(HI,xnγ) 2002Ha20,2002Pe05

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Zoltan Elekes and Janos Timar	NDS 129, 191 (2015)	28-Feb-2015

2002Ha20, 2001Ha16: ^{92}Mo(^{40}Ca,3pnγ) E=170 MeV. Measured Eγ, γγ, (particle)γ coincidence using clarion detector array in conjunction with the CsI portion of the charged particle detector array HyBall, and the Recoil Mass Spectrometer (RMS). Clarion array consisted of 11 clover Ge detectors and 10 smaller single-crystal Ge detectors. In a second experiment at E=184 MeV, measured Eγ, Iγ, γγ, γγ(θ)(DCO) using Gammasphere spectrometer comprised of 99 suppressed Ge detectors in conjunction with the Microball CsI array.

2002Pe05: ^{92}Mo(^{40}Ca,3pnγ) E=190 MeV. Measured Eγ, γγ using gasp array consisting of 40 Compton-suppressed Ge detectors and the 80-element BGO ball, and isis ball consisting of 40 ΔE-E Si telescopes.

1998Sm08: ^{94}Mo(^{40}Ca,αpnγ) E=180 MeV. Measured Eγ, Iγ, γγ, γγ(θ), particle-γ coincidence using Gammasphere array with 92 detectors and Microball array of particle detectors.

All data are from 2002Ha20, except when otherwise noted.

^{128}Pr Levels

E(level)†	Jπ‡	$T_{1/2}$	Comments
0	(3+)	2.84 s *9*	Jπ: from log *ft* values of β+ decay (1999Xi03). $T_{1/2}$: from 2012Au07.
0+x&a	(6+)#		Additional information 1.
59.0+x*b* *8*	(7+)#		
152.5+x*a* *8*	(8+)#		
196.6+x *10*			
286.6+x*b* *8*	(9+)#		
443.5+x*a* *8*	(10+)#		
529.7+x*c* *10*	(7+)		
627.3+x*e* *8*	(9+)		
654.6+x*b* *8*	(11+)#		
800.0+x*c* *8*	(9+)		
838.3+x*d* *8*	(10+)		
875.1+x*a* *8*	(12+)#		
1095.6+x*e* *8*	(11+)		
1157.5+x*b* *8*	(13+)#		
1185.1+x*c* *8*	(11+)		
1379.1+x*d* *9*	(12+)		
1440.6+x*a* *8*	(14+)#		
1646.3+x *9*			
1669.5+x*c* *8*	(13+)		
1723.9+x*e* *11*	(13+)		
1779.4+x*b* *8*	(15+)#		
1917.9+x*g* *9*	(13+)		
2048.1+x*d* *14*	(14+)		
2121.6+x*a* *8*	(16+)#		
2182.4+x*f* *8*	(14+)		
2288.4+x*c* *9*	(15+)		
2499.7+x*b* *8*	(17+)#		
2508.9+x*g* *9*	(15+)		
2833.3+x*f* *9*	(16+)		
2894.7+x*a* *8*	(18+)#		
3001.6+x*c* *9*	(17+)		

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(HI,xnγ) 2002Ha20,2002Pe05 (continued)

^{128}Pr Levels (continued)

E(level)[†]	Jπ[‡]	Comments
3204.6+x[g] 9	(17+)	
3297.3+x[b] 8	(19+)[#]	
3583.0+x[f] 9	(18+)	
3742.0+x[a] 8	(20+)[#]	
3801.3+x[c] 9	(19+)	
3991.8+x[g] 9	(19+)	
4163.8+x[b] 8	(21+)[#]	
4412.7+x[f] 9	(20+)	
4661.7+x[a] 8	(22+)[#]	
4680.2+x[c] 9	(21+)	
4854.0+x[g] 9	(21+)	
5105.7+x[b] 8	(23+)[#]	
5312.6+x[f] 9	(22+)	
5639.4+x[c] 10	(23+)	
5665.5+x[a] 8	(24+)[#]	
5789.9+x[g] 9	(23+)	
6133.7+x[b] 9	(25+)[#]	
6290.9+x[f] 9	(24+)	
6683.3+x[c] 11	(25+)	
6766.4+x[a] 9	(26+)[#]	
6810.3+x[g] 10	(25+)	
7252.8+x[b] 9	(27+)[#]	
7358.6+x[f] 10	(26+)	
7807.2+x[c] 12	(27+)	
7924.8+x[g] 11	(27+)	
7971.4+x[a] 9	(28+)[#]	
8464.7+x[b] 9	(29+)[#]	
8523.9+x[f] 11	(28+)	
8989.9+x[c] 13	(29+)	
9137.4+x[g] 12	(29+)	
9283.3+x[a] 10	(30+)[#]	
9767.6+x[b] 10	(31+)[#]	
9786.9+x[f] 15	(30+)	
10221.9+x[c] 14	(31+)	
10444.4+x[g] 16	(31+)	
10700.9+x[a] 11	(32+)[#]	
11159.2+x[b] 12	(33+)[#]	
11516.4+x[c] 15	(33+)	
12202.9+x?[a] 14	(34+)[#]	
12644.4+x[b] 13	(35+)[#]	
12884.6+x[c] 16	(35+)	
14216.8+x[b] 14	(37+)[#]	
14332.3+x[c] 16	(37+)	
15849.3+x?[c] 18	(39+)	
0+y	(5−)	Additional information 2.
39.6+y[&h] 13	(4−)	
97.6+y[&i] 10	(5−)	

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(HI,xnγ) 2002Ha20,2002Pe05 (continued)

^{128}Pr Levels (continued)

E(level)[†]	J$^{\pi}$[‡]
116.3+y *8*	(6$^-$)
151.6+y[h] *8*	(6$^-$)
240.7+y[i] *8*	(7$^-$)
262.3+y[k] *8*	(7$^-$)
364.5+y[j] *8*	(8$^-$)
387.7+y[h] *8*	(8$^-$)
545.1+y[i] *8*	(9$^-$)
561.5+y[k] *8*	(9$^-$)
751.0+y[j] *8*	(10$^-$)
788.2+y[h] *8*	(10$^-$)
985.2+y[i] *8*	(11$^-$)
1015.2+y[k] *8*	(11$^-$)
1272.4+y[j] *8*	(12$^-$)
1318.0+y[h] *8*	(12$^-$)
1546.8+y[i] *8*	(13$^-$)
1599.0+y[k] *8*	(13$^-$)
1906.4+y[j] *8*	(14$^-$)
1954.8+y[h] *8*	(14$^-$)
2213.0+y[i] *8*	(15$^-$)
2283.0+y[k] *8*	(15$^-$)
2627.7+y[j] *8*	(16$^-$)
2676.8+y[h] *8*	(16$^-$)
2958.1+y[i] *8*	(17$^-$)
3042.6+y[k] *8*	(17$^-$)
3411.1+y[j] *8*	(18$^-$)
3467.3+y[h] *8*	(18$^-$)
3761.9+y[i] *9*	(19$^-$)
3861.5+y[k] *8*	(19$^-$)
4241.1+y[j] *8*	(20$^-$)
4321.2+y[h] *8*	(20$^-$)
4632.7+y[i] *9*	(21$^-$)
4731.6+y[k] *8*	(21$^-$)
4784.5+y *13*	(21$^-$)
5153.9+y[j] *9*	(22$^-$)
5243.4+y[h] *9*	(22$^-$)
5597.3+y[i] *9*	(23$^-$)
5696.4+y[k] *10*	(23$^-$)
5736.5+y *17*	(23$^-$)
6180.4+y[j] *10*	(24$^-$)
6231.2+y[h] *10*	(24$^-$)
6669.2+y[i] *9*	(25$^-$)
6751.5+y *19*	(25$^-$)
6778.3+y[k] *11*	(25$^-$)
7278.6+y[h] *11*	(26$^-$)
7316.7+y[j] *11*	(26$^-$)
7821.2+y *14*	(27$^-$)
7861.3+y[i] *11*	(27$^-$)
7948.7+y[k] *12*	(27$^-$)

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(HI,xnγ) 2002Ha20,2002Pe05 (continued)

^{128}Pr Levels (continued)

E(level)[†]	Jπ[‡]	Comments
8391.5+y[h] 12	(28⁻)	
8546.8+y[j] 12	(28⁻)	
8977.2+y 17	(29⁻)	
9123.0+y[i] 12	(29⁻)	
9577.7+y[h] 13	(30⁻)	
9815.6+y[j] 13	(30⁻)	
10208.2+y 20	(31⁻)	
10419.9+y[i] 13	(31⁻)	
10839.7+y[h] 14	(32⁻)	
11114.2+y?[j] 18	(32⁻)	
11773.4+y?[i] 18	(33⁻)	
12174.1+y[h] 15	(34⁻)	
13583.6+y?[h] 20	(36⁻)	
0+z[l]	(8⁻)[@]	Additional information 3. Possibly an isomer with $T_{1/2}$>80 ns (2002Ha20).
242.47+z[m] 16	(9⁻)[@]	
507.43+z[l] 16	(10⁻)[@]	
792.37+z[m] 19	(11⁻)[@]	
1095.69+z[l] 21	(12⁻)[@]	
1416.51+z[m] 25	(13⁻)[@]	
1754.2+z[l] 3	(14⁻)[@]	
2109.1+z[m] 3	(15⁻)[@]	
2480.7+z[l] 4	(16⁻)[@]	
2868.8+z[m] 4	(17⁻)[@]	
3275.4+z[l] 4	(18⁻)[@]	
3694.9+z[m] 4	(19⁻)[@]	
4133.4+z[l] 5	(20⁻)[@]	
4587.6+z[m] 5	(21⁻)[@]	
5061.9+z[l] 7	(22⁻)[@]	
5552.8+z[m] 7	(23⁻)[@]	
6065.4+z[l] 9	(24⁻)[@]	
6596.3+z[m] 9	(25⁻)[@]	
7150.1+z[l] 10	(26⁻)[@]	
7720.4+z[m] 10	(27⁻)[@]	
8316.0+z[l] 11	(28⁻)[@]	
8924.0+z[m] 11	(29⁻)[@]	
9558.3+z[l] 12	(30⁻)[@]	
10205.7+z[m] 12	(31⁻)[@]	
10876.6+z[l] 13	(32⁻)[@]	
11560.1+z[m] 13	(33⁻)[@]	
12263.3+z[l] 14	(34⁻)[@]	
12977.1+z?[m] 17	(35⁻)[@]	
13722.3+z?[l] 18	(36⁻)[@]	

[†] From least-squares fit to Eγ′s (by the evaluators).

