Adopted Levels, Gammas

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	N. Nica	NDS 141, 1 (2017)	1-Feb-2017

$Q(\beta^-)=-2.69\times10^3$ *3*; $S(n)=8.07\times10^3$ *4*; $S(p)=2.58\times10^3$ *4*; $Q(\alpha)=3.51\times10^3$ *3* 2017Wa10
$Q(\varepsilon)=6.60\times10^3$ *3*; $S(2n)=1.801\times10^4$ *4*; $S(2p)=7.80\times10^3$ *4*; $Q(\varepsilon p)=8.4\times10^2$ *3* 2017Wa10
Additional information 1.

The data are from ^{158}Yb $\varepsilon+\beta+$ decay which only populates the 74-keV level and from the (HI,xnγ) reactions which populated primarily the levels above a $J^\pi=(9^-)$ level of unknown energy.

Model calculations that may be of interest include (1986Al32,1987Ba07).

^{158}Tm Levels

Cross Reference (XREF) Flags

A ^{158}Yb ε decay
B (HI,xnγ)

E(level)†	J^π#	$T_{1/2}$‡	XREF	Comments
0.0	2^-	3.98 min *6*	A	%ε+%β^+=100 μ=+0.042 *17*; Q=+0.74 *11* $T_{1/2}$: Weighted average of 4.3 m *2* (1970De13), 4.02 m *10* (1975Ag01), and 3.94 m *6* (1993Al03); other: 3.9 m (1969NeZW). J^π: J from atomic-beam magnetic resonance (1984Ek01) and laser spectrometry (1986Al32) and $\pi=-$ from log $f^{1u}t$=8.7 to 4^+ level in ^{158}Er. configuration: The review of 1990Ja11 indicates that the low-lying orbitals are ν,3/2[521]; π,5/2[402]; π,7/2[404]; and π,1/2[411]. The proton-neutron pair that gives a 2^- level as the lower energy coupling is configuration ((π,7/2(404))-(ν,3/2(521))). μ,Q: From 2014StZZ compilation (μ) and 2016St14 evaluation (Q); the values are based on data of 1988Al04 (also 1986Al32 and 1987Mi31 by same authors), measured by LASER resonance ionization mass spectroscopy. Evaluated RMS charge radius: $<r^2>^{1/2}$=5.1235 fm *69* (2013An02). $\Delta<r^2>$ values have been reported by 1986Al32, 1987Mi31, and 1988Al04 (all the same authors). From the latter, $\Delta<r^2>$(158-169)=1.002 fm^2 *7* directly from a table and $\Delta<r^2>$(158-160)=0.261 fm^2 *8* by comparison of two table entries.
74.1 *1*	$(1)^+$	1.74 ns *4*	A	J^π: from E1 γ to 2^- and strong population in ε decay from 0^+ of ^{158}Yb parent (see comments in ^{158}Yb ε decay). $T_{1/2}$: From ^{158}Yb ε decay (1990AbZW, γ(t)).
0.0+x	(5^+)	≈20 ns	B	$T_{1/2}$: Reassessed because of typografical error by 2012Au07 from ≈ 20 s to ≈ 20 ns (based on 1996 Priv. Comm. with the first author of the initial 1981Dr07 paper). Although the correction appeared after so many years, it looks consistent with some possible abnormality signaled in the initial assignment. Indeed, in their ^{150}Sm(^{14}N,6nγ) study, 1981Dr07 observe the γ's in ^{158}Er following ε decay with intensities which differ from those reported in the ε decay of the ^{158}Tm ground state and, thereby, deduce the existence of an isomer. However they suggested in the text a half-life of about 20 s, while 20 ns was marked on their level scheme, with the former adopted (because the γ's were seen after the beam was turned off, so 20 s looked more reasonable), which however proved to be just a typografical error so 20 ns was finally adopted. J^π: Postulated by 1981Dr07 authors who based on the level scheme suggest a possible J^π of 5^+ for this level.
0.0+y@	(9^-)	16 ns *4*	B	E(level): The decay of this level has not been established. 1981Dr07 report γ's of 98.7 and 128.7 (the third placement of a γ of the latter energy) depopulating this level and 1986Dr06 (by the same authors) still report this ≈ 130 γ, but do not report the

