^{120}Sn(^{45}Sc,4nγ) 1988Yu05

History			
Type	Author	Citation	Literature Cutoff Date
Full Evaluation	C. W. Reich	NDS 112,2497 (2011)	1-Jun-2011

Additional information 1.

Data are from the ^{120}Sn(^{45}Sc,4nγ) reaction, E(^{45}Sc)=205 MeV, with modifications based on data from 2006Br12 in ^{139}La(^{28}Si,6nγ). The product mass was deduced from the observation of γ's from this reaction and from the ^{118}Sn(^{48}Ti,p4nγ) reaction, E(^{48}Ti)=230 MeV, and from their lack of observation in ^{147}Sm(^{19}F,xng), with E(^{19}F)= 83, 90 and 94 MeV, where the energies are high enough to remove only 4 neutrons. Measured Eγ, Iγ, $\gamma\gamma$, $\gamma\gamma(\theta)$ using an array of 12 Compton-suppressed Ge detectors and 50 BGO detectors.

Half-life values have been measured for several levels. They have been mentioned (1993YuZZ) in abstracts and shown graphically as Q_t values in earlier laboratory reports from the group that carried out the measurements summarized in this data set, but they have not as yet been published.

^{161}Lu Levels

E(level)[†]	J$^\pi$[‡]	Comments
z[&]	11/2$^-$	E(level): z=204.0+x In the Adopted Levels and 203.5+x in ^{139}La(^{28}Si,6nγ).
266.3+z[@]	13/2$^-$	
375.3+z[&]	15/2$^-$	
758.7+z[@]	17/2$^-$	
883.7+z[&]	19/2$^-$	
1358.7+z[@]	21/2$^-$	
1488.5+z[&]	23/2$^-$	
1828.0+z[a]	21/2$^+$	
2011.5+z[b]	23/2$^+$	
2012.8+z[@]	25/2$^-$	E(level): 25/2$^-$ band member is defined At 2229.5+x In the Adopted Levels due to the reversed ordering of the 668.1-654.4 cascade by 2006Br12 In ^{139}La(^{28}Si,6nγ).
2161.0+z[&]	27/2$^-$	
2194.3+z[a]	25/2$^+$	
2325.0+z[b]	27/2$^+$	
2485.8+z[a]	29/2$^+$	
2680.8+z[@]	29/2$^-$	
2700.7+z[b]	31/2$^+$	
2819.7+z[&]	31/2$^-$	
2951.4+z[a]	33/2$^+$	
3046.4+z[@]	33/2$^-$	
3206.2+z[b]	35/2$^+$	
3263.8+z[&]	35/2$^-$	
3503.7+z[@]	37/2$^-$	
3541.9+z[a]	37/2$^+$	
3786.2+z[&]	39/2$^-$	
3835.6+z[b]	39/2$^+$	
4068.9+z[@]	41/2$^-$	
4238.2+z[a]	41/2$^+$	
4385.9+z[&]	43/2$^-$	
4571.2+z[b]	43/2$^+$	
4709.9+z[@]	45/2$^-$	
5015.6+z[a]	45/2$^+$	

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^{120}Sn(^{45}Sc,4nγ) 1988Yu05 (continued)

^{161}Lu Levels (continued)

E(level)[†]	J$^{\pi}$[‡]	Comments
5063.5+z[&]	47/2$^-$	
5381.2+z[b]	(47/2$^+$)	
5419.9+z[@]	49/2$^-$	
5811.3+z[&]	51/2$^-$	
5859+z?[a]	(49/2$^+$)	
6162+z[b]	(51/2$^+$)	
6198+z[@]	53/2$^-$	
6629+z[&]	55/2$^-$	
6943+z[b]	(55/2$^+$)	
7053+z[@]	57/2$^-$	
7534+z[&]	59/2$^-$	
7791+z[#b]	(59/2$^+$)[#]	E(level): corresponds to 8800.2+x, (63/2$^+$) level In the Adopted Levels.
7992+z[@]	61/2$^-$	
8499+z[&]	63/2$^-$	
8692+z[#b]	(63/2$^+$)[#]	E(level): corresponds to 9701.2+x, (67/2$^+$) level In the Adopted Levels.
8996+z[@]	65/2$^-$	
9527+z?[&]	(67/2$^-$)	
9640+z[#b]	(67/2$^+$)[#]	E(level): corresponds to 10649.7+x, (71/2$^+$) level In the Adopted Levels.
10019+z[@]	(69/2$^-$)	
10625+z[#b]	(71/2$^+$)[#]	E(level): corresponds to 11633.5+x, (75/2$^+$) level In the Adopted Levels.
11009+z[@]	(73/2$^-$)	
11664+z[#b]	(75/2$^+$)[#]	E(level): corresponds to 12672.7+x, (79/2$^+$) level In the Adopted Levels.
12070+z[@]	(77/2$^-$)	E(level): corresponds to 13309.9+x, (81/2$^-$) level In the Adopted Levels. A 1037.9γ from 77/2$^-$ to 73/2$^-$ In the work of 2006Br12 In ^{139}La(^{28}Si,6nγ) is missing In the cascade defined by 1988Yu05.
12738+z?[b]	(79/2$^+$)	E(level): corresponds to 14817.9+x, (87/2$^+$) level In the Adopted Levels. A 1070.2γ from 85/2$^+$ to 81/2$^+$ In the work of 2006Br12 In ^{139}La(^{28}Si,6nγ) is missing In the cascade defined by 1988Yu05.
13835+z?[b]	(83/2$^+$)	E(level): this level not reported by 2006Br12 In ^{139}La(^{28}Si,6nγ).