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(HI,xnγ) 2002Ha20,2002Pe05 (continued)

^{128}Pr Levels (continued)

‡ from Adopted Levels, Gammas, except as noted.
# Spins were consistently higher by one unit in 1998Sm08.
@ Note that spins are higher by one unit in Table 1 of 2002Ha20. This is a typographical error as confirmed in an e-mail reply (May 8, 2002 from D.J. Hartley). In 1998Sm08, spins were consistently higher by two units.
& Seen only in 2002Pe05.
[a] Band(A): $\pi h_{11/2}\nu h_{11/2}$, α=0 yrast. At high spins, alignment gain is attributed to second $h_{11/2}$ proton crossing.
[b] Band(a): $\pi h_{11/2}\nu h_{11/2}$, α=1 yrast. See comment for its signature partner.
[c] Band(B): $\pi h_{11/2}\nu(h_{9/2},f_{7/2})$, α=1. Decoupled-band with $K^\pi=(2^+,1^+)$.
[d] Band(C): $\pi h_{11/2}\nu h_{11/2}$, α=0 side.
[e] Band(c): $\pi h_{11/2}\nu h_{11/2}$, α=1 side.
[f] Band(D): band based on 14^+ α=0. Possible 4-quasiparticle structure involving $\nu h_{11/2}$.
[g] Band(d): band based on 13^+ α=1. Possible 4-quasiparticle structure involving $\nu h_{11/2}$.
[h] Band(E): $\pi h_{11/2}\nu(d_{3/2},s_{1/2})$, α=0. $K^\pi=(1^-,2^-)$. $\pi(d_{5/2},g_{7/2})\otimes\nu h_{11/2}$ in 2002Pe05.
[i] Band(e): $\pi h_{11/2}\nu(d_{3/2},s_{1/2})$, α=1. $K^\pi=(1^-,2^-)$. $\pi(d_{5/2},g_{7/2})\otimes\nu h_{11/2}$ in 2002Pe05.
[j] Band(F): $\pi h_{11/2}\nu d_{5/2}$ $K^\pi=(4^-)$, α=0. $\pi(d_{5/2},g_{7/2})\otimes\nu h_{11/2}$ in 2002Pe05.
[k] Band(f): $\pi h_{11/2}\nu d_{5/2}$ $K^\pi=(4^-)$, α=1. $\pi(d_{5/2},g_{7/2})\otimes\nu h_{11/2}$ in 2002Pe05.
[l] Band(G): $\pi g_{9/2}\nu h_{11/2}$ $K^\pi=(8^-)$, α=0.
[m] Band(g): $\pi g_{9/2}\nu h_{11/2}$ $K^\pi=(8^-)$, α=1. Possibly $\pi_{9/2}[404]\nu_{7/2}[523]$, $K^\pi=(8^-)$ configuration (according to e-mail reply from D.J. Hartley, May 8, 2002).

γ(^{128}Pr)

E_γ †	I_γ	E_i(level)	J_i^π	E_f	J_f^π	Mult.	Comments
54‡		151.6+y	(6^-)	97.6+y	(5^-)		
59‡		59.0+x	(7^+)	0+x	(6^+)		
89.0 *2*		240.7+y	(7^-)	151.6+y	(6^-)	M1+E2	
93.5 *2*		152.5+x	(8^+)	59.0+x	(7^+)	M1+E2	DCO=0.60 *8*.
102.2 *2*	6.0 *3*	364.5+y	(8^-)	262.3+y	(7^-)	(M1+E2)	
110.9 *2*		262.3+y	(7^-)	151.6+y	(6^-)	M1+E2	DCO=0.53 *7*.
112‡		151.6+y	(6^-)	39.6+y	(4^-)		
116		116.3+y	(6^-)	0+y	(5^-)		E_γ: from Fig. 3 of 2002Ha20.
123.8 *2*	19 *1*	364.5+y	(8^-)	240.7+y	(7^-)	M1+E2	DCO=0.52 *5*.
125‡		240.7+y	(7^-)	116.3+y	(6^-)		
126‡		387.7+y	(8^-)	262.3+y	(7^-)		
134.1 *2*	100	286.6+x	(9^+)	152.5+x	(8^+)	M1+E2	DCO=0.49 *2*.
143‡		240.7+y	(7^-)	97.6+y	(5^-)		
147.0 *2*	19 *1*	387.7+y	(8^-)	240.7+y	(7^-)	M1+E2	DCO=0.6 *1*.
152.5‡		152.5+x	(8^+)	0+x	(6^+)		
156.8 *2*	97 *4*	443.5+x	(10^+)	286.6+x	(9^+)	M1+E2	DCO=0.47 *2*.
157.5 *2*	11.1 *7*	545.1+y	(9^-)	387.7+y	(8^-)	M1+E2	DCO=0.7 *1*.
173.7 *2*	6.9 *4*	561.5+y	(9^-)	387.7+y	(8^-)	M1+E2	DCO=0.72 *8*.
180.6 *2*	14.2 *7*	545.1+y	(9^-)	364.5+y	(8^-)	M1+E2	DCO=0.8 *1*.
183.5 *5*	<2	627.3+x	(9^+)	443.5+x	(10^+)	(M1+E2)	
189.5 *2*	11.0 *6*	751.0+y	(10^-)	561.5+y	(9^-)	M1+E2	DCO=0.51 *5*.
196.9 *2*	3.5 *3*	985.2+y	(11^-)	788.2+y	(10^-)	(M1+E2)	
197.0 *2*	12.6 *6*	561.5+y	(9^-)	364.5+y	(8^-)	M1+E2	DCO=0.49 *4*.
206.3 *2*	9.0 *6*	751.0+y	(10^-)	545.1+y	(9^-)	(M1+E2)	
210.9 *2*	3.1 *4*	838.3+x	(10^+)	627.3+x	(9^+)	(M1+E2)	
211.1 *2*	83 *4*	654.6+x	(11^+)	443.5+x	(10^+)	M1+E2	DCO=0.47 *2*.
220.4 *2*	66 *3*	875.1+x	(12^+)	654.6+x	(11^+)	M1+E2	DCO=0.47 *2*.

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(HI,xnγ) 2002Ha20,2002Pe05 (continued)

γ(^{128}Pr) (continued)

E_γ †	I_γ	E_i(level)	J_i^π	E_f	J_f^π	Mult.	Comments
220.6 *5*	2.6 *4*	1095.6+x	(11^+)	875.1+x	(12^+)	(M1+E2)	
226.3 *2*	3.1 *3*	788.2+y	(10^-)	561.5+y	(9^-)	M1+E2	DCO=0.8 *1*.
226.7 *2*	6.4 *5*	1015.2+y	(11^-)	788.2+y	(10^-)	(M1+E2)	
227.6 *2*	14.4 *7*	286.6+x	(9^+)	59.0+x	(7^+)	(E2)	
235‡		985.2+y	(11^-)	751.0+y	(10^-)		
236.1 *2*	3.5 *4*	387.7+y	(8^-)	151.6+y	(6^-)	(E2)	
241‡		240.7+y	(7^-)	0+y	(5^-)		
242.4 *2*		242.47+z	(9^-)	0+z	(8^-)	(M1+E2)	
243.0 *2*	8.2 *6*	788.2+y	(10^-)	545.1+y	(9^-)	M1+E2	DCO=0.8 *1*.
248.1 *2*	9.9 *5*	364.5+y	(8^-)	116.3+y	(6^-)		DCO=0.57 *8*.
257.1 *2*	11.4 *6*	1272.4+y	(12^-)	1015.2+y	(11^-)	M1+E2	DCO=0.48 *5*.
257.2 *2*	3.4 *2*	1095.6+x	(11^+)	838.3+x	(10^+)	(M1+E2)	
264.2 *2*	16.0 *8*	1015.2+y	(11^-)	751.0+y	(10^-)	M1+E2	DCO=0.44 *4*.
264.3 *2*	3.7 *2*	2182.4+x	(14^+)	1917.9+x	(13^+)	(M1+E2)	
264.9 *2*	7.2 *4*	507.43+z	(10^-)	242.47+z	(9^-)	(M1+E2)	
270.3 *5*	<2	800.0+x	(9^+)	529.7+x	(7^+)	(E2)	
271.5 *2*	7.0 *6*	387.7+y	(8^-)	116.3+y	(6^-)		DCO=0.6 *1*.
275‡		1546.8+y	(13^-)	1272.4+y	(12^-)		
280.8 *2*	3.0 *2*	1599.0+y	(13^-)	1318.0+y	(12^-)	(M1+E2)	
282.4 *2*	45 *3*	1157.5+x	(13^+)	875.1+x	(12^+)	M1+E2	DCO=0.38 *2* for 282.4+283.1.
283 *1*	<2	1379.1+x	(12^+)	1095.6+x	(11^+)	(M1+E2)	
283.1 *2*	39 *3*	1440.6+x	(14^+)	1157.5+x	(13^+)	M1+E2	DCO=0.38 *2* for 282.4+283.1.
283.2 *2*	4.2 *4*	545.1+y	(9^-)	262.3+y	(7^-)	(E2)	
285.0 *2*	4.7 *3*	792.37+z	(11^-)	507.43+z	(10^-)	(M1+E2)	
290.2 *5*	<2	1669.5+x	(13^+)	1379.1+x	(12^+)	(M1+E2)	
291.0 *2*	26 *1*	443.5+x	(10^+)	152.5+x	(8^+)	E2	DCO=1.03 *6*.
299.1 *2*	11.1 *6*	561.5+y	(9^-)	262.3+y	(7^-)	E2	DCO=0.91 *9*.
303.0 *2*	4.1 *3*	1318.0+y	(12^-)	1015.2+y	(11^-)	(M1+E2)	
303.3 *2*	3.9 *3*	1095.69+z	(12^-)	792.37+z	(11^-)	(M1+E2)	
304.4 *2*	11.1 *7*	545.1+y	(9^-)	240.7+y	(7^-)	E2	DCO=1.0 *1*.
307‡		2213.0+y	(15^-)	1906.4+y	(14^-)		
307.4 *2*	5.8 *4*	1906.4+y	(14^-)	1599.0+y	(13^-)	M1+E2	DCO=0.4 *1*.
320.6 *5*	2.5 *2*	1416.51+z	(13^-)	1095.69+z	(12^-)	(M1+E2)	
320.8 *5*	<2	561.5+y	(9^-)	240.7+y	(7^-)	(E2)	
324.5 *2*	3.9 *6*	2833.3+x	(16^+)	2508.9+x	(15^+)	(M1+E2)	
326.5 *2*	5.1 *8*	2508.9+x	(15^+)	2182.4+x	(14^+)	(M1+E2)	
326.6 *2*	6.8 *4*	1599.0+y	(13^-)	1272.4+y	(12^-)	M1+E2	DCO=0.41 *4*.
327‡		2283.0+y	(15^-)	1954.8+y	(14^-)		
332.5 *5*	2.1 *2*	1318.0+y	(12^-)	985.2+y	(11^-)	(M1+E2)	
333.1 *2*		529.7+x	(7^+)	196.6+x			
337.7 *5*	2.4 *2*	1754.2+z	(14^-)	1416.51+z	(13^-)	(M1+E2)	
338.7 *2*	28 *1*	1779.4+x	(15^+)	1440.6+x	(14^+)	M1+E2	DCO=0.40 *5*.
342.1 *2*	20.9 *9*	2121.6+x	(16^+)	1779.4+x	(15^+)	M1+E2	DCO=0.47 *6*.
344.7 *5*	2.8 *2*	2627.7+y	(16^-)	2283.0+y	(15^-)	(M1+E2)	
345 *1*	<2	1723.9+x	(13^+)	1379.1+x	(12^+)	(M1+E2)	
346.9 *5*	2.1 *2*	1185.1+x	(11^+)	838.3+x	(10^+)	M1+E2	DCO=0.7 *1*.
354.9 *5*	<2	2109.1+z	(15^-)	1754.2+z	(14^-)	(M1+E2)	
355.6 *2*	3.7 *3*	1954.8+y	(14^-)	1599.0+y	(13^-)	(M1+E2)	
356.8 *5*	<2	800.0+x	(9^+)	443.5+x	(10^+)	M1+E2	DCO=0.6 *1*.
368.1 *2*	32 *2*	654.6+x	(11^+)	286.6+x	(9^+)	E2	DCO=0.99 *5*.
368.1 *5*	<2	3411.1+y	(18^-)	3042.6+y	(17^-)	(M1+E2)	
371.4 *2*	4.9 *4*	3204.6+x	(17^+)	2833.3+x	(16^+)	(M1+E2)	
371.8 *5*	<2	2480.7+z	(16^-)	2109.1+z	(15^-)	(M1+E2)	
376.7 *2*	5.3 *3*	2283.0+y	(15^-)	1906.4+y	(14^-)	M1+E2	DCO=0.37 *8*.

