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^-)=−2220.47 *27*; S(n)=4946.31; S(p)=17533.4 *13*; Q(α)=−10648.36 *8* 2021Wa16
S(n)=4946.3087 *5* 2021Wa16
S_{2n}=23667.02 *6*; S_{2p}=31630.10 *24* (2021Wa16).
1929Ki01, 1929Ki02: Discovered ^{13}C in the carbon spectrum from an electric furnace. See (2012Th01).
1984De53: Natural abundance: 1.10% *3*.
1985De42: Deduced rms charge radius 2.4628 fm *39* from 2p-1s muonic transition. See also (1984Aa02).
Mass measurements: 1935Be02, 1969Wo03, 1993VaZY, 1995Di08, 1995Va38, 1997Br44, 2004Ra33, 2006Re19.

Nuclear moments:
Measurements: $^{13}C_{g.s.}$ 1954Ro34 μ=+0.7024118 *14*, 2005An15 μ=0.7023694 *35*. $^{13}C^*$(3.85 MeV) 1981Ru04 μ=1.40 *4*.
Tabulations: 1964Li14, 1967Sh14, 1969Fu11, 1972Gl06, 1975Go12, 1989Ra17, 2011StZZ: μ(3.85 MeV)=1.40 *4*, 2019StZV: μ=0.702369 *4*.
Calculations: 1937Ro01, 1963Be36, 1968Pe16, 1974Ha27, 1984Ka25, 1988Va03, 1990Iw02, 1991Bo02, 1996Ka14, 1999Ga57, 1999Ki27, 2003Su04, 2003Su09, 2003Su28, 2004Sa58, 2005Ko18, 2012Fu06, 2013Ma60, 2017Ya19, 2021Fr07, 2022St06, 2023Se01.

Theory:
Ground state and level properties: 1961Ku17, 1963Se19, 1966El08, 1967Ba12, 1970Pe18, 1971Gr02, 1971Ja13, 1973Ma48, 1975Er09, 1975Me24, 1975Yu03, 1978Sm02, 1981Av02, 1981Li19, 1983Sh38, 1984Fr13, 1987Sa15, 1990Mo17, 1992Zh01, 1993Ki01, 1993Pa19, 1993Sa20, 1995Vi06, 1996Ki24, 1996Ot01, 1996Re19, 1996Su24 1997Ba54, 1997Mo06, 1997Po12, 1998Ch38, 1998Sh16, 2000Ko23, 2001Ot04, 2003Sa50, 2003Su28, 2005Ni24, 2006Ko02, 2007Na16, 2007Sa50, 2014Ho08, 2015Sh21, 2019Bi03, 2020Su20, 2020So01, 2021Ga21, 2021Ma32, 2022Sa37, 2023Ch04.
Shell model: 1965Co25, 1970Hs02, 1971Ja14, 1971No02, 1973Ha49, 1973Sa30, 1978Bo31, 1983Va08, 1983Va08, 1983Va31, 1984Va06, 1987Nu02, 1988Wo04, 1990Bl16 1990Sk05, 1990Va01, 1992Kw01, 1993Go03, 1993Ki23, 1993Po11, 1993Zh17, 1996Ki27, 2003Na21, 2005Na41, 2006Le33, 2007Gu03, 2008Sh16, 2009Um05, 2010Ti04, 2012Yu07, 2013Ma60, 2015Fo06, 2016Ho14, 2018Fu14, 2018Ti08.
Cluster model and multi-body forces: 1974Si04, 1989Va06, 1995Ho13, 1996Du12, 1997De27, 1997Ho04, 1997Ka25, 1997Vo17, 2001Ka66, 2002Mi32, 2002Vo19, 2003Fr39, 2003Mi33, 2003Mi34, 2003Th06, 2003Vo24, 2004Bu25, 2004Mc02, 2004Na35, 2004Th11, 2004To14, 2004Vo09, 2005Du03, 2005NeZZ, 2006It06, 2006Ka55, 2006Ta28, 2007Fr22, 2008Ya24, 2009Yo03, 2010VoZY, 2011Fu01, 2011Ya08, 2012Ya16, 2015Ya16, 2017De19, 2020Ca21, 2020Ro08.

Various topics:
Mirror and analog states: 1938Be05, 1963Fa03, 1971Ar03, 1971DiZT, 1971Ng01, 1972Ch16, 1974Ch46, 1975Gr03, 1975Ku21, 1973Sa25, 1975Me24, 1980Ba54, 1985An28 (IMME), 1986RoZQ, 1986Si22, 1995Fo18, 1998Ao02, 2005Ti14, 2006Sh10, 2011Ti09, 2012Am06 (IMME), 2015Fr04, 2018Fo04, 2019Mu05, 2022Va06.
Nuclear size: 1976Du04, 1982Sc11, 1992He21, 1992La13, 1996Sh13, 2001Oz03, 2001Oz04, 2002Me12, 2003Li31, 2004Ne16, 2005Ch02, 2006Pe01, 2008Ch34, 2011Gu03, 2016Og03 (radius of 3.09 MeV state), 2017Ah08, 2023De29.
Electromagnetic transitions: 1970Fo14, 1971DiZT, 1972Gu05, 1978Ki08, 1982MoZR, 1983Mi08, 1984Ku07, 1984Sc09, 1985Uc01, 2001Ra41, 2004Sa58, 2004Su23, 2005Sa63, 2021Sh20, 2011SuZU, 2015IzZZ.
Giant resonance: 1962Ea01, 1963Pe04, 1972Le06, 1974Mu13, 1989GoZQ, 1992Ba02, 2004El05, 2004Is09.
Others: 1981Pl03, 1986Co21, 1990Mu10, 1994Fe06, 2009Ti11, 2013Ti05, 1978Le04, 1982We02, 2012Su15, 2013Su17, 2015Mo24, 2023Ga25, 2024Zh23.

Unplaced experimental results:
1966De09: ^{17}O(d,^{6}Li). DWBA analysis of L=3 α transfer to ^{13}Cg.s..
1969Ba17: ^{14}N(α,αp). Analysis of sequential decay proecsses.
1973Va07, 1974Bu06, 1978Da17 : ^{13}C(pol. d,d). Measured angular distributions and polarization observables to low-lying states.
1974Li15: ^{16}O(π^-,^{13}Cγ). Discussed population of $^{13}C^*$(3684, 3854).
1975Sc35, 1975Sc42: ^{14}C(^{16}O,^{17}O). DWBA analysis of the ground state reaction.
1976We21: Optical model analysis of (^{13}C,$^{13}C_{g.s.}$) reactions on ^{12}C, ^{16}O, ^{28}Si and ^{32}S.

Adopted Levels, Gammas (continued)

1988Ya06, 1988Ya02: ^{28}Si(^{13}C,^{13}C$_{g.s.}$) E=60 MeV. Optical model analysis.
2020Li05: ^{28}Si(^{13}C,^{13}C) E=30 and 34 MeV. Coupled channels analysis.
1977Ar06: ^{232}Th(^{22}Ne,^{13}C) E=172 MeV. Analysis of secondary isotope production.
1979Pr07: ^{12}C(^{16}O,^{15}O) E=128 MeV. DWBA analysis of ground state reaction.
1980Mi01: ^{27}Al(^{16}O,^{13}C) E=88 MeV. Analyzed reaction mechanism and Q-value dependence for production of various reaction products.
1981Wh01: ^{14}C(π^+,p). Analysis of (π^+,p) systematics for a variety of targets.
1984Ho23: ^{197}Au(^{20}Ne,^{13}C). Analysis of cluster-stripping reaction dynamics.
1991Eu01: ^{7}Li(^{6}Li,γ) $E_{c.m.}$=1-8 MeV. Analyzed capture reactions to γ_0, γ_1, γ_{2+3}, γ_4 and γ_{5-7}.
1999Az04, 2001Az01: ^{14}N(^{7}Be,^{8}B). ANC approach to improve understanding of astrophysical ^{7}Be+p→^{8}B reaction.
2021Ci02: ^{181}Ta(^{18}O,^{13}C). ^{13}C*(3853) benchmark of the AGATA+VAMOS+PARIS setup at GANIL. Eγ=3852.170 keV *22* derived in (1980Wa24) is referenced.
2021Su15: C(^{14}C,^{13}C) E≈240 MeV/nucleon. Glauber model analysis of single-neutron removal cross sections.
2022Bo01: ^{12}C(X,^{13}C): X=^{15,16}O, ^{14}N E≈400 MeV/nucleon. Analyzed fragmentation products.
2023Me12: ^{nat}C(X,^{13}C): X=^{14}C, ^{14}N, ^{16}O, ^{16}N E≈240 MeV/nucleon. Analyzed fragmentation products.
2023Sp01: ^{12}C(^{18}O,^{17}O) E=275 MeV. DWBA analysis of charge-exchange reactions.
2022Ur01, 2024Ur02: ^{13}C(d,d), (d,d$_{1-10}$) E=18 MeV. FRESCO analysis of angular distributions; deduced deformation lengths.
2024Ra22: ^{2}H(^{13}N,^{2}He) E=94 MeV/nucleon. Measured charge-exchange cross sections to high-lying states that could participate in high-energy electron capture reactions.

