Adopted Levels, Gammas 2004Ti06

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	J. H. Kelley, C. G. Sheu, J. L. Godwin, et al.	NP A745 155 (2004)	31-Mar-2004

Q(β^-)=−1068.0 *9*; S(n)=1664.54 *8*; S(p)=16886.32 *9*; Q(α)=−2308 *20* 2012Wa38
Note: Current evaluation has used the following Q record −1068.1 11 *1665.4 4* 16888.2 *4* −2467 *50* 2003Au03.
See other reaction references in (1988Aj01).
For states belonging to E1 and E2 giant resonances see footnote j in Table 9.8 of (1984Aj01).

^{9}Be Levels

Cross Reference (XREF) Flags

A	^{9}Li β^- decay	K	^{9}Be(γ,p),(γ,d),(γ,t)	U	^{10}B(e,e′p)
B	^{6}Li(t,n),(t,p)	L	^{9}Be(e,e),(e,e′),(e,en),(e,ep)	V	^{10}B(d,^{3}He)
C	^{7}Li(d,γ)	M	^{9}Be(π^+,π^+),^{9}Be(π^-,π^-)	W	^{10}B(t,α)
D	^{7}Li(d,p)	N	^{9}Be(n,n′),^{9}Be(n,2n)	X	^{11}B(p,^{3}He)
E	^{7}Li(^{3}He,p),(^{3}He,pγ)	O	^{9}Be(p,p),(p,p′)	Y	^{11}B(d,α),^{11}B(d,αn)
F	^{7}Li(^{3}He,pn)	P	^{9}Be(d,d),(d,d′)	Z	^{12}C(n,α),^{12}C(n,nα)
G	^{7}Li(α,d)	Q	^{9}Be(^{3}He,^{3}He′),^{9}Be(^{3}He,2α)	Others:	
H	^{7}Li(^{6}Li,α)	R	^{9}Be(α,α′),^{9}Be(α,2α)	AA	^{13}C(^{3}He,^{7}Be)
I	^{9}Be(γ,γ′)	S	^{9}Be(^{6}Li,^{6}Li′),^{9}Be(^{7}Li,^{7}Li′)		
J	^{9}Be(γ,n),(γ,α),(γ,2α)	T	^{10}Be(d,t)		

E(level)	J$^{\pi}$	T$_{1/2}$	XREF	Comments
0.0	3/2$^-$	stable	A C E GHI LMNOPQRSTUVWXYZ	XREF: Others: AA T=1/2; μ=−1.1778 *9*; Q=+0.05288 *38*
1684 *20*	1/2$^+$	214 keV *5*	C E GH J L NOPQR T W YZ	%IT=1.4×10^{-6}; %n≈100 E(level): there are 13 reported values for the first excited state energy. The values range from 1600 keV to 1830 keV, and uncertainties are cited with ≈10-30 keV accuracy. The neutron threshold affects the observed values. (1988Aj01,2004Ti06) accepted 1684 keV *7* from ^{9}Be(e,e′) (1987Ku05). The evaluator accepts this value, but has increased the uncertainty. Other values are given in ^{7}Li(^{3}He,p), ^{9}Be(γ,n), ^{9}Be(e,e′), ^{9}Be(p,p′), ^{10}B(t,α) and ^{11}B(d,αn). Γ: From weighted average of 217 keV *10* from ^{9}Be(e,e′), 220 keV *8* from ^{10}B(t,α), 224 keV *25* from ^{10}B(d,α), and 200 keV *10* from ^{10}B(d,α). Other values not included in the weighted average are 150 keV *50* from ^{9}Be(p,p′) and 165 keV *25* from ^{10}Be(d,t). Γ$_{\gamma}$=0.30 eV *12* (1987Ku05).
2429.4 *13*	5/2$^-$	0.78 keV *13*	A C EFGH J LMNOPQRSTUVWXYZ	XREF: Others: AA %IT=1.2×10^{-4}; %n>7.0 *10*; %α>1 %n to ^{8}Be g.s.=7.0 *10* ^{7}Li(^{3}He,pn) (1966Ch20). E(level): from weighted average of 2429.2 keV *17* from ^{7}Li(^{3}He,p), 2433 keV *5* from ^{9}Be(p,p′), 2434 keV *5* from ^{9}Be(p,p′), 2432 keV *4* from ^{9}Be(p,p′), 2430 keV *5* from ^{9}Be(p,p′), 2422 keV *5* from ^{11}B(d,α), 2431 keV *6* from ^{11}B(d,α), 2424 keV *5* from ^{11}B(d,α). Γ: From ^{11}B(d,α) and ^{9}Be(e,e′). The value Γ$_{\gamma}$/Γ=1.16×10^{-4} *14* is determined from ^{11}B(d,a γ);

