^{150}Sm(α,5nγ) **1981Pi09**

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh and Jun Chen	NDS 185, 2 (2022)	23-Aug-2022

Also includes ^{148}Sm(α,3nγ) and ^{149}Sm(α,4nγ) from 1981Pi09 which only gives detailed results from ^{150}Sm(α,5nγ).

1981Pi09: (α,5nγ) E=67 MeV and (α,3nγ) E=44 MeV from the cyclotron at Julich; (α,4nγ) E=42-53 MeV from the Stockholm cyclotron. Measured Eγ, Iγ, $\gamma\gamma$-coin, $\gamma\gamma$(t), $\gamma(\theta)$, γ(lin pol) with two Ge(Li) detectors and a NaI(Tl) scintillator; measured conversion electrons with an orange spectrometer. Deduced levels, J^π, $T_{1/2}$, conversion coefficient, γ-ray multipolarity, transition strength. Comparisons with shell-model calculations. Results from (α,4nγ) are not given in details but are mentioned by the authors to be in excellent agreement with those from (α,5nγ). Measurement of (α,3nγ) was only used for $\gamma\gamma$-list mode coincidence because of the cleanest selection of the ^{149}Gd exit channel.

All data are from (α,5nγ) in 1981Pi09, unless otherwise noted.

Other:

1989Ar10: Sm(α,xn) E=threshold to 87 MeV; measured cross sections.

^{149}Gd Levels

E(level)[†]	J^π[‡]	$T_{1/2}$[#]	Comments
0.0[@]	7/2$^-$		
165.2 *3*	5/2$^-$		
775.30[@] *9*	11/2$^-$		
795.90[&] *9*	9/2$^-$		
873.49[a] *10*	11/2$^+$	1.6 ns *6*	
955.97[a] *11*	13/2$^+$		
1484.05[@] *11*	15/2$^-$		
1609.26[&] *15*	13/2$^-$		
1740.10[a] *20*	17/2$^+$		
2058.25 *14*	17/2$^-$		
2231.77[&] *24*	17/2$^-$		
2383.73 *18*	19/2$^-$		
2401.50[a] *21*	21/2$^+$		
2524.26[&] *20*	21/2$^-$		
2856.4 *3*			J^π: (21/2,23/2,25/2$^+$) in the Adopted Levels.
3084.8 *3*	23/2$^+$		
3134.6 *4*	23/2$^-$		
3227.83 *23*	23/2$^+$		
3294.70 *23*	25/2$^+$		
3387.42 *24*	27/2$^+$	6.0 ns *5*	$T_{1/2}$: 1979HjZZ report 6.2 ns for a 3382 level. Search for α decay (Eα=6-16 MeV) proved negative (1980Vr01).
3611.97 *23*	25/2$^-$		
3632.51 *25*	27/2$^+$		J^π: (27/2$^-$) in the Adopted Levels.
3765.6 *4*	29/2		
4324.3? *3*	(29/2$^-$)		
4572.4 *5*	(31/2)		

† From a least-squares fit to γ-ray energies.

‡ As given in 1981Pi09, based on their $\gamma(\theta)$ data and polarization data for selected transitions. The assignments in the Adopted Levels are almost the same as in 1981Pi09, with the exception that many of the assignments in the Adopted Levels are placed in parentheses as strong arguments seem lacking. Other exception is J^π of 3632 level, 27/2$^+$ assigned by 1981Pi09, but (27/2$^-$) in the Adopted Levels.

\# From $\gamma\gamma$(t) of (α,4nγ) in 1981Pi09.

@ Band(A): $\nu 2f^3_{7/2}$. Sequence from 1981Pi09.

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$^{150}Sm(\alpha,5n\gamma)$ 1981Pi09 (continued)

^{149}Gd Levels (continued)

[&] Band(B): $\nu h_{9/2}\otimes\nu 2f^2_{7/2}$. Sequence from 1981Pi09.

[a] Band(C): $\nu f^3_{7/2}\otimes(3^-$ in $^{148}Gd)$. Sequence from 1981Pi09.

$\gamma(^{149}Gd)$

A_2, A_4 and pol values are from 1981Pi09, with positive pol indicating magnetic nature and negative pol for electric nature. Note that Pol=[N(parallel)−N(perpendicular)]/[N(parallel)+N(perpendicular)], in 1981Pi09, where N=number of counts. The numerator in this definition is opposite to the commonly used expression for Pol as [N(perpendicular)-N(parallel)]/[N(perpendicular)+N(parallel)].

