^{167}Er(p,nγ) 1976Sv01

History

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

Includes ^{168}Er(p,2nγ),E(p)=12 MeV.

1976Sv01: (p,nγ),E(p)=8-12 MeV beam from 12 MV EN Tandem Van de Graaff generator at the University of Uppsala. Self-supporting 1-2 mg/cm^2 thick targets of 91.5% enriched ^{167}Er. Measured Eγ, Iγ, $\gamma\gamma$-coin, ce, level lifetimes by (ce)(ce)(t) using two Ge(Li) detectors and a low-energy photon spectrometer (LEPS) for γ rays and a thick Si(Li)-detector mounted in a magnetic spectrometer for conversion electrons. ^{168}Er(p,2nγ),E(p)=12 MeV for a few measurements.

1976Li07 (from the same lab and group as 1976Sv01): measured half-lives of 117-keV level by (117 ce(K)(t)) and 142-keV levels by (144 ce(K))(132 ce(K))(t) using magnetic long-lens electron-electron coincidence spectrometer.

^{167}Tm Levels

E(level)[†]	J$^\pi$[‡]	T$_{1/2}$	Comments
0.0[#]	1/2$^+$		
10.419[#] *25*	3/2$^+$		Additional information 1.
116.71[#] *3*	5/2$^+$	66 ps *7*	T$_{1/2}$: from (117 ce(K))(t) (1976Li07,1976Sv01).
142.52[#] *4*	7/2$^+$	343 ps *15*	T$_{1/2}$: from (142 ce(K))(132 ce(K))(t) (1976Li07,1976Sv01).
171.84[@] *4*	1/2$^-$		
179.66[&] *5*	7/2$^+$		
187.76[@] *5*	5/2$^-$		
286.02[@] *5*	9/2$^-$		
290.99[@] *5*	3/2$^-$		
293.06[a] *5*	7/2$^-$		
296.43[&] *6*	9/2$^+$		
326.69[#] *5*	9/2$^+$		
371.23[#] *5*	11/2$^+$		
383.98[a] *6*	9/2$^-$		
436.32[&] *7*	11/2$^+$		
460.15[@] *6*	7/2$^-$		
470.51[@] *6*	13/2$^-$		
470.61[b] *16*	3/2$^+$		
496.94[a] *9*	11/2$^-$		
522.15[b] *10*	5/2$^+$		Band assignment from the Adopted Levels. In 1976Sv01, this level assigned to ν5/2[402] band.
557.76[c] *11*	5/2$^+$		Band assignment from the Adopted Levels. In 1976Sv01, this level assigned to ν3/2[411] band.
597.78[&] *8*	13/2$^+$		
622.31[#] *7*	13/2$^+$		
632.13[a] *10*	13/2$^-$		
658.09[c] *13*	7/2$^+$		Band assignment from the Adopted Levels. In 1976Sv01, this level assigned to ν3/2[411] band.
689.33[#] *8*	15/2$^+$		
699.15[@] *8*	11/2$^-$		
741.77[@] *12*	17/2$^-$		
779.35[&] *11*	15/2$^+$		
788.15[a] *11*	15/2$^-$		
840.23[b] *18*	11/2$^+$		
852.56 *21*	3/2$^-$		

Continued on next page (footnotes at end of table)

^{167}Er(p,nγ) 1976Sv01 (continued)

^{167}Tm Levels (continued)

E(level)[†]	Jπ[‡]	E(level)[†]	Jπ[‡]	E(level)[†]	Jπ[‡]	E(level)[†]	Jπ[‡]
881.5 *3*	5/2⁻	944.9 *3*	11/2⁺	1001.67[b] *19*	13/2⁺	1086.90[#] *17*	19/2⁺
928.00[c] *21*	11/2⁺	965.52[a] *22*	17/2⁻	1008.6 *3*	9/2⁻	1096.57[@] *16*	21/2⁻
929.1?[d] *4*	9/2⁻	978.38[&] *16*	17/2⁺	1008.62[@] *15*	15/2⁻	1159.3 *3*	19/2⁻
935.18 *16*	7/2⁻	993.75[#] *18*	17/2⁺	1044.37[d] *17*	11/2⁻	1194.95[&] *23*	19/2⁺

[†] From a least-squares adjustment of Eγ, omitting the 639.89γ (which fits its placement poorly) and allowing 1 keV uncertainty in values for which no uncertainty was stated by authors.

[‡] From relative excitation functions, multipolarities of transitions, and fits of cascades of coincident γ rays into an interconnected set of rotational bands (authors′ values).

[#] Band(A): π1/2[411].

[@] Band(B): π1/2[541].

[&] Band(C): π7/2[404].

[a] Band(D): π7/2[523].

[b] Band(E): π3/2[411]. Band assignment for levels in π3/2[411] and π5/2[402] from the Adopted Levels. In 1976Sv01, the assignments differ above 500 keV as stated in comments for individual levels.

[c] Band(F): π5/2[402]. Band assignment for levels in π3/2[411] and π5/2[402] from the Adopted Levels. In 1976Sv01, the assignments differ above 500 keV as stated in comments for individual levels. A 683.7, 7/2⁺ level decaying by a 161.5γ (double placement) is not given in the Adopted Levels.

[d] Band(G): π9/2[514]. Assignment of levels for this band from the Adopted Levels. In 1976Sv01, only the 1044.7 level is assigned to this band.

γ(^{167}Tm)

Conversion coefficients from 1976Sv01 are deduced from comparison of measured conversion-electron intensities with γ-ray intensities recorded at the same angle (55°).

