

Adopted Levels, Gammas

Type	Author	History	Citation	Literature Cutoff Date
Full Evaluation	Yu. Khazov, A. Rodionov and G. Shulyak		NDS 136, 163 (2016)	14-Jul-2016

$Q(\beta^-)=1542.3$; $S(n)=6258.5$; $S(p)=5311.4$; $Q(\alpha)=1909.4$ [2012Wa38](#)

Produced and identified by [1960Fu05](#), cyclotron, (p,3n) reaction.

The ^{146}Pm level scheme is a result of studies of $^{146}\text{Nd}(p,n\gamma)$ and the $^{136}\text{Xe}(^{15}\text{N},5n\gamma)$, $^{146}\text{Nd}(d,2n\gamma)$, $^{148}\text{Nd}(d,4n\gamma)$ reactions.

Only five common levels were determined from the first and other reactions.

 ^{146}Pm LevelsCross Reference (XREF) Flags

A $^{146}\text{Nd}(p,n\gamma)$
B (HI,xn γ)

E(level) [†]	J ^π [‡]	T _{1/2} [@]	XREF	Comments
0.0	3 ⁻	5.53 y 5	AB	$\% \beta^- = 34.3$ 15; $\% \epsilon = 65.7$ 15 $\% \beta^-$, $\% \epsilon$: from $I\gamma = 34.6\%$ 15 for 747.2 keV, E2 transition, see ^{146}Pm β^- decay; weighted average of 34.7 18 (1966Bu03), 37.0 55 (1968Ta09), 33.3 35 (1970Av03) assuming ($I(\gamma + ce)747.2$, $^{146}\text{Sm} + I(\gamma + ce)453.8$, ^{146}Nd) = 100% and no β^- and ($\epsilon + \beta^+$) feedings to $^{146}\text{Sm}(\text{g.s.})$ and $^{146}\text{Nd}(\text{g.s.})$ correspondingly. Other: $\% \beta^- = 34.0$ 13, $\% \epsilon = 66.0\%$ 13 (1997Pe22 , 2012Au07). T _{1/2} : from $\gamma(t)$ and $\beta(t)$, T _{1/2} = 5.53 y 5 or 2020 d 18 (1967Bu12); see 2012Au07 . Other: 1600 d 80 (1963Pa21), 2019.83 d (2014Le18). J ^π : from $\beta\gamma(\theta)$ (1974Dr08), shape factor of β^- -spectrum (1974Sc06). J ^π : from most possible depopulation of 33.3 keV, J = (6 ⁻) level to g.s., J = 3 ⁻ through the 17.2 keV level (J = 3 or J = 6 are unlikely). J ^π : 734.0 γ E2 from (8 ⁻), 198.9 γ E2, $\Delta J = 0$ from (6 ⁻). J ^π : 73.1 γ (M1) to 3 ⁻ . T _{1/2} : lifetime belongs to μs -range (from $\gamma\gamma(t)$ of 1992Ue01). J ^π : 137.9 γ M1 from (6 ⁻), 61.0 γ D to (6 ⁻). J ^π : 245.0 γ M1+E2 from (5 ⁺), 713.3 γ ($\Delta J = 1$) from (7 ⁺), 74.3 γ (E1) to (6 ⁻). J ^π : 136 γ M1,E2 to 3 ⁻ . J ^π : 132.6 γ (M1) to (4 ⁻ , 5 ⁻), 149.9 γ M1,E2 to 3 ⁻ . J ^π : 212.4 γ M1 to 3 ⁻ . J ^π : 588.7 γ E1 from (7 ⁺). J ^π : 162.4 γ M1+E2 to (4 ⁻). J ^π : 285.2 γ M1 to 3 ⁻ . J ^π : 216.3 γ M1 to (5 ⁻), 277.3 γ M1 to (6 ⁻), 310.6 γ to 3 ⁻ . J ^π : 468.2 γ E2, stretched, from (7 ⁺). J ^π : 318.8 γ M1 to (4 ⁻). J ^π : 282.8 γ M1+E2 to (5 ⁻).
17.23 8	[4 ⁻ , 5 ⁻] [#]		AB	
33.26 7	(6 ⁻)		AB	
73.14 7	(4 ⁻) [#]		AB	
83.18 7			A	
89.09 7			A	
94.27 8	(5 ⁻)		AB	
107.55 10	(6 ⁺)		B	
136.42 6	(2,3,4) ⁻		A	
149.86 6	(3 ⁻ , 4 ⁻ , 5 ⁻)		A	
166.93 6			A	
187.82 7			A	
201.10 6			A	
212.42 5	(2,3,4) ⁻		A	
232.17 9	(6 ⁻)		B	
235.55 9	(5 ⁻) [#]		AB	
285.20 7	(2,3,4) ⁻		A	
292.64 11			A	
302.46 6			A	
310.57 6	(5 ⁻)		A	
352.58 12	(5 ⁺)		B	
391.97 6	(3,4,5) ⁻		A	
417.90 8			A	
452.59 9			A	
518.38 11	(6 ⁻) [#]		AB	
532.17 7			A	
564.42 12			A	
581.64 11			A	
589.49 11			A	

