$^{12}C(^{12}C,p\gamma)$ 2013Je04,1977Ke05,1979Lu02

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	M. S. Basunia[#], A. Chakraborty[##]	NDS 171,1 (2021)	1-Jun-2020

Other references: 2018Ji01,2017Mu04,2007Sp03,2006Ba64,2006Ag08, 2005Bb06,2005Je06,1990Ti02,1984FO12,1981Zy01,1980An08,1980Ke15, 1977Ev02,1977Ke02,1976Ba05,1976Ba53,1975Jo03,1975Ke07,1975Gr25, 1975Co14,1975Co10,1974Vo02,1974Va01,1974Ke16,1973Fr07,1972Fr01, 1973Wa26.

2013Je04: E(^{12}C)=16, 22 MeV provided by the ATLAS accelerator at ANL. Target=160 μg/cm^2 ^{12}C. Measured Eγ, Iγ, $\gamma\gamma$-coin, $\gamma\gamma(\theta)$(DCO), $T_{1/2}$ using the Gammasphere array and the fractional Doppler shift technique. Deduced levels, J, π, multipolarity, bands. Comparison with shell-model calculations.

1977Ke05: $^{12}C(^{12}C,p)$ E=38.82 MeV. Measured p$\gamma(\theta$,t), DSA.

1979Lu02: $^{12}C(^{12}C,p)$ E=14.3 MeV. Measured Eγ, Ep, pγ coincidence.

1990Ti02: $^{12}C(^{12}C,p)$ E=15-24 MeV. Measured DSA. coincidence.

1984Fo12: $^{12}C(^{12}C,p)$ E=39 MeV. Magnetic spectrometer $\sigma(\theta)$, $\sigma(E_p)$.

1976Ba05: $^{12}C(^{12}C,p)$ E=38.6 MeV. Measures p$\gamma(\theta)$, DSA.

1975Jo03, 1972Fr01: $^{12}C(^{12}C,p)$ E=28.2 MeV. Measures p$\gamma(\theta)$, linear polarization.

1973Wa26: $^{12}C(^{12}C,p)$ E=19 MeV. Measured Eγ, DSA.

^{23}Na Levels

E(level)[†]	J$^\pi$[@]	$T_{1/2}$[&]	σ(tot)[a]	Comments
0.0[b]	3/2$^+$		82 *6*	
439.82[b] *15*	5/2$^+$	1.22 ps *7*	83 *7*	$T_{1/2}$: From mean lifetime of 1.76 ps *10*: weighted average of 1.80 ps *11* (1990Ti02) and 1.63 ps *20* (1973Wa26).
2075.9[b] *4*	7/2$^+$		126 *7*	
2391.1 *5*	1/2$^+$		46 *4*	
2640.5[c] *6*	1/2$^-$		54 *5*	E(level): Other: 2657 *7* (1984Fo12).
2703.2[b] *4*	9/2$^+$	0.092 ps *8*	124 *6*	$T_{1/2}$: From mean lifetime of 0.133 ps *12*: weighted average of 0.139 ps *10* (1990Ti02) and 0.11 ps *2* (1973Wa26).
2982.1 *5*	3/2$^+$		85 *6*	
3677.8[c] *5*	3/2$^-$		62 *5*	
3847.8[c] *4*	5/2$^-$		101 *6*	E(level): Other: 3859 *5* (1984Fo12).
3914.5 *4*	5/2$^+$		95 *6*	
4417[‡] *10*			40 *5*	
4774.8 *5*	7/2$^+$			
5384[‡] *5*			70 *5*	
5533.7[b] *5*	11/2$^+$	10.4 fs *55*	380 *12*	J$^\pi$: From 1975Jo03, based on particle γ-ray linear polarization and angular correlation measurements of 3458γ. $T_{1/2}$: From mean lifetime of 15 fs *8*: Weighted average of 20 fs *12* (1977Ke05), and 12 fs *8* (1973Fr07).
5754[‡#] *6*			65 *5*	
5925.5 *5*	7/2$^+$		119 *6*	E(level): Other: 5943 *7* (doublet) (1984Fo12).
5965.9 *9*	3/2$^-$			
6041.5[c] *6*	7/2$^-$		102 *6*	E(level): Other: 6032 *5* (1984Fo12).
6114.6 *6*	11/2$^+$	35 fs *9*	1103 *20*	$T_{1/2}$: From τ=50 fs *13*: weighted average of 39 fs *13* (1977Ke05) and 75 fs *20* (1973Fr07).
6234.7[b] *6*	13/2$^+$	16 fs *8*	345 *10*	E(level): Other: 6229 *4* (doublet) (1984Fo12). $T_{1/2}$: From mean lifetime of 23 fs *12*: Weighted average of 19 fs *18* (1977Ke05) and 24 fs *12* (1973Fr07).
6353.8[c] *5*	9/2$^-$	21 fs *5*	24.5 *8*	J$^\pi$: Q γ to 5/2$^-$, RUL (1973Fr07 – (^{12}C,pγ)), and band assignment. $T_{1/2}$: From mean lifetime of 30 fs *7* (1972Fr01).
6577.6 *6*	9/2$^+$		82 *6*	E(level): Other: 6582 *7* (1984Fo12).

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$^{12}C(^{12}C,p\gamma)$ 2013Je04,1977Ke05,1979Lu02 (continued)

^{23}Na Levels (continued)

E(level)[†]	J^{π}[@]	$T_{1/2}$[&]	σ(tot)[a]	Comments
6617.9 *8*	(7/2$^+$)		84 *5*	E(level): Other: 6610 *8* (1984Fo12).
6730[‡] *7*			51 *4*	
6820.0 *8*	5/2$^-$		55 *4*	E(level): Other: 6825 *8* (1984Fo12).
6880.6 *11*	(7/2,11/2)		83 *5*	E(level): Other: 6874 *6* (1984Fo12).
6936[‡#] *6*			110 *6*	
7054.7 *11*	(5/2,13/2)		151 *7*	E(level): Other: 7075 *4* (doublet) (1984Fo12).
7125.3 *6*	9/2$^+$		185 *8*	E(level): Other: 7119 *5* (1984Fo12).
7184.9 *6*	9/2$^+$		122 *6*	E(level): Other: 7176 *8* (doublet) (1984Fo12).
7267.7 *6*	13/2$^+$	18 fs *6*	835 *17*	E(level): Other: 7272 *3* (doublet) (1984Fo12). $T_{1/2}$: From mean lifetime of 26 fs *8* (1977Ke05). Other: <21 fs (τ <30 fs (1973Fr07)).
7279.9 *11*	(1/2,9/2)			
7393.0 *6*	11/2$^+$	<18 fs	655 *15*	E(level): Other: 7398 *4* (doublet) (1984Fo12). $T_{1/2}$: From <21 fs (τ <30 fs (1973Fr07)).
7477.0 *11*	(1/2,9/2)			
7489.0 *7*	3/2$^-$			
7563.6 *11*	(5/2,9/2)		121 *6*	E(level): Other: 7566 *3* (1984Fo12).
7686.6 *7*	9/2$^+$		218 *8*	E(level): Other: 7697 (1984Fo12).
7750.6 *11*	5/2$^+$			
7835.3 *7*	7/2$^+$			
7872.7 *8*	3/2$^+$		344 *10*	E(level): Other: 7863 *6* (1984Fo12).
7973.7 *11*	(3/2,11/2)	<28 fs		$T_{1/2}$: From mean lifetime <40 fs (1973Fr07).
7991.0 *6*	11/2$^+$		274 *10*	E(level): Other: 7987 *6* (1984Fo12).
8068[‡#] *4*			112 *6*	
8301.3 *11*	(7/2$^-$)	<59 fs		$T_{1/2}$: From mean lifetime <85 fs (1973Fr07).
8318.9 *9*	9/2$^+$		532 *13*	E(level): Other: 8326 *4* (1984Fo12).
8432.0 *11*	(5/2,13/2)			
8483[‡#] *4*			212 *8*	
8651.0 *11*	(3/2,7/2)		249 *9*	E(level): Other: 8633 *5* (1984Fo12).
8722[‡#] *12*			95 *6*	
8798.4 *8*	(3/2,7/2)$^+$			
8820.3 *7*	9/2$^-$			
8828.1 *11*	1/2$^+$		300 *9*	E(level): Other: 8839 *15* (1984Fo12).
8945.1 *8*	(3/2$^+$)			
8946.4 *6*	7/2$^-$	21 fs *10*		$T_{1/2}$: From mean lifetime 30 fs *15* (1973Fr07).
8963.5 *11*	(1/2,9/2)		344 *10*	E(level): Other: 8965 *9* (1984Fo12).
8972.9 *11*	5/2$^+$			
9039.0 *7*	15/2$^+$			
9042.3 *8*	(7/2,9/2)$^+$	10 fs *5*	1550 *30*	E(level): Others: 9051 *7* (1984Fo12). $T_{1/2}$: From mean lifetime of 15 fs *7*: Weighted average of 19 fs *10* (1977Ke05) and 11 fs *+8−9* (1976Ba05). Other: <21 fs (1973Fr07).
9101.0 *6*	13/2$^+$			
9172.2 *11*	(7/2,11/2)			
9207.1 *11*	3/2$^-$			
9210.0 *6*	11/2$^+$			
9213.0 *11*	(1/2,5/2)			
9285.1 *11*	(5/2,9/2)			
9292.1 *9*	(7/2,11/2)			J^{π}: (7/2,11/2) and (11/2$^+$) in Table I and the latter in Fig. 5 (2013Je04).
9325.3 *11*	(7/2,11/2)			
9398.7 *11*	7/2$^-$			
9400.9 *7*	(3/2,7/2)			
9541.1 *12*	(13/2$^+$)			
9627.9[c] *9*	11/2$^-$	2.8 fs *14*		$T_{1/2}$: From τ=4 fs *2* (2013Je04).
9802.9[b] *7*	15/2$^+$	4.2 fs *14*		$T_{1/2}$: From τ=6 fs *2* : Weighted average of mean lifetimes 4 fs *2*