E_γ †	I_γ	E_i(level)	J^π_i	E_f	J^π_f	Mult. ‡	δ	α @	Comments
(10.419 *25*)		10.419	3/2+	0.0	1/2+	M1+E2	0.043 *+4−3*	648 *38*	E_γ,Mult.,δ,α: from the Adopted Gammas, where values were adopted from ^{167}Yb ε decay.
25.80 *20*	2 *1*	142.52	7/2+	116.71	5/2+				
x38.00 *20*	7 *1*								
x38.90 *20*	9 *1*								
44.4		371.23	11/2+	326.69	9/2+				E_γ: from level-scheme Fig. 11b in 1976Sv01, transition obscured by x rays in singles spectrum.
62.95 *4*	14 *1*	179.66	7/2+	116.71	5/2+	[M1]		11.72 *17*	Mult.: M1 quoted by 1976Sv01 from 1971Fu10 (^{167}Yb ε decay data). Iγ(p,2nγ)/Iγ(p,nγ)=0.76 *2*.
67.02 *5*	1.0 *5*	689.33	15/2+	622.31	13/2+				
x68.83 *5*	2.0 *2*								
85.21 *4*	4.9 *4*	371.23	11/2+	286.02	9/2−				Iγ(p,2nγ)/Iγ(p,nγ)=0.43 *3*.
90.91 *2*	17.5 *11*	383.98	9/2−	293.06	7/2−	[M1]		4.08 *6*	Mult.: (M1) quoted by 1976Sv01 from 1971Fu10 (^{167}Yb ε decay data). Iγ(p,2nγ)/Iγ(p,nγ)=0.53 *2*.
98.30 *10*	6 *2*	286.02	9/2−	187.76	5/2−	[E2]		3.28 *5*	Mult.: E2 quoted by 1976Sv01 from 1971Fu10 (^{167}Yb ε decay data).
99.25 *6*	9 *1*	470.51	13/2−	371.23	11/2+	[E1]		0.340 *5*	Mult.: E1 quoted by 1976Sv01 from 1970Wi09 ((α,2nγ) data).
106.25 *4*	102.4 *67*	116.71	5/2+	10.419	3/2+	[M1]		2.61 *4*	Mult.: M1 quoted by 1976Sv01 from 1971Fu10 (^{167}Yb ε decay data). Iγ(p,2nγ)/Iγ(p,nγ)=1.00 *1*.
x109.93 *5*	4.0 *3*								Iγ(p,2nγ)/Iγ(p,nγ)=1.05 *5*, possibly mixed with a γ ray in ^{166}Tm.
112.95 *10*	15.7 *11*	496.94	11/2−	383.98	9/2−				Iγ(p,2nγ)/Iγ(p,nγ)=0.33 *10*.
113.41 *5*	76.2 *51*	293.06	7/2−	179.66	7/2+	[E1]		0.2392 *34*	Mult.: E1 quoted by 1976Sv01 from 1971Fu10 (^{167}Yb ε decay data). Delayed γ. Iγ(p,2nγ)/Iγ(p,nγ)=0.71 *3*.
116.77& *5*	40.1& *27*	116.71	5/2+	0.0	1/2+				Iγ(p,2nγ)/Iγ(p,nγ)=0.70 *1*.
116.77& *5*	40.1& *27*	296.43	9/2+	179.66	7/2+				
132.12 *5*	100.0 *69*	142.52	7/2+	10.419	3/2+	E2#		1.094 *15*	α(K)exp=0.43 *4* α(K)=0.524 *7*; α(L)=0.437 *6*; α(M)=0.1064 *15* Ice(K)=2.49 *27*. Iγ(p,2nγ)/Iγ(p,nγ)=0.71 *1*.

$^{167}_{69}$Tm$_{98}$-3

γ(^{167}Tm) (continued)

E_γ[†]	I_γ	E_i(level)	J_i^π	E_f	J_f^π	Mult.[‡]	α[@]	Comments
135.27 *5*	11.3 *8*	632.13	13/2−	496.94	11/2−	(M1+E2)[#]	1.16 *15*	α(K)exp=0.44 *6* α(K)=0.79 *30*; α(L)=0.28 *11*; α(M)=0.066 *29* Ice(K)=0.30 *3*. Iγ(p,2nγ)/Iγ(p,nγ)=0.21 *3*.
[x]137.70 *20*								Weak γ. Iγ(p,2nγ)/Iγ(p,nγ)=1.54 *10*, possibly mixed with a transition in ^{166}Tm.
139.91 *5*	15.8 *12*	436.32	11/2+	296.43	9/2+	M1[#]	1.190 *17*	α(K)exp=1.01 *10* α(K)=0.997 *14*; α(L)=0.1504 *21*; α(M)=0.0335 *5* Ice(K)=1.00 *1*. Iγ(p,2nγ)/Iγ(p,nγ)=0.43 *2*.
143.53 *5*	65.7 *46*	286.02	9/2−	142.52	7/2+	E1[#]	0.1282 *18*	α(K)exp=0.073 *30* α(K)=0.1070 *15*; α(L)=0.01655 *23*; α(M)=0.00368 *5* Ice(K)=0.30 *4*. Iγ(p,2nγ)/Iγ(p,nγ)=0.59 *1*.
156.11 *6*	6.9 *6*	788.15	15/2−	632.13	13/2−			Mult.: M1 in 1976Sv01, but no ce data. Iγ(p,2nγ)/Iγ(p,nγ)=0.15 *4*.
161.45[&] *6*	13.2[&] *10*	171.84	1/2−	10.419	3/2+	D[#]		α(K)exp=0.46 *5* Placement from four levels in Table I of 1976Sv01. Ice(K)=0.43 *3*. Iγ(p,2nγ)/Iγ(p,nγ)=3.6 *15*.
161.45[&] *6*	13.2[&] *10*	597.78	13/2+	436.32	11/2+	D[#]		
161.45[&a] *6*	13.2[&] *10*	1001.67	13/2+	840.23	11/2+			
169.20 *10*	1.8 *3*	460.15	7/2−	290.99	3/2−			
[x]170.75 *10*	2.2 *3*							
171.80 *6*	5.4 *5*	171.84	1/2−	0.0	1/2+	E1[#]	0.0798 *11*	α(K)exp=0.053 *20* α(K)=0.0668 *9*; α(L)=0.01015 *14*; α(M)=0.002256 *32* Ice(K)=0.020 *7*. Iγ(p,2nγ)/Iγ(p,nγ)=2.25 *25*.
174.0 *2*		460.15	7/2−	286.02	9/2−	(M1)[#]	0.645 *9*	α(K)exp=0.70 *20* α(K)=0.540 *8*; α(L)=0.0812 *12*; α(M)=0.01810 *26* Ice(K)=0.20 *4* for 174.27γ+174.0γ. Iγ(p,2nγ)/Iγ(p,nγ)=2.00 *20* for 174.27γ+174.0γ. Mult.: α(K)exp gives mult=M1 for 174.27γ+174.0γ doublet (1976Sv01). But ΔJ^π requires E1 for this placement, the placement of 174.0γ from 460 level, expected as M1 may be dominant.
174.27 *7*	3.7 *4*	290.99	3/2−	116.71	5/2+	(E1)[#]	0.0769 *11*	α(K)exp=0.70 *20* α(K)=0.0644 *9*; α(L)=0.00977 *14*; α(M)=0.002171 *30* Ice(K)=0.20 *4* for 174.27γ+174.0γ. Iγ(p,2nγ)/Iγ(p,nγ)=2.00 *20* for 174.27γ+174.0γ. Mult.: from (p,2nγ)/(p,nγ) excitation-strength ratios (1976Sv01).

