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Nuclear Data Sheets for A = 148*

N. NICA

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Abstract: The experimental nuclear structure data available through October 2013 have been reviewed. A summary of information obtained in various reaction and decay experiments is presented, together with adopted level schemes.

Cutoff Date: October 2013.

General Policies and Organization of Material: See the January issue of the *Nuclear Data Sheets* or http://www.nndc.bnl.gov/nds/NDSPolicies.pdf.

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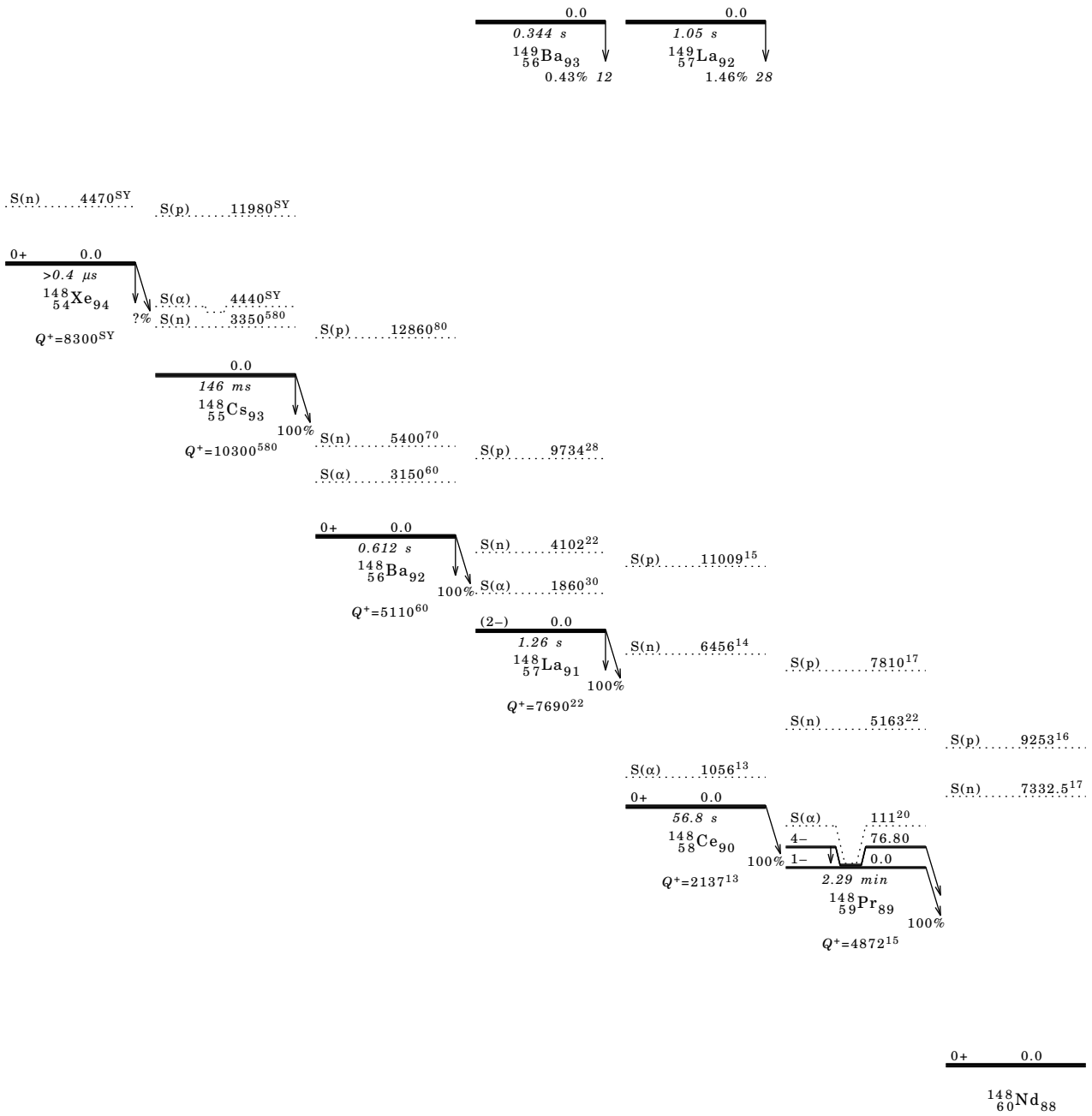
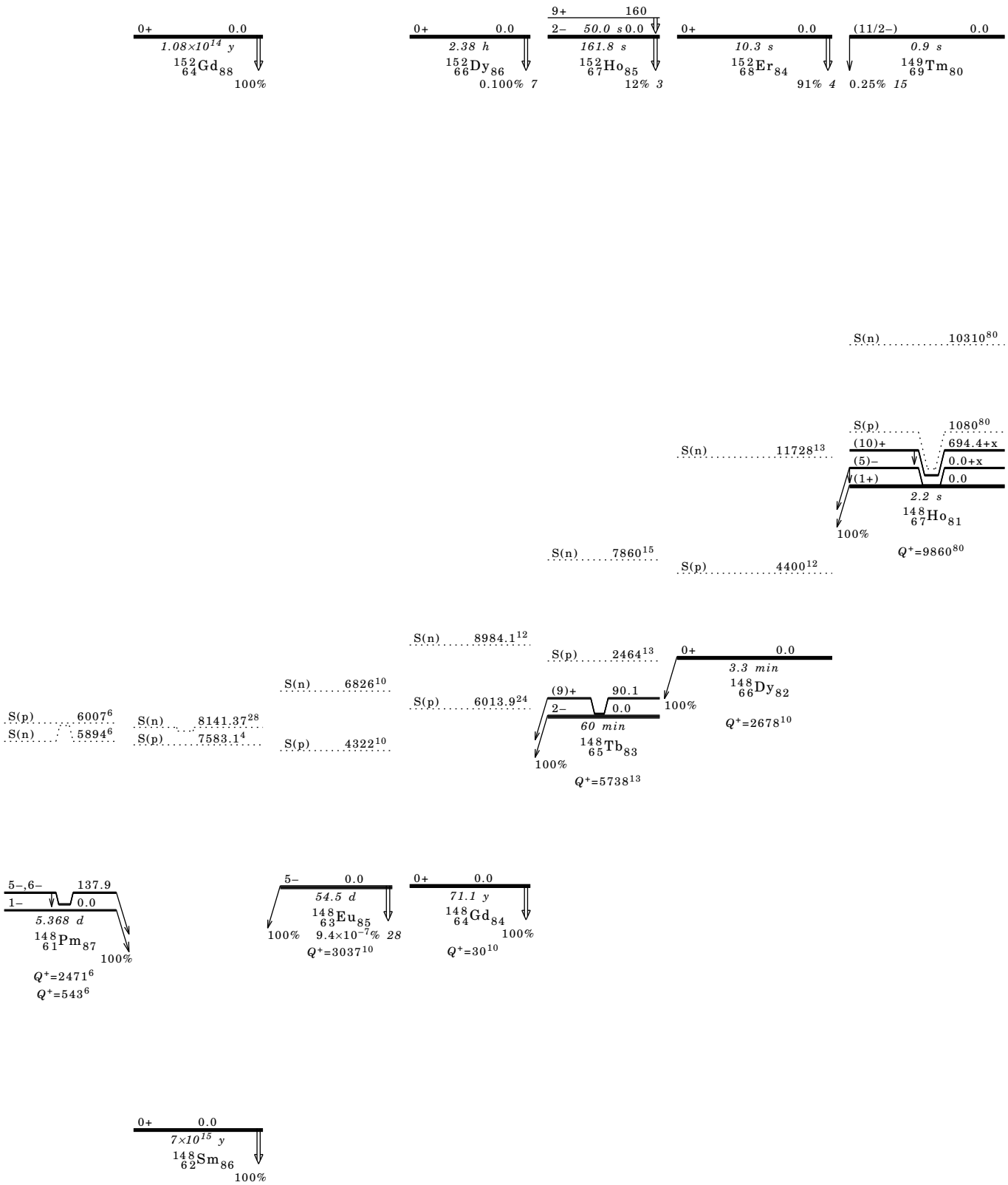
Skeleton Scheme for A=148



Skeleton Scheme for A=148 (continued)



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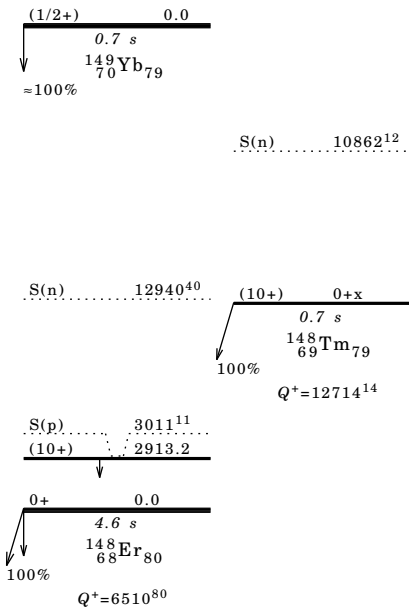


Ground-State and Isomeric-Level Properties

Nuclide	Level	Jπ	$T_{1/2}$	Decay Modes
^{148}Xe	0.0	0+	>0.4 μs	%β⁻=?; %β⁻n=?
^{148}Cs	0.0		146 ms *6*	%β⁻=100; %β⁻n=25.1 *25*
^{148}Ba	0.0	0+	0.612 s *17*	%β⁻=100; %β⁻n=0.4 *3*
^{148}La	0.0	(2−)	1.26 s *8*	%β⁻=100; %β⁻n=0.15 *3*
^{148}Ce	0.0	0+	56.8 s *3*	%β⁻=100
^{148}Pr	0.0	1−	2.29 min *2*	%β⁻=100
	76.80	4−	2.01 min *7*	%IT=36 *10*; %β⁻=64 *10*
^{148}Nd	0.0	0+	stable	
^{148}Pm	0.0	1−	5.368 d *7*	%β⁻=100
	137.9	5−,6−	41.29 d *11*	%β⁻=95.8 *6*; %IT=4.2 *6*
^{148}Sm	0.0	0+	7×10^{15} y *3*	%α=100
^{148}Eu	0.0	5−	54.5 d *5*	%α=9.4×10^{-7} *28*; %ε+%β⁺=100
^{148}Gd	0.0	0+	71.1 y *12*	%α=100
^{148}Tb	0.0	2−	60 min *1*	%ε+%β⁺=100
	90.1	(9)+	2.20 min *5*	%ε+%β⁺=100
^{148}Dy	0.0	0+	3.3 min *2*	%ε+%β⁺=100
^{148}Ho	0.0	(1+)	2.2 s *11*	%ε+%β⁺=100
	0.0+x	(5)−	9.59 s *15*	%ε+%β⁺=100; %εp=0.08 *1*
	694.4+x	(10)+	2.36 ms *6*	%IT=100
^{148}Er	0.0	0+	4.6 s *2*	%ε+%β⁺=100; %εp≈0.15
	2913.2	(10+)	13 μs *3*	%IT=100
^{148}Tm	0+x	(10+)	0.7 s *2*	%ε+%β⁺=100
^{149}Ba	0.0		0.344 s *7*	%β⁻n=0.43 *12*; ...
^{149}La	0.0		1.05 s *3*	%β⁻n=1.46 *28*; ...
^{149}Er	0.0	(1/2+)	4 s *2*	%εp=7 *2*; ...
	741.8	(11/2−)	8.9 s *2*	%εp=0.18 *7*; ...
^{149}Tm	0.0	(11/2−)	0.9 s *2*	%εp=0.25 *15*; ...
^{149}Yb	0.0	(1/2+)	0.7 s *2*	%εp≈100
^{152}Gd	0.0	0+	1.08×10^{14} y *8*	%α=100
^{152}Dy	0.0	0+	2.38 h *2*	%α=0.100 *7*
^{152}Ho	0.0	2−	161.8 s *3*	%α=12 *3*; ...
	160	9+	50.0 s *4*	%α=10.8 *17*; ...
^{152}Er	0.0	0+	10.3 s *1*	%α=91 *4*; ...

Adopted Levels

Q(β⁻)=8300 *SY*; S(n)=4470 *SY* 2012Wa38.
Uncertainties based on syst: ΔQ(β⁻)=610, ΔS(p)=280 (2012Wa38).
Q(β⁻n)=4950 *200* (2012Wa38,syst).
2010Oh02: ^{148}Xe nuclide identified in Be(^{238}U,F) and Pb(^{238}U,F) reactions with a $^{238}U^{86+}$ beam energy of 345 MeV/nucleon produced by the cascade operation of the RBIF accelerator complex of the linear accelerator RILAC and four cyclotrons RRC, fRC, IRC and SRC. Identification of ^{148}Xe nuclei was made on the basis of magnetic rigidity, time–of–flight and energy loss of the fragments using BigRIPS fragment separator. Experiments performed at RIKEN facility.
Based on A/Q spectrum and Z versus A/Q plot (Q=charge state), one count was assigned to ^{148}Xe isotope.
Structure calculations:
1984Na22: calculated equilibrium shapes.
1986Au02: calculated two–neutron separation energies.
1988So08: calculated equilibrium deformation, energy.
1988Ha24: calculated atomic masses.
1992Na07: calculated equilibrium deformation as function of rotational frequency, shape change features.
1994Ma02: calculated levels, energy splitting, transition probabilities.

^{148}Xe Levels

E(level)	Jπ	$T_{1/2}$	Comments
0.0	0+	>0.4 μs	%β⁻=? ; %β⁻n=? Measured σ=70 pb (2010Oh02), systematic uncertainty≈30%. $T_{1/2}$: lower limit from time–of–flight in 2010Oh02, as communicated to B. Singh by T. Kubo (private communication, July 14, 2010). Actual half–life is expected to be much longer as suggested by the calculated values of 123 ms (1997Mo25), 126 ms (2002Pf04). Probability of misidentification of ^{148}Xe isotope=0.46% (2010Oh02). Calculated %β⁻n=11.0 (1997Mo25); 9.6 (2002Pf04).

$^{148}_{55}Cs_{93}$ $^{148}_{55}Cs_{93}$

Adopted Levels

Q(β⁻)=10300 *580*; S(n)=3350 *580*; S(p)=11980 *SY*; Q(α)=−4440 *SY* 2012Wa38.
Uncertainties based on syst: ΔS(p)=610, ΔQ(α)=700 (2012Wa38).
Q(β⁻n)=4900 *580* (2012Wa38,syst).

^{148}Cs Levels

E(level)	$T_{1/2}$	Comments
0.0	146 ms *6*	%β⁻=100; %β⁻n=25.1 *25*. %β⁻n: from 1986ReZR. Other: 24% *17* (1993Ru01). $T_{1/2}$: unweighted average of: 158 ms *7* (1986Hi08), 146 ms *3* (1986ReZR), 140 ms *12* (1993Ru01), 130 ms *40* (1978Ko29), 170 ms *7* (1980HaYY), and 130 ms *10* (1986Wa17); others: 158 ms and 140 ms (2009Pa49, from different samples), 158 ms (2006Ho05).

Adopted Levels, Gammas

Q(β⁻)=5110 *60*; S(n)=5400 *70*; S(p)=12860 *80*; Q(α)=–3150 *60* 2012Wa38.
Q(β⁻n)=1010 *60* (2012Wa38).

^{148}Ba Levels

Cross Reference (XREF) Flags

A ^{148}Cs β⁻ Decay
B ^{248}Cm SF Decay
C ^{252}Cf SF Decay
D ^{254}Cf SF Decay

E(level)	Jπ†	XREF	$T_{1/2}$	Comments
0.0‡	0+	ABCD	0.612 s *17*	$T_{1/2}$: unweighted average of 0.607 s *25* (1984Ch02), 0.620 s *5* (1986Wa17), 0.63 s *5* (1982Ga24), 0.55 s *5* (1993Ru01), and 0.653 s *2* (1986ReZR). Others: ≈0.7 s (1981ChZX), 0.47 s *3* (1981En05), 0.47 s 20 (1979En02). %β⁻=100; %β⁻n=0.4 *3*. %β⁻n: recommended value of 1993Ru01 based on the following data: 23.9 *21* (1981En05), ≤0.01 (1982Ga24), ≤0.03 (1983Re10), 0.057 *20* (1986ReZR), and 0.72 *20* (1993Ru01). $<r^2>^{1/2}$=4.9773 fm *168* (2004An14).
141.8‡ *1*	2+	ABCD		
423.10‡ *15*	4+	ABC		
687.2§ *7*	1–	A		
775.00§ *23*	(3–)	AB		
807.90‡ *18*	6+	BC		
963.20§ *25*	(5–)	BC		
1049.2	2+	A		
1255.70§ *20*	7–	BC		
1264.70‡ *20*	8+	BC		
1644.92§ *21*	9–	BC		
1767.78‡ *22*	10+	BC		
2117.30§ *25*	(11–)	BC		
2303.5‡ *3*	(12+)	BC		
2659.3?§ *4*		B		
2867.0?‡ *4*		B		

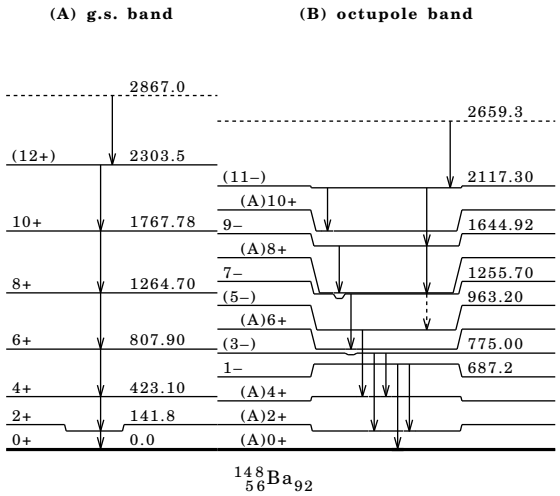
† From DCO ratios, linear polarization, and γγγ(θ) from ^{248}Cm SF decay data which are in agreement with the γγ(θ), γγγ(θ) from ^{252}Cf SF decay data, and systematics for even–even nuclei with A≈150.
‡ (A): g.s. band.
§ (B): Octupole band.

γ(^{148}Ba)

E(level)	Eγ	Iγ	Mult.†	α
141.8	141.8 *1*	100		
423.10	281.3 *1*	100	E2	
687.2	545.5	87		
	687.2	100		
775.00	351.9	21		
	633.2 *2*	100		
807.90	384.8 *1*	100	E2	0.0209
963.20	540.1 *2*	100	D	
1049.2	626.1	21		
	907.5	86		
	1049.1	100		
1255.70	293.0§ *3*	<6		
	447.8 *1*	100 *13*	E1	0.00421
1264.70	456.8 *1*	100	E2	0.01269
1644.92	380.2 *1*	100 *14*	E1	0.00626
	389.2 *2*	43 *14*		
1767.78	503.1 *1*	100	E2	0.00969
2117.30	349.5 *2*	75 *25*	D	
	472.4 *2*	100 *25*		
2303.5	535.7 *2*	100	E2	
2659.3?	542.0 *2*	100		
2867.0?	563.5 *2*	100		

† From ^{248}Cm SF decay dataset based on DCO and linear polarization measurements.
§ Placement of transition in the level scheme is uncertain.

Adopted Levels, Gammas (continued)



^{148}Cs β⁻ Decay 1986Hi08

Parent ^{148}Cs: E=0.0; Jπ=?; $T_{1/2}$=146 ms *6*; Q(g.s.)=10300 *580*; %β⁻ decay=100.

^{148}Cs–%β⁻ decay: Partial decay scheme given by authors (hence no γ–ray intensities normalized as per 100 decays of the parent and no β branchings were deduced).

Measured: Eγ, Iγ, γγ coin, $T_{1/2}$.

^{148}Ba Levels

E(level)	Jπ†
0.0	0+
141.7	2+
423.1	4+
687.2	1−
775.0	(3−)
1049.2	2+

† Adopted values.

γ(^{148}Ba)

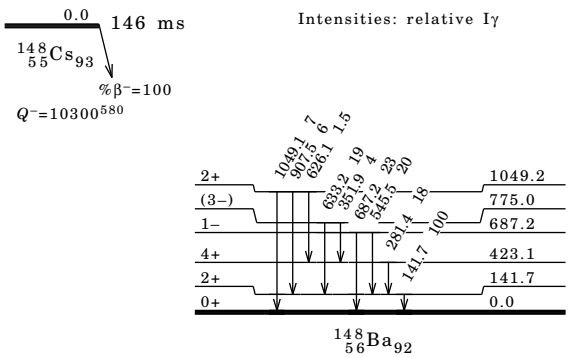
Eγ	E(level)	Iγ†
141.7	141.7	100
281.4	423.1	18
351.9	775.0	4
545.5	687.2	20
626.1	1049.2	1.5
633.2	775.0	19
687.2	687.2	23
907.5	1049.2	6
1049.1	1049.2	7

† Relative intensity.

^{148}Cs β⁻ Decay 1986Hi08 (continued)

Decay Scheme

Intensities: relative Iγ



^{248}Cm SF Decay 1997Ur01

Parent ^{248}Cm: E=0.0; Jπ=0+; $T_{1/2}$=3.48×10^5 y *6*; %SF decay=?

Eurogam2, 52 Ge including 24, four–crystal clover detectors, 4 LEPS. Measured: Eγ, Iγ, DCO ratios, γγγ(θ), linear polarization. Assigned by coincidence with Zr partner. Other: 1997AhZZ.

^{148}Ba Levels

E(level)†	Jπ‡	Comments
0.0§	0+	
141.80§ *10*	2+	
423.10§ *15*	4+	
775.00# *23*	(3−)	
807.90§ *18*	6+	Jπ: 6+.
963.20# *25*	(5−)	Jπ: (5−).
1255.70# *20*	7−	Jπ: 7−.
1264.70§ *20*	8+	Jπ: 8+.
1644.92# *21*	9−	E(level): 1665.0 in 1997Ur01 is a typographical error. Jπ: 9−.
1767.78§ *22*	10+	Jπ: 10+.
2117.30# *25*	(11−)	Jπ: (11−).
2303.5§ *3*	(12+)	Jπ: (12+).
2659.3?# *4*		
2867.0?§ *4*		

† From a least–squares fit to Eγ data.

‡ From adopted levels; supporting assignments based on DCO ratios, linear polarization, and γγγ(θ) from this data set are given in comments.

§ (A): g.s. band.

(B): Octupole band.

γ(^{148}Ba)

1997Ur01 give the following characteristic values for DCO ratios:

a) from γγγ(θ), for a stretched quadrupole transition DCO=1.00, independent of the spin value of the initial level; for a stretched, unmixed dipole transition DCO=1.20, independent of the spin value of the initial level; for a non–stretched, unmixed dipole transition in a 4 –>4 –>2 –>0 cascade DCO=0.91; and for a stretched, unmixed dipole transition in a 3 –>4 –>2 –>0 cascade DCO=1.28.

b) from γγ(θ), for a stretched quadrupole transition DCO=0.89 independent of the spin value of the initial level; for a stretched, unmixed dipole transition DCO=1.09 independent of the spin value of the initial level; for a non–stretched, unmixed dipole transition DCO=0.81 for a 6 –>6 –>4 cascade, and DCO=0.82 for a 8 –>8 –>6 cascade; and for a stretched, unmixed dipole transition in a 3 –>4 –>2 cascade DCO=1.19.

1997Ur01 give the following characteristic values for linear polarization: for a stretched quadrupole transition +0.14 for electric transition and −0.14 for magnetic transition independent of the spin value of the initial level; for a stretched unmixed dipole transition +0.09 for electric transition and −0.09 for magnetic transition independent of the spin value of the initial level.

Continued on next page (footnotes at end of table)

^{248}Cm SF Decay 1997Ur01 (continued)

γ(^{148}Ba) (continued)

Eγ	E(level)	Iγ†	Mult.‡	Comments
141.8 *1*	141.80	100 *5*		
281.3 *1*	423.10	86 *5*	Q	DCO=0.89 *4* (γγ(θ)).
293.0§ *3*	1255.70	≤1		
349.6 *2*	2117.30	6 *2*	D	DCO=1.23 *12* (γγ(θ)).
380.2 *1*	1644.92	14 *2*	E1	DCO=1.3 *2* (γγγ(θ)); 1.2 *1* (γγ(θ)); lin pol=0.1 *1*.
384.8 *1*	807.90	70 *5*	E2	DCO=0.98 *6* (γγγ(θ)); 0.89 *3* (γγ(θ)); lin pol=0.12 *4*.
389.2 *2*	1644.92	6 *2*		
447.8 *1*	1255.70	16 *2*	E1	DCO=1.2 *2* (γγγ(θ)); 1.17 *7* (γγ(θ)); lin pol=0.6 *3*.
456.8 *1*	1264.70	35 *4*	E2	DCO=1.03 *8* (γγγ(θ)); 0.92 *3* (γγ(θ)); lin pol=0.20 *4*.
472.3 *2*	2117.30	8 *2*		
503.1 *1*	1767.78	17 *2*	E2	DCO=0.93 *5* (γγ(θ)); lin pol=0.4 *2*.
535.7 *2*	2303.5	9 *2*	Q	DCO=0.8 *1* (γγ(θ)).
540.1 *2*	963.20	8 *1*	D	DCO>1 (γγ(θ)).
542.0 *2*	2659.3?	4 *2*		
563.5 *2*	2867.0?	5 *2*		
633.2 *2*	775.00	3 *1*		

† Relative intensity.
‡ Deduced by evaluator based on DCO and linear polarization measurements.
§ Placement of transition in the level scheme is uncertain.

^{252}Cf SF Decay 1998ZhZH,1997Ha64,1995Zh39

Parent ^{252}Cf: E=0.0; Jπ=0+; $T_{1/2}$=2.645 y *8*; %SF decay=?
1998ZhZH,1997Ha64,1995Zh39: measured Eγ, Iγ, x–ray x–ray coin, γX–ray coin, γγ(θ), γγγ(θ).
All data are from 1998ZhZH and 1997Ha64.

^{148}Ba Levels

E(level)	Jπ†	Comments
0.0	0+	
141.6	2+	
423.0	4+	
808.0	6+	Jπ: 6+.
962.8	(5−)	Jπ: (5−).
1256.0	7−	Jπ: (7−).
1265.0	8+	Jπ: 8+.
1645.7	9−	Jπ: (9−).
1768.3	10+	Jπ: 10+.
2118.1	(11−)	Jπ: (11−).
2304.2	(12+)	Jπ: 12+.

† From adopted levels; supporting assignments from this data set based on γγ(θ), γγγ(θ), and systematics are given in the table comments.

γ(^{148}Ba)

Eγ	E(level)	Iγ†	Eγ	E(level)	Iγ†	Eγ	E(level)	Iγ†
141.6	141.6		385.0	808.0	80	503.3	1768.3	11
281.4	423.0	100	389.7	1645.7		535.9	2304.2	
293.2	1256.0		447.4	1256.0		539.8	962.8	
350.8	2118.1		457.0	1265.0	28			
380.4	1645.7		472.4	2118.1				

† Relative intensity.

^{254}Cf SF Decay 1979SeZV

Parent ^{254}Cf: E=0.0; Jπ=0+; $T_{1/2}$=60.5 d *2*; %SF decay=?
Measured: γ.

^{148}Ba Levels

E(level)	Jπ†
0.0	0+
142.5	2+

† Adopted values.

γ(^{148}Ba)

Eγ	E(level)	Iγ†	Comments
142.5	142.5	0.64 *26*	Iγ: I(γ+ce) per 100 fissions.

† Absolute intensity per 100 fissions.

Adopted Levels, Gammas

Q(β⁻)=7690 *22*; S(n)=4102 *22*; S(p)=9734 *28*; Q(α)=–1860 *30* 2012Wa38.
Q(β⁻n)=1234 *21* (2012Wa38).

^{148}La Levels

The bands observed in ^{148}La are interpreted as aligned coupling of $[\pi h_{11/2} \nu h_{9/2}]_{low\ spin}$ to the deformed core rotor. (^{252}Cf SF decay dataset, 2009Lu11).

Cross Reference (XREF) Flags

A ^{148}Ba β⁻ Decay
B ^{149}Ba β⁻n Decay (0.344 s)
C ^{252}Cf SF Decay

E(level)†	Jπ‡	XREF	$T_{1/2}$	Comments
0.0	(2–)	A C	1.26 s *8*	%β⁻=100; %β⁻n=0.15 *3*. Recommended delayed neutron emission probability (1993Ru01). Others: 0.24% *2* (1993Ru01), 0.13% *1* (1983Re10), 0.143% *15* (1986ReZR), 0.11% *1* (1986Wa17), 0.13% *2* (1984Ma39), <0.1% (1982Ga24). $T_{1/2}$: weighted average of 1.55 s *3* (1982Ga24), 1.42 s *7* (1983Re10), 1.40 s *2* (1986Wa17), 1.428 s *12* (1993Ru01), 1.38 s *2* (1986ReZR) and 1.05 s *1* (1983Gi04). Others: 1.7 s *5* (1973SeYW), 1.29 s *8* (1969WiZX). Jπ: 56.1γ from (1+) is E1, strong β⁻ to (3–) level in ^{148}Ce.
47.21 *3*	(1–,2–)	A		Jπ: 47.2γ to (2–) is M1, no γ from (1+).
56.034 *25*	(1+)	A C	67 ns *4*	$T_{1/2}$: from 1984Ch02 (β⁻ decay). Other: 58 ns *3* (1974ClZX, SF decay). J=1+ from log *ft*=4.8 via 0+ parent (1984Ch02); parentheses on adopted Jπ indicate uncertainty in β⁻ branching estimates.
61.44 *3*	(–)	A		Jπ: 61.48γ to (2–) is M1,E2.
109.89 *3*	(1+)	A		J=1+ from log *ft*=5.0 via 0+ parent (1984Ch02); parentheses on adopted Jπ indicate uncertainty in β⁻ branching estimates.
133.668 *24*	(–)	A		Jπ: γ to (2)– is E2,M1.
140.92§ *22*	(2+)	C		Jπ: M1 γ to (1+), 56 (0+,1+ excluded by authors presumably based on the rotational character of this nucleus).
154.49 *4*		A		
159.42 *6*		A		
168.71 *4*		A		
201.26 *5*		A		
217.86 *4*		A		
230.46 *5*		A		
261.08 *5*		A		
282.2# *4*	(3+)	C		
287.08 *5*		A		
338.80 *10*		A		
350.6§ *4*	(4+)	C		
363.85 *7*		A		
369.23 *4*		A		
401.15 *7*		A		
441.7# *4*	(5+)	C		
471.89 *5*		A		
500.22 *5*		A		
538.08 *11*		A		
554.13 *11*		A		
663.0§ *4*	(6+)	C		
708.2# *5*	(7+)	C		
717.22 *9*		A		
830.67 *11*		A		
1060.1§ *5*	(8+)	C		
1101.8# *6*	(9+)	C		
1229.04 *10*		A		
1252.47 *7*		A		
1495.9§ *6*	(10+)	C		
1612.4# *7*	(11+)	C		
1980.0§ *7*	(12+)	C		
2226.0# *7*	(13+)	C		

† From a least–squares fit to Eγ data, with normalized χ^2=6.65> critical χ^2=1.57. This fact is due to Eγ's from ^{148}Ba β⁻ decay dataset, reported with higher than realistic precision.
‡ For levels assigned in either band, assumed by 2009Lu11 (SF decay) based on the rotational character of this nucleus.
§ (A): Band based on (2+), α=0. Upbend at ħω≈0.2 MeV.
# (B): Band based on (3+), α=1.

Adopted Levels, Gammas (continued)

γ(^{148}La)

E(level)	Eγ†	Iγ†‡	Mult.§	α	Comments
47.21	47.22 *4*	100	(M1)	9.47	
56.034	56.08 *4*	100	E1	1.140	B(E1)(W.u.)=9.6×10^{-6} *6*.
61.44	61.48 *4*	100	M1,E2	8 *4*	
109.89	48.44 *4*	58 *1*	E1	1.682	
	53.81 *4*	100 *2*	M1,E2	13 *7*	
	109.87 *5*	23 *2*			
133.668	72.20 *5*	50 *5*			
	86.44 *4*	52 *2*	M1,E2	2.5 *9*	
	133.53# *4*	100 *2*	E2,M1	0.60 *12*	
140.92	84.7 *3*	100	M1	1.74 *3*	Mult.: from α(exp)=1.51 *49* (2009Lu11).
	141.1 *3*	20.2	[E1]	0.0907	
154.49	44.43 *6*	7 *1*			
	98.5 *2*	100 *21*			
	107.32 *5*	15 *2*			
159.42	49.65 *8*	19 *4*			
	98.1 *2*	100 *23*			
168.71	112.73 *5*	33 *2*			
	168.68 *5*	100 *7*			
201.26	46.30 *6*	3 *2*			
	145.48 *5*	100 *3*			
217.86	58.52 *6*	18 *2*			
	84.02# *5*	100 *8*			
	156.42 *6*	82 *5*			
	218.30# *10*	20 *5*			
230.46	96.58# *6*	66 *7*			
	120.95 *20*	100 *20*			
	174.55 *5*	97 *10*			
261.08	92.40 *5*	100 *4*			
	127.38 *6*	62 *8*			
282.2	141.3 *3*	100	M1(+E2)	0.50 *9*	Mult.: from α(exp)=0.54 *18* (2009Lu11).
287.08	153.39 *8*	50 *8*			
	177.06 *6*	100 *8*			
338.80	205.13 *9*	100			
350.6	68.4 *3*	18.9	[M1(+E2)]	5.6 *24*	
	209.7 *3*	100	[E2]	0.1517	
363.85	230.37 *17*	21 *18*			
	307.79 *6*	100 *6*			
369.23	214.96 *5*	100 *4*			
	235.62 *6*	45 *2*			
	259.37 *5*	69 *4*			
	312.76 *6*	40 *6*			
401.15	246.66 *6*	100 *10*			
	345.1 *2*	20 *5*			
441.7	91.1 *3*	53.6	[M1(+E2)]	2.1 *7*	
	159.5 *3*	100	[E2]	0.386	
471.89	270.25# *12*	41 *4*			
	317.63 *20*	18 *3*			
	410.65 *7*	42 *2*			
	415.78 *6*	100 *2*			
500.22	212.95 *7*	29 *3*			
	390.3 *2*	18 *10*			
	444.28 *5*	100 *3*			
538.08	369.3 *2*	23 *9*			
	404.46 *14*	100 *9*			
	476.6 *2*	95 *36*			
554.13	185.0 *2*	46 *27*			
	323.63 *12*	100 *8*			
663.0	221.3 *3*	13.9	[M1(+E2)]	0.123 *5*	
	312.4 *3*	100	[E2]	0.0413	
708.2	266.5 *3*	100	[E2]	0.0686	
717.22	583.6 *2*	10 *3*			
	607.33 *11*	100 *8*			
	661.1 *2*	14 *5*			

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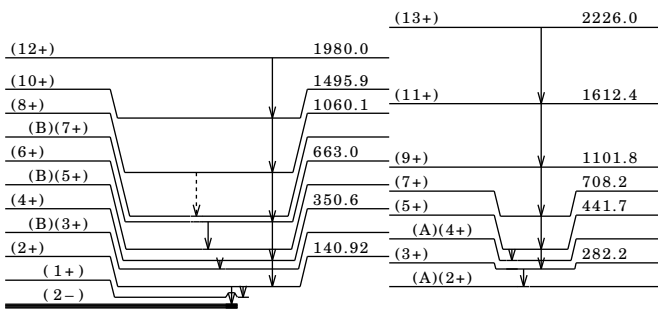
Adopted Levels, Gammas (continued)

γ(^{148}La) (continued)

E(level)	Eγ†	Iγ†‡	Mult.§	α
830.67	569.6 *2*	68 *32*		
	600.2 *2*	100 *36*		
	720.8 *2*	95 *36*		
	774.6 *2*	27 *14*		
1060.1	351.9@ *3*	<4	[M1(+E2)]	0.032 *4*
	397.1 *3*	100	[E2]	0.0199
1101.8	393.6 *3*	100	[E2]	0.0204
1229.04	757.15 *13*	74 *32*		
	1011.2 *2*	100 *42*		
1229.04	1173.0 *2*	63 *42*		
1252.47	535.2 *2*	18 *10*		
	1118.82 *7*	100 *5*		
	1196.3 *2*	41 *13*		
1495.9	435.8 *3*	100	[E2]	0.01516
1612.4	510.6 *3*	100	[E2]	
1980.0	484.1 *3*	100	[E2]	0.01127
2226.0	613.6 *3*	100	[E2]	

† From ^{148}Ba β⁻ decay or ^{252}Cf SF decay (for the only common 56γ, Eγ is from ^{148}Ba β⁻ decay).
‡ Relative photon branching from each level.
§ Based on α(K)exp measurements from γ's from ^{148}Ba β⁻ decay; based on α(exp) measurements for γ's from ^{252}Cf SF decay.
# Differs by 3σ or more from the value calculated from the energy difference of initial and final levels.
@ Placement of transition in the level scheme is uncertain.

(A) Band based on (2+), α=0. **(B) Band based on (3+), α=1**



$^{148}_{57}La_{91}$

^{148}Ba β⁻ Decay 1984Ch02

Parent ^{148}Ba: E=0.0; Jπ=0+; $T_{1/2}$=0.612 s *17*; Q(g.s.)=5110 *60*; %β⁻ decay=100.
Measured: Eγ, Iγ, Ice, γγ coin, γγ(t) coin, $T_{1/2}$, K x ray.
β⁻ branchings to various levels as given by 1984Ch02 are given in comments. More work needs to be done to get better estimates of these values.
The level scheme is incomplete.

^{148}La Levels

E(level)†	Jπ‡	$T_{1/2}$	Comments
0.0	(2−)	1.26 s *8*	$T_{1/2}$: from Adopted Levels. Iβ≈0 (1984Ch02).
47.21 *3*	(1−,2−)		
56.033 *25*	(1+)	67 ns *4*	$T_{1/2}$: from 1984Ch02 (γγ(t)).
61.44 *3*	(−)		
109.89 *3*	(1+)		
133.668 *24*	(−)		
154.49 *4*			
159.42 *6*			
168.71 *4*			
201.26 *5*			

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^{148}Ba β⁻ Decay 1984Ch02 (continued)

^{148}La Levels (continued)

E(level)†	E(level)†	E(level)†
217.86 *4*	369.22 *4*	717.22 *9*
230.46 *5*	401.15 *7*	830.67 *11*
261.08 *5*	471.89 *5*	1229.04 *10*
287.08 *5*	500.22 *5*	1252.47 *7*
338.80 *10*	538.08 *11*	
363.85 *7*	554.13 *11*	

† From a least–squares fit to Eγ data.
‡ From adopted levels.

β⁻ radiations

Eβ⁻	E(level)	Iβ⁻†‡	Log *ft*
(4640 *60*)	471.89	7	5.2
(4740 *60*)	369.22	6	5.3
(4890 *60*)	217.86	7	5.3
(4980 *60*)	133.668	9	5.2
(5000 *60*)	109.89	17	5.0
(5050 *60*)	56.033	23	4.8

† From net γ transition intensities at each level as estimated by 1984Ch02.
‡ Absolute intensity per 100 decays.

γ(^{148}La)

Iγ normalization: from Iγ(absolute, 56 keV)=29.2% *8* obtained by using the absolute γ intensities from the decay of ^{148}Ce to ^{148}Pr (1983Ar15).

Eγ	E(level)	Iγ†@	Mult.‡	α	Comments
44.43 *6*	154.49	0.7 *1*			
46.30 *6*	201.26	0.2 *1*			
47.22 *4*	47.21	3.2 *1*	(M1)	9.47	Mult.: α(K)exp=9.3 *21* is consistent with M1 or E2. From intensity balance at g.s. Mult must be mainly M1.
48.44 *4*	109.89	5.7 *1*	E1	1.682	Mult.: α(K)exp=2.3 *6*.
49.65 *8*	159.42	0.5 *1*			
53.81 *4*	109.89	9.8 *2*	M1,E2	13 *7*	Mult.: α(K)exp=6.4 *7*.
56.08 *4*	56.033	100.0 *3*	E1	1.140	Mult.: α(K)exp=0.98 *8*.
58.52 *6*	217.86	1.1 *1*			
61.48 *4*	61.44	7.8 *1*	M1,E2	8 *4*	Mult.: α(K)exp=2.8 *8*.
72.20 *5*	133.668	6.6 *6*			
84.02 *5*	217.86	6.1 *5*			
86.44 *4*	133.668	6.9 *3*	M1,E2	2.5 *9*	Mult.: α(K)exp=1.4 *2*.
92.40 *5*	261.08	2.6 *1*			
96.58 *6*	230.46	2.0 *2*			
98.1§ *2*	159.42	2.6# *6*			
98.5§ *2*	154.49	9.9# *21*			
107.32 *5*	154.49	1.5 *2*			
109.87 *5*	109.89	2.3 *2*			
112.73 *5*	168.71	1.5 *1*			
120.95 *20*	230.46	3.0 *6*			
127.38 *6*	261.08	1.6 *2*			
133.53 *4*	133.668	13.3 *2*	E2,M1	0.60 *12*	Mult.: α(K)exp=0.6 *2*.
145.48 *5*	201.26	6.0 *2*			
153.39 *8*	287.08	1.2 *2*			
156.42 *6*	217.86	5.0 *3*			
168.68 *5*	168.71	4.6 *3*			
174.55 *5*	230.46	2.9 *3*			
177.06 *6*	287.08	2.4 *2*			
185.0§ *2*	554.13	1.2# *7*			
205.13 *9*	338.80	2.0 *2*			

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^{148}Ba β$^-$ Decay 1984Ch02 (continued)

γ(^{148}La) (continued)

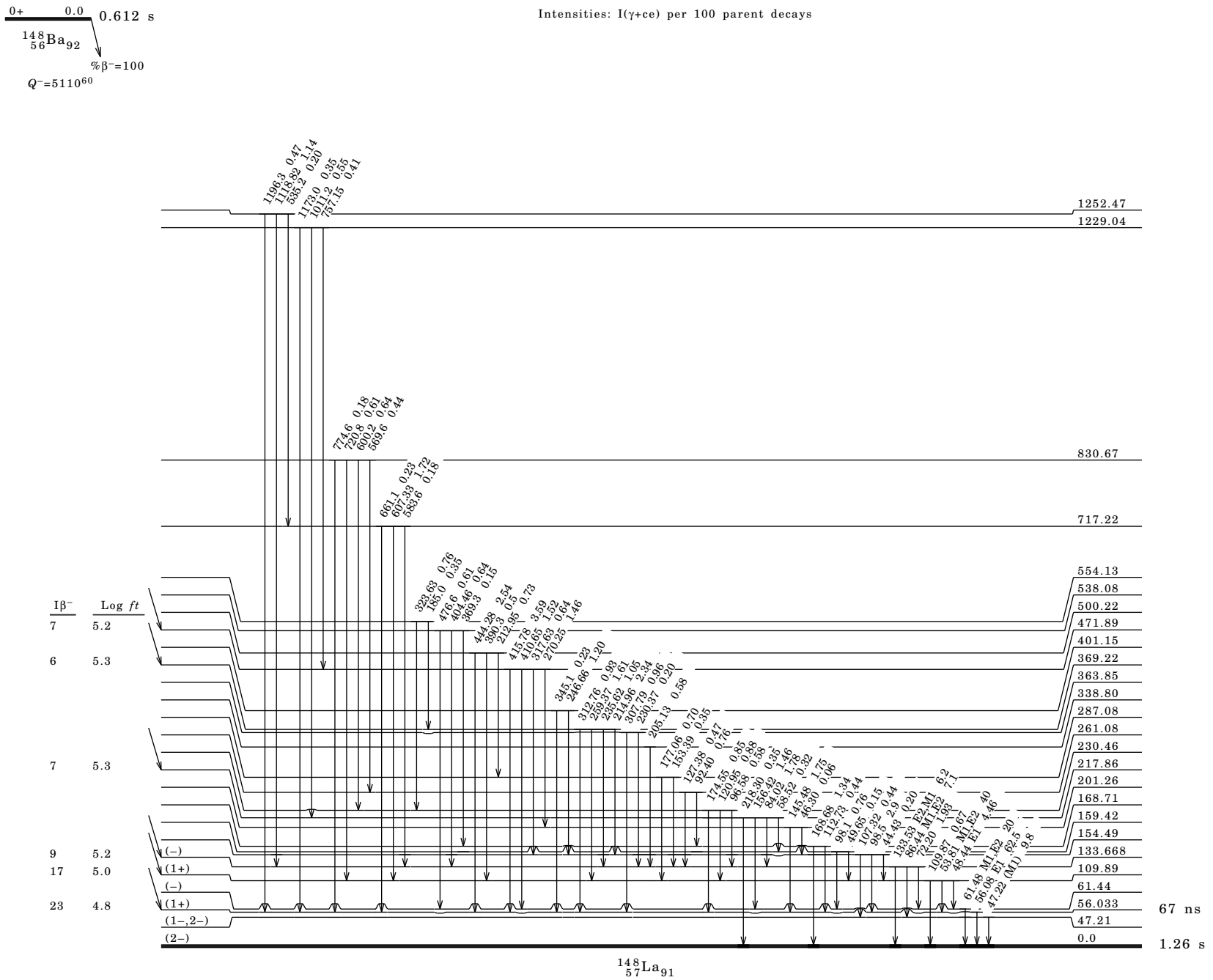
Eγ	E(level)	Iγ†@
212.95 *7*	500.22	2.5 *3*
214.96 *5*	369.22	8.0 *3*
218.30 *10*	217.86	1.2 *3*
230.37 *17*	363.85	0.7 *6*
235.62 *6*	369.22	3.6 *2*
246.66 *6*	401.15	4.1 *4*
x256.70 *17*		2.6 *9*
259.37 *5*	369.22	5.5 *3*
270.25 *12*	471.89	5.0 *5*
307.79 *6*	363.85	3.3 *2*
312.76 *6*	369.22	3.2 *5*
317.63 *20*	471.89	2.2 *4*
323.63 *12*	554.13	2.6 *2*
345.1§ *2*	401.15	0.8# *2*
369.3§ *2*	538.08	0.5# *2*
390.3§ *2*	500.22	1.6# *9*
404.46 *14*	538.08	2.2 *2*
410.65 *7*	471.89	5.2 *2*
415.78 *6*	471.89	12.3 *3*
x426.9		2.4 *8*
444.28 *5*	500.22	8.7 *3*
476.6§ *2*	538.08	2.1# *8*
535.2§ *2*	1252.47	0.7# *4*
569.6§ *2*	830.67	1.5# *7*
583.6§ *2*	717.22	0.6# *2*
600.2§ *2*	830.67	2.2# *8*
607.33 *11*	717.22	5.9 *5*
661.1§ *2*	717.22	0.8# *3*
720.8§ *2*	830.67	2.1# *8*
757.15 *13*	1229.04	1.4 *6*
774.6§ *2*	830.67	0.6# *3*
x872.99 *9*		1.8 *2*
1011.2§ *2*	1229.04	1.9# *8*
1118.82 *7*	1252.47	3.9 *2*
1173.0§ *2*	1229.04	1.2# *8*
1196.3§ *2*	1252.47	1.6# *5*

† Relative intensity deduced from singles spectra.
‡ From α(K)exp.
§ Deduced from coincidence spectra. The evaluator has assumed ΔEγ=0.2 keV.
# Deduced from coincidence spectra.
@ For absolute intensity per 100 decays, multiply by 0.292 *8*.
x γ ray not placed in level scheme.

^{148}Ba β⁻ Decay 1984Ch02 (continued)

Decay Scheme

Intensities: I(γ+ce) per 100 parent decays



$^{148}_{57}La_{91}$–6

^{149}Ba β⁻n Decay (0.344 s) 1986Wa17,1993Ru01

Parent ^{149}Ba: E=0.0; Jπ=?; $T_{1/2}$=0.344 s *7*; Q(g.s.)=1620 syst; %β⁻n decay=0.43 *12*.
^{149}Ba–J: (3/2–) mentioned but not adopted in 2004Si16 (quoted from 2012Au07 and 1997Mo25, syst).
^{149}Ba–$T_{1/2}$: from 2004Si16, weighted average of 0.346 s *6* (neutron timing,1986Wa17) and 0.324 s *18* (1993Ru01). Others: 0.356 s *8* (1986ReZU), 0.4 s (γ timing,1987MaZY).
^{149}Ba–Q(β⁻n): ΔQ(β⁻n)=200 (2012Wa38, syst).
^{149}Ba–%β⁻n decay: adopted in 2004Si16 from 1986Wa17; others: 0.58 *8* (1986ReZU), 3.9 *12* (1993Ru01).

^{252}Cf SF Decay 2009Lu11

Parent ^{252}Cf: E=0.0; Jπ=0+; $T_{1/2}$=2.645 y *8*; %SF decay=?
2009Lu11: γ rays from the spontaneous fission of ^{252}Cf were detected with the Gammasphere array. Measured Eγ, Iγ, γγ–coincidence.
1974ClZX: measured Eγ, Iγ, γ(t). On the basis of multiparameter coincidences, 1974ClZX assigned 56γ to ^{147}La; however, 1984Ch02 demonstrated that 56γ depopulates level in ^{148}La, not in ^{147}La.
Others: 1970Jo20, 1971Ho29.

^{148}La Levels

The bands observed in ^{148}La are interpreted as aligned coupling of $[\pi h_{11/2}\nu h_{9/2}]_{low\ spin}$ to the deformed core rotor. (2009Lu11).

E(level)†	Jπ‡	$T_{1/2}$	Comments
0.0	(2–)§		
56.33 *25*	(1+)§	58 ns *3*	$T_{1/2}$: from 1974ClZX (γ(t)).
141.07# *25*	(2+)		Jπ: M1 γ to (1+), 56 (0+,1+ excluded by authors presumably based on the rotational character of this nucleus).
282.4@ *4*	(3+)		
350.8# *4*	(4+)		
441.9@ *4*	(5+)		
663.2# *4*	(6+)		
708.4@ *5*	(7+)		
1060.3# *5*	(8+)		
1102.0@ *6*	(9+)		
1496.1# *6*	(10+)		
1612.6@ *7*	(11+)		
1980.2# *7*	(12+)		
2226.2@ *7*	(13+)		

† From least–squares fit to Eγ's assuming 0.3 keV uncertainty for each γ (by evaluator).
‡ For levels assigned in either band, assumed by 2009Lu11 based on.
§ From Adopted Levels dataset (2009Lu11 give same value as firm assignment).
# (A): Band based on (2+), α=0. Upbend at ħω≈0.2 MeV.
@ (B): Band based on (3+), α=1.

γ(^{148}La)

E(level)	Eγ	Iγ	Mult.	Comments
56.33	56.3 *3*	100	E1	Iγ: 1974ClZX report 305 *21* photons per 1.0×10⁵ fissions. Mult.: from α(exp)=0.96 *24* (2009Lu11).
141.07	84.7 *3*	100	M1	Mult.: from α(exp)=1.51 *49* (2009Lu11).
	141.1 *3*	20.2		
282.4	141.3 *3*	100	M1(+E2)	Mult.: from α(exp)=0.54 *18* (2009Lu11).
350.8	68.4 *3*	18.9		
	209.7 *3*	100		
441.9	91.1 *3*	53.6		
	159.5 *3*	100		
663.2	221.3 *3*	13.9		
	312.4 *3*	100		
708.4	266.5 *3*	100		
1060.3	351.9† *3*	<4		
	397.1 *3*	100		
1102.0	393.6 *3*	100		
1496.1	435.8 *3*	100		
1612.6	510.6 *3*	100		
1980.2	484.1 *3*	100		
2226.2	613.6 *3*	100		

† Placement of transition in the level scheme is uncertain.

Adopted Levels, Gammas

Q(β⁻)=2137 *13*; S(n)=6456 *14*; S(p)=11009 *15*; Q(α)=–1056 *13* 2012Wa38.

^{148}Ce Levels

Cross Reference (XREF) Flags

A ^{148}La β⁻ Decay
B ^{149}La β⁻n Decay (1.05 s)
C ^{252}Cf SF Decay
D ^{235}U(n,F) E=thermal

E(level)[†]	Jπ[‡]	XREF	$T_{1/2}$	Comments
0.0[@]	0+[§]	A CD	56.8 s *3*	%β⁻=100. $T_{1/2}$: weighted average of: 56 s *1* (1983Ar15) and 56.9 s *3* (2004Ko05). Others: 48 s *1* (1974Ar25), 45.1 s *5* (1986BuZV). Measured δ<r²> =1.089 fm² *2* relative to ^{144}Ce (2003Ch60); <r²>$^{1/2}$=4.9911 fm *35* (2004An14).
158.467[@] *5*	2+[§]	A CD	1.01 ns *6*	μ=0.74 *12* (2005St24,1986Gi05,1999Sm05). μ: from γγ(θ,H) in ^{148}La β⁻ decay (1986Gi05), and time–integral perturbed angular correlation method in ^{252}Cf SF decay (1999Sm05). g=0.38 *5*. g: weighted average of 0.37 *6* (1999Sm05) and 0.39 *8* (2009Go09) in ^{252}Cf SF decay. Jπ: ΔJ=2, E2 γ to 0+, g.s. $T_{1/2}$: weighted average of 0.95 ns *8* (1980ChZM, from ^{254}Cf SF decay, not included in ^{148}Ce evaluation) and 1.06 ns *8* (1974JaZN, ^{252}Cf SF decay dataset). Others (from ^{252}Cf SF decay dataset): 1.3 ns *2* (1970Wa05), 0.9 ns *3* (2006Hw01).
453.45[@] *5*	4+[§]	A CD	<1.2 ns	$T_{1/2}$: 0.2 ns *+10–2* from ^{252}Cf SF decay (2004Li66) was adopted as a limit by evaluator.
760.32 *4*	(1–)	A		Jπ: γ's to 0+, and 2+; strong β⁻ from (2–) parent; systematics of 1– levels in A=140–152 region.
770.43 *6*	0+	A		Jπ: from γγ(θ) in ^{148}La β⁻ decay.
839.52[@] *16*	6+[§]	CD		
841.39 *5*	(3–)	A		Jπ: γ to 2+, and 4+; no γ to 0+; systematics of 3– levels.
935.59 *5*	(2+)	A		Jπ: strong γ's to 2+, and 4+ and weak γ to 0+ g.s. is typical for J=2+ member of β–vibrational band, ΔE(2+ to 0+)(β–vibr)=165 keV is comparable with ΔE(2+ to 0+)(g.s.)=158 keV.
989.90 *4*	(2+)	A		Jπ: γ's to 0+ and 4+.
1116.63[a] *5*	(3+)	A C		Jπ: γ's to 2+ and 4+ respectively; band member in ^{252}Cf decay dataset in accordance with systematics for γ–vibrational bands in A=144–152 nuclei.
1223.98 *11*	(4+)	A		Jπ: γ to 4+; systematics for β–vibrational bands in A=144–152 nuclei.
1290.32[@] *20*	8+[§]	C		
1351.40[&] *23*	(7–)	C		
1368.89 *5*		A		
1415.61 *7*		A		
1423.04[a] *14*	(5+)	C		
1456.88? *25*		A		
1486.33[b] *21*	(4–)	A C		
1497.07 *7*	(2+,1)[#]	A		
1554.76 *9*		A		
1558.51? *16*		A		
1584.11? *17*		A		
1589.91 *6*	(2+,1)[#]	A		
1622.78? *12*		A		
1625.98? *10*		A		
1682.00[b] *19*	(6–)	C		
1728.39 *11*		A		
1753.58[&] *23*	(9–)	C		
1786.67[a] *18*	(7+)	C		
1788.66[c] *23*	(7)	C		
1790.7[@] *3*	10+[§]	C		
1891.20 *8*	(2+,1)[#]	A		
1927.69? *21*		A		
1954.09[b] *22*	(8–)	C		
2095.20[c] *23*	(9)	C		
2144.48 *15*		A		
2153.67 *14*	(2+,1)[#]	A		

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Adopted Levels, Gammas (continued)

^{148}Ce Levels (continued)

E(level)[†]	Jπ[‡]	XREF
2192.37? *24*		A
2198.76[a] *24*	(9+)	C
2224.7[&] *3*	(11−)	C
2252.22 *14*		A
2306.9[b] *4*	(10−)	C
2327.8[@] *3*	12+[§]	C
2486.8[c] *3*	(11)	C
2550.36 *21*	(2+,1)[#]	A
2673.5[a] *3*	(11+)	C
2751.1[b] *5*	(12−)	C
2751.7[&] *3*	(13−)	C
2887.9[@] *4*	14+[§]	C
2969.2[c] *3*	(13)	C
3287.3[b] *5*	(14−)	C
3326.4[&] *4*	(15−)	C
3464.1[@] *4*	16+[§]	C
3898.7[b] *6*	(16−)	C
3944.2[&] *4*	(17−)	C
4065.8[@] *4*	18+[§]	C
4685.4[@] *5*	20+[§]	C
5311.2[@] *5*	22+[§]	C

[†] From a least−squares fit to Eγ data.
[‡] From 2006Ch24 based on presumed rotational−band structure and systematics, unless noted otherwise.
[§] E2 γ to 0+ band member and regular band sequence.
[#] Gammas to 0+ and 2+.
[@] (A): Kπ=0+ band, α=+1.
[&] (B): Kπ=7− band, α=+1.
[a] (C): Kπ=3+ band, α=−1.
[b] (D): Kπ=4− band, α=−1.
[c] (E): Band based on 7.

γ(^{148}Ce)

E(level)	Eγ[†]	Iγ[‡]	Mult.	α	Comments
158.467	158.468 *5*	100	E2	0.407	Mult.: from K/L in ^{252}Cf SF decay and RUL. B(E2)(W.u.)=86 *6*.
453.45	295.07 *9*	100	[E2]	0.0513	B(E2)(W.u.)>4.3.
760.32	601.88 *6*	89 *1*			
	760.30 *6*	100 *5*			
770.43	611.81 *7*	100	E2		Mult.: from γγ(θ) and syst for β−vibrational levels in A≈150 deformed nuclei (^{148}La β$^-$ decay).
839.52	386.15 *20*	100			
841.39	387.92 *10*	22 *1*			
	682.97 *6*	100 *8*			
935.59	482.19 *7*	13 *1*			
	777.16 *6*	100 *3*			
989.90	(54.24)				
	536.38 *16*	5.3 *6*			
	831.33 *6*	55 *3*			
	989.85 *6*	100 *3*			
1116.63	663.20 *7*	38 *1*			
	958.23 *6*	100 *1*			
1223.98	770.53 *10*	100			
1290.32	450.75 *20*	100			
1351.40	511.9 *2*	100			
1368.89	252.45 *7*	42 *3*			
	378.93 *4*	100 *10*			
	433.32 *8*	28.2 *14*			
1415.61	298.81 *14*	72 *6*			
	425.68 *8*	100 *6*			
	1257.42 *14*	61 *6*			
1423.04	306.3 *2*	96 *5*			
	583.5 *3*	58 *3*			
	969.65 *25*	100 *5*			
1456.88?	1298.46[§] *25*	100			
1486.33	369.7 *2*	100			Eγ: from ^{252}Cf SF decay.
1497.07	1338.64 *8*	100 *6*			
	1496.97 *12*	34 *3*			
1554.76	713.37 *12*	69 *8*			
	794.44 *11*	100 *8*			
1558.51?	1105.06 *15*	100			
1584.11?	1425.58[§] *11*	100			
1589.91	654.53 *11*	58 *17*			
	819.28 *8*	100 *25*			

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Adopted Levels, Gammas (continued)

γ(^{148}Ce) (continued)

E(level)	Eγ†	Iγ‡	Mult.	α	Comments
1589.91	1431.56 *10*	100 *4*			
	1589.93 *13*	63 *4*			
1622.78?	1464.36§ *11*	100			
1625.98?	257.09 *9*	100			
1682.00	195.7§				
	258.85 *20*	100			
1728.39	887.12 *12*	100 *13*			
	967.4 *4*	88 *25*			
	1569.65 *25*	88 *25*			
1753.58	402.2 *2*	47 *4*			
	463.2 *2*	100 *5*			
1786.67	104.8 *2*	67 *4*	E1	0.214 *4*	Mult.: based on α(exp) (^{252}Cf SF decay).
	363.65 *20*	100 *6*			
	947.3 *2*	81 *6*			
1788.66	949.1 *2*	100			
1790.7	500.8 *5*	100			
1891.20	1130.95 *10*	86 *9*			
	1732.67 *16*	55 *5*			
	1891.02 *17*	100 *5*			
1927.69?	1769.27§ *21*	100			
1954.09	166.95 *20*	100 *5*	E1	0.0584	Mult.: based on α(exp) (^{252}Cf SF decay).
	271.75 *20*	49 *3*			
2095.20	306.5 *2*	100 *8*			
	804.9 *2*	65 *5*			
2144.48	1303.3 *3*	5 *5*			
	1985.93 *17*	100 *2*			
2153.67	1995.23 *16*	100 *3*			
	2153.56 *23*	22 *3*			
2192.37?	2033.95§ *24*				
2198.76	244.95 *25*	100 *9*			
	411.9 *2*	67 *6*			
2224.7	434.1 *2*	100 *6*			
	471.1 *2*	42 *4*			
2252.22	1316.69 *18*	6.4 *8*			
	2093.66 *21*	100 *2*			
2306.9	108.0 *6*	54 *3*	E1	0.197 *5*	Mult.: based on α(exp) (^{252}Cf SF decay).
	352.9 *4*	100 *8*			
2327.8	103.1 *2*	4.6 *7*			
	536.95 *25*	100 *6*			
2486.8	391.55 *20*	100 *8*			
	696.1 *2*	100 *8*			
2550.36	2391.94 *22*	100 *7*			
	2549.8 *6*	9 *6*			
2673.5	474.7 *2*	100			
2751.1	444.2 *2*	100			
2751.7	423.9 *2*	100 *9*			
	527.0 *2*	65 *9*			
2887.9	136.3 *2*	8.2 *11*			
	559.7 *5*	100 *5*			
2969.2	482.5 *2*	100 *12*			
	641.4 *2*	71 *12*			

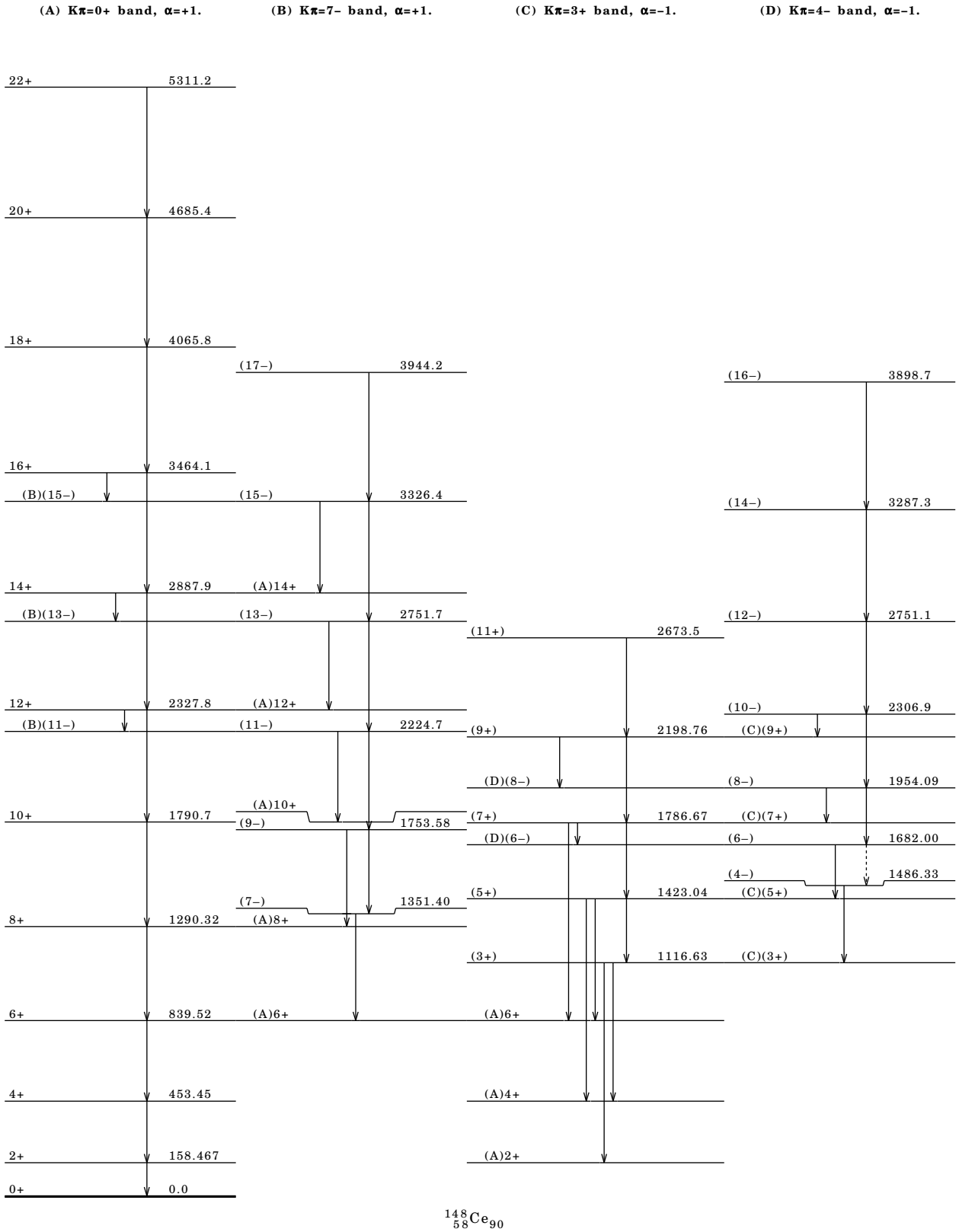
E(level)	Eγ†	Iγ‡
3287.3	536.2 *2*	100
3326.4	438.4 *2*	100 *14*
	574.7 *2*	64 *7*
3464.1	137.8 *2*	4.1 *13*
	576.15 *20*	100 *5*
3898.7	611.4 *2*	100
3944.2	617.8 *2*	100
4065.8	601.65 *20*	100
4685.4	619.6 *2*	100
5311.2	625.8 *2*	100

† From ^{148}La β^- decay for transitions not related to band structures, while for in–band and inter–band transitions Eγ's are from ^{252}Cf SF decay; for levels common to both datasets, Eγ's are from ^{148}La β^- decay.

‡ Relative photon branching from each level.

§ Placement of transition in the level scheme is uncertain.

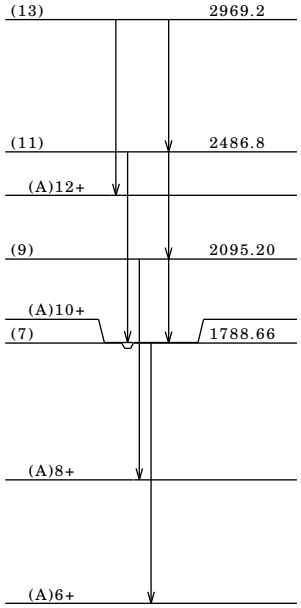
Adopted Levels, Gammas (continued)



$^{148}_{58}Ce_{90}$

Adopted Levels, Gammas (continued)

(E) Band based on 7.



$^{148}_{58}Ce_{90}$

^{148}La β⁻ Decay 1983Gi04

Parent ^{148}La: E=0.0; Jπ=(2–); $T_{1/2}$=1.26 s *8*; Q(g.s.)=7690 *22*; %β⁻ decay=100.
Measured: γ, ce, γγ, γγ(t), γγ(θ) (1983Gi04,1982PfZZ), γγ(θ,H), β, βγ (1982Br23).
β⁻ feeding was determined assuming no β⁻ decay to g.s.
Decay scheme is that of 1983Gi04 and is incomplete.

^{148}Ce Levels

E(level)†	Jπ‡	$T_{1/2}$‡	Comments
0.0	0+	56.8 s *3*	
158.467 *5*	2+	1.01 ns *6*	g=0.37 *6* (1986Gi05). g: from γγ(θ,H).
453.45 *5*	4+	<1.2 ns	
760.32 *4*	(1–)		Jπ: 1– preferred; 1+,2+ are possible.
770.43 *6*	0+		Jπ: from γ(θ) of the 612γ–158γ cascade.
841.39 *5*	(3–)		Jπ: 3– preferred; 2+,3+,4+ are possible.
935.59 *5*	(2+)		Jπ: 2+ preferred; 3,4+ are possible.
989.90 *4*	(2+)		Jπ: 2+.
1116.62 *5*	(3+)		Jπ: 3+ preferred; 2+,3–,4+ are possible.
1223.98 *11*	(4+)		Jπ: 4+ preferred; 2+,3 are possible.
1368.89 *5*			
1415.61 *7*			
1456.88? *25*			
1486.07 *9*	(4–)		
1497.07 *7*	(2+,1)		
1554.76 *9*			
1558.51? *16*			
1584.00? *12*			
1589.91 *6*	(2+,1)		
1622.78? *12*			
1625.98? *10*			

E(level)†	Jπ‡
1728.39 *11*	
1891.20 *8*	(2+,1)
1927.69? *21*	
2144.48 *15*	
2153.67 *14*	(2+,1)
2192.37? *24*	
2252.23 *14*	
2550.36 *21*	(2+,1)

† From a least–squares fit to Eγ data (normalized χ^2=1.96> critical χ^2=1.77).
‡ Adopted values.

β⁻ radiations

Eβ⁻	E(level)	Iβ⁻†‡	Log *ft*	Comments
(5140 *22*)	2550.36	4.2	5.95	
(5438 *22*)	2252.23	7.45	5.80	
(5498 *22*)	2192.37?	0.67	6.87	
(5536 *22*)	2153.67	4.00	6.11	
(5546 *22*)	2144.48	2.56	6.30	
(5762 *22*)	1927.69?	0.89	6.84	
(5799 *22*)	1891.20	2.95	6.33	
(5962 *22*)	1728.39	1.22	6.76	
(6064 *22*)	1625.98?	0.33	7.36	
(6067 *22*)	1622.78?	0.89	6.93	
(6100 *22*)	1589.91	4.3	6.26	
(6106 *22*)	1584.00?	0.89	6.95	
(6131 *22*)	1558.51?	0.33	7.38	
(6135 *22*)	1554.76	1.22	6.82	
(6193 *22*)	1497.07	2.39	6.54	
(6204 *22*)	1486.07	0.67	7.10	
(6233 *22*)	1456.88?	0.83	7.02	
(6274 *22*)	1415.61	2.34	6.58	
(6321 *22*)	1368.89	6.4	6.16	
(6466 *22*)	1223.98	0.50	7.31	log $f^{1u}t$=9.13 *7*.
(6573 *22*)	1116.62	2.39	6.66	
(6700 *22*)	989.90	10.6	6.05	
(6754 *22*)	935.59	5.3	6.36	
(6849 *22*)	841.39	6.8	6.28	
(6920 *22*)	770.43	1.6	6.93	
(6930 *22*)	760.32	14.0	5.99	
(7237 *22*)	453.45	1.84	9.06 1u	

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^{148}La β⁻ Decay 1983Gi04 (continued)

β⁻ radiations (continued)

Eβ⁻	E(level)	Iβ⁻†‡	Log *ft*
(7532 *22*)	158.467	12.4	6.20

† From 1983Gi04 (who assumed no g.s. β⁻ feeding) slightly adjusted by evaluator because of slightly different conversion coefficients (the intensities of uncertain gammas were included in the intensity balances). However because of large Q(β⁻), β⁻ decay may populate many >2550 levels of ^{148}Ce. Possible γ's from these levels (unobserved yet) may change the adopted balance of intensity for observed levels. Therefore, the adopted Iβ should be considered as an upper limit of real Iβ, and log *ft* as a lower limit of real values of log *ft*.

‡ Absolute intensity per 100 decays.

γ(^{148}Ce)

Iγ normalization: from ΣI(γ+ce)(g.s.)=100 and assuming no β⁻ feeding to g.s.

Eγ	E(level)	Iγ†	Mult.	α	I(γ+ce)‡	Comments
(54.24)	989.90				0.50 *17*	Iγ: if E2 (α≈18) Iγ≈0.5, if M1 (α≈7) Iγ≈1.3. I(γ+ce): from γγ coin data.
158.468 *5*	158.467	1000 *20*	E2	0.407		Mult.: from adopted γ's. Eγ: from 1979Bo26.
252.45 *7*	1368.89	30 *2*				
257.09 *9*	1625.98?	6 *1*				
295.07 *9*	453.45	120 *2*	[E2]	0.0513		
298.81 *14*	1415.61	13 *1*				
369.45 *8*	1486.07	12 *1*				
378.93 *4*	1368.89	71 *7*				Eγ: from 1979Bo26.
387.92 *10*	841.39	25 *1*				
425.68 *8*	1415.61	18 *1*				
433.32 *8*	1368.89	20 *1*				
482.19 *7*	935.59	17 *1*				
536.38 *16*	989.90	9 *1*				
601.88 *6*	760.32	137 *2*				
611.81 *7*	770.43	52 *1*	E2			Mult.: from γγ(θ) and syst for β–vibrational levels in A≈150 deformed nuclei.
654.53 *11*	1589.91	14 *4*				
663.20 *7*	1116.62	27 *1*				
682.97 *6*	841.39	116 *9*				
713.37 *12*	1554.76	9 *1*				
760.30 *6*	760.32	154 *7*				
770.53 *10*	1223.98	9 *1*				
777.16 *6*	935.59	129 *2*				
794.44 *11*	1554.76	13 *1*				
819.28 *8*	1589.91	24 *6*				
831.33 *6*	989.90	93 *5*				
887.12 *12*	1728.39	8 *1*				
x921.31 *13*		10 *2*				
958.23 *6*	1116.62	71 *1*				
967.4 *4*	1728.39	7 *2*				
989.85 *6*	989.90	168 *5*				
1105.06 *15*	1558.51?	6 *1*				
1130.95 *10*	1891.20	19 *2*				
1257.42 *14*	1415.61	11 *1*				
1298.46§ *25*	1456.88?	15 *1*				
1303.30 *30*	2144.48	2 *2*				
1316.69 *18*	2252.23	8 *1*				
1338.64 *8*	1497.07	32 *2*				
1425.58§ *11*	1584.00?	16 *1*				
1431.56 *10*	1589.91	24 *1*				
1464.36§ *11*	1622.78?	16 *1*				
1496.97 *12*	1497.07	11 *1*				
1569.65 *25*	1728.39	7 *2*				
1589.93 *13*	1589.91	15 *1*				
1732.67 *16*	1891.20	12 *1*				
1769.27§ *21*	1927.69?	16 *2*				

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^{148}La β$^-$ Decay 1983Gi04 (continued)

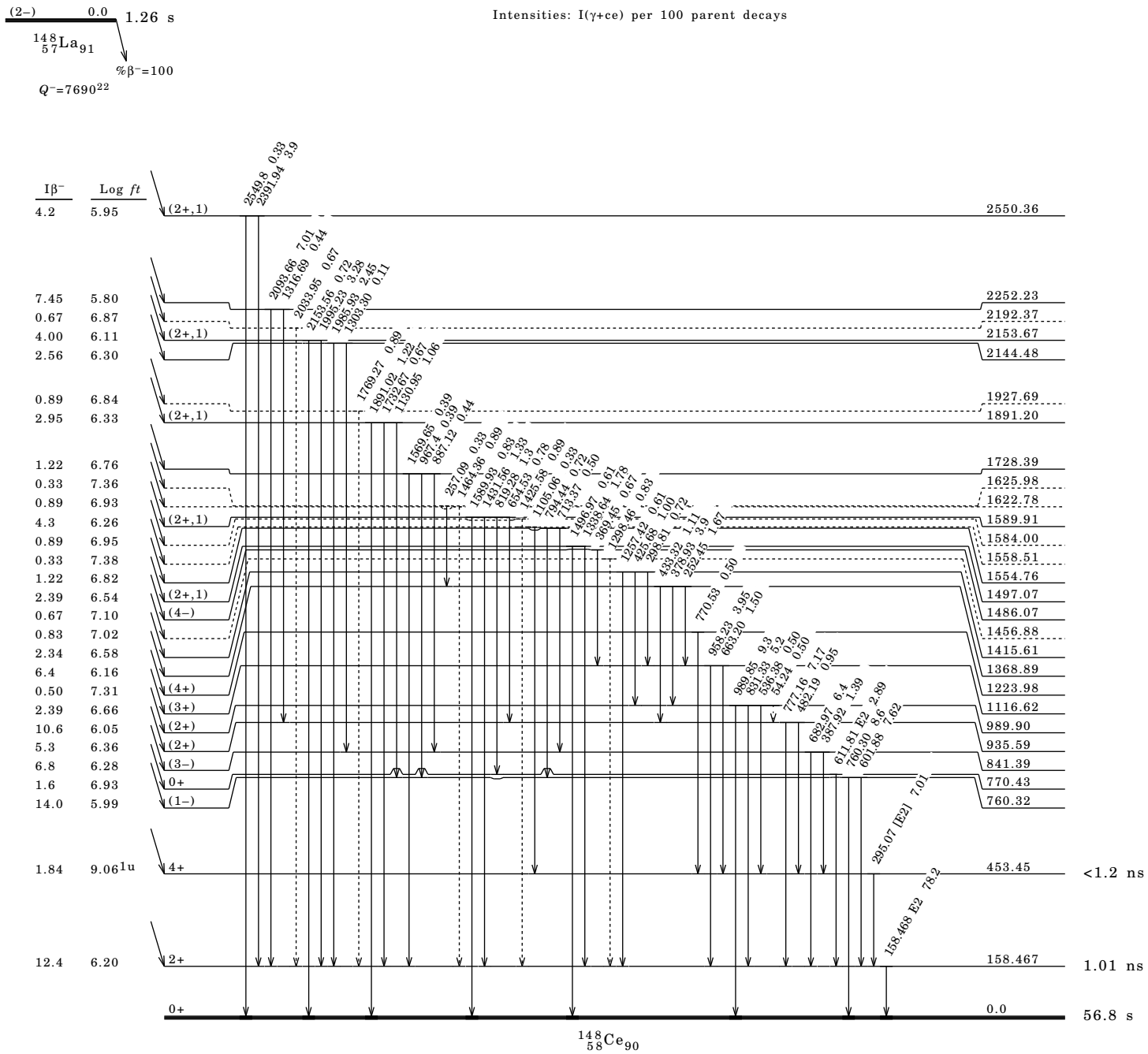
γ(^{148}Ce) (continued)

Eγ	E(level)	Iγ†
1891.02 *17*	1891.20	22 *1*
1985.93 *17*	2144.48	44 *1*
1995.23 *16*	2153.67	59 *2*
x2031.17 *20*		21 *2*
2033.95§ *24*	2192.37?	12 *2*
2093.66 *21*	2252.23	126 *2*
2153.56 *23*	2153.67	13 *2*
x2219.89 *25*		27 *2*
2391.94 *22*	2550.36	70 *5*
2549.8 *6*	2550.36	6 *4*

† For absolute intensity per 100 decays, multiply by 0.0556 *9*.
‡ Absolute intensity per 100 decays.
§ Placement of transition in the level scheme is uncertain.
x γ ray not placed in level scheme.

Decay Scheme

Intensities: I(γ+ce) per 100 parent decays



^{149}La β⁻n Decay (1.05 s) 1986Wa17

Parent ^{149}La: E=0.0; Jπ=?; $T_{1/2}$=1.05 s *3*; Q(g.s.)=2110 *200*; %β⁻n decay=1.46 *28*.
Measured $T_{1/2}$ and %β⁻n. Other (from the same group): 1986ReZU.
%β⁻n=1.17 *12* (1986Wa17), 1.74 *13* (1993Ru01). Other: 1.07 *13* (1986ReZU).

^{252}Cf SF Decay 2006Ch24,1995Ha20,1998ZhZH

Parent ^{252}Cf: E=0.0; Jπ=0+; $T_{1/2}$=2.645 y *8*; %SF decay=?
This reaction and level scheme was multiply studied by same group. Almost all references after 1990 (shown in the following two entries) are published by this group.
2006Ch24: measured Eγ, Iγ, γγ using Gammasphere array of 102 Compton suppressed Ge detectors. Deduced octupole correlations. Gave the most complete level scheme. All data in the tables are from this source, unless indicated otherwise.
1971Ch44: measured I(γ+ce).
1995Ha20,1995ZhZV,1998ZhZH,1999HaZV: measured Eγ, Iγ, γγx–ray, γX–ray, γγ(θ), γγγ(θ).
2009Go09: measured g–factor of the first 2+ state by the method of correlation attenuations in randomly oriented magnetic fields, or Integral Perturbed Angular Correlation technique (IPAC), using the Gammasphere array.
1999Sm05: measured g–factor of the first 2+ state using time–integral perturbed angular correlation method.
See also: measured γ, γγ, K x ray (1995Zh39,1988Ph02,1970Wi16,1970Wa05,1971Ho29,1972Ho08,1974ClZX), γ(t) (2004Li66,1974JaZN,1974JaYY,1970Wa05,1970Wi16) γ(θ) (2010SmZZ).

^{148}Ce Levels

E(level)†	Jπ‡	$T_{1/2}$	Comments
0.0#	0+§		
158.65# *20*	2+§	1.06 ns *8*	Jπ: ΔJ=2, E2 γ to 0+, g.s. $T_{1/2}$: from 1974JaZN, 1974JaYY. Others: 0.9 ns *3* (2006Hw01), 1.3 ns *3* (1970Wa05), ≈0.9 ns (1970Wi16). g=0.38 *5*. g: weighted average of 0.37 *6* (1999Sm05) and 0.39 *8* (2009Go09).
453.8# *3*	4+§	0.2 ns *+10−2*	$T_{1/2}$: from 2004Li66 (0.2 ns *10* given in this reference was adjusted by evaluator to 0.2 ns *+10−2*).
839.9# *4*	6+§		
1117.3& *3*	(3+)		
1290.7# *4*	8+§		
1351.8@ *4*	(7−)		
1423.6& *3*	(5+)		
1487.0a *4*	(4−)		
1682.5a *4*	(6−)		
1754.0@ *4*	(9−)		
1787.2& *4*	(7+)		
1789.1b *4*	(7)		
1791.1# *4*	10+§		
1954.6a *4*	(8−)		
2095.6b *4*	(9)		
2199.3& *4*	(9+)		
2225.1@ *4*	(11−)		
2307.4a *5*	(10−)		
2328.2# *4*	12+§		

E(level)†	Jπ‡
2487.2b *4*	(11)
2674.0& *4*	(11+)
2751.6a *6*	(12−)
2752.1@ *4*	(13−)
2888.3# *5*	14+§
2969.6b *4*	(13)
3287.8a *6*	(14−)
3326.7@ *5*	(15−)
3464.5# *5*	16+§
3899.2a *6*	(16−)
3944.5@ *5*	(17−)
4066.2# *5*	18+§
4685.8# *6*	20+§
5311.6# *6*	22+§

† From least–squares fit to Eγ's.
‡ From 2006Ch24 based on presumed rotational–band structure and systematics, unless noted otherwise.
§ E2 γ to 0+ band head and regular band sequence.
# (A): Kπ=0+ band, α=+1.
@ (B): Kπ=7− band, α=+1.
& (C): Kπ=3+ band, α=−1.
a (D): Kπ=4− band, α=−1.
b (E): Band based on 7.

^{252}Cf SF Decay 2006Ch24,1995Ha20,1998ZhZH (continued)

γ(^{148}Ce)

Eγ†	E(level)	Iγ‡	Mult.	α	I(γ+ce)	Comments
103.1 *2*	2328.2	0.82 *12*				103.1 (2006Ch24).
104.8 *2*	1787.2	4.8 *3*	E1	0.214		α(exp)=0.20 *4* (2006Ch24). 104.8 (2006Ch24). Mult.: based on α(exp).
108.0 *6*	2307.4	3.7 *2*	E1	0.197 *5*		α(exp)=0.16 *4* (2006Ch24). 108.6 (2006Ch24), 107.4 (1995Ha20). Mult.: based on α(exp).
136.3 *2*	2888.3	0.75 *10*				136.3 (2006Ch24).
137.8 *2*	3464.5	0.3 *1*				137.8 (2006Ch24).
158.65 *20*	158.65	115 *6*	E2	0.406	2.31§ *35*	158.8 (2006Ch24), 158.5 (1995Ha20). Mult.: K/L=3.7 (1970Wa05).
166.95 *20*	1954.6	8.7 *4*	E1	0.0584		α(exp)=0.044 *8* (2006Ch24). 167.1 (2006Ch24), 166.8 (1995Ha20). Mult.: based on α(exp).
195.7#	1682.5					195.7 (2006Ch24).
244.95 *25*	2199.3	3.3 *3*				244.7 (2006Ch24), 245.2 (1995Ha20).
258.85 *20*	1682.5	8.9 *5*				258.9 (2006Ch24), 258.8 (1995Ha20).
271.75 *20*	1954.6	4.3 *3*				271.9 (2006Ch24), 271.6 (1995Ha20).
295.15 *25*	453.8	100 *5*			1.84§ *28*	295.4 (2006Ch24), 294.9 (1995Ha20). (295.1γ)(158.5γ)(θ): A_2=+0.046 *6*, A_4=+0.001 *9* (2009Go09, ^IPAC).
306.3 *2*	1423.6	8.8 *5*				306.5 (2006Ch24), 306.1 (1995Ha20).
306.5 *2*	2095.6	3.7 *3*				306.5 (2006Ch24).
352.9 *4*	2307.4	6.8 *6*				353.3 (2006Ch24), 352.6 (1995Ha20).
363.65 *20*	1787.2	7.2 *4*				363.7 (2006Ch24), 363.6 (1995Ha20).
369.7 *2*	1487.0	8.0 *5*				369.7 (2006Ch24).
386.15 *20*	839.9	75 *5*			1.20§ *18*	386.1 (2006Ch24), 386.2 (1995Ha20).
391.55 *20*	2487.2	2.4 *2*				391.5 (2006Ch24), 391.6 (1995Ha20).
402.2 *2*	1754.0	2.7 *2*				402.2 (2006Ch24).
411.9 *2*	2199.3	2.2 *2*				411.8 (2006Ch24), 412.0 (1995Ha20).
423.9 *2*	2752.1	2.3 *2*				423.9 (2006Ch24).
434.1 *2*	2225.1	4.8 *3*				434.1 (2006Ch24).
438.4 *2*	3326.7	1.4 *2*				438.4 (2006Ch24).
444.2 *2*	2751.6	3.9 *3*				444.3 (2006Ch24), 444.1 (1995Ha20).
450.75 *20*	1290.7	45 *3*				450.7 (2006Ch24), 450.8 (1995Ha20).
463.2 *2*	1754.0	5.7 *3*				463.3 (2006Ch24), 463.1 (1995Ha20).
471.1 *2*	2225.1	2.0 *2*				471.1 (2006Ch24).
474.7 *2*	2674.0	1.0 *1*				474.7 (2006Ch24).
482.5 *2*	2969.6	1.7 *2*				482.5 (2006Ch24).
500.8 *5*	1791.1	35 *2*				500.3 (2006Ch24), 501.3 (1995Ha20).
511.9 *2*	1351.8	10.1 *6*				511.8 (2006Ch24), 512.0 (1995Ha20).
527.0 *2*	2752.1	1.5 *2*				527.0 (2006Ch24).
536.2 *2*	3287.8	2.2 *2*				536.1 (2006Ch24), 536.3 (1995Ha20).
536.95 *25*	2328.2	18 *1*				537.2 (2006Ch24), 536.7 (1995Ha20).
559.7 *5*	2888.3	9.2 *5*				560.2 (2006Ch24), 559.2 (1995Ha20).
574.7 *2*	3326.7	0.9 *1*				574.7 (2006Ch24).
576.15 *20*	3464.5	7.3 *4*				576.2 (2006Ch24), 576.1 (1995Ha20).
583.5 *3*	1423.6	5.3 *3*				583.8 (2006Ch24), 583.2 (1995Ha20).
601.65 *20*	4066.2	4.5 *3*				601.6 (2006Ch24), 601.7 (1995Ha20).
611.4 *2*	3899.2	1.2 *1*				611.3 (2006Ch24), 611.5 (1995Ha20).
617.8 *2*	3944.5	0.22 *8*				617.8 (2006Ch24).
619.6 *2*	4685.8	2.3 *2*				619.7 (2006Ch24), 619.5 (1995Ha20).
625.8 *2*	5311.6	0.8 *2*				625.8 (2006Ch24).
641.4 *2*	2969.6	1.2 *2*				641.4 (2006Ch24).
663.45 *20*	1117.3	7.6 *4*				663.4 (2006Ch24), 663.5 (1995Ha20).
696.1 *2*	2487.2	2.4 *2*				696.1 (2006Ch24).
804.9 *2*	2095.6	2.4 *2*				804.9 (2006Ch24), 804.9 (1995Ha20).
947.3 *2*	1787.2	5.8 *4*				947.5 (2006Ch24), 947.1 (1995Ha20).
949.1 *2*	1789.1	5.8 *4*				949.1 (2006Ch24).
958.65 *25*	1117.3	10.5 *6*				958.9 (2006Ch24), 958.4 (1995Ha20).
969.65 *25*	1423.6	9.2 *5*				969.9 (2006Ch24), 969.4 (1995Ha20).

† Mean value of Eγ's given in comment with uncertainty adopted as half the difference of Eγ's and not smaller than 0.2 keV.

Footnotes continued on next page

^{252}Cf SF Decay 2006Ch24,1995Ha20,1998ZhZH (continued)

γ(^{148}Ce) (continued)

‡ Relative intensity.
§ γ+ce per 100 SF decays (1971Ch44).
# Placement of transition in the level scheme is uncertain.

^{235}U(n,F) E=thermal 1973Kh05

Measured: γ, ce.

^{148}Ce Levels

E(level)	Jπ†
0.0	0+
159 *2*	2+
454 *3*	4+
840	6+

† Adopted values.

γ(^{148}Ce)

Eγ	E(level)	Mult.	α	Comments
159 *2*	159	E2	0.402 *19*	Mult.: K/L=2.8; consistent with E2.
296 *2*	454			
386 *2*	840			

Adopted Levels, Gammas

Q(β⁻)=4872 *15*; S(n)=5163 *22*; S(p)=7810 *17*; Q(α)=–111 *20* 2012Wa38.

^{148}Pr Levels

Cross Reference (XREF) Flags

A ^{148}Ce β⁻ Decay
B ^{148}Pr IT Decay

E(level)†	Jπ	XREF	$T_{1/2}$	Comments
0.0	1–	AB	2.29 min *2*	%β⁻=100. configuration: π3/2+[411] ⊗ ν5/2–[523] (^{148}Pr IT decay). $T_{1/2}$: weighted average of: 2.25 min *8* (1986Wa06), 2.33 min *5* (1986BuZV), 2.27 min *4* (1979Ik06), 2.28 min *5* (1979Ta17), 2.28 min *9* (1976Ya06). Other: 2.47 min *13* (1969WiZX). Jπ: log *ft*=7.2 and 7.0 for β–transitions to 0+ and 2+ levels in ^{148}Pr (2.29) β⁻ decay, and 121.2γ from π=– level is M1,E2.
76.80 *20*	4–	B	2.01 min *7*	%IT=36 *10*; %β⁻=64 *10*. configuration: π5/2+[413] ⊗ ν3/2–[532] (^{148}Pr IT decay). Jπ: ΔJ=3 M3 γ to 1–, g.s. $T_{1/2}$: weighted average of 2.0 min *1* (1979Ik06), 2.02 min *9* (1986Wa06).
98.166 *3*	1–,2–,3–	A		Jπ: E2 to 1–, g.s.
98.967 *20*	0–,1–,2–	A		Jπ: M1 to 1–, g.s.
105.161 *19*	(0,1,2)–	A		Jπ: M1,E2 γ to 1–, g.s.
121.169 *3*	0–,1–,2–	A		Jπ: E1 γ from 1+, 391.
195.993 *13*	1	A		Jπ: log *ft*=5.72 via 0+ parent in ^{148}Ce β⁻ decay gives Jπ=1+; M1,E2 γ to π=–, 105 level gives negative parity indicating an inconsistency.
273.744 *25*	0+,1+,2+	A		Jπ: E1 γ to 1–, g.s.
287.20 *5*		A		
289.656 *19*	+	A		Jπ: E1 γ to π=–, 105.
332.75 *9*		A		
352.70 *8*	–	A		Jπ: M1,E2 γ to π=–, 105.
390.684 *19*	1+	A		Jπ: log *ft*=4.5 via 0+ parent; 0+ strongly unlikely from level scheme and systematics (as shown by 1983Ar15 in ^{148}Ce β⁻ decay).
467.77 *9*		A		
520.83 *4*	1+	A		Jπ: log *ft*=4.95 via 0+ parent; 0+ strongly unlikely from level scheme and systematics (as shown by 1983Ar15 in ^{148}Ce β⁻ decay).
626.36 *20*		A		
765.46 *11*	1+	A		Jπ: log *ft*=5.6 via 0+ parent; 0+ strongly unlikely from level scheme and systematics (as shown by 1983Ar15 in ^{148}Ce β⁻ decay).

† From a least–squares fit to Eγ data (normalized χ^2=1.95> critical χ^2=1.76).

γ(^{148}Pr)

E(level)	Eγ	Iγ	Mult.	α	Comments
76.80	76.8 *2*	100	M3	354 *7*	Mult.: from α(K)exp and α(L)exp in ^{148}Pr IT decay. B(M3)(W.u.)=0.045 *13*.
98.166	98.166 *3*	100	E2†	2.26	
98.967	98.99 *3*	100	M1†	1.333	
105.161	105.20 *3*	100	M1,E2†	1.4 *4*	
121.169	121.169 *3*	100	M1,E2†	0.91 *16*	
195.993	74.5 *5*	2.1			
	90.89 *3*	32	M1,E2†	2.3 *7*	
	98.0 *1*	20			
	195.977 *14*	100			
273.744	168.52 *4*	6.1			
	273.77 *5*	100	E1†	0.01645	
287.20	188.5 *3*	63			
	287.17 *10*	100			
289.656	184.53 *4*	29	E1†	0.0469	
	191.6 *1*	29			
	289.64 *6*	100			
332.75	332.7 *1*	100			

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Adopted Levels, Gammas (continued)

γ(^{148}Pr) (continued)

E(level)	Eγ	Iγ	Mult.	α
352.70	231.6 *2*	19	M1,E2†	0.121 *5*
	247.52 *9*	53		
	352.4 *2*	100		
390.684	101.029 *4*	21	M1,E2†	1.7 *4*
	103.2 *1*	1.5		
	116.92 *3*	22	M1,E2†	1.02 *20*
	194.69 *5*	24		
	269.52 *5*	100	E1†	0.01713
	285.5 *1*	4.7		
	291.724 *17*	98	E1†	0.01396
	390.79 *16*	7.8		
467.77	193.8 *2*	21		
467.77	271.5 *2*	41		
	346.3 *2*	36		
	369.09 *12*	100		
520.83	167.8 *2*	15		
	187.9 *2*	20		
	233.71 *5*	13		
	324.85 *5*	100		
	399.43 *19*	10		
	421.778 *62*	48		
626.36	521.2 *2*	100		
765.46	375.0 *2*	51		
	478.17 *12*	100		

† From α(K)exp in ^{148}Ce β$^-$ decay, except if noted otherwise.

^{148}Ce β$^-$ Decay 2004Ko05,1983Ar15,1997Gr09

Parent ^{148}Ce: E=0.0; Jπ=0+; $T_{1/2}$=56.8 s *3*; Q(g.s.)=2137 *13*; %β$^-$ decay=100.

2004Ko05: ^{148}Ce produced by on–line spectrometer KUR–ISOL following the ^{235}U(n,F) E=thermal reaction, implanted in tape and transported periodically to the measuring location equipped with three Si(Li) detectors, HPGe, and plastic scintillator detectors. Measured ce (FWHM=1.8 eV at 258 keV), γ, β–gated ce and γ, ce–γ coin, $T_{1/2}$.

1997Gr09,1996Gr20: total absorption γ–ray spectrometer (TAGS) system used to measure β$^-$ decay intensities, and the g.s. β$^-$ feeding when operated in the 4πγ–β coin mode.

Measured: γ, γγ, K x ray (1983Ar15,1977Bj02,1974Ar25,1973SeYX), βγ (1978St03,1981Eb01), γ (1979Bo26), see 1986BuZV.

Level scheme is that of 1983Ar15. TAGS data with a number of pseudolevels with a substantial β$^-$ feeding to them indicates that the level scheme has large uncertainties associated with it.

^{148}Pr Levels

E(level)†	Jπ‡	$T_{1/2}$	Comments
0.0	1–	2.29 min *2*	%β$^-$=100 (adopted value). $T_{1/2}$: adopted value.
98.166 *3*	1–,2–,3–		
98.967 *20*	0–,1–,2–		
105.161 *19*	(0,1,2)–		
121.169 *3*	0–,1–,2–		
195.993 *13*	1		
273.744 *25*	0+,1+,2+		
287.20 *5*			
289.656 *19*	+		
332.75 *9*			
352.70 *8*	–		
390.684 *19*	1+		Jπ: log *ft*=4.5 for β$^-$ decay from 0+.
467.77 *9*			
520.83 *4*	1+		Jπ: log *ft*=5.0 for β$^-$ decay from 0+.
626.36 *20*			
765.45 *11*	1+		Jπ: log *ft*=5.6 for β$^-$ decay from 0+.

† From a least–squares fit to Eγ data (normalized χ^2=1.95> critical χ^2=1.76).

‡ Adopted levels; supported by log *ft* values, level decay patterns and level systematics (1983Ar15).

^{148}Ce β⁻ Decay 2004Ko05,1983Ar15,1997Gr09 (continued)

β⁻ radiations

When the calculated feeding overlaps zero within three standard deviations, the code GTOL (part of ENSDF Analysis Programs) calculates estimated upper limits (90% confidence level) which are given by evaluator in the table comments (see "Statistics for Nuclear and Particle Physics", Louis Lyons, Cambridge University Press, 1986).

Eβ⁻	E(level)	Iβ⁻†‡#	Log *ft*	Comments
(1372 *13*)	765.45	2.1 *3*	5.57 *7*	Iβ⁻: 5.31–7.08 from TAGS (1997Gr09).
(1511 *13*)	626.36	0.70 *16*	6.20 *10*	Iβ⁻: 2.48 from TAGS (1997Gr09).
(1616 *13*)	520.83	16.3 *9*	4.95 *3*	Iβ⁻: 16.68 from TAGS (1997Gr09).
(1669 *13*)	467.77	3.3 *3*	5.70 *5*	Iβ⁻: 3.34 from TAGS (1997Gr09).
(1746 *13*)	390.684	59 *4*	4.52 *4*	Iβ⁻: 51.09 from TAGS (1997Gr09).
(1784 *13*)	352.70	2.1 *3*	6.01 *7*	Iβ⁻: 2.19 from TAGS (1997Gr09).
(1804@ *13*)	332.75			Iβ⁻: 0.0 from TAGS (1997Gr09); 0.00 *19* from I(γ+ce) imbalance; GTOL upper limit (method 1): 0.3.
(1847 *13*)	289.656	0.1 *16*	7 *7*	Iβ⁻: 5.84 from TAGS (1997Gr09); GTOL upper limit (method 1): 2.7.
(1850 *13*)	287.20	0.1 *7*	7 *3*	Iβ⁻: 0.73 from TAGS (1997Gr09); GTOL upper limit (method 1): 1.1.
(1863@ *13*)	273.744			Iβ⁻: 1.67 from TAGS (1997Gr09); −2.1 *10* from I(γ+ce) imbalance; GTOL upper limit (method 1): 0.7.
(1941 *13*)	195.993	5.8 *17*	5.71 *13*	Iβ⁻: 1.88 from TAGS (1997Gr09); GTOL upper limit (method 1): 9.2.
(2016§@ *13*)	121.169			Iβ⁻: 6 *3* from I(γ+ce) imbalance; GTOL upper limit (method 1): 9.2.
(2032§@ *13*)	105.161			Iβ⁻: 1 *3* from I(γ+ce) imbalance; GTOL upper limit (method 1): 5.3.
(2038§@ *13*)	98.967			Iβ⁻: 5.6 *19* from I(γ+ce) imbalance.
(2039§@ *13*)	98.166			Iβ⁻: 0.0 *4* from I(γ+ce) imbalance; GTOL upper limit (method 1): 0.6.
(2137§@ *13*)	0.0			Iβ⁻: 4 *5* (1983Ar15); 0 *6* from I(γ+ce) imbalance; GTOL upper limit (method 1): 0.7.

† From I(γ+ce) imbalances at each level, unless indicated otherwise. In computing I(γ+ce), 1983Ar15 assumed that γ's from E(level)<380 keV were M1, and γ's from E(level)>380 keV were E1 in general. The evaluator has changed these assumed multipolarities to be consistent with ΔJπ.

‡ TAGS analysis gives the following pseudolevels and associated Iβ (in %) in addition to the discrete levels listed. 880 keV 1.56; 970 keV 1.15–2.29; 1060 keV 0.73; 1150 keV 2.35; 1260 keV≤1.33; 1360 keV 0.31; and 1430 keV 0.57. The TAGS spectrum of ^{148}Ce 56s decay, while predominantly ^{148}Ce, is estimated to contain <10% contribution from ^{148}Pr 2.0 min decay. A simultaneous analysis of both these nuclides was done, and the authors feel that in the energy range from ≈750 keV to ≈1300 keV, there is some ambiguity in the final results because of overlapping peaks. Since the resolution of the TAGS system is typically 50–100 keV, the intensity assigned to a pseudolevel may represent β⁻ feeding to a single level or a group of levels. The same limitation applies to the intensity assigned to a known level, since it could include feeding to known or unknown levels in the resolution energy range.

§ ΣIβ over g.s. and first four excited states is 0.0% *21* from TAGS analysis (1997Gr09).

Absolute intensity per 100 decays.

@ Existence of this branch is questionable.

γ(^{148}Pr)

α(K)exp were derived from Iγ and I(K x ray) for the same transition (1983ChZG).

Iγ normalization: from ΣI(γ+ce)=100% to g.s. and assuming no β⁻ feeding to g.s. as found by TAGS analysis (1997Gr09).

Eγ	E(level)	Iγ#	Mult.†	α	Comments
74.5 *5*	195.993	8 *4*	[M1]	3.02 *8*	
90.89 *3*	195.993	123 *7*	M1,E2§	2.3 *7*	Mult.: α(K)exp=1.11 *10* (2004Ko05); α(K)exp=1.4 *1* (1983ChZG).
98.0 *1*	195.993	77 *5*	[M1]	1.372	
98.166 *3*	98.166	93 *5*	E2‡	2.26	Eγ: from 1979Bo26. Mult.: α(K)exp=1.3 *2*, α=2.6 *3* (1983ChZG).
98.99 *3*	98.967	742 *40*	M1‡	1.333	Mult.: α(K)exp=0.9 *2* (1983ChZG).
101.029 *4*	390.684	215 *11*	M1,E2§	1.7 *4*	Eγ: from 1979Bo26. Mult.: α(K)exp=0.94 *6* (2004Ko05); α(K)exp=0.5 *2* (1983ChZG).
103.2 *1*	390.684	15 *15*	[M1]	1.184	
105.20 *3*	105.161	314 *15*	M1,E2§	1.4 *4*	Mult.: α(K)exp=0.75 *6* (2004Ko05); α(K)exp=0.9 *1* (1983ChZG).
116.92 *3*	390.684	225 *12*	M1,E2§	1.02 *20*	Eγ: 117.336 *7* (1979Bo26) probably belongs to another nuclide (1983Ar15). Mult.: α(K)exp=0.98 *9* (2004Ko05); α(K)exp=0.6 *2* (1983ChZG).
121.169 *3*	121.169	790 *38*	M1,E2§	0.91 *16*	Eγ: from 1979Bo26. Mult.: α(K)exp=0.53 *4* (2004Ko05); α(K)exp=0.5 *2* (1983ChZG).
167.8 *2*	520.83	66 *7*	[E1]	0.0607	
168.52 *4*	273.744	20 *3*	[E1]	0.0600	
184.53 *4*	289.656	99 *5*	E1§	0.0469	Mult.: α(K)exp=0.021 *7* (2004Ko05).

