^{230}Th(d,p) 1987Wh01

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh, Jagdish K. Tuli, and Edgardo Browne	NDS 185, 560 (2022)	31-Aug-2022

1987Wh01: E(d)=20 MeV. Measured proton spectra, $\sigma(\theta)$ from 15° to 75° in 5° step using a Q3D magnetic spectrometer at the Princeton cyclotron facility. FWHM=10 keV. Target was 100 μg/cm^2 99.9% enriched in ^{230}Th deposited on a 40 μg/cm^2 carbon backing.

Others:

1977Wi07: E(d)=17 MeV. Measured proton spectra, $\sigma(\theta)$ using Enge split-pole magnetic spectrograph at the University of Rochester tandem van de Graaff accelerator. Total of 12 levels up to 592 keV, with measured cross sections listed at 80° were reported. See (d,t) dataset for Nilsson configurations were proposed for the levels.

1970Er04 (also 1965Br22): E(d)=11.96 MeV. Measured proton spectra using broad-range magnetic spectrograph at ANL tandem Van de Graaff accelerator. FWHM=15 keV. A total of 30 levels reported up to 1671 keV. Cross section data are reported at 140°. Results reported in 1965Br22 are superseded by those in 1970Er04. One set of level energies in 1970Er04 is from (d,p) and (d,t) work.

^{231}Th Levels

Cross section of 32 μb/sr at 80° was listed for the population of a known level at 42 keV, but in (d,p) spectrum Fig. 3 and data in Table 4 of 1987Wh01, there was no evidence of the population of this level.

Consult Table IV in 1987Wh01 for experimental cross sections at 10°, 15°, 20°, 25°, 30°, 35°, 50°, 55°, 65°, 70° and 75°.

E(level)	J$^\pi$[†]	L	Comments
94[#] *3*	9/2$^+$		dσ/dΩ=10 μb/sr (45°), 5 μb/sr (60°). E(level): 98 *1*, 9/2, *ν*5/2[633] (1970Er04); 98 *3*, 9/2, *ν*5/2[633] (1977Wi07).
162[#] *2*	11/2$^+$		dσ/dΩ=26 μb/sr (45°), 19 μb/sr (60°). E(level): 164 *1*, 11/2, *ν*5/2[633] (1970Er04); 164 *3*, 11/2, *ν*5/2[633] (1977Wi07).
186[@] *2*	5/2$^-$		dσ/dΩ=9 μb/sr (40°), 13 μb/sr (50°).
205[@] *3*	7/2$^-$		dσ/dΩ=5 μb/sr (40°), 2 μb/sr (60°).
225[&] *3*	3/2$^+$		dσ/dΩ=10 μb/sr (40°), 7 μb/sr (55°). E(level): 228 *3*, 3/2, *ν*3/2[631] (1970Er04).
240[&] *1*	5/2$^+$	2	dσ/dΩ=63 μb/sr (45°), 93 μb/sr (60°). E(level): 242.6 *10*, 5/2, *ν*3/2[631] (1970Er04); 240 *5*, 5/2, *ν*3/2[631] (1977Wi07).
248[a] *1*	1/2$^+$	0	dσ/dΩ=181 μb/sr (45°), 58 μb/sr (60°).
271[a] *1*	3/2$^+$	2	dσ/dΩ=303 μb/sr (45°), 198 μb/sr (60°). E(level): 272 *3*, doublet, 1/2,3/2, *ν*1/2[631] (1970Er04); 274 *4*, 1/2,3/2, 1/2[631] (1977Wi07).
280[@] *3*	11/2$^-$		dσ/dΩ=41 μb/sr (45°), 44 μb/sr (60°).
301[a] *1*	5/2$^+$		dσ/dΩ=30 μb/sr (45°), 24 μb/sr (60°). E(level): 299 *10* (1977Wi07).
317[c] *1*	5/2$^+$		dσ/dΩ=18 μb/sr (45°), 55 μb/sr (60°).
326[&] *1*	9/2$^+$	4	dσ/dΩ=442 μb/sr (45°), 271 μb/sr (60°). E(level): 324 *2*, 9/2, *ν*3/2[631] (1970Er04); 324 *3*, 9/2, *ν*3/2[631] (1977Wi07).
335[@] *2*	13/2$^-$		dσ/dΩ=42 μb/sr (45°), 28 μb/sr (60°).
351[a] *1*	7/2$^+$		dσ/dΩ=37 μb/sr (45°), 17 μb/sr (60°). E(level): 347 *10* (1977Wi07).
380[c] *1*	7/2$^+$		dσ/dΩ=25 μb/sr (45°), 14 μb/sr (60°).
403[@] *2*	15/2$^-$[‡]	7[‡]	dσ/dΩ=34 μb/sr (45°), 32 μb/sr (60°). E(level): 405 *2*, 9/2, *ν*1/2[631] (1970Er04); 400 *4*, 15/2, *ν*5/2[752] (1977Wi07).
449[c] *1*	9/2$^+$[‡]	4[‡]	dσ/dΩ=204 μb/sr (45°), 133 μb/sr (60°).
465 *2*			dσ/dΩ=21 μb/sr (45°), 21 μb/sr (60°). E(level): 467 *10* (1977Wi07).
490[a] *3*	11/2$^+$		dσ/dΩ=21 μb/sr (45°), 22 μb/sr (60°).

