^{239}Pu – Comments on evaluation of decay data
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This evaluation was originally done in October 2005 and then revised in January 2007. The literature available by January 2007 has been included.

1. Decay Scheme

The decay scheme is based on the evaluation of Browne (2003Br12). It can be considered as basically completed though there are weak gamma rays observed in experiment and unplaced in the decay scheme. Besides several weak gamma transitions expected from the decay scheme have not been observed in ^{239}Pu alpha decay yet. They have been taken from data on nuclear reactions, in particular, from ^{234}U(n,γ)-reaction (1979Al03), and also from ^{235}Pa β^- decay (1986Mi10).

Many alpha transitions to ^{235}U excited levels with energy more than 600 keV were not observed either. They are expected from data on level spins and gamma rays de-excited these levels (see 2003Br12).

2. Nuclear Data

Q(α) value is from 2003Au03.

The evaluated half-life of ^{239}Pu is based on the experimental results given in Table 1. Re-estimated values and uncertainties were used for averaging where necessary.

Table 1. Experimental values of the ^{239}Pu half-life (in years)

Reference	Author(s)	Value	Measurement method
1970OeZZ	Oetting	24 048 (25) [a, b]	Calorimetry
1975Al15	Alexandrov *et al.*	24 060 (19) [b]	Specific activity
1975GlZQ	Glover *et al.*	24 115 (80)	Specific activity
1977Ja08	Jaffe *et al.*	24 124 (14)	Specific activity
1977Ja08	Jaffe *et al.*	24 139 (13)	Mass spectrometry
1978Se12	Seabaugh *et al.*	24 101 (10) [b]	Calorimetry
1978Gunn	Gunn	24 102 (10) [b]	Calorimetry
1978Lu10	Lucas *et al.*	24 112 (33) [c]	Specific activity
1978Ma45	Marsch *et al.*	24 164 (17) [b]	Mass spectrometry
1978Pr07	Prindle *et al.*	24 019 (15) [d]	Specific activity
1978Pr07	Prindle *et al.*	24 089 (19) [d]	Mass spectrometry
1981Brown	Brown	24 088 (25) [b]	Specific activity

[a] Value corrected in 1977Ja08 is given.
[b] Uncertainty quoted by authors for the 95 % confidence level has been reduced by a factor 2.
[c] Uncertainty combined from a standard deviation of 16 yr and a systematic error of 50 yr by Holden (1989Ho24) is given.
[d] Uncertainty corrected by Holden (1989Ho24) is given.

The weighted mean of the 12 values is 24 100 with the internal uncertainty of 4,5 and external uncertainty of 11 and $\chi^2/\nu = 5{,}9$. The unweighted mean is 24 097 (12). The LWEIGHT computer program has chosen the weighted mean and the external uncertainty of 11.

Thus, the recommended value of the ^{239}Pu half-life is 24 100 (11) years. It agrees well with the value of 24 101 (12) years deduced from constant matching in a least-squares fit of thermal data for fissile nuclei (1984Di08) and can be compared to the recommended values from the Russian handbook

(1988ChZL) of 24 100 (20) years and from the critical review by Glover and Nichols (1990GlZZ) of 24 113 (11) years.

The adopted ^{239}Pu spontaneous fission half-life of 8 (2) × 10^{15} years is the value recommended in 2000Ho27. It is based on the experimental results given in Table 2.

Table 2. Experimental values of the spontaneous fission ^{239}Pu half-life (in 10^{15} years)

Reference	Author(s)	Value	Measurement method
1952Se67	Segre	5,5 (16)	Ionization chamber
1985Dr09	Druzhinin *et al.*	7,8 (16)	$\lambda_{SF} / \lambda_{\alpha}$ = 3,1 (6)·10^{-12}

2.1 Alpha Transitions

The energies of the alpha transitions have been deduced from the Q value and the level energies given in Table 3 from 2003Br12. The latter ones were deduced from a least squares fit to γ ray energies from ^{239}Pu α decay. The energies of the gamma rays adopted from 2003Br12 are given below, in Table 9.

Table 3. ^{235}U levels populated in the ^{239}Pu α-decay

Level number	Energy, keV	Spin and parity	Half-life	Probability of α-transition (%)
0	0	7/2–	7,04(1)·10^{8} y	~0,03 [b]
1	0,0765 (4)	1/2+	≈26 min	70,79 (10)
2	13,0400 (21)	3/2+	0,50(3) ns	17,14 (4)
3	46,207 (10)	9/2–		< 0,02
4	51,7007 (11)	5/2+	191(5) ps	11,87 (3)
5	81,741 (4)	7/2+		0,052 (8)
6	103,035 (10)	11/2–		0,0375 (12)
7	129,2961 (10)	5/2+		0,013 (4)
8	150,467 (15)	9/2+		0,0182 (27)
9	170,708 (14)	13/2–		
10	171,388 (5)	7/2+		0,0034 (10)
11	197,119 (14)	11/2+		0,007 (1)
12	225,423 (8)	9/2+		0,0050 (7)
13	249,130 (12)	15/2–		0,0030 (16)
14	291,144 (19)	11/2+		0,0007 (3)
15	294,669 (15)	13/2+		0,0018 (5)
16	332,845 (4)	5/2+		0,00354 (7)
17	338,52 (6)	17/2–		≈2,2·10^{-5}
18	357,30 (6) **?**	(15/2+)		1,7 (4)·10^{-5}
19	367,069 (8)	7/2+		0,000944 (17)
20	393,225 (6)	3/2+		0,00125 (3)
21	414,779 (11)	9/2+		0,00075 (11)
22	426,755 (3)	5/2+		0,00570 (5)
23	445,716 (20)	7/2+		4,00 (11)·10^{-5}
24	474,297 (13)	7/2+		0,00056 (5)
25	509,92 (17)	(9/2+)		3,3 (7)·10^{-6}
26	533,228 (10)	9/2+		0,00086 (3)
27	608,08 (5)	11/2+		1,2 (4)·10^{-5}
28	633,17 (6)	(5/2)–		2,84 (7)·10^{-6}
29	637,81 (5)	3/2–		3,22 (21)·10^{-6}
30	658,97 (4)	1/2–		2,64 (6)·10^{-5}
31	664,541 (23)	(5/2)–		6,31 (11)·10^{-6}
32	670,99 (4)	(7/2)–		< 3,4·10^{-8}
33	701,02 (3)	(7/2)–		7,07 (13)·10^{-6}
34	703,757 (19)	3/2–		1,14 (3)·10^{-5}
35	720,25 (3)	(9/2)–		2,13 (9)·10^{-6}
36	750,07 (16)	(9/2–)		3,4 (4)·10^{-7}
37	761,04 (5)	(1/2)–		1,03 (17)·10^{-7}

Level number	Energy, keV	Spin and parity	Half-life	Probability of α-transition (%)
38	769,27 (6)	1/2+		$2,7\ (3)\cdot10^{-5}$
39	769,5 (3)	3/2–		$1,03\ (12)\cdot10^{-5}$
40	777,59 (19)	(11/2)–		$2,47\ (19)\cdot10^{-7}$
41	779,51 (3)	3/2+		$1,01\ (11)\cdot10^{-6}$
42	805,72 (6)	3/2–		$8,4\ (14)\ )\cdot10^{-8}$
43	821,25 (4)	5/2+		$3,0\ (3)\cdot10^{-7}$
44	843,859 (10)	(1/2)+		$2,28\ (12)\cdot10^{-7}$
45	845,3 (10) **?**	(7/2+)		$\sim4,2\cdot10^{-8}$
46	865,20 (2) [a]	3/2+		$9,8\ (13)\cdot10^{-8}$
47	891,89 (15)	5/2+		$1,99\ (12)\cdot10^{-7}$
48	968,451 (20)	3/2+		$6,1\ (15)\cdot10^{-8}$
49	970,52 (22) **?**	(5/2,7/2)		$4,1\ (4)\cdot10^{-8}$
50	986,65 (17)	(13/2-)		$7,7\ (7)\cdot10^{-8}$
51	992,72 (22)	(5/2+)		$2,0\ (3)\cdot10^{-7}$
52	1057,58 (13)	(7/2)		$9,3\ (9)\cdot10^{-8}$
53	1116,20 (20) **?**	(5/2–)		$2,1\ (5)\cdot10^{-8}$

[a] Obtained as a sum of E(level ‘10’) and E($\gamma_{46,10}$)

[b] Value based on systematics (see 2003Br12 and comments therein)

The probabilities of the most intense transitions $\alpha_{0,1,}$ $\alpha_{0,2}$ and $\alpha_{0,4}$ have been obtained by averaging experimental results from measurements with semi-conductor detectors of 1987Bo25, 1992Bl13, 1993Ga28, 1994Ra27, 1996Sa24, 1996Vi07 and 2002Da21 (see Table 4). They agree with each other and disagree with early measurements with magnetic spectrometers of 1961Dz05, 1963Ba09, 1976BaZZ (Table 4) and 1952As28, 1957As83, 1957No15. The values evaluated from the above experimental results have been recommended as more precise than those that are deduced from γ-ray transition intensity balances.

The probabilities of the transitions $\alpha_{0,k}$ (k =5÷8, 10, 13, 15, 16, 19÷22, 24, 26) evaluated from all the available experimental data reported with uncertainties are compared in Table 4 with the values deduced from intensity balances. The latter ones were recommended as more precise. The experimental P(α)-values have been recommended in those cases ($\alpha_{0,11,}$ $\alpha_{0,12,}$ $\alpha_{0,14}$) where the intensity balances were used for obtaining P(γ+ce)-values (see several γ-ray transitions with deduced ICC and (E2/M1)-admixture ratios in section 2.2).

The probabilities of the remaining α-transitions including unobserved but expected from the decay scheme have been evaluated from the P(γ+ce) balances for corresponding levels of ^{235}U.

The values of hindrance factors were calculated using ALPHAD code and r_0 (^{235}U) = 1,5122, average of r_0 (^{234}U) = 1,5075 and r_0 (^{236}U) = 1,5168 from 1998Ak04.