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$^{12}C(^{12}C,p\gamma)$ 2013Je04,1977Ke05,1979Lu02 (continued)

^{23}Na Levels (continued)

E(level)[†]	Jπ[@]	$T_{1/2}$[&]	Comments
			(2013Je04), 12 fs *8* (1976Ba05), 11 fs *6* (1977Ke05)), and 21 fs *9* (1977Ev02).
9875.2 *8*	(7/2,11/2)		
9917.3 *11*	(1/2,9/2)		
9923.9 *11*	(3/2,7/2)		
9964.2 *12*	(9/2,13/2)		
9987.9 *12*	11/2$^-$		
10033.4 *9*	(3/2,11/2)		
10036.0 *11*	(3/2,7/2)		
10156.0 *11*	(1/2,9/2)		
10212.4 *12*	(3/2,11/2)		
10237.5 *11*	(3/2,11/2)		
10333.5 *11*	(3/2,11/2)		
10353.6[c] *7*	13/2$^-$	<0.69 fs	$T_{1/2}$: From τ < 1 fs (2013Je04). Other: <18 fs (τ <25 fs (1973Fr07)).
10404.1 *12*	(11/2$^-$)		
10408.5 *11*	(3/2,11/2)		
10438.2 *11*	(1/2,9/2)		
10590.2 *7*	13/2$^-$		
10697.5 *8*	(7/2,11/2)		
10759.2 *12*	(9/2,17/2)		
10797.7 *11*	(3/2,11/2)		
10860.5 *8*	(3/2,9/2)		
10922.7 *11*	(3/2,11/2)		
11073.2[b] *9*	17/2$^+$	34.7 fs *69*	$T_{1/2}$: From τ=50 fs *10* (2013Je04).
11271.4 *9*	11/2$^-$	12.5 fs *21*	$T_{1/2}$: From τ=18 fs *3* (2013Je04).
11424.3 *9*	(11/2$^+$)		
11538.4 *9*	15/2$^+$		
11651.2 *9*	(13/2$^+$)		
12013.2 *11*	(3/2,11/2)		
12592.8 *9*		<14 fs	E(level): From 1979Lu02. $T_{1/2}$: From τ<20 fs (1977Ke05).

[†] From least-squares fit to γ-ray energies, except otherwise noted.
[‡] From 1984Fo12.
[#] Doublet.
[@] From 2013Je04, based on γ-ray multipolarities and placements.
[&] From mean lifetime (listed in comments) determined by fractional Doppler shift technique (2013Je04), except where otherwise noted.
[a] From 1984Fo12 in units of μb.
[b] Band(A): K^π=1/2$^+$ g.s. band.
[c] Band(B): K^π=(1/2$^-$) band.

$\gamma(^{23}Na)$

E_γ[†]	I_γ[†]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	δ[&]	Comments
170 *1*	0.13 *3*	3847.8	5/2$^-$	3677.8	3/2$^-$			
312 *1*	0.06 *1*	6353.8	9/2$^-$	6041.5	7/2$^-$			
439.80 *15*		439.82	5/2$^+$	0.0	3/2$^+$	M1+E2	+0.12 *5*	DCO=0.95 *1* (2013Je04); A_2=−0.19 *4*; A_4=+0.14 *10* (1977Ke05) E_γ: From 1973Wa26. Other: 440 *1* (2013Je04).
591 *1*	0.3 *1*	2982.1	3/2$^+$	2391.1	1/2$^+$			
626.8 *4*	35.2 *2*	2703.2	9/2$^+$	2075.9	7/2$^+$	M1+E2	+0.07 *5*	DCO=0.90 *1* (2013Je04); A_2=−0.18 *4*; A_4=+0.01 *6* (1977Ke05) E_γ: From 1973Wa26. Other: 627 *1* (2013Je04).

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$^{12}C(^{12}C,p\gamma)$ 2013Je04,1977Ke05,1979Lu02 (continued)

$\gamma(^{23}Na)$ (continued)

E_γ †	I_γ †	E_i(level)	J_i^π	E_f	J_f^π	Mult.#	δ&	Comments
701 *1*	2.0 *1*	6234.7	13/2$^+$	5533.7	11/2$^+$	M1+E2	+1.05 *70*	DCO=0.90 *2* (2013Je04); A_2=−0.03 *7*; A_4=+0.06 *12*(1977Ke05)
819 *1*	0.4 *1*	6353.8	9/2$^-$	5533.7	11/2$^+$	D		DCO=1.00 *12* (2013Je04) E_γ: 820 in figure 11 of 2013Je04.
860 *1*	0.6 *1*	4774.8	7/2$^+$	3914.5	5/2$^+$	D		DCO=0.91 *10* (2013Je04)
866 *1*	0.16 *4*	3847.8	5/2$^-$	2982.1	3/2$^+$	D		DCO=0.82 *7* (2013Je04)
932 *1*	0.08 *2*	3914.5	5/2$^+$	2982.1	3/2$^+$			
984 *1*	0.3 *1*	8820.3	9/2$^-$	7835.3	7/2$^+$			
1033 *1*	0.5 *1*	7267.7	13/2$^+$	6234.7	13/2$^+$			DCO=1.56 *16* (2013Je04); A_2=+0.00 *19*; A_4=+0.18 *27*(1977Ke05) ΔJ=0 transition.
1037 *1*	0.2 *1*	3677.8	3/2$^-$	2640.5	1/2$^-$	D		DCO=0.81 *2* (2013Je04)
1070 *1*	0.6 *1*	11424.3	(11/2$^+$)	10353.6	13/2$^-$	D		DCO=0.76 *7* (2013Je04)
1087 *1*	0.2 *1*	10033.4	(3/2,11/2)	8946.4	7/2$^-$			
1110 *1*	0.4 *1*	9101.0	13/2$^+$	7991.0	11/2$^+$	D+Q		DCO=0.77 *21* (2013Je04)
1151 *1*	0.3 *1*	5925.5	7/2$^+$	4774.8	7/2$^+$	D+Q		DCO=1.39 *25* (2013Je04)
1153 *1*	3.1 *1*	7267.7	13/2$^+$	6114.6	11/2$^+$	M1+E2		DCO=0.76 *2* (2013Je04); A_2=−0.33 *7*; A_4=+0.15 *10*(1977Ke05) I_γ: Branching 84 *3* (2013Je04), 68 *6* (1979Lu02) relative to Iγ(2506γ).
1207 *1*	1.2 *3*	3847.8	5/2$^-$	2640.5	1/2$^-$	Q		DCO=1.76 *7* (2013Je04)
1259 *1*	2.3 *1*	7184.9	9/2$^+$	5925.5	7/2$^+$	D+Q		DCO=0.80 *1* (2013Je04)
1266 *1*	0.15 *5*	10212.4	(3/2,11/2)	8946.4	7/2$^-$			
1287 *1*	0.6 *1*	3677.8	3/2$^-$	2391.1	1/2$^+$	D		DCO=0.68 *9* (2013Je04)
1523[a] *1*	0.2[a] *1*	3914.5	5/2$^+$	2391.1	1/2$^+$			3/2$^+$ listed for initial level in Table I of 2013Je04 seems a misprint.
1523[a] *1*	0.2[a] *1*	9210.0	11/2$^+$	7686.6	9/2$^+$			
1579 *1*	1.8 *1*	6353.8	9/2$^-$	4774.8	7/2$^+$	D		DCO=0.84 *2* (2013Je04)
1636 *1*	100.0	2075.9	7/2$^+$	439.82	5/2$^+$	D@		A_2=−0.16 *4*; A_4=+0.02 *7* (1977Ke05)
1701 *1*	0.09 *3*	8318.9	9/2$^+$	6617.9	(7/2$^+$)			
1708 *1*	0.9 *1*	9101.0	13/2$^+$	7393.0	11/2$^+$	D+Q		DCO=0.71 *9* (2013Je04)
1734 *1*	1.3 *1*	7267.7	13/2$^+$	5533.7	11/2$^+$	M1+E2		DCO=1.39 *12* (2013Je04)
1756 *1*	0.7 *1*	7991.0	11/2$^+$	6234.7	13/2$^+$	D+Q		DCO=1.15 *12* (2013Je04)
1771 *1*	0.5 *2*	9039.0	15/2$^+$	7267.7	13/2$^+$			A_2=−0.21 *10*; A_4=+0.03 *15*(1977Ke05) I_γ: Branching 16 *6* (2013Je04), 32 *3* (1979Lu02) relative to Iγ(2804γ).
1772 *1*	18.0 *2*	3847.8	5/2$^-$	2075.9	7/2$^+$	D		DCO=1.00 *1* (2013Je04)
1817 *1*	0.13 *1*	9210.0	11/2$^+$	7393.0	11/2$^+$			
1821 *1*	1.6 *1*	8946.4	7/2$^-$	7125.3	9/2$^+$	D		DCO=0.83 *11* (2013Je04)
1838 *1*	0.4 *1*	3914.5	5/2$^+$	2075.9	7/2$^+$	D+Q		DCO=0.56 *8* (2013Je04)
1859 *1*	0.6 *1*	7393.0	11/2$^+$	5533.7	11/2$^+$			DCO=1.20 *9* (2013Je04)
1943 *1*	0.3 *1*	9210.0	11/2$^+$	7267.7	13/2$^+$			
1951 *1*	1.3 *1*	2391.1	1/2$^+$	439.82	5/2$^+$			I_γ: Branching 68 *5* (2013Je04), 56 *3* (1979Lu02) relative to Iγ 2391γ.
2010 *1*	0.6 *1*	5925.5	7/2$^+$	3914.5	5/2$^+$	D		DCO=0.91 *5* (2013Je04)
2025 *1*	5.1 *3*	9210.0	11/2$^+$	7184.9	9/2$^+$	D+Q		DCO=1.01 *4* (2013Je04)
2034 *1*	0.8 *2*	11073.2	17/2$^+$	9039.0	15/2$^+$	D+Q		DCO=0.85 *7* (2013Je04)
2072 *1*	2.1 *2*	4774.8	7/2$^+$	2703.2	9/2$^+$			
2076 *1*	11.8 *8*	2075.9	7/2$^+$	0.0	3/2$^+$	Q		DCO=1.72 *4* (2013Je04); A_2=+0.38 *15*; A_4=−0.46 *27* (1977Ke05)
2194 *1*	2.9 *1*	6041.5	7/2$^-$	3847.8	5/2$^-$	D+Q		DCO=0.67 *3* (2013Je04)
2263 *1*	58.9 *3*	2703.2	9/2$^+$	439.82	5/2$^+$	E2		DCO=1.62 *6* (2013Je04); A_2=+0.40 *4*; A_4=−0.25 *7* (1977Ke05)
2288 *1*	0.8 *2*	5965.9	3/2$^-$	3677.8	3/2$^-$			
2325 *1*	0.2 *1*	11271.4	11/2$^-$	8946.4	7/2$^-$			