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Adopted Levels, Gammas (continued) ^{146}Pm Levels (continued)

E(level) [†]	J^π [‡]	XREF	Comments
649.03 8		A	
665.82 12		A	
675.53 8		A	
699.52 12		A	
703.48 12		A	
758.50 8		A	
765.28 7		A	
767.24 10	(8 ⁻)	B	J^π : 105.7 γ E1 from (9 ⁺).
791.50 9		A	
810.82 12		A	
820.81 9	(7 ⁺)	B	J^π : 52.5 γ (E2), stretched, from (9 ⁺).
833.59 9		A	
872.97 11	(9 ⁺)	B	J^π : from a comparison of the level scheme of ^{146}Pm with level schemes of isotones ^{148}Eu and ^{150}Tb (1995Rz02).
873.72 12		A	
920.82 12		A	
1028.28 12		A	
1111.88 15		B	
1353.21 14	(10)	B	
1440.38 18		B	
1511.64 14	(11 ⁺)	B	
1966.91 15	(12)	B	
2005.31 15	(12)	B	
2236.41 15	(13 ⁺)	B	
2551.18 16	(14)	B	
2605.99 16	(14)	B	
3037.58 19	(16)	B	
3054.62 16	(14,15)	B	
3247.50 17	(16)	B	
3790.90 20	(18)	B	
4099.18 21		B	
4110.81 22		B	
4180.89 21	(20)	B	
4219.91 22	(19)	B	
4872.53 21	(20)	B	
4969.09 24		B	
5250.71 24	(21)	B	
5338.78 23	(22)	B	
5378.69 22		B	
5453.7 3	(21,23)	B	J^π : 203.0 γ Q ($\Delta J=0, 2$) to (21).
5640.18 22	(21)	B	J^π : 253.0 γ Q ($\Delta J=0, 2$) from (23), 767.7 γ to (20).
5686.31 22	(22)	B	
5787.29 24		B	
5893.19 22	(23)	B	
5986.73 23	(24)	B	
6292.29 24		B	
6432.9 3		B	
6513.7 3		B	
6619.20 24	(25)	B	
6837.9 3	(25,27)	B	J^π : 218.7 γ Q ($\Delta J=0, 2$) to (25).
6876.5 3		B	

[†] From a least-squares fit to $E\gamma$'s; normalized $\chi^2=0.5$.[‡] Assigned by the evaluators regarding the 872.9 keV, $J^\pi=9^+$ level as suggested in 1995Rz02, and using R(DCO) and $\alpha(\text{exp})$

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Adopted Levels, Gammas (continued) ^{146}Pm Levels (continued)

values, except as noted.

Deduced in [2011KhZZ](#) on the basis of assigned multiplicities and assumption $J^\pi=9^+$ for 872.9 keV level according to [1995Rz02](#).@ $\gamma\gamma(t)$ spectra have not shown any levels with $T_{1/2}>10$ ns ([1995Rz02](#)).

