^{166}Er(d,t) 1969Tj01,1976Ma33,1979Ja23

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh and Jun Chen	NDS 194,460 (2024)	31-Oct-2022

1969Tj01: E(d)=12 MeV. Measured triton spectra at 60°, 90°, and 125° using targets of 40 μg/cm^2 thickness on 40 μg/cm^2 carbon foils, and analysis of outgoing tritons by a magnetic spectrograph and photographic emulsion plates at the EN Tandem Van de Graaff accelerator of the Niels Bohr Institute. FWHM≈6 keV. A total of 31 levels reported up to 1383 keV. DWBA analysis. Band assignments based on Nilsson configurations made on the basis of "finger-print" method of population intensity of levels.

1976Ma33 (also 1973Ma43): E(d)=17 MeV. Measured σ(E(t),θ) at 19 angles from 8° to 65° (lab) at the University of Pittsburgh three stage Van de Graaff accelerator. Target was 94.9% enriched and ≈100 μg/cm^2 thick on carbon backing. Tritons were analyzed using a split-pole spectrograph and particle tracks recorded on photographic emulsion plates. FWHM≈12 keV. Absolute cross sections accurate up to 15%. DWBA analysis. In 1973Ma43, 12 levels was reported up to 587 keV.

1979Ja23 (also 1975Ja18, 1975Ja19, 1972Ja16): E(d)=12.08 MeV. Measured $\sigma(\theta)$ at 15 angles from 10° to 150° using magnetic spectrograph and photographic emulsion plates at the EN Tandem Van de Graaff accelerator of the Niels Bohr Institute. DWBA analysis. A total of 13 levels reported up to 1039 keV.

Theory and analysis:

1984Pe03: E(d)=12 MeV, analyzed $\sigma(\theta)$, coupled-channel analysis for 11/2[505] state at 547 keV.

1980Pe07: E(d)=17 MeV, analyzed $\sigma(\theta)$, CCBA analysis for 51, 467 and 547 keV states.

^{165}Er Levels

Band assignments are from 1969Tj01, based on 'fingerprint' method.

E(level)[†]	J$^\pi$[#]	L[†]	C^{2}S[‡]	Comments
0[a]	5/2$^-$	3	0.090	J=5/2, ν5/2[523] (1969Tj01). L=3 in 1979Ja23. dσ/dΩ (μb/sr): 30 (60°), 34 (90°), 17 (125°) (1969Tj01). dσ/dΩ (30°)=50 μb/sr (1976Ma33). dσ/dΩ (μb/sr): 1 (20°), 3 (25°), 5 (30°), 6 (35°), 10 (40°), 12 (45°), 20 (50°), 30 (60°), 32 (75°), 34 (90°), 27 (105°), 17 (125°), 9 (150°) (1979Ja23).
51[g] 2	5/2$^+$	@	0.039	J=5/2, ν5/2[642] for a 48 level (1969Tj01). dσ/dΩ (μb/sr): 8 (60°), 3 (90°), 2 (125°) (1969Tj01). dσ/dΩ(30°)=33 μb/sr (1976Ma33).
76[a] 2	7/2$^-$	3	0.060	J=7/2, ν5/2[523] for a 76 level (1969Tj01). dσ/dΩ (μb/sr): 11 (60°), 16 (90°), 9 (125°) (1969Tj01). dσ/dΩ (30°)=32 μb/sr (1976Ma33). dσ/dΩ (μb/sr): 1 (25°), 3 (30°), 13 (35°), 17 (40°), 29 (45°), 37 (50°), 53 (60°), 70 (75°), 71 (90°), 62 (105°), 37 (125°), 25 (150°) (1979Ja23).
97[g] 2	9/2$^+$	4	0.92	J=9/2, ν5/2[642] for a 98 level (1969Tj01). L=4 in 1979Ja23 for 98 level. dσ/dΩ (μb/sr): 53 (60°), 71 (90°), 37 (125°) (1969Tj01). dσ/dΩ (30°)=110 μb/sr (1976Ma33).
174[a] 2	9/2$^-$	5	1.0	J=9/2, ν5/2[523] for a 176 level (1969Tj01). L=5 in 1979Ja23 for 176 level. dσ/dΩ (μb/sr): 15 (60°), 33 (90°), 27 (125°) (1969Tj01). dσ/dΩ (30°)=35 μb/sr (1976Ma33). dσ/dΩ (μb/sr): 1 (30°), 1 (35°), 3 (40°), 6 (45°), 10 (50°), 15 (60°), 27 (75°), 33 (90°), 35 (105°), 27 (125°), 21 (150°) (1979Ja23).
241[b] 2	3/2$^-$	1	0.17	J=3/2, ν3/2[521] for a 242 level (1969Tj01). L=1 in 1979Ja23 for 242 level. dσ/dΩ (μb/sr): 159 (60°), 233 (90°), 124 (125°) (1969Tj01). dσ/dΩ (30°)=360 μb/sr (1976Ma33). dσ/dΩ (μb/sr): 6 (10°), 9 (15°), 14 (20°), 21 (25°), 31 (30°), 46 (35°), 68 (40°), 81 (45°), 102 (50°), 159 (60°), 164 (75°), 233 (90°), 136 (105°), 124 (125°), 70 (150°) (1979Ja23).

