^{148}Sm(^{16}O,3nγ),^{122}Sn(^{44}Ca,5nγ) 1980Ri08,1988Fe01,1990TeZW

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	C. W. Reich	NDS 112,2497 (2011)	1-Jun-2011

Additional information 1.

The reactions that have been used are: ^{148}Sm(^{16}O,3nγ) with E(^{16}O)=82 MeV (1980Ri02,1980Ri08); Sm($^{16,\ 18O,\ 18}$Onγ) (1976HeZZ,1980GaZJ); ^{125}Te(^{40}Ar,4nγ) with E(^{40}Ar)=180 MeV (1983HaYY); and ^{116}Cd(^{48}Ti,3nγ) with E(^{48}Ti)=205 MeV and the inverse kinematic reaction ^{48}Ti(^{116}Cd,3nγ) with E(^{116}Cd)=495 MeV (1988Fe01, and preliminary version 1985Fe02). Related papers include 1982Ch12 and 1983Ga16. Similar reactions are used to study continuum states (1978Ne01, 1980Ne01, 1982An13, 1982Sa21, 1983De02, 1983Ja04).

1990TeZW: ^{122}Sn(^{44}Ca,5n), E(^{44}Ca)=200 MeV. Both unbacked and backed (with Au) targets. Gammas were detected using the TESSA 3 array of 16 escape-suppressed Ge detectors and a 50-element BGO inner ball. These authors present their data in the form of a level scheme only, with no uncertainties for any of the data. Their proposed scheme, consisting of 5 decay sequences, is in essential agreement with the earlier studies, except that it extends to higher spins and places different γ′s at the top of the some of the previously assigned decay sequences.

1991SmZZ: measured lifetimes of some of the ^{161}Yb levels populated using the ^{122}Sn(^{44}Ca,5n) reaction at E(^{44}Ca)=200 MeV. Their results are presented, graphically, in the form of transition quadrupole moments for various of the γ rays. No attempt was made by the evaluator to deduce $T_{1/2}$ values from this information.

1988Fe01: measured lifetimes of many of these levels using the recoil-distance technique and the ^{116}Cd+^{48}Ti (E(^{48}Ti)=205 MeV, target enrichment=90%) and the ^{48}Ti+^{116}Cd (E(^{116}Cd)=495 MeV, target enrichment=99.1%) reactions. 1985Fe02 give preliminary values for many of the $T_{1/2}$ values reported there.

The level scheme and γ-ray energies are those reported by 1990TeZW, unless noted otherwise.

^{161}Yb Levels

Additional information 2.

E(level)[†]	Jπ[#]	$T_{1/2}$[@]	Comments
0[&]	3/2−		
43.67[&] *18*	5/2−		
110.79[&] *9*	7/2−		
211.1[a]	(9/2+)		E(level): the interpretation of the in-beam data is based the existence of a 9/2+ level at, or near, this energy. The interpretation of the ^{161}Lu ε decay includes a level at this energy that decays directly to the 3/2− g.s., and which, therefore, has a lower spin.
220.7[&]	9/2−		
230.6[a]	(13/2+)		E(level): value reported by 1990TeZW, but the basis for it is not given. In particular, no deexciting γ transition is reported.
462.6[a]	(17/2+)	85 ps *6*	
552.7[&]	13/2−	6 ps *3*	
703.0[b]	(15/2+)		
859.9[a]	(21/2+)	7.2 ps *6*	
1006.7[&]	17/2−	3.5 ps *21*	
1117.0[b]	(19/2+)		
1382.3[a]	(25/2+)	1.5 ps *3*	
1535.9[&]	21/2−	<21 ps	
1649.0[b]	(23/2+)		
1999.2[a]	(29/2+)	1.6 ps *3*	
2044.4[c]	(25/2−)		
2098.1[&]	25/2−		
2259.0[b]	(27/2+)		

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$^{148}Sm(^{16}O,3n\gamma),^{122}Sn(^{44}Ca,5n\gamma)$ 1980Ri08,1988Fe01,1990TeZW (continued)

^{161}Yb Levels (continued)