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)

^{158}Tm Levels (continued)

E(level)[†]	Jπ[#]	$T_{1/2}$[‡]	XREF	Comments
				98.7 γ. Later articles do not report these γ's, so they have not been adopted. $T_{1/2}$: From 1981Dr07.
129.3+y[@] *8*	(11⁻)		B	
150.0+y?[&]	(10⁻)		B	
383.0+y[&] *9*	(12⁻)	1.9 ps *6*	B	
512.0+y[@] *9*	(13⁻)	4.5 ps *7*	B	
811.5+y[&] *9*	(14⁻)	1.8 ps *5*	B	
1028.5+y[@] *9*	(15⁻)	0.8 ps *3*	B	
1356.1+y[&] *9*	(16⁻)	0.6 ps *6*	B	
1639.3+y[@] *9*	(17⁻)	1.2 ps *5*	B	
1992.2+y[&] *10*	(18⁻)	0.2 ps *+4−2*	B	
2320.5+y[@] *10*	(19⁻)	0.5 ps *+6−5*	B	
2701.7+y[&] *10*	(20⁻)		B	
2727.4+y[a]	(19⁺)		B	
3013.6+y[b]	(20⁺)		B	
3052.9+y[@] *10*	(21⁻)		B	
3058.3+y[c]	J		B	E(level): From tentative placement (1989An04) of depopulating γ to 19⁻ level.
3279.2+y[a]	(21⁺)		B	
3348.2+y[c]	(J+1)		B	
3463.3+y[&]	(22⁻)		B	
3606.0+y[b]	(22⁺)		B	
3654.8+y[c]	(J+2)		B	
3838.1+y[@] *12*	(23⁻)		B	
3901.9+y[a]	(23⁺)		B	
3997.2+y[c]	(J+3)		B	
4261+y?[&]	(24⁻)		B	
4274.9+y[b]	(24⁺)		B	
4326.8+y[c]	(J+4)		B	
4598.8+y[a]	(25⁺)		B	
4712.1+y[@] *16*	(25⁻)		B	
4722.0+y[c]	(J+5)		B	
5006.0+y[b]	(26⁺)		B	
5071.3+y[c]	(J+6)		B	
5361.2+y[a]	(27⁺)		B	
5635.8+y?[@]	(27⁻)		B	
5780.0+y?[b]	(28⁺)		B	
6159.9+y[a]	(29⁺)		B	
7032.8+y[a]	(31⁺)		B	
7940.5+y[a]	(33⁺)		B	
8820+y[a]	(35⁺)		B	
9310+y	(36⁺)		B	
10280+y?	(38⁺)		B	
10357+y?			B	

[†] Values are from the individual decay and reaction data and the uncertainties for the levels above the (9⁻) level are relative to the

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)

^{158}Tm Levels (continued)

(9⁻) level.

‡ Unless noted otherwise, from (HI,xnγ) study of 1987Ga09 (by recoil distance method).

\# Assignments from the (HI,xnγ) data are based on the observed and assumed quadrupole nature of the crossover γ′s and the assignment of J^π=(9⁻) for the lowest observed level. This J^π was deduced by 1981Dr07 based on alignment considerations in the neighboring nuclides ^{157}Er and ^{157}Ho.

@ Band(A): π=− band, signature=1.

& Band(B): π=− band, signature=0.

a Band(C): π=+ band, signature=1.

b Band(D): π=+ band, signature=0.

c Band(E): band fragment.

γ(^{158}Tm)

