^{142}Nd(^{30}Si,5nγ) 1992Th06

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh and Jun Chen	NDS 191,1 (2023)	22-Aug-2023

Includes ^{142}Nd(^{28}Si,3nγ) from 2016Li49, where lifetimes were measured for (17/2$^+$), (21/2$^+$) and (25/2$^+$) levels of the yrast band.

1992Th06: E(^{30}Si)=165 MeV from the NSF Tandem Van de Graaff accelerator of the Daresbury Laboratory. Target was a stack of two thin (0.5 mg/cm^2) metallic Nd foils, 98% enriched. Measured Eγ, Iγ, two and three-fold $\gamma\gamma$-coin, $\gamma\gamma(\theta)$(DCO) at 37° and 79° using Compton-suppressed Ge detectors. Deduced levels, J, π, band structures, γ-ray multipolarities. Comparison with cranked shell model calculations.

2016Li49: ^{142}Nd(^{28}Si,3nγ),E(^{28}Si)=144 MeV beam from the HI-13 tandem accelerator at the China Institute of Atomic Energy (CIAE). Target was a stretched ≈1 mg/cm^2 isotopically enriched ^{142}Nd with a 3.00 mg/cm^2 Au support facing the beam and a 6.0 mg/cm^2 Au foil to stop the recoils in the CIAE plunger. The γ rays were detected using nine Compton-suppressed HPGe detectors and two planar HPGe detectors. Measured Eγ, Iγ, $\gamma\gamma$-coin, level lifetimes by recoil-distance Doppler shifts (RDDS). Deduced B(E2), transition quadrupole moments. Comparisons with cranked shell-model calculations.

^{167}W Levels

Band assignments are proposed by 1992Th06, unless otherwise stated.
Quasiparticle nomenclature for orbitals:
A: first $\nu i_{13/2}$,α=+1/2.
B: first $\nu i_{13/2}$,α=−1/2.
C: second $\nu i_{13/2}$,α=+1/2.
D: second $\nu i_{13/2}$,α=−1/2.
E: lowest negative-parity neutron orbital,α=−1/2.
F: lowest negative-parity neutron orbital,α=+1/2.

E(level)[†]	J$^\pi$[‡]	$T_{1/2}$[#]	Comments
0.0	(5/2$^-$)		J$^\pi$: from the Adopted Levels.
79.2 *3*	(7/2$^-$)		E(level): from the Adopted Levels.
125.9[@] *22*	13/2$^+$		Likely an isomer in ^{167}W.
215.6[c] *11*	(9/2$^-$)		
350.6[@] *21*	17/2$^+$	139 ps *10*	$T_{1/2}$: from RDDS, mean lifetime=201 ps *15* (2016Li49). Transition quadrupole moment Q(t)=4.4 *2* (2016Li49).
553.3[c] *12*	(13/2$^-$)		
756.2[@] *21*	21/2$^+$	7.0 ps *9*	$T_{1/2}$: from RDDS, mean lifetime=10.1 ps *13* (2016Li49). Transition quadrupole moment Q(t)=4.7 *3* (2016Li49).
1023.2[c] *13*	(17/2$^-$)		
1295.4[@] *20*	25/2$^+$	1.8 ps *6*	$T_{1/2}$: from RDDS, mean lifetime=2.6 ps *8* (2016Li49). Transition quadrupole moment Q(t)=4.5 *7* (2016Li49).
1527.1[d] *14*	(21/2$^-$)		
1598.7[c] *15*	(21/2$^-$)		
1782.6[a] *21*	23/2$^-$		
1920.4[d] *17*	(25/2$^-$)		
1932.3[@] *20*	29/2$^+$		
2093.6[b] *15*	(25/2$^-$)		
2104.7[a] *20*	27/2$^-$		
2407.8[d] *18*	(29/2$^-$)		
2428.1[b] *18*	(29/2$^-$)		
2479.2[a] *20*	31/2$^-$		
2629.0[@] *21*	33/2$^+$		
2821.8[b] *19*	(33/2$^-$)		

