Adopted Levels, Gammas

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Ninel Nica, Balraj Singh	NDS 113,1563 (2012)	28-May-2012

Q(β^-)=5383.0 *9*; S(n)=6282.7 *14*; S(p)=11323.3 *11*; Q(α)=−11101 *14* 2012Wa38
Note: Current evaluation has used the following Q record 5382.96 81 *6282.7 14* 11323.311 −11101 *14* 2011AuZZ.
S(2n)=16386.5 *8*, S(2p)=28065 *86* (2011AuZZ).
Values in 2003Au03: Q(β^-)=5374 *5*, S(n)=6251 *5*, S(p)=11354 *17*, Q(α)=−11110 *15*, S(2n)=16395 *5*, S(2p)=28070 *90*.
Mass excess=−24548.71 keV *81* (2009Kw02) is considered in 2011AuZZ evaluation.
^{34}P identified and produced in bombardment of chlorine with fast neutrons (1946Bl01, also Zunti and Bleuler, Helv. Phys. Acta 18, 263 (1945)); measured half-life. In a paper by J.M. Cork and W. Middleton, Phys. Rev. 58, 474 (1940), a 12.7-s activity was found and ascribed to a phosphorus isotope of mass greater than 31.
^{34}P is of some relevance in connection with approach to the so called 'island of inversion'.
Measurement of strong absorption radius: 1999Ai02: Si(^{34}P,X) reaction at 38-80 MeV/nucleon, NSCL facility. The ^{34}P beam was obtained from fragmentation of ^{55}Mn beam with ^{9}Be target at 50-90 MeV/nucleon, NSCL facility.
Additional information 1.

^{34}P Levels

Cross Reference (XREF) Flags

A	^{34}Si β^- decay (2.77 s)	E	^{30}Si(^{7}Li,^{3}He)	I	^{36}S(d,α),(pol d,α)
B	^{35}Si β^-n decay (0.78 s):?	F	Coulomb excitation	J	^{36}S(pol d,$\alpha\gamma$)
C	^{18}O(^{18}O,pnγ) E=20-44 MeV	G	^{34}S(t,^{3}He)	K	^{115}In(^{34}S,Xγ)
D	^{18}O(^{18}O,pnγ) E=34 MeV	H	^{34}S(^{7}Li,^{7}Be),(^{11}B,^{11}C)	L	^{176}Yb(^{36}S,Xγ),^{160}Gd(^{37}Cl,Xγ),

E(level)†	Jπ‡	$T_{1/2}$#	XREF	Comments
0	1^+	12.43 s *10*	A CDEFGHIJKL	%β^-=100 r_0^2 (strong absorption)=1.14 fm^2 *8* (1999Ai02). Jπ: allowed β transition from 0^+ in ^{34}Si decay; unnatural parity state in (pol α,d). $T_{1/2}$: weighted average of 12.40 s *12* (1946Bl01) and 12.45 s *10* (1973Go33). Other: 12.5 s (1958Sc31).
429.09 *11*	2^+	1.3 ps *+6−3*	A CDEFGHIJKL	Jπ: natural parity state from (pol d,α); ΔJ=1, M1+E2 γ to 1^+.
1607.77 *20*	1^+	0.52 ps *+45−14*	A CD FGHIJK	XREF: K(?). Jπ: allowed β transition from 0^+ in ^{34}Si decay; unnatural parity state from (pol d,α).
2228.6 *4*	$2^{(-)}$	>2 ps	C FG IJ	Jπ: ΔJ=1, D(+Q) γ to 1^+, 1608; π=(−) more likely based on qualitative decay-strength arguments in ^{18}O(^{18}O,pnγ) E=20-44 MeV. Assignment consistent with unnatural parity in ^{36}S(pol d,$\alpha\gamma$), but not consistent with the observed population in the Coulomb excitation (hence a different level is not excluded).
2305.1@ *4*	$4^{(-)}$	2.0 ns *1*	CD GhIJKL	Jπ: ΔJ=2, (M2(+E3)) γ to 2^+, 429; unnatural parity state from (pol d,α). $T_{1/2}$: from 2011MaZP (γ-ray coincidence fast-timing technique) other: 0.3 to 2.5 ns from $\gamma\gamma$(t) (2002AsZY) in ^{198}Pt(^{37}Cl,xγ). Additional information 2.
2320.6@ *4*	$3^{(-)}$	>7 ps	CD h KL	Jπ: ΔJ=1, (E1) γ to 2^+, 429.
2372 *20*			I	
2628 *12*			I	
2675.5 *8*	$(1^+,2^-,3^+)$		IJ	Jπ: gammas to 1^+ and 2^+; unnatural parity state from (pol d,α). 1^+ is less likely if 370γ to $4^{(-)}$ exists.
3086 *15*			I	