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^{148}Ce β⁻ Decay 2004Ko05,1983Ar15,1997Gr09 (continued)

γ(^{148}Pr) (continued)

Eγ	E(level)	Iγ#	Mult.†	α	Comments
187.9 *2*	520.83	90 *5*	[E1]	0.0447	
188.5 *3*	287.20	69 *7*	[E1]	0.0443	
191.6 *1*	289.656	99 *6*	[M1]	0.209	Eγ: 190.839 *6* (1979Bo26) probably belongs to another nuclide (1983Ar15).
193.8 *2*	467.77	20 *4*	[E1]	0.0411	
194.69 *5*	390.684	240 *3*	[E1]	0.0406	
195.977 *14*	195.993	390 *20*	[M1]	0.197	Eγ: from 1979Bo26.
231.6 *2*	352.70	20 *4*	M1,E2§	0.121 *5*	Mult.: α(K)exp=0.119 *20* (2004Ko05).
233.71 *5*	520.83	60 *6*	[M1]	0.1221	Eγ: 233.844 *13* (1979Bo26) probably belongs to another nuclide (1983Ar15).
247.52 *9*	352.70	56 *6*	[M1]	0.1046	Eγ: 247.086 *25* (1979Bo26) probably belongs to another nuclide (1983Ar15).
269.52 *5*	390.684	1018 *51*	E1§	0.01713	Eγ: from 1979Bo26. Mult.: α(K)exp=0.0097 *8* (2004Ko05); α(K)exp=0.022 *8* (1983ChZG).
271.5 *2*	467.77	40 *6*	[E1]	0.01681	
273.77 *5*	273.744	326 *16*	E1§	0.01645	Mult.: α(K)exp=0.0086 *18* (2004Ko05).
285.5 *1*	390.684	48 *5*	[E1]	0.01476	
287.17 *10*	287.20	110 *10*	[E1]	0.01454	
289.64 *6*	289.656	340 *20*	[M1]	0.0689	
291.724 *17*	390.684	1000 *50*	E1§	0.01396	Eγ: from 1979Bo26. Mult.: α(K)exp=0.0086 *9* (2004Ko05).
324.85 *5*	520.83	453 *20*	[E1]	0.01062	
332.7 *1*	332.75	90 *9*	[M1]	0.0478	
346.3 *2*	467.77	35 *4*	[E1]		
352.4 *2*	352.70	106 *12*	[M1]	0.0412	
369.09 *12*	467.77	97 *13*			
375.0 *2*	765.45	41 *9*			
390.79 *16*	390.684	79 *14*			
399.43 *19*	520.83	46 *12*			
421.78 *6*	520.83	218 *11*			Eγ: from 1979Bo26.
478.17 *12*	765.45	80 *12*			
521.2 *2*	626.36	41 *9*			

† γ's from E(level)<380 keV were assumed to be M1, and γ's from E(level)>380 keV were assumed to be E1 in general by 1983Ar15, except as indicated otherwise. The evaluator has changed these multipolarities to be consistent with ΔJπ.

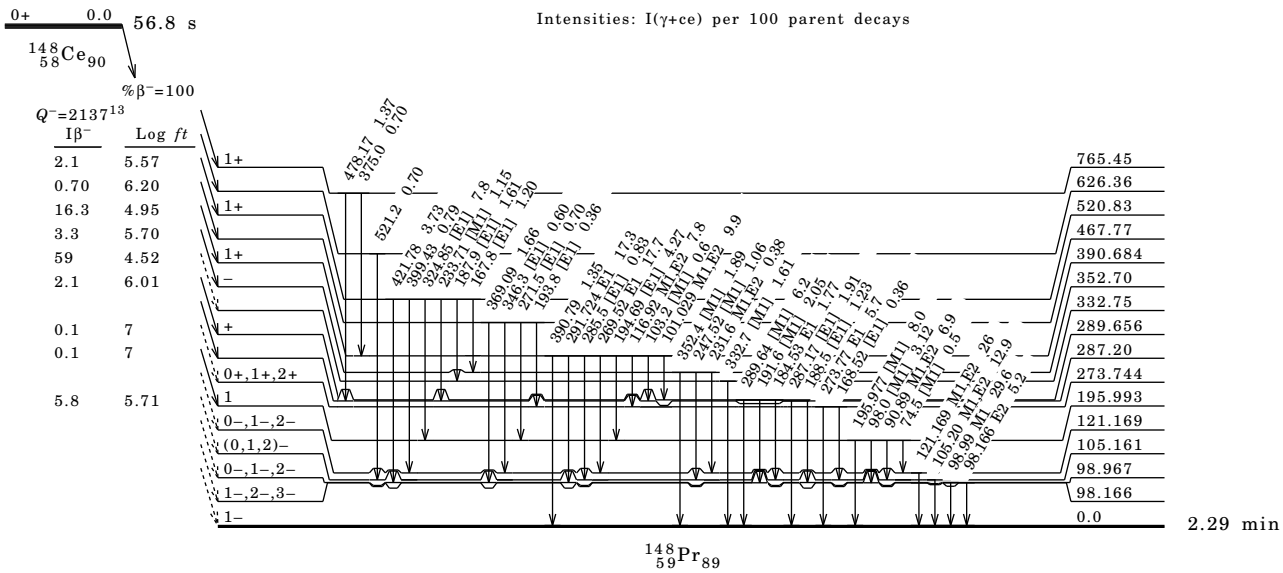
‡ From α(K)exp (1983ChZG).

§ From α(K)exp (2004Ko05).

For absolute intensity per 100 decays, multiply by 0.0171 *7*.

Decay Scheme

Intensities: I(γ+ce) per 100 parent decays



^{148}Pr IT Decay 2004Ko05,2008KoZO

Parent ^{148}Pr: E=76.8; Jπ=4–; $T_{1/2}$=2.01 min *7*; %IT decay=36 *10*.
2004Ko05,2008KoZO: see 2004Ko05 description in ^{148}Ce β^- decay (2008KoZO later confirm 2004Ko05).

^{148}Pr Levels

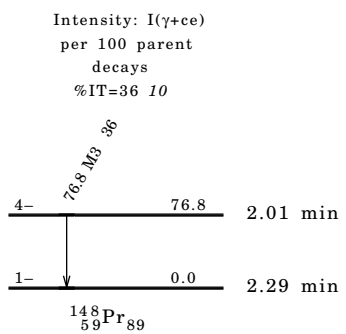
E(level)	Jπ	$T_{1/2}$	Comments
0.0	1–	2.29 min *2*	%β^-=100 (adopted value). configuration: π3/2+[411] ⊗ ν5/2–[523]. Jπ,$T_{1/2}$: adopted values.
76.8 *2*	4–	2.01 min *7*	%IT=36 *10*; %β^-=64 *10*. configuration: π5/2+[413] ⊗ ν3/2–[532]. Jπ: ΔJ=3 M3 γ to 1–, g.s. $T_{1/2}$: adopted value.

γ(^{148}Pr)

Eγ	E(level)	Iγ†	Mult.	α	Comments
76.8 *2*	76.8	100	M3	354 *7*	Mult.: based on α(K)exp=151 *39* and α(L)exp=125 *33* (2004Ko05).

† For absolute intensity per 100 decays, multiply by 0.0010 *3*.

Decay Scheme



Adopted Levels, Gammas

Q(β^-)=–543 *6*; S(n)=7332.5 *17*; S(p)=9253 *16*; Q(α)=599 *3* 2012Wa38.
Measured hyperfine structure and isotope shifts: 2005Ma10, 2005Ro35, 2001Mb05.
The band designations are from Coulomb excitation.

^{148}Nd Levels

Cross Reference (XREF) Flags

A ^{148}Pr β^- Decay (2.29 min)	F ^{150}Nd(p,t)
B ^{148}Pr β^- Decay (2.01 min)	G ^{148}Nd(n,n'γ)
C ^{146}Nd(t,p)	H ^{150}Nd(α,α2nγ)
D ^{148}Nd(d,d')	I ^{148}Nd(p,p')
E Coulomb Excitation	J ^{148}Nd(γ,γ')

E(level)	Jπ	XREF	$T_{1/2}$	Comments
0.0[b]	0+	ABCDEFGHIJ	stable	Double β^- decay to the lowest 2+ levels of ^{148}Sm was not observed ($T_{1/2}$>2.7×10^{18} y) (1982Be20); 2009Ba21 give limits for (0ν+2ν) transitions to the 2+$_1$, 0+$_1$, and 2+$_2$ states in ^{148}Sm of the order of ≈(4–8)×' 10^{20} y. Rms charge radius <r^2>$^{1/2}$=4.9986 fm *19* (2004An14). β_4=0.07 *2* (2003Na39).
301.705[b] *16*	2+‡#	ABCDEFGHIJ	80 ps& *3*	$T_{1/2}$: other value: 79 ps *1* from B(E2)=1.37 *2* which is the unweighted average of 1.30 *6* (1997Ib01), 1.36 *3* (1971Cr01), 1.39 *2* (1988Ah01), 1.42 *5* (1980FaZW), 1.39 *2* (1986Sc30). Others: 0.96 *10* (1966Ec02), 0.95 *15* (1967BuZW). μ=+0.73 *3* (2005St24,2001Ho02). μ: measured by transient field integral perturbed angular correlation method; Others: +0.64 *8* (1978Ka36), +0.86 *14* (1972Ku10), +0.86 *14* (1972Ku10), +0.96 *8* (1970Be36), +1.00 *8* (1978FaZP), +1.12 *24* (1967Be08), 0.81 *8* (1987Be08), 0.70 *4* (1997StZR,1990St18). Q=–1.46 *13* (2005St24,1970Ge08). Q: Others: –1.36 *30* (1971Cr01), –0.67 *11* (1978FaZP).
752.29[b] *7*	4+‡#	AB DE GHI	6.9 ps& *3*	μ=+1.4 *2* (2005St24,2001Ho02). μ: measured by transient field integral perturbed angular correlation method. B(E4)↑=0.16 *5* (2003Na39). $T_{1/2}$: other value: 6.9 ps *2* from B(E2)(2+$_1$ → 4+$_1$)=0.784 *24*, which is the unweighted average of 0.80 *3* (1997Ib01) and 0.768 *24* (1980FaZW); other: 0.81 (1967BuZX).
916.93[d] *8*	0+‡#	A CDEFG I	4.4 ps& *3*	XREF: F(970). B(E2)(2+$_1$ → 0+$_2$)=0.025 *1* (1997Ib01); 0.039 *7* (1980FaZW).
999.33[c] *7*	3–‡#	ABCDE GHI		B(E3)(0+ → 3–)=0.32 *2* (1997Ib01), 0.40 *8* (1988Ah01), 0.13 *4* (1967BuZX).
1023.17[c] *6*	1–‡#	A DE G IJ		Jπ: from $\gamma\gamma(\theta)$ and linear pol; γ to 2+ is E1.
1170.95[d] *7*	2+‡#	A CDE G I	1.4 ps& *1*	
1242.26[e] *11*	5–‡#	B E GHI	1.0 ps& *1*	Jπ: γ to 4+ is E1(+M2), no γ to J<4.
1248.85[e] *6*	2+‡#	A DE G I	1.4 ps& *2*	
1279.81[b] *12*	6+†#	B E GH	2.9 ps& *2*	μ=+1.6 *3* (2005St24,2001Ho02). μ: measured by transient field integral perturbed angular correlation method. Jπ: γ to 4+ is E2 from lin pol.
1400 *2*	(0+,1–)‡	D I		
1432 *2*	(0+,1–)‡	D I		
1475 *2*	(1–)‡	D I		
1511.61[e] *7*	3+#	A E G		Jπ: γ's to 2+ and 4+ are M1+E2.
1515.6 *3*		A		
1521.64 *16*	1	G		Jπ: $\gamma(\theta)$ and linear–polarization in (n,n'γ).
1577 *2*	2+‡	D I		
≈1600	0+	F		Jπ: L(p,t)=0.
1604.1[d] *6*	4+‡#	DE I		
1644.5[c] *6*	7–†#	E H	1.0 ps& *2*	
1645.6 *3*		A G		Jπ: $\gamma\gamma(\theta)$ in ^{148}Pr β^- decay suggest J=0; $\gamma(\theta)$ and observation of 1645 in (n,n'γ) suggest J=1,2+.
1654 *2*	(3–)‡	D I		
1659.92 *5*	2+	A G		Jπ: γ's to 3–, 0+; $\gamma(\theta)$.

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Adopted Levels, Gammas (continued)

^{148}Nd Levels (continued)

E(level)	Jπ	XREF	$T_{1/2}$	Comments
1683.38[e] *18*	4+‡#	A CDE G I		
1688.12 *12*	3+,4+,5+	B G		Jπ: γ to 4+ is M1+E2.
1725 *2*	3−‡	CD I		
1729.11 *15*	3+	G		Jπ: γ's to 2+ and 4+ are M1+E2.
1778 *2*	(3−)‡	D I		
1809.0 *3*		c G		
1824.55 *16*		c G		
1837 *2*	(1−)‡	D I		
1856.2[b] *8*	8+†#	E H	1.4 ps[&] *2*	
1858.4 *4*	(2+,3)	BC G		Jπ: γ to 2+ is D+Q; γ to 4+.
1887 *2*	4+‡	D I		
2034 *2*	3−‡	CD I		
2073.73 *14*	2(+)	A C		Jπ: J=2 from γ(θ) in β⁻ decay; γ to 0+.
2098 *2*	4+‡	D I		
2099.1[e] *8*	6+#	E		
2131.8[c] *9*	9−†#	E H		
2145 *2*	4+‡	D I		
2149.0[d] *6*	6+#	E		
2153.0 *10*	(1,2+)@	J	0.6 ps[a] *4*	
2182.2 *4*		A C		
2197 *2*	5−‡	D I		
2236.8 *9*		A		
2257 *4*	(2+)‡	CD I		
2286	(3−)‡	D I		
2341 *4*	3−‡	D I		
2375.9 *7*	1§	J		
2388 *4*	4+‡	D I		
2406.20 *19*	0,1,2	A		Jπ: log *ft*=7.0 from 1− parent.
2431.48 *17*	2+‡	A D I		
2471.2[b] *10*	(10+)†#	E H		
2481.0 *10*	1§	J	0.14 ps[a] *4*	
2484 *4*	3−‡	D I		
2544.7 *6*	(1−)‡	A D IJ	0.25 ps[a] *10*	J=(1) from γ(θ) and linear−polarization data from (γ,γ').
2590 *4*	4+‡	D I		
2642 *4*	4+‡	D I		
2676.4[c] *11*	(11−)†#	E H		
2682 *4*	0+‡	D I		
2689.0 *10*	1§	J	86 fs[a] *22*	
2709 *4*	4+‡	D I		
2726.1[d] *10*	8+#	E		
2729.9 *7*	(1)§	J		
2736.0 *10*	1§	J	0.12 ps[a] *7*	
2770 *4*	4+‡	D I		
2795.0 *10*	(1,2+)@	J	0.25 ps[a] *10*	
2807 *4*	3−‡	D I		
2839.0 *10*	1§	J	0.08 ps[a] *3*	
2845.0 *10*	(1)§	J	0.27 ps[a] *18*	
2871 *4*	(3−)‡	D I		
2913 *4*	4+‡	D I		
2920.0 *10*	1§	J	0.08 ps[a] *3*	
2922.9 *7*	1§	J		
2930.63 *21*	(2−)	A		Jπ: γ's to 3−, 2+, 1−; no γ to 0+.
2961 *4*	4+‡	D I		
2982.0 *10*	1§	J	27 fs[a] *11*	
3002.0 *10*	(1,2+)@	J	0.12 ps[a] *6*	
3022 *4*	4+‡	D I		
3036.8 *9*		A		
3068 *4*	(3−)‡	D I		
3091.9 *7*	1§	D IJ		
3106.2[b] *14*	(12+)#	E		
3113.0 *10*	1§	J	0.11 ps[a] *3*	
3129.9 *8*		A		
3136.0 *10*	1§	J	54 fs[a] *15*	

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Adopted Levels, Gammas (continued)

^{148}Nd Levels (continued)

E(level)	Jπ	XREF	$T_{1/2}$	Comments
3142 *4*	4+‡	D I		
3176.0 *10*	(1)§	J	57 fs[a] *23*	
3191 *4*	4+‡	D I		
3191.0 *10*	(1)	J	0.13 ps[a] *4*	
3205.0 *10*	(1,2+)@	J	0.16 ps[a] *9*	
3214.9 *7*	1§	J		
3241 *4*	4+‡	D I		
3264.4[c] *15*	(13−)#	E		
3265.0 *10*	1§	J	0.11 ps[a] *4*	
3281.0 *10*	(1,2+)@	J	0.21 ps[a] *15*	
3340.9 *7*	1§	J		
3369.9 *7*	1§	J		
3377.9 *7*	1§	J		
3404.9 *7*	1§	J		
3414.9 *7*	1§	J		
3490.0 *10*	(1)§	J	71 fs[a] *23*	
3527.9 *7*	(1,2+)@	J		
3544.9 *7*	1§	J		
3596.9 *7*	(1)§	J		
≈3650	2+	F		Jπ: L(p,t)=2.
3689.0 *10*	1§	J	11 fs[a] *3*	
3716.9 *7*	(1)§	J		
3755.1 *10*	(1)§	J	0.07 ps[a] *3*	
3771.1 *10*	(1)§	J	57 fs[a] *24*	
3793.1 *10*	1§	J		
3805.1 *10*	1§	J	35 fs[a] *13*	
3826.1 *10*	(1,2+)@	J	57 fs[a] *24*	
3860.9 *7*	1§	J		

† From γ(θ) and DCO measurement in (α,α2nγ); since details are not given (1988Ur01), some of these assignments, especially for higher J values, are considered as tentative.
‡ From coupled–channel analysis of (p,p') and (d,d') data.
§ From γ(θ) in (γ,γ').
# From Coulomb excitation; since details are not given, some of these assignments, especially for higher J values, are considered as tentative.
@ From γ to 0+.
& From recoil–distance method (RDM) in Coulomb excitation.
a From $\Gamma_{\gamma0}/\Gamma$ and $\Gamma_{\gamma0}$ in (γ,γ').
b (A): g.s. band.
c (B): Negative–parity band.
d (C): β–vibrational band.
e (D): γ–vibrational band.

γ(^{148}Nd)

E(level)	Eγ†	Iγ	Mult.‡	δ‡§	α	Comments
301.705	301.702 *16*	100	E2		0.0515	B(E2)(W.u.)=57.9 *22*.
752.29	450.58 *7*	100	E2		0.01566	B(E2)(W.u.)=94 *4*.
916.93	615.21 *8*	100	E2		0.00687	B(E2)(W.u.)=31.2 *22*.
999.33	246.8 *6*	5.3 *7*	[E1]		0.0225	Eγ: mean value of 246.2 *2* (n,n'γ) and 247.4 *3* (β⁻ decay (2.29 min)). Iγ: mean value of 6.0 *6* (n,n'γ) and 4.5 *6* (β⁻ decay (2.01 min)).
	697.61 *7*	100 *12*	E1		0.00191	
1023.17	721.43 *8*	67 *11*	E1		1.78×10^{-3}	
	1023.18 *7*	100 *11*	E1		8.95×10^{-4}	
1170.95	418.2 *4*	2.8 *13*	[E2]		0.0193	Iγ: from (n,nγ); 5 *3* in β⁻ decay data. B(E2)(W.u.)=16 *8*.
	869.23 *7*	100 *7*	M1+E2	+8 *+12−2*	0.00307	B(M1)(W.u.)=0.0003 *+10−3*; B(E2)(W.u.)=14.4 *19*.
	1171.06 *15*	16.4 *16*	E2		1.62×10^{-3}	B(E2)(W.u.)=0.54 *8*.

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Adopted Levels, Gammas (continued)

γ(^{148}Nd) (continued)

E(level)	Eγ†	Iγ	Mult.‡	δ‡§	α	Comments
1242.26	489.96 *8*	100	E1(+M2)	+0.03 *2*	0.00418 *11*	B(E1)(W.u.)=0.00205 *21*.
1248.85	496.8 *6*	5 *3*				
	947.09 *10*	44 *3*	E2(+M1)		0.0032 *7*	δ: >+100 or <−9.
	1248.89 *8*	100 *6*	E2		1.43×10^{-3}	B(E2)(W.u.)=1.9 *4*.
1279.81	527.51 *10*	100	E2		0.01020	B(E2)(W.u.)=102 *7*.
1511.61	759.32 *18*	22.6 *26*	M1+E2		0.0053 *12*	δ: +0.35 *15* or +5.0 *+15−22*.
	1209.92 *8*	100 *7*	M1+E2		0.0018 *4*	δ: >400, <−28 or 0.20 *4*.
1515.6	492.4 *3*	100				
1521.64	605.2 *3*	44 *9*				
	1521.46 *18*	100 *9*				
1604.1	604.8					
	851.8					
	1302.3					
1644.5	364.6	100 *5*	(E1)		0.00832	B(E1)(W.u.)=0.0043 *10*.
	402.0	15 *5*	E2		0.0217	B(E2)(W.u.)=150 *60*.
1645.6	622.7 *4*	100 *25*				
	1343.5 *5*	88 *12*				
	1645.6 *10*	19 *5*				
1659.92	636.5 *3*	17 *3*				
	660.0 *3*	26 *3*				
	1358.23 *5*	100 *17*				
1683.38	512.2 *4*	15 *9*				
	933.7 *24*	9 *3*				
	1381.7 *2*	100 *13*				
1688.12	935.83 *10*	100 *6*	M1+E2		0.0033 *7*	δ: −0.53 *+8−10* or +3.0 *5*.
	1386.1 *5*	9 *3*				
1729.11	976.8 *2*	83 *14*	M1(+E2)	+0.00 *+13−14*	0.00358 *6*	
	1427.4 *2*	100 *15*	M1+E2	+0.37 *5*	1.50×10^{-3} *2*	
1809.0	297.5 *3*	100 *30*				
	637.3 *7*	47 *16*				
1824.55	825.23 *15*	100 *17*				
	1071.9 *7*	40 *14*				
1856.2	211.7	38 *6*	E1		0.0337	B(E1)(W.u.)=0.0049 *11*.
	576.2	100 *6*	E2		0.00811	B(E2)(W.u.)=98 *17*.
1858.4	1106.2 *5*	84 *7*				
	1556.7 *4*	100 *8*				
2073.73	562.4 *2*	19 *4*				
	825.3 *9*	100 *7*				
	903.1 *7*	78 *11*				
	1050.5 *7*	22 *4*				
	1156.5 *2*	30 *7*				
	1771.7 *6*	89 *7*	(M1(+E2))	−0.03 *+25−28*	1.12×10^{-3} *2*	
2099.1	819.3					
	1346.8					
2131.8	275.5	100 *10*	E1		0.01686	
	487.4	80 *10*	E2		0.01261	
2149.0	504					
	869.3					
	907					
	1396.8					
2153.0	2153 *1*	100				
2182.2	522.2 *4*					
	1880.9 *7*					
2236.8	1065.5 *13*	100				
2375.9	2074 *1*	98 *30*				
	2376 *1*	100				
2406.20	894.4 *4*	38 *5*				
	1157.4 *2*	100 *29*				
2431.48	918.4 *6*	11 *8*				
	1182.7 *2*	14 *3*				
	1260.7 *4*	36 *14*				
	1409.8 *9*	6 *6*				
	2129.6 *5*	100 *17*				

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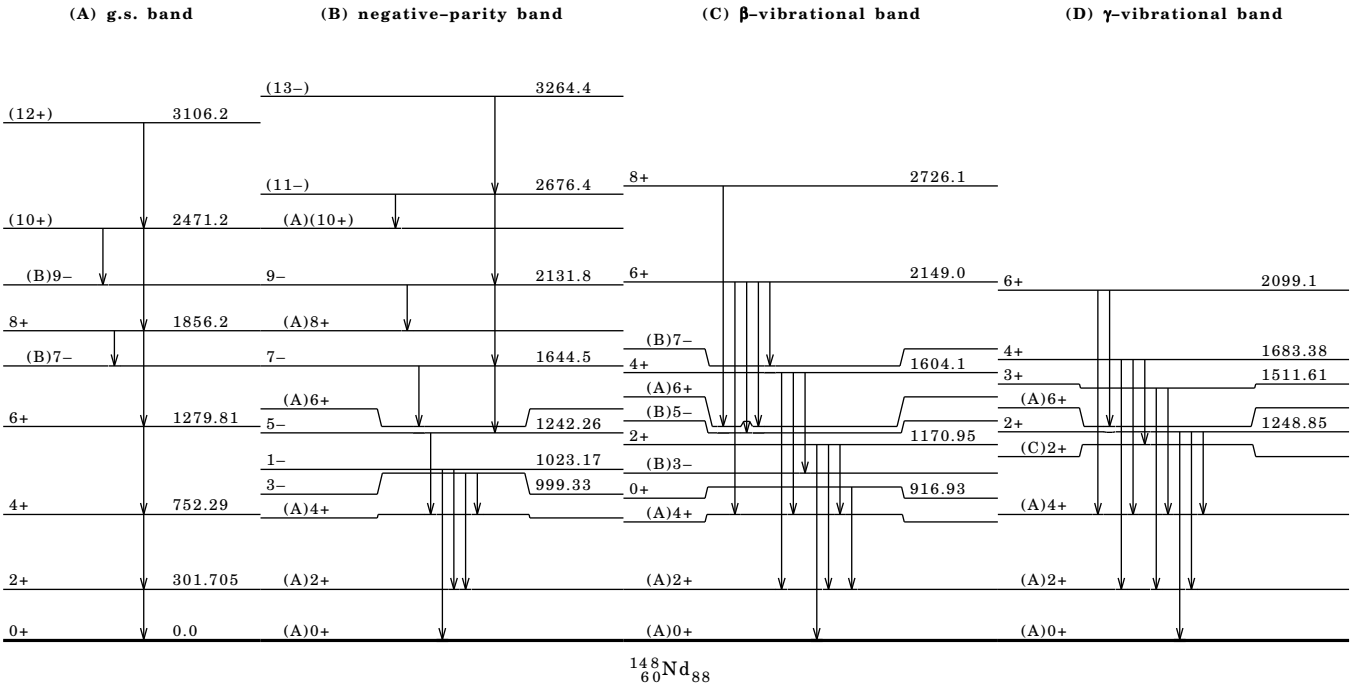
Adopted Levels, Gammas (continued)

γ(^{148}Nd) (continued)

E(level)	Eγ†	Iγ	Mult.‡
2471.2	339.4	100 *33*	D
	615.0	67 *33*	(Q)
2481.0	2481 *1*	100	
2544.7	1521.8 *6*		
	2544 *1*		
2676.4	205.3	40 *20*	D
	544.6	100 *20*	Q
2689.0	2689 *1*	100	
2726.1	1446.3	100	
2729.9	2428 *1*	100	
	2730 *1*	84 *22*	
2736.0	2736 *1*	100	
2795.0	2795 *1*	100	
2839.0	2839 *1*	100	
2845.0	2845 *1*	100	
2920.0	2920 *1*	100	
2922.9	2621 *1*	61 *18*	
	2923 *1*	100	
2930.63	1271.2 *5*	33 *8*	
	1418.6 *7*	29 *13*	
	1907.1 *3*	71 *21*	
	1931.9 *5*	42 *17*	
	2629.0 *6*	100 *25*	
2982.0	2982 *1*	100	
3002.0	3002 *1*	100	
3036.8	800.0 *1*	50 *42*	
	2735.3 *11*	100 *42*	
3091.9	2790 *1*	100	
	3092 *1*	86 *7*	
3106.2	635	100	
3113.0	3113 *1*	100	
3129.9	2106.7 *8*	100	
3136.0	3136 *1*	100	
3176.0	3176 *1*	100	
3191.0	3191 *1*	100	
3205.0	3205 *1*	100	
3214.9	2913 *1*	24 *9*	
	3215 *1*	100	
3264.4	588	100	
3265.0	3265.0 *10*	100	
3281.0	3281 *1*	100	
3340.9	3039 *1*	45 *10*	
	3341 *1*	100	
3369.9	3068 *1*	70 *25*	
	3370 *1*	100	
3377.9	3076 *1*	100	
	3378 *1*	98 *29*	
3404.9	3103 *1*	67 *18*	
	3405 *1*	100	
3414.9	3113 *1*	100	
	3415 *1*	52 *31*	
3490.0	3490 *1*	100	
3527.9	3226 *1*	61 *28*	
	3528 *1*	100	
3544.9	3243 *1*	52 *31*	
	3545 *1*	100	
3596.9	3295 *1*	56 *24*	
	3597 *1*	100	
3689.0	3689 *1*	100	
3716.9	3415 *1*		
	3717 *1*		
3755.1	3755 *1*	100	
3771.1	3771 *1*	100	
3793.1	3793 *1*	100	
3805.1	3805 *1*	100	
3826.1	3826 *1*	100	
3860.9	3559 *1*	15 *6*	
	3861 *1*	100	

† From β^- decay, (n,n'γ), Coulomb ex., (α,α2nγ), and (γ,γ').
‡ From γ(θ) in β^- decay, (n,n'γ), (α,α2nγ), (γ,γ') and linear–polarization data in (n,n'γ).
§ If no value given it was assumed δ=1.00 for E2/M1, δ=1.00 for E3/M2 and δ=0.10 for the other multipolarities.

Adopted Levels, Gammas (continued)



^{148}Pr β⁻ Decay (2.29 min) 1988Ka14,1997Gr09

Parent ^{148}Pr: E=0.0; Jπ=1–; $T_{1/2}$=2.29 min *2*; Q(g.s.)=4872 *15*; %β⁻ decay=100.

1997Gr09,1996Gr20: total absorption γ–ray spectrometer (TAGS) system used to measure β–decay intensities, and the g.s. β⁻ feeding when operated in the 4πγ–β coin mode.

Measured: γ, γγ (1988Ka14,1986Wa06,1986BuZV,1979Ta17,1979Ik06,1979Bo26,1977Re11,1977BJ02,1976Ya06,1976Sk04) γγ(θ) (1988Ka14,1979Ik06), β, βγ (1986Gr11,1979Ik06,1978St03,1976LoZT).

Level scheme is that of 1988Ka14. TAGS data with a number of pseudolevels with ≈25% β⁻ feeding to them indicates that the level scheme is not complete and has large uncertainties associated with it.

^{148}Nd Levels

E(level)†	Jπ‡	Comments
0.0	0+	
301.703 *16*	2+	
752.21 *13*	4+	J=4 from γγ(θ) (1988Ka14).
916.88 *10*	0+	J=0 from γγ(θ) (1979Ik06,1988Ka14).
999.29 *10*	3–	J=3 from γγ(θ) (1988Ka14); consistent with J=3 from γγ(θ) (1979Ik06).
1023.19 *13*	1–	J=1 from γγ(θ) (1988Ka14); consistent with J=1 from γγ(θ) (1979Ik06).
1170.92 *13*	2+	J=2 from γγ(θ) (1988Ka14); consistent with J=2 from γγ(θ) (1979Ik06).
1248.63 *9*	2+	J=2 from γγ(θ) (1988Ka14).
1511.54 *14*	3+	J=(1,3) from γγ(θ) (1988Ka14).
1515.6 *4*		
1645.58 *25*		J=0 from γγ(θ) (1988Ka14).
1659.91 *6*	2+	J=(2,3) from γγ(θ) (1988Ka14).
1683.3 *4*	4+	J=(3,4) from γγ(θ) (1988Ka14).
2073.67 *16*	2(+)	J=2 from γγ(θ) (1988Ka14).
2182.2 *4*		J=(1–4) from γγ(θ) (1988Ka14).
2236.8 *9*		
2406.01 *20*	2+	
2431.33 *18*	2+	
2545.0 *7*	(1–)	

Continued on next page (footnotes at end of table)

^{148}Pr β⁻ Decay (2.29 min) 1988Ka14,1997Gr09 (continued)

^{148}Nd Levels (continued)

E(level)†	Jπ‡	Comments
2930.63 *22*	(2−)	
3036.8 *9*		
3129.9 *9*		E(level): from 1979Ik06; level not observed by 1988Ka14.

† From a least–squares fit to Eγ data.
‡ Adopted values; supported by γγ(θ) from this data set.

β⁻ radiations

Eβ⁻	E(level)	Iβ⁻†‡§	Log *ft*	Comments
(1742 *15*)	3129.9	0.081 *19*	7.78 *11*	Iβ⁻: 1.23 from TAGS (1997Gr09).
(1835 *15*)	3036.8	1.1 *5*	6.74 *20*	Iβ⁻: 1.45 from TAGS (1997Gr09).
(1941 *15*)	2930.63	4.1 *6*	6.26 *7*	Iβ⁻: 6.43 from TAGS (1997Gr09).
(2327 *15*)	2545.0	0.9 *3*	7.24 *15*	Iβ⁻: 1.24 from TAGS (1997Gr09).
(2441 *15*)	2431.33	3.7 *6*	6.71 *8*	Iβ⁻: 5.26 from TAGS (1997Gr09).
(2466 *15*)	2406.01	1.8 *4*	7.04 *10*	Iβ⁻: 2.48 from TAGS (1997Gr09).
(2635# *15*)	2236.8	0.1 *4*	8.4 *18*	Iβ⁻: 0.75 from TAGS (1997Gr09).
(2690 *15*)	2182.2	0.5 *3*	7.7 *3*	Iβ⁻: 0.75 from TAGS (1997Gr09).
(2798 *15*)	2073.67	5.7 *4*	6.76 *4*	Iβ⁻: 4.72 from TAGS (1997Gr09).
(3189 *15*)	1683.3	2.6 *6*	7.34 *10*	Iβ⁻: 1.55 from TAGS (1997Gr09).
(3212 *15*)	1659.91	8.8 *12*	6.82 *6*	Iβ⁻: 5.27 from TAGS (1997Gr09).
(3226 *15*)	1645.58	0.93 *15*	7.81 *7*	Iβ⁻: 0.54 from TAGS (1997Gr09).
(3356 *15*)	1515.6	1.00 *19*	7.85 *9*	Iβ⁻: 0.32 from TAGS (1997Gr09).
(3360# *15*)	1511.54	0.4 *10*	8.2 *11*	Iβ⁻: 0.143 from TAGS (1997Gr09).
(3623 *15*)	1248.63	4.2 *16*	7.36 *17*	Iβ⁻: 0.30 from TAGS (1997Gr09).
(3701 *15*)	1170.92	2.5 *9*	7.63 *16*	Iβ⁻: 0.51 from TAGS (1997Gr09).
(3849 *15*)	1023.19	4.3 *11*	7.46 *12*	Iβ⁻: 0.36 from TAGS (1997Gr09). Eβ⁻: 3000 *250* (1976LoZT).
(3873 *15*)	999.29	4.2 *9*	7.49 *10*	Iβ⁻: 0.29 from TAGS (1997Gr09).
(3955 *15*)	916.88	1.9 *4*	7.87 *10*	Iβ⁻: 0.96 from TAGS (1997Gr09).
(4120 *15*)	752.21	1.3 *6*	8.11 *20*	Iβ⁻: 0.0 from TAGS (1997Gr09).
4500 *200*	301.703	27.6 *23*	6.98 *4*	Iβ⁻: 18.22 from TAGS (1997Gr09). Eβ⁻: 3630 *200* (1976LoZT).
4800 *200*	0.0	21.9 *15*	7.20 *3*	Eβ⁻: from 1979Ik06. Other: 5010 *120* (1978St03); see 1986Gr11. Iβ⁻: from TAGS (1997Gr09).

† From I(γ+ce) imbalance at each level, unless indicated otherwise.
‡ TAGS analysis gives the following pseudolevels and associated Iβ (in %) in addition to the discrete levels listed. 2650 keV 1.18; 2750 keV 1.39; 2850 keV 0.80; 3200 keV 0.70; 3300 keV 0.80; 3400 keV 1.39; 3500 keV 1.61; 3600 keV 0.86; 3700 keV 0.75; 3800 keV 1.29; 3900 keV 2.04; 4000 keV 4.82; 4100 keV 4.50; 4200 keV 1.82; 4300 keV 0.96; 4400 keV 0.32; 4500 keV 0.064; 4600 keV 0.032; 4700 keV 0.011. The TAGS spectrum is estimated to have ≈1.5% uncorrected contamination of ^{148}Pr(2.0 min). Since the resolution of the TAGS system is typically 50–100 keV, the intensity assigned to a pseudolevel may represent β⁻ feeding to a single level or a group of levels. The same limitation applies to the intensity assigned to a known level, since it could include feeding to known or unknown levels in the resolution energy range.
§ Absolute intensity per 100 decays.
# Existence of this branch is questionable.

γ(^{148}Nd)

Iγ normalization: ΣI(γ+ce) and g.s. β⁻ feeding of 21.9% *15* from TAGS analysis (1997Gr09). The uncertainty in Iγ normalization does not include that due to an incomplete decay scheme as indicated by ≈25% β⁻ feeding to the pseudolevels observed in the TAGS measurements.

Eγ§	E(level)	Iγ§#	Mult.†	α	Comments
247.4 *3*	999.29	1.3 *5*			
301.702 *16*	301.703	100	E2	0.0515	Mult.: from γγ(θ) (1979Ik06). Eγ: from 1979Bo26.
418.7 *1*	1170.92	0.3 *2*			Eγ,Iγ: also seen in 1986Wa06.
450.8 *3*	752.21	4.7 *7*	E2	0.01564	
492.4 *3*	1515.6	1.6 *3*			

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^{148}Pr β⁻ Decay (2.29 min) 1988Ka14,1997Gr09 (continued)

γ(^{148}Nd) (continued)

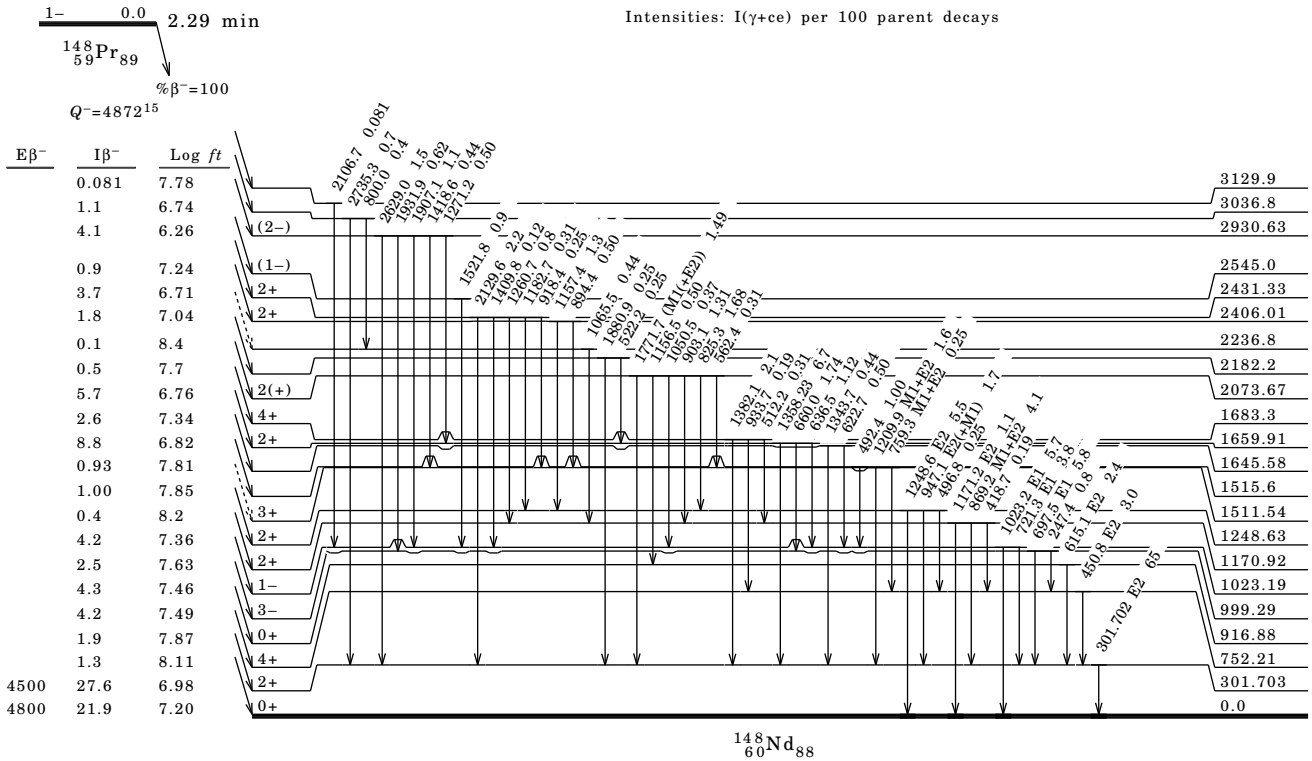
Eγ§	E(level)	Iγ§#	Mult.†	Comments
496.8 *6*	1248.63	0.4 *3*		
512.2 *4*	1683.3	0.5 *3*		
522.2 *4*	2182.2	0.4 *1*		
562.4 *2*	2073.67	0.5 *1*		
615.1 *1*	916.88	3.9 *6*	E2	
622.7 *4*	1645.58	0.8 *2*		
636.5 *3*	1659.91	1.8 *3*		
660.0 *3*	1659.91	2.8 *3*		
697.5 *1*	999.29	9.3 *11*	E1	δ(Q/D)=+0.08 *77* (1988Ka14).
721.3 *3*	1023.19	6.1 *10*	E1	δ(Q/D)=+0.04 *+70–60* (1988Ka14).
759.3 *3*	1511.54	0.4 *1*	M1+E2	δ: +0.035 *15* or +5.0 *+15–22*.
800.0 *1*	3036.8	0.6 *5*		
825.3 *9*	2073.67	2.7 *2*		
869.2 *2*	1170.92	6.6 *10*	M1+E2	δ†: +8 *+12–2*.
894.4 *4*	2406.01	0.8 *1*		
903.1 *7*	2073.67	2.1 *3*		
918.4 *6*	2431.33	0.4 *3*		
933.7 *24*	1683.3	0.3 *1*		
947.1 *3*	1248.63	2.8 *5*	E2(+M1)	δ: >+100 or <–9.
x999.0 *5*		0.7 *4*		
1023.2 *2*	1023.19	9.1 *10*	E1	
1050.5 *7*	2073.67	0.6 *1*		
1065.5 *13*	2236.8	0.7 *3*		
1156.5 *2*	2073.67	0.8 *2*		
1157.4 *2*	2406.01	2.1 *6*		
1171.2 *3*	1170.92	1.7 *5*	E2	
1182.7 *2*	2431.33	0.5 *1*		
1209.9 *2*	1511.54	2.6 *14*	M1+E2	δ: >400, <–28 or 0.20 *4*.
1248.6 *1*	1248.63	8.8 *24*	E2	
1260.7 *4*	2431.33	1.3 *5*		
1271.2 *5*	2930.63	0.8 *2*		
1343.7 *3*	1645.58	0.7 *1*		
1358.23 *5*	1659.91	10.7 *18*		
1382.1 *10*	1683.3	3.4 *8*		
1409.8 *9*	2431.33	0.2 *2*		
1418.6 *7*	2930.63	0.7 *3*		
1521.8 *6*	2545.0	1.4 *4*		
x1658.5 *12*		0.6 *4*		
x1682.8 *10*		0.7 *3*		
1771.7 *6*	2073.67	2.4 *2*	(M1(+E2))	δ†: –0.03‡ *+25–28*.
1880.9 *7*	2182.2	0.4 *4*		
1907.1 *3*	2930.63	1.7 *5*		
1931.9 *5*	2930.63	1.0 *4*		
2106.7 *8*	3129.9	0.13 *3*		Eγ,Iγ: from 1979Ik06; γ not observed by 1988Ka14. 1979Ik06 also place a 2130.37γ 20 depopulating this level. 1988Ka14; however, show a 2129.6γ 5 depopulating the 2431.7 level.
2129.6 *5*	2431.33	3.6 *6*		
x2141.8 *10*		0.6 *4*		
x2222.5 *10*		0.6 *5*		
2629.0 *6*	2930.63	2.4 *6*		
2735.3 *11*	3036.8	1.2 *5*		
x2982.6 *5*		1.0 *2*		

† From adopted gammas; supported by γγ(θ) from this data set.
‡ From γγ(θ) (1988Ka14).
§ From 1988Ka14.
# For absolute intensity per 100 decays, multiply by 0.622 *18*.
x γ ray not placed in level scheme.

^{148}Pr β⁻ Decay (2.29 min) 1988Ka14,1997Gr09 (continued)

Decay Scheme

Intensities: I(γ+ce) per 100 parent decays



^{148}Pr β⁻ Decay (2.01 min) 1979Ik06,1986Wa06

Parent ^{148}Pr: E=76.8 *2*; Jπ=4−; $T_{1/2}$=2.01 min *7*; Q(g.s.)=4872 *15*; %β⁻ decay=64 *10*.

Measured: γ, γγ (1979Ik06,1986Wa06,1984Ch30,1976Ya06); %β⁻ of the parent (2004Ko05,2008KoZO).

1997Gr09,1996Gr20: total absorption γ–ray spectrometer (TAGS) system used to measure β⁻ decay intensities, and the g.s. β⁻ feeding when operated in the 4πγ–β coin mode.

Level scheme is that of 1979Ik06 with some modifications indicated by 1986Wa06 and 1982DeYW. TAGS data with a number of pseudolevels with ≈69% β⁻ feeding to them indicates that the level scheme is not complete and has large uncertainties associated with it.

^{148}Nd Levels

E(level)†	Jπ‡	Comments
0.0	0+	
301.702 *16*	2+	
752.4 *3*	4+	
999.23 *12*	3−	
1242.1 *4*	5−	E(level): not observed by 1979Ik06; supported by 1986Wa06 data.
1279	6+	
1687.4 *7*	(3,4,5)+	
1858.5 *4*	(2+,3)	

† From a least–squares fit to Eγ data (level 1279 was held fixed).

‡ Adopted values.

^{148}Pr β⁻ Decay (2.01 min) 1979Ik06,1986Wa06 (continued)

β⁻ radiations

β–feeding was determined assuming no ground–state β decay.

Eβ⁻	E(level)	Iβ⁻†‡	Log *ft*
(3090 *15*)	1858.5	9.0 *9*	6.69 *9*
(3261 *15*)	1687.4	1.6 *2*	7.53 *9*
(3950 *15*)	999.23	42 *5*	6.47 *9*
(4196 *15*)	752.4	43 *5*	6.57 *9*

† From I(γ+ce) balance at each level.

‡ TAGS analysis gives the following pseudolevels and associated Iβ (in %) in addition to the discrete levels listed. 1600 keV 0.9; 1950 keV 1.6; 2050 keV 2.7; 2150 keV 2.1; 2250 keV 2.1; 2400 keV 20.3; 2500 keV 5.2; 2600 keV 1.2; 2700 keV 1.7; 2800 keV 3.5; 2900 keV 3.6; 3000 keV 1.3; 3100 keV 1.0; 3200 keV 1.9; 3300 keV 1.9; 3400 keV 1.6; 3500 keV 0.6; 3600 keV 0.6; 3700 keV 1.0; 3800 keV 1.3; 3900 keV 3.0; 4000 keV 3.0; 4100 keV 3.0; 4200 keV 0.6; 4300 keV 1.3; 4400 keV 0.6; 4500 keV 0.3; 4600 keV 0.16. A simultaneous analysis of the spectra of both ^{148}Ce and ^{148}Pr 2.0 min decay was done, and the authors feel that in the energy range from ≈750 keV to ≈1300 keV, there is some ambiguity in the final results because of overlapping peaks. TAGS analysis indicates that transitions to the pseudolevels above 1859 keV account for ≈68% of β⁻ intensity in this decay. Since the resolution of the TAGS system is typically 50–100 keV, the intensity assigned to a pseudolevel may represent β⁻ feeding to a single level or a group of levels. The same limitation applies to the intensity assigned to a known level, since it could include feeding to known or unknown levels in the resolution energy range.

γ(^{148}Nd)

For some gammas part of the observed Iγ may belong to 2.27–min ^{148}Pr β⁻ decay.

For possible additional γ's see ^{148}Pr β⁻ decay (2.29 min).

Iγ normalization: ΣI(γ+ce)(g.s.)=100 (assuming no β⁻ to 0+ g.s. from parent). The uncertainty in Iγ normalization does not include that due to an incomplete decay scheme as indicated by ≈69% β⁻ feeding to the pseudolevels observed in the TAGS measurements.

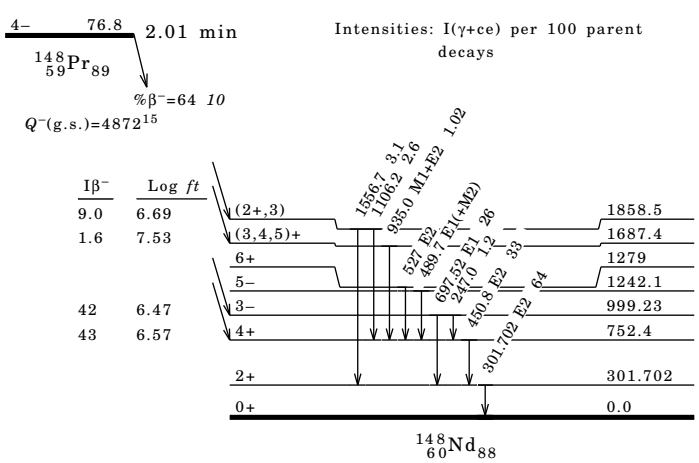
Eγ†	E(level)	Iγ‡§	Mult.	δ	α	Comments
247.0 *10*	999.23	3.6 *5*				
301.702 *16*	301.702	190 *15*	E2		0.0515	Eγ: from 1979Bo26.
450.8 *3*	752.4	100 *7*	E2		0.01564	
489.7 *3*	1242.1		E1(+M2)	+0.03 *2*		Eγ: from 1979Ta17; placement supported by the data of 1986Wa06 and 1982DeYW.
527	1279		E2		0.01023	Eγ: from 1986Wa06; 1979Ik06 observe a level at 1275.0 keV depopulated by 522.
697.52 *12*	999.23	80 *7*	E1			
935.0 *6*	1687.4	3.2 *2*	M1+E2			δ: −0.53 *+8−10* or +3.0 *5*.
1106.2 *5*	1858.5	8.2 *7*				
1556.7 *4*	1858.5	9.8 *8*				

† From 1979Ik06, unless indicated otherwise.

‡ Relative intensity (1979Ik06).

§ For absolute intensity per 100 decays, multiply by 0.32 *6*.

Decay Scheme



^{146}Nd(t,p) 1972Ch11

E=12.72 MeV, FWHM≈20 keV.
Measured: σ(E,θ).

^{148}Nd Levels

E(level)	L	σ(max)†	E(level)	σ(max)†	E(level)	σ(max)†
0.0	0	100	1677 *15*	15	2086 *20*	10
299 *15*	(2)	46	1720 *15*	15	2188 *20*	5
911 *15*	0	15	1813 *20*	11	2251 *15*	23
993 *15*		10	1869 *20*	10		
1165 *15*		30	2033 *20*	8		

† σ(max) in arbitrary units.

^{148}Nd(γ,γ′) 1990Pi04,1993Ma08

1990Pi04: Eγ(max)=4.1 MeV; measured Eγ, Iγ, σ(θ).
1993Ma08: Eγ(max)=4.1 MeV; measured Eγ, Iγ.

^{148}Nd Levels

All B(M1) are from 1993Ma08.

E(level)†	Jπ#	$T_{1/2}$&	$\Gamma_{\gamma0}$ (meV)@	Comments
0.0	0+			
(302)	2+			
1023 *1*	1−		5.3 *24*	
2153‡ *1*	(1,2+)	0.6 ps *4*	0.7 *4*	$\Gamma_{\gamma0}/\Gamma$=100% *30*.
2376 *1*	1		4.8 *10*	B(M1)↑=0.09 *2*. J=1.
2481‡ *1*	1	0.14 ps *4*	3.2 *8*	$\Gamma_{\gamma0}/\Gamma$=100% *20*.
2544‡ *1*	(1−)	0.25 ps *10*	1.8 *6*	$\Gamma_{\gamma0}/\Gamma$=100% *20*.
2689‡ *1*	1	86 fs *22*	5.3 *11*	$\Gamma_{\gamma0}/\Gamma$=100% *15*.
2730 *1*	(1)		5.2 *15*	
2736‡ *1*	1	0.12 ps *7*	3.8 *19*	$\Gamma_{\gamma0}/\Gamma$=100% *30*.
2795‡ *1*	(1,2+)	0.25 ps *10*	1.8 *6*	$\Gamma_{\gamma0}/\Gamma$=100% *20*.
2839‡ *1*	1	0.08 ps *3*	5.5 *16*	$\Gamma_{\gamma0}/\Gamma$=100% *15*.
2845‡ *1*	(1)	0.27 ps *18*	1.7 *10*	$\Gamma_{\gamma0}/\Gamma$=100% *30*.
2920‡ *1*	1	0.08 ps *3*	5.8 *17*	$\Gamma_{\gamma0}/\Gamma$=100% *20*.
2923 *1*	1		8.0 *21*	B(M1)↑=0.08 *2*. J=1.
2982‡ *1*	1	27 fs *11*	17 *6*	$\Gamma_{\gamma0}/\Gamma$=100% *20*.
3002‡ *1*	(1,2+)	0.12 ps *6*	3.9 *18*	$\Gamma_{\gamma0}/\Gamma$=100% *30*.
3092 *1*	1		30 *5*	
3113‡§ *1*	1	0.11 ps *3*	4.0 *10*	$\Gamma_{\gamma0}/\Gamma$=100% *15*.
3136‡ *1*	1	54 fs *15*	8.4 *20*	$\Gamma_{\gamma0}/\Gamma$=100% *15*.
3176‡ *1*	(1)	57 fs *23*	8 *3*	$\Gamma_{\gamma0}/\Gamma$=100% *15*.
3191‡ *1*	(1)	0.13 ps *4*	3.6 *10*	$\Gamma_{\gamma0}/\Gamma$=100% *15*.
3205‡ *1*	(1,2+)	0.16 ps *9*	2.8 *15*	$\Gamma_{\gamma0}/\Gamma$=100% *20*.
3215 *1*	1		17 *3*	B(M1)↑=0.13 *2*. J=1.
3265‡ *1*	1	0.11 ps *4*	4.3 *16*	$\Gamma_{\gamma0}/\Gamma$=100% *20*.
3281‡ *1*	(1,2+)	0.21 ps *15*	2.2 *15*	$\Gamma_{\gamma0}/\Gamma$=100% *30*.
3341 *1*	1		29 *5*	B(M1)↑=0.20 *4*. J=1.
3370 *1*	1		8.4 *22*	B(M1)↑=0.06 *2*. J=1.
3378 *1*	1		9 *3*	
3405 *1*	1		11 *3*	B(M1)↑=0.07 *2*. J=1.
3415 *1*	1		10 *9*	
3490‡§ *1*	(1)	71 fs *23*	6.4 *18*	$\Gamma_{\gamma0}/\Gamma$=100% *15*.

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^{148}Nd(γ,γ') 1990Pi04,1993Ma08 (continued)

^{148}Nd Levels (continued)

E(level)†	Jπ#	$T_{1/2}$&	$\Gamma_{\gamma0}$ (meV)@	Comments
3528 *1*	(1,2+)		7.3 *24*	B(M1)↑=0.04 *1*. J=(1,2+) (1990Pi04).
3545 *1*	1		11 *3*	B(M1)↑=0.06 *2*. J=1.
3597 *1*	(1)		12 *4*	B(M1)↑=0.07 *2*. J=(1).
3689‡ *1*	1	11 fs *3*	40 *9*	$\Gamma_{\gamma0}/\Gamma$=100% *15*.
3717 *1*	(1)		14 *4*	B(M1)↑=0.07 *2*. J=(1).
3755‡ *1*	(1)	0.07 ps *3*	6.2 *24*	$\Gamma_{\gamma0}/\Gamma$=100% *20*.
3771‡ *1*	(1)	57 fs *24*	8 *3*	$\Gamma_{\gamma0}/\Gamma$=100% *20*.
3793‡§ *1*	1		9 *3*	$\Gamma_{\gamma0}/\Gamma$=100% *20* with $\Gamma_{\gamma0}$=9 meV 3; or, $\Gamma_{\gamma0}/\Gamma$=66% *20* with $\Gamma_{\gamma0}$=14 meV 6 (see the comment on the 3717 gamma). These correspond to $T_{1/2}$=51 fs *20* and 33 fs *17*, respectively.
3805‡ *1*	1	35 fs *13*	13 *4*	$\Gamma_{\gamma0}/\Gamma$=100% *20*.
3826‡ *1*	(1,2+)	57 fs *24*	8 *3*	$\Gamma_{\gamma0}/\Gamma$=100% *20*.
3861 *1*	1		56 *12*	B(M1)↑=0.25 *5*. J=1.

† From 1990Pi04.
‡ Levels with no detectable branching to other levels.
§ Decay properties of this level uncertain; there could be possible branching to the first excited 2+ level.
# From adopted levels; supported by σ(θ) from this data set. These assignments are given in comments.
@ Calculated for pure dipole radiation using the experimental branching ratio to the first excited 2+ state given in comments.
& From $\Gamma_{\gamma0}/\Gamma$ and $\Gamma_{\gamma0}$.

γ(^{148}Nd)

E(level)	Eγ†	Iγ‡
1023	721 *1*	81 *30*
	1023 *1*	100
2153	2153 *1*	100
2376	2074 *1*	65 *20*
	2376 *1*	100
2481	2481 *1*	100
2544	2544 *1*	100
2689	2689 *1*	100
2730	2428 *1*	91 *26*
	2730 *1*	100
2736	2736 *1*	100
2795	2795 *1*	100
2839	2839 *1*	100
2845	2845 *1*	100
2920	2920 *1*	100
2923	2621 *1*	61 *18*
	2923 *1*	100
2982	2982 *1*	100
3002	3002 *1*	100
3092	2790 *1*	80 *6*
	3092 *1*	100
3113	3113 *1*	100
3136	3136 *1*	100
3176	3176 *1*	100
3191	3191 *1*	100
3205	3205 *1*	100
3215	2913 *1*	24 *9*
	3215 *1*	100
3265	3265 *1*	100
3281	3281 *1*	100
3341	3039 *1*	45 *10*
	3341 *1*	100
3370	3068 *1*	53 *19*
	3370 *1*	100
3378	3076 *1*	77 *23*
	3378 *1*	100
3405	3103 *1*	51 *14*
	3405 *1*	100
3415	3113 *1*	100
	3415 *1*	52 *31*
3490	3490 *1*	100
3528	3226 *1*	61 *28*
	3528 *1*	100
3545	3243 *1*	52 *31*
	3545 *1*	100
3597	3295 *1*	56 *24*
	3597 *1*	100
3689	3689 *1*	100
3717	3415 *1*	

Continued on next page (footnotes at end of table)

^{148}Nd(γ,γ') 1990Pi04,1993Ma08 (continued)

γ(^{148}Nd) (continued)

E(level)	Eγ†	Iγ‡	Comments
3717	3717 *1*		Iγ(3415)/Iγ(3717)=0.5 *4*, and $\Gamma_{\gamma 0}$=14 meV 4 assuming two separate levels at 3717 and 3415 with a branching to the first excited 2+ level; or Iγ(3415)/Iγ(3717)=1.5 *3*, and $\Gamma_{\gamma 0}$=22 meV 6 assuming one level at 3717 with branching to the first excited 2+ level and a level at 3113 without such branching.
3755	3755 *1*	100	
3771	3771 *1*	100	
3793	3793 *1*	100	
3805	3805 *1*	100	
3826	3826 *1*	100	
3861	3559 *1*	15 *6*	
	3861 *1*	100	

† Deduced from level energies.
‡ Relative photon branching from each level obtained from the branching ratios (1990Pi04) which have a $(E\gamma_0/E\gamma_2)^3$ factor in their definition.

^{148}Nd(n,n'γ) 1984GoZQ,1982DeYW

Fast reactor neutrons.
Measured: γ, γ(θ) (1982DeYW), linear pol of γ (1984GoZQ).

^{148}Nd Levels

E(level)	Jπ†	Comments
0.0	0+	
301.60 *7*	2+	
752.18 *10*	4+	
916.81 *11*	0+	
999.21 *10*	3−	
1023.12 *7*	1−	
1170.90 *10*	2+	
1242.14 *13*	5−	J=5, or (3) with J=5 preferred.
1248.81 *8*	2+	
1279.69 *14*	6+	J=6.
1511.51 *11*	3+	J=3.
1521.46 *18*	1	J=1.
1645.4 *2*		J=1,2.
1659.6 *2*	2+	J=2.
1683.3 *2*	4+	J=1−3.
1687.91 *14*	(3,4,5)+	J=3,4.
1729.0 *2*	3+	J=2,3.
1808.6 *4*		
1824.4		J=2−4.
1858.6 *3*	(2+,3)	J=3.

† Adopted values; supported by γ(θ) and linear−polarization data from this data set. J assignments by 1982DeYW are given in comments.

γ(^{148}Nd)

Eγ†	E(level)	Iγ‡	Mult.	δ	Comments
246.2 *2*	999.21	0.68 *7*			
297.5 *3*	1808.6	1.0 *3*			
301.60 *7*	301.60	113 *10*			
418.2 *4*	1170.90	0.20 *9*			
450.58 *7*	752.18	24.7 *15*			
489.96 *8*	1242.14	4.5 *4*	E1(+M2)§	+0.03 *2*	Mult.: A_2=−0.20 *4*, A_4=+0.04 *5*; lin pol=2.35 *19*.

Continued on next page (footnotes at end of table)

^{148}Nd(n,n'γ) 1984GoZQ,1982DeYW (continued)

γ(^{148}Nd) (continued)

Eγ†	E(level)	Iγ‡	Mult.	δ	Comments
527.51 *10*	1279.69	2.8 *2*	E2§		α: 0.0103. Mult.: lin pol=3.4 *9*.
605.2 *3*	1521.46	0.48 *10*			
615.21 *8*	916.81	4.6 *4*			
637.3 *7*	1808.6	0.47 *16*			
660.0 *5*	1659.6	0.51 *15*			
697.61 *7*	999.21	11.3 *8*			
721.43 *8*	1023.12	4.3 *4*			
759.32 *18*	1511.51	0.62 *7*	M1+E2§		Mult.: A_2=−0.28 *9*, A_4=+0.07 *11*; lin pol=0.7 *3*. δ: +0.35 *15* or +5.0 *+15−22*.
825.23 *15*	1824.4	0.70 *12*			Mult.: A_2=−0.31 *9*, A_4=+.06 *11*; lin pol=1.7 *6*.
869.23 *7*	1170.90	7.1 *6*	M1+E2§	+8 *+12−2*	Mult.: A_2=+0.01 *4*, A_4=+0.02 *5*; lin pol=0.75 *7*.
x912					Mult.: A_2=−0.16 *13*, A_4=+0.01 *14*; lin pol=0.73.
935.83 *10*	1687.91	1.85 *14*	M1+E2§		Mult.: A_2=+0.01 *4*, A_4=−0.03 *6*; lin pol=0.58 *14*. δ: −0.53 *+8−10* or +3.0 *5*.
947.09 *10*	1248.81	2.2 *2*	M1+E2§		Mult.: A_2=−0.06 *4*, A_4=+0.01 *4*; lin pol=0.95 *14*. δ: >+100, <−9.
976.8 *2*	1729.0	0.67 *11*	(M1(+E2))#	+0.00 *+13−14*	Mult.: A_2=−0.08 *10*, A_4=+0.03 *12*.
1023.18 *7*	1023.12	6.0 *4*			
1071.9 *7*	1824.4	0.28 *10*			
1106.0 *10*	1858.6	0.4 *2*			
1171.06 *15*	1170.90	1.27 *12*			
1209.92 *8*	1511.51	2.74 *18*	M1+E2§		Mult.,δ: A_2=+0.05 *5*, A_4=+0.06 *6*; lin pol=1.7 *4*; δ>+100, <−28 or +0.20 *4*.
1248.89 *8*	1248.81	5.0 *3*			
1343.8 *2*	1645.4	1.40 *18*			Mult.: A_2=+0.09 *6*, A_4=+0.04 *7*.
1358.0 *2*	1659.6	1.28 *15*	(M1(+E2))#		Mult.,δ: A_2=+0.22 *6*, A_4=+0.00 *7*; δ=+0.02 *2* or +2.2 *+5−4*.
1381.7 *2*	1683.3	1.06 *14*			Mult.: A_2=+0.09 *5*, A_4=+0.00 *5*.
1386.1 *5*	1687.91	0.16 *6*			
1427.4 *2*	1729.0	0.81 *12*	M1+E2§	+0.37 *5*	Mult.: A_2=+0.20 *5*, A_4=+0.02 *6*; lin pol=0.6 *3*.
1521.46 *18*	1521.46	1.1 *1*			Mult.: A_2=+0.13 *7*, A_4=+0.01 *8*.
1557.0 *3*	1858.6	0.69 *17*	(M1+E2)#		Mult.: A_2=−0.52 *10*, A_4=+0.07 *11*; −1.9<δ<−0.26.
1645.6 *10*	1645.4	0.26 *9*			

† 73 more γ's were observed. Eγ's are not given (1982DeYW).
‡ Iγ(125°) in relative units.
§ From γ(θ) and linear−polarization data (1984GoZQ).
# From γ(θ) and ΔJπ.
x γ ray not placed in level scheme.

^{148}Nd(p,p') 1993Pi06

1993Pi06: E=30.5 MeV, FWHM=12−15 keV; measured σ(θ), coupled−channel analysis.
1993Co03: E=26 MeV, FWHM≈50 keV; measured σ(θ), coupled−channel analysis.
See 1993Pi06 for the level coupling parameters deduced from the coupled−channel analysis.

^{148}Nd Levels

Given in table comments are the coupling parameters β_λ (1993Pi06).

E(level)†	Jπ‡	Comments
0.0	0+	
303 *2*	2+	0.1980.
752 *2*	4+	0.0539.
920 *2*	0+	0.0036.
998 *2*	3−	0.1420.
1022 *2*	1−	0.0110.
1171 *2*	2+	0.0209.
1242§	5−	
1244 *2*	2+	0.0460.

Continued on next page (footnotes at end of table)

^{148}Nd(p,p') 1993Pi06 (continued)

^{148}Nd Levels (continued)

E(level)†	Jπ‡	Comments
1400 *2*	(0+,1−)	
1432 *2*	(0+,1−)	
1475 *2*	(1−)	0.0020.
1577 *2*	2+	0.0113.
1602 *2*	4+	0.0144.
1654 *2*	(3−)	0.0170.
1685 *2*	4+	0.0630.
1725 *2*	3−	0.0696.
1778 *2*	(3−)	0.0089.
1837 *2*	(1−)	0.0036.
1887 *2*	4+	0.0310.
2034 *2*	3−	0.0348.
2098 *2*	4+	0.0414.
2145 *2*	4+	0.0122.
2197 *2*	5−	0.0333.
2257 *4*	(2+)	0.0171.
2286 *4*	(3−)	0.0121.
2341 *4*	3−	0.0187.
2388 *4*	4+	0.0242.
2429 *4*	2+	0.0163.
2484 *4*	3−	0.0125.
2544 *4*	(1−)	0.0025.
2590 *4*	4+	0.0280.
2642 *4*	4+	0.0110.
2682 *4*	0+	0.0039.
2709 *4*	4+	0.0187.
2770 *4*	4+	0.0190.
2807 *4*	3−	0.0123.
2871 *4*	(3−)	0.0153.
2913 *4*	4+	0.0216.
2961 *4*	4+	0.0159.
3022 *4*	4+	0.0200.
3068 *4*	(3−)	0.0089.
3096 *4*	(1−)	0.0019.
3142 *4*	4+	0.0241.
3191 *4*	4+	0.0163.
3241 *4*	4+	0.0214.

† From combined (p,p') and (d,d') data (1993Pi06).
‡ From coupled–channel analysis of σ(θ) in (p,p') and (d,d') (1993Pi06).
§ Observed by 1993Co03 who analyzed their data using coupled–channel calculations to obtain Jπ and a coupling constant β_5=0.046 *3*. These authors ascribe this state to the coupling of 302 keV Jπ=2+, and the 999 keV Jπ=3− states by octupole coupling or by direct excitation. Not observed by 1993Pi06 with a higher resolution.

^{148}Nd(d,d') 1993Pi06

1993Pi06: E=30.5 MeV, FWHM=12–15 keV; measured σ(θ), coupled–channel analysis.
See 1993Pi06 for the level coupling parameters deduced from the coupled–channel analysis.

^{148}Nd Levels

Given in table comments are the coupling parameters β_λ (1993Pi06).

E(level)†	Jπ‡	Comments
0.0	0+	
303 *2*	2+	0.1970.
752 *2*	4+	0.0490.
920 *2*	0+	0.0044.
998 *2*	3−	0.1260.
1022 *2*	1−	

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^{148}Nd(d,d') 1993Pi06 (continued)

^{148}Nd Levels (continued)

E(level)†	Jπ‡	Comments
1171 *2*	2+	0.0193.
1244 *2*	2+	0.0460.
1400 *2*	(0+,1−)	
1432 *2*	(0+,1−)	
1475 *2*	(1−)	
1577 *2*	2+	0.0111.
1602 *2*	4+	0.0128.
1654 *2*	(3−)	0.0167.
1685 *2*	4+	0.0552.
1725 *2*	3−	0.0597.
1778 *2*	(3−)	0.0083.
1837 *2*	(1−)	0.0036.
1887 *2*	4+	0.0296.
2034 *2*	3−	0.0323.
2098 *2*	4+	0.0349.
2145 *2*	4+	
2197 *2*	5−	0.0300.
2257 *4*	(2+)	0.0163.
2286 *4*	(3−)	0.0101.
2341 *4*	3−	0.0158.
2388 *4*	4+	0.0157.
2429 *4*	2+	0.0171.
2484 *4*	3−	0.0115.
2544 *4*	(1−)	0.0026.
2590 *4*	4+	0.0221.
2642 *4*	4+	
2682 *4*	0+	0.0039.
2709 *4*	4+	0.0179.
2770 *4*	4+	0.0174.
2807 *4*	3−	0.0129.
2871 *4*	(3−)	0.0137.
2913 *4*	4+	0.0189.
2961 *4*	4+	0.0137.
3022 *4*	4+	0.0139.
3068 *4*	(3−)	
3096 *4*	(1−)	
3142 *4*	4+	0.0171.
3191 *4*	4+	0.0126.
3241 *4*	4+	0.0150.

† From combined (p,p') and (d,d') data (1993Pi06).
‡ From coupled–channel analysis of σ(θ) in (p,p') and (d,d') (1993Pi06).

Coulomb Excitation 1997Ib01,1993Ib01,1991Ib01

1997Ib01,1993Ib01,1991Ib01: Coulomb excitation with ^{58}Ni, ^{92}Mo, and a beam of ^{148}Nd ions on a ^{208}Pb target. Measured Eγ, Iγ, $T_{1/2}$ by recoil–distance method (RDM), extracted E1, E2, and E3 matrix elements from the observed γ yields and level lifetimes including experimental corrections.

The level scheme is from 1997Ib01.

E(α)=6–9 MeV (1970Ge08), see 1986Sc30, 1980FaZW, E(^{16}O)=50–60 MeV (1967BuZX), 35 MeV (1972Ku10), 54–67 MeV (2003Na39), E(^{80}Se)=310 MeV (1988BuZX). Others: 1966Ec02, 1971Cr01, 1978FaZP, 1978Ka36.

Measured: γ, γγ, (K x ray)γ (1967BuZW,1967BuZX,1988BuZX), γ (1966Ec02,1978FaZP), σ(E) in ^{148}Nd(x,x') (1971Cr01,1978FaZP), B(E4)↑, β_4 (2003Na39), g–factor (2001Ho02,2000Ho25,1990St18,1987Be08,1978KA36,.

Coulomb Excitation 1997Ib01,1993Ib01,1991Ib01 (continued)

^{148}Nd Levels

E(level)	Jπ†	$T_{1/2}$‡	Comments
0.0§	0+		β_4=0.07 *2* (2003Na39).
301.7§	2+	80 ps *3*	B(E2)=1.37 *2*, unweighted average of: 1.30 *6* (1997Ib01), 1.36 *3* (1971Cr01), 1.39 *2* (1988Ah01), 1.42 *5* (1980FaZW), 1.39 *2* (1986Sc30). Others: 0.96 *3* (1966Ec02), 0.95 *15* (1967BuZW). $T_{1/2}$: 2003Na39 give 78.00 ps with no uncertainty. g=+0.357 *8* (2001Ho02). g: others: +0.363 *16* (2005Ho25, superseded by 2001Ho02), +0.35 *2* (1990St18), +0.41 *4* (1987Be08), +0.32 *4* (1978Ka36), +0.43 *7* (1972Ku10), +0.48 *4* (1970Be36), +0.50 *4* (1968Be42), +0.56 *12* (1967Be08). Q=−0.67 *11* (1978FaZP). Others: −1.36 *30* (1971Cr01), −1.46 *13* (1970Ge08).
752.2§	4+	6.9 ps *3*	g=+0.360 *25* (2001Ho02). B(E4)↑=0.16 *5* (2003Na39). B(E2)(2+$_1$ → 4+$_1$)=0.80 *3* (1997Ib01), 0.768 *24* (1980FaZW). Other: 0.81 (1967BuZX). Jπ: from αγ(θ) (1963Ha20). $T_{1/2}$: 2003Na39 give 7.03 ps with no uncertainty.
916.8@	0+	4.4 ps *3*	B(E2)(2+$_1$ → 0+$_2$)=0.025 *1* (1997Ib01), 0.039 *7* (1980FaZW) B(E2)(2+ to 0+)=0.039 *7* (1980FaZW).
999.2#	3−		Jπ: from αγ(θ) (1963Ha20). B(E3)↑=0.32 *2* (1997Ib01), 0.40 *8* (1988Ah01), 0.13 *4* (1967BuZX).
1023.1#	1−		B(E1)↑=0.010 *+2−1* (1997Ib01), 0.014 *6* (1990Pi04, as quoted by 1997Ib01). B(E1)(2+$_1$ → 1−)=0.0036 *+5−13* (1997Ib01), 0.006 *5* (1990Pi04, as quoted by 1997Ib01).
1170.9@	2+	1.4 ps *1*	B(E2)(2+$_1$ → 2+$_2$)=0.085 *5* (1997Ib01), 0.12 *2* (1980FaZW). B(E2)(0+$_1$ → 2+$_2$)=0.015 *1* (1997Ib01), 0.020 *3* (1980FaZW).
1242#	5−	1.0 ps *1*	
1248.8&	2+	1.4 ps *2*	B(E2)↑=0.073 *3* (1997Ib01), 0.084 *12* (1980FaZW). B(E2)(2+$_1$ → 2+$_3$)=0.026 *1* (1997Ib01), 0.026 *6* (1980FaZW).
1279.7§	6+	2.9 ps *2*	g=+0.27 *5* (2001Ho02).
1514&	3+		
1604@	4+		
1645#	7−	1.0 ps *2*	
1687&	4+		
1857§	8+	1.4 ps *2*	
2099&	6+		
2132#	9−		
2149@	6+		
2472§	(10+)		
2677#	(11−)		
2726@	8+		
3107§	(12+)		
3265#	(13−)		

† Adopted values.
‡ From RDM (1991Ib01).
§ (A): g.s. band.
# (B): Negative−parity band.
@ (C): β−vibrational band.
& (D): γ−vibrational band.

γ(^{148}Nd)

Eγ†	E(level)	Mult.	α	Eγ†	E(level)	Eγ†	E(level)
205	2677			576	1857	907	2149
247.0	999.2			588	3265	934.8	1687
275	2132			604.8	1604	947.1	1248.8
301.7	301.7			615	2472	1023.1	1023.1
365.3	1645			615.1	916.8	1170.9	1170.9
403	1645			635	3107	1212.3	1514
450.5	752.2	E2	0.0158	697.5	999.2	1248.8	1248.8
487	2132			721.4	1023.1	1302.3	1604
489.8	1242			761.8	1514	1346.8	2099
496.6	1248.8			819.3	2099	1385.3	1687
504	2149			851.8	1604	1396.8	2149
528	1279.7			869.2	1170.9	1446.3	2726
545	2677			869.3	2149		

† As read from the energy level diagram in 1997Ib01.

^{150}Nd(p,t) 1972Ya07,1971BaZA

E=52.1 MeV FWHM≈80 keV (1972Ya07); measured σ(θ), DWBA and coupled channel Born approximation (CCBA) analysis.
Others: 1971Ya11, 1966Ma30.

^{148}Nd Levels

E(level)	L	E(level)	L
0.0	0	≈1600	0
310	2	3650	2
≈970	0		

^{150}Nd(α,α2nγ) 1988Ur01

E=52 MeV.
Measured: γ, γγ, γ(θ).
Decay scheme and Jπ were presented in 1988Ur01.

^{148}Nd Levels

E(level)	Jπ†	E(level)	Jπ†	E(level)	Jπ†
0.0‡	0+	1242.6§	5−	2132.0§	9−
301.8‡	2+	1280.1‡	6+	2471.3‡	(10+)
752.5‡	4+	1644.6§	7−	2676.6§	(11−)
999.3§	3−	1856.3‡	8+		

† From adopted levels; supported by γ(θ) and DCO data from this data set.
‡ (A): g.s. band.
§ (B): Negative–parity band.

γ(^{148}Nd)

According to 1987Ur01 quoted by 1988Ur01 all DCO ratios were measured in ΔJ=2 gates for which DCO ratios equal to 1.00 are from dipole, ΔJ=1 transitions and DCO ratios equal to 1.94 are from quadrupole, ΔJ=2 transitions.

Eγ	E(level)	Iγ‡	Mult.†	Comments
205.3	2676.6	2 *1*	D	DCO=2.0 *3*.
211.7	1856.3	6 *1*	D	DCO=1.88 *16*.
275.5	2132.0	10 *1*	D	DCO=1.82 *13*.
301.8	301.8	100 *5*		Known to be ΔJ=2 transition.
339.4	2471.3	3 *1*	D	DCO=2.2 *3*.
364.6	1644.6	20 *1*	(D)	DCO=1.75 *6*.
402.0	1644.6	3 *1*	Q	DCO=0.92 *15*.
450.7	752.5	90 *5*	Q	DCO=1.01 *2*.
487.4	2132.0	8 *1*	Q	DCO=1.02 *8*.
490.1	1242.6	20 *1*	(D)	DCO=1.70 *8*.
527.6	1280.1	53 *3*	Q	DCO=1.01 *2*.
544.6	2676.6	5 *1*	Q	DCO=0.91 *18*.
576.2	1856.3	16 *1*	Q	DCO=0.99 *3*.
615.0	2471.3	2 *1*	(Q)	DCO=1.06 *12*; for the unresolved 615.0 and 615.1 doublet.
x615.1		5 *2*	(Q)	
697.5	999.3	10 *1*	(D)	DCO=1.56 *15*.

† From DCO and RUL (1988Ur01).
‡ Relative intensity.
x γ ray not placed in level scheme.

Adopted Levels, Gammas

Q(β⁻)=2471 *6*; S(n)=5894 *6*; S(p)=6007 *6*; Q(α)=1460 *6* 2012Wa38.

^{148}Pm Levels

Cross Reference (XREF) Flags

A ^{148}Pm IT Decay (41.29 d)
B ^{148}Nd(p,nγ)
C ^{149}Sm(d,^{3}He)

E(level)†	Jπ	XREF	$T_{1/2}$	Comments
0.0	1−	ABC	5.368 d *7*	%β⁻=100. μ=1.84 *19* (1989Ra17,1963Gr10). Q=+0.2 *2* (1989Ra17,1965Al10). $T_{1/2}$: weighted average of: 5.370 d *9* (1970Ca09), 5.364 d *15* and 5.365 d *20* (1971Ca23). Others: 5.37 d *4* (1971Mo04), 5.39 d *6* (1962Re03). Jπ: J=1 from atomic–beam magnetic resonance (1976Fu06,1965Al10), π=− from the observed shape of the β⁻ spectrum and log *ft* (1963Ba06). This assignment is confirmed by the shape of the β⁻ spectrum and β–γ(θ) (1963Ba31) and (e,e'p) data (1971Sh08).
75.70 *25*	1−,2−	ABC		Jπ: 0−,1−,2− from M1 to 1−; not 0− from E4 from 137.9 level.
137.1 *6*		Bc		
137.9 *3*	5−,6−	ABc	41.29 d *11*	%β⁻=95.8 *6*; %IT=4.2 *6*. μ=1.82 *18* (1989Ra17,1963Gr10). $T_{1/2}$: from 1971Wa05. Others: 41.4 d *8* (1971BaZW), 40.9 d *2* (1971Mo04), 40.6 d *4* (1962Re03). Jπ: J=5,6,7 from log *ft* to 6+ 2194.5–keV level; not 7 and π=− from E4 to 75.7 level.
215.3 *4*		Bc		
219.9 *3*		Bc		
292.0 *3*		B		
302.9 *4*		B		
304.7 *3*		Bc		
308.9 *3*		Bc		
363.4 *4*		BC		
379.7 *3*		B		
385.6 *4*		B		
388.1 *3*		BC		
409.6 *4*		Bc		
413.5 *4*		Bc		
440.1 *3*		B		
452.0 *3*		B		
462 *6*		C		
526.5 *4*		Bc		
529.4 *5*		Bc		
543.4 *4*		B		
545.7 *4*		B		
550.3 *4*		BC		
561.3 *4*		B		
564.2 *4*		Bc		
573.1 *3*		Bc		
611.2 *5*		BC		
622.7 *6*		B		
641.9 *5*		BC		
655.7 *5*		Bc		
660.5 *6*		Bc		
669.6 *4*		B		
672.9 *4*		B		
700 *6*		C		
715 *6*		C		
726.3 *3*		B		
745 *6*		C		

E(level)†	XREF
797.0 *6*	B
800.6 *7*	B
810 *6*	C
859 *6*	C
910 *6*	C
958 *6*	C

† From a least–squares fit to Eγ data from (p,nγ).

Adopted Levels, Gammas (continued)

$\gamma(^{148}Pm)$

E(level)	Eγ	Mult.†	α	I(γ+ce)	Comments
75.70	75.7 *5*	M1	3.45 *9*	100	
137.9	62.2 *5*	E4	1.23×10^4 *7*	100	B(E4)(W.u.)=0.0073 *13*.
215.3	78.2 *5*				
219.9	219.9 *5*				
292.0	154.1 *5*				
	216.3 *5*				
	292.0 *5*				
302.9	165.0 *5*				
304.7	84.5 *5*				
	229.0 *5*				
	304.7 *5*				
308.9	88.9 *5*				
	171.0‡ *5*				
	233.2 *5*				
	308.9 *5*				
363.4	148.0 *5*				
	225.5 *5*				
379.7	76.8‡ *5*				
	87.9 *5*				
	159.8 *5*				
	379.7 *5*				
385.6	170.1 *5*				
	248.0 *5*				
388.1	79.2‡ *5*				
	83.4‡ *5*				
	96.1 *5*				
	250.2‡ *5*				
	312.4 *5*				
	388.1 *5*				
409.6	194.4 *5*				
	271.7 *5*				
	333.9‡ *5*				
413.5	121.6 *5*				
	337.7 *5*				
440.1	131.2 *5*				
	137.1 *5*				
	148.1 *5*				
	302.2 *5*				
	364.4 *5*				
452.0	88.6 *5*				
	149.1 *5*				
	160.0 *5*				
	314.1 *5*				
	376.3 *5*				
526.5	112.9 *5*				
	223.6 *5*				
	311.1 *5*				
529.4	119.8 *5*				
	141.3 *5*				
543.4	129.8 *5*				
	328.3 *5*				
	405.5 *5*				
545.7	157.6 *5*				
	166.0 *5*				
	236.8 *5*				
	241.0 *5*				
	253.7‡ *5*				
	407.8‡ *5*				
550.3	162.2 *5*				
	186.9 *5*				
	247.4 *5*				
	258.3‡ *5*				
	412.4 *5*				

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Adopted Levels, Gammas (continued)

γ(^{148}Pm) (continued)

E(level)	Eγ	E(level)	Eγ	E(level)	Eγ
561.3	173.1 *5*	573.1	435.2 *5*	669.6	364.8 *5*
	181.5 *5*	611.2	197.8 *5*	672.9	259.3 *5*
	341.6 *5*		395.8 *5*		263.3 *5*
	485.5‡ *5*	622.7	77.0‡ *5*		284.8 *5*
564.2	154.6 *5*		318.0 *5*	726.3	274.3 *5*
	176.1 *5*	641.9	333.0 *5*		338.2 *5*
	184.5 *5*		422.0 *5*		346.6 *5*
	200.8 *5*	655.7	215.6 *5*		362.9 *5*
	272.2‡ *5*		246.1 *5*		421.6 *5*
	426.3 *5*		270.2‡ *5*	797.0	356.9 *5*
573.1	133.0‡ *5*	660.5	296.9‡ *5*		494.1‡ *5*
	193.4 *5*		351.6 *5*	800.6	274.1 *5*
	264.2 *5*	669.6	229.5 *5*		497.7‡ *5*
	268.4 *5*		284.1 *5*		
	281.0 *5*		360.6‡ *5*		

† From α data in ^{148}Pm IT decay.
‡ Placement of transition in the level scheme is uncertain.

^{148}Pm IT Decay (41.29 d)

Parent ^{148}Pm: E=137.9 *3*; Jπ=5−,6−; $T_{1/2}$=41.29 d *11*; %IT decay=4.2 *6*.
See also ^{148}Pm β^- decay (41.29 d).
Measured: γ (1970Gr09,1962Re03), ce (1963Ba31,1961Ha23,1970GrYP).

^{148}Pm Levels

E(level)	Jπ†	$T_{1/2}$†	Comments
0.0	1−	5.368 d *2*	
75.80 *10*	1−,2−		
137.9 *3*	5−,6−	41.29 d *11*	%IT=4.2 *6*; derived from 4.6 *5* (1971Mo04) after reducing it to conform to a lower Iγ(1465) adopted in the decay of ^{148}Pm g.s. Others: 6.5% *17*, from Iγ(1460) in the decay of 41 d activity, and 5.1% *18*, from Iγ(75) (1962Re03); 6.9% *7* (1963Ba31).

† Adopted levels.

γ(^{148}Pm)

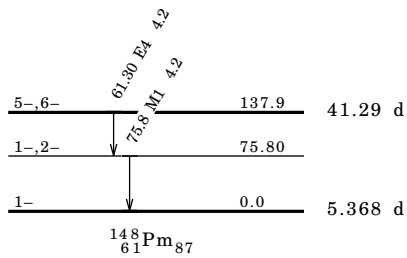
Eγ†	E(level)	Iγ§	Mult.‡	α	I(γ+ce)§	Comments
61.30 *5*	137.9		E4	13590	100	Mult.: L1:L2:L3=≤15:300 *20*:300 *20* (1970GrYP), K:L2:L3=weak:100:100 (1961Ha23), K:L:M+=<80:880 *110*:290 *60* (1963Ba31); ce(L)(61.5γ)/ce(L)(75.5γ)=10 *2* (1963Ba31).
75.8 *1*	75.80	22.2 *5*	M1	3.44	100	Iγ: I(75.8γ)/I(630γ in ^{148}Sm)=0.0128 *21* (unweighted average of 0.0105 *22* (1970Gr09), 0.011 *4* (1962Re03), 0.017 *5* (1963Ba31)). Mult.: α(K)exp=2.5 *8*, K:L:M+=790 *120*:90 *18*:18 *8* (1963Ba31), K:L1:L3=≈6:1:<1 (1961Ha23), L1:L2+L3=100 *10*: ≤10 (1970GrYP).

† From 1970GrYP.
‡ From α data (1962Re03,1963Ba31,1970GrYP).
§ For absolute intensity per 100 decays, multiply by 0.042 *6*.

^{148}Pm IT Decay (41.29 d) (continued)

Decay Scheme

Intensities: I(γ+ce) per
100 parent decays
%IT=4.2 *6*



^{148}Nd(p,nγ) 1989Le01

E=8 MeV.
Measured: γ, γγ coincidences using HERA array of 21 Compton–suppressed germanium detectors.

^{148}Pm Levels

E(level)†	Jπ‡	E(level)†	E(level)†
0.0	1−	385.3 *5*	564.2 *4*
75.70 *25*	1−,2−	388.1 *3*	573.1 *3*
137.2 *5*		409.6 *4*	611.2 *5*
137.9 *3*	5−,6−	413.5 *4*	622.7 *6*
215.3 *4*		440.1 *3*	641.9 *5*
219.9 *3*		452.0 *3*	655.7 *5*
292.0 *3*		526.4 *4*	660.5 *6*
302.9 *4*		529.4 *5*	669.5 *4*
304.7 *3*		543.4 *4*	672.9 *4*
308.9 *3*		545.7 *4*	726.3 *3*
363.4 *4*		550.3 *4*	797.0 *6*
379.7 *3*		561.3 *4*	800.5 *7*

† From a least–squares fit to Eγ data.
‡ From adopted levels.

γ(^{148}Pm)

Eγ	E(level)	Eγ	E(level)	Eγ	E(level)
62.2 *5*	137.9	133.0† *5*	573.1	176.1 *5*	564.2
75.7 *5*	75.70	137.1 *5*	440.1	181.5 *5*	561.3
76.8† *5*	379.7	141.3 *5*	529.4	184.5 *5*	564.2
77.0† *5*	622.7	148.0 *5*	363.4	186.9 *5*	550.3
78.2 *5*	215.3	148.1 *5*	440.1	193.4 *5*	573.1
79.2† *5*	388.1	149.1 *5*	452.0	194.4 *5*	409.6
83.4† *5*	388.1	154.1 *5*	292.0	197.8 *5*	611.2
84.5 *5*	304.7	154.6 *5*	564.2	200.8 *5*	564.2
87.9 *5*	379.7	157.6 *5*	545.7	215.6 *5*	655.7
88.6 *5*	452.0	159.8 *5*	379.7	216.3 *5*	292.0
88.9 *5*	308.9	160.0 *5*	452.0	219.9 *5*	219.9
96.1 *5*	388.1	162.2 *5*	550.3	223.6 *5*	526.4
112.9 *5*	526.4	165.0 *5*	302.9	225.5 *5*	363.4
119.8 *5*	529.4	166.0 *5*	545.7	229.0 *5*	304.7
121.6 *5*	413.5	170.1 *5*	385.3	229.5 *5*	669.5
129.8 *5*	543.4	171.0† *5*	308.9	233.2 *5*	308.9
131.2 *5*	440.1	173.1 *5*	561.3	236.8 *5*	545.7

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^{148}Nd(p,nγ) 1989Le01 (continued)

γ(^{148}Pm) (continued)

Eγ	E(level)	Eγ	E(level)	Eγ	E(level)
241.0 *5*	545.7	292.0 *5*	292.0	362.9 *5*	726.3
246.1 *5*	655.7	296.9† *5*	660.5	364.4 *5*	440.1
247.4 *5*	550.3	302.2 *5*	440.1	364.8 *5*	669.5
248.0 *5*	385.3	304.7 *5*	304.7	376.3 *5*	452.0
250.2† *5*	388.1	308.9 *5*	308.9	379.7 *5*	379.7
253.7† *5*	545.7	311.1 *5*	526.4	388.1 *5*	388.1
258.3† *5*	550.3	312.4 *5*	388.1	395.8 *5*	611.2
259.3 *5*	672.9	314.1 *5*	452.0	405.5 *5*	543.4
263.3 *5*	672.9	318.0 *5*	622.7	407.8† *5*	545.7
264.2 *5*	573.1	328.3 *5*	543.4	412.4 *5*	550.3
268.4 *5*	573.1	333.0 *5*	641.9	421.6 *5*	726.3
270.2† *5*	655.7	333.9† *5*	409.6	422.0 *5*	641.9
271.7 *5*	409.6	337.7 *5*	413.5	426.3 *5*	564.2
272.2† *5*	564.2	338.2 *5*	726.3	435.2 *5*	573.1
274.1 *5*	800.5	341.6 *5*	561.3	485.5† *5*	561.3
274.3 *5*	726.3	346.6 *5*	726.3	494.1† *5*	797.0
281.0 *5*	573.1	351.6 *5*	660.5	497.7† *5*	800.5
284.1 *5*	669.5	356.9 *5*	797.0		
284.8 *5*	672.9	360.6† *5*	669.5		

† Placement of transition in the level scheme is uncertain.

^{149}Sm(d,^{3}He) 1988No02

E=27.7 MeV, FWHM=16 keV.
Measured: σ(E) analyzing ^{3}He with the Princeton quadrupole–dipole–dipole–dipole (QDDD) spectrometer.

^{148}Pm Levels

E(level)	E(level)	E(level)
0.0	462 *6*	715 *6*
76 *6*	526 *6*	745 *6*
137 *6*	553 *6*	810 *6*
219 *6*	567 *6*	859 *6*
305 *6*	609 *6*	910 *6*
363 *6*	644 *6*	958 *6*
389 *6*	659 *6*	
413 *6*	700 *6*	

Adopted Levels, Gammas

Q(β⁻)=–3037 *10*; S(n)=8141.37 *28*; S(p)=7583.1 *4*; Q(α)=1986.9 *10* 2012Wa38.

^{148}Sm Levels

The band designations and suggested configurations are from (HI,xnγ).