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$^{12}C(^{12}C,p\gamma)$ 2013Je04,1977Ke05,1979Lu02 (continued)

$\gamma(^{23}Na)$ (continued)

E_γ[†]	I_γ[†]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	δ[&]	Comments
2350 *1*	0.4 *1*	7125.3	$9/2^+$	4774.8	$7/2^+$			
2362 *1*	0.4 *1*	10353.6	$13/2^-$	7991.0	$11/2^+$			
2364 *1*	3.8 *2*	6041.5	$7/2^-$	3677.8	$3/2^-$	Q		DCO=1.75 *15* (2013Je04)
2391 *1*	1.9 *2*	2391.1	$1/2^+$	0.0	$3/2^+$			
2441 *1*	0.7 *2*	11651.2	$(13/2^+)$	9210.0	$11/2^+$			
2457 *1*	1.7 *2*	7991.0	$11/2^+$	5533.7	$11/2^+$			DCO=1.82 *17* (2013Je04) ΔJ=0 transition.
2506 *1*	9.2 *1*	6353.8	$9/2^-$	3847.8	$5/2^-$	Q		DCO=1.65 *3* (2013Je04) E_γ: Other: 2502 (1979Lu02).
2535 *1*	1.5 *1*	9802.9	$15/2^+$	7267.7	$13/2^+$	D+Q		DCO=0.64 *3* (2013Je04); A_2=−0.39 *10*; A_4=−0.34 *19*(1977Ke05)
2542 *1*	3.4 *1*	2982.1	$3/2^+$	439.82	$5/2^+$	D+Q		DCO=0.54 *7* (2013Je04)
2592 *1*	0.5 *1*	8946.4	$7/2^-$	6353.8	$9/2^-$			
2599 *1*	0.4 *1*	10590.2	$13/2^-$	7991.0	$11/2^+$			
2632 *1*	0.6 *1*	9210.0	$11/2^+$	6577.6	$9/2^+$			$7/2^+$ listed for initial level in Table I of 2013Je04 seems a misprint.
2640 *1*	3.1 *3*	2640.5	$1/2^-$	0.0	$3/2^+$			
2663 *1*	0.4 *1*	6577.6	$9/2^+$	3914.5	$5/2^+$			
2674 *1*	0.04 *1*	9292.1	(7/2,11/2)	6617.9	$(7/2^+)$			
2699 *1*	3.7 *2*	4774.8	$7/2^+$	2075.9	$7/2^+$			DCO=1.72 *6* (2013Je04) Mult.: DCO value more consistent with Q, whereas levels scheme indicates D as ΔJ=0. M1+E2 in 2013Je04. M1 in Adopted Gammas.
2780 *1*	1.4 *1*	8820.3	$9/2^-$	6041.5	$7/2^-$			E_γ: 2777 in figure 11 of 2013Je04.
2792[‡]	25[‡]	12592.8		9802.9	$15/2^+$			
2804 *1*	3.1 *2*	9039.0	$15/2^+$	6234.7	$13/2^+$	D+Q		DCO=0.74 *3* (2013Je04); A_2=−0.17 *5*; A_4=−0.21 *8* (1977Ke05)
2830 *1*	14.2 *2*	5533.7	$11/2^+$	2703.2	$9/2^+$	D+Q	+0.17 *11*	DCO=1.24 *2* (2013Je04); A_2=+0.03 *7*; A_4=+0.01 *12*(1977Ke05)
2866 *1*	0.8 *1*	9101.0	$13/2^+$	6234.7	$13/2^+$			DCO=1.63 *21* (2013Je04) ΔJ=0 transition.
2911 *1*	0.5 *1*	7686.6	$9/2^+$	4774.8	$7/2^+$			
2960 *1*	0.11 *3*	10353.6	$13/2^-$	7393.0	$11/2^+$			
2973 *1*	0.7 *1*	6820.0	$5/2^-$	3847.8	$5/2^-$			DCO=1.53 *13* (2013Je04) ΔJ=0 transition. E_γ: 2972 in Figure 11 of 2013Je04.
2982 *1*	4.4 *1*	2982.1	$3/2^+$	0.0	$3/2^+$			
2986 *1*	0.9 *1*	9101.0	$13/2^+$	6114.6	$11/2^+$			
3095 *1*	1.8 *2*	9210.0	$11/2^+$	6114.6	$11/2^+$			DCO=1.82 *16* (2013Je04) ΔJ=0 transition.
3141 *1*	2.5 *2*	6820.0	$5/2^-$	3677.8	$3/2^-$			E_γ: 3142 in Figure 11 of 2013Je04.
3237 *1*	6.6 *1*	3677.8	$3/2^-$	439.82	$5/2^+$			
3274 *1*	3.4 *3*	9627.9	$11/2^-$	6353.8	$9/2^-$	D+Q		DCO=0.60 *5* (2013Je04)
3284 *1*	0.7 *1*	9210.0	$11/2^+$	5925.5	$7/2^+$			
3322 *1*	0.2 *1*	10590.2	$13/2^-$	7267.7	$13/2^+$			
3325 *1*	0.7 *1*	5965.9	$3/2^-$	2640.5	$1/2^-$	D+Q		DCO=1.12 *11* (2013Je04)
3408 *1*	3.1 *2*	3847.8	$5/2^-$	439.82	$5/2^+$			
3411 *1*	10.7 *1*	6114.6	$11/2^+$	2703.2	$9/2^+$	M1(+E2)	+0.26 *33*	DCO=1.21 *5* (2013Je04); A_2=+0.15 *15*; A_4=+0.39 *22*(1977Ke05)
3458 *1*	3.9 *1*	5533.7	$11/2^+$	2075.9	$7/2^+$	Q		DCO=1.65 *7* (2013Je04); A_2=+0.55 *18*; A_4=−0.82 *32*(1977Ke05)
3474 *1*	0.3 *1*	3914.5	$5/2^+$	439.82	$5/2^+$			
3505 *1*	0.5 *1*	9039.0	$15/2^+$	5533.7	$11/2^+$			A_2=+0.06 *14*; A_4=+0.50 *25*(1977Ke05) I_γ: Branching 16 *3* (2013Je04), 35 *3* (1979Lu02) relative to Iγ(2804γ).

Continued on next page (footnotes at end of table)

$^{12}C(^{12}C,p\gamma)$ 2013Je04,1977Ke05,1979Lu02 (continued)

$\gamma(^{23}Na)$ (continued)