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^{166}Er(d,t) 1969Tj01,1976Ma33,1979Ja23 (continued)

^{165}Er Levels (continued)

E(level)[†]	Jπ[#]	L[†]	C²S[‡]	Comments
296[c] 2	1/2⁻	1	0.11	J=1/2, ν1/2[521] for a 297 level (1969Tj01). L=1 in 1979Ja23 for 297 level. dσ/dΩ (μb/sr): 92 (60°), 92 (90°), 39 (125°) (1969Tj01). dσ/dΩ (30°)=240 μb/sr (1976Ma33). dσ/dΩ (μb/sr): 5 (10°), 10 (15°), 11 (20°), 11 (25°), 21 (30°), 31 (35°), 41 (40°), 59 (45°), 72 (50°), 92 (60°), 88 (75°), 92 (90°), 70 (105°), 39 (125°), 25 (150°) (1979Ja23).
356[c] 2	3/2⁻	1	0.020	J=3/2, ν1/2[521] for a 355 level (1969Tj01). L=1 in 1979Ja23 for 355 level. dσ/dΩ (μb/sr): 12 (60°), 9 (90°), 5 (125°) (1969Tj01). dσ/dΩ (30°)=40 μb/sr (1976Ma33). dσ/dΩ (μb/sr): 1 (20°), 1 (25°), 2 (30°), 3 (35°), 5 (40°), 7 (45°), 6 (50°), 12 (60°), 11 (75°), 9 (90°), 7 (105°), 5 (125°), 1 (150°) (1979Ja23).
371[b] 2	7/2⁻	3	0.71	J=7/2, ν3/2[521] for a 372 level (1969Tj01). L=3 in 1979Ja23 for 372 level. dσ/dΩ (μb/sr): 164 (60°), 217 (90°), 136 (125°) (1969Tj01). dσ/dΩ (30°)=280 μb/sr (1976Ma33). dσ/dΩ (μb/sr): 4 (20°), 13 (25°), 25 (30°), 59 (40°), 69 (45°), 98 (50°), 164 (60°), 182 (75°), 217 (90°), 165 (105°), 102 (125°), 68 (150°) (1979Ja23).
383[c] 2	5/2⁻	@	0.11	J=5/2, ν1/2[521] for ≈384 level (1969Tj01). dσ/dΩ (μb/sr): ≈13 (60°), ≈21 (90°), ≈13 (125°) (1969Tj01). dσ/dΩ (30°)=45 μb/sr (1976Ma33).
431 2		0	0.021	dσ/dΩ(30°)=30 μb/sr.
467[b] 2	9/2⁻	@	0.40	J=9/2, ν3/2[521] for a 469 level (1969Tj01). dσ/dΩ (μb/sr): 2 (60°), ≈5 (90°), 5 (125°) (1969Tj01). dσ/dΩ (30°)=15 μb/sr (1976Ma33).