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^{142}Nd(^{30}Si,5nγ) 1992Th06 (continued)

^{167}W Levels (continued)

E(level)[†]	Jπ[‡]	E(level)[†]	Jπ[‡]	E(level)[†]	Jπ[‡]	E(level)[†]	Jπ[‡]
2937.2[a] 20	35/2−	4197.4[a] 21	43/2−	5700.7[d] 26	(49/2−)	7334.1[d] 29	(57/2−)
2960.3[d] 18	(33/2−)	4213.2[d] 21	(41/2−)	5849.4[a] 26	51/2−	7694.7[a] 29	(59/2−)
3313.5[b] 20	(37/2−)	4602.2[b] 21	(45/2−)	6052.9[&] 25	53/2+	7730.5[&] 29	61/2+
3331.3[@] 22	37/2+	4627.3[&] 23	45/2+	6242.0[b] 25	(53/2−)	8108.5[b] 29	(61/2−)
3509.6[a] 21	39/2−	4933.9[d] 24	(45/2−)	6499.4[d] 28	(53/2−)	8660.5[&] 31	(65/2+)
3556.8[d] 19	(37/2−)	4984.5[a] 23	47/2−	6764.8[a] 27	(55/2−)	9662.0[&] 32	(69/2+)
3907.9[b] 20	(41/2−)	5311.2[&] 23	49/2+	6859.8[&] 27	57/2+		
3983.6[&] 22	41/2+	5385.4[b] 23	(49/2−)	7153.3[b] 27	(57/2−)		

[†] From a least-squares fit to Eγ data, however, most levels in the level scheme decay by single transitions.
[‡] Assignments from 1992Th06, based on measured DCO-ratios and deduced band structure.
[#] From 2016Li49, recoil-distance Doppler-shift (RDDS) method, uncertainty is statistical only.
[@] Band(A): Band A, $\nu i_{13/2}$,α=+1/2.
[&] Band(a): Band A → ABC,α=+1/2. Alignment of two $i_{13/2}$ neutrons after 37/2+ in Band A, with configuration changing from $\nu i_{13/2}$ to $\nu i_{13/2}\otimes\nu i^2_{13/2}$.
[a] Band(B): Band FAB,α=−1/2. Alignment of two $i_{13/2}$ neutrons to a negative-parity neutron orbital.
[b] Band(C): Band EAB,α=+1/2. Alignment of two $i_{13/2}$ neutrons to a negative-parity neutron orbital.
[c] Band(D): Band E,α=+1/2. Lowest negative−parity neutron orbital.
[d] Band(E): α=+1/2 band. Cranked shell model classification is uncertain (1992Th06); the alignment pattern differs greatly from those for the other π=− bands. Assigned as α=+1/2 based on systematics for similar bands in lighter N=93 isotones.

γ(^{167}W)

All data are from 1992Th06 unless otherwise indicated.
DCO ratios are for gates on ΔJ=2, quadrupole (E2) transitions. Expected values are ≈1.0 for ΔJ=2, quadrupole, and ≈0.6 for ΔJ=1, dipole transitions, as determined by 1992Th06 from weighted averaged value of 1.0 for known stretched quadrupole transitions.