E_γ †	I_γ †	E_i(level)	J_i^π	E_f	J_f^π	Mult.#	Comments
3531 *1*	16.4 *2*	6234.7	$13/2^+$	2703.2	$9/2^+$	E2	DCO=1.82 *3* (2013Je04); A_2=+0.39 *7*; A_4=−0.24 *12*(1977Ke05) Mult.,δ: Other: δ=−0.03 *15* for $13/2^+$ and +1.05 *70* for $9/2^+$ for D+Q (1977Ke05).
3568 *1*	2.1 *1*	9802.9	$15/2^+$	6234.7	$13/2^+$	D+Q	DCO=1.50 *7* (2013Je04); A_2=+0.23 *5*; A_4=+0.08 *9* (1977Ke05) E_γ: Other: 3569.2 *8* (1977Ke05).
3586 *1*	2.4 *2*	9627.9	$11/2^-$	6041.5	$7/2^-$	Q	DCO=1.71 *17* (2013Je04)
3650 *1*	4.6 *1*	6353.8	$9/2^-$	2703.2	$9/2^+$		DCO=1.69 *6* (2013Je04) E_γ: Other: 3646 (1979Lu02). I_γ: Branching 50 *1* (2013Je04), 28 *1* (1979Lu02) relative to Iγ(2506γ). ΔJ=0 transition.
3811 *1*	2.3 *2*	7489.0	$3/2^-$	3677.8	$3/2^-$		
3833 *1*	1.6 *2*	9875.2	(7/2,11/2)	6041.5	$7/2^-$		
3848 *1*	6.9 *3*	3847.8	$5/2^-$	0.0	$3/2^+$	D+Q	DCO=1.23 *5* (2013Je04) I_γ: Branching 38 *2* (2013Je04), 25 (1979Lu02) relative to Iγ 1772γ.
3850 *1*	1.8 *2*	5925.5	$7/2^+$	2075.9	$7/2^+$	D+Q	DCO=1.51 *6* (2013Je04)
3874 *1*	0.5 *1*	6577.6	$9/2^+$	2703.2	$9/2^+$		
3914 *1*	2.7 *3*	3914.5	$5/2^+$	0.0	$3/2^+$	D+Q	DCO=1.13 *8* (2013Je04)
3920 *1*	0.3 *1*	7835.3	$7/2^+$	3914.5	$5/2^+$	D+Q	DCO=1.10 *13* (2013Je04)
3946 *1*	2.2 *2*	9987.9	$11/2^-$	6041.5	$7/2^-$	Q	DCO=1.76 *15* (2013Je04)
3999 *1*	5.1 *2*	10353.6	$13/2^-$	6353.8	$9/2^-$	Q	DCO=1.61 *6* (2013Je04)
4007 *1*	0.6 *1*	9541.1	$(13/2^+)$	5533.7	$11/2^+$	D+Q	DCO=1.07 *8* (2013Je04)
4038 *1*	3.2 *3*	6114.6	$11/2^+$	2075.9	$7/2^+$		I_γ: Branching 30 *3* (2013Je04), 20 (1979Lu02) relative to Iγ 2391γ.
4047 *1*	3.3 *2*	8820.3	$9/2^-$	4774.8	$7/2^+$	D+Q	DCO=0.83 *4* (2013Je04)
4169 *1*	1.3 *1*	10404.1	$(11/2^-)$	6234.7	$13/2^+$	(D)	DCO=0.86 *11* (2013Je04)
4177 *1*	2.5 *3*	6880.6	(7/2,11/2)	2703.2	$9/2^+$		DCO=0.86 *7* (2013Je04)
4236 *1*	0.5 *1*	10590.2	$13/2^-$	6353.8	$9/2^-$		
4269 *1*	0.6 *1*	9802.9	$15/2^+$	5533.7	$11/2^+$	Q	DCO=1.85 *16* (2013Je04); A_2=+0.45 *10*; A_4=−0.14 *17*(1977Ke05)
4270 *1*	0.2 *1*	11538.4	$15/2^+$	7267.7	$13/2^+$		
4278 *1*	7.4 *2*	6353.8	$9/2^-$	2075.9	$7/2^+$	D	DCO=1.01 *2* (2013Je04) E_γ: Other: 4273 (1979Lu02). I_γ: Branching 80 *2* (2013Je04), 20 *5* (1979Lu02) relative to Iγ(2506γ).
4335 *1*	7.5 *2*	4774.8	$7/2^+$	439.82	$5/2^+$	D+Q	DCO=1.08 *2* (2013Je04) δ: By evaluators based on DCO value of 1.08 *2*. M1 in 2013Je04.
4343 *1*	0.4 *1*	10697.5	(7/2,11/2)	6353.8	$9/2^-$	D+Q	DCO=0.95 *9* (2013Je04) $(11/2^-)$ listed for initial level in Table I of 2013Je04.
4351 *1*	1.0 *2*	7054.7	(5/2,13/2)	2703.2	$9/2^+$		
4355 *1*	0.5 *1*	10590.2	$13/2^-$	6234.7	$13/2^+$	D+Q	DCO=1.77 *19* (2013Je04) ΔJ=0 transition.
4422 *1*	2.8 *1*	7125.3	$9/2^+$	2703.2	$9/2^+$		DCO=1.51 *9* (2013Je04) ΔJ=0 transition.
4430 *1*	0.9 *1*	9964.2	(9/2,13/2)	5533.7	$11/2^+$	D+Q	DCO=0.57 *6* (2013Je04)
4466 *1*	0.2 *1*	11651.2	$(13/2^+)$	7184.9	$9/2^+$		
4482 *1*	2.1 *2*	7184.9	$9/2^+$	2703.2	$9/2^+$		DCO=1.74 *5* (2013Je04) ΔJ=0 transition.
4501 *1*	2.0 *2*	6577.6	$9/2^+$	2075.9	$7/2^+$	D+Q	DCO=0.90 *4* (2013Je04) Mult.: DCO ratio indicates D. ΔJ=1 transition. M1+E2 in 2013Je04 and in Adopted Gammas.
4524 *1*	0.5 *1*	10759.2	(9/2,17/2)	6234.7	$13/2^+$		

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$^{12}C(^{12}C,p\gamma)$ 2013Je04,1977Ke05,1979Lu02 (continued)

$\gamma(^{23}Na)$ (continued)

E_γ †	I_γ †	E_i(level)	J_i^π	E_f	J_f^π	Mult.#	Comments
4564 *1*	3.7 *1*	7267.7	$13/2^+$	2703.2	$9/2^+$	E2	DCO=1.50 *13* (2013Je04); A_2=+0.45 *11*; A_4=−0.37 *19*(1977Ke05)
4689 *1*	6.1 *1*	7393.0	$11/2^+$	2703.2	$9/2^+$	D+Q	DCO=1.03 *2* (2013Je04) E_γ: Other: 4686 (uncertain placement in 1973Fr07).
4736 *1*	0.4 *1*	8651.0	(3/2,7/2)	3914.5	$5/2^+$		DCO=1.05 *9* (2013Je04)
4768 *1*	0.4 *1*	7750.6	$5/2^+$	2982.1	$3/2^+$	D+Q	DCO=0.94 *9* (2013Je04)
4820 *1*	0.6 *1*	10353.6	$13/2^-$	5533.7	$11/2^+$	D	DCO=0.80 *5* (2013Je04) E_γ: 4819 in figure 11 of 2013Je04.
4838 *1*	0.4 *1*	11073.2	$17/2^+$	6234.7	$13/2^+$	Q	DCO=1.69 *22* (2013Je04)
4848 *1*	0.3 *1*	7489.0	$3/2^-$	2640.5	$1/2^-$	D+Q	DCO=0.93 *9* (2013Je04)
4890 *1*	0.2 *1*	7872.7	$3/2^+$	2982.1	$3/2^+$		
4950 *1*	0.16 *4*	8798.4	$(3/2,7/2)^+$	3847.8	$5/2^-$		
4983 *1*	0.6 *1*	7686.6	$9/2^+$	2703.2	$9/2^+$	D+Q	DCO=1.11 *14* (2013Je04) ΔJ=0 transition.
5030 *1*	0.2 *1*	8945.1	$(3/2^+)$	3914.5	$5/2^+$		
5036 *1*	0.6 *1*	11271.4	$11/2^-$	6234.7	$13/2^+$	D	DCO=1.02 *7* (2013Je04)
5049 *1*	2.1 *1*	7125.3	$9/2^+$	2075.9	$7/2^+$	D+Q	DCO=0.85 *4* (2013Je04) Mult.: DCO ratio indicates D. ΔJ=1 transition. M1+E2 in 2013Je04.
5056 *1*	1.2 *2*	10590.2	$13/2^-$	5533.7	$11/2^+$	D	DCO=0.82 *3* (2013Je04)
5097 *1*	2.4 *1*	7489.0	$3/2^-$	2391.1	$1/2^+$	D	DCO=1.15 *13* (2013Je04)
5108 *1*	2.1 *1*	7184.9	$9/2^+$	2075.9	$7/2^+$	D+Q	DCO=0.98 *6* (2013Je04)
5131 *1*	0.8 *2*	7835.3	$7/2^+$	2703.2	$9/2^+$	D+Q	DCO=1.03 *9* (2013Je04)
5258 *1*	1.0 *2*	10033.4	(3/2,11/2)	4774.8	$7/2^+$		$(9/2^+)$ listed for initial level in Table I of 2013Je04.
5287 *1*	4.2 *1*	7991.0	$11/2^+$	2703.2	$9/2^+$	D+Q	DCO=0.68 *2* (2013Je04)
5292 *1*	0.2 *1*	9207.1	$3/2^-$	3914.5	$5/2^+$	D	DCO=1.00 *15* (2013Je04)
5323.6‡ *19*	50‡	12592.8		7267.7	$13/2^+$		A_2=+0.04 *7*; A_4=−0.32 *11* (1977Ke05)
5481 *1*	0.9 *1*	7872.7	$3/2^+$	2391.1	$1/2^+$	D+Q	DCO=1.11 *18* (2013Je04)
5484 *1*	2.4 *1*	5925.5	$7/2^+$	439.82	$5/2^+$	D+Q	DCO=1.54 *5* (2013Je04)
5486 *1*	0.2 *1*	9400.9	(3/2,7/2)	3914.5	$5/2^+$		
5487 *1*	0.3 *1*	7563.6	(5/2,9/2)	2075.9	$7/2^+$		DCO=0.70 (2013Je04)
5615 *1*	0.9 *1*	8318.9	$9/2^+$	2703.2	$9/2^+$	Q	DCO=1.63 *16* (2013Je04) $13/2^+$ listed as initial level in Table I of 2013Je04 seems a misprint ΔJ=0 transition for $J^\pi(8319)=9/2^+$.
5722 *1*	0.4 *1*	9400.9	(3/2,7/2)	3677.8	$3/2^-$		
5728 *1*	0.8 *1*	8432.0	(5/2,13/2)	2703.2	$9/2^+$		
5897 *1*	0.9 *2*	7973.7	(3/2,11/2)	2075.9	$7/2^+$		
5925 *1*	4.6 *3*	5925.5	$7/2^+$	0.0	$3/2^+$	Q	DCO=1.92 *7* (2013Je04)
5990 *1*	0.05 *1*	8972.9	$5/2^+$	2982.1	$3/2^+$		
6002 *1*	0.3 *1*	9917.3	(1/2,9/2)	3914.5	$5/2^+$		
6004 *1*	0.2 *1*	11538.4	$15/2^+$	5533.7	$11/2^+$		
6114 *1*	2.7 *2*	8820.3	$9/2^-$	2703.2	$9/2^+$		DCO=1.65 *10* (2013Je04) ΔJ=0 transition. E_γ: 6115 in figure 11 of 2013Je04.
6137 *1*	2.0 *2*	6577.6	$9/2^+$	439.82	$5/2^+$		
6177 *1*	2.6 *2*	6617.9	$(7/2^+)$	439.82	$5/2^+$		
6230 *1*	0.14 *2*	9213.0	(1/2,5/2)	2982.1	$3/2^+$		DCO=1.53 *34* (2013Je04)
6240 *1*	2.4 *2*	8946.4	$7/2^-$	2703.2	$9/2^+$	D	DCO=1.02 *5* (2013Je04) Initial level is listed as 8944 in table I of 2013Je04, it should be 8945 as for 2592γ. E_γ: 6242 listed in figure 11 of 2013Je04.
6355‡	25‡	12592.8		6234.7	$13/2^+$		
6397 *1*	1.0 *2*	9101.0	$13/2^+$	2703.2	$9/2^+$	Q	DCO=1.83 *18* (2013Je04)
6418 *1*	0.07 *2*	9400.9	(3/2,7/2)	2982.1	$3/2^+$		(1/2,7/2) listed for initial level in Table I of 2013Je04 seems a misprint.

