

(HI,xn γ) 2007Ax01,1976Av06,1978Me19

Type	Author	History	Citation	Literature Cutoff Date
Full Evaluation	Yang Dong, Huo Junde		NDS 128, 185 (2015)	10-Jul-2015

1976St19: $^{24}\text{Mg}(^{32}\text{S},3\text{pn}\gamma)$, E=70-120 MeV, $\gamma\gamma$ -coin, $\gamma(\theta)$, Ge(Li) detectors.

1976Av06: $^{39}\text{K}(^{16}\text{O},2\text{pn}\gamma)$, E=37-52 MeV, $\text{p}\gamma$ coin, $\gamma\gamma$ coin, $\gamma(\theta)$, a 40 cm³ coaxial Ge(Li) detector of 3.7 keV resolution (FWHM) at 1.33 MeV. $\text{p}\gamma$ -coin with the Ge(Li) and an annular silicon detector at 180°, $\gamma\gamma$ -coin with two Ge(Li) detectors.

1978Me19: $^{27}\text{Al}(^{28}\text{Si},2\text{pn}\gamma)$, E=65-81 MeV, $\sigma(\text{E}\gamma,\theta)$, $\gamma\gamma$ -coin. a Ge(Li) detector of ≈ 2.8 keV resolution (FWHM) at 1332 keV. $\gamma\gamma$ -coin with two Ge(Li) detectors.

1979Me03: $^{28}\text{Si}(^{28}\text{Si},3\text{pn}\gamma)$, E=65-90 MeV, $\sigma(\text{E}\gamma,\theta)$, $\gamma\gamma$ -coin. a Ge(Li) detector of ≈ 2.3 keV resolution (FWHM) at 1332 keV, a Si(Li) detector used to look for low-energy photons, $\gamma\gamma$ -coin with two Ge(Li) detectors.

1980DeZA: $^{27}\text{Al}(^{32}\text{S},\alpha 2\text{pn}\gamma)$, E=130 MeV, $\gamma\gamma$ -coin.

1983Th05: $^{27}\text{Al}(^{28}\text{Si},2\text{pn}\gamma)$, $^{28}\text{Si}(^{28}\text{Si},3\text{pn}\gamma)$, E=65-90 MeV, deduced relative σ .

2003Ax01: $^{24}\text{Mg}(^{32}\text{S},3\text{pn}\gamma)$ E=130 MeV, GASP spectrometer plus the ISIS array. $^{28}\text{Si}(^{28}\text{Si},3\text{pn}\gamma)$ E=110, 115 MeV. E=110 MeV, 4 π γ -array Euroball III with ISIS and Neutron-Wall. E=115 MeV, GASP spectrometer plus the ISIS array.

2007Ax01: same authors as 2003Ax01. 1. $^{28}\text{Si}(^{28}\text{Si},3\text{pn}\gamma)$ E=110 MeV; measured $\text{E}\gamma$, $\text{I}\gamma$, $\gamma\gamma$, using EUROBALL array consisting of 26 clover and 15 cluster Compton-suppressed HPGe detectors, 4 π ISIS charged particle detector consisting of 40 Si telescopes and a neutron wall detector. 2. $^{24}\text{Mg}(^{32}\text{S},3\text{pn}\gamma)$ E=130 MeV; measured $\text{E}\gamma$, $\text{I}\gamma$, $\gamma\gamma$ coin, $\gamma(\theta)$, $\gamma(\text{lin pol})$ using the 4 π GASP array consisting of 40 Compton-suppressed HPGe detectors, a multiplicity filter of 80 BGO detectors and 4 π ISIS charged particle detector consisting of 40 Si telescopes. 3. $^{28}\text{Si}(^{28}\text{Si},3\text{pn}\gamma)$ E=115 MeV using the same detection system as in experiment #2. Measured lifetimes using Doppler-shift attenuation method. Comparisons with large-scale shell-model calculations in complete fp orbitals.

All data are from 2007Ax01, except as noted.