^{13}C Levels

Cross Reference (XREF) Flags

A	^{13}B β^- decay	X	^{12}C(n,γ):res	AT	^{13}C(α,α),(α,α'),(α,$\alpha'\gamma$)
B	^{13}N ε decay	Y	^{12}C(n,n):res	AU	^{13}C(^{6}Li,^{6}Li),(^{7}Li,^{7}Li)
C	^{14}B β^-n decay	Z	^{12}C(n,p):res	AV	^{13}C(^{9}Be,^{9}Be),(^{9}Be,^{9}Be′)
D	^{17}N $\beta^-\alpha$ decay	Others:		AW	^{13}C(^{11}B,^{11}B)
E	^{1}H(^{12}B,p):res	AA	^{12}C(n,n′),(n,n′γ):res	AX	^{13}C(^{18}O,^{18}O)
F	^{7}Li(^{9}Be,α^{9}Be),^{14}C(^{13}C,α^{9}Be)	AB	^{12}C(p,π^+)	AY	^{14}C(p,d)
G	^{9}Be(α,α):res	AC	^{12}C(d,p),(d,pγ)	AZ	^{14}C(d,t)
H	^{9}Be(α,nγ):res	AD	^{12}C(t,d),^{13}C(t,t),(t,t′)	BA	^{14}C(^{3}He,α)
I	^{9}Be(^{6}Li,d),(^{7}Li,t)	AE	^{12}C(^{3}He,2p)	BB	^{14}N(γ,p)
J	^{9}Be(^{9}Be,^{13}Cγ)	AF	^{12}C(α,^{3}He)	BC	^{14}N(μ^-,νn)
K	^{9}Be(^{16}O,^{12}C)	AG	^{12}C(^{7}Li,^{6}Li),(^{8}Li,^{7}Li)	BD	^{14}N(n,d),(n,dγ)
L	^{10}B(t,p):res	AH	^{12}C(^{9}Be,^{8}Be)	BE	^{14}N(p,2p)
M	^{10}B(α,p),(α,pγ)	AI	^{12}C(^{11}B,^{10}B),(^{12}C,^{11}C)	BF	^{14}N(d,^{3}He)
N	^{10}B(^{6}Li,^{3}He)	AJ	^{12}C(^{13}C,^{13}C),(^{13}C,X)	BG	^{14}N(t,α)
O	^{10}B(^{7}Li,α)	AK	^{12}C(^{14}N,^{13}N)	BH	^{15}N(p,^{3}He)
P	^{10}B(^{10}B,^{13}C)	AL	^{13}C(γ,γ')	BI	^{15}N(d,α)
Q	^{10}B(^{14}N,^{11}C)	AM	^{13}C(γ,n),(γ,nγ),(γ,p)	BJ	^{16}O(n,α),(n,$\alpha\gamma$)
R	^{11}B(d,γ):res	AN	^{13}C(γ,p)	BK	^{16}O(p,p^{3}He)
S	^{11}B(d,p):res	AO	^{13}C(e,e),(e,e′),(e,e′p)	BL	^{16}O(α,α^{3}He)
T	^{11}B(d,nγ):res	AP	^{13}C(π,π),(π,π')	BM	^{20}Ne(n,2α)
U	^{11}B(^{3}He,p),(^{3}He,pγ),(α,d)	AQ	^{13}C(n,n),(n,n′),(n,n′γ)	BN	^{93}Nb(^{12}C,^{13}C)
V	^{11}B(^{6}Li,α)	AR	^{13}C(p,p),(p,p′),(p,pn)	BO	^{159}Tb(^{19}F,^{13}C),^{154}Sm(^{16}O,^{13}C)
W	^{12}C(n,γ):E=thermal	AS	^{13}C(^{3}He,^{3}He),(^{3}He,^{3}He′)	BP	^{165}Ho(^{14}N,n^{12}C)

E(level)	J$^\pi$	T$_{1/2}$ or Γ	XREF			Comments
0	1/2$^-$	stable	ABCD	IJK MNOPQ	UVWX	XREF: Others: AB, AC, AD, AE, AF, AG, AH, AI, AJ, AK, AL, AO, AP, AQ, AR, AS, AT, AU, AV, AW, AX, AY, AZ, BA, BB, BC, BD, BE, BF, BG, BH, BI, BJ, BK, BL, BM,

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Adopted Levels, Gammas (continued)

^{13}C Levels (continued)

E(level)	J^{π}	$T_{1/2}$ or Γ	XREF	Comments
				BN, BO μ=0.702369 *4* (2019StZV,2005An15) J^{π}: From mixed L=0+2 in ^{15}N(pol. p,^{3}He) (1974Ma12) and trivial shell model consideration.
3089.451 *19*	1/2^{+}	0.98 fs *9*	A IJK MNOPQ UVW	XREF: Others: AB, AC, AD, AF, AG, AH, AI, AK, AL, AO, AP, AQ, AR, AS, AT, AU, AW, AX, AY, AZ, BA, BB, BC, BD, BE, BF, BG, BH, BI, BJ, BK, BO %IT=100 XREF: BE(3100). E(level): From least squares fit to E_{γ}=169.300 keV *4*, 764.316 keV *10* and 3089.049 keV *20* (1980Wa24), and E_{γ}=595.22 keV *8* from (1982Mu14, 2008FiZZ) and E_{γ}=3684.01 keV *6* from (1967Pr10, 1982Mu14, 2008FiZZ). J^{π}: From E1 (no E2) from 1/2^{-} in ^{13}C(e,e′) (1989Mi01). $T_{1/2}$: From τ=1.42 fs *13* corresponding to Γ=0.464 eV *42* which is the weighted average of 0.463 eV *56* and 0.413 eV *50* (1968Ro02), 0.537 eV *42* (1993Mo23), and 0.39 eV *6* (1975Ra22).
3684.496 *22*	3/2^{-}	1.13 fs *6*	A IJ MNOpQ UVW	XREF: Others: AB, AC, AD, AF, AG, AH, AI, AK, AL, AO, AP, AQ, AR, AS, AT, AU, AV, AW, AX, AY, AZ, BA, BB, BC, BD, BE, BF, BG, BH, BI, BJ, BK, BL, BN, BO %IT=100 XREF: p(3.78E3). E(level): From least squares fit to E_{γ}=169.300 keV *4*, 764.316 keV *10* and 3089.049 keV *20* (1980Wa24), and E_{γ}=595.22 keV *8* from (1982Mu14, 2008FiZZ) and E_{γ}=3684.01 keV *6* from (1967Pr10, 1982Mu14, 2008FiZZ). J^{π}: From M1+E2 from 1/2^{-} in ^{13}C(e,e′) (1989Mi01). $T_{1/2}$: From τ=1.63 fs *9* obtained from the average of τ=1.59 fs *13* (1991Li12: Γ_0^2/Γ=0.408 eV *26*) and τ=1.63 fs *12* (1993Mo23: Γ=0.403 eV *30*) from ^{13}C(γ,γ′) and τ=1.82 fs *25* (1970Wi04: Γ=0.36 eV *5*) from ^{13}C(e,e′).
3853.796 *21*	5/2^{+}	8.6 ps *2*	A IJK MNOp UV	XREF: Others: AB, AC, AD, AE, AF, AG, AH, AI, AJ, AK, AO, AP, AQ, AR, AS, AT, AW, AX, AY, AZ, BA, BB, BC, BD, BG, BI, BJ, BK %IT=100 μ=1.40 *4* (1981Ru04,2011StZZ,2020StZV) XREF: p(3.78E3). E(level): From least squares fit to E_{γ}=169.300 keV *4*, 764.316 keV *10* and 3089.049 keV *20* (1980Wa24), and E_{γ}=595.22 keV *8* from (1982Mu14, 2008FiZZ) and E_{γ}=3684.01 keV *6* from (1967Pr10, 1982Mu14, 2008FiZZ). J^{π}: From M2+E3 from 1/2^{-} in ^{13}C(e,e′) (1989Mi01). $T_{1/2}$: from τ_m=12.4 ps *3* which is the weighted average of ^{12}C(d,p) values: τ_m=12.4 ps *8* (1974Be48), 13.0 ps *4* (1975Ra29), 12.6 ps *3* (1977He12) and 12.2 ps *4* (1981Ru04) and ^{10}B(α,p) values: τ_m=10.7 ps *10* (1969He22) and 9.9 ps *9* (1970Ga01). See also τ_m=9.0 ps *+25−15* (1968Ri16).
(4946.33 *5*)	1/2^{+}		W	E(level),J^{π}: From L=0 ^{12}C(n,γ):E=thermal capture state.

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Adopted Levels, Gammas (continued)

^{13}C Levels (continued)

