

<sup>150</sup>Sm(<sup>19</sup>F,5n $\gamma$ ) **1996Ju01**

Type	Author	History	Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh and Jun Chen <sup>#</sup>		NDS 147, 1 (2018)	30-Nov-2017

E=105 MeV. Measured E $\gamma$ , I $\gamma$ ,  $\gamma\gamma$ ,  $\gamma\gamma(\theta)$ (DCO) using an array of 6 Compton-suppressed Ge detectors. Comparisons with Cranked-Shell model calculations.

<sup>164</sup>Lu Levels

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>
0+x <sup>a</sup>	(8 <sup>+</sup> ) <sup>#</sup>	3417.9+x <sup>b</sup> 10	(21 <sup>+</sup> ) <sup>#</sup>	2788.1+y <sup>@</sup> 6	(21 <sup>-</sup> )	2127.5+z <sup>d</sup> 10	(17 <sup>+</sup> )
141.1+x <sup>b</sup> 4	(9 <sup>+</sup> ) <sup>#</sup>	0+y <sup>&amp;</sup>	(10 <sup>-</sup> )	3111.6+y <sup>&amp;</sup> 6	(22 <sup>-</sup> )	2777.1+z <sup>d</sup> 13	
309.5+x <sup>a</sup> 4	(10 <sup>+</sup> ) <sup>#</sup>	93.4+y <sup>@</sup> 3	(11 <sup>-</sup> )	3488.9+y <sup>@</sup> 7	(23 <sup>-</sup> )	0+u <sup>c</sup>	(10 <sup>-</sup> )
520.1+x <sup>b</sup> 5	(11 <sup>+</sup> ) <sup>#</sup>	259.0+y <sup>&amp;</sup> 3	(12 <sup>-</sup> )	3809.4+y <sup>&amp;</sup> 7	(24 <sup>-</sup> )	344.4+u <sup>c</sup> 5	(12 <sup>-</sup> )
745.0+x <sup>a</sup> 6	(12 <sup>+</sup> ) <sup>#</sup>	421.3+y <sup>@</sup> 4	(13 <sup>-</sup> )	4197.9+y <sup>@</sup> 7	(25 <sup>-</sup> )	755.8+u <sup>c</sup> 7	(14 <sup>-</sup> )
1012.3+x <sup>b</sup> 6	(13 <sup>+</sup> ) <sup>#</sup>	658.4+y <sup>&amp;</sup> 4	(14 <sup>-</sup> )	4532.4+y <sup>&amp;</sup> 8	(26 <sup>-</sup> )	1227.9+u <sup>c</sup> 9	(16 <sup>-</sup> )
1279.6+x <sup>a</sup> 6	(14 <sup>+</sup> ) <sup>#</sup>	885.0+y <sup>@</sup> 4	(15 <sup>-</sup> )	4946.3+y <sup>@</sup> 8	(27 <sup>-</sup> )	1747.6+u <sup>c</sup> 10	(18 <sup>-</sup> )
1587.3+x <sup>b</sup> 7	(15 <sup>+</sup> ) <sup>#</sup>	1170.0+y <sup>&amp;</sup> 4	(16 <sup>-</sup> )	5307.4+y <sup>&amp;</sup> 8	(28 <sup>-</sup> )	2301.5+u <sup>c</sup> 12	(20 <sup>-</sup> )
1885.5+x <sup>a</sup> 7	(16 <sup>+</sup> ) <sup>#</sup>	1454.2+y <sup>@</sup> 5	(17 <sup>-</sup> )	0+z <sup>d</sup>	(9 <sup>+</sup> )	2885.9+u <sup>c</sup> 14	(22 <sup>-</sup> )
2212.3+x <sup>b</sup> 8	(17 <sup>+</sup> ) <sup>#</sup>	1767.2+y <sup>&amp;</sup> 5	(18 <sup>-</sup> )	401.8+z <sup>d</sup> 5	(11 <sup>+</sup> )		
2519.4+x <sup>a</sup> 8	(18 <sup>+</sup> ) <sup>#</sup>	2099.3+y <sup>@</sup> 5	(19 <sup>-</sup> )	908.3+z <sup>d</sup> 7	(13 <sup>+</sup> )		
2817.5+x <sup>b</sup> 8	(19 <sup>+</sup> ) <sup>#</sup>	2424.3+y <sup>&amp;</sup> 5	(20 <sup>-</sup> )	1494.1+z <sup>d</sup> 9	(15 <sup>+</sup> )		

