

Adopted Levels, Gammas

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	D. De Frenne	NDS 110,1745 (2009)	31-Dec-2008

Q(β^-)=1000 13; S(n)=8125 9; S(p)=11971 10; Q(α)=-4703 12 [2012Wa38](#)
 Note: Current evaluation has used the following Q record 1008 228116 2011904 27-4695 29 [2003Au03](#).
 Q(β^-)=996 14 ([2006Ha32](#)) with Penning trap setup at IGISOL.

 ^{102}Mo LevelsCross Reference (XREF) Flags

A	^{102}Nb β^- decay (1.3 s)	F	^{235}U (n,F)
B	^{102}Nb β^- decay (4.3 s)	G	^{238}U (α ,F γ)
C	^{248}Cm , ^{252}Cf SF decay	H	^{100}Mo (t,p)
D	^{100}Mo (t,p γ)	I	^{168}Er (^{30}Si ,X γ)
E	^{100}Mo (^{18}O , ^{16}O γ)		

E(level) @	J π $\ddagger$	T $_{1/2}$ $\dagger$	XREF	Comments
0.0 &	0 ⁺	11.3 min 2	ABCDEFGHI	% β^- =100 T $_{1/2}$: weighted average of: 11.2 min 3 (1980De06), 11.8 min 4 (1976Ki11), 11.0 min 5 (1966Ga28), 11.0 min 3 (1954Wi32), 11.5 min 5 (1954Fl21).
296.610 & 4	2 ⁺	125 ps 4	ABCDEFGHI	$\beta_2 = 0.311$ 5 (2001Ra27) $\mu = +0.84$ 14 (1985Me13 , 1987Bo17 , 2005St24 , 1989Ra17) T $_{1/2}$: from $\beta\gamma$ (t) on mass separated fission products (1991Li39). and time-integral perturbed angular correlations with Gammasphere (2005Sm08). Other: 114 ps 3 from ^{100}Mo (^{18}O , ^{16}O γ), see also 2001Ra27 . Other: 0.28 1 deduced from T $_{1/2}$ (1991Li39). J $^\pi$: L(t,p)=2. μ : From PAC measurements of the (401 γ -296 γ) cascade in the β^- decay of ^{102}Nb (high spin + low spin isomer); + from 2005Sm08 . Other: +0.8 4 (2005Sm08).
698.26 d 12	0 ⁺	28 ps 11	AB DEFGH	J $^\pi$: L(t,p)=0.
743.73 & 5	4 ⁺	12.5 ps 25	BCDE G I	$\beta_2 = 0.27$ 3 (1991Li39) β_2 : Deduced from T $_{1/2}$ 1/2 (1991Li39). J $^\pi$: L(t,p)=(4) and J=4 from $\gamma\gamma$ (θ) in ^{102}Nb β^- decay (4.3 s). J $^\pi$: L(t,p)=2.
847.89 c 6	2 ⁺		AB DEFGH	J $^\pi$: L(t,p)=2.
1144.5 d 10	(2 ⁺)		G	No detailed arguments given for J $^\pi$ assignment (2004Hu02) but γ to 0 ⁺ .
1245.54 9	(3 ⁺)		AB D	J $^\pi$ =(3 ⁺) based on the γ decay pattern in ^{102}Nb β^- decay (4.3 s) (1988GiZX).
1249.74 9	2 ⁺		H	J $^\pi$: L(t,p)=2.
1327.91 & 10	6 ⁺		BCDE G I	
1334 5	0 ⁺		H	J $^\pi$: L(t,p)=0.
1398.39 c 8	(4 ⁺)		B D G	J $^\pi$: from (t,p $\gamma\gamma$). Based on systematics and branching pattern.
1608 2	2 ⁺		H	J $^\pi$: L(t,p)=2.
1616.89 12			B	
1747.76 12			B	
1869.76 13			B	
1881 5	3 ⁻		H	J $^\pi$: L(t,p)=3.
2010.4 c 10	(6 ⁺)		G	No detailed arguments given for J $^\pi$ assignment by 2004Hu02 but γ to (4 ⁺).
2018.82 & 14	8 ⁺	1.8 ps 3	CD G I	
2108 3	1 ⁻		H	J $^\pi$: L(t,p)=1.
2122 5	0 ⁺		H	J $^\pi$: L(t,p)=0.
2147.5 a 5	(5 ⁻)		I	

