^{31}Ar εp decay (15.0 ms) 2000Fy01,2013Ko13

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	M. S. Basunia, A. Chakraborty	NDS 197,1 (2024)	31-May-2024

Parent: ^{31}Ar: E=0.0; $J^\pi=5/2^+$; $T_{1/2}$=15.0 ms *3*; Q(εp)=18100 *syst*; %εp decay=68 *3*

^{31}Ar-J^π,$T_{1/2}$: from the Adopted Levels of ^{31}Ar (2022Ch37).

^{31}Ar-Q(εp): 18060 *200* (syst,2012Wa38).

^{31}Ar-%εp decay: from 2015Li20. Using total %branching of 3.60 *44* (2014Ko17) and the ΣI_p of the placed proton groups in this dataset yields a branching of 67(8)%, where ΣI_p=242 *4*.

Others: 1987Bo36, 1989Re02, 1998Ax02, 1999Th09, (2002Fy01, 2014Ko17, 2013Ko13, 2014Ko34 – all from the same research group of 2000Fy01).

2000Fy01, 1998Ax02, 2002Fy01: ^{31}Ar produced at the ISOLDE facility at CERN bombarding CaO target with 1 GeV pulsed protons; 13 Si p-i-n diodes, double-sided Si strip, Si surface barrier and HPGe detectors; identified and measured β-particles, delayed proton energy and intensity, excitation energy of ^{30}S deduced following the two-proton emission.

2013Ko13: Cocktail beam including ^{31}Ar was produced from collision of versatile arc discharge plasma ion source on CaO powder target at ISOLDE-CERN facility. The resulting beam at 60 keV was impinged on 50 μg/cm^2 carbon foil. The detector setup included six double- sided silicon strip detectors (DSSSDs) and two Miniball HPGe cluster detectors. Measured Eγ, E(p), I(p), pγ-coin, pp-coin, pp(θ), Deduced IAS in ^{31}Cl, ^{30}S, branching ratios for β^+p, β^+2p, and β^+3p decay modes, proton- and γ-widths.

^{30}S Levels

E(level)	J^π[&]	$T_{1/2}$	Comments
0.0	0^+[a]	1.1798 s *6*	$T_{1/2}$: From the Adopted Levels.
2210.2 *11*	2^+[a]	169 fs *23*	
3404.4 *16*	2^+[a]	121 fs *15*	
3667.7 *3*	(0^+)	>1 ps	E(level): from 2014Ko17. J^π: other: 0^+ in 2014Ko17.
3677.0 *3*	(1^+)	97 fs *55*	E(level): From 2014Ko17. J^π: other: 1^+ in 2014Ko17.
4689.2[#] *24*	(3^+)[a]		Γ_γ/Γ_p>3.8 at 95% confidence limit (2013Ko13). J^π: other: 3^+ in 2014Ko17.
4809.0[#@] *3*	(2^+)		E(level): from 2014Ko17. J^π: other: 2^+ in 2014Ko17.
5136 *2*	(4^+)	38 fs *14*	E(level): from 2000Fy01.
5217.4 *7*	(3^+)		E(level): other: 5227 *3* in 2013Ko13. 1814.4 and 3008.5 gammas reported in 2012Lo14 (^{3}He,nγ) from a 5218.8,0^+ level were not seen by 2013Ko13. $J^\pi=3^+$ in 2014Ko17 suggests that 5227 level is different from the 5218.8 level. The assignment of 0^+ (2010Se07 – (p,t)) is in disagreement. J^π: from pp(θ) data (2014Ko17); first proton from excited state in ^{31}Cl to 5227 level in ^{30}S, followed by a second proton to $1/2^+$ g.s. in ^{29}P from the 5227 level in ^{30}S. Analysis assumed 0^+,1^+, 2^+,3^+,4^+ for the 5227 state in ^{30}S, and concluded 3^+ as the most probable assignment. Γ_γ/Γ_p<0.5 at 95% confidence limit (2013Ko13).
5389 *2*	(2^+)		E(level): from 2000Fy01. Other: 5392 *4* (2013Ko13).
5842 *4*	(4^+)		E(level): from 2000Fy01. Other: 5847 *4* (2013Ko13) – No clear evidence of a 3637.7-keV γ reported earlier from this level. Γ_γ/Γ_p<9 at 95% confidence limit (2013Ko13); in disagreement with 15.7 (2012Al23) for a $5835.5,4^+$ level.
5945?[†] *3*	4,5		
6064[†] *3*	1^-		
6202[†] *3*			
6280.1[†] *12*			

