^{24}Mg(^{16}O,2αpγ) 2006Io02

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Jun Chen and Balraj Singh	NDS 184, 29 (2022)	24-Jun-2022

2006Io02: two separate experiments performed with thin and thick ^{24}Mg targets. E=70 MeV ^{16}O beam from the XTU Tandem Accelerator of the Legnaro National Laboratory. Targets were 400 μg/cm^2 self-supporting ^{24}Mg foil and 750 μg/cm^2 ^{24}Mg on a 15 mg/cm^2 Au backing. In thick target experiment, measured Eγ, Iγ, γγ(θ) with the GASP array of 40 Compton-suppressed HPGe detectors and an 80-element BGO ball. In the thin target experiment, measured γ-2α-p coin and lifetimes with same detector array used as well as the 4π charged-particle detector ISIS consisting of 40 ΔE-E Si telescopes. Deduced levels, J, π, γ-ray multipolarities. Comparisons with shell-model calculations.

Other: 1982Ra25.

All data are from 2006Io02, unless otherwise noted.

^{31}P Levels

E(level)†	Jπ#	E(level)†	Jπ#	$T_{1/2}$‡	E(level)†	Jπ#	$T_{1/2}$‡
0.0@	1/2+	6453.6@ *4*	11/2+		9313.0@ *4*	13/2+	
1266.1@ *3*	3/2+	6501.4& *4*	9/2−		9449.9 *4*	13/2−	35 fs *14*
2233.7@ *3*	5/2+	6796.1 *4*	9/2−		9599.7 *4*	13/2+	
3294.9 *3*	5/2+	6824.0& *4*	11/2−		10037.0 *4*	13/2+	
3414.7@ *3*	7/2+	7442.0 *4*	11/2+		10217.0& *4*	15/2−	76 fs *21*
4191.1 *4*	5/2+	7859.8 *4*	11/2−		10520.1@ *4*	15/2+	0.67 ps *7*
4430.9& *3*	7/2−	8077.0 *4*	11/2−		10759.3 *4*	15/2−	
4633.7 *3*	7/2+	8343.5 *5*	11/2+		11296.9@ *4*	17/2+	1.32 ps *14*
5343.1@ *3*	9/2+	8414.3 *4*	11/2−		11733.9 *5*	15/2+	
5892.1 *4*	9/2+	8705.3& *4*	13/2−	159 fs *28*	13879.1 *10*	(19/2+)	
6079.5 *5*	9/2+	9176.0 *4*	13/2−	83 fs *28*			

† From a least-squares fit to γ-ray energies.
‡ From line-shape analysis with DSAM method (2006Io02).
# As proposed for excited states by 2006Io02 based on measured γγ(θ)(ADO) data. Assignments are the same in Adopted Levels, except that some have been given in parentheses where no strong argument is available.
@ Member of yrast π=+ sequence.
& Member of yrast π=− sequence.

γ(^{31}P)

R_{ADO}=[Iγ(34°)+Iγ(146°)]/2Iγ(90°); R_{ADO}≈0.8 for pure ΔJ=1 stretched transition, ≈1.35 for ΔJ=2 stretched transition and ≈1.4 for ΔJ=0 (2006Io02).

Eγ	Iγ	E_i(level)	J^π_i	E_f	J^π_f	Mult.†	δ‡	Comments
239.8 *2*	0.26 *5*	4430.9	7/2−	4191.1	5/2+			
483.1 *2*	0.21 *5*	10520.1	15/2+	10037.0	13/2+			
537.5 *2*	0.19 *4*	11296.9	17/2+	10759.3	15/2−			
628.4 *2*	0.48 *4*	8705.3	13/2−	8077.0	11/2−			
709.4 *2*	0.54 *8*	5343.1	9/2+	4633.7	7/2+			
744.7 *2*	1.4 *2*	9449.9	13/2−	8705.3	13/2−	D&		Mult.: ΔJ=0 transition. R_{ADO}=1.44 *16*.
767.3 *2*	0.31 *6*	10217.0	15/2−	9449.9	13/2−			
776.8 *2*	1.5 *2*	11296.9	17/2+	10520.1	15/2+	M1+E2	+0.17 *10*	R_{ADO}=1.04 *10*.