 ^{52}Mn Levels

E(level) [†]	J ^{π}	T _{1/2}	Comments
0.0	6 ⁺ \ddagger		
376.5 9	2 [#]		
545.4 10	1 ⁺ $\#$		
731.3 5	4 ⁺		J ^{π} : from Adopted Levels.
823.8 9	3 ⁺ $\#$		
869.6 4	7 ⁺ \ddagger	<0.38 [@] ps	
883.2 11			
885.4 11	2 ⁺ $\#$		
1231.4 9			
1253.4 14	$\#$		J ^{π} : 2003Ax01 determined the level was J ^{π} =5 ⁺ , but 708 γ to J ^{π} =1 ⁺ . So it keeps only the parity value.
1277.8 10	(5 ⁺) $\#$		
1646.3 12	3		
1682.1 10	(5 ⁺) $\#$		
2042.8 14			
2285.3 4	8 ⁺ \ddagger	<0.69 [@] ps	
2710.0 8	7 ⁺		
2907.1 5	9 ⁺ \ddagger	<0.4 [@] ps	
3602.0 6	8 ⁺		
3797.1 11	(9 ⁺) $\#$		
3836.2 6	11 ⁺	15.2 ps 14	T _{1/2} : RDM (1976Av06).
3891.0 6	8 ⁺		
4161.1 7	10 ⁺	0.12 ps 4	
4197.9 9	(9 ⁺)		
4679.1 5	9 ⁻	>0.78 ps	

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(HI,xn γ) 2007Ax01,1976Av06,1978Me19 (continued) ^{52}Mn Levels (continued)

<u>E(level)[†]</u>	<u>J^π</u>	<u>E(level)[†]</u>	<u>J^π</u>	<u>T_{1/2}</u>	<u>E(level)[†]</u>	<u>J^π</u>	<u>T_{1/2}</u>
5051.0 10	(10 ⁺)	8383.3 10	(13 ⁺)		11186.4 13	(14 ⁻)	
5412.3 9	(10 ⁺)	8581.3 9	(13 ⁻)		11194.4 14		
5856.2 7	11 ⁺	8786.3 13	13 ⁺	0.11 ps 4	11278.4 13	(14 ⁻)	
6060.2 9	11 ⁻	8893.3 10	14 ⁺	0.42 ps 7	12010.4 14	(15 ⁻)	
6483.3 9	(11 ⁺)	9371.4 10	13 ⁻		12061.4 14	(17 ⁺)	76 fs 21
7466.3 8	12 ⁺	9905.4 12	15 ⁺	71 fs 7	12065.4 16	(16 ⁺) [#]	
7700.3 8	(12 ⁺)	10177.4 10	(14 ⁻)		13616.5 14	(15 ⁻)	
8151.3 7	13 ⁺	11132.4 14	(16 ⁺)		15569.5 17	(16 ⁻)	

[†] From a least-squares fit to the E γ values.

[‡] From excitation functions and $\gamma(\theta)$ analyses, 1976St19 and 1976Av06.

[#] From 2003Ax01 based on angular distribution and polarization measurements.

[@] From DSAM results of 1976Av06.

 $\gamma(^{52}\text{Mn})$

<u>Eγ</u>	<u>Relative intensity</u>
325	1.54 21
451	0.41 10
510	1.44 10
622	49.3 15
685	2.2 3
695	0.85 18
742	21.5 4
788	2.3 4
853	0.86 25
892	1.6 4
929	61.8 16
1012	14.2 8
1071	0.93 24
1077	2.78 22
1254	12.3 10
1320	0.95 20
1381	3.9 3
1415	58.5 15
1522	3.2 3
1596	1.5 3
1606	1.40 24
1695	4.8 4
1840	1.45 18
1876	2.74 21
1907	2.03 23
1953	1.38 19
2020	8.9 5
2037	36.9 10
2156	4.03 23
2295	7.2 3
2338	1.50 15
2394	0.95 14
2415	1.74 22
2430	0.46 23
2521	2.54 14
2647	1.68 12
2732	0.33 6
2949	1.99 19
3021	1.92 17
3127	1.36 18

3539 2.12 21
 3630 2.87 19
 3809 1.01 15
 3864 1.49 21
 4315 14.3 3
 4547 4.99 17
 4745 0.77 8
 5535 0.32 7
 Intensities are from ²⁴Mg(³²S,3pn γ) E=130 MeV
 (2007Ax01).