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Adopted Levels, Gammas 2004Ti06 (continued)

^{9}Be Levels (continued)

E(level)	J^{π}	$T_{1/2}$	XREF	Comments
				this can Be used with Γ_{γ}=9.1×10^{-2} eV *10* from ^{9}Be(e,e′) (1968Cl08) to deduce the Γ. %n to ^{8}Be g.s.=7.0 *10* ^{7}Li(^{3}He,pn) (1966Ch20).
2.78×10^{3} *12*	1/2^{-}	1.10 MeV *12*	A C E O	XREF: Others: AA %n≈100 %n decay mainly to ^{8}Be g.s. From ^{9}Li β-decay (1970Ch07). E(level): Γ: from ^{9}Li β-decay (1970Ch07). Other values from ^{7}Li(^{3}He,p) are E_x=2900 keV *250* and Γ=1.00 MeV *25* (1971Ad01).
3049 *9*	5/2^{+}	282 keV *11*	EF H J L NOPQR T WXYZ	%IT=1×10^{-6}; %n>87 %n to ^{8}Be g.s.=87 *13* from ^{7}Li(^{3}He,pn) (1966Ch20,1968Co08). E(level): from weighted average of 3031 keV *10* from ^{7}Li(^{3}He,p), 3076 keV *15* from ^{7}Li(^{3}He,p), 3040 keV *10* from ^{9}Be(γ,n), 3000 keV *30* from ^{9}Be(γ,n), 3077 keV *9* from ^{9}Be(γ,n), 3040 keV *15* from ^{9}Be(p,p′), 3040 keV *15* from ^{9}Be(d,d′), 3020 keV *30* from ^{9}Be(α,α′), 3020 keV *30* from ^{11}B(d,α) and 3050 keV *30* from ^{11}B(d,α). The uncertainty is enlarged by the evaluator. It appears that the value given in (1979Aj01) is based on three values, 3076 keV *15*, 3040 keV *10* and 3040 keV *15*. Γ: From weighted average of 289 keV *22* from ^{7}Li(^{3}He,p), 294 keV *20* from ^{9}Be(d,d), 280 keV *25* from and ^{10}Be(d,t) and 257 keV *25* from ^{11}B(d,α). The value 549 keV *12* was measured in ^{9}Be(γ,n), but is excluded from the weighted average. Other values that have no significance in the weight are given in ^{9}Be(e,e′), ^{9}Be(p,p), ^{9}Be(α,α) and ^{10}B(t,α).
4704 *25*	(3/2)$^{+}$	743 keV *55*	C EF J L OPQR Y	XREF: Others: AA %IT>1.6×10^{-6}; %n<100 %n to ^{8}Be g.s.=13 *4* from ^{7}Li(^{3}He,pn) (1968Co08). E(level): Γ: from (1968Kr02) in ^{7}Li(^{3}He,p). Other values from ^{7}Li(^{3}He,p) (1968Co07) E_x=4.57 MeV *10* and Γ=0.8 MeV *2*.
5.59×10^{3} † *10*	(3/2^{-})	1.33 MeV *36*	O U	E(level): Γ: J^{π}: from ^{9}Be(p,p′) (1991Di03); also see ^{10}B(e,e′p) where E_x=5.72 MeV *25* is reported.
6380 *60*	7/2^{-}	1.21 MeV *23*	EF H JK MNOPQRS UV Z	%IT>6.8×10^{-8}; %n<100 %n to ^{8}Be g.s. ≤2; to ^{8}Be*(3010)=55 *14*. Prior to (2004Ti06) only one broad level had been confirmed for ^{9}Be in the energy range between 6 and 7 MeV. New measurements, have confirmed the existence of a second level. As a result, the broad J^{π}=7/2^{-} level that had previously been placed at 6.76 MeV has been relocated at 6.42 MeV. The newly identified