$^{167}_{69}$Tm$_{98}$-4

γ(^{167}Tm) (continued)

E_γ[†]	I_γ	E_i(level)	J_i^π	E_f	J_f^π	Mult.[‡]	α[@]	Comments
								Mult.: α(K)exp gives mult=M1 for 174.27γ+174.0γ doublet (1976Sv01). But ΔJ^π requires E1 for this placement, the placement of 174.0γ from 460 level, expected as M1 may be dominant.
176.34 *6*	21.5 *17*	293.06	7/2⁻	116.71	5/2⁺	E1[#]	0.0746 *10*	α(K)exp=0.073 *13* α(K)=0.0624 *9*; α(L)=0.00946 *13*; α(M)=0.002103 *29* Ice(K)=0.12 *2*. Iγ(p,2nγ)/Iγ(p,nγ)=0.71 *3*.
177.33 *6*	41.7 *32*	187.76	5/2⁻	10.419	3/2⁺	E1[#]	0.0735 *10*	α(K)exp=0.060 *10* α(K)=0.0615 *9*; α(L)=0.00932 *13*; α(M)=0.002071 *29* E_γ,I_γ: for an unresolved doublet as indicated by 1976Sv01, but the other placement is not given. Ice(K)=0.192 *8*. Iγ(p,2nγ)/Iγ(p,nγ)=1.66 *4*.
[x]178.04 *7*	5.2 *5*							Iγ(p,2nγ)/Iγ(p,nγ)=1.10 *20*, possibly mixed with a transition in ^{168}Tm.
181.47 *8*	2.1 *4*	779.35	15/2⁺	597.78	13/2⁺			1976Sv01 state that the peak in the spectrum is seriously disturbed by other transitions.
184.17 *8*	38.5 *20*	326.69	9/2⁺	142.52	7/2⁺			
184.51 *7*	19.7 *20*	470.51	13/2⁻	286.02	9/2⁻			
193[a]		1159.3	19/2⁻	965.52	17/2⁻			
199.00 *30*		978.38	17/2⁺	779.35	15/2⁺			E_γ: 1976Sv01 take value from 1970Wi09.
204.00 *20*	2.3 *4*	496.94	11/2⁻	293.06	7/2⁻	E2	0.2434 *35*	α(K)exp=0.126 *30* α(K)=0.1546 *22*; α(L)=0.0682 *10*; α(M)=0.01637 *24* Ice(K)=0.092 *15*.
210.01 *7*	18.0 *15*	326.69	9/2⁺	116.71	5/2⁺	E2	0.2211 *31*	α(K)=0.1422 *20*; α(L)=0.0606 *9*; α(M)=0.01452 *20* Ice(K)=0.85 *2*. Iγ(p,2nγ)/Iγ(p,nγ)=1.60 *10*. Mult.: α(K)exp normalized to α(K)(E2)=0.1422 (and not α(K)(M2)=1.55) gives consistent α(K)exp values for transitions of known multipolarities.
218.77 *20*	3.9 *4*	689.33	15/2⁺	470.51	13/2⁻	(E1)	0.0426 *6*	α(K)exp=0.021 *8* α(K)=0.0358 *5*; α(L)=0.00533 *8*; α(M)=0.001183 *17* Ice(K)=0.033 *20*. I_γ: for a doublet.
228.67[&] *7*	66.8[&] *57*	371.23	11/2⁺	142.52	7/2⁺	(E2)	0.1674 *23*	α(K)exp=0.11 *2* α(K)=0.1114 *16*; α(L)=0.0431 *6*; α(M)=0.01028 *14* E_γ: 229.67 in Table I of 1976Sv01 seems a misprint, Eγ listed as 228.7 authors′ Fig. 11b. Ice(K)=2.58 *5* for doublet. Iγ(p,2nγ)/Iγ(p,nγ)=0.37 *1* for doublet.
228.67[&] *7*	66.8[&] *57*	699.15	11/2⁻	470.51	13/2⁻			
238.79 *15*	5.3 *4*	699.15	11/2⁻	460.15	7/2⁻			E_γ: unresolved doublet, mixed with line from (p,p′) reaction.
[x]244.66 *20*	2.9 *4*							γ not observed in (p,2nγ).

^{167}Er(p,nγ) 1976Sv01 (continued)

γ(^{167}Tm) (continued)

E_γ †	I_γ	E_i(level)	J_i^π	E_f	J_f^π	Mult.‡	α@	Comments
247.98 *15*	4.6 *4*	632.13	13/2⁻	383.98	9/2⁻	E2	0.1290 *18*	α(K)exp=0.07 *2* α(K)=0.0883 *12*; α(L)=0.0313 *4*; α(M)=0.00745 *11* Ice(K)=0.113 *14*.
251.07 *8*	11.0 *11*	622.31	13/2⁺	371.23	11/2⁺	M1	0.2345 *33*	α(K)exp=0.19 *2* α(K)=0.1968 *28*; α(L)=0.0293 *4*; α(M)=0.00653 *9* Ice(K)=0.709 *15*. Iγ(p,2nγ)/Iγ(p,nγ)=0.27 *7*.
256.67 *8*	13.6 *14*	436.32	11/2⁺	179.66	7/2⁺	E2	0.1157 *16*	α(K)exp=0.079 *8* α(K)=0.0801 *11*; α(L)=0.0274 *4*; α(M)=0.00651 *9* Ice(K)=0.387 *8*. Iγ(p,2nγ)/Iγ(p,nγ)=0.44 *7*.
271.26 *10*	11.6 *14*	741.77	17/2⁻	470.51	13/2⁻	(E2)	0.0973 *14*	α(K)exp=0.063 *7* α(K)=0.0685 *10*; α(L)=0.02220 *31*; α(M)=0.00526 *7* Ice(K)=0.218 *8* for doublet with Eγ=272.30.
272.30 *10*	2.5 *10*	460.15	7/2⁻	187.76	5/2⁻			α(K)exp=0.063 *7* Ice(K)=0.218 *8* for 272.30γ+271.26γ. α(K)exp for 272.30γ+271.26γ. Iγ(p,2nγ)/Iγ(p,nγ)=0.66 *22* probably for 272.30γ+271.26γ.
280.60 *20*	1.8 *5*	290.99	3/2⁻	10.419	3/2⁺			Iγ(p,2nγ)/Iγ(p,nγ)=1.5 *9*.
291.02& *9*	13.9& *15*	290.99	3/2⁻	0.0	1/2⁺	(E1)	0.0207 *3*	α(K)exp=0.022 *4* α(K)=0.01745 *24*; α(L)=0.00255 *4*; α(M)=0.000565 *8* Ice(K)=0.129 *8* for doublet. Iγ(p,2nγ)/Iγ(p,nγ)=1.60 *10*. Mult.: α(K)exp gives E1 or E2 for doublet. ΔJ^π required E1 for placement from 291.0 level.
291.02& *9*	13.9& *15*	788.15	15/2⁻	496.94	11/2⁻	(E2)	0.0784 *11*	α(K)=0.0562 *8*; α(L)=0.01707 *24*; α(M)=0.00403 *6*
295.67 *9*	18.0 *19*	622.31	13/2⁺	326.69	9/2⁺	E2	0.0747 *10*	α(K)exp=0.048 *5* α(K)=0.0538 *8*; α(L)=0.01609 *23*; α(M)=0.00380 *5* Ice(K)=0.274 *8*. Iγ(p,2nγ)/Iγ(p,nγ)=0.24 *5*.
301.26 *9*	14.7 *17*	597.78	13/2⁺	296.43	9/2⁺	E2	0.0705 *10*	α(K)exp=0.052 *6* α(K)=0.0511 *7*; α(L)=0.01503 *21*; α(M)=0.00354 *5* Ice(K)=0.257 *7*. Iγ(p,2nγ)/Iγ(p,nγ)=0.27 *4*.
304.50 *20*		993.75	17/2⁺	689.33	15/2⁺			E_γ,I_γ: weak γ from γγ-coin data.
318.15 *15*	16.3 *20*	689.33	15/2⁺	371.23	11/2⁺	E2	0.0599 *8*	α(K)exp=0.043 *5* α(K)=0.0439 *6*; α(L)=0.01233 *17*; α(M)=0.00290 *4* Ice(K)=0.250 *8*.
331.43 *20*	1.7 *4*	658.09	7/2⁺	326.69	9/2⁺	(M1+E2)	0.082 *29*	α(K)exp=0.049 *15* α(K)=0.066 *27*; α(L)=0.0122 *16*; α(M)=0.00278 *29* Ice(K)=0.039 *7*.
333.36 *20*	2.2 *4*	965.52	17/2⁻	632.13	13/2⁻	(E2)	0.0522 *7*	α(K)exp=0.033 *10*