E(level)	J^{π}	$T_{1/2}$ or Γ	XREF	Comments
6860.04‡ *46*	$5/2^{+}$	6 keV	I MNOP UV Y	XREF: Others: AB, AC, AD, AG, AH, AI, AK, AO, AP, AQ, AR, AS, AT, AW, AY, BF, BG, BH, BI, BP Γ_{n0}/Γ=0.99 *+1−9* (1973Ad02) XREF: P(6.75E3). Decay Mode: n. E(level): From (1990Pi05) ^{12}C(d,p). J^{π}: From L=2 and phase-shift analysis in ^{12}C(n,n) (1973Ab07). Γ: From (1977Ta08) ^{12}C(d,p). See other values around Γ=7-9 keV listed in ^{12}C(n,n):res.
7492 *10*	$(7/2^{+})$	<5 keV	I NOp UV	XREF: Others: AB, AC, AD, AI, AO, AP, AS, AT, AW, BG, BI Γ_{γ}/Γ=0.003 *1* (1971HiZF) XREF: V(7500). Decay Mode: γ. E(level): From the average of 7470 keV *20* (1955Mc75) and 7500 keV *12* (1959Yo25) ^{11}B(^{3}He,p). J^{π}: From E3+M4 from $1/2^{-}$ in ^{13}C(e,e′) (1989Mi01). Γ: From (1959Yo25) ^{11}B(^{3}He,p).
7547 *3*	$5/2^{-}$	1.2 keV *3*	A I MNOpQ UV Y	XREF: Others: AB, AC, AD, AG, AI, AM, AO, AP, AQ, AR, AS, AT, AU, AV, AW, AY, BB, BE, BF, BG, BH, BI $\Gamma_{\gamma 0}$=0.110 eV *15* (1980Ho11) XREF: V(7550)ag(7600)AY(7560)BE(7500)BI(7530). Decay Modes: γ, n. E(level): From the average of 7546 keV *5* (1975He02) ^{12}C(n,n), 7554 keV *12* (1959Yo25) ^{11}B(^{3}He,p) and 7547 keV *3* ^{13}C(e,e′). J^{π}: From E2+M3 from $1/2^{-}$ in ^{13}C(e,e′) (1989Mi01). The conference proceedings (1970CiZY) reports J=(5/2) and L=2 from ^{12}C(n,n): res. Γ: From (1975He02) ^{12}C(n,n). See also 6.5 keV (1970CiZY) ^{12}C(n,n) and 5 keV (1977Ta08) ^{12}C(d,p).
7688 *5*	$3/2^{+}$	69 keV *4*	I NO UV Y	XREF: Others: AB, AC, AD, AG, AI, AM, AO, AR, AS, AT, AW, AY, BE, BG, BI $\Gamma_{\gamma 0}$=0.6 eV *1* (1980Ho11) XREF: Y(7658)AC(7641)ag(7600)BE(7800)BI(7640). Decay Modes: γ, n. E(level): From average of E_x=7694 keV *14* (1959Yo25) ^{11}B(^{3}He,p), 7690 keV *10* (2013Ca25) ^{12}C(^{11}B,^{10}B) and 7686 keV *6* (1980Fu04) ^{13}C(α,α'). See also 7641 keV *20* (1955Mc75) ^{12}C(d,p), and 7658 keV *9* (1973Fa06) ^{12}C(n,n). J^{π}: From L=2 and phase-shift analysis in ^{12}C(n,n) (1973Ab07). Γ: From the average of Γ=60 keV *13* (1955Mc75) ^{12}C(d,p), 75 keV *15* (1959Yo25) and 70 keV *10* (1970Me24) from ^{11}B(^{3}He,p) and 70 keV *5* (1980Fu04) ^{13}C(α,α'). $\Gamma_{\gamma 0}$: From (1980Ho11) ^{13}C(γ,n_0).

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Adopted Levels, Gammas (continued)

^{13}C Levels (continued)

E(level)	J^{π}	$T_{1/2}$ or Γ	XREF	Comments
8220 *40*	$3/2^{+}$	1026 keV *15*	Y	XREF: Others: AB, AC, AD, AE, AH, AI, AM, AO, AR, AW, AY $\Gamma_{\gamma 0}$=7.0 eV *9* (1980Ho11) $\Gamma_{n0}/\Gamma \approx 1.0$ (1972Ga13) XREF: AB(8400)AC(8.4E3)AE(8000)AI(8250)AO(8200)AR(8200). Decay Modes: γ, n. E(level): From the unweighted average of values in ^{12}C(n,n): E_x=8149 keV *15* (1973Fa06), 8193 keV *50* (1960Ts02) and 8267 keV *50* (1966Li03). See also 8400 keV *300* (1955Mc75) ^{12}C(d,p). J^{π}: From L=2 and phase-shift analysis in ^{12}C(n,n) (1973Ab07). Γ: From average of Γ=1050 keV *100* (1966Li03) and 1025 keV *15* (1975Fa06) ^{12}C(n,n). See also 375 keV (1977Wo04) ^{13}C(γ,n). $\Gamma_{\gamma 0}$: From (1980Ho11) ^{13}C(γ,n_0).
8866 *9*	$1/2^{-}$	179 keV *17*	A I N UV Y	XREF: Others: AC, AM, AO, AP, AR, AS, AT, AY, BB, BF, BG, BH, BI, BJ $\Gamma_{\gamma 0}$=5.4 eV *5* (1980Ho11) $\Gamma_{n0}/\Gamma \approx 1.0$ (1972Ga13) Decay Modes: γ, n. E(level): From the average of E_x=8869 keV *36* (1959Yo25) ^{11}B(^{3}He,p), 8860 keV *30* (1970Me24) ^{11}B(^{3}He,p), 8874 keV *14* (1973Fa06) ^{12}C(n,n), 8860 keV *20* (1970Wi04) ^{13}C(e,e′), 8860 keV *30* (1969Ba06) ^{13}C(^{3}He,^{3}He′) and 8860 keV *20* (1962Si04) ^{14}N(t,α). See other values in ^{11}B(^{3}He,p), ^{15}N(p,^{3}He) and ^{15}N(d,α). J^{π}: From L=1 and phase-shift analysis in ^{12}C(n,n) (1973Ab07). Γ: From the weighted average (external errors) of Γ=142 keV *30* from ^{11}B(^{3}He,p), 205 keV *15* from ^{12}C(n,n), 190 keV *35* (1970Wi04) ^{13}C(e,e′) and 145 keV *20* (1962Si04) ^{14}N(t,α).
9499.71# *6*	$9/2^{+}$	1.72 keV *8*	I MNOP UV Y	XREF: Others: AA, AB, AC, AD, AE, AG, AI, AM, AO, AP, AR, AS, AT, AY, BF, BG, BH, BI, BP $\Gamma_{n0}/\Gamma \approx 1.0$ (1972Ga13) XREF: AA(9522). Decay Modes: γ, n. E(level),Γ: From (1980Ci03) ^{12}C(n,n). See also E_x=9500 keV *7* (1989Mi01) ^{13}C(e,e′) and 9510 keV *12* from ^{11}B(^{3}He,p). J^{π}: From M4(+E5) from $1/2^{-}$ in ^{13}C(e,e′) (1989Mi01); analysis of the $\sigma(\pi^+)/\sigma(\pi^-)$ in (1979De34) ^{13}C($\pi^{\pm}$,$\pi^{\pm}$) is consistent with a pure neutron transition and $9/2^{+}$; further support for an L=4 transfer is found in ^{13}C(p,p′) see references in (1981Aj01). See also J^{π}=($1/2^{-}$,$3/2^{-}$) from phase-shift analysis of ^{12}C(n,n) in (1972Ga13). Later, based on the (1972Ga13) result, $J^{\pi}=3/2^{-}$ was deduced in comparisons of mirror pairs in (1968Hi01) ^{14}N(d,^{3}He) and (d,t) and (1968Fl03) ^{15}N(p,^{3}He)

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Adopted Levels, Gammas (continued)

^{13}C Levels (continued)

E(level)	J^π	$T_{1/2}$ or Γ	XREF	Comments
				and (p,t), but note: in these studies J^π for $^{13}C^*$(9.5 MeV) was still speculative because the $3/2^-$ partner in ^{13}N was absent or unresolved.
9894.50# *17*	$3/2^-$	23.7 keV *4*	A I NOP UV Y	XREF: Others: AA, AC, AM, AO, AR, AS, AT, AY, BG, BI Γ_{n0}=20.6 keV *5* (1980Ci03) Γ_{n0}/Γ=0.869 (1980Ci03) XREF: AA(9946). Γ_{n1}/Γ_{n0}<0.15 (1973Ad02). Decay Modes: γ, n. E(level),Γ: From (1980Ci03) ^{12}C(n,n). See also E_x=9946 keV and Γ<80 keV (1959Ha13) ^{12}C(n,n′) and 9898 keV *12* in ^{11}B(^{3}He,p). J^π: From phase-shift analysis of ^{12}C(n,n) in (1972Ga13).
10463‡		200 keV	O U	XREF: Others: AA, AO, AT Decay Mode: n. E(level),Γ: From (1959Ha13) ^{12}C(n,n′). See also E_x=(10460) keV and $J^\pi=5/2^+$ (1989Mi01) ^{13}C(e,e′).
10753.73 *30*	$7/2^-$	50.9 keV *6*	HI N p U Y	XREF: Others: AA, AC, AD, AR, AS, AT, BG, BH Γ_{n0}=43.4 keV *9* (1980Ci03) Γ_{n0}/Γ=0.853 (1980Ci03) XREF: BG(10736). Decay Mode: n. E(level): From (1980Ci03) ^{12}C(n,n). See also 10752 keV *5* (1969Da13) ^{12}C(n,n) and 10775 keV *5* (1973Go04) ^{12}C(d,p). J^π: From phase-shift analysis of ^{12}C(n,n) in (1972Ga13). Γ: From (1980Ci03) ^{12}C(n,n). See also 56 keV *2* (1973Go04).
10812.8 *6*	$(5/2)^-$	18.7 keV *4*	HI MN p U Y	XREF: Others: AA, AC, AR, AS, AT, BG Γ_{n0}=4.7 eV *3* (1980Ci03) Γ_{n0}/Γ=0.25 Decay Modes: n, α. E(level): From (1980Ci03) ^{12}C(n,n). See also 10815 keV *2* (1994Wr01) ^{9}Be(α,α) and 10818 keV *5* (1973Go04) ^{12}C(d,p). J^π: In (1974Ho06) the state is suggested as the analog of the $^{13}N^*$(10.36 MeV) $J^\pi=5/2^-$ member of the $J^\pi=5/2^-$&$7/2^-$ doublet from comparison of the ^{10}B(^{6}Li,^{3}He) and ^{10}B(^{6}Li,t) reactions. See also L=4 from $J^\pi=1/2^-$ in ^{9}Be(^{6}Li,d). Γ: From (1994Wr01). See also 18.1 keV *10* (1980Ci03) and 24 keV *3* (1973Go04).
11001# *2*	$1/2^+$	56.4 keV *1*	HI NO U Y	XREF: Others: AA, AC, AM, AR, AT, AY, BG Γ_{n0}/Γ=0.4 *1* (1972Ga13) XREF: I(10969)AA(10970). Decay Modes: γ, n, α. E(level): From the average of E_x=10994 keV *7* (1972Ga13) ^{12}C(n,n), 11002 keV *2* (1994Wr01) ^{9}Be(α,n) and 10997 keV *8* (1973Go04) ^{12}C(d,p).