E_γ	I_γ[†]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[‡]	α[#]	Comments
77.6 *1*	27.7 *15*	873.49	$11/2^+$	795.90	$9/2^-$	E1	0.576	A_2=−0.20 *2*; A_4=−0.04 *3* Mult.: from intensity balance (1981Pi09).
82.5 *1*	15.8 *8*	955.97	$13/2^+$	873.49	$11/2^+$	D		A_2=−0.28 *3*; A_4=−0.05 *4*
98.2 *1*	27.6 *15*	873.49	$11/2^+$	775.30	$11/2^-$	E1	0.307	A_2=+0.31 *1*; A_4=−0.001 *1* Mult.: from intensity balance (1981Pi09).
159.6 *1*	14.0 *7*	3387.42	$27/2^+$	3227.83	$23/2^+$	E2	0.478	A_2=+0.28 *1*; A_4=−0.06 *2*
165.1 *3*	3.9 *4*	165.2	$5/2^-$	0.0	$7/2^-$	D+Q		A_2=+0.10 *3*; A_4=+0.01 *4*
180.6 *1*	20.1 *10*	955.97	$13/2^+$	775.30	$11/2^-$	D		A_2=−0.23 *1*; A_4=−0.01 *1*
245.1 *2*	4.3 *4*	3632.51	$27/2^+$	3387.42	$27/2^+$			A_2=+0.33 *4*; A_4=+0.03 *6*
248.1[@] *3*	16.7 *17*	4572.4	(31/2)	4324.3?	$(29/2^-)$	(D)		A_2=−0.15 *1*; A_4=0.00 *2* E_γ,I_γ: unresolved from a background line.
292.5 *3*	7.5 *8*	2524.26	$21/2^-$	2231.77	$17/2^-$	Q		A_2=+0.32 *2*; A_4=−0.09 *3*
325.5 *3*	3.9 *4*	2383.73	$19/2^-$	2058.25	$17/2^-$	D+Q		A_2=−0.38 *4*; A_4=−0.01 *6*
337.8 *2*	5.8 *6*	3632.51	$27/2^+$	3294.70	$25/2^+$	D		A_2=−0.38 *3*; A_4=−0.04 *5*
378.2 *3*	6.9 *7*	3765.6	29/2	3387.42	$27/2^+$	D		A_2=−0.14 *3*; A_4=−0.01 *4*
449.0 *2*	6.1 *6*	2058.25	$17/2^-$	1609.26	$13/2^-$	(Q)		A_2=+0.37 *3*; A_4=−0.05 *5*
454.9 *2*	11.7 *6*	2856.4		2401.50	$21/2^+$	(Q)		A_2=+0.26 *2*; A_4=−0.01 *3*
466.0 *2*	33.9 *17*	2524.26	$21/2^-$	2058.25	$17/2^-$	E2	0.017	A_2=+0.31 *2*; A_4=−0.03 *3*; pol=−0.08 *4* $\gamma(\theta)$ data corrected for a 6% contribution from the 465.6 M1 transition in ^{148}Gd.
[x]499.5 *3*	12.2 *6*					(Q)		A_2=+0.33 *2*; A_4=0.00 *3*
528.0 *1*	16.4 *9*	1484.05	$15/2^-$	955.97	$13/2^+$	D		A_2=−0.23 *2*; A_4=−0.03 *2*
574.2 *1*	33.4 *16*	2058.25	$17/2^-$	1484.05	$15/2^-$	M1	0.018	A_2=−0.21 *1*; A_4=+0.01 *1*; pol=+0.12 *3*
622.6 *3*	4.7 *5*	2231.77	$17/2^-$	1609.26	$13/2^-$			A_2=+0.01 *6*; A_4=−0.02 *8*
630.4 *5*	7.6 *8*	795.90	$9/2^-$	165.2	$5/2^-$	(Q)		A_2=+0.23 *3*; A_4=−0.07 *4* E_γ,I_γ: obscured by a strong transition in ^{148}Gd.
643.7 *2*	7.0 *7*	2383.73	$19/2^-$	1740.10	$17/2^+$	D		A_2=−0.19 *4*; A_4=−0.05 *5*
661.4 *1*	56 *3*	2401.50	$21/2^+$	1740.10	$17/2^+$	E2		A_2=+0.30 *1*; A_4=−0.08 *1*; pol=−0.06 *3*
683.3 *2*	5.6 *6*	3084.8	$23/2^+$	2401.50	$21/2^+$	D+Q		A_2=−0.95 *4*; A_4=−0.02 *6*
703.6 *2*	15.8 *16*	3227.83	$23/2^+$	2524.26	$21/2^-$	E1		A_2=−0.21 *3*; A_4=+0.00 *3*; pol=−0.08 *9*; α(K)exp<0.0065 (1981Pi09) $\gamma(\theta)$ data corrected for a 28% contribution from 704.0 E2 transition in ^{150}Gd.
708.8 *1*	54 *5*	1484.05	$15/2^-$	775.30	$11/2^-$	E2		A_2=+0.34 *1*; A_4=−0.06 *1*; pol=−0.09 *3* E_γ: doublet. The weak component also belongs to ^{149}Gd, but it is not placed (1981Pi09).
712.3[@] *2*	12.3 *6*	4324.3?	$(29/2^-)$	3611.97	$25/2^-$	Q		A_2=+0.39 *2*; A_4=−0.10 *3*
733.1 *4*	5.5 *6*	3134.6	$23/2^-$	2401.50	$21/2^+$	D		A_2=−0.16 *4*; A_4=−0.07 *6*
747.5 *5*	≈6	2231.77	$17/2^-$	1484.05	$15/2^-$			A_2=+0.18 *1*; A_4=−0.02 *2* I_γ: from $\gamma\gamma$. Obscured by a strong 742.2 line in ^{146}Sm.
750.8 *5*	9.0 *9*	3134.6	$23/2^-$	2383.73	$19/2^-$	Q		A_2=+0.29 *2*; A_4=−0.08 *3*

