Adopted Levels, Gammas

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	Jun Chen	NDS 179,1 (2022)	30-Nov-2021

Q(β^-)=3989 *5*; S(n)=8239 *5*; S(p)=9448 *5*; Q(α)=−11148 *5* 2021Wa16
S(2n)=18885 *5*, S(2p)=23668 *5* (2021Wa16).

^{48}Sc Levels

Cross Reference (XREF) Flags

A	^{48}Ca β^- decay: ?	F	^{48}Ca(^{3}He,t)	K	^{48}Ti(^{7}Li,^{7}Be): IV giant res
B	^{46}Ca(^{3}He,p)	G	^{48}Ca(^{6}Li,^{6}He)	L	^{49}Ti(d,^{3}He)
C	^{46}Ca(α,d)	H	^{48}Ti(μ^-,γ)	M	^{49}Ti(t,α)
D	^{48}Ca(p,n),(pol p,n)	I	^{48}Ti(d,2p)	N	^{50}Ti(p,^{3}He):IAS
E	^{48}Ca(p,nγ)	J	^{48}Ti(t,^{3}He)	O	^{50}Ti(d,α),(pol d,α)

E(level)†	J$^\pi$	T$_{1/2}$	XREF	Comments
0.0	6$^+$	43.71 h *9*	BCDEFGH JKLMNO	%β^-=100 μ=3.737 *12* (2007Oh10) XREF: D(?). J$^\pi$: spin from atomic beam (1976Fu06,1967Re06); parity from L(^{3}He,t)=L(d,α)=6 from 0$^+$; 6$^+$ also from $\beta\gamma$ circular polarization in ^{48}Sc β^- decay (1966Va14). T$_{1/2}$: weighted average of 43.67 h *9* (1969Ra16, β^-), 44.1 h *3* (1300γ), 43.9 h *6* and 45.2 h *15* (175γ) (1963Hi02), 44.0 h *9* (1959Po64), 43.4 h *5* (1945Hi04), and 44 h *1* (1940Wa01, Quartz-fibre electroscope). Other: 43.2 h (1963Ho17). μ: from 2007Oh10 using the nuclear magnetic resonance on oriented nuclei (NMR-ON). See also 2019StZV compilation.
130.93 *7*	5$^+$		BCDEFGH J L O	J$^\pi$: spin=5 from $\gamma(\theta)$ in (p,nγ); L(t,^{3}He)=4+6 and L(d,α)=4 from 0$^+$.
252.33 *8*	4$^+$		BCDEFGH J LM O	XREF: M(230). J$^\pi$: spin=4 from $\gamma(\theta)$ in (p,nγ); L(^{3}He,t)=L(t,^{3}He)=L(d,α)=4 from 0$^+$.
388? *20*			M	
622.61 *10*	3$^+$		BCDEFGHIJ LM O	J$^\pi$: spin=3 from $\gamma(\theta)$ in (p,nγ); L(^{3}He,p)=2 from 0$^+$, L(t,^{3}He)=L(d,α)=2+4 from 0$^+$.
1096 *2*	7$^+$		BCD FG J L O	E(level): from (d,α). Others: 1095 *5* from (^{3}He,t), 1091 *8* from (t,^{3}He), and 1091 *10* from (d,^{3}He). J$^\pi$: from analyzing power in (d,α),(pol d,α); L(^{3}He,t)=L(d,α)=6 from from 0$^+$.
1142.66 *17*	2$^+$		BCDEFGH J LM O	J$^\pi$: spin=2 from p$\gamma(\theta)$ in (p,nγ); L(^{3}He,p)=2 from 0$^+$.
1401.77 *19*	2$^-$		DEF HIJ L O	J$^\pi$: from $\gamma(\theta$,pol) in (p,nγ); L(d,α)=1 from 0$^+$, L(^{3}He,t)=3 from 0$^+$.
1432? *15*			F	
1592? *20*			D	
1891.10 *21*	3$^-$		DE H J LM O	J$^\pi$: 1638.8γ E1+M2 to 4$^+$, 489.3γ M1+E2 to 2$^-$.
2063.9 *6*	5$^+$		B DE J	XREF: D(2059). J$^\pi$: spin=5 from γ-excit and $\gamma(\theta)$ in (p,nγ); L(t,^{3}He)=4+6 from 0$^+$. Other: (1,2) from (p,n) based on auto-correlation coefficient is discrepant.
2103.5 *3*	4$^-$		DEF J LM O	J$^\pi$: spin=4 from γ-excit and $\gamma(\theta)$ in (p,nγ); L(d,^{3}He)=L(t,α)=0 from 7/2$^-$; L(t,^{3}He)=L(d,α)=3 from 0$^+$. Other: 3$^-$ from comparison of CCBA to $\sigma(\theta)$ in (t,^{3}He) is discrepant.
2165 *2*	4$^-$,5$^-$		D J LM O	XREF: D(?). E(level): from (d,α). Others: 2165 *4* from (p,n), 2158 *10* from (t,^{3}He),

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Adopted Levels, Gammas (continued)

^{48}Sc Levels (continued)