[†] From unweighted fit to γ energies; γ's with questionable placements are omitted from fit, except where they are the only γ's determining the level energies. The energy of the first level z here corresponds to 204.0+x in 'Adopted Levels', except as noted.

[‡] Assignments are those of the authors and are based on the systematics of the transition energies and the signature splitting for the Ho, Tm and Lu isotopes and on the $h_{11/2}$ level sequences in other isotopes. Levels having two deexciting γ's which can be assigned as a cascade and a crossover transition with appropriate multipolarities (Q and D+Q, respectively) have J$^{\pi}$'s without parentheses, while those having only one reported deexciting γ are generally shown in parentheses. The relative parity of the bands is deduced by interpreting the high-energy dipole transitions as being E1, rather than M1. All assignments are consistent with those those in the Adopted Levels, except that these are given in parentheses there due to lack of strong supporting arguments.

[#] An 809.9γ from 59/2$^+$ to 55/2$^+$ In the work of 2006Br12 In ^{139}La(^{28}Si,6nγ) reaction is missing In the cascade defined by 1988Yu05. Thus z=1009+x and spin should be increased by two units.

[@] Band(A): Negative-parity band, α=+1/2. associated with the configuration=(π $h_{11/2}$).

[&] Band(a): Negative-parity band, α=−1/2. associated with the configuration=(π $h_{11/2}$).

[a] Band(B): Positive-parity band, α=+1/2.

[b] Band(b): Positive-parity band, α=−1/2.

^{120}Sn(^{45}Sc,4nγ) 1988Yu05 (continued)

$\gamma(^{161}Lu)$

Iγ normalization: only relative Iγ, so no normalization given.
Angular correlation ratio: R=[$I_{\gamma\gamma}$(two detectors at 30°)]/ [$I_{\gamma\gamma}$(one detector at 30°, other at 90°)]. Authors use these data to distinguish between dipole and quadrupole multipolarities, but do not indicate which values correspond to these two possibilities.