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^{24}Mg(^{16}O,2αpγ) 2006Io02 (continued)

γ(^{31}P) (continued)

Eγ	Iγ	Ei(level)	J^π_i	Ef	J^π_f	Mult.[†]	δ[‡]	Comments
903.9 *3*	0.22 *4*	10217.0	15/2⁻	9313.0	13/2⁺			
920.4 *3*	0.32 *7*	10520.1	15/2⁺	9599.7	13/2⁺			
967.6 *3*	0.71 *5*	2233.7	5/2⁺	1266.1	3/2⁺			
988.4 *2*	1.0 *1*	7442.0	11/2⁺	6453.6	11/2⁺	D+Q		Mult.: ΔJ=0 transition. R_{ADO}=1.6 *4*.
1016.4 *2*	1.6 *2*	4430.9	7/2⁻	3414.7	7/2⁺	D[@]		Mult.: ΔJ=0 transition. R_{ADO}=1.43 *21*.
1041.0 *2*	1.0 *2*	10217.0	15/2⁻	9176.0	13/2⁻	M1+E2	≥+0.30	R_{ADO}=1.47 *22*.
1061.0 *3*	7.3 *3*	3294.9	5/2⁺	2233.7	5/2⁺	D+Q		R_{ADO}=1.32 *7*. Mult.: ΔJ=0 transition.
1063.5 *4*	1.4 *1*	7859.8	11/2⁻	6796.1	9/2⁻			
1069.8 *3*	1.8 *2*	10520.1	15/2⁺	9449.9	13/2⁻			
1080.1 *3*	0.8 *2*	11296.9	17/2⁺	10217.0	15/2⁻			
1099.2 *4*	0.8 *3*	9176.0	13/2⁻	8077.0	11/2⁻			
1106.4 *4*	0.10 *4*	9449.9	13/2⁻	8343.5	11/2⁺			
1110.5 *3*	3.8 *4*	6453.6	11/2⁺	5343.1	9/2⁺	D+Q		R_{ADO}=1.13 *10*.
1135.7 *3*	16.1 *9*	4430.9	7/2⁻	3294.9	5/2⁺	D[@]		R_{ADO}=0.83 *4*.
1181.1 *3*	2.4 *2*	3414.7	7/2⁺	2233.7	5/2⁺	D+Q		R_{ADO}=0.48 *9*.
1207.3 *4*	0.25 *8*	10520.1	15/2⁺	9313.0	13/2⁺			
1218.8 *3*	5.0 *2*	4633.7	7/2⁺	3414.7	7/2⁺	D+Q		Mult.: ΔJ=0 transition. R_{ADO}=1.44 *9*.
1253.4 *3*	2.2 *2*	8077.0	11/2⁻	6824.0	11/2⁻	D[&]		Mult.: ΔJ=0 transition. R_{ADO}=1.25 *15*.
1259.6 *4*	0.60 *7*	11296.9	17/2⁺	10037.0	13/2⁺			
1266.1 *4*	100 *3*	1266.1	3/2⁺	0.0	1/2⁺	D+Q		R_{ADO}=0.75 *2*.
1338.7 *4*	4.8 *4*	4633.7	7/2⁺	3294.9	5/2⁺	D+Q		R_{ADO}=1.15 *10*.