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)

^{34}P Levels (continued)

E(level)[†]	Jπ[‡]	$T_{1/2}$[#]	XREF	Comments
3201 *16*			I	
3291 *23*			G I	
3352.5 *5*	$5^{(-)}$	0.36 ps *+12−8*	CD G L	XREF: G(?). Jπ: ΔJ=1, D(+Q) γ to $4^{(-)}$, 2305; π=(−) more likely in ^{18}O(^{18}O,pnγ) E=20-44 MeV based on theory.
3482 *8*			I	
3546 *12*			I	
3752.4 *6*	$(3^-,4^-)$	0.26 ps *6*	CD	Jπ: D(+Q) γ to $3^{(-)}$, 2321 and D,E2 γ to $2^{(-)}$, 2229; π=(−) in ^{18}O(^{18}O,pnγ) E=20-44 MeV based on qualitative decay-strength and theory arguments.
3911.6 *11*	$(3^-,4^-)$	0.14 ps *7*	C	Jπ: D,E2 γ to $3^{(-)}$, 2321; π=(−) in ^{18}O(^{18}O,pnγ) E=20-44 MeV based on qualitative decay-strength and theory arguments.
3942.8? *11*			D	
3951.3 *5*	(5^-)	0.111 ps *35*	CD	Jπ: ΔJ=1, (M1(+E2)) γ to $4^{(-)}$, 2305.
4305.9 *11*	$(1^+,2^-,3^+)$		IJ	Jπ: γ to 1^+; unnatural parity state from (pol d,α).
4438 *13*			HIJ	
4446.6 *21*	(4^-)	<0.10 ps	C	Jπ: D,E2 γ to $3^{(-)}$, 2321; (4^-) in ^{18}O(^{18}O,pnγ) E=20-44 MeV based on qualitative decay-strength and theory arguments.
4630.1 *5*	$6^{(-)}$	0.30 ps *5*	CD	Jπ: ΔJ=1, (M1) γ to (5^-), 3951; ΔJ=2, (E2) γ to $4^{(-)}$, 2305.
4723			L	
4744.4 *10*	$(1^+,2^-,3^+,4^-)$		IJ	Jπ: γ to 2^+; unnatural parity state from (pol d,α).
5012.7 *21*	(2^-)	<0.07 ps	C	Jπ: D,E2 γ to $3^{(-)}$, 2321; (2^-) in ^{18}O(^{18}O,pnγ) E=20-44 MeV based on qualitative decay-strength and theory arguments.
5280.7 *21*	(3^-)	<0.07 ps	C	Jπ: D,E2 γ to $3^{(-)}$, 2321; (3^-) in ^{18}O(^{18}O,pnγ) E=20-44 MeV based on qualitative decay-strength and theory arguments.
5394.2 *6*	(6^-)	0.11 ps *+8−5*	C	Jπ: ΔJ=1, D(+Q) γ to $5^{(-)}$, 3352; π=(−) in ^{18}O(^{18}O,pnγ) E=20-44 MeV based on qualitative decay-strength and theory arguments.
5726.4 *13*	$(3^-,4,5,6^-)$		C	Jπ: γ to $5^{(-)}$, 3352 and γ to $4^{(-)}$, 2305.
6180.7 *21*	(6^-)	<0.07 ps	C	Jπ: D,E2 γ to $5^{(-)}$, 3352; (6^-) in ^{18}O(^{18}O,pnγ) E=20-44 MeV based on qualitative decay-strength and theory arguments.
6193.8 *10*			C	Jπ: (7^+) based on shell-model arguments is suggested but not adopted in ^{18}O(^{18}O,pnγ) E=20-44 MeV (2012Be11); possible 2 particle-hole $\pi f_{7/2}\otimes\nu f_{7/2}$ intruder state.
6237.2 *5*	$7^{(+)}$	>6.9 ps	CD KL	Jπ: ΔJ=1, D(+Q) γ to $6^{(-)}$, 4630; ΔJ=2, M2(+E3) γ to $5^{(-)}$, 3352. π=(+) is assigned in both ^{18}O(^{18}O,pnγ) datasets based on level scheme and shell-model arguments; possible 2 particle-hole $\pi f_{7/2}\otimes\nu f_{7/2}$ intruder state.
6357.2 *8*	(7^-)	<0.035 ps	C	Jπ: E2 γ to (5^-), 3951.
7426.2 *21*		<0.07 ps	C	
7920.1 *10*		>0.35 ps	C	