$\gamma(^{146}\text{Pm})$									
$E_i(\text{level})$	J_i^π	$E_\gamma^\dagger$	$I_\gamma^\dagger$	E_f	J_f^π	Mult. [#]	$\alpha^\&$	Comments	
73.14	(4 ⁻)	73.1 1	100	0.0	3 ⁻	(M1) [@]	3.82	E_γ : unplaced in $^{146}\text{Nd}(\text{p},\text{n}\gamma)$.	
83.18		83.2 1	100	0.0	3 ⁻				
89.09		89.1 1	100	0.0	3 ⁻				
94.27	(5 ⁻)	61.0 1	100	33.26	(6 ⁻)	D [@]	0.598		
107.55	(6 ⁺)	74.3 [‡] 1	100 [‡]	33.26	(6 ⁻)	(E1) [@]			0.70 6
136.42	(2,3,4) ⁻	136.4 1	100	0.0	3 ⁻	M1,E2			
149.86	(3 ⁻ ,4 ⁻ ,5 ⁻)	132.6 1	24.9 9	17.23	[4 ⁻ ,5 ⁻]	(M1)	0.694		
		149.9 1	100 3	0.0	3 ⁻	M1,E2			0.52 3
166.93		93.8 1	100	73.14	(4 ⁻)				
187.82		98.7 1	35.8 10	89.09					
		104.7 1	46.1 16	83.18					
		187.8 1	100 3	0.0	3 ⁻				
201.10		106.8 1	36.9 15	94.27	(5 ⁻)				
		167.8 1	37.4 15	33.26	(6 ⁻)				
		201.1 1	100 3	0.0	3 ⁻				
212.42	(2,3,4) ⁻	62.6 1	17.3 8	149.86	(3 ⁻ ,4 ⁻ ,5 ⁻)				
		76.0 1	45.3 15	136.42	(2,3,4) ⁻				
		195.2 1	18.4 8	17.23	[4 ⁻ ,5 ⁻]				
		212.4 1	100 3	0.0	3 ⁻	M1	0.188		
232.17	(6 ⁻)	137.9 [‡] 1	65 [‡] 4	94.27	(5 ⁻)	M1	0.622	E_γ : unplaced in $^{146}\text{Nd}(\text{p},\text{n}\gamma)$.	
		198.9 [‡] 1	100 [‡] 5	33.26	(6 ⁻)	E2	0.206	E_γ : unplaced in $^{146}\text{Nd}(\text{p},\text{n}\gamma)$.	
235.55	(5 ⁻)	162.4 1	100	73.14	(4 ⁻)	M1+E2	0.402 10		
285.20	(2,3,4) ⁻	97.4 1	4.3 7	187.82					
		196.1 1	43.2 14	89.09					
		285.2 1	100 4	0.0	3 ⁻	M1	0.0850		
292.64		142.8 1	100	149.86	(3 ⁻ ,4 ⁻ ,5 ⁻)	M1,E2	0.60 4		
302.46		135.6 1	34.4 18	166.93					
		166.0 1	11.7 6	136.42	(2,3,4) ⁻				
		302.4 ^a 1	100 3	0.0	3 ⁻	M1,E2	0.063 10		
310.57	(5 ⁻)	216.3 1	100 3	94.27	(5 ⁻)	M1	0.179		
		277.3 1	79 3	33.26	(6 ⁻)	M1	0.0916		
		310.6 1	6.2 4	0.0	3 ⁻				
352.58	(5 ⁺)	245.0 [‡] 1	100 [‡]	107.55	(6 ⁺)	M1+E2	0.116 13	E_γ : unplaced in $^{146}\text{Nd}(\text{p},\text{n}\gamma)$.	
391.97	(3,4,5) ⁻	179.5 1	100 3	212.42	(2,3,4) ⁻				
		190.8 1	14.3 10	201.10					
		225.1 1	13.3 10	166.93					
		318.8 1	83 3	73.14	(4 ⁻)	M1	0.0633		
		374.8 2	10.2 20	17.23	[4 ⁻ ,5 ⁻]				
		392.0 1	77 3	0.0	3 ⁻				
417.90		250.9 1	99 4	166.93					
		281.5 1	43 2	136.42	(2,3,4) ⁻	M1	0.0880		
		384.7 1	100 4	33.26	(6 ⁻)				
452.59		251.5 1	100 4	201.10					
		358.4 2	11.8 15	94.27	(5 ⁻)				
		419.3 1	22.8 15	33.26	(6 ⁻)				
518.38	(6 ⁻)	282.8 1	100	235.55	(5 ⁻)	M1+E2	0.076 11		
532.17		319.8 1	85 3	212.42	(2,3,4) ⁻				