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^{150}Sm(α,5nγ) 1981Pi09 (continued)

γ(^{149}Gd) (continued)

E_γ	I_γ[†]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[‡]	Comments
775.3 *1*	100 *5*	775.30	11/2⁻	0.0	7/2⁻	E2	A_2=+0.26 *1*; A_4=−0.05 *1*; pol=−0.09 *2*
784.3 *3*	67 *3*	1740.10	17/2⁺	955.97	13/2⁺	E2	A_2=+0.27 *1*; A_4=−0.06 *1*; pol=−0.10 *2*
795.9 *1*	52 *3*	795.90	9/2⁻	0.0	7/2⁻	M1+E2	A_2=+0.07 *1*; A_4=+0.03 *1*; pol=+0.16 *5*
813.3 *2*	7.5 *8*	1609.26	13/2⁻	795.90	9/2⁻	Q	A_2=+0.22 *4*; A_4=−0.08 *5*
826.4 *4*	2.5 *3*	3227.83	23/2⁺	2401.50	21/2⁺		
834.2 *3*	5.8 *6*	1609.26	13/2⁻	775.30	11/2⁻	D(+Q)	A_2=−0.16 *3*; A_4=−0.02 *4*
863.0 *4*	2.3 *2*	3387.42	27/2⁺	2524.26	21/2⁻	(E3)	A_2=+0.54 *8*; A_4=+0.14 *12*
893.2 *1*	23.0 *12*	3294.70	25/2⁺	2401.50	21/2⁺	Q	A_2=+0.32 *1*; A_4=−0.08 *2*
899.6 *2*	6.9 *7*	2383.73	19/2⁻	1484.05	15/2⁻	(Q)	A_2=+0.28 *3*; A_4=+0.01 *5*
1087.7 *1*	19.3 *10*	3611.97	25/2⁻	2524.26	21/2⁻	E2	A_2=+0.34 *2*; A_4=−0.09 *3*; pol=−0.12 *6*