γ(^{167}Tm) (continued)

E_γ[†]	I_γ	E_i(level)	J^π_i	E_f	J^π_f	Mult.[‡]	α[@]	Comments
								α(K)=0.0387 *5*; α(L)=0.01044 *15*; α(M)=0.002447 *35* Ice(K)=0.034 *7*.
342.50[a] *20*		522.15	5/2+	179.66	7/2+			I_γ: weak.
343.28[&] *15*	28.0[&] *32*	460.15	7/2−	116.71	5/2+			α(K)exp=0.017 *3* Ice(K)=0.20 *2* for doublet. α(K)exp for doublet gives mult=E1 or E2. Iγ(p,2nγ)/Iγ(p,nγ)=0.94 *3* for doublet.
343.28[&] *15*	28.0[&] *32*	779.35	15/2+	436.32	11/2+			
354.80 *10*		1096.57	21/2−	741.77	17/2−			E_γ: from γγ-coin data.
371.26[&] *30*	3.9[&] *5*	993.75	17/2+	622.31	13/2+	(E2)	0.0382 *5*	α(K)exp=0.025 *5* α(K)=0.0289 *4*; α(L)=0.00718 *10*; α(M)=0.001675 *24* Ice(K)=0.050 *7*.
371.26[&] *30*	3.9[&] *5*	1159.3	19/2−	788.15	15/2−	(E2)	0.0382 *5*	
372.43 *15*	9.9 *6*	699.15	11/2−	326.69	9/2+	(E1)	0.01141 *16*	α(K)exp=0.010 *2* α(K)=0.00963 *14*; α(L)=0.001385 *19*; α(M)=0.000307 *4* E_γ,I_γ: probably a doublet. Ice(K)=0.049 *7*. Iγ(p,2nγ)/Iγ(p,nγ)=0.34 *5*.
379.60 *20*	2.9 *4*	522.15	5/2+	142.52	7/2+	(M1)	0.0775 *11*	α(K)exp=0.071 *12* α(K)=0.0652 *9*; α(L)=0.00960 *14*; α(M)=0.002135 *30* Ice(K)=0.105 *7*.
380.60 *15*	3.3 *4*	978.38	17/2+	597.78	13/2+	(E2)	0.0356 *5*	α(K)exp=0.033 *7* α(K)=0.0271 *4*; α(L)=0.00661 *9*; α(M)=0.001538 *22* Ice(K)=0.056 *7*.
386.40[a] *15*	4.2 *5*	1008.62	15/2−	622.31	13/2+			α(K)exp=0.061 *9* E_γ,Mult.: placed by evaluators based on the Adopted Level, Gammas, but M1 from ce data is inconsistent ΔJ^π, which requires E1. It is likely that this γ ray is a doublet. Ice(K)=0.133 *7*.
397.57 *15*	3.9 *4*	1086.90	19/2+	689.33	15/2+	(E2)	0.0316 *4*	α(K)exp=0.016 *4* α(K)=0.02417 *34*; α(L)=0.00571 *8*; α(M)=0.001327 *19* Ice(K)=0.031 *7*.
405.50 *20*	4.5 *5*	522.15	5/2+	116.71	5/2+	(M1)	0.0652 *9*	α(K)exp=0.059 *8* α(K)=0.0548 *8*; α(L)=0.00806 *11*; α(M)=0.001792 *25* E_γ,I_γ: mixed with a line from ^{166}Er. Ice(K)=0.143 *7* for doublet. α(K)exp for doublet.
413.50 *25*	5.4 *6*	699.15	11/2−	286.02	9/2−	(M1+E2)	0.045 *17*	α(K)exp=0.03 *1* α(K)=0.037 *15*; α(L)=0.0063 *13*; α(M)=0.00143 *27* Ice(K)=0.091 *7*.
415.60[&] *20*	3.0[&] *4*	557.76	5/2+	142.52	7/2+	(M1+E2)	0.045 *17*	α(K)exp=0.03 *1*

From ENSDF

$^{167}_{69}$Tm$_{98}$-7

γ(^{167}Tm) (continued)

E_γ†	I_γ	E_i(level)	J^π_i	E_f	J^π_f	Mult.‡	α@	Comments
								α(K)=0.036 *15*; α(L)=0.0062 *13*; α(M)=0.00141 *27* Ice(K)=0.054 *7* for doublet. α(K)exp for doublet. Iγ(p,2nγ)/Iγ(p,nγ)=0.91 *30* for doublet.
415.60& *20*	3.0& *4*	1194.95	19/2+	779.35	15/2+	(E2)	0.0279 *4*	
440.92 *15*	4.0 *5*	557.76	5/2+	116.71	5/2+	(M1)	0.0524 *7*	α(K)exp=0.044 *7* α(K)=0.0441 *6*; α(L)=0.00646 *9*; α(M)=0.001436 *20* Ice(K)=0.101 *7* for doublet. α(K)exp for doublet. Iγ(p,2nγ)/Iγ(p,nγ)=1.50 *35* for doublet. I_γ: for a doublet.
x456.37 *25*	2.6 *4*					(M1)	0.0479 *7*	α(K)exp=0.044 *9* α(K)=0.0403 *6*; α(L)=0.00590 *8*; α(M)=0.001312 *18* Ice(K)=0.068 *7*.
460.32 *20*	10.8 *6*	470.61	3/2+	10.419	3/2+	(M1)	0.0468 *7*	α(K)exp=0.038 *4* α(K)=0.0394 *6*; α(L)=0.00577 *8*; α(M)=0.001282 *18* E_γ: mixed with a line from ^{166}Er. Ice(K)=0.242 *8* for doublet. α(K)exp for doublet. Iγ(p,2nγ)/Iγ(p,nγ)=1.70 *15* for doublet.
468.91 *25*	4.9 *5*	840.23	11/2+	371.23	11/2+	(M1)	0.0446 *6*	α(K)exp=0.042 *6* α(K)=0.0376 *5*; α(L)=0.00550 *8*; α(M)=0.001222 *17* Ice(K)=0.123 *7*, also contribution from a line in ^{166}Er. Iγ(p,2nγ)/Iγ(p,nγ)=0.67 *20*.
470.40 *25*	5.7 *5*	470.61	3/2+	0.0	1/2+	(M1)	0.0443 *6*	α(K)exp=0.034 *5* α(K)=0.0373 *5*; α(L)=0.00545 *8*; α(M)=0.001211 *17* E_γ: mixed with a line from ^{166}Er. Ice(K)=0.118 *7*. Iγ(p,2nγ)/Iγ(p,nγ)=1.90 *20* for doublet.
474.71 *25*	3.0 *4*	935.18	7/2−	460.15	7/2−	(M1)	0.0432 *6*	α(K)=0.0364 *5*; α(L)=0.00533 *7*; α(M)=0.001183 *17* E_γ,I_γ: for a doublet in 1976Sv01, but the other placement is not given.
x486.62 *25*	3.4 *4*					(M1)	0.0405 *6*	α(K)exp=0.045 *8* α(K)=0.0341 *5*; α(L)=0.00499 *7*; α(M)=0.001109 *16* E_γ: 1976Sv01 place this γ to feed a 11/2+ levels, but it is uncertain which level it is. A similar transition was also seen and unplaced in (α,2nγ). Ice(K)=0.095 *7*.
511.70 *20*		522.15	5/2+	10.419	3/2+			E_γ: from ce data.
513.90 *30*		840.23	11/2+	326.69	9/2+			E_γ: from ce data, unplaced in 1976Sv01. Placed from the Adopted Gammas.
515.60 *20*		658.09	7/2+	142.52	7/2+			E_γ: from ce spectrum.
537.59 *35*	1.4 *4*	1008.62	15/2−	470.51	13/2−	(M1)	0.0314 *4*	α(K)exp=0.030 *10* α(K)=0.0264 *4*; α(L)=0.00385 *5*; α(M)=0.000855 *12*