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Adopted Levels, Gammas (continued)

$\gamma(^{146}\text{Pm})$ (continued)								
$E_i(\text{level})$	J_i^π	E_γ †	I_γ †	E_f	J_f^π	Mult. #	α &	Comments
532.17		532.2 1	100 4	0.0	3 ⁻			
564.42		376.6 1	100	187.82				
581.64		289.1 2	19.5 24	292.64				
		369.2 1	100 4	212.42	(2,3,4) ⁻			
589.49		278.9 2	12.7 14	310.57	(5 ⁻)			
		388.4 1	100 4	201.10				
649.03		461.2 1	78 6	187.82				
		560.0 1	100 8	89.09				
		565.8 1	94 8	83.18				
665.82		453.4 1	100	212.42	(2,3,4) ⁻			
675.53		283.5 1	39 3	391.97	(3,4,5) ⁻			
		365.0 1	45 3	310.57	(5 ⁻)			
		440.0 1	100 5	235.55	(5 ⁻)			
699.52		563.1 1	100	136.42	(2,3,4) ⁻			
703.48		392.9 1	100	310.57	(5 ⁻)			
758.50		557.4 1	39 4	201.10				
		591.5 1	59 4	166.93				
		608.7 1	100 5	149.86	(3 ⁻ ,4 ⁻ ,5 ⁻)			
765.28		233.2 1	22.5 11	532.17				
		462.8 1	42.7 23	302.46				
		552.9 1	99 4	212.42	(2,3,4) ⁻			
		615.3 1	100 6	149.86	(3 ⁻ ,4 ⁻ ,5 ⁻)			
767.24	(8 ⁻)	535.0 [‡] 1	100 [‡] 8	232.17	(6 ⁻)	E2	0.01027	
		734.0 [‡] 1	58 [‡] 7	33.26	(6 ⁻)	E2	0.00470	
791.50		480.9 1	100 8	310.57	(5 ⁻)			
		655.1 1	92 11	136.42	(2,3,4) ⁻			
810.82		674.4 1	100	136.42	(2,3,4) ⁻			
820.81	(7 ⁺)	302.4 ^{a‡} 1	<0.01 [‡]	518.38	(6 ⁻)	(E1) @	0.01384	
		468.2 [‡] 1	14.3 [‡] 9	352.58	(5 ⁺)	E2	0.01469	
		588.7 [‡] 1	100 [‡] 5	232.17	(6 ⁻)	E1	0.00287	
		713.3 [‡] 1	45 [‡] 3	107.55	(6 ⁺)			Mult.: $\Delta J=1$ (1995Rz02).
833.59		523.0 1	100 5	310.57	(5 ⁻)			
		632.5 ^a 1	19 5	201.10				
872.97	(9 ⁺)	52.2 [‡] 1	100 [‡] 50	820.81	(7 ⁺)	(E2)	27.0 5	
		105.7 [‡] 1	71 [‡] 5	767.24	(8 ⁻)	E1	0.230	
873.72		737.3 1	100	136.42	(2,3,4) ⁻			
920.82		784.4 1	100	136.42	(2,3,4) ⁻			
1028.28		263.0 1	100	765.28				
1111.88		759.3 [‡] 1	100 [‡]	352.58	(5 ⁺)			
1353.21	(10)	480.2 [‡] 1	100 [‡]	872.97	(9 ⁺)	D		
1440.38		328.5 [‡] 1	100 [‡]	1111.88				
1511.64	(11 ⁺)	158.4 [‡] 1	6.5 [‡] 6	1353.21	(10)			
		638.7 [‡] 1	100 [‡] 6	872.97	(9 ⁺)	E2	0.00656	
1966.91	(12)	455.2 [‡] 1	50 [‡] 3	1511.64	(11 ⁺)	D		
		613.7 [‡] 1	100 [‡] 6	1353.21	(10)	E2	0.00724	
2005.31	(12)	493.7 [‡] 1	100 [‡]	1511.64	(11 ⁺)	D		
2236.41	(13 ⁺)	231.2 [‡] 1	11.3 [‡] 11	2005.31	(12)	D		
		269.5 [‡] 1	7.0 [‡] 8	1966.91	(12)			
		724.8 [‡] 1	100 [‡] 5	1511.64	(11 ⁺)	E2	0.00484	
2551.18	(14)	314.8 [‡] 1	62 [‡] 4	2236.41	(13 ⁺)	D		
		584.2 [‡] 1	100 [‡] 6	1966.91	(12)	E2	0.00819	