[†] From least-squares fit to Eγ data.
[‡] From γ multipolarities and other arguments as listed.
[#] Except when noted otherwise, values are from DSAM measurements in ^{18}O(^{18}O,pnγ) (2012Be11).
[@] Member of $\pi s_{1/2}\otimes\nu f_{7/2}$ configuration.

Adopted Levels, Gammas (continued)

$\gamma(^{34}P)$

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Mult.[‡]	δ[‡]	Comments
429.09	2^+	429.08 *11*	100	0	1^+	M1(+E2)	+0.11 *+13−12*	B(M1)(W.u.)=0.21 *+5−10*; B(E2)(W.u.)=50 *+130−50* Mult.: M1 from ^{115}In(^{34}S,Xγ); D(+Q) from ^{18}O(^{18}O,pnγ) E=20-44 MeV. δ: other values (both from ^{36}S(pol d,$\alpha\gamma$)): −14 to +11 (possible but not allowed by RUL); −0.52 *10* (gives B(E2)(W.u.)>910, which is unrealistic in view of RUL=100).
1607.77	1^+	1178.63 *19*	100 *3*	429.09	2^+	(M1+E2)	+1.0 *6*	B(M1)(W.u.)=0.008 *+6−8*; B(E2)(W.u.)=24 *+16−24* Mult.: (M1+E2) in ^{36}S(pol d,$\alpha\gamma$) and $\Delta(\pi)$=no; also D+Q in ^{18}O(^{18}O,pnγ) E=20-44 MeV. δ: +0.96 *64* or +0.96 *26* in ^{36}S(pol d,$\alpha\gamma$);
		1607.7 *5*	55 *4*	0	1^+	M1+E2	−0.13 *6*	B(M1)(W.u.)=0.0036 *+10−31*; B(E2)(W.u.)=0.09 *9* Mult.: (M1+E2) in ^{36}S(pol d,$\alpha\gamma$) and $\Delta(\pi)$=no. δ: from ^{36}S(pol d,$\alpha\gamma$); −8 *+3−6* also possible but less likely.
2228.6	$2^{(-)}$	620.6 *4*	68 *14*	1607.77	1^+	(E1(+M2))	+0.07 *16*	B(E1)(W.u.)<0.00041 Mult.: ΔJ=1, D(+Q) in ^{18}O(^{18}O,pnγ) E=20−44 MeV; (E1(+M2)) from $\Delta\pi$=(yes).
		1799.7 *6*	100 *16*	429.09	2^+	[E1]		B(E1)(W.u.)<2.4×10^{-5}
		2229 *1*	59 *14*	0	1^+	[E1]		B(E1)(W.u.)<7.6×10^{-6}
2305.1	$4^{(-)}$	1875.9 *4*	100	429.09	2^+	(M2(+E3))	0.00 *12*	B(M2)(W.u.)=0.064 *4* Mult.,δ: ΔJ=2, Q γ in ^{18}O(^{18}O,pnγ) E=20−44 MeV; (M2+E3) with δ=−0.65 *28* from $\gamma\gamma(\theta)$(DCO) and $\gamma\gamma$(lin pol) in ^{18}O(^{18}O,pnγ) E=34 MeV.
2320.6	$3^{(-)}$	1891.4 *5*	100	429.09	2^+	(E1(+M2))	+0.07 *14*	B(E1)(W.u.)<1.4×10^{-5}; B(M2)(W.u.)<0.42 Mult.: ΔJ=1, D γ from DCO (^{115}In(^{34}S,Xγ)) and $\gamma(\theta)$ in (^{18}O(^{18}O,pnγ) E=20-44 MeV; (E1) from $\gamma\gamma$(lin pol) (^{115}In(^{34}S,Xγ)).
2675.5	$(1^+,2^-,3^+)$	370[@]	<18	2305.1	$4^{(-)}$			
		1068	46 *18*	1607.77	1^+			
		2246	100 *26*	429.09	2^+			
		2675[@]	36 *20*	0	1^+			
3352.5	$5^{(-)}$	1031.7 *7*	2 *1*	2320.6	$3^{(-)}$	[E2]		B(E2)(W.u.)=4.0 *+22−25*
		1047.5 *4*	100 *1*	2305.1	$4^{(-)}$	(M1(+E2))	+0.02 *9*	B(M1)(W.u.)=0.052 *+12−18*; B(E2)(W.u.)=0.1 *+7−1* Mult.,δ: ΔJ=1, D(+Q) γ in ^{18}O(^{18}O,pnγ) E=20-44 MeV; (M1(+E2)) more likely from $\Delta\pi$=(no).
3752.4	$(3^-,4^-)$	1431.8 *6*	100 *2*	2320.6	$3^{(-)}$	(M1(+E2))	+0.18 *+15−14*	B(M1)(W.u.)=0.026 *7*; B(E2)(W.u.)=1.6 *+27−16* Mult.: D,E2 based on RUL; M1(+E2) more likely in ^{18}O(^{18}O,pnγ) E=20-44 MeV from $\Delta\pi$=(no).
		1446[@]		2305.1	$4^{(-)}$			