Continued on next page (footnotes at end of table)

(HI,xnγ) 2002Ha20,2002Pe05 (continued)

γ(^{128}Pr) (continued)

E_γ [†]	I_γ	E_i(level)	J_i^π	E_f	J_f^π	Mult.	Comments
377.9 *2*	18.7 *9*	2499.7+x	(17$^+$)	2121.6+x	(16$^+$)	M1+E2	DCO=0.37 *5*.
378.6 *2*	4.3 *3*	3583.0+x	(18$^+$)	3204.6+x	(17$^+$)	(M1+E2)	
385.2 *2*	4.1 *3*	1185.1+x	(11$^+$)	800.0+x	(9$^+$)	E2	DCO=1.07 *8*.
386.4 *2*	20 *1*	751.0+y	(10$^-$)	364.5+y	(8$^-$)	E2	DCO=1.00 *7*.
388 *1*	<2	2868.8+z	(17$^-$)	2480.7+z	(16$^-$)	(M1+E2)	
393.9 *2*	3.0 *3*	2676.8+y	(16$^-$)	2283.0+y	(15$^-$)	(M1+E2)	
395.0 *2*	11.9 *6*	2894.7+x	(18$^+$)	2499.7+x	(17$^+$)	M1+E2	DCO=0.37 *6*.
400.4 *2*	15 *1*	788.2+y	(10$^-$)	387.7+y	(8$^-$)	E2	DCO=1.00 *9*.
402.7 *2*	10.4 *5*	3297.3+x	(19$^+$)	2894.7+x	(18$^+$)	M1+E2	DCO=0.41 *6*.
408.3 *5*	2.5 *2*	3991.8+x	(19$^+$)	3583.0+x	(18$^+$)	(M1+E2)	
415.0 *5*	2.1 *4*	3042.6+y	(17$^-$)	2627.7+y	(16$^-$)	(M1+E2)	
420.8 *2*	3.0 *2*	4412.7+x	(20$^+$)	3991.8+x	(19$^+$)	(M1+E2)	
421.8 *2*	6.5 *3*	4163.8+x	(21$^+$)	3742.0+x	(20$^+$)	M1+E2	DCO=0.43 *8*.
424.0 *2*	11.4 *6*	985.2+y	(11$^-$)	561.5+y	(9$^-$)	E2	DCO=0.9 *1*.
431.6 *2*	53 *2*	875.1+x	(12$^+$)	443.5+x	(10$^+$)	E2	DCO=0.96 *3*.
439.8 *2*	25 *1*	985.2+y	(11$^-$)	545.1+y	(9$^-$)	E2	DCO=1.03 *9*.
441.2 *5*	2.9 *2*	4854.0+x	(21$^+$)	4412.7+x	(20$^+$)	(M1+E2)	
444.0 *2*	3.8 *3*	5105.7+x	(23$^+$)	4661.7+x	(22$^+$)	M1+E2	DCO=0.51 *6*.
444.6 *2*	6.0 *4*	3742.0+x	(20$^+$)	3297.3+x	(19$^+$)	M1+E2	DCO=0.51 *6*.
449.9 *5*	<2	3861.5+y	(19$^-$)	3411.1+y	(18$^-$)	(M1+E2)	
453.8 *2*	12.2 *6*	1015.2+y	(11$^-$)	561.5+y	(9$^-$)	E2	DCO=1.0 *1*.
458.4 *5*	2.9 *2*	5312.6+x	(22$^+$)	4854.0+x	(21$^+$)	(M1+E2)	
468.2 *5*	<2	6133.7+x	(25$^+$)	5665.5+x	(24$^+$)	(M1+E2)	
468.4 *5*	<2	1095.6+x	(11$^+$)	627.3+x	(9$^+$)	(E2)	
470.4 *2*	4.5 *4*	1015.2+y	(11$^-$)	545.1+y	(9$^-$)	(E2)	
477.5 *5*	<2	5789.9+x	(23$^+$)	5312.6+x	(22$^+$)	(M1+E2)	
484.4 *2*	4.2 *3*	1669.5+x	(13$^+$)	1185.1+x	(11$^+$)	E2	DCO=0.92 *7*.
490 *1*	<2	4731.6+y	(21$^-$)	4241.1+y	(20$^-$)	(M1+E2)	
498.1 *2*	5.4 *3*	4661.7+x	(22$^+$)	4163.8+x	(21$^+$)	(M1+E2)	
501.5 *5*	<2	6290.9+x	(24$^+$)	5789.9+x	(23$^+$)	(M1+E2)	
502.9 *2*	39 *2*	1157.5+x	(13$^+$)	654.6+x	(11$^+$)	E2	DCO=1.04 *7*.
507.5 *2*	8.4 *8*	507.43+z	(10$^-$)	0+z	(8$^-$)	(E2)	
519.1 *5*	<2	6810.3+x	(25$^+$)	6290.9+x	(24$^+$)	(M1+E2)	
521.6 *2*	24 *1*	1272.4+y	(12$^-$)	751.0+y	(10$^-$)	E2	DCO=1.06 *9*.
529.5 *2*	17.7 *9*	1318.0+y	(12$^-$)	788.2+y	(10$^-$)	E2	DCO=1.00 *9*.
536.2 *2*	3.3 *3*	2182.4+x	(14$^+$)	1646.3+x			
541[#] *1*	<2	1379.1+x	(12$^+$)	838.3+x	(10$^+$)	(E2)	
548.2 *5*	<2	7358.6+x	(26$^+$)	6810.3+x	(25$^+$)	(M1+E2)	
549.9 *2*	8.1 *6*	792.37+z	(11$^-$)	242.47+z	(9$^-$)	(E2)	
559.9 *5*	2.3 *5*	5665.5+x	(24$^+$)	5105.7+x	(23$^+$)	(M1+E2)	
561.5 *2*	26 *1*	1546.8+y	(13$^-$)	985.2+y	(11$^-$)	E2	DCO=1.0 *1*.
565.6 *2*	59 *3*	1440.6+x	(14$^+$)	875.1+x	(12$^+$)	E2	DCO=1.00 *4*.
573.8 *2*	4.3 *3*	1669.5+x	(13$^+$)	1095.6+x	(11$^+$)	E2	DCO=0.9 *1*.
583.8 *2*	15.8 *8*	1599.0+y	(13$^-$)	1015.2+y	(11$^-$)	E2	DCO=0.92 *9*.
588.2 *2*	10.4 *6*	1095.69+z	(12$^-$)	507.43+z	(10$^-$)	(E2)	
591.2 *2*	3.6 *4*	2508.9+x	(15$^+$)	1917.9+x	(13$^+$)	(E2)	
618.9 *2*	8.3 *5*	2288.4+x	(15$^+$)	1669.5+x	(13$^+$)	E2	DCO=0.99 *5*.
621.8 *2*	39 *2*	1779.4+x	(15$^+$)	1157.5+x	(13$^+$)	E2	DCO=1.00 *5*.
624.2 *2*	9.3 *6*	1416.51+z	(13$^-$)	792.37+z	(11$^-$)	(E2)	
628 *1*	2.5 *3*	1723.9+x	(13$^+$)	1095.6+x	(11$^+$)	(E2)	
634.2 *2*	22 *1*	1906.4+y	(14$^-$)	1272.4+y	(12$^-$)	E2	DCO=0.99 *7*.
636.9 *2*	16.5 *8*	1954.8+y	(14$^-$)	1318.0+y	(12$^-$)	E2	DCO=1.0 *1*.
650.6 *2*	4.3 *4*	2833.3+x	(16$^+$)	2182.4+x	(14$^+$)	(E2)	
658.5 *2*	10.1 *6*	1754.2+z	(14$^-$)	1095.69+z	(12$^-$)	(E2)	
666.2 *2*	24 *1*	2213.0+y	(15$^-$)	1546.8+y	(13$^-$)	E2	DCO=1.1 *1*.