E_γ[†]	I_γ[‡]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	Comments
109.0	10.8 *23*	375.3+z	15/2$^-$	266.3+z	13/2$^-$	D	R=0.73 *9*.
125.0	5.7 *9*	883.7+z	19/2$^-$	758.7+z	17/2$^-$	D	R=0.93 *17*.
130.0[&]	2.0 *7*	1488.5+z	23/2$^-$	1358.7+z	21/2$^-$		
130.8	19 *4*	2325.0+z	27/2$^+$	2194.3+z	25/2$^+$	D	R=0.72 *14*.
139.7	5.2 *8*	2819.7+z	31/2$^-$	2680.8+z	29/2$^-$		
148.6	<0.8	2161.0+z	27/2$^-$	2012.8+z	25/2$^-$		E_γ: γ not reported by 2006Br12 In ^{139}La(^{28}Si,6nγ).
160.8	23 *4*	2485.8+z	29/2$^+$	2325.0+z	27/2$^+$	D	R=0.84 *12*.
182.8	<13	2194.3+z	25/2$^+$	2011.5+z	23/2$^+$		R=1.00 *12*.
183.5	<13	2011.5+z	23/2$^+$	1828.0+z	21/2$^+$		R=1.00 *12*.
214.8	21 *3*	2700.7+z	31/2$^+$	2485.8+z	29/2$^+$		R=0.93 *11*.
217.3	36.4 *17*	3263.8+z	35/2$^-$	3046.4+z	33/2$^-$	D	R=0.87 *3*.
226.7	36.3 *19*	3046.4+z	33/2$^-$	2819.7+z	31/2$^-$	D	R=0.77 *4*.
239.9	32.3 *14*	3503.7+z	37/2$^-$	3263.8+z	35/2$^-$	D	R=0.82 *4*.
250.7	13 *3*	2951.4+z	33/2$^+$	2700.7+z	31/2$^+$	D	R=0.71 *7*.
254.8	18.1 *27*	3206.2+z	35/2$^+$	2951.4+z	33/2$^+$	D	R=0.83 *8*.
266.3	44 *3*	266.3+z	13/2$^-$	z	11/2$^-$	D	R=0.92 *7*.
282.5	18 *8*	3786.2+z	39/2$^-$	3503.7+z	37/2$^-$		
282.8	23 *1*	4068.9+z	41/2$^-$	3786.2+z	39/2$^-$	D	R=0.80 *3*.
291.3	4.4 *7*	2485.8+z	29/2$^+$	2194.3+z	25/2$^+$		R=0.99 *23*. Branching ratio: Iγ(291)/Iγ(161)=0.19 *3*.
293.7	9.0 *14*	3835.6+z	39/2$^+$	3541.9+z	37/2$^+$	D	R=0.89 *14*.
316.9	19.6 *15*	4385.9+z	43/2$^-$	4068.9+z	41/2$^-$	D	R=0.82 *3*.
324.0	20.3 *15*	4709.9+z	45/2$^-$	4385.9+z	43/2$^-$	D	R=0.85 *9*.
333.1	4.9 *9*	4571.2+z	43/2$^+$	4238.2+z	41/2$^+$		R=1.37 *22*.
335.8	7.9 *13*	3541.9+z	37/2$^+$	3206.2+z	35/2$^+$		R=0.90 *15*.
353.7	14.1 *10*	5063.5+z	47/2$^-$	4709.9+z	45/2$^-$	D	R=0.83 *4*.
356.4	14.0 *10*	5419.9+z	49/2$^-$	5063.5+z	47/2$^-$	D	R=0.88 *7*.
366.3	4.4 *7*	2194.3+z	25/2$^+$	1828.0+z	21/2$^+$		Branching ratio: Iγ(366)/Iγ(183)>0.34.
366.4	5.1 *1*	3046.4+z	33/2$^-$	2680.8+z	29/2$^-$	Q	R=1.08 *13*. Branching ratio: Iγ(366)/Iγ(227)=0.14 *1*.
375.3	69 *4*	375.3+z	15/2$^-$	z	11/2$^-$	Q	R=1.12 *3*. Branching ratio: Iγ(375)/Iγ(109)=5.2 *11*.
376.0		2700.7+z	31/2$^+$	2325.0+z	27/2$^+$		
383.4	27.4 *14*	758.7+z	17/2$^-$	375.3+z	15/2$^-$	D	R=0.95 *10*.
386.4	9.3 *6*	6198+z	53/2$^-$	5811.3+z	51/2$^-$	D	R=0.79 *5*.
391.4	11.0 *5*	5811.3+z	51/2$^-$	5419.9+z	49/2$^-$		R=0.98 *8*.
402.6	5.9 *9*	4238.2+z	41/2$^+$	3835.6+z	39/2$^+$		
423.4	5.2 *5*	7053+z	57/2$^-$	6629+z	55/2$^-$		
430.9	8.3 *5*	6629+z	55/2$^-$	6198+z	53/2$^-$	D	R=0.88 *5*.
444.0	16.9 *14*	3263.8+z	35/2$^-$	2819.7+z	31/2$^-$	Q	R=1.29 *6*. Branching ratio: Iγ(444)/Iγ(217)=0.44 *2*.
444[&]		5015.6+z	45/2$^+$	4571.2+z	43/2$^+$		E_γ: γ is shown in level scheme, but not in table.
457.4	13.8 *11*	3503.7+z	37/2$^-$	3046.4+z	33/2$^-$	Q	R=1.24 *7*. Branching ratio: Iγ(457)/Iγ(240)=0.40 *2*.
458.3[&]	3.9 *9*	7992+z	61/2$^-$	7534+z	59/2$^-$		
465.5	14 *3*	2951.4+z	33/2$^+$	2485.8+z	29/2$^+$	Q	R=1.46 *20*. Branching ratio: Iγ(465)/Iγ(251)=1.05 *9*.
474.9	19.2 *7*	1358.7+z	21/2$^-$	883.7+z	19/2$^-$	D	R=0.84 *12*.
481.5	6.3 *9*	7534+z	59/2$^-$	7053+z	57/2$^-$		