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Adopted Levels, Gammas (continued) $\gamma(^{146}\text{Pm})$ (continued)

$E_i(\text{level})$	J_i^π	$E_\gamma^\dagger$	$I_\gamma^\dagger$	E_f	J_f^π	Mult. [#]	$\alpha^\&$	Comments
2605.99	(14)	369.6 ‡ I	59 ‡ 3	2236.41	(13 ⁺)	D		
		600.6 ‡ I	100 ‡ 5	2005.31	(12)	E2	0.00764	
3037.58	(16)	486.4 ‡ I	100 ‡	2551.18	(14)	E2	0.01324	
3054.62	(14,15)	448.6 ‡ I	‡	2605.99	(14)			
		503.4 ‡ I	36 ‡ 4	2551.18	(14)			
		818.3 ‡ I	100 ‡ 8	2236.41	(13 ⁺)	Q		
3247.50	(16)	192.9 ‡ I	8.1 ‡ 8	3054.62	(14,15)			
		641.5 ‡ I	100 ‡ 6	2605.99	(14)	E2	0.00649	
3790.90	(18)	543.4 ‡ I	100 ‡	3247.50	(16)	E2	0.00987	
4099.18		1061.6 ‡ I	100 ‡	3037.58	(16)			
4110.81		319.9 ‡ I	100 ‡	3790.90	(18)			
4180.89	(20)	390.0 ‡ I	100 ‡	3790.90	(18)	E2	0.0246	
4219.91	(19)	429.0 ‡ I	100 ‡	3790.90	(18)	D		
4872.53	(20)	1081.6 ‡ I	100 ‡	3790.90	(18)	Q		
4969.09		869.9 ‡ I	100 ‡	4099.18				
5250.71	(21)	1030.8 ‡ I	100 ‡	4219.91	(19)	Q		
5338.78	(22)	1157.9 ‡ I	100 ‡	4180.89	(20)	Q		
5378.69		1197.8 ‡ I	100 ‡	4180.89	(20)			
5453.7	(21,23)	203.0 ‡ I	100 ‡	5250.71	(21)	E2	0.192	
5640.18	(21)	261.6 ‡ I	40 ‡ 7	5378.69				
		767.7 ‡ I	22 ‡ 2	4872.53	(20)			
		1459.1 ‡ I	100 ‡ 16	4180.89	(20)			
5686.31	(22)	813.7 ‡ I	100 ‡ 8	4872.53	(20)	Q		
		1505.6 ‡ I	48 ‡ 6	4180.89	(20)			
5787.29		448.4 ‡ I	100 ‡	5338.78	(22)			
5893.19	(23)	207.0 ‡ I	39 ‡ 7	5686.31	(22)	D		
		253.0 ‡ I	81 ‡ 7	5640.18	(21)			Mult.: $\Delta J=0, 2$ (1995Rz02).
		514.4 ‡ I	37 ‡ 7	5378.69				
		554.4 ‡ I	100 ‡ 9	5338.78	(22)			
5986.73	(24)	93.5 ‡ I	100 ‡ 10	5893.19	(23)			
		648.0 ‡ I	100 ‡ 16	5338.78	(22)			
6292.29		953.6 ‡ I	100 ‡	5338.78	(22)			
6432.9		979.2 ‡ I	100 ‡	5453.7	(21,23)			
6513.7		1060.0 ‡ I	100 ‡	5453.7	(21,23)			
6619.20	(25)	327.0 ‡ I	21 ‡ 3	6292.29				
		632.5 ‡ I	100 ‡ 6	5986.73	(24)	D		
		831.8 ‡ I	43 ‡ 4	5787.29				
6837.9	(25,27)	218.7 ‡ I	100 ‡	6619.20	(25)	E2	0.1501	
6876.5		257.3 ‡ I	100 ‡	6619.20	(25)			

[†] From $^{146}\text{Nd}(\text{p},\text{n}\gamma)$ except as noted.[‡] From (HI,xn γ).[#] From $\alpha(\text{exp})$ and DCO ratios, see 1992Ue01 and 1995Rz02, datasets $^{146}\text{Nd}(\text{p},\text{n}\gamma)$ and (HI,xn γ), except as noted.

