Adopted Levels, Gammas

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	J. H. Kelley, C. G. Sheu and J. E. Purcell	NDS 198,1 (2024)	1-Aug-2024

Q(β^-)=13436.9 *10*; S(n)=4878.8 *17*; S(p)=15804.8 *22*; Q(α)=−10817.9 *10* 2021Wa16
S_{2n}=8248.4 *17*; S_{2p}=38744 *1*; Q(β-n)=8490.6 *10* (2021Wa16).

General theory:
1973Sa25, 1973Sa30, 1974Ch46, 1981Av02, 1981Se06, 1983Va08, 1984Va06, 1990Wo10, 1991Po11, 1994Ho21, 1995Ka23, 1997Ba54, 1997Re07, 1999Gu14, 1999Kn04, 1999Ta09, 2001Ka66, 2001Ta04, 2003Is17, 2003Jh01, 2003Sm02, 2003Su04, 2004Um01, 2005Ar12, 2007Gu03, 2008Ka24, 2008Ka36, 2008Sh16, 2011Al11, 2011SuZU, 2012Yu07, 2013Ma60, 2014Me02, 2015Fo06, 2015Ka02, 2015Sh21, 2020Ch40, 2021Ca23, 2021Ma32, 2022Mo36, 2023Me02.

Calculations related to dipole and quadrupole moments:
1972Gu05, 1984Ku07, 1984Va06, 1988Va03, 1991Bo02, 1998Hu08, 1999Ki27, 1999Ki28, 2001Sa24, 2002Sa12, 2003Is17, 2003Jh01, 2003Sm02, 2003Su04, 2003Su28, 2003Um02, 2014Ra17, 2021Ca23.

Mirror nuclear decay and fundamental symmetry effect studies:
1970Wi02, 1971Bl12, 1973Sa25, 1973Wi11, 1977Az02, 1977Ri08, 1993Ch06, 1999Ba21, 2023Se01.

Other relevant results:
1973Sa25: General review of the A=13 isobars and discussion on the isobaric multiplet mass equation. See also (1983An15).
2010Ma44: Measured G-parity conservation via correlations of nuclear spins and β-ray angular distribution. Found $\alpha_-(^{13}B)$=+0.05% *2* MeV^{-1} and g_{II}/g_a=−0.8 *5*.

^{13}B Levels

Cross Reference (XREF) Flags

A	^{14}Be β^-n decay	P	^{12}C(^{9}Be,^{8}B)	AD	^{14}C(γ,p)
B	^{1}H(^{12}Be,^{13}Be)	Q	^{12}C(^{12}Be,^{13}B)	AE	^{14}C(d,^{3}He)
C	^{1}H(^{13}B,X)	R	^{12}C(^{13}C,^{12}N)	AF	^{14}C(t,^{4}He)
D	^{2}H(^{12}B,p)	S	^{12}C(^{14}C,^{13}N)	AG	^{14}C(^{11}B,^{12}C)
E	^{2}H(^{13}B,^{13}B)	T	^{12}C(^{15}N,^{14}O)	AH	^{15}N(p,3p)
F	^{2}H(^{15}C,α)	U	^{12}C(^{16}O,^{13}B),(^{18}O,^{13}B)	AI	^{16}O(^{14}C,^{17}F)
G	^{4}He(^{9}Li,α)	V	^{13}C(γ,π^+)	AJ	^{48}Ca(^{11}B,^{13}B)
H	^{4}He(^{12}Be,^{13}Bγ)	W	^{13}C(μ^-,ν)	AK	^{136}Xe(p,^{13}B)
I	^{7}Li(^{7}Li,p),^{7}Li(^{7}Li,pγ)	X	^{13}C(π^-,γ)	AL	^{181}Ta(^{22}Ne,^{13}B),(^{20}Ne,^{13}B)
J	^{9}Be(^{13}B,X)	Y	^{13}C(π^-,π^0)	AM	^{197}Au(^{15}N,^{13}B)
K	^{9}Be(^{14}B,^{13}Bγ),^{197}Au(^{14}B,^{13}Bγ)	Z	^{13}C(n,p)	AN	^{208}Pb(^{13}B,^{13}B)
L	^{9}Be(^{15}N,^{13}B)	Others:		AO	^{232}Th(^{18}O,^{13}B),^{232}Th(^{22}Ne,^{13}B)
M	^{9}Be(^{40}Ar,^{13}B)	AA	^{13}C(d,^{2}He)	AP	^{238}U(^{18}O,^{13}B)
N	^{11}B(t,p)	AB	^{13}C(t,^{3}He)	AQ	U(p,^{13}B),^{232}Th(p,^{13}B)
O	^{11}B(^{18}O,^{16}O)	AC	^{13}C(^{7}Li,^{7}Be)		