<sup>†</sup> From least-squares fit to E $\gamma$  data. In order to see correspondence between levels given here and those in Adopted Levels, the energies and spins should be adjusted as follows: 1. The 0+x, (8<sup>+</sup>) level here corresponds to the 130.0+x, (9<sup>+</sup>) level in the Adopted Levels. Thus energy should be increased by  $\approx$ 130 keV and spin increased by one unit to get a matching Adopted level. 2. The 0+y, (10<sup>-</sup>) here corresponds to the 199.5+x, (10<sup>-</sup>) level in Adopted Levels. Thus replace y by 199.5+x to get a matching Adopted level. The 0+z, (9<sup>+</sup>) level here corresponds to 297.4+x, (10<sup>+</sup>) in Adopted Levels.

<sup>‡</sup> As suggested by 1996Ju01. The assignments are based on  $\gamma\gamma(\theta)$ (DCO) data and band associations from  $\gamma\gamma$  coin data.

<sup>#</sup> Spin is greater by 1 unit in Adopted Levels (from 1999To08), thus the signature partners are interchanged.

<sup>@</sup> Band(A):  $\pi 7/2[523] \otimes \nu 5/2[642], \alpha=1$ .

<sup>&</sup> Band(a):  $\pi 7/2[523] \otimes \nu 5/2[642], \alpha=0$ .

<sup>a</sup> Band(B):  $\pi 7/2[523] \otimes \nu 3/2[521], \alpha=0$ .

<sup>b</sup> Band(b):  $\pi 7/2[523] \otimes \nu 3/2[521], \alpha=1$ .

<sup>c</sup> Band(C):  $\pi 1/2[541] \otimes \nu 5/2[642], \alpha=0$ . The 344-411-472-520-554-584 cascade has not been reported in any of the several other studies (2007Br09, 1999To08, 1997Ca29 and 1996Wa25), thus this structure is not included in the Adopted Levels.

<sup>d</sup> Band(D):  $\pi 1/2[411] \otimes \nu 5/2[642], \alpha=1$ .

$\gamma(^{164}\text{Lu})$

E $\gamma$ <sup>†</sup>	I $\gamma$	E <sub>i</sub> (level)	J <sub>i</sub> $\pi$	E <sub>f</sub>	J <sub>f</sub> $\pi$	Mult. <sup>@</sup>	Comments
<sup>x</sup> 82.3 <sup>‡</sup> 5	13 3						
93.4 3	35 4	93.4+y	(11 <sup>-</sup> )	0+y	(10 <sup>-</sup> )	D	DCO=0.71 18
<sup>x</sup> 104.2 <sup>#</sup> 7	4.4 10						
141.1 5	17.8 25	141.1+x	(9 <sup>+</sup> )	0+x	(8 <sup>+</sup> )	D	DCO=0.65 16
<sup>x</sup> 142.9 <sup>‡</sup> 5	8.6 20						
162.3 3	106 9	421.3+y	(13 <sup>-</sup> )	259.0+y	(12 <sup>-</sup> )	D	DCO=0.66 6
<sup>x</sup> 162.4 <sup>‡</sup> 3	43 4						DCO=0.91 17

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<sup>150</sup>Sm(<sup>19</sup>F,5n $\gamma$ ) 1996Ju01 (continued)

$\gamma(^{164}\text{Lu})$  (continued)