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Adopted Levels, Gammas 2004Ti06 (continued)

^{9}Be Levels (continued)

E(level)	J^{π}	$T_{1/2}$	XREF	Comments
				level, a J^{π}=9/2^{+}, has been placed at 6.76 MeV. Both levels are broad, greater than Γ=1.2 MeV, and the evaluator has made a best estimate for determining the xref assignments. The xref assignments are ambiguous because in many cases authors simply refer to the (at that time only) known broad state near 6.8 MeV. E(level): from ^{9}Be(p,p′) (1991Di03). Also see of 7/2^{-} states reported at 6.40 MeV *10* in ^{9}Be(e,e′), and 6.67 MeV *14* reported in ^{10}Be(e,e′p). Γ: From ^{9}Be(p,p′) (1991Di03).
6760 *60*	9/2^{+}	1.33 MeV *9*	EF JK O	%IT>0; %n<100 E(level): Γ: J^{π}: from ^{9}Be(p,p′) (1991Di03). Also see comment for 9be*(6380).
7940[†] *80*	(5/2^{-})	≈1000 keV	A O U	E(level): Γ: from ^{9}Be(p,p′) (1965Ha17). Also see ^{10}Be(e,e′p) where E_x=7.81 MeV *18* is reported. J^{π}=(5/2^{-}) from ^{10}Be(e,e′p). Also see supporting information in (1993Ch06) discussion on β-decay; this level had previously been assigned J^{π}=(1/2^{-}) based on branching ratios observed in β-decay see (1988Aj01) Table 9.7.
11282 *22*	(7/2^{-})	575 keV *50*	A EF J L O R UVW	%n>15 %n to ^{8}Be g.s.=2≤; to ^{8}Be*(3010)=14 *4*. E(level): from weighted average of 11290 keV *30* from ^{7}Li(^{3}He,p), 11280 keV *50* from ^{9}Be(p,p) and 11270 keV *40* from ^{10}B(t,α). Other values in the literature are 11.3 MeV *2* from ^{9}Be(γ,n), and 11170 keV *30* from ^{10}B(e,e′p). The later was excluded from the weighted average. Γ: From weighted average of 620 keV *70* from ^{7}Li(^{3}He,p) and 530 keV *70* from ^{10}B(t,α). J^{π}: from ^{10}Be(e,e′p). Also see ^{9}Be(e,e′) and ^{9}Be(p,p′) where (7/2^{+}) was suggested.
11810 *20*	5/2^{-}	400 keV *30*	A F H J X	XREF: Others: AA %IT>0; %n<100 T=1/2 %n to ^{8}Be g.s.=3≤; to ^{8}Be*(3010)=12 *4*. E(level): Γ: from ^{7}Li(^{3}He,p) (1968Co07). Other values in the literature are E_x=11.9 MeV *2* and Γ=0.5 MeV *1* from ^{7}Li(^{6}Li,α). J^{π}: from ^{9}Li β-decay (2003Pr11). Also see ^{11}B(p,^{3}He) where (3/2^{-}) was suggested.
13790 *30*	(5/2^{-},7/2^{-})	590 keV *60*	E H L O X	%IT>0; %n<100 T=1/2 E(level): from weighted average of 13780 keV *30* from ^{7}Li(^{3}He,p) and 13840 keV *50* from ^{9}Be(e,e′). Γ: From ^{7}Li(^{3}He,p).