1344.3 *5*	0.09 *3*	10520.1	15/2⁺	9176.0	13/2⁻			
1373.2 *5*	0.8 *1*	9449.9	13/2⁻	8077.0	11/2⁻			
1445.6 *4*	1.2 *2*	6079.5	9/2⁺	4633.7	7/2⁺	D+Q	+0.13 *8*	R_{ADO}=0.94 *13*.
1480.8 *3*	15.1 *6*	6824.0	11/2⁻	5343.1	9/2⁺	D[@]		R_{ADO}=0.81 *4*.
1511.9 *5*	0.16 *4*	10217.0	15/2⁻	8705.3	13/2⁻			
1516.8 *5*	1.6 *3*	11733.9	15/2⁺	10217.0	15/2⁻	D[@]		Mult.: ΔJ=0 transition. R_{ADO}=1.31 *18*.
1590.1 *5*	1.1 *2*	8414.3	11/2⁻	6824.0	11/2⁻	D[&]		Mult.: ΔJ=0 transition. R_{ADO}=1.37 *11*.
1697[#a]	<0.03[#]	11296.9	17/2⁺	9599.7	13/2⁺			
1733.9 *6*	0.9 *3*	9176.0	13/2⁻	7442.0	11/2⁺			
1802.8 *5*	0.6 *1*	10217.0	15/2⁻	8414.3	11/2⁻			
1814.5 *4*	4.2 *4*	10520.1	15/2⁺	8705.3	13/2⁻	D[@]		R_{ADO}=0.81 *8*.
1819.6 *6*	0.61 *6*	6453.6	11/2⁺	4633.7	7/2⁺			
1871.1 *6*	1.2 *6*	9313.0	13/2⁺	7442.0	11/2⁺			
1881.3 *4*	9.5 *8*	8705.3	13/2⁻	6824.0	11/2⁻	M1+E2	+0.20 *6*	R_{ADO}=1.08 *7*.
1909.2 *5*	0.9 *1*	8705.3	13/2⁻	6796.1	9/2⁻			
1913.1 *5*	0.7 *3*	8414.3	11/2⁻	6501.4	9/2⁻			
1928.4 *4*	33.7 *13*	5343.1	9/2⁺	3414.7	7/2⁺	D+Q		R_{ADO}=0.82 *4*.
1957.2 *6*	0.55 *6*	4191.1	5/2⁺	2233.7	5/2⁺			
1984[#a]	<0.03[#]	11296.9	17/2⁺	9313.0	13/2⁺			
2007.8 *7*	0.2 *1*	9449.9	13/2⁻	7442.0	11/2⁺			
2028.6 *4*	25.9 *9*	3294.9	5/2⁺	1266.1	3/2⁺	D+Q		R_{ADO}=1.16 *4*.
2048.3 *4*	2.9 *4*	5343.1	9/2⁺	3294.9	5/2⁺	Q		R_{ADO}=1.32 *12*.
2070.4 *4*	7.1 *4*	6501.4	9/2⁻	4430.9	7/2⁻	D+Q		R_{ADO}=1.72 *20*.
2139.6 *5*	0.54 *8*	10217.0	15/2⁻	8077.0	11/2⁻			
2148.6 *4*	75 *3*	3414.7	7/2⁺	1266.1	3/2⁺	Q		R_{ADO}=1.44 *4*.
2176.4 *6*	0.09 *2*	10520.1	15/2⁺	8343.5	11/2⁺			