Eγ[†]	Iγ[‡]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[&]	α[a]	Comments
(79.2 3)		79.2	(7/2−)	0.0	(5/2−)			Eγ: from the Adopted Levels, Gammas dataset.
136.4 10	5.3[#] 9	215.6	(9/2−)	79.2	(7/2−)			DCO=0.82 20
224.7 5	83.2[#] 32	350.6	17/2+	125.9	13/2+	E2	0.210 3	B(E2)↓=0.58 4 (2016Li49) DCO=0.85 4
322.1 10	8.4 18	2104.7	27/2−	1782.6	23/2−	Q		DCO=1.00 10
323.4 10	3.7 17	2428.1	(29/2−)	2104.7	27/2−			
334.5 10	8.5 14	2428.1	(29/2−)	2093.6	(25/2−)	Q		DCO=0.96 13
337.7 5	18.1[@] 24	553.3	(13/2−)	215.6	(9/2−)			DCO=0.84 22
342.6 10	2.6 5	2821.8	(33/2−)	2479.2	31/2−			DCO=0.94 23
374.5 5	21.8 11	2479.2	31/2−	2104.7	27/2−	Q		DCO=0.95 7
376.3 10	≈1.7	3313.5	(37/2−)	2937.2	35/2−			DCO=0.96 38
393.3 10	6.0 15	1920.4	(25/2−)	1527.1	(21/2−)	Q		DCO=1.17 27
393.7 5	15.2 24	2821.8	(33/2−)	2428.1	(29/2−)	Q		DCO=1.15 11
405.6 5	100.0[#] 22	756.2	21/2+	350.6	17/2+	E2	0.0362 5	DCO=0.89 5 B(E2)↓=0.71 9 (2016Li49)
[x]428.7 10	1.1 4							
458.0 5	20.7 8	2937.2	35/2−	2479.2	31/2−	Q		DCO=1.03 8

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^{142}Nd(^{30}Si,5nγ) 1992Th06 (continued)

γ(^{167}W) (continued)