E(level)†	Jπ	XREF	Comments
			2164 *7* from (d,^{3}He), and 2140 *20* from (t,α).
			Jπ: L(d,α)=5 from 0^+; 4^-,5^- from comparison of CCBA to $\sigma(\theta)$ in (t,^{3}He).
2190.44 *22*	3^+	B DE H J	XREF: B(2202?)D(2185)J(2195).
			Jπ: from $\gamma(\theta$,pol) in (p,nγ); L(t,^{3}He)=2+4 from 0^+.
2196 *15*	(5^+)	C F	E(level): from (α,d).
			Jπ: L(α,d)=4 from 0^+; (5^+) tentatively assigned from DWBA analysis in (α,d).
2.20×10^3 *2*	1^+	I	Jπ: from analysis of measured dσ/dΩ in (d,2p).
2275.51 *25*	2^+	BCDEF H J	XREF: B(2288)C(2281).
			Jπ: from $\gamma(\theta$,pol) in (p,nγ); L(^{3}He,p)=L(t,^{3}He)=2 from 0^+.
2310? *7*		DE	XREF: D(?)E(?).
			E(level): unweighted ave of 2303 *5* from (p,n) and 2316 *2* from (p,nγ).
2386? *6*	2^+	D J lM o	XREF: l(2395)M(2360)o(2389).
			E(level): from (p,n). Others: 2390 *20* from (t,^{3}He), 2360 *20* from (t,α). It is likely that this level is the same as the 2390 level in (p,nγ).
			Jπ: from comparison of CCBA to $\sigma(\theta)$ in (t,^{3}He); (2) from auto-correlation coefficient in (p,n).
2390.7 *6*	3,4	E l o	XREF: l(2395)o(2389).
			Jπ: from $\gamma(\theta)$ in (p,nγ).
2517.4 *4*	1^+	BCDEFGHIJ O	Jπ: spin=1 from $\gamma(\theta)$ in (p,nγ); L(^{3}He,t)=0 and L(^{3}He,p)=0+2 from 0^+.
2560.2 *5*	$(3)^-$	DE J LM	XREF: M(2530).
			Jπ: L(t,α)=0 and L(d,^{3}He)=(0) from $7/2^-$; 1417.5γ to 2^+.
2619.5 *6*	(4,5)	Ef	Jπ: from γ-excit and branching ratios in (p,nγ).
2626 *2*		f O	E(level): from (d,α).
2640.2 *4*	$1,2^-$	DEf H	Jπ: from γ-excit and $\gamma(\theta$,pol) in (p,nγ).
2670.4 *4*	1^-,2^-	DEF H J M O	XREF: F(2655)M(2700).
			Jπ: from γ-excit and $\gamma(\theta$,pol) in (p,nγ). Other: L(t,α)=3 from $7/2^-$ is inconsistent.
2729.0 *8*	$(4^+,5^+)$	B DE H L O	XREF: B(2682)L(2732).
			Jπ: (4,5) from γ-excit and branching ratios in (p,nγ); $(4,5)^+$ from comparison of $\sigma(\theta)$ in ^{46}Ca(^{3}He,p) to the shapes of the 1^+ to 5^+ states in (^{3}He,p) for a group at 2682 *20*.
2739? *10*	2^-	J	Jπ: L(t,^{3}He)=1+3 from 0^+.
2783.3 *4*	2^+	DE H J	Jπ: from comparison of CCBA to $\sigma(\theta)$ in (t,^{3}He).
2811.3 *4*	1,2,3	DE J	Jπ: from $\gamma(\theta)$ in (p,nγ).
2891.3 *4*	2^-	DEF O	Jπ: L(^{3}He,t)=3 and L(d,α)=1 from 0^+.
2924.0 *5*	(3)	DE J	Jπ: from $\gamma(\theta)$ in (p,nγ).
2960 *7*		D j	XREF: D(?)j(2969).
			E(level): from (p,n). Other: 2969 *10* from (t,^{3}He).
2978? *15*	(5^+)	C	Jπ: from DWBA analysis in (α,d).
2980.8 *3*	1^+	B DEF HIJ O	XREF: B(2988)D(2974)J(2989)O(2985).
3026.3 *3*	(2,3)	DE H	Jπ: from γ-excit and branching ratios in (p,nγ). Other: 1^+ suggested from dσ/dΩ from (p,n) is inconsistent.
3056.6 *3*	1^+	BCDEFGHIJ O	Jπ: L(^{3}He,p)=L(t,^{3}He)=L(d,α)=0+2 from 0^+.
3150.0 *4*	1^+	B DEF HIj	XREF: B(3168)F(3160)j(3160).
			Jπ: L(^{3}He,p)=0+2 from 0^+; 1^+ suggested from dσ/dΩ in (d,2n) and (p,n).
3170 *13*	$(3)^+$	C F j	XREF: j(3160).
			E(level): weighted average of 3151 *15* from (α,d) and 3179 *10* from (^{3}He,t).
			Jπ: L(^{3}He,t)=4 from 0^+; (3^+) from DWBA analysis in (α,d).
3216.2 *6*	$(0,1,2,3^+)$	cDE j o	XREF: c(3206)j(3230)o(3220).
			Jπ: 698.5γ to 1^+.
3230 *7*	(4^+)	bc F j o	XREF: b(3232)c(3206)j(3230)o(3220).
			E(level): from (^{3}He,t).
			Jπ: from DWBA analysis in (^{3}He,t); L(α,d)=4 from 0^+ for a group at 3206 *15*. Other: L(^{3}He,p)=0(+2) for a group at 3232 *20* is inconsistent.
3258 *6*		B D g	XREF: B(3232)g(3270).

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Adopted Levels, Gammas (continued)

^{48}Sc Levels (continued)