^{167}Er(p,nγ) 1976Sv01 (continued)

γ(^{167}Tm) (continued)

E$_\gamma$†	I$_\gamma$	E$_i$(level)	J$_i^\pi$	E$_f$	J$_f^\pi$	Mult.‡	α@	Comments
								Placement from Adopted Gamma.
541.28 *25*		658.09	7/2$^+$	116.71	5/2$^+$	(M1)	0.0308 *4*	Ice(K)=0.026 *7*. α(K)exp=0.035 *8* α(K)=0.0260 *4*; α(L)=0.00378 *5*; α(M)=0.000840 *12* E$_\gamma$: for doublet as indicated by 1976Sv01, but the other placement is unknown.
547.20& *20*	5.7& *5*	557.76	5/2$^+$	10.419	3/2$^+$	(M1)	0.0300 *4*	Ice(K)=0.059 *7* for doublet. α(K)exp=0.025 *4* α(K)=0.02528 *35*; α(L)=0.00368 *5*; α(M)=0.000817 *11* Ice(K)=0.097 *7* for doublet. α(K)exp for doublet. Iγ(p,2nγ)/Iγ(p,nγ)=2.00 *50* for doublet.
547.20& *20*	5.7& *5*	1044.37	11/2$^-$	496.94	11/2$^-$	(M1)	0.0300 *4*	Placement from the Adopted Gammas. Different placement in 1976Sv01.
556.77 *20*	3.4 *4*	928.00	11/2$^+$	371.23	11/2$^+$	(M1)	0.0287 *4*	α(K)exp=0.021 *4* α(K)=0.02418 *34*; α(L)=0.00352 *5*; α(M)=0.000781 *11* E$_\gamma$: unplaced in 1976Sv01. Placement from the Adopted Gammas. Ice(K)=0.048 *7* for a doubly-placed γ. Iγ(p,2nγ)/Iγ(p,nγ)=0.95 *30*.
^{x}570.64 *20*	4.6 *4*					(M1)	0.0269 *4*	α(K)exp=0.022 *4* α(K)=0.02271 *32*; α(L)=0.00330 *5*; α(M)=0.000733 *10* Ice(K)=0.071 *7*. Iγ(p,2nγ)/Iγ(p,nγ)=1.10 *30*.
^{x}576.86 *35*	1.8 *4*							
^{x}583.03 *25*	2.9 *4*							
^{x}590.63 *30*	2.6 *4*							Iγ(p,2nγ)/Iγ(p,nγ)=1.50 *30*.
^{x}600.18 *15*	5.6 *5*					(M1)	0.0237 *3*	α(K)exp=0.019 *3* α(K)=0.01998 *28*; α(L)=0.00290 *4*; α(M)=0.000644 *9* Ice(K)=0.078 *7*.
630.00 *40*	1.6 *5*	1001.67	13/2$^+$	371.23	11/2$^+$	(M1)	0.02096 *30*	α(K)exp=0.017 *8* α(K)=0.01768 *25*; α(L)=0.00256 *4*; α(M)=0.000568 *8* Placement from Adopted Gammas. Ice(K)=0.020 *7*.
636.00 *35*	2.1 *5*	929.1?	9/2$^-$	293.06	7/2$^-$	(M1)	0.02046 *29*	α(K)exp=0.017 *6* α(K)=0.01726 *24*; α(L)=0.002500 *35*; α(M)=0.000555 *8* Placement from Adopted Gammas. Ice(K)=0.027 *7*.
^{x}640.10 *30*	5.0 *5*					(M1)	0.0201 *3*	α(K)exp=0.019 *5* α(K)=0.01698 *24*; α(L)=0.002459 *35*; α(M)=0.000546 *8* Ice(K)=0.042 *7*.
649.36 *20*	5.0 *5*	935.18	7/2$^-$	286.02	9/2$^-$	(M1)	0.01942 *27*	α(K)exp=0.015 *3* α(K)=0.01638 *23*; α(L)=0.002370 *33*; α(M)=0.000526 *7* Ice(K)=0.057 *7*.
^{x}653.12 *40*	1.9 *5*							

$^{167}_{69}$Tm$_{98}$-9

γ(^{167}Tm) (continued)