E(level)[†]	Jπ[#]	$T_{1/2}$[@]	E(level)[†]	Jπ[#]	E(level)[†]	Jπ[#]
2304.6[d]	(27/2−)		4473.2[d]	(43/2−)	8832.3[d]	(63/2−)
2478.3[&]	29/2−		4811.4[&]	45/2−	9090.2[&]	65/2−
2560.6[c]	(29/2−)		4812.0[a]	(45/2+)	9095.0[‡a]	(65/2+)
2680.1[a]	(33/2+)	<1.4 ps	5142.9[‡c]	(45/2−)	9844.3[d]	(67/2−)
2686.5[d]	(31/2−)		5266.4[d]	(47/2−)	10010.5[a]	(69/2+)
2915.7[&]	33/2−	4.2 ps *8*	5578.6[a]	(49/2+)	10053.2[&]	69/2−
2919.0[b]	(31/2+)		5631.6[&]	49/2−	10914.3?[d]	(71/2−)
3108.8[c]	(33/2−)		5963.5[c]	(49/2−)	10972.5[a]	(73/2+)
3167.4[d]	(35/2−)		6120.2[d]	(51/2−)	11105.2[&]	73/2−
3387.4[a]	(37/2+)		6405.6[a]	(53/2+)	11988.5[a]	(77/2+)
3443.5[&]	37/2−	<2.8 ps	6500.1[&]	53/2−	12044.3?[d]	(75/2−)
3627.0[b]	(35/2+)		6813.8[c]	(53/2−)	12218.2[&]	77/2−
3712.6[c]	(37/2−)		6977.5[d]	(55/2−)	13054.5[a]	(81/2+)
3766.9[d]	(39/2−)		7288.8[a]	(57/2+)	13364.5[&]	81/2−
4074.9[&]	41/2−		7347.4[&]	57/2−	14181.5[a]	(85/2+)
4092.5[a]	(41/2+)		7876.7[‡d]	(59/2−)	14531.5[&]	85/2−
4350.0[b]	(39/2+)		8194.7[‡&]	61/2−	15709.4?[&]	(89/2−)
4382.8[c]	(41/2−)		8198.0[a]	(61/2+)		

[†] From 1990TeZW, unless noted otherwise. The values below 215 keV are taken from the ^{161}Lu ε decay study.
[‡] The earlier studies reported no band members above this level. All the higher-lying members of this band are those as reported by 1990TeZW.
[#] From adopted values. The spins from the heavy-ion studies are based largely on $\gamma(\theta)$ results, the observed γ-deexcitation of the levels, and general considerations of rotational-band structure.
[@] From 1988Fe01, recoil-distance measurements.
[&] Band(A): K^π=3/2− g.s. band. Based on the deduced alignment (≈2.5) and the signature, 1980Ri08 conclude that the configuration is a mixture of the 3/2−[521] and 3/2−[532] Nilsson orbitals. Above the J=7/2 level, only the signature=+1/2 portion of the band has been established. (See, however, the comment on the “negative-parity band, α=−1/2 band” below.).
[a] Band(B): yrast band, α=+1/2. From the observed alignment, the band is assumed to be associated with the $i_{13/2}$ state and, hence to have positive parity.
[b] Band(C): positive-parity band, α=−1/2. This band structure looks like that expected for the unfavored members of the $i_{13/2}$ band (1980Ri08).
[c] Band(D): negative-parity band, α=+1/2.
[d] Band(E): negative-parity band, α=−1/2. 1980Ri08 suggest that, although not observed at the lower spins, this band may be the signature=−1/2 portion of the g.s. band.

$\gamma(^{161}Yb)$

E_γ[†]	E_i(level)	J_i^π	E_f	J_f^π	Comments
43.7[‡] *3*	43.67	5/2−	0	3/2−	
67.13[‡] *20*	110.79	7/2−	43.67	5/2−	
100.3	211.1	(9/2+)	110.79	7/2−	E_γ: from 1980Ri08.
109.9	220.7	9/2−	110.79	7/2−	E_γ: from level energy difference.
110.78[‡] *10*	110.79	7/2−	0	3/2−	
176.9 *1*	220.7	9/2−	43.67	5/2−	E_γ: from 1980Ri08.