Table 4. Experimental and recommended probabilities (%) of most intense α-transitions observed in ^{239}Pu decay [*]

	α-part. energy	1961 Dz05	1963Ba09 1976BaZZ	1965 Ho04	1966 Ah02	1987 Bo25	1992 Bl13	1993 Ga28**	1994 Ra27	1996 Sa24	1996 Vi07	2002 Da21**	Evaluated from data of the measurements	Deduced from P(γ+ce) balance	Recommended
$\alpha_{0,1}$	5156	72	73,3 (8)			71,2 (7)	70,73 (46)	70,77 (14)	71,6 (2)	70,91 (11)	71 (5)	70,71 (10)	70,79 (10) [a]	70,8 (4)	70,79 (10)
$\alpha_{0,2}$	5144	17	15,1 (8)			16,7 (5)	17,56 (28)	17,11 (14)	16,6 (2)	17,12 (9)	18 (4)	17,16 (4)	17,14 (4) [b]	17,1 (3)	17,14 (4)
$\alpha_{0,4}$	5106	11	11,5 (8)	11,5		12,1 (2)	11,80 (19)	11,94 (7)	11,8 (1)	11,84 (5)	11,1 (15)	11,88 (3)	11,87 (3) [c]	11,9 (3)	11,87 (3)
$\alpha_{0,5}$	5076	0,038	0,036 (3)	0,043			0,03 (1)	0,078 (8)		0,054 (6)		0,057 (2)	0,050 (7) [d]	0,052 (8)	0,052 (8)
$\alpha_{0,6}$	5055	0,030	0,025 (5)	≥0,0033				0,047 (13)		0,036 (4)		0,044 (2)	0,038 (4) [e]	0,0375 (12)	0,0375 (12)
$\alpha_{0,7}$	5029		0,005 (1)	0,0038	0,005			0,009 (3)		0,016 (2)		0,023 (1)	0,014 (9) [f]	0,013 (4)	0,013 (4)
$\alpha_{0,8}$	5009	0,018	0,013 (5)	0,011				0,017 (2)		0,021 (6)		0,034 (2)	0,017 (2) [g]	0,0182 (27)	0,0182 (27)
$\alpha_{0,10}$	4988	0,008	0,007 (2)	0,0041	0,006			0,013 (2)				0,018 (1)	0,010 (2) [h]	0,0034 (10)	0,0034 (10)
$\alpha_{0,11}$	4963	0,008	0,006 (3)	0,0044				0,007 (1)				0,0157 (12)	0,007 (1) [h]		0,007 (1)
$\alpha_{0,12}$	4935	0,008	0,0040 (10)	0,0029	0,003			0,0060 (10)				0,0135 (11)	0,0050 (7) [h]		0,0050 (7)
$\alpha_{0,13}$	4912	~0,003	0,0005 (3)					0,0024 (9)				0,0097 (9)	0,0007 (3) [h]	0,0030 (16)	0,0030 (16)
$\alpha_{0,14}$	4870		0,0007 (3)									0,0089 (9)	0,0007 (3) [i]		0,0007 (3)
$\alpha_{0,15}$	4867	0,004	0,002 (2)	0,0007	0,0008			0,0019 (7)				0,011 (1)	0,0019 (7) [h]	0,0018 (5)	0,0018 (5)
$\alpha_{0,16}$	4829		0,0015	0,0021	0,0021			0,0024 (7)					0,0024 (7)	0,00354 (7)	0,00354 (7)
$\alpha_{0,19}$	4796		0,0007 (2)	0,0008	0,0007			0,0012 (6)					0,0075 (19) [j]	0,000944 (17)	0,000944 (17)
$\alpha_{0,20}$	4770		0,0008 (3)	≥0,001	0,0006			0,0015 (6)					0,00094 (27) [j]	0,00125 (3)	0,00125 (3)
$\alpha_{0,21}$	4749		≈0,0006		0,0004							0,0059 (8)	≈0,0005 [k]	0,00075 (11)	0,00075 (11
$\alpha_{0,22}$	4737	0,007	0,0045 (10)	0,003	0,005			0,0051 (8)				0,0109 (10)	0,0045 (10) [h]	0,00570 (5)	0,00570 (5)
$\alpha_{0,24}$	4690				0,0005 (2)								0,0005 (2)	0,00056 (5)	0,00056 (5)
$\alpha_{0,26}$	4632				0,0007 (2)								0,0007 (2)	0,00086 (3)	0,00086 (3)

[*] Other measurements: 1957No15, 1963Bj03, 1981AhZV, 1984Ah06, 1990An33. The 1957No15 results are from measurements with magnetic spectrometer. In 1963Bj03 the $\alpha_{0,30}$ and $\alpha_{0,38}$ probabilities (%) were measured: 0,00008(3) and 0,000025(8), respectively. These values have been adopted as recommended $\alpha_{0,30}$ and $\alpha_{0,38}$ probabilities. The value of α_{30} probability (%) calculated from γ-ray transition intensity balance of 0,000 026 4 (6) disagrees with 1963Bj03 and the calculated value of α_{38} probability (%) of 0,000 027 (4) agrees well with 1963Bj03. In 1984Ah06 the ($\alpha_{0,1}$+$\alpha_{0,2}$)- probability (%) was measured as 88,0 (6) in agreement with all the available measurements. In 1990An33 the $\alpha_{0,1}$, $\alpha_{0,2}$, $\alpha_{0,4}$ -probabilities (%) were measured: 73 (1), 15 (1), 12 (1), respectively.
** 2002Da21 analyzed α spectrum of 1993Ga28. The values of 1993Ga28 are combined results from measurements at CIEMAT (Spain) and IRMM (Belgium).

[a] The LWEIGHT computer program has identified one after another 1996Vi07, 1994Ra27 and 1987Bo25 values as outliers and recommended a weighted average (70,79) of the 4 remaining values and an internal uncertainty of 0,064. The smallest experimental uncertainty of 0,10 is adopted for the evaluated value.

[b] The LWEIGHT computer program has identified 1996Vi07 as outlier and (after omitting this value) recommended a weighted average (17,14) of the 6 remaining values and an internal uncertainty of 0,034. The smallest experimental uncertainty of 0,04 is adopted for the evaluated value.

[c] The LWEIGHT computer program has identified one after another 1996Vi07 and 1987Bo25 values as outliers and (after omitting these values) recommended a weighted average (11,87) of the 5 remaining values and an internal uncertainty of 0,023. The smallest experimental uncertainty of 0,03 is adopted for the evaluated value.

[d] The LWEIGHT computer program has increased the uncertainty of 2002Da21 to 0,00247 and recommended a weighted average (0,050) of the 5 discrepant experimental values (1976BaZZ, 1992Bl13, 1993Ga28, 1996Sa24, 2002Da21) with the expanded uncertainty of 0,007.

[e] The LWEIGHT computer program has increased the uncertainty of 2002Da21 to 0,00304 and recommended a weighted average (0,038) of the 4 experimental values (1976BaZZ, 1993Ga28, 1996Sa24, 2002Da21) with an external uncertainty (0,004).

[f] The LWEIGHT computer program has recommended a weighted average (0,014) of the 4 highly discrepant experimental values (1976BaZZ, 1993Ga28, 1996Sa24 and 2002Da21) and expanded the uncertainty to 0,009.

[g] A weighted average of the 3 experimental values (1976BaZZ, 1993Ga28, 1996Sa24). The value of 0,034 (2) from 2002Da21 has been omitted as outlier. This big value leads to the appreciable intensity disbalance for the level “8” (150,5 keV).

[h] A weighted average of the 2 experimental values (1976BaZZ, 1993Ga28). The value from 2002Da21 has been omitted as this big value leads to the considerable intensity imbalance. Reported experimental data are discrepant.

[i] Value from 1976BaZZ. The value from 2002Da21 has been omitted as this big value leads to the considerable intensity imbalance.

[j] A weighted average of the values from 1976BaZZ and 1993Ga28.

[k] An unweighted average of the values from 1976BaZZ and 1966Ah02. The value from 2002Da21 has been omitted as this big value leads to the considerable intensity imbalance

2.2. Gamma Transitions and Internal Conversion Coefficients

The gamma-ray transition probabilities and total internal conversion coefficients (ICC's) for (M1+E2)-transitions $\gamma_{2,1}$ (12,98 keV), $\gamma_{3,0}$ (46,21 keV), $\gamma_{4,2}$ (38,66 keV), $\gamma_{12,10}$ (54,04 keV), $\gamma_{11,8}$ (46,68 keV) and $\gamma_{14,12}$ (65,71 keV) were deduced from intensity balances for the corresponding levels ("2", "3", "4", "10", "11" and "14", respectively). The total internal conversion coefficients (ICC's) and (E2/M1)-admixture ratios for these transitions were obtained using the α-transition probabilities and γ-ray emission probabilities evaluated from experimental data. For the gamma-ray transition $\gamma_{3,0}$ (46,21 keV) the values of P(γ+ce), total ICC and (E2/M1)-admixture ratio have been deduced supposing a negligible intensity of the questionable α-transition to the level "3" (1/2+→9/2–).

For gamma-ray transition $\gamma_{5,4}$ (30,04 keV) the value P(γ+ce) = 0,033 (11) % is obtained from the intensity balance for the level "5" by use of the value $P(\alpha_{0,5})$ = 0,050 (7) % evaluated directly from α-spectrometric experimental data. This corresponds to the adopted M1 multipolarity for $\gamma_{5,4}$ -transition: $P(\gamma_{5,4}+ce)$ = 0,0346 (14) % has been deduced using the theoretical α_T (M1) = 58,6 (12).

The multipolarity of the gamma-ray transition $\gamma_{10,7}$ (41,93 keV) has also been adopted as M1 because even small E2 admixture leads to larger total ICC disturbing P(γ+ce) - balance for the level "7"(129,3 keV).

The transition probabilities for the remaining gamma-rays have been deduced from their gamma-ray emission probabilities and total ICC's interpolated from theoretical values of 2002Ba85 using the BrIcc package (Table 11). The multipolarities and admixture coefficients δ(E2/M1) have been taken from 2003Br12 (see comments therein and in footnotes to Table 11). The uncertainties of α_K, α_L, α_M, α_T for pure multipolarities have been taken as 2 %.

The total ICC for E0+M1 transitions are experimental values from (n, γ) reaction data of 1979Al03 (see 2003Br12 and comments therein).

3. Atomic Data

3.1. Fluorescence yields

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

3.2. X Radiations

The energies of U LX-rays were deduced from 1994Le28 and 1994Le37 where the fine structure of LX radiation was measured in the decay of ^{239}Pu. Other measurements of U LX-rays can be found in 1983Ah02, 1984Bo41, 1992Ba08 and 1995Jo23.