E(level)†	Jπ	XREF		Comments
				E(level): from (p,n).
				Jπ: L(^{3}He,p)=0(+2) for a group at 3232 *20* gives 1$^+$,0$^+$; L(^{6}Li,^{6}He)=3,(2) from 0$^+$ for a group at 3270.
3281 *10*		C g J		XREF: g(3270).
				E(level): from (t,^{3}He). Other: 3289 *15* from (α,d).
				Jπ: (5$^+$) from DWBA analysis in (α,d) for a group at 3289 *15*; L(^{6}Li,^{6}He)=3,(2) from 0$^+$ for a group at 3270.
3295.7 *6*	(0$^+$ to 4$^+$)	DE j		XREF: D(3290)j(3305).
				Jπ: 2153γ to 2$^+$.
3302.0 *3*	(0 to 3$^+$)	DE j		XREF: D(3298)j(3305).
				Jπ: 245.4γ to 1$^+$.
3327.8 *4*	(4$^-$)	DEFG	O	XREF: F(3341)G(3342).
				Jπ: from DWBA analysis in (^{3}He,t); L(^{6}Li,^{6}He)=3,(2) from 0$^+$.
3353 *10*		D		
3372 *5*		D		
3387 *5*	0$^-$,1$^-$,2$^-$	J	o	E(level): from (d,α). Other: 3393 *10* from (t,^{3}He).
				Jπ: L(d,α)=1 from 0$^+$.
3438 *17*		G J		E(level): unweighted average of 3455 *10* from (^{6}Li,^{6}He) and 3421 *15* from (t,^{3}He).
				Jπ: L(^{6}Li,^{6}He)=2,(3) from 0$^+$.
3485 *7*	3,4$^+$	D F		Jπ: from DWBA analysis in (^{3}He,t).
				E(level): weighted average of 3480 *5* from (p,n) and 3494 *7* from (^{3}He,t).
3496 *5*	2$^-$,1$^-$	J	O	Jπ: from comparison of CCBA to $\sigma(\theta)$ in (t,^{3}He).
				E(level): from (t,^{3}He). Other: 3496 *5* from (d,α).
3519 *6*	(2,3)$^+$	B D		E(level): weighted average of 3502 *20* from (^{3}He,p) and 3520 *6* from (p,n).
				Jπ: from DWBA analysis in (^{3}He,p).
3568 *5*		D J	O	E(level): weighted average of 3563 *5* from (p,n), 3576 *15* from (t,^{3}He), and 3573 *5* from (d,α).
3619 *5*		D		
3655 *8*		D		
3671 *5*		cD g j		XREF: c(3689)g(3680)j(3679).
				E(level): from (p,n).
				Jπ: see comment for 3690 level.
3690 *5*		bc Fg ij	O	XREF: b(3698)c(3689)F(3688)g(3680)i(3700)j(3679).
				E(level): from (d,α). Others: 3688 *10* from (^{3}He,t), 3689 *15* from (α,d).
				Jπ: 1$^+$ from L(^{3}He,p)=0+2 for a group at 3698 *15*, (2$^+$) from DWBA analysis in (^{3}He,t) for a group at 3688 *10*; (6$^+$) from DWBA analysis in (α,d); L(^{6}Li,^{6}He)=3,(2) from 0$^+$ for a group at 3680 *10*. Different J^π from different reactions might indicate different levels around this energy.
3712 *5*	1$^+$	b D FG iJ		XREF: b(3698)F(3720)i(3700)J(3719).
				E(level): weighted average of 3708 *5* from (p,n), 3720 *10* from (^{3}He,t), 3714 *10* from (^{6}Li,^{6}He), and 3719 *15* from (t,^{3}He).
				Jπ: L(^{3}He,p)=L(t,^{3}He)=0+2 from 0$^+$.
3743 *4*		D J	O	E(level): weighted average of 3743 *4* from (p,n), 3751 *15* from (t,^{3}He), and 3741 *5* from (d,α).
3776 *5*		D	O	E(level): weighted average of 3774 *5* from (p,n) and 3778 *5* from (d,α).
3806 *5*		D F		E(level): from (p,n).
3832 *9*		F	O	E(level): weighted average of 3820 *10* from (^{3}He,t), and 3838 *7* from (d,α).
				Jπ: from DWBA analysis in (^{3}He,t).
3870 *7*		D J	O	XREF: J(3887).
				E(level): weighted average of 3887 *15* from (t,^{3}He), 3862 *10* from (p,n) and 3871 *7* from (d,α).
3919 *10*		D		
3957? *5*		D		

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Adopted Levels, Gammas (continued)

^{48}Sc Levels (continued)

E(level)[†]	Jπ	XREF	Comments
3974? *5*		D	
3985 *5*		D ij	XREF: i(4000)j(3999). E(level): from (p,n). Jπ: 1^+ from (d,2p) for a group at 4.00E3 *2*.
4024 *5*		b D f ij	XREF: b(4038)f(4040)i(4000)j(3999). E(level): from (p,n), Jπ: 1^+ from (d,2p) for a group at 4.00E3 *2* and from (^{3}He,p) for a group at 4038 *20*, (1^+) from (^{3}He,t) for a group at 4040 *10*.
4065 *5*		b D f O	XREF: b(4038)f(4040)O(4071). E(level): weighted average of 4062 *5* from (p,n) and 4071 *7* from (d,α). Jπ: see comment for 4024 level.
4093 *7*		D J	E(level): weighted average of 4091 *5* from (p,n) and 4112 *15* from (t,^{3}He).
4141 *5*	1^+	D I	E(level): from (p,n). Jπ: from dσ/dΩ in (p,n) and (d,2p).
4168 *5*		bcD FG j O	XREF: b(4168)c(4178)j(4170)O(4159). E(level): weighted average of 4173 *5* from (p,n), 4169 *10* from (^{6}Li,^{6}He), and 4159 *8* from (d,α). Other: 4171 from (^{3}He,t). Jπ: 1^+ from (^{3}He,p) for a group at 4168 *15*; (3^+) from (α,d) for a group at 4178 *15*; L(^{6}Li,^{6}He)=0 from 0^+ gives 0^+,1^+.
4190 *10*	(1^+)	bc F j	XREF: b(4168)c(4178)j(4170). E(level): from (^{3}He,t). Jπ: from DWBA analysis in (^{3}He,t). Other: 1^+ from (^{3}He,p) for a group at 4168 *15* and (3^+) from (α,d) for a group at 4178 *15*.
4256 *14*	(1^+)	F J	E(level): weighted average of 4265 *10* from (^{3}He,t) and 4236 *15* from (t,^{3}He). Jπ: from DWBA analysis in (^{3}He,t).
4289 *5*	1^+	D IJ O	E(level): weighted average of 4290 *5* from (p,n), 4268 *20* from (t,^{3}He), and 4288 *8* from (d,α). Jπ: from dσ/dΩ in (d,2p).
4328 *10*	1^+,0^+	B F	E(level): weighted average of 4322 *20* from (^{3}He,p) and 4330 *10* from (^{3}He,t). Jπ: from DWBA analysis in (^{3}He,p).
4396 *8*		O	
4437 *15*		FG J	E(level): weighted average of 4450 *15* from (^{6}Li,^{6}He) and 4424 *15* from (t,^{3}He). Jπ: L(^{6}Li,^{6}He)=3,(2) from 0^+.
4560 *15*		FG J	E(level): weighted average of 4566 *15* from (^{6}Li,^{6}He) and 4550 *20* from (t,^{3}He). Jπ: L(^{6}Li,^{6}He)=2,(3) from 0^+.
4.67×10^3?	5^+,6^+,7^+	F	E(level): it is probably the same level as the 4682 level seen in (^{3}He,p) and the 4671 level seen in (^{6}Li,^{6}He), but *Jπ* is inconsistent. See 4677 level. Jπ: L(^{3}He,t)=6 from 0^+.
4677 *15*	1^+	B G	E(level): weighted average of 4682 *15* from (^{3}He,p) and 4671 *15* from (^{6}Li,^{6}He). Jπ: L(^{3}He,p)=0+2 from 0^+; L(^{6}Li,^{6}He)=3,(2) from 0^+.
4735 *15*		G i	E(level): from (^{6}Li,^{6}He). Jπ: 1^+ from dσ/dΩ in (d,2p) for a group at 4.76E3 *2*; L(^{6}Li,^{6}He)=3,(2) from 0^+.
4786 *10*	1^+	B D F i	E(level): weighted average of 4778 *15* from (^{3}He,p) and 4790 *10* from (^{3}He,t). Jπ: L(^{3}He,p)=0+2 from 0^+; also from dσ/dΩ in (p,n).
4862 *15*	$(2,3)^+$	B	Jπ: from DWBA analysis in (^{3}He,p).
5012 *15*	$(2,3)^+$	B G	E(level): weighted average of 5028 *20* from (^{3}He,p) and 5003 *15* from (^{6}Li,^{6}He). Jπ: from DWBA analysis in (^{3}He,p); L(^{6}Li,^{6}He)=2,(3) from 0^+.
5050 *10*		F	
5111 *10*		F	
5202 *15*	$(2,3)^+$	B FG	E(level): weighted average of 5208 *15* from (^{3}He,p) and 5190 *20* from (^{6}Li,^{6}He). Jπ: from DWBA analysis in (^{3}He,p); L(^{6}Li,^{6}He)=2,(3) from 0^+.
5230 *10*	(1^+)	F	Jπ: from DWBA analysis in (^{3}He,t).

