Adopted Levels, Gammas

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh	NDS 75,199 (1995)	31-May-1995

Q(β^-)=−336 *25*; S(n)=6979 *3*; S(p)=4719.1 *24*; Q(α)=2150 *3* 2012Wa38
Note: Current evaluation has used the following Q record −350 50 *6979.3 27* 4718.1 *24* 2150 3 1993Au05,1993Au07.
Hyperfine structure studies: 1992Ne09, 1993BoZR.
Cross sections and yields:
1992Ro24: Yb(α,xnp).
1994Mo10, 1992Mo14, 1990Si17: ^{169}Tm(α,n).
1986Gr12, 1986Gr05: (^{3}He,F).
1984Jh01, 1975Ba35: (n,xn) theory.
Nuclear structure calculations: 1988Fr16, 1987So10, 1986So15, 1979Ad07, 1978Ko15, 1976Ek02, 1972Ne21, 1966So02.
A 4-h isomer in ^{172}Lu proposed by 1951Wi08 was not confirmed in later studies (1967Ba57,1960Wi11,1960Bu27).

^{172}Lu Levels

Band assignments are from 1976El11.

Cross Reference (XREF) Flags

A	^{172}Hf ε decay (1.87 y)	D	^{171}Yb(^{3}He,d),(α,t)
B	^{172}Lu IT decay (3.7 min)	E	^{174}Yb(p,3nγ)
C	^{172}Lu IT decay (440 μs)		

E(level)	J$^\pi$[c]	T$_{1/2}$	XREF	Comments
0.0[†]	4$^-$	6.70 d *3*	ABCDE	%ε+%β^+=100 μ=2.25 *10* (1976Kr04,1989Ra17) Q=3.80 *7* (1993HaZU) J$^\pi$: spin from atomic beam (1974Ek03). Parity from Nilsson-model configuration deduced from cross section data in (α,t) and (^{3}He,d) reactions and from comparison of experimental μ with that calculated from configuration=((π 7/2[404])(ν 1/2[521])) (1976Kr04,1976Ek02). Small admixture of configuration=((π 1/2[541])(ν 7/2[633])) is possible. T$_{1/2}$: weighted average of 6.70 d *5* (1951Wi08), 6.50 d *20* (1960Dz02), 6.70 d *4* (1960Wi11), 6.70 d *1* (1962Bo12), and 6.70 d *10* (1963Ra14). μ: low temperature nuclear orientation (1976Kr04) using μ=2.245 for ^{177}Lu g.s. (1976Kr04). Others: 3.0 (1992Ne09,1993BoZR); 2.90 *1* from NMR on oriented nuclei (quoted by 1993HaZU from work by Konig et al. (to be published)). Q: NMR on oriented nuclei (quoted by 1993HaZU from work by Konig et al. (to be published)). Q(intrinsic)=7.5 (1992Ne09,1993BoZR). Δ<r^2>(^{175}Lu−^{172}Lu)=−0.2 fm^2 (1992Ne09,1993BoZR).
41.86 *4*	1$^-$	3.7 min *5*	ABC	%IT=100 %ε+%β^+<0.18 from Iβ^+<0.015% (1967Dz10) and ε/β^+=11.2 (1971Go40). Only Lu-x rays were seen in the photon spectrum. J$^\pi$: M3 γ to 4$^-$. Probable configuration=((ν 5/2[512])(π 7/2[404])). T$_{1/2}$: L x ray(t) (1962Va07).
65.79[#] *4*	(1)$^+$[d]	0.332 μs *20*	A d	J$^\pi$: E1 γ to 1$^-$ and bandhead assignment. The band assignment is from (^{3}He,d), (α,t) (1976El11). In ^{172}Hf ε decay studies (1979To18,1966Ha23) this level was proposed as the bandhead of a K^π=0$^+$ band having configuration=((ν 7/2[633])(π 7/2[404])) but a level with this

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Adopted Levels, Gammas (continued)

^{172}Lu Levels (continued)