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Adopted Levels, Gammas (continued) ^{102}Mo Levels (continued)

E(level) @	J^π ‡	$T_{1/2}$ †	XREF	Comments
2239 5	(4 ⁺)		H	J^π : L(t,p)=(4).
2248 7	2 ⁺		H	J^π : L(t,p)=2.
2305 3	2 ⁺		H	J^π : L(t,p)=2.
2321 8	2 ⁺		H	J^π : L(t,p)=2.
2366 1	2 ⁺		H	J^π : L(t,p)=2.
2412 4			H	
2418.12 25	(10 ⁺)		D	J^π : suggested from level at 2416 keV in (t,p) and (t,p $\gamma\gamma$) results in which a 399.3 γ from an observed γ -ray triplet at 400-keV decays to (8 ⁺) level.
2460.3 ^b 5	(6 ⁻)		I	J^π : $J^\pi=(5^-)$ suggested in $^{238}\text{U}(\alpha, \text{F}\gamma)$.
2480.94 8	(3 ⁺)		B D	J^π : from $\gamma\gamma(\theta)$ in ^{102}Nb β^- decay (4.3 s). Absence in (t,p) suggests positive parity.
2485 4	2 ⁺		H	J^π : L(t,p)=2.
2502 1	4 ⁺		H	J^π : L(t,p)=4.
2522 2	3 ⁻		H	J^π : L(t,p)=3.
2547.8 ^a 5	(7 ⁻)		I	J^π : $J^\pi=(4^+)$ suggested in $^{238}\text{U}(\alpha, \text{F}\gamma)$.
2608 1			H	
2659 4	4 ⁺		H	J^π : L(t,p)=4.
2684 7	3 ⁻		H	J^π : L(t,p)=3.
2704 4	0 ⁺		H	J^π : L(t,p)=0.
2742 2			H	
2790.3 ^{&} 6	(10 ⁺)	1.03 ps 18	C G I	J^π : from $\gamma\gamma$ and band structure in ^{248}Cm SF. $T_{1/2}$: from Doppler-profile method in ^{248}Cm SF (1996Sm04).
2797 4			H	
2828.8 ^b 8	(8 ⁻)		G	J^π : $J^\pi=(7^-)$ suggested in $^{238}\text{U}(\alpha, \text{F}\gamma)$.
2851 1			H	
2872 3	2 ⁺		H	J^π : L(t,p)=2.
2943 4	0 ⁺		H	J^π : L(t,p)=0.
2988 11	4 ⁺		H	J^π : L(t,p)=4.
3005.9 ^a 11	(9 ⁻)		I	J^π : $J^\pi=(6^+)$ suggested in $^{238}\text{U}(\alpha, \text{F}\gamma)$.
3010 7	2 ⁺		H	J^π : L(t,p)=2.
3063 2	4 ⁺		H	J^π : L(t,p)=4.
3091 3	3 ⁻		H	J^π : L(t,p)=3.
3125 3	2 ⁺		H	J^π : L(t,p)=2.
3162 5	4 ⁺		H	J^π : L(t,p)=4.
3193 7	2 ⁺		H	J^π : L(t,p)=2.
3248 1			H	
3369.5 ^b 13	(10 ⁻)		G	J^π : $J^\pi=(9^-)$ suggested in $^{238}\text{U}(\alpha, \text{F}\gamma)$.
3614.9 ^a 15	(11 ⁻)		I	J^π : $J^\pi=(8^+)$ suggested in $^{238}\text{U}(\alpha, \text{F}\gamma)$.
3625.2 ^{&} 12	(12 ⁺)		G I	
3632.3 8	(12 ⁺)	0.66 ps 12	C	J^π : from $\gamma\gamma$ and band structure in ^{248}Cm SF. Following 2007La03 3625 keV level is member of $\Delta J=2$ g.s. Yrast band and not 3622.3 keV level.
4053.1 16	(11 ⁻)		G	
4363.7 18	(10 ⁺)		G	
4504.4 ^{&} 15	(14 ⁺)		G	
4856.8 19	(13 ⁻)		G	
5230.8 21	(12 ⁺)		G	
5470.9 ^{&} 18	(16 ⁺)		G	
5764.6 22	(15 ⁻)		G	
6200.5 23	(14 ⁺)		G	

† Unless noted otherwise, determined by the recoil-distance Doppler-shift method (1975Bo39) from $^{100}\text{Mo}(^{18}\text{O}, ^{16}\text{O}\gamma)$, except for g.s. and 296 level.