$^{34}_{15}P_{19}$-3

Adopted Levels, Gammas (continued)

γ(^{34}P) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Mult.[‡]	δ[‡]	Comments
3752.4	(3⁻,4⁻)	1523.9 *9*	7.5 *22*	2228.6	2(−)	(E2,M1)		Mult.: D,E2 based on RUL; E2,M1 more likely in ^{18}O(^{18}O,pnγ) E=20-44 MeV from Δπ=(no).
3911.6	(3⁻,4⁻)	1591 *1*	100	2320.6	3(−)	(M1,E2)		Mult.: D,E2 based on RUL; (M1,E2) from Δπ=(no). B(M1)(W.u.)=0.040 *+26−16* if M1; B(E2)(W.u.)=61 *+41−20* if E2.
		1606[@]		2305.1	4(−)			
3942.8?		1637.7[#] *10*		2305.1	4(−)			
3951.3	(5⁻)	1631.5 *11*	4.2 *21*	2320.6	3(−)	[E2]		B(E2)(W.u.)=2.7 *16*
		1646.1 *4*	100 *2*	2305.1	4(−)	(M1(+E2))	−0.03 *18*	B(M1)(W.u.)=0.043 *14*; B(E2)(W.u.)=0.06 *+67−6* Mult.: (M1) γ from γγ(θ)(DCO) and γγ(θ,lin pol) in ^{18}O(^{18}O,pnγ) E=34 MeV; ΔJ=1, D γ in ^{18}O(^{18}O,pnγ) E=20-44 MeV.
4305.9	(1⁺,2⁻,3⁺)	1631[@]		2675.5	(1⁺,2⁻,3⁺)			
		2698		1607.77	1⁺			
4438		2135[@]		2305.1	4(−)			
4446.6	(4⁻)	2126 *2*	100	2320.6	3(−)	(M1,E2)		Mult.: D,E2 based on RUL; (M1,E2) from Δπ=(no).
4630.1	6(−)	678.8 *4*	67 *11*	3951.3	(5⁻)	(M1(+E2))	+0.12 *11*	B(M1)(W.u.)=0.093 *23*; B(E2)(W.u.)=11 *+21−11* Mult.: (M1) γ from γγ(θ)(DCO) and γγ(lin pol) in ^{18}O(^{18}O,pnγ) E=34 MeV; ΔJ=1, D+Q γ in ^{18}O(^{18}O,pnγ) E=20-44 MeV.
		2325.1 *5*	100 *4*	2305.1	4(−)	(E2(+M3))	+0.02 *+11−10*	B(E2)(W.u.)=2.5 *5* Mult.: (E2) γ from γγ(θ)(DCO) and γγ(lin pol) in ^{18}O(^{18}O,pnγ) E=34 MeV dataset; ΔJ=2, Q in ^{18}O(^{18}O,pnγ) E=20-44 MeV.
4723		2403[@]		2320.6	3(−)			
4744.4	(1⁺,2⁻,3⁺,4⁻)	4315		429.09	2⁺			
5012.7	(2⁻)	2692 *2*	100	2320.6	3(−)	(M1,E2)		Mult.: D,E2 γ based on RUL; (M1,E2) from Δπ=(no).
5280.7	(3⁻)	2960 *2*	100	2320.6	3(−)	(M1,E2)		Mult.: D,E2 γ based on RUL; (M1,E2) from Δπ=(no).
5394.2	(6⁻)	762.9 *8*	15 *6*	4630.1	6(−)	[M1(+E2)]		B(M1)(W.u.)=0.027 *+20−12*
		1442.6 *7*	100 *11*	3951.3	(5⁻)	(M1(+E2))	+0.02 *5*	B(M1)(W.u.)=0.036 *+17−27*; B(E2)(W.u.)=0.03 *+14−3* Mult.: ΔJ=1, D(+Q) in ^{18}O(^{18}O,pnγ) E=20-44 MeV; (M1(+E2)) from Δπ=(no).
		2042 *1*	44 *9*	3352.5	5(−)	(M1(+E2))	+0.05 *14*	B(M1)(W.u.)=0.006 *+3−5*; B(E2)(W.u.)=0.01 *+8−1* Mult.: ΔJ=1, D(+Q) in ^{18}O(^{18}O,pnγ) E=20-44 MeV; (M1(+E2)) from Δπ=(no).
		3090 *2*	28 *9*	2305.1	4(−)	[E2]		B(E2)(W.u.)=0.42 *+24−34*
5726.4	(3⁻,4,5,6⁻)	2373.9 *15*	100 *8*	3352.5	5(−)			
		3421 *2*	28 *8*	2305.1	4(−)			