E(level)	J^{π}[c]	$T_{1/2}$	XREF	Comments
				configuration will not be populated in proton transfer reactions (^{3}He,d) and (α,t). Thus the $K^{\pi}=0^+$ assignment is unlikely if it is a common level populated in both studies.
				$T_{1/2}$: $\gamma\gamma$(t) in ^{172}Hf ε decay (1965Br26).
68‡ *3*	(3^-)[d]		dE	J^{π}: in (^{3}He,d) and (α,t) the group is a triplet with contributions from 66, $(1)^+$ K=1; 68, (3^+) K=1; and 68, (3^-) K=3 levels as calculated by 1976El11 and compared with experimental cross sections in (^{3}He,d) and (α,t).
68# *3*	(3^+)[d]		d	J^{π}: see comment for level above.
109.41 *10*	$(1)^+$	440 μs *12*	A C	%IT=100 J^{π}: E1 γ to 1^-, M1+E2 γ from $(1)^+$ and log *ft*=8.7 from 0^+. In ^{172}Hf ε decay study, 1979To18 assigned this as 1^+ bandhead of configuration=((ν 1/2[521])(π 1/2[541])) but calculations and experimental cross sections in (^{3}He,d), (α,t) (1976El11) suggest E≈66 keV for this bandhead. $T_{1/2}$: weighted average of 430 μs *50* (1965Bj01), 450 μs *20* (1966Gr22), 434 μs *15* (1967Co26).
109.85 *4*	$(2)^+$	2.30 ns *12*	A	J^{π}: E2 γ to $(1)^+$. In ^{172}Hf ε decay study, 1979To18 suggest this level as 2^+ member of the $K^{\pi}=0^+$ band with configuration=((ν 7/2[633])(π 7/2[404])); the 65.8 and 191.6 levels are assigned as the 0^+ and 1^+ members, respectively. But from (^{3}He,d) and (α,t) results, the latter two levels are assigned (1976El11) different configurations. $T_{1/2}$: (K x ray+82γ)(ce(L)(44γ))(t) in ^{172}Hf ε decay (1967Ja10).
111.13† *17*	(5^-)		E	
132# *3*	(2^+)[d]		D	
148# *3*	(5^+)[d]		D	
168‡ *3*	(4^-)		E	
179.85 *4*	$(1)^+$		A	J^{π}: M1 γ to $(1)^+$. Probable configuration=((π 5/2[402])(ν 7/2[633])).
191.60@ *4*	$(1)^+$	≤0.5 ns	A D	J^{π}: M1+E2 γ to $(1)^+$ and band assignment. 1976El11 assign this as 1^+ member of a $K^{\pi}=0^+$ band having configuration=((ν 1/2[521])(π 1/2[541])) on the basis of energy calculation and experimental cross sections. 1979To18 assigned this as 1^+ member of a $K^{\pi}=0^+$ band with configuration=((ν 7/2[633])(π 7/2[404])). A level with this configuration will not be populated in (^{3}He,d) and (α,t). If this a common level populated in both studies, the latter configuration is unlikely. $T_{1/2}$: (K x ray+82γ)(ce(L)(126γ))(t), (K x ray)(126γ)(t) in ^{172}Hf ε decay.
196.58? *11*	$(0,1,2)^-$		A	J^{π}: M1 γ to 1^-.
204.00? *21*	$(0^+,1^+,2^+)$		A	J^{π}: (M1+E2) γ from $(0^+,1^+)$.
210# *3*	(4^+)[d]		D	
213.57 *17*	(6^-)	150 ns	E	J^{π}: γ's to 5^- and 4^-. Possible $K^{\pi}=6^-$ band with configuration=((π 7/2[404])(ν 5/2[512])). $T_{1/2}$: γ(t) (1974BeXY).
232.33 *10*	$(1)^+$		A	J^{π}: M1+E2 γ to $(1)^+$ and log *ft*=7.8 from 0^+.
237@ *5*	(0^+)[d]		D	E(level): on the basis of J^{π} assignments, this level seems to be different from the 232.5 or 237.3 levels populated in ^{172}Hf ε decay.
237.32 *14*	$(0^-,1^-)$		A	J^{π}: probable configuration=((π 1/2[411])(ν 1/2[521])).
244.7† *3*	(6^-)		E	
252.2? *3*	$(0^+,1^+)$		A	J^{π}: (M1) γ to $(1)^+$ and log *ft*≈7.6 from 0^+.