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Adopted Levels, Gammas (continued)

^{13}C Levels (continued)

E(level)	J^{π}	$T_{1/2}$ or Γ	XREF	Comments
				J^{π}: From L=0 transfer in (1990Ya01) ^{14}C(p,d). See also the resonance phase analysis in (1956Ja28: E_x=11010 keV) ^{9}Be(α,n) and phase-shift analysis in (1972Ga13) ^{12}C(n,n). Γ: From (1994Wr01) ^{9}Be(α,n). See also Γ=33 keV *5* (1998Le17) ^{9}Be(^{6}Li,d) and 82 keV *15* (1973Go04) ^{12}C(d,p).
11076.01‡ *18*	1/2$^-$	4.681 keV *19*	HI NO U Y	XREF: Others: AA, AC, AO, AR, AS, AT, AY, BG, BH Γ_{n0}/Γ=0.63 (1980Ci03) Decay Modes: n, α. E(level): From (1980Ci03) ^{12}C(n,n). See also E_x=11076 keV *2* (1994Wr01) ^{9}Be(α,n), 11080 keV *5* (1973Go04) ^{12}C(d,p) and 11080 keV *5* (1989Mi01) ^{13}C(e,e′). J^{π}: From E0+M1 from 1/2$^-$ in ^{13}C(e,e′) (1989Mi01). Γ: From (1994Wr01). See also Γ=4.0 keV *4* (1980Ci03).
11727 *2*	3/2$^-$	122.5 keV *8*	HI U Y	XREF: Others: AC, AO, AP, AR, AT, AY, BB, BE, BF, BG, BH %n≥80; %α>0 (1983To19,1994Wr01) Γ_{n0}/Γ=0.80 *8* (1983To19) XREF: AO(11750)AR(11748)AT(11748)AY(11750) BB(11800)BE(11900)BH(11800). Decay Modes: n, α. E(level): From (1994Wr01) ^{9}Be(α,n). See also E_x=11733 keV *15* (1996Ku07) ^{9}Be(α,n) and 11748 keV *10* (1973Go03) ^{12}C(d,p). J^{π}: From phase-shift analysis of ^{12}C(n,n) in (1983To19). Γ: From (1994Wr01). See also Γ=125 keV *20* (1962Si04) ^{14}N(t,α), 107 keV *14* (1973Go03) and 38 keV *10* (1998Le17) ^{9}Be(^{7}Li,t). Γ_n: See also Γ_{n0}/Γ=0.67 16 and Γ_{n0}/Γ=0.33 8 (1973Ad02).
11848‡ *4*	7/2$^+$	68 keV *4*	HI M PQ	XREF: Others: AA, AC, AO, AP, AR, AS, AT %n>0 (1959Ha13) XREF: H(11825)AP(11820). Decay Mode: n. E(level): From the average of E_x=11851 keV *5* (1973Go03) ^{12}C(d,p) and 11845 keV *5* (1989Mi01) ^{13}C(e,e′). J^{π}: From E3+M4 from 1/2$^-$ in ^{13}C(e,e′) (1989Mi01). Γ: From (1973Go03) where the peak is well resolved. See also Γ=144 keV *5* (1989Mi01) and 46 keV *9* (1998Le17) ^{9}Be(^{6}Li,d).
11947 *3*	5/2$^+$	148.7 keV *4*	FGHI MNO Y	XREF: Others: AA, AB, AC, AO, AR %n≈60; %α=40 (1983To19,1974Sa16) Γ_{n0}/Γ=0.51 *6* (1983To19) Γα/Γ=0.4 (1974Sa16)

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Adopted Levels, Gammas (continued)

^{13}C Levels (continued)

E(level)	J^{π}	$T_{1/2}$ or Γ	XREF	Comments
				XREF: G(11990)M(11900)AR(11920). Decay Modes: n, α. E(level): From the average of ^{9}Be(α,n) E_{res} values given in (1955Ta28, 1996Ku07, 1994Wr01). J^{π}: From phase-shift analysis of ^{12}C(n,n) in (1983To19) and M2+E3 from $1/2^{-}$ in ^{13}C(e,e′) (1989Mi01). See discrepant J^{π} values $(1/2^{-},7/2^{-})$ reported in ^{9}Be(α,n) (1956Ja28, 1970Va23, 1969Kl09). Γ: From (1994Wr01) ^{9}Be(α,n). See also Γ=150 keV *13* (1996Ku07) ^{9}Be(α,n) and see (1983To19) ^{12}C(n,n) where E_x=11.97 MeV *8* and Γ=500 keV *80* are reported. Note: the broad E_x=11.84 and 11.95 MeV states are typically poorly resolved.
12055† *3*	$1/2^{-}$	≈38 keV		XREF: Others: AT E(level),J^{π},Γ: From (2021In04) ^{13}C(α,α′). DWBA analysis indicated a doublet at E_x=12055 keV *1* with Γ=38 keV *4*. They find ΔL=0 and 2, which they assign L=0 and L=2 to the two states: one with $J^{\pi}=1/2^{-}$ and the other to $(3/2,5/2)^{-}$. The ΔE=1 keV is statistical; the evaluator assumes 3 keV uncertainty from the Grand Raiden focal plane energy calibration.
12055 *3*	$(3/2,5/2)^{-}$	≈38 keV	Y	XREF: Others: AT %n≥84 Γ_{n0}/Γ=0.84 (1980Ci03) XREF: Y(12071.9). Decay Mode: n. E(level),J^{π},Γ: From (2021In04) ^{13}C(α,α′). DWBA analysis indicated a doublet at E_x=12055 keV *1* with Γ=38 keV *4*. They find ΔL=0 and 2, which they assign L=0 and L=2 to the two states: one with $J^{\pi}=1/2^{-}$ and the other to $(3/2,5/2)^{-}$. The ΔE=1 keV is statistical; the evaluator assumes 3 keV uncertainty from the Grand Raiden focal plane energy calibration. See also a ^{12}C(n,n) resonance reported with E_x=12072 keV *2* with Γ=82 keV *4* and $J^{\pi}=(3/2^{-})$.
12120# *70*	$3/2^{+}$	540 keV *70*	Y	XREF: Others: AM, AR Γ_{n0}/Γ=0.28 *5* (1983To19) XREF: AM(12106)AR(12106). Decay Modes: γ, n. E(level),Γ: From (1983To19) ^{12}C(n,n):res. See also E_x=12106 keV and Γ=150 keV (1977Wo04) ^{13}C(γ,n). In (1986Aj01) and later, the evaluations accepted E_x=12106 keV from (1977Wo04) and Γ=540 keV from the phase-shift analysis of (1983To19). The past and present evaluations accept much of the (1983To19) analysis; for this $J^{\pi}=3/2^{+}$ level, E_x and Γ from (1983To19) are accepted. J^{π}: From phase-shift analysis of ^{12}C(n,n) in (1983To19).

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Adopted Levels, Gammas (continued)

^{13}C Levels (continued)

E(level)	J^{π}	$T_{1/2}$ or Γ	XREF	Comments
				The past and present evaluations accept much of the (1983To19) analysis; for this $J^{\pi}=3/2^{+}$ level, E_x and Γ from (1983To19) are accepted. J^{π}: From phase-shift analysis of ^{12}C(n,n) in (1983To19).
12130 *46*	$5/2^{-}$	77 keV *30*	I N Y	XREF: Others: AC, BG $\Gamma_{n0}/\Gamma=0.43$ *6* (1983To19) XREF: N(12110)AC(12108). Decay Modes: n. E(level),Γ: From (1983To19) ^{12}C(n,n):res. See also $E_x=12131$ keV *30* and Γ=125 keV *30* (1962Si04) ^{14}N(t,α) and 12108 keV *5* with Γ=81 keV *8* (1973Go03) ^{12}C(d,p). J^{π}: From phase-shift analysis of ^{12}C(n,n) in (1983To19).
12141 *2*	$1/2^{+}$	370.2 keV *17*	H Y	$\Gamma_{n0}/\Gamma=0.50$ *7* (1983To19) XREF: H(12141). Decay Modes: n, α. E(level): From (1994Wr01) ^{9}Be(α,n). See also $E_x=12139$ keV *65* (1983To19) ^{12}C(n,n):res. J^{π}: From phase-shift analysis of ^{12}C(n,n) in (1983To19). See previously reported $J^{\pi}=5/2^{-}$ from ^{9}Be(α,pol. n) (1969Kl09). Γ: From (1994Wr01). See also Γ=426 keV *70* (1983To19).
12189‡ *7*	$3/2^{-}$	130 keV *40*	H Op Y A	XREF: Others: AO, AR $\Gamma_{n0}/\Gamma=0.73$ *8* (1983To19) XREF: H(12180)p(12.3E3)Y(12268). Decay Modes: n, α. E(level): From the average of $E_x=12187$ keV *10* (1989Mi01) ^{13}C(e,e′) and 12190 keV *10* (1988Co05: priv. comm.) See also $E_x=12268$ keV *65*, Γ=186 keV *50* and $J^{\pi}=3/2^{-}$ from (1983To19) ^{12}C(n,n), which had been adopted in (1985Aj01). J^{π}: From phase-shift analysis of ^{12}C(n,n):res in (1983To19). Γ: From Γ=180 keV (1959Ha13) ^{12}C(n,n), 120 keV (1969Kl09) ^{9}Be(α,n), 109 keV *48* (1989Mi01) ^{13}C(e,e′) and 110 keV *50* (1988Co05) ^{13}C(p,p′).
12282 *6*	$1/2^{-}$	122 keV *22*	HI p	XREF: Others: AT, BE XREF: H(12229)p(12.3E3)BE(12300). Decay Modes: n, α. E(level),Γ: From (2021In04) ^{13}C(α,α′). E(level): A statistical ΔE=5 keV is given in the text; the evaluator assumes 3 keV uncertainty from the Grand Raiden focal plane energy calibration and added that in quadrature. J^{π}: From L=0 in ^{13}C(α,α′) (2021In04).
12420‡ *2*	$7/2^{-}$	226 keV *3*	H NOp Y A	XREF: Others: AO, AR, BH $\Gamma_{n0}/\Gamma=0.42$ *6* (1983To19) XREF: p(12.3E3)AO(12438)AR(12438). Decay Modes: n, α. E(level),Γ: From (1994Wr01) ^{9}Be(α,n). See also