Adopted Levels, Gammas (continued) ^{102}Mo Levels (continued)

[‡] Unless noted otherwise, from observed band structure and systematics in $^{238}\text{U}(\alpha, \text{F}\gamma)$ and $^{168}\text{Er}(^{30}\text{Si}, \text{x}\gamma)$.

[#] After contact with S.Lalkowski, (November 14, 2007), one of authors of the $^{168}\text{Er}(^{30}\text{Si}, \text{X}\gamma)$ experiment (2007La03), the evaluator got convincing evidence for the correctness of the level scheme and J^π assignments for members of band(β) presented by (2007La03) over these of (2004Hu02) in $^{238}\text{U}(\alpha, \text{F}\gamma)$. The interpretation of the observed band structure given by (2007La03) is a.o. based on systematics of very reliable data on $^{98,100}\text{Mo}$ and ^{104}Ru . Nevertheless an experimental confirmation of the results of 2007La03 would be very welcome.

[@] The level energies were calculated using a least-squares procedure using the Adopted Gammas.

[&] Band(A): Probable member of a $\Delta J=2$ g.s. Yrast band. (2004Hu02, 2007La03).

^a Band(B): γ sequence based on (5^-) (2007La03).

^b Band(C): γ sequence based on (6^-) (2007La03).

^c Band(D): γ band (2004Hu02).

^d Band(E): β band (2004Hu02).

$\gamma(^{102}\text{Mo})$								
$E_i(\text{level})$	J_i^π	$E_\gamma^\dagger$	$I_\gamma^\ddagger$	E_f	J_f^π	Mult. [#]	$\alpha^@$	Comments
296.610	2 ⁺	296.611 4	100	0.0	0 ⁺	[E2]	0.0257	B(E2)(W.u.)=74 9
698.26	0 ⁺	401.89 13	100	296.610	2 ⁺	[E2]		B(E2)(W.u.)=70 30
		696.6		0.0	0 ⁺	E0		I(696)/I(401)=4.2×10 ⁻³ (1989Es01).
743.73	4 ⁺	447.13 6	100	296.610	2 ⁺	[E2]		B(E2)(W.u.)=89 18
847.89	2 ⁺	551.63 8	100 5	296.610	2 ⁺			
		847.37 9	58 6	0.0	0 ⁺			
1144.5	(2 ⁺)	446.2	100	698.26	0 ⁺			
1245.54	(3 ⁺)	397.69 20	19. 4	847.89	2 ⁺			
		948.85 11	100. 11	296.610	2 ⁺			
1249.74	2 ⁺	401.7 3	25. 13	847.89	2 ⁺			
		506.10 20	25. 13	743.73	4 ⁺			
		552.00 20	50. 13	698.26	0 ⁺			
		953.20 20	100. 25	296.610	2 ⁺			
		1249.10 20	75. 25	0.0	0 ⁺			
1327.91	6 ⁺	584.19 8	100	743.73	4 ⁺			
1398.39	(4 ⁺)	550.25 15	94. 5	847.89	2 ⁺			
		654.64 9	100. 7	743.73	4 ⁺			
		1102.40 20	44. 11	296.610	2 ⁺			
1616.89		367.30 20	78. 22	1249.74	2 ⁺			
		873.5 3	22. 11	743.73	4 ⁺			
		1320.20 20	100. 22	296.610	2 ⁺			
1747.76		1004.00 20	100. 21	743.73	4 ⁺			
		1451.10 20	37. 8	296.610	2 ⁺			
1869.76		624.10 20	39. 9	1245.54	(3 ⁺)			
		1021.90 20	100. 22	847.89	2 ⁺			
		1126.10 20	30. 9	743.73	4 ⁺			
2010.4	(6 ⁺)	612.0		1398.39	(4 ⁺)			
2018.82	8 ⁺	690.90 10	100	1327.91	6 ⁺			
2147.5	(5 ⁻)	1403.6 5	100	743.73	4 ⁺			
2418.12	(10 ⁺)	399.30 ^{&} 20	100	2018.82	8 ⁺			
2460.3	(6 ⁻)	1132.4 5	100	1327.91	6 ⁺			
2480.94	(3 ⁺)	733.10 20	3.6 7	1747.76				
		864.30 20	4.3 7	1616.89				
		1082.60 20	4.3 7	1398.39	(4 ⁺)			
		1231.00 20	3.6 7	1249.74	2 ⁺			
		1235.30 20	33. 5	1245.54	(3 ⁺)			
		1633.10 20	100 12	847.89	2 ⁺			
		1737.20 20	5.0 12	743.73	4 ⁺			