505[h] 2	1/2⁺	0	0.17	J=1/2, ν1/2[660] for a 507 level (1969Tj01). L=0 in 1979Ja23 for 507 level. dσ/dΩ (μb/sr): 114 (60°), ≈168 (90°), 102 (125°) (1969Tj01). dσ/dΩ(30°)=400 μb/sr. dσ/dΩ (μb/sr): 46 (10°), 5 (15°), 4 (20°), 6 (25°), 19 (30°), 40 (35°), 65 (40°), 79 (45°), 89 (50°), 114 (60°), 140 (75°), 168 (90°), 106 (105°), 102 (125°), 68 (150°) (1979Ja23).
532[i] 2	3/2⁺	2	0.57	J=3/2, ν3/2[402] for a 534 level (1969Tj01). L=2 in 1979Ja23 for 534 level. dσ/dΩ (μb/sr): 169 (60°), ≈305 (90°) (1969Tj01). dσ/dΩ (30°)=390 μb/sr (1976Ma33). dσ/dΩ (μb/sr): 10 (10°), 14 (15°), 14 (20°), 18 (25°), 24 (30°), 29 (35°), 43 (40°), 66 (45°), 102 (50°), 169 (60°), 198 (75°), 305 (90°), 230 (105°), 140 (150°) (1979Ja23).
547[d] 2	11/2⁻	5[@]	1.7	L=5 in 1979Ja23 for 547 level. dσ/dΩ (μb/sr): ≈17 (60°), ≈57 (90°), ≈36 (125°) (1969Tj01). dσ/dΩ (30°)=63 μb/sr (1976Ma33). dσ/dΩ (μb/sr): 3 (10°), 5 (15°), 2 (20°), 4 (25°), 4 (30°), 3 (35°), 6 (40°), 6 (45°), 10 (50°), 17 (60°), 35 (75°), 57 (90°), 14 (105°), 36 (125°), 35 (150°) (1979Ja23).
573[e] 2	7/2⁻	(3)	0.10	J=7/2, ν5/2[512] for a 575 level (1969Tj01). dσ/dΩ (μb/sr): ≈10 (60°), ≈18 (90°), 13 (125°) (1969Tj01). dσ/dΩ (30°)=40 μb/sr (1976Ma33).
587 2		@		J=11/2, ν5/2[505] for a 591 level (1969Tj01). dσ/dΩ (μb/sr): ≈18 (60°), ≈33 (90°), ≈27 (125°) (1969Tj01). dσ/dΩ (30°)=70 μb/sr (1976Ma33). E(level): doublet with $J^{\pi}=3/2^{+}$ and $(1/2,3/2)^{-}$. A 591 group assigned by 1969Tj01 as 11/2[505], but 11/2[505] is located at 547 keV by 1970Hj02 in (α,3nγ). This group may correspond to doublet at 589 in 'Adopted Levels', one component of which is assigned as $3/2^{+}$ member of configuration= ν1/2[660]+(K−2 γ vibration built on ν5/2[642]). L: (1) in 1976Ma33 is inconsistent with $3/2^{+}$ and $(1/2^{-},3/2^{-})$ doublet from other studies. C^2S: 0.03 for L=1, 0.02 for L=2.
599 2		(2)	0.071	dσ/dΩ (μb/sr): ≈10 (60°), ≈23 (90°), ≈9 (125°) (1969Tj01).