Continued on next page (footnotes at end of table)

^{230}Th(d,p) 1987Wh01 (continued)

^{231}Th Levels (continued)

E(level)	Jπ†	L	Comments
530[d] 3	11/2⁻&11/2⁺		E(level),Jπ: doublet, 11/2⁻ member of ν7/2[743] and 11/2⁺ member of ν5/2[622]. dσ/dΩ=5 μb/sr (45°), 5 μb/sr (60°).
555[e] 1	1/2⁻‡	1‡	dσ/dΩ=50 μb/sr (45°), 43 μb/sr (60°). E(level): 557 1, 1/2, ν1/2[501] (1970Er04); 555 4, 1/2, ν1/2[501] (1977Wi07) (1977Wi07).
568 3			dσ/dΩ=7 μb/sr (45°), 17 μb/sr (50°).
579[b] 1	9/2⁺‡	4‡	dσ/dΩ=192 μb/sr (45°), 105 μb/sr (60°). E(level): 582 3 (1970Er04).
592[f] 2	3/2⁻&3/2⁻		E(level),Jπ: doublet, 3/2⁻ member of ν1/2[501] and 3/2⁻ bandhead of ν3/2[761]. dσ/dΩ=38 μb/sr (45°), 32 μb/sr (60°). E(level): 595 3 (1970Er04); 592 5, 3/2,5/2, ν1/2[501] (1977Wi07).
622[i] 3	3/2⁻&5/2⁻		E(level),Jπ: doublet, 3/2⁻ member of ν3/2[631]⊗0⁻ and 5/2⁻ member of ν5/2[752]⊗0⁺. dσ/dΩ=16 μb/sr (45°), 16 μb/sr (50°). E(level): 622 2 (1970Er04).
653[f] 3	7/2⁻		dσ/dΩ=20 μb/sr (45°), 18 μb/sr (60°). E(level): 647 2 (1970Er04).
684[g] 2	5/2⁻		dσ/dΩ=31 μb/sr (45°), 18 μb/sr (60°). E(level): 686 2 (1970Er04).
704[d] 2	15/2⁻		dσ/dΩ=24 μb/sr (45°), 22 μb/sr (60°).
724[h] 3	7/2⁻		dσ/dΩ=8 μb/sr (45°), 10 μb/sr (70°). E(level): 718 2 (1970Er04).
745 3			dσ/dΩ=14 μb/sr (45°), 21 μb/sr (60°).
802 2			dσ/dΩ=40 μb/sr (45°), 23 μb/sr (60°).
813 3			dσ/dΩ=27 μb/sr (45°), 8 μb/sr (60°). E(level): 815 2 (1970Er04).
837[j] 3	3/2⁺		dσ/dΩ=32 μb/sr (45°), 23 μb/sr (60°).
867 2			dσ/dΩ=56 μb/sr (45°), 53 μb/sr (60°).
881 2			dσ/dΩ=47 μb/sr (45°), 30 μb/sr (60°). E(level): 877 2 (1970Er04).
893[k] 2	7/2⁺		dσ/dΩ=26 μb/sr (45°), 25 μb/sr (60°). E(level): 892 2 (1970Er04).
947 3			dσ/dΩ=13 μb/sr (45°), 13 μb/sr (60°).
965[k] 5	9/2⁺		dσ/dΩ=21 μb/sr (50°), 16 μb/sr (60°).
981 3			dσ/dΩ=15 μb/sr (45°), 12 μb/sr (60°).
1002 3			dσ/dΩ=19 μb/sr (45°), 19 μb/sr (60°). E(level): 1008 2 (1970Er04).
1016 3			dσ/dΩ=55 μb/sr (45°), 27 μb/sr (60°).
1058 2			dσ/dΩ=109 μb/sr (45°), 69 μb/sr (60°).
1067 2			dσ/dΩ=37 μb/sr (45°), 34 μb/sr (60°).
1087 3			dσ/dΩ=20 μb/sr (45°), 22 μb/sr (60°). E(level): 1086 2 (1970Er04).
1101 2			dσ/dΩ=83 μb/sr (45°), 49 μb/sr (60°). E(level): 1107 3 (1970Er04).
1114 3			dσ/dΩ=35 μb/sr (45°), 13 μb/sr (60°).
1162 2			dσ/dΩ=37 μb/sr (45°), 29 μb/sr (60°).
1175 2			dσ/dΩ=49 μb/sr (45°), 23 μb/sr (60°).
1202 2			dσ/dΩ=76 μb/sr (45°), 40 μb/sr (60°).
1213 2			dσ/dΩ=117 μb/sr (45°), 75 μb/sr (60°).
1226 2			dσ/dΩ=29 μb/sr (45°), 31 μb/sr (60°).
1282 3			dσ/dΩ=44 μb/sr (45°), 40 μb/sr (60°). E(level): 1275 3 (1970Er04).
1329 2			dσ/dΩ=38 μb/sr (45°), 33 μb/sr (60°).
1339 2			dσ/dΩ=122 μb/sr (45°), 94 μb/sr (60°).
1350 2			dσ/dΩ=105 μb/sr (45°), 91 μb/sr (60°).
1366 4			dσ/dΩ=61 μb/sr (45°), 32 μb/sr (60°).