$^{34}_{15}P_{19}$-4

Adopted Levels, Gammas (continued)

$\gamma(^{34}P)$ (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Mult.[‡]	δ[‡]	Comments
6180.7	(6^-)	2828 *2*	100	3352.5	$5^{(-)}$	(M1,E2)		Mult.: D,E2 γ based on RUL; (M1,E2) more likely from $\Delta\pi$=(no).
6193.8		1563.4 *14*	49 *10*	4630.1	$6^{(-)}$			
		2841 *2*	100 *10*	3352.5	$5^{(-)}$			
6237.2	$7^{(+)}$	842.5 *6*	48 *10*	5394.2	(6^-)	(E1(+M2))	+0.05 *14*	B(E1)(W.u.)<3.0×10^{-5}; B(M2)(W.u.)<3.2 I_γ: from $^{18}O(^{18}O,pn\gamma)$ E=20-44 MeV. Mult.: ΔJ=1, D(+Q) γ in $^{18}O(^{18}O,pn\gamma)$ E=20−44 MeV; (E1(+M2)) more likely from $\Delta\pi$=(yes).
		1607.5 *4*	100 *13*	4630.1	$6^{(-)}$	(E1(+M2))	+0.05 *9*	B(E1)(W.u.)<9.0×10^{-6}; B(M2)(W.u.)<0.18 I_γ: from $^{18}O(^{18}O,pn\gamma)$ E=20-44 MeV. Mult.: ΔJ=1, D(+Q) γ in $^{18}O(^{18}O,pn\gamma)$ E=20−44 MeV; (E1(+M2)) more likely from $\Delta\pi$=(yes).
		2884.3 *6*	90 *13*	3352.5	$5^{(-)}$	M2(+E3)	+0.11 *18*	B(M2)(W.u.)<0.79; B(E3)(W.u.)<28 I_γ: from $^{18}O(^{18}O,pn\gamma)$ E=20-44 MeV. Mult.: ΔJ=2, Q(+O) γ in $^{18}O(^{18}O,pn\gamma)$ E=20−44 MeV; (M2(+E3)) more likely from $\Delta\pi$=(yes).
		3931.7 *9*	13 *8*	2305.1	$4^{(-)}$	[E3]		B(E3)(W.u.)<9.2 I_γ: from $^{18}O(^{18}O,pn\gamma)$ E=20-44 MeV.
6357.2	(7^-)	2405.9 *7*	75 *14*	3951.3	(5^-)	E2		B(E2)(W.u.)>13 Mult.: ΔJ=2, Q γ in $^{18}O(^{18}O,pn\gamma)$ E=20-44 MeV; D,E2 based on RUL.
		3004 *2*	100 *14*	3352.5	$5^{(-)}$	[E2]		B(E2)(W.u.)>5.8
7426.2		1189 *2*	100	6237.2	$7^{(+)}$	D,E2		Mult.: D,E2 γ based on RUL.
7920.1		1683 *1*	100 *6*	6237.2	$7^{(+)}$	D,E2		Mult.: D,E2 γ based on RUL.
		1726 *1*	49 *6*	6193.8		D,E2		Mult.: D,E2 γ based on RUL.