Cross Reference (XREF) Flags

A ^{148}Nd 2β⁻ Decay	I ^{147}Sm(n,γ) E=3.4 eV	^{148}Sm(p,p'), (pol p,p')
B ^{148}Pm β⁻ Decay (5.368 d)	J ^{147}Sm(n,γ) E=24.5 keV	^{148}Sm(d,d')
C ^{148}Pm β⁻ Decay (41.29 d)	K ^{147}Sm(n,X): Resonances	^{149}Sm(d,t)
D ^{148}Eu ε Decay	L ^{147}Sm(d,p)	^{150}Sm(p,t)
E ^{152}Gd α Decay	M ^{148}Sm(γ,γ')	^{151}Eu(μ⁻,3nγ)
F ^{147}Sm(n,γ) E=thermal	N ^{148}Sm(e,e')	Coulomb Excitation
G ^{147}Sm(n,γ) E=0.020–1.0 keV	O Others:	(HI,xnγ)
H ^{147}Sm(n,γ) E=0.1–10 keV	^{148}Sm(n,n'γ)	

E(level)†	Jπ	XREF	$T_{1/2}$	Comments
0.0#	0+	ABCDEFGHIJ LMNO	7×10^{15} y *3*	%α=100. $T_{1/2}$: from 1970Gu14. Others: 8×10^{15} y *2* (1968Ko06), $>3\times10^{15}$ y (1987AlZX), see also 1960Ka23, 1961Ma05, 1946Cu01. Rms charge radius $<r^2>^{1/2}$=5.0009 fm *16* (2004An14).
550.255# *8*	2+	ABCD FGHIJ LMNO	7.72 ps *32*	Jπ: E2 to 0+. $T_{1/2}$: from 2001Ra27, based on their adopted B(E2)↑=0.720 *30* derived from Coul. ex., (e,e'), and $T_{1/2}$ from RDM. μ=+0.508 *42* (2005St24,1987Ba65). Q=–0.98 *27* (2005St24,1973ClZF). μ, other: +0.61 *7* (1987Be08).
1161.529@ *12*	3–	BCD FGH J LM O	0.6 ps *+4–2*	Jπ: E1 to 2+ and L(d,t)=0. $T_{1/2}$: from thermal–neutron capture data using γ–ray induced Doppler (GRID) broadening technique. B(E3)↑=0.37 *3* (Coul. ex., 1968Ke04).
1180.261# *12*	4+	CD FGH J L O	2.39 ps *24*	$T_{1/2}$: from B(E2)(2+ to 4+)=0.43 *4* (Coul. ex., 1968Ke04). Jπ: J=4 from γγ(θ) in β⁻ decay; π=+ from E2 to 2+.
1424.46 *4*	0+	AB G L o		Jπ: J=0 from γγ(θ) in β⁻ decay; π=+ from L(p,t)=0.
1434.0 *8*		F H o		
1454.115 *13*	2+	AB D FGHIJ M O	285 fs *28*	$T_{1/2}$: from ^{148}Sm(γ,γ'); other: 0.36 ps *11* (Coul. ex., from B(E2)↑=0.36 ps *11* and and branching 1454γ=0.499 *5*). Jπ: E2 to 0+.
1461.1	(1,2+)	l o		Jπ: γ to 0+.
1465.137 *11*	1–	B D FGH lM o	92 fs *8*	$T_{1/2}$: from ^{148}Sm(γ,γ'). B(E1)↑=0.013 *5* (Coul. ex., 1968Ve01). Jπ: J=1 from γγ(θ) in β⁻ decay; π=– from E1 to 0+.
1594.247@ *12*	5–	CD FGH L O		Jπ: J=5 from γγ(θ) in β⁻ decay; π=– from E1 to 4+. This disagrees with J=3– or 4– from average–resonance capture in (n,γ).
1659.4 *8*	(2,3,4+)	F		Jπ: thermal–neutron capture γ assumed to be D from 3–,4– capturing state and γ to 2+.
1664.278 *22*	2+	B D GHIJ L O	0.25 ps *8*	$T_{1/2}$: from B(E2)=0.03 *1* and 1664γ branching=0.34 *1*. Jπ: J=2 from γ(θ) in β⁻ decay; π=+ from L(d,p)=3.
1717.8 *10*		F		
1733.465 *12*	4+	CD FGH J L O		Jπ: J=4 from γγ(θ) in ε decay; π=+ from L(d,p)=1+3.
1894.824 *14*	4+	CD FGHI O		Jπ: J=4 from γγ(θ) in ε decay; π=+ from L(d,t)=3.
1903.773 *18*	3+	D GH O		Jπ: 3+,4+ from average neutron capture, and M1 to 2+.
1905.908# *13*	6+	CD G L O		Jπ: J=6 from γγ(θ) in β⁻ decay; π=+ from E1 to 5–.
1920.97 *6*	0+	B G M O		Jπ: L(p,t)=0.
1972.480 *21*	2+	G I L O		Jπ: L(d,t)=1 and γ to 0+.
2031.403 *13*	4–	D FGH O		Jπ: L(d,t)=0, and log *ft*=8.9 via 5– parent in ε decay.
2041 *8*		L		
2057.960 *22*	2–	B G O		Jπ: J=2 from γγ(θ) in β⁻ decay; π=– from M1 to 1–.
2095.595[a] *13*	6+	CD GH L o		Jπ: J=6 from γγ(θ) in β⁻ decay; π=+ from E1 to 5–.
2111.053 *13*	4+	D FGHI L o		Jπ: E2 to 2+ and E1+M2 to 5–. Disagrees with J=3+ (1984Kr09) in ε decay.
2128.64@ *7*	7–‡	D G O		

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Adopted Levels, Gammas (continued)

^{148}Sm Levels (continued)

E(level)[†]	Jπ	XREF				$T_{1/2}$	Comments
2142.5 *20*	(2,3,4)		I				Jπ: from 3− (n,γ) resonance and average−resonance neutron capture.
2146.35 *3*	2+[§]		FGH	M	o	<64.1 fs	$T_{1/2}$: from ^{148}Sm(γ,γ').
2147.499 *13*	5+	D	G	L	o		Jπ: J=5 from γ(θ) in ε decay; π=+ from L(d,p)=1+3.
2194.061 *14*	6+[‡]	CD	GH	L	O		
2204.99 *15*	0+		G		O		Jπ: L(p,t)=0.
2208.85 *7*	(1,2+)		GH		O		Jπ: γ to 0+.
2214.215 *15*	5+	D	FGH	L	o		Jπ: J=5 from γ(θ) in ε decay; π=+ from L(d,t)=1.
2228.042 *17*	4+	D	FGHI	L	o		Jπ: J=4 from γ(θ) in ε decay; π=+ from L(d,p)=1+3.
2277 *3*	+			l	O		Jπ: L(d,t)=3.
2284.406 *21*	(1,2+)	B	G	lM	O	46 fs *5*	Jπ: γ to 0+. $T_{1/2}$: from ^{148}Sm(γ,γ').
2313.57 *8*	2+	B	GH		O		Jπ: J=2 from γγ(θ) in β⁻ decay; π=+ from E1 to 3−.
2318.5 *5*	+	D		L	O		Jπ: L(d,t)=1.
2327.09 *5*	4+[§]	D	FGHI		O		
2327.62 *9*	3+[§]		G		O		
2339.21 *8*	3−[§]	D	GH	L	O		
2344 *3*	3−,4−				O		Jπ: L(d,t)=0.
2358 *4*	0+				O		Jπ: L(p,t)=0.
2374.447 *16*	5+,6+	D	G		O		Jπ: J=5,6 from γ(θ) in ε decay; π=+ from M1 to 6+.
2381.67 *10*	2+[§]		G	LM	O	87 fs *17*	Jπ: from ^{148}Sm(γ,γ') based on angular correlations (π=+ from linear polarization in ^{148}Sm(n,n'γ)). $T_{1/2}$: from ^{148}Sm(γ,γ').
2390.43 *7*	3+[§]	D	GHI		O		
2392.32 *7*	7+[‡]	D	G		O		
2397.8 *10*			F	L	O		
2440.8 *10*			F H				
2442.29 *10*	(2+)		G		O		Jπ: γ to 0+ and γ to 4+.
2467.38 *8*	3(−)[§]		G		O		
2472.48 *16*	1[§]		G	M	O	37 fs *3*	$T_{1/2}$: from ^{148}Sm(γ,γ').
2490.004 *14*	4+	D	GH		O		Jπ: J=4 from γ(θ) in ε decay; π=+ from M1,E2 to 4+.
2496 *3*	+			L	O		Jπ: L(d,p)=1.
2513.50 *18*	1[§]		GH	M	O	99 fs *5*	$T_{1/2}$: from ^{148}Sm(γ,γ').
2524.101 *16*	4+	D	FGHI		O		Jπ: J=4 from γ(θ) in ε decay; π=+ from M1 to 4+.
2532.39 *4*	4−,5−	D	G	L	O		Jπ: J=4,5 from γγ(θ) in ε decay; π=− from M1,E2 from 5−,6−. This contradicts Jπ=+ from L(d,p)=L(d,t)=1 for levels at 2532 *3*, and 2531 *3*, respectively, both observed by 1975Oe01. In (d,t), the level is an unresolved doublet; hence, the L assignments could be suspect.
2539.82 *17*	3−[§]		GH		O		
2541.8 *10*			F				
2544.67[a] *15*	8+[‡]				O		
2567.89 *19*	2+[§]		G	l	O		
2570.832 *19*	4(−)[§]	D	GH	l	O		
2583.862 *16*	4(−)[§]	D	G	l	O		
2631.8 *10*			F				
2633.15 *8*	3−[§]		G		O		
2641.222 *17*	5+[§]	D	FGH		O		
2645.50 *15*	4+,5+		G	L	O		Jπ: L(d,p)=L(d,t)=1; γ to 5−.
2673.07 *4*	4+	D	G		O		Jπ: J=4 from γ(θ) in ε decay; π=+ from polarization data in (n,γ) E=0.020−1.0 keV.
2675.20 *14*	(3+,4,5−)	D					Jπ: gammas to 3− and 5+.
2681.8 *10*			F				
2683.467 *12*	4−,5−	D	G	L	O		Jπ: J=4,5 from γ(θ) in ε decay; π from M1 to 5−.
2692.8 *10*			F				
2697.77 *12*	3+,4+[§]		G		O		
2698.539 *16*	5−,6−	D					Jπ: J=5,6 from γ(θ) in ε decay; π=− from M1 to 5−.
2701.92 *4*	4(−),(3−)[§]	D	G		O		
2704.6 *5*	(1,2+)		G	LM	O	20.1 fs *12*	Jπ: γ to 0+. $T_{1/2}$: from ^{148}Sm(γ,γ').
2711.8 *10*			F		o		
2713.334 *20*	3+,4+[§]	D	G		o		

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Adopted Levels, Gammas (continued)

^{148}Sm Levels (continued)

E(level)[†]	Jπ	XREF	$T_{1/2}$	Comments
2714.98[#] *16*	8+[‡]	O		
2716.05 *4*	(4+,5,6+)	D G		Jπ: γ's to 4+, 6+.
2719.8 *5*	(3−,4−)	G O		Jπ: L(d,t)=(0).
2723.506 *23*	4+	D FG O		Jπ: J=3,4 from γγ(θ) in ε decay and γ to 6+; π=+ from M1 to 4+.
2727.31 *6*	5+	D G L O		Jπ: J=5,6 from γ(θ) in (n,γ), γ to 3− makes J=6 unlikely; π=+ from L(d,p)=1+3.
2734.44 *19*	(3)	D O		Jπ: gammas to 1− and 3− and log *ft*=10.0 from 5−.
2738.79 *20*	(8+)[‡]	O		
2753.15 *6*	3+[§]	FG O		E(level): from (n,γ).
2762.1 *5*	1+	LM O	7.5 fs *4*	Jπ: from ^{148}Sm(γ,γ') based on angular correlations and L(d,p)=1+3.
2801.752 *13*	5+	D G O		Jπ: J=5 from γγ(θ) in ε decay; π=+ from M1 to 5+.
2806.73 *10*	3+,4+[§]	G O		
2807.35[@] *16*	9−[‡]	O		
2809 *3*		L		
2812.8 *10*		F		
2815.584 *18*	4−	D G O		Jπ: J=4 from γ(θ) in ε decay; π=− from M1 to 5−.
2822 *2*	+	L O		Jπ: L(d,t)=1.
2828.13 *15*		G O		
2830.660 *14*	5+	D G		Jπ: J=5 from γ(θ) in ε decay; π=+ from M1 to 5+.
2846.9 *3*	(3−,4−)	G O		Jπ: L(d,t)=(0).
2861.07 *8*	4−,5−	D FG O		Jπ: J=4,5 from γ(θ) in ε decay; π=− from M1 to 5−. J=3,4 from γ(θ) in (n,γ) E=0.020–1.0 keV; however, M1 to 5− rules out J=3.
2862.06 *11*	3+,4+[§]	G L O		
2891.8 *5*		FG L		
2908.13 *22*	3−,4−	D G O		Jπ: L(d,t)=0.
2917.8 *10*		F		
2928.84 *5*	(4,5,6)+	D G L O		Jπ: γ's to 4+, 6+ and L(d,p)=1+3.
2931.98 *20*		G O		
2941.1 *7*	2+,3−[§]	G		
2942.82 *18*	8−[‡]	O		
2952.7 *9*		G L O		
2967.6 *7*	3+,4+[§]	FG O		
2976.32 *20*	8−[‡]	O		
2980.50 *19*	3+,4+[§]	G O		
2991.78 *16*	3+,4+[§]	FG L O		
2993 *3*		O		
3004 *3*		L O		
3014.1 *6*	3−,4−	G O		Jπ: L(d,t)=0.
3022 *3*		L		
3038.8 *6*	1	M	41.4 fs *22*	Jπ: from ^{148}Sm(γ,γ') based on angular correlations. $T_{1/2}$: from ^{148}Sm(γ,γ').
3045 *2*	+	L O		Jπ: L(d,p)=1+3.
3050.5 *4*		FG O		
3063.25 *22*	3−[§]	FG l O		
3073 *3*		l O		
3082.1 *4*	1	M	10.2 fs *7*	Jπ: from ^{148}Sm(γ,γ') based on angular correlations. $T_{1/2}$: from ^{148}Sm(γ,γ').
3089.84 *23*	2+,3−[§]	FG		
3095.25 *19*	9(+)[‡]	O		
3098 *3*	(3−,4−)	O		Jπ: L(d,t)=(0).
3107.8 *4*	3+,4+[§]	FG O		
3112 *2*	+	L O		Jπ: L(d,p)=1+3.
3138.46 *11*	3(−),4(−)[§]	FG O		
3153.5 *3*	+	G L O		Jπ: L(d,p)=1+3.
3164.8 *4*	3+,4+[§]	FG		
3178.0 *15*	+	G L O		Jπ: L(d,p)=1+3.
3188.31[d] *17*	9−[‡]	O		
3189.8 *8*	2+,3−[§]	G		
3197.4 *10*	3−,4−	G O		Jπ: L(d,t)=0.
3216.15 *18*	9−[‡]	O		

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Adopted Levels, Gammas (continued)

^{148}Sm Levels (continued)

E(level)[†]	Jπ	XREF	Comments
3221.2 *4*		G l O	
3224.83 *19*		G l O	
3235.23[a] *17*	10+[‡]	O	
3235.8 *10*		F	
3245 *3*	+	L O	Jπ: L(d,p)=1+3.
3253.45 *17*	10−[‡]	O	
3255.3 *5*	(1,2+)	M	Jπ: γ to 0+. B(E1)↑=4.4×10^{-5} *3* (γ,γ', 1993Zi05).
3261.8 *10*		F	
3276.2 *5*		G L O	
3286.8 *10*		F	
3291.5 *5*	(1,2+)	M	Jπ: γ to 0+. B(E1)↑=1.7×10^{-5} *2* (γ,γ', 1993Zi05).
3308.8 *10*		F L O	
3322.6 *3*	(10+)[‡]	O	
3337.8 *10*		F	
3347 *3*	+	L O	Jπ: L(d,p)=1.
3375.8 *10*		F	
3387.8 *10*	3−,4−	F l O	Jπ: L(d,t)=0.
3397 *3*		l O	
3398.13[#] *16*	10+[‡]	O	
3403.8 *10*		F L O	
3413.8 *10*		F O	
3421.90[b] *16*	11−[‡]	O	
3428 *3*		O	
3437.8 *10*		F	
3451.9 *5*	(1,2+)	LM O	Jπ: γ to 0+.
3465.8 *10*		F O	
3479.8 *10*		F L	
3483.6 *5*	(1,2+)	M	Jπ: γ to 0+. B(E1)↑=6.0×10^{-5} *15* (γ,γ', 1993Zi05).
3488 *4*	(3−,4−)	O	Jπ: L(d,t)=(0).
3507.8 *10*		F O	
3519.8 *10*		F l	
3526.57 *18*	10−[‡]	O	
3530 *4*	(3−,4−)	l O	Jπ: L(d,t)=(0).
3534.9 *5*	(1,2+)	lM	Jπ: γ to 0+. B(E1)↑=5.8×10^{-5} *4* (γ,γ', 1993Zi05).
3545.63 *17*	10−[‡]	O	
3546 *4*	(3−,4−)	l O	Jπ: L(d,t)=(0).
3562.8 *10*		F l	
3572 *4*		O	
3586.0 *5*	(1,2+)	LM	Jπ: γ to 0+.
3598.8 *10*	(3−,4−)	F O	Jπ: L(d,t)=(0).
3613.8 *10*		F l	
3614.76[@] *17*	11−[‡]	O	
3628 *4*	(3−,4−)	l O	Jπ: L(d,t)=(0).
3635.8 *10*		F	
3640.4 *4*	(11)[‡]	O	
3652 *4*	(3−,4−)	L O	Jπ: L(d,t)=(0).
3668 *10*		L	
3674 *4*		O	
3701.8 *10*	(3−,4−)	F l O	Jπ: L(d,t)=(0).
3714 *4*		l O	
3734 *4*	(3−,4−)	L O	Jπ: L(d,t)=(0).
3752 *4*		l O	
3766.8 *10*		F l	
3774 *4*	(3−,4−)	L O	Jπ: L(d,t)=(0).
3797 *4*		L O	
3806.98[d] *18*	11−[‡]	O	
3812.0 *5*	(1,2+)	M	Jπ: γ to 0+.
3817 *4*	3−,4−	O	Jπ: L(d,t)=0.
3831.8 *10*		F	

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Adopted Levels, Gammas (continued)

^{148}Sm Levels (continued)

E(level)[†]	Jπ	XREF	Comments
3843.6 *5*	(1,2+)	M	Jπ: γ to 0+. B(E1)↑=0.6×10^{-5} *2* (γ,γ', 1993Zi05).
3844.8 *10*		F L	
3865.8 *10*	3−,4−	F O	Jπ: L(d,t)=0.
3884.3 *5*	(1,2+)	lM O	Jπ: γ to 0+.
3895.4 *5*	(1,2+)	M	Jπ: γ to 0+.
3902 *4*	3−,4−	l O	Jπ: L(d,t)=0.
3920.8 *10*	3−,4−	F L O	Jπ: L(d,t)=0.
3951 *4*		L O	
3971.8 *10*	(3−,4−)	F O	Jπ: L(d,t)=(0).
3990 *4*	(3−,4−)	L O	Jπ: L(d,t)=(0).
3992.62[a] *17*	12+[‡]	O	
4005 *4*		O	
4011 *4*		O	
4026 *4*	3−,4−	L O	Jπ: L(d,t)=0.
4041 *4*		L O	
4085 *10*		L	
4104.39[#] *17*	12+[‡]	O	
4107 *10*		L	
4108.70 *18*	12−[‡]	O	
4110.68[b] *17*	13−[‡]	O	
4122.8 *10*		F L	
4166 *10*		L	
4189.28 *19*	12+[‡]	O	
4192 *10*		L	
4196.25 *18*	12−[‡]	O	
4214 *10*		L	
4228 *10*		L	
4241.52 *21*	13−[‡]	O	
4255 *10*		L	
4290 *10*		L	
4334 *10*		L	
4357 *10*		L	
4383 *10*		L	
4397.78[@] *18*	13−[‡]	O	
4402 *10*		L	
4444 *10*		L	
4466 *10*		L	
4510 *10*		L	
4512.91[d] *19*	13−[‡]	O	
4516.75 *19*	13+[‡]	O	
4535 *10*		L	
4573 *10*		L	
4592 *10*		L	
4630 *10*		L	
4649 *10*		L	
4675 *10*		L	
4735 *10*		L	
4784 *10*		L	
4805.18[#] *18*	14+[‡]	O	
4824 *10*		L	
4842.69[b] *18*	15−[‡]	O	
4864.69[a] *17*	14+[‡]	O	
4876 *10*		L	
4889.71 *19*	14−[‡]	O	
4909.65 *19*	14+[‡]	O	
4917.55 *18*	14−[‡]	O	
4951.75 *23*	14(−)[‡]	O	
5087.55 *19*	15−[‡]	O	
5136.13[@] *19*	15−[‡]	O	
5217.20 *20*	15(−)[‡]	O	
5274.93 *20*	15+[‡]	O	
5287.77[d] *25*	15−[‡]	O	

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Adopted Levels, Gammas (continued)

^{148}Sm Levels (continued)

E(level)[†]	Jπ	XREF	$T_{1/2}$	Comments
5320.28 *19*	16−[‡]	O		
5496.39[#] *19*	16+[‡]	O		
5524.48[a] *19*	16+[‡]	O		
5556.54 *21*	16−[‡]	O		
5561.19[b] *20*	17−[‡]	O		
5578.31 *21*	16(+)[‡]	O		
5649.57 *20*	17−[‡]	O		
5777.74 *21*	17+[‡]	O		
5837.32[&] *22*	17−[‡]	O		
5946.08[#] *19*	18+[‡]	O		
6011.15 *21*	18[‡]	O		
6029.22 *21*	18−[‡]	O		
6195.29[&] *21*	19−[‡]	O		
6392.23 *23*	19−[‡]	O		
6477.07 *20*	19−[‡]	O		
6557.5? *4*	(19)[‡]	O		
6592.79[#] *21*	20(+)[‡]	O		
6694.32[c] *21*	21(−)[‡]	O	32 ns *3*	$T_{1/2}$: from DSAM in (HI,xnγ) (1998UrZZ).
6913.3[&] *3*	21(−)[‡]	O		
7329.3[#] *3*	22(+)[‡]	O		
7332.92[c] *23*	23(−)[‡]	O		
7620.4[&] *3*	23(−)[‡]	O		
7942.5 *3*	(22)[‡]	O		
7977.6[#] *3*	24(+)[‡]	O		
8010.61[c] *25*	25(−)[‡]	O		
8214.5[&] *3*	25(−)[‡]	O		
8358.8 *3*	(24)[‡]	O		
8602.2[c] *3*	27(−)[‡]	O		
8659.5[#] *5*	26(+)[‡]	O		
8931.5? *7*	(27)[‡]	O		
9045.9 *3*	(26)[‡]	O		
9601.2[c] *4*	29[‡]	O		
9898.2 *11*	(28)[‡]	O		
10439.0[c] *4*	31[‡]	O		
10609.1 *4*	(30)[‡]	O		
11524.7 *5*	(32)[‡]	O		

[†] From the data sets which provided Eγ, and other particle–transfer reactions.
[‡] From (HI,xnγ) based on γ–ray excitation functions, γ(θ), DCO ratios, γ–ray linear polarization, Ice spectra, $T_{1/2}$, prompt and delayed Ice spectra. π of levels upto J=19 were deduced from linear–polarization data. Jπ assignments of high–spin levels should be considered as tentative pending publication of detailed data.
[§] From γ(θ), primary–capture γ $I\gamma/E_{\gamma}^{5}$, and linear–polarization data in (n,γ) E=0.020–1.0 keV and (n,n'γ).
[#] (A): Band 1; g.s. band.
[@] (B): Band 2; octupole band.
[&] (C): Band 3.
[a] (D): Band 4.
[b] (E): Band 5.
[c] (F): Band 6.
[d] (G): Band 7.

γ(^{148}Sm)

E(level)	Eγ[†]	Iγ[‡]	Mult.[§]	Comments
550.255	550.273 *9*	100	E2	B(E2)(W.u.)=31.2 *13*.
1161.529	611.293 *8*	100	E1	Mult.: E1+M2 with δ=+0.026 *13* from ^{148}Sm β^- decay, +0.08 *4* from (HI,xnγ), and <0.4 from (n,n'γ). However, RUL estimate of δ is ≤0.007 and the evaluator has set the mult=E1. B(E1)(W.u.)=0.0018 *+6–12*.
1180.261	629.987 *8*	100	E2	B(E2)(W.u.)=51 *6*.
1424.46	874.18 *3*	100	E2	

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Adopted Levels, Gammas (continued)

γ(^{148}Sm) (continued)

E(level)	Eγ†	Iγ‡	Mult.§	δ	α	Comments
1434.0	884.2 *10*	100				
1454.115	903.831 *15*	100 *2*	M1+E2	+2.32[a] *10*		B(M1)(W.u.)=0.0082 *11*; B(E2)(W.u.)=30 *3*.
	1454.110 *20*	99.6 *2*	E2			B(E2)(W.u.)=3.3 *4*.
1461.1	910.7	56				
	1461.1	100				
1465.137	303.59 *3*	0.17 *2*				If E2 B(E2)(W.u.)=67.
	914.916 *15*	51.6 *4*	E1			B(E1)(W.u.)=0.00117 *11*.
	1465.101 *13*	100 *3*	E1			B(E1)(W.u.)=0.00055 *6*.
1594.247	414.028 *12*	100 *3*	E1+M2	−0.013[@] *10*		
	432.745 *8*	27.6 *15*	E2		0.0190	
1659.4	1109 *1*	100				
1664.278	1113.92 *3*	100 *3*	M1+E2	−0.565[a] *21*		B(M1)(W.u.)=0.032 *11*; B(E2)(W.u.)=4.5 *15*.
	1664.20 *4*	51.6 *16*	E2			B(E2)(W.u.)=1.3 *5*.
1733.465	279.30 *5*	0.65 *3*	E2		0.0703	
	553.231 *14*	100 *17*	M1+E2	+1.66[&] *20*	0.0117 *4*	
	571.962 *7*	74 *2*	E1			
	1183.208 *16*	12.8 *3*	E2			
1894.824	300.65 *7*	2.9 *2*	[E1]		0.01463	
	714.769 *13*	91 *2*	M1+E2			δ: +0.25 *10* or −1.5 *5* from γγ(θ); −0.03≤δ≤+1.02 from γ(θ,T); all from ^{148}Eu ε decay.
	1344.740 *23*	100 *8*	E2			δ(M3/E2)=−0.01 *8*.
1903.773	449.66 *9*	7 *3*				
	723.58 *5*	15.4 *7*				
	742.16 *11*	4.5 *4*				
	1353.509 *17*	100 *2*	M1+E2	+8.2[a] *12*		
1905.908	311.570 *20*	14.2 *3*	E1		0.01337	
	725.673 *9*	100 *2*	E2			
1920.97	1370.71 *6*	100				
1972.480	308.29 *11*	9.5 *10*				
	810.65 *14*	12 *2*				
	1422.216 *20*	100 *3*	M1+E2	−0.556[a] *24*		
	1972.8 *3*	9.9 *8*				
2031.403	437.18 *4*	3.5 *1*	M1		0.0303	
	851.4 *5*	0.28 *13*				
	869.891 *8*	100 *2*	M1+E2	−1.7[&] *3*		
2057.960	393.80 *3*	1.6 *2*				
	592.83 *3*	36.0 *7*	M1+E2		0.011 *3*	δ: +11 *+11−4* or −0.20 *5* from ^{148}Pm β^- decay.
	896.42 *3*	100 *1*	M1+E2	+1.32[#] *9*		
	1507.68 *3*	0.6 *1*				
2095.595	189.721 *16*	6.9 *2*	M1,E2		0.264 *16*	
	362.09 *3*	1.0 *2*				
	501.312 *11*	37.4 *8*	E1+M2	−0.017[@] *14*		
	915.331 *8*	100 *2*	E2			
2111.053	216.16 *6*	2.2 *2*	M1		0.195	
	377.560 *20*	11.6 *26*	M1		0.0442	
	446.52 *6*	3.0 *2*	(E2)		0.01744	
	516.793 *14*	31 *1*	E1+M2	0.48 *8*	0.015 *3*	δ: calculated from %E1=81 *5* estimated from Ice data in ^{148}Eu ε decay.
	656.93 *3*	10.3 *6*				
	930.807 *19*	100 *21*	E2			Mult.: from Ice data in ^{148}Eu ε decay. M1+E2 from (n,n'γ); however, since this γ is doubly placed in this reaction, the result is suspect.
	949.590 *20*	17.6 *4*				
	1560.786 *17*	61.6 *16*	E2			
2128.64	222.71 *12*	22.9 *21*	E1		0.0318	
	534.38 *7*	100 *21*	E2		0.01077	
2146.35	985.16 *20*	10.4 *12*				
	1596.08 *3*	100 *3*	M1+E2	−0.11[a] *5*		B(M1)(W.u.)>0.069; B(E2)(W.u.)>0.019.
	2146.3	<17				
2147.499	116.01 *4*	1.49 *4*	E1		0.184	
	241.653 *15*	14.3 *3*	M1+E2	−0.34[&] *11*	0.141 *3*	
	243.83 *4*	3.2 *1*	E2		0.1086	

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Adopted Levels, Gammas (continued)

γ(^{148}Sm) (continued)

E(level)	Eγ[†]	Iγ[‡]	Mult.[§]	δ	α	Comments
2147.499	252.60 *3*	1.33 *4*	M1,E2		0.112 *16*	
	414.057 *16*	100 *5*	M1+E2	−1.8[&] *8*	0.025 *4*	
	553.260 *15*	50 *21*	E1			
	967.306 *17*	26.9 *6*	M1+E2			δ: +0.42 *10* or +2.0 *5* from γγ(θ); +0.55 +*17*−*11* or −2.8 +*11*−*9* from γ(θ,T) all from ^{148}Eu ε decay.
2194.061	98.530 *20*	12.2 *2*	M1+E2	0.18	1.79 *3*	δ: from M1/E2=30 from ^{148}Eu ε decay.
	288.141 *13*	61.9 *4*	M1+E2	+0.088[@] *21*	0.0898	
	299.1 *2*	0.44 *9*				
	460.80 *20*	2.06 *9*				
	599.81 *3*	61.8 *6*	E1+M2	−0.021[@] *11*		
	1013.808 *11*	100 *1*	E2+M3	−0.025[@] *14*		
2204.99	1654.72 *15*	100				
2208.85	1658.58 *7*	100 *4*				
	2208.9 *3*	24 *4*				
2214.215	66.72 *9*	0.33 *4*	M1		5.43	Iγ: from ce(K) and α(K).
	182.83 *3*	1.9 *4*	E1		0.0537	
	308.45 *10*	0.96 *9*	E2,M1		0.063 *12*	
	310.14 *10*	1.9 *4*	E2		0.0507	
	319.270 *20*	2.0 *1*	M1,E2		0.057 *12*	
	480.89 *8*	1.21 *6*	M1		0.0238	
	620.04 *3*	11.6 *7*	E1+M2	+0.13[&] *5*		
	1033.986 *14*	100 *2*	M1+E2	−1.9[&] *6*		
2228.042	322 *1*	4.6 *24*				
	495.25 *6*	11 *5*	M1		0.0221	
	774.2 *5*	2.4 *12*				
	1047.570 *20*	46 *7*	M1			
	1066.75 *3*	91.7 *22*				
	1677.85 *3*	100 *3*	E2			
2284.406	362.8[c] *2*	<5				
	819.27 *3*	30 *5*				
	1734.12 *3*	87 *2*				
	2284.39 *3*	100 *5*	D			
2313.57	1152.20 *15*	42 *3*	E1+M2	−0.10[a] *9*		
	1763.26 *8*	100 *4*	M1+E2	+2.2[a] *5*		
	2314.0[c] *2*	<4				
2318.5	1138.4[c] *5*	100				
2327.09	216.16 *6*	0.99 *7*				
	423.5 *4*	1.9 *5*				
	432.745 *8*	5 *3*	M1		0.0311	
	662.79 *5*	5.1 *2*				
	732.99 *7*	2.9 *3*				
	1146.805 *14*	100 *2*	M1+E2	−2.0[&] *5*		
	1165.54 *5*	4.1 *2*				
	1776.87 *4*	3.3 *1*				
2327.62	1166.08 *17*	11.3 *16*				
	1777.35 *10*	100 *4*				
2339.21	885.6 *8*	19 *3*				
	1159.15 *20*	30 *4*				
	1177.6 *4*	8 *5*				
	1788.90 *9*	100 *4*	E1+M2	+0.06[a] *4*		
2374.447	468.500 *12*	100 *2*	M1+E2	≥0.41[&]	0.020 *5*	
	780.11 *6*	27.4 *9*				
	1194.185 *17*	30.4 *7*				
2381.67	1831.40 *10*	100	M1+E2	+0.46[a] *8*		B(M1)(W.u.)<0.042; B(E2)(W.u.)>0.79.
2390.43	1229.6 *5*	59 *30*				
	1840.06 *8*	100 *6*	M1+E2	−1.37[a] *12*		
2392.32	263.96 *20*	20 *4*	Q+D			
	486.45 *6*	100 *5*	M1+E2	−0.15[b] *8*	0.0229 *5*	
2442.29	778.19 *11*	25 *2*				
	1262.0 *3*	15 *3*				
	2441.88 *20*	100 *6*				
2467.38	1305.75 *10*	42 *4*				

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)

γ(^{148}Sm) (continued)

E(level)	Eγ†	Iγ‡	Mult.§	δ	α	Comments
2467.38	1917.25 *12*	100 *5*				
2472.48	1922.28 *25*	100 *12*				
	2472.41 *20*	71 *14*	D			
2490.004	583.4 *5*	1.5 *8*				
	594.89 *4*	14.7 *5*				
	756.581 *12*	23.1 *5*	M1,E2			
	826.30 *16*	2.0 *2*				
	1036 *1*	8.2 *16*				
	1309.778 *16*	36.1 *8*	M1+E2			δ: −0.21≤δ≤+1.47 from ^{148}Eu ε decay.
	1328.504 *15*	100 *2*	E1			
	1939.17 *4*	5.2 *2*				
2513.50	2513.48 *18*	100	D			
2524.101	296.21 *7*	3.2 *2*	M1		0.0836	
	310.14 *10*	6.0 *17*	M1		0.0740	
	620.04 *3*	11.9 *26*				
	790.20 *20*	2.4 *3*				
	859.90 *20*	2.1 *3*				
	929.85 *3*	72 *13*	[E1]			
	1069.82 *4*	13.0 *4*				
	1343.87 *3*	100 *8*	M1+E2	+0.20&		
	1362.640 *19*	35.3 *8*	E1			
	1973.81 *4*	3.2 *1*				
2532.39	157.8 *5*	9 *4*				
	938.10 *9*	100 *4*				
	1370.97 *17*	16.7 *12*				
2539.82	1378.31 *23*	100 *10*				
	1989.52 *25*	73 *7*				
2544.67	152.1 *2*	1.23				
	350.5 *2*					
	415.9 *1*	100 *5*	E1			
	449.0 *11*	35 *4*	E2		0.0172 *3*	
	638.5 *1*	32	E2			
2567.89	2017.65 *19*	100 *7*	M1+E2			δ: −0.46 *19* or 1/δ=+0.01 *13* from (n,n'γ).
	2567.0 *10*	30 *6*				
2570.832	356.47 *15*	8.7 *20*				
	423.5 *4*	27 *7*				
	539.1 *5*	7 *4*				
	667.170 *20*	76 *15*				
	976.50 *4*	57.6 *15*				
	1390.44 *14*	6.9 *8*				
	1409.160 *20*	100 *3*	D+Q			δ: +0.04 *12* if J=4−; >+0.47 or <−0.47 if J=3−, from ^{148}Eu ε decay.
2583.862	989.606 *10*	100 *2*	M1,E2			
	1422.21 *18*	2.9 *2*				
2633.15	1471.61 *16*	21.8 *20*				
	2082.88 *9*	100 *4*	E1			
2641.222	493.51 *20*	4.9 *18*				
	735.00 *5*	10.5 *18*	M1+E2	−1.1& *6*		
	736.90 *20*	1.8 *4*				
	745.87 *5*	4.6 *3*				
	1047.570 *20*	4.3 *25*				
	1460.630 *19*	100 *2*	M1+E2	+2.1& *16*		
2645.50	1051.25 *14*	100				
2673.07	478.4 *4*	22 *3*				
	1219.01 *9*	51 *4*				
	1492.81 *4*	100 *3*				
	1511.49 *7*	42 *3*				
	2122.75 *8*	13.9 *6*				
2675.20	460.80 *20*	100 *12*				
	643.90 *20*	84 *7*				
	1513.9 *4*	46 *12*				
2683.467	455.30 *15*	13.3 *14*				
	489.2 *5*	9 *5*				

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)

γ(^{148}Sm) (continued)

E(level)	Eγ†	Iγ‡	Mult.§	δ	α	Comments
2683.467	587.52 *6*	57.2 *21*				
	651.5 *5*	9 *5*				
	787.98 *18*	13.0 *18*				
	1089.154 *18*	100 *2*	M1			
	1503.200 *2*	91 *2*				
	1521.85 *3*	75 *2*				
2697.77	1517.81 *22*	24 *3*				
	1536.03 *22*	55 *8*				
	2147.47 *16*	100 *8*				
2698.539	166.15 *3*	18.4 *6*	M1,E2		0.397 *8*	
	504.57 *7*	37.6 *14*				
	587.52 *6*	31.9 *12*				
	602.62 *3*	9 *4*				
	667.170 *20*	18 *6*				
	792.59 *6*	32.1 *14*				
	1104.321 *16*	100 *2*	M1			
2701.92	1107.67 *3*	100 *3*				
	1540.27 *15*	61 *6*				
2704.6	2154.6 *3*	33.5 *22*				
	2704.6 *5*	100				
2713.334	385.9 *6*	7 *3*				
	485.90 *14*	7.4 *13*				
	979.843 *15*	100 *2*				
	1533.10 *20*	15.1 *13*				
	2163.9 *3*	2.6 *3*				
2714.98	586.2 *1*		E1			
	808.7 *1*		E2			
2716.05	810.12 *4*	74.8 *24*				
	1121.70 *20*	22.8 *24*				
	1535.84 *10*	100 *4*				
2719.8	2169.5 *5*	100				
2723.506	332.91 *13*	1.4 *3*				Eγ: 1985Si16 relate this γ to ^{150}Eu ε decay.
	495.25 *6*	35 *1*	M1		0.0221	
	575.97 *10*	6.2 *8*				
	817.5 *5*	1.4 *7*				
	828.61 *12*	4.7 *4*				
	1058.7 *5*	1.4 *7*				
	1269.3 *4*	1.8 *4*				
	1543.289 *27*	100 *3*	M1+E2			δ: −0.17 *11* or +1.35 *30* from ^{148}Eu ε decay.
	2173.28 *4*	31.2 *8*				
2727.31	832.82 *14*	27.6 *16*				
	1133.12 *8*	52.8 *24*				
	1547.14 *10*	100 *16*				
	1565.29 *11*	35.8 *16*				
2734.44	1269.3 *4*	100 *21*				
	1572.90 *20*	84 *7*				
2738.79	544.6 *2*					
	643.0 *2*					
2753.15	2202.88 *6*	100	M1+E2			δ: +0.05 *6* or −5.6 *+30−14* from (n,n'γ).
2762.1	2213.0 *10*	68 *4*				
	2762.1 *5*	100				
2801.752	161.00 *6*	0.62 *3*				
	474.2 *4*	0.11 *6*				
	574 *1*	0.42 *22*				
	654.220 *8*	34.8 *8*	M1+E2	+0.9& *3*		
	690.74 *3*	2.62 *6*				
	705.91 *18*	0.37 *9*				
	770.307 *10*	9.1 *2*				
	895.847 *10*	13.9 *3*	M1+E2	−0.20& *11*		
	906.87 *3*	4.5 *1*				
	1068.25 *10*	2.0 *2*				
	1207.473 *14*	13.6 *3*	E1+M2			δ: −0.36≤δ≤+1.52 from ^{148}Eu ε decay.

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)

γ(^{148}Sm) (continued)

E(level)	Eγ†	Iγ‡	Mult.§	δ	α	Comments
2801.752	1621.510 *20*	100 *2*	M1+E2			δ: +4.1 *6*, or +1.75 *50*, or +0.45 *10* from ^{148}Eu ε decay.
2806.73	1073.32 *16*	74 *5*				
	1626.38 *18*	54 *5*				
	1645.7 *3*	43 *5*				
	2256.36 *16*	100 *7*				
2807.35	92.2 *2*		E1		0.343 *6*	
	262.5	18	E1		0.0207	
	678.6 *1*	100 *6*	E2			
2815.584	92.6 *5*	10 *5*				
	291.3 *3*	5.7 *8*				
	441.23 *14*	6.1 *11*				
	587.52 *6*	62 *2*				
	704.4 *3*	10 *3*				
	1082.096 *17*	100 *2*				
	1151.3 *4*	10 *5*				
	1221.37 *4*	73 *3*	M1			
	1635.31 *3*	84 *2*	E1+M2			δ: −0.05≤δ≤+1.06 from ^{148}Eu ε decay.
	1654.02 *15*	62 *7*				
2828.13	1233.88 *14*	100				
2830.660	157.8 *5*	0.27 *14*				
	602.62 *3*	8.0 *2*				
	636.86 *7*	0.78 *14*				
	683.153 *7*	34.5 *8*	M1+E2			δ: +0.85 *+35–50* or −0.06 *+38–18* from ^{148}Eu ε decay.
	701.9 *5*	0.52 *27*				
	719.64 *7*	7.4 *4*				
	735.00 *5*	0.8 *4*	M1+E2	−1.1& *6*		
	799.23 *3*	11.3 *3*				
	924.75 *3*	8.5 *2*	M1			
	935.20 *20*	1.43 *14*				
	1097.18 *3*	3.35 *12*	M1			
	1236.374 *16*	11.0 *2*	E1			
	1650.436 *24*	100 *3*	M1+E2			δ: +0.53 *+6–5* or +2.92 *42*; +0.50 *15* or +1.75 *50* from ^{148}Eu ε decay.
2846.9	1685.2 *3*	100 *18*				
	2297.0 *5*	50 *14*				
2861.07	485.90 *14*	11 *2*				
	646.9 *5*	7 *3*				
	1127.69 *4*	58 *2*				
	1266.76 *5*	100 *2*	M1			
	1680.90 *15*	20.3 *25*				
	1699.54 *6*	10.5 *4*				
2862.06	1128.04 *15*	85 *6*				
	1682.91 *25*	55 *10*				
	2312.13 *21*	100 *7*				
2891.8	2341.5 *5*	100				
2908.13	1746.59 *22*	100				
2928.84	817.5 *5*	29 *15*				
	832.9 *5*	29 *15*				
	1748.58 *5*	100 *3*				
2931.98	1477.3 *4*	26 *5*				
	2381.89 *22*	100 *8*				
2941.1	2390.8 *7*	100				
2942.82	814.1 *2*	100				
2952.7	2402.4 *9*	100				
2967.6	936.38[c] *10*	100 *10*				
	2417.3 *7*	49 *10*				
2976.32	847.4 *2*	100	E2(+M1)			δ: large δ (from γ(θ) in (HI,xnγ)).
2980.50	1800.26 *19*	100				
2991.78	1258.41[c] *10*	45 *3*				
	1810.94 *25*	28 *3*				
	2441.88 *20*	100 *6*				

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)

γ(^{148}Sm) (continued)

E(level)	Eγ†	Iγ‡	Mult.§	δ	α	Comments
3014.1	2463.8 *6*	100				
3038.8	2489	<10				
	3038.5 *7*	100 *4*				
3050.5	1888.7 *4*	100 *15*				
	2500.6 *5*	76 *17*				
3063.25	1399.02 *22*	100				
3082.1	2531.9 *9*	8.8 *15*				
	3082.0 *4*	100 *3*				
3089.84	1909.4 *4*	78 *15*				
	1928.4 *3*	100 *16*				
	2539.6 *6*	82 *18*				
3095.25	702.6 *2*	100				
3107.8	2557.5 *4*	100				
3138.46	1976.91 *10*	100				
3153.5	1973.3 *3*	100				
3164.8	2003.3 *4*	100				
3178.0	2627.7 *15*	100				
3188.31	212.1 *2*					
	245.2 *2*					
	381.4 *2*					
	473.3 *2*					
	643.6 *2*					
	1059.5 *2*					
3189.8	2639.5 *8*	100				
3197.4	1743.3	100				Eγ: multiplet.
3216.15	671.4 *2*					
	1087.5 *2*					
3221.2	2041.0 *4*	100				
3224.83	2044.58 *19*	100				
3235.23	690.6 *1*	100	E2			
3253.45	158.2 *1*					
	446.1 *1*		M1+E2	−0.10[b] *5*	0.0287 *5*	
3255.3	3255.3 *5*	100				
3276.2	2725.9 *5*	100				
3291.5	3291.5 *5*	100				
3322.6	583.8 *2*	100				
3398.13	590.8 *1*		E1			
	683.1 *1*		E2			
	853.4[c] *3*					
3421.90	168.5 *1*					
	186.7 *1*		E1		0.0508	
	205.8 *2*					
	614.5 *1*		E2			
3451.9	3451.9 *5*	100				
3483.6	3483.6 *5*	100				
3526.57	310.6 *3*					
	338.4 *2*					
	719.1 *1*					
3534.9	3534.9 *5*	100				
3545.63	329.4 *2*					
	357.4 *1*					
	568.8 *3*					
	602.9 *1*					
	738.5 *2*					
3586.0	3586.0 *5*	100				
3614.76	216.6 *1*		E1		0.0342	
	807.4 *1*		E2			
3640.4	317.8 *2*	100				
3806.98	261.2 *2*					
	385.4 *2*					
	618.6 *1*					
3812.0	3811.9 *5*	100				
3843.6	3843.5 *5*	100				

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Adopted Levels, Gammas (continued)

$\gamma(^{148}Sm)$ (continued)

E(level)	Eγ†	Iγ‡	Mult.§	α
3884.3	3884.2 *5*	100		
3895.4	3895.3 *5*	100		
3992.62	570.6 *2*		E1	
	594.7 *2*			
	757.3 *1*		E2	
4104.39	489.6 *1*		E1	
	682.2 *2*		E1	
	706.2 *1*		E2	
	869.6 *2*			
4108.70	855.2 *1*	100		
4110.68	688.8 *1*	100		
4189.28	196.5 *2*			
	767.5 *2*			
4196.25	389.2 *2*			
	650.8 *1*			
	669.4 *2*			
4241.52	248.9 *2*			
	819.9 *3*			
4397.78	293.3 *2*		E1	0.01558
	783.0 *1*		E2	
4512.91	316.7 *2*			
	402.2 *2*			
	705.9 *2*			
4516.75	408.0 *1*	100		
4805.18	407.4 *2*		E1	
	616.0 *2*			
	694.7 *2*		E1	
	700.8 *2*		E2	
	812.6 *2*			
4842.69	732.0 *1*	100		
4864.69	466.9 *2*			
	623.3 *2*			
	675.3 *2*			
	754.0 *2*			
	760.3 *2*			
	872.0 *1*			
4889.71	373.0 *2*		E1	
	781.0 *1*		E2	
4909.65	799.0 *2*			
	805.2 *2*			
	917.1 *2*			
4917.55	400.5 *2*			
	404.6 *2*			
	721.4 *1*			
	808.9 *2*			
4951.75	843.0 *2*	100		
5087.55	170.0 *2*			
	198.0 *2*			
	244.9 *2*			
	976.8 *2*			
5136.13	331.0 *2*		E1	0.01150
	738.3 *2*		E2	
5217.20	265.4 *2*			
	327.6 *2*			
	819.3 *2*			
5274.93	385.1 *2*		E1	
	758.2 *1*		E2	
5287.77	445.0[d] *3*			
	774.9 *2*			
5320.28	103.1 *3*			
	184.1 *2*			
	233.0 *2*			
	402.8 *2*			

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Adopted Levels, Gammas (continued)

γ(^{148}Sm) (continued)

E(level)	Eγ†	Iγ‡	Mult.§	α
5320.28	430.6 *2*			
5496.39	360.3 *2*		E1	
	586.6 *2*			
	631.8 *2*			
	653.7 *2*		E1	
	691.2 *2*		E2	
5524.48	615.0 *2*			
	659.6 *2*			
	681.7 *2*			
	719.4 *2*			
5556.54	281.7[c] *5*			
	666.8 *1*			
5561.19	718.5 *1*	100		
5578.31	442.2 *2*			
	713.4 *2*			
	773.3 *2*			
5649.57	92.7 *3*			
	329.8 *2*			
	432.0 *5*			
	561.9 *2*			
	806.7[c] *5*			
5777.74	281.4 *3*			
	502.8 *1*			
5837.32	517.0 *2*	100		
5946.08	108.7 *2*		E1	0.220
	296.5 *2*			
	384.9 *2*		E1	
	421.6 *2*			
	449.7 *2*		E2	0.01710
6011.15	233.4 *2*			
	361.5 *2*			
6029.22	379.9 *2*			
	708.8 *2*			
6195.29	166.1 *1*			
	184.0 *2*			
	249[c]		E1	0.0237
	358.0 *2*		E2	0.0329
6392.23	381.0 *3*			
	742.6 *2*			
6477.07	466.0 *2*			
	531.0 *1*			
	827.6 *2*			
	915.9[c] *5*			
6557.5?	779.8 *3*	100		
6592.79	397.5 *2*		E1	
	646.6 *2*		E2	
6694.32	101.5 *1*			
	217.3 *1*			
	302.0 *2*			
6913.3	718.0 *2*	100		
7329.3	416.0 *3*		E1	
	736.5 *2*		E2	
7332.92	638.6 *1*	100		
7620.4	291.2 *2*		E1	0.01587
	707.1 *2*		E2	
7942.5	1248.2 *2*	100		
7977.6	357.2 *3*		E1	
	648.2 *2*		E2	
8010.61	677.7 *1*	100		
8214.5	236.9 *2*		E1	0.0270
	594.2 *2*		E2	
8358.8	348.0[c] *5*			
	1025.8 *2*			

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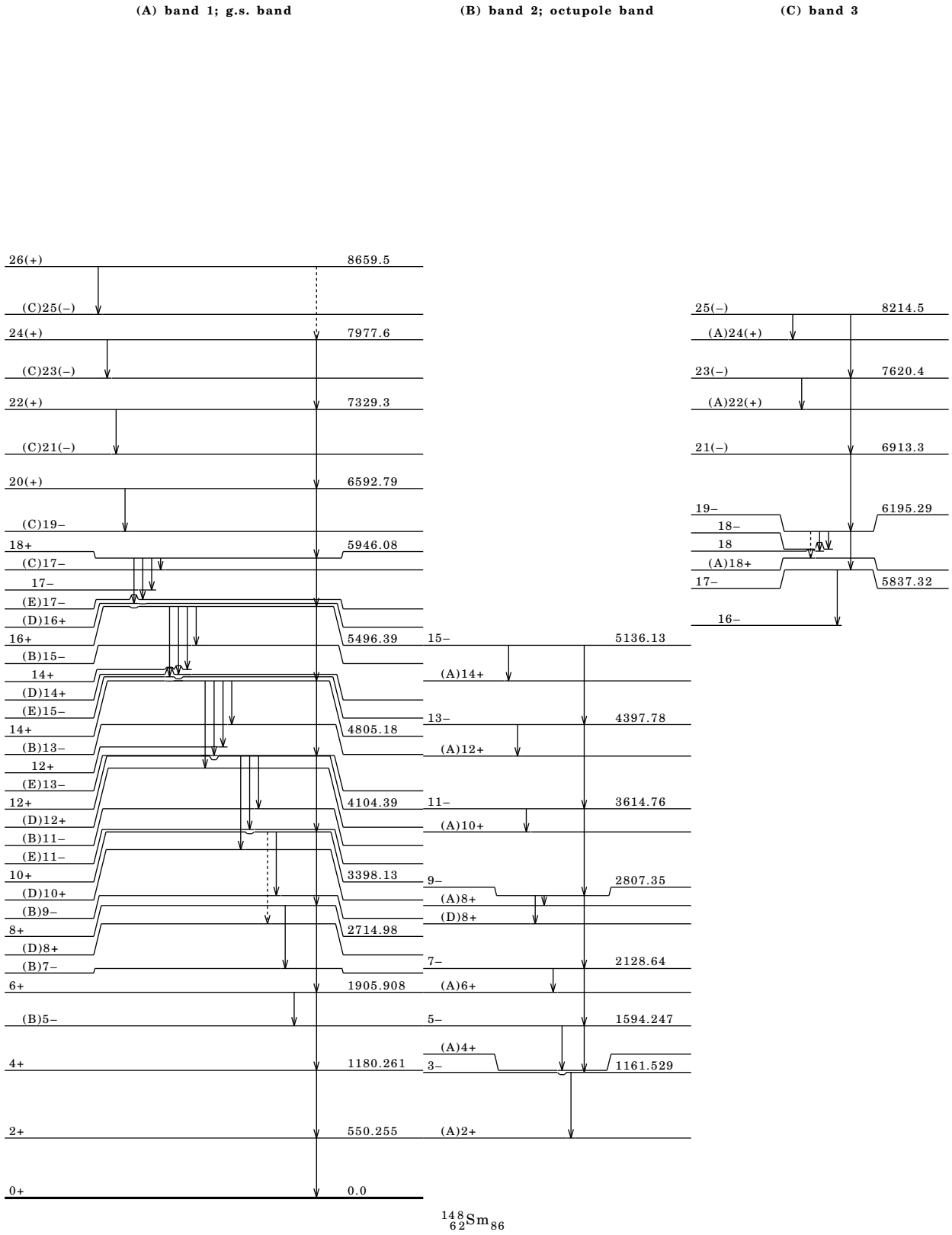
Adopted Levels, Gammas (continued)

$\gamma(^{148}Sm)$ (continued)

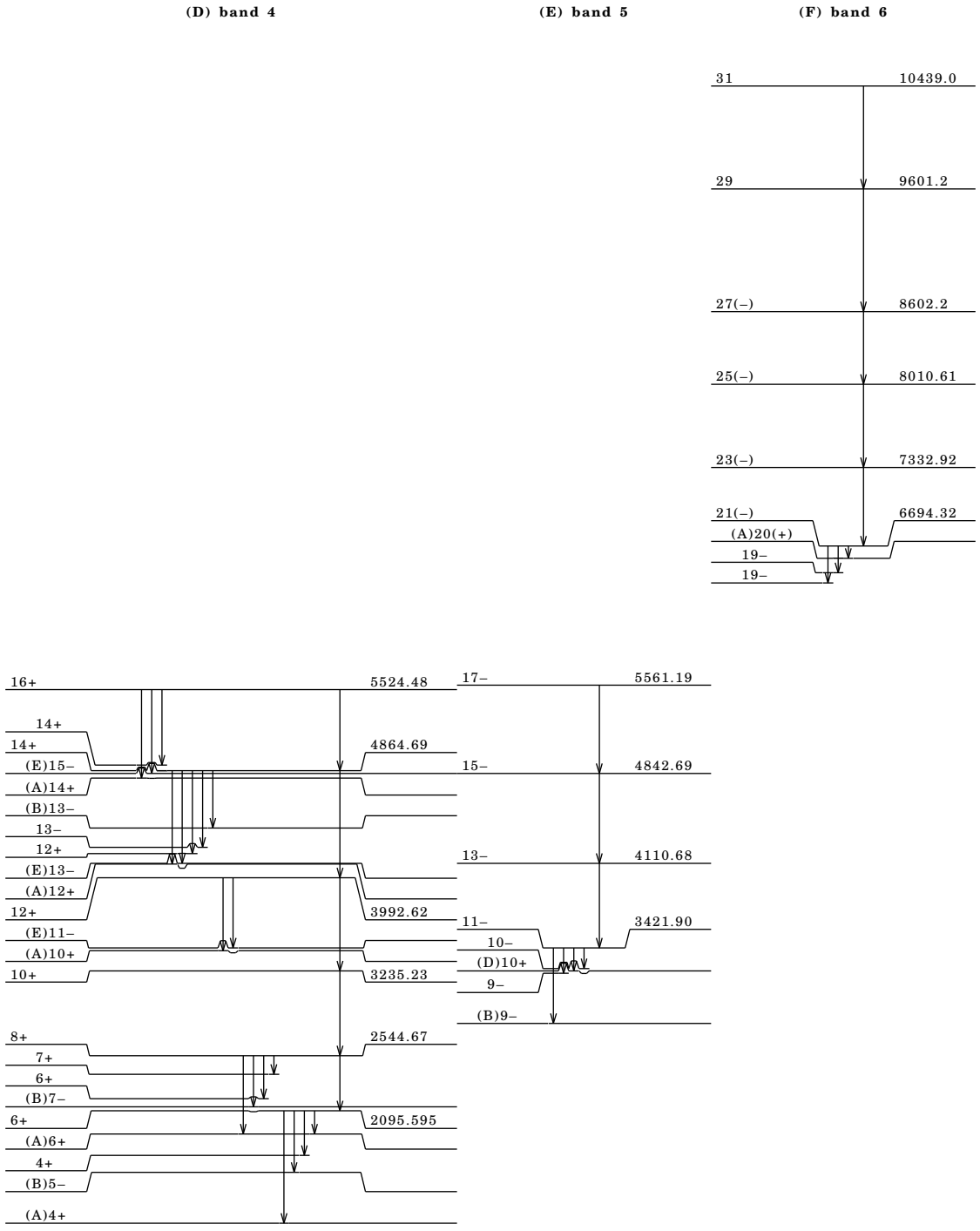
E(level)	Eγ†	Iγ‡	Comments
8602.2	591.6 *1*	100	
8659.5	445.0[d] *3*		
	681.4[c] *5*		
8931.5?	272.0 *5*	100	
9045.9	687.0 *3*		
	1035.3 *2*		
9601.2	999.0 *2*	100	
9898.2	1296.0		Eγ: doublet.
10439.0	837.8 *2*	100	
10609.1	1007.9 *2*	100	
11524.7	915.0[c] *5*		
	1085.7 *2*		

† From β^- decay, ε decay, (n,γ), (γ,γ'), (n,n'γ), Coulomb ex., and (HI,xnγ) data.
‡ Relative photon branching from each level.
§ From α(K)exp, γγ(θ) in ^{148}Pm β^- decay (5.370 d, and 41.29 d); Ice, γ(θ) of polarized nuclei, and γγ(θ) in ^{148}Eu ε decay; γ(θ) and linear polarization of gammas in (n,n'γ); γ(θ), DCO, α(K)exp, linear polarization of gammas and $T_{1/2}$ in (HI,xnγ). See individual data sets for details.
# From ^{148}Pm β^- decay (5.370 d).
@ From ^{148}Pm β^- decay (41.29 d).
& From ^{148}Eu ε decay.
a From (n,n'γ).
b From (HI,xnγ).
c Placement of transition in the level scheme is uncertain.
d Multiply placed.

Adopted Levels, Gammas (continued)



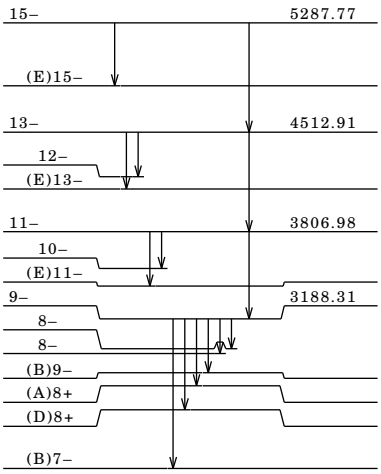
Adopted Levels, Gammas (continued)



$^{148}_{62}Sm_{86}$

Adopted Levels, Gammas (continued)

(G) band 7



$^{148}_{62}Sm_{86}$

^{148}Nd 2β⁻ Decay 2009Ba21

Parent ^{148}Nd: E=0.0; Jπ=0+; $T_{1/2}$=stable+; Q(g.s.)=1928.3 *19*; %2β⁻ decay=?

2009Ba21: measured in the Modane Underground Laboratory at 4800 m under earth using 400–cm^3 low–background HPGe measuring 3046 g of Nd_2O_3 powder placed in the detector cap for 11320.5 h.

Others: 1982Be20.

Level scheme quoted by 2009Ba21 from 2000Bh03.

^{148}Sm Levels

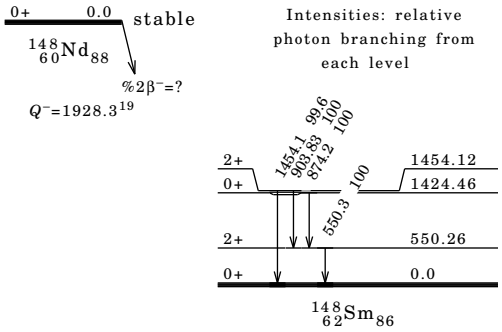
E(level)	Jπ	Comments
0.0	0+	
550.26	2+	$T_{1/2}$(0ν+2ν,ββ) to this level: >6.6×10^{20} y (2009Ba21); other: >0.03×10^{20} y (1982Be20).
1424.46	0+	$T_{1/2}$(0ν+2ν,ββ) to this level: >7.9×10^{20} y (2009Ba21).
1454.12	2+	$T_{1/2}$(0ν+2ν,ββ) to this level: >3.8×10^{20} y (2009Ba21); other: >0.027×10^{20} y (1982Be20).

γ(^{148}Sm)

E(level)	Eγ	Iγ†
550.26	550.3	100
1424.46	874.2	100
1454.12	903.83	100
	1454.1	99.6

† Relative branching from each level.

Decay Scheme



^{148}Pm β⁻ Decay (5.368 d) 1977Ka14

Parent ^{148}Pm: E=0.0; Jπ=1–; $T_{1/2}$=5.368 d *7*; Q(g.s.)=2471 *6*; %β⁻ decay=100.

Measured: γ (1984LaZZ,1977Ka14,1971Mo04,1971Ca23,1963Ba31), γγ (1984LaZZ,1977Ka14,1963Ba31,1962Sc04,1962Re04,1959Bh95), γγ(θ) (1977Ka14,1968Wy02,1964Ha17,1963Ba31,1962Re03,1962Sc04), βγ (1963Ba31,1962Sc04,1962Re03,1961El02,1959Bh95), ce (1963Ba31), analysis of non–unique β⁻ spectra (1983Ro06).

Decay scheme is that of 1977Ka14.

Observed β groups: 2480 *30* (50%), 1930 *30* (10%), 1020 *30* (40%) (1963Ba31), see also 1962Sc04, 1962Re03, 1930β–γ(θ) (1971Sh08,1970Gr09,1968Wy02,1968Am03,1967Na03,1963Ba31), 2480β shape factor (1972AmZX,1963Ba06).

^{148}Sm Levels

E(level)†	Jπ‡	Comments
0.0	0+	
550.274 *17*	2+	J=2 (1977Ka14).
1161.537 *24*	3–	J=3 (1963Ba31).
1424.46 *4*	0+	J=0 (1977Ka14).
1454.217 *23*	2+	J=2, most probably (1977Ka14).

Continued on next page (footnotes at end of table)

^{148}Pm β⁻ Decay (5.368 d) 1977Ka14 (continued)

^{148}Sm Levels (continued)

E(level)†	Jπ‡	Comments
1465.129 *19*	1−	J=1 or 3; J=3 ruled out by γ to 0+ (1977Ka14).
1664.160 *21*	2+	J=2, strongly preferred (1977Ka14).
1921.58 *20*	0+	
2057.961 *22*	2−	J=2 (1977Ka14).
2284.405 *21*	(1,2+)	J=1, most probably (1977Ka14).
2314.01 *15*	2+	J=2 (1977Ka14).

† From a least–squares fit to Eγ data.
‡ Adopted values; supporting assignments from this data set are given in comments.

β⁻ radiations

Eβ⁻	E(level)	Iβ⁻†‡	Log *ft*
(157 *6*)	2314.01	0.0091 *15*	8.71 *9*
(187 *6*)	2284.405	0.096 *4*	7.92 *5*
(413 *6*)	2057.961	1.36 *4*	7.885 *25*
(549 *6*)	1921.58	0.0138 *14*	10.29 *5*
(807 *6*)	1664.160	0.018 *4*	10.76 *10*
(1017 *6*)	1454.217	0.093 *4*	10.406 *21*
1020 *30*	1465.129	33.4 *8*	7.834 *14*
(1047 *6*)	1424.46	0.236 *9*	10.048 *19*
1930 *30*	550.274	9.4 *3*	9.450 *15*
2480 *30*	0.0	55.5 *11*	9.117 *10*

† From I(γ+ce) imbalance at each level.
‡ Absolute intensity per 100 decays.

γ(^{148}Sm)

α(K)exp were normalized to α(K)(550γ)=0.00825 (1963Ba31), and to α(K)(630γ)=0.0060 (1970GrYP), assuming both gammas to be E2.

Iγ normalization: from the measurement of the emission probability of the 1465γ=22.2% *5* (1971Ca23) using β⁻, γ and 4πβγ coin counting.

Eγ†	E(level)	Iγ‡&	Mult.§	δ#	α	Comments
303.59 *3*	1465.129	1.7 *2*				
362.8[a] *2*	2284.405	<0.1				
393.80 *3*	2057.961	0.7 *1*				
550.27 *3*	550.274	991 *7*	E2@		0.00998 *14*	α(K)exp=7.9×10^{-3} *6* (1970GrYP).
592.83 *3*	2057.961	15.9 *3*	M1+E2		0.011 *3*	δ: +11 *+11−4* or −0.20 *5* (1977Ka14).
611.26 *3*	1161.537	46.0 *5*	E1@		0.00277 *4*	α(K)exp=2.5×10^{-3} *8* (1970GrYP). δ: +0.026 *13* (1977Ka14); δ≤0.18 from ≤3%, M2 mixing (1970GrYP).
819.27 *3*	2284.405	0.6 *1*				
874.18 *3*	1424.46	10.6 *3*	E2		0.00332 *5*	
896.42 *3*	2057.961	44.2 *4*	M1+E2	+1.32 *9*	0.00386 *9*	δ: from 1977Ka14.
903.94 *3*	1454.217	1.9 *1*	M1+E2	+2.32 *10*	0.00339 *6*	
914.85 *3*	1465.129	516 *4*	E1@		0.00122 *2*	α(K)exp=6.8×10^{-4} *19* (1963Ba31). δ: δ(M2/E1)=0.000 *4* (1977Ka14).
1113.88 *3*	1664.160	1.0 *1*	M1+E2	−0.565 *21*	0.00279 *5*	
1152.5 *2*	2314.01	0.13 *6*	E1+M2	−0.10 *9*	0.00086 *15*	
1371.3 *2*	1921.58	0.62 *6*				
1454.21 *3*	1454.217	2.3 *1*	E2		0.00123 *2*	
1465.12 *3*	1465.129	1000	E1		0.00070 *1*	Iγ: absolute Iγ=22.2% *5* (1971Ca23), 24.3% *25* (1971Mo04), 24% *2* (1962Re03), 23% *5* (1963Ba31). α(K)exp=4.7×10^{-4} *14* (1963Ba31).
1507.68 *3*	2057.961	0.25 *4*				
1664.15 *3*	1664.160	0.51 *5*	E2		0.00104 *2*	
1734.12 *3*	2284.405	1.74 *3*				
1763.7 *2*	2314.01	0.28 *3*	M1+E2	+2.2 *5*	0.00104 *3*	

Continued on next page (footnotes at end of table)

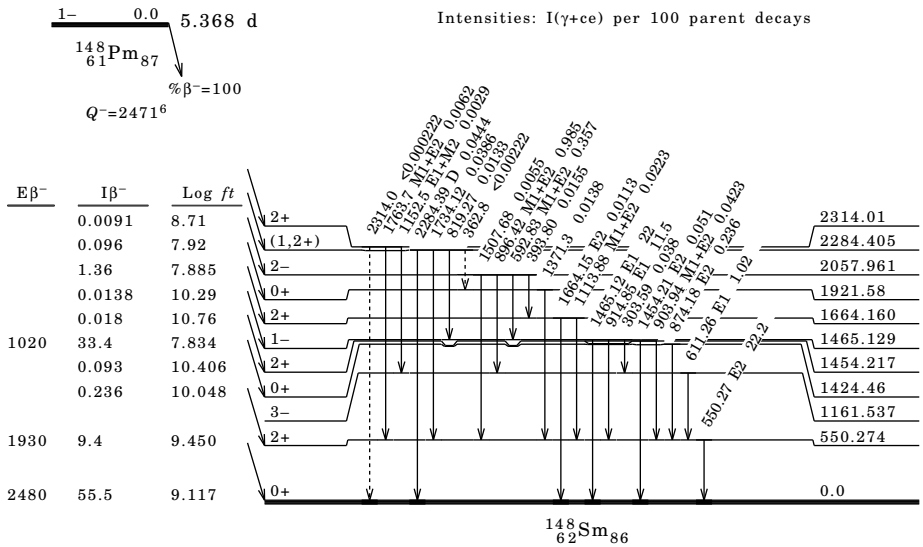
^{148}Pm β⁻ Decay (5.368 d) 1977Ka14 (continued)

γ(^{148}Sm) (continued)

Eγ†	E(level)	Iγ‡&	Mult.§
2284.39 *3*	2284.405	2.0 *1*	D
2314.0[a] *2*	2314.01	<0.01	

† From 1977Ka14.
‡ Relative intensity from 1977Ka14.
§ From adopted gammas. Supporting data from this decay are given in comments.
# From adopted gammas.
@ From α(K)exp.
& For absolute intensity per 100 decays, multiply by 0.0222 *5*.
a Placement of transition in the level scheme is uncertain.

Decay Scheme



^{148}Pm β⁻ Decay (41.29 d) 1977Ka14

Parent ^{148}Pm: E=137.9 *3*; Jπ=5−,6−; $T_{1/2}$=41.29 d *11*; Q(g.s.)=2471 *6*; %β⁻ decay=95.8 *6*.
See also ^{148}Pm IT decay.
Measured: γ (1984LaZZ,1977Ka14,1971Mo04,1970GrYP,1963Ba31), γγ (1984LaZZ,1977Ka14,1963Ba31,1962Re03), γγ(θ) (1977Ka14,1963Ba31,1962Sc04,1962Re03), β⁻ (1963Ba31), ce (1963Ba31,1970GrYP).
Decay scheme is that of 1977Ka14.

^{148}Sm Levels

E(level)†	Jπ‡	Comments
0.0	0+	
550.27 *3*	2+	J=2 (1977Ka14).
1161.53 *4*	3−	J=3 if J(1595)=5 (1963Ba31); J=3 or 4, J=4 excluded from γ intensity considerations (1977Ka14).
1180.24 *4*	4+	J=4 consistent with γγ(θ) (1963Ba31); J=4 (1977Ka14).
1594.31 *4*	5−	J=3 or 5; γ from J=6 excludes J=3 (1977Ka14).
1733.48 *4*	4+	J=4 (1977Ka14).
1894.93 *12*	4+	J=4 probable (1977Ka14).
1905.94 *5*	6+	J=6 (1963Ba31); J=6 (1977Ka14).
2095.57 *4*	6+	J=6 (1963Ba31); J=4 or 6 with J=6 favored (1977Ka14).
2194.05 *4*	6+	J=6 (1963Ba31); J=6 (1977Ka14).

Footnotes continued on next page

^{148}Pm β⁻ Decay (41.29 d) 1977Ka14 (continued)

^{148}Sm Levels (continued)

† From a least–squares fit to Eγ data.
‡ Adopted values; supporting assignments from this data set are given in comments.

β⁻ radiations

Eβ⁻	E(level)	Iβ⁻†‡	Log *ft*
(415 *6*)	2194.05	56.4 *5*	7.178 *22*
(513 *6*)	2095.57	19.5 *3*	7.949 *19*
(703 *6*)	1905.94	22.9 *4*	8.348 *16*
(1015 *6*)	1594.31	0.96 *23*	10.29 *11*

† From I(γ+ce) balance at each level and assuming no β–feeding to the g.s.
‡ For β⁻ intensity per 100 decays, multiply by 0.958 *6*.

γ(^{148}Sm)

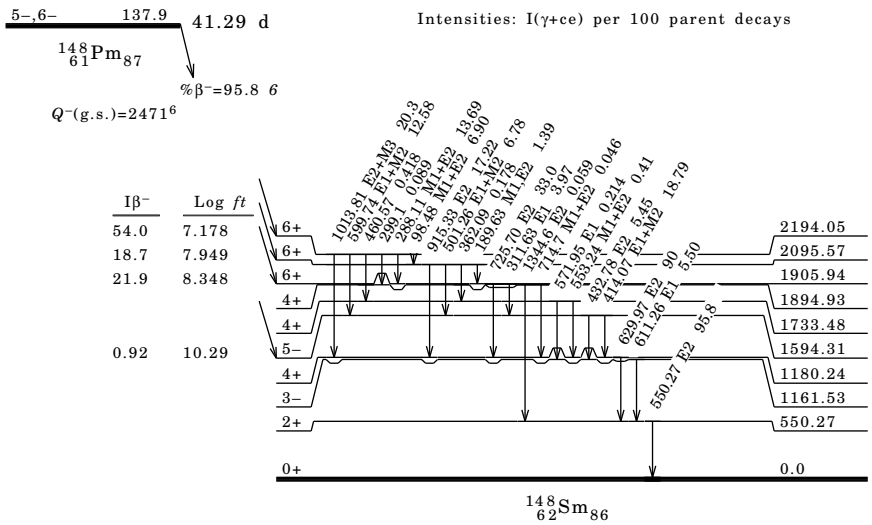
α(K)exp were normalized to α(K)(550γ)=0.00825 (1963Ba31), and to α(K)(630γ)=0.0060 (1970GrYP), assuming both gammas to be E2.
Iγ normalization: I(γ+ce)(550γ)=95.8% *6*, and assuming no β⁻ decay to g.s.

Eγ	E(level)	Iγ†#	Mult.‡	δ§	α	Comments
98.48 *3*	2194.05	2.78 *5*	M1+E2	0.18	1.79	α(K)exp=1.0 *2* (1970GrYP), 1.9 *8* (1963Ba31).
189.63 *3*	2095.57	1.24 *3*	M1,E2		0.264 *16*	α(K)exp=0.11 *4* (1970GrYP), 0.17≈(1963Ba31).
288.11 *3*	2194.05	14.11 *10*	M1+E2	+0.088 *21*	0.0898	α(K)exp=0.048 *9* (1970GrYP), 0.062 *20* (1963Ba31). δ: from 1977Ka14.
299.1 *2*	2194.05	0.10 *2*				
311.63 *3*	1905.94	4.40 *5*	E1		0.01337	α(K)exp=0.011 *2* (1970GrYP), 0.012 *4* (1963Ba31). δ(M2/E1)=+0.003 *19* (1977Ka14).
362.09 *3*	2095.57	0.20 *2*				
414.07 *3*	1594.31	20.97 *17*	E1+M2	−0.013 *10*	0.00670 *11*	α(K)exp=0.0065 *20* (1963Ba31).
432.78 *3*	1594.31	6.01 *7*	E2		0.0190	Mult.: α(K)exp=0.017 *5* (1963Ba31), 0.017 *3* (1970GrYP). δ(M3/E2)=+0.25 *37* (1977Ka14).
460.57 *3*	2194.05	0.47 *2*				
501.26 *3*	2095.57	7.58 *8*	E1+M2	−0.017 *14*	0.00431 *8*	α(K)exp=0.0032 *8* (1970GrYP), 0.0033 *9* (1963Ba31).
550.27 *3*	550.27	106.6 *8*	E2		0.00998 *14*	α(K)exp=0.0079 *6* (1970GrYP).
553.24 *3*	1733.48	0.45 *4*	M1+E2	+1.66 *20*	0.0117 *4*	
571.95 *3*	1733.48	0.24 *1*	E1		0.00320 *5*	
599.74 *3*	2194.05	14.09 *13*	E1+M2	−0.021 *11*	0.00290 *5*	α(K)exp=0.0020 *7* (1970GrYP).
611.26 *3*	1161.53	6.16 *10*	E1		0.00277 *4*	α(K)exp=0.0025 *8* (1970GrYP), 0.0024 *8* (1963Ba31).
629.97 *3*	1180.24	100	E2		0.00710 *10*	α(K)exp=0.0060 *12* (1963Ba31). δ: δ(M3/E2)=−0.007 *5* (1977Ka14).
714.7 *2*	1894.93	0.051 *6*	M1+E2		0.0070 *18*	
725.70 *3*	1905.94	36.9 *3*	E2		0.00506 *7*	α(K)exp=0.0046 *4* (1970GrYP), 0.0038 *7* (1963Ba31). δ(M3/E2)=+0.002 *8* (1977Ka14).
915.33 *3*	2095.57	19.29 *20*	E2		0.00300 *5*	α(K)exp=0.0025 *4* (1970GrYP), 0.0025 *5* (1963Ba31). δ(M3/E2)=+0.016 *27* (1977Ka14).
1013.81 *3*	2194.05	22.79 *19*	E2+M3	−0.025 *14*	0.00243 *4*	α(K)exp=0.0024 *4* (1970GrYP), 0.0020 *4* (1963Ba31).
1344.6 *2*	1894.93	0.066 *5*	E2		0.00139 *2*	

† Relative intensity from 1977Ka14.
‡ From adopted gammas. Supporting data from this decay are from α(K)exp (1963Ba31,1970GrYP), γγ(θ) (1977Ka14).
§ From adopted gammas. δ from γγ(θ) (1977Ka14) are given in comments.
# For absolute intensity per 100 decays, multiply by 0.890 *9*.

^{148}Pm β⁻ Decay (41.29 d) 1977Ka14 (continued)

Decay Scheme



^{148}Eu ε Decay 1985Si16,1987Ad08

Parent ^{148}Eu: E=0.0; Jπ=5−; $T_{1/2}$=54.5 d *5*; Q(g.s.)=3037 *10*; %ε+%β⁺ decay=100.

Measured: Eγ, Iγ (1987Ad08,1985Si16,1985AdZU,1984LaZZ,1978Ad07,1973To01,1967Cl01), γγ (1987Ad08,1985Si16,1984LaZZ,1978Ad07,1967Cl01), ce (1967Cl01,1968Ha39,1978Ad07), γγ(θ), (1985Si16,1962Su02,1962Sc04), γ(θ) of polarized nuclei (1984Kr09), β⁺ (1970Ag01,1963Ba32).

Level scheme is that of 1987Ad08 in general with some changes in placement from 1985Si16.

Eβ+=920 *30* 0.13% *4* (1963Ba32); 940 *40* (0.13%), 540 *30* (0.06% *2*) (1970Ag01).

^{148}Sm Levels

E(level)†	Jπ‡	Comments
0.0	0+	
550.268 *11*	2+	Jπ=2+ (1984Kr09).
1161.534 *12*	3−	Jπ=3− (1984Kr09).
1180.257 *12*	4+	Jπ=4+ (1984Kr09).
1454.143 *13*	2+	
1465.19 *25*	1−	Jπ=1− (1987Ad08).
1594.252 *12*	5−	Jπ=5− (1984Kr09),.
1664.303 *22*	2+	
1733.476 *12*	4+	Jπ=4+ (1984Kr09), 4+ (1985Si16), 4+ (1987Ad08).
1894.832 *14*	4+	Jπ=4+ (1984Kr09), 4+ (1985Si16), 4+ (1987Ad08).
1903.728 *18*	3+	Jπ=3+,4+ (1984Kr09), 3+ (1987Ad08).
1905.864 *13*	6+	Jπ=6+ (1984Kr09).
2031.423 *13*	4−	Jπ=4− (1984Kr09), 4− (1985Si16), 4− (1987Ad08).
2095.593 *13*	6+	Jπ=6+ (1984Kr09), 6+ (1985Si16), 6+ (1987Ad08).
2111.058 *13*	4+	Jπ=3+ (1984Kr09), (4)+ (1985Si16), 4+ (1987Ad08).
2128.62 *7*	7−	Jπ=7− (1985Si16), 7− (1987Ad08).
2147.516 *13*	5+	Jπ=5+ (1984Kr09), 5+ (1985Si16), 5+ (1987Ad08).
2194.052 *14*	6+	Jπ=6+ (1987Ad08).
2214.217 *15*	5+	Jπ=5+ (1984Kr09), 5+ (1985Si16), 5+ (1987Ad08).
2228.057 *17*	4+	Jπ=4+ (1984Kr09), 4+ (1985Si16), 4+ (1987Ad08).
2318.5? *5*	+	E(level): from 1985Si16; 1987Ad08 could find no evidence to support the existence of this level.
2327.426 *14*	4+	Jπ=4+ (1984Kr09), 4+ (1985Si16), 4+ (1987Ad08). E(level): (n,γ) E=0.020–1.0 keV data show two closely–spaced levels at 2327.09 *5* Jπ=4+, and 2327.62 *9* Jπ=3+. Eγ=1166.08 and 1777.35 are assigned to the level with higher energy. It is possible that these levels were not completely resolved in the ε decay data.
2339.19 *18*	3−	Jπ=(3−) (1987Ad08).
2374.395 *16*	5+,6+	Jπ=5+,6+ (1984Kr09), 5+ (1987Ad08).

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^{148}Eu ε Decay 1985Si16,1987Ad08 (continued)

^{148}Sm Levels (continued)

E(level)†	Jπ‡	Comments
2390.43 *7*	3+	Jπ=3+,4+ (1987Ad08).
2391.77 *14*	7+	
2490.017 *14*	4+	Jπ=4+ (1984Kr09), 4+ (1985Si16), 4+ (1987Ad08).
2524.390 *16*	4+	Jπ=4+ (1984Kr09), 4+ (1985Si16), 4+ (1987Ad08).
2532.38 *4*	4−,5−	Jπ=4−,5− (1987Ad08).
2570.794 *19*	4(−)	Jπ=3−,4− (1984Kr09), (4−) (1985Si16), 4− (1987Ad08).
2583.861 *16*	4(−)	Jπ=4−,5− (1987Ad08).
2641.237 *17*	5+	Jπ=4+,5+ (1984Kr09), 4+ (1985Si16), 4+,5+ (1987Ad08).
2673.07 *4*	4+	Jπ=4+ (1987Ad08).
2675.20 *14*	(3+,4,5−)	
2683.464 *12*	4−,5−	Jπ=4−,5− (1987Ad08).
2698.531 *16*	5−,6−	Jπ=5−,6− (1987Ad08).
2701.92 *4*	4(−),3(−)	
2713.332 *20*	3+,4+	Jπ=3+,4+ (1987Ad08).
2716.00 *4*	(4+,5,6+)	
2723.517 *23*	4+	Jπ=4+, (3+) (1984Kr09), 3+,4+ (1987Ad08).
2727.31 *6*	5+	
2734.45 *19*	(3)	Jπ=(3−) (1987Ad08).
2801.736 *13*	5+	Jπ=5+ (1984Kr09), 5+ (1985Si16), 5+ (1987Ad08).
2815.583 *18*	4−	Jπ=4− (1984Kr09), 4− (1987Ad08).
2830.665 *14*	5+	Jπ=5+ (1984Kr09), 5+ (1985Si16), 5+ (1987Ad08).
2861.08 *3*	4−,5−	Jπ=4−,5− (1987Ad08).
2906.3? *15*	3−,4−	E(level): from 1985Si16.
2928.84 *5*	(4,5,6)+	

† From a least-squares fit to Eγ data.
‡ Adopted values; supporting arguments from this data set are indicated in comments.

β⁺,ε Data

Eε	E(level)	Iε†§	Log *ft*	I(ε+β⁺)‡§
(108 *10*)	2928.84	0.055 *8*	8.49 *15*	0.055 *8*
(176 *10*)	2861.08	0.300 *11*	8.35 *7*	0.300 *11*
(206 *10*)	2830.665	6.98 *20*	7.15 *6*	6.98 *20*
(221 *10*)	2815.583	0.80 *3*	8.17 *6*	0.80 *3*
(235 *10*)	2801.736	8.48 *23*	7.21 *5*	8.48 *23*
(303 *10*)	2734.45	0.025 *3*	10.00 *7*	0.025 *3*
(310 *10*)	2727.31	0.191 *16*	9.14 *5*	0.191 *16*
(313 *10*)	2723.517	1.34 *4*	8.30 *4*	1.34 *4*
(321 *10*)	2716.00	0.180 *7*	9.20 *4*	0.180 *7*
(324 *10*)	2713.332	0.282 *12*	9.01 *4*	0.282 *12*
(335 *10*)	2701.92	0.210 *10*	9.17 *4*	0.210 *10*
(338 *10*)	2698.531	0.93 *4*	8.54 *4*	0.93 *4*
(354 *10*)	2683.464	0.755 *25*	8.67 *4*	0.755 *25*
(362 *10*)	2675.20	0.043 *4*	9.94 *5*	0.043 *4*
(364 *10*)	2673.07	0.216 *10*	9.24 *4*	0.216 *10*
(396 *10*)	2641.237	1.44 *6*	8.50 *3*	1.44 *6*
(453 *10*)	2583.861	0.479 *15*	9.11 *3*	0.479 *15*
(466 *10*)	2570.794	0.40 *3*	9.21 *4*	0.40 *3*
(505 *10*)	2532.38	0.052 *8*	10.17 *7*	0.052 *8*
(513 *10*)	2524.390	4.2 *3*	8.28 *4*	4.2 *3*
(547 *10*)	2490.017	2.51 *7*	8.565 *22*	2.51 *7*
(645 *10*)	2391.77	0.016 *3*	11.07^{1u} *9*	0.016 *3*
(647 *10*)	2390.43	0.017 *6*	11.04^{1u} *16*	0.017 *6*
(663 *10*)	2374.395	0.635 *19*	9.341 *20*	0.635 *19*
(698 *10*)	2339.19	0.0056 *6*	11.44 *5*	0.0056 *6*
(710 *10*)	2327.426	2.41 *9*	8.825 *22*	2.41 *9*
(809 *10*)	2228.057	0.29 *5*	9.86 *8*	0.29 *5*
(823 *10*)	2214.217	9.4 *3*	8.369 *19*	9.4 *3*
(843 *10*)	2194.052	1.35 *4*	9.234 *18*	1.35 *4*
(889 *10*)	2147.516	17.2 *23*	8.18 *6*	17.2 *23*

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^{148}Eu ε Decay 1985Si16,1987Ad08 (continued)

β⁺,ε Data (continued)

Eε	E(level)	Iβ⁺§	Iε†§	Log *ft*	I(ε+β⁺)‡§
(908 *10*)	2128.62		0.106 *25*	10.41 *11*	0.106 *25*
(926 *10*)	2111.058		2.7 *3*	9.02 *5*	2.7 *3*
(941 *10*)	2095.593		3.34 *10*	8.941 *17*	3.34 *10*
(1006 *10*)	2031.423		4.43 *16*	8.879 *19*	4.43 *16*
(1131 *10*)	1905.864		10.2 *4*	8.623 *20*	10.2 *4*
(1142 *10*)	1894.832		2.62 *18*	9.22 *4*	2.62 *18*
(1304 *10*)	1733.476	0.0040 *10*	12.7 *23*	8.65 *8*	12.7 *23*
1942 *30*	1180.257	0.09 *7*	4 *3*	9.5 *4*	4 *3*

† From analysis of 1987Ad08 data.
‡ From intensity balance at each level.
§ Absolute intensity per 100 decays.

γ(^{148}Sm)

Iγ normalization: from ΣI(γ+ce) to g.s.=100, assuming ε decay to g.s.=0.0.

Eγ‡	E(level)	Iγ‡d	Mult.†a	δ†a	α	Comments
66.72 *9*	2214.217	0.36 *4*	M1		5.43	
92.6§ *5*	2815.583	0.27b *14*				
98.530 *20*	2194.052	1.41 *4*	M1+E2	0.18	1.79 *3*	δ: from M1/E2=30 (1968Ha39).
116.01 *4*	2147.516	2.09 *6*	E1		0.184	
x151.6 *3*		0.160 *20*				Iγ: <0.14 (1985Si16).
157.8§f *5*	2532.38	0.14bf *7*				
	2830.665	0.14bf *7*				
161.00 *6*	2801.736	0.400 *20*				
166.15 *3*	2698.531	0.94 *3*	M1,E2		0.397 *8*	
182.83 *3*	2214.217	2.1 *4*	E1		0.0537	
189.721 *16*	2095.593	2.48 *6*	M1,E2		0.264 *16*	
216.16e *6*	2111.058	0.42e *3*	M1		0.195	
	2327.426	0.27ce *2*				
x218.3 *3*		0.110 *20*				
222.71 *12*	2128.62	0.32 *3*	E1		0.0318	
241.653 *15*	2147.516	20.0 *4*	M1+E2	−0.34 *11*	0.141 *3*	δ: from γ(θ,T) (1984Kr09).
243.83 *4*	2147.516	4.50 *14*	E2		0.1086	
252.60 *3*	2147.516	1.86 *6*	M1,E2		0.112 *16*	
x255.35 *13*		0.310 *20*				
279.30 *5*	1733.476	1.17 *5*	E2		0.0703	
288.141 *13*	2194.052	4.82 *11*	M1+E2	+0.088 *21*	0.0898	
291.3 *3*	2815.583	0.150 *20*				
296.21 *7*	2524.390	0.76 *4*	M1		0.0836	
300.65 *7*	1894.832	0.76 *4*	[E1]		0.01463	
308.45§ *10*	2214.217	1.04 *10*	E2,M1		0.063 *12*	Eγ,Iγ: 307.4 *2*, 0.74 *7* (1987Ad08).
310.14e *10*	2214.217	2.1e *4*	E2		0.0507	Eγ,Iγ: 309.51 *19*, 2.9 *2* unplaced in 1987Ad08.
	2524.390	1.4e *4*	M1		0.0740	
311.570 *20*	1905.864	24.9 *5*	E1		0.01337	δ(M2/E1)=+0.03 *7* from γ(θ,T)(1984Kr09).
319.270 *20*	2214.217	2.16 *6*	M1,E2		0.057 *12*	
322 *1*	2228.057	0.27 *14*				Eγ: from 1968Ha39. Observed also in 1985Si16.
332.91 *13*	2723.517	0.14 *3*				Eγ: 1985Si16 suggest this γ belongs to ^{150}Eu ε decay.
356.47 *15*	2570.794	0.17 *4*				
362.5 *3*	2095.593	0.36 *6*				Eγ,Iγ: 1985Si16 place a 361.5–keV γ from 2886 level based on γγ data.
377.560 *20*	2111.058	2.2 *5*	M1		0.0442	Mult.: M1 from 1985Si16 but E1(E2) in 1987Ad08.
385.9 *6*	2713.332	0.20 *9*				
414.028 *12*	1594.252	143 *4*	E1+M2	−0.013 *10*	0.00670 *11*	

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^{148}Eu ε Decay 1985Si16,1987Ad08 (continued)

γ(^{148}Sm) (continued)

Eγ[‡]	E(level)	Iγ[‡d]	Mult.[†a]	δ[†a]	α	Comments
414.057 *16*	2147.516	140 *7*	M1+E2	−1.8 *8*	0.025 *4*	δ: from γ(θ,T). Second possible value δ=−0.38 +*16*−*34* is not compatible with α(K)exp data (1984Kr09). δ=1.9 +*25*−*6* from E2=78% 17 (1987Ad08).
423.5[f] *4*	2327.426	0.53[f] *13*				
	2570.794	0.53[f] *13*				
432.745[e] *8*	1594.252	39.5[e] *21*	E2		0.0190	δ(M3/E2)=−0.04 *8* from γ(θ,T)(1984Kr09).
	2327.426	1.4[e] *7*	M1		0.0311	
437.18 *4*	2031.423	2.66 *8*	M1		0.0303	
441.23 *14*	2815.583	0.16 *3*				
446.52 *6*	2111.058	0.56 *4*	(E2)		0.01744	
449[§] *1*	1903.728	0.7 *3*				
455.30 *15*	2683.464	0.38 *4*				
460.80[f] *20*	2194.052	0.26[f] *3*				Placement proposed only by 1985Si16.
	2675.20	0.26[f] *3*				Placement proposed by 1987Ad08.
468.500 *12*	2374.395	5.85 *13*	M1+E2	≥0.41	0.020 *5*	δ: from γ(θ,T) (1984Kr09).
474.2 *4*	2801.736	0.07 *4*				
478.4 *4*	2673.07	0.30 *4*				
480.89 *8*	2214.217	1.31 *6*	M1		0.0238	
485.90[#f] *14*	2391.77	0.22[f] *4*	M1+E2	−0.15 *8*	0.0229 *5*	
	2713.332	0.22[f] *4*				
	2861.08	0.22[f] *4*				
489.2[§] *5*	2683.464	0.27 *14*				
493.51[§] *20*	2641.237	0.8 *3*				
495.25 *6*	2228.057	0.66 *28*	M1		0.0221	
	2723.517	3.56[c] *11*	M1		0.0221	
501.312 *11*	2095.593	13.5 *3*	E1+M2	−0.017 *14*	0.00431 *8*	δ(M2/E1)=−0.16 +*15*−*19* from γ(θ,T) (1984Kr09); =0.20 from E1/M2=24 (1968Ha39).
504.57 *7*	2698.531	1.92 *7*				
516.793 *14*	2111.058	5.89 *19*	E1+M2	0.48 *8*	0.015 *3*	δ: calculated from %E1=81 *5* (1987Ad08).
532[§g] *1*	2906.3?	0.27 *14*				
534.38 *7*	2128.62	1.4 *3*	E2		0.01077	
539.1[§] *5*	2570.794	0.14 *7*				
550.284 *12*	550.268	1370 *30*	E2		0.00998 *14*	
553.231 *14*	1733.476	180 *30*	M1+E2	+1.66 *20*	0.0117 *4*	Mult.: δ from γ(θ,T) (1984Kr09). The mixing ratio, $\lvert q(E_0/E_2)\rvert$=0.55 *14*; and the ratio $X(E_0/E_2)$=0.014 *7*, both calculated using the given δ, Rossel conversion coefficients (1978Ro22), and weighted average of α(K)exp= 11.7×10^{-3} *10* (1984Kr09).
553.260 *15*	2147.516	70 *30*	E1		0.00344 *5*	
571.962 *7*	1733.476	133 *3*	E1		0.00320 *5*	δ(M2/E1)=+0.05 *2* (1984Kr09), −0.10 *10*, +0.00 *5*, >+9, or >+0.65 (1985Si16).
574[§] *1*	2801.736	0.27 *14*				
575.97[§] *10*	2723.517	0.64 *8*				
583.4[§] *5*	2490.017	0.27 *14*				
587.52[#f] *6*	2683.464	1.63[f] *6*				
	2698.531	1.63[f] *6*				
	2815.583	1.63[f] *6*				
594.89 *4*	2490.017	2.69 *9*				
599.81 *3*	2194.052	4.78 *9*	E1+M2	−0.021 *11*	0.00290 *5*	
602.62[#e] *3*	2698.531	0.44[ce] *22*				
	2830.665	4.11[ce] *8*				
611.293 *8*	1161.534	285 *6*	E1		0.00277 *4*	δ(M2/E1)=+0.03 *2* from γ(θ,T) (1984Kr09).
620.04[e] *3*	2214.217	12.5[e] *8*	E1+M2	+0.13 *5*	0.0033 *5*	δ: from 1984Kr09.
	2524.390	2.8[ce] *6*				
629.987 *8*	1180.257	1000 *22*	E2		0.00710 *10*	δ(M3/E2)=−0.01 *6* from γ(θ,T) (1984Kr09).
636.86 *7*	2830.665	0.40 *7*				
643.90 *20*	2675.20	0.218 *19*				
646.9[§] *5*	2861.08	0.14 *7*				
651.5[§] *5*	2683.464	0.27 *14*				

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^{148}Eu ε Decay 1985Si16,1987Ad08 (continued)

γ(^{148}Sm) (continued)

Eγ[‡]	E(level)	Iγ[‡d]	Mult.[†a]	δ[†a]	α	Comments
654.220 *8*	2801.736	22.5 *5*	M1+E2	+0.9 *3*	0.0090 *9*	δ: from γ(θ,T) (1984Kr09).
656.93 *3*	2111.058	1.96 *12*				
662.79 *5*	2327.426	1.39 *5*				
667.170[e] *20*	2570.794	1.5[ce] *3*				
	2698.531	0.9[ce] *3*				
683.153 *7*	2830.665	17.8 *4*	M1+E2		0.0079 *21*	Mult.: δ=+0.85 *+35–50* or −0.06 *+38–18* (1984Kr09).
690.74 *3*	2801.736	1.69 *4*				
701.9[§] *5*	2830.665	0.27 *14*				
704.4[§] *3*	2815.583	0.27 *7*				
705.91 *18*	2801.736	0.24 *6*				
714.769 *13*	1894.832	23.9 *5*	M1+E2		0.0070 *18*	δ: +0.25 *10* or −1.5 *5*, from γγ(θ) (1985Si16), −0.03≤δ≤+1.02 from γ(θ,T) (1984Kr09). The mixing ratio, 1.1≤|q(E_0/E_2)|≤26; and 0.085≤X(E_0/E_2)≤50; both calculated using −0.03≤δ≤ 1.02, Rossel conversion coefficients (1978Ro22), and weighted average α(K)exp=9.7×10^{-3} *9* (1984Kr09).
719.64 *7*	2830.665	3.80 *20*				
725.673 *9*	1905.864	176 *4*	E2		0.00506 *7*	
732.99 *7*	2327.426	0.78 *7*				
735.00[e] *5*	2641.237	1.7[e] *3*	M1+E2	−1.1 *6*	0.0064 *12*	δ: from 1984Kr09.
	2830.665	0.44[e] *22*	M1+E2	−1.1 *6*	0.0064 *12*	δ: from 1984Kr09.
736.90[&] *20*	2641.237	0.29 *7*				
742.16[&] *11*	1903.728	0.34 *3*				
745.87[&] *5*	2641.237	0.74 *5*				
756.581[&] *12*	2490.017	4.23 *9*	M1,E2		0.0061 *16*	
770.307[&] *10*	2801.736	5.88 *13*				
774.2[§] *5*	2228.057	0.14 *7*				
780.11[&] *6*	2374.395	1.60 *5*				
787.98[&] *18*	2683.464	0.37 *5*				
790.20[&] *20*	2524.390	0.57 *6*				
792.59[&] *6*	2698.531	1.64 *7*				
799.23[&] *3*	2830.665	5.82 *16*				
810.12[&] *4*	2716.00	0.95 *3*				
817.5[§f] *5*	2723.517	0.14[f] *7*				
	2928.84	0.14[f] *7*				
826.30[&] *16*	2490.017	0.36 *4*				
828.61 *12*	2723.517	0.48 *4*				Eγ: placement in 1985Si16.
832.82 *14*	2727.31	0.34 *2*				
832.9[§] *5*	2928.84	0.14 *7*				
851.4[§] *5*	2031.423	0.21 *10*				
[x]856.9 *2*		0.44 *6*				
859.90 *20*	2524.390	0.49 *6*				
869.891 *8*	2031.423	76.3 *16*	M1+E2	−1.7 *3*	0.00391 *18*	δ: from γ(θ,T) (1984Kr09). Others: −2.5 *5*, −4.5 *15*, or −0.55 *20* from γγ(θ) (1985Si16).
895.847 *10*	2801.736	9.00 *20*	M1+E2	−0.20 *11*	0.00504 *12*	δ: from γ(θ,T) (1984Kr09).
903.831 *15*	1454.143	5.15 *11*	M1+E2	+2.32 *10*	0.00339 *6*	
906.87 *3*	2801.736	2.89 *7*				
915.331 *8*	2095.593	36.1 *8*	E2		0.00300 *5*	Mult.: γγ(θ) consistent with pure Q transition (1985Si16).
924.75 *3*	2830.665	4.38 *11*	M1		0.00474 *7*	
929.85 *3*	2524.390	17 *3*	[E1]		0.00118 *2*	Mult.: assumed E1 in order to extract mult for 930.807γ.
930.807 *19*	2111.058	19 *4*	E2		0.00290 *4*	
935.20 *20*	2830.665	0.74 *7*				
938.10 *9*	2532.38	1.62 *7*				
949.590 *20*	2111.058	3.34 *8*				
[x]961.4[§] *5*		0.14 *7*				

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^{148}Eu ε Decay 1985Si16,1987Ad08 (continued)

γ(^{148}Sm) (continued)

Eγ[‡]	E(level)	Iγ[‡d]	Mult.[†a]	δ[†a]	α	Comments
967.306 *17*	2147.516	37.6 *8*	M1+E2		0.0035 *8*	δ: +0.42 *10* or +2.0 *5* from γγ(θ) (1985Si16); +0.55 +*17*–*11* or −2.8 +*11*–*9* from γ(θ,T) (1984Kr09).
976.50 *4*	2570.794	1.13 *3*				
979.843 *15*	2713.332	2.98 *7*				
989.606 *10*	2583.861	6.45 *14*	M1,E2		0.0033 *8*	
1013.808 *11*	2194.052	7.40 *16*	E2+M3	−0.025 *14*	0.00243 *4*	
1033.986 *14*	2214.217	108.0 *20*	M1+E2	−1.9 *6*	0.00260 *21*	δ: from (γ,θ,T) (1984Kr09). Others: 1.1 +*8*–*4*, from %M1=45 *24* (1987Ad08), −1.0 *4*, or −0.8 +*2*–*15* (1985Si16).
1036[§] *1*	2490.017	1.5 *3*				
1047.570[e] *20*	2228.057	2.7[e] *4*	M1		0.00353 *5*	
	2641.237	0.7[ce] *4*				
1058.7[§] *5*	2723.517	0.14 *7*				
1066.75 *3*	2228.057	5.42 *13*				
1068.25[§] *10*	2801.736	1.26 *11*				
1069.82 *4*	2524.390	3.05 *9*				
1082.096 *17*	2815.583	2.63 *6*				
1089.154 *18*	2683.464	2.85 *7*	M1		0.00322 *5*	
1097.18 *3*	2830.665	1.73 *6*	M1		0.00316 *5*	
1104.321 *16*	2698.531	5.11 *11*	M1		0.00311 *5*	
1107.67 *3*	2701.92	1.81 *5*				
1113.92 *3*	1664.303	1.90 *5*	M1+E2	−0.565 *21*	0.00279 *5*	
1121.70 *20*	2716.00	0.29 *3*				
1127.69 *4*	2861.08	1.17 *4*				
1133.12 *8*	2727.31	0.65 *3*				
1138.4[g] *5*	2318.5?	0.27 *7*				Eγ: reported only by 1985Si16; not observed by 1987Ad08.
1146.805 *14*	2327.426	27.3 *6*	M1+E2	−2.0 *5*	0.00207 *11*	δ: from 1985Si16. Other: −0.05 +*14*–*11* or +1.05 *25* (1984Kr09). The mixing ratio, $\|q(E_0/E_2)\|$=0.65 *30*; and the ratio, $X(E_0/E_2)$=0.07 *7*, both calculated using δ=+1.05 *25*, Rossel conversion coefficients (1978Ro22), and weighted average of α(K)exp=2.39×10^{-3} *33* (1984Kr09).
1151.3[§] *4*	2815.583	0.27 *14*				
1165.54 *5*	2327.426	1.12 *4*				
1183.208 *16*	1733.476	23.1 *5*	E2		0.00176 *3*	Mult.: γγ(θ) consistent with pure Q transition (1985Si16).
1194.185 *17*	2374.395	1.78 *4*				
[x]1201.3[§] *5*		0.14 *7*				
1207.473 *14*	2801.736	8.76 *19*	E1(+M2)		0.003 *3*	δ: −0.36≤δ≤+1.52 (1984Kr09).
1219.01 *9*	2673.07	0.70 *6*				
1221.37 *4*	2815.583	1.91 *7*	M1		0.00247 *4*	
1229.6 *5*	2390.43	0.14 *7*				Eγ: observed in 1967Cl01, 1985Si16; not seen in 1987Ad08, 1968Ha39.
1236.374 *16*	2830.665	5.68 *13*	E1		0.00074 *1*	δ(M2/E1)=−0.2 +*4*–*3* (1984Kr09), 0.50 *11* from E1=80% *7* (1987Ad08).
1266.76 *5*	2861.08	2.02 *5*	M1		0.00228 *4*	
1269.3[f] *4*	2723.517	0.19[f] *4*				Eγ: placement in 1985Si16.
	2734.45	0.19[f] *4*				Eγ: placement of 1987Ad08.
1309.778 *16*	2490.017	6.61 *15*	M1(+E2)		0.0018 *4*	δ: −0.21≤δ≤+1.47 (1984Kr09).
1328.504 *15*	2490.017	18.3 *4*	E1		0.00071 *1*	δ(M2/E1)=−0.02 *6* (1984Kr09), +0.10 *10* (1985Si16).
1343.87 *3*	2524.390	23.5 *19*	M1+E2	+0.20	0.00198 *3*	δ: from γγ(θ) (1985Si16).
1344.740 *23*	1894.832	26.3 *22*	E2		0.00139 *2*	δ(M3/E2)=−0.01 *8* (1984Kr09).
1353.550 *20*	1903.728	8.70 *20*	M1+E2	+8.2 *12*	0.00139 *2*	δ: +0.58 +*44*–*20* or +3.4 +*46*–*18* (1984Kr09).
1362.640 *19*	2524.390	8.29 *19*	E1		0.00070 *1*	δ(M2/E1)=+0.05 *9* from γ(θ,T) (1984Kr09).
1370.97 *17*	2532.38	0.270 *20*				
[x]1377.4[§] *5*		0.14 *7*				
1390.44 *14*	2570.794	0.136 *16*				

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^{148}Eu ε Decay 1985Si16,1987Ad08 (continued)

γ(^{148}Sm) (continued)

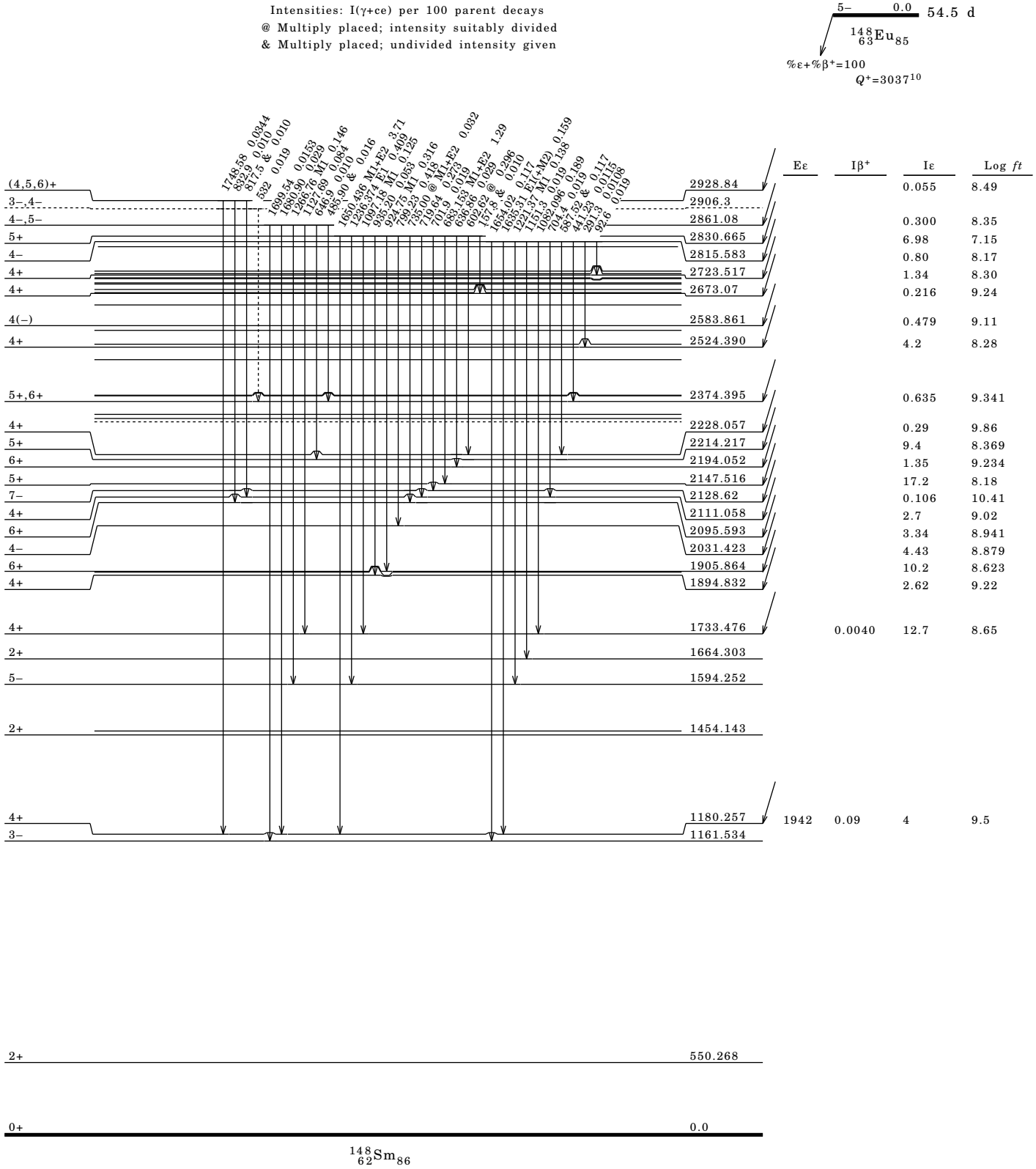
Eγ‡	E(level)	Iγ‡d	Mult.†a	δ†a	α	Comments
1409.160 *20*	2570.794	1.96 *5*	D+Q			δ: +0.04 *12* if J=4−; ≥0.47 if J=3− (1984Kr09).
x1419.6§ *5*		0.07 *3*				
1422.21 *18*	2583.861	0.186 *16*				
1454.110 *20*	1454.143	5.13 *12*	E2		0.00123 *2*	
1460.630 *19*	2641.237	16.2 *4*	M1+E2	+2.1 *16*	0.0013 *3*	Mult.: δ from γ(θ,T) (1984Kr09). Other: −1.25<δ<+0.10 (1985Si16).
1465.2 *3*	1465.19	0.22 *7*	E1		0.00070 *1*	
1492.81 *4*	2673.07	1.37 *4*				
1503.200 *2*	2683.464	2.59 *6*				
1511.49 *7*	2673.07	0.58 *4*				
1513.9 *4*	2675.20	0.12 *3*				
1521.85 *3*	2683.464	2.13 *6*				
1533.10 *20*	2713.332	0.45 *4*				
1535.84 *10*	2716.00	1.27 *5*				
1540.27 *15*	2701.92	1.11 *11*				
1543.289 *27*	2723.517	10.3 *3*	M1+E2		0.00133 *21*	Mult.: δ=−0.17 *11* or +1.35 *30* (1984Kr09).
1547.14§ *10*	2727.31	1.23 *20*				Iγ: from 1987Ad08.
1560.786 *17*	2111.058	11.7 *3*	E2		0.00112 *2*	δ(M3/E2)=+0.00 *10* from γγ(θ) (1985Si16).
1565.29 *11*	2727.31	0.440 *20*				
1572.90 *20*	2734.45	0.159 *14*				
1621.510 *20*	2801.736	64.6 *15*	M1+E2		0.00124 *18*	δ: =+4.1 *6* (1984Kr09), +1.75 *50* or +0.45 *10* (1985Si16).
1635.31 *3*	2815.583	2.21 *6*	E1(+M2)		0.0018 *11*	δ: −0.05≤δ≤+1.06 (1984Kr09).
1650.436 *24*	2830.665	51.6 *16*	M1+E2		0.00121 *17*	δ: +0.53 *+6−5* or +2.92 *42* (1984Kr09), +0.50 *15* or +1.75 *50* (1985Si16).
1654.02 *15*	2815.583	1.63 *19*				
1664.20 *4*	1664.303	0.98 *3*	E2		0.00104 *2*	
1677.85 *3*	2228.057	5.91 *20*	E2		0.00103 *2*	δ(M3/E2)=+0.00 *10* (1985Si16); −0.11 *+27−35* (1984Kr09).
1680.90 *15*	2861.08	0.41 *5*				
1699.54 *6*	2861.08	0.213 *8*				
1748.58 *5*	2928.84	0.478 *15*				
1776.87 *4*	2327.426	0.91 *3*				
1788.91 *18*	2339.19	0.078 *8*	E1+M2	+0.06 *4*	0.00080 *2*	
1840.06 *8*	2390.43	0.236 *15*	M1+E2	−1.37 *12*	0.00105 *2*	
x1843.5§ *5*		0.03 *1*				
x1917.50 *16*		0.029 *5*				
1939.17 *4*	2490.017	0.96 *3*				
1973.81 *4*	2524.390	0.740 *20*				
2122.75 *8*	2673.07	0.190 *8*				
2163.9 *3*	2713.332	0.077 *8*				
2173.28 *4*	2723.517	3.21 *8*				

† From Ice, γ(θ) of polarized nuclei, and γγ(θ) data of 1968Ha39, 1978Ad07, 1984Kr09, 1985Si16, 1987Ad08.
‡ From 1987Ad08, except as noted otherwise.
§ From 1985Si16.
# Placement by 1985Si16.
@ Placement by 1987Ad08.
& Placement by 1987Ad08 changed to match level energy differences with Eγ.
a From adopted gammas. Supporting data from this decay are given in comments.
b Renormalized Iγ from 1985Si16.
c From 1987Ad08, divided in the same ratio as in 1985Si16.
d For absolute intensity per 100 decays, multiply by 0.0719 *16*.
e Multiply placed; intensity suitably divided.
f Multiply placed; undivided intensity given.
g Placement of transition in the level scheme is uncertain.
x γ ray not placed in level scheme.