$E_\gamma$ <sup>†</sup>	$I_\gamma$	$E_i(\text{level})$	$J_i^\pi$	$E_f$	$J_f^\pi$	Mult. <sup>@</sup>	Comments
165.6 3	100 5	259.0+y	(12 <sup>-</sup> )	93.4+y	(11 <sup>-</sup> )	D	DCO=0.57 6
168.4 5	23.6 25	309.5+x	(10 <sup>+</sup> )	141.1+x	(9 <sup>+</sup> )	D	DCO=0.62 7
<sup>x</sup> 172.3 <sup>‡</sup> 3	40 4						DCO=0.85 15
<sup>x</sup> 184.8 <sup>‡</sup> 5	22 3						DCO=0.71 15
210.7 5	17.4 19	520.1+x	(11 <sup>+</sup> )	309.5+x	(10 <sup>+</sup> )	D	DCO=0.59 7
224.9 5	14.5 16	745.0+x	(12 <sup>+</sup> )	520.1+x	(11 <sup>+</sup> )		DCO=0.81 16
226.7 3	71 5	885.0+y	(15 <sup>-</sup> )	658.4+y	(14 <sup>-</sup> )	D	DCO=0.63 8
237.2 3	98 7	658.4+y	(14 <sup>-</sup> )	421.3+y	(13 <sup>-</sup> )	D	DCO=0.57 5
259.0 5	16.0 13	259.0+y	(12 <sup>-</sup> )	0+y	(10 <sup>-</sup> )		DCO=0.78 17 DCO is too low for $\Delta J=2$ , quadrupole.
267.3 5	10.2 11	1012.3+x	(13 <sup>+</sup> )	745.0+x	(12 <sup>+</sup> )	D&	DCO=0.58 5
267.3 5	12.7 16	1279.6+x	(14 <sup>+</sup> )	1012.3+x	(13 <sup>+</sup> )		
284.2 3	32 4	1454.2+y	(17 <sup>-</sup> )	1170.0+y	(16 <sup>-</sup> )		
285.0 3	58 5	1170.0+y	(16 <sup>-</sup> )	885.0+y	(15 <sup>-</sup> )	D&	DCO=0.64 8
298.2 5	5.8 22	2817.5+x	(19 <sup>+</sup> )	2519.4+x	(18 <sup>+</sup> )		
298.3 5	6.9 17	1885.5+x	(16 <sup>+</sup> )	1587.3+x	(15 <sup>+</sup> )	D&	DCO=0.55 10
307.3 5	5.8 14	2519.4+x	(18 <sup>+</sup> )	2212.3+x	(17 <sup>+</sup> )		
307.6 5	9.1 18	1587.3+x	(15 <sup>+</sup> )	1279.6+x	(14 <sup>+</sup> )	D&	DCO=0.44 15
309.5 5	20.3 25	309.5+x	(10 <sup>+</sup> )	0+x	(8 <sup>+</sup> )	(Q)	DCO=0.89 15
313.0 5	29.7 22	1767.2+y	(18 <sup>-</sup> )	1454.2+y	(17 <sup>-</sup> )	D	DCO=0.51 8
320.5 5	12.5 17	3809.4+y	(24 <sup>-</sup> )	3488.9+y	(23 <sup>-</sup> )		
323.5 5	20 3	3111.6+y	(22 <sup>-</sup> )	2788.1+y	(21 <sup>-</sup> )		
325.1 5	21.1 23	2424.3+y	(20 <sup>-</sup> )	2099.3+y	(19 <sup>-</sup> )	D&	DCO=0.56 10
327.1 7	2.9 7	2212.3+x	(17 <sup>+</sup> )	1885.5+x	(16 <sup>+</sup> )		
327.8 3	50 4	421.3+y	(13 <sup>-</sup> )	93.4+y	(11 <sup>-</sup> )	Q	DCO=0.99 15
332.1 5	23.4 18	2099.3+y	(19 <sup>-</sup> )	1767.2+y	(18 <sup>-</sup> )	D	DCO=0.59 12
334.5 5	8.6 17	4532.4+y	(26 <sup>-</sup> )	4197.9+y	(25 <sup>-</sup> )		
344.4 5	17.4 26	344.4+y	(12 <sup>-</sup> )	0+u	(10 <sup>-</sup> )	Q	DCO=1.00 15