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^{120}Sn(^{45}Sc,4nγ) 1988Yu05 (continued)

$\gamma(^{161}Lu)$ (continued)

E_γ[†]	I_γ[‡]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	Comments
492.4	16.3 *6*	758.7+z	17/2$^-$	266.3+z	13/2$^-$	Q	R=1.26 *18*. Branching ratio: Iγ(492)/Iγ(383)=0.68 *4*.
505.4	22 *4*	3206.2+z	35/2$^+$	2700.7+z	31/2$^+$	Q	R=1.10 *15*. Branching ratio: Iγ(505)/Iγ(255)=1.20 *10*.
508.4	100.0 *22*	883.7+z	19/2$^-$	375.3+z	15/2$^-$	Q	R=1.13 *4*. Branching ratio: Iγ(508)/Iγ(125)=17.4 *25*.
519.3	7.7 *7*	2680.8+z	29/2$^-$	2161.0+z	27/2$^-$		
522.4	9 *4*	3786.2+z	39/2$^-$	3263.8+z	35/2$^-$		Branching ratio: Iγ(522)/Iγ(282)=0.50 *10*.
524.4	8 *3*	2012.8+z	25/2$^-$	1488.5+z	23/2$^-$		E$_\gamma$: γ not reported by 2006Br12 In ^{139}La(^{28}Si,6nγ). The 522.6 and 525.6 γ rays In ^{139}La(^{28}Si,6nγ) are placed from negative-parity levels.
565.2	18.2 *9*	4068.9+z	41/2$^-$	3503.7+z	37/2$^-$	Q	R=1.21 *8*. Branching ratio: Iγ(565)/Iγ(283)=0.78 *11*.
590.6	11.3 *17*	3541.9+z	37/2$^+$	2951.4+z	33/2$^+$	Q	R=1.15 *25*. Branching ratio: Iγ(591)/Iγ(336)=1.44 *15*.
599.7	16.7 *20*	4385.9+z	43/2$^-$	3786.2+z	39/2$^-$	Q	R=1.25 *6*. Branching ratio: Iγ(600)/Iγ(317)=0.85 *7*.
599.9	29 *5*	1358.7+z	21/2$^-$	758.7+z	17/2$^-$	Q	R=1.20 *7*. Branching ratio: Iγ(600)/Iγ(475)=1.53 *26*.
604.9	85.8 *19*	1488.5+z	23/2$^-$	883.7+z	19/2$^-$	Q	R=1.21 *6*. Branching ratio: Iγ(605)/Iγ(130)=43 *14*.
629.3	21 *3*	3835.6+z	39/2$^+$	3206.2+z	35/2$^+$	Q	R=1.25 *16*. Branching ratio: Iγ(629)/Iγ(294)=2.36 *20*.
641.0	17.0 *7*	4709.9+z	45/2$^-$	4068.9+z	41/2$^-$	Q	R=1.52 *15*. Branching ratio: Iγ(641)/Iγ(324)=0.86 *7*.
652.5	9.2 *15*	2011.5+z	23/2$^+$	1358.7+z	21/2$^-$	D[@]	R=0.76 *7*.
654.4	17.8 *8*	2012.8+z	25/2$^-$	1358.7+z	21/2$^-$		Branching ratio: Iγ(654)/Iγ(524)=2.0 *7*. 668.1-654.4 cascade is reversed In ^{139}La(^{28}Si,6nγ) (2006Br12).
658.7	54.0 *14*	2819.7+z	31/2$^-$	2161.0+z	27/2$^-$	Q	R=1.28 *7*. Branching ratio: Iγ(659)/Iγ(140)=12 *6*.
668.1	10.3 *6*	2680.8+z	29/2$^-$	2012.8+z	25/2$^-$		668.1-654.4 cascade is reversed In ^{139}La(^{28}Si,6nγ) (2006Br12). Branching ratio: Iγ(668)/Iγ(519)=1.34 *10*.
672.6	75.0 *18*	2161.0+z	27/2$^-$	1488.5+z	23/2$^-$	Q	R=1.12 *6*. Branching ratio: Iγ(673)/Iγ(149)>94.
677.5	17.1 *7*	5063.5+z	47/2$^-$	4385.9+z	43/2$^-$	Q	R=1.32 *8*. Branching ratio: Iγ(677)/Iγ(354)=1.14 *6*.
696.3	11.3 *17*	4238.2+z	41/2$^+$	3541.9+z	37/2$^+$	Q	R=1.15 *20*. Branching ratio: Iγ(696)/Iγ(403)=1.9 *4*.
710.1	17 *2*	5419.9+z	49/2$^-$	4709.9+z	45/2$^-$	Q	R=1.32 *12*. Branching ratio: Iγ(710)/Iγ(356)=1.24 *8*.
735.6	18.0 *27*	4571.2+z	43/2$^+$	3835.6+z	39/2$^+$	Q	R=1.18 *14*. Branching ratio: Iγ(736)/Iγ(333)=3.66 *41*.
747.8	13.7 *8*	5811.3+z	51/2$^-$	5063.5+z	47/2$^-$	Q	R=1.29 *9*. Branching ratio: Iγ(748)/Iγ(391)=1.27 *9*.
777.4	10.5 *16*	5015.6+z	45/2$^+$	4238.2+z	41/2$^+$		
777.8	12 *2*	6198+z	53/2$^-$	5419.9+z	49/2$^-$	Q	R=1.62 *16*. Branching ratio: Iγ(778)/Iγ(386)=1.30 *14*.
781	<20	6162+z	(51/2$^+$)	5381.2+z	(47/2$^+$)	Q	R=1.3 *1*.
781	<20	6943+z	(55/2$^+$)	6162+z	(51/2$^+$)	Q	R=1.3 *1*.
810	<22	5381.2+z	(47/2$^+$)	4571.2+z	43/2$^+$	Q	R=1.3 *1*.
817.3	10.2 *8*	6629+z	55/2$^-$	5811.3+z	51/2$^-$	Q	R=1.45 *19*. Branching ratio: Iγ(817)/Iγ(431)=1.24 *12*.