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Adopted Levels, Gammas (continued)

 $\gamma(^{146}\text{Pm})$ (continued)

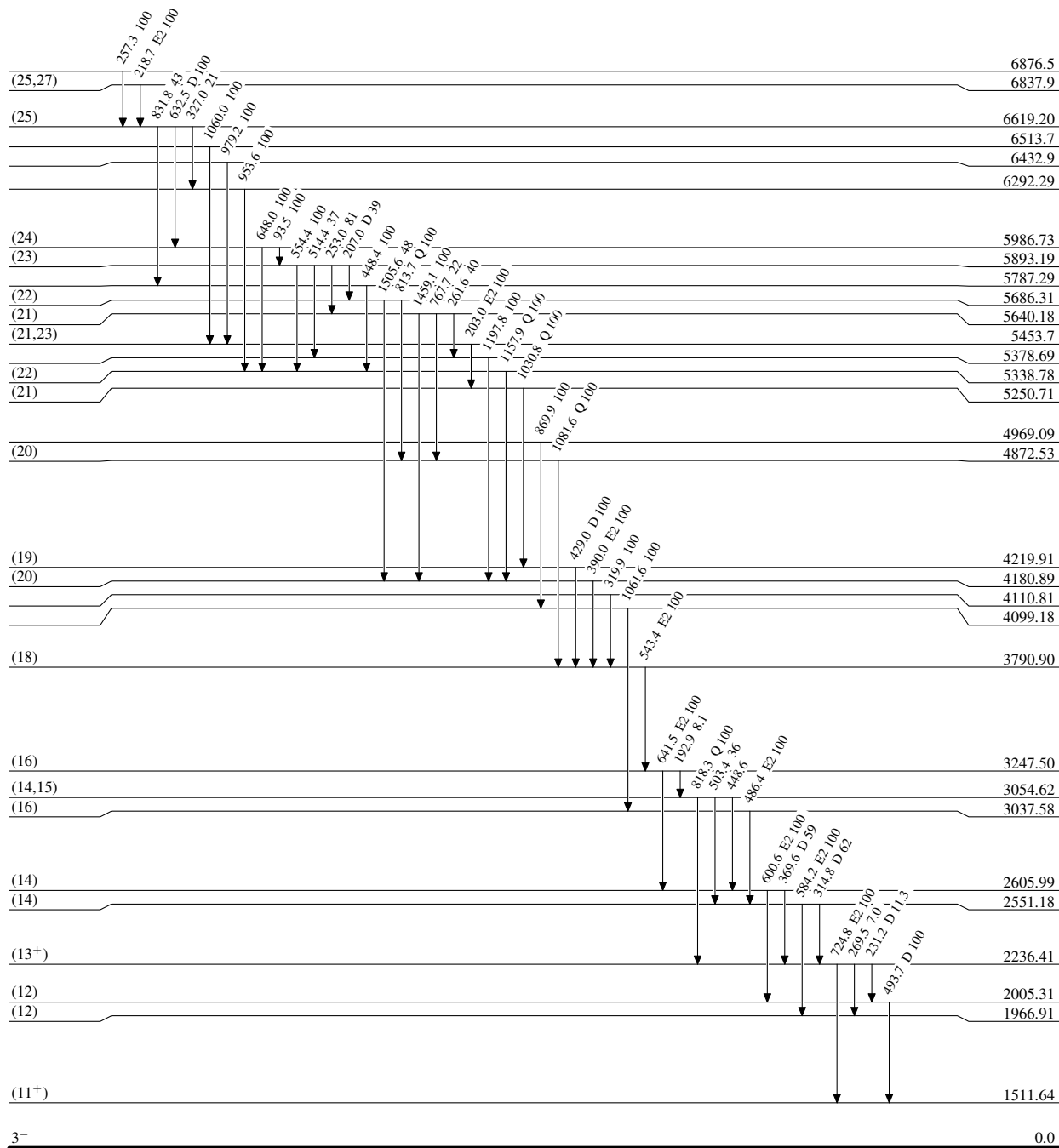
[@] Assigned in [2011KhZZ](#) from RUL for the excited levels (besides 17.2 keV and 33.3 keV) with $T_{1/2} < 10$ ns ([1995Rz02](#)), assumption that the levels of 0.0, 73.1, 235.5 and 518.3 keV belong to the ground state rotational band, and decay pattern.