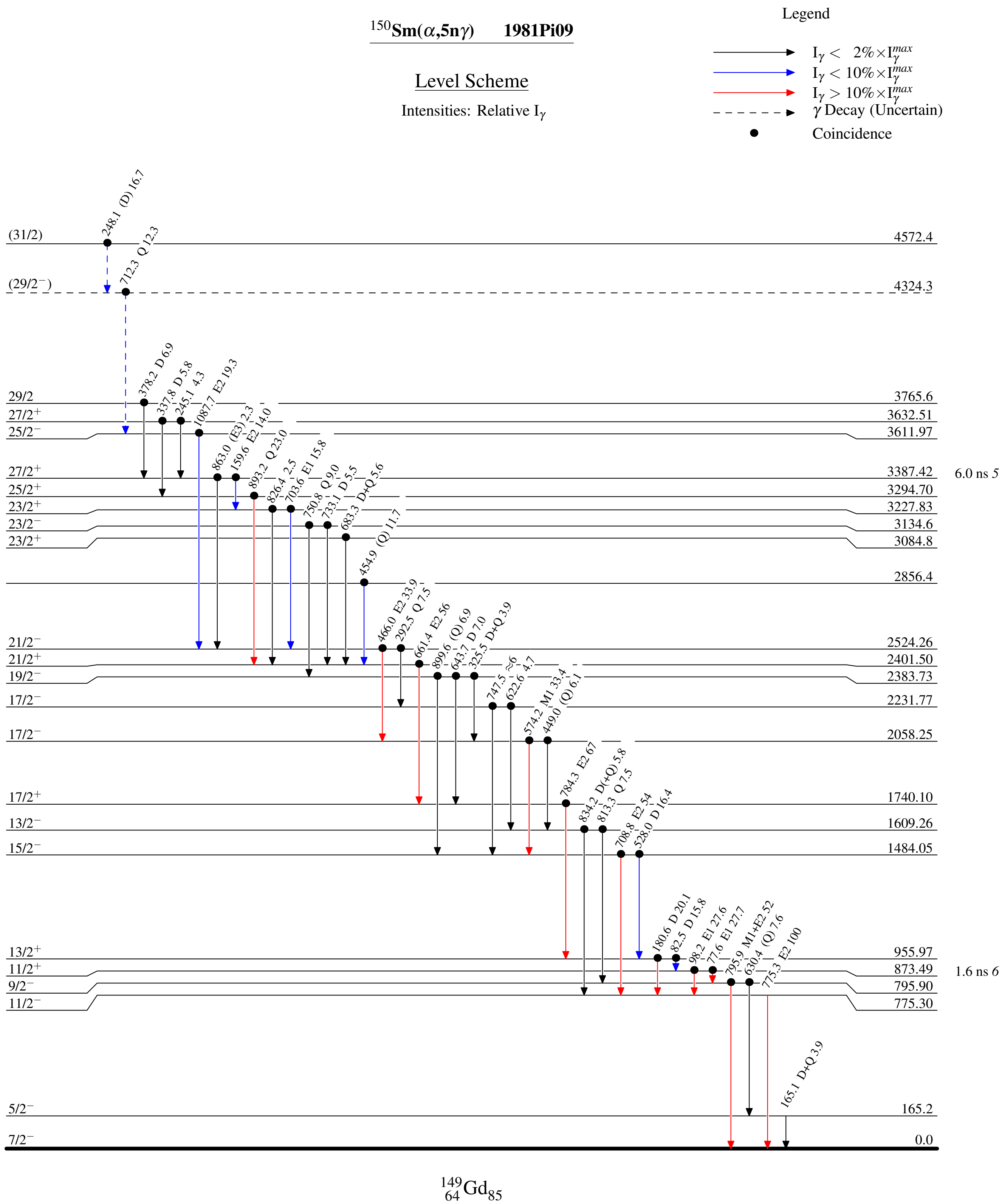
† Intensities are from (α,5nγ) E=67 MeV, θ=125°. Note that the original values have been re-normalized by the evaluators to Iγ(775.3γ)=100 (from original 641). Based on a general statement in 1981Pi09 that the intensity uncertainty is ≈5% and larger for weak or unresolved lines, the evaluators have assigned 5% for Iγ>10 and 10% for unresolved γ rays and Iγ<10.

‡ From $\gamma(\theta)$ of (α,5nγ) and γ(lin pol) of (α,4nγ) (at 51 MeV) in 1981Pi09, unless otherwise noted. RUL for E2 and M2 is used when deduced from $\gamma(\theta)$ only. Mult=Q is most likely E2.