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(HI,xnγ) 2002Ha20,2002Pe05 (continued)

γ(^{128}Pr) (continued)

E_γ †	I_γ	E_i(level)	J_i^π	E_f	J_f^π	Mult.	Comments
669 *1*	<2	2048.1+x	(14^+)	1379.1+x	(12^+)	(E2)	
681.1 *2*	44 *2*	2121.6+x	(16^+)	1440.6+x	(14^+)	E2	DCO=0.99 *4*.
684.0 *2*	17.7 *9*	2283.0+y	(15^-)	1599.0+y	(13^-)	E2	DCO=1.06 *7*.
692.6 *2*	9.9 *6*	2109.1+z	(15^-)	1416.51+z	(13^-)	(E2)	
696.0 *2*	4.9 *4*	3204.6+x	(17^+)	2508.9+x	(15^+)	(E2)	
713.2 *2*	8.1 *5*	3001.6+x	(17^+)	2288.4+x	(15^+)	E2	DCO=1.07 *6*.
720.3 *2*	36 *2*	2499.7+x	(17^+)	1779.4+x	(15^+)	E2	DCO=1.01 *5*.
721.2 *2*	15.8 *8*	2627.7+y	(16^-)	1906.4+y	(14^-)	E2	DCO=1.00 *6*.
721.9 *2*	10.8 *7*	2676.8+y	(16^-)	1954.8+y	(14^-)	E2	DCO=1.1 *1*.
726.4 *2*	10.5 *6*	2480.7+z	(16^-)	1754.2+z	(14^-)	(E2)	
741.6 *5*	<2	2182.4+x	(14^+)	1440.6+x	(14^+)	(E2)	
745.1 *2*	15.5 *8*	2958.1+y	(17^-)	2213.0+y	(15^-)	E2	DCO=1.1 *1*.
749.5 *2*	3.8 *4*	3583.0+x	(18^+)	2833.3+x	(16^+)	(E2)	
759.6 *2*	9.4 *5*	3042.6+y	(17^-)	2283.0+y	(15^-)	E2	DCO=1.1 *1*.
759.7 *2*	6.6 *4*	2868.8+z	(17^-)	2109.1+z	(15^-)	(E2)	
772 *1*		1646.3+x		875.1+x	(12^+)		
773.1 *2*	30 *1*	2894.7+x	(18^+)	2121.6+x	(16^+)	E2	DCO=0.98 *4*.
783.4 *2*	10.7 *6*	3411.1+y	(18^-)	2627.7+y	(16^-)	E2	DCO=0.94 *9*.
787.2 *2*	3.8 *3*	3991.8+x	(19^+)	3204.6+x	(17^+)	(E2)	
790.5 *2*	9.0 *5*	3467.3+y	(18^-)	2676.8+y	(16^-)	E2	DCO=1.2 *1*.
794.7 *2*	5.6 *3*	3275.4+z	(18^-)	2480.7+z	(16^-)	(E2)	
797.5 *2*	27 *1*	3297.3+x	(19^+)	2499.7+x	(17^+)	E2	DCO=0.97 *9*.
799.7 *2*	6.7 *4*	3801.3+x	(19^+)	3001.6+x	(17^+)	E2	DCO=1.04 *5*.
803.8 *2*	11.7 *6*	3761.9+y	(19^-)	2958.1+y	(17^-)	E2	DCO=1.2 *1*.
819.0 *2*	6.5 *4*	3861.5+y	(19^-)	3042.6+y	(17^-)	(E2)	
826.1 *2*	4.2 *3*	3694.9+z	(19^-)	2868.8+z	(17^-)	(E2)	
829.7 *2*	4.0 *4*	4412.7+x	(20^+)	3583.0+x	(18^+)	(E2)	
830.0 *2*	6.4 *4*	4241.1+y	(20^-)	3411.1+y	(18^-)	E2	DCO=1.0 *1*.
847.4 *2*	22 *1*	3742.0+x	(20^+)	2894.7+x	(18^+)	E2	DCO=0.94 *5*.
853.9 *2*	5.9 *4*	4321.2+y	(20^-)	3467.3+y	(18^-)	(E2)	
858.0 *2*	3.4 *3*	4133.4+z	(20^-)	3275.4+z	(18^-)	(E2)	
862.3 *2*	3.6 *3*	4854.0+x	(21^+)	3991.8+x	(19^+)	(E2)	
866.6 *2*	21 *1*	4163.8+x	(21^+)	3297.3+x	(19^+)	E2	DCO=0.84 *9*.
870.1 *2*	3.5 *3*	4731.6+y	(21^-)	3861.5+y	(19^-)	(E2)	
870.8 *2*	6.2 *4*	4632.7+y	(21^-)	3761.9+y	(19^-)	E2	DCO=1.1 *1*.
878.9 *2*	6.0 *3*	4680.2+x	(21^+)	3801.3+x	(19^+)	E2	DCO=0.95 *6*.
892.7 *2*	3.3 *3*	4587.6+z	(21^-)	3694.9+z	(19^-)	(E2)	
899.8 *2*	5.0 *3*	5312.6+x	(22^+)	4412.7+x	(20^+)	(E2)	
912.8 *2*	3.1 *3*	5153.9+y	(22^-)	4241.1+y	(20^-)	(E2)	
919.6 *2*	14.0 *7*	4661.7+x	(22^+)	3742.0+x	(20^+)	E2	DCO=0.96 *7*.
922.2 *2*	3.4 *3*	5243.4+y	(22^-)	4321.2+y	(20^-)	(E2)	
923 *1*		4784.5+y	(21^-)	3861.5+y	(19^-)		
928.5 *5*	2.2 *2*	5061.9+z	(22^-)	4133.4+z	(20^-)	(E2)	
935.9 *2*	3.8 *3*	5789.9+x	(23^+)	4854.0+x	(21^+)	(E2)	
941.8 *2*	13.9 *7*	5105.7+x	(23^+)	4163.8+x	(21^+)	E2	DCO=1.0 *1*.
952 *1*		5736.5+y	(23^-)	4784.5+y	(21^-)		
959.2 *2*	3.7 *2*	5639.4+x	(23^+)	4680.2+x	(21^+)	E2	DCO=1.2 *1*.
964.6 *2*	5.0 *3*	5597.3+y	(23^-)	4632.7+y	(21^-)	(E2)	
964.8 *5*	2.3 *2*	5696.4+y	(23^-)	4731.6+y	(21^-)	(E2)	
965.2 *5*	2.2 *2*	5552.8+z	(23^-)	4587.6+z	(21^-)	(E2)	
978.2 *2*	3.2 *3*	6290.9+x	(24^+)	5312.6+x	(22^+)	(E2)	
987.8 *5*	2.4 *2*	6231.2+y	(24^-)	5243.4+y	(22^-)	(E2)	
992 *1*		1646.3+x		654.6+x	(11^+)		
1003.5 *5*	<2	6065.4+z	(24^-)	5061.9+z	(22^-)	(E2)	
1003.7 *2*	10.1 *5*	5665.5+x	(24^+)	4661.7+x	(22^+)	E2	DCO=1.1 *1*.
1015 *1*		6751.5+y	(25^-)	5736.5+y	(23^-)		

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(HI,xnγ) 2002Ha20,2002Pe05 (continued)

γ(^{128}Pr) (continued)

E_γ [†]	I_γ	E_i(level)	J_i^π	E_f	J_f^π	Mult.	Comments
1020.5 *5*	2.0 *2*	6810.3+x	(25^+)	5789.9+x	(23^+)	(E2)	
1024.7 *5*	<2	2182.4+x	(14^+)	1157.5+x	(13^+)	(M1+E2)	
1026.5 *5*	2.4 *2*	6180.4+y	(24^-)	5153.9+y	(22^-)	(E2)	
1028.0 *2*	9.9 *5*	6133.7+x	(25^+)	5105.7+x	(23^+)	E2	DCO=1.0 *1*.
1043.5 *5*	<2	6596.3+z	(25^-)	5552.8+z	(23^-)	(E2)	
1043.9 *5*	2.5 *2*	6683.3+x	(25^+)	5639.4+x	(23^+)	E2	DCO=0.9 *1*.
1044[#] *1*	<2	1917.9+x	(13^+)	875.1+x	(12^+)	(M1+E2)	
1047.4 *5*	<2	7278.6+y	(26^-)	6231.2+y	(24^-)	(E2)	
1067.9 *5*	<2	7358.6+x	(26^+)	6290.9+x	(24^+)	(E2)	
1071.9 *2*	3.0 *3*	6669.2+y	(25^-)	5597.3+y	(23^-)	(E2)	
1081.9 *5*	<2	6778.3+y	(25^-)	5696.4+y	(23^-)	(E2)	
1084.7 *5*	<2	7150.1+z	(26^-)	6065.4+z	(24^-)	(E2)	
1100.9 *2*	5.0 *3*	6766.4+x	(26^+)	5665.5+x	(24^+)	E2	DCO=1.0 *1*.
1112.9 *5*	<2	8391.5+y	(28^-)	7278.6+y	(26^-)	(E2)	
1114.5 *5*	<2	7924.8+x	(27^+)	6810.3+x	(25^+)	(E2)	
1119.1 *2*	5.7 *3*	7252.8+x	(27^+)	6133.7+x	(25^+)	(E2)	
1123.9 *5*	2.1 *2*	7807.2+x	(27^+)	6683.3+x	(25^+)	(E2)	
1124.1 *5*	<2	7720.4+z	(27^-)	6596.3+z	(25^-)	(E2)	
1136.3 *5*	<2	7316.7+y	(26^-)	6180.4+y	(24^-)	(E2)	
1152 *1*		7821.2+y	(27^-)	6669.2+y	(25^-)		
1156 *1*		8977.2+y	(29^-)	7821.2+y	(27^-)		
1165.3 *5*	<2	8523.9+x	(28^+)	7358.6+x	(26^+)	(E2)	
1165.9 *5*	<2	8316.0+z	(28^-)	7150.1+z	(26^-)	(E2)	
1170.4 *5*	<2	7948.7+y	(27^-)	6778.3+y	(25^-)	(E2)	
1182.7 *5*	<2	8989.9+x	(29^+)	7807.2+x	(27^+)	(E2)	
1186.2 *5*	<2	9577.7+y	(30^-)	8391.5+y	(28^-)	(E2)	
1192.1 *5*	<2	7861.3+y	(27^-)	6669.2+y	(25^-)	(E2)	
1203.6 *5*	<2	8924.0+z	(29^-)	7720.4+z	(27^-)	(E2)	
1205.0 *2*	2.5 *2*	7971.4+x	(28^+)	6766.4+x	(26^+)	(E2)	
1211.9 *2*	3.4 *2*	8464.7+x	(29^+)	7252.8+x	(27^+)	(E2)	
1212.6 *5*	<2	9137.4+x	(29^+)	7924.8+x	(27^+)	(E2)	
1230.1 *5*	<2	8546.8+y	(28^-)	7316.7+y	(26^-)	(E2)	
1231 *1*		10208.2+y	(31^-)	8977.2+y	(29^-)		
1232.0 *5*	<2	10221.9+x	(31^+)	8989.9+x	(29^+)	(E2)	
1242.3 *5*	<2	9558.3+z	(30^-)	8316.0+z	(28^-)	(E2)	
1261.7 *5*	<2	9123.0+y	(29^-)	7861.3+y	(27^-)	(E2)	
1261.9 *5*	<2	10839.7+y	(32^-)	9577.7+y	(30^-)	(E2)	
1263 *1*	<2	9786.9+x	(30^+)	8523.9+x	(28^+)	(E2)	
1268.8 *5*	<2	9815.6+y	(30^-)	8546.8+y	(28^-)	(E2)	
1281.7 *5*	<2	10205.7+z	(31^-)	8924.0+z	(29^-)	(E2)	
1294.5 *5*	<2	11516.4+x	(33^+)	10221.9+x	(31^+)	(E2)	
1296.9 *5*	<2	10419.9+y	(31^-)	9123.0+y	(29^-)	(E2)	
1299[#] *1*	<2	11114.2+y?	(32^-)	9815.6+y	(30^-)	(E2)	
1302.9 *5*	<2	9767.6+x	(31^+)	8464.7+x	(29^+)	(E2)	
1307 *1*	<2	10444.4+x	(31^+)	9137.4+x	(29^+)	(E2)	
1311.9 *5*	<2	9283.3+x	(30^+)	7971.4+x	(28^+)	(E2)	
1318.3 *5*	<2	10876.6+z	(32^-)	9558.3+z	(30^-)	(E2)	
1334.4 *5*	<2	12174.1+y	(34^-)	10839.7+y	(32^-)	(E2)	
1354[#] *1*	<2	11773.4+y?	(33^-)	10419.9+y	(31^-)	(E2)	
1354.4 *5*	<2	11560.1+z	(33^-)	10205.7+z	(31^-)	(E2)	
1368.2 *5*	<2	12884.6+x	(35^+)	11516.4+x	(33^+)	(E2)	
1386.7 *5*	<2	12263.3+z	(34^-)	10876.6+z	(32^-)	(E2)	
1391.6 *5*	<2	11159.2+x	(33^+)	9767.6+x	(31^+)	(E2)	
1410[#] *1*	<2	13583.6+y?	(36^-)	12174.1+y	(34^-)	(E2)	