& [Additional information 1](#).

^a Multiply placed.

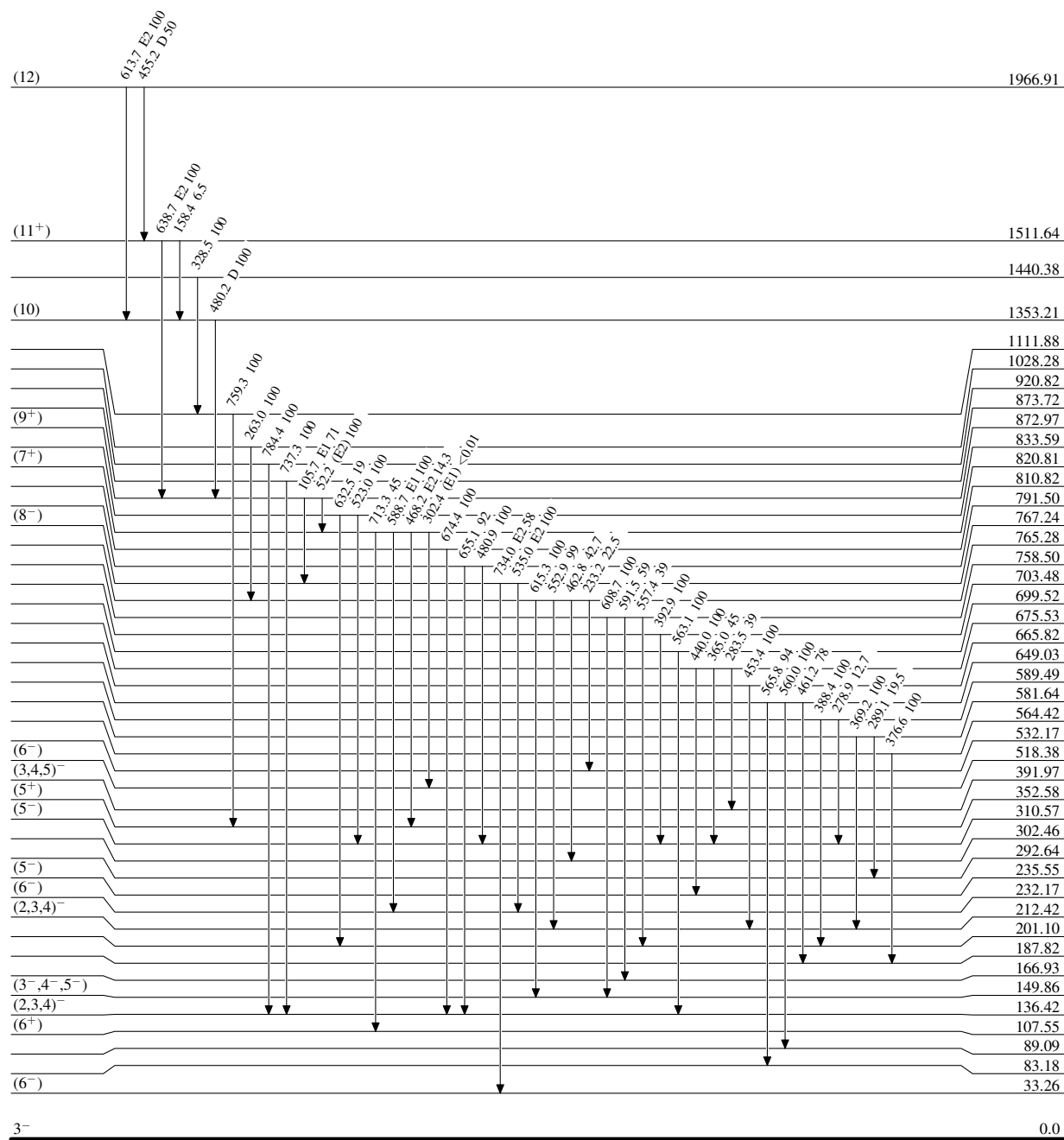
Adopted Levels, Gammas**Level Scheme**

Intensities: Relative photon branching from each level



Adopted Levels, Gammas**Level Scheme (continued)**