E_γ †	I_γ	E_i(level)	J_i^π	E_f	J_f^π	Mult. ‡	α @	Comments
^{x}657.22 *30*	2.3 *4*							
660.70 *25*	3.5 *5*	1044.37	11/2⁻	383.98	9/2⁻	(M1)	0.01859 *26*	α(K)exp=0.015 *4* α(K)=0.01568 *22*; α(L)=0.002268 *32*; α(M)=0.000503 *7* Ice(K)=0.041 *7* for doubly-placed γ.
664.79 *20*	4.5 *4*	852.56	3/2⁻	187.76	5/2⁻	(E2)	0.00857 *12*	α(K)exp=0.008 *3* α(K)=0.00697 *10*; α(L)=0.001238 *17*; α(M)=0.000281 *4* Ice(K)=0.028 *7* for doubly-placed γ in the Adopted Gammas.
^{x}669.93 *30*	2.6 *4*							
693.71 *30*	4.0 *5*	881.5	5/2⁻	187.76	5/2⁻	(M1+E2)	0.012 *4*	α(K)exp=0.011 *3* α(K)=0.010 *4*; α(L)=0.0016 *4*; α(M)=3.5×10^{-4} *10* E_γ: doublet, unplaced in 1976Sv01. Placement from the Adopted Gammas. Ice(K)=0.036 *7* for doublet.
^{x}719.32 *25*	4.2 *5*					(E2)	0.00715 *10*	α(K)exp=0.007 *3* α(K)=0.00586 *8*; α(L)=0.001008 *14*; α(M)=0.0002280 *32* Ice(K)=0.023 *7*.
722.54 *25*	6.5 *10*	1008.6	9/2⁻	286.02	9/2⁻	(E2)	0.00708 *10*	α(K)exp=0.007 *2* α(K)=0.00580 *8*; α(L)=0.000997 *14*; α(M)=0.0002253 *32* Ice(K)=0.038 *7*.
751.50 *50*	2.3 *8*	1044.37	11/2⁻	293.06	7/2⁻	(E2)	0.00649 *9*	α(K)exp=0.007 *4* α(K)=0.00533 *7*; α(L)=0.000902 *13*; α(M)=0.0002036 *29* Ice(K)=0.014 *7*.
765.23 *25*	3.7 *5*	944.9	11/2⁺	179.66	7/2⁺	(E2)	0.00623 *9*	α(K)exp=0.007 *3* α(K)=0.00512 *7*; α(L)=0.000862 *12*; α(M)=0.0001945 *27* Ice(K)=0.021 *7*. E_γ: unplaced in 1976Sv01. Placement from the Adopted Gammas.
^{x}781.18 *25*	3.7 *5*							
^{x}793.0 *5*	1.0 *5*							α(K)exp=0.030 *21* Ice(K)=0.010 *5*. α(K)exp=0.011 *15* in 1976Sv01 seems a misprint. From Ice(K) in 1976Sv01, evaluators deduce 0.030 *21*, normalized to ce data for 210γ. 1976Sv01 give mult(804γ)=(M1), but α(K)exp is also consistent with higher multipolarities such as M2, E3.
^{x}804.38 *20*	1.0 *5*							α(K)exp=0.033 *27* Ice(K)=0.011 *7*. α(K)exp=0.011 *15* in 1976Sv01 seems a misprint. From Ice(K) in 1976Sv01, evaluators deduce 0.033 *27*, normalized to ce data for 210γ. 1976Sv01 give mult(804γ)=(M1), but α(K)exp is also consistent with higher multipolarities such as M2, E3.
^{x}902.75 *18*	7.9 *6*							
^{x}957.32 *35*	3.7 *6*							
^{x}963.27 *35*	4.2 *6*							
^{x}982.35 *40*	2.5 *6*							

γ(^{167}Tm) (continued)

[†] Uncertainties in 1976Sv01 are statistical only, but the authors state that divergence is expected as <0.1 keV below 500 keV.

[‡] From α(K)exp deduced from Ice(K) values normalized to ce and Iγ data for the 210.0γ (mult=E2, α(K)=0.1422) for most transitions, and to ce and Iγ data for 139.9γ (mult=M1, α(K)=0.999) for others as indicated. Note that authors′ α(K)exp values can be reproduced from their measured Ice(K) given under comments and relative Iγ very well for γ rays with energy up to Eγ=318 keV, however, for other transitions, authors α(K)exp values are significantly different from Ice(K)/Iγ with the above normalizations, making Mult assignments for those transitions questionable. For this reason, the evaluators have placed firm Mult assignments for those transitions in the parentheses as tentative.

[#] The ce data normalized to ce and Iγ data for 139.9γ (mult=M1, α(K)=0.999).

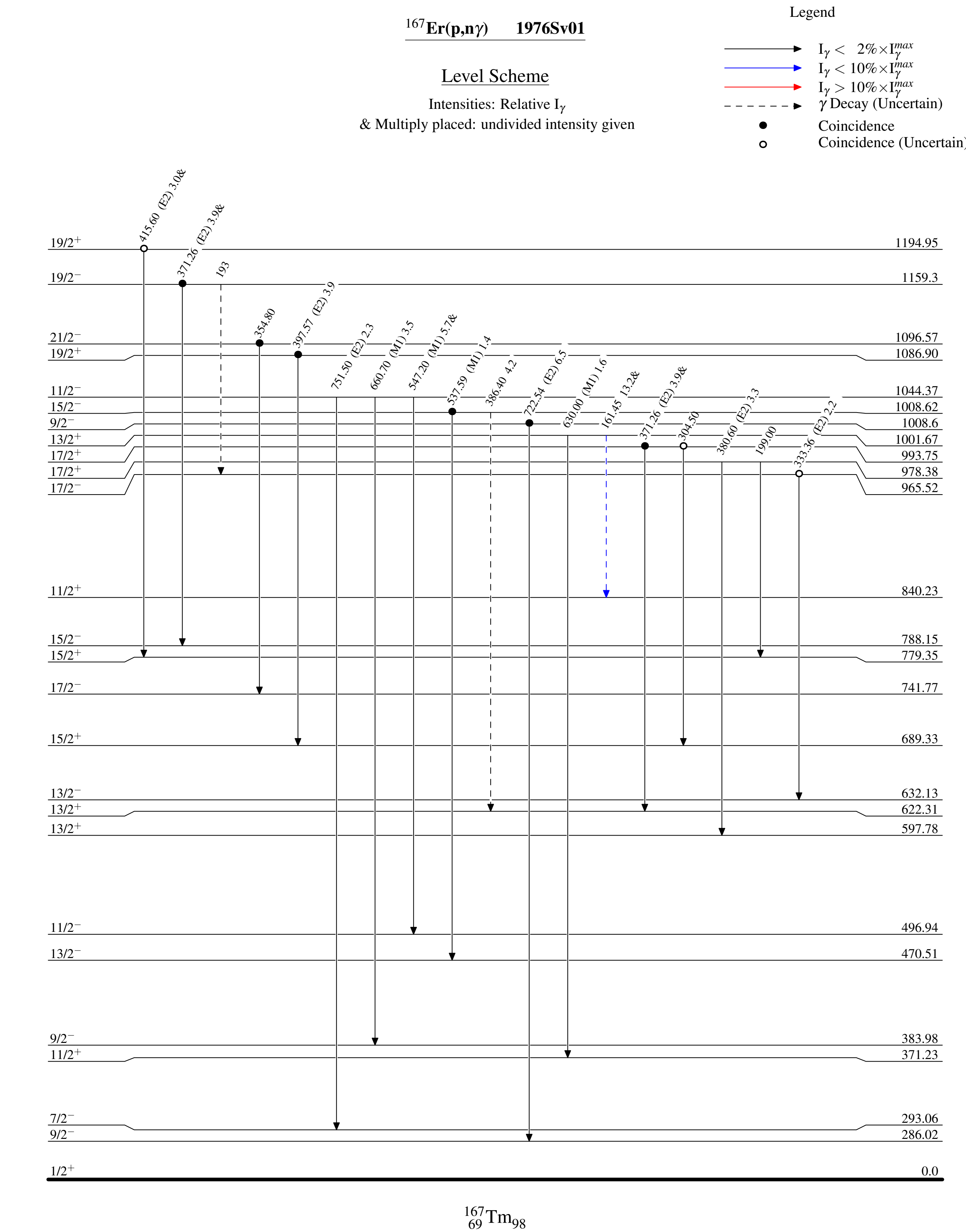
[@] Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on γ-ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.

[&] Multiply placed with undivided intensity.

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

[x] γ ray not placed in level scheme.