Continued on next page (footnotes at end of table)

(HI,xnγ) 2002Ha20,2002Pe05 (continued)

$\gamma(^{128}Pr)$ (continued)

E_γ [†]	I_γ	E_i(level)	J_i^π	E_f	J_f^π	Mult.
1417[#] *1*	<2	12977.1+z?	(35^-)	11560.1+z	(33^-)	(E2)
1417.6 *5*	<2	10700.9+x	(32^+)	9283.3+x	(30^+)	(E2)
1447.7 *5*	<2	14332.3+x	(37^+)	12884.6+x	(35^+)	(E2)
1459[#] *1*	<2	13722.3+z?	(36^-)	12263.3+z	(34^-)	(E2)
1485.2 *5*	<2	12644.4+x	(35^+)	11159.2+x	(33^+)	(E2)
1502[#] *1*	<2	12202.9+x?	(34^+)	10700.9+x	(32^+)	(E2)
1517[#] *1*	<2	15849.3+x?	(39^+)	14332.3+x	(37^+)	(E2)
1572.4 *5*	<2	14216.8+x	(37^+)	12644.4+x	(35^+)	(E2)

[†] Based on a general comment by 2002Ha20, 0.2 keV uncertainty is assigned to most γ rays, except 0.5 keV for weak lines ($I\gamma<3$) and 1 keV when $E\gamma$ is quoted to the nearest keV.

[‡] Seen only in 2002Pe05.

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

(HI,xnγ) 2002Ha20,2002Pe05

Level Scheme

Intensities: Relative I_γ

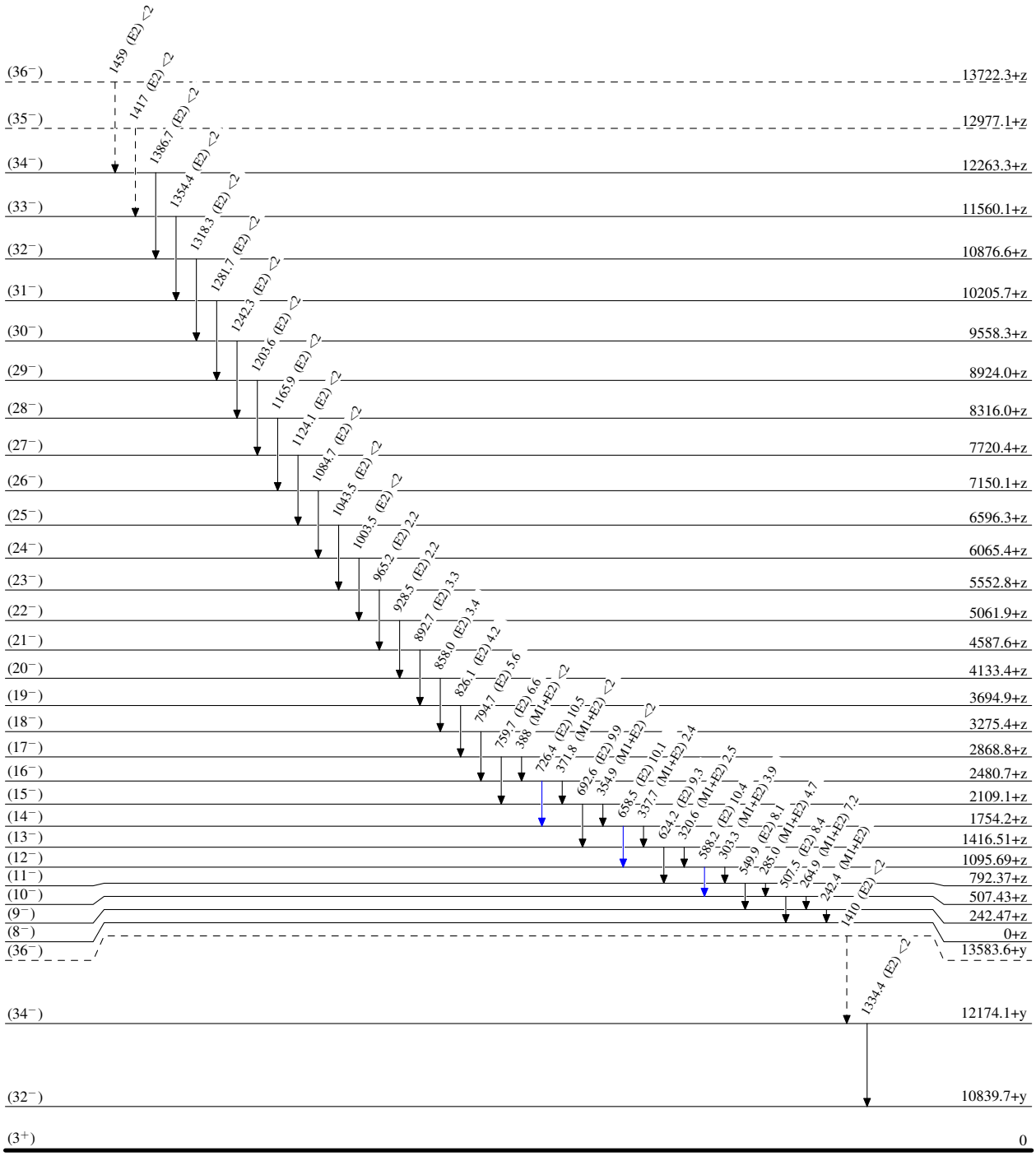
Legend

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

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

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

γ Decay (Uncertain)



$^{128}_{59}Pr_{69}$

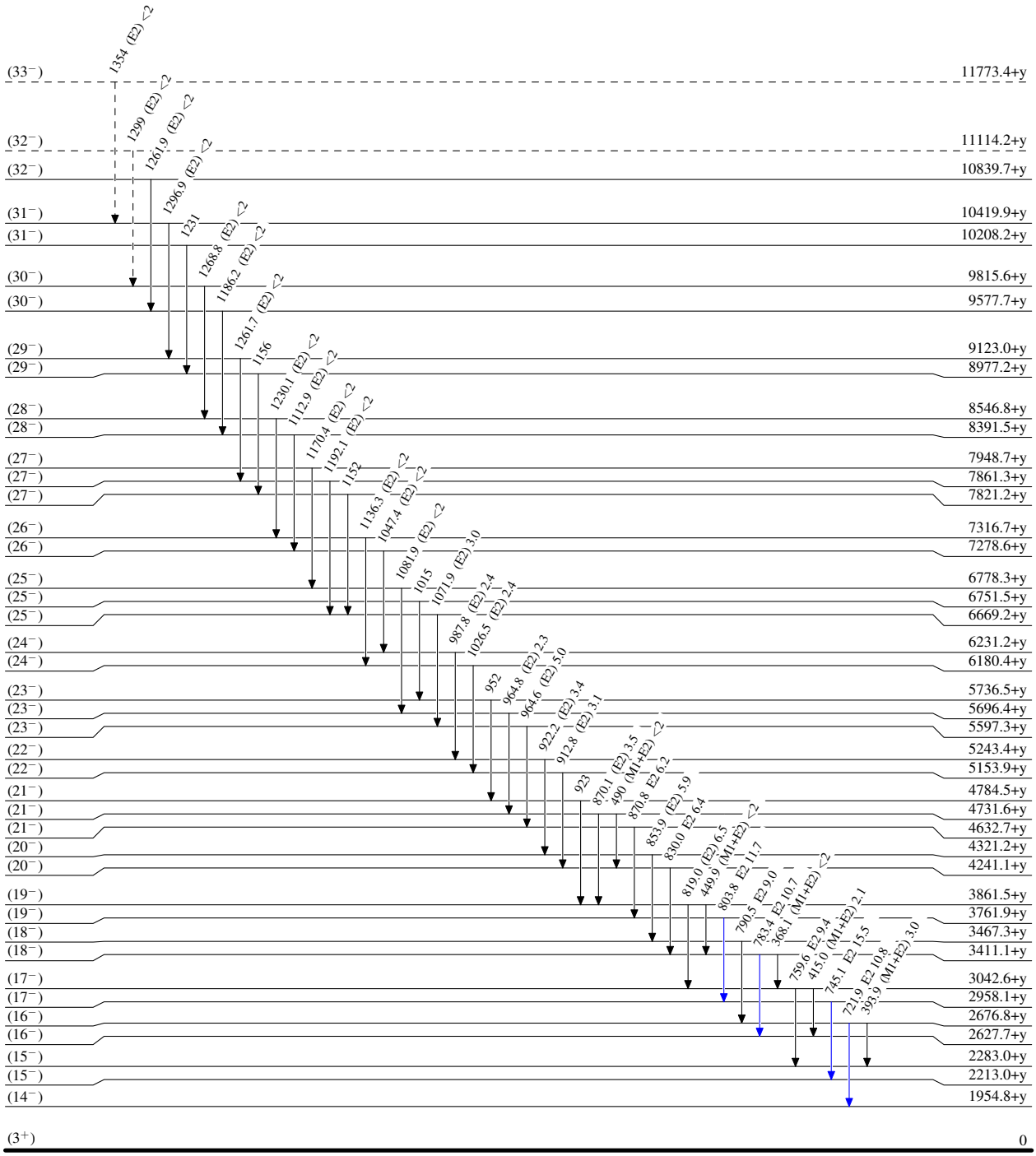
(HI,xnγ) 2002Ha20,2002Pe05

Level Scheme (continued)