$E_i(\text{level})$	J_i^π	E_γ	$I_\gamma^@$	E_f	J_f^π	Mult.	δ	Comments
545.4	1 ⁺	168.9 [†] 3	100 ^{&}	376.5	2			I_γ : $I_\gamma=4.1$ is relative to $I_\gamma(869)=100$.
731.3	4 ⁺	355 ^a		376.5	2			
		731.3 [‡] 5		0.0	6 ⁺			I_γ : $I_\gamma<20$ is relative to $I_\gamma(869)=100$, from 1976St19.
823.8	3 ⁺	447.2 [†] 4	100 ^{&}	376.5	2			I_γ : $I_\gamma=4.4$ is relative to $I_\gamma(869)=100$.
869.6	7 ⁺	869.5 4	100	0.0	6 ⁺	M1+E2	-0.26 9	E_γ : Weighted average values of 869.3 keV 5 (1976St19), 869.4 keV 5 (1976Av06), 869.2 keV 6 (1978Me19), and 870.1 keV 5 (1979Me03). POL=-0.0580 43, $A_2=-0.41$ 3, $A_4=+0.06$ 6 (2007Ax01). Other: $\delta=-0.10$ 5 (1976Av06).
883.2		507 ^a		376.5	2			
885.4	2 ⁺	509 ^a		376.5	2			
1231.4		346 ^a		885.4	2 ⁺			
		500 ^a		731.3	4 ⁺			
		855 ^a		376.5	2			
1253.4	+	708 ^{ab}		545.4	1 ⁺			
1277.8	(5 ⁺)	395 ^a		883.2				
		453.8 ^{&} 6	&	823.8	3 ⁺			I_γ : $I_\gamma=1.5$ is relative to $I_\gamma(869)=100$.
1646.3	3	415 ^a		1231.4				
		763 ^a		883.2				
1682.1	(5 ⁺)	404 ^a		1277.8	(5 ⁺)			
		951 ^a		731.3	4 ⁺			
2042.8		1219 ^a		823.8	3 ⁺			
2285.3	8 ⁺	1415.5 [‡] 3	88.4 23	869.6	7 ⁺	M1+E2	-0.49 8	POL=-0.0155 57, $A_2=-0.53$ 2, $A_4=+0.02$ 1 (2007Ax01). Other: $\delta=-0.30$ 10 (1976Av06).
		2285.8 [#] 10	11.6 10	0.0	6 ⁺	E2		POL=+0.012 24, $A_2=+0.26$ 10, $A_4=-0.05$ 12 (2007Ax01).
2710.0	7 ⁺	1840 2	7 3	869.6	7 ⁺			
		2710 7	3 5	0.0	6 ⁺			
2907.1	9 ⁺	621.7 [‡] 3	47.0 12	2285.3	8 ⁺	M1+E2	-0.23 4	POL=-0.0623 61, $A_2=-0.37$ 2, $A_4=+0.00$ 5 (2007Ax01). Other: $\delta=-0.08$ 7 (1976Av06).
		2037.7 [‡] 5	53.0 15	869.6	7 ⁺	E2		POL=+0.0444 76, $A_2=-0.37$ 2, $A_4=+0.00$ 5 (2007Ax01).
3602.0	8 ⁺	695	1.51 10	2907.1	9 ⁺	D+Q	+0.31 17	$A_2=-0.37$ 15, $A_4=+0.00$ 6 (2007Ax01).
		892	0.83 9	2710.0	7 ⁺			
		2732	3.11 23	869.6	7 ⁺			
		3602	95 3	0.0	6 ⁺	Q		$A_2=+0.17$ 10, $A_4=-0.08$ 16 (2007Ax01).
3797.1	(9 ⁺)	890 ^a		2907.1	9 ⁺			
3836.2	11 ⁺	929.1 [‡] 4	100	2907.1	9 ⁺	E2		POL=+0.0681 52, $A_2=+0.21$ 1, $A_4=-0.05$ 2 (2007Ax01).
3891.0	8 ⁺	984	21.3 10	2907.1	9 ⁺	D+Q	+0.66 26	$A_2=-0.55$ 11, $A_4=+0.01$ 22 (2007Ax01).

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(HI,xn γ) 2007Ax01,1976Av06,1978Me19 (continued) $\gamma(^{52}\text{Mn})$ (continued)