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^{120}Sn(^{45}Sc,4nγ) 1988Yu05 (continued)

γ(^{161}Lu) (continued)

E_γ[†]	I_γ[‡]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	Comments
843.0[&]	4.7 *8*	5859+z?	(49/2$^+$)	5015.6+z	45/2$^+$		
847.1	6.3 *11*	7791+z	(59/2$^+$)	6943+z	(55/2$^+$)	Q	R=1.4 *2*.
854.2	8.4 *7*	7053+z	57/2$^-$	6198+z	53/2$^-$		Branching ratio: Iγ(854)/Iγ(423)=1.62 *17*.
901.5	5.8 *11*	8692+z	(63/2$^+$)	7791+z	(59/2$^+$)	Q	R=1.2 *2*.
905.0	9.0 *1*	7534+z	59/2$^-$	6629+z	55/2$^-$		Branching ratio: Iγ(905)/Iγ(481)=1.42 *31*.
939.8	7.6 *12*	7992+z	61/2$^-$	7053+z	57/2$^-$		Branching ratio: Iγ(940)/Iγ(458)=1.93 *29*.
943.7[&]	3.8 *7*	1828.0+z	21/2$^+$	883.7+z	19/2$^-$	D[@]	R=0.51 *9*.
948	3.9 *8*	9640+z	(67/2$^+$)	8692+z	(63/2$^+$)	Q	R=1.3 *3*.
965.8	≤1.8	8499+z	63/2$^-$	7534+z	59/2$^-$		
985	<2.3	10625+z	(71/2$^+$)	9640+z	(67/2$^+$)		
990	<2	11009+z	(73/2$^-$)	10019+z	(69/2$^-$)		
1004.4	4.3 *8*	8996+z	65/2$^-$	7992+z	61/2$^-$		
1023	<2.5	10019+z	(69/2$^-$)	8996+z	65/2$^-$		
1028[&]	<1.5	9527+z?	(67/2$^-$)	8499+z	63/2$^-$		
1039	<2.5	11664+z	(75/2$^+$)	10625+z	(71/2$^+$)		
1061	<2	12070+z	(77/2$^-$)	11009+z	(73/2$^-$)		
1074[&]	<1.2	12738+z?	(79/2$^+$)	11664+z	(75/2$^+$)		
1097[&]	<1.0	13835+z?	(83/2$^+$)	12738+z?	(79/2$^+$)		E_γ: this γ not reported by 2006Br12 In ^{139}La(^{28}Si,6nγ).

[†] Uncertainties are 0.1 keV for most γ's; for weak or contaminated γ's, uncertainty is 0.5 or 1.0 keV (1988Yu05).