^{148}Eu ε Decay 1985Si16,1987Ad08 (continued)

Decay Scheme

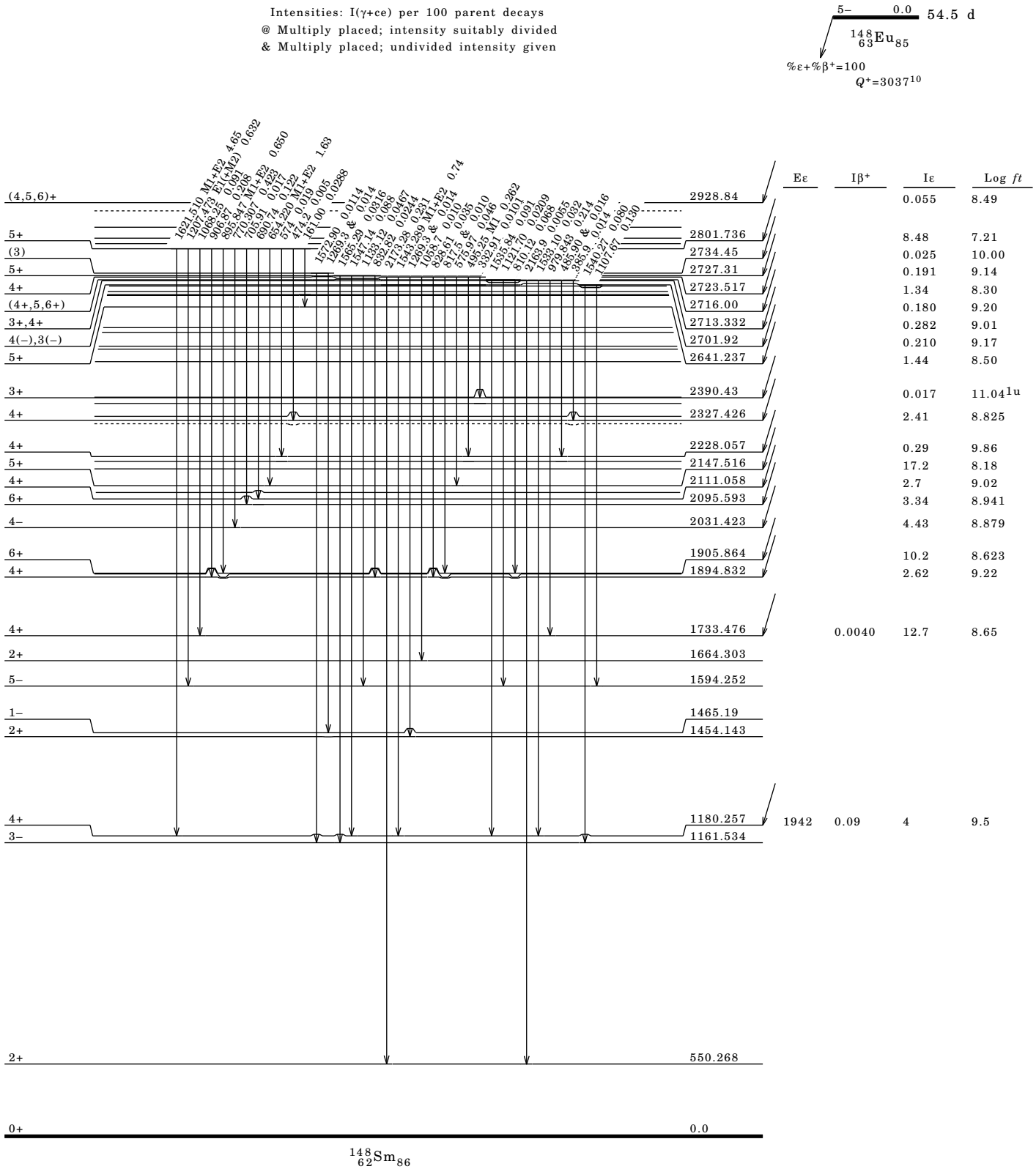
Intensities: I(γ+ce) per 100 parent decays
@ Multiply placed; intensity suitably divided
& Multiply placed; undivided intensity given



^{148}Eu ε Decay 1985Si16,1987Ad08 (continued)

Decay Scheme (continued)

Intensities: I(γ+ce) per 100 parent decays
@ Multiply placed; intensity suitably divided
& Multiply placed; undivided intensity given

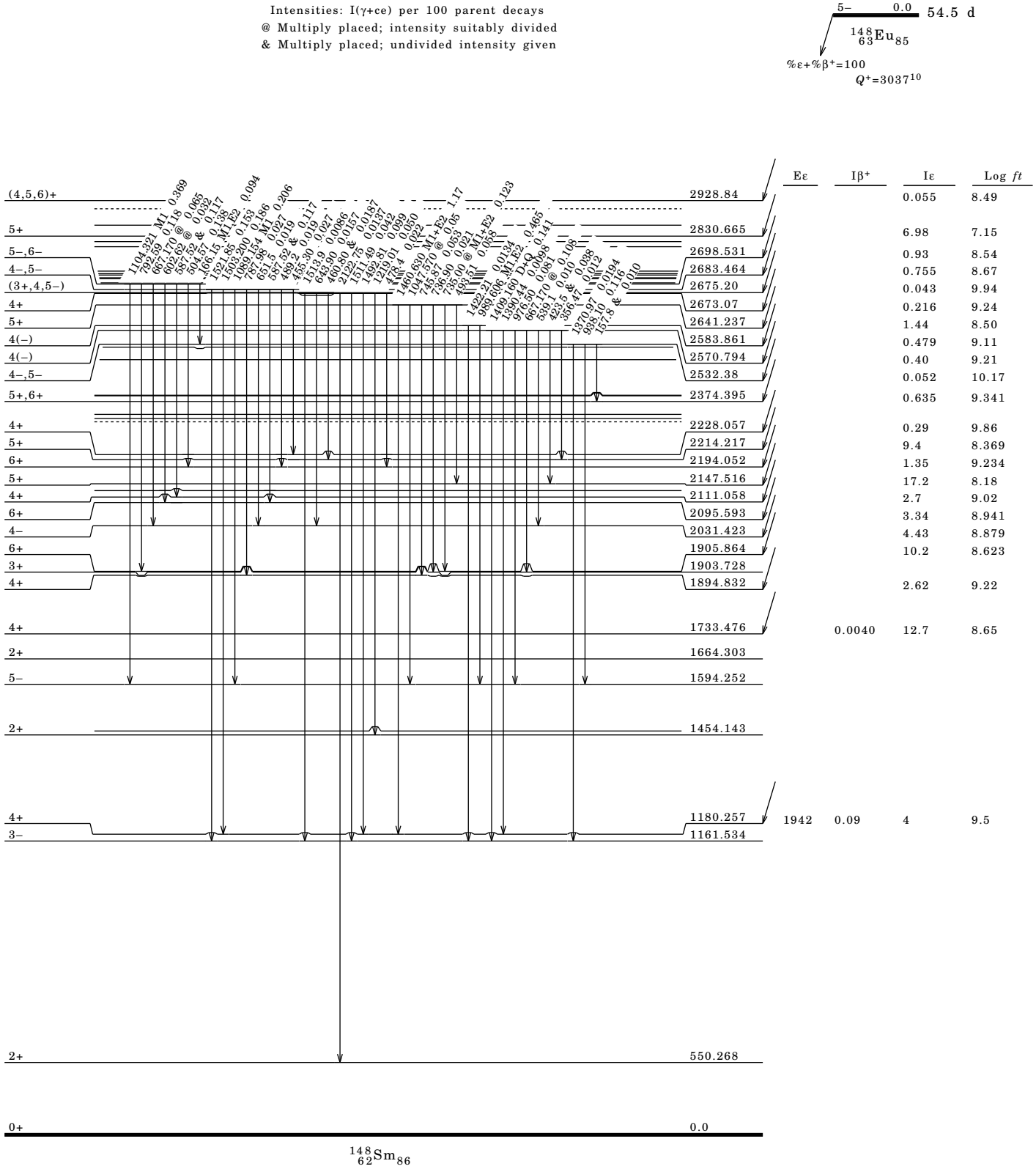


	Eε	Iβ+	Iε	Log ft
2928.84			0.055	8.49
2801.736			8.48	7.21
2734.45			0.025	10.00
2727.31			0.191	9.14
2723.517			1.34	8.30
2716.00			0.180	9.20
2713.332			0.282	9.01
2701.92			0.210	9.17
2641.237			1.44	8.50
2390.43			0.017	11.04 1u
2327.426			2.41	8.825
2228.057			0.29	9.86
2147.516			17.2	8.18
2111.058			2.7	9.02
2095.593			3.34	8.941
2031.423			4.43	8.879
1905.864			10.2	8.623
1894.832			2.62	9.22
1733.476		0.0040	12.7	8.65
1180.257	1942	0.09	4	9.5

^{148}Eu ε Decay 1985Si16,1987Ad08 (continued)

Decay Scheme (continued)

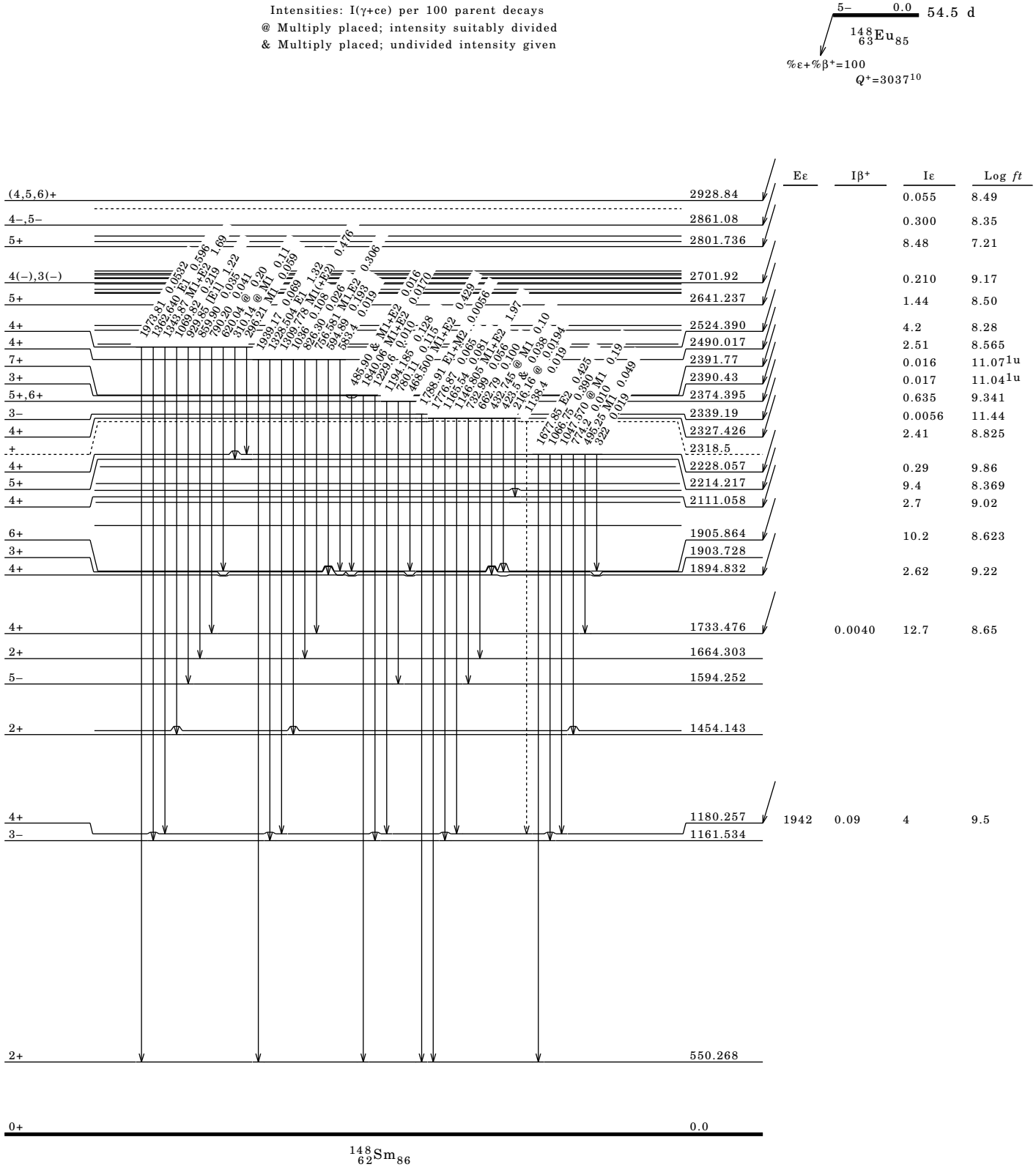
Intensities: I(γ+ce) per 100 parent decays
@ Multiply placed; intensity suitably divided
& Multiply placed; undivided intensity given



^{148}Eu ε Decay 1985Si16,1987Ad08 (continued)

Decay Scheme (continued)

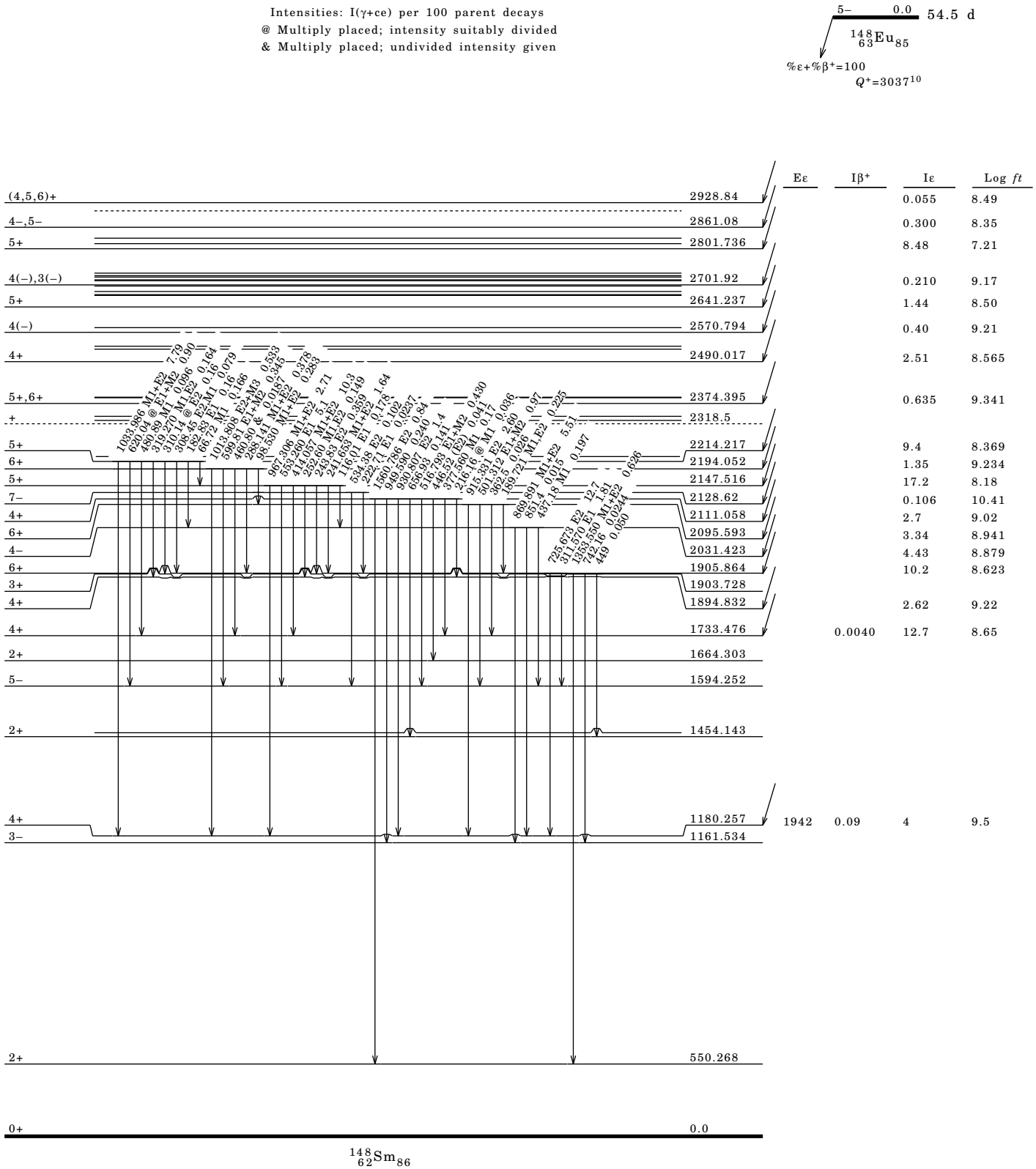
Intensities: I(γ+ce) per 100 parent decays
@ Multiply placed; intensity suitably divided
& Multiply placed; undivided intensity given



^{148}Eu ε Decay 1985Si16,1987Ad08 (continued)

Decay Scheme (continued)

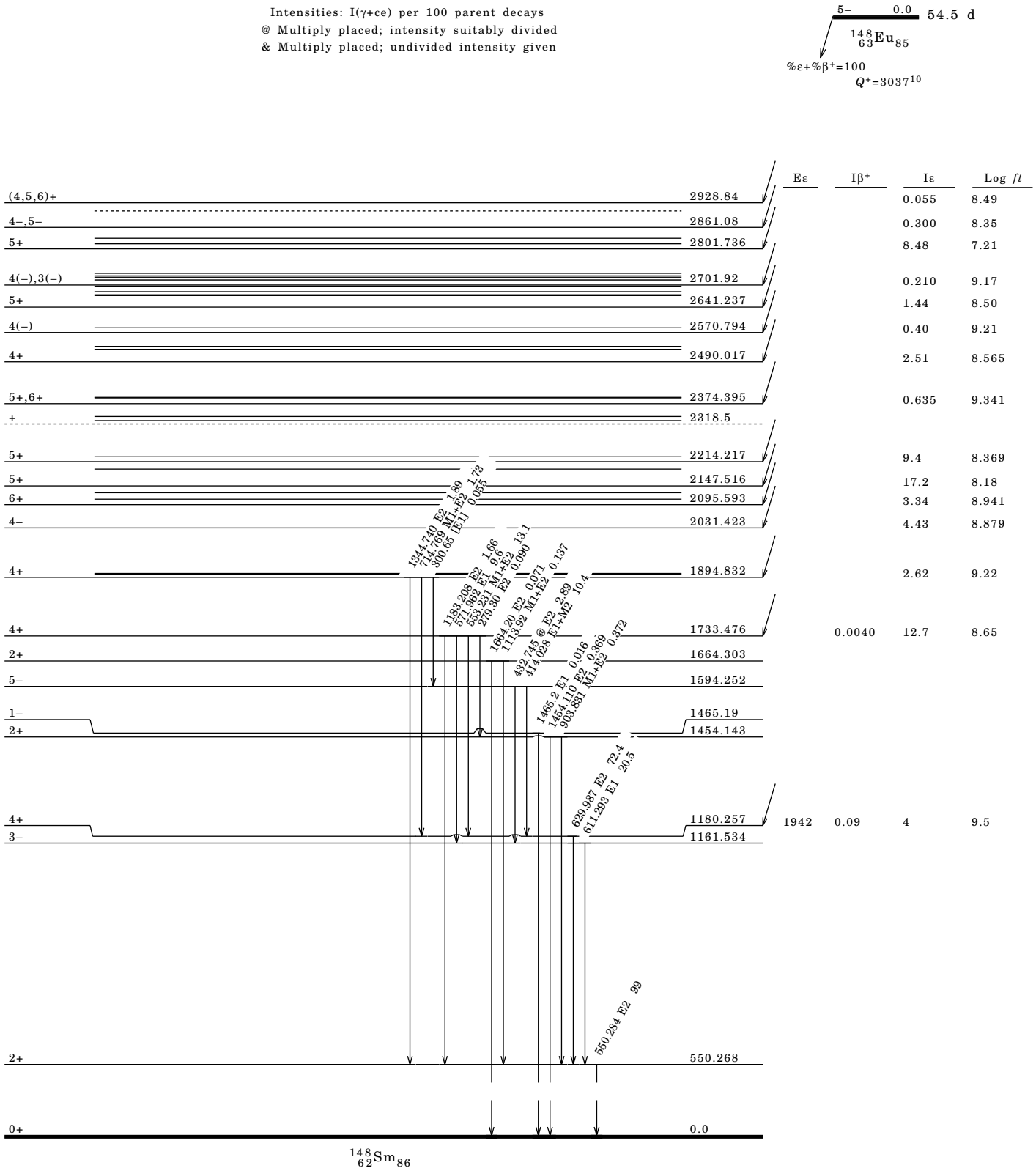
Intensities: I(γ+ce) per 100 parent decays
@ Multiply placed; intensity suitably divided
& Multiply placed; undivided intensity given



^{148}Eu ε Decay 1985Si16,1987Ad08 (continued)

Decay Scheme (continued)

Intensities: I(γ+ce) per 100 parent decays
@ Multiply placed; intensity suitably divided
& Multiply placed; undivided intensity given



^{152}Gd α Decay 1961Ma05

Parent ^{152}Gd: E=0.0; Jπ=0+; $T_{1/2}$=1.08×10^{14} y *8*; Q(g.s.)=2204.9 *14*; %α decay=100.
$T_{1/2}$(^{152}Gd)=1.08×10^{14} y *8*, measured by 1961Ma05 and adopted in 1996Ar09, is used in calculations here.

%α=100. ^{152}Gd is β stable.

^{148}Sm Levels

E(level)	Jπ
0.0	0+

α radiations

Eα	E(level)	Iα†§	HF‡	Comments
2146.9 *14*	0.0	100	1.000	Eα: calculated from Q(α)(^{152}Gd)=2204.9 *14*. Eα=2140 *30* was measured by 1961Ma05. Iα: only one α group was observed. An upper limit of 2.3×10^{-9}% is calculated for intensity of an unobserved 1595–keV α branch to the 2+ state at 550.265–keV in ^{148}Sm by requiring HF(1611.2α)>1.

† α intensity per 100 α decays.
‡ r_0(^{148}Sm)=1.576 *5* is calculated from HF(2145.1α)=1.0.
§ Absolute intensity per 100 decays.

^{147}Sm(n,γ) E=thermal 1971Gr37,1993Ju01

1971Gr37: thermal–neutron capture; measured Eγ, Iγ.
1993Ju01: thermal–neutron capture; measured $T_{1/2}$ using the γ–ray induced Doppler (GRID) broadening technique.
Other: 1969Re04.

^{148}Sm Levels

E(level)†	Jπ‡	$T_{1/2}$	Comments
0.0	0+		
550.0 *5*	2+		
1161.0 *7*	3–	0.6 ps *+4–2*	$T_{1/2}$: from 1993Ju01 deduced using Bethe level density formula; 0.5 ps *+4–2* if a constant temperature Fermi–gas model is used.
1180.3 *7*	4+		
1434.0 *8*			
1455.8 *6*	2+		
1465.0 *10*	1–		
1593.7 *7*	5–		
1659.4 *8*	(2,3,4+)		
1717.8 *10*			
1733.4 *7*	4+		
1893.9 *8*	4+		
2031.8 *10*	4–		
2110.8 *10*	4+		
2146.8 *10*	2+		
2215.8 *10*	5+		
2227.8 *10*	4+		
2326.8 *10*	4+		
2397.8 *10*			
2440.8 *10*			
2524.8 *10*	4+		
2541.8 *10*			
2631.8 *10*			
2640.8 *10*	5+		
2681.8 *10*			
2692.8 *10*			
2711.8 *10*			

Continued on next page (footnotes at end of table)

^{147}Sm(n,γ) E=thermal 1971Gr37,1993Ju01 (continued)

^{148}Sm Levels (continued)

E(level)†	Jπ‡	E(level)†	Jπ‡	E(level)†	Jπ‡
2722.8 *10*	4+	3235.8 *10*		3562.8 *10*	
2753.8 *10*	3+	3261.8 *10*		3598.8 *10*	(3−,4−)
2812.8 *20*		3286.8 *10*		3613.8 *10*	
2860.8 *10*	4−,5−	3308.8 *10*		3635.8 *10*	
2890.8 *10*		3337.8 *10*		3701.8 *10*	(3−,4−)
2917.8 *10*		3375.8 *10*		3766.8 *10*	
2965.8 *10*	3+,4+	3387.8 *10*	3−,4−	3831.8 *10*	
2991.8 *10*	3+,4+	3403.8 *10*		3844.8 *10*	
3049.8 *10*		3413.8 *10*		3865.8 *10*	3−,4−
3062.8 *10*	3−	3437.8 *10*		3920.8 *10*	3−,4−
3088.8 *10*	2+,3−	3465.8 *10*		3971.8 *10*	(3−,4−)
3106.8 *10*	3+,4+	3479.8 *10*		4122.8 *10*	
3138.8 *10*	3(−),4(−)	3507.8 *10*		8141.9§	3−,4−#
3163.8 *10*	3+,4+	3519.8 *10*			

† From a least−squares fit to Eγ data with the thermal−neutron capture level held fixed at 8141.9 keV.
‡ Adopted values.
§ The energy of the thermal−neutron capture state 8149.9 (1971Gr37) is considered to be a typographical error and should be 8141.9. The value adopted in this evaluation for the neutron separation energy is S(n)=8141.37 *28* (2012Wa38).
# For s−wave capture on a 7/2− target.

γ(^{148}Sm)

Eγ†	E(level)	Iγ‡#	Eγ†	E(level)	Iγ‡#	Eγ†	E(level)	Iγ‡#
413.7 *10*	1593.7	4.3	4579 *1*	8141.9	0.07	5419 *1*	8141.9	0.05
432.4 *10*	1593.7	1.3	4622 *1*	8141.9	0.17	5430 *1*	8141.9	0.17
x479.1 *10*		<7.6§	4634 *1*	8141.9	0.07	5449 *1*	8141.9	0.08
x497.7 *10*		2.0	4662 *1*	8141.9	0.03	5460 *1*	8141.9	0.11
550.0 *10*	550.0	50	4676 *1*	8141.9	0.05	5501 *1*	8141.9	0.13
572.3 *10*	1733.4	2.2	4704 *1*	8141.9	0.04	5510 *1*	8141.9	0.02
611.1 *10*	1161.0	11	4728 *1*	8141.9	0.06	5600 *1*	8141.9	0.01
630.2 *10*	1180.3	19	4738 *1*	8141.9	0.07	5617 *1*	8141.9	0.20
884.2 *10*	1434.0	1.2	4754 *1*	8141.9	0.03	5701 *1*	8141.9	0.26
905.5 *10*	1455.8	1.0	4766 *1*	8141.9	0.05	5744 *1*	8141.9	0.05
x915.2 *10*		1.8	4804 *1*	8141.9	0.14	5815 *1*	8141.9	0.06
1109 *1*	1659.4	1.4	4833 *1*	8141.9	0.15	5914 *1*	8141.9	0.21
1183 *1*	1733.4	1.2	4855 *1*	8141.9	0.06	5926 *1*	8141.9	0.01
1344 *1*	1893.9	1.7	4880 *1*	8141.9	0.05	5995 *1*	8141.9	0.03
1456 *1*	1455.8	0.8	4906 *1*	8141.9	0.04	6031 *1*	8141.9	0.08
1465 *1*	1465.0	1.5	4978 *1*	8141.9	0.12	6110 *1*	8141.9	0.19
x3937 *1*		0.07	5003 *1*	8141.9	0.10	6248 *1*	8141.9	1.1
4019 *1*	8141.9	0.17	5035 *1*	8141.9	0.17	6408 *1*	8141.9	0.09
4170 *1*	8141.9	0.04	5053 *1*	8141.9	0.03	6424 *1*	8141.9	0.01
4221 *1*	8141.9	0.06	5079 *1*	8141.9	0.07	6482 *1*	8141.9	0.11
4276 *1*	8141.9	0.19	5092 *1*	8141.9	0.06	6548 *1*	8141.9	0.02
4297 *1*	8141.9	0.08	5150 *1*	8141.9	0.22	6686 *1*	8141.9	0.01
4310 *1*	8141.9	0.08	5176 *1*	8141.9	0.15	6708 *1*	8141.9	0.10
4375 *1*	8141.9	0.04	5224 *1*	8141.9	0.04	6961 *1*	8141.9	0.14
4440 *1*	8141.9	0.04	5251 *1*	8141.9	0.19	6983 *2*	8141.9	0.006
4506 *1*	8141.9	0.16	5281 *1*	8141.9	0.21	7592 *1*	8141.9	0.70
4528 *1*	8141.9	0.11	5329 *2*	8141.9	0.007			
4543 *1*	8141.9	0.04	5388 *1*	8141.9	0.03			

† From 1971Gr37.
‡ Iγ per 100 n−captures (1971Gr37).
§ Contaminated by impurity line.
# Absolute intensity per 100 neutron captures.
x γ ray not placed in level scheme.

^{147}Sm(n,X): Resonances 2007Ko54,2006MuZX

Jπ(^{147}Sm g.s.)=7/2−.

2007Ko54: neutron beam produced using an 800 MeV proton beam and a tungsten target. Enriched Sm target. Experiment performed using MLNSC at LANSCE. Measured neutrons using 4π DANCE array consisting of 160 BaF_2 crystals. Measured neutron flux with a BF_3 detector, a ^{235}U fission chamber and solid state surface–barrier detector. Deduced average widths, neutron strength functions and level spacings.

^{148}Sm Levels

$2g\Gamma_n$, Γ_γ, $2g\Gamma_n^0$, and Γ_α are from 2006MuZX.

E(level)†	Jπ‡	L	Comments
S(n)−16.73	(4)	0	L: from 2006MuZX. Γ_γ=(73.4) meV, $2g\Gamma_n^0$=65.95 meV, Γ_α=0.71 μeV.
S(n)+0.00340 *2*	3		E(n)(lab)=3.397 20 eV (2006MuZX) (the value in the table is truncated because of format restriction). $2g\Gamma_n$=1.16 2 meV, Γ_γ=65 3 meV, $2g\Gamma_n^0$=0.629 11 meV, Γ_α=1.8 2 μeV.
S(n)+0.01832 *5*	4		E(n)(lab)=0.01836 eV. $2g\Gamma_n$=78 1 meV, Γ_γ=70 3 meV, $2g\Gamma_n^0$=18.3 2 meV, Γ_α=0.30 3 μeV.
S(n)+0.02716	3		$2g\Gamma_n$=5.95 30 meV, Γ_γ=79 5 meV, $2g\Gamma_n^0$=1.14 6 meV, Γ_α=0.25 8 μeV.
S(n)+0.02974 *10*	3		E(n)(lab)=0.02976. $2g\Gamma_n$=12.9 3 meV, Γ_γ=73 4 meV, $2g\Gamma_n^0$=2.37 6 meV, Γ_α=0.4 1 μeV.
S(n)+0.0321 *1*	4		E(n)(lab)=0.03214. $2g\Gamma_n$=43.0 12 meV, Γ_γ=68 5 meV, $2g\Gamma_n^0$=7.59 21 meV, Γ_α=0.25 7 μeV.
S(n)+0.03964 *10*	4		E(n)(lab)=0.03970. $2g\Gamma_n$=79 1 meV, Γ_γ=67 4 meV, $2g\Gamma_n^0$=12.5 2 meV, Γ_α=0.20 5 μeV.
S(n)+0.04071 *10*	3		E(n)(lab)=0.04072. $2g\Gamma_n$=4.5 2 meV, $2g\Gamma_n^0$=0.71 3 meV, Γ_α=(0.3) μeV.
S(n)+0.04934 *10*	4		E(n)(lab)=0.04936. $2g\Gamma_n$=17.0 3 meV, Γ_γ=75 4 meV, $2g\Gamma_n^0$=2.42 4 meV, Γ_α=0.014 70 μeV.
S(n)+0.05804 *10*	3		E(n)(lab)=0.05809. $2g\Gamma_n$=37 1 meV, Γ_γ=77 5 meV, $2g\Gamma_n^0$=4.86 13 meV, Γ_α=0.29 8 μeV.
S(n)+0.06496#	3§		
S(n)+0.06513#	4		E(n)(lab)=0.0651 1 (2006MuZX). $2g\Gamma_n$=5.1 3 meV, $2g\Gamma_n^0$=0.63 4 meV, Γ_α=0.12 7 μeV.
S(n)+0.07612 *10*	4		E(n)(lab)=0.07615. $2g\Gamma_n$=19.2 meV, Γ_γ=74 5 meV, $2g\Gamma_n^0$=2.20 7 meV, Γ_α<0.3 μeV.
S(n)+0.07988 *20*	4		E(n)(lab)=0.07989. $2g\Gamma_n$=4.0 3 meV, $2g\Gamma_n^0$=0.45 3 meV, Γ_α<3.6 μeV.
S(n)+0.08355 *20*	3		E(n)(lab)=0.08360. $2g\Gamma_n$=65.8 20 meV, Γ_γ=76 5 meV, $2g\Gamma_n^0$=7.21 22 meV, Γ_α=2.5 3 μeV.
S(n)+0.0949 *2*	3		E(n)(lab)=0.09490. $2g\Gamma_n$=5.6 4 meV, $2g\Gamma_n^0$=0.57 4 meV.
S(n)+0.0995 *2*	4		E(n)(lab)=0.09954. $2g\Gamma_n$=261 4 meV, Γ_γ=79 5 meV, $2g\Gamma_n^0$=26.2 4 meV.
S(n)+0.1026 *2*	3		E(n)(lab)=0.10269. $2g\Gamma_n$=171 6 meV, Γ_γ=76 7 meV, $2g\Gamma_n^0$=16.9 6 meV, Γ_α=1.14 17 μeV.
S(n)+0.1069 *2*	4		E(n)(lab)=0.10693. $2g\Gamma_n$=47 2 meV, Γ_γ=82 5 meV, $2g\Gamma_n^0$=4.5 2 meV, Γ_α=0.72 22 μeV.
S(n)+0.10858 *30*	4		$2g\Gamma_n$=1.0 4 meV, $2g\Gamma_n^0$=0.096 40 meV.
S(n)+0.12365 *20*	3		E(n)(lab)=0.12371. $2g\Gamma_n$=155 5 meV, Γ_γ=73 6 meV, $2g\Gamma_n^0$=13.6 4 meV, Γ_α=1.1 2 μeV.
S(n)+0.14000#	(3)§		E(n)(lab)=0.1400 2 (2006MuZX). $2g\Gamma_n$=77 2 meV, $2g\Gamma_n^0$=6.5 2 meV, Γ_α=0.48 15 μeV.
S(n)+0.14327 *20*	4		$2g\Gamma_n$=2.7 6 meV, $2g\Gamma_n^0$=0.23 5 meV, Γ_α=3.6 μeV.
S(n)+0.14010#	(4)§		
S(n)+0.15154 *20*	3		$2g\Gamma_n$=143 4 meV, Γ_γ=75 5 meV, $2g\Gamma_n^0$=11.6 3 meV, Γ_α=0.31 12 μeV.
S(n)+0.1609 *2*	3		E(n)(lab)=0.16103. $2g\Gamma_n$=48 meV, $2g\Gamma_n^0$=3.8 2 meV, Γ_α=4.8 12 μeV.
S(n)+0.16174 *30*	4		E(n)(lab)=0.16188. $2g\Gamma_n$=14.7 16 meV, $2g\Gamma_n^0$=1.16 13 meV.
S(n)+0.16362 *30*	4		$2g\Gamma_n$=150 4 meV, Γ_γ=77 4 meV, $2g\Gamma_n^0$=11.7 3 meV, Γ_α=2.7 6 μeV.
S(n)+0.17175 *30*	4		E(n)(lab)=0.17180. $2g\Gamma_n$=16.0 17 meV, Γ_γ=69 4 meV, $2g\Gamma_n^0$=1.22 13 meV.
S(n)+0.17959 *30*	3		E(n)(lab)=0.17968. $2g\Gamma_n$=9.0 9 meV, $2g\Gamma_n^0$=0.67 7 meV.
S(n)+0.18412 *30*	3		E(n)(lab)=0.18414. $2g\Gamma_n$=340 6 meV, $2g\Gamma_n^0$=25.0 4 meV, Γ_α=19.5 16 μeV.

Continued on next page (footnotes at end of table)

^{147}Sm(n,X): Resonances 2007Ko54,2006MuZX (continued)

^{148}Sm Levels (continued)

E(level)†	Jπ‡	Comments
S(n)+0.19104 *30*	3	E(n)(lab)=0.19107. $2g\Gamma_n$=30.0 16 meV, Γ_γ=79 5 meV, $2g\Gamma_n^0$=2.17 12 meV, Γ_α=3.5 14 μeV.
S(n)+0.1935 *3*	4	E(n)(lab)=0.19361. $2g\Gamma_n$=10.5 10 meV, $2g\Gamma_n^0$=5.6 10 meV, Γ_α=0.40 7 μeV.
S(n)+0.19803 *30*	3	$2g\Gamma_n$=10.5 meV, Γ_γ=61 4 meV, $2g\Gamma_n^0$=0.746 114 meV, Γ_α=4 μeV.
S(n)+0.20603 *30*	4	$2g\Gamma_n$=208 4 meV, Γ_γ=83 5 meV, $2g\Gamma_n^0$=14.5 3 meV.
S(n)+0.22165 *30*	3	$2g\Gamma_n$=115 5 meV, Γ_γ=67 6 meV, $2g\Gamma_n^0$=7.73 34 meV, Γ_α=3.9 7 μeV.
S(n)+0.22528 *30*	3	$2g\Gamma_n$=210 4 meV, Γ_γ=86 5 meV, $2g\Gamma_n^0$=14.0 3 meV, Γ_α=1.2 3 μeV.
S(n)+0.2279 *3*	(4)	$2g\Gamma_n$=2.9 13 meV, $2g\Gamma_n^0$=0.6 3 meV, Γ_α=0.7 2 μeV.
S(n)+0.2287 *3*	4§	E(n)(lab)=0.22853. $2g\Gamma_n$= meV, Γ_γ= meV, $2g\Gamma_n^0$= meV, Γ_α= μeV.
S(n)+0.24076 *30*	4	$2g\Gamma_n$=14 2 meV, Γ_γ=91 6 meV, $2g\Gamma_n^0$=0.90 13 meV.
S(n)+0.24762 *30*	4	$2g\Gamma_n$=156 6 meV, Γ_γ=69 6 meV, $2g\Gamma_n^0$=9.91 38 meV.
S(n)+0.25713#	3§	E(n)(lab)=0.25713 40 (2006MuZX). $2g\Gamma_n$=86 6 meV, $2g\Gamma_n^0$=5.4 4 meV.
S(n)+0.25800#	4§	
S(n)+0.26357 *40*	3	$2g\Gamma_n$=65 4 meV, $2g\Gamma_n^0$=4.0 2 meV.
S(n)+0.26623 *40*	4	E(n)(lab)=0.26626. $2g\Gamma_n$=200 6 meV, Γ_γ=72 6 meV, $2g\Gamma_n^0$=12.3 4 meV.
S(n)+0.27076 *40*	3	E(n)(lab)=0.27072. $2g\Gamma_n$=78 4 meV, Γ_γ=85 5 meV, $2g\Gamma_n^0$=4.7 2 meV, Γ_α=1.2 5 μeV.
S(n)+0.2744 *4*	3	E(n)(lab)=0.27440. $2g\Gamma_n$=18 2 meV, $2g\Gamma_n^0$=1.1 1 meV.
S(n)+0.28328 *40*	4	$2g\Gamma_n$=22 2 meV, Γ_γ=58 10 meV, $2g\Gamma_n^0$=1.3 1 meV.
S(n)+0.29010#	(4)§	E(n)(lab)=0.2901 4 (2006MuZX). $2g\Gamma_n$=40 3 meV, Γ_γ=68 6 meV, $2g\Gamma_n^0$=2.3 2 meV.
S(n)+0.29030#	(3)§	
S(n)+0.30828 *40*	3	E(n)(lab)=0.30830. $2g\Gamma_n$=7 2 meV, $2g\Gamma_n^0$=0.42 11 meV.
S(n)+0.31206 *40*	4	$2g\Gamma_n$=21 4 meV, $2g\Gamma_n^0$=1.19 20 meV.
S(n)+0.32113 *40*	3	$2g\Gamma_n$=10 1 meV, $2g\Gamma_n^0$=0.56 6 meV.
S(n)+0.3301 *4*	3	E(n)(lab)=0.33010. $2g\Gamma_n$=67 4 meV, $2g\Gamma_n^0$=3.7 2 meV.
S(n)+0.3321 *5*	4	$2g\Gamma_n$=73 4 meV, $2g\Gamma_n^0$=4.0 2 meV.
S(n)+0.3404 *5*	4	$2g\Gamma_n$=180 6 meV, $2g\Gamma_n^0$=9.76 33 meV.
S(n)+0.34986 *50*	3	$2g\Gamma_n$=62 5 meV, $2g\Gamma_n^0$=3.3 3 meV.
S(n)+0.35932 *50*	4	$2g\Gamma_n$=380 30 meV, $2g\Gamma_n^0$=20 12 meV.
S(n)+0.36215 *50*	4	$2g\Gamma_n$=31 4 meV, $2g\Gamma_n^0$=1.6 2 meV.
S(n)+0.3792 *6*	4	$2g\Gamma_n$=394 12 meV, $2g\Gamma_n^0$=20.2 6 meV.
S(n)+0.3819 *6*	3	E(n)(lab)=0.3824. $2g\Gamma_n$=139 8 meV, $2g\Gamma_n^0$=7.11 41 meV, Γ_α=5.1 16 μeV.
S(n)+0.3905 *6*	4	$2g\Gamma_n$=120 7 meV, $2g\Gamma_n^0$=6.07 35 meV.
S(n)+0.3964 *6*	4	E(n)(lab)=0.3965. $2g\Gamma_n$=67 5 meV, $2g\Gamma_n^0$=3.4 3 meV.
S(n)+0.3985 *7*	3	E(n)(lab)=0.3986. $2g\Gamma_n$=102 8 meV, $2g\Gamma_n^0$=5.11 40 meV.
S(n)+0.4048 *7*	3	E(n)(lab)=0.4051. $2g\Gamma_n$=33 4 meV, $2g\Gamma_n^0$=1.6 2 meV.
S(n)+0.4118 *7*	3	E(n)(lab)=0.4120. $2g\Gamma_n$=55 5 meV, $2g\Gamma_n^0$=2.7 2 meV.
S(n)+0.4176#	3§	E(n)(lab)=0.4181 8 (2006MuZX). Jπ: (4) (2007Ko54). $2g\Gamma_n$=238 12 meV, $2g\Gamma_n^0$=11.6 6 meV.
S(n)+0.4192#	4§	
S(n)+0.4213 *8*	4	E(n)(lab)=0.4218. $2g\Gamma_n$=68 5 meV, $2g\Gamma_n^0$=3.3 2 meV.
S(n)+0.4331 *8*	4	$2g\Gamma_n$=17 4 meV, $2g\Gamma_n^0$=0.82 19 meV.
S(n)+0.4358 *8*	3	E(n)(lab)=0.4357. $2g\Gamma_n$=156 9 meV, $2g\Gamma_n^0$=7.47 43 meV.
S(n)+0.4398 *8*	4	E(n)(lab)=0.4402. $2g\Gamma_n$=39 4 meV, $2g\Gamma_n^0$=1.9 2 meV.
S(n)+0.4467	3	E(n)(lab)=0.4469. $2g\Gamma_n$=7 3 meV, $2g\Gamma_n^0$=0.3 1 meV.

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^{147}Sm(n,X): Resonances 2007Ko54,2006MuZX (continued)

^{148}Sm Levels (continued)

E(level)†	Jπ‡	Comments
S(n)+0.45845	4	E(n)(lab)=0.4586. $2g\Gamma_n$=100 7 meV, $2g\Gamma^0_n$=4.67 33 meV.
S(n)+0.46267	3	E(n)(lab)=0.4629. $2g\Gamma_n$=53 6 meV, $2g\Gamma^0_n$=2.5 3 meV.
S(n)+0.4757	4	E(n)(lab)=0.4760. $2g\Gamma_n$=117 8 meV, $2g\Gamma^0_n$=5.36 37 meV.
S(n)+0.4795	3	E(n)(lab)=0.4798. $2g\Gamma_n$=117 11 meV, $2g\Gamma^0_n$=8.08 50 meV, Γ_α=2.2 10 μeV.
S(n)+0.4863	3	E(n)(lab)=0.4864. $2g\Gamma_n$=111 8 meV, $2g\Gamma^0_n$=5.03 36 meV.
S(n)+0.496	4	E(n)(lab)=0.4962. $2g\Gamma_n$=120 9 meV, $2g\Gamma^0_n$=5.39 40 meV.
S(n)+0.4987	3	E(n)(lab)=0.4986. $2g\Gamma_n$=294 15 meV, $2g\Gamma^0_n$=13.2 7 meV.
S(n)+0.5135#	(3)§	E(n)(lab)=0.5134 (2006MuZX). $2g\Gamma_n$=474 20 meV, $2g\Gamma^0_n$=20.9 9 meV, Γ_α=1.7 10 μeV.
S(n)+0.5154#	(4)§	
S(n)+0.5287	4	E(n)(lab)=0.5289. $2g\Gamma_n$=72 7 meV, $2g\Gamma^0_n$=3.1 3 meV.
S(n)+0.5324	3	E(n)(lab)=0.5325. $2g\Gamma_n$=60 7 meV, $2g\Gamma^0_n$=2.6 3 meV.
S(n)+0.5379	4	E(n)(lab)=0.5381. $2g\Gamma_n$=575 22 meV, $2g\Gamma^0_n$=24.8 9 meV.
S(n)+0.5460#	(3)§	E(n)(lab)=0.5456 (2006MuZX). $2g\Gamma_n$=185 12 meV, $2g\Gamma^0_n$=7.92 51 meV.
S(n)+0.5526	3	E(n)(lab)=0.5532. $2g\Gamma_n$=367 26 meV, $2g\Gamma^0_n$=15.6 11 meV, Γ_α=3.3 11 μeV.
S(n)+0.5462#	(4)§	
S(n)+0.5544	4	E(n)(lab)=0.5545. $2g\Gamma_n$=248 20 meV, $2g\Gamma^0_n$=10.5 8 meV.
S(n)+0.5595	3	E(n)(lab)=0.5597. $2g\Gamma_n$=207 14 meV, $2g\Gamma^0_n$=8.75 59 meV, Γ_α=2.8 10 μeV.
S(n)+0.5634	4	$2g\Gamma_n$=219 15 meV, $2g\Gamma^0_n$=9.23 63 meV.
S(n)+0.5676	3§	$2g\Gamma_n$=38 7 meV, $2g\Gamma^0_n$=1.6 3 meV.
S(n)+0.5742	4	E(n)(lab)=0.5743. $2g\Gamma_n$=101 9 meV, $2g\Gamma^0_n$=4.22 38 meV.
S(n)+0.5801	3	E(n)(lab)=0.5802. $2g\Gamma_n$=124 11 meV, $2g\Gamma^0_n$=5.15 46 meV.
S(n)+0.5876	3	E(n)(lab)=0.5878. $2g\Gamma_n$=83 9 meV, $2g\Gamma^0_n$=3.4 4 meV.
S(n)+0.5973	4	E(n)(lab)=0.5974. $2g\Gamma_n$=176 13 meV, $2g\Gamma^0_n$=7.20 53 meV.
S(n)+0.6057	4	E(n)(lab)=0.6060. $2g\Gamma_n$=125 11 meV, $2g\Gamma^0_n$=5.12 45 meV.
S(n)+0.6126	3§	$2g\Gamma_n$=93 10 meV, $2g\Gamma^0_n$=3.8 4 meV, Γ_α=3.7 19 μeV.
S(n)+0.6172	4§	$2g\Gamma_n$=493 25 meV, $2g\Gamma^0_n$=19.8 10 meV.
S(n)+0.6226	4§	$2g\Gamma_n$=151 13 meV, $2g\Gamma^0_n$=6.05 52 meV.
S(n)+0.6253	3§	$2g\Gamma_n$=74 10 meV, $2g\Gamma^0_n$=3.0 4 meV.
S(n)+0.6339	3	E(n)(lab)=0.6340. $2g\Gamma_n$=29 8 meV, $2g\Gamma^0_n$=1.2 3 meV.
S(n)+0.6447	4§	$2g\Gamma_n$=60 9 meV, $2g\Gamma^0_n$=2.4 4 meV.
S(n)+0.6485	4§	$2g\Gamma_n$=209 15 meV, $2g\Gamma^0_n$=8.21 59 meV.
S(n)+0.6519	3§	$2g\Gamma_n$=102 11 meV, $2g\Gamma^0_n$=3.99 43 meV.
S(n)+0.6592	3§	Jπ: (4) (2006MuZX). E(n)(lab)=0.6595. $2g\Gamma_n$=80 10 meV, $2g\Gamma^0_n$=3.1 4 meV, Γ_α=16.1 76 μeV.
S(n)+0.6688	4	$2g\Gamma_n$=65 10 meV, $2g\Gamma^0_n$=2.5 4 meV.
S(n)+0.6775	3§	$2g\Gamma_n$=159 14 meV, $2g\Gamma^0_n$=6.11 54 meV.
S(n)+0.6831	4§	$2g\Gamma_n$=236 18 meV, $2g\Gamma^0_n$=9.03 69 meV.
S(n)+0.6874	4§	$2g\Gamma_n$=19 9 meV, $2g\Gamma^0_n$=0.72 34 meV.
S(n)+0.6968	4§	E(n)(lab)=0.6970. $2g\Gamma_n$=87 12 meV, $2g\Gamma^0_n$=3.3 5 meV.
S(n)+0.702	3§	$2g\Gamma_n$=50 10 meV, $2g\Gamma^0_n$=1.9 4 meV.

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^{147}Sm(n,X): Resonances 2007Ko54,2006MuZX (continued)

^{148}Sm Levels (continued)

E(level)†	Jπ‡	Comments
S(n)+0.713	3	E(n)(lab)=0.7140. $2g\Gamma_n$=193 18 meV, $2g\Gamma_n^0$=7.23 67 meV.
S(n)+0.724	3§	$2g\Gamma_n$=42 11 meV, $2g\Gamma_n^0$=1.6 4 meV.
S(n)+0.729	4§	$2g\Gamma_n$=266 21 meV, $2g\Gamma_n^0$=9.85 78 meV.
S(n)+0.734	3§	$2g\Gamma_n$=448 29 meV, $2g\Gamma_n^0$=16.5 11 meV.
S(n)+0.744	4	E(n)(lab)=0.7443. $2g\Gamma_n$=64 12 meV, $2g\Gamma_n^0$=2.3 4 meV.
S(n)+0.754	4§	$2g\Gamma_n$=233 20 meV, $2g\Gamma_n^0$=8.49 73 meV.
S(n)+0.758	3§	$2g\Gamma_n$=337 26 meV, $2g\Gamma_n^0$=12.2 9 meV.
S(n)+0.764#	4§	E(n)(lab)=0.765 (2006MuZX). $2g\Gamma_n$=1060 40 meV, $2g\Gamma_n^0$=38.3 14 meV.
S(n)+0.766#	3§	
S(n)+0.796	3	E(n)(lab)=0.7962. $2g\Gamma_n$=130 5 meV, $2g\Gamma_n^0$=4.61 18 meV.
S(n)+0.8095	4	E(n)(lab)=0.8080. $2g\Gamma_n$=450 30 meV, $2g\Gamma_n^0$=16 11 meV.
S(n)+0.823	4	E(n)(lab)=0.8210. $2g\Gamma_n$=380 29 meV, $2g\Gamma_n^0$=13.2 10 meV.
S(n)+0.838	4	E(n)(lab)=0.8361. $2g\Gamma_n$=162 19 meV, $2g\Gamma_n^0$=5.61 66 meV.
S(n)+0.847	4§	$2g\Gamma_n$=17 16 meV, $2g\Gamma_n^0$=0.58 55 meV.
S(n)+0.850	(3)§	$2g\Gamma_n$=217 25 meV, $2g\Gamma_n^0$=7.44 86 meV.
S(n)+0.854	(4)§	$2g\Gamma_n$=950 60 meV, $2g\Gamma_n^0$=33 2 meV.
S(n)+0.858	4§	$2g\Gamma_n$=223 31 meV, $2g\Gamma_n^0$=7.61 106 meV.
S(n)+0.864	3§	$2g\Gamma_n$=70 16 meV, $2g\Gamma_n^0$=2.4 5 meV.
S(n)+0.875	3§	E(n)(lab)=0.8752. Jπ: 4 (2006MuZX). $2g\Gamma_n$=590 40 meV, $2g\Gamma_n^0$=20 1 meV.
S(n)+0.880	4§	$2g\Gamma_n$=14 14 meV, $2g\Gamma_n^0$=0.47 47 meV.
S(n)+0.896	4	E(n)(lab)=0.8961. $2g\Gamma_n$=740 50 meV, $2g\Gamma_n^0$=25 2 meV.
S(n)+0.911	3§	$2g\Gamma_n$=36 17 meV, $2g\Gamma_n^0$=1.2 6 meV.
S(n)+0.922	4§	$2g\Gamma_n$=180 25 meV, $2g\Gamma_n^0$=5.93 82 meV.
S(n)+0.930	3§	$2g\Gamma_n$=530 50 meV, $2g\Gamma_n^0$=17 2 meV.
S(n)+0.935	4§	$2g\Gamma_n$=1140 70 meV, $2g\Gamma_n^0$=37.3 23 meV.
S(n)+0.943	4§	$2g\Gamma_n$=470 40 meV, $2g\Gamma_n^0$=15 1 meV.
S(n)+0.953	(3)§	$2g\Gamma_n$=71 21 meV, $2g\Gamma_n^0$=2.3 7 meV.
S(n)+0.962	3§	$2g\Gamma_n$=219 30 meV, $2g\Gamma_n^0$=7.06 97 meV.
S(n)+0.984	3§	$2g\Gamma_n$=420 40 meV, $2g\Gamma_n^0$=13 1 meV.
S(n)+0.991	4§	$2g\Gamma_n$=302 33 meV, $2g\Gamma_n^0$=9.59 105 meV.
S(n)+1.001		$2g\Gamma_n$=77 23 meV, $2g\Gamma_n^0$=2.4 7 meV.
S(n)+1.009		$2g\Gamma_n$=37 21 meV, $2g\Gamma_n^0$=1.2 7 meV.
S(n)+1.016		$2g\Gamma_n$=113 26 meV, $2g\Gamma_n^0$=3.55 82 meV.
S(n)+1.025		$2g\Gamma_n$=82 27 meV, $2g\Gamma_n^0$=2.6 8 meV.
S(n)+1.028		$2g\Gamma_n$=390 50 meV, $2g\Gamma_n^0$=12 2 meV.
S(n)+1.039		$2g\Gamma_n$=220 40 meV, $2g\Gamma_n^0$=6.8 12 meV.
S(n)+1.050		$2g\Gamma_n$=580 50 meV, $2g\Gamma_n^0$=18 12 meV.
S(n)+1.056		$2g\Gamma_n$=84 26 meV, $2g\Gamma_n^0$=2.6 8 meV.
S(n)+1.062		$2g\Gamma_n$=720 60 meV, $2g\Gamma_n^0$=22 2 meV.
S(n)+1.070		$2g\Gamma_n$=165 31 meV, $2g\Gamma_n^0$=5.04 95 meV.
S(n)+1.084		$2g\Gamma_n$=710 60 meV, $2g\Gamma_n^0$=22 2 meV.
S(n)+1.102		$2g\Gamma_n$=380 40 meV, $2g\Gamma_n^0$=11 1 meV.
S(n)+1.112		$2g\Gamma_n$=990 60 meV, $2g\Gamma_n^0$=30 2 meV.
S(n)+1.117		$2g\Gamma_n$=142 28 meV, $2g\Gamma_n^0$=4.25 84 meV.
S(n)+1.128		$2g\Gamma_n$=200 33 meV, $2g\Gamma_n^0$=5.95 98 meV.
S(n)+1.132		$2g\Gamma_n$=480 50 meV, $2g\Gamma_n^0$=14 1 meV.
S(n)+1.139		$2g\Gamma_n$=109 26 meV, $2g\Gamma_n^0$=3.23 77 meV.
S(n)+1.148		$2g\Gamma_n$=111 28 meV, $2g\Gamma_n^0$=3.28 83 meV.
S(n)+1.153		$2g\Gamma_n$=198 32 meV, $2g\Gamma_n^0$=5.83 94 meV.
S(n)+1.181		$2g\Gamma_n$=420 40 meV, $2g\Gamma_n^0$=12 1 meV.
S(n)+1.187		$2g\Gamma_n$=53 26 meV, $2g\Gamma_n^0$=1.5 8 meV.
S(n)+1.196		$2g\Gamma_n$=350 40 meV, $2g\Gamma_n^0$=10 1 meV.
S(n)+1.207		$2g\Gamma_n$=470 50 meV, $2g\Gamma_n^0$=14 1 meV.

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^{147}Sm(n,X): Resonances 2007Ko54,2006MuZX (continued)

^{148}Sm Levels (continued)

E(level)†	Comments
S(n)+1.216	$2g\Gamma_n$=410 50 meV, $2g\Gamma^0_n$=12 1 meV.
S(n)+1.228	$2g\Gamma_n$=960 60 meV, $2g\Gamma^0_n$=27 2 meV.
S(n)+1.246	$2g\Gamma_n$=330 40 meV, $2g\Gamma^0_n$=9.3 11 meV.
S(n)+1.257	$2g\Gamma_n$=890 70 meV, $2g\Gamma^0_n$=25 2 meV.
S(n)+1.265	$2g\Gamma_n$=111 32 meV, $2g\Gamma^0_n$=3.12 90 meV.
S(n)+1.279	$2g\Gamma_n$=570 60 meV, $2g\Gamma^0_n$=16 2 meV.
S(n)+1.292	$2g\Gamma_n$=140 40 meV, $2g\Gamma^0_n$=3.9 11 meV.
S(n)+1.298	$2g\Gamma_n$=250 40 meV, $2g\Gamma^0_n$=6.9 11 meV.
S(n)+1.308	$2g\Gamma_n$=100 40 meV, $2g\Gamma^0_n$=2.8 11 meV.
S(n)+1.318	$2g\Gamma_n$=270 50 meV, $2g\Gamma^0_n$=7.4 14 meV.
S(n)+1.323	$2g\Gamma_n$=490 60 meV, $2g\Gamma^0_n$=13 2 meV.
S(n)+1.332	$2g\Gamma_n$=170 40 meV, $2g\Gamma^0_n$=4.7 11 meV.
S(n)+1.356	$2g\Gamma_n$=120 40 meV, $2g\Gamma^0_n$=3.3 11 meV.
S(n)+1.365	$2g\Gamma_n$=510 60 meV, $2g\Gamma^0_n$=14 2 meV.
S(n)+1.396	$2g\Gamma_n$=580 70 meV, $2g\Gamma^0_n$=16 2 meV.
S(n)+1.404	$2g\Gamma_n$=560 70 meV, $2g\Gamma^0_n$=15 2 meV.
S(n)+1.428	$2g\Gamma_n$=960 90 meV, $2g\Gamma^0_n$=25 2 meV.
S(n)+1.449	$2g\Gamma_n$=210 50 meV, $2g\Gamma^0_n$=5.5 13 meV.
S(n)+1.458	$2g\Gamma_n$=170 50 meV, $2g\Gamma^0_n$=4.5 13 meV.
S(n)+1.472	$2g\Gamma_n$=560 70 meV, $2g\Gamma^0_n$=15 2 meV, Γ_α=34.2 104 μeV.
S(n)+1.517	$2g\Gamma_n$=1110 100 meV, $2g\Gamma^0_n$=28.5 26 meV.
S(n)+1.528	$2g\Gamma_n$=100 50 meV, $2g\Gamma^0_n$=2.6 23 meV.
S(n)+1.539	$2g\Gamma_n$=840 90 meV, $2g\Gamma^0_n$=21 2 meV.
S(n)+1.561	$2g\Gamma_n$=320 70 meV, $2g\Gamma^0_n$=8.1 18 meV.
S(n)+1.566	$2g\Gamma_n$=220 60 meV, $2g\Gamma^0_n$=5.6 15 meV.
S(n)+1.580	$2g\Gamma_n$=410 80 meV, $2g\Gamma^0_n$=10 2 meV.
S(n)+1.594	$2g\Gamma_n$=870 100 meV, $2g\Gamma^0_n$=22 3 meV.
S(n)+1.610	$2g\Gamma_n$= 390 100 meV, $2g\Gamma^0_n$=9.7 25 meV.
S(n)+1.634	$2g\Gamma_n$=820 140 meV, $2g\Gamma^0_n$=20 3 meV.
S(n)+1.646	$2g\Gamma_n$=1420 170 meV, $2g\Gamma^0_n$=35.0 42 meV.
S(n)+1.663	$2g\Gamma_n$=490 120 meV, $2g\Gamma^0_n$=12 3 meV.
S(n)+1.679	$2g\Gamma_n$=390 80 meV, $2g\Gamma^0_n$=9.5 20 meV.
S(n)+1.705	$2g\Gamma_n$=360 80 meV, $2g\Gamma^0_n$=8.7 19 meV.
S(n)+1.710	$2g\Gamma_n$=110 60 meV, $2g\Gamma^0_n$=2.7 15 meV.
S(n)+1.720	$2g\Gamma_n$=310 70 meV, $2g\Gamma^0_n$=7.5 17 meV.
S(n)+1.732	$2g\Gamma_n$=520 90 meV, $2g\Gamma^0_n$=12 2 meV.
S(n)+1.738	$2g\Gamma_n$=290 80 meV, $2g\Gamma^0_n$=7.0 19 meV.
S(n)+1.744	$2g\Gamma_n$=1030 120 meV, $2g\Gamma^0_n$=24.7 29 meV.
S(n)+1.780	$2g\Gamma_n$=200 70 meV, $2g\Gamma^0_n$=4.7 17 meV.
S(n)+1.794	$2g\Gamma_n$=230 70 meV, $2g\Gamma^0_n$=5.4 17 meV.
S(n)+1.799	$2g\Gamma_n$=490 110 meV, $2g\Gamma^0_n$=12 3 meV.
S(n)+1.819	$2g\Gamma_n$=200 80 meV, $2g\Gamma^0_n$=4.7 19 meV.
S(n)+1.827	$2g\Gamma_n$=200 70 meV, $2g\Gamma^0_n$=4.7 16 meV.
S(n)+1.888	$2g\Gamma_n$=100 70 meV, $2g\Gamma^0_n$=2.3 16 meV.
S(n)+1.898	$2g\Gamma_n$=890 140 meV, $2g\Gamma^0_n$=20 3 meV.
S(n)+1.902	$2g\Gamma_n$=690 120 meV, $2g\Gamma^0_n$=16 3 meV.
S(n)+1.912	$2g\Gamma_n$=260 90 meV, $2g\Gamma^0_n$=5.9 21 meV.
S(n)+1.929	$2g\Gamma_n$=400 100 meV, $2g\Gamma^0_n$=9 2 meV.
S(n)+1.937	$2g\Gamma_n$=170 80 meV, $2g\Gamma^0_n$=3.9 18 meV.
S(n)+1.956	$2g\Gamma_n$=530 110 meV, $2g\Gamma^0_n$=12 2 meV.
S(n)+1.967	$2g\Gamma_n$=260 90 meV, $2g\Gamma^0_n$=5.9 20 meV.
S(n)+1.974	$2g\Gamma_n$=350 100 meV, $2g\Gamma^0_n$=7.9 23 meV.
S(n)+1.988	$2g\Gamma_n$=230 90 meV, $2g\Gamma^0_n$=5.2 20 meV.

† S(n)+E(n), where S(n)=8141.37 *28* (2012Wa38), E(n) in c.m. system which can be obtained from (147/148)E(n)(lab). The listed neutron energies in the table are in the lab system E(n)(lab) from 2006MuZX, while in comments are listed the E(n)(lab) values given by 2007Ko54 from book by S.I. Sukhoruchkin et al., Low Energy Neutron Physics (Springer–Verlag, Berlin 1998) (reference 15 in 2007Ko54).

‡ From 2006MuZX, unless noted otherwise.

§ Determined by 2007Ko54 by resonance analysis.

Partially resolved doublet and energy from 2007Ko54.

^{147}Sm(n,γ) E=3.4 eV 1972Ge12

Primary neutron capture gammas from the 3.4 eV resonance of ^{147}Sm were studied by 1972Ge12; 1970Bu19 measured average–resonance neutron capture spectra using the Argonne in–pile (n,γ) facility.
Others: 1968SpZZ, 1964Ka30, 1957Fe31.

^{148}Sm Levels

E(level)	Jπ†	Comments
0.0	0+	
550.5	2+	Jπ: 2+.
1453	2+	Jπ: 2+.
1648.6?		Jπ: 2,3,4.
1663.4	2+	Jπ: 2+.
1894.1	4+	Jπ: 4+.
1970.9	2+	Jπ: 2,3,4.
2110.7	4+	Jπ: 3+,4+.
2142.5	(2,3,4)	Jπ: 2,3,4.
2227.6	4+	Jπ: 3+,4+.
2326.8	4+	Jπ: 4+,(2+,3+).
2389.2	3+	Jπ: 3+,4+.
2524.2	4+	Jπ: 3+,4+.
8141.6‡ *4*	3−	

† Adopted values; Jπ assignments based on 3.4 eV and average resonance neutron capture data of 1970Bu19 are given in comments.
‡ Corresponds to neutron resonance with E(n)=3.4 eV.

γ(^{148}Sm)

Eγ†	E(level)	Iγ§	Eγ†	E(level)	Iγ§	Eγ†	E(level)	Iγ§
5616.4 *9*	8141.6	217 *33*	5999.1‡ *10*	8141.6	107 *25*	6478.2 *6*	8141.6	471 *56*
5752.4 *9*	8141.6	114 *21*	6030.9 *4*	8141.6	42 *19*	6493.0‡# *8*	8141.6	16 *7*
5814.8‡ *8*	8141.6	145 *35*	6170.7‡ *10*	8141.6	145 *23*	6688.0 *3*	8141.6	78 *17*
5914.0 *4*	8141.6	263 *37*	6247.5 *3*	8141.6	1000 *80*	7591.1 *3*	8141.6	363 *44*

† From 1970Bu19, except where noted otherwise.
‡ Observed only by 1972Ge12, not observed by 1970Bu19.
§ Relative intensity (1972Ge12).
# Placement of transition in the level scheme is uncertain.

^{147}Sm(n,γ) E=0.020–1.0 keV 1997Go20

1997Go20: E=≈20 eV to ≈1 keV; measured Eγ, Iγ, γ(θ), and linear polarization following average–resonance neutron capture of filtered reactor neutrons.
Others: 1985GoZL, 1987Be48.
All data are from 1997Go20, unless indicated otherwise.

^{148}Sm Levels

E(level)†	Jπ‡	ΣI_γ§	Comments
0.0	0+		
550.255 *8*	2+	0.377 *25*	
1161.531 *15*	3−	0.068 *10*	
1180.231 *14*	4+	0.52 *3*	
1424.45 *3*	0+		
1454.059 *14*	2+	0.138 *13*	
1465.137 *11*	1−		
1594.241 *18*	5−	0.056 *10*	
1664.223 *15*	2+	0.166 *14*	
1733.440 *20*	4+	0.272 *20*	
1894.94 *3*	4+	0.306 *22*	
1903.773 *18*	3+	0.356 *25*	Jπ: 3+; Jπ=3− ruled out by linear–polarization data.

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^{147}Sm(n,γ) E=0.020–1.0 keV 1997Go20 (continued)

^{148}Sm Levels (continued)

E(level)†	Jπ‡	ΣI$_\gamma$§	Comments
1905.857 *25*	6+		
1920.97 *6*	0+		
1972.480 *21*	2+	0.105 *12*	
2031.39 *5*	4−	0.034 *8*	Jπ: 4−.
2057.93 *5*	2−		
2095.180 *20*	6+		
2110.95 *3*	4+	0.278 *20*	
2128.46 *4*	7−		
2146.35 *3*	2+	0.289# *21*	Jπ: 2+; Jπ=2− and 3+ ruled out by linear−polarization data.
2147.447 *24*	5+	0.289# *21*	
2193.93 *5*	6+		
2204.99 *15*	0+		
2208.85 *7*	(1,2+)	0.093 *11*	Jπ: 2+.
2214.36 *5*	5+	0.062 *10*	Jπ: 5+.
2228.22 *4*	4+	0.168 *15*	
2284.37 *13*	(1,2+)		Jπ: 1.
2313.57 *8*	2+	0.101 *13*	Jπ: 2+.
2327.09 *5*	4+	0.44@ *3*	Jπ: 4+.
2327.62 *9*	3+	0.44@ *3*	Jπ: 3+.
2339.21 *8*	3−	0.059 *11*	Jπ: 3−.
2374.31 *6*	5+,6+		
2381.67 *10*	3+,4+	0.174 *14*	Jπ: 3+,4+.
2390.45 *6*	3+	0.143 *13*	Jπ: 3+.
2392.32 *7*	7+		
2442.29 *10*	(2+)	0.061 *10*	Jπ: 2+.
2467.38 *8*	3(−)		Jπ: 3−; π=− based on small primary−capture Iγ.
2472.48 *16*	1		Jπ: 1.
2489.99 *5*	4+	0.202 *16*	
2513.50 *18*	1		Jπ: 1.
2524.875 *25*	4+	0.24 *4*	
2532.51 *6*	4−,5−		Jπ: (5−).
2539.82 *17*	3−	0.071 *11*	Jπ: 3−.
2567.92 *19*	2+	0.050 *11*	Jπ: 2+.
2570.72 *6*	4(−)		Jπ: 4−; π=− because of small primary−capture Iγ.
2583.75 *7*	4(−)		Jπ: 4−; π=− because of small primary−capture Iγ.
2633.15 *8*	3−	0.085 *12*	Jπ: 3−.
2640.76 *6*	5+	0.069 *11*	Jπ: 5+.
2645.50? *15*	4+,5+	0.135 *14*	
2673.12 *9*	4+	0.160 *15*	Jπ: 3+,4+.
2683.22 *6*	4−,5−	0.154 *15*	
2697.77 *12*	3+,4+	0.141 *14*	Jπ: 3+,4+.
2701.70 *20*	4(−),(3−)		Jπ: 4−,(3−); π=− because of small primary−capture Iγ.
2704.6 *5*	(1,2+)		Jπ: 1.
2713.27 *6*	3+,4+	0.161 *16*	Jπ: 3+,4+.
2716.27 *22*	(4+,5,6+)		
2719.8 *5*	(3−,4−)		
2723.46 *6*	4+	0.149 *19*	Jπ: 3+,4+.
2727.18 *9*	5+		Jπ: 5,6.
2753.15 *6*	3+	0.18 *4*	Jπ: 3+.
2801.73 *10*	5+	0.056 *11*	
2806.73 *10*	3+,4+	0.105 *13*	Jπ: 3+,4+.
2815.46 *9*	4−	0.072 *12*	
2828.13 *15*			
2830.54 *16*	5+	0.113& *19*	
2835.7? *4*		0.113& *19*	
2846.9 *3*	(3−,4−)		
2861.07 *8*	4−,5−	0.300a *24*	Jπ: 3+,4+.
2862.06 *11*	3+,4+	0.300a *24*	Jπ: 3+,4+.
2891.8 *5*			
2908.13 *22*	3−,4−		
2928.74 *13*	(4,5,6)+		
2931.98? *20*			
2941.1 *7*	2+,3−	0.043 *10*	Jπ: 2+,3−.

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^{147}Sm(n,γ) E=0.020–1.0 keV 1997Go20 (continued)

^{148}Sm Levels (continued)

E(level)†	Jπ‡	ΣI$_\gamma$§	Comments
2952.7 *9*			
2967.6 *7*	3+,4+	0.132 *15*	Jπ: 3+,4+.
2980.50 *19*	3+,4+	0.111 *5*	Jπ: 3+,4+.
2991.78 *16*	3+,4+	0.127 *14*	Jπ: 3+,4+.
3014.1 *6*	3−,4−	0.065 *12*	Jπ: 3−.
3050.5 *4*			
3063.25 *22*	3−	0.041 *10*	Jπ: 3−.
3089.84 *23*	2+,3−	0.077 *12*	Jπ: 2+,3−.
3107.8 *4*	3+,4+	0.123 *14*	Jπ: 3+,4+.
3117.3? *10*			
3138.46 *11*	3(−),4(−)	0.029 *9*	Jπ: 3−,4−; π=− from small primary−capture Iγ.
3153.5 *3*	+		
3164.8 *4*	3+,4+	0.142 *21*	Jπ: 3+,4+.
3178.0 *15*	+		
3189.8 *8*	2+,3−	0.046 *44*	Jπ: 2+,3−.
3197.4 *10*	3−,4−		
3221.2 *4*		0.068 *18*	
3224.83 *19*			
3276.2 *5*			

† From a least−squares fit to the Eγ data.
‡ Adopted values. Supporting assignments from this reaction based on γ(θ), primary capture Iγ/E$_\gamma^5$, and linear−polarization data are given in comments.
§ Sum of primary transitions to this level.
# Sum of primary transitions to the 2146 and 2148 levels.
@ Sum of primary transitions to the 2327 and 2328 levels.
& Sum of primary transitions to the 2831 and 2836 levels.
a Sum of primary transitions to the 2861 and 2862 levels.

γ(^{148}Sm)

Eγ	E(level)	Iγ†
189.63 *7*	2095.180	0.064 *12*
222.56 *6*	2128.46	0.262 *17*
241.70 *10*	2147.447	0.176 *14*
263.96 *20*	2392.32	0.059 *12*
288.10 *7*	2193.93	0.334 *17*
308.29 *11*	1972.480	0.127 *10*
309.93 *9*	2524.875	0.116 *10*
311.61 *5*	1905.857	0.492 *15*
x375.1 *3*		0.032 *10*
377.50 *8*	2110.95	0.176 *12*
414.026@ *21*	1594.241	11.9@ *3*
	2147.447	11.9@ *3*
423.57 *13*	2570.72	0.094 *11*
432.71 *3*	1594.241	2.45 *6*
449.66 *9*	1903.773	0.23 *9*
468.44 *6*	2374.31	0.363 *15*
486.45 *6*	2392.32	0.294 *14*
495.02@ *7*	2228.22	0.314@ *14*
495.07@ *7*	2723.46	0.314@ *14*
501.21 *6*	2095.180	0.524 *25*
516.71 *16*	2110.95	0.260 *12*
534.24 *4*	2128.46	0.99 *3*
550.273 *9*	550.255	100
553.17@ *3*	2147.447	5.18@ *13*
553.22@ *3*	1733.440	5.18@ *13*
571.96 *3*	1733.440	3.33 *8*
587.34 *19*	2815.46	0.049 *9*
592.82 *8*	2057.93	0.196 *11*
599.58 *9*	2193.93	0.242 *20*
611.272 *16*	1161.531	21.9 *6*
619.03@ *9*	2524.875	0.227@ *14*
619.83@ *9*	2214.36	0.227@ *14*
629.975 *14*	1180.231	43.4 *11*
654.20 *19*	2801.73	0.055 *9*
657.02 *8*	2110.95	0.257 *12*
666.96& *10*	2570.72	0.147 *10*
683.01 *25*	2830.54	0.034 *8*
x708.13 *10*		0.172 *12*
714.72 *5*	1894.94	1.21 *24*
723.58 *5*	1903.773	0.514 *23*
725.65 *3*	1905.857	3.49 *9*
734.08 *15*	2640.76	0.102 *9*
742.4‡ *3*	1903.773	0.149 *12*
756.61 *11*	2489.99	0.126 *9*
778.19 *11*	2442.29	0.112 *9*
780.09 *10*	2374.31	0.166 *20*
788.22 *7*	2683.22	0.292 *15*
817.82 *22*	2928.74	0.068 *13*
869.86 *4*	2031.39	2.83 *8*
874.19 *3*	1424.45	0.463 *17*
885.6 *8*	2339.21	0.101 *15*
896.39 *5*	2057.93	0.81 *3*
903.815 *19*	1454.059	2.71 *7*
914.916@ *15*	1465.137	1.95@ *5*
	2095.180	1.95@ *5*
930.68@ *3*	2110.95	1.73@ *5*
	2524.875	1.73@ *5*
936.38& *10*	2967.6	0.166 *16*

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^{147}Sm(n,γ) E=0.020–1.0 keV 1997Go20 (continued)

γ(^{148}Sm) (continued)

Eγ	E(level)	Iγ†
938.27 *5*	2532.51	0.49 *3*
949.48 *10*	2110.95	0.302 *15*
967.98& *7*	2147.447	0.93 *5*
976.49 *10*	2570.72	0.246 *13*
979.78 *6*	2713.27	0.529 *18*
985.16 *20*	2146.35	0.098 *11*
989.50 *6*	2583.75	0.410 *17*
x996.33 *14*		0.212 *14*
1013.73 *8*	2193.93	0.512 *24*
1033.99 *6*	2214.36	1.49 *4*
1035.85 *8*	2489.99	0.33 *3*
1047.66 *14*	2228.22	0.542 *29*
1051.25 *14*	2645.50?	0.162 *13*
1066.56 *5*	2228.22	0.691 *22*
1073.32 *16*	2806.73	0.211 *14*
1082.02 *14*	2815.46	0.170 *13*
1089.20 *17*	2683.22	0.183 *13*
x1102.59 *14*		0.173 *13*
1107.5 *3*	2701.70	0.28 *3*
1113.98 *2*	1664.223	1.98 *5*
x1125.6 *4*		0.058 *12*
1128.04@ *15*	2861.07	0.206@ *14*
	2862.06	0.206@ *14*
1132.78 *11*	2727.18	0.274 *18*
1146.86 *4*	2327.09	1.42 *4*
1152.20 *15*	2313.57	0.268 *24*
1159.15 *20*	2339.21	0.156 *23*
1166.08 *17*	2327.62	0.106 *15*
x1177.3@ *4*		0.044@ *24*
1177.6§@ *4*	2339.21	0.044@ *24*
1183.19 *6*	1733.440	0.60 *3*
x1209.24 *23*		0.127 *13*
1219.32 *17*	2673.12	0.186 *18*
1220.78 *25*	2815.46	0.115 *18*
1228.69& *19*	2390.45	0.124 *15*
1233.88 *14*	2828.13	0.156 *15*
x1235.97 *21*		0.095 *13*
x1258.41@ *10*		0.203@ *13*
1258.41@& *10*	2991.78	0.203@ *13*
1262.0 *3*	2442.29	0.068 *13*
1266.60 *10*	2861.07	0.242 *14*
1305.75 *10*	2467.38	0.144 *13*
1309.73 *15*	2489.99	0.265 *15*
1328.51 *9*	2489.99	0.56 *4*
1344.67@ *3*	1894.94	3.06@ *8*
	2524.875	3.06@ *8*
1353.509 *17*	1903.773	3.33 *8*
1362.67 *17*	2524.875	0.142 *13*
1370.71@ *6*	1920.97	0.212@ *14*
1370.74@& *13*	2532.51	0.212@ *14*
1378.31 *23*	2539.82	0.238 *24*
1399.02 *22*	3063.25	0.154 *13*
1409.05 *8*	2570.72	0.452 *19*
1422.216 *20*	1972.480	1.18 *3*
1454.039 *20*	1454.059	2.57 *7*
1460.65 *6*	2640.76	0.602 *21*
1465.101 *13*	1465.137	1.81 *5*
x1469.6 *3*		0.082 *14*
1471.61 *16*	2633.15	0.154 *14*
1477.3 *4*	2931.98?	0.055 *11*
1492.79 *10*	2673.12	0.283 *15*
1503.02 *11*	2683.22	0.255 *15*
1517.81 *22*	2697.77	0.094 *13*
1533.55 *19*	2713.27	0.156 *13*
1536.03@ *22*	2697.77	0.22@ *3*
	2716.27	0.22@ *3*
1540.13 *25*	2701.70	0.19 *3*
1543.27 *10*	2723.46	0.39 *3*
1547.15 *13*	2727.18	0.280 *22*
1560.72 *6*	2110.95	0.68 *3*
1596.08 *3*	2146.35	0.94 *3*
1621.51 *11*	2801.73	0.216 *14*
1626.38 *18*	2806.73	0.153 *14*
1635.35 *18*	2815.46	0.148 *14*
1645.7 *3*	2806.73	0.122 *15*
1650.35 *20*	2830.54	0.126 *14*
1654.72 *15*	2204.99	0.17 *3*
1658.58 *7*	2208.85	0.512 *20*
1664.20 *2*	1664.223	0.84 *3*
x1668.4 *4*		0.080 *14*
1674.2 *4*	2835.7?	0.172 *15*
1677.79 *13*	2228.22	0.91 *9*
1681.02 *22*	2861.07	0.109 *22*
1682.91 *25*	2862.06	0.132 *25*
1685.2 *3*	2846.9	0.111 *20*
x1690.6 *4*		0.055 *14*
x1692.9 *3*		0.085 *15*
x1704.8 *4*		0.066 *14*
1734.04 *19*	2284.37	0.086 *14*
x1741.2 *3*		0.081 *14*
1743.3‡#	3197.4	0.16 *2*
1746.59 *22*	2908.13	0.116 *18*
1748.48 *16*	2928.74	0.17 *3*
1763.26 *8*	2313.57	0.50 *3*
1777.35 *10*	2327.62	0.94 *4*
x1780.67 *25*		0.096 *15*
1788.90 *9*	2339.21	0.523 *20*
x1796.47 *25*		0.108 *14*
1800.26 *19*	2980.50	0.142 *14*
1810.94 *25*	2991.78	0.125 *14*
x1813.7 *3*		0.207 *20*
x1822.61 *19*		0.282 *19*
1831.40 *10*	2381.67	0.589 *24*
1840.18 *6*	2390.45	0.89 *4*
x1858.1 *3*		0.105 *17*
x1879.35 *25*		0.134 *14*
1888.7 *4*	3050.5	0.100 *15*
1909.4 *4*	3089.84	0.075 *14*
1917.25 *12*	2467.38	0.339 *18*
1922.28 *25*	2472.48	0.113 *14*
1928.4 *3*	3089.84	0.096 *15*
x1947.9‡ *4*		0.16 *3*
x1966.96 *19*		0.142 *14*
x1970.8 *7*		0.042 *12*
1973.3 *3*	3153.5	0.138 *14*
1976.91 *10*	3138.46	0.276 *18*
1989.52 *25*	2539.82	0.174 *17*
2003.3 *4*	3164.8	0.090 *16*
x2006.2 *6*		0.075 *25*
2017.65 *19*	2567.92	0.220 *18*
x2023.4 *6*		0.057 *14*
2041.0 *4*	3221.2	0.081 *15*
2044.58 *19*	3224.83	0.196 *17*
2082.88 *9*	2633.15	0.708 *26*
x2086.0 *6*		0.099 *16*
2132.67& *14*	2683.22	0.308 *18*

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^{147}Sm(n,γ) E=0.020–1.0 keV 1997Go20 (continued)

γ(^{148}Sm) (continued)

Eγ	E(level)	Iγ†
2147.47 *16*	2697.77	0.40 *3*
x2155.7 *3*		0.153 *15*
2169.5 *5*	2719.8	0.126 *18*
2174.27 *20*	2723.46	0.307 *20*
x2188.2 *3*		0.142 *18*
2202.88 *6*	2753.15	0.82 *3*
2208.9 *3*	2208.85	0.125 *20*
x2213.2 *5*		0.088 *20*
x2241.9 *7*		0.096 *17*
2256.36 *16*	2806.73	0.284 *20*
x2268.7 *8*		0.053 *15*
2284.41 *18*	2284.37	0.183 *17*
x2287.3 *8*		0.052 *15*
2297.0 *5*	2846.9	0.055 *15*
x2304.2 *8*		0.082 *16*
2312.13 *21*	2862.06	0.242 *18*
x2317.2 *6*		0.109 *17*
x2329.5 *6*		0.094 *16*
x2334.6 *4*		0.186 *19*
2341.5 *5*	2891.8	0.128 *15*
x2350.2 *6*		0.100 *18*
x2360.7 *11*		0.068 *17*
x2368.4 *13*		0.049 *17*
2381.89 *22*	2931.98?	0.213 *18*
2390.8 *7*	2941.1	0.087 *17*
2402.4 *9*	2952.7	0.087 *17*
2417.3 *7*	2967.6	0.082 *16*
x2421.1 *8*		0.064 *16*
x2430.9 *7*		0.074 *15*
x2434.8 *5*		0.112 *16*
2441.88@ *20*	2442.29	0.450@ *25*
2441.88@ *20*	2991.78	0.450@ *25*
x2451.2 *8*		0.058 *16*
x2456.4 *6*		0.083 *16*
2463.8 *6*	3014.1	0.083 *16*
2472.41 *20*	2472.48	0.080 *16*
x2485.8 *5*		0.095 *18*
2500.6 *5*	3050.5	0.076 *17*
2513.48 *18*	2513.50	0.120 *16*
x2528.7 *9*		0.078 *17*
x2533.1 *15*		0.033 *14*
2539.6 *6*	3089.84	0.079 *17*
2557.5 *4*	3107.8	0.156 *17*
2567.0 *10*	3117.3?	0.069 *6*
x2578.8 *8*		0.065 *16*
2627.7 *15*	3178.0	0.037 *15*
2639.5 *8*	3189.8	0.055 *14*
x2652.5 *8*		0.078 *16*
x2700.2 *9*		0.075 *16*
2704.6 *5*	2704.6	0.053 *16*
2725.9 *5*	3276.2	0.116 *16*
x4842.7 *7*		0.053 *10*
x4855.6 *5*		0.143 *15*
x4872.1 *7*		0.060 *10*
x4878.6 *4*		0.174 *17*
x4937.4 *9*		0.060 *11*
x4995.1 *10*		0.054 *15*
x5012.8 *5*		0.109 *13*
x5038.8 *8*		0.127 *14*

† Relative intensity.
‡ Multiplet.
§ Assumed by the evaluator. 1172.6 *4* (1997Go20) is considered to be a typographical error.
# Assumed by the evaluator. 1943.3 (1997Go20) is considered to be a typographical error.
@ Multiply placed; undivided intensity given.
& Placement of transition in the level scheme is uncertain.
x γ ray not placed in level scheme.

^{147}Sm(n,γ) E=0.1–10 keV 1970Bu19

Measured γ's following average–resonance neutron capture with Ge(Li) detector as singles and triple coin with the two annihilation γ rays of a split–ring NaI(Tl) detector.

^{148}Sm Levels

E(level)	Jπ†	Comments
0.0	0+	
550.5	2+	Jπ: 2+,5+.
1162.2	3−	Jπ: 3−,4−.
1180.1	4+	Jπ: 3+,4+.
1433.5?		Jπ: 1−,6−, (2−,5−).
1453.6	2+	Jπ: 2+,5+.
1465?	1−	
1595.0	5−	Jπ: 3−,4−.
1663.4	2+	Jπ: 2+,5+.
1732.9	4+	Jπ: 3+,4+.
1894.2	4+	Jπ: 3+,4+.

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^{147}Sm(n,γ) E=0.1–10 keV 1970Bu19 (continued)

^{148}Sm Levels (continued)

E(level)	Jπ†	Comments
1902.9	3+	Jπ: 3+,4+.
2031.4?	4−	Jπ: 2+,3+,4+,5+.
2080.3?		Jπ: 2+,5+.
2096.1?	6+	Jπ: not 2+ to 5+.
2110.7	4+	Jπ: 3+,4+.
2146.4	2+	Jπ: 3+,4+.
2158.0?		Jπ: 2+,5+.
2173.4?		Jπ: 2+,5+.
2194.6?	6+	Jπ: not 2+ to 5+.
2208.7?	(1,2+)	Jπ: 2+,5+.
2212.7	5+	Jπ: 2+,5+.
2227.6	4+	Jπ: 3+,4+.
2314.2	2+	Jπ: 2+,5+.
2326.8	4+	Jπ: not 3+,4+.
2338.6	3−	Jπ: 3−,4−.
2389.2	3+	Jπ: 3+,4+.
2440.7		Jπ: (3−,4−).
2489.5	4+	Jπ: 3+,4+.
2513.4?	1	Jπ: 3+,4+.
2524.2	4+	Jπ: 3+,4+.
2538.4	3−	Jπ: 2+,5+.
2570.3?	4(−)	Jπ: 3−,4−.
2639.4	5+	Jπ: 2+,5+.
S(n)+x§	2+,3,4,5+‡	

† Adopted values. Jπ assignments based on average–resonance capture data are given in comments.
‡ Values possible for L=0 and L=1 neutron resonances with Jπ(^{147}Sm g.s.)=7/2− in the energy range 0.1–10 keV.
§ x=0.1–10 keV, S(n)=8141.37 *28* keV (2012Wa38).

γ(^{148}Sm)

Eγ‡§	E(level)	Iγ@	Mult.†
5502.2 *18*	S(n)+x	162 *40*	(E1)
5572.1 *18*	S(n)+x	40 *20*	M1
5603.2 *9*	S(n)+x	169 *20*	E1
5616.4 *9*	S(n)+x	400 *28*	E1
5628.2 *5*	S(n)+x	376 *38*	E1
5652.1 *7*	S(n)+x	369 *37*	E1
5701.7 *18*	S(n)+x	75 *30*	(M1)
5752.4 *9*	S(n)+x	367 *55*	E1
5803.8 *14*	S(n)+x	53 *16*	M1
5814.8#	S(n)+x	<200	E1
5827.4 *9*	S(n)+x	224 *27*	E1
5914.0 *4*	S(n)+x	436 *35*	E1
5928.9 *14*	S(n)+x	170 *34*	E1
5932.9 *9*	S(n)+x	162 *32*	E1
5947.8&	S(n)+x	<50	(M1,E2)
5968.2 *9*	S(n)+x	89 *18*	E1
5983.6 *4*	S(n)+x	155 *19*	E1
5995.2 *4*	S(n)+x	512 *31*	E1
6030.9 *4*	S(n)+x	616 *31*	E1
6046.3&	S(n)+x	<25	(M1,E2)
6061.3 *4*	S(n)+x	177 *27*	E1
6111.0& *10*	S(n)+x	≤119	(M1,E2)
6238.7 *3*	S(n)+x	652 *33*	E1
6247.5 *3*	S(n)+x	630 *32*	E1
6408.7 *3*	S(n)+x	737 *37*	E1
6478.2 *6*	S(n)+x	385 *39*	E1
6547.4 *18*	S(n)+x	65 *13*	M1
6677.3&	S(n)+x	<7	(E2)
6688.0 *3*	S(n)+x	393 *24*	E1
6708.9 *14*	S(n)+x	25 *10*	E2,M1
6961.5 *3*	S(n)+x	1072 *54*	E1
6980.2 *5*	S(n)+x	108 *16*	M1
7591.1 *3*	S(n)+x	841 *42*	E1

† Multipolarity was derived from analysis of Iγ/Eγ^5.
‡ Measured at E(n)=thermal.
§ Existence of γ's: 5947.8, 6046.3, 6111.0, 6677.3 is questionable.
# From 1972SmZY, possible doublet.
@ Relative intensity.
& Placement of transition in the level scheme is uncertain.

^{147}Sm(n,γ) E=24.5 keV 1979MuZR

Measured: γ.

^{148}Sm Levels

E(level)	Jπ†
0.0	0+
550.5	2+
1162	3−
1180	4+
1448?	
1457	2+
1664	2+
1734	4+
8166‡	

† Adopted values.
‡ The energy of n−capture states for E(n)=24 keV with J=2−5.

γ(^{148}Sm)

Eγ	E(level)	Iγ
6431.2	8166	54
6501.1	8166	45
6708.8	8166	48
6717.5	8166	26
6984.3	8166	100
7002.2	8166	36
7615.2	8166	67

^{147}Sm(d,p) 1975Oe01,1964Ke03

J(^{147}Sm)=7/2−.
E=12.5 MeV, FWHM=9−12 keV (1975Oe01), 12 MeV FWHM=0.1% (1964Ke03).
Measured: σ(E,θ), DWBA analysis.

^{148}Sm Levels

E(level)†	L§	(2J+1)C²S§
0.0	3	2.11
551 *3*	1+3	1.14+1.12
1163 *3*	2	0.39
1181 *3*	1+3	0.34+1.06
1427@		
1464# *8*		
1594# *8*		
1666 *3*	3	1.46
1736 *3*	1+3	0.49+3.15
1906‡ *3*	1+3	0.56+9.10
1976 *3*	1+3	0.56+0.64
2041# *8*		
2100 *3*	1+3	0.10+3.14
2116 *3*		
2151 *3*	1+3	0.54+0.87
2199 *3*	3	1.85
2218 *3*	1+3	0.51+0.78
2233 *3*	1+3	0.26+0.41
2280# *8*		
2318 *3*		
2333 *3*	1	0.69
2379 *3*	3	3.39
2395 *3*	1	1.34
2496 *3*	1	1.41
2532 *3*	1	2.81
2575# *10*		
2649 *3*	1	2.06
2682# *10*		
2705 *3*	1+3	0.41+0.67
2729 *3*	1+3	1.03+1.70
2760‡ *3*	1+3	0.50+0.85
2809‡ *3*		
2824‡ *3*		
2868 *3*	1	0.55
2902# *10*		
2930‡ *3*	1+3	0.66+1.28
2950# *10*		
2989 *3*		
3001 *3*		
3022 *3*		
3046 *3*	1+3	0.90+0.93
3068# *10*		
3112 *3*	1+3	0.50+1.16
3154 *3*	1+3	0.31+1.50
3178 *3*	1+3	0.63+0.84
3218# *10*		
3243 *3*	1+3	0.58+0.73
3273# *10*		
3307 *3*		
3349 *3*	1	1.35
3389# *10*		
3409 *3*		
3450# *10*		
3479 *3*		
3526 *10*		
3556 *10*		
3586 *10*		
3621 *10*		
3658 *10*		
3668 *10*		
3712 *10*		
3734 *10*		
3761 *10*		
3780 *10*		
3794 *10*		
3847 *10*		

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^{147}Sm(d,p) 1975Oe01,1964Ke03 (continued)

^{148}Sm Levels (continued)

E(level)†	E(level)†	E(level)†
3890 *10*	4214 *10*	4535 *10*
3924 *10*	4228 *10*	4573 *10*
3953 *10*	4255 *10*	4592 *10*
3990 *10*	4290 *10*	4630 *10*
4028 *10*	4334 *10*	4649 *10*
4043 *10*	4357 *10*	4675 *10*
4085 *10*	4383 *10*	4735 *10*
4107 *10*	4402 *10*	4784 *10*
4127 *10*	4444 *10*	4824 *10*
4166 *10*	4466 *10*	4876 *10*
4192 *10*	4510 *10*	

† Levels below 3500 keV are from 1975Oe01, unless indicated otherwise; all levels above 3500 keV are from 1964Ke03.
‡ Unresolved doublet, levels less than 10 keV apart.
§ From DWBA analysis (1975Oe01).
# Observed only by 1964Ke03.
@ Level masked by impurities.

^{148}Sm(γ,γ') 2005Li14,1993Zi05

2005Li14: Eγ≤3.2 MeV; measured Eγ, Iγ, γ(θ), for θ=90°, 127°, and 150°, $\Gamma_{\gamma0}$, transition strengths. Deduced J values, $T_{1/2}$ values, and absolute photon scattering cross sections (relative to known cross sections in ^{27}Al). Identified 2+, 2146–keV level as one–phonon $2^+_{1,ms}$ mixed–symmetry state.
1993Zi05: Eγ=2–4 MeV; measured Eγ, Iγ, γ(θ), for θ=90°, 127°, of resonance fluorescence spectrum.
1976Me17: Eγ=1.2–3.8 MeV; measured σ(θ).
Others: 1965Me04, 1990Zi06, 1991Ra03, 1991Ri02.
Below 3082 level data are mostly from 2005Li14 and 1993Zi05; above this level all data are from 1993Zi05.

^{148}Sm Levels

E(level)†	Jπ‡	$T_{1/2}$§	$\Gamma_{\gamma0}$ (meV)	Comments
0.0	0+			
550.255# *8*	2+			
1161.529# *12*	3−			
1454.10 *15*	2+	285 fs *28*	0.80 *8*	$\Gamma_{\gamma0}$: from 2005Li14.
1465.160 *16*	1−	92 fs *8*	3.25 *25*	$\Gamma_{\gamma0}$: from 2005Li14. $T_{1/2}$: other: 0.097 ps +*14*–*11* from $\Gamma_{\gamma0}$=0.0031 eV *4* (1976Me17), and adopted $\Gamma_{\gamma0}/\Gamma$=0.659 *7*.
1920.97# *6*	0+			
2146.62 *18*	2+	<64.1 fs	1.20 *24*	E(level): 2146.35 *3* quoted by 2005Li14 as from 2000Bh03. $\Gamma_{\gamma0}$: from 2005Li14.
2284.42 *4*	1	46 fs *5*	4.3 *4*	Jπ: (1,2+) (2000Bh03). $\Gamma_{\gamma0}$: from 2005Li14.
2381.1 *4*	2(+)	87 fs *17*	1.6 *3*	Jπ: 2 from angular correlation ratios (2005Li14), π=(+) from more likely E2 quadrupole 2381γ to 0+, g.s.; 3+,4+ (2000Bh03). $\Gamma_{\gamma0}$: from 2005Li14.
2472.23 *19*	1	37 fs *3*	6.5 *4*	$\Gamma_{\gamma0}$: from 2005Li14.
2512.3 *5*	1	99 fs *5*	6.6 *4*	$\Gamma_{\gamma0}$: from 2005Li14. Other: $\Gamma_{\gamma0}$=9.1 *6* (1993Zi05); $\Gamma_{\gamma1}/\Gamma_{\gamma0}$=0.00 *5* (1993Zi05).
2704.91 *17*	1	20.1 fs *12*	17 *1*	Jπ: (1,2+) (2000Bh03). $\Gamma_{\gamma0}$: from 2005Li14.
2762.6 *5*	1+	7.5 fs *4*	36.1 *9*	Jπ: (1,2+) (2000Bh03). B(E1)=4.6×10^{-5} *3* (1993Zi05 for E1 transition which however is actually M1 (2005Li14)). $\Gamma_{\gamma0}$: from 2005Li14. $\Gamma_{\gamma0}$=33.9 *21* (1993Zi05); $\Gamma_{\gamma1}/\Gamma_{\gamma0}$=0.68 *4*.

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^{148}Sm(γ,γ') 2005Li14,1993Zi05 (continued)

^{148}Sm Levels (continued)

E(level)†	Jπ‡	$T_{1/2}$§	$\Gamma_{\gamma0}$ (meV)	Comments
3038.8 *6*	1	41.4 fs *22*	11.0 *6*	Jπ: (1,2+) (2000Bh03). B(M1)=0.12 *8* (1993Zi05 for M1 transition which however is not fully confirmed by 2005Li14 (D)). $\Gamma_{\gamma0}$: from 2005Li14. $\Gamma_{\gamma0}$=13 *9* (1993Zi05); $\Gamma_{\gamma1}/\Gamma_{\gamma0}$=0.68 *4*.
3082.1 *4*	1	10.2 fs *7*	41 *3*	Jπ: (1,2+) (2000Bh03). B(M1)=0.39 *4* (1993Zi05 for M1 transition which however is not fully confirmed by 2005Li14 (D)). $\Gamma_{\gamma0}$: from 2005Li14. $\Gamma_{\gamma0}$=35 *10* (1993Zi05); $\Gamma_{\gamma1}/\Gamma_{\gamma0}$=0.10 *3*.
3255.3 *5*	(1,2+)		53 *3*	B(E1)↑=4.4×10^{-5} *3*. $\Gamma_{\gamma1}/\Gamma_{\gamma0}$=1.37 *8*.
3291.5 *5*	(1,2+)		20.7 *23*	B(E1)↑=1.7×10^{-5} *2*. $\Gamma_{\gamma1}/\Gamma_{\gamma0}$=1.10 *14*.
3451.9 *5*	(1,2+)		15.4 *12*	$\Gamma_{\gamma1}/\Gamma_{\gamma0}$=0.00 *6*.
3483.6 *5*	(1,2+)		88 *22*	B(E1)↑=6.0×10^{-5} *15*. $\Gamma_{\gamma1}/\Gamma_{\gamma0}$=0.05 *1*.
3534.9 *5*	(1,2+)		89 *6*	B(E1)↑=5.8×10^{-5} *4*. $\Gamma_{\gamma1}/\Gamma_{\gamma0}$=0.20 *1*.
3586.0 *5*	(1,2+)		7.2 *11*	$\Gamma_{\gamma1}/\Gamma_{\gamma0}$=0.00 *9*.
3812.0 *5*	(1,2+)		33 *3*	$\Gamma_{\gamma1}/\Gamma_{\gamma0}$=0.00 *4*.
3843.6 *5*	(1,2+)		12 *4*	B(E1)↑=0.6×10^{-5} *2*. $\Gamma_{\gamma1}/\Gamma_{\gamma0}$=1.4 *4*.
3884.3 *5*	(1,2+)		51 *4*	$\Gamma_{\gamma1}/\Gamma_{\gamma0}$=0.00 *3*.
3895.4 *5*	(1,2+)		28 *3*	$\Gamma_{\gamma1}/\Gamma_{\gamma0}$=0.00 *5*.

† From a least–squares fit to Eγ data.
‡ Up to 3082.0 level inclusively, adopted by 2005Li14 from angular correlation ratios, unless indicated otherwise; above 3082.0 level, from adopted levels, gammas dataset.
§ From 2005Li14, unless indicated otherwise.
# From 2000Bh03 (hold fixed in the least–squares fit to Eγ data).

γ(^{148}Sm)

E(level)	Eγ	Iγ	Mult.	Comments
1454.10	903.83 *15*	100 *2*	[M1,E2]	Eγ: from 2005Li14. Iγ: quoted by 2005Li14 as from 2000Bh03. B(M1)=0.0147 *19* (2005Li14); B(E2)=1388×10^{-4} *150* (2005Li14).
	1454.2 *5*	99.6 *2*	E2	Eγ: from 2005Li14. Iγ: quoted by 2005Li14 as from 2000Bh03. B(E2)=152×10^{-4} *15* (2005Li14).
1465.160	303.59 *3*	0.17 *2*	[E2]	Eγ,Iγ: quoted by 2005Li14 as from 2000Bh03. B(E2)=2648×10^{-4} *380* (2005Li14).
	914.916 *15*	51.6 *4*	[E1]	Eγ,Iγ: quoted by 2005Li14 as from 2000Bh03. B(E1)=2.09×10^{-5} *24* (2005Li14).
	1465.3 *6*	100 *3*	[E1]	Eγ: from 2005Li14; other: 1465 (1993Zi05). Iγ: quoted by 2005Li14 as from 2000Bh03. B(E1)=0.98×10^{-5} *8* (2005Li14).
2146.62	985.16 *20*	10.4 *12*	[E1]	Eγ,Iγ: quoted by 2005Li14 as from 2000Bh03. B(E1)=≥0.607×10^{-5} (2005Li14).
	1596.1 *4*	100 *11*	[M1]	Eγ,Iγ: from 2005Li14. B(M1)=≥0.116 (2005Li14).
	2146.3	<17	[E2]	Eγ,Iγ: from 2005Li14. B(E2)=32.5×10^{-4} *65* (2005Li14).
2284.42	362.8† *2*	<5		Eγ,Iγ: quoted by 2005Li14 as from 2000Bh03.
	819.27 *3*	30 *5*	[D]	Eγ,Iγ: quoted by 2005Li14 as from 2000Bh03. B(M1)=0.205 *41* (2005Li14); B(E1)=2.26×10^{-5} *46* (2005Li14).
	1734.2 *4*	99 *6*	[D]	Eγ,Iγ: from 2005Li14. B(M1)=0.0712 *80* (2005Li14); B(E1)=0.768×10^{-5} *89* (2005Li14).
	2284.5 *3*	100 *6*	[D]	Eγ,Iγ: from 2005Li14. B(M1)=0.0315 *30* (2005Li14); B(E1)=0.347×10^{-5} *34* (2005Li14).