Eγ[†]	Iγ[‡]	Ei(level)	J^π_i	Ef	J^π_f	Mult.[&]	α[a]	Comments
469.9 *5*	19.3[@] *30*	1023.2	(17/2⁻)	553.3	(13/2⁻)	Q		DCO=1.04 *14*
[x]473.8 *10*	2.6 *6*							DCO=1.50 *72*
487.2 *10*	3.5[@] *14*	1782.6	23/2⁻	1295.4	25/2⁺	(D)		DCO=0.77 *14*
487.4 *5*	11.7 *21*	2407.8	(29/2⁻)	1920.4	(25/2⁻)	Q		DCO=1.03 *16*
491.7 *5*	14.6 *11*	3313.5	(37/2⁻)	2821.8	(33/2⁻)	(Q)		DCO=0.90 *11*
494.9 *10*	6.4 *15*	2093.6	(25/2⁻)	1598.7	(21/2⁻)	Q		DCO=1.34 *20*
503.9 *5*	11.6 *15*	1527.1	(21/2⁻)	1023.2	(17/2⁻)	Q		DCO=0.92 *16*
539.2 *5*	84.3 *20*	1295.4	25/2⁺	756.2	21/2⁺	E2	0.0175 *3*	DCO=0.96 *6* B(E2)↓=0.67 *21* (2016Li49)
546.9 *10*	6.9 *9*	2479.2	31/2⁻	1932.3	29/2⁺	D		DCO=0.52 *8*
552.5 *5*	10.0 *15*	2960.3	(33/2⁻)	2407.8	(29/2⁻)			DCO=0.79 *18*
566.6 *10*	4.6 *16*	2093.6	(25/2⁻)	1527.1	(21/2⁻)	Q		DCO=1.39 *45*
572.4 *5*	17.4 *24*	3509.6	39/2⁻	2937.2	35/2⁻	Q		DCO=0.99 *9*
[x]575.1 *10*	2.9 *10*							DCO=0.83 *26*
575.4 *10*	8.1 *12*	1598.7	(21/2⁻)	1023.2	(17/2⁻)	Q		DCO=0.91 *13*
594.4 *5*	15.2 *15*	3907.9	(41/2⁻)	3313.5	(37/2⁻)	Q		DCO=1.18 *12*
596.5 *5*	9.5 *29*	3556.8	(37/2⁻)	2960.3	(33/2⁻)	(Q)		DCO=1.14 *28*
[x]607.6 *10*	5.6 *5*					D		DCO=0.58 *22*
[x]631.7 *10*	5.4 *15*							DCO=0.99 *17*
636.9 *5*	52.5 *13*	1932.3	29/2⁺	1295.4	25/2⁺	Q		DCO=0.94 *6*
643.7 *5*	16.5 *8*	4627.3	45/2⁺	3983.6	41/2⁺	Q		DCO=1.05 *10*
652.3 *5*	22.7 *9*	3983.6	41/2⁺	3331.3	37/2⁺	Q		DCO=1.03 *9*
656.4 *10*	9.4 *13*	4213.2	(41/2⁻)	3556.8	(37/2⁻)	(Q)		DCO=1.50 *58*
[x]663.0 *10*	2.9 *6*							DCO=0.85 *40*
[x]666.1 *10*	2.9 *8*							
683.9 *5*	13.0 *9*	5311.2	49/2⁺	4627.3	45/2⁺			DCO=0.86 *10*