E_i(level)	J^π_i	E_γ	I_γ	E_f	J^π_f	Mult.†	α‡	Comments
74.1	(1)⁺	74.1 *1*	100	0.0	2⁻	E1	0.731	α(K)=0.599 *9*; α(L)=0.1030 *15*; α(M)=0.0230 *4* α(N)=0.00525 *8*; α(O)=0.000681 *10*; α(P)=2.56×10⁻⁵ *4* B(E1)(W.u.)=0.000189 *5* Mult.: From measured I_{XK}/I_γ and deduced limit on α_K(exp) in ^{158}Yb ε decay.
129.3+y	(11⁻)	129.3# *8*	100# *15*	0.0+y	(9⁻)			
383.0+y	(12⁻)	233@		150.0+y?	(10⁻)			
		253.8 *3*	100 *11*	129.3+y	(11⁻)	D		
512.0+y	(13⁻)	129.3# *8*	243# *15*	383.0+y	(12⁻)			
		382.5 *5*	100	129.3+y	(11⁻)	E2	0.0352	α(K)=0.0267 *4*; α(L)=0.00650 *10*; α(M)=0.001512 *23* α(N)=0.000349 *6*; α(O)=4.55×10⁻⁵ *7*; α(P)=1.428×10⁻⁶ *21* B(E2)(W.u.)=1.3×10² *8*
811.5+y	(14⁻)	299.4 *2*	100 *6*	512.0+y	(13⁻)	D		
		428.7 *8*		383.0+y	(12⁻)			
1028.5+y	(15⁻)	217.0 *4*	43 *5*	811.5+y	(14⁻)	D		If γ is pure M1, BM1W=1.3 *5*.
		516.5 *1*	100 *6*	512.0+y	(13⁻)	[E2]	0.01577	α(K)=0.01253 *18*; α(L)=0.00251 *4*; α(M)=0.000576 *8* α(N)=0.0001335 *19*; α(O)=1.79×10⁻⁵ *3*; α(P)=6.92×10⁻⁷ *10* B(E2)(W.u.)=2.6×10² *10*
1356.1+y	(16⁻)	327.6 *1*	100 *9*	1028.5+y	(15⁻)	D		If γ is pure M1, BM1W=1.2 *12*.
		544.1 *5*	39 *4*	811.5+y	(14⁻)	E2	0.01384	α(K)=0.01106 *16*; α(L)=0.00216 *3*; α(M)=0.000494 *7* α(N)=0.0001144 *17*; α(O)=1.545×10⁻⁵ *22*; α(P)=6.13×10⁻⁷ *9* B(E2)(W.u.)=1.1×10² *11*
1639.3+y	(17⁻)	283.1 *4*	54 *8*	1356.1+y	(16⁻)	D		If γ is pure M1, BM1W=0.27 *12*.
		610.9 *2*	100 *6*	1028.5+y	(15⁻)	E2	0.01045	B(E2)(W.u.)=7.E+1 *3* α(K)=0.00844 *12*; α(L)=0.001556 *22*; α(M)=0.000354 *5* α(N)=8.22×10⁻⁵ *12*; α(O)=1.121×10⁻⁵ *16*; α(P)=4.72×10⁻⁷ *7*
1992.2+y	(18⁻)	353.0 *2*	100 *10*	1639.3+y	(17⁻)	D		If γ is pure M1, BM1W=3 +*6*−*3*.
		636.1 *2*	<52	1356.1+y	(16⁻)	[E2]	0.00949	α(K)=0.00770 *11*; α(L)=0.001393 *20*; α(M)=0.000317 *5*

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)

$\gamma(^{158}Tm)$ (continued)