$E_i(\text{level})$	J_i^π	E_γ	$I_\gamma^@$	E_f	J_f^π	Mult.	δ	Comments
3891.0	8 ⁺	1181	39.5 12	2710.0	7 ⁺			
		1606	22.1 11	2285.3	8 ⁺			
		3021	17.0 11	869.6	7 ⁺			
4161.1	10 ⁺	325	13.7 20	3836.2	11 ⁺	M1(+E2)	+0.06 10	POL=-0.027 67, A ₂ =-0.21 5, A ₄ =+0.00 9 (2007Ax01).
		1254	65 3	2907.1	9 ⁺	D+Q	-0.44 18	A ₂ =-0.54 6, A ₄ =+0.02 8 (2007Ax01).
		1876	21 3	2285.3	8 ⁺			
4197.9	(9 ⁺)	3328	100	869.6	7 ⁺			
4679.1	9 ⁻	788	8.78 23	3891.0	8 ⁺	D+Q	-0.50 68	A ₂ =-0.54 11, A ₄ =+0.02 17 (2007Ax01).
		1077	72 4	3602.0	8 ⁺			
		1772	4.09 22	2907.1	9 ⁺			
		2394	6.6 4	2285.3	8 ⁺			
		3809	1.20 16	869.6	7 ⁺			
		4679	7.2 3	0.0	6 ⁺			
5051.0	(10 ⁺)	853		4197.9	(9 ⁺)			
		890		4161.1	10 ⁺			
5412.3	(10 ⁺)	3127	100	2285.3	8 ⁺			
5856.2	11 ⁺	1695	26.0 19	4161.1	10 ⁺	D+Q	-0.13 11	A ₂ =-0.29 9, A ₄ =+0.00 12 (2007Ax01).
		2020	61 3	3836.2	11 ⁺	D+(Q)	-0.33 66	A ₂ =+0.17 11, A ₄ =-0.01 16 (2007Ax01).
		2949	13.3 14	2907.1	9 ⁺			
6060.2	11 ⁻	1381	100	4679.1	9 ⁻	E2		POL=+0.14 5, A ₂ =+0.25 12, A ₄ =0.00 17 (2007Ax01).
6483.3	(11 ⁺)	1071	24 6	5412.3	(10 ⁺)			
		2647	76 8	3836.2	11 ⁺			
7466.3	12 ⁺	983		6483.3	(11 ⁺)	D+Q	-0.38 4	A ₂ =-0.55 18, A ₄ =+0.01 6 (2007Ax01).
		1610		5856.2	11 ⁺			
		3630		3836.2	11 ⁺			
7700.3	(12 ⁺)	3539		4161.1	10 ⁺			
		3864		3836.2	11 ⁺			
8151.3	13 ⁺	451		7700.3	(12 ⁺)			
		685	1.3 5	7466.3	12 ⁺	D(+Q)	-0.24 52	A ₂ =-0.40 16, A ₄ =+0.01 28 (2007Ax01).
		2295	14 4	5856.2	11 ⁺			
		4315	84.9 12	3836.2	11 ⁺			
8383.3	(13 ⁺)	4547	100	3836.2	11 ⁺			
8581.3	(13 ⁻)	2521	77 3	6060.2	11 ⁻			
		4745	23.0 19	3836.2	11 ⁺			
8786.3	13 ⁺	1320	100	7466.3	12 ⁺			
8893.3	14 ⁺	510	18 4	8383.3	(13 ⁺)			
		742	82.1 23	8151.3	13 ⁺	M1(+E2)	-0.10 48	POL=-0.081 12, A ₂ =-0.27 3, A ₄ =+0.00 6 (2007Ax01).
9371.4	13 ⁻	3311		6060.2	11 ⁻			
		5535		3836.2	11 ⁺			
9905.4	15 ⁺	1012		8893.3	14 ⁺			
		1522		8383.3	(13 ⁺)			
10177.4	(14 ⁻)	1596		8581.3	(13 ⁻)			
		2026		8151.3	13 ⁺			
11132.4	(16 ⁺)	1227	100	9905.4	15 ⁺			
11186.4	(14 ⁻)	1815	100	9371.4	13 ⁻			
11194.4		1823 ^a		9371.4	13 ⁻			
11278.4	(14 ⁻)	1907	100	9371.4	13 ⁻			
12010.4	(15 ⁻)	1833	100	10177.4	(14 ⁻)			
12061.4	(17 ⁺)	929		11132.4	(16 ⁺)			
		2156		9905.4	15 ⁺	Q		A ₂ =+0.24 7, A ₄ =+0.01 11 (2007Ax01).
12065.4	(16 ⁺)	2160 ^a		9905.4	15 ⁺			
13616.5	(15 ⁻)	2338		11278.4	(14 ⁻)			

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(HI,xn γ) 2007Ax01,1976Av06,1978Me19 (continued)

$\gamma(^{52}\text{Mn})$ (continued)

<u>$E_i(\text{level})$</u>	<u>J_i^π</u>	<u>E_γ</u>	<u>$I_\gamma^{\text{@}}$</u>	<u>E_f</u>	<u>J_f^π</u>
13616.5	(15 ⁻)	2430		11186.4	(14 ⁻)
15569.5	(16 ⁻)	1953	100	13616.5	(15 ⁻)

[†] Weighted average of 1976Av06 and 1978Me19.