687.8 *5*	12.7 *9*	4197.4	43/2⁻	3509.6	39/2⁻	Q		DCO=1.25 *16*
694.3 *5*	11.1 *8*	4602.2	(45/2⁻)	3907.9	(41/2⁻)	Q		DCO=1.24 *16*
696.7 *5*	39 *6*	2629.0	33/2⁺	1932.3	29/2⁺	Q		DCO=0.94 *10*
702.3 *5*	32.6 *13*	3331.3	37/2⁺	2629.0	33/2⁺	Q		DCO=0.94 *10*
720.7 *10*	6.1 *7*	4933.9	(45/2⁻)	4213.2	(41/2⁻)	(Q)		DCO=1.04 *25*
[x]724.5 *10*	3.1 *10*							DCO=1.18 *36*
741.7 *10*	8.5 *5*	6052.9	53/2⁺	5311.2	49/2⁺			DCO=0.85 *13*
[x]757.4 *10*	5.4 *9*					D		DCO=0.63 *19*
766.8 *10*	3.0 *7*	5700.7	(49/2⁻)	4933.9	(45/2⁻)			DCO=1.31 *40*
783.2 *10*	6.6 *9*	5385.4	(49/2⁻)	4602.2	(45/2⁻)	Q		DCO=1.12 *16*
787.1 *10*	8.7 *12*	4984.5	47/2⁻	4197.4	43/2⁻	(Q)		DCO=0.92 *14*
798.7 *10*	1.3 *5*	6499.4	(53/2⁻)	5700.7	(49/2⁻)			
806.9 *10*	4.8 *23*	6859.8	57/2⁺	6052.9	53/2⁺	(Q)		DCO=1.30 *30*
809.3 *5*	21.8 *27*	2104.7	27/2⁻	1295.4	25/2⁺	D		DCO=0.62 *6*
[x]820.1 *10*	2.2 *5*							
834.7[b] *10*	0.9 *4*	7334.1	(57/2⁻)	6499.4	(53/2⁻)			
856.6 *10*	5.0 *7*	6242.0	(53/2⁻)	5385.4	(49/2⁻)	(Q)		DCO=1.08 *26*
864.9 *10*	4.0 *6*	5849.4	51/2⁻	4984.5	47/2⁻	Q		DCO=1.3 *3*
870.7 *10*	3.3 *6*	7730.5	61/2⁺	6859.8	57/2⁺	(Q)		DCO=1.50 *55*
911.3 *10*	3.4 *7*	7153.3	(57/2⁻)	6242.0	(53/2⁻)			DCO=0.91 *50*
915.4 *10*	2.2 *5*	6764.8	(55/2⁻)	5849.4	51/2⁻			DCO=1.10 *50*
929.9 *10*	≈1.5[@]	7694.7	(59/2⁻)	6764.8	(55/2⁻)			
930.0 *10*	2.0[@] *6*	8660.5	(65/2⁺)	7730.5	61/2⁺			DCO=0.81 *17*
955.2 *10*	2.4 *11*	8108.5	(61/2⁻)	7153.3	(57/2⁻)			
1001.4[b] *10*	1.5 *6*	9662.0	(69/2⁺)	8660.5	(65/2⁺)			DCO=1.38 *60*
1026.4 *10*	7.0 *5*	1782.6	23/2⁻	756.2	21/2⁺			