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^{148}Sm(^{16}O,3nγ),^{122}Sn(^{44}Ca,5nγ) 1980Ri08,1988Fe01,1990TeZW (continued)

γ(^{161}Yb) (continued)

Eγ[†]	Ei(level)	J^{π}_{i}	Ef	J^{π}_{f}	Mult.[#@]	δ[&]	Comments
232.0	462.6	(17/2+)	230.6	(13/2+)	E2		
240.4	703.0	(15/2+)	462.6	(17/2+)	M1+E2	−0.17[a] *8*	Eγ: computed by the evaluator from the level-energy difference.
256.4	1117.0	(19/2+)	859.9	(21/2+)	M1+E2	−0.20 *11*	Iγ(256.4γ)/Iγ(414.5γ)=0.49 *12* (1982Ch12). Eγ: value reported by 1980Ri08. 1990TeZW show this γ in their level scheme, but do not give an energy for it.
264.7	1649.0	(23/2+)	1382.3	(25/2+)	M1+E2	−0.20 *10*	Iγ(264.7γ)/Iγ(532.8γ)=0.15 *3* (1982Ch12).
332.0	552.7	13/2−	220.7	9/2−			
355.1	2915.7	33/2−	2560.6	(29/2−)			
380.2	2478.3	29/2−	2098.1	25/2−			
381.9	2686.5	(31/2−)	2304.6	(27/2−)			
397.3	859.9	(21/2+)	462.6	(17/2+)	E2		
414.5	1117.0	(19/2+)	703.0	(15/2+)			
433.5	2478.3	29/2−	2044.4	(25/2−)			
437.4	2915.7	33/2−	2478.3	29/2−			
454.0	1006.7	17/2−	552.7	13/2−			
472.4	703.0	(15/2+)	230.6	(13/2+)	M1+E2	+0.6[a] *4*	Eγ: computed by the evaluator from the level-energy difference.
480.9	3167.4	(35/2−)	2686.5	(31/2−)			
487.3[b]	3167.4	(35/2−)	2680.1	(33/2+)			
508.5	2044.4	(25/2−)	1535.9	21/2−			
516.2	2560.6	(29/2−)	2044.4	(25/2−)			
522.4	1382.3	(25/2+)	859.9	(21/2+)	E2		
527.8	3443.5	37/2−	2915.7	33/2−			
529.2	1535.9	21/2−	1006.7	17/2−			
532.8	1649.0	(23/2+)	1117.0	(19/2+)			
548.2	3108.8	(33/2−)	2560.6	(29/2−)			
562.2	2098.1	25/2−	1535.9	21/2−			
599.5	3766.9	(39/2−)	3167.4	(35/2−)			
603.8	3712.6	(37/2−)	3108.8	(33/2−)			
610.5	2259.0	(27/2+)	1649.0	(23/2+)			
616.9	1999.2	(29/2+)	1382.3	(25/2+)	E2		
631.4	4074.9	41/2−	3443.5	37/2−			
653.9	1117.0	(19/2+)	462.6	(17/2+)	M1+E2	+0.5 *+10−1*	Iγ(653.9γ)/Iγ(414.5γ)=0.72 *15* (1982Ch12). Eγ: value reported by 1980Ri08. 1990TeZW show this γ in their level scheme, but do not give an energy for it.
660.1	2919.0	(31/2+)	2259.0	(27/2+)			
670.2	4382.8	(41/2−)	3712.6	(37/2−)			
680.9	2680.1	(33/2+)	1999.2	(29/2+)	E2		
687.3	2686.5	(31/2−)	1999.2	(29/2+)			Eγ: from level energy difference.
705.1	4092.5	(41/2+)	3387.4	(37/2+)			
706.3	4473.2	(43/2−)	3766.9	(39/2−)			
707.3	3387.4	(37/2+)	2680.1	(33/2+)	E2		
708.0	3627.0	(35/2+)	2919.0	(31/2+)			
719.5	4812.0	(45/2+)	4092.5	(41/2+)			
723.0	4350.0	(39/2+)	3627.0	(35/2+)			
736.5	4811.4	45/2−	4074.9	41/2−			
760.1	5142.9	(45/2−)	4382.8	(41/2−)			
766.6	5578.6	(49/2+)	4812.0	(45/2+)			Eγ: 1980Ri08 report Eγ=759.5 and 1983HaYY report Eγ=767 for the transition assigned to connect these two states.
788.9	1649.0	(23/2+)	859.9	(21/2+)	M1+E2	+0.40 *15*	Iγ(788.9γ)/Iγ(532.8γ)=0.49 *9* (1982Ch12). Eγ: value reported by 1982Ch12. 1990TeZW show