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^{24}Mg(^{16}O,2αpγ) 2006Io02 (continued)

γ(^{31}P) (continued)

E_γ	I_γ	E_i(level)	J^π_i	E_f	J^π_f	Mult.[†]	δ[‡]	Comments
2197.0 4	18.6 6	4430.9	7/2−	2233.7	5/2+	D[@]		R_{ADO}=0.83 5.
2203.6 6	0.9 2	8705.3	13/2−	6501.4	9/2−			
2233.5 4	26 4	2233.7	5/2+	0.0	1/2+	Q		R_{ADO}=1.24 8.
2251.6 5	0.8 1	8705.3	13/2−	6453.6	11/2+			
2351.6 6	0.5 1	9176.0	13/2−	6824.0	11/2−			
2356.8 6	0.8 2	10217.0	15/2−	7859.8	11/2−			
2365.0 4	4.2 3	6796.1	9/2−	4430.9	7/2−	D+Q		R_{ADO}=0.70 5.
2393.0 4	22.9 6	6824.0	11/2−	4430.9	7/2−	Q		R_{ADO}=1.47 7.
2399.7 5	3.4 4	4633.7	7/2+	2233.7	5/2+			
2477.3 6	0.23 7	5892.1	9/2+	3414.7	7/2+			
2516.8 6	1.0 1	7859.8	11/2−	5343.1	9/2+	D[@]		R_{ADO}=0.85 11.
2557.7 9	0.8 2	11733.9	15/2+	9176.0	13/2−			
2582.1 9	0.7 3	13879.1	(19/2+)	11296.9	17/2+			
2594.7 6	0.4 2	10037.0	13/2+	7442.0	11/2+			
2625.7 6	1.4 1	9449.9	13/2−	6824.0	11/2−	M1+E2	≥+0.2	R_{ADO}=1.31 21.
2722.3 5	5.0 4	9176.0	13/2−	6453.6	11/2+	D[@]		R_{ADO}=0.84 7.
2733.6 6	1.1 2	8077.0	11/2−	5343.1	9/2+			
2859.1 6	1.8 2	9313.0	13/2+	6453.6	11/2+	D+Q	+0.25 10	R_{ADO}=1.16 18.
2924.7 6	1.5 1	4191.1	5/2+	1266.1	3/2+			
3028.5 9	1.4 3	11733.9	15/2+	8705.3	13/2−			
3038.7 5	22.5 7	6453.6	11/2+	3414.7	7/2+	Q		R_{ADO}=1.24 7.
3078.1 6	0.18 3	10520.1	15/2+	7442.0	11/2+			
3086.4 6	1.3 1	6501.4	9/2−	3414.7	7/2+			
3109.4 6	4.7 3	5343.1	9/2+	2233.7	5/2+	Q		R_{ADO}=1.27 16.
3145.7 7	0.09 4	9599.7	13/2+	6453.6	11/2+			
3164.6 7	0.9 2	4430.9	7/2−	1266.1	3/2+			
3233.4 7	0.5 1	9313.0	13/2+	6079.5	9/2+			
3294.7 7	0.28 5	3294.9	5/2+	0.0	1/2+			
3367.6 7	0.5 2	4633.7	7/2+	1266.1	3/2+			
3380.7 6	1.6 3	6796.1	9/2−	3414.7	7/2+			
3392.5 6	4.0 9	10217.0	15/2−	6824.0	11/2−	Q		R_{ADO}=1.34 14.
3428.6 6	2.0 1	7859.8	11/2−	4430.9	7/2−	Q		R_{ADO}=1.36 17.
3582.8 7	0.13 5	10037.0	13/2+	6453.6	11/2+			
3645.6 7	0.9 2	8077.0	11/2−	4430.9	7/2−	Q		R_{ADO}=1.3 3.
3658.2 5	2.4 2	5892.1	9/2+	2233.7	5/2+	Q		R_{ADO}=1.31 21.
3707.6 7	0.2 1	9599.7	13/2+	5892.1	9/2+			
3846.3 7	2.4 2	6079.5	9/2+	2233.7	5/2+			
3934.6 7	1.5 2	10759.3	15/2−	6824.0	11/2−	Q		R_{ADO}=1.27 25.
3983.3 7	0.9 1	8414.3	11/2−	4430.9	7/2−	Q		R_{ADO}=1.35 21.
4026.6 5	5.3 2	7442.0	11/2+	3414.7	7/2+	Q		R_{ADO}=1.37 13.
4066[#a]	<0.06[#]	10520.1	15/2+	6453.6	11/2+			
4144.5 7	0.17 5	10037.0	13/2+	5892.1	9/2+			
4257.1 8	0.06 3	9599.7	13/2+	5343.1	9/2+			
4431.0 7	0.28 6	4430.9	7/2−	0.0	1/2+	[E3]		
4472.7 9	0.06 2	11296.9	17/2+	6824.0	11/2−	[E3]		
4693.6 8	1.0 2	10037.0	13/2+	5343.1	9/2+	Q		R_{ADO}=1.4 3.
4928.5 8	1.1 1	8343.5	11/2+	3414.7	7/2+	Q		R_{ADO}=1.4 3.
5280.3 19	0.7 1	11733.9	15/2+	6453.6	11/2+	Q		R_{ADO}=1.5 3.

