice placed - $\gamma_{24,8}$ and $\gamma_{29,13}$) has been computed from the level energies. The energy and relative emission probability of the gamma ray $\gamma_{3,0}$(680,7) has been taken from 1969An01. The energy of the unplaced gamma-ray γ 1316,4 keV has been adopted from 1970Ri19.

The energies of the remaining weak gamma rays have been taken from 1968Me18.

The measured and evaluated values of relative gamma ray emission probabilities are shown in Table 4.

Table 4. Measured and evaluated values of relative gamma ray emission probabilities in the decay of ^{154}Eu

keV	1968Me18	1969Va09	1970RiZY	1980Ro22	1980Sh15	1984Iw03	1986Wa35	1989Ki10	1989 Schima	1990Me15	1990He05	1992El11	1992Ha02	1992Sm02	1992Sa04	Evaluated value
58,4	0,0113(11)															0,0113(11)
80,4	0,008(4)															0,008(4)
82.0	0,009(6)															0,009(6)
123,1			116(6)		115,4(23)	118,5(13)	111,7(16)	122,1(36)	117,0(11)	114,1(20)	116,5(12)		115,6(15)	113,0(15)	115,4(7)	115,9(8)
125,4	0,0197(56)															0,020(6)
129,5	0,039(6)															0,039(6)
131,6	0,0310(14)				0,037			0,025					0,035(3)			0,0317(13)
134,8	0,0203(11)				0,03			0,024					0,027(6)			0,0205(11)
146,0	0,073(3)		0,085(27)		0,12(1)			0,078(28)					0,075(10)			0,074(3)
156,2	0,0282(12)				0,025			0,019					0,027(3)			0,0280(11)
159,9	<0,003												0,0030(15)			0,0030(15)
162,1	0,0028(14)												0,0035(17)			0,0031(11)
165,9	0,0065(14)				0,021			0,019					0,012(4)			0,0071(14)
180,7	0,0127(28)	0,0058(58)			0,015			<0,001					0,0116(17)			0,0115(17)
184,7	0,0113(28)				0,017			0,003					0,010(3)			0,011(3)
188,2		0,692(17)	0,61(12)		0,70(12)			0,88(10)		0,682(22)			0,658(27)	0,651(15)		0,684(15)
195,5	0,0056(28)															0,006(3)
197					0,005			0,004								0,0045(5)
202,5												0,08(2)				0,08(2)
209,4	0,0068(23)												0,0072(16)			0,0071(16)
219,4	0,0065(25)												0,0067(19)			0,0066(19)
229,0	0,0056(22)												0,0085(25)			0,0069(22)
232,0	0,0677(30)		0,079(43)		0,081(40)			0,059(22)					0,068(6)			0,068(3)
237,0	0,017(11)				0,026			0,024					0,019(9)			0,018(9)
247,9			20,1(10)	20,51(20)	19,34(37)	19,91(14)	19,615(98)	23,04(59)	19,82(16)	19,72(32)	19,8(2)		19,65(44)	19,5(2)	19,857(93)	19,76(9)
260,9	0,0056(25)							0,017					0,0066(20)			0,0062(20)
267,4	0,039(2)				0,023			<0,001					0,037(7)			0,039(2)
269,8	0,0197(28)				0,01			0,017					0,022(4)			0,0205(28)
274,0	0,0113(6)												0,0105(12)			0,0111(6)
279,9	0,0085(4)												0,0092(21)			0,0085(4)
290,0	0,0096(5)												0,010(2)			0,0096(5)
295,7	0,0068(4)												0,0073(15)			0,0068(4)
296,0	0,0039(25)															0,004(3)
301,3	0,0282(12)				0,032			0,03					0,032(2)			0,0292(12)
305,1	0,0496(22)	0,058(12)			0,07			0,078					0,055(7)			0,050(2)
308,2	≤0,005				0,01								0,0068(17)			0,0068(17)
312,3	0,0414(19)	0,055(12)			0,06			0,069					0,059(5)			0,053(4)
315,4	0,0130(7)	0,037(12)			0,03			0,027					0,027(6)			0,021(4)
320	0,0028(20)															0,0028(20)