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Adopted Levels, Gammas 2004Ti06 (continued)

^{9}Be Levels (continued)

E(level)	J^π	$T_{1/2}$	XREF	Comments
				J^π: from ^{9}Be(p,p′) (1991Di03). Also see ^{11}B(p,^{3}He) where (3/2$^-$) was suggested.
14392.2 *18*	3/2$^-$	365 eV *29*	E I L O Q WX	%IT=4.4; %α=43; %n=52.6 T=3/2; $\Gamma_{\gamma0}$=6.6 eV *4* E(level): from ^{11}B(p,^{3}He); see comments in ^{11}B(p,^{3}He). Other values are given as 14396 keV *5* from ^{7}Li(^{3}He,p), 14388 keV *15* from ^{9}Be(e,e′). Γ: Deduced from the values $\Gamma_{\gamma0}$=6.6 eV *4* (see discussion in ^{9}Be(γ,γ)) and $\Gamma_{\gamma0}/\Gamma$=0.0181 *9* from ^{7}Li(^{3}He,p γ) (1978Di08). (1976Mc10) measured the branching ratios $\Gamma_{n\ 0}/\Gamma$=0.028 *21* and $\Gamma_{n\ 1}/\Gamma$=0.50 *11*; these can Be used with Γ=365 eV *29* to deduce Γ_n=192 eV *43*. Γα: Using Γ=365 eV *29*, Γ_γ=16.1 eV *14* and Γ_n=192 eV *43* we can deduce Γα=156 eV *43*.
14.48×10^3† *9*	(5/2$^-$)	≈800 keV	U W	E(level): from ^{10}B(e,e′p). Other value 14.4 MeV *3* ^{9}Be(p,p′). Γ: From ^{10}B(t,α). Other value ≈1.0 MeV ^{9}Be(p,p′). J^π: from ^{10}B(e,e′p).
15100† *50*			H L O X	%IT>0 E(level): from ^{9}Be(e,e′). Γ: From ^{9}Be(p,p′).
15970† *30*		≈300 keV	L O X	%IT>0 T=1/2 E(level): Γ: from ^{9}Be(e,e′). Also see ^{11}B(p,^{3}He) (1971Ha10) who report 15960 keV *40*.
16671† *8*	(5/2$^+$)	41 keV *4*	E L O W	%IT>0 E(level): Γ: from ^{7}Li(^{3}He,p). Other value E_x=16631 keV *15* from ^{9}Be(e,e′).
16977.1 *5*	1/2$^-$	389 eV *10*	CD I L O	%IT=6.1; %n<74; %p≈3.1; %d=15.9; %α<62 T=3/2 E(level): from ^{7}Li(d,γ) E_{res}=360.8 keV *3* and the (2003Au03) mass excess tables. Γ: From ^{9}Be(γ,X) resonance absorption following (1992Ki05). Other values 490 keV *50* (1987Zi01) and 303 keV *30* (1986Be33); see discussion in (1992Ki05). Γ_γ: =23.8 eV *16* see comments in ^{7}Li(d,γ). γ-ray branching ratios are measured in (1971Sc19). Γ_p: =12 eV *+12−6* from (1992Ki05). Other value, using $\Gamma_p/\Gamma_{\gamma0}$≈0.5 (1965Im01) gives Γ_p≈12. Γ_d: =62 eV *10* from (1992Ki05) and (1986Be33) using ω-γ=ω Γ_γ widthd/Γ. Γ_{n0}: ≈36 eV from (1965Im01) using $\Gamma_{n0}/\Gamma_\gamma$≈1.5. Γ_n: Γα: since Γ=389 eV *10*, we can

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Adopted Levels, Gammas 2004Ti06 (continued)

^{9}Be Levels (continued)