[†] From γγ(θ)(ADO) data of 2006Io02. The evaluators assign mult=Q for ΔJ=2, quadrupole transitions and D or D+Q for ΔJ=1 and in a few cases ΔJ=0 transitions. 2006Io02 assign E2 for the former and mostly M1+E2 for the latter, and E1 for pure dipole transitions, except for 744.7γ, 1253.4γ and 1590.1γ for which they assign M1. When level lifetimes are known, RUL is used to

Continued on next page (footnotes at end of table)

^{24}Mg(^{16}O,2αpγ) 2006Io02 (continued)

γ(^{31}P) (continued)

assign M1+E2.

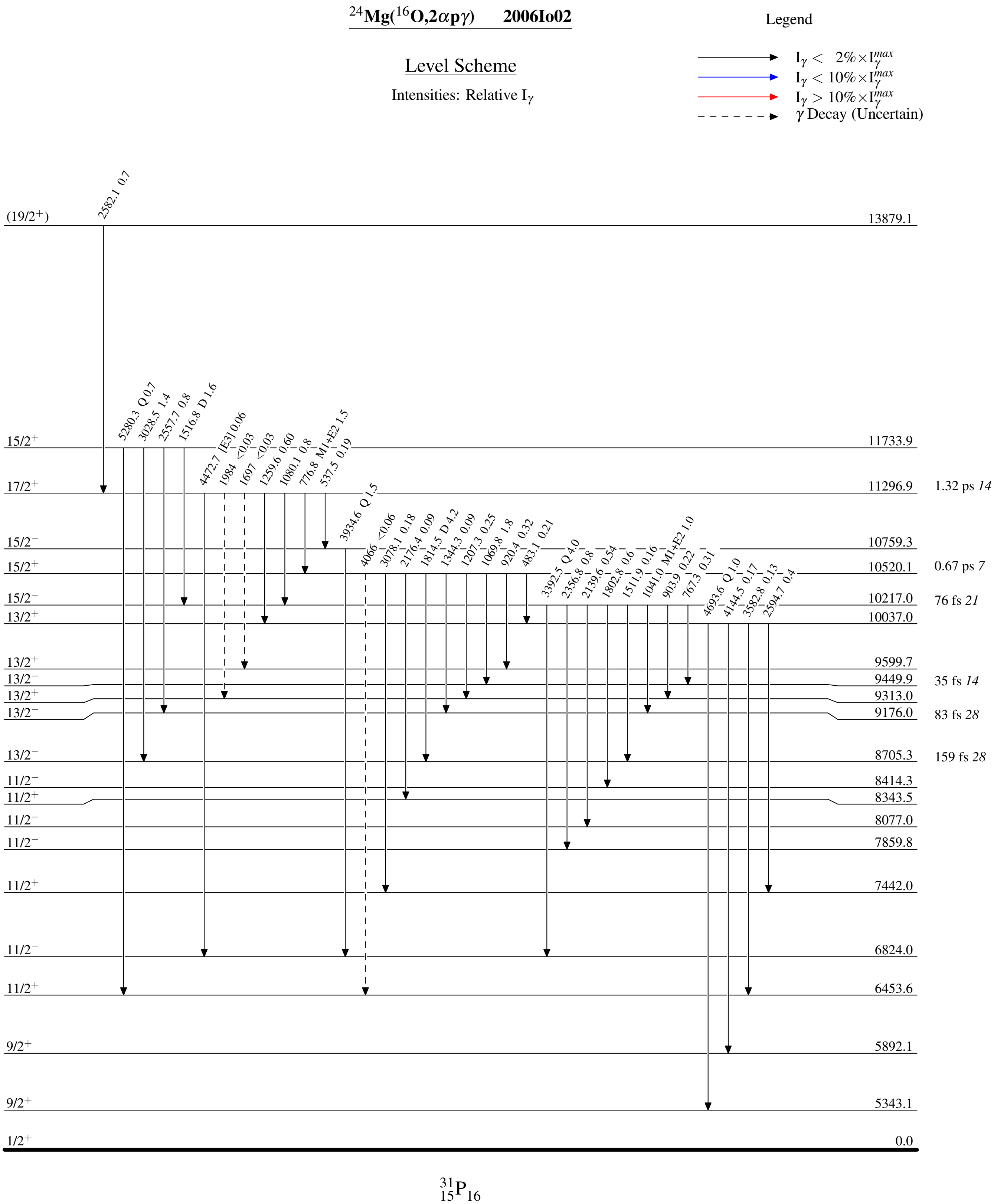
‡ From $\gamma\gamma(\theta)$(ADO) data of 2006Io02.