keV	1968Me18	1969Va09	1970RiZY	1980Ro22	1980Sh15	1984Iw03	1986Wa35	1989Ki10	1989 Schima	1990Me15	1990He05	1992El11	1992Ha02	1992Sm02	1992Sa04	Evaluated value
322,0	0,189(9)	0,193(9)	0,16(4)		0,21(4)			0,168(22)					0,189(10)			0,189(9)
329,9	0,0259(4)		0,036(26)		0,032			0,023					0,031(10)			0,0260(14)
346,7	0,085(3)				0,067								0,075(6)			0,083(3)
368,2	0,0085(4)												0,0081(17)			0,0085(4)
370,7	0,015(4)				0,03			0,007					0,018(6)			0,016(4)
375,2	0,0051(28)												0,0059(23)			0,0056(23)
382,0	0,0285(12)				0,028			0,006					0,027(3)			0,0283(12)
397,1	0,085(3)	0,066(9)	0,12(5)		0,12(4)			0,070(16)					0,076(8)			0,082(3)
401,3		0,55(3)	0,58(10)		0,57(8)	0,49(4)		0,58(6)		0,56(3)	0,543(6)		0,54(3)			0,543(6)
403,5	0,076(3)		0,054(32)		0,042(40)								0,067(8)			0,075(3)
414,3	0,0141(18)												0,015(2)			0,0142(18)
419,4	0,011(6)												0,0094(41)			0,010(6)
422,1	≤0,0034												0,0062(24)			0,0062(24)
435,9	≤0,0073												0,011(3)			0,011(3)
444,5		1,64(4)	1,69(15)	1,53(6)	1,54(3)	1,63(3)	1,87(11)	2,11(6)		1,58(3)	1,600(15)		1,66(7)	1,628(17)	1,564(38)	1,606(15)
463,9	0,0121(7)												0,019(8)			0,0122(7)
467,8	0,161(7)	0,173(17)	0,20(9)		0,16(8)			0,18(3)					0,184(7)			0,173(7)
478,2		0,605(22)	0,69(15)		0,63(10)	0,626(27)		0,64(5)		0,68(3)	0,644(6)		0,63(3)	0,648(12)		0,643(6)
480,6	0,0138(8)															0,0138(8)
483,7	0,0141(8)				0,04			0,045					0,033(12)			0,0142(8)
484,6	0,0113(6)															0,0113(6)
488,3	0,020(9)												0,021(10)			0,020(9)
506,4	0,017(6)							0,017					0,018(4)			0,018(4)
510	0,103(5)		0,17(8)		0,14(8)			0,28(5)					0,19(3)			0,17(2)
512,0	≤0,17	0,092(20)														0,092(20)
518,0	0,132(6)	0,144(26)	0,16(9)		0,18(8)			0,17(5)					0,144(18)			0,135(6)
533,1 $	0,031(6)				0,032			0,04					0,034(8)			0,032(6)
545,6	0,047(6)	0,035(29)											0,036(6)			0,041(6)
557,6		0,75(3)	0,74(10)		0,72(10)	0,758(24)		0,80(10)		0,73(3)	0,778(11)		0,75(3)	0,767(12)		0,767(11)
563,4												0,008(2)				0,008(2)
569,2	0,0282(12)				0,044			0,024					0,0410(64)			0,0286(23)
582,0		2,62(7)	2,53(23)	2,86(11)	2,45(5)	2,61(3)	2,45(5)	2,72(12)		2,51(3)	2,543(2)		2,53(3)	2,53(23)		2,54(2)
591,7		14,44(31)	14,8(8)	13,62(24)	13,57(26)	14,35(6)	14,05(14)	15,84(66)	14,19(11)	14,14(15)	14,21(11)		14,18(31)	14,0(14)	14,338(117)	14,18(7)
597,5	0,0158(9)															0,0158(9)
598,3	0,0172(10)				0,026								0,0280(54)			0,0176(21)
600,0	0,017(11)															0,017(11)
602,8	0,096(4)				0,1			0,15					0,096(8)			0,096(4)
613,3	0,262(11)	0,288(20)	0,22(8)		0,25(8)			0,29(7)					0,265(19)			0,267(11)
620,5	0,0262(14)												0,023(6)			0,0260(14)
625,2		0,922(32)	0,89(12)		0,84(5)	0,927(21)	0,90(4)	0,92(9)		0,90(3)			0,91(2)	0,906(10)		0,909(10)
642,4	0,011(6)							0,040(28)					0,013(5)			0,013(5)