[‡] Weighted average values of 1976St19, 1976Av06, and 1978Me19.

[#] From 1976St19.

[@] From branching ratio, see 2007Ax01.

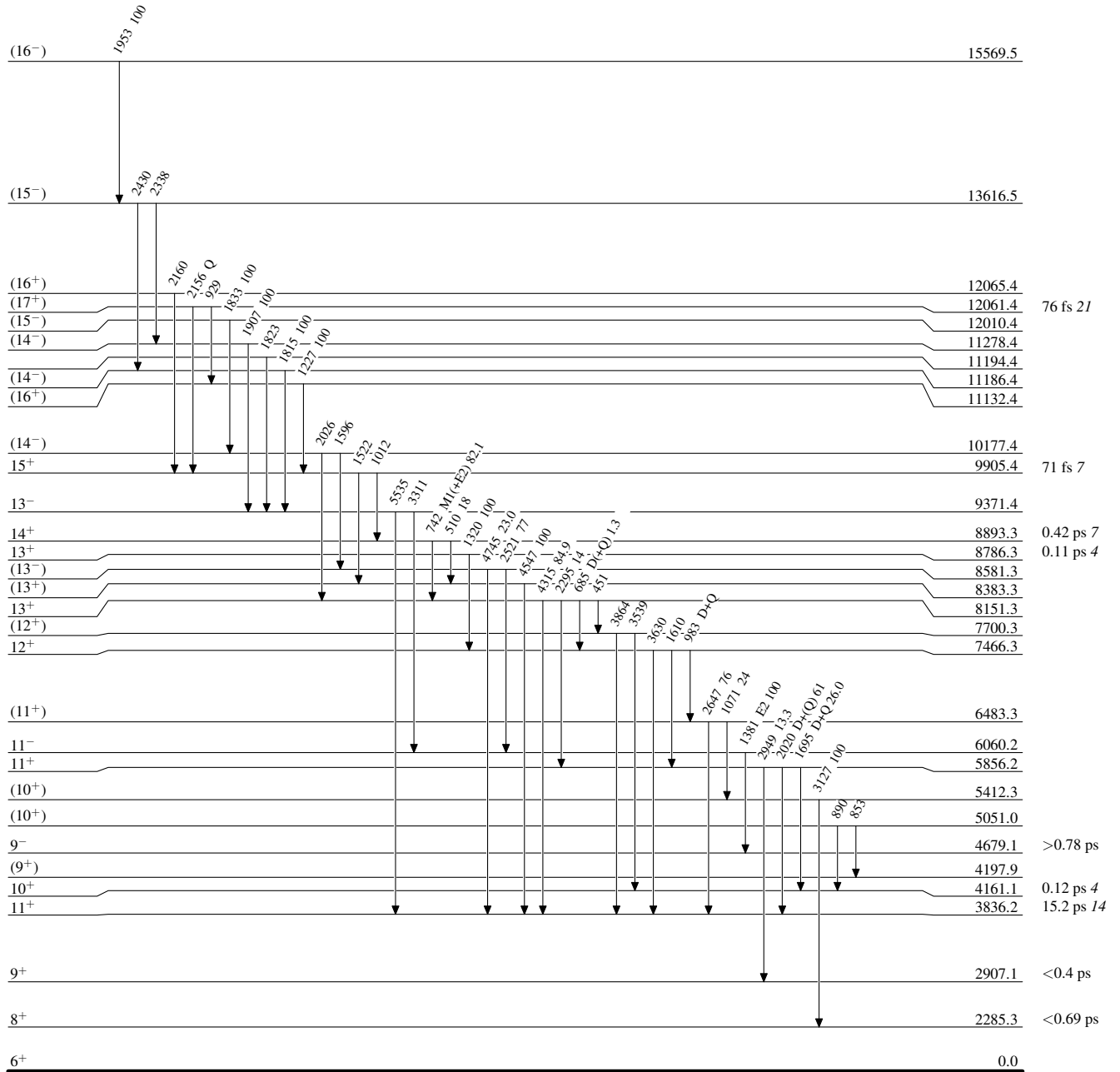
[&] From 1978Me19.