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^{148}Sm(γ,γ') 2005Li14,1993Zi05 (continued)

γ(^{148}Sm) (continued)

E(level)	Eγ	Iγ	Mult.	Comments
2381.1	1830.9 *5*	100 *10*	[M1,E2]	Eγ,Iγ: from 2005Li14. B(M1)=0.042 *10* (2005Li14); B(E2)=38×10^{-4} *14* (2005Li14).
	2381.1 *6*	43 *7*	[E2]	Eγ,Iγ: from 2005Li14. B(E2)=25.8×10^{-4} *42* (2005Li14).
2472.23	1922.0 *5*	92 *8*	[D]	Eγ,Iγ: from 2005Li14. B(M1)=0.072 *8* (2005Li14); B(E1)=0.80×10^{-5} *9* (2005Li14).
	2472.2 *2*	100 *3*	[D]	Eγ,Iγ: from 2005Li14. B(M1)=0.0372 *25* (2005Li14); B(E1)=0.411×10^{-5} *27* (2005Li14).
2512.3	2512.3 *5*	100 *3*	[D]	Eγ: weighted average of 2512.3 *5* (1993Zi05) and 2513.5 *2* (2005Li14). Iγ: from 2005Li14. B(M1)=0.0361 *19* (2005Li14); B(E1)=0.400×10^{-5} *21* (2005Li14).
2704.91	2154.6 *3*	33.5 *22*	[D]	Eγ,Iγ: from 2005Li14. B(M1)=0.0492 *42* (2005Li14); B(E1)=0.544×10^{-5} *48* (2005Li14).
	2704.9 *2*	100 *3*	[D]	Eγ,Iγ: from 2005Li14. B(M1)=0.0742 *42* (2005Li14); B(E1)=0.821×10^{-5} *47* (2005Li14).
2762.6	2213.0 *10*	68 *4*	[M1]	Eγ: from 2005Li14. Iγ: from 1993Zi05. B(M1)=0.196 *16* (2005Li14).
	2762.4 *5*	100 *2*	[M1]	Eγ: weighted average of 2762.1 *5* (1993Zi05) and 2763.2 *9* (2005Li14). Iγ: from 2005Li14. B(M1)=0.1480 *79* (2005Li14).
3038.8	2489	<10		Eγ: from 2005Li14. Iγ: from 1993Zi05.
	3038.5 *7*	100 *4*	[D]	Eγ: weighted average of 3037.6 *5* (1993Zi05) and 3039.0 *4* (2005Li14). Iγ: from 2005Li14. B(M1)=0.0339 *19* (2005Li14); B(E1)=0.374×10^{-5} *21* (2005Li14).
3082.1	2531.9 *9*	8.8 *15*	[D]	Eγ,Iγ: from 2005Li14. B(M1)=0.194 *36* (2005Li14); B(E1)=0.215×10^{-5} *40* (2005Li14).
	3082.0 *4*	100 *3*	[D]	Eγ: weighted average of 3080.9 *5* (1993Zi05) and 3082.2 *2* (2005Li14). Iγ: from 2005Li14. B(M1)=0.1219 *86* (2005Li14); B(E1)=1.348×10^{-5} *95* (2005Li14).
3255.3	3255.3 *5*			
3291.5	3291.5 *5*			
3451.9	3451.9 *5*			
3483.6	3483.6 *5*			
3534.9	3534.9 *5*			
3586.0	3586.0 *5*			
3812.0	3811.9 *5*			
3843.6	3843.5 *5*			
3884.3	3884.2 *5*			
3895.4	3895.3 *5*			

† Placement of transition in the level scheme is uncertain.

^{148}Sm(e,e') 1972LeYB

Measured σ(E).
See also the review in 1991Ri02.

^{148}Sm Levels

E(level)	Jπ	Comments
0.0	0+	
550	2+	B(E2)↑=0.811 *37*.

^{148}Sm(n,n'γ) 1997Go20

1997Go20: E=reactor fast neutrons, measured Eγ, Iγ, γ(θ), and linear polarization of γ–rays.
Reactor fast neutrons: measured: γ (1978AhZX,1977Ak06), γ(θ) (1985GoZL). Other: 1997GoZR.
All data are from 1997Go20, unless indicated otherwise.
See also (n,γ) E=0.020–1.0 keV dataset for data of 1997Go20.

^{148}Sm Levels

E(level)†	Jπ‡	Comments
0.0	0+	
550.256 *8*	2+	
1161.534 *15*	3−	
1180.234 *14*	4+	
1424.45 *3*	0+	
1454.061 *14*	2+	
1465.136 *11*	1−	
1594.264 *18*	5−	
1664.225 *15*	2+	
1733.483 *21*	4+	
1894.95 *3*	4+	
1903.776 *18*	3+	Jπ: 3+; Jπ=3− ruled out by linear–polarization data.
1905.91 *3*	6+	
1920.97 *6*	0+	
1972.476 *21*	2+	
2031.40 *5*	4−	Jπ: 4−.
2057.94 *5*	2−	
2095.170 *20*	6+	
2110.956 *25*	4+	
2128.49 *4*	7−	
2146.35 *3*	2+	Jπ: 2+; Jπ=2− and 3+ ruled out by linear–polarization data.
2147.528 *24*	5+	
2194.05 *5*	6+	
2204.99 *15*	0+	
2208.85 *7*	(1,2+)	Jπ: 2+.
2214.24 *6*	5+	Jπ: 5+.
2228.07 *5*	4+	
2284.37 *13*	(1,2+)	Jπ: 1.
2313.57 *8*	2+	Jπ: 2+.
2327.10 *5*	4+	Jπ: 4+.
2327.62 *9*	3+	Jπ: 3+.
2339.21 *9*	3−	Jπ: 3−.
2374.35 *6*	5+,6+	
2381.67 *10*	3+,4+	Jπ: 3+,4+.
2390.45 *6*	3+	Jπ: 3+.
2392.09 *17*	7+	
2442.41 *9*	(2+)	Jπ: 2+.
2467.38 *8*	3(−)	Jπ: 3−; π=− based on small primary–capture Iγ.
2472.48 *16*	1	Jπ: 1.
2490.00 *5*	4+	
2513.50 *18*	1	Jπ: 1.
2524.920 *25*	4+	
2532.54 *6*	4−,5−	Jπ: (5−).
2539.82 *17*	3−	Jπ: 3−.
2567.89 *19*	2+	Jπ: 2+.
2570.65 *7*	4(−)	Jπ: 4−; π=− because of small primary–capture Iγ.
2583.77 *7*	4(−)	Jπ: 4−; π=− because of small primary–capture Iγ.
2633.24 *11*	3−	Jπ: 3−.
2640.77 *6*	5+	Jπ: 5+.
2673.12 *9*	4+	Jπ: 3+,4+.
2683.22 *6*	4−,5−	
2697.74 *16*	3+,4+	Jπ: 3+,4+.
2701.8 *3*	4(−),(3−)	Jπ: 4−,(3−); π=− from small primary–capture Iγ.
2704.6 *5*	(1,2+)	Jπ: 1.
2713.27 *7*	3+,4+	Jπ: 3+,4+.
2723.72 *9*	4+	Jπ: 3+,4+.
2727.19 *9*	5+	Jπ: 5,6.
2734.6 *5*	(3)	

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^{148}Sm(n,n'γ) 1997Go20 (continued)

^{148}Sm Levels (continued)

E(level)†	Jπ‡	Comments
2753.15 *6*	3+	Jπ: 3+.
2801.75 *11*	5+	
2806.74 *10*	3+,4+	Jπ: 3+,4+.
2815.46 *11*	4−	
2828.15 *15*		
2847.3 *5*	(3−,4−)	
2861.09 *8*	4−,5−	Jπ: 3+,4+.
2861.87 *12*	3+,4+	Jπ: 3+,4+.
2928.72 *16*	(4,5,6)+	
2931.98? *20*		
2967.2 *5*	3+,4+	Jπ: 3+,4+.
2980.51 *19*	3+,4+	Jπ: 3+,4+.
2992.26 *14*	3+,4+	Jπ: 3+,4+.
3014.1 *6*	3−,4−	Jπ: 3−.
3050.9 *5*		
3063.25 *22*	3−	Jπ: 3−.
3107.8 *4*	3+,4+	Jπ: 3+,4+.
3138.46 *11*	3(−),4(−)	Jπ: 3−,4−; π=− from small primary−capture Iγ.
3221.2 *4*		
3276.2 *5*		

† From a least−squares fit to Eγ data.
‡ From adopted levels. Supporting assignments from this reaction based on γ(θ), primary capture $I\gamma/E_\gamma^5$, and linear−polarization data are given in comments.

γ(^{148}Sm)

Eγ	E(level)	Iγ†	Mult.§	δ§
222.56 *6*	2128.49	0.109 *13*		
241.70 *10*	2147.528	0.069 *12*		
288.10 *7*	2194.05	0.101 *20*		
x301.7 *4*		0.152 *15*		
308.29 *11*	1972.476	0.146 *16*		
311.61 *5*	1905.91	0.164 *20*		
377.50 *8*	2110.956	0.064 *12*		
414.026@ *21*	1594.264	3.75@ *10*		
	2147.528	3.75@ *10*		
432.71 *3*	1594.264	0.96 *3*	E2#	
449.66 *9*	1903.776	0.171 *14*		
468.44 *6*	2374.35	0.124 *15*		
486.18 *16*	2392.09	0.196 *21*		
501.21 *6*	2095.170	0.18 *5*		
516.71 *6*	2110.956	0.20 *3*		
534.24 *4*	2128.49	0.37 *4*		
x544.6 *4*		0.058 *12*		
550.273 *9*	550.256	100	E2#	
553.17@ *3*	2147.528	2.3@ *5*		
553.22@ *3*	1733.483	2.3@ *5*		
571.96 *3*	1733.483	1.46 *6*	E1(+M2)#	<0.4
592.82 *8*	2057.94	0.29 *4*		
599.58 *9*	2194.05	0.077 *14*		
611.272 *16*	1161.534	15.4 *4*	E1(+M2)#	<0.4
619.03 *9*	2524.920	0.049 *10*		
620.23 *25*	2214.24	0.049 *10*		
629.975 *14*	1180.234	17.5 *4*	E2#	
x641.8 *4*		0.040 *11*		
657.02 *8*	2110.956	0.092 *9*		
666.7 *3*	2570.65	0.079 *14*		
x708.0 *3*		0.094 *16*		
714.72 *5*	1894.95	0.66 *3*		

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^{148}Sm(n,n'γ) 1997Go20 (continued)

γ(^{148}Sm) (continued)

Eγ	E(level)	Iγ†	Mult.§	δ§	Comments
723.58 *5*	1903.776	0.35 *4*			
725.65 *3*	1905.91	1.08 *4*			
734.08 *15*	2640.77	0.092 *9*			
756.61 *11*	2490.00	0.052 *10*			
x762.3 *6*		0.055 *10*			
778.19 *11*	2442.41	0.081 *13*			
780.09 *10*	2374.35	0.040 *13*			
788.22 *7*	2683.22	0.079 *11*			
x808.6 *3*		0.12 *3*			
810.65 *14*	1972.476	0.19 *3*			
819.2 *4*	2284.37	0.096 *15*			
x821.7 *8*		0.040 *13*			
869.86 *4*	2031.40	1.58 *5*	M1+E2		Mult.: A_2=−0.56 *10*, A_4=−0.07 *13*. δ: −0.23 *8* or −2.3 *8*.
874.19 *3*	1424.45	2.26 *6*	E2#		γ(θ) isotropic; A_2=0.002 *9*, A_4=−0.002 *12*.
885.6 *8*	2339.21	0.032 *10*			
x890.8 *4*		0.071 *11*			
896.39 *5*	2057.94	1.30 *4*	M1+E2	>+0.2	Mult.: A_2=−0.19 *6*, A_4=0.10 *7*.
903.815 *19*	1454.061	4.15 *11*	M1+E2	+2.32 *10*	Mult.: A_2=0.167 *9*, A_4=−0.033 *12*. δ: weighted average of +2.33 *11* (1997Go20), and +2.26 *22* (1985GoZL).
914.916@ *15*	1465.136	1.95@ *5*			
	2095.170	1.95@ *5*			
930.68@ *3*	2110.956	0.624@ *20*			Mult.: M1+E2, δ=−0.91 *9*; A_2=−0.15 *3*, A_4=−0.06 *4* (1997Go20); M1+E2, δ=−0.80 *7* (1985GoZL); however, since this γ is doubly placed, this result is suspect.
	2524.920	0.624@ *20*			
936.38& *10*	2967.2	0.086 *16*			
938.27 *5*	2532.54	0.129 *18*			
949.48 *10*	2110.956	0.108 *15*			
x956.2 *5*		0.166 *15*			
967.98 *7*	2147.528	0.152 *15*			
976.49 *10*	2570.65	0.061 *9*			
979.78 *6*	2713.27	0.140 *13*			
985.16 *20*	2146.35	0.202 *20*			
989.50 *6*	2583.77	0.184 *18*			
x996.4 *5*		0.056 *10*			
1014.02 *8*	2194.05	0.253 *15*			
1033.99 *6*	2214.24	0.46 *3*	M1+E2	−2.4 *6*	Mult.: A_2=−0.60 *4*, A_4=0.12 *6*.
1035.85 *8*	2490.00	0.080 *12*			
1047.66 *14*	2228.07	0.231 *14*			
1059.02& *25*	2513.50	0.113 *12*			
x1063.9 *8*		0.045 *15*			
1066.56 *5*	2228.07	0.277 *20*			
1073.32 *16*	2806.74	0.048 *11*			
1082.02 *14*	2815.46	0.071 *11*			
x1085.5 *4*		0.065 *11*			
1089.20 *17*	2683.22	0.059 *12*			
x1102.4 *4*		0.064 *11*			
1107.5 *3*	2701.8	0.108 *12*			
1113.98 *2*	1664.225	2.76 *8*	M1+E2	−0.565 *21*	Mult.: A_2=−0.091 *8*, A_4=−0.012 *11*. δ: weighted average of −0.57 *3* (1997Go20) and −0.56 *3* (1985GoZL).
1128.04@ *15*	2861.09	0.051@ *11*			
	2861.87	0.051@ *11*			
1132.78 *11*	2727.19	0.077 *12*			
1146.86 *4*	2327.10	0.513 *20*	M1+E2	−0.21 *3*	Mult.: A_2=0.21 *3*, A_4=−0.01 *3*. δ: weighted average of −0.19 *5* (1997Go20), and −0.22 *4* (1985GoZL).
1152.20 *15*	2313.57	0.254 *19*	E1+M2	−0.10 *9*	Mult.: A_2=0.00 *4*, A_4=−0.05 *6*.
x1153.8 *5*		0.059 *13*			
1159.15 *20*	2339.21	0.147 *13*			

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^{148}Sm(n,n'γ) 1997Go20 (continued)

γ(^{148}Sm) (continued)

Eγ	E(level)	Iγ†	Mult.§	δ§	Comments
1166.08 *17*	2327.62	0.060 *12*			
1177.6@ *4*	2339.21	0.087@ *17*			Eγ: assumed by the evaluator. 1172.6 *4* (1997Go20) is considered to be a typographical error.
x1177.9@ *4*		0.087@ *12*			
x1181.0 *6*		0.117 *25*			
1183.19 *6*	1733.483	0.23 *3*			
x1197.3 *5*		0.050 *11*			
x1210.0 *4*		0.059 *12*			
1219.32 *17*	2673.12	0.131 *20*			
1220.78 *25*	2815.46	0.072 *14*			
1229.2 *6*	2390.45	0.056 *14*			
1233.88 *14*	2828.15	0.077 *15*			
x1258.4@ *6*		0.061@ *12*			
1258.41@& *10*	2992.26	0.061@ *12*			
1262.0 *3*	2442.41	0.102 *18*			
1266.60 *10*	2861.09	0.069 *12*			
1270.2 *7*	2734.6	0.046 *12*			
1305.75 *10*	2467.38	0.100 *12*			
1309.73 *15*	2490.00	0.103 *12*			
1328.51 *9*	2490.00	0.237 *14*			
1344.67@ *3*	1894.95	1.19@ *4*			
	2524.920	1.19@ *4*			
x1346.7 *4*		0.131 *26*			
1353.509 *17*	1903.776	1.73 *5*	M1+E2	+8.2 *12*	Mult.: A_2=0.19 *2*, A_4=0.122 *27*. δ: other: +10 *+6–2* (1985GoZL).
1362.67 *17*	2524.920	0.030 *12*			
1370.71 *6*	1920.97	0.615 *20*			Mult.: γ(θ) isotropic; A_2=0.00 *4*, A_4=–0.06 *5*.
1378.31 *23*	2539.82	0.163 *13*			
1399.02 *22*	3063.25	0.056 *10*			
1409.05 *8*	2570.65	0.147 *15*			
1422.216 *20*	1972.476	1.54 *4*	M1+E2	−0.556 *24*	Mult.: A_2=–0.09 *1*, A_4=–0.014 *14*. δ: weighted average of −0.56 *3* (1997Go20) and −0.55 *4* (1985GoZL).
x1449.6 *4*		0.080 *16*			
1454.039 *20*	1454.061	3.96 *12*	E2#		
1460.65 *6*	2640.77	0.12 *3*			
1465.101 *13*	1465.136	3.36 *10*	E1#		
1471.61 *16*	2633.24	0.093 *12*			
1477.3 *4*	2931.98?	0.032 *10*			
1492.79 *10*	2673.12	0.108 *12*			
1503.02 *11*	2683.22	0.089 *11*			
1543.27 *10*	2723.72	0.118 *12*			
1547.15 *13*	2727.19	0.075 *11*			
1560.72 *6*	2110.956	0.243 *14*	E2		Mult.: A_2=0.30 *3*, A_4=–0.08 *4*.
x1563.5 *5*		0.080 *11*			
1572.5 *6*	2734.6	0.055 *11*			
x1584.3 *7*		0.037 *11*			
1596.08 *3*	2146.35	1.09 *3*	M1+E2	−0.11 *5*	Mult.: A_2=0.11 *2*, A_4=–0.02 *3*.
1621.51 *11*	2801.75	0.060 *11*			
1626.38 *18*	2806.74	0.067 *11*			
1635.35 *18*	2815.46	0.055 *11*			
1645.7 *3*	2806.74	0.055 *11*			
1654.72 *15*	2204.99	0.315 *18*			
1658.58 *7*	2208.85	0.71 *3*			
1664.20 *2*	1664.225	1.25 *4*	E2#		
1677.79 *13*	2228.07	0.402 *16*	E2#		
1681.02 *22*	2861.09	0.090 *11*			
1682.1 *4*	2861.87	0.090 *13*			
1734.04 *19*	2284.37	0.230 *14*			
x1741.5‡ *6*		0.071 *13*			
1748.48 *16*	2928.72	0.081 *14*			
1763.26 *8*	2313.57	0.602 *24*	M1+E2	+2.2 *5*	Mult.: A_2=0.16 *3*, A_4=–0.03 *4*.
1777.35 *10*	2327.62	0.55 *5*			

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^{148}Sm(n,n'γ) 1997Go20 (continued)

γ(^{148}Sm) (continued)

Eγ	E(level)	Iγ†	Mult.§	δ§	Comments
1788.90 *9*	2339.21	0.360 *18*	E1+M2	+0.06 *4*	Mult.: A_2=−0.13 *4*, A_4=0.03 *5*.
1800.26 *19*	2980.51	0.052 *11*			
1810.94 *25*	2992.26	0.046 *12*			
x1814.1 *6*		0.056 *12*			
x1822.6 *6*		0.043 *10*			
1831.40 *10*	2381.67	0.409 *20*	M1+E2	+0.46 *8*	Mult.: A_2=0.24 *5*, A_4=−0.04 *7*.
1840.18 *6*	2390.45	0.381 *19*	M1+E2	−1.37 *12*	Mult.: A_2=−0.52 *4*, A_4=0.13 *6*.
x1858.4 *3*		0.061 *13*			
x1860.6 *3*		0.147 *15*			
1917.25 *12*	2467.38	0.171 *15*			
1922.28 *25*	2472.48	0.157 *15*			
1972.8 *3*	1972.476	0.152 *12*			
1976.91 *10*	3138.46	0.129 *12*			
1989.52 *25*	2539.82	0.123 *13*			
2017.65 *19*	2567.89	0.233 *16*	M1+E2		Mult.: A_2=−0.04 *7*, A_4=0.08 *10*. δ: −0.46 *19* or 1/δ=+0.01 *13*.
2041.0 *4*	3221.2	0.028 *10*			
2083.03 *14*	2633.24	0.330 *20*	E1(+M2)	+0.02 *9*	Mult.: A_2=−0.18 *7*, A_4=0.01 *9*.
2132.67& *14*	2683.22	0.113 *12*			
2147.47 *16*	2697.74	0.208 *17*			
x2155.5 *5*		0.067 *11*			
2174.27 *20*	2723.72	0.124 *12*			
x2187.6 *4*		0.078 *11*			
2202.88 *6*	2753.15	0.300 *20*	M1+E2		Mult.: A_2=−0.12 *5*, A_4=0.03 *7*. δ: +0.05 *6* or −5.6 +*30*−*14*.
2208.9 *3*	2208.85	0.126 *12*			
x2212.6 *4*		0.086 *11*			
2256.36 *16*	2806.74	0.092 *11*			
2284.41 *18*	2284.37	0.249 *17*	D		Mult.: A_2=−0.08 *4*, A_4=0.02 *6*.
2297.0 *5*	2847.3	0.061 *11*			
x2304.3 *5*		0.081 *12*			
2312.13 *21*	2861.87	0.080 *12*			
2381.89 *22*	2931.98?	0.149 *16*			
x2431.2 *4*		0.115 *13*			
2442.42@ *16*	2442.41	0.281@ *20*			Mult.: E2; A_2=0.29 *7*, A_4=0.04 *9* (1997Go20). However, since this γ is doubly placed, this result is suspect.
	2992.26	0.281@ *20*			
2463.8 *6*	3014.1	0.046 *11*			
2472.41 *20*	2472.48	0.187 *16*	D		Mult.: A_2=−0.19 *7*, A_4=0.02 *9*.
x2478.8 *9*		0.037 *11*			
2500.6 *5*	3050.9	0.044 *11*			
2513.48 *18*	2513.50	0.254 *20*	D		Mult.: A_2=−0.11 *5*, A_4=0.08 *7*.
x2533.1 *7*		0.047 *12*			
2557.5 *4*	3107.8	0.047 *12*			
2567.0 *10*	2567.89	0.069 *13*			
x2699.2 *8*		0.052 *15*			
2704.6 *5*	2704.6	0.103 *20*			
2725.9 *5*	3276.2	0.050 *16*			
x2763.0 *8*		0.060 *17*			

† Relative intensities.
‡ Multiplet.
§ From γ(θ) and linear–polarization data.
# Multipolarity known from earlier work that is confirmed by the present data of 1997Go20.
@ Multiply placed; undivided intensity given.
& Placement of transition in the level scheme is uncertain.
x γ ray not placed in level scheme.

^{148}Sm(p,p'), (pol p,p') 1964Ke03

1964Ke03: E=12.03 MeV, FWHM=0.1%; measured σ(E,θ).
1989Ob02: E=24 MeV, FWHM=18 keV; measured σ(θ) for elastic and inelastic scattering, coupled–channels (CC) and collective–models analysis.
1989Gu09: E=66.5 MeV, FWHM≤25 keV; measured σ(θ) for elastic and inelastic scattering, first–order vibrational model, CC analysis.
1993Co03: E=26 MeV, FWHM=about 50 keV; measured σ(θ) for inelastic scattering, coupled–channels analysis.
1993Pe16: E(pol p)=20.4 MeV, FWHM=20 keV and 80%–90% polarization; measured σ(θ) for elastic and inelastic scattering, DWBA and CC analysis.
See also 1967Ku14, 1967St09, 1970Br19, 1971Kr10, 1972Ku15, 1972Wo03, 1972Ku32, 1974Ku21.

^{148}Sm Levels

E(level)†	Comments
0.0	
552 *3*	β_2=0.132 (1989Ob02); 0.120 *10* (1993Co03). See also 1993Pe16 for details of coupled–channel analysis and the deformation parameters deduced.
1165‡ *5*	β_3=0.120 (1989Ob02); 0.130 *10* (1993Co03). See also 1993Pe16 for details of coupled–channel analysis and the deformation parameters deduced.
1182‡ *5*	
1432 *8*	
1464 *8*	
1594 *8*	
1669 *8*	
1740 *8*	
1909 *8*	
1982 *8*	
2104 *8*	
2152 *8*	
2222 *8*	

† From (d,p) and (p,p') data (1964Ke03).
‡ Unresolved doublet (1964Ke03).

^{148}Sm(d,d') 1968Ve01

E=12.1 MeV.
Other: 1966Ze03.
Measured: σ(E,θ), FWHM=7–10 keV.

^{148}Sm Levels

E(level)	σ(E)†	E(level)	σ(E)†	E(level)	σ(E)†
0.0	10000	1733 *4*	66	2378 *4*	1.7
551 *2*	574	2094 *4*	8	2463 *4*	11
1162 *2*	314	2109 *4*	12	2527 *4*	10
1181 *2*	51	2147 *4*	7	2635 *4*	3
1454 *2*	11	2225 *4*	25	2711 *4*	3
1465 *2*	8	2309 *4*	7	2722 *4*	13
1594 *4*	30	2336 *4*	52	2847 *4*	5
1663 *4*	10	2370 *4*	1.5	2864 *4*	3

† σ(E) in μb/sr (at 125°).

Coulomb Excitation

E(p)=4.5 MeV, E(d)=4.5 MeV (1960El07), E(α)=15.1 MeV (1968Ve01), 10–13 MeV (1970Ge07), E(^{16}O)=35–40 MeV (1970Ge07), 36, 39 MeV (1966Ec02), 40–49 MeV (1968Ke04), 27 MeV (1967Si03), 35–72 MeV (1976SmZQ,1977SmZO), E(^{32}S)=51–53 MeV (1967Si03), E(^{48}Ti)=130 MeV (2008Fi08), see also 1971Di02 (^{40}Ar beam), 1977SmZO (^{63}Cu beam), 1973ClZF.
Measured: γ, γγ, B(E2), γ(t).

^{148}Sm Levels

E(level)	Jπ†	$T_{1/2}$	Comments
0.0	0+		
550.43	2+	7.72 ps *32*	μ: μ=+0.492 *44* (1987Ba65). Q: Q=−0.77 *34* (1967Si03), −0.97 *27* (1973ClZF). $T_{1/2}$: from the evaluation of 2001Ra27. B(E2)↑=0.720 *30* (2001Ra27). Adopted B(E2) is evaluated based on the following data: B(E2)=0.89 *10* (1960El07), 0.70 *8* (1966Ec02), 0.79 *8* (1967Si03), 0.65 *5* (1968Ve01), 0.63 *5* (1968Ke04), 0.705 *25* (1970Ge07), 0.725 *25* (1973ClZF, based on B(E2)(^{152}Sm)=3.35), 0.811 *37* (1972LeYB) and $T_{1/2}$=7.33 ps *40* (1971Di02).
1161.94	3−		B(E3)=0.37 *3* (1968Ke04). B(E3): other: B(E3)=0.39 *4* (1968Ve01) (value given by the authors has been increased by 10% to account for multiexcitation correction as estimated by them).
1180.69	4+	2.39 ps *24*	$T_{1/2}$: from B(E2)(2+ to 4+)=0.43 *4* (1968Ke04). Other: 2.3 ps *6* by DSRM (1971Di02). Measured (2008Fi08) σ(4+)/σ(2+)=0.0157 *2*.
1425.93	0+		
1454.0	2+	0.36 ps *11*	B(E2)↑=0.060 *14*. B(E2): unweighted average of 0.074 *10* and 0.046 *10* (1968Ke04). $T_{1/2}$: from B(E2) and branching 1454γ=0.499 *5*.
1461.1	(1,2+)		
1465.7	1−		B(E1)=0.013 *5* (1968Ve01).
1663.1	2+	0.25 ps *8*	B(E2)↑=0.03 *1* (1968Ve01). $T_{1/2}$: from B(E2).
1907.55	6+		

† Adopted values.

γ(^{148}Sm)

Eγ†	E(level)	Iγ‡	Comments
550.43	550.43	100	
611.51	1161.94	4.2	
x615.01		2.5	
630.26	1180.69	2.5	Measured B(E2)(4+ to 2+)/B(E2)(2+ to 0+)=1.33 *4* (2008Fi08).
726.96	1907.55	0.18	
875.5	1425.93	0.25	
903.6	1454.0	0.70	
910.7	1461.1	1.08	
915.3	1465.7	0.71	
1112.7	1663.1	2.4	
1454.0	1454.0	0.78	
1461.1	1461.1	1.91	
1465.7§	1465.7	≤0.17	
1663.1	1663.1	0.22	

† From 1977SmZO.
‡ Relative intensity from 1977SmZO measured at θ=90° (lab).
§ Placement of transition in the level scheme is uncertain.
x γ ray not placed in level scheme.

^{149}Sm(d,t) 1975Oe01

1975Oe01: E=17 MeV, FWHM=9–11 keV; measured σ(E,θ), DWBA analysis.
1992Da01,1994Ko29: E=6, 8 MeV polarized deuterons; measured angular distribution and tensor–analyzing powers for a determination of triton properties. No data on ^{148}Sm.
Jπ(target)=7/2–.

^{148}Sm Levels

E(level)	L	C^2S	E(level)	L	C^2S	E(level)	L	C^2S
0.0	3	0.61	2731 *3*			3428 *3*		
550 *3*	3	0.33	2759 *3*			3449 *3*		
1162 *3*	0	0.01	2821† *3*	1	0.04	3463 *4*		
1181 *3*	3	0.41	2843 *3*	(0)	0.01	3488 *4*	(0)	0.07
1456 *3*	1	0.07	2866 *3*			3504 *4*		
1666 *3*	3	0.19	2906 *3*	0	0.04	3530 *4*	(0)	0.11
1736 *3*	3	0.60	2927 *3*			3546 *4*	(0)	0.17
1898 *3*	3	0.30	2936 *3*			3572 *4*		
1910 *3*	3	0.74	2952‡ *3*			3600 *4*	(0)	0.07
1976 *3*	1	0.06	2989† *3*			3628 *4*	(0)	0.14
2035 *3*	0	0.01	2993† *3*			3652 *4*	(0)	0.09
2099 *3*	3	0.43	3006† *3*			3674 *4*		
2117 *3*	(0)	0.03	3017 *3*	0	0.08	3696 *4*	(0)	0.10
2151 *3*	1+3	0.05+0.18	3044 *3*			3714 *4*		
2198 *3*	3	0.28	3055† *3*			3734 *4*	(0)	0.05
2218 *3*	1	0.06	3073† *3*			3752 *4*		
2232 *3*			3098 *3*	(0)	0.04	3774 *4*	(0)	0.11
2277 *3*	3	0.03	3113 *3*			3797 *4*		
2318 *3*	1	0.01	3138‡ *3*			3817 *4*	0	0.09
2331 *3*	1+3	0.01+0.03	3153 *3*			3843 *4*	0	0.09
2344 *3*	0	0.05	3175 *3*			3862 *4*	0	0.13
2380 *3*	3	0.21	3198 *3*	0	0.03	3888 *4*		
2396 *3*	1	0.06	3226 *3*			3902 *4*	0	0.05
2473 *3*			3247 *3*			3924 *4*	0	0.17
2496 *3*	1	0.06	3274 *3*			3951† *4*		
2531† *3*	1	0.14	3313‡ *3*			3975 *4*	(0)	0.08
2574 *3*			3344 *3*			3990 *4*	(0)	0.04
2646 *3*	1	0.04	3385 *3*	0	0.09	4005 *4*		
2683 *3*			3397 *3*			4011‡ *4*		
2705 *3*	1+3	0.02+0.04	3405‡ *3*			4026 *4*	0	0.07
2720 *3*	(0)	0.05	3417 *3*			4041 *4*		

† Possible unresolved doublet; less than 10 keV apart.
‡ Weakly excited level.

^{150}Sm(p,t) 1972De47

E=19.0 MeV, FWHM=8 keV; measured σ(E,θ).
Others: 1971IsZX, 1982Na06 (E(p)=52 MeV), 1973Oe02 (E(p)=25.5 MeV), 1982Pa13.

^{148}Sm Levels

E(level)	L	σ†	E(level)	L	σ†	E(level)	L	σ†
0.0	0	1166	1665 *3*	(2)	48	2358 *4*	0	78
549 *3*	(2)	82	1736 *3*	(4)	14	2540 *4*	(2,4)	43
1162 *3*	3	19	1923 *4*	0	12	2725‡		
1181 *3*		9	2103§			2870‡		
1426 *3*	0	217	2149 *4*		14	2950‡		
1458 *3*		20	2206 *4*	0	32			
1595 *4*		3	2231 *5*		6			

† Maximum of differential cross section.
‡ Observed by 1969LeZP.
§ Weak doublet.

^{151}Eu(μ⁻,3nγ) 1971Pe14

Measured: Eγ, γ(t).

^{148}Sm Levels

E(level)	Jπ†
0.0	0+
550.35 *9*	2+

† Adopted values.

γ(^{148}Sm)

Eγ	E(level)	Iγ	Comments
550.35 *9*	550.35	0.064 *25*	Iγ: yield per μ⁻ stopped in the target.

(HI,xnγ) 1979Ha19,1985Si16,1991Ur01

^{146}Nd(α,2nγ) E(α)=23.4 MeV (1979Ha19), E(α)=26 MeV (1985Si16).
^{148}Nd(^{3}He,3nγ) E(^{3}He)=26.8 MeV (1979Ha19).
^{148}Nd(α,4nγ) E(α)=40–50 MeV (1977BrYX); E(α)=68 MeV (1988UrZY).
^{138}Ba(^{13}C,3nγ) E(^{13}C)=55 MeV (1987UrZZ,1987UrZV,1988UrZX,1991Ur01,1998UrZZ).
^{150}Nd(α,6nγ), E(α)=68 MeV (1987UrZW).
^{130}Te(^{22}Ne,4nγ), E(^{22}Ne)=85 MeV (1990UrZY,1990UrZS,1991Ur01).
Measured: Eγ, Iγ, γγ, γ(θ) (1977BrYX,1979Ha19,1985Si16,1987UrZZ,1988UrZY), γ–ray excitation functions (1979Ha19), ce (1979Ha19,1985Si16), γ(t) (1977BrYX,1979Ha19,1988UrZY), linear polarization of gammas (1988UrZX,1990UrZY,1990UrZS,1991Ur01), DCO (1991Ur01), $T_{1/2}$ (1998UrZZ).
The energy levels and placement of gammas follows 1990UrZS, 1998UrZZ.

^{148}Sm Levels

The band designations and suggested configurations are from 1990UrZS, 1991Ur01.
B(E1)/B(E2) branching ratios are from 1991Ur01.

E(level)†	Jπ‡	Comments
0.0§	0+	
550.41§ *10*	2+	Jπ: 2+ (1979Ha19,1985Si16,1990UrZS).
1161.74# *13*	3−	Jπ: 3− (1979Ha19,1985Si16,1990UrZS).
1180.39§ *13*	4+	Jπ: 4+ (1979Ha19,1985Si16,1990UrZS).
1594.54# *14*	5−	Jπ: 5− (1979Ha19,1985Si16,1990UrZS). B(E1)/B(E2)=0.68×10^{-4} *4* (1991Ur01); 0.62×10^{-4} (1979Ha19).
1733.52 *19*	4+	Jπ: 4+ (1985Si16).
1906.17§ *15*	6+	Jπ: 6+ (1979Ha19,1985Si16,1990UrZS). B(E1)/B(E2)=0.81×10^{-4} *5* (1991Ur01); 0.90×10^{-4} (1979Ha19).
2031.44 *24*	4−	Jπ: 4− (1985Si16).
2095.85& *15*	6+	Jπ: 6+ (1979Ha19,1985Si16,1990UrZS). B(E1)/B(E2)=1.22×10^{-4} *7*.
2128.79# *15*	7−	Jπ: 7− (1979Ha19,1985Si16,1990UrZS). B(E1)/B(E2)=0.62×10^{-4} *4* (1991Ur01); 0.69×10^{-4} (1979Ha19).
2194.13 *15*	6+	Jπ: (6+) (1979Ha19), 6+ (1985Si16,1990UrZS). B(E1,600γ)/B(E2,1014γ)=1.9×10^{-4} *5*.
2392.67 *18*	7+	Jπ: (6+,7+) (1979Ha19), 7+ (1985Si16,1990UrZS).
2544.67& *15*	8+	Jπ: 8+ (1979Ha19,1985Si16,1990UrZS). B(E1)/B(E2)=1.80×10^{-4} *8*. Configuration=$((\nu[(f^{3}_{7/2}),h_{9/2}])_{8+}\pi(d^{-2}_{5/2})_{0+})_{8+}$.
2714.98§ *16*	8+	Jπ: 8+ (1990UrZS). B(E1)/B(E2)=0.8×10^{-4} *1*.
2738.79 *20*	(8+)	Jπ: (8+) (1990UrZS).
2807.35# *16*	9−	Jπ: 9− (1979Ha19,1985Si16,1990UrZS). B(E1,92γ)/B(E2,678γ)=4.9×10^{-4} *9* (1991Ur01); B(E1,262γ)/B(E2,678γ)=0.3×10^{-4} (1979Ha19).
2942.82 *18*	8−	Jπ: 8− (1990UrZS).
2976.32 *20*	8−	Jπ: (8−) (1979Ha19), 8− (1990UrZS).

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(HI,xnγ) 1979Ha19,1985Si16,1991Ur01 (continued)

^{148}Sm Levels (continued)

E(level)[†]	Jπ[‡]	Comments
3095.25 *19*	9(+)	Jπ: 9(+) (1990UrZS).
3188.31[c] *17*	9−	Jπ: 9− (1990UrZS).
3216.15 *18*	9−	Jπ: 9− (1990UrZS).
3235.23[&] *17*	10+	Jπ: 10+ (1979Ha19,1985Si16,1990UrZS).
3253.45 *17*	10−	Jπ: 10− (1979Ha19,1985Si16,1990UrZS). Configuration=(ν $(i_{13/2},f^3{}_{7/2})_{10-}(\pi(d^{-2}{}_{5/2})_{0+}))_{10-}$ and (ν $[(i_{13/2},h_{9/2})_{10-}(f^2{}_{7/2})_{0+}]_{10-}(\pi(d^{-2}{}_{5/2})_{0+})_{10-}$.
3322.6 *3*	(10+)	Jπ: (10+) (1990UrZS).
3398.13[§] *16*	10+	Jπ: 10+ (1990UrZS). B(E1)/B(E2)=1.5×10^{-4} *3*.
3421.90[a] *16*	11−	Jπ: (11−) (1979Ha19,1985Si16), 11− (1990UrZS). B(E1)/B(E2)=1.04×10^{-3} *5*. Configuration=(ν $i_{13/2},h_{9/2})_{11-}(f^2{}_{7/2})_{0+}](\pi(d^{-2}{}_{5/2})_0)_{11-}$.
3526.57 *18*	10−	Jπ: 10−.
3545.63 *17*	10−	Jπ: 10−.
3614.76[#] *17*	11−	Jπ: 11−. B(E1)/B(E2)=2.9×10^{-4} *3*.
3640.4 *4*	(11)	Jπ: (11).
3806.98[c] *18*	11−	Jπ: 11−.
3992.62[&] *17*	12+	Jπ: 12+. B(E1)/B(E2)=0.49×10^{-4} *5*.
4104.39[§] *17*	12+	Jπ: 12+. B(E1,489γ)/B(E2,706γ)=5.1×10^{-4} *12*; B(E1,682γ)/B(E2,706γ)=0.19×10^{-4} *5*.
4108.70 *18*	12−	Jπ: 12−.
4110.68[a] *17*	13−	Jπ: 13−.
4189.28 *19*	12+	Jπ: 12+.
4196.25 *18*	12−	Jπ: 12−.
4241.52 *21*	13−	Jπ: 13−.
4397.78[#] *18*	13−	Jπ: 13−. B(E1)/B(E2)=1.9×10^{-4} *4*.
4512.91[c] *19*	13−	Jπ: 13−.
4516.75 *19*	13+	Jπ: 13+.
4805.18[§] *18*	14+	Jπ: 14+. B(E1,407γ)/B(E2,701γ)=0.9×10^{-4} *2*; B(E1,694γ)/B(E2,701γ)=0.06×10^{-4} *1*.
4842.69[a] *18*	15−	Jπ: 15−.
4864.69[&] *17*	14+	Jπ: 14+.
4889.71 *19*	14−	Jπ: 14−. B(E1)/B(E2)=1.1×10^{-4} *1*.
4909.65 *19*	14+	Jπ: 14+.
4917.55 *18*	14−	Jπ: 14−.
4951.75 *23*	14(−)	Jπ: 14(−).
5087.55 *19*	15−	Jπ: 15−.
5136.13[#] *19*	15−	Jπ: 15−. B(E1)/B(E2)=0.4×10^{-4} *1*.
5217.20 *20*	15(−)	Jπ: 15(−).
5274.93 *20*	15+	Jπ: 15+. B(E1)/B(E2)=0.7×10^{-4} *1*.
5287.77[c] *25*	15−	Jπ: 15−.
5320.28 *19*	16−	Jπ: 16−.
5496.39[§] *19*	16+	Jπ: 16+. B(E1,361γ)/B(E2,692γ)=1.2×10^{-4} *2*; B(E1,654γ)/B(E2,692γ)=0.8×10^{-4} *1*.
5524.48[&] *19*	16+	Jπ: 16+.
5556.54 *21*	16−	Jπ: 16−.
5561.19[a] *20*	17−	Jπ: 17−.
5578.31 *21*	16(+)	Jπ: 16(+).
5649.57 *20*	17−	Jπ: 17−.
5777.74 *21*	17+	Jπ: 17+.
5837.32[@] *22*	17−	Jπ: 17−.
5946.08[§] *19*	18+	Jπ: 18+. B(E1,73γ)/B(E2,449γ)=1.2×10^{-4} *2*; B(E1,385γ)/B(E2,449γ)=0.05×10^{-4} *1*. configuration=(ν$[(i_{13/2}{}^2)_{12+},(f_{7/2}{}^2)_{6+}]_{18}\pi(d_{5/2}{}^{-2})_{0+})_{18+}$.
6011.15 *21*	18	Jπ: 18.
6029.22 *21*	18−	Jπ: 18−.

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(HI,xnγ) 1979Ha19,1985Si16,1991Ur01 (continued)

^{148}Sm Levels (continued)

E(level)†	Jπ‡	$T_{1/2}$	Comments
6195.29@ *21*	19−		Jπ: 19−. B(E1)/B(E2)<0.025×10^{-4}.
6392.23 *23*	19−		Jπ: 19−.
6477.07 *20*	19−		Jπ: 19−.
6557.5? *4*	(19)		Jπ: (19).
6592.79§ *21*	20(+)		Jπ: 20+. B(E1)/B(E2)=0.11×10^{-4} *3*. configuration=(ν[(i$_{13/2}$)^2)$_{12+}$(h$_{9/2}$,f$_{7/2}$)$_{8+}$]$_{20+}$π(d$_{5/2}$)$^{-2}$$_{0+}$)$_{20+}$.
6694.32b *21*	21(−)	32 ns *3*	Jπ: 21−. configuration=(ν(i$_{13/2}$,h$_{9/2}$)$_{11-}$(f$_{7/2}$)^2)$_{0+}$ (π(h$_{11/2}$)^2)$_{10+21-}$. $T_{1/2}$: by DSAM using ^{130}Te(^{22}Ne,4nγ).
6913.3@ *3*	21(−)		Jπ: 21(−).
7329.3§ *3*	22(+)		Jπ: 22+. B(E1)/B(E2)<2.3×10^{-4}.
7332.92b *23*	23(−)		Jπ: 23−.
7620.4@ *3*	23(−)		Jπ: 23(−). B(E1)/B(E2)=1.7×10^{-4} *5*.
7942.5 *3*	(22)		Jπ: (22).
7977.6§ *3*	24(+)		Jπ: 24+. B(E1)/B(E2)=0.8×10^{-4} *3*.
8010.61b *25*	25(−)		Jπ: 25−.
8214.5@ *3*	25(−)		Jπ: 25(−). B(E1)/B(E2)=4.5×10^{-4} *15*.
8358.8 *3*	(24)		Jπ: (24).
8602.2b *3*	27(−)		Jπ: 27−.
8659.5§ *5*	26(+)		Jπ: 26(+).
8931.5? *7*	(27)		Jπ: (27).
9045.9 *3*	(26)		Jπ: (26).
9601.2b *4*	29		Jπ: 29.
9898.2 *11*	(28)		Jπ: (28).
10439.0b *4*	31		Jπ: 31.
10609.1 *4*	(30)		Jπ: (30).
11524.7 *5*	(32)		Jπ: (32).

† From a least squares fit to the Eγ data.

‡ From adopted levels. Jπ assignments from this reaction based on: γ–ray excitation functions, γ(θ), Ice spectra, $T_{1/2}$, prompt and delayed γ and Ice spectra, γγ(t) spectra (1979Ha19); γ(θ), Ice, γγ coin. (1985Si16); γ(θ), DCO, γ–ray linear polarization data, $T_{1/2}$ (1990UrZS,1991Ur01,1998UrZZ) are given in comments. For levels at 3527 and above, all assignments are from 1990UrZS, 1991Ur01, 1998UrZZ. π of levels up to J=19 have been deduced from linear–polarization data (1991Ur01). J assignments for higher spin values may be tentative. 1991Ur01 also claim to have observed simplex structure from enhanced E1 transitions.

§ (A): Band 1; g.s. band.

(B): Band 2; octupole band.

@ (C): Band 3.

& (D): Band 4.

a (E): Band 5.

b (F): Band 6.

c (G): Band 7.

γ(^{148}Sm)

Directional correlation from oriented nuclei (DCO), and linear–polarization data are from 1998UrZZ,1988UrZX.

Eγ†	E(level)	Iγ‡	Mult.§	α	Comments
92.2 *2*	2807.35		E1	0.343 *6*	
92.7 *3*	5649.57				
98.3 *2*	2194.13	0.5 *1*	D+(Q)		Mult.: A_2=−0.23 *4*, A_4=−0.20 *5* (1979Ha19).
101.5 *1*	6694.32				DCO=1.74 *6*.
103.1 *3*	5320.28				
108.7 *2*	5946.08		E1	0.220	
152.1 *2*	2544.67	0.1			DCO=1.9 *2*.
158.2 *1*	3253.45				
166.1 *1*	6195.29				DCO=2.4 *5*; lin pol=−0.46 *8*.

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(HI,xnγ) 1979Ha19,1985Si16,1991Ur01 (continued)

γ(^{148}Sm) (continued)

Eγ†	E(level)	Iγ‡	Mult.§	α	Comments
168.5 *1*	3421.90				DCO=1.95 *8*; lin pol=–0.11 *8*.
170.0 *2*	5087.55				
184.0 *2*	6195.29				DCO=1.6 *2*.
184.1 *2*	5320.28				
186.7 *1*	3421.90	1.8 *2*	E1	0.0508	Mult.: A_2=–0.38 *4*, A_4=+0.05 *5*; α(K)exp=0.059 *9* (1985Si16). DCO=1.81 *2*; lin pol=0.43 *10*.
190.0 *2*	2095.85	0.7	D+Q		Mult.: A_2=+0.13 *7*, A_4=–0.05 *10* (1979Ha19). Lin pol=–0.06 *24*.
196.5 *2*	4189.28				
198.0 *2*	5087.55				
205.8 *2*	3421.90				
212.1 *2*	3188.31				
216.6 *1*	3614.76		E1	0.0342	
217.3 *1*	6694.32				DCO=1.08 *7*.
222.7 *1*	2128.79	8.0 *4*	E1	0.0318	Mult.: A_2=–0.21 *1*, A_4=–0.02 *2*, α(K)exp=0.029 *4* (1985Si16); α(K)exp=0.022 *10* (1979Ha19). δ(M2/E1)=0.04 *8* from γ(θ); 0.09 +*8*–*15* from α(exp) (1979Ha19). DCO=1.78 *5*; lin pol=0.44 *8*.
233.0 *2*	5320.28				
233.4 *2*	6011.15				
236.9 *2*	8214.5		E1	0.0270	
x241.3 *5*		0.23 *5*			
244.9 *2*	5087.55				DCO=1.1 *1*; lin pol=0.15 *33*.
245.2 *2*	3188.31				DCO=0.9 *1*.
248.9 *2*	4241.52				Lin pol=0.8 *8*.
249#	6195.29		E1	0.0237	
261.2 *2*	3806.98				
262.5	2807.35	2.9	E1	0.0207	Mult.: A_2=+0.33 *5*, A_4=–0.18 *6* (1979Ha19).
264.0 *2*	2392.67	1.9	Q+D		Mult.: A_2=+0.28 *1*, A_4=+0.03 *2*; ΔJ=0 (1979Ha19).
265.4 *2*	5217.20				
272.0 *5*	8931.5?				
281.4 *3*	5777.74				
281.7# *5*	5556.54				
287.9 *2*	2194.13	1.2 *2*	M1+E2	0.077 *14*	Mult.: A_2=+0.6 *2*, A_4=–0.1 *2* (1985Si16).
291.2 *2*	7620.4		E1	0.01587	
293.3 *2*	4397.78		E1	0.01558	
296.5 *2*	5946.08				
302.0 *2*	6694.32				DCO=1.00 *8*.
310.6 *3*	3526.57				
311.6 *1*	1906.17	3.3 *3*	E1	0.01337	Mult.: A_2=–0.23 *2*, A_4=+0.07 *3* (1985Si16). Lin pol=0.18 *15*.
316.7 *2*	4512.91				
317.8 *2*	3640.4				
327.6 *2*	5217.20				
329.4 *2*	3545.63				
329.8 *2*	5649.57				
331.0 *2*	5136.13		E1	0.01150	
338.4 *2*	3526.57				
348.0# *5*	8358.8				
350.5 *2*	2544.67				
357.2 *3*	7977.6		E1		
357.4 *1*	3545.63				Lin pol=0.01 *26*.
358.0 *2*	6195.29		E2	0.0329	
360.3 *2*	5496.39		E1		
361.5 *2*	6011.15				DCO=1.8 *2*.
373.0 *2*	4889.71		E1		
379.9 *2*	6029.22				
381.0 *3*	6392.23				
381.4 *2*	3188.31				Lin pol=0.7 *5*.
384.9 *2*	5946.08		E1		
385.1 *2*	5274.93		E1		DCO=1.4 *1*.
385.4 *2*	3806.98				DCO=1.5 *1*; lin pol=0.45 *19*.
389.2 *2*	4196.25				

Continued on next page (footnotes at end of table)

(HI,xnγ) 1979Ha19,1985Si16,1991Ur01 (continued)

γ(^{148}Sm) (continued)

Eγ†	E(level)	Iγ‡	Mult.§	α	Comments
397.5 *2*	6592.79		E1		
400.5 *2*	4917.55				
402.2 *2*	4512.91				Lin pol=0.4 *3*.
402.8 *2*	5320.28				
404.6 *2*	4917.55				
407.4 *2*	4805.18		E1		Lin pol=0.44 *22*.
408.0 *1*	4516.75				
414.2 *1*	1594.54	44 *3*	E1		Mult.: A_2=−0.24 *2*, A_4=−0.03 *3* (1985Si16); α(K)exp=0.0050 *13* (1979Ha19). δ(M2/E1)=0.03 *5* from γ(θ); 0.10 +*7*−*12* from α(exp) (1979Ha19). DCO=1.67 *2*; lin pol=0.40 *4*.
415.9 *1*	2544.67	8.1 *4*	E1		Mult.: A_2=−0.15 *2*, A_4=−0.03 *3*, α(K)exp=31×10^{-4} *12* (1979Ha19). δ(M2/E1)=0.04 *4* from γ(θ); 0.16 +*12*−*20* from α(exp) (1979Ha19). DCO=1.67 *2*; lin pol=0.22 *4*.
416.0 *3*	7329.3		E1		
421.6 *2*	5946.08				
430.6 *2*	5320.28				
432.0 *5*	5649.57				
432.8 *1*	1594.54	9.6 *5*	E2	0.0190	Mult.: A_2=+0.30 *2*, A_4=−0.15 *3*, α(K)exp=1.8×10^{-2} *3* (1985Si16); α(K)exp=1.7×10^{-2} *2* (1979Ha19). DCO=1.00 *2*; lin pol=0.49 *8*.
442.2 *2*	5578.31				
445.0@ *3*	5287.77				
	8659.5				
446.1 *1*	3253.45	5.0 *5*	M1+E2	0.0287 *5*	δ: −0.10 *5*. Mult.: A_2=−0.57 *6*, A_4=−0.08 *8*; α(K)exp=0.016 *3* (1985Si16). δ: from 1979Ha19. DCO=2.3 *2*; lin pol=−0.12 *6*.
449.0 *11*	2544.67	2.8 *3*	E2	0.0172 *3*	Mult.: A_2=+0.37 *12*, A_4=−0.11 *3*, α(K)exp=0.016 *4* (1979Ha19). DCO=1.05 *5*; lin pol=0.42 *6*.
449.7 *2*	5946.08		E2	0.01710	DCO=1.04 *4*.
466.0 *2*	6477.07				Lin pol=−1.1 *5*.
466.9 *2*	4864.69				DCO=1.54 *6*.
473.3 *2*	3188.31				
486.5 *2*	2392.67	6.4 *4*	M1+E2	0.0229 *5*	δ: −0.15 *8*. Mult.: A_2=−0.38 *8*, A_4=−0.02 *9*, α(K)exp=0.017 *4* (1985Si16); α(K)exp=0.023 *3* (1979Ha19). δ: from 1979Ha19; 0.50 +*15*−*13* from α(exp) (1979Ha19). DCO=1.74 *15*; lin pol=−0.8 *3*.
489.6 *1*	4104.39		E1		
501.3 *1*	2095.85	3.1 *3*	E1		Mult.: α(K)exp=0.0045 *10* (1985Si16). Lin pol=−0.1 *3*.
502.8 *1*	5777.74				
517.0 *2*	5837.32				
531.0 *1*	6477.07				DCO=1.76 *7*.
534.3 *1*	2128.79	31 *2*	E2	0.01077	Mult.: A_2=+0.33 *1*, A_4=−0.08 *2*, α(K)exp=0.011 *2* (1985Si16); α(K)exp=0.007 *3* (1979Ha19). DCO=0.99 *2*; lin pol=0.55 *6*.
544.6 *2*	2738.79				
550.4 *1*	550.41	100	E2		Mult.: A_2=+0.30 *1*, A_4=−0.06 *2*; α(K)exp=0.0080 *10* (1985Si16). DCO=0.99 *1*; lin pol=0.54 *5*.
553.2 *2*	1733.52	2.1 *2*			
561.9 *2*	5649.57				Lin pol=0.16 *32*.
568.8 *3*	3545.63				
570.6 *2*	3992.62		E1		Lin pol=0.44 *24*.
571.7 *2*	1733.52	1.7 *2*			
583.8 *2*	3322.6				
586.2 *1*	2714.98		E1		Lin pol=−0.12 *23*.
586.6 *2*	5496.39				
590.8 *1*	3398.13		E1		Lin pol=−0.9 *5*.
591.6 *1*	8602.2				DCO=0.95 *5*.
594.2 *2*	8214.5		E2		
594.7 *2*	3992.62				

Continued on next page (footnotes at end of table)

(HI,xnγ) 1979Ha19,1985Si16,1991Ur01 (continued)

γ(^{148}Sm) (continued)

Eγ†	E(level)	Iγ‡	Mult.§	Comments
599.6 *1*	2194.13	2.0 *2*	E1	
602.9 *1*	3545.63			
611.3 *1*	1161.74	19 *1*	E1+M2	δ: +0.08 *4*. δ: from 1979Ha19; 0.15 +*16*–*9* from α(exp) (1979Ha19). Mult.: A_2=−0.21 *1*, A_4=−0.00 *2* (1985Si16); α(K)exp=30×10^{-4} *6* (1979Ha19). DCO=1.63 *5*; lin pol=0.21 *9*.
614.5 *1*	3421.90	1.5 *2*	E2	Mult.: A_2=+0.47 *4*, A_4=−0.15 *5* (1979Ha19). DCO=1.01 *2*; lin pol=0.49 *10*.
615.0 *2*	5524.48			
616.0 *2*	4805.18			
618.6 *1*	3806.98			Lin pol=0.47 *14*.
623.3 *2*	4864.69			
630.0 *1*	1180.39	76 *4*	E2	Mult.: A_2=+0.31 *1*, A_4=−0.06 *2* (1985Si16); α(K)exp=60×10^{-4} *5* (1979Ha19). DCO=0.98 *2*; lin pol=0.18 *5*.
631.8 *2*	5496.39			
638.5 *1*	2544.67	2.6	E2	Mult.: A_2=+0.13 *10*, A_4=+0.10 *16* (1979Ha19). DCO=0.99 *4*; lin pol=0.5 *5*.
638.6 *1*	7332.92			DCO=0.99 *3*.
643.0 *2*	2738.79			Lin pol=−0.17 *23*.
643.6 *2*	3188.31			
646.6 *2*	6592.79		E2	DCO=0.99 *5*.
648.2 *2*	7977.6		E2	
650.8 *1*	4196.25			
653.7 *2*	5496.39		E1	
659.6 *2*	5524.48			
666.8 *1*	5556.54			
669.4 *2*	4196.25			Lin pol=0.48 *29*.
671.4 *2*	3216.15			Lin pol=−0.0 *4*.
675.3 *2*	4864.69			
677.7 *1*	8010.61			DCO=1.00 *3*.
678.6 *1*	2807.35	16 *1*	E2	Mult.: A_2=+0.31 *2*, A_4=−0.05 *3*, α(K)exp=0.0066 *10* (1985Si16); α(K)exp=0.0065 *20* (1979Ha19). DCO=1.00 *5*; lin pol=0.46 *7*.
681.4# *5*	8659.5			
681.7 *2*	5524.48			
682.2 *2*	4104.39		E1	
683.1 *1*	3398.13		E2	
687.0 *3*	9045.9			
688.8 *1*	4110.68			DCO=1.02 *2*; lin pol=0.50 *9*.
690.6 *1*	3235.23	1.5 *2*	E2	Mult.: α(K)exp=50×10^{-4} *10* (1979Ha19). Lin pol=0.33 *12*.
691.2 *2*	5496.39		E2	
694.7 *2*	4805.18		E1	
700.8 *2*	4805.18		E2	
702.6 *2*	3095.25			
705.9 *2*	4512.91			
706.2 *1*	4104.39		E2	
707.1 *2*	7620.4		E2	
708.8 *2*	6029.22			
713.4 *2*	5578.31			
718.0 *2*	6913.3			
718.5 *1*	5561.19			DCO=0.98 *4*.
719.1 *1*	3526.57			
719.4 *2*	5524.48			
721.4 *1*	4917.55			
725.8 *1*	1906.17	23 *2*	E2	Mult.: A_2=+0.33 *2*, A_4=−0.05 *3*, α(K)exp=0.45×10^{-2} *10* (1985Si16); α(K)exp=0.40×10^{-2} *10* (1979Ha19). DCO=0.98 *3*; lin pol=0.49 *13*.
732.0 *1*	4842.69			DCO=1.00 *3*; lin pol=0.67 *17*.
736.5 *2*	7329.3		E2	
738.3 *2*	5136.13		E2	
738.5 *2*	3545.63			
742.6 *2*	6392.23			

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(HI,xnγ) 1979Ha19,1985Si16,1991Ur01 (continued)

γ(^{148}Sm) (continued)

Eγ†	E(level)	Iγ‡	Mult.§	Comments
754.0 *2*	4864.69			
757.3 *1*	3992.62		E2	DCO=1.10 *6*; lin pol=0.4 *4*.
758.2 *1*	5274.93		E2	DCO=1.0 *1*.
760.3 *2*	4864.69			
767.5 *2*	4189.28			
773.3 *2*	5578.31			
774.9 *2*	5287.77			
779.8 *3*	6557.5?			
781.0 *1*	4889.71		E2	DCO=0.96 *6*; lin pol=1.4 *7*.
783.0 *1*	4397.78		E2	Lin pol=1.1 *4*.
799.0 *2*	4909.65			
805.2 *2*	4909.65			
806.7# *5*	5649.57			
807.4 *1*	3614.76		E2	
808.7 *1*	2714.98		E2	
808.9 *2*	4917.55			
812.6 *2*	4805.18			
814.1 *2*	2942.82			
819.3 *2*	5217.20			
819.9 *3*	4241.52			
827.6 *2*	6477.07			
837.8 *2*	10439.0			
843.0 *2*	4951.75			
847.4 *2*	2976.32	11.0	M1+E2	Mult.: A_2=−0.20 *3*, A_4=+0.19 *3*; large δ (1979Ha19).
853.4# *3*	3398.13			
855.2 *1*	4108.70			DCO=1.00 *6*; lin pol=0.6 *4*.
869.6 *2*	4104.39			
869.7 *2*	2031.44	1.7 *2*	E2+M1	Mult.: α(K)exp=0.0025 *10* (1985Si16).
872.0 *1*	4864.69			
915.0# *5*	11524.7			
915.4 *1*	2095.85	6.3 *4*	E2	Mult.: A_2=+0.31 *4*, A_4=−0.09 *5*, α(K)exp=0.0013 *4* (1985Si16). DCO=1.00 *5*; lin pol=0.31 *22*.
915.9# *5*	6477.07			
917.1 *2*	4909.65			
976.8 *2*	5087.55			DCO=1.0 *1*.
999.0 *2*	9601.2			DCO=0.78 *8*.
1007.9 *2*	10609.1			DCO=1.6 *3*.
1013.7 *1*	2194.13	3.2 *3*	E2	Mult.: A_2=+0.08 *6*, A_4=−0.05 *8* (1979Ha19). DCO=1.02 *8*.
1025.8 *2*	8358.8			DCO=1.7 *2*.
1035.3 *2*	9045.9			DCO=0.6 *1*.
1059.5 *2*	3188.31			DCO=0.9 *1*.
1085.7 *2*	11524.7			
1087.5 *2*	3216.15			
1248.2 *2*	7942.5			
1296.0	9898.2			Eγ: doublet. DCO=1.8 *4*.

† From 1998UrZZ.
‡ Relative intensity. Data with uncertainty are from 1985Si16, others are from 1979Ha19.
§ From γ(θ), DCO, α(K)exp, linear polarization, and $T_{1/2}$. α(K)exp were normalized to α(K)exp(E2,550γ)=0.0083 (1979Ha19). For details see 1979Ha19, 1985Si16, 1990UrZS, 1991Ur01, and 1998UrZZ.
# Placement of transition in the level scheme is uncertain.
@ Multiply placed.
x γ ray not placed in level scheme.

Adopted Levels, Gammas

Q(β^-)=–30 *10*; S(n)=6826 *10*; S(p)=4322 *10*; Q(α)=2692 *10* 2012Wa38.
Astrophysical S factor for ^{147}Sm(p,γ): 2010Iv02.
Penning trap atomic mass measurements: 2000Be42, 2001Bo59.
Hyperfine structure (coupling constants and g–factor): 2000Tr07.

^{148}Eu Levels

Cross Reference (XREF) Flags

A ^{148}Eu IT Decay
B ^{124}Sn(^{29}Si,p4nγ): SD
C ^{130}Te(^{27}Al,α5nγ)
D ^{139}La(^{13}C,4nγ)
E ^{150}Sm(p,3nγ) E=26 MeV

E(level)	Jπ†	XREF	$T_{1/2}$	Comments
0.0	5–	A CDE	54.5 d *5*	%α=9.4×10^{-7} *28* (1964To04); %ε+%β^+=100. $T_{1/2}$: from 1969GuZW. Other: 54 d *1* (1959Ei31,1953Ma17,1950Wi64). Jπ: atomic beam (1972Ek05); HF=11.5 for α to 5– ^{144}Pm. μ=+2.340 *10* (2005St24,1985Ah02). Q=+0.35 *6* (2005St24,1985Ah02). μ,Q: by collinear fast beam LASER spectroscopy – accelerated beam method. Rms charge radius <r^2>$^{1/2}$=5.0059 fm *176* (2004An14).
232.80 *9*	6–	A CDE		Jπ: 232.8γ to 5– is M1, M1 from higher spin level.
312.20 *9*	6–	A DE		
518.49 *12*	7–	A DE		
708.41§ *10*	7+	A CDE		
720.4§ *3*	9+	A CD	162 ns *8*	μ=+6.120 *45* (2005St24,1980Ba67). μ: measured by time dependent perturbed angular distribution method. $T_{1/2}$: weighted average of 163 ns *10* (1981Pi10, γ(t) with pulsed beam), 170 ns *20* (1980Ba67, γ(θ,H,t), and 152 ns *21* (1995Jo04, $\gamma\gamma$(t)).
728.7	8+	D		
811.4	8+	D		
1172.9	9+	D		
1265.8	10+	D		
1413.1§	11+	CD		
1478.3	10+	D		
1609.4	10–	D		
1669.9b	11–	CD		
1841.1#	12–	CD		
1955?	(10)	D		
1991.8	12+	D		
2140.6§	13+	CD		
2203?	(11)	D		
2351.1b	13–	CD		
2539.9	14+	D		
2545.8#	14–	CD		
2599.0	13+	D		
2877.7	14+	D		
2898.0	16+	D		
2974.9§	15+	CD		
3047.3b	15–	CD		
3205.5#	16–	CD		
3306?	(15)	D		
3653.2#	18–	CD		
3712?	(16)	D		
3819.5	(17)	D		
3845.8	17+	D		
4008.3	19–	CD		
4066.5	(18)	D		
4086.5#	20–	CD		
4200.7	18+	D		
4283.9	(18)	D		
4335.6	21–	D		
4393.7	(18)	D		
4424.8	18+	D		

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Adopted Levels, Gammas (continued)

^{148}Eu Levels (continued)

E(level)	Jπ†	XREF
4651.0	19+	D
4750.3	20+	D
5017.1	20+	D
5125.1	(21)	D
5179.6?	21+	D
5207.2	21−	D
5215.6	22+	D
5301.9[@]	21−	CD
5366.2	21−	D
5389.6[#]	22−	CD
5519.0[@]	22−	CD
5794.0[@]	23−	CD
5943.3	23−	D
6073.1	23−	D
6100.4[@]	24−	CD
6306.1	24+	D
6330.7?		D
6384.8	24+	D
6435.6[@]	25−	CD
6703.4[@]	26−	CD
7028.3[&] *9*	27(−)‡	C
7497.4[&] *9*	(27)	C
7526.8[a] *10*	28(−)‡	C
7590.8[&] *10*	28(−)‡	C
7852.9 *10*	(29)	C
8170.9[&] *10*		C
8517.9[a] *10*		C
8632.5[&] *10*	(29)	C
9245.6[&] *10*	(31)	C
9623.6[a] *11*		C
10480.0[a] *11*		C
11088.1[a] *12*		C
x[c]	J	B
747.7+x[c] *1*	J+2	B
1545.6+x[c] *2*	J+4	B
2393.9+x[c] *3*	J+6	B
3293.4+x[c] *3*	J+8	B
4244.8+x[c] *4*	J+10	B
5248.6+x[c] *4*	J+12	B
6305.7+x[c] *5*	J+14	B
7416.4+x[c] *5*	J+16	B
8581.7+x[c] *5*	J+18	B
9801.8+x[c] *6*	J+20	B
11077.5+x[c] *6*	J+22	B
12408.4+x[c] *7*	J+24	B
13795.9+x[c] *7*	J+26	B
15239.2+x[c] *7*	J+28	B
16738.1+x[c] *8*	J+30	B
18293.2+x[c] *9*	J+32	B
y[d]	J	B
844.2+y[d] *6*	J+2	B
1739.0+y[d] *8*	J+4	B
2685.1+y[d] *10*	J+6	B
3683.2+y[d] *11*	J+8	B
4734.1+y[d] *13*	J+10	B
5838.3+y[d] *14*	J+12	B
6996.2+y[d] *17*	J+14	B
8208.6+y[d] *19*	J+16	B
9477.3+y[d] *20*	J+18	B
10799.3+y[d] *20*	J+20	B
12177.1+y[d] *22*	J+22	B
13611.1+y[d] *22*	J+24	B
15100.3+y[d] *25*	J+26	B
16644.4+y[d] *30*	J+28	B

† Based on γ(θ), γ excitation functions, Ice from ^{148}Eu IT decay and (p,3nγ); γ(θ), DCO, linear polarization, Ice, and γ excitation functions from (^{13}C,4nγ); and DCO from (^{27}Al,α5nγ) for normal deformed states. Some of these assignments especially for higher energy levels may be tentative.

‡ From DCO analysis in ^{130}Te(^{27}Al,α5nγ) dataset (2001Kl03).

§ (A): Sequence based on 7+.

[#] (B): Sequence based on 12−.

[@] (C): Sequence based on 21−.

[&] (D): Sequence based on 26−.

[a] (E): Sequence based on 28(−).

[b] (F): Sequence based on 11−.

[c] (G): SD−1 band (1998Ha21). conf=π(6^2(1/2[301],α=+1/2)) ν7^1 (1998Ha21). This band shows evidence of ΔJ=2 staggering (average staggering of 0.30 keV *13*) for several transition in the middle energy region (1997Ha19). Percent population intensity=0.79 *8* of ^{148}Eu channel (1998Ha21).

[d] (H): SD−2 band (1998Ha21). configuration=π(6^2(1/2[301],α=−1/2)) ν7^1 (1998Ha21). Percent population=0.24 *3* or 30% *3* of SD−1 band (1998Ha21).

γ(^{148}Eu)

E(level)	Eγ	Iγ	Mult.†	δ	α	I(γ+ce)	Comments
232.80	232.8 *1*	100	M1		0.1738		
312.20	79.4[@]	4					
	312.2 *1*	100	M1		0.0791		
518.49	206.3 *2*	24 *10*	M1		0.242		
	285.7 *1*	100 *21*	M1		0.1002		
708.41	190.0 *3*	1.0 *3*					
	396.2 *1*	43 *3*	E1				
	475.6 *1*	100	E1				
720.4	(12.0 *4*)		[E2]		4.0×10^4 *8*	14400 *300*	B(E2)(W.u.)=7.4 *20*.
	201.9 *3*	100 *30*	M2		1.415		B(M2)(W.u.)=0.14 *5*.
811.4	90.7	69	M1		2.44		
	292.5	100					
1172.9	361.7	100	M1+E2	≈0.7	≈0.0469		
	452.2	24	M1+E2	§	0.024 *7*		
1265.8	537.1	33	E2		0.01110		
	545.1	100	M1+E2	§	0.015 *4*		
1413.1	147.3	5.1	M1		0.615		
	692.4	100	E2				
1478.3	305.4	47	M1		0.0839		

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Adopted Levels, Gammas (continued)

γ(^{148}Eu) (continued)

E(level)	Eγ	Iγ	Mult.†	δ	α
1478.3	666.9	24	E2		
	749.7	100	E2		
	757.5	56	E2		
1609.4	343.5	39	E1		0.01093
	436.4	9	E1		
	888.7	100	E1		
1669.9	60.5	1.3	M1		7.87
	191.6	18.7	E1		0.0491
	256.8	100	E1		0.0228
	404.1	12.6	E1		
1841.1	171.2	76	M1		0.404
	428.0	100	E1		
1955?	783.0	100			
1991.8	578.4	56	M1+E2	§	0.013 *4*
	726.0	100	E2		
2140.6	148.7	0.6			
	299.5	7.5	E1		0.01538
	727.5	100	E2		
2203?	248.0	100			
2351.1	210.5	3.6	E1		0.0383
	681.2	100	E2		
2539.9	399.7	100	M1		0.0414
	548.7	58	E2		0.01050
2545.8	194.8	37	M1		0.283
	405.1	34	E1		
	704.7	100	E2		
2599.0	458.6	100	E2		0.01688
	1185.9	26			
2877.7	278.7	100	M1+E2	1.3‡ *10*	0.086 *19*
2898.0	358.1	100	E2		0.0341
2974.9	429.1	78			
	834.3	100	E2		
3047.3	696.2	100	E2		
3205.5	158.2	26	M1+E2	§	0.490 *15*
	230.5	15	E1		0.0301
	659.6	100	E2		
3306?	429.0	100			
3653.2	447.7	100	E2		0.0180
3712?	405.9	100			
3819.5	921.5	100			
3845.8	947.8	100	M1+E2	§	
4008.3	355.1	100	M1		0.0564
4066.5	220.7	100			
4086.5	79.0	2.2	M1+E2	1.1‡ *+6−4*	4.8 *5*
	433.7	100	E2		0.0197
4200.7	1302.7	100	E2		
4283.9	464.4	100			
4335.6	248.7	100	M1		0.1453
4393.7	574.3	80			
	1495.7	100			
4424.8	1526.8	100			
4651.0	226.6	100	M1		0.187
	257.3	100			
4750.3	414.7	100	E1		
	549.0	14			
	742.0	21			
5017.1	366.1	100	M1+E2	0.8‡ *+10−6*	0.044 *8*
5125.1	1117.0	100			
5179.6?	1092.7	100	E1		
5207.2	1198.9	100			
5215.6	465.3	100	E2		0.01623
5301.9	1293.6	100	E2		
5366.2	1279.3	100			

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)

γ(^{148}Eu) (continued)

E(level)	Eγ	Iγ	Mult.†	δ	α
5389.6	1302.7	100	E2		
5519.0	152.8	12.5	M1+E2	§	0.547 *12*
	217.1	100	M1		0.210
	1432.1	75	(E2)		
5794.0	275.0	100	M1		0.1109
	586.7	21			
5943.3	553.7	100			
6073.1	683.5	100			
6100.4	157.1	43			
	306.4	100	M1+E2	≈1.7‡	≈0.0619
	710.0	93			
6306.1	1090.5	100			
6330.7?	536.8	100			
6384.8	1169.2	100	E2		
6435.6	129.2	50			
	335.2	100	M1+E2	1.5‡ *9*	0.049 *11*
	362.2	93			
6703.4	267.8	100	M1		0.1191
7028.3	325.5				
7497.4	794.5				
7526.8	498.5				
7590.8	562.5				
7852.9	824.6				
8170.9	580.2				
8517.9	991.1				
8632.5	1135.1				
9245.6	613.0				
	1074.7				
9623.6	1105.7				
10480.0	856.4				
11088.1	608.1				
747.7+x	747.7 *1*	0.93# *9*			
1545.6+x	797.9 *2*	0.93# *9*			
2393.9+x	848.3 *1*	1.09# *11*			
3293.4+x	899.5 *2*	0.98# *10*			
4244.8+x	951.4 *2*	1.14# *11*			
5248.6+x	1003.8 *2*	1.10# *11*			
6305.7+x	1057.1 *2*	0.80# *8*			
7416.4+x	1110.7 *2*	1.05# *10*			
8581.7+x	1165.3 *2*	0.89# *9*			
9801.8+x	1220.1 *2*	0.78# *8*			
11077.5+x	1275.7 *2*	0.59# *6*			
12408.4+x	1330.9 *2*	0.74# *7*			
13795.9+x	1387.5 *2*	0.60# *6*			
15239.2+x	1443.3 *2*	0.39# *4*			
16738.1+x	1498.9 *3*	0.48# *5*			
18293.2+x	1555.1 *4*	0.31# *3*			
844.2+y	844.2 *6*				
1739.0+y	894.8 *5*				
2685.1+y	946.1 *6*				
3683.2+y	998.1 *5*				
4734.1+y	1050.9 *5*				
5838.3+y	1104.2 *6*				
6996.2+y	1157.9 *9*				
8208.6+y	1212.4 *8*				
9477.3+y	1268.7 *7*				
10799.3+y	1322.0 *5*				
12177.1+y	1377.8 *7*				
13611.1+y	1434.0 *6*				
15100.3+y	1489.2 *10*				
16644.4+y	1544.1 *14*				

† Based on Ice from ^{148}Eu IT decay and (p,3nγ); and γ(θ), DCO, linear polarization, Ice data from (^{13}C,4nγ).

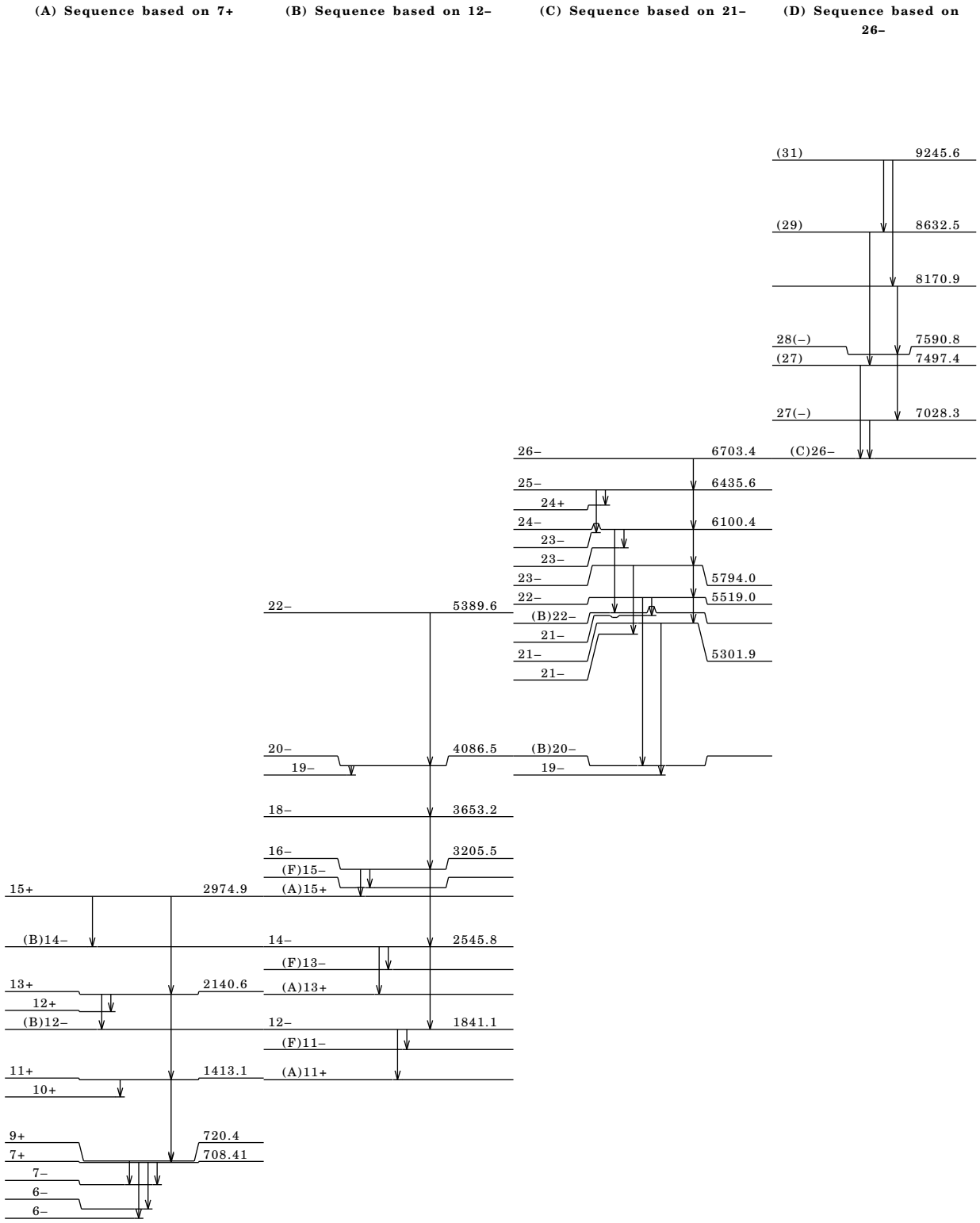
‡ Estimated from Ice data in (^{13}C,4nγ).

§ Not given by authors in (^{13}C,4nγ).

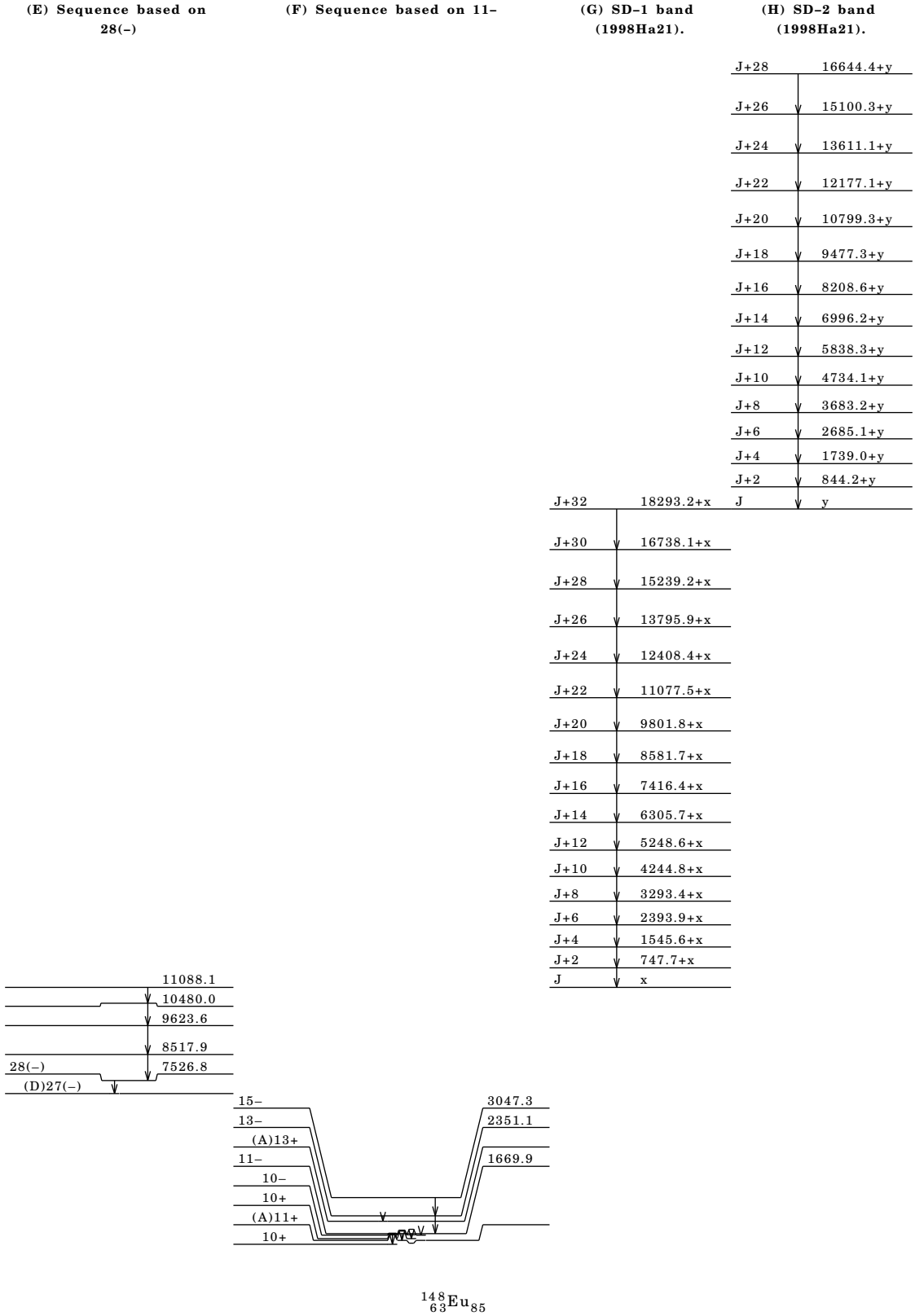
\# Relative intensities within the SD–1 band, normalized to ≈1 for the strongest transition in the mid–energy region of the band.

@ Placement of transition in the level scheme is uncertain.

Adopted Levels, Gammas (continued)



Adopted Levels, Gammas (continued)



$^{148}_{63}Eu_{85}$

^{148}Eu IT Decay 1981Pi10

Parent ^{148}Eu: E=720.4 *3*; Jπ=9+; $T_{1/2}$=162 ns *8*; %IT decay=100.
Production: Sm(p,xnγ) E=17–31 MeV.
Measured: Eγ, Iγ, γ(θ), γγ coin, γ excitation functions, Ice, γ(t).
Decay scheme is from 1981Pi10.

^{148}Eu Levels

E(level)†	Jπ‡	$T_{1/2}$§	Comments
0.0	5–		
232.80 *9*	6–		
312.20 *9*	6–		
518.49 *12*	7–		
708.41 *10*	7+		
720.4 *3*	9+	162 ns *8*	g=+0.680 *5* (1980Ba67,1980RiZT). $T_{1/2}$: weighted average of 163 ns *10* (1981Pi10), 170 ns *20* (1980Ba67), and 152 ns *21* (1995Jo04). 1981Pi10 gives a $T_{1/2}$=235 ns *14* which is quoted by 1995Jo04 as the mean life and not the half–life. The evaluator has adopted this interpretation as it makes the 1981Pi10 data consistent with other two measurements.

† From a least–squares fit to the Eγ data.
‡ From adopted levels; supported by γ(θ), γ excitation functions, and Ice from this data set.
§ $T_{1/2}$<1.5 ns for excited states other than the isomer.

γ(^{148}Eu)

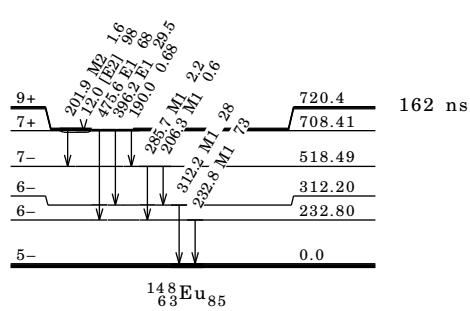
I(γ+ce) normalization: ΣI(γ+ce) to g.s.=100.

Eγ	E(level)	Iγ‡#	Mult.†	α	I(γ+ce)#	Comments
(12.0)	720.4		[E2]	39600	144 *3*	I(γ+ce): from the balance of I(γ+ce) for the 708–keV level.
190.0 *3*	708.41	1.0 *3*				
201.9 *3*	720.4	1.0 *3*	M2	1.415		Mult.: α(K)exp=1.3 *5* (normalized to α(K)exp(233γ)), compatible with α(K)exp; E4 was ruled out by $T_{1/2}$.
206.3 *2*	518.49	0.7 *3*	M1	0.242		α(K)exp=0.19 *4*.
232.8 *1*	232.80	91 *5*	M1	0.1738		α(K)exp=0.14 *1*; K/L=6.9 *7*.
285.7 *1*	518.49	2.9 *6*	M1	0.1002		α(K)exp=0.088 *9*; K/L=6.7 *10*.
312.2 *1*	312.20	38 *3*	M1	0.0791		α(K)exp=0.063 *6*; K/L=6.9 *8*.
396.2 *1*	708.41	43 *3*	E1	0.00774		α(K)exp=0.007 *2*; this value has been corrected for a 2% contribution of the 396 keV M2 transition in ^{147}Eu.
475.6 *1*	708.41	100	E1	0.00505		α(K)exp=0.005 *1*.

† From conversion electron data; α(K)exp were normalized to that of 347γ in ^{149}Eu assumed to be M2.
‡ Relative intensity.
# For absolute intensity per 100 decays, multiply by 0.68 *3*.

Decay Scheme

Intensities: I(γ+ce) per 100
parent decays
%IT=100



$^{124}Sn(^{29}Si,p4n\gamma)$: SD 1998Ha21

1998Ha21 (also 1997Ha19): $^{124}Sn(^{29}Si,p4n\gamma)$ E=158 MeV. Measured Eγ, γγγγ, γγγγ(particle) coin using GAMMASPHERE array of 95 HPGe detectors and MICROBALL particle–detector array of 95 elements. Deduced SD bands. TRS and single–particle Routhian calculations.

^{148}Eu Levels

E(level)	Jπ	E(level)	Jπ	E(level)	Jπ
x†	J	11077.5+x† *6*	J+22	4734.1+y‡ *13*	J+10
747.7+x† *1*	J+2	12408.4+x† *7*	J+24	5838.3+y‡ *14*	J+12
1545.6+x† *2*	J+4	13795.9+x† *7*	J+26	6996.2+y‡ *17*	J+14
2393.9+x† *3*	J+6	15239.2+x† *7*	J+28	8208.6+y‡ *19*	J+16
3293.4+x† *3*	J+8	16738.1+x† *8*	J+30	9477.3+y‡ *20*	J+18
4244.8+x† *4*	J+10	18293.2+x† *9*	J+32	10799.3+y‡ *20*	J+20
5248.6+x† *4*	J+12	y‡	J	12177.1+y‡ *22*	J+22
6305.7+x† *5*	J+14	844.2+y‡ *6*	J+2	13611.1+y‡ *22*	J+24
7416.4+x† *5*	J+16	1739.0+y‡ *8*	J+4	15100.3+y‡ *25*	J+26
8581.7+x† *5*	J+18	2685.1+y‡ *10*	J+6	16644.4+y‡ *30*	J+28
9801.8+x† *6*	J+20	3683.2+y‡ *11*	J+8		

† (A): SD–1 band (1998Ha21). configuration=π(6^2(1/2[301],α=+1/2)) ν7^1 (1998Ha21). This band shows evidence of ΔJ=2 staggering (average staggering of 0.30 keV *13*) for several transitions in the middle energy region (1997Ha19). Percent population intensity=0.79 *8* of ^{148}Eu channel (1998Ha21).

‡ (B): SD–2 band (1998Ha21). configuration=π(6^2(1/2[301],α=–1/2)) ν7^1 (1998Ha21). Percent population=0.24 *3* or 30% *3* of SD–1 band (1998Ha21).

γ(^{148}Eu)

Eγ†	E(level)	Iγ	Eγ†	E(level)	Iγ	Eγ†	E(level)	Iγ
747.7 *1*	747.7+x	0.93 *9*	1050.9 *5*	4734.1+y		1322.0 *5*	10799.3+y	
797.9 *2*	1545.6+x	0.93 *9*	1057.1 *2*	6305.7+x	0.80 *8*	1330.9 *2*	12408.4+x	0.74 *7*
844.2 *6*	844.2+y		1104.2 *6*	5838.3+y		1377.8 *7*	12177.1+y	
848.3 *1*	2393.9+x	1.09 *11*	1110.7 *2*	7416.4+x	1.05 *10*	1387.5 *2*	13795.9+x	0.60 *6*
894.8 *5*	1739.0+y		1157.9 *9*	6996.2+y		1434.0 *6*	13611.1+y	
899.5 *2*	3293.4+x	0.98 *10*	1165.3 *2*	8581.7+x	0.89 *9*	1443.3 *2*	15239.2+x	0.39 *4*
946.1 *6*	2685.1+y		1212.4 *8*	8208.6+y		1489.2 *10*	15100.3+y	
951.4 *2*	4244.8+x	1.14 *11*	1220.1 *2*	9801.8+x	0.78 *8*	1498.9 *3*	16738.1+x	0.48 *5*
998.1 *5*	3683.2+y		1268.7 *7*	9477.3+y		1544.1 *14*	16644.4+y	
1003.8 *2*	5248.6+x	1.10 *11*	1275.7 *2*	11077.5+x	0.59 *6*	1555.1 *4*	18293.2+x	0.31 *3*

† From 1998Ha21.

$^{130}Te(^{27}Al,\alpha5n\gamma)$ 2001Kl03

2001Kl03: E=155 MeV, measured Eγ and γγ using GAMMASPHERE Ge detector array in conjunction with Microball, a 4π CsI(Tl) charged particle detector array.

^{148}Eu Levels

E(level)†	Jπ‡	E(level)†	Jπ‡	E(level)†	Jπ‡
0.0	5–	3047.2[c] *6*	15–	6702.8[a] *9*	26–
232.9 *3*	6–	3205.4[@] *6*	16–	7028.3[a] *9*	27(–)§
708.7[#] *3*	7+	3653.1[@] *6*	18–	7497.4[a] *9*	(27)
720.7[#] *3*	9+	4008.1 *7*	19–	7526.8[b] *10*	28(–)§
1413.1[#] *5*	11+	4086.9[@] *7*	20–	7590.8[a] *10*	28(–)§
1669.9[c] *5*	11–	5301.6[&] *7*	21–	7852.9 *10*	(29)
1841.1[@] *5*	12–	5389.7[@] *7*	22–	8170.9[a] *10*	
2140.6[#] *5*	13+	5518.6[&] *8*	22–	8517.9[b] *10*	
2351.1[c] *6*	13–	5793.5[&] *8*	23–	8632.5[a] *10*	(29)
2545.8[@] *5*	14–	6099.8[&] *8*	24–	9245.6[a] *10*	(31)
2974.9[#] *6*	15+	6435.0[&] *8*	25–	9623.6[b] *11*	

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$^{130}Te(^{27}Al,\alpha 5n\gamma)$ 2001Kl03 (continued)

^{148}Eu Levels (continued)

E(level)†
10480.0[b] *11*
11088.1[b] *12*

† From least–squares fit to Eγ's, assuming Δ(Eγ)=0.3 keV.
‡ Except whether noted otherwise, all Jπ values are quoted from 1995Jo04, in $^{139}La(^{13}C,4n\gamma)$.
§ From DCO analysis (2001Kl03).
# (A): Sequence based on 7+.
@ (B): Sequence based on 12–.
& (C): Sequence based on 21–.
a (D): Sequence based on 26–.
b (E): Sequence based on 28(–).
c (F): Sequence based on 11–.

$\gamma(^{148}Eu)$

Eγ	E(level)	Eγ	E(level)	Eγ	E(level)
12.0† *4*	720.7	428.0	1841.1	710.0	6099.8
158.2	3205.4	433.7	4086.9	727.5	2140.6
217.1	5518.6	447.7	3653.1	794.5	7497.4
230.5	3205.4	475.6† *1*	708.7	824.6	7852.9
232.8† *1*	232.9	498.5‡	7526.8	834.3	2974.9
256.8	1669.9	562.5‡	7590.8	856.4	10480.0
267.8	6702.8	580.2	8170.9	991.1	8517.9
275.0	5793.5	608.1	11088.1	1074.7	9245.6
299.5	2140.6	613.0	9245.6	1105.7	9623.6
306.4	6099.8	659.6	3205.4	1135.1	8632.5
325.5‡	7028.3	681.2	2351.1	1293.6	5301.6
335.2	6435.0	692.4	1413.1	1302.7	5389.7
355.1	4008.1	696.2	3047.2		
405.1	2545.8	704.7	2545.8		

† From 2000Bh03 for ^{148}Eu.
‡ γ ray subject to DCO analysis (2001Kl03).

$^{139}La(^{13}C,4n\gamma)$ 1995Jo04,1994Jo09

1995Jo04,1994Jo09: E(^{13}C)=58–67 MeV; measured Eγ, Iγ, γγ(t), γ(θ), DCO, linear polarization of gammas, Ice, γ excitation functions.
1980Ba67: $^{139}La(^{12}C,3n\gamma)$, E($^{12}C$)=75 MeV. Observed an isomeric state with $T_{1/2}$=170 ns *20*, g=+0.680 *5* and the following gammas: 233.3, 312.7, 434.8, 583.1, 650.2, 730.6, and 937.0.
All data are from 1995Jo04, unless indicated otherwise.

^{148}Eu Levels

E(level)	Jπ†	$T_{1/2}$	E(level)	Jπ†	E(level)	Jπ†
0.0	5–		1609.4	10–	2898.0	16+
232.9	6–		1669.9	11–	2974.9	15+
312.4	6–		1841.1	12–	3047.3	15–
518.7	7–		1955?	(10)	3205.5	16–
708.7	7+		1991.8	12+	3306?	(15)
720.7	9+	152 ns *21*	2140.6	13+	3653.2	18–
728.7	8+		2203?	(11)	3712?	(16)
811.4	8+		2351.1	13–	3819.5	(17)
1172.9	9+		2539.9	14+	3845.8	17+
1265.8	10+		2545.8	14–	4008.3	19–
1413.1	11+		2599.0	13+	4066.5	(18)
1478.3	10+		2877.7	14+	4086.9	20–

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$^{139}La(^{13}C,4n\gamma)$ 1995Jo04,1994Jo09 (continued)

^{148}Eu Levels (continued)

E(level)	Jπ†	E(level)	Jπ†	E(level)	Jπ†
4200.7	18+	5179.6?	21+	6073.1	23−
4283.9	(18)	5207.2	21−	6100.4	24−
4335.6	21−	5215.6	22+	6306.1	24+
4393.7	(18)	5301.9	21−	6330.7?	
4424.8	18+	5366.2	21−	6384.8	24+
4651.0	19+	5389.6	22−	6435.6	25−
4750.3	20+	5519.0	22−	6703.4	26−
5017.1	20+	5794.0	23−		
5125.1	(21)	5943.3	23−		

† From adopted levels, supported by γ(θ), DCO, linear polarization, Ice, and γ excitation function data from this data set. Some of these assignments, especially for the higher levels, may be tentative.

γ(^{148}Eu)

Eγ	E(level)	Iγ†	Mult.‡	δ	α	Comments
60.5	1669.9	0.5	M1		7.87	α(L)exp=1.2 *4*.
79.0	4086.9	0.5	M1+E2	1.1§ *+6−4*	4.8 *5*	α(L)exp=1.8 *5*.
79.4	312.4	0.8				
90.7	811.4	1.1	M1		2.44	α(L)exp=0.23 *6*.
129.2	6435.6	0.7				
147.3	1413.1	5.1	M1		0.615	DCO=2.2 *4*; α(K)exp=0.36 *7*; α(L)exp=0.05 *2*.
148.7	2140.6	0.2				
152.8	5519.0	0.3	M1+E2		0.547 *12*	α(K)exp=0.25 *9*. δ: not given by authors.
157.1	6100.4	0.6				
158.2	3205.5	11.9	M1+E2		0.490 *15*	DCO=2.3 *3*; α(K)exp=0.31 *4*; α(L)exp=0.03 *1*. δ: not given by authors.
171.2	1841.1	15.8	M1		0.404	DCO=1.8 *2*; α(K)exp=0.33 *3*; α(L)exp=0.033 *8*.
189.9	708.7	1.0				
191.6	1669.9	7.3	E1		0.0491	DCO=2.0 *3*; lin pol=0.21 *9*; α(K)exp=0.045 *3*.
194.8	2545.8	11.8	M1		0.283	DCO=2.0 *3*; lin pol=−0.4 *3*; α(K)exp=0.176 *5*; α(L)exp=0.023 *2*.
202.0	720.7	1.2	M2		1.413	α(K)exp=0.8 *3*.
206.3	518.7	1.5	M1		0.242	α(K)exp=0.35 *9*.
210.5	2351.1	1.3	E1		0.0383	DCO=1.0 *2*; α(K)exp=0.02 *1*; B(E1)/B(E2)=0.5×10^{-4} *2* (1994Jo09).
217.1	5519.0	2.4	M1		0.210	DCO=1.8 *3*; lin pol=−0.3 *3*; α(K)exp=0.15 *4*.
220.7	4066.5	0.5				
226.6	4651.0	2.0	M1		0.187	DCO=2.4 *7*; lin pol=−0.8 *2*; α(K)exp=0.09 *5*.
230.5	3205.5	6.8	E1		0.0301	DCO=1.9 *4*; lin pol=0.0 *2*; α(K)exp=0.05 *2*; B(E1)/B(E2)=1.2×10^{-4} *2* (1994Jo09).
232.9	232.9	52.4	M1		0.1736	DCO=2.0 *1*; lin pol=−0.19 *5*; α(K)exp=0.15.
248.0	2203?	0.3				
248.7	4335.6	5.5	M1		0.1453	DCO=2.1 *3*; lin pol=−0.5 *4*; α(K)exp=0.12 *2*.
256.8	1669.9	39.0	E1		0.0228	DCO=1.0 *1*; lin pol=−0.91 *4*; α(K)exp=0.030 *5*.
257.3	4651.0	2.0				
267.8	6703.4	4.0	M1		0.1191	DCO=1.8 *3*; lin pol=−0.5 *3*; α(K)exp=0.093 *9*.
275.0	5794.0	3.8	M1		0.1109	DCO=1.7 *3*; lin pol=−0.5 *2*; α(K)exp=0.06 *2*.
278.7	2877.7	7.3	M1+E2	1.3§ *10*	0.086 *19*	DCO=1.5 *1*; α(K)exp=0.07 *2*.
285.8	518.7	7.2	M1		0.1001	DCO=2.1 *5*; α(K)exp=0.10 *3*.
292.5	811.4	1.6				DCO=1.4 *2*.
299.5	2140.6	2.6	E1		0.01538	DCO=1.8 *3*; lin pol=0.5 *2*; α(K)exp=0.01 *1*.
305.4	1478.3	4.4	M1		0.0839	DCO=1.8 *4*; lin pol=−0.3 *1*; α(K)exp=0.15 *10*.
306.4	6100.4	1.4	M1+E2	≈1.7§	≈0.0619	DCO=1.8 *3*; α(K)exp=0.05 *4*.
312.4	312.4	21.9	M1		0.0790	DCO=1.7 *1*; lin pol=−0.3 *1*; α(K)exp=0.084 *9*.
335.2	6435.6	1.4	M1+E2	1.5§ *9*	0.049 *11*	DCO=2.9 *6*; lin pol=−0.7 *10*; α(K)exp=0.04 *1*.
343.5	1609.4	3.0	E1		0.01093	DCO=1.5 *7*; α(K)exp=0.01 *1*.
355.1	4008.3	23.2	M1		0.0564	DCO=1.9 *2*; lin pol=−0.4 *1*; α(K)exp=0.045 *5*.
358.1	2898.0	18.0	E2		0.0341	DCO=1.0 *2*; lin pol=0.5 *1*; α(K)exp=0.026 *4*.
361.7	1172.9	6.2	M1+E2	≈0.7§	≈0.0469	DCO=1.1 *2*; lin pol=0.2 *5*; α(K)exp=0.04 *2*.