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$^{12}C(^{12}C,p\gamma)$ 2013Je04,1977Ke05,1979Lu02 (continued)

$\gamma(^{23}Na)$ (continued)

E_γ [†]	I_γ [†]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	Comments
6436 *1*	0.2 *1*	8828.1	$1/2^+$	2391.1	$1/2^+$		
6468 *1*	0.5 *1*	9172.2	(7/2,11/2)	2703.2	$9/2^+$		DCO=1.04 *15* (2013Je04)
6553 *1*	0.13 *2*	8945.1	$(3/2^+)$	2391.1	$1/2^+$	D+Q	DCO=1.29 *20* (2013Je04)
6588 *1*	1.4 *2*	9292.1	(7/2,11/2)	2703.2	$9/2^+$		(7/2,11/2) listed for initial level in Table I of 2013Je04 seems a misprint.
6621 *1*	1.8 *2*	9325.3	(7/2,11/2)	2703.2	$9/2^+$		
6839 *1*	1.9 *2*	7279.9	(1/2,9/2)	439.82	$5/2^+$		
6872 *1*	0.6 *1*	8946.4	$7/2^-$	2075.9	$7/2^+$		
6965 *1*	2.1 *1*	9042.3	$(7/2,9/2)^+$	2075.9	$7/2^+$		
7036 *1*	3.3 *2*	7477.0	(1/2,9/2)	439.82	$5/2^+$		
7171 *1*	1.6 *2*	9875.2	(7/2,11/2)	2703.2	$9/2^+$		DCO=1.09 *11* (2013Je04)
7208 *1*	2.2 *2*	9285.1	(5/2,9/2)	2075.9	$7/2^+$		DCO=1.03 *5* (2013Je04)
7860 *1*	1.6 *1*	8301.3	$(7/2^-)$	439.82	$5/2^+$	D	DCO=0.93 *5* (2013Je04)
7993 *1*	1.9 *2*	10697.5	(7/2,11/2)	2703.2	$9/2^+$	(D)	DCO=1.08 *5* (2013Je04)
8160 *1*	1.6 *2*	10237.5	(3/2,11/2)	2075.9	$7/2^+$		
8256 *1*	2.6 *2*	10333.5	(3/2,11/2)	2075.9	$7/2^+$		
8331 *1*	1.3 *2*	10408.5	(3/2,11/2)	2075.9	$7/2^+$		
8357 *1*	1.4 *1*	8798.4	$(3/2,7/2)^+$	439.82	$5/2^+$	D+Q	DCO=0.85 *3* (2013Je04)
8522 *1*	0.2 *1*	8963.5	(1/2,9/2)	439.82	$5/2^+$		
8601 *1*	0.4 *1*	9042.3	$(7/2,9/2)^+$	439.82	$5/2^+$		
8720 *1*	0.05 *1*	10797.7	(3/2,11/2)	2075.9	$7/2^+$		
8782 *1*	0.13 *5*	10860.5	(3/2,9/2)	2075.9	$7/2^+$		
8845 *1*	0.06 *1*	10922.7	(3/2,11/2)	2075.9	$7/2^+$		
8957 *1*	0.4 *1*	9398.7	$7/2^-$	439.82	$5/2^+$	D	DCO=0.92 *12* (2013Je04) E_γ: 8956 in figure 11 of 2013Je04.
9347 *1*	0.04 *2*	11424.3	$(11/2^+)$	2075.9	$7/2^+$		
9482 *1*	0.4 *1*	9923.9	(3/2,7/2)	439.82	$5/2^+$		DCO=0.54 *9* (2013Je04)
9594 *1*	0.5 *1*	10036.0	(3/2,7/2)	439.82	$5/2^+$		DCO=1.01 *15* (2013Je04)
9714 *1*	0.08 *2*	10156.0	(1/2,9/2)	439.82	$5/2^+$		
9935 *1*	0.22 *4*	12013.2	(3/2,11/2)	2075.9	$7/2^+$		
9996 *1*	0.05 *1*	10438.2	(1/2,9/2)	439.82	$5/2^+$		
10419 *1*	0.03 *1*	10860.5	(3/2,9/2)	439.82	$5/2^+$		

† From 2013Je04. Uncertainty of 1 keV is assigned based on a note in 2013Je04 that crossover transition energies were reproduced within 0.5 to 1 keV as compared to the energy sums of two coincident γ-ray energies.

‡ From 1979Lu02. Iγ in % from the level.

From DCO ratios (2013Je04), except otherwise noted. A value of 0.9 *1* was expected for pure stretched-dipole transitions and 1.8 *1* for pure stretched-quadrupole ones (2013Je04). The DCO ratio was extracted from measured γ-ray intensities at 90° as well as at 32° and 37° against gating on the "all" axis. Evaluators assign without sign as D, D+Q, Q compared to M1 or E1, M1+E2, E2, etc. in 2013Je04, except where RUL can be used for known level lifetime.

@ From $\gamma(\theta)$ measurements. A2 and A4 values listed in comments.

& From 1977Ke05, except otherwise noted. Phase convention from 1970Kr03 (ENSDF policy).

a Multiply placed with intensity suitably divided.

$^{12}C(^{12}C,p\gamma)$ 2013Je04,1977Ke05,1979Lu02

Level Scheme

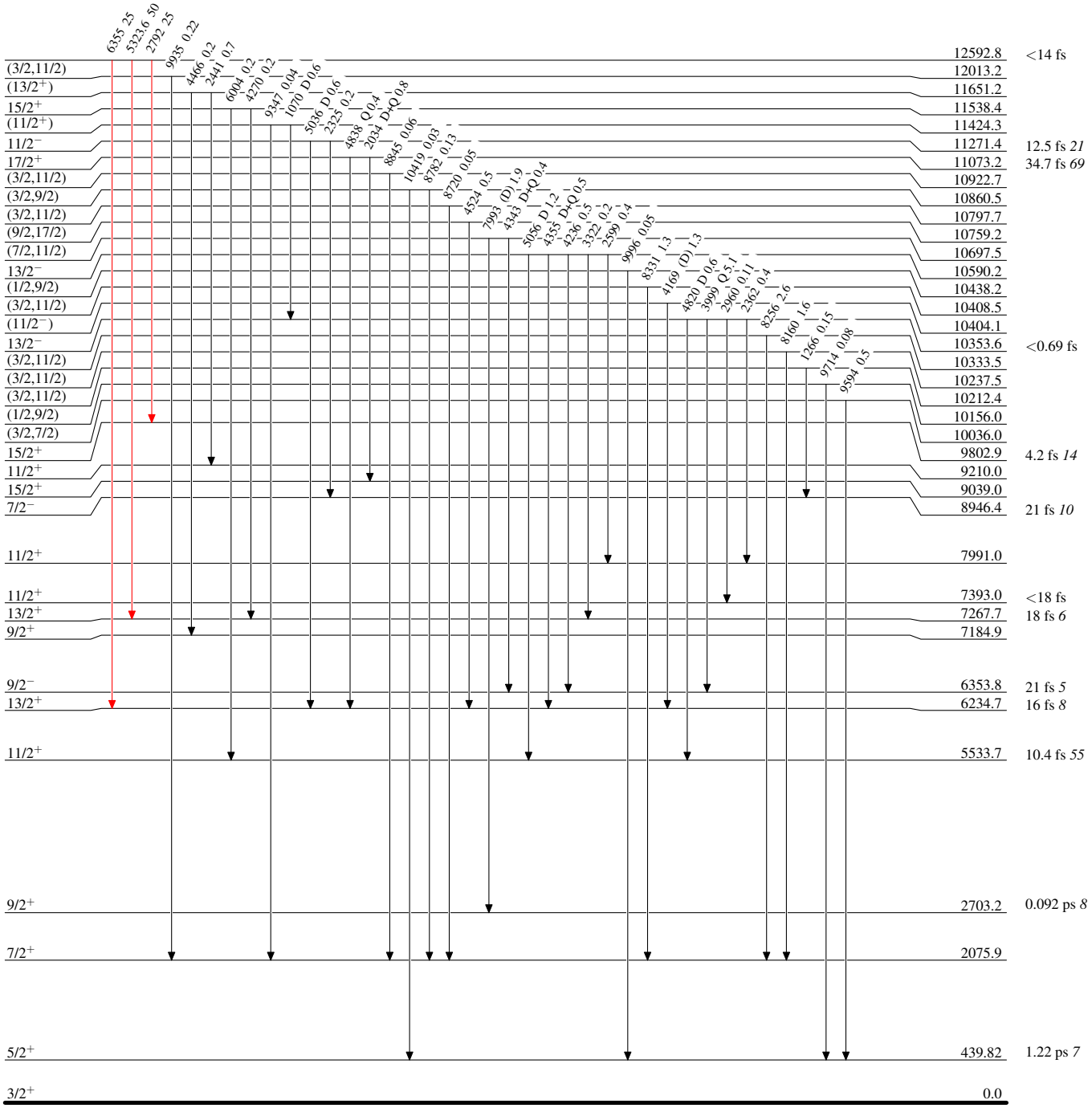
Intensities: Relative I_γ

Legend

$I_\gamma < 2\% \times I_\gamma^{max}$

$I_\gamma < 10\% \times I_\gamma^{max}$

$I_\gamma > 10\% \times I_\gamma^{max}$



$^{23}_{11}Na_{12}$

$^{12}C(^{12}C,p\gamma)$ 2013Je04,1977Ke05,1979Lu02

Level Scheme (continued)