E(level)	J^π	$T_{1/2}$ or Γ	XREF	Comments
0.0	3/2$^-$	17.30 ms *17*	A CDEF HIJKLMNOP RSTUVWX Z	XREF: Others: AA, AB, AC, AD, AE, AF, AG, AH, AI, AJ, AK, AL, AM, AN, AO, AP, AQ %β^-=100 %β^-n=0.276 *37* (1974Al12) T=3/2 μ=+3.1778 *5* (2004Na38,2019StZV) Q=0.0365 *8* (2021StZZ) μ: See previous value +3.17712 *51* (1971Wi09,1989Ra17).

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Adopted Levels, Gammas (continued)

^{13}B Levels (continued)

E(level)	J^{π}	$T_{1/2}$ or Γ	XREF	Comments
				Q: From β−NMR in (2004Na38,2004Na46), sign=(+). See previous values Q=0.0374 *14* (1973HaVZ,1989Ra17) and Q=0.0369 *10* in (2003Og03). %β^-n: See also (1962Ma19,1969Jo21). The preliminary work of found %β-n=0.254 *36* in an experiment that didn't resolve discrete neutron decay groups; the work of (1974Al12) was carried out by the same group, but with significantly improved experimental sensitivity and neutron group resolution. See theoretical discussion in (2003Fo11). $T_{1/2}$: From the weighted average of 17.39 ms *41* (1962Ma19), 17.33 ms *17* (1971Wi07), 17.6 ms *12* (1988Sa04), 16.7 ms *6* (1994ReZZ). $T_{1/2}$: Excluded values are 16.59 ms *2* (2006Ge21), ≈17.36 (2002GeZT, 2005GeZY), 17.0 ms *4* (1997So34) and 16 ms 1 (1968Ch28), 11 ms 9 (1991Re02) and 16.7 ms *3* (1995ReZZ, 2008ReZZ). See also the evaluated value $T_{1/2}$=17.16 ms *18* in (2015Bi05). J^{π}: (2000Gu23) ^{9}Be(^{14}B,^{13}Bγ): L=0 proton removal from ^{14}B, and allowed β^- decay to ^{13}C J^{π}=1/2$^-$, 3/2$^-$ and 5/2$^-$ states.
3483 *5*	1/2$^+$		D H K N p v x z	%IT=100 XREF: p(3600)v(3.5E3)x(3.5E3)z(3.5E3). E(level): From average of 3483 keV *5* (1964Mi04) and 3482 keV *10* (1978Aj02). J^{π}: From (2010Ba06) where L=0 is dominant in ^{12}B(d,p), arguments from spectroscopic factor analysis and shell model expectation of pure L=0 strength from a 1/2$^+$ state support this assignment. In (2000Gu23) ^{9}Be(^{14}B,^{13}Bγ): L=1 proton removal from ^{14}B is reported; arguments based on cross section values led to an assignment of 3/2$^+$. See also π=+ (1978Aj02) ^{11}B(t,p).
3536.4 *17*	3/2$^-$	0.90 ps *21*	A HI N p v x z	XREF: Others: AB, AC %IT=100 XREF: p(3600)v(3.5E3)x(3.5E3)z(3.5E3)AB(3.6E3)AC(3.5E3). E(level): From average of 3537 keV *2* (2002Ao03:Eγ=3536 keV *2*) ^{14}Be β-n, 3536.8 keV *42* (1969Th01) ^{7}Li(^{7}Li,pγ), 3533 keV *5* (1964Mi04) ^{11}B(t,p) and 3531 keV *10* (1978Aj02) ^{11}B(t,p). $T_{1/2}$: From (2009Iw03) ^{7}Li(^{7}Li,pγ). J^{π}: From (2009Iw03) ^{7}Li(^{7}Li,pγ) based on lifetime and M1+E2 decay to ^{13}B$_{g.s.}$. See also 3/2$^-$ from (2009Gu23) ^{13}C(t,^{3}He) and see π=− (1978Aj02) ^{11}B(t,p).
3681 *5*	(5/2$^+$,3/2$^+$)	38 fs *14*	D F HI K NOp rst	XREF: Others: AA %IT=100 XREF: p(3600)r(3690)s(3680)t(3720)aa(3.8E3). E(level): From average of 3681 keV *5* (1964Mi04) ^{11}B(t,p) and 3681 keV *10* (1978Aj02) ^{11}B(t,p).