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^{31}Ar εp decay (15.0 ms) 2000Fy01,2013Ko13 (continued)

^{30}S Levels (continued)

E(level)	Jπ&	E(level)	Jπ&	E(level)	Jπ&	E(level)
6338.6† *14*		6855† *4*		7237?†‡ *5*	(3⁻)	7598 *4*
6541† *4*		6927† *4*	(1⁻)	7295† *14*	(2⁺)	7693 *4*
6643?† *3*		7078† *7*	0⁺	7352† *8*	(2⁺)	7924† *5*
6762† *4*	2⁺	7123† *10*	(1,2)	7485 *4*	(4⁺)	

† Followed by two-proton decay of ^{31}Ar β^+ decay (2000Fy01).
‡ Not adopted.
# Decay is not uniquely identified in the spectra (2014Ko17).
@ As listed in 2014Ko17.
& From the Adopted Levels.
a Same in 2014Ko17, except where otherwise noted.

γ(^{30}S)

E_γ†	I_γ†	E_i(level)	J_i^π	E_f	J_f^π
1194.2 *11*	35 *4*	3404.4	2⁺	2210.2	2⁺
2210.1 *11*	100 *8*	2210.2	2⁺	0.0	0⁺
2478.9 *21*	16 *4*	4689.2	(3⁺)	2210.2	2⁺
3407 *7*	22 *7*	3404.4	2⁺	0.0	0⁺

† From 2013Ko13.

Delayed Protons (^{30}S)

Particle normalization: from branching/ΣI$_p$.

E(p)†	E(^{30}S)	I(p)†d	E(^{31}Cl)c	Comments
446#@ *15*		0.49# *16*	725	
754#& *15*		3.0# *3*	3254	
974#@e *15*		1.4# *2*	1271	
1289#& *9*		0.95# *20*	3807	
3242#a *12*		2.2# *8*	7019	
3534#b *10*		2.4# *4*	7584	
4466#@ *10*		0.69# *20*	4880	
4624#@ *9*		0.7# *2*	5043	
4743#b *9*		1.7# *3*	8834	
6175#& *12*		2.8# *12*	8857	
9379#@ *13*		0.33# *20*	9958	
1131 *5*	5217.4	2.0 *4*	6650	I(p): weighted average of 2.7 *16* (2000Fy01) and 2.0 *4* (1998Ax02).
1133e *15*	0.0	2.0 *4*	1435	
1211 *4*	5136	1.2 *3*	6652	I(p): weighted average of 1.7 *5* (2000Fy01) and 1.0 *3* (1998Ax02).
1300 *13*	5217.4	1.0 *2*	6825	I(p): weighted average of 0.7 *11* (2000Fy01) and 1.0 *2* (1998Ax02).
1416 *2*	0.0	35.7 *17*	1728	I(p): unweighted average of 34.0 *3* (2000Fy01) and 37.4 *12* (1998Ax02).
1504 *2*	2210.2	6.3 *3*	4029	I(p): weighted average of 6.2 *2* (2000Fy01) and 7.0 *6* (1998Ax02).
1641e *8*	2210.2	2.88 *14*	4170	I(p): weighted average of 2.88 *14* (2000Fy01) and 3.0 *6* (1998Ax02).

