^{232}Th(n,n′γ) 1975McZA,1985Da21

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	E. Browne	NDS 107, 2579 (2006)	1-Nov-2004

Placement of γ rays in the level scheme is based on excitation curves. Neutron energy was varied between 750 and 2100 keV by 1975McZA. Inelastic cross sections measured and compared to calculated values from Hauser-Feshbach. See also 1978AhZX for γ rays observed in fast reactor neutrons on ^{232}Th.

E(n)=770-2100 keV, Ge(Li); experimental cross-sections compared to compound nucleus statistical model calculations (1985Da21). Other cross section calculations: 1982Ch21, 1986Sh08. (n,n′) cross sections for E(n)=950-2100 keV measured and compared to results for (n,n′γ) (1985Ci05).

E(n)=2000 keV. Measured Eγ, Iγ, γ(θ). Deduced γ-ray multipolarities (2000Ma97).

^{232}Th(n,n), E=3400-15000 keV. Deduced deformation parameters (2004Su12).

^{232}Th(n,n), E=144 keV (1997Ca48); E=3400 keV (1996Vl01); E≤300 keV (1996De08); E=epithermal (1995Hu10); Others: 1994Ca05, 1993DeZW, 1992Ko11.

^{232}Th(pol N,N) 2003Ha40, 2000Sh02, 2000Mi09, 1998St14, 1998Bb03, 1997Ca25, 1995Fl07, 1995Ca22, 1993Ur01, 1991Fr08.

^{232}Th Levels

Additional levels at 1352.9, 1619.1, 1647.7, 1691.2, 1716.5, and 1721.8 have been suggested in 1977McZJ.

E(level)	J^{π}‡	$T_{1/2}$	Comments
0	0^+		
49.4	2^+		
162.1	4^+		
333.1	6^+		
714.3	1^-		
730.4	0^+		
774.1	2^+		
774.3	3^-		
785.4	2^+		
829.7	(3^+)		
873.1	4^+		
883.3	5^-		
890.4	(4^+)		
960.5	(5^+)		
1053.7	(2^+)		
1073.2	2^+		
1077.5	1^-		
1078.8	(0^+)		
1094.4	(3^+)		
1106.0	3^-		
1121.8	(2^+)		
1143.7	(4^-)		
1148.4	(4^+)		
1182.8	3^-		
1208.2	(5^-)		
1218.3			
1303.2	$(1,2^+)$		
1329.3	(2^+)		
1387.8	2^+		
1414	4^+	2.2 ps *5*	Band head of a two-phonon $K^{\pi}=4^+$ γγ vibrational band. $T_{1/2}$: From Adopted Levels. From ^{232}Th(n,n′γ) (2000Ma97). $T_{1/2}$: 628γ (4^+ to 2^+) is stretched E2, from γ(θ) (2000Ma97).
1450.4			

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^{232}Th(n,n′γ) 1975McZA,1985Da21 (continued)

^{232}Th Levels (continued)

E(level)	Jπ‡	E(level)	Jπ‡	E(level)	E(level)
1480.2		1561.4	(1,2+)	1647.6	1808.4?#
1485.3	(5,6)	1573.3	(1,2+)	1692	1825.3?#
1489.0	(1,2+)	1578.3?†	(2+)	1716.5?#	1833.7?#
1519.8		1609.1		1727.3	
1554.6	2+	1618.1		1738.1	

† Not reported by 1977McZJ.
‡ From 1985Da21 based on γ-ray deexcitation and on Hauser-Feshbach calculations.
# Level not adopted.

γ(^{232}Th)