Continued on next page (footnotes at end of table)

^{230}Th(d,p) 1987Wh01 (continued)

^{231}Th Levels (continued)

E(level)	Comments
1376 *5*	dσ/dΩ=24 μb/sr (50°), 31 μb/sr (60°).
1390 *5*	dσ/dΩ=48 μb/sr (50°), 28 μb/sr (60°).
1404 *5*	dσ/dΩ=100 μb/sr (45°), 88 μb/sr (60°). E(level): 1398 *3* (1970Er04).
1414 *5*	dσ/dΩ=110 μb/sr (55°), 89 μb/sr (60°).

† Based on L values and a comparison with calculated cross sections for various Nilsson orbitals, including Coriolis mixing (1987Wh01). L-transfers listed here are from Fig. 4 of 1987Wh01. Evaluator has considered probable but not definite L values, as shown in parentheses.

‡ 1987Wh01 mentioned that the spin-parity assignment should be considered as tentative for a new level observed only in (d,p). Later (d,t) study, however, by 2008Bu14 has confirmed this level, thus evaluators assign definite L and J^{π} values.

Band(A): ν5/2[633].

@ Band(B): ν5/2[752].

& Band(C): ν3/2[631].

a Band(D): ν1/2[631].

b Band(E): ν7/2[624].

c Band(F): ν5/2[622].

d Band(G): ν7/2[743].

e Band(H): ν1/2[501].

f Band(I): ν3/2[761].

g Band(J): ν5/2[503].