[†] Weighted averages of all available data, unless otherwise stated. Energies given without uncertainties are from level-energy differences.
[‡] Unless commented otherwise, from $\gamma(\theta)$ in $^{18}O(^{18}O,pn\gamma)$ E=20-44 MeV dataset (2012Be11).
[#] Weak γ ray, considered uncertain by evaluators.
[@] Placement of transition in the level scheme is uncertain.

$^{34}_{15}P_{19}$-5

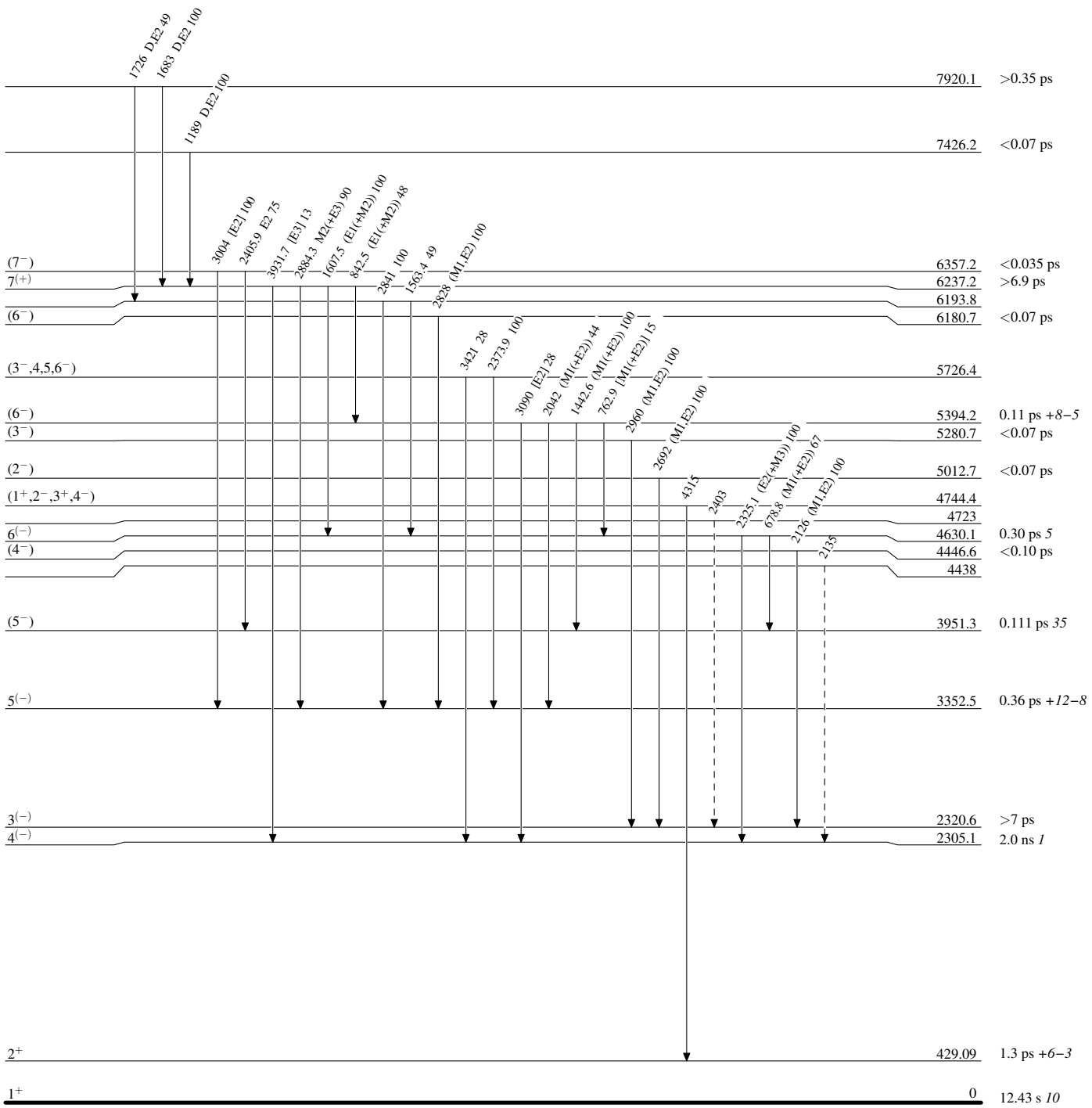
Adopted Levels, Gammas

Legend

Level Scheme

Intensities: Relative photon branching from each level

γ Decay (Uncertain)