361.0 5	6.2 19	5307.4+y	(28 <sup>-</sup> )	4946.3+y	(27 <sup>-</sup> )		
363.4 5	14.8 13	2788.1+y	(21 <sup>-</sup> )	2424.3+y	(20 <sup>-</sup> )	D	DCO=0.58 14
377.5 5	7.8 12	3488.9+y	(23 <sup>-</sup> )	3111.6+y	(22 <sup>-</sup> )	D	DCO=0.66 18
379.0 5	18.5 15	520.1+x	(11 <sup>+</sup> )	141.1+x	(9 <sup>+</sup> )	(Q)	DCO=0.97 16
388.5 5	7.0 11	4197.9+y	(25 <sup>-</sup> )	3809.4+y	(24 <sup>-</sup> )	D	DCO=0.58 15
399.5 3	42.2 25	658.4+y	(14 <sup>-</sup> )	259.0+y	(12 <sup>-</sup> )	Q	DCO=0.99 10
401.8 5	13.1 20	401.8+z	(11 <sup>+</sup> )	0+z	(9 <sup>+</sup> )	(Q)	DCO=1.00 16
411.4 5	13.1 22	755.8+u	(14 <sup>-</sup> )	344.4+u	(12 <sup>-</sup> )	(Q)	DCO=0.92 12
413.7 5	7.0 19	4946.3+y	(27 <sup>-</sup> )	4532.4+y	(26 <sup>-</sup> )		
435.5 5	24.0 19	745.0+x	(12 <sup>+</sup> )	309.5+x	(10 <sup>+</sup> )	Q	DCO=1.01 10
463.7 3	78 5	885.0+y	(15 <sup>-</sup> )	421.3+y	(13 <sup>-</sup> )	Q	DCO=0.96 12
472.1 5	11.6 23	1227.9+u	(16 <sup>-</sup> )	755.8+u	(14 <sup>-</sup> )	(Q)	DCO=0.92 15
492.2 5	20.3 16	1012.3+x	(13 <sup>+</sup> )	520.1+x	(11 <sup>+</sup> )	Q	DCO=0.99 10
506.5 5	13.1 26	908.3+z	(13 <sup>+</sup> )	401.8+z	(11 <sup>+</sup> )	(Q)	DCO=1.00 18
511.5 3	53 4	1170.0+y	(16 <sup>-</sup> )	658.4+y	(14 <sup>-</sup> )	Q	DCO=0.97 12
519.7 5	8.0 16	1747.6+u	(18 <sup>-</sup> )	1227.9+u	(16 <sup>-</sup> )	(Q)	DCO=0.96 16
534.5 5	25.1 25	1279.6+x	(14 <sup>+</sup> )	745.0+x	(12 <sup>+</sup> )	(Q)	DCO=0.95 14
553.9 5	5.1 11	2301.5+u	(20 <sup>-</sup> )	1747.6+u	(18 <sup>-</sup> )	Q	DCO=1.12 17
569.2 3	63 5	1454.2+y	(17 <sup>-</sup> )	885.0+y	(15 <sup>-</sup> )	Q	DCO=1.34 16
575.0 5	18.9 18	1587.3+x	(15 <sup>+</sup> )	1012.3+x	(13 <sup>+</sup> )	Q	DCO=0.98 8
584.4 7	3.6 13	2885.9+u	(22 <sup>-</sup> )	2301.5+u	(20 <sup>-</sup> )	(Q)	DCO=0.97 25
585.8 5	9.4 23	1494.1+z	(15 <sup>+</sup> )	908.3+z	(13 <sup>+</sup> )	Q	DCO=1.07 18
597.1 3	49 4	1767.2+y	(18 <sup>-</sup> )	1170.0+y	(16 <sup>-</sup> )	Q	DCO=0.98 12
600.4 5	8.7 13	3417.9+x	(21 <sup>+</sup> )	2817.5+x	(19 <sup>+</sup> )	Q	DCO=1.10 25
605.2 5	7.6 13	2817.5+x	(19 <sup>+</sup> )	2212.3+x	(17 <sup>+</sup> )	Q	DCO=1.10 25
606.0 5	25.8 23	1885.5+x	(16 <sup>+</sup> )	1279.6+x	(14 <sup>+</sup> )	(Q)	DCO=0.93 15