E_i(level)	J^π_i	E_γ	I_γ	E_f	J^π_f	Mult.†	α‡	Comments
								α(N)=7.35×10^{-5} *11*; α(O)=1.006×10^{-5} *15*; α(P)=4.31×10^{-7} *6* B(E2)(W.u.)=1.1×10^2 *+16−11*
2320.5+y	(19$^-$)	328.2 *3*	46	1992.2+y	(18$^-$)	D		If γ is pure M1, BM1W=0.7 *8*.
		681.3 *2*	100 *11*	1639.3+y	(17$^-$)	E2	0.00809	α(K)=0.00660 *10*; α(L)=0.001161 *17*; α(M)=0.000263 *4* α(N)=6.11×10^{-5} *9*; α(O)=8.40×10^{-6} *12*; α(P)=3.71×10^{-7} *6* B(E2)(W.u.)=1.0×10^2 *+11−10*
2701.7+y	(20$^-$)	381.3 *6*	<31	2320.5+y	(19$^-$)			
		709.5 *5*	100 *12*	1992.2+y	(18$^-$)	E2	0.00738	α(K)=0.00604 *9*; α(L)=0.001044 *15*; α(M)=0.000236 *4* α(N)=5.49×10^{-5} *8*; α(O)=7.58×10^{-6} *11*; α(P)=3.39×10^{-7} *5*
2727.4+y	(19$^+$)	734.9		1992.2+y	(18$^-$)			
3013.6+y	(20$^+$)	286.2		2727.4+y	(19$^+$)			
		692.9		2320.5+y	(19$^-$)			
3052.9+y	(21$^-$)	350.9 *8*	<33	2701.7+y	(20$^-$)			
		732.2 *5*	100 *10*	2320.5+y	(19$^-$)	E2	0.00688	α(K)=0.00564 *8*; α(L)=0.000963 *14*; α(M)=0.000218 *3* α(N)=5.06×10^{-5} *8*; α(O)=7.00×10^{-6} *10*; α(P)=3.17×10^{-7} *5*
3058.3+y	J	737.8@		2320.5+y	(19$^-$)			
3279.2+y	(21$^+$)	265.4		3013.6+y	(20$^+$)			
		551.6		2727.4+y	(19$^+$)			
		578		2701.7+y	(20$^-$)			
3348.2+y	(J+1)	289.8		3058.3+y	J			
3463.3+y	(22$^-$)	409.7		3052.9+y	(21$^-$)			
		762.6		2701.7+y	(20$^-$)			
3606.0+y	(22$^+$)	326.9		3279.2+y	(21$^+$)			
		592.4		3013.6+y	(20$^+$)			
3654.8+y	(J+2)	306.7		3348.2+y	(J+1)			
		596.5		3058.3+y	J			
3838.1+y	(23$^-$)	375		3463.3+y	(22$^-$)			
		785.2 *6*	100	3052.9+y	(21$^-$)	E2	0.00589	α(K)=0.00485 *7*; α(L)=0.000809 *12*; α(M)=0.000182 *3* α(N)=4.24×10^{-5} *6*; α(O)=5.89×10^{-6} *9*; α(P)=2.74×10^{-7} *4*
3901.9+y	(23$^+$)	295.9		3606.0+y	(22$^+$)			
		622.6		3279.2+y	(21$^+$)			
3997.2+y	(J+3)	342.4		3654.8+y	(J+2)			
		649		3348.2+y	(J+1)			
4261+y?	(24$^-$)	798@		3463.3+y	(22$^-$)			
4274.9+y	(24$^+$)	372.9		3901.9+y	(23$^+$)			
		668.9		3606.0+y	(22$^+$)			
4326.8+y	(J+4)	329.4		3997.2+y	(J+3)			
		672.1		3654.8+y	(J+2)			
4598.8+y	(25$^+$)	324.0		4274.9+y	(24$^+$)			
		697.0		3901.9+y	(23$^+$)			
4712.1+y	(25$^-$)	874 *1*	100	3838.1+y	(23$^-$)	E2	0.00467	α(K)=0.00387 *6*; α(L)=0.000624 *9*; α(M)=0.0001401 *20* α(N)=3.26×10^{-5} *5*; α(O)=4.56×10^{-6} *7*; α(P)=2.19×10^{-7} *4*
4722.0+y	(J+5)	395.5		4326.8+y	(J+4)			

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)

γ(^{158}Tm) (continued)

E_i(level)	J^π_i	E_γ	E_f	J^π_f	E_i(level)	J^π_i	E_γ	E_f	J^π_f
4722.0+y	(J+5)	724.8	3997.2+y	(J+3)	5780.0+y?	(28^+)	774[@]	5006.0+y	(26^+)
5006.0+y	(26^+)	407.1	4598.8+y	(25^+)	6159.9+y	(29^+)	798.7	5361.2+y	(27^+)
		731	4274.9+y	(24^+)	7032.8+y	(31^+)	872.9	6159.9+y	(29^+)
5071.3+y	(J+6)	349.5	4722.0+y	(J+5)	7940.5+y	(33^+)	907.7	7032.8+y	(31^+)
		744.2	4326.8+y	(J+4)	8820+y	(35^+)	879	7940.5+y	(33^+)
5361.2+y	(27^+)	355	5006.0+y	(26^+)	9310+y	(36^+)	490	8820+y	(35^+)
		762.6	4598.8+y	(25^+)	10280+y?	(38^+)	970[@]	9310+y	(36^+)
5635.8+y?	(27^-)	923.7[@]	4712.1+y	(25^-)	10357+y?		1047[@]	9310+y	(36^+)

† Assignments from (HI,xnγ) studies are evaluator′s interpretation of the $\gamma(\theta)$ data of 1985Ho04 and the quadrupole transitions have been assigned as E2.