E(level)	J^{π}	$T_{1/2}$	XREF	Comments
				subtract the known partial widths and obtain $\Gamma\alpha+\Gamma_n$=290 eV *20*. Then Γ_n<290 eV and $\Gamma\alpha$<255 eV.
17300 *5*	(5/2)$^-$	195 keV	D J L O	%IT>4.6×10^{-5}; %n<100; %p>0; %d>0; %α>0 E(level): from ^{7}Li(d,p) E_{res}=775 keV *6* and the (2003Au03) mass excess tables. Γ: From ^{7}Li(d,p).
17495 *5*	(7/2)$^+$	47 keV	D L O U	%IT>1.7×10^{-5}; %n<100; %p>0; %d>0; %α>0 E(level): from ^{7}Li(d,p) E_{res}=1026 keV *6* and the (2003Au03) mass excess tables. Also see ^{9}Be(e,e′) E_x=17480 keV *20*. Γ: From ^{7}Li(d,p).
18020† *50*			L	%IT>0 E(level): from ^{9}Be(e,e′).
18580 *40*			D L	%IT>0; %n<100; %p>0; %d>0; %α>0 E(level): from average of 18540 keV *50* from ^{7}Li(d,p) and 18620 keV *50* from ^{9}Be(e,e′).
18.65×10^3? *5*	(5/2$^-$)	0.3 MeV *1*	O	%p≤100 T=(3/2). E(level): Γ: from ^{9}Be(p,p′). Also see (1985Pn01) who report on the decay of the ^{9}Li hypernucleus to π^- + 9be*(18.1 MeV *1*) Γ≤300 keV. They report the state as J^{π}=5/2$^-$, T=3/2 and indicate α decay into ^{8}Li+p.
19200 *50*		310 keV *80*	D H J	%n<100; %p>0; %d>0; %^{3}H>0 E(level): Γ: from ^{7}Li(d,p).
19465† *45*	(9/2$^+$)	0.6 MeV *3*	J L O	%IT>0 E(level): from weighted average of 19510 keV *50* from ^{9}Be(e,e′) and 19420 keV *50* from ^{9}Be(p,p′). Uncertainty is enlarged by evaluator. Γ: From ^{9}Be(p,p′).
19.9×10^3? *2*			J	%IT>0; %n≤100 E(level): from ^{9}Be(γ,n) (1975Kn03).
20510? *30*		0.6 MeV *1*	B D J O	%IT>0; %p<100; %d>0 E(level): from (1964Te04) ^{9}Be(γ,absorption) 20.47 MeV *4* and ^{9}Be(p,p′). The authors of (1964Te04) used (Haslam et al., Can. J. Phys. 31 (1953) 210) to deduce that the decay mode is primarily proton decay, with some small contribution from d- and/or triton-decay. Γ: From ^{9}Be(p,p′).
20750 *30*		0.68 MeV *9*	J L O	%IT>0; %n<100; %p>0; %^{3}H>0 E(level): from weighted average of 20730 keV *40* from (1964Te04) ^{9}Be(γ,absorption), 20760 keV *50* from ^{9}Be(e,e′) and 20800 keV *100* from ^{9}Be(p,p′). Γ: From ^{9}Be(p,p′).
21.4×10^3? *2*			J	%IT>0; %n<100 E(level): from ^{9}Be(γ,n) (1975Kn03).
22.4×10^3? *2*			J O	%IT>0; %n<100 Γ: Broad. E(level): from ^{9}Be(γ,n) (1975Kn03).
23.8×10^3? *2*			J	%IT>0; %n<100

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Adopted Levels, Gammas 2004Ti06 (continued)

^{9}Be Levels (continued)

E(level)	XREF	Comments
27.0×10^{3} *5*	J	E(level): from ^{9}Be(γ,n) (1975Kn03). %IT>0; %n<100 Γ: Broad. E(level): from ^{9}Be(γ,n) (1975Kn03).

† Decay mode not specified.

γ(^{9}Be)

See Tables 9.3, 9.4, 9.5, 9.9 and 9.10 in (2004Ti06). See also Montgomery et al. Can. J. Phys. 62 (1984) 764.