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^{142}Nd(^{30}Si,5nγ) 1992Th06 (continued)

γ(^{167}W) (continued)

† 1992Th06 state uncertainty of ≤1 keV for weak transitions and doublets, and <0.5 keV for all the other gamma rays. Evaluators have assigned ΔE_γ=0.5 keV for γ rays with Iγ≥10, and 1 keV for doublets and gammas with Iγ<10.

‡ Photon intensity relative to I(406γ)=100, neglecting time window effects and residual angular correlation effects; taken from spectra coincident with 225γ, 406γ, 338γ or 470γ. Data for Eγ≤200 are not very reliable (1992Th06).

From two-fold projection spectrum.

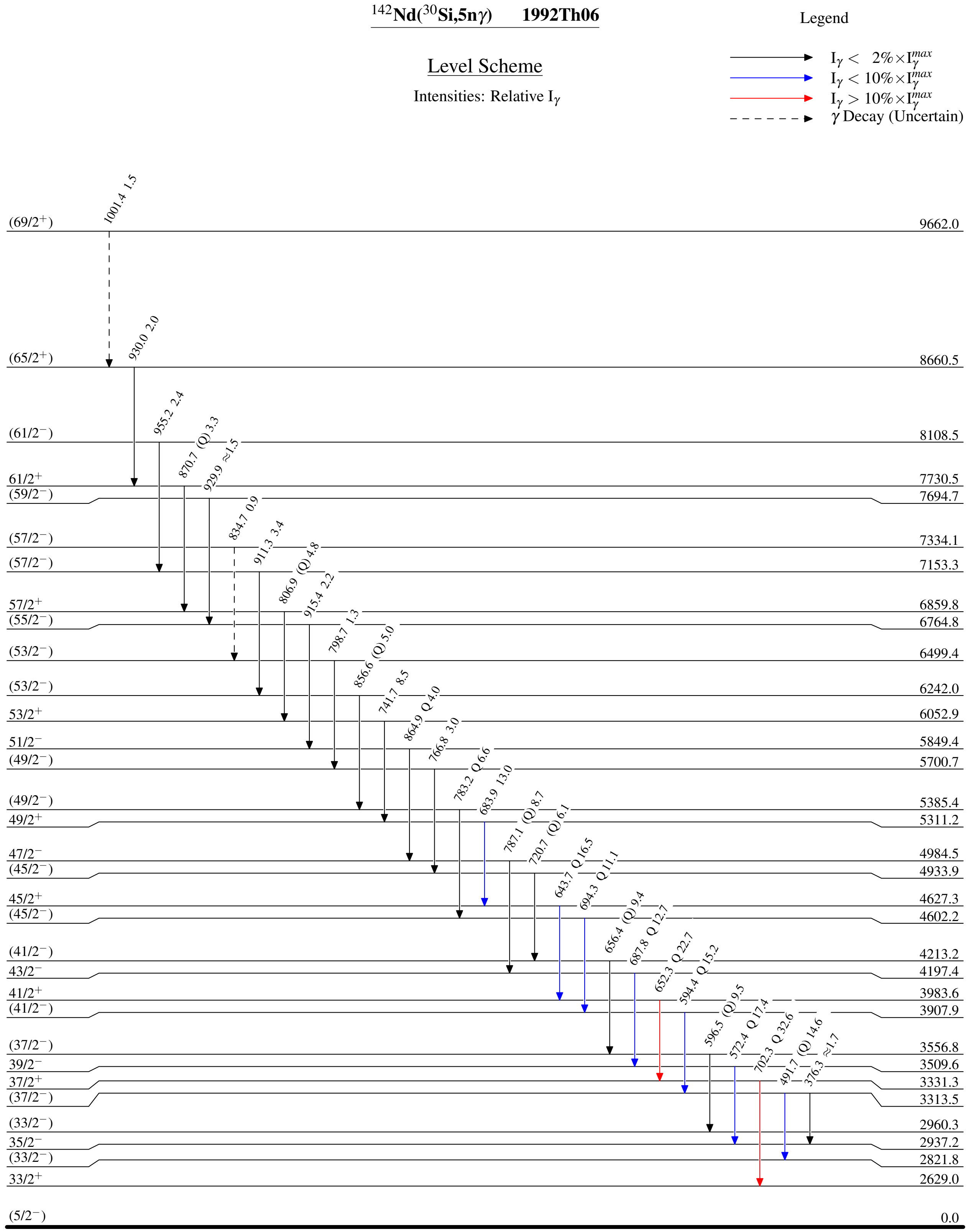
@ From relative intensities in coincidence spectra.