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Adopted Levels, Gammas (continued)

^{172}Lu Levels (continued)

E(level)	J$^{\pi}$[c]	XREF	Comments
290‡ 3	(5$^-$)	E	
296 3		D	
314@ 5	(2$^+$)[d]	D	
355@ 5	(3$^+$)[d]	D	
399.3† 4	(7$^-$)	E	
406& 3	(2$^-$)	D	
434‡ 3	(6$^-$)	E	
437 5		D	
466& 3	(3$^-$)	D	
513 3	(3$^-$)	D	J$^{\pi}$: K^{π}=3$^-$ bandhead with probable configuration=((π 5/2[402])(ν 1/2[521])).
576.8† 4	(8$^-$)	E	
581[a] 3	(5$^+$)[d]	D	
602‡ 3	(7$^-$)	E	
614@ 5	(5$^+$)[d]	D	
640[b] 3	(5$^+$)[d]	D	
663 5		D	
685[a] 3	(6$^+$)[d]	D	
720[b] 3	(6$^+$)[d]	D	

† Band(A): K$^{\pi}$=4$^-$ band. Configuration=((ν 1/2[521])(π 7/2[404])).
‡ Band(B): K$^{\pi}$=3$^-$ band. Configuration=((ν 1/2[521])(π 7/2[404])).
# Band(C): K$^{\pi}$=1$^+$ band. Configuration=((ν 1/2[521])(π 1/2[541])).
@ Band(D): K$^{\pi}$=0$^+$ band. Configuration=((ν 1/2[521])(π 1/2[541])).
& Band(E): K$^{\pi}$=2$^-$ band. probable configuration=((ν 1/2[521])(π 5/2[402])).
[a] Band(F): K$^{\pi}$=4$^+$ band. Configuration=((ν 1/2[521])(π 9/2[514])).
[b] Band(G): K$^{\pi}$=5$^+$ band. Configuration=((ν 1/2[521])(π 9/2[402])).
[c] For levels populated in (p,3nγ), J^{π} values are tentative and are based on ΔJ=(1) cascade of γ rays above 4$^-$ and (3$^-$) bandheads.
[d] From comparison of experimental and calculated cross sections in (α,t) and (^{3}He,d).

Adopted Levels, Gammas (continued)

$\gamma(^{172}Lu)$

E_i(level)	J_i^π	E_γ	I_γ	E_f	J_f^π	Mult.[†]	δ[†]	α[‡]	Comments
41.86	1^-	41.86 *4*	100	0.0	4^-	M3		2.58×10^4	B(M3)(W.u.)=0.054 *8*
65.79	$(1)^+$	23.9331 *2*	100	41.86	1^-	E1		3.3	B(E1)(W.u.)=1.11×10^{-5} *8*
109.41	$(1)^+$	67.35 *10*	100	41.86	1^-	E1		0.99	B(E1)(W.u.)=8.2×10^{-10} *3*
109.85	$(2)^+$	44.17 *10*	46 *8*	65.79	$(1)^+$	E2		122	B(E2)(W.u.)=200 *60*
		68.00 *10*	100 *10*	41.86	1^-	[E1]		0.96	B(E1)(W.u.)=5.2×10^{-6} *11*
111.13	(5^-)	111.2 *2*	100	0.0	4^-				
168	(4^-)	99.6 *2*	100	68	(3^-)				
179.85	$(1)^+$	69.99 *10*	33 *4*	109.85	$(2)^+$	M1+E2	0.16 *2*	10.7	
		114.061 *3*	100 *11*	65.79	$(1)^+$	M1		2.59	
191.60	$(1)^+$	11.8	0.3 *1*	179.85	$(1)^+$	[M1]		79	B(M1)(W.u.)≥0.009
		81.7513 *5*	40 *2*	109.85	$(2)^+$	M1+E2	0.066 *15*	6.8	B(M1)(W.u.)≥0.005; B(E2)(W.u.)≥0.8
		125.812 *3*	100 *5*	65.79	$(1)^+$	M1+E2	0.16 *2*	1.94	B(M1)(W.u.)≥0.0033; B(E2)(W.u.)≥1.8
196.58?	$(0,1,2)^-$	154.72[#] *10*	100	41.86	1^-	M1		1.09	
204.00?	$(0^+,1^+,2^+)$	12.41[#] *20*	100	191.60	$(1)^+$	[M1]		256	
213.57	(6^-)	102.5 *2*	61 *6*	111.13	(5^-)	[M1,E2]		3.3 *2*	If M1, B(M1)(W.u.)=2.2×10^{-5}. If E2, B(E2)(W.u.)=0.9.
		213.5 *2*	100 *10*	0.0	4^-	[E2]		0.226	B(E2)(W.u.)=0.039
232.33	$(1)^+$	41.13 *10*	24 *2*	191.60	$(1)^+$	M1+E2	0.14 *5*	12 *3*	
		122.916 *3*	100 *10*	109.41	$(1)^+$	M1+E2	2.3 *10*	1.6 *1*	
237.32	$(0^-,1^-)$	127.91 *10*	100	109.41	$(1)^+$	[E1]		0.185	Mult.: from absence of conversion lines in ^{172}Hf ε decay.
244.7	(6^-)	133.6 *2*	100	111.13	(5^-)				
252.2?	$(0^+,1^+)$	48.17 *20*	≈8	204.00?	$(0^+,1^+,2^+)$	(M1+E2)	≈0.2	8.2	
		60.65	≈100	191.60	$(1)^+$	(M1)		2.7	
290	(5^-)	122.2 *2*	100	168	(4^-)				
399.3	(7^-)	154.6 *2*	100	244.7	(6^-)				
434	(6^-)	144.2 *2*	100	290	(5^-)				
576.8	(8^-)	177.5 *2*	100	399.3	(7^-)				
602	(7^-)	168.0 *2*	100	434	(6^-)				