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Adopted Levels, Gammas (continued)

^{13}B Levels (continued)

E(level)	J^{π}	$T_{1/2}$ or Γ	XREF	Comments
				$T_{1/2}$: From (2009Iw03) ^{7}Li(^{7}Li,pγ). J^{π}: From (2010Ba06) where L=2 is dominant in ^{12}B(d,p); arguments from spectroscopic factor analysis and shell model expectation of dominant L=2 strength from a 5/2^{+} state support this assignment. A 3/2^{+} state, with equal admixtures of L=0 and 2, is expected within 60 keV of the 5/2^{+} state. (2000Gu23) ^{9}Be(^{14}B,^{13}Bγ) had suggested J^{π}=3/2^{+} and 5/2^{+} for ^{13}B*(3.48,3.61 MeV), respectively, based in L=1 proton removal from ^{14}B and cross section arguments. See also π=+ (1978Aj02) ^{11}B(t,p).
3713 *5*	1/2^{-}	≤0.21 fs	HI N p rst	XREF: Others: AA, AE %IT=100 XREF: p(3600)r(3690)s(3680)t(3720)aa(3.8E3). E(level): From average of 3712 keV *5* (1964Mi04) ^{11}B(t,p) and 3715 keV *10* (1978Aj02) ^{11}B(t,p). $T_{1/2}$: From (2009Iw03) ^{7}Li(^{7}Li,pγ). J^{π}: From (1975Ma41, 2016Be08) ^{14}C(d,^{3}He) based on L=1 and the spectroscopic factor magnitude. See also π=− (1978Aj02) ^{11}B(t,p) and (5/2^{-}) from analysis of various 1p plus 2n transfer reactions on ^{12}C in (2000Ka21) where the E_x=3.6 and 3.7 MeV states are unresolved.
4131 *5*	$^{-}$	≤0.21 fs	HI K NO RST	XREF: Others: AC %IT=100 XREF: AC(4.0E3). E(level): From average of 4134.1 keV *78* (1969Th01) ^{7}Li(^{7}Li,pγ), 4130 keV *10* (1964Mi04) ^{11}B(t,p) and 4128 keV *10* (1978Aj02) ^{11}B(t,p). $T_{1/2}$: From (2009Iw03) ^{7}Li(^{7}Li,pγ). J^{π}: See π=− (1978Aj02) ^{11}B(t,p).
4829 *6*	1/2^{+}	≤0.21 fs	HI N S	XREF: Others: AE, AI %IT=100 XREF: S(4910). E(level): From average of 4833 keV *10* (1972Wy01) ^{7}Li(^{7}Li,p), 4820 keV *10* (1964Mi04) ^{11}B(t,p) and 4834 keV *10* (1978Aj02) ^{11}B(t,p). $T_{1/2}$: From (2009Iw03) ^{7}Li(^{7}Li,pγ). J^{π}: From L(p)=0: (2008Ot05) ^{4}He(^{12}Be,^{13}B). See also (1/2^{+}) (2016Be08) ^{14}C(d,^{3}He) where L=0 is deduced. In (2000Ka21) ^{16}O(^{14}C,^{17}F), ^{13}B*(4.8,6.9 MeV) are reported; the authors suggest a mechanism with one $1p_{1/2}$ and two $1p_{3/2}$ proton transfers from ^{16}O; leaving remaining protons to couple to 0^{+} for the lower state and 2^{+} for the higher state, resulting in J^{π}=1/2^{-} and (3/2,5/2)$^{-}$, respectively.
5024[†] *6*			I N R T	E(level): From average of 5033 keV *8* (1972Wy01) ^{7}Li(^{7}Li,p), 5010 keV *10* (1964Mi04) ^{11}B(t,p) and 5023 keV *10* (1978Aj02) ^{11}B(t,p).
5106[†] *10*		60 keV *10*	D N p	XREF: Others: AA, AB XREF: p(5200). E(level),Γ: From (1978Aj02).