Intensities: Relative I_γ

Legend

$I_\gamma < 2\% \times I_\gamma^{max}$
$I_\gamma < 10\% \times I_\gamma^{max}$
$I_\gamma > 10\% \times I_\gamma^{max}$
γ Decay (Uncertain)



$^{128}_{59}Pr_{69}$

(HI,xnγ) 2002Ha20,2002Pe05

Level Scheme (continued)

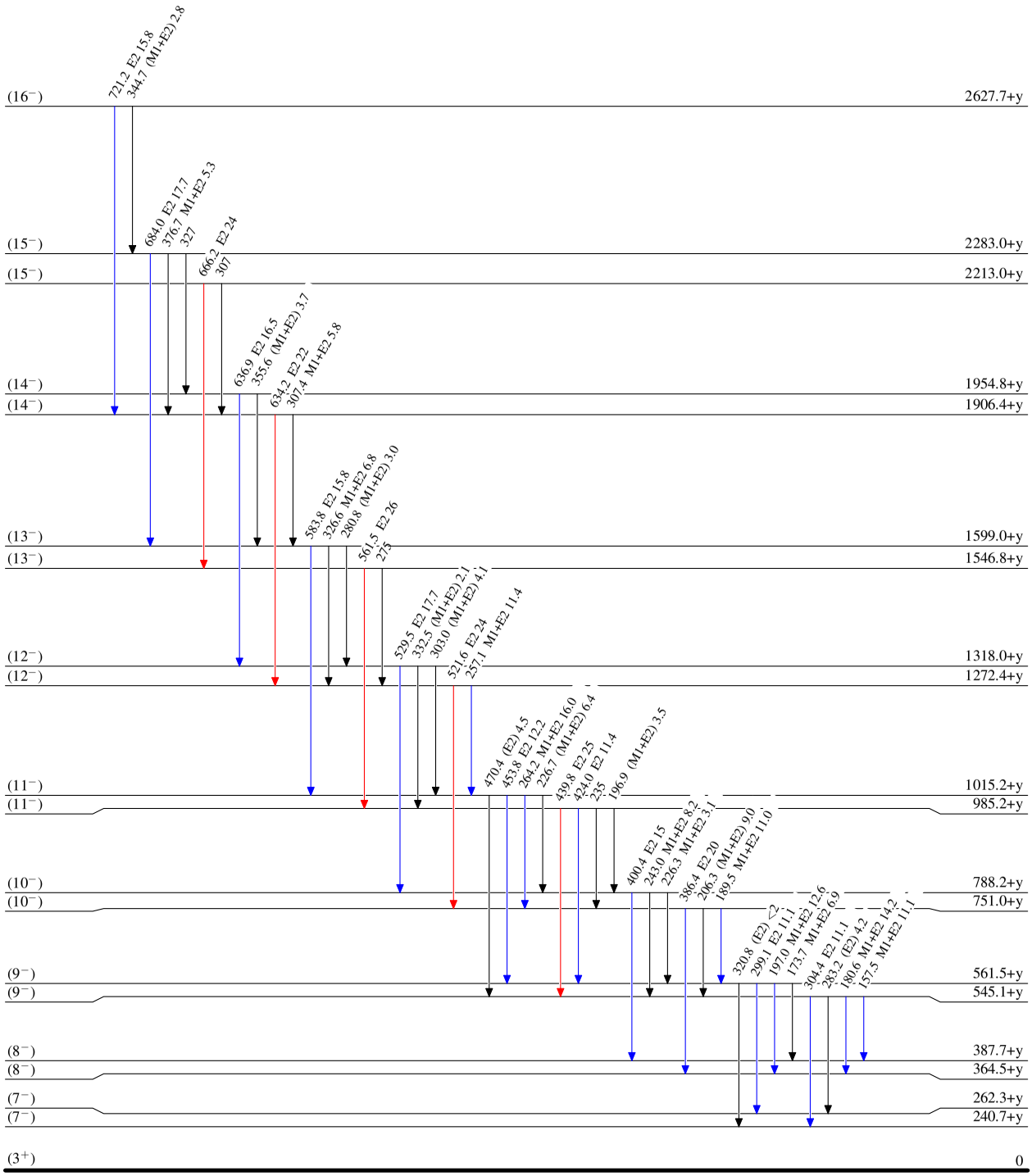
Intensities: Relative I_γ

Legend

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

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

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



$^{128}_{59}Pr_{69}$

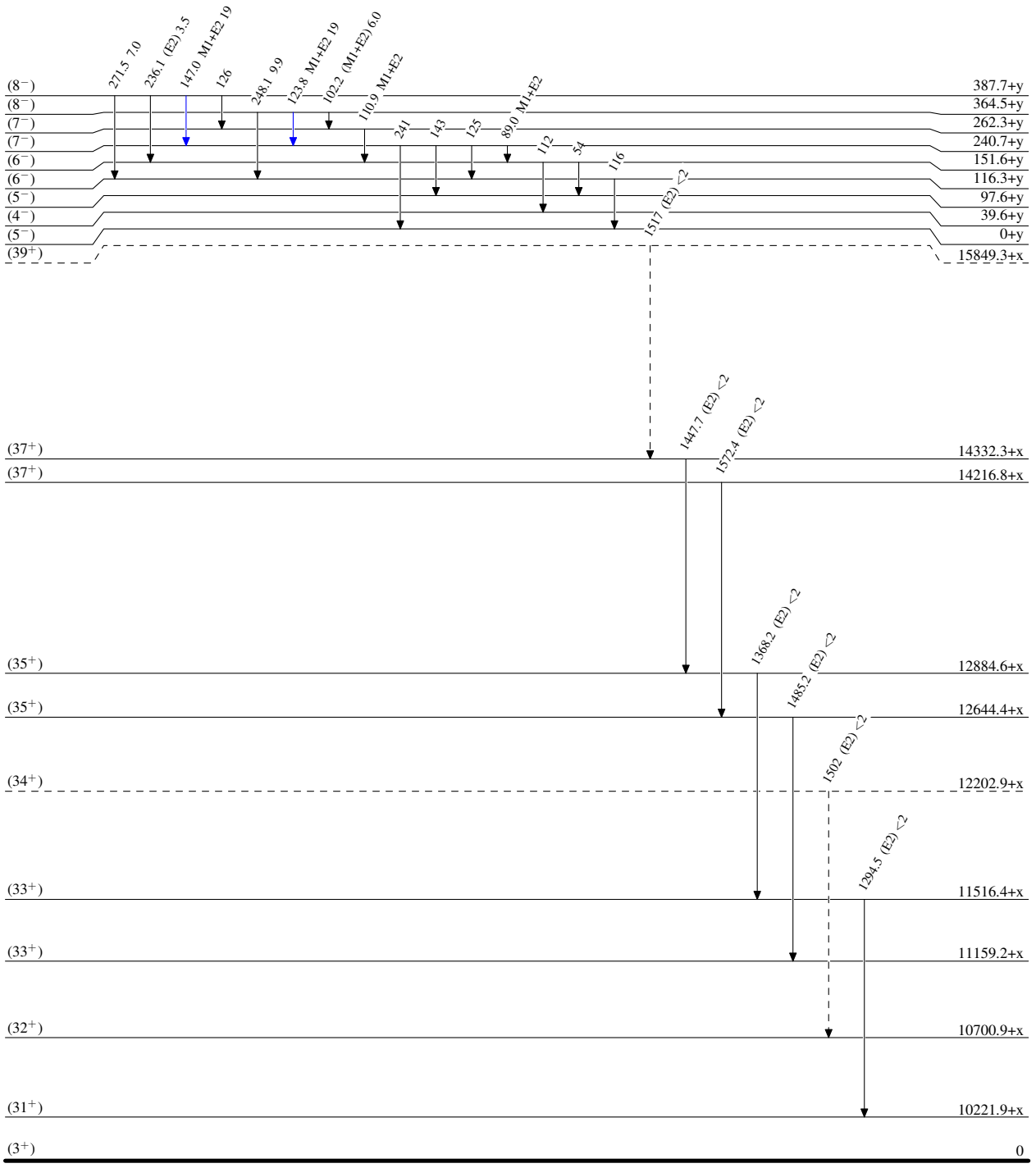
(HI,xnγ) 2002Ha20,2002Pe05

Level Scheme (continued)

Intensities: Relative I_γ

Legend

$I_\gamma < 2\% \times I_\gamma^{max}$
$I_\gamma < 10\% \times I_\gamma^{max}$
$I_\gamma > 10\% \times I_\gamma^{max}$
γ Decay (Uncertain)



$^{128}_{59}Pr_{69}$

(HI,xnγ) 2002Ha20,2002Pe05

Level Scheme (continued)