keV	1968Me18	1969Va09	1970RiZY	1980Ro22	1980Sh15	1984Iw03	1986Wa35	1989Ki10	1989 Schima	1990Me15	1990He05	1992El11	1992Ha02	1992Sm02	1992Sa04	Evaluated value
649,4	0,214(9)		0,28(11)		0,25(8)			0,30(10)					0,26(2)			0,223(9)
650,6	0,0282(12)															0,0282(12)
664,7	0,082(3)				0,072			0,03					0,088(15)			0,082(3)
668,9	0,034(8)				0,042			0,031					0,042(7)			0,038(7)
676,6		0,432(30)	0,43(11)		0,52(10)	0,47(5)	0,45(27)	0,53(11)		0,45(3)			0,46(5)			0,45(3)
692,4		5,07(13)	4,97(30)	4,86(8)	4,92(10)	5,182(29)	5,14(5)	5,75(15)		5,10(9)	5,09(4)		5,13(12)	5,04(5)	5,085(59)	5,12(3)
715,8		0,40(6)	0,32(13)		0,61(8)			0,27(12)		0,592(28)			0,52(2)	0,57(3)		0,54(3)
723,3		56,5(12)	60,1(31)	55,40(41)	55,33(106)	58,19(27)	57,23(46)	64,9(21)	57,6(4)	57,2(6)	57,3(4)		57,78(89)	56,9(6)	58,107(276)	57,46(27)
737,6	≤0,024												0,018(7)			0,018(7)
756,8		12,71(23)	12,9(6)	12,51(11)	12,62(24)	13,18(8)	12,89(13)	13,61(20)		12,99(15)	12,9(11)		13,02(24)	12,8(2)	13,035(127)	12,98(8)
774,4	0,028(14)												0,022(11)			0,024(11)
790,1	0,031(8)												0,029(9)			0,030(8)
800,2	0,092(14)							0,09					0,088(30)			0,091(14)
815,6		1,38(6)	1,38(18)	1,45(8)	1,47(10)	1,51(5)	1,48(3)	1,63(12)		1,44(3)	1,455(14)		1,52(4)	1,481(15)		1,467(14)
830,3	≤0,0141				0,02								0,023(8)			0,023(8)
845,4		1,614(62)	1,60(22)		1,58(10)	1,687(22)	1,64(10)	1,61(61)		1,66(3)	1,737(20)		1,69(3)	1,659(17)		1,68(2)
850,7		0,663(30)	0,60(13)		0,67(8)	0,692(23)		0,68(13)		0,68(3)			0,68(2)	0,699(14)		0,692(14)
873,2		33,72(75)	34,8(17)	33,6(25)	34,47(70)	35,18(16)	34,66(21)	35,7(13)	34,95(31)	34,65(30)	34,81(28)		35,01(44)	34,5(4)	34,342(266)	34,87(16)
880,6	0,231(10)	0,14(6)	0,20(8)		0,28(8)			0,22(11)					0,26(4)			0,231(10)
892,8		1,41(4)	1,31(10)	1,38(12)	1,43(3)	1,497(26)	1,55(3)	1,51(10)		1,49(3)			1,48(5)	1,416(16)		1,473(16)
898,4	0,0056(14)															0,0056(14)
904,1		2,45(7)	2,42(17)	2,47(8)	2,49(5)	2,62(3)	2,65(8)	2,74(13)		2,54(6)	2,537(22)		2,58(5)	2,54(3)		2,551(22)
906,1	0,0338(16)															0,0338(16)
919,2	0,0352(16)												0,025(11)			0,0350(16)
924,5	0,166(8)	0,173(29)	0,19(10)		0,18(10)			0,13(6)					0,189(8)			0,177(8)
928,4	≤0,0141												0,013(6)			0,013(6)
981,3	0,023(6)												0,025(5)			0,024(5)
984,5	0,018(11)												0,029(6)			0,027(6)
996,3		29,39(71)	29,4(15)	29,7(21)	30,30(65)	30,09(15)	30,87(12)	31,0(19)	29,9(3)	30,14(30)	29,78(23)		30,29(51)	29,9(3)	29,206(269)	30,1(1)
1004,7		50,4(11)	50,6(25)	50,93(32)	51,40(103)	52,04(25)	52,05(31)	54,84(225)	51,9(5)	51,8(6)	51,55(40)		52,07(89)	51,6(4)	51,233(276)	51,17(25)
1012,8	0,0082(34)															0,008(3)
1023	0,020(8)												0,019(7)			0,019(7)
1033,4	0,0338(16)												0,029(8)			0,0336(16)
1047,4	0,141(7)				0,23(10)			0,17(6)					0,16(5)			0,142(7)
1049,4	0,0493(22)															0,0493(22)
1072,2	≤0,0113												0,010(4)			0,010(4)
1110	0,008(6)															0,008(6)
1118,5		0,403(58)	0,30(8)		0,37(10)			0,04		0,296(25)			0,31(3)			0,31(4)
1124,2	0,0197(28)															0,020(3)
1128,5		0,89(6)	0,79(9)		0,94(8)	0,90(4)		0,88(6)		0,885(25)	0,952(15)		0,89(5)	0,892(10)		0,91(1)
1136,1	0,0211(28)							0,042								0,021(3)