[†] From ce data in ^{172}Hf ε decay.

[‡] 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.

$^{172}_{71}Lu_{101}$-4

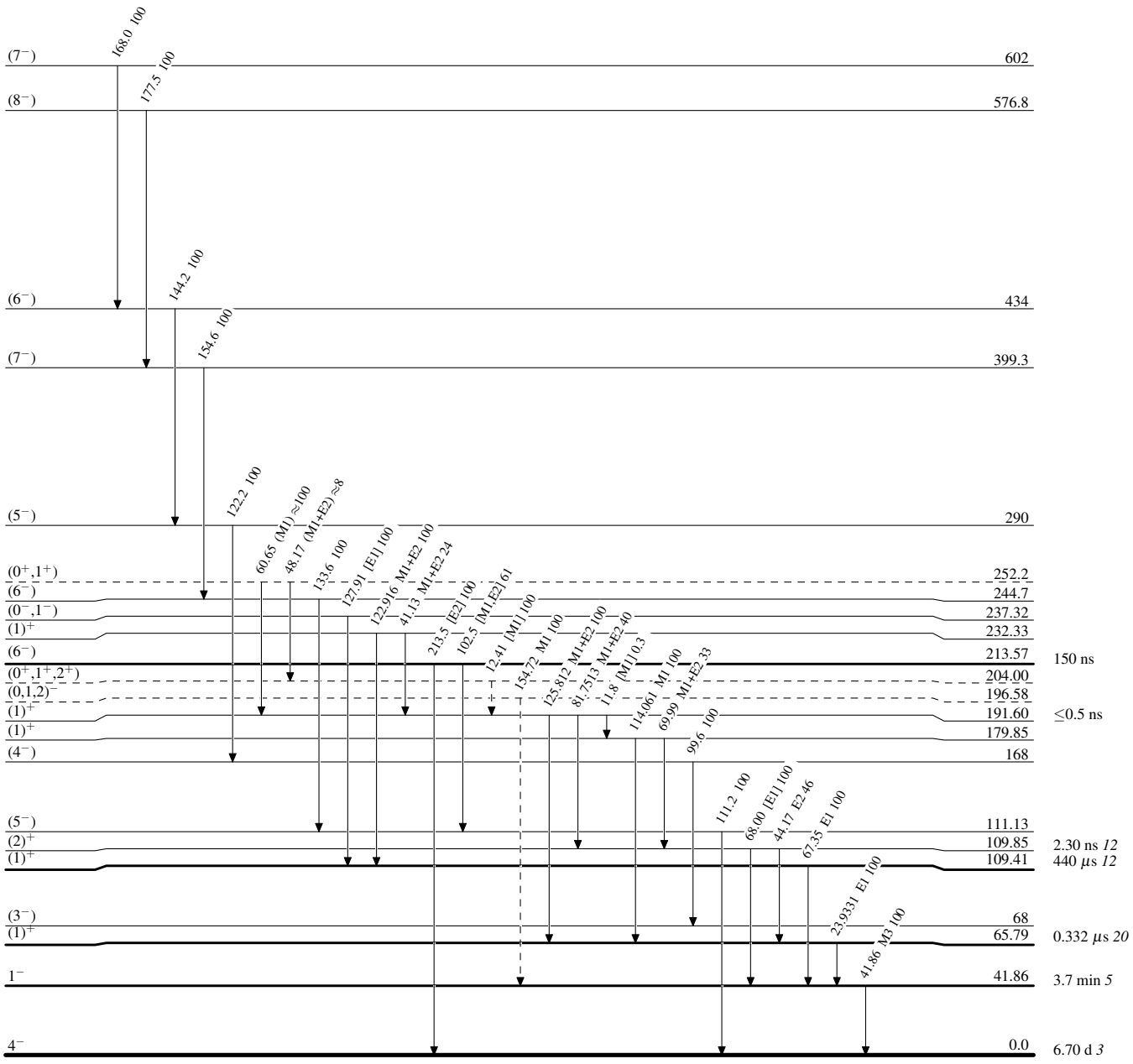
Adopted Levels, Gammas

Legend

Level Scheme

Intensities: Relative photon branching from each level

γ Decay (Uncertain)



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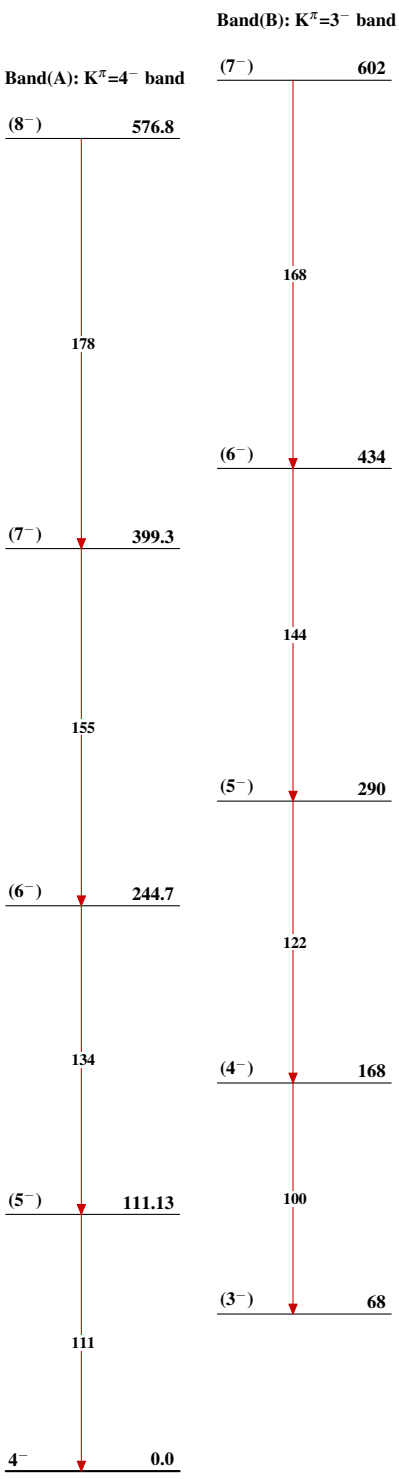
Adopted Levels, Gammas



$^{172}_{71}Lu_{101}$

Adopted Levels, Gammas (continued)

Band(C): $K^{\pi}=1^{+}$ band

(4^{+}) **210**

(5^{+}) **148**

(2^{+}) **132**

(3^{+}) **68**

$(1)^{+}$ **65.79**

$^{172}_{71}Lu_{101}$

Adopted Levels, Gammas (continued)

Band(G): $K^{\pi}=5^{+}$ band

(6^{+}) 720

Band(F): $K^{\pi}=4^{+}$ band

(6^{+}) 685

(5^{+}) 640

Band(D): $K^{\pi}=0^{+}$ band

(5^{+}) 614

(5^{+}) 581

Band(E): $K^{\pi}=2^{-}$ band

(3^{-}) 466

(2^{-}) 406

(3^{+}) 355

(2^{+}) 314

(0^{+}) 237

$(1)^{+}$ 191.60

$^{172}_{71}Lu_{101}$