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^{31}Ar εp decay (15.0 ms) 2000Fy01,2013Ko13 (continued)

Delayed Protons (continued)

E(p)[†]	E(^{30}S)	I(p)[†d]	E(^{31}Cl)[c]	Comments
1643 *2*	3404.4	2.88 *14*	5367	
1819 *3*	5217.4	2.88 *14*	7362	I(p): weighted average of 2.88 *14* (2000Fy01) and 3.0 *6* (1998Ax02).
1870‡ *3*	3404.4	0.8‡ *2*	5601	
1923‡ *3*	5217.4	0.44‡ *14*	7469	
2008 *2*	3404.4	10.0 *2*	5744	I(p): weighted average of 10.0 *2* (2000Fy01) and 10.8 *10* (1998Ax02).
2084 *2*	0.0	100.0 *3*	2418	I(p): weighted average of 100.0 *6* (2000Fy01) and 100.0 *3* (1998Ax02).
2253 *2*	0.0	4.5 *5*	2593	I(p): unweighted average of 4.0 *3* (2000Fy01) and 5.0 *2* (1998Ax02).
2327‡ *4*	0.0	5.1‡ *4*	2669	
2881 *3*	0.0	1.01 *13*	3242	I(p): weighted average of 0.99 *13* (2000Fy01) and 1.7 *9* (1998Ax02).
2881 *3*	3404.4	0.99 *13*	6646	
3020‡ *3*	2210.2	1.08‡ *14*	5596	
3153‡ *4*	2210.2	0.44‡ *10*	5733	
3249 *4*	0.0	1.21 *19*	3622	I(p): weighted average of 1.17 *15* (2000Fy01) and 2.2 *8* (1998Ax02).
3432 *3*	0.0	0.95 *17*	3811	I(p): weighted average of 0.89 *11* (2000Fy01) and 1.4 *3* (1998Ax02).
3432‡ *3*	3667.7	0.89‡ *11*	7479	
3561 *11*	3404.4	2.6 *5*	7349	I(p): weighted average of 3.6 *8* (2000Fy01) and 2.4 *4* (1998Ax02).
3634 *3*	0.0	7.7 *16*	4020	I(p): unweighted average of 6.1 *8* (2000Fy01) and 9.2 *7* (1998Ax02).
3806‡ *4*	5217.4	0.53‡ *13*	9415	
3902 *3*	0.0	2.9 *7*	4297	I(p): unweighted average of 2.22 *14* (2000Fy01) and 3.5 *6* (1998Ax02).
3902‡ *3*	2210.2	2.22‡ *14*	6507	
4030 *3*	2210.2	8.0 *10*	6640	I(p): unweighted average of 7.02 *2* (2000Fy01) and 8.9 *8* (1998Ax02).
4200 *4*	0.0	1.9 *8*	4605	I(p): unweighted average of 1.09 *18* (2000Fy01) and 2.6 *7* (1998Ax02).
4200‡ *4*	7693	1.09‡ *18*	12295	
4289‡ *4*	7598	0.31‡ *8*	12286	
4389 *5*	0.0	0.90 *31*	4801	I(p): unweighted average of 0.59 *11* (2000Fy01) and 1.2 *2* (1998Ax02).
4389‡ *5*	7485	0.59‡ *11*	12258	
4730 *5*	2210.2	1.68 *18*	7363	I(p): weighted average of 1.68 *18* (2000Fy01) and 1.7 *3* (1998Ax02).
5276 *5*	0.0	19.1 *15*	5717	I(p): unweighted average of 17.6 *3* (2000Fy01) and 20.6 *9* (1998Ax02).
5632 *9*	0.0	0.32 *5*	6085	I(p): weighted average of 0.37 *9* (2000Fy01) and 0.31 *5* (1998Ax02).
5952‡ *7*	5842	0.19‡ *6*	12254	
6049‡ *9*	0.0	0.51‡ *12*	6516	
6145 *7*	0.0	1.7 *12*	6616	I(p): unweighted average of 0.51 *12* (2000Fy01) and 2.8 *12* (1998Ax02).
6386‡ *7*	5389	0.26‡ *5*	12254	
6540 *8*	0.0	0.90 *11*	7042	I(p): weighted average of 0.84 *11* (2000Fy01) and 1.1 *2* (1998Ax02).
6540‡ *8*	5217.4	0.84‡ *11*	12241	
6950 *9*	0.0	1.05 *35*	7448	I(p): unweighted average of 0.70 *9* (2000Fy01) and 1.4 *3* (1998Ax02).
7074 *9*	0.0	0.51 *7*	7576	E(p): In 2013Ko13, a comparable group 7010 *80* proposed feeding 4687.7 and/or 4809.0 levels. I(p): weighted average of 0.49 *7* (2000Fy01) and 0.7 *2* (1998Ax02).
8095 *12*	3667.7	0.40 *15*	12299	E(p): from 1998Ax02. In 2013Ko13, a comparable group 8080 *80* proposed feeding this level at 8095 or the 3677 level. I(p): unweighted average of 0.25 *4* (2000Fy01) and 0.55 *14* (1998Ax02).
8347 *15*	3404.4	0.55 *10*	12296	I(p): weighted average of 0.51 *6* (2000Fy01) and 0.82 *16* (1998Ax02).
8860‡ *19*	0.0	0.22‡ *19*	9422	
9493 *20*	2210.2	0.30 *4*	12286	I(p): weighted average of 0.30 *4* (2000Fy01) and 0.33 *20* (1998Ax02).
11657 *25*	0.0	0.27 *4*	12313	E(p): from 1998Ax02. I(p): unweighted average of 0.27 *4* (2000Fy01) and 0.23 *11* (1998Ax02).
11858‡ *29*	0.0	0.034‡ *3*	12521	