From table IV of 2006Io02, with intensity deduced from branching ratio.

@ E1 assigned by 2006Io02 based on $\gamma\gamma$(ADO) data which suggest pure dipole.

& M1 assigned by 2006Io02 based on $\gamma\gamma$(ADO) data which suggest pure dipole.

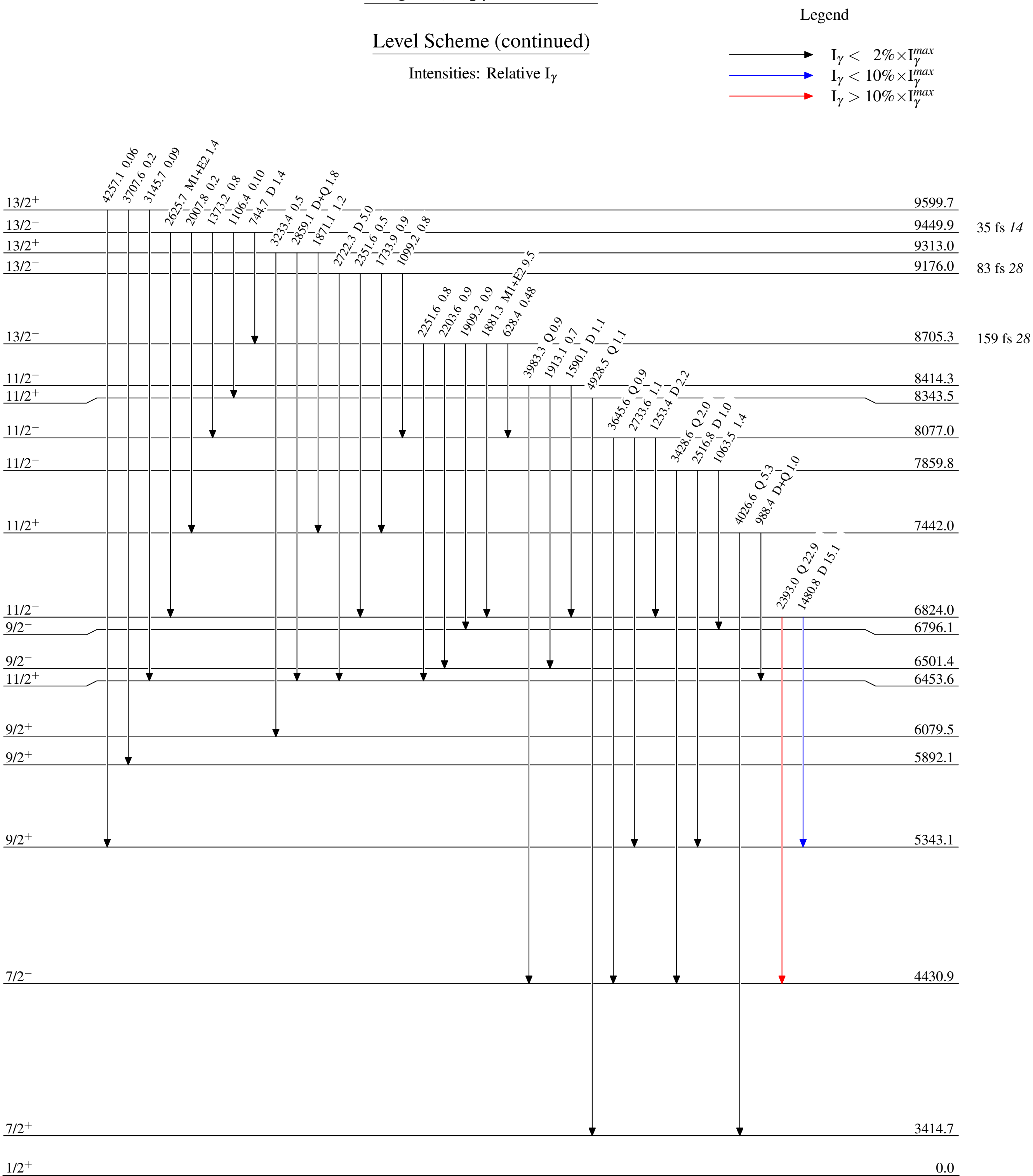
[a] Placement of transition in the level scheme is uncertain.