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$^{139}La(^{13}C,4n\gamma)$ 1995Jo04,1994Jo09 (continued)

$\gamma(^{148}Eu)$ (continued)

Eγ	E(level)	Iγ†	Mult.‡	δ	α	Comments
362.2	6435.6	1.3				DCO=1.2 *3*.
366.1	5017.1	1.8	M1+E2	0.8§ *+10−6*	0.044 *8*	DCO=1.8 *3*; α(K)exp=0.037 *7*.
396.4	708.7	18.4	E1		0.00773	DCO=1.8 *1*; lin pol=0.12 *8*; α(K)exp=0.026 *2*.
399.7	2539.9	14.4	M1		0.0414	DCO=1.8 *1*; lin pol=−0.29 *6*; α(K)exp=0.032 *5*.
404.1	1669.9	4.9	E1		0.00738	DCO=1.7 *2*; lin pol=0.0 *3*; α(K)exp=0.008 *5*.
405.1	2545.8	10.8	E1		0.00734	DCO=1.8 *1*; lin pol=0.33 *6*; α(K)exp=0.005 *3*; B(E1)/B(E2)=0.67×10^{-4} *5* (1994Jo09).
405.9	3712?	1.2				DCO=1.8 *5*.
414.7	4750.3	5.7	E1		0.00694	DCO=1.7 *3*; α(K)exp=0.005 *2*.
428.0	1841.1	20.8	E1		0.00645	DCO=1.8 *2*; lin pol=0.27 *8*; α(K)exp=0.007 *2*.
429.0	3306?	4.3				DCO=1.5 *1*.
429.1	2974.9	4.7				DCO=1.4 *8*.
433.7	4086.9	22.4	E2		0.0197	DCO=1.0 *1*; lin pol=0.49 *9*; α(K)exp=0.015 *2*.
436.4	1609.4	0.7	E1		0.00616	α(K)exp=0.007 *4*.
447.7	3653.2	56.3	E2		0.0180	DCO=1.0 *1*; lin pol=0.67 *5*; α(K)exp=0.0146.
452.2	1172.9	1.5	M1+E2		0.024 *7*	α(K)exp=0.01 *1*. δ: not given by authors.
458.6	2599.0	3.9	E2		0.01688	DCO=1.1 *1*; α(K)exp=0.013 *5*.
464.4	4283.9	1.3				
465.3	5215.6	2.8	E2		0.01623	DCO=0.9 *2*; lin pol=0.7 *6*; α(K)exp=0.01 *1*.
475.8	708.7	40.8	E1		0.00505	DCO=1.7 *2*; lin pol=0.2 *2*; α(K)exp=0.0029 *3*.
536.8	6330.7?	0.4				
537.1	1265.8	4.4	E2		0.01110	DCO=1.3 *4*; lin pol=0.3 *3*.
545.1	1265.8	13.5	M1+E2		0.015 *4*	DCO=1.4 *2*; lin pol=−0.39 *8*. δ: not given by authors.
548.7	2539.9	8.4	E2		0.01050	DCO=0.9 *3*; lin pol=0.5 *2*.
549.0	4750.3	0.8				
553.7	5943.3	1.4				DCO=1.3 *4*.
574.3	4393.7	0.4				
578.4	1991.8	6.0	M1+E2		0.013 *4*	DCO=1.7 *5*; lin pol =−0.1 *1*. δ: not given by authors.
586.7	5794.0	0.8				
659.6	3205.5	45.1	E2		0.00665	DCO=0.92 *8*; lin pol=0.6 *2*.
666.9	1478.3	2.3	E2		0.00648	DCO=1.0 *2*.
681.2	2351.1	35.6	E2		0.00616	DCO=0.96 *7*; lin pol=0.34 *7*.
683.5	6073.1	2.8				DCO=1.9 *4*.
692.4	1413.1	100	E2		0.00593	DCO=0.99 *9*; lin pol=0.5 *1*.
696.2	3047.3	22.2	E2		0.00585	DCO=0.99 *9*; lin pol=0.4 *7*.
704.7	2545.8	31.5	E2		0.00569	DCO=0.90 *8*; lin pol=0.5 *1*.
710.0	6100.4	1.3				
726.0	1991.8	10.7	E2		0.00530	DCO=0.86 *7*.
727.5	2140.6	34.8	E2		0.00528	DCO=0.9 *3*; lin pol=0.7 *2*.
742.0	4750.3	1.2				
749.7	1478.3	9.4	E2		0.00492	DCO=0.8 *2*.
757.5	1478.3	5.3	E2		0.00481	
783.0	1955?	1.0				
834.3	2974.9	6.0	E2		0.00387	DCO=1.3 *2*; lin pol=0.3 *3*.
888.7	1609.4	7.6	E1		1.36×10^{-3}	DCO=1.9 *3*; lin pol=0.3 *2*.
921.5	3819.5	1.7				DCO=1.5 *4*.
947.8	3845.8	1.3	M1+E2		0.0039 *10*	DCO=3.1 *9*; lin pol=0.1 *5*. δ: not given by authors.
1090.5	6306.1	1.5				DCO=1.2 *2*.
1092.7	5179.6?	3.6	E1		9.19×10^{-4}	DCO=1.6 *3*; lin pol=0.5 *7*.
1117.0	5125.1	0.5				
1169.2	6384.8	4.2	E2		0.00190	DCO=0.9 *2*; lin pol=1 *1*.
1185.9	2599.0	1.0				DCO=1.1 *4*.
1198.9	5207.2	1.0				DCO=1.3 *4*.
1279.3	5366.2	1.5				DCO=1.0 *2*.
1293.6	5301.9	4.0	E2		1.57×10^{-3}	DCO=0.8 *2*; lin pol=1 *1*.
1302.7	4200.7	2.4	E2		1.55×10^{-3}	DCO=0.9 *1*; lin pol=1 *1*.
	5389.6	5.8	E2		1.55×10^{-3}	DCO=1.01 *7*; lin pol=1 *1*.
1432.1	5519.0	1.8	(E2)		1.32×10^{-3}	DCO=0.8 *2*.
1495.7	4393.7	0.5				

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$^{139}La(^{13}C,4n\gamma)$ 1995Jo04,1994Jo09 (continued)

$\gamma(^{148}Eu)$ (continued)

Eγ	E(level)	Iγ†
1526.8	4424.8	0.8

† Relative intensity; uncertainty for most intense transitions is 5%, and is as high as 25% for weak ones.
‡ From γ(θ), DCO, linear polarization, and Ice data from this data set.
§ Estimated from the internal conversion coefficient data.

$^{150}Sm(p,3n\gamma)$ E=26 MeV 1981Pi10

Measured: Eγ, Iγ, γ(θ), γγ coin, γ excitation functions, Ice, γ(t). See ^{148}Eu IT decay.
Level scheme is from 1981Pi10.

^{148}Eu Levels

E(level)†	Jπ‡
0.0	5−
232.80 *9*	6−
312.20 *9*	6−
518.49 *12*	7−
708.41 *10*	7+

† From a least–squares fit to the Eγ data.
‡ From adopted levels; supported by γ(θ), γ excitation functions and Ice data from IT decay and this data set.

$\gamma(^{148}Eu)$

Eγ	E(level)	Iγ‡	Mult.†	α	Comments
190.0 *3*	708.41	1.3 *4*			Iγ: from (p,2nγ) data; γ obscured in (p,3nγ) reaction.
206.3 *2*	518.49	7.6 *8*	M1	0.242	A_2=−0.16 *3*, A_4=+0.01 *4*.
232.8 *1*	232.80	205 *12*	M1	0.1738	A_2=−0.10 *1*, A_4=+0.00 *1*.
285.7 *1*	518.49	50 *4*	M1	0.1002	A_2=−0.08 *1*, A_4=+0.00 *1*.
312.2 *1*	312.20	101 *7*	M1	0.0791	A_2=−0.10 *1*, A_4=+0.01 *1*.
396.2 *1*	708.41	42 *3*	E1	0.00774	A_2=−0.12 *1*, A_4=+0.01 *1*.
475.6 *1*	708.41	100	E1	0.00505	A_2=−0.14 *1*, A_4=+0.01 *1*.

† From conversion electron data; α(K)exp were normalized to that of 347γ in ^{149}Eu assumed to be M2.
‡ Relative intensity.

Adopted Levels, Gammas

Q(β⁻)=–5738 *13*; S(n)=8984.1 *12*; S(p)=6013.9 *24*; Q(α)=3271.21 *3* 2012Wa38.
Other reactions: 1991Fl03: spin dependence of GDR in Gd isotopes.
There are problems in reconciling log *ft* values from ^{148}Tb ε decay (2.20 min) with ΔJπ of the transitions. More data are needed to clarify these problems.

^{148}Gd Levels

Cross Reference (XREF) Flags

A ^{148}Tb ε Decay (60 min)	D ^{148}Gd(p,p')
B ^{148}Tb ε Decay (2.20 min)	E (HI,xnγ)
C ^{152}Dy α Decay	F (HI,xnγ): SD

E(level)[†]	Jπ[‡]	XREF	$T_{1/2}$[§]	Comments
0.0[#]	0+	ABCDE	71.1 y *12*	%α=100. $T_{1/2}$: weighted average of values (in y): 74.6 *30* (1981Pr06), and 70.9 *10* (2003Fu10, preliminary result after two year measurement). Others: 97.5 y *65* (1966Fr11), 84 y *9* (1962Si14), see also 1953Ra02.
784.433[#] *15*	2+	AB DE	4.2 ps *12*	Jπ: L(p,p')=2.
1273.492[@] *18*	3–	AB DE	34.7 ps *21*	Jπ: L(p,p')=3.
1416.378[#] *20*	4+	AB DE	8.1 ps *24*	Jπ: L(p,p')=4.
1810.98[#] *7*	6+	B DE	178 ps *20*	Jπ: L(p,p')=6. log *ft*=6.3 from (9)+ to this level is very low.
1834.59 *5*	2+,3+	A		Jπ: from γ(θ) of oriented nuclei in ε decay (60 min).
1863.445 *24*	2+	A D		Jπ: L(p,p')=2.
1912.97[@] *6*	4–	AB E		Jπ: γ to 3– is M1, no γ to 2+.
2082.11[@] *6*	5–	AB DE	2.6 ps *13*	Jπ: L(p,p')=5.
2188.67 *4*	2+	A D		Jπ: L(p,p')=2.
2233.60 *4*	3–	A D		Jπ: L(p,p')=3.
2310.97 *5*	2+	A D		Jπ: L(p,p')=2.
2424.10 *9*	3+,4+	A		Jπ: from γ(θ) of oriented nuclei in ε decay (60 min); π from M1+E2 γ to 4+, 1416.
2503.70 *6*	(1,2,3)–	A		Jπ: γ to 3– is E2,M1 and γ to 2+.
2505.80 *4*	3–	A D		Jπ: γ to 4+ is E1; γ to 2+; seen in (p,p').
2522.04 *11*	4+	A D		Jπ: L(p,p')=4.
2563.81[@] *9*	7–	B E	21.3 ps *30*	Jπ: γ to 5– ΔJ=2, E2; γ to 6+ is E1.
2566.82[@] *18*	6–	E		
2614.59 *5*	2+	A D		Jπ: L(p,p')=2.
2632.65[&] *8*	5–	A DE		Jπ: L(p,p')=5.
2693.35[#] *10*	8+	B DE	13.2 ps *28*	Jπ: γ to 6+ is ΔJ=2, E2; no γ to J<6.
2694.67[@] *13*	9–	B E	16.6 ns *3*	Jπ: γ to 7– is E2, γ to 6+ is E3 (from γ(θ) and RUL). $T_{1/2}$: weighted average of 17.5 ns *10* (1990Pi17), 17.5 ns *10* (1984Lu09), 16.5 *3* (1979Ha15), 17.3 ns *20* (1973Kr10), 16.3 ns *9* (1972HaXQ), and 16.7 ns *9* (1971HaXD). μ=–0.162 *18* (2005St24,1987Da27). μ: Other: –0.252 *81* (1979Ha15); both 1987Da27 and 1979Ha15 used the time dependent perturbed angular distribution method. Q=1.01 *5* (2005St24,1982Ha22). Q: measured by the time dependent perturbed angular distribution method (1982Ha22).
2700.06 *7*	(1–,2+)	A		Jπ: γ to 0+ and 3–.
2763 *3*	4+	D		Jπ: L(p,p')=4.
2782.60[#] *17*		B E		Jπ=(4+,5,6+) from gammas to 4+ and 6+; not consistent with log *ft*=7.1 or log $f^{1u}t$=8.6 from ^{148}Tb ε decay (2.20 min).
2868.74[#] *20*	(5)+	B DE		
2872.89 *7*	(2–,3,4+)	A		Jπ: gammas to 2+ and 4–.
2886.31 *10*	(2+,3,4+)	A		Jπ: gammas to 2+ and 4+.
2915.50 *8*	3–	A D		Jπ: L(p,p')=3.
2934.9[#] *5*	(7)+	E		
2936.61[&] *24*	7–	B DE	3.8 ps *26*	
3029.59[@] *13*	8–	B E	52 ps *13*	
3045.7 *3*		B		
3065		A		
3076.12 *24*		A		
3089.70 *8*	(1–,2+)	A		Jπ: gammas to 0+ and 3–.
3128.8 *3*		B		
3130.87 *16*	(1,2+)	A		Jπ: γ to 0+.

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Adopted Levels, Gammas (continued)

^{148}Gd Levels (continued)

E(level)[†]	Jπ[‡]	XREF	$T_{1/2}$[§]	Comments
3152.48[&] *14*	8−	B E		
3157.0 *3*		B		
3179.7[&] *6*	7−	E		
3295.03 *15*	(1,2+)	A		Jπ: γ to 0+.
3310.4[&] *4*	8−	E		
3357.80 *24*		B		
3367.26[&] *15*	9−	E	19.1 ps *21*	
3478.0 *3*	(8,9)	B		Jπ: log $f^{1u}t$=7.4 in ε decay from (9)+ and γ to 6+.
3502.1 *4*		B		
3574.94 *21*	(1−,2+)	A		Jπ: gammas to 0+ and 3−.
3645.92 *23*	(8+)	B		Jπ: gammas to 6+ and 8+; and log $f^{1u}t$=7.3 in ε decay from (9)+.
3666.6[#] *4*	10−	B E		
3701.48[@] *20*	11−	E	<5 ps	$T_{1/2}$: adopted by evaluator from 1 ps +*4*−*1* in (HI,xnγ).
3758.24[a] *19*	10+	B E	7.6 ps *10*	
3768.35 *24*		B		
3808.34 *19*	(8+)	B		Jπ: gammas to 6+ and 9−; and log $f^{1u}t$=7.3 in ε decay from (9)+.
3822.4[@] *4*	10+	E		
3868.66 *18*		B		
3918.22[&] *19*	10−	E	8.9 ps *15*	
3980.42[@] *20*	12+	E	60 ps *5*	
3990.51 *20*	(8,9,10)+	B		Jπ: log *ft*=5.9 in ε decay from (9)+.
4051.0 *6*	(2+,3,4+)	A		Jπ: gammas to 2+ and 4+.
4068.22 *25*	(2)	A		Jπ: gammas to 0+ and 4−.
4119.24 *14*	(8)+	B		Jπ: log *ft*=5.2 for ε decay from (9)+; γ to 6+.
4121.47[&] *21*	11−	E	4.6 ps *34*	
4170.25 *20*	(8,9−)	B		Jπ: gammas to 7− and 9−; and log $f^{1u}t$=7.0 in ε decay from (9)+.
4271.4 *4*		B		
4312.01 *17*	(8,9,10)+	B		Jπ: log *ft*=5.1 for ε decay from (9)+.
4408.90 *16*	(8)+	B		Jπ: log *ft*=5.3 for ε decay from (9)+; and γ to (5)+.
4429.74[&] *23*	12−	E	12 ps *9*	
4500.33[a] *19*	12+	E	3.9 ps *21*	
4542.27 *22*		A		
4551.04[&] *23*	13−	E	38 ps *6*	
4740.6[&] *4*	13(−)	E		Jπ: from (HI,xnγ) (1990Pi17); 13− from (HI,xnγ) (1990Dr06).
4906.0[&] *3*	14−	E	<12 ps	$T_{1/2}$: adopted by evaluator from 3 ps +*9*−*3* in (HI,xnγ).
5025.83[a] *21*	14+	E	25 ps *14*	
5117.51[&] *25*	15−	E	16 ps *8*	
5167.8[@] *4*	14+	E		
5355.57[a] *25*	16+	E	184 ps *26*	
5438.6 *4*	16	E		
5578.6 *9*		E		
5800.3 *9*		E		
5832.7[a] *3*	18+	E		
5882.8 *8*	17	E		
5933.7[&] *5*	17	E		
6210.9[b] *4*	17	E		
6268.4 *8*	18	E		
6381.4 *6*	18	E		
6545.6[b] *4*	18−	E		
6574.9 *6*	19+	E		
6640.8[b] *3*	19−	E		
6834.5[a] *4*	20−	E	1.5 ns *3*	
7051.3 *7*	19+	E		
7110.3 *8*	20+	E		
7155.7 *5*	21−	E		
7274.2 *8*	20+	E		
7333.6 *9*		E		
7530.8 *7*	21+	E		
7790.8 *7*	22+	E		
8004.9 *7*	22−	E		
8242.9 *9*	22−	E		
8304.5 *8*	23−	E		
8309.1 *9*	23+	E		

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Adopted Levels, Gammas (continued)

^{148}Gd Levels (continued)

E(level)†	Jπ‡	XREF	$T_{1/2}$§	Comments
8364.0 *7*	23−	E		
8455.5 *7*	23−	E		
8609.1 *10*	23	E		
8639.1 *8*	24−	E		
8832.1 *8*	24	E		
8987.1 *9*	25−	E		
9243.7 *10*	25−	E		
9258.8 *9*		E		
9652.7 *11*	26−	E		
9757.6 *10*	26	E		
9934.3 *13*		E		
9957.3 *12*	26−	E		
10046.5 *9*	25−	E		
10063.0 *12*	27	E		
10317.9 *9*	27−	E		
10474.3 *12*	27	E		
10694.0 *11*	27−	E		
10760.1 *14*	28	E		
10869.8 *14*	28	E		
11158.4 *11*	28	E		
11185.7 *12*	29	E		
11456.9 *12*	29	E		
11477.9 *12*	29−	E		
11545.9 *11*	29−	E		
11587.0 *12*	30	E		
11727.6 *13*	30	E		
12012.8 *16*		E		
12064.1 *13*	30	E		
12138.6 *11*	31−	E		
12284.9 *12*	30	E		
12381.9 *13*	31	E		
12529.5 *12*	32	E		
12683.2 *13*	33	E		
13039.1 *13*	33	E		
13125.9 *15*	33−	E		
13147.7 *13*	32	E		
13244.0 *15*		E		
13354.3? *16*		E		
13555.0 *14*	33	E		
13736.0 *13*	34	E		
13869.9 *14*	35	E	1.5 ns *3*	μ=+21 *6* (1989Ha15).
13888.3 *16*	33	E		
13911.5 *17*		E		
14011.3 *17*	34	E		
14145.8 *16*	35	E		
14206.6 *17*	36	E		
14924.4 *17*	36	E		
15165.7? *19*	38	E		
15727.8 *19*	37	E		
16077.6 *22*		E		
16112.1 *19*	38	E		
16204.2? *22*	40	E	<0.17 ps	
16257.4? *22*	40	E		
16406.8 *22*	40	E		
16473.7 *22*	39	E		
17241.0? *24*	40	E		
17320.2? *24*		E		
17370.8 *24*	42	E		
18482 *3*	44	E	<0.17 ps	
19149?	(46)	E		

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Adopted Levels, Gammas (continued)

^{148}Gd Levels (continued)

E(level)[†]	Jπ[‡]	XREF	Comments
x[c]	J≈(29)	F	Jπ: ≈(29) from 699.9γ as a possible J=31 to J=29 transition based on the assignment (1993Ha19) of 652.3γ as a J=29 to J=27 transition. A tentative 652.3γ was reported by 1993Ha19 but is removed by 1995DeZZ. Theoretical analysis by 1993Ra07 suggests J=27, 29; J=25, 27 was proposed (1993Ra07) with the 652.3γ as the lowest energy transition.
699.90+x[c] *10*	J+2	F	
1447.80+x[c] *15*	J+4	F	
2243.61+x[c] *18*	J+6	F	
3090.31+x[c] *20*	J+8	F	
3988.21+x[c] *23*	J+10	F	
4938.51+x[c] *25*	J+12	F	
5942.4+x[c] *3*	J+14	F	
7001.1+x[c] *3*	J+16	F	
8115.3+x[c] *3*	J+18	F	
9285.9+x[c] *4*	J+20	F	
10513.7+x[c] *4*	J+22	F	
11799.3+x[c] *4*	J+24	F	
13143.4+x[c] *4*	J+26	F	
14545.9+x[c] *5*	J+28	F	
16007.3+x[c] *5*	J+30	F	
17527.8+x[c] *6*	J+32	F	
19108.3+x[c] *9*	J+34	F	
20748.3+x[c] *13*	J+36	F	
22448.6+x[c] *15*	J+38	F	
y[d]	J≈(30)	F	Jπ: ≈(30) from assignment of 789γ as J=34 to 32 transition. Negative parity is suggested by 1993Ha19. 1993Ra07 suggest J=30, 32 (assuming 789γ as the lowest transition).
741.8+y[d] *3*	J+2	F	
1530.7+y[d] *4*	J+4	F	
2369.5+y[d] *5*	J+6	F	
3258.6+y[d] *5*	J+8	F	
4198.4+y[d] *5*	J+10	F	
5188.8+y[d] *6*	J+12	F	
6228.5+y[d] *7*	J+14	F	
7316.3+y[d] *7*	J+16	F	
8451.5+y[d] *7*	J+18	F	
9634.2+y[d] *7*	J+20	F	
10865.4+y[d] *8*	J+22	F	
12146.3+y[d] *8*	J+24	F	
13478.6+y[d] *8*	J+26	F	
14861.9+y[d] *9*	J+28	F	
16299.4+y[d] *10*	J+30	F	
17790.5+y[d] *13*	J+32	F	
19336.7+y[d] *17*	J+34	F	
z[e]	J	F	
830.3+z[e] *6*	J+2	F	
1706.0+z[e] *7*	J+4	F	
2631.0+z[e] *7*	J+6	F	
3606.7+z[e] *8*	J+8	F	
4634.2+z[e] *8*	J+10	F	
5713.8+z[e] *9*	J+12	F	
6846.5+z[e] *9*	J+14	F	
8032.4+z[e] *10*	J+16	F	
9271.7+z[e] *10*	J+18	F	
10564.6+z[e] *10*	J+20	F	
11909.1+z[e] *11*	J+22	F	
13304.4+z[e] *12*	J+24	F	
14739.6+z[e] *13*	J+26	F	
16182.2+z[e] *16*	J+28	F	E(level): the ordering of the 1447.7γ–1442.6γ cascade is adopted from 1996De04, based on relative Iγ's. A reverse ordering is proposed by 1995DeZZ.
17629.9+z[e] *17*	J+30	F	
19101.9+z[e] *20*	J+32	F	
u[f]	J	F	

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)

^{148}Gd Levels (continued)

E(level)†	Jπ‡	XREF
849.7+u[f] *3*	J+2	F
1739.7+u[f] *4*	J+4	F
2678.4+u[f] *5*	J+6	F
3666.8+u[f] *5*	J+8	F
4706.4+u[f] *6*	J+10	F
5797.5+u[f] *7*	J+12	F
6941.7+u[f] *8*	J+14	F
8139.7+u[f] *8*	J+16	F
9392.5+u[f] *9*	J+18	F
10700.6+u[f] *9*	J+20	F
12065.0+u[f] *10*	J+22	F
13486.4+u[f] *11*	J+24	F
14964.9+u[f] *11*	J+26	F
16501.8+u[f] *15*	J+28	F
v[g]	J	F
853.7+v[g] *3*	J+2	F
1753.6+v[g] *4*	J+4	F
2698.5+v[g] *5*	J+6	F
3689.9+v[g] *5*	J+8	F
4727.8+v[g] *6*	J+10	F
5812.4+v[g] *6*	J+12	F
6944.3+v[g] *7*	J+14	F
8123.8+v[g] *7*	J+16	F
9350.3+v[g] *7*	J+18	F
10624.1+v[g] *7*	J+20	F
11946.2+v[g] *8*	J+22	F
13315.9+v[g] *8*	J+24	F
14733.0+v[g] *9*	J+26	F
16197.9+v[g] *10*	J+28	F
17711.0+v[g] *14*	J+30	F
19273.0+v[g] *17*	J+32	F
w[h]	J	F
802.2+w[h] *3*	J+2	F
1651.6+w[h] *4*	J+4	F
2549.0+w[h] *4*	J+6	F
3494.9+w[h] *5*	J+8	F
4491.0+w[h] *5*	J+10	F
5537.8+w[h] *5*	J+12	F
6637.2+w[h] *6*	J+14	F
7789.4+w[h] *6*	J+16	F
8996.2+w[h] *6*	J+18	F
10257.2+w[h] *7*	J+20	F
11573.8+w[h] *7*	J+22	F
12945.9+w[h] *7*	J+24	F
14374.4+w[h] *7*	J+26	F
15859.6+w[h] *8*	J+28	F
17402.0+w[h] *9*	J+30	F
r[i]	J	F
911.8+r[i] *4*	J+2	F
1873.7+r[i] *5*	J+4	F
2892.1+r[i] *6*	J+6	F
3969.0+r[i] *7*	J+8	F
5101.0+r[i] *8*	J+10	F
6287.7+r[i] *9*	J+12	F
7527.4+r[i] *10*	J+14	F
8817.6+r[i] *10*	J+16	F
10152.6+r[i] *10*	J+18	F
11530.7+r[i] *11*	J+20	F
12956.2+r[i] *12*	J+22	F
14431.4+r[i] *13*	J+24	F
15960.3+r[i] *14*	J+26	F
s[j]	J	F
887.0+s[j] *3*	J+2	F
1822.4+s[j] *5*	J+4	F
2812.3+s[j] *7*	J+6	F
3858.2+s[j] *7*	J+8	F
4961.4+s[j] *13*	J+10	F
6120.6+s[j] *13*	J+12	F
7332.7+s[j] *13*	J+14	F
8596.7+s[j] *14*	J+16	F
9908.0+s[j] *14*	J+18	F
11263.4+s[j] *15*	J+20	F
12664.9+s[j] *15*	J+22	F
14115.5+s[j] *16*	J+24	F
15618.5+s[j] *16*	J+26	F
t[k]	J	F
868.4+t[k] *3*	J+2	F
1783.4+t[k] *5*	J+4	F
2745.6+t[k] *6*	J+6	F
3755.3+t[k] *6*	J+8	F
4811.6+t[k] *6*	J+10	F
5916.5+t[k] *7*	J+12	F
7069.9+t[k] *7*	J+14	F
8271.5+t[k] *8*	J+16	F
9521.3+t[k] *8*	J+18	F
10818.5+t[k] *8*	J+20	F
12157.8+t[k] *10*	J+22	F
13509.8+t[k] *13*	J+24	F

† From a least–squares fit to Eγ data with ΔEγ=1 keV for Eγ's with no assigned uncertainty.

‡ Except where noted otherwise, Jπ assignments are based on conversion electron and γ(θ) of oriented nuclei from ε decay (60 min), conversion electron data from ε decay (2.20 min), γγ(θ), excitation function, conversion electron and γγ(θ) data from (HI,xnγ). Band designations for normal deformed states are from (HI,xnγ) (1990Pi17).

§ From (HI,xnγ), unless indicated otherwise.

(A): v^2 states.

@ (B): v^2 x octupole states.

& (C): v^2 x $\pi^{+1}\pi^{-1}$ states.

a (D): v^2 x π^2 states.

b (E): $v^2\pi^2$ x octupole states.

c (F): SD–1 band (1995DeZZ,1993Ha19,1988De10). configuration=$\pi 6^2$ $\nu(7^1 1/2[651],\alpha=-1/2)$ (1998By02). Q(intrinsic)=14.6 *2* (1996Sa15). Percent population=1.6 *1* (1996De04), 1.30 *15* (1993Ha19), 0.72 *25* (1997Zh03) in ^{124}Sn(^{29}Si,5nγ) E=157 MeV (1996De04,1997Zh03), E=155 MeV (1993Ha19). Other values from 1992Fl02: 1.9 *5* in ^{76}Ge(^{76}Ge,4nγ); 0.8 *2* in ^{124}Sn(^{29}Si,5nγ) and 0.5 *2* in ^{122}Sn(^{30}Si,4nγ).

d (G): SD–2 band (1995DeZZ,1993Ha19,1996De04). configuration=$\pi 6^2$ $\nu(7^1 1/2[651],\alpha=+1/2)$ (1998By02). Promotion of neutron from 1/2[651],α=–1/2 to 1/2[651],α=+1/2. Q(intrinsic)=14.8 *3* (1996Sa15). Percent population=0.7 *2* (1996De04), 0.62 *20* (1993Ha19).

e (H): SD–3 band (1995DeZZ,1996De04). This band reveals a backbend at a rotational frequency of ≈0.72 MeV. configuration=$\pi 6^2$ ν((1/2[651],α=–1/2)(1/2[651],α=+1/2)) (1998By02). Promotion of neutron from 1/2[770],α=–1/2 to 1/2[651],α=+1/2. Q(intrinsic)=17.8 *13* (1996Sa15). Percent population=0.4 *2* (1996De04), 18% *3* of SD–1 (1995DeZZ).

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Adopted Levels, Gammas (continued)

^{148}Gd Levels (continued)

f (I): SD–4 band (1995DeZZ,1996De04). configuration=$\pi 6^2$ $\nu(7^1(1/2[651],\alpha=-1/2)(1/2[651],\alpha=+1/2))$ (1998By02). Promotion of neutron from 5/2[642],α=+1/2 to 1/2[651],α=+1/2. Percent population=0.5 *2* (1996De04), 12% *4* of SD–1 band (1995DeZZ).

g (J): SD–5 band (1995DeZZ,1996De04). configuration=$\pi(6^4 1/2[301]^{-2})$ $\nu(7^2(1/2[651],\alpha=-1/2)$ $(1/2[651],\alpha=+1/2))$ (1998By02). This involves promotion of two neutrons from 1/2[411] to 7^1 and 1/2[651],α=+1/2 orbitals. Or configuration=$\pi(6^2(1/2[301],\alpha=-1/2)^{-1}(3/2[651],\alpha=+1/2))$ $\nu(7^1 1/2[651],\alpha=-1/2)$ (1998By02). This band is identical (in transition energies) to ^{152}Dy SD–1 band. Percent population=0.5 *1* (1996De04), 23% *4* of SD–1 band (1995DeZZ).

h (K): SD–6 band (1995DeZZ,1996De04,1997Ha19). configuration=$\pi 6^2$ $\nu(7^1(1/2[651],\alpha=-1/2)(1/2[651],\alpha=+1/2))$ (1998By02). Promotion of neutron from 1/2[411],α=+1/2 to 1/2[651],α=+1/2. 1997Ha19 provide evidence for ΔJ=2 staggering of 0.37 keV *12*, and propose that this band is identical to ^{149}Gd SD–1, yrast band. Percent population=0.4 *1* (1996De04), 16% *3* of SD–1 band (1995DeZZ).

i (L): SD–7 band (1998By02). configuration=$\pi 6^2$ $\nu(7^1(5/2[402]$ or $9/2[514]))$ (1998By02). Promotion of neutron from 1/2[651],α=–1/2 to 5/2[402] or 9/2[514]. Bands SD–7 and SD–8 are probably signature partners. Percent population=5–10% of SD–1 band (1998By02).

j (M): SD–8 band (1998By02). configuration=$\pi 6^2$ $\nu(7^1(5/2[402]$ or $9/2[514]))$ (1998By02). Promotion of neutron from 1/2[651],α=–1/2 to 5/2[402] or 9/2[514]. Bands SD–7 and SD–8 are probably signature partners. Percent population=5–10% of SD–1 band (1998By02).

k (N): SD–9 band (1998By02). Percent population=5–10% of SD–1 band (1998By02).

γ(^{148}Gd)

E(level)	Eγ†	Iγ§	Mult.‡	δ	α	Comments
784.433	784.430 *16*	100	E2		0.00466	B(E2)(W.u.)=10 *3*.
1273.492	489.049 *12*	100# *2*	E1+M2	+0.18 *9*	0.008 *3*	B(E1)(W.u.)=5.7×10^{-5} *4*; B(M2)(W.u.)=40 *40*.
	1273.5	0.87# *7*	[E3]		0.00338	Eγ: from (HI,xnγ). B(E3)(W.u.)=42 *5*.
1416.378	142.878 *14*	2.90 *13*	E1		0.1116	B(E1)(W.u.)=0.00029 *9*.
	631.947 *17*	100 *2*	E2		0.00772	B(E2)(W.u.)=14 *5*.
1810.98	394.55 *8*	100	E2		0.0267	B(E2)(W.u.)=7.0 *8*.
1834.59	1050.15 *4*	100	E2+M3		0.00266 *18*	δ: +3 *+4–1* or –0.12 *19* if Jπ=2+; or +0.31 *12* if Jπ=3+ from γ(θ) of oriented nuclei in ε decay (60 min).
1863.445	589.9 *7*	5.2 *3*				
	1079.025 *25*	100.0 *22*	M1+E2	+4.6 *+35–14*	0.00242 *8*	
	1863.39 *4*	49.2 *10*				
1912.97	639.47 *7*	100	M1		0.01362	
2082.11	169.2 *1*	4.3				
	271.1 *2*	8.8	E1(+M2)	≤0.23	0.034 *14*	B(E1)(W.u.)>0.00016.
	666.0 *4*	7.2	E1(+M2)	≤0.34	0.0042 *17*	B(E1)(W.u.)>8.4×10^{-6}.
	808.7 *1*	100	E2		0.00435	B(E2)(W.u.)=11 *6*.
2188.67	915.30 *12*	14.2 *16*				
	1404.22 *4*	100.0 *24*	M1+E2		0.0018 *4*	δ: +2.0 *+10–7* or +0.04 *+19–14* from γ(θ) of oriented nuclei in ε decay (60 min).
	2188.65 *7*	80 *3*				
2233.60	960.09 *7*	100 *9*	M1+E2		0.0040 *11*	δ: +0.02 *+21–14* or +1.3 *+4–5* from γ(θ) of oriented nuclei in ε decay (60 min).
	1449.16 *4*	84 *3*	E1(+M2)	+0.09 *10*	0.00078 *10*	δ: from γ(θ) of oriented nuclei in ε decay (60 min).
2310.97	1526.45 *7*	55.0 *22*	M1+E2		0.0015 *3*	δ: +2.4 *+22–10* or –0.0 *2* from γ(θ) of oriented nuclei in ε decay (60 min).
	2311.03 *7*	100 *3*				
2424.10	1007.72 *9*	100 *9*	M1+E2		0.0036 *9*	δ: –1.2 *8* if Jπ=3+; +0.6 *8* if Jπ=4+ from γ(θ) of oriented nuclei in ε decay (60 min).
	1639.66 *22*	65 *9*				
2503.70	1230.18 *5*	56.6 *23*	E2,M1		0.0023 *5*	Mult.: from internal conversion and γ(θ) data in ε decay (60 min).
	1719.63 *20*	100 *6*				
2505.80	1089.41 *3*	100.0 *22*	E1		9.69×10^{-4}	Mult.: from internal conversion and γ(θ) data in ε decay (60 min).
	1722.5 *3*	15 *4*				
2522.04	1105.65 *11*	100 *5*	M1+E2		0.0029 *7*	δ: –0.18 *20* or +1.5 *+10–6* from γ(θ) of oriented nuclei in ε decay (60 min).
	1248.2 *8*	33 *8*				
	1737.9 *6*	27 *5*				
2563.81	481.65 *10*	100	E2		0.01541	B(E2)(W.u.)=13.0 *19*.
	752.8 *2*	68	E1		0.00197	Iγ: from (HI,xnγ). B(E1)(W.u.)=1.07×10^{-5} *15*.

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Adopted Levels, Gammas (continued)

γ(^{148}Gd) (continued)

E(level)	Eγ†	Iγ§	Mult.‡	δ	α	Comments
2566.82	484.8 *2*		M1		0.0274	
	653.6 *5*		E2		0.00712	
	755.6 *4*					
2614.59	1342.2 *6*	9 *4*				
	1830.14 *4*	100 *6*	M1+E2		0.00120 *16*	δ: +2.5 *+14−8* or −0.03 *5* from γ(θ) of oriented nuclei in ε decay (60 min).
	2614.3 *6*	38 *3*				
2632.65	820.3 *4*		E1(+M2)	≤0.34	0.0026 *10*	
	1215.2 *4*		E1(+M2)	≤0.37	0.0012 *4*	
	1357.8 *4*					
	1848.36 *8*					
2693.35	129.5 *2*	3.4	E1		0.1454	B(E1)(W.u.)=0.00028 *6*.
	882.41 *8*	100	E2		0.00359	B(E2)(W.u.)=1.7 *4*.
2694.67	130.8 *3*	100.0# *16*	E2		0.956 *16*	Iγ: other: I(130.8γ)/I(883.6γ)=0.67 *8* from comparison of measured $T_{1/2}$ and presented B(E3)(W.u.)(883.6γ) (1984Lu09). B(E2)(W.u.)=7.31 *25*.
	883.6 *3*	66.0# *16*	E3		0.00802	B(E3)(W.u.)=33.6 *12*.
2700.06	1426.49 *8*	43 *3*				
	1915.54 *19*	63 *4*	M1+E2	+0.8 *6*	0.00119 *10*	δ: from γ(θ) in ε decay (60 min).
	2700.57 *20*	100 *4*				
2782.60	971.7 *3*	68				
	1366.4 *3*	100				
2868.74	1057.7 *3*	100	M1,E2		0.0032 *8*	
2872.89	960.09c *7*	100 *9*				
	1599.39 *6*	100 *3*				
	2089 *1*	41 *6*				
2886.31	382.0 *8*	24 *12*				
	1470.1 *8*	20 *8*				
	2101.87 *10*	100 *8*				
2915.50	1002.48 *9*	27.7 *17*	M1,E2		0.0036 *9*	
	1641.98 *21*	37 *5*				
	2131.14 *11*	100 *3*	E1+M2	−0.19 *7*	0.00101 *3*	
2934.9	241.5 *5*	100	M1		0.171	
2936.61	1125.6 *3*	100	E1(+M2)	≤0.14	0.00099 *8*	B(E1)(W.u.)>1.4×10^{-5}; B(M2)(W.u.)<5.2.
3029.59	334.9 *2*	63	M1		0.0714	B(M1)(W.u.)=0.0042 *11*.
	465.8 *2*	100	M1		0.0303	B(M1)(W.u.)=0.0025 *7*.
3045.7	1234.7 *3*	100				
3065	1230c	100				
3076.12	1802.62 *24*	100				
3089.70	1007.72 *9*	100 *9*				
	1816.06 *9*	69 *4*				
	3090.5 *15*	25 *8*				
3128.8	1317.8 *3*	100				
3130.87	2345.1 *8*	63 *9*				
	3130.89 *16*	100 *7*				
3152.48	122.9 *1*	75				
	457.9 *3*	100				
	588.6 *3*	95	M1		0.01675	
3157.0	1346.0 *3*	100				
3179.7	243.1 *5*	100	M1		0.168	
3295.03	2510.56 *15*	100 *8*				
	3295.5 *10*	33 *11*				
3310.4	280.6 *5*					
	373.8 *3*		M1		0.0535	
3357.80	1546.9 *3*	100				
3367.26	57					Eγ,Iγ: measured by 2003Po02 which give I(γ+ce) branching=5.8%.
	214.8 *1*	48	M1		0.235	B(M1)(W.u.)=0.0186 *21*.
	337.7 *3*	57	M1		0.0699	B(M1)(W.u.)=0.0057 *7*.
	430.5 *4*	34				
	673.9 *3*	100	E1(+M2)	≤0.41	0.0047 *23*	B(E1)(W.u.)>1.0×10^{-5}; B(M2)(W.u.)<22.

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Adopted Levels, Gammas (continued)

γ(^{148}Gd) (continued)

E(level)	Eγ†	Iγ§	Mult.‡	δ	α	Comments
3367.26	803.4	46				
3478.0	1667.0 *3*	100				
3502.1	938.3 *3*	100				
3574.94	2301.44 *21*	100 *10*				
	3574.6 *10*	90 *13*				
3645.92	952.7 *3*	25				
	1834.8 *3*	100				
3666.6	971.9 *3*	100	M1		0.00490	
3701.48	1006.8 *2*	100	E2		0.00271	B(E2)(W.u.)>2.3.
3758.24	1063.6 *2*	100	E1(+M2)	≤0.18	0.00115 *14*	B(E1)(W.u.)>2.2×10^{-5}; B(M2)(W.u.)<3.8.
3768.35	1957.2 *3*	100				
3808.34	1113.7 *3*	39				
	1115.0 *3*	50				
	1997.3 *3*	100				
3822.4	1127.5	100				
	1129.1	29				
3868.66	1174.0 *3*	100				
	1175.4 *3*	28				
3918.22	551.0 *2*	27				
	765.7 *2*	100	E2		0.00492	B(E2)(W.u.)=2.6 *5*.
	888.6 *3*	73				
3980.42	278.9 *2*	100.0# *2*	E1(+M2)	≤0.19	0.028 *9*	B(E1)(W.u.)>0.00016; B(M2)(W.u.)<390.
	1285.6 *5*	2.7# *2*	E3		0.00331	B(E3)(W.u.)=69 *8*.
3990.51	1208.2 *3*	87				
	1295.5 *3*	17				
	1297.2 *3*	100				
4051.0	2634.6 *10*	39 *10*				
	2777.5 *10*	≈20				
	3266.4 *10*	100 *61*				
4068.22	2155.33 *25*	100 *16*				
	2794.6 *10*	51 *11*				
	4066.8 *10*	43 *11*				
4119.24	1089.7 *3*	13.0				
	1250.5 *3*	8.7				
	1336.6 *3*	13.0				
	1424.6 *3*	21.7				
	1425.9 *3*	100				
	1555.4 *3*	19.1				
	2308.2 *3*	23.5				
4121.47	420.6 *5*	5.4				
	754.2 *2*	100	E2		0.00509	B(E2)(W.u.)≈11.
4170.25	1475.6 *3*	100				
	1476.9 *3*	80				
	1606.4 *3*	33				
4271.4	1578.0 *3*	100				
4312.01	443.4 *3*	4.4				
	954.3 *3*	22.2				
	1282.3 *3*	23.3				
	1618.7 *3*	100				
	1748.1 *3*	50				
4408.90	540.3 *3*	8.9				
	640.4 *3*	23.2				
	1540.1 *3*	7.1				
	1714.3 *3*	28.6				
	1715.7 *3*	100				
	1845.0 *3*	37.5				
4429.74	308.4 *2*	100	M1		0.0888	B(M1)(W.u.)=0.029 *22*.
	511.6	88				
	727.9 *5*	20				
4500.33	519.9 *1*	100	E2		0.01260	B(E2)(W.u.)=40 *22*.
	677.9 *3*	17	E2		0.00653	B(E2)(W.u.)=1.8 *10*.
	742.1 *1*	76	E2		0.00529	B(E2)(W.u.)=5 *3*.
	798.9	9				

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)

γ(^{148}Gd) (continued)

E(level)	Eγ†	Iγ§	Mult.‡	α	Comments
4542.27	3125.4 *3*	47 *6*			
	3269.2 *3*	100 *8*			
4551.04	121.3 *1*	100			
	429.5 *3*	73			
	571.0	30			
4740.6	311.0 *4*	100	D		
4906.0	355.0 *2*	100			
5025.83	285.5 *5*	5			
	475.3 *5*	13	D		
	525.5 *1*	100	E2	0.01225	B(E2)(W.u.)=10 *6*.
	1045.3 *3*	7			
5117.51	211.5 *2*	78	D		
	566.4 *2*	100	E2	0.01012	B(E2)(W.u.)=7 *4*.
5167.8	1187.4 *3*	100			
5355.57	238.0 *2*	13	D		
	329.8 *2*	100			
5438.6	321.1 *3*	100			
	532.1	16			
5578.6	410.8	100			
5800.3	221.8	100			
5832.7	477.1 *1*	100	E2	0.01580	
5882.8	444.3	100			
5933.7	133.4	≈15			
	495.1 *6*	100	D		
	578.3	39			
	816.0	36			
6210.9	378.4	25	D		
	855.3 *3*	100			
6268.4	435.6	100			
6381.4	447.7	100			
	498.7	43			
	548.8	36			
6545.6	334.7 *3*	100	D		
	612.1	9			
6574.9	193.4	62	D		
	306.3	27			
	742.1	100			
6640.8	808.1 *2*	100	D		
6834.5	193.7 *2*	63	D		
	259.4	13	D		
	288.9 *2*	41	E2	0.0677	B(E2)(W.u.)=0.96 *20*.
	1001.9 *3*	100			
7051.3	670.0	100	D		
	1218.6	55			
7110.3	1277.5	100			
7155.7	321.1 *3*	100	D		
	515.7	8	E2	0.01287	
7274.2	223.0	14			
	699.3	100			
7333.6	758.7	100			
7530.8	197.2	28			
	256.7	100	D		
	420.4	7			
	479.4	9			
7790.8	260.0	100	D		
	680.5	9	E2	0.00647	
8004.9	849.2	7			
	1170.5	100	E2	0.00200	
8242.9	1408.4	100			
8304.5	1148.8	100			
8309.1	518.2	100	D		
8364.0	573.5	5			
	1208.2	100	E2	0.00188	

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)

γ(^{148}Gd) (continued)

E(level)	Eγ†	Iγ§	Mult.‡	α
8455.5	151.1	21		
	212.7	32		
	450.6	73		
	664.6	100	D	
8609.1	818.2	100		
8639.1	183.6	100	D	
	330	31		
	634.3	76		
8832.1	222.9	45		
	376.7	17	D	
	468.2	12		
	522.8	100	D	
8987.1	155.0	65		
	348.0	79		
	623.0	100	E2	0.00799
9243.7	604.5	100		
9258.8	619.6	100		
	895	84		
9652.7	665.7	100		
9757.6	513.9	54	D	
	770.7	100	D	
9934.3	1102.2	100		
9957.3	713.7	100		
10046.5	787.9	24		
	1682.4	100		
	1741.8	8		
10063.0	305.3	100	D	
10317.9	271.5	100	E2	0.0822
	360.6	13	D	
	560.5	10		
	665	12		
	1330.6	8		
10474.3	716.6	100		
10694.0	1041.5	100		
10760.1	697	100		
10869.8	807	100		
11158.4	464.5	12		
	684.1	19		
	840.4	100	D	
11185.7	1122.6	100	E2	0.00217
11456.9	271.1	22		
	298.5	100	D	
11477.9	1160.0	100	E2	0.00203
11545.9	851.9	76		
	1227.9	100	E2	0.00182
11587.0	130.1	100		
11727.6	541.9	78		
	858.0	74		
	967.4	100		
12012.8	555.9	100		
12064.1	878.4	100		
12138.6	74.5			
	411.0	39	D	
	551.8	14		
	592.7	100	E2	0.00903
	660.7	48	E2	0.00694
12284.9	828.0	42	D	
	1126.5	100		
12381.9	925.0	100		
12529.5	244.5	10		
	390.9	100	D	
	942.6	19		
12683.2	1096.0	100		

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)

γ(^{148}Gd) (continued)

E(level)	Eγ†	Iγ§	Mult.‡	α
13039.1	355.8	6		
	509.7	100	D	
	657.2	27		
13125.9	987.3	100		
13147.7	464.2	40		
	765.8	100		
	1009.3	60		
13244.0	561.0	100		
13354.3?	824.8	100		
13555.0	1025.6	100		
13736.0	181.0	8	D	
	492.1	5		
	588.3	20		
	696.7	100	D	
13869.9	134.0	100	D	
	1340.3	19		
13888.3	849.2	100		
13911.5	41.6	100		
14011.3	972.2	100		
14145.8	1106.7	100	E2	0.00223
14206.6	295.1	14		
	336.7	100	D	
14924.4	778.6	100		
	1036.1	27		
15165.7?	959.1	100	E2	0.00301
15727.8	803.4	100		
16077.6	349.8	100		
16112.1	1187.7	100		
16204.2?	1038.5	100		
16257.4?	1091.7	100		
16406.8	294.7	100		
16473.7	1308.0	100		
17241.0?	834.2	100		
17320.2?	846.5	100		
17370.8	964.0	100		
18482	1110.9	100		
19149?	667[c]	100		
699.90+x	699.9 *1*	0.54@ *15*		
1447.80+x	747.9 *1*	0.87@ *9*		
2243.61+x	795.8 *1*	0.99@ *8*		
3090.31+x	846.7 *1*	0.97@ *8*		
3988.21+x	897.9 *1*	1.00@ *8*		
4938.51+x	950.3 *1*	0.97@ *8*		
5942.4+x	1003.9 *1*	1.00@ *10*		
7001.1+x	1058.7 *1*	0.98@ *9*		
8115.3+x	1114.2 *1*	0.99@ *10*		
9285.9+x	1170.6 *1*	1.00@ *15*		
10513.7+x	1227.8 *1*	0.84@ *7*		
11799.3+x	1285.6 *1*	0.71@ *8*		
13143.4+x	1344.0 *2*	0.66@ *7*		
14545.9+x	1402.5 *2*	0.55@ *6*		
16007.3+x	1461.4 *2*	0.48@ *7*		
17527.8+x	1520.5 *3*	0.34@ *5*		
19108.3+x	1580.5 *6*	0.19@ *3*		
20748.3+x	1640.0 *10*	0.15@ *5*		
22448.6+x	1700.3 *6*	0.07@ *3*		
741.8+y	741.8& *3*			
1530.7+y	788.9 *2*	0.46@ *10*		
2369.5+y	838.8 *2*	0.88@ *9*		
3258.6+y	889.1 *2*	0.89@ *9*		
4198.4+y	939.8 *2*	0.93@ *15*		
5188.8+y	990.4 *3*	1.00@ *11*		
6228.5+y	1039.7 *2*	0.95@ *20*		

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)

γ(^{148}Gd) (continued)

E(level)	Eγ†	Iγ§
7316.3+y	1087.8 *2*	1.03@ *15*
8451.5+y	1135.2 *2*	0.94@ *10*
9634.2+y	1182.7 *2*	0.82@ *8*
10865.4+y	1231.2 *2*	0.79@ *8*
12146.3+y	1280.9 *2*	0.77@ *8*
13478.6+y	1332.2 *2*	0.62@ *7*
14861.9+y	1383.3 *3*	0.56@ *6*
16299.4+y	1437.5 *5*	0.44@ *5*
17790.5+y	1491.1 *8*	0.27@ *4*
19336.7+y	1546.2 *10*	0.23@ *4*
830.3+z	830.3[a] *6*	0.23@[a] *5*
1706.0+z	875.7 *3*	0.42@ *6*
2631.0+z	925.0 *2*	0.43@ *7*
3606.7+z	975.7 *3*	0.62@ *7*
4634.2+z	1027.5 *2*	0.63@ *8*
5713.8+z	1079.6 *3*	0.95@ *11*
6846.5+z	1132.7 *2*	1.00@ *12*
8032.4+z	1185.9 *3*	0.93@ *30*
9271.7+z	1239.3 *3*	0.72@ *15*
10564.6+z	1292.9 *3*	0.95@ *20*
11909.1+z	1344.5 *3*	0.71@ *18*
13304.4+z	1395.2 *4*	0.64@ *15*
14739.6+z	1435.2 *5*	0.46@ *8*
16182.2+z	1442.6 *10*	0.40@ *12*
17629.9+z	1447.7 *6*	0.18@ *9*
19101.9+z	1472.0 *10*	0.22@ *8*
849.7+u	849.7& *3*	
1739.7+u	890.0 *2*	0.62@ *15*
2678.4+u	938.7 *2*	0.60@ *12*
3666.8+u	988.4 *3*	0.64@ *10*
4706.4+u	1039.6 *3*	0.68@ *10*
5797.5+u	1091.1 *3*	0.92@ *15*
6941.7+u	1144.2 *3*	1.05@ *20*
8139.7+u	1198.0 *3*	1.00@ *15*
9392.5+u	1252.8 *3*	1.02@ *13*
10700.6+u	1308.1 *3*	0.88@ *15*
12065.0+u	1364.4 *3*	0.90@ *18*
13486.4+u	1421.3 *4*	0.82@ *10*
14964.9+u	1478.5 *4*	0.57@ *9*
16501.8+u	1536.9 *10*	0.30@ *10*
853.7+v	853.7 *3*	0.45@ *6*
1753.6+v	899.9 *2*	0.83@ *9*
2698.5+v	944.9 *3*	0.85@ *10*
3689.9+v	991.4 *2*	0.86@ *10*
4727.8+v	1037.9 *2*	0.85@ *20*
5812.4+v	1084.6 *2*	1.00@ *15*
6944.3+v	1131.9 *2*	1.00@ *13*
8123.8+v	1179.5 *2*	0.90@ *10*
9350.3+v	1226.5 *2*	0.80@ *10*
10624.1+v	1273.8 *2*	0.80@ *10*
11946.2+v	1322.1 *2*	0.52@ *8*
13315.9+v	1369.6 *2*	0.50@ *10*
14733.0+v	1417.1 *3*	0.44@ *7*
16197.9+v	1464.9 *4*	0.31@ *5*
17711.0+v	1513.1 *10*	0.26@ *4*
19273.0+v	1562[a] *1*	0.20@[a] *6*
802.2+w	802.2[b] *3*	
1651.6+w	849.44 *22*	
2549.0+w	897.40 *16*	0.91@ *12*
3494.9+w	945.86 *15*	1.00@ *12*
4491.0+w	996.08 *19*	1.00@ *22*
5537.8+w	1046.83 *14*	1.00@ *10*
6637.2+w	1099.39 *16*	0.95@ *18*
7789.4+w	1152.20 *15*	0.97@ *10*
8996.2+w	1206.76 *24*	1.00@ *15*
10257.2+w	1261.00 *16*	1.00@ *19*
11573.8+w	1316.57 *14*	0.96@ *10*
12945.9+w	1372.10 *22*	0.78@ *9*
14374.4+w	1428.55 *24*	0.77@ *10*
15859.6+w	1485.15 *26*	0.70@ *15*
17402.0+w	1542.4 *4*	0.63@ *15*
911.8+r	911.8 *4*	
1873.7+r	961.9 *3*	
2892.1+r	1018.4 *3*	
3969.0+r	1076.9 *3*	
5101.0+r	1132.0 *4*	
6287.7+r	1186.7 *3*	
7527.4+r	1239.7 *4*	
8817.6+r	1290.2 *3*	
10152.6+r	1335.0 *3*	
11530.7+r	1378.1 *4*	
12956.2+r	1425.4 *4*	
14431.4+r	1475.2 *4*	
15960.3+r	1528.9 *5*	
887.0+s	887.0 *3*	
1822.4+s	935.4 *4*	
2812.3+s	989.9 *4*	
3858.2+s	1045.9 *3*	
4961.4+s	1103.2 *10*	
6120.6+s	1159.2 *3*	
7332.7+s	1212.1 *3*	
8596.7+s	1264.0 *3*	
9908.0+s	1311.3 *3*	
11263.4+s	1355.4 *4*	
12664.9+s	1401.4 *4*	
14115.5+s	1450.6 *4*	
15618.5+s	1503.0 *5*	
868.4+t	868.4 *3*	
1783.4+t	915.0 *3*	
2745.6+t	962.2 *3*	
3755.3+t	1009.7 *2*	
4811.6+t	1056.3 *2*	
5916.5+t	1104.9 *2*	
7069.9+t	1153.4 *2*	
8271.5+t	1201.6 *3*	
9521.3+t	1249.8 *2*	
10818.5+t	1297.2 *3*	
12157.8+t	1339.3 *6*	
13509.8+t	1351.9 *7*	

† From ε decay, (HI,xnγ), and (HI,xnγ):SD.

‡ Except where noted otherwise, mult assignments are based on conversion electron and γ(θ) of oriented nuclei from ε decay (60 min), conversion electron data from ε decay (2.20 min), γγ (θ), excitation function, conversion electron and γγ(θ) data from (HI,xnγ).

§ Relative photon branching from each level for gammas from normal deformed states as opposed to relative intensity within each SD band.

Branching ratio from (HI,xnγ) (2000Po13).

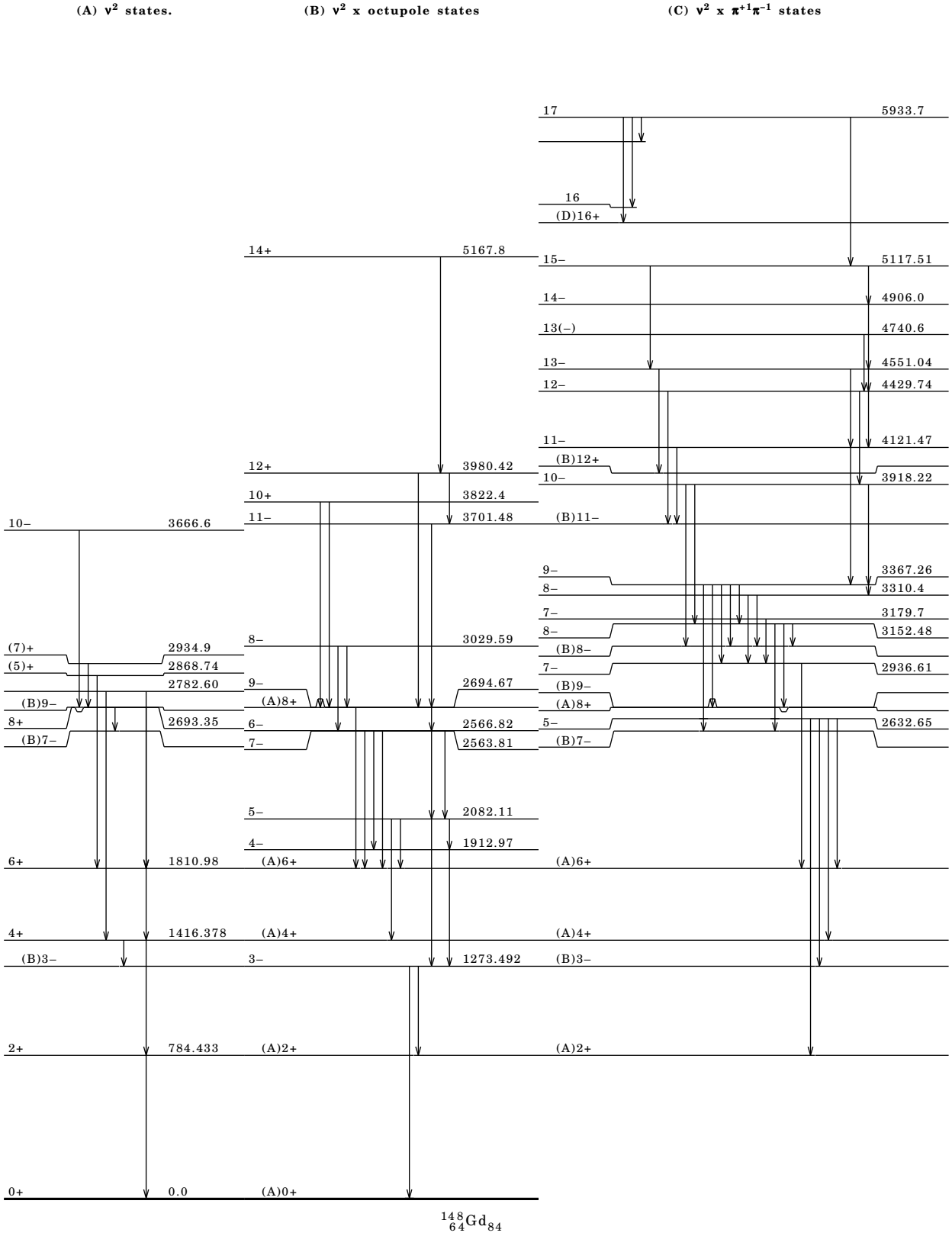
Footnotes continued on next page

Adopted Levels, Gammas (continued)

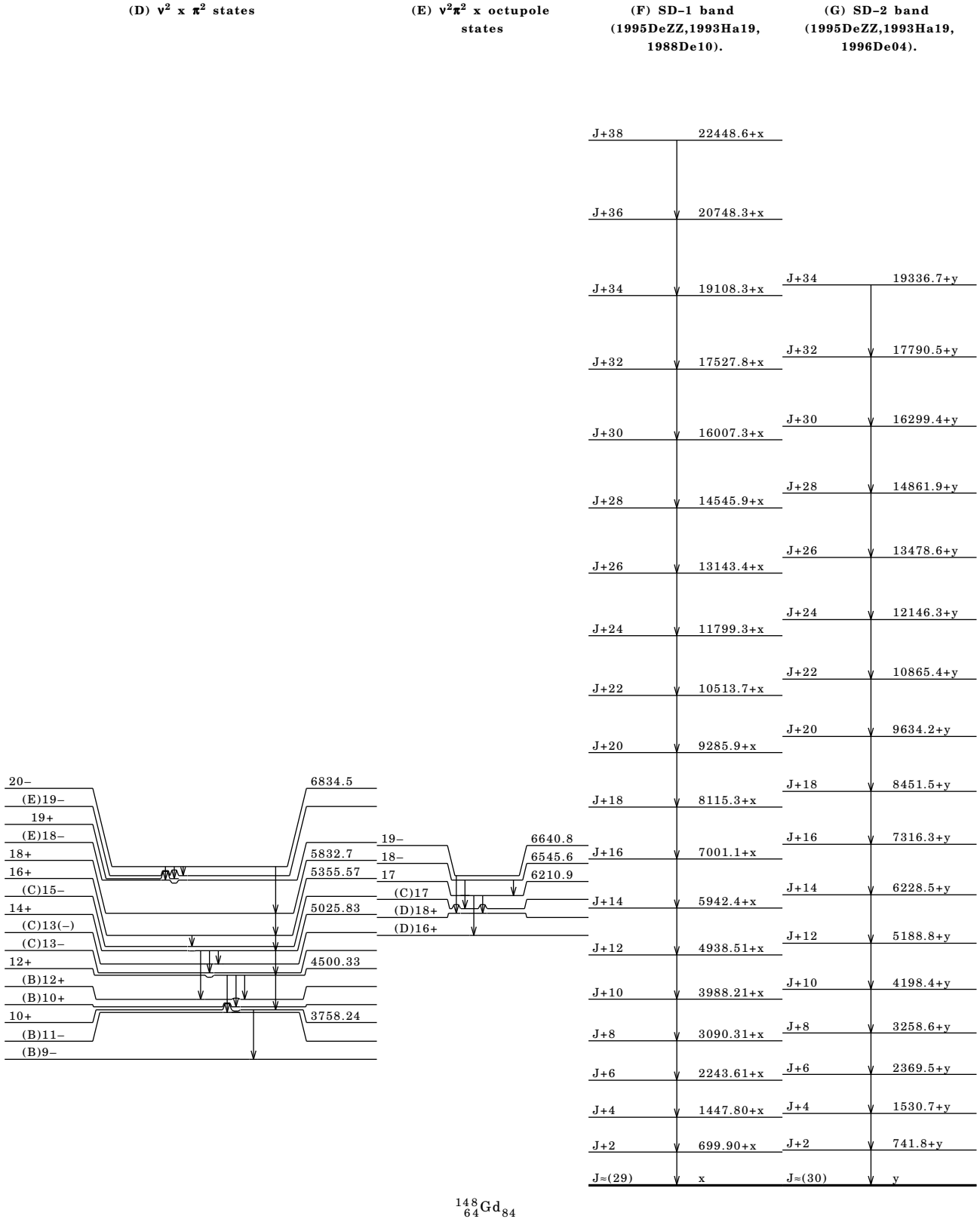
$\gamma(^{148}Gd)$ (continued)

@ Relative intensity within each SD band, normalized to ≈1 for the most intense transition in that band.
& γ not reported by 1996De04.
a From 1996De04 only.
b From 1995DeZZ. γ not reported by 1996De04 and 1997Ha19.
c Placement of transition in the level scheme is uncertain.

Adopted Levels, Gammas (continued)

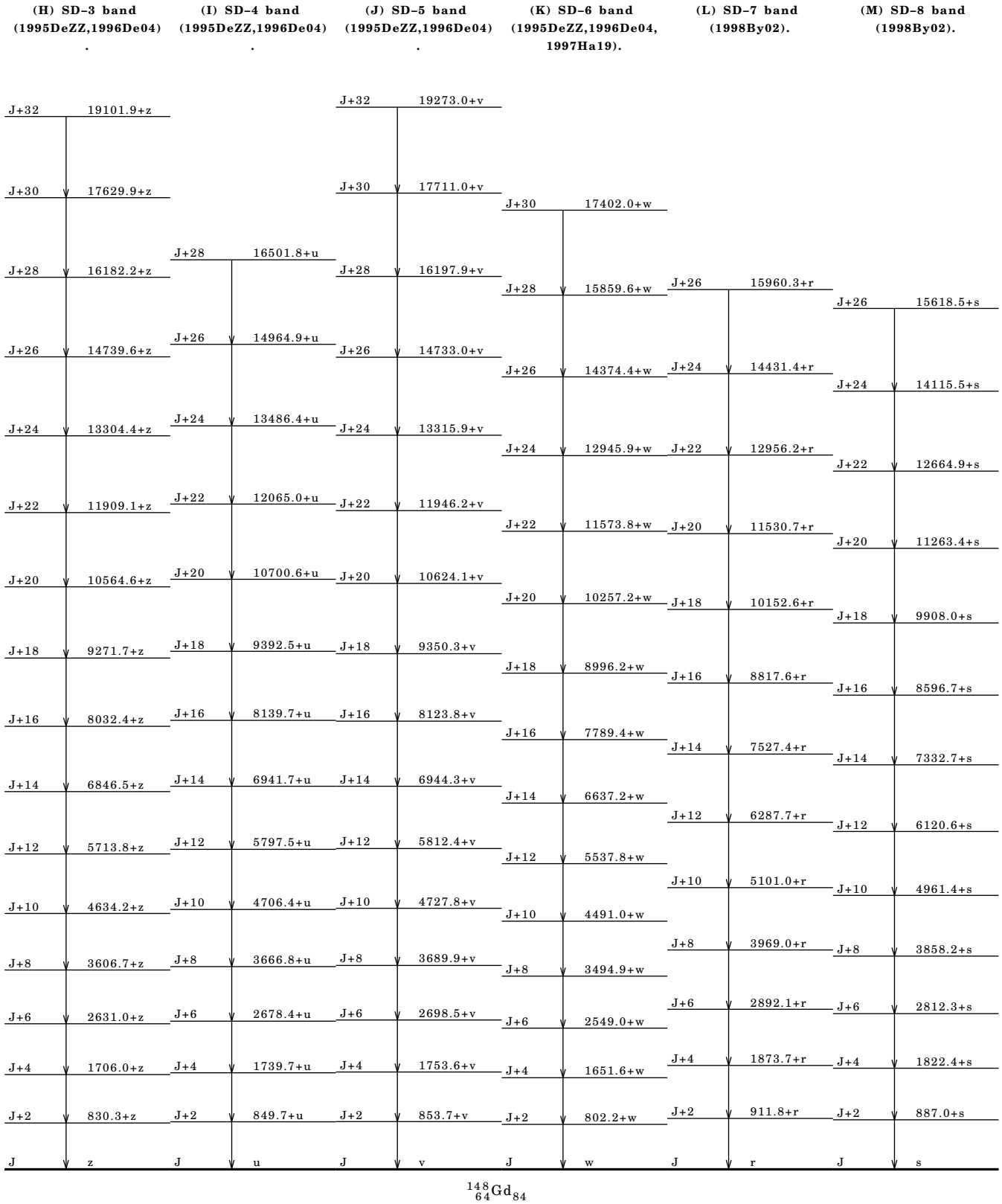


Adopted Levels, Gammas (continued)



$^{148}_{64}Gd_{84}$

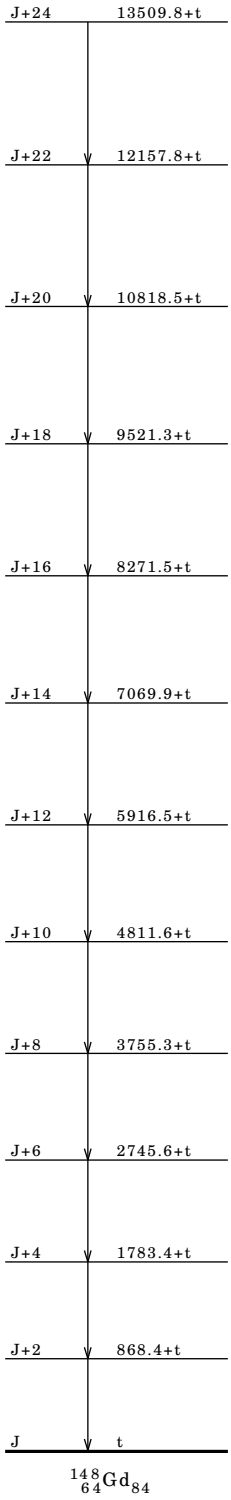
Adopted Levels, Gammas (continued)



$^{148}_{64}Gd_{84}$

Adopted Levels, Gammas (continued)

(N) SD-9 band (1998By02).



^{148}Tb ε Decay (60 min) 1979ShZF,1985Ti03

Parent ^{148}Tb: E=0.0; Jπ=2–; $T_{1/2}$=60 min *1*; Q(g.s.)=5738 *13*; %ε+%β$^+$ decay=100.

1993KrZW,1992KrZN: measured Eγ, Iγ, γγ coin, ce, γ(θ) from oriented nuclei. The following levels with their assigned Jπ by these authors have not been placed in the level scheme because their placement was not shown: scheme: 3521, 3795 (1,2+), 4274 (2+,3,4+), 4338 (3–,4+), 4559 (1–,2+), 4862 (2–,3,4), 4960, 5018 (3,4), 5061 (3–,4+), 5303, 5400 (3–,4+).

Measured: γ, γγ (1973Kr10,1973Vy01,1973Vy02,1974Ne01,1979ShZF,1985TI03), γ(θ) (1985Ti01), ce (1973Vy01,1979ShZF), β$^+$ (1961Bo19,1975PyZZ), Gamow–Teller strength distribution (2003NaZV, 2001AlZY).

Decay scheme is that of 1979ShZF and 1985Ti03.

Level scheme is incomplete and the evaluated Iβ and Iε, especially for the weak transitions, are less reliable.

^{148}Gd Levels

E(level)†	Jπ‡	E(level)†	Jπ‡	E(level)†	Jπ‡
0.0	0+	2310.97 *5*	2+	2915.51 *8*	3–
784.433 *15*	2+	2424.10 *9*	3+,4+#	3065	
1273.490 *18*	3–	2503.70 *6*	(1,2,3)–	3076.12 *24*	
1416.376 *20*	4+	2505.80 *4*	3–	3089.65 *8*	(1–,2+)
1834.59 *5*	2+,3+§	2522.03 *11*	4+	3130.87 *16*	(1,2+)
1863.445 *24*	2+	2614.59 *5*	2+	3295.03 *15*	(1,2+)
1912.98 *7*	4–	2632.81 *9*	5–	3574.94 *21*	(1–,2+)
2082.00 *7*	5–	2700.06 *7*	(1–,2+)	4051.0 *6*	(2+,3,4+)
2188.67 *4*	2+	2872.89 *7*	(2–,3,4+)	4068.24 *25*	(1)
2233.60 *4*	3–	2886.31 *10*	(2+,3,4+)	4542.27 *22*	

† From a least–squares fit to Eγ.
‡ From adopted levels; supported by internal conversion data and γ(θ) of oriented nuclei from this decay.
§ From γ(θ) from oriented nuclei (1993KrZW).
# From γ(θ) of oriented nuclei.

β$^+$,ε Data

β$^+$ with Eβ=4610 *80* (Iβ=1.00, Iβ/ce(K)(784γ)≈10), 3840 *150* (0.47), 2730 *300* (0.75) (1975PyZZ); 4600, 2600 (1961Bo19) were observed. However, from ε/β$^+$=1.541 *93* (to 1864 level) follows Q(ε)=5290 *50*; therefore, Eβ+(g.s.)=4270 *45* (1985Ti01).

Level scheme is incomplete and the evaluated Iβ and Iε, especially for the weak transitions, are less reliable.

Eε	E(level)	Iβ$^+$†	Iε†	Log *ft*	I(ε+β$^+$)†	Comments
(1196 *13*)	4542.27		0.81 *6*	6.72 *4*	0.81 *6*	
(1670 *13*)	4068.24	0.0047 *7*	0.60 *7*	7.16 *6*	0.60 *7*	
(1687 *13*)	4051.0	0.0048 *20*	0.55 *22*	7.20 *18*	0.55 *22*	
(2163 *13*)	3574.94	0.028 *3*	0.45 *5*	7.51 *5*	0.48 *5*	
(2443 *13*)	3295.03	0.045 *6*	0.35 *4*	7.72 *6*	0.40 *5*	
(2607 *13*)	3130.87	0.173 *13*	0.96 *7*	7.35 *4*	1.13 *8*	
(2648 *13*)	3089.65	0.205 *16*	1.04 *8*	7.32 *4*	1.25 *9*	
(2662 *13*)	3076.12	0.084 *12*	0.42 *6*	7.73 *7*	0.50 *7*	
(2822 *13*)	2915.51	0.426 *19*	1.56 *6*	7.202 *20*	1.99 *8*	
(2852 *13*)	2886.31	0.20 *2*	0.71 *9*	7.56 *6*	0.91 *11*	
(2865 *13*)	2872.89	0.342 *19*	1.17 *6*	7.342 *25*	1.51 *8*	
(3038 *13*)	2700.06	0.369 *13*	0.95 *3*	7.483 *17*	1.32 *4*	
(3105 *13*)	2632.81	0.17 *1*	0.41 *2*	7.872 *25*	0.58 *3*	
(3123 *13*)	2614.59	0.82 *4*	1.86 *10*	7.216 *25*	2.68 *14*	
(3216 *13*)	2522.03	0.14 *1*	0.84 *6*	9.17^{1u} *4*	0.98 *7*	
(3232 *13*)	2505.80	0.89 *4*	1.71 *7*	7.282 *21*	2.60 *11*	ε/β$^+$=3.43 *77* (1985Ti01).
(3234 *13*)	2503.70	0.73 *5*	1.40 *9*	7.37 *3*	2.13 *13*	
(3314 *13*)	2424.10	0.39 *3*	0.68 *6*	7.71 *4*	1.07 *9*	
(3427 *13*)	2310.97	0.722 *22*	1.08 *3*	7.534 *16*	1.80 *5*	
(3504 *13*)	2233.60	0.84 *4*	1.15 *6*	7.528 *24*	1.99 *10*	Iε: ε/β$^+$=3.23 *88* (1985Ti01).
(3549 *13*)	2188.67	1.82 *4*	2.33 *5*	7.230 *14*	4.15 *9*	
3750 *300*	1863.445	9.36 *18*	8.34 *16*	6.754 *12*	17.7 *3*	Iε: ε/β$^+$=1.541 *93*; εK(exp)/β$^+$=1.265 *100* (1985Ti01). Iβ$^+$: Iβ$^+$(rel)=0.75.
(3825 *13*)	1912.98	1.05 *6*	0.98 *6*	7.67 *3*	2.03 *12*	
(3903 *13*)	1834.59	0.44 *2*	0.38 *1*	8.101 *19*	0.82 *3*	
(4322 *13*)	1416.376	2.79 *10*	4.22 *15*	8.992^{1u} *19*	7.01 *24*	
(4465 *13*)	1273.490	6.3 *3*	3.2 *2*	7.294 *25*	9.5 *5*	

Continued on next page (footnotes at end of table)

^{148}Tb ε Decay (60 min) 1979ShZF,1985Ti03 (continued)

β⁺,ε Data (continued)

Eε	E(level)	Iβ⁺†	Iε†	Log *ft*	I(ε+β⁺)†	Comments
(4954 *13*)	784.433	21.8 *13*	7.5 *5*	7.02 *3*	29.3 *18*	Iβ⁺: Iβ⁺(rel)=0.47 (1975PyZZ).
(5738 *13*)	0.0	≈3.0	≈1.5	≈9.9 1u	≈4.5	I(ε+β⁺): from Iβ⁺/ce(K)(784γ)≈10 (1975PyZZ), ε/β⁺ ratio, and sum of Iγ, Iε+Iβ⁺ to g.s.=100.

† Absolute intensity per 100 decays.

γ(^{148}Gd)

α(K)exp were normalized to α(K)(784γ)=0.0039 (E2) (1979ShZF,1993KrZW).
Iγ normalization: from Iβ⁺/ce(K)(784γ)≈10 to g.s. (1975PyZZ), and ΣIγ, Iβ⁺, Iε to g.s.=100.

Eγ†	E(level)	Iγ‡&	Mult.#	δ@	α	Comments
142.878 *14*	1416.376	0.367 *17*	E1		0.1116	Mult.: α(K)exp=0.120 *24* (1973Vy01).
382.0§ *8*	2886.31	0.18§ *9*				
489.049 *12*	1273.490	23.5 *5*	E1+M2	+0.18 *9*	0.008 *3*	Mult.: α(K)exp=0.0046 *3* (1979ShZF,1993KrZW), α(L)exp=0.00062 *9* (1993KrZW). δ: from 1993KrZW, 1992KrZN. A_2=0.00 *16* (1993KrZW,1992KrZN).
589.9§ *7*	1863.445	0.71§ *4*				
631.947 *17*	1416.376	12.65 *25*	E2		0.00772	Mult.: α(K)exp=0.0066 *4* (1979ShZF,1993KrZW), α(L)exp=0.00112 *13* (1993KrZW). A_2=−0.39 *15* (1992KrZN).
639.47 *7*	1912.98	3.14 *12*	M1		0.01362	Mult.: α(K)exp=0.0086 *8* (1979ShZF), 0.0087 *8* (1993KrZW).
784.430 *16*	784.433	100.0 *19*	E2		0.00466	Mult.: α(K)exp=0.0039 (1979ShZF,1993KrZW) normalization value; α(L)exp=0.00062 *4* (1993KrZW), α(M)exp=0.000149 *17* (1993KrZW). A_2=−0.73 *24* (1992KrZN).
808.56 *7*	2082.00	0.524 *22*	E2		0.00435	A_2=−0.21 *16* (1992KrZN).
x841.59 *16*		0.316 *22*				
915.30 *12*	2188.67	0.36 *4*				
960.09b *7*	2233.60	1.28b *11*	M1+E2		0.0040 *11*	Mult.: α(K)exp=0.0043 *9* (1979ShZF), 0.0043 *10* (1993KrZW). δ: +0.02 *+21−14* or +1.3 *+4−5* (1993KrZW). A_2=−0.45 *13* (1993KrZW,1992KrZN).
	2872.89	1.28b *11*				
1002.48 *9*	2915.51	0.399 *24*	M1,E2		0.0036 *9*	Mult.: α(K)exp=0.0030 *14* (1979ShZF,1993KrZW). A_2=0.02 *24* (1992KrZN,1993KrZW).
1007.72b *9*	2424.10	0.77b *7*	M1+E2		0.0036 *9*	Mult.: α(K)exp=0.0033 *8* (1979ShZF,1993KrZW). δ: −1.2 *8* if Jπ=3+; +0.6 *8* if Jπ=4+. A_2=−0.44 *15* if Jπ=3+, −0.46 *15* if Jπ=4+ (1992KrZN,1993KrZW).
	3089.65	0.77b *7*				
1050.15 *4*	1834.59	0.965 *33*	E2+M3		0.00266 *18*	Mult.: α(K)exp=0.0023 *8* (1979ShZF,1993KrZW). δ: +3 *+4−1* or −0.12 *19* if Jπ=2+ or +0.31 *12* if Jπ=3+ (1993KrZW). A_2=−0.27 *23* if Jπ=2+; −0.23 *19* if Jπ=3+ (1993KrZW).
1079.025 *25*	1863.445	13.6 *3*	M1+E2	+4.6 *+35−14*	0.00242 *8*	Mult.: α(K)exp=0.00162 *11* (1979ShZF,1993KrZW). δ: from 1985Ti01 (γγ(θ)). Other: >+4 (1993KrZW). A_2=0.030 *20* (1993KrZW,1992KrZN).
1089.41 *3*	2505.80	2.68 *6*	E1		9.69×10^{-4}	Mult.: α(K)exp=0.0014 *4* (1979ShZF,1993KrZW).
1105.65 *11*	2522.03	0.73 *4*	M1+E2		0.0029 *7*	Mult.: α(K)exp=0.0023 *7* (1979ShZF,1993KrZW). δ: −0.18 *20* or +1.5 *+10−6* (1993KrZW). A_2=−0.30 *16* (1993KrZW).
x1167§a		0.13§ *4*				
x1215.0§ *6*		0.20§ *4*				
1230§a	3065	0.39§ *14*				

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^{148}Tb ε Decay (60 min) 1979ShZF,1985Ti03 (continued)

γ(^{148}Gd) (continued)

Eγ[†]	E(level)	Iγ[‡&]	Mult.[#]	δ[@]	α	Comments
1230.18 *5*	2503.70	0.98 *4*	E2,M1		0.0023 *5*	Mult.: α(K)exp=0.0022 *10* (1979ShZF).
1248.2[§] *8*	2522.03	0.24[§] *6*				
1342.2[§] *6*	2614.59	0.20[§] *9*				
1404.22 *4*	2188.67	2.54 *6*	M1+E2		0.0018 *4*	Mult.: α(K)exp=0.0020 *5* (1979ShZF,1993KrZW). δ: +2.0 +*10*−*7* or +0.04 +*19*−*14* (1993KrZW). A_2=−0.47 *18* (1993KrZW,1992KrZN).
1426.49 *8*	2700.06	0.33 *2*				
1449.16 *4*	2233.60	1.08 *4*	E1+M2	+0.09 *10*	0.00078 *10*	δ: from 1993KrZW,1992KrZN. A_2=0.17 *18* (1993KrZW,1992KrZN).
1470.1[§] *8*	2886.31	0.15[§] *6*				
1526.45 *7*	2310.97	0.76 *3*	M1+E2		0.0015 *3*	δ: +2.4 +*22*−*10* or −0.0 *2* (1993KrZW,1992KrZN). A_2=−0.40 *25* (1993KrZW,1992KrZN).
1599.39 *6*	2872.89	1.28 *4*				
1639.66 *22*	2424.10	0.50 *7*				
1641.98 *21*	2915.51	0.53 *7*				
x1679[§a]		0.33[§] *5*				
1719.63 *20*	2503.70	1.73 *11*				
1722.5 *3*	2505.80	0.41 *11*				Eγ: Differ by 3σ from value calculated as ΔE_{levels}.
1737.9[§] *6*	2522.03	0.20[§] *4*				
1802.62 *24*	3076.12	0.60 *8*				
1816.06 *9*	3089.65	0.53 *3*				
1830.14 *4*	2614.59	2.17 *12*	M1+E2		0.00120 *16*	Iγ: from 1985Ti03. 2.49 *7* (1979ShZF). δ: +2.5 +*14*−*8*, or −0.03 *5* (1993KrZW). A_2=−0.38 *18* (1992KrZN,1993KrZW).
1848.36 *8*	2632.81	0.69 *3*				
1863.39 *4*	1863.445	6.69 *13*				
1915.54 *19*	2700.06	0.48 *3*	M1+E2	+0.8 *6*	0.00119 *10*	A_2=−0.88 *28* (1992KrZN,1993KrZW).
x1988.7 *4*		0.39 *5*				
2089 *1*	2872.89	0.52 *8*				
2101.87 *10*	2886.31	0.75 *6*				Iγ: from 1985Ti03.
2131.14 *11*	2915.51	1.44 *5*	E1+M2	−0.19 *7*	0.00101 *3*	A_2=−0.18 *21* (1992KrZN,1993KrZW).
2155.33 *25*	4068.24	0.37 *6*				Iγ: from 1985Ti03.
x2168.0 *4*		0.37 *5*				
2188.65 *7*	2188.67	2.04 *7*				A_2=−0.78 *21* (1992KrZN).
x2247.32 *12*		0.39 *4*				
x2288.10 *15*		0.48 *4*				
2301.44 *21*	3574.94	0.30 *3*				
2311.03 *7*	2310.97	1.38 *4*				A_2=−0.43 *23* (1992KrZN).
x2331.92 *15*		0.61 *3*				
2345.1[§] *8*	3130.87	0.52[§] *7*				
x2362.9 *3*		0.68 *4*				
x2485.94 *15*		0.63 *5*				
2510.56 *15*	3295.03	0.36 *3*				
x2593.3 *6*		0.31 *12*				
2614.3 *6*	2614.59	0.82 *6*				
2634.6[§] *10*	4051.0	0.16[§] *4*				
2700.57 *20*	2700.06	0.76 *3*				
2777.5[§] *10*	4051.0	≈0.08[§]				
2794.6[§] *10*	4068.24	0.19[§] *4*				
x2858.5 *5*		0.33 *8*				
x2871.8 *7*		0.45 *8*				
3090.5[§] *15*	3089.65	0.19[§] *6*				
3125.4 *3*	4542.27	0.31 *4*				
3130.89 *16*	3130.87	0.82 *6*				
3266.4[§] *10*	4051.0	0.41[§] *25*				
3269.2 *3*	4542.27	0.66 *5*				
3295.5[§] *10*	3295.03	0.12[§] *4*				
x3552.9 *5*		0.35 *4*				
3574.6[§] *10*	3574.94	0.27[§] *4*				
x3644.9 *5*		0.44 *5*				
x3685.8 *5*		0.60 *5*				
x3983.7 *5*		0.35 *4*				

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^{148}Tb ε Decay (60 min) 1979ShZF,1985Ti03 (continued)

γ(^{148}Gd) (continued)

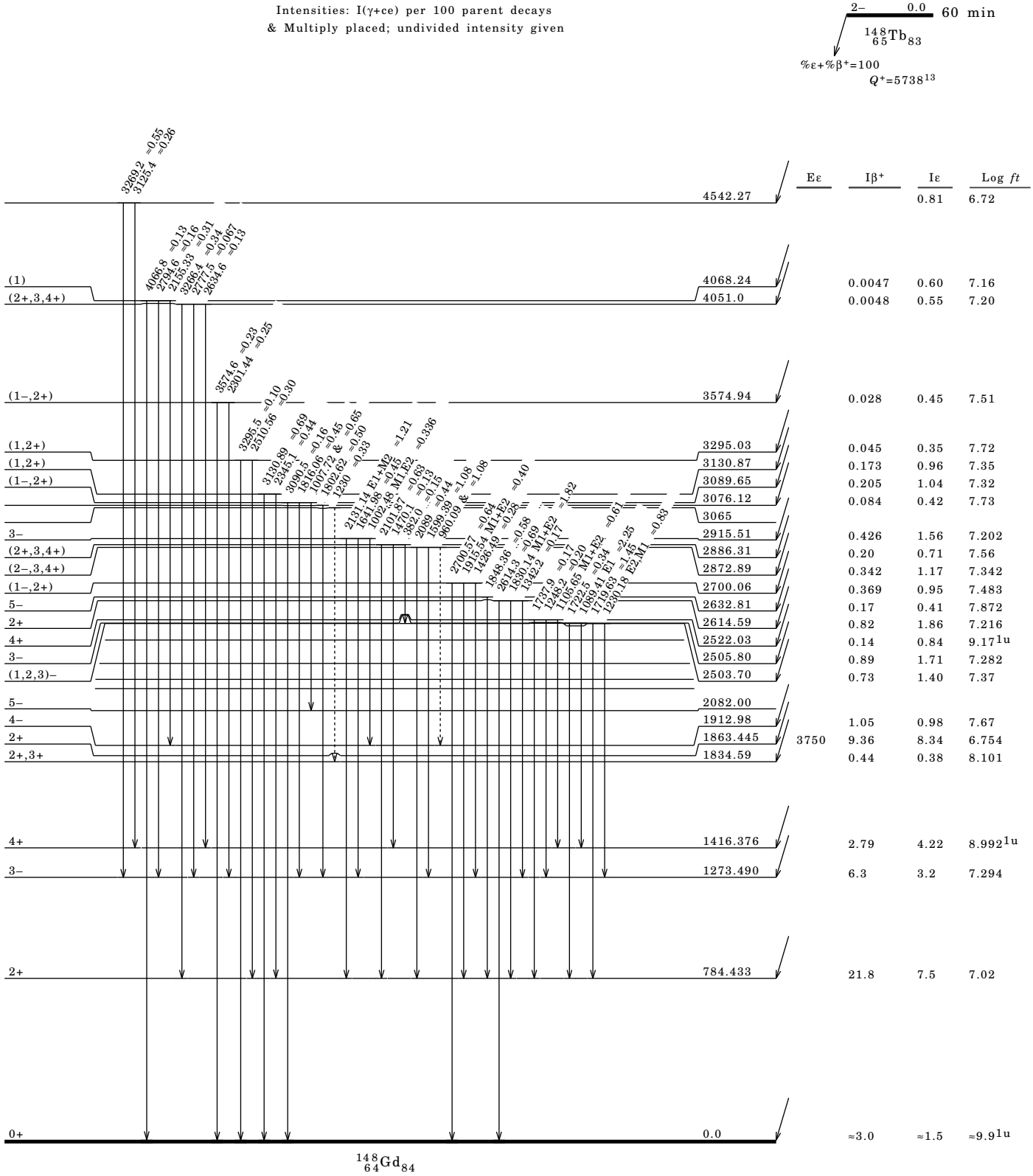
Eγ†	E(level)	Iγ‡&
4066.8§ *10*	4068.24	0.16§ *4*

† From 1979ShZF, except as indicated otherwise.
‡ Relative intensity from 1979ShZF, except as indicated otherwise.
§ From 1985Ti03.
# From adopted gammas; supported by internal conversion data and γ(θ) of oriented nuclei from this decay.
@ From adopted gammas; supported by γ(θ) from 1993KrZW, 1992KrZN from this decay.
& For absolute intensity per 100 decays, multiply by ≈0.84.
a Placement of transition in the level scheme is uncertain.
b Multiply placed; undivided intensity given.
x γ ray not placed in level scheme.

^{148}Tb ε Decay (60 min) 1979ShZF,1985Ti03 (continued)

Decay Scheme

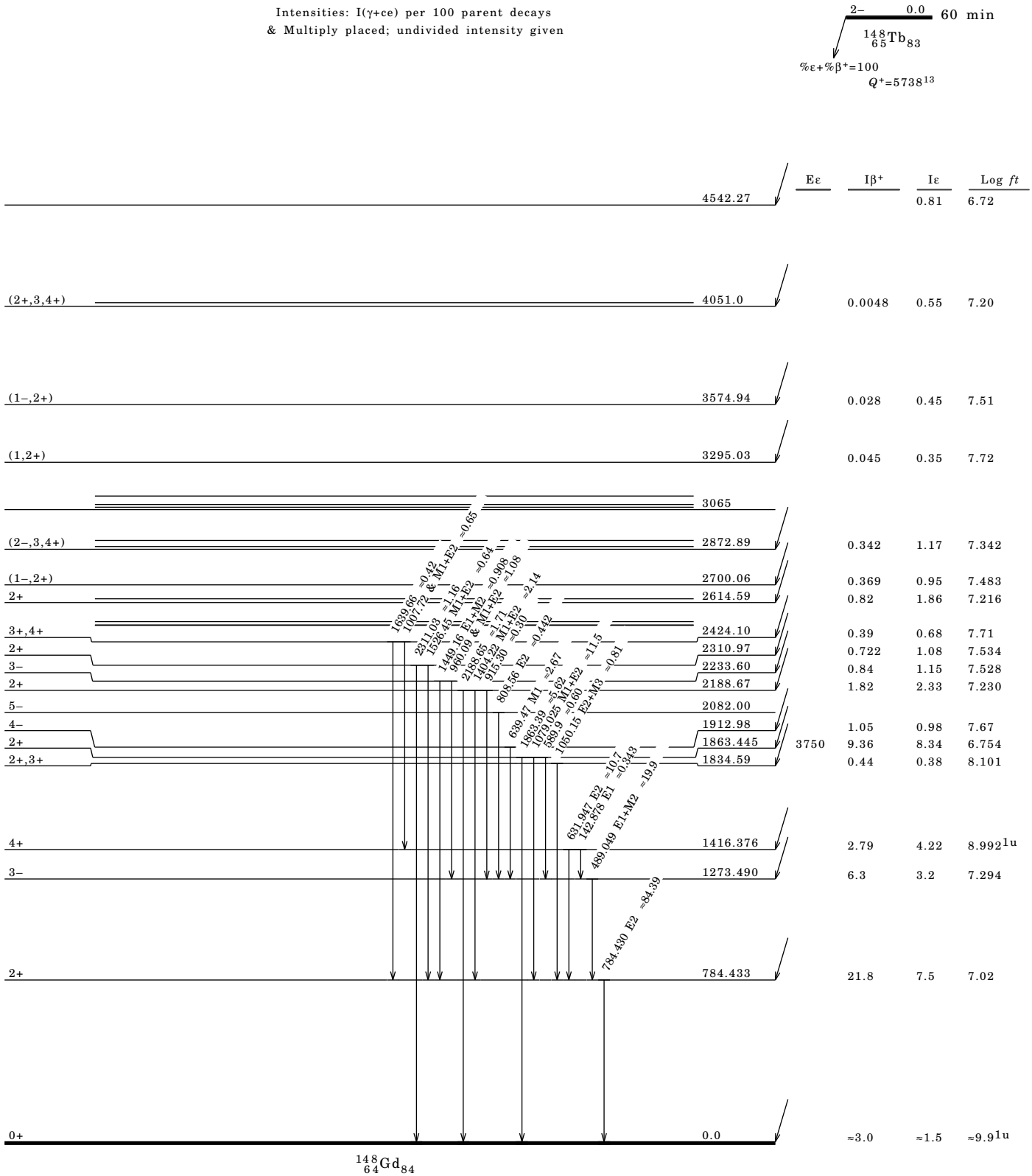
Intensities: I(γ+ce) per 100 parent decays
& Multiply placed; undivided intensity given



^{148}Tb ε Decay (60 min) 1979ShZF,1985Ti03 (continued)

Decay Scheme (continued)

Intensities: I(γ+ce) per 100 parent decays
& Multiply placed; undivided intensity given



^{148}Tb ε Decay (2.20 min) 1991CoZY

Parent ^{148}Tb: E=90.1 *3*; Jπ=(9)+; $T_{1/2}$=2.20 min *5*; Q(g.s.)=5738 *13*; %ε+%β$^+$ decay=100.
1991CoZY: measured Eγ, Iγ, γγ coin, $T_{1/2}$.
1985Sc09: measured Iβ$^+$/(Iε+Iβ$^+$), Iβ$^+$/εK(exp) to the 2693–keV level to determine Q(ε)–.
1981Sc21: measured ε/β$^+$ to the 2693–keV level to determine Q(ε)–.
1974Ne01: measured Eγ, Iγ, γγ coin, $T_{1/2}$.
1973Bo13: measured Eγ, Iγ, γγ coin, $T_{1/2}$.
2003NaZV: measured Gamow–Teller strength distribution.
Other: 1971Ar31.
There are problems in reconciling log *ft* values from ^{148}Tb ε decay (2.20 min) with ΔJπ of the transitions. More data are needed to clarify these problems.
All data and the level scheme are from 1991CoZY, unless indicated otherwise.

^{148}Gd Levels

E(level)†	Jπ‡	$T_{1/2}$	Comments
0.0	0+		
784.48 *6*	2+		
1273.36 *11*	3−		
1416.34 *9*	4+		
1810.89 *12*	6+		
1912.9 *3*	4−		
2082.13 *15*	5−		
2563.83 *13*	7−		
2693.28 *13*	8+		
2694.63 *16*	9−	17.5 ns	
2782.54 *19*			
2868.67 *22*	(5)+		
2936.1 *4*	7−		
3029.49 *20*	8−		
3045.6 *4*			
3128.7 *4*			
3152.49 *23*	8−		
3156.9 *4*			
3357.7 *3*			
3477.9 *4*	(8,9)		Jπ: log $f^{1u}t$=7.4 from (9)+ and γ to 6+.
3502.1 *4*			
3645.84 *25*	(8+)		
3666.3 *4*	10−		
3758.3 *4*	10+		
3768.28 *25*			
3808.27 *22*	(8+)		
3868.61 *21*			
3990.45 *22*	(8,9,10)+		Jπ: log *ft*=5.9 from (9)+.
4119.18 *17*	(8,9)+		Jπ: log *ft*=5.2 from (9)+; γ to 6+.
4170.22 *22*	(8,9−)		
4271.3 *4*			
4311.95 *20*	(8,9,10)+		Jπ: log *ft*=5.1 from (9)+.
4408.86 *19*	(8)+		Jπ: log *ft*=5.3 from (9)+; γ to (5)+.

† From a least–squares fit to Eγ.
‡ Adopted values; supported by internal conversion data, log *ft* values from this decay, and related in–beam work.

β$^+$,ε Data

Eε	E(level)	Iβ$^+$‡	Iε‡	Log *ft*	I(ε+β$^+$)†‡
(1419 *13*)	4408.86	0.00131	1.15	5.3	1.15
(1516 *13*)	4311.95	0.0050	1.80	5.2	1.80
(1557 *13*)	4271.3	0.00061	0.16	6.2	0.16
(1658 *13*)	4170.22	0.0024	0.32	6.0	0.32
(1709 *13*)	4119.18	0.0225	2.26	5.2	2.28
(1838 *13*)	3990.45	0.0086	0.46	5.9	0.47
(1959 *13*)	3868.61	0.0069	0.22	6.3	0.23
(2020 *13*)	3808.27	0.013	0.33	6.1	0.34
(2182 *13*)	3645.84	0.030	0.47	6.1	0.50

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^{148}Tb ε Decay (2.20 min) 1991CoZY (continued)

β⁺,ε Data (continued)

Eε	E(level)	Iβ⁺‡	Iε‡	Log *ft*	I(ε+β⁺)†‡	Comments
(2326 *13*)	3502.1	0.010	0.11	6.8	0.12	
(2350 *13*)	3477.9	0.055	0.54	6.1	0.60	
(2470 *13*)	3357.7	0.013	0.097	6.9	0.11	
(2671 *13*)	3156.9	0.022	0.11	6.9	0.13	
(2676 *13*)	3152.49	0.033	0.16	6.7	0.19	
(2799 *13*)	3029.49	0.10	0.39	6.4	0.49	
(2892 *13*)	2936.1	0.032	0.34	7.9[1u]	0.37	
3030 *30*	2693.28	27.9 *4*	62.2 *4*	4.259 *12*	90.1 *1*	Eε: from Q(ε)–=5725 *30* (1985Sc09). Other: 5755 *50* (1981Sc21).
(3046 *13*)	2782.54	0.034	0.086	7.1	0.12	
(3133 *13*)	2694.63	0.538 *12*	1.20 *2*	5.973 *14*	1.74 *3*	
(4017 *13*)	1810.89	1.25 *2*	0.962 *20*	6.288 *14*	2.21 *4*	

† From γ transition intensity balance at each level. Based on the existing data, the following levels have negative β⁺+ε feeding (not given here): 784.48, 1273.36, 1416.34, 2563.83.

‡ Absolute intensity per 100 decays.

γ(^{148}Gd)

All data and the level scheme are from 1991CoZY, unless indicated otherwise.
Iγ normalization: I(784γ+ce) to g.s.=100.

Eγ†	E(level)	Iγ§@	Mult.#	δ	α	Comments
123.0 *3*	3152.49	0.7				
129.5‡ *2*	2693.28	31	E1		0.1454	Iγ: 25 *4* (1973Bo13), 27 *3* (1974Ne01).
130.8 *3*	2694.63	10.7	E2		0.956 *16*	
142.7‡ *3*	1416.34	32	E1		0.1119 *17*	Iγ: 24 *3* (1973Bo13), 21 *3* (1974Ne01).
169.2 *3*	2082.13	1.3				
271.0 *3*	2082.13	4.0	E1+M2	≤0.23	0.034 *14*	
334.8 *3*	3029.49	3.4	M1		0.0715	
394.55‡ *8*	1810.89	965	E2		0.0267	Iγ: 860 *50* (1973Bo13), 900 *50* (1974Ne01).
443.4 *3*	4311.95	0.4				
457.9 *3*	3152.49	0.6				
465.6 *3*	3029.49	5.4	M1		0.0303	
481.65‡ *10*	2563.83	38	E2		0.01541	Iγ: 30 *4* (1973Bo13), 26 *3* (1974Ne01).
488.83‡ *10*	1273.36	62	E1+M2	+0.18 *9*	0.008 *3*	Iγ: 52 *5* (1973Bo13), 52 *5* (1974Ne01).
540.3 *3*	4408.86	0.5				
588.6 *3*	3152.49	0.6	M1		0.01675	
631.87‡ *6*	1416.34	937	E2		0.00772	Iγ: 950 *50* (1973Bo13), 900 *50* (1974Ne01).
639.5 *5*	1912.9	1.3	M1		0.01362	
640.4 *3*	4408.86	1.3				
665.8 *3*	2082.13	4.0	E1+M2	≤0.34	0.0042 *17*	
753.0‡ *1*	2563.83	21	E1		0.00197	Iγ: 17 *2* (1973Bo13), 20 *2* (1974Ne01).
784.48‡ *6*	784.48	1000	E2		0.00466	
808.1‡ *6*	2082.13	29	E2		0.00436	Iγ: 29 *3* (1973Bo13), 27 *3* (1974Ne01).
882.41‡ *8*	2693.28	900	E2		0.00359	Iγ: 920 *40* (1973Bo13), 944 *50* (1974Ne01).
883.6 *3*	2694.63	11.1	E3		0.00802	
938.3 *3*	3502.1	1.2				
952.7 *3*	3645.84	1.0				
954.3 *3*	4311.95	2.0				1991CoZY show this γ depopulating the 4409 level. However, such a placement does not lead to a final level observed by them. The evaluator has assumed that the Eγ is correct and the final level is 3358 keV as shown by 1991CoZY, leading to an initial level of 4312.5 keV.
971.7& *3*	2782.54	1.9&				
	3666.3	0.6&	M1		0.00490	
1057.7 *3*	2868.67	1.4	M1,E2		0.0032 *8*	
1063.7 *3*	3758.3	0.6	E1+M2	≤0.18	0.00115 *14*	
1089.7 *3*	4119.18	1.5				
1113.7 *3*	3808.27	0.7				
1115.0 *3*	3808.27	0.9				

Continued on next page (footnotes at end of table)

^{148}Tb ε Decay (2.20 min) 1991CoZY (continued)

γ(^{148}Gd) (continued)

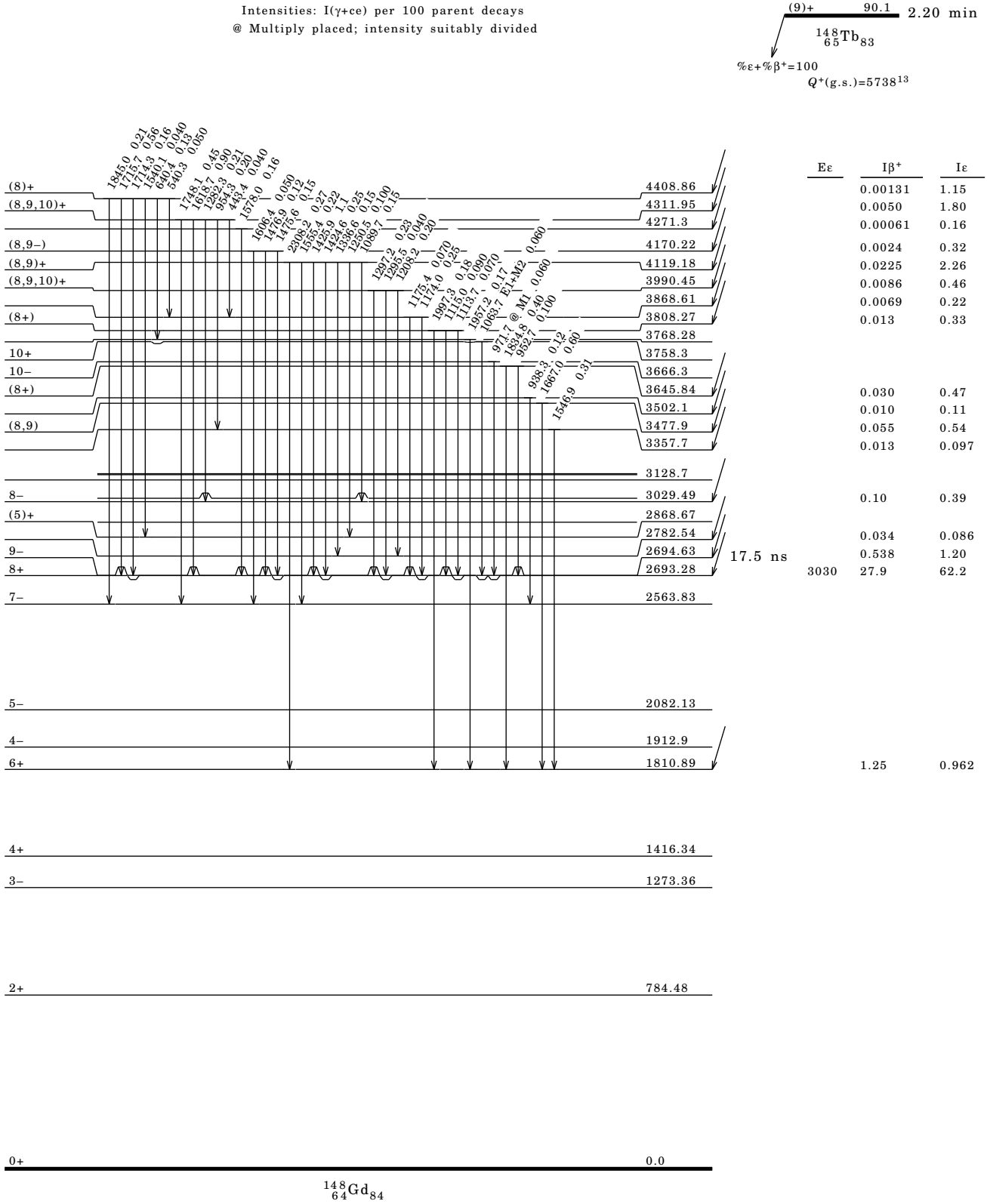
Eγ†	E(level)	Iγ§@	Mult.#	δ	α	Comments
1125.2 *3*	2936.1	3.7	E1+M2	≤0.14	0.00099 *8*	
1174.0 *3*	3868.61	2.5				
1175.4 *3*	3868.61	0.7				
1208.2 *3*	3990.45	2.0				
1234.7 *3*	3045.6	0.6				
1250.5 *3*	4119.18	1.0				1991CoZY show this γ depopulating the 3991 level. However, such a placement does not lead to a final level observed by them. The evaluator has assumed that Eγ is correct, and the final level is 2869 keV as shown by 1991CoZY leading to an initial level of 4119.5 keV.
1282.3 *3*	4311.95	2.1				
1295.5 *3*	3990.45	0.4				
1297.2 *3*	3990.45	2.3				
1317.8 *3*	3128.7	0.8				
1336.6 *3*	4119.18	1.5				
1346.0 *3*	3156.9	1.3				
1366.4 *3*	2782.54	2.8				
1424.6 *3*	4119.18	2.5				
1425.9 *3*	4119.18	11.5				
1475.6 *3*	4170.22	1.5				
1476.9 *3*	4170.22	1.2				
1540.1 *3*	4408.86	0.4				
1546.9 *3*	3357.7	3.1				
1555.4 *3*	4119.18	2.2				
1578.0 *3*	4271.3	1.6				
1606.4 *3*	4170.22	0.5				
1618.7 *3*	4311.95	9.0				
1667.0 *3*	3477.9	6.0				
1714.3 *3*	4408.86	1.6				
1715.7 *3*	4408.86	5.6				
1748.1 *3*	4311.95	4.5				
1834.8 *3*	3645.84	4.0				
1845.0 *3*	4408.86	2.1				
1957.2 *3*	3768.28	1.7				
1997.3 *3*	3808.27	1.8				
2308.2 *3*	4119.18	2.7				

† From 1991CoZY, unless indicated otherwise. The evaluator has assumed a ΔEγ=0.3 keV, since the authors did not give these data.
‡ From 1973Bo13.
§ Relative intensity.
# From adopted gammas; supported by internal conversion data this decay.
@ For absolute intensity per 100 decays, multiply by 0.099536.
& Multiply placed; intensity suitably divided.