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Adopted Levels, Gammas (continued)

^{13}C Levels (continued)

E(level)	J^{π}	$T_{1/2}$ or Γ	XREF	Comments
				E_x=12434 keV *46* (1983To19) ^{12}C(n,n) and 12438 keV *12* (1989Mi01) ^{13}C(e,e′).
				J^{π}: From phase-shift analysis of ^{12}C(n,n) in (1983To19).
12450?† *4*	1/2$^-$	<70 keV		XREF: Others: AT
				E(level),J^{π},Γ: From (2021In04) ^{13}C(α,α').
				J^{π}: From L=0 in ^{13}C(α,α') (2021In04).
				E(level): A statistical ΔE=3 keV is given in the text; the evaluator assumes 3 keV uncertainty from the Grand Raiden focal plane energy calibration and added that in quadrature.
12601?† *4*	1/2$^-$	<70 keV		XREF: Others: AT
				E(level),J^{π},Γ: From (2021In04) ^{13}C(α,α').
				J^{π}: From L=0 in ^{13}C(α,α') (2021In04).
				E(level): A statistical ΔE=3 keV is given in the text; the evaluator assumes 3 keV uncertainty from the Grand Raiden focal plane energy calibration and added that in quadrature.
12775?† *6*	1/2$^-$	<70 keV		XREF: Others: AT
				E(level),J^{π},Γ: From (2021In04) ^{13}C(α,α').
				J^{π}: From L=0 in ^{13}C(α,α') (2021In04).
				E(level): A statistical ΔE=5 keV is given in the text; the evaluator assumes 3 keV uncertainty from the Grand Raiden focal plane energy calibration and added that in quadrature.
≈13000#			HI M	XREF: Others: AM
				XREF: I(12830)M(13010).
				E(level): From (1996Ku07, 1968Le24) ^{9}Be(α,n).
				Decay Modes: γ, n, α.
				Γ: broad.
13.20×10^3 *10*	3/2$^-$	340 keV	G I	XREF: Others: AY
				Γα=294 keV; Γ_n=46 keV (2011Fr12)
				XREF: AY(13280).
				Decay Modes: n, α.
				E(level): From (2006Pr01) ^{7}Li(^{9}Be,α).
				J^{π},Γ: From R-matrix analysis of ^{9}Be(α,α) in (2011Fr12).
13420	(9/2$^-$)	41 keV *6*	FGHI M	XREF: Others: AR
				%n>0; %α>0 (2017Lo04)
				XREF: F(13.2E3).
				Decay Modes: n, α.
				E(level): From (1973Go15) ^{9}Be(α,α).
				J^{π}: From (1973Go15) ^{9}Be(α,α), where 9/2$^-$ was deduced by comparison of the resonance shapes for other J^{π}=9/2$^-$ resonances, and from (2017Lo04) R-matrix analysis of ^{9}Be(α,n) and ^{9}Be(α,α).
				Γ: From the average of values given in ^{9}Be(α,n) and ^{9}Be(α,α).
13.6×10^{3}# *2*	7/2$^-$	619 keV *50*	FGH O Y	XREF: Others: AA, AM
				Γα/Γ=0.86; Γ_n/Γ=0.14 (2011Fr12)
				Decay Modes: γ, n, α.
				E(level): From (2006Pr01) ^{7}Li(^{9}Be,α).

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Adopted Levels, Gammas (continued)

^{13}C Levels (continued)

E(level)	J^{π}	$T_{1/2}$ or Γ	XREF	Comments
				Γ: From (1985To02) ^{12}C(n,n′). J^{π}: From polarization data and phase-shift analysis of ^{12}C(n,n),(pol. n,$n_{0,1}$) in (1985To02).
13760[#]	$5/2^{+}$	77 keV *30*	GHI	XREF: Others: AM, AO, AR Γα/Γ=0.306; Γ_n/Γ=0.694 (2011Fr12) Decay Modes: γ, n, α. E(level): From (2011Fr12) ^{9}Be(α,α). J^{π}: From R-matrix analysis of ^{9}Be(α,α) in (2011Fr12). Γ: From (1998Le17) ^{9}Be(^{7}Li,t). See also Γ=117 keV (2012Wh01) ^{9}Be(^{7}Li,t) and Γ=335 keV (2011Fr12).
13920?[†] *30*		100 keV *30*	I	E(level),Γ: From (1998Le17) ^{9}Be(^{7}Li,t).
14.13×10^{3}	$(3/2^{-},5/2^{-})$	160 keV *20*	FGHI M p Y	XREF: Others: AB, AR Γα/Γ≈1; Γ_n/Γ>0 (2011Fr12) XREF: F(14.2E3)M(14080)Y(14167)AB(14E3). Decay Modes: n, α. E(level): From (1988Co05) ^{13}C(p,p′). Γ: From (1998Le17) ^{9}Be(^{7}Li,t). J^{π}: Polarization data and phase-shift analysis of ^{12}C(n,n),(pol. n,$n_{0,1}$) in (1985To02) indicate $J^{\pi}=3/2^{-}$ while an R-matrix analysis of ^{9}Be(α,α) in (2011Fr12) indicates $J^{\pi}=5/2^{-}$. See extensive discussion and comparative fits in (2011Fr12). In (2002Mi32,2003Mi34) known levels were surveyed and, based on level spacings, they suggest this state is the $J^{\pi}=9/2^{-}$ member of a rotational band.
14390[‡] *15*	$7/2^{-}$	282 keV *65*	GHI	XREF: Others: AO, AR Γα/Γ=0.108; Γ_n/Γ=0.892 (2011Fr12) XREF: I(14360). Decay Modes: n, α. E(level),Γ: From (1989Mi01) ^{13}C(e,e′). J^{π}: From R-matrix analysis of ^{9}Be(α,α) in (2011Fr12,2018Lo07). See also $J^{\pi}=7/2^{(+)}$ from (1973Go15) ^{9}Be(α,α_0), and see $J^{\pi}=(1/2,5/2)^{-}$ from (1973De14) ^{9}Be(α,α_0).
14.5×10^{3}[†] *1*	$(1/2,3/2)^{+}$			XREF: Others: AT Decay Modes: (n). E(level),J^{π},Γ: From L=1 in (2021In04) ^{13}C(α,α′). E(level): (1985To02) suggests two broad and overlapping $J^{\pi}=3/2^{-}$ states in this region. Γ: broad.
14582[‡] *10*	$9/2^{+}$	227 keV *41*	FGHI	XREF: Others: AO, AR %n=14; %α=86 (2011Fr12) Γα/Γ=0.856; Γ_n/Γ=0.144 (2011Fr12) Decay Modes: n, α.

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Adopted Levels, Gammas (continued)

^{13}C Levels (continued)

E(level)	J^{π}	$T_{1/2}$ or Γ	XREF	Comments
				E(level),Γ: From (1989Mi01) ^{13}C(e,e′). J^{π}: From R-matrix analyses of ^{9}Be(α,α) in (2011Fr12,2018Lo07).
14819[†]			M	XREF: Others: AP E(level): From (1991Br26) ^{10}B(α,p) and ^{10}B(^{9}Be,^{6}Li).
14983[#] *10*	7/2^{-}	380 keV *53*	FGH Y	XREF: Others: AM, AO, AR $\Gamma\alpha/\Gamma$=0.586; Γ_{n}/Γ=0.414 (2011Fr12) XREF: H(14941)Y(14997). Decay Modes: γ, n, α. E(level),Γ: From (1989Mi01) ^{13}C(e,e′). J^{π}: From polarization data and phase-shift analysis of ^{12}C(n,n),(pol. n,$n_{0,1}$) in (1985To02).
15108.7 *9*	3/2^{-}	5.49 keV *25*	GHI U Y	XREF: Others: AM, AO, AR, AS, AT, AY, BA, BH T=3/2 (1966Ba13,1967Pe07,1969Ad01) $\Gamma_{\gamma 0}$=23.2 eV *15* $\Gamma_{\gamma 1}$=4.12 eV *74* (1977Ma16) $\Gamma_{\alpha 0}$=0.104 keV *28* (1978Hi06) Γ_{n0}=0.38 eV *10* Γ_{n}: Γ_{n1}=1.43 eV *18* and Γ_{n2}=0.14 eV *10*. Decay Modes: γ, n, α. E(level): From average of E_{x}=15109.3 keV *14* (1978Hi06) ^{9}Be(α,α) and 15108.2 keV *12* (1987Hi03) ^{12}C(n,n). J^{π}: From M1+E2 from 1/2^{-} in ^{13}C(e,e′) (1989Mi01). Γ: From (1978Hi06) ^{9}Be(α,α). $\Gamma_{\gamma 0}$: Obtained using the average of $\Gamma_{\gamma 0}/\Gamma$=0.0053 *6* (1968Co27) and $\Gamma_{\gamma 0}/\Gamma$=0.00396 *30* (1977Ma16), which yields $\Gamma_{\gamma 0}/\Gamma$=0.00423 *27*; this value with Γ=5.49 keV *25* (1978Hi06) gives $\Gamma_{\gamma 0}$=23.2 eV *18*; this value is then averaged with $\Gamma_{\gamma 0}$(M1)=22.7 eV *27* and $\Gamma_{\gamma 0}$(E2)=0.59 eV *11* from (1969Wi22,1970Wi04) to obtain $\Gamma_{\gamma 0}$=23.2 eV *15*. The transition widths to other levels are determined in (1977Ma16). Γ_{γ}: $\Gamma_{\gamma(2+3)}$=18.2 eV *24* and $\Gamma_{\gamma\rightarrow 7.55}$ MeV<0.9 eV (1977Ma16). Γ_{n}: See Γ_{n0}/Γ=0.070 *18*, Γ_{n1}/Γ=0.261 *30* and Γ_{n2}/Γ=0.026 *18* (1973Ad02).
15270	(5/2^{-},9/2^{+})	493 keV	FGH Y	$\Gamma\alpha$=154 keV; Γ_{n}=339 keV (2011Fr12) Decay Modes: n, α. E(level),Γ: From (2011Fr12) ^{9}Be(α,α). J^{π}: From (2011Fr12,1985To02). In (1991Aj01) the resonance is listed with J^{π}=9/2^{+}, based on polarization data and phase-shift analysis of ^{12}C(n,n),(pol. n,$n_{0,1}$) in (1985To02), but the R-matrix analysis of (2011Fr12) ^{9}Be(α,α) find that interference from a J^{π}=9/2^{+} resonance is