Eγ#	Iγ†	Ei(level)	Jπi	Ef	Jπf	Mult.	Comments
(49.37 *1*)	100	49.4	2+	0	0+		
≈75.1@		1148.4	(4+)	1073.2	2+		
(112.75 *2*)	100	162.1	4+	49.4	2+		
(170.9 *4*)	100	333.1	6+	162.1	4+		
332.1 *5*	28 *6*	1106.0	3−	774.1	2+		
523.43‡	27‡ *4*	1414	4+	890.4	(4+)	(M1+E2)	Mult.: M1 or E1 from γ(θ). Decay scheme requires M1+E2 (2000Ma97).
523.8@ *10*		1485.3	(5,6)	960.5	(5+)		
530.3@ *16*		1489.0	(1,2+)	960.5	(5+)		
550.3 *2*	100	883.3	5−	333.1	6+		
584.28‡	25‡ *5*	1414	4+	829.7	(3+)	E2	Mult.: From γ(θ) in 2000Ma97.
≈611.9		774.1	2+	162.1	4+		
612.3 *1*		774.3	3−	162.1	4+		Iγ(612)/Iγ(774)=9.5 *24* (1984BlZS); from Coul. ex. evaluator concludes that >90% of Iγ(612γ) comes from the 774.4-keV (Jπ=3−) level, and <10% from the 774.1-keV (Jπ=2+) level.
627.2 *2*	34 *3*	960.5	(5+)	333.1	6+		
628.57‡	48‡ *5*	1414	4+	785.4	2+	E2	Mult.: From γ(θ) in 2000Ma97.
664.9 *2*	86 *2*	714.3	1−	49.4	2+		
667.5 *4*	16 *4*	829.7	(3+)	162.1	4+		
680.9 *2*		730.4	0+	49.4	2+		
714.2 *2*	14 *2*	714.3	1−	0	0+		
≈724.7		774.1	2+	49.4	2+		
724.7 *5*		774.3	3−	49.4	2+		
728.0 *2*	85 *3*	890.4	(4+)	162.1	4+		
730.4		730.4	0+	0	0+		From comparison of cross sections of (n,n′) and (n,n′γ) of 1982TaZR it appears that I(γ+ce)(730 E0)≈Iγ(680.9).
735.9 *2*	64 *3*	785.4	2+	49.4	2+		
774.1 *2*		774.1	2+	0	0+		
780.2 *2*	84 *4*	829.7	(3+)	49.4	2+		
785.4 *2*	36 *3*	785.4	2+	0	0+		
797.9 *2*	66 *3*	960.5	(5+)	162.1	4+		
815.0 *2*	32 *12*	1148.4	(4+)	333.1	6+		
823.6 *2*	100	873.1	4+	49.4	2+		
840.5 *4*	15 *3*	890.4	(4+)	49.4	2+		
884.8 *3*	100	1218.3		333.1	6+		

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^{232}Th(n,n′γ) 1975McZA,1985Da21 (continued)

γ(^{232}Th) (continued)

E_γ [#]	I_γ [†]	E_i(level)	J_i^π	E_f	J_f^π	E_γ [#]	I_γ [†]	E_i(level)	J_i^π	E_f	J_f^π
932.3 *2*	44 *4*	1094.4	(3^+)	162.1	4^+	1400.9 *2*		1450.4		49.4	2^+
943.6 *2*	8 *2*	1106.0	3^-	162.1	4^+	1417.0 *5*	36 *6*	1578.3?	(2^+)	162.1	4^+
959.3 *4*	25 *3*	1121.8	(2^+)	162.1	4^+	1430.7 *2*	100	1480.2		49.4	2^+
981.2 *2*	100	1143.7	(4^-)	162.1	4^+	1440.0 *5*	53 *7*	1489.0	$(1,2^+)$	49.4	2^+
986.3 *2*	68 *12*	1148.4	(4^+)	162.1	4^+	1447.0 *5*	100	1609.1		162.1	4^+
1004.2 *2*	56 *5*	1053.7	(2^+)	49.4	2^+	1470.4 *2*	100	1519.8		49.4	2^+
1020.4 *6*	23 *3*	1182.8	3^-	162.1	4^+	1485.5 *8*	100	1647.6		162.1	4^+
1023.7 *2*	100	1073.2	2^+	49.4	2^+	1489.3 *5*	47 *7*	1489.0	$(1,2^+)$	0	0^+
1029.3 *2*	100	1078.8	(0^+)	49.4	2^+	1505.0 *2*	60 *3*	1554.6	2^+	49.4	2^+
1045.5 *5*	56 *4*	1094.4	(3^+)	49.4	2^+	1523.8 *2*	31 *12*	1573.3	$(1,2^+)$	49.4	2^+
1046.9 *2*	100	1208.2	(5^-)	162.1	4^+	1527.4 *8*	31 *6*	1578.3?	(2^+)	49.4	2^+
1053.5 *8*	44 *5*	1053.7	(2^+)	0	0^+	1555.3 *7*	22 *8*	1554.6	2^+	0	0^+
1056.2 *2*	64 *6*	1106.0	3^-	49.4	2^+	1561.4 *5*	100	1561.4	$(1,2^+)$	0	0^+
1072.5 *2*	69 *3*	1121.8	(2^+)	49.4	2^+	1568.6 *7*	100	1618.1		49.4	2^+
1077.5 *2*	100	1077.5	1^-	0	0^+	1572.8 *2*	69 *12*	1573.3	$(1,2^+)$	0	0^+
1121.8 *2*	5 *3*	1121.8	(2^+)	0	0^+	1578.3 *14*	33 *6*	1578.3?	(2^+)	0	0^+
1133.1 *2*	77 *3*	1182.8	3^-	49.4	2^+	1641.5 *10*	100	1692		49.4	2^+
1167.0 *2*	74 *5*	1329.3	(2^+)	162.1	4^+	1679.1 *15*	62 *10*	1727.3		49.4	2^+
1225.5 *2*	51 *8*	1387.8	2^+	162.1	4^+	1716.5 *6*	100	1716.5?		0	0^+
1303.2 *6*	100	1303.2	$(1,2^+)$	0	0^+	1727.3 *8*	38 *10*	1727.3		0	0^+
1322.8 *2*	100	1485.3	(5,6)	162.1	4^+	1738.1 *10*	100	1738.1		0	0^+
1328.9[@] *12*	26 *5*	1329.3	(2^+)	0	0^+	1808.4 *20*	100	1808.4?		0	0^+
1338.1 *2*	32 *3*	1387.8	2^+	49.4	2^+	1825.3 *4*	100	1825.3?		0	0^+
1387.5 *2*	17 *4*	1387.8	2^+	0	0^+	1833.7 *17*	100	1833.7?		0	0^+
1392.0 *5*	16 *3*	1554.6	2^+	162.1	4^+						