& From $\gamma\gamma(\theta)$(DCO) ratios in 1992Th06 and RUL where level $T_{1/2}$ is available from 2016Li49.

[a] 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.

[b] Placement of transition in the level scheme is uncertain.

[x] γ ray not placed in level scheme.



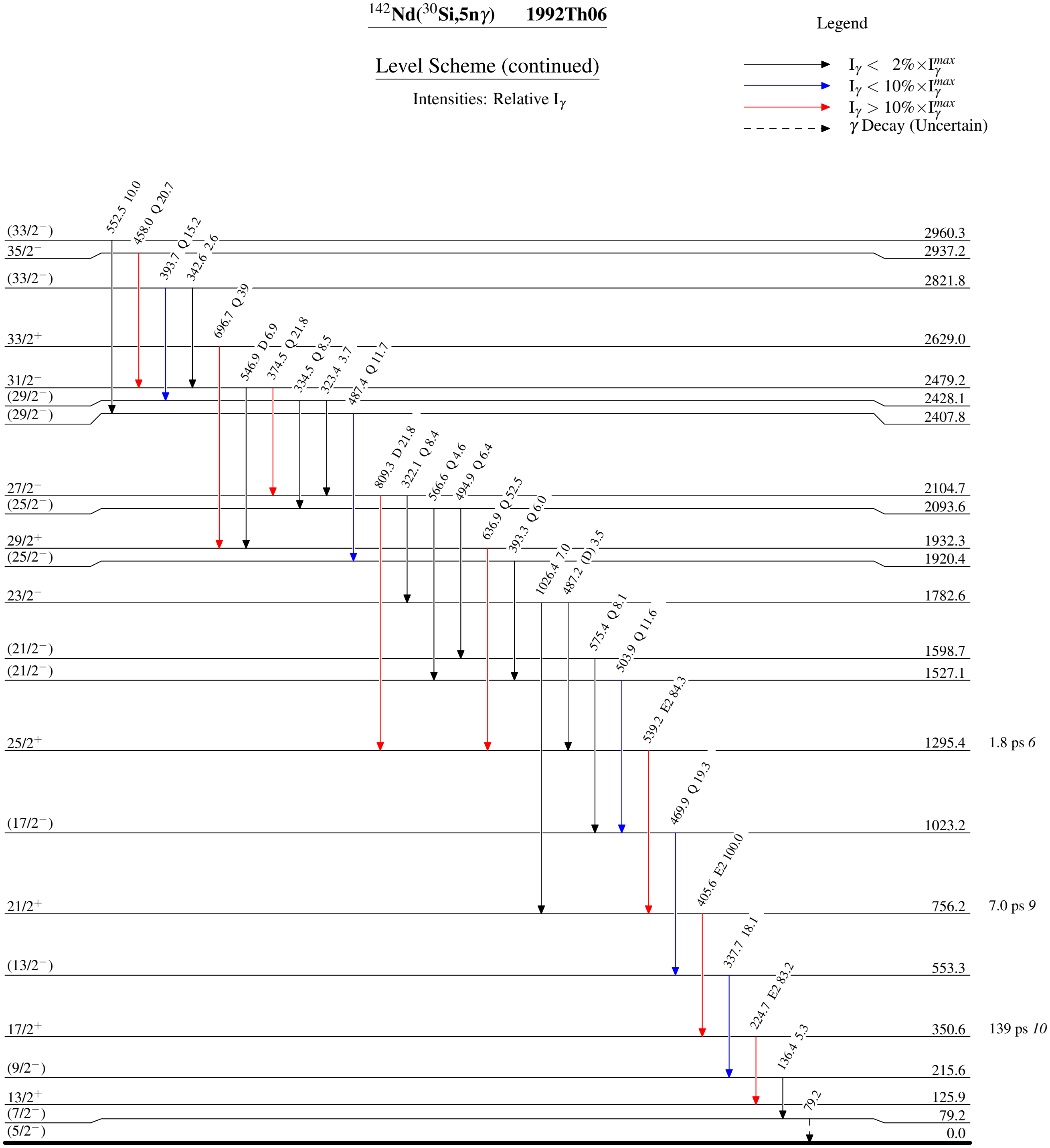
142Nd(30Si,5nγ) 1992Th06
Level Scheme
Intensities: Relative Iγ
Legend
Iγ < 2%×Iγmax
Iγ < 10%×Iγmax
Iγ > 10%×Iγmax
γ Decay (Uncertain)
(69/2+) 9662.0
(65/2+) 8660.5
(61/2−) 8108.5
61/2+ 7730.5
(59/2−) 7694.7
(57/2−) 7334.1
(57/2−) 7153.3
57/2+ 6859.8
(55/2−) 6764.8
(53/2−) 6499.4
(53/2−) 6242.0
53/2+ 6052.9
51/2− 5849.4
(49/2−) 5700.7
(49/2−) 5385.4
49/2+ 5311.2
47/2− 4984.5
(45/2−) 4933.9
45/2+ 4627.3
(45/2−) 4602.2
(41/2−) 4213.2
43/2− 4197.4
41/2+ 3983.6
(41/2−) 3907.9
(37/2−) 3556.8
39/2− 3509.6
37/2+ 3331.3
(37/2−) 3313.5
(33/2−) 2960.3
35/2− 2937.2
(33/2−) 2821.8
33/2+ 2629.0
(5/2−) 0.0
1001.4 1.5
930.0 2.0
955.2 2.4
870.7 (Q) 3.3
929.9 ≈1.5
834.7 0.9
911.3 3.4
806.9 (Q) 4.8
915.4 2.2
798.7 1.3
856.6 (Q) 5.0
741.7 8.5
864.9 Q 4.0
766.8 3.0
783.2 Q 6.6
683.9 13.0
787.1 (Q) 8.7
720.7 (Q) 6.1
643.7 Q 16.5
694.3 Q 11.1
656.4 (Q) 9.4
687.8 Q 12.7
652.3 Q 22.7
594.4 Q 15.2
596.5 (Q) 9.5
572.4 Q 17.4
702.3 Q 32.6
491.7 (Q) 14.6
376.3 ≈1.7