The U KX-ray energies were taken from 1999ScZX where the calculated values based on X-ray wavelengths from 1967Be65 (Bearden). In Table 5 the adopted values of U KX-ray energies are compared with experimental values.

Table 5. Experimental and adopted (calculated) values of U KX-ray energies (keV)

	1976GuZN	1982Ba56	1983Ah02	Adopted
$K\alpha_2$	94,655 (5)	94,656 (2)	94,67 (2)	94,666
$K\alpha_1$	98,442 (5)	98,435 (2)	98,45 (2)	98,440
$K\beta_3$	110,42	110,416 (3)	110,42 (3)	110,421
$K\beta_1$	111,30	111,300 (2)	111,31 (2)	111,298
$K\beta_5$	-	111,868 (5)- $K\beta_5''$ 111,868 (5)- $K\beta_5'$	112,01 (5)	111,964
$K\beta_{2,4}$	114,54	-	114,50 (3)	114,46
$KO_{2,3}$	115,40	-	115,40 (5)	115,377

3.3. Auger Electrons

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

4. Alpha emissions

The energy of the alpha particles corresponding to the alpha transition to the first excited state of ^{235}U, E($\alpha_{0,1}$), has been adopted from the absolute measurement of 1980RyZX taking into account the correction of –0,11 keV recommended by A. Rytz in 1991Ry01.

The energies of all other α-emission energies have been deduced from the alpha transition energies taking into account the recoil energies.

In Table 6 the deduced (evaluated) values of α-emission energies are compared with the experimental results obtained with alpha spectrometers.

Table 6. Experimental and evaluated α-emission energies in ^{239}Pu decay (keV)

	Measured [a]					Recommended in 1991Ry01	Evaluated
	1962Le11	1963Ba09	1966Ho09	1968Ba25	1981AhZV		
$\alpha_{0,1}$	5156,7 (6)	5156,6 (8)	5157	5156,6 (8)		5156,59 (14) [b]	5156,59 (14)
$\alpha_{0,2}$	5144,0 (7)	5144	5144	5144,3 (8)		5144,3 (8)	5143,82 (21)
$\alpha_{0,4}$	5106,0 (7)	5106	5105	5105,8 (8)		5105,8 (8)	5105,81 (21)
$\alpha_{0,5}$		5077	5075		5076 (5)		5076,28 (21)
$\alpha_{0,6}$		5055	5055		5054 (5)		5055,34 (21)
$\alpha_{0,7}$		5030	5029		5028 (3)		5029,51 (21)
$\alpha_{0,8}$		5009	5007		5006 (5)		5008,70 (21)
$\alpha_{0,10}$		4987	4988		4987 (3)		4988,13 (21)
$\alpha_{0,11}$		4962	4960		4960 (5)		4962,83 (21)
$\alpha_{0,12}$		4936	4932		4934 (3)		4935,00 (21)
$\alpha_{0,13}$		4913			4912 (5)		4911,69 (21)
$\alpha_{0,14}$		4872			4871 (5)		4870,38 (21)
$\alpha_{0,15}$		4867	4864		4866 (5)		4866,91 (21)
$\alpha_{0,16}$		4829	4829		4828 (3)		4829,38 (21)
$\alpha_{0,19}$		4800	4794		4795 (4)		4795,73 (21)
$\alpha_{0,20}$			4769		4769 (5)		4770,01 (21)
$\alpha_{0,21}$					4749 (5)		4748,81 (21)
$\alpha_{0,22}$		4738	4739		4736 (3)		4737,05 (21)
$\alpha_{0,24}$		4694	4694		4691 (3)		4690,29 (21)
$\alpha_{0,26}$ [c]		4635	4639		4632 (3)		4632,35 (21)

[a] Original values have been adjusted taking into account changes in calibration energies as suggested in 1991Ry01.
[b] Absolute measurement; the value has been adopted as recommended in 1991Ry01 (see text above).
[c] Other measurements: 1963Bj03, 1975Ba65, 1992Fr04, 1999Sa19. In 1963Bj03 the $\alpha_{0,38}$ and $\alpha_{0,30}$ energies were measured: ≈ 4380 keV and 4510 (20) keV, respectively. In 1975Ba65 the measurement value of the $\alpha_{0,1}$ energy (5156,77 (41) keV) is reported. In 1992Fr04 the $\alpha_{0,1}$ energy was measured by time-of-flight method: 5155,36 (19) keV. In 1999Sa19 alpha peak fitting parameters for analysis of the complex alpha spectrum ^{239}Pu + ^{240}Pu (keV) were deduced and the following alpha energies were used: $\alpha_{0,1}$.-5156,59; $\alpha_{0,2}$.-5143,90; $\alpha_{0,4}$.-5105,80; $\alpha_{0,5}$.-5076,00.

5. Electron Emissions

The energies of the conversion electrons have been calculated from the gamma transition energies and the electron binding energies. The emission probabilities of conversion electrons have been deduced from the evaluated P(γ) and ICC values. The experimental spectrum of the conversion electrons in the decay of ^{239}Pu is given in 1965Tr03. The conversion electrons were measured also in 1979Al03.

The total absolute emission probability of K Auger electrons has been calculated using the evaluated total emission probability of U KX-rays and the adopted ω_K = 0,970 (4).

The absolute total emission probability of L Auger electrons were computed using the evaluated total absolute emission probability of U LX–rays and the adopted ϖ_L = 0,500 (19).

6. Photon Emissions

6.1. X-Ray Emissions

6.1.1. LX-Rays

The evaluated absolute emission probabilities of U LX–rays have been obtained as weighted means of measurement values from 1992Bl07 (and 1994Mo36 by the same group), 1994Le28 and 1994Le37 (Table 7). The uncertainties of the evaluated values are not less than the smallest quoted experimental uncertainties.

Table 7. Experimental and evaluated values of absolute LX-ray emission probabilities in the decay of ^{239}Pu (per 100 disintegrations)

LX-ray	Energy, keV	1992Bl07, 1994Mo36	1994Le28	1994Le37	Evaluated
Ll	11,62	0,0996 (11)	0,1027 (21)	0,1016 (17)	0,1008 (11)
Lt	11,90	-	0,00214 (18)	-	0,00214 (18)
$L\alpha_2$	13,44	- [a]	0,143 (5)	0,150 (18)	0,146 (13)
$L\alpha_1$	13,62	- [a]	1,507 (19)	1,498 (31)	1,503 (22)
$L\eta$	15,40	0,0566 (10)	0,0498 (10)	0,0544 (9)	0,0537 (19)
$L\beta$	17,06	2,301 (23)[b]	2,27 (4)[b]	2,28 (5)[b]	2,288 (23)
$L\gamma$	20,30	0,568 (6)[b]	0,564 (10)[b]	0,579 (14)[b]	0,569 (6)
LX total		4,67 (5)	4,63 (5)	4,66 (6)	4,66 (5)

[a].In 1992Bl07 the total Lα-ray intensity of 1,649 (20) was measured in agreement with the value of 1,649 (18) from 1994Le28 and the value of 1,648 (36) from 1994Le37.

[b] In all the three quoted works the intensities of individual L_β and Lγ components were also measured.

The evaluated P(XL) = 4,66 (5) % exceeds slightly the value of 4,5 (1) % calculated using the evaluated total absolute emission probability of L conversion electrons and the adopted value ϖ_L = 0,500 (19).

Other measurement results of P(XL) are: 5,3 (5) % (1966Ah02), 4,76 (12) % (1968Swinth), 4,60 (10) % (1971Swinth), 4,50 (14) % (1984Geidelman).

6.1.2. KX-Rays

The evaluated absolute emission probabilities of U KX–rays have been obtained as weighted means of measurement values from 1976GuZN and 1994Mo36 (Table 8). Uncertainty in detector efficiency (2 %) was added to the uncertainties listed in 1976GuZN and their values were renormalized to the adopted absolute emission probability of the γ-ray $\gamma_{7,0}$ (129,3 keV) of 6,31 (4)$\times10^{-3}$.

Table 8. Experimental and evaluated values of absolute U KX-ray emission probabilities in the decay of ^{239}Pu (per 100 disintegrations)

KX-ray	Energy, keV	1976GuZN	1994Mo36	Evaluated
$K\alpha_2$	94,666	0,004 25 (9)	0,004 17 (4)	0,004 18 (4)
$K\alpha_1$	98,440	0,006 81 (14)	0,006 52 (9)	0,006 61 (9)
$K\beta_3$	110,421	0,000 801 (16)	0,000 797 (6)	0,000 798 (6)
$K\beta_1$	111,298	0,001 56 (3)	0,001 536 (12)	0,001 536 (20)
$K\beta_5$	111,964	0,000 031 (3)	0,000 054 (11)	0,000 033 (3)
$K\beta_{2,4}$	114,46	0,000 633 (18)	0,000 629 (7)	0,000 629 (7)
K_{OP}	115,37-115,58	0,000 654 (16)	0,000 708 (9)	0,000 68 (3)
KX total		0,014 74 (29)	0,014 41 (14)	0,014 47 (14)

6.2. Gamma-Ray Emissions

The recommended γ-ray energies have been adopted from 2003Br12 based on experimental data of 1979Al03 ((n,γ)-results) and 1968Cl02, 1971GuZY, 1976GuZN, 1982He02, 1992Bl07, 1994Mo36 (^{239}Pu α-decay). Other measurements: 1965Tr03, 1966Ah02, 1966Ho09 (Table 9). For several weak transitions γ-ray the energies have been deduced directly from the level energies or adopted from 1979Al03 (see footnotes to Table 9).

The absolute γ-ray emission probabilities have been deduced using the evaluated γ-ray relative probabilities and the absolute emission probability of the γ-ray $\gamma_{7,0}$ (129,3 keV) of 6,31 (4)$\times 10^{-5}$ obtained as a weighted average of the 5 absolute measurement results (per 10^5 disintegrations): 6,26 (13) from 1976GuZN, 6,23 (4) from 1980Despres, 6,41 (5) from 1982He02, 6,48 (10) from 1984Iw02 and 6,31 (4) from 1994Mo36. The uncertainty (0,04) of the evaluated value is the smallest experimental uncertainty.