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^{166}Er(d,t) 1969Tj01,1976Ma33,1979Ja23 (continued)

^{165}Er Levels (continued)

E(level)†	Jπ#	L†	C²S‡	Comments
				dσ/dΩ (30°)=35 μb/sr (1976Ma33).
648& 2		&		dσ/dΩ (μb/sr): 3 (90°), 6 (125°) for a 652 level (1969Tj01). dσ/dΩ (30°)=15 μb/sr (1976Ma33).
674 2		2	0.021	dσ/dΩ (30°)=12 μb/sr (1976Ma33).
721& 2		&		dσ/dΩ (μb/sr): 5 (60°), 5 (125°) for a 724 level (1969Tj01). dσ/dΩ (30°)=15 μb/sr (1976Ma33).
741j 2	1/2+	0	0.28	J=1/2, ν1/2[400] for a 742 level (1969Tj01). L=0 in 1979Ja23 for 746 level. dσ/dΩ (μb/sr): 114 (60°), 190 (90°), 139 (125°) (1969Tj01). dσ/dΩ (30°)=420 μb/sr (1976Ma33). dσ/dΩ (μb/sr): 8 (10°), 4 (15°), 1 (20°), 3 (25°), 11 (30°), 28 (35°), 53 (40°), 62 (45°), 72 (50°), 114 (60°), 150 (75°), 190 (90°), 140 (105°), 139 (125°), 85 (150°) (1979Ja23).
760 2		3	0.24	dσ/dΩ (μb/sr): 15 (60°), 40 (90°), 24 (125°) (1969Tj01). dσ/dΩ (30°)=82 μb/sr (1976Ma33). dσ/dΩ (μb/sr): 3 (30°), 4 (35°), 4 (40°), 6 (45°), 11 (50°), 15 (60°), 18 (75°), 40 (90°), 23 (105°), 24 (125°), 18 (150°) (1979Ja23).
817e 2	11/2−	@	1.7	J=11/2, ν5/2[512] for an 817 level (1969Tj01). dσ/dΩ (μb/sr): 30 (60°), 58 (90°), 32 (125°) (1969Tj01). dσ/dΩ (30°)=150 μb/sr (1976Ma33). L: 3 from 1976Ma33 is inconsistent with adopted $J^{\pi}=11/2^{-}$. C²S: for L=5; 0.34 for L=3.
840 2		(1)	0.008	dσ/dΩ (30°)=10 μb/sr (1976Ma33).
863 2		2	0.084	dσ/dΩ (μb/sr): 14 (60°), 17 (90°), 6 (125°) (1969Tj01). dσ/dΩ (30°)=36 μb/sr (1976Ma33).
920 2	1/2−	(1)	0.006	dσ/dΩ (30°)=10 μb/sr (1976Ma33).
955 2		(4)	0.3	dσ/dΩ (30°)=30 μb/sr (1976Ma33).
971 2		(2)	0.02	dσ/dΩ (μb/sr): 9 (60°), 14 (90°), 13 (125°) (1969Tj01). dσ/dΩ (30°)=10 μb/sr (1976Ma33).
1039f 2	3/2−	1	0.20	J=3/2, ν1/2[530] for a 1039 level (1969Tj01). L=1 in 1979Ja23 for 1039 level. dσ/dΩ (μb/sr): 65 (60°), 96 (90°), 56 (125°) (1969Tj01). dσ/dΩ (30°)=300 μb/sr (1976Ma33). dσ/dΩ (μb/sr): 6 (20°), 6 (25°), 10 (30°), 16 (35°), 23 (40°), 31 (45°), 65 (60°), 75 (75°), 96 (90°), 70 (105°), 56 (125°), 40 (150°) (1979Ja23).
1064f 2	5/2−	@	0.073	J=5/2, ν1/2[530] for a 1063 level (1969Tj01). dσ/dΩ (μb/sr): 4 (60°), 8 (90°), 5 (125°) (1969Tj01). dσ/dΩ (30°)=35 μb/sr (1976Ma33). L: (1) from 1976Ma33 is inconsistent with adopted $J^{\pi}=5/2^{-}$. C²S: for L=3; 0.026 for L=1. Band assignment is tentative.
1106 2		(3)	0.069	dσ/dΩ (μb/sr): 8 (60°), 9 (90°), 6 (125°) (1969Tj01). dσ/dΩ (30°)=13 μb/sr (1976Ma33).
1139 2		2	0.074	dσ/dΩ (μb/sr): 9 (60°), 15 (90°), 9 (125°) (1969Tj01). dσ/dΩ (30°)=25 μb/sr (1976Ma33).
1172f 2	7/2−	(3)	0.10	J=7/2, ν1/2[530] for an 1172 level (1969Tj01). dσ/dΩ (μb/sr): 6 (60°), 17 (90°), 14 (125°) (1969Tj01). dσ/dΩ (30°)=35 μb/sr (1976Ma33). L: 5 or 6 from reevaluation of 1969Tj01 by 1975Gr37. The data of 1976Ma33 do not fit any L value but best agreement is obtained for L=3. Band assignment is tentative.
1250 2				dσ/dΩ (30°)=10 μb/sr (1976Ma33).
1274 2		(3)	0.26	dσ/dΩ (μb/sr): 18 (60°), 28 (90°), 24 (125°) (1969Tj01). dσ/dΩ (30°)=80 μb/sr (1976Ma33).
1290 2		(1)	0.02	dσ/dΩ (30°)=30 μb/sr (1976Ma33).
1332 2				dσ/dΩ (30°)=20 μb/sr (1976Ma33).