[†] From 2000Fy01, except otherwise noted.

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^{31}Ar εp decay (15.0 ms) 2000Fy01,2013Ko13 (continued)

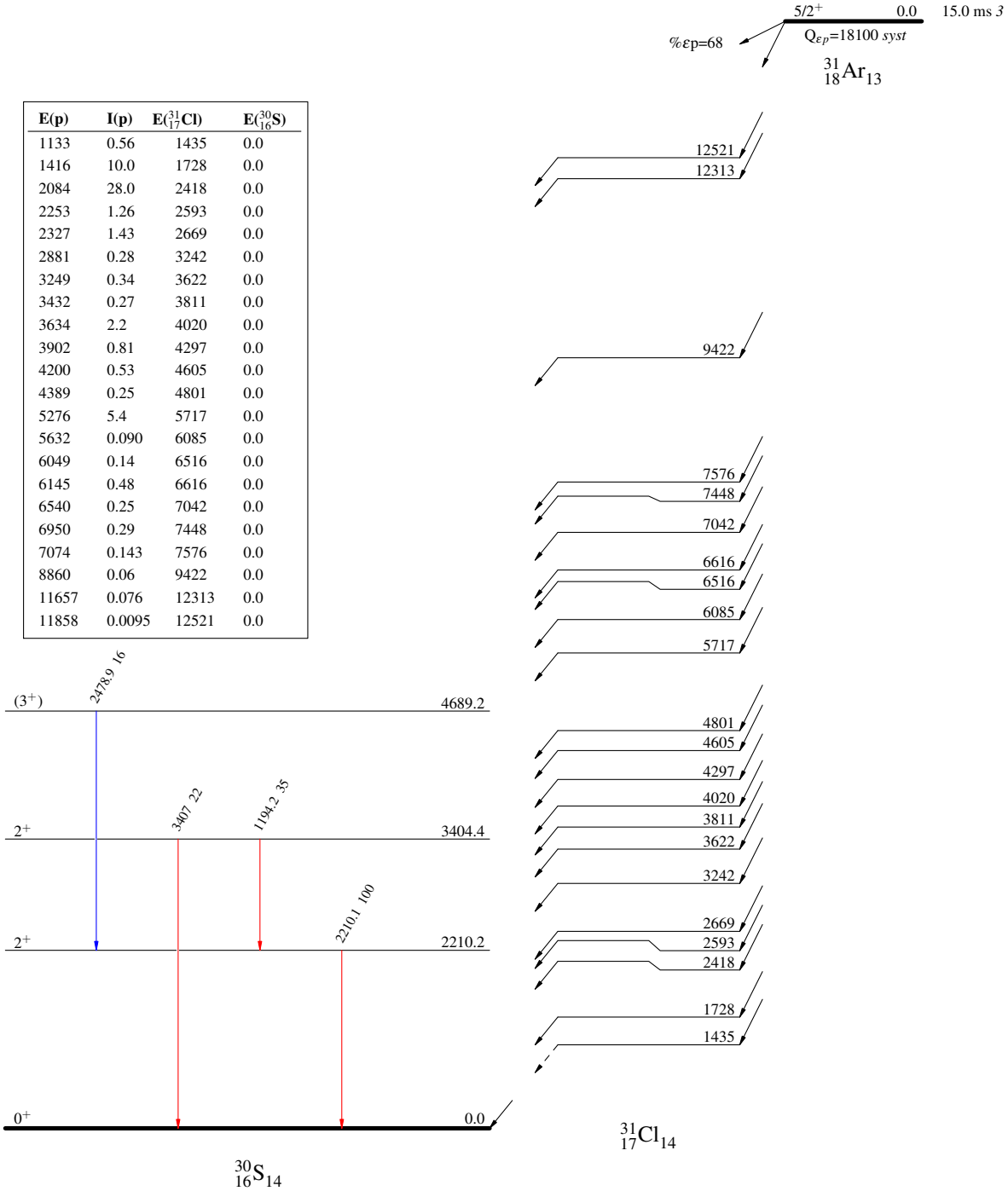
Delayed Protons (^{30}S) (continued)