‡ Additional information 2.

Multiply placed with undivided intensity.

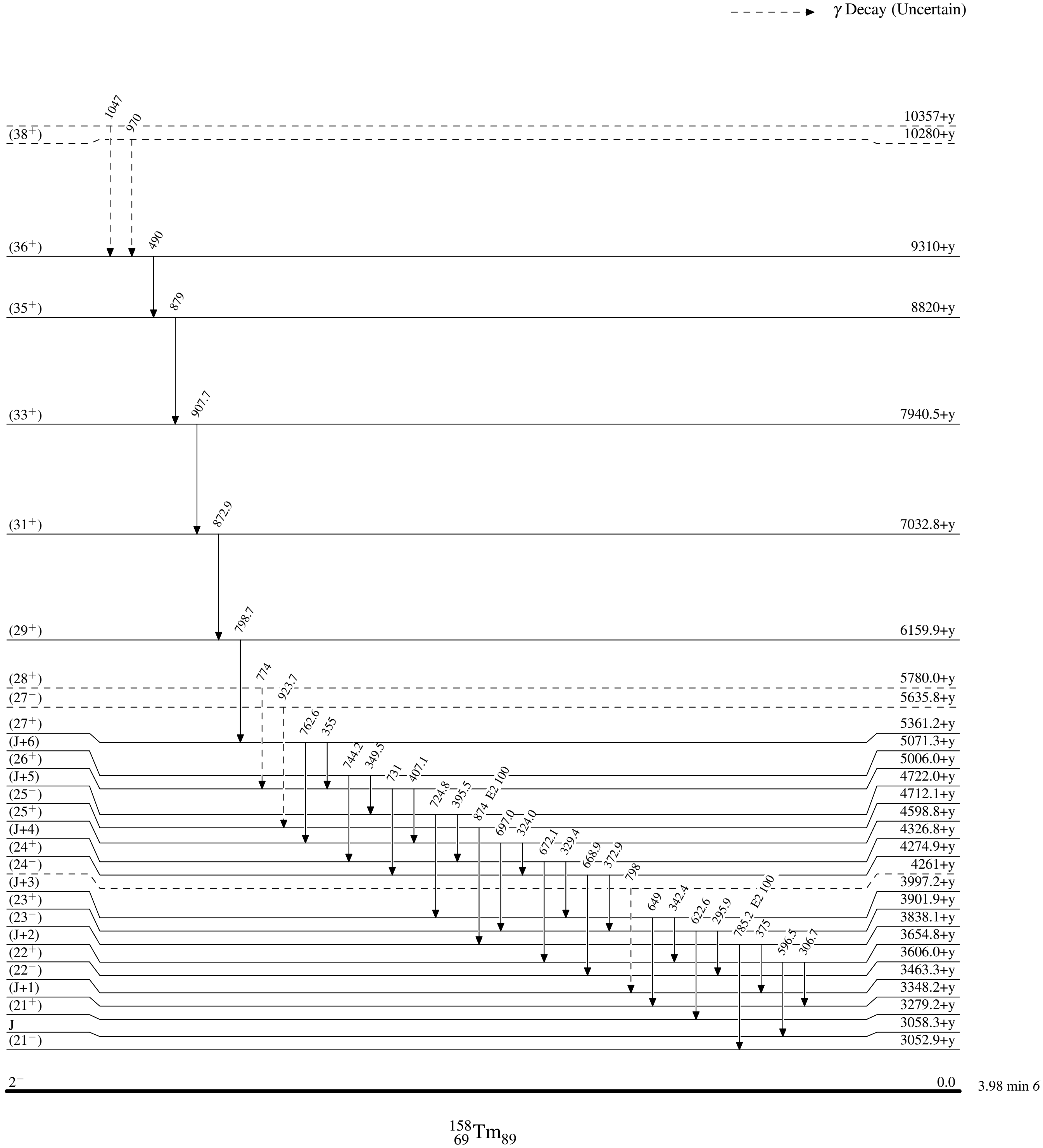
@ Placement of transition in the level scheme is uncertain.