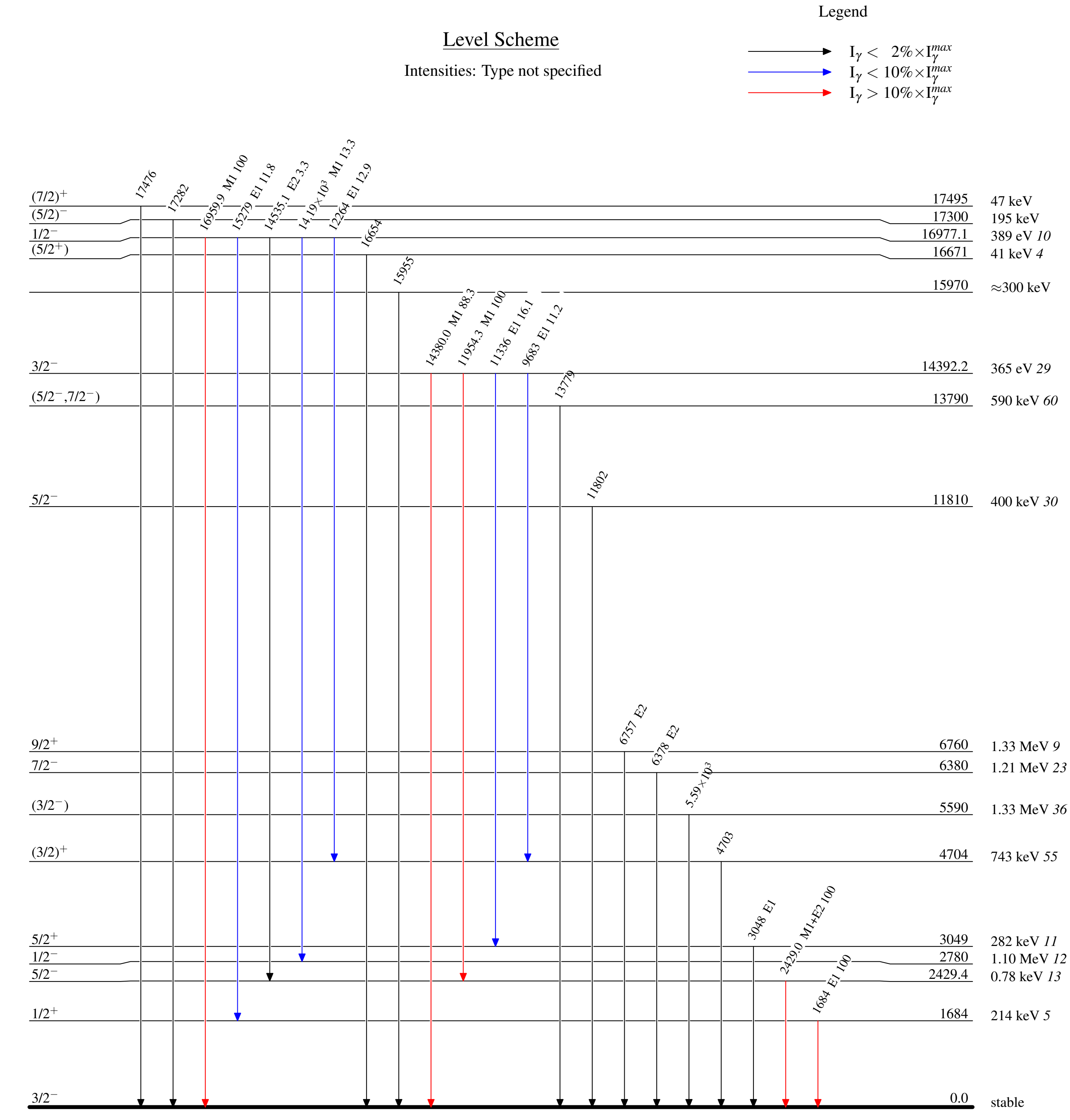
E_i(level)	J^π_i	E_γ†	I_γ	E_f	J^π_f	Mult.	Comments
1684	1/2$^+$	1684 *20*	100	0.0	3/2$^-$	E1	Γ_γ=0.30 eV *12*; B(E1)(W.u.)=0.21 *9*
2429.4	5/2$^-$	2429.0 *13*	100	0.0	3/2$^-$	M1+E2	Γ_γ=9.1×10^{-2} eV *10*; B(M1)(W.u.)=0.30 *3*; B(E2)(W.u.)=24.4 *18*
3049	5/2$^+$	3048 *9*		0.0	3/2$^-$	E1	Γ_γ=0.30 eV *25*; B(E1)(W.u.)=3.6×10^{-2} *30*
4704	(3/2)$^+$	4703 *25*		0.0	3/2$^-$		Γ_γ: $(2J_f+1)/(2J_I+1)\Gamma_{\gamma0}$=2.4 eV *12*.
5.59×10^{3}	(3/2$^-$)	5.59×10^{3} *10*		0.0	3/2$^-$		
6380	7/2$^-$	6378 *60*		0.0	3/2$^-$	E2	Γ_γ=8.2×10^{-2} eV *35*; B(E2)(W.u.)=8.5 *36*
6760	9/2$^+$	6757 *60*		0.0	3/2$^-$	E2	
11810	5/2$^-$	11802 *20*		0.0	3/2$^-$		
13790	(5/2$^-$,7/2$^-$)	13779 *30*		0.0	3/2$^-$		
14392.2	3/2$^-$	9683 *25*	11.2 *24*	4704	(3/2)$^+$	E1	Γ_γ=0.84 eV *19*; B(E1)(W.u.)=3.1×10^{-3} *7*
		11336 *9*	16.1 *34*	3049	5/2$^+$	E1	Γ_γ=1.20 eV *27*; B(E1)(W.u.)=2.8×10^{-3} *6*
		11954.3 *22*	100 *5*	2429.4	5/2$^-$	M1	Γ_γ=7.48 eV *7*; B(M1)(W.u.)=0.208 *20*