‡ Reported in 2000Fy01 only.
# Reported in 1998Ax02 only, not in their later publication in 2000Fy01. Evaluators list these as unplaced and not considered for normalization. Consideration of these proton groups would give higher branching compared to the adopted one.
@ Feeding g.s. in 1998Ax02.
& Feeding 1st excited state in 1998Ax02.
a Feeding 3404 level in 1998Ax02.
b Feeding 3668 level in 1998Ax02.
c From E(c.m.)+S(p)(^{31}Cl)+E(level)(^{30}S), where S(p)=264 *3* (2021Wa16) and E(c.m.) deduced from E(p) listed under comments using E(c.m)=[1+mass(p)/mass(^{30}S)]×E(p).
d For absolute intensity per 100 decays, multiply by 0.28 *2*.
e Placement of transition in the level scheme is uncertain.

^{31}Ar εp decay (15.0 ms) 2000Fy01,2013Ko13

Decay Scheme

γ Intensities: Relative I_γ
I(p) Intensities: I(p) per 100 parent decays



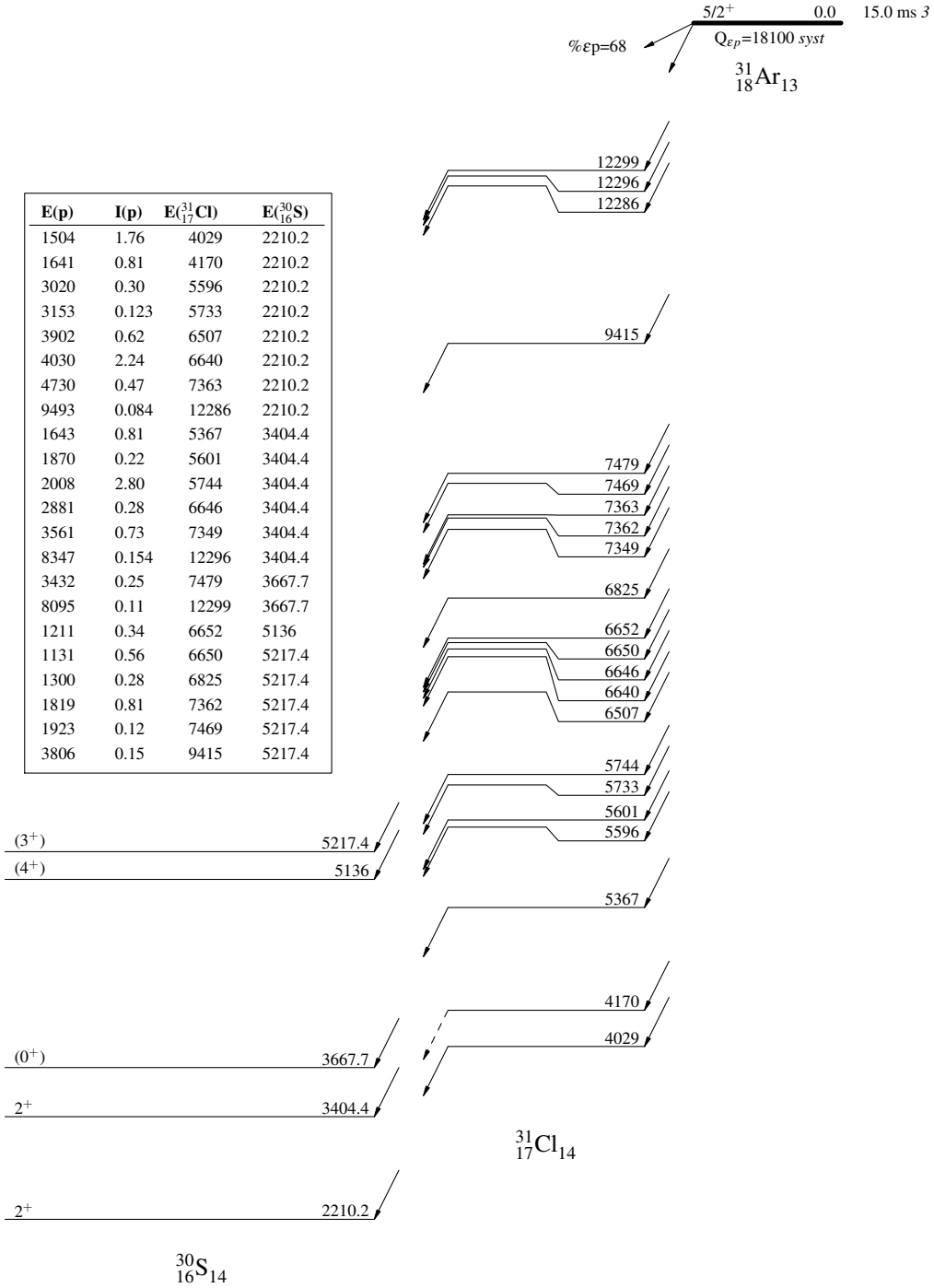
E(p)	I(p)	E($^{31}_{17}$Cl)	E($^{30}_{16}$S)
1133	0.56	1435	0.0
1416	10.0	1728	0.0
2084	28.0	2418	0.0
2253	1.26	2593	0.0
2327	1.43	2669	0.0
2881	0.28	3242	0.0
3249	0.34	3622	0.0
3432	0.27	3811	0.0
3634	2.2	4020	0.0
3902	0.81	4297	0.0
4200	0.53	4605	0.0
4389	0.25	4801	0.0
5276	5.4	5717	0.0
5632	0.090	6085	0.0
6049	0.14	6516	0.0
6145	0.48	6616	0.0
6540	0.25	7042	0.0
6950	0.29	7448	0.0
7074	0.143	7576	0.0
8860	0.06	9422	0.0
11657	0.076	12313	0.0
11858	0.0095	12521	0.0

^{31}Ar εp decay (15.0 ms) 2000Fy01,2013Ko13

Decay Scheme (continued)