Adopted Levels, Gammas

Legend

Level Scheme

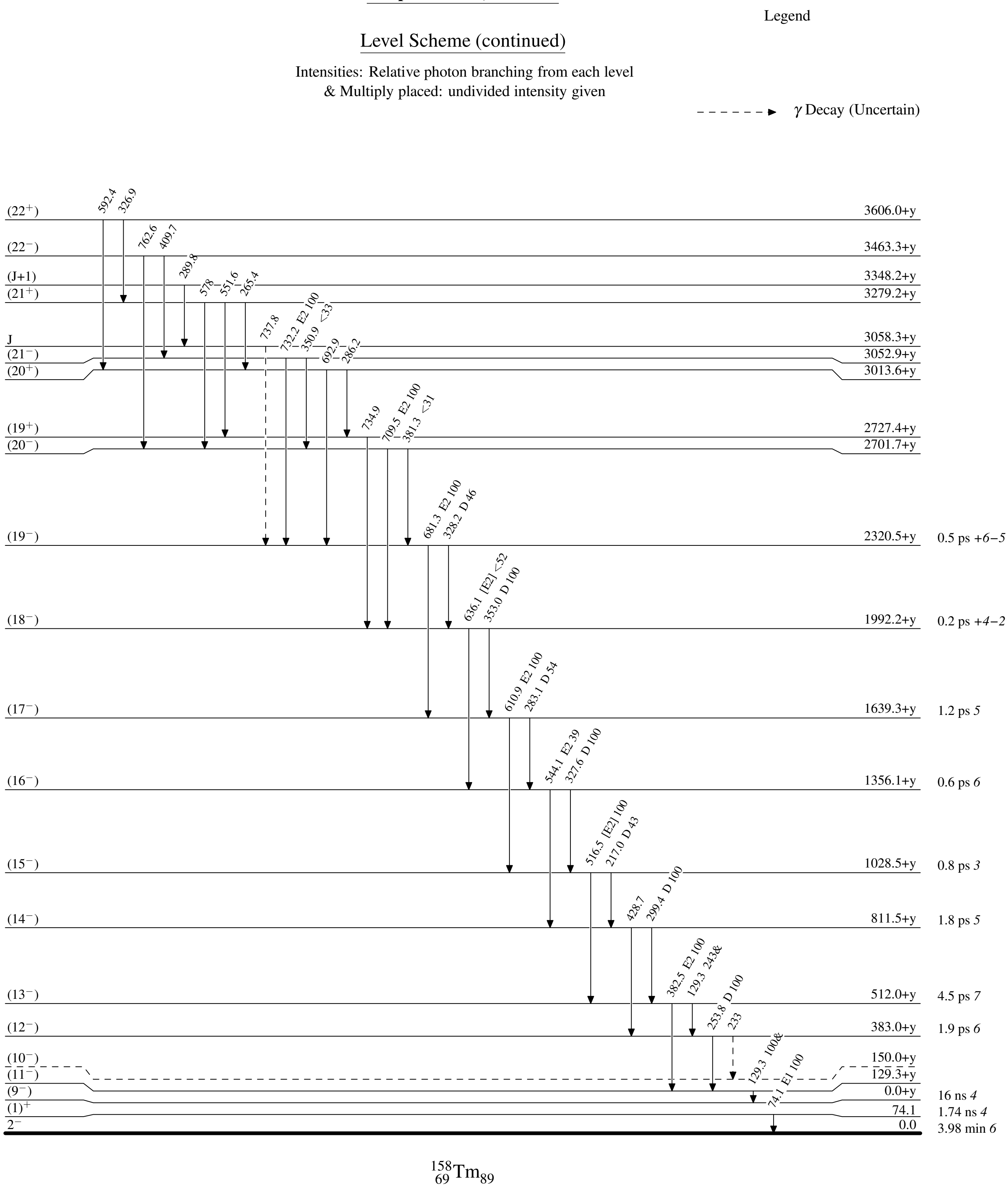
Intensities: Relative photon branching from each level