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Adopted Levels, Gammas (continued)

^{13}C Levels (continued)

E(level)	J^{π}	$T_{1/2}$ or Γ	XREF	Comments
				incompatible with their finding of a $J^{\pi}=9/2^{+}$ resonance at $E_x=14582$; they assign $J^{\pi}=5/2^{-}$. The issue is unresolved.
15526‡ *11*	$3/2^{-}$	147 keV *23*	H M Y	XREF: Others: AO, AR XREF: Y(15458). Decay Modes: n, α. E(level),Γ: From (1989Mi01) ^{13}C(e,e′). J^{π}: From polarization data and phase-shift analysis of ^{12}C(n,n),(pol. n,$n_{0,1}$) in (1985To02).
16080‡ *7*	$7/2^{+}$	148 keV *13*	FGH M O Y	XREF: Others: AO, AP, AR, AS, AT Γα/Γ=0.15; Γ_n/Γ=0.85 (2011Fr12) XREF: H(16023)Y(16103)AP(16050). Decay Modes: n, α. E(level),Γ: From (1986Hi06) ^{13}C(e,e′). J^{π}: From R-matrix analysis in (2011Fr12) ^{9}Be(α,α), a comparison (1981Pe08) of the ^{13}C(^{3}He,t) with the ^{13}C(^{3}He,^{3}He)^{13}N*(16.0 MeV: $7/2^{+}$) angular distributions, and from E3+M4 from $1/2^{-}$ in ^{13}C(e,e′) (1986Hi06).
16.1×10^{3}†‡ *1*	$(1/2,3/2)^{+}$			XREF: Others: AO, AT XREF: AO(16183). E(level),J^{π}: From L=1 in (2021In04) ^{13}C(α,α′). See also E_x=16183 keV and Γ=40 keV *20* (1989Mi01) ^{13}C(e,e′).
16152 *35*	$(5/2^{-})$	240 keV	GH Y	XREF: Others: AR Γα/Γ=0.091; Γ_n/Γ=0.909 (2011Fr12) XREF: Y(16103). Decay Modes: n, α. E(level),Γ: From (1966Mi12) ^{9}Be(α,n). J^{π}: From R-matrix analysis in (2011Fr12) ^{9}Be(α,α). See other discussion on polarization data and phase-shift analysis in (1985To02) ^{12}C(n,n).
16948# *35*		330 keV	F H	XREF: Others: AM, AO, AR XREF: F(16.8E3). Decay Modes: γ, n, α. E(level),Γ: From (1966Mi12) ^{9}Be(α,n).
17363 *69*		190 keV	H	XREF: Others: AR Decay Modes: n, α. E(level),Γ: From (1966Mi12) ^{9}Be(α,n).
17533 *3*		17 keV *6*	Y	XREF: Others: AP T=(3/2) (1987Hi03) XREF: AP(17500). Decay Mode: n. E(level),Γ: From (1987Hi03) ^{12}C(n,n).
17709 *35*	$(3/2^{-},5/2)$	225 keV	H	XREF: Others: AO, AR Decay Modes: n, α. E(level): From (1966Mi12) ^{9}Be(α,n). J^{π}: From (1988Co05) ^{13}C(p,p′), L=2 or 3 were consistent, but $7/2^{+}$ was considered unlikely because of the shape at small angles. Γ: From average of Γ=170 (1965Gr22) and 280 (1966Mi12) from ^{9}Be(α,n). See also

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Adopted Levels, Gammas (continued)

^{13}C Levels (continued)

E(level)	J$^{\pi}$	T$_{1/2}$ or Γ	XREF	Comments
				Γ=300 keV (1971Be51). E(level): In (1981Aj01) E$_x$=17699 keV *5* is listed; the origin of this value is untraceable.
17920?# *50*	(9/2$^+$,7/2$^+$)		M	XREF: Others: AM, AP Decay Modes: γ, n. E(level),J$^{\pi}$: From (1982Se04) ^{13}C(π,π); angular distributions are consistent with ΔJ=4, ΔL=3 and ΔS=1 amplitudes indicating (9/2$^+$,7/2$^+$).
18081 *3*		12 keV *7*	Y	T=(3/2) (1987Hi03) Decay Mode: n. E(level),Γ: From (1987Hi03) ^{12}C(n,n).
18332 *35*		305 keV	H	XREF: Others: AO, AR Decay Modes: n, α. E(level): From (1965Gr22) ^{9}Be(α,n). Γ: From Γ=210 keV (1965Gr22) and Γ=400 keV (1966Mi12) in ^{9}Be(α,n).
18497?†‡ *10*		91 keV *23*		XREF: Others: AO E(level),Γ: From (1989Mi01) ^{13}C(e,e′).
18699# *5*	(3/2$^+$,5/2$^+$)	98 keV *11*	H	XREF: Others: AN, AO, AR XREF: H(18750)AN(18600). Decay Modes: γ, n, p, α. E(level),Γ: From (1989Mi01) ^{13}C(e,e′). J$^{\pi}$: From (1988Co05) ^{13}C(p,p) where the angular distribution suggests the state corresponds to ^{12}C(18.3 MeV: 2$^-$;T=0)⊗1$p_{1/2}$ and where the ^{12}C state is that reported in (1983Ba57).
19.0×10^3 *1*		≈600 keV	F P	XREF: F(18.7E3). Decay Modes: α. E(level),Γ: From ^{10}B(^{10}B,^{7}Be) and ^{10}B(^{10}B,α+^{9}Be) (2023Je05).
19512	5/2$^-$	≥500 keV	T Y	XREF: Others: AO, AR XREF: T(19692)AO(19300). Decay Modes: n, d. E(level),Γ: From (1987To03) ^{12}C(n,n). J$^{\pi}$: From polarization data and phase-shift analysis of ^{12}C(n,n),(pol. n,n$_{0,1}$) in (1987To03). See also (1980Th07).
19.74×10^3?	(3/2,5/2,7/2)$^+$	200 keV	E	T=3/2 Decay Mode: p. E(level),J$^{\pi}$,Γ: From (2008Sk06) ^{1}H(^{12}B,p). J$^{\pi}$: From L=0,2 in ^{1}H(^{12}B,p). J=3/2$^+$ is preferred.

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)

^{13}C Levels (continued)

E(level)	J^{π}	$T_{1/2}$ or Γ	XREF	Comments
19.9×10^{3}		≈600 keV	E ST	XREF: Others: AA, AR XREF: E(19740)AA(19798). Decay Modes: p, n, d. E(level),Γ: From (1967Di01) ^{11}B(d,n).
20021‡ *12*		232 keV *27*	T	XREF: Others: AO, AR Decay Modes: n, d. E(level),Γ: From (1989Mi01) ^{13}C(e,e′).
20057 *4*		11 keV *8*	Y	T=(3/2) (1987Hi03) Decay Mode: n. E(level),Γ: From (1987Hi03) ^{12}C(n,n).
20111	$1/2^{-}$	1090 keV	Y	XREF: Others: AO Γ_{n0}/Γ=0.16 (1987To03) XREF: AO(20100). Decay Mode: n. E(level),Γ: From (1987To03) ^{12}C(n,n). See also E_x=20.1 MeV and Γ=0.7 MeV from (1971Be51) ^{13}C(e,e′). J^{π}: From polarization data and phase-shift analysis of ^{12}C(n,n),(pol. n,$n_{0,1}$) in (1987To03).
20111	$5/2^{+}$	440 keV	Y	Γ_{n0}/Γ=0.05 (1987To03) Decay Mode: n. E(level),Γ: From (1987To03) ^{12}C(n,n). J^{π}: From polarization data and phase-shift analysis of ^{12}C(n,n),(pol. n,$n_{0,1}$) in (1987To03).
20.13×10^{3}?	$(5/2,1/2,3/2)^{-}$	120 keV	E	T=3/2 Decay Mode: p. E(level),J^{π},Γ: From (2008Sk06) ^{1}H(^{12}B,p). J^{π}: From L=1 in ^{1}H(^{12}B,p). $J=5/2^{-}$ is preferred.
20185	$7/2^{+}$	630 keV	Y	Γ_{n0}/Γ=0.11 (1987To03) Decay Modes: n. E(level),J^{π},Γ: From polarization data and phase-shift analysis of ^{12}C(n,n),(pol. n,$n_{0,1}$) in (1987To03).
20296	$7/2^{-}$	1.56 MeV	Y	Γ_{n0}/Γ=0.08 (1987To03) Decay Mode: n. E(level),Γ: From (1987To03) ^{12}C(n,n). J^{π}: From polarization data and phase-shift analysis of ^{12}C(n,n),(pol. n,$n_{0,1}$) in (1987To03).
20.30×10^{3}?	$(5/2,3/2,7/2)^{+}$	170 keV	E	%p≤100 (2008Sk06) T=3/2 Decay Mode: p. E(level),J^{π},Γ: From (2008Sk06) ^{1}H(^{12}B,p).