The relative experimental and evaluated γ-ray emission probabilities are given in Table 10. The evaluated values have been obtained by averaging experimental values listed in Table 10 or have been adopted from one of the experimental works, in most cases from 1976GuZN. The averaging-out has been done using the LWEIGHT computer program. The uncertainties are not less than the smallest experimental uncertainties.

In Table 11 the multipolarities, E2/M1 mixing ratios and ICC are shown for soft gamma rays with energy less than 120 keV and comments of deducing multipolarities (with uncertainties for E2/M1 mixing ratios where possible) are given. The δ-mixing ratios for other gamma rays (with energy more than 120 keV) are given in the footnote at the bottom of Table 11.

Table 9. Experimental and adopted energies of gamma rays in ^{239}Pu decay (keV)

	1965 Tr03	1966 Ah02	1966 Ho09	1968 Cl02	1971 GuZY	1976 GuZN	1979 Al03	1982 He02	1994 Mo36	Adopted
$\gamma_{1,0}$										0,0765 (4)
$\gamma_{2,1}$					13,0				12,975 (10)	12,975 (10)
$\gamma_{-1,1}$									14,22 (3)	14,22 (3)
$\gamma_{5,4}$					30,09	30,04 (10)		30,251 (10)	30,03 (10)	30,04 (2)
$\gamma_{4,2}$		38,7 (1)	37		38,69			38,660 (2)		38,661 (2)
$\gamma_{-1,2}$					40,57	40,41 (5)				40,41 (5)
$\gamma_{10,7}$				41,99 (10)		42,06 (3)			41,93 (5)	41,93 (5)
$\gamma_{3,0}$		46,2 (1)			46,23			46,218 (10)		46,21 (5)
$\gamma_{11,8}$						46,69 (10)			46,68 (3)	46,68 (3)
$\gamma_{7,5}$					47,56				47,60 (3)	47,60 (3)
$\gamma_{4,1}$		51,6 (1)	52		51,628	51,629 (10)	51,628 (4)	51,624 (1)		51,624 (1)
$\gamma_{12,10}$					54,05	54,040	54,026 (5)	54,039 (8)		54,039 (8)
$\gamma_{6,3}$		56,8 (2)			56,828	56,838		56,825 (3)		56,828 (3)
$\gamma_{14,12}$					65,69	65,74 (10)		65,675 (20)		65,708 (30)
$\gamma_{9,6}$					67,69	67,67		67,674 (12)		67,674 (12)
$\gamma_{5,2}$		68,3 (2)	69		68,73	68,72	68,697 (3)	68,696 (6)		68,696 (6)
$\gamma_{8,5}$										68,73 (2) [b]
$\gamma_{-1,3}$										74,96 (10)
$\gamma_{7,4}$		77,6 (2)		77,60 (5)		77,607	77,599 (2)	77,592 (14)		77,592 (14)
$\gamma_{13,9}$				78,48 (5)	78,38	78,42		78,44 (3)		78,43 (2)
$\gamma_{17,13}$										89,39 (6) [b]
$\gamma_{10,5}$				89,59		89,59		89,73 (4)	89,64 (3)	89,64 (3)
$\gamma_{12,7}$						96,13 (5)			96,14 (3)	96,14 (3)
$\gamma_{15,11}$			97,4 (6)		97,6 (3)					97,6 (3)
$\gamma_{8,4}$			98,7 (5)		98,81	98,78 (2)				98,78 (2)
$\gamma_{6,0}$		103,0	102,8 (8)		103,03	103,02 (2)		103,086 (14)		103,06 (3)
$\gamma_{11,5}$			117,6 (11)		115,35	115,38 (5)				115,38 (5)
$\gamma_{7,2}$		116,0			116,24	116,26 (2)	116,262 (3)			116,26 (2)
$\gamma_{10,4}$					119,72	119,708		119,73 (3)	119,70 (3)	119,70 (3)

	1965 Tr03	1966 Ah02	1966 Ho09	1968 Cl02	1971 GuZY	1976 GuZN	1979 Al03	1982 He02	1994 Mo36	Adopted
$\gamma_{14,10}$										119,76 (2) [b]
$\gamma_{12,6}$				122,35 (12)						122,35 (12)
$\gamma_{37,29}$							123,228 (5)			123,228 (5)
$\gamma_{21,14}$					123,67	123,62 (5)				123,62 (5)
$\gamma_{9,3}$			124,3 (15)		124,52	124,51 (3)				124,51 (3)
$\gamma_{10,3}$		125,0			125,17	125,21 (10)				125,21 (10)
$\gamma_{7,0}$		129,3 (2)	129,3 (3)		129,28	129,294 (10)	129,302 (2)	129,296 (1)		129,296 (1)
$\gamma_{19,12}$		141,7 (3)			141,64	141,657 (20)		141,62 (4)		141,657 (20)
$\gamma_{12,5}$					143,4		143,655 (6)			143,35 (20)
$\gamma_{15,8}$		144,2	144,1 (8)		144,19	144,211		144,201 (3)		144,201 (3)
$\gamma_{13,6}$		146,0			146,05	146,077		146,094 (6)		146,094 (6)
$\gamma_{10,2}$					158,3	158,1 (3)				158,1 (3)
$\gamma_{18,11}$				159,6 (2)		160,19 (5)				160,19 (5)
$\gamma_{16,10}$			160,3 (11)	160,07 (13)	161,45		161,449 (3)	161,482 (12)		161,450 (15)
$\gamma_{17,9}$					168,1	167,81 (5)				167,81 (5)
$\gamma_{10,0}$		171,4	171,3 (5)		171,34	171,344	171,370 (11)	171,393 (6)		171,393 (6)
$\gamma_{42,28}$							172,560 (11)			172,560 (8)
$\gamma_{12,4}$					173,6	173,70 (5)				173,70 (5)
$\gamma_{12,3}$		179,2 (2)	178,6 (8)		179,17	179,19		179,220 (12)		179,220 (12)
$\gamma_{-1,4}$					184,3	184,55 (5)				184,55 (5)
$\gamma_{14,6}$					188,27	188,23 (10)				188,23 (10)
$\gamma_{21,12}$		189,1	189,2 (16)		189,34	189,32		189,360 (10)		189,360 (10)
$\gamma_{-1,5}$				193,13 (12)		193,13 (12)	195,220 (12)			193,13 (12)
$\gamma_{19,10}$		195,6	195,7 (8)		195,65	195,66	195,70 (2)	195,679 (8)		195,679 (8)
$\gamma_{-1,6}$					197,98	196,87 (5)	196,872 (7)			196,87 (5)
$\gamma_{16,7}$		203,5	203,5 (8)	203,34 (8)	203,52	203,537	203,553 (7)	203,550 (5)		203,550 (5)
$\gamma_{21,11}$										218,0 (5)
$\gamma_{12,0}$			224,9 (15)		225,43	225,37		225,384 (15)		225,42 (4)
$\gamma_{19,7}$				238,2 (2)	237,77	237,38	237,774 (6)	237,77 (10)		237,77 (10)
$\gamma_{26,14}$			241,2 (20)		242,09	242,08 (3)				242,08 (3)
$\gamma_{21,10}$					243,33	243,38		243,38 (3)		243,38 (3)
$\gamma_{14,3}$					244,80	244,95 (5)	244,583 (8)			244,92 (5)
$\gamma_{24,12}$					248,95	248,95		248,95 (5)		248,95 (5)
$\gamma_{22,10}$		255,5	255,1 (5)	258,20 (10)	255,33	255,38		255,384 (15)		255,384 (15)
$\gamma_{20,7}$		264,0			263,93	263,93	263,916 (4)	263,97 (3)		263,95 (3)
$\gamma_{30,20}$					265,54	265,7 (3)				265,7 (3)
$\gamma_{16,4}$					281,2	281,2 (2)				281,2 (2)
$\gamma_{19,5}$					285,3	285,3 (2)				285,3 (2)
$\gamma_{22,7}$		297,6	297,8 (8)		297,43	297,49	297,42 (3)	297,46 (3)		297,46 (3)
$\gamma_{24,10}$					302,87	302,87		302,87 (5)		302,87 (5)
$\gamma_{26,12}$					307,81	307,85		307,85 (5)		307,85 (5)
$\gamma_{21,6}$		311,8	312,8 (15)		311,69	311,74		311,78 (4)		311,78 (4)
$\gamma_{23,7}$					316,35	316,41	316,444 (6)	316,41 (4)		316,41 (3)
$\gamma_{16,2}$					319,7	319,68 (10)				319,68 (10)