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Adopted Levels, Gammas (continued) $\gamma(^{102}\text{Mo})$ (continued)

$E_i(\text{level})$	J_i^π	$E_\gamma^\dagger$	$I_\gamma^\ddagger$	E_f	J_f^π	Mult. [#]	δ	Comments
2480.94	(3 ⁺)	2184.3 2	15.0 2I	296.610	2 ⁺	(M1+E2)	-0.5	δ : from $\gamma\gamma(\theta)$ in ^{102}Nb β^- decay (4.3 s).
2547.8	(7 ⁻)	400.1 5	100 4	2147.5	(5 ⁻)			
		1220.1 5	50 5	1327.91	6 ⁺			
2790.3	(10 ⁺)	771.5 5	100	2018.82	8 ⁺			
2828.8	(8 ⁻)	368.4		2460.3	(6 ⁻)			
		810.0		2018.82	8 ⁺			
3005.9	(9 ⁻)	458.1		2547.8	(7 ⁻)			
3369.5	(10 ⁻)	540.7		2828.8	(8 ⁻)			
3614.9	(11 ⁻)	609.0		3005.9	(9 ⁻)			
3625.2	(12 ⁺)	834.9		2790.3	(10 ⁺)			
3632.3	(12 ⁺)	842.0 5		2790.3	(10 ⁺)			
4053.1	(11 ⁻)	683.6		3369.5	(10 ⁻)			
4363.7	(10 ⁺)	748.8		3625.2	(12 ⁺)			
4504.4	(14 ⁺)	879.2		3625.2	(12 ⁺)			
4856.8	(13 ⁻)	803.7		4053.1	(11 ⁻)			
5230.8	(12 ⁺)	867.1		4363.7	(10 ⁺)			
5470.9	(16 ⁺)	966.5		4504.4	(14 ⁺)			
5764.6	(15 ⁻)	907.8		4856.8	(13 ⁻)			
6200.5	(14 ⁺)	969.7		5230.8	(12 ⁺)			

[†] The gamma energies were calculated using as a weighted average using gammas of ^{102}Nb $\beta^\pm$ decay (1.3 s), ^{102}Nb $\beta^\pm$ decay (4.3 s), $^{100}\text{Mo}(^{18}\text{O},^{16}\text{O})$, ^{248}Cm , ^{252}Cf SF decay, $^{100}\text{Mo}(\text{t},\text{p}\gamma)$, $^{238}\text{U}(\alpha,\text{F}\gamma)$ and $^{168}\text{Er}(^{30}\text{Si},\text{x}\gamma)$.

[‡] Relative branchings of each level were deduced as a weighted average of data from ^{102}Nb β^- decay (4.3 s), $^{100}\text{Mo}(\text{t},\text{p}\gamma\gamma)$, $^{168}\text{Er}(^{30}\text{Si},\text{X}\gamma)$ and $^{100}\text{Mo}(^{18}\text{O},^{16}\text{O})$.

[#] Unless noted otherwise, deduced from level scheme.

[@] 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.