[‡] For most γ's, value is the sum of the intensities observed in the coincidence gates on the 266 and 375 γ's. As noted by the authors, some intensities were deduced from other coincidence spectra. The intensities of the two gate γ's (i.e., 266 and 375) were obtained from the sum of the spectra in coincidence with the 383, 492, and 508 γ's. Branching ratios from coincidence spectra gated above a spin J are given under comments. These are generally more precise than those deduced relative gamma-ray intensities.

[#] DCO ratios (the ratio of the coincidence intensity between two detectors at 30° with respect to the beam and between one detector at 30° and one at 90° with respect to the beam) are given for most γ's. These ratios generally distinguish between ΔJ=1 and ΔJ=2 transitions, but the implied multipolarities are not given by the authors. The listed values are those inferred by the evaluator from the consideration that those γ's having DCO ratios that are significantly greater than unity (of the order of 1.2) are Q and those whose ratios are significantly below unity (of the order of 0.8) are D. It is expected that these will generally be M1 and E2, rather than E1 and M2. Some amount of E2 admixture in the ΔJ=1 transitions is to be expected.

[@] The DCO ratio indicates a stretched dipole transition (1988Yu05). These authors consider these to be E1 transitions, based on the fact that these energetic (interband) dipole transitions compete favorably with the intraband M1 and E2 transitions.