	1965 Tr03	1966 Ah02	1966 Ho09	1968 Cl02	1971 GuZY	1976 GuZN	1979 Al03	1982 He02	1994 Mo36	Adopted
$\gamma_{19,3}$		321,1			320,8	320,88		320,862 (20)		320,862 (20)
$\gamma_{24,8}$	324	323,9	322,8 (8)		323,76	323,81	323,853 (4)	323,841 (29)		323,84 (3)
$\gamma_{16,0}$	331,1 (5)	333,0	333,2 (5)		332,80	332,838	332,841 (2)	332,845 (5)		332,845 (5)
$\gamma_{26,11}$	336,1 (7)	336,3			336,06	336,107		336,120 (12)		336,113 (12)
$\gamma_{20,4}$	342,6 (7)	341,7	340,0 (20)		341,48	341,510 (2)	341,510 (2)	341,502 (19)		341,506 (10)
$\gamma_{24,7}$										345,001 (13) [b]
$\gamma_{22,5}$	345,6 (7)	345,1 (3)	345,2 (5)		344,96	345,014	345,003 (4)	345,013 (4)		345,013 (4)
$\gamma_{-1,7}$						350,8 (3)				350,8 (3)
$\gamma_{19,2}$					354,1	354,0 (5)				354,0 (5)
$\gamma_{26,10}$	363,5 (10)		363,4 (20)		361,9	361,89		361,90 (6)		361,89 (5)
$\gamma_{19,0}$		367,4			367,02	367,050		367,096 (26)		367,073 (25)
$\gamma_{21,3}$		368,7	369,3 (15)		368,53	368,550		368,557 (27)		368,554 (20)
$\gamma_{22,4}$	375,2 (3)	375,2 (2)	376,3 (5)		375,02	375,042	375,043 (7)	375,054 (3)		375,054 (3)
$\gamma_{20,2}$	380,7 (7)	380,4	381,3 (15)		380,16	380,166	380,173 (3)	380,191 (6)		380,191 (6)
$\gamma_{26,8}$	383,2 (7)	382,9	382,7 (15)		382,72	382,751		382,698 (16)		382,75 (5)
$\gamma_{24,5}$	392,5 (7)				392,45	392,53	392,552 (6)	392,53 (3)		392,53 (3)
$\gamma_{20,1}$	393,4 (7)	393,4 (3)	393,5 (8)		393,06	393,14	393,138 (6)	393,14 (3)		393,14 (3)
$\gamma_{23,3}$					399,44	399,51	399,530 (12)	399,54 (9)		399,53 (6)
$\gamma_{25,6}$	406,2 (5)		408,0 (15)		406,2 (5)	406,9		406,77 (25)		406,8 (2)
$\gamma_{27,11}$					410,77	411,15 (30)				411,2 (3)
$\gamma_{42,20}$										412,49 (6) [b]
$\gamma_{22,2}$	414,0 (3)	413,7	414,2 (5)		413,69	413,712	413,710 (13)	413,713 (5)		413,713 (5)
$\gamma_{24,4}$	422,8 (7)	422,6	423,4 (8)		422,57	422,586	422,596 (8)	422,598 (19)		422,598 (19)
$\gamma_{22,1}$		426,7			426,67	426,68 (8)				426,68 (3)
$\gamma_{24,3}$						428,4 (3)				428,4 (3)
$\gamma_{26,6}$					430,0	430,08 (10)				430,08 (10)
$\gamma_{23,0}$			445,8 (8)		445,78	445,72 (3)	445,740 (17)	445,81 (10)		445,72 (3)
$\gamma_{-1,8}$						446,82 (20)				446,82 (20)
$\gamma_{26,5}$	452,0 (7)	451,6	451,9 (5)		451,45	451,474		451,481 (10)		451,481 (10)
$\gamma_{27,8}$					457,57	457,61 (5)				457,61 (5)
$\gamma_{24,2}$					461,29	461,25 (5)				461,25 (5)
$\gamma_{25,3}$					463,8	463,9				463,9 (3)
$\gamma_{24,0}$					474,4	473,9				473,9 (5)
$\gamma_{26,4}$			480,7 (20)		481,55	481,54		481,78 (12)		481,66 (12)
$\gamma_{26,3}$					487,0	487,06				487,06 (10)
$\gamma_{31,10}$					493,1	493,08 (5)				493,08 (5)
$\gamma_{-1,9}$						497,0				497,0 (5)
$\gamma_{27,5}$						526,4				526,4 (4)
$\gamma_{-1,10}$					538,9	538,8 (2)				538,8 (2)
$\gamma_{33,8}$					550,6	550,5 (2)				550,5 (2)
$\gamma_{-1,11}$					557,7	557,3 (5)				557,3 (5)
$\gamma_{36,10}$						579,4 (3)				579,4 (3)
$\gamma_{31,5}$						582,89	582,75 (8)			582,89 (10)
$\gamma_{29,4}$					586,4	586,3	586,940 (14)			586,3 (3)

	1965 Tr03	1966 Ah02	1966 Ho09	1968 Cl02	1971 GuZY	1976 GuZN	1979 Al03	1982 He02	1994 Mo36	Adopted
$\gamma_{43,12}$						596,0				596,0 (5)
$\gamma_{33,6}$					598,4	597,99 (5)				597,99 (5)
$\gamma_{36,8}$						599,6 (2)				599,6 (2)
$\gamma_{40,10}$					607,3	606,9 (2)				606,9 (2)
$\gamma_{-1,12}$						608,9 (2)				608,9 (2)
$\gamma_{31,4}$					612,9	612,83 (3)	612,838 (6)			612,83 (3)
$\gamma_{35,6}$					617,4	617,10 (10)	617,212 (7)			617,10 (10)
$\gamma_{31,3}$					618,9	618,28 (6)	618,335 (6)			618,28 (6)
$\gamma_{33,5}$						619,21 (6)				619,21 (6)
$\gamma_{29,2}$							624,75 (10)			624,78 (5)
$\gamma_{32,3}$					624,8	624,78 (5)				624,78 (3)
$\gamma_{28,0}$					633,19	633,15 (6)	633,088 (6)			633,15 (6)
$\gamma_{29,1}$										637,73 (5) [b]
$\gamma_{29,0}$			636,0 (30)		637,97	637,84 (6)	637,77 (1)			637,80 (5)
$\gamma_{38,7}$					640,15	640,075		639,99 (10)		639,99 (10)
$\gamma_{30,2}$			645,5 (30)		646,02	645,969	645,894 (5)	645,98 (3)		645,94 (4)
$\gamma_{33,4}$					649,5	649,32 (6)				649,32 (6)
$\gamma_{-1,13}$						650,529 (60)				650,529 (60)
$\gamma_{34,4}$					652,19	652,074	652,052 (5)	651,79 (10)		652,05 (2)
$\gamma_{33,3}$					654,86	654,88 (8)	654,80 (2)			654,88 (8)
$\gamma_{30,1}$					658,99	658,929	658,862 (5)	658,63 (15)		658,86 (6)
$\gamma_{31,0}$					664,67	664,58 (5)	664,520 (12)			664,58 (5)
$\gamma_{36,5}$						668,2 (5)				668,2 (5)
$\gamma_{43,4}$						670,8				670,8 (5)
$\gamma_{32,0}$										670,99 (4)
$\gamma_{40,6}$					674,2	674,05 (3)				674,05 (3)
$\gamma_{40,5}$										674,4 (5)
$\gamma_{-1,14}$					686,16	685,97 (11)	685,861 (6)			685,97 (11)
$\gamma_{-1,15}$						688,1 (3)				688,1 (3)
$\gamma_{34,2}$					690,85	690,81 (8)	690,730 (22)			690,81 (8)
$\gamma_{-1,16}$						693,2 (5)				693,2 (5)
$\gamma_{46,10}$							693,81 (1)			693,81 (1) [c]
$\gamma_{41,5}$						697,8				697,8 (5)
$\gamma_{-1,17}$						699,6 (5)				699,6 (5)
$\gamma_{33,0}$					701,00	701,1 (2)				701,1 (2)
$\gamma_{34,1}$					703,79	703,68 (5)	703,680 (22)			703,68 (5)
$\gamma_{-1,18}$						712,96 (5)				712,96 (5)
$\gamma_{44,7}$						714,71	714,57 (1)			714,71 (14)
$\gamma_{39,4}$					717,76	717,72	718,23 (1)	718,0 (5)		718,0 (5)
$\gamma_{35,0}$						720,3 (5)				720,3 (5)
$\gamma_{47,10}$							720,550 (25)			720,56 (3)
$\gamma_{41,4}$					727,81	727,9	727,860 (25)			727,9 (2)
$\gamma_{46,7}$						736,5	735,910 (15)			736,5 (5)
$\gamma_{-1,19}$						742,7 (5)				742,7 (5)

	1965 Tr03	1966 Ah02	1966 Ho09	1968 Cl02	1971 GuZY	1976 GuZN	1979 Al03	1982 He02	1994 Mo36	Adopted
$\gamma_{37,2}$						747,4	747,97 (1)			747,4 (5)
$\gamma_{38,2}$					}	}756,4 (2)	756,190 (35)			756,23 (6) [b]
$\gamma_{39,2}$			756,0 (30)		}756,40	}	756,87 (6)			756,4 (4)
$\gamma_{47,7}$							762,6 (2)			762,6 (2)
$\gamma_{45,5}$						763,7	763,60 (15)			763,60 (15) [c]
$\gamma_{41,2}$			766,8 (30)			766,6	766,53 (4)			766,47 (3)
$\gamma_{51,12}$							767,29 (4)			767,29 (4)
$\gamma_{38,1}$							769,15 (8)		769,19 (4) [a]	769,15 (8)
$\gamma_{39,1}$					769,38	769,4 (5)	769,59			769,4 (5)
$\gamma_{43,4}$							769,87 (2)			769,54 (4)
$\gamma_{-1,20}$						777,1				777,1 (3)
$\gamma_{41,1}$					779,5	779,61	779,42 (2)			779,43 (3) [b]
$\gamma_{-1,21}$					787,3	786,9 (2)	786,90 (2)			786,9 (2)
$\gamma_{-1,22}$					793,0	788,5 (3)				788,5 (3)
$\gamma_{42,2}$						792,9	792,58 (5)			792,68 (6) [b]
$\gamma_{-1,23}$					796,5	796,9 (3)				796,9 (3)
$\gamma_{-1,24}$					803,3	803,2 (2)				803,2 (2)
$\gamma_{42,1}$						805,9	805,65 (1)			805,65 (6) [b]
$\gamma_{43,2}$					808,2	808,4	808,19 (4)			808,21 (4) [b]
$\gamma_{46,4}$					813,9	813,7	813,510 (17)			813,7 (2)
$\gamma_{50,9}$						816,0 (2)				816,0 (2)
$\gamma_{43,0}$					821,1					821,25 (4) [b]
$\gamma_{51,10}$						821,3 (2)				821,3 (2)
$\gamma_{-1,25}$						826,8 (3)				826,8 (3)
$\gamma_{-1,26}$					828,8	828,9 (2)	828,82 (4)			828,9 (2)
$\gamma_{52,12}$					832,1	832,5				832,2 (2)
$\gamma_{-1,27}$						837,3 (2)				837,3 (2)
$\gamma_{47,4}$					839,0	840,4	840,26 (10)			840,4 (2)
$\gamma_{44,1}$					843,8	844,0	843,78 (1)			843,780 (10)
$\gamma_{47,2}$					879,0	879,2				879,2 (3)
$\gamma_{47,1}$						891,0				891,0 (3)
$\gamma_{-1,28}$						895,4 (3)				895,4 (3)
$\gamma_{-1,29}$						898,1 (3)				898,1 (3)
$\gamma_{-1,30}$						905,5 (3)				905,5 (3)
$\gamma_{-1,31}$						911,7 (3				911,7 (3)
$\gamma_{49,4}$						918,7 (3)				918,7 (3)
$\gamma_{-1,32}$						931,9 (3)				931,9 (3)
$\gamma_{50,3}$					940,1	940,3 (3)				940,3 (3)
$\gamma_{48,2}$					956,4	955,6	955,390 (21)			955,41 (2) [b]
$\gamma_{49,2}$						957,6 (3)				957,6 (3)
$\gamma_{48,1}$							968,390 (34)			968,37 (2)
$\gamma_{51,2}$					979,5	979,7				979,7 (3)
$\gamma_{-1,33}$						982,7 (3)				982,7 (3)
$\gamma_{53,7}$					986,7	986,9	986,920 (35)			986,92 (4) [c]