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$^{150}\text{Sm}(^{19}\text{F},5\text{n}\gamma)$  1996Ju01 (continued) $\gamma(^{164}\text{Lu})$  (continued)

$E_\gamma$ †	$I_\gamma$	$E_i(\text{level})$	$J_i^\pi$	$E_f$	$J_f^\pi$	Mult. @	Comments
624.9 5	12.0 12	2212.3+x	(17 <sup>+</sup> )	1587.3+x	(15 <sup>+</sup> )	Q	DCO=1.02 15
633.4 5	5.1 13	2127.5+z	(17 <sup>+</sup> )	1494.1+z	(15 <sup>+</sup> )	Q	DCO=1.03 17
633.8 5	10.9 11	2519.4+x	(18 <sup>+</sup> )	1885.5+x	(16 <sup>+</sup> )	(Q)	DCO=0.93 20
645.2 3	39 3	2099.3+y	(19 <sup>-</sup> )	1454.2+y	(17 <sup>-</sup> )	Q	DCO=1.01 13
649.6 7	4.7 18	2777.1+z		2127.5+z	(17 <sup>+</sup> )	Q	DCO=1.15 25
657.0 3	34 3	2424.3+y	(20 <sup>-</sup> )	1767.2+y	(18 <sup>-</sup> )	Q	DCO=1.05 12
687.3 3	33 4	3111.6+y	(22 <sup>-</sup> )	2424.3+y	(20 <sup>-</sup> )		
689.1 5	26 3	2788.1+y	(21 <sup>-</sup> )	2099.3+y	(19 <sup>-</sup> )	Q&	DCO=0.95 10
697.6 5	15.6 17	3809.4+y	(24 <sup>-</sup> )	3111.6+y	(22 <sup>-</sup> )	Q	DCO=1.18 18
700.8 5	16.4 20	3488.9+y	(23 <sup>-</sup> )	2788.1+y	(21 <sup>-</sup> )	(Q)	DCO=0.98 17
709.1 5	8.6 13	4197.9+y	(25 <sup>-</sup> )	3488.9+y	(23 <sup>-</sup> )	(Q)	DCO=1.04 25
723.0 5	6.3 14	4532.4+y	(26 <sup>-</sup> )	3809.4+y	(24 <sup>-</sup> )	(Q)	DCO=1.02 30
748.5 5	7.0 22	4946.3+y	(27 <sup>-</sup> )	4197.9+y	(25 <sup>-</sup> )		
775.0 5	5.5 13	5307.4+y	(28 <sup>-</sup> )	4532.4+y	(26 <sup>-</sup> )		

† Uncertainty=0.3 for  $I_\gamma > 30$ , 0.5 for  $I_\gamma = 5-30$ , 0.7 for  $I_\gamma < 5$ , based on a general statement by the authors.

‡ Transition below  $J^\pi = (11^-)$  in band  $\pi 7/2[523] \nu 5/2[642]$ .

# Transition below  $J^\pi = (9^-)$  in band  $\pi 7/2[523] \nu 3/2[521]$ .

@ Assignments are by the evaluators, based on DCO data for 37° and 79° geometry, where with gates on  $\Delta J=2$ , quadrupole transitions, expected DCO ratios are  $\approx 1.0$  for  $\Delta J=2$ , quadrupole and  $\approx 0.5$  for  $\Delta J=1$ , dipole transitions. Assignment of mult=Q indicates  $\Delta J=2$ , quadrupole (most likely E2) and mult=D indicates  $\Delta J=1$ , dipole or dipole+quadrupole. It should be noted that DCO ratios here for  $\Delta J=1$  transitions are generally larger than expected for pure dipole, indicating quadrupole (most likely E2) admixture in these transitions.

& DCO ratio is for a doublet within the same band.

x  $\gamma$  ray not placed in level scheme.