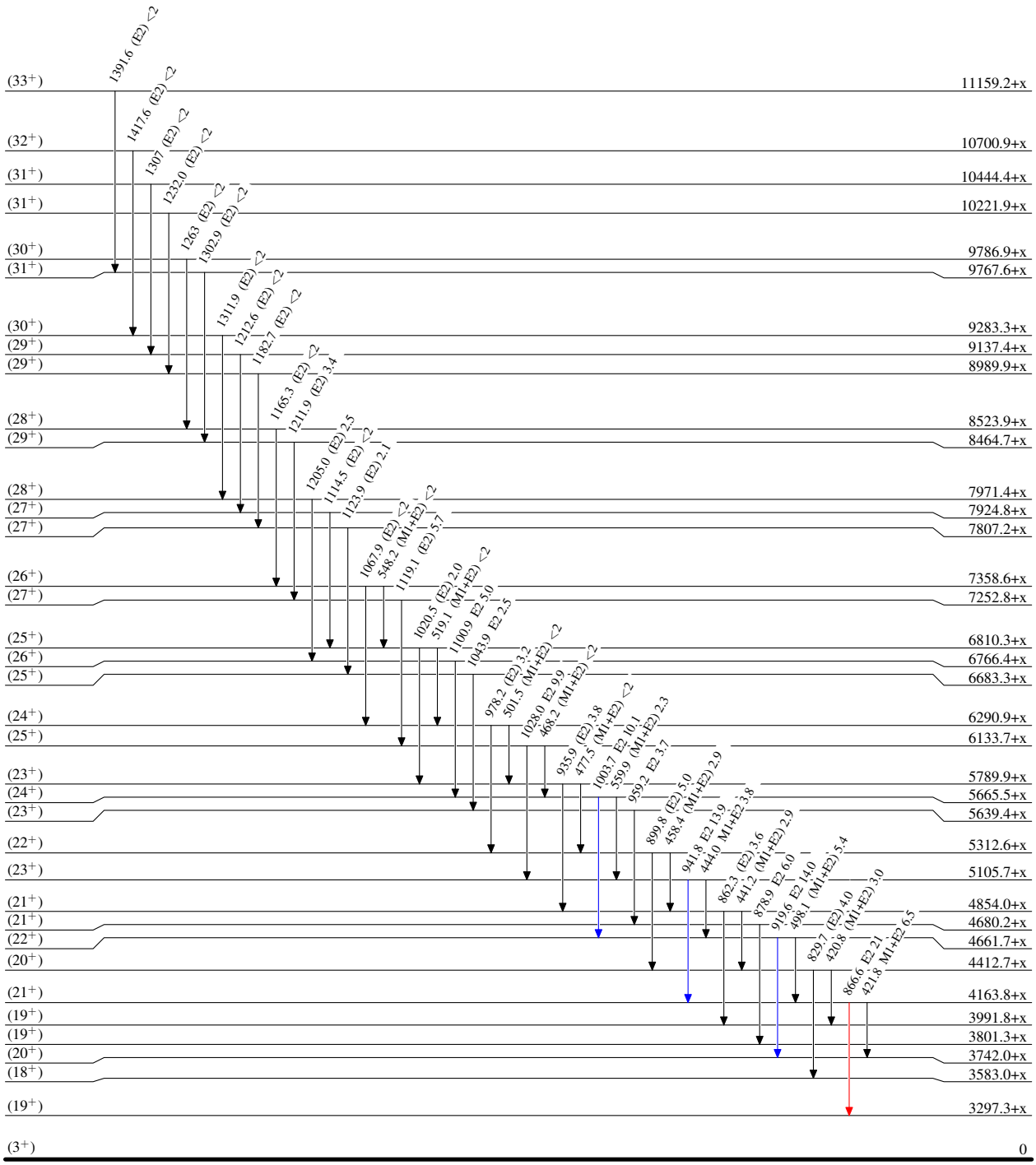
Intensities: Relative I_γ

Legend

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

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

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



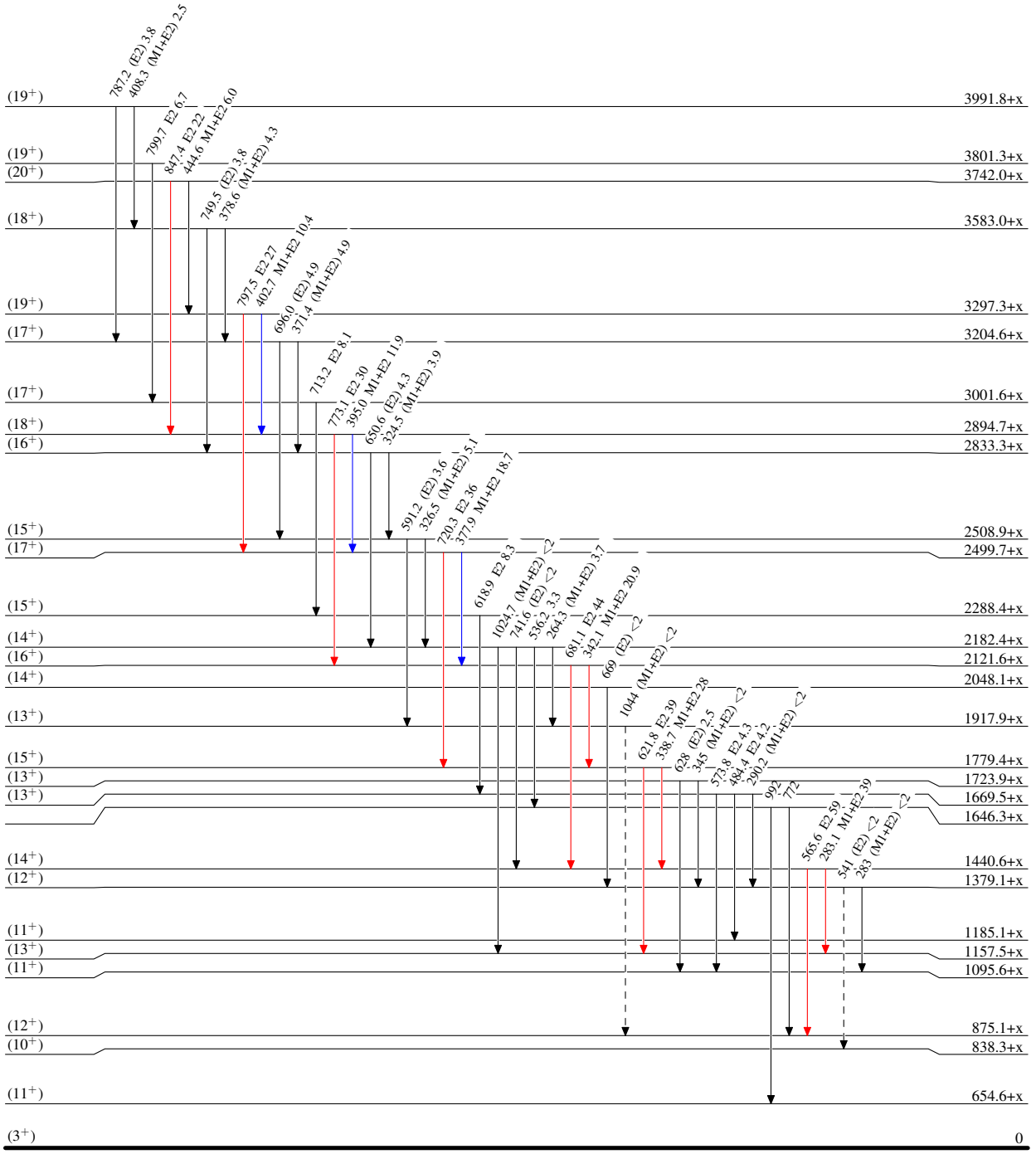
$^{128}_{59}Pr_{69}$

(HI,xnγ) 2002Ha20,2002Pe05

Level Scheme (continued)

Intensities: Relative I_γ

Legend
$I_\gamma < 2\% \times I_\gamma^{max}$
$I_\gamma < 10\% \times I_\gamma^{max}$
$I_\gamma > 10\% \times I_\gamma^{max}$
γ Decay (Uncertain)

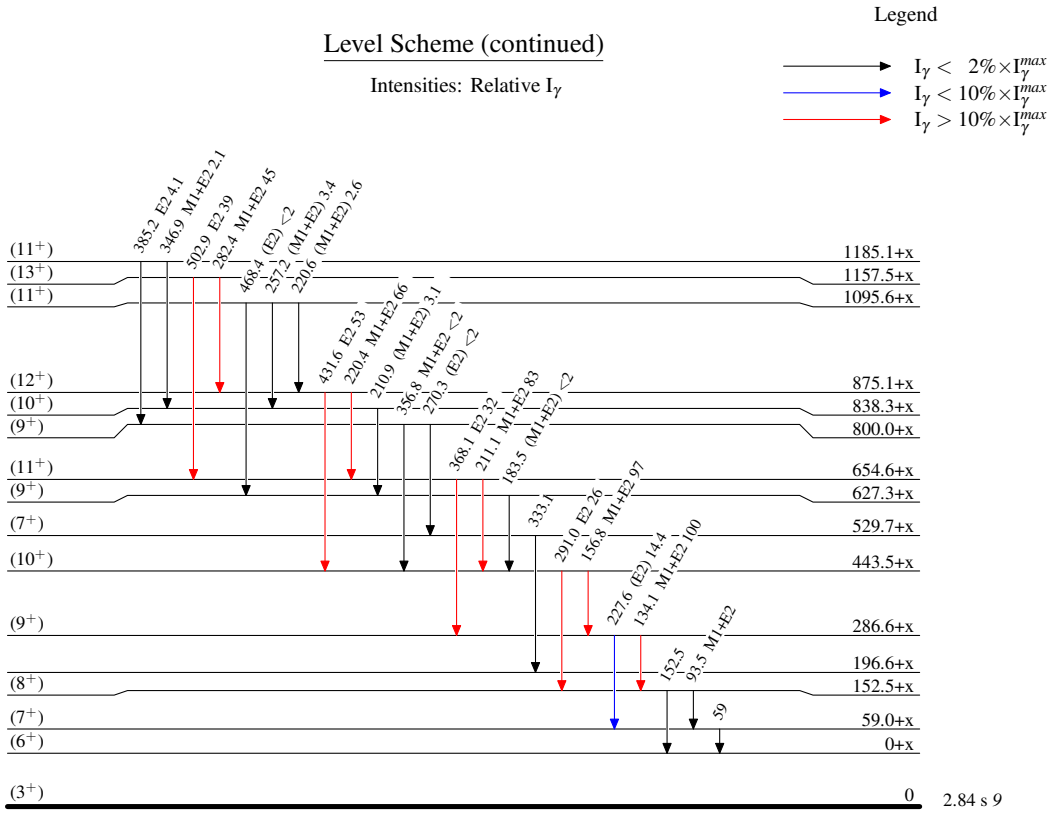


$^{128}_{59}Pr_{69}$

(HI,xnγ) 2002Ha20,2002Pe05

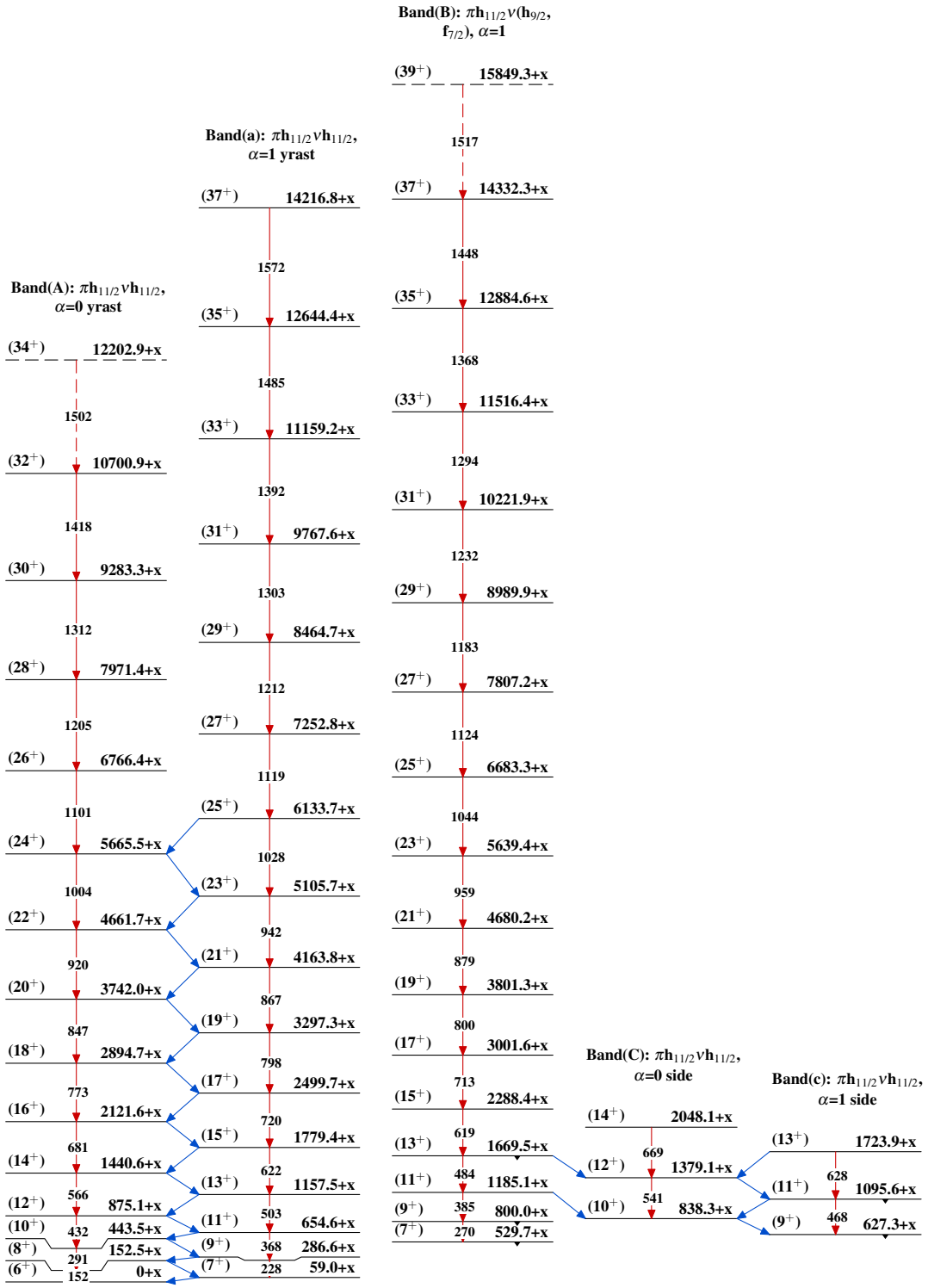
Level Scheme (continued)

Intensities: Relative I_γ



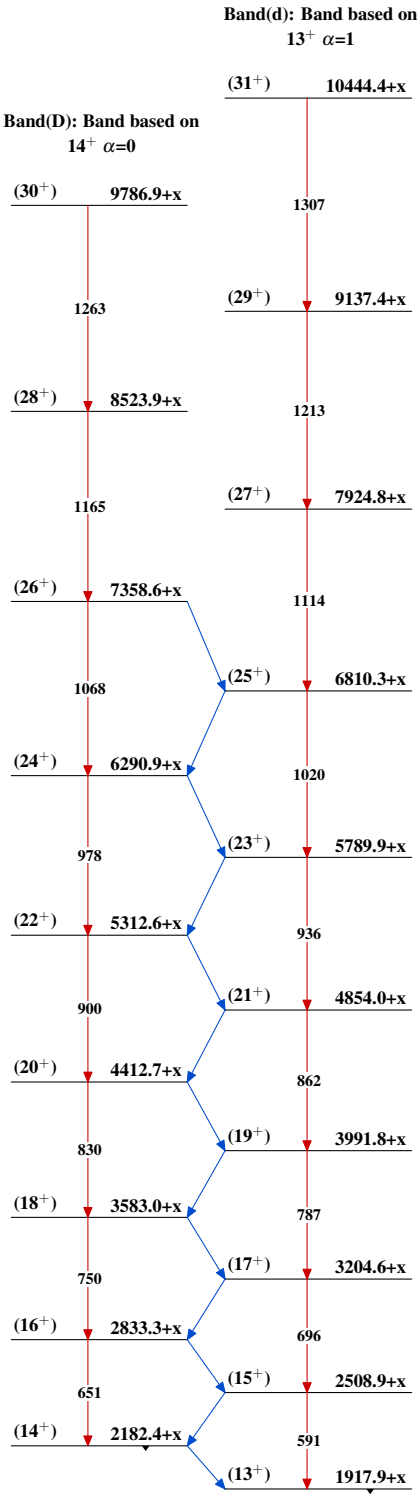
$^{128}_{59}Pr_{69}$

(HI,xnγ) 2002Ha20,2002Pe05



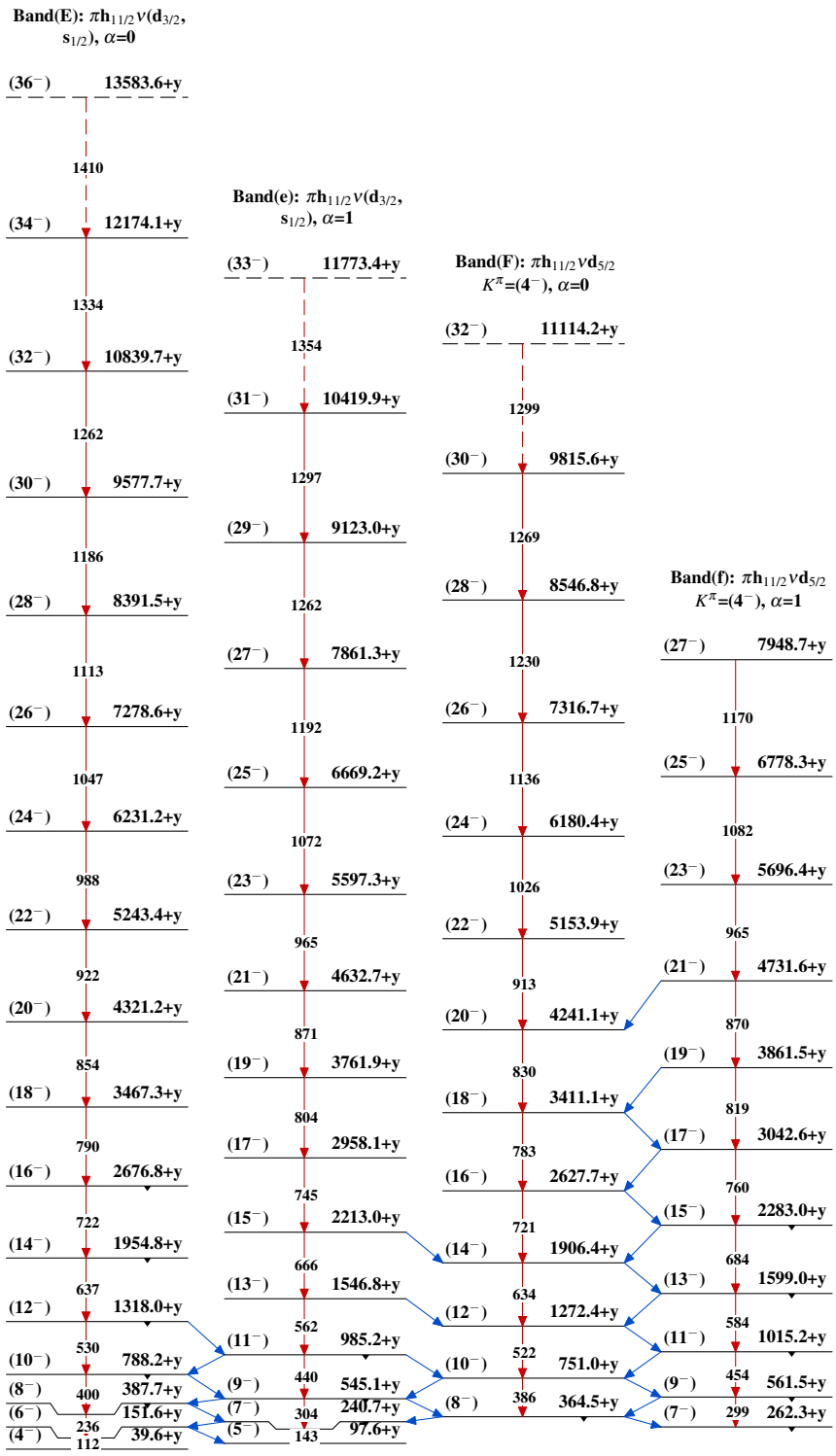
$^{128}_{59}Pr_{69}$

(HI,xnγ) 2002Ha20,2002Pe05 (continued)



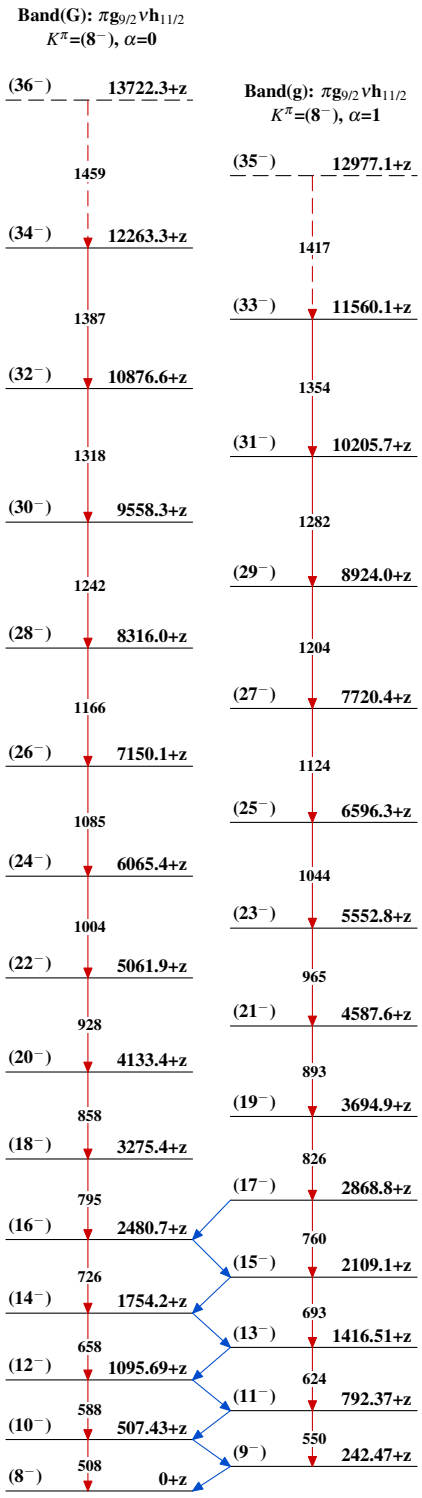
$^{128}_{59}Pr_{69}$

(HI,xnγ) 2002Ha20,2002Pe05 (continued)



$^{128}_{59}Pr_{69}$

(HI,xnγ) 2002Ha20,2002Pe05 (continued)



$^{128}_{59}Pr_{69}$