[†] From 1985Da21 in % from level, unless otherwise specified. Others: 1972Mc19, 1984BlZS, 1982TaZR.
[‡] From 2000Ma97.
[#] From 1975McZA, 1984BlZS, 1985Da21, unless otherwise specified.
[@] Placement of transition in the level scheme is uncertain.

^{232}Th(n,n′γ) 1975McZA,1985Da21

Level Scheme

Intensities: Relative I_γ

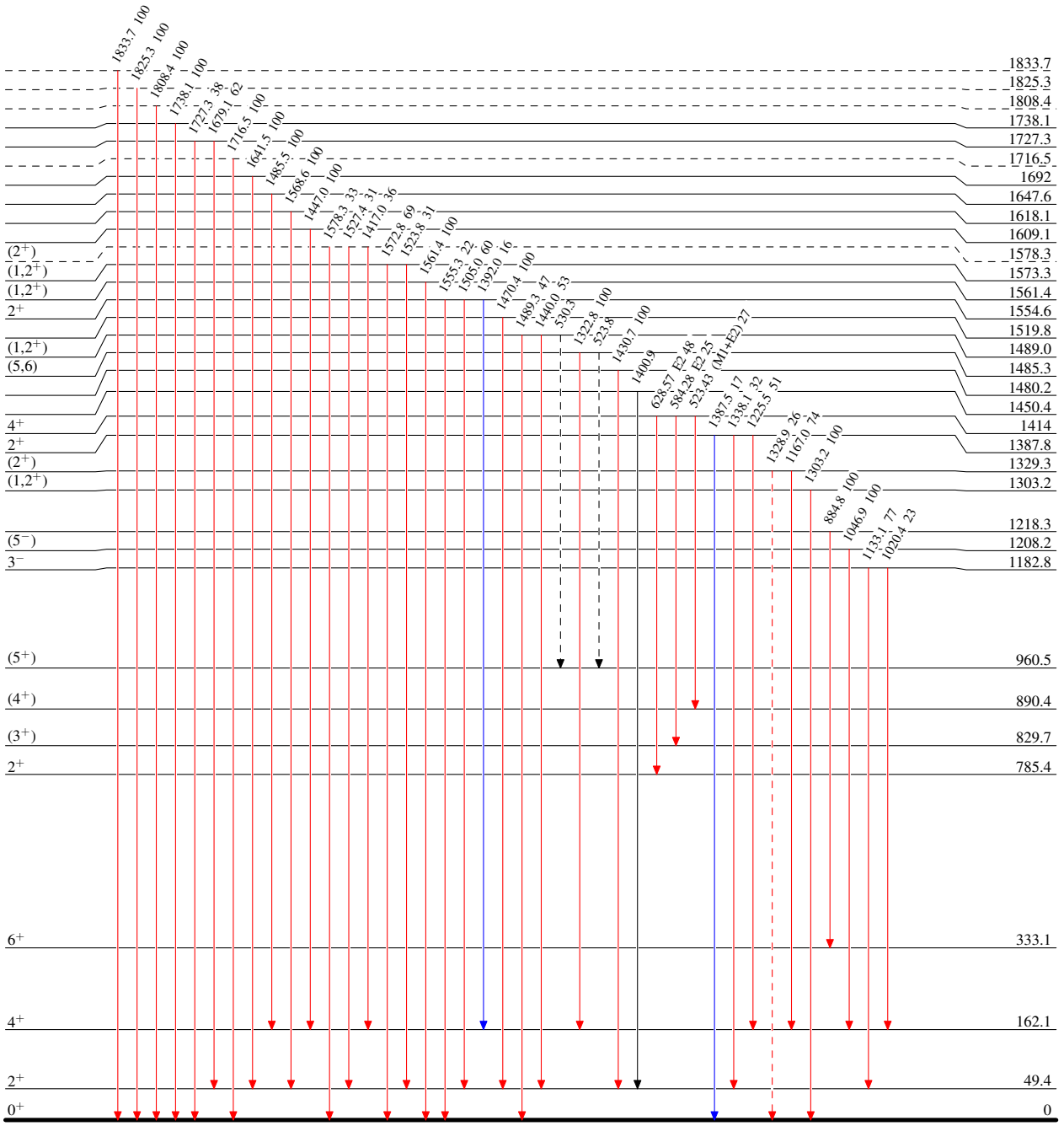
Legend

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

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

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

γ Decay (Uncertain)