	1965 Tr03	1966 Ah02	1966 Ho09	1968 Cl02	1971 GuZY	1976 GuZN	1979 Al03	1982 He02	1994 Mo36	Adopted
$\gamma_{51,1}$					992,5	992,7	992,639 (33)			992,64 (3) [c]
$\gamma_{52,4}$					1005,5	1005,7				1005,7 (3)
$\gamma_{-1,34}$						1009,4 (3)				1009,4 (3)
$\gamma_{52,0}$					1057,3					1057,3 (2)

[a] Measured in 1980Despres
[b] Obtained as a level energy difference
[c] Adopted from 1979Al03

Table 10. Experimental and evaluated relative emission probabilities of gamma rays in decay of ^{239}Pu [&]

	Energy, keV	1966 Ah02	1976 GuZN	1980 Despres	1982 He02	1984 Iw02	1992 Bl07	1994 Mo36	Evaluated
$\gamma_{1,0}$	0,077								~0,00016 [a]
$\gamma_{2,1}$	12,98						540 (14)	540 (14)	540 (14)
$\gamma_{-1,1}$	14,22							87 (6)	87 (6) *
$\gamma_{5,4}$	30,04		3,47 (13)		15,4 (4)			4,4 (13)	3,47 (13)
$\gamma_{4,2}$	38,66	152 (15)	168 (4)		157,0 (4)		165,8 (24)	165,5 (21)	166 (3)
$\gamma_{-1,2}$	40,41		2,58 (26)						2,58 (26) *
$\gamma_{10,7}$	41,93		2,64 (10)		4,07 (10)			2,31 (24)	2,59 (12)
$\gamma_{3,0}$	46,21	16 (2)	11,8 (12)		14,6 (7)			11,43 (17)	11,5 (2)
$\gamma_{11,8}$	46,68		0,93 (6)		1,2 (1)			0,74 (4)	0,80 (9)
$\gamma_{7,5}$	47,60							0,99 (4)	0,99 (4)
$\gamma_{4,1}$	51,62	410 (40)	431 (9)		422 (3)		434 (6)	431 (4)	427 (3)
$\gamma_{12,10}$	54,04		3,19 (8)		3,01 (7)			3,08 (4)	3,08 (4)
$\gamma_{6,3}$	56,83	16 (2)	18,0 (4)		17,4 (4)			18,26 (21)	18,0 (2)
$\gamma_{14,12}$	65,71		0,72 (4)		0,72 (6)			0,82 (5)	0,75 (4)
$\gamma_{9,6}$	67,67		2,57 (7)		2,70 (11)			2,40 (4)	2,50 (8)
$\gamma_{5,2}$	68,70	}14 (2)	8,15 (18)		7,9 (2)			7,69 (10)	5,7 (16) [b]
$\gamma_{8,5}$	68,73	}							2,1 (10) [b]
$\gamma_{-1,3}$	74,96								0,60 (10) [c] *
$\gamma_{7,4}$	77,59	11,2	6,23 (13)		6,8 (2)			6,02 (8)	6,08 (9)
$\gamma_{13,9}$	78,43		2,43 (6)		2,1 (2)			2,44 (4)	2,43 (4)
$\gamma_{17,13}$	89,39								~0,03 [d]
$\gamma_{10,5}$	89,64				0,47 (8)			0,43 (3)	0,43 (3)
$\gamma_{12,7}$	96,14		0,36 (7)					0,60 (3)	0,60 (3)
$\gamma_{15,11}$	97,6								1,4 (10) [e, a]
$\gamma_{8,4}$	98,78		19,5 (7)					23,2 (11)	21,4 (18)
$\gamma_{6,0}$	103,06		3,47 (9)					3,42 (9)	3,44 (9)
$\gamma_{11,5}$	115,38		7,27 (18)						7,3 (8) [f]
$\gamma_{7,2}$	116,26		9,54 (24)					8,99 (17)	9,2 (3)
$\gamma_{10,4}$	119,70		}0,479 (14)		}0,53 (2)			0,479 (29)	0,33 (4) [g]
$\gamma_{14,10}$	119,76		}		{				0,15 (2) [g, i]
$\gamma_{12,6}$	122,35		0,05 (3)					0,015 (2)	0,015 (2) [i]
$\gamma_{37,29}$	123,23								0,000025 (6) [h]
$\gamma_{21,14}$	123,62		0,315 (20)					0,376 (14)	0,376 (14)
$\gamma_{9,3}$	124,51		0,98 (4)					1,08 (3)	1,08 (3)
$\gamma_{10,3}$	125,21		1,13 (3)					0,892 (24)	0,892 (24)
$\gamma_{7,0}$	129,30	100	100	100	100	100		100	100

	Energy, keV	1966 Ah02	1976 GuZN	1980 Despres	1982 He02	1984 Iw02	1992 Bl07	1994 Mo36	Evaluated
$\gamma_{19,12}$	141,66	0,6 (1)	0,511 (15)	0,45 (7)	0,46 (8)	0,63 (18)			0,509 (15)
$\gamma_{12,5}$	143,35		0,276 (12)	0,45	}4,80 (9)	}4,75 (13)			0,276 (12)
$\gamma_{15,8}$	144,20	5 (1)	4,52 (10)	4,75 (24)	}	}			4,52 (10)
$\gamma_{13,6}$	146,09	2,1 (2)	1,90 (4)	1,80 (18)	2,00 (10)	1,91 (10)			1,91 (4)
$\gamma_{10,2}$	158,1		0,0160 (16)						0,0160 (16)
$\gamma_{18,11}$	160,19		0,099 (20)						0,099 (20) [i]
$\gamma_{16,10}$	161,45		1,92 (4)	2,00 (12)	1,96 (4)	1,91 (10)			1,94 (10)
$\gamma_{17,9}$	167,81		0,047 (12)						0,047 (12)
$\gamma_{10,0}$	171,39	1,8 (2)	1,76 (5)	1,69 (10)	1,74 (4)	1,70 (9)			1,74 (4)
$\gamma_{42,28}$	172,56								~0,00005 [h]
$\gamma_{12,4}$	173,70		0,049 (12)						0,049 (12)
$\gamma_{12,3}$	179,22	1,2 (2)	1,05 (3)	1,04 (8)	1,04 (3)	1,00 (5)			1,04 (3)
$\gamma_{-1,4}$	184,55		0,034 (10)						0,034 (10) *
$\gamma_{14,6}$	188,23		0,174 (18)						0,174 (18)
$\gamma_{21,12}$	189,36	1,5 (2)	1,33 (4)	1,33 (12)	1,30 (2)	1,28 (3)			1,30 (2)
$\gamma_{-1,5}$	193,13		0,142 (15)						0,142 (15) *
$\gamma_{19,10}$	195,68	1,9 (2)	1,70 (4)	1,64 (11)	1,68 (3)	1,68 (4)			1,68 (3)
$\gamma_{-1,6}$	196,87		0,059 (7)						0,059 (7) *
$\gamma_{16,7}$	203,55	9 (1)	8,95 (18)	8,94 (42)	8,90 (13)	8,95 (14)			8,93 (13)
$\gamma_{21,11}$	218,0								0,019 (16) [i]
$\gamma_{12,0}$	225,42		0,249 (11)	0,22 (2)	0,23 (2)	0,23 (2)			0,238 (11)
$\gamma_{19,7}$	237,77		0,230 (10)	0,23 (2)		0,32 (2)			0,230 (10)
$\gamma_{26,14}$	242,08		0,117 (8)	}	}	}			0,117 (8)
$\gamma_{21,10}$	243,38		0,404 (11)	}0,41	}0,38 (3)	}0,61 (4)			0,404 (11)
$\gamma_{14,3}$	244,92		0,081 (8)	}	}	}			0,081 (8)
$\gamma_{24,12}$	248,95		0,115 (12)	0,112 (11)	0,11 (1)	0,106 (20)			0,111 (10)
$\gamma_{22,10}$	255,38	1,6 (2)	1,29 (4)	1,27 (10)	1,27 (3)	1,23 (3)			1,26 (3)
$\gamma_{20,7}$	263,95	0,6 (1)	0,417 (15)	0,40 (4)	0,42 (4)	0,39 (3)			0,411 (15)
$\gamma_{30,20}$	265,7		0,025 (6)						0,025 (6)
$\gamma_{16,4}$	281,2		0,035 (5)	0,033 (10)		0,025 (13)			0,034 (5)
$\gamma_{19,5}$	285,3		0,030 (6)	0,03					0,030 (6)
$\gamma_{22,7}$	297,46	0,9 (1)	0,802 (23)	0,77 (8)	0,78 (2)	0,77 (2)			0,78 (2)
$\gamma_{24,10}$	302,87		0,081 (7)	0,070 (12)	0,075 (10)	0,074 (12)			0,077 (7)
$\gamma_{26,12}$	307,85		0,088 (6)	0,076 (12)	0,08 (2)	0,073 (12)			0,083 (6)
$\gamma_{21,6}$	311,78	0,5 (1)	0,412 (12)	0,39 (4)	0,40 (3)	0,36 (8)			0,408 (12)
$\gamma_{23,7}$	316,41		0,217 (8)	0,21 (4)	0,20 (4)	0,196 (14)			0,211 (8)
$\gamma_{16,2}$	319,7		0,077 (8)			}0,85 (2)			0,077 (8)
$\gamma_{19,3}$	320,86	0,8 (1)	0,856 (19)	0,86 (8)	0,86 (3)	}			0,856 (19)
$\gamma_{24,8}$	323,84	0,9 (1)	0,866 (19)	0,82 (8)	0,84 (2)	0,81 (2)			0,84 (2)
$\gamma_{16,0}$	332,85	8 (1)	8,08 (16)	7,64 (32)	7,70 (11)	7,64 (11)			7,74 (11)
$\gamma_{26,11}$	336,11	1,8 (2)	1,81 (4)	1,72 (13)	1,73 (4)	1,75 (4)			1,76 (4)
$\gamma_{20,4}$	341,51	1,2 (1)	1,058 (22)	1,05 (10)	1,00 (4)	1,02 (2)			1,03 (2)
$\gamma_{24,7}$	345,00	}	}						<0,8 [i]
$\gamma_{22,5}$	345,013	}8,7 (9)	}8,93 (18)	8,75 (30)	8,67 (13)	8,61 (11)			8,69 (11)
$\gamma_{-1,7}$	350,8		0,028 (6)						0,028 (6) *
$\gamma_{19,2}$	354,0		0,012 (5)						0,012 (5)
$\gamma_{26,10}$	361,89		0,195 (11)	0,18 (2)	0,22 (2)	0,17 (1)			0,185 (11)