^{148}Tb ε Decay (2.20 min) 1991CoZY (continued)

Decay Scheme

Intensities: I(γ+ce) per 100 parent decays
@ Multiply placed; intensity suitably divided

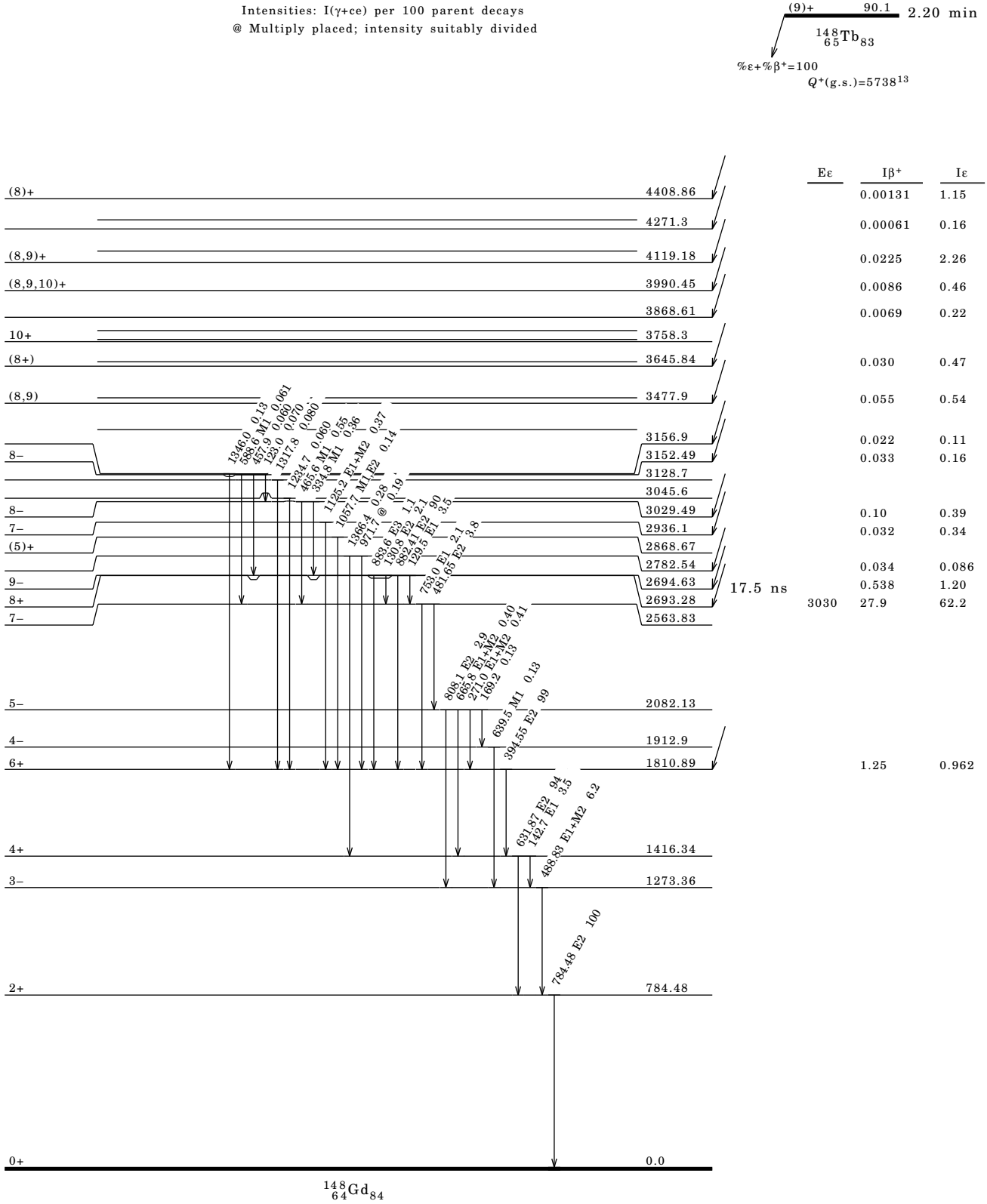


Eε	Iβ+	Iε	Log *ft*
	0.00131	1.15	5.3
	0.0050	1.80	5.2
	0.00061	0.16	6.2
	0.0024	0.32	6.0
	0.0225	2.26	5.2
	0.0086	0.46	5.9
	0.0069	0.22	6.3
	0.013	0.33	6.1
	0.030	0.47	6.1
	0.010	0.11	6.8
	0.055	0.54	6.1
	0.013	0.097	6.9
	0.10	0.39	6.4
	0.034	0.086	7.1
	0.538	1.20	5.973
3030	27.9	62.2	4.259
	1.25	0.962	6.288

^{148}Tb ε Decay (2.20 min) 1991CoZY (continued)

Decay Scheme (continued)

Intensities: I(γ+ce) per 100 parent decays
@ Multiply placed; intensity suitably divided



^{152}Dy α Decay

Parent ^{152}Dy: E=0.0; Jπ=0+; $T_{1/2}$=2.38 h *2*; Q(g.s.)=3726 *4*; %α decay=0.100 *7*.
$T_{1/2}$(^{152}Dy)=2.38 h *2* is adopted in 1996Ar09 as the weighted average of $T_{1/2}$=2.41 h *5* and 2.37 h *2*, measured by 1962Si14 and 1965Ma51, respectively. The adopted half–life of 2.38 h *2* is used in calculations here.

%α=0.100 *7* is adopted by 1996Ar09, obtained from the α branching determined by 1974To07 as 0.108% *11* and 0.094% *9* from I(256.9γ in ε decay)/Iα and I(K x ray)/Iα, respectively.

Q(α)(^{152}Dy)=3726 *4* is recommended by 2012Wa38.

^{148}Gd Levels

E(level)	Jπ
0.0	0+

α radiations

Eα	E(level)	Iα†§	HF‡	Comments
3628 *4*	0.0	100	1.000	Eα: recommended by 1991Ry01. Iα: only one α group was observed. An upper limit of 1.6×10^{-5} per 100 α decays is calculated for intensity of an unobserved 2864–keV α to the 2+ state at 784.43 keV in ^{148}Gd by requiring HF(2864α)>1.

† α intensity per 100 α decays.
‡ r_0(^{148}Gd)=1.581 *5* is calculated from HF(3628α)=1.0.
§ For α intensity per 100 decays, multiply by 0.00100 *7*.

^{148}Gd(p,p') 1990De22

E=24.7 MeV, FWHM=12 keV; measured σ(E,θ), DWBA analysis.
For σ(exp)/σ(calc)≈B(EL)(W.u.) see 1990De22.

^{148}Gd Levels

E(level)	L†	dσ/dΩ(30°)(mb/sr)‡
0.0		
785 *1*	2	
1273 *1*	3	4.42
1416 *1*	4	0.61
1811 *2*	6	0.07
1863 *3*	2	0.28
2082 *2*	5	0.09
2189 *3*	2	0.58
2234 *3*	3	0.55
2308 *5*	2	0.09
2507 *4*		0.05
2523 *4*	4	0.15
2616 *4*	2	0.10
2632 *1*	5	0.43
2692 *4*		0.06
2763 *3*	4	0.12
2868 *3*		0.03
2917 *3*	3	0.05
2936 *4*	(7)	0.04

† From DWBA analysis.
‡ Absolute cross section uncertainty ≈20%.

(HI,xnγ) 1990Dr06,1990Pi17

Incident particles:
^{3}He: E not given (1984Lu09), E=27 MeV (1990Pi17).
α: E=54 MeV (1990Pi17), E=51 MeV (1984Lu09), 48 MeV (1973Kr10), 30 MeV (1979Ha15).
^{11}B: E=49 MeV (2000Po13,2003Po02,2002Bi03).
^{19}F: E=73.5 MeV (1993Pi01).
^{28}Si: E=125 MeV (1990Pi17,2000Po13), E=108–144 MeV (1982Ha22,1979Ha15).
^{36}S: E=170 MeV (1987Pi07,1990Dr06),.
Reactions:
^{116}Cd(^{36}S,4nγ): 1990Dr06, 1987Pi07.
^{124}Sn(^{28}Si,4nγ): 1990Pi17, 1982Ha22, 2000Po13.
^{133}Cs(^{19}F,4nγ): 1993Pi01.
^{141}Pr(^{11}B,4nγ): 2000Po13, 2003Po02, 2002Bi03.
^{148}Sm(α,4nγ): 1990Pi17, 1984Lu09, 1973Kr10.
^{148}Sm(^{3}He,3nγ): 1990Pi17, 1984Lu09.
Measured:
Eγ,Iγ,γ(θ), γγ coin, (1973Kr10,1984Lu09,1987Pi07,1990Dr06,1990PI17), Ice (1984Lu09,1990Pi17), γ excitation functions (1984Lu09,1990Pi17), DCO ratios (1987Pi07,1990Dr06), $T_{1/2}$(1973Kr10,1987Pi07,1990Pi17,1990Dr06,1993Pi01,2003Po02).
The energy level scheme follows 1990Pi17, 1990Dr06 which supersede 1987Pi07.

^{148}Gd Levels

E(level)†	Jπ‡	$T_{1/2}$§	Comments
0.0#	0+		
784.50# *10*	2+	4.2 ps *12*	
1273.64@ *13*	3−	34.7 ps *21*	
1416.46# *13*	4+	8.1 ps *24*	
1811.35# *15*	6+	178 ps *20*	
1913.12@ *17*	4−		
2082.32@ *15*	5−	2.6 ps *13*	
2564.20@ *17*	7−	21.3 ps *30*	
2567.05@ *22*	6−		
2631.6& *3*	5−		
2693.6# *3*	8+	13.2 ps *28*	Configuration=ν($f_{7/2}h_{9/2}$) (2003Po02).
2695.05@ *18*	9−	16.6 ns *3*	$T_{1/2}$: weighted average of 17.5 ns *10* (1990Pi17), 17.5 ns *10* (1984Lu09), 16.5 ns *3* (1979Ha15), 17.3 ns *20* (1973Kr10), 16.3 ns *9* (1972HaXQ), and 16.7 ns *9* (1971HaXD). μ=−0.162 *18* (1989Ra17,1987Da27). Q=1.01 *5* (1989Ra17,1982Ha22).
2782.9# *8*			
2869.0# *4*	(5)+		
2935.1# *6*	(7)+		
2937.0& *3*	7−	3.8 ps *26*	
3029.96@ *20*	8−	52 ps *13*	
3152.84& *20*	8−		
3180.1& *6*	7−		
3310.7& *4*	8−		
3367.62& *21*	9−	19.1 ps *21*	
3667.0# *4*	10−		
3701.85@ *23*	11−	1 ps *+4−1*	$T_{1/2}$: 2003Po02 quote mean lifetime=1.8 ps *57*. Configuration=ν($f_{7/2}h_{9/2}$)⊗3−⊗3− (2003Po02).
3758.61a *23*	10+	7.6 ps *10*	
3822.8@ *4*	10+		
3918.58& *23*	10−	8.9 ps *15*	
3980.80@ *24*	12+	60 ps *5*	$T_{1/2}$: weighted average of: 58 ps *7* (1993Pi01, plunger method); 61 ps *6* (2003Po02, also given by 2000Po13, plunger method).
4121.80& *25*	11−	4.6 ps *34*	
4430.1& *3*	12−	12 ps *9*	
4500.71a *23*	12+	3.9 ps *21*	
4551.4& *3*	13−	38 ps *6*	
4740.9& *4*	13(−)		
4906.3& *3*	14−	3 ps *+9−3*	$T_{1/2}$: 2003Po02 quote mean lifetime=4 ps *13*.
5026.20a *24*	14+	25 ps *14*	
5117.8& *3*	15−	16 ps *8*	
5168.2@ *4*	14+		
5355.9a *3*	16+	184 ps *26*	
5438.9& *4*	16		
5579.0			

Continued on next page (footnotes at end of table)

(HI,xnγ) 1990Dr06,1990Pi17 (continued)

^{148}Gd Levels (continued)

E(level)[†]	Jπ[‡]	$T_{1/2}$[§]	Comments
5800.8			
5833.0[a] *3*	18+		
5883.3	17		
5934.0[&] *8*	17		
6211.2[b] *4*	17		
6268.9	18		
6381.9	18		
6546.0[b] *4*	18−		
6575.3	19+		
6641.1[b] *4*	19−		
6834.9[a] *4*	20−	1.5 ns *3*	$T_{1/2}$: weighted average of the values (in ns): 1.5 *3* 1990Pi17 (plunger method), 1.7 *6* (2001Gu31, recoil shadow anisotropy method). Other: 1.8 ns (1990Dr06).
7051.8	19+		
7110.8	20+		
7156.0[a] *5*	21−		
7274.6	20+		
7334.1			
7531.3	21+		
7791.3	22+		
8005.3	22−		
8243.2	22−		
8304.9	23−		
8309.6	23+		
8364.5	23−		
8455.9	23−		
8609.6	23		
8639.5	24−		
8832.5	24		
8987.5	25−		
9244.0	25−		
9259.0			
9653.1	26−		
9758.1	26		
9934.7			
9957.8	26−		
10046.9	25−		
10063.5	27		
10318.4	27−		
10474.7	27		
10694.5	27−		
10760.7	28		
10870.1	28		
11158.8	28		
11186.2	29		
11457.3	29		
11478.4	29−		
11546.4	29−		
11587.4	30		
11728.1	30		
12013.2			
12064.4	30		
12139.1	31−		
12285.5	30		
12382.3	31		
12530.0	32		
12683.4	33		
13039.5	33		
13126.4	33−		
13148.0	32		
13244.2			
13354.8?			
13555.4	33		
13736.3	34		

Continued on next page (footnotes at end of table)

(HI,xnγ) 1990Dr06,1990Pi17 (continued)

^{148}Gd Levels (continued)

E(level)†	Jπ‡	$T_{1/2}$§	Comments
13870.3	35	1.5 ns *3*	$T_{1/2}$: from 2001Gu31 (recoil shadow anisotropy method). Other: ≈2 ns (1990Dr06). g=+0.60 *16* (1989Ha15).
13888.7	33		
13911.9			
14011.7	34		
14146.2	35		
14207.0	36		
14924.8	36		
15166.1?	38		
15728.2	37		
16078.0			
16112.5	38		
16204.6?	40	<0.17 ps	$T_{1/2}$: estimated by 1990Dr06 by noting that the 1038γ is fast compared to the stopping time in the Pb target backing.
16257.8?	40		
16407.2	40		
16474.1	39		
17241.4?	40		E(level): listed as 17341.4 (1990Dr06); level energy diagram gives 17241.4.
17320.6?			
17371.2	42		
18482.1	44	<0.17 ps	$T_{1/2}$: estimated by 1990Dr06 by noting that the 1111γ is fast compared to the stopping time in the Pb target backing.
19149?	(46)		

† From a least–squares fit to Eγ from 1990Pi17, combined with level energies from 1990Dr06.
‡ From adopted levels, supported by γγ(θ), excitation function, and conversion electron spectral measurements from this data set. Jπ assignments for higher levels may be tentative.
§ Except for the values referred in comments, all the other values are from 2003Po02.
# (A): ν^2 states.
@ (B): ν^2 x octupole states.
& (C): ν^2 x $\pi^{+1}\pi^{-1}$ states.
a (D): ν^2 x π^2 states.
b (E): $\nu^2\pi^2$ x octupole states.

γ(^{148}Gd)

DCO=Iγ(35°)/Iγ(90°) (1990Dr06).

Eγ†	E(level)	Iγ&	Mult.‡	α	Comments
41.6	13911.9				Eγ: not listed by 1990Dr06; shown in the level energy diagram.
57[c]	3367.62				Iγ: I(γ+ce) branching=5.8% (2003Po02).
74.5[a]	12139.1				
121.3 *1*	4551.4	70			Iγ: 13 *2* (^{3}He,3n); 56 *6* (^{28}Si,4n); 96 *6* (α,4n). A_2=–0.19 *1*, A_4=–0.01 *2* (α,4n); A_2=–0.12 *3*, A_4=–0.02 *4* (^{3}He,3n).
122.9 *1*	3152.84	15			Eγ: 1990Dr06 list this γ depopulating a 3135.0 level; this must be a typographical error and should read 3153.0. Iγ: 15 *2* (^{3}He,3n); 23 *3* (^{28}Si,4n); 32 *2* (α,4n). A_2=0.40 *3*, A_4=0.00 *4* (α,4n); A_2=0.37 *3*, A_4=–0.03 *5* (^{3}He,3n).
129.5[c]	2693.6				
130.1[a]	11587.4	78			DCO=0.94 *7*; for the unresolved doublet of this γ and the 130.9–keV γ from 2695 level.
130.9 *1*	2695.05	206[d] *5*	E2	0.954	α(L)exp=0.26 *8*. Iγ: 78 *5* (^{3}He,3n); 192 *15* (^{28}Si,4n); 184 *10* (α,4n) % photon branching: 60.3% *10* (2000Po13); 61% *3* (1993Pi01). A_2=0.21 *1*, A_4=–0.05 *1* (α,4n); A_2=0.21 *1*, A_4=–0.04 *1* (^{3}He,3n). DCO=0.94 *7*; for the unresolved doublet of this γ and the 130.1–keV γ from 11587 level.
133.4[a]	5934.0	≈5			Eγ: not placed in 1990Pi17.
134.0[a]	13870.3	182	D#		DCO=0.66 *5*.
142.8 *1*	1416.46	15			Iγ: 15 *2* (^{3}He,3n); 16 *2* (^{28}Si,4n); 19 *2* (α,4n). A_2=–0.23 *5*, A_4=–0.00 *7* (α,4n); A_2=–0.19 *3*, A_4=–0.08 *4* (^{3}He,3n).
151.1[a]	8455.9	16			DCO=0.56 *13*.

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(HI,xnγ) 1990Dr06,1990Pi17 (continued)

γ(^{148}Gd) (continued)

Eγ[†]	E(level)	Iγ[&]	Mult.[‡]	α	Comments
155.0[a]	8987.5	70			DCO=0.59 *7*.
169.2 *1*	2082.32	13			Iγ: 13 *2* (^{3}He,3n); 18 *3* (^{28}Si,4n); 12 *2* (α,4n). A_2=−0.42 *8*, A_4=−0.04 *12* (α,4n); A_2=−0.34 *4*, A_4=−0.01 *6* (^{3}He,3n).
181.0[a]	13736.3	23	D[#]		DCO=0.70 *11*.
183.6[a]	8639.5	128	D[#]		DCO=0.74 *3*.
193.4[a]	6575.3	81	D[#]		DCO=0.71 *5*.
193.7 *2*	6834.9	145	D[#]		Iγ: 70 *6* (^{28}Si,4n); 29 *2* (α,4n). A_2=−0.27 *4*, A_4=0.01 *5* (α,4n). DCO=0.71 *3*.
197.2[a]	7531.3	58			DCO=0.93 *7*.
211.5 *2*	5117.8	73	D[#]		Iγ: 51 *4* (^{28}Si,4n); 46 *3* (α,4n). A_2=−0.10 *2*, A_4=0.05 *5* (α,4n). DCO=0.74 *6*.
212.7[a]	8455.9	24			DCO=0.89 *11*.
214.8 *1*	3367.62	29	M1	0.235	Mult.: α(K)exp=16×10^{-2} *6*; also ΔJ=1 from DCO (1990Dr06). Iγ: 16 *2* (^{3}He,3n); 24 *3* (^{28}Si,4n); 47 *3* (α,4n). A_2=−0.54 *3*, A_4=0.04 *4* (α,4n); A_2=−0.49 *4*, A_4=0.02 *6* (^{3}He,3n). DCO=0.52 *4*.
221.8[a]	5800.8	13			Eγ: not placed in 1990Pi17.
222.9[a]	8832.5	35			DCO=0.83 *5*; for the unresolved doublet of this γ and the 223.0–keV γ from the 7275 level.
223.0[a]	7274.6	23			DCO=0.83 *5*; for the unresolved doublet of this γ and the 222.9–keV γ from the 8832 level.
238.0 *2*	5355.9	94	D[#]		Iγ: 50 *4* (^{28}Si,4n); 26 *2* (α,4n). A_2=−0.26 *5*, A_4=0.02 *7* (α,4n). DCO=0.74 *3*.
241.5 *5*	2935.1		M1	0.171	α(K)exp=12×10^{-2} *4* measurement of unresolved 241.5 keV and 243.1–keV gammas. Iγ=5 *2* (^{3}He,3n). A_2=0.33 *12*, A_4=−0.12 *7* (^{3}He,3n).
243.1 *5*	3180.1		M1	0.168	α(K)exp=12×10^{-2} *4* measurement of unresolved 241.5 keV and 243.1–keV gammas. Iγ=5 *2* (^{3}He,3n). A_2=0.06 *9*, A_4=0.09 *13* (^{3}He,3n).
244.5[a]	12530.0	38			DCO=1.41 *9*.
256.7[a]	7531.3	206	D[#]		Eγ: not placed in 1990Pi17. DCO=0.84 *2*.
259.4[a]	6834.9	30	D[#]		DCO=0.58 *6*.
260.0[a]	7791.3	268	D[#]		Not placed in 1990Pi17. DCO=0.81 *2*.
271.1 *2*	2082.32	27	E1+M2	0.034 *14*	δ[@e]: ≤0.23. α(K)exp<0.04. Iγ: 16 *2* (^{3}He,3n); 26 *5* (α,4n). A_2=−0.16 *4*, A_4=−0.06 *5* (α,4n); A_2=−0.14 *5*, A_4=−0.02 *7* (^{3}He,3n).
271.1[a]	11457.3	50			DCO=1.6 *15*.
271.5[a]	10318.4	242	E2	0.0822	DCO=1.37 *6*.
278.9 *2*	3980.80	410	E1+M2	0.028 *9*	δ[@e]: ≤0.19. Mult.: α(K)exp<3×10^{-2}; also ΔJ=1 transition from DCO (1990Dr06). Iγ: 38 *5* (^{3}He,E(n)); 250 *25* (^{28}Si,4n); 233 *16* (α,4n). A_2=−0.27 *1*, A_4=−0.02 *1* (α,4n); A_2=−0.22 *2*, A_4=0.00 *2* (^{3}He,3n). DCO=0.70 *2*.
280.6 *5*	3310.7				Iγ=4 *2* (^{3}He,3n). A_2=0.43 *14*, A_4=−0.05 *19* (^{3}He,3n).
285.5 *5*	5026.20	27			Eγ: γ obscured by background gammas. Iγ: ≈15 (^{28}Si,4n); ≈8 (α,4n). DCO=0.67 *4*.
288.9 *2*	6834.9	94	E2[§]	0.0677	Iγ: from (^{28}Si,4n); 15 *3* (α,4n) obscured by a background γ; 53 *4* (α,4n). DCO=1.41 *5*.
294.7[a]	16407.2	88			DCO=1.32 *6*.
295.1[a]	14207.0	35			DCO=0.86 *7*.
298.5[a]	11457.3	224	D[#]		DCO=0.73 *2*.
305.3[a]	10063.5	180	D[#]		DCO=0.75 *10*.

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(HI,xnγ) 1990Dr06,1990Pi17 (continued)

γ(^{148}Gd) (continued)

Eγ†	E(level)	Iγ&	Mult.‡	α	Comments
306.3[a]	6575.3	35			DCO=0.55 *11*.
308.4 *2*	4430.1	113	M1	0.0888	Mult.: α(K)exp=9.8×10^{-2} *20*; also ΔJ=1 transition from DCO (1990Dr06). Iγ: 21 *2* (^{3}He,3n); 112 *7* (^{28}Si,4n); 127 *7* (α,4n). A_2=−0.10 *1*, A_4=0.01 *2* (α,4n); A_2=−0.10 *3*, A_4=−0.03 *4* (^{3}He,3n). DCO=0.86 *3*.
311.0 *4*	4740.9	24	D#		Iγ: 44 *4* (^{28}Si,4n); 27 *4* (α,4n). A_2=−0.19 *4*, A_4=0.06 *5* (α,4n). DCO=0.68 *6*.
321.1 *3*	5438.9	80			Iγ: 180 *13* (^{28}Si,4n) intensity of unresolved doublet from 7156 and 5439 levels; ≈36 (α,4n). DCO=0.85 *5*.
	7156.0	323	D#		Iγ: 180 *13* (^{28}Si,4n) intensity of unresolved doublet from 5439 and 7156 levels; ≈26 (α,4n). DCO=0.64 *2*.
329.8 *2*	5355.9	713			Iγ: 620 *40* (^{28}Si,4n); 239 *12* (α,4n). A_2=0.26 *1*, A_4=−0.09 *1* (α,4n). DCO=1.33 *3*; for the unresolved doublet of this γ and the 330−keV γ from the 8640 level.
330[a]	8639.5	40			DCO=1.33 *3*; for the unresolved doublet of this γ and the 329.8−keV γ from the 5356 level.
334.7 *3*	6546.0	91	D#		Iγ: unresolved doublet in (α,4n); intensity obtained from the branching ratio of the 334.9 and 465.8−keV gammas. 76 *8* (^{28}Si,4n); 34 *10* (α,4n). DCO=0.74 *4*.
334.9 *2*	3029.96	55	M1	0.0714	α(K)exp=5.7×10^{-2} *11*. Iγ: 35 *3* (^{3}He,3n), 40 *8* (^{28}Si,4n). A_2=−0.12 *2*, A_4=0.01 *3* (^{3}He,3n). DCO=0.85 *8*.
336.7[a]	14207.0	248	D#		DCO=0.66 *3*.
337.7 *3*	3367.62	35	M1	0.0699	α(K)exp=4.9×10^{-2} *15*. Iγ: 11 *2* (^{3}He,3n); 41 *10* (^{28}Si,4n); 55 *4* (α,4n). A_2=−0.76 *3*, A_4=0.04 *4* (α,4n); A_2=−0.82 *6*, A_4=0.04 *9* (^{3}He,3n). DCO=0.41 *6*.
348.0[a]	8987.5	85			DCO=0.51 *2*.
349.8[a]	16078.0	12			DCO=1.6 *4*.
355.0 *2*	4906.3	63			Iγ: 95 *8* (^{28}Si,4n); 88 *7* (α,4n). A_2=−0.10 *2*, A_4=−0.01 *3* (^{28}Si,4n). DCO=0.83 *4*; for the unresolved doublet of this γ and the 355.8−keV γ from the 13040 level.
355.8[a]	13039.5	20			DCO=0.83 *4*; for the unresolved doublet of this γ and the 355.0−keV γ from the 4907 level.
360.6[a]	10318.4	32	D#		DCO=0.74 *5*.
373.8 *3*	3310.7	22	M1	0.0535	Mult.: α(K)exp=5.6×10^{-2} *17*; also ΔJ=1 transition from DCO (1990Dr06). Iγ: 15 *2* (^{3}He,3n); 22 *4* (^{28}Si,4n); 23 *2* (α,4n). A_2=−0.06 *5*, A_4=0.01 *8* (α,4n); A_2=−0.11 *5*, A_4=−0.08 *7* (^{3}He,3n). DCO=0.74 *11*.
376.7[a]	8832.5	13	D#		DCO=0.66 *11*.
378.4[a]	6211.2	19	D#		DCO=0.79 *9*.
390.9[a]	12530.0	381	D#		DCO=0.69 *2*.
394.9 *1*	1811.35	698	E2	0.0267	Mult.: α(K)exp=2.4×10^{-2} *4*; also ΔJ=2 from DCO (1990Dr06) assumed to be E2. Iγ: 560 *30* (^{3}He,3n); 680 *40* (^{28}Si,4n); 700 *40* (α,4n). A_2=0.21 *1*, A_4=−0.06 *1* (α,4n); A_2=0.21 *1*, A_4=−0.04 *1* (^{3}He,3n). DCO=1.41 *3*.
410.8[a]	5579.0	15			Eγ: not placed in 1990Pi17. DCO=0.78 *12*.
411.0[a]	12139.1	70	D#		DCO=0.74 *5*.
420.4[a]	7531.3	15			DCO=1.14 *11*.
420.6 *5*	4121.80	10			Iγ: 21 *4* (^{28}Si,4n); 13 *2* (α,4n). A_2=0.21 *2*, A_4=−0.02 *17* (α,4n).

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(HI,xnγ) 1990Dr06,1990Pi17 (continued)

γ(^{148}Gd) (continued)

Eγ[†]	E(level)	Iγ[&]	Mult.[‡]	α	Comments
429.5 *3*	4551.4	51			Iγ: 68 *6* (^{28}Si,4n); 51 *8* (α,4n). A_2=0.26 *3*, A_4=−0.08 *4* (α,4n). DCO=1.51 *21*; for the unresolved doublet of this γ and the 430.5−keV γ from the 3368 level.
430.5 *4*	3367.62	21			Iγ: ≈7 (^{3}He,3n); 17 *4* (^{28}Si,4n); 22≈(α,4n). A_2=0.22 *3*, A_4=−0.02 *4* (α,4n); A_2=0.21 *6*, A_4=−0.06 *9* (^{3}He,3n). DCO=1.51 *21*; for the unresolved doublet of this γ and the 429.5−keV γ from the 4552 level.
435.6[a]	6268.9	46			DCO=1.35 *8*.
444.3[a]	5883.3	45			DCO=0.87 *6*.
447.7[a]	6381.9	76			DCO=0.82 *4*.
450.6[a]	8455.9	55			DCO=1.16 *6*.
457.9 *3*	3152.84	20			Iγ: 8 *2* (^{3}He,3n); 14 *3* (^{28}Si,4n); 30 *3* (α,4n). A_2=−0.16 *5*, A_4=0.09 *7* (α,4n); A_2=−0.02 *7*, A_4=−0.03 *10* (^{3}He,3n). DCO=0.90 *10*.
464.2[a]	13148.0	12			DCO=0.99 *16*; for the unresolved doublet of this γ and the 464.5−keV γ from the 11159 level.
464.5[a]	11158.8	22			DCO=0.99 *16*; for the unresolved doublet of this γ and the 464.2−keV γ from the 13148 level.
465.8 *2*	3029.96	55	M1	0.0303	Mult.: α(K)exp=2.8×10^{-2} *6*; also ΔJ=1 transition from DCO (1990Dr06). Iγ: 47 *4* (^{3}He,3n); 54 *8* (^{28}Si,4n); 71 *11* (α,4n). A_2=−0.18 *2*, A_4=0.01 *2* (α,4n); A_2=−0.28 *3*, A_4=0.04 *4* (^{3}He,3n). DCO=0.71 *7*.
468.2[a]	8832.5	9			DCO=0.92 *19*.
475.3 *5*	5026.20	77	D[#]		Iγ: ≈30 (^{28}Si,4n); ≈20 (α,4n). A_2=−0.15 *2*, A_4=0.05 *3* (α,4n). DCO=0.68 *3*.
477.1 *1*	5833.0	732	E2[§]	0.01580	Iγ: 548 *33* (^{28}Si,4n); 181 *13* (α,4n). A_2=0.28 *1*, A_4=−0.11 *2* (α,4n). DCO=1.39 *3*.
479.4[a]	7531.3	19			DCO=1.7 *3*.
481.9 *1*	2564.20	354	E2	0.01538	Mult.: α(K)exp=1.4×10^{-2} *2*; also ΔJ=2 from DCO (1990Dr06) assumed to be E2. Iγ: 164 *10* (^{3}He,3n); 360 *30* (^{28}Si,4n); 322 *19* (α,4n). A_2=0.20 *1*, A_4=−0.06 *1* (α,4n); A_2=0.24 *1*, A_4=−0.05 *1* (^{3}He,3n). DCO=1.38 *4*.
484.8 *2*	2567.05		M1	0.0274	α(K)exp=2.1×10^{-2} *9*. Iγ=4 *2* (α,4n), 16 *2* (^{3}He,3n). A_2=−1.2 *4*, A_4=0.4 *5* (α,4n); A_2=−0.33 *5*, A_4=0.04 *7* (^{3}He,3n).
489.1 *1*	1273.64	340	E1+M2	0.00511 *18*	δ[@e]: ≤0.063. Mult.: α(K)exp=0.39×10^{-2} *6*; also ΔJ=1 transition from DCO (1990Dr06). Iγ: 312 *18* (^{3}He,3n); 272 *16* (^{28}Si,4n); 301 *18* (α,4n). A_2=−0.21 *1*, A_4=0.02 *1* (α,4n); A_2=−0.14 *1*, A_4=0.00 *1* (^{3}He,3n). DCO=0.73 *2*.
492.1[a]	13736.3	15			DCO=1.16 *19*.
495.1 *6*	5934.0	33	D[#]		Iγ: ≈19 (α,4n). A_2=−0.27 *4*, A_4=0.05 *6* (α,4n). DCO=0.68 *6*.
498.7[a]	6381.9	33			DCO=1.13 *12*.
509.7[a]	13039.5	354	D[#]		DCO=0.77 *2*.
511.6[a]	4430.1	≈100			Iγ: ≈70 (α,4n). DCO=1.22 *15*.
513.9[a]	9758.1	66	D[#]		DCO=0.75 *4*.
515.7[a]	7156.0	27	E2	0.01287	DCO=1.3 *3*.
518.2[a]	8309.6	136	D[#]		DCO=0.87 *6*.
519.9 *1*	4500.71	334	E2[§]	0.01260	Iγ: 10 *2* (^{3}He,3n); 258 *18* (^{28}Si,4n); 118 *10* (α,4n). A_2=0.38 *2*, A_4=−0.01 *3* (α,4n); A_2=0.16 *9*, A_4=0.03 *13* (^{3}He,3n). DCO=1.45 *6*.
522.8[a]	8832.5	78	D[#]		DCO=0.76 *4*.

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(HI,xnγ) 1990Dr06,1990Pi17 (continued)

γ(^{148}Gd) (continued)

Eγ[†]	E(level)	Iγ[&]	Mult.[‡]	α	Comments
525.5 *1*	5026.20	587	E2[§]	0.01225	Iγ: 6 *3* (^{3}He,3n); 500 *40* (^{28}Si,4n); 220 *15* (α,4n). A_2=0.31 *1*, A_4=−0.12 *1* (α,4n); A_2=0.46 *13*, A_4=−0.26 *19* (^{3}He,3n). DCO=1.40 *3*.
532.1[a]	5438.9	13			DCO=1.4 *4*.
541.9[a]	11728.1	21			DCO=1.09 *15*.
548.8[a]	6381.9	27			DCO=1.15 *11*.
551.0 *2*	3918.58	12			Iγ: ≈10 (^{3}He,3n); 25 *3* (^{28}Si,4n); ≈20 (α,4n). DCO=0.82 *6*; for the unresolved doublet of this γ and the 551.8–keV γ from the 12139 level.
551.8[a]	12139.1	25			DCO=0.82 *6*; for the unresolved doublet of this γ and the 551.2–keV γ from the 3919 level.
555.9[a]	12013.2	28			DCO=1.54 *14*.
560.5[a]	10318.4	25			DCO=0.77 *6*; for the unresolved doublet of this γ and the 561.0–keV γ from the 13244 level.
561.0[a]	13244.2	16			DCO=0.77 *6*; for the unresolved doublet of this γ and the 560.5–keV γ from the 10318 level.
566.4 *2*	5117.8	94	E2[§]	0.01012	Iγ: 106 *10* (^{28}Si,4n); 75 *10* (α,4n). A_2=0.28 *2*, A_4=−0.05 *3* (α,4n). DCO=1.33 *6*.
571.0[a]	4551.4	21			Iγ: ≈15 (α,4n). DCO=1.01 *12*.
573.5[a]	8364.5	12			DCO=0.82 *14*.
578.3[a]	5934.0	13			DCO=0.57 *17*.
588.3[a]	13736.3	55			DCO=1.46 *11*.
588.6 *3*	3152.84	19	M1	0.01675	Mult.: α(K)exp=1.2×10^{-2} *3*; also ΔJ=1 transition from DCO (1990Dr06). Iγ: 12 *3* (^{3}He,3n); 19 *3* (^{28}Si,4n); 25 *2* (α,4n). A_2=−0.31 *8*, A_4=0.02 *12* (α,4n); A_2=−0.19 *7*, A_4=−0.05 *10* (^{3}He,3n). DCO=0.87 *19*.
592.7[a]	12139.1	178	E2	0.00903	DCO=1.46 *8*.
604.5[a]	9244.0	95			DCO=0.96 *9*.
612.1[a]	6546.0	8			
619.6[a]	9259.0	19			Eγ: 1990Dr06 list this γ as depopulating a 9249 level; however, their energy level diagram shows this γ depopulating the 9259 level. The placement here follows the energy level diagram.
623.0[a]	8987.5	107	E2	0.00799	DCO=1.42 *7*.
632.0 *1*	1416.46	678	E2	0.00772	Mult.: α(K)exp=0.59×10^{-2} *9*; also ΔJ=2 from DCO (1990Dr06); assumed to be E2. Iγ: 630 *40* (^{3}He,3n); 700 *40* (^{28}Si,4n); 710 *40* (α,4n). A_2=0.21 *1*, A_4=−0.06 *1* (α,4n); A_2=0.22 *1*, A_4=−0.04 *1* (^{3}He,3n). DCO=1.41 *4*.
634.3[a]	8639.5	97			DCO=1.26 *7*.
639.4 *2*	1913.12	11	M1	0.01362	Mult.: α(K)exp=0.80×10^{-2} *15*; also ΔJ=1 transition from DCO (1990Dr06). Iγ: 54 *5* (^{3}He,3n); 17 *4* (α,4n). A_2=−0.67 *9*, A_4=0.05 *12* (α,4n); A_2=−0.42 *3*, A_4=0.01 *4* (^{3}He,3n). DCO=0.71 *20*.
653.6 *5*	2567.05		E2	0.00712	α(K)exp=0.7×10^{-2} *3*. Iγ=6 *2* (^{3}He,3n). A_2=0.10 *15*, A_4=−0.01 *22* (^{3}He,3n).
657.2[a]	13039.5	94			DCO=1.43 *6*.
660.7[a]	12139.1	85	E2	0.00694	DCO=1.45 *7*.
664.6[a]	8455.9	75	D[#]		DCO=0.69 *8*.
665[a]	10318.4	30			DCO=0.96 *7*; for the unresolved triplet of this γ and the 665.7–keV γ from the 9653 level and the 666.0–keV γ from the 2082 level.
665.7[a]	9653.1	152			DCO=0.96 *7*; for the unresolved triplet of this γ and the 665–keV γ from the 10318 level and the 666.0–keV γ from the 2082 level.

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(HI,xnγ) 1990Dr06,1990Pi17 (continued)

γ(^{148}Gd) (continued)

Eγ[†]	E(level)	Iγ[&]	Mult.[‡]	α	Comments
666.0 *4*	2082.32	22	E1+M2	0.0042 *17*	δ[@e]: ≤0.34. α(K)exp<0.5×10^{-2}. Iγ: 24 *4* (^{3}He,3n); 22 *4* (α,4n). A_2=−0.30 *8*, A_4=−0.13 *11* (α,4n); A_2=−0.05 *4*, A_4=0.03 *6* (^{3}He,3n). DCO=0.96 *7*; for the unresolved triplet of this γ and the 665−keV γ from the 10318 level and the 665.7−keV γ from the 9653 level.
[x]666.3 *3*		185 *15*			
667[abf]	19149?				
670.0[a]	7051.8	29	D[#]		DCO=0.74 *14*.
673.9 *3*	3367.62	61	E1+M2	0.0047 *23*	δ[@e]: ≤0.41. Mult.: α(K)exp<0.6×10^{-2}; also ΔJ=1 transition from DCO (1990Dr06). Iγ: 14 *4* (^{3}He,3n); 46 *5* (^{28}Si,4n); 45 *6* (α,4n). A_2=−0.21 *4*, A_4=0.03 *6* (α,4n); A_2=−0.09 *7*, A_4=−0.09 *11* (^{3}He,3n). DCO=0.88 *5*.
677.9 *3*	4500.71	57	E2[§]	0.00653	Iγ: 43 *5* (^{28}Si,4n); 26 *4* (α,4n). A_2=0.22 *7*, A_4=−0.03 *10*. DCO=1.41 *15*.
680.5[a]	7791.3	25	E2	0.00647	DCO=1.34 *15*.
684.1[a]	11158.8	35			DCO=1.10 *8*.
696.7[a]	13736.3	282	D[#]		DCO=0.75 *2*; for the unresolved doublet of this γ and the 697−keV γ from the 10761 level made of mostly this γ.
697[a]	10760.7	≈20			DCO=0.75 *2*; for the unresolved doublet of this γ and the 696.7−keV γ from the 13736 level.
699.3[a]	7274.6	163			Eγ: not placed in 1990Pi17. DCO=1.09 *4*.
713.7[a]	9957.8	28			DCO=1.01 *12*.
716.6[a]	10474.7	35			DCO=1.02 *8*.
727.9 *5*	4430.1	23			Iγ: 23 *3* (^{28}Si,4n); 23 *4* (α,4n). A_2=−0.17 *8*, A_4=−0.03 *11* (α,4n). DCO=1.23 *19*.
742.1 *1*	4500.71	253	E2[§]	0.00529	Iγ: 7 *2* (^{3}He,3n); 276 *19* (^{28}Si,4n); 105 *9* (α,4n). A_2=0.28 *2*, A_4=−0.08 *3* (α,4n); A_2=0.06 *13*, A_4=0.04 *19* (^{3}He,3n). DCO=1.34 *6*.
742.1[a]	6575.3	131			DCO=1.03 *9*.
752.9 *2*	2564.20	242	E1[#]	0.00197	α(K)exp=0.26×10^{-2} *10* measurement for unresolved 752.9 and 754.2 gammas. Iγ: 107 *11* (^{3}He,3n); 201 *20* (^{28}Si,4n); 182 *18* (α,4n). A_2=−0.16 *1*, A_4=0.03 *2* (α,4n); A_2=−0.20 *1*, A_4=0.04 *2* (^{3}He,3n). DCO=0.77 *5*.
754.2 *2*	4121.80	185	E2[§]	0.00509	α(K)exp=0.26×10^{-2} *10* measurement for unresolved 752.9 and 754.2 gammas. Iγ: 31 *5* (^{3}He,3n); 200 *20* (^{28}Si,4n); 187 *18* (α,4n). A_2=0.22 *1*, A_4=−0.12 *2* (α,4n); A_2=0.48 *6*, A_4=−0.25 *8* (^{3}He,3n). DCO=1.32 *11*.
755.6 *4*	2567.05				Iγ=19 *4* (^{3}He,3n). A_2=0.04 *8*, A_4=0.12 *10* (^{3}He,3n).
758.7[a]	7334.1	53			DCO=1.44 *13*.
765.7 *2*	3918.58	45	E2	0.00492	α(K)exp=0.43×10^{-2} *17*. Iγ: 29 *4* (^{3}He,3n); 70 *7* (^{28}Si,4n); 55 *5* (α,4n). A_2=0.24 *3*, A_4=−0.11 *5* (α,4n); A_2=0.15 *4*, A_4=−0.01 *6* (^{3}He,3n). DCO=1.20 *13*.
765.8[a]	13148.0	30			DCO=1.01 *16*.
770.7[a]	9758.1	122	D[#]		DCO=0.70 *3*.
778.6[a]	14924.8	108			DCO=1.72 *7*.
784.5 *1*	784.50	1000	E2	0.00466	Mult.: α(K)exp=0.35×10^{-2} *4*; also ΔJ=2 from DCO (1990Dr06) assumed to be E2. A_2=0.23 *1*, A_4=−0.07 *1* (α,4n); A_2=−0.21 *1*, A_4=−0.03 *1* (^{3}He,3n). DCO=1.44 *3*.
787.9[a]	10046.9	35			DCO=1.36 *11*.
798.9[a]	4500.71	29			DCO=0.63 *5*.

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(HI,xnγ) 1990Dr06,1990Pi17 (continued)

γ(^{148}Gd) (continued)

Eγ[†]	E(level)	Iγ[&]	Mult.[‡]	α	Comments
803.4[a]	3367.62	28			Iγ: ≈24 (α,4n). DCO=1.13 *10*; for the unresolved doublet of this γ and another γ of the same energy from the 15728 level.
	15728.2	16			DCO=1.13 *10*; for the unresolved doublet of this γ and another γ of the same energy from the 3368 level.
807[a]	10870.1	≈20			
808.1 *2*	6641.1	197	D[#]		Iγ: from (^{28}Si,4n); ≈50 (α,4n) since it could not be resolved from the stronger 808.7–keV γ; 150 *30* (α,4n). DCO=0.62 *7*.
808.7 *1*	2082.32	305	E2	0.00435	Mult.: α(K)exp=0.35×10^{-2} *5*; also ΔJ=2 from DCO (1990Dr06) assumed to be E2. Iγ: 191 *13* (^{3}He,3n); 270 *30* (^{28}Si,4n); 238 *24* (α,4n). A_2=0.22 *1*, –0.06 *1* (^{3}He,3n). DCO=1.45 *17*.
816.0[a]	5934.0	12			DCO=0.68 *15*.
818.2[a]	8609.6	43			DCO=0.73 *6*.
820.3 *4*	2631.6		E1+M2	0.0026 *10*	δ[@e]: ≤0.34. α(K)exp=0.2×10^{-2} *1*. Iγ=8 *3* (^{3}He,3n). A_2=0.15 *13*, A_4=0.03 *18* (^{3}He,3n).
824.8[ab]	13354.8?	≈20			
828.0[a]	12285.5	14	D[#]		DCO=0.71 *14*.
834.2[a]	17241.4?	8			DCO=1.2 *3*.
840.4[a]	11158.8	183	D[#]		DCO=0.70 *2*.
846.5[a]	17320.6?	15			DCO=0.75 *9*.
849.2[a]	8005.3	12			DCO=1.10 *9*; for the unresolved doublet of this γ and another γ of the same energy from the 13889 level.
	13888.7	28			DCO=1.10 *9*; for the unresolved doublet of this γ and another γ of the same energy from the 8005 level.
851.9[a]	11546.4	96			DCO=1.30 *7*.
855.3 *3*	6211.2	75			Iγ: 40 *5* (^{28}Si,4n); 23 *3* (α,4n). A_2=–0.48 *4*, A_4=0.09 *14* (α,4n). DCO=0.70 *4*.
858.0[a]	11728.1	20			DCO=1.13 *18*.
878.4[a]	12064.4	44			DCO=0.65 *5*.
882.2 *3*	2693.6	80	E2	0.00360	α(K)exp=0.50×10^{-2} *8* unresolved measurement for the 882 and 884–keV gammas from the 2694 and 2695 levels, respectively. Iγ: 77 *9* (^{3}He,3n); 85 *20* (^{28}Si,4n); 77 *15* (α,4n). A_2=0.31 *3*, A_4=–0.04 *4* (α,4n); A_2=0.23 *1*, A_4=–0.04 *2* (^{3}He,3n). DCO=1.53 *21*.
883.6 *2*	2695.05	312[d] *5*	E3	0.00802	α(K)exp=0.50×10^{-2} *8* for the 882 and 884–keV gammas from the 2694 and 2695 levels, respectively. Iγ: 106 *10* (^{3}He,3n); 330 *30* (^{28}Si,4n); 255 *25* (α,4n); % photon branching: 39.7% *10* (2000Po13); 39% *3* (1993Pi01). A_2=0.40 *1*, A_4=0.02 *1* (α,4n); A_2=0.40 *1*, A_4=0.01 *2* (^{3}He,3n). DCO=1.59 *10*.
888.6 *3*	3918.58	33			α(K)exp=0.4×10^{-2} *2*. Iγ: 8 *2* (^{3}He,3n); 38 *5* (^{28}Si,4n); 23 *3* (α,4n). A_2=0.32 *9*, A_4=–0.12 *13* (α,4n); A_2=0.01 *11*, A_4=–0.18 *15* (^{3}He,3n). DCO=0.85 *10*.
895[a]	9259.0	16			
925.0[a]	12382.3	160			DCO=1.37 *6*.
942.6[a]	12530.0	71			DCO=1.62 *12*.
959.1[a]	15166.1?	150	E2	0.00301	DCO=1.42 *7*.
964.0[a]	17371.2	18			DCO=1.2 *3*.
967.4[a]	11728.1	27			DCO=1.46 *17*.
971.9 *3*	3667.0		M1	0.00490	α(K)exp=0.39×10^{-2}. Iγ: ≈24 (^{3}He,3n) estimated from coincidence data, since this was an unresolved doublet in this reaction; 29 *4* (α,4n). A_2=0.00 *7*, A_4=0.02 *10* (α,4n).
972	2782.9				Eγ: unresolved doublet in (^{3}He,3n) reaction. Iγ<4 (α,4n), ≈5 (^{3}He,3n).
972.2[a]	14011.7	34			DCO=0.83 *12*.

Continued on next page (footnotes at end of table)

(HI,xnγ) 1990Dr06,1990Pi17 (continued)

γ(^{148}Gd) (continued)

Eγ†	E(level)	Iγ&	Mult.‡	α	Comments
987.3[a]	13126.4	33			DCO=1.34 *11*.
1001.9 *3*	6834.9	229			Iγ: 246 *20* (^{28}Si,4n); 30 *4* (α,4n). A_2=0.24 *6*, A_4=−0.26 *9* (α,4n). DCO=1.26 *4*.
1006.8 *2*	3701.85	422	E2	0.00271	Mult.: α(K)exp=0.22×10^{-2} *4*; also ΔJ=2 from DCO (1990Dr06) assumed to be E2. Iγ: 78 *8* (^{3}He,3n); 380 *30* (^{28}Si,4n); 270 *20* (α,4n). A_2=0.29 *1*, A_4=−0.09 *1* (α,4n); A_2=0.35 *2*, A_4=−0.10 *3* (^{3}He,3n). DCO=1.39 *4*.
1009.3[a]	13148.0	18			DCO=1.05 *23*.
1025.6[a]	13555.4	31			DCO=0.79 *9*.
1036.1[a]	14924.8	29			DCO=0.89 *8*.
1038.5[ab]	16204.6?	>20			DCO=0.95>.
1041.5[a]	10694.5	111			DCO=1.18 *7*.
1045.3 *3*	5026.20	39			Iγ: 45 *5* (^{28}Si,4n); 25 *4* (α,4n). A_2=0.29 *8*, A_4=−0.00 *11* (α,4n). DCO=1.33 *13*.
1057.6 *3*	2869.0		M1	0.00400	α(K)exp=0.24×10^{-2} *6*. Iγ=14 *3* (^{3}He,3n). A_2=0.04 *11*, A_4=0.03 *15* (^{3}He,3n).
1063.6 *2*	3758.61	260	E1+M2	0.00115 *14*	δ[@e]: ≤0.18. Mult.: α(K)exp=0.09×10^{-2} *2*; also ΔJ=1 transition from DCO (1990Dr06). Iγ: 30 *5* (^{3}He,3n); 223 *18* (^{28}Si,4n); 130 *20* (α,4n). A_2=−0.17 *2*, A_4=0.12 *3* (α,4n); A_2=−0.13 *4*, A_4=0.05 *5* (^{3}He,3n). DCO=0.71 *2*.
1091.7[ab]	16257.8?	>10			DCO>1.23.
1096.0[a]	12683.4	57			DCO=1.4 *3*.
1102.2[a]	9934.7	24			DCO=1.45 *18*.
1106.7[a]	14146.2	132	E2	0.00223	DCO=1.34 *5*.
1110.9[ab]	18482.1	>10			DCO=0.94>.
1122.6[a]	11186.2	122	E2	0.00217	DCO=1.40 *8*.
1125.6 *3*	2937.0	35	E1+M2	0.00099 *8*	δ[@e]: ≤0.14. Mult.: α(K)exp=0.07×10^{-2} *2*; also ΔJ=1 transition from DCO (1990Dr06). Iγ: 50 *5* (^{3}He,3n); 49 *6* (α,4n). A_2=−0.20 *5*, A_4=0.01 *6* (α,4n); A_2=−0.15 *3*, A_4=−0.00 *4* (^{3}He,3n). DCO=0.68 *17*.
1126.5[a]	12285.5	33			DCO=1.50 *24*.
1127.5	3822.8	28			Iγ: 13 *4* (α,4n). DCO=0.80 *20*.
1129.1	3822.8	8			Iγ: 4 *1* (α,4n). DCO=1.2 *4*.
1148.8[a]	8304.9	39			DCO=1.62 *17*.
1160.0[a]	11478.4	108	E2	0.00203	DCO=1.32 *7*.
1170.5[a]	8005.3	170	E2	0.00200	Eγ: not placed in 1990Pi17. DCO=1.32 *6*.
1187.4 *3*	5168.2	14			Iγ: 24 *4* (^{28}Si,4n); 24 *3* (α,4n). A_2=0.32 *16*, A_4=−0.10 *22* (α,4n). DCO=1.32 *7*; for the unresolved doublet of this γ and the 1187.7−keV γ from the 16112 level.
1187.7[a]	16112.5	107			DCO=1.32 *7*; for the unresolved doublet of this γ and the 1187.4−keV γ from the 5168 level.
1208.2[a]	8364.5	264	E2	0.00188	Eγ: not placed in 1990Pi17. DCO=1.42 *6*.
1215.2 *4*	2631.6		E1+M2	0.0012 *4*	δ[@e]: ≤0.37. α(K)exp<0.13×10^{-2}. A_2=−0.06 *7*, A_4=0.05 *10* (^{3}He,3n). Iγ=15 *4* (^{3}He,3n).
1218.6[a]	7051.8	16			DCO=1.9 *5*.
1227.9[a]	11546.4	126	E2	0.00182	DCO=1.45 *7*.

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(HI,xnγ) 1990Dr06,1990Pi17 (continued)

γ(^{148}Gd) (continued)

Eγ†	E(level)	Iγ&	Mult.‡	α	Comments
1273.5	1273.64	2.95 *24*	[E3]	0.00338	Eγ: from 2003Po02; also observed by 2000Po13. Iγ: from 2002Bi03 measured branching ratios Iγ(1273γ)=0.86% *7* and Iγ(489γ)=99.14% *7* and relative intensity of $I\gamma_{rel}$=489γ; 2002Bi03 supersede Iγ(1273γ)=0.85% *11* (2000Po13).
1277.5[a]	7110.8	47			DCO=1.46 *15*.
1285.6 *5*	3980.80	10	E3	0.00331	Iγ: branching estimated to be 2.6% *2* (2000Po13); 2.8% *2* (1993Pi01); 11 *3* (α,4n). DCO=1.2 *4*.
1308.0[a]	16474.1	21			DCO=0.96 *18*.
1330.6[a]	10318.4	19			DCO=0.80 *23*.
1340.3[a]	13870.3	35			DCO=1.58 *25*.
1357.8 *4*	2631.6				Iγ=7 *2* (^{3}He,3n). A_2=0.31 *20*, A_4=−0.03 *28* (^{3}He,3n).
1366	2782.9				Iγ≈8 (^{3}He,3n).
1408.4[a]	8243.2	27			DCO=1.61 *25*.
1682.4[a]	10046.9	143			DCO=1.45 *8*.
1741.8[a]	10046.9	11			DCO=1.3 *4*.

† From 1990Pi17 (data with uncertainties) and 1990Dr06, unless mentioned otherwise.
‡ From γγ(θ) and conversion electron data (1990Pi17), unless indicated otherwise.
§ ΔJ=2 transition from DCO (1990Dr06); assumed to be E2 (quoted typical value for stretched quadrupole is 1,39).
# ΔJ=1 transition from DCO (1990Dr06) (quoted typical value for pure stretched dipole is 0.71).
@ Estimated from α(K)exp (1990Pi17).
& Relative intensity from (^{36}S,4nγ) (1990Dr06).
a From (^{36}S,4nγ) (1990Dr06).
b Transition fast compared to the recoil stopping time in the Pb target backing.
c Measured only by 2003Po02 (quoting Eγ from 2000Bh03).
d I(131γ)+I(884γ)=190+328=518 (1990Dr06) decaying 2595, 9− was divided according with % photon branching: 60.3% *10* for 131γ and 39.7% *10* for 884γ (2000Po13).
e If no value given it was assumed δ=1.00 for E2/M1, δ=1.00 for E3/M2 and δ=0.10 for the other multipolarities.
f Placement of transition in the level scheme is uncertain.
x γ ray not placed in level scheme.

(HI,xnγ): SD 1998By02,1996De04,1995DeZZ

1998By02: ^{124}Sn(^{30}Si,6nγ) E=158 MeV. Measured Eγ, Iγ, γγγ using EUROGAM array of 54 Compton–suppressed Ge detectors. Three new SD bands reported.
1996De04: ^{124}Sn(^{29}Si,5nγ) E=157 MeV. Discrete γ–ray data for 6–SD bands obtained with GASP array (40 Compton–suppressed Ge detectors and 80 BGO detectors).
1995DeZZ: ^{124}Sn(^{30}Si,6nγ). Discrete γ–ray data for 6–SD bands obtained from higher–fold γ–ray coincidence data using the EUROGAM array consisting of 54 Compton–suppressed Ge detectors.
1996Sa15 (see also 2001Cl05): ^{124}Sn(^{30}Si,6nγ) E=158 MeV. Measured lifetimes and deduced Q for SD–1, SD–2, SD–3 bands, using the EUROGAM array consisting of 54 Compton–suppressed Ge detectors.
1997Zh03: study of feeding mechanism of SD bands through observation of continuum γ rays feeding normal and superdeformed states, using GASP array, yrast–SD band reported.
1997Ha19: ^{124}Sn(^{29}Si,5nγ) E=158 MeV. Deduced six SD bands, evidence for ΔJ=2 staggering for SD–6 band.
1993Ha19: ^{124}Sn(^{30}Si,5nγ) E=155 MeV.
1992Fl02: ^{124}Sn(^{30}Si,5nγ) E=155 MeV, ^{122}Sn(^{30}Si,4nγ).
1988Dr01: ^{116}Cd(^{36}S,4nγ) E=170 MeV.
1988De10: ^{124}Sn(^{30}Si,5nγ) E=155 MeV and ^{104}Ru(^{48}Ca,4nγ) E=215 MeV.

^{148}Gd Levels

E(level)	Jπ
x#	J≈(29)†
699.9+x#	J+2
1447.8+x#	J+4
2243.6+x#	J+6
3090.3+x#	J+8

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(HI,xnγ): SD 1998By02,1996De04,1995DeZZ (continued)

^{148}Gd Levels (continued)

E(level)	Jπ
3988.2+x#	J+10
4938.5+x#	J+12
5942.4+x#	J+14
7001.1+x#	J+16
8115.3+x#	J+18
9285.9+x#	J+20
10513.7+x#	J+22
11799.3+x#	J+24
13143.3+x#	J+26
14545.8+x#	J+28
16007.2+x#	J+30
17527.7+x#	J+32
19108.2+x#	J+34
20748.2+x#	J+36
22448.5+x#	J+38
y@	J≈(30)‡
741.8+y@	J+2
1530.7+y@	J+4
2369.5+y@	J+6
3258.6+y@	J+8
4198.4+y@	J+10
5188.8+y@	J+12
6228.5+y@	J+14
7316.3+y@	J+16
8451.5+y@	J+18
9634.2+y@	J+20
10865.4+y@	J+22
12146.3+y@	J+24
13478.5+y@	J+26
14861.8+y@	J+28
16299.3+y@	J+30
17790.4+y@	J+32
19336.6+y@	J+34
z&	J
830.3+z&	J+2
1706.0+z&	J+4
2631.0+z&	J+6
3606.7+z&	J+8
4634.2+z&	J+10
5713.8+z&	J+12
6846.5+z&	J+14
8032.4+z&	J+16
9271.7+z&	J+18
10564.6+z&	J+20
11909.1+z&	J+22
13304.3+z&	J+24
14739.5+z&	J+26
16182.1+z§&	J+28
17629.8+z&	J+30
19101.8+z&	J+32
u[a]	J
849.7+u[a]	J+2
1739.7+u[a]	J+4
2678.4+u[a]	J+6
3666.8+u[a]	J+8
4706.4+u[a]	J+10
5797.5+u[a]	J+12
6941.7+u[a]	J+14
8139.7+u[a]	J+16
9392.5+u[a]	J+18
10700.6+u[a]	J+20
12065.0+u[a]	J+22
13486.3+u[a]	J+24
14964.8+u[a]	J+26
16501.7+u[a]	J+28
v[b]	J
853.7+v[b]	J+2
1753.6+v[b]	J+4
2698.5+v[b]	J+6
3689.9+v[b]	J+8
4727.8+v[b]	J+10
5812.4+v[b]	J+12
6944.3+v[b]	J+14
8123.8+v[b]	J+16
9350.3+v[b]	J+18
10624.1+v[b]	J+20
11946.2+v[b]	J+22
13315.8+v[b]	J+24
14732.9+v[b]	J+26
16197.8+v[b]	J+28
17710.9+v[b]	J+30
19272.9+v[b]	J+32
w[c]	J
802.2+w[c]	J+2
1651.6+w[c]	J+4
2549.0+w[c]	J+6
3494.9+w[c]	J+8
4491.0+w[c]	J+10
5537.8+w[c]	J+12
6637.2+w[c]	J+14
7789.4+w[c]	J+16
8996.2+w[c]	J+18
10257.2+w[c]	J+20
11573.7+w[c]	J+22
12945.8+w[c]	J+24
14374.4+w[c]	J+26
15859.5+w[c]	J+28
17401.9+w[c]	J+30
r[d]	J
911.8+r[d]	J+2
1873.7+r[d]	J+4
2892.1+r[d]	J+6
3969.0+r[d]	J+8
5101.0+r[d]	J+10
6287.7+r[d]	J+12
7527.4+r[d]	J+14
8817.6+r[d]	J+16
10152.6+r[d]	J+18
11530.7+r[d]	J+20
12956.1+r[d]	J+22
14431.3+r[d]	J+24
15960.2+r[d]	J+26
s[e]	J
887.0+s[e]	J+2
1822.4+s[e]	J+4
2812.3+s[e]	J+6
3858.2+s[e]	J+8
4961.4+s[e]	J+10
6120.6+s[e]	J+12
7332.7+s[e]	J+14
8596.7+s[e]	J+16
9908.0+s[e]	J+18
11263.4+s[e]	J+20
12664.8+s[e]	J+22
14115.4+s[e]	J+24
15618.4+s[e]	J+26
t[f]	J
868.4+t[f]	J+2
1783.4+t[f]	J+4
2745.6+t[f]	J+6
3755.3+t[f]	J+8
4811.6+t[f]	J+10
5916.5+t[f]	J+12
7069.9+t[f]	J+14
8271.5+t[f]	J+16
9521.3+t[f]	J+18
10818.5+t[f]	J+20
12157.8+t[f]	J+22
13509.7+t[f]	J+24

† From 699.9γ as a possible J=31 to J=29 transition based on the assignment (1993Ha19) of 652.3γ as a J=29 to J=27 transition. A tentative 652.3γ was reported by 1993Ha19 but is removed by 1995DeZZ. Theoretical analysis by 1993Ra07 suggests J=27, 29; J=25, 27 was proposed (1993Ra07) with the 652.3γ as the lowest energy transition.

‡ From assignment of 789γ as J=34 to 32 transition. Negative parity is suggested by 1993Ha19. 1993Ra07 suggest J=30, 32 (assuming 789γ as the lowest transition).

§ The ordering of the 1447.7γ–1442.6γ cascade is adopted from 1996De04, based on relative Iγ's. A reverse ordering is proposed by 1995DeZZ.

(A): SD–1 band (1995DeZZ,1993Ha19,1988De10). configuration=$\pi 6^2$ $\nu(7^1 1/2[651],\alpha=-1/2)$ (1998By02). Q(intrinsic)=14.6 *2* (1996Sa15). Percent population=1.6 *1* (1996De04), 1.30 *15* (1993Ha19), 0.72 *25* (1997Zh03) in ^{124}Sn(^{29}Si,5nγ) E=157 MeV (1996De04,1997Zh03), E=155 MeV (1993Ha19). Other values from 1992Fl02: 1.9 *5* in ^{76}Ge(^{76}Ge,4nγ); 0.8 *2* in ^{124}Sn(^{29}Si,5nγ) and 0.5 *2* in ^{122}Sn(^{30}Si,4nγ).

@ (B): SD–2 band (1995DeZZ,1993Ha19,1996De04). configuration=$\pi 6^2$ $\nu(7^1 1/2[651],\alpha=+1/2)$ (1998By02). Promotion of neutron from 1/2[651],α=–1/2 to 1/2[651],α=+1/2. Q(intrinsic)=14.8 *3* (1996Sa15). Percent population=0.7 *2* (1996De04), 0.62 *20* (1993Ha19).

& (C): SD–3 band (1995DeZZ,1996De04). This band reveals a backbend at a rotational frequency of ≈0.72 MeV. configuration=$\pi 6^2$ ν((1/2[651],α=–1/2)(1/2[651],α=+1/2)) (1998By02). Promotion of neutron from 1/2[770],α=–1/2 to 1/2[651],α=+1/2. Q(intrinsic)=17.8 *13* (1996Sa15). Percent population=0.4 *2* (1996De04), 18% *3* of SD–1 (1995DeZZ).

Footnotes continued on next page

(HI,xnγ): SD 1998By02,1996De04,1995DeZZ (continued)

^{148}Gd Levels (continued)

[a] (D): SD–4 band (1995DeZZ,1996De04). configuration=$\pi 6^2$ $\nu(7^1(1/2[651],\alpha=-1/2)(1/2[651],\alpha=+1/2))$ (1998By02). Promotion of neutron from 5/2[642],α=+1/2 to 1/2[651],α=+1/2. Percent population=0.5 *2* (1996De04), 12% *4* of SD–1 band (1995DeZZ).

[b] (E): SD–5 band (1995DeZZ,1996De04). configuration=$\pi(6^4 1/2[301]^{-2})$ $\nu(7^2(1/2[651],\alpha=-1/2)$ $(1/2[651],\alpha=+1/2))$ (1998By02). This involves promotion of two neutrons from 1/2[411] to 7^1 and 1/2[651],α=+1/2 orbitals. Or configuration=$\pi(6^2(1/2[301],\alpha=-1/2)^{-1}(3/2[651],\alpha=+1/2))$ $\nu(7^1 1/2[651],\alpha=-1/2)$ (1998By02). This band is identical (in transition energies) to ^{152}Dy SD–1 band. Percent population=0.5 *1* (1996De04), 23% *4* of SD–1 band (1995DeZZ).

[c] (F): SD–6 band (1995DeZZ,1996De04,1997Ha19). configuration=$\pi 6^2$ $\nu(7^1(1/2[651],\alpha=-1/2)(1/2[651],\alpha=+1/2))$ (1998By02). Promotion of neutron from 1/2[411],α=+1/2 to 1/2[651],α=+1/2. 1997Ha19 provide evidence for ΔJ=2 staggering of 0.37 keV *12*, and propose that this band is identical to ^{149}Gd SD–1, yrast band. Percent population=0.4 *1* (1996De04), 16% *3* of SD–1 band (1995DeZZ).

[d] (G): SD–7 band (1998By02). configuration=$\pi 6^2$ $\nu(7^1(5/2[402]$ or $9/2[514]))$ (1998By02). Promotion of neutron from 1/2[651],α=–1/2 to 5/2[402] or 9/2[514]. Bands SD–7 and SD–8 are probably signature partners. Percent population=5–10% of SD–1 band (1998By02).

[e] (H): SD–8 band (1998By02). configuration=$\pi 6^2$ $\nu(7^1(5/2[402]$ or $9/2[514]))$ (1998By02). Promotion of neutron from 1/2[651],α=–1/2 to 5/2[402] or 9/2[514]. Bands SD–7 and SD–8 are probably signature partners. Percent population=5–10% of SD–1 band (1998By02).

[f] (I): SD–9 band (1998By02). percent population=5–10% of SD–1 band (1998By02).

γ(^{148}Gd)

Two additional SD bands are reported by 1998By02 with the following γ–ray cascades. The assignment to ^{148}Gd is not firm. The first band (u1) is similar to SD–9 band in the moment of inertia plot with Eγ's close to the midpoint energies of SD–9 band. The second band (u2) has transition energies close to 3/4 point energies of SD–2 band, but the moment plots show differences.

Unassigned SD band u1 Eγ	unassigned SD band u2 Eγ
888.1 *13*	934.3 *7*
933.7 *9*	977.6 *7*
980.6 *8*	1028.0 *6*
1027.5 *7*	1074.6 *8*
1078.0 *8*	1122.5 *6*
1127.3 *7*	1172.9 *7*
1177.3 *10*	1222.8 *7*
1227.5 *9*	1272.7 *7*
1278.1 *9*	1324.3 *8*
1335.9 *11*	1375.6 *7*
	1426.9 *8*
	1477.0 *10*
	1530.4 *10*

Eγ[†]	E(level)	Iγ[‡]	Comments
699.9 *1*	699.9+x	0.54 *15*	Eγ: 700.2 *1* (1996De04).
741.8 *3*	741.8+y		Eγ: γ not reported by 1996De04.
747.9 *1*	1447.8+x	0.87 *9*	Eγ: 748.6 *1* (1996De04).
788.9 *2*	1530.7+y	0.46 *10*	Eγ: 790.2 *5* (1996De04).
795.8 *1*	2243.6+x	0.99 *8*	Eγ: 797.7 *1* (1996De04).
802.2 *3*	802.2+w		Eγ: from 1995DeZZ. γ not reported by 1996De04 and 1997Ha19.
830.3 *6*	830.3+z	0.23 *5*	Eγ,Iγ: from 1996De04 only.
838.8 *2*	2369.5+y	0.88 *9*	Eγ: 839.3 *3* (1996De04).
846.7 *1*	3090.3+x	0.97 *8*	Eγ: 847.8 *1* (1996De04).
849.44 *22*	1651.6+w		Eγ: 849.0 *2* (1995DeZZ). γ not reported by 1996De04.
849.7 *3*	849.7+u		Eγ: not reported by 1996De04.
853.7 *3*	853.7+v	0.45 *6*	Eγ: 853.8 *9* (1996De04).
868.4 *3*	868.4+t		
875.7 *3*	1706.0+z	0.42 *6*	Eγ: 875.8 *5* (1996De04).
887.0 *3*	887.0+s		
889.1 *2*	3258.6+y	0.89 *9*	Eγ: 890.1 *2* (1996De04).
890.0 *2*	1739.7+u	0.62 *15*	Eγ: 891.1 *3* (1996De04).
897.40 *16*	2549.0+w	0.91 *12*	Eγ: 897.6 *2* (1995DeZZ), 899.0 *3* (1996De04).
897.9 *1*	3988.2+x	1.00 *8*	Eγ: 899.1 *1* (1996De04).
899.9 *2*	1753.6+v	0.83 *9*	Eγ: 900.9 *3* (1996De04).
911.8 *4*	911.8+r		
915.0 *3*	1783.4+t		
925.0 *2*	2631.0+z	0.43 *7*	Eγ: 925.7 *8* (1996De04).
935.4 *4*	1822.4+s		
938.7 *2*	2678.4+u	0.60 *12*	Eγ: 939.6 *4* (1996De04).

Continued on next page (footnotes at end of table)

(HI,xnγ): SD 1998By02,1996De04,1995DeZZ (continued)

γ(^{148}Gd) (continued)

Eγ†	E(level)	Iγ‡	Comments
939.8 *2*	4198.4+y	0.93 *15*	Eγ: 941.3 *2* (1996De04).
944.9 *3*	2698.5+v	0.85 *10*	Eγ: 945.4 *3* (1996De04).
945.86 *15*	3494.9+w	1.00 *12*	Eγ: 946.1 *4* (1995DeZZ), 946.7 *5* (1996De04).
950.3 *1*	4938.5+x	0.97 *8*	Eγ: 951.5 *1* (1996De04).
961.9 *3*	1873.7+r		
962.2 *3*	2745.6+t		
975.7 *3*	3606.7+z	0.62 *7*	Eγ: 976.8 *6* (1996De04).
988.4 *3*	3666.8+u	0.64 *10*	Eγ: 988.6 *4* (1996De04).
989.9 *4*	2812.3+s		
990.4 *3*	5188.8+y	1.00 *11*	Eγ: 990.8 *2* (1996De04).
991.4 *2*	3689.9+v	0.86 *10*	Eγ: 992.4 *3* (1996De04).
996.08 *19*	4491.0+w	1.00 *22*	Eγ: 996.0 *3* (1995DeZZ), 997.0 *5* (1996De04).
1003.9 *1*	5942.4+x	1.00 *10*	Eγ: 1004.8 *2* (1996De04).
1009.7 *2*	3755.3+t		
1018.4 *3*	2892.1+r		
1027.5 *2*	4634.2+z	0.63 *8*	Eγ: 1028.8 *4* (1996De04).
1037.9 *2*	4727.8+v	0.85 *20*	Eγ: 1038.7 *2* (1996De04).
1039.6 *3*	4706.4+u	0.68 *10*	Eγ: 1041 *1* (1996De04).
1039.7 *2*	6228.5+y	0.95 *20*	Eγ: 1040.0 *2* (1996De04).
1045.9 *3*	3858.2+s		
1046.83 *14*	5537.8+w	1.00 *10*	Eγ: 1046.9 *2* (1995DeZZ), 1047.8 *5* (1996De04).
1056.3 *2*	4811.6+t		
1058.7 *1*	7001.1+x	0.98 *9*	Eγ: 1059.5 *1* (1996De04).
1076.9 *3*	3969.0+r		
1079.6 *3*	5713.8+z	0.95 *11*	Eγ: 1080.6 *4* (1996De04).
1084.6 *2*	5812.4+v	1.00 *15*	Eγ: 1086.5 *3* (1996De04).
1087.8 *2*	7316.3+y	1.03 *15*	Eγ: 1088.9 *3* (1996De04).
1091.1 *3*	5797.5+u	0.92 *15*	Eγ: 1092.7 *4* (1996De04).
1099.39 *16*	6637.2+w	0.95 *18*	Eγ: 1099.1 *4* (1995DeZZ), 1099 *1* (1996De04).
1103.2 *10*	4961.4+s		
1104.9 *2*	5916.5+t		
1114.2 *1*	8115.3+x	0.99 *10*	Eγ: 1114.9 *1* (1996De04).
1131.9 *2*	6944.3+v	1.00 *13*	Eγ: 1133.8 *3* (1996De04).
1132.0 *4*	5101.0+r		
1132.7 *2*	6846.5+z	1.00 *12*	Eγ: 1133.4 *4* (1996De04).
1135.2 *2*	8451.5+y	0.94 *10*	Eγ: 1136.0 *2* (1996De04).
1144.2 *3*	6941.7+u	1.05 *20*	Eγ: 1145.3 *3* (1996De04).
1152.20 *15*	7789.4+w	0.97 *10*	Eγ: 1152.0 *2* (1995DeZZ), 1152.4 *4* (1996De04).
1153.4 *2*	7069.9+t		
1159.2 *3*	6120.6+s		
1170.6 *1*	9285.9+x	1.00 *15*	Eγ: 1171.4 *2* (1996De04).
1179.5 *2*	8123.8+v	0.90 *10*	Eγ: 1180.4 *3* (1996De04).
1182.7 *2*	9634.2+y	0.82 *8*	Eγ: 1183.1 *3* (1996De04).
1185.9 *3*	8032.4+z	0.93 *30*	Eγ: 1186 *1* (1996De04).
1186.7 *3*	6287.7+r		
1198.0 *3*	8139.7+u	1.00 *15*	Eγ: 1199 *1* (1996De04).
1201.6 *3*	8271.5+t		
1206.76 *24*	8996.2+w	1.00 *15*	Eγ: 1206.2 *2* (1995DeZZ), 1206 *1* (1996De04).
1212.1 *3*	7332.7+s		
1226.5 *2*	9350.3+v	0.80 *10*	Eγ: 1228.7 *9* (1996De04).
1227.8 *1*	10513.7+x	0.84 *7*	Eγ: 1228.4 *1* (1996De04).
1231.2 *2*	10865.4+y	0.79 *8*	Eγ: 1233.3 *3* (1996De04).
1239.3 *3*	9271.7+z	0.72 *15*	Eγ: 1239.8 *4* (1996De04).
1239.7 *4*	7527.4+r		
1249.8 *2*	9521.3+t		
1252.8 *3*	9392.5+u	1.02 *13*	Eγ: 1253.4 *5* (1996De04).
1261.00 *16*	10257.2+w	1.00 *19*	Eγ: 1260.5 *2* (1995DeZZ), 1260.7 *4* (1996De04).
1264.0 *3*	8596.7+s		
1273.8 *2*	10624.1+v	0.80 *10*	Eγ: 1275.5 *5* (1996De04).
1280.9 *2*	12146.3+y	0.77 *8*	Eγ: 1281.7 *5* (1996De04).
1285.6 *1*	11799.3+x	0.71 *8*	Eγ: 1286.4 *1* (1996De04).
1290.2 *3*	8817.6+r		
1292.9 *3*	10564.6+z	0.95 *20*	Eγ: 1293.2 *4* (1996De04).

Continued on next page (footnotes at end of table)

(HI,xnγ): SD 1998By02,1996De04,1995DeZZ (continued)

γ(^{148}Gd) (continued)

Eγ†	E(level)	Iγ‡	Comments
1297.2 *3*	10818.5+t		
1308.1 *3*	10700.6+u	0.88 *15*	Eγ: 1309.2 *5* (1996De04).
1311.3 *3*	9908.0+s		
1316.57 *14*	11573.7+w	0.96 *10*	Eγ: 1315.7 *3* (1995DeZZ), 1317.3 *5* (1996De04).
1322.1 *2*	11946.2+v	0.52 *8*	Eγ: 1323.2 *4* (1996De04).
1332.2 *2*	13478.5+y	0.62 *7*	Eγ: 1333.1 *5* (1996De04).
1335.0 *3*	10152.6+r		
1339.3 *6*	12157.8+t		
1344.0 *2*	13143.3+x	0.66 *7*	Eγ: 1344.4 *1* (1996De04).
1344.5 *3*	11909.1+z	0.71 *18*	Eγ: 1347.0 *8* (1996De04).
1351.9 *7*	13509.7+t		
1355.4 *4*	11263.4+s		
1364.4 *3*	12065.0+u	0.90 *18*	Eγ: 1365.1 *5* (1996De04).
1369.6 *2*	13315.8+v	0.50 *10*	Eγ: 1370.0 *4* (1996De04).
1372.10 *22*	12945.8+w	0.78 *9*	Eγ: 1372.1 *2* (1995DeZZ), 1372.7 *5* (1996De04).
1378.1 *4*	11530.7+r		
1383.3 *3*	14861.8+y	0.56 *6*	Eγ: 1385.7 *5* (1996De04).
1395.2 *4*	13304.3+z	0.64 *15*	Eγ: 1395.9 *10* (1996De04).
1401.4 *4*	12664.8+s		
1402.5 *2*	14545.8+x	0.55 *6*	Eγ: 1404.0 *2* (1996De04).
1417.1 *3*	14732.9+v	0.44 *7*	Eγ: 1417.1 *5* (1996De04).
1421.3 *4*	13486.3+u	0.82 *10*	Eγ: 1422 *1* (1996De04).
1425.4 *4*	12956.1+r		
1428.55 *24*	14374.4+w	0.77 *10*	Eγ: 1428.5 *3* (1995DeZZ), 1429 *1* (1996De04).
1435.2 *5*	14739.5+z	0.46 *8*	Eγ: 1436.3 *10* (1996De04).
1437.5 *5*	16299.3+y	0.44 *5*	Eγ: 1438 *1* (1996De04).
1442.6 *10*	16182.1+z	0.40 *12*	Eγ: 1445.9 *15* (1996De04).
1447.7 *6*	17629.8+z	0.18 *9*	Eγ: 1449.5 *15* (1996De04).
1450.6 *4*	14115.4+s		
1461.4 *2*	16007.2+x	0.48 *7*	Eγ: 1462.7 *2* (1996De04).
1464.9 *4*	16197.8+v	0.31 *5*	Eγ: 1465.6 *5* (1996De04).
1472.0 *10*	19101.8+z	0.22 *8*	Eγ: 1474 *2* (1996De04).
1475.2 *4*	14431.3+r		
1478.5 *4*	14964.8+u	0.57 *9*	Eγ: 1480 *1* (1996De04).
1485.15 *26*	15859.5+w	0.70 *15*	Eγ: 1483.6 *6* (1995DeZZ), 1485 *1* (1996De04).
1491.1 *8*	17790.4+y	0.27 *4*	Eγ: 1492 *1* (1996De04).
1503.0 *5*	15618.4+s		
1513.1 *10*	17710.9+v	0.26 *4*	Eγ: 1513 *1* (1996De04).
1520.5 *3*	17527.7+x	0.34 *5*	Eγ: 1521.0 *2* (1996De04).
1528.9 *5*	15960.2+r		
1536.9 *10*	16501.7+u	0.30 *10*	Eγ: 1538 *1* (1996De04).
1542.4 *4*	17401.9+w	0.63 *15*	Eγ: 1540 *1* (1996De04).
1546.2 *10*	19336.6+y	0.23 *4*	Eγ: 1544 *1* (1996De04).
1562 *1*	19272.9+v	0.20 *6*	Eγ: from 1996De04 only.
1580.5 *6*	19108.2+x	0.19 *3*	Eγ: 1581.2 *3* (1996De04).
1640.0 *10*	20748.2+x	0.15 *5*	Eγ: 1640.0 *4* (1996De04).
1700.3 *6*	22448.5+x	0.07 *3*	Eγ,Iγ: from 1996De04 only.

† From 1995DeZZ for SD–1 to SD–5 bands; from 1997Ha19 for SD–6 band; from 1998By02 for SD–7 to SD–9 bands, unless otherwise stated. Values for six SD bands are also available from 1996De04, but seem to be higher than those quoted by 1995DeZZ, systematically, by ≈1 keV. Earlier values are available from 1988De10 (for SD–1) and 1993Ha19 (for SD–1 and SD–2).

‡ For SD bands, values are relative intensities within each band taken from 1996De04. Values for SD–1 and SD–2 bands are also available from 1993Ha19.

Adopted Levels, Gammas

Q(β⁻)=–2678 *10*; S(n)=7860 *15*; S(p)=2464 *13*; Q(α)=2663 *17* 2012Wa38.
Mass measurement (Penning trap): 2000Be42.

^{148}Tb Levels

Cross Reference (XREF) Flags

A ^{148}Dy ε Decay
B ^{152}Ho α Decay (50.0 s)
C ^{152}Ho α Decay (161.8 s)
D (HI,xnγ)

E(level)	Jπ†	XREF	$T_{1/2}$	Comments
0.0	2–	A CD	60 min *1*	%ε+%β⁺=100. μ=–1.75 *2* (1997StZR,1990Al36,2005St24). Q=–0.29 *20* (1997StZR,1990Al36,2005St24). μ,Q: measured by collinear fast beam LASER spectroscopy – accelerated beam method. Jπ: J=2 from optical–isotope shift and hyperfine–structure data measurement (1990Al36); π=– from E1 620γ from 1+ level. $T_{1/2}$: from 1975SpZU, 66 min *10* (1961Bo19), see also 1960To04. Rms charge radius $<r^2>^{1/2}$=4.9299 fm *1507* (2004An14).
90.1 *3*	(9)+	B D	2.20 min *5*	%ε+%β⁺=100. $T_{1/2}$: from 1973Bo13. Others: 2.43 min *7* (1975SpZU), 2.3 min *2* (1974Ne01). E(level): from level scheme (balance of Eγ) (1987StZU). Jπ: log *ft*≈4.5 to 8+ and systematics.
109.6 *2*	4–	A CD	80 ns *4*	$T_{1/2}$: from (^{6}Li,2nγ) (1987StZV).
178.4 *2*	2+	A CD	7.0 ns *6*	$T_{1/2}$: from (^{6}Li,2nγ) (1987StZV).
195.4	3–	A CD		
280.9	3+	A CD		
327.9 *4*	7+	B D	4.5 ns *4*	$T_{1/2}$: from (^{6}Li,2nγ) (1987StZV).
345	5–	D		
351.3	5+	D		
375.3	4+	D		
406.0 *4*	8+	B D	≤0.7 ns	$T_{1/2}$: from (^{6}Li,2nγ) (1987StZV).
425.8	6+	D		
620.24 *1*	1+	A	≤0.25 ns	Jπ: log *ft*=3.9 via 0+ parent. $T_{1/2}$: from 1975AlZE, 1975VaYY (^{148}Dy ε decay).
657.8	(3–)	A		Jπ: γ to 2– is (M1).
794.5	2–	A		
950.8	(2–,1–)	A		
1095.8	(11)–	D	22 ns *1*	Jπ: γ to (9)+ is M2+E3 and systematics. $T_{1/2}$: unweighted average of 22 ns *1* (1979Br28), 25 ns *2* (1979Si08), 20 ns *2* (1980Bo07), and 20 ns *2* (1980Ja16).
1220	(5–)	D		
1246	(6–)	D		
1247.2	1+	A		Jπ: log *ft*=5.4 via 0+.
1249	9–	D		
1267	10+	D		
1276.9	1	A		
1295	(8–)	D		
1305	(7–)	D		
1332.7	1	A		
1365.9	1	A		
1380.0	(12)–	D		Jπ: γ to (11)– is M1 ΔJ=1; no γ to J<10.
1484	(10+)	D		
1642.9	1+	A		Jπ: log *ft*=5.9 via 0+.
1654	(8+)	D		
1723	(9+)	D		
1828.5	1	A		
1840.1	1+	A		Jπ: log *ft*=5.4 via 0+.
2361.7		D		
2714.0	(14)–	D		Jπ: γ to (12)– is E2 ΔJ=2.
2868.4		D		
2953.9	(15)–	D		Jπ: see 3168 level.

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Adopted Levels, Gammas (continued)

^{148}Tb Levels (continued)

E(level)	Jπ†	XREF	$T_{1/2}$	Comments
3167.9	(16)–	D		Jπ: 214γ and 240γ are M1+E2, crossover 454γ is ΔJ=2 Q. This establishes Jπ=(15)– and (16)– for levels: 2953.9 and 3167.9.
3367.1		D		
3594.9	(17–)	D		
3801.8	(17)–	D		Jπ: γ to (16)– is M1+E2 ΔJ=1.
4178.5	(17)	D		
4238.9	(17)	D		
4295.7	(18)	D		
4422.9	(18–)	D		
4504.9	(18)	D		
4862.1	(18)	D		
4946.1		D		
5008.9	(18)	D		
5172.4	(18)	D		
5225.4	(19–)	D		
5314.5	(19)	D		
5558.4	(19)	D		
5747.0	(20–)	D		
6489.8	(21+)	D		
6523.3	(21)	D		
6933.5		D		
7270.0	(23+)	D		
7341.9	(23–)	D		
7620.4	(24+)	D		
7760.9	(26+)	D		
7833.8		D		
8338.1		D		
8618.6	(27+)	D	1.310 μs *7*	$T_{1/2}$: from 1995Id01. Others: 1.3 μs *5* (1980Ja16), 0.84 μs *4* (1981BeYH).
9196.0		D		
9576.9	(29)	D		
9920.0		D		
9972.5		D		
10148.0		D		
10424.4		D		
10511.6		D		
10752.6		D		
10791.6		D		
10880.1		D		
10963.9		D		
11445.7		D		
12116.2		D		
12342.5		D		
12449.3		D		
13060.2		D		
13379.6		D		
14090.6		D		

† From analysis of γ(θ), α(K)exp, and systematics, except where noted otherwise.

γ(^{148}Tb)

E(level)	Eγ	Iγ	Mult.†	α	Comments
109.6	109.6 *2*	100	E2	1.86	B(E2)(W.u.)=3.36 *18*.
178.4	178.4 *2*	100	E1	0.0636	B(E1)(W.u.)=5.7×10^{-6} *5*.
195.4	85.8	100	M1	3.41	
280.9	102.5	100	M1	2.05	
327.9	237.8 *2*	100	E2	0.1297	B(E2)(W.u.)=3.1 *3*.
351.3	241.7	100	E1	0.0287	
375.3	94.4	100	M1	2.59	
406.0	78.1		M1	4.48	
	315.9 *2*		M1	0.0906	

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Adopted Levels, Gammas (continued)

γ(^{148}Tb) (continued)

E(level)	Eγ	Iγ	Mult.†	δ‡	α	Comments
425.8	74.4		M1		5.15	
	97.8		M1		2.34	
620.24	339.6	0.04				
	442.0	0.13	(M1)		0.0376	B(M1)(W.u.)>1.3×10^{-6}.
	620.24 *1*	100	E1		0.00308	B(E1)(W.u.)>4.0×10^{-6}.
657.8	462.1	65	(M1)		0.0335	
	657.8	100	(M1)		0.01373	
794.5	136.9	62	(M1)		0.898	
	616.2	5				
	794.9	100	(M1)		0.00860	
950.8	156.0	3				
	772.0	3				
	950.8	100	(M1)		0.00557	
1095.8	690.2					
	1006.2		E3+M2	2.2 *6*	0.0072 *7*	
1220	793.9					
	869.5					
1246	820.1					
	917.9					
1247.2	627	4.7				
	1068.9	5.3				
	1247.2	100	E1		8.42×10^{-4}	
1249	842.5	100	E1		1.65×10^{-3}	
1267	1177.2	100				
1276.9	1097	5.3				
	1276.9	100				
1295	888.7					
	967.1					
1305	899	100				
1332.7	1332.7	100				
1365.9	1085.4	100				
	1187.5	75				
	1366	50				
1380.0	284.1 *2*	100	M1		0.1202	
1484	1078.2					
	1394.0					
1642.9	691.9	100				
	847.1	47				
	1642.9	5.9				
1654	1228					
	1247.7					
	1563.0					
1723	1317.4					
	1395.3					
	1633					
1828.5	1547	25				
	1650.2	100				
1840.1	890.0	86				
	1045.9	100				
	1840.1	21				
2361.7	981.7	100				
2714.0	1334.1 *3*	100	E2		1.65×10^{-3}	
2868.4	506.7	100				
2953.9	240.0 *2*	100	M1+E2	+0.09 *2*	0.189	
3167.9	214.1 *2*	100 *10*	M1+E2		0.22 *4*	
	454.1 *3*	16 *4*	Q			
3367.1	498.7	100				
3594.9	427.0 *2*		M1+E2		0.032 *10*	
	640.8					
3801.8	434.7					
	634.2 *2*		M1+E2		0.012 *4*	
4178.5	1010.6	100				
4238.9	1071.0	100				

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Adopted Levels, Gammas (continued)

γ(^{148}Tb) (continued)

E(level)	Eγ	Iγ
4295.7	493.8	
	700.8	
4422.9	184.0	
	244.7	
	621§ *1*	
	828	
4504.9	82.0	100
4862.1	566.3	
	1060.4	
4946.1	522.5 *5*	100
5008.9	1207.1	100
5172.4	1370.6	
5225.4	216.6	
	363.0	
	720.5	
	802.5	
	929.4	
	1631.0	
5314.5	142.3	
	452.0	
	809.7	
5558.4	333.0	100
5747.0	521.6	100
6489.8	742.6	
6489.8	931.5	
	1175.5	
6523.3	1208.8	100
6933.5	443.7	100
7270.0	336.6	
	746.6	
	780.1	
7341.9	71.9	
7620.4	278.4	
	350.6	
7760.9	140.2	
	418.7	
	491.4	
7833.8	72.9	100
8338.1	504.4	
	577.0	
8618.6	280.6	
	784.8	
	857.7	
9196.0	577.4	100
9576.9	958.3	100
9920.0	1302.3	100
9972.5	775.5	
	1353.9	
10148.0	175.3	
	227.2	
	571.1	
	952.0	
10424.4	847.6	100
10511.6	934.7	100
10752.6	328.0	
	1175.7	
10791.6	1214.7	100
10880.1	88.5	100
10963.9	172.3	
	452.7	
	816.3	
11445.7	481.8	
	565.6	
	654.1	
	693.7	
12116.2	1152.3	100
12342.5	896.8	100
12449.3	1003.6	100
13060.2	944.0	100
13379.6	930.3	100
14090.6	1030.4	100

† From conversion electron data in ε decay, and γ(θ), DCO ratios, conversion electron and linear–polarization data in (HI,xnγ).
‡ If no value given it was assumed δ=1.00 for E2/M1, δ=1.00 for E3/M2 and δ=0.10 for the other multipolarities.
§ Placement of transition in the level scheme is uncertain.

^{148}Dy ε Decay 1985ZuZX

Parent ^{148}Dy: E=0.0; Jπ=0+; $T_{1/2}$=3.3 min *2*; Q(g.s.)=2678 *10*; %ε+%β$^+$ decay=100.
Measured: γ, ce (1985ZuZX,1985Kl05,1975Gr35,1975To03,1974La32,1974La28,1974GrYZ); γ, γγ, (K x ray)γ (1988To03,1985ZuZX,1985Kl05); ε/β$^+$ (1985Sc09,1981Sp03,1981Sc21); γ, β, x–rays, Gamow–Teller resonance (total absorption spectrometer, 2004Al35; see also 2007EsZX,2004AlZY,2003NaZV,2001AlZY).
Decay scheme is from 1985ZuZX. Shown also in tables are data from 2004Al35 (total absorption spectrometer).

^{148}Tb Levels

E(level)	Jπ†	$T_{1/2}$	Comments
0.0	2–	60 min *1*	
109.6 *9*	4–		
178.5 *5*	2+		
195.5 *10*	3–		J=(3,4)– (1985ZuZX).
280.9 *7*	3+		J=(2,3)+ (1985ZuZX).
620.241 *10*	1+	≤0.25 ns	Jπ: 1+ (1985ZuZX). $T_{1/2}$: from 1975AlZE, 1975VaYY.
657.8 *7*	(3–)		(2,3)– (1985ZuZX).
794.8 *5*	2–		Jπ: 2–, (1)– (1985ZuZX).
950.6 *6*	(2–,1–)		J=2–,(1)– (1985ZuZX).
1247.3 *6*	1+		Jπ: 1+ from log *ft*=5.4 from 0+; 1+ (1985ZuZX).
1276.2 *8*	1		Jπ: 1 (1985ZuZX).
1332.7 *10*	1		Jπ: 1 (1985ZuZX).
1366.1 *7*	1		Jπ: 1 (1985ZuZX).
1642.5 *7*	1+		Jπ: 1+ from log *ft*=5.9 from 0+; 1–, (0)– (1985ZuZX).
1828.3 *9*	1		Jπ: 1.
1840.5 *7*	1+		Jπ: 1+ from log *ft*=5.4 from 0+; 1–, (0)– (1985ZuZX).

† Adopted values. Supporting arguments from this data set and the assignments by 1985ZuZX are given in comments. Some Jπ assignments by 1985ZuZX are not supported by log *ft* values.

^{148}Dy ε Decay 1985ZuZX (continued)

β⁺,ε Data

ε/β⁺=22.2 *20*, Q(ε)=2680 *30* (1985Sc09). Others: ε/β⁺=21.7 *39*, Q(ε)=2652 keV +*65–50* (1981Sc21); ε/β⁺=14.7 *27*, Q(ε)=2800 *60* (1981Sp03).

I(ε+β⁺) and log *ft* data from 2004Al35 are given in comments in the table below, together with same data from 1985Kl05 for comparison.

Eε	E(level)	Iβ⁺†	Iε†	Log *ft*	I(ε+β⁺)†	Comments
(838 *10*)	1840.5		0.52	5.4	0.52	
(850 *10*)	1828.3		0.05	6.4	0.05	
(1036 *10*)	1642.5		0.25	5.9	0.25	
(1312 *10*)	1366.1		0.07	6.6	0.07	I(ε+β⁺)=0.07, log *ft*=6.7 (1985Kl05).
(1345 *10*)	1332.7		0.14	6.4	0.14	I(ε+β⁺)=0.14, log *ft*=6.4 (1985Kl05, to 1333 alone); I(ε+β⁺)=0.31 *3*, log *ft*=5.99 (2004Al35, to 1333+1366).
(1402 *10*)	1276.2		0.19	6.3	0.19	I(ε+β⁺)=0.19, log *ft*=6.3 (1985Kl05).
(1431 *10*)	1247.3	0.0019	1.6	5.4	1.6	I(ε+β⁺)=1.6, log *ft*=5.4 (1985Kl05, to 1247 alone); I(ε+β⁺)=1.90 *4*, log *ft*=5.28 (2004Al35, to 1247+1277).
(1727 *10*)	950.6	<0.0004	<0.04	>7.1	<0.04	I(ε+β⁺)<0.04, log *ft*>7.1 (1985Kl05); I(ε+β⁺)=0.0070 *3*, log *ft*=7.90 (2004Al35).
(1883 *10*)	794.8	0.002	0.09	6.9	0.09	I(ε+β⁺)=0.09, log *ft*=6.9 (1985Kl05); I(ε+β⁺)=0.0 (2004Al35).
(2020 *10*)	657.8	<0.001	<0.04	>7.3	<0.04	I(ε+β⁺)<0.04, log *ft*>7.3 (1985Kl05); I(ε+β⁺)=0.0 (2004Al35).
2032 *60*	620.241	3.75	93.1	3.9	96.8	I(ε+β⁺)=96.8, log *ft*=3.95 (1985Kl05); I(ε+β⁺)=96.2 *2*, log *ft*=3.92 (2004Al35).
(2397 *10*)	280.9	<0.004	<0.04	>7.5	<0.04	I(ε+β⁺)<0.4, log *ft*>7.5 (1985Kl05); I(ε+β⁺)=0.0070 *1*, log *ft*=8.21 (2004Al35).
(2483 *10*)	195.5	<0.01	<0.09	>7.1	<0.1	I(ε+β⁺)<0.1, log *ft*>7.1 (1985Kl05); I(ε+β⁺)=0.0 (2004Al35).
(2500 *10*)	178.5	<0.02	<0.2	>6.8	<0.2	I(ε+β⁺)<0.2, log *ft*>6.8 (1985Kl05); I(ε+β⁺)=0.0 (2004Al35).
(2568 *10*)	109.6	<0.003	<0.02	>7.8	<0.02	I(ε+β⁺)<0.2, log *ft*>7.9 (1985Kl05); I(ε+β⁺)=0.0 (2004Al35).

† Absolute intensity per 100 decays.

γ(^{148}Tb)

Iγ normalization: I(γ+ce)(g.s.)=100 assuming that the g.s. feeding is zero.

Eγ	E(level)	Iγ†#	Mult.‡	α	Comments
85.8	195.5	4	M1	3.41	
102.3	280.9	3	M1	2.06	
109.4	109.6	5	E2	1.88	
136.9	794.8	13	(M1)	0.898	
156.0	950.6	1			
178.3	178.5	54	E1	0.0637	
339.6	620.241	4			
442.0	620.241	13	(M1)	0.0376	
462.1	657.8	11	(M1)	0.0335	
616.2	794.8	1			
620.24 *1*	620.241	10000	E1	0.00308	Mult.: α(K)exp=265×10⁻⁵ *30* (1975Gr35). Eγ: from 1985Kl05.
627	1247.3	7			
657.8	657.8	17	(M1)	0.01373	
691.9	1642.5	17		0.0124	M1 (1985ZuZX); contradicts Δπ.
772.0	950.6	1			
794.9	794.8	21	(M1)	0.00860	
847.1	1642.5	8			M1 (1985ZuZX); contradicts Δπ.
890.0	1840.5	25			M1 (1985ZuZX); contradicts Δπ.
950.8	950.6	40	(M1)	0.00557	
1045.9	1840.5	29			M1 (1985ZuZX); contradicts Δπ.
1068.9	1247.3	8			
1085.4	1366.1	4			
1097	1276.2	1			
1187.5	1366.1	3			
1247.2	1247.3	150	E1	8.42×10⁻⁴	
1276.9	1276.2	19			
1332.7	1332.7	15			
1366	1366.1	2			
1547	1828.3	1			

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^{148}Dy ε Decay 1985ZuZX (continued)

γ(^{148}Tb) (continued)

Eγ	E(level)	Iγ†#
1642.9	1642.5	1
1650.2	1828.3	4
1840.1	1840.5	6

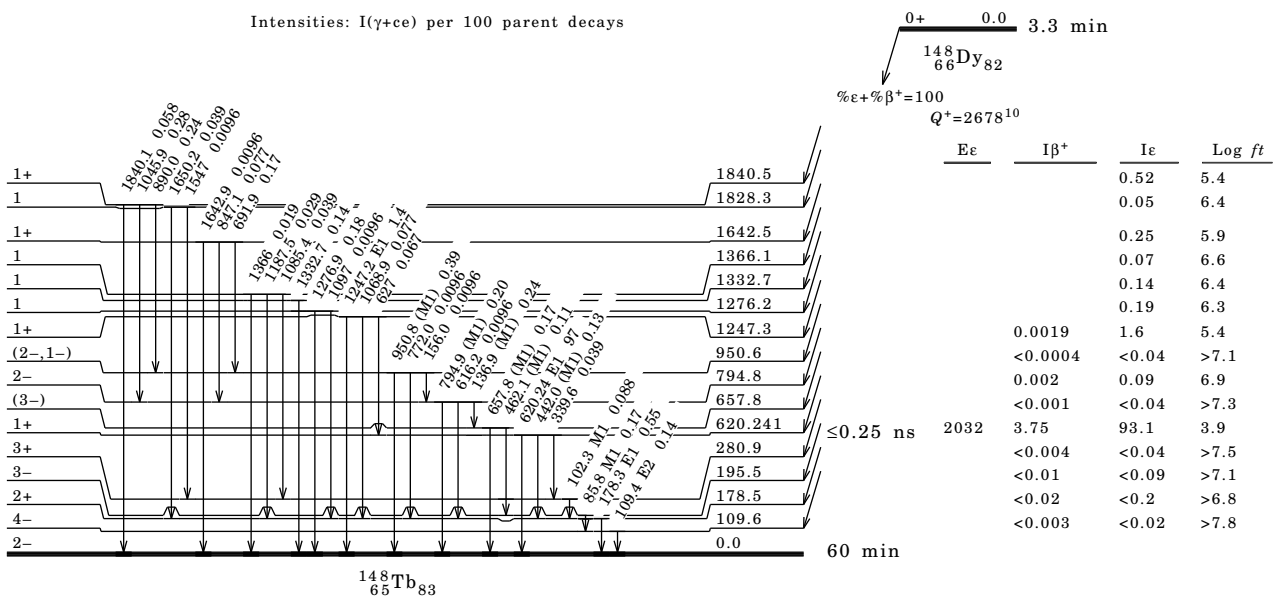
† I(178.5γ+950.6γ+1247.3γ)≈2.5% of I(620γ) (1988To03).