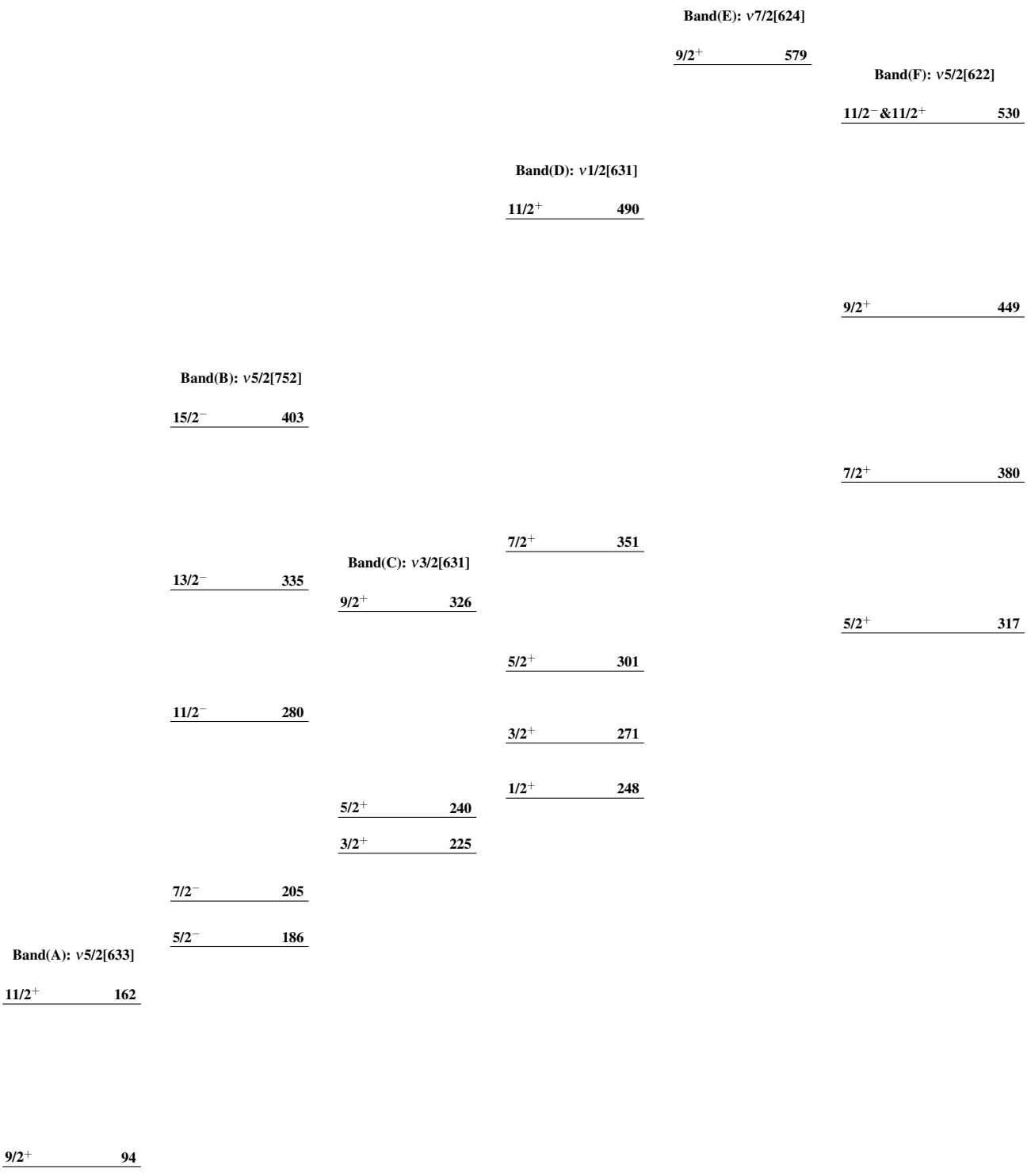
h Band(f): ν1/2[770].

i Band(g): $\nu 5/2[752]\otimes 0^+ + \nu 3/2[631]\otimes 0^-$. Admixture of two configurations.

j Band(c): $\nu 1/2[631]\otimes 0^+$.