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

^{120}Sn(^{45}Sc,4nγ) 1988Yu05

Level Scheme

Intensities: Relative I_γ

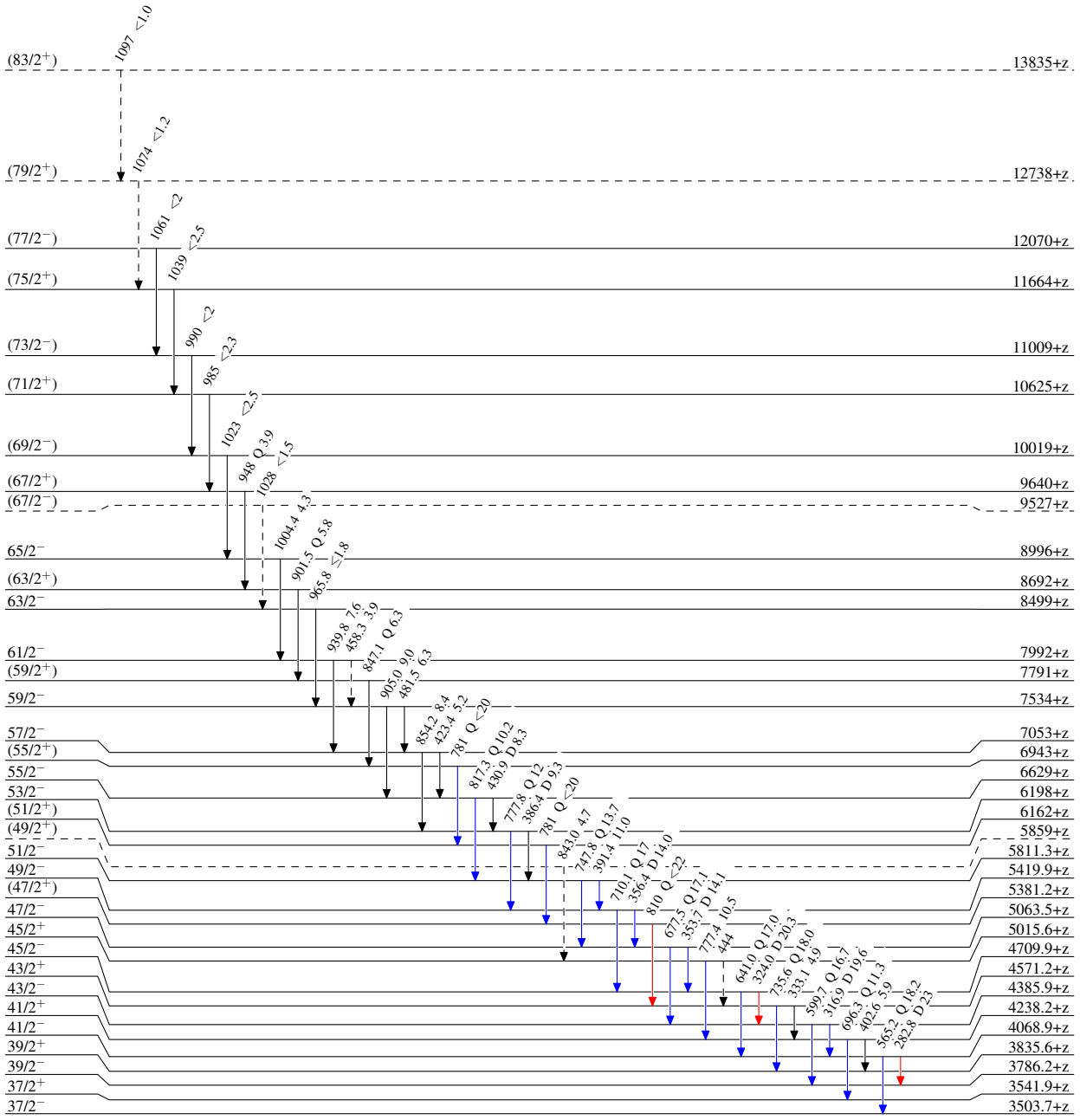
Legend

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

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

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

γ Decay (Uncertain)



$^{161}_{71}Lu_{90}$

^{120}Sn(^{45}Sc,4nγ) 1988Yu05

Level Scheme (continued)