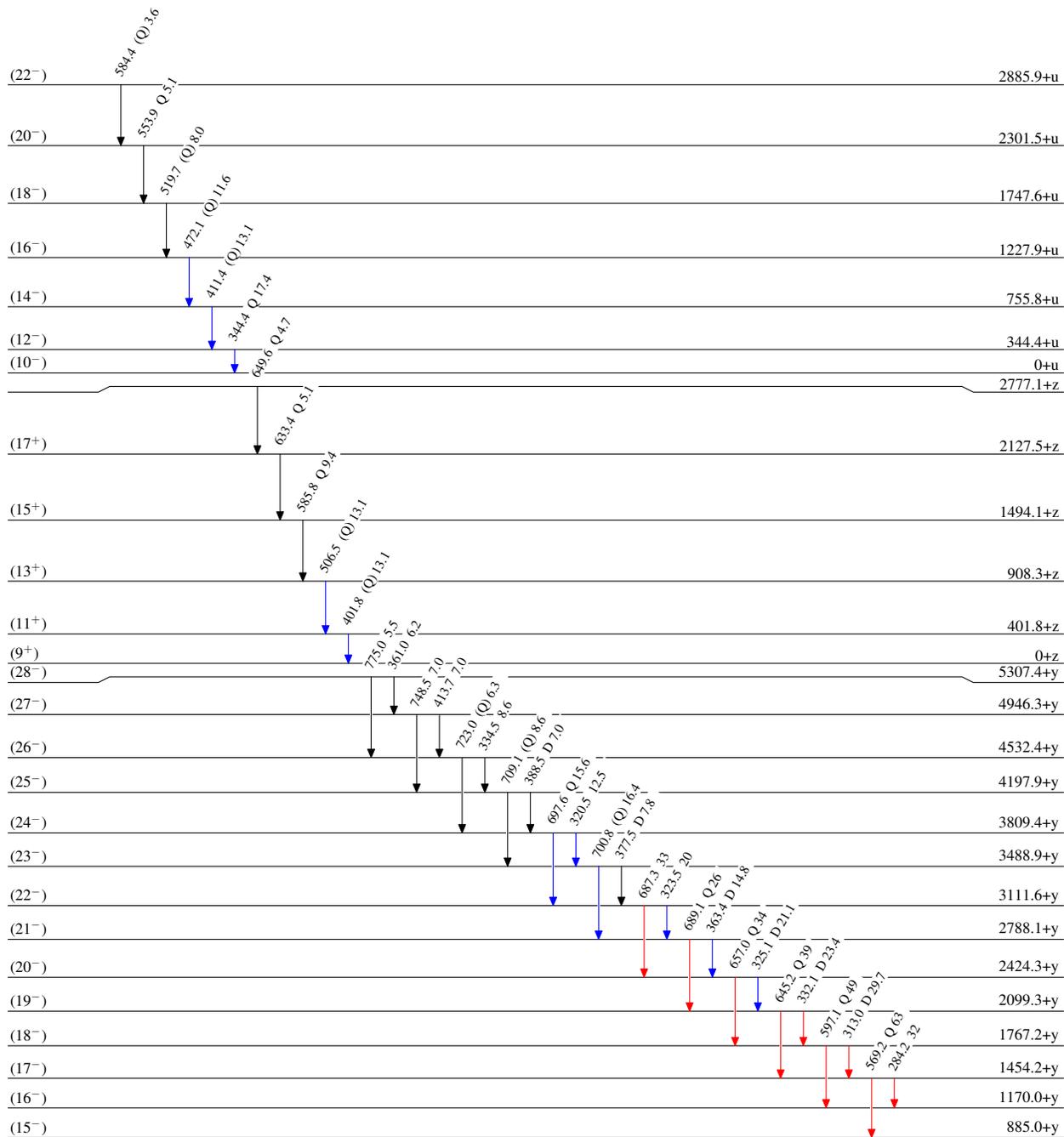
$^{150}\text{Sm}(^{19}\text{F},5n\gamma)$  1996Ju01

Level Scheme

Intensities: Relative  $I_\gamma$

Legend

- $I_\gamma < 2\% \times I_\gamma^{\text{max}}$
- $I_\gamma < 10\% \times I_\gamma^{\text{max}}$
- $I_\gamma > 10\% \times I_\gamma^{\text{max}}$