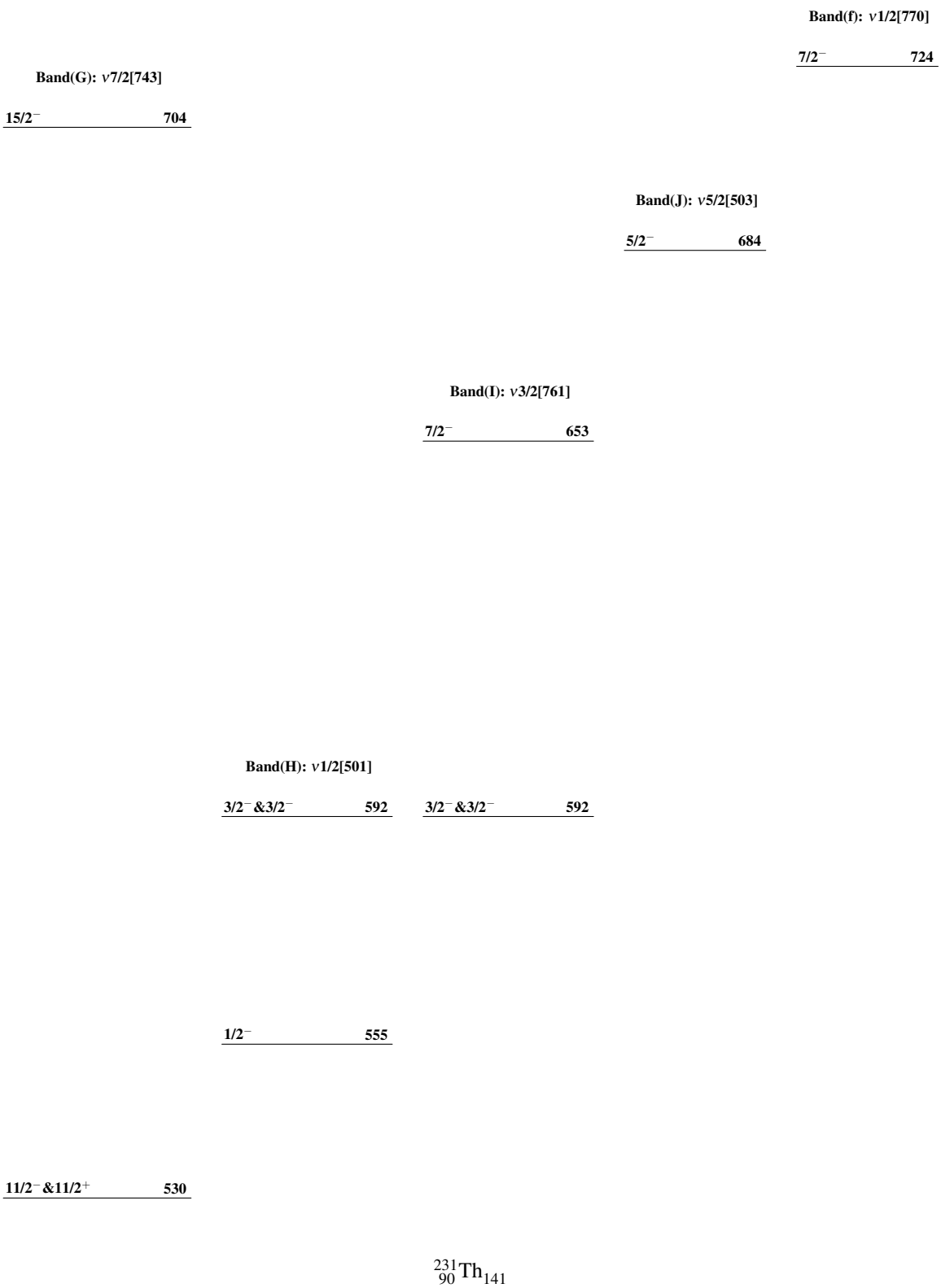
k Band(d): $\nu 1/2[640]+\nu 1/2[631]\otimes 0^+$. Admixture of two configurations.

^{230}Th(d,p) 1987Wh01



$^{231}_{90}Th_{141}$

^{230}Th(d,p) 1987Wh01 (continued)



$^{231}_{90}Th_{141}$

^{230}Th(d,p) 1987Wh01 (continued)

Band(d): ν1/2[640]+ν1/2[631]$\otimes$0$^+$

9/2$^+$ 965

7/2$^+$ 893

Band(c): ν1/2[631]$\otimes$0$^+$

3/2$^+$ 837

Band(g): ν5/2[752]$\otimes$0$^+$ + ν3/2[631]$\otimes$0$^-$

3/2$^-$&5/2$^-$ 622

$^{231}_{90}Th_{141}$