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Adopted Levels, Gammas (continued)

^{13}B Levels (continued)

E(level)	J^{π}	$T_{1/2}$ or Γ	XREF	Comments
5388† *6*	(1/2,3/2)$^-$	14 keV *5*	D I NOp RST	XREF: Others: AE XREF: p(5200). E(level): From average of 5391 keV *8* (1972Wy01) ^{7}Li(^{7}Li,p), 5380 keV *10* (1964Mi04) ^{11}B(t,p), and 5393 keV *10* (1978Aj02) ^{11}B(t,p). Γ: From average of 15 keV *5* (1964Mi04) and 10 keV *10* (1978Aj02). J^{π}: From L(p)=1 in ^{14}C(d,^{3}He) (2016Be08).
5557?† *7*			I	E(level): From (1972Wy01) ^{7}Li(^{7}Li,p).
6167† *6*		<20 keV	I NOP T	XREF: Others: AE XREF: AE(6.3E3). E(level): From average of 6169 keV *8* (1972Wy01) ^{7}Li(^{7}Li,p), 6170 keV *20* (1964Mi04) ^{11}B(t,p) and 6164 keV *10* (1978Aj02) ^{11}B(t,p). Γ: In Fig. 10 of (1978Aj02) this state is narrower than the E_x=5.39 MeV state. It's width is assigned Γ<20 keV. See also Γ≈60 keV (2000Ka21) ^{12}C(^{15}N,^{14}O).
6425† *7*		36 keV *5*	I NOP RST V X ZA	XREF: Others: AE XREF: S(6370)AE(6.3E3). E(level): From average of 6419 keV *8* (1972Wy01) ^{7}Li(^{7}Li,p) and 6434 keV *10* (1978Aj02) ^{11}B(t,p). Γ: From (1978Aj02). J^{π}: In (2000Ka21) analysis of ^{12}C(^{13}C,^{12}N),(^{14}C,^{13}N) and (^{15}N,^{14}O) multi-nucleon transfer reactions suggest J^{π}=(9/2$^+$).
6934† *9*		55 keV *15*	I N ST	XREF: Others: AB, AI XREF: AI(6900). E(level): From average of 6939 keV *15* from (1972Wy01) ^{7}Li(^{7}Li,p) and 6932 keV *10* (1978Aj02) ^{11}B(t,p) See also (2000Ka21) where E_x≈6930 keV and Γ≈150 keV are reported. J^{π}: In (2000Ka21) ^{16}O(^{14}C,^{17}F), ^{13}B*(4.8,6.9 MeV) are reported; the authors suggest a mechanism with one $1p_{1/2}$ and two $1p_{3/2}$ proton transfers from ^{16}O; leaving remaining protons to couple to 0$^+$ for the lower state and 2$^+$ for the higher state, resulting in J^{π}=1/2$^-$ and (3/2,5/2)$^-$, respectively. Γ: From (1978Aj02).
7516?† *8*			I st X Z	XREF: s(7580)t(7760). E(level): From (1972Wy01). E(level): A low-energy shoulder is reported on the 8133 keV peak reported in (2000Ka21) ^{12}C(^{14}C,^{13}N) and ^{12}C(^{15}N,^{13}O); the authors suggest this group may correspond to unresolved groups that include^{13}B*(7516,7859).
7859?† *20*			I st	XREF: s(7580)t(7760). E(level): From (1972Wy01). E(level): A low-energy shoulder is reported on the 8133 keV peak reported in (2000Ka21) ^{12}C(^{14}C,^{13}N) and ^{12}C(^{15}N,^{13}O); the authors suggest this group may correspond to unresolved

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Adopted Levels, Gammas (continued)

^{13}B Levels (continued)