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^{148}Sm(^{16}O,3nγ),^{122}Sn(^{44}Ca,5nγ) 1980Ri08,1988Fe01,1990TeZW (continued)

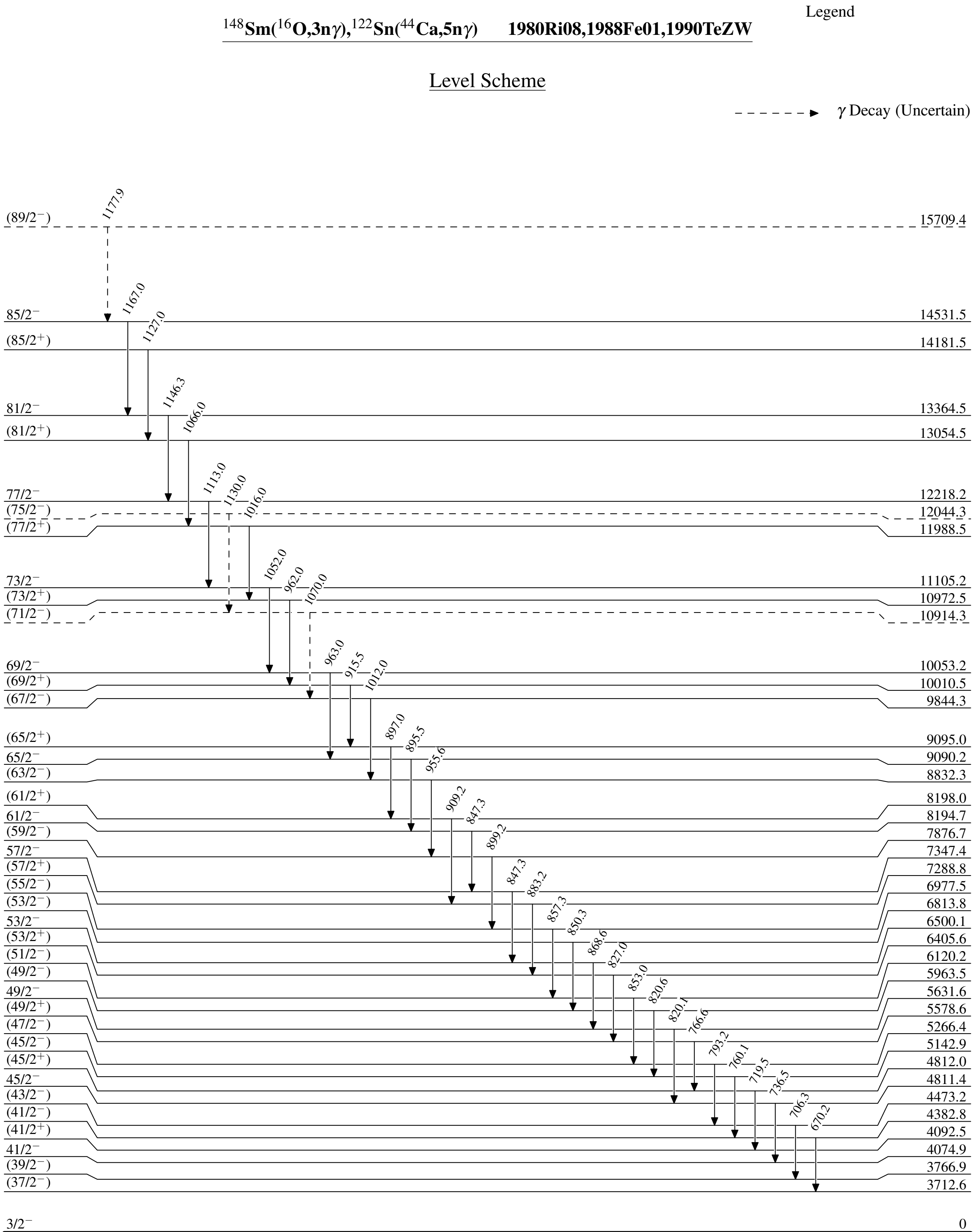
γ(^{161}Yb) (continued)