keV	1968Me18	1969Va09	1970RiZY	1980Ro22	1980Sh15	1984Iw03	1986Wa35	1989Ki10	1989 Schima	1990Me15	1990He05	1992El11	1992Ha02	1992Sm02	1992Sa04	Evaluated value
1140,7		0,634(30)	0,69(10)		0,73(8)	0,671(14)		0,75(6)		0,65(3)	0,671(8)		0,68(4)	0,682(11)		0,673(8)
1153,1	0,039(11)												0,024(10)			0,031(10)
1160,3	0,124(6)		0,10(3)		0,13(10)			0,12(4)					0,131(12)			0,125(6)
1170,7	0,012(6)												0,010(3)			0,010(3)
1188,6		0,27(1)	0,23(5)		0,29(8)			0,25(4)		0,25(3)			0,265(20)			0,266(20)
1216,8	≤0,010												0,0096(28)			0,010(3)
1232,1	0,026(17)												0,021(14)			0,023(14)
1241,6		0,43(3)	0,30(7)		0,40(5)	0,38(5)		0,45		0,366(17)			0,38(4)			0,380(17)
1246,1		2,54(7)	2,40(22)	2,35(5)	2,48(10)	2,49(4)	2,52(5)	2,51(12)		2,48(3)	2,449(23)		2,45(8)	2,48(2)	2,403(48)	2,470(23)
1274,4	100	100	100	100	100	100	100	100	100	100	100		100	100	100	100
1290,1	0,0324(15)		0,068(26)		0,086(20)			0,064					0,077(9)			0,071(9)
1292,0	0,0369(17)												0,035(3)			0,0364(15)
1295,5	0,0254(29)				0,026(3)			0,061					0,027(3)			0,026(3)
1316,4			0,074(29)		0,053(10)			0,029(19)								0,050(10)
1387,0	0,056(6)	<0,029											0,055(5)			0,055(5)
1397,4	0,0084(28)							0,012					0,0093(22)			0,0090(22)
1408,5	0,059(8)				0,082(10)								0,063(8)			0,066(8)
1415,0	0,0113(6)				0,004			0,02					0,017(6)			0,0114(6)
1418,6	0,0208(12)		0,027(16)		0,039			0,041(11)					0,037(5)			0,031(5)
1419,0	0,0056(3)															0,0056(3)
1425,9	0,0037(22)												0,0031(19)			0,0034(19)
1489,6	0,0084(14)												0,0081(12)			0,0082(12)
1494,0			1,88(9)	2,10(4)	1,91(8)	2,058(17)	1,99(2)	1,72(8)		1,99(4)	1,979(16)		2,04(8)	2,00(3)		2,00(2)
1510,0	0,0141(28)	<0,012											0,013(4)			0,014(3)
1522	0,0017(8)															0,0017(8)
1531,4	0,0172(12)		0,009(5)		0,018(5)								0,018(2)			0,0171(12)
1537,9			0,15(2)		0,15(1)			0,12(1)		0,155(6)			0,160(13)			0,151(6)
1554	≤0,004												0,0032(15)			0,0032(15)
1596,5			5,15(26)	5,19(8)	4,81(10)	5,247(30)	5,237(84)	4,54(18)	5,08(5)	5,13(8)	5,078(40)		5,12(17)	5,08(5)	5,083(22)	5,11(3)
1667,3	0,0056(8)												0,0053(12)			0,0055(8)
1674,9	0,0039(11)				0,006(1)			0,004					0,0041(16)			0,0049(11)
1716,9	0,0017(11)							0,0017(9)					0,0017(9)			0,0017(9)
1773	0,0008(6)							0,0010(6)					0,0010(6)			0,0010(6)
1838,0	0,0023(6)							0,0027(11)					0,0027(11)			0,0024(6)
1895	0,0017(6)							0,0020(9)					0,0020(9)			0,0018(6)