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Adopted Levels, Gammas (continued)

^{48}Sc Levels (continued)

E(level)†	Jπ	$T_{1/2}$	XREF	Comments
5296 *11*			FG	E(level): weighted average of 5290 *10* from (^{3}He,t) and 5318 *20* from (^{6}Li,^{6}He). Jπ: L(^{6}Li,^{6}He)=2,(3) from 0$^+$.
5354 *10*	(2,3)$^+$		B Fg	XREF: g(5318). E(level): weighted average of 5342 *15* from (^{3}He,p), 5360 *10* from (^{3}He,t), and 5318 *20* from (^{6}Li,^{6}He). Jπ: from DWBA analysis in (^{3}He,p).
5438 *10*	1$^+$		B F	E(level): weighted average of 5422 *25* from (^{3}He,p) and 5440 *10* from (^{3}He,t). Jπ: from DWBA analysis in (^{3}He,p).
5513 *10*	(2,3)$^+$		B FG	E(level): weighted average of 5512 *20* from (^{3}He,p), 5485 *20* from (^{6}Li,^{6}He), 5520 *10* from (^{3}He,t). Jπ: from DWBA analysis in (^{3}He,p); L(^{3}He,t)=(2,3) from 0$^+$; L(^{6}Li,^{6}He)=2,(3) from 0$^+$.
5595 *20*	(2,3)$^+$		B FG	E(level): weighted average of 5608 *20* from (^{3}He,p) and 5574 *25* from (^{6}Li,^{6}He). Jπ: from DWBA analysis in (^{3}He,p); L(^{6}Li,^{6}He)=2,(3) from 0$^+$.
5754 *10*	1$^+$		B F	E(level): weighted average of 5742 *15* from (^{3}He,p) and 5760 *10* from (^{3}He,t). Jπ: L(^{3}He,p)=0+2 from 0$^+$.
5.88×10^3	3$^+$,4$^+$,5$^+$		F	Jπ: L(^{3}He,t)=4 from 0$^+$.
5900 *10*			F	
5962 *10*	0$^+$,1$^+$		FG	E(level): weighted average of 5960 *10* from (^{3}He,t) and 5975 *25* from (^{6}Li,^{6}He). Jπ: L(^{6}Li,^{6}He)=0 from 0$^+$.
6020 *10*	(2$^-$,3$^-$,4$^-$)		F	Jπ: L(^{3}He,t)=(3) from 0$^+$.
6187 *25*	(0$^+$,1$^+$,2$^+$,3$^+$)		G	Jπ: L(^{6}Li,^{6}He)=0,(2) from 0$^+$.
6242 *15*	(2,3)$^+$		B	Jπ: from DWBA analysis in (^{3}He,p).
6250 *10*	(1$^+$)		F	Jπ: from DWBA analysis in (^{3}He,t).
6400 *10*			F	
6460 *10*			F	
6620 *10*			F	
6677.6 *21*	0$^+$		B DEFG N	T=4 XREF: F(6710). IAS(^{48}Ca g.s.). See 1997Jo08 for parameters of the isovector potential deduced from σ(θ) of ^{48}Ca(p,n) E=35 MeV.
6832 *20*	1$^+$,2$^+$,3$^+$		B	Jπ: L(^{3}He,p)=2 from 0$^+$.
6952 *15*	1$^+$,2$^+$,3$^+$		B	Jπ: L(^{3}He,p)=2 from 0$^+$.
≈7.5×10^3	(1$^+$)		G K	XREF: K(?). Jπ: from (^{6}Li,^{6}He).
≈7.78×10^3	‡		F	
≈10.6×10^3	‡		F	
≈13.3×10^3	‡		F	
13.8×10^3 *5*		2.2×10^3 keV *5*	K	Width from (^{7}Li,^{7}Be).
16840 *10*	(1$^+$)		D F	T=4 E(level): from (^{3}He,t). Other: 16810 *5* from (p,n). Jπ: from DWIA and DWBA analysis of σ(θ) in (p,n),(pol p,n).

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Adopted Levels, Gammas (continued)

^{48}Sc Levels (continued)

E(level)†	$T_{1/2}$	XREF	Comments
			T=4 Gamow-Teller state.
17.8×10^3 *10*	6.0×10^3 keV *10*	K	Width from (^{7}Li,^{7}Be).

† From a least-squares fit to γ-ray energies for levels connected with γ transitions and from individual reactions for others as noted otherwise.
‡ $\sigma(\theta)$ in (^{3}He,t) similar to those for the 2.52 MeV, 1^+, and 1.14 MeV, 2^+, state although the 2^+ was not resolved from the 7^+.