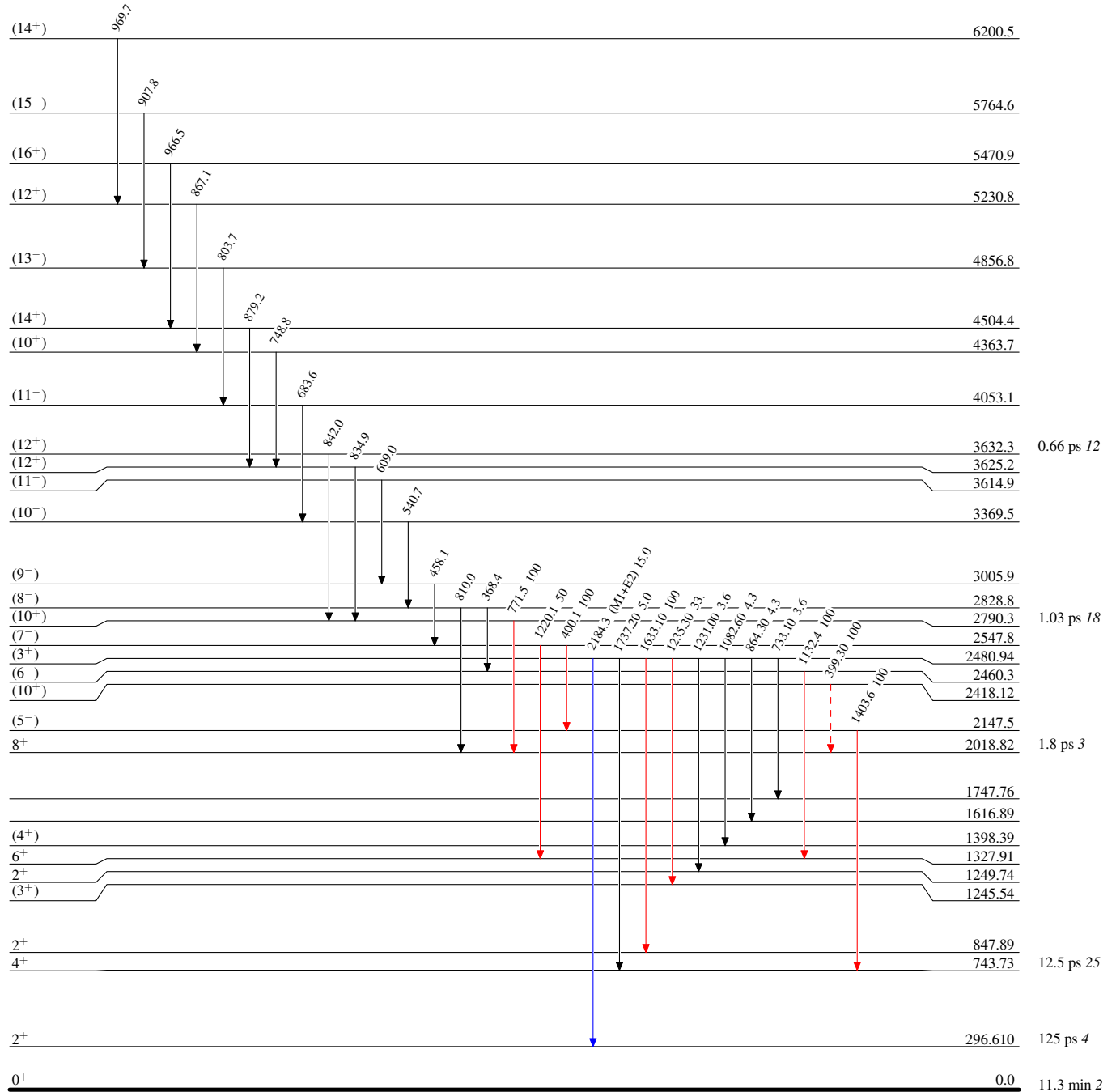
Adopted Levels, Gammas

Legend

Level Scheme

Intensities: Type not specified

- $I_\gamma < 2\% \times I_\gamma^{\max}$
 —→ $I_\gamma < 10\% \times I_\gamma^{\max}$
 —→ $I_\gamma > 10\% \times I_\gamma^{\max}$
 - - - - -→ γ Decay (Uncertain)