	Energy, keV	1966 Ah02	1976 GuZN	1980 Despres	1982 He02	1984 Iw02	1992 Bl07	1994 Mo36	Evaluated
$\gamma_{19,0}$	367,07	1,6 (2)	1,38 (3)	1,38 (6)	1,44 (3)	1,35 (2)			1,38 (3)
$\gamma_{21,3}$	368,55	1,4 (2)	1,44 (3)	1,39 (6)	1,37 (3)	1,38 (2)			1,39 (2)
$\gamma_{22,4}$	375,05	25 (3)	25,1 (5)	24,9 (8)	24,2 (3)	24,2 (3)			24,4 (3)
$\gamma_{20,2}$	380,19	5 (1)	4,87 (10)	4,78 (26)	4,75 (7)	4,77 (6)			4,78 (6)
$\gamma_{26,8}$	382,75	4 (1)	4,13 (8)	4,08 (32)	4,02 (6)	4,04 (5)			4,05 (5)
$\gamma_{24,5}$	392,53		}8,83 (18)	}8,72 (35)	}8,55 (13)	1,91 (25)			1,91 (25)
$\gamma_{20,1}$	393,14	10 (1)	}	}	}	6,64 (26)			6,64 (26)
$\gamma_{23,3}$	399,53		0,097 (4)		0,09 (1)	0,103 (17)			0,097 (4)
$\gamma_{25,6}$	406,8		0,010 (4)		0,046 (11)				0,010 (4)
$\gamma_{27,11}$	411,2		0,11 (5)						0,11 (5)
$\gamma_{42,20}$	412,49					}23,0 (3)			~0,00029 [j]
$\gamma_{22,2}$	413,71	25 (3)	23,8 (5)	23,8 (8)	23,0 (3)	}			23,2 (3)
$\gamma_{24,4}$	422,60	2,0 (3)	1,90 (4)	1,91 (14)	1,88 (4)	1,90 (3)			1,90 (3)
$\gamma_{22,1}$	426,68	0,3 (1)	0,372 (9)	0,36 (4)		0,42 (2)			0,379 (9)
$\gamma_{24,3}$	428,4		0,0160 (16)						0,0160 (16)
$\gamma_{26,6}$	430,1		0,069 (3)	0,068 (7)		0,065 (6)			0,068 (3)
$\gamma_{23,0}$	445,72		0,139 (4)	0,146 (15)		0,13 (11)			0,139 (4)
$\gamma_{-1,8}$	446,8		0,0135 (20)						0,0135 (20) *
$\gamma_{26,5}$	451,48	3,4 (5)	3,02 (7)	3,08 (19)	2,96 (4)	2,93 (4)			2,96 (4)
$\gamma_{27,8}$	457,61		0,0238 (5)	0,026 (3)		0,023 (6)			0,0239 (5)
$\gamma_{24,2}$	461,25		0,0363 (8)						0,0363 (8)
$\gamma_{25,3}$	463,9		0,0044 (5)						0,0044 (5)
$\gamma_{24,0}$	473,9		0,0009 (5)						0,0009 (5)
$\gamma_{26,4}$	481,7		0,0735 (15)	0,077 (8)		0,069 (4)			0,0731 (15)
$\gamma_{26,3}$	487,1		0,042 (3)						0,042 (3)
$\gamma_{31,10?}$	493,08		0,0139 (5)	0,014 (2)		0,013 (3)			0,0139 (5)
$\gamma_{-1,9}$	497,0		0,0007 (4)						0,0007 (4) *
$\gamma_{27,5}$	526,4		0,0009 (3)						0,0009 (3)
$\gamma_{-1,10}$	538,8		0,0049 (3)						0,0049 (3) *
$\gamma_{33,8}$	550,5		0,0067 (4)	0,0074 (8)		0,0079 (31)			0,0069 (4)
$\gamma_{-1,11}$	557,3		0,0006 (3)						0,0006 (3) *
$\gamma_{36,10}$	579,4		0,0014 (3)						0,0014 (3)
$\gamma_{31,5}$	582,9		0,0098 (4)						0,0098 (4)
$\gamma_{29,4}$	586,3		0,00244 (25)						0,00244 (25)
$\gamma_{43,12}$	596,0		0,00062 (19)						0,00062 (19)
$\gamma_{33,6}$	597,99		0,0267 (10)	0,032 (3)		0,030 (3)			0,0275 (10)
$\gamma_{36,8}$	599,6		0,0032 (4)						0,0032 (4)
$\gamma_{40,10}$	606,9		0,00192 (20)						0,00192 (20)
$\gamma_{-1,12}$	608,9		0,00185 (19)						0,00185 (19) *
$\gamma_{31,4}$	612,83		0,0151 (8)	0,025		0,016 (4)			0,0151 (8)
$\gamma_{35,6}$	617,10		0,0214 (12)	}0,08 (1)	}0,09 (1)	}0,069 (5)			0,0214 (12)
$\gamma_{31,3}$	618,28		0,0326 (12)	}	}	}			0,0326 (12)
$\gamma_{33,5}$	619,21		0,0193 (12)						0,0193 (12)
$\gamma_{29,2}$	624,78		0,0073 (3) }						0,0073 (3) [k]
$\gamma_{32,3}$	624,78		}						<0,0003 [k]
$\gamma_{28,0}$	633,15		0,0404 (9)	0,043 (4)		0,036 (3)			0,0404 (9)
$\gamma_{29,1}$	637,73		}0,0409 (10)	}0,047 (5)		}0,047 (4			0,0101 (10) [k]

	Energy, keV	1966 Ah02	1976 GuZN	1980 Despres	1982 He02	1984 Iw02	1992 Bl07	1994 Mo36	Evaluated
$\gamma_{29,0}$	637,80		}	}		}			0,0304 (30) [k]
$\gamma_{38,7}$	639,99		0,131 (3)	0,139 (14)	0,16 (2)	0,142 (5)			0,134 (3)
$\gamma_{30,2}$	645,94		0,238 (5)	0,25 (3)	0,21 (2)	0,236 (6)			0,236 (5)
$\gamma_{33,4}$	649,32		0,0114 (8)						0,0114 (8)
$\gamma_{-1,13}$	650,53		0,0043 (7)						0,0043 (7) *
$\gamma_{34,4}$	652,05		0,105 (3)	0,105 (11)	0,125 (15)	0,102 (5)			0,105 (3)
$\gamma_{33,3}$	654,88		0,0359 (8)	0,029 (7)		0,023 (5)			0,0359 (8)
$\gamma_{30,1}$	658,86		0,155 (4)	0,159 (16)	0,125 (14)	0,150 (5)			0,152 (4)
$\gamma_{31,0}$	664,58		0,0265 (6)	0,027 (3)		0,026 (3)			0, 0265 (6)
$\gamma_{36,5}$	668,2		0,00063 (19)						0,00063 (19)
$\gamma_{43,4}$?	670,8		}0,00014 (4)						<0,00014 (4) [l, i]
$\gamma_{32,0}$?	670,99		}						<0,00014 (4) [l, i]
$\gamma_{40,6}$	674,05		0,0082 (3)	}0,0096 (10)		0,0080 (3)			0,0080 (3) [k]
$\gamma_{40,5}$	674,4			}					0,0016 (2) [k]
$\gamma_{-1,14}$	685,97		0,0199 (5)	0,0158 (16)		0,023 (4)			0,0199 (5) *
$\gamma_{-1,15}$	688,1		0,00177 (18)						0,00177 (18) *
$\gamma_{34,2}$	690,81		0,0089 (5)	0,0104 (10)		0,014 (3)			0,0093 (7)
$\gamma_{-1,16}$	693,2		}0,00080 (24)						0,0005 (2) [g] *
$\gamma_{46,10}$	693,81		}						0,0003 (1) [g]
$\gamma_{41,5}$	697,8		0,00117 (24)						0,00117 (24)
$\gamma_{-1,17}$	699,6		0,00126 (25)						0,00126 (25) *
$\gamma_{33,0}$	701,1		0,0082 (3)	0,0095 (10)		0,0106 (34)			0,0083 (3)
$\gamma_{34,1}$	703,68		0,063 (2)	0,067 (7)		0,070 (4)			0,065 (2)
$\gamma_{-1,18}$	712,96		0,00082 (10)						0,00082 (10) *
$\gamma_{44,7}$	714,7		0,00125 (13)						0,00125 (13)
$\gamma_{39,4}$	718,0		0,0438 (9)	0,048 (5)		0,042 (3)			0,0438 (9)
$\gamma_{35,0}$	720,3		}0,00078 (8)						0,00046 (5) [g]
$\gamma_{47,10}$	720,56		}						0,00032 (3) [g]
$\gamma_{41,4}$	727,9		0,00198 (11)						0,00198 (11)
$\gamma_{46,7}$	736,5		0,00048 (14)						0,00048 (14)
$\gamma_{-1,19}$	742,7		0,00060 (18)						0,00060 (18) *
$\gamma_{37,2}$	747,4		0,00129 (26)						0,00129 (26)
$\gamma_{38,2}$	756,23		}0,0554 (11)	}0,061 (6)		}0,054 (4)			0,044 (8) [g]
$\gamma_{39,2}$	756,4		}	}		}			0,011 (3) [g]
$\gamma_{47,7}$	762,6								~0,00016 [g]
$\gamma_{45,5}$	763,60		0,00052 (26)						0,00035 [g]
$\gamma_{41,2}$	766,47		}0,00439 (24)						0,0021 (3) [g]
$\gamma_{51,12}$	767,29		}						0,0022 (5) [g,i]
$\gamma_{38,1}$	769,15		}0,179 (4)	}0,20 (2)		}0,187 (5)			0,081 (16) [g]
$\gamma_{39,1}$	769,4		}	}		}			0,108 (19) [g]
$\gamma_{43,4}$	769,54		}	}		}			- [m]
$\gamma_{-1,20}$	777,1		0,00044 (11)						0,00044 (11) *
$\gamma_{41,1}$	779,43		0,00217 (14)						0,00217 (14)
$\gamma_{-1,21}$	786,9		0,00138 (14)						0,00138 (14) *
$\gamma_{-1,22}$	788,5		0,00056 (11)						0,00056 (11)
$\gamma_{42,2}$	792,68		0,00032 (6)						0,00032 (6)
$\gamma_{-1,23}$	796,9		0,00024 (5)						0,00024 (5) *