‡ From adopted gammas; supported by α(K)exp whose values and normalization are not given by authors (1985ZuZX). These are considered to be tentative especially since there are inconsistencies between Jπ deduced from log *ft* and multipolarities of γ transitions.

For absolute intensity per 100 decays, multiply by 0.009639.

Decay Scheme

Intensities: I(γ+ce) per 100 parent decays



Eε	Iβ+	Iε	Log *ft*
		0.52	5.4
		0.05	6.4
		0.25	5.9
		0.07	6.6
		0.14	6.4
		0.19	6.3
	0.0019	1.6	5.4
	<0.0004	<0.04	>7.1
	0.002	0.09	6.9
	<0.001	<0.04	>7.3
2032	3.75	93.1	3.9
	<0.004	<0.04	>7.5
	<0.01	<0.09	>7.1
	<0.02	<0.2	>6.8
	<0.003	<0.02	>7.8

^{152}Ho α Decay (161.8 s)

Parent ^{152}Ho: E=0.0; Jπ=2−; $T_{1/2}$=161.8 s *3*; Q(g.s.)=4507.3 *13*; %α decay=12 *3*.

^{152}Ho−%α decay: from 1977Ha48; others: 0.017 *3* and 0.03 (1974Sc19), 0.30 +*30*−*15* (1963Ma17).

Measured: Eα (1977Ha48,1974PeZS,1973BoXL,1970To16,1967Ha34,1963Ma17), α−γ coin (1987LiZT), branching (1977Ha48,1974Sc19,1963Ma17).

^{148}Tb Levels

E(level)	Jπ
0.0	2−
110	4−
178	2+
195	3−
281	3+

^{152}Ho α Decay (161.8 s) (continued)

α radiations

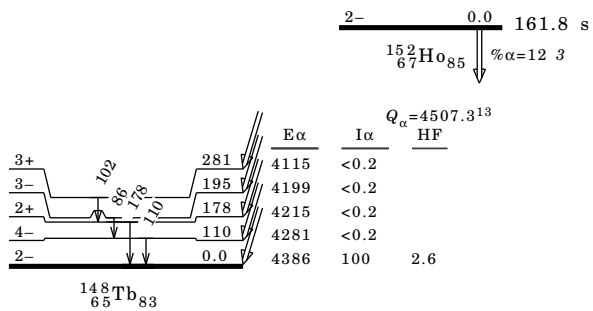
Eα	E(level)	Iα†	HF	Comments
4115	281	<0.2		
4199	195	<0.2		
4215	178	<0.2		
4281	110	<0.2		
4386 *3*	0.0	100	2.6	Eα: from 1987LiZT; others: 4387 *3* (1973BoXL), 4395 *10* (1977Ha48), 4345 *15* (1974PeZS), 4380 *10* (1970To16), 4370 *20* (1967Ha34), 4380 *20* (1963Ma17).

† For α intensity per 100 decays, multiply by 0.12 *3*.

γ(^{148}Tb)

Eγ	E(level)
86	195
102	281
110	110
178	178

Decay Scheme



^{152}Ho α Decay (50.0 s)

Parent ^{152}Ho: E=160 *1*; Jπ=9+; $T_{1/2}$=50.0 s *4*; Q(g.s.)=4507.3 *13*; %α decay=10.8 *17*.
^{152}Ho–%α decay: av of 1979To09 and 1981Ga36; others: 0.064 *13* and 0.04 *1* (1974Sc19), 0.19 *5* (1963Ma17).
Measured: Eα (1973BoXL,1970To16,1963Ma17), α–γ coin (1987LiZT) branching (1979To09,1978ToZZ,1974Sc19,1963Ma17).

^{148}Tb Levels

E(level)	Jπ†	$T_{1/2}$	Comments
90.1 *3*	(9)+	2.20 min *5*	$T_{1/2}$: from adopted levels, gammas dataset.
328	7+		
406	8+		

† From Adopted Levels.

α radiations

Eα	E(level)	Iα†	HF	Comments
4149	406	<0.2		
4225	328	<0.2		
4454 *3*	90.1	100	2.5	Eα: from 1987LiZT; others: 4453 *3* (1973BoXL), 4460 *10* (1970To16), 4450 *20* (1963Ma17).

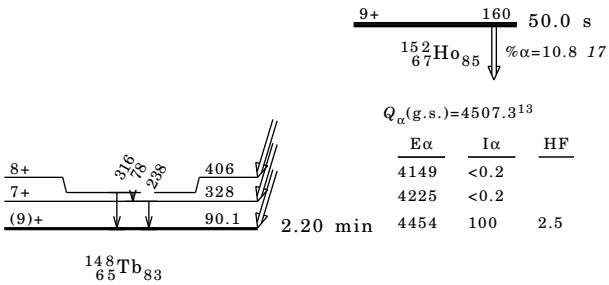
† For α intensity per 100 decays, multiply by 0.108 *17*.

^{152}Ho α Decay (50.0 s) (continued)

γ(^{148}Tb)

Eγ	E(level)
78	406
238	328
316	406

Decay Scheme



(HI,xnγ) 1995Sc25

Production: (HI,xpynγ) with ions: α (1979Br28), ^{6}Li, ^{7}Li (1993KlZZ,1987StZU,1987StZV,1988StZX), ^{10}B (1979Si08), ^{12}C, ^{14}N, ^{16}O (1980Ja16), ^{13}C (1995Id01), ^{16}O (1978BeYX), ^{31}P (1995Sc25),^{50}Ti, ^{65}Cu (1980Bo07), ^{130}Te (1995Id01).

Measured: γ, γ(t) (1978BeYX,1979Si08,1979Br28,1980Bo07,1980Ja16,1980Kh06,1982TaZS), γ(θ), γγ, ce (1978BeYX,1979Si08,1979Br28,1987StZU,1987StZV,1988StZX), linear polarization (1979Br28).

The level scheme is a combination of the data of many groups, including the results of ^{144}Sm(^{6}Li,xnγ), ^{144}Sm(^{7}Li,xnγ) (1993KlZZ,1987StZU,1987StZV,1988StZX), and the ^{122}Sn(^{31}P,5nγ), ^{120}Sn(^{31}P,3nγ) (1995Sc25) studies, with all level energies shifted up 90.1 keV. Out of a total of 31 excited states observed by 1995Id01, 8 levels from 5969 to 11795 keV are not confirmed by 1995Sc25 and have been left out.

2007Po13,2005Od04,2005Od03,2002GoZY: remeasured the 8618.6, 1.310 *7* μs isomer.

1980Vr01: search for α decay of high–spin isomers in ^{148}Tb with a $T_{1/2}$=19 ns; no evidence of α decay was observed.

^{148}Tb Levels

E(level)	Jπ†	$T_{1/2}$	Comments
0.0	2–	60 min *1*	
90.1 *3*	(9)+		E(level): from 1988StZX.
109.6 *2*	4–	80 ns‡ *4*	
178.4 *2*	2+	7.0 ns‡ *6*	
195.4	3–		
280.9	3+		
327.9 *4*	7+	4.5 ns‡ *4*	
345	5–		
351.3	5+		
375.3	4+		
406.0 *4*	8+	≤0.7 ns‡	
425.8	6+		
1095.8	(11)–	22 ns *1*	$T_{1/2}$: unweighted average of 22 ns *1* (1979Br28), 25 ns *2* (1979Si08), 20 ns *2* (1980Bo07), and 20 ns *2* (1980Ja16).
1220	(5–)		
1246	(6–)		
1249	9–		
1267	10+		
1295	(8–)		
1305	(7–)		
1380.0	(12)–		
1484	(10+)		
1654	(8+)		
1723	(9+)		

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(HI,xnγ) 1995Sc25 (continued)

^{148}Tb Levels (continued)

E(level)	Jπ†	E(level)	Jπ†	$T_{1/2}$	E(level)
2361.7		5225.4	(19−)		9972.5
2714.0	(14)−	5314.5	(19)		10148.0
2868.4		5558.4	(19)		10424.4
2953.9	(15)−	5747.0	(20−)		10511.6
3167.9	(16)−	6489.8	(21+)		10752.6
3367.1		6523.3	(21)		10791.6
3594.9	(17−)	6933.5			10880.1
3801.8	(17)−	7270.0	(23+)		10963.9
4178.5	(17)	7341.9	(23−)		11445.7
4238.9	(17)	7620.4	(24+)		12116.2
4295.7	(18)	7760.9	(26+)		12342.5
4422.9	(18−)	7833.8			12449.3
4504.9	(18)	8338.1			13060.2
4862.1	(18)	8618.6	(27+)	1.310 μs§ *7*	13379.6
4946.1		9196.0			14090.6
5008.9	(18)	9576.9	(29)		
5172.4	(18)	9920.0			

† From adopted levels; supported by γ(θ), conversion electron data, and systematics. Details not given by authors.
‡ From 1987StZV (γγ(t)).
§ From 1995Id01 (particle–γ coincidence data). Others: 1.3 μs *5* (1980Ja16), 0.84 μs *4* (1981BeYH).

γ(^{148}Tb)

Eγ	E(level)	Iγ§	Mult.‡	α	Comments
71.9	7341.9				
72.9	7833.8				
74.4	425.8		M1†	5.15	
78.1	406.0		M1†	4.48	
82.0	4504.9				
85.8	195.4		M1†	3.41	
88.5	10880.1				
94.4	375.3		M1†	2.59	
97.8	425.8		M1†	2.34	
102.5	280.9		M1†	2.05	
109.6 *2*	109.6		E2†	1.86	
140.2	7760.9				
142.3	5314.5				
172.3	10963.9				
175.3	10148.0				
178.4 *2*	178.4		E1†	0.0636	
184.0	4422.9				
214.1 *2*	3167.9	49 *5*	M1+E2	0.22 *4*	Mult.: A_2=−0.14 *1*, A_4=−0.01 *2* (1979Br28), A_2=−0.17 *3*, A_4=+0.09 *3*, α(K)exp=0.22 *3* (1979Si08).
216.6	5225.4				
227.2	10148.0				
237.8 *2*	327.9		E2†	0.1297	
240.0 *2*	2953.9	59 *6*	M1+E2	0.189	δ‡#: +0.09 *2*. Iγ: corrected for a 15% *8* contribution from the 240–keV γ from ^{145}Eu. Mult.: A_2=−0.09 *1*, A_4=+0.00 *2*; linear polarization=0.92 *6* (1979Br28), A_2=−0.11 *2*, A_4=+0.03 *2*, α(K)exp=0.16 *2* (1979Si08).
241.7	351.3		E1†	0.0287	
244.7	4422.9				
278.4	7620.4				
280.6	8618.6				
284.1 *2*	1380.0	100	M1†	0.1202	Mult.: A_2=−0.18 *1*, A_4=+0.01 *1*, linear polarization=0.94 *5* (1979Br28), A_2=−0.24 *3*, A_4=+0.02 *3*, α(K)exp=0.086 *5* (1979Si08).
315.9 *2*	406.0		M1†	0.0906	
328.0	10752.6				
333.0	5558.4				
336.6	7270.0				

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(HI,xnγ) 1995Sc25 (continued)

γ(^{148}Tb) (continued)

Eγ	E(level)	Iγ§	Mult.‡	α	Comments
350.6	7620.4				
363.0	5225.4				
418.7	7760.9				
427.0 *2*	3594.9	23 *3*	M1+E2	0.032 *10*	Mult.: A_2=+0.25 *5*, A_4=+0.07 *7* (1979Br28),.
434.7	3801.8				
443.7	6933.5				
452.0	5314.5				
452.7	10963.9				
454.1 *3*	3167.9	8 *2*	Q		Mult.: A_2=+0.4 *1*, A_4=–0.2 *2* (1979Br28).
481.8	11445.7				
491.4	7760.9				
493.8	4295.7				
498.7	3367.1				
504.4	8338.1				
506.7	2868.4				
521.6	5747.0				
522.5 *5*	4946.1	12 *1*			M: A_2=+0.2, A_4=–0.1 *1* (1979Br28).
565.6	11445.7				
566.3	4862.1				
571.1	10148.0				
577.0	8338.1				
577.4	9196.0				
621@ *1*	4422.9	≈6			
634.2 *2*	3801.8	29 *3*	M1+E2	0.012 *4*	Mult.: A_2=–0.13 *4*, A_4=–0.02 *6* (1979Br28).
640.8	3594.9				
654.1	11445.7				
690.2	1095.8				
693.7	11445.7				
700.8	4295.7				
720.5	5225.4				
742.6	6489.8				
746.6	7270.0				
775.5	9972.5				
780.1	7270.0				
784.8	8618.6				
793.9	1220				
802.5	5225.4				
809.7	5314.5				
816.3	10963.9				
820.1	1246				
828 *1*	4422.9	≈14			Iγ: composite γ in singles spectrum; Iγ estimated from coincidence spectra with ≈50% uncertainty. Mult.: A_2=–0.08 *4*, A_4=–0.02 *5* (1979Br28).
842.5	1249		E1†	1.65×10^{-3}	
847.6	10424.4				
857.7	8618.6				
869.5	1220				
888.7	1295				
896.8	12342.5				
899	1305				
917.9	1246				
929.4	5225.4				
930.3	13379.6				
931.5	6489.8				
934.7	10511.6				
944.0	13060.2				
952.0	10148.0				
958.3	9576.9				
967.1	1295				
981.7	2361.7				
1003.6	12449.3				

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(HI,xnγ) 1995Sc25 (continued)

γ(^{148}Tb) (continued)

Eγ	E(level)	Iγ§	Mult.‡	α	Comments
1006.2	1095.8	98 *16*	M2+E3†	0.0071 *6*	δ‡#: 2.23 *55*. Iγ: corrected for a 25% *8* contribution from the 1007–keV γ in ^{148}Gd. Mult.: A_2=+0.04 *2*, A_4=–0.06 *2*, α(K)exp=0.0067 *9*, linear polarization=1.09 *12* (1979Br28), A_2=–0.03 *2*, A_4=–0.02, α(K)exp=0.0055 *5*, E3 (1979Si08).
1010.6	4178.5				
1030.4	14090.6				
1060.4	4862.1				
1071.0	4238.9				
1078.2	1484				
1152.3	12116.2				
1175.5	6489.8				
1175.7	10752.6				
1177.2	1267				
1207.1	5008.9				
1208.8	6523.3				
1214.7	10791.6				
1228	1654				
1247.7	1654				
1302.3	9920.0				
1317.4	1723				
1334.1 *3*	2714.0	87 *9*	E2	1.65×10^{-3}	Mult.: A_2=+0.31 *2*, A_4=–0.07 *3*, α(K)exp=0.00141 *17* (1979Br28). Others: A_2=+0.30 *3*, A_4=+0.00 *3*, α(K)exp=+0.0021 *2*, M1+E2, δ=+0.32 *5* (1979Si08).
1353.9	9972.5				
1370.6	5172.4				
1394.0	1484				
1395.3	1723				
1563.0	1654				
1631.0	5225.4				
1633	1723				

† From γ(θ), DCO ratios, and conversion electron data (1993KlZZ,1987StZV,1987StZU,1988StZX).
‡ From γ(θ), linear polarization, and conversion electron data of 1979Br28 and 1979Si08, unless indicated otherwise.
§ Relative intensity (1979Br28).
# If no value given it was assumed δ=1.00 for E2/M1, δ=1.00 for E3/M2 and δ=0.10 for the other multipolarities.
@ Placement of transition in the level scheme is uncertain.

Adopted Levels, Gammas

Q(β⁻)=–9860 *80*; S(n)=11728 *13*; S(p)=4400 *12*; Q(α)=1481 *29* 2012Wa38.
Mass measurement (Penning trap): 2007Ra37, 2000Be42.
Gamow–Teller giant state (total absorption spectroscopy): 2004Al35.

^{148}Dy Levels

Cross Reference (XREF) Flags

A	^{148}Ho ε Decay (2.2 s)	D	^{149}Er εp Decay (8.9 s)
B	^{148}Ho ε Decay (9.59 s)	E	^{152}Er α Decay
C	^{149}Er εp Decay (4 s)	F	(HI,xnγ)

E(level)[§]	Jπ[†]	XREF	$T_{1/2}$	Comments
0.0	0+	AB EF	3.3 min *2*	$T_{1/2}$: unweighted average of 3.1 min *1* (1975To03) and 3.5 min *2* (1974GrYZ,1974La32,1975Gr35). %ε+%β⁺=100. Rms charge radius $<r^2>^{1/2}$=5.0538 fm *2030* (2004An14); others: see 2000Ga58.
1677.3	2+	AB F		Jπ: γ to 0+ is E2.
1687.5	3–	B F		Jπ: γ to 0+ is E3.
2348.3	5–	B F		Jπ: E2 to 3– and log *ft*=5.8 from (5)–.
2426.7	4+	B F		
2731.0	6+	B F		
2738.1	7–	B F		
2832.2	8+	B F	65 ns *10*	$T_{1/2}$: from 1980Kl09 (HI,xnγ).
2853.9	(5,6)–	B		Jπ: log *ft*=5.5 from (5)– and M1 to 5–.
2919.1	10+	F	471 ns *20*	$T_{1/2}$: from 1981Ha17 (HI,xnγ). Other: 480 ns *30* (1978Da14) (HI,xnγ).
2969.6	(5,6,7)–[‡]	B		
2995.2	(4)–	B		
3115.4	(6,7)–	B		Jπ: log *ft*=6.2 from (5)– and M1 to 7–.
3171.7	(5,6,7)–[‡]	B		
3188.6	(5,6,7)–[‡]	B		
3279.6	(6)–	B		
3323.2	(6)–	B		
3327.7	(5)–	B		
3405.0	(8)–	B		
3755.8	(5,6,7)–[‡]	B		
3980.7	(11–)	F		
4289.5	(5,6,7)–[‡]	B		
4393.0	(5,6,7)–[‡]	B		
4459.8	(5,6,7)–[‡]	B		
4477.2	(12–)	F		
4634.2	(5,6,7)–[‡]	B		
4761.9	(5,6,7)–[‡]	B		
4851.4	(12+)	F		
5054.6	(5,6,7)–[‡]	B		
5261.0	(5,6,7)–[‡]	B		
5270.4	(13)	F		
5410.5	(14+)	F		
5522.9	(14–)	F		
5772.4	(15–)	F		
5985.5	(16–)	F		
6264.5	(17–)	F		
6591.8	(18)	F		
6601?[#]		F		
7115.7	(17–)	F		
7434.6	(18+)	F		
8198.5	(19)	F		
8532.0	(20)	F		
8785.4		F		
9017.4		F		
9169.6		F		
9289.8	(21)	F		
9704.3		F		
10058.0		F		
10103.1		F		
10111.5	(23)	F		

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Adopted Levels, Gammas (continued)

^{148}Dy Levels (continued)

E(level)§	XREF
10456.4	F
10933.5	F
11816.4	F
12536.8	F
12651.5	F
13220.0	F
14235.0	F

† The values of Jπ are based on unpublished data on γ(θ) and α(K)exp (1989DrZZ,1986DiZZ), see also 1982JuZY, 1981Kl05, and 1981Ha17 (HI,xnγ); the values of Jπ for levels populated only in ε decay were derived from branching and log *ft* data (1989Ta11).
‡ From log *ft* values for ε decay from (5)–.
§ Levels with E>2919.1 and J>10 are from 1989DrZZ.
# From 1981Ha17, not observed in 1989DrZZ.

γ(^{148}Dy)

E(level)	Eγ†	Iγ	Mult.†	α	Comments
1677.3	1677.3 *1*	100	E2	1.24×10^{-3}	
1687.5	(10)	≈0.75	[E1]	27.0	
	1687.5 *1*	100	E3	0.00213	
2348.3	660.8 *1*	100	E2‡	0.00759	
2426.7	739.4 *1*	100 *7*	E1	0.00224	
	749.4 *2*	50 *4*	E2	0.00568	
2731.0	304.3 *1*	100	E2	0.0618	
	382.7		E1	0.00951	
2738.1	389.8 *1*	100	E2‡	0.0298	
2832.2	94.1 *2*	100 *20*	E1	0.363 *6*	B(E1)(W.u.)≈4.5×10^{-6}.
	101.2 *6*	20 *4*	E2	2.59 *7*	B(E2)(W.u.)=3.8 *13*.
2853.9	504.3 *2*	100	M1‡	0.0291	
2919.1	86.9	100	E2	4.60	B(E2)(W.u.)=0.93 *7*.
2969.6	115.6 *3*	23 *1*	M1‡	1.58 *3*	
	542.0 *5*	12 *2*			
	620 *1*	49 *14*			
	1281.3 *2*	100 *3*			
2995.2	567.3 *2*	81 *6*			
	1307.2 *2*	100 *9*			
3115.4	261.5 *5*	13 *3*			
	282.2 *5*	10 *2*			
	376.1 *5*	28 *4*	M1‡	0.0621	
	765.9 *2*	100 *5*			
3171.7	1483.4 *2*	100			
3188.6	1500.3 *2*	100			
3279.6	164.1 *3*	28 *4*	M1‡	0.588	
	425.7 *4*	31 *6*			
	930.0 *3*	100 *7*			
3323.2	353.6 *4*	33 *5*	M1‡	0.0730	
	583.7 *3*	24 *6*			
	973.6 *2*	100 *3*			
3327.7	1639.4 *4*	100			
3405.0	665.8 *4*	100			
3755.8	1328.3 *5*	28 *6*			
	1405.9 *2*	100 *6*			
3980.7	1061.1	100	E1	1.12×10^{-3}	
4289.5	1101.0 *3*	63 *3*			
	1320.0 *2*	55 *3*			
	1861.5 *4*	26 *3*			
	1939.7 *3*	100 *4*			
	2600.9 *4*	16 *2*			
4393.0	1397.3 *3*	100 *10*			
	1661.5 *8*	31 *7*			
	2043.4 *4*	35 *8*			

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Adopted Levels, Gammas (continued)

γ(^{148}Dy) (continued)

E(level)	Eγ†	Iγ	Mult.†	α
4459.8	2110.2 *4*	100		
4477.2	496.5	100	M1	0.0302
4634.2	2284.6 *4*	100 *8*		
	2945.8 *10*	17 *6*		
4761.9	2412.4 *4*	100 *8*		
	3073.4 *6*	27 *6*		
4851.4	1932.3	100	E2	1.10×10^{-3}
5054.6	2705.0 *4*	100		
5261.0	2291.4 *4*	100		
5270.4	418.3			
	794.0		D	
5410.5	559.1	100	E2	0.01139
5522.9	1045.7	100	E2	0.00277
5772.4	361.8		E1	0.01087
	502.2		Q	
5985.5	212.7			
	462.9		E2	0.0186
6264.5	279.4		M1	0.1366
	491.4		E2	0.01586
6591.8	327.3	100	D	
6601?	829#	100		
7115.7	851.6			
	1130.9		(D)	
7434.6	318.4		D	
	1170.6		(E1)	9.49×10^{-4}
8198.5	763.95	100	D	
8532.0	333.5	100	D	
8785.4	586.9	100		
9017.4	818.9			
9169.6	152.0		D	
	637.9			
	971.0			
9289.8	757.8	100	D	
9704.3	535.2		D	
	1171.9			
10058.0	353.7	100	D	
10103.1	933.5	100		
10111.5	407.1			
	821.8		Q	
10456.4	353.3			
	398.5			
	750.5			
10933.5	477.4			
	821.0#			
11816.4	882.9	100	Q	
12536.8	720.4	100	D	
12651.5	114.7		D	
13220.0	568.5	100	(D)	
14235.0	1015.0	100		

† Data for γ's from levels with E>2919.1 and J>10 are from 1989DrZZ. γ's with mult labeled D and Q are stretched ΔJ=1 and ΔJ=2 transitions respectively (from γ(θ)) (1989DrZZ).

‡ From ce data in ^{148}Ho ε decay (9.59 s).

Placement of transition in the level scheme is uncertain.

^{148}Ho ε Decay (2.2 s) 1982No08

Parent ^{148}Ho: E=0.0; Jπ=(1+); $T_{1/2}$=2.2 s *11*; Q(g.s.)=9860 *80*; %ε+%β$^+$ decay=100.
Measured: γ, γγ, γ(t) (1988To03,1982No08).

^{148}Dy Levels

E(level)	Jπ†
0.0	0+
1677.7 *3*	2+

† From adopted values.

β$^+$,ε Data

Normalization is from 1982No08; the basis is not given.

Eε	E(level)	Iβ$^+$†	Iε†	Log *ft*	I(ε+β$^+$)†
(8180 *80*)	1677.7	6.9 *13*	0.50 *10*	5.49 *24*	7.4 *14*
(9860 *80*)	0.0	89.1 *14*	3.50 *11*	4.80 *22*	92.6 *14*

† Absolute intensity per 100 decays.

^{148}Ho ε Decay (2.2 s) 1982No08 (continued)

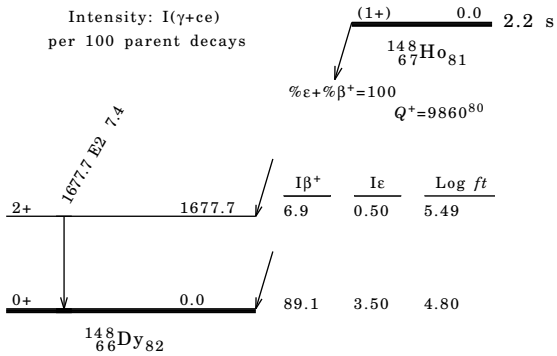
γ(^{148}Dy)

Normalization is from 1982No08; the basis is not given.

Eγ	E(level)	Iγ‡	Mult.†
1677.7 *3*	1677.7	7.4 *14*	E2

† From adopted gammas.
‡ Absolute intensity per 100 decays.

Decay Scheme



^{148}Ho ε Decay (9.59 s) 1988To03,1989Ta11,1996Ga24

Parent ^{148}Ho: E=0.0+x; Jπ=(5–); $T_{1/2}$=9.59 s *15*; Q(g.s.)=9860 *80*; %ε+%β+ decay=100.
Others: 1981GaZS, 1979To01.
Measured: γ, γγ, K x ray, delayed protons (1988To03), γ, γγ, Xγ (1989Ta11), ce (1996Ga24).

^{148}Dy Levels

Delayed proton emission probability=0.08% *1* (1988To03).

E(level)†	Jπ‡	Comments
0.0	0+	
1677.81 *17*	2+	
1688.31 *17*	3–	
2349.65 *21*	5–	Jπ: E2 to 3– and log *ft*=5.8 from (5)–.
2427.82 *19*	4+	
2732.25 *23*	6+	
2739.30 *25*	7–	
2833.7 *3*	8+	
2853.97 *25*	(5,6)–	Jπ: log *ft*=5.5 and M1 to 5–.
2969.56 *22*	(5,6,7)–§	
2995.27 *22*	(4)–	
3115.6 *3*	(6,7)–	Jπ: log *ft*=6.2, M1 to 7–.
3171.7 *3*	(5,6,7)–§	
3188.57 *24*	(5,6,7)–§	
3279.7 *3*	(6)–	
3323.2 *3*	(6)–	
3327.7 *5*	(5)–	
3405.1 *5*	(8)–	
3755.6 *3*	(5,6,7)–§	
4289.47 *23*	(5,6,7)–§	
4392.8 *3*	(5,6,7)–§	
4459.9 *5*	(5,6,7)–§	
4634.3 *5*	(5,6,7)–§	
4762.0 *4*	(5,6,7)–§	
5054.7 *5*	(5,6,7)–§	

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^{148}Ho ε Decay (9.59 s) 1988To03,1989Ta11,1996Ga24 (continued)

^{148}Dy Levels (continued)

E(level)†	Jπ‡
5261.0 *5*	(5,6,7)–§

† From a least–squares fit to Eγ data.
‡ Adopted values, supported by log *ft* values and γ branchings.
§ From log *ft* values for ε decay from (5)–.

β+,ε Data

ε feeding was determined on the assumption of no ε decay to ^{148}Dy ground state. log *ft* values calculated by setting parent level energy=0.0.

Eε	E(level)	Iβ+†	Iε†	Log *ft*	I(ε+β+)†
(4600+x *80*)	5261.0	1.13 *10*	0.60 *6*	5.54 *6*	1.73 *15*
(4810+x *80*)	5054.7	0.85 *10*	0.38 *5*	5.78 *6*	1.23 *14*
(5100+x *80*)	4762.0	1.81 *14*	0.65 *6*	5.59 *5*	2.46 *19*
(5230+x *80*)	4634.3	1.37 *13*	0.46 *5*	5.77 *6*	1.83 *17*
(5400+x *80*)	4459.9	0.87 *10*	0.25 *3*	6.05 *6*	1.12 *13*
(5470+x *80*)	4392.8	2.15 *20*	0.61 *6*	5.69 *6*	2.76 *25*
(5570+x *80*)	4289.47	9.5 *3*	2.50 *14*	5.09 *4*	12.0 *4*
(6100+x *80*)	3755.6	3.0 *3*	0.58 *5*	5.81 *5*	3.6 *3*
(6450+x *80*)	3405.1	0.92 *14*	0.144 *23*	6.46 *8*	1.06 *16*
(6530+x *80*)	3327.7	1.88 *11*	0.284 *21*	6.17 *4*	2.16 *13*
(6540+x *80*)	3323.2	2.28 *13*	0.344 *24*	6.09 *4*	2.62 *15*
(6580+x *80*)	3279.7	2.05 *14*	0.303 *24*	6.15 *5*	2.35 *16*
(6670+x *80*)	3188.57	2.23 *17*	0.31 *3*	6.15 *5*	2.54 *19*
(6690+x *80*)	3171.7	2.28 *15*	0.319 *24*	6.14 *4*	2.60 *17*
(6740+x *80*)	3115.6	2.24 *16*	0.305 *25*	6.17 *5*	2.55 *18*
(6860+x *80*)	2995.27	0.82 *20*	0.11 *3*	6.65 *11*	0.93 *23*
(6890+x *80*)	2969.56	6.7 *8*	0.85 *11*	5.74 *6*	7.6 *9*
(7010+x *80*)	2853.97	13.5 *3*	1.61 *7*	5.48 *3*	15.1 *3*
(7030+x *80*)	2833.7	0.71 *21*	0.084 *25*	6.77 *13*	0.79 *23*
(7120+x *80*)	2739.30	2.34 *22*	0.26 *3*	6.28 *5*	2.60 *24*
(7130+x *80*)	2732.25	3.1 *3*	0.34 *3*	6.16 *5*	3.4 *3*
(7430+x *80*)	2427.82	3.6 *3*	0.36 *3*	6.19 *5*	4.0 *3*
(7510+x *80*)	2349.65	9.2 *9*	0.87 *9*	5.81 *5*	10.1 *10*

† Absolute intensity per 100 decays.

γ(^{148}Dy)

Iγ normalization: ΣI(γ+ce)(g.s.)=100.

Eγ†	E(level)	Iγ§&	Mult.#	α	I(γ+ce)&	Comments
(10.5)	1688.31	0.51 *4*	[E1]	26.1	13.8 *11*	Eγ,Iγ: from balance of I(γ+ce)(10.5γ)/I(γ+ce)(1688γ)= 0.167 *13*, measured by 1989Ta11.
94.5 *2*	2833.7	0.44 *5*	E1	0.359 *6*		Eγ: from 1988To03.
101.5 *3*	2833.7	0.11 *6*	E2	2.57 *5*		
115.6 *3*	2969.56	1.30 *5*	M1@	1.58 *3*		α(K)exp=1.3 *3* (1996Ga24).
164.1 *3*	3279.7	0.37 *5*	M1@	0.588		α(K)exp=4.2×10^{-1} *12* (1996Ga24).
261.5 *5*	3115.6	0.27 *7*				
282.2 *5*	3115.6	0.20 *5*				
304.5 *2*	2732.25	1.50 *7*	E2	0.0616		
353.6 *4*	3323.2	0.54 *8*	M1@	0.0730		α(K)exp=8×10^{-2} *5* (1996Ga24).
376.1 *5*	3115.6	0.57 *8*	M1@	0.0621		α(K)exp=5.5×10^{-2} *26* (1996Ga24).
382.6 *2*	2732.25	2.76 *13*	E1			
389.6 *2*	2739.30	5.11 *9*	E2@	0.0299		α(K)exp=1.9×10^{-2} *5* (1996Ga24).
425.7 *4*	3279.7	0.42 *8*				
x435.4‡ *6*		0.6‡ *1*				
504.3 *2*	2853.97	18.62 *11*	M1@	0.0291		α(K)exp=2.3×10^{-2} *5* (1996Ga24).
x540.5 *5*		0.46 *11*				
542.0 *5*	2969.56	0.67 *11*				

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^{148}Ho ε Decay (9.59 s) 1988To03,1989Ta11,1996Ga24 (continued)

γ(^{148}Dy) (continued)

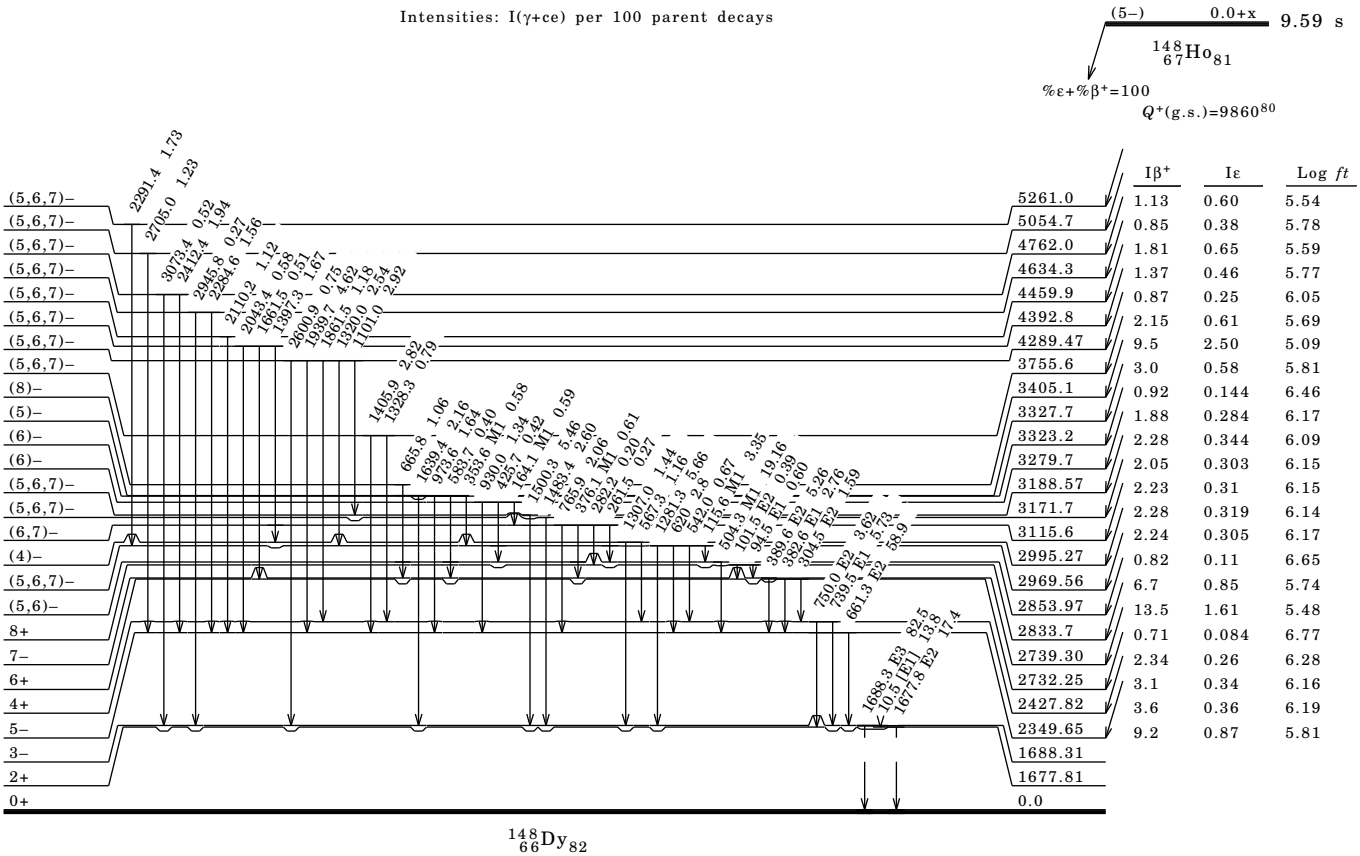
Eγ†	E(level)	Iγ§&	Mult.#	Comments
567.3 *2*	2995.27	1.16 *8*		
583.7‡ *3*	3323.2	0.4‡ *1*		
620 *1*	2969.56	2.79 *80*		
661.3 *2*	2349.65	58.94 *16*	E2@	α(K)exp=5.9×10^{-3} *13* (1996Ga24).
665.8 *4*	3405.1	1.06 *16*		
739.5 *2*	2427.82	5.73 *10*	E1	
750.0 *2*	2427.82	3.62 *9*	E2	
x760.4 *3*		0.47 *7*		
765.9 *2*	3115.6	2.06 *10*		
x917.3 *4*		0.32 *11*		
930.0 *3*	3279.7	1.34 *10*		
x961.2‡ *3*		0.8‡ *1*		
973.6 *2*	3323.2	1.64 *5*		
x996.0 *4*		0.45 *11*		
1101.0 *3*	4289.47	2.92 *13*		
x1176.4‡ *6*		1.1‡ *3*		
x1202.2 *4*		0.49 *12*		
1281.3 *2*	2969.56	5.66 *17*		Iγ: derived from coincidence data.
1307.0 *2*	2995.27	1.44 *13*		
1320.0 *2*	4289.47	2.54 *16*		
1328.3 *5*	3755.6	0.79 *17*		
x1391.8 *4*		0.71 *14*		
1397.3 *3*	4392.8	1.67 *17*		
1405.9 *2*	3755.6	2.82 *18*		
1483.4 *2*	3171.7	2.60 *16*		
1500.3 *2*	3188.57	5.46 *13*		
x1504.3‡ *6*		1.3‡ *2*		
x1600.4‡ *4*		0.8‡ *2*		
1639.4 *4*	3327.7	2.16 *12*		
1661.5 *8*	4392.8	0.51 *12*		
1677.8 *2*	1677.81	17.4 *11*	E2	
1688.3 *2*	1688.31	82.47 *30*	E3	
1861.5 *4*	4289.47	1.18 *14*		
1939.7 *3*	4289.47	4.62 *17*		
2043.4 *4*	4392.8	0.58 *13*		
2110.2 *4*	4459.9	1.12 *13*		
2284.6 *4*	4634.3	1.56 *13*		
2291.4 *4*	5261.0	1.73 *14*		
2412.4 *4*	4762.0	1.94 *15*		
2600.9 *4*	4289.47	0.75 *11*		
2705.0 *4*	5054.7	1.23 *14*		
2945.8 *10*	4634.3	0.27 *10*		
3073.4 *6*	4762.0	0.52 *11*		

† From 1989Ta11, unless indicated otherwise.
‡ Observed only in 1988To03.
§ Relative intensity (1989Ta11).
# From adopted gammas supported by ce data from this data set.
@ From ce data (1996Ga24).
& For absolute intensity per 100 decays, multiply by 1.00 *1*.
x γ ray not placed in level scheme.

^{148}Ho ε Decay (9.59 s) 1988To03,1989Ta11,1996Ga24 (continued)

Decay Scheme

Intensities: I(γ+ce) per 100 parent decays



^{149}Er εp Decay (4 s) 1989Fi01

Parent ^{149}Er: E=0.0; Jπ=(1/2+); $T_{1/2}$=4 s *2*; Q(g.s.)=6823 *29*; %εp decay=7 *2*.
^{149}Er–Q(εp): from 2012Wa38.
Measured p, γ, x, β+ in singles and coin. FWHM for protons ≈35 keV.

^{148}Dy Levels

E(level)	Jπ
0.0	0+

Delayed protons

Particle normalization: %εp=7 *2* (1989Fi01).

E(p)	E(^{148}Dy)	I(p)†	E(^{149}Ho)	Comments
2653	0.0	≈2.9	4100	
2850	0.0	≈2.3	4310	
3105	0.0	≈3.1	4560	
3330	0.0	≈1.1	4800	
3830	0.0	≈4.0	5300	
3909	0.0	≈6.4	5370	≈80% of the proton decay proceeds to continuum states.

† For intensity per 100 decays, multiply by 0.07 *2*.

^{149}Er εp Decay (8.9 s) 1989Fi01

Parent ^{149}Er: E=741.8 *4*; Jπ=(11/2−); $T_{1/2}$=8.9 s *2*; Q(g.s.)=6823 *29*; %εp decay=0.18 *7*.
^{149}Er−Q(εp): from 2012Wa38.
Measured p, γ, x, β^+ in singles and coin. FWHM for protons ≈35 keV.

^{148}Dy Levels

E(level)	Jπ†
0.0	0+
1677.9	2+
1688.4	3−
2349.4	5−
2427.6	4+
2732.3	6+
2739.3	7−

† From adopted levels.

Delayed protons

Particle normalization: %ε+%β^+=96.5 *7*; %εp=0.18 *7* (1989Fi01).

E(^{148}Dy)	I(p)†
0.0	72
1677.9	3
1688.4	7
2349.4	5
2427.6	6
2732.3	4
2739.3	3

† For intensity per 100 decays, multiply by 0.0018 *7*.

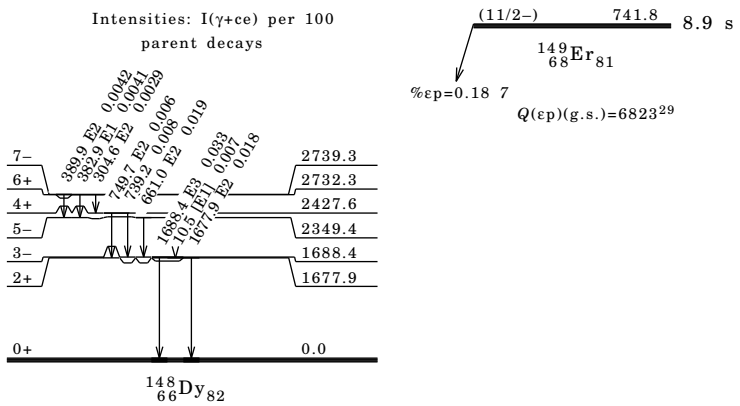
γ(^{148}Dy)

Eγ	E(level)	Iγ‡	Mult.†	α	I(γ+ce)‡
10.5	1688.4	0.2	[E1]	26.1	5
304.6	2732.3	2	E2	0.0616	
382.9	2732.3	3	E1	0.00950	
389.9	2739.3	3	E2	0.0298	
661.0	2349.4	14	E2	0.00759	
739.2	2427.6	6			
749.7	2427.6	4	E2	0.00567	
1677.9	1677.9	13	E2	1.24×10^{-3}	
1688.4	1688.4	24	E3	0.00212	

† From adopted gammas.
‡ For absolute intensity per 100 decays, multiply by 0.0014 *6*.

^{149}Er εp Decay (8.9 s) 1989Fi01 (continued)

Decay Scheme



^{152}Er α Decay

Parent ^{152}Er: E=0.0; Jπ=0+; $T_{1/2}$=10.3 s *1*; Q(g.s.)=4934.4 *16*; %α decay=91 *4*.
^{152}Er–Q(α): from 2012Wa38.
$T_{1/2}$(^{152}Er)=10.3 s *1*, measured by 1982Bo04 and adopted by 1996Ar09, is used in calculations here.

%α=91 *4* is used in calculations. This branching is an unweighted average of %α=93 *4* (1979Ho10), %α=94 *4* (1987To02) and %α=86 *4* (1987To02), determined by counting different γ's and the 4804α. %α=90 *4* is adopted by 1996Ar09 from the α branchings obtained by 1987To02.

^{148}Dy Levels

E(level)	Jπ
0.0	0+

α radiations

Eα	E(level)	Iα†§	HF‡	Comments
4804.3 *16*	0.0	100	1.000	Eα: recommended by 1991Ry01 from the measured energies of 4800 *10* (1970To16), 4806 *10* (1977Ha48), 4804 *2* (1981De22), 4805 *3* (1982Bo04), 4809 *10* (1983Ml01). The original energies are adjusted for changes in calibration energies, as recommended by 1991Ry01. Iα: only one α group was observed. An upper limit of 6.8×10^{-10} per 100 α decays is calculated for an unobserved 3171–keV α to the 1677.3–keV, 2+ state in ^{148}Dy by requiring HF(3171α)>1.

† α intensity per 100 α decays.
‡ r_0(^{148}Dy)=1.567 *3* is calculated from HF(4804α)=1.0.
§ For α intensity per 100 decays, multiply by 0.91 *4*.

(HI,xnγ)

(^{40}Ar,4nγ) E=175 MeV (1985DiZZ,1986DiZZ,1989DrZZ), (^{32}S,4nγ) E=145 MeV (1981Ha17), (^{16}O,4nγ) E=85–92 MeV, (α,8nγ) E=90–120 MeV (1982JuZY,1981Kl05,1980Kl09,1978Da14).

Measured: γ, γγ, γ(θ), γ(t) (1989DrZZ,1983JuZX,1982JuZY,1981Ha17,1981Kl05,1980Da18,1978Da14), ce (1978Da14,1981Kl05,1982JuZY).

Level scheme is that proposed by 1989DrZZ.

^{148}Dy Levels

E(level)	Jπ†	$T_{1/2}$	Comments
0.0	0+		
1677.3	2+		
1687.5	3−		
2348.3	5−		
2426.7	4+		
2731.0	6+		
2738.1	7−		
2832.2	8+	65 ns *10*	$T_{1/2}$: from 1980Kl09.
2919.1	10+	471 ns *20*	$T_{1/2}$: from 1981Ha17. Other: 480 ns *30* (1978Da14).
3980.7	(11−)		
4477.2	(12−)		
4851.4	(12+)		
5270.4	(13)		
5410.5	(14+)		
5522.9	(14−)		
5772.4	(15−)		
5985.5	(16−)		
6264.5	(17−)		
6591.8	(18)		
6601?			
7115.7	(17−)		
7434.6	(18+)		
8198.5	(19)		
8532.0	(20)		
8785.4			
9017.4			
9169.6			
9289.8	(21)		
9704.3			
10058.0			
10103.1			
10111.5	(23)		
10456.4			
10933.5			
11816.4			
12536.8			
12651.5			
13220.0			
14235.0			

† Adopted values, supported by unpublished data on γ(θ) and α(K)exp (1989DrZZ,1986DiZZ). Jπ assignments for levels above 3 MeV are considered as tentative.

γ(^{148}Dy)

Eγ‡	E(level)	Mult.†‡	α	Comments
(10.5)	1687.5			Eγ: established by γγ but not seen (1978Da14). E from E(level) difference.
86.9	2919.1	E2	4.60	α(exp)=4.8 *4*, α(L)exp=2.9 *4* (1980Da18).
94.1	2832.2	E1	0.363	α(exp)=0.40 *6*, α(L)exp<0.05 (1980Da18).
101.2	2832.2	E2	2.59	α(exp)=1.9 *4*, α(L)exp=1.3 *3* (1980Da18).
114.7	12651.5	D		
152.0	9169.6	D		
212.7	5985.5			
279.4	6264.5	M1	0.1366	Mult.: R=0.43 *4*.
304.3	2731.0	E2	0.0618	α(K)exp=5×10^{-2} *1* (1980Da18).

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(HI,xnγ) (continued)

γ(^{148}Dy) (continued)

Eγ‡	E(level)	Iγ	Mult.†‡	α	Comments
318.4	7434.6		D		
327.3	6591.8		D		
333.5	8532.0		D		Mult.: R=0.67 *6*.
353.3	10456.4				
353.7	10058.0		D		Mult.: R=0.71 *10*.
361.8	5772.4		E1	0.01087	Mult.: R=0.64 *9*.
382.7	2731.0		E1	0.00951	α(K)exp=1.1×10^{-2} *3* (1980Da18).
389.8	2738.1		E2	0.0298	α(K)exp=2.0×10^{-2} *3* (1980Da18).
398.5	10456.4				
407.1	10111.5				
418.3	5270.4				
462.9	5985.5		E2	0.0186	Mult.: R=1.04 *8*.
477.4	10933.5				
491.4	6264.5		E2	0.01586	
496.5	4477.2	129	M1	0.0302	α(K)exp=2.0×10^{-2} *5* (1980Da18). Mult.: R=0.76 *4*.
502.2	5772.4		Q		
535.2	9704.3		D		
559.1	5410.5		E2	0.01139	
568.5	13220.0		(D)		
586.9	8785.4		D		
637.6	9169.6				
660.8	2348.3		E2	0.00759	α(K)exp=0.60×10^{-2} *7* (1980Da18).
720.4	12536.8		D		
739.4	2426.7		E1	0.00224	α(K)exp=0.18×10^{-2} *8* (1980Da18).
749.4	2426.7		E2	0.00568	α(K)exp=0.55×10^{-2} *15* (1980Da18).
750.5	10456.4				
757.8	9289.8		D		
763.9	8198.5		D		Mult.: R=0.65 *5*.
794.0	5270.4		D		
818.9	9017.4		(D)		
821.0#	10933.5				
821.8	10111.5		Q		
829#	6601?				Eγ: observed only in 1981Ha17, not observed in 1989DrZZ.
851.6	7115.7		(D+Q)		
882.9	11816.4		Q		
933.5	10103.1				
971.0	9169.6		(Q)		
1015.0	14235.0				
1045.7	5522.9	108	E2	0.00277	Mult.: R=1.14 *9*. α(K)exp=0.23×10^{-2} *3* (1980Da18).
1061.6	3980.7	126	E1	1.12×10^{-3}	α(K)exp=0.08×10^{-2} *1* (1980Da18). Mult.: R=0.80 *4*.
1130.9	7115.7		(D)		
1170.6	7434.6		(E1)	9.49×10^{-4}	Mult.: R=1.00 *11*.
1171.9	9704.3		(Q)		
1677.3	1677.3		E2	1.24×10^{-3}	α(K)exp=0.11×10^{-2} *2* (1980Da18).
1687.5	1687.5		E3	0.00213	α(K)exp=0.18×10^{-2} *2* (1980Da18).
1932.3	4851.4	38	E2	1.10×10^{-3}	Mult.: R=1.28 *20*.

† From 1978Da14, 1980Kl09, 1982JuZY, 1980Da18, R=Iγ(0°)/Iγ(90°) (1981Ha17).

‡ From 1989DrZZ (for levels with E>2919, J>10). γ's labeled D and Q are ΔJ=1 and ΔJ=2 stretched transitions, respectively.

Placement of transition in the level scheme is uncertain.

Adopted Levels, Gammas

Q(β^-)=–6510 *80*; S(n)=10310 *80*; S(p)=1080 *80*; Q(α)=1950 *90* 2012Wa38.
Q(εp)=5460 *80*, S(2n)=22900 *80*, S(2p)=4810 *100* (2012Wa38).
Mass measurement (Penning trap): 2007Ra37.

^{148}Ho Levels

Cross Reference (XREF) Flags

A ^{148}Ho IT Decay (2.36 ms)
B ^{148}Er ε Decay (4.6 s)
C ^{149}Tm εp Decay (0.9 s)
D ^{112}Sn(^{40}Ar,p3nγ)

E(level)	Jπ	XREF	$T_{1/2}$	Comments
0.0	(1+)	B	2.2 s *11*	%ε+%β^+=100. $T_{1/2}$: from 1982No08. Jπ: probable allowed β transitions to 0+ g.s. in ^{148}Dy and from 0+ g.s. in ^{148}Er.
0.0+x	(5)–	A D	9.59 s *15*	%ε+%β^+=100; %εp=0.08 *1* (1988To03). E(level): 250 *100* from systematics (2011AuZY). $T_{1/2}$: from 1989Ta11, 1988To03; others: 9.7 s *3* (1988To03), 10 s *2* (1981GaZS), 9 s *1* (1979To01). Jπ: shell–model prediction (2010Ko12) with configuration= $\pi h_{11/2}\otimes\nu s_{1/2}{}^{-1}$. Parity from log *ft*≈5.3 to negative parity level at 2348 in ^{148}Dy.
32.3+x	(5–)	A D		Possible configuration=$\pi h_{11/2}\otimes\nu d_{3/2}{}^{-1}$.
141.5+x	(6–)	A D		Possible configuration=$\pi h_{11/2}\otimes\nu d_{3/2}{}^{-1}$.
141.7 *1*		B		
244.0 *1*		B		
315.3 *1*		B		
321.3+x	(7)–	A D		Jπ: E2 γ to (5)–. Possible configuration= $\pi h_{11/2}\otimes\nu(d_{3/2}{}^{-1}$ or $d_{5/2}{}^{-1})$.
429.3 *5*		B		
512.7 *6*		B		
525 *1*		B		
609.5 *3*		B		
694.4+x	(10)+	A D	2.36 ms *6*	%IT=100. $T_{1/2}$: from γ(t). Weighted average of 2.62 ms *18* (2010Ko12) and 2.35 ms *4* (1989Br22,1984Br07). Jπ: E3 γ to (7)–; shell–model prediction with configuration= $\pi h_{11/2}\otimes\nu h_{11/2}{}^{-1}$; also (10+) isomer in N=81 nuclides of ^{142}Pm, ^{146}Tb and ^{150}Tm.
924.9 *4*		B		
1311.8 *3*		B		
1636.8 *6*		B		
1645.8+x†‡ *13*	(11)	D		
2121.8 *5*		B		
2191.0+x†‡ *14*	(12)	D		
2735.3+x†‡ *14*	(13)	D		
2885.3+x†‡ *14*	(14)	D		
3040.1+x *15*	(15)	D		
3068.2+x†‡ *15*	(15)	D		
3168.5+x†‡ *15*	(15)	D		
3363.4+x‡ *15*	(17)	D		
3379.4+x *15*	(16)	D		
3789.4+x‡ *15*	(18)	D		

† If positive parity, then possible member of configuration= $(\pi h_{11/2}{}^3)_{27/2}\otimes\nu d_{5/2}{}^{-1}$.
‡ (A): γ sequence based on (11).

γ(^{148}Ho)

E(level)	Eγ	Iγ	Mult.	α	Comments
32.3+x	32.3 *7*	100			
141.5+x	108.5 *2*	100 *7*			
	141.5 *4*	45 *8*			
141.7	141.7 *1*	100			
244.0	244.0 *1*	100			
315.3	315.3 *1*	100			
321.3+x	180.2 *1*	47 *2*	[M1+E2]	0.42 *8*	
	321.3 *1*	100 *3*	E2	0.0543	Mult.: from ce data (2010Ko12).

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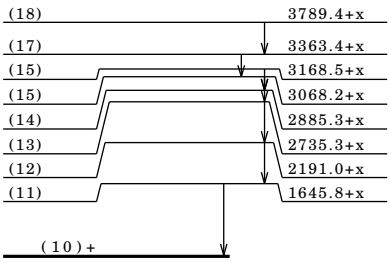
Adopted Levels, Gammas (continued)

γ(^{148}Ho) (continued)

E(level)	Eγ	Iγ	Mult.	α	Comments
429.3	287.6 *4*	100			
512.7	268.7 *5*	100			
525	383 *1*	100			
609.5	609.5 *3*	100			
694.4+x	373.1 *1*	100	E3	0.1229	Mult.: ce data in 2010Ko12. B(E3)(W.u.)=0.350 *9*.
924.9	924.9 *4*	100			
1311.8	1311.8 *3*	100			
1636.8	1027.3 *4*	100			
1645.8+x	951.8	100	D,Q		
2121.8	2121.8 *5*	100			
2191.0+x	545.2	100	D		
2735.3+x	544.3	100	D		
2885.3+x	150.0	100	D		
3040.1+x	154.8	100			
3068.2+x	182.9	100	(M1+E2)		
3168.5+x	283.2	100	(M1+E2)		
3363.4+x	295.2	100	Q		
3379.4+x	339.3	100			
3789.4+x	426.0	100			

(A) γ sequence based on (11)



$^{148}_{67}Ho_{81}$

^{148}Ho IT Decay (2.36 ms) 1989Br22,1984Br07

Parent ^{148}Ho: E=694.4+x; Jπ=(10)+; $T_{1/2}$=2.36 ms *6*; %IT decay=100.
1989Br22,1984Br07: ^{90}Zr(^{60}Ni,pnγ), E(^{60}Ni)=230 MeV, 250 MeV; measured Eγ, Iγ, γγ coin, (K x ray)γ coin, $T_{1/2}$.

^{148}Ho Levels

E(level)	Jπ†	$T_{1/2}$	Comments
0.0+x	(5)−		
32.3+x	(5−)		
141.5+x	(6−)		
321.3+x	(7)−		
694.4+x	(10)+	2.36 ms *6*	$T_{1/2}$: from γ(t). Weighted average of 2.62 ms *18* (2010Ko12) and 2.35 ms *4* (1989Br22,1984Br07).

† From Adopted Levels.

^{148}Ho IT Decay (2.36 ms) 1989Br22,1984Br07 (continued)

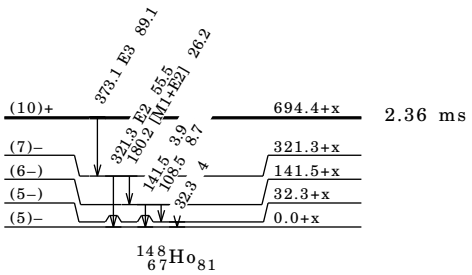
γ(^{148}Ho)

Eγ†	E(level)	Iγ‡#	Mult.§	α	Comments
32.3 *7*	32.3+x	5 *4*			
108.5 *2*	141.5+x	9.8 *7*			
141.5 *4*	141.5+x	4.4 *8*			
180.2 *1*	321.3+x	29.4 *10*	[M1+E2]	0.42 *8*	
321.3 *1*	321.3+x	62.3 *17*	E2	0.0543	
373.1 *1*	694.4+x	100.0 *22*	E3	0.1229	Mult.: from α estimated from intensity balance, see also Adopted Gammas.

† From 1989Br22.
‡ Relative intensity (1989Br22).
§ From Adopted Gammas.
# For absolute intensity per 100 decays, multiply by 0.8906 *14*.

Decay Scheme

Intensities: Iγ per 100 parent decays
%IT=100



^{148}Er ε Decay (4.6 s) 1988To03,1989Ta11

Parent ^{148}Er: E=0.0; Jπ=0+; $T_{1/2}$=4.6 s *2*; Q(g.s.)=6510 *80*; %ε+%β$^+$ decay=100.
^{148}Er–Q(ε): From 2011AuZZ.
Measured: γ (1989Ta11,1988To03,1982No08), γγ, (K x ray)γ (1989Ta11,1988To03), delayed p (1988To03).
No normalization has been given since the decay scheme is incomplete.

^{148}Ho Levels

Delayed proton emission probability ≈0.15% (1988To03).

E(level)†	Jπ	$T_{1/2}$	Comments
0.0	(1+)	2.2 s *11*	Jπ: 1988To03 estimate that the sum of the total transition intensities of 142γ, 244γ, and 315γ (if they are M1+E2) represent ≈25% of the total β$^-$ decay strength. Hence, they estimate ≈75% of the β$^-$ decay strength populating the g.s. with log *ft*≈4.7 and assign (1+) to the g.s.
141.6 *4*			
243.8 *4*			
315.2 *4*			
429.1 *7*			
512.5 *7*			
524.6 *11*			
609.5 *3*			
924.9 *4*			
1311.8 *3*			
1636.8 *5*			
2121.8 *5*			

† From a least–squares fit to Eγ data.

^{148}Er ε Decay (4.6 s) 1988To03,1989Ta11 (continued)

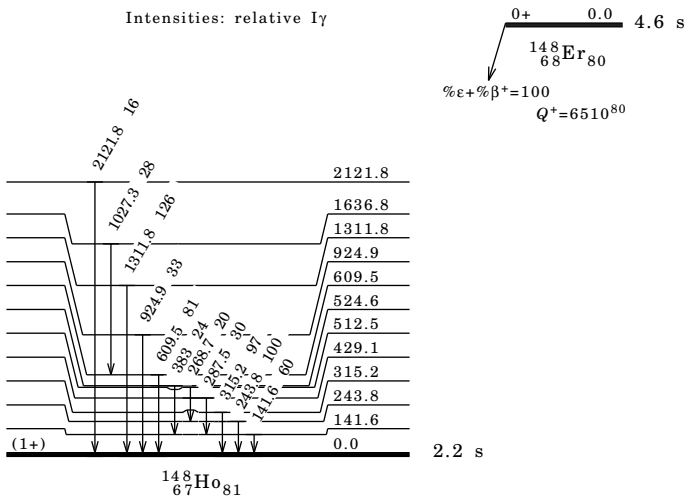
γ(^{148}Ho)

Iγ normalization: From Iγ(absolute)=6.4% *14* for 243.8γ and 5.8% *13* for 315.2γ (1982No08).

Eγ†	E(level)	Iγ‡§	Comments
141.6 *4*	141.6	60 *3*	
243.8 *4*	243.8	100 *5*	Iγ: 6.4% *14* (1982No08).
268.7 *5*	512.5	20 *5*	
287.5 *5*	429.1	30 *5*	
315.2 *4*	315.2	97 *7*	Iγ: 5.8% *13* (1982No08).
383 *1*	524.6	24 *7*	Eγ,Iγ: estimated from coincidence data.
609.5 *3*	609.5	81 *6*	
924.9 *4*	924.9	33 *7*	
1027.3 *4*	1636.8	28 *7*	
1311.8 *3*	1311.8	126 *11*	
2121.8 *5*	2121.8	16 *5*	

† From 1989Ta11.
‡ Relative intensity (1989Ta11).
§ For absolute intensity per 100 decays, multiply by 0.062 *13*.

Decay Scheme



^{149}Tm εp Decay (0.9 s) 1987To12

Parent ^{149}Tm: E=0; Jπ=(11/2−); $T_{1/2}$=0.9 s *2*; Q(g.s.)=6820 syst; %εp decay=0.25 *15*.
^{149}Tm−Q(εp): 6820 *310* (syst,2012Wa38).
^{149}Tm−%εp decay: %εp=0.2 *+2−1* (1987To12).
Measured delayed protons and p(x ray) coin. The proton spectrum was observed (1987To12) to have a weak peak with $T_{1/2}$≈0.9 s.
%εp=0.2 *+2−1* (1987To12), estimated from total β decay intensity.

$^{112}Sn(^{40}Ar,p3n\gamma)$ 2010Ko12

Includes $^{114}Sn(^{40}Ar,p5n\gamma)$.

E(^{40}Ar)=200, 206, 232 MeV. Measured Eγ, Iγ, ce, γγ, γ(θ), (ce)γ coin, γ(t), γγ(t) in the in–beam and beam–off modes using the OSIRIS–II array consisting of 12 Compton suppressed HPGe detectors at the Heavy Ion Laboratory (HIL), University of Warsaw cyclotron. The conversion electrons were detected with six Si(Li) detectors located inside the chamber, in which the combination of two magnetic fields was generated to separate e^+ from e^-.

^{148}Ho Levels

E(level)†	Jπ‡	$T_{1/2}$	Comments
0+x	5–	9.59 s *15*	Jπ: 2010Ko12 state that 6–, as suggested in ε decay of this isomer to ^{148}Dy, is not ruled out. $T_{1/2}$: from Adopted Levels. Configuration=$\pi h_{11/2}\otimes\nu s_{1/2}^{-1}$.
33.0+x *8*	(5–)		Configuration=$\pi h_{11/2}\otimes\nu d_{3/2}^{-1}$.
141.0+x *7*	(6–)		Configuration=$\pi h_{11/2}\otimes\nu d_{3/2}^{-1}$.
321.0+x *8*	7–		Configuration=$\pi h_{11/2}\otimes\nu(d_{3/2}^{-1},d_{5/2}^{-1})$.
694.0+x *13*	10+	2.62 ms *18*	Configuration=$\pi h_{11/2}\otimes\nu h_{11/2}^{-1}$. $T_{1/2}$: from weighted average of 2.97 ms *49* from 108γ(t), 2.68 ms *19* from 180γ(t), 2.58 ms *21* from 321γ(t), and 2.60 ms *15* from 373γ(t) (2010Ko12).
1645.8+x# *13*	(11)		If 11–, configuration=$\pi h_{11/2}{}^3{}_{27/2}\otimes\nu d_{5/2}^{-1}$. 2010Ko12 list (11+) in table III, but comparison with shell–model predictions seems to suggest 11– with above configuration.
2191.0+x§# *14*	(12)		In table V, configuration=$\pi h_{11/2}{}^3{}_{27/2}\otimes\nu d_{3/2}^{-1}$, but in text on page 10, it seems that neutron hole is in $d_{5/2}$; possibly a misprint in table V.
2735.3+x§# *14*	(13)		
2885.3+x§# *14*	(14)		
3040.1+x *15*	(15)		
3068.2+x§# *15*	(15)		
3168.5+x§ *15*	(15)		
3363.4+x# *15*	(17)		
3379.4+x *15*	(16)		
3789.4+x# *15*	(18)		

† From Eγ's, assuming 0.3 keV uncertainty when Eγ stated to tenths of keV, 1 keV otherwise.
‡ From 2010Ko12.
§ If positive parity, then possible member of configuration= $(\pi h_{11/2}{}^3)_{27/2}\otimes\nu d_{5/2}^{-1}$.
# (A): γ sequence based on (11).

γ(^{148}Ho)

Ratio R=W(25°)/W(90°), angular distribution ratio; Mean uncertainty of R does not exceed 15%. The expected values are: 1.4 for the ΔJ=2, quadrupole transition, and 0.8 for ΔJ=1, dipole.

Eγ†	E(level)	Iγ†	Mult.	Comments
33	33.0+x			
108	141.0+x			
141	141.0+x			
150.0	2885.3+x	100 *10*	D	R=0.7.
154.8	3040.1+x	90 *9*		
180	321.0+x			
182.9	3068.2+x	82 *8*	M1+E2	R=1.0.
283.2	3168.5+x	34 *4*	M1+E2	R=1.0.
288§	321.0+x	≤0.74		Eγ: γ not seen, only an upper limit given.
295.2	3363.4+x	74 *8*	Q	Mult.: E2 in 2010Ko12. R=1.6.
321	321.0+x		E2	α(K)exp=0.043 *8*, α(L)exp + α(M)exp=0.013 *5*. K/(L+M+)=3.1 *7*.
339.3	3379.4+x	68 *7*		
373	694.0+x		E3	α(K)exp=0.065 *10*, α(L)exp + α(M)exp=0.046 *8*. K/(L+M+)=1.8 *5*.
426.0	3789.4+x	34 *4*		
544.3	2735.3+x	296‡ *30*	D	R=0.8 for 544.3+545.2 doublet.
545.2	2191.0+x	296‡ *30*	D	R=0.8 for 544.3+545.2 doublet.
951.8	1645.8+x	123 *13*	D,Q	R=1.2.

† At E(^{40}Ar)=206 MeV.
‡ Combined intensity for 544.3+545.2 doublet.
§ Placement of transition in the level scheme is uncertain.

Adopted Levels, Gammas

Q(β⁻)=–12714 *14*; S(n)=12940 *40*; S(p)=3011 *11*; Q(α)=2666 *13* 2012Wa38.
Q(εp)=5428 *14*, S(2n)=23300 *12*, S(2p)=3502 *12* (2012Wa38).
1982No08: identification and production of ^{148}Er isotope.

^{148}Er Levels

In the table below, observed levels in ^{148}Er are classified in terms of spherical shell–model configurations while comparing with the known states in N=80 isotones and other neighboring nuclides (^{146}Dy,^{144}Gd,^{148}Dy and ^{150}Er). The valence orbitals are: $h_{11/2}$, $s_{1/2}$, $d_{3/2}$, $g_{7/2}$ 2–neutron holes; 2–4 proton orbitals (mainly $h_{11/2}$) outside the ^{146}Gd core. Six–qp configurations are expected above 7 MeV, but 2001Ro15 did not identify specific levels for these configurations due to high level density.

Classification of states in ^{148}Er (2001Ro15)

Possible configuration	Levels
2–quasineutron	646,2+; 1523,4+
2–quasiproton	2253,5–; 2704,7–
$\pi h_{11/2}{}^2$	2782,8+
$\pi h_{11/2}{}^2$	2913,10+
$\nu h_{11/2}{}^{-1}\otimes\nu d_{3/2}{}^{-1}$	2535,7–
$\pi h_{11/2}{}^2\otimes\nu(s_{1/2}{}^{-1},d_{3/2}{}^{-1})$	3528,11+; 3723,12+
$\pi h_{11/2}{}^2\otimes\nu(d_{3/2}{}^{-1},d_{5/2}{}^{-1})$	4523,13+; 4704,14+
$\pi h_{11/2}{}^2\otimes 3-$	4609,12–
$\pi h_{11/2}{}^2\otimes\nu(d_{3/2}{}^{-1},h_{11/2}{}^{-1})$	5097,14–; 5137,14–;
($d_{3/2}$ orbital could be $s_{1/2}$ also)	5248,15–; 5715,16–;
	6187,17–; 6218,17–
$\pi h_{11/2}{}^3\otimes\pi(s_{1/2})$	4678,13–
$\pi h_{11/2}{}^3\otimes\pi(d_{3/2})$	4983,15–
$\pi h_{11/2}{}^4$	5304,16+
$\pi h_{11/2}{}^2\otimes\nu(h_{11/2}{}^{-2}$	5946,16+; 6394,17+
	6636,18+; 6709,18+
	6921,19+; 7354,20+

Cross Reference (XREF) Flags

A ^{148}Tm ε Decay (0.7 s)
B ^{149}Yb εp Decay (0.7 s)
C ^{92}Mo(^{58}Ni,2pγ)

E(level)[†]	Jπ[‡]	XREF	$T_{1/2}$	Comments
0.0	0+	ABC	4.6 s *2*	%ε+%β⁺=100; %εp≈0.15 (1988To03). Delayed proton emission probability ≈0.15% (if I(141γ+244γ+315γ)≈25%) (1988To03). $T_{1/2}$: average of 4.8 s *2* (1989Ta11), 4.4 s *2* (1988To03), 4.5 s *4* (1982No08).
645.89[§] *10*	2+	ABC		Jπ: ΔJ=2, quadrupole (E2) γ to 0+.
1522.68[§] *15*	(4+)	A C		Jπ: ΔJ=2, quadrupole (E2) γ to 0+.
2252.48 *18*	(5–)	A C		
2525.05[§] *25*	(6+)	A C		
2535.08 *21*	(7–)	A C		
2703.88 *20*	(7–)	C		
2782.1[§] *4*	(8+)	A C		
2913.2[§] *4*	(10+)	A C	13 μs *3*	%IT=100. $T_{1/2}$: γ(t) (1982No07).
3171.18 *22*		C		
3354.6? *3*		C		
3529.0 *4*	(11+)	C		
3723.3[#] *4*	(12+)	C		
4174.1 *3*		C		
4532.0 *5*	(13+)	C		
4609.4[a] *5*	(12–)	C		
4678.4[b] *4*	(13–)	C		
4704.5[#] *4*	(14+)	C		
4983.5[b] *4*	(15–)	C		
5097.8[a] *5*	(14–)	C		
5127.4 *5*	(14+)	C		
5137.6 *5*		C		

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)

^{148}Er Levels (continued)

E(level)[†]	Jπ[‡]	XREF
5248.2[a] *5*	(15−)	C
5304.1[&] *4*	(16+)	C
5715.7[a] *5*	(16−)	C
5742.6[@] *5*	(16+)	C
5946.5[#] *4*	(16+)	C
6009.4? *5*		C
6088.1[b] *5*	(16−)	C
6103.0 *5*	(17+)	C
6187.5[a] *5*	(17−)	C
6219.0 *5*	(17−)	C
6287.4 *5*		C
6290.0[b] *4*	(17−)	C
6395.0[#] *5*	(17+)	C
6518.4[&] *5*	(18+)	C
6636.9 *5*	(18+)	C
6709.8[#] *5*	(18+)	C
6770.4 *6*		C
6895.3[@] *6*	(18+)	C
6921.7[#] *5*	(19+)	C
7027.3[a] *5*	(19−)	C
7051.6[&] *5*	(19+)	C
7091.8[b] *5*	(19−)	C
7294.8[@] *6*	(19+)	C
7354.3[#] *5*	(20+)	C
7532.5[&] *5*	(20+)	C
7585.3 *5*	(20+)	C
7670.8 *5*		C
7723.0 *5*	(20−)	C
7733.4[@] *7*	(20+)	C
7739.5 *7*		C
7832.4[&] *5*	(21+)	C
7878.7[@] *7*	(21+)	C
8017.9[a] *5*	(21−)	C
8119.7[b] *5*	(21−)	C
8201.4 *6*		C
8274.7?[a] *5*	(22−)	C
8304.0 *6*		C
8549.1?[a] *5*	(23−)	C
9018.3[&] *6*	(23+)	C
9590.7[a] *6*		C

[†] From least–squares fit to Eγ data.
[‡] All assignments are from ^{92}Mo(^{58}Ni,2pγ), based on γ–anisotropy data, decay pattern, yrast type of population in heavy–ion studies, γ–sequence assignments. The parentheses are added by the evaluators.
[§] (A): Yrast cascade based on g.s.
[#] (B): γ sequence based on (12+).
[@] (C): γ sequence based on (16+).
[&] (D): γ sequence based on (16+).
[a] (E): γ sequence based on (12−).
[b] (F): γ sequence based on (13−).

γ(^{148}Er)

E(level)	Eγ[†]	Iγ[†]	Mult.[‡]	α	Comments
645.89	645.9 *1*	100	(E2)[§]		
1522.68	876.8 *1*	100	(E2)[§]		
2252.48	729.8 *1*	100	D[@]		
2525.05	1002.4 *2*	100	(E2)[§]		
2535.08	282.6 *2*	100	Q[§]		
2703.88	168.8 *1*	100 *9*	D(+Q)[#]		
	451.4 *1*	67 *7*	(Q)[§]		
2782.1	78 *1*	2.2			
	247.1 *3*	46			
	257.1 *2*	100	(E2)[§]		
2913.2	131.2 *2*	100	E2	1.082	Mult.: from measured α(K)exp in in–beam γ–ray study.
3171.18	467.3 *1*	100			
3354.6?	650.7 *2*	100			
3529.0	615.7 *2*	100	D(+Q)[#]		
3723.3	194.4 *1*	4.9 *3*	D(+Q)[#]		
	810.1 *1*	100.0 *14*	Q[§]		
4174.1	819.5 *1*	100			
4532.0	809.4 *4*	37 *4*			
	1003.1 *3*	100 *3*	Q[§]		
4609.4	885.9 *2*	100 *7*	D(+Q)[#]		
	1080.5 *4*	85 *5*	D[@]		
4678.4	955.0 *1*	100	D[@]		
4704.5	981.1 *1*	100	Q[§]		
4983.5	305.1 *1*	100	Q[§]		
5097.8	393.0 *3*	21 *4*	(D+Q)[#]		
	488.1 *3*				
	565.8 *1*	100 *5*	D[@]		
5127.4	1404.3 *4*	100	Q[§]		
5137.6	459.2 *2*	100			
5248.2	110.5 *2*	100 *5*	D[@]		
	150.4 *3*				
5304.1	599.6 *1*	100	Q[§]		
5715.7	467.4 *1*	100	D(+Q)[#]		

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)

γ(^{148}Er) (continued)

E(level)	Eγ†	Iγ†	Mult.‡
5742.6	1038.1 *2*	100	Q§
5946.5	203.8 *2*		
	819.2& *2*	2.3 *2*	
	1242.0 *1*	100.0 *18*	Q§
6088.1	345.5 *3*	36 *4*	
	1104.5 *3*	100 *3*	D(+Q)#
6103.0	798.9 *4*	100	D(+Q)#
6187.5	471.8 *2*	100 *6*	D(+Q)#
	1204.3 *2*	46 *4*	Q§
6219.0	503.3 *2*	100 *7*	D(+Q)#
	1235.4 *2*	69 *4*	Q§
6287.4	1304.1 *4*	100	
6290.0	201.9 *1*	100 *4*	D(+Q)#
	343.5 *1*	44 *3*	(D)@
6395.0	385.6& *4*	17 *3*	
	448.5 *1*	100 *3*	D(+Q)#
6518.4	415.4 *3*	46 *5*	D(+Q)#
	1214.3 *1*	100 *3*	Q§
6636.9	242.0 *2*	36 *3*	D(+Q)#
	346.9 *1*	100 *10*	D@
6709.8	314.8 *1*	100	D(+Q)#
6770.4	1054.7 *3*	100	
6895.3	1152.7 *3*	100	
6921.7	211.9 *1*	100 *4*	D(+Q)#
	284.7 *2*	26 *4*	
7027.3	739.9 *3*	56 *5*	Q§
	808.0 *2*	167 *17*	
	839.8 *1*	100 *5*	Q§
7051.6	533.2 *1*	100	D(+Q)#
7091.8	381.8 *4*	85 *6*	D@
	454.8 *2*	50 *4*	D@
	801.9 *2*	100 *4*	Q§
7294.8	399.5 *2*	100	D(+Q)#
7354.3	432.6 *1*	100	D(+Q)#
7532.5	480.9 *1*	100	D(+Q)#
7585.3	948.4 *2*	100	Q§
7670.8	1152.4 *2*	100	
7723.0	631.2 *2*	100	D(+Q)#
7733.4	438.6 *3*	100	D(+Q)#
7739.5	969.1 *4*	100	
7832.4	299.9 *1*	100	D(+Q)#
7878.7	145.3& *3*	100	D(+Q)#
8017.9	990.6 *1*	100	Q§
8119.7	1027.9 *2*	100	Q§
8201.4	616.1 *3*	100	
8274.7?	256.8 *2*	100	
8304.0	1252.4 *3*	100	
8549.1?	274.4 *1*	100	D(+Q)#
9018.3	1185.9 *3*	100	Q§
9590.7	1041.6 *3*	100	

† From ^{92}Mo(^{58}Ni,2pγ).

‡ From γ–asymmetry data in ^{92}Mo(^{58}Ni,2pγ).

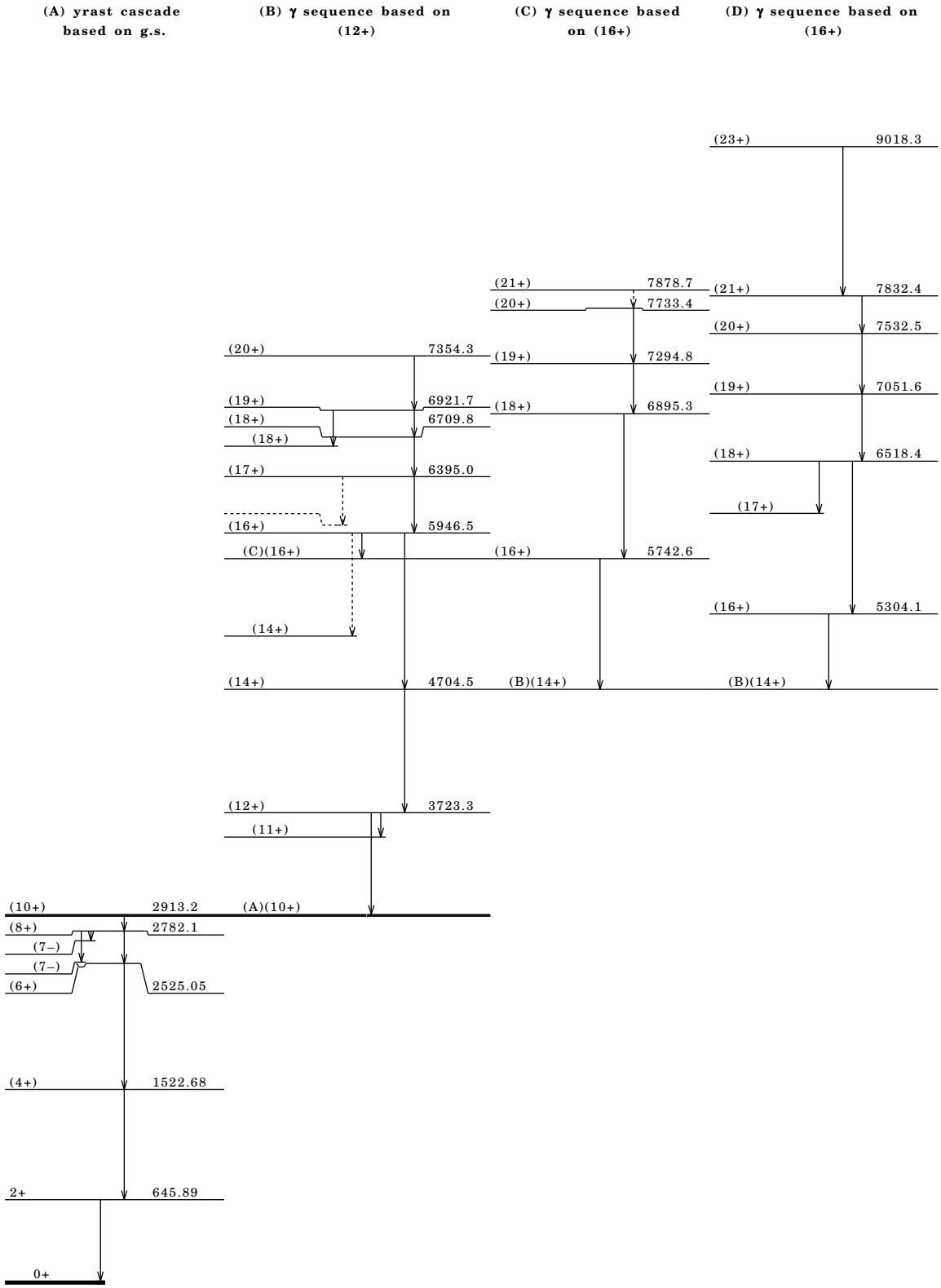
§ From γ–asymmetry, ΔJ=2, quadrupole (most likely E2). Mult=(E2) is assigned to transitions in the yrast sequence from g.s. to (10+) isomer, based on definite E2 for (10+) to (8+) transition and stretched quadrupoles to other four transitions.

From γ–asymmetry, ΔJ=1, dipole+quadrupole (most likely M1+E2). In a few cases transition is indicated as ΔJ=0.

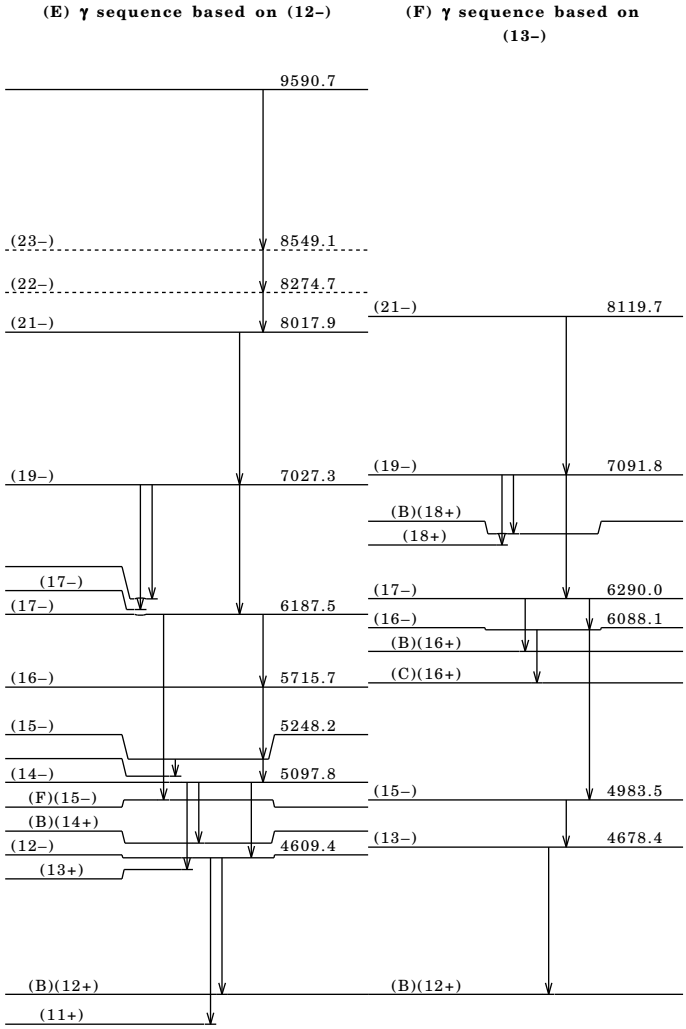
@ From γ–asymmetry, ΔJ=1, dipole (most likely E1).

& Placement of transition in the level scheme is uncertain.

Adopted Levels, Gammas (continued)



Adopted Levels, Gammas (continued)



$^{148}_{68}Er_{80}$

^{148}Tm ε Decay (0.7 s) 1982No08

Parent ^{148}Tm: E=0+x; Jπ=(10+); $T_{1/2}$=0.7 s *2*; Q(g.s.)=12714 *14*; %ε+%β$^+$ decay=100.
^{148}Tm–Q(ε): From 2012Wa38.
1982No08: ^{148}Tm produced in ^{92}Mo(^{58}Ni,np) E=233–250 MeV. Measured: Eγ, Iγ, γγ, γ(t).
Level scheme is from 1982No08. The present decay scheme seems incomplete and several γ rays may have been unobserved. In addition, from systematics of odd–odd Tm nuclei, several isomers in ^{148}Tm are expected with Jπ values in the range of 1–10, although evidence of isomerism in ^{148}Tm was not found in the mass measurement by 2008Ra03.

^{148}Er Levels

E(level)	Jπ†
0.0	0+
646.6 *3*	2+
1524.0 *4*	(4+)
2254.3? *5*	(5−)
2526.9? *5*	(6+)
2537.3 *6*	(7−)
2784.4 *6*	(8+)
2915.5 *7*	(10+)

† From Adopted Levels.

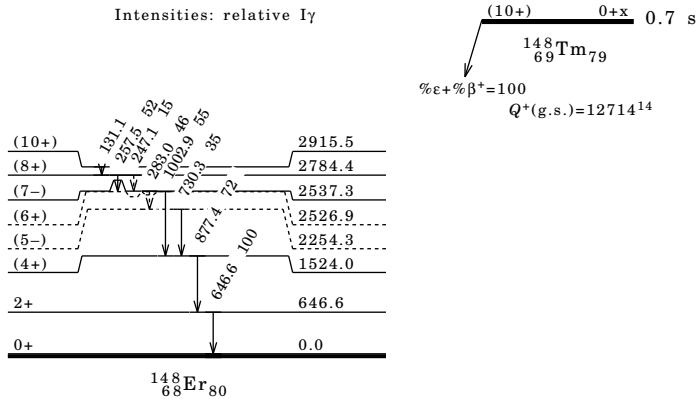
γ(^{148}Er)

Eγ	E(level)	Iγ
131.1 *3*	2915.5	
247.1† *3*	2784.4	15 *10*
257.5 *3*	2784.4	52 *20*
283.0† *3*	2537.3	46 *20*
646.6 *3*	646.6	100
730.3 *3*	2254.3?	35 *15*
877.4 *3*	1524.0	72 *25*
1002.9 *3*	2526.9?	55 *20*

† Placement of transition in the level scheme is uncertain.

Decay Scheme

Intensities: relative Iγ



^{149}Yb εp Decay (0.7 s) 2001Xu06

Parent ^{149}Yb: E=0; Jπ=(1/2+); $T_{1/2}$=0.7 s *2*; Q(g.s.)=10990 syst; %εp decay≈100.
^{149}Yb–Q(εp): 10990 *500* (syst,2012Wa38).
^{149}Yb–%εp decay: %εp≈100 (2001Xu06).
2001Xu06 (also 2005Xu04, 2006Xu07): measured delayed protons and px coin. The proton spectrum was observed (2001Xu06).

^{148}Er Levels

E(level)†	Jπ†	Comments
0.0	0+	
646	2+	E(level): 646γ observed by 2001Xu06 indicate feeding to 2+ state.

† From Adopted Levels, Gammas dataset.

^{92}Mo(^{58}Ni,2pγ) 2001Ro15

2001Ro15: E=260 MeV. Measured Eγ, Iγ, γγ, γγ(θ)(DCO) using the NORDBALL array consisting of 15 BGO–shielded HPGe detectors situated in three rings at 79°, 101° and 143° relative to the beam direction. Interpretation of level structure in terms of spherical shell model and comparison with the structure of N=80 isotones (^{146}Dy, ^{144}Gd) and neighboring nuclides (^{148}Dy, ^{150}Er).
1982No07: E=250 MeV. Measured: Eγ, Iγ, γγ, γ(t). Levels reported up to 2913, 10+.

^{148}Er Levels

For classification of observed levels in terms of shell–model configurations, as proposed in 2001Ro15, see Adopted Levels.

E(level)†	Jπ‡	$T_{1/2}$	Comments
0.0§	0+		
645.89§ *10*	2+		
1522.68§ *15*	4+		
2252.48 *18*	5–		
2525.05§ *25*	6+		
2535.08 *21*	7–		
2703.88 *20*	7–		
2782.1§ *4*	8+		
2913.2§ *4*	10+	13 μs *3*	%IT=100. $T_{1/2}$: γ(t) (1982No07).
3171.18 *22*			
3354.6? *3*			
3529.0 *4*	11+		
3723.3# *4*	12+		
4174.1 *3*			
4532.0 *5*	13+		
4609.4a *5*	12–		
4678.4b *4*	13–		
4704.5# *4*	14+		
4983.5b *4*	15–		
5097.8a *5*	14–		
5127.4 *5*	14+		
5137.6 *5*			
5248.2a *5*	15–		
5304.1& *4*	16+		
5715.7a *5*	16–		
5742.6@ *5*	16+		
5946.5# *4*	16+		
6009.4? *5*			
6088.1b *5*	16–		
6103.0 *5*	17+		
6187.5a *5*	17–		
6219.0 *5*	17–		
6287.4 *5*			
6290.0b *4*	17–		

Continued on next page (footnotes at end of table)

^{92}Mo(^{58}Ni,2pγ) 2001Ro15 (continued)

^{148}Er Levels (continued)

E(level)†	Jπ‡	E(level)†	Jπ‡	E(level)†	Jπ‡
6395.0# *5*	17+	7294.8@ *6*	(19+)	8017.9a *5*	21−
6518.4& *5*	18+	7354.3# *5*	20+	8119.7b *5*	21−
6636.9 *5*	18+	7532.5& *5*	20+	8201.4 *6*	
6709.8# *5*	18+	7585.3 *5*	20+	8274.7?a *5*	(22−)
6770.4 *6*		7670.8 *5*		8304.0 *6*	
6895.3@ *6*	(18+)	7723.0 *5*	(20−)	8549.1?a *5*	(23−)
6921.7# *5*	19+	7733.4@ *7*	(20+)	9018.3& *6*	23+
7027.3a *5*	19−	7739.5 *7*		9590.7a *6*	
7051.6& *5*	19+	7832.4& *5*	21+		
7091.8b *5*	19−	7878.7@ *7*	(21+)		

† From least−squares fit to Eγ data.
‡ As proposed in 2001Ro15, based on γ(anisotropy) data for many transitions, decay patterns, γ sequences, and yrast type of population in heavy−ion in−beam γ−ray measurements.
§ (A): Yrast cascade based on g.s.
# (B): γ sequence based on 12+.
@ (C): γ sequence based on 16+.
& (D): γ sequence based on 16+.
a (E): γ sequence based on 12−.
b (F): γ sequence based on 13−.

γ(^{148}Er)

The γ anistropy information was extracted from projected spectra recorded at 79°, 101° and 143° relative to the beam direction. The assignments of levels spins was based mostly on these anistropies, defined as asymmetry ratio R=2Iγ(143°)/[Iγ(79°+101°]. Expected average values are 1.4 for ΔJ=2, quadrupole and 0.7 for ΔJ=1, dipole. The ΔJ=0, dipole transitions have nearly the same ratio as for ΔJ=2, quadrupole, as judged from listed values in contents of table 3 of 2001Ro15.

Eγ	E(level)	Iγ	Mult.	α	Comments
78‡ *1*	2782.1	2.0‡			
110.5 *2*	5248.2	7.9 *4*	D		R=0.50 *7*.
131.2 *2*	2913.2		E2	1.082	α(K)exp=0.53 *20* (1982No07). Mult.: from α(K)exp deduced from measured K x ray(Er)/I(131γ) in K x ray−γ coin (1982No07).
145.3& *3*	7878.7	4.4 *4*	D(+Q)#		R=0.65 *5*.
150.4 *3*	5248.2				
168.8 *1*	2703.88	8.7 *8*	D(+Q)#		R=2.1 *7*, ΔJ=0 transition.
194.4 *1*	3723.3	7.3 *5*	D(+Q)#		R=0.64 *9*.
201.9 *1*	6290.0	18.1 *7*	D(+Q)#		R=0.65 *5*.
203.8 *2*	5946.5				
211.9 *1*	6921.7	14.2 *6*	D(+Q)#		R=0.75 *6*.
242.0 *2*	6636.9	4.8 *4*	D(+Q)#		Iγ: uncertainty of 4.0 in 2001Ro15 seems a misprint, evaluators assign 0.4. R=0.8 *1*.
247.1‡ *3*	2782.1	6.0‡			
256.8 *2*	8274.7?	5.6† *6*			Iγ: see comment for 257.1γ.
257.1 *2*	2782.1	8.4† *9*	Q§		Iγ: 14.0 *17* for 257.1+256.8, about 60% intensity for 257.1. R=0.9 *2* for 257.1+256.8.
274.4 *1*	8549.1?	16.5 *6*	D(+Q)#		R=0.84 *7*.
282.6 *2*	2535.08	13.9 *6*	Q§		R=1.3 *1*.
284.7 *2*	6921.7	3.7 *5*	#		R=0.5 *2*.
299.9 *1*	7832.4	7.3 *5*	D(+Q)#		R=0.8 *1*.
305.1 *1*	4983.5	41.7 *7*	Q§		R=1.28 *4*.
314.8 *1*	6709.8	17.9 *6*	D(+Q)#		R=0.86 *5*.
343.5 *1*	6290.0	8.0 *6*	(D)@		R=1.0 *1*.
345.5 *3*	6088.1	5.8† *6*			Iγ: see comment for 346.9γ.
346.9 *1*	6636.9	13.5† *14*	D@		Iγ: 19.3 *7* for 345.5+346.9, about 70% intensity for 346.9. R=0.70 *5* for 345.5+346.9.
381.8 *4*	7091.8	10.0 *7*	D@		R=0.8 *1*.
385.6& *4*	6395.0	4.1 *7*			R=1.2 *4*.
393.0 *3*	5097.8	3.8 *7*	(D+Q)#		R=1.5 *6*, ΔJ=0 transition.

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$^{92}Mo(^{58}Ni,2p\gamma)$ 2001Ro15 (continued)

$\gamma(^{148}Er)$ (continued)

Eγ	E(level)	Iγ	Mult.	Comments
399.5 *2*	7294.8	8.4 *8*	D(+Q)#	R=0.7 *1*.
415.4 *3*	6518.4	6.8 *7*	D(+Q)#	R=0.7 *1*.
432.6 *1*	7354.3	16.7 *7*	D(+Q)#	R=0.78 *6*.
438.6 *3*	7733.4	7.5 *6*	D(+Q)#	R=0.9 *1*.
448.5 *1*	6395.0	24.6 *7*	D(+Q)#	R=0.91 *5*.
451.4 *1*	2703.88	5.9† *6*	(Q)§	Iγ: 11.7 *5* for 451.8+451.4; 50% assigned for each component arbitrarily. R=1.00 *9* for 451.4+451.8.
x451.8 *2*		5.9† *6*		Iγ: see comment for 451.4γ.
454.8 *2*	7091.8	5.9 *5*	D@	R=0.36 *8*.
459.2 *2*	5137.6	7.4 *6*		R=1.0 *2*.
467.3 *1*	3171.18	5.8† *6*		Iγ: see comment for 467.4γ.
467.4 *1*	5715.7	23.1† *23*	D(+Q)#	Iγ: 28.9 *7* for 467.3+467.4, about 80% intensity for 467.4. R=0.85 *5* for 467.3+467.4.
471.8 *2*	6187.5	9.8 *6*	D(+Q)#	R=0.78 *9*.
480.9 *1*	7532.5	14.1 *12*	D(+Q)#	R=0.45 *9*.
488.1 *3*	5097.8			
503.3 *2*	6219.0	13.0 *9*	D(+Q)#	R=0.9 *1*.
533.2 *1*	7051.6	17.1 *8*	D(+Q)#	R=0.66 *7*.
565.8 *1*	5097.8	17.7 *8*	D@	R=0.91 *8*.
599.6 *1*	5304.1	37.4 *7*	Q§	R=1.60 *6*.
615.7 *2*	3529.0	38† *4*	D(+Q)#	Iγ: 41.9 *7* for 615.7+616.1, about 90% intensity for 615.7. R=0.56 *2*.
616.1 *3*	8201.4	4† *1*		Iγ: see comment for 615.7γ.
631.2 *2*	7723.0	7.6 *5*	(D+Q)#	R=1.1 *1*.
645.9 *1*	645.89	28.0 *7*	Q§	R=1.42 *7*.
650.7 *2*	3354.6?	6.8 *5*		R=2.2 *3*.
729.8 *1*	2252.48	19.3 *7*	D@	R=0.96 *7*.
739.9 *3*	7027.3	5.8 *5*	Q§	R=1.5 *2*.
798.9 *4*	6103.0	11.9 *6*	D(+Q)#	R=0.35 *9*.
801.9 *2*	7091.8	11.8 *5*	Q§	R=1.4 *1*.
808.0 *2*	7027.3	17.4† *17*		Iγ: 174.1 for 810.1+809.4+808.0, about 10% intensity for 808.0.
809.4 *4*	4532.0	8.7† *9*		Iγ: 174.1 5 for 810.1+809.4+808.0, about 5% intensity for 809.4.
810.1 *1*	3723.3	148† *15*	Q§	Iγ: 174.1 *15* for 810.1+809.4+808.0, about 85% intensity for 810.1. R=1.43 *2* for 810.1+809.4+808.0.
819.2& *2*	5946.5	0.8† *1*		Iγ: see comment for 819.5.
819.5 *1*	4174.1	6.9† *7*		Iγ: 7.7 *5* for 819.5+819.2, about 95% intensity for 819.5. R=2.0 *3* for 819.5+819.2.
839.8 *1*	7027.3	10.4 *5*	Q§	R=1.4 *1*.
876.8 *1*	1522.68	24.0 *6*	Q§	R=1.44 *7*.
885.9 *2*	4609.4	9.4 *7*	D(+Q)#	R=1.1 *2*, ΔJ=0 transition.
948.4 *2*	7585.3	7.1 *4*	Q§	R=2.1 *3*.
955.0 *1*	4678.4	50.1 *8*	D@	R=1.01 *3*.
969.1 *4*	7739.5	3.1 *5*		
981.1 *1*	4704.5	100.0 *7*	Q§	R=1.60 *3*.
990.6 *1*	8017.9	18.0 *5*	Q§	R=1.50 *8*.
1002.4 *2*	2525.05	10.0† *10*	(Q)§	Iγ: see comment for 1003.1γ.
1003.1 *3*	4532.0	23.6† *24*	Q§	Iγ: 33.6 *7* for 1002.4+1003.1, about 70% intensity for 1003.1. R=1.56 *6* for 1002.4+1003.1.
1027.9 *2*	8119.7	8.0 *4*	Q§	R=1.8 *2*.
1038.1 *2*	5742.6	25.0 *6*	Q§	R=1.45 *7*.
1041.6 *3*	9590.7	7.2 *4*		R=1.6 *2*.
1054.7 *3*	6770.4	5.8 *5*		
1080.5 *4*	4609.4	8.0 *5*	D@	R=0.88 *9*.
1104.5 *3*	6088.1	16.3 *5*	D(+Q)#	R=0.86 *6*.
1152.4 *2*	7670.8	6.4† *6*		Iγ: see comment for 1152.7γ.
1152.7 *3*	6895.3	9.5† *10*		Iγ: 15.9 *8* for 1152.7+1152.4, about 60% intensity for 1152.7.
1185.9 *3*	9018.3	3.1 *3*	Q§	R=2.1 *4*.
1204.3 *2*	6187.5	4.5 *4*	Q§	R=1.2 *2*.
1214.3 *1*	6518.4	14.8 *5*	Q§	R=1.52 *9*.
1235.4 *2*	6219.0	9.0 *5*	Q§	R=1.3 *1*.
1242.0 *1*	5946.5	34.2 *6*	Q§	R=1.48 *5*.
1252.4 *3*	8304.0	17.8 *6*		R=0.89 *6*.

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^{92}Mo(^{58}Ni,2pγ) 2001Ro15 (continued)

γ(^{148}Er) (continued)

Eγ	E(level)	Iγ	Mult.	Comments
1304.1 *4*	6287.4	13.5† *14*		Iγ: 15.0 *5* for 1304.9+1304.1, about 90% intensity for 1304.1. R=1.59 *9* for 1304.9+1304.1.
1304.9& *4*	6009.4?	1.5† *2*		Iγ: see comment for 1304.1γ.
1404.3 *4*	5127.4	4.2 *3*	Q§	R=1.5 *2*.

† Unresolved structure. Intensity and DCO ratios are combined for both components. Based on the thickness of the arrows by which the γ–rays are drawn in the level–scheme figures, the evaluator has given under comments estimate of separate intensities for the components.
‡ γ from 1982No07 only. Intensity at E=250 MeV, renormalized to 28.0 for 645.9γ.
§ From γ–asymmetry, ΔJ=2, quadrupole (most likely E2).
# From γ–asymmetry, ΔJ=1, dipole+quadrupole (most likely M1+E2). In a few cases transition is indicated as ΔJ=0.
@ From γ–asymmetry, ΔJ=1, dipole (most likely E1).
& Placement of transition in the level scheme is uncertain.
x γ ray not placed in level scheme.

Adopted Levels

S(n)=10862 *12*; S(p)=–550 *40*; Q(α)=3420 *13* 2012Wa38.
Q(εp)=9703 *11*, S(2n)=24020 *200* (syst), S(2p)=2105 *12* (2012Wa38).
1982No08: identification and production of ^{148}Tm isotope in ^{92}Mo(^{58}Ni,X) reaction at 233–250 MeV at Munich MP tandem facility.
Mass measurement (Penning trap): 2008Ra03 (also 2007Ra37). Isotope production using ^{92}Mo(^{58}Ni,X) at E=4.36, 4.60 MeV/nucleon at GSI facility, SHIPTRAP for mass measurements.

^{148}Tm Levels

E(level)	Jπ	$T_{1/2}$	Comments
0+x	(10+)	0.7 s *2*	%ε+%β$^+$=100. E(level): although 2008Ra03 in their mass measurements did not find evidence of an isomer, it is unlikely that 10+ corresponds to the g.s. From shell–model analysis, this state is more likely an isomeric state. Also, in the complete chart of nuclides, maximum (definite) spin assigned to a g.s. is 8+. From systematics of odd–odd Tm nuclides, two or three closely spaced isomers are expected in the spin range 1–10. $T_{1/2}$: from decay curve for 646.6γ (1982No08). Jπ: possible β feeding of (10+) state in ^{148}Er with configuration=$(\pi\ 1h_{11/2})^{+2}{}_{10+}$; shell–model prediction of following configurations: $(\pi 1h_{11/2}{}^{+1}\otimes\nu 1h_{11/2})^{-1}$ or $(\pi 1h_{11/2}{}^{+1}\otimes\nu 1h_{9/2}{}^{+1})$. 1982No08 proposed J≥6.

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