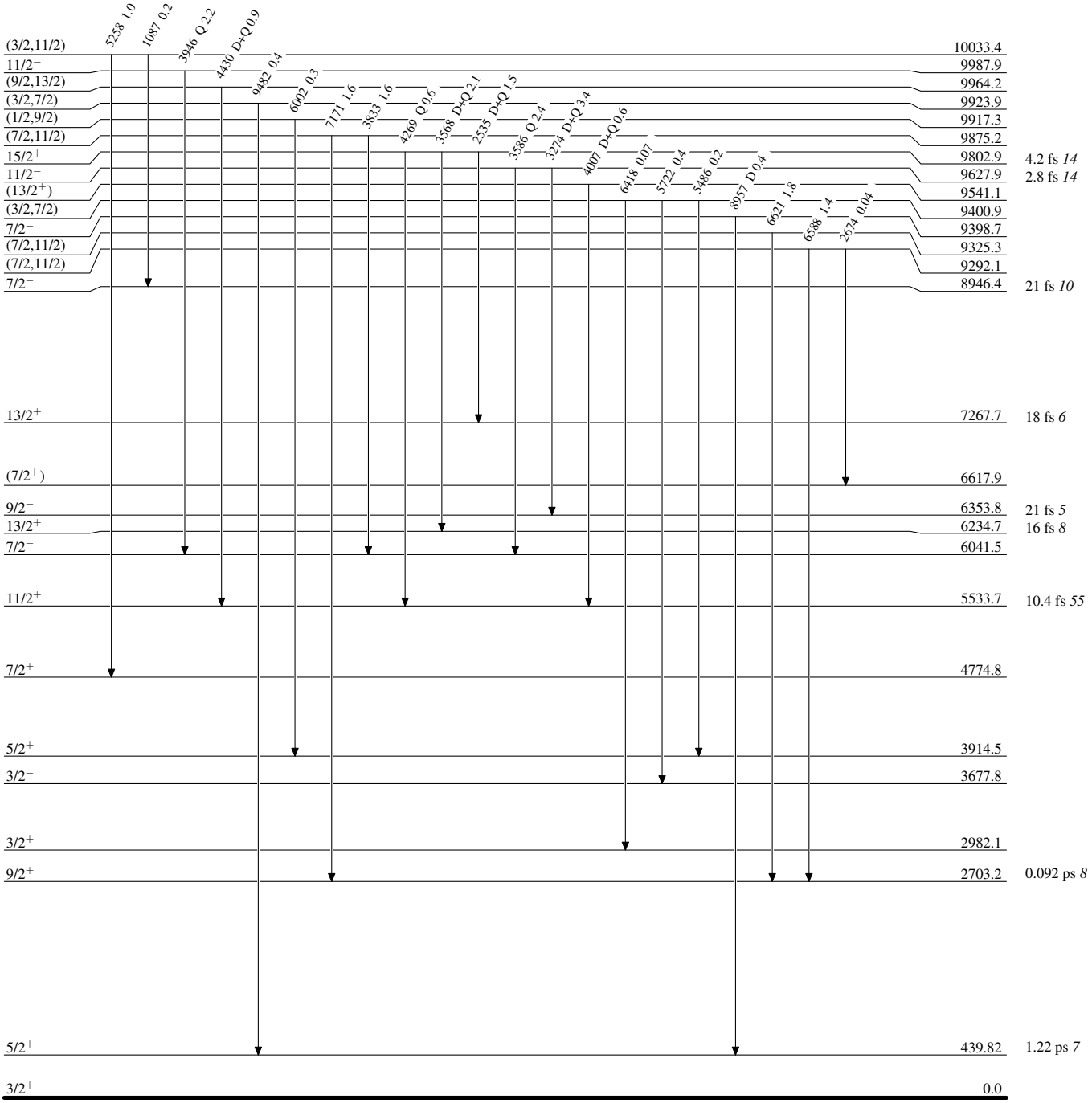
Intensities: Relative I_γ

Legend

$I_\gamma < 2\% \times I_\gamma^{max}$

$I_\gamma < 10\% \times I_\gamma^{max}$

$I_\gamma > 10\% \times I_\gamma^{max}$



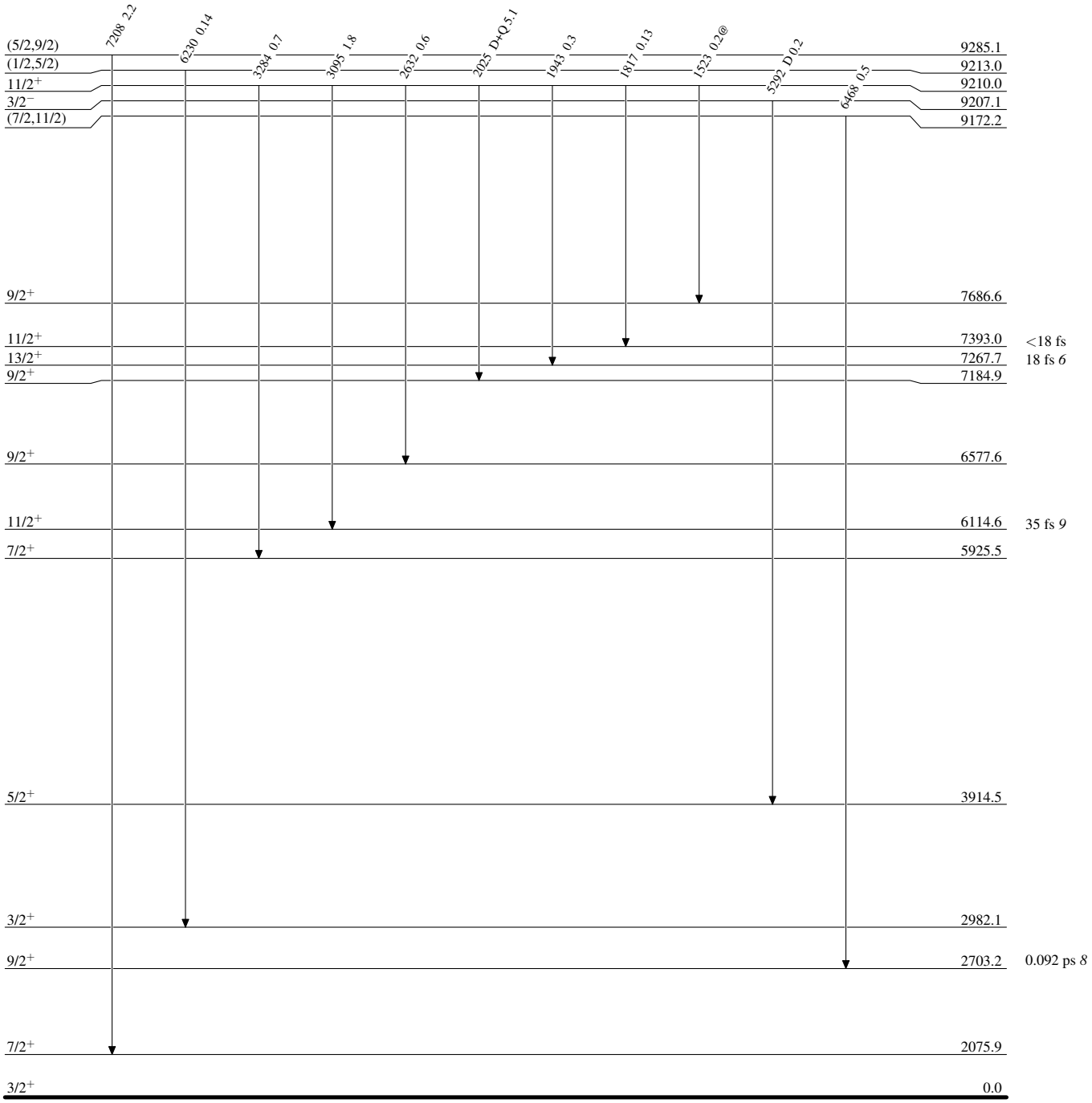
$^{23}_{11}Na_{12}$

$^{12}C(^{12}C,p\gamma)$ **2013Je04,1977Ke05,1979Lu02**

Level Scheme (continued)

Intensities: Relative I_γ
@ Multiply placed: intensity suitably divided

Legend
$I_\gamma < 2\% \times I_\gamma^{max}$
$I_\gamma < 10\% \times I_\gamma^{max}$
$I_\gamma > 10\% \times I_\gamma^{max}$