E_γ [†]	E_i(level)	J^π_i	E_f	J^π_f	Comments
					this γ in their level scheme, but do not give an energy for it.
793.2	5266.4	(47/2⁻)	4473.2	(43/2⁻)	
820.1	5631.6	49/2⁻	4811.4	45/2⁻	
820.6	5963.5	(49/2⁻)	5142.9	(45/2⁻)	
827.0	6405.6	(53/2⁺)	5578.6	(49/2⁺)	E_γ: 1983HaYY report Eγ=830 for the γ connecting these two states.
847.3	7347.4	57/2⁻	6500.1	53/2⁻	E_γ: 1983HaYY report Eγ=870 for the γ connecting these two states.
847.3	8194.7	61/2⁻	7347.4	57/2⁻	E_γ: 1983HaYY report Eγ=898 for the γ connecting these two states.
850.3	6813.8	(53/2⁻)	5963.5	(49/2⁻)	
853.0	6120.2	(51/2⁻)	5266.4	(47/2⁻)	E_γ: 1980Ri08 report Eγ=850 and 1983HaYY report Eγ=855 for the transition assigned to connect these two states.
857.3	6977.5	(55/2⁻)	6120.2	(51/2⁻)	
868.6	6500.1	53/2⁻	5631.6	49/2⁻	E_γ: 1983HaYY report Eγ=848 for the transition proposed to connect these two states.
883.2	7288.8	(57/2⁺)	6405.6	(53/2⁺)	
895.5	9090.2	65/2⁻	8194.7	61/2⁻	
897.0	9095.0	(65/2⁺)	8198.0	(61/2⁺)	E_γ: 1983HaYY report Eγ=917 for the γ connecting these two states.
899.2	7876.7	(59/2⁻)	6977.5	(55/2⁻)	E_γ: 1983HaYY report Eγ=955 for the γ connecting these two states.
909.2	8198.0	(61/2⁺)	7288.8	(57/2⁺)	E_γ: 1983HaYY report Eγ=898 for the γ connecting these two states.
915.5	10010.5	(69/2⁺)	9095.0	(65/2⁺)	E_γ: 1983HaYY report Eγ=964 for the γ connecting these two states.
922.3	2304.6	(27/2⁻)	1382.3	(25/2⁺)	
955.6	8832.3	(63/2⁻)	7876.7	(59/2⁻)	
962.0	10972.5	(73/2⁺)	10010.5	(69/2⁺)	
963.0	10053.2	69/2⁻	9090.2	65/2⁻	
1012.0	9844.3	(67/2⁻)	8832.3	(63/2⁻)	
1016.0	11988.5	(77/2⁺)	10972.5	(73/2⁺)	
1052.0	11105.2	73/2⁻	10053.2	69/2⁻	
1066.0	13054.5	(81/2⁺)	11988.5	(77/2⁺)	
1070.0 [b]	10914.3?	(71/2⁻)	9844.3	(67/2⁻)	
1113.0	12218.2	77/2⁻	11105.2	73/2⁻	
1127.0	14181.5	(85/2⁺)	13054.5	(81/2⁺)	
1130.0 [b]	12044.3?	(75/2⁻)	10914.3?	(71/2⁻)	
1146.3	13364.5	81/2⁻	12218.2	77/2⁻	
1167.0	14531.5	85/2⁻	13364.5	81/2⁻	
1177.9 [b]	15709.4?	(89/2⁻)	14531.5	85/2⁻	

† From 1990TeZW, unless noted otherwise.
‡ From ^{161}Lu ε decay.
# From γ(θ) in Sm(^{16}O,^{18}O,xnγ) (1976HeZZ) and comments of 1982Ch12. Where $T_{1/2}$ values are known, RUL establishes that the quadrupole transitions are in fact E2 rather than M2.
@ Additional information 4.
& From γ(θ) as quoted in 1982Ch12.
a γ(θ) results allow another value of δ (1982Ch12).
b Placement of transition in the level scheme is uncertain.