^{167}Er(p,nγ) 1976Sv01

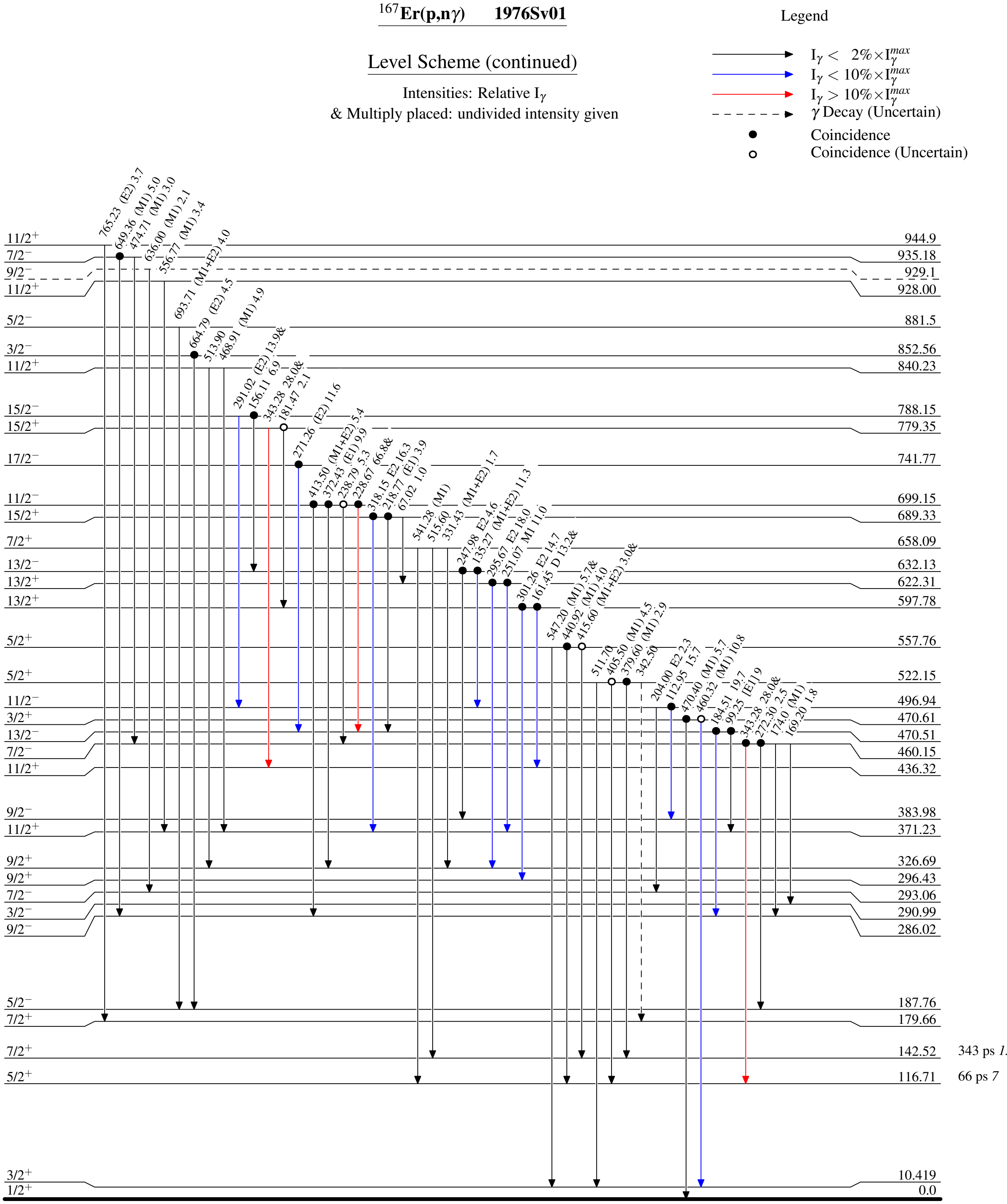


^{167}**Er(p,nγ) 1976Sv01**

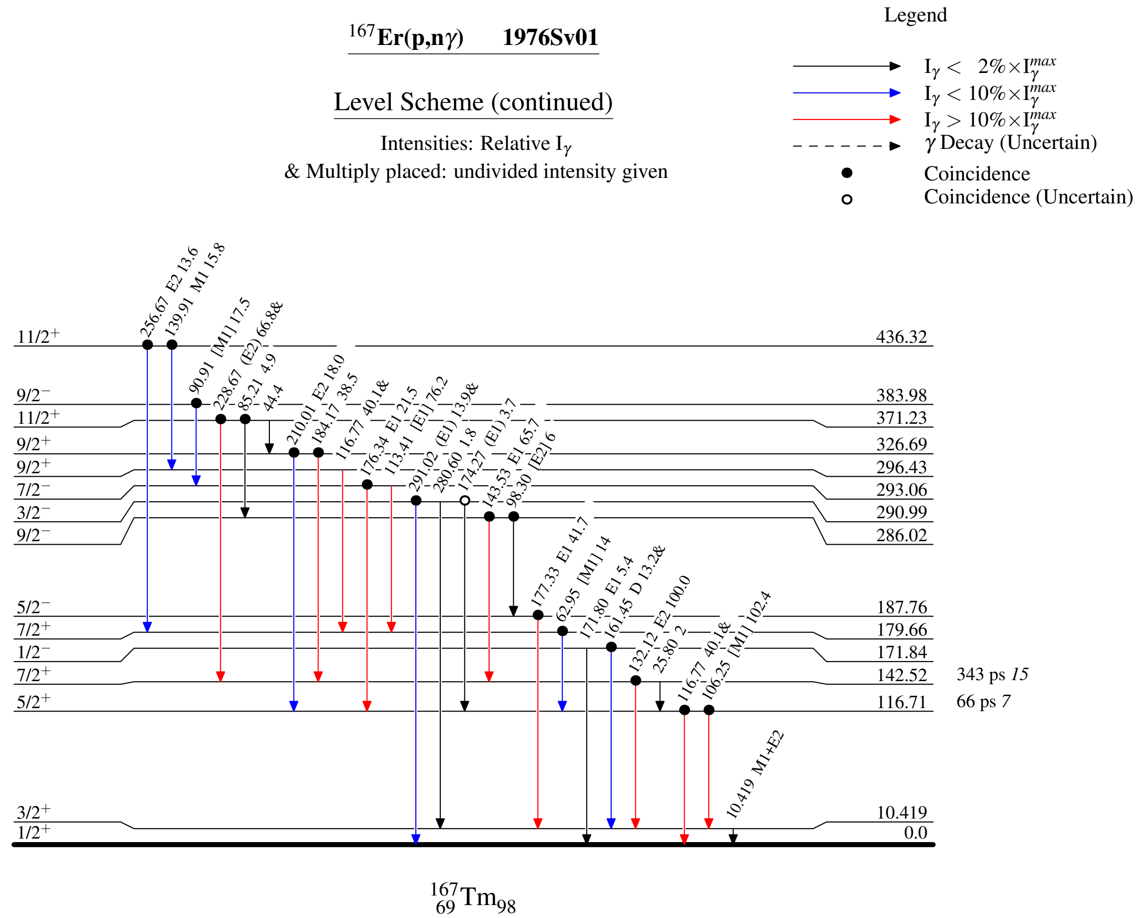
Level Scheme (continued)