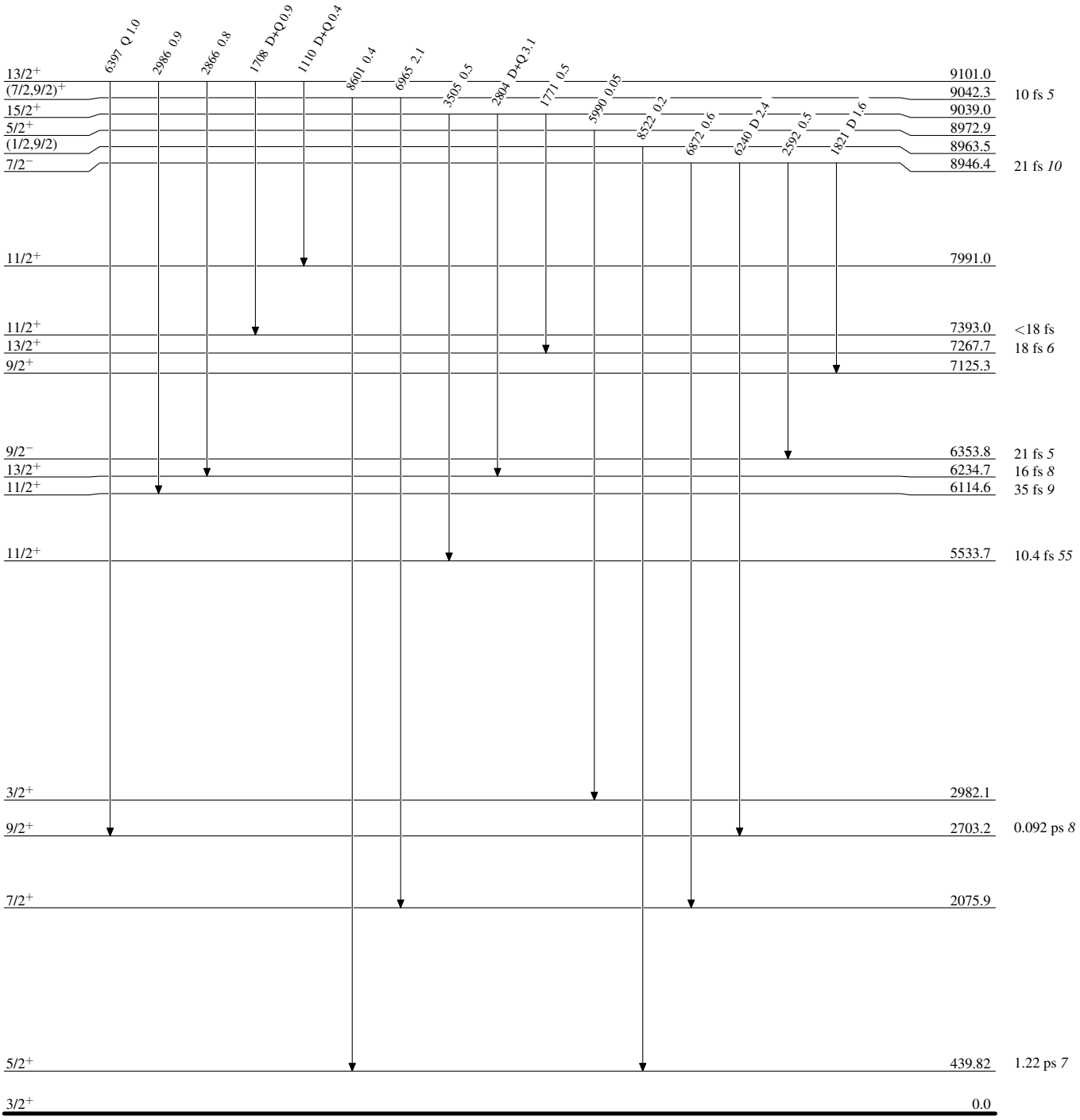
$^{23}_{11}Na_{12}$

$^{12}C(^{12}C,p\gamma)$ **2013Je04,1977Ke05,1979Lu02**

Level Scheme (continued)

Intensities: Relative I_γ
@ Multiply placed: intensity suitably divided

Legend
$I_\gamma < 2\% \times I_\gamma^{max}$
$I_\gamma < 10\% \times I_\gamma^{max}$
$I_\gamma > 10\% \times I_\gamma^{max}$



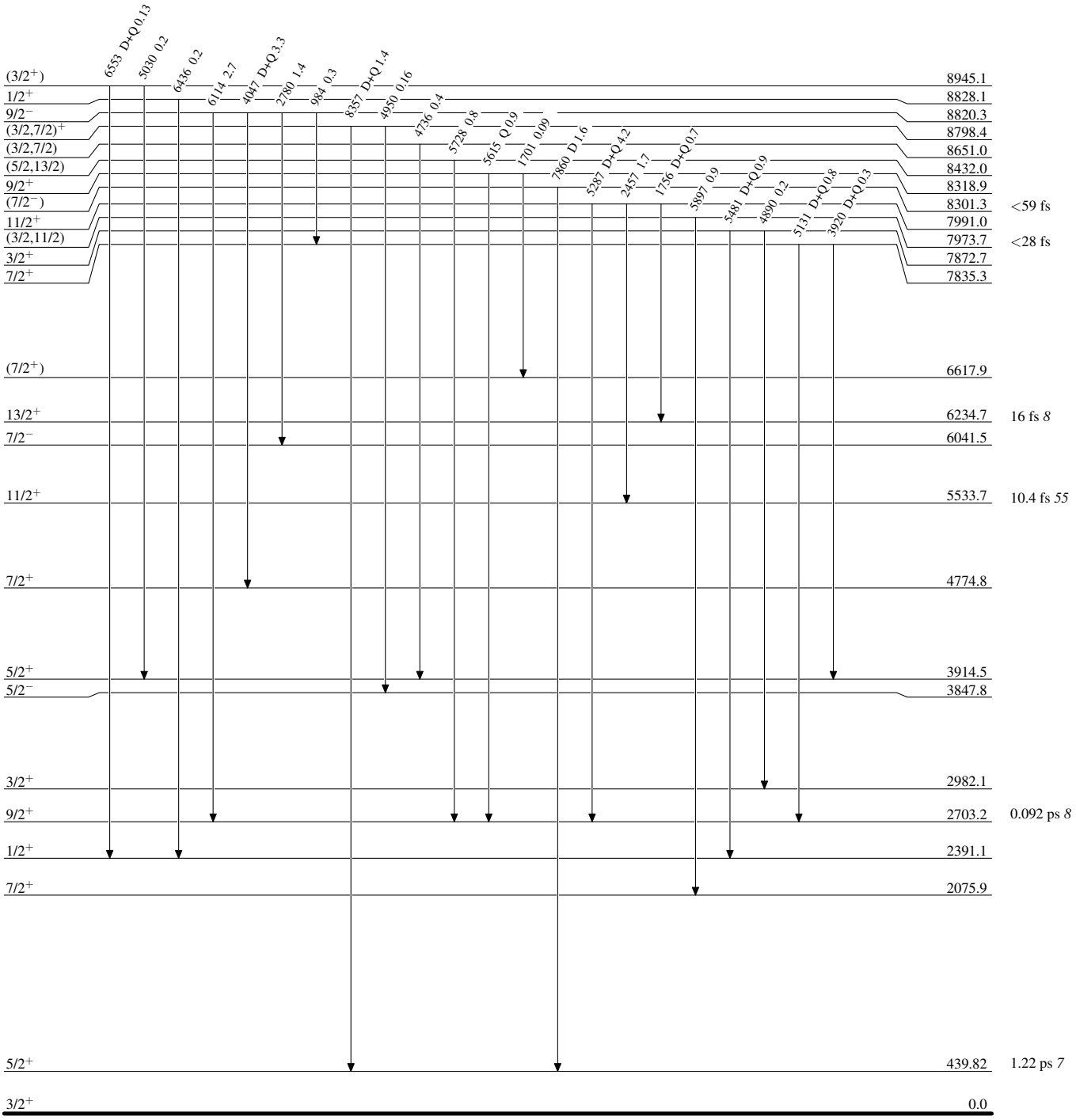
$^{23}_{11}Na_{12}$

$^{12}C(^{12}C,p\gamma)$ **2013Je04,1977Ke05,1979Lu02**

Level Scheme (continued)

Intensities: Relative I_γ
@ Multiply placed: intensity suitably divided

Legend
$I_\gamma < 2\% \times I_\gamma^{max}$
$I_\gamma < 10\% \times I_\gamma^{max}$
$I_\gamma > 10\% \times I_\gamma^{max}$



$^{23}_{11}Na_{12}$

$^{12}C(^{12}C,p\gamma)$ 2013Je04,1977Ke05,1979Lu02

Level Scheme (continued)

Intensities: Relative I_γ
@ Multiply placed: intensity suitably divided

Legend
$I_\gamma < 2\% \times I_\gamma^{max}$
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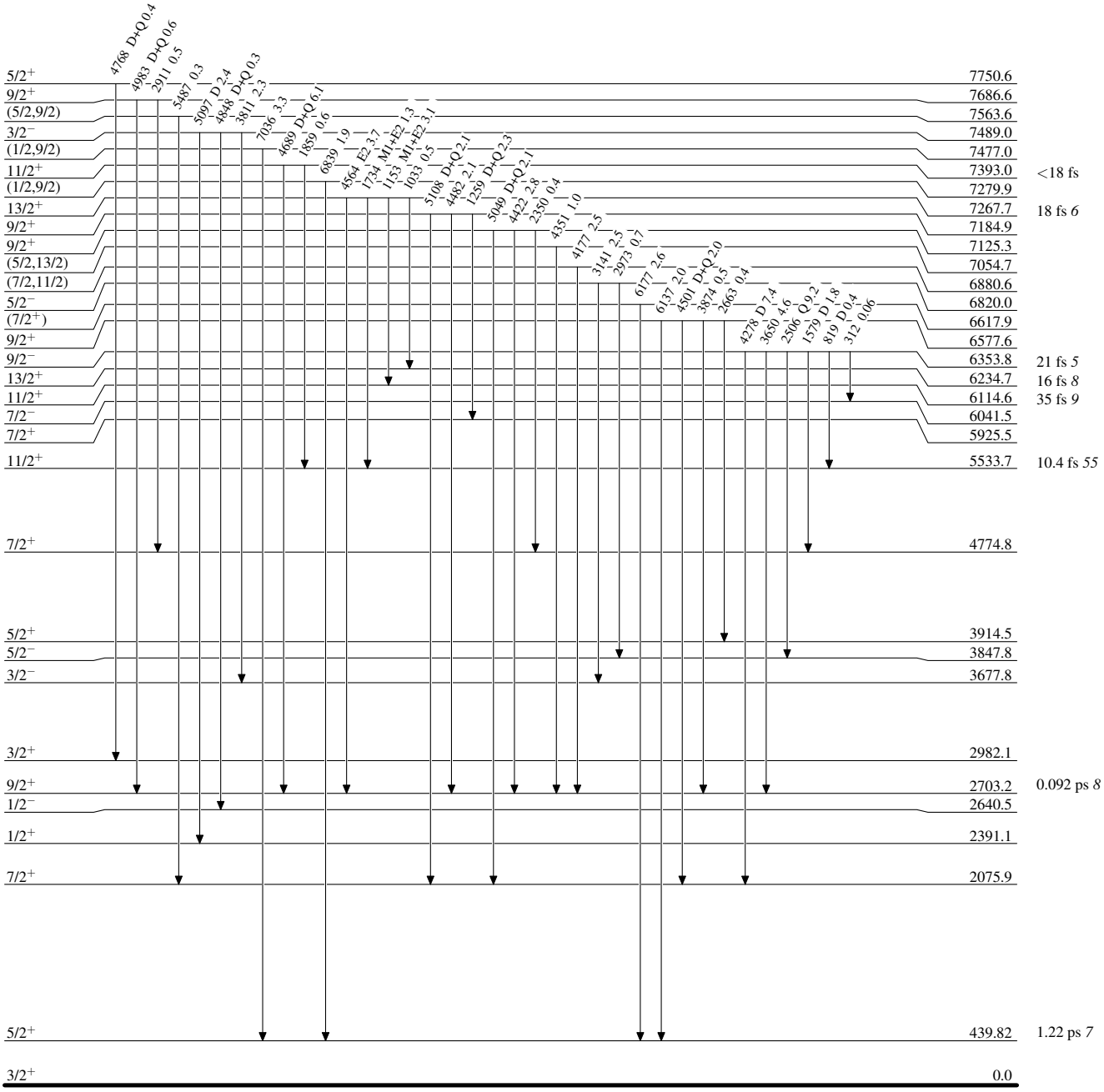
$I_\gamma > 10\% \times I_\gamma^{max}$