Adopted Levels, Gammas (continued)

γ(^{48}Sc)

E_i(level)	J_i^π	E_γ[‡]	I_γ[‡]	E_f	J_f^π	Mult.[#]	δ[#]	α[†]	Comments
130.93	5$^+$	130.93 *7*	100	0.0	6$^+$	M1(+E2)	0.04 *5*	0.0081 *6*	α(K)=0.0073 *6*; α(L)=0.00066 *5*; α(M)=8.2×10^{-5} *7* α(N)=4.50×10^{-6} *34* E_γ: weighted average of 130.6 *2* from (p,nγ) and 130.94 *4* from (μ^-,γ). Mult.,δ: from α(exp) in (p,nγ).
252.33	4$^+$	121.40 *4*	100	130.93	5$^+$	(M1(+E2))	−0.04 *9*	0.0098 *20*	α(K)=0.0089 *18*; α(L)=0.00080 *17*; α(M)=9.9×10^{-5} *21* α(N)=5.5×10^{-6} *11* E_γ: weighted average of 121.2 *2* from (p,nγ) and 121.41 *4* from (μ^-,γ). Mult.: D(+Q) from γ(θ) in (p,nγ); Δπ=no from level scheme.
622.61	3$^+$	370.28 *5*	100	252.33	4$^+$	(M1(+E2))	−0.02 *2*	0.000645 *9*	α(K)=0.000587 *8*; α(L)=5.18×10^{-5} *7*; α(M)=6.43×10^{-6} *9* α(N)=3.59×10^{-7} *5* E_γ: weighted average of 370.2 *2* from (p,nγ) and 370.29 *5* from (μ^-,γ). Mult.: D(+Q) from γ(θ) in (p,nγ); Δπ=no from level scheme.
1142.66	2$^+$	520.1 *2*	100	622.61	3$^+$	M1+E2	−0.08 *+2−6*	0.000306 *6*	α(K)=0.000278 *6*; α(L)=2.45×10^{-5} *5*; α(M)=3.03×10^{-6} *6* α(N)=1.700×10^{-7} *35* E_γ: weighted average of 519.9 *2* from (p,nγ) and 520.3 *2* from (μ^-,γ). Mult.,δ: from γ(θ,pol) and α(exp) in (p,nγ).
1401.77	2$^-$	259.1 *2*	4.2 *11*	1142.66	2$^+$	(E1+M2)	−0.08 *6*	0.00139 *8*	α(K)=0.00127 *7*; α(L)=0.000111 *7*; α(M)=1.38×10^{-5} *8* α(N)=7.7×10^{-7} *4* I_γ: from (p,nγ). Other: 4.2 *13* from (μ^-,γ). Mult.,δ: D+Q and δ from γ(θ) in (p,nγ); Δπ=yes from level scheme. δ: other: −1.8 *3* also from (p,nγ) is ruled out by RUL since it would require an isomeric $T_{1/2}$>60 ns for 1402 level.
		779.1 *3*	100.0 *11*	622.61	3$^+$	E1+M2	−0.04 *1*	7.72×10^{-5} *11*	α(K)=7.02×10^{-5} *10*; α(L)=6.15×10^{-6} *9*; α(M)=7.63×10^{-7} *11* α(N)=4.28×10^{-8} *6* E_γ: weighted average of 779.0 *2* from (p,nγ) and 780.1 *8* from (μ^-,γ). I_γ: from (p,nγ). Other: 100 *24* from (μ^-,γ). Mult.,δ: from γ(θ,pol) and α(exp) in (p,nγ).
1891.10	3$^-$	489.3 *3*	72.5 *20*	1401.77	2$^-$	M1+E2		5.8×10^{-4} *24*	α(K)=5.3×10^{-4} *21*; α(L)=4.7×10^{-5} *19*; α(M)=5.8×10^{-6} *24* α(N)=3.2×10^{-7} *13* I_γ: from (p,nγ). Other: 69 *12* from (μ^-,γ). δ: −0.08 *3* or +8 *2*.
		748.3 *4*	13.2 *20*	1142.66	2$^+$	(E1+M2)		8.66×10^{-5} *30*	α(K)=7.87×10^{-5} *27*; α(L)=6.90×10^{-6} *24*; α(M)=8.55×10^{-7}

$^{48}_{21}Sc_{27}$-7

Adopted Levels, Gammas (continued)

γ(^{48}Sc) (continued)

E_i(level)	J_i^π	E_γ[‡]	I_γ[‡]	E_f	J_f^π	Mult.[#]	δ[#]	α[†]	Comments
									30 α(N)=4.79×10^{-8} *17* I_γ: weighted average of 13.7 *20* from (p,nγ) and 12.5 *25* from (μ^-,γ). Mult.: D+Q from γ(θ) in (p,nγ); Δπ=yes from level scheme. δ: +0.02 *11* or +3.7 *+28−16*.
1891.10	3$^-$	1268.3 *6*	11.8 *20*	622.61	3$^+$				I_γ: from (p,nγ). Other: 12.5 *31* from (μ^-,γ).
		1638.8 *3*	100.0 *20*	252.33	4$^+$	E1+M2	+0.05 *3*	0.000392 *6*	α(K)=1.787×10^{-5} *28*; α(L)=1.561×10^{-6} *25*; α(M)=1.936×10^{-7} *31* α(N)=1.089×10^{-8} *17*; α(IPF)=0.000372 *5* I_γ: from (p,nγ). Other: 100 *21* from (μ^-,γ).
2063.9	5$^+$	1811.8[@] *6*	31.6 *13*	252.33	4$^+$				
		2063.9 *6*	100.0 *13*	0.0	6$^+$	(M1(+E2))	−0.02 *3*		Mult.: D(+Q) from γ(θ) in (p,nγ); Δπ=no from level scheme.
2103.5	4$^-$	1481.0 *4*	100 *4*	622.61	3$^+$	(E1(+M2))	0.00 *3*	0.000271 *4*	α(K)=2.092×10^{-5} *30*; α(L)=1.828×10^{-6} *26*; α(M)=2.266×10^{-7} *32* α(N)=1.274×10^{-8} *18*; α(IPF)=0.0002483 *35* Mult.: D(+Q) from γ(θ) in (p,nγ); Δπ=yes from level scheme. Same for 1851.1γ and 1972.5γ.
		1851.1 *5*	45.1 *20*	252.33	4$^+$	(E1(+M2))	−0.12 *+12−8*	0.000544 *13*	α(K)=1.51×10^{-5} *7*; α(L)=1.32×10^{-6} *6*; α(M)=1.64×10^{-7} *7* α(N)=9.2×10^{-9} *4*; α(IPF)=0.000527 *13* Mult.: D(+Q) from γ(θ) in (p,nγ); Δπ=yes from level scheme. Same for 1851.1γ and 1972.5γ.
		1972.5 *5*	51.0 *20*	130.93	5$^+$	(E1(+M2))	−0.02 *4*	0.000636 *9*	α(K)=1.344×10^{-5} *20*; α(L)=1.173×10^{-6} *18*; α(M)=1.454×10^{-7} *22* α(N)=8.19×10^{-9} *12*; α(IPF)=0.000621 *9* Mult.: D(+Q) from γ(θ) in (p,nγ); Δπ=yes from level scheme. Same for 1851.1γ and 1972.5γ.
2190.44	3$^+$	1567.7 *3*	28.2 *13*	622.61	3$^+$	M1+E2	+0.09 *4*	0.0001203 *17*	α(K)=3.13×10^{-5} *4*; α(L)=2.74×10^{-6} *4*; α(M)=3.40×10^{-7} *5* α(N)=1.912×10^{-8} *27*; α(IPF)=8.59×10^{-5} *12* I_γ: from (p,nγ). Other: 28 *12* from (μ^-,γ).
		1938.1 *3*	100.0 *13*	252.33	4$^+$	M1(+E2)	+0.01 *1*	0.0002477 *35*	α(K)=2.166×10^{-5} *30*; α(L)=1.893×10^{-6} *27*; α(M)=2.348×10^{-7} *33* α(N)=1.323×10^{-8} *19*; α(IPF)=0.0002239 *31* I_γ: from (p,nγ). Other: 100 *33* from (μ^-,γ).
2275.51	2$^+$	1132.8 *3*	100.0 *14*	1142.66	2$^+$	M1+E2	+0.03 *2*	6.39×10^{-5} *9*	α(K)=5.67×10^{-5} *8*; α(L)=4.97×10^{-6} *7*;