Intensities: Relative I_γ

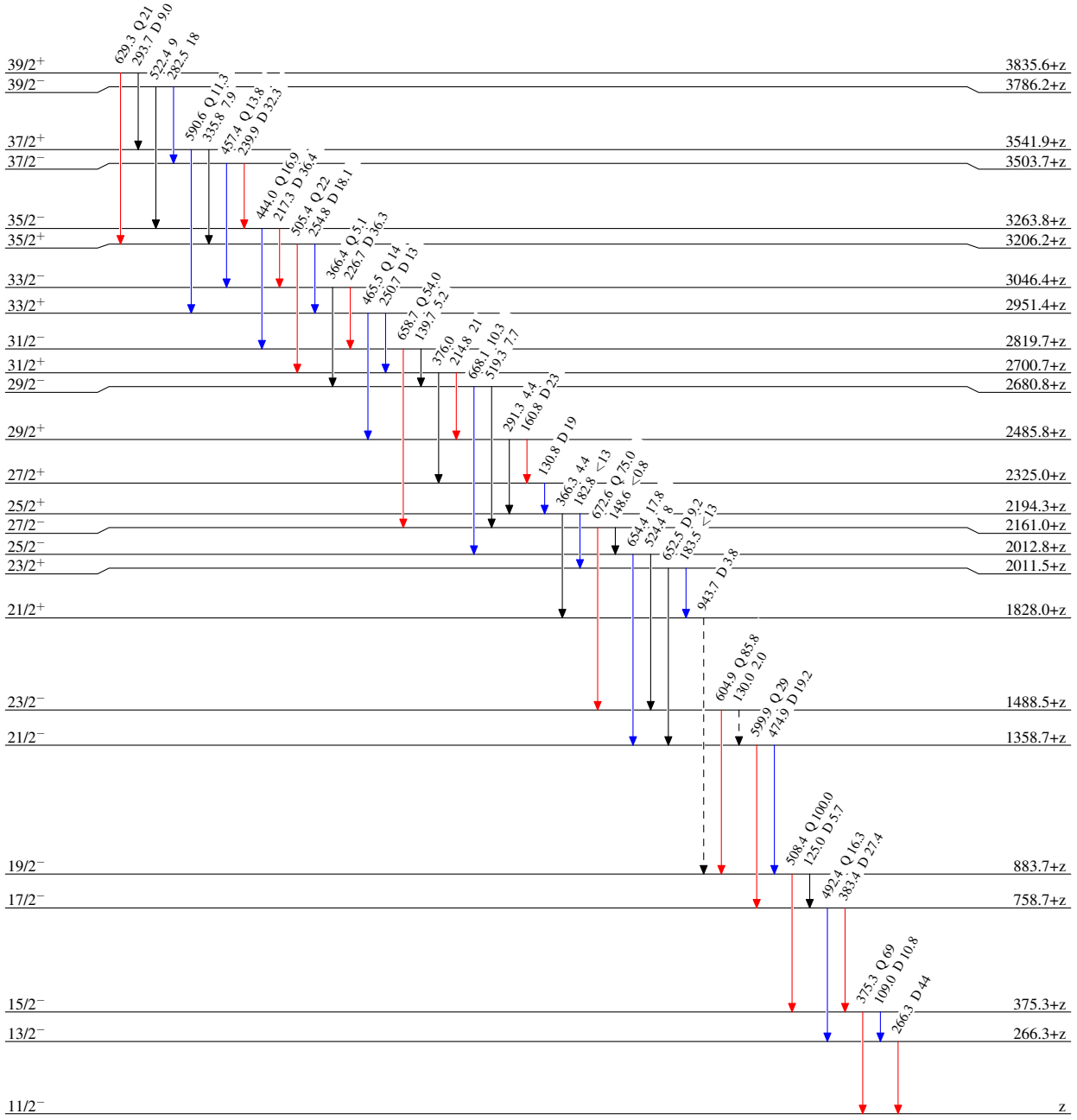
Legend

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

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

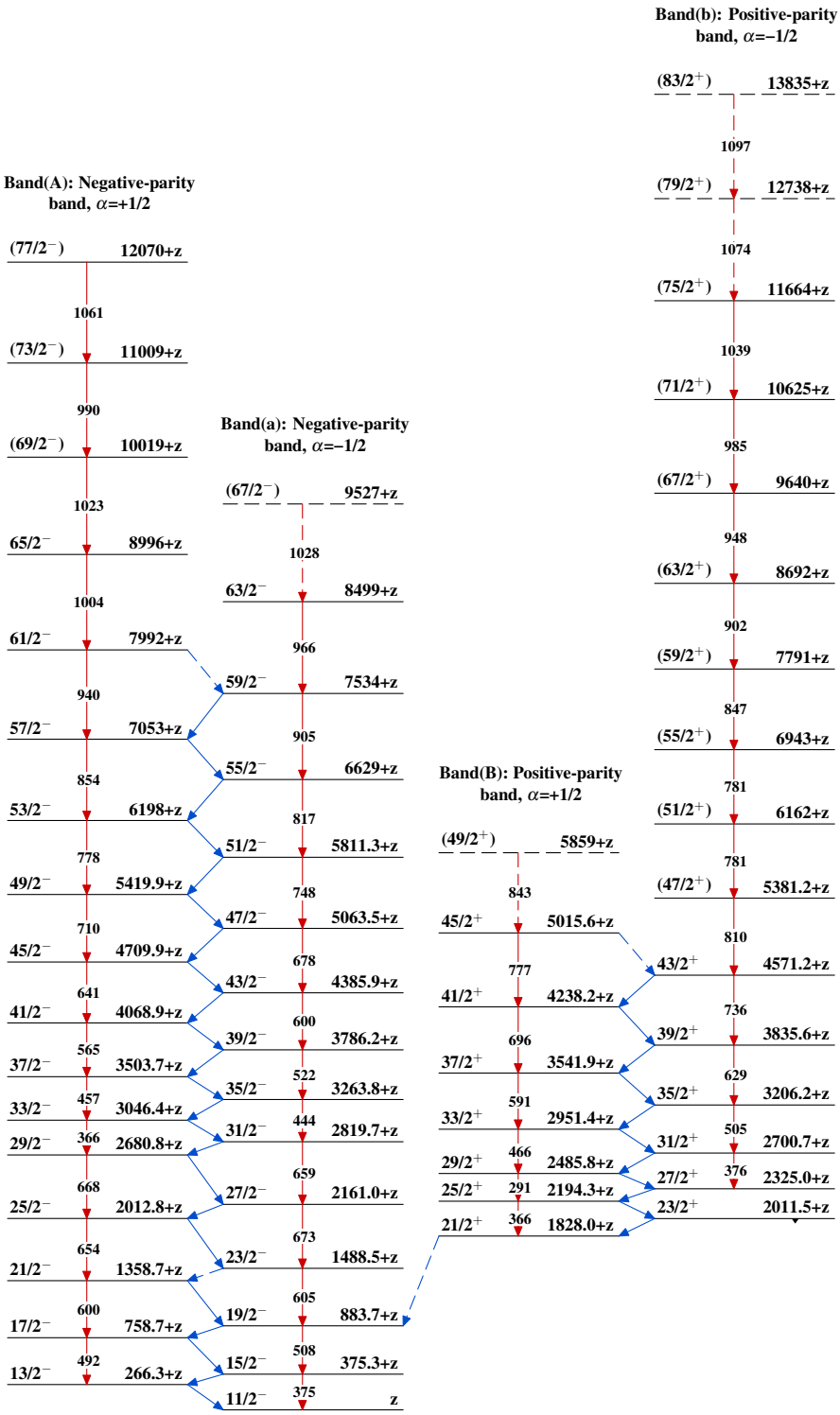
$I_\gamma > 10\% \times I_\gamma^{max}$

γ Decay (Uncertain)



$^{161}_{71}Lu_{90}$

^{120}Sn(^{45}Sc,4nγ) 1988Yu05



$^{161}_{71}Lu_{90}$