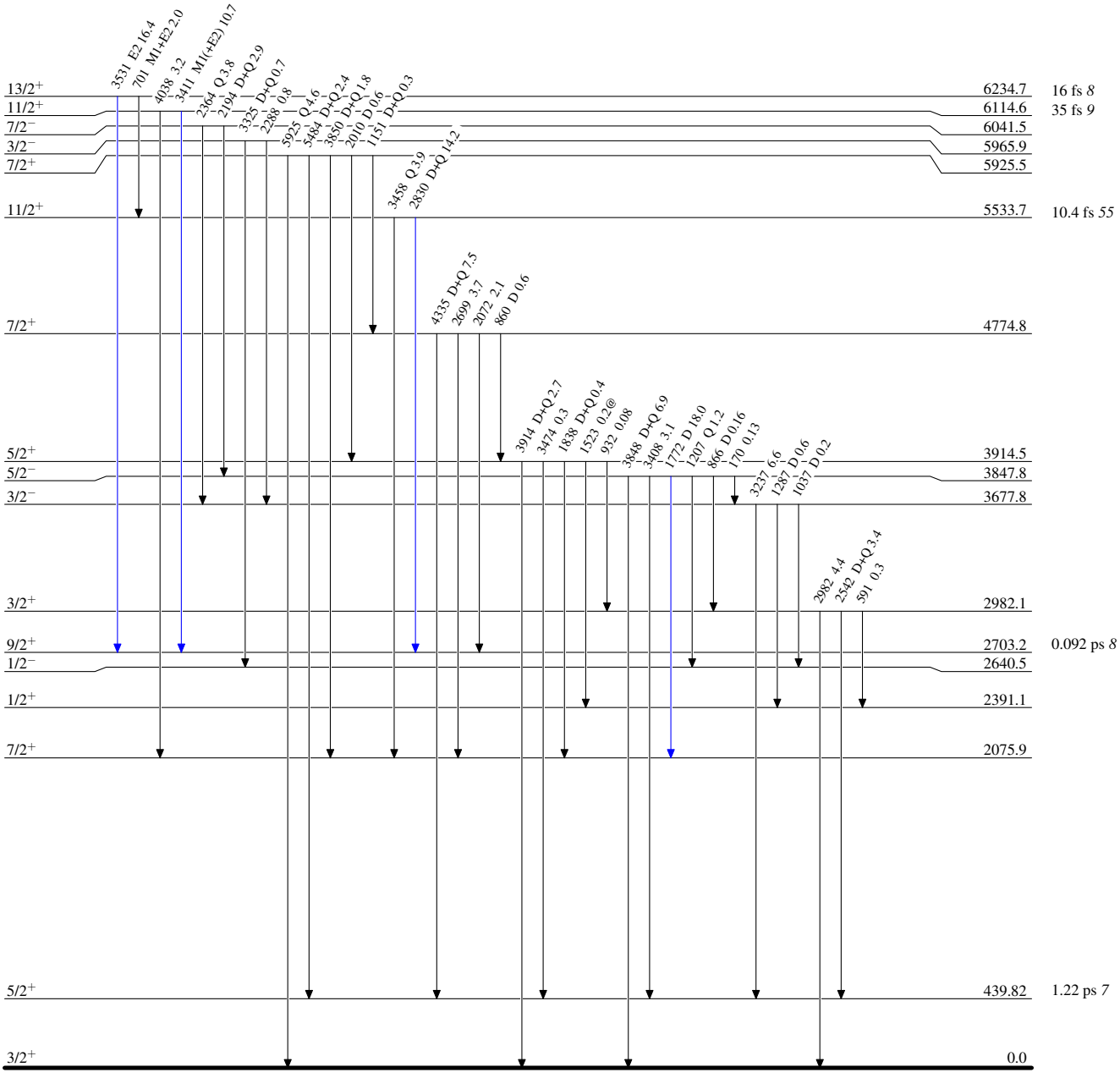
$^{23}_{11}Na_{12}$

$^{12}C(^{12}C,p\gamma)$ 2013Je04,1977Ke05,1979Lu02

Level Scheme (continued)

Intensities: Relative I_γ
@ Multiply placed: intensity suitably divided

Legend
$I_\gamma < 2\% \times I_\gamma^{max}$
$I_\gamma < 10\% \times I_\gamma^{max}$
$I_\gamma > 10\% \times I_\gamma^{max}$

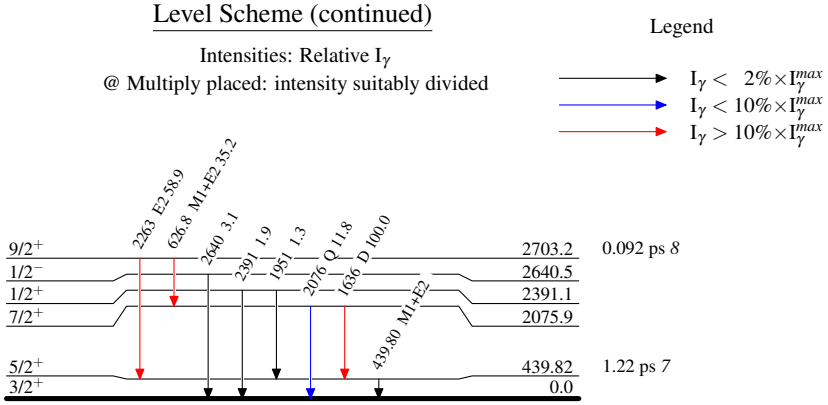


$^{23}_{11}Na_{12}$

$^{12}C(^{12}C,p\gamma)$ 2013Je04,1977Ke05,1979Lu02

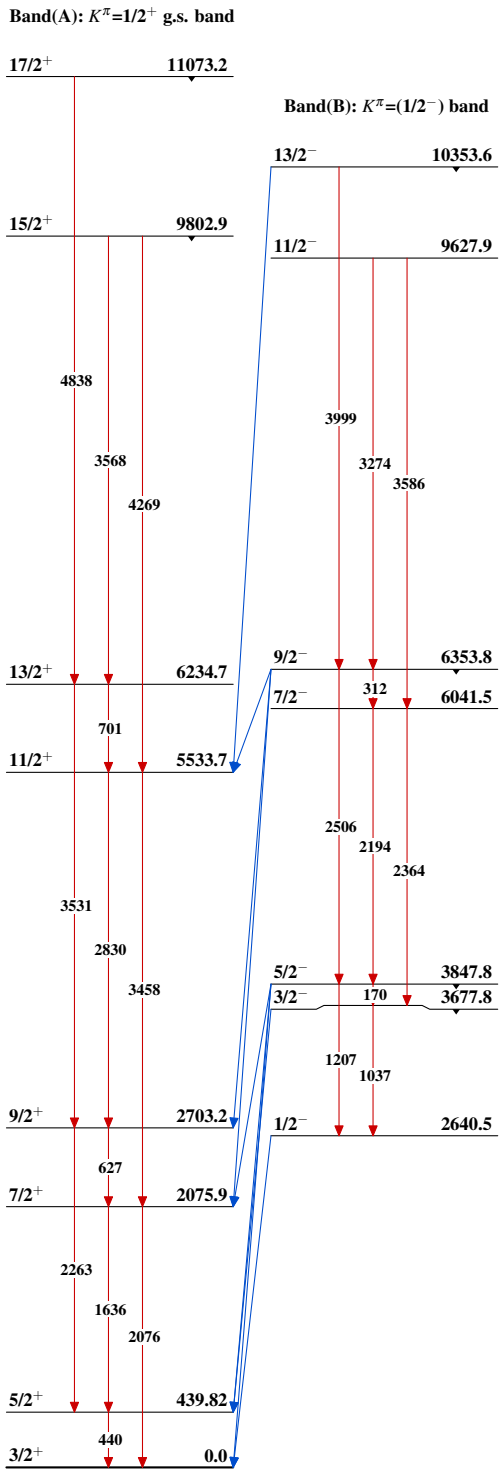
Level Scheme (continued)

Intensities: Relative I_γ
@ Multiply placed: intensity suitably divided



$^{23}_{11}Na_{12}$

$^{12}C(^{12}C,p\gamma)$ 2013Je04,1977Ke05,1979Lu02



$^{23}_{11}Na_{12}$