	Energy, keV	1966 Ah02	1976 GuZN	1980 Despres	1982 He02	1984 Iw02	1992 Bl07	1994 Mo36	Evaluated
$\gamma_{-1,24}$	803,2		0,00102 (7)						0,00102 (7) *
$\gamma_{42,1}$	805,65		0,00044 (7)						0,00044 (7)
$\gamma_{43,2}$	808,21		0,00193 (10)						0,00193 (10)
$\gamma_{46,4}$	813,7		0,00072 (7)						0,00072 (7)
$\gamma_{50,9}$	816,0		0,00039 (6)						0,00039 (6)
$\gamma_{43,0}$	821,25		}0,00088 (9)						0,00079 (17) [n]
$\gamma_{51,10}$	821,3		}						~0,00009 [n]
$\gamma_{-1,25}$	826,8		0,00029 (10)						0,00029 (10) *
$\gamma_{-1,26}$	828,9		0,00212 (13)						0,00212 (13) *
$\gamma_{52,12}$	832,2		0,00047 (6)						0,00047 (6)
$\gamma_{-1,27}$	837,3		0,00031 (6)						0,00031 (6) *
$\gamma_{47,4}$	840,4		0,00077 (8)						0,00077 (8)
$\gamma_{44,1}$	843,78		0,00214 (12)						0,00214 (12)
$\gamma_{47,2}$	879,2		0,00058 (6)						0,00058 (6)
$\gamma_{47,1}$	891,0		0,00119 (13)						0,00119 (13)
$\gamma_{-1,28}$	895,4		0,00012 (4)						0,00012 (4) *
$\gamma_{-1,29}$	898,1		0,00028 (6)						0,00028 (6) *
$\gamma_{-1,30}$	905,5		0,00012 (4)						0,00012 (4) *
$\gamma_{-1,31}$	911,7		0,00022 (5)						0,00022 (5) *
$\gamma_{49,4}$	918,7		0,00014 (5)						0,00014 (5)
$\gamma_{-1,32}$	931,9		0,00020 (7)						0,00020 (7) *
$\gamma_{50,3}$	940,3		0,00079 (8)						0,00079 (8)
$\gamma_{48,2}$	955,41		0,00049 (5)						0,00049 (5)
$\gamma_{49,2}$	957,6		0,00051 (5)						0,00051 (5)
$\gamma_{48,1}$	968,37								~0,00044 [h]
$\gamma_{51,2}$	979,7		0,00044 (7)						0,00044 (7)
$\gamma_{-1,33}$	982,7		0,00017 (4)						0,00017 (4) *
$\gamma_{53,7}$	986,92		0,00033 (7)						0,00033 (7)
$\gamma_{51,1}$	992,64		0,00042 (6)						0,00042 (6)
$\gamma_{52,4}$	1005,7		0,00028 (4)						0,00028 (4)
$\gamma_{-1,34}$	1009,4		0,00022 (4)						0,00022 (4) *
$\gamma_{52,0}$	1057,3								0,00071 (11) [j]

[&] Other measurements for some γ rays: 1965Tr03, 1966Ho09, 1968Cl02, 1971GuZY, 1981UmZZ, 1992Ba08, 1992Co10, 1997Bu23, 1997Ko52.

* Unplaced in level scheme.

[a] Deduced from P(γ+ce) and total ICC.

[b] Intensity suitably divided for doublet in 2003Br12 (see comments therein).

[c] From 1971GuZY. Reported also in Coulomb excitation, see comments in 2003Br12.

[d] Intensity suitably divided for doublet in 2003Br12 using systematics.

[e] Seen in conversion electron spectrum only (1965Tr03).

[f] From 1976GuZN and corrected for X-ray component in 2003Br12.

[g]. Intensity suitably divided for doublet in 2003Br12 based on (n, γ) data (1979Al03).

[h] From (n, γ) data (1979Al03). See 2003Br12.

[i] Placement of this transition in the level scheme is uncertain (2003Br12).

[j] From 2003Br12.

[k] Intensity suitably divided for doublet in 1996Firestone.

[l] Multiply placed, undivided intensity given.

[m] E0-transition.

[n] Possible doublet (see 2003Br12); multiply placed.

Table 11. Energies, multipolarities, E2/M1 mixing ratios and ICC for soft gamma rays (< 120 keV) in decay of ^{239}Pu [*]

Energy (keV)	Multipolarity	δ-mixing ratio	K	L1	L2	L3	L	M	TOT
0,0765 (4)	E3								
12,975 (10)	M1+0,19 (2) %E2 [a]	0,0436 (23) [a]						451 (13)	607 (17) [a]
14,22 (3)									
30,04 (2)	(M1) [a]			104,9 (21)	12,42 (25)	0,687 (14)	118,0 (24)	28,7 (6)	157 (3)
38,661 (2)	M1+22,2 (16) %E2 [a]	0,534 (24) [a]		42,3 (8)	110 (7)	96 (7)	249 (14)	67 (4)	339 (19)
40,41 (5)									
41,93 (5)	(M1) [a]			39,3 (8)	4,66 (9)	0,249 (5)	44,2 (9)	10,71 (21)	58,6 (12)
46,21 (5)	M1+1,8 (5) %E2 [a]	0,134 (19) [a]		29,0 (6)	7,0 (11)	3,3 (9)	39,4 (19)	9,8 (5)	52,6 (27) [a]
46,68 (3)	M1+9 (5) %E2 [a]	0,32 (9) [a]		26,6 (12)	21 (10)	16 (9)	63 (17)	17 (5)	86 (24) [a]
47,60 (3)	(M1)			27,0 (5)	3,22 (6)	0,170 (3)	30,4 (6)	7,37 (15)	40,4 (8)
51,624 (1)	E2			4,20 (8)	120,4 (24)	101,8 (20)	226 (5)	62,6 (13)	310 (6)
54,039 (8)	M1 [a]			18,6 (4)	2,22 (4)	0,1154 (23)	21,0 (4)	5,08 (10)	27,8 (6)
56,828 (3)	M1+5,0 (8) %E2 [b]	0,23 (2) [b]		15,4 (3)	5,7 (7)	3,3 (5)	24,3 (11)	6,14 (30)	32,6 (15)
65,708 (30)	M1+4 (6) %E2 [a]	0,21 (16) [a]		10,1 (7)	2,8 (29)	1,35 (24)	14 (5)	3,,6 (13)	19 (6) [a]
67,674 (12)	M1+3,63 (11) %E2 [b]	0,194 (3) [b]		9,33 (19)	2,34 (5)	1,01 (3)	12,7 (4)	3,15 (9)	16,9 (5)
68,696 (6)	E2			1,19 (24)	31,6 (6)	24,5 (5)	57,3 (11)	15,9 (3)	78,6 (16)
68,73 (2)	(M1+20 %E2) [c]	0,5 [c]		7,6	7,2	4,9	20	5,2	27
74,96 (10)									

Energy (keV)	Multipolarity	δ-mixing ratio	K	L1	L2	L3	L	M	TOT
77,592 (14)	M1(+20 (32) %E2) [d]	0,5 (5) [d]		5,3 (2)	4 (5)	2,7 (40)	12 (7)	3,2 (21)	17 (10)
78,43 (2)	M1(+20 (32) %E2) [d]	0,5 (5) [d]		5,2 (17)	4 (5)	2,6 (40)	12 (7)	3,1 (20)	16 (10)
89,39 (6)	[M1]			4,28 (9)	0,519 (10)	0,0253 (5)	4,82 (10)	1,167 (23)	6,40 (13)
89,64 (3)	(M1+E2)						11 (6)	2,8 (17)	14 (8)
96,14 (3)	[E2]			0,318 (6)	6,72 (14)	4,63 (9)	11,67 (23)	3,24 (7)	16,0 (3)
97,6 (3)	M1+20 (19) %E2 [d]	0,5 (3) [d]		2,71 (6)	1,6 (11)	0,9 (8)	5,2 (14)	1,3 (4)	7,0 (19)
98,78 (2)	E2			0,289 (6)	5,94 (12)	4,05 (8)	10,28 (21)	2,85 (6)	14,1 (3)
103,06 (3)	E2			0,250 (5)	4,90 (10)	3,29 (7)	8,44 (17)	2,34 (5)	11,58 (23)
115,38 (5)	E2			0,172 (3)	2,95 (6)	1,88 (4)	5,00 (10)	1,39 (3)	6,87 (14)
116,26 (2)	M1(+24 (36) %E2) [d]	0,56 (56) [d]	8,4 (18)	1,5 (6)	0,9 (9)	0,5 (6)	2,9 (6)	0,74 (16)	12,2 (26)
119,70 (3)	(M1+E2)		5 (5)				3,1 (11)	0,8 (3)	9 (4)
119,76 (2)	[E2]		0,200 (4)	0,154 (3)	2,49 (5)	1,57 (3)	4,22 (8)	1,169 (23)	5,99 (12)

* For gamma rays with energies more than 120 keV the multipolarities are taken from 2003Br12 based on conversion electron data of 1965Tr03, experimental (n,γ) results of 1979Al03 or assigned from the decay scheme (in square brackets). The δ-mixing ratios are: 1,0 (10) for $\gamma_{26,5}$ (451,5 keV), < 1 for $\gamma_{40,10}$ (606,9 keV), < 0,5 for $\gamma_{28,0}$ (633,2 keV), 1,2 (2) for $\gamma_{46,7}$ (736,5 keV), 0,6 (2) for $\gamma_{46,7}$ (955,4 keV) and 0,6 (3) $\gamma_{46,7}$ (968,4 keV).

[a] Deduced from intensity balance.
[b] From muonic ^{235}U atom.
[c] From systematics.
[d] From conversion electron data of 1965Tr03.

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