$^{148}Sm(^{16}O,3n\gamma),^{122}Sn(^{44}Ca,5n\gamma)$ 1980Ri08,1988Fe01,1990TeZW

Level Scheme



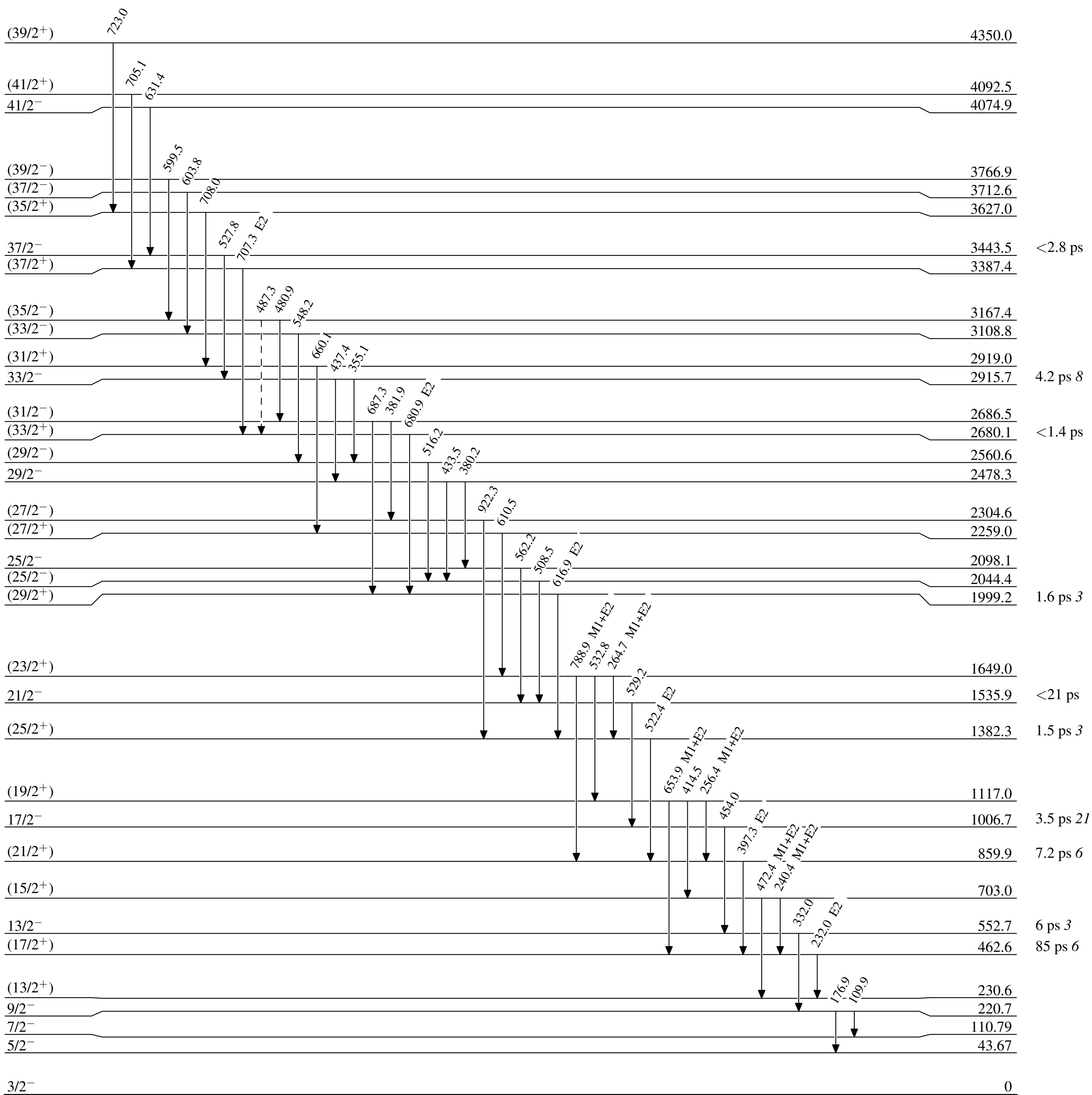
$^{161}_{70}Yb_{91}$

$^{148}Sm(^{16}O,3n\gamma),^{122}Sn(^{44}Ca,5n\gamma)$ 1980Ri08,1988Fe01,1990TeZW