E(level)	J^{π}	$T_{1/2}$ or Γ	XREF	Comments
				groups that include ^{13}B*(7516,7859).
8134[†] *7*		100 keV *15*	I NO RST	XREF: O(8.32E3). E(level): From average of 8129 keV *10* (1972Wy01) and 8138 keV *10* (1978Aj02). Γ: From (1978Aj02).
8683[‡] *7*		89 keV *20*	I N RST	E(level): From average of 8682 keV *9* (1972Wy01) and 8684 keV *10* (1978Aj02). Γ: From (1978Aj02).
9.0×10^{3}		≈8.1 MeV	Y	T=3/2 (1994Ha41) E(level),Γ: From (1994Ha41). Represents the T=3/2 giant resonance built on ^{13}C$_{g.s.}$
9440[‡] *30*		81 keV *25*	N RST	XREF: R(9310). E(level),Γ: From (1978Aj02).
9.5×10^{3}?[‡] *3*				XREF: Others: AC Γ: Γ=broad. E(level),Γ: From (1990Na03) ^{13}C(^{7}Li,^{7}Be).
10220[‡] *20*		210 keV *20*	F N RST X Z	XREF: Others: AB E(level),Γ: From (1978Aj02). J^{π}: In (2000Ka21) analysis of ^{12}C(^{13}C,^{12}N),(^{14}C,^{13}N) and (^{15}N,^{14}O) multi-nucleon transfer reactions suggest J^{π}=(11/2^{-}).
10890[#] *20*			N	E(level): From (1978Aj02).
11050[#]		1.8 MeV	RST	XREF: R(11180)S(10980). Γ: Broad, possibly many states. E(level),Γ: From (2000Ka21) ^{12}C(^{15}N,^{14}O).
11.7×10^{3}[#]	(5/2^{+},7/2^{+})		F N	E(level),J^{π}: From (2014Wu10) ^{2}H(^{15}C,α). See also (11.8 MeV) (1978Aj02) ^{11}B(t,p). J^{π}: For 11.7- and 12.2-MeV doublet. Comparison of the angular distribution of the E_x≈12 MeV group with the ^{2}H(^{14}C,α)^{12}B*(5.61, J^{π}=3^{+}) suggests this doublet results from the coupling of a 1s$_{1/2}$ neutron to an aligned [(0p$_{3/2}$)$^{-2}$]$_{3+}$ configuration in ^{12}B (2014Wu10).
12.2×10^{3}[#]	(5/2^{+},7/2^{+})		F	E(level): From (2014Wu10) ^{2}H(^{15}C,α). J^{π}: See comment on E_x=11.7 MeV.
13.6×10^{3} *1*		≤320 keV	I Q T	%α≤100 E(level),Γ: From (2008Ch28) ^{12}C(^{12}Be,^{13}Be), see also E_x=13.65 MeV *23* and Γ≈300 keV (2000Ka21) ^{12}C(^{15}N,^{14}O).
14390[#]		≈400 keV	T	E(level),Γ: From (2000Ka21) ^{12}C(^{15}N,^{14}O).
16.3×10^{3}			G	E(level): From (2022Di05) ^{4}He(^{9}Li,α). %α: Observed in ^{4}He(^{9}Li,α).

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Adopted Levels, Gammas (continued)

^{13}B Levels (continued)

E(level)	J^π	$T_{1/2}$ or Γ	S	XREF	Comments
18.25×10^3 *10*	1/2$^+$	0.7 MeV *+4−3*		B G	T=(5/2) (2023Hu20) XREF: G(18.4E3). Γ: T=0.66 MeV $^{+40}_{-25}$. E(level),J^π,Γ: From R-matrix analysis in (2023Hu20). See also 18.4 MeV from (2022Di05) ^{4}He(^{9}Li,α). %p,%α: Observed in ^{1}H(^{12}Be,^{13}Be) and ^{4}He(^{9}Li,α).
19.95×10^3 *6*	5/2$^+$	0.60 MeV *10*	0.49 *8*	B G	T=(5/2) (2023Hu20) XREF: G(19.5E3). E(level),J^π,Γ: From R-matrix analysis in (2023Hu20). See also 19.5 MeV from (2022Di05) ^{4}He(^{9}Li,α). %p,%α: Observed in ^{1}H(^{12}Be,^{13}Be) and ^{4}He(^{9}Li,α).

† Decay mode not reported; only IT and neutron emission are possible.
‡ Decay mode not reported; IT, 1n and 2n emission are possible.
# Decay mode not reported; IT, 1n, 2n and α emission are possible.