Adopted Levels, Gammas (continued)

γ(^{48}Sc) (continued)

E_i(level)	J_i^π	E_γ[‡]	I_γ[‡]	E_f	J_f^π	Mult.[#]	α[†]	Comments
								α(M)=6.16×10^{-7} *9* α(N)=3.47×10^{-8} *5*; α(IPF)=1.560×10^{-6} *25* I_γ: from (p,nγ). Other: 100 *40* from (μ^-,γ).
2275.51	2$^+$	1652.9 *3*	42.9 *14*	622.61	3$^+$	M1+E2	0.000167 *21*	α(K)=3.02×10^{-5} *18*; α(L)=2.65×10^{-6} *16*; α(M)=3.28×10^{-7} *20* α(N)=1.85×10^{-8} *11*; α(IPF)=0.000133 *19* I_γ: from (p,nγ). Other: 43 *18* from (μ^-,γ). δ: −0.03 *2* or +7.7 *12*.
2310?		2062[@]	100	252.33	4$^+$			
2390.7	3,4	1767.8 *8*	100 *6*	622.61	3$^+$	D+Q		δ: −0.0 *2* or −1.6 *6* if J=3 or +0.06 *2* or −4 *+1−2* if J=4.
		2138.5 *8*	89 *4*	252.33	4$^+$	D+Q		δ: +0.06 *7* or −6 *+3−2* if J=3 or −0.35 *10* if J=4.
2517.4	1$^+$	1374.7 *3*	100	1142.66	2$^+$	M1(+E2)	8.8×10^{-5} *11*	α(K)=4.3×10^{-5} *4*; α(L)=3.77×10^{-6} *32*; α(M)=4.7×10^{-7} *4* α(N)=2.63×10^{-8} *22*; α(IPF)=4.1×10^{-5} *7* δ: −0.06 *20* or +4.3 *+51−70*.
2560.2	(3)$^-$	1417.5 *6*	100 *9*	1142.66	2$^+$			
		2307.9 *8*	72 *10*	252.33	4$^+$	(E1+M2)	0.000854 *13*	α(K)=1.088×10^{-5} *21*; α(L)=9.49×10^{-7} *19*; α(M)=1.177×10^{-7} *23* α(N)=6.63×10^{-9} *13*; α(IPF)=0.000842 *13* Mult.: D+Q from γ(θ) in (p,nγ); Δπ=yes from level scheme. δ: 0.00 *4* or +8 *2* if J=3 or +0.74 *10* or −6.0 *20* if J=4. The smaller δ values are favored but the larger ones can′t be completely ruled out by RUL.
2619.5	(4,5)	2367.2 *8*	79 *4*	252.33	4$^+$			
		2488.5 *8*	100 *4*	130.93	5$^+$			
2640.2	1,2$^-$	1238.4 *3*	100	1401.77	2$^-$	D+Q		δ: +0.36 *2* or −14 *3* if J^π=2$^-$, −0.05≤δ<+0.2 if J^π=1$^-$, or −0.27≤δ<+∞ if J^π=1$^+$.
2670.4	1$^-$,2$^-$	1268.5 *3*	100	1401.77	2$^-$	M1+E2	7.4×10^{-5} *9*	α(K)=5.1×10^{-5} *5*; α(L)=4.4×10^{-6} *4*; α(M)=5.5×10^{-7} *5* α(N)=3.09×10^{-8} *29*; α(IPF)=1.86×10^{-5} *34* δ: −0.50 *10* or −5.5 *+20−30* if J=1 or +14 *2* if J=2.
2729.0	(4$^+$,5$^+$)	2476.6 *8*	100	252.33	4$^+$			
2783.3	2$^+$	892.0 *5*	100.0 *17*	1891.10	3$^-$			I_γ: from (p,nγ). Other: 100 *34* from (μ^-,γ).
		1381.9 *5*	58 *4*	1401.77	2$^-$			I_γ: from (p,nγ). Other: 59 *25* from (μ^-,γ).
		2160.4 *8*	13 *6*	622.61	3$^+$			I_γ: weighted average of 12 *7* from (p,nγ) and 14 *6* from (μ^-,γ).
2811.3	1,2,3	1409.4 *3*	100	1401.77	2$^-$	D+Q		δ: −0.45 *10* if J=1, +0.47 *2* or −15 *5* if J=2, or −0.09 *1* if J=3.
2891.3	2$^-$	1748.7 *5*	100 *4*	1142.66	2$^+$	(E1+M2)	0.000471 *7*	α(K)=1.64×10^{-5} *4*; α(L)=1.430×10^{-6} *32*; α(M)=1.77×10^{-7} *4* α(N)=9.98×10^{-9} *23*; α(IPF)=0.000453 *7* Mult.,δ: D+Q with δ=+0.04 *12* or −2.5 *1* from γ(θ) in (p,nγ); Δπ=yes from level scheme. The smaller δ is favored but the larger one can′t be completely ruled out by RUL.
		2268.6 *5*	82 *4*	622.61	3$^+$	(E1+M2)	0.000829 *13*	α(K)=1.114×10^{-5} *22*; α(L)=9.73×10^{-7} *19*; α(M)=1.206×10^{-7} *24* α(N)=6.79×10^{-9} *14*; α(IPF)=0.000817 *13* Mult.,δ: D+Q with δ=−0.03 *6* or +7 *+4−2* from γ(θ) in (p,nγ);