		14380.0 *18*	88.3 *44*	0.0	3/2$^-$	M1	Γ_γ=6.6 eV *4*; B(M1)(W.u.)=0.106 *6*
15970		15955 *30*		0.0	3/2$^-$		
16671	(5/2$^+$)	16654 *8*		0.0	3/2$^-$		
16977.1	1/2$^-$	12264 *25*	12.9 *13*	4704	(3/2)$^+$	E1	Γ_γ=2.2 eV *3*; B(E1)(W.u.)=4.0×10^{-3} *6*
		14.19×10^{3} *12*	13.3 *42*	2.78×10^{3}	1/2$^-$	M1	Γ_γ=2.2 eV *7*; B(M1)(W.u.)=3.7×10^{-2} *11*
		14535.1 *14*	3.3 *7*	2429.4	5/2$^-$	E2	Γ_γ=0.56 eV *12*; B(E2)(W.u.)=0.94 *21*
		15279 *20*	11.8 *6*	1684	1/2$^+$	E1	Γ_γ=1.99 eV *15*; B(E1)(W.u.)=1.9×10^{-3} *2*
		16959.9 *5*	100 *6*	0.0	3/2$^-$	M1	Γ_γ=16.9 eV *10*; B(M1)(W.u.)=0.165 *10*
17300	(5/2)$^-$	17282 *5*		0.0	3/2$^-$		$(2J_f+1)/(2J_I+1)\Gamma_{\gamma0}$=7.3 eV *13* (1973Be19).
17495	(7/2)$^+$	17476 *5*		0.0	3/2$^-$		$(2J_f+1)/(2J_I+1)\Gamma_{\gamma0}$=0.40 eV *3* (1973Be19).

† From level energy difference; recoil correction applied.

Adopted Levels, Gammas 2004Ti06

Level Scheme

Intensities: Type not specified



$^{9}_{4}Be_{5}$