Level Scheme (continued)

Legend

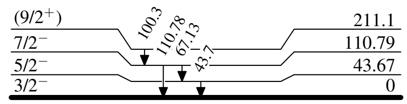
γ Decay (Uncertain)



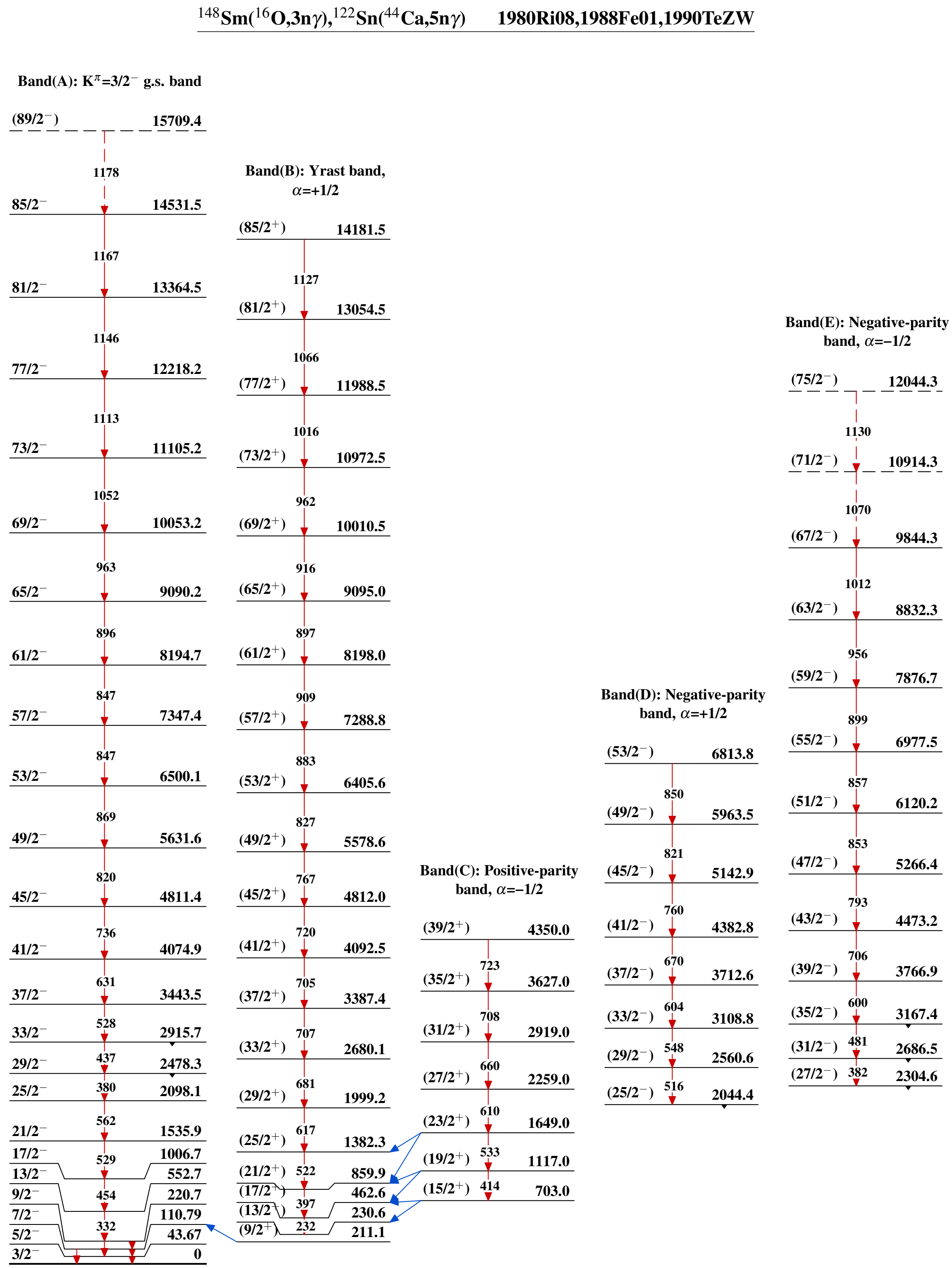
$^{161}_{70}Yb_{91}$

^{148}Sm(^{16}O,3nγ),^{122}Sn(^{44}Ca,5nγ) 1980Ri08,1988Fe01,1990TeZW

Level Scheme (continued)



$^{161}_{70}Yb_{91}$


$^{148}Sm(^{16}O,3n\gamma),^{122}Sn(^{44}Ca,5n\gamma)$ 1980Ri08,1988Fe01,1990TeZW
Band(A): K$^{\pi}$=3/2$^-$ g.s. band
(89/2$^-$) 15709.4
1178
85/2$^-$ 14531.5
1167
81/2$^-$ 13364.5
1146
77/2$^-$ 12218.2
1113
73/2$^-$ 11105.2
1052
69/2$^-$ 10053.2
963
65/2$^-$ 9090.2
896
61/2$^-$ 8194.7
847
57/2$^-$ 7347.4
847
53/2$^-$ 6500.1
869
49/2$^-$ 5631.6
820
45/2$^-$ 4811.4
736
41/2$^-$ 4074.9
631
37/2$^-$ 3443.5
528
33/2$^-$ 2915.7
437
29/2$^-$ 2478.3
380
25/2$^-$ 2098.1
562
21/2$^-$ 1535.9
17/2$^-$ 1006.7
529
13/2$^-$ 552.7
454
9/2$^-$ 220.7
7/2$^-$ 110.79
332
5/2$^-$ 43.67
3/2$^-$ 0
Band(B): Yrast band, α=+1/2
(85/2$^+$) 14181.5
1127
(81/2$^+$) 13054.5
1066
(77/2$^+$) 11988.5
1016
(73/2$^+$) 10972.5
962
(69/2$^+$) 10010.5
916
(65/2$^+$) 9095.0
897
(61/2$^+$) 8198.0