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Adopted Levels, Gammas (continued)

^{13}C Levels (continued)

E(level)	J^{π}	$T_{1/2}$ or Γ	XREF	Comments
				J^{π}: From L=0,2 in ^{1}H(^{12}B,p). J=5/2^{+} is preferred.
20342	9/2^{+}	320 keV	Y	Γ_{n0}/Γ=0.06 (1987To03) Decay Modes: n. E(level),Γ: From (1987To03) ^{12}C(n,n). J^{π}: From polarization data and phase-shift analysis of ^{12}C(n,n),(pol. n,$n_{0,1}$) in (1987To03).
20429†‡ *8*		112 keV *23*		XREF: Others: AO, AR E(level),Γ: From (1989Mi01) ^{13}C(e,e′).
20.52×10^{3} *7*	(5/2^{-})	510 keV *70*	RST XYZ	XREF: Others: AO XREF: R(20200)Z(20500). Decay Modes: γ, p, n, d. E(level),Γ: From (1984Wo05) ^{12}C(n,γ). See (1984Wo05) for discussion on penetrability effects that impact the ^{11}B(d,nγ) results of (1958Ka31): E_x=20521 keV *8* and Γ=115 keV *10*, and (1964Ku09): E_x=20521 keV *16* and Γ=120 keV. In (1984Wo05) primary and secondary doorway states at E_x=20.52 and 21.05 MeV with Γ=0.51 MeV *7* and 4.2 MeV *4*, respectively, are discussed. E(level): In (1985Au10) ^{11}B(pol. d,γ) the two doorway states are found at E_x=20.20 MeV *7* and 20.57 MeV *84* with Γ=0.56 MeV *9* and 5.64 MeV *43*, respectively, which suggests a lower energy for the these states. J^{π}: From polarization data and phase-shift analysis of ^{12}C(n,n),(pol. n,$n_{0,1}$) in (1987To03).
20.93×10^{3}† *10*		0.24 MeV *10*		XREF: Others: AR E(level),Γ: From (1988Co05) ^{13}C(p,p′).
21050 *60*		4.2 MeV *4*	R X	XREF: Others: AM, AN XREF: R(20.57E3)X(21050)AM(20.8E3)AN(20700). Decay Modes: γ, p, n, d. E(level),Γ: From (1984Wo05) ^{12}C(n,γ). See comments on the E_x=20.52 MeV level.
21281 *15*		160 keV *15*	ST	XREF: Others: AO, AR Decay Modes: p, n, d. E(level),Γ: From (1958Ka31) ^{11}B(d,p). See also Γ=530 keV in (2003So24) ^{7}Li(^{9}Be,α) and Γ=400 keV (1971Be51) ^{13}C(e,e′).
21.3×10^{3}		530 keV	F	Decay Mode: α. E(level),Γ: From (2003So24) ^{7}Li(^{9}Be,α+^{9}Be).

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Adopted Levels, Gammas (continued)

^{13}C Levels (continued)

E(level)	J^{π}	$T_{1/2}$ or Γ	XREF	Comments
21466‡ *8*	$(9/2^+,7/2^+)$	268 keV *14*	M	XREF: Others: AB, AO, AP, AR %n=24; %p=76 (2022Ci07) T=(3/2) (1986Hi06) Γ_n/Γ=0.24 *5* Γ_{p0}/Γ<0.23; Γ_{p1}/Γ=0.69 *6* XREF: M(21400)AP(21370). Decay Modes: p, n. Γ: partial widths from (2022Ci07). Γ_p: $\Gamma_{p(2+3)}/\Gamma$=0.07 2. Γ_n: Decay is to $^{12}C^*$(15.11 MeV: $J^{\pi}=1^+$, T=1). T: T=3/2 is suggested by (2022Ci07) because of the strong neutron branch to $^{12}C^*$(15.1 MeV: T=1) state. E(level),Γ: From (1986Hi06,1989Mi01) ^{13}C(e,e′). J^{π}: From M4 from $1/2^-$ in ^{13}C(e,e′) in (1986Hi06); $9/2^+$ is strongly preferred. See also (1982Se04) ^{13}C(π,π) where angular distributions are consistent with ΔJ=4, ΔL=3 and ΔS=1 amplitudes indicating $(9/2^+,7/2^+)$, and see discussion in (1988Co05).
21703 *4*		18 keV *9*	Y	XREF: Others: AP T=(3/2) (1987Hi03) XREF: AP(21600). Decay Mode: n. E(level),Γ: From (1987Hi03) ^{12}C(n,n). J^{π}: See $J^{\pi}=(9/2,7/2)^+$ in (1982Se04) ^{13}C($\pi^{\pm},\pi^{\pm}$).
21814 *17*	≥5/2	144 keV *21*	P T	XREF: Others: AO, AR XREF: P(22.0E3). Decay Modes: n, d. E(level),Γ: From (1964Ku09) ^{11}B(d,n). J^{π}: From (1988Co05) ^{13}C(p,p) where a uniform magnitude in the angular distribution suggests a high spin.
22.2×10^3 *1*	≤5/2	1.1 MeV *5*	R T Z	XREF: Others: AO, AR XREF: Z(22000). Decay Modes: γ, p, n, d. E(level),Γ: From (1988Co05) ^{13}C(p,p′). J^{π}: From (1988Co05) ^{13}C(p,p′) where forward peaking in the angular distribution suggests low spin.
23.0×10^3# *2*	$(5/2^+,3/2^+)$	≈1.5 MeV	Y	XREF: Others: AA, AN, AO, AR XREF: AN(23500)AO(24700). Decay Modes: γ, n, p. E(level),J^{π}: From (1970De14) ^{12}C(n,n) where the resonance is best fit with a $d_{5/2}$ component, but where $d_{3/2}$ and $f_{7/2}$ could not be ruled out. See also (1988Co05) ^{13}C(p,p′) where forward peaking in the angular distribution suggests low spin (≤5/2). Γ: See references in ^{12}C(n,n).
23.6×10^3 *1*		≈1.1 MeV	F P	XREF: F(23.9E3).

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Adopted Levels, Gammas (continued)

^{13}C Levels (continued)

E(level)	$T_{1/2}$ or Γ	XREF		Comments
				Decay Mode: α. E(level): From ^{10}B(^{10}B,α+^{9}Be) (2023Je05). Γ: From ^{7}Li(^{9}Be,α+^{9}Be) (2003So24,2004So19,2004So35).
24×10^{3}# *2*	10 MeV *2*			XREF: Others: AM, AN, AO XREF: AN(24500)AO(24700). Decay Modes: γ, p, n. E(level),Γ: From (1957Co57) ^{13}C(γ,n),(γ,p).
26000?#				XREF: Others: AN, AO XREF: AO(25500). Decay Modes: γ, p. E(level): From (1983Zu02) ^{13}C(γ,p).
26791			T	Decay Modes: n, d. E(level): From (1965Al17) ^{11}B(d,nγ).
27466		L	T	XREF: Others: AO XREF: L(28025)AO(27300). Decay Modes: p, n, d, t. E(level): From (1965Al17) ^{11}B(d,nγ).
≈30×10^{3}#				XREF: Others: AM, AO XREF: AO(28100). Decay Modes: γ, n. E(level): From (1979Ju01) ^{13}C(γ,n).

† Decay mode not specified.
‡ In (1991Aj01), γ is listed as a decay mode based on the level′s population in ^{13}C(e,e′). This interpretation is not followed here.
# This level is populated in either photo-neutron or photo-proton production; therefore γ is listed as a decay mode, but no decay γ ray is listed since no decay transitions are observed.

Adopted Levels, Gammas (continued)

γ(^{13}C)

Additional information 1.