$^{34}_{15}P_{19}$

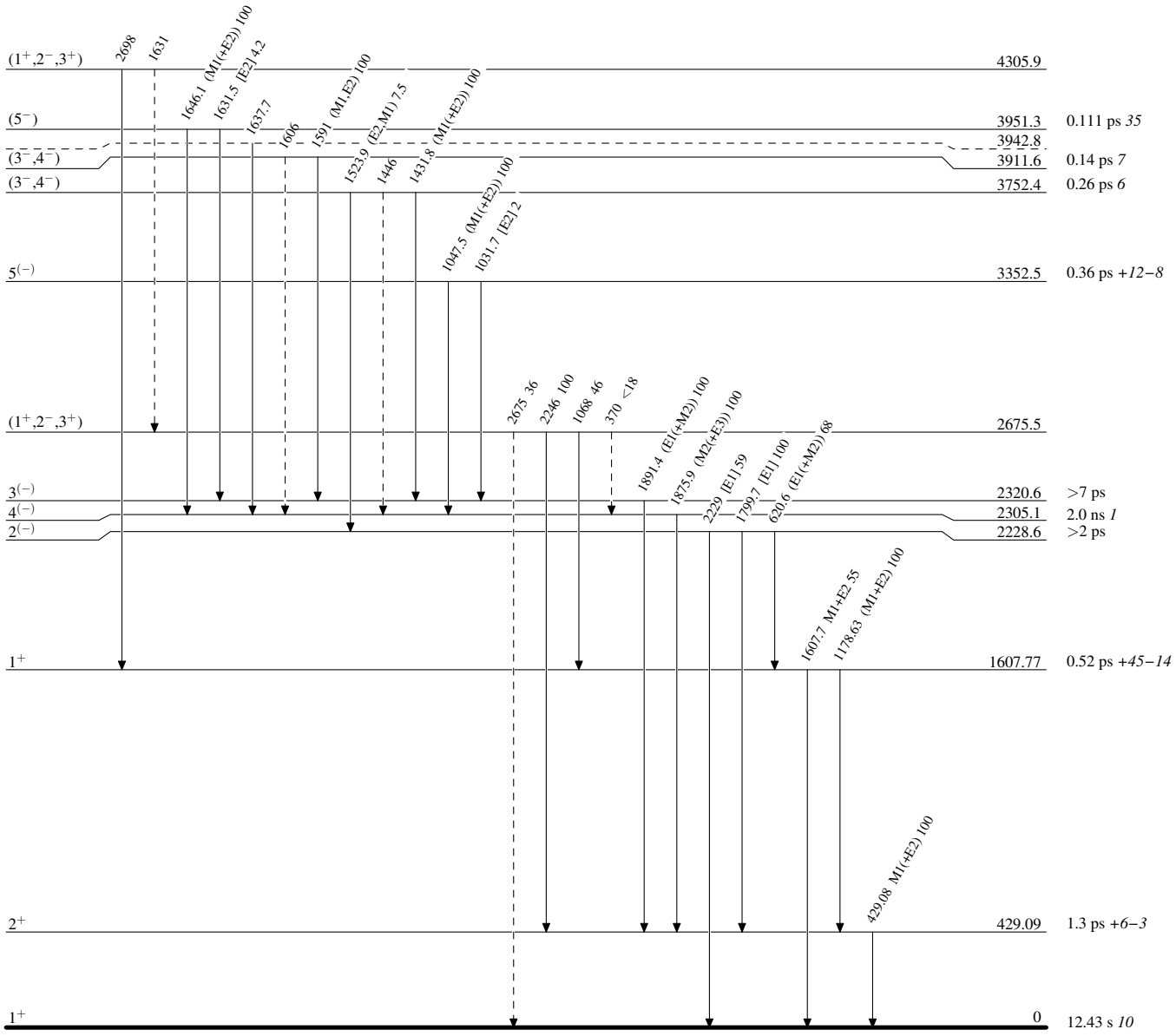
Adopted Levels, Gammas

Legend

Level Scheme (continued)

Intensities: Relative photon branching from each level

γ Decay (Uncertain)



$^{34}_{15}P_{19}$