^a From 2003Ax01.

^b Placement of transition in the level scheme is uncertain.

(HI,xn γ) 2007Ax01,1976Av06,1978Me19**Level Scheme**

Intensities: % photon branching from each level

 $^{52}_{25}\text{Mn}_{27}$

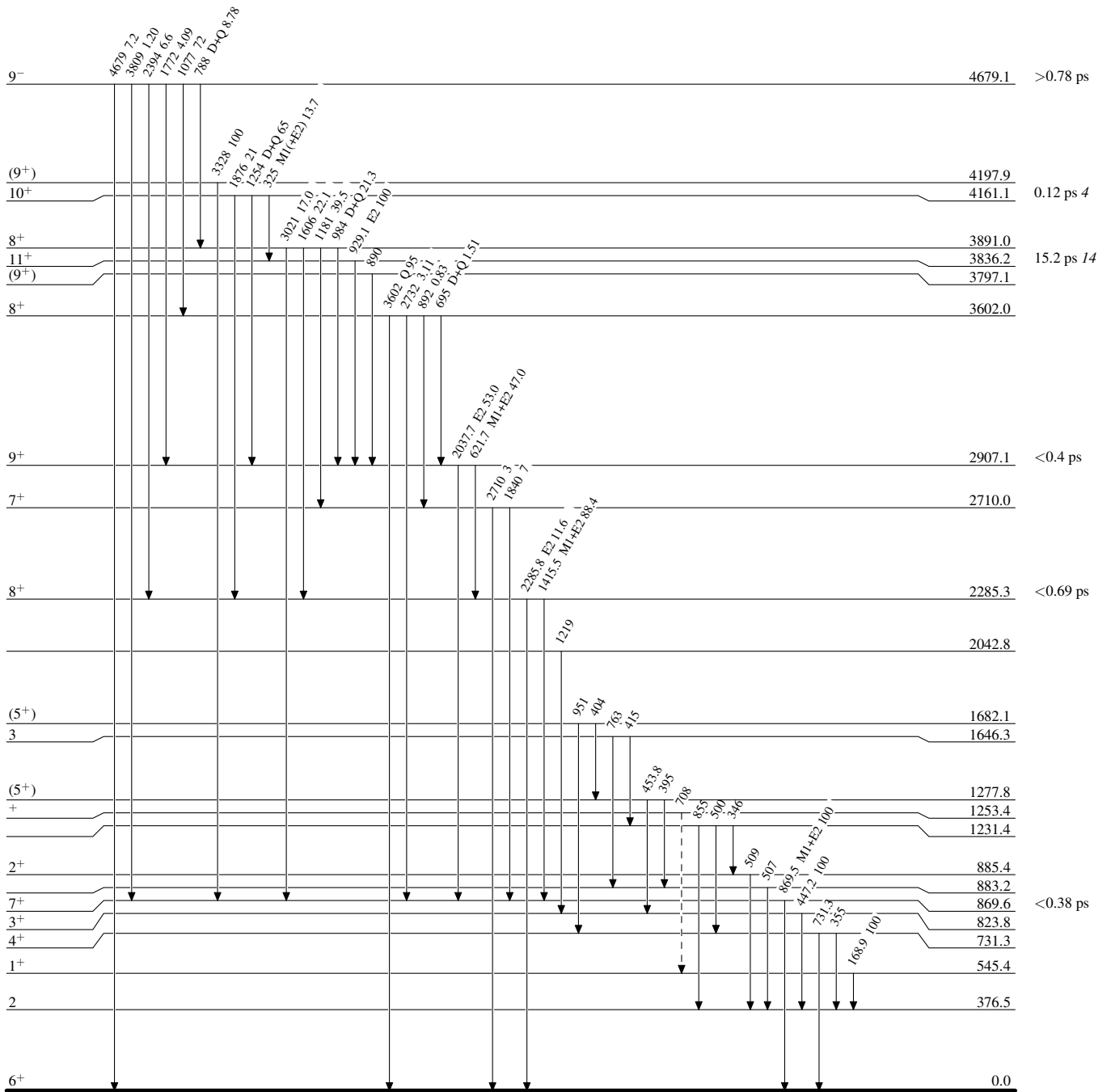
(HI,xn γ) 2007Ax01,1976Av06,1978Me19

Legend

Level Scheme (continued)

Intensities: % photon branching from each level

-----► γ Decay (Uncertain)



⁵²Mn₂₇