909
(57/2$^+$) 7288.8
883
(53/2$^+$) 6405.6
827
(49/2$^+$) 5578.6
767
(45/2$^+$) 4812.0
720
(41/2$^+$) 4092.5
705
(37/2$^+$) 3387.4
707
(33/2$^+$) 2680.1
681
(29/2$^+$) 1999.2
617
(25/2$^+$) 1382.3
522
(21/2$^+$) 859.9
(17/2$^+$) 462.6
397
(13/2$^+$) 230.6
232
(9/2$^+$) 211.1
Band(C): Positive-parity band, α=−1/2
(39/2$^+$) 4350.0
723
(35/2$^+$) 3627.0
708
(31/2$^+$) 2919.0
660
(27/2$^+$) 2259.0
610
(23/2$^+$) 1649.0
533
(19/2$^+$) 1117.0
414
(15/2$^+$) 703.0
Band(D): Negative-parity band, α=+1/2
(53/2$^-$) 6813.8
850
(49/2$^-$) 5963.5
821
(45/2$^-$) 5142.9
760
(41/2$^-$) 4382.8
670
(37/2$^-$) 3712.6
604
(33/2$^-$) 3108.8
548
(29/2$^-$) 2560.6
516
(25/2$^-$) 2044.4
Band(E): Negative-parity band, α=−1/2
(75/2$^-$) 12044.3
1130
(71/2$^-$) 10914.3
1070
(67/2$^-$) 9844.3
1012
(63/2$^-$) 8832.3
956
(59/2$^-$) 7876.7
899
(55/2$^-$) 6977.5
857
(51/2$^-$) 6120.2
853
(47/2$^-$) 5266.4
793
(43/2$^-$) 4473.2
706
(39/2$^-$) 3766.9
600
(35/2$^-$) 3167.4
481
(31/2$^-$) 2686.5
382
(27/2$^-$) 2304.6

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