γ(^{13}B)

Additional information 1.

E_i(level)	J^π_i	E_γ	I_γ	E_f	J^π_f	Mult.	α†	Comments
3483	1/2$^+$	3482	100	0.0	3/2$^-$			E_γ: 3482 keV *6* from Level Energy Difference.
3536.4	3/2$^-$	3536 *2*	100	0.0	3/2$^-$	[M1,E2]	0.00093 *8*	α(K)=1.221×10^{-7} *23*; α(L)=4.98×10^{-9} *10* α(IPF)=0.00093 *8* B(M1)(W.u.)<7.2×10^{-4} (2009Iw03); B(E2)(W.u.)<0.81 (2009Iw03) E_γ,I_γ: From (2002Ao03) ^{14}Be β-n.
3681	(5/2$^+$,3/2$^+$)	3680	100	0.0	3/2$^-$	[E1]	1.55×10^{-3} *2*	α(K)=9.05×10^{-8} *13*; α(L)=3.69×10^{-9} *5* α(IPF)=0.001552 *22* B(E1)(W.u.)=7.7×10^{-4} *28* E_γ,I_γ: See (2000Gu23,2009Iw03). B(E1)(W.u.): See also 6.4E-4 23 in (2009Iw03).
3713	1/2$^-$	178	<10‡	3536.4	3/2$^-$			E_γ: 178 keV *6* from Level Energy Difference.
		3713 *5*	100‡	0.0	3/2$^-$			E_γ: 3713 keV *5* from Level Energy Difference.
4131	−	418 *8*	<14‡	3713	1/2$^-$			E_γ: 418 keV *8* from Level Energy Difference.
		596 *8*	33‡ *14*	3536.4	3/2$^-$			E_γ: 596 keV *8* from Level Energy Difference.
		4131 *6*	100‡ *14*	0.0	3/2$^-$			E_γ: 4131 keV *8* from Level Energy Difference.

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Adopted Levels, Gammas (continued)

$\gamma(^{13}B)$ (continued)

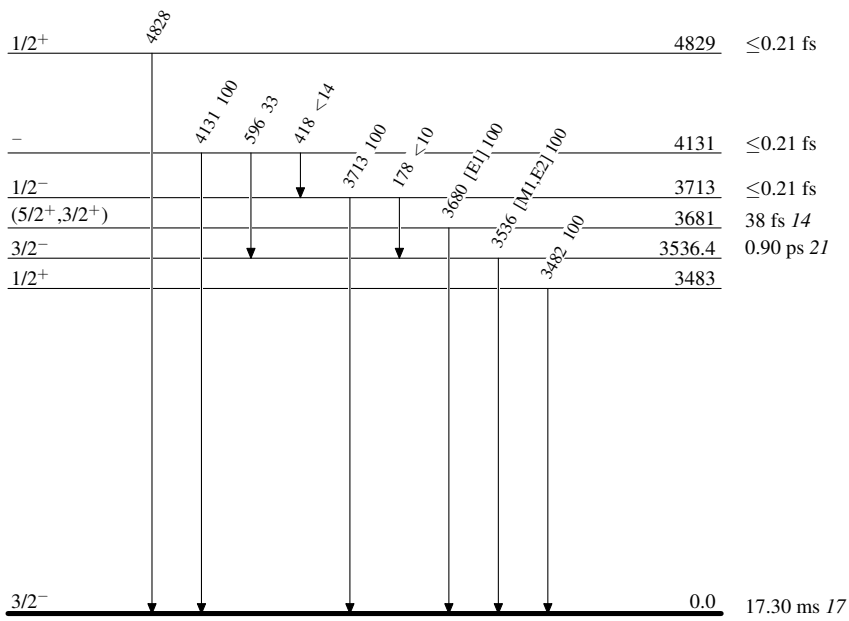
E_i(level)	J^π_i	E_γ	E_f	J^π_f	Comments
4829	$1/2^+$	4828	0.0	$3/2^-$	E_γ: 4828 keV *6* from Level Energy Difference.

† Additional information 2.
‡ From (1963Ca09).

Adopted Levels, Gammas

Level Scheme

Intensities: Relative photon branching from each level



$^{13}_{5}B_{8}$