E_i(level)	J_i^π	E_γ	I_γ	E_f	J_f^π	Mult.	δ	α†	Comments
3089.451	1/2+	3089.049 *20*	100	0	1/2−	[E1]		1.28×10^{-3} *2*	α(K)=1.959×10^{-7} *27*; α(L)=8.98×10^{-9} *13* α(IPF)=0.001284 *18* B(E1)(W.u.)=0.0427 *39* E_γ: From (1980Wa24) ^{10}B(α,pγ). See also E_γ=3088.95 keV *19* from ^{12}C(n,γ):E=th (1982Mu14,2008FiZZ).
3684.496	3/2−	595.22 *8*	0.75 *3*	3089.451	1/2+	[E1]			B(E1)(W.u.)=0.0382 *25* E_γ: From E_γ=595.5 *2* (1982Mu14) and 595.16 keV *9* (2008FiZZ). from ^{12}C(n,γ):E=th. I_γ: From (1982Mu14).
		3684.01 *6*	100.00 *3*	0	1/2−	[M1+E2]	−0.094 *9*	9.10×10^{-4} *13*	α(K)=1.996×10^{-7} *28*; α(L)=9.15×10^{-9} *13* α(IPF)=0.000910 *13* B(M1)(W.u.)=0.384 *20*; B(E2)(W.u.)=3.5 *7* Mult.,δ: From (1980Wa24) who used B(E2) from (1970Wi04) ^{13}C(e,e′) and τ_m to obtain δ=−0.094 *9*. See also δ=−0.096 *+30−21* (1966Po11), δ=−0.154 *54* (1973Go02) and δ=−0.100 *8* (1969Wi22, 1970Wi04). E_γ: From E_γ=3684.0 *2* (1982Mu14), 3683.94 keV *17* (1967Pr10), and 3684.02 keV *7* (2008FiZZ) from ^{12}C(n,γ):E=th. See also E_γ=3685.041 keV *20* (1991Li12) ^{13}C(γ,γ). I_γ: From (1982Mu14). Mult.: From (1980Wa24).
3853.796	5/2+	169.300 *4*	58.1@ *10*	3684.496	3/2−	[E1]		1.47×10^{-4} *2*	α(K)=0.0001402 *20*; α(L)=6.42×10^{-6} *9* B(E1)(W.u.)=0.01065 *28* E_γ: From (1980Wa24) ^{10}B(α,pγ) and ^{12}C(d,pγ). See also E_γ=169.356 keV *20* (1984Sc09).
		764.316 *10*	1.92@ *6*	3089.451	1/2+	[E2]			B(E2)(W.u.)=1.67 *7* E_γ: From (1980Wa24) ^{10}B(α,pγ) and ^{12}C(d,pγ).
		3854 *1*	100.0@ *10*	0	1/2−	[E3+M2]	+0.12 *3*	7.29×10^{-4} *10*	α(K)=2.406×10^{-7} *34*; α(L)=1.102×10^{-8} *15* α(IPF)=0.000729 *10* B(M2)(W.u.)=0.473 *12*; B(E3)(W.u.)=10.8 *49* Mult.,δ: From (1966Po11) γγ angular correlations in ^{12}C(d,pγ). E_γ: From (1969Li07). 3853.183 keV *21* is deduced from E_x and level-energy difference.
(4946.33)	1/2+	1261.74# *4*	47.96# *65*	3684.496	3/2−				

Adopted Levels, Gammas (continued)

γ(^{13}C) (continued)

E_i(level)	J_i^π	E_γ	I_γ	E_f	J_f^π	Mult.	δ	Comments
(4946.33)	1/2$^+$	1856.89[#] *19*	0.24[#] *2*	3089.451	1/2$^+$			
		4945.32[#] *6*	100.0[#] *14*	0	1/2$^-$			
7492	(7/2$^+$)	7490[‡]		0	1/2$^-$	[E3]		Γ_γ: $\Gamma\gamma/\Gamma$ from (1971HiZF) ^{11}B(^{3}He,pγ).
7547	5/2$^-$	7545[‡]		0	1/2$^-$	[E2+M3]	0.009 *6*	Γ_γ=0.110 eV *15* (1980Ho11) B(E2)(W.u.)=3.2 *2*; B(M3)(W.u.)=35 *21* Γ_γ: From (1980Ho11) ^{13}C(γ,n$_0$). The decay γ ray is reported in (1971HiZF) ^{11}B(^{3}He,pγ). δ: Deduced from Γ_γ(E2)=0.115 eV *7* and Γ_γ(M3)=1.01E−5 eV *61*, which are the electromagnetic partial widths determined in (1969Wi22, 1970Wi04) ^{13}C(e,e′).
8866	1/2$^-$	8863[‡]		0	1/2$^-$	[M1]		Γ_γ=5.4 eV *5* (1980Ho11) B(M1)(W.u.)=0.374 *35* $\Gamma_{\gamma 0}$: From (1980Ho11) ^{13}C(γ,n$_0$). The decay γ ray is observed in (2001Ne09) ^{16}O(n,$\alpha\gamma$).
15108.7	3/2$^-$	7559[‡]	<3.9	7547	5/2$^-$	[M1]		Γ_γ<0.9 eV B(M1)(W.u.)<0.101 I_γ: From (1977Ma16).
		11419[‡]	78 *10*	3684.496	3/2$^-$	[M1]		B(M1)(W.u.)≤0.589 I_γ: From (1977Ma16). Γ: $\Gamma\gamma_{2+3}$=18.2 eV *24* unresolved.
		12013[‡]	17.8 *32*	3089.451	1/2$^+$	[E1]		Γ_γ=4.12 eV *74* B(E1)(W.u.)=6.3×10^{-3} *12* I_γ: From (1977Ma16).
		15099[‡]	100.0 *65*	0	1/2$^-$	[M1+E2]	0.161 *17*	Γ_γ=23.2 eV *15* B(M1)(W.u.)=0.317 *21*; B(E2)(W.u.)=0.51 *11* I_γ: From $\Gamma_{\gamma 0}$ deduced from analysis of (1968Co27, 1977Ma16, 1978Hi06, 1969Wi22, 1970Wi04). Mult.,δ: From $\Gamma_{\gamma 0}$(M1)=22.7 eV *27* and $\Gamma_{\gamma 0}$(E2)=0.59 eV *11* (1969Wi22, 1970Wi04) ^{13}C(e,e′). See also δ^2=0.009 *+18−8* and δ=0.095 *7* (1968Di04) from ^{12}C(p,γ), which is used in earlier studies of the analog transition since the ^{13}C and ^{13}N δs are expected to be similar.
20.52×10^3	(5/2$^-$)	20503[‡]		0	1/2$^-$			Decay transition reported in (1984Wo05) ^{12}C(n,γ) and (1985Au10) ^{11}B(pol. d,γ).
21050		21037[‡]		0	1/2$^-$			Decay transition reported in (1984Wo05) ^{12}C(n,γ) and (1985Au10) ^{11}B(d,γ).
22.2×10^3	≤5/2	22180[‡]		0	1/2$^-$			Decay transition reported in (1981Ka16) ^{11}B(d,γ).

$^{13}_{6}C_{7}$-20

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

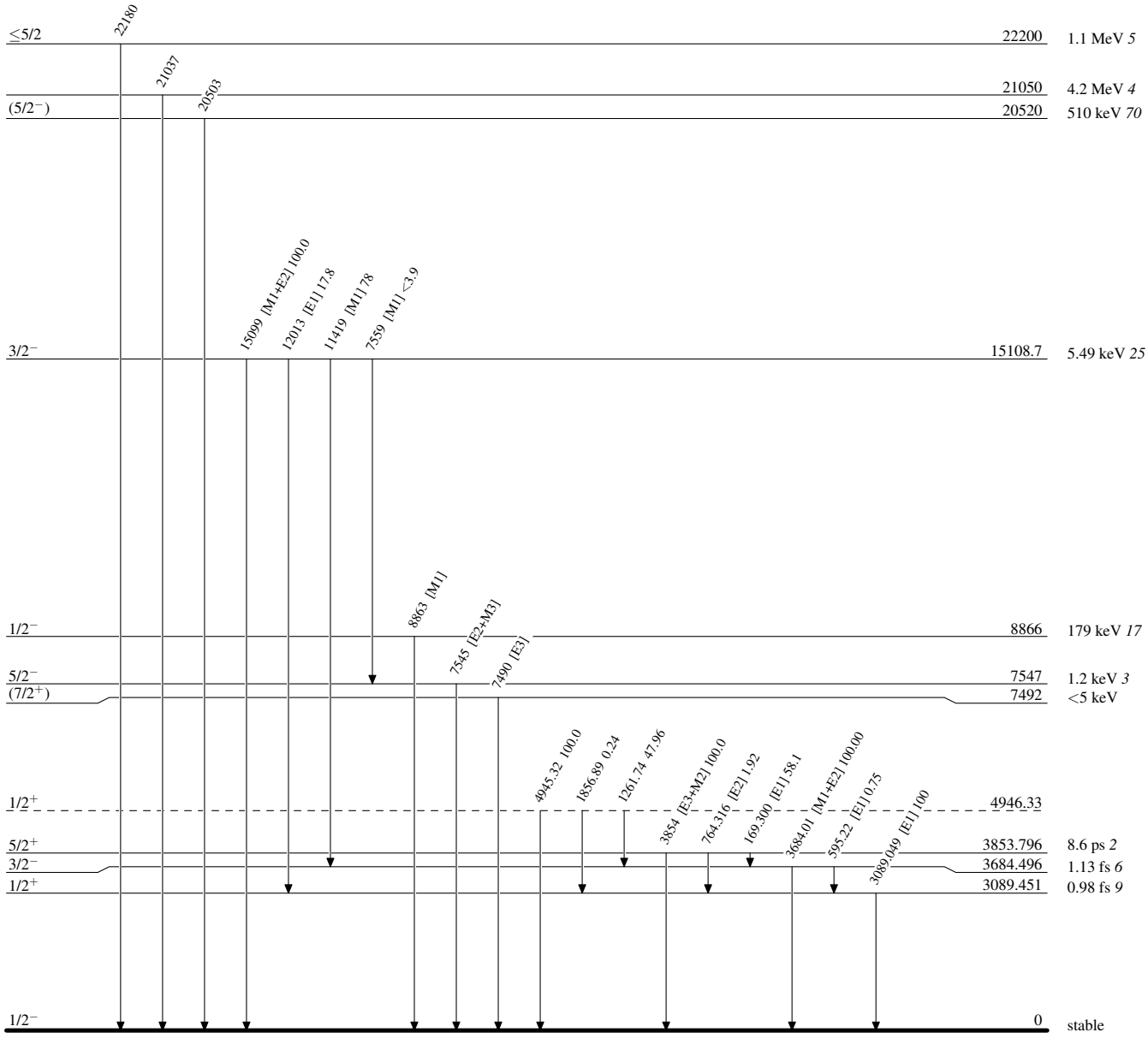
† Additional information 2.
‡ From level-energy difference.
# From $^{12}C(n,\gamma)$:E=thermal.
@ From (1980Wa24).

$^{13}_{6}C_{7}$-21

Adopted Levels, Gammas

Level Scheme

Intensities: Relative photon branching from each level



$^{13}_{6}C_{7}$