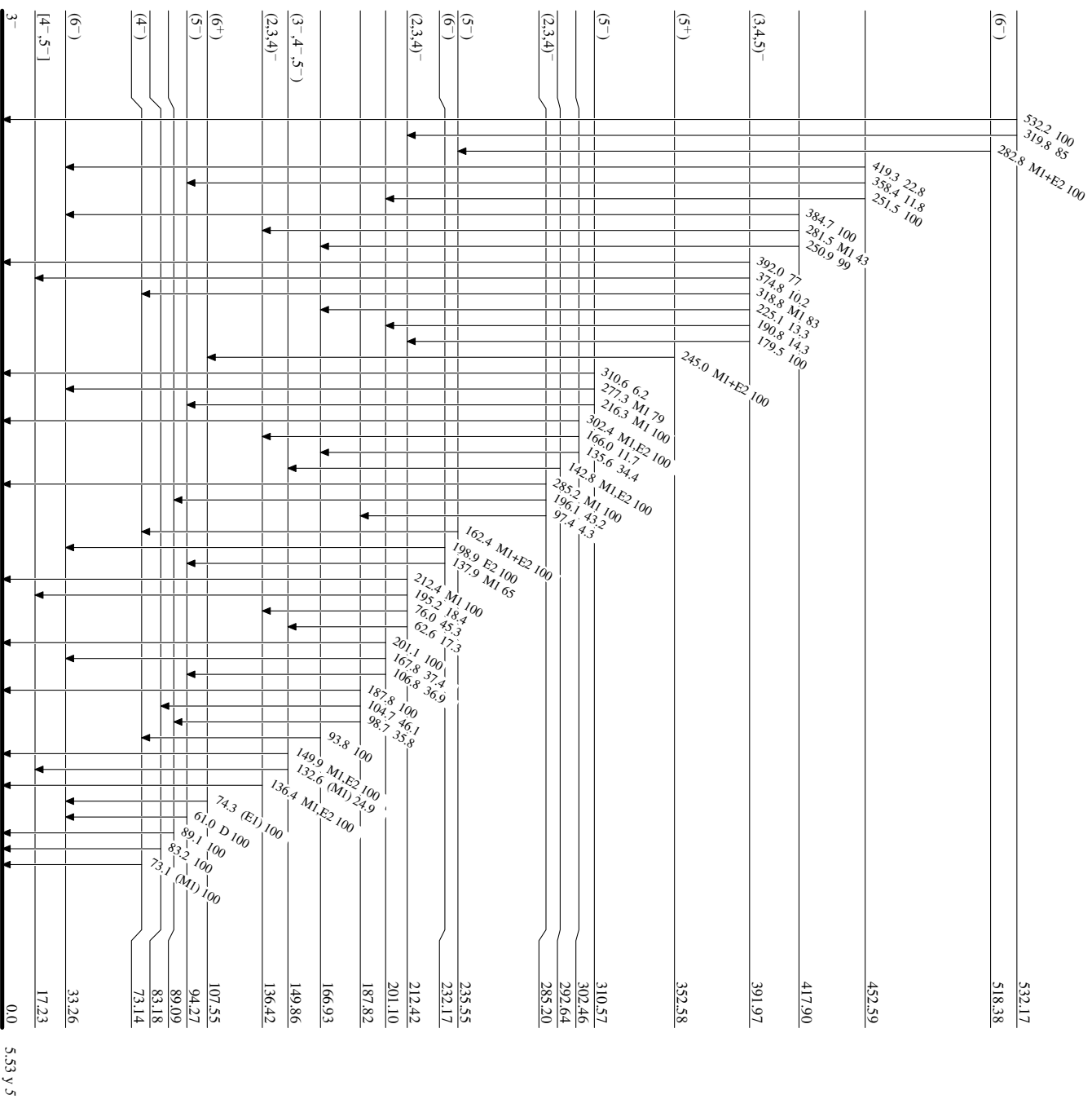
Intensities: Relative photon branching from each level



Adopted Levels, Gammas

Level Scheme (continued)

Intensities: Relative photon branching from each level



$^{146}\text{Pm}_{85}$