^{24}Mg(^{16}O,2αpγ) 2006Io02
Level Scheme
Intensities: Relative Iγ
Legend
Iγ < 2%×Iγ^max
Iγ < 10%×Iγ^max
Iγ > 10%×Iγ^max
γ Decay (Uncertain)
(19/2+) 13879.1
15/2+ 11733.9
17/2+ 11296.9 1.32 ps 14
15/2− 10759.3
15/2+ 10520.1 0.67 ps 7
15/2− 10217.0 76 fs 21
13/2+ 10037.0
13/2+ 9599.7
13/2− 9449.9 35 fs 14
13/2+ 9313.0
13/2− 9176.0 83 fs 28
13/2− 8705.3 159 fs 28
11/2− 8414.3
11/2+ 8343.5
11/2− 8077.0
11/2− 7859.8
11/2+ 7442.0
11/2− 6824.0
11/2+ 6453.6
9/2+ 5892.1
9/2+ 5343.1
1/2+ 0.0
2582.1 0.7
5280.3 Q 0.7
3028.5 1.4
2557.7 0.8
1516.8 D 1.6
4472.7 [E3] 0.06
1984 <0.03
1697 <0.03
1259.6 0.60
1080.1 0.8
776.8 M1+E2 1.5
537.5 0.19
3934.6 Q 1.5
4066 <0.06
3078.1 0.18
2176.4 0.09
1814.5 D 4.2
1344.3 0.09
1207.3 0.25
1069.8 1.8
920.4 0.32
483.1 0.21
3392.5 Q 4.0
2356.8 0.8
2139.6 0.54
1802.8 0.6
1511.9 0.16
1041.0 M1+E2 1.0
903.9 0.22
767.3 0.31
4693.6 Q 1.0
4144.5 0.17
3582.8 0.13
2594.7 0.4
$^{31}_{15}$P$_{16}$

^{24}Mg(^{16}O,2αpγ) 2006Io02

Level Scheme (continued)