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^{166}Er(d,t) 1969Tj01,1976Ma33,1979Ja23 (continued)

^{165}Er Levels (continued)

E(level)[†]	L[†]	C^2S[‡]	Comments
1379 *2*	(3)	0.10	dσ/dΩ (μb/sr): 10 (60°), 13 (90°), 12 (125°) for a 1383 level (1969Tj01). dσ/dΩ (30°)=36 μb/sr (1976Ma33).
1411 *2*			dσ/dΩ (30°)=10 μb/sr (1976Ma33).
1489 *2*	0	0.11	dσ/dΩ (30°)=92 μb/sr (1976Ma33).

† From 1976Ma33, unless otherwise stated. 1969Tj01 give almost all the levels in agreement with those from 1976Ma33. 1979Ja23 give data for 13 levels up to 1039 with L-transfer assignments in agreement with those from 1976Ma33.

‡ $C^2S=N[(2J+1)(d\sigma/d\Omega)(exp)]/[d\sigma/d\Omega(DWBA)]$, N=3.33; J=angular momentum transfer assumed in the calculation. Values are from 1976Ma33.

From 1969Tj01, 1976Ma33 and 1979Ja23, based on L(d,t) assignments and subsequent band assignments with Nilsson configurations.

@ Anomalous shape of $\sigma(\theta)$; cannot be fitted with any DWBA calculation.

& Weak peak, $\sigma(\theta)$ poorly fitted with any L value.

a Band(A): ν5/2[523]. A=11.0. Experimental cross sections are smaller than those from theoretical calculations. Predicted/experimental cross sections for 5/2, 7/2, 9/2, 11/2, respectively are: 39/39, 41/19, 65/43, 5/-. Relative ($C^2_{j,l}$) coefficients respectively are: 0.07/0.11, 0.08/0.06, 0.79/0.83, 0.06/-. The $11/2^-$ member is obscured by strong 298 group from 1/2[521]. The band parameter and comparisons with theory are from 1969Tj01.

b Band(B): ν3/2[521]. A=10.8. Predicted/experimental cross sections for 3/2, 5/2, 7/2, 9/2, 11/2, respectively are: 157/334, 0/-, 281/340, 21/≈9, 9/-. Relative ($C^2_{j,l}$) coefficients respectively are: 0.10/0.23, 0/-, 0.53/0.66, 0.25/0.11, 0.11/-. The band parameter and comparisons with theory are from 1969Tj01.

c Band(C): ν1/2[521]. A=12.3, a=0.56.

d Band(D): ν11/2[505]. Assignment from 1970Hj02. In 1969Tj01, 591 level is tentatively assigned as 11/2[505].

e Band(E): ν5/2[512]. Assignment in 1969Tj01 from (d,p). A=12.2.

f Band(F): ν1/2[530]. A=10.2, a=0.53.