$^{164}_{71}\text{Lu}_{93}$

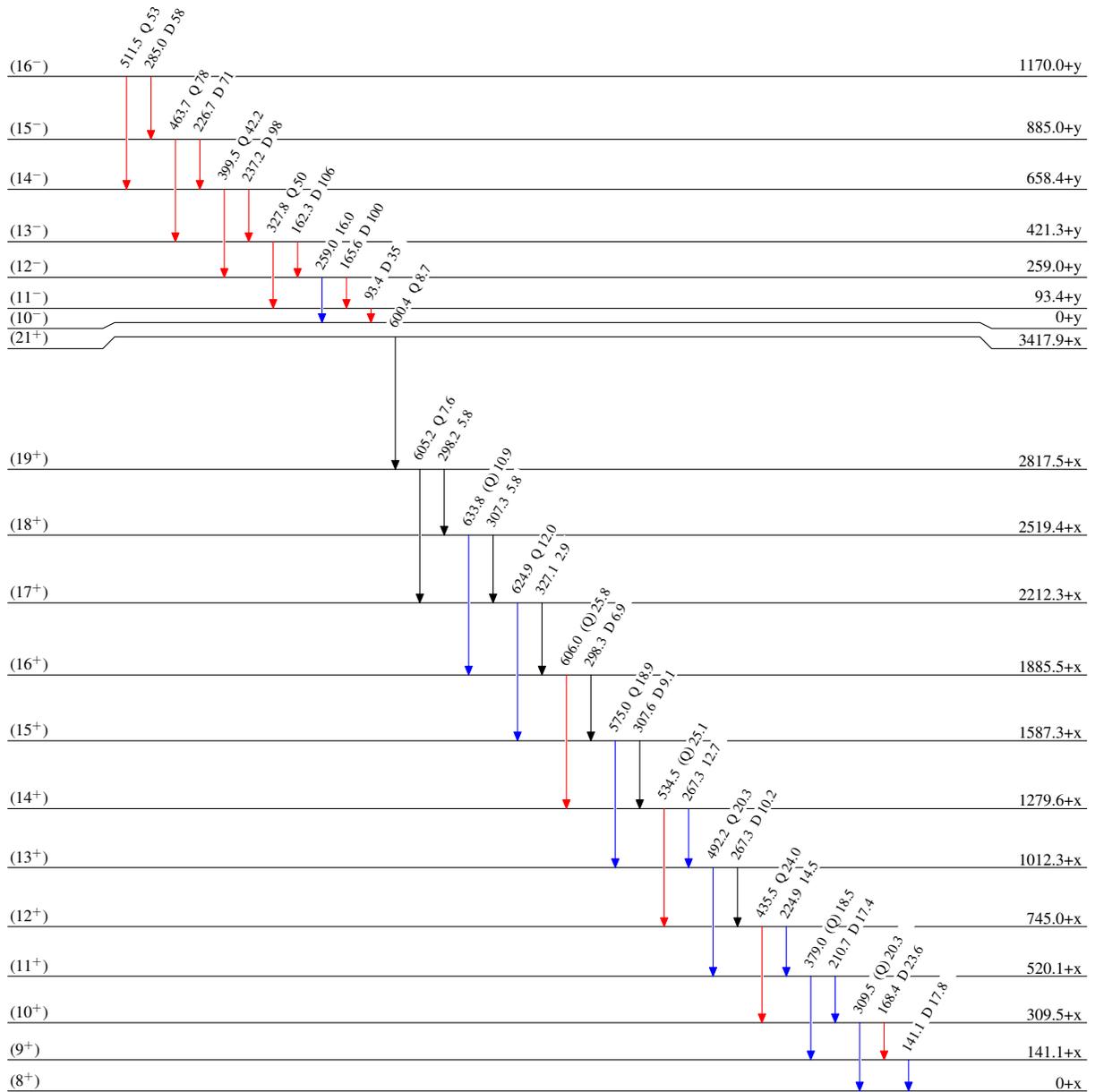
$^{150}\text{Sm}(^{19}\text{F},5\text{n}\gamma)$  1996Ju01

Level Scheme (continued)

Intensities: Relative  $I_\gamma$

Legend

- $I_\gamma < 2\% \times I_\gamma^{\text{max}}$
- $I_\gamma < 10\% \times I_\gamma^{\text{max}}$
- $I_\gamma > 10\% \times I_\gamma^{\text{max}}$



$^{164}_{71}\text{Lu}_{93}$

$^{150}\text{Sm}(^{19}\text{F},5n\gamma)$  1996Ju01