Intensities: Relative I_γ

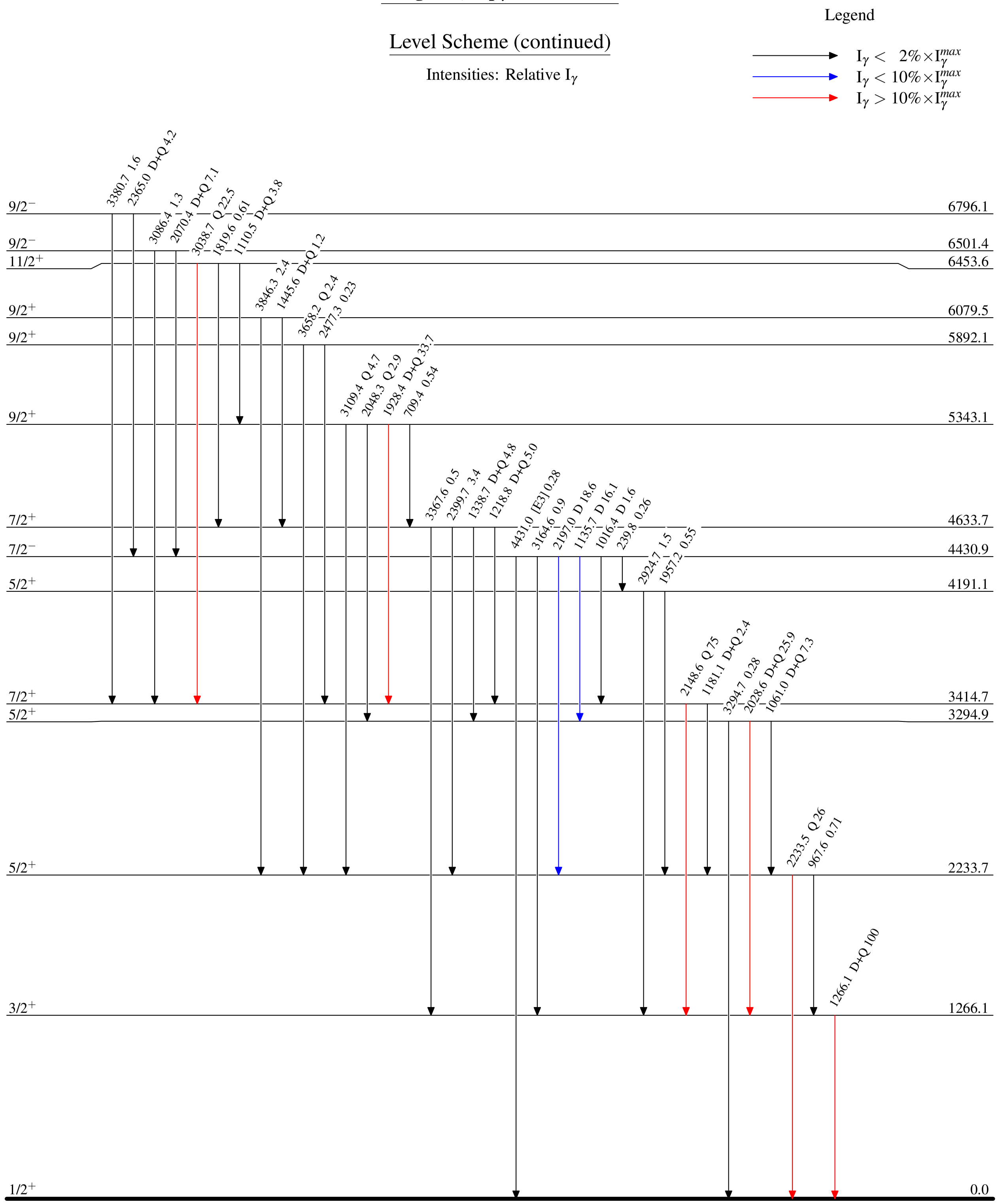


$^{31}_{15}P_{16}$

$^{24}Mg(^{16}O,2\alpha p\gamma)$ 2006Io02

Level Scheme (continued)

Intensities: Relative I_γ



$^{31}_{15}P_{16}$