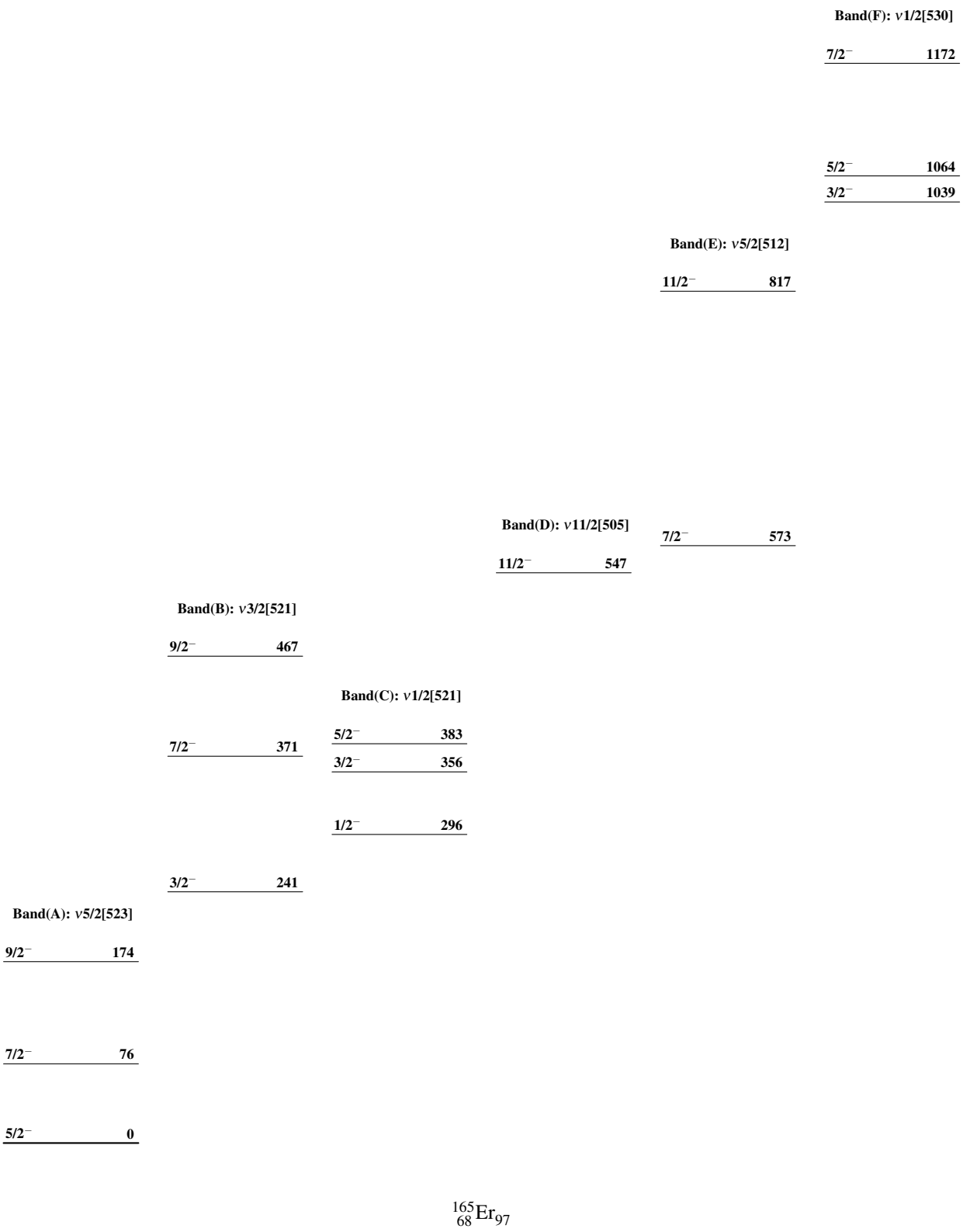
g Band(G): ν5/2[642] (?).

h Band(H): ν1/2[660].

i Band(I): ν3/2[402]. As stated by 1969Tj01, rotational states built on 3/2[402] are expected but not seen.