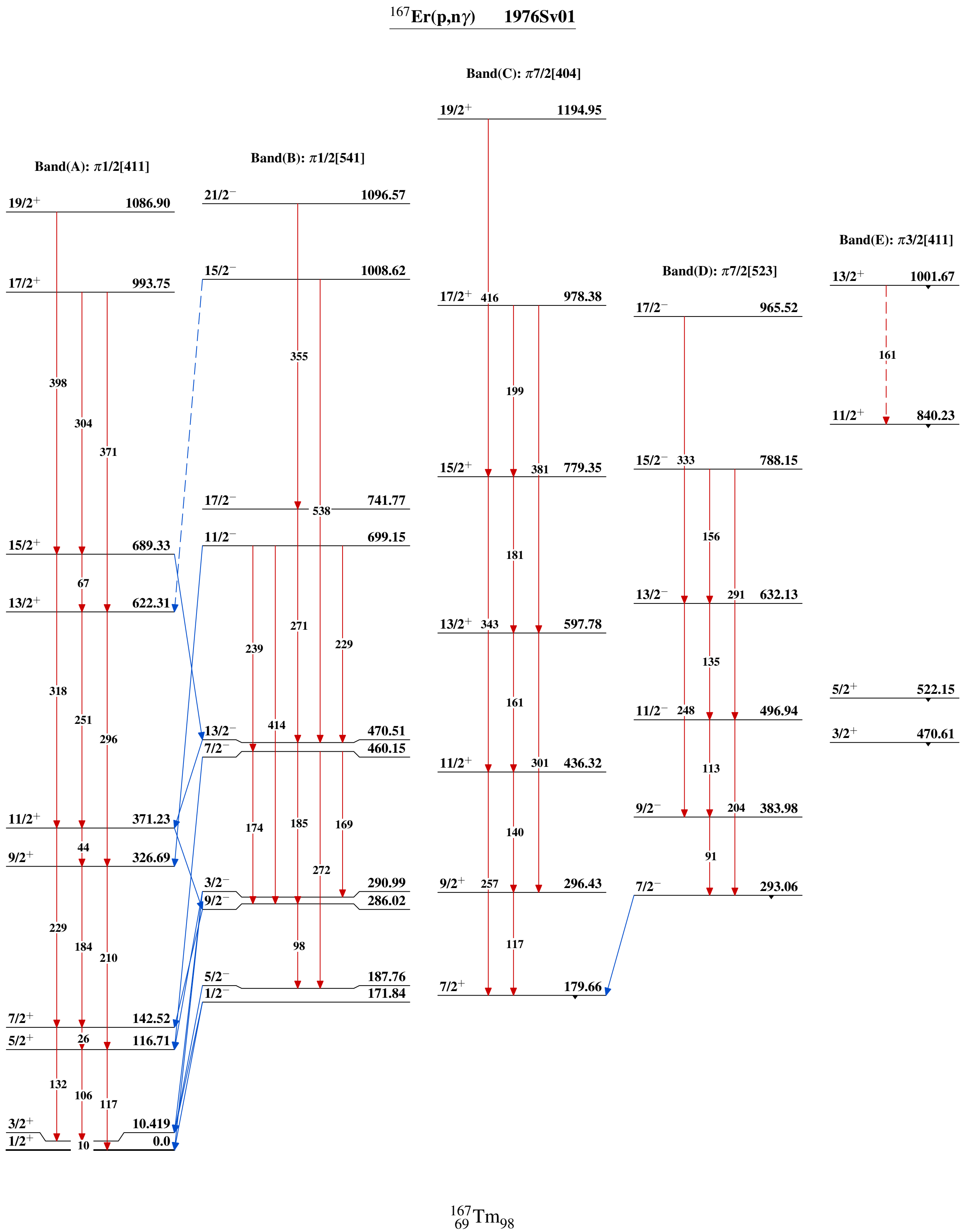
Intensities: Relative I_γ

& Multiply placed: undivided intensity given



$^{167}_{69}Tm_{98}$


^{167}Er(p,nγ) 1976Sv01
Level Scheme (continued)
Intensities: Relative Iγ
& Multiply placed: undivided intensity given
Legend
Iγ < 2%×Iγ^max
Iγ < 10%×Iγ^max
Iγ > 10%×Iγ^max
γ Decay (Uncertain)
Coincidence
Coincidence (Uncertain)
11/2+ 436.32
9/2− 383.98
11/2+ 371.23
9/2+ 326.69
9/2+ 296.43
7/2− 293.06
3/2− 290.99
9/2− 286.02
5/2− 187.76
7/2+ 179.66
1/2− 171.84
7/2+ 142.52 343 ps 15
5/2+ 116.71 66 ps 7
3/2+ 10.419
1/2+ 0.0
256.67 E2 13.6
139.91 M1 15.8
90.91 [M1] 17.5
228.67 (E2) 66.8&
85.21 4.9
44.4
210.01 E2 18.0
184.17 38.5
116.77 40.1&
176.34 E1 21.5
113.41 [E1] 76.2
291.02 (E1) 13.9&
280.60 1.8
174.27 (E1) 3.7
143.53 E1 65.7
98.30 [E2] 6
177.33 E1 41.7
62.95 [M1] 14
171.80 E1 5.4
161.45 D 13.2&
132.12 E2 100.0
25.80 2
116.77 40.1&
106.25 [M1] 102.4
10.419 M1+E2
$^{167}_{69}Tm_{98}$


^{167}Er(p,nγ) 1976Sv01
Band(A): π1/2[411]
Band(B): π1/2[541]
Band(C): π7/2[404]
Band(D): π7/2[523]
Band(E): π3/2[411]
19/2+ 1086.90
17/2+ 993.75
15/2+ 689.33
13/2+ 622.31
11/2+ 371.23
9/2+ 326.69
7/2+ 142.52
5/2+ 116.71
3/2+ 10.419
1/2+ 0.0
21/2− 1096.57
15/2− 1008.62
17/2− 741.77
11/2− 699.15
13/2− 470.51
7/2− 460.15
3/2− 290.99
9/2− 286.02
5/2− 187.76
1/2− 171.84
19/2+ 1194.95
17/2+ 978.38
15/2+ 779.35
13/2+ 597.78
11/2+ 436.32
9/2+ 296.43
7/2+ 179.66
17/2− 965.52
15/2− 788.15
13/2− 632.13
11/2− 496.94
9/2− 383.98
7/2− 293.06
13/2+ 1001.67
11/2+ 840.23
5/2+ 522.15
3/2+ 470.61
398
304
371
67
318
251
296
44
229
184
210
26
132
106
117
10
355
538
239
414
271
229
174
185
169
272
98
416
199
381
181
343
161
301
140
257
117
333
156
291
135
248
113
204
91
161
$^{167}_{69}Tm_{98}$

^{167}Er(p,nγ) 1976Sv01 (continued)

$^{167}_{69}Tm_{98}$