$ This energy corresponds to the two gamma-rays: $\gamma_{24,8}$ and $\gamma_{29,13}$. The former one was added in 1998Re22 with a relative emission probability of 0,020(7). Considering the experimental intensity of 0,032(5) as a sum of intensities $\gamma_{24,8}$ and $\gamma_{29,13}$, it leads to the $\gamma_{29,13}$ relative emission probability of 0,012(8)-see section 4.2.

The gamma ray emission probabilities have been computed from their relative evaluated emission probabilities given in Table 3 using the normalization factor K = 0,3489(34). This value has been obtained from the intensity balance for gamma transitions to the ground states of ^{154}Gd and ^{154}Sm assuming that the ground states are not populated directly by beta or electron capture decay. Then, $P_{\gamma+ce}$ ($\gamma_{1,0}$ Sm) + Σ $P_{\gamma+ce}$ ($\gamma_{i,0}$ Gd)=100% where i=1, 3, 5, 6, 9, 11, 17, 18, 19, 20, 30, 33.

There are several measurements of the absolute emission probabilities (P_γ) of some prominent gamma rays in the decay ^{154}Eu$\rightarrow$^{154}Gd.

The evaluated (calculated) value of $P_{\gamma 1,0}$ (123,07 keV) =40,4(5)% agrees well with the value of 40,6(7)% measured in 1991ZaZZ.

The evaluated value of $P_{\gamma 16,1}$ (1274,43 keV)=34,9(3)% agrees well with the value of 34,8(2)% measured in 1994Co02, and it differs somewhat from the value of 35,32(12)% obtained in 1992Ha02.

The values of $P_{\gamma 2,1}$ (247,93 keV)=6,96(8) % and $P_{\gamma 6,0}$ (996,26keV) = 10,36(18)% measured in 1997Ka47 agree with the evaluated (calculated) values of 6,89(7)% and 10,50(10)%, respectively.

5. Electron Emissions

The energies of the conversion electrons have been calculated from the gamma transition energies given in 2.2 and the electron binding energies.

The emission probabilities of conversion electrons have been deduced from the evaluated P_γ and ICC values.

The absolute total emission probabilities of Gd and Sm K Auger electrons have been computed by using their corresponding evaluated total $P(ce_K)$ for Gd and Sm and their adopted ω_K from section 3.

The absolute total emission probabilities of Gd and Sm L Auger electrons have been computed using their corresponding evaluated total $P(ce_K)$ and $P(ce_L)$ for Gd and Sm and their adopted ϖ_L and n_{KL} from section 3.

Average energies of β^-spectrum components have been calculated using the LOGFT program.

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