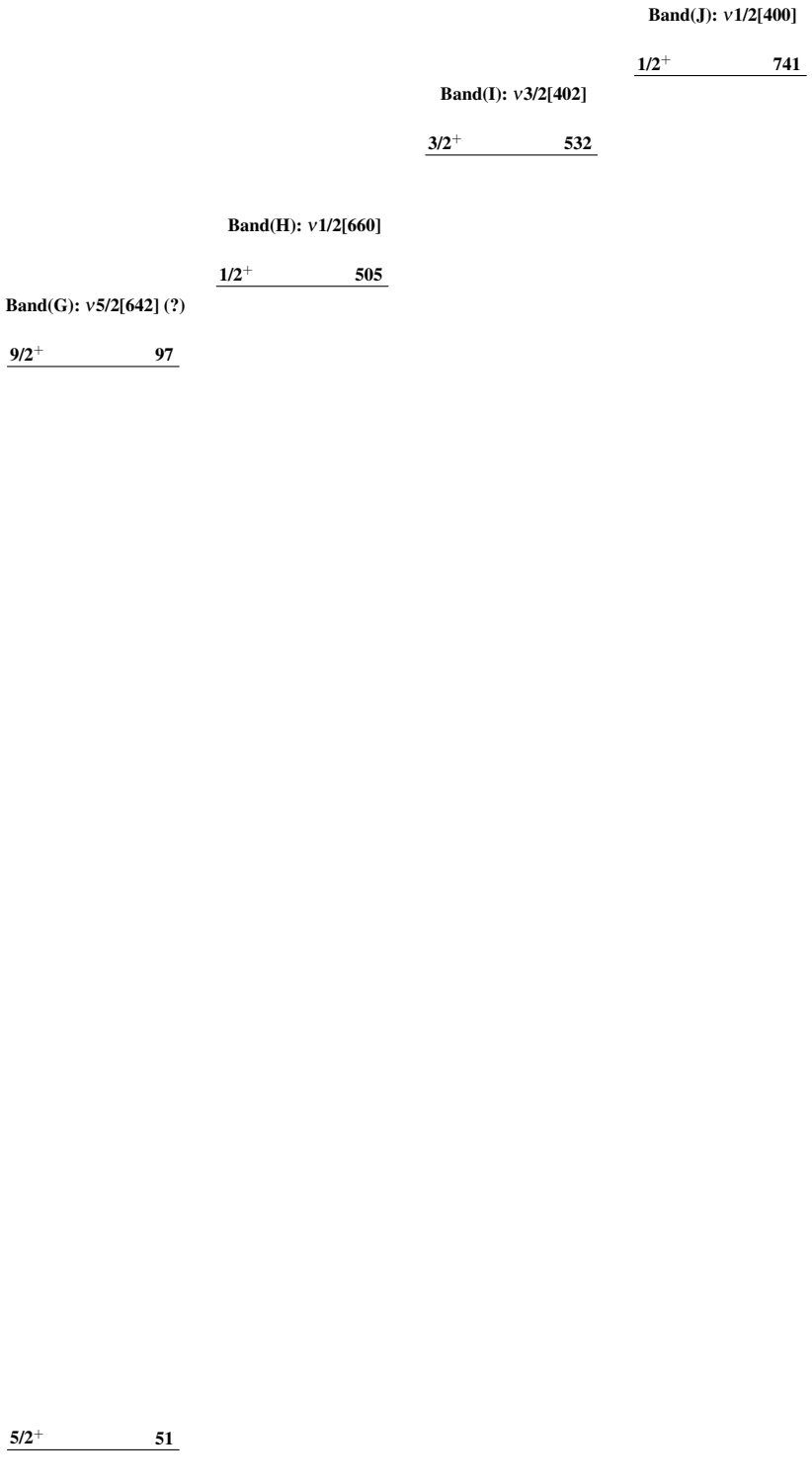
j Band(J): ν1/2[400]. As stated by 1969Tj01, rotational states built on 3/2[402] are expected but not seen.

^{166}Er(d,t) 1969Tj01,1976Ma33,1979Ja23



$^{165}_{68}Er_{97}$

^{166}Er(d,t) 1969Tj01,1976Ma33,1979Ja23 (continued)



$^{165}_{68}Er_{97}$