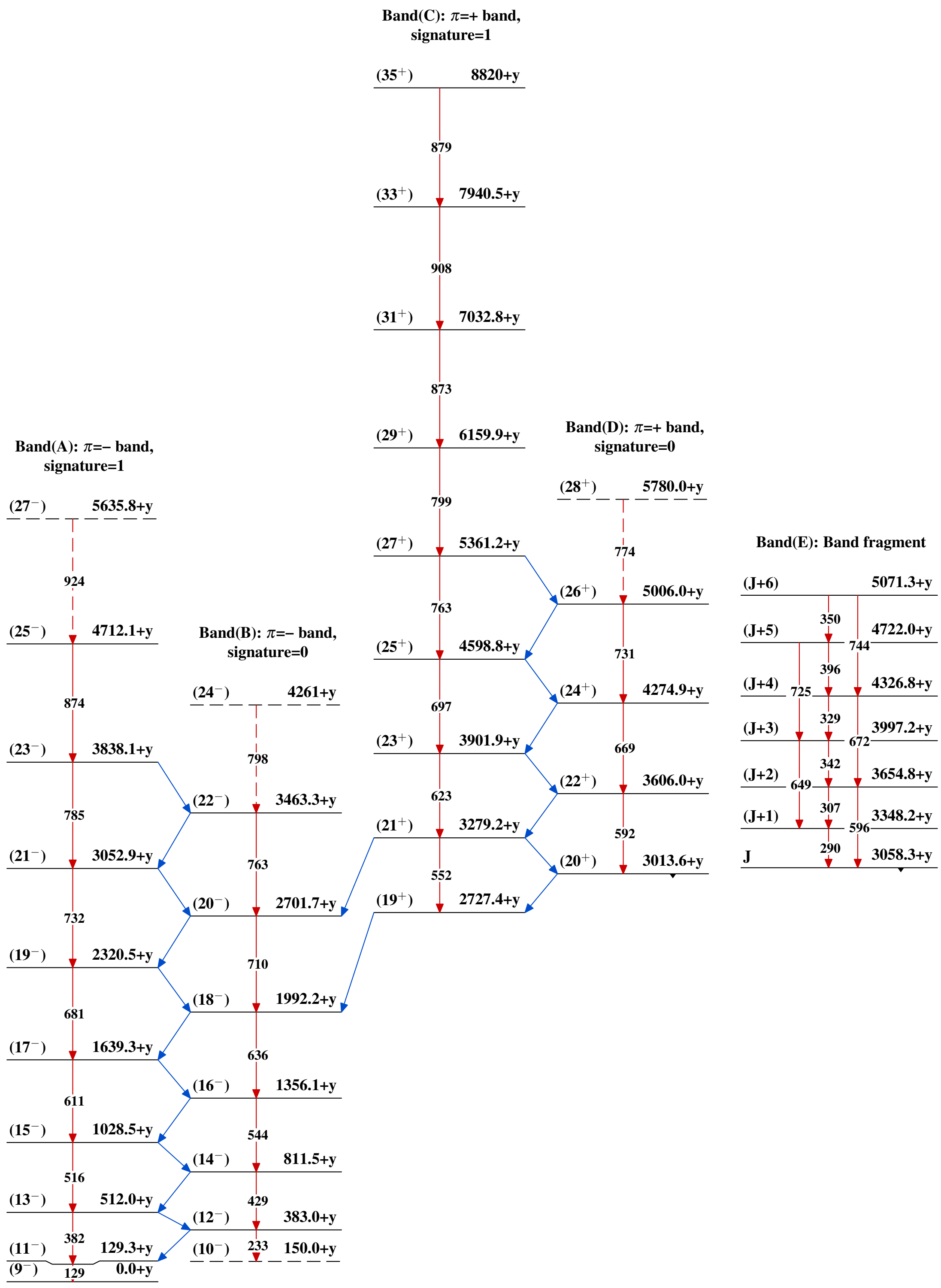
Adopted Levels, Gammas

Level Scheme (continued)

Intensities: Relative photon branching from each level
& Multiply placed: undivided intensity given



Adopted Levels, Gammas



$^{158}_{69}Tm_{89}$