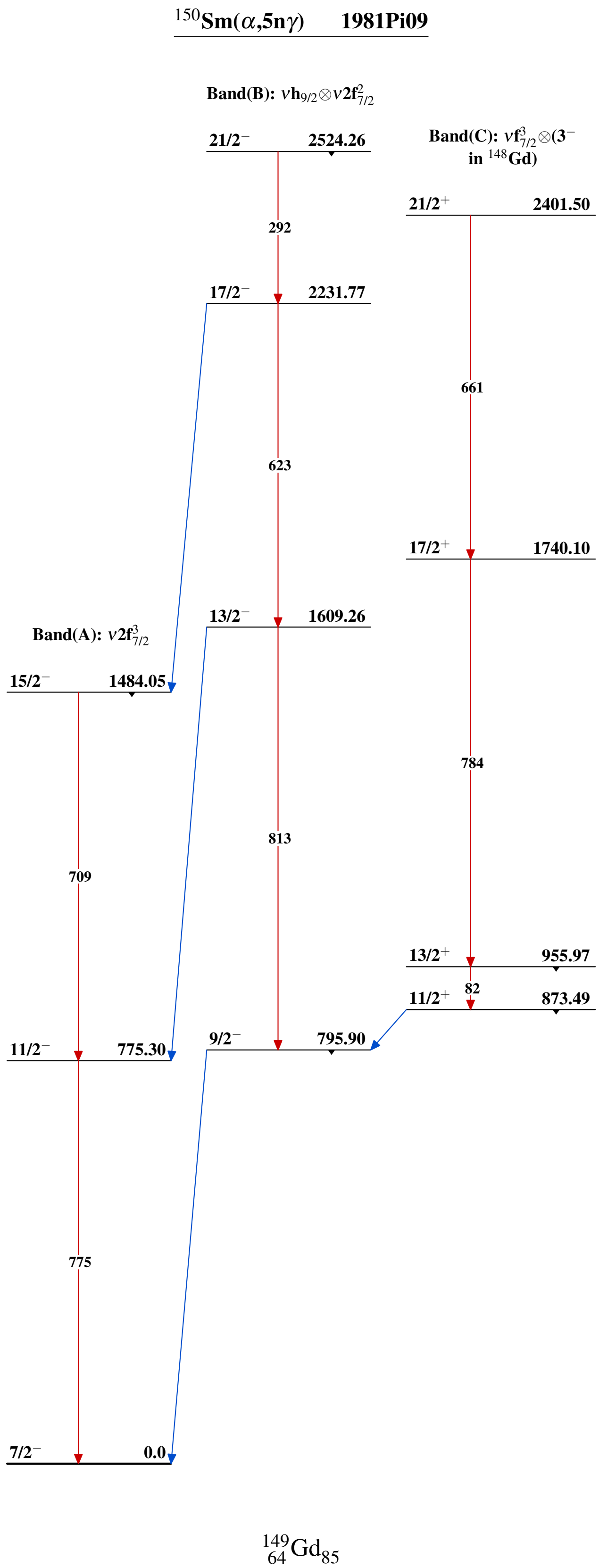
Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on γ-ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.

@ Placement of transition in the level scheme is uncertain.

^{x} γ ray not placed in level scheme.



^{150}Sm(α,5nγ) 1981Pi09
Level Scheme
Intensities: Relative Iγ
Legend
Iγ < 2%×Iγmax
Iγ < 10%×Iγmax
Iγ > 10%×Iγmax
γ Decay (Uncertain)
Coincidence
(31/2) 4572.4
(29/2−) 4324.3
29/2 3765.6
27/2+ 3632.51
25/2− 3611.97
27/2+ 3387.42 6.0 ns 5
25/2+ 3294.70
23/2+ 3227.83
23/2− 3134.6
23/2+ 3084.8
2856.4
21/2− 2524.26
21/2+ 2401.50
19/2− 2383.73
17/2− 2231.77
17/2− 2058.25
17/2+ 1740.10
13/2− 1609.26
15/2− 1484.05
13/2+ 955.97
11/2+ 873.49 1.6 ns 6
9/2− 795.90
11/2− 775.30
5/2− 165.2
7/2− 0.0
248.1 (D) 16.7
712.3 Q 12.3
378.2 D 6.9
337.8 D 5.8
245.1 4.3
1087.7 E2 19.3
863.0 (E3) 2.3
159.6 E2 14.0
893.2 Q 23.0
826.4 2.5
703.6 E1 15.8
750.8 Q 9.0
733.1 D 5.5
683.3 D+Q 5.6
454.9 (Q) 11.7
466.0 E2 33.9
292.5 Q 7.5
661.4 E2 56
899.6 (Q) 6.9
643.7 D 7.0
325.5 D+Q 3.9
747.5 ≈6
622.6 4.7
574.2 M1 33.4
449.0 (Q) 6.1
784.3 E2 67
834.2 D(+Q) 5.8
813.3 Q 7.5
708.8 E2 54
528.0 D 16.4
180.6 D 20.1
82.5 D 15.8
98.2 E1 27.6
77.6 E1 27.7
795.9 M1+E2 52
630.4 (Q) 7.6
775.3 E2 100
165.1 D+Q 3.9
$^{149}_{64}$Gd$_{85}$



^{150}Sm(α,5nγ) 1981Pi09
Band(B): $\nu h_{9/2}\otimes\nu 2f^2_{7/2}$
Band(C): $\nu f^3_{7/2}\otimes$(3$^-$ in ^{148}Gd)
Band(A): $\nu 2f^3_{7/2}$
21/2$^-$ 2524.26
17/2$^-$ 2231.77
13/2$^-$ 1609.26
9/2$^-$ 795.90
21/2$^+$ 2401.50
17/2$^+$ 1740.10
13/2$^+$ 955.97
11/2$^+$ 873.49
15/2$^-$ 1484.05
11/2$^-$ 775.30
7/2$^-$ 0.0
292
623
813
661
784
82
709
775
$^{149}_{64}$Gd$_{85}$