Adopted Levels, Gammas (continued)

γ(^{48}Sc) (continued)

E_i(level)	J_i^π	E_γ[‡]	I_γ[‡]	E_f	J_f^π	Mult.[#]	δ[#]	α[†]	Comments
									Δπ=yes from level scheme. The smaller δ is favored but the larger one can't be completely ruled out by RUL.
2924.0	(3)	2301.2 *6*	100.0 *16*	622.61	3^+	D+Q			δ: +0.38 *5* or +1.7 *2* if J=2 or +0.20 *4* if J=3 from γ(θ) and linear polarization in (p,nγ).
		2671.8 *8*	58.7 *16*	252.33	4^+	D+Q	−0.17 *2*		
2980.8	1^+	1838.3 *3*	100	1142.66	2^+	D+Q			δ: +0.34 *8* or +1.5 *3*.
3026.3	(2,3)	835.6 *5*	100 *7*	2190.44	3^+				I_γ: from (p,nγ). Other: 100 *18* from (μ^-,γ).
		1624.4 *5*	17 *4*	1401.77	2^-				I_γ: from (p,nγ). Other: 16 *6* from (μ^-,γ).
		1883.8 *6*	22 *4*	1142.66	2^+				I_γ: from (p,nγ). Other: 23 *7* from (μ^-,γ).
		2403.7 *6*	78 *4*	622.61	3^+				I_γ: from (p,nγ). Other: 77 *23* from (μ^-,γ).
3056.6	1^+	1913.9 *3*	100	1142.66	2^+	(M1+E2)		0.000268 *30*	α(K)=2.32×10^{-5} *11*; α(L)=2.02×10^{-6} *10*; α(M)=2.51×10^{-7} *12* α(N)=1.41×10^{-8} *7*; α(IPF)=0.000243 *29* Mult.: D+Q from γ(θ) in (p,nγ); Δπ=no from level scheme. δ: +0.15 *+2−1* or +2 *1*.
3150.0	1^+	2007.3 *3*	100	1142.66	2^+	(M1+E2)		0.000308 *34*	α(K)=2.13×10^{-5} *9*; α(L)=1.86×10^{-6} *8*; α(M)=2.31×10^{-7} *10* α(N)=1.30×10^{-8} *6*; α(IPF)=0.000285 *33* Mult.: D+Q from γ(θ) in (p,nγ); Δπ=no from level scheme. δ: +0.08≤δ<2.6 *1*.
3216.2	(0,1,2,3$^+$)	698.8 *5*	100	2517.4	1^+				
3295.7	(0$^+$ to 4$^+$)	2153.0 *5*	100	1142.66	2^+				
3302.0	(0 to 3$^+$)	245.4 *4*	47 *4*	3056.6	1^+				
		321.4 *4*	57 *4*	2980.8	1^+				
		490.5 *6*		2811.3	1,2,3				
		631.4 *4*	100 *4*	2670.4	1^-,2^-				
3327.8	(4$^-$)	2185.1 *6*	63 *6*	1142.66	2^+				
		2705.5 *8*	100 *6*	622.61	3^+				
		3075.2 *8*	80 *6*	252.33	4^+				
		3196.4 *8*	43 *3*	130.93	5^+				
6677.6	0^+	4160 *2*		2517.4	1^+				