$^{232}_{90}Th_{142}$

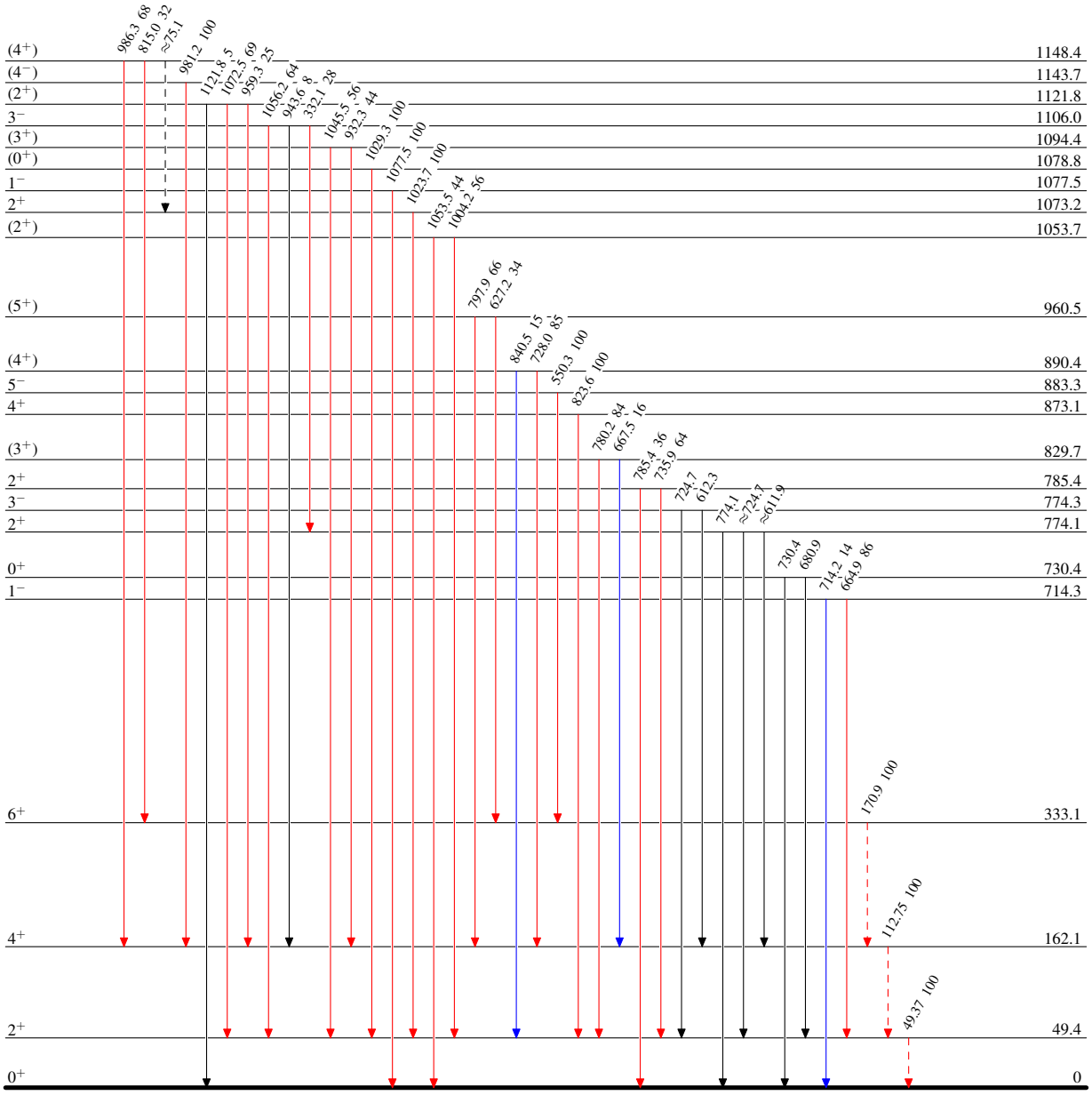
^{232}Th(n,n′γ) 1975McZA,1985Da21

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)



$^{232}_{90}Th_{142}$