γ Intensities: Relative I_γ
I(p) Intensities: I(p) per 100 parent decays

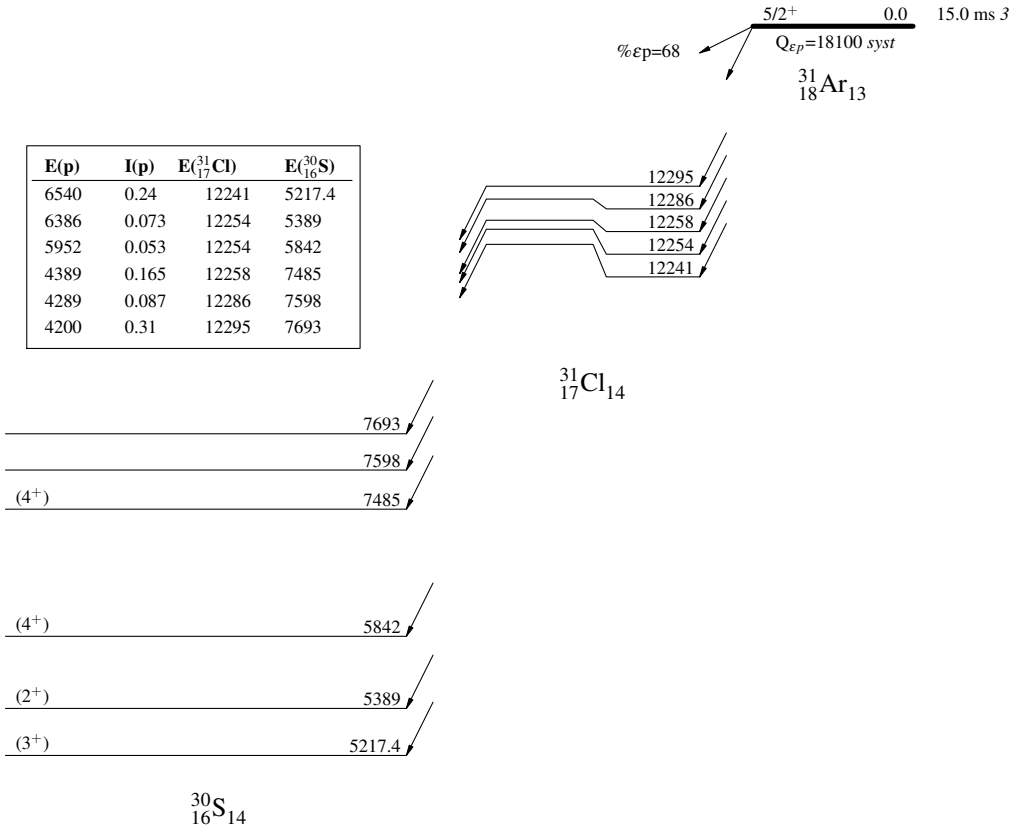
E(p)	I(p)	$E(^{31}_{17}Cl)$	$E(^{30}_{16}S)$
1504	1.76	4029	2210.2
1641	0.81	4170	2210.2
3020	0.30	5596	2210.2
3153	0.123	5733	2210.2
3902	0.62	6507	2210.2
4030	2.24	6640	2210.2
4730	0.47	7363	2210.2
9493	0.084	12286	2210.2
1643	0.81	5367	3404.4
1870	0.22	5601	3404.4
2008	2.80	5744	3404.4
2881	0.28	6646	3404.4
3561	0.73	7349	3404.4
8347	0.154	12296	3404.4
3432	0.25	7479	3667.7
8095	0.11	12299	3667.7
1211	0.34	6652	5136
1131	0.56	6650	5217.4
1300	0.28	6825	5217.4
1819	0.81	7362	5217.4
1923	0.12	7469	5217.4
3806	0.15	9415	5217.4



^{31}Ar εp decay (15.0 ms) 2000Fy01,2013Ko13

Decay Scheme (continued)

γ Intensities: Relative I_γ
I(p) Intensities: I(p) per 100 parent decays



E(p)	I(p)	E($^{31}_{17}$Cl)	E($^{30}_{16}$S)
6540	0.24	12241	5217.4
6386	0.073	12254	5389
5952	0.053	12254	5842
4389	0.165	12258	7485
4289	0.087	12286	7598
4200	0.31	12295	7693