$^{167}_{74}W_{93}$

$^{142}Nd(^{30}Si,5n\gamma)$ 1992Th06

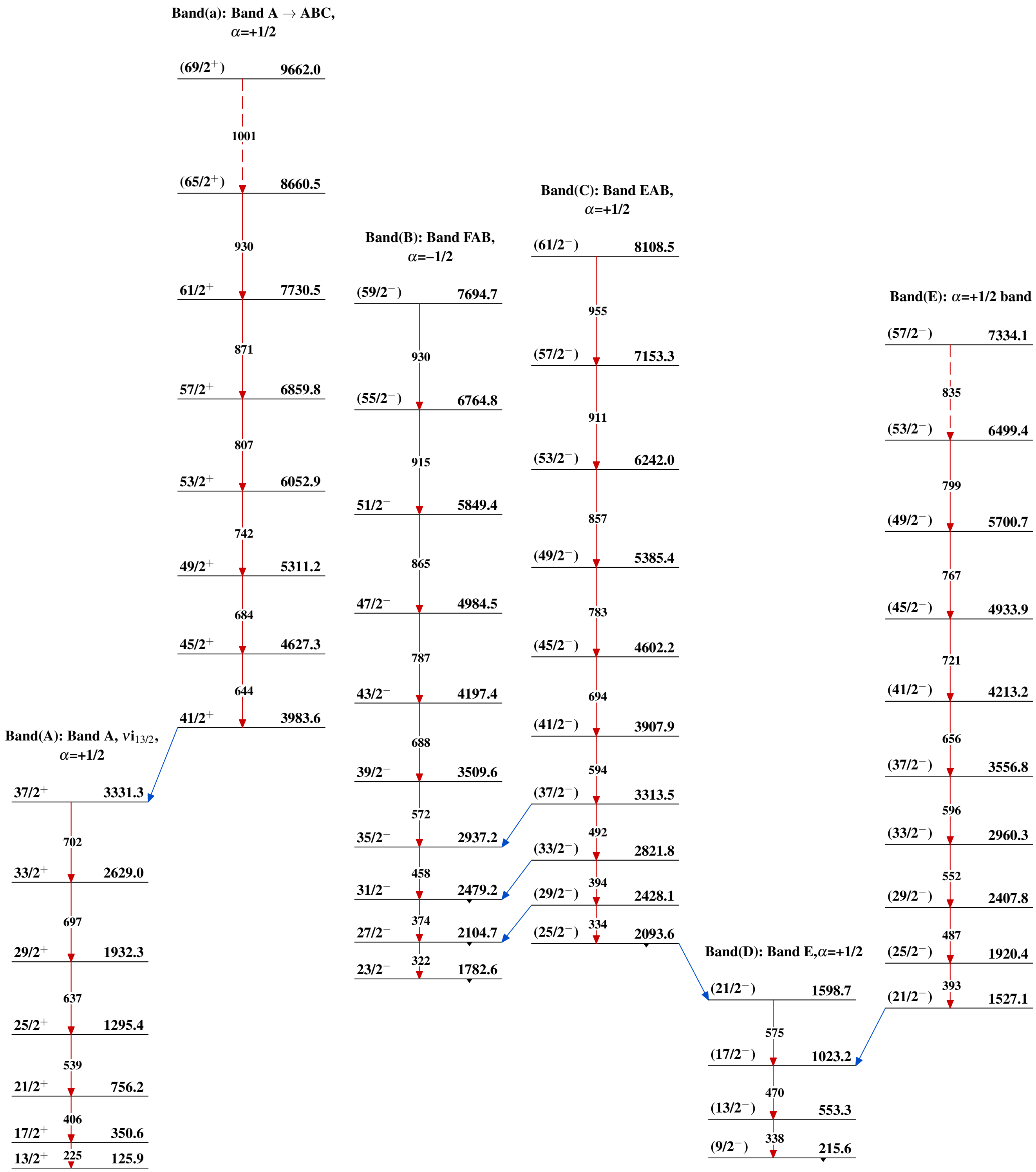
Level Scheme (continued)

Intensities: Relative I_γ



$^{167}_{74}W_{93}$

$^{142}Nd(^{30}Si,5n\gamma)$ 1992Th06



$^{167}_{74}W_{93}$