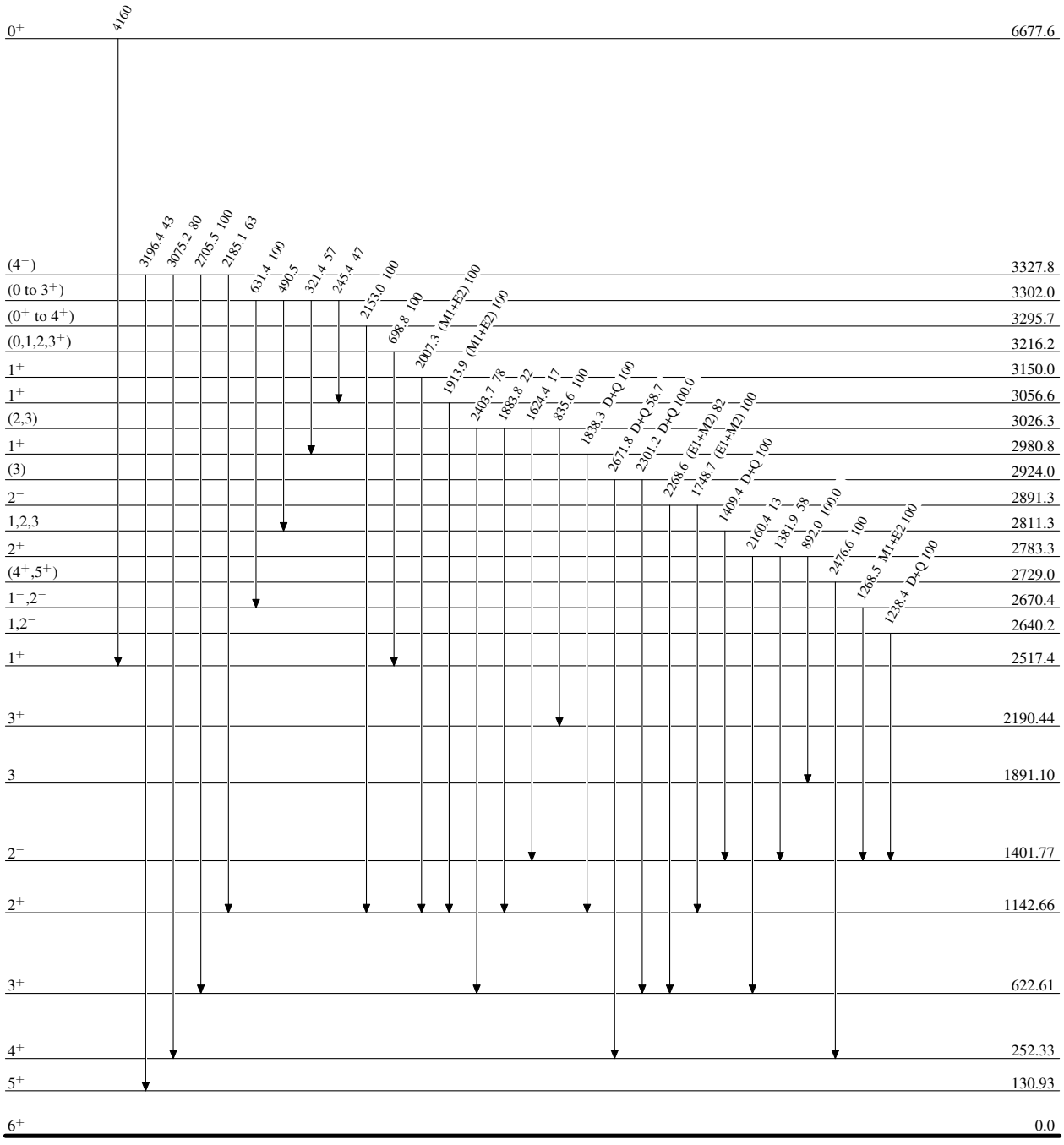
† Additional information 1.
‡ From (p,nγ), unless otherwise noted.
# From γ(θ,pol) in (p,nγ), except as noted.
@ Placement of transition in the level scheme is uncertain.

$^{48}_{21}Sc_{27}$-10

Adopted Levels, Gammas

Level Scheme

Intensities: Relative photon branching from each level



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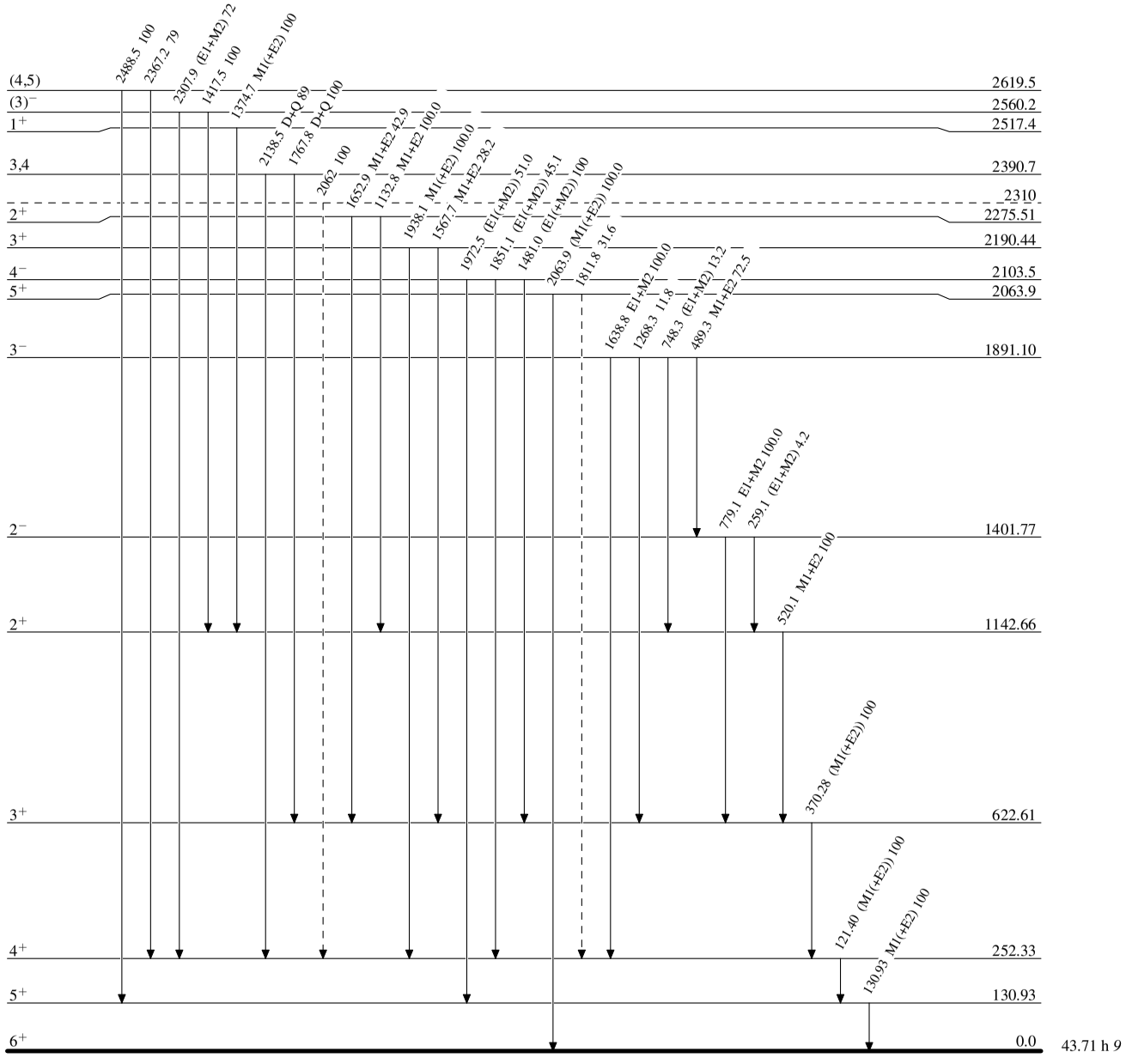
Adopted Levels, Gammas

Legend

Level Scheme (continued)

Intensities: Relative photon branching from each level

γ Decay (Uncertain)



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