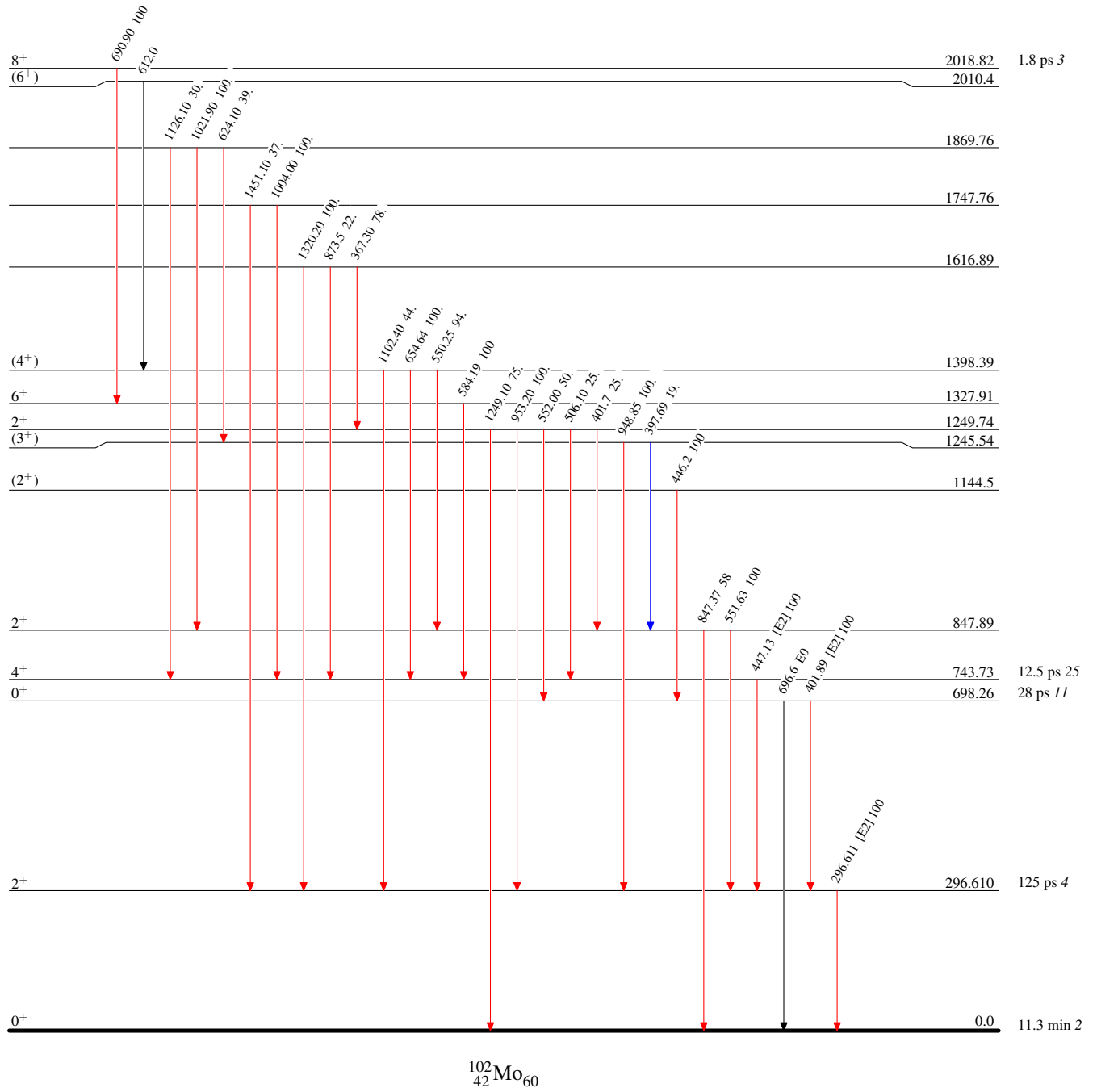


Adopted Levels, Gammas**Level Scheme (continued)**

Intensities: Type not specified

Legend

-  $I_\gamma < 2\% \times I_\gamma^{\max}$
 $I_\gamma < 10\% \times I_\gamma^{\max}$
 $I_\gamma > 10\% \times I_\gamma^{\max}$



Adopted Levels, Gammas

Band(A): Probable member
of a $\Delta J=2$ g.s. Yrast
band

(16⁺) 5470.9

966

(14⁺) 4504.4

879

(12⁺) 3625.2

835

(10⁺) 2790.3

772

8⁺ 2018.82

691

6⁺ 1327.91

584

4⁺ 743.73

447

2⁺ 296.610

297

0⁺ 0.0

Band(B): γ sequence
based on (5⁻) (2007La03)

(11⁻) 3614.9

609

(9⁻) 3005.9

458

(7⁻) 2547.8

400

(5⁻) 2147.5

Band(C): γ sequence
based on (6⁻) (2007La03)

(10⁻) 3369.5

541

(8⁻) 2828.8

368

(6⁻) 2460.3

Band(D): γ band
(2004Hu02)

(6⁺) 2010.4

612

(4⁺) 1398.39

550

2⁺ 847.89

Band(E): β band
(2004Hu02)

(2⁺) 1144.5

446

0⁺ 698.26