

**(HI,xnγ) 1989An04,1989Ri01,1985Ho04**

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	N. Nica	NDS 141, 1 (2017)	1-Feb-2017

Studies:

- 1981Dr07,1982DrZX: <sup>150</sup>Sm(<sup>14</sup>N,6nγ) at 107 MeV; report isomer as well as E<sub>γ</sub> and I<sub>γ</sub> for levels to 19<sup>-</sup>.
- 1985Fo09: <sup>128</sup>Te(<sup>35</sup>Cl,5nγ) at 172 MeV; report E<sub>γ</sub> and I<sub>γ</sub> for levels to 28<sup>-</sup>.
- 1985Ho04: <sup>141</sup>Pr(<sup>22</sup>Ne,5nγ) at 120 MeV; report E<sub>γ</sub>, I<sub>γ</sub>, γ(θ) for levels to 25<sup>-</sup>.
- 1986Dr06: <sup>148</sup>Sm(<sup>14</sup>N,4nγ) at 86 MeV and <sup>150</sup>Sm(<sup>14</sup>N,6nγ) at 97 MeV; report E<sub>γ</sub> for levels to 23<sup>-</sup>.
- 1987Ga09: <sup>128</sup>Te(<sup>35</sup>Cl,5nγ) at 150 MeV; report lifetimes for levels with J<sup>π</sup> of 12<sup>-</sup> to 19<sup>-</sup>.
- 1989An04: <sup>125</sup>Te(<sup>37</sup>Cl,4nγ) at 160 MeV and used detector array; report E<sub>γ</sub> for levels to 23<sup>-</sup> and 33<sup>+</sup>.
- 1989Ri01: <sup>110</sup>Pd(<sup>51</sup>V,3nγ) at 220 MeV and used detector array; report E<sub>γ</sub> for levels to 24<sup>-</sup> and 38<sup>+</sup>.

<sup>158</sup>Tm Levels

The energy of the lowest observed level has not been determined.

The scheme is from 1989Ri01 and 1989An04 which agree quite well; other references also agree well except that 1985Fo09 shows several higher spin, negative-parity levels which have not been verified and which are not included here.

E(level) <sup>†</sup>	J <sup>π‡</sup>	T <sub>1/2</sub> <sup>#</sup>	Comments
0.0+x	(5 <sup>+</sup> )	≈20 ns	E(level): This level is reported by 1981Dr07 but no confirmation of the decay information for it has been reported. T <sub>1/2</sub> : From 1981Dr07; value given in text as 20 s, and on level scheme as 20 ns. Since the γ's are observed after the beam is turned off, it was initially assumed that 20 s is the correct value, that however was reassessed to 20 ns by 2012Au07 (see comment in Adopted Levels table).
0.0+y <sup>@</sup>	(9 <sup>-</sup> )	16 ns 4	E(level): The energy of this level has not been established. 1981Dr07 report γ's of 98.7 and 128.7 (the third placement of a γ of the latter energy) depopulating this level and 1986Dr06 (by the same authors) still report this ≈ 130 γ, but do not report the 98.7 γ. Later articles do not report these γ's, so they have not been included here. T <sub>1/2</sub> : From 1981Dr07.
129.3+y <sup>@</sup> 8	(11 <sup>-</sup> )		E(level): 1989Ri01 tentatively place two additional γ's from this level. They are 116 and 190 keV and would populate levels at Y+14 and Y-60. Since these γ's have not been reported elsewhere, they are not included here.
150.0+y? <sup>&amp;</sup>	(10 <sup>-</sup> )		E(level): Reported only by 1985Fo09.
383.0+y <sup>&amp;</sup> 9	(12 <sup>-</sup> )	1.9 ps 6	
512.0+y <sup>@</sup> 9	(13 <sup>-</sup> )	4.5 ps 7	
811.5+y <sup>&amp;</sup> 9	(14 <sup>-</sup> )	1.8 ps 5	
1028.5+y <sup>@</sup> 9	(15 <sup>-</sup> )	0.8 ps 3	
1356.1+y <sup>&amp;</sup> 9	(16 <sup>-</sup> )	0.6 ps 6	
1639.3+y <sup>@</sup> 9	(17 <sup>-</sup> )	1.2 ps 5	
1992.2+y <sup>&amp;</sup> 10	(18 <sup>-</sup> )	0.2 ps +4-2	
2320.5+y <sup>@</sup> 10	(19 <sup>-</sup> )	0.5 ps +6-5	
2701.7+y <sup>&amp;</sup> 10	(20 <sup>-</sup> )		
2727.4+y <sup>a</sup>	(19 <sup>+</sup> )		
3013.6+y <sup>b</sup>	(20 <sup>+</sup> )		
3052.9+y <sup>@</sup> 10	(21 <sup>-</sup> )		
3058.3+y <sup>c</sup>	J		E(level): From tentative placement (1989An04) of depopulating γ to 19 <sup>-</sup> level.
3279.2+y <sup>a</sup>	(21 <sup>+</sup> )		
3348.2+y <sup>c</sup>	(J+1)		
3463.3+y <sup>&amp;</sup>	(22 <sup>-</sup> )		

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(HI,xn $\gamma$ ) **1989An04,1989Ri01,1985Ho04** (continued)

<sup>158</sup>Tm Levels (continued)

E(level) <sup>†</sup>	J $\pi$ <sup>‡</sup>	E(level) <sup>†</sup>	J $\pi$ <sup>‡</sup>	E(level) <sup>†</sup>	J $\pi$ <sup>‡</sup>	E(level) <sup>†</sup>	J $\pi$ <sup>‡</sup>
3606.0+y <sup>b</sup>	(22 <sup>+</sup> )	4274.9+y <sup>b</sup>	(24 <sup>+</sup> )	5071.3+y <sup>c</sup>	(J+6)	7940.5+y <sup>a</sup>	(33 <sup>+</sup> )
3654.8+y <sup>c</sup>	(J+2)	4326.8+y <sup>c</sup>	(J+4)	5361.2+y <sup>a</sup>	(27 <sup>+</sup> )	8820+y <sup>a</sup>	(35 <sup>+</sup> )
3838.1+y <sup>@</sup> 12	(23 <sup>-</sup> )	4598.8+y <sup>a</sup>	(25 <sup>+</sup> )	5635.8+y? <sup>@</sup>	(27 <sup>-</sup> )	9310+y	(36 <sup>+</sup> )
3901.9+y <sup>a</sup>	(23 <sup>+</sup> )	4712.1+y <sup>@</sup> 16	(25 <sup>-</sup> )	5780.0+y? <sup>b</sup>	(28 <sup>+</sup> )	10280+y?	(38 <sup>+</sup> )
3997.2+y <sup>c</sup>	(J+3)	4722.0+y <sup>c</sup>	(J+5)	6159.9+y <sup>a</sup>	(29 <sup>+</sup> )	10357+y?	
4261+y? <sup>&amp;</sup>	(24 <sup>-</sup> )	5006.0+y <sup>b</sup>	(26 <sup>+</sup> )	7032.8+y <sup>a</sup>	(31 <sup>+</sup> )		

<sup>†</sup> Values are from least-squares fit to the  $\gamma$  energies and the uncertainties are relative to the energy of the (9<sup>-</sup>) level at Y.

<sup>‡</sup> Assignments are based on the observed and assumed quadrupole nature of the crossover  $\gamma$ 's and the assignment of J $\pi$ =(9<sup>-</sup>) for the lowest observed level. This (9<sup>-</sup>) was deduced by 1981Dr07 based on alignment considerations in the neighboring nuclides <sup>157</sup>Er and <sup>157</sup>Ho.

# Unless noted otherwise, from 1987Ga09 (by recoil distance method).

@ Band(A):  $\pi$ =- band, signature=1.

& Band(B):  $\pi$ =- band, signature=0.

<sup>a</sup> Band(C):  $\pi$ =+ band, signature=1.

<sup>b</sup> Band(D):  $\pi$ =+ band, signature=0.

<sup>c</sup> Band(E): band fragment.

$\gamma$ (<sup>158</sup>Tm)

Listed in comments are the angular correlation coefficients I $\gamma$ (0 $^\circ$ )/I $\gamma$ (90 $^\circ$ ) and I $\gamma$ (30 $^\circ$ )/I $\gamma$ (90 $^\circ$ ) from Table 5 of 1985Ho04 (see the paper for definitions).

E $\gamma$ <sup>†</sup>	I $\gamma$ <sup>‡</sup>	E <sub>i</sub> (level)	J $\pi$ <sub>i</sub>	E <sub>f</sub>	J $\pi$ <sub>f</sub>	Mult. <sup>#</sup>	Comments
129.3 <sup>&amp;</sup> 8	243 <sup>&amp;</sup> 15	129.3+y	(11 <sup>-</sup> )	0.0+y	(9 <sup>-</sup> )		
129.3 <sup>&amp;</sup> 8	243 <sup>&amp;</sup> 15	512.0+y	(13 <sup>-</sup> )	383.0+y	(12 <sup>-</sup> )		
217.0 4	60 7	1028.5+y	(15 <sup>-</sup> )	811.5+y	(14 <sup>-</sup> )	D	0.84 11, 0.95 16 (1985Ho04).
233 <sup>a</sup>		383.0+y	(12 <sup>-</sup> )	150.0+y?	(10 <sup>-</sup> )		E $\gamma$ : From 1985Fo09, but not reported in 1989An04.
253.8 3	159 11	383.0+y	(12 <sup>-</sup> )	129.3+y	(11 <sup>-</sup> )	D	0.89 7, 1.17 11 (1985Ho04).
265.4		3279.2+y	(21 <sup>+</sup> )	3013.6+y	(20 <sup>+</sup> )		
283.1 4	53 8	1639.3+y	(17 <sup>-</sup> )	1356.1+y	(16 <sup>-</sup> )	D	0.54 12, 0.67 16 (1985Ho04).
286.2		3013.6+y	(20 <sup>+</sup> )	2727.4+y	(19 <sup>+</sup> )		
289.8		3348.2+y	(J+1)	3058.3+y	J		
295.9		3901.9+y	(23 <sup>+</sup> )	3606.0+y	(22 <sup>+</sup> )		
299.4 2	84 6	811.5+y	(14 <sup>-</sup> )	512.0+y	(13 <sup>-</sup> )	D	0.95 6, 1.18 20 (1985Ho04).
306.7		3654.8+y	(J+2)	3348.2+y	(J+1)		
324.0		4598.8+y	(25 <sup>+</sup> )	4274.9+y	(24 <sup>+</sup> )		
326.9		3606.0+y	(22 <sup>+</sup> )	3279.2+y	(21 <sup>+</sup> )		
327.6 1	102 9	1356.1+y	(16 <sup>-</sup> )	1028.5+y	(15 <sup>-</sup> )	D	1.10 8, 0.90 7 (1985Ho04, doublet).
328.2 3	25	2320.5+y	(19 <sup>-</sup> )	1992.2+y	(18 <sup>-</sup> )	D	1.10 8, 0.90 7 (1985Ho04, doublet).
329.4		4326.8+y	(J+4)	3997.2+y	(J+3)		
342.4		3997.2+y	(J+3)	3654.8+y	(J+2)		
349.5		5071.3+y	(J+6)	4722.0+y	(J+5)		
350.9 8	<20	3052.9+y	(21 <sup>-</sup> )	2701.7+y	(20 <sup>-</sup> )		
353.0 2	48 5	1992.2+y	(18 <sup>-</sup> )	1639.3+y	(17 <sup>-</sup> )	D	0.61 12, 1.11 23 (1985Ho04).
355		5361.2+y	(27 <sup>+</sup> )	5006.0+y	(26 <sup>+</sup> )		
372.9		4274.9+y	(24 <sup>+</sup> )	3901.9+y	(23 <sup>+</sup> )		

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(HI,xn $\gamma$ ) **1989An04,1989Ri01,1985Ho04** (continued)

$\gamma(^{158}\text{Tm})$  (continued)

$E_\gamma$ †	$I_\gamma$ ‡	$E_i(\text{level})$	$J_i^\pi$	$E_f$	$J_f^\pi$	Mult. #	Comments
375		3838.1+y	(23 <sup>-</sup> )	3463.3+y	(22 <sup>-</sup> )		
381.3 6	<15	2701.7+y	(20 <sup>-</sup> )	2320.5+y	(19 <sup>-</sup> )		
382.5 5	100	512.0+y	(13 <sup>-</sup> )	129.3+y	(11 <sup>-</sup> )	E2	1.52 38, 1.64 41 (1985Ho04).
395.5		4722.0+y	(J+5)	4326.8+y	(J+4)		
407.1		5006.0+y	(26 <sup>+</sup> )	4598.8+y	(25 <sup>+</sup> )		
409.7		3463.3+y	(22 <sup>-</sup> )	3052.9+y	(21 <sup>-</sup> )		
428.7 8		811.5+y	(14 <sup>-</sup> )	383.0+y	(12 <sup>-</sup> )		
490		9310+y	(36 <sup>+</sup> )	8820+y	(35 <sup>+</sup> )		$E_\gamma$ : Placement from 1989Ri01; 1989An04 place $\gamma$ of this energy from a level of 8430 keV to the 33 <sup>+</sup> level.
516.5 1	139 9	1028.5+y	(15 <sup>-</sup> )	512.0+y	(13 <sup>-</sup> )		
544.1 5	40 4	1356.1+y	(16 <sup>-</sup> )	811.5+y	(14 <sup>-</sup> )	E2	1.48 20, 1.78 26 (1985Ho04).
551.6		3279.2+y	(21 <sup>+</sup> )	2727.4+y	(19 <sup>+</sup> )		
578		3279.2+y	(21 <sup>+</sup> )	2701.7+y	(20 <sup>-</sup> )		
592.4		3606.0+y	(22 <sup>+</sup> )	3013.6+y	(20 <sup>+</sup> )		
596.5		3654.8+y	(J+2)	3058.3+y	J		
610.9 2	98 6	1639.3+y	(17 <sup>-</sup> )	1028.5+y	(15 <sup>-</sup> )	E2	1.47 13, 1.56 12 (1985Ho04).
622.6		3901.9+y	(23 <sup>+</sup> )	3279.2+y	(21 <sup>+</sup> )		
636.1 2	<25	1992.2+y	(18 <sup>-</sup> )	1356.1+y	(16 <sup>-</sup> )		
649		3997.2+y	(J+3)	3348.2+y	(J+1)		
668.9		4274.9+y	(24 <sup>+</sup> )	3606.0+y	(22 <sup>+</sup> )		
672.1		4326.8+y	(J+4)	3654.8+y	(J+2)		
681.3 2	54 6	2320.5+y	(19 <sup>-</sup> )	1639.3+y	(17 <sup>-</sup> )	E2	1.38 22, 1.43 23 (1985Ho04).
692.9		3013.6+y	(20 <sup>+</sup> )	2320.5+y	(19 <sup>-</sup> )		
697.0		4598.8+y	(25 <sup>+</sup> )	3901.9+y	(23 <sup>+</sup> )		
709.5 5	49 6	2701.7+y	(20 <sup>-</sup> )	1992.2+y	(18 <sup>-</sup> )	E2	1.44 17, 1.30 22 (1985Ho04).
724.8		4722.0+y	(J+5)	3997.2+y	(J+3)		
731		5006.0+y	(26 <sup>+</sup> )	4274.9+y	(24 <sup>+</sup> )		
732.2 5	60 6	3052.9+y	(21 <sup>-</sup> )	2320.5+y	(19 <sup>-</sup> )	E2	1.39 21, 1.73 31 (1985Ho04).
734.9		2727.4+y	(19 <sup>+</sup> )	1992.2+y	(18 <sup>-</sup> )		
737.8 <sup>a</sup>		3058.3+y	J	2320.5+y	(19 <sup>-</sup> )		
744.2		5071.3+y	(J+6)	4326.8+y	(J+4)		
762.6		3463.3+y	(22 <sup>-</sup> )	2701.7+y	(20 <sup>-</sup> )		
762.6		5361.2+y	(27 <sup>+</sup> )	4598.8+y	(25 <sup>+</sup> )		
774 <sup>@a</sup>		5780.0+y?	(28 <sup>+</sup> )	5006.0+y	(26 <sup>+</sup> )		
785.2 6	32 4	3838.1+y	(23 <sup>-</sup> )	3052.9+y	(21 <sup>-</sup> )	E2	1.37 23, 1.42 21 (1985Ho04).
798 <sup>@a</sup>		4261+y?	(24 <sup>-</sup> )	3463.3+y	(22 <sup>-</sup> )		
798.7		6159.9+y	(29 <sup>+</sup> )	5361.2+y	(27 <sup>+</sup> )		
872.9		7032.8+y	(31 <sup>+</sup> )	6159.9+y	(29 <sup>+</sup> )		
874 1	28 7	4712.1+y	(25 <sup>-</sup> )	3838.1+y	(23 <sup>-</sup> )	E2	1.27 26, 1.29 25 (1985Ho04).
879 <sup>@</sup>		8820+y	(35 <sup>+</sup> )	7940.5+y	(33 <sup>+</sup> )		
907.7		7940.5+y	(33 <sup>+</sup> )	7032.8+y	(31 <sup>+</sup> )		
923.7 <sup>@a</sup>		5635.8+y?	(27 <sup>-</sup> )	4712.1+y	(25 <sup>-</sup> )		
970 <sup>a</sup>		10280+y?	(38 <sup>+</sup> )	9310+y	(36 <sup>+</sup> )		
1047 <sup>@a</sup>		10357+y?		9310+y	(36 <sup>+</sup> )		

† Values with uncertainties are from 1985Ho04, other values are from 1989An04, unless otherwise noted; others: 1981Dr07, 1985Fo09, 1986Dr06, 1989Ri01.

‡ From 1985Ho04 from <sup>141</sup>Pr(<sup>22</sup>Ne,5n $\gamma$ ) at 120 MeV; others: 1981Dr07, 1985Fo09.

# From evaluator's interpretation of the  $\gamma(\theta)$  data of 1985Ho04. The quadrupole transitions have been assigned as E2.

@ From 1989Ri01.

& Multiply placed with undivided intensity.

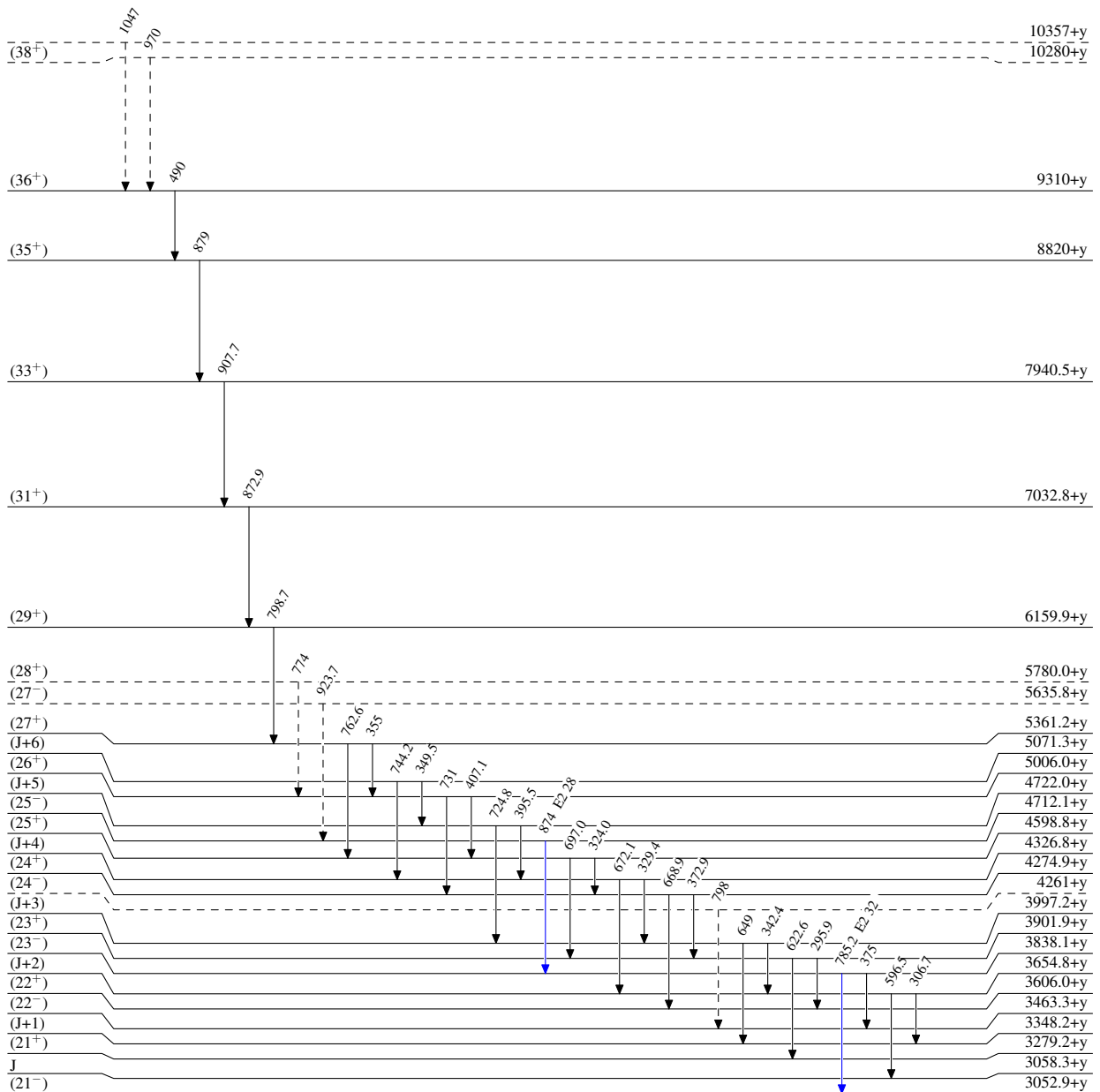
<sup>a</sup> Placement of transition in the level scheme is uncertain.

**(HI,xn $\gamma$ ) 1989An04,1989Ri01,1985Ho04**

Legend

**Level Scheme**  
 Intensities: Relative  $I_\gamma$

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



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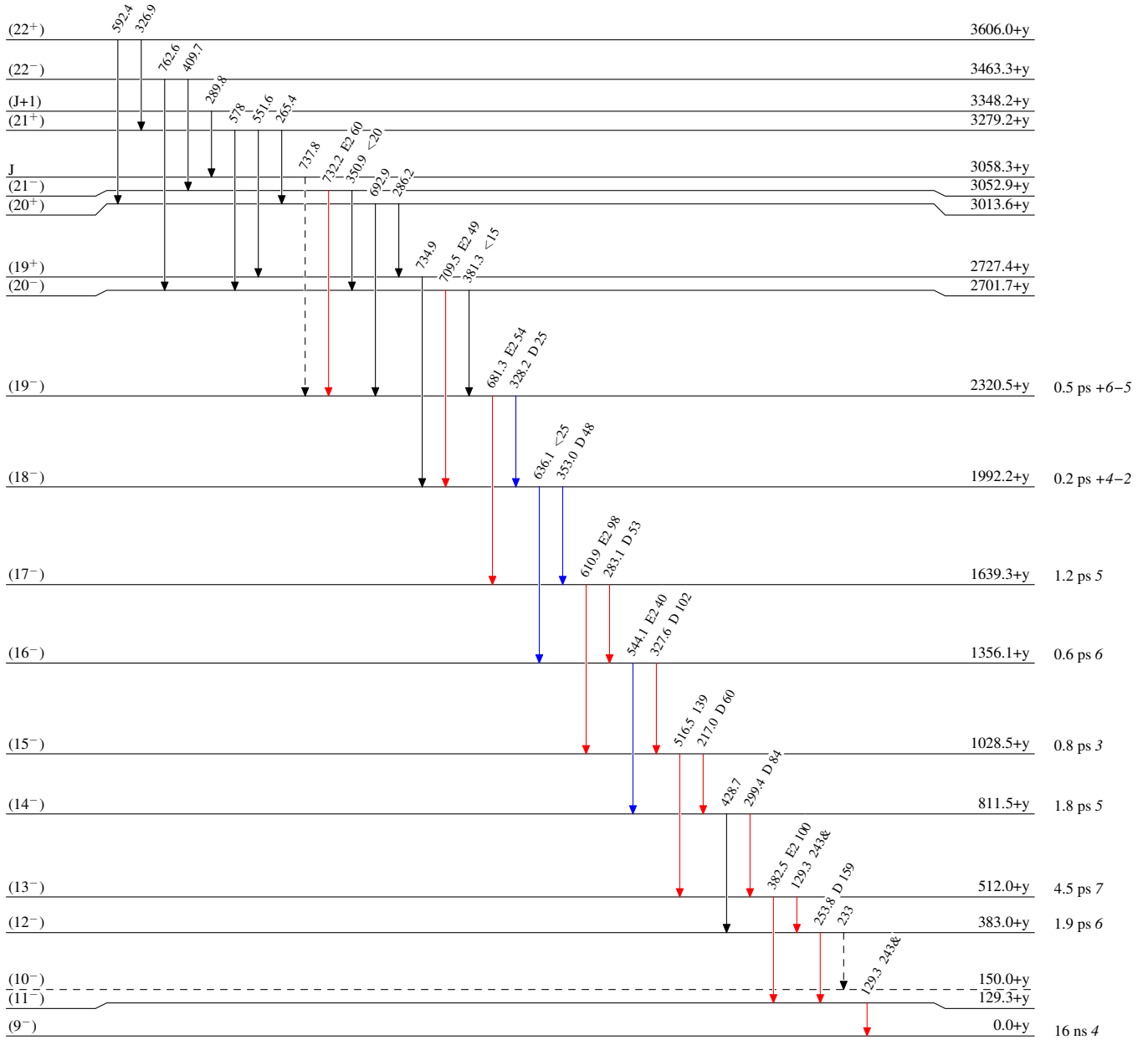
(HI,xn $\gamma$ ) 1989An04,1989Ri01,1985Ho04

Level Scheme (continued)

Intensities: Relative I $\gamma$   
& Multiply placed: undivided intensity given

Legend

- I $\gamma$  < 2%  $\times$  I $\gamma^{max}$
- I $\gamma$  < 10%  $\times$  I $\gamma^{max}$
- I $\gamma$  > 10%  $\times$  I $\gamma^{max}$
- - -  $\rightarrow$   $\gamma$  Decay (Uncertain)



<sup>158</sup>Tm<sub>89</sub>

**(HI,xn $\gamma